SPECIAL BONUS SECTION: 18 STRATEGIES FOR EASIER ASSEMBLY

HATE YOUR DOVETAIL JIG? 5 QUICK & EASY TUNEUPS FIX EVERYTHING

FEBRUARY 2006
ISSUE #153

POPULAR Woodworking

Learn How ▪ Discover Why ▪ Build Better

BUILD BETTER, BUILD FASTER

Blend Hand, Power Tools In ANY Shop

4 TRUTHS About SCREWS

And 13 Tricks for Tighter Joints

FAST FIXES

for Drippy, Spurting Spray Guns

PLUS

- 5-minute Chisel Fix
- 'Ultimate' Hand Tool Shop
- Want Bowls? Get a Chainsaw

$5.99US $7.99CAN
02
0 74470 01355 6
DISPLAY UNTIL 1-30-2006

Grizzly Industrial®

Purveyors of Fine Machinery®

THE ULTIMATE 10" CONTRACTOR-STYLE TABLE SAWS W/CAST IRON WINGS & TABLE

- Motor: 2 HP, 110V/220V, single-phase
- Precision ground cast iron table size: 27" x 39⅝" w/wings
- Arbor: ⅝" • Rip capacity: 30"
- Cutting capacity: 3⅛" @ 90°, 2⅛" @ 45°
- Shop Fox® Aluma-Classic™ Fence
- Approx. shipping weight: 298 lbs.

T1 SERIES

RIGHT-TILT
G0444Z ONLY $575.00

LEFT-TILT
G0576 ONLY $615.00

$85 shipping ANYWHERE IN LOWER 48 STATES

10" LEFT TILTING SUPER HEAVY-DUTY TABLE SAW

- Motor: 3 HP, 220V, single-phase
- Precision ground cast iron table w/ 2 cast iron extension wings
- Table size w/ wings attached: 27" x 40⅛"
- Arbor: ⅝" (accepts dado blades up to 13/16")
- Cutting capacity: 8" L & 26" R of blade
- Max. depth of cut: 3" @ 90°, 2⅛" @ 45°
- Approx. shipping weight: 465 lbs.

INCLUDES SHOP FOX® CLASSIC FENCE

G1023SL ONLY $975.00

$85 shipping ANYWHERE IN LOWER 48 STATES

10" LEFT TILTING SAW W/ 7' RAILS & EXTENSION TABLE

- Motor: 3 HP, 220V, single-phase, 3450 RPM
- Precision ground cast iron table
- Extension table size: 27" x 44"
- Arbor: ⅝" (accepts dado blades up to 13/16")
- Cutting capacity: 8" left, 54" right
- Max. depth of cut: 3" @ 90°, 2⅛" @ 45°
- Approx. shipping weight: 540 lbs.

WOOD MAGAZINE TOP VALUE APPROVED 2005

INCLUDES SHOP FOX® CLASSIC FENCE

$85 shipping ANYWHERE IN LOWER 48 STATES

G1023SLX ONLY $1250.00

6" JOINTER

New!

- Motor: 1 HP, 110V, single-phase
- Table size: 6" x 46"
- Max. depth of cut: ⅛"
- Max. rabbeting capacity: ½"
- Cutterhead knives: 3
- Cutterhead dia.: 2½"
- Cutterhead speed: 4800 RPM
- Cuts per minute: 14,400
- Cast iron fence
- Approx. shipping weight: 270 lbs.

BUILT-IN "KICK STAND" MOBILE BASE!

INCLUDES A FREE PAIR OF SAFETY PUSH BLOCKS

INTRODUCTORY PRICE!

G0452 ONLY $325.00

$85 shipping ANYWHERE IN LOWER 48 STATES

8" X 75" JOINTERS

New!

- Motor: 2 HP, 110V/220V, single-phase, TEFC, 3450 RPM
- Precision ground cast iron table
- Cutterhead knives: 4 HSS, 8" x ¾" x ⅛" (G0586)
- Cutterhead speed: 5500 RPM
- Cutterhead diameter: 3"
- Max. depth of cut: ⅛"
- Max. rabbeting depth: ½"
- Cuts per minute: 22,000 (G0586)
- Approx. shipping weight: 558 lbs.

INCLUDES FREE PAIR OF SAFETY PUSH BLOCKS

MADE IN ISO 9001 FACTORY

INTRODUCTORY PRICE!

4 BLADE CUTTERHEAD
G0586 ONLY $655.00

SPIRAL CUTTERHEAD
G0593 ONLY $995.00

$135 shipping ANYWHERE IN LOWER 48 STATES

8" X 76" JOINTER

- Motor: 3 HP, 220V, single phase, TEFC, 3450 RPM
- Total table size: 8" x 76 5/16"
- Infeed table size: 8" x 43⅜"
- Cutterhead knives: 4 HSS, 8" x ¾" x ⅛"
- Cutterhead speed: 4900 RPM
- Cutterhead diameter: 3 3/16"
- Max. depth of cut: ⅛"
- Max. rabbeting depth: ½"
- Cuts per minute: 19,600
- Approx. shipping weight: 461 lbs.

PARALLELOGRAM TABLE ADJUSTMENT SYSTEM!

INCLUDES CAST IRON FENCE

New!

INTRODUCTORY PRICE!

$85 shipping ANYWHERE IN LOWER 48 STATES

G0490 ONLY $750.00

15" PLANER

New!

- Motor: 3 HP, 220V, single-phase
- Precision ground cast iron table size: 15" x 20"
- Max. cutting height: 8"
- Min. stock thickness: 3/16"
- Min. stock length: 12"
- Max. cutting depth: ⅛"
- Feed rate: 16 FPM & 30 FPM
- Cutterhead diameter: 3"
- Number of knives: 3
- Cutterhead speed: 5000 RPM
- Approx. shipping weight: 661 lbs.

BUILT-IN "KICK STAND" MOBILE BASE!

INTRODUCTORY PRICE!

G0453 ONLY $775.00

$135 shipping ANYWHERE IN LOWER 48 STATES

OSCILLATING SPINDLE / 12" DISC SANDER

- Motor: 1 HP, 110V, single-phase, TEFC
- Cast iron tables tilt to 45°
- Oscillating sander table: 14½" square
- Disc sander table: 17½" x 10"
- Spindle sizes: ¼", ⅝", 1½" & 2"
- Spindle speed: 1725 RPM
- Stroke length: 1"
- Approx. shipping weight: 180 lbs.

MADE IN ISO 9001 FACTORY!

FANTASTIC PRICE!

G0529 ONLY $450.00

$65 shipping ANYWHERE IN LOWER 48 STATES

12" BABY DRUM SANDER

- Sanding motor: 1½ HP, 110/220V, single-phase
- Conveyor motor: 1/10 HP, 110V, single-phase, variable speed 0-15 FPM
- Drum speed: 2300 FPM
- Max. stock size: 12" w x 3¾"
- Min. stock length: 8"
- Drum size: 4"
- Belt: 3" hook & loop
- Approx. shipping weight: 199 lbs.

New!

INDUSTRIAL-DUTY CONVEYOR BELT & SIDE HANDLES FOR PORTABILITY

INTRODUCTORY PRICE!

$65 shipping ANYWHERE IN LOWER 48 STATES

G0459 ONLY $425.00

7651
MEDIA CODE
POP0602

1-800-523-4777

24 HOURS A DAY FROM ANYWHERE IN THE U.S.A.

CUSTOMER SERVICE: 570-546-9663 FAX: 1-800-438-5901

FULL YEAR WARRANTY GRIZZLY Power Tools & Machinery

- ALMOST A MILLION SQUARE FEET PACKED TO THE RAFTERS WITH MACHINERY & TOOLS
- 2 OVERSEAS QUALITY CONTROL OFFICES STAFFED WITH QUALIFIED GRIZZLY ENGINEERS
- HUGE PARTS FACILITY WITH OVER 1 MILLION PARTS IN STOCK AT ALL TIMES
- TRAINED SERVICE TECHNICIANS AT ALL 3 LOCATIONS
- MOST ORDERS SHIPPED THE SAME DAY
- 24 HOUR ORDERING BY PHONE OR ONLINE

Bellingham, WA • Muncy, PA • Springfield, MO

14" BANDSAW

- Motor: 3/4 HP, 110V/220V, single-phase, TEFC
- Precision ground cast iron table
- Table size: 14" x 14"
- Table tilt: 45° right, 15° left
- Cutting capacity/throat: 13 1/2"
- Max. cutting height: 6"
- Blade size: 92 1/2" to 93 1/2" (1/8" to 3/4" wide)
- Blade speed: 3000 FPM
- 4" dust port
- Approx. shipping weight. 163 lbs.

MADE IN ISO 9001 FACTORY!

INCLUDES QUICK BLADE RELEASE SYSTEM, 3/8" BLADE, FENCE & MITER GAUGE

G0580 ONLY $325.00 $65 Shipping Anywhere in Lower 48 States

THE ULTIMATE 14" BANDSAW

- Motor: 1 HP, 110V/220V, single-phase, TEFC
- Precision ground cast iron table
- Deluxe extruded aluminum fence
- Cutting capacity/throat: 13 1/2"
- Max. cutting height: 6"
- Blade size: 92 1/2" - 93 1/2" long (1/8" – 3/4" wide)
- 2 blade speeds: 1500 & 3200 FPM
- Approx. shipping weight: 198 lbs.

MADE IN ISO 9001 FACTORY!

INCLUDES FENCE, MITER GAUGE, 3/8" BLADE & QUICK BLADE RELEASE SYSTEM

BEST NEW TOOL Woodworker

G0555 ONLY $425.00 $65 Shipping Anywhere in Lower 48 States

17" HEAVY-DUTY BANDSAW

- Motor: 2 HP, 110V/220V, single-phase, TEFC, 1725 RPM
- Precision ground cast iron table
- Table size: 17" x 17" x 1 1/2"
- Max. cutting height: 12"
- Blade length: 131 1/2"
- Blade sizes: 1/8" - 1"
- Blade speeds: 1600 & 3300 FPM
- Dust port: (2) 4"
- Approx. shipping weight: 342 lbs.

MADE IN ISO 9001 FACTORY!

INCLUDES 1/2" BLADE, FENCE & HEAVY-DUTY MITER GAUGE

$85 Shipping Anywhere in Lower 48 States

G0513 ONLY $795.00

20" PLANER

New!

- Motor: 5 HP, 220V, single-phase
- Max. cutting width: 20"
- Max. cutting height: 8"
- Min. stock thickness: 3/16"
- Min. stock length: 7.5"
- Max. cutting depth: 1/8"
- Feed rate: 16 FPM & 20 FPM
- Cutterhead diameter: 3 1/8"
- Number of knives: 4
- Cutterhead speed: 5000 RPM
- Table size: 20" x 25 3/4" (20" x 55 5/8" w/ extension)
- Approx. shipping weight: 935 lbs.

BUILT-IN "KICK STAND" MOBILE BASE!

INTRODUCTORY PRICE!

G0454 ONLY $1175.00 $165 Shipping Anywhere in Lower 48 States

1½ HP SHAPER

- Motor: 1 1/2 HP, 110V/220V, single-phase
- Precision ground cast iron table
- Table size : 20 1/4" x 18"
- Spindle travel: 3"
- 2 interchangeable spindles: 1/2" & 3/4"
- Spindle openings on table: 1 1/4", 3 1/2" & 5"
- Spindle speeds: 7000 & 10,000 RPM
- Max. cutter diameter: 5"
- Approx. shipping weight: 221 lbs.

SHOWN W/ OPTIONAL G1706 WING

INCLUDES MITER GAUGE & FENCE WITH SAFETY GUARDS & HOLD-DOWN SPRINGS

G1035 ONLY $515.00 $65 Shipping Anywhere in Lower 48 States

3 HP SHAPER

- Motor: 3 HP, 220V, single-phase w/ reversing switch
- Precision ground cast iron table
- Table size w/ standard wing attached: 30 1/2" x 28 1/4"
- 3 interchangeable spindles: 1/2", 3/4" & 1"
- Spindle travel: 3"
- Spindle openings on table: 1 3/8", 2 3/4", 4 & 5 1/2"
- Spindle speeds: 7000 & 10,000 RPM
- Approx. shipping weight: 357 lbs

INCLUDES MITER GAUGE & FENCE WITH HOLD-DOWN SPRINGS

MAGNETIC SWITCH

$85 Shipping Anywhere in Lower 48 States

G1026 ONLY $950.00

24" VARIABLE SPEED DRUM SANDER

- Drum motor: 5 HP, 220V, single-phase
- Conveyor motor: 1/4 HP
- Conveyor speed: variable, 0 - 20 FPM
- Max. stock thickness: 4 1/4"
- Sandpaper: 3" hook & loop
- Control panel with amp load meter
- Dust ports: (2) 4"
- Approx. shipping weight: 489 lbs

INCLUDES A HEAVY-DUTY RUBBER CONVEYOR BELT!

Z SERIES

G1066Z ONLY $1795.00 $85 Shipping Anywhere in Lower 48 States

2 HP CYCLONE DUST COLLECTOR

- Motor: TEFC Class "F", 2 HP, 220V, single-phase
- Amps: 12.5
- Cycle/RPM: 60 Hertz/ 3450 RPM
- Intake hole size: 7"
- Impeller: 13 1/2" steel, riveted
- Suction capacity: 1354 CFM @ 2.5" SP
- Static pressure: 10.4"
- Filtration: 0.2-2 micron, 99.9% efficiency
- Filter surface area: 86 sq. ft.
- Collection Drum: Steel, 35 gallons
- Approx. shipping weight: 315 lbs.

G0440 ONLY $745.00 $85 Shipping Anywhere in Lower 48 States

3 HP CYCLONE DUST COLLECTOR

- Motor: TEFC Class "F", 3 HP, 220V, single-phase
- Amps: 19.5
- Cycle/RPM: 60 Hertz/ 3450 RPM
- Intake hole size: 8"
- Impeller: 15" steel, riveted
- Suction capacity: 1654 CFM @ 2.0" SP
- Static pressure: 14.2"
- Filtration: 0.2-2 micron, 99.9% efficiency
- Filter surface area: 108 sq. ft.
- Collection Drum: Steel, 55 gallons
- Approx. shipping weight: 396 lbs.

$85 Shipping Anywhere in Lower 48 States

G0441 ONLY $1195.00

VISA MasterCard AMERICAN EXPRESS DISCOVER NOVUS

grizzly.com

OVER 12,000 PRODUCTS ONLINE!

ADVERTISED PRICES GO INTO EFFECT JAN. 1, 2006. SEE OUR WEBSITE FOR CURRENT PRICES.

CALL NOW FOR YOUR FULL COLOR 604 PAGE **FREE 2006 CATALOG**

CIRCLE NO. 127 ON FREE INFORMATION CARD.

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.

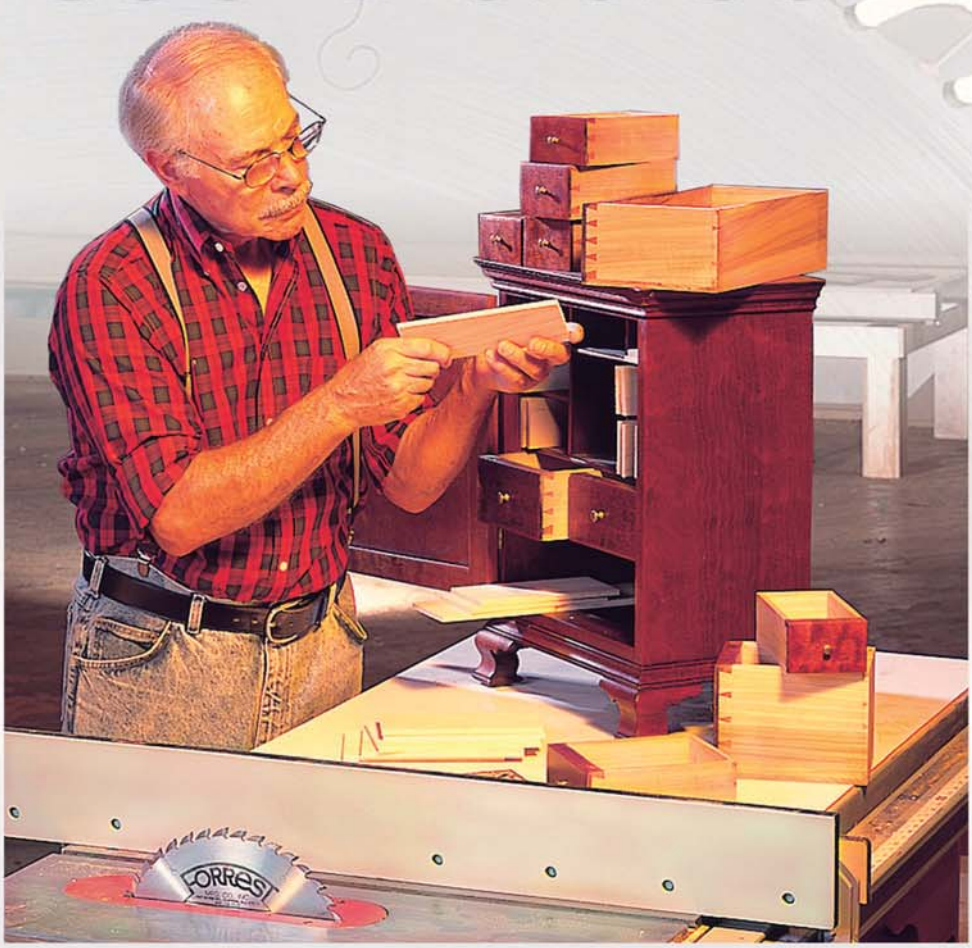
Forrest saw blades are simply the best that money can buy. They're made in the USA by the same family-owned business that's been producing and sharpening them for over 55 years. And they're backed by a 30-day money back guarantee. It's no wonder that serious woodworkers give them such high praise!

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

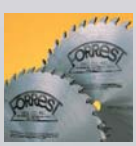
"These are the finest blades I have ever owned and you should be proud of your quality product."
Patrick T. Hankard–South Windsor, CT

"[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

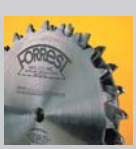
The message is clear. If you're looking for quality, performance, and value, it pays to choose Forrest blades every time.



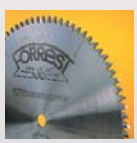
Our Most Popular Blades:



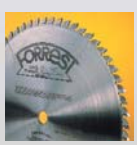
Woodworker II – This award-winning, all purpose blade is the finest of its type. It turns big jobs into easy-to-handle ones.



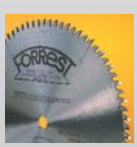
Dado-King – The world's finest multi-tooth dado set. It works effectively in all directions—with the grain or across it.



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

FORREST

The First Choice of Serious Woodworkers Since 1946

CIRCLE NO. 120 ON FREE INFORMATION CARD.

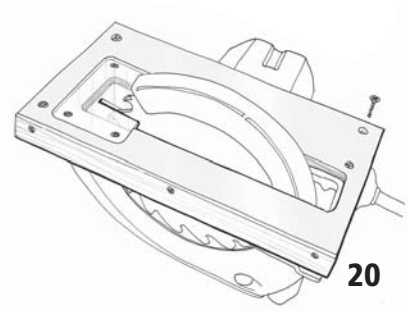
Code PW

contents

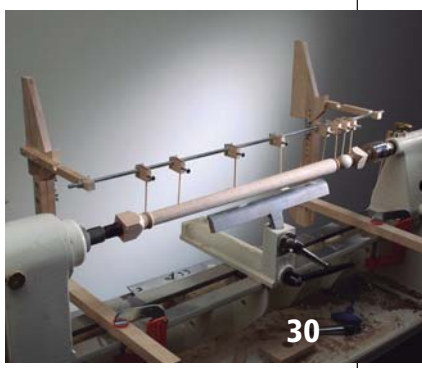
POPULAR Woodworking
Learn How ▪ Discover Why ▪ Build Better

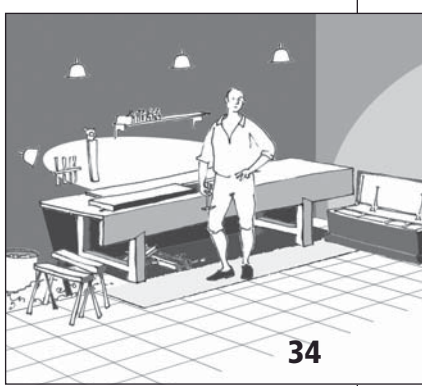
IN EVERY ISSUE


16


20

26


30


34


88


92

Popular Woodworking (ISSN 0884-8823, USPS 752-250) is published 7 times a year in February, April, June, August, October, November and December by F+W Publications Inc. Editorial and advertising offices are located at 4700 E. Galbraith Road, Cincinnati, Ohio 45236; tel.: 513-531-2222. Unsolicited manuscripts, photographs and artwork should include ample postage on a self-addressed, stamped envelope (SASE); otherwise they will not be returned. Subscription rates: A year's subscription (7 issues) is $19.96; outside of U.S. add $7/year • Canada Publications Mail Agreement No. 40025316. Canadian return address: 2744 Edna St., Windsor, ON N8Y 1V2 • Copyright 2005 by *Popular Woodworking*. Periodicals postage paid at Cincinnati, Ohio, and additional mailing offices. Postmaster: Send all address changes to *Popular Woodworking*, P.O. Box 420235, Palm Coast, FL 32142-0235 Canada GST Reg. # R122594716 • Produced and printed in the U.S.A.


ON
OFF
DELTA
INDUSTRIAL
The American Woodshop
THE NEW YANKEE WORKSHOP

DELTA's new hybrid saws are designed to make your heart race. Their powerful 1 3/4 HP motors are enclosed in full-size cabinets for enhanced stability and space-saving footprints. Additional features include a left tilting blade, fully integrated dust port, large table surface and your choice of three fences including Biesemeyer® or DELTA® UNIFENCE®. This is the saw to get your blood pumping. For more information about DELTA's complete hybrid saw line-up, visit deltamachinery.com/hybrid.

DUST PORT

ACCESSIBLE MOTOR

3 FENCE OPTIONS

DELTA®

YOUR ACHIEVEMENT. OUR TOOLS.

CIRCLE NO. 112 ON FREE INFORMATION CARD.

ON THE COVER

The trick to becoming faster and more accurate is to combine the brute force of power tools with the finesse and accuracy of hand tools. We show you how to get started down this path by combining bench planes with power jointers and planers.

Cover photo by Al Parrish

DEPARTMENTS

PROJECTS, TOOLS AND TECHNIQUES

38

64

82

SETTING THE STANDARD FOR MITER SAWS. AGAIN.

SEE ALL THREE SAWS IN ACTION!

www.DEWALT.com/pw

INTRODUCING THREE NEW MITER SAWS FROM DEWALT.®

The best miter saws in the shop are now even better — as DEWALT introduces the re-designed line of 12" miter saws. Each of these saws delivers greater accuracy and capacity, with the durability, portability, and easy-to-use features that you expect from the leader in miter saws. The DW718 Double-Bevel Sliding Compound Miter Saw has best-in-class capacity and a tall fence design for the highest vertical capacity available. In addition, the DW715 Compound Miter Saw and DW716 Double-Bevel Compound Miter Saw provide greater capacity, plus 11 miter detents with override capability for repeatable accuracy. Also available is the DW7187 adjustable laser accessory, designed exclusively for each of these new 12" miter saws. With innovative features for better performance, DEWALT has set the standard for miter saws. Again.

DEWALT®

CIRCLE NO. 113 ON FREE INFORMATION CARD.

POPULAR WOODWORKING®

February 2006, Vol. 26, No. 1
popularwoodworking.com
Editorial Offices 513-531-2690

SUBSCRIPTION SERVICES: Subscription inquiries, orders and address changes can be made at popularwoodworking.com (click on "Customer Service FAQs"). Or by mail: *Popular Woodworking*, P.O. Box 420235, Palm Coast, FL 32142-0235. Or call toll-free 877-860-9140 or 386-246-3369. Include your address with all inquiries. Allow 6 to 8 weeks for delivery.

NEWSSTAND DISTRIBUTION: Curtis Circulation Co., 730 River Road, New Milford, NJ 07646

ATTENTION RETAILERS:
To carry *Popular Woodworking* in your store, call 800-894-4656 or write Magazine Retail Sales, P.O. Box 5014, Iola, WI 54945-5014.

Back issues are available. Call 800-258-0929 for pricing or visit popularwoodworking.com. Send check or money order to: *Popular Woodworking* Back Issues, F+W Publications Products, 700 E. State St., Iola, WI 54990. Please specify publication, month and year.

fw
F+W PUBLICATIONS INC.

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.

WOODSTOCK SHOP FOX® INTERNATIONAL

INNOVATIVE PRODUCTS DESIGNED FOR PRACTICAL USE

WE DESIGN OUR MACHINES TO THE MOST STRINGENT STANDARDS, TRIPLE CHECK EACH ONE FOR QUALITY ASSURANCE AND BACK EVERY MACHINE WITH A FULL TWO-YEAR WARRANTY!

2 YEAR WARRANTY

15" PLANER with OPEN STAND

W1723

This planer delivers the power, speed, smooth cuts and features to make your planing jobs easy!

FEATURES:

- 3 HP, 220V, single-phase motor
- Maximum width: 15"
- Maximum thickness: 6"
- Feed speeds: 16 & 20 FPM
- Cutterhead speed: 5000 RPM
- Cutterhead diameter: 3"
- Cuts per minute: 15,000
- Approx. shipping weight: 400 lbs.

Head moves up and down while table height remains stationary!

5 HP, 20" PLANERS

The heavyweight champion of planers! This machine has all the features you'll ever need, plus a few more!

FEATURES:

- 5 HP, 220V, single-phase TEFC motor
- Precision ground cast iron tables
- Table size: 25¾" x 20"
- Cutting height: 8"
- Max. depth of cut: W1683 - ⅛", W1718 - 5/64"
- Cutterhead speed: 5500 RPM
- Cutterhead diameter: 3⅛"
- Feed rates: 18 & 23 FPM
- Anti-kickback design
- Approx. shipping weight: 778 lbs.

W1718 Spiral Cutterhead

W1683 20" Planer

W1718 20" Planer w/ Spiral Cutterhead

10" LEFT-TILT TABLE SAW with EXTENSION KIT

The ever dependable W1677 Left-Tilt table saw is even better with this extension kit to increase ripping capacity!

FEATURES:

- 3 HP, 220V, single-phase motor
- Precision ground cast iron table with T-slots
- Maximum blade height: 3"
- Ripping capacity: 52"
- ⅝" arbor accepts dado sets up to 13/16"
- Heavy-duty cast iron miter gauge
- Approx. shipping weight: 474 lbs.

Includes 7' extension rails, extension table, legs & SHOP FOX® Classic Fence

W1677EXT1

6" x 89" OSCILLATING EDGE SANDER

This sander is packed with so many fantastic features that we just don't have room to list them all! Here are just a few:

W1730

FEATURES:

- 2 HP, 220V, single-phase TEFC motor
- Precision ground cast iron tables
- Table size: 26⅞" x 12"
- Table travel: 3¾" vert., 5" horiz.
- Aux. table travel: 10"
- Sanding belt speed: 3150 RPM
- Oscillation stroke: ¾"
- Drive drum diameter: 7"
- Platen with graphite pad: 6¾" x 30¼"
- 3 spindle drums: 1½", 2" & 3" x 4½" high
- Approx. shipping weight: 462 lbs.

Includes adjustable miter gauge & removeable fence

¾ HP MORTISING MACHINE

FEATURES:

- ¾ HP, single-phase motor
- Adjustable depth stop rod
- Gas spring return
- Double support columns
- Jacobs taper #2 spindle
- Heavy cast iron construction
- Micro adjustable fence
- Approx. shipping weight: 90 lbs.

W1671

Unique swiveling head assembly!

We designed this Mortising Machine to address all the frustrations found in other models on the market.

2 HP SHAPER

W1674

We designed this 2 HP Shaper to give maximum performance.

FEATURES:

- 2 HP, 110V/220V, single-phase motor
- Large precision ground cast iron table: 24" x 21"
- Heavy-duty miter gauge
- ½" and ¾" spindles included
- 3" spindle travel
- Heavy cast iron construction
- Cabinet stand with powder coated paint
- Approx. shipping weight: 270 lbs.

Shown with D2057 Adjustable Mobile Base (not included)

WOODSTOCK INTERNATIONAL INC.

7666

SHOP FOX® is a registered trademark of Woodstock International, Inc.

sales@shopfox.biz

TO SEE OUR INNOVATIVE MACHINES AT AN AUTHORIZED DEALER, PLEASE CALL FOR THE LOCATION NEAREST YOU!

SHOPFOX.BIZ 1-800-840-8420

CIRCLE NO. 169 ON FREE INFORMATION CARD.

There is No Shame In Using Sandpaper

Among many of my hand-tool friends, there's a notion that real woodworkers don't use sandpaper. Instead they use cutting tools only – hand planes and spokeshaves – to prepare a surface for finishing. A dirty cheater will use a card scraper to clean up a bit of tear-out. But woodworkers who pick up pieces of sandpaper, well, there are even worse names for those people.

In some ways this intolerance is understandable, if not forgivable. Many hand-tool woodworkers began the craft as power-tool woodworkers with a full array of random-orbit sanders, drum sanders, detail sanders, pad sanders and – most important – air scrubbers.

Then they had something that's akin to a religious conversion. Either someone put a well-tuned hand plane in their mitts or they got sick and tired of coughing up the fine sanding dust that clogs many nasal passages.

They threw out their sandpaper and decided that if the woodworkers of yore could build nice furniture with hand planes alone, then they could, too.

But there are some problems with this approach. First, the woodworkers of yore actually did use sandpaper. Early inventories of woodworking shops and tool dealers show sandpaper in significant quantities in the early 1800s. Some high-style furniture demanded it – especially with the advent of French polishing, which requires a flat surface.

The second problem is that finishing straight from the tools can be as inefficient as power sanding. Your smoothing plane (the last tool to touch the wood) has to be tweaked out to an extraordinary degree to finish straight from the tool. That means an iron that is wicked sharp and set perfectly in the mouth. And it assumes your wood is fairly mild and easy to plane. I don't know about you, but every project I work on involves wood that has reversing grain, a few knots, some curly figure and boards that are simply ill-mannered. Getting all of these to behave under a smoothing plane involves superhuman effort. Sure, some woodworkers can do it, but most of us will struggle and wonder what we are doing wrong – or why this all takes so dang long.

You see, sandpaper is a logical and smart part of the wood-preparation process. It's all about removing material in an efficient way. Jointers, planers, hand planes and scrapers all remove wood pretty quickly and leave a decent surface. But when it comes to taking your surfaces to the very last, a few swipes with #220-grit sandpaper is remarkably more efficient than endless experimentation with a plane.

And if you need guidance from the woodworkers of yore for this, look to the Egyptians. They invented saws, cutting tools, plywood, dovetails and mortise-and-tenon joinery thousands of years ago. They often finished their furniture straight from the tools, too, according to Geoffrey Killen in his book "Egyptian Woodworking and Furniture" (Shire). But when they needed a project to be nice, they turned to sandstone and rubbed it with the grain, according to a wall relief in Ti's Fifth-Dynasty tomb. And if it was good enough for them, it's good enough for me, too. **PW**

Christopher Schwarz
Editor

CONTRIBUTORS

GLEN HUEY

Glen Huey started his media career on the pages of *Popular Woodworking* eight years ago with a Shaker hanging cabinet. Today, he is also the author of three books as well as host of a series of project-specific DVDs (available at woodworkersedge.com). He also finds time to teach weekend classes at Woodcraft stores around the region and is teaching weekend and week-long classes at American Sycamore Retreat in Cloverdale, Ind. But Glen still builds custom furniture for clients (hueyfurniture.com) and also finds time to offer clever furniture projects on our pages. On page 64 Glen takes a kitchen storage concept and turns it into a multi-media storage cabinet that's perfect for his DVDs.

DAVID THIEL

Long-time subscibers to this magazine know that David Thiel is a power-tool maven, and that his mind is an encyclopedia of model numbers, motor statistics and quotes from Monty Python movies. But he's also a professionally trained cabinetmaker who came up in his father's shop, building everything from custom furniture to chili parlors in the Cincinnati area. So when it came time for us to publish our seven-part series on building casework, David was the name at the top of our list. He knows how to do it quickly and efficiently. To read part four of our series, which covers smart carcase assembly, simply turn to the section in the center of this magazine.

WOODCRAFT®

Helping You Make Wood Work®

For A Free Catalog Or To Find Your Local Woodcraft Store, Visit www.woodcraft.com Or Call 800-542-9115.

When woodworking is your passion, quality woodworking tools, supplies and advice from Woodcraft can help take your project to the next level.

Exotic Hardwoods And Lumber

Check your local Woodcraft store for a wide selection of random width and length hardwoods, specialty turning stock and much more.

RIKON Mini Lathe Model 70-100

Distributed exclusively by Woodcraft, this Mini Lathe features a 1/2 HP motor, 12" Swing with 16" between centers, 12 position indexed head and 6 speeds: 430, 810, 1230, 1810, 2670, 3900. Test drive one at your local Woodcraft store today!

Dept: 06PW02P

QUALITY WOODWORKING TOOLS • SUPPLIES • ADVICE™

CIRCLE NO. 166 ON FREE INFORMATION CARD.

ROUTER BIT
DEPTH-STOP

ALIGNMENT
LINES

INCREASED
CAPABILITIES

THE CURE FOR PERSISTENT JOINT PROBLEMS.

FAST. EASY. ACCURATE. PORTER-CABLE's new dovetail jigs take all the traditional headaches out of cutting perfect dovetails every time. With patent-pending alignment lines and router bit depth-stop, set-up and adjustments are painless. Both features enable you to create more precise joints with a professional look. Plus they're ready to go right out of the box with no dreaded assembly. Dovetails just don't get any simpler. For more information and video tips, visit porter-cable.com/jigs today.

PORTER CABLE®

REDEFINING PERFORMANCE®

CIRCLE NO. 151 ON FREE INFORMATION CARD.

Hay Shop Worth the Price of Membership

Patience Just One of Their Virtues

Thank you for your article in the November 2005 issue (#151) about the Anthony Hay Cabinet Shop in Colonial Williamsburg. It is a real treasure. I am fortunate enough to live within a short driving distance from Williamsburg and am able to take advantage of this wonderful resource. The craftsmen at the shop are not only masters of their art, they are more than willing to talk with amateurs like me. They have infinite patience and really appear to enjoy helping others. They are one of the main reasons I maintain an annual membership.

Mike Garner
Richmond, Virginia

Were Wiping Varnish Photos Reversed?

I liked the article by Bob Flexner on wiping varnish ("The Basics of Wiping Varnish," November 2005) and I believe that he is the world guru on finishing.

However, the picture on page 73 is totally reversed and upside down. It looks like you rotated the image of the wood samples and showed the first coat of finish as the fourth coat. Also, the 25 percent- and 75 percent-photos are reversed.

Dave Kraatz
Gladstone, Missouri

Actually the photos on page 73 are correct. We checked them three times (and had Bob check them as well) because there was some confusion on the staff at first, too.

In our new shop here in Cincinnati we don't have a spray booth anymore, so we use a lot of wiping varnish when finishing projects. What's shown in those photos is exactly how wiping varnish behaves for me.The first coat is dark and dull. Then as the sheen comes up in successive coats it appears lighter to the eye, although it's not, really. It's just a trick of the sheen.

— Christopher Schwarz, editor

Left-tilt Table Saws Were Made by Companies Other Than Powermatic

Your answer to "Right-tilt? Left-Tilt? Should I Care" ("Q&A," December 2005, issue #152) has the statement that, "Until about 10 years ago, the Powermatic was the only saw that leaned to the left."

Actually, Sears also sold a left tilt-table way back when. It was manufactured by Emerson Electric Co.

I own a Craftsman 100 saw " Serial #113-29990" with a vintage date of about 1960. I can't yet pin that date down for sure. However, it is definitely a left-tilt saw. It also has another number stamped on the tag, 1257, that is not identified. My guess is that maybe that's a production number.

I use it ever day and still use the original miter gauge and rip fence, which are very accurate. (Might I also add that I bought it at a flea market for $100.)

John Timms
via e-mail

Oops! I wasn't aware of the Sears saw, although a quick check on eBay revealed one for sale (at time of publication). I'm going to do some digging to find out when it was made.

— Robert L. Lang, senior editor

Lonnie Bird's Chest(s) of Drawers: The Story Behind the Story

Lonnie Bird's chest of drawers on the cover of the November 2005 issue and the accompanying article raised some questions on one of the Internet newsgroups and we wanted to share the story with you here.

In the article, Lonnie comments on his being able to use a single 22"-wide board for the sides and top of the chest. The question arose from the cover photo, which obviously shows a two-piece side on the case.

There is, of course, a fine explanation.

The chest on the cover is actually one of two matching pieces that Lonnie made for his two daughters. The pieces were made from a tree that had special meaning to the family, so having all the wood come from that one tree for both chests was important. Even more important was making sure that both daughters felt the pieces were equally special. (Those of you with children will surely understand this.) Lonnie had enough of the wide lumber to make two single-board tops and two sides. To be fair, each chest ended up with a single-board top and one single-board side. Unfortunately, the photo angle that we needed for the cover showed the pieced board on this chest, while the other side is a single board.

Also, during our printing process, the cover photo came out a lot more reddish and with a lot more contrast than the original.

Here's a photo from Lonnie that shows one of the finished cases with the single-board side showing and (we hope) more accurate color reproduction. **PW**

— PW Editors

Photo by Lonnie Bird

WRITE TO US

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

How to send your letter:

- E-mail: popwood@fwpubs.com
- Fax: 513-891-7196
- Mail carrier:
  Letters • *Popular Woodworking*
  4700 E. Galbraith Road
  Cincinnati, OH 45236

It hates splinters as much as you do.

REVOLUTIONARY NEW TOOL! AVAILABLE NOW *

Introducing the Festool TS Saws, the latest generation of plunge-cut saws that are reshaping the world of power tools.

Featuring a splinterguard that ensures splinter-free cuts on both sides of the blade.

FastFix saw blade changing system

Precise angle cuts with no offset

Perfectly straight cuts with included guide rail

Spring-loaded riving knife

Dust extraction with 360° swivelling connector

TS PLUNGE-CUT SAWS

TS 55 - 1 15/16" CUTTING DEPTH
AVAILABLE NOW

TS 75 - 2 3/4" CUTTING DEPTH
AVAILABLE IN 2006

Festool's new TS Saws and guide rail system provide straight, splinter-free cuts on both sides of the blade right out of the box. Unlike conventional pendulum-cover circular saws, Festool's design allows the saw blade to retract into the housing giving you the option to start and end the cut accurately anywhere on the material. All of this innovation means a quicker, safer and more cost-effective precision tool. Contact us or visit your local dealer to learn more about the entire Festool system and the new TS saws.

TS75 plunge-cut saw

Fasten your tool belts!

Go online to www.festoolusa.com or call 888-337-8600.

FESTOOL®

CIRCLE NO. 118 ON FREE INFORMATION CARD.

Details and Materials For Making Hammers

Is Brass a Good Material for Making Your Own Hammers?

I've read and watched with interest as your magazine continues to explore the once-abandoned frontier of hand tools. Of particular interest to me right now is the hammer – that old-fashioned, oft-ignored and overly abused tool that has been around forever.

Since seeing and admiring the Glen-Drake Tite-Hammer that you wrote about (Tool Test, June 2005, issue #148), I sketched some designs and am making my own versions of a chisel hammer. In the past few weeks, I've found that brass is easy and quite fun to work with. I haven't used my 3" x 21" belt sander in years and was about to purchase one of those 1"-wide belt sanders to do some woodworking and metalworking when I came up with an idea. I took some scrap wood and a few hours of thought, and converted my Porter-Cable belt sander into something more stationary that can be used for shaping metal, wood, etc. The belt runs vertically and I have an adjacent work surface that can be tilted when the need arises. It even has dust collection.

But back to my original topic, hammers. I was on the verge of buying a Warrington-pattern hammer when I decided to make one myself out of the extra brass I now have lying around. Hammers have a new-found place of honor in my shop – alongside my dovetail saw and hand planes.

Dave Brown
Washington, DC

My personal hammer collection is completely out of hand. I'm up to 20. All are being used (I swear it), and I'm learning loads about the Warrington cross pane and its proper orientation to the work. Warringtons are nice because the pane (we sometimes call it the "peen" in North America) is useful for starting small brads between the fingers. It allows you to hold the brad and strike the nail without striking your finger. There are other English patterns with a cross pane, including the Lancashire and London patterns.

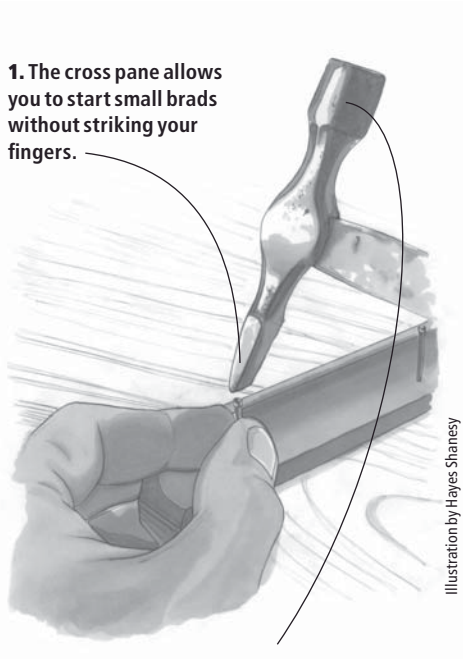


Illustration by Hayes Shanesy

2. Once the brad is seated in the work, turn the hammer around and drive it home with the face.

I'll be curious as to how your Warrington hammer performs. I'd be worried that the brass wouldn't do well when struck on nails or other harder metals. Although a brass hammer should be fine for striking a plastic or wooden chisel handle, my brass hammers get beat up just from the hoops on my Japanese chisels.

You might want to try making a Warrington hammer from an old ripping hammer – the ripping hammers have a straighter claw, which might give you some meat to make the cross pane.

— Christopher Schwarz, editor

What Happened to QuickCAD?

I have recently been able to buy a computer for my personal use and want to purchase a furniture-design program to use to make illus-

continued on page 18

continued from page 16

trations of my projects. I remember reading in one of the articles about a program called QuickCAD that cost around $50 (now probably $75) that a home-shop woodworker can purchase to use to design their projects ("CAD for Woodworkers," June 2003, issue #134). It was a neat software program with which you could actually draw your project with dimensions, change the view, etc. Where can I purchase this program?

Hank Jacob
Lewisburg, Pennsylvania

QuickCAD was produced by Autodesk, the parent company of AutoCAD. I say "was" because it no longer exists. But don't worry, there are other inexpensive software packages out there that are probably better and more user-friendly. Lately, I've been suggesting that folks look at TurboCAD (800-833-8082 or turbocad.com). The company has a line of products from entry-level to advanced and it seems to have a good tutorial system.

The bad news might be that there is no "free lunch" in the world of CAD. All of the software packages are just as dumb as a pencil until you're comfortable with them. There is no "now-make-it-a-great-design" button. My best advice is to take a CAD class, perhaps at a local community college. That's how I got started.

— John Hutchinson, project illustrator

Can You Resharpen Forstners?

