CELEBRATING 25! YEARS

BONUS SECTION: THE BEST & WORST JOINTS FOR CASEWORK

THE ANVIL TEST – A SMASHING TEST OF 10 JOINTS LEAVES 1 SURVIVOR

DECEMBER 2005
ISSUE #152

POPULAR Woodworking

Learn How ▪ Discover Why ▪ Build Better

BEST DRILL, BEST PRICE

Shocking Truths About 14.4v Drills

You Don't Know Shaker

Discover How They Really Built Things

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- 11 Top Tools of 2005
- Turn 2 Holiday Ornaments

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THE ULTIMATE 10" CONTRACTOR STYLE TABLE SAWS

W/ CAST IRON WINGS & TABLE

- Motor: 2 HP, 110V/220V, single-phase
- Precision ground cast iron table w/ extension wings
- Table size w/ wings attached: 39⅝" x 27"
- Arbor diameter: ⅝" • Rip capacity: 30"
- Cutting capacity: 3⅛" @ 90°, 2⅛" @ 45°
- Approx. shipping weight: 298 lbs.

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INCLUDES SHOP FOX® ALUMA-CLASSIC™ FENCE

Z SERIES

G0444Z RIGHT-TILT
REG. ~~$575.00~~
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G0576 LEFT-TILT
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$78 shipping ANYWHERE IN LOWER 48 STATES

10" LEFT TILTING SUPER HEAVY-DUTY TABLE SAW

- Motor: 3 HP, 220V, single-phase, 3450 RPM
- Precision ground cast iron table
- Table size with wings: 27" x 40⅛"
- Arbor: ⅝" (accepts dado blades up to 13/16")
- Cutting capacity: 8" left, 26" right
- Max. depth of cut: 3" @ 90°, 2⅛" @ 45°
- Approx. shipping weight: 465 lbs.

INCLUDES SHOP FOX® CLASSIC™ FENCE & CAST IRON MITER GAUGE

G1023S
REG. ~~$955.00~~
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12" PROFESSIONAL CABINET SAWS

- Motor: 5 HP, 220V, single-phase
- Precision ground cast iron table
- Table size with wings: 30¼" x 48"
- Dual arbors: ⅝" & 1"
- Max. rip capacity: 50"
- Max. depth of cut: 4" @ 90°, 2⅝" @ 45°
- Cast iron miter gauge
- Dust port: 4"
- Approx. shipping weight: 613 lbs.

FEATURES NEW SHOP FOX® LONG REACH FENCE

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G5959Z LEFT-TILT
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8" x 65" SUPER HEAVY-DUTY JOINTER W/HANDWHEELS

8" JOINTER BLOWOUT!

- Motor: 1½ HP, 110V/220V, single-phase
- Precision ground cast iron table
- Cutterhead knives: 3 HSS
- Cutterhead diameter: 3"
- Cutterhead speed: 5000 RPM
- Max. depth of cut: ½"
- Magnetic safety switch
- Heavy-duty center mounted fence
- Approx. shipping weight: 451 lbs.

MADE IN ISO 9001 FACTORY!

FREE PAIR OF SAFETY PUSH BLOCKS!

G1018HW ~~$765.00~~
CLOSEOUT PRICE
ONLY $595.00
WHILE THEY LAST – NO BACKORDERS!

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8" x 75" JOINTER

8" JOINTER BLOWOUT!

- Motor: 2 HP, 110V/220V, single-phase,TEFC
- Precision ground cast iron table (includes two 5" extensions)
- Cutterhead speed: 5500 RPM
- Max. depth of cut: ½"
- Magnetic safety switch
- Heavy-duty center mounted fence
- Approx. shipping weight: 489 lbs.

INCLUDES JACK SCREW & ACCESSORY SPRING KIT PLUS FREE PAIR OF SAFETY PUSH BLOCKS!

MADE IN ISO 9001 FACTORY!

G0500
4 BLADE CUTTERHEAD
~~$875.00~~
CLOSEOUT PRICE
ONLY $695.00

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WHILE THEY LAST – NO BACKORDERS!

15" PLANER WITH CLOSED STAND

15" PLANER BLOWOUT!

- Motor: 3 HP, 220V, single-phase, 3450 RPM
- Precision ground cast iron table
- Table size: 14⅞" x 20"
- Max. cutting height: 6⅛"
- Max. cutting depth: ⅛"
- Feed rate: 16 & 20 FPM
- Cutterhead knives: 3 HSS
- Cutterhead speed: 5000 RPM
- Cutterhead diameter: 3"
- Magnetic safety switch
- Dust port: 4"
- Approx. shipping weight: 555 lbs.

FRONT & REAR 3 ROLLER EXTENSION TABLES

G0551 ~~$745.00~~
CLOSEOUT PRICE
ONLY $650.00

$130 shipping ANYWHERE IN LOWER 48 STATES

WHILE THEY LAST – NO BACKORDERS!

OSCILLATING SPINDLE / 12" DISC SANDER

- Motor: 1 HP, 110V, single-phase,TEFC
- Precision ground cast iron tables
- Disc sander table: 17¾" x 10", tilts 45°
- Oscillating sander table: 14½" x 14½", tilts 45°
- Spindle sizes: ¼", ⅝", 1½" & 2"
- Spindle oscillation: 60 SPM
- Spindle speed: 1725 RPM
- Stroke length: 1"
- Approx. shipping weight: 180 lbs.

MADE IN ISO 9001 FACTORY!

EASY CHANGE SPINDLE SANDPAPER SLEEVES

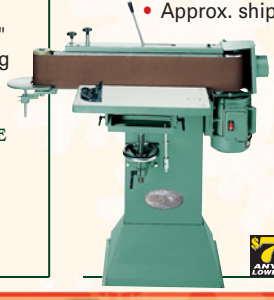
G0529
ONLY $450.00

$58 shipping ANYWHERE IN LOWER 48 STATES

6" x 80" FLOOR MODEL EDGE SANDER

- Motor: 1½ HP, 110V/220V, single-phase,TEFC
- Precision ground cast iron table size: 22" x 10½"
- Table tilt: 60° - 0° - 60°
- End table size: 4¼" x 8"
- Belt speed: 1800 FPM
- Belt tilt: 90°
- Graphite coated platen: 6¾" x 29¾"
- Approx. shipping weight: 254 lbs.

ADJUSTS FOR HORIZONTAL FACE SANDING



INCLUDES ADJUSTMENT KNOBS, QUICK BELT RELEASE, BALL BEARING OPERATION AND BUILT IN DUST HOOD

G1140
ONLY $550.00

$78 shipping ANYWHERE IN LOWER 48 STATES

24" DRUM SANDER

- Drum motor: 5 HP, 220V, single-phase
- Conveyor motor: ¼ HP
- Feed rate: 11 FPM
- Max. stock thickness: 4¼"
- Drum size: 6"
- Computer balanced drums
- Dust ports: (2) 4"
- Approx. shipping weight: 442 lbs.

INCLUDES A HEAVY-DUTY RUBBER CONVEYOR BELT!

H5037 OPTIONAL HOOK & LOOP CONVERSION KIT AVAILABLE

G1066R
REG. ~~$1325.00~~
SALE $1250.00

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FULL YEAR WARRANTY GRIZZLY Power Tools & Machinery

14" INDUSTRIAL BANDSAW

14" BANDSAW BLOWOUT!

- Motor: 1½ HP, 110V/220V, single-phase, TEFC
- Precision ground cast iron table
- Table size: 19¾" x 14⅜" x 1½"
- Max. cutting height: 8⅛"
- Blade length: 100½"
- Blade size: ⅛" - ¾"
- Blade speed: 3000 FPM
- Extruded aluminum fence
- Dust port: 4"
- Approx. shipping weight: 215 lbs.

MADE IN ISO 9001 FACTORY!

BALL BEARING BLADE GUIDES INCLUDED!

G0570 ~~$695.00~~
CLOSEOUT PRICE
ONLY $595.00

$58 shipping ANYWHERE IN LOWER 48 STATES

WHILE THEY LAST – NO BACKORDERS!

17" HEAVY-DUTY BANDSAW

MADE IN ISO 9001 FACTORY!

- Motor: 2 HP, 110V/220V, single-phase, TEFC, 1725 RPM
- Precision ground cast iron table
- Table size: 17" x 17" x 1½"
- Max. cutting height: 12"
- Blade length: 131½"
- Blade sizes: ⅛" - 1"
- Blade speeds: 1600 & 3300 FPM
- Dust port: (2) 4"
- Approx. shipping weight: 342 lbs.

INCLUDES ½" BLADE, FENCE & HEAVY-DUTY MITER GAUGE

G0513
REG. ~~$845.00~~
SALE $775.00

$78 shipping ANYWHERE IN LOWER 48 STATES

21" SUPER HEAVY-DUTY BANDSAW
WITH TILTING GEARED TABLE

- Motor: 3 HP, 220V, single-phase, TEFC
- Precision ground cast iron table
- Table size: 29½" x 20¾" x 1⅞"
- Max. cutting height: 14"
- Blade length: 165"
- Blade size: ¼" - 1⅜"
- Blade speed: 4600 FPM
- Cast iron fence
- Dust port: (2) 4"
- Approx. shipping weight: 684 lbs.

INCLUDES 1" BLADE & QUICK CHANGE BLADE RELEASE/ TENSIONER LEVER

NEW FOR 2005!

MADE IN ISO 9001 FACTORY!

G0566
INTRODUCTORY PRICE
ONLY $1595.00

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20" PLANER BLOWOUT!

20" PLANER

- Cutterhead motor: 3 HP, 220V, single-phase
- Precision ground cast iron table size: 25¾" x 20"
- 2 speed automatic feed: 18 & 23 FPM
- Max. cutting height: 8⅝"
- Max. cutting depth: ⅛"
- Cutterhead knives: 4 HSS
- Cutterhead speed: 5500 RPM
- Cutterhead diameter: 3¼"
- Approx. shipping weight: 776 lbs.

Popular Woodworking TOOL BUYING GUIDE Editor's Choice

1999 WOOD MAGAZINE EDITOR'S CHOICE TOP VALUE

MADE IN ISO 9001 FACTORY!

G1033 ~~$1395.00~~
CLOSEOUT PRICE
ONLY $1150.00

WHILE THEY LAST – NO BACKORDERS!

$155 shipping ANYWHERE IN LOWER 48 STATES

3 HP SHAPER

- Motor: 3 HP, 220V, single-phase
- Precision ground cast iron table
- Table with standard wing attached: 30½" x 28¼"
- Spindle travel: 3"
- 3 interchangeable spindles: ½", ¾" & 1"
- Spindle openings on table: 1⅜", 2¾", 4" & 5½"
- Spindle speeds: 7000 & 10,000 RPM
- Magnetic power switch
- Approx. shipping weight: 357 lbs.

INCLUDES MITER GAUGE & FENCE WITH HOLD-DOWN SPRINGS

G1026
REG. ~~$935.00~~
SALE $895.00

$78 shipping ANYWHERE IN LOWER 48 STATES

PROFESSIONAL SPINDLE SHAPER

- Motor: 5 HP, 220V, single-phase, TEFC
- Precision ground cast iron table size: 35½" x 28"
- Cast iron fence assembly
- Spindle travel: 3¼"
- Spindle capacity: 5"
- Spindle sizes: ¾", 1" & 1¼" x 7½"
- Spindle speeds: 3600, 5100, 8000 & 10,000 RPM
- Max. cutter diameter: 5⅞"
- Approx. shipping weight: 602 lbs.

INCLUDES CAST IRON MITER GAUGE & 4 SPRING STEEL HOLD DOWNS

G5912Z
REG. ~~$2095.00~~
SALE $2050.00

$130 shipping ANYWHERE IN LOWER 48 STATES

Z SERIES

18" WIDE-BELT SANDER

- Motor: 5 HP, 220V, single-phase
- Conveyor feed motor: ½ HP
- Elevation motor: ⅓ HP
- Sanding belt oscillation: ½" – ⅝"
- Conveyor speed: 16.4, 23, 32.8 FPM
- Max. board width: 17½"
- Max. board thickness: 6"
- Min. board length: 8½"
- Min. board thickness: ⅛"
- Surface speed of drums: 3550 FPM
- Approx. shipping weight: 1008 lbs.

MADE IN ISO 9001 FACTORY!

G0527
ONLY $4195.00

$210 shipping ANYWHERE IN LOWER 48 STATES

2 HP DUST COLLECTOR
W/2.5 MICRON BAG

- Motor: 2 HP, 220V, single-phase, 3450 RPM
- Air suction capacity: 1550 CFM
- Static pressure: 11"
- Standard bag filtration: 2.5 micron
- 6" inlet has removable "Y" fitting w/ two 4" inlets
- Impeller: 12" balanced steel, radial fin
- Height w/ bags inflated: 78"
- Bag capacity: 5.4 cubic feet
- Approx. shipping wt: 123 lbs.

Popular Woodworking TOOL BUYING GUIDE Editor's Choice

1999 WOOD MAGAZINE EDITOR'S CHOICE TOP VALUE

Readers' Choice Awards

RECEIVE A FREE G3376 2 STAGE CYCLONE SEPARATOR WITH PURCHASE OF G1029Z

MADE IN ISO 9001 FACTORY!

Z SERIES

G1029Z
REG. ~~$295.00~~
SALE $285.00

$58 shipping ANYWHERE IN LOWER 48 STATES

2 HP DUST COLLECTOR

- Motor: 2 HP, 220V, single-phase
- Air suction capacity: 1700 CFM
- Static pressure: 10"
- Filter capacity: 1 micron
- 6" inlet has removable "Y" fitting w/ three 4" inlets
- Heavy-duty steel intake
- Bag capacity: 5.4 cubic feet
- Sound rating: 74dB
- Dimensions: 31½"W x 37⅜"L x 71"H
- Approx. shipping weight: 155 lbs.

MADE IN ISO 9001 FACTORY!

3 HANDLE CONTROLLED FLAPPERS CLEAN FINE DUST FROM FILTER

G0548
ONLY $495.00

$58 shipping ANYWHERE IN LOWER 48 STATES

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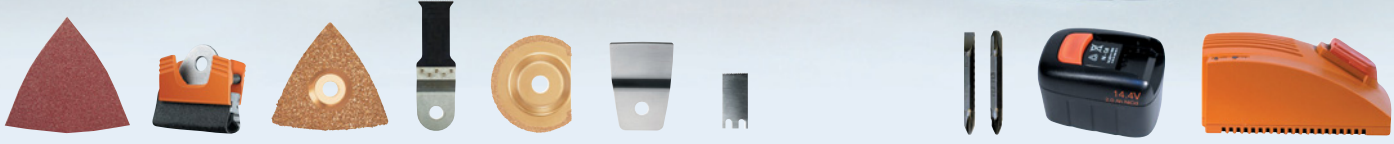
Deck your halls with the FEIN Holiday Combo Pack

Get a MultiMaster XL Kit plus a HandyMaster 14.4V Cordless Drill kit. A $520 value for only $399.



detail sand | profile sand | rasp | flush-cut | regrout | scrape | notch | drill/screw | power | recharge

Sand the halls. Scrape the deck. Regrout the kitchen. Assemble a swing set. There's no end of things you can do, when you purchase this FEIN holiday package of two. Everything you need to make your holidays bright and your home ready for company. For more information, a free brochure and a dealer near you call **1-800-441-9878** or visit us on the web at **www.feinus.com**.

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contents

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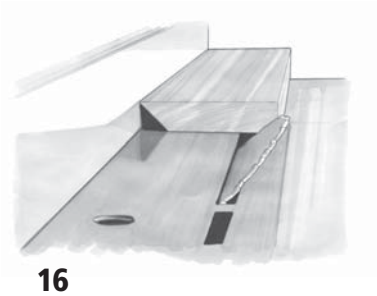
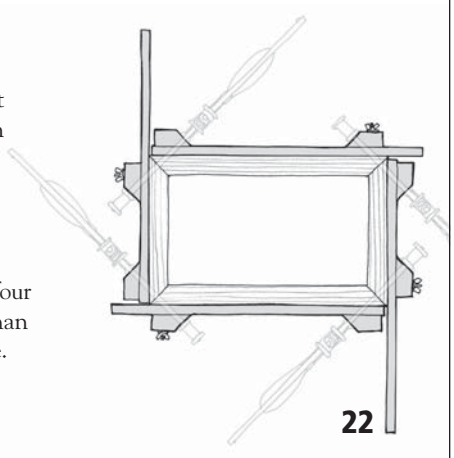
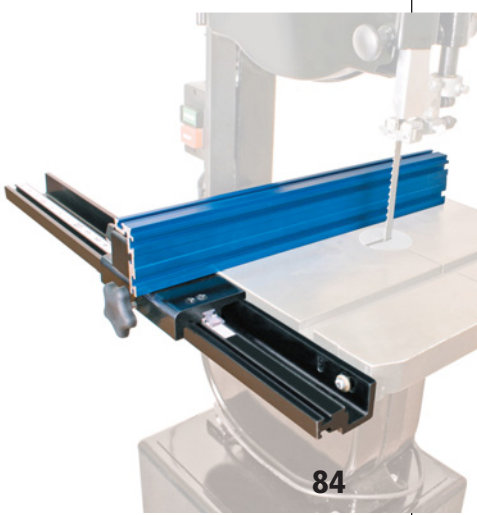
Learn How ▪ Discover Why ▪ Build Better

IN EVERY ISSUE


16


22


32


84


90


98

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ANOTHER VERY PRECISE REASON WHY DELTA MAKES WOODWORKING EASY.

Like every DELTA® tool, precision and ease of use are what this band saw is all about. The Rapid Release™ blade tension lever means a fast, simple-to-use operation that will make your band saw more accurate and last longer. Other features include a powerful 3/4 HP motor, a safe and accurate micro-meter adjustment on the lower blade guides which are angled for more precise cuts, a 4" integrated dust port and a large 16" X 16" cast iron table that tilts for beveling operations. Is today the day to add one to your workshop? Precisely. Visit deltamachinery.com for more details or to join our DELTA Owner's Group.

DELTA®

YOUR ACHIEVEMENT. OUR TOOLS.

ON THE COVER

14.4-volt drills have become lighter and cheaper recently, but do they belong in a woodshop? We investigate whether the extra power justifies the extra expense when you compare these big boys to 12v drills.

Cover photo by Al Parrish

DEPARTMENTS

PROJECTS, TOOLS AND TECHNIQUES

Forrest Blades

Quality Blades for America's Craftsmen

Serious woodworkers demand perfection. That's why so many of them choose Forrest saw blades.

Forrest quality is legendary. Our proprietary manufacturing process, hand straightening, and unique grade of C-4 micrograin carbide give you smooth, quiet cuts without splintering, scratching, or tearouts. In fact, independent tests rate our blades as #1 for rip cuts and crosscuts.

Forrest saw blades are simply the best that money can buy. They're made in the USA by the same family-owned business that's been producing and sharpening them for over 55 years. And they're backed by a 30-day money back guarantee. It's no wonder that serious woodworkers give them such high praise!

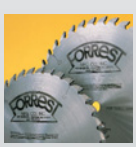
"Your blades are without question the best by miles, and I have tried them all."
Bob Jensen–Fridley, MN

"These are the finest blades I have ever owned and you should be proud of your quality product."
Patrick T. Hankard–South Windsor, CT

"[Forrest blades] cut true, with no vibration. I was a carpenter by trade for over 60 years and continue to be an active woodworker. So, I can say with confidence that Forrest blades are the best."
Carl Stude–Burbank, CA

The message is clear. If you're looking for quality, performance, and value, it pays to choose Forrest blades every time.

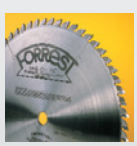
Our Most Popular Blades:



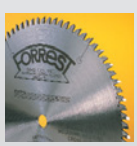
Woodworker II – This award-winning, all purpose blade is the finest of its type. It turns big jobs into easy-to-handle ones.

Dado-King – The world's finest multi-tooth dado set. It works effectively in all directions—with the grain or across it.

Chop Master – Produces perfect miters every time—with no bottom splinters. You get smooth edges on all types of wood.



Woodworker I – Great for table and radial saws. It trims and crosscuts all woods up to 2" and is ideal for plywood.



Duraline Hi A/T – Our best blade for birch and oak ply veneers. It also delivers a clean cut on melamine and vinyl over particle board.

Forrest blades come in a wide variety of sizes and are available for practically every application. Call or send for our complete list of products.

Three Convenient Ways To Order

We back our blades with a 30-day money back guarantee. So, choose the method most convenient for you and order today:

- **Visit one of our fine-quality dealers or retailers.**
- **Call us toll free at 1-800-733-7111.** (In NJ, 973-473-5236) Ask about special discounts, free shipping on orders over $275, and discounts for blade sharpening.
- **Contact our internet store:** www.stores.yahoo.com/forrestman

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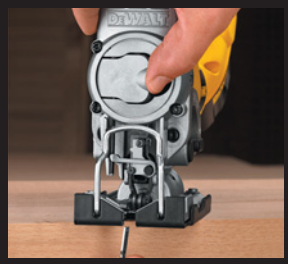
SAFETY NOTE

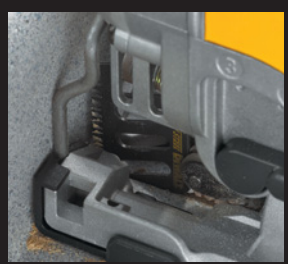
Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Popular Woodworking*, these have been removed to provide clarity. In some cases we'll use an awkward body position so you can better see what's being demonstrated. Don't copy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

CUT CIRCLES AROUND OTHER JIG SAWS.



All-metal lever-action keyless blade clamp for fast and easy blade changes.

6.5 Amp motor delivers the most power in class, enough power for the toughest applications.



Unique flush cutting blade cuts all the way to the front of the shoe.

Rubber grip provides better control and comfort in all applications.

INTRODUCING THE NEW PREMIUM JIG SAWS FROM DEWALT®

Cut circles around other jig saws with the DW331K premium jig saw from DEWALT. Designed with productivity and accuracy in mind, the 6.5 Amp DW331K offers an all-metal gear case, all-metal keyless blade change, four-position orbital action and a unique flush cutting blade only offered by DEWALT. This new premium jig saw, available in corded and 18V cordless, allows you to make straight, radius, scroll and plunge cuts through wood, laminate, pressure treated lumber, sheet metal and plastics with more precision than ever.

For more information, call **1-800-4DEWALT** or visit our web site at **www.DEWALT.com**

DEWALT®

CIRCLE NO. 112 ON FREE INFORMATION CARD.

The Dot on the Box Isn't That Important

Just about every day we get at least one call from a reader who wants assistance with selecting a tool or machine. And I'm always amazed by both how much research they've done and how misguided it usually is.

Part of the problem is that these readers are usually new to woodworking, so they're not sure which features are important and which aren't. And part of the problem is the way we make, market and purchase items in our consumer culture. These two problems feed off one another and make it difficult to make sense of our tool catalogs.

When we compare one tool to another, we usually end up lining up all the features of one tool against the other. This is a primitive defense against our ignorance about a tool. We're usually trying to buy something we've never owned before so we research and compare features down to the smallest detail. Some of these features are valid and useful. Brand A jointer has a 1-horsepower motor; brand B has a 1½-hp motor – so brand B is (we hope) more powerful.

Other features aren't important, however. Some band saws offer two or three speeds. And I hear readers regularly state that this is a feature they weigh as they choose one saw over another. Is this an important feature on a band saw? Not for most of us. The slower speeds are for metal-cutting blades. I've never used a metal-cutting blade on my band saw, nor do I expect to. It's not that important.

Then there are features that are somewhat useful. To stay on the topic of band saws, many machines come with a fence. This seems useful except when the fence can't be easily adjusted to compensate for the drift of the blade.

And then there are the bells and whistles. I call these the "dots on the box." These are the features listed in the marketing materials or on the tool's packaging. Some are important; most are not. Here are some dots: a wrist strap, bubble level, light, laser or 30 clutch settings on a cordless drill.

We tend to favor the tool (or child's stroller or automobile) that has the most features. But do you know what these features really do? Do you know if they are something that you'll really need? I think most of us simply think, "That light on the cordless drill might be nice to have – in case I ever assemble a highboy in the basement during a blackout." I'm guilty of this behavior myself.

The next time you buy a tool, see if you can identify the three or four critical features of that sort of tool and focus only on those. Then try to find out how well each tool is made – something that's never called out on the box.

If you can do this, I think you'll pick simpler tools that are made well. If we're lucky, this might encourage manufacturers to make tools that focus more on function than features. And you are not alone in this. We will do our part here at *Popular Woodworking* to help you identify the core features and ignore the fluff.

Check out our review of 14.4-volt cordless drills on page 70. What's important about a cordless drill? More than anything, how many holes and screws you can get out of a charge, how well-balanced and well-made the tool is and (as always) the price. Features beyond these core attributes are either lowering the quality or raising the price. **PW**

Christopher Schwarz
Editor

CONTRIBUTORS

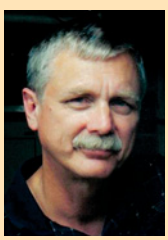
KATHY SOMERVILLE

After earning a doctorate in exercise physiology, Kathy spent 10 years as the owner and operator of a restaurant and catering business before turning her love of woodworking into full-time employment. Now, she's retail operations director for woodworking and gardening tool company Lee Valley Tools, as well as an avid gardener and woodworking teacher.

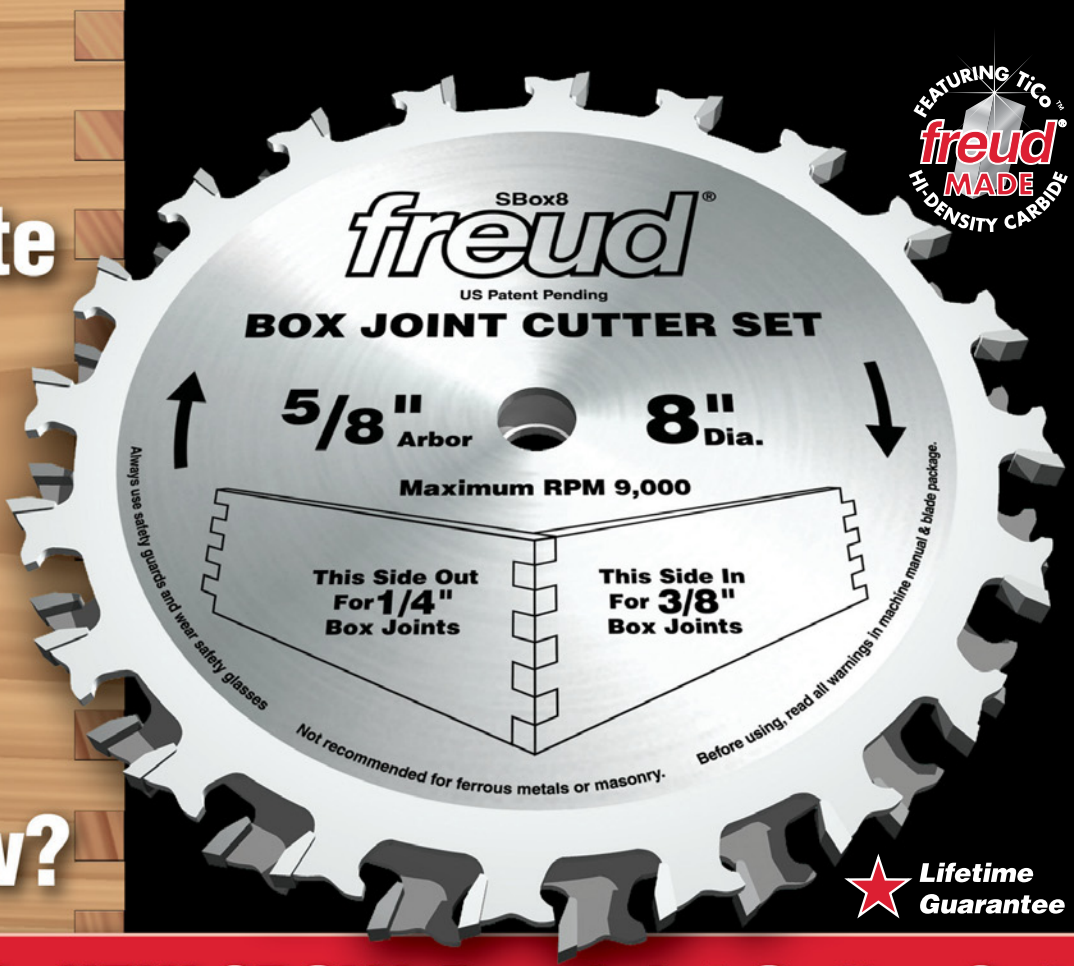
Also a passionate turner, Kathy sells her turned bowls and kaleidoscopes – for which she even makes the colored glass pieces. When time allows, Kathy heads for the mountain lakes of Alberta with her grandfather's 1913 Sponson canoe that she restored. In this issue, Kathy teaches us how to make a "chair devil" (page 80).

KERRY PIERCE

To simply call Kerry an English teacher, chairmaker or author gives short shrift to his many talents. In addition to building beautiful Shaker ladderbacks (we've had several in our office here) and teaching chairmaking at the Marc Adams School of Woodworking, Kerry constructs equally impressive case pieces. Add these other facts to that list: Kerry is a talented illustrator, some of his furniture is built using recycled motorcycle crates and all his pieces are made using a humble set of tools you'd find in almost any garage. In this issue we launch a series of articles by Kerry about Shaker furniture (page 38) that showcase all of his skills as a builder, teacher and thought-provoking writer.



How Do You Create Flawless Box Joints On A Table Saw?



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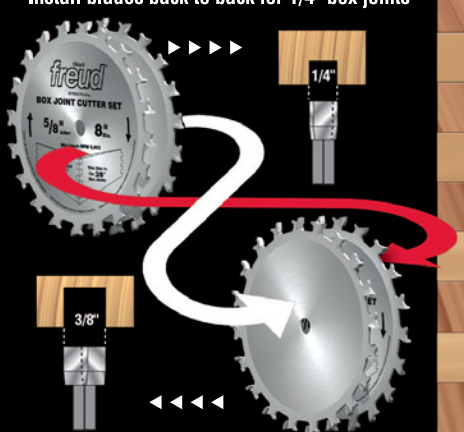
Install blades back to back for 1/4" box joints



Install blades face to face for 3/8" box joints

Freud's engineers have done it again. They have invented a new cutter set that provides a simple and accurate way to cut perfectly square, chip-free, flat-bottom box joints, without shims or awkward adjustments.

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A precision box joint is ideal for drawers, jewelry boxes, humidors and other projects where strength and appearance are critical. In the past, creating box joints usually required a dado set, router bit, or several cuts with a single flat-top saw blade, which are all time consuming, expensive and don't guarantee flawless results. Freud's new **Box Joint Cutter Set** features a unique tooth rake design that cuts perfectly square, clean pins and slots through the end grain. Plus, Freud's unique TiCo™ Hi-Density Carbide was developed and manufactured by Freud specifically for the box joint application ensuring a perfect finish and extra long cutting life.

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Exploding Grinding Wheels Wreak Havoc

You Could Put an Eye Out Doing That

I recently retired after a 34-year career with Norfolk Southern Corp. I worked at the Roanoke Locomotive Shop where locomotives were overhauled. We had a huge machine shop, with bench-type grinders and pedestal-supported grinders throughout the shop. I was involved with safety, serving as the shop safety chairman for a number of years. I am familiar with the ANSI standards covering grinding wheels as well as manufacturers' recommendations for their use. I have also seen numerous grinding wheel accidents, involving both small and large wheels.

In John Wilson's "$5 Router Plane" (August 2005, issue #149), he makes a comment that could lead to significant injury, including the loss of an eye. Under one of the step photos, he states: "Grind the cutter to a 30° angle. Grinding manufacturers don't recommend side grinding but I've always felt safe." He has, perhaps, never seen a grinding wheel explode at thousands of rpm. They can and will create havoc, and one of the easiest ways to set off a potential catastrophe is to use a wheel for other than its intended purpose.

The reason the manufacturers say not to do this is because the wheel on your standard bench grinder is not made for side grinding. If it were, it would have side tool rests or supports. Grinding wheels can be purchased for this purpose. The Allen wrench could be safely ground into a cutter on the face of the wheel, using Vise-Grips to hold it. One could also use a belt sander, a disk grinder or a small-diameter drum sander in a drill press.

E.L. Noell
Roanoke, Virginia

Fear of Dovetailing Conquered

Over the years I have read plenty of articles on dovetailing. After reading them, I was always so intimidated that I never dared try my hand at them.

Frank Klausz changed all that. "Frank Klausz's Final Word on Dovetails" (October 2005, issue #150) and the accompanying charts and pictures were so clear that I immediately went to my shop and got started practicing my dovetailing even without the proper tools (which I have since ordered!). No, my dovetails are not perfect yet (I still need to practice cutting straight and square), but I am making a solid joint and having fun. Thanks Frank!

In a couple of months, maybe Frank can help me move on to the more sophisticated techniques like blind dovetails . . . .

Robert L. Grenier
Walpole, New Hampshire

The Breaker – Not the Wire – is the Likely Culprit in Laundry-room Fire

In response to "Efficient Shop Wiring" (October 2005), I would not recommend this type of circuit for shop wiring. Back a few years ago, my house caught on fire because of a circuit like that in the laundry area. The dryer was wired for 220 volts and they took one leg and made a 110v circuit for the washer. The breaker got hot but it didn't trip so the breaker fried. Had we been away, the house would have burned. That's my two cents.

Ray Oliver
Coleman, Michigan

It sounds as if the fault was in the breaker itself and not caused by the wiring. All wiring needs to be sized to the breaker feeding it. For a dryer with the usual 30-amp breaker, that would be No. 10 – rather heavy to use for a common 110v outlet. But properly wired, an operational breaker would trip before the wire overheated. If your washer outlet were connected to the dryer circuit with a smaller-gauge wire, then the wire could have overheated without tripping the breaker. But that's not the fault of the wiring scheme; it's from using too small a gauge wire for the associated breaker. Because the

continued on page 14

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continued from page 12

breaker fried, it appears that's where the fault actually lay.

– Bruce D. Wedlock, author

Wiring May be Efficient, but is it Safe?

Since my electrical experience derives from hooking up my 60-year-old Lionel train set, I hesitate to challenge folks with credentials like Bruce Wedlock. Yet it appears to me there is a potentially lethal circuit error in "Efficient Shop Wiring" (October 2005). In the sidebar "Easy Automatic Dust Control," both the text and the schematic specify a SPST switch to shunt a similarly configured switch in the Automater to control a 220v dust collector. With both switches open, one leg of the 220v circuit is still energized and presents a dangerous 120v current path from it to the frame of the grounded device. It appears to me that the Automater should only be used to control 120v devices with a grounded neutral or to control a DPDT relay to switch a 220v load.

Daniel Freeman
Greeneville, Tennessee

Your suggestion of adding a DPDT relay to control a 220v load is sound. I recommend it.

– Bruce D. Wedlock, author

Silicone-based Products Beat WD-40

I was very surprised to read your response in "Removing Rust from Tools" (August 2005).

WD-40 has a base similar to DOT 3 brake fluid, which absorbs water from the air, causing brake systems to rust. I recommend oil, wax or 100 percent silicone products for treating metal and tools.

Eric D. Birch
Binghampton, New York

WD-40 has its fans and detractors, but we have found it to be a good rust-preventative in our shop at Popular Woodworking. *Silicone-based products are prized for their rust-preventive properties, but they should be used cautiously in the woodshop. Silicone contamination of your wood can cause finishing problems, such as fisheye, with film finishes.* **PW**

—Christopher Schwarz, editor

CLARIFICATION

In "Build an Oil Wicke" (October 2005) we state that raw linseed oil is OK for the wicke. Although raw linseed oil cures much more slowly than boiled linseed oil, the raw oil is still labeled as a fire hazard (though we have not been able to determine the true risk). To be on the safe side, we recommend you use the other oil mentioned in the article for your wicke: mineral oil.

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- Variable feed rate: 0 - 20 FPM
- Surface speed of drums: 2300 FPM
- Approx. shipping weight: 495 lbs.

Does a Saw's Tilt Direction Matter?

