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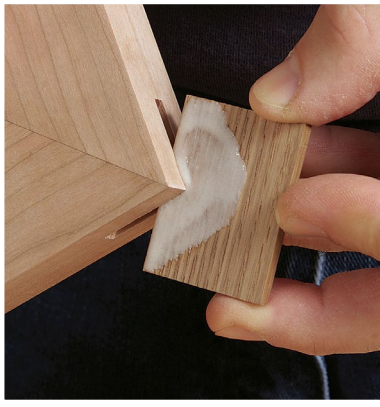

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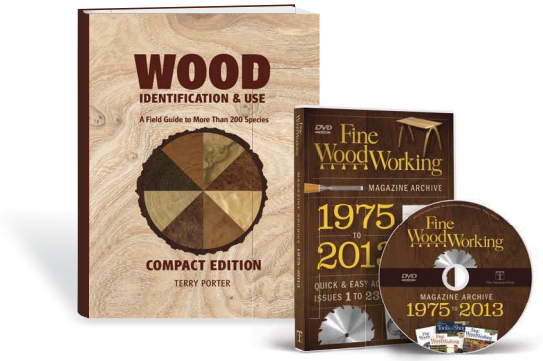

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The Taunton Press

THE BEST OF Fine WoodWorking

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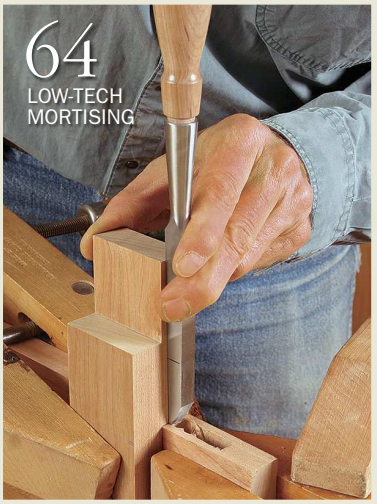

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editor's letter

GET SERIOUS ABOUT JOINERY

Even if your furniture has perfect proportions, glass-smooth surfaces, and a flawless finish, it will fall apart in time if the joinery isn't up to snuff. After all, the essence of fine woodworking—building pieces to last—is being able to cut and fit sound joinery.

Most furniture has more than one type of joint in it, with each assigned a specific function in the piece—dovetails for drawers, mortise-and-tenons for doors or table legs. That means you need to know how to cut a wide range of joints. Fortunately, they're all here in this special collection of articles from *Fine Woodworking* magazine.

We combed our archives to find the best, most comprehensive joinery techniques. Some are traditional and recognizable, while others truly are cutting edge. Take dovetails, for instance. We offer a time-tested hand-cut method, but for those who prefer power tools, we've included two fast machine methods using either the bandsaw or tablesaw. Each one allows you to be creative with the layout and make dovetails that look handmade.

But it's not just dovetails. We'll also show you how to cut clean miters with precision, how to tackle tight-fitting mortise-and-tenons even if the pieces are curved, and where and how to use screws, dowels, and biscuits effectively. Finally, we'll show you how to fix, or hide, the most common joinery mistakes we all make—even the pros.

So dive in and discover new, or better, ways to work. Soon you'll be well-prepped to build any type of furniture, from boxes to tables to chests of drawers, and to build each one to last.

—Tom McKenna, *Joinery* editor

The Best of Fine Woodworking

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The Best of Fine Woodworking: (ISSN: 1936-8127) is published by The Taunton Press, Inc., Newtown, CT 06470-5506. Telephone 203-426-8171. Canadian GST paid registration #123210981.

Printed in the USA

on the web

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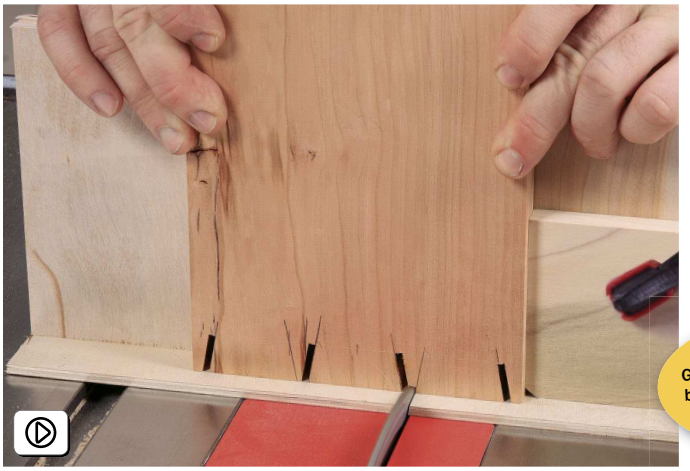

Tips for Tablesawn Dovetails

When faced with a daunting number of dovetails, set down your router and fire up your tablesaw. Our quick video takes you through the entire process, step by step.

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3 Steps to Great Glue-Ups

From edge joints and mortise-and-tenon joints to dovetails and dadoes, our series on great glue-ups will ensure that your joints stick for the long haul. Learn the how, why, and where for gluing a wide variety of woodworking's most common joints.

Better Joints with a Handsaw

Why bother with finicky machinery and jig setups when building a one-off furniture project? The humble backsaw is ready to go, straight out of your toolbox. Learn a variety of exercises designed to boost accuracy when cutting joints by hand.

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Sharpen Your Tablesaw Skills

Learn how to unlock your tablesaw's full potential with furniture maker and teacher Marc Adams. Our latest workshop highlights a variety of techniques, including how to:

- Build your own splitters and zero-clearance throat plates
- Construct a custom crosscut sled
- Tackle basic joinery

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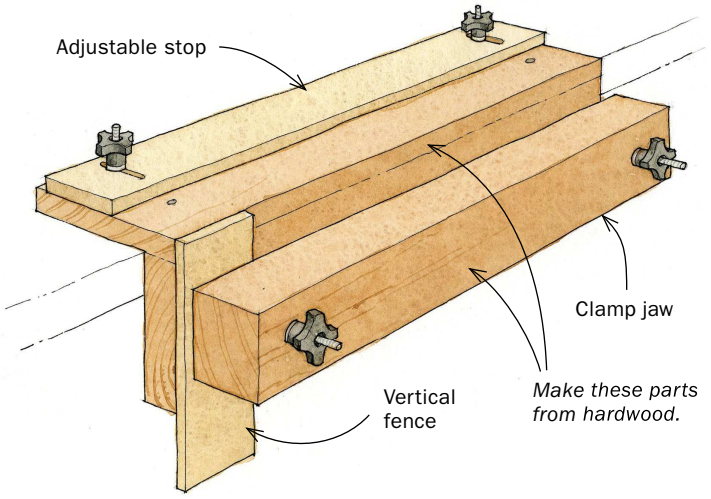
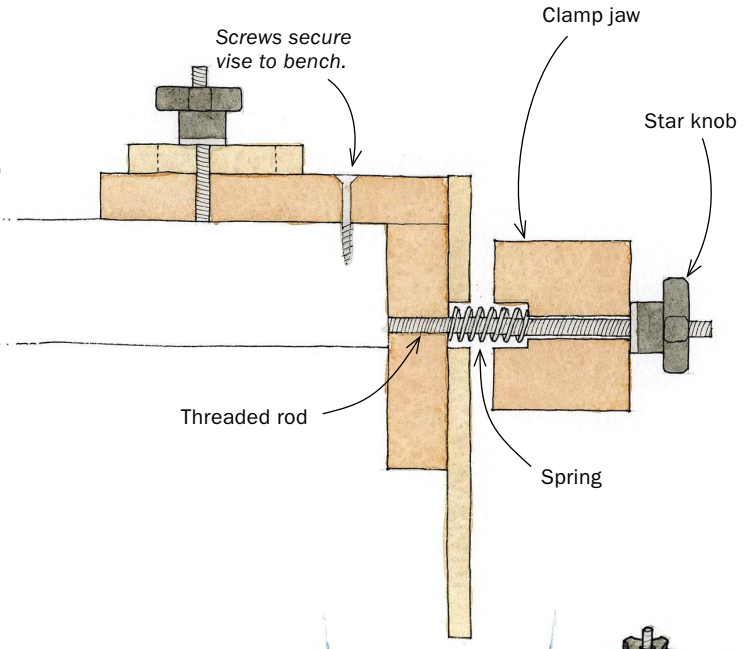
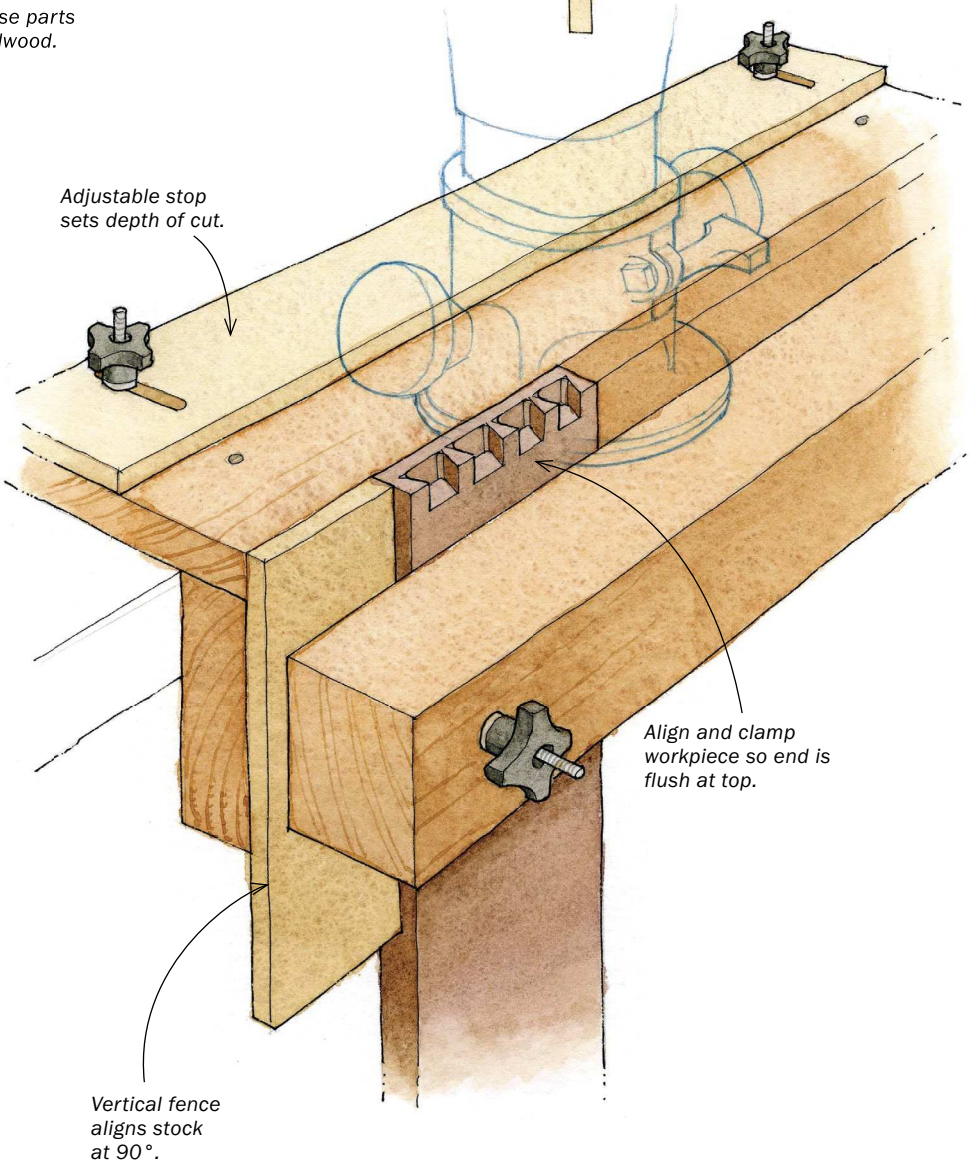
quick tips