Over the years, my Forstner bits have gotten dull. These bits are expensive, so I would like to get them resharpened. Do you know where I can send them for resharpening?

Also, what is the recommended speed for using a Forstner bit on the drill press?

Trevor Anderson
Bronx, New York

Your Forstner bits can be sharpened by any reputable sharpening service, but you're just as well off to do it yourself. A set of diamond honing stones will help you touch-up the cutting edges, but you can also use a fine mill file. Different-shaped stones, such as a gouge slip, will let you touch up the interior, curved edges. Don't sharpen the outside diameter of the bit or you'll change the diameter of the Forstner.

As to your speed question, it's tied to the diameter of the Forstner bit. Smaller bits (1/4" or 3/8" in diameter) will operate best at higher speeds around 2,000 rpm for soft woods and 1,400 to 1,600 rpm for hard woods. Larger bits (2" in diameter) prefer slower speeds ranging from 500 rpm in hard woods and 400 rpm for soft woods.

— David Thiel, senior editor

I Need Clues to Working Wenge

I am going to build a jewelry box out of some wenge that came my way. I have never used this exotic before and would appreciate any hints you could clue me into. It seems to be a mild wood other than the fact that it's very hard. It seems to machine well also. I guess my concern would be with glue.

Chuck Fatula
Ellwood City, Pennsylvania

Wenge (millettia laurentii, and pronounced "wen-gee") is a hard, strong and beautiful dark wood that planes very well. It also has a coarse texture that makes it prone to tear-out when shaping it with a router. The wood has a higher resin content that, as you suspect, will interfere with gluing (and finishing).

Water-based glues can be less effective with resinous woods. A polyvinyl acetate glue (PVA) such as Titebond II will work for your joinery, but a little preparation beforehand will improve the joint. First it's best to machine the joint just before gluing, then wipe the surface to be glued with a thinner, such as alcohol or acetone, and let it dry for 10 minutes or so. You could also use one of the polyurethane glues, which are excellent with resinous exotics (as long as the wood isn't too dry; poly glues need moisture to cure). **PW**

— David Thiel, senior editor

WRITE TO US

Every day we get questions from readers on all subjects about their woodworking. Some are letters; many are e-mail messages. We are more than happy to share our woodworking experience with you by answering your questions or adding some clarity to whatever aspect of the craft you are unsure about. In addition to the hundreds we answer privately every month, we want to share the best questions here with readers.

Send your questions via e-mail to popwood@fwpubs.com, or by mail to:

Q&A • *Popular Woodworking*
4700 E. Galbraith Road
Cincinnati, OH 45236

The new FEIN Turbo I Vac. Your tools turn it on.

Introducing our new, small vac with auto-start.

Plug in your tool and turn it on. The new FEIN Turbo I Vac is one of the world's quietest, most powerful vacuums. Very portable at only 18 pounds, it reaches every corner with a lengthy 16-foot. hose. And it comes with a brush and crevice tool. Whether you use it as a conventional vacuum or as part of a sanding system, you'll love the Turbo I.

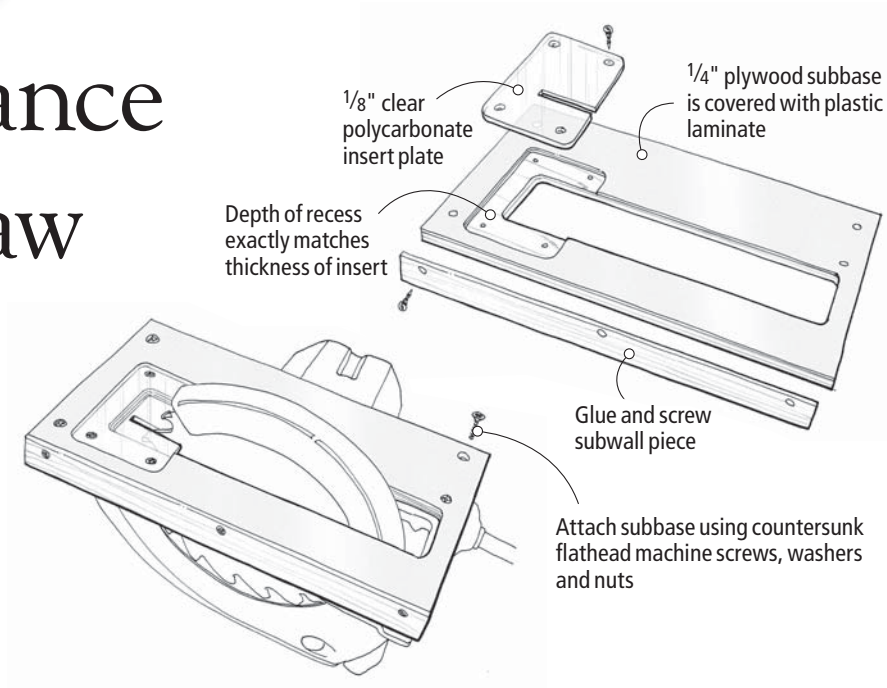
For more information, a free brochure and a dealer near you, call **1-800 441-9878** or visit us on the web at **www.feinus.com**.

Powered by Innovation

CIRCLE NO. 117 ON FREE INFORMATION CARD.

Compiled by Paul Anthony
Illustrations by Matt Bantly

Zero-clearance Circular Saw



THE WINNER:

When working with plywood, I typically rough-cut project parts with my circular saw, then trim them to final size on my table saw to clean up the rough edges and tear-out. However, when a finished part is too big to maneuver on my table saw, I'm forced to cut it to final size with my circular saw, which is why I developed this subbase for it that includes a replaceable zero-clearance insert plate. Just as with a zero-clearance table saw throat plate, the insert plate presses down the wood fibers adjacent to the saw blade during the cut, minimizing tear-out.

Begin by making the 1/4"-thick plywood subbase. (Mine is covered with plastic laminate for easy sliding.) Cut it to the dimensions of your saw base, then use a jigsaw to cut out the opening for the blade and guard. Next, rout the recess for the 1/8"-thick, clear polycarbonate plastic (Lexan) insert. It's important that the depth of the recess exactly matches the thickness of the subbase so that the insert contacts the workpiece during the cut. Finish the subbase by gluing and screwing on a thin sidewall piece for easy alignment to the saw base, as well as improved bearing against a straightedge during use.

Make the insert plate, and perhaps some replacements for later or for beveled cuts. To make the initial saw cut in the insert plate, straddle the saw across a couple of 2x4s, and slowly lower the spinning blade to its full depth through the base.

Suwat Phruksawan
Pleasant Hill, California

CASH AND PRIZES FOR YOUR TRICKS AND TIPS!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives a set of three specialty planes from Veritas Tools valued at $500. This quality woodworking set includes a low-angle jack plane, apron plane and a bullnose plane that can also be used as a chisel plane.

Runners-up each receive a check for $25 to $100. When submitting a trick (either by mail or e-mail) you must include your complete mailing address and a daytime phone number. If your trick is selected for publication, an editor will need to contact you. All entries become the property of *Popular Woodworking*. You can send your trick by e-mail to popwoodtricks@fwpubs.com, or mail it to Tricks of the Trade, *Popular Woodworking*, 4700 E. Galbraith Road, Cincinnati, OH 45236.

Staining in Tight Spots

I make a lot of boxes, some of them fairly ornate. This can present finishing challenges, as it can be difficult to apply and wipe away stains and oils in tight areas. I've discovered a great method of application is to use craft pipe cleaners, which are longer and thicker than regular pipe cleaners. Their thickness makes them great finish applicators and prevents the wire core from coming in contact with the workpiece and causing damage. They are also very cost-effective to use. I use one end to apply the stain, then the other to wipe away the excess. Then I clip off the used portions and save the remainder for the next project.

Jim Durante
Bothell, Washington

Smoother Turning

Cutting with a skew chisel or a gouge on the lathe can be a tricky business. One thing you can do to make things go a bit more smoothly is to rub a little paraffin on the backs of your chisels and on the edge of the tool rest. It is amazing what a little lubrication can do to help you make smoother cuts.

Ken Burton
New Tripoli, Pennsylvania

continued on page 22

CIRCLE NO. 100 ON FREE INFORMATION CARD.

CIRCLE NO. 163 ON FREE INFORMATION CARD.

CIRCLE NO. 172 ON FREE INFORMATION CARD.

CIRCLE NO. 147 ON FREE INFORMATION CARD.

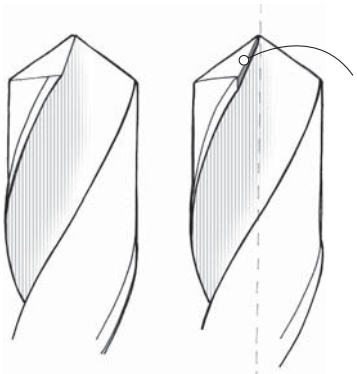
CIRCLE NO. 103 ON FREE INFORMATION CARD.

continued from page 20

Better Drilling for Plastics and Soft Metals

Drilling Plexiglas or soft metals such as brass and aluminum can be tricky. Typical high-speed steel twist bits have a positive cutting angle, and tend to dig in and chip Plexiglas or jam and break when drilling soft metals. The solution is to grind a small flat on the cutting edge, with the plane of the flat parallel to the axis of the drill. This will produce the 0°-cutting angle appropriate for plastics and soft metals. A 1/32"-wide flat is enough to produce the scraping cut necessary to avoid snagging the material. The flat can be ground in seconds on a fine power wheel, or by using a light touch at a sander. A bench stone or stick wrapped with carbide paper is a little slower but just as effective. Forget filing; high-speed steel is just too hard. Afterward, segregate your modified bits because they won't work well for wood or steel.

Ric Hanisch
Quakertown, Pennsylvania



Clean, Temporary Attachment

Making a cabriole leg or other shapely part often requires bandsawing different profiles on two adjacent faces. After the first profile is sawn, the offcuts must be temporarily re-attached in order to provide support and to re-establish the cutline for sawing the second profile. The traditional approach is to tape the pieces back together for the second cut. However, the parts may start to collapse as the tape is cut through. Another approach is to re-attach the parts using hot-melt glue, which will hold the parts together throughout the cut, while allowing them to be pulled apart afterward. Unfortunately, the glue can tear wood fibers from the workpiece when removing the support pieces.

I've found that the best approach is to combine the use of hot-melt glue with wide cellophane packing tape (available at office-supply stores). After cutting out the first profile, I apply the tape to several strategic spots on the workpiece, burnishing it in place to ensure good contact. Then I squeeze an appropriate amount of hot-melt glue onto the tape and press the offcuts back into place. Now, when I pull away the offcuts afterward, there's no damage to the work piece.

This technique works just as well when temporarily applying templates for pattern routing. In that case, I also apply tape to the template to prevent damage to it.

Paul Anthony
PW contributor

Extend Your Bench

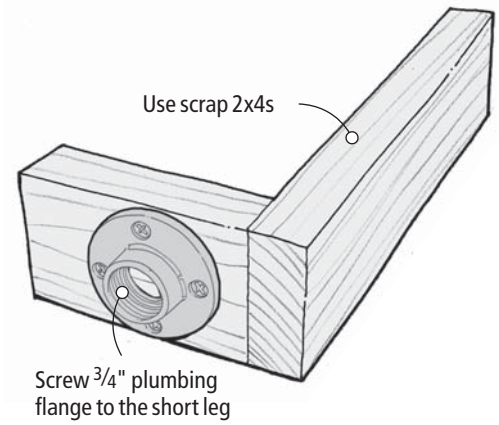
I recently built a new workbench with a fairly typical face vise and tail vise arrangement. However, due to the small size of my shop, the bench is only 5' long. While that is sufficient to handle most boards I work with, I occasionally need to secure a longer board for face planing. For those cases, I made this jig to extend the clamping capacity of my tail vise.

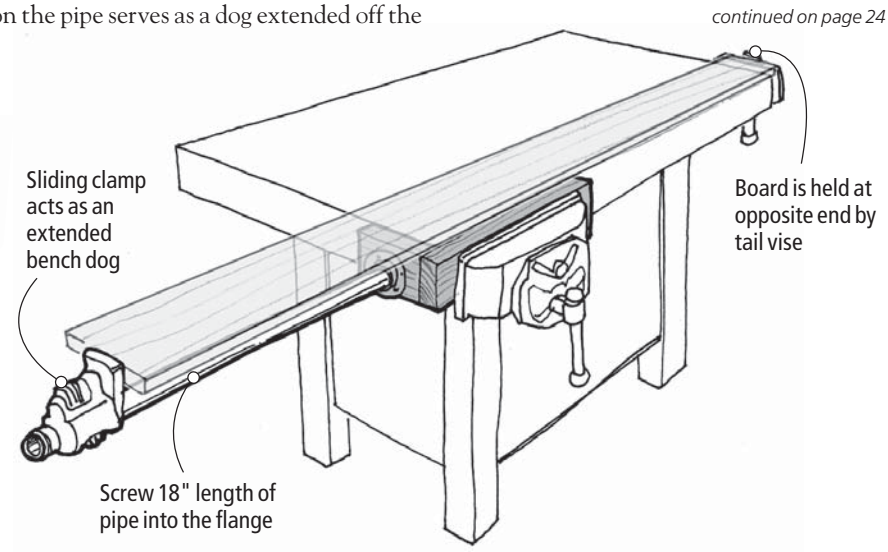
Constructed from 2 x 4 scrap, the L-shaped jig includes a 3/4"-diameter plumbing flange screwed to the short leg. With the long leg of the jig clamped into my face vise, the plumbing flange aligns with the row of dog holes in the bench top. The clamped leg is a bit longer than the width of the face vise jaws to prevent racking.

To use the jig, I remove the fixed clamp head from a 3/4" pipe clamp, and screw the pipe into the flange. The sliding clamp jaw on the pipe serves as a dog extended off the end of the bench, and allows clamping of long boards using the tail vise at the opposite end. I have found that an 18" length of pipe serves my purposes. If I ever need to attach a longer pipe, I plan to support it at its end with a roller stand to keep the assembly from sagging.

Steven Sampson
Wilbraham, Massachusetts

continued on page 24





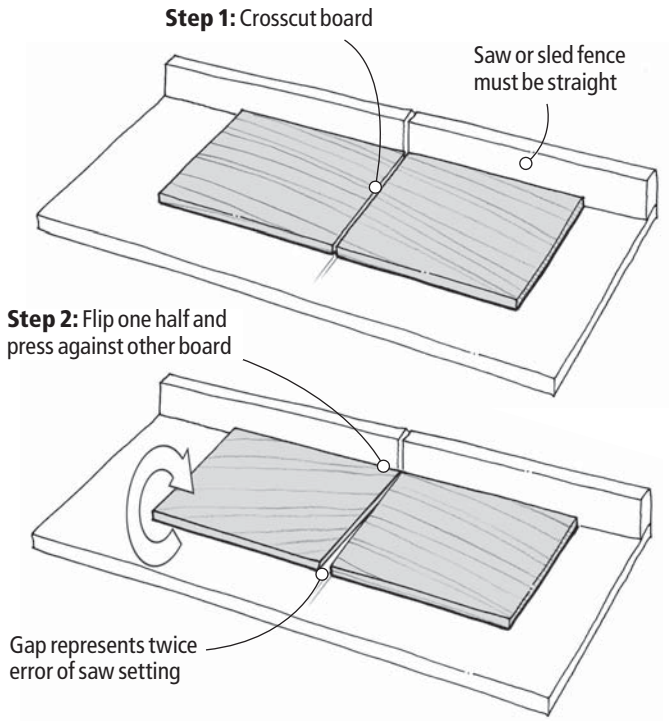
continued from page 23

Checking for Square

When checking a saw's 90° setting, or the alignment of a crosscut sled fence, the best measure of accuracy is to check the cut rather than to simply gauge the blade's relation to the fence. And to check the cut, you don't really need a terrifically accurate square; all you need is a reliably straight fence and a straight-edged board about 2' long, that you've ripped to a consistent width.

Here's the old trick: Crosscut the board in half, making sure that it's in good contact with your saw or sled fence. Now flip one half of the board over and push the two sawn ends together with the long edges of the board firmly contacting the fence. If the two ends meet completely, your saw is accurately set at 90° (assuming your fence is truly straight). Any gap between the two boards represents twice the error of your saw setting. If you're not sure about your saw fence, you can double-check your pieces by registering them against a reliable straightedge or jointer table.

Mick Vohrmann
Tampa, Florida



Stopping Apron Chafe

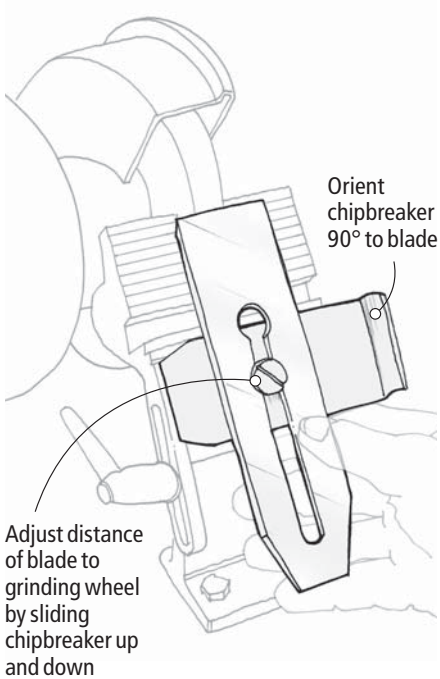
Like many woodworkers, I wear a shop apron to keep certain tools close at hand, and to stay a bit cleaner. I like the kind with a strap that loops around my neck, because it's easy to slip into. Unfortunately, the strap chafes my neck, especially when my apron pockets are loaded with tools. I've found that the way to prevent that is to cover the neck strap with a fleece seat belt cover (available through many automotive supply stores.) It sure makes the apron a lot more comfortable to wear.

Linda Doyle
Plano, Texas

Chipbreaker Grinding Guide

When grinding the edge of a plane blade, you need a guide of some sort to ensure a straight edge and an even grind. Some aftermarket tool rests include blade-holding jigs that run in a groove in the rest. Alternatively, you can simply clamp to the blade a short wood or metal "fence" that runs along the front edge of the tool rest. However, many typical metal-bodied smoothing planes, jack planes and jointer planes have their own built-in guide of sorts. Simply switch the chipbreaker to the opposite side of the blade and orient it perpendicular to the blade. You can slide the chipbreaker up or down the blade as necessary to create the proper distance from the cutting edge, then lock the chipbreaker in place using its own screw.

Joe Wajszczuk
Platteville, Wisconsin

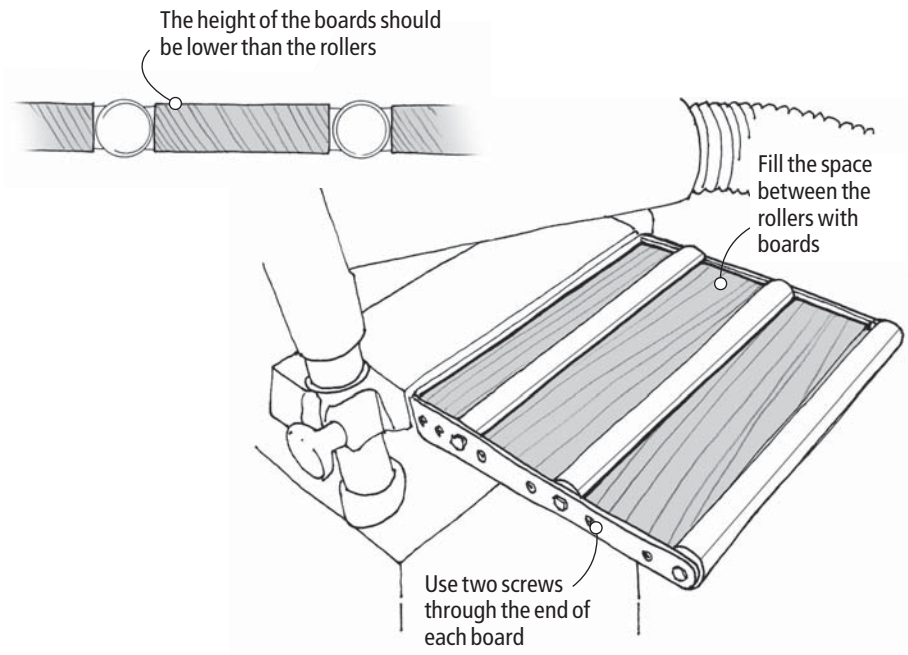


Prevent Painful Planer Pinch

The auxiliary support rollers on large stationary planers pose a hazard to hands and fingers. If you're not careful when reaching for a board exiting the planer, your fingers can easily be trapped between the end of the board and one of the rollers, causing serious pain. On the infeed side, a board entering the planer can shift sideways suddenly, pushing an errant finger against a roller and a metal side rail.

To prevent this danger, I filled in the spaces between my support rollers with boards. Each board is simply screwed in place through holes that I drilled through the metal side rails. Use at least two screws at each end of a filler board, and make sure that the boards are slightly below the level of the rollers. **PW**

Rob Mousel
Hanover, Minnesota



Makita Offer Lithium-ion Tools in a Smart Size

News of Makita's new 18-volt Lithium-ion drill was well received in the *Popular Woodworking* shop. While we're always happy to hear about improved performance in a tool, we're not so excited about it coming at the expense of increased weight and size. An 18v that is sized like a 12v is just right.

The LXT BDF451 drill/driver is one of the tools in a new line of cordless tools from Makita that are powered by the new Sony-made Li-ion battery. The drill offers all the best features available, including a 1/2"-keyless locking chuck with a 16-position clutch, three-speed transmission and a clever and handy shift-lock to quickly move between drilling and driving functions.

The LXT also includes a new four-pole motor designed to increase the tool's performance. The motor generates energy every 90° of rotation rather than the standard 180° generation found in two-pole motors. This makes it possible to use a smaller, yet more efficient motor.

The 18v, 3-amp hour batteries are charged by a fan-cooled 45-minute smart charger that communicates with a computer chip in the battery, recognizing battery history and condition to increase battery life. Plus, there's a light for dark corners and the drill is backed by a limited 3-year warranty.

We ran the LXT through a test used in our recent 14.4v drill review (December 2005). Using a 1" spade bit to drill through 1 3/4"-thick poplar boards, the 14.4v drills averaged 18 holes per charge (with the best producing 25). The Li-ion Makita produced 42 holes on a single charge. This is a good increase in performance from a drill sized slightly larger and heavier than a standard 12v drill. In the same test, a Milwaukee 28v Li-ion drill produced 66 holes.

Bottom line: This is smart-sized technology for the wood shop. The LXT drill/driver is well-made with solid performance and lots of features. The price is steep when purchased alone, but if you buy the drill in a four-tool combo kit (LXT400 includes a hammer drill, impact driver and 6 1/2" circular saw) for $629, you'll make the price much more palatable.

— *David Thiel*

SPECIFICATIONS

Makita LXT BDF451 Drill/Driver
Street price: $309
Speeds: 0-300/600/1,700 rpm
Max Torque: 560 in./lbs.
Performance: ●●●●○
Price range: $$$$$
Makita: 1-800-462-5482 or makitausa.com

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

Veritas Router Plane Tweaks Joints for a Perfect Fit

The Veritas router plane won't replace your electric router. In fact, it's actually an excellent complement to the power tool with which it shares its name.

I turn to a router plane to clean up and tweak the joinery created by my power tools or the coarser hand planes that cut joinery. The router plane absolutely shines at cleaning up mortises for hinges, trimming tenon cheeks to perfection and making the bottoms of dados and rabbets flat and smooth. It also can clean up the background of low-relief carvings, and (with the help of a fence) produce grooves and recesses for inlays.

The Veritas router plane is superior in every way to the Stanley No. 71 I've been using for years. The Veritas has a precise adjuster with an ingenious depth stop that is far better than the odd depth stop on the old No. 71. And the Veritas is made to a much higher level of fit and finish than my vintage tool.

The Veritas comes with 1/4"- and 1/2"-wide cutters and a third cutter that has a V-shaped 1/2"-wide cutting edge (the skew cut from the V-shape is supposed to leave a smoother surface when required). All of these are a bit of a challenge to sharpen because of the post, and so you can remove the cutter from the post on both of the 1/2"-wide cutters. Even with this improvement and a small sharpening jig included with the plane, it's a trick – but you'll get used to it.

The optional fence screws to the side of the plane and works against both straight and curved surfaces. You can screw a longer shop-made fence to the Veritas fence to use the tool as a small plow plane for making grooves, although it isn't as ergonomic or fast as my dedicated plow plane.

I found the balance of the tool and the angled knobs to be superior to my old Stanley. But if you don't like the handles, Veritas sells an inexpensive kit that allows you to make custom knobs.

All in all, I'm thrilled that Veritas has introduced another excellent plane for joinery. And this one isn't just for the hand-tool crowd – a router plane can refine joinery created by even the most fussy power-tool user.

— *Christopher Schwarz*

SPECIFICATIONS

Veritas Router Plane
Street price: $125
Body: Ductile iron, 2 lbs.
Optional fence: Aluminum face, $15.75
Performance: ●●●●●
Price range: $$$
Lee Valley Tools: 800-871-8158 or leevalley.com

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

Thin Wood, Safe and Easy

Don't let the name "Luthier's Friend" scare you off if you don't make guitars. This precision thickness sander has many practical woodshop applications, especially intarsia.

Thickness planers tend to eat material under 1/8" thick and we can't all afford a thickness sander, but this drill press attachment can run material down to less than a 1/64" thick.

A special sanding drum (with your choice of sanding grit sleeve) is inserted into your drill press. Adjust the fence to just less than your material's starting thickness and start sanding. As with a full-size drum sander, the wood is fed against the rotation of the drum requiring positive pressure as it's fed past the drum (a featherboard might make this easier). Each quarter-turn of the fence-adjustment knob reduces the space for the next pass. And the dust hood does a nice job of keeping things tidy when hooked to a shop vacuum.

The Luthier's Friend is a simple and convenient way to make thin pieces for special projects without taking out a loan. *— DT*

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

SPECIFICATIONS

Luthier's Friend
Street price: $159
Includes: 50-, 80-, and 120-grit sleeves
Material capacity: 2 3/4" wide
Performance: ●●●●○
Price range: $$$$
Luthier's Friend: 512-454-3425 or luthiersfriend.com

Worx Cordless – The New Kid

Worx (Greenville, S.C.) has launched a complete line of portable power tools and this drill is the first of those products we've tested. We ran the Worx 14.4-volt drill through the same tests used in our December 2005 drill review, and here's how it stacked up:

We were able to drill 10 1"-diameter spade bit holes in 1 3/4"-thick poplar on one battery charge, while the other drills ranged from nine to 25 holes. We sank 99 1/4" x 1 1/2"-long lag screws in the same thickness poplar, while the test drills ranged from 16 to 164. Weighing 4.4 pounds, the Worx drill placed as the second lightest drill in the test.

The drill comes with a one-hour smart charger, a built in bubble level, a magnetic tray to hold screws and bits and on-board storage for two double-ended bits.

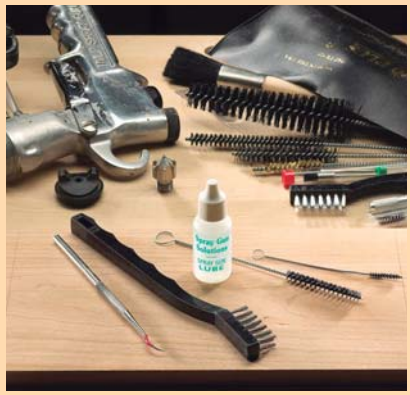
It has a 3/8" chuck, which was a rarity in our group test; Skil was the the only other competitor with a 3/8" chuck. That leads me to my conclusion and evaluation.

The Worx drill performed much better than the Skil in our test. Many of the features are those of a professional tool and it's priced at the affordable end of the 14.4v category. But when entering an already crowded market, we were expecting more from the Worx drill. We're anxious to see the rest of the product line. **PW** *— DT*

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

SPECIFICATIONS

Worx WT155K 14.4v Cordless Drill
Street price: $169
Speeds: 0-350 and 0-1,200 rpm
Stated torque: 310 in./lbs.
Performance: ●●○○○
Price range: $$
Worx: 866-354-9679 or worxpowertools.com



SPRAY GUN SOLUTIONS: A TOOL FOR EVERY CLOG

Keeping your spray gun clean is the key to keeping it working. The problem is that the cleaning brushes that come with most spray guns will take you only so far. Sometimes there's gunk or a clog in a place that no brush will reach.

The Master 2000 cleaning kit ($34.99, storage pouch not included) is the set of tools you'll wish you always had. There are seven pointy needles in several diameters for cleaning out clogged holes in your air cap. Plus there are a variety of brushes and picks that will get into the deepest cavities of your gun, including a handy 12"-long pick-up tube brush.

There's also a bottle of spray gun lube to keep the trigger moving smoothly and the packing lubricated – a necessary maintenance task that is often overlooked.

After six months of using the Master 2000 kit on my high-volume, low-pressure (HVLP) gun, I've found that I keep the gun cleaner and that the tool works more predictability and smoothly than ever before.

For more information, contact Spray Gun Solutions at sgskits.com or 303-424-3741. Also, be sure to read Bob Flexner's piece on diagnosing common spray gun problems on page 98 of this issue. With this information and a cleaning kit, you should be spraying without sputters. *— CS*

TOOL RATINGS

Performance is generally 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 popwood.com to sign up for our free e-mail newsletter.

— David Thiel, senior editor

Spindle Dancer Jig

A modern interpretation of a classic trick from old-school turners.

I believe there are two types of wood turners, those who turn for pleasure and those who turn out of necessity. I started in the latter group. I started turning because I needed to make spindles and my goal was to get the best results with the least amount of effort.

Once you've developed some competence for turning, making spindles is easy. And making multiples is just more time. Over the years I've come across articles showing an old turner's trick for multiples. A rod is suspended above the lathe with lengths of wires hung from it. The turner cuts at the spot under each wire until the bouncing wire swings free, indicating the correct diameter has been reached.

I decided this trick could be applied to a lathe jig that would work like a profile gauge. Each wire could be adjusted and readjusted for different spindle profiles, and you could use as many or as few wires as necessary. So was born the Spindle Dancer Jig.

by Eric A. Hedberg

Eric is a writer and woodworker in St. Paul, Minnesota. When he isn't designing creative woodworking jigs, he actually takes time to work on the projects for which they were meant.

The Parts of the Jig

The star of this jig is the dancer. Each tiny dancer pivots on a rod above the lathe. The dancers can be positioned at any location along a threaded rod. The dancer tiptoes on the work on an adjustable rod of wood, bamboo or wire secured with a screw. The offset pivot causes each dancer to swing quickly out of the way when the desired diameter is reached.

The spindle dancer jig has three main components; the dancers and rod, the rod supports, and the setup board. I added a little ledge to the top at the supports. This allows you to keep your template handy.

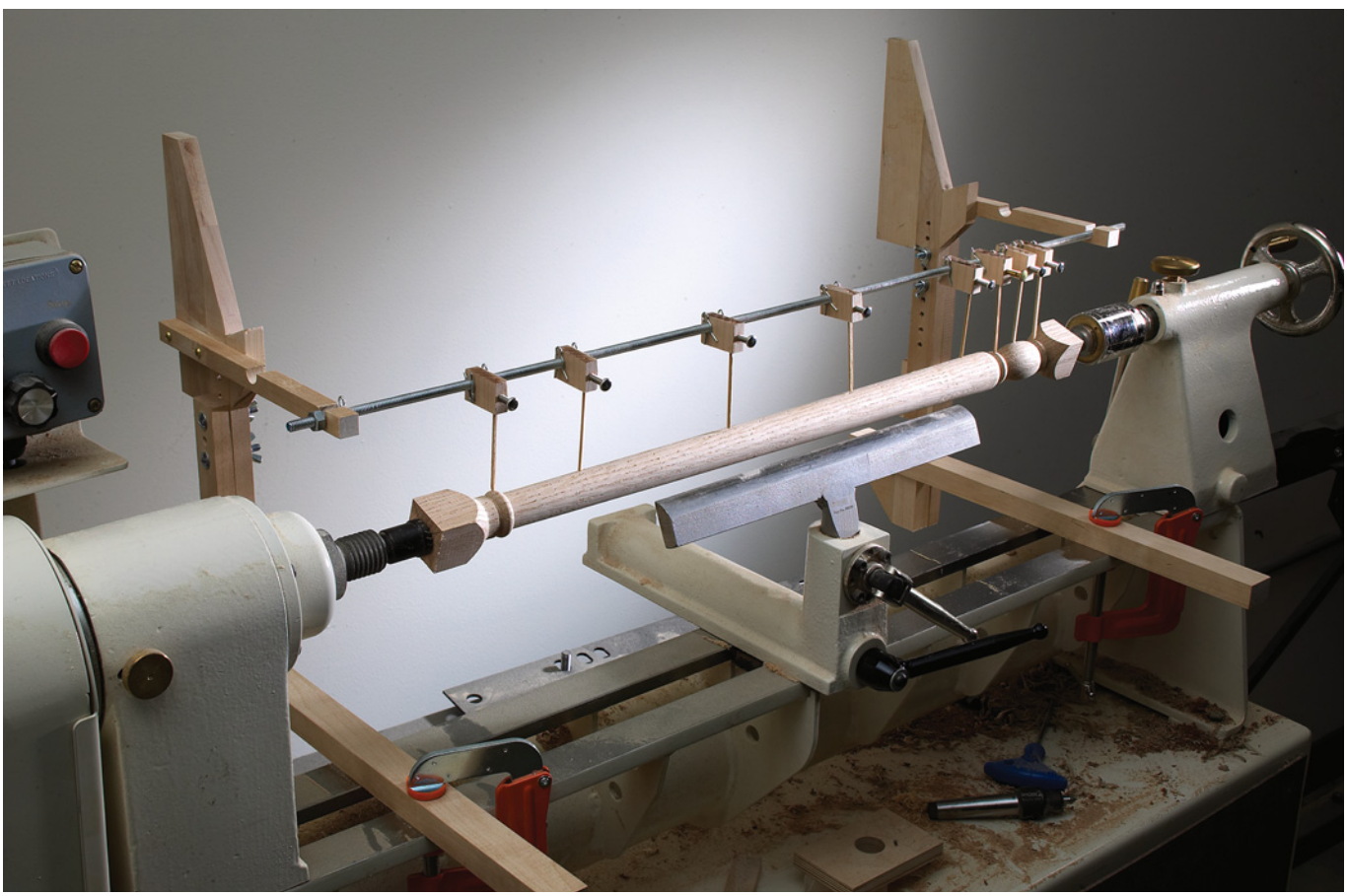


Photo by Al Parrish

Making the Dancers

The dancer blocks are made of a tight-grained hardwood such as maple. A strip of 3/8"-thick x 1 1/4"-wide wood is crosscut into 3/4"-long blocks (make plenty of extras).

Once you have a bunch of blocks, there are three holes that need to be drilled in each: the 1/4" pivot hole that slips over the threaded rod, the hole to hold the dancer rod, and the screw hole to hold the dancer rod in place.

All three of these holes should be accurately drilled in each block. You'll find the locations for the holes shown on the illustrations (see page 32).

I did a little extra work on the screw hole. While wood will accept screw threads reasonably well, over time those threads can wear. So I added something extra to my jig. Start by drilling the hole with a #29 bit (it's a little larger than a 1/8" bit) that intersects and passes about a 1/8" beyond the rod hole. Thread the hole with an 8-32 tap and saturate the wood threads with cyanoacrylate glue. After it's dry, rethread the holes. The glue helps bind the fibers and takes out some of the slop.

As I mentioned earlier, the thin dancer rods themselves can be wire, wood or any other convenient material. Hardwood is preferable over softwood; plastic pick-up sticks would also be a good option.

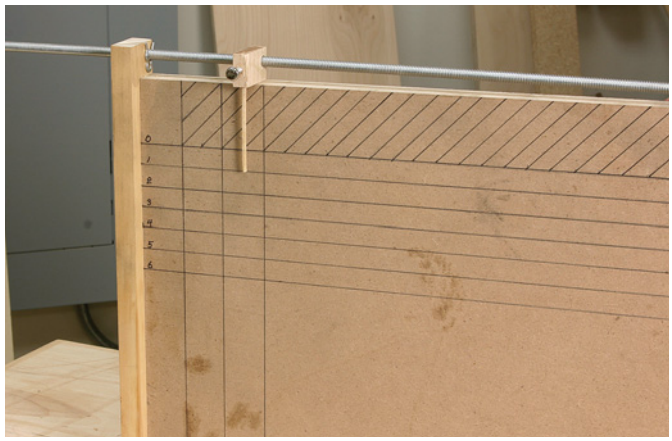
The threaded rod that supports the dancers should be sized in length to fit your lathe bed once the support arms are in place.

The Rod Supports

My rod supports are built as a mirror pair out of maple and birch pieces that I had in my leftover bin. Plywood, other hardwoods or even a metal fabrication will work just as well. You may choose to omit the drawing holder at the top, but I find mine very handy.

One rod support is placed at each end of the lathe bed to hold the threaded rod of dancers. Because each lathe is different, some customization may be needed for bed and swing variations. The two most important components are the adjustable vertical supports and the rod support arms.

My rod support arms are designed so that the centerline of the rod is 8 1/4" (6 1/4" swing plus 2" dancer clearance) above the bed. The 2" dancer clearance is a critical dimension. If your lathe has an 8" swing this distance would be 10" (8" + 2"). The distance from the edge of the vertical post to the rod centerline is 6", giving me lots of clearance for the biggest of spindles and room to temporarily hang my dancer rod just behind the spindle.



Shown at left is the setup board with its indicator lines. The spindle pattern is taped in position on the board and then the dancers are adjusted to meet the pattern.

Each vertical support has two sides: a fixed side that mounts to the lathe bed and an adjustable side with the rod support arm attached. There are three holes (spaced 1/2" apart) drilled in each side of the vertical supports. The hole locations on the fixed support are called out on the illustration. To locate the holes on the adjustable side, set the supports so that the center line of the dancer pivot is exactly 2" above the chuck center line. Mark the hole locations on the adjustable side and drill the three 3/16" holes, using the holes in the fixed side as a template.

The guides braces and supports (G, H & J) are cut to size and attached to the fixed side of the supports using glue. At the top of the adjustable side, there is a bird's mouth fabricated of some wood leftovers. It acts as a holder for the drawing of the finished spindle or a sample spindle/pattern.

The Setup Table

The setup table is Medium-Density Fiberboard (MDF) or plywood wide enough for your widest spindle and long enough for the spindles you normally make plus at least 2" for spindle "waste." From the edge of one long side measure over 1/2" and draw a parallel line. Between the edge and the "0" line you just made, fill the space with crosshatch lines to indicate a "no-turning zone." From the edge of the no-turning zone, make at least six parallel lines exactly 1/2" apart. Starting with your first line, mark each one with a name: 0, 1, 2 and so on. From the left side of the setup jig, mark two or three lines parallel to the edge at 1" increments to account for turning waste.

Next is the alignment edge stop. It is 1 1/4"-wide with a thickness of at least 1/4". At the top drill a 1/4"-diameter hole 1/4" from each edge. Bolt one of the dancers with a 1/4" bolt temporarily to the right side of the edge piece matching top, front and back edges. Using the dancer as a stop, attach the edge piece so the dancer just touches the edge of the setup board.

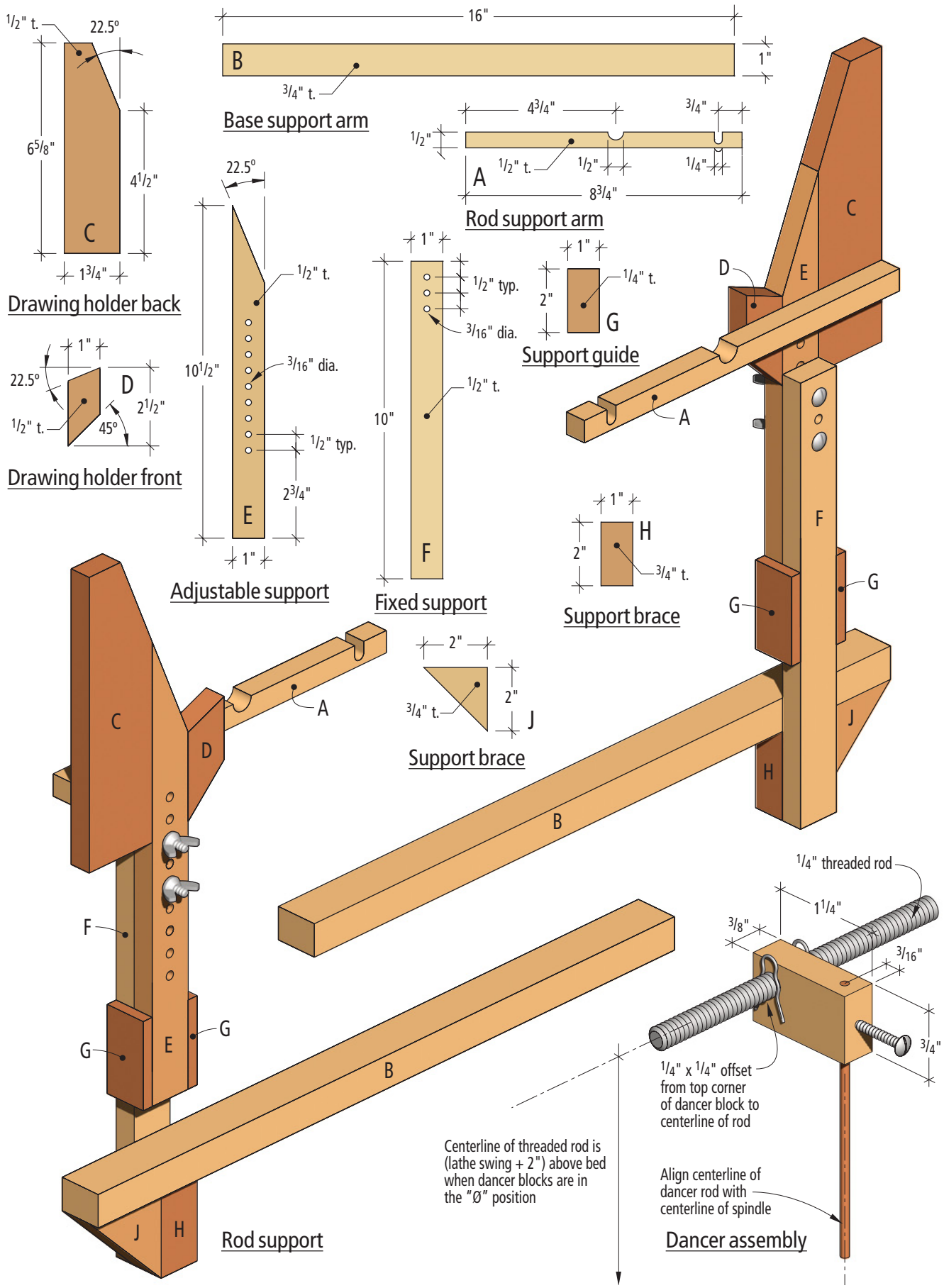
How to Use the Dancer Jig

Let's start with how to position the supports. Temporarily mount the supports (In 0-height position, with the three holes aligned) to the lathe at the desired width, allowing chuck and tail clearance. With a dancer temporarily attached at either end of your threaded rod, lay the rod in the front notch in the support arm. Adjust the dancer rods in the two dancers so they are perpendicular to the support arm and lathe bed. Adjust the support's position so the rods are aligned with the centerline of the lathe. Lock the supports in position and mark the support positions on your lathe bed for future reference.

