

ENDURANCE TEST: FEIN DETAIL SANDER
4 SHOP TRICKS FROM PBS' SCOTT PHILLIPS

February 2001 #121

Popular Woodworking

TOOL REPORT 2001

Jointers

10 Ways to
Get Straight
with Crooked Wood

Stop Mauling Figured Woods

Plus

- Modern nesting tables
- Shaker bench
- Rolling table saw cabinet

\$175
Workbench

Easy to Build;
Lasts a Lifetime

www.popwood.com

\$4.99US \$6.99CAN



0 09281 01355 6



70



27



50

IN THIS ISSUE

35 Hand Tool Report 2001

Even the most hard-core power tool user needs a few quality hand tools. We tested combination squares, block planes and chisels and tell you which are the best.

46 Chisel Use

Chisels are one of the oldest and simplest woodworking tools, and they're also one of the most misunderstood. Learn the three basic ways to use a chisel and you'll be amazed at what you can accomplish.

50 Nesting Tables

These aren't your grandma's nesting tables. We gave an old idea a modern twist to construct these sleek and contemporary plywood tables.

54 Get Straight With Crooked Wood

If you want wood that isn't warped, you need a jointer — and you need to know how to use it. Here's the straight story on where to stand, where to put your hands and how to properly navigate a board over the cutterhead so it is flat and true.



46



74

60 Taming Wild Woods
It's common to see a curly maple board go into a planer looking perfect and come out looking like a dog chewed it up. Learn how the pros surface their figured woods with great results.
By Troy Sexton

64 \$175 Workbench
Build a super-sturdy workbench in 30 hours for less than \$175 — and that includes the cost of the wood, hardware and vise! We show you how to do it with just a few common tools.

70 Under the Table Saw Cabinet
Say farewell to your space-wasting tool stands and say hello to this versatile and spacious cabinet that holds your contractor saw and a ton of stuff.
By Nick Engler

74 Shaker Bench
This simple and sturdy bench is a great way to learn wedged through-tenons, a rock-solid joinery technique that should be in your joinery arsenal.

IN EVERY ISSUE

6 Out On a Limb
Of Poachers & Game Wardens

8 Letters
Mail from readers

12 Tool Test
Get the straight dope on Fein's new plunge router, Delta's new scroll saw and an amazing new angle finder from Grizzly

22 Tricks of the Trade
Scott Phillips shows you tricks that help tune up your block plane, finish figured woods and choose the right saw blade.

27 Ingenious Jigs
Nick Engler shows you the secrets to bending wood and how he used that technique to build a replica of a Wright Brothers glider.

30 Flexner on Finishing
The Best Way to Reglue Furniture

32 Projects From the Past
Table Aquarium

78 Endurance Test
Fein's Multi Master

82 Classifieds

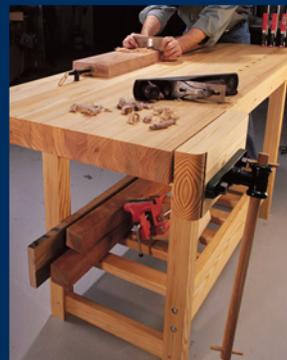
85 Caption the Cartoon
Win a Freud router bit set

88 Out of the Woodwork
1,000 Tools, One Price

ON THE COVER

Don't spend hundreds or thousands on a workbench when you can build one that can last a lifetime for \$175.

Cover photo by Al Parrish



eagle america

Circle #103 on Resource Directory Coupon

liebel

Circle #135 on Resource Directory Coupon

Popular Woodworking®

February 2001, Vol. 21, No. 1
www.popularwoodworking.com

Editor & Publisher **Steve Shanesy**

Art Director **Tricia Barlow**

Senior Editors **David Thiel,**
Christopher Schwarz

Associate Editor **Jim Stuard**

Photographer **Al Parrish**

Contributing Editors

Nick Engler

Bob Flexner

Glen Huey

Scott Phillips

Troy Sexton

Technical Advisers:

Bill Austin Makita USA, Inc.

Scott Box Delta International

Chris Carlson S-B Power Tool

Dale Zimmerman Franklin International

General Manager **Jeffrey M. Lapin**

Editorial Director **David Fryxell**

CIRCULATION

David Lee, Director

Lynn Kruezkamp, Group Manager

PRODUCTION

Barbara Schmitz,

Director of Manufacturing

Martha Wallace, Magazine Production Dir.

Heather Griffin, Production Coordinator

Ruth Preston, Studio Manager

ADVERTISING

National Sales Representative

Bill Warren, Five Mile River Assoc. LLC

RR1 Box 1400, Stockton Springs, ME 04981

Tel. (207) 469-1981; Fax (207) 469-3050

Advertising Sales

Joe Wood, Tel. (513) 336-9760

Fax (513) 336-9761

Classified Advertising Sales

Joan Wright, Tel. (800) 388-1820

Advertising Production Coordinator

Debbie Thomas, Tel. (513) 531-2690, ext. 219

SUBSCRIPTION SERVICES Subscription inquiries, orders and address changes can be made at www.popularwood.com (click on Subscriber Services). Or by mail:

Popular Woodworking,

P.O. Box 5369, Harlan, IA 51593 or call (515) 280-1721. Include your address with all inquiries. Allow 6 to 8 weeks for delivery.

NEWSSTAND DISTRIBUTION Curtis Circulation

Co., 730 River Rd., New Milford, NJ 07646,

(201) 634-7400, fax (201) 634-7499

Popular Woodworking (ISSN 0884-8823, USPS 752-250) is published six times a year in February, April, June, August, October and December by F&W Publications, Inc. Editorial and advertising offices are located at 1507 Dana Ave., Cincinnati, OH 45207; tel.: (513) 531-2222. Unsolicited manuscripts, photographs and artwork should include ample postage on a self-addressed, stamped envelope (SASE); otherwise they will not be returned. Subscription rates: A year's subscription (6 issues) is \$24.96; outside of U.S. add \$7/year.

Canada Publications Mail Agreement No. 0546232. Canadian return address: 2744 Edna St., Windsor, ON N8Y 1V2

Copyright ©2001 by *Popular Woodworking*. Periodicals postage paid at Cincinnati, Ohio, and additional mailing offices. Postmaster: Send all address changes to *Popular Woodworking*, P.O. Box 5369, Harlan, IA 51593 Canada GST Reg. #R122594716

Produced and printed in the U.S.A.

ATTENTION RETAILERS:

To carry *Popular Woodworking* in your store, call (513) 531-2690, ext. 327, or write: Dealer Program, F&W Publications, Inc., 1507 Dana Ave., Cincinnati, OH 45207. **Woodworker's Book Club:** 1507 Dana Ave., Cincinnati, OH 45207; (513) 531-8250

Audit Bureau of Circulation membership applied for.

Of Poachers & Game Wardens

For many years I've subscribed to the theory that poachers usually make the best game wardens. And why shouldn't this be so? A successful poacher would know both the habits of his prey and the habits of the people who protect the prey. So after converting to the "straight and narrow," a poacher cum game warden would know all the wiles of the most cunning poachers in the territory. And so equipped, his ability to protect his charges would be hugely advanced.

I tell you this because in my current responsibilities as editor of this magazine, I consider myself a sort of woodworking tool and machinery game warden. As we test and evaluate tools, as we do in this issue with chisels, combination squares and low-angle block planes, I see it as one of my jobs to make sure that the tools we test are identical to the merchandise you get out of the box when you bring it home from the store. We don't want to have any ringers in our "test lab."

Now what you don't know about me is that long ago I was a fair to middlin' poacher who worked the fields of public relations and product promotion. I didn't push woodworking tools, mind you. But it's fair to say the tricks to hustling cross over many a product.

Knowing this, we are vigilant in looking for signs that a tool arriving from a manufacturer might show signs of tampering, that the manufacturers' engineering lab had tweaked an off-the-shelf tool before shipping it to us.

What baffles me is just how little of this "puttin' your best foot forward" behavior actually happens. Not only do we see little evidence of this when examining tools, but we actually receive a number of tools that are truly defective.

Of course, this runs contrary to what many woodworking magazine readers think happens. And in many ways I don't blame them, for I too would be somewhat skeptical were it not for the unique position

I'm in. And as a former "poacher" I guess I'd have to say that this new breed of PR man/product promoter is either too ethical to rig the tools, too lazy or simply needs to learn at the knee of some retired practitioner. I don't want to encourage this behavior for it eases my duties, but I'm still surprised by its absence.

Now for those who still don't believe we get tools that have been given "extra attention," consider this parade of tool problems that have marched through our shop over the past few years. This is just a partial list.

- The switch on a DeWalt scroll saw that broke after five minutes of use.
- A Delta planer that arrived on our doorstep with many of its internal parts missing.
- Random orbit sanders from Bosch and Black & Decker that stopped spinning after a few weeks of use.
- A Grizzly table saw that wouldn't bevel to 45°.
- The fence on a DeWalt table saw that could not be squared to the blade.
- The motor on a Delta sander that quit after 10 minutes of use.
- A Great Tools cordless drill battery that wouldn't take a charge.

After investigating each of these broken tools we discovered that we had received one of a handful of tools that was defective — rarely was our one bad tool indicative of an entire line of bad tools. This goes to show you two things. First, that we face many of the same issues that readers do when acquiring tools. Sometimes you need to send a tool back. Secondly, tool reviews are rarely rigged, in our opinion. Manufacturers know that a good review in a magazine isn't worth a hill of beans if almost every customer that buys the tool wants to return it. **PW**



CONTACT INFORMATION

Steve Shanesy

Editor & Publisher

Specialties: Projects, techniques, article and project selection
513-531-2690 ext. 238
steves@fwpubs.com



David Thiel

Senior Editor

Specialties: Projects, new products and tools, tricks of the trade
513-531-2690 ext. 255
davidt@fwpubs.com



Christopher Schwarz

Senior Editor

Specialties: Author liaison, website, projects, photography
513-531-2690 ext. 407
chriss@fwpubs.com



Jim Stuard

Associate Editor

Specialties: Projects, carving, turning, project illustrations
513-531-2690 ext. 348
jims@fwpubs.com



Tricia Barlow

Art Director

Specialties: Magazine and cover design, photo direction
513-531-2690 ext. 599
triciab@fwpubs.com



Got Questions or Problems With Your Subscription?

To report problems with your subscription visit our website at popwood.com, call our subscription offices at 515-280-1721, or write to *Popular Woodworking*, P.O. Box 5369, Harlan, IA 51593.

Our Privacy Promise to You

We make portions of our customer list available to carefully screened companies that offer products and services we believe you may enjoy. If you do not want to receive those offers and/or information, please let us know by contacting us at: List Manager, F & W Publications, 1507 Dana Ave., Cincinnati, OH 45207

SAFETY NOTE

Safety is your responsibility.

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

Cyclone collectors ideal for the home workshop

Cyclones Seem Expensive, but They do so Much More

Just a quick note to say that I wish your tool reviews on dust collection would not disregard cyclone units. Dust collection is probably a misnomer for the advice/recommendations you are giving. These bag units should be called "chip collectors" instead. With the initial "poof" of their bag(s), your room is filled with the really dangerous fine wood particles. Folks that realize this usually go on to purchase a high-priced ceiling air filtration unit to complete the job of "collection."

I've purchased and installed the Oneida cyclone unit (\$695 + piping) and it is fabulous. It is two-stage, capturing the bigger particles in a drum and the finer particles in a filter. No bags. What may seem like an extravagant expense only for the rich should really be considered reasonably priced when you add up a chip collector and ceiling filtration combo.

The site at www.oneida-air.com is a one-stop place to get everything you need — including ductwork layout and design. The company was excellent to work with.

Paul Todys
Milford, Ohio

Editor's note: You make a good point about the ambient filtration system working with a single-stage collector. A system like the Oneida does a good job of collecting chips and finer dust. I wonder though if the ambient system still isn't a necessity for those looking for as dust-free a shop as possible when it comes to dust from sanders, routers etc.?

Does Advertising Affect Which Tools are Recommended?

This is a note to thank you for your extensive research and concise listings in the 2001 Tool Buying Guide. I am new to woodworking after a 20-year layoff and am now in search of the best chop saw and table saw value. The reviews and recommendations were great! You've narrowed the search down for me considerably.

I did have one question concerning that issue of your magazine, however. How much direct correlation is there between the rating a certain product got vs. whether that product's manufacturer advertises in your magazine?

For example, I noticed that Makita and Grizzly were rated high in several different types of equipment whereas the DeWalt name rarely got honorable mention. Is it coincidence that I did not see any DeWalt advertising in the magazine but I did see it for Makita and Grizzly?

Don't misunderstand my position, I am not accusing your magazine of anything. Through other forums, I have found others somewhat unhappy with the DeWalt name as well. I am merely trying to be an informed consumer who is doing his homework and own research before I go out and lay hundreds down on machinery. I liked what you had to say, I just want to make sure I can take it at face value.

Cal Tinkey
Buffalo, New York

Editor's note: We get this question all the time.

continued on page 10

dremel

WE WANT TO HEAR FROM YOU

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

How to Send Your Letter:

- E-mail: Popwood@FWPubs.com
- Fax: 513-531-0919
- Mail carrier:

Letters • Popular Woodworking • 1507 Dana Ave. Cincinnati, OH 45207

FACTORY
DIRECT
PRICES

FREE
CATALOG

Call
1-800-642-0011
Mention offer
7604 for a
free catalog



- ◆ Grandfather Clocks
- ◆ Mantel & Wall Clocks
- ◆ Clock & Furniture Kits
- ◆ Satisfaction Guaranteed



Emperor Clock, LLC
PO Box 1089 Dept 7604
Fairhope AL 36533

www.emperorclock.com

Circle #104 on Resource Directory Coupon

smithy

Circle #115 on Resource Directory Coupon

Great Tools... Free Catalog



Ad Code# 3500

Industrial-Type Nail Remover
Makes An Impossible Job Easy
Pulls out nails from a wood board whose
head is flush with the surface *without de-*
stroying the surface. Add \$5.25 for S&H.
98N14.02 Nail Remover \$18.75

One of hundreds of great tools from
Garrett Wade. Get our FREE catalog.

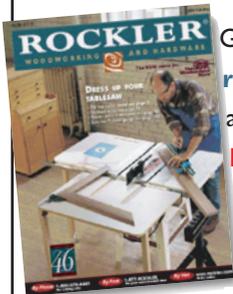
Garrett Wade

Call Toll-Free 800-221-2942
www.garrettwade.com

Circle #105 on Resource Directory Coupon

FREE!

WOODWORKING CATALOG



Go to
rockler.com/go/19

and order your
FREE catalog today!

Or call
1-800-403-9736

Check out our complete
exclusive line of jigs and
shop tables for your band
saw, drill press and router.
PLUS thousands of other
great products!



Code 11503

ByPhone

ByFoot

ByNet

1-800-403-9736 1-877-ROCKLER www.rockler.com

Circle #114 on Resource Directory Coupon

LETTERS

continued from page 8

Pretty much every major tool company advertises with us (even DeWalt has this year), so no matter who we recommend, it appears that we're playing favorites. Even those hand-ful that don't advertise get recommended. Hitachi is a good example (in chop saws in particular, a category you were looking at). Panasonic and Milwaukee also come to mind.

Rest assured we try to keep advertising and editorial functions completely separate. The four editors argued about these recommendations for days this summer. And I don't think the fact that someone was an advertiser or not came up once during the debate. Mostly it was about how well a tool functioned, how good the price was and the reputation of the manufacturer.

Which Dye for the Morris Chair? Water- or Alcohol-Based?

I am about to begin building two of the Morris chairs you built and described in issue #115, June 2000. I have a question about the finishing. I use Moser's aniline dyes for all my work, but I use water-based dyes exclusively. You specified alcohol-based for the chair. Is there a particular reason to use the alcohol-based dye? Also, I use the water-base for two reasons — I think it penetrates more effectively in tight-grained woods such as birch, and it stays wet longer, which allows me to ensure there are no drips or uneven application areas. What is your feeling about the chair specifically and water-based dye in general?

Martin S. Nadler
Northport, New York

Editor's note: I prefer the water-based dyes myself, but the stuff we had on hand was alcohol-based. In general, I prefer the water-base because it's more colorfast. With water-based dyes you do have to deal with the raised grain, but a light sanding after coloring takes care of that. **PW**

CORRECTIONS

In the "Ultimate Miter Saw Stand" article in the August 2000 issue, There are two minor corrections. The back, part "C," is 24½" wide. Plus, the dimensions for parts "U" and "V" were switched.

Fein Unveils its First Router: Tough, Gutsy and Worth it

Fein's first router for the U.S. market is a large brute in a tight package. Weighing in at 12 pounds, the RT-1800 generates a big 3¼ horsepower (15 amps) and feels smaller in your hands than other monster plunge routers. The RT-1800 offers variable speeds from 8,000 to 22,000 rpm, soft-start to reduce wear on the motor and improve router control, and electronic feedback control that maintains continuous torque under load. Also standard is a ½" collet (though a ¼" insert is available as an accessory for \$29) and a spindle lock for single-wrench bit changes.

During our tests we were impressed with the ease of cut; the motor was unfazed while using a ¾" cove bit in white oak. Torque is maintained throughout the speed ranges with no problem, and vibration is very low, making for pleasurable operation. The plunge mechanism is smooth, even when the router base overhangs an edge, such as when using a profile bit on a board's edge. Some other big routers will bind in this situation, but not the Fein. The router's fine adjustment knob works well, but you cannot adjust it while the plunge springs are engaged due to the strength of the springs.

Also standard is a removable dust extraction shroud with a pop-out plate to adjust for large- or small-diameter bits. Chips are directed out the clear plastic shroud and through a 1½"-diameter port that you connect to your shop vacuum. During grooving and mortising operations the dust collection was nearly perfect. During edge-routing, however, the dust collection did little good. As an added bonus, many woodworkers will be pleased to find out that their Porter-Cable template bushings fit perfectly on the Fein.

We were a little disappointed that a ¼" collet was not included as a standard item. But with a 3¼ hp router, the ½" collet will likely see most of the use anyway. One accessory worth paying for is the micro-adjustable edge guide, which has an 8½" reach. Simple in design, the guide is easy to fine-tune and costs less than \$60.

With a price tag of \$350 this is one of the most expensive routers on the market. The excellent performance of this router, combined with Fein's reputation for longevity under heavy work loads, makes the money well spent for any commercial application, as well as for the demanding home woodworker. However, we'd like to see Fein toss in the edge guide and ¼" collet to make this an even better deal.

For more information, circle #160 on the Resource Directory Coupon.



SPECIFICATIONS:

RT-1800 Plunge Router

Street Price: \$350

Motor: 15amp, 3¼hp

RPM: 8,000 - 22,000

Collet: ½" std., ¼" available

Plunge depth: 3"

Base size: 6¾"

Weight: 12 lbs.

Performance: ●●●●●

Value: ●●●●○

Fein: 800-441-9878, or
www.feinus.com

HOW WE RATE TOOLS

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

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

while "one" means we consider it pricey. However, a tool with a low value rating may be worth the high price.

If our tool reviews don't answer all your questions, e-mail me at DavidT@FWPubs.com or call me at 513-531-2690, ext. 255. If we haven't reviewed the tool you're considering, there's a good chance I've used the tool, but simply haven't had a chance to write a review. Give me a call and see if I can help. You can also check out our past published tool reviews at our website: www.popwood.com.

—David Thiel, senior editor

TOOL TEST

Delta 20" Scroll Saw Aims for the Middle

There are two different groups of scroll saw users: those who use the scroll saw as their main tool, and those who use one occasionally. If you're in the first category, you usually buy an expensive (\$1,000 plus) scroll saw with a stand and all the bells and whistles. The second group usually buys a benchtop model for about \$200 that is fine for occasional use. However, there were always two scroll saws in the middle of the pack that were worth paying attention to: the 18" Delta Q3 (\$390) and the 20" DeWalt DW788 (\$450 with stand). Both are excellent machines, with performance that — in our opinion — rivals some higher-priced saws. For years we favored the DeWalt because of the extra capacity. But now Delta has come along with a new 20" saw for \$480 that makes the decision a lot tougher.

Many of the features on the 40-680 are similar to the DeWalt. There's an oversized tear-drop-shaped cast iron table, the tilting table has a positive stop at 90°, there's an adjustable dust blower, parallel arm design for smooth cuts, convenient switch locations, quick-change toolless blade holders and a sturdy, height-adjustable stand.

The differences are worth noting. Instead of electronic variable speed, Delta's 40-680 uses an induction motor and stepped pulleys to change the speed — much like on a drill press. This setup allows sustained cutting power while still keeping the motor cool during long periods of use. Also, officials at Delta contend (and I'll support this with my experience) that most scroll saw users pick one speed and use it most of the time. Another Delta improvement is an upper arm lock that holds the arm in the "up" position for easier blade changing and for threading the blade through holes in the material for interior cuts.

In use we found this to be a smooth, powerful and easy-to-use saw. It has the feel of a stationary machine rather than a benchtop model and performed very well. Even with a slightly higher price, our "best of both worlds" scroll saw recommendation now leans toward the new Delta 40-680.

For more information, circle #161 on the Resource Directory Coupon.



SPECIFICATIONS:

Model 40-680 Scroll Saw

Street Price: \$480

Motor: 3.5 amp, 120v

Speeds: 6 (400, 700, 1,200, 1,400, 1,600, 2,000 cutting strokes per minute)

Table Size: 20" x 16"

Table tilt: 47° right, 15° left

Weight: 115 lbs.

Stroke: 7/8"

Throat: 20 1/2"

Thickness of cut: 2"

Blade length: 5"

Performance: ●●●●○

Value: ●●●●○

Delta: 800-438-2486, or
www.deltawoodworking.com



SPECIFICATIONS:

Grizzly G9900 Dial Protractor

Street Price: \$39.95 plus shipping

Materials: All-steel construction

Accuracy: To within 1/12 of a degree

Performance: ●●●●●

Value: ●●●●○

Grizzly: 800-523-4777, or
www.grizzly.com

Grizzly's Dial Protractor Offers Machinist's Accuracy on a Woodworker's Budget

When setting your table saw blade to any angle other than 45°, it's wise to be skeptical of the gauge on your saw. Most of us have turned to the \$30 plastic gauges or even more expensive options to double-check our setups, but now there's a better option.

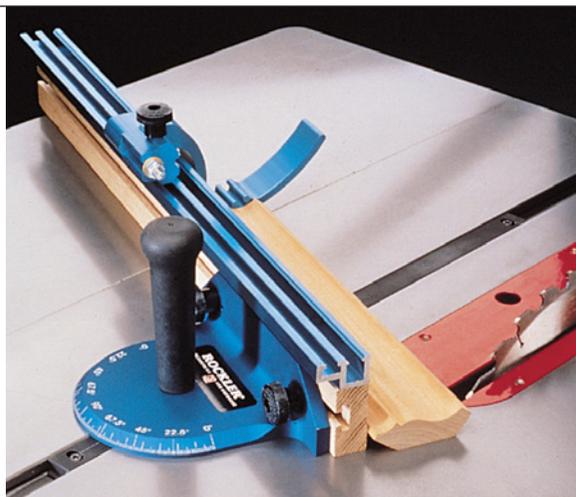
Grizzly Industrial, which makes woodworking and metalworking machinery, now offers a dial protractor that not only sets or checks an angle with astounding accuracy, but it's only \$39.95. Capable of measuring to within 1/12th of a degree, this well-made tool is an angle maniac. By using the 60° and 45° bevels on the beams themselves, quick referencing of angles is made even more simple. These fixed bevels, in addition to the acute angle attachment, allow you to determine angles by simply adding or subtracting the angle of the attachment. Believe it or not this measuring device has so many possibilities it comes with a book of instructions. And every week we come up with some new use for this tool. If you work with angles in your shop (and who doesn't) this protractor will save you hours of swearing and prevent lots of mistakes.

For more information, circle #162 on the Resource Directory Coupon.

TOOL TEST

Rockler's Precision Miter Gauge is Accurate and Affordable

You might be tempted to throw away the miter gauge that came with your table saw once you get a gander at this new accessory from Rockler Woodworking and Hardware. The Sure-Loc Miter Gauge is the newest aftermarket miter gauge to hit the market, and it's got a lot going for it. For starters, your miter angle is locked in by meshing two sets of aluminum teeth: one on the miter bar and the other on the head of the gauge. The teeth allow you to set cutting angles between 0° and 90° in 2½° increments. Why 2½° and not 1° increments? A spokesman for Rockler says that the way the gauge is now manufactured, 1° increments would require teeth that are too fragile and liable to get gummed up with dust.



SPECIFICATIONS:

Sur-Loc Miter Gauge

Street Price: \$120 with fence and stop

Max crosscut: 25³/₁₆"

Miter: 0° to 90° in 2.5° increments

Materials:

Head and bar: anodized aluminum

Handle: polymer

Fence: aluminum, wood

Performance: ●●●●○

Value: ●●●●○

Rockler Woodworking: 800-279-4441, or www.rockler.com

Our tests showed the Sure-Loc to be dead on when cutting angles, though sometimes you have to remove the gauge from the table saw to see which teeth are where when setting your angle.

On the plus side, the miter bar adjusts to a perfect fit in your miter slot using only an Allen wrench. Even more impressive is that the adjustment can take place with the miter bar in its slot, unlike other adjustable aftermarket miter bars.

On the downside, the Sure-Loc's fence has one of the limitations that many of its competitors have: it's not long enough to crosscut a standard 28"-long table leg. The Sur-Loc will crosscut only to 25³/₁₆" in a pinch. Perhaps the next generation of miter gauge fences will solve this odd oversight. And one more thing: be sure to hold on to your old miter gauge. Though the Sur-Loc is far and away more accurate, you'll want the adjustability of your old miter gauge when cutting compound miters, which routinely need angles in ½° increments. For more information, circle #163 on the Resource Directory Coupon.

Delta's Two-Stage Dust Collector

In a perfect world, we'd all own two-stage dust collectors. In your typical single-stage collector, all the chips and fine dust from your machines are sucked through the impeller and deposited in a bag, which is usually a pain to empty. In a two-stage collector, the big chips spin around the sides of the drum while the fine dust is sucked through the impeller and sent to a cloth bag. As a result, emptying the collector's drum is easier.

Until recently, many two-stage collectors were too expensive for home woodworkers. Enter the new Delta 50-660. This ¾ hp machine sucks 540 cubic feet per minute, which is more than enough to keep up with any single wood-working machine. We first connected the 50-660 to a 12" jointer and face-jointed some wide boards. No problem. Then we connected it to our 25"-wide stationary belt sander. Our centrally ducted dust collection system (which has its share of leaks) has trouble keeping up with all the fine dust this monster produces, but the 50-660 had no problem. As the 35-gallon drum filled up, we noticed that the collector became less efficient at separating the dust from the chips, but that's to be expected.

To empty the collector, you simply lift the lid off the drum and roll the drum to the garbage. The cloth bag is removed by simply flipping a quick-release lever that is threaded into the bag. The cloth bag is zippered on one end so you can quickly empty its dust. The bag is rated to capture dust as small as 2 microns, which is adequate for a healthy home shop.

When you compare the 50-660 to single-stage collectors, it looks a bit pricey at \$349. But when you add up how much it would cost to upgrade a single-stage collector with a cyclone separator and high-quality dust bags, we think you'll find the 50-660 to be a good deal.

For more information, circle #164 on the Resource Directory Coupon.



SPECIFICATIONS:

Model 50-660 Dust Collector

Street Price: \$349

Motor: ¾ hp, 115v

RPM: 3,450

CFM: 540

Max. static pressure: 7" in water

Weight: 60 lbs.

Bag area: 11 sq. ft.

dBa: 77 @ 5 ft.

Drum size: 35 gallon

Performance: ●●●●○

Value: ●●●●○

Delta: 800-438-2486, or www.deltawoodworking.com

TOOL TEST

One-Handed Clamps With Bar-Clamp Power

American Tool has expanded the Quick Grip line of clamps to include its new Advantage models. The Advantage clamps merge a one-handed clamp design with an F-style threaded screw design resulting in an easy-to-use clamp with good holding power. With a reported 600 pounds of clamping force, the Advantage clamps stand up to all but the most strenuous clamping tasks, while the non-marring pad on the swiveling jaw allows the clamp to tighten without sliding pieces out of parallel from one another. The mostly steel construction of the clamp gives a solid feel, and the pieces are well machined for easy adjustment. Available in 6", 12" and 24" lengths, we expect the Advantage clamps to sell for about \$35 for the 24" clamp.