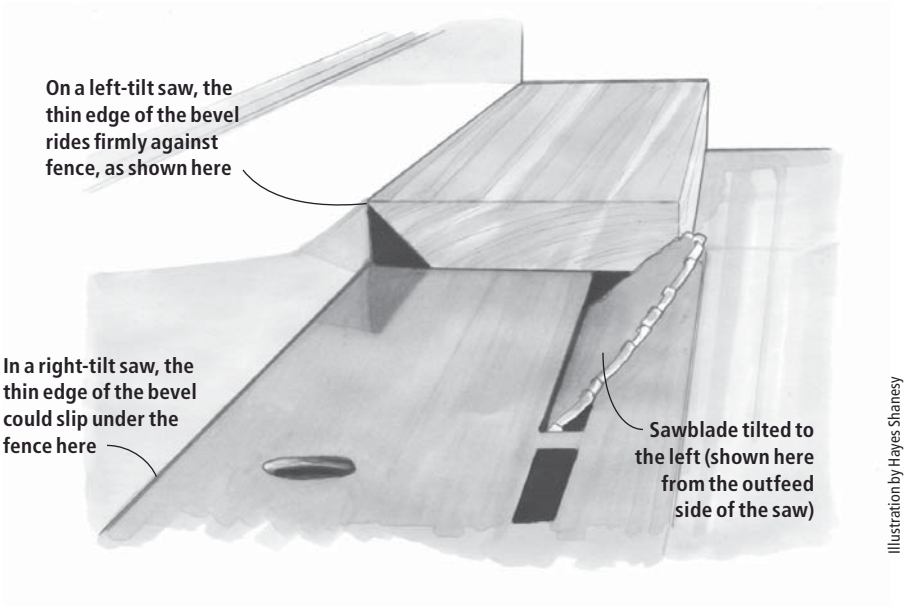

Illustration by Hayes Shanesy

Right-tilt? Left-tilt? Should I Care?

I have tried to find the answer to this question in books, magazines and on the Internet but to no avail. I would love to know the advantages and disadvantages of a right-tilt table saw vs. a left-tilt table saw.

Larry D. Taylor
Isom, Kentucky

The biggest difference comes, as you might expect, when you tilt the blade to make miter and bevel cuts. When you are beveling two long edges using the fence, the left-tilt saw has an advantage because with the fence in the normal position, to the right of the blade, the point of the bevel won't be at the bottom of the fence, where it could slip under the fence. You can achieve this desirable setup with a right-tilt saw, but the fence would need to be positioned on the left of the blade, which many people find awkward. (You also generally have less capacity on that side of the blade.) Also, when you are making a cut on the end of a board with the miter gauge, the top of the blade will be toward your hand with a left-tilt saw, and away from it with a right-tilt saw. If you have a stop on the miter gauge, and the miter gauge to the left of the blade, the pointy end can slip under the stop with a left-tilt saw. In the last few years, left-tilt saws have become more popular as more manufacturers offer saws in this configuration. Until about 10 years ago, the Powermatic was the only saw that leaned to the left.

For most operations, it doesn't make a difference. It all depends on how important this is to you, in relation to your budget. Although I prefer a left-leaning saw, if I found a good price on a right-tilt, I would likely buy it. On the other hand, it wouldn't be a bad thing to have one of each.

— Robert Lang, senior editor

What Should I Do When a Tabletop Cups After I Bring it in From the Shop?

I am making a cherry drop-leaf table. My lumber was flat at glue-up and flat after glue-up. I do my woodworking in non-climate-controlled area, but the wood was completely dry. I brought a leaf and center tabletop to my air-conditioned home to kind of show it off.

I noticed the two pieces (mainly the center) were cupped, concave up. The tabletop center piece is 42½" wide and the cup depth is about ¼" to ⅜". I returned the top and leaves

continued on page 19

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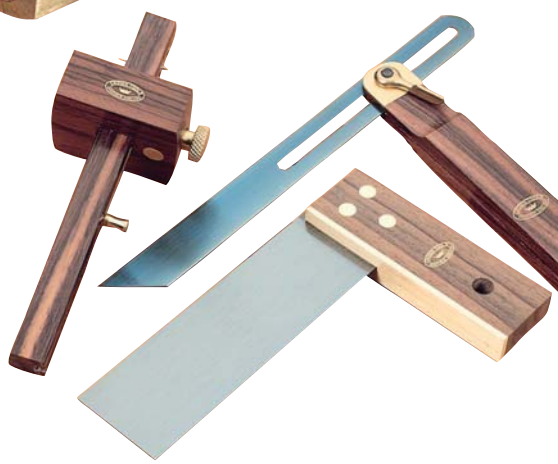

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continued from page 16

to the shop and put weight on them to try to get the cup out. Is the problem the humidity change? (The table will eventually be in an air-conditioned house.) What is the best way to fix it? What should I do to prevent it in the future? If I put the top on the table frame and screw it down close to its edges (allowing for seasonal movement) that would probably take out the cup but would that solution be likely to fail? Is the problem due to moving the panels too early after milling and gluing?

Bruce Meuth
Mont Belvieu, Texas

It's likely that your problem will correct itself. If the panel was flat in your shop then it likely will be flat when it reaches equilibrium inside your house. Chances are the problem is that there was a period when one face of your boards was shrinking faster than the other face, causing the cup. This sometimes happens when you have a board with one face on a bench and the other face exposed to sunlight, or some other heat source that reduces the moisture content more quickly on the exposed face.

In all likelihood the top will return to flat when both faces of the boards reach the same moisture content.

— Christopher Schwarz, editor

How Do You Disassemble Chairs?

I need to disassemble three maple Windsor side chairs – the dog has made many teeth marks in the chairs' stretchers.

What type of glue does the chair industry use? (The chairs are of a 1965 vintage.) What technique – water, steam, alcohol, heat – should I use? I can drill some holes in the underside because the chairs will be painted in their new life. I have new side and medial stretchers in hand.

Roger Kerr
Stockbridge, Michigan

Modern yellow glues (polyvinyl acetate) were invented after World War II. Before that, almost everything was built using hide glue.

The first thing to do is to inspect the chair closely and determine if any of the joints have been reinforced with pegs or have had screws or nails driven into the joints. These must be drilled out or removed. If you're lucky, you should be able to then disassemble the stretchers and legs of the undercarriage with mallet taps.

If the joints are stubborn, the next step is to try using a spreader clamp to gently apply pressure to dislodge the joints. If that doesn't work, you can drill a small hole in the joint and inject a solution of 50 percent warm water and 50 percent vinegar into the joint. Allow the solution to soak in and then try the mallet and clamp again.

Scrape the joints clean, trying to remove as little wood as possible. You can tighten up a joint by wrapping a wood shaving around the tenon and then gluing the tenon, shaving and mortise together. I prefer hide glue for chair repairs because it has a longer setup time and is reversible with heat and steam. However, yellow glue will work fine. Some people prefer to use epoxy as it has gap-filling properties, which can further tighten up a joint. **PW**

— Christopher Schwarz, editor


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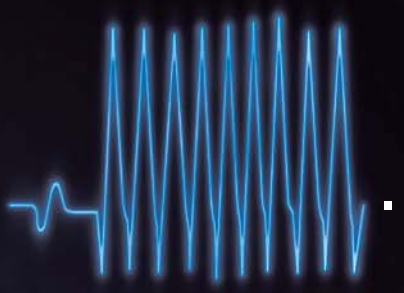

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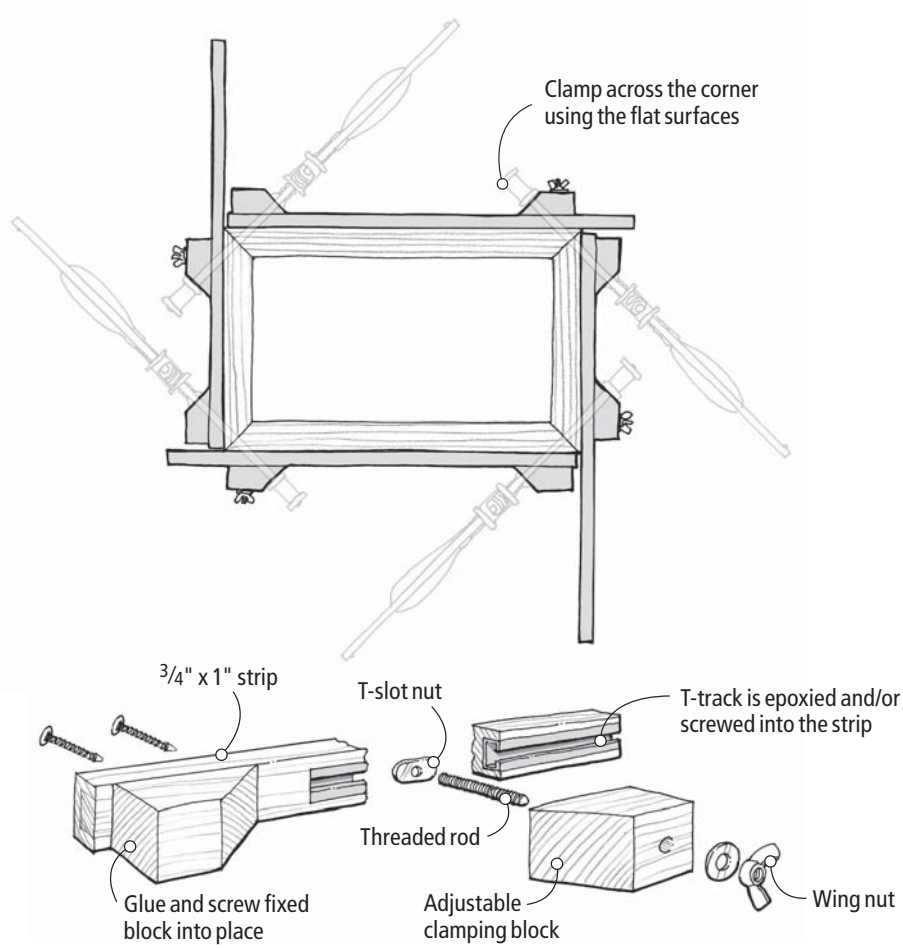
Compiled by Paul Anthony
Illustrations by Matt Bantly

Handy Miter Clamping Jig



THE WINNER:

Clamping up frames with mitered corners can be troublesome, so I devised this jig to help. Basically, the jig is four strips of wood, each of which includes a pair of corner clamping blocks. The angled faces of the blocks allow clamping pressure to be directed perpendicular to the joint line – the most effective method for pulling and holding the joints together. One clamping block is glued and screwed in place to one end of each strip, while the other is adjustable along its length, in order to clamp frames of different sizes. The adjustable clamping block attaches with a threaded rod and wing nut to a length of aluminum T-track that's recessed into the strip.

I made the strips from 1"-wide x 3/4"-thick hardwood. Make them any length you like. The 3/4"-wide T-track is epoxied into its groove. Although you could rout a stopped groove to accept the T-track, I cut a through-groove using a stack dado set on the table saw, then I glued filler blocks into the end that received the fixed clamping block. (Make sure that the T-track is flush with the face of the strip, and not recessed.) To attach each adjustable clamping block to its T-track, I used a short

continued on page 24

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continued from page 22

length of threaded rod that screws into a T-slot nut in the track at one end, and is tightened in place with a large wing nut.

When setting up the jig, it helps to temporarily clamp the strips to the frame members using spring clamps. Then clamp across each of the corners, tightening the clamps a little at a time in succession to keep them somewhat evenly spaced.

Michael Walker
Alberta, Canada

A High-tech Plane Holster

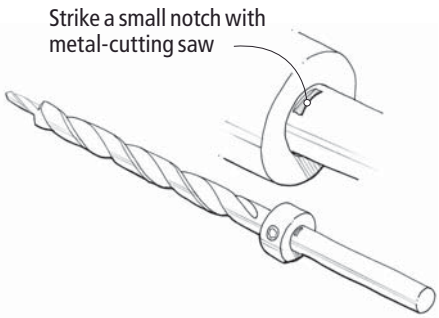
The leather case I bought a few years back to protect my (very expensive) cell phone is three sizes too big for my new model. Fortunately, the case turned out to be just right for my smallest block plane. Holstering the plane on my belt keeps it handy and protects it from getting knocked around on my bench or lost on the job site.

Joe Wajszczuk
Westminster, Colorado

Time-saving Drill Setup

I use my pocket-screw jig a lot to join materials of different thickness, primarily ½"- and ¾"-thick material. It used to be that every time I switched from one thickness to the other, I had to measure the amount the step-bit projected from the jig in order to reset the stop collar. Finally, I realized that I only needed to mark the bit itself, so I used my metal-cutting saw to strike a small notch on the shank of the bit to mark the appropriate stop collar position. It sure has made changeovers easier.

Yaniv Matza
Tamarac, Florida



Two Glues Can be Better Than One

No single adhesive is suitable for all gluing jobs, but frequently a combination of two glues can solve some tricky problems. My favorite combination is a slow-cure epoxy with either hot-melt glue or contact cement. The epoxy glue is strong, waterproof and it has superior gap-filling properties. However, it needs a long clamping time or an initial means of fixing, such as screws, and this is not always possible. In these cases I use a dab or two of hot-melt glue (be careful not to use too much or it will leave a gap) to hold the pieces together initially. Alternatively, for larger, flat pieces I mark one or more strips (which will be in contact) on the glued surfaces and apply contact cement to these strips. The contact cement grips instantaneously and holds the pieces together until the epoxy cures. I found this particularly useful when I had to glue something flexible, such as a sheet of metal, to a vertical surface and the bond had to be absolutely waterproof.

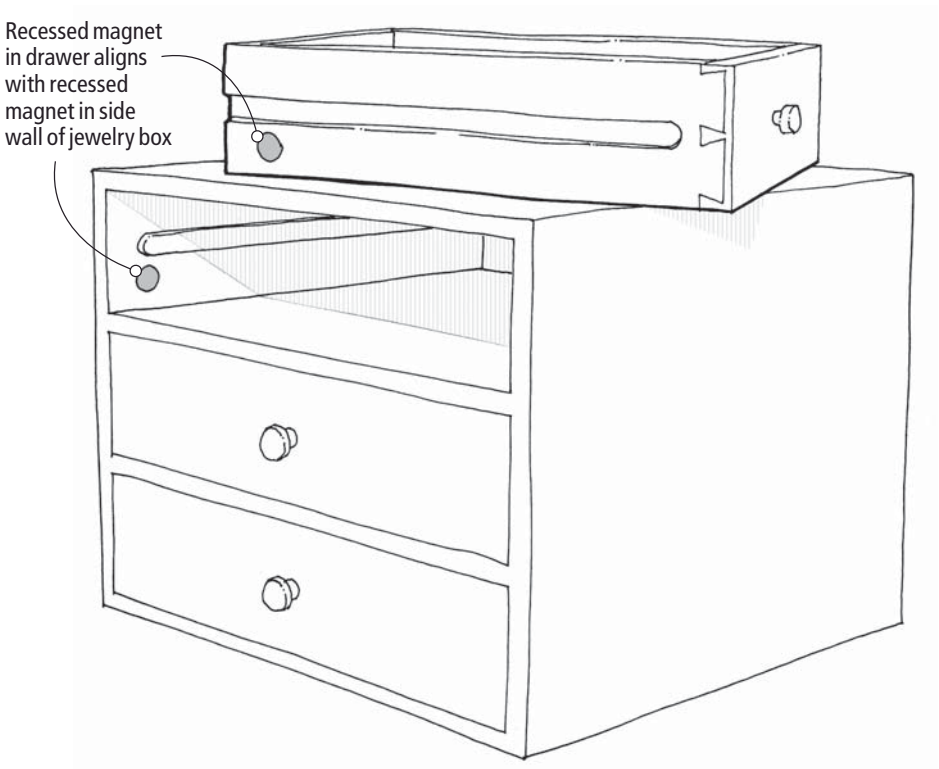
Frank Penicka
Mount Pearl, Newfoundland

Hidden Drawer Stop

I recently finished a couple of small jewelry boxes and was uncertain about how to keep the drawers from sliding all the way out. I came up with this idea, which works great. A couple of small rare earth magnets are inset at the rear of the drawers and at the front of the carcase on each side. When the drawer is pulled out it "catches" when the magnets line up. A stronger "pull" releases the drawers so they could be removed if required.

Larry Tuck
Beaconsfield, Quebec

continued on page 26



continued from page 25

Flattening a Board on a Router Table

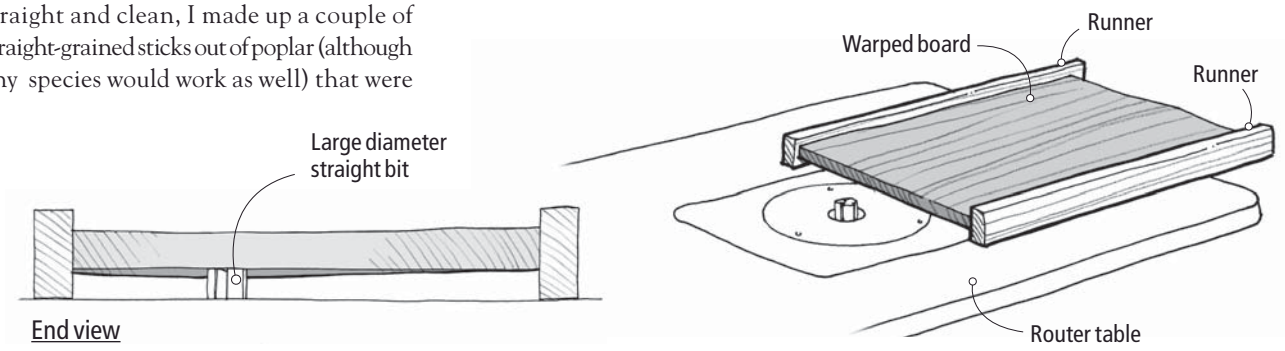
I had a beautiful piece of crotch oak that I wanted to use as a door panel, but it was badly warped. It was too wide to run across my jointer without ripping it in half first, and I didn't want to do that. Normally, I might hand plane a board under these circumstances, but the crotch figure on this board would have presented a real challenge After thinking about it a bit, I realized that I could do it on my router table.

After ripping the edges of the panel straight and clean, I made up a couple of straight-grained sticks out of poplar (although any species would work as well) that were about 1/2" wider than the thickness of my panel. I centered them on the panel edges, attached them with double-sided tape and temporarily applied clamp pressure to ensure a good bond. The sticks could now serve as runners to hold the panel slightly above the surface of the router table's top while I routed the piece flat.

I installed a large-diameter straight bit in my router table, and I adjusted it to cut just 1/8" or so into the panel by sliding the panel on its runners back and forth across the bit. Incrementally deeper cuts on subsequent passes created a flat surface on one face of the board, after which I flipped the whole assembly over to rout the opposite face, adjusting the bit height until I arrived at my desired thickness. After that, all it took was a bit of scraping and sanding to finish up.

James Hogarth
Wichita, Kansas

continued on page 28



Tricks of the Trade

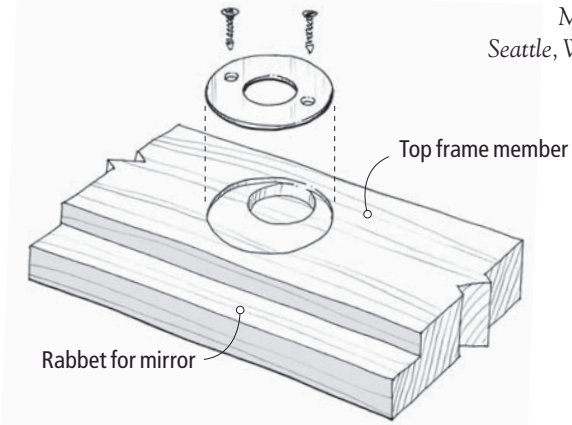
continued from page 26

A Washer Hanger

I made a large mirror frame recently, which needed to hang flat against the wall rather than lean outward, a side-effect of using picture frame wire. A keyhole slot offered a good solution, but I didn't have the appropriate router bit to make it. Then I remembered a method I once saw used on an old frame.

To create a hanger, the maker had drilled a shallow recess to accept a flush-mounted metal washer. Then a second, deeper hole had been drilled inside the recess that was offset and tangent to it, and toward the top of the frame. The washer, which had a couple of holes drilled through it – was installed into the shallow recess with a couple of small screws – creating a strong, lipped recess to accept the head of a nail or screw. It worked great for my mirror. **PW**

Mary Mater
Seattle, Washington



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The Lost Arts & Mysteries

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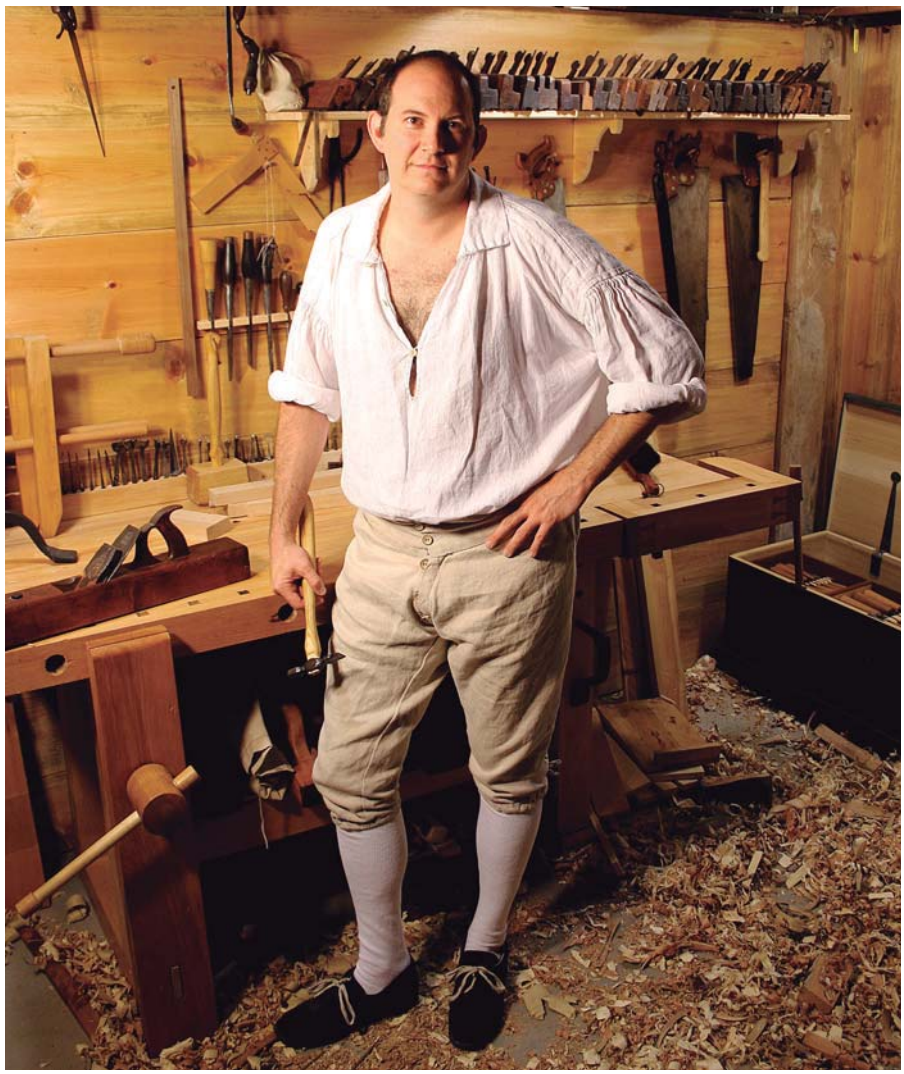

Photos by the author

Adam Cherubini in his workshop in New Jersey. In addition to exploring 18th-century woodworking techniques at home, Adam volunteers in the joiners' shop at Pennsbury Manor (pennsburymanor.org).

Arts & Mysteries is a phrase that oft appears in the contracts or indentures between master craftsmen and their apprentices. Exact usage varies, but the context is usually something like "*… the apprentice shall keep secret his Master's Arts & Mysteries …*" or "*…the Master shall teach the Arts & Mysteries of his trade….*" Nowhere was the phrase "Arts & Mysteries" ever defined. It may have been a purposely ambiguous "term of art" with a nonspecific intended meaning.

A notion of secrecy is usually associated with the phrase. We know little about the state of the art of the craft during the 18th century. Not a single book was written on the subject in the English language throughout the entirety of the 18th century.

Joseph Moxon's late 17th-century text "Mechanick's Exercises" and Peter Nicholson's early 19th-century text "Mechanical Exercises" serve as bookends that imply a wealth of information between them. In that time, the backsaw was invented, and carcase joinery, veneering, inlaying and carving all achieved their zenith.

We have and cherish furniture from the period. We see the joinery and marks from the tools used. But extant pieces fail to answer even basic questions such as: Did they saw before they planed? Was the tenon cut before the mortise? And how were drawers fitted? One piece in the Philadelphia Museum of Art has a drawer that perfectly, seemingly intentionally, fits another piece by the same maker. Is this coincidence? Or were drawers made to a template and the carcase made around them? We just don't know.

As the 18th century drew to a close, economic forces decreased the influence of the trade guilds. Craftsmen worked more and more for price-conscious lower-class buyers. Factories emerged, and unskilled laborers were increasingly employed. The guilds' centuries-old oral tradition ended, and the Arts & Mysteries slipped into the abyss.

by Adam Cherubini

Adam makes reproduction furniture using the tools and techniques of the 18th century. He was included in Early American Life magazine's 2005 directory of the top 200 traditional craftsmen in America. See www.EALonline.com You can contact Adam at adam.cherubini@verizon.net.

Why Should We Care?

At this point you may be wondering why modern woodworkers should care about the techniques woodworkers employed two centuries ago. A brief review of period account books seems to indicate that 18th-century craftsmen did what we cannot. They worked accurately and quickly using simple, sometimes crude tools. A small chest of drawers might have taken as little as a week to complete. The largest secretary or highboy might have been three or four weeks' work. Craftsmen

performing similar work today, and with the aid of "money is no object" machines, spend months on similar pieces.

And just to put this into perspective: Some of these men were in poor health. In some cases, sewage ran through the center of their narrow streets. They worked in dim, cramped conditions. The average urban craftsman, the same individual who turned out the finest pieces, probably worked in what we would call his living room. This room would house his many children, possibly an elderly relative, and the hearth where his spouse prepared his meals. Additionally, American tradesmen conducted their business transactions by trading merchandise. Cash was reserved for overseas trade. So the craftsman's shop may have also stored barrels of soap, fabrics and other bulk goods taken as payment.

The entirety of such a space could be as small as a modern one-car garage (so stop bellyaching about your shop!). By modern standards, we could only categorize such existence as "third world" conditions.

Despite the differences in our situations, we know that they bought lumber more or less the same way that we do – sawn into boards of roughly the required dimensions. Like many of us home woodworkers, they generally didn't produce items in sufficient quantities to justify specialty jigs or templates, but we don't know the extent to which templates or jigs were used. (Chairmakers may have been exceptions to this.) Like many of us, they worked in small shops. Like us, they strived for high-quality products and took pride in their work, but the realities of their economy demanded speed and thrift.

From my perspective, I'd say we share more in common with the pre-industrial shops of the late 18th century than we do with the industrialized furniture factories of the early 20th century. Few of us produce any real quantities of items. Machine setups and custom-made jigs are difficult to justify for a single operation. The tools we use, though inarguably designed with someone else in mind, probably aren't the whole problem. The way in which we use them similarly reflects the needs of mass production more than custom one-offs. At the very least, I hope we can agree that the methods we use probably don't reflect a universally superior approach to woodworking. There are other ways.

So What are the Arts & Mysteries?

I think it's safe to assume the Arts & Mysteries weren't something like a secret handshake that a dying master revealed to his grandson. Likewise, it's likely they weren't even a set of techniques that could be observed or passed down informally. They certainly are more than a collection of preferred joints used for specific furniture types. In short, if they were easy to describe, illustrate or demonstrate, they wouldn't be lost today.

My guess is that the Arts & Mysteries are the embodiment of a different approach to solving the everyday problems woodworkers face. If an apprentice asked how to correct a wayward saw cut, his master would teach him to lay his saw down into the cut, effectively increasing the length of the blade in the kerf. If that same apprentice asked how to straighten a board's edge, his master would offer a long plane. The apprentice may have never realized that the solution to both problems was the same. But in time, he would seek something long to make something straight. By learning his master's technique, the apprentice would eventually mimic his master's approach as well. For the apprentice, the Arts & Mysteries of his master's trade were never discussed or defined, but constantly reinforced. As more operations were performed on machinery, young woodworkers saw fewer examples of the "old ways" in their work.

The tools in my shop are representative of early tools not only in their outward appearance, but in their selection as well. All of the tools typical of early shops are present. Additionally, their specific sizes and varieties were chosen to allow them to work together. Mortise chisels match plow irons. Firming gouges match sash planes. The brad awls, gimlets and bits match the nails, screws and the shop's doweling plate. The result is a workshop in which the tools help each other, making projects easier to complete.

How can we do fine work in less-than-ideal conditions or with low-quality tools? These pieces constructed 280 years ago in Philadelphia's early baroque style were probably built before the backsaw was invented. They may not be your style, but they suggest what can be done quickly in modest conditions.

In each of the preceding articles I offered an approach that I think helps explain the speed and efficiency of early shops. Like the old masters, I attempted to use examples to illustrate each "mystery" or approach. In this article, the last in my series, I'll review the preceding five articles, and reveal the secret "mystery" in each.

The Striking Knife: Working Together

The striking knife is a helpful enough tool for its intended task. But what makes the striking knife so interesting is that it's also helpful for other tools. As a marking device it is adequate I suppose. It marks wood, not unlike a sharp pencil, and more faintly in some instances. But unlike the pencil, it makes layout easier in dim light, aids in sawing, allows the use of ripsaws for crosscut operations and provides a positive place to position a chisel. As such, it's particularly like many other tools in the period woodworker's tool chest. The tools work together to help each other and the craftsman achieve the desired quality quickly, without requiring total mastery of hand tool techniques. The concept, like the tool, enables the exhausted veteran and the beginner alike.

I don't see this level of cooperation with modern tools and I often see the opposite. For example: The electric router can shape a moulding, but in most cases it fails to produce a finish-ready surface. Sanding a delicate moulding is difficult and can destroy fine features. These tools don't help each other.

Sometimes the cooperation exists not in the use of a particular tool, but in the selection of its size. Obviously, mortise chisels and match planes are chosen based upon the stock thickness. Less obvious may be my preference to have plow plane irons and mortise chisels in matching sizes. When making a frame for a panel, for example, I prefer to plow the groove first then make the mortise. Cutting the mortise is much easier when the mortise chisel perfectly fits the groove.

Unfortunately, I don't know enough about power tools to suggest how this concept may be used in a modern shop. But I think it's important to be aware of it. The relationship between your tools is as important as the individuals themselves. Getting those individuals to work together as a team will create a more productive and more enjoyable shop.

Advanced Chiseling: Tool Slaving

In skilled hands, the chisel is fantastically effective. I've seen masters use chisels in ways I'm certain I will never master. Though I may need 20 years to achieve that level of proficiency, I certainly can apply one advanced chisel technique immediately. Tool slaving is a technique evidenced throughout period furniture. It's a way of producing accuracy without excessive skill. Simply put, tool slaving is using a feature of a tool to define the size of a joint or cut. Carvers do something similar I'm told, by carving shapes that are the size and shape of their tools.

Probably the best example I can think of is making a mortise of the exact width of the chisel. Little skill is required to make a very precise mortise this way. The tool provides that accuracy almost automatically. You can try to drill holes, then clean up the sides with a chisel. But your ability to make a square-sided mortise is limited by your skill. Other examples include using the straight sole of the try plane to straighten an edge or produce a sprung joint, or using the straight blade of a jointer to match-plane two edges simultaneously. Tools like dado planes give you no choice but to define a feature based on the width of the plane's iron, yet there are some who would scribe the shoulders, cut the dado, then pare to the lines with a chisel!

Knowing a plane's "true" name can unlock its true purpose. Sure, a rabbet plane is obviously used to make a rabbet. But then consider carefully the "fore plane" – so named because it is designed to be used before the other planes for surfacing boards.

As it happens, I'm writing this article on my dining room table. Its top is made of two 8'-long black walnut boards, glued together at the center. Trees usually get narrower toward the top so the boards are a little narrower at one end than the other. Consequently, the table is 36" wide at one end, and a touch under 35" at the other. If you were making a similar table with the same stock, would you have ripped a bit off each board to square them up? I think most people would. It's what we learned to do in shop class. If you want to work faster with whatever tools you're using, challenging arbitrary requirements is a good first step.

Tools can also be used as gauges. Using that same mortise chisel to lay out the matching tenon is an obvious next step. I use a sharp firming chisel to lay out dovetail spacing. I use a chisel to position mouldings on a case. Your chisels are like a set of machinist's gauge blocks. They are like rulers of fixed and convenient sizes. Every time you pick one up, it is the same width as it was last time, and you always have them handy.

Tool slaving, like gauging, is a way of approaching woodworking that is antithetical to rulers and measurements. Not only are rulers less accurate than either gauging or slaving (since mating parts must be individually measured), they are totally arbitrary as well. Working to a set of drawings is only important when your tenons go into a bin to be later chosen at random and fitted to the mortises made elsewhere down the assembly line. Because we have responsibility for the entire joint, we can simply skip the measurements altogether. There's probably some way you can gauge a tenon from a hollow-chisel mortiser – this is certainly not a hand tool-only concept. You can think of the fence on your table saw like the fence on a marking gauge if you wish. I'm convinced good craftsmen know this and do this. They may not know what it's called, but they do it. I want you to know it's a concept that can be employed in your shop for a whole range of operations on a whole range of tools. And I think you'll be surprised how often it is not only appropriate, but faster for whatever you're doing.

Rumplestiltskin: Single-purpose Optimized Tools

The average late 18th-century cabinetmaker probably had between 30 and 70 wood planes in his tool kit. Like modern professional woodshops, the period woodworker took advantage of optimized, single-purpose tools to improve efficiency.

We've probably all seen Norm Abram's "New Yankee Workshop." Mention the show to any woodworker and you'll invariably hear something like: "That guy's got every tool there is." Most of us probably don't have the shop space – let alone the money – for all the specialty sanders, planers, shapers and saws that Abram has. We make mortises with our drill presses and rip, crosscut and make dados, rabbets and sometimes even mouldings on our table saws. While cost- and space-efficient, this is not an efficient way to work.

Specialty hand tools offer a low-price, low-space alternative that can actually save you time when you consider the setup time required to get your table saw or router table ready for an operation it wasn't designed for.

Using specialty hand tools doesn't require years of mastery. It's as easy to cut a dado with a dado plane as it is for Abram to cut a slot with his biscuit joiner or turn a leg with the duplicator on his lathe. The only trick is selecting the right tool for the job. Recognizing that each plane has a single name associated with its one intended purpose helps us select the right tool and reminds us of the efficiency of using optimized, dedicated tools. Yes you can swap irons on your plane to convert it from a high-angle plane to a low-angle one. Yes, you can convert your jack plane into a smooth-

Courtesy of the Pennsylvania Historical and Museum Commission, Pennsbury Manor

The craftsman who built this fine turn-of-the-18th-century English chest patiently moulded and mitered the many pieces that comprise its decorative front. But clearly his patience ran out when he got to the back. Some scholars suggest such pieces are evidence of the role of apprentices in early workshops. While it may be true that an apprentice executed the back of this piece, the master who so carefully made the front inevitably approved of the workmanship. I believe the difference in quality between the front and back solely represents the values of period craftsmen and their customers, and is not in any way reflective of the difference in skill between masters and apprentices.

ing plane. You can also convert your table saw into a lathe, but is it a good idea? There are very nice, very smart people who do such things, but I wonder how long it takes them to complete their projects.

Sawing Faster: Avoiding Arbitrary Requirements

The trick to sawing faster is not sawing at all. That's the fastest saw cut! The trick to not sawing is understanding what the real goal is. In an assembly line, quality is measured in thousandths of an inch. Dimensional consistency is important to the machines and workers down the line. Most of us don't have such requirements.

The goal is to make quality, good-looking furniture, regardless of the exact measurements. Sometimes you need a dimension, such as table height or chair height. But most times you don't. We don't really care whether the high boy is 78" or 75" tall. For interior guts, there are few requirements governing their exact dimensions. How wide does a drawer runner need to be? Is 2" wide enough? How about 2½"? If any size will work, can't we just use the scraps from the shop floor as they are? I know it takes only a few seconds to pass a board over a table saw. And because it's quick and easy, you may never ask yourself if you really need to do it. When all you have is a handsaw, you find yourself asking this question more and more: Do I really need to saw this board? More often than you might think, the answer is "no." The working title for this article was "How to saw faster than a table saw." Because the answer was the mystery of the article, we felt the title was teasing. But now you really do know how to saw faster than a table saw.