Directing the Dancers

Start by laying the profile drawing of the spindle you want to make on the setup table. Touch the widest diameter of the spindle to the "0" line and then slide the profile down until its center line aligns with one of the other numbered lines (1, 2, 3 etc.). When you've found that line, move it to the right to allow for waste, and tape down the drawing.

Determine which diameters you want to duplicate off the profile. Mount your threaded


1/2" t.
22.5°
6 5/8"
4 1/2"
C
1 3/4"
Drawing holder back
1"
22.5°
D
2 1/2"
1/2" t.
45°
Drawing holder front
16"
B
3/4" t.
1"
Base support arm
4 3/4"
3/4"
1/2"
1/2" t.
1/2"
1/4"
A
8 3/4"
Rod support arm
22.5°
1/2" t.
10 1/2"
3/16" dia.
1/2" typ.
2 3/4"
E
1"
Adjustable support
1"
1/2" typ.
3/16" dia.
10"
1/2" t.
F
Fixed support
1"
1/4" t.
2"
G
Support guide
1"
H
2"
3/4" t.
Support brace
2"
2"
3/4" t.
J
Support brace
C
D
E
F
G
H
J
A
B
Rod support
1/4" threaded rod
1 1/4"
3/8"
3/16"
3/4"
1/4" x 1/4" offset
from top corner
of dancer block to
centerline of rod
Centerline of threaded rod is
(lathe swing + 2") above bed
when dancer blocks are in
the "Ø" position
Align centerline of
dancer rod with
centerline of spindle
Dancer assembly

rod to the setup board with the appropriate number of dancers on the rod in roughly the correct linear positions. Put a hairpin (see supplies box) on the sides of each dancer to hold it in place. Loosen the lock screw of each dancer and slide the adjustable rod down until it touches the edge of the spindle profile and then lock down the screw.

After all the dancers have been set, lift out the dancer rod. The dancers should all swing freely. If not, just turn the hairpin slightly to give a bit more clearance.

Shall We Dance?

The last adjustment to be made on the supports is height. Depending on the size of your spindle you need to raise each side in 1/2" increments. For example, if your centerline is on the #2 line you need to raise your supports two positions which is 1".

Chuck up your spindle stock and rough it round. Set the dancers over the work so their "feet" are to the front and the rod nut is touching the left support. Use a hairpin on the opposite side of the left support to hold it in place. Fire up and start turning.

I use a parting tool to cut each diameter. As I get closer to the true diameter, the dancer really starts to jump, then suddenly swings out of the way and takes a bow. If I want to work a section at a time, I lift the rod and set it back in the holding position. After each dancer has finished its performance, I complete the show by turning down the profiles and get ready for the next act. **PW**

SPINDLE DANCER JIG

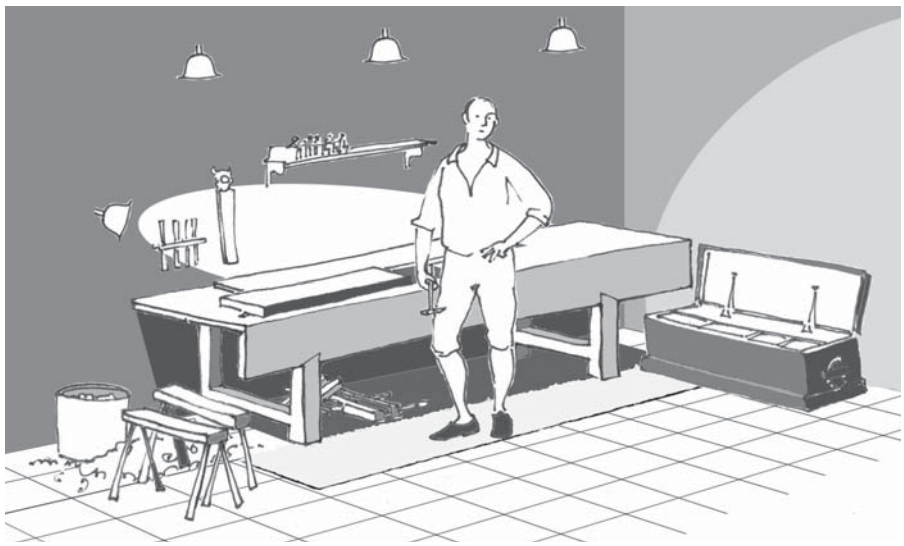
	NO.	LETT.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL
❑	2	A	Rod support arms	1/2	1/2	8 3/4	Hardwood
❑	2	B	Base support arms	3/4	1	16	Hardwood
❑	2	C	Drawing holder backs	1/2	1 3/4	6 5/8	Hardwood
❑	2	D	Drawing holder fronts	1/2	1	2 1/2	Hardwood
❑	2	E	Adjustable vertical supports	1/2	1	10 1/2	Hardwood
❑	2	F	Fixed vertical supports	1/2	1	10	Hardwood
❑	4	G	Vertical support guides	1/4	1	2	Hardwood
❑	2	H	Vertical support braces	3/4	1	2	Hardwood
❑	2	J	Base support braces	3/4	2	2	Hardwood
❑			Dancer blocks	3/8	3/4	1 1/4	Hardwood
❑			Dancer rods	1/8	1/8	3	Hardwood

SUPPLIES

McMaster-Carr
630-600-3600 or mcmaster.com
- hairpin clips
  #98395A218, $5.65 for 100

The 'Ultimate' Hand Tool Shop

Perfection doesn't exist. But you can come close.



Illustrations by the author

I'm using cartoons to illustrate most of this column for two important reasons. Not only does it allow me to show the "ultimate" shop without actually having the ultimate shop, it also helps to reinforce the notion that the "ultimate hand-tool shop" exists only in our imaginations, and is totally devoid of the real-life compromises and practicalities that shape real-world workshops.

One of the first things any beginning woodworker must do is set up a workshop. Like so many other things a novice woodworker must do, the preparation of a workshop shapes the capabilities and enjoyment of the craft long after the novice has become an intermediate or advanced woodworker.

Fortunately, many books and articles have been published on the subject. Unfortunately, few – if any – address the unique needs of hand tool usage. All too often, I see benches that are much too short, free standing, or shoved into some filthy corner. Provisions for sharpening appear to be haphazard afterthoughts. Tool storage solutions are typically completely inadequate for the unique needs of hand tools and their convenient usage. The general lack of consideration for the unique needs of hand tool usage conspires to limit the potential of any would-be hand tool craftsman.

Unlike modern shops where each new tool purchase requires a corresponding additional allotment of floor space, once a few basic hand tool work areas are established, there's rarely a need for any additional growth. The trick is getting these areas laid out in such a way that they don't prevent your future success.

Space to Plane

A workbench is used for hand planing and a host of joinery operations. When I built my 6'-long workbench, I thought carefully about the size of furniture I wanted to make. Nothing on that list was more than 4' long, so I thought a 6' bench would be plenty long enough. But there were two things I missed: First, a 40"-wide by 20"-deep chest of drawers needs approximately 8' of base moulding. You can't make 8'-long passes over stock resting on a 6' bench. Crosscutting the stock before moulding has disadvantages. Second, I find it best to plane my stock before I saw it. That way, I know where the knots are, where the sapwood or difficult grain is, etc. This helps me avoid those areas when I cut mouldings or saw joints. Consequently, I prefer to plane my stock in the lengths in which I purchase it. Because I buy mostly 8' stock and rarely need more than 8' of moulding, I recommend setting aside space for a roughly 2' x 8' workbench.

Eight feet of shop space isn't enough room for an 8' bench. All planes need "run-off" room. Because the shavings tend to fly off this end of the bench anyway, I find this a convenient location for a trash barrel.

Don't put the end of your bench too close to a wall. Someday you may take my advice and get yourself a 30"-long plane. Make sure you have room to use it. I think it wise to allow a couple feet for run-off room.

Locating your bench with the back against a wall provides it with stability for sawing or other work perpendicular to the long front edge of the bench. A piece of scrap placed between your stock and the wall provides a convenient backstop for material being planed. The wall also prevents tools from being knocked off the back and provides a convenient location for a chisel rack and other tool storage.

An anti-fatigue mat in front of your bench is more than a luxury. Plane shavings can make finished wood or concrete floors quite slippery, even after they've been swept away. Planing long stock requires quite a bit of foot work, so I recommend considering a sweepable non-slip work mat of some sort.

Room to Saw

Learning to saw by hand offers woodworkers the opportunity to explore traditional joinery. Like anything else one attempts to learn, it's easier to saw with good tools and the right space. In Anglo-American shops, ripping is performed on sawhorses using a wide-bladed "western" saw.

The size and shape required for ripping fits well directly adjacent to the bench. I think this resulting 4' x 11' rectangle is the absolute mini-

by Adam Cherubini

Adam makes reproduction furniture using the tools and techniques of the 18th century. He demonstrates his crafts at Pennsbury Manor in Bucks County, Pennsylvania, on Historic Trades Days. You can contact him at adam.cherubini@verizon.net

mum size for the ultimate hand tool shop.

One advantage of working wood with hand tools is that you have the ability to work very wide stock that would be too heavy or unwieldy to muscle across machines. Having space to rip directly in front of your workbench saves you from having to carry some big boards through your shop. That said, if space is tight you can rip almost anywhere. It's quite easy to take your sawhorses outside and rip on the patio or in the garden.

Many woodworkers enjoy the convenience of a tail vise. Not me. Its limited usefulness is overshadowed by the difficulties it creates for essential crosscut sawing. The right end of the bench is the perfect place for cutting joints and accurate crosscuts. Anglo-American woodworkers got away without tail vises for at least 100 years and so can you. You needn't leave much space to the right of your bench for the offcut. A long offcut is difficult to support here anyway.

Tool Storage Space

Hand tools aren't like hand-held power tools. Dropping them is generally disastrous. Metal tools are sensitive to rust, which can cause pits in polished metal blades. Wooden tools are sensitive to changes in humidity. Finding efficient ways of storing hand tools has been the effort of craftsmen for centuries. Rather than propose a revolutionary solution made from Medium-Density Fiberboard, a quick look back at what has been done might be wise.

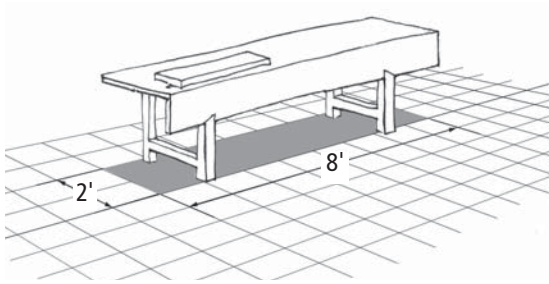
Images of pre-industrial shops clearly reveal a two-pronged approach to storing tools. Oft-used tools, generically referred to as "bench tools" because of their ever-present location on the bench, are shown stored on open shelves, or hung from hooks on the walls.

Tool chests, frequently painted a blue green color (perhaps because the copper-based pigment was inexpensive), are shown in several images of pre-industrial shops. For many years I believed these chests were merely a convenient means of transporting a journeyman's tools as he "journeyed" from shop to shop. I was wrong. These chests are deceptively large and insanely heavy. And the term "journeyman" is an English corruption of the French word for "work day" (journée) referring not to the traveling nature of the worker but rather the way in which he is compensated for his work (for a day's work). These chests are a surprisingly efficient way to store hand tools. Tools are easily accessed, safe from the hazards of the workshop, movable (with some difficulty) and the chest is unobtrusive. Made correctly, the chest's tight-fitting lids seem to protect the contents from rust. *Popular Woodworking* has offered a variety of plans for tool chests and wall-hung cabinets. One advantage of a traditional tool chest is that it can be relocated seasonally if necessary.

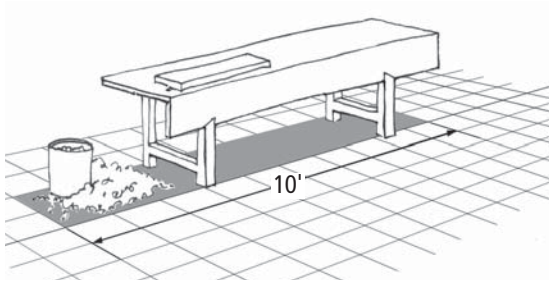
If we define the "bench tools" properly and narrowly as those tools used almost continuously, rust should not be a problem. But great changes in humidity or temperature require us to reconsider the whole concept of bench tools. A fine tool chest may make an excellent window seat or coffee table. Tool chests from the 18th century are often indistinguishable from blanket chests. So why not put one in your bedroom? Tools required for a day's work could be unpacked and hung on walls or laid on open shelves only to be returned at the end of a day's work with no great loss in efficiency and some significant gain in peace of mind.

Lumber Storage Space

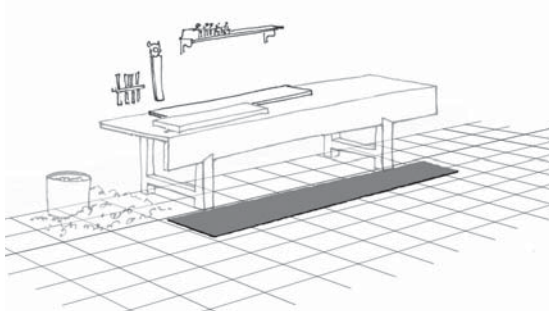
Planing and sawing by hand forces you to read the grain, and feel its movement, variations in density, etc. I'm not one of those people who falls in love with wood or its grain. But a thorough familiarity with the material is inescapable. Before too long, every hand tool user develops preferences for certain lumber species, air-dried stock as opposed to kiln dried or steamed, and even specific cuts of wood such as quartersawn, plainsawn heart wood, flitches, etc. Consequently, and without exception, the

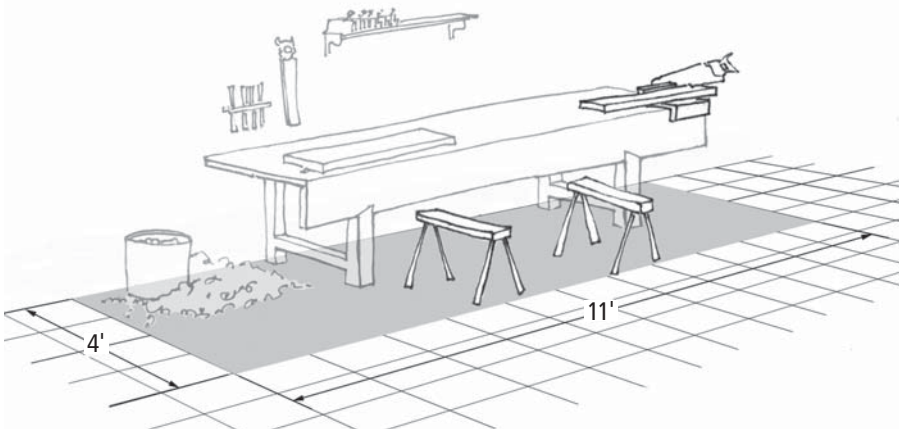


First, place your bench against a wall. A 2' x 8' bench is, in my opinion, the minumum amount of space necessary for the bench.

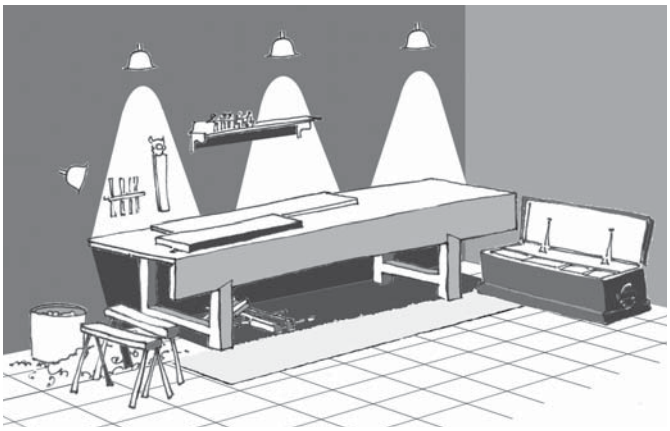


You don't want to strike the wall with your jointer plane. Put the end of your bench 2' from the wall – and it's a good place for a trash can.

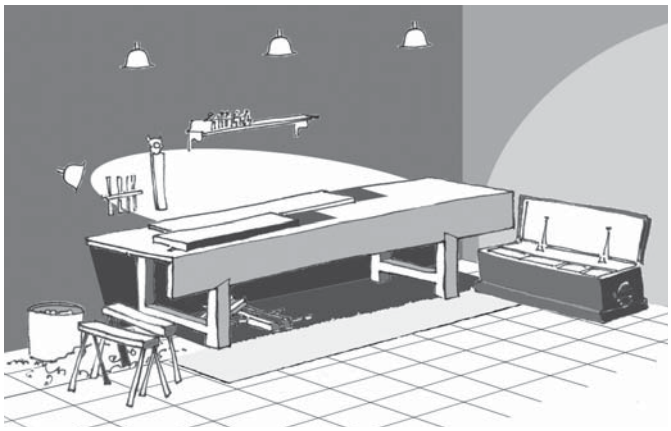

An anti-fatigue mat in front of your bench is an essential part of your shop. It gives you sure footing and is good for your back, too.



Set aside 2' of space in front of your bench for ripping at the sawhorses. Add 1' to the right of the bench for crosscutting.



Creating shadows on your bench is important. Shadows allow you to see a profile develop on your work. Create light sources by having lamps you can switch off individually.



A raking light, as shown above, will quickly point out imperfections in your work, from tear-out to plane tracks.

hand tool users I know purchase wood that meets their preferences regardless of whether they have an immediate use for it or not. So I think it is wise, if at all possible, to prepare for the long-term storage of a great quantity of lumber for future projects.

However, your lumber rack needn't necessarily share your workspace. You may find your garage, woodshed, or even a shady portion of your lawn or garden a convenient location for your lumber rack.

When designing your lumber rack, consider such things as providing sufficient airflow through the racks, accessibility and shading the lumber from sunlight. If children are a part of your life, please take every precaution to make your lumber rack safe for someone who may mistake it for a jungle gym.

Sharpening Space

It has been said that the key to working with hand tools is first learning how to sharpen them. No ultimate hand tool shop is complete without some provisions for sharpening. Although Jacques-Andre Roubo's 18th-century text clearly shows a dedicated sharpening area, this isn't an absolute necessity. The workbench can be a convenient place to sharpen because it is sturdy and just the right height for such an activity. But there are several reasons why many prefer a dedicated area as Roubo illustrated. Most sharpening equipment requires some sort of lubrication, which can make a mess of your bench and any future projects. Grinders used by many woodworkers spew nasty abrasive particle dust. Let's face it. Sharpening is messy business.

If space is short, consider some sort of mat to protect your bench from oil or water that will fly off the end of your stones. This rubber mat serves double duty. It protects the bench and keeps the stone from slipping around.

For light honing, your bench may indeed suffice, but when more serious work is needed, it's nice to have a dedicated sharpening area. A grinder and a small shop-built table of a convenient height will fit the bill. Now the sharpening station needn't necessarily be in the workshop. This could be in an unheated or otherwise undesirable location. But an inconvenient sharpening area may discourage you from sharpening. Nothing will discourage a woodworker faster or more completely than working with dull tools. In the "ultimate" workshop, there would be some well-equipped sharpening area. The rest of us just need to find a space we can make a mess in.

Lighting your Workspace

In my article about the Anthony Hay cabinetshop in Colonial Williamsburg (November 2005), Mack Headley described some of the benefits of working in "raking" light. The natural light from a nearby window casts shadows, allowing him to read a surface when planing or carving. I have found knife lines to be all but invisible under the shadow-less flood of light from 4'-fluorescent shop lights. Soon after that visit to Colonial Williamsburg, I removed the 4' shop lights over my bench and began experimenting with different sorts of lights. Lighting is a complicated subject that I hope to read about in some future issue of

While a dedicated sharpening station is preferred, if tight space requires that you sharpen on your bench, consider some sort of mat to protect it from oil or water – and to keep the stone from slipping around.

Multiple low-wattage lights such as these offer great flexibility. The diffusers are a great help in reducing glare.

Popular Woodworking. Until then, here's what I ended up with.

Lighting the ends of the bench is important. Although it's counter-intuitive, the ability to turn off lights individually can help you better see what you need to see.

Over my bench I'm using an array of 13-watt, compact fluorescent bulbs in clamp work light fixtures (they have a color temperature of 3500K). These bulbs shed a nice white light, are inexpensive, and, most important, can be turned off individually or quickly repositioned, giving me shadows when and where I need them. I made sure to position lights over the ends of the bench where the finest work is done. You could substitute standard incandescent bulbs in similar fixtures or choose the much hotter and even brighter halogens, but these would need special fixtures. I found higher-color temperature compact fluorescent (CF) bulbs provided better illumination than lower-color CF bulbs with twice the wattage.

With the raking light switched on and the over-bench lights switched off, I can easily see when I need to sharpen my smooth plane.

I prefer the flexibility of multiple low wattage lights. I can't think of a better application for this approach than these "raking" lights. A strong light would blind you.

To produce a raking light, I'm using the same 13w, 3500K CF bulbs attached to the wall behind the left end of my bench. To keep from being blinded, I attached a photographic filter material (Cinegel #3000) called a "gel" (it looks like tracing paper) to the front of each fixture with binder clips to act as a diffuser (see photo at left). This material won't catch fire even in direct contact with the fluorescent bulb and is inexpensive.

An Inviting Shop

By far one of the coolest things about an ultimate hand tool shop is that with a few precautions, it can be made safe enough for a baby. Woodworking is such a solitary hobby, but it needn't be so. Without the noise and the dust of machinery, the shop can be a pleasant place to be. My shop has toys for my children (although they prefer tenon cheeks and plane shavings) and a comfortable place to sit down. The warm wood paneling didn't take long to install, but it really took away the harshness of the cinderblock walls. The ultimate shop is a shop you want to be in. The ultimate shop is a shop where a child or grandchild, neighbor or spouse feels welcome. The ultimate shop is a shop in which woodworking can be shared.

Conclusion

I hope I haven't misled you though. There is no actual "ultimate" hand tool shop. Every shop is the result of several, often unfortunate, compromises. Nor should you consider the hand tool shop as necessarily separate from a modern shop. Instead, you can incorporate "ultimate" hand tool shop features in the space created by pushing aside your 12" planer and 6" jointer.

But the one aspect of the ultimate hand tool shop that really earns its title is that it can fit into the end of a garage without moving your car, or just as easily into a spare bedroom, or garden shed, or patio. It's the ultimate workshop because it can allow someone in a big city to make something wonderful in a very small space.

The truly ultimate hand tool shop offers craftsmen not just a different way to work, but an opportunity to work. **PW**

THE DOMINY SHOP

The reconstructed Dominy Shop at Winterthur offers a peek into a rural pre-industrial woodshop. The Dominy family produced a wide variety of items including furniture and clocks in their East Hampton, N.Y., home from the 1760s to the 1840s.

Although the "ultimate" hand tool shop I've described in this article was not based on this reconstruction, we can see many of the elements I discussed including the position of the workbenches, tool storage and even the color of the chest in the back corner.

This unique reconstruction, (which was based on 1940s sketches of the original shop and eyewitness accounts) validates our notions of period shops. The Dominy-made furniture and clocks included with the exhibit earn the shop its inclusion in any "ultimate" hand tool shop article.

Winterthur, formerly the estate of H.F. DuPont, is located in Delaware's Brandywine Valley. The museum, which includes a celebrated collection of American art and antique, is open year-round. For more information, call 800-448-3883 or visit winterthur.org. —*AC*

Photo courtesy of Winterthur

Coarse, Medium &

Using bench planes with your machinery will speed your work. But first you must understand how the bench plane system works.

by Christopher Schwarz

Contact Chris at 513-531-2690 ext. 1407 or chris.schwarz@fwpubs.com. *A DVD that explores this system is available from Lie-Nielsen Toolworks, 800-327-2520 or lie-nielsen.com.*

Photos by Al Parrish

Too often we hear that hand tools are slow and power tools are fast. Even people who love hand tools talk about how they enjoy handwork because it forces them to slow their work on a project, to ponder the details, to enjoy the smell of the freshly cut lumber and to labor in quiet harmony with the wood.

That's all very bucolic – but it's also a bit ill-informed.

Fine

To my mind, people who think hand tools are slow are either using the wrong tool for a task, or they are people who will work slowly no matter what tool is in their hand. I have found that to become truly efficient at woodworking is to first ignore whether or not the tool in your hand has a power cord or a finely honed blade. Instead, you should make sure that you know whether that tool is a coarse tool for hogging off material, a medium tool for refining and truing the work, or a fine tool that's the last to touch your work.

This classification system – coarse, medium and fine – works for many of the tools of the craft, from sandpaper to hand planes. And putting each tool into its place is the first step toward knowing its true use at the bench.

Once you know what each tool is used for, you'll also be able to figure out which tools (if any) should be used before it and which tools (if any) should be used after it. Plus you'll know – in general terms – how long you should be using that tool before you switch to a finer one.

The net result of this is you will become much faster because you'll always have the right tool in your hand.

To show how this approach works, let's look at surfacing lumber. This coarse, medium and fine system will first help you understand what bench planes are for and then show you how bench planes can be blended seamlessly with powered jointers and planers and other surfacing tools.

First Understand the Bench Plane System

Bench planes are the mainstay of a shop that uses hand tools or blends hand and power tools. Bench planes were designed to make lumber smooth and true before any joinery operations (and before applying a finish).

To surface wood with bench planes, you need three planes: a fore plane, a jointer plane and a smoothing plane. It sounds simple, but the problem is that over the years, hand-plane manufacturers have designed bench planes in many lengths and widths (too many, really), and they have given them misleading numbers. Stanley, for example, numbers its bench planes from the diminutive No. 1 up to the massive No. 8. And there are more than just eight planes in that numbering system (there are Nos. 4½, 5¼, and 5½, too). Do you need all 11 planes? No. Do you need to start working with the No. 1 then progress to a No. 8? Absolutely not. So which planes do you need? Good question. Let's hit the books.

Ignore Some Numbers

What's more important than the model number that's cast into a plane's bed is the overall length of the tool – that's the key to unlocking its function.

And once you understand the plane's intended function, then you'll know how to incorporate it into your shop, no matter what set of tools or machines you own.

In a nutshell, the fore plane is the tool for coarse work, and it does a job similar to a powered jointer and power planer. The jointer plane is the medium tool, and it works like a random-orbit sander, drum sander or belt sander (in the right hands). And the smoothing plane is the fine tool; it does the detail work performed by powered pad sanders, hand scrapers and sanding blocks. So let's first take a close look at these three planes.

Fore Planes: Rough & Ready

Fore planes are between 14" and 20" long and are so named because they are the planes that are used "before" the other hand planes. They are the "coarse" tool – the roughest of the bunch. They require more strength and stamina to use than any other hand tool, and I use mine as little as possible now that I own a powered jointer and planer.

In the Stanley numbering system, the No. 5 (14" long and commonly called a jack plane) and the No. 6 (18" long) planes qualify as fore planes.

The fore plane is used to rapidly take a bowed or cupped board to a state where it's reasonably flat. Fore planes don't take a fine shaving. They take coarse curls of lumber so the work gets done quickly. Their middling length is an advantage. They are long enough so that the sole touches a lot of the surface of the board. This helps you true the face of the board more easily and prevents you from overshooting your mark – turning high spots into deep valleys by accident. (Why are scrub planes so short, then? I think these 10"-long tools were used more for hogging wood off edges or for localized work – but that's another story.)

Like a powered planer, the fore plane produces thick curls so it can rapidly reduce a board in thickness. Shown is my crusty-but-trusty Stanley No. 5 (some people call this a jack plane) and my sweet Scioto Works 16" wooden-stock fore plane.

If the length of the fore plane is an asset, why not make them really long? Working with fore planes is strenuous, so having them shorter and lighter makes them easier to handle than a longer plane. Whenever I use my fore plane, I marvel at its perfection of design. It's exactly long enough – but no more.

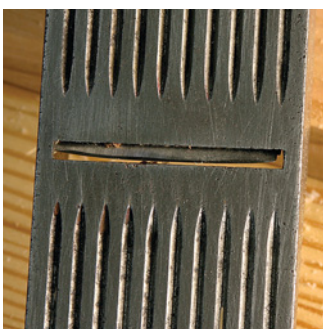
Once you know that the fore plane is for roughing, this also tells you how to set up the tool for use. The flatness of the sole isn't a concern for rough work. If the sole looks flat and the tool won't rock when the tool is flat on your bench, you're in good shape.

I wouldn't recommend you spend hours flattening the sole of your fore plane so you can take .001" shavings. Save that drudgery for another plane (or avoid the drudgery – more on that later).

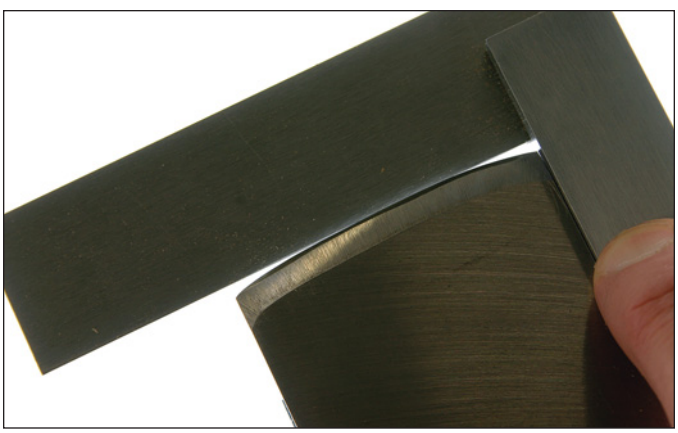
My metal fore plane is a sorry old Stanley No. 5 with a handmade tote that looks like it was fashioned by a blind beaver. The tool is rusty in spots. The sole's flatness is questionable – but it works like a dream.

Back to set-up. Because you want to remove thick shavings, open up the mouth of the tool and make the tool easy to push by cambering the tool's cutting edge. A fore plane with a blade sharpened straight across (like you would with a chisel or block plane) can be quickly immobilized by a tough patch of wood. And the cambered iron (I like an 8" radius) helps reduce tear-out because there are no corners digging into the wood. If your plane has a chipbreaker, set it so it's back at least 1/16" from the corners.

Fore planes are pushed diagonally across a board's face. Work diagonally one way across the face, then diagonally the other. Check your progress with winding sticks. Working diagonally will generally get you where you need to be, but if there's a persistent high spot, work at it selectively with the fore plane. The goal is to get the board flat and almost to your finished thickness – as close as you dare.



Fore planes need a wide-open mouth to pass the thick shavings they produce. A tight mouth will clog and slow you down.

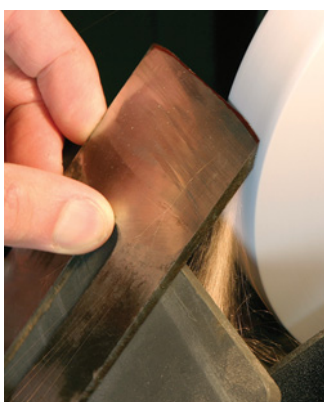


A silhouette of the shape of my fore plane's cambered iron. It's an 8" radius, which allows me to take an almost 1/16"-thick shaving in softwood.

Working diagonally is the key to using the fore plane. The diagonal motion reduces tear-out and assists in truing the face.

Jointer Planes: Join the Flat-World Society

When the work is nearly flat and nearly to finished thickness, fetch your jointer plane – sometimes also called a try plane. Jointer planes are tools with soles 22" long or longer. Longer is better in the world of jointer planes. In the Stanley system, the No. 7 (22" long) and the No. 8 (24" long) are the jointers. Wooden-bodied jointer planes can be much longer.



Cambering the iron on a fore plane is a task best handled on a bench grinder.

The jointer plane is the "medium" tool. It brings the surface of the board to a state where joinery can be performed. Jointer planes take a finer shaving than the fore plane, but nothing that would be called gossamer. I generally go for a shaving that's about .006" thick. That's about the thickness of two or three sheets of typing paper. The length of the jointer plane is its greatest asset. When you can push a jointer plane across the entire surface of the board and remove a full-width, full-length shaving from every point, the board is quite flat (flatter than most machinery can

Winding sticks (I like aluminum angle) exaggerate any warp or high spots on the board's face. View the winding sticks so they are in line with one another.

A jointer plane's major asset is the length of its sole. The longer the sole, the flatter your board will become. Shown is a Lie-Nielsen No. 7 plane (left) and the Veritas bevel-up jointer. The jointer I covet (not shown) is the Clark & Williams jointer, which can be as long as 30".

get it, I've found). The plane's sole rides over the valleys of a board and flattens the hills. When the hills are the same level as the valleys, you're done.

If this tool is so accurate, why not begin work with a jointer plane and skip the fore plane? Though a .006"-thick shaving sounds like a lot, it's not. With rough-sawn wood, you could work one face all day with a jointer plane – a fore plane can remove much more wood in a hurry. And the jointer planes are more unwieldy. I'd much rather push my fore plane, which weighs less than 5 lbs., for a lot longer than my No. 8, which weighs 10 lbs.

Because the jointer plane is a precision instrument, it requires more attention than its coarser, shorter cousin. The sole should be reasonably flat. There's been a lot written about this topic, but the bottom line is that the tool must work – that's its true test. Can you flatten the sole of an old metal jointer plane yourself? Perhaps, but I can't. Though I've flattened the soles of many planes, I end up making jointer planes worse. There is too much cast iron to work with there.

And that's why I recommend you spend a little money when buying a jointer plane. In fact, if I had to buy only one precision plane, it would be a toss-up between the jointer plane and the smoothing plane. There's a good argument for buying a premium metal jointer plane and a vintage wooden-soled fore plane and smoothing plane. Then you could use the metal jointer to true the soles of the two wooden planes.

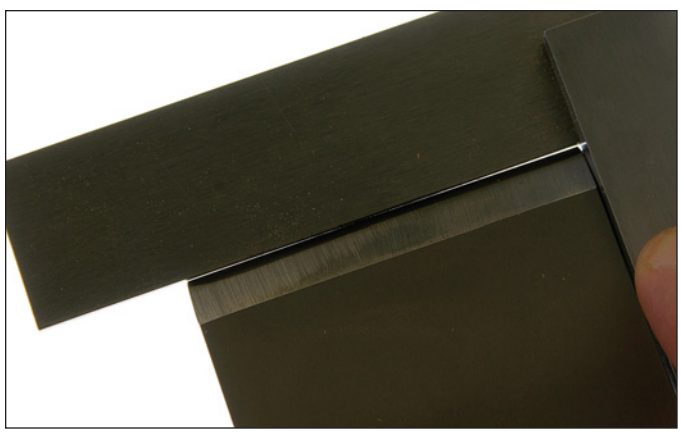
No matter which jointer plane you acquire, the setup is similar. Some historical texts recommend an iron sharpened straight across, but I prefer a slight camber to the cutting edge, which is also historically correct – it depends on who you read. The camber should be much slighter than the curve on your fore plane. I like a curve that allows a .006"-thick shaving that's almost the entire width of the iron. Practice will get you where you need to be.

The mouth needs to be fairly open to pass this shaving, but there's no need for a gaping maw. Keeping the mouth fairly tight can reduce tear-out. And though the jointer plane isn't generally a finishing plane (that's the job of the smoothing plane), reducing tear-out will make less work for the smoothing plane. The chipbreaker needs to be somewhere between 1/16" and 1/8" from the cutting edge in my experience.

When I work a board's face with a jointer plane, I tend to work in the direction of the grain – not diagonally like with the fore plane. However, when I'm flattening a

There are lots of ways to get the proper camber on the iron for a jointer plane. Shown is the Odate crowning plate from Powell Manufacturing – essentially, it's a diamond sharpening stone that's concave in the middle.

The mouth of the jointer plane is a fine balance. You want it open enough to pass a fairly thick shaving, yet tight enough to limit tear-out as much as possible.



A silhouette of the shape of my jointer plane's cambered iron. I placed a feeler gauge on the end to see how far back the corners were swept: it's .005".

On narrower cabinet components, the jointer plane works along the grain. Skewing the tool slightly during the cut makes it easier to push and does assist in flattening. One wider panels – say 14" and wider – I'll begin with a few diagonal passes before switching to long-grain ones.

Smoothing planes are the elite (and most demanding) planes in your shop. Shown is a Lie-Nielsen No. 4, a Veritas bevel-up smoother, a wooden-bodied Clark & Williams smoother, and my most guilty pleasure: a custom-made plane by Wayne Anderson (bottom right). Yes, it's a smoothing plane, too.

Smoothing planes remove wispy shavings and prepare a surface for finishing.

big tabletop, a largish panel or my benchtop, I'll begin with diagonal strokes. This helps keep a larger surface in true.

As you start to work, the first pass or two should produce irregular shavings as you remove the high spots left by the fore plane. After a few passes, long and wide shavings should emerge from the mouth. When this happens all the way across a board's width, you are ready to work the other face of the board.

If you're surfacing the board entirely by hand, use a marking gauge to scribe the finished thickness on all four edges of the boards and work that rough face with the fore plane almost to the scribe line. Then true the second face with your jointer plane.

This is the point at which I'll typically perform joinery on the piece (with some exceptions). If you proceed to the smoothing plane before you cut your joints, you can make more work for yourself in the end.

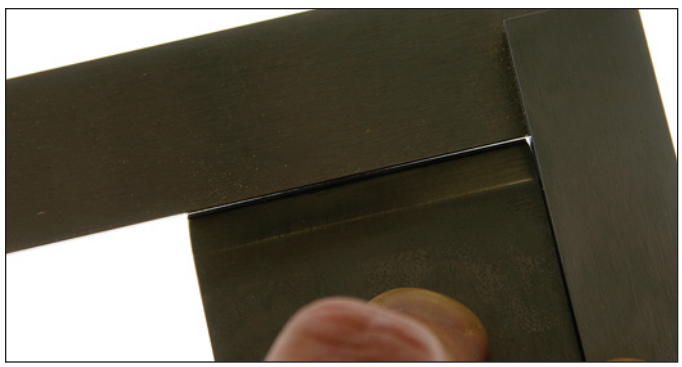
That's because joinery can be hard on a board. You'll mark it up with the typical shop bruises from cutting and clamping. When the joinery is complete, I'll generally assemble the project and then smooth the exterior – if possible. Sometimes you have to go to the smoothing plane before assembly. Experience will be your guide.

Smoothing Planes: An Addiction for Some

The smoothing plane is the tool that usually hooks woodworkers into hand tools. They're the "fine" tool in the troika of hand planes and they produce gossamer shavings and leave shimmering surfaces. I like my smoothing planes, but if I've done a good job with my other planes, the smoothing plane should see only a little use.

This is a good thing because it saves you on sharpening and setup. Fore planes are the easiest

The mouth of a smoothing plane should be as tight as possible. This requires tweaking and experimentation. Once you get the mouth set, however, you shouldn't have to change that setting.



A silhouette of a smoothing plane iron. The camber is slight: .002" or maybe a little more.

tool to set up and sharpen (they don't have to be surgically sharp), jointers take a little more work in both departments and smoothing planes are the trickiest tool.

Smoothing planes require a cutter with a gently curved super-sharp cutting edge, a fine mouth, perfect alignment of the cutter in the center of the mouth and a lot of other fine tweaks that demand fussing, fussing, fussing. So if you're using your smoothing plane as little as possible, then you're also spending less time tweaking and more time woodworking.

There are a lot of sizes of smoothing planes, but in general they are 7" to 10" in length. The Stanley No. 4 is the most common size at 9" long with a 2"-wide cutter. The bigger planes, such as the No. 4½, are suited for larger-scale work, such as dining tables. The smaller planes, such as the No. 3, are suited for smaller work, such as narrow door stiles and rails.

The smoothing plane needs to take a fine shaving, anywhere from .002" thick down to stuff that cannot be measured. So you need the sole to be as flat as possible to consistently take this shaving. You can try to tune the sole of your smoothing plane, or you can do what I do – let someone who knows what they are doing handle this job with a surface grinder. If you purchase a nice hand plane from Veritas, Lie-Nielsen or Clifton and the sole is out of whack, then send it back. You shouldn't have to flatten the sole if you pay more than $175 for a plane.

The powered jointer (above) and planer (right) are faster than a fore plane (though they won't burn as many calories during use).

Other considerations: The mouth needs to be as tight as you can get without it clogging with shavings. The chipbreaker needs to be set near the cutting edge. I like less than 1/16" – as close as I can get without clogging. And the iron needs to have the slightest camber, just a couple thousandths at the corners. I achieve this by applying selective finger pressure at the iron's corners while sharpening. I also find that smoothing planes are the place to lavish your sharpening skills. To get the edge as perfect as you can, polish it up to the highest grit you have available. In my experience, sharper edges reduce tear-out as much as a tight mouth or the pitch of the blade (higher pitches reduce tear-out but make the tool harder to push).

When working with a smoothing plane, make passes parallel to the grain of the board, making sure that your strokes overlap slightly. Work from the edge of the board near you across to the far edge. Your first strokes will remove the high spots left by the jointer plane and your shavings could look inconsistent. Once you make a couple passes across the face, you should be able to get full-length shavings that are as wide as your blade allows. When this occurs and the board looks good, put down the plane. Clean up any localized tear-out with a hand scraper.

If necessary, I'll make a few strokes with #220-grit sandpaper to blend the planed surfaces with the scraped ones. This should take only a few strokes.

Hand scrapers and sanding blocks are an accepted and historically accurate way to prepare a piece of wood for finishing.

What This Means: Blending Hand and Power

Armed with this understanding of hand planes, you can now unlock an important secret. Almost all of our power tools can be classified as coarse, medium or fine tools – just like the hand planes used for surfacing wood.

Think about your powered jointer and planer as coarse tools, like the fore plane. Their job is to remove lots of stock in a hurry. But their surface needs to be refined before finishing (unless you build only chicken coops).

What are the medium tools? I classify large random-orbit sanders, belt sanders and drum sanders as medium tools. They remove the marks left by the coarse machining process and can indeed true a board when wielded by a skilled user. Some people are satisfied to stop at this phase – and truth be told, I'll sometimes stop after using my jointer plane when building something intended for the shop or for pure utility.

But most power-tool woodworkers go a step further. They scrape and hand sand to remove the scratches left by random-orbit

A drum sander (left) can level and true a panel much like a jointer plane. A random-orbit sander (above) is ideal for removing machining marks in a power-tool workshop.

sanders and pad sanders – the so-called pigtails you see on so many furniture-store pieces. In the power-tool world, these hand tools are the "fine" tools.

Once you classify your power tools, you can use them in conjunction with your hand tools. Let's say that the only bench plane you own is a smoothing plane. When should you use it? First joint and plane your stock (a coarse operation). Get it as true and flat as possible with your drum sander or belt sander (that's medium). And then finish things up with the smoothing plane, scrapers and sandpaper (fine).

This information can also be used to guide your tool purchases. What plane should you buy at the flea market if you don't own a powered jointer or planer? (A fore plane.)