For more information, circle #165 on the Resource Directory Coupon.



SPECIFICATIONS:

Advantage Quick Grip Clamps

Street Price: \$35 for 24" version

Sizes available: 6", 12" and 24"

Jaw depth: 3"

Clamping force: 600 lbs.

Materials: Steel body and heads.

Performance: ●●●●○

Value: ●●●●○

American Tool: 800-866-5740, or

www.quick-gripclamp.com

TOOL SCOOP NEW TOOLS FROM VERITAS

Works stops on the magazine for an afternoon when the new Lee Valley Tools catalog shows up in the mail. This year's catalog has several new items from Lee Valley's manufacturing company, Veritas, that are worthy of attention. Call 800-871-8158 for a catalog or to order.



- **Ball Tail for Low-Angle Block Plane:** If you own (or are about to buy) the Veritas low-angle block plane reviewed in this issue, you might want to consider buying this accessory that converts the plane to a low-angle smoother. The ball tail screws onto the back of the plane, and a high wooden knob replaces the small brass knob on the front. After we re-ground the cutting edge on the plane blade to 25 degrees, we were quite pleased with what these add-ons did to the plane. You can tackle much bigger jobs (such as a small tabletop) and not have to worry about tearout because of the low angle of the blade. At \$21.50, it's a must-have accessory.



- **Jointer Fence:** This aluminum fence for your iron or steel plane allows you to cut perfect 90° angles on the edges of boards. It attaches to the side of any bench plane from a #4 to a #7 using rare earth magnets. It easily converts for either right- or left-handers. One last bonus: the fence is drilled so you can add accessory fences that will allow you to shoot edges at any angle. The hand tool guys in our shop were quite impressed with this \$25.75 gizmo and are fighting over who gets to use it. These items can also be ordered through www.leevalley.com.



SPECIFICATIONS:

Model FDS12DVA Drill/Driver & Flashlight

Street Price: \$110

Battery: 12 volt, 1.4 amp-hour (2)

RPM: 0-350/0-1,050

Max. torque: 191 inch-lbs.

Clutch settings: 22

Charger time: 1 hour

Weight: 3.4 lbs.

Chuck: 3/8" keyless

Brake: Yes

Performance: ●●●●○

Value: ●●●●○

Hitachi: 800-706-7337, or
www.hitachi.com

Hitachi 12-Volt Kit is One Amazing Deal

We've been telling readers for years about the amazing value offered by Hitachi's 9.6 volt FDS10DVAL drill/driver kit. Now we can add a new amazing value in the 12-volt category from the same company. Hitachi's new FDS12DVA is one of the lowest priced 12-volt cordless drills out there, and it's got features all over the place — not to mention the really good flashlight that's included. This isn't the most powerful drill on the market, though the 191 inch-pounds of torque is respectable for most shop applications, and the battery is only a 1.4 amp-hour, which is nearly the lowest amp-hour rating in the category. But priced at \$110, this is a very capable drill/driver offering an electronic brake, a variable two-speed motor, keyless chuck and 22 clutch settings. Throw in two batteries, the flashlight, a nice set of screw tips and magnetic holder and this is a real bargain. The ergonomics on the drill are quite good with a well-balanced, center-handle design and one of the lowest weights in this category. The handle is slim enough to get a good grip, and the switches are easy to operate and conveniently located. This is a great gift for yourself or someone you care about (but don't want to spend hundreds of dollars on).

For more information, circle #166 on the Resource Directory Coupon.

'Wood Mill' Promises Precision, Safety

Popular Woodworking gets a sneak peek at a new type of woodworking machine that could change the way you work wood.

Grizzly Industrial has developed a new breed of woodworking machine that promises a degree of accuracy, versatility and safety you don't normally find in a woodshop.

The G9959 "Wood Mill" is essentially a metalworking milling machine that has been modified to accommodate woodworking tasks. Those familiar with milling machines will notice that compared to metalworking machines the G9959 has a faster spindle speed, larger table and a large throat capacity of 18½".

Shiraz Balolia, president of the Bellingham, Wash.,-based Grizzly Industrial, is a metalworker and woodworker and says he designed this mill with the woodworker in mind.

"It seemed that I was using my milling machine at home more for woodworking than for metalworking," Balolia says. "But it lacked some features that woodworking required."

So how does this 1,350-pound cast iron machine work? In most woodworking operations you guide the tool or the work with your hand. In contrast, the G9959 steps in to give you an exceptional measure of safety. You clamp your workpiece to the large 10" x 34" table, install the appropriate cutter into the spindle and then make your cut by manipulating the handles. Your hands never go near the cutter. The length and location of your cuts are controlled by a series of stops. In essence you can set up a precise series of cuts and make them on as many pieces as you like — with perfect repeatability.

The type of cut you make is almost limitless. The 18½" throat means the Wood Mill can work to the center of 37"-wide parts. It also has a variable head ram that swings out, slides in and out and tilts 90°

in both directions. In addition to accepting a huge assortment of widely available metalworking cutters, the Wood Mill can also accept an array of router bits and shaper cutters.

The Wood Mill can perform hundreds of traditional woodworking operations that oftentimes require various machines. It can cut precision dovetails, make raised panels, cut mortises and tenons, plus more common dadoes, grooves and edge profiles. With numerous accessories available, it can also cut and sand perfect circles, make rope turnings and taper stock. It also functions as a drill press and radial drill. And if that's not enough, the "Wood Mill" also functions as a traditional metalworking milling machine.

The Wood Mill represents many new possibilities in woodworking and will require new approaches to traditional methods of machining wood. In a future issue we will report on our first-hand experience with the machine and provide a full product review. Grizzly officials expect the G9959 to retail for less than \$2,000 and be available in early 2001. **PW**



Milling machines excel at dealing with round shapes. Clockmakers will be amazed at what this machine could do for their woodworking.



The table travels left to right 18½" and forward and back 10¾".



The head tilts 90° both ways and swivels 360°. The 1½hp motor has nine speeds between 440 and 5,000 rpm.

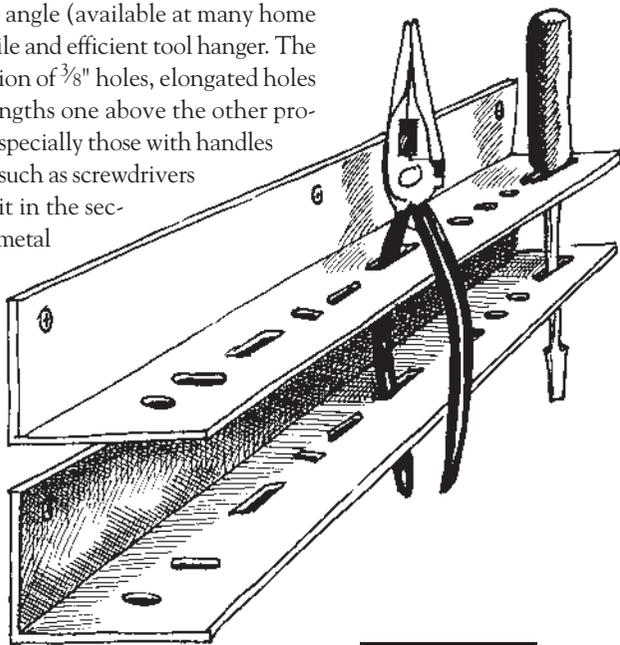
Dirt cheap way to store hand tools, bits and more

THE WINNER:

Steel Angle Tool Holder

Two lengths of slotted steel angle (available at many home center stores) make a versatile and efficient tool hanger. The angle I used has a combination of $\frac{3}{8}$ " holes, elongated holes and 2" slots. Placing the lengths one above the other provides stability to the tools, especially those with handles that make them top-heavy, such as screwdrivers and putty knives. Look for it in the section of the store that carries metal strapping and threaded rod. Expect to pay about \$5.50 for a 48" length.

*Edmond S. Block
Anchorage, Alaska*



price cutter

TRICKS OF THE TRADE FROM THE AMERICAN WOODSHOP



GREETINGS FROM 'THE AMERICAN WOODSHOP'

As host of "The American Woodshop" I've collected a lot of tips, tricks and great woodworking ideas over the years. Some are basic helpful hints, while others are just good common-sense solutions to everyday problems. I'm happy to be able to share these with you here. In addition to my ideas, we'll pick the best tip or trick sent in by a reader and publish it on these pages as well. Delta Woodworking Machinery is the sponsor for the Tricks of The Trade column, and they're giving away a model 22-560 12 1/2" benchtop planer (shown at left) to the best "trickster."



To submit your tip or trick, either e-mail it along with a daytime phone number to DavidT@FWPubs.com or mail it to: Tricks of the Trade • Popular Woodworking • 1507 Dana Ave. • Cincinnati, OH 45207.

- Scott Phillips



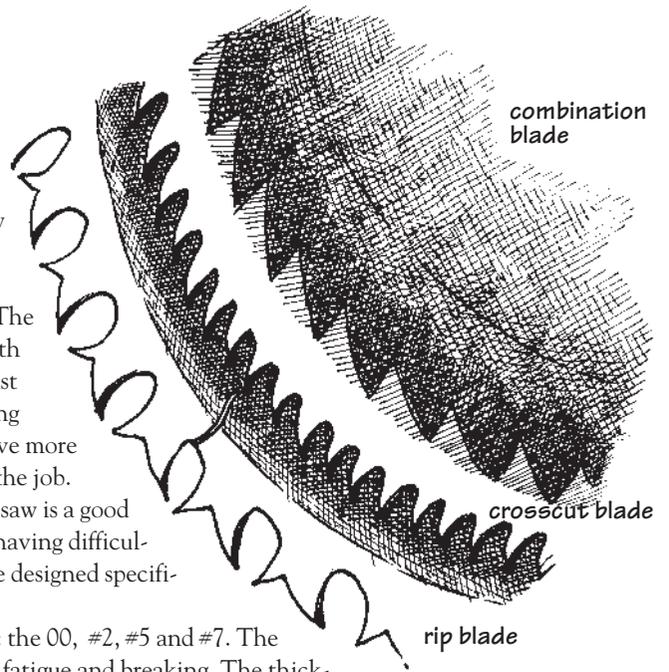
Fewer Teeth Equals More Cutting

Many woodworkers select a blade for their table saw, scroll saw or band saw that has many more teeth than they need for a smooth cut. The basic job of a blade is to cut the wood and remove the saw dust from the cut. Different blades work better for ripping (cutting with the grain) or crosscutting (cutting across the grain), though combination blades are designed to do both jobs reasonably well. The general rule is that blades designed for ripping have fewer teeth with deep gullets (the valley between the teeth that carries away the dust and chips) to help remove the long shavings produced when cutting along the wood grain. Crosscuts are best made with blades that have more teeth and shallow gullets. The trick is to select the right blade for the job.

Table saw: My favorite blade for all-around work on the table saw is a good (\$60 and up) combination blade with 40 carbide teeth. If you are having difficulties making rip cuts with a combination blade, try a 24-tooth blade designed specifically for ripping.

Scroll saw: For scroll saw work, you need basically four blades: the 00, #2, #5 and #7. The thinnest blades (00 and #2) need to run at slower speeds to reduce fatigue and breaking. The thicker blades work best at the faster speeds. I recommend premium quality blades that have been precisely milled. The package usually will say the blades have been precision ground.

Band saw: Band saw performance can be remarkably improved if you use a premium steel blade with the correct tooth count. I use three blades on my 1hp band saw. For scrolling-style cuts I like the 14 tooth-per-inch (TPI) $\frac{1}{8}$ " blade supported by cool blocks and the standard thrust bearings. For general-purpose cutting the $\frac{1}{4}$ ", 6 tpi blade is excellent. The $\frac{1}{2}$ "-wide 3 or 4 tpi blade works great for resaw work if the band saw is properly tuned up.



continued on page 24

performax

Build Your Own Corporate Ladder.

We can supply the right tools.



Become a Woodcraft Franchise Owner.

Owning your own business can be empowering, especially when power tools are involved. Turn your love for woodworking into a dynamic investment by becoming a Woodcraft retail store franchise owner. Contact us soon. Opportunities are limited.

To find out more contact:
Bill Carroll
Director of
Franchise Operations
bill_carroll@woodcraft.com
304-422-5412
F01PW01Q



WOODCRAFT
Helping You Make Wood Work®

1177 Rosemar Road, P.O. Box 245
Parkersburg, WV 26102-0245

continued from page 23

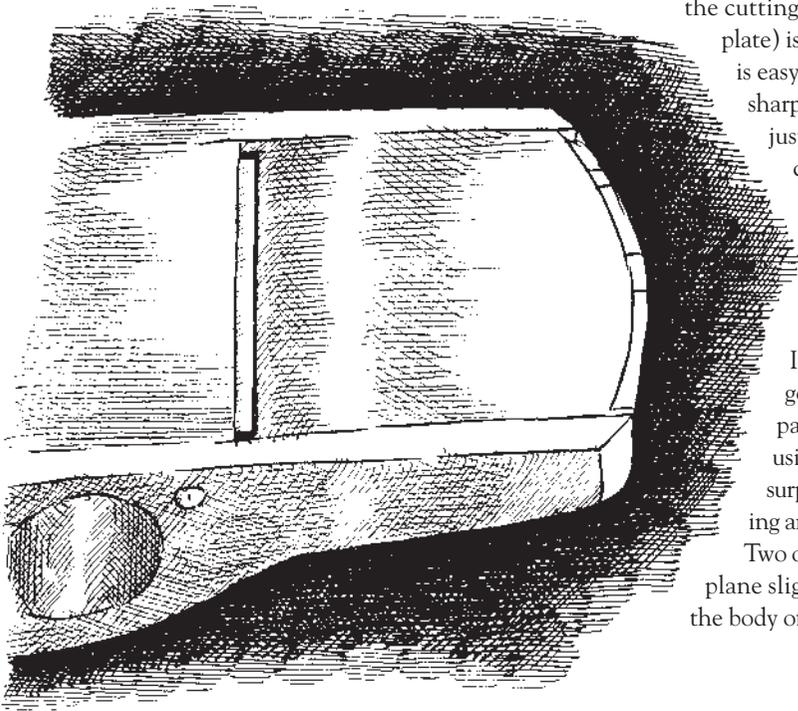
Planely Speaking

So many times woodworkers will properly sharpen plane blades, hone them to perfection and still be dissatisfied with the cut. To make planes perform better, make sure the throat (the gap between

the cutting edge of the blade and the rear edge of the throat plate) is set properly. The throat on low-angle block planes is easy to set because the throat plate is adjustable. First sharpen the blade and hone it. Then set the blade so it just barely comes through the sole of the plane. The cutting edge should be one- to two-thousandths of an inch below the sole. Lastly, loosen and move the throat plate to close the gap between the cutting edge and the rear edge of the throat plate to about $\frac{1}{32}$ ".

Make a few practice cuts on the edge of a board. If the plane grabs, retract the blade just a hair. If you get a partial shaving, adjust the cutting edge so it is parallel to the mouth of the plane. Experiment by using the plane on different species of wood. You'll be surprised how different densities of wood require opening and closing the mouth to get the best cutting results. Two other suggestions are to try skewing the body of the plane slightly to better shear the wood fibers. Also, cradle the body of the plane with your hands for a more stable cut.

continued on page 26



powermatic

econ

Circle #128 on Resource Directory Coupon

AIRY[®]

AIR COMPRESSOR

Air Boss Series

Designed for Nail and Staple Tools



NEW!

Contractor Pack

Model No. HD1517-2462

- Air Compressor Hot-Dog HD1517
- 18 Gauge 1 1/8" Finish Nailer 0241
- 18 Gauge 1" Narrow Crown Stapler 0626
- 3/4" x 50' Air Hose
- Carrying Case

1425 S Allec Street
 Anaheim, CA 92805
 Tel (714) 776-3235
 Fax (714) 776-3358
 Service hotline (888) 835-2479
 e-mail: airyusa@airy.com
<http://www.airy.com>

AIRY tools are recognized as the #1 Best Value in pneumatic nailers. Just listen to what the experts have to say about AIRY tools.

Circle #121 on Resource Directory Coupon

terrco

Circle #116 on Resource Directory Coupon

FREE!

Over 600,000 Sold!

Woodworking Information Kit



Visit us at www.shopsmithmarkv.com

If you've ever wanted to be a do-it-yourself woodworker, you'll want to discover Shopsmith's MARK V.

It's the five most important tools – a table saw, lathe, drill press, disc sander, and horizontal boring machine – all in one compact, easy to use, affordable unit.

The MARK V takes up about the same space as a bicycle, and costs a lot less than the tools it replaces.

Call TOLL FREE Today
1-800-543-7586
 For Your FREE Info Package



Shopsmith Inc.
 6530 Poe Avenue
 Dayton, OH 45414-2591

Circle #140 on Resource Directory Coupon

HARDWOOD MARKETPLACE

NIAGARA LUMBER

YOU'LL APPRECIATE OUR DIFFERENCE
 Prepaid Freight • Surfaced • Bundled • Shrink Wrapped • Guaranteed

- All lumber is Select and better grade, 4" and wider, averaging 6"-7" in width, lengths are 6'-8'. All stock meets or exceeds National Hardwood Lumber Assoc. grade rules.
- All domestic lumber is Northern Appalachian grown, exhibiting characteristics of fine grain, texture and uniform color.

Visa/Mastercard/Discover accepted
NIAGARA LUMBER & WOOD PRODUCTS, INC.
 47 Elm Street
 East Aurora, NY 14052
 Call Toll-Free 1-800-274-0397
www.niagaralumber.com

Reader Service #146

WEST PENN HARDWOODS, INC.

SATISFACTION GUARANTEED
 NO MINIMUM ORDERS

QUARTER-SAWN WHITE OAK
 HIGH FIGURE CURLY MAPLE

NOW ALSO EXOTIC SPECIES:
 BLOODWOOD, BUBINGA,
 JATоба, SPANISH CEDAR PADAUK,
 PURPLEHEART, ZEBRAWOOD
 AND MORE

ALL CREDIT CARDS ACCEPTED

CALL FOR FREE CATALOG & PRICING
TOLL FREE (888)636-WOOD (9663)
 117 S. 4TH STREET
 OLEAN, NY 14760

Reader Service #147

TRICKS OF THE TRADE

continued from page 24

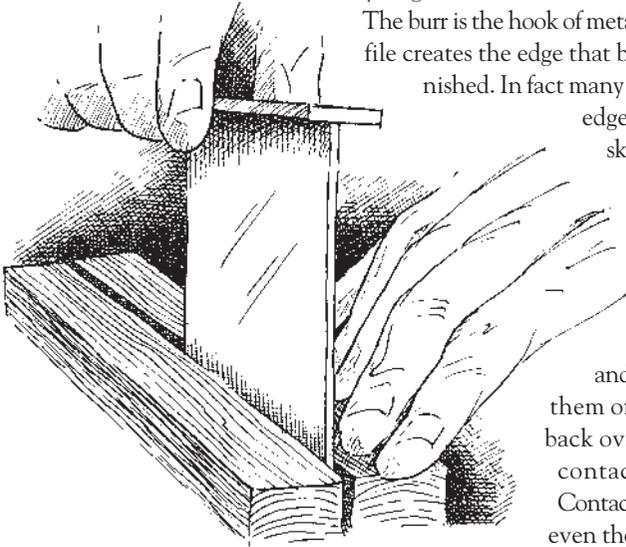
File This One Under 'Must-Have Tools'

Cabinet scrapers are one of the greatest tools ever invented. You can use them to produce beautifully smooth surfaces, remove excess glue, strip finishes, resurface workbenches, clean up squeeze-out in corner joints, smooth figured grain — you name it. But everybody has a different way of sharpening these tools. That's OK, but it amazes me that no one really talks about the most important part of sharpening a cabinet scraper: buying the right file to make a good burr. A high quality single-cut mill bastard file is the key to a great burr.

The burr is the hook of metal that shaves the wood. The file creates the edge that becomes the burr when burnished. In fact many times I just file the scraper's

edge at an 86° or 87° angle and skip burnishing. Whatever the technique, the edge and the tool will not perform properly if you use a low quality or multicut file.

So spend a little more and buy high quality files and use a file card to clean them often. And never drag a file back over the scraper's edge. Only contact during the push stroke. Contact on the back-stroke will dull even the best files in no time at all.



FINISHING FIGURED WOODS

This is a great way to get the best look for tiger, bird's eye and quilted maple. (Remember to always do test samples on scrap boards before you finish your project.)

First rag on a linseed oil base coat to highlight the grain. Now use a synthetic woven extra fine pad or 300-grit abrasive to lightly wet sand the surface smooth with the linseed oil still on the wood. Wipe off the residue after 10 minutes and let this dry overnight. On day two wipe on multiple coats of 1 1/2 lb. garnet shellac. Orange shellac isn't dark enough to get the pumpkin glow of aged maple. Garnet shellac, freshly made and cut with denatured alcohol, wipes on beautifully with an all-cotton pad. Fold the pad so it fills a lightly closed hand. Then fold the edges of the cloth to the inside as these will fray and deposit lint on the finish. Dip the pad in the 1 1/2 lb. cut and wipe light coats on in fluid passes from edge to edge, working with the grain. This dries in minutes so successive coats build quickly to a lustrous sheen. Once you get the desired color and surface, let this dry for one hour, then lightly wax with either clear or shaded wax. PW

modine

Circle #137 on Resource Directory Coupon

s. larose

Circle #139 on Resource Directory Coupon



woodcraft

Circle #118 on Resource Directory Coupon

THE STANDARD IN SANDERS



Clayton Spindle Sanders are built in the USA with precision balanced spindles, oversized bearings, and a premium Baldor Induction Motor.

- Benchtop and full-sized, professional models
- Large table surface
- Built-in dust port
- Quick-change drums

Clayton tackles the toughest sanding jobs...smoothly.
FREE COLOR CATALOG, call: 1-800-971-5050

CLAYTON
Spindle Sanders

CLAYTON MACHINE CORP.

ROYAL OAK, MI 48068-0520

Circle #102 on Resource Directory Coupon

Bending Wood the Wright Way

Cold bending is a whole lot easier with this flexible clamping fixture.

In my mind, there are three classifications of woodworking techniques. There are many that I classify as “useful,” a smaller number that I think of as “indispensable,” and then a very few that represent a true breakthrough in woodworking technology. Bending wood is one of the latter.

The ability to alter the grain direction as our imagination dictates while preserving the strength inherent in a straight piece of wood allows us to create the elegant beauty of a continuous-arm Windsor chair and the inspiring sweep of a vaulted ceiling. We first explored our world in sailing ships with bent wood hulls, then left it in airplanes with bent wood wings. Our world would be much less beautiful and much less exciting without this simple woodworking technique.

I’m currently engaged in a woodworking project designed to create a little excitement, and bending wood is at the very heart of it. I’m part of a group of historians and aviators who are recreating the six experimental airplanes of the Wright brothers, beginning with their model glider of 1899 and ending with the 1905 Wright Flyer 3, the first practical airplane. The frames of these primitive aircraft are a collection of bent wood parts — ribs, wing ends, braces and skids — ingeniously arranged to catch the wind and lift a man into the air.

True Geniuses Prefer Cold Bending

When most of us hear the words “bending wood,” we think of steam bending. The wood is heated briefly in low-pressure steam to soften the lignin (a glue-like protein that holds the cellulose fibers together). While the wood is still hot, it’s clamped into a bending form. The cellulose fibers telescope to conform to the curve, and the lignin cools to hold them in place. Or almost. In actual practice, the fibers never quite conform, and when you remove the wood from the bending form, there is a great deal of springback — the wood loses



some of its curve. If the wood is not attached to the other parts in the project so as to hold the curve, it may continue to relax and it will spring back even more. This problem plagued the Wright brothers while they were doing their glider experiments — they calculated precise curves for the ribs to fly as efficiently as possible, only to have the ribs relax and lose a good deal of curvature before they could get their gliders in the air.

To solve this problem, they eventually abandoned steam bending for an early form of cold bending. They arranged the parts of the ribs for their Flyers in a bending form, then nailed them together with

brads. They could not use glue — the adhesives 100 years ago were not weather-proof. A good rain and the wings would have come apart.

Fortunately, we have a much larger and more reliable selection of adhesives to choose from than the Wrights. We decided to make the bent wood ribs of our replica Wright gliders by laminating the parts with a water-resistant aliphatic resin (yellow) glue. You could also use Resorcinol, epoxy or polyurethane glue for an application like ours. If your project won’t be exposed to the weather, you can use almost any good wood glue.

To cold-bend wood, first resaw your

stock into thin strips and plane it so the thickness is even. The thickness of the strips depends to a large extent on the radius of the curve. The tighter the radius,

the thinner the strips. I use this chart as a jumping-off point:

- 2" to 4" radius — $\frac{3}{32}$ " thick
- 4" to 8" radius — $\frac{1}{8}$ " thick

HELP KIDS BUILD A WRIGHT FLYER

The most exciting woodworking project in 100 years.

The year 2003 will mark the 100th anniversary of the first controlled, sustained flight. On Dec. 17, 1903, Wilbur and Orville Wright flew their first powered aircraft, called simply the Flyer, 852 feet across the sands of Kitty Hawk, North Carolina. This coming anniversary presents a unique opportunity to get young people all across America excited about avia-

tion — and woodworking!
The Wright brothers built the gliders and airplanes in their workshop in Dayton, Ohio. These machines were largely made of wood: spruce for the straight parts, ash for the bent parts and a little boxwood for the pulleys. The end result of these labors was that the Wrights, by virtue of their ingenuity and craftsmanship, achieved the age-old dream of flight. The story of their woodworking projects has become one of the most inspiring stories in American history. That said, it is becoming harder and harder for young people to acquire the woodworking skills that gave us the airplane and a thousand other useful and beautiful innovations. High school shop programs are becoming a thing of the past. Vocational schools train students for industry, which relies more and more on computer-aided manufacturing. The old manual machine setups — what we use every time we make a cut or drill a hole — are no longer being taught on a wide scale, and our craft will suffer if we don't find other ways to introduce young people to the joys of woodworking.

Company (WBAC) of Dayton, Ohio, that addresses these concerns directly. The WBAC is a non-profit educational organization of craftsmen, historians and aviators who are building replicas of Wright aircraft, including the 1903 Wright Flyer. They will build the Flyer with the involvement of young people across America! Here's how it works: The WBAC has scripted a learning experience for kids ages 10 to 18 during which they learn a little aviation, a little history and a little woodworking. During this experience, which takes just a few hours of a morning or an afternoon, the kids build $\frac{1}{4}$ -scale ribs of the Flyer that they can take home. Then the whole class comes together to build a full-scale rib. The kids sign it and send it to the WBAC in Dayton, Ohio. There, more kids under the supervision of accomplished craftsmen, will assemble the ribs in a replica Flyer, that's 40 feet from wingtip to wingtip.

And that's not all. Each of the kids who works on a rib gets to sign it. The WBAC also invites each young person to make a prediction about what the next 100 years of aviation will bring. All the signatures will be preserved on the replica Flyer, and the predictions will be edited and assembled into a large book. The completed kid-built Flyer and the book will be unveiled at the Dayton International Airport on December 17, 2002 (a year before the centennial anniversary), where it will serve as a milestone in both aviation and craftsmanship, pointing 100 years back and looking 100 years forward.

We're looking for woodworkers to serve as teachers and mentors to help conduct these learning experiences and to communicate the thrill of building something wonderful to children. The WBAC will send you information on these experiences if you'll just raise your hand and say "I'll do it." You can contact them through the Internet at www.wright-brothers.org, or write Wright Brothers Aeroplane Company, Kids Build a Flyer!, P.O. Box 204, West Milton, OH 45383.

Meanwhile, we'll continue to report on this exciting woodworking project as it progresses. PW

- 8" to 12" radius — $\frac{3}{16}$ " thick
- 12" radius or larger — $\frac{1}{4}$ " thick

There are other factors to consider: the species of wood, the slope of the grain (as it runs between the faces of the strips), the strength you want, and the amount of springback you can tolerate. For maximum strength and minimum springback, we decided to glue up the ribs from $\frac{1}{8}$ "-thick strips, although the radius of the curve was nowhere near 8".