The Plane My Brother Is: Turn Your Face to London

How do you define quality? To the period woodworker, quality furniture was good-looking furniture, furniture that achieved the artistic intentions of the designer, furniture that exhibited a specific style. Joinery was important, like the quality of the stitching in your shirt. But do you really choose your shirts based on their seams? Every craftsman appreciates finely made joints and finely planed surfaces. But this is an aesthetic every bit as arbitrary as any other. Axes can be used to make fine furniture, because not every bit of fine furniture needs to be fine.

When you look under, behind or inside the finest furniture of the 18th century, you see joinery and surfaces that don't look exactly "masterful." They look hurried. OK, sloppy. While some have excused such work as that which is necessary to earn a living, I prefer to view it as reflective of the craftsman's definition of quality. He wasn't selling joints anymore than Armani sells stitches. Craftsmen used the phrase "Turn your face to London" to describe how their efforts were focused on making the outside of a piece the best looking it could possibly be.

I know many will be unconvinced by this and will continue to plane (and sand) the insides of their cases and undersides of their tabletops. The only thing I can tell you is that while you are concentrating on your surfaces and your joinery, you may be missing the larger picture of proportion, color and composition.

Given the choice between a painting that looks good only from far away and a painting that looks good only up close, which one would you choose? There's no right answer. I'd just like to make the point that you often can't have both.

Exploring in Your Shop

Like the old masters, the real wisdom I offered in my articles lay beneath the techniques I demonstrated. Unlike the old masters, I lack the experience and training to be confident in my conclusions. That's where you come in. For unlike so many other woodworking articles that feature projects you may never build or tools you don't have, you can try these techniques tomorrow and see if they work. Try building something without a ruler or tape measure. The mystery in the striking knife article wasn't about the knife itself. So try using your carpenter's knife to mark a board before you handsaw it and see if it helps. Ask yourself why it's necessary to four-square absolutely everything. How square does a table edge need to be? How parallel must its sides be?

Most important of all, let's recognize that we just don't know it all. Let's give our ancestors the benefit of the doubt and try to understand why they did what they did. Let's go exploring together. We can turn over a few stones and see what we find. **PW**

MORE ARTS & MYSTERIES

This article marks the end of my first year writing this magazine's "Arts & Mysteries" column. I hope you enjoyed reading these articles as much as I enjoyed writing them.

The topics were very academic, which can offend some woodworkers' pragmatic sensibilities. It's difficult for me to believe the editorial staff thought these articles would receive mass appeal. And yet here they are in print.

These were not particularly easy articles to write. From the very first instance, I planned to shroud the intended subject of each article in a seemingly practical technique. As a result, each article was more difficult to grasp. I apologize for that. But it served an important purpose to keep the mysteries … well, mysterious.

I felt that if I wrote the mysteries directly, an important aspect of period woodworking, perhaps the only thing I'm certain of, would be overlooked. There are mysteries in the world of woodworking. There are enough for all of us to discover something new, share our findings and still leave our grandchildren searching. Mysteries lie beneath our tools, like bugs under stones. Many blindly step over them. But the curious are always rewarded. Why is a wooden smoother shaped like a coffin? Why are the sides of some old mortise chisels beveled? How do you sharpen a plane blade without a flat stone? Should a ripsaw have fleam? I don't know the answers. But you don't need me. You can make your own discoveries as I have – by asking questions, examining old tools, old furniture, old books and trying. — *AC*

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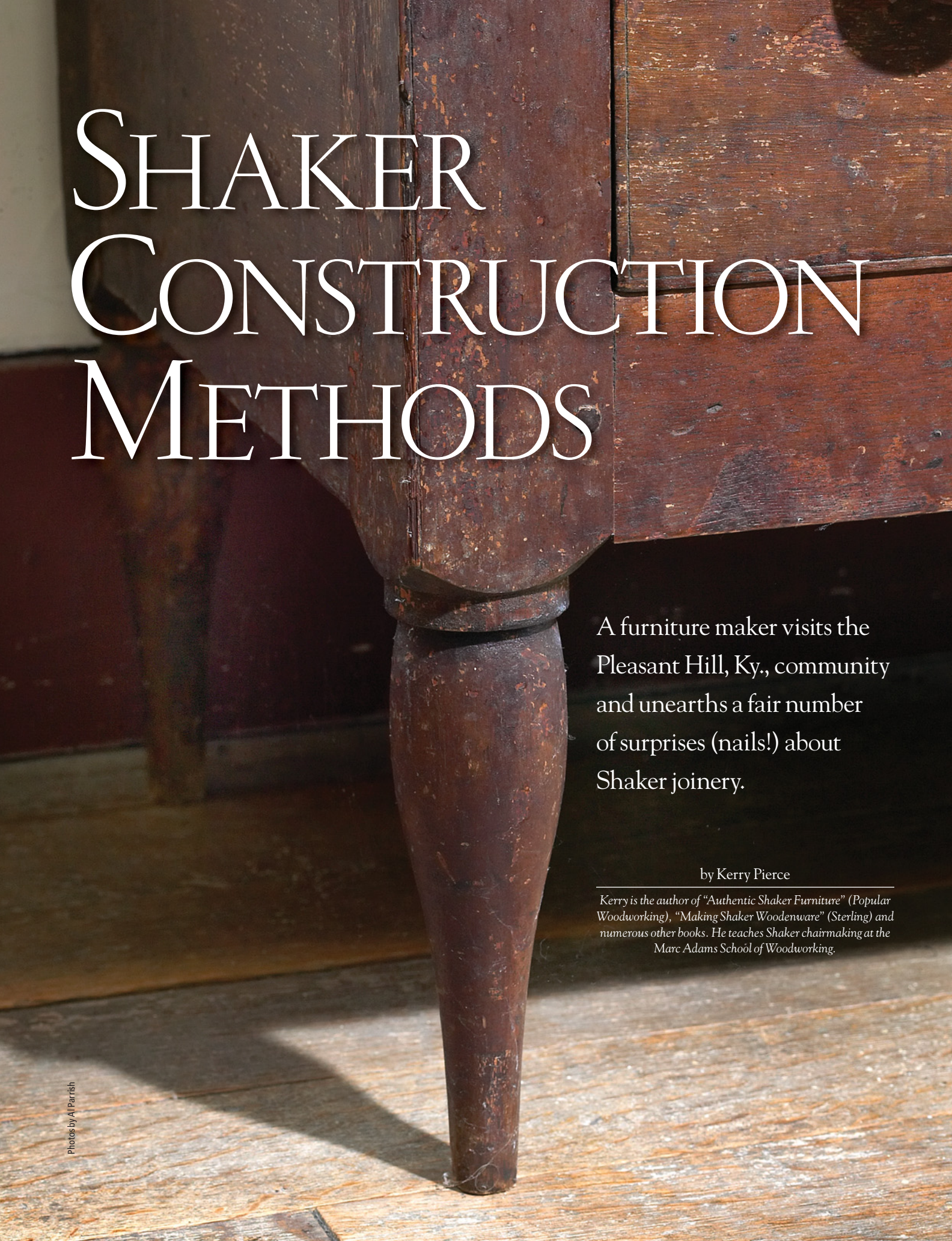
Shaker Construction Methods



A furniture maker visits the Pleasant Hill, Ky., community and unearths a fair number of surprises (nails!) about Shaker joinery.

by Kerry Pierce

Kerry is the author of "Authentic Shaker Furniture" (Popular Woodworking), "Making Shaker Woodenware" (Sterling) and numerous other books. He teaches Shaker chairmaking at the Marc Adams School of Woodworking.

Photos by Al Parrish

This signed piece by Charles Hamlin bears the date "Jan. 30th 1877," although some authorities believe it is a much earlier construction.

If you're planning to stay at the restored Shaker Village at Pleasant Hill, Ky., I have some advice: At dawn, after spending the night in a building designed, built and once occupied by the Shakers, walk out onto the lawn. At that moment when the gathering heat of day is burning away the last smoky tendrils of nighttime fog, look across the hills surrounding the village. Scan the horizon to the early morning music of birds and distant livestock. If you do this, I think you'll know something about how it felt to have awakened there 150 years ago when Pleasant Hill was a thriving community of 500 practicing Shakers.

I know. This past summer I did it on three consecutive mornings during a visit I made in order to study some of the Shaker furniture in the Pleasant Hill collection.

Of course, the Shakers wouldn't have slept in air-conditioned comfort, as I had. And they were more likely to have gone to their early morning job assignments than to have stepped outside at dawn for a quiet, reflective moment alone.

But if – like me – you've spent a good part of your adult life studying and building Shaker furniture, you're susceptible to the power of the moment. You step outside and you look and you believe.

The Problem With Modern Versions of Shaker Forms

I've been working in the Shaker genre for more than 25 years, and for much of that time, I've been writing about the stuff I build in an effort to share with others what I have learned about Shaker design principles and construction methods. Like most contemporary makers of Shaker work, I have found the drawing books of Ejner Handberg (Berkshire House Publishers) to be rich sources of ideas – although there is little detail in Handberg's books about how the pieces he studied and measured were assembled.

That kind of technical information can best be found in John Kassay's magnificent volume: "The Book of Shaker Furniture" (University of Massachusetts Press), a book I've encountered on the bench of just about every maker of Shaker furniture I've ever visited. But even in the cases of those pieces so beautifully drawn by Kassay, there are bits and pieces of missing and/or puzzling information that forces makers like myself to offer up our best guesses.

For example, in my book "Authentic Shaker Furniture" (Popular Woodworking Books), I documented the re-creation of a Shaker sewing desk drawn by Kassay. Some of the construction methods detailed by Kassay seemed eccentric, suggesting to me that the original Shaker craftsman had added complexities for reasons that are not now obvious to the modern eye.

As a result, I simplified the construction of the desk to eliminate enigmatically placed parts. I also changed the drawer graduation to an arrangement I found more appealing, and I opted to open each drawer with a pair of relatively small knobs, rather than the single oversized knob affixed to each drawer in the original. These were all changes that – in my opinion – constituted improvements on the original, while remaining faithful to the Shaker aesthetic of minimalism and elegance.

In addition, despite the wealth of detail in Kassay's many drawings of the piece, there are no references in those drawings to the methods used by the Shaker builder to fasten in place the desk's two different tops. So here too I had to proceed guided by my instincts and experience. The result is a piece of furniture that – although it is recognizably Shaker – is not an exact replica of any Shaker original.

And this circumstance is not unusual. Although I've built and sold hundreds of pieces of "Shaker" work, I can't recall a single piece that was an absolute replica of any specific original. All were modified to a greater or lesser extent to suit my tastes and/or those of my clients. Sometimes the changes were nothing more than the substitution of one material for another – say cherry for plain hard maple. At other times, the changes were more comprehensive, as in the case of the Shaker sewing desk that appeared in "Authentic Shaker Furniture."

I think this approach is common among contemporary makers of Shaker-inspired work. We rarely produce exact replicas. Instead, we do what the 19th-century Shaker craftsmen did: We take a form that has been passed down to us from earlier makers and re-create that form in the light of our own tastes and experiences.

Built the Way Furniture Should be Built

Most of the furniture in the Pleasant Hill collection is well conceived and well executed, some of it brilliantly so. The cupboard over chest of drawers, signed and dated by Charles Hamlin in 1877, is one such piece (shown above). This

towering monument to the art of furniture making has a weight and presence rivaling that of large, high-style casework built in the outside world.

A trio of enormous frame-and-panel doors conceals the cupboard's interior. The geometry of these doors consists of two horizontal series of rectangles unadorned by shaped edges. Above the doors, the case is surmounted by a wide cove moulding anchored in place by a pair of horizontal fillets. In the outside world, the doors would have been framed in moulded edges and the crown moulding would have presented a clutter of shadow lines. Such an iteration would certainly have had appeal, but I prefer the simplicity of the straightforward handling of forms in the Hamlin piece.

For me, this piece comes most sharply into focus when I examine the tiny wood escutcheons on the doors. The maker wisely chose to avoid the visual distraction of metal escutcheons on the front of a piece that, except for the slivers of visible hinge pins, is an unbroken seascape of wood.

Good joinery is evident throughout the piece. The lower case is built between a pair of post-and-panel ends with mortise-and-tenon joinery used to frame the drawers, which are nicely dovetailed. The frame-and-panel doors of the upper case also employ mortise-and-tenon joinery, and the crown moulding is held in place with a series of glue blocks.

These wood escutcheons integrate nicely into the expansive wood doors of the Hamlin cupboard over case of drawers.

This use of good wood-to-wood joinery is evident almost everywhere in the Pleasant Hill furniture collection. There are, however, some exceptions, and that's where I think the story of Pleasant Hill joinery becomes very intriguing.

The Exalted Place Of the Lowly Nail

Shaker furniture makers have been revered, in particular since the Shaker chairmaking operation of Mt. Lebanon under the direction of Brother Robert Wagan won acclaim at the Philadelphia Centennial Exhibition in 1876. In fact, at one point in the mid-20th century, this reverence had reached such a point that any country piece assembled with dovetails was apt to be identified as Shaker. That perception was inaccurate – as you'll see, there is some Shaker furniture built to different standards of craftsmanship than you might expect. And that perception was also unfair to those craftsmen in the outside world who made carefully constructed country furniture using dovetails, as well as executing many other signatures of fine workmanship.

While the craftsmanship in the very best Shaker work did, in fact, rival high-style furniture of the period, the Shakers were capable of employing techniques, even in their best work, that modern craftsmen might find unusual or disconcerting.

For example, Shaker craftsmen made widespread use of nails – and not just for the installation of mouldings, but also for structural applications.

During my visit at Pleasant Hill, I did measured drawings of several pieces, including the miniature blanket chest and the hanging cupboard shown above, and several of those pieces, including these two, are held together, – at least in part – by nails.

This nicely proportioned miniature blanket chest features dovetailed joinery on the case itself and simple nails to hold in place the chest's bottom.

Many Shaker utilitarian pieces, such as this hanging cupboard, made use of nails in structural contexts.

The case and plinth of the miniature chest are, of course, nicely dovetailed, but the bottom of the chest is held in place through the use of nails driven through the chest's front and back into the edges of the chest bottom. This is not what most contemporary makers would describe as good joinery. In fact, because the chest bottom has shrunk across its width, there are unsightly gaps visible on each side of that bottom panel when you look down into the open chest from above.

More properly that bottom would have been fitted into grooves plowed on the insides of the chest sides and ends. That technique would have eliminated not only the nails that hold the bottom in place but also the unsightly gaps.

The hanging cupboard, although an elegant manifesta-

tion of the Shaker aesthetic, uses nails for nearly all its structural elements. The sides, top and bottom are nailed together. The bottom and back are nailed in place, as is the frame around the door. Only the door itself exhibits the kind of joinery, through tenons, that could be identified as truly appropriate for that application.

But, having said that, I must then remind myself that the cabinet is still intact, 150 years after its construction. Yes, I would have preferred to find in the cabinet the kind of joinery that a first-class modern maker would employ in assembling such a piece. Specifically, I would have preferred that the cabinet's sides, top and bottom be assembled with dovetails, and I would have preferred to find mortise-and-tenon joinery in the frame around the door. But my preferences have more to do with my woodworking prejudices than with the ability of the piece to survive from one generation to the next.

And I have firsthand knowledge that my joinery prejudices aren't necessarily supported by the facts. In the small stand of trees beside my shop, we have a chicken coop that has a door I made almost 20 years ago from some common-grade cherry boards which, because of knots, wane and sap streaks, were just not good enough to be used in furniture. I built the door when the cherry was green and soft enough to be nailed easily. In the 20 years since its construction, the cherry has hardened and shrunk around those nails, clenching each in a death grip with this result: That door will now never come apart.

I know that hardwood furniture nailed together in such a way is all but indestructible, but my woodworking prejudices, honed by 30 years of cutting wood-to-wood joinery, are difficult to ignore.

The Intersection of Joinery and Aesthetics

The hanging cupboard is made of poplar, a soft material usually green in color, often exhibiting wide areas of gray and black. Poplar is an easily worked species, frequently used by Midwestern cabinetmakers as a secondary wood for drawer sides and bottoms, as well as the interior structural components of cabinets featuring more desirable primary woods, such as cherry or walnut. Poplar is not, however, often itself used as a primary wood, except in the case of utilitarian furniture, such as this hanging cupboard.

I am, therefore, more inclined to accept nailed construction in such a piece. Plus, the cupboard was given a heavy red stain which, when the piece was new, probably all but obliterated any sign of the nails in the finished piece.

The Pleasant Hill craftsmen, however, didn't restrict the use of nails to utilitarian furniture made of poplar and stained red. They also made use of nails in the construction of furniture made of the finest locally available materials, and in the construction of pieces finished natural, used these nails even in places where they could be easily seen.

The chest of drawers appearing below is one such piece. The chest has its mortise-and-tenoned frame pegged together, not with wood pegs, but with nails, the heads of which are clearly visible.

For many years, I repaired antique furniture in my shop, and I sometimes came across constructions like the one appearing in this detail photo. Usually, however, the nail driven through the tenon was a fairly recent addition. Someone, perhaps the current owner, perhaps another recent owner, had opted to fix a weakened glue joint by driving a nail through a tenon. But I suspect the nails in this Pleasant Hill chest of drawers were driven through the

This detail shows the head of a nail driven through a mortise-and-tenon joint.

Shaker craftsmen used nails as structural devices even when those nails were visible and became, therefore, a part of a piece's aesthetic. This chest of drawers, for example, has nails driven through the tenons of its mortise-and-tenon front, as well as nails driven down through the top into the posts on the ends of the chest.

tenons by the Shaker craftsman who built the piece.

I say this for several reasons. First, there is the evident age of the nails. They have been in place so long that the iron in the nails has leached into the surrounding wood, darkening its color. Second, this piece, and some others like it in the Pleasant Hill collection, made such widespread use of nails in similar contexts that this form of joinery appears to have been an accepted method of assembly in the Pleasant Hill workshops under the direction of at least some Shaker craftsmen. And third, this is a technique I have seen not only in the work of this Shaker community, but also in the work of other Shaker communities (as well as in the work of many country furniture makers of the period in the outside world).

In the Pleasant Hill furniture I examined, nails showed up in other contexts as well. Although cabinet tops were typically fastened in place with pocket screws, this method of attachment seems to have been routinely reinforced by nails driven down through the top into the end grain of a table or chest's posts.

When used to peg tenons or to hold down a top, this use of nails is not just a matter of joinery; it is also a part of the Pleasant Hill aesthetic. These metal fasteners are visible to the casual viewer, sometimes glinting reflected light into the eye, drawing our attention to something our modern perceptions of joinery tells us should not be there.

It is in this context that the nails used in Pleasant Hill furniture are most problematic for me. If you drive a nail through a mortise-and-tenon joint some would argue that you have created a powerful joint, particularly after the wood has shrunk down around that nail, but I am, nevertheless, troubled by the fact that the nail head is visible in the finished piece.

The Mystery of the Half-blind Dovetail

When you're cutting dovetails by hand (the only way I know how to

VISIT PLEASANT HILL

Tucked into the rolling hills of the bluegrass region of Kentucky, the Shaker Village of Pleasant Hill is an inspiring place for woodworkers and their families to experience Shaker life. Here you can stay in their buildings (updated with air conditioning and private baths), eat Shaker meals in the Trustee's Office dining room, and explore all the details and trappings of Shaker life at your leisure.

Pleasant Hill includes 34 restored buildings from the community, which existed in the area from 1805 until 1923, when the last remaining resident of the community died. The 2,800 acres includes hiking and horse trails, and a steamwheeler excursion on the Dixie Belle from the village's dock on the Kentucky River.

The Centre Family Dwelling is home to a large collection of Shaker furniture pieces, including most of those in this article (some are in the Meeting House, and can be viewed on daily tours). The other buildings are also loaded with the details of Shaker craftsmanship you've seen in the many books about Shaker work. Plus, you can experience demonstrations of Shaker singing and craftsmanship ongoing at the village.

For those seeking a complete woodworking vacation, Berea, Ky., is a short drive away, which is home to many of the regions best woodworkers (Brian Boggs, Kelly Mehler, Warren May, David Wright and Don Weber to name just a few).

For more information on Pleasant Hill, call 800-734-5611 or visit shakervillageky.org. For more information on Berea, visit berea.com

– Christopher Schwarz

The East Family Dwelling is one of several buildings on the grounds of the restored Shaker community at Pleasant Hill, Ky., in which visitors can stay in comfortable rooms with air conditioning and private baths while enjoying the community's 19th-century ambience.

Pocket screws, like these crudely formed examples, were often used by Shaker craftsmen to hold tops in place.

This nail is driven through the top of a chest of drawers into the chest's end panel.

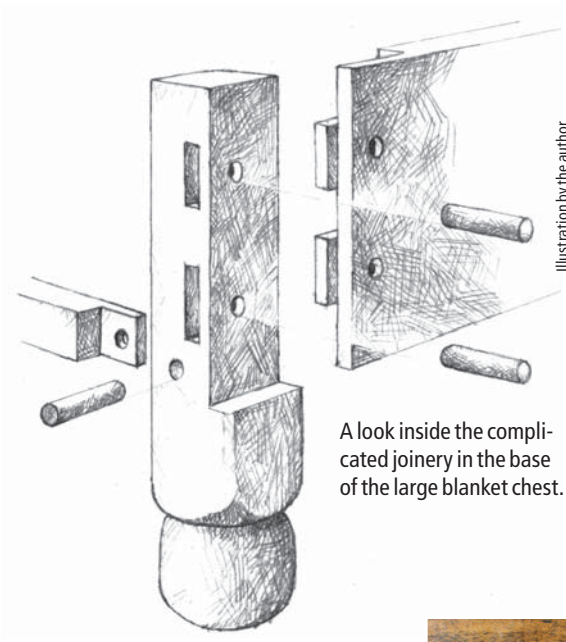


Illustration by the author

A look inside the complicated joinery in the base of the large blanket chest.

This large Pleasant Hill blanket chest features a proliferation of finely cut dovetails as well as an ingeniously executed bit of joinery uniting the post and rail in the chest's base.

cut them and the method used by 19th-century Shakers), the easiest type to cut are through dovetails. Half-blind dovetails are much more time-consuming to create by hand because every socket for every tail must be chopped out with chisels. This probably doubles the time and effort required to cut a set of dovetails, but there are many applications for which this extra effort is justified.

For example, while through dovetails are perfectly acceptable at the back of a drawer, half-blind dovetails are preferred – in most cases – for attaching the drawer front because half-blind dovetails don't allow the joinery to disturb the look of that drawer front. This is because the ends of the tails will be concealed by a covering of wood when the drawer is closed.

It's customary for modern makers who are assembling a case in which all sides are open to the eye to assemble that case with through dovetails. This is because the extra effort required to cut half-blind dovetails seems misplaced when the dovetails can be seen from one side, if not from both. Nevertheless, there are a number of Pleasant Hill blanket chests on which the maker (s) took the time to cut half-blind dovetails on the front corners of the chest but used through dovetails on the back corners.

Puzzling Over Why

If the craftsman's intention was to hide the joinery, full-blind dovetails would have been the correct choice because the half-blind joinery is still visible to an observer standing at the front of the chest. Plus, the backs of these chests feature through dovetails which are visible from both the back and the sides.

And this approach was not used consistently in the creation of Pleasant Hill chests. The miniature blanket chest mentioned earlier in this story was assembled with through dovetails on all four corners, a method that would be used by most modern makers of such casework.

I'm attracted to this puzzle for two reasons. First, I enjoy the process of trying to determine why a maker, separated from me by a century or more, might have chosen to do a thing in a way that – at least to me – seems counter-intuitive. That is, I'm drawn by my nosiness, my unvarnished need to pry. But the puzzle is important in another way as well. If I someday decide to reproduce one of these Pleasant Hill blanket chests, what kind of joinery will I use? The one I found in the original or the one that makes the most sense to me?

The Exuberant Expression of Craftsmanship

Dovetail joinery is the best option when joining one end of a board to another at an angle of 90°. This traditional joint provides mechanical resistance to separation in one direction while providing a significant amount of glue surface to resist separation in the other direction.

The number of dovetails a craftsman might distribute along a 90° corner is determined by the amount of abuse the piece might experience as well as the look the craftsman wants to achieve. If you'll examine the miniature blanket chest on page 40, you'll see a fairly typical distribution of pins and tails for a context like

this. That is, you'll see a fairly small number of fairly wide tails. This is more than enough joinery to keep these sides together. But if you look at the corners of the full-size blanket chest on page 43, you'll see a much different situation. The maker of this chest packed that corner with a huge number of pins and tails. This significantly increased the amount of time and effort required to cut the joinery, an increase that probably can't be explained simply by considering the amount of abuse the chest was likely to receive.

Then why? Why go through the trouble to cut all those pins and tails? Why not lighten the workload with a distribution more like that found on the miniature blanket chest?

Before I offer my best guess at an answer, I'd like to draw your attention to one other feature of the full-sized blanket chest. Look closely at the joinery with which the base of the chest is assembled. When I first examined this piece, I didn't really see the many complications presented by this union of post and rail.

But later – after I'd gotten out a pencil and piece of paper, after I'd taken the time to articulate the cutting of this little flourish of skill – I had what I think is an insight into the mind of the craftsman who made this chest.

He was, I believe, a man who loved joinery, a man who loved the process of carefully fitting one part to another. Maybe that precision was an act of worship, an offering to God, but maybe it was something else as well, something that all of us – regardless of our religious persuasion – can understand. Maybe it was nothing more than an exuberant expression of the sheer joy he found in craftsmanship.

What They Knew

I think we study the furniture of our woodworking ancestors for two reasons. First, we want to grow as furniture makers. We want to know what they knew, and the record of what they knew is written in the work that survives them. But there is another motivation that is, to me, even more important. It is the same motivation that pushed me out of bed at dawn onto the lawn behind the East Family Dwelling.

To the extent that is possible when separated from them by a 150-year chasm of time, I want to know what it felt like to be one of the 19th-century Shakers who produced the marvelous furniture now on display at Pleasant Hill. I want to climb inside their woodworking skin, to feel the heft of their tools in my hands, to experience vicariously the joy they found in the simple act of creating beautiful objects in wood. **PW**

COMING NEXT: MORE GROUNDBREAKING STORIES ABOUT SHAKER WORK

Kerry Pierce's investigation into Shaker life and work has shed new light on the craftsmanship from the woodworkers at the Pleasant Hill, Ky., community.

For our February 2006 issue, Kerry has written a companion piece to this article that examines the decorative details found on Shaker furniture from this community. These details will help make your next Shaker-inspired project more authentic. Following that article, we will publish measured drawings of several pieces of Shaker furniture from the community of Pleasant Hill that have never appeared anywhere, including plans for the hanging cabinet shown in this article. — *CS*

Coming in February 2006: Kerry examines the stylistic furniture details found on Shaker pieces at the Pleasant Hill community. Coming later in 2006: Measured drawings and construction information for building this unusual octagonal-leg table (far right) from the Pleasant Hill community.

WOODWORKING ESSENTIALS

BY DAVID THIEL

CHAPTER 3

Casework Construction: Case Joinery

In chapter three of our continuing look at case construction we're going to take a look at many of the most practical joinery possibilities for building casework furniture.

As you might imagine, this is a huge topic. Casework runs the gamut from jewelry boxes to kitchen cabinetry, and there are literally dozens of ways to form the cases. Some are traditional joinery methods, such as rabbets, dados and dovetails. Others involve more contemporary mechanical fasteners, such as wood screws, pocket screws and biscuits.

Because of the volume of joinery options, we're only going to be able to briefly discuss the different types, the benefits and deficits of each joint and what casework application each joint is best suited for. What we won't be doing is showing you how to make each joint. But plenty of woodworking books can help you with this part of the equation.

Face Frame or Frameless?

Before we dive into the joinery, let's take a moment to review the two main types of case construction. Case pieces can be built with just the sides, top and bottom, with an optional back – this is called a frameless design. Carcases can also be built with a rigid front frame (formed of stiles and rails) added to the front of the box for extra strength (and it does offer a different look, too).

The type of casework construction you choose, face frame or frameless, will help direct you to the proper joinery. In general, a frameless cabinet requires stronger carcase joinery, while a cabinet with a frame can rely more on the frame for strength and use less stout joinery for the carcase. There are, of course, joints that work for both types of cases.

And because we've mentioned frames, we need to look at two distinct categories of joinery as well: Joinery for box construction (frameless), versus joinery for the construction of the frames themselves.

While a dovetail is an excellent carcase joint, it's not a practical frame joint. Similarly, a mortise and tenon is an excellent joint for frames, but is usually impractical for box building.

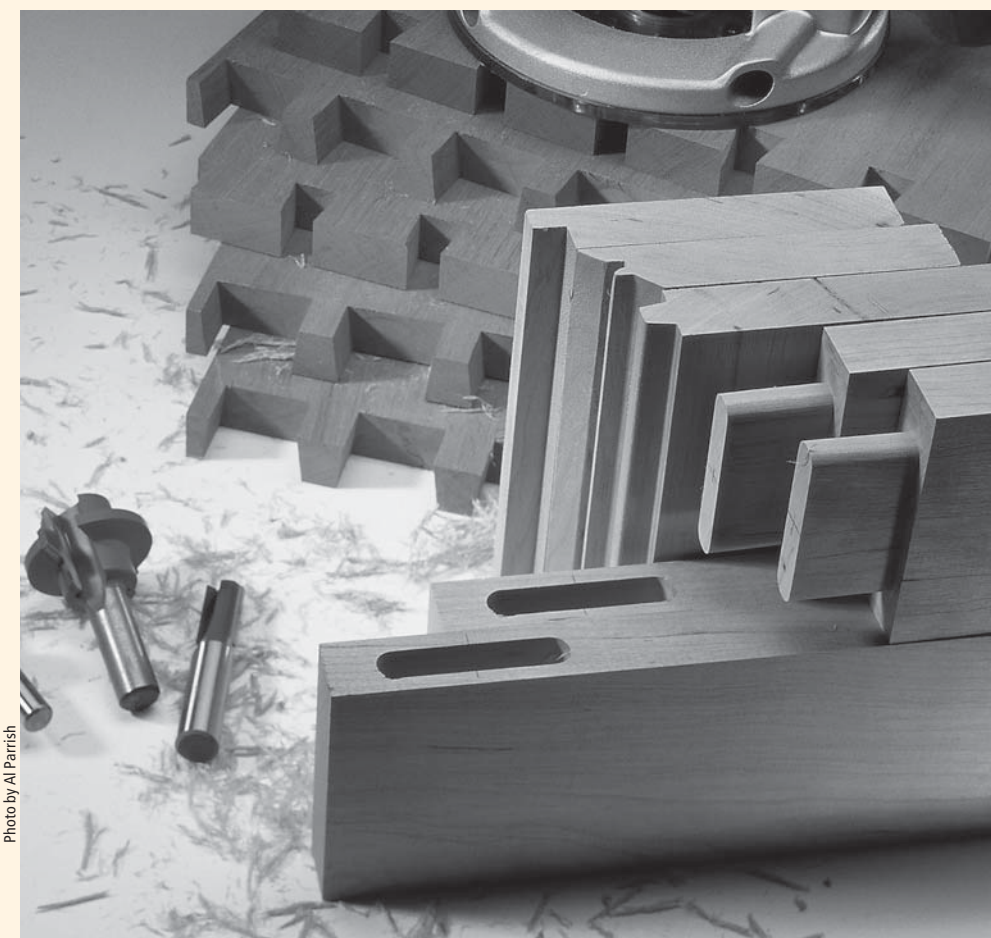


Photo by Al Parrish

Box Joinery Without Frames

Let's take a look at some of the joints that are best used when building a case piece that is purely frameless. The chart at right offers a good/better/best comparison of some of these joints.

Some of the joints that aren't represented on the chart are the more mechanical joints, i.e. screws. Screws all by themselves can be used to hold cabinetry together fairly successfully. The difficulty being they're not very attractive. In a utility cabinet, that's not a problem, but it's not what you want in a piece of fine furniture.

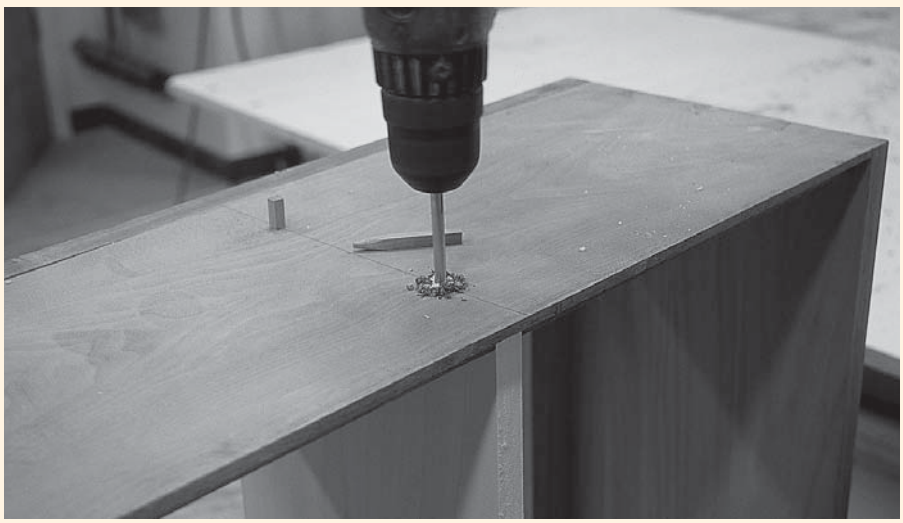
You can countersink the screw and add a plug, but you'll still see the plug. If the arrangement of the pieces allows, pocket screws (below left) are an option. By placing the screws on the underside of pieces, the screws essentially disappear. Or, these holes can also be plugged, as with a standard screw hole.

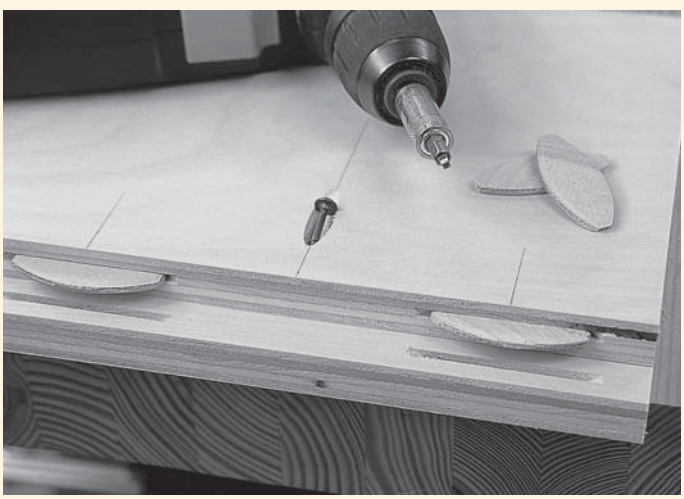
Another mechanical fastener that should be discussed is nails. Whether fired from a pneumatic nailer or knocked in with a hammer, there's lots of commercial furniture that is held together with nails. As with screws, placement is critical for visibility. Nails will add strength to a joint, but not as much as a screw. It's probably better to think of a nail as a fast clamp while the glue dries.

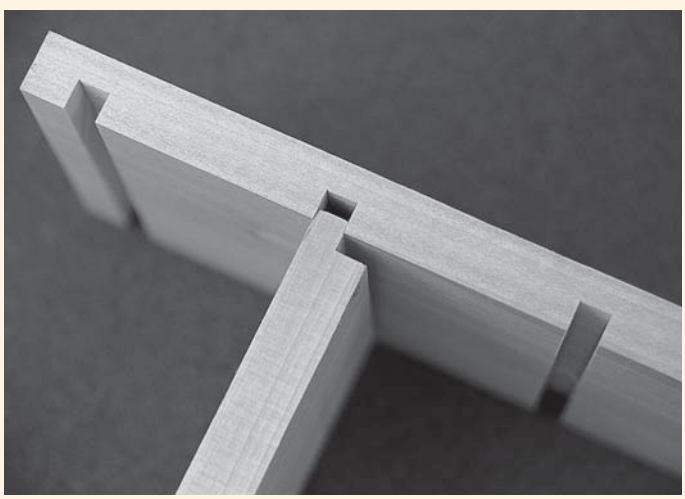
Pneumatic nails do have one benefit over wire nails: The surfaces of the brad nails are coated with an adhesive to hold the clips of nails together. One positive side benefit of the adhesive is that as the nail is driven at speed into the wood, the adhesive heats up, softens and actually serves to glue the nail into the joint.