Here's how I personally blend power and hand tools in my shop. My coarse tools are my powered 8" jointer and 15" planer. Though I own two fore planes, I use them only when a board is too wide for my powered equipment.

Once the coarse stuff is over, I use my jointer plane to true my stock before cutting my joinery. This medium tool removes snipe and machine marks, and makes the boards flatter than my power equipment can. Finally, my smoothing plane is my primary fine tool, although I scrape and hand sand, too.

It's important to use the tools in the right order (start with coarse; end with fine) and that you don't skip any steps between. Skipping wastes time. It's frustrating to use a fine tool right after a coarse tool. Try using a smoothing plane on a larger board that's fresh from your powered planer. Then use a smoothing plane on a board that you first dressed with your jointer plane. You'll notice a significant difference.

The other important idea is to work as long as you can with the coarse tool. You wouldn't remove 1/16" of a board's thickness with a random-orbit sander. So don't use your jointer or smoothing planes to do that, either. This is a common error and is one way hand tools get a reputation as slow.

One last thing: I don't use hand tools because of a romantic obsession with the past. Once I adopted this system of coarse, medium and fine, I became faster, my joinery became tighter (because my boards were perfectly true) and my finished results looked better.

And once you understand how coarse, medium and fine works with surfacing lumber, you can apply the idea to other workshop processes. Here's a hint at the possibilities: When cutting curves, the coarse tool is the band saw, the medium tool is the rasp and the fine tool is the spokeshave. And there's more. A lot more. **PW**

Christopher will be teaching a class at the Marc Adams School of Woodworking on May 8-12 that explores this principle and other forgotten hand-tool techniques. Visit marcadams.com or call 317-535-4013 for more information.

SOURCES

Anderson Planes
763-241-0138 or
andersonplanes.com

Clark & Williams
479-253-7416 or
planemaker.com

Lie-Nielsen Toolworks
800-327-2520 or
lie-nielsen.com

Powell Manufacturing
781-237-4876

Veritas (Lee Valley Tools)
800-871-8158 or
leevalley.com

The concept of coarse, medium and fine works with other operations as well. For cutting curves, think of your band saw as the coarse tool, your rasp as the medium tool and your spokeshave as the fine tool.

WOODWORKING ESSENTIALS

BY DAVID THIEL

CHAPTER 4

Casework Construction: Smart Assembly

What are we talking about when we say "smart assembly?" In previous chapters, we've discussed a couple of issues that can complicate casework: proper material preparation and choosing the proper joint to make the strongest furniture. Another place to trip up when building case furniture is in the assembly of your components.

Most casework is larger than the average breadbox (although that breadbox is also casework). Because of that large size, cases can be awkward to fit and assemble.

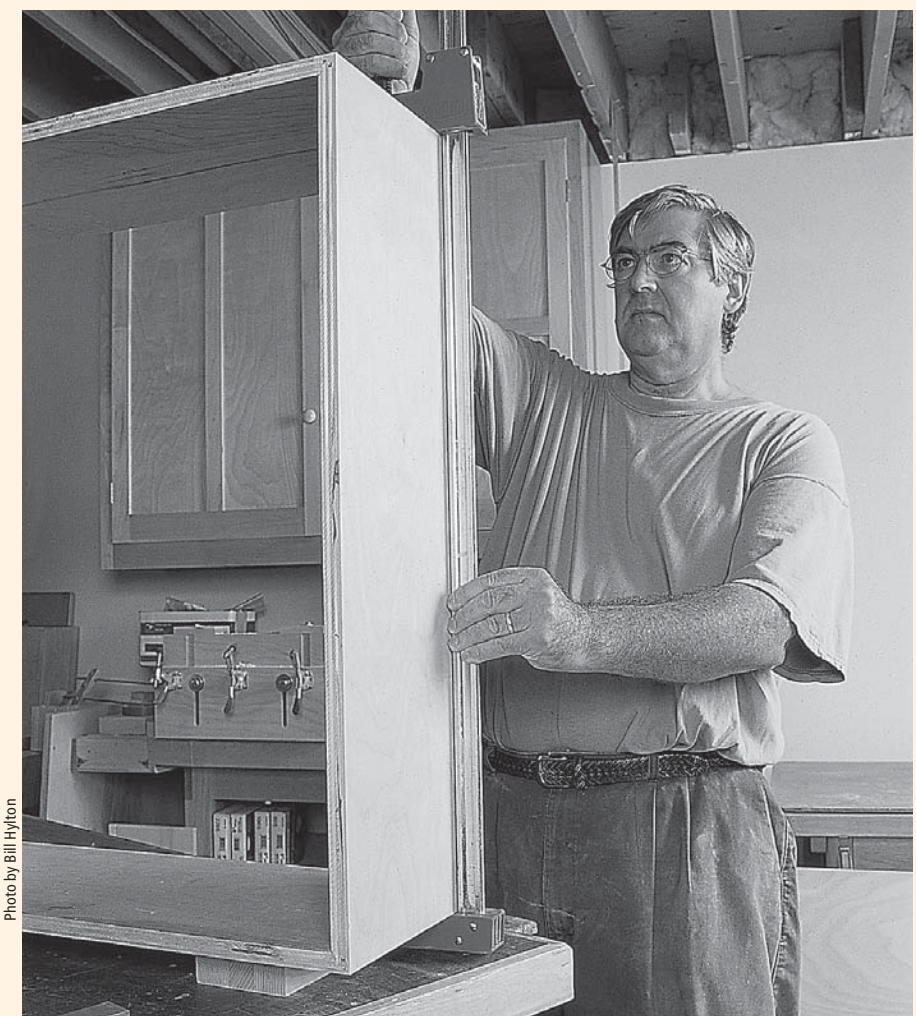


Photo by Bill Hylton

Another complication is that many case pieces are more than just four sides, a top and a bottom. Each side can be as many as five pieces (a frame-and-panel side, for example), and accurately fitting, gluing and assembling all those pieces is like trying to build a jigsaw puzzle without a table.

In this chapter, you'll learn to: test the fit of the pieces prior to gluing; work in stages; and use proper clamping techniques – all of which will help to make your casework construction a more pleasurable and successful experience.

Other assembly issues we'll discuss were briefly touched upon in the previous chapter, but here we'll go into more detail about attaching backs to your case pieces. We'll also spend some time focusing on mechanical assembly options – namely, screws and nails.

Test Fit Your Pieces

This is one of those steps in building furniture that gets forgotten or ignored because we get in a hurry. After carefully measuring and cutting all our joinery for a piece, we hold the pieces near each other, give them a critical squint

Author Bill Hylton understands the benefits of good joinery (a lock miter at the corners of this piece) and proper clamping during assembly. By using the lock miter joint, the number of clamps required is greatly reduced – as is the complexity.

with our eye, then decide everything looks good enough to add glue. Shortly after that, we're knocking apart a sticky mess because something just didn't fit right under clamp pressure.

As with proper sanding before finishing, test fitting case pieces without glue is always a good idea. As the number of pieces in a project increases, the opportunity for mistakes increases as well. Case pieces have more parts than any other type of woodworking project except intarsia. So take a few minutes to follow these rules about test fitting.

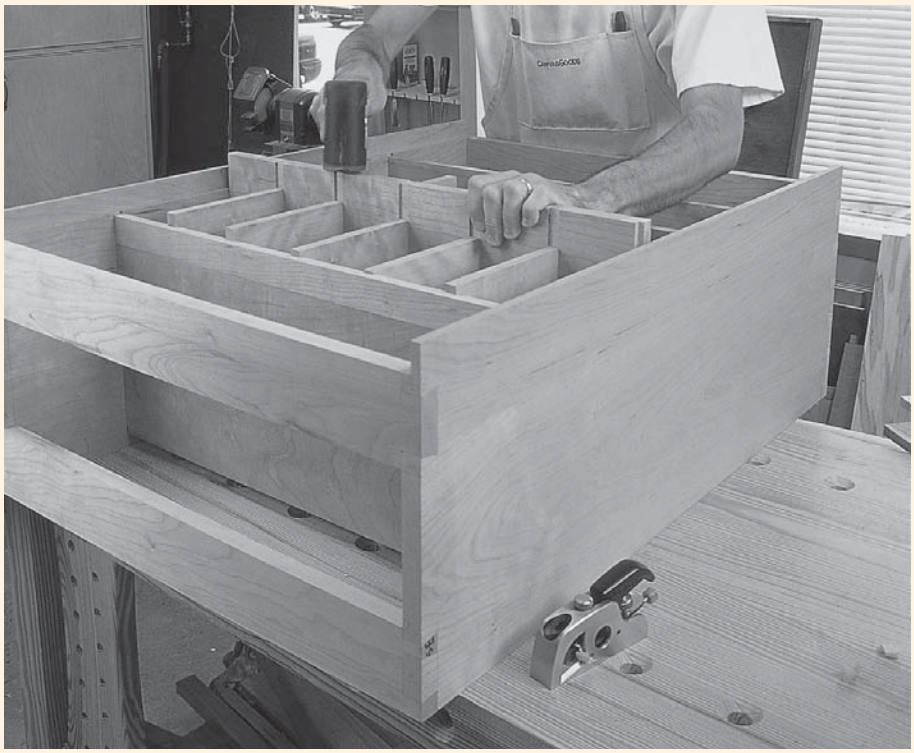
■ Work from the outside in. Test fit the case joinery first. This fit will determine the overall shape and size of the case itself. Any pieces that are attached (drawer dividers or shelves) will need to fit after the exterior fit is finalized.

■ With the corners fit, use the back of your case to square up everything. It keeps things in shape while fitting the interior. If you'd prefer to leave the back off for finishing, tack it in place with a couple of nails that can later be easily removed.

■ With the case fit and squared, take your interior measurements at the carcase's corners and build the interior structure from those measurements. A common mistake is to fit the interior pieces to the case based on measurements taken from where they will be attached. If your case sides are bowed at the center, you'll only be building that bow into your furniture. That's why you measure at the corners.

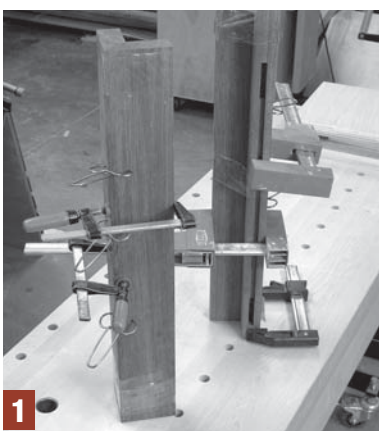
■ As you fit the interior parts, it's much easier to have the joinery (and the pieces) slightly oversized on purpose. If you try to fit the pieces perfectly beforehand, you stand a better chance of going too far and making the fit loose. It's easier to use a hand plane or sandpaper to fit the pieces perfectly.

■ For face frames, don't try to fit the frame perfectly to the case; it's unlikely to work. You're better off building the



Fitting each of the interior dividers in this case can take a while, but it's well worth the effort. The plane shown in the right corner of the photo is the correct tool. A shoulder or rabbet plane allows you to fine-tune joinery prior to assembly for a less stressful experience. Once the glue is on the pieces, the mallet is used to tap everything into place.

Working in Stages – Step by Step



Getting miters perfect is tricky enough when not attached to a panel. With all the joinery prepared, glue them up first.

The back assembly (with pre-finished panels) is already in the clamps, except for the corners. They're the final addition to the back assembly.

Clamping in two dimensions on the flipped back assembly is no problem. Remember not to use glue on the panels so they can float in the grooves. Take the time to check the frame to ensure it's square. With the back clamped up, repeat the process on the front panel.

frame slightly oversized (1/16") in both directions. Then, you can simply take a router with a bearing-guided straight bit and run around the outside of the case to make the frame flush.

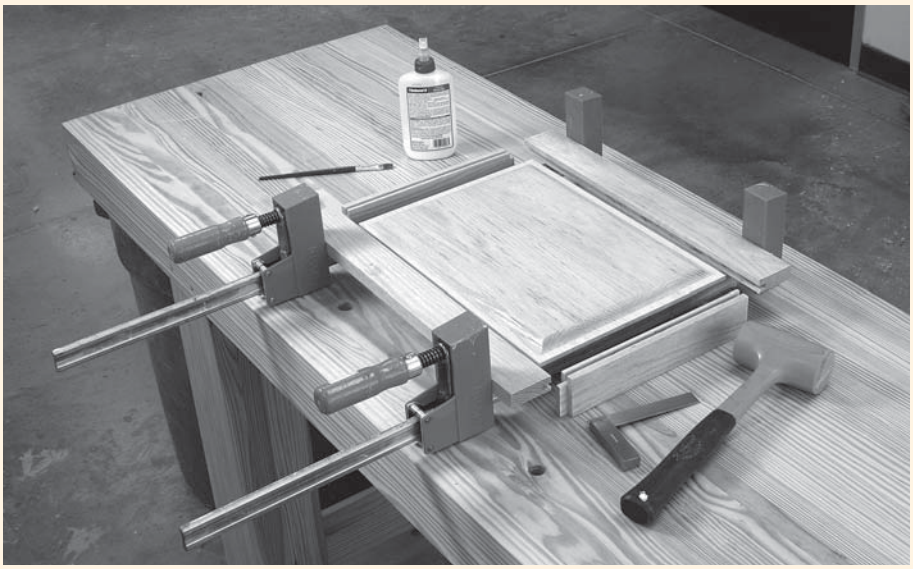
Work in Stages

This lesson really is common sense. Rather than try to glue up and assemble a case piece all at once, it's much easier to assemble the case in pieces. There are a few physical limitations that make this technique not only smart, but necessary.

Most of us work in our shops without an assistant. (Even if you do have someone you can get to help, it's unlikely they'll be knowledgeable enough in woodworking to do more than lend a hand.) That leaves us with two hands that never seem to be adequate to the task of gluing and assembling a case piece. There are just too many pieces to juggle at once.

Although glue is great at making things stick together, until it dries it's a pretty good lubricant. That means all the glued pieces have a tendency to slip around. So now you're juggling a slippery collection of parts.

One side comment, choosing the best glue for assembly will help you out. Standard yellow glues dry quickly and work well for assembling panels, but when you're working with so many pieces, a slower curing glue is helpful. There are yellow glues available with longer open times, such as Titebond Extend. Polyurethane glues have a longer open time, but can be messy. Hide glue is a third alternative because it's reversible with heat and water.



Having everything on hand for an assembly and knowing the order in which the assembly will progress will help you avoid mishaps. Although we show a door here, the same preparedness is even more important with a case assembly. The pieces are in place and the clamps adjusted. The mallet, square and glue brush are ready to go. What's missing? How about a rag and a bucket of clean water to wipe off the excess glue?

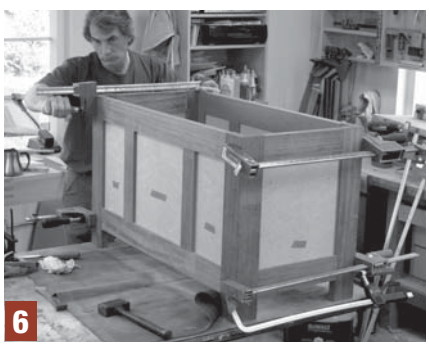
When you get all the parts glued and assembled, it's time to put clamps on until the glue dries (leave them on for at least 30 minutes). But what if you don't have 16 3'-long clamps?

Working in stages solves all these problems. Gluing and assembling one end of a case piece is a job that's easily managed with only two hands. And that one end is likely to require only a few clamps – and most woodworking shops have at least a few clamps. All of this results in a more pleasant woodworking experience with fewer chances for mistakes. And those are results worth working toward.

The photo essay below walks you through a typical assembly process for a

Next, add the sides. Start by gluing the side rails in place then slide the panels into place. Add glue to the tenons of the ends of the rails.

It's then fairly simple to tap the front of the case into place on the positioned sides and much easier than gluing it all at once.



With the four sides glued and in place, squaring the case as you clamp across the piece is no problem. Because the corners and the two long sides have already been squared during glue up, you have to worry about only a couple of the angles. *—DT*

blanket chest and is representative of the great majority of case pieces.

I'd like to drag your mind back to the earlier topic of dry-fitting for a moment. This is another valuable technique that will make working in stages all the more easy. When you dry fit an assembly, it's an opportunity to find out if you indeed have enough clamps to assemble the case piece. It's also a chance to leave those clamps set to fit the glue-up in question, so you don't have to fumble around once the glue is on the project.

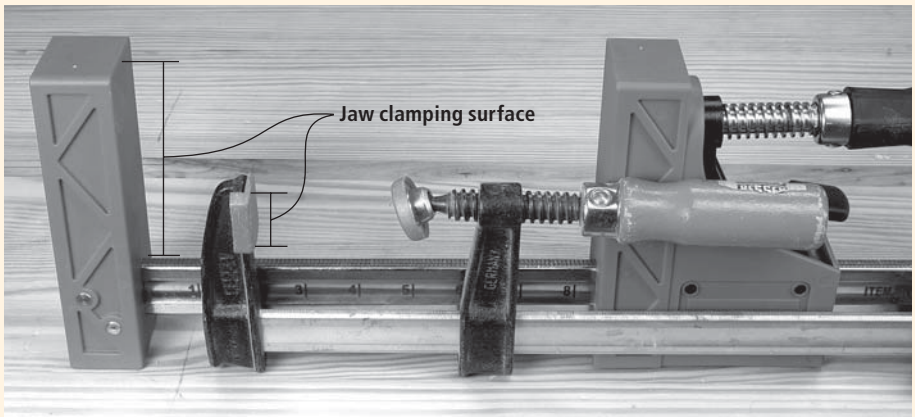
And when you're dry-fitting, it's a good idea to at least pantomime applying glue to the pieces. You may find that you're trying to apply glue to a joint that you can't adequately reach with the pieces in place. Think of it as a dress rehearsal. Knowing the what, where, when and how before you start makes the actual assembly, well – planned.

Smart Clamping

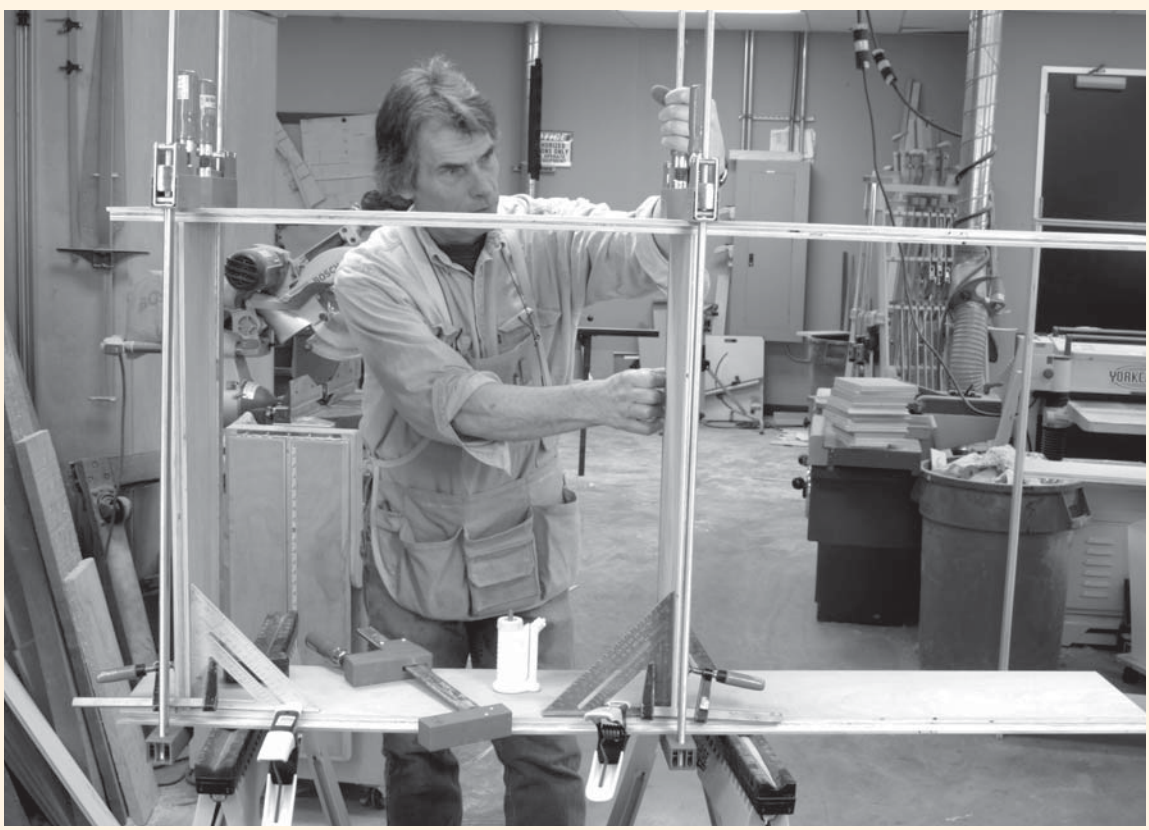
We've already started talking about smart clamping on the previous page. By adjusting your clamp jaws and having the clamps ready to use within easy reach, you're working smart.

That clamping preparedness carries into lots of areas including what type of clamp to use, where the piece you're going to assemble is positioned, and simple little steps that make it easier to assemble cases when you're working alone in the shop.

Let's start with the clamps. I know this is an area on which it's going to be hard to give absolute advice because we likely all own a very different collection of clamps. Many of us use bar clamps



This may sound like an advertisement, and if it does, oh well. It's an endorsement I'll stand behind. When parallel-jaw clamps (at the rear in the above picture) came onto the woodworking scene, they had a huge impact. The jaws allow you to clamp with even pressure anywhere along the length of the jaw. Another benefit is that the design allows the clamp to lay on your workbench, ready to use, without falling over. That's something your standard F-style clamp (propped-up in front) just can't do. Parallel-jaw clamps represent money well-spent for your woodworking shop.



Even with dados run in the sides of this bookcase, gluing and clamping the shelves in place can be awkward because of the shelf length. My co-worker, Bob Lang, has anticipated this difficulty and is using a couple of speed squares to help him keep the shelves at a 90° angle during glue-up. The squares are clamped to the shelf and to the lower case side. Then the opposite case side is clamped across the shelf. This not only helps to ensure a square case, but keeps things from wiggling too much while you're assembling the case.

Freud's NEW ULTIMATE 2-1/4 HP ROUTER...

Above-Table Height Adjustment

Above-table micro-adjustability to 1/128" increments makes adjustments quick, easy, and accurate.

Above-Table Bit Change

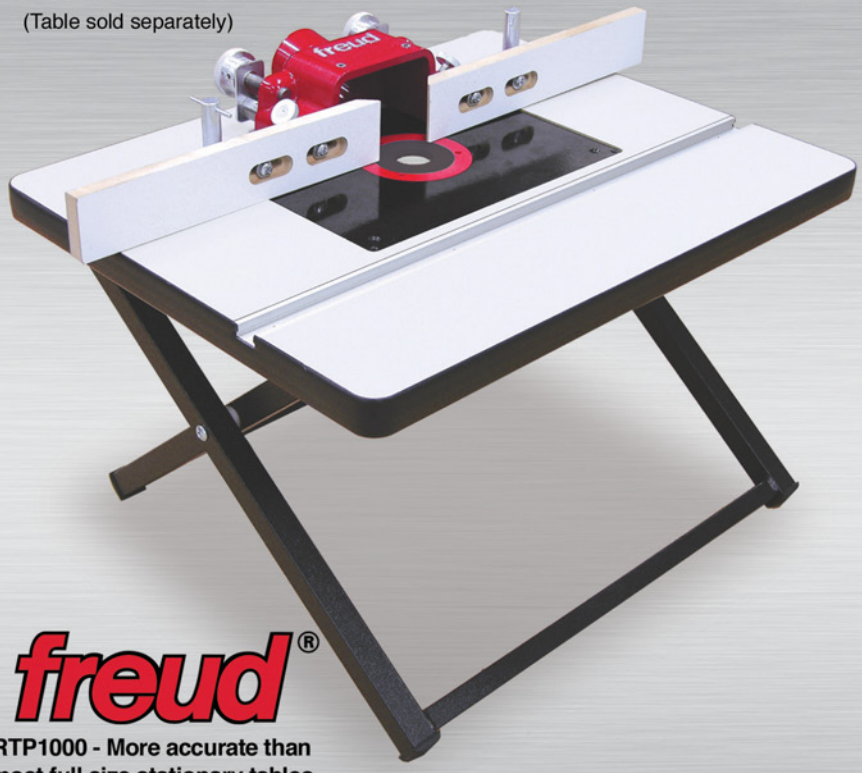
Auto spindle lock with above the table collet extension provides for fast, easy, one handed bit change.

freud®

FT1700VCE - 14 AMP
Electronic Variable Speed
(Router sold separately)

...Combined with the NEW ULTIMATE PORTABLE ROUTER TABLE...

For Use With All Routers
(Table sold separately)



freud®

RTP1000 - More accurate than most full size stationary tables

CIRCLE NO. 122 ON FREE INFORMATION CARD.

Micro-Adjustable Fence

Industry leading accuracy with dual-adjustability on both infeed and outfeed fences–accurate to .001"

Portable & Convenient

Folds down to a compact 4" in depth for space-saving storage in your workshop or for easy transportation.

...Creates the ULTIMATE ROUTER SYSTEM

To find a dealer near you visit: www.freudtools.com (US) 1-800-472-7307 (Canada) 1-800-263-7016

Making Custom Entry Doors

Making custom doors for your home just got a lot easier with revolutionary new router bits from Freud.

A home's front door can signal important messages to all who pass by, including the design of the home, the pride the homeowner has in his house; it can even comment on the sort of people who live there. It's intriguing to think that a front door could represent a kind of "calling card" that says "a woodworker lives here."

To deliver that message, a door might be more expressive in appearance than "off the rack doors," or quite conventional but very well crafted. Obvious options come to mind, such as an out-of the-ordinary wood species, or simply choice selection of standard door lumber.

Constructing an entry or interior door presents some challenges but the same principles as cabinet doors apply. For most woodworkers, stepping up to entry or passage doors is now within their reach.

Why? Freud, a manufacturer familiar to many woodworkers, now offers a unique stile and rail router bit set for entry and interior doors. This set is not only scaled up to cut the cope-and-stick profiles for door making, the revolutionary design of the "cope" cutter can make the long, stout tenons that provide the strength these big doors require; tenons 2 1/2" long or longer.

The versatile new Freud tooling that makes the door will also make the sidelights and transoms. But for this article, the focus is the door itself, and complete instructions are provided on the inside of this poster.

For complete information on door building, including transoms, sidelights, changing the bits for different thickness interior vs. exterior doors, Freud offers a mini-DVD and separate poster that accompanies the bits when purchased.

Lumber Selection and Preparation

For an exterior door, choose a hardwood such as oak, mahogany, walnut or cherry. For a painted door, poplar is a good choice. Regardless of species, be sure you have straight-grained wood for the stiles and rails. Lumber for panels can be flat sawn and may even look better.

For interior doors, pine is often used if it's to be painted. Natural finished doors should be an attractive hardwood. Interior door thickness should be 1 3/8".

For all doors, it's important that all stock is properly prepared. Lumber should be flat and all edges and end cuts square.

Developing a Cutting List

First carefully measure the existing opening for your new door. Also check that the opening is square. Use the opening size (not the old door) to build to. You'll do a final fitting when hanging the door. If the opening is out of square, add enough to trim later.

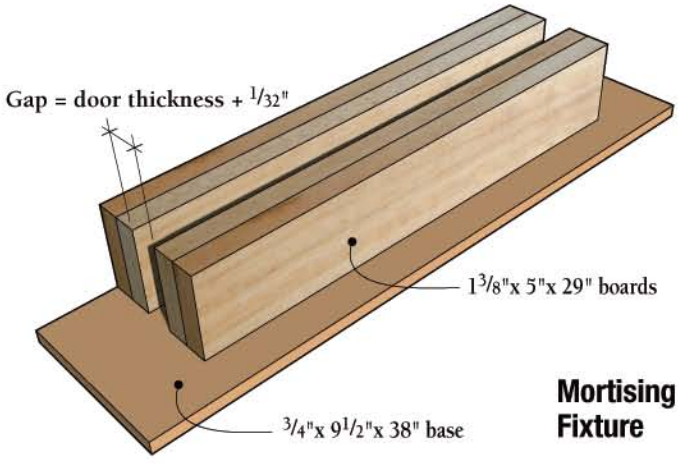
While just guidelines, door parts often follow standard sizes to accommodate structural requirements. That's why bottom rails are usually extra wide. Door stiles must be a minimum width to support the door and accommodate the long rail tenons. Factor into these sizes an aesthetic consideration for pleasing proportions. Use the callouts on the door at left as starting points for these sizes.

Now follow these easy formulas to determine the specific dimensions of parts to create the door to fit your opening. All exterior parts are 1 3/4" thick.

- Full length stiles = height of opening
- Length of the center stile or rail with stub tenon = distance between the stock +1"
- Rail lengths with 2 1/2" tenons = opening width - (2X stile width) + 5"
- Raised panel width = distance between the stiles + 3/4"; length = distance between the rails + 7/8"
- Glass inserts = distance between stiles or rails + 3/4".

A Fixture for Mortising

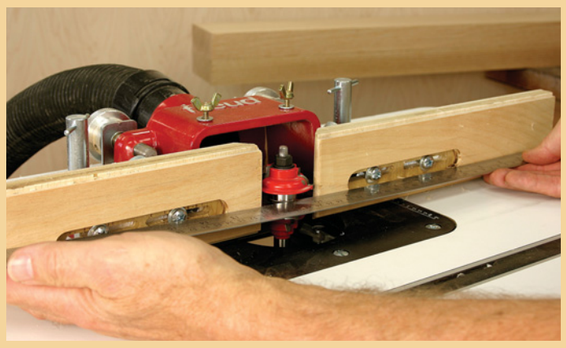
An easily made fixture to support the long stiles while mortising is helpful. It is comprised of two sides made from two thicknesses of 2x6s glued together, and a 3/4" bottom. The space between the sides is 1 3/4" plus two sheets of paper, just enough to allow the work to slip through but still be easily clamped tight. The height of the sidewalls is just 1/4" more than the width of the stiles. The bottom is both longer and wider than the sides to allow ample surface for clamping the fixture in place and to provide more support for the work. The drawing below provides the details.



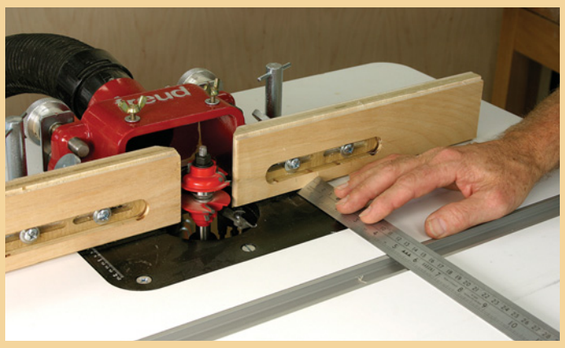
Mortising Fixture

Custom Doors: Step by Step

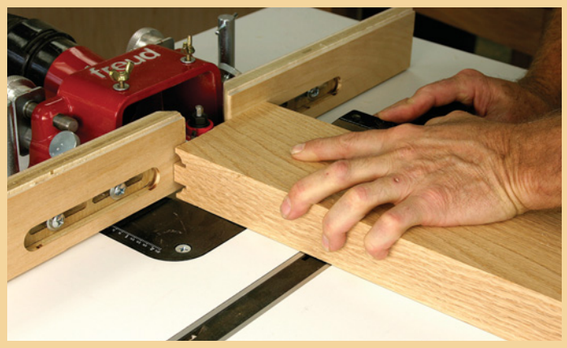
FREUD'S REVOLUTIONARY ENTRY-DOOR ROUTER BITS



1 Once all your door parts are cut to exact size, begin cutting the joints using Freud's revolutionary entry door stile and rail matched set. Make the cope cut first. Set up the bit in a minimum 2 1/4-horsepower router mounted in a router table that has a miter slot. Always unplug the router when making any adjustments. Set the bit height so that the cut is centered on 1 3/4"-thick stock. Set the fence opening as close to the bit as possible. Bring the fence in line with the front of the guide bearings between the top and bottom cutters. Use a straightedge to check fence alignment.



2 With the bit's height and fences set, make sure the infeed and outfeed fences are parallel to the miter slot. Use a ruler as shown above to check parallelism. When satisfied, lock the fence securely in place. Now is a good time to double-check that the router bit height is locked tight as well. Before making any cuts, go through and organize your door parts to segregate stiles, rails and panels. Select and mark which face you determine is best and stack the parts so the best face is down. Routing all parts face down will compensate for any difference in thickness.



3 Next make certain the miter gauge is square to the fence. Since you've cut square ends on your parts, place one against the miter gauge, snug it up to the fence and look for any gaps. Adjust the fence so that the end of the part touches the fence along the surface. Now make a test cut on scrap of the exact same thickness to be sure your cut is centered. Make any adjustments needed. Before running all the parts, add a back-up board to your miter gauge to prevent blow out when the stock exits the cut. Attach the board so that it nearly touches the fence.

4 When all the rail ends have been cope cut, the profile will have produced a stub tenon typical of that found on matched stile-and-rail sets used to make cabinet doors. It is at this stage Freud's new tooling ingenuity shows. The top part of the cope cutter disassembles from the lower half allowing the bottom half to begin making progressively longer tenons while continuously making the coping cut. When removing the top part of the cutter, be sure to keep the bit height setting the same. By so doing, the progressively longer tenon will maintain the same thickness.

5 To make the longer tenons, the fence is reset after each pass. Move the fence back in 1/2" increments, and each time you reset the fence, use a ruler to check for parallelism. As before, use the end of your rail set against the miter gauge to be sure the entire end is contacting the fence. When making these progressive cuts, you'll have to turn the work from one face to the other in order to cut both faces. You'll also need to reset the back-up board close to the fence each time the fence is adjusted.

6 Repeat step 5 until you have produced a tenon with a total length 2 1/2". Note in the photo above how the fences are almost fully closed to more fully support the work. When running the rails multiple times, keep good downward pressure on the work. You can make these multiple cuts easier by first removing some of the waste where the tenon is formed. Use a band saw to cut enough material so that the router bit is making more of a clean up and final cope cut instead of "hogging off" all the material.

7 After all the tenons are made (don't forget the center stile ends require a stub tenon cope cut) change router bits to make the stick profile cut. Use a stub tenon already formed to help set the bit height. When set, bring the fences in line with the front of the bit's guide bearings as before. Add a fresh end to the miter-gauge back upboard and make a test cut. The height is correct when the stub tenon end is flush to the stile surface. Adjust until both faces are flush when the parts are mated together.

8 Before running the stick profile cuts, set up both infeed and outfeed stock supports. These supports are essential when running the long door stiles both from a safety and accuracy point of view. Also make sure your router table is completely stable with no risk of tipping. Now, run the stick profile cuts on the stiles. Remember that the profile is cut on one edge of the long stiles and and top and bottom rails; and on both edges of the shorter center stile and middle rail.

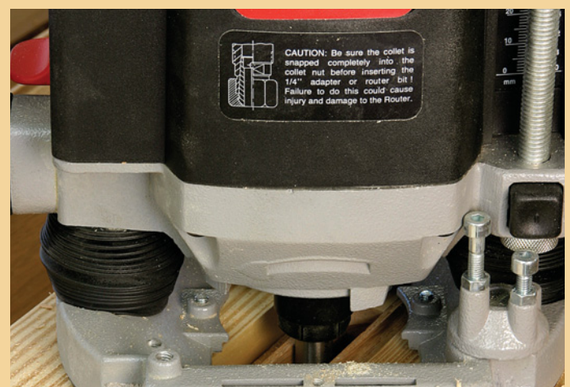
PANEL RAISING

9 Now it's time to raise the door panels. The process is very similar to raising panels for cabinet doors with one major exception – the panel is raised on both faces instead of just the cabinet exterior face. Use a panel-raising bit that's capable of producing a deep fillet in the center field of the raised portion of the panel. Freud's bit #99-515 is a good choice. Make the cut in three passes. Do this by setting the fences forward of the final cut, moving them back in steps until the final cut is made.

10 When running the panels, run the cross grain ends first and then the long grain sides. This will cut away any tear-out that may occur when exiting the cut on end grain. Also, keep good pressure both down and to the fence. Before making the final cut, use scrap to test cut the fit in the groove made by the sticking profile. It should be an easy slip-fit with no gaps showing. When running the final pass, consistent downward pressure is necessary to produce a consistently thick panel edge.

DEEP MORTISES

11 Next, cut the deep mortises on the stiles. Lay out and mark their locations carefully. Remember that the tenons on the top and bottom rails will be haunched so the mortises will start 1" from the stile ends. Also, the wide bottom rail tenon should be divided into two tenons with a 1" separation between them. After layout, I tacked small pieces of scrap in the grooves that represented the exact stopping and starting locations for each tenon. These acted as references for drilling away the waste and as guide for the router bit on the clean up cut.



12 Use the fixture described earlier mounted securely to the drill press table. Center a 9/16" Forstner or brad-point bit in the center groove of the stile. Chain drill out the waste in the mortise locations to a depth of 2 1/2". When done, clamp the fixture to a bench and set up to rout the mortises to final dimension, 5/8" wide, the same as the width of the stile groove. Use Freud's 1/2" straight router bits. Set the bit so that a portion of the smooth bit shank is guided by the sides of the stile groove. You'll need at least three passes to reach the final 2 1/2" depth. When done, square up the mortise corners with a chisel.

FINISHING UP

13 Before you can test fit the mortises and tenons, you'll need to haunch the top and bottom rails and remove 1" of tenon from the center of the bottom rail tenons, thus creating two tenons on the bottom rail. Use a band saw or table saw to cut away the waste. To cut across the waste, you can cut just shy of the coped profile edge as shown above and the resulting stub tenon will still fit nicely. Just make sure your haunch cuts and lower rail tenon dividing cuts match up to the mortises you've already made.

14 When done, the lower rail tenons will look like those shown above. The top rail tenon haunch will look like the lower left edge in the photo above. Haunching tenons produce both a far stronger and more attractive joint. Now test fit the tenons and dry assemble the entire door. Make any necessary fitting adjustments to the joinery and make sure that when dry assembled, the door is square measuring from corner to corner. When satisfied, glue the door together. I use 1-hour setting, two-part epoxy glue for strength and to prevent future joint line creep.

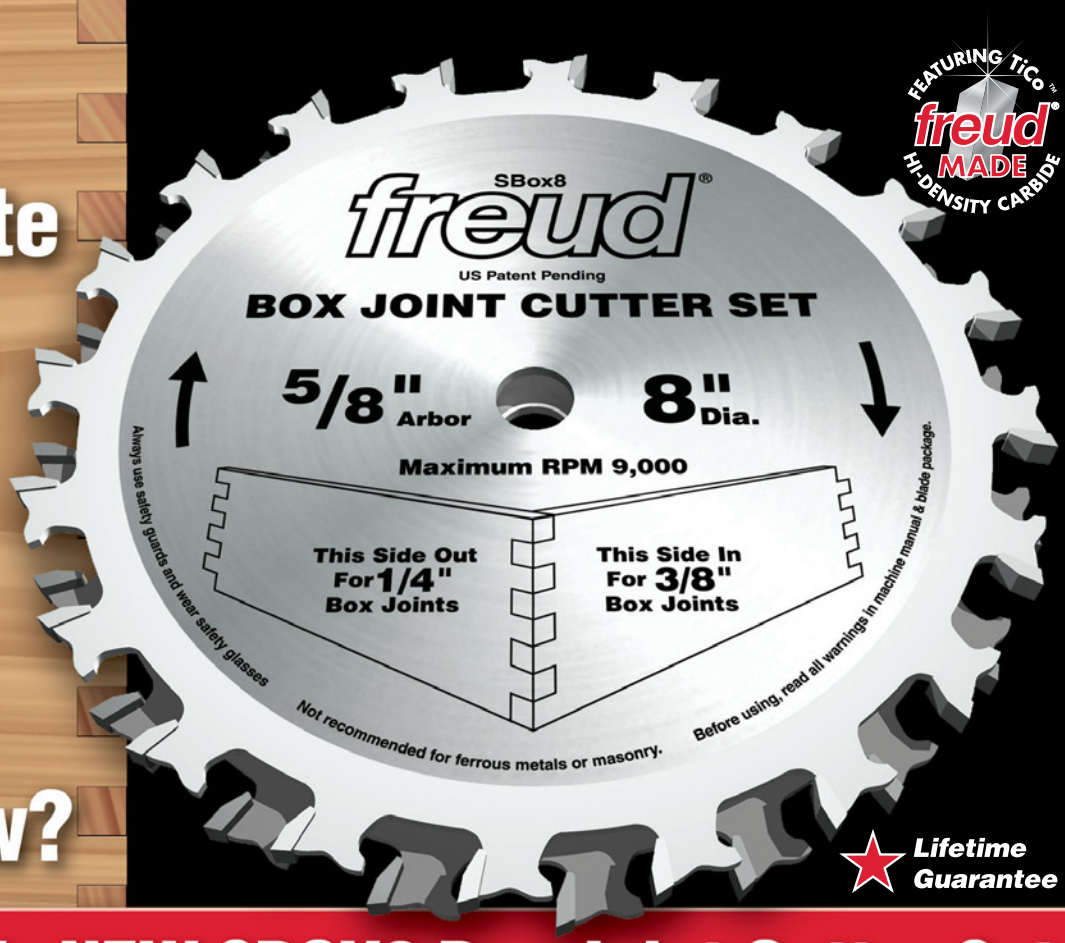
15 If you use a glass insert, rout away the stick profile on one side of the opening. Make new moulding with a similar profile to hold the glass in place.

Funding for this special pull-out poster provided by

freud®

POPULAR WOODWORKING

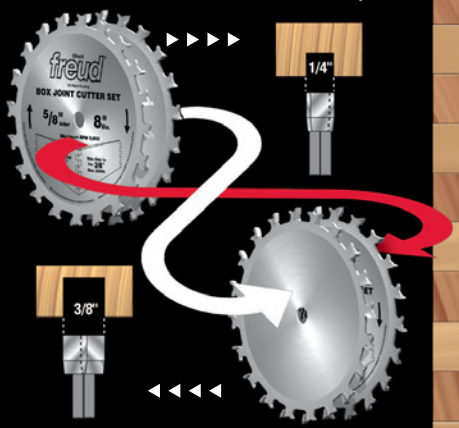
How Do You Create Flawless Box Joints On A Table Saw?



With Freud's NEW SBOX8 Box Joint Cutter Set

Freud SBOX8 Box Joint Cutter Set | A Non-Freud Standard Dado Cutter

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.

Square Box Joints Every Time

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.

Fast, Easy Set-up

Simply install the 8" diameter, 5/8" arbor blades on your table saw back to back for 1/4" box joints, or face to face for 3/8" box joints. Follow the instructions included to build a jig to use with your table saw's miter gauge for completing finished joints. Just cut, flip, glue and clamp and you're done…it's that easy.

Choose the ONLY table saw box joint set on the market today—choose Freud. Whether you're a woodworking enthusiast or full-time professional, Freud's new Box Joint Cutter Set is the fast, easy, accurate solution.

ISO 9001
VISION 2000
CERTIFICATE REGISTRATION # 50 100 4138

freud®
Precisely what you need.