Stack the strips as you will glue them together. If you use strips that were all resawn from the same board, flip every other strip end for end to reverse the grain slope. Spread a thin layer of glue on the face of one strip, lay the next strip on top of it, spread more glue and repeat. If you're laminating a large number of strips, you may want to choose an adhesive with an extended working time.

Before the glue sets, clamp the laminated strip in the bending form. Let the glue set up for its full clamp time. If you're not sure of the clamp time, wait a full day before you remove the assembly from the bending form. As you release the clamps, there will be a small amount of springback. If the curve is critical (as it was for our glider ribs) make the curves in the bending form slightly tighter to compensate.

Making a Cold Bending Form

Pretty simple, huh? The only real trick to cold bending is in making a form that will apply an even clamping pressure all along the laminated assembly. Traditional bending forms consist of two parts, the form (the positive shape) and the press (the negative shape). Both of these parts are normally cut from the same stock. Begin by drawing the curve you want on the face of the stock. Cut the curve with a band saw, separating the stock into two parts. On the negative part, mark the thickness of the bent wood part. (Tip: Use a compass like a calipers, set it to the desired thickness. Follow the curve with the point of the compass, marking the thickness with the scribe.) Cut away the thickness on the band saw — this will create the press.

The trouble with this traditional bending form is that the press doesn't compensate for small variations in the thickness of the laminated stock or a band saw blade



A replica of the Wright Brothers' 1900 Glider that Nick Engler built and got airborne at Kitty Hawk, N.C., in late October.

tion — and woodworking!

The Wright brothers built the gliders and airplanes in their workshop in Dayton, Ohio. These machines were largely made of wood: spruce for the straight parts, ash for the bent parts and a little boxwood for the pulleys. The end result of these labors was that the Wrights, by virtue of their ingenuity and craftsmanship, achieved the age-old dream of flight. The story of their woodworking projects has become one of the most inspiring stories in American history.

That said, it is becoming harder and harder for young people to acquire the woodworking skills that gave us the airplane and a thousand other useful and beautiful innovations. High school shop programs are becoming a thing of the past. Vocational schools train students for industry, which relies more and more on computer-aided manufacturing. The old manual machine setups — what we use every time we make a cut or drill a hole — are no longer being taught on a wide scale, and our craft will suffer if we don't find other ways to introduce young people to the joys of woodworking.

Popular Woodworking has lent its support to a unique program of the Wright Brothers Aeroplane



Spread the glue on the surface of each strip with a $\frac{3}{8}$ "-32 threaded rod to draw the adhesive out as evenly as possible. Note that I've placed the strip on a long scrap to elevate it above the bench. This allows the extra glue to drip over the edge.

that wanders a hair off the line. Consequently when you apply the clamps, the clamping pressure may not be completely even all along the form. This may result in weak laminations or even gaps between the laminations when the glue dries.

To ensure that this didn't happen to our glider ribs, I designed a compensating press. After cutting away the thickness of the bent wood part, use the compass to mark yet another curve on the negative part, this one 1" larger in radius than the curve you just cut. Saw this curve then cut the 1"-thick piece into 3"-long segments. Adhere the segments back to the negative part temporarily with double-face carpet tape. Glue a strip of canvas to the inside curve of the segments and cover the canvas with 6-mil plastic.

When you separate the segments from the negative part and discard the tape, they should be held together by the canvas like the tambours of a rolltop desk. This is your



Clamp the laminated strips in the bending form, spacing the clamps every 3" — dead center in the middle of each segment of the press. I drilled $\frac{1}{4}$ "-diameter holes in the form to hold the top face of the clamps and automatically space them.

press. When you squeeze the laminated stock to the form, arrange the clamps in the middle of each segment; this will compensate for any variation in stock thickness or inaccuracies in the bending form and keep the clamping pressure relatively even.

Note: The plastic on the press will keep any glue that squeezes out from between the laminations from sticking to the canvas. To prevent the squeeze-out from sticking to the form, apply paste wax to the form before each glue-up.

Spreading the Glue

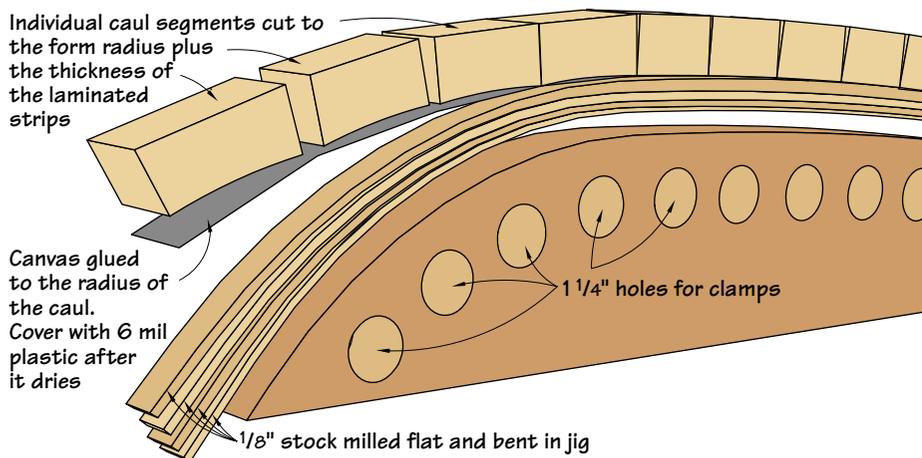
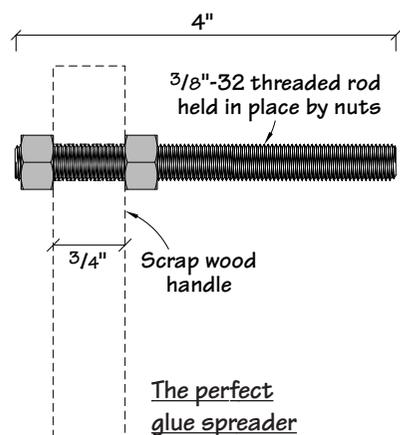
Just as uneven clamping pressure will reduce the strength of the lamination, so will an uneven application of glue. You must spread it as evenly as possible, and I've got just the ticket. This little trick was shown to me by the good folks at Franklin International (makers of Titebond glue). Get rid of your glue brushes and spread the glue



Before you tighten the clamps, just snug them up to hold the stock against the form. With a scrap of wood and a hammer, tap the top edges of the strips to even them up. Then tighten the clamps until the gaps disappear between the laminations.

with the teeth of a $\frac{3}{8}$ " x 32 threaded rod. The threads spread the glue to just the right thickness (about 0.005") for a strong joint with a minimum of squeeze-out. For this particular project, I mounted a short length of threaded rod in a wooden handle. Between glue-ups, I keep the rod submerged in water to prevent the glue from drying on the threads. **PW**

Nick Engler is a craftsman, pilot and the author of 52 books on woodworking. He's also the director of the Wright Brothers Aeroplane Co. — you can find out more about the Wright aircraft he's helping to build at www.wright-brothers.org.



The Best Way to Reglue Furniture



Old furniture joints were glued with animal hide glue, which must be removed before regluing with any glue other than hot hide glue so the new glue can bond to the wood.

Quick fixes never last. Here's how to make sure the joints in your antiques stay tight.

Of all the steps involved in restoring old furniture, regluing is by far the most important. Poorly done refinish jobs can be redone; badly made replacement parts can be remade and reinserted; sloppy touch-ups can be removed and done over – all without permanent damage to the furniture. But shoddy regluing can, and often does, lead to the complete destruction of the furniture.

Despite the importance of the regluing step, only a small percentage of professional and amateur restorers do it well. As a result, much of our old furniture is becoming unusable.

Five Methods

There are five ways to reglue or “tighten up” furniture. In order, from worst to best, these methods are as follows.

- Use nails, screws, brackets and other metal fasteners.
- Insert white or yellow glue, cyanoacrylate (super glue), or epoxy into the joints without totally disassembling the furniture.
- Disassemble the furniture and apply fresh glue, usually white, yellow or epoxy, on top of the existing glue and clamp back together.
- Apply hot animal hide glue over the old hide glue that remains in the joints (after removing any loose or deteriorated glue) and clamp the joints back together.
- Clean all the old glue out of the joints, apply fresh glue (usually hide, white or yellow) and clamp the joints back together. In furniture with dowels, remove all the dowels that are loose and either reuse them after cleaning both them and the holes, or replace them with new dowels after cleaning the holes. Even better, replace all the dowels by drilling out those that are still tight but likely to come loose

relatively soon. Then clean the holes and reglue the joints with new dowels as if everything were new.

Metal Fasteners

Inserting nails or screws and attaching metal fasteners is the worst thing that can be done to furniture. Any stress put on the joints can cause the wood to split, and sometimes cause tenons or dowels to completely break off. At best, the fasteners just hold the joints together; they don't make the joints tight.

“Wooden nails” (dowels) inserted perpendicularly through a wobbly mortise-and-tenon joint are just as destructive and difficult to deal with as metal nails. Unfortunately, many people find wooden nails somehow romantic, as if these “nails” are evidence of great craftsmanship, so they are sometimes added to old furniture.

Inserting Glue Into Joints

The practice of inserting glue into joints without disassembling the furniture is very widespread. Three methods are used: drip glue at the edges of the joints and hope it runs into them; drill holes into the joints and insert the glue through a syringe; and pull the joints open just enough to expose small parts of the tenons or dowels and apply glue to them.

The glues most often used with this technique are cyanoacrylate and epoxy, though white and yellow glues are also used. Cyanoacrylate and epoxy are more expensive and difficult to use, but it's usually reasoned that they are stronger.

Though this method produces joints that usually remain tight for a year or so, long-term soundness rarely occurs because only a part of the surface area is “reglued,” and it is still sealed with old glue, so the new glue doesn't get to the wood.



You can easily dissolve and wash off old hide glue with hot water or vinegar. If the glue is stubborn, scrub it with a stainless-steel kitchen scrubber or coarse Scotch-Brite pad and hot water.

Disassembling and Applying Glue

A better practice is to disassemble the joints before applying the new glue – usually white, yellow, epoxy or polyurethane glue. This method exposes more surface area to these glues, so there's a better chance that the joints will remain tight for at least a few years.

But the wood is still sealed with the old glue, so just as with the previous method, whatever bond is achieved is made to the old glue, not to the wood. The bond achieved is thus no stronger than that of the remaining old glue to the wood, and that glue has already given way once. Moreover, when the joints break down again, as they surely will, proper regluing will be much more difficult because all the newly applied glue will have to be removed in addition to the original glue.

Using Hide Glue

All furniture made or repaired before the 1950s was glued with animal hide glue. This glue is made from the broth of animal skins, usually cattle, and has to be heated to about 140 degrees to be made

liquid. Animal hide glue has the unique characteristic of dissolving quickly in hot water.

Because hot hide glue is both hot and wet, it dissolves old hide glue when applied over it, and a strong bond to the wood is usually achieved without the old glue having to be removed first.

The great advantage of continuing to use hide glue in joints glued originally with hide glue is that regluing is fast and very effective. When hide glue was the only glue available, everyone used it, and this is surely a primary reason that so much very old furniture has survived so long. Most of the old-furniture joint problems you see today are the result of one of the three lesser-quality regluing methods (discussed above) having been used.

The product called "Liquid Hide Glue" is the same as hot hide glue, except for added preservatives (to keep the glue from rotting for about a year) and gel depressants (to keep the glue liquid at room temperature). It can be used fairly effectively in place of hot hide glue as long as it is first heated to about 140 degrees.

Cleaning Joints

An even better practice than using hot hide glue over old hide glue is to clean all the old glue out of the joints before applying new glue. The strongest bonds are achieved when the wood is totally clean. This was the condition that existed when the joints were first glued.

Once the wood is clean, any glue can be applied, and the result will be strong, long-lasting bonds. The only rationale for using hide glue at this point rather than another glue is that the joints will be easier to reglue next time.

There are two ways to clean old glue off of wood: dissolve it off, or scrape or sand it off. Dissolving is the better method by far, because it's totally effective and doesn't change the dimensions of the parts. Because the old glue has penetrated somewhat into the wood, it's not possible to scrape or sand off all the glue without also removing some of the wood, and this creates air spaces in the joints. Tight wood-to-wood contact, which is necessary for a strong bond, is lost.

Hide glue is the easiest glue to dissolve and wash off. White and yellow glues are next. Each of these glues dissolve or break down in hot water or vinegar. Epoxy, urea-formaldehyde (plastic-resin), cyanoacrylate and polyurethane glues have to be scraped or sanded off because they can't be dissolved.

Not all furniture is deserving of the time it takes to reglue with one of the better methods, but all better quality furniture is.

PW

Bob Flexner is a nationally known finishing expert in Norman, Oklahoma. Each of the better methods of regluing is shown on his videotape "Repairing Furniture With Bob Flexner." Send \$19.95 to Bob Flexner, P.O. Box 214, Norman, OK 73070.

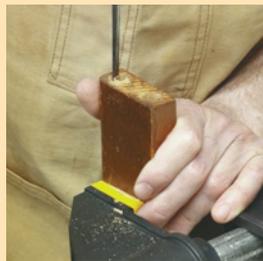
HOW TO REMOVE STUBBORN DOWELS



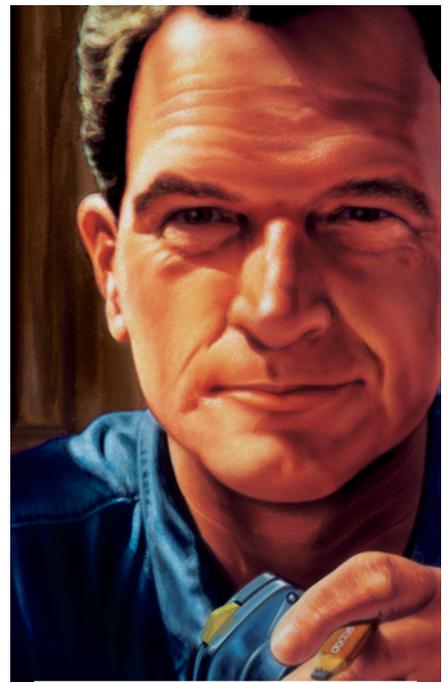
To remove an old dowel that won't budge even with a pair of pliers, first saw off the dowel just above flush.



Then drill out the center of the dowel using a brad-point drill bit $\frac{1}{16}$ " smaller in diameter than the diameter of the dowel. The brad point helps maintain center as you're drilling; the smaller bit reduces the risk of changing the location of the hole.



Use a $\frac{1}{8}$ " inch chisel or other sharp, narrow tool to pick away the remaining cylindrical part of the dowel. Then clean any remaining dowel or glue from the hole with the correct-size twist drill bit or a needle-nose rasp.



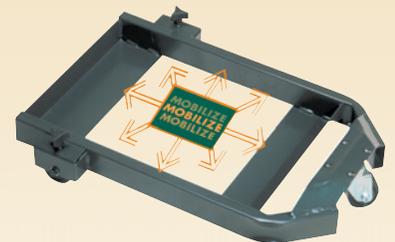
Can you move several thousand pounds of shop machines alone?

I have the typical garage problem: cars, lawn mower, garden tools, bikes, kids toys, etc. and not enough space to share with my heavy shop machines.

When I mobilized my shop machines and workbench, I created the space I needed to do my projects without sacrificing family storage space.

Have the freedom to move your machines, create an organized, safe and spacious work area, and allow for additional machines with easy shop cleanup.

You can, with a mobile base from HTC.



Call toll-free, **1-800-624-2027** for your nearest dealer and FREE, full color Shop Solutions Catalog.

HTC Products Inc.
P.O. Box 839
Royal Oak, MI
48068-0839



©HTC Products, Inc. 2000



Circle #107 on Resource Directory Coupon

The Deltagram

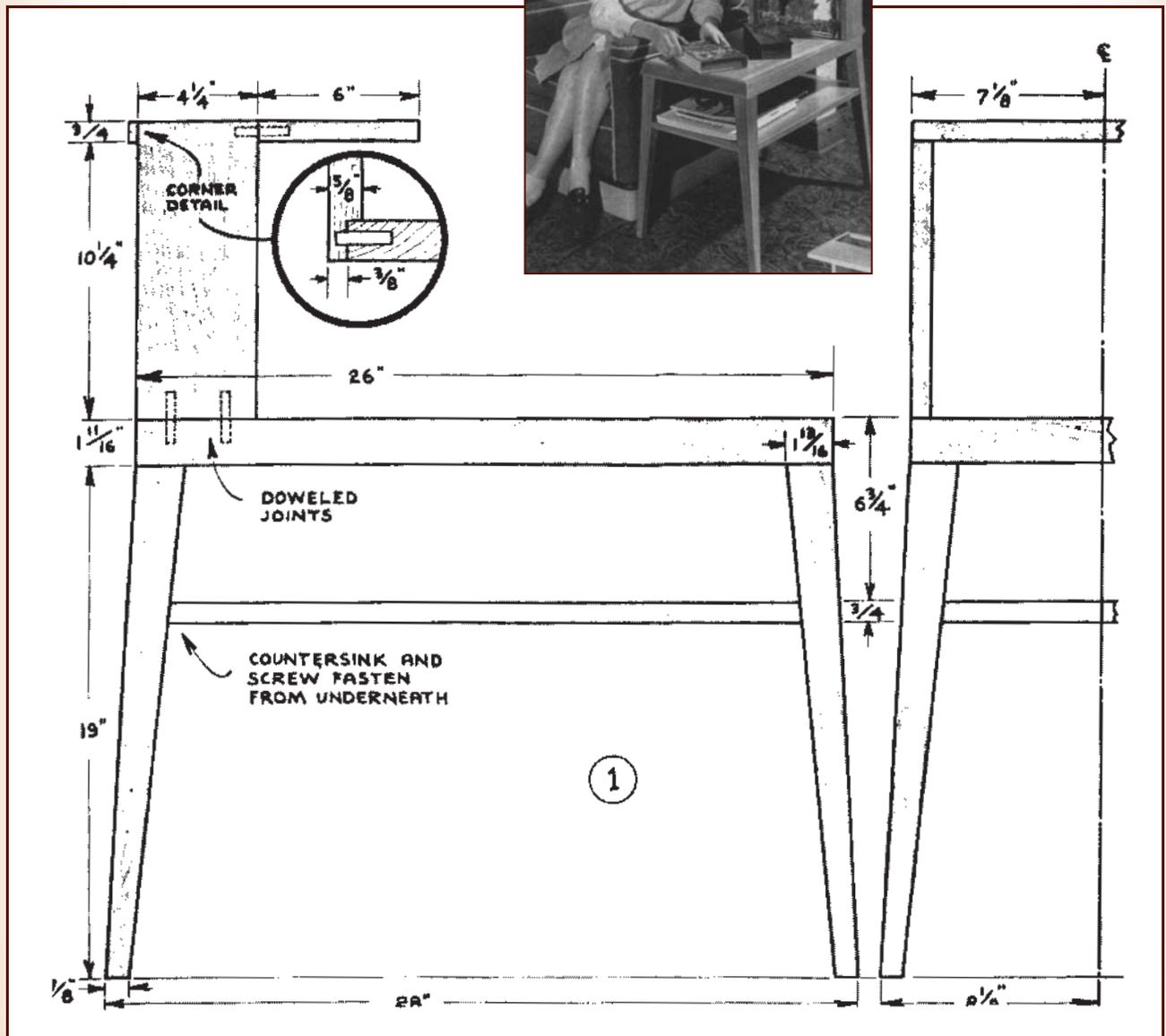
A nostalgic look back at plans published by Delta Machinery during the World War II era.

From Vol. 13, Issue No. 3, 1944



Table Aquarium

Here's the latest word in a modern home aquarium. The design presented here is built around a 12" x 12" glass block. Glass blocks come in a variety of sizes in clear and wavy glass. This table is suitable for an end table or occasional table, having shelf space for books, ash trays, etc. It is made from birch and finished natural. The drawing shows the details and dimensions of the table. The table top is $\frac{3}{4}$ " birch fitted into a frame, or a solid glue-up. The legs are cut and tapered on the band saw and then planed smooth. A jig clamped to the drill press table makes it an easy matter to drill dowel holes for fastening the legs to the table. Apply oil and rub down well. Shellac and more rubbing is then followed by an even coat of a good quality varnish. **PW**



tool report 2001

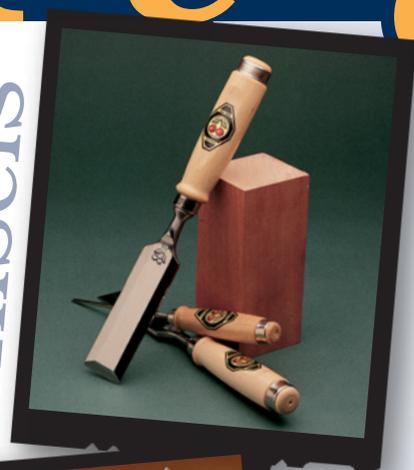
No matter what sort of woodworking you do, you need a low-angle block plane, a combination square and a set of chisels. It really is that simple.

A combination square allows you to lay out joints and set up your machinery with greater accuracy than a tape measure or block of wood. A low-angle block plane trims joints that aren't perfectly flush and removes sawblade marks on the edges of boards (thereby reducing sanding). And chisels chop and pare anything to any shape, and they are essential to squaring up hinge mortises. In fact, these tools are so basic to woodworking, they are often forgotten by magazines that test tools.

Until now. >>

By David Thiel and Christopher Schwarz

chisels



squares



planes



combination

A high-quality combination square is essential to accurate woodworking. Armed with this tool, there's almost nothing you can't measure.

Squares have been an indispensable part of woodworking for millennia. A tool that measures right angles is critical to building a square project. Over the years, squares evolved from shop-made wooden gadgets to mass-produced brass and steel

wonders, but they were essentially the same tool. Then, in 1877, Laroy Starrett invented the combination square: a handle with a blade that can slide left to right and lock in any position. This innovation allowed the tool to be used as a ruler, a try square, a miter square, a scribe (with the scribe tip), a depth gauge and even a level — in a pinch. Purchase a combination square with a protractor and center-finding head and there's little you cannot measure or lay out.

While a versatile tool, the combination square is still quite simple. This might lead you to believe that one tool is as good as the next — not true. Prices range widely. And quality ranges from nearly unusable to ultra-precise.

Basic Materials

With an exception or two, combination squares are made entirely of metal, but the type of metal is important. The blades can be made of hardened or tempered steel, and can be finished in a number of ways to make the blade more readable or durable. The heads are steel, iron or brass. The better the materials, the more likely your square will remain square after rough handling.

The markings on the blade and heads are critical. On bargain models (which we've not included in this review because we don't recommend them) the graduation marks can be as thick as $\frac{1}{16}$ " and stenciled on or stamped. This makes accurate measurements difficult, and with time the marks will wear off. Better squares have machine-milled fine graduation marks and often include etched gradations for better readability. Squares can be purchased with different types of markings on the blade, with the most useful being $\frac{1}{8}$ ths, $\frac{1}{16}$ ths, $\frac{1}{32}$ nds and $\frac{1}{64}$ ths.

How They Work

Beyond the materials, a combination square should be easy to use. The head should move smoothly and lock down positively and quickly; and if the blade is removed, it should be easy to reattach. On protractor heads, changing the angle should be smooth, and the head should lock without changing the setting.

To test the squares for this article, the editors judged each square for its overall fit and finish. We also tested each square to determine if it was in fact square with the standard head, and again with the protractor head set to 90° . To determine the smoothness of operation and reliability, we moved the blade 100 times through the head. (By the way, all of the blades moved more

smoothly after this test.) We then checked the tool to see if it was still square.

Finally, we compared the scales on the blades for accuracy and readability. Our comments and ratings are listed in the chart at right. All ratings are on a scale of one to five, with "one" being unacceptable and "five" being outstanding.



squares

combination squares at a glance

Square	Street price	Blade readability	Fit & finish	Smoothness	Accuracy	Scale
Bridge City CS-12	\$149	●●●●	●●●●●	●●●●●	●●●●●	1/32, .5mm
General MG-S281-4R	\$118	●●●●●	●●●●●	●●●●●	●●●●●	1/8, 1/16, 1/32, 1/64
Grizzly G5726	\$30	●●●●●	●●●●●	●●●●●	●●●●●	1/8, 1/16, 1/32, 1/64
Starrett C434-12-R	\$138	●●●●●	●●●●●	●●●●●	●●●●●	1/8, 1/16, 1/32, 1/64
Woodcraft I4L90	\$120	●●●●●	●●●●●	●●●●●	●●●●●	1/8, 1/16, 1/32, 1/64
Woodworker's Supply	\$50	●●●●	●●●●	●●●●	●●●●	.5mm, 1mm, 1/32, 1/64

Bridge City CS-12

Bridge City 800-253-3332 www.bridgcitytools.com

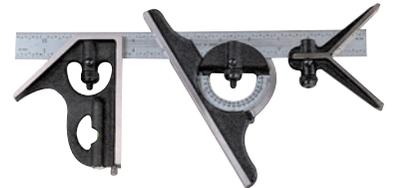
Price: \$149 This beautiful tool has a head made from solid brass and Juara, an exotic wood.
Blade Readability: 3.5 The fit and finish are excellent, and the square proved accurate after use. In fact, if this square ever does go out of alignment, you can send it back to Bridge City for calibration for just \$5. Bridge City does not manufacture a protractor or center-finding head for this tool, and the square does not include a scribe or bubble level. In our testing we found the blade a little stiff initially, but after repeated use and some 3-in-1 oil, it performed better. We were disappointed that the standard 12" blade is available with only 32nds and metric measurements. All-in-all, this is a very attractive and accurate square, but it falls short of supporting its expense.



General MG-S281-4R

General Tools 212-431-6100 www.generaltools.com

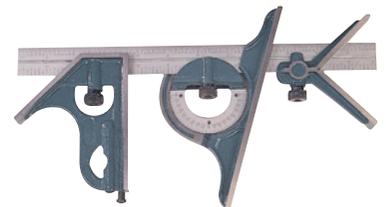
Price: \$118 This square is a close second to the Starrett. With a satin-finished blade offering easily read scales, it proved well-machined, accurate and smooth-operating after a little use and oil. The pin is kept from rotating by an extra thumbscrew applied through the head into the pin. This works well, but isn't as refined a design as the Starrett. Parts of the head are thicker than on the Starrett, which may indicate a more durable tool over time. All-in-all, a nice tool that will provide years of good service.



Grizzly G5726

Grizzly 800-523-4777 www.grizzly.com

Price: \$30 We drew a quality line for testing at \$25 or more, and that allowed this Chinese-made set from Grizzly to enter the competition — and we're glad it did. We didn't expect much from this square, but were pleasantly surprised. The fit and finish wasn't perfect, but the blade was more readable than some higher-priced competitors. We tested two squares, and one tested out of square by 1/2°, while the other tested accurate. With a few strokes of a file, the out-of-square head was easily trued. Smoothness of operation was decent. What can we say? For \$30 this is a darn good deal. Even if it takes a little tweaking to get things right, it's a bargain.



The head of a combination square is one-half of the tool's accuracy. Note the slot in the head for the blade. If not ground accurately, your blade will never be square, and neither will your projects.

squares

Starrett C434-12-R

L.S. Starrett 978-249-355 | www.starrett.com



Price: \$138
Blade Readability: 4.75
Overall Fit and Finish: 5
Smoothness of Operation: 5
Accuracy: 5
Scale: 1/8, 1/16, 1/32 and 1/64
Head: forged & hardened steel or cast iron
Blade: hardened & tempered

The granddaddy of all squares, the Starrett is often held up for high praise, and we feel it's justified after our tests. Well-machined, with excellent fit and finish, the scales on the satin-finished blade are well-etched and easy to read. The locking pin drops into a machined depression in the head to keep the pin aligned, but still makes it easy to rotate the pin when necessary. The blade moves the smoothest of any we tested. The protractor head is equally well-machined and just as accurate, with the scale milled into the metal rather than attached as a plate, as with the other squares we tested. This tool is rated best overall by all our editors and is certainly worth its price. As a testament to this tool's long life, we've bought well-worn Starrett squares that were more than 30 years old from flea markets (about \$20 to \$25) that were still dead square.