The more traditional approach to assembling a carcase is to use a wood joint such as a rabbet, dado or dovetail. As you look at the chart, the most obvious piece of information to be gained is that the more complicated the joint, the better it holds. Why? Two reasons. First, as you "complicate" the joint what you're really doing is adding gluing surfaces to the joint. While a butt joint has one

The shelf is fit into a dado, resulting in much better strength than a simple butt joint. By adding a peg or two to the joint, you add even more strength and the opportunity to add a visual element to the piece. In this case it's the proverbial square peg in a round hole. A hole is drilled through the side and into the shelf. A piece of square stock cut to the diameter of the hole is then tapered at one end and driven into the hole. When fully seated in the hole, the peg is cut flush to the cabinet side and sanded smooth. The result is the appearance of a square peg and lots of extra strength.



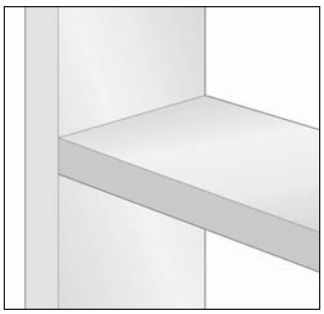




These two examples of joinery would work well for a case piece without a frame. The photo on the left shows plywood construction, reinforced and aligned with biscuits. To add an even stronger touch, a pocket screw is inserted through the bottom and used to pull the joint tight. Veneer tape will hide the plywood edge. At the right, a solid lumber piece is built using a rabbet and dado joint for the top, bottom and shelves.

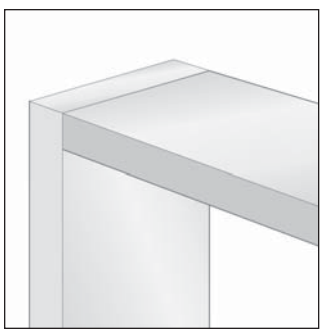
Casework Box Joinery

Good



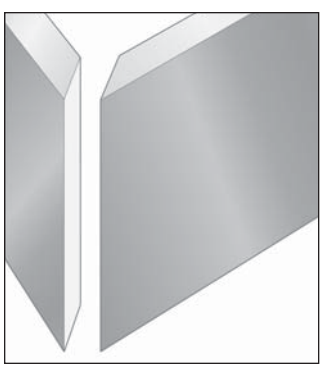
T-Butt

A standard joint for cabinetry, this is a simple but weak joint that requires little investment in terms of time, machinery or tools.



Corner Butt

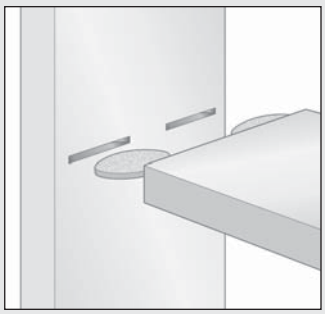
The same simple joint can be used in the middle of a case piece (top) or to form a corner as shown directly above.



Miter

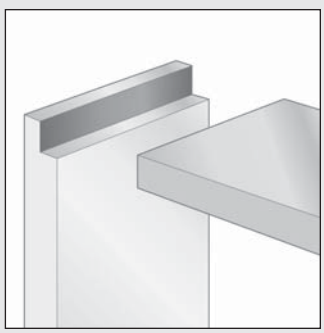
This traditional box joint hides end grain. With most casework, the joint will be short-grain-to-short-grain, which offers very little strength.

Better



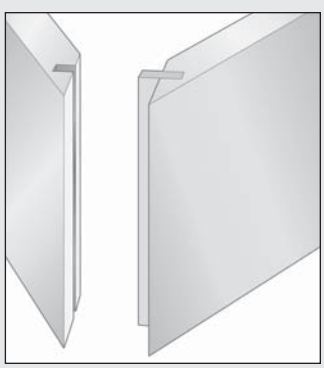
Butt with Biscuit

Adding reinforcement (biscuits as shown, dowels or screws) to a butt joint improves the joint's strength.



Rabbet

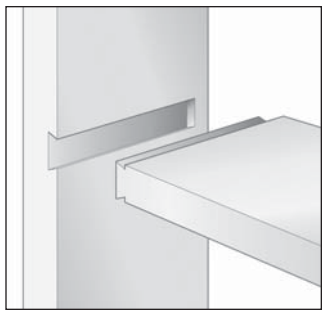
A rabbet joint offers more gluing surface than a butt joint and also adds better support to a corner joint.



Splined Miter

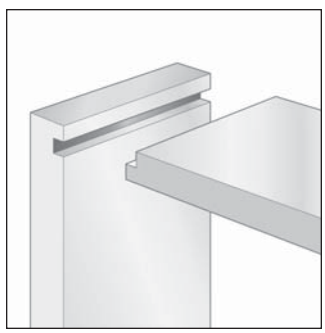
Adding a spline to a miter joint increases strength and improves alignment. It also provides the opportunity for an artistic element.

Best



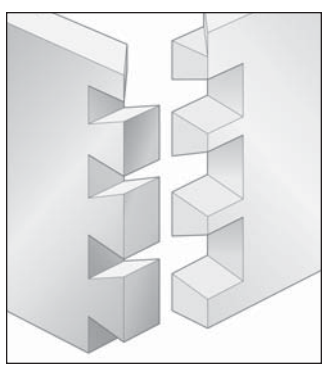
Sliding Dovetail

A sliding-dovetail joint effectively locks the two pieces together for great strength. This joint can be stopped (as shown) or through.



Rabbet and Dado

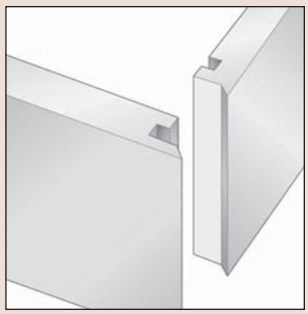
By locking the rabbet in a dado, the strength and protection against racking on this corner joint are greatly improved.



Dovetailed Miter

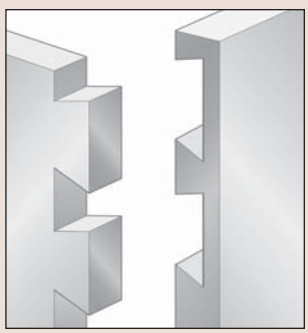
This joint offers visible joinery, but shows only a miter on the edges of the box, which makes it both attractive and strong.

A Step Further



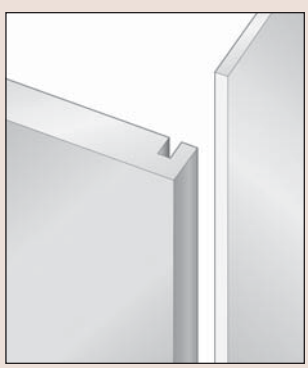
Locking Miter

This joint is an improvement over a miter joint, without adding a biscuit or spline. It offers greater gluing surface and strength.



Half-blind Dovetail

No joint provides as much strength as a dovetail. This joint can be partially visible (as above), completely visible or completely hidden.



Groove and Panel

When it comes to adding a back to a case piece, this joint offers strength and convenience. For a removable back, a rabbet is preferred.

Illustrations by Len Churchill

surface meeting another, a dado joint has three surfaces in contact between the two pieces. You also gain different grain orientation in the joint, which further adds to the gluing strength.

Second, when you move into the most complicated joints you gain locking strength in the wood itself. Dovetails and locking miters are two very good examples of this strength. Even without glue, the sheer mechanics of interlocking pieces of wood adds significant strength.

You're doing the same thing by adding dowels or biscuits to a joint – increasing interlocking strength and increasing the gluing surfaces.

One case joint that I want to focus on for a minute is a sliding dovetail. This is a complicated joint to create, but well worth the effort. And with the proper steps most of the complication can be removed or at least minimized.

A sliding dovetail joint adds tremendous locking strength between a divider panel and case sides, or when using a web frame to complete a case. It not only provides strength to pull the two sides together, but protects against racking (corner-to-corner motion).

Full-depth drawer dividers aren't always necessary in a cabinet. To decrease weight, you can use a dividing rail at the front with drawer runners along the side to guide the drawer. But because you're taking material away, it's more difficult to keep the strength in the cabinet. That's where the sliding dovetail comes into play.

By cutting a dovetail-shaped socket in the cabinet sides and a matching tail on the ends of the drawer divider, a much stronger and lighter case is possible.

Photo by Al Parrish

This drawer cabinet uses sliding dovetails on the drawer divider rails to reduce weight while maintaining case strength. Sliding dovetails can be tricky to execute, but with the proper setup and a little practice, they're a handy option for a need such as this.

Box Joinery With Frames

Now that we've shown that frameless case pieces can be built with joinery that provides excellent strength, why would we want to add a frame to the case? Two simple reasons: strength and aesthetics.

While many case pieces are designed to sit on the floor, such as a dresser or chest of drawers, there are many examples of beautiful wall cabinets that hang suspended without any support below.

Cabinetmaker Troy Sexton understands the best of all worlds. The dresser he's assembling is made of sections that are of frame-and-panel construction. This is a frameless cabinet, so Troy had to be certain of the strength in his joinery. He used the same cope-and-stick shaper knives to form the joints for the visible outside panels and the interior dividers. To assemble the case, he cut dados in the panels to add joint stength. At left, he's using a brad nailer to hold everything together while letting the glue dry. Finally, he nailed on the back, held in place by rabbets.

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Dovetailed Drawers *Every Time!*

Professional tips combined with a professional jig make perfect dovetailed drawers a sure thing.

Building a dovetailed drawer is one of the rites of passage that every woodworker must accomplish. As with most woodworking tasks, proper preparation, the right tools and a little practice can make the most seemingly difficult task simple.

When considering building a drawer, your first question should be, "What kind?" Drawers can be constructed to work with metal drawer slides, with wooden drawer runners or fit to almost perfectly slip into a drawer opening.

When using drawer slides, you need to allow for 1" in width side-to-side, so the drawer must be narrower than the opening. Also, because of the way the slides roll, the drawer sides and back must be at least 1/2" shorter than the drawer space height or you won't be able to get the drawer in or out of the hole. Without metal slides, you gain extra storage space.

Your next decision is what the drawer is going to look like from the outside. You need to know if the drawer should close with the drawer front flush to the face of the cabinet (an inset drawer) or if the drawer front will extend partially (a lipped drawer) or completely beyond (an overlay drawer) the cabinet face. This information will determine both the depth of the drawer and how the drawer front is attached to the drawer sides.

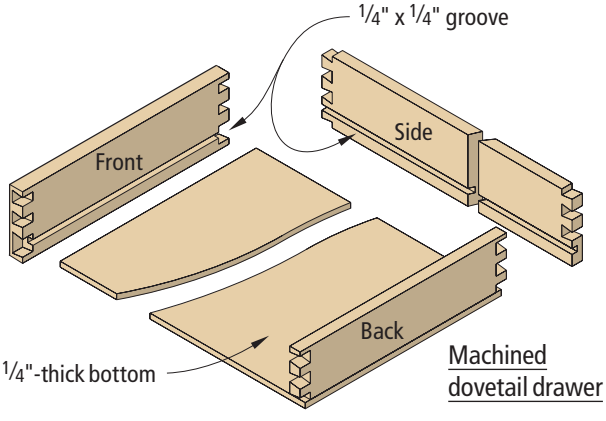
For this article we're going to focus on a dovetailed inset drawer that will fit inside a cabinet that has full-depth drawer dividers (the top, bottom and sides of the drawer space run uninterrupted from front-to-back). Because of this arrangement no drawer hardware is necessary; the cabinet itself will guide the drawer. But the drawer must be sized slightly smaller than the opening (both in height and width) and the depth of the drawer will be critical as well. So we need to start by measuring the drawer space. Our drawer opening is 4" tall x 12" wide, while the depth of the drawer opening is 12".

Our drawer will be constructed of 1/2"-thick poplar sides and back, a 3/4"-thick walnut front and a 1/4"-thick plywood bottom. We'll use machine-made half-blind dovetails on the front joints and through dovetails at the rear of the drawer.

Because the drawer will be inset and flush to the front of the cabinet, it's important that the drawer be only slightly smaller in width and height than the opening, so we're going to build the drawer to be 1/32" less than the drawer opening. This will give us a good starting point, and then we'll sand to fit the drawer to the space. As for the depth of the drawer, here's a secret: We're going to make the drawer about 1/4" shy of the space. Then we glue a 3/16"-deep block to the back of the drawer and plane the block until we have a perfect fit.

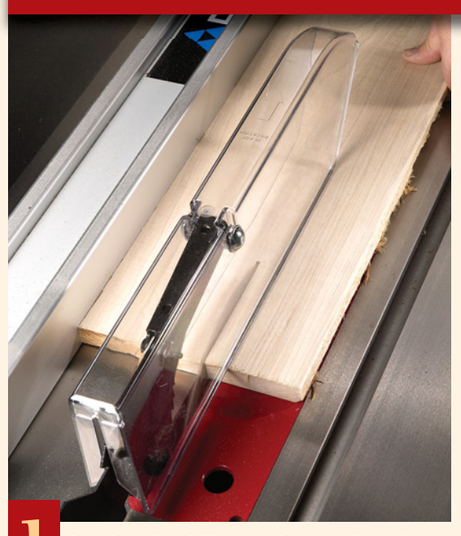
A through dovetail allows both the side and back to run all the way to the corner of the drawer. A half-blind dovetail will hold the drawer sides 1/4" or so back from the front of the drawer. Traditionally, the joint at the front of a drawer is a half-blind dovetail while the joint at the back of the drawer is a through dovetail. That's the plan we'll follow here.

While dovetails can be cut by hand, that takes a certain amount of practice to perfect. A dovetail jig, used with a router, can take a lot of the time and practice out of that process, but you still need to get things set up correctly. The steps and photos on the following page will walk you through the necessary steps to prepare the wood and make the drawer.



12 Steps to Perfect Dovetailed Drawers

LUMBER PREPARATION



1 Lumber should be rough-cut to length and width to make sure you're not preparing more lumber than necessary. Even though you may have found a wonderful 8"-wide board, if you've only got a 6" jointer, it's not going to fit. Luckily our drawer is 4" tall (calling for 4"-wide lumber), so our 6" jointer is fine. But we need to rough-cut the lumber to slightly over 4" wide first.

Remember, when you're buying lumber for a project, allow a certain amount of extra so that you can pick the best grain pattern and avoid any defects in the lumber. We like to allow about 20 percent extra when buying lumber.

2 The pieces for the drawer are fairly short in this case (all around 12" long) and that's about the minimum you want to run through a planer, so leave them longer for now. To square and straighten the lumber, we head to the jointer first.

The first step is to make one face (the broad side of the board) flat. When you run the board over the jointer, make sure that you're not forcing the board flat to the jointer table. The idea is to make the board flat, so if you push the curve out of the wood during this step you just end up with a thinner curved board. Let the knives trim away the high spots on the board. Usually a 1/64" or 1/32" cut is deep enough.

3 Once you have one of the faces flat, it's time to get one of the edges straight. By putting the recently straightened face against the fence you not only get a straight edge, but one that's square to the face as well. Use the same "trimming" action to straighten one of the edges. You may think that you can skip this part if it's not going to be a glue joint, but when you go to rip the board to its final thickness, it's necessary to have a straight, square edge.

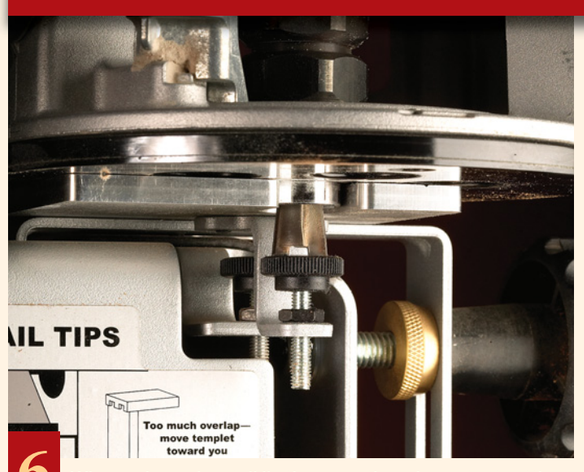
4 With all your pieces straight and square, it's time to head to the planer to get them all to their final thickness. For our sample drawer we're looking for 1/2"-thick sides and back, while the front will finish out at 3/4". Run all of your pieces with the flattened face against the table. Light cuts are the best way to start until most of the opposite surface is flat. Check the thickness of the piece to see how much further you need to go.

Start alternating cuts on both sides of the board to balance out any internal tension and internal moisture in the wood. Alternate one side to the next with each pass until you've reached your final thickness.

5 While you know the final length of the front and back pieces (a hair shy of 12", the exact size of the opening) the depth of the drawer space gets us only half way. Make a test run using your half-blind dovetail to determine how far back the dovetail will start. The standard set-back is about one-third the thickness of the drawer front. Once you get the dovetail working perfectly in the jig, that dimension may be 1/16" off in either direction. Subtract that dimension from the overall depth of the drawer space, then add another 1/16" to the size for fitting.

Crosscut the boards to their final lengths on the table saw using a miter gauge with a stop.

CUTTING THE DOVETAILS

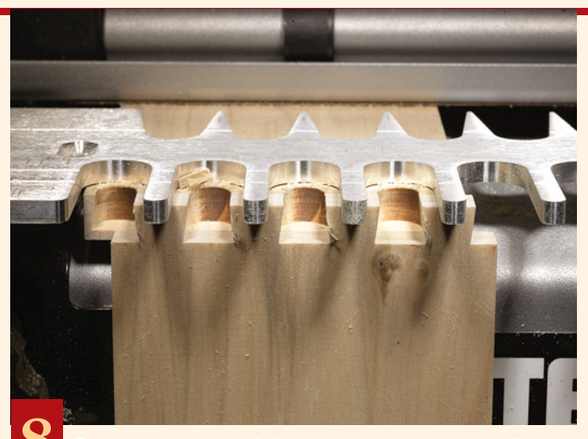


6 When using a dovetail jig there are three important settings to prepare: the position of the wood in the jig, the depth of cut for the bit and how to guide the bit over the template. For the first set of dovetails we need a dovetail bit and a 3/4"-diameter template guide attached to the router base. The collar on the guide fits snugly in the spaces of the jig to accurately guide the router.

With the Porter-Cable Jig we're using, the same template guide collar fits into a built-in bit depth-setting guide mounted on the template. As you fine-tune the joint, you can adjust the guide up or down so you can "remember" the proper depth setting. If you're having trouble remembering all the details, there are even simple instructions printed on the side of the jig to refresh your memory.

7 A half-blind dovetail cuts partway into the drawer front, exposing the joint only from the side of the drawer. The fun part with this jig is that both the drawer front and drawer side can be run at the same time! The front is mounted in the jig horizontally at the top, while the side is mounted vertically at the front. The two pieces are offset slightly and the drawer side is centered on the jig template to make sure the tail spacing is even.

As you start to make your cut, first make a light, climbing cut (from right to left) over the face of the board to define the edge. This way, as the router is backed out of each guide space, the risk of tear-out is minimized. Always run a test piece and check the fit. It's time (and material) well spent. When everything is set correctly, your finished joint will look like this in the jig.



8 For our drawer we're following the traditional dovetail drawer pattern of using a through dovetail joint at the rear of the drawer. To make this joint you need to use two separate setups on the dovetail jig: one to cut the tails (which we'll do first) and one to cut the matching pins. When cutting through dovetails, you can't run both pieces of the joint at the same time as we did with the half-blind joint. Both the sides and drawer back will be mounted vertically in the jig.

To cut the tails you use the same 3/4" template guide and dovetail bit as used in the half-blind step. An additional template is used in place of the template used for the half-blind dovetails. Set up the template with the side marked for the tails facing you. Once again, use the jig's router depth guide to set up the bit depth (to approximately the thickness of the drawer back). A scrap piece is placed in the horizontal position of the jig directly behind the drawer side. This scrap piece eliminates tear-out on the back face of the side during the cut.

9 The next step is cutting the pins on the back board. This requires a change of template, as well as a change of router bit and template guide. Simply turn the template around to direct the angled tines to the front of the jig.

The drawer back is mounted at the front of the jig, just as the sides were. The waste board can be turned to present a fresh, uncut edge, but it's a good idea to align the scrap board to fit directly behind the side piece. If you don't, there's a chance of tear-out on the last pin as shown in the photo above. You also need to switch to a straight bit and the 5/8" template guide for this step. As before, the template offers an adjustable bit-depth guide for this step. Adjust the depth of the bit and get ready to cut.

Because the bit is removing more material in this step, start at the left of the jig and walk the router into the first space allowing the template guide to ride along the left side of the space on the push in, and along the ride side of the space as you exit the space. Repeat this process along the template.

ASSEMBLING, FITTING AND FINISHING THE DRAWER

10 We used two rip cuts on the table saw to form the 1/4" grooves for the bottom. Test your bottom material to adjust the groove for a snug fit. Run the front and sides, but don't run the groove in the back. The drawer could be built to trap the bottom in grooves between the sides, front and back, but this makes finishing the drawer more difficult. Instead, the bottom is designed to slide in and out of the grooves. To do this, the width of the back is reduced to allow the bottom edge to stop at the top of the grooves on the sides. Adjust your rip fence, raise the blade and make that cut on the back piece.

11 There's one extra step we like to take in making a drawer, which is to round over the top edge of the sides to give the drawer a more hand-friendly feel when it's opened. We make the cut in one pass with a 1/2" beading bit in the router table. Set the fences on the router table to make a cut leaving just the slightest part of the edge uncut. This allows the edge to ride evenly on the fences and avoids snipe at the end of the cut.

Before you assemble the drawer, sand the interior surfaces through 120 grit (it's much easier to sand the interior before assembly). Then add glue to the interior surfaces of the pins and tails and use a non-marring mallet to tap the drawer together. The fit should be snug, but you shouldn't have to force the pieces together. Clamp across the sides of the drawer placing the jaws of the clamps directly behind the joint to allow the sides to fit fully into the joint.

12 Next, measure for the drawer bottom between the inside of the grooves and to the back edge of the drawer back, then cut the bottom to size.

Now check the drawer's fit against the drawer opening. Sand or plane the sides and bottom edges of the drawer to allow the drawer to slip in without any force. Push the drawer all the way into the case and measure the recess at the front. Cut and glue a slightly larger block to the back of the drawer and plane the block to a perfect flush fit. To allow the same gap around all four edges of the drawer front, take a block place and slightly bevel the bottom front edge of the drawer front to leave a slight shadow line matching the gap at the top and sides.

Finish-sand the drawer and wipe or brush on the finish of your choice. Then slide the bottom into place. Check the drawer for square one last time, and then nail the bottom in place into the drawer's back piece.

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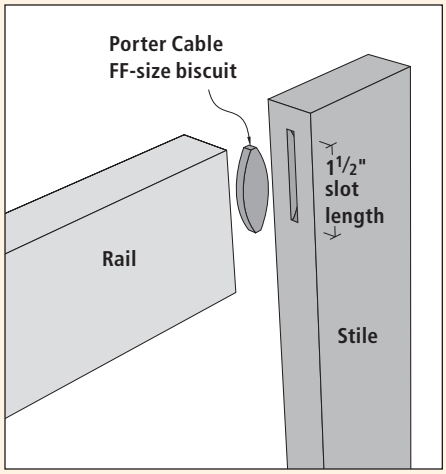
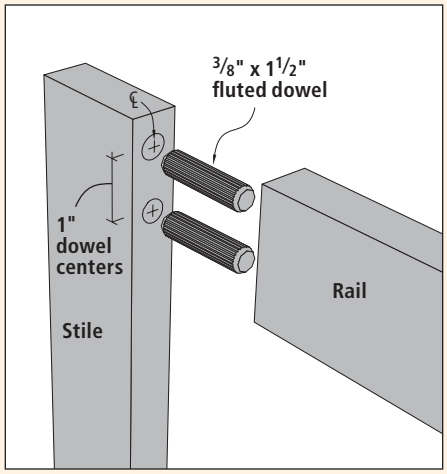
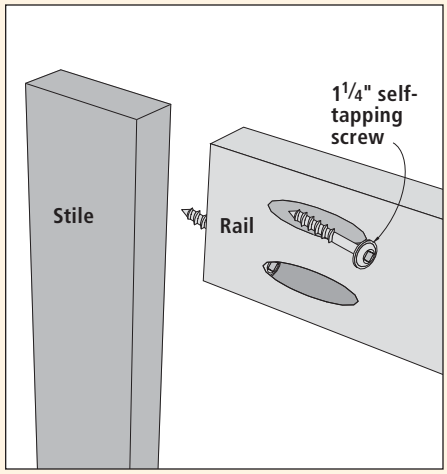


Biscuit joints can work well in face-frame joinery, but don't assume you can use a #20. You need a smaller biscuit so the joint won't show.



Dowels are a decent alternative for joining face frame parts, but they can be tricky to align to get the faces perfectly flush.



Pocket screws add lots of strength to a face frame joint. And unlike other types of screws, these are easily hidden on the inside face.

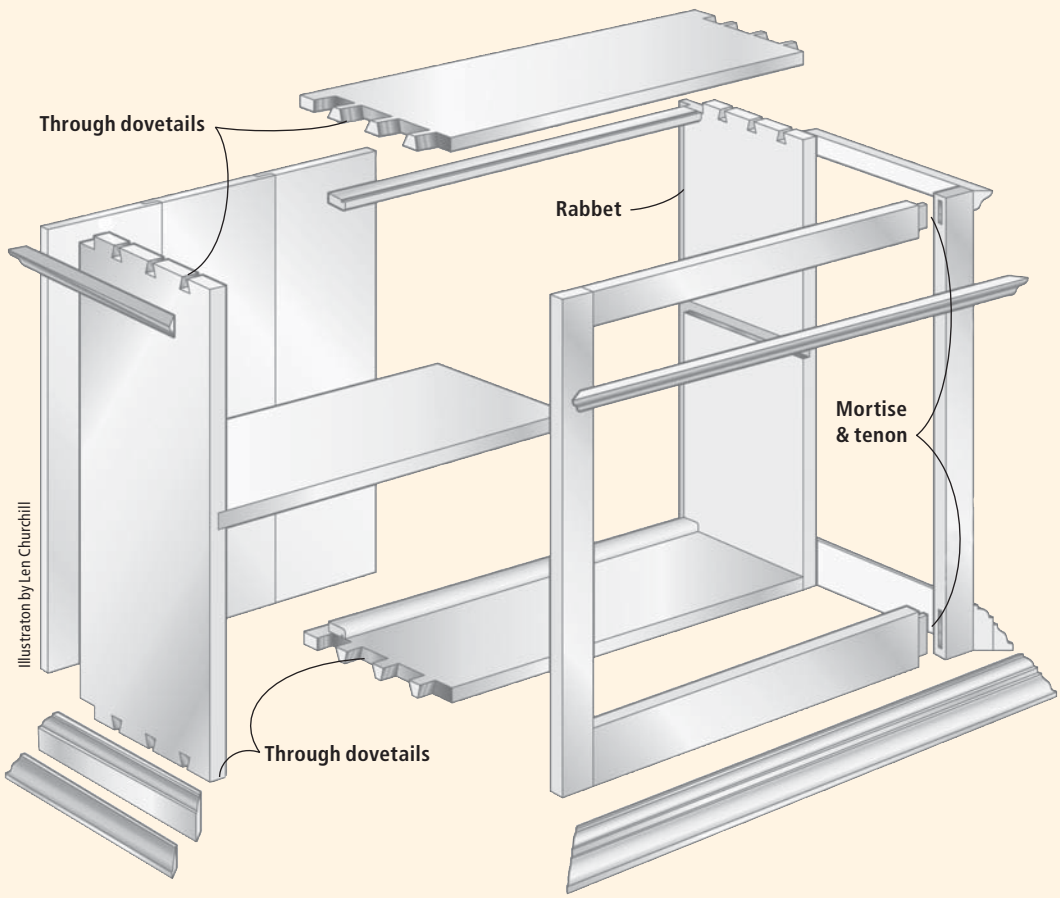
If your wall cabinet is going to store books or dishes, you're going to need all the strength you can get to counteract gravity. That's one good reason to add a frame to an already strong case.

The second reason is aesthetics. Sometimes a traditional cabinet you're building calls out for a face frame. Even if strength isn't a concern, the look of a face frame can dress up what some might call a plain piece of furniture. If you're adding a face frame for looks, then strength isn't your first concern and so the joinery used on the frame itself can be of many different styles.

Face-frame Joints

Face frames on cabinets are close cousins to frame-and-panel doors. Many of the same joinery options are available for face frames as are used in making doors. To determine what joint is best for the application, you need to look at the strength and appearance requirements.

In some instances a butt joint is possible on a face frame. This would be one of those aesthetic situations where a case is already plenty strong on its own, but you want the look of a face frame. The frame is then simply glued or nailed to the case and the stiles (the vertical pieces) and rails (the horizontal pieces) are butted together. While this is fre-



At left is a diagram of a hanging wall cabinet. When a case piece like this is hung on a wall, strength becomes an important factor. With no floor to support the weight, the joints have to be even more reliable. This piece uses strong joints in the box itself, with through-dovetails at the corners of the case. The solid wood back is rabbetted into the case, then fastened by nails. The face frame is assembled with mortise-and-tenon joints in the corners then glued to the box. The frame-to-case strength can be increased even more by pegging the frame in place. There is a lot of strength in this cabinet's joinery.

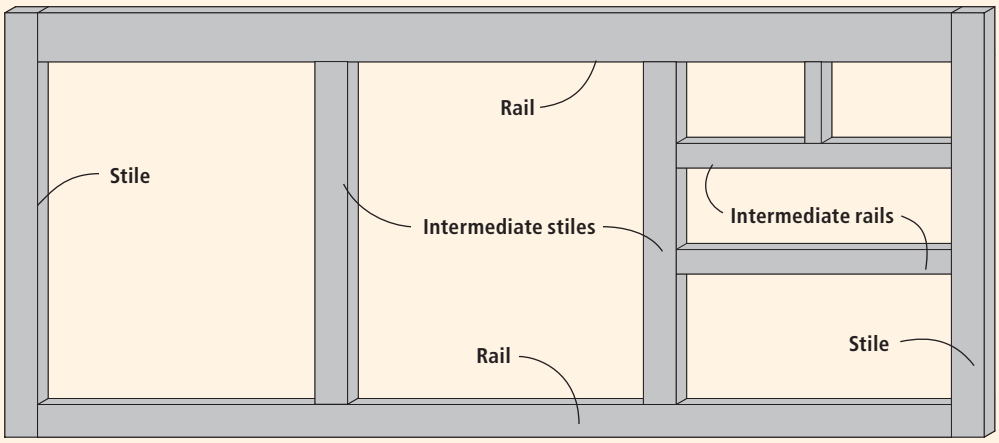


Illustration by David Thiel

When talking about face frames for cabinetry, it's a good idea to know what to call all the pieces. The outer vertical parts are stiles (and always run through), while the horizontal parts are rails (and always run between stiles).Of course, there are circumstances where other terminology is necessary. When stiles and rails are within the perimeter of the frame they are intermediate stiles or rails.

quently done in commercial furniture, I'm going to suggest you go a step further (as a woodworker, you owe it to yourself). The butted ends can move over time leaving a sloppy-looking joint.

Some modern mechanical options for face-frame joinery include biscuits, dowels and pocket screws. All will add strength and even accuracy in aligning the pieces at the joint. Nails (air-powered or not) aren't a good option with face frames as they're likely to split the wood when you work near the ends of boards.

Beyond the mechanical options, some interlocking joints that work well include a half-lap joint or bridle joint. These joints offer a reasonable gluing surface to hold things tight over time, but are still fairly quick to create. The strength is moderate, but certainly better than a butt joint.

Because we're speaking of aesthetics, consider using a lapped dovetail. This variation on the half-lap adds an interesting visual element and also adds some strength to the joint.

But when it comes to making a face frame for strength, the mortise and tenon is the way to go. This joint has been around for millennia – really! And it can be easily created with a router alone, a mortiser and table saw, or with simple hand tools.

To make sure your mortise-and-tenon joints are as strong as possible, here are a few rules to follow:

1. If you're using a mortiser to create your joint, the tenon thickness should be one-half the thickness of the stock piece. So if you're using $\frac{3}{4}$"-thick material, the tenon should be $\frac{3}{8}$" thick. For creating the joint with a mallet and chisel, one-third the material thickness is preferable.

2. To avoid tearing out the wall of the mortise at the end of the joint, set the mortise (and the tenon) back from the end, leaving at least a $\frac{3}{8}$" edge shoulder on the tenon.

3. In general, the tenon length in casework should be no shorter than 1", and $1\frac{1}{4}$" is a reasonable length.

If you'd like to consider another option to the standard mortise and tenon, how about a loose tenon? The beauty of this joint is that the mortises can be made in a drill press and the loose tenon pieces can be run off in mass quantity on a table saw. Then the tenon edges can simply be rounded with a router. This joint offers the same strength as a traditional mortise and tenon without quite as much fuss.

The mortise-and-tenon joint does one other thing that a face frame is very good at: it keeps the cabinet square. A mortise-and-tenon joint (when properly constructed) is a very rigid, square frame

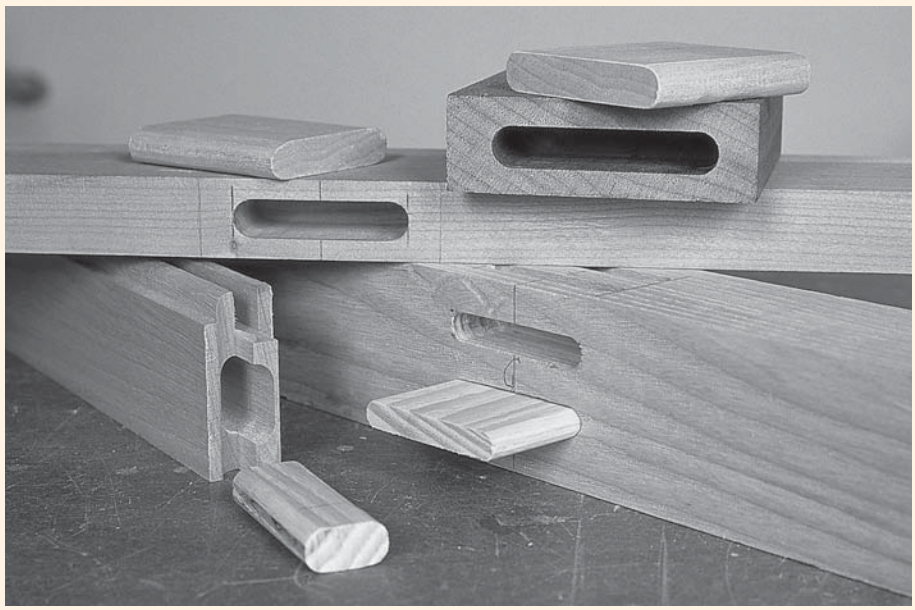
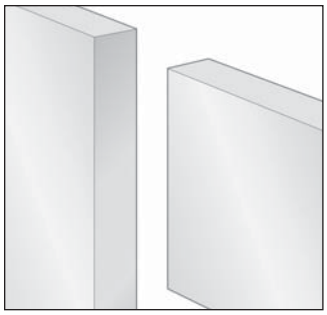


Photo by Bill Hylton

Loose tenons are a simple option over the traditional mortise and tenon. While you still need to machine the mortise (two in fact), this is more easily created on a drill press or plunge router with a straight bit, tools you likely already own. The tenons themselves are easily created in bulk using the table saw and a router.