EDITED AND DRAWN BY JIM RICHEY

Portable vise is great for dovetailing







I made this fixture for routing away the waste between pins in half-blind dovetails, but it also works well for tasks like sawing the tails or routing a dovetail socket in the top of a table leg.

It is essentially a portable, twin-screw vise mounted on a right-angle bracket that gets screwed to the edge of a bench. An adjustable stop at the rear of the fixture sets the router's depth of cut.

Use a tough hardwood like oak or maple for the wooden parts. Make the twin screws from ⅜-in. threaded rod cut into 7-in. lengths and mount them in a pair of holes that are either tapped or fitted with threaded inserts. A pair of matching but slightly larger holes in the clamp jaw allow for a sliding fit. I counterbored these holes on the backside to accommodate compression springs that make it easier to open the jaw. Finally, I glued a thin vertical fence to the fixture, drilling through the fence to accommodate the left-hand screw, to keep the workpiece perpendicular.

Clamp the workpiece in place so the end is flush with the top of the vise. Now set the stop parallel to the work so that it stops the bit on—or just short of—the baseline.

I like a ¼-in. straight bit for this task because it lets me cut to full depth in one pass and is easy to control. After routing as close to the layout lines as I dare, I keep the workpiece in the vise and trim the pins to fit with a sharp chisel.

—PHILIP A. HOUCK, Boston, Mass.

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Dedicated sled delivers perfect finger joints

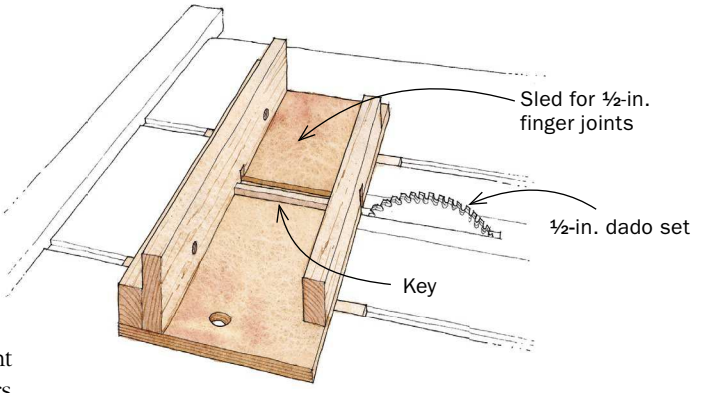
Most tablesaw jigs for cutting finger joints (also called box joints) mount to the miter gauge and must be tweaked every time they are reattached. I took a different approach, making a simple sled to cut one size of fingers.

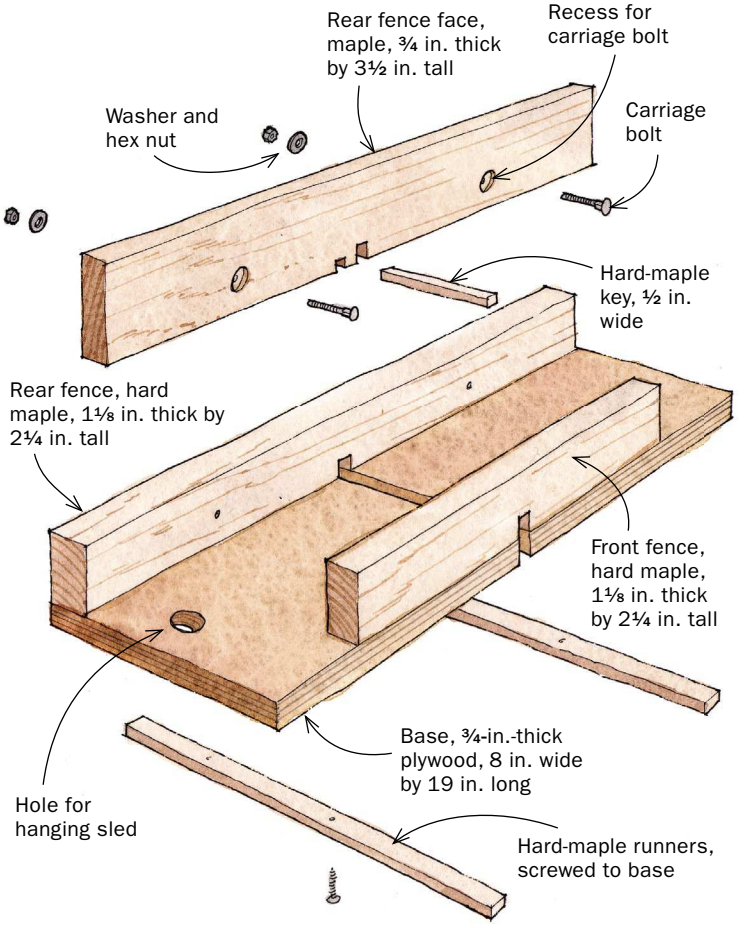
The sled shown here makes ½-in. fingers. After assembling it, cut a ½-in. dado slot through it, and then use the same dado setup to cut a notch ½ in. wide by ¼ in. deep in the lower edge of the rear fence face. Don't bolt this fence face to the rear (fixed) fence just yet.

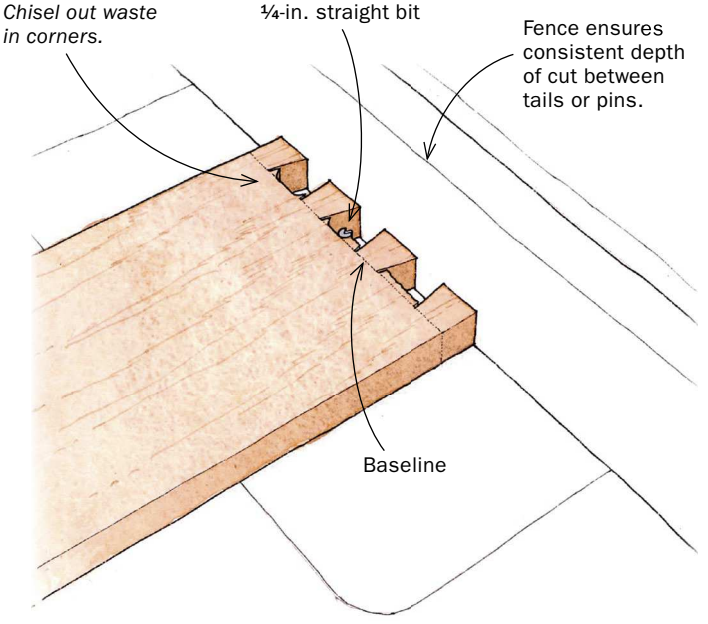
Glue a snug-fitting key in the notch and, using a scrap of the key stock as a spacer, position the fence face so the key is ½ in. from the slot in the base (this dimension will change if you use different size fingers). Clamp the fence face at this position, then install small recessed carriage bolts from the front of the fence face, enlarging the holes through the fixed fence slightly. Lock the fence with washers and hex nuts and cut a trial joint. If you need to adjust the setup, loosen the hex nuts slightly, tap the fence face left or right as needed, and retighten the nuts.