To find a dealer near you visit: www.freudtools.com (US) 1-800-472-7307 (Canada) 1-800-263-7016

CIRCLE NO. 174 ON FREE INFORMATION CARD.

that our fathers or grandfathers used. Many of us have invested hundreds (if not thousands) of dollars on state-of-the-art clamps. While I can recommend an "optimal" clamp collection, chances are you'll make do with the clamps you have. So let's take a look at how to use them.

Clamps exert their force at a specific point on the jaws. Making sure that pressure is placed directly over the area being clamped, and that the pressure is being exerted evenly across the piece, will improve the joint and also keep the case from racking during assembly.

The photo below on the previous page shows the clamp holding the shelf on the right positioned with the bar centered on the shelf thickness. The clamp is slid up against the shelf to allow the full length of the jaw to support the shelf. The clamp on the left is kicked to the left at the bottom. This could result in racking the structure during clamping. If the squares weren't being used to hold things at right angles, this could be a problem.

Whenever possible, use a clamp that is only slightly longer than the required clamping size. This isn't something that's going to affect your furniture piece; rather, it's a detail that will affect your ease of clamping. Fighting with a 4'-long bar clamp to clamp a face frame on a 12"-deep bookcase is awkward.

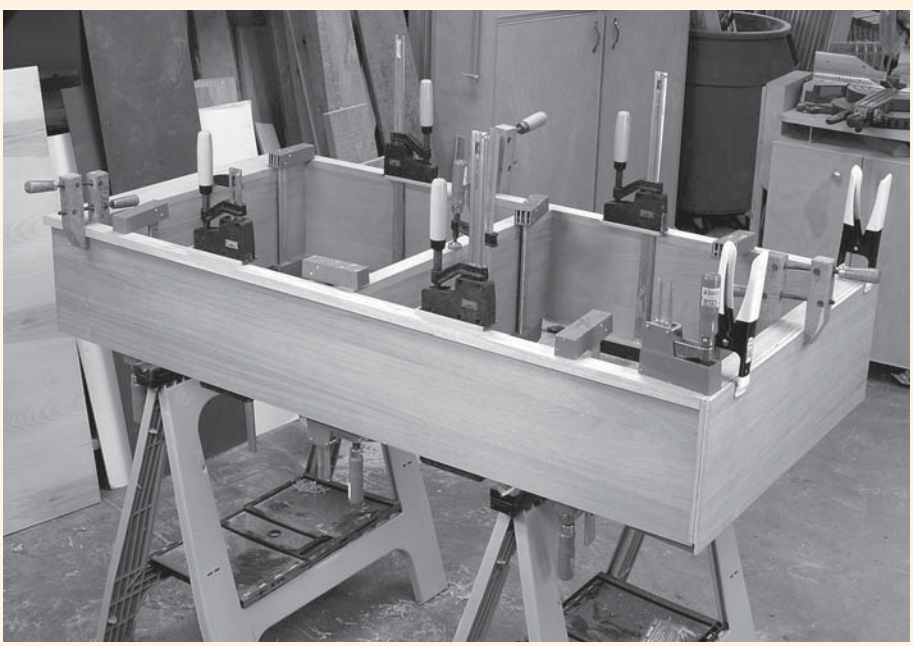
As important as using the right clamps and positioning them correctly is thinking a step or two ahead about where the clamping is taking place. Being able to easily place clamps to provide the best pressure may require moving to a larger, smaller or entirely different work surface, as shown below.

One of my favorite case-clamping tricks uses some old clamping technology. The clamps (pictured below right) are most commonly called hand screws. Hand screws have been around for a long time, but they're the clamps I most often use for help with assembly. They take getting used to, but they're very handy when you're working in the shop alone.

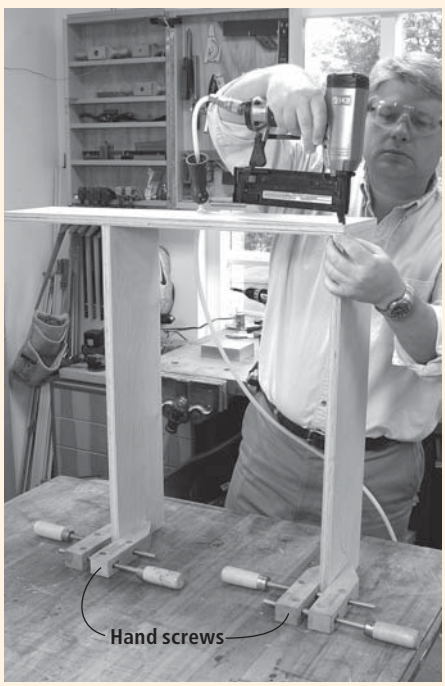
These hand screws also make an excellent installation tool for case pieces. Case pieces frequently work like building blocks, attaching to one another to form a wall of bookcases or a run of kitchen cabinets. When installing these units, it's often difficult to align the cases while attaching them to the wall. By clamping two case sides together using the sides of the clamps, rather than the jaws, these clamps provide quick, solid holding power across a much larger area to hold cabinets in perfect alignment. Add the screws to hold the pieces together and you're done.

Another handy smart-clamping trick comes into play when attaching backs to case pieces. While a case piece should be checked for square throughout the construction steps, it will still retain enough flexibility to shift out of square. Attaching the back is one of the easiest ways to guarantee that the case stays square, but that means you need to square the case while attaching the back. This is a three-handed job – unless you use a clamp.

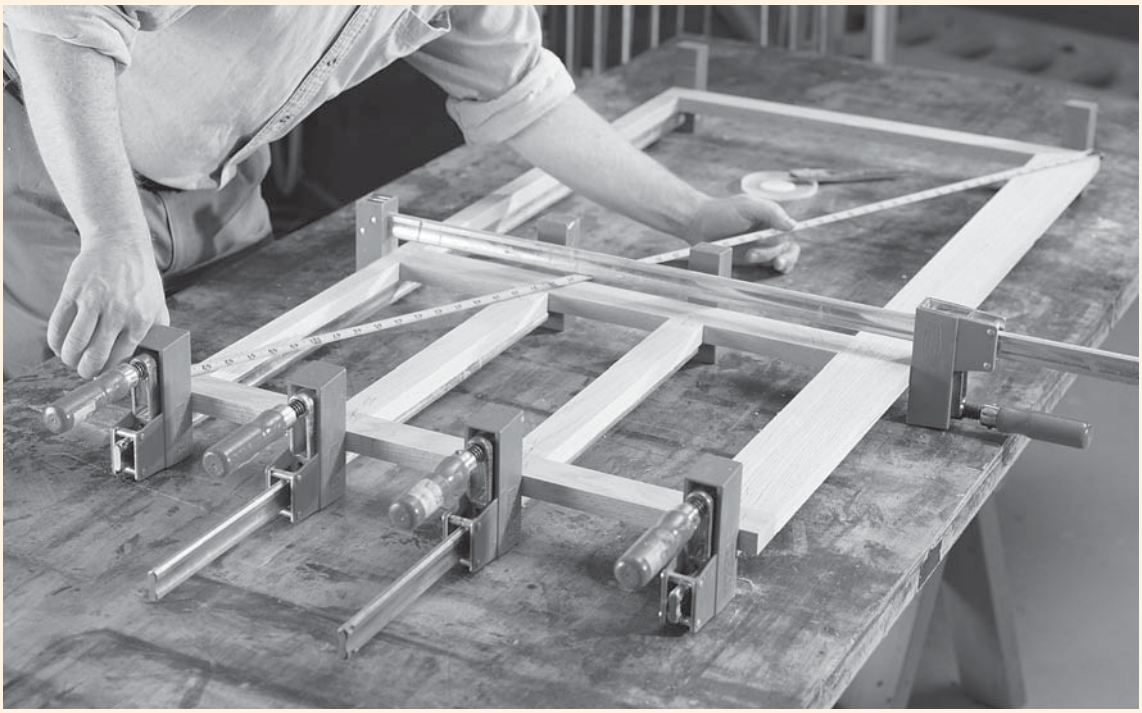
Measure diagonally across the back of the case in both directions. Determine the longer dimension and then place a long bar clamp running from corner to corner across the longer dimension. Slowly tighten the clamp until the diago-



Where you position your work is as important as where you position the clamps. To attach the face frame to this bookcase, a number of clamps were needed to apply pressure around the entire perimeter of the case. If the case were positioned on a flat surface, you wouldn't be able to place any clamps to the inside of the case. A couple of sawhorses work best in this case.



This is a strange instance of using clamps for a non-clamping procedure. Many case pieces are simply screwed or nailed together. If you're working by yourself it can be tricky to hold everything in place while you're nailing. By using hand screws to support the shelves during assembly, you've added a shop assistant.



Whether squaring the face frame for your cabinet or the cabinet itself, this is the best way to do it. Using either a tape measure or a wooden folding rule, measure from corner to corner in both diagonal directions. The difference between the two measurements will show you how out of square your piece is. By running a clamp across the piece with the longer diagonal measurement, you can pull up half the difference between the two measurments and make a square frame or cabinet.

nal dimensions are the same, then nail the back in place. Simple.

Adding Backs

Not every case piece has to have a back. But if it does, the most common way to fit the back into the case is by using a rabbet joint on the case sides, top and bottom (although the top and bottom are optional). This hides the back from view and offers an easy reference edge to square up the case.

The rabbet joint also offers the flexibility of using different thicknesses of back. If your case piece is a smaller size and will rest on the floor, a 1/4"-thick back is adequate. If your case is larger, or will be hung on the wall (often through the back itself) a 1/2"- or 3/4"-thick back will be preferable. The back rabbet can be easily adjusted to accommodate any of these back sizes.

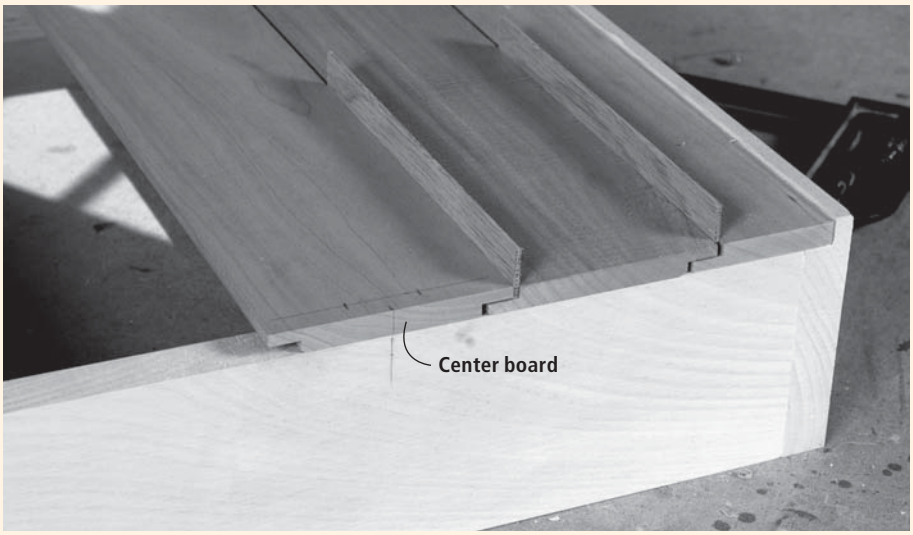
Another advantage to a rabbeted back is the ability to temporarily attach the back during construction, but remove it for easier finishing. If a captured back (fit into grooves in the case pieces) were used, it would need to be permanently installed during construction of the case.

The rabbet in the case pieces can be created prior to assembling the case using the table saw or a router. This can require some pre-planning to avoid running a through-rabbet in a side that might leave a gap where the case pieces meet. Another option is to assemble the case and then run the rabbet on the case using a rabbeting router bit, although this can be a balancing act and creates a small amount of work after the rabbet is finished (see photo below).

The back itself can be plywood or solid wood. The advantage of plywood is not having to concern yourself with the movement inherent to solid wood. While a stable material, plywood won't look as natural as a solid-wood back – no matter how good the veneer face is. Solid-wood backs look good and the necessary "planking" of the boards to accommodate wood movement can add a pleasing visual element to an otherwise plain expanse of wood grain.

When working with solid backs, there are details to remember in constructing

A rabbet run on the inside edge of the case pieces is a common way to hide a case back. These rabbets can be created during the initial milling of the case pieces, or created with a bearing-guided rabbeting bit in a router after assembly. When using a rabbeting bit, the last step is to come back with a sharp chisel and square out the corners.



This simple shiplapped back shows a variation on the pattern. The center board of the back is rabbeted on both edges on one face. The boards to either side (only one is shown above) are rabbeted on diagonally opposed corners, and the end board has no rabbet on one side where it mates with the rabbet in the cabinet side. To allow for movement, the pieces are evenly spaced with some simple scraps of wood. Coins also make fine spacers for shiplapped backs.

and attaching the back to ensure it will remain intact and continue to look good. The photo above explains some of these important steps.

Screws and Nails

In the last chapter, we discussed a number of joints used to construct and assemble case pieces. I touched on using nails and screws for assembly, now I want to spend a little time discussing these techniques in detail.

Screws and nails are most often thought of in case construction for utility furniture. The thought is that these mechanical fasteners will be visible and the only appropriate place for that is tucked away in a laundry room or garage.

Don't assume these types of joinery are inferior. In many cases, they will prove stronger than a number of joints that take three times longer to create.

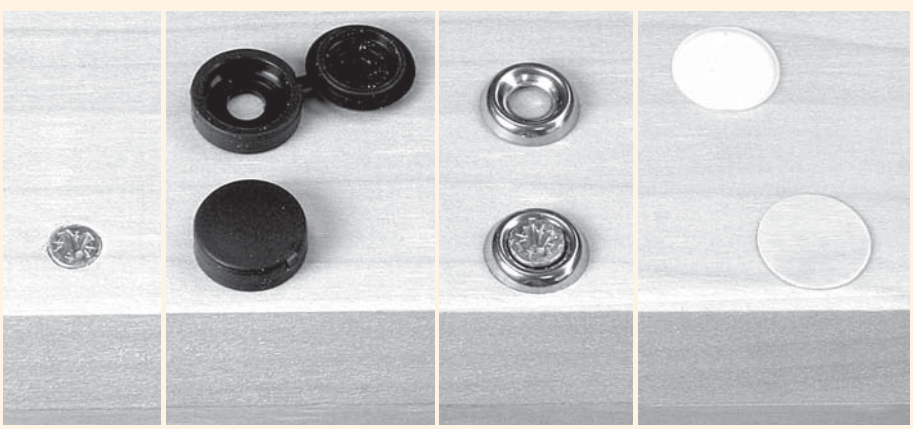
And as far as visibility goes, there are two schools of thought. A very popular design style today is more of an industrial look that leaves much of the hardware (and joinery, including bare plywood edges) exposed. By adding little touches to the hardware, you can dress up a simple screw and make it part of the design.

As to using nails as a decorative element, I'm not going to try to stretch that far. Nails should be hidden. Whether installed with a hammer or a pneumatic nail gun, if nails are in a visible part of a cabinet they should be countersunk below the wood surface and puttied.

Along those same lines, it's often more desirable to hide screws rather than build them into the design. One method is to countersink the head of the screw below the surface of the wood, then glue a plug into the hole. You can use a decorative plug that actually sticks above the surface, known as a button plug. You see this type of device in a lot of knock-down, assemble-yourself furniture sold today. It's not the hallmark of quality, but it's better than an exposed screw. One other hiding method is to use self-adhesive paper discs that have a wood-grain pattern printed on the non-sticky side. Let's just say that method and its cousin, the plastic cap that sticks in the screw head, are beneath the level to which a woodworker should aspire.

The best method to hide the screw is to use a plug of the same species and grain pattern, sanded flush. If you make your own plugs (simple to do on a drill press with a tapered plug-cutting bit) from the wood you're using for your project, you stand a good chance of hiding the screw.

Pocket screws are another alternative. There are a couple of ways to hide pocket screws. The first is to place the screw location out of sight. By screwing shelves to the case sides from the underside of the shelf, the screws will be hidden. Planning how the assembly will work can make this a very effective way to use the strength of screws without the visibility. You can also plug the hole from a pocket hole screw using shaped plugs designed for this specific purpose. Again, you can match species and grain pattern



Pictured are a few simple ways to dress up a screw and leave it visible … if you consider the look appealing. Not everyone will. At far left is the bare screw. Next is a screw cover that is placed over the screw as it's installed; the cap is then closed over the screw head. Third from the left is a trim washer that is also placed over the screw before installation. At the far right is a self-adhesive wood-grain patch that simply sticks over the screw head. Above it is a plastic cap that taps into the recesses in the screw head. It's up to you whether these options are good choices.

The best use of nails is an invisible application. For a complicated chest of drawers (as shown at left) the drawer dividers can be tricky. Rather than use complicated joinery, a well-placed (meaning hidden) nail is driven at an angle through the vertical divider and up into the web frame divider. This angled nailing is called toenailing and works with or without pneumatic tools (but it's hard to swing a hammer in this tight a space).

to more efficiently hide the plug.

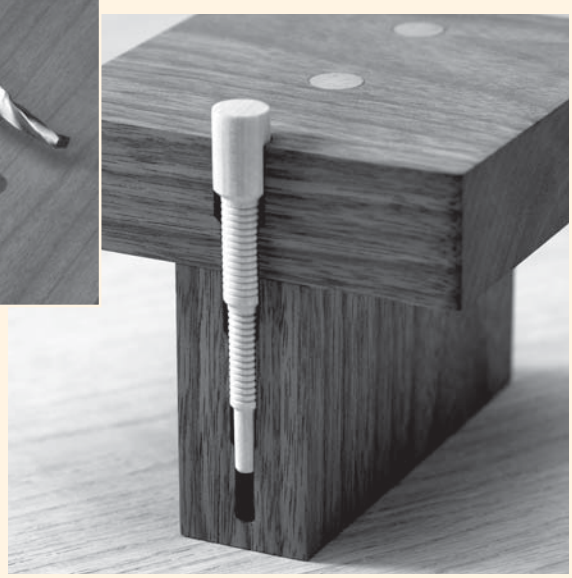
Another visible option that crosses the wood/metal fastener concept is a dowel. While dowels have been used as fasteners for many years, there is a product on the market now that uses a stepped dowel designed to be used essential like a nail. By building the look of the dowel head into your design you can save time, build a solid joint and add a decorative element to your project.

To use these dowels you simply clamp the pieces to be joined in their final position, adding glue if required. Next, a stepped drill bit (see below) is used to drill through both pieces of the project. Glue is added to the stepped dowel and then it is tapped into place with a hammer. The stepped design of the dowel is slightly larger than the diameter of the hole and the dowel compresses into the space making a tight fit.

It's still a good idea to leave the clamps on the piece long enough to give the glue time to set up, but once that's done the dowel is cut flush to the surface and lightly sanded.

While the old joints are still very effective, we continue to devise new and useful methods to improve and simplify the process. **PW**

Miller dowels can be used as accents to your piece, or the dowels' wood species can be matched to the project's to hide this useful joinery option.



Photos courtesy of Miller Dowel

Modifying Stock Chisels

Out-of-the box chisels can derail your chances of tight dovetails. Improve almost any tool with these quick fixes.

Photo by Al Parrish

In my recent article on cutting dovetails ("Your First Hand-cut Dovetails," February 2005) I stated that the process of creating this time-honored joint is simply sawing and chiseling to a line. And it is. But like any hand-tool process, you'll achieve the best results and greatest personal satisfaction if the

by Lonnie Bird

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

tools are sharp and in tune. I'm sure that you've read articles on the importance of tuning hand planes. Most chisels need tuning, too. But I think you'll find the process of tuning chisels to be less time-consuming than tuning a plane. Best of all, the quality of your work will improve. Read on and I'll explain the problems with many chisels and how you can quickly and easily modify them before tackling that next set of dovetails.

Signs of a Good Chisel

A good chisel should be a well-balanced extension of your hand. When chopping (such as when removing the waste between dovetails), the chisel is held vertically (or nearly so) and struck with a mallet. The extra force of a mallet is required to push the chisel edge through tough end-grain. But just because a mallet is used doesn't mean that chopping is a crude process made with brute force. On the contrary, the force of impact should be precise and controlled. And for the greatest control, the chisel should be gripped not by the handle, but on the shaft with the hand braced on the work, just as you grip a pencil. (Try gripping a pencil at the eraser end and signing your name; you can't get the control that you normally do.)

But what does the grip have to do with fine-tuning the chisel? It has more than you might think. Unfortunately, many chisels are too long and heavy for effective chopping; the extra mass and length make the chisel top-heavy and difficult to control. Although long chisels are an important part of a woodworker's tool kit, they're for paring, not chopping. Besides, most of today's chisels are too short for effective paring; but more on that in a minute.

Compounding the length and balance problems is that the ends of the handles on many chisels are excessively rounded. When chopping, as the mallet strikes the round surface, it has a tendency to glance off. The solution is to change the shape; the end of the handle should be slightly crowned, not rounded. A crowned end will absorb the impact of the mallet and direct it to the cutting edge.

Now let's examine the other end of the chisel, adjacent to the cutting edge. Like many chisels that were manufactured years ago, most of today's chisels are bevel-edged. In other words, the sides of the chisel are chamfered. The reason for the beveled edges is so that you can easily cut into an acute corner, such as the space between dovetails. However, the problem with many chisels is that the sides are not beveled nearly enough. To be effective the sides should be beveled to almost a knife edge. Examine the chisels from your kit closely and you'll most likely see that a square portion of the sides remains. As a result, each time that you make a cut next to a dovetail, the corners of the chisel crush the adjacent surfaces and spoil the crisp appearance of the joint.

Fortunately, the excessive length, rounded ends and square sides are all easily corrected. And it takes just a few minutes to tune the tools and fix the problems. The results are well worth it, too. After modifying a chisel you'll be surprised at how much easier it is to use. In fact, your skill level will seemingly jump up a notch or two. First let's address the problem with the excess length.

Grinding down the side bevels on a stock chisel is a quick process when using a motorized grinder. Set the tool rest close to the wheel and work the first 1" of the tool. Quench the blade to avoid overheating the steel.

Most chisels today are the wrong length for chopping or paring. Above, the short chisel (left) is the right length for chopping. The long chisel (right) is the right length for paring. The Marples chisel (middle) isn't a good length for chopping or paring.

Step photos by the author

Cutting off the extra handle length dramatically improves the balance of the chisel.

Fixing Excessive Length

Years ago, many chisels were available in two lengths: The long length was for paring; the shorter length was for chopping with a mallet. For more than 20 years I've used the Stanley No. 750s. These venerable socket chisels were manufactured by the thousands up until the late 1960s. The short length, around 9", and light weight make them perfectly balanced. And remember, balance is the key. In addition, the

Carefully ground sides (left) look like a knife edge. This helps you produce cleaner, tighter dovetails.

Using the proper grip and having a tool with narrow side bevels add control to the dovetailing process.

leather-tipped ash handles were slightly crowned so that a blow from a mallet landed squarely on the end.

At the same time Stanley was producing the No. 750s it also made a longer version, the No. 720. The extra length of these chisels make them ideal for paring long, thin shavings. Yet, most chisels that are manufactured today are too long for controlled chopping and too short to gain the leverage often needed for paring.

The exception is the Lie-Nielsen chisels (see "Buying Chisels Ready for Woodworking" below).

The solution is to cut off a portion of the handle. I know that sounds drastic, but it dramatically improves the balance of the tool. (And I'll admit, the sawed-off handle won't look pretty either, but your dovetails will.) After sawing off the excess with a hand saw, use a file to shape a small chamfer around the perimeter and slightly crown the end. This will ensure that mallet blows land squarely on the end rather than glancing off. If you grimace at the thought of such a radical modification to your prized chisels, then I suggest that you purchase an inexpensive set of plastic-handled tools and dedicate them specifically for chopping.

Grinding the Sides

The next step in the tune-up is to grind the sides of the chisel to nearly a knife edge. There's no need to bevel the entire length of the blade; 1" is enough to reach inside of most dovetails. You don't need an expensive wet wheel grinder for this step – an ordinary dry grinder with 6" wheels works fine. To prevent burning the steel, I use a pink aluminum oxide wheel and stop often to quench the tool in a can of water. I usually use the factory bevel as a guide and just slowly grind away the excess steel. Use care and don't grind into the back of the blade. As I'm grinding, I pause periodically to cool the steel and inspect the edge. The entire process usually takes just a minute or so. Finally, don't forget to polish the back and hone the bevel. For more on sharpening see "Sharpening Plane Irons and Chisels" (you can download a free pdf at popularwoodworking.com from the "Magazine Extras" page). For information on restoring vintage chisels, see "Resurrecting Chisels" from February 2005.

Now give the newly transformed chisel a try. I think that you'll be pleasantly surprised with the results. **PW**

BUYING CHISELS READY FOR WOODWORKING

No doubt most every woodworker is familiar with Lie-Nielsen planes. Thomas Lie-Nielsen has taken a number of old Stanley designs, such as the esteemed Bed Rock bench plane, and made significant improvements. The result is some of the best planes available today.

Now he's at it again. This time he has developed a line of chisels based upon the old and long-discontinued Stanley No. 750s. Like the No. 750s, the Lie-Nielsen socket chisels are short, lightweight and have perfect balance. And with just a bit of honing and polishing, the Lie-Nielsen chisels are ready to use. Unlike the old Stanleys, there's no need to further bevel the sides; they come ground to a thin, almost knife-like edge. The chisels come equipped with hornbeam handles sans the leather washers on the end. But in my experience there is no need for the leather cap; the hornbeam is tough. In fact, I've used my chisels for months and the handles appear as new.

Lie-Nielsen socket chisels (right) are based upon the old Stanley No. 750s.

Rosewood handles are also available for an extra charge; but Lie-Nielsen recommends the hornbeam if you intend to use the tools with a mallet.

If you're interested in the Stanley No. 750s there are still plenty of old ones available. Of course many are ground down from years of use. But it's not uncommon to find those with most of the original length remaining. Similar to any old tool, the collectors drive up the price on the chisels in pristine condition. But those that exhibit minor wear and discoloration can be had at a reasonable price. Once you have your hands on a set you'll still need to tune them by beveling the edges further, but you'll be rewarded with perfectly balanced chisels at a price lower than most new chisels. *– LB*

Tri-fold Storage Cabinet

Photos by Al Parrish

This versatile piece is useful for more than hiding plastic boxes.

Electronic entertainment is a permanent reality in almost every home. Unfortunately the media used to store that entertainment changes quickly. From 8-track to CD and VHS to DVD, our entertainment storage continues to be a tricky proposition.

If these media were as attractive as leather-bound books, that would call for an open bookcase-style solution. But most modern media are, well, pretty ugly. This is especially true if you've gone to the trouble of building attractive period furniture for your home.

After wandering through a home center store and noticing a clever pantry cabinet design, I carried the thought a step further and realized the same multi-layered storage could work next to my entertainment center.

Once the cabinet was finished, I recognized even more uses for this versatile cabinet. It would actually make a very nice dry bar, or you could certainly place it in the kitchen and use it as a pantry. What an idea!

If you would like to see more photos of the construction steps for this cabinet, visit my web site at hueyfurniture.com.

by Glen Huey

Glen, a contributing editor for Popular Woodworking, *is also a woodworking book author and instructor. He builds furniture for clients at his shop, Malcolm L. Huey & Son, in Middletown, Ohio. See more of his work at hueyfurniture.com.*

Conception

I went to work deciding what type of storage I'd need. DVDs and CDs were at the top of the list, but I've still got some VHS tapes and LPs sitting around that I wanted to store out of sight as well. I decided a free-standing cabinet would give me ultimate flexibility. And because much of the furniture in my home is early American, I used all these guidelines to work up the storage cabinet shown here.

The main door is capable of holding 150 DVDs, while the interior door will store 125 CDs. The drawer can hold VCR tapes or anything else that might need storing. If you have some LPs in your home, skip the drawer and the lower section will hold them.

Overall Construction

The cabinet is essentially a box with two layers of doors. I simply added a period-appropriate base and crown to dress it up. The outer door is of raised-panel construction to continue the look of finished furniture.

Because of the weight the cabinet would be supporting, I used torsion-box design for the top and dado joinery to hold everything tight and square.

Box First

Construction starts with the box of the cabinet. I built the piece out of solid cherry and poplar, with one exception – a plywood back to add even more rigidity when compared to a solid-wood shiplapped back.

Start with the two sides. The left side is a normal rectangle, but the right side is L-shaped to allow space for the second door. To save a bit of lumber, create the right side of the cabinet by gluing the short piece to the long piece with the top of the short piece held 15" up from the bottom edge.

Because it's always a good idea to leave some room for trimming in a glued-up panel, that 15" mark may actually be 15½". After the glue is dry, all you need to do is clean up the seam and trim the panel to size.

The other panels that create the exterior box are the sub-top and the bottom. To join these panels together, you need to first cut a ½" x ¾" rabbet at the bottom and top edges of both sides. I use a straightedge and a router bit with a top-mount bearing for this step.

While you're routing, cut a ½"-wide x ¼"-deep rabbet on the back edge of both sides to accept the plywood back. As you work, make sure that you end up with a mirror image in the sides, except for the notched area.

Because of the depth of the two doors, the base and sub-top of the cabinet extend forward beyond the sides of the cabinet. To make these pieces look and fit right I notched both the top and bottom pieces to fit around the sides.

To set up the table saw to notch the sub-top and bottom, you need to locate where the blade moves below the table and ends the cut. To do this, raise the blade to ensure that it will cut the required thickness, then with a square against the fence and the blade, slowly rotate the blade toward you by hand until the square stops traveling. Mark the location.

To make the notches, mark the location on the pieces where you want the cut to stop (12¾" in from the edge), then run the piece into the blade until the lines meet. Finish the cut with a hand saw and chisels, then cut a ½" x ¼" rabbet on the back edges of the sub-top and bottom for the back.

Step photos by the author

Cutting a full board into the above L-shape is wasteful, so I simply glued two boards together to provide the necessary shape for the right side.

Solid Shelving

The shelves for the inside of the case are permanently mounted in the case using stopped dados. The same alignment and routing set-up as is used for rabbeting the bottoms and the sides is used to produce the 1/4" x 3/4" dados for the shelves in the case.

There's one last dado to cut, the one for the drawer. I used a drawer design that allows the 1/4"-thick drawer bottom to extend beyond the width of the drawer. When the bottom is slid into these 1/4" x 1/4" dados in the cabinet sides, no drawer slides are necessary.

Because the shelves are 5 5/8" wide (the full depth of the narrow part of the case) and the dado is stopped at 5 3/8", you need to notch the front corners of the upper shelves. Set the table saw fence to cut a 1/4" width, including the blade thickness, and raise the blade to 1/4" height. Two passes over the blade with the shelves on their front edges (using your miter gauge) will produce this notch.

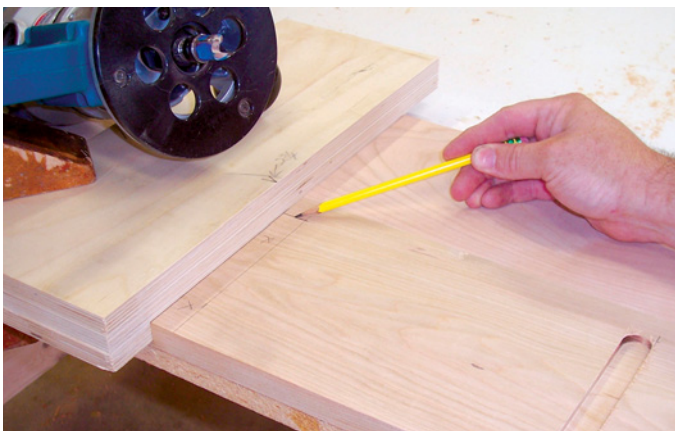
With all the notches and grooves cut, you're ready to assemble the case. Align the sub-top and bottom into position. Use a pilot bit with a countersink and fasten the sides to the top and bottom with screws. Then glue and nail the shelves in place.

Live, On Stage: The Doors!

Set the case aside to dry and begin the doors by milling the parts to width and length according to the cutting list. Both doors begin with a 45°-bevel cut at the corners. I cut these on my table saw with the blade tipped over to a 45° bevel.

After the bevels are cut, you can then assemble the front door frame by adding glue to the joints and clamping everything together with a band clamp. Then set it aside and we will return to it later.

The second door requires a couple of other operations before assembling. Cut a 1/4" x 1/4" groove



To make the dados for the shelves in the case itself, set the bit to cut a 1/4" in depth and run the groove in 5 3/8" from the back edge of the cabinet for the upper shelves, and all the way through for the full shelf that is at the 15" mark produced in the first step.

If you choose to add the drawer, cut one other dado in the sides. Set up a dado blade to run a 1/4" groove that is a 1/4" deep. The drawer bottom will slip into this groove and serve as a drawer slide.

After notching the front edge of the shelves, slide them into the stopped dados in the case. Then nail them through the outside of the case with a small finish nail.

As you attach the sub-top and bottom with screws, notice that each piece is notched to extend past the width of the sides and fits into a rabbet.

Use biscuits to attach the narrow shelves in the inside door. Add glue to the biscuits and assemble the unit. Clamp, check for square and allow the glue to dry.

along the back edges of all the frame pieces for the back .

Next, cut a 1/4" x 1/4" groove, 1/2" in from the front edge of the door bottom and the two shelves. These grooves will hold the retaining strips that we'll get to in a minute.

Now lay out the position of the two shelves in the second door. I used biscuits to attach the shelves to the sides. Cut the slots for two #20 biscuits in each end of each shelf. Glue the two shelves between the sides. After this is dry, glue the top and bottom of the door in place and clamp with a band clamp.

Tapered Retainers

In building this piece, I challenged myself to find different methods to use in construction. After using the jointer many times to make tapered legs, I decided to use the same process to make the retainer strips that fit into the grooves in the shelves of the second door.

The retainer pieces are called out in the cutting list as 3/4" x 1 1/4" x 21 1/2". Each piece will yield two retainers, so you need to run the tapers on two pieces.

Begin by setting the jointer depth to cut one-half the height of the total taper. In this case a 1/4" (half of the 1/2" taper), and mark a line that is one-quarter of the length of the retainer (I wanted the piece to peak at the center). Run the board over the jointer up to that line on both ends. Then start with either end and rock the piece until the corner rests on the infeed table and run the final pass to complete the tapering of the retainer. Reverse the piece and repeat the last step.

To finish off the retainer strips, run a bead detail on both sides of the top, tapered edge, using a 1/4" corner bead bit. Then resaw the piece to the needed 1/4" pieces, leaving the center section as waste. The strips are then glued into the grooves created in the bottom and two shelves of the door.

Spline Reinforcements

The corner miters for both doors, as well as the drawer box, are reinforced with glued-in spline keys to add strength.

I created the slots for the splines on the table saw, using an auxiliary fence set up. You can arrange the splines in a design or simply fit the cuts to the mitered end. Then, make the spline keys to fit and install them with glue.

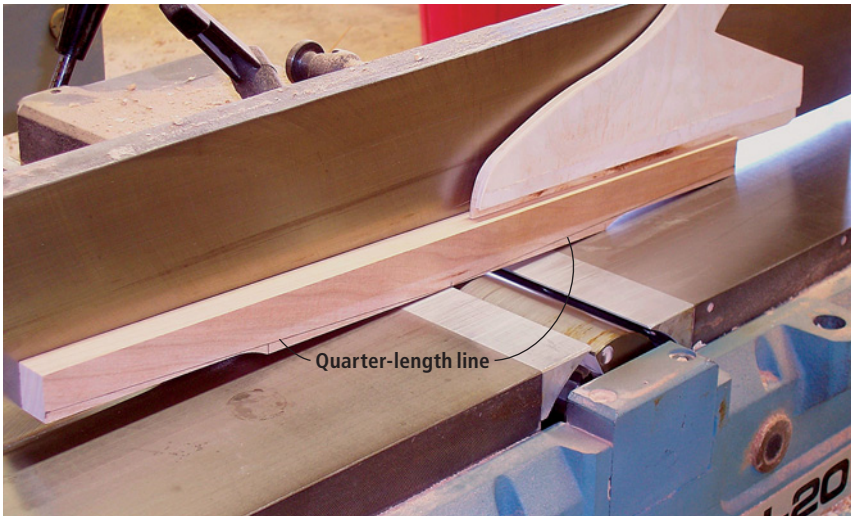
Front/Back for the Door

The next step is to create the front of the cabinet, which is also the back of the front door. The front is a twin raised-panel facade. Begin by cutting mortises for the intermediate vertical frame piece (or muntin) in the top and bottom rails as well as the needed mortises at both ends of the stiles that will accept the rails. Then, begin the process of cutting the tenons.

While all four shoulder cuts for the muntin are cut at 1 1/4", the rails need to have a haunched tenon as shown below. Complete the cheek cuts with the tenon jig on the table saw and the edge cuts at the band saw.

To create the groove for the

To form the "peaked" retainer, run the piece over the jointer to the quarter-length line on both ends. Then flip the piece and kick the front end up and make another pass on of the retainer.



An auxiliary fence on your table saw makes cutting the spline groove simple. Lay out a 45° angle and attach guide sticks as shown. Raise the blade to cut as much as possible without penetrating the interior of the door and make the cuts.

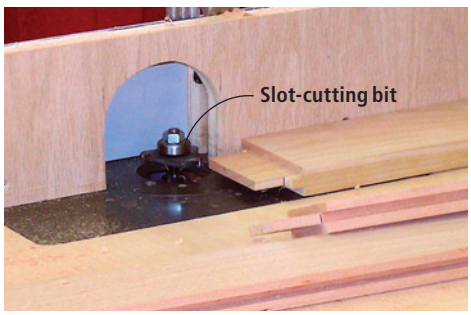
After the glue on the splines has dried, trim the keys to the piece with a flush-cutting hand saw, then sand to a smooth finish.

After defining the face shoulders for the tenon for the front door panel, offset the edge shoulder to create a haunch on the tenon. That offset is 3/8", or the depth of the groove that will hold the raised panels.

panels I like to use a three-wing 1/4" slot cutter on my router table. Assemble the frame without glue and make any necessary adjustments to the pieces. While the frame is together, check the measurements of the panel spaces. Add 5/8" to the opening to arrive at the final sizes of the panels.

Next, mill the panels to size and raise their edges. You can use a router bit, the shaper or a table saw to raise the panels. Once complete, assemble the entire front and allow the glue to dry.

When the front is ready, check the fit of the panel to the door frame. Glue the panel to the frame leaving an even overhang on all sides. Clamp the front in place and set it aside to dry. Then use a straight router bit with a bottom-mounted bearing to trim the panel to the frame, then sand flush.



To cut the panel groove, set up an auxiliary fence on your router table. Align the cutter with the tenon, and cut the groove on the interior edge of the door rails and stiles and on both muntin edges.

Glue the door panel to the door frame, allowing an even overhang on all sides. Check the door for square after glue-up.

Front Door Storage

Next up is the shelves and retainer dowels for the front door. I chose pocket screws here because I wanted to remove the shelves to make finishing easier.

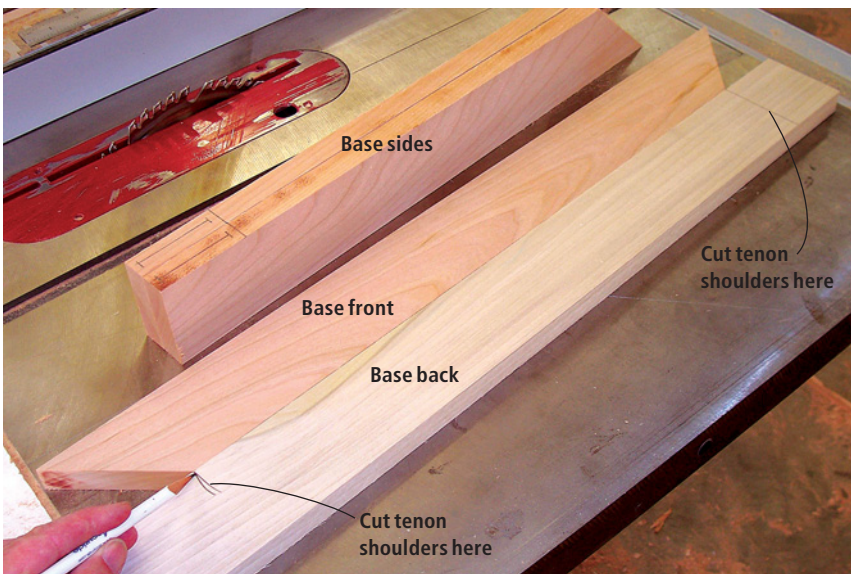
The dowel retainers are the last step before fitting the front door to the case. Locate and drill a 5/16" hole that is 2" above each shelf and the door bottom, and 3/8" from the back edge of the door. Then simply bow the dowels and spring them into the holes.

Home Base With Feet

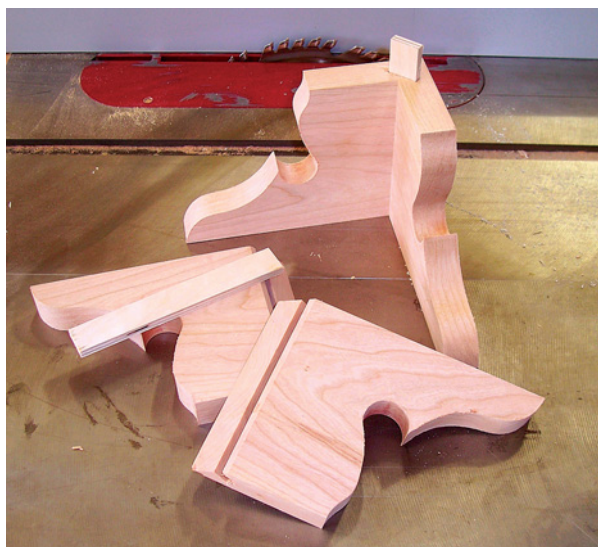
The base frame is mitered at the front, but not at the rear. To make the base frame, mill the pieces to size, miter the front corner pieces, then lay out and cut the mortises in the base frame sides. To get an accurate length for the base frame back piece, lay out the location of two tenons on the base back using the base front as a guide.

Cut biscuit slots in the mitered

Using pocket hole screws to attach the shelves allows you to remove the shelves to make finishing easier.



Transfer the tenon width to the end of the back. Then position that line at the rear edge of the angle cut in the base frame front and mark the opposite end also at the rear of the angle cut. Cut the back to the mark.



Remember when making the 45° cut for the splines that you need to adjust the blade height as well. Then make the splines that will fit into the slots and glue the front feet together.

ends of the front and sides and make tenons to match the mortises in the ends of the back. To assemble the unit, apply glue to the mortises, then slip them together. Glue the biscuits and apply the remaining clamps. You will be able to apply the necessary pressure to each clamp to align the mitered ends and close up any gaps.

To give your cabinet legs (or in this case, feet), select and mill the material for your front and side feet, then use the pattern to cut the profile of the pieces (shown at right) at the band saw.

The front feet pieces are joined together at a miter, so the next step is to miter those mating edges. Because the blade on a table saw tilts only one way, and you want as large a surface as possible to support the foot during the cut, you'll have to do some shifting to miter the mating feet.