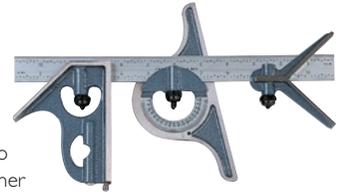


Woodcraft 14L90

Woodcraft 800-225-1153 www.woodcraft.com

Price: \$120
Blade Readability: 4.5
Overall Fit and Finish: 4.25
Smoothness of Operation: 4
Accuracy: 5
Scale: 1/8, 1/16, 1/32 and 1/64
Head: cast iron
Blade: hardened & tempered

Though priced similarly to the General, there are differences in design that keep this square from being its equal. The castings are decent (some quite thick), though they aren't as clean as the other top performers. The square proved accurate, and the smoothness of operation was good, but not excellent. The markings on the satin-finish blade are well-etched and easy to read. The pin is milled with an oversized tang to keep the pin from spinning completely around. However, to rotate the pin to use another scale the pin must be almost completely removed. The protractor head has the blade affixed to the side of the head rather than through the middle, which makes it impossible to use both sides for complementary angles.

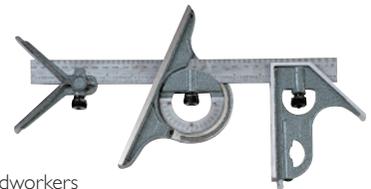


Woodworker's Supply 916-703

Woodworker's Supply 800-645-9292

Price: \$50
Blade Readability: 3
Overall Fit and Finish: 2.5
Smoothness of Operation: 3
Accuracy: 4
Scale: .5mm, 1mm, 1/32 and 1/64
Head: cast iron
Blade: tempered

This bargain square is made in China and can be a serviceable tool — if you're willing to do a little work. Both of the units we tested were not square when they came out of the box. However, by repeatedly rubbing the blade against one area of the head (about 150 or 200 times), we were able to bring both tools into alignment. The castings are rougher than those on the other squares, though no major burrs stood in the way of using the tool. We looked closer at these squares than most woodworkers would and noticed that the guide channel on the blade on this square (and on Grizzly's) had square sides. This seemed to make the blade more difficult to move.



VARIATIONS ON THE THEME

The **Odd-Job #1** is a tool designed by Stanley in the early 1900s as a pocket combination square. It's currently made by Simpson Machine Tool Co. and sold through several catalog companies. The **Odd Job** has many of the same functions as a combination square, yet it really is a different animal. The most notable difference is the wooden ruler and the fact that you can use it as a compass. The well-machined bronze casting is a joy to hold in your hand, and the little guy slips nicely into your shop apron. Available for \$60 from Woodcraft 800-225-1153.

The **Veritas Sliding Square** is a tool that deserves serious attention.

Though not a true combination square, this tool is well-made, accurate and a bargain at \$25 (especially if you cannot afford a more expensive traditional combination square). The **Sliding Square** is unique in that it allows you to work in two axes at once, something that requires two setups with a combination square. Its small size allows you to slip it inside a shop apron, and the tool excels at drawing lines parallel to the edge of a board. For joint or hinge layout, this is an outstanding tool.

Available from Lee Valley Tools 800-871-8158.



low-angle block planes

I've always had a block plane. As far back as I can remember it's been one tool I've always had. The one — OK the three — I own now are a lot better quality than the first few, but there's always been a place at my workbench for a block plane. No matter how high-tech or low-tech your shop, a low-angle block plane will come in handy. Whether it's trimming an inset door to fit just right, or straightening an edge that was cut with a jig-saw, nothing else gives you a flat, crisp edge.

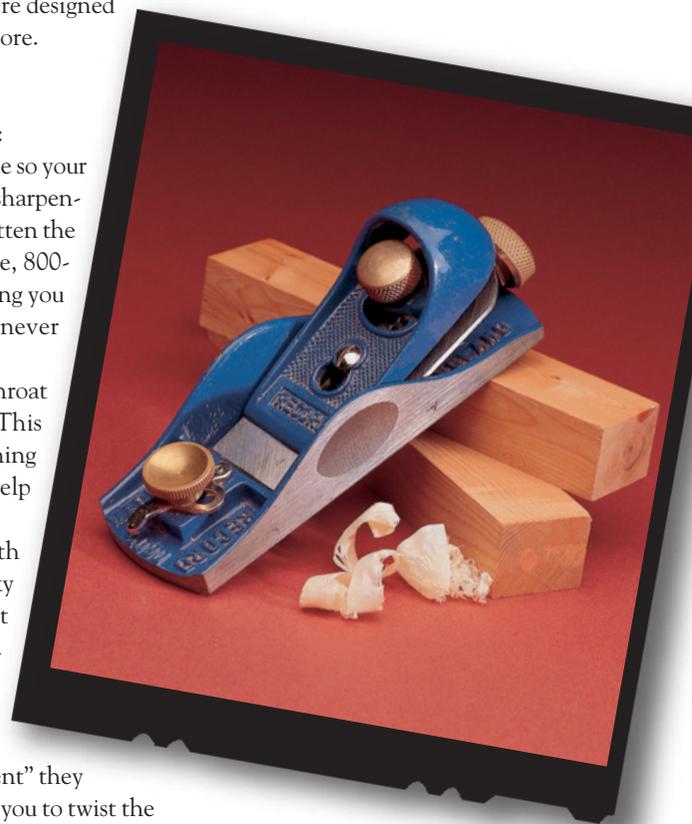
Standard block planes appear to have their blades set at a lower angle to the sole than a traditional jack plane's 45° angle. It is set lower, at a 20° angle, but the blade is flipped bevel-up in a block plane, achieving a 45° cutting angle again. The type of block plane we prefer in the *Popular Woodworking* shop is a low-angle block plane. With the blade set at 12° to the sole rather than 20°, these planes slice cleanly through figured and dense woods. Though low-angle block planes were designed originally for cutting end grain, we've found them capable of much more.

Plane Anatomy

Here's what to pay attention to when buying a low-angle block plane:

- **Sole flatness:** When you buy any plane, you should flatten the sole so your cuts are more smooth and precise. You can flatten the plane on a flat sharpening stone, or you can buy some silicon carbide grit and kerosene and flatten the sole on a piece of thick glass (call Lee Valley Tools for silicon carbide, 800-871-8158). In general, the more expensive the plane, the less flattening you will have to do. However, once you flatten the sole, you'll probably never have to do it again — until you drop it.
- **Adjustable throat:** All the planes in our test have an adjustable throat — the throat is the space between the blade and the blade opening. This feature is critical to low-angle block planes because a small throat opening can prevent tear-out in tricky woods, and a large throat opening can help you hog off material in a hurry.
- **Ergonomics:** Planes come in different sizes, especially in the width department. Depending on the size of your hand, a plane can feel chunky or too small in your grip. Try to hold a plane before you buy it to see if it feels right. Also, hold the plane in your hand and consider its weight. A heavy plane will take a heavier cut, but a lightweight plane is less likely to wear you out.
- **Lateral adjustment:** The name of this feature is somewhat of a misnomer. When plane makers say their planes have “lateral adjustment” they mean there's a lever you can move at the back of the plane that allows you to twist the blade left or right a bit to square it up to the throat. Is this a good thing? That depends on you. If you are a meticulous sharpener, and you can grind the edge of the blade square to the sides, then lateral adjustment isn't for you. (Even those planes without a

In a world of power tools, the simple low-angle block plane still deserves a place of respect.



planes

“lateral adjustment” lever can be adjusted a tiny bit to compensate for small errors.) If you’re a little sloppy at the stone, lateral adjustment will help you compensate for your less-than-perfect edge. However, the downside to lateral adjustment is that it’s one more thing that can fall out of adjustment, so tuning up a plane with this feature will take longer.

- **Preparing the blade for use:** The blade that comes with your plane could be ready to use out of the box (though this is unlikely), or it could be so messed up it’s good only as a book-mark. First you must flatten the back of your blade before you sharpen it (much like you flattened the sole), then you grind a bevel on the front edge, and finally you hone and strop your cutting edge. In general, we recommend a cutting angle of 25°. Though some manufacturers grind their blades to 20°, we’ve found edges at this angle are more susceptible to crumbling during use, which means you’ll be sharpening more. The only way to find the ideal cutting angle is to experiment a bit over the years and find what’s best for you.

Also, some catalog companies carry aftermarket blades that are of higher quality than the stock blade that came with your bargain plane. Woodcraft (800-225-1153) carries blades by Hock and Samurai. Lee Valley Tools (800-871-8158) carries blades by Hock and blades they manufacture themselves.

- **Blade adjustment:** In all the planes tested here, you turn a knob to increase or decrease the height of the blade. What’s important to note is how sloppy these knobs are. On some planes, you have to turn the knob almost 360 degrees before the blade will budge. On other planes, the adjustment is far more sensitive and requires little or no spinning. Also, pay attention to how

finely the adjustment works — we measured this by seeing how many turns it took to move the blade 1/16". In the world of block planes, we prefer finer adjustment because the difference between a perfect shaving and a torn up piece of wood is a tiny movement of the blade.

- **Blade thickness:** The thicker the blade, the less chatter you’ll get. Inexpensive planes have irons that are just over 5/64" thick (.08"). More expensive planes have blades that are about 1/8" (.125") thick. Aftermarket blades, such as those from Hock and Lee Valley, weigh in at a beefy 3/32" (.094") thick.

Testing

All these planes were tested with their stock blades. First the sole of the plane and the back of the blade were lapped flat (if needed). We then ground the cutting edge square to the sides, and then honed and stropped a secondary bevel. Finally, the planes were put to use. All ratings are on a scale of one to five, with “one” being unacceptable and “five” being outstanding.

A couple notes on the categories these planes were judged on. “Turns to move 1/16”” indicates how many full turns of the height adjustment knob were necessary to move the blade forward 1/16". “Height knob slop” indicates how much we needed to turn the height knob before the blade would move either in or out. And “throat/blade variance” indicates how much wider the plane’s throat is compared to the blade.

No matter which plane you choose, from \$40 to \$600, rest assured that you will be able to tune it after some practice to produce perfect shavings. The only question is how easy that tuning will be and how good-looking you want your tool to be. **PW**

low-angle block planes at a glance

Plane	Street price	Setup required	Fit & finish	Performance	Lateral adj.	Height knob slop	Weight (oz.)
Bridge City CT-7	\$600	●●●●●	●●●●●	●●●●●	no	1/2 turn	25.1
Lie-Nielsen 60 1/2	\$150	●●●●●	●●●●●	●●●●●	no	1/4 turn	25.4
Record 60 1/2	\$45	●●●	●●●	●●●	no	1 turn	22.2
Stanley 60 1/2	\$40	●●	●●●	●●	yes	2/3 turn	23.2
Veritas	\$85	●●●●	●●●●●	●●●●●	yes	1/16 turn	28.4

Bridge City CT-7

Bridge City 800-253-3332 www.bridgecitytools.com

Price:	\$600
Setup required:	4.75
Overall fit and finish:	5
Lateral adjustment:	No
Turns to move 1/16":	2 1/2
Blade width/thickness:	1 3/16"/.115"
Height knob slop:	1/2 turn
Weight:	25.1 oz
Throat/blade variance:	1/16"
Performance:	4

This is a beautiful plane, well-finished and machined with a solid brass body that’s double-dovetailed to the steel sole. The edges are beveled to give a smooth feel in the hand, and the overall impression is that of a piece of jewelry. That said, we found the machining on the throat plate to be a little loose. The pommel was placed a little further back on the plane and felt less comfortable to some of us than other planes. The cap lock-down screw, mounted under the cap, works smoothly and is easily accessible. However, if you back out the blade a bit too much the cap will come loose, so be careful. The CT-7 does not have lateral adjustment, so hone up on your sharpening skills. But the blade (shipped at a 20° bevel) takes a nice edge and performs quite well. If anything goes wrong with this tool, Bridge City will recalibrate it or replace it for \$5. If the Lie-Nielsen plane is a Mercedes-Benz, then the Bridge City is a Lamborghini — with the associated price and eccentricities.



Lie-Nielsen 60½

Lie-Nielsen 800-327-2520 www.lie-nielsen.com

Editor's Choice

Price:	\$150
Setup required:	4.5
Overall fit and finish:	4.75
Lateral adjustment:	No
Turns to move ¼":	2¼
Blade width/thickness:	1 ⅜", .120"
Height knob slop:	¼ turn
Weight:	25.4 oz
Throat/blade variance:	0"
Performance:	5

This is a very attractive, well-cast and well-machined tool. The throat adjustment is lever-activated and works very nicely — the best of all the planes tested. The cap lock-down screw is mounted under the cap in a position that forces your fingers to bump the plane body, making it slightly awkward to adjust, but less likely to move during use. The cap lock-down uses a single-point rear support. There is a single oval finger indent on either side of the plane body. This tool has the simplest and most elegant design of any tested. The blade is almost exactly the same width as the throat opening, making any lateral adjustment tricky. This requires you to sharpen the blade perfectly square. It's a very nice plane, and the Mercedes-Benz of low-angles. This plane feels like an extension of your hand, and it is worth the price.



Record 60½

American Tool 937-382-381 | www.recordtool.com

Price:	\$45
Setup required:	3
Overall fit and finish:	3
Lateral adjustment:	No
Turns to move ¼":	2
Blade width/thickness:	1 ⅝", .080"
Height knob slop:	1 turn
Weight:	22.2 oz
Throat/blade variance:	¼"
Performance:	3

This plane is on the more affordable end of the price scale, so there are some trade-offs. The castings on this plane are rougher; though the plane is machined well enough. This is the widest plane tested, and may feel awkward or bulky in small hands, but it proves fairly lightweight. There is some lateral adjustment available by manually moving the blade, and the throat adjusts using a lever. The cap lock-down is a top-mounted screw that is awkward to grasp and difficult to lock tightly. Of all the planes, we encountered the most "chatter" when planing with the Record, though it was not unacceptable. This plane uses a single-point rear support blade hold down, and offers single oval finger indents on the plane's sides. Overall, for a less pricey plane, the feel and performance of the tool are quite good.



Stanley 60½

Stanley Works 860-225-5111 | www.stanleyworks.com

Price:	\$40
Setup required:	2
Overall fit and finish:	3
Lateral adjustment:	Yes
Turns to move ¼":	2¼
Blade width/thickness:	1 ⅜", .081"
Height knob slop:	⅔ turn
Weight:	23.2 oz
Throat/blade variance:	¼"
Performance:	2

The Stanley was the least expensive plane we tested, and it has some nice features to recommend it. The castings and machining actually proved nicer than the more expensive Record. It is one of only two planes we tested with lateral adjustment levers to provide extra flexibility. The throat is adjusted using a lever, and the cap is locked using a cam lever, which allows you to quickly release the cap and then replace it at the exact same setting you had it at before. The cap hold-down uses a ⅞"-diameter rear support, and there are single oval finger indents on the plane's sides. Setup on the tool was problematic. The sole needed the most work, as did the blade. The blade did not hold an edge very well, and we recommend replacing it. But with a little bit of effort the Stanley blossoms into a nicely designed and affordable low-angle plane.



Veritas 05P22.01

Lee Valley/Veritas 800-871-8158 www.leevalley.com

Best Value

Price:	\$85
Setup required:	3.5
Overall fit and finish:	4
Lateral adjustment:	Yes
Turns to move ¼":	1
Blade width/thickness:	1 ⅞", .120"
Height knob slop:	⅓ turn
Weight:	28.4 oz
Throat/blade variance:	¼"
Performance:	4

The mid-priced Veritas was the most unusual of the planes tested. This plane includes two adjustable screws on the sides that lock the blade square to reduce chatter. The plane also offers a well-machined rear knob that controls both lateral adjustment and blade height. The throat adjustment is manual with a lock-down screw. The cap lock-down screw is mounted under the cap and turns smoothly to engage the 1"-diameter rear support. Three graduated round finger indents on the plane's sides may or may not feel great in your hand. Almost as wide as the Record, this plane may feel awkward or heavy in smaller hands. The plane ships with a 20° bevel on the edge. Also available from the manufacturer are two handles (one for the front, one for the back) that virtually transform this plane into a low-angle smoothing plane for less than \$22.



bevel-edge ch

The most expensive chisel does not always hold the best edge. Our tests show that some cheap chisels give you a real clean cut.

Woodworking chisels have been an essential part of a woodworker's tool kit since neolithic times (8000 to 3000 B.C.), but it wasn't until the 16th century that Germans developed

the bevel-edge chisels you can now buy at almost any hardware store.

Bevel-edge chisels are designed for most general-purpose woodworking tasks. The bevel on the long edges allows you to get into tight places other chisels could never go, such as the bottom of a dovetail joint. As originally designed, bevel-edge chisels were not supposed to be struck with a mallet. You used your weight and a keen edge to pare and slice your wood. If you needed to chop a mortise, you reached for a brawny mortising chisel. These days, however, many manufacturers add on handles made from tough plastic or metal-reinforced wood that simply beg to be banged. You're not likely to break your chisels this way, but you will end up sharpening them more because the cutting edge of a bevel-edge chisel is not typically designed for striking operations.

So What's in a Chisel?

Chisels have a number of parts that are important to know when shopping. The handle is obvious; at the point where the steel meets the handle is sometimes a piece of leather called a shock washer, which helps absorb shock. The rounded area of metal below the handle is called the bolster. The remainder of the chisel is the blade. The "face" of the blade is the underside; the bevels on the edges are actually on the "back" of a chisel. It sounds backward, I know, but you'll soon find that the face of the chisel is most often what is touching the work and is of primary concern. Finally, the "cutting edge" of a chisel is the end that you sharpen.

What to Look For

Chisels are a personal choice for woodworkers. It's no good to have the best steel in the world on a handle that tortures your hand. You need to find a chisel that performs well and feels comfortable. Here's how:

- **Handle:** You can get chisels with plastic handles or wood. The handles can be round, vaguely square, octagons or even odder shapes. Find a handle that feels good in your hand and know this: round-handled chisels will roll off your bench and onto a concrete floor, usually blade-first.
- **Blade:** There is a lot to consider when choosing a blade. First, the face of all chisels must be lapped reasonably flat, especially at the cutting edge. Only one set of chisels (from Freud) was dead flat out of the box. The others required varying degrees of lapping to flatten. The face can bow one of two ways. If the face bows out in the middle, it is said to be "belly." Personally, I'd return a chisel that had more than a little belly to it. These take a lot of work to fix, sometimes with a belt sander. If the face bows at the ends, the chisel is said to be "hollow." Japanese

chisel-makers intentionally make their chisels with a hollow face. A hollow face certainly makes it easier to lap the face at the cutting edge. However, too much hollow and you're in trouble; your chisel will want to dig into your work.

Another thing to consider is how hard the blade is. Western chisels are typically hardened to a Rockwell hardness between 58 and 62. This is harder than a scraper or a hand saw, but softer than carbide on a sawblade or router bit.



isels

You would think that harder is always better, but consider this: the harder the blade the more brittle it is. Or, put another way, the blade on a chisel is a trade-off between toughness and sharpness. Softer blades are tougher and withstand abuse without breaking. Harder blades are sharper and more likely to retain an edge during normal use, but they are brittle and more likely to fail under stress.

• **Bevel angle:** The standard cutting angle on a chisel is 25°, which is a good all-purpose cutting angle. However, Leonard Lee, the president of Veritas and Lee Valley Tools, recommends two exceptions. First, grind your narrowest chisels to 30°; this will make the edge tougher (narrow chisels get a lot more abuse). Second, grind the bevel of your largest chisel to 20° and use it only for light paring cuts (never mortising). This will give you a chisel that can make delicate cuts in difficult woods. Grind the ones in the middle to 25°.

How We Tested the Chisels

Testing chisels can be somewhat of a subjective exercise. Here's what we did to get the most meaningful results we could.

• **Ergonomics:** Luckily, the four editors who

evaluated the chisel handles have remarkably different hands. Each handle was evaluated on a scale of one to five, with "one" being "unacceptable" and "five" being "outstanding." The scores were then averaged.

• **Fit and Finish:** Each chisel set was rated on a scale of "one" to "five" on how well-manufactured and finished each chisel was right out of the box.

• **Initial Flatness:** To test for flatness, we first colored the face of every chisel with red waterproof marker. Then we lapped the first 2¾" of each face on a coarse diamond stone. Each chisel was stroked 20 times over the stone and the face was examined to see if it was flat, bellied or hollow. Chisels that were flat or mostly hollow received a ranking between "five" and "three." Chisels that were mostly bellied received a ranking of "two."

• **Hardness:** We took a ¾" chisel (or its metric equivalent) from each set and tested its hardness on the Rockwell scale using an industrial hardness tester at the University of Cincinnati's College of Applied Sciences. David Conrad, the program director of the Certificate Program, performed the tests for us. We tested each chisel in two locations on the face, once at ¾" up the blade and a second time at 1½" up the blade. Both scores are noted on the chart.

• **Ease of Setup:** Two editors set up a ¾" chisel from each of the 20 sets. First we lapped the face, hollow-ground the bevel to 25° and then honed and stropped a secondary bevel on the cutting edge. We noted how much work it took to achieve a keen edge and gave each chisel a score from "one" to "five."

• **Need to be Rehoned?:** This is the most subjective of the rankings. After each chisel was as sharp as it could get, we tested the durability of the edge using what we consider to be a real-world test (although a punishing one). The editors used each chisel to cut two ½" x 2" x ½" notches in a piece of white oak using a small mallet and hand pressure. The same cutting technique was used on each test piece. Then all the editors examined each edge and determined if the chisel was OK to continue using, would need to be rehoned soon or needed to be rehoned immediately.

What's interesting is that the harder chisels weren't always the most durable. While the Woodworker's Supply hornbeam chisel, one of the hardest chisels, fared well, some considerably softer chisels did well, too, including the Two Cherries and Craftsman chisels. And some chisels that ranked as the hardest (Rockwell 61) needed rehoning after the test.



chisels

bevel-edge chisel sets

	Set Price	No. of Chisels	Fit and Finish	Initial Flatness	Ease of Setup	Type Of Handle	Ergonomics	Hardness of Blade*	Need to be Rehoned?
Ashley Isles	\$80	6	●●●●●	●●●●●	●●●●●	W	●●●●●	59/58	No
Buck Brothers	15	3	●●●●	●●●●	●●	P	●●●	59/58	Yes
Craftsman 36857	20	3	●●●	●●	●●	P	●●●	56/55	No
Crown/Woodworker's Supply	53	4	●●●●●	●●●●●	●●●●●	W	●●●●●	51/48	Yes
E.C.E.**	77	4	●●●●●	●●●●●	●●●●●	W	●●●●●	59/60	No
Footprint	30	4	●●●	●●●●●	●●	P	●●●●●	58/59	Soon
Freud WC-104	54	4	●●●●●	●●●●●	●●●●●	W	●●●●●	59/57	Yes
Garrett/Wade 10T15.01	70	6	●●●●●	●●	●●●●●	W	●●●●●	60/60	Soon
Grizzly G5836	30	4	●●●	●●●●●	●●●●●	W	●●●●●	61/60	Yes
Lee Valley Butyrate	38	5	●●●●●	●●●●●	●●	P	●●●	59/60	Yes
Lee Valley Wood Handle	38	5	●●●	●●●●●	●	W	●●●●●	61/59	Yes
Marples Butyrate Handle	100	6	●●●●●	●●●●●	●●●●●	P	●●●●●	60/59	Yes
Marples Blue Chip	35	5	●●●●●	●●●●●	●●●●●	P	●●●●●	60/61	No
Pfeil Swiss Made	150	8	●●●	●●●●●	●●●●●	W	●●●●●	60/60	Yes
Sandvik	94	6	●●●●●	●●●●●	●●●●●	W	●●●●●	59/60	Yes
Sorby Boxwood	112	4	●●●●●	●●	●●	W	●●●●●	58/59	Soon
Sorby Gilt Edge	159	5	●●●●●	●●●●●	●●●●●	W	●●●●●	57/58	Yes
Stanley 16-180	14	3	●●●	●●●●●	●●	P	●●●	59/59	No
Two Cherries/Hirsch	80	4	●●●●●	●●	●●	W	●●●●●	56/56	No
Woodworker's Supply Hornbeam	33	4	●●●	●●●●●	●●●●●	W	●●●	61/59	No

*All hardness numbers are on the Rockwell "C" scale. The first number is the hardness of the metal measured $\frac{3}{4}$ " up from the cutting edge. The second number is the hardness $1\frac{1}{2}$ " up from the cutting edge. **Chisels not sold as set. Price is for 6mm, 12mm, 20mm and 24mm chisels. Ratings are on a basis of 1 to 5 with "one" being "unacceptable" and "five" being "outstanding"; W=wood; P=plastic; Chisels in red are recommended; see the text for details.

Ashley Isles

Editor's Choice

Available from: *Jesada Tools, 800-531-5559, www.jesada.com*

These British-made chisels had the best ergonomics of all the chisels tested. The 6"-long beech handle is slightly bulbous in the middle, and the $1\frac{1}{4}$ " diameter allows you to get a good grip for striking or paring. The edge held up nicely, too. If you buy the set of six chisels, the price averages out to \$13.33 per chisel — a good bargain for a set of lifetime tools.

Buck Brothers

Available from: *home center stores, including Home Depot*

We had high hopes for this chisel. Many of us know someone with an old set of "Bucks" that has aged nicely. Alas, the modern version does not live up to the legend. Though the chisel's handle is designed to be struck, it is far too short to be struck comfortably. We predict lots of blood blisters on your index finger and thumb.

Craftsman

Best Value

Available from: *Craftsman, 800-377-7414, www.sears.com/craftsman*

These are the funkiest-looking chisels in the bunch. The blade is short and crudely finished and

the handle is an odd shape. However, once we got the chisel set up (which was quite a chore) the edge held up surprisingly well. The handle is a little slippery, especially when your hands are sweaty, but overall these chisels are a good bargain at less than \$7 each.

Crown/WW Supply

Available from: *Woodcraft, 800-225-1153, www.woodcraft.com; or Woodworker's Supply, 800-645-9292*

These British chisels were easy to flatten, easy to hone and easy to hold. However, the cutting edge was also easy to destroy. These nice-looking chisels had the softest metal of the entire bunch, and that edge quickly became unusable during our test. Woodworker's Supply carries these chisels under its own label.

E.C.E.

Editor's Choice

Available from: *David Warren Direct, 800-724-7758, www.ecemmerich.com*

These nice German chisels have handles made from hornbeam, a European hardwood that is tough and difficult to split. However, like several other chisels in this test, it suffers from what we call "lumpy handle syndrome." Basically, the handle needs sanding to remove the slick finish. Luckily, this is a simple task for you to do. Sand off the

lacquer and add a coat of oil to get a better grip. Despite our issue with the handle, the cutting edge fared well in our tests. Overall, these are quality chisels.

Footprint

Available from: *Craftsman, 800-377-7414, www.sears.com/craftsman*

We weren't impressed with these chisels right out of the package. The polypropylene handles seemed a bit crude, and the blades needed a lot of work. That said, some of us found these chisels very comfortable to hold, and the cutting edge held up OK in use. Though not as polished a tool as the Marples Blue Chips, the Footprints would still make a decent set of mid-priced bench chisels.

Freud

For a local dealer, contact Freud at 800-334-4107

When we started flattening the face of these chisels we were stunned by how flat they were. However, when it came to cutting wood, the Freuds didn't hold up as well as we hoped. Our testers found the handle a little short, but comfortable. And the handles suffer from "lumpy handle syndrome" (see the E.C.E. review), but that can be easily remedied.

Garrett Wade

Available from: *Garrett Wade, 800-221-2942, www.garrettwade.com*

These Czechoslovakian chisels look a lot like the Freud chisels, but the blades are tougher and held up a lot better in use. The handles are a bit lumpy, but serviceable. Overall, these are decent mid-priced chisels.

Grizzly

Available from: *Grizzly, 800-523-4777, www.grizzly.com*

While these chisels were easy to flatten and sharpen, they simply didn't hold an edge as well as we hoped. The handle would be more comfortable if you refinished it, but it is still a little on the thin side. While we've found Grizzly's machinery to be an excellent value, these chisels did not make the cut.

Lee Valley Butyrate Handle

Available from: *Lee Valley Tools, 800-871-8158, www.leevalley.com*

While nicely made, these Japanese-made chisels were some of the most uncomfortable to hold. The detents in the side were too deep, and our hands quickly became sore after using these chisels to cut a couple joints. The face of the chisels needed a lot of work to flatten, and the edge was quickly destroyed by white oak.