To use the jig, mount the appropriate dado blades, set the depth of cut to accommodate the stock thickness, and go. You can add a sacrificial backer board (¼-in. hardboard) to reduce tearout when cutting fingers that are shorter than the slot in the fence. The ½-in. fingers work well for most of my needs, but if you need other sizes, make a separate jig for each size.

—DENNIS THEISEN, Grand Rapids, Mich.







Trim dovetail waste on the router table

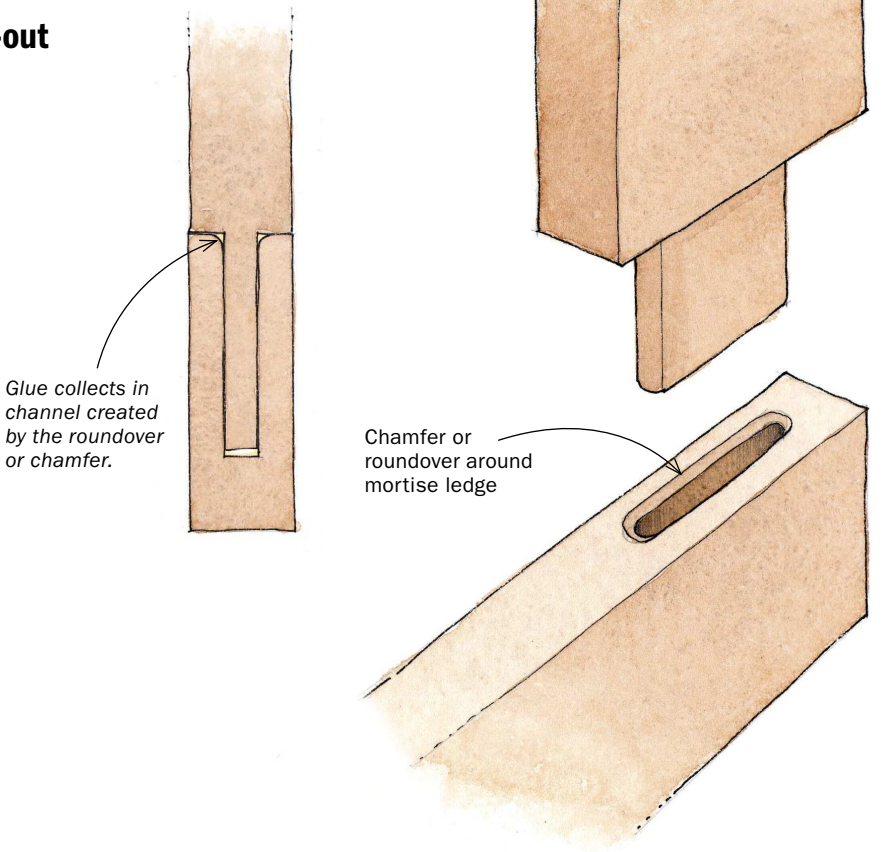
Here's a neat way to clean out waste between hand-cut dovetails and pins, without cutting beyond the baseline. First, mark out the tails (or the pins if you prefer) and use a handsaw to cut the sidewalls. Remove most of the material between tails with a coping saw, leaving about ⅛ in. of waste at the bottom. Now, use a small straight router bit in a router table to clean out the rest of the waste. Use the fence to register the workpiece and to ensure the bit cuts to a consistent depth between tails. Don't let the bit slip into the tails. This process leaves the bottom of the waste area perfectly square to the sides and perfectly straight and flat. All that remains is a small amount of chisel cleanout in the corners. The waste between pins can be cleaned out the same way.

—BILL LAW, Cincinnati, Ohio

Mortise-and-tenons with no squeeze-out

Like other woodworkers, I'd had problems with glue squeezing out of mortise-and-tenon joints as they're clamped up. So I came up with the idea of chamfering or rounding over the top edge of the mortise. As the tenon is inserted, excess glue collects in the channel created by the chamfer, instead of oozing out. The tiny chamfer will not weaken the joint. You can make the chamfer with a carving knife or a roundover router bit with a small pilot bearing. I use a ¼-in. roundover bit with a 3⁄16-in. pilot and adjust the height to give a roundover between 1⁄16 in. and ⅛ in. Miniature brass-pilot roundover bits as small as 1⁄16 in. are available from pricecutter.com and other suppliers.

—CURTIS WHITTINGTON, Boerne, Texas



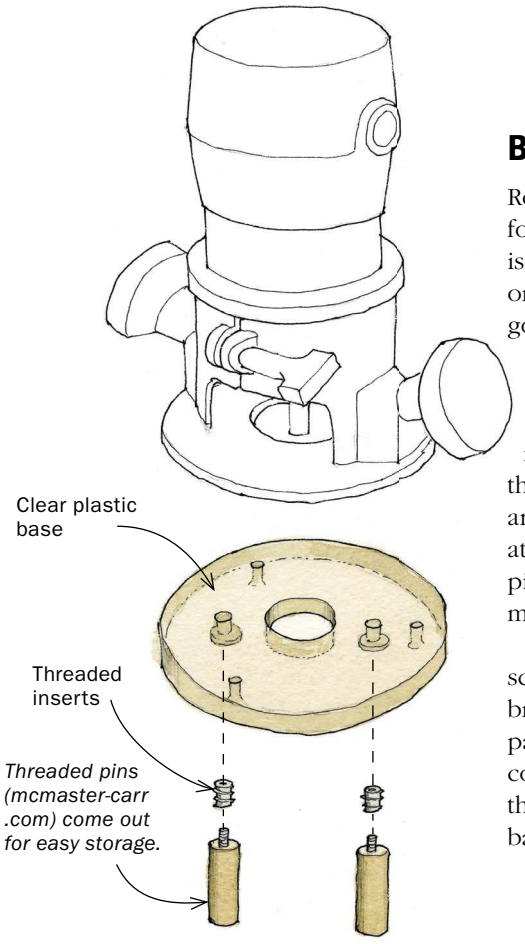
Better base for routing mortises

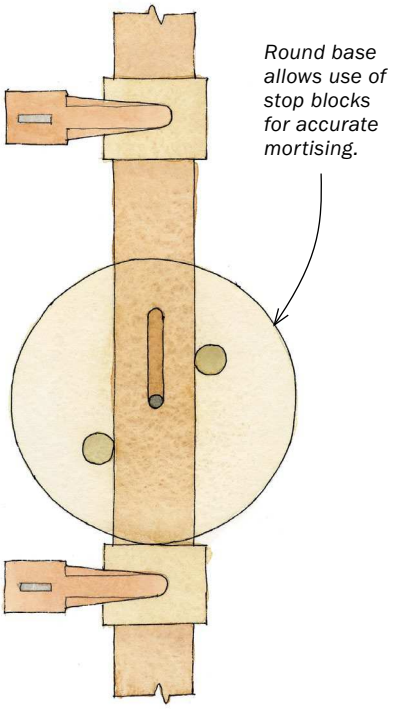
Recently I made a self-centering mortising base for my router. Unlike others I'd seen, this base is made from ½-in. or ¾-in. Plexiglas, acrylic, or Lexan. The clear base lets me see what's going on when using the tool.

Instead of square, I made the base round, which allows me to clamp stop blocks on the workpiece to control the length of the mortise. A round base will always contact the stop block at the center. A square base, angled to make the cut, will strike a stop block at its corner, which could cause the router to pivot offline. This is enormously helpful when making identical mortises in a set of legs.

Finally, my router base has removable screw-on pins. This way the pins can't be broken off or bent and made loose. I epoxy a pair of threaded inserts in the base and then counterbore the base with a Forstner bit to seat the pins. The result is a sturdy and storable base that will last quite some time.

—ADAM LINDSAY, San Diego, Calif.