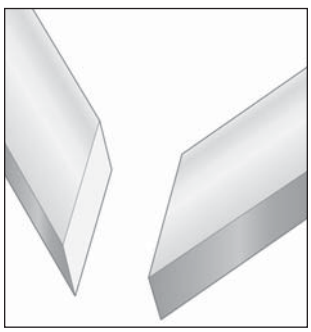
Casework Frame Joinery

Good



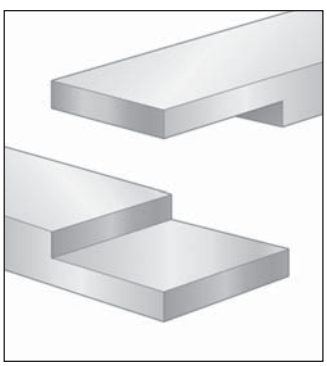
Butt

This joint really doesn't belong in the "good" category. It's structurally weak and provides poor glue adhesion.



Miter

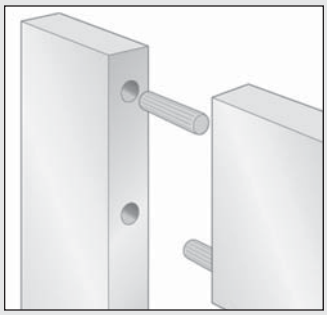
A corner miter offers slightly better strength than a butt joint because of the short-grain match, but it still won't hold up to much abuse.



Half-lap

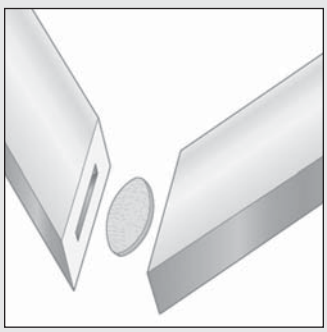
A good corner joint, the half-lap adds strength and more gluing surface, but requires accurate machining and is a very visible joint.

Better



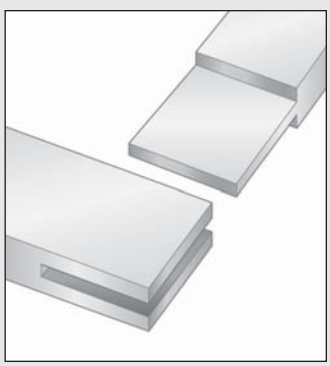
Butt with Dowels

Adding a mechanical fastener (spline, biscuit or dowels as above) greatly improves the strength of this corner joint.



Miter with Biscuit

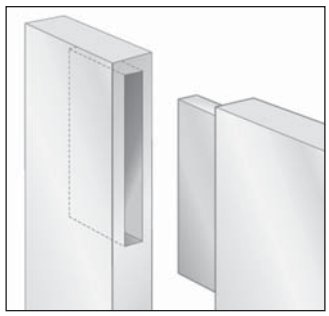
Biscuits offer improved strength and alignment for what can be a tricky and weak corner joint. Dowels are also an option here.



Corner Bridle

Better than a half-lap, the bridle joint offers greater strength, more gluing surface and security against racking.

Best

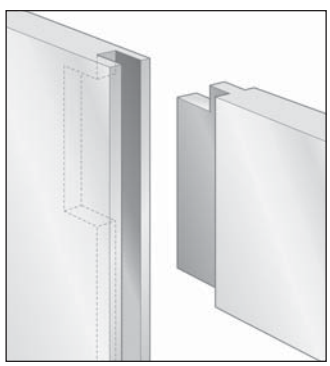


Mortise and Tenon

The ultimate in frame strength, the mortise and tenon guards against racking, is strong with lots of gluing surface and is invisible.

Miter with Spline

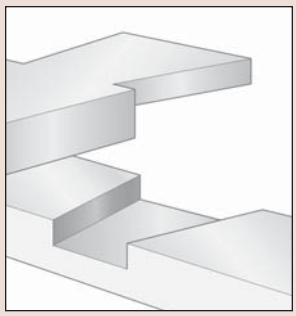
Another way to strengthen a corner miter is with a spline. Beyond the adding gluing surface, a spline can be used as a decorative element.



Haunched Mortise

A variation on the mortise and tenon, this joint allows a panel to be added into the assembly with less work than a cope-and-stick joint.

A Step Further

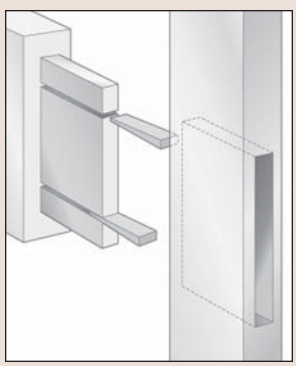


T-Lap Dovetail

Better than a half-lap, the dovetail lap adds locking strength for either a corner joint or mid-rail joinery, but requires even more accuracy.

Cope & Stick

Frames in casework needn't always be plain. A frame-and-panel design dresses up a piece and adds strength.



Wedged Through-tenon

A great visual element and very strong, the wedged through-tenon takes some practice but adds amazing strength.

Illustrations by Len Churchill

and you can actually use it to square up a cabinet that may have joinery that allows more play than is preferable.

I mentioned cope and stick. This is a joinery technique most often reserved for doors because of the edge detailing accompanying the joinery. But this joinery technique can be used for cabinet sides as well, to excellent effect.

With the face frame complete, it needs to be attached to the cabinet. In most cases glue and clamping work fine, but a couple of brad nails can help as well. You could also use biscuits or pocket screws if you feel alignment help or quicker assembly time is a benefit.

Back Joinery

Now that we're at the back end of the article, I should say a couple of words about back joinery (sorry – couldn't resist). One of the most common methods of adding a back to a case piece is by milling a rabbet at the back edge of the sides, top and bottom. The rabbet can be adjusted in width to accommodate 1/4" plywood backs, or 1/2" or 3/4" solid backs, depending on your requirements. One tip: if you're making a large case piece that will be mounted to the wall, it's a good idea to recess the back slightly (1/4"). Thus, any imperfections in the wall won't keep the cabinet from fitting tightly against it.

If you're using a solid back, there's joinery that will help span what can be a very large area, while at the same time counteracting any problems with wood contraction or expansion due to changes in humidity. A shiplap joint or tongue-and-groove joint make using solid wood safe. And these joints leave an attractive back in the case.

Those are the basics of case joinery. With this information, you'll be able to choose the best joints for strong and attractive furniture. **PW**

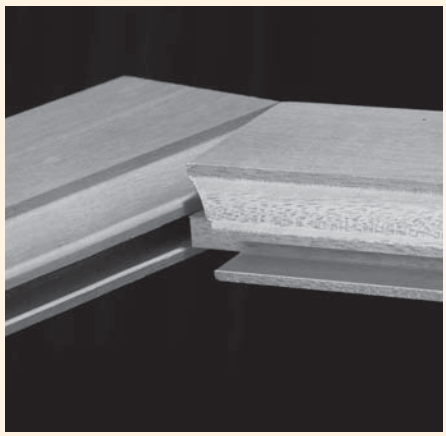


Photo by Al Parrish

The cope-and-stick joint is a standard for most frame-and-panel doors. But the same joint can be used to create panels for casework. The profile on the cope and stick can vary greatly, but an ovolo, as shown above, is very traditional.

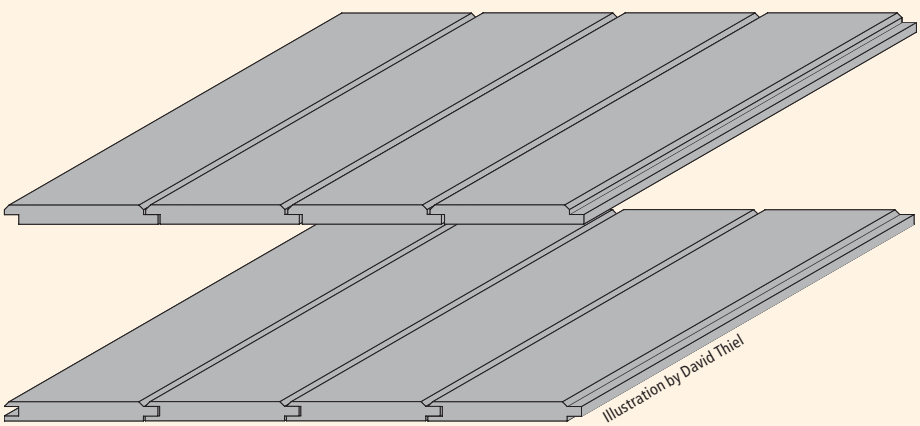


Illustration by David Thiel

Two joints for solid backs are the shiplap joint (top) and the tongue-and-groove joint. Both allow a solid wood back to move with seasonal humidity changes. The shiplap joint requires slightly less accuracy, but the tongue-and-groove joint offers a locking feature to counteract any warping.

Best New Tools of 2005

We test a fair number of tools and machines here at *Popular Woodworking*, but some years generate a different crop of "Best New Tools" than other years.

In 2005, we actually didn't get to test as many of the serious cast-iron machines as we usually like. This wasn't part of some plan, it just worked out that way. Look for us to make up some time in that department in 2006. But as a result, you aren't going to see any table saws, planers or band saws on this year's list.

The other thing fertilizing this particular harvest of new tools has been the undeniable bumper crop of high-quality hand tools. For years, this sleepy side of the tool-making world was dominated by big corporations that weren't investing in innovations in quality hand tools.

And as these tools slipped in quality, many woodworkers became uninterested in using them. But thanks to Veritas, Lie-Nielsen Toolworks and other small manufacturers, we are officially in a second golden age of hand-tool manufacturing. Many of the hand tools available today are as good (or even better) than those produced during the creative apogee of our craft.

If you've ever been frustrated by your dime-store chisels or flea-market planes, I urge you to try again. Purchase a small block plane or a chisel from one of these new companies and I bet you'll find that it will flip a switch in your head. These tools really work.

As always, the hand-held power tool market is highly competitive, and the new crop of these tools has some big surprises. Who knew that you could make a laminate trimmer this powerful (Bosch did), or that you could make a jigsaw that cuts right up to a wall (DeWalt found a way).

One last note: We've tested all these tools in our shop. You might not agree with our preferences, but they are real and they're based on some real shop time by woodworkers just like you.

— Christopher Schwarz, editor

The Winners

Bosch
DeWalt
Festool
Grex
JessEm
Jet
Lie-Nielsen
Powell Manufacturing
Ray Iles
Veritas

Bosch PR20 EVS Palm-grip Router

877-267-2499 or boschtools.com

Trim routers have been a mainstay in the laminate industry for years. But as these one-handed tools have acquired more features and power, they have migrated into woodworking shops. With the release of the new Bosch Colt, we think your fixed-base router is going to get a little jealous.

The Colt – called the PR20 EVS – is a 5.7-amp tool that wears a 1-horsepower sticker. Horsepower ratings aside, the pint-sized tool packs real punch. Need to round over a table edge? No problem. Need to trim patterns flush? This tool and its small base will get you in tight places your router could never go.

In fact, we think your fixed-base router might get a vacation once the Bosch lands in your shop. It has enough power to do any chore that a 1/4" bit up to 1 5/16" in diameter can handle, including hinge mortising and even dovetailing. We tested the variable-speed model ($132), with speeds between 16,000 rpm to 35,000 rpm, though there is a single-speed model available, the PR10E ($100).

Other great features: The tool's coarse and fine depth adjustments let you quickly get your depth real close and then dial it in perfectly. There's a collet lock for one-wrench bit changes, and the top of the tool is flat so it sits firmly on your bench during bit changes. And the tool's power cord is nice and long.

This colt is going to stay in our stable.

DeWalt DW331 Jigsaw

800-433-9258 or dewalt.com

We never cared much for the last generation of DeWalt jigsaws. The blade changing was tricky and the tool never ran as smoothly as a Bosch. But the new DeWalt DW331 is a curve-cutting maestro. Everything we disliked on the old tool, we really like on this new and very-much-improved jigsaw.

First, the radical stuff: This jigsaw cuts right up to the front of the tool's shoe. No other jigsaw does this magic trick, and it will save your bacon the next time you want to work right into a corner. You'll need a special DeWalt blade to do this, and this special blade will reduce your curve-cutting capacity while it's installed. But hey, it's great feature.

Everything else about the tool is quality, too. The blade changing is as easy as anyone else's on the market – flip a lever and the blade falls out. The shoe bevels without any tools (with stops at the common angles), there's a blower you can easily turn off and on, and the DW331 is compact, balanced and has a nice long cord.

In the motor department, it's got the guts to cut countertops with a standard 1" blade stroke and variable speed between 500 and 3,100 strokes per minute. Costing about $150, it's a fair price for a premium jigsaw that we think is a challenger to the throne.

Festool BPS 12 Cordless Drill

888-337-8600 or festoolusa.com

I don't like disposable tools. And I'm particularly irked by how quickly my cordless drills meet their demise. First the batteries go, then the brushes fry, then the motor cooks.

So when Festool officials said their new drill would sink a million screws, I sat up and paid attention. No, the battery won't last that long – you'll still get a limited number of charges from the 1.3 amp-hour NiCd. But the motor is brushless, and after extensive stress-testing, the German engineers could find no evidence of wear in the tool's motor. So you'll need to buy new batteries, but (perhaps) never a new drill.

There are more improvements. The BPS 12 is more than a half-pound lighter (at 4.02 lbs.) than my previous favorite drill, the Festool CDD 12 FX. That's significant. The grip is narrower and softer, which makes it easier to hold. The balance has improved, as have the clutch controls. Plus the drill is even quieter than any of the 20-odd others in our shop – you'd be surprised by how much a drill whines.

Festool officials were concerned that this drill wouldn't sell well in the American market. Like all quality equipment, this drill costs quite a bit ($345). Consumers seem to like – or be accustomed to – buying a new drill every two years. So a lifetime drill might be a hard sell.

I say we should prove them wrong.

Grex 23-gauge Headless Pinner

888-447-3926 or grexusa.com

In the interest of full disclosure, know this: We're fools for 23-gauge headless pinners. There's no better pneumatic tool for attaching delicate mouldings without worrying about splitting the work.

The only limitation we've encountered with these fine air guns is that they generally only fire pins up to 1" in length. That does get you most of the way there, but more often than not, we want a 1 3/8" pin for attaching 3/4"- or 7/8"-thick moulding. Our prayers to the pneumatic goddess were answered this year with the Grex P635 headless pinner.

This tool goes to 1 3/8" (1 1/8" and 1 3/8" pins are available from suppliers). If that's all the tool did, we'd be happy. But the Grex goes a step further; it's a well-designed gun.

The fit and finish is excellent, for starters. It also exhausts out the rear and has a silencer. The safety on the gun is both safe and convenient. And the magazine for loading the pins is thoughtfully designed: A small metal clip keeps the pins from falling out of the magazine when you open it up, and the magazine automatically adjusts for different pin sizes (some pinners require you to reconfigure the magazine when you change to a different length). Plus, the tool's shape and size allow you to get in tight spaces under mouldings. It's pricey ($199) but we're completely sold.

JessEm MastRSlide 7500

866-272-7492 or jessem.com

For more than a decade, we've struggled to find the perfect crosscutting attachment for our table saw. We've been through other sliding tables and just about every high-end aftermarket miter gauge.

All left something to be desired for us, but we've been especially frustrated by the sliding tables. The ones that sit on the shop floor go out of alignment with just a hip check. Others tables just couldn't hold the tolerances we wanted during normal use.

Our search for the perfect sliding table ended this year with the JessEm MastRSlide ($540). This table system takes up little space, is lightweight, has all the capacity a traditional shop would want and can be used on a saw with a mobile base.

But the real reason we love it is this: You can make a square crosscut, remove the fence for ripping and then return to crosscutting without realigning everything. No other sliding table system has given us that feature day-in, day-out.

The JessEm does a lot of fancy mitering tricks, and the fence can be positioned at the front edge, back edge or near the middle of the sliding carriage. And the fence telescopes to handle stock up to 48" long. You'll be seeing it in step-by-step photos in future editions of our magazine – this one is a keeper.

JET Parallel-jaw Clamp

800-274-6848 or jettools.com

We've always been particular in our preference for the red Bessey parallel-jaw clamps in our shop. But this year Jet has introduced its own line of red parallel-jaw clamps that in many ways are better than our trusty Bessey K-bodies.

These Jet clamps are far less fussy to engage and release. They have bigger clamping faces that allow them to be used on edge. They have a kickstand at the end of the bar to prevent the clamps from tipping up. They can be turned into a spreader clamp. The handles are bigger and easier to grip.

And, of course, the Jets apply all the pressure right where you need it with almost no flexing of the bar (we tested all of the clamps in our shop and found these flex the least). And although we've been using them for less than a year, we anticipate they will be quite durable. The main screw thread is a tough Acme-style design. And we've dropped them repeatedly with no damage to the red composite resin cladding.

Available in 12" to 98" lengths, we found the Jets priced between $33 and $70 each, depending on the size. This actually was a bit more than K-body clamps at press time, so be sure to shop around when you're ready to buy because prices could change.

Lie-Nielsen Convex-sole Block Plane

800-327-2520 or lie-nielsen.com

We generally reach for a hand plane when we wish to make a surface flat or true. But this year Lie-Nielsen Toolworks has introduced a small block plane that will make you think about curves and depth.

Based loosely on the long-gone Stanley 100½ model-maker's plane, the Lie-Nielsen version has a sole that curves in two directions. From front-to-back, the sole is a gentle 27" radius. Across the width, it's a considerably tighter 3" radius.

What's this tool good for? If you make seats for wooden chairs or stools, you will find this tool easier to wield than a traditional travisher – especially if you already have block-plane skills. I also use it for sneaking into crown mouldings to remove router burn marks or to trim two mitered concave surfaces. It is, quite simply, a plane that will go places that you would never before go with a plane.

Like all Lie-Nielsen tools, the company has improved on the original. This plane has the cutter pitched at a low angle – you insert the cutter with its bevel up. This makes the plane more comfortable to hold and allows you to easily sharpen a steep pitch on the blade to reduce tear-out – for chair seats, this is invaluable. Also, the body is made using indestructible ductile iron. At $85, it's a small price to pay for entering the third dimension of planing.

Powell Manufacturing Odate Crowning Plate

781-237-4876

Long-time readers know that we're fans of sharpening jigs. We've watched beginners struggle far too much to simply allow them to flail while freehanding.

One of the biggest challenges in sharpening a plane iron for a jointer or smoothing plane is establishing a slight crown – sometimes called a camber – on the cutting edge. You need this camber to plane a board without leaving gutters behind. To sharpen a camber, it usually takes selective pressure on the corners. Even with a jig this takes some practice.

Now Japanese woodworker Toshio Odate and diamond sharpening expert David Powell have developed a diamond sharpening plate system that allows you to camber the blade reliably and easily – even your first time out of the gate. The 3¼" x 7¼" plate is available in a variety of grits from #220-grit up to #1,200 (I recommend the #600-grit for most work). The plates have a slight (.0025") dish to them. So you simply sharpen the tool like you would a straight-edged blade, but the plate sharpens a perfect camber at the cutting edge. You can then easily refine this edge on your polishing stone or you can buy one of the Odate plates that will dress your waterstones so they also have this slight dish.

A curved blade is the secret to excellent work with a hand plane, and this sharpening aid is well worth the $110 in our book.

Ray Iles Mortise Chisels

800-426-4613 or toolsforworkingwood.com

If you've ever tried mortising with a mortise chisel I bet you've been frustrated and wondered how our ancestors did it. Sure they had more hand-tool skills, but they also had the right tools.

Almost every mortising chisel I've ever used has been designed to make mortising difficult. They are too lightweight or – even worse – they are ground poorly and twist in use. Ray Iles, the son of legendary toolmaker Ashley Iles, has finally fixed this problem by introducing mortising chisels based on hard-to-find 18th- and 19th-century tools. And, more importantly, he has made them with the details and attention to quality that will allow you to mortise with incredible speed and accuracy.

The Ray Iles mortisers are made using durable D2 steel. The sides of the blades have been ground with a slight trapezoidal shape, which makes them easy to withdraw from the cut. The beech handles are tapered in two directions so they are easy to keep square in the cut. And the tools are heavy, which makes them beaver through the wood like no other new mortising chisel on the planet.

The chisels come in 1/16" increments from 3/16" up to ½" and prices from $53.95 to $97.95. Here's our recommendation: Buy the 5/16" or ¼" chisel and give it a try in some ¾" stock. We think you'll be convinced after cutting the first joint that these tools are a different kind of animal.

Veritas Bevel-up Bench Planes

800-871-8158 or leevalley.com

If you use bench planes, your core set should include three tools: a jack, jointer and smoothing plane. Used together, these three tools flatten and smooth surfaces, and perform many other workshop tasks.

This year, Veritas introduced two tools – a jointer plane ($225) and a smoothing plane ($185) – that complete a set of these three essential planes. Together, they are an excellent value, are easy for beginning planers to set up and, most importantly, perform brilliantly. What's unique about these tools is they have the bevel of the iron facing up, like a block plane, and they all use the same 2¼"-wide iron. This bevel-up feature makes the tools easy to set up (there's no chipbreaker to mess with) and having the three same-size irons (with different pitches or shapes) allows you to swap blades around for tricky grain or to put off a sharpening session.

All three tools have an adjustable sliding mouth plate to close up the throat and an ingenious stop system to keep you from damaging the cutting edge with the mouth plate.

The jointer plane also allows you to screw on a 90° fence for truing edges of boards, another nice feature for beginning planers. These three tools are ideal for anyone wishing to explore hand planes. You'll get started on the right foot, you'll find the tools versatile for different styles of woodworking and you'll never outgrow them.

Veritas Mk. II Honing Guide

800-871-8158 or leevalley.com

Honing guides are a boon to new woodworkers who don't have time to hone their honing skills on a daily basis. But which one to buy? There are so many. I think you need two: the cheap $14 side-clamp guide in every catalog and this new one from Veritas.

The Mk. II honing guide excels at sharpening a perfect square edge on chisels and plane irons. Its genius is the guide's "registration jig." This clamps to the front of the honing guide and does two important jobs: It squares the tool perfectly in the jig and allows you to precisely set whatever sharpening angle you desire. (You can even set the jig to hone shallow back bevels on plane irons, a useful and clever trick.)

The jig handles almost every tool in our shop with the exception of a few mortise chisels. And, despite all the markings and settings on the jig, it is simple and intuitive to set up and use. It is perfect for beginners and expert woodworkers alike.

The only operation the stock guide won't handle is honing a gentle camber on the iron for a smoothing, jointer or jack plane. That's what you need the side-clamp guide for. The Mk. II's wide roller dictates the edge be square. There are some workarounds that allow you to use this jig for cambered edges, but for now it's simpler to also buy the second guide.

This jig was a long time in development, and we think that Veritas has created a nearly perfect guide that is an excellent value ($48.50).

TOO NEW to Test

Blue Spruce Toolworks Dovetail Chisels

This small company makes the best marking knives, and now it is beginning to offer some sweet chisels designed for dovetails. The side bevels are actually concave so you can sneak in tight spaces.

503-631-7485 or bluesprucetoolworks.com

Grizzly G0480 10" Jointer

We got to see this machine in Las Vegas, but we haven't been able to get one in the shop yet. But wow. It's a 10" model with a carbide-insert cutterhead (a design we really like). The bed is nice and long at 84", and the retro-style base is a nice touch in this world of look-alike machinery. The price: a fair $2,095.

800-523-4777 or grizzly.com

Makita and DeWalt Laser-guided Miter Saws

Before you drop a wad on a laser miter saw, wait until you see the newest saws from Makita and DeWalt. We saw early versions at the Las Vegas woodworking show, and it looks like these two companies really figured out how to do it right. And the DeWalt miter saw has an astonishing crosscut capacity.

800-462-5482 or makitatools.com
800-433-9258 or dewalt.com

Powermatic 701 Benchtop Mortiser

It looks like Powermatic has figured out the benchtop mortiser. A close inspection revealed a new kind of hold-down, a brutish depth-stop and a patented way of setting the bits. **PW**

800.274.6848 or powermatic.com

Photo by Al Parrish

TALL CHEST:

CONSTRUCTING LIPPED DRAWERS

The key to quality work is to fit the parts before assembly and to pay close attention to the fine details.

Few things speak of craftsmanship like a fine drawer. Flawless dovetails, crisp, yet mildly textured hand-planed surfaces, and a smooth, precise fit all say "it's handmade." Making fine drawers requires sharp, well-tuned hand tools, careful measurements and a concentration of effort. It's both challenging and a great source of personal satisfaction.

When speaking of drawers, there are generally two types that are used in fine furniture: flush and lipped. A third drawer type, overlay, is typically reserved for use in kitchen and shop cabinets where the work is often not as detailed.

The front of a flush-fitting drawer, sometimes referred to as an inset drawer, is flush with the surrounding casework when closed. However, a lipped drawer has a small overhang, or lip, which overlaps the opening. The lip is created by cutting a shallow rabbet along the ends and top edge. Like an overlay drawer, the front of a lipped drawer conceals the opening. However, unlike an overlay drawer, most of the thickness of a lipped drawer is contained within the opening when the drawer is closed. This gives the drawer front an appearance of thinness and refinement. And, like a flush drawer, a lipped drawer must be carefully constructed to fit the opening in the case.

When constructing a flush drawer I build it to the same dimensions as the opening. After assembly, I carefully shave it to fit with a sharp plane. By carefully removing just a few shavings at a time, the drawer can be adjusted to fit minor discrepancies in the opening. The result is a precise fit and a uniform reveal around the perimeter of the drawer front. And, of course, the drawer should open and close effortlessly without the slightest hint of binding.

When constructing a lipped drawer the goals are much the same. However, because the lip prohibits hand planing of the sides after assembly, much of the fitting of a lipped drawer must be performed before assembly. The key is to first fit the drawer front and then make the corresponding sides and back to match.

First Mill the Parts

When constructing lipped drawers, I always begin with careful measurements of the case opening and then add for the lip. I add $^{15}/_{32}$" to the length and $^{7}/_{32}$" to the height. Then I mill the drawer fronts to size and shape a $^{1}/_{4}$" rabbet to create a lip. Afterward, I test the fit by placing the drawer front in its opening and, if necessary, I'll use a shoulder plane to fine-tune the fit. Although the lip will hide the space between the drawer front and the opening, too large of a space will create the feeling of a sloppy fit. Using the above measurements yields $^{1}/_{64}$" on each side of the drawer and $^{1}/_{32}$" at the top. These measurements work well for full-scale drawers which fit within large casework, such as the chest featured in the last issue of *Popular Woodworking* (#151). When making diminutive drawers I reduce the tolerances to $^{1}/_{128}$" on each side. Although it may sound tedious, the key, as mentioned earlier, is to first carefully fit the drawer front.

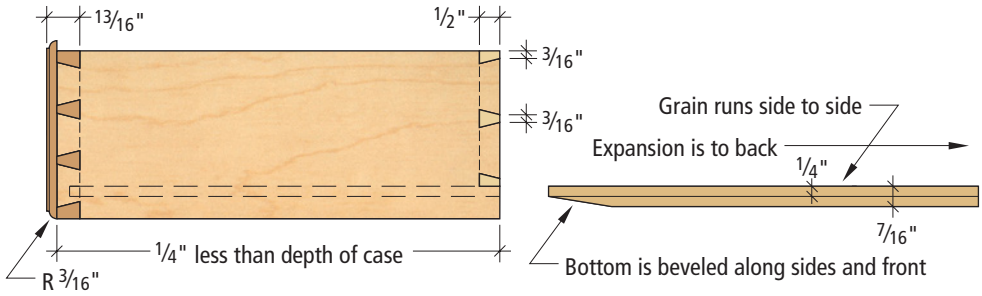
Here's how: To fit the front I first measure the length of the drawer opening. For example, using a round number, 12", I add $^{15}/_{32}$" for the lip which creates a total length of $12^{15}/_{32}$". Next, I use the router table to cut a $^{1}/_{4}$" rabbet on each end. This reduces the length of the drawer front (at the rabbets) to $11^{31}/_{32}$". Notice that the total is $^{1}/_{32}$" less than the opening, which creates $^{1}/_{64}$" of clearance on each side.

Next I measure the height of the opening and add $^{7}/_{32}$". Cut-

by Lonnie Bird

Lonnie is the author of "The Complete Illustrated Guide to Using Woodworking Tools" (The Taunton Press) and teaches woodworking. You can learn more about his classes online at lonniebird.com.

ting a 1/4" rabbet along the top edge (the bottom edge isn't rabbeted) creates 1/32" clearance. If the drawer is tall, such as the largest drawers in a chest, I'll cut the rabbet slightly deeper to allow for seasonal expansion. I also take into account the time of year. If I'm constructing the drawers in January I know that they'll expand in July. If I'm constructing the drawers in July I'll leave less space.



Drawer details

Although it may at first seem complicated, once you've cut the first drawer front it begins to make sense. Take a look at the picture below on the right and you'll get the idea of how the parts go together. Also, you may be wondering why the lower edge of the drawer front isn't rabbeted. The drawers on the old casework that I've had the opportunity to study also lack a rabbet on the lower edge of the drawer front. It's a logical approach; once the drawer is fit within the case it will appear that there is a lip around the entire perimeter. And deleting the lip on the lower edge simplifies cutting and aligning the grooves for the drawer bottom.

Once you're satisfied with the fit of each drawer front, the next step is to mill the corresponding sides and back to match. The height of the sides and back should equal the front at the rabbet. The length of the back is equal to the front minus the 1/4" rabbets. To determine the length of the sides, I measure the depth of the case and subtract 1/4". The 1/4" space at the back of the case provides room for the drawer bottom to expand without pushing the drawer out of the opening.

After sizing all the drawer parts, I cut a groove for the drawer bottom. It's important to position the groove to avoid cutting into the area that will later become the half-pin. Also, the drawer back is ripped down at this point to align with the top of the groove as it joins the drawer sides. After assembly, the drawer bottom slides into the groove underneath the drawer back.

Smooth the Parts

With the drawer parts sized, the next logical step would seem to be cutting the dovetails. But smoothing the inside faces of the pin boards after the joints are cut will result in small gaps in the dovetails. So it's best to smooth the inside faces now, before layout. Later on, after the joints are cut, I'll smooth the outside faces.

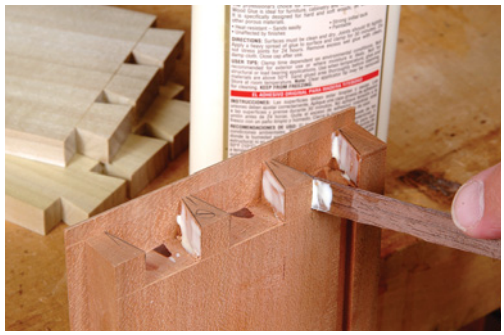
When it comes to smoothing wood, I prefer planing to sanding. It's not that I don't use abrasives in my shop; I do, but only to a limited degree. Besides, smoothing drawer parts with a hand plane has several advantages over sanding. It's

Step photos by the author

Carefully measure the openings for the drawers to acheive a precise fit of the drawer box. Add for the lip to determine the exact size of the drawer front.

The lip on the drawer front, made from cherry, overlaps the frame of the cabinet when the drawers are completed.

I use a smoothing plane to smooth the inside of the tail boards before assembling the drawers. The inside of the pin boards are done before layout of the joints.



I apply glue only to the long-grain surfaces of the pin boards. Glue on the tails will only squeeze out and make a mess.

A gentle tap with a dead blow mallet completes the assembly of the joint.

considerably faster, it leaves the surfaces truly flat, it's quiet so I can enjoy the stereo, and it creates no dust. Best of all, a sharp bench plane with a crowned iron creates a smooth, yet subtly textured surface that appeals to the senses. As usual when planing, it's important to keep an eye on grain direction and remove just enough of the stock thickness to eliminate the mill marks. You don't want to inadvertently plane a taper into the drawer parts.

Lay Out Your Pins

The next step is to measure and mark the location of each pin. I begin by marking the baselines on the front, back and side pieces. It's important to note that the baseline must be equal to the stock thickness minus a small amount for smoothing the outer surfaces. The layout must be precise. If the tails are proud at assembly time the drawer may not fit the opening. If the pins are proud and trimmed flush, the drawer will fit loosely within its opening.

Next, I mark the half-pins at the upper and lower corners. Then I divide the remaining space by the desired number of tails. During the initial layout I use a pencil. If I'm satisfied with the proportion of tails to pins I'll incise the layout with a marking knife.

With the layout complete I remove the bulk of the waste from between the half-blind pins with a router, then square the corners with a chisel and mallet (see "Solid Carcase Joinery: Half-blind Dovetails," issue #151). I cut the pins on the drawer backs with a dovetail saw. The last step of the process is to scribe the tails from the pins. I position the pin board over the tail board and mark each tail with a knife. Afterward, I saw the dovetails and chop the waste area from between each tail.

Assembly

With all the dovetail joints cut and fit, the next step is to assemble the drawers. But first I rout a thumbnail profile around the perimeter of each drawer front. The small, 3/16"-radius thumbnail eliminates the harsh corner and adds a bit of refinement. I smooth the outside faces of the parts to remove all traces of mill marks.

During glue-up I apply glue to the long-grain surfaces of just the pins; glue that's applied to the tails will only squeeze out and make a mess. Gentle taps with a mallet will drive the joints together. Once all four joints are assembled I check the corners for square. If necessary I'll gently push on the acute corners in order to make the sides of the drawer box 90°. I don't use clamps on a drawer; clamps will twist and distort the box. If the dovetail joints are accurate, clamp pressure isn't necessary. Instead, I simply tap the joints together with a mallet and place the drawer on a flat surface until the glue sets.

Install the Bottom

The last step in the construction of the drawer is to install the bottom. Remember: The grain in the bottom should run from side-to-side; this causes seasonal expansion to occur out the back of the drawer rather than pushing against the drawer sides. I mill the bottoms 7/16" thick, bevel the edges to fit the grooves, and slide them into place. A small amount of strategically located glue will force the bottom to expand out the back. I apply glue to the groove at the drawer front and about 1" along the side groove. Once the glue dries, the bottom is free to float, but only out the drawer back. I pin the bottom to the back with a small cut nail. But first I drill a hole in the bottom and elongate it so that the bottom can expand underneath the head of the nail.

Final Fitting

If my measurements were accurate and my cutting precise, the drawers will slide smoothly in their openings. Sometimes, I need to use a block plane and shave a small amount from the edges of the sides or back. I like the insides of drawers to have an unfinished look, but I also like them to remain clean. A thin wash coat of shellac will seal out dirt without the look or feel of a thick finish. After finishing, I apply a light coat of wax to the drawer runners and the lower edges of the drawer sides. **PW**

14.4-VOLT Drills

They're more powerful and affordable than ever, but are they a good choice for you?

Photos by Al Parrish

For the past decade we've been telling you that for woodworking, a 12-volt drill is more than adequate. So why are we testing 14.4v drills here? Because many of the phone calls we field are from woodworkers who also work around the house and on larger projects that may benefit from a little more power. Beyond that, these drills have been getting more powerful and the prices are now very competitive.

So we're tackling 14.4v drills in this issue to determine if there is a benefit to these larger, heavier tools and if the benefit is worth the price. To avoid excluding anyone, we're also testing 15.6v drills from three manufacturers that offer this slightly higher voltage.

Testing Parameters

We test for real-world applications, and this test is no different. We first charged and discharged each drill battery twice to condition the battery before charging them all again for testing.

The testing itself was in two stages. The first was drilling 1" holes with a standard spade bit through 1¾" poplar, using a brand new bit for each drill. Because drilling a hole relies on the operator's energy as well as the tool's energy, we performed the hole test twice with different testers averaging the two results (rounding up). Each drill was run at high speed, with the clutch set for drilling.

During this test we noticed significant heat build-up in the drills and recorded the temperature at the motor and at the battery.

The second test was for torque. We recharged the batteries and used a standard 7/16" hex driver to sink ¼" x 1½" lag screws into more 1¾"-thick poplar boards. The drills were set for the low-speed/high-torque setting for this phase. We didn't experience the same heat build-up during this phase of the test, so we did not record that information.

Other statistics we recorded were weight, grip girth and the manufacturer's stated torque – as well as other useful information including the battery charge time and revolutions per minute in both high and low gear.

To give us a comparable view of the 14.4v drills, we ran the same two tests using a 12v Panasonic drill (the winner in our previous 12v review) and one of the new 28v lithium ion drills from Milwaukee. The results were interesting, to say the least.

Observations

One thing that surprised us was the relatively low number of 1" holes we could bore on a charge. Upon reflection we realized a 1" hole in fairly thick solid wood isn't a task for wimps. Our 12v baseline test proved that there was indeed an advantage (in most cases) to the 14.4v power.