Lee Valley Wooden Handle

Available from: *Lee Valley Tools, 800-871-8158, www.leevalley.com*

These chisels are absolutely identical to those offered by Grizzly. We suspect they are made in the same factory. Unfortunately, they suffer from the same set of problems. The handle should be refinished and the cutting edge was not as durable as we hoped.

Marples Butyrate Handle

Available from: *Craftsman, 800-377-7414, www.sears.com/craftsman*

These British chisels have a large and comfortable handle that is easy to grip and strike with a mallet. While the blades look identical in every respect to the blades on the less expensive Marples Blue

Chip chisels, the edge did not hold up as well in our tests. Maybe we got a bad chisel.

Marples Blue Chip

Editor's Choice

Available from: *a variety of sources, including Lee Valley Tools, 800-871-8158, www.leevalley.com*

Best Value

For many of us, the Marples Blue Chip chisel was already on our bench before we began this test. Our testing confirmed what we have known for years. The Blue Chip is an economical and hardy chisel, if not a pageant winner. Sand off the seam on the polypropylene handle and you've got a chisel that will serve you well for many years.

Pfeil Swiss Made

Available from: *Woodcraft, 800-225-1153, www.woodcraft.com*

The handles on these Swiss chisels are unfinished and vaguely bamboo-shaped. While some editors seemed to like this form, others reported it a bit uncomfortable while making paring cuts. The chisels were tough to set up, and the edge was not as durable as we like.

Sandvik

Available from: *Professional Hardware and Supply, 800-248-1919, www.profhdwr.com*

These Swedish chisels have an excellent handle that is well-finished, finely detailed and feels good in your hand. The blade of the Sandvik chisel was easy to flatten and hone, but the cutting edge did not hold up well in use.

Sorby Boxwood

Available from: *Garrett Wade, 800-221-2942, www.garrettwade.com; or Woodcraft, 800-225-1153, www.woodcraft.com*

When we showed off the array of chisels we tested to visitors, they invariably picked up this one first. This chisel's classic lines and boxwood handle have an almost irresistible pull. That said, we recommend you knock down the edges of the octagonal handle a bit before use, or your fingers and palm will suffer: The blade was difficult to lap flat, though the cutting edge was reasonably durable in use.

Sorby Gilt Edge

Available from: *Garrett Wade, 800-221-2942, www.garrettwade.com*

While these chisels scored well across the board, the cutting edge came up a bit short in our tests. That's too bad because these chisels have so much going for them. The overall design is sleek, and the chisel feels quite balanced in your hand.

Stanley

Best Value

Available from: *home center stores, including Lowe's*

These British-made chisels are not easy on the eyes. The handle is too stubby. The blade is too short. That said, these chisels hold onto an edge like a dog on red meat. And here's the bonus: these are the least expensive chisels we tested. If you're strapped for cash, these are the chisels that should be in your toolbox.

Two Cherries/Hirsch

Editor's Choice

Available from: *Highland Hardware, 800-241-6748 or www.highlandhardware.com*
These chisels — while a bit on the pricey side — were all around good performers. The editors found the handle to be comfortable (though some might recommend refinishing the handle), and the blade held a nice edge. Be advised that you will have to work for it. The chisels we tested required a good bit of setup, mostly lapping the face.

Woodworker's Supply

Best Value

Available from: *Woodworker's Supply, 800-645-9292*

We didn't expect much from this chisel when it showed up. The handle was a bit ugly and was too skinny for our tastes. But when it came time to get to work, these chisels were ready. The faces were reasonably flat, and the chisels were easy to set up. Add to all that the fact that the edge proved quite durable in our tests and you have a pretty good bargain.



On the right is a chisel whose face is “bellied.” It will take considerable work to get the face flat enough to sharpen properly. On the left is a chisel whose face is “hollow.” You could hone the chisel right now and produce a keen edge. However, further flattening will result in a chisel that won’t dig into your work.



An easy guide
to whether you should
be pushing, paring
or pounding your chisels,
in any given situation.

by Jim Stuard

Chisel



Photo by Al Parrish

Use

Back when I started as an apprentice cabinetmaker, a chisel was something to be beaten with a large hammer. That was before I learned how to properly sharpen and use these tools. Since then it's become apparent there are three distinct chisel operations that every woodworker should know: paring, light chopping and heavy mortise chopping.

There's a right way and a wrong way to make these cuts. This article will show you how to use your chisel with the least amount of effort, damage to the chisel and damage to your work.

Before I begin, there are a couple things to mention about safety. One nice thing about chisels is you don't have to wear hearing protection. But there are safety issues. Wear safety glasses when chopping or mortising, and I mean that. A chisel breaking can send pieces of metal flying, possibly causing an eye injury.

Second, if you have any reservations about using the sharp end of a chisel while paring, consider using a Kevlar protective glove, which is routinely used by carvers. The glove will dull the impact of a slipped chisel and reduce your chance of injury. Finally, never use a chisel that's pointing toward your body. Always be mindful of the direction a chisel is going and where your hands are. This is the first thing to check before making a cut of any kind. The last thing you want to do on a Sunday afternoon is explain to an emergency room physician how you almost gave yourself a DIY appendectomy while working on Aunt Betty's blanket chest.

Paring

The one thing that amazes most beginning woodworkers is how seldom you really need to hit the chisel to get it to work right (the exception to this is, of course, mortising). Paring is a process of using the knife edge of a sharp chisel to slice small amounts of wood off. With a little technique and a sharp chisel, you can get into places inaccessible to a plane or knife.

Paring is basically the finest work you can do with a chisel. Some examples of paring include:

- Trimming the cheeks of a mortise to fit a tenon that's too large.
- In the absence of a shoulder plane, par-



Paring: One Hand Steers, the Other Pushes

To do this properly, you need to use both hands on the chisel to get the most control. One hand is on the chisel blade as close as you can get to the edge. The other hand is firmly on the handle. How much you push down on the blade as you push forward determines the amount of wood removed. You can also angle the chisel into the wood to get a more aggressive cut. That is where having a flat face on your chisel is important.

ing the tenon to fit the mortise.

- When you lay out a hinge mortise, after chopping the mortise sides, you basically have to pare the waste out to the edges of the hinge layout.

- If the space between dovetails is large enough (i.e. the pins) for a chisel, they can be pared, on their sides, to fit.

Before beginning, make sure your work is secured on your bench or in your vise. This will impart more of the force of your pushing into the work, thereby giving you more control of the cut. Paring requires pushing a chisel while it lies flat on a surface, slicing into the wood grain. This can be either with or across the grain. When

you pare, you're generally not taking off large amounts of wood. Just gently slicing little shavings off.

To pare well, the chisel needs to have a flat face and a sharp edge. See the story at right on flattening for more about this. You can generally tell when your edge isn't cutting the way it should when paring end grain. If the grain starts to collapse and bend over from the chisel pushing through, the chisel needs sharpening. I won't go into a long diatribe on sharpening here, but suffice it to say that if your chisels are coming up dull, you either need to increase the frequency or quality of your sharpening.

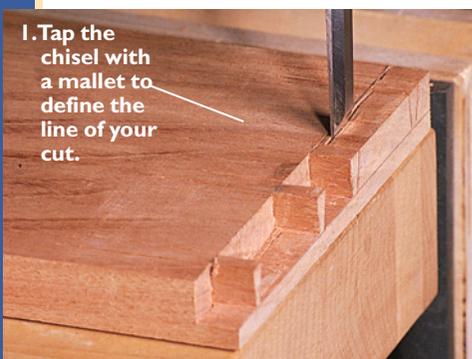
Light Chopping

At some time you'll have to do some chopping with a bench chisel. A half-blind dovetail joint is a good example of how to use chopping to remove wood. Other uses for chopping are defining a hinge mortise, low relief carving and through-dovetails.

When chopping, you can use the same force you would use when mortising — just not as often. Bevel-edged bench chisels shouldn't be used for mortising. They aren't designed for this purpose. Mortise chisels have a steeper cutting angle ground on them: 30° compared to 25° for bench chisels. Their blades are thicker with square flat sides to stand up to a pounding. Bench chisels are thinner and beveled on the sides to get into tight spaces.

Most bench chisel chopping consists of light tapping of the chisel to define a cut line or remove a small amount of waste. Chopping is the most vigorous use that a bench chisel should see. Upon reading our reviews of 20 different bench chisels, only about half stood up to repeated medium/heavy chopping. If you plan on heavy use for your chisels, consult our review to get an idea of what to look for in a bench chisel.

Before beginning, make sure your work



1. Tap the chisel with a mallet to define the line of your cut.



2. Push the chisel forward to remove the waste



3. Angled cuts help break up the waste

Light Chopping

After defining the pins with your dovetail saw, start chopping the waste out by chopping to a line approximately 1/32" away from the actual marked line. What happens when you chop with a chisel is the bevel will push the chisel toward the line as it's struck. You have to compensate for this by starting in a little from the line, then remove the waste.

Use a combination of paring and light chopping technique to remove the waste. The procedure is to chop a line, across the grain, then remove the waste by pushing into the end grain down to the cut line. Depending on the wood, you may or may not need to tap the chisel with a mallet. Re-cut another line and repeat till you get down to the marking gauge line.

To remove the rest of the waste up to the gauge line, start by pushing a series of angled cuts into the waste up to the line. Yes Virginia, you can pare end grain but only with sharp tools. Proceed to pare or gently chop out the waste, cutting across the end grain. Some light paring is required to get into the corners along with a sharp, pointy knife.

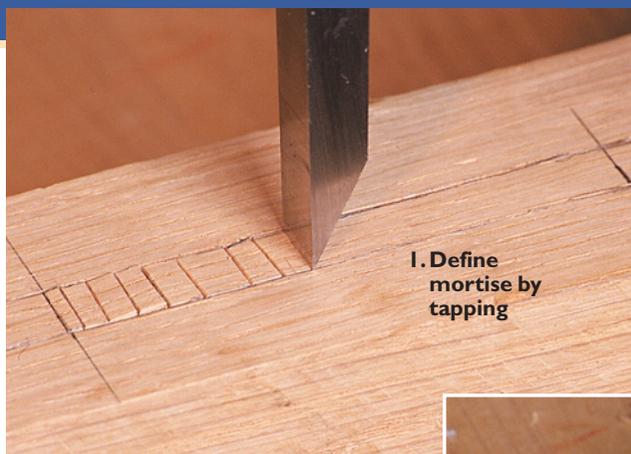
has a direct connection with the ground. That is, place the work directly over the leg of a bench or table. This imparts all the force of the blow directly into the cut and not into flexing your bench's top.

Mortising

I'm sure that back in the days when all mortising was done with manual labor, there were large muscular blokes all hammering and chopping away. This is certainly the woodworking equivalent of heavyweight boxing. The chisel and the wood both take an incredible pounding.

Mortising has one purpose: to make a square flat-sided hole in a piece of wood to receive a tenon. To that end, mortising chisels are the beefiest chisels you can buy. They have a steep grind (30°) and high flat sides to take a beating and guide the chisel while mortising. A bench chisel, with its thin profile, is likely to wander in your cut, ruining your mortise. Not to mention that if you hit a bench chisel as hard as you hit a mortising chisel, especially the small sizes like 1/2" and 3/8", they might actually fracture. Also, repeated pounding of a bench chisel will either roll or collapse the cutting edge.

If you own only one mortising chisel, I recommend a 3/8" tool. Tenons are typically half the thickness of your stock, and most stock is 3/4" thick. Make sure the mortising chisel you buy has a long handle be-



1. Define mortise by tapping

Mortising

First, lay out a mortise and start by lightly chopping a series of lines, inside the layout lines, across the grain (left).

Next, using the bevel side of the chisel, remove the waste and repeat (right). After you get the first couple of layers knocked out, it's easier to just wail away and start taking large amounts of waste out of the mortise. When you get to the bottom of the mortise, start checking the depth with a combination square. When you get towards the finished depth, it's easier to just reach into the mortise with the chisel, bevel side down and pare out fine amounts of wood till you get to the finished depth. If necessary, use a wide bench chisel to pare the cheeks of the mortise.



2. Push chisel this way to remove waste

cause you're going to hit it pretty hard. If the handle is too short, it's your hand that will take the abuse.

Mortising has three parts. One, light tapping. This defines where the mortise will go and begins the mortise. Two, heavy pounding, which is what most of us think about when we talk about mortising. Three, paring. This is the only time you should use a bench chisel while mortising: to pare the sides of a mortise after chopping. **PW**



Here's the finished results of using a mortising machine (left) and a hand cut mortise (right). The hand-chopped mortise is prettier, right?



4. Finally, pare the waste out

IN DEFENSE OF A FLAT CHISEL FACE

Did you ever wonder why sharpening experts tell you that your chisel face has to be flat? Well, if your face isn't flat, one of two things will occur. If the chisel face is bowed you'll start digging into the wood; if the chisel face is bellied, you'll need to lift the chisel to get it to start cutting.

Either condition requires lapping. I like to use a coarse diamond stone, and then work up to a couple of finer grits. There's lots of other lapping equipment out there, but one of the cheapest alternatives is to use dark gray wetsanding paper (start with 150 grit and move up gradually to 400 or 600) on a flat surface. A thick piece of glass does nicely. Just soak the paper in water before use. Lay it down on the flat surface and the surface tension of the water will adhere it to the surface fairly well. Rub the chisel until it is flat at least two-thirds of the way up. This might take a while. Consider it paying your dues before you get into the high-falootin' chisel-use party. Get as fine a polish on your chisel face as you can to eliminate catches or nicks. It also helps to finely sand the edges of the chisel face. If you pinch your finger between a piece of wood and the edge of the chisel, you'll stand less chance of scissoring a cut on your hand.



THE BOURNE SUPREMACY
ROBERT LUDLUM

COLD MOUNTAIN
CHARLES FRAZIER

THE BOURNE ULTIMATUM
ROBERT LUDLUM

Nesting Tables

One table or three
— how you use these
sleek tables is up to you.

If you've been looking for an excuse to buy a really nice table saw blade — or at least get your old one sharpened — this is the project. While these tables are simple to build, precision and a sharp saw blade will make the difference between a relaxing weekend project or a frustrating exercise in gluing up miters.

I made these tables using three sheets of plywood. Essentially I ripped each sheet down the middle and glued the two pieces from each sheet together to make a 1½"-thick slab. Then I beveled the front edge and glued thin solid-wood pieces to cover the slab's plywood edges. Finally, I cut the legs and top for each table from the slab and biscuited the pieces together. This method allows the grain on the top to continue uninterrupted down the legs.

Make a Slab

Start the tables by ripping three sheets of plywood in half to just under 24" in width. You won't need all that width, but it will come in handy later. As for the lengths, using the full 96" is a little wasteful, but it makes gluing the two halves together easier.

After ripping the sheets, determine which three faces are most attractive and mark these as the outsides of the tables. Next glue the pairs



Photo by Al Parrish

by David Thiel

GETTING THE ANGLE ON BISCUITS

Most of us have used biscuits at some time. If you haven't, they're a great way to align a piece for glue-up, and more importantly provide improved strength to what may be a less-than-perfect glue joint. Many biscuit joints occur with two right-angled pieces mating, but biscuits work just as effectively on mitered joints. In our nesting table case we have multiple 45° joints that need critical alignment and could use extra strength. How to cut the biscuits on the mitered edge is a question best answered by the type of biscuit jointer you own. Below are four options that will take into account even the most basic jointers.



The Porter-Cable model 557 jointer offers a 135° variable fence, allowing you to set the fence for just the right angle and hold the machine firmly against the piece for a very accurate cut.



If your jointer's fence is restricted to 90° of variation, you'll need to make your cut from the inside of the piece and carefully align the face of the leg with the face of the machine.



If your jointer is designed for only 90° biscuiting, don't fret. We've got not one, but two ways to simplify your cuts. The first method is to clamp two beveled pieces together, miters in, to form a 90° pocket, then place the jointer into the groove formed and make your cuts.



... or if you're feeling inside out, flip the pieces so that the miters face out, clamp the pieces together, and make your cuts from the outside. This is the preferred method of the two.

together. To keep the sheets from sliding around during glue-up, pound a nail into each slab about 1" from the ends. These ends will be cut off anyway, and it makes glue-up much easier. Stack the three pairs together, then clamp across the stack using stout wood braces to spread the pressure.

After the glue is dry, square off one end of each slab. Then cut the slabs to 68", 62½" and 55" in length. Don't pitch the fall-off pieces, they'll be useful later. Next rip each slab to 23" wide to give you one flat edge. You could run one edge over a jointer, but the adhesive in plywood is murder on high speed steel knives. When you have one square edge, set the table saw's blade to bevel at 33° and rip the three slabs to 21⅝", 20⅝" and 19⅝" wide respectively. Again, save the fall-off.

Homemade Veneer

You're now ready to run some solid lumber to cover the plywood edges. I used soft maple edging on my birch ply tables.

Run out six lengths of 3/16"-thick solid wood for the edges. To plane wood that thin, you probably will have to put an extra board over the bed of your planer — most planers aren't designed for wood that thin.

With the strips ready, it's time to glue them to the slabs. Go find the fall-off from the bevel cuts and grab a couple other sturdy solid strips. Use the fall-off as a caul for clamping. By gluing the edges on the slabs with the bevel facing up, gravity is on your side. I also cheated a little by tacking the edge strips in place with a few small brads at either end. Once again, the extra inch in length will be cut off, so the nail holes won't show.

Glue the edging to the three slabs, then trim the edging flush to the plywood. I used a router with a flush-cutting bit for the back edges, and I used a jack plane to get the beveled edges nearly flush. Then I used a random orbit sander to flush the edges perfectly. To soften the edges I used some



Glue up the Slabs

Spacers underneath the slab allow the solid wood edging to hang over to evenly cover the edges. It doesn't take a lot of pressure to clamp the edges, and too much pressure will force the front edge caul to slide.

120 grit paper and a block of wood to round over the sharp edges.

Make Your Miters

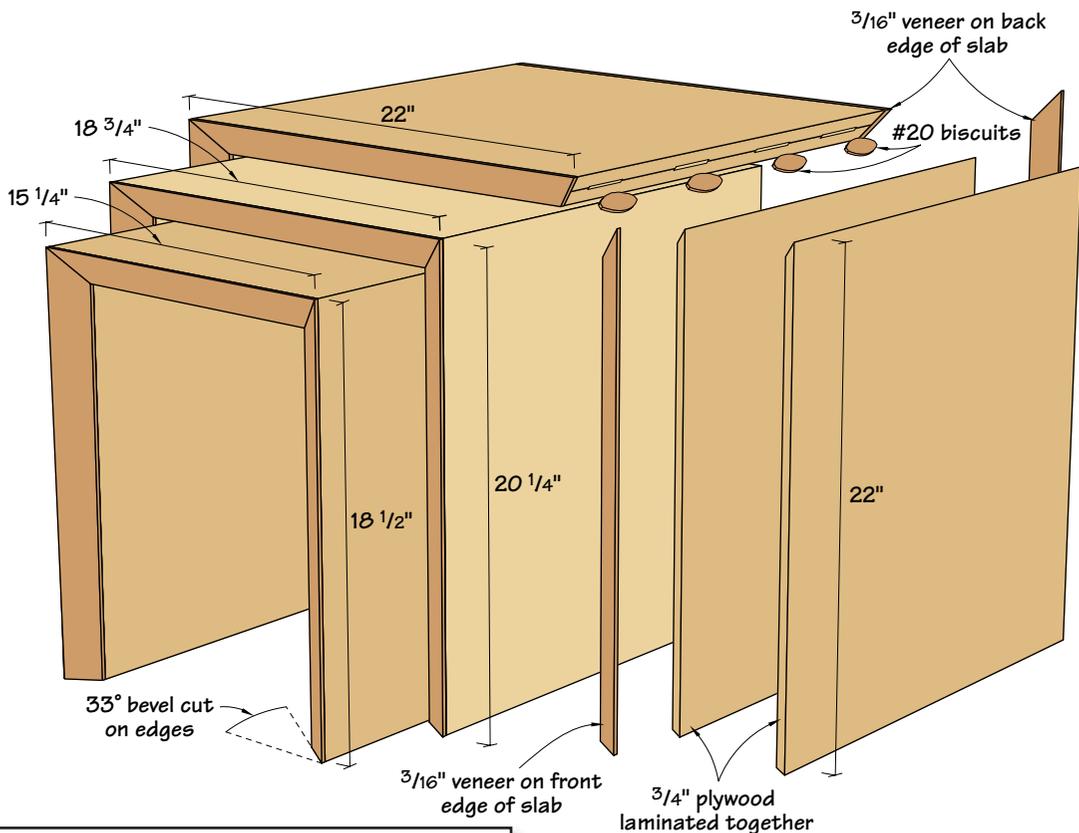
The tables slip inside one another with a ¼" gap between each, so accurate cutting and spacing is important. To make the mitered corners and still maintain the grain pattern on the table tops, first crosscut the three slabs into three parts. Use the table saw with the blade set to 90°. Start by marking the middle of each slab and cut the top section from the middle of each slab, allowing the excess length to remain on the leg sections.

You're now ready to do the precision cutting, and you'll see quickly why a sharp blade is important. Start with the largest top (22" x 22") and set the blade bevel to exactly 45° and the rip fence to cut the miter exactly to the width of the top. If you have a left-beveling table saw you're in luck as the inside of the table is on the tearout side. If you have a right tilt, that sharp blade is important. Make the first bevel cut on one end, then spin the top



Center-cut Slab

The first miter cut on the center slab (on a right-tilt saw) will balance the fall-off piece on the blade. Be aware of possible kickback of the scrap piece.



NESTING TABLES

No.	Item	Dimensions T W L	Material
4	Sides*	3/4" x 22" x 22"	Birch ply
2	Tops*	3/4" x 22" x 22"	Birch ply
4	Sides*	3/4" x 21" x 20 1/4"	Birch ply
2	Tops*	3/4" x 21" x 18 3/4"	Birch ply
4	Sides*	3/4" x 20" x 18 1/2"	Birch ply
2	Tops*	3/4" x 20" x 15 1/4"	Birch ply
6	Veneer edges	3/16" x 2" x 96"	Birch/Maple

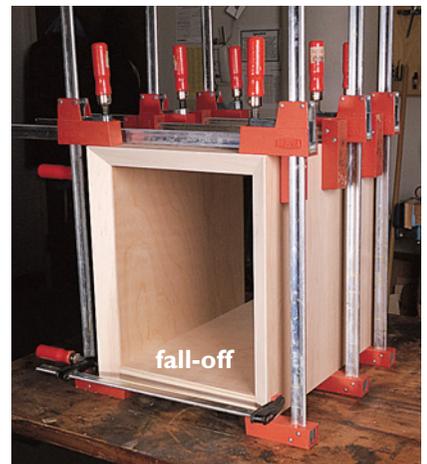
*Sizes are of finished components, not cutting sizes.

and make the cut on the opposite end. Again, with a right tilt you have the extra difficulty of the first miter trying to slide under the rip fence. Adjust your cut for any variance and consider adding an auxiliary fence that fits tight to the table sur-

face. Repeat this with all three tops. You're now ready to make the miter cuts on the legs. Start with the 22"-high legs and work through the 20 1/4"- and 18 1/2"-high legs, checking the spacing between the tables by "dry-nesting" as you go.

Assembly

The hard part is done. The rest is biscuits and clamps. I used four #20 biscuits for each miter joint. With the biscuits cut, the fall-off pieces from cutting the slabs to length come into play. You'll stick them between the legs while gluing up the miters. It makes glue-up much easier. First check the internal dimension between the miters on each table top. Try to be as exact as possible, then cut spacers from the fall-off pieces for each table. Finish sand the interior faces of each table and the beveled front edge of each piece before assembly. Put glue on the miters and biscuits and glue the tables. Pay careful attention to the miter joint where the top and legs join.



A Little to the Left

Enough clamps and careful adjustment during glue-up will ensure tight miters and an evenly spaced opening from top to bottom.

Unlike the hardwood edging, you only have about 1/16" of veneer to sand to match the joint.

With the tables assembled sand the outer faces, paying extra care with the mitered joint. You're now ready to finish. I chose to simply add a few coats of clear finish to the tables, but any number of stains to match an existing decor will work well. **PW**



Disappearing Miter Trick

Unless your rip fence is tight to the saw table, the miter will have a tendency to slide under the fence during the second cut (on right tilt saws). Recheck your measurements to accommodate this, or add a tight-fitting auxiliary fence to the standard rip fence.

GET STRAIGHT WITH crooked wood

For some, the most simple machine in the shop is also the most misunderstood. Getting it right on your jointer is the first step to a trouble-free project.

my first lesson in a wood shop was humility. The instructor in the adult education class let us loose on the shop floor after grueling weeks of classroom work. I was anxious to start my project, smoothing the lumber that I purchased “rough and random” just like the pros, I thought. I headed straight for the big, cast iron planer.

I knew enough to start the board on the right end of the machine, and I figured out how to adjust the bed for the right amount of cut. Anxious as a cat in a cage I fed in one board, then another and another.

I stopped to inspect

my work and saw the glorious results of rough cherry transformed into smooth wood. My moment of triumph, the feeling of being sent up to the “big,” was quickly dashed when I realized that the boards, while smooth on one side, were coming out just as cupped, warped and twisted as when they went in.

“How come the boards aren’t straight when they come out?” I asked the instructor passing by.

“Did you face joint them first?” he asked. I guess the sheepish look on my face was all the answer he needed. “Take it over to the jointer and I’ll show you what to do.” In the next 10 minutes I got the best first-hand instruction on how to flatten stock a fledgling woodworker might hope for. It has served me well surfacing thousands of board feet of lumber, and I’m going to give you that same lesson here. And I’ll add a few tricks I’ve learned over the past 20 years as well.

Introduction to Jointers

While jointers are more versatile than most people realize, far and away their primary function is to



With the help of a 6" jointer, this pile of rough red oak boards was turned into perfectly flat lumber.

by Steve Shanesy



Photos by Al Parrish

JOINTER SAFETY QUIZ

OK, it's time to test your knowledge of safety rules when operating a jointer, which is the second-most dangerous machine in the wood-working shop. (Anything with a circular saw, including radial and table saws, are the most dangerous.)

1. Check stock before jointing to make sure it is free of:
 - a) splinters,
 - b) bowing,
 - c) knots and other defects,
 - d) twists.
2. Use a _____ when jointing a thin piece of stock or when face jointing:
 - a) glove,
 - b) push block,
 - c) assistant,
 - d) roller stand.
3. Always keep your fingers away from the:
 - a) switch,
 - b) fence,
 - c) outfeed table,
 - d) revolving cutterhead.
4. As you make your cut, stand _____ the jointer.
 - a) behind,
 - b) in front of,
 - c) on the infeed end and to the left of,
5. The shortest piece of stock you should attempt to run on the jointer is:
 - a) 12",
 - b) 5",
 - c) 24",
 - d) 20".
6. Before turning on the jointer, check to make sure:
 - a) you are wearing safety glasses,
 - b) all parts of the machine are locked securely,
 - c) you have ear protection,
 - d) all the above.
7. You can edge joint end grain so long as the piece is at least 12" long.
 - a) true,
 - b) false.
8. The safety guard should be in place at all times except when:
 - a) jointing thin stock,
 - b) edge jointing,
 - c) cutting rabbets or face jointing stock wider than the capacity of the machine.

(Answers: 1) c; 2) b; 3) d; 4) c; 5) a; 6) b; 7) a; 8) c)

flatten rough stock by removing cups, warps and twists on the wide dimension or face of the lumber or to straighten an edge by removing any warp or bow. After jointing one face and one edge to make them geometrically perpendicular to each other, the board can then be planed so that the opposing face will be both parallel and perpendicular to the jointed edge.

Starting a project with lumber that is straight and flat with consistent thickness is fundamental to all woodworking, except turning and carving. For this reason, I rank the jointer ahead of the planer in terms of importance in the wood shop. Even lumber purchased smooth may not be flat or straight enough.

And it is absolutely true that the more sophisticated a project, the more important the matter of flat, straight stock becomes. Consider a project with panel doors. If glued-up panels aren't flat, they will put a twist in the door that's impossible to fix. If the stiles or rails that hold the panel are twisted or warped, the door will not be flat. The same can be said of table aprons, cabinet sides and tabletops.

Of course, the proper setup of a jointer is critical to the machine's ability to produce the intended results. Check your machine's manual for proper setup. In general, a properly set jointer will have infeed and outfeed tables that are on the same

plane, with the outfeed table set to a height that is exactly the height of the cutterhead knives when any knife is at its highest point of rotation.