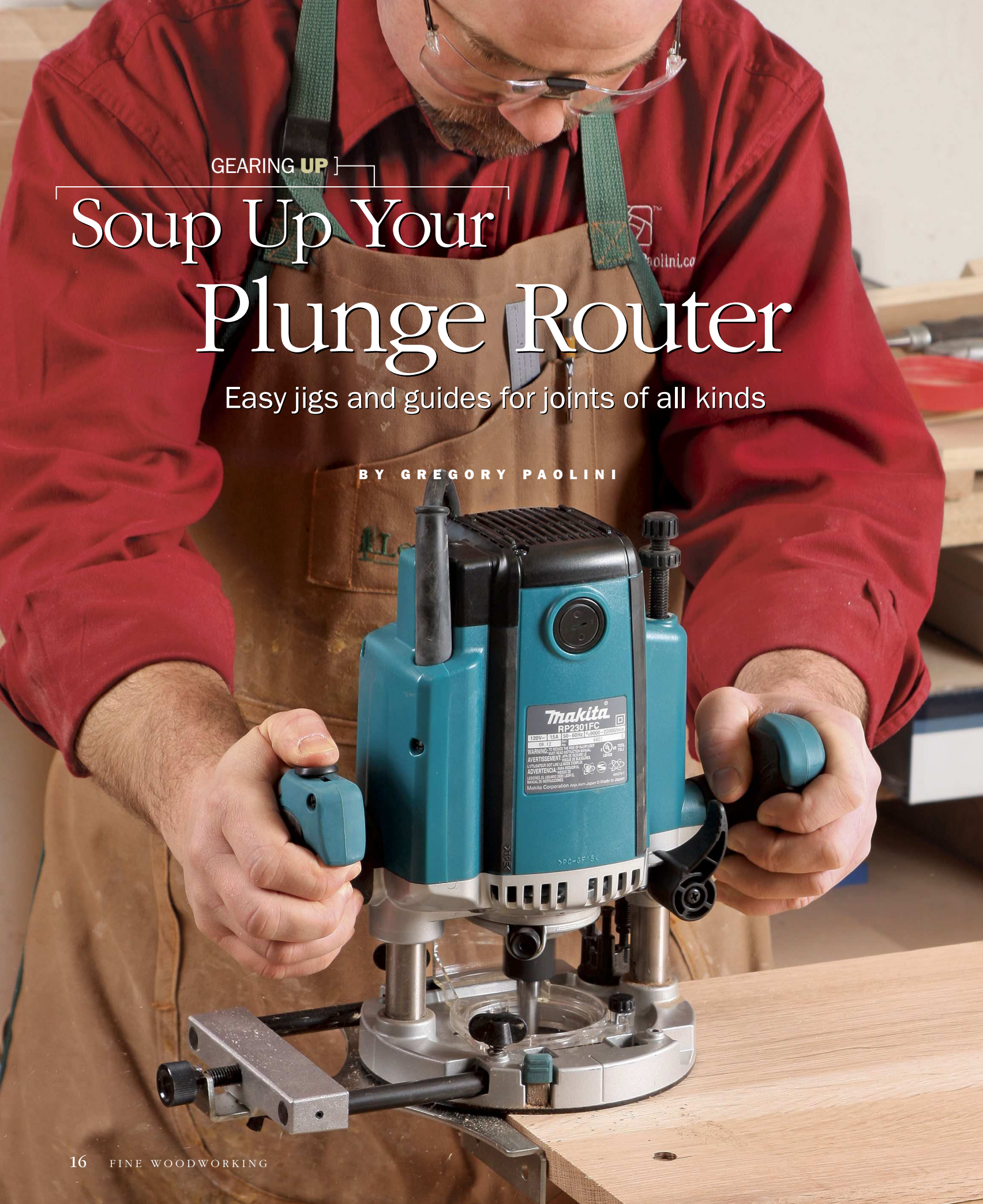


GEARING UP

Soup Up Your Plunge Router

Easy jigs and guides for joints of all kinds

BY GREGORY PAOLINI



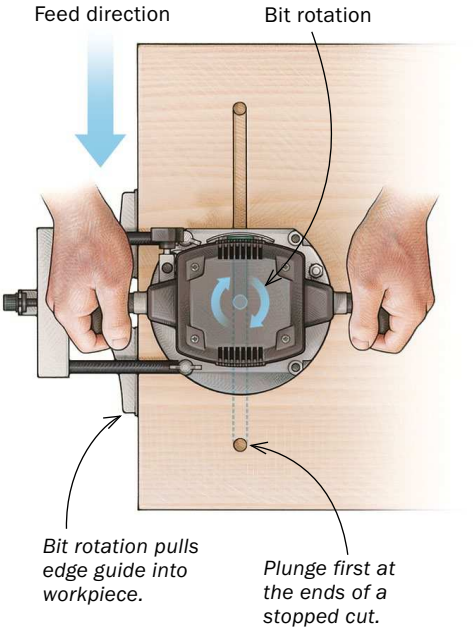
Near an edge? Use an edge guide

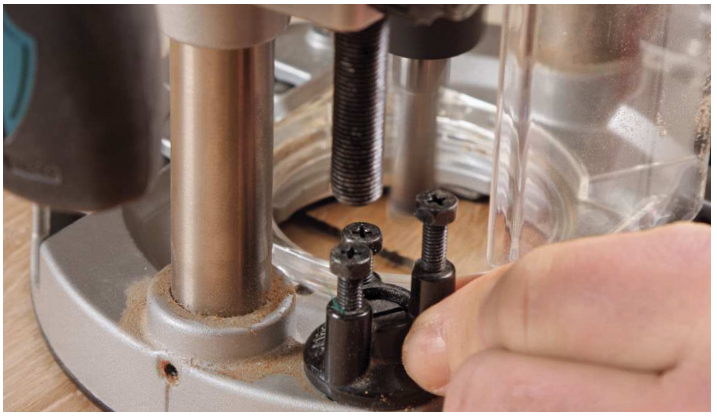
An edge guide is the simplest way to control a plunge router, because it goes on in seconds and adjusts easily. It's the right choice for many mortising jobs, and it works great for dadoes and grooves near the edge, too.

Mount the guide on the right. *Then start by making a plunge cut at both ends of the cut to create clean and accurate end walls. Rout between the holes by pushing the router away from you so that the bit's rotation pulls the router and edge guide against the workpiece (right). But don't rout into those first two plunge cuts, or you might accidently cut into the end walls.*

THE RIGHT DIRECTION

Use the rotation of the bit to your advantage by putting the edge guide on the right side of the router and pushing it away from you.





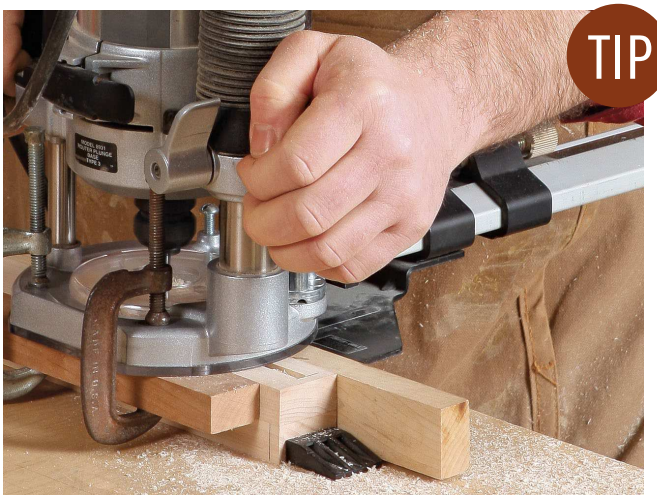
Adjust the depth between passes. *You can leave the power on, but for safety, move the turret as a separate operation, not while you're raising the bit or moving the router.*

Push after plunging. *Separate the two actions so you have greater control over them.*

Because it can plunge into and out of cuts, a plunge router is a versatile joinery machine. On its own, it's a great tool for tackling mortises and dadoes. But add guide bushings to the setup, and you'll increase the tool's versatility even more. This article will help you master a number of joinery cuts using a plunge router. I'll also give you some great tips on using guide bushings.

How to guide the router

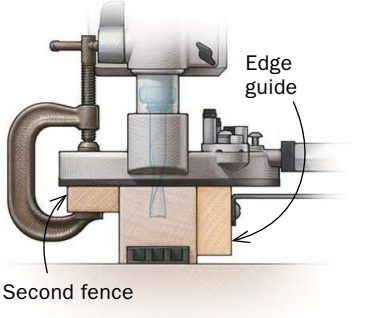
To make joinery cuts with a plunge router, you need some way to guide the router.



TIP

DOUBLE UP FOR MORTISES

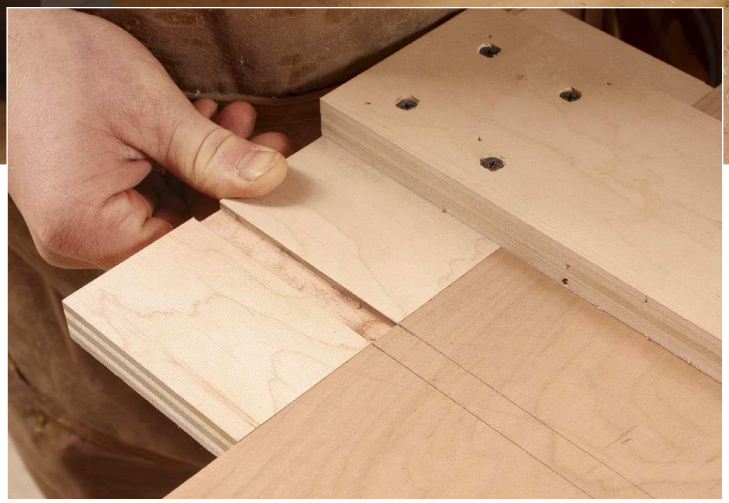
A second fence, clamped to the base, makes the router more stable on a leg, and keeps the bit from wandering.



Photos: staff; drawings, pp. 17–18: Christopher Mills

T-square is another option for dadoes

Use this guide for dadoes and sliding dovetails that are too far from the ends to use the router's edge guide.



Two strips make a great guide. *Rout through the fence, and then just align that cut with your layout lines (right).*

Depending on the task at hand, you can use an edge guide, a straightedge, or a guide bushing and template.