The heat build-up in the drilling tests was also a surprise. Again, we were tasking these drills beyond normal use, but some became uncomfortable to hold. Heat can negatively affect both battery life and the life of the motor so we felt it important to include this information.

In general the drills were remarkably similar in amenities, but some have extra features worth mentioning. Two drills offer fuel gauges while another two offer task lights (see photos below).

Also, two of the drills offer three speeds while the rest offer two. Both the Makita and the DeWalt have a third, intermediate gear, offering a balance of torque versus speed. This feature is potentially more valuable than lights and fuel gauges, but to keep things fair the two drills were tested only in high-speed and high-torque settings in the hole test.

During the lag screw test we attempted to use the clutch on each drill to control the depth of drive. We found most of the clutches difficult to fine-tune to seat our screws. The clutches either didn't kick in, or didn't drive the screw. Kudos to the Hitachi, Milwaukee and Porter-Cable drills for clutches that work.

Conclusions

While we concede there are situations where a 14.4v drill will be a better choice than a 12v drill, we're not sure the occasional extra power is worth spending $200. It's the consensus of the staff that buying a corded ½" drill for $100 (to do the heavy work in the shop) might make more sense. You'd be able to drill lots more holes and you'd never have to charge it.

We tended to favor the models that were lighter in weight and better balanced in the hand. This might not matter to you if you're looking for a drill for occasional use only, but if you'll be drilling holes or driving screws for any length of time, it may be the most important factor.

But if we're sticking to the drills tested, the consensus also seems to be that spending a little extra to get a 15.6v drill makes sense.

Finally, we opted for a tie in the 14.4v category, giving equal honors to the Makita and the DeWalt for strong results in both tests, strong features and comfort. We're recognizing the Milwaukee drill as a Best Value opportunity for its balance of performance, comfort and price.

But overall, the Panasonic 15.6v is a no-brainer for best overall in either class, provding superior performace and comfort.

by David Thiel and Robert W. Lang

Comments or questions? Contact David at 513-531-2690 ext. 1255 or david.thiel@fwpubs.com, or Bob at 513-531-2690 ext. 1327 or robert.lang@fwpubs.com.

Skil and Moty-Ko offer fuel gauges to help you determine how much juice is left in a battery. A nice idea, but we're not sure how accurate or useful these gauges are.

The Hitachi and Makita drills have multi-position LED lights. Both are handy in a dark corner, but neither are a reason to choose these drills over others in the test.

BOSCH

This drill feels big in your hand. While its weight is in the middle of the pack and the grip girth isn't the largest, it's still a big drill. Performance was also big in the testing, coming in third in the spade hole test and fourth in the lag screw test. The Bosch drill also has a very quick 30-minute charge, which we like, and it has the highest stated torque in the test (except for the Milwaukee V28).

The model we tested also has the new BlueCore battery designed to dissipate heat. Our temperature readings showed the Bosch at a comfortable level, nearly the coolest of all the drills tested.

The grip and feel of the drill are comfortable (though large) and the nose-up attitude of the motor and chuck is designed to prevent your wrist from maintaining an awkward angle. The single-sleeve locking chuck works well and the carbide teeth in the jaws grab and hold a bit tight.

The Bosch is a good drill and finishes near the top of the pack – but that includes price as well, sitting comfortably as the third-highest price in the category. While finishing just out of the winner's circle, this is a drill to take notice of.

BOSCH
33614-2G

877-267-2499 • boschtools.com

DEWALT

DeWalt shares top honors in the test by placing first in the number of spade holes drilled and second in the number of lag screws drilled. With a one-two punch like that, it's a knockout.

The three-speed drill also fell comfortably in the middle of the competition when it came to grip size and weight. It also finished with pleasantly low temperature readings. The all-metal, locking single-sleeve chuck teams up with carbide jaw pads for a top-quality bit-holding experience.

One slight quibble could be the one-hour charge, but a shorter charge time isn't the norm in this category, so we can hardly count the longer charge time against it.

We also thought the drill was a little louder (a clacking metallic noise) than was pleasant, but this noise is actually a normal function in DeWalt drills.

As for price, the DC983KA is in a three-way tie for second place, making it a pricier drill, but when it can post winning numbers in the speed and torque tests, we're OK with that price.

The DeWalt is a good drill with a decent feel in the hand, good performance and the nice feature of an extra speed setting.

DEWALT
DC983KA

800-433-9258 • dewalt.com

FEIN

The Fein ABS 14 is a fairly new model for the company and this drill has nothing to be ashamed of. During testing it scored higher than average in holes drilled and screws driven.

Only two other 14.4v drills were lighter than the Fein (Metabo and Skil) and the performance of those two was nowhere near as good as the ABS 14. Hand-in-hand with that lighter weight is a reasonably small grip that feels good in your hand. Because of this smaller overall feel, we didn't expect as good a showing during the testing and so we were pleasantly surprised.

The chuck is a single-sleeve locking design with good jaws that will hold all but the smallest of bit diameters. The Fein also sports a 35-minute recharge – that's always a plus.

The Fein is priced at the top of the pack (just under $200), but with its combination of good performance and convenient size and feel, it's a drill that we'd comfortably recommend. This same drill is available with 3.0 amp/hour nickel metal-hydride (NiMH) batteries that should enhance the performance even further. Nice job.

FEIN ABS 14

800-441-9878 • feinus.com

HITACHI

We're still trying to decide if the look of the Hitachi drill is cool, or just freaky (Bob votes for freaky). It's definitely different and stands out in a crowd. Unfortunately, it needs a little something extra to make it stand out because its performance in the two tests was decent, but middle-of-the-road. Of course, the cool little light on the hook is fun. I'll stop short of calling it a bright light, but it does chase away the shadows in a dark corner.

The Hitachi is priced down from the top of the pack, about $20 less than the $200 drills. With that savings the slight drop in performance numbers isn't too scary. It's still a decent tool. It offers a 50-minute charger, which is faster than some and slower than others. The all-metal chuck is decent, but the jaws are average.

The grip girth on the Hitachi is one of the largest in the test group, but the weight is still in the middle of the pack.

Bottom line: It's a good drill with good performance and it's priced slightly less than some of the competitors. Add to that the eye-catching looks of this drill and we're sure they're going to sell a bunch of them.

HITACHI
DS 14DMR

800-829-4752 • hitachi.com/hpt

MAKITA

Another of the just-under-$200 drills, the Makita shares the Editor's Choice award with the DeWalt. It stands out as the only drill that comes standard with NiMH in the 14.4v category. This drill is also rated at 3.0 amp hours compared to 2.0 with most of the competition. That said, the performance results for this tool were mixed. It finished second in number of holes drilled, but in the middle of the pack in the number of lag screws sunk.

This drill is also one of the three-speed units, offering a middle gear with mixed torque and speed capabilities. Along with the third speed, Makita added a fast bypass to switch between clutch-controlled screwing and full-speed drilling. This is a handy addition. They've also included a task light mounted on the battery.

The Makita has the largest grip girth in the test and we noticed pretty high temperatures out of the motor and battery after testing. It's also the second-heaviest drill in the test.

But when balancing the performance, features and the feel of the drill (even with the larger size and weight), we felt this drill was one we'd buy and enjoy having in our shop.

MAKITA
6339DWDE

Editor's Choice

800-462-5482 • makita.com

METABO

The Metabo 14.4v drill has the unfortunate distinction of being the most expensive in the category (by $20), balanced with fairly mediocre results in the testing. It finished eighth in drilling holes and ninth in sinking lag screws.

It also finished in the middle of the pack on grip girth and motor and battery heat after testing, but is the second-lightest drill (behind the Skil). It does offer a short recharge time of 35 minutes, supported almost certainly by the fan-cooled smart charger. But other than that, it's a fairly basic and average drill.

Both Metabo drills in the test have a quirky feature that we've commented on before. The forward and reverse switch operates opposite of every other drill in the test. Again, this isn't a deficit, but it does take some getting used to.

While it's an OK drill, we don't feel that the extra expense is supported by the features or performance of the tool. Bottom line: While there's nothing wrong with this drill, your money is better spent elsewhere.

METABO
BSZ 14.4

800-638-2264 • metabousa.com

MILWAUKEE

Excluding the Skil, this is the least expensive drill in the test at just over $160. The features are mostly basic, but the Milwaukee does offer a reversible battery pack, allowing you to move the weight and size to either the front or back of the grip. This proves handy in tight spots.

This tool also offers a clever belt hook, but I'm afraid the value of this was lost on the woodworkers in our shop. In testing we found the Milwaukee drill had average results in both drilling holes and sinking lag screws, matched by average temperature readings after testing.

On the plus side, the drill weighed in on the lighter end of the scale and had a medium-sized grip girth. Taking the weight, size and grip into account, this drill had a very nice feel in the hand. And when you can shift the battery weight around, it's even nicer.

We like the feel and balance of the Milwaukee and though the performance results are average, average isn't a bad thing. In light of the nearly $40 savings over the other drills in the category, we've decided to give this drill the Best Value award.

MILWAUKEE
0612-22

Best Value

800-729-3878 • milwaukeetool.com

MOTY-KO

This one's a strange one. It's a new brand of drill that's actually not headed for the larger home-center stores. You'll be able to find it online and in contractor-supply stores.

I also say strange because the results on the drill are a strange mix. Priced at the high end of the pack at $199, it's a drill that actually produced the winning number of lag screws by a whopping 49 more screws! The results in the hole drilling were decent as well, but oddly out-of-sync in comparison to the screw test.

Motor temperatures were a little higher after testing, but still not out of line. Although heavy, it's not the heaviest drill and the grip girth was acceptably in the middle of the pack. The one-hour charger is also the norm, rather than an exception.

Two extra features on the drill include a fuel gauge to let you know how much juice is left, and a simple bubble level mounted on top.

While all of these things indicate a good drill that deserves recognition, we did run into some charging issues (it thought it was full, but it wasn't) during testing that give us pause in a tool that doesn't yet have a track record.

MOTY-KO
14DD

317-322-5265 • motyko.com

PORTER-CABLE

The Porter-Cable 14.4v drill is a solid tool that we thought should have done better in the testing. The features are pretty standard, with an all-metal chuck and good jaws. The most recent upgrade in the tool was the addition of replaceable grip pads that let the user adjust the width of the grip for maximum comfort.

Unfortunately, that doesn't make up for the below-average results during testing. This drill finished one place out of last in the screw-driving competition and finished below average on the number of holes drilled on one charge.

It's also the third-heaviest drill in the test and has the most difficult battery to remove of all the drills tested. The weight also contributed to the drill feeling out of balance in the hand.

While the price of the Porter-Cable is in the affordable range, we don't feel the technology has kept up with the pack. It's our opinion that there are drills with better features and performance for about the same or slightly more money.

PORTER-CABLE
9978

800-321-9443 • porter-cable.com

RIDGID

The Ridgid is the heaviest drill we tested and its size is near the top of the scale as well. With numbers like that, we sort of expected more. The testing numbers put this tool in the average category for number of holes drilled, and closer to the bottom of the scale for lag screws, beating only the Metabo, Porter-Cable and Skil drills.

The drill is reasonably priced at just under $190, but its biggest asset is the two-bay fan-cooled charger that lets you charge both batteries in about 30 minutes.

The Ridgid offers all the basic features found throughout the drills in the test, and includes an all-metal chuck with carbide insert jaws.

Our finding is that it finishes slightly below average in performance, and was uncomfortable to use for an extended period. Even the two-bay charger has a hard time overcoming the drill's massive size and weight.

RIDGID
R83015

866-539-1710 • ridgid.com

SKIL

You might think that a drill priced less than half of all the other drills in the competition would be in line for a bargain recognition. That would be true if the drill performed anywhere near half as well as the other drills tested. Not so.

The Skil is priced and designed to make the very occasional home woodworker happy. Its price is low, but honestly it is a 14.4v tool in name only. The drill was simply outclassed by the competition. We saw significantly better results from our 12v baseline drill. Also on the downside: This is the only 14.4v drill with the smaller 3/8"-capacity chuck.

We might have forgiven the low number of holes, but when matched with very poor lag screw numbers, oh well.

On the positive side, it's the lightest drill in the test. Unfortunately the benefit didn't seem to carry over to the size of the drill. It has a large frame, but we're not sure why.

There are a couple of features worth mentioning on this drill. The batteries include a fuel gauge that will probably give some comfort to the occasional user. Mounted on top of the drill is a slip-off drill gauge that may prove handy.

SKIL
2587-05

877-754-5999 • skil.com

FESTOOL 15.6 VOLT

Comparing the Festool in this category is a little unfair because of the tool's accessory capabilities. The interchangeable chucks (one for working in tight corners and one for right-angle drilling , both sold as accessories for around $85 each) make this tool more than a standard drill, but for the sake of comparison, it's still a 15.6v drill.

The benefit of an extra 1.6 volts seems obvious with more holes and more screws completed than nearly all of the 14.4v drills. It's also a comfortably sized and weighted drill, with good balance and a comfortable grip.

The jaws in the chuck offer the tightest tolerance of any in the test and the overall feel of the drill is small compared to the performance.

Compared to the other 15.6v drills, the Festool finished well with respectable numbers. The Panasonic, however, far out-paced the Festool's results. And when you compare the $400 price tag to the retail price on the Panasonic, you've really got to want the option of extra chucks to make this tool your first choice.

FESTOOL
TDK 15.6 CE

888-337-8600 • festoolusa.com

METABO 15.6 VOLT

The Metabo is the largest of the three 15.6v drills tested and it weighs in at the top as well. It's hard not to compare this drill to the 14.4v drills tested, especially because Metabo had a tool in each category. The performance was good, but not as good as the other two 15.6v drills. In fact, some of the 14.4v drills were able to surpass the performance of this $300 drill.

The features on the drill are basic in all respects save one. This drill offers a "pulse" feature that provides short, high-torque bursts of energy to make it easier to break loose stubborn screws and to start a screw or hole. It's a nice feature, but it doesn't compensate for the size and price.

Overall, we would have been ecstatic if the results from this drill would have been the results for the Metabo 14.4v. Unfortunately it falls short of providing strong competition in the small but scrappy 15.6v category.

METABO
BSP 15.6
PLUS

800-638-2264 • metabousa.com

PANASONIC 15.6 VOLT

What can I say? This higher-powered drill is lighter than eight of the 14.4v drills in the test and is smaller than some. It feels like a 12v drill but performs better than every drill except the 28v Milwaukee. It kicks tail!

That said, there's nothing particularly unusual about the drill as far as features. It has a fairly standard 55-minute charger and a two-speed transmission. The clutch works well enough, but it too suffered from finicky adjustment. The chuck is a single-sleeve locking design and the jaws in the chuck close to a perfect, tight fit.

In comparing the Panasonic to the other 15.6v drills, it performed substantially better and was significantly less expensive. This drill led us to our conclusion that buying a 15.6v drill rather than a 14.4v can be less expensive (it's the same price or less than seven of the 14.4v drills) and with much more impressive results – and in a smaller, more comfortable package!

It was an easy decision to name this drill not only the Editor's Choice in the 15.6v category, but also an overall Editor's Choice and Best Value – all in one handy package! **PW**

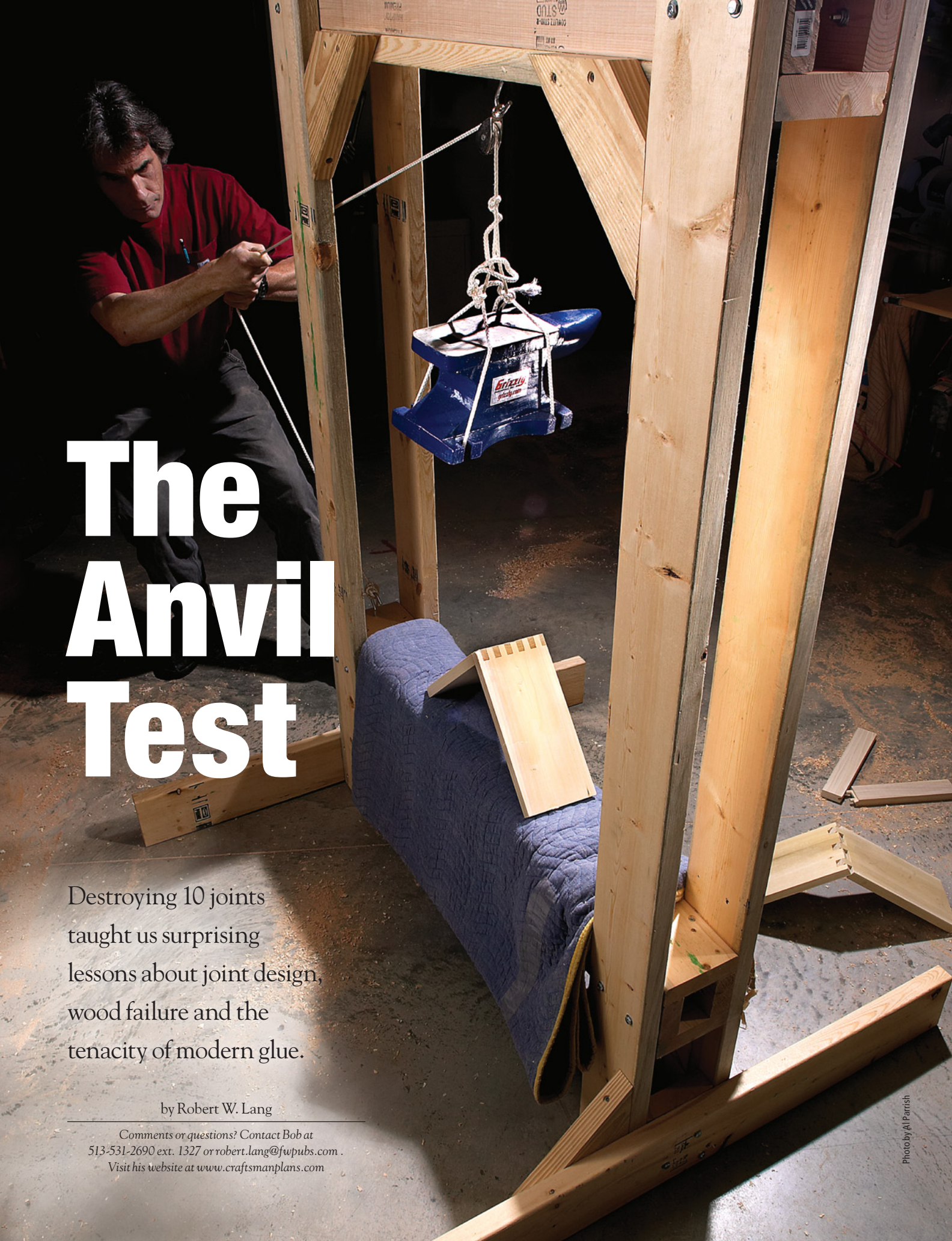
PANASONIC
EY6432GQKW

800-338-0552 • panasonic.com

CORDLESS DRILLS

14.4-VOLT MODELS	STREET PRICE	BATTERY PRICE	AMP HOUR	BATTERY TYPE	CHARGE TIME	TORQUE INCH/LB	RPM LO/HI	# HOLES MADE	# SCREWS DRIVEN	MOTOR TEMP/°F	BATTERY TEMP/°F	WEIGHT (LBS)	GRIP GIRTH
Bosch 33614-2G	$198.84	$54.95	2.0	NiCd	:30	500	400/1,400	20	108	136	136	5.40	6"
DeWalt DC983KA	199.99	66.25	2.4	NiCd	1:00	450	450/1,800**	25	115	140	140	5.50	5 5/8"
Fein ABS 14	199.99	77.00	2.0	NiCd*	:35	327	400/1,400	18	114	145	128	4.72	5 3/8"
Hitachi DS 14DMR	179.99	59.88	2.0	NiCd	:50	442	400/1,500	16	99	144	135	5.42	6"
Makita 6339DWDE	199.99	79.88	3.0	NiMH	1:00	450	600/1,700**	24	101	187	205	5.64	6 1/8"
Metabo BSZ 14.4	222.00	93.00	1.4	NiCd	:35	487	400/1,400	12	89	154	124	4.62	5 3/4"
Milwaukee 0612-22	161.79	54.99	1.7	NiCd	1:00	390	400/1,400	14	104	161	162	4.96	5 3/8"
Moty-Ko 14DD	199.00	59.99	2.0	NiCd	1:00	380	360/1,150	18	164	175	133	5.58	5 3/8"
Porter-Cable 9978	179.99	69.99	2.0	NiCd	1:00	420	450/1,400	13	76	173	146	5.60	5 5/8"†
Ridgid R83015	189.00	59.95	1.9	NiCd	:30	415	400/1,600	16	91	170	168	6.36	5 5/8"
Skil 2587-05	79.99	45.00	1.2	NiCd	1:00	250	350/1,250	9	16	133	128	4.12	5 3/4"
15.6-VOLT MODELS													
Festool TDK 15.6 CE	400.00	110.00	2.4	NiCd	:50	220	400/1,400	29	150	158	139	5.32	5 1/2"
Metabo BSP 15.6 PLUS	303.00	109.00	2.4	NiCd	1:50	230	400/1,400	20	197	161	182	5.98	6 1/4"
Panasonic EY6432GQKW	189.90	79.99	3.5	NiMH	:55	390	450/1,450	43	287	210	151	4.82	5 5/8"
BASELINE MODELS													
Panasonic 12 VOLT	179.00	89.99	3.5	NiMH	:55	293	400/1,300	24	57	163	130	4.24	6 5/8"
Milwaukee 28 VOLT	419.00	159.95	3.0	L-ION	1:00	600	600/1,800	66	300+	153	100	6.82	5 1/2"

*NiMH batteries also available; **Motors are three-speed, only high and low are stated; †Grip is adjustable with pads (included).



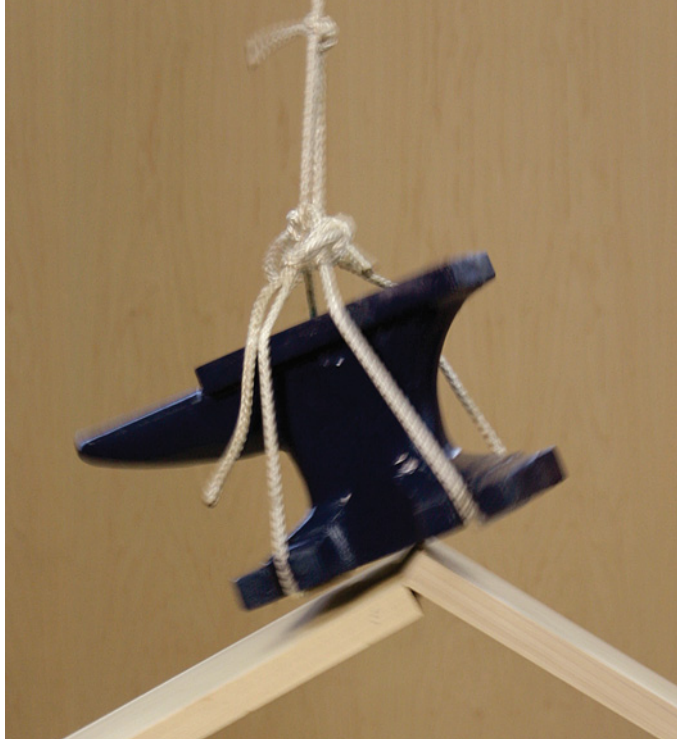
The Anvil Test

Destroying 10 joints taught us surprising lessons about joint design, wood failure and the tenacity of modern glue.

by Robert W. Lang

Comments or questions? Contact Bob at 513-531-2690 ext. 1327 or robert.lang@fwpubs.com . Visit his website at www.craftsmanplans.com

Photo by Al Parrish



We don't recommend dropping anvils on your furniture, but studying how and why joints fail can improve your woodworking.

It has been said that we learn more from failure than from success. One of the first pieces of furniture I made was a coffee table with rails tenoned into the legs. I didn't know that the tenons were too large in proportion to the size of the legs until several years after the table was finished.

On the way to the bathroom one night, I accidently kicked one leg. The wood surrounding the tenon gave way, and the leg went flying. Up to that point, my work was successful; yet in an instant, a nice table was reduced to kindling. This was a joint-design lesson learned the hard way.

Much of what we know about woodworking is someone else's experience, or the embellished retelling of someone else's experience. When we find a method that works, we hang on to it and then we recommend it to others – never sure if it really is a good way or if we just got lucky.

If you want to start an argument, or at least a lively discussion among woodworkers, the relative strength of joints will almost always get one going. Like most good arguments, this one can't be settled conclusively.

In order to add a little fuel to the fire, we decided to test 10 common joints by dropping an anvil on them. We used two sizes of anvils: 26 pounds and 54 lbs. All our joints were carefully prepared using poplar, and they were glued together with Titebond Xtend glue, which was allowed at least 24 hours to cure. The anvils were dropped from about 18" above the joint using the contraption shown at left.

We picked an extreme example not to crown a king of woodworking joints, but to examine how and why joints fail. After deliberately destroying these joints, we found ways to improve our joinery methods and produce better work.

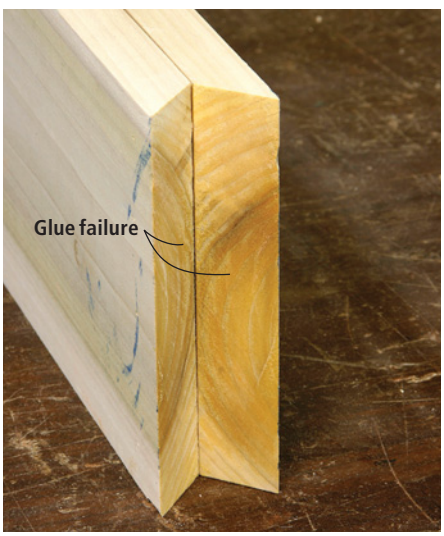
Weaker Carcase Joints

The first joints we examined were simple butt joints, and some typical ways of reinforcing them. All of these broke beneath the 26 lb. anvil, a result we expected. What we didn't expect was how well the polyvinyl acetate glue held.

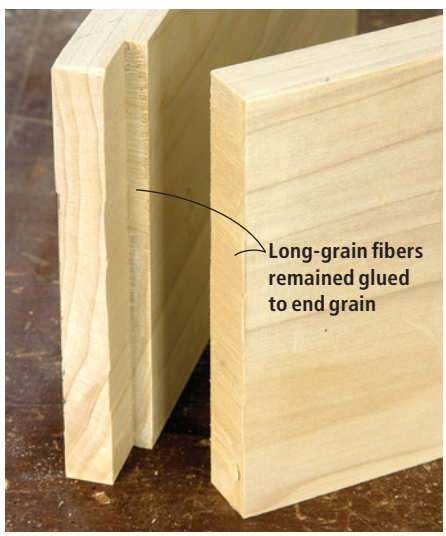
Most of us have been taught that glue will not hold on end grain, and in the mitered joint, the glue did indeed fail (below left). The grain in a miter joint is mainly short-grain to short-grain.

In the rabbet joint, however, the bond is long-grain to end-grain. Does the presence of long grain improve the strength of the joint? As you can see, the wood fibers failed beside the glue line (below center). If you look closely at the photo, the end grain of both pieces isn't seen. Long grain from the adjacent piece is.

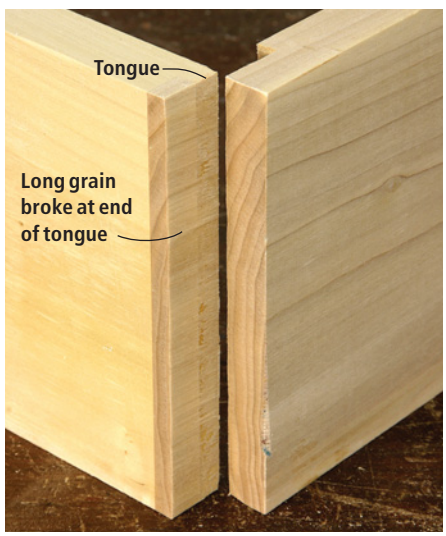
This was true with all of the joints we tested. From a simple butt joint to through-dovetail joints, the glue typically held to the long-grain wood fibers, even when the other component of the joint was end grain.



Glue doesn't hold well to end-grain or short-grain surfaces, as in this miter joint. When the anvil hit, the glue line failed.

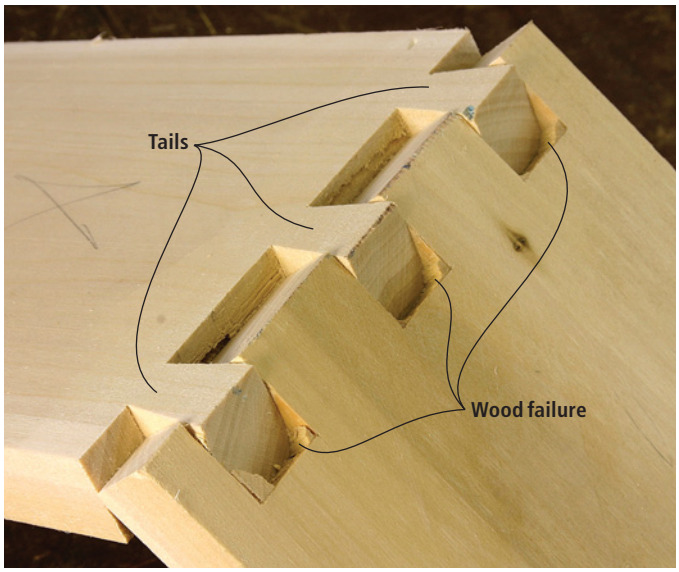


The presence of long grain in the joint increases its strength, even if the other component is end grain. Here, the glue line held and the wood failed next to the joint.



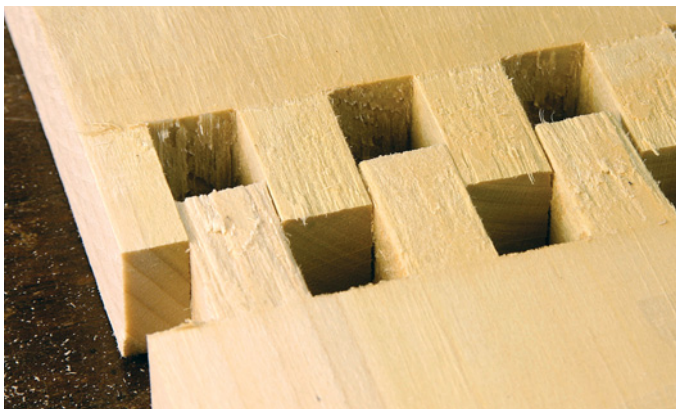
Although the tongue added to the rabbet joint made it stronger mechanically, it left a weak point in the wood that broke on the joint line.

A joint will fail at the weakest point, even if it is in the surrounding wood, as seen in this biscuit joint.



Notice that the wood failed at the short grain on the tails, and that the glue held on the end grain between the pins.

The small anvil bounced, but the large one caused the wood to fail and the glue lines to fracture in this splined miter joint.



The box joint doesn't have the wedge strength of the dovetail, and folds like a hinge. Again, notice that the glue line held where long grain meets end grain.

In the housed rabbet joint the wood broke neatly across the joint line, leaving a thin layer of long grain intact (previous page). The break continued across the short tongue that held firmly to the end grain of the two adjacent surfaces. This joint was theoretically stronger mechanically, but it reveals our second important discovery: The wood will break at the weakest point within or near the joint.

This is important when designing joints. The sizes of the components of the joint are important, but so is the amount of wood next to the joint. The mortises and tenons on my coffee table weren't bad, but there wasn't enough wood left beyond them for the joint to stay together under stress.

The biscuit joint above held together where the biscuit was in contact with the wood, but the wood itself broke out at the short grain at the edge of the biscuit. The weakest point wasn't at the joint; it was just beyond it.

Stronger Carcase Joints

As we expected, box joints and dovetail joints were significantly stronger than the first group of joints. They each survived the impact from the smaller anvil with minimal damage. With the larger anvil, the dovetail at top gave way but the two pieces did not completely separate (top). Notice that the glue held on to the end-grain surfaces, and that the wood fractured on the short grain of the tails. The joint opened up about halfway, where the tails and pins wedged against each other.

The parallel surfaces of the box joint above, without the benefit of the dovetail's wedging action, unfolded like a hinge. Once again, failure occurred from the wood fibers at the glue line, not the glue itself.

The last box-type joint we tested was a miter, reinforced with cross-grain splines (above right). This held as well as the dovetail under the 26 lb. anvil, but it broke when the heavier anvil fell.

Stout Frame Joinery

We then turned our attention to joints commonly seen in tables and chairs as opposed to boxes and cases. In particular: mortise-and-tenon joints, and some of the methods that have been developed as alternatives such as dowels and pocket screws.

One of the big questions we had was how pocket screws would compare to mortise-and-tenon joints. In this test, the pocket screws did well under both anvils (facing page).

While this was impressive, I would be reluctant to use pocket screws instead of mortises and tenons in all applications. As the traditional joint fails, the tenon pulls away from the mortise gradually before letting go completely.

With pocket screws, when the joint is stressed, the screw holds on to the wood until the wood breaks, leaving something that likely can't be repaired. The long-term performance is also a concern. In many antiques with screwed joints, annual shrinking and swelling crushes the wood surrounding the screw, defeating the screw's ability to hold.

In testing our drawbored mortise-and-tenon joint (lower right, next page), the $\frac{3}{8}$"-thick tenon was almost half the thickness of the $\frac{7}{8}$"-thick pieces being joined. The amount of wood remaining next to the mortise was thin enough to be fractured on impact.

A larger joint was then tested, with a $\frac{1}{2}$"-thick tenon in $1\frac{3}{4}$"-thick material. The tenon was

pulled tightly together with a 1/4"-diameter oak dowel. The thicker components, along with a tenon less than one-third the thickness of the stock, produced a joint of great strength (below center).

A dowel joint of the same-size components, however, did not hold together. The dowels held when the grain in the dowel was parallel to the grain of the wood (below right). In the other direction, where the grain of the dowel was 90° to the grain of the wood, the glue joint failed and the dowels popped out of their holes.

Seasonal wood movement is also a long-term issue with dowel joints. As the wood and the dowel expand and contract, the dowel and the hole change shape from round to oval. Over time, only a tiny area of contact between the dowel and the wood remains.

Designing for Time

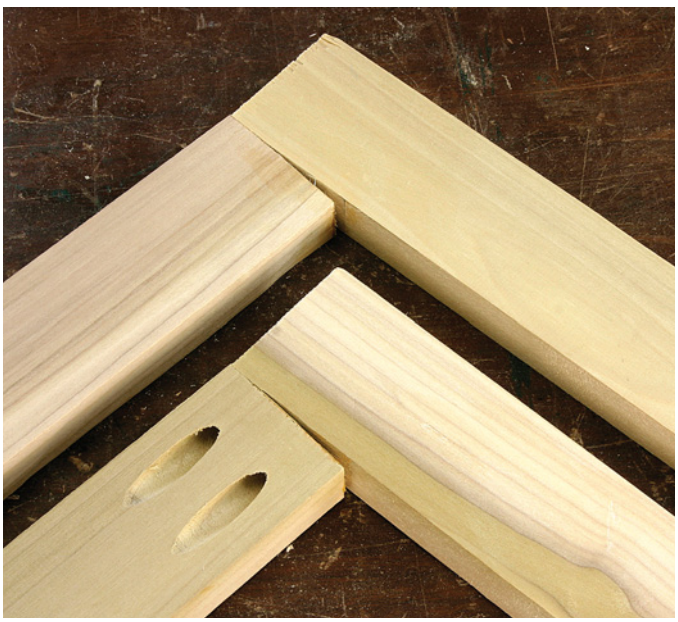
Nearly any joint can work short-term, but if your sights are set higher than that, consider not only how you will join your components, but also the sizes and scale of the components.

In preparing these joints for testing, I used sizes and proportions that I would normally use. Most of these joints I would still make the same way. If a biscuit or rabbet location was changed in location or proportion, the failure would likely still occur, but on the other side of the joint. But I don't think I will ever again make a mortise that is more than a third of a piece's thickness.

Understanding what the wood will likely do, and what to expect from a glue in any given situation is a lesson well worth going to a few extremes to learn, though you can do this without an anvil.