Sizing up Rough Lumber

In any pile of rough lumber you will find a few boards that are relatively straight, most will be cupped to some degree, some will be bowed or crooked, and some will be twisted or "in wind." Your objective is to eliminate these defects and still have enough thickness left in the board for your project.

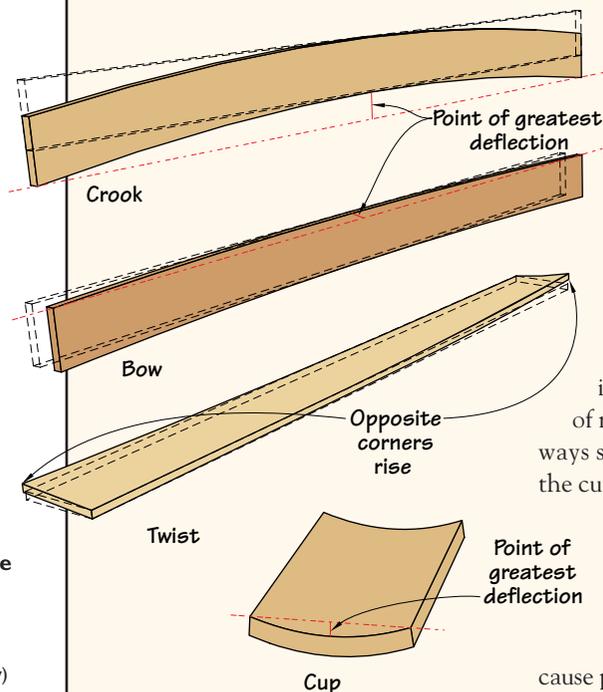
But unless you want to end up with a piece of veneer, it's usually advisable to first crosscut the material into smaller lengths before jointing. And sometimes it even helps to rip the rough stock on the band saw. An 8-foot-long board with a good bow in it will hardly seem warped when cut into four pieces. Or if that board has a crook in it that starts 30" from the end and then runs true, you'll have no problem when you cut the board at the crook. The same is true with wide cupped boards. Reduce the width by half and most of the cupping is gone.

A twisted board can be made useable when cut to shorter lengths, but a severely twisted board may be firewood.

Knowing this, one of the best ways to save time, effort and lumber is to carefully select boards in the rough for their intended use in your project. Few project

parts require long lengths, so the first step is crosscutting to rough length. Generally speaking, lengths of between 3 and 5 feet are manageable. Find multiples of part lengths on your cutting list that fall into these lengths. To help keep all your parts straight, pencil mark the ends of the boards. When cutting stock to rough length, first remove any end checks, then add an inch or two at most for finished trim. When selecting boards of rough lumber for your project, always start with the longest parts from the cutting list and then pick the boards with the least warp, cupping, bowing or twist. In the other extreme, don't rough cut pieces less than 14" to 16" long. These lengths are more dangerous to joint and can cause problems while planing. Selecting

Straight boards shown dashed for context





◀ step 1 ▶

Rock the board on the jointer table across its width to find the flattest area, then maintain this plane as you begin the cut. Stand near the back of the board and do not use any downward pressure on the board. Use your left hand to keep the board to the fence and your right hand to move the board forward and in the correct plane. Let the force of the cutterhead in the wood keep the board down on the outfeed table. Keep your body positioned as shown until the board is supported on the jointer tables.



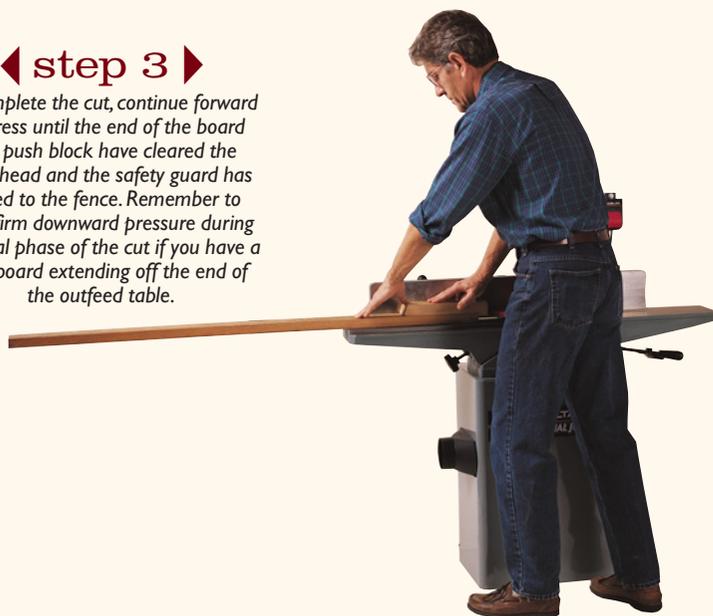
◀ step 2 ▶

With the board supported, move toward the cutterhead by taking shuffling steps with your feet. Again, the right hand keeps the board to the fence and applies only enough downward force to control the stock. Use a shuffling motion to move your hands and always keep one hand on the board. When your left hand is about 18" from the cutterhead, pause, and while keeping firm control of the stock, reach for the push block with your right, then position it on the end of the board. Now continue moving the board forward.



◀ step 3 ▶

To complete the cut, continue forward progress until the end of the board and push block have cleared the cutterhead and the safety guard has closed to the fence. Remember to keep firm downward pressure during the final phase of the cut if you have a long board extending off the end of the outfeed table.





Start edge jointing with the face jointed side pressed to the fence by your left hand. Your right hand supports the board off the table. Stand well behind the cutterhead with your hips and shoulders about 30 degrees to the jointer tables.



When the board is supported by the tables, take a shuffling step forward. While keeping the jointed face flat to the fence, move your left hand to the outfeed side and maintain downward pressure. Alternate hand pressure as you move the board.



At the completion of the cut, move your hand right on top of the board over the cutterhead making sure the board remains flat on the outfeed table. Note the high position of my hand. On narrow stock, a push stick should be used.

and cutting to rough length is also the best time to cut out knots or any other defect present in the lumber.

So what do you do with an 8" -wide board when you have a 6" jointer? If you have a band saw, you can rip it; if not, you can use a technique described in the box at right.

Face Jointing

When selecting the face to joint on any rough board, first give the piece a once-over. Look for cupping, warping and twisting. For cupped or warped boards, joint the face so that the cupped or warped side (concave) is down. This reduces the chance the board will rock on the infeed or outfeed table as it moves over the cutterhead. The flat surface you create on the first jointer pass must remain on the same plane during every pass, or the board will never get truly flat.

Before turning on the machine, set the fence for a width that's slightly more than your widest board. Don't be concerned about squaring the fence to the table at this time. Now set the infeed table so that it is about $\frac{1}{16}$ " below the high point of the knife in the cutterhead. Be sure and lock the infeed table in place. To determine which way the board should go through

the jointer, you need to read the grain direction of the board. See the story "Taming Wild Woods" elsewhere in this issue.

To begin the face-jointing operation, position the board on the table with the fingers of your left hand bearing slight pressure down and to the fence. Before moving the board forward, try rocking the board across its width. If you feel it rocking, apply pressure so that it stays in one position and remember to apply pressure the same way on the next pass. Put your right hand on the back end of the board to steady the board and push it into and across the cutterhead. On long boards, your right hand must also keep the board on the same plane as the infeed table.

The speed with which you feed the stock depends on the depth of your cut, the hardness of the wood and the width of the stock. As a general guideline, a feed rate of one foot every two to three seconds is appropriate. Go slower for figured woods or your final pass.

As you move the stock forward, continue to keep it against the fence with slight

downward pressure. Allow the the knives of the cutterhead to pull the stock down and against the outfeed table. Be advised that the knives may not contact the board during the entire pass. Keep your hands away from the cutterhead until the final portion of the board approaches the knives. This is not only for safety's sake, but also to help you resist the temptation to push down too much on the board. Forcing the board flat to the infeed table defeats the purpose of jointing the stock. Before your right hand is closer than a foot from the cutterhead, stop feeding the stock long enough to pick up your push block with

These boards were painted black to better show progressive passes on the jointer with the left photo the first pass. Even though some black or rough-sawn areas remain by the third pass, it is ready for planing, starting on the opposite face.



your right hand, put it in position and then continue the cut. While stopped, apply more downward pressure to secure the board. Now move your left hand to the part of the board on the outfeed side of the table and allow your right hand, holding the push block, to finish the pass.

With boards over 3 feet long you'll need to change foot position during each pass. Because you are standing with your right foot nearly perpendicular to the table and your left foot skewed slightly outward, foot movement should be in a shuffling motion, leading with your left foot, then following with the right. Never take steps by crossing over your legs.

Some boards require only one pass before they are ready to plane, others need several. Remember: The objective of face jointing is not to smooth the entire bottom surface, but to flatten it to the point where it can maintain a parallel plane relative to the planer's cutterhead knives in the next operation. The board is ready for the planer when there is enough flattened surface along the width and length of the board to prevent the planer's feed rollers from pushing the face-jointed surface out of parallel with the planer knives. One reason to avoid smoothing one entire face is that you save some extra thickness for the planing operation.

Edge Jointing

Before moving to the planer, edge joint your boards. This is easier than face jointing because you have less surface to run over the cutterhead, and you have a flattened surface to press against the jointer fence.

Before starting the edge jointing process, always make sure your jointer fence is square to the jointer tables. Holding your board's jointed face flat against a squared fence will ensure you produce a jointed edge that's square to the jointed face. Also, examine your board's edges by sighting along them to determine which edge is straighter. The straightest edge is the one to joint. If the edge is severely bowed, set your infeed table to take a deeper cut, say $\frac{1}{8}$ ".

Also, if the edge is bowed severely, make multiple passes over the ends of the boards before taking a full pass along its length. Remember, if the jointed leading edge of your board runs off the end of your outfeed table before the cutterhead joints the trail-

continued on page 84

WHEN YOUR STOCK IS TOO WIDE

You have a 6" or 8" jointer and a 13" planer. You have a 10"-wide board and no band saw to rip it to a usable width. Or you don't want to rip down a beautiful wide board that will look great in a panel door or countertop. The board isn't flat. What do you do?

Many woodworkers don't realize they can double the width capacity of their jointer by face jointing just half the width of the board at a time. Yes, special care must be taken because the safety guard must be removed. I consider the technique relatively safe because the cutterhead is completely covered by the board. Obviously, care must be taken before and after the cut when the spinning knives are unprotected. But if you're like me and consider wide stock special when making tabletops and doors, this technique is for you.

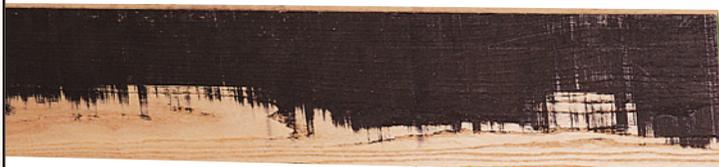
Not all boards are candidates for this technique. Ones that are severely cupped or in wind will not work. Select a board that is relatively straight without severe cupping that mostly has high- and low-spot problems.

Use all the techniques described in the article for face jointing. But for this technique, adjust your fence for a cut that will be about $\frac{1}{8}$ " greater than half the width of the board. Set the infeed table to take a light cut, say $\frac{1}{16}$ " or less. Proceed as normal but pay special attention to maintaining the plane of the board on the tables, especially in the second phase when you turn the board to joint the rough half.

Face joint one half on one pass, then turn the board and face joint the other half. Check the board, looking for any problem that might present itself. Watch especially for any big differences where the two cuts intersect in the middle of the board. Expect some differences here, say $\frac{1}{16}$ " but no more than $\frac{1}{8}$ ". A slight ridge is to be expected in the middle, but that should disappear when jointing the opposite side or at least not get worse. Continue alternating sides until you have flattened the board to the same criteria as described in the face-jointing section of the main article. In general you want the plane of the jointed face to be maintained during the planing operation. And when planing, take light passes to put as little downward pressure as possible on the board from the feed rollers. Let the planer take skimming passes until the face is flat enough that it can be turned and run face down to clean up the face-jointed side. Then turn one more time and clean up the opposing face as needed.



Face joint stock that's wider than your jointer capacity by removing the guard and setting the fence to a bit more than half the width of the board. Run one side as you would normally, taking light passes. Then flip the board end for end and face joint the other side. Take a couple passes on each side before turning and be careful not to get too deep a ridge in the middle.



Only one side of this board has been face jointed. Note the straight line of black.

After several passes on each side of this face, the board is about ready to run through the planer.



taming



A few simple tricks and a jig will help you say farewell to tear-out forever.

after building a project using curly maple for the first time, you probably thought the wood should be named “cursed” maple instead. Unless you know what you’re doing at the jointer and the planer, highly figured woods are likely to emerge looking like a buffet lunch for a rowdy beaver.

Why should you work with these difficult boards? While these figured woods are a challenge to joint, plane and nail, they can make a simple cabinet scream for attention and praise. And learning to properly surface these woods is a simple matter of changing the way you run your boards over your jointer and through your planer.

Don't I need special equipment to work with curly woods?

The best way to surface highly figured woods is with a thickness sander. However, a high quality thickness sander is going to cost you at least \$900. That's a fair price for a professional who deals with curly maple every day. But for a home woodworker, \$900 is a lot of flame birch. Rest assured your standard jointer and planer can still tackle the task.

So what do I have to do to my machines to get them to surface figured woods?

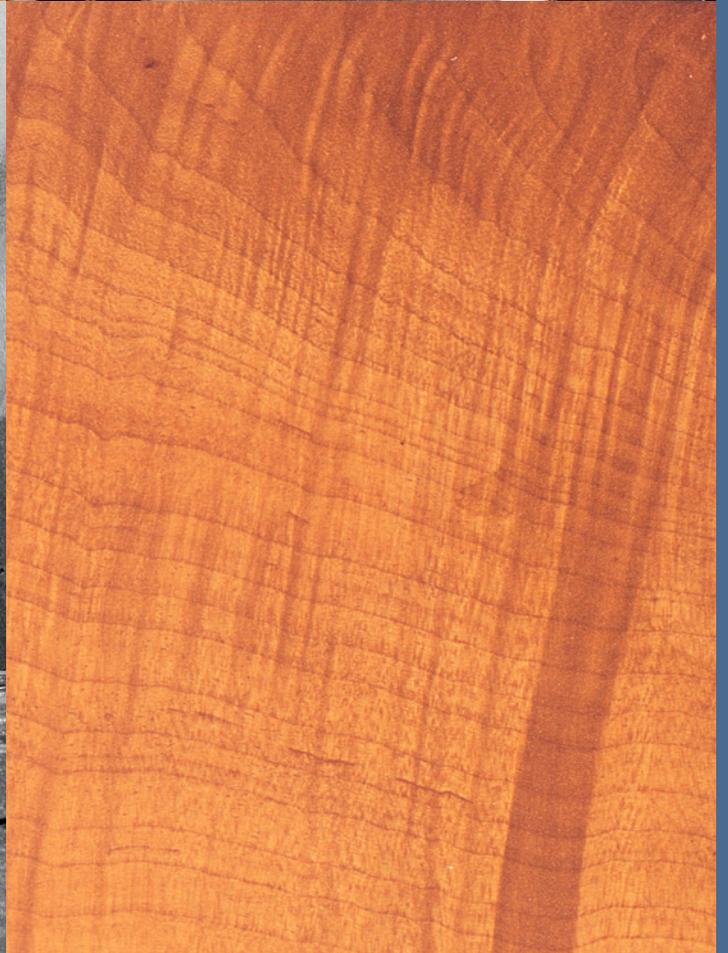
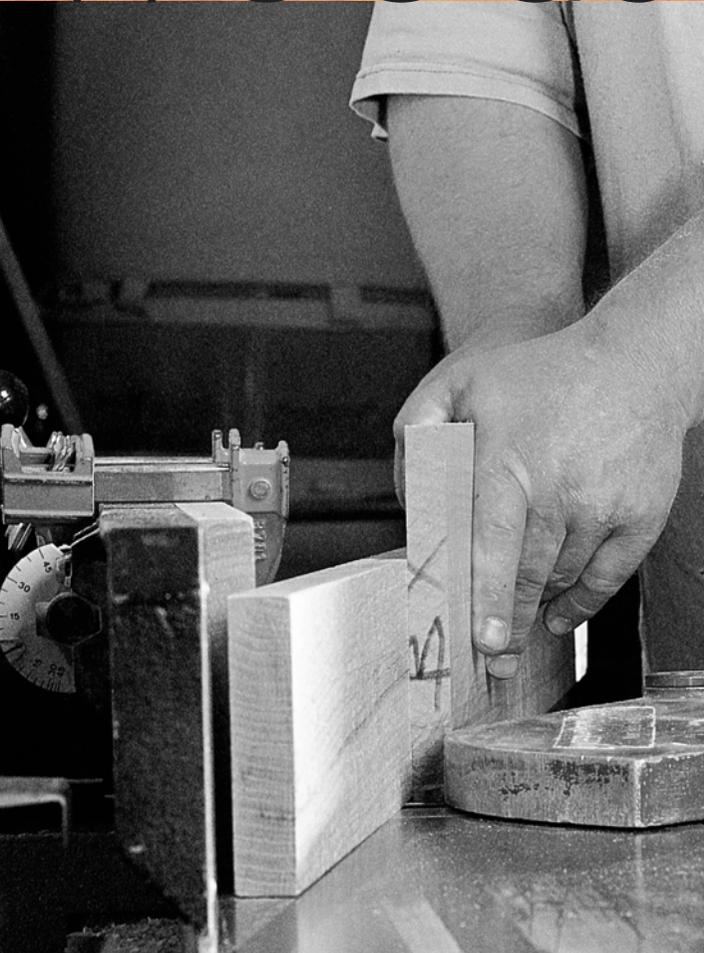
The first step is to do a quick tune-up. Install sharp knives, or at least hone

by Troy Sexton

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



woods





When face-jointing figured wood, it's best to run it over the cutterhead slowly and at an angle (left). The board at top was run straight over the knives. The same board at bottom after I ran it over the cutterhead at an angle.

How will I know if a board is tearing out?

Use your ears. When a board is tearing out it sounds like an irregular popping. If a board begins tearing out as soon as you begin your pass, the first thing to do is slow down your feed rate. Slower speeds can help quite a bit. If that doesn't help, save yourself some trouble and lift it off the jointer and turn it around.

I've read that another trick is to take really light passes to reduce tear-out. Will this help?

I find the opposite is true. Taking a good-sized cut ($\frac{1}{16}$ " or more) with your jointer and planer will result in less tear-out than taking a bunch of really light cuts. And you'll get your work done faster, too.

After I joint one face, the next step is the planer. What should I do here?

The rules are the same. Run your boards at an angle and take a good-sized cut. If the board tears out, turn it around and try again. If your planer has different feed rates, choose a slower one. And there's one more thing to remember with the planer: you'll get less tear-out if you run your boards through with them butted end-to-end.

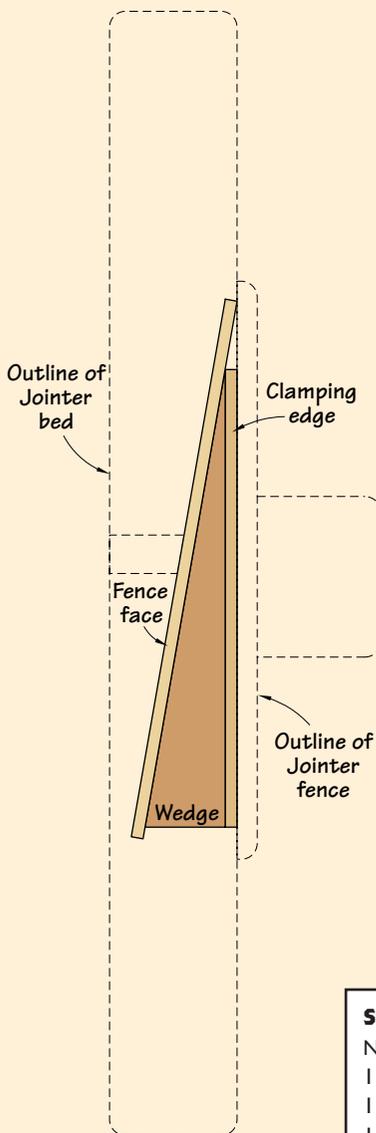
them while fixed in the machine's cutterhead. Over the years I've found that curly woods are harder on knives than straight-grained woods. So as you touch up your knives, check for nicks in the blades. If your machine allows you to shift the knives side-to-side, do that to cancel out the nicks.

Are there any tricks to face-jointing a board?

Yes. The trick is to run the board over the cutterhead at an angle. Even a slight angle helps. I've seen people with small jointers (usually 6") take the machine's fence off its track and then run their boards at an angle without the fence guiding them. However I can't recommend this procedure. If your boards are too wide to pass over your jointer at an angle, rip your stock into more manageable widths.

How important is grain direction here?

Very. A curly board that looks awful when it comes off the jointer may look great if you turn the board end-for-end and run it again. Irregular grain can be hard to read. If you're getting tear-out in one direction, turn the board and try it again. You can often see which direction to run the board by looking at the edge grain. See the drawing at right for an example of how to read the edge grain.



Plan View, Skewing Jig on Jointer

SKEWING JIG FOR 8" JOINTER

No.	Item	Dimensions T W L
1	Fence face	$\frac{3}{4}$ " x 4" x 34"
1	Clamping edge	$\frac{3}{4}$ " x 5" x 30"
1	Wedge	$1\frac{3}{4}$ " x $5\frac{1}{2}$ " x $28\frac{1}{2}$ "



This simple jig makes edge-jointing curly maple a breeze. It cocks the wood at a 10° angle to reduce tear-out. Want dramatic proof? The board at top was run over the jointer without the jig. The same board below after I attached the jig to my fence.



This prevents your planer from taking really large chunks off the end of the board.

I've read that wetting a board with water can reduce tear-out. Is this true?

It can. I've tried this trick myself a few times but haven't had good results. The idea is that by wetting the board it will make the bits of end grain on the surface a bit softer and easier to cut. It's a fact that wetting the end grain makes it easier to cut with a block plane, but I just haven't had any luck with this technique on the planer. However, other woodworkers report that soaking irregular grain — even in the difficult-to-plane crotch area — produces excellent results. Give it a try.

The final step is to joint one edge before I rip it on my table saw. Are all the rules the same?

Yup. And to make life easier, you should build my simple skewing jig. This simple wedge clamps to the fence of my 8" jointer and runs the stock over the knives at a 10°



Again, run your boards through at an angle at a slow feed rate (left). If you're planing more than one board, butting them end-to-end also will reduce tear-out. The board at top was run through the planer straight. The same board is below it after I ran it through the planer at an angle.



angle. I made my jig from scrap, and it works great. Clamp this puppy to your fence, set your jointer to take a decent-sized cut and feed your stock slowly over the knives. Listen for tear-out and adjust.

Anything else I should know?

These tricks should go a long way toward taming your figured wood, but there's one other trick to master, and that's nailing. Because the grain in figured woods is so irregular, you can easily split thin pieces (such as moulding) when you nail them to a case with a brad nailer. As a result, you should nail your moulding while paying attention to the grain. Brads are rectangular shaped. If you put the long edges of the brad perpendicular to the grain lines, the nail will act as a wedge, and it is likely to split the wood. If you put the long edges of the brad parallel to the grain, then chances are your wood will stay in one piece. It also can help with some boards to pre-drill your nail holes with a small drill bit. **PW**

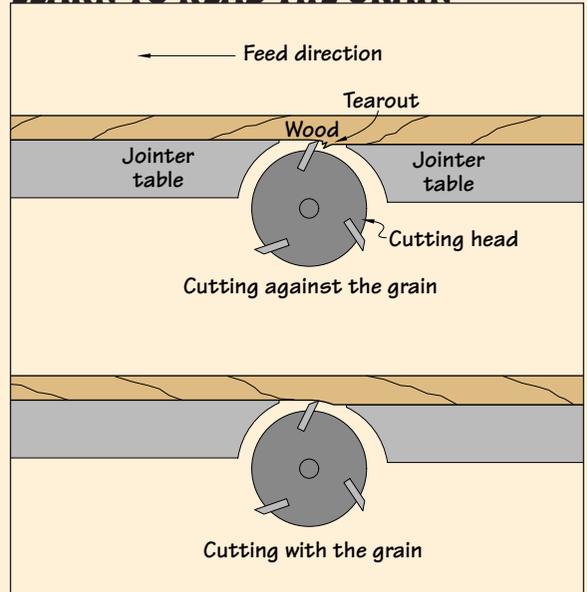
WHAT IS FIGURED WOOD?

Highly figured woods have a three-dimensional quality you won't find in their straight-grained brethren. Many appear striped, and the most dramatic boards make the wood itself look wavy. "Figure" is a natural phenomenon, though foresters haven't figured out how to make a tree grow to produce curly grain. As a result, the wood is highly sought after by professional cabinetmakers, and they sometimes jealously guard their sources. Patient home woodworkers can usually find figured woods by carefully picking through stacks of rough-sawn lumber.

The grain in your garden-variety curly maple can look like many strands of wavy hair. Where these waves intersect the surface of your board, they actually expose some end grain. End grain, as you probably know, absorbs more stain than the surface grain. And that's why when you put stain or dye on figured wood it can get that almost striped appearance.

Figure can show up in many species of wood, including maple, cherry, birch, walnut, oak and even poplar. And there are many different names to describe it, such as flame, curly, tiger and fiddleback to name a few. But all these highly figured woods have one thing in common: wild grain. In fact, the reason these woods are so eye-catching is also the reason they're so hard to work with: the grain is constantly changing directions. And this is important to understand in order to get smooth boards without any tear-out.

TO AVOID TEAR-OUT, LEARN TO READ THE GRAIN



\$175

For about the cost of a quality jigsaw you can build a bench that will retire from woodworking long after you do. And by the way, the price includes everything — wood, hardware and even the vise.

by Christopher Schwarz

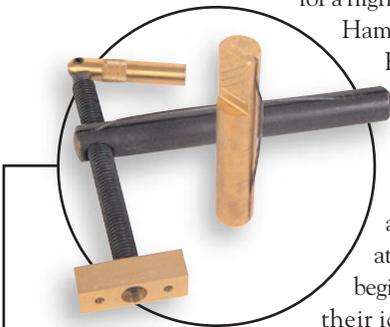
I've hauled my grandfather's workbench across snow-covered Appalachian mountains, down narrow stairwells and into a dirt-floored garage that should have been torn down during the Eisenhower administration. I've built a lot of good stuff on that bench, but now it's time to retire the old horse.

For starters, the bench is too low for the way I work. And the top is pockmarked with three different shapes and sizes of dog holes. And during the last few years I've become fed up with the tool tray. The only thing it seems designed to hold is enough sawdust for a family of gerbils. So I need a new bench, but there's no way I'm going to spend \$1,200 to \$1,400 for a high-quality bench from Hoffman & Hammer or Ulmia.

Enter Bob Key from Georgia. He and his son have been building benches using off-the-rack pine for a few years and have even built a website showing how quick and easy this is to do (visit them at www.mindspring.com/~bobkey/beginners.htm). I was impressed with their idea. So I spent a week reading every book on benches I could find. I pored over the woodworking catalogs. And after a lot of figuring I came up with a simple plan: Build a bench for

less than \$175.

Believe it or not, I came in 92 cents under budget and ended up with a bench that is tough, sturdy and darn versatile. I made a few compromises when choosing the hardware to keep the cost down, but I designed the bench so that it can later be upgraded with a nice tail vise. However, I made no com-



8	2 x 8 x 12' Southern yellow pine boards @ \$9.57 each	76.56
8	3/8" x 16 x 6" hex bolts @ 51 cents each	4.08
8	3/8" x 16 hex nuts @ 7 cents each	.56
16	5/16" washers @ 3 cents each	.48
1	Veritas Bench Dog (see Supplies for ordering information)	8.95
1	Veritas Wonder Dog (see Supplies for ordering information)	19.95
1	Veritas Front Vise (see Supplies for ordering information)	63.50

Total Cost \$174.08
plus tax and shipping.

workbench





When you glue up your top, you want to make sure all the boards line up. Lay down your glue and then clamp up one end with the boards perfectly flush. Then get a friend to clamp a handscrew on the seam and twist until the boards are flush. Continue clamping up towards your friend, having your friend adjust the handscrews as needed after each clamp is cinched down.

is useful for joinery and opening cans of peanut butter.

Preparing Your Lumber

Cut your lumber to length. You've probably noticed that your wood has rounded corners and the faces are probably less than glass-smooth. Your first task is to use your jointer and planer to remove those rounded edges and get all your lumber down to $1\frac{3}{8}$ " thick.

Once your lumber is thicknessed, start working on the top. If this is your first bench, you can make the top, then throw it up on sawhorses to build the base. The top is made from $1\frac{3}{8}$ " x $3\frac{3}{8}$ " x 70" boards turned on edge and glued face-to-face. It will take five of your 2 x 8s to make the top. Build the top in stages to make the task more manageable. Glue up a few boards, then run the assembly through the jointer and planer to get them flat. Make a few

more assemblies like this, then glue all the assemblies together into one big top.

When you finally glue up the whole top, you want to make sure you keep all the boards

in line. This will save you hours of flattening the top later with a hand plane. See the photo above for a life-saving tip when you get to this point. After the glue is dry, square the ends of your assembled top. If you don't have a huge sliding table on your table saw, try cutting the ends square using a circular saw (the top is so thick you'll have to make a cut from both sides). Or you can use a hand saw and a piece of scrap wood clamped across the end as a guide.

Build the Base

The base is constructed using mortise-and-tenon joinery. Essentially, the base has two

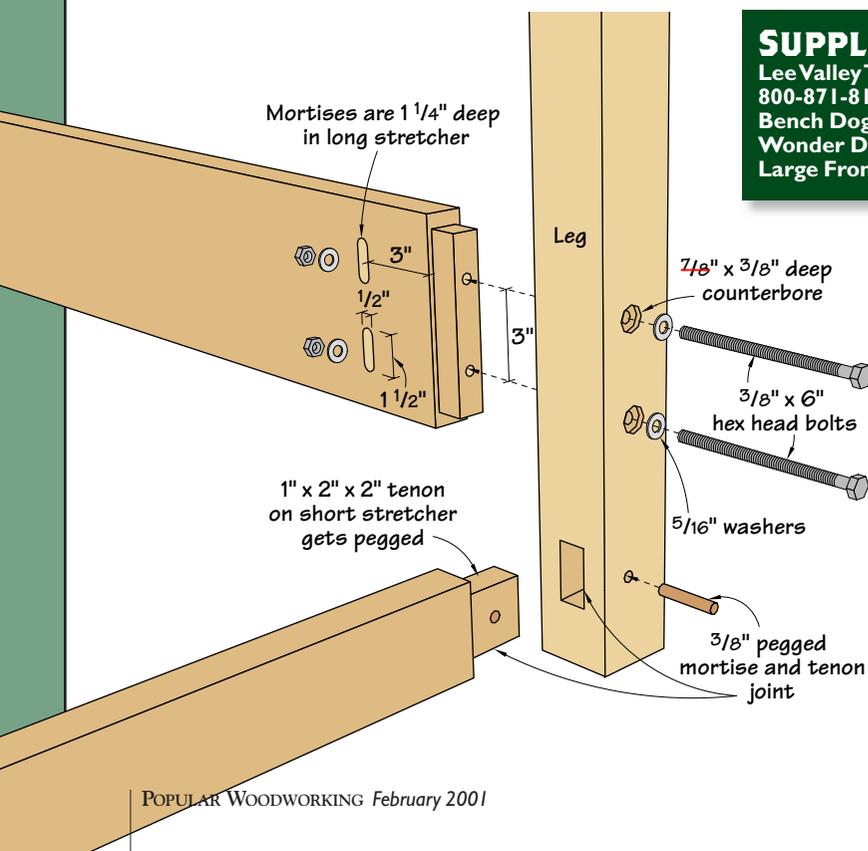
promises in the construction of the top or base. You can dance on this bench.

Let's Go Shopping

OK friends, it's time to make your shopping list. First a word about the wood. I priced my lumber from a local Lowe's. It was tagged as Southern yellow pine, appearance-grade. Unlike a lot of dimensional stock, this stuff is pretty dry and knot-free. Even so, take your time and pick through the store's pile of 12-foot-long 2 x 8s with care to get the best ones possible. You can hide a few tight knots in the

top, but with luck you won't have to.

Here's the story on the hardware. The bolts, nuts and washers are used to connect the front rails to the two ends of the bench. Using this hardware, we'll borrow a technique used by bed makers to build a joint that is stronger than any mortise and tenon. The Bench Dog and Wonder Dog will keep you from having to buy an expensive tail vise. Using these two simple pieces of hardware, you can clamp almost anything to your bench for planing, sanding and chopping. The traditional face vise goes on the front of your bench and



SUPPLIES

Lee Valley Tools
800-871-8158
Bench Dog #05G04.01, \$8.95
Wonder Dog #05G10.01, \$19.95
Large Front Vise #70G08.02, \$63.50

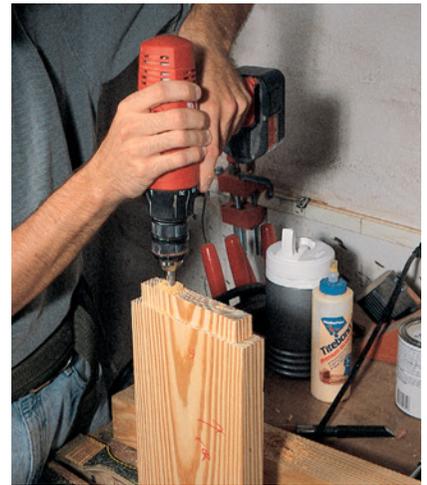
end assemblies that are joined by two rails. The end assemblies are built using big 1" -thick, 2"-long tenons. The front rails are attached to the ends using 1" x 1" mortise-and-tenon joints and the 6"-long bolts.

Begin working on the base by cutting all your pieces to size. The 2 $\frac{3}{4}$ "-square legs are made from two pieces of pine laminated together. Glue and clamp the legs and set them aside. Now turn your attention to cutting the tenons on the rails. It's a good idea to first make a "test" mortise in a piece of scrap so you can fit your tenons as they are made. I like to make my tenons on the table saw using a dado stack. Place your rails face down on your table saw and use a miter gauge to nibble away at the rails until the tenons are the right size. Because pine is soft, be sure to make the shoulders on the edges 1" wide on the upper side rails. This precaution will prevent your tenons from blowing out the top of your legs.

Now use your tenons to lay out the locations of your mortises. See the photo at right for how this works. Clamp a piece of scrap to your drill press to act as a fence and chain-drill the mortises in the legs. Make your mortises about $\frac{1}{16}$ " deeper than your tenons are



Drilling the $\frac{3}{8}$ " holes for the bolts is easier if you do it in this order. First drill the holes in the legs using your drill press. Now assemble the leg and front rail. Drill into the rail using the hole in the leg as a guide (left). Remove the leg from the rail and continue drilling the hole in the rail. The hole you drilled before will once more act as a guide. You still need to be careful and guide your drill straight and true (right).



long. This will give you a little space for any excess glue.

Once you've got your mortises drilled, use a mortise chisel to square the round corners. Make sure your tenons fit, then dry-fit your base. Label each joint so you can reassemble the bench later.

Bed Bolts

There's a bit of a trick to joining the front rails to the legs. Workbenches, you see, are subject to a lot of racking back and forth. A plain old mortise-and-tenon joint just won't hack it. So we bolt it. First study the diagram at left to see how these joints work. Now here's the best way to make them.

First chuck a 1" Forstner bit in your drill press to cut the countersink in the legs for the bolt head. Drill the countersinks, then chuck a $\frac{3}{8}$ "-brad-point bit in your drill press and drill in the center of the counterbore through the leg and into the mortise.

Now fit the front rails into the leg mortises. Chuck that $\frac{3}{8}$ " bit into your hand drill and drill as deeply as you can through the leg and into the rail. The hole in the leg will guide the bit as it cuts into the rail. Then remove the leg and drill the $\frac{3}{8}$ " hole even deeper. You probably will have to use an extra-long drill bit for this.

OK, here's the critical part. Now you need to cut two small mortises on each rail. These mortises will hold a nut and a washer and must intersect the $\frac{3}{8}$ " holes you just drilled. With the leg and rail assembled, carefully figure out where the mortises need to go. Drill the mortises in the rails as shown in the photo. Now test your assembly. Thread the joint with the bolt, two washers and a nut. Use a ratchet and wrench



After you cut your tenons, lay them directly on your work and use the edges like a ruler to mark where the mortise should start and end (top). Use a 1" Forstner bit in your drill press to cut overlapping holes to make your mortise (middle). Now square up the edges of the mortise using a mortise chisel and a small mallet (right).



THE PLEASURE AND PAIN OF PINE

Southern yellow pine is cheap, but you probably know that it likes to twist, cup, wind and bow — everything but corkscrew. There's a way to prevent this, and it's a simple trick that will help reduce warping in all your projects.

First, after you cut your pieces to size, store them on edge with about an inch of space between them. One of the major reasons pine bows is that it's not completely dry (surprise). When you stack it flat, one side is exposed to the atmosphere and the other is not. As a result, one side dries faster than the other and the board bends. Leave a pine board alone for a night like this and the next morning you'll probably have a bowl.

Here's another tip. When you get set to assemble your top, do it all in one day. Surface all your boards and glue them up as fast as you can. If a pine board is in a lamination, it's much less likely to bow because it has other boards that may cancel out its tendency to warp.

Drilling your dog holes may seem like hard work using a brace and bit. It is. However, you get an amazing amount of torque this way — far more than you can get with a cordless drill. Sadly, I had cooked my corded drill, so this was my only option.



Screw the ledgers to the front rails. Make sure they don't cover the mortises for the bed bolts, or you are going to be in trouble. Now bolt the front rails to the two ends (no glue necessary). Rub a little Vaseline or grease on the threads first because after your bench is together you want to seal up those mortises with hot-melt glue. The Vaseline will ensure your bolts will turn for years to come.

Screw the cleats to the top of the upper side rails. Then drill oval-shaped holes in the cleats that will allow you to screw the top to the base. Now screw the seven slats to the ledgers.

Finishing the Top

Before you attach your top, it's best to drill your dog holes and attach the vise. Lay out the location of the two rows of dog holes using the diagram. I made a simple jig to guide a $\frac{3}{4}$ " auger bit in a brace and bit. The jig is shown in action in the photo above.

Now position your vise on the underside of the top and attach it with the bolts provided by the manufacturer. This Czech-made vise is of surprising quality, with a heavy-duty Acme-thread screw. The only downside to the vise is you are going to

have to make your own wooden face. I must confess I didn't have enough wood left over from my 2 x 8s to make the face. So I made it from a small piece of scrap from another project. You'll need to drill three holes in the wooden face so it fits over the bars, but this is pretty self-evident when you pull the vise out of the box. All the European benches I've seen have a bead cut on the edges. I'm not one to argue with tradition, so I used a beading bit in a router table to cut beads on mine, too.

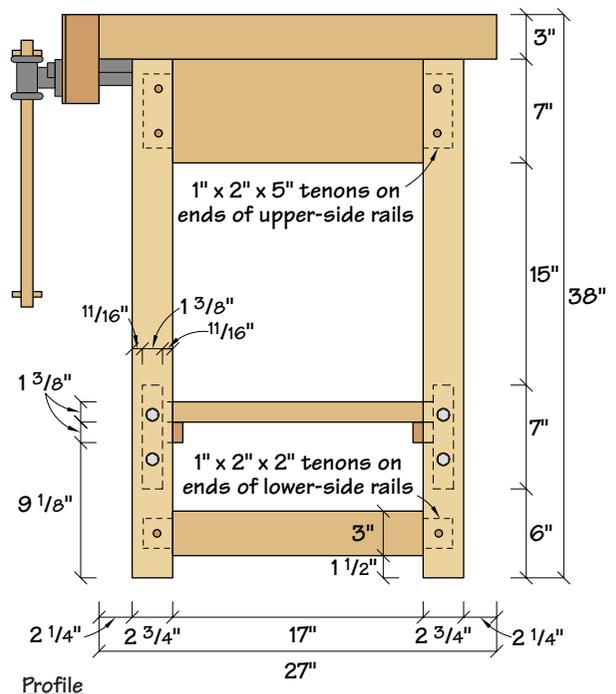
Make the vise's handle from a length of 1" -diameter oak dowel. My handle is 20" long, which is just the right length to miss whacking me in the head at every turn. I'm a tall guy, so you might want to make yours a bit shorter.

You are now almost done. It's necessary to flatten the top. Use "winding sticks" to determine if your top is flat.

Winding sticks are simply identical, straight lengths of hardwood. Put

one on one end of the top and the other on the far end. Now crouch down so your eye is even with the sticks. If your top is flat, the sticks will line up perfectly. If not, you'll quickly see where you need work. Use a jack plane to flatten the high spots. Then sand your top and rag on a couple coats of an oil/varnish blend on the base and top.

With the bench complete, I was pleased with the price and the time it took, which was about 30 hours. However, I'm now itching to build a cabinet beneath the bench and to add a leg jack for planing the edges of long boards. Maybe I'll get to that next issue, or maybe I'll let a future granddaughter take care of those details. **PW**



\$175 WORKBENCH

No.	Item	Dimensions T W L	Comments
1	Top	3" x 27" x 70"	
4	Legs	2 $\frac{3}{4}$ " x 2 $\frac{3}{4}$ " x 35"	
2	Front rails	1 $\frac{3}{8}$ " x 7" x 49"	1" TBE
2	Upper side rails	1 $\frac{3}{8}$ " x 7" x 21"	2" TBE
2	Lower side rails	1 $\frac{3}{8}$ " x 3" x 21"	2" TBE
2	Ledgers	1 $\frac{3}{8}$ " x 1 $\frac{3}{8}$ " x 47"	
7	Slats	1 $\frac{3}{8}$ " x 3" x 18 $\frac{1}{2}$ "	
2	Cleats	1 $\frac{3}{8}$ " x 1 $\frac{3}{8}$ " x 17"	

TBE= Tenon, both ends



Under- the- Table **Saw** **Cabinet**

The first secret to creating a pleasant, productive woodshop is to get rid of your power tool stands. I mean that sincerely. Unless you pay a zillion dollars for top-of-the-line tools, the stands that come with most woodworking machines are engineering afterthoughts. The dead space beneath them wastes one of the most precious commodities in your workshop: space to work.

So the second secret is to replace each stand with something that does more than hold the tool up in the air. With a little ingenuity, you can create a stand that provides convenient storage for accessories, additional work surface, dust collection, and maybe even holds a second tool. It doesn't have to be a piece of fine cabinetry — a plywood box with some shelves and drawers is infinitely more useful than those skinny metal legs that come with most power tools.

The cabinet that cradles my table saw shows some of the possibilities. Although its odd shape makes it look complex, it's built up from three simple boxes. The largest box (the base) has a few shelves where I store the larger accessories. It also serves as a dust collector. The table saw rests over a cut-out in the top of the box. Wood chips fall down through this cut-out, slide down an inclined board, and are whisked away through a shop vacuum hook-up.

The box on the left side holds frequently used accessories: push sticks, saw inserts and a miter gauge. A notch in the sides of this box keeps my saw fence ready when I'm not using it. The box on the right has a few drawers where I keep stuff I don't use as often: saw blades, a dado cutter, a moulding head and some alignment tools.

I replaced the saw extension on each side of the table saw with the cabinet tops. These tops are

Oodles of storage, built-in dust collection, doubles as a huge router table — what more could you want?



To make the odd-shaped cabinet, I attached three plywood boxes to each other. Each box has shelves and drawers for storage. The base box includes a dust collector.

By Nick Engler

Nick is a contributing editor to Popular Woodworking, the author of 52 books on woodworking, and an inventor of woodworking tools, jigs and fixtures. His most recent project, a flying full-size replica of the Wright Brother's 1902 glider, is making its rounds to schools and museums across the country.



The saw cabinet offers plenty of storage, even a place to keep the fence when it's not in use.

made from medium density fiberboard (MDF) and covered with plastic laminate to make them more durable. The right top is a shade over 4-feet long to accommodate my saw's Unifence and to increase my ripping capacity. There's also a cut-out in this top that holds a router, making the saw stand double as the mother of all router tables.

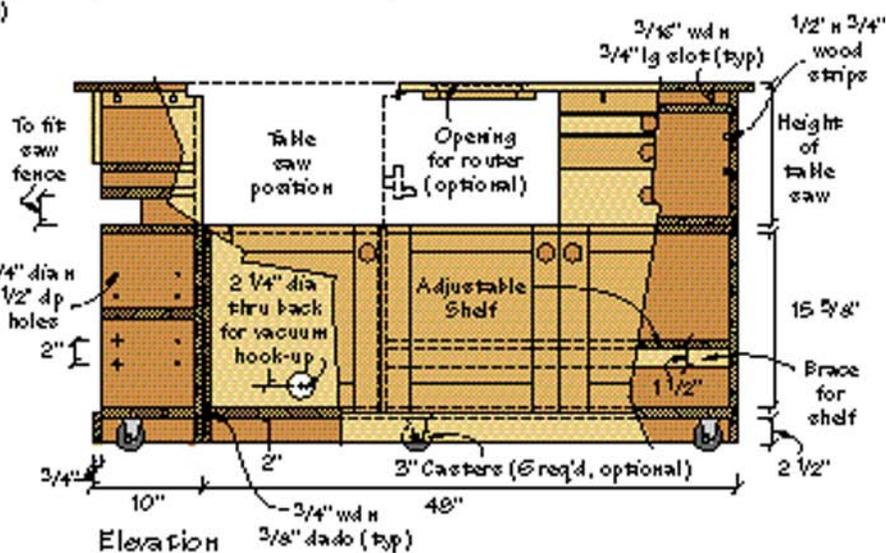
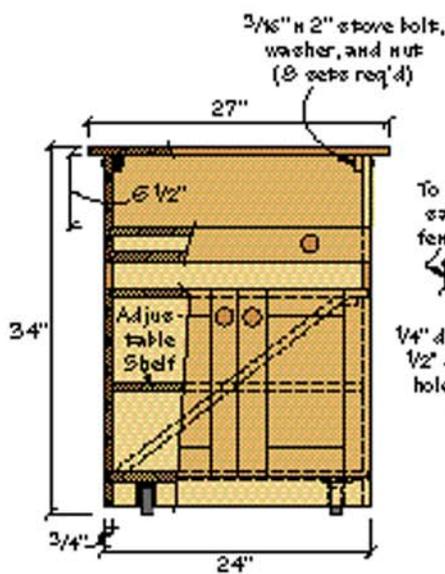
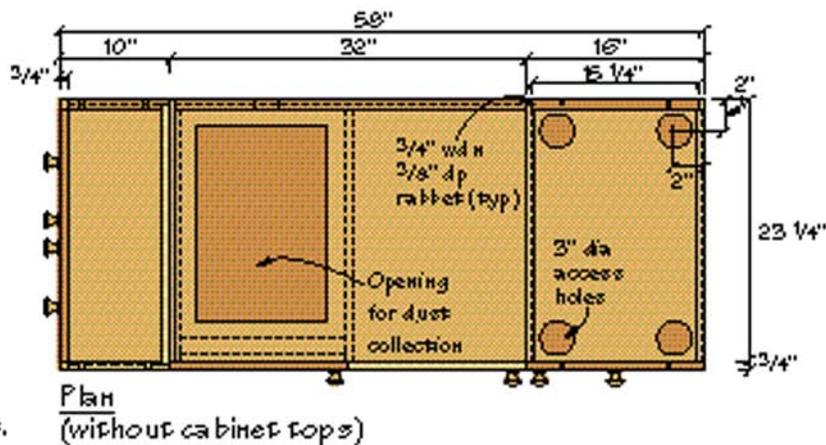
For all the capability and convenience that a homemade tool stand like this offers, it's not a difficult project to build. The first step is to adjust the size of the cabinet to your table saw. The dimensions shown here are just suggestions. Start with the most important dimension: the height of the saw table above the floor. I made this cabinet to hold the saw table at 34", but

you may prefer it a little higher or lower. Also decide whether or not you need your saw to be mobile. I need the mobility, so I mounted the cabinet on 3" swivel casters. Without the casters, I would have made the cabinet a little taller.

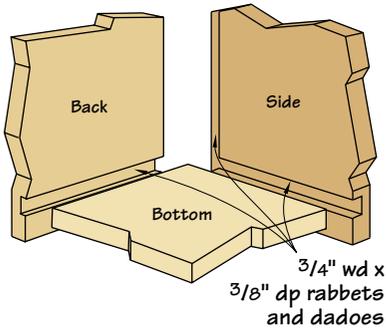
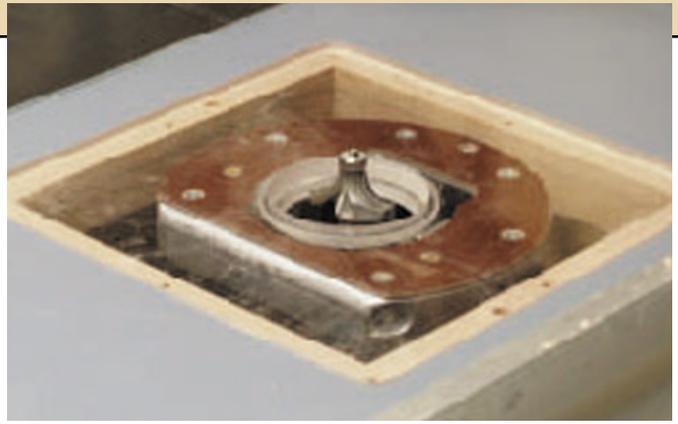
The joinery is simple and straightforward. The plywood box parts interlock

with a few dadoes and rabbets, as shown in the Box Joinery Detail (right). This makes a strong, solid construction.

The doors are mounted with "overlay" cabinet hinges, covering the front edges of the boxes. I made frame-and-panel doors because I like their looks, but you don't have to get that fancy. Simple slabs of ply-



The right cabinet top has a cut-out for a router, letting the saw stand double as a router table. For routing operations, I bolt a router table fence to the saw fence (right).



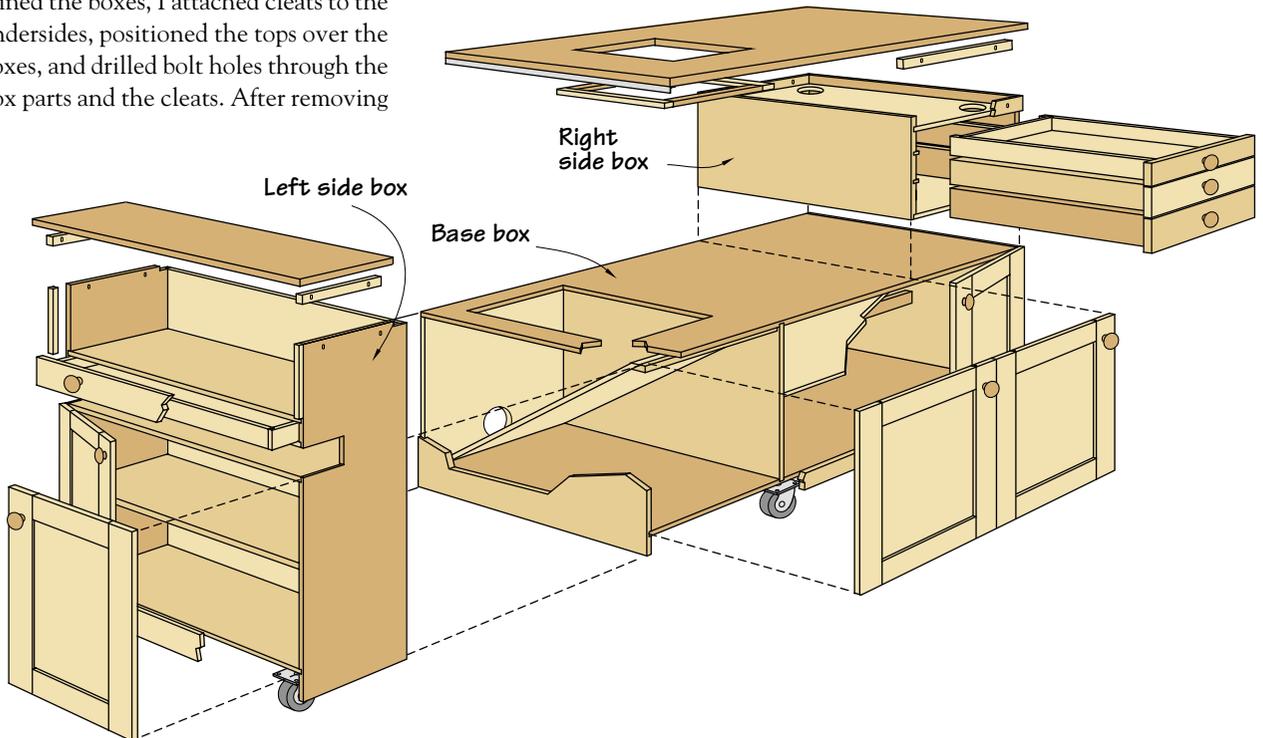
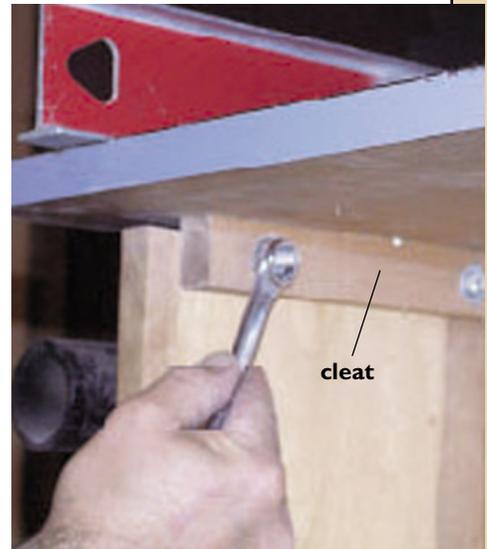
Box Joinery Detail

wood make fine doors.

The drawers slide on fixed plywood shelves or wood strips mounted to the sides of the boxes — no hardware required. Each drawer is a small box, assembled with rabbets, dados and grooves. The drawer faces are made to cover the front edges of the boxes, just like the doors.

The only joinery in this project that requires any real finesse is where the cabinet tops join the saw and the cabinet. I recycled the hardware that secured the saw's extension wings to attach the cabinet tops to the table saw. Where the tops joined the boxes, I attached cleats to the undersides, positioned the tops over the boxes, and drilled bolt holes through the box parts and the cleats. After removing

the tops, I enlarged the holes in the boxes to make vertical slots. The slots let me adjust the tops a fraction of an inch so I can get them perfectly level with the work surface of the table saw. The 3" diameter access holes in the top of the right box let me reach the bolts when I perform this adjustment. **PW**



Shaker Bench



Four boards and a little space along a wall is all you need for this cozy bench for two.

With nothing more than wedged tenons and some good engineering, this is a phenomenally strong bench. The wedged tenons create a splayed dovetail effect that completely locks this bench together. I built this bench using only The Little Shop Mark II, a workshop on wheels that uses only \$1,000 in tools.

Begin construction by cutting out the four boards according to the Schedule of Materials. The extra length on the stretcher and legs is to accommodate a little extra length on the tenons for trimming.

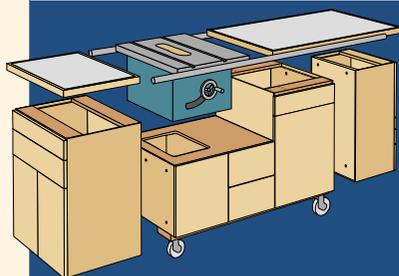
After cutting and cleaning up the tenons, lay out and cut the through-mortises, which are angled to accommodate the wedged tenons. Cut the mortises to fit right over the tenons. To lay out the arc on the stretcher, drive a

nail into the top of the arc at the center of the board. Then drive a nail into the starting point of both ends of the arc, as close to the edge of the board as possible. Take a strip of wood approximately $\frac{1}{8}$ " x $\frac{1}{2}$ " x 36" and bend it into an arc between the nails and trace a line on the stretcher. Remove the nails, cut out the arc and clean up the edge with a drawknife.

Now make the cutouts in the end panels. Lay them out according to the diagram, then cut them out with a coping saw. Make some relief cuts into the waste side to make cutting it out a little easier.

Once you have all the joinery fit, it's time to get ready to assemble the bench. This is a completely clamp-free glue up. The wedges driven into the tenons act as the "clamps" to

by Jim Stuard



WHAT IS THE LITTLE SHOP MARK II?

The Little Shop That Could Mark II is a rolling workshop on wheels that contains only \$1,000 in tools. It was featured in the September 1999 issue of *Popular Woodworking*. And though we're sold out of that issue, you can see the plans for this rolling shop on our website (www.popularwoodworking.com) or you can pick up a copy of the new book "25 Essential Projects for Your Workshop" (Popular Woodworking Books) that features complete plans for the Little Shop.

Photo by Al Parrish

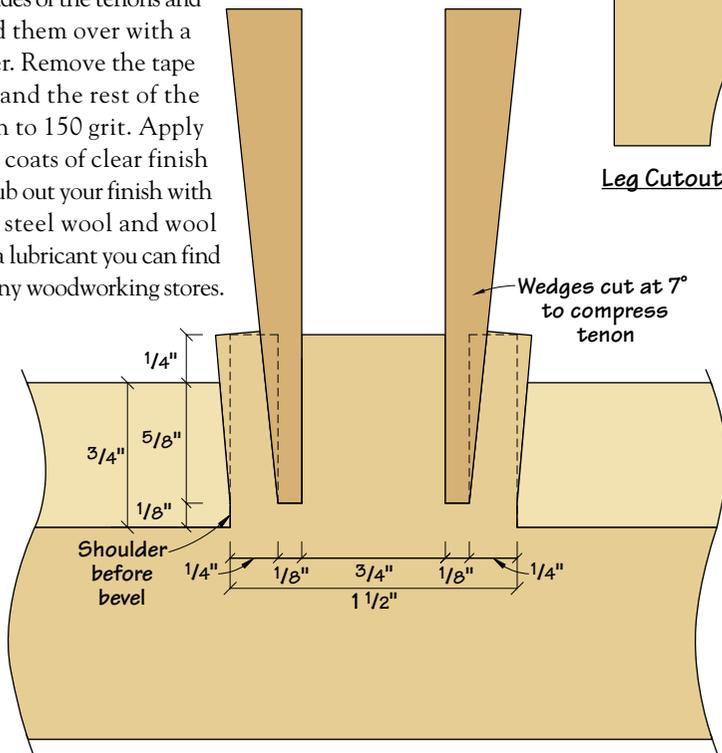


hold the entire bench together. The wedges are cut at an angle wider than the 5° of the mortise because the wedge itself becomes compressed when driving into the tenon. This compression takes away some of the wedges' ability to spread the tenon. That's why you make wedges with a 7° taper. This yields a good spread on the tenon during assembly.

Now is the time to test a set of wedges in a joint. Using no glue, assemble a joint. Tap in a couple of wedges and see if they completely spread a joint apart before bottoming out in the tenon slot. If they leave a little room, cut a little off of the wedge's narrow end and taper it to fit the top of the slot accordingly. This gives a little more play to spread the tenon apart. Gently disassemble the dry-fit joint and proceed to glue up the bench and drive home the wedges with glue on them. It helps to wait a bit to clean up the squeezed-out glue. This lets it get a "skin" that keeps the mess to a minimum. Clean up with a chisel and a damp rag.

After cutting the tenon a little proud, mask off the tenon for sanding by taping around the entire tenon with two widths of masking tape. The tape keeps you from sanding a depression in the top around the tenon. Chisel and plane an angle on all four sides of the tenons and round them over with a sander. Remove the tape and sand the rest of the bench to 150 grit. Apply three coats of clear finish and rub out your finish with some steel wool and wool wax, a lubricant you can find at many woodworking stores.

PW



Wedge Detail



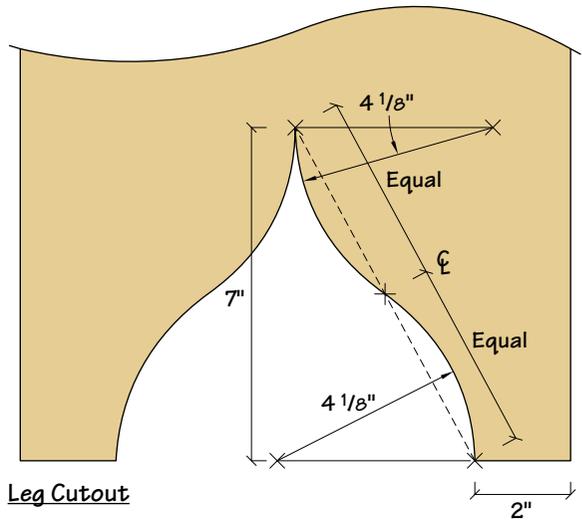
Glue up Your Panels

Using lumber from a friend's cherry tree that had been cut down, milled and air-dried, I glued up two boards to make the top and ends for this bench. Some scraping of the joint is required after gluing. Try to arrange your boards so the joint between them is invisible.

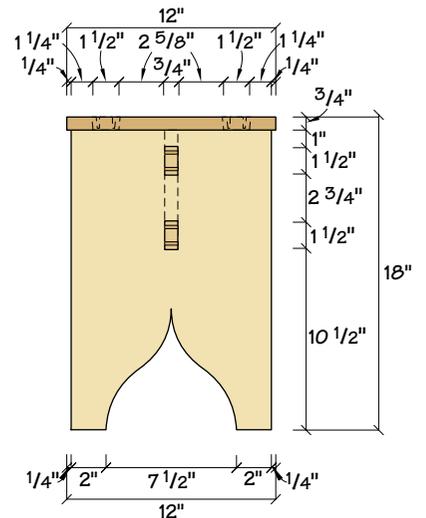


Cutting Tenons

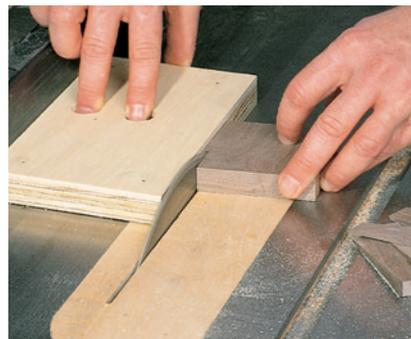
Cut the tenons to the actual width on the table saw. Set the blade to 1" high, defining the length of the tenons. After marking the depth with a gauge, cut the waste out from between the tenons. Set the saw to 7/8" high for cutting the slots that accept the wedges used to hold the table together. See the diagram for the actual size of the outer parts of the tenon. Use a backing board on your miter gauge to hold the boards upright



Leg Cutout



Profile



Routing a Shoulder

Next, set up the router table with a $\frac{1}{4}$ " straight bit to clean up the shoulders of the tenons. Mark on the router table fence where you need to stop and start each cut and gently push the tenon ends of the boards against the bit, missing the tenon.

Tapered Mortises

When you can press fit everything together, make a simple angle gauge to cut the 5° angle on the narrow widths of the mortises. The 5° angle widens the top of the mortise by about $\frac{1}{8}$ ". Split this measurement and mark both sides of the mortise, with a $\frac{1}{16}$ " offset, for setting the angle gauge. Before chiseling the angle, take a small saw and cut the sides of the mortises to the marks, reducing tearout. Clamp the gauge in place and gently chisel out the angle on the mortise sides. The angle shouldn't go completely to the other side of the mortise. This leaves a softer bend for

the tenon to make (see diagram), thereby reducing cracking — something you have to be careful about in a brittle wood such as cherry.

Wedges

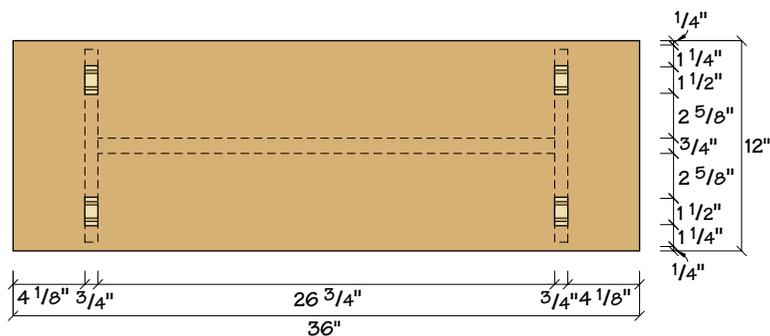
The wedges are cut on the table saw using a simple jig (see diagram below). The stock is $\frac{3}{4}$ " x 6" x 3". That means the grain direction is in the 3" dimension. Make a simple jig to hold the wedge stock while cutting on the saw.



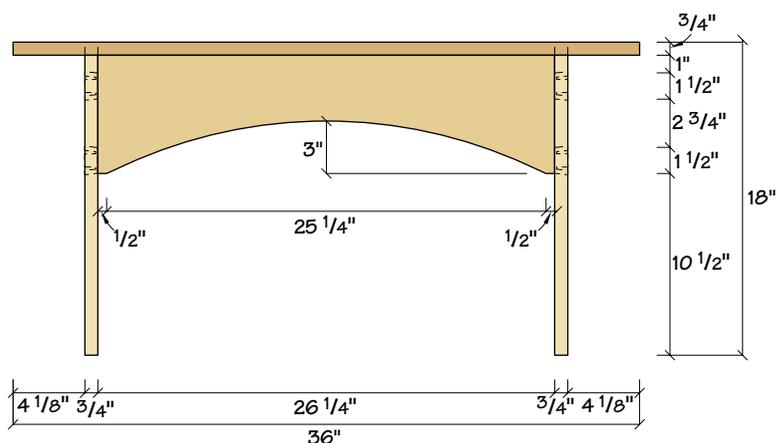
SHAKER BENCH

No.	Item	Dimensions T W L	Material
1	Top	$\frac{3}{4}$ " x 12" x 36"	Cherry
2	Ends*	$\frac{3}{4}$ " x $11\frac{1}{2}$ " x $18\frac{1}{4}$ "	Cherry
1	Stretcher**	$\frac{3}{4}$ " x 6" x $28\frac{1}{4}$ "	Cherry
16	Wedges	$\frac{3}{4}$ " x $\frac{1}{2}$ " x 3"	Walnut

* $\frac{1}{4}$ " added to length for trimming of tenon
 ** $\frac{1}{4}$ " added to both ends for trimming of tenon



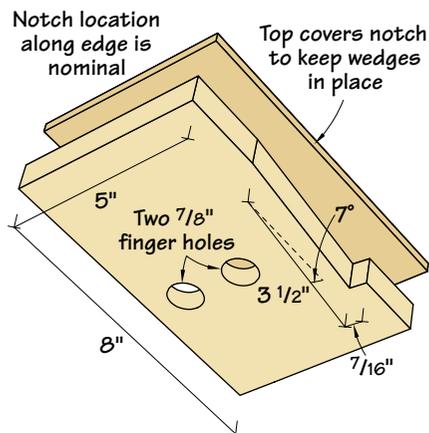
Plan



Elevation

Trimming Tenons

When the glue is dry and cleaned up, make a template out of the cover from a steno pad. The front and back will do. Just tape them together and cut out a couple of holes for the tenons to come through. The more difficult set of tenons to reach are the ones below the top. Set your template up for those. Lay the template over the tenons and cut them flush with the template.



Wedge-cutting jig, shown from below

Fein Multi-Master Sander

I was first introduced to the Fein Multi-Master tool at the time I was learning about all the other Fein tools, and frankly, I was baffled. Why was a company with a quality reputation like Fein selling a “detail” sander? Every other name brand “detail” sander I had ever used was a tool for hobbyists that seriously underperformed. And while a good idea, these “detail” sanders were poorly executed. As a category, I had written them off.

Then there was the Fein “Triangle Sander,” as it was then called. It removed material aggressively. It was powerful, yet felt good (even in my small hand) and didn’t vibrate to the point of numbness after long sanding sessions. Incredibly, it did lots more tricks in addition to sanding. It could cut numerous thin materials, including wood, plastic, vinyl flooring and drywall. It could aggressively scrape paint, be used as a rasp, even remove grout for tile work and cut away hardened glazing compound when replacing broken windows.

Of course, I had only read about all these other functions when I decided to buy one myself. I had used one in our shop here at work only for sanding. But now I was facing some remodeling work at home as well as some woodworking projects that were perfectly suited to this multi-purpose machine. Over the past three years at home I’ve put my Multi-Master through its paces: scraping multiple layers of paint (I live in an 1870s Victorian), cutting grout and sanding what could be a mile worth of mouldings.

This German-made little sanding marvel is powered by a 1.5-amp motor with a rated output of 160 watts. The tool features a variable-speed feature that is especially handy when using some of the dozens of attachments made for the tool.

The Multi-Master comes with a standard sanding pad designed for hook-and-loop or pressure-sensitive-adhesive backed

sandpaper, 10 sanding sheets each of 60, 80 and 120 grit sandpaper, a saw blade and rigid scraper. The generous rubber power cord is 16 feet long. It also comes with an Allen wrench and locking screw sets for securing the tools to the machine.

An additional accessory is Fein’s dust removal attachment that actually works and doesn’t get in the way of sanding. In all, there are more than 40 attachments available from Fein Tools for the Multi-Master, not including various sanding grits. Sandpaper runs from 36 grit to 400 grit and is available in either pressure sensitive adhesive (PSA) or hook and loop.

OK, so what about price? All this capability does have a cost. The Multi-Master with aforementioned standard accessories sells for \$179 (that’s the street price). Pricy? Yes, but the way I look at it I’ve got a lifelong tool that does so many different jobs extremely well that it’s like buying several dedicated tools. And because most of the jobs it does are jobs I hate (hand sanding in tight spaces and scraping paint come to mind) it’s well worth it. **PW**

— Steve Shanesy



Photos by Al Parrish

SPECIFICATIONS:

Multi-Master • MSxe 636 II

Street Price: \$179

Amps: 1.5

Oscillations: 12,000-21,000 per minute

Noise: 75dB

Sanding pad size: 3" corner to corner

Weight: 2.4 pounds

NICE FEATURES:

- Aggressive sanding with finesse, great array of attachments for many other tasks — all of which really work

- Feels good in the hand without fatigue

- Good dust collection as optional feature

- 16 foot rubber cord

RECOMMENDED MODIFICATIONS:

- A little lower price would be nice

- Tooth brush attachment a must! Just kidding

Fein: 800-441-9878, or
www.feinus.com

ABOUT OUR ENDURANCE TESTS

It's nice to know how a new tool performs, but most woodworkers also want to know how long the tool will last. Each issue we tell you about tools that have stood up to regular use in our shop for at least a year. We tell you how the tools have fared, any recommendations we have and if the tools have passed the *Popular Woodworking* Endurance Test. — David Thiel, senior editor

Hitachi FDS10DVAL Cordless Drill Kit

I first wrote nice things about this drill/flashlight set in our very first e-mail newsletter in May 1999 (visit www.popularwoodworking.com to subscribe for free). I've been using the tool since November 1998, and it still deserves a place of honor in my shop. It's not the most powerful 9.6v drill on the market, but I paid \$85 for it two years ago, and the darn thing is great.

The model FDS10DVAL has plenty of power for any household chore and everything but the most demanding workshop applications. It has all the features of a much more expensive tool, and it comes with an adjustable-head flashlight that is better than many stand-alone flashlights.

After two years of use the set is holding up well. Even after hundreds of charges, the batteries still take and hold a good charge, and the gears still perform well on all the clutch and speed settings. I've dropped the thing I don't know how many times, and I've finally managed to crack one of the battery casings, though the battery still functions fine. Though I've not had any problems with it, the forward/reverse switch seems a little fragile, and the plastic skin of the drill can be slippery in the cold or when wet. And lastly, the battery's footprint is a little small, which makes this drill tricky to balance on your bench when you set it down. Save yourself some

frustration and learn to set it down on its side instead of on the battery. In all, however, these are minor quibbles that shouldn't stop you from purchasing this set.

What should stop you from purchasing this drill is if you have unrealistic expectations. I recently read a review of this tool on the Internet by a guy who was pleased with his purchase but was disappointed with the drill's performance when using a masonry bit. Let me clear this up. No 9.6-volt cordless drill should be used with a masonry bit. To expect that of this or any other low-voltage cordless drill is just silly. However, if you're looking for a drill up to the task of drilling up to 1/2" holes in wood, driving home a good number of 2" x #8 screws, or just putting together a piece of knock-down furniture from the store, a 9.6-volt drill is a fine choice. And as 9.6-volt drills go, the Hitachi FDS10DVAL is a great performer at an amazing price.

At press time, I went on-line and found this drill/driver kit for sale at Coastal Tool (www.coastaltool.com) for \$70 plus \$5 shipping — the lowest price we've seen. **PW**

— David Thiel



SPECIFICATIONS:

Model FDS10DVAL

Drill/Driver & Flashlight

Street Price: \$70 - \$85

Battery: 9.6 volt, 1.2 amp hour (2)

RPM: 0-280/0-850

Max. torque: 130 inch-lbs.

Clutch settings: 5

Charger time: 1 hour

Weight: 3.3 lbs.

Chuck: 3/8" keyless

Brake: Yes

NICE FEATURES:

- Great price, flashlight, two batteries, two speeds, electronic brake, quality construction, only five clutch settings

RECOMMENDED MODIFICATIONS:

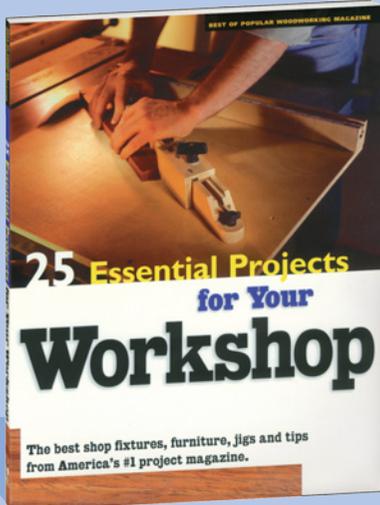
- Add a soft skin for improved grip
- Beef-up the forward/reverse switch

Hitachi: 800-706-7337, or
www.hitachi.com

adams wood

HELP YOURSELF

Create projects that really *will* help you where it matters most—in your workshop.



1-55870-541-4 • \$22.99 • #70472

Learn how to build:



Shop stools and router tables



Drill press jig tables



Table saw accessory cabinets



Roll-around assembly tables and much, much more

Designed for woodworkers of all skill levels and interest areas.



POPULAR WOOD WORKING BOOKS

Available now at your local bookstore or by calling 1-800-289-0963

Jointers

continued from page 59

ing edge, you will produce a curved edge instead of a straight one.



Our push block is a piece of 1 3/4" x 3 1/2" x 1 0/4" maple. Note the heel that drops down about 3/8" from the sole at the back.

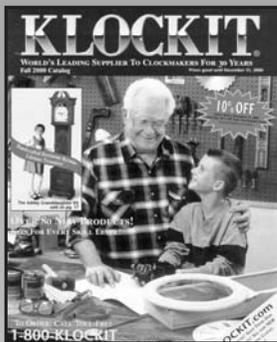
To start the edge-jointing operation, position your feet and body as you did for face jointing. Again, start with your body nearer the end of the board away from the cutterhead. Place the face-jointed side of the board against the fence. Support the back of the board that's off the table with your right hand and use your left hand to force the board down on the infeed table and against the fence. In edge jointing, more downward pressure is needed than in face jointing, especially if part of your board is hanging off the end of the infeed table.

Ease the board into the cutterhead. Once it is over the outfeed table, increase the feed rate. You can use a faster feed rate than for face jointing because so little surface is being cut. But don't go so fast as to cause tear out, especially on the final pass. Use a shuffling motion for moving both your hands and feet. Always keep one hand firmly on the board to maintain downward pressure and keep the face flat against the fence.

Some woodworkers keep both hands on the infeed side of the table until the last of the board approaches the cutterhead and then move their left hand to the outfeed side. Others, once the whole board is supported by the jointer tables, immediately place the left hand on the outfeed side and keep the right hand on the infeed side until the pass is over. I've done it both ways and either method gets the job done.

Finally, be aware of the importance of keeping the face-jointed surface flat against the fence. It's easy, especially on larger and heavier boards, to allow the board to simply rest on the edge being jointed. This, of course, will not result in an edge that's perpendicular to the face-jointed edge and will lead to problems later in your project construction. Now it's time to move on to other machining operations, which we'll cover in the next issue. **PW**

Circle #100 on Resource Directory Coupon



FREE* CATALOG!

Mention DEPT. PW20
*(Canada \$2 • Foreign \$5)

From start to finish, Klockit has it all!

- Quality Clock Kits For All Skill Levels
- Clock Components - Quartz and Mechanical
- Music Movements & Boxes
- Tools & Finishing Supplies
- Dials, Hardware, Finishing Supplies & More!
- Finished Clocks & Watches - Including the *Amazing New Atomic Time Technology!*
- Personalized Clocks

VISIT US AT
www.klockit.com

Internet Exclusive Products!
Listen to Mechanical
& Music Movements!

KLOCKIT

Department PW20
1-800-KLOCKIT
that's 556-2548

Circle #108 on Resource Directory Coupon

3395

CARTOON



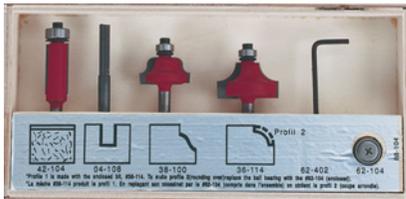
Illustrated by Bob Rech
bobrech@juno.com



#47

Submit your caption(s) for this issue's cartoon on a postcard to *Popular Woodworking*, Cartoon Caption #47, 1507 Dana Ave., Cincinnati, OH 45207 by **Feb. 16**. Winners will be chosen by the editorial staff.

The winner will receive a four-piece router bit set from Freud, including a flush trim bit, straight bit, roman ogee and beading bit, plus a bearing to convert the beading bit into a $\frac{5}{8}$ " roundover bit. The runners-up each win a one-year subscription to *Popular Woodworking*.



Sponsored by **freud**[®]



#45

"That new hammer will be just the thing for building Shaker furniture."

Dan Reeve, of Belfast, Maine, is the winner of our Cartoon Contest from the October issue and recipient of a fine set of Quick Grip clamps. The following runners-up each receive a one-year subscription to *Popular Woodworking*:

"You shouldn't be the one who's nervous, I'm the one holding the nail!"

Bobby Berry, Morris, Oklahoma

"Aren't you glad we bought the deluxe model with the anti-vibration handle?"

Scott and Diane Grant, Algona, Iowa

"That ought to give you the distressed look you want for this project."

John W. Mince Jr., Clarksville, Tennessee

visit our website at
www.popularwoodworking.com

www.osbornewood.com
OSBORNE 
Wood Products, Inc.

**Finally! 6 good reasons
to NOT hide your sofa legs.**



8116 Highway 123 North • Toccoa, GA 30577

Call for a catalog: 1-800-746-3233

Order line: 1-800-849-8876 • Español: 1-877-445-6034

Circle #110 on Resource Directory Coupon

4 Essential Tools in 1



PLANER – Dimension your own lumber to meet your exact specs without paying custom milling fees.



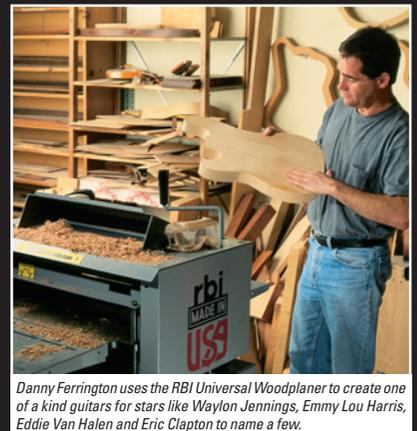
SANDER – Replace hours of tedious hand sanding with one pass.



MOLDER – Create special moldings for your home from over 500 standard patterns, or create your own custom patterns.



GANG SAW – Rip lumber accurately to your specs with a finish that's as smooth as a joined edge.



Danny Ferrington uses the RBI Universal Woodplaner to create one of a kind guitars for stars like Waylon Jennings, Emmy Lou Harris, Eddie Van Halen and Eric Clapton to name a few.

Call Toll Free and get a Free Fact Kit

1-800-487-2623

rbiindustries, inc.

PO Box 369 • Harrisonville, MO 64701

www.rbiwoodtools.com



K383

IMPORTANT: Cover removed to show woodplaner components. Do not operate machine without cover.

No Risk 30 Day Trial

1,000 Tools, One Price

Economic research proves that all tools—from a screwdriver to a drill press—cost the same.

Of all the words in the English language, there are few that are as open to interpretation as the word “economy.” Countless institutes of higher learning offer undergraduate programs focused on “Economics.” They mold young minds to consider every issue in terms of cost/benefit relationships and collective value. After four years, if the student’s mind has become sufficiently moldy, they are invited to pursue a graduate degree in the field.

Now, you might ask what Economics has to do with woodworking. I propose that outside of the world of International Banking and High Finance, there is no other group more financially polarized than woodworkers. We have our own little micro-economic universe where we vacillate somewhere between two economic extremes. A less sensitive observer might call these boundaries “The Cheap” and “The Exorbitant.” However, in the interest of unity, we’ll call them the “Tool for a Day” and the “Tool for a Lifetime” philosophies.

Advocates of the “Tool for a Day” approach will argue that the quality of the tool is secondary to the skill of the craftsman. After all, an artisan of sufficient talent should have no problem building a Chippendale Highboy using nothing more than popsicle sticks and a steak knife.

The “Tool for a Lifetime” crowd takes a different view of hardware purchases, living and dying by the mantra, “You get what you pay for!” Any tool that has the honor of entering their shop must not only be of the very highest quality, but also have an unquestionable pedigree, the proper paint scheme and a degree from Stanford.

As I said before, most of us drift between these two extremes — our buying habits depending on the reason for the purchase. When buying a tool for a job we love, we’ll slide toward the exorbitant end

of the scale, perhaps buying the “ultimate jigsaw,” knowing it will spend years as a faithful servant. On the other hand, when it

comes to scraping the peeling paint from the front door, we’re more likely to use the license plate off the family station wagon before coughing up the 75 cents necessary to buy a scraper. It is the nature of man.

Now, as my wife, Helga, will tell you (and anyone else within a five-mile radius), I am a GIANT in the field of spending money at the hardware store. And by combining my vast personal experience with extensive research (which included looking up the word “economy” in the dictionary), I believe I have unraveled the mysteries surrounding the economics of tool buying. I have chosen to give it the modest title: The Grand Unification Theory of Hardware Acquisition.

It is my supposition that, in the end, all tools cost the same price, and that price is \$1,500. Now, like gravity and the notion that the world is round, I realize that this idea is ahead of its time and it will be met with resistance. Allow me to assure you that I arrived at this conclusion in a sober state, and I can offer convincing evidence of its veracity.

First, consider the table saw — the king of shop tools. For about \$1,500 a woodworker can buy a Delta Unisaw. Our intrepid buyer can rest assured this tool will last him the rest of his natural life — regardless of any advances in medical technology. If, on the other hand, he purchases a \$500 contractor’s saw, he should expect to replace it two more times during his life. Correspondingly, those buyers whose wives will only allow them to invest in a \$150 table



Illustration by Jim Benton

saw are destined to buy 10 of them before they punch their timecards for the last time.

I know what you’re thinking, “Sure, your theory works fine for the big stationary equipment, but there’s no way anyone is going to spend \$1,500 on a hammer.” *Au contraire*, that’s the beauty of the system. The smaller the tool, the more likely you are to misplace it — forcing you to buy another. The Department of Defense has recognized this principle for years. Consequently, it has taken a proactive stance by paying the entire cost of hammers upfront. Coincidence? I don’t think so.

Of course, as with all advances in human enlightenment, there is a dark side.

I arrived home the other night to find Helga sitting comfortably in front of a shiny new sewing machine. Being an expert in assessing the value of ANYTHING based on its number of buttons, I realized this “tool” was roughly the same price as a fully equipped sport/utility vehicle. Nonetheless, being a glutton for punishment, I had to ask....

She just smiled and said, “Based on the conventional wisdom, it’s safe to assume your granddaughter will be using THIS to make HER granddaughter’s wedding dress....” It was clear her logic would be indisputable. So I poured a drink and retired for the evening, comfortable in the knowledge that my philosophy was right. I was broke, but I was right. **PW**

Walt Akers can be found continuing his economic research at the hardware store in Seaford, Virginia.