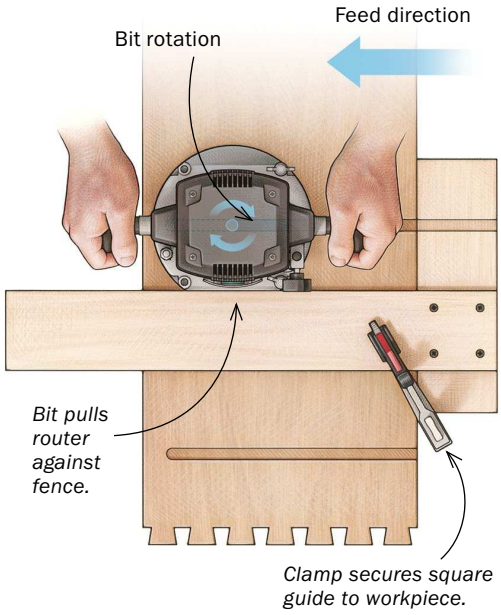
An edge guide attaches to the router's base, so it can be used only for cuts parallel and close to an edge. That makes it perfect for mortises in chair and table legs, and grooves and dadoes near the edge of a panel.

There are several types of straightedges, but they all get clamped to the workpiece. The router's base rides along the straight edge, which keeps it on the straight and narrow.

A template combined with a guide bushing is often the simplest, fastest way to make accurate and repeatable cuts—some of them difficult or impossible with any other type of guide. Used with simple shopmade templates, bushings make it

Keep to the right of the fence and push. *The rotation of the bit will pull the router into the fence, so it won't wander in the cut.*

AGAIN, USE THE SPIN TO YOUR ADVANTAGE



A straightedge for angled cuts

This shopmade guide is the right choice for angled mortises and grooves like those in the bookcase at right. See p. 22 for an alternate method using guide bushings.

Trim the base for zero-clearance. *Afterward, the edge of the base shows exactly where the bit will cut.*

easy to cut mortises, bore dowel and shelf-pin holes, and rout evenly spaced stopped dadoes in a carcase.

Don't forget the offset

The most important thing to learn about using bushings is the offset—the distance between the cutting edge of the router bit and the outside edge of the bushing. The offset is the key to creating jigs and templates to cut the sizes and shapes you want. To determine the offset, subtract the bit diameter from the bushing diameter and divide by two. For example, with a ¾-in.-dia. bushing and a ½-in.-dia. bit, the difference is ¼ in. Half that, or ⅛ in., is the offset, so the edge of the template must be ⅛ in. from the edge of the cut.

Second, be sure the offset is large enough for chips to exit the cut and that you use a spiral upcutting bit, which helps direct chips up and out of the cut. I like to use a bushing with a ½-in. or ⅝-in. outside diameter and a ¼-in.-dia. bit.

Third, be sure the bushing isn't longer than your template is thick. Otherwise, the bushing will hit the workpiece and you'll be dead in the water.

The other key is that the bit and guide bushing are very close to concentric; otherwise, the offset will be greater on one

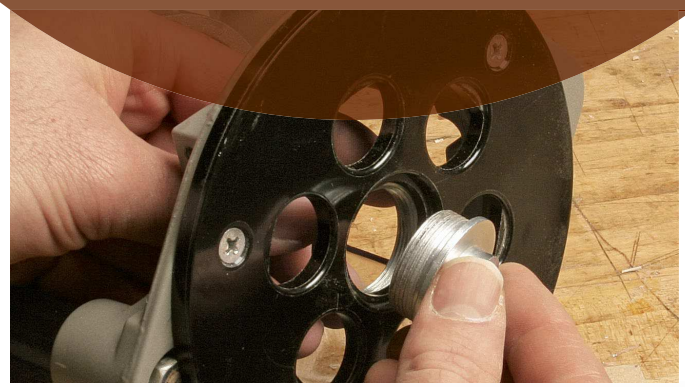
Lay it on the line. *Because the base is zero-clearance, there's no need to account for an offset or make fussy measurements (left). Paolini uses an offcut from the base to support the other side of the router (below) so that he doesn't have to worry about it tipping and ruining the cut.*

side of the router than the other. That can produce a too-narrow mortise or a slot with a wavy edge. Some router manufacturers sell centering cones to help adjust the offset, but I use a simpler method. If the offset is slight, I keep the router in the same relative position with each pass. To help guide my eye, I put a piece of green masking tape on top of the base.

Gregory Paolini is a professional furniture maker in Waynesville, N.C.

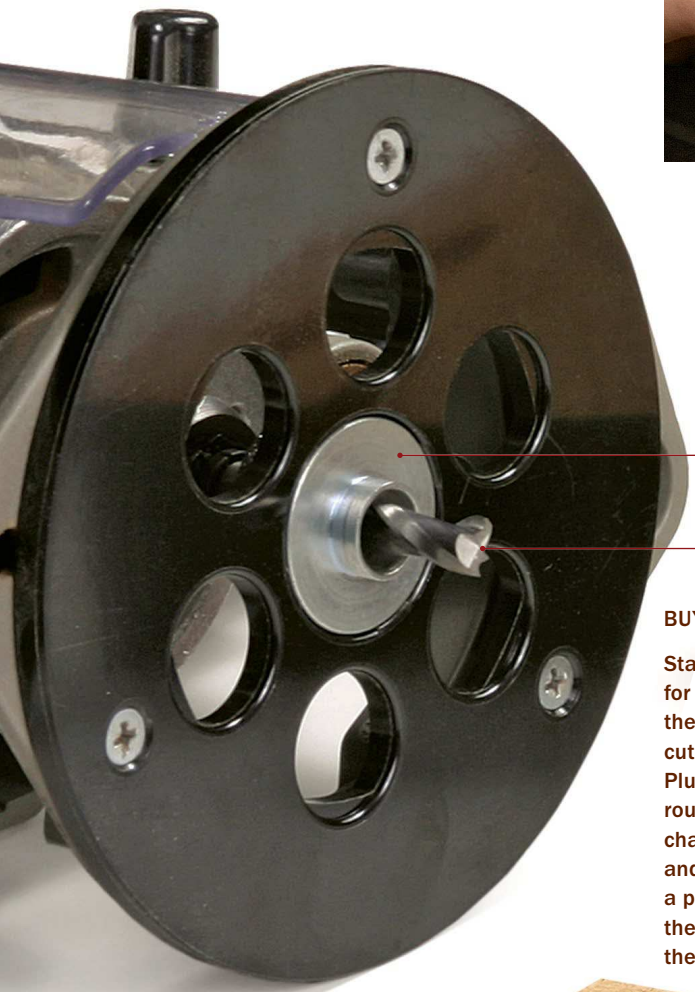
5 super jigs for bushings

These simple templates and patterns let you cut mortises, holes, slots, and elaborate shapes with a plunge router fitted with a guide bushing and a spiral upcutting bit. All the jigs begin with a piece of ¼-in.-thick plywood or MDF.



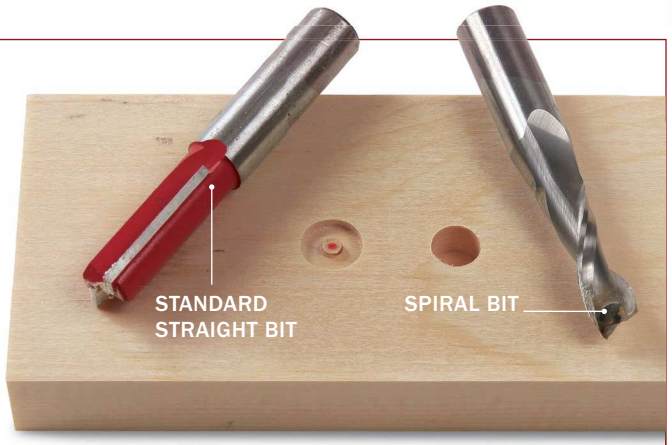
BETTER THAN BEARINGS

The advantage of a guide bushing is that it stays fixed and stable against its reference surface while allowing the bit to spin and plunge freely.



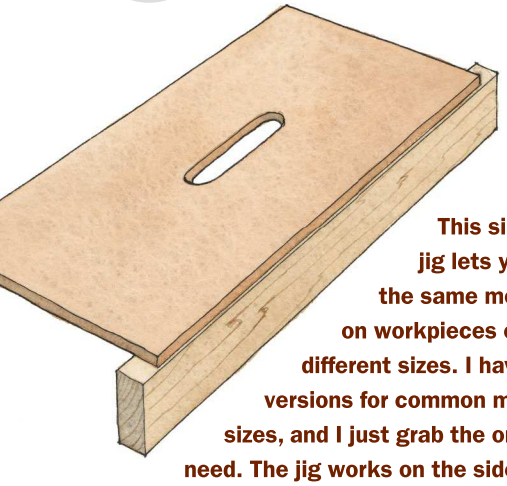
BUY BITS THAT PLUNGE

Standard bits don't work for plunge cuts, because they are designed to cut a horizontal path. Plunge one and you'll rout a shallow circular channel with a raised and burned center. On a plunging bit, however, the cutters continue to the center.