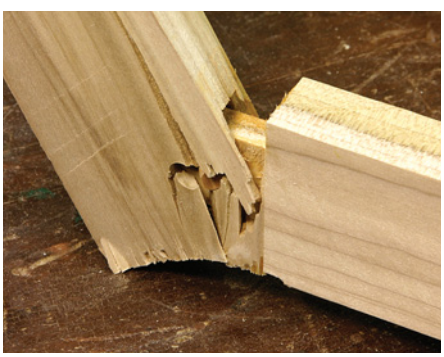
When you try a new method, make some practice joints and see how well they hold together. Sam Maloof once tossed one of his early chairs from the roof of his garage just to see how strong it was. He learned something about his joinery methods that day. And that's the same lesson here: Our successes emerge from the splinters of our failures. **PW**

Editor's note: See our anvil test in action at select WoodWorks shows. Visit woodworksevents.com.

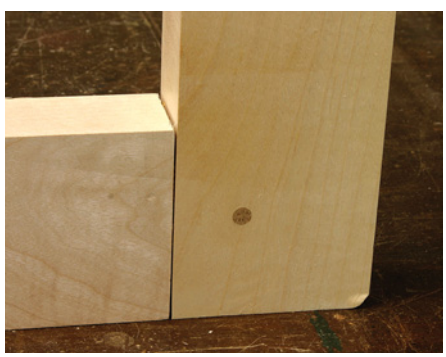


Mortise-and-tenon joints and pocket-screwed butt joints showed similar amounts of damage from the 26 lb. anvil.

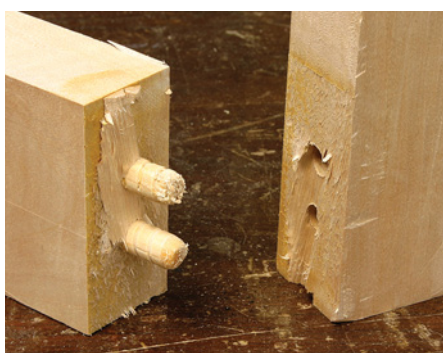
The 54 lb. anvil also damaged both joints. Note how the peg in the tenon and the screw destroyed the edge of the stile.



Not much material was left between the mortise and the edge of the wood in the thinner material.



In this mortise-and-tenon joint, more material beside the mortise made the difference between minor damage and complete destruction.



In this dowel joint, the only strength is the long grain of the dowel to the long grain of the piece on the left. At every other point, the joint is weak.

Chair Devils

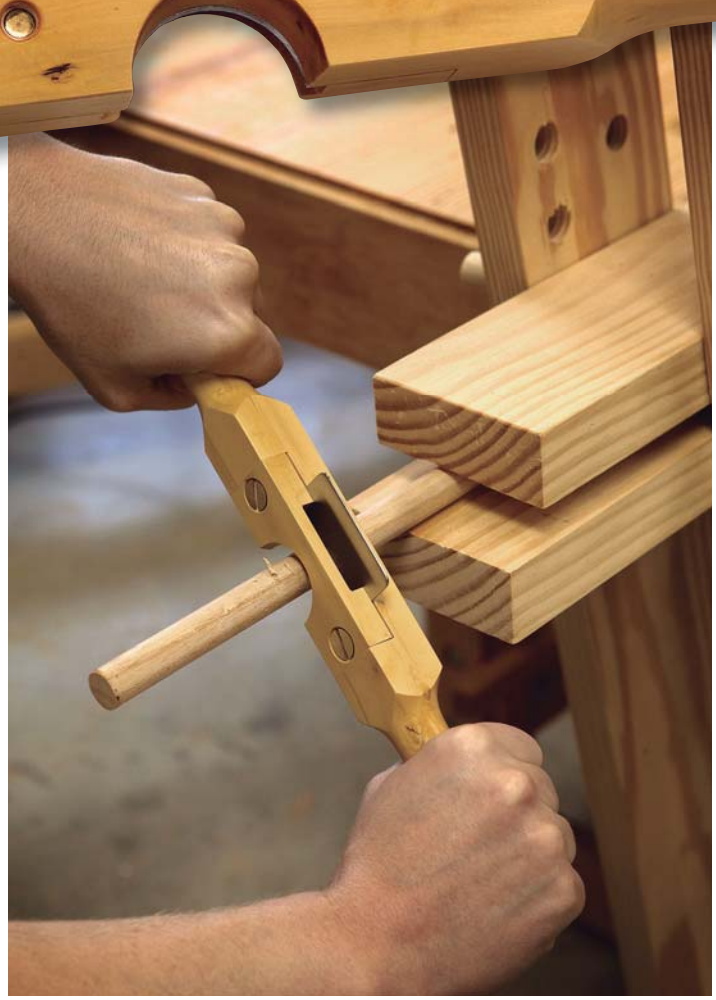
Designed to remove tool marks from chair spindles and posts, this hard-to-find scraping tool is simple to make.

The chair devil in front is made entirely from boxwood. The one behind it has a spalted beech body with the blade clamp made from African blackwood.

Last year I spent a week in the Cobden, Ontario, workshop of David Fleming, learning to make a ladderback Appalachian chair. One tool that particularly fascinated me was the chair devil or spindle scraper. This deceptively simple tool removes any spokeshave marks that remain after shaping chair spindles and posts. I photographed and measured the tool that Fleming made, and I returned to Calgary to make my own. I found a brief description of the tool and its construction in Drew Langsner's book "The Chairmaker's Workshop" (Lark). I enlisted the aid of machinist Larry Diegel, who helped me shape the metal parts of this tool

by Kathy Somerville and Larry Diegel

Kathy has been building furniture, building and restoring canoes and wooden boats, and turning wood for 20 years. She teaches diverse courses such as turning, and making paddles, spokeshaves and Shaker boxes. Larry, who has been a machinist for 25 years, teaches courses on making spokeshaves and metalworking.



Photos by Al Parrish

as well as streamline the building process. It turned out that making a chair devil is not difficult; you should be able to complete the project in a day using tools and machines you already own.

It's a good idea to use a hardwood to make the tool's body, also called the stock. Boxwood, African blackwood and ebony are excellent choices but they might be hard to obtain. Maple, beech or dogwood also would be good choices. Cherry makes a fine stock, but a harder wood should be used for the blade clamp.

Cut the hardwood blank for the chair devil to 1 1/8" x 1 1/16" x 14". The tool will eventually be 12" long – the blank is left long so the handles can be shaped on the lathe. Cut the hardwood for the blade clamp to 1/2" x 1 1/8" x 3 1/2". You will later trim the length of this piece as you fit it precisely into the recess.

Cut the Recess in the Blank

We used a table saw and sled to define the edges of the 3 1/4" x 1/2" notch for the blade as shown at right. Though this is a crosscut operation, the flat teeth of a rip blade will produce a cleaner cut. A combination blade also will do. A crosscut blade will leave cuts that require more clean-up.

You could easily cut this notch with a handsaw and chisel, but the table saw makes nice square corners. To lay out the location of the notch, make a mark halfway along the length of the body of the chair devil and measure out 1 5/8" on either side of your mark. Use a square to extend these lines all the way around the body of the blank. Set the saw blade so that it projects 1/2" above the surface of your table saw's sled. You'll use the lines drawn around the body to cut the recess.

Place the blank on the sled so the saw blade will cut just to the inside of one line. Make a reference mark on the sled fence that's aligned with the line marking one end of the recess on the blank. Make a cut that falls just inside one edge of the recess. Use this reference mark to measure the distance that the blank must be moved to have the second cut fall exactly on the shoulder of the recess. Now make the second cut on the other side of the recess. Then make repeated and overlapping cuts between these two kerfs to clean out the waste.

This technique leaves some saw blade marks in the recess. Clean these up with a chisel, a shoulder plane or a file.

Make the Blade Clamp

Cut the blade clamp to its final length using the table saw sled. Sneak up on the length by making small cuts until the blade clamp just fits into the notch. Using the sled makes it easy to trim small amounts from the length of the clamp until you have a good fit.

A 1 1/2" x 1/4" notch must be cut in the blade clamp to allow the shavings to escape (see illustration). Use the same notching method on the blade clamp that you used for the stock.

The blade clamp is secured to the stock with two 1/4-20 x 1" machine screws. If you're using an extremely dense wood such as boxwood, African blackwood or ebony, the wooden stock of the chair devil can be tapped to accept the machine screws. If you use any other hardwood (or if you don't have a machinist's tap), then 1/2"-long brass insert nuts should be used to accept the screws.

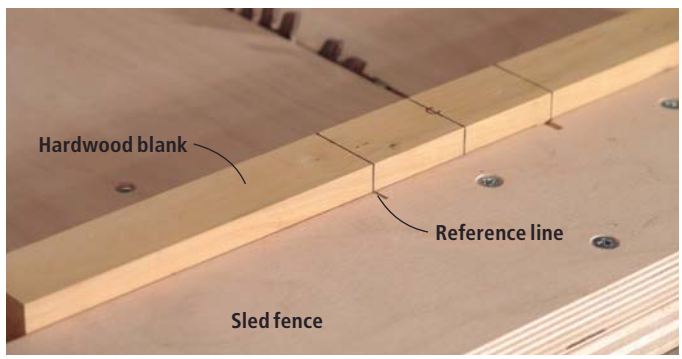
If you have chosen a very hard wood and want to thread the body of the chair devil, mark a line 5/16" in from either end of the blade clamp and 9/16" in from either side. Use a 13/64" brad-point bit to drill completely through the blade clamp and body. Slightly chamfer the entrance and exit holes on the body. Use a 1/4"- 20 UNC tap to thread the holes. Back out the tap handle frequently and use a square to check that the tap is perfectly plumb to the chair devil body as shown below. Check for plumb in two directions by sighting from both the side and the end of the chair devil body.

Use a 1/4" twist bit to enlarge the holes in the blade clamp. This provides a clearance hole for the machine screw. Use an 82° countersink to chamfer the entrance hole on the blade clamp to accept the machine screw heads.

If you decide to install threaded inserts in the stock, mark the locations of the holes as described earlier. Secure the blade clamp in the recess. Use a brad-point bit to drill 1/4" holes all the way through the blade clamp and chair devil's stock. Drill 3/8" holes through the chair devil's stock with a twist drill bit. Slightly chamfer all of the 3/8" holes. Put a bit of wax on the threads of the insert nuts then twist them into place.

A Simple Blade and Mouth

The blade of the chair devil is made from a 2 3/8" x 6" x .042" cabinet scraper. We used a 1 1/8" aluminum oxide sanding drum (#50 grit) to shape the blade of the



Step photos by Peter Reynolds

Set the blank onto the sled so that the saw blade will make a cut that is just to the inside of one end of the recess. Draw a line on the fence of the sled that is aligned with one of the lines that were drawn on the blank. This will act as a reference line for the next cut.

Remove the tap handle frequently and use a square to check that the tap is threading perfectly plumb. Sight from both the side and the end of the blank to ensure that plumb is achieved in two directions.

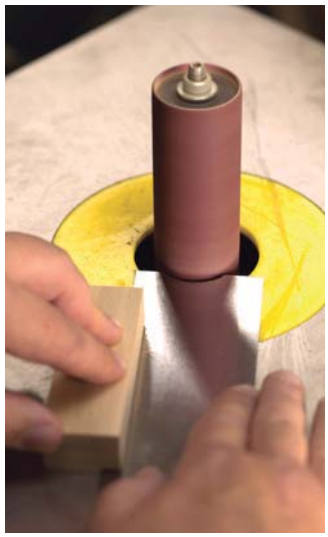
chair devil. Draw a semicircle with a diameter of 1 1/8" on the 2 3/8" side of the scraper blade. With the sanding drum running at 700 rpm, slowly sand the scraper up to the semicircular line as shown at right. Your hands will tell you when you're getting the scraper too hot, which causes the steel to lose its temper. It should become warm at most. Sand a 30° bevel on the blade by holding the blade at a 30° angle for the final shaping.

Use a hacksaw with a good-quality bi-metal blade to cut the scraper into a 2" x 1 5/8" rectangle. Use a file to clean up the edge and remove any burr.

Now secure the blade clamp to the body of the chair devil with the machine screws. Draw a 1 1/8"-diameter semicircle on the top of the blade clamp. Use the drum sander to remove the wood in the semicircular area. The mouth opening is relieved so that the chair devil can be canted forward in use. Create this relief angle (shown in the illustration) with the drum sander by holding the chair devil at a 20° angle for the final stages of sanding the mouth opening.

Turn the Handles

Chair devil handles have traditionally been turned on a lathe. Use a spur center on one end and a live center on the other. The notch of the chair devil is a weak spot that might snap when the tailstock is tightened. To prevent this, use the machine screws to hold the blade clamp in place while you turn. Use a spindle gouge to create a curve that fits your hand. Turn both ends until almost parted off, and then use a handsaw to complete the cut. A little hand sanding will bring the ends to shape. If you don't have a lathe you can use rasps and files to shape the handles.



Use a sanding drum running at 700 rpm to create the mouth opening in the scraper. Do not let the metal get too hot; your fingers will tell you when to let the metal cool down before continuing.

Use a spindle gouge to shape the handles of the tool to the desired shape. In this photo the blade clamp is removed, but you may find that the chair devil is stronger and vibrates less if the clamp is fastened into the recess during the turning process.

Sharpening and Use

While scrapers are often used with a hook, I found this tool works best without one. Sharpen the blade by flattening the face rather than grinding the mouth. To use the chair devil, install the blade so the flat side of the blade is facing the front of the tool, and the beveled side faces the back. Cant the body of the devil forward and draw the scraper blade along the wood. Experiment with the cant angle until the scraper cleanly shaves the wood. You'll find that the tool quickly removes the ridges left from a spokeshave and brings spindles beautifully round. **PW**

SUPPLIES

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

1 • 1/4"-20 x 1" flat-head bolts
#44Z08.04, $1.70/pkg of 10

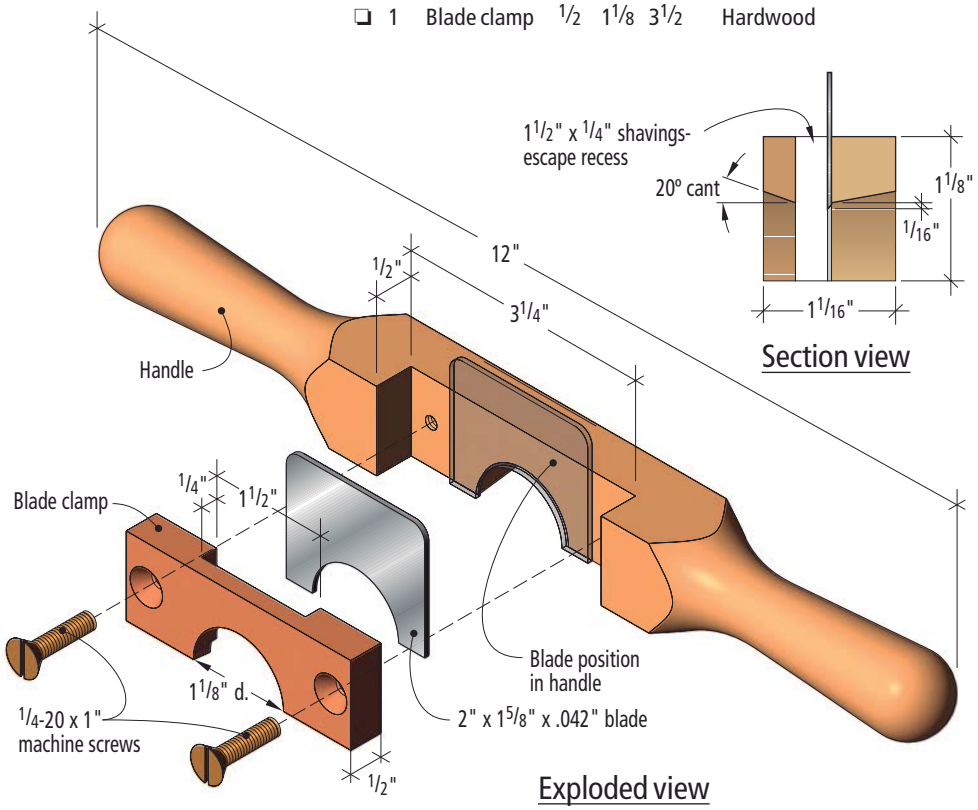
1 • brass insert nuts
#00M90.01, $4.95/pkg of 10

1 • cabinet scraper (1mm)
#05K30.01, $4.10

Prices correct at time of publication.

CHAIR DEVIL

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL
❑	1	Blank	1 1/8	1 1/16	14	Hardwood
❑	1	Blade clamp	1/2	1 1/8	3 1/2	Hardwood



Milwaukee's V28 System: Nearly Corded

Who needs 28 volts of power? Me – especially if it's sized like an 18 volt and will let me use a cordless circular saw that feels like a corded saw!

The Milwaukee V28, lithium-ion-powered system is revolutionary. Milwaukee set out to make a more powerful tool without a significant increase in weight – and the company succeeded. While even an 18v drill is larger and heavier than what I want to use all day long in my shop, the power and run time made possible with this technology makes sense.

One of the benefits of the lithium ion batteries is that they run the tool right up to the end of the battery's charge. One second you're sinking screws at full speed, the next second the battery is out. It runs 'til it's done.

I had the opportunity to use the V28 drill extensively during our 14.4v drill test (see page 70). Sinking the lag screws was the responsibility of the tools being tested. Taking the screws out of the boards was the job of the V28. I removed nearly 2,500 1½"-long lag screws on three charges and had constant, high-torque power the entire time. The drill also offers a hammer drill function that takes a flick of a switch to engage.

While the run time on the drill is impressive, I think this system and the battery technology really shines with the circular saw. Cordless circ saws have always been underpowered and thus sacrifice depth of cut for more power. The V28 circular saw offers a 6½"-diameter blade with a 2⅛" depth of cut at 90°. Even better, it really feels like a corded tool. When you make a cut, the blade doesn't slow as you enter the cut and the torque stays high through the entire cut. Very nice.

The tools are sold in a kit that includes the two batteries, a one-hour charger, drill, circular saw, reciprocating saw and flashlight. The tools can also be purchased individually for approximately $400 each, so the kit offers substantial savings.

This battery technology is great and we're anxious to see what other tools or voltages will soon benefit from it. — *David Thiel*

For more information, circle # 180 on Free Information Card.

SPECIFICATIONS

Milwaukee V28 System

Street price: H7085 kit, $729.95
Hammer drill: H7082, $419.95
Circular saw: H7084, $419.95
Sawzall: H7081, $419.95
Impact wrench: H7086, $479.95
Performance: ●●●●●
Price range: $$$$$
Milwaukee: 800-729-3878 or milwaukeetool.com

Lap-Sharp Sharpening System: Quality at a Price

Getting the hang of sharpening is not an easy task for the amateur woodworker. The Lap-Sharp addresses this by offering a simple powered system that will take you from grinding to polishing. The machine is extremely well made, with a foot-switch-controlled-gear drive motor and a selection of color-coded flat aluminum discs that hold various pressure-sensitive abrasives. The selection of abrasives included is well suited to sharpening and polishing most edge tools.

Using the Lap-Sharp is straightforward. The backs of chisels and plane irons are placed on the flat platter, then the foot switch is used to turn on the machine. This is a lot easier than trying to come in for a landing on a moving disc or grinding wheel. A tool guide is included for sharpening bevels, and a jig for planer and jointer knives is available as an optional accessory.

I found the Lap-Sharp very effective for flattening backs and squaring the edges of card scrapers. Some skill is required to effectively hone a bevel. As the outside of the disc is moving slightly faster than the inside, you need to develop the right touch to obtain an even edge. Because material is removed rather quickly, you can go a little too far with the finer grits, making it necessary to go back a step or two as you learn to use the sharpener.

Most of the abrasives need water as a lubricant, provided by a light misting of the surface with the included spray bottle. This can get messy if you're not careful. While the machine itself is rock solid, the abrasives do wear out and need to be regularly replaced. Like the machine itself, these aren't cheap so there will be significant ongoing expenses. In all, this is a solid, well-made machine that does what it was designed to do. If this approach to sharpening appeals to you, you won't be disappointed. — *Robert W. Lang*

For more information, circle # 181 on Free Information Card.

SPECIFICATIONS

Lap-Sharp LS-200

Street price: $595
Performance: ●●●●○
Price range: $$$$$
Wood Artistry: 707-838-1976 or woodartistry.com

Holdfasts that Really Work

Holdfasts are something of an obsession of mine. They're an almost-vanished tool that does an amazing job of quickly securing your work with just a mallet tap. Sadly, the only ones that really work these days are those made by blacksmiths. All the manufactured ones we've tested are poor substitutes.

Until now. The masterminds at Tools for Working Wood have patented a process for making a holdfast that works extraordinarily well for an equally extraordinary price: about $30 for a pair. We were allowed to test a pre-production version of this tool and were very impressed when we compared it to the other dozen or so variants in our shop. This new one from Tools for Working Wood – sold under its Gramercy Tools line – has a bit of a high-tech look, but it works as well (and sometimes better) than the old-school versions.

It works well in thick benchtops (which is always a challenge) and in holes 3/4" and 11/16" in diameter. Buy a pair. It will change your workholding for the better – instantly.

— Christopher Schwarz

For more information, circle #182 on Free Information Card.

SPECIFICATIONS

Gramercy Tools Holdfast
Street price: $29.95/pr., $16.95/ea.
Material: steel
Height/Reach: 11 1/4"/6 1/2"
Performance: ●●●●●
Price range: $
Tools for Working Wood: 800-426-4613 or toolsforworkingwood.com

The VersaClamp Offers Quick Vise-like Clamping

Sometimes the vise on your bench is not where the work is. For work occasions away from your bench (or on a utility bench) there is the VersaClamp.

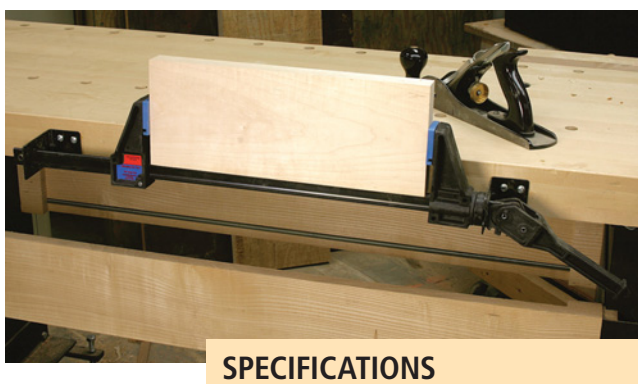
This fairly inexpensive tool has two mounting brackets that screw to whatever work surface you've got. Then the clamp is slipped into place and the cam handle is rotated into the closed position. A stated 400 lbs. of pressure holds your work in place for planing, sanding, scraping, screwing – you name it. The clamp can be rotated to a horizontal or angled position for the most convenient use.

But the name of the tool is *Versa*Clamp – and it's versatile because the clamp can be removed from the brackets and used as a free-hand clamp for basic clamping operations up to a 20" width.

The soft clamping pads are removable and replaceable, and all the metal parts are chemically coated to prevent rust.

This is a handy tool for the occasional woodworker or hobbyist. Because the brackets allow the clamp to be removed and used elsewhere, there is more play than we'd normally prefer in a vise-type application. Because of its affordable price, the VersaClamp is a reasonable alternative to pricey woodworking vises so it certainly will be a welcome addition to craft and job-site applications. *— DT*

For more information, circle # 183 on Free Information Card.



SPECIFICATIONS

TS Tool Company VersaClamp
Street price: $34.95
Performance: ●●●●○
Price range: $$
TS Tool Co.: 812-933-5421 or tstoolco.com

GREAT NECK MULTI-TOOL

This tool has "gift" written all over it. As part of its complete line of "Heritage Tools," Great Neck has introduced a line of hand tools that brings back the look of wood, but still offers the convenience of today's multi-tools.

The new line includes screwdrivers, chisels, a utility knife, a torpedo level and the clever 14-in-1 hammer multi-tool pictured above. This multi-tool includes a hammer, a nail claw, two slotted screwdrivers, a Phillips screwdriver, linesman pliers, regular pliers, a serrated blade, a razor knife, wire cutters, a wire stripper, a can opener, a key holder and a file.

This tool is a great addition to your shop or the tool drawer in the kitchen, and I want one for the glove compartment of my car. The 14-in-1 tool is packaged with a 4-in-1 screwdriver for only $24.99; a brass-accented version is sold separately in a cherry display box for $39.99.

For more information on Great Neck tools and the Heritage Tool line, visit its web site at greatnecksaw.com/heritage.

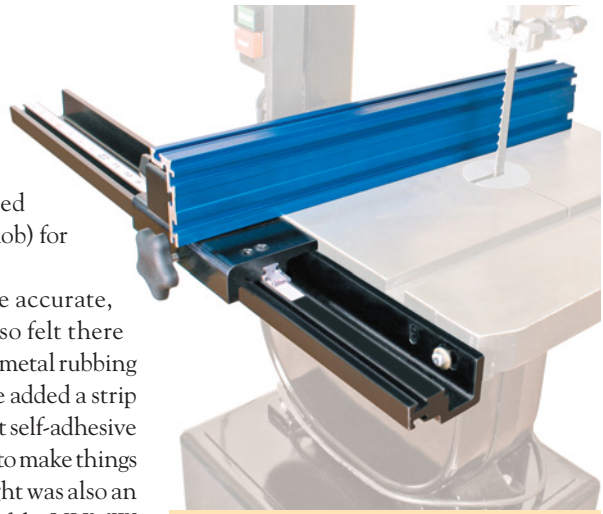
— DT

TOOL RATINGS

Performance is rated on a one-to-five scale. You won't see a low rating ("one or two") because we don't publicize inferior tools. "Five" indicates the leader in the category. Five dollar signs indicates highest price in the category. Three indicates an average price. If you have tool questions, call me at 513-531-2690 ext. 1255, or e-mail me at david.thiel@fwpubs.com. Or visit our web site at popularwoodworking.com to sign up for our free e-mail newsletter.

— David Thiel, senior editor

Kreg's Band Saw Fence for the Picky Woodworker



For many woodworkers, a board clamped across the table makes a fine band saw fence. If you're feeling ambitious you might even make it L-shaped for extra support and added height for resawing. So why spend more than $100 for a manufactured band saw fence? I'll give you a three-word-answer: accuracy, adjustability and stability.

If you learn anything as a woodworker, learn that wood continues to move. It shrinks and expands, so when you're counting on accuracy, having the dimensions of your fence change isn't acceptable. The aluminum guide bar and fence of the Kreg fence are rigid and stable. The well-marked tape measure and easy-to-read indicator cursor make accurate set-up a snap.

Another advantage of this fence is its adjustability. The fence can be angled for blade drift and just as easily adjusted to make sure the fence face is square to the table – all from above with the fence in place.

Assembly is also relatively easy with holes pre-drilled in the guide bar to fit most of the major-brand band saws. The Kreg fence requires only a front rail, and the fence assembly mounts easily to the bar (locking into a dovetailed track with the single front knob) for positive alignment.

We found this fence to be accurate, adjustable and stable. We also felt there was a little too much metal-to-metal rubbing when moving the fence, so we added a strip of ultra-high molecular weight self-adhesive tape to the bottom of the fence to make things slicker. Because the fence height was also an easy adjustment, the addition of the UHMW tape was no problem.

The fence is also set up to add an accessory micro-adjuster for even more accuracy (although it's fussy to set up) and resaw guides in two different heights (4½" and 7").

If your woodworking demands more than just a wooden fence and a couple of clamps, take a look at what Kreg has to offer. — *DT*

For more information, circle # 184 on Free Information Card.

SPECIFICATIONS

Kreg Precision Band Saw Fence
Street price: $107.99
Mounts to: Most 14" band saws
Optional accessories: Micro-adjuster and resaw guide
Performance: ●●●●○
Price range: $$$$
Kreg: 800-447-8638 or kregtools.com

Woodpecker Aluminum Squares – Accurate but Delicate

Today's CNC machining can produce incredibly accurate results. This new line of squares is an example of that. They are guaranteed to be accurate to .001" over their entire length, and are also guaranteed to stay that way. I looked at the Precision Woodworking T-Square, the Precision Aluminum Square and the Mini Square and found them all to be as accurate as claimed. But aluminum is fragile – using a marking knife or bumping it on a table saw top can damage these tools' reference edges.

The Precision Aluminum Square is the familiar try-square form, with an extra ledge in the stock that allows it to lay flat on the work. A scale is engraved on the blade, but the thickness of the blade made it difficult to transfer measurements. It is also an unusual size – in between a try-square and a framing square – which may or may not fit your needs or working habits.

The T-square has beveled edges on its scales, making it easier to use for layout work. In addition, it has a series of holes at precise 1/16" intervals. Put the point of your pencil in the hole you need, and making lines parallel to an edge is quick and precise. For layout work, it acts like a drafting machine, letting you mark and measure with the same device. The numerical scale on the blade is in 1/32" increments, allowing finer divisions than the holes allow. A 24"-long version is also available.

The Mini Square, at 1⅝" x 2⅝", is designed to be small enough to check chisel edges during grinding and sharpening without interfering with the chisel handle. It's a handy size, but the semi-circular cut-out at the inside corner made it difficult for me to check the corner of the chisel.

If you're willing to pay a premium price for reference and layout tools, and willing to adapt how you work to how these tools function, then you will be happy with these squares. **PW**

— *RL*

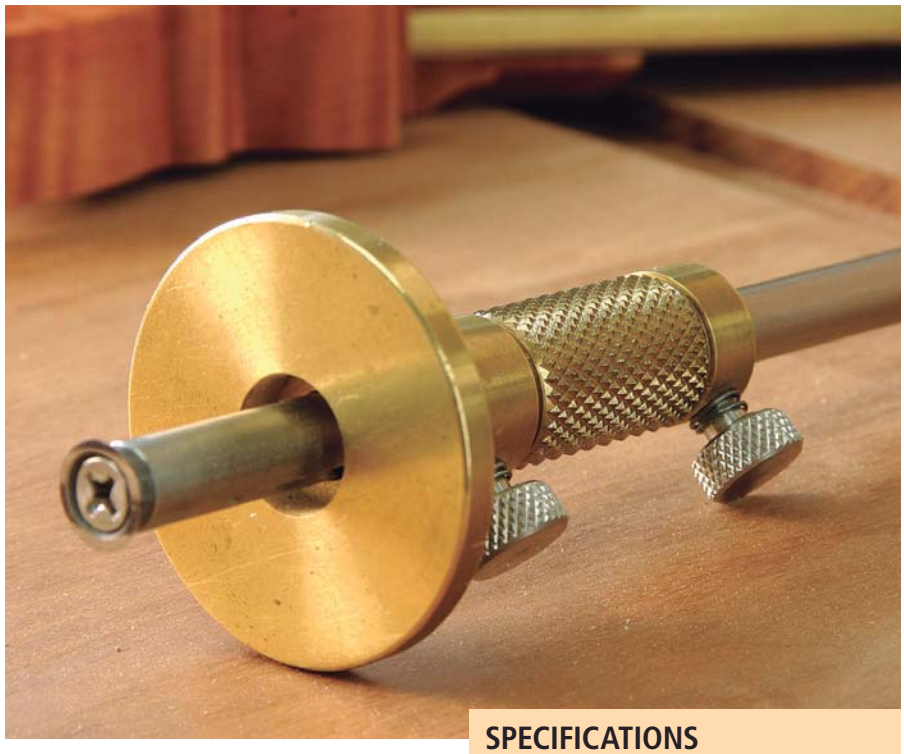
For more information, circle # 185 on Free Information Card.

SPECIFICATIONS

Woodpecker Squares
Street price: $29.95 to $129.95
Performance: ●●●○○
Price range: $$$$$
Woodpeckers: 800-752-0725 or woodpeck.com

Tite-Mark Gauge

Yes, it's expensive. But it's also possibly the finest cutting gauge ever made for woodworking.



The Tite-Mark cutting gauge showed up on my desk in 2001 wrapped in plastic and shrouded in questions about its true value as a woodworking tool.

With an $80 price tag, it was the most expensive gauge I'd ever seen. At the time, all the inexpensive but serviceable marking gauges cost about $12. Premium ones pushed the $30 mark. But $80? No one would want to pay that much.

Well, as it turned out, I did.

After about 20 minutes in the shop with the Tite-Mark, I was ready to pull out my credit card and hand it over to Kevin Drake, a former drummer-turned-woodworker who invented the Tite-Mark cutting gauge. Though I have tested many gauges since 2001 (and some of these cost even more than $80) the Tite-Mark is still my single-favorite gauge. Period.

Why is this tool always on my bench? Because it works intuitively, simply and quickly. And it's dang accurate. Most marking or cutting gauges adjust in a coarse manner. You attempt to set them to the exact thickness of a board when dovetailing – for example – and you end up scooting the post in and out through the head a few times just to get it in the neighborhood of correct. And then when you cinch the head on the post, your measurement can change as everything on the gauge tightens up.

If you've used a marking gauge for years and years, you've come to expect this sloppiness and compensate for it. You might not even notice all the time you're wasting with the fiddling. But a few minutes with the Tite-Mark will show you what a sham your old gauge is. The following operation can be completed one-handed: Get the head close to the right measurement (an adjustable nylon setscrew keeps the head from sliding wildly). Lock the rear spring-loaded thumbscrew and then turn the beautifully knurled barrel of the tool to adjust the head in and out to the exact measurement required. Lock the second thumbscrew and you'll cut a line exactly where you want it.

The cutter is A2 tool steel (hardened to Rc60) and makes a perfect line. Though the cutter works great out of the box, rubbing it on a fine polishing stone further improves it. My only problem with the tool was with the cutter, actually. I've shattered the edge of two cutters in the last four years. One chipped when I dropped the tool (my fault). The other incident occurred mysteriously (I blame my curious children). So do order an extra cutter (about $6) to have on hand.

Other features of the tool: The cutter retracts into the head to protect it and allows you to store the tool on its head. And the location of the rear thumbscrew prevents the tool from easily rolling off your bench.

In addition to marking out baselines for dovetailing, you're going to find many other uses for this tool. I actually use the Tite-Mark to remove the last bit of waste between my pins and tails – it's like a chisel with a depth stop. I also use it all the time for marking out lines on my work for nails or screws. And when I'm cleaning up through-mortises, I find the Tite-Mark just the tool for getting a crisp joint at the all-important visible edge.

There also are a variety of accessories for the Tite-Mark you might find useful – including additional blades for mortising and scoring your stock; and a longer 9" rod (and even longer ones are on the way) to extend your reach.