Two feet are cut using the miter gauge in the normal method. To miter the mating feet you need to reverse the miter gauge (still in the same slot) with the auxiliary fence at the outfeed end of the table saw.

Set the A foot to the blade in order to determine where to set a stop block to keep the foot from moving away from the blade while cutting. Position the B foot with the face up and the top edge against the fence. Push the foot through the blade while holding it flat to the table and tight to the fence. The miters need to be cut in only the four pieces selected to be the front feet of your piece.

With the feet cut to matching angles, leave the blade at 45° and move your fence to the blade to make the first cut for a spline. Geometry is your friend here. With the blade set to cut at a 45° angle, making a cut into the mitered corner of the foot results in a cut that will line up with the groove in its mate. Raise the cut to just over 3/8" and make a pass on the saw. Reposition the fence so that a second pass over the blade will produce a 1/4" groove. The side and back feet are joined with screws. Place the back foot into a 3/4" x 5/8" rabbet made in each side foot, add glue and attach.

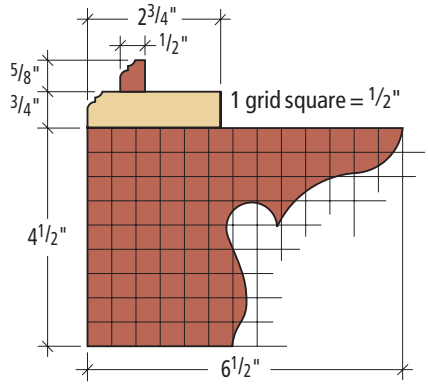
The completed foot assemblies are then attached to the base frame. After the glue is set, add glue blocks to all corners of each assembly.

Sand the base to 180 grit, profile the edge with your favorite router bit, and attach it to the case with 1 1/4" screws at the front and halfway down each side. Finish the process with 1 1/4" nails along the balance of each side and the back edge. Next, add the transition moulding that also has a routed edge.

Hanging the Doors

The doors for this project are built to fit exactly, as in no additional room for hinge gap. Therefore, before each door is hung you need to create a rabbet in the edge of the hinge side of each door to compensate for the hinge spacing.

When attaching the hinge, use



Foot pattern


The screws at front and middle of the base hold the two assemblies tight at the front and force any wood movement to the back where the nails will allow slight movement.


In order to avoid any cross-grain construction problems, the grain in the front-to-back pieces runs the same direction as the grain in my top.

the hinge as a template to locate the screws in both the door and the case. Set the two side by side, reposition the hinge, and attach the door to the case. The hinge for both doors will need to be cut to length. A bi-metal blade at the band saw or a hacksaw would work equally well.

SUPPLIES

Rockler
800-279-4441 or rockler.com

1 • 1 1/16" x 36" piano hinge
#19241, $8.99

1 • 1 1/16" x 48" piano hinge
#19259, $9.99

Woodcraft
800-225-1153 or woodcraft.com

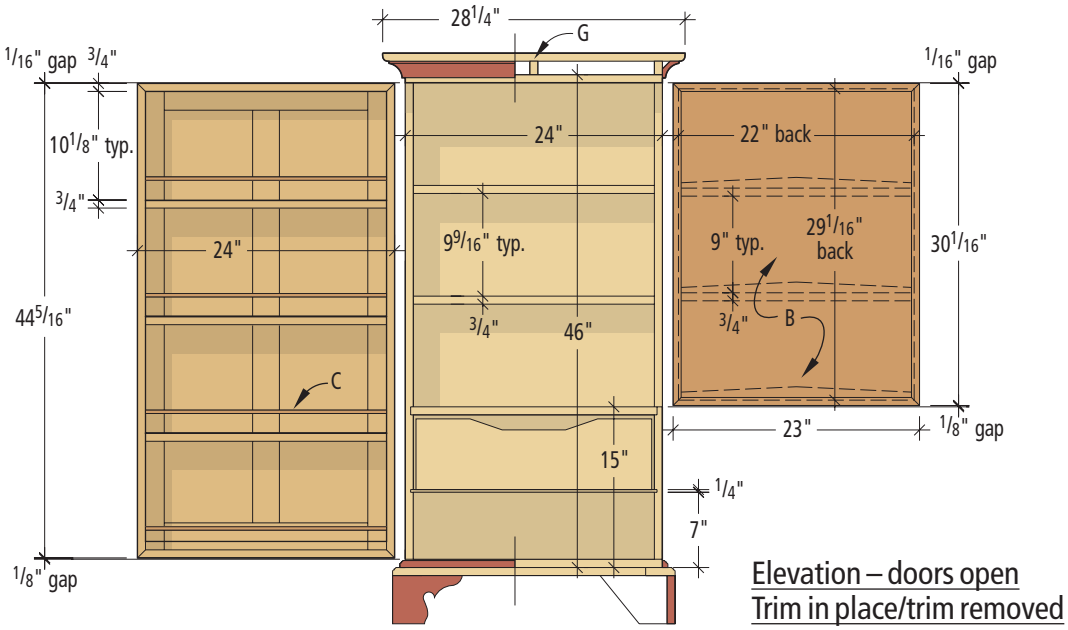
1 • draw catch w/eye
#85H98, $2.99

Prices correct at time of publication.

Torsion Top

I wanted to add support to the top unit of this project because of the amount of overhang that was needed to swing the second door. I decided to use a torsion box design, building a stable box structure by adding ribs between the top and sub-top.

Mill the material for your top to size, then rout a 1/2" roundover profile on the front and sides. Set the top in place on the cabinet and draw a line around the case top, defining its location on the top.



Elevation – doors open
Trim in place/trim removed

TRI-FOLD STORAGE CABINET

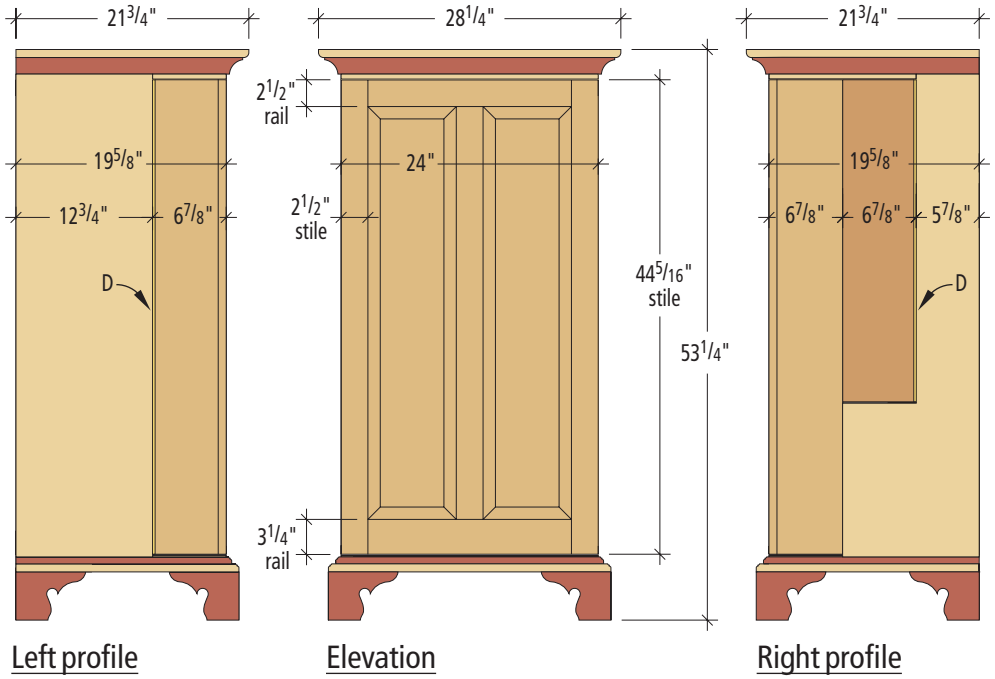
	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
CARCASE	1	Left side	3/4	12 3/4	46	Cherry	
	1	Right side	3/4	5 7/8	46	Cherry	
	1	Right side	3/4	6 7/8	15	Cherry	
	2	Bottom & sub-top	3/4	19 5/8	24	Cherry	
	1	Lower shelf	3/4	12 3/4	23	Cherry	
	1	Case back	1/4	23 1/2	45 1/2	Plywood	
	2	Shelves	3/4	5 5/8	23	Cherry	
FRONT DOOR	2	Door stiles	3/4	2 1/2	44 5/16	Cherry	
	1	Top rail	3/4	2 1/2	21 1/2	Cherry	1 1/4" TBE
	1	Bottom rail	3/4	3 1/4	21 1/2	Cherry	1 1/4" TBE
	1	Muntin	3/4	2 1/2	41 1/16	Cherry	1 1/4" TBE
	2	Panels	5/8	8 7/8	39 3/16	Cherry	5/16" RAS
	2	Stile returns	3/4	6 1/8	44 5/16	Cherry	
	2	Rail returns	3/4	6 1/8	24	Cherry	
	3	Front door shelves	3/4	5 5/8	22 1/2	Cherry	
	4	Dowels	5/16	–	23	Cherry	
SECOND DOOR	2	Door sides	3/4	6 7/8	30 1/16	Cherry	
	2	Door top & bottom	3/4	6 7/8	23	Cherry	
	2	Inner door shelves	3/4	5 5/8	21 1/2	Cherry	
	2	Retainers	3/4	1 1/4	21 1/2	Cherry	
	40	Spline keys	1/8	1 1/4	2 1/2	Cherry	
	1	Door back	1/4	22	29 1/16	Plywood	

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
BASE	1	Base front	3/4	2 3/4	26 1/4	Cherry	MBE
	2	Base sides	3/4	2 3/4	20 3/4	Cherry	MOE
	1	Base back	3/4	2 3/4	23 1/4	Poplar	1 1/4" TBE
	6	Base feet	3/4	4 1/2	6 1/2	Cherry	
	2	Rear feet	3/4	4 1/2	6 1/2	Poplar	
	4	Foot blocks	3/4	3/4	4 1/2	Poplar	
	8	Foot blocks	3/4	3/4	3	Poplar	
	3	Mouldings	1/2	5/8	26	Cherry	Miter to fit
TOP	1	Case top	3/4	21 3/4	28 1/4	Cherry	
	1	Torsion block	3/4	1 1/4	24	Cherry	
	3	Torsion blocks	3/4	18 7/8	1 1/4	Poplar	
	3	Cove	3/4	2 1/4	28	Cherry	Miter to fit
DRAWER	2	Drawer front & back	3/4	6 3/4	22	Cherry	
	2	Drawer sides	3/4	6 3/4	11 1/2	Cherry	
	1	Drawer bottom	1/4	12 1/4	22 7/8	Plywood	
	20	Drawer splines	1/8	1 1/8	2 1/2	Cherry	

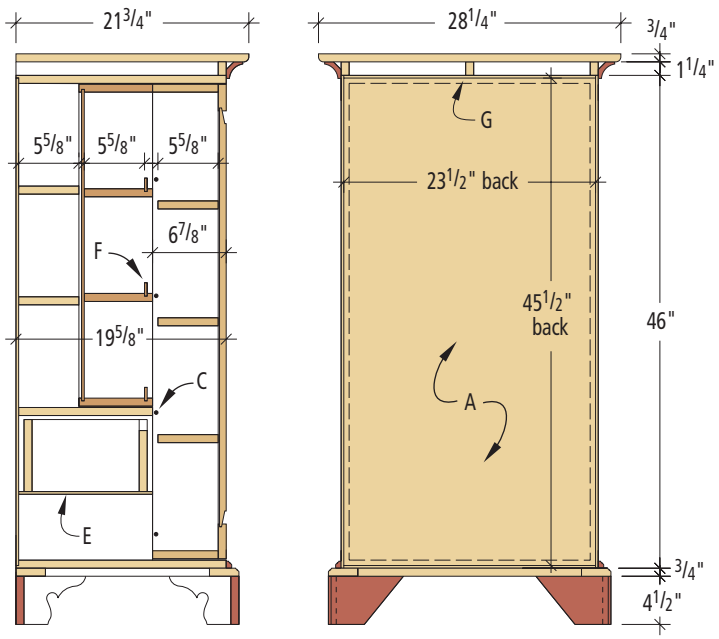
Key: TBE= tenons both ends; RAS=rabbets all sides; MBE= miters both ends; MOE=miter one end

I chose to use 1¼" pieces that are countersunk and screwed to the top along those lines made in the previous step. Next, invert the case onto the top unit and attach the two assemblies with screws.

To complete the furniture look of the piece I added a shop-made cove moulding below the top, covering the torsion pieces. The cove moulding is made at the table saw (See *Popular Woodworking* issue #117 for further information), though you could use a piece of stock moulding if you prefer.



Left profile Elevation Right profile



Section Back

Notes:

- **A** 1/4" plywood back in 1/2" w. x 1/4" d. rabbet
- **B** 1/4" plywood back in 1/4" x 1/4" groove
- **C** 5/16" dowel aligned with front edge of shelf
- **D** Piano hinge in door rabbet equal to thickness of both hinge leaves
- **E** 1/4" plywood drawer bottom in 1/4" x 1/4" dado
- **F** 1/4" thick retainer in 1/4" x 1/4" groove
- **G** 3/4" x 1 1/4" torsion block

A Drawer and a Finish

The drawer box for this project is made in the same way as are the door frames. The corners are mitered and then spline keys are added for support. The entire box is set onto a piece of 1/4" plywood where it will slide into the grooves that were dadoed into both sides of the cabinet.

Finally, the front door is attached to the case. Remember to create the rabbet in the hinge side of the door frame that will compensate for the hinge gap. Hang the front door to the case, then make any necessary adjustments.

Before starting to finish the project you will need to cut and fit the plywood for the case back. Do not attach this until after the finishing of the project because you'll want to access the piece from all angles while applying your finish.

I elected to apply a shellac and precatlyzed lacquer finish to this piece – the shellac (GarnetLac) for a mellow shading and the lacquer for protection. This also would have been a great piece for an oil/varnish finish. From there, just add the continuous hinges and the exterior door latch.

My finished piece is a nice combination of traditional furniture styling with high-tech entertainment storage. I just hope the next electronic "medium" is of a similar size to today's. **PW**

The cove moulding is attached to the torsion buildup, below the top. I used a shop-made cove for this piece.

Rethinking Shaker Design

An examination of the furniture built by the Western communities expands our notions of what is 'Shaker.'

The restored Shaker community at Pleasant Hill, Ky., gives admirers of Shaker architecture, furniture and life an opportunity to get very close to the source of that admiration. Guests can stay in rooms once home to Shaker Brothers and Sisters. They can walk a gravel boulevard that once was a part of a turnpike connecting the Pleasant Hill community to the outside world. They can tour the gardens and fields that once put food on Shaker tables. They can even dine in the Village Trustees' Office in much the same way as 19th-century visitors to Pleasant Hill once dined in the company of the community's Shakers.

Although the rooms in which visitors stay are furnished with reproductions of Pleasant Hill originals, it's possible to move from room to room in the Centre Family Dwelling and look firsthand at original Pleasant Hill chairs, tables and casework.

In such a setting, it's possible to immerse the senses in the Shaker experience; and for makers and/or admirers of Shaker-inspired furniture, that's an opportunity not to be missed.

Furniture by Law

Although Mother Ann Lee, the Prophetess who led the very first group of Shakers into the American wilderness of New York State, did not herself write, her views on all things Shaker eventually became codified in the "Millennial Laws" published years after her death. Although most of the material in the 1845 laws refers to issues of worship and personal conduct, some of it touches on the subject of furnishings for Shaker dwellings and can provide modern students of Shaker design some insight into Mother Ann's thinking. The following line from the "Millennial Laws," for example, provides a theoretical underpinning for the design of furniture and architecture: "Beadings, mouldings, and cornices which are merely for fancy may not be made by Believers."

During the following century, this and other similar directives guided the hands of Shaker craftsmen as they designed and constructed the buildings and furnishings for their environments. In addition, when the Shakers purchased goods from the outside world – as was the case, for example, with many of the timepieces so necessary in the regimented lifestyle of these communalists – they stripped away superfluous ornamentation before adopting those items into their culture.

But Shaker furniture didn't spring fully formed from the directives of Mother Ann Lee. That furniture was firmly rooted in the country furniture of the period in which it was built. The first Pleasant Hill makers – Kentuckians who migrated to the region from Eastern states – brought with them the design vocabularies of country furniture in those Eastern states. Later, as Kentucky craftsmen in the outside world began to develop an identifiable regional style, that style, too, was added to the Pleasant Hill mix. What resulted was an aesthetic that is identifiable both as Shaker – in most cases – and Western. ("Western" in this context refers to communities in the Western extremity of the Shaker nation, including the Pleasant Hill and South Union communities in Kentucky.)

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.

The Centre Family Dwelling (at top right of the picture above) is made of handcut limestone blocks, each one quarried, transported and hoisted into place by the Shakers. The gravel road above was once the turnpike connecting Pleasant Hill with the outside world. It now runs through the middle of the restored Shaker community at Pleasant Hill, Ky.

This stately cupboard-on-chest – poised on its dainty tip-toes – presents a style of drawer graduation with which we are very comfortable, having its largest drawer at the bottom and its smallest drawer at the top.

The drawers of this cupboard-over-chest are graduated in what we might see as reverse order, with the smallest drawer at the bottom and the largest drawer at the top. What was the purpose for this arrangement?

Photos by Al Parrish

Patterns Familiar and Odd

When the Shakers stripped surface ornamentation from period furniture, they drew our attention to the forms underlying that ornamentation.

Instead of carving and veneering, we see the height and width of chests and cupboards. We see the

height and width of drawers and doors. We see pattern as drawers ascend a chest front, as doors move across a cupboard.

In some cases, these basic forms are arranged according to furniture-making tradition, when, for example, a set of drawers is graduated from a large bottom drawer to a small top drawer. The cupboard-over-chest on the previous page exhibits this type of graduation. The bottom drawer front is 8⅞" wide, the next one up measures 8⅛", the next one up measures 7", and the top drawer measures only 5⅞". This orderly progression is one our experience with drawers encourages us to accept.

At other times, however, Shaker craftsmen manipulated these basic forms for reasons of function of which we now may be unaware. The drawers of the second cupboard-over-chest were graduated in a way that is less familiar, a way that was perhaps intended to suit a particular use. Instead of the largest drawer being at the bottom – as can be seen in the chest of drawers below – the drawers of this cupboard-over-chest are graduated in reverse, with the largest drawer being at the top. The bottom drawer front measures 8" wide, the next one up measures 9½" and the top drawer measures 10".

"All work done, or things made in the church for their own use, ought to be faithfully and well done, but plain and without superfluity."

– Shaker Father Joseph Meacham, 1790

This Pleasant Hill chest of drawers is a study in Shaker simplicity – with the exception of two details: the decorative turnings on the feet, and the scratch-stock simulated cock bead surrounding each drawer front, which retains a crisp appearance even in the close-up.

Why the Eccentric Design?

It seems unlikely that the maker learned his craft this way. There is a centuries-old tradition of graduating drawers with the smaller drawers to the top. More likely, the maker was meeting a particular need in the Shaker community, one that required a large drawer at waist height.

He was, in effect, grafting onto the Shaker appreciation of the basic form the architecture aphorism: "Form follows function."

My first experience with this kind of design eccentricity made me a little uncomfortable. Thirty years ago, when I discovered Shaker furniture, I had little experience with work that didn't follow the familiar patterns of classical American period furniture. Shaker focus on simplicity and function opened my eyes, demonstrating to me that there are other "right" ways to design a piece of furniture, and these ways were not confined to matters of drawer graduation.

In the world outside the Shaker community, table, chest and cupboard tops were usually made with shaped edges. At the very least, these edges were given a slight radius, but many Pleasant Hill tops are simply cut square. The top of the chest of drawers at left is one example. The intermediate top in the cupboard on the previous page, the top of the drawer unit, is another.

Here, too, we are forced to see not the embellishment of the basic form (a moulded edge), but the form itself – the simple, unsoftened rectangle of wood that makes up the chest top.

Shaker furniture – with its unadorned squares, rectangles and cylinders – forces us to look with fresh eyes at the fundamental shapes which, combined, make up a piece of furniture. In Shaker hands, these shapes were not simply blank canvasses on which the craftsman could seduce the eye with carving, veneering and moulding. They are shapes worthy of our appreciation in their own right. There is beauty in a simple rectangle, in a simple square, in a simple circle. Shaker Brothers Calvin Green and Seth Youngs Wells explained it this way in "A Summary View of the Millennial Church or United Society of Believers," published in 1823: "Any thing may, with strict propriety, be called perfect, which perfectly answers the purpose for which it was designed. A circle may be called a perfect circle when it is perfectly round …." It is the pursuit of this state of fundamental perfection – coupled with the primacy of function – that distinguishes the best Shaker work.

There are, of course, some details of Pleasant Hill furniture in which craftsmen deviated from this focus on basic forms. Many of the early chests of drawers have turned feet, which present a succession of coves and beads that seem out of place on a piece that otherwise exhibits little embellishment. Each foot of the chest of drawers at left includes a pair of wide coves, each topped by a narrow bead.

In addition, each of the drawer fronts is framed in a scratched narrow bead meant to simulate a decorative effect seen on much high-style furniture of the period. High-style furniture often featured drawer fronts framed in thin mitered strips tacked in place so that the front edge of these strips – rounded to a bead – was standing proud of the drawer front. Sometimes these strips, called cock beading, were tacked to the drawer front itself. Sometimes they were

THE GRAIN IS THE SURFACE DECORATION

In addition to focusing our attention on the basic forms of a piece of furniture, the removal of ornamentation has other consequences. One of these – long understood by Shaker craftsmen – is that the simpler the basic form, the better the setting for the display of figured material. This magnificent curly cherry secretary stands in one of the rooms on the second floor of the Meetinghouse. If the secretary had been decorated with carving or veneering or moulding, the effect of the curly cherry might have been compromised.

—KP

Photo by Roger Selvidge, courtesy of the Shaker Village at Pleasant Hill, Ky.

tacked to the opening in which the drawer front was housed.

Cock beading provided an appealing detail to high-style furniture, but it represented a significant investment of time, an investment that makers of simpler, county furniture could not always justify. As a result, country furniture makers in Kentucky and elsewhere often created a simulated cock beading around drawer fronts. In the case of very large drawer fronts, that cock beading might be created with a side-bead plane (a kind of moulding plane), but much more often the craftsman would use a shop-made tool called a scratch stock. A scratch stock is simply a bit of thin metal fixed in a wooden holder. The bit of thin metal would be cut with the shape of a bead and quirk – a narrow recessed part of a moulding. It would then be drawn around the perimeter of the drawer front, scratching out a little bead, which – at least at a distance – resembled a cock bead. In the hands of a skilled craftsman, this lowly tool could produce a reasonable facsimile, but more often scratch-stock cock beads – particularly on the ends of drawers where the scratch stock had to be dragged across the grain – were often crudely formed.

Such deviations from the theoretical foundation of Shaker furniture do not – in my view – detract from the beauty of that furniture. The bits of decorative turning and scratched cock bead are nothing more than minor imperfections that serve to put a human signature on the work of the Pleasant Hill craftsmen.

Laboring for God

It's impossible to understand the Shakers without appreciating the importance of work in their culture. Their movement began at a time when the mere maintenance of human life required a significant output of labor. But of course, the Shakers of Pleasant Hill did much more than maintain life. In the first three decades of the 19th century, they erected a community in the Kentucky wilderness that remains today as a monument to human effort.

Anyone who tours the enormous restored Shaker community at Pleasant Hill will be struck by the amount of labor the community represents. The Centre Family Dwelling, shown on the first page of this article, was built to provide accommodations for 100 Shakers. It's made of hand-cut limestone blocks, each one quarried by the Shakers, each one transported to the building site by the Shakers and each one hoisted into place by the Shakers. Then, once the huge facility had been erected, it was fitted with windows and trim – all made by hand – and filled with furniture – also made by hand.

This single structure at Pleasant Hill represents an enormous investment of human labor – labor that the Shakers offered as an act of devotion to God. It is in this context of sanctified labor that the third element of Shaker furniture-making comes into play. It wasn't enough that furniture be simple and functional; it also had to present a physical manifestation of the sanctity of work.

Simplicity, function and sanctity – these are some of the identifying characteristics of the best Shaker furniture, and these are characteristics that can be read in much of the furniture attributed to Pleasant Hill makers.

"Most pieces (of western Shaker work) are very well constructed, convey a feeling of strength, and ... are honest expressions of cabinetmakers working in a style they knew best."

– John Kassay
in "The Book of Shaker Furniture"

Different than Eastern Shaker Communities

Pleasant Hill furniture makers were aware of the work being produced in the outside world. Many of these makers were simply converts who came into the community as adults, bringing with them intimate knowledge of the world they'd left behind. Plus, throughout its history, the Pleasant Hill community was actively involved in trading with

This Pleasant Hill hanging cupboard conveys a feeling of lightness thanks, in part, to the radiused 3/8" top.

the outside world. This pollination of Shaker vision by regional worldly influences gave the furniture of Pleasant Hill a character that is not quite like the furniture produced in Eastern Shaker communities.

One of the characteristics that distinguishes high-style furniture from its country cousin is the use of thin material. Builders of high-style furniture recognized a need to match thickness to application, a need to use, for example, 1/2" material in situations in which thicker material would look clumsy. Obviously, a reduction in thickness doesn't enable a piece to better carry a load. The reduction is necessary to impart a measure of visual grace.

Some Pleasant Hill work acknowledges this truth. Like the Shaker furniture of Eastern communities, this work conveys a feeling of lightness through the use of thin material. The hanging cupboard above illustrates this principle. Although it's supported by an unseen hidden top measuring 7/8" thick, the top we do see is only 3/8" thick, and a further sense of lightness is conveyed via the top's radiused edge.

According to John T. Kirk, author of "The Shaker World" (Harry N. Abrams), the appearance of lightness and fragility is a notion that, in the case of one New Lebanon drying rack, the Shakers pushed "almost to silliness" with posts measuring only 13/16" square. He further describes the seat rungs of a pair of Canterbury cane-seated chairs as "almost ridiculously insubstantial." This style of construction was possible in a community in which care of the acoutrements of life was mandated by, in the case of the Shakers, Millennial Law, which (among other things) prohibited leaning chairs back against a wall, and even putting one's feet on the rungs of a chair for fear of wearing out that rung.

Twenty years ago, when I was building my first Shaker rockers, I made a number of examples out of cherry which I had – at least in my mind – turned to perhaps foolishly frail dimensions, with posts only 1 1/4" in diameter and rungs no more than 3/4" in diameter at their centerpoints. Now, when I build those same chairs, I use diameters of 1 3/8" and 7/8". But I should also point out that those early "frail" rockers of mine are still in use in homes scattered across Ohio.

Much Pleasant Hill furniture, however, is built to a different standard, making use of thick material in contexts in which many makers in Eastern Shaker communities would have used thin material.

The top of the little table with eight-sided legs below is one example. The top of that table measures a full 7/8" thick. A table of similar size (with a top 1/2" narrower but more than 7" longer) from the Hancock community, was drawn by John Kassay in "The Book of Shaker Furniture." It's fitted with a top only 7/16" thick (although it is banded in 9/16"-wide strips, presumably to keep notions like buttons from falling to the floor). Even if we include the banding as part of the top's thickness, it still measures 5/16" less than the top of the Pleasant Hill table.

The extra thickness on the Pleasant Hill table might have resulted from nothing more than workshop fatigue, since the top still has what appears to be the marks of a large circular saw, marks a more energetic craftsman would have planed away. This would have resulted in a thinner top of lighter appearance. The apron sections on this table are also thicker than necessary, measuring between 1" and 1 1/8" in thickness. And although the legs on this table are thinner than on many other Pleasant Hill tables, they are thicker than the legs of many Eastern tables of similar proportions.

In fact, it is in the legs of Pleasant Hill tables that the Western preference for parts thick in cross section is most apparent. The legs of the Leander Gettys work table (far right) are simply massive, with

The thickness of the top and legs of this Pleasant Hill side table gives it a more muscular look than side tables of similar size made in Eastern communities. Note the circular-saw marks across the top.

"Members of the church of God ... are forbidden to make anything for Believers that will have a tendency to feed ... pride and vanity."

– from Millennial Laws, 1845

the square upper sections measuring 3 3/8" on a side. True: the table is large, but there are examples of Eastern Shaker tables of similar dimension built with less substantial undercarriages. It's not just the thickness of the part that gives these legs their visual bulk. It's the fact that the legs retain most of this thickness along most of their length. Large tables with heavy legs made in Eastern communities have much of their thickness cut away as the legs descend to the floor, resulting in a leg that appears much lighter.

Puzzling the Past

In the evening of my next-to-last day at Pleasant Hill this past summer, I went alone to the rooms above the Meetinghouse. These were the rooms in which the community's elders and eldresses had lived. They were fitted with a good deal of original Pleasant Hill furniture and probably looked much as they had 150 years ago.

It had been a blistering day, and the rooms were not air-conditioned. Even in the twilight of late evening, the air was hot and close, but spending time in these rooms alone was important to me – so important that I didn't notice the heat until later, after I'd left the Meetinghouse

I didn't touch anything that evening, although I had touched many things during the day as Al Parrish, the magazine's photographer, and I had carried and turned pieces, moving them into position to be photographed.

Instead, I kept my hands folded behind my back in what I now think was an unconscious attitude of respect for those who had once lived in these rooms.

What they – and the men and women in their charge – had accomplished here in the Kentucky wilderness in the first third of the 19th century, working largely with hand tools, is almost beyond belief.

I looked at lamps, at a ledger, at a marvelous curly cherry secretary. I looked at oval boxes and blanket chests and simple Shaker beds, at rugs, at a mirror, at all the products of Shaker craft on display.

Then in the hallway that connected the rooms, I studied each of the oversized black-and-white photos of 19th-century Pleasant Hill Shakers that hung there, trying to get a sense, via these images, of who these people had been.

The rooms were quiet, the silence broken only by the faint sounds of my feet moving across the wood floors. The only light was the muted late-evening glow coming through the windows.

I like to puzzle over the historical origins of Shaker furniture. I want to know why it is the way it is, but I'm even more interested in the work's emotional origins.

Did the craftsman who made the sponge-painted oval boxes

The legs on this table exhibit the typically abrupt Pleasant Hill transition from square upper section to turned lower section. The legs are atypical in their relatively thin diameter.

The legs on the Leander Gettys work table are massive. While the table is certainly large, there are examples of Eastern Shaker tables of similar size with less substantial undercarriages.

in the quarters above the Meetinghouse feel the same pride in his workmanship I feel in mine? And what about the maker of that magnificent secretary? Did he step back and admire the beauty and strength of the piece he'd built with his own hands?

To have seen the work as a product of his efforts would have been antithetical to Shaker belief, but would it have been possible to have succeeded so brilliantly at these individual works without taking personal satisfaction in the accomplishment? That is, I think, the paradox of Shaker furniture. When it is good, it is very good.

It is work that, for most modern woodworkers, would provide nourishing meals for healthy egos. Is it possible that the 19th-century Pleasant Hill craftsmen who produced this work could have done so without feeling the pride that we would have felt in their places? **PW**

"Hands to work and hearts to God."
— Mother Ann Lee

SEPARATED, THEN REUNITED

Pedestal stands like this example were fairly common products of Pleasant Hill workshops. Few, however, carry the history of this particular stand. The ovolo-cornered top was once the lapboard for Sister Mary Carmichael Settles (1836-1923), the last living Pleasant Hill Shaker, who had joined the community as a widow with two children. After Settle's death, her granddaughter had the lapboard placed on this pedestal. The stand then came into the possession of Hazel Hamilton, a dealer in Shaker furniture. Hamilton had the lapboard removed from this base and replaced with a more "Shaker-esque" round top.

Later, when the stand and lapboard were returned to the Pleasant Hill community, the two original parts were reunited.

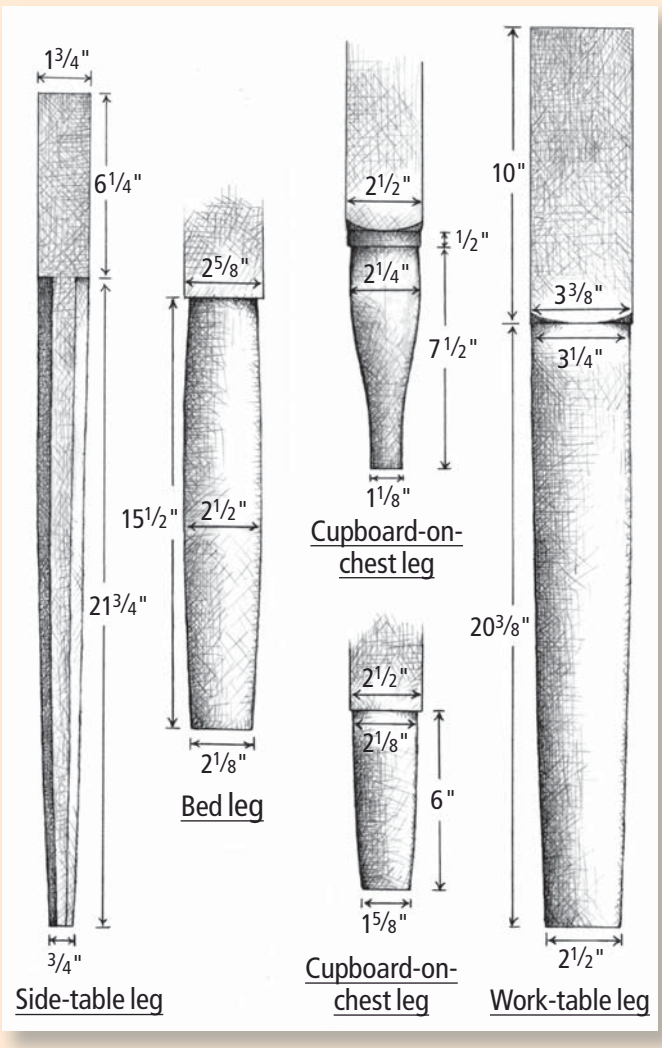
Unfortunately, the craftsman who reunited them didn't properly align the base and top. The tops of Shaker tripod stands of this type should be aligned so that that one of the top's long sides is parallel to a line connecting the ends of two of the tripod feet. *— KP*

PLEASANT HILL LEG SHAPES

In the earlier examples of Pleasant Hill casework, legs tended to be more ornate than in examples dating from the mid-century. The legs on these earlier pieces often exhibit beads and coves. Later pieces, such as the Gettys work table, are more severe, with long, unbroken tapers from the square upper section to the floor.

In addition to this severity, these later legs are typified by a heaviness not found in the legs in Eastern Shaker communities. This is most evident in the leg of the Gettys work table, which is remarkably thick all the way from the squared apron section to the floor. The bed leg shown below is similarly massive from square shoulder to floor.

Another feature of Pleasant Hill legs is the usually abrupt transition from square apron section to round (or octagonal) lower section. The side table leg, the bed leg and the cupboard-on-chest leg all have transitionless sawn shoulders below the square apron section. The Getty's work table leg exhibits a minimal turned transition at the shoulder, and the top-most cupboard-over-chest leg is the only leg on this page with a fully developed transition from square apron section to turned lower section. It is also – perhaps not coincidentally – the most delicate leg on this page. *— KP*



Illustrations by the author

Some dovetail jigs promise you everything...

The Keller Dovetail System only promises what it can deliver.

Fast setup. No test cuts. Precision joinery. Unlimited widths. Classic and variable spacing. Compound, acute and obtuse angles. Curved dovetails. Box joints. Made in USA since 1976. 20-yr. warranty. 30-day money-back guarantee.

"Your best choice. It's the easiest of all the jigs to use and great for production use."
–Woodworker's Journal

VIDEO: $8.95 + $2 P/H

KELLER & CO.
1327 'I' Street, Dept. P16
Petaluma, CA 94952
1-800-995-2456
707-763-9336
www.kellerdovetail.com

Keller Dovetail System
Simple. Fast. Accurate. Enjoyable!

CIRCLE NO. 133 ON FREE INFORMATION CARD.

BUILD YOUR BEST DRAWER BOXES WITH MILLER DOWEL

Using the Mini-X Miller Dowel in drawer construction is the easiest method to build strong, good looking drawers. They are as strong as dovetails, and as fast and easy to use as screws. Mini-X Miller Dowels are available in Birch, Black Walnut, Cherry, and Red Oak.

Choose Miller Dowels for simple, easy-to-make drawer boxes with the satisfying look and craftsmanship of all-wood joinery.

DRILL STEPPED PILOT HOLE | ADD GLUE & INSERT | TAP & FINISH

U.S. Patent Nos. 6,267,527, D456,700, D484,781
TM 2004 Miller is a trademark of the Miller Dowel Company

WWW.MILLERDOWEL.COM
TOLL FREE:866-WOODPEG

FURNITURE • CABINETRY • DRAWERS • FRAMES • WOODCRAFT • MILLWORK

CIRCLE NO. 141 ON FREE INFORMATION CARD.

LOWEST PRICES UNBEATABLE QUALITY

WORKHORSE ROUTER TABLES
MUSTANG Router Table
DON'T SETTLE FOR SECOND BEST!

Vertical and Horizontal Routing In One Table!

- Portable design for ease of use
- Quiet deluxe cabinet base
- Laminated 12 ply birch 1-3/16" ultra flat top
- Deluxe fence system
- Fits all routers with up to 3-1/2" diam. bits

ONLY $215
REG $295 - WL-TAB1

PRO CABINETMAKER
6 pc Door Set

- 1/2" Shank Router Bits
- 2-pc Rail & Stile (Roman Ogee)
- Drawer Lock
- 3 1/4" D Panel Raiser (Ogee) with UnderCutter
- Door Lip
- Reversible Glue Joint

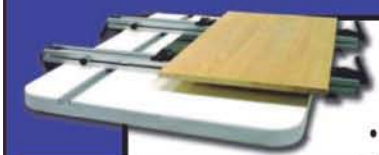
ONLY $119 set
$175 VALUE
WL-2020-1

800-472-6950
ORDER 24/7
WOODLINE.CC

FREE STRAP CLAMP

8 Piece PICTURE FRAME SET
Perfect for making great looking picture frames. Bits can be combined to form complex mouldings or simple decorative frames.
OUR PRICE ONLY
$75 set
WL-2008
$189 VALUE
CARBIDE

66 Piece Master Woodworking Router Bit Collection
This may not be every bit you'll ever need, but it's close! Use this set to complete your collection!
WL 2066 1/2" Shank..... $189
WL 2065 1/4" Shank..... $189



PROGRIP
YOUR PARTNER IN WOODWORKING

- Reliable cam-action system for variable pressure levels
- Double T-slot system for limitless accessory jig applications
- Unique Back-To-Back system that can be separated into 2 individual clamps for unbelievable versatility in all projects

Ask About Our 90 degree Heads for TRU-GRIP Clamps and PROGRIP Clamps

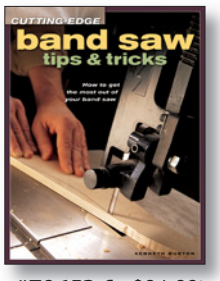
24" ProGrip Bar Clamp.....$22.95
36" ProGrip Bar Clamp.....$24.95
50" ProGrip Bar Clamp.....$28.95
36" ProGrip Back-To-Back Bar Clamp.....$40.95
50" ProGrip Back-To-Back Bar Clamp...$49.95

SOLID ALUMINUM Advanced Aluminum Multi-Channel Extrusion Body Provides Unmatched Rock-Solid Stability and Long-Term Reliability

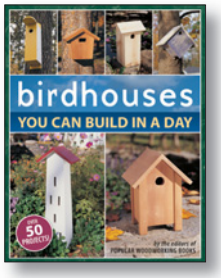
The BEST Bar Clamps At The BEST Prices!

FREE CATALOG 1-800-472-6950
WOODLINE USA
111 Wheeler St, LaVergne TN, 37086

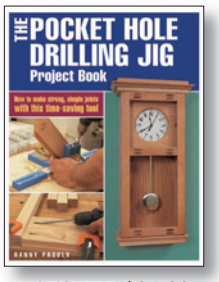
CIRCLE NO. 167 ON FREE INFORMATION CARD.



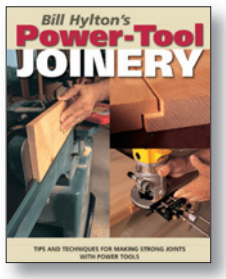
#70653-1 ~~$24.99~~



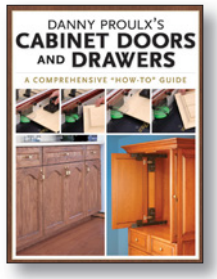
#70656-4 ~~$24.99~~



#70637-4 ~~$24.99~~



#70691-1 ~~$24.99~~

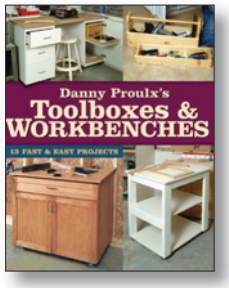


#70692-9 ~~$24.99~~

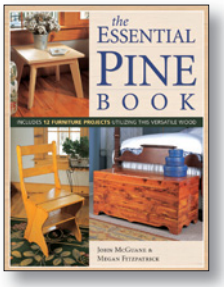
Join **WoodWorker's Book Club** and

CHOOSE 3 BOOKS

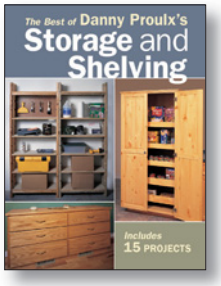
with a 4th Book for just



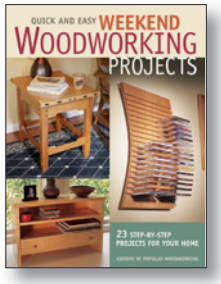
#70659-8 ~~$24.99~~



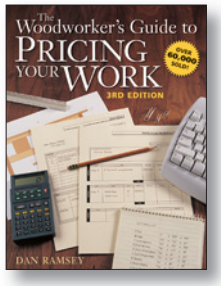
#70663-0 ~~$24.99~~



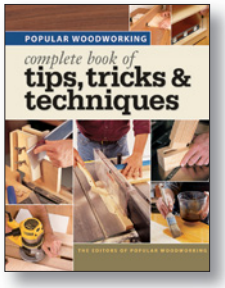
#70684-6 ~~$24.99~~



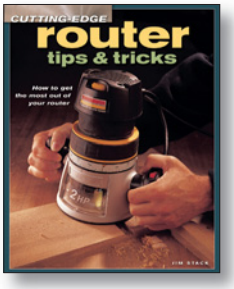
#70698-6 ~~$24.99~~



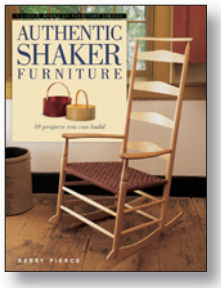
#70690-3 ~~$22.99~~



#70669-7 ~~$28.99~~ hc



#70649-9 ~~$24.99~~

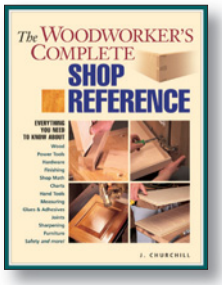


#70607-7 ~~$24.99~~

#70552-5 ~~$24.99~~

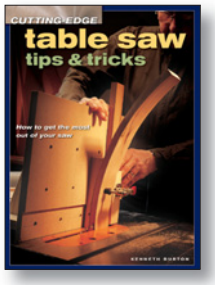
#70648-1 ~~$24.99~~

#70491-6 ~~$24.99~~

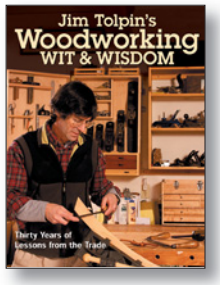


#70579-8 ~~$26.99~~

#70626-7 ~~$24.99~~



#70569-9 ~~$24.99~~



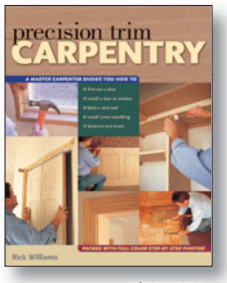
#70672-1 ~~$19.99~~

All books are softcover unless marked hc. Prices shown are publishers' list prices.

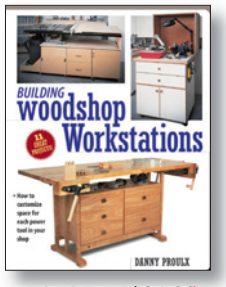
#70534-3 ~~$24.99~~

#70661-4 ~~$24.99~~

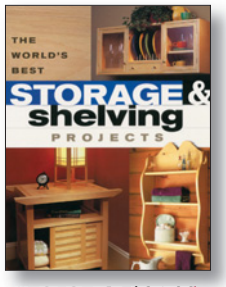
#70697-8 ~~$24.99~~



#70584-8 ~~$24.99~~



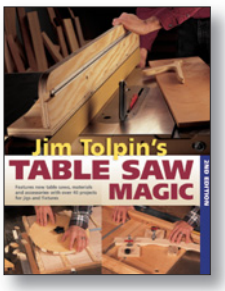
#70585-5 ~~$24.99~~



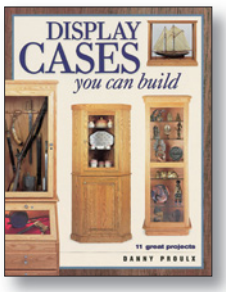
#70587-1 ~~$24.99~~

FREE

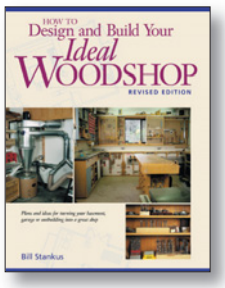
$9.99 plus shipping & handling



#70627-5 ~~$24.99~~



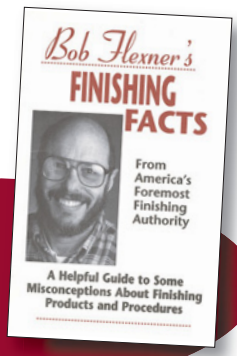
#70547-5 ~~$24.99~~



#70522-8 ~~$27.99~~

#70533-5 ~~$26.99~~

Plus get a ***FREE*** *Gift*



Uncover the secrets to getting the perfect finish — every time! Finishing guru Bob Flexner shows you how.

A $3.95 value, yours FREE with membership!

Join online @ www.WoodWorkersBookClub.com for an even larger book selection!

How the Club Works

- **FREE CLUB *NEWS*** About every 4 weeks (14 times per year), you'll receive the *NEWS*, featuring a Main Selection and 100 or more of the newest and best woodworking instruction books.
- **EASY ORDERING** To place an order or cancel the Main Selection, simply respond online at www.WoodWorkersBookClub.com or return your Selection Card by the marked date. If we don't hear from you, we'll send the Main Selection automatically. On future prepaid orders, shipping & handling is FREE!
- **RETURN PRIVILEGE** If the *NEWS* is delayed and you ever receive the Main Selection without having 15 days to notify us, you may return the selection at Club expense.
- **NO-OBLIGATION MEMBERSHIP** You have no obligation to buy any more books; you're just agreeing to try the Club for 9 months. After that, you may cancel at any time. Each time you buy a book, your membership will be renewed for 6 months from the purchase date.

WOODWORKER'S BOOK CLUB
P.O. Box 9274
Central Islip, NY
11722-9274

1-800-448-0912

Call TOLL FREE Monday-Saturday,
9a.m.-7p.m. M-F 9a.m.-6p.m. Sat EST
www.WoodWorkersBookClub.com

WoodWorker's Book Club is a Division of F+W Publications, Inc.

MEMBERSHIP SAVINGS CERTIFICATE

YES! I want to join WoodWorker's Book Club! Please send me:

My 1st Book **FREE**	My 2nd Book **FREE**	and My 3rd Book **FREE**	with My 4th Book for just $9.99	Plus My **FREE** Gift
# ☐☐☐☐☐-☐	# ☐☐☐☐☐-☐	# ☐☐☐☐☐-☐	# ☐☐☐☐☐-☐	# 8 0 3 9 0 - 8

VISA/MasterCard/AmEx Orders Call **TOLL FREE 1-800-448-0912**
9a.m.-7p.m. M-F 9a.m.-6p.m. Sat EST

I'm enclosing $9.99 plus $7.99 shipping & handling, for a total of just $17.98.

☐ Check enclosed (or) Charge my ☐ VISA ☐ MasterCard ☐ AmEx

Acct. # _____ Exp. _____

Signature _____

I have read How the Club Works and understand I have ***NO OBLIGATION*** *to buy any more books.*

Name _____
(PLEASE PRINT)

Address _____

City _____ State/Prov. _____ ZIP/PC _____

Offer good for new members in U.S. and Canada only. In CA, CO, GA, MA, MI, NY and OH please add applicable state tax. In Canada provide a street address and remit in U.S. funds; enclose $10.39 s&h and $1.43 GST for a total of $21.81. One membership per household. Allow 3-4 weeks for delivery. The Club reserves the right to approve all applications and may cancel membership at any time.

Mail today to: **WOODWORKER'S BOOK CLUB** • P.O. Box 9274 • Central Islip, NY 11722-9274

ORDER CODE: KAB06PW

Successful Screwing

Everything you always wanted to know about screws, but were afraid to ask.

Photo by Al Parrish

Many of the tools and fasteners we use in woodworking have been around for thousands of years. The concept of the screw goes back to the ancient Greeks. Archimedes took a wedge, a simple but powerful device, and wrapped it around a cylinder. The helical threads allowed the leverage derived from the wedge to be delivered via a circular motion.

Until the industrial age, screws were expensive, hand-made items. Certain applications justified their use, but in most cases other methods made more sense. In the 18th and 19th centuries, machinery was developed that made the price of screws reasonable; in the 20th century, better methods of driving screws were developed.

Most woodworkers have a love/hate relationship with screws and screwdrivers. They work well, but it seems like cheating. Screws exert a lot of force, but that force is concentrated in two rather delicate areas – the tiny bit of metal where the thread extends from the shank, and the interface between the driver and the head.

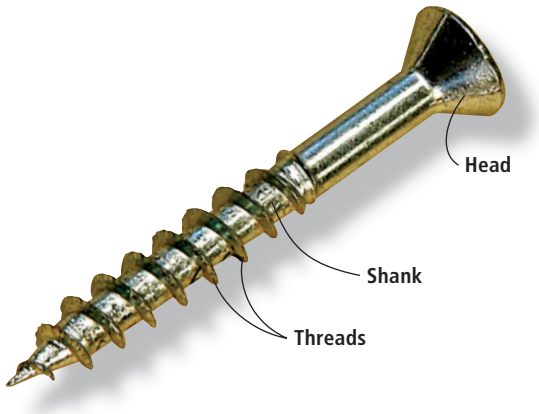
When things go wrong, these weak links fail, which is usually the result of trying to force a screw to do something it wasn't designed to do, using the wrong tool, or using the wrong technique.

A Clamp With a Twist

I like to think of screws as clamps. As the threads bite into one piece of wood, the head pulls the other piece tightly to it. Take a look at the cutaway picture at the bottom left of the next page, which shows two pieces that have been properly screwed together. The threads are gripping in only the lower piece. In that piece, the hole is the size of the unthreaded

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.



portion of the screw, which allows the threads to tightly grip the surrounding wood. The hole in the upper piece is slightly larger than the shank of the screw, and the head sits in a countersink.

In the two center pictures below, the hole on the right was made by force-feeding the screw without first drilling a pilot hole. Instead of neatly cut threads, the wood has been torn and crushed. This damage continues beyond the screw, and the surrounding wood is starting to split. The trick is to get the holes the right size so that the threads hold securely without the shank damaging the surrounding wood.

There are a couple of other bad things that can happen as a result of not drilling a pilot hole, or drilling a pilot hole that's too small. If the threads engage in the upper piece of wood, it can prevent the two pieces from pulling together, sometimes called "bridging." When attempting to force the pieces together by applying more pressure on the driver, the threads can be stripped, or in harder woods the screw head can be damaged or the screw can snap.

Three Bits in One

The pilot hole, the clearance hole and the countersink can be drilled in one step with a special bit, as seen at upper left. The Fuller countersink has been the standard for years.The big advantage is the tapered bit, which ensures that the clearance hole is big enough and that the threads grip all the way to the end of the screw.

The biggest problem with the Fuller countersink is the attachment of the countersink cutter to the shaft of the bit. The small Allen head setscrews don't hold well on the round bit. The countersink can slip on the bit when it meets resistance on the surface of the wood.

A newer style from Amana (far right) has larger set screws, and the shaft that fits in the chuck of the drill is an integral part of the countersink. In addition to being less likely to slip, the Amana countersink has a carbide tip that lasts longer, especially when drilling plywood or particle board.

Choose the right diameter drill bit by holding the bit behind the screw. You should be able to observe that the screw threads are wider than the bit, and the bit is about the size of the shank.

I set the depth of the countersink by holding the bit beside the screw, and setting the end of the tapered bit just short of the point of the screw. If you're using a straight bit, set the end of the bit to where the taper begins on the screw. Unfortunately, this may cause splitting in hardwoods. I prefer the tapered bit for solid wood, and the carbide countersink for man-made materials.

How Long a Screw

Screw diameters are specified in gauge sizes, with the higher gauge number indicating a larger diameter. For most woodworking applications, #6 is the smallest useful gauge and #12 is the largest. The best general-purpose size is probably #8 gauge. For attaching hardware to wood, smaller #4 or #5 screws are often used.

The right screw length depends on the thickness of the pieces being joined, and the orientation of the parts of the joint. Ideally, the screw should be 2 to 3 times the thickness of the piece being attached. For example, a 1/4"-thick drawer bottom or cabinet back should be held in place with a 3/4"-long screw. For thicker pieces, like 3/4"-cabinet parts, a 1 3/4" long screw is sufficient.

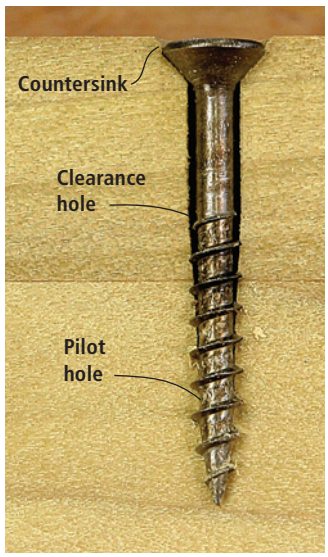
Longer screws introduce problems of drilling the pilot hole deep enough, and of keeping the hole straight so the screw doesn't come out the far side of the wood.

All Screws Aren't the Same

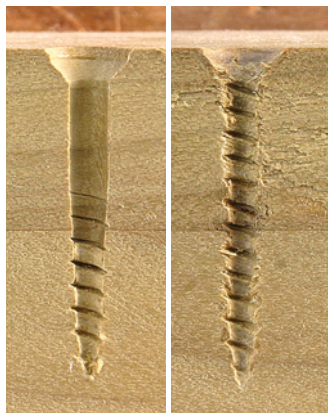
If you're working with softer woods, it doesn't make much difference what type of screw you use.

The Fuller countersink is driven by the drill bit. When the countersink meets resistance, it tends to slip on the drill bit's shaft.

The Amana countersink extends into the drill's chuck. It is less likely to slip, and has a long-lasting carbide tip but doesn't come with a tapered bit.



For a screw to work effectively, it must fit its hole precisely.



The hole on the left was bored with a tapered bit, allowing the shank to slide in the upper piece of wood, and the threads to cut neatly in the lower piece. The ragged hole on the right is the result of driving a screw without first drilling a pilot hole.

The screw on the left is made for woodworking. The drywall screw on the right is smaller in diameter, threaded the entire length of the shaft, and made of brittle metal.

In harder woods, you're better off spending a little more for screws that are designed and manufactured as wood screws. Drywall screws are rather brittle, and their small diameter gives them only marginal strength. The bottom right picture on page 79 shows the differences.

In harder woods, you may need to use a lubricant to make driving easier and to prevent the screw from snapping. I use beeswax from a toilet bowl ring, an inexpensive way to obtain it. I keep it in 35mm film containers, and one ring will supply my needs for several years. Paraffin also works, but it isn't as easy to use. Some people use soap, but soap can attract moisture, causing damage to the screw.

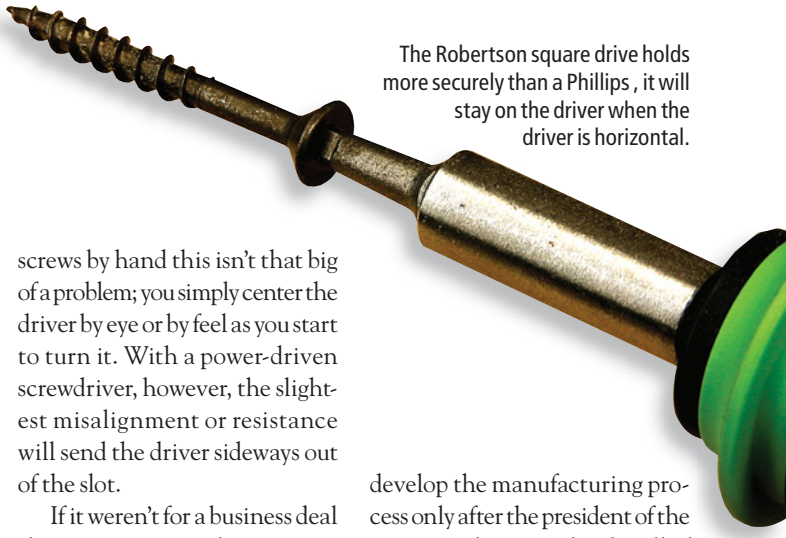
Different finishes, some purely decorative and some that offer corrosion resistance, are available for the metal in screws, but for most interior applications the extra expense isn't warranted. Brass screws for hardware require special handling as the soft metal is easy to damage. Use a steel screw of the same size to cut the threads, then replace it with the brass screw, and don't use a power driver on brass.

Driving Around in Circles

It is easy to get frustrated with any of the drivers in common use. Each has its quirks and shortcomings. The common (or slotted) screw head was the only choice until about 100 years ago when the development of automobile assembly lines created the need to drive more screws in less time.

If the tip of the screwdriver isn't centered perfectly over the head of a slotted screw, the driver will tend to slip sideways from the slot as it turns. If you're driving screws by hand this isn't that big of a problem; you simply center the driver by eye or by feel as you start to turn it. With a power-driven screwdriver, however, the slightest misalignment or resistance will send the driver sideways out of the slot.

You can save a lot of room in your toolbox by using replaceable insert tips with a hand driver, or a magnetic bit holder in your cordless drill.



The Robertson square drive holds more securely than a Phillips , it will stay on the driver when the driver is horizontal.

If it weren't for a business deal that went sour and one man's stubbornness, the Phillips-head screw might never have come into existence. In 1908, Canadian P. L. Robertson invented a tapered square recess driver and head combination. The big advantage to this is that the driver centers itself in the head, and doesn't slip under pressure. The Robertson head holds so well, that the screw will stay with the driver even when held horizontally.

Robertson lost money in his first attempt to produce and distribute his design in the United States, and from then on insisted on not licensing his design to any other manufacturers. Henry Ford wanted to use these fasteners on his assembly line, but wanted to manufacture them himself. Robertson wouldn't budge, and while long popular in Canada, square-drive screws have only recently caught on in the United States.

The Phillips head didn't come into existence until the 1930s, and was actually invented by John P. Thompson, who couldn't convince any screw manufacturers the cross-shaped recess could be manufactured affordably. Henry F. Phillips bought the rights from Thompson, obtained patents on the design and searched for a manufacturer.

The American Screw Co. spent half a million dollars to develop the manufacturing process only after the president of the company threatened to fire all of his engineers. General Motors was the first customer, and Phillips-head screws were first used in Cadillacs made in 1936.

Not a Flaw, That's a Feature

What most of us consider to be the Phillips-head screw's biggest defect was actually an advantage when it was first adopted. Because the intersection of the crossed recesses is slightly rounded, the driver will slip, or cam-out, when a Phillips-head screw becomes tight. This prevented overtightening on the assembly line, but is the bane of any woodworker who has had a screwdriver slip and go dancing across a finished surface.

In the last 25 years, cordless drills have become the preferred method of driving screws for woodworking, and the general frustration with the Phillips bit

SUPPLIES

McFeely's Square Drive Screws
800-443-7937 or
www.mcfeelys.com

- screws, bit and drivers

"One Good Turn: A Natural History of the Screwdriver and the Screw"
by Witold Rybczynski (Scribner)

has led to an increase in popularity of the Robertson square drive, as well as other types.

The Quadrex or Combo drive is a combination of the Phillips and Robertson types. In theory, either driver may be used but they work much better with a square drive, the Phillips being relegated to emergency status when a square driver can not be found.

The Pozi-Drive was patented by the Phillips company and features the same cross-shaped recesses as the Phillips, but the intersection has an additional square recess that reduces cam out considerably. This type is commonly used in European cabinet hardware. A Phillips bit can be used, but problems of cam-out and head stripping are much worse than if the Pozi-Drive bit is used.

Numerous other drive configurations exist, but their purpose seems to be keeping the average person from taking something apart because the right driver isn't available. None of these other drive systems offer any real advantages over the Robertson.

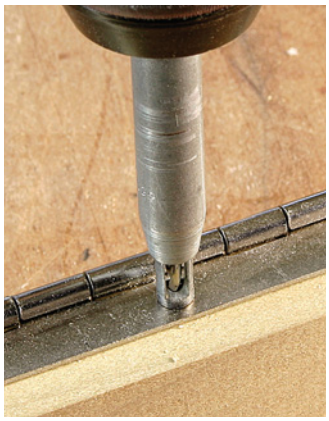
Whatever type of driver is used, the interface between driver and screw head should be a close fit to prevent damage to the screw head or the end of the driver. Flat-tip screw drivers can be filed back to shape if they get damaged, but other styles of bits aren't really repairable. You might increase the life span of a rounded off Robertson bit by grinding a little off the end, but I know of no way to fix a damaged Phillips bit.

Rather than fill a drawer or two of my toolbox with various sizes and shapes of screwdrivers, I use insert tips in a driver with storage in the handle and a magnetic tip as seen at bottom left on the previous page. These tips also fit magnetic bit holders for driving with a cordless drill. Magnetism is your friend when power driving a lot of screws, or when placing a screw in a hard to reach location.

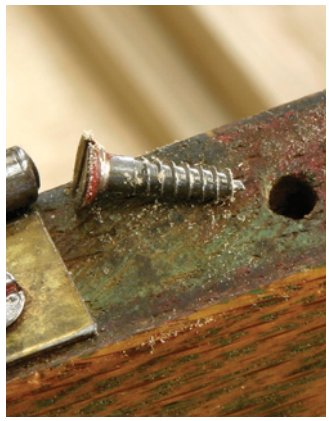
Head in the Right Direction

The countersink-style head is the most commonly used head in woodworking, and it has another advantage in addition to coming flush with or slightly below the surface of the wood. The wedging action of the countersink lines the parts up in the same orientation whenever you take it apart and put it back together. Most of the time this is what you want, but sometimes you need to allow for wood movement.

Due to this wedging action, screw holes for hardware need to be exactly in the center of the countersink in the hardware. Once again, a special drill bit comes to the rescue. The Vix bit (above) has the drill bit enclosed in a self-centering guide. A spring inside the guide keeps the drill bit out of the way until you begin to apply downward pressure.



The Vix bit has a self-centering spring loaded guide that makes it invaluable when drilling holes for hardware.

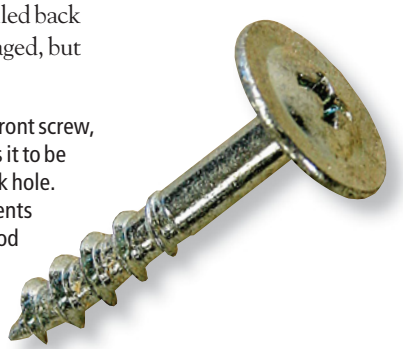


Seasonal wood movement can eventually crumble the fragile interface between the wood and the threads of the screw, enlarging the hole.

If you put the pilot hole in the wrong place or strip it out, you can repair the damage with a small piece of wood glued in the hole. For stripped holes, toothpicks can be used. Glue them in and break them off flush with the surface until there is enough wood in the hole for the screw to bite. To move a hole, it's better to whittle a small piece of wood from scrap, glue it in and make it flush with a chisel cut. This makes it easier to drill a new pilot hole.

Pan-head screws allow for the two parts to slide around below the flat head. This allows you to adjust the joint slightly as it comes together, as with a pocket screw. To attach a solid wood tabletop or cabinet top you need to allow for the wood to expand and contract. If the hole in the attached piece is elongated, the wood is free to shrink or swell while remaining firmly in place.

A variation of the pan head screw, the truss head screw (left) has an oversized head that functions as a built-in washer. Also known as a drawer-front screw, this style allows for both minor adjustments of position, and seasonal wood movement.



The truss-head, or drawer-front screw, has a large head that allows it to be placed in an oversized shank hole. This permits slight adjustments and allows for seasonal wood movement.

The Robertson square drive, Combo drive and Phillips head screws (l to r).

Winding Up

So is it cheating to use screws? Like any method of joining wood, there are times when a screw is ideal, and times when another choice is better. When I worked on wood boats or built commercial cabinets, I used thousands of screws without a second thought. For other work, I only use them in a few specific situations.

Like a clamp, a screw isn't really a permanent fastener. Over time, the fragile connection between wood and metal deteriorates as these different materials move in different ways. This may take decades, but whenever I remove a screw from an antique, I usually find crumbled bits of wood as seen above.

A screw may not last forever, but for attaching a solid wood top or hardware, or reinforcing joints in unseen places, it is the best fastener. Using it correctly will improve the odds of your work outlasting you. **PW**

Powermatic Model 66

After 10 years this solid, reliable machine continues to be a shop mainstay.

Photo by Al Parrish

It's surprising we haven't written an Endurance Test about the Powermatic Model 66 table saw before now. When we set up the *Popular Woodworking* shop more than 10 years ago, it was the first machine we bought, and it's been the central machine in our shop ever since.

It's not overstating this saw's reputation to say that if you ask most home woodworkers what saw they would like to have, the Model 66 usually tops the list. In fact, lots of professional woodworkers also prefer the 66. We're not surprised. It's built like a tank, and it has run almost trouble-free during hundreds and hundreds of hours of service.

Our 10" left-tilt Model 66 is the cream of the crop with a 5-horsepower, three-phase motor that continues to sing with quiet confidence and provide enough cutting power to handle any job. That includes hundreds of ¾"-wide x ½"-deep dados and literally tens-of-thousands of board feet run in 8/4 hard maple and white oak. And the saw continues to operate nearly as vibration-free as the first day we set it up.

One of the visual aspects of this saw that continues to impress is the mirror-polished cast iron table. It looks beautiful and has always been flat and smooth within more-than-acceptable tolerances. In fact, we've even used one of the cast iron wings as a lapping plate for trueing hand plane soles.

The saw's trunnion system has remained true and solid throughout the years with hardly any adjustment necessary, even to the 90° and 45° blade stops. Just this year we started to notice some play in the blade bearing and performed what is thus far our only major maintenance: We replaced the bearing assembly. Now, it runs like new.

We have had to clean out the threads in the worm gears for the height and beveling adjustment mechanisms – but that's maintenance any saw will require.

Changes over the year? Very few. Our saw came equipped with a Biesemeyer 50" rip fence, which has since been replaced by an equally nice (and some might say better) Accufence. The newer fence incorporates ¾"-thick side boards (rather than the previous ½"-thick boards) to improve fence flatness.

During the previous decade, much of the tooling used to create the machined parts in the saw has been upgraded, improving the overall part quality. Powermatic has also upgraded the motor belts to reduce heat at the pulley. That's good for the belts and good for the pulley. The arbor assembly has also changed from a two-piece unit to a one-piece forged assembly that offers less chance for misalignment during rough use. One cosmetic change is a more durable powder-coat finish on the cabinet instead of the paint job on ours.

We do have some minor issues. When the blade is tipped to make a 45°-bevel cut, you're likely to bump your knuckles on the underside of the fence rail. Also, the location of the 4" dust port allows saw dust to build up at the front corners of the cabinet and that translates into dusty worm gears over time.

But if we were to set up shop again, it's safe to say we'd be shopping for another "66." **PW**

— David Thiel

SPECIFICATIONS

Powermatic Model 66

Original price: $1,950
Today's price: $2,399
Motor: 5hp, 3ph
Cast iron table size: 28" x 37½"
Weight: 600 lbs.
What we like: Strong, sturdy, reliable, lots of power and very low vibration. Nearly maintenance free during many years.
What we'd change: Deflecting dust chute to channel dust to port; improved knuckle clearance around the wheels and motor cover.
For more information: Contact Powermatic at 800-274-6848 or wmhtoolgroup.com

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*.

Preparing Green Wood

Here's how to take your stock from logs to lathe.

Photos by Al Parrish

There is nothing like some quality time with a chainsaw to remind you that wood comes from trees. As a turner, sooner or later you'll be cutting up green logs for at least some of your material. (If you will be using a chainsaw to cut large pieces, be sure you are well-versed in its safe use.)

Once upon a time, not so very long ago, I was sitting in my booth at a craft show when a young man came in and began looking at some bowls I'd made. He was clearly quite intrigued, and also seemed a bit puzzled. Finally he held up a bowl he had been examining and asked, "How do you get the edges to curl up like that?"

It wasn't a silly question from his point of view; wood comes in flat boards, right?

As woodworkers, you of course already know that wood actually comes from trees. However, if you build furniture, shelves, fixtures and the like, you may have experience only with wood that has already been cut into boards. It has probably been dried as well, usually in a kiln, but certainly at least air-dried. It is a far different thing to deal with a log that is freshly cut from a tree and sopping wet.

One of the great things about turning is that you will be able to use many wonderful woods you will seldom, if ever, encounter as a "flat" woodworker. In addition to the usual domestics such as oak, ash, maple, cherry, walnut, hickory, you will happen upon and acquire what I call exotic domestics – woods such as dogwood, lilac, holly and fruitwoods, as well as ornamentals such as boxwood, rose of Sharon and many others.

Some of these trees (especially the ornamentals) never attain a size that makes them a viable source for commercial lumber; others (such as persimmon and hackberry) do get quite large, but are not common enough to have commercial use. Hackberry is lovely turning wood but is generally considered a weed tree from a landscaper's perspective; if you come across one of good size, it's a find.

So there are two main things you will need to know when you do find these woods. The first is how to cut it up: What shapes and sizes of pieces will you want, and where are they located in the log? Second, how do you get this wood, which will often be very wet, dry enough to use without cracking?

It's important to understand how wet wood behaves. It's beyond the scope of this article to thoroughly cover the topic of wood structure. This would take volumes, and many have been written. One of the best and most useful I have found is "Understanding Wood," by R. Bruce Hoadley (Taunton). I encourage you to read this book; it will greatly expand your comprehension of all aspects of wood as a material. In the meantime, there are a few basic considerations that will enable you to get your wood finds from the log to the lathe.

As a furniture maker, you would be concerned with wood movement on a fine scale,

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.

as your (usually kiln-dried) lumber fluctuates between as little as 6 to 8 percent moisture content. For some kinds of turnings, you will want wood equally dry. Fitted-lid boxes, for example, just won't work if made from wood with higher moisture content than somewhere around 8 or 10 percent. Bowls, on the other hand, might be fine at 12 percent or even higher. Still, some woods when completely green may contain twice as much water by weight as they do wood fibers. That's 200 percent moisture content.

Generally, softer woods have a higher moisture content than hardwoods, but even hard maple has 65 percent or more when freshly cut. If you obtain the wood when it is this wet, it has a long way to go before it is ready for finish turning.

As wood dries it shrinks, and it occurs drastically more sideways (across the grain) than lengthwise (end-to-end). A large piece of wet wood is losing moisture much more rapidly from the outside surfaces than it is from the interior. As the piece dries, shrinking wood surrounds wood that is not yet shrinking; the stress causes it to split. The primary goal in drying a piece of wood is to slow down this moisture loss just enough to equalize it throughout the piece to prevent splitting. If you halt the loss entirely, the wood will rot; if you slow it more than necessary, it will just take longer to dry, and if you slow it not enough, the wood will split.

For two reasons, larger bowls are usually rough-turned from green wood then put back on the lathe when dry for finish turning. First, it is much easier to remove all that wood from the interior of the bowl when it is wet than after it dries. Second, it is difficult or impossible to dry very thick pieces of wood without having them split, because if you slow the moisture loss enough to prevent cracking for long, the wood will stay wet enough to begin to decay. Even if the wood does not rot, at best it will take a very long time to dry.

Because a piece of wood is basically a bundle of fibers and vessels (rather like a very tight bundle of straws), it loses moisture much more rapidly at the end grain than at the side grain. The ends of green wood will start cracking first, often very soon after it is cut. So the first thing to do with wet wood you cannot immediately put on the lathe to rough-turn is to coat the ends with green wood sealer, a water-based wax. If checking has begun, coating the ends will not stop it, so where this is the case, you must cut off the end past the checking then wax this fresh surface before it cracks.

In a pinch, you can hold a big chunk of green wood in a plastic garbage bag to keep it from checking, but only for a very short time (perhaps a few weeks at most); holding all the moisture in a piece of wood for very long will cause it to rot.

Different species of wood will behave very differently during this process. If I'm processing freshly cut cedar, I will coat one end before I cut the other; that's how fast it will begin checking. On the other hand, I've had dogwood that's been on the ground in the woods for years and is badly checked on the end, but cutting off only an inch or two reveals perfectly sound wood. Large pieces, or even smaller ones of some species, can be held at this stage for only a short time. They will quickly begin to deteriorate, so it is important to proceed with the next step in processing them (roughing out, cutting into smaller pieces, etc.) as soon as possible.

A roughed-out bowl is much more stable than a large, solid piece of green wood, but it may be necessary to slow the drying at this stage, too. You will have to determine this by trial-and-error, based on results in your particular situation. In a dry climate, you may need to coat the entire roughed-out bowl with wax. In a more humid area, this may not be necessary; coating just the end grain may be sufficient. It will also depend on other variables, including the species of wood, how thick the blank is, the micro-climate in which you will store it as it dries (a heated or air-conditioned space may be much drier than one that is not regulated) and the moisture content of the wood to begin with.

Some people put the blanks into paper bags or piles of shavings. I find these methods a bit too labor-intensive; I coat the end grain of a roughed-out bowl (both inside and outside); this is usually enough to allow it to dry without damage. If the piece has burly or highly figured wood such as crotch figure, I coat those

On top of my bench are roughed-out bowls dry enough to be brought into the shop. On the bench surface are freshly turned rough bowl blanks, with sealer drying on the end grain; also a small pile of green wood that has been cut into a variety of sizes and shapes. The end grain has been waxed on all these pieces, and they are stacked openly to allow the wax to dry. Below are boxes labeled for several types of work; dry wood being cut up on the band saw can go directly into these boxes.

areas as well because there is considerable end grain exposed in such wood, which makes it prone to checking.

Squares that will be used for smaller items can usually be dried successfully by coating just the end grain. You should stack the pieces with lots of space in between so the wax can dry completely. Store the wood in very open stacks during the early stages of drying to prevent mold growth, as it will be losing a lot of moisture at this stage. When the wood is quite dry, you can re-stack it, place it in boxes, or store in some other manner that provides ready access. **PW**

These wire-drawer carts are ideal for storing my cut, waxed pieces until they are dry enough to be sorted into storage boxes. These contain redbud, holly, pear, honey locust and birch cut into pieces that I will use for a wide variety of small turnings.

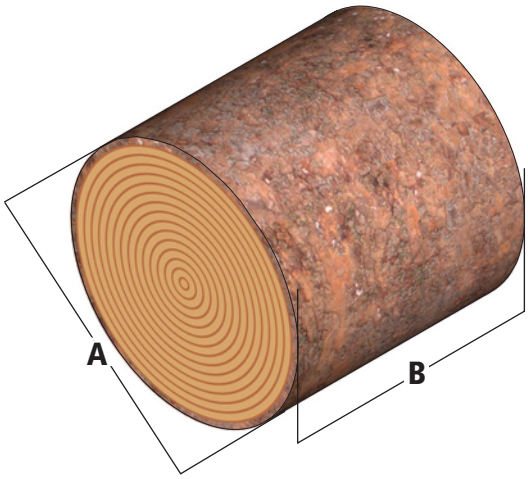
Most wood will quickly begin to split at the pith, so when you cut half-sections like these redbud pieces, you should remove a slab from the center of the log or limb. The piece on the right was cut exactly in the center, and has split rather badly. The piece on the left was cut about an inch to the side of the center, eliminating the problem.

Different species will behave very differently in drying. The first piece on the left is redbud, and although the ends were coated with sealer, the drastic sideways shrinkage has caused a split along the entire length of the piece. Because the split stops at the center, it can still be cut up for smaller items such as bottle stoppers or pens. The second limb is lilac, and the split has followed the spiral growth of the wood around the axis rendering this piece useful only for very small items. The two pieces on the right are dogwood, and even the larger one (about 7" in diameter) has dried with no checking at all.

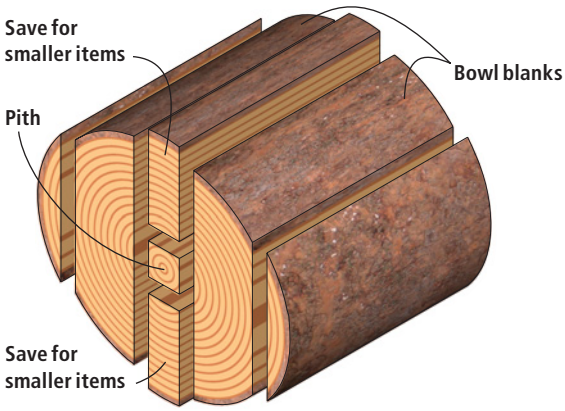
These pieces of drying wood are all fairly small, so they do not need to be roughed out to dry successfully. Leaving them to dry this way preserves the possibility of using them either for bowls or to cut into squares that would become tool handles, candlesticks, boxes, bottle stoppers or other small items. The piece on the left has been cut round on the band saw, because I plan to shape it into a bowl.

On these pieces of sycamore cut from a half-section of log, the end grain has been waxed. The upper-left piece is a bowl blank; the rest are squares (the grain runs lengthwise), including the large one on the right, which could be used for an end-grain bowl as well as for a large-diameter spindle turning.

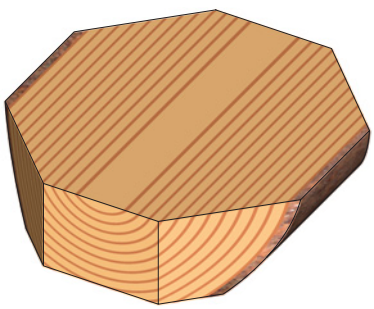
FROM LOG TO LATHE



If you will be able to process a log immediately for bowl blanks, cut the length "B" to the same measurement as the diameter "A." This allows you to get as large a bowl as possible from each half of the piece. If you will have to hold it for a short time, cut it somewhat longer; then any checking on the ends can be cut off later and still leave adequate length.



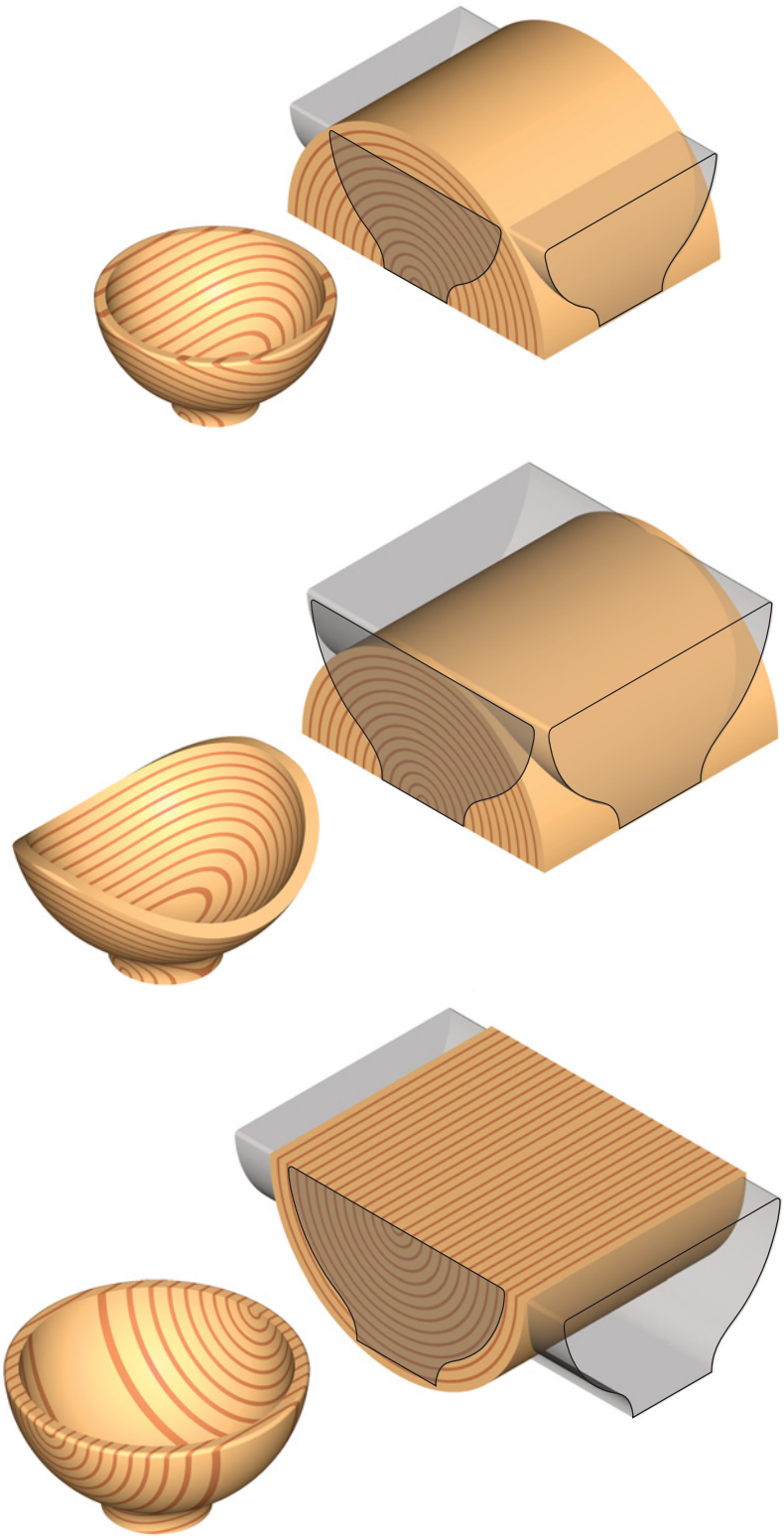
A typical layout for cutting a log section for bowls. Cut off a slice on either side (unless the piece is to become a natural-edge bowl), then cut a slab out of the center to remove the pith. There will be a board on either side of the pith that is useable for smaller items. If the log is large enough, you may also be able to cut useable wood from the outer slabs for tops, pens, etc. The large slabs from either side of the pith will be bowl blanks.



If the slabs are too large to cut to rounds on your band saw, cut off the corners with the chainsaw. This piece is ready to be mounted on the lathe and roughed out to dry. — *JD*

GRAIN PATTERNS IN BOWLS

This shows the two most common ways to orient a bowl in a half-section of log (the top two images are the same orientation with a different bowl shape in the end), with the resulting bowls and the basic pattern the grain will present in each one. — *JD*



Half-Blind Dovetails by Jig

Not everyone's ready to tackle hand-cut dovetails. Here's how to get the most from your router and jig.

Photos by the author

Dovetail jigs can produce excellent results in a short amount of time. The key is knowing how to adjust the jig to achieve a perfect fit.

Dovetails are prime joints. Long history, great appearance and cachet. Used in boxes, drawers and carcases. But for many woodworkers, cutting dovetails the traditional way – with saw and chisels – is an insurmountable challenge.

If you aren't ready to tackle hand-cut dovetails, there are plenty of router accessories on the market to help. There are so many in fact, and they have so many variations in setup and operation, that I'm going to narrow my focus to the most common: the half-blind dovetail jig.

The typical half-blind dovetail jig consists of a metal base with two clamping bars to hold the workpieces. A comb-like template rests on the top to guide the router in cutting both pieces at once. The appropriate bit and bushing are packaged with the jig. Usually you use a 1/2", 14° dovetail bit and a 7/16" guide bushing to make the cuts.

Use any router, which is to say, the one you have. I typically use a 2-horsepower fixed-base model. The ability to plunge is irrelevant, and plunge routers generally are awkward for work on the edge owing to their high centers of gravity. Brute power doesn't contribute anything. When the urge to rout half-blind dovetails seizes you, get out your jig and clamp it at the edge of your workbench. Presumably, you'll have stored the instructions and the right bit and guide bushing with the jig.

Select your materials and make sure all like parts are jointed and planed uniformly. Not all the parts must be the same thickness. The fronts can be 3/4" thick, and the sides and backs 1/2" thick, for example. Or 3/4" and 5/8". Everything can be 11/16". Just be certain the fronts are consistently sized, the sides are consistently sized, and so too the backs.

Set Up the Router

Install the guide bushing. (If you have a centering mandrel, use it to center the bushing to the bit's axis.) Adjust the router so the collet is relatively close to the bushing. Carefully insert the dovetail bit through the bushing and into the collet. Tighten the collet nut.

Adjust the depth of cut next, as shown on the facing page. When you do this, turn the bit slowly by hand to absolutely ensure that the bit doesn't contact the bushing. The cutting end of the bit is too large to pass through the bushing. If you use a steel bushing, it will damage the bit's carbide, so you want to avoid accidental contact.

Check your jig's instruction for the recommended depth-of-cut setting. It's often in the 21/32" to 23/32" range, depending upon the thickness of the template. A good generic starting point is 3/8" plus the template thickness (to get an accurate measurement of the template, use dial calipers).

Clamp the Work in the Jig

The work has to be clamped in the jig in a particular way. When you cut following the template, tails are formed on the front board in the jig, and sockets into which the tails nest are cut simultaneously into the top board.

So the socket piece – and that's always the drawer front or back – is on top. The tail piece – the drawer side – is at the front. Alignment is critical: The tail board overlaps the end of the socket board, and its end must be flush with the upper face of the socket board. The boards must be perpendicular to each other. In addition, the tail board is offset. Both boards are clamped in the jig with their "inside" faces out.

Here's an easy way to do it. Roughly position the tail piece in the jig, with its top end well above the jig. Slip the socket piece under the top clamping bar, and butt it tightly against the tail piece. Clamp it firmly. Now loosen the clamp holding the tail piece and lower it until its end is flush with the other workpiece. Clamp it firmly.

by Bill Hylton

Bill is the author of several books about furniture construction and router operations. His latest book, released in late 2005, is "Frame & Panel Magic" (Popular Woodworking Books).

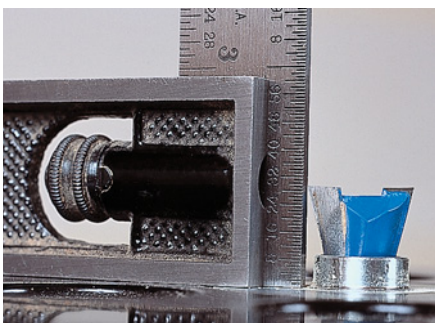
Both pieces need to be against the alignment pins or stops. These pins align the parts so they are offset exactly 7/16", which is half the center-to-center spacing of standard router-cut half-blind dovetails (7/8"). Every jig has these pins on the right and on the left. Use those on the left for now.

The template must rest flat on the work. Its fore-and-aft alignment is critical to the fit of the joint, but don't worry about it for now. Use the out-of-the-box setting for your initial test cuts, and adjust as necessary.

Cut a Test Joint

Rest the router on the template with its bit clear of the work. Switch on the router, and make a quick, shallow scoring cut across the tail piece, feeding from right to left (yes, this is a climb cut).

The purpose of this cut is to prevent tear-out along what will be the inside shoulder.



In setting the depth of cut, you must account for the template thickness as well as the cut itself. Use a small machinist's square to set the bit extension from the baseplate.

What often happens is that the bit blows out splinters as it emerges from each slot of the jig's template. If there's no shoulder established first, these splinters can run down the face of the drawer side, defacing it.

Now rout the dovetails, slot by slot, beginning on the left and working to the right. Feed the router into each slot of the template, then back it out. Keep the router firmly against the template as you round the tip of each template finger; you want to completely form each tail – no little lumps.

I usually zip back through the slots after the first pass, just to be sure I didn't pull out of a slot too soon, leaving that socket only partially cut. Don't just lift the router from the template. The bit will ruin both the cut and the template. Instead, turn off the power and pull the router toward you, getting it well clear of the jig before lifting it.

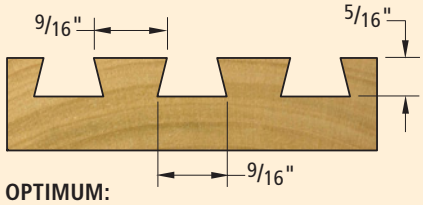
Take a good look at the work and be sure you haven't missed a spot. If you have, re-rout it before moving anything clamped in the jig. Remove the template, unclamp the work, and test assemble the joint.

Fine-tune the Setup

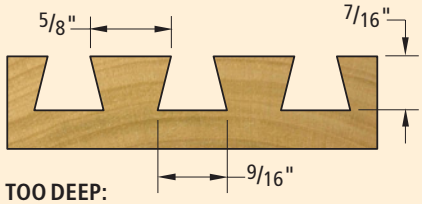
Slip the test pieces together. Maybe something's not quite right. Perhaps the fit is too loose. Or too tight. Or the sockets aren't deep enough. Or the parts are a little offset. All of these ills are cured with some fine-tuning.

The bit's cut depth is the primary control of fit. The way it works is shown in the drawing, "Setting Depth of Cut," above. The cut – the socket – is always the size of the cutter.

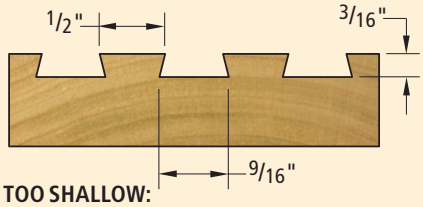
SETTING DEPTH OF CUT



OPTIMUM:
Pin formed matches slot cut by dovetail bit.



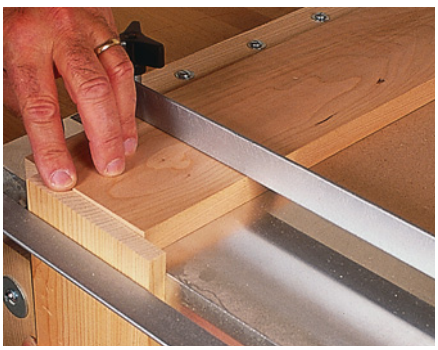
TOO DEEP:
Pin formed is wider than slot.



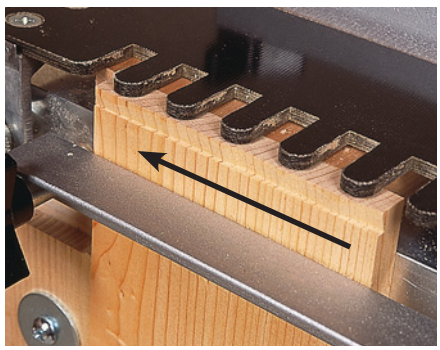
TOO SHALLOW:
Pin formed is narrower than slot.

But when you alter the depth of the cut, the width of the material left between sockets changes. Because you are cutting both tails and sockets at the same time, the material between the sockets is in fact the tail.

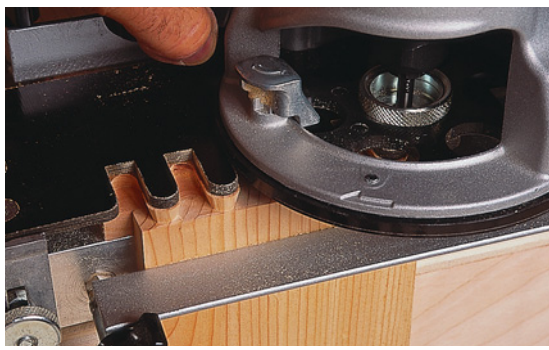
In practice, this aspect of the setup is at the same time deceptive and frustrating. The transition from "no fit" to "perfect fit" is abrupt – just a 1/32" change can make all the



Line up the workpieces carefully as you clamp them in the jig. Snug the end of the socket piece (it's on top) against the inner face of the tail piece (it's on the front). Make sure the pieces are flush against the guide pins or stops. (The pin on the jig is hidden by the socket board and clamping bar.)



Chipping along the shoulder of the tail piece is a problem. To eliminate this, make a shallow scoring cut across the tail piece first. A climb cut – where you feed the router from right to left – is most effective here. Just be sure the router doesn't get away from you.



Move the router along the template, feeding the router into each slot and keeping the guide tight against the template as you come out of one slot and round the finger into the next slot. Any little bump on either tail or socket will prevent assembly of the joint.

difference. What often happens is that you lose confidence in the adjustment regimen after one or two incremental changes with no apparent effect. "Well, this isn't getting me anywhere!" you think, and start adjusting in the other direction. And you seesaw between increasing and decreasing the cut depth, never hit the right setting, get totally frustrated, and shelve the jig, never to use it again.

Take heart. Remember that woodworkers have been using these jigs for decades, and that routers have been pretty primitive tools for most of that time. You can do it. Be patient, methodical and persistent. Here's what you do:

- Reduce the cut depth to loosen the fit.
- Increase cut depth to tighten the fit.

Once the depth of cut is dead on, analyze a new test cut and determine if other adjustments are needed.

The relationship of the joint surfaces is controlled by the template's fore-and-aft position. Ideally, the surfaces are flush when the joint is seated tightly.

- If the side is recessed, the pin is short and the socket is long. Shift the template back.
- If the side is proud of the front's end, the pin is long and the socket is short. Shift the template forward.

Your jig's instruction sheet should explain exactly how to accomplish this. Generally, the template bracket sets against a nut on the mounting stud. Turn the nut and the template moves. These studs usually are 1/4"-20 bolts, so a full turn of the nut will move the template in or out 50 thousandths of an inch.

Look at the edges next. When the joint is assembled, the adjoining edges should be flush. If they aren't, you may not have had the workpieces snug against the alignment pins. Or the pins may be slightly misadjusted.

Any other problems you have will have stemmed from misalignment of the workpieces in the jig. Make sure the top surface of the socket piece is flush with the top end of the tail piece, that they are at right angles to each other, that the template is square to the workpieces, and so forth.

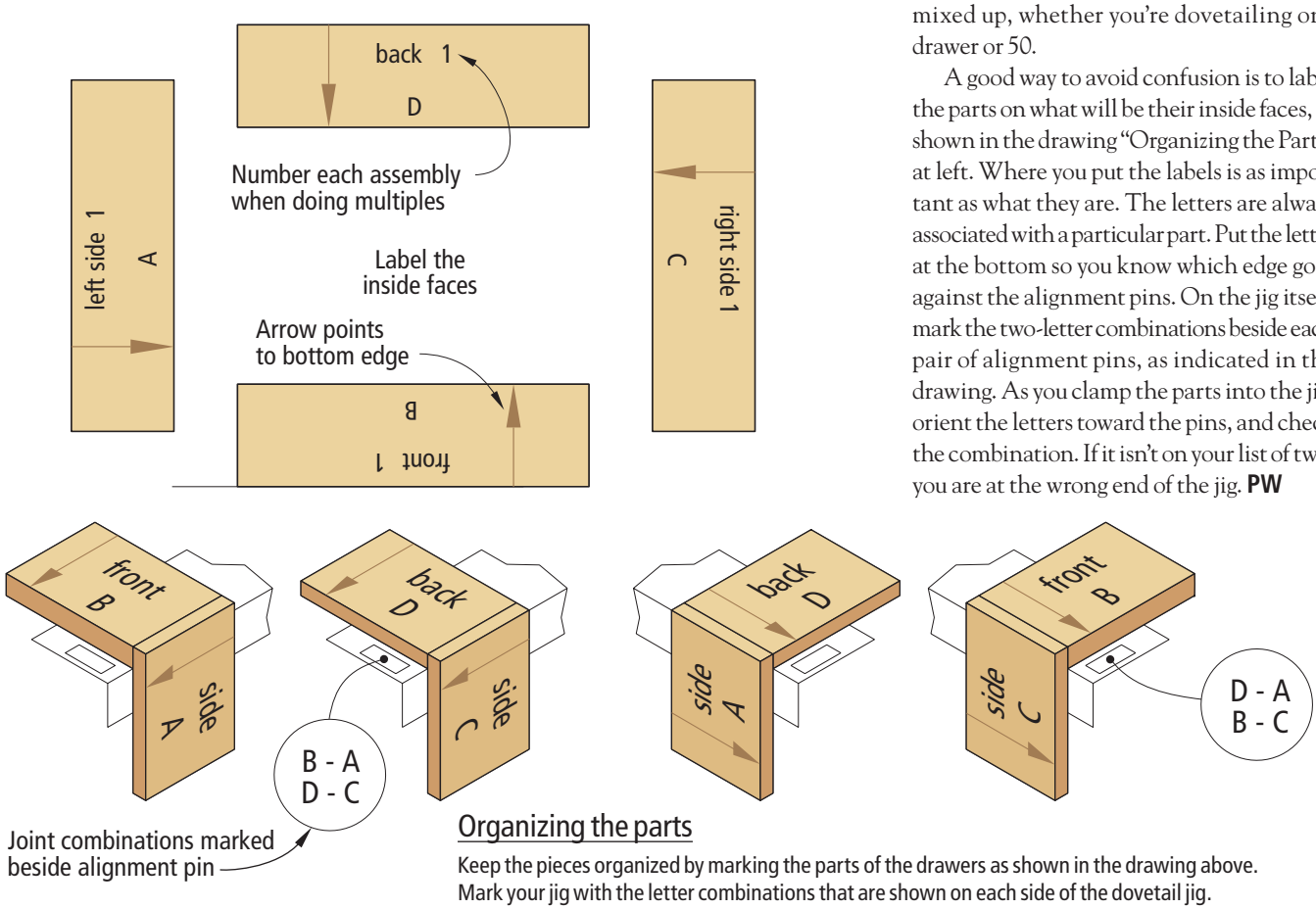
If your test joint doesn't fit fit exactly, the nature of the misfit cues you how to correct it on your next cut. If the tails are tight or loose in the sockets, adjust the cutting depth. If the tails fit, but aren't flush, adjust the position of the template.

When you've successfully fine-tuned the setup using the alignment pins on the left, cut a test joint at the other end of the jig. Do any additional tuning needed there.

Dovetailing the Good Wood

Before starting on the actual project parts, make sure you're organized. The parts are worked "inside out." If you are doing drawers, the sides always go on the front of the jig, and the fronts and backs always go on the top. Some joints are cut on the right side of the jig, others on the left. It's easy to get mixed up, whether you're dovetailing one drawer or 50.

A good way to avoid confusion is to label the parts on what will be their inside faces, as shown in the drawing "Organizing the Parts" at left. Where you put the labels is as important as what they are. The letters are always associated with a particular part. Put the letter at the bottom so you know which edge goes against the alignment pins. On the jig itself, mark the two-letter combinations beside each pair of alignment pins, as indicated in the drawing. As you clamp the parts into the jig, orient the letters toward the pins, and check the combination. If it isn't on your list of two, you are at the wrong end of the jig. **PW**

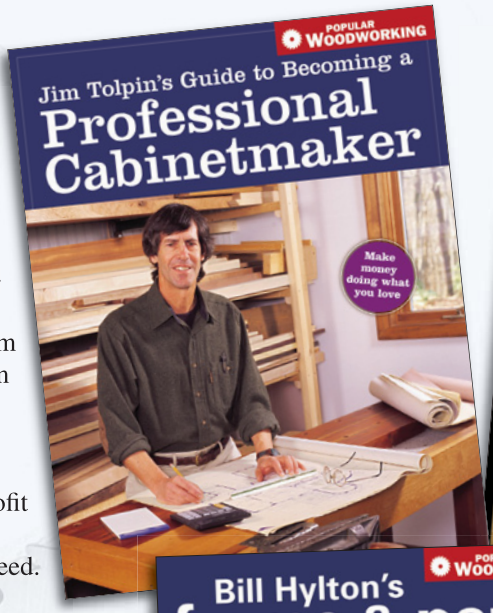


Organizing the parts

Keep the pieces organized by marking the parts of the drawers as shown in the drawing above. Mark your jig with the letter combinations that are shown on each side of the dovetail jig.

TAKE YOUR WOODWORKING TO THE NEXT LEVEL

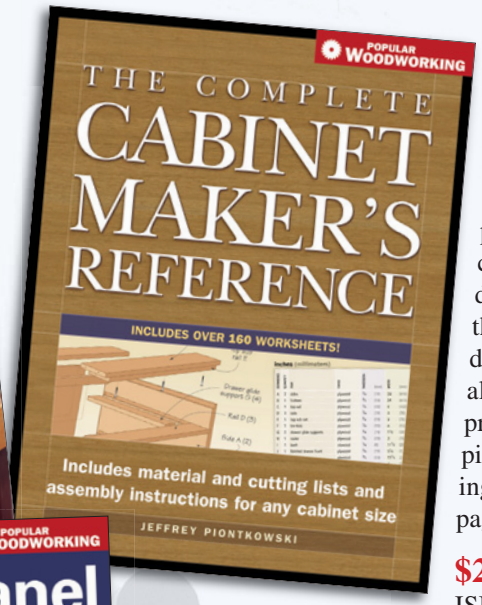
with these books from Popular Woodworking



Jim Tolpin's Guide to Becoming a Professional Cabinetmaker
Jim Tolpin

If you've ever dreamed of turning your cabinet-making hobby into a vocation, learn how from someone who did it. Jim Tolpin provides proven strategies for working with clients, saving on costs and improving profit margins, plus all the business forms you'll need.

$24.99
ISBN 1-55870-753-0
#70705-K



The Complete Cabinetmaker's Reference
Jeffrey Piontkowski

This indispensable resource not only provides complete cutting lists for standard-sized cabinets for the kitchen, bathroom, den and bedroom, but it also shows how to adapt projects for custom-sized pieces. Handy spiral binding makes photocopying pages easy.

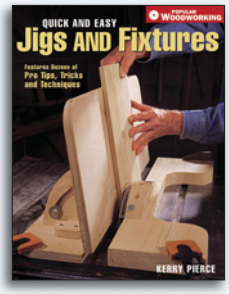
$29.99
ISBN 1-55870-757-3
#70710-K

Bill Hylton's Frame & Panel Magic
Bill Hylton

Hylton makes creating eye-catching panels easy with this definitive guide. Step-by-step techniques for producing raised, flat, veneered, curved-edge, and glazed panels are explained in an unintimidating way that will teach this essential woodworking skill in no time at all.

$24.99
ISBN 1-55870-740-9
#70693-K

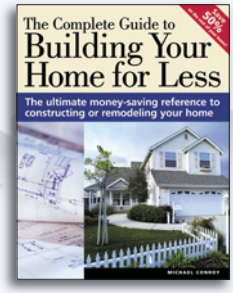
Also available...



Quick and Easy Jigs and Fixtures
Kerry Pierce

Contains nearly two dozen jig and fixture designs for a range of popular tools.

$24.99 • ISBN 1-55870-709-3
#70661-K



The Complete Guide to Building Your Home for Less
Michael Conroy

Insider tips, secrets from the pros and finance-savvy techniques in a single accessible reference.

$19.99 • ISBN 1-55870-769-7
#70721-K

Order these and other Popular Woodworking Books!
Call 1-800-448-0915 or Go online
www.popularwoodworking.com/store/books

POPULAR WOODWORKING BOOKS is an imprint of F+W Publications, Inc.

PRODUCT INDEX

	PAGE #	CIRCLE #	WEB ADDRESS
ABRASIVES			
Norton Abrasives	18	144	nortonabraisves.com
ADHESIVES			
EpoxyHeads	8	115	epoxyheads.com
Franklin International	22-23	121	titebond.com
Gorilla Glue	16	125	gorillaglue.com
Old Brown Glue	102	146	patrickedwareds.com
BITS, BLADES & CUTTERS			
Amana Tool	21	103	amanatool.com
CMT	17	110	cmtusa.com
Forrest	2	120	stores.yahoo.com/forrestman
Freud	49-56	122, 174	freudtools.com
Infinity Tools	87	129	infinitytools.com
Routerbits.com	102	156	routerbits.com
Woodline USA	79	167	woodline.com
BOOKS			
Popular Woodworking Books	95	—	
Woodworker's Book Club	80-81	—	woodworkersbookclub.com
BUILDINGS			
SteelMaster Buildings	103	157	steelmasterusa.com
FASTENERS			
McFeely's	24	140	mcfeelys.com
Miller Dowel	79	141	millerdowel.com
FURNITURE & PROJECT PARTS			
Adams Wood Products	21	100	adamswoodproducts.com
Architectual Products	102	104	archpro.com
Exotic Wood Elegance	102	116	exoticwoodelegance.com
Osborne Wood Products	29	148	osbornewood.com
HAND TOOLS			
Alisam Engineering	102	102	alisamengineering.com
Bob's Rule	87	108	bobsrule.com
Fine Tool Journal	103	119	finetoolj.com
Japan Woodworker	27	130	thejapanwoodworker.com
Lee Valley	87	135	leevalley.com
Lie-Nielsen Toolworks	27	136	lie-nielsen.com
Robert Larson	33	155	rlarson.com
Tools for Working Wood	33	159	toolsforworkingwood.com
Traditional Woodworker	102	160	traditionalwoodworker.com
Wood Artistry	102	165	woodartistry.com
HARDWARE			
Ball & Ball	25	106	ballandball-us.com
Whitechapel Ltd.	21	163	whitechapel-ltd.com
Woodworker's Hardware	27	170	wwhardware.com
KITS & PLANS			
Glen-L Marine	103	124	glen-l.com
Pygmy Boats	103	153	pygmyboats.com
Texas Knifemaker	102	158	texasknife.com
U-Bild.com	103	161	u-bild.com
POWER TOOLS			
Delta Machinery	4-5	112	deltamachinery.com
DeWalt	7	113	dewalt.com
Fein Power Tools	19	117	feinus.com
Festool USA	15	118	festool-usa.com
General Mfg.	24	123	general.ca
Grizzly Industrial	C2-1	127	grizzly.com
Makita USA	C4	138	makitatools.com
Porter-Cable Corp.	12-13	151	portercable.com
Powermatic	C3	152	powermatic.com
RB Industries	25	154	rbiwoodtools.com
Wilke Machinery	29	164	wilkemach.com
Woodstock International	9	169	woodstockinternational.com
POWER TOOL ACCESSORIES			
Beall Tool	103	107	bealltool.com
Craftsman Gallery	103	111	thecraftsmangallery.com
JDS	27	131	thejdscompany.com
Jointech	97	132	jointech.com
Keller & Company	79	133	kellerdovetail.com
Kreg Tool	17	134	kregtool.com
Leigh Industries	33	No	leighjigs.com
Mule Cabinetmaker	8	142	mulecab.com

	PAGE #	CIRCLE #	WEB ADDRESS
Mystic Works	102	143	featherbow.com
Woodpeckers	27	168	woodpeck.com
SAWMILLS & KILNS			
Granberg International	102	126	granberg.com
Norwood Industries	103	145	norwoodindustries.com
SCHOOL/INSTRUCTION			
Center for Furniture Craftsmanship	27	—	woodschool.org
Marc Adams School	29	139	marcadams.com
SHOP ACCESSORIES			
Airware America	102	101	airwareamerica.com
Diefenback Benches	102	114	workbenches.com
Oneida Air Systems	21	147	oneida-air.com
TURNING SUPPLIES			
Augums Pen Works	102	105	augumspenworks.com
Packard Woodworks	103	149	packardwoodworks.com
WOOD & VENEERS			
M.L. Condon	102	137	—
Wall Lumber	87	162	walllumber.com
Woodfinder	103	—	woodfinder.com
Woodworker's Source	102	171	woodworkerssource.com
WOODWORKING CATALOGS			
Hartville Tool	25	128	hartvilletool.com
Woodcraft	11-17	166, 175	woodcraft.com
Woodworker's Supply	21	172	woodworker.com
WOODWORKING SHOWS			
Woodworking Shows, The	87	173	thewoodworking shows.com
Woodworks Shows	100-101	—	woodworksevents.com

See something you want? Need more information?

Use the Free Information Card in this issue to receive free advertiser information.

For ***faster service***, go ***online*** at www.popularwoodworking.com and click "FREE INFORMATION" or ***fax the card*** to 585-321-0043.

Win a Grex 23-Gauge Pinner!

When you request information, you're automatically entered in our drawing to win a Grex P635 23-gauge headless pinner. Pinners are the best tools for attaching delicate mouldings without worrying about splitting the work. This well-designed pneumatic tool shoots up to 1 3/8" pins, a real benefit when attaching 3/4" mouldings. The fit and finish is excellent. It also exhausts out the rear and has a silencer. The safety on the gun is both safe and convenient. The magazine for loading the pins is thoughtfully designed. The tool's shape and size allow you to get in tight spaces under the mouldings. This Grex pinner earned our 2005 Best New Tool award. We'll select one lucky winner from the first 200 information requests received from this issue.

(See Advertiser Index or Product Index for circle numbers.)

ADVERTISER INDEX

Common Spray Gun Problems

Don't be a drip – learn how to keep your equipment in fine working order.

In the last issue I showed you how to maintain and clean a spray gun. Keeping parts oiled and the spray gun free of gummy or solidified finish is critical for achieving good results. Problems can still occur, however, even with a clean spray gun.

The most common problems are unevenness in the spray pattern, pulsating spray and a gun that drips. Following is a discussion of how you can identify and correct each of these problems.

Photos by the author

Spray Pattern That's Heavy at the Ends or in the Middle

Spray normally exits a spray gun in an oval pattern, often called a "fan" because it resembles the shape of an unfolded hand fan. To get an even coating on the wood, the fan pattern should be even from end to end.

Uneven spray patterns that are heavy at both ends or heavy in the middle and light at the ends are common problems, especially if you use a compressor (instead of a turbine) to supply the air. The uneven pattern is caused by the air pressure you are using not being appropriate for the viscosity of the liquid you're spraying.

Too much air pressure will push the liquid to the ends of the spray pattern. Too little air pressure will leave the liquid bunched in the center of the spray pattern.

With this explanation, the correction is obvious. If the fan pattern is heavy at the ends, decrease the air pressure or increase the viscosity of the finish (add less thinner). If the fan pattern is bunched in the middle, increase the air pressure (if you are using a compressor) or add thinner to decrease the viscosity of the finish.

If you are using a turbine to supply air to your spray gun, you have to thin the finish to correct a center-heavy fan pattern because you can't increase the air pressure.

To test your spray pattern, spray a short burst of finish onto paper, cardboard or scrap wood. The goal is to create an elongated and evenly shaped oval pattern.

Spray Pattern Heavy at One End

If the spray pattern is heavy at only one end, there is an obstruction in the air cap or fluid nozzle, or one of these parts is damaged.

To determine which part has the problem, spray a short burst of finish onto paper, cardboard or scrap wood. Then rotate the air cap one-half turn and spray another burst. If the disrupted pattern stays the same, the problem is in the fluid nozzle. If the pattern reverses, the problem is in the air cap.

Try cleaning the part that is causing the problem. If this doesn't work, the part is probably damaged (usually the tip of the fluid nozzle), and you will have to replace it.

by Bob Flexner

Bob is the author of "Understanding Wood Finishing" (Reader's Digest) and a contributing editor to Popular Woodworking.

Pulsating Spray

A pulsating or fluttering spray is usually caused by blockage in the spray-gun cup's air-inlet hole. When finish is being drained from the cup as you spray, the volume has to be replaced by air. If the air-inlet hole is blocked, the replacement air can enter only through the fluid passageway and this results in a pulsating spray. (It's similar to the "gluck, gluck" when you pour paint thinner rapidly from a full can.)

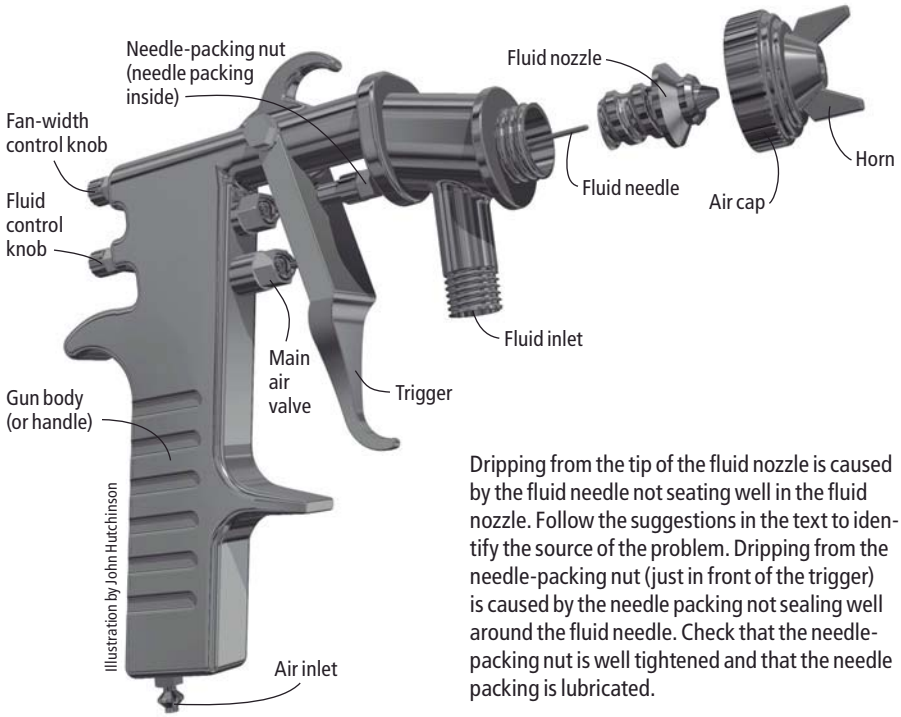
The solution is obvious. Clean the air-inlet hole on the cup.

Pulsating can also be caused by air getting into the fluid passageway and mixing with the finish. There are three ways this can happen.

- The most common is tipping a gun with a low liquid level in the cup too far as you spray. Be sure that the angle of the bend in the tube running into the cup is forward, and add more stain or finish if necessary.
- The cause can also be a needle packing (the gasket that surrounds the fluid needle

just in front of the trigger) that is dry or too loosely compressed by the needle-packing nut, or an untightened or damaged fluid nozzle. Check the tightness of the needle-packing nut and fluid nozzle, and if this doesn't solve the problem, oil or replace the needle packing or replace a damaged fluid nozzle.

• An obstruction in the fluid passageway may also allow air to enter the fluid stream. Try "backflushing" the passagway by pressing your finger over the center hole of the air cap while spraying a short burst. If this doesn't remove the obstruction, take the gun apart and do a thorough cleaning.



Dripping from the tip of the fluid nozzle is caused by the fluid needle not seating well in the fluid nozzle. Follow the suggestions in the text to identify the source of the problem. Dripping from the needle-packing nut (just in front of the trigger) is caused by the needle packing not sealing well around the fluid needle. Check that the needle-packing nut is well tightened and that the needle packing is lubricated.

Dripping from the Front of the Gun

The cause of fluid (stain or finish) leaking from the tip of the fluid nozzle at the front of the spray gun is the fluid needle not seating well in the fluid nozzle.There are a number of possible causes. Here are the most common in rough order of their frequency.

• The packing that surrounds the fluid needle may be squeezed so tightly by the needle-packing nut that it prevents the needle from moving freely. Loosen the nut a little.

• The needle packing may have dried and hardened to the point that it doesn't allow the needle to close tightly. Lubricate the needle packing with a non-silicone oil such as mineral oil. Apply the oil to the fluid needle and move it back and forth several times with the trigger, or remove the needle and needle-packing nut and apply several drops of oil directly to the packing.

• There may be dirt, paint or finish stuck in the tip of the fluid nozzle that prevents the fluid needle from seating fully. Clean the fluid nozzle.

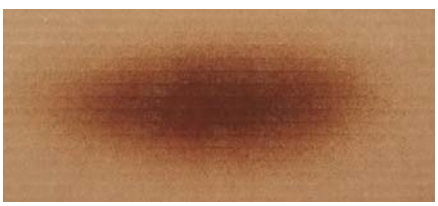
• The tip of the fluid nozzle or the tip of the fluid needle may be badly worn or damaged, which prevents proper seating. Replace the damaged part.

• The spring that pushes the fluid needle closed may have weakened or broken. This spring is located just inside the screw-knob on the back of the gun that controls the fluid needle. Replace the spring.

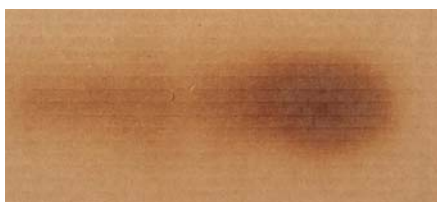
• The fluid needle may be too small or too large for the fluid nozzle, which prevents proper seating. Change parts so the two seat well. Fluid needles and nozzles are sold as sets meant to work together. You can buy them from the manufacturer of your spray gun.

To get an even coating using a spray gun, the spray pattern should be an elongated oval that is even from end to end.

If the spray pattern is heavy on the ends and light in the middle (called a "split" pattern), there is too much air pressure for the viscosity of the liquid. Reduce the pressure or add less thinner.



If the spray pattern is bunched up in the center even with the spray-gun controls wide open, there isn't enough air pressure for the viscosity of the liquid. Increase the air pressure (if your air is supplied by a compressor) or thin the liquid.



If the spray pattern is heavy at one end, there is an obstruction in the fluid nozzle or air cap, or one of these parts is damaged. Clean the gun. If this doesn't solve the problem, the damaged part must be replaced.

Dripping from the Packing Nut

If the needle packing isn't sealing well around the fluid needle, fluid will pass through and drip from the needle-packing nut. There are two possible causes.

• The needle-packing nut may not be screwed on tightly enough to press the needle packing into contact with the needle. Try screwing this nut tighter (but not so tight that it interferes with the easy movement of the needle).

• The needle packing may be worn or dry. First, try lubricating the packing with a non-silicone oil such as mineral oil. If this doesn't work, replace the packing with a new one, which you can get from your spray-gun supplier or from an auto-body supply store. **PW**

the Wood Works Show

...revs up & comes alive!

See the newest **tools** and **supplies** you won't find in retail stores. **Watch** and **learn** from experts who come from around the world. **Meet** and **network** with other woodworkers who share your interests.

the Show that has it all

★**Somerset, NJ**
Garden State
Exhibition Center
January 6-8, 2006

3rd Year! **Springfield, MA**
Eastern States Exposition
January 13-15, 2006

4th Year! **Ontario, CA**
Ontario Convention Center
February 3-5, 2006

★**Green Bay, WI**
Brown County Veterans
Memorial Complex
February 10-12, 2006

★**Palmer, AK**
Alaska State Fairgrounds
March 24-26, 2006

★**San Rafael, CA**
Marin Center
April 21-23, 2006

SHOW HOURS
Friday 12pm–6pm
Saturday 10am–6pm
Sunday 10am–4pm
Admission Only $10

★New Location

www.woodworksevents.com

the WoodWorks Show in Action!

- 100 plus exhibitor booths (compare before you buy)
- Continuous floor demonstrations (furniture making, joinery, turning++)
- In-depth seminars with experts & authors (2-hour classes)
- Meet manufacturer reps (Jet, Bosch, Laguna, Micro Fence++)
- Special Show prices (great deals)

3 days only~ Don't miss out!

...the best new deal in woodworking!

Presenting Sponsor

POPULAR WOODWORKING

Invites you to be part of these great shows, coming to your hometown. See you there!

Education Sponsor

JET. POWERMATIC

Finishing Sponsor

ZINSSER

SawDust Café Sponsor

Mini Max USA

Turning 'In Sponsor

Woodturning Design

WOODWORKS EXHIBITORS* (partial list)

Adjust-A-Bench
Allied Piano/Webb Phillips & Assoc.
American Tool
Antique Toolwear
Bad Dog Tools
Battels Hardware & Tool Co.
Bench Dog
Bessey Clamps
BladePoint Laser Guides
Bosch Tools & Accessories
Brentwood Machinery & Tools
Colonial Saw Co.
Compliant Spray Systems
Delta
DeWalt
DMT®
Drill Doctor
Enviro-Safety Products
Epilog Laser
Excalibur
FeatherBow®
Fein
Festool
Fine Tool Journal
Fisch Precision Tools
Freud
General
Grex Power Tools
Gross Stabil
Hawk Woodworking Tools
Hearne Hardwoods
Hegner
JapaneseTools.com
JDS Company
Jet Equipment & Tools
Jevons Tool Company
Jointech
Kreg Tool Company
Laguna Tools
Larry's Tool Outlet
Lee Valley & Veritas Tools
Legacy Woodworking Mach.
Makita
Manny's Woodworker's Place
Mesa Vista Design
Micro Fence
Mini Max USA
Miracle Products
New Edge Cutting Tools
One Man Stand
Oneway Manufacturing
Performax
Porter Cable
Powermatic
PS Wood Machines
Quality Engraving, LLC
Quickgrip
Ridge Carbide Tool Co.
Rikon Power Tools
SandFlee®
Senco
Sommerfeld's Tools for Wood
Sunhill Machinery
Swing Paints
Time-Shaver Tools, Inc.
Tool Factory Outlet
Tool Time Liquidators
Trend
TruGrip™
Turbinaire
West Penn Hardwoods
Williams & Hussey Mach. Co.
Wilton
Wing Enter / Little Giant

*Not all exhibitors at all locations. Visit our web site for updated list.

the WoodWorks Show

Call 866-917-4408 or visit woodworksevents.com

Order your tickets online and save!

www.woodworksevents.com

WOODWORKER'S MARKETPLACE

Classified

Classified rate is $5.00 per word, 15-word minimum. Order must be accompanied by payment; ads are non-commissionable. Send to: Popular Woodworking, 4700 E. Galbraith Rd., Cincinnati, OH 45236. Phone: 610-821-4425, Fax: 610-821-7884.

Bits, Blades & Cutters

PLANER KNIVES ANYONE CAN CHANGE at a price anyone can afford. Instant, accurate knife changes. Every machine, every time. German quality. Time-proven performance. Superior customer service. Dispoz-A-Blade.com. 800-557-8092.

Books

WE HAVE A WIDE VARIETY of woodworking books – from small projects, to home improvement, to enhancing your woodworking skills, and more! To see our full line of books, please visit our web site at www.popularwoodworking.com/store/books!

Business Opportunities

$400 WEEKLY ASSEMBLING PRODUCTS from home. Rush SASE: Home Assembly - PW, Box 216, New Britain, CT 06050-0216.

Finishing Supplies & Equipment

SPRAY-ON SUEDE – Line boxes easily. Free brochure with sample. DonJer, 13142 Murphy Road, Winnebago, IL 61088; 800-336-6537; www.donjer.com

Kits & Plans

CARLYLE LYNCH MEASURED DRAWINGS Museum and private collection furniture plans by Carlyle Lynch. Catalog $2. PO Box 13007, Arlington, TX 76094; 817-861-1619.

Power Tools

FEIN TOOLS - YOU'RE JUST ONE CLICK AWAY from the Fein Tools that you can'tdo without - MultiMaster Tools - Sanders - Routers - Grinder - Vacuums and more, plus all Accessories and Parts. http://www.waltertool.com or 800-356-6926.

Schools/Instruction

WOODWORKING COURSE Novice through intermediate, self-paced. Interactive CD-ROM based. Windows compatible. Only $29.00. Order at www.fineboxes.com or 613-821-5160.

Tools

CNC ROUTER FACTORY SALE
4x8 Complete with Controller $4,999.00
16"x16" Complete with Controller $3,450.00
1x1 Complete with Controller $2,950.00
Allow 5 to 6 weeks for delivery.
If you're not in a hurry you can save big.
Ask about refurbished units and save more.
Get photos by email at router@darientel.net
912-269-0134. www.cncwoodrouter.com

Wood & Veneers

WWW.WALNUTWOODS.NET Black Walnut Burl Veneer, lumber, turning stock, gunstocks. Buckeye Burl slabs. Call 559-277-8456, Newton Woods, Fresno, CA.

Hardwood/Softwood Lumber

HARDWOOD FLOORING, oak $2.20 sq.ft. Custom molding. Spread Eagle Woodworks. 715-696-6174. www.gopicturethis.net

Small Shop, Big Lessons

Many woodworkers dream of 'going pro.' Before you take the leap, read this.

Illustration by Pat Lewis

It's now been more than three decades since I began to work wood for a living. In the beginning, I operated alone out of a one-car garage outfitted with a minimal number of tools. Today, I am the sole proprietor of a one-man cabinet shop, operating out of a two-car garage outfitted with a minimal number of tools. "That boy's gone far," I can hear you saying. "Now he's got room for a second car." There is, however, an important difference: This boy can now afford a second car!

It took nearly a decade, however, before I could make that claim. It took that long for me to realize that it wasn't my woodwork that needing improving, but rather the way in which I was working the wood. Let me explain: I had started out building highly refined pieces of casework, filling them with lovely hand joinery and intricate detailing, and calling the results of my efforts kitchen cabinets. But unlike the other cabinetmakers in town (who also produced what people called kitchen cabinets), I was going broke like nearly every custom furnituremaker I had ever met. Here's what I finally figured out was going wrong:

First, I did not have the faintest idea about how to go about building cabinets – in fact, I didn't really know what a kitchen cabinet was. Second, my methods and tooling, such as they were, were primitive and counterproductive. And third, I was an abysmally poor businessman. If I was going to make a real living at this game, I was going to have to understand what the market considered a quality piece of cabinetry; learn how to build it as efficiently as possible; and figure out how to better present myself and my products to the public.

I began my education by visiting a high-end cabinet retail outlet. People spent good money for these cabinets and I wanted to see what was so good about them. Looking closely at the simple but refined casework – which was actually not that costly – I discovered their secret to producing such a product at such a price: Modular case components and interchangeable hardware systems. What a revelation! One size of case component, fitted with a double row of holes, could serve any type of cabinet by carrying any combination of doors, drawers, rollouts or shelves. The beauty of it boggled the mind – especially the fact that such a system could be easily and efficiently produced in a small shop.

The trick was to stop thinking "furniture" and start thinking "casework." Taking this to heart, I revamped my shop with tooling that could efficiently cut sheetstock to size and produce rows of holes on 32mm centers to accept the European hardware system. I also revamped my woodworking process, coming up with a production flow chart that mapped, grouped and sequenced the cabinetmaking process, start to finish.

Then came the hard part – figuring out how to better sell my products to the public. It turned out that this really meant figuring out how to better sell myself. Not even having an act to clean up, I had to make one up! By observing and talking with some successful businessmen I learned not only the nitty-gritty of paperwork and business structures, but also how to deal pleasantly (and profitably) with the cast of characters that populate the world of the businessman.

What I ultimately ended up with was the ability to create and sell an attractive piece of cabinetwork (not furniture!) whose market value made it worth my time to produce. If I hadn't learned to do that within my first decade in the business, I probably would have ended up going back to college for an advanced degree and would now be stuck with a real job. I shudder to think .... **PW**

by Jim Tolpin

Jim adapted this article from his latest book, the revised edition of "Jim Tolpin's Guide to Becoming a Professional Cabinetmaker" (Popular Woodworking).

POWER IS NOW ON REBATE

LOOK FOR THE "POWER DOLLAR$" TAG AND SAVE BIG!

Powermatic's Feature-laden 14" Band Saw
"Powermatic's 14" band saw has all the bells and whistles...this is a quality machine. The bottom line is this: In the 14" cast-iron category, the Powermatic PWBS-14CS [is] loaded with all the features available and puts in a great performance."
Performance: ●●●●●

— David Thiel, Senior Editor
Popular Woodworking, October 2004

The Gold Standard Since 1921.®

POWERMATIC®

powermatic.com

SELECT POWERMATIC PRODUCTS ON REBATE. See participating stores for details.
Purchase must be made between September 1, 2005 and March 31, 2006 to qualify.
CIRCLE NO. 152 ON FREE INFORMATION CARD.

18V POWER. 12V WEIGHT.™

LXT LITHIUM-ION

3 YEAR WARRANTY

visit makitatools.com or call 1-800-4MAKITA

18V 4-Piece Combo Kit (LXT400)

FREE 18V LXT Recipro Saw by Mail with purchase of Combo Kit (LXT400)
Limited time offer, visit makitatools.com for details.

THE FUTURE OF CORDLESS IS NOW.

Makita's new LXT is Lithium-Ion Extreme Technology. The new Makita built, 4-pole maximum torque motor delivers more efficient power in a compact size. LXT is 40% lighter with an ergonomic shape that fits like a glove. The LXT Lithium-Ion Battery and Optimum Charging System produces 280% more lifetime work with 2X more cycles. The Optimum Charging System also controls the current with a CPU and built-in fan to maximize the overall battery life.

MORE WORK. LESS WEIGHT. BETTER ENGINEERING.™

makita®
INDUSTRIAL POWER TOOLS

CIRCLE NO. 138 ON FREE INFORMATION CARD.