Drawings, pp. 21–23: Jim Richey

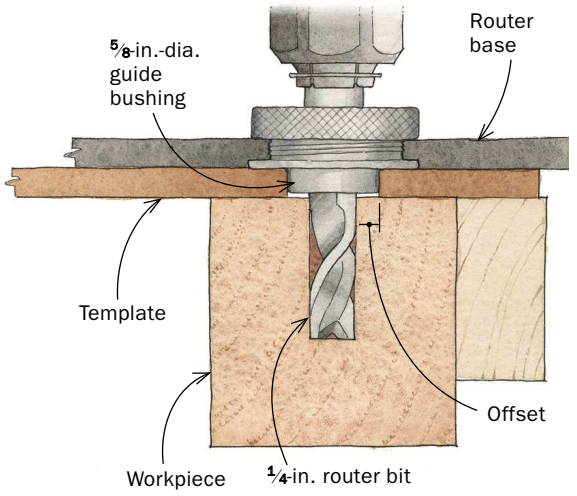
1 MORTISING IS JOB ONE



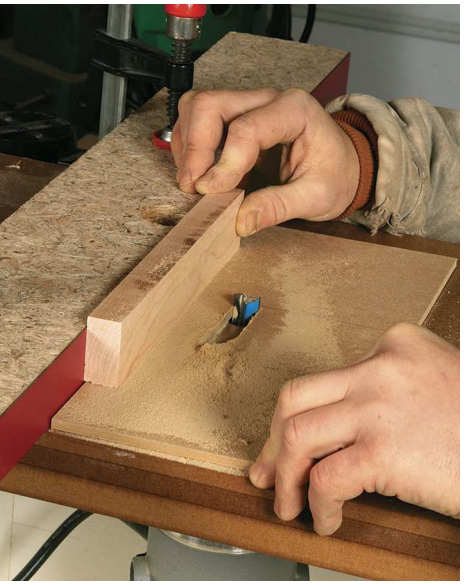
This simple jig lets you cut the same mortise on workpieces of different sizes. I have versions for common mortise sizes, and I just grab the one I need. The jig works on the sides and ends of a workpiece, so it's ideal for loose-tenon joinery.

Make the base as wide as your router's base and twice as long. Attach it to a hardwood fence milled flat and square. Lay out the mortise slot on the bottom of the template, adding the proper offset to the width and length. Cut the slot at the router table, and try to make it fit the bushing exactly. If you have a bit that's the same size as the outside of the guide bushing, use it. Otherwise, use a smaller bit and cut the slot in multiple passes. Some people drill a starter hole for this kind of cut, but I find it unnecessary. I rest the right side of the template on the router table, then carefully lower the left side onto the spinning bit and move the template right to left to make the cut.

For workpieces of different thicknesses, add shims next to the fence.

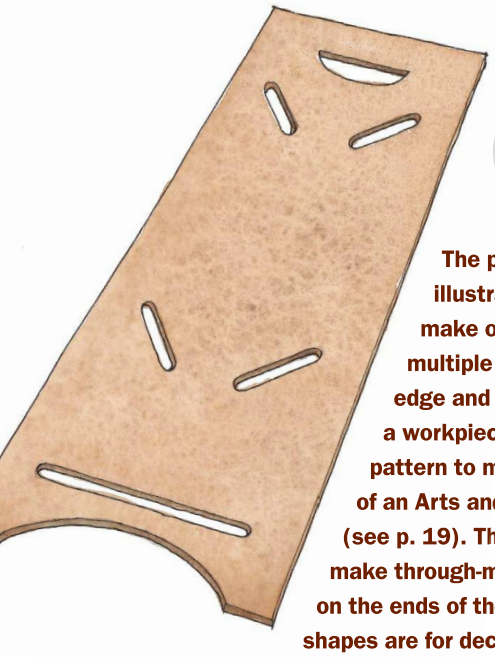


Attach the fence. *Leave the fence slightly proud of the base so you can reference off it when cutting the slot for the bushing.*



Slot the base. *Hold the jig's fence against the router-table fence and carefully lower the template onto the bit to start the slot.*

How to use the jig. *Attach the jig using a vise (shown) or clamps. Make full-depth plunge cuts at the ends of the slot, with a series of shallower passes to clean out the middle. Blow out the chips before making a final pass. Don't forget to record the bushing size and bit size on the jig for future reference.*



2 MAKE A FULL PATTERN FOR A FURNITURE PART

The pattern shown here illustrates how you can make one template for multiple cuts both on the edge and in the middle of a workpiece. I created this pattern to make the end pieces of an Arts and Crafts book rack (see p. 19). The angled slots make through-mortises for tenons on the ends of the shelves; the other shapes are for decorative cutouts. I made all the cuts with a ½-in.-dia. bushing and a ¼-in. bit. It takes time and a bit of math to lay out and cut the slots. But you end up with a pattern that is well suited to limited production runs.

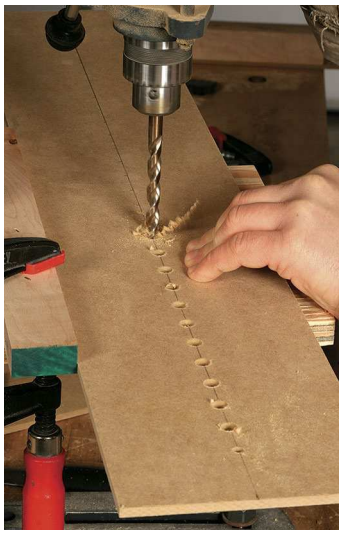
Just align the edge of the pattern with the edge of the workpiece and clamp the two together.

One template, multiple cuts. *Paolini designed this template so he could make angled cuts for through-mortises as well as decorative curved cutouts on the ends of a book rack.*

3 MAKE YOUR OWN SHELF-PIN JIG

You can buy a commercial template for drilling shelf-pin holes, but it takes only five minutes to make your own. The router bit has to be the same diameter as the shelf pins, typically ¼ in. I use that bit with a ⅜-in.-dia. bushing. When setting the router's depth stop, don't forget to factor in the thickness of the template.

I usually cut the template long enough to fit the side of the cabinet I'm drilling, but it will work for taller pieces, too. Just drill the end holes with a ¼-in. bit, then drill the remaining holes for the bushing. To drill a second set of holes, use a ¼-in. drill bit to align the template with the last shelf-pin hole you drilled.



Drill, then drill again. *Drill a series of holes sized to match the guide bushing (above). Clamp the template to the workpiece and make a series of shallow plunge cuts (right) for the shelf-pin holes.*

Photos, except where noted: David Heim

4 CIRCLE-CUTTING TRAMMEL

Cutting a perfect circle for a tabletop is a breeze if you use a guide bushing to position the router on a simple rectangular trammel.

Drill a pilot hole at one end for a screw that will be the circle's center point. From that center point, measure the desired radius plus half the router-bit diameter, and mark another center point. Drill a hole the same size as the outside diameter of the guide bushing you'll use. You can add more bushing holes to get several sizes of circle from one trammel. The size of the bit and bushing aren't critical. I usually use a ⅜-in.-dia. bit and a ⅝-in.-dia. bushing.

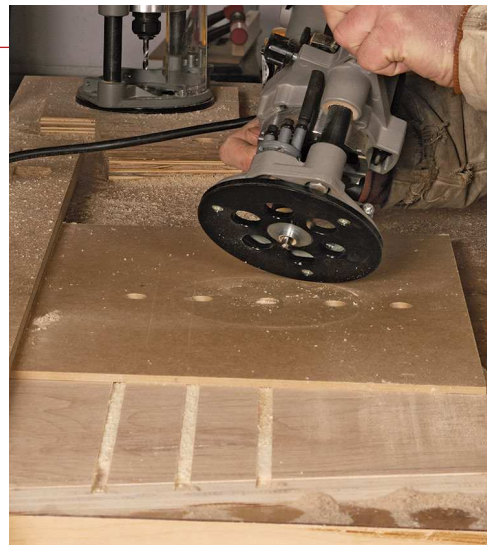
To make the circle, work on the underside of the workpiece. Anchor the center-point screw, slip the bushing into its hole, and make a series of shallow passes.

World's simplest trammel. *A screw acts as the pivot point (in the underside of the stock), and the guide bushing drops into another hole. The bushing allows you to plunge the bit as you make progressively deeper cuts.*

5 PARALLEL-GROOVE JIG

Use this jig to make evenly spaced long cuts, such as flutes in architectural elements or dadoes in the sides of a small cabinet (shown). The jig requires only one setup—you don't need to reset a fence for each new cut. And the jig allows you to make a series of stopped dadoes or grooves on the workpiece, which is tedious with a router and edge guide, and impossible with a tablesaw.

Unlike the other jigs shown here, this one is meant to slide along a fence rather than be clamped or pinned to the workpiece, so setup takes a couple of extra minutes. Make the jig wide enough that it will slide along the fence without tipping. Drill holes the same size as the outside diameter of the guide bushing, on the centers for the grooves you want to cut. For a ⅜-in.-dia. groove, I used a ⅝-in. bushing. Clamp a fence to the workpiece parallel to the desired grooves; if you're making stopped cuts, add blocks to set the beginning and end of the cuts. Butt the template against the fence, fit the router bushing into the first guide hole, and push the router along the fence to make the cut. Repeat until you have as many grooves as you need.



One setup, multiple grooves. *This template is simply a large router base that you slide along a fence. The series of holes for a guide bushing produces evenly spaced slots without having to move the fence.*

Work Safer with Featherboards

These helpers let you cut joinery with confidence

BY BOB VAN DYKE

THREE TYPES

Store-bought and shopmade featherboards abound. The best choice for a particular machine setup depends on a number of factors.

MAGNETIC FEATHERBOARDS

Rare-earth magnets make these a go-to choice for metal tables.

A woodworker's third hand is often a featherboard—an accessory that guides workpieces through woodworking machinery. Featherboards are made of plastic or wood with thin fingers cut into an angled end. Mounted to a fence, they push a workpiece snug against the table. Mounted to a tabletop, they keep a workpiece tight against the fence. Like a hand moving over a bird's feather, a workpiece fed past a correctly positioned featherboard will only move easily toward a blade or bit, and is prevented from kicking back.

Featherboards add accuracy and consistency to many types of cuts made on a tablesaw, router table, or bandsaw. They also allow woodworkers to keep their hands away from the blade or bit—and that makes for safer and cleaner cuts. That means you can cut joinery with confidence.

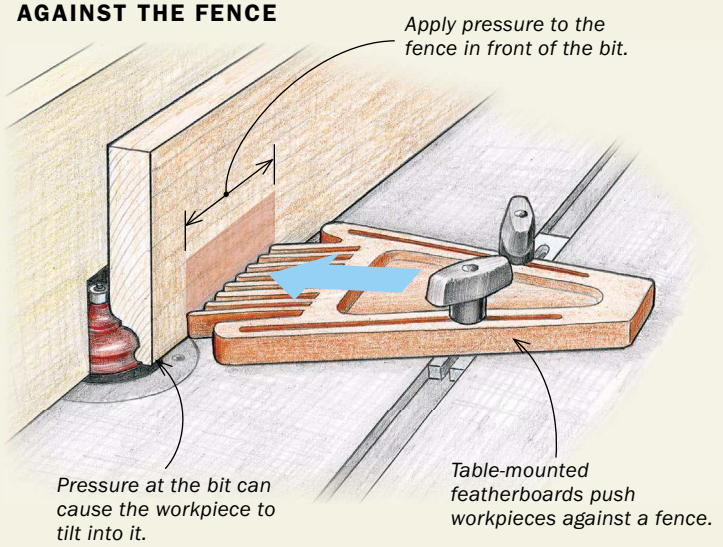
There's a variety of featherboards, some store-bought and others shopmade. If you have none, start by using the shopmade featherboard—it will handle any situation. Adding the other two styles to your collection makes some operations even easier,

Featherboard basics

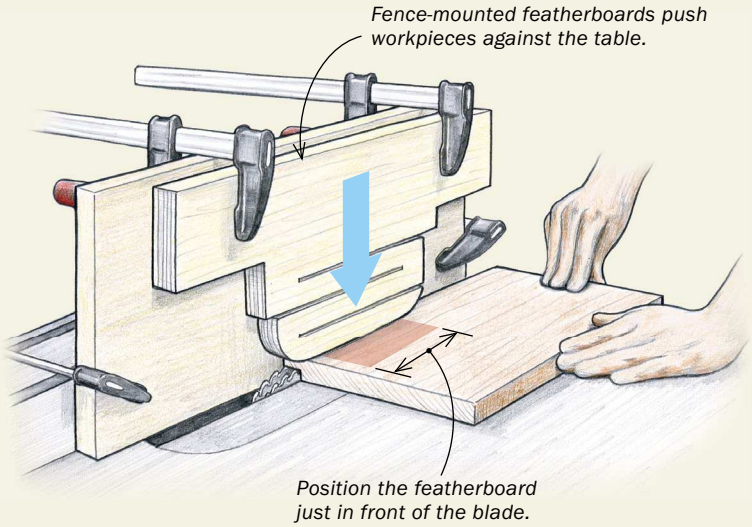
In general, place most or all of the featherboard ahead of or above a cutting edge, rather than right over it or past it. This is critical on cuts like rabbets or molding. When no material is left against a fence or table to resist the featherboard's pressure, a workpiece can dive into the bit.

When ripping, make sure that *all* of the pressure is ahead of the blade. Otherwise, it will jam the offcut against the blade, possibly causing the piece to kick back violently.

AGAINST THE FENCE



AGAINST THE TABLE



Photos: Ken St. Onge; drawings: John Tetreault

SLOT-MOUNTED

A good option for tables and fences with miter slots or T-tracks.

SHOPMADE

You have to make these yourself, but this three-cut type is quick and easy, and works for any situation.

and that means you'll be more likely to reach for a featherboard when you need one.

At the tablesaw

I frequently use a tablesaw and dado blade to cut grooves and rabbets. To cut a groove in the edge of a rail or stile, a single featherboard attached to the tabletop will ensure a workpiece stays flat against the rip fence. To position it, hold the workpiece against the fence and set the featherboard's fingers against

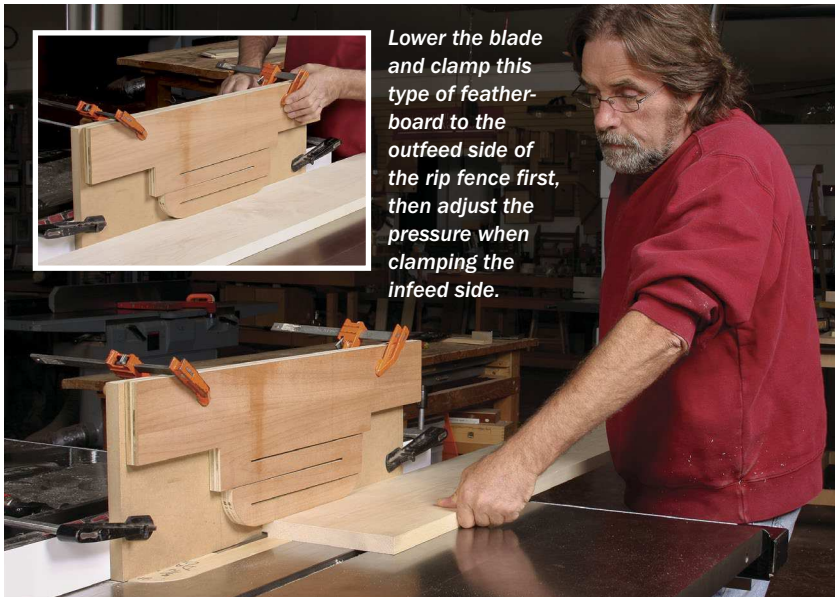
The third cut's a charm. *Van Dyke prefers three-cut featherboards to the traditional type with many "feathers." Make one by cutting two kerfs at one edge, stopping just shy of the end. Then cut a third kerf starting from the opposite edge, between the other two. Then cut a slight curve along the bottom edge.*

Tablesaw tasks

RIP ACCURATE GROOVES

Set the workpiece against the rip fence and butt the featherboard against it. Use medium pressure: The workpiece should be snug against the fence but shouldn't stick or bind.

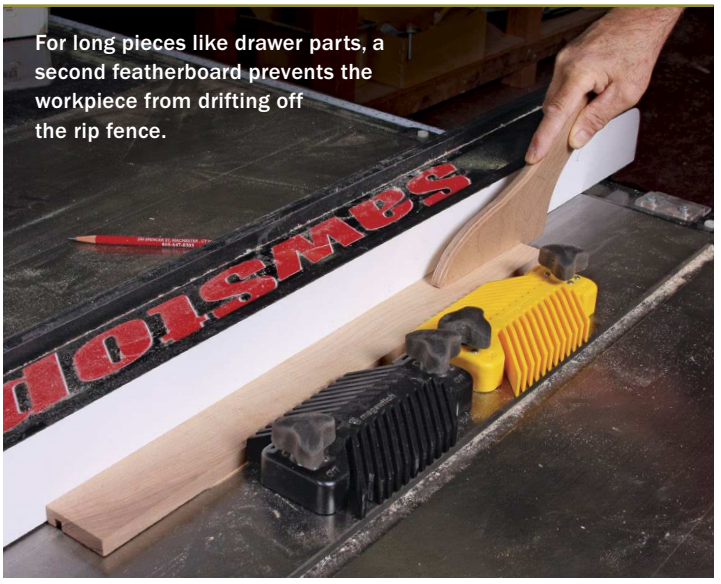
CUT CONSISTENT RABBETS



Lower the blade and clamp this type of featherboard to the outfeed side of the rip fence first, then adjust the pressure when clamping the infeed side.

Tablesaw tasks continued

ADD SUPPORT FOR LONG PARTS



For long pieces like drawer parts, a second featherboard prevents the workpiece from drifting off the rip fence.

the workpiece, just in front of the blade. For cutting grooves in a longer workpiece, such as a drawer side, add a second featherboard to the outfeed side. It will prevent the workpiece from skewing away from the rip fence as it exits the blade. With both of these cuts, a store-bought, magnetic featherboard is easiest to set, but it won't work on an aluminum- or granite-topped tablesaw. In those cases, slot-mounted or shopmade featherboards will work.

When cutting rabbets—where the depth of cut must be consistent—clamp a shopmade featherboard to the rip fence to keep the workpiece snug against the table as it moves. In this case, I prefer a featherboard made with just three cuts (see photo, p. 25)—a technique I learned from renowned teacher Will Neptune. Set the featherboard just in front of the lowered blade and place the first clamp on the outfeed side of the fence. Then pivot the featherboard into the workpiece using medium pressure. Use a second clamp on the infeed side. Position the featherboard over the blade and the infeed side of the fence, with the bulk of the pressure just before the leading edge of the blade. This assures an even cut and prevents the workpiece from pivoting.

To cut rabbets on narrower pieces, start with a wider workpiece. Rabbet the edge and then rip the piece to width.

For some cuts, use blocking to raise a featherboard off the table slightly. This technique helps with vertical cuts, like the bevels on raised panels. It prevents the workpiece from tipping, and moves the pressure away from the blade so that cutoff pieces won't be forced into the blade and kicked back. For blocking, screw a shopmade featherboard to an L-shaped base and clamp the base to the table.

Beginning woodworkers tend to overuse featherboards when ripping on the tablesaw. I use them only for cumbersome or repetitive cuts, such as ripping 30 pieces of 6-in.-wide stock down to 4 in. wide. In those cases, a featherboard will prevent your hand from accidentally touching the blade if your attention wanders. Remember to set the featherboard directly in front of the blade to avoid kickback.

RAISE THE FEATHERBOARD FOR PANELS

For raised panels and tall workpieces, move the featherboard above the blade and use a tall auxiliary fence.

Start with a base. *Two pieces of plywood make a solid foundation for a featherboard.*

Watch the length. *Make the base long enough to be clamped to the tablesaw's edge.*

Keep it vertical. *The featherboard keeps the panel pressed snugly against the fence.*

Router table aid

HAPPY RABBETS

Neglecting to use a featherboard when rabbeting a panel can leave inconsistent cuts. Stepped surfaces are a telltale sign of cuts made with uneven pressure.

At the router table

Featherboards are also a frequent companion at the router table. I often use them mounted to a fence to keep workpieces flat against the table. Many commercial router tables and fences come equipped with T-tracks, miter slots, or both, making slot-mounted featherboards a good option. But if your router table lacks slots, shopmade featherboards clamped to the table or fence also work well—I use them on my own shopmade router tables.

When routing rabbets, I use a single featherboard attached to the fence. Position it as just as you would with a tablesaw, with the bulk of the pressure from the featherboard focused on the infeed side of the table, just in front of the leading edge of the bit. Use the same technique for other operations where the depth of cut is critical.

Lock it down. *Slotted featherboards attach to the T-tracks on some router-table fences, but you can use shopmade featherboards if your fence has no grooves.*

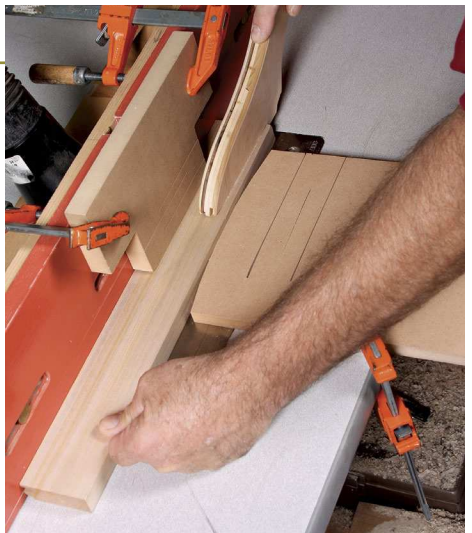
Vanishing act. *The step disappears when a featherboard is used.*

CHATTER-FREE MOLDINGS

For making moldings on the router table, add a featherboard for burn-free, consistent cuts.

ACCURATE PROFILES

Thin stock, like the parts of a cope-and-stick frame, needs multiple featherboards. A push stick helps, too.



Attach a featherboard to the router table when cutting molding profiles. The featherboard will keep the workpiece tight against the fence and leave a more consistent, chatter-free cut. For taller pieces, use the blocking technique to raise the featherboard over the bit.

Some operations at the router table require featherboards attached both to the fence and table. The inside molding—called sticking—for a cope-and-stick door frame is a typical example. The double-featherboard setup will make more consistent cuts, reduce chatter, and stabilize the workpiece as it exits the bit. The same setup also helps in routing very thin stock, but leave enough room to use a push stick.

Resawing help

Featherboards will help when resawing stock on the bandsaw. Place the stock against a resaw fence, and butt a featherboard against it, just in front of the blade. A magnetic featherboard works best for metal tables, but shopmade and slot-mounted featherboards should also do the trick.

Regardless of which style of featherboard you use, these accessories will add accuracy and safety to your woodworking. □

Bob Van Dyke is director of the Connecticut Valley School of Woodworking.

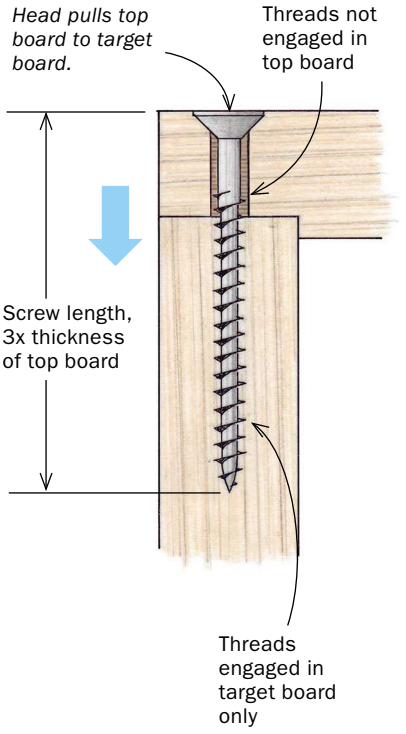
BASIC **JOINTS**

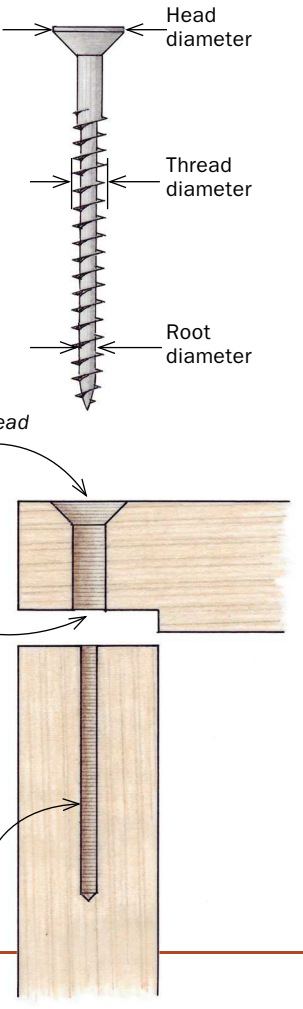
Screws
Joinery in a Box

How to get maximum holding power in every situation

BY ROBERT J. SETTICH

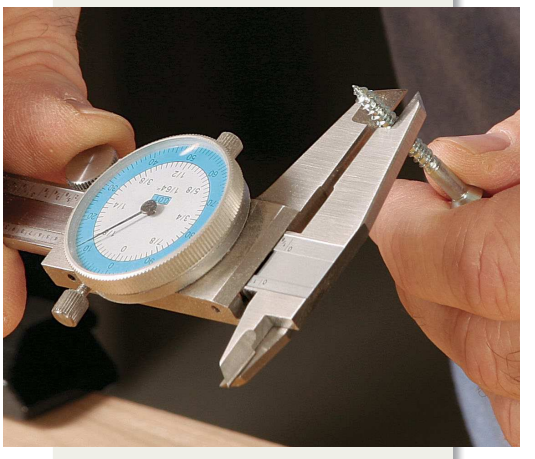
Anatomy of a screw joint





SIZING PILOT AND CLEARANCE HOLES

A caliper zeroes in on the screw's root and outside-thread diameters. You'll need both measurements in order to choose the proper bits for the drilling sequence.



Photos: Charlie Reina; drawings: Vince Babak

The drilling sequence

In furniture making, where accuracy is essential, the order in which you drill your holes can be critical. But drill with the right bits, in the right sequence, and the screw will bring the boards tightly together.

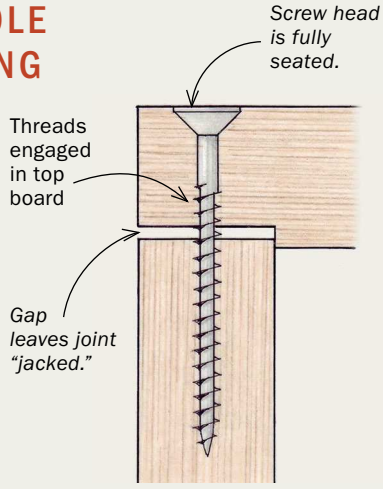
Start with the pilot hole. *With the workpieces clamped tightly together, drill the pilot hole to the depth of the screw's length. The drill bit is the same diameter as the root of the screw.*

Clearance hole is next. *Switch to a bit matching the screw's outside thread diameter and drill through the top board only. A tape flag keeps you from drilling too deeply.*

Then make headroom. *A countersink bit makes the tapered hole that will fit the head of the screw. This single-cutter type creates chatter-free results.*

A CLEARANCE HOLE PREVENTS JACKING

With no clearance hole, the screw threads engage the top board. If the joint is not clamped, the top board can lift and stay separated from the target board, especially if the screw raises a bump of wood as it enters the target board.



Bring it home. *Drive the screw all the way, so it seats firmly in the countersink. This draws the boards together and keeps the screw head at or below the top surface.*

COMBO BITS