But even in its base configuration I think you'll find (as I have) that the Tite-Mark is the one gauge you've always needed. **PW**

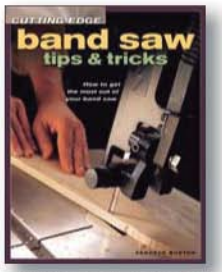
— Christopher Schwarz

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

SPECIFICATIONS

Tite-Mark

Street price: $79
Rod length: 7" (9" available)
Head size: 1 5/8" diameter
For more information: Contact Glen-Drake Toolworks at 800-961-1569 or glen-drake.com



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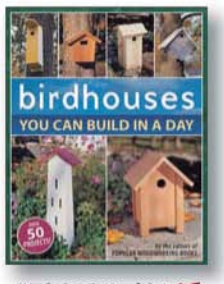

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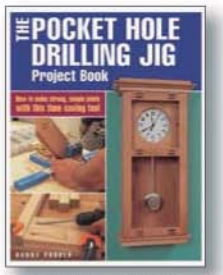

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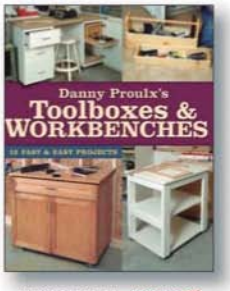

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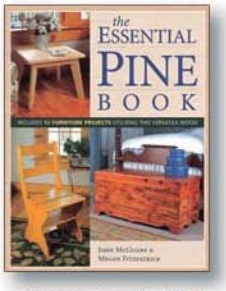

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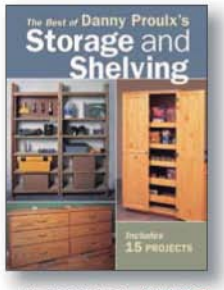

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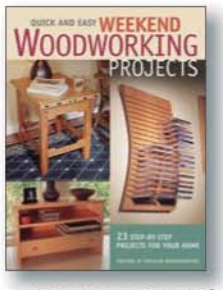

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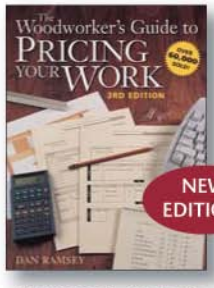

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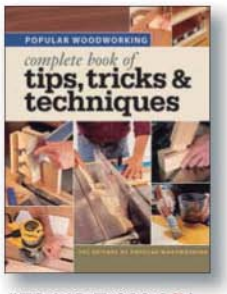

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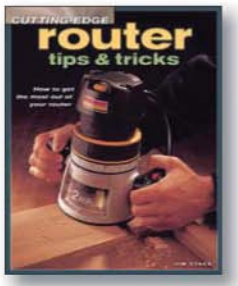

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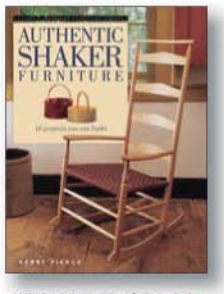

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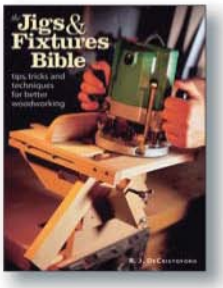

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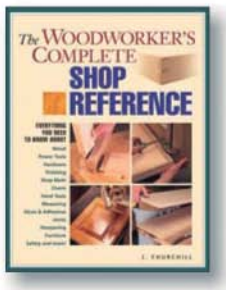

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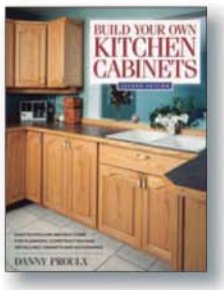

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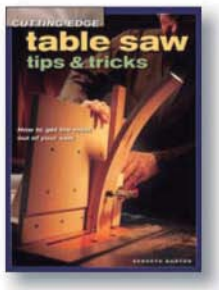

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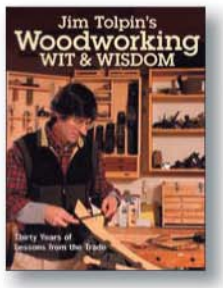

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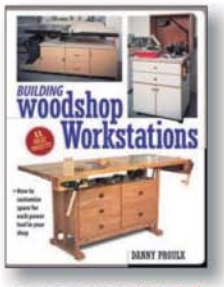

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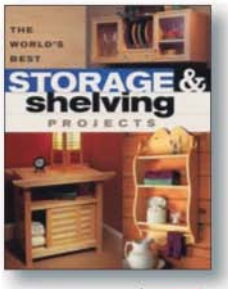

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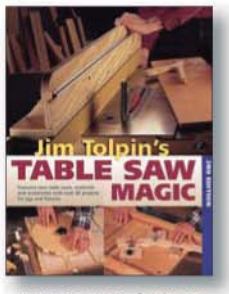

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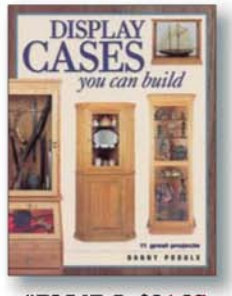

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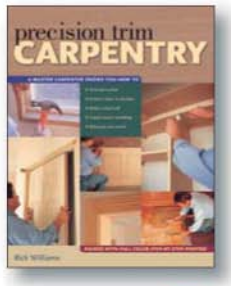

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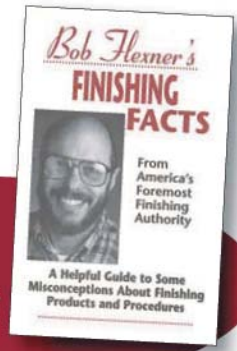

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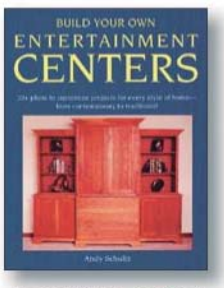

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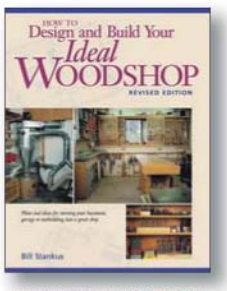

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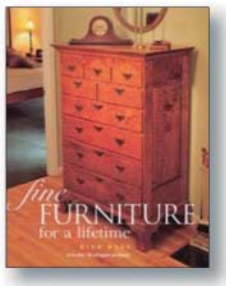

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Two Holiday Turning Projects

Turn spindle and hollow-globe ornaments using a waste block mount.

Photos by Al Parrish

A spindle ornament is the perfect gift for all your family and friends. They can easily be turned in quantity. The more complex hollow-globe ornament is a special gift someone will always treasure.

For woodturners, the nip of autumn in the air usually triggers thoughts of holiday projects. Here are two ornaments you may enjoy making. A simple spindle or "icicle" ornament provides the opportunity to practice technique and design while producing gifts in quantity, should that be your goal. The more complex hollow-globe ornament is slightly more challenging. It would be nice as a special gift or to keep and pass down in your own family.

Spindle Ornament

Prepare and mount the workpiece as described in the story "Waste Block Mount" on page 91. Using a small spindle gouge, begin shaping the ornament. The possibilities here are endless. In general, I find shapes that vary greatly in diameter from one part of the spindle to another are pleasing to the eye. Many people make very angular shapes on spindle ornaments, but I like full, round shapes. Pay attention to transitions; the different parts must relate to one another in some way. And as always, curves must be smooth; make sure there are no bumps or dips in them so the ornament will look finished and harmonious.

When you have a pleasing shape roughed out, begin to refine the surface. Once you have the shape you like cleanly turned, turn the left end close to the axis but don't part off yet; leave about 1/4" diameter. Turn the right end very close to the axis, again not quite parting it off. This leaves enough support to sand and finish without breaking the piece off.

You should, however, still sand and finish gently, minimizing the lateral pressure on the piece. Then part off the right end, sand and finish the tip. Part the workpiece off at the headstock. Then sand and polish the top, install a tiny eye screw and ribbon, and the ornament is complete.

Hollow-globe Ornament

This ornament is turned in three parts (four, if you turn the globe in two pieces as I have here, instead of one), which are then glued together to complete the piece. Many people turn this type of ornament by hollow-turning the globe in one piece. For this article, I am hollowing the globe by dividing it into two pieces and excavating each one separately. I've chosen this technique because, in spite of requiring two mountings, it's somewhat easier, especially for relative beginners; and because when I started out to make these, I couldn't find the bent-tip hollowing tool I thought I had somewhere.

Start by making the globe. Use a piece of wood about 3" to 4" square by 4" to 5" long. Turn it between centers to the shape of a cylinder, then cut a tapered tenon on each end. Part almost into the center in the middle of the piece, remove it from the lathe and cut it apart on the band saw. Mount the first half in a waste block as described in "Waste Block Mount." Shorter pieces are especially prone to being twisted from your hand during my "burn fit" procedure, so you may wish to hold the piece in Channellock pliers or fit it without the lathe turned on.

Cut a straight shoulder on the end of the piece and rough in the outside shape. Using the tailstock to mount a drill bit, drill a 1/2"-

continued on page 94

by Judy Ditmer

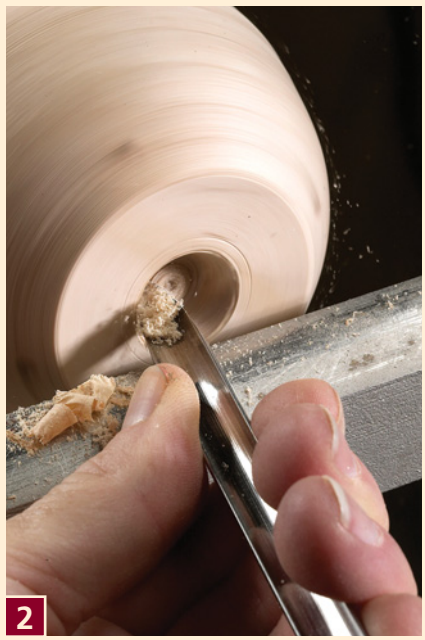
Judy, author of two turning books and many articles, has been turning since 1985. She teaches and demonstrates her skills throughout the United States and Canada.

WASTE BLOCK MOUNT

This glued-tenon waste block mount is a useful technique for many turning projects. It wastes little of the workpiece material and is quite strong. And, there are no chuck jaws protruding to bite knuckles or fingers, and no metal for the gouge to hit. I like to use hard maple, but any close-grained hardwood will do. Avoid open-grained woods such as oak, which can split apart along grain lines.

1

Prepare your workpieces by turning them between centers to a cylinder and cutting a slightly tapered round tenon on one end. Mount a waste block onto a faceplate, turn it round and flatten the surface. Measure the diameter of the tenon on the workpiece with a caliper and transfer this to the waste block. With the lathe on, gently touch the left point of the caliper to the waste block. Remember: The wood to the right of center is moving upward; if you touch it there, it can grab the caliper. Make a light mark and move the caliper until the right-hand point lines up with the mark; then push the caliper in to make a deeper mark.



2

Using the mark as a guide, cut a tapered hole in the waste block. The taper makes it easier to fit the tenon.

3

After cutting the hole to the approximate size of the tenon, and with the lathe on, firmly grasp the workpiece and push it into the waste block. This will burnish where there is good contact. There should be good contact at the outside of the cylinder and at the tenon, as shown here. An important caution: If the fit is too tight, or the hole is shorter than the tenon, the cylinder can twist and be pulled from your hands. If you are uncomfortable with this method, fit the piece with the lathe off until it's right. This will take longer, but the workpiece won't be pulled from your hand.

4

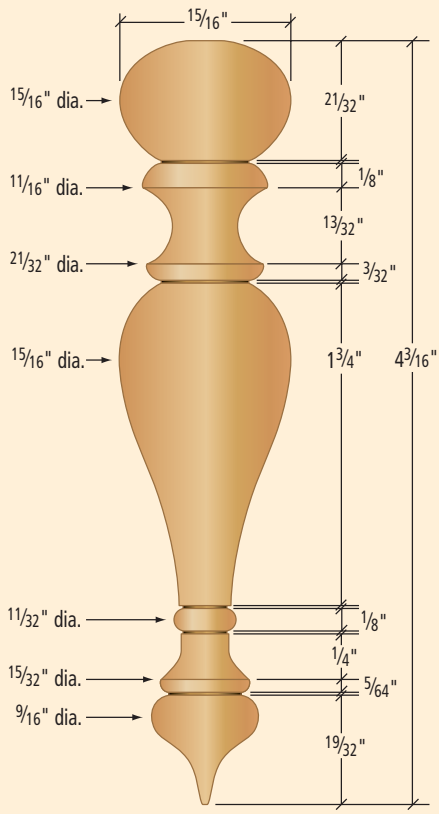
Use extra-thick cyanoacrylate glue to attach the workpiece to the waste block. First, spray accelerator on the waste block, and apply the glue to the end of the cylinder and the tenon. Push the tenon into the hole and twist to spread the glue evenly. Hold the piece for a few seconds until the glue grabs, then wait a couple minutes to ensure that the glue has set. Finish as much of the workpiece as possible before the final parting off; you should not expect to do the roughing-in and shaping of the piece without tailstock support. You are ready to begin working. *– JD*

SPINDLE ORNAMENT

Left to right: Squares (about 1" x 1" x 6") ready to prepare; turned to round and ready to mount; finished "icicle" ornaments (4 1/2" long, 1" largest diameter).

Begin shaping the piece, using an appropriately sized spindle gouge. Mine has a long "fingernail" grind; the side of the tool can remove a lot of material, and the tip is good for fine detail.

Continue refining the shapes. Take your time and get it right; you can get faster later.



Spindle ornament

Here I am using a steel wire (always attach wire to dowels or other scrap, and hold the dowels, not the wire itself) to burn details into the work. Complete the turning, sand and finish the piece. I use a hard wax, which is applied and buffed while the piece is on the lathe.

Part off the right end, being careful to smoothly complete the shape at the end. Sand and finish the end. Be gentle; too much sideways pressure could pull the piece from the mounting or break it off at a narrow place.

Part the piece off at the left.

The completed ornament. You can hand sand and polish the small area at the top where it was parted off; then attach a tiny eye screw and ribbon for hanging.

continued on page 94

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continued from page 92

diameter hole through the piece into the waste block. With a fingernail-grind spindle gouge, remove most of the wood inside the piece to reduce the weight. Continuing the rough shape you've established, part the piece off.

Mount the other half of the globe stock and drill it as you did the first. Mark the diameter of the shoulder from the other piece on the end and cut a straight recess to fit the two pieces together. It doesn't need to fit as well as a box lid, because it will be glued together, but it should fit closely enough that the pieces can't move side-to-side. Hollow out this piece as you did the first, then glue the two halves together. If the grain is pronounced, make sure the lines match up.

Finish turning the outside of the globe. Be careful to leave enough material at the headstock end to hold the piece on the lathe. Remember, there is a 1/2" hole at the center. But try to get close enough that the unfinished part at the top will later be covered by the flange on the spindle. You may wish to turn a detail of some kind at the middle of the globe, where the halves join; it's hard to completely hide such a joint, so making a decorative cut of some kind is a good choice to help disguise it. Sand and finish; then part off.

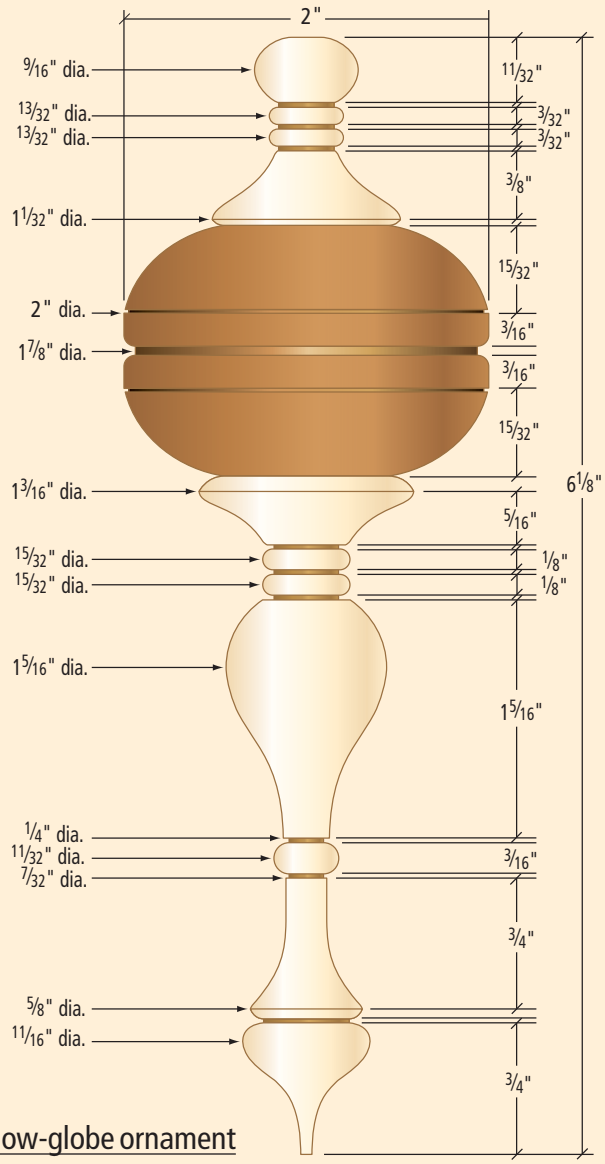
Now make the spindles. Again, mount the prepped workpiece (cylinder with a tenon at one end) as described in "Waste Block Mount." Turn the spindle as previously described for the simple ornament, making a 1/2" tenon and a slightly undercut flange at the end that will attach to the globe. The flange should be as wide as possible to cover the area on the globe where you parted it off; this saves having to sand and finish that small part. When you have finished the first piece, part it off, mount the other piece and repeat the entire process. The top spindle is usually made considerably shorter than the bottom, but you could play around with this. Just make sure you undercut the flange so the curve of the globe will fit into it and not leave a gap where the two pieces meet, and have a clean, 1/2" tenon for alignment in assembling the parts.

Glue the pieces together, install a small eye screw in the top and attach a ribbon. Your ornament is finished.

Now that you know the process, you should make a few more of them to refine your understanding and designs. You may want to keep the best one for yourself!

HOLLOW-GLOBE ORNAMENT

Left to right: rough stock, prepped stock, finished ornament (6 1/8" long, 2" largest diameter).



Hollow-globe ornament

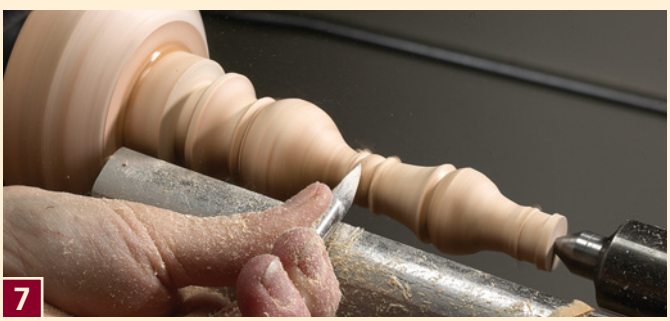
Mount the first half of the globe stock. Cut a straight shoulder on the end, and rough in the shape of the ball.

Drill a 1/2"-diameter hole all the way through the workpiece into the waste block.

Hollow out the interior with a spindle gouge.

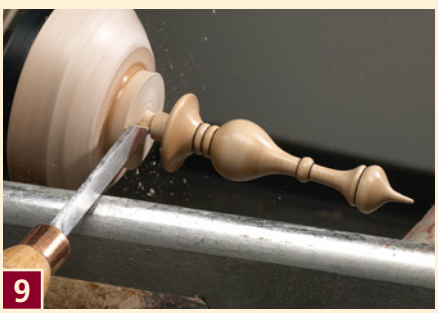
Here I have mounted the second half, cut a recess to fit the first half, and hollowed out the interior.

Glue the halves together and complete the exterior; sand, finish and part off.



Mount and turn the long (lower) spindle. This is just like turning the icicle ornament; see those instructions for more detail.

Make a wide, undercut flange and a 1/2"-diameter tenon at one end.



When sanded, finished and parted off at the narrow end, part it off at the end of the tenon.

Make the short (top) spindle or finial.

For any of the spindles, after hand-sanding the end you parted off (unless it will be hidden in the finished piece), use a buffing wheel to complete the finishing. **PW**

PRODUCT INDEX

	PAGE #	CIRCLE #	WEB ADDRESS
ADHESIVES			
EpoxyHeads	30	114	epoxyheads.com
Franklin International	24-25	119	titebond.com
Gorilla Glue	30	122	gorillaglue.com
Old Brown Glue	102	143	patrickedwareds.com
BITS, BLADES & CUTTERS			
Amana Tool	8	102	amanatool.com
CMT	83	108	cmtusa.com
Forrest	7	118	stores.yahoo.com/forrestman
Freud	11	120	freudtools.com
Infinity Tools	30	127	infinitytools.com
Routerbits.com	102	154	routerbits.com
Woodline USA	31	168	woodline.com
BOOKS			
Woodworker's Book Club	88-89	—	woodworkersbookclub.com
Woodworker's Library	102	171	woodworkerslibrary.com
BUILDINGS			
SteelMaster Buildings	103	157	steelmasterusa.com
FASTENERS			
McFeely's	27	138	mcfeelys.com
Miller Dowel	26	139	millerdowel.com
Red Top Screws	103	152	redtopscrews.com
FURNITURE & PROJECT PARTS			
Adams Wood Products	31	100	adamswoodproducts.com
Architectual Products	102	103	archpro.com
Exotic Wood Elegance	102	115	exoticwoodelegance.com
Osborne Wood Products	18, 83	146, 177	osbornewood.com
HAND TOOLS			
Bob's Rule	31	107	bobsrule.com
Fine Tool Journal	103	117	finetoolj.com
Japan Woodworker	97	128	thejapanwoodworker.com
Lee Valley	8	133	leevalley.com
Lie-Nielsen Toolworks	97	134	lie-nielsen.com
Manny's Woodworker's Place	102	136	mannyswoodbooks.com
Robert Larson	27	153	rlarson.com
Tools for Working Wood	83	159	toolsforworkingwood.com
Traditional Woodworker	102	161	traditionalwoodworker.com
Wood Artistry	103	166	woodartistry.com
HARDWARE			
Ball & Ball	93	105	ballandball-us.com
Whitechapel Ltd.	31	164	whitechapel-ltd.com
Woodworker's Hardware	26	170	wwhardware.com
KITS & PLANS			
Pygmy Boats	103	150	pygmyboats.com
Texas Knifemaker	102	158	texasknife.com
U-Bild.com	102	162	u-bild.com
MISCELLANEOUS			
Dakota Alert	103	110	dakotaalert.com
POWER TOOLS			
Delta Machinery	4-5, 20-21	111, 174	deltamachinery.com
DeWalt	9, 19, 37	112, 175, 179	dewalt.com
Fein Power Tools	2	116	feinus.com
General Mfg.	18	121	general.ca
Grizzly Industrial	C2-1	124	grizzly.com
Hitachi Power Tools	12-13	126	hitachi.com/hpt
Jet Tools	22-23	129, 176	jettools.com
Makita USA	C4	135	makitatools.com
Oneway	93	145	oneway.on.ca
Porter-Cable Corp.	Poster	149, 178	portercable.com
RB Industries	93	151	rbiwoodtools.com
Ryobi	29	155	ryobitools.com
Sears Craftsman	C3	156	craftsman.com
Wilke Machinery	28	165	wilkemach.com
Woodstock International	15	169	woodstockinternational.com
POWER TOOL ACCESSORIES			
Beall Tool	103	106	bealltool.com
Craftsman Gallery	103	109	thecraftsmangallery.com
Jointech	14	130	jointech.com
Keller & Company	83	131	kellerdovetail.com
Kreg Tool	27	132	kregtool.com

	PAGE #	CIRCLE #	WEB ADDRESS
Leigh Industries	18	—	leighjigs.com
Mule Cabinetmaker	93	140	mulecab.com
Mystic Works	102	141	featherbow.com
TopCell Batteries	26	—	namrep.com
SAWMILLS & KILNS			
Granberg International	102	123	granberg.com
Norwood Industries	103	142	norwoodindustries.com
SCHOOL/INSTRUCTION			
Marc Adams School	27	137	marcadams.com
SHOP ACCESSORIES			
Airware America	102	101	airwareamerica.com
Diefenback Benches	102	113	workbenches.com
Oneida Air Systems	26	144	oneida-air.com
TURNING SUPPLIES			
Augums Pen Works	102	104	augumspenworks.com
Packard Woodworks	103	147	packardwoodworks.com
WOOD & VENEERS			
Panoply	14	148	panoplycorp.com
Wall Lumber	93	163	walllumber.com
Woodfinder	103	—	woodfinder.com
Woodworker's Source	102	172	woodworkerssource.com
WOODWORKING CATALOGS			
Hartville Tool	30	125	hartvilletool.com
Woodcraft	16-17	167	woodcraft.com
Woodworker's Supply	93	173	woodworker.com
WOODWORKING SHOWS			
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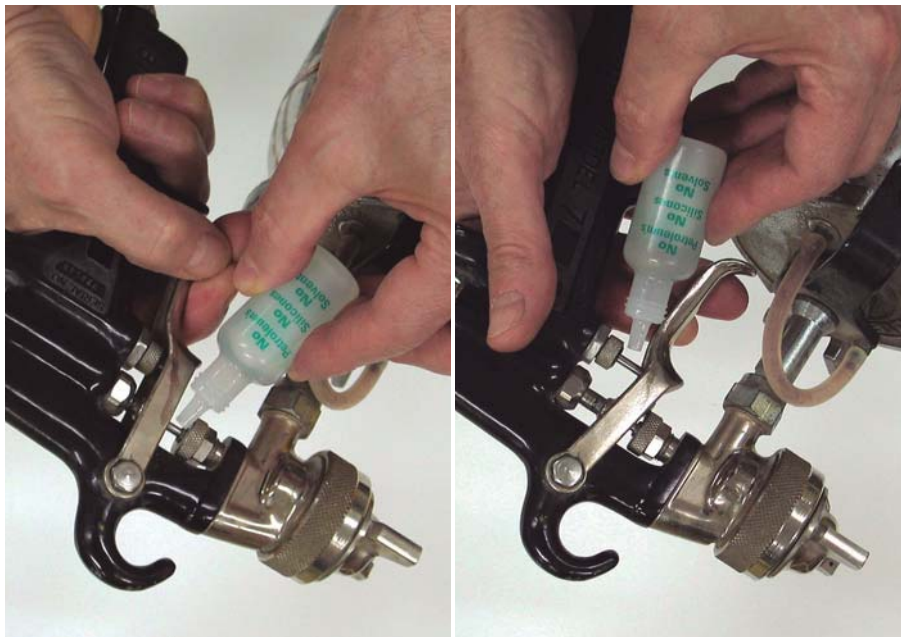
(See Advertiser Index or Product Index for circle numbers.)

ADVERTISER INDEX

Spray Gun Maintenance

Avoid problems and lengthen the life of your tool with two simple acts.



Photos by the author

It's important to keep the fluid-needle "packing" oiled and flexible so it seals around the needle to prevent leaking. The packing is held in place by the packing nut, which is just in front of the trigger. Lubricate the packing without removing the nut by applying oil to the needle (left). If your spray gun has an exposed air-valve needle behind the trigger (right), you should keep it oiled also. Use oil that is free of silicone and petroleum distillate.

As with any tool, a properly working spray gun is a joy to use. On the other hand, one that isn't working well can go unused or even end up in the trash if you don't know how to resolve the problems.

You can avoid most problems by keeping your spray gun well maintained. There are three levels of maintenance: lubricate the moving parts, clean the spray gun and rebuild the spray gun.

I cover lubricating and cleaning below. Rebuilding can be accomplished in two ways. You can do it yourself with a kit of springs, washers and packings that you buy from the manufacturer, or you can have someone rebuild the gun for you.

If your spray gun is sold at an auto-body supply store, you can usually buy the kit there, and most of these stores know someone who will rebuild your gun for you. Some manufacturers of turbine guns supply kits and a rebuilding service, but not all. Spray Gun Repair (860-928-1802 or spraygunrepair.com) rebuilds most guns.

The need to rebuild a spray gun should be as rare as the need to rebuild a router unless you let paint or finish cure in the gun. You can avoid the need for rebuilding for a very long time, and maybe forever, if you follow these simple lubricating and cleaning procedures.

Lubricating a Spray Gun

There are two parts on a spray gun that should be lubricated often: the fluid-needle packing, which is similar to a gasket and located just in front of the gun's trigger, and the air valve just behind the trigger. You can also lubricate the pin that the trigger swings on and the screw threads at the back of the gun. But I don't find either of these critical.

Use a type of oil that doesn't contain silicone or petroleum distillate (thinner). Mineral oil is a good choice. Auto-body supply stores and many spray-gun manufacturers sell a handy oil-containing squeeze bottle with the correct oil.

If you use the spray gun on a daily basis, you should perform the lubrication at the end of each day. Otherwise, you can do it at the end of each project, before you put the spray gun away.

Cleaning a Spray Gun

If you spray only shellac or lacquer, it's rare that you should have to disassemble the spray gun and clean it. The thinner makes the gun self-cleaning because alcohol or lacquer thinner dissolves any finish that might have hardened and caused blockage.

However, spraying any other finish or any paint can lead to blockage if you don't clean the spray gun adequately after each use The easiest way to do this is to spray solvent through the gun. To remove blockage you will have to do a thorough cleaning.

Some manufacturers sell cleaning kits containing brushes, picks and needles of proper sizes for cleaning their guns. For this article I'm using a kit sold by Spray Gun Solutions (303-424-3741 or spraygunsolutions.com), which includes cleaning tools that fit any spray gun.

For a cleaning solvent, I'm using lacquer thinner. This is the most effective solvent to use, even if the finish you are cleaning is water-based. I'm using a Binks #7 spray gun for the photos. It's an old-fashioned high-pressure gun, but its parts photograph well. Every spray gun is a little different. Use the following as a guide for cleaning your gun.

by Bob Flexner

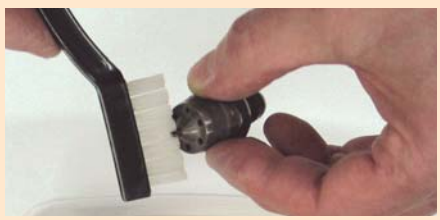
Bob is author of "Understanding Wood Finishing" now in its second, fully revised, edition. To purchase, visit amazon.com, your local bookstore or a woodworking supply store.

HOW TO CLEAN A SPRAY GUN

Remove the air cap, fluid nozzle, fluid needle and plastic air tube, and soak them in lacquer thinner. After soaking you may be able to clean these parts adequately using compressed air. Otherwise, perform the following steps.

Scrub the air cap inside and out using various brushes. Be very careful if you use a toothpick because it may break off and become lodged, which will create greater problems. You can use an old toothbrush for most surfaces.

If necessary, clean the atomization holes using a needle of some sort. For example, the needle on a small brass safety pin works well. Don't damage these holes by using a metal that is harder than the metal in the cap or larger than the holes themselves, or you may end up having to replace the air cap.



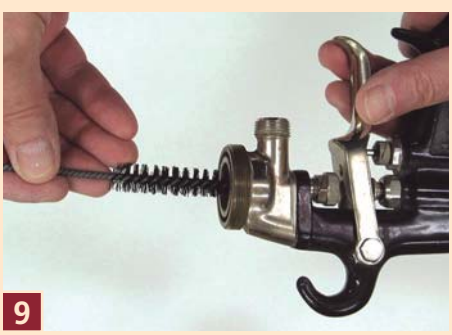
Follow the same cleaning procedures on the fluid nozzle that you used on the air cap.

Wipe the fluid needle with solvent and a cloth to remove any finish or paint stuck to it. Don't use an abrasive such as steel wool on the tip or you will damage it.

Remove all blockages from the air tube.

Use a round bristle brush to scrub the inside of the fluid tube.

Use a brush, metal pick or toothpick to remove any blockage from the air inlet hole on the top of the spray-gun cup. The dimensions of this hole aren't critical like on the air cap and fluid nozzle.



Finally, use a round bristle brush to scrub the fluid chamber and fluid inlet. Then reassemble the gun. **PW**

QUALITY SUPPORT

For spray-gun support, contact the company that sold you the gun or look at the manufacturer's web site, which often has very helpful information. The availability of customer support is one of the most important considerations when choosing a brand of gun to buy. *– BF*

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A Whiff of the Past

The scents of our work can evoke a sense of reverie.

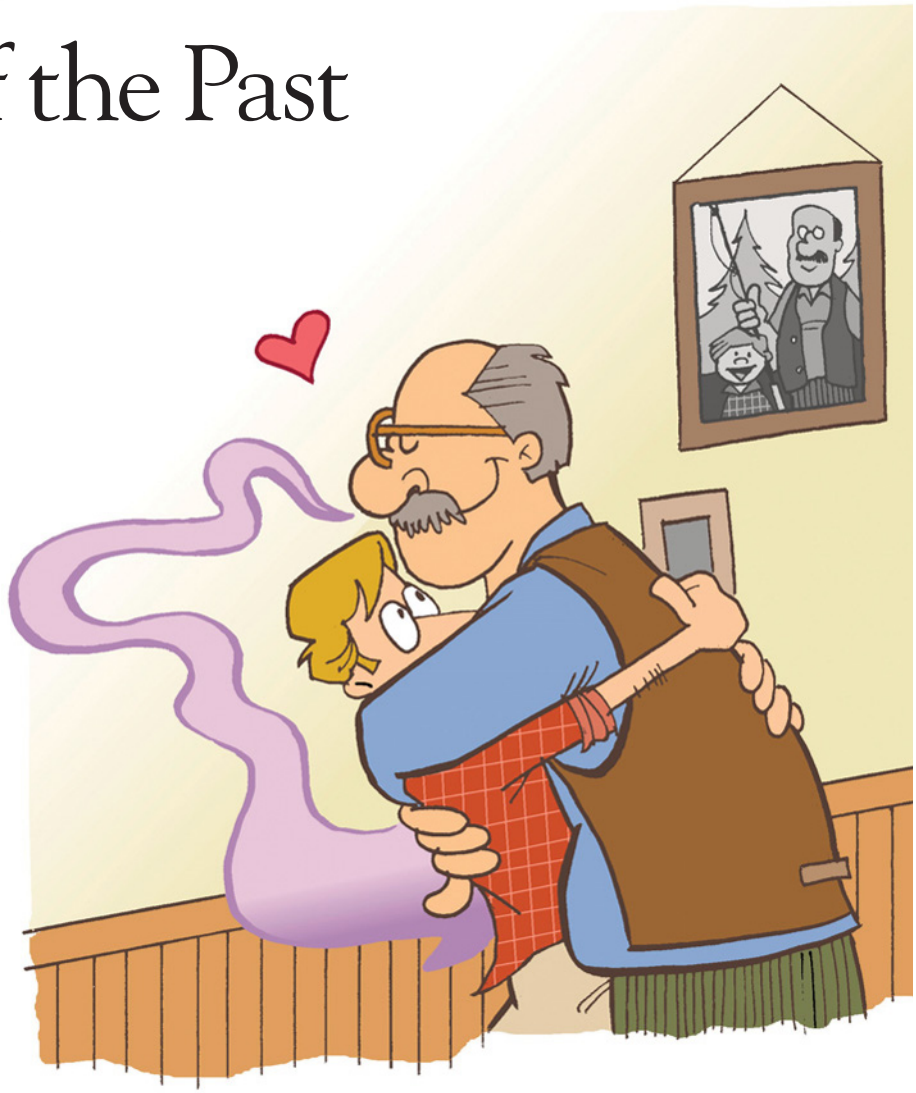

Illustration by Pat Lewis

If anything can plunge you into a nostalgic reverie, it's a scent.

I don't know whether it's because I'm getting older or because my father is getting older, but smells have triggered a lot of memories for me lately, mostly related to him.

Just the other day I was sniffing myself – as I'm wont to do as I wish to avoid knocking people out – and a memory of my father came wafting back.

I was about 4 years old and my father had just picked me up from nursery school. He was carrying me when I smelled what came to be, for me, that "man smell" – a combination of the metallic, oily, sweaty smell that comes from working with metals and machines all day. It's an honest smell that's not at all unpleasant.

Why did catching a whiff of myself bring back that memory? It was the same smell.

For years I was a white-collar worker in the computer industry (corporations do leave a smell on you – but not one that is all that pleasant). I now work with metals and make tools, as did my father, a master tool and die maker of the old school. I make hand planes, along with other tools, so that "man smell" is something I now smell pretty much every day.

It's funny, but I know that my dad's memories are triggered by that smell, too. Recently, my parents visited me. I had just returned from the shop when I passed very close by my father. He grabbed me by the shoulders and took a deep breath through his nose. He smiled – that was all. We didn't say anything but it was one of those "I know that you know that I know" moments. I smiled right back.

I also work with wood and that smell brings back its own set of memories. You know – fresh-cut wood combined with sweat and, in my case, the smells of the forest – another "man smell."

I recently cut up a maple tree that had been hit by lightning and the smell transported me back to the farm and age 11.

My father had a 14-acre plot he bought as an investment. It had about one clear acre; the rest was forest. The first summer we turned that one acre over by hand with shovels, then planted potatoes. I hated every minute of it. (Nostalgia doesn't have to be pleasant!)

The next year my father wanted more clear acreage so I came to know the smell of cut wood as we felled the trees. We cleared about two acres with a hand ax and a two-man saw. I hated that, too.

But I have good memories as well. A creek ran along the front of that piece of land, and on one of those rare occasions where I was simply allowed to play, I met my first love.

She was 10 to my 11, and a farmer's daughter from the farm across the way (yeah, yeah – I know all the jokes). I was catching frogs when I heard this tentative "Hello." Looking up, I saw a girl with dark hair and the deepest, bluest eyes I had ever – and have ever – seen. Instant love.

Pause for a deep intake of breath – let it out slowly and revel in that memory.

You know the saying: "Stop and smell the roses." It must have been a very wise person who said that.

Stop, smell and remember. **PW**

by Ben Knebel

Ben Knebel is a tool collector and one of the founders of the Shepherd Tool Co., which sells infill hand planes and kits for building planes. Visit shepherdtool.com for more information.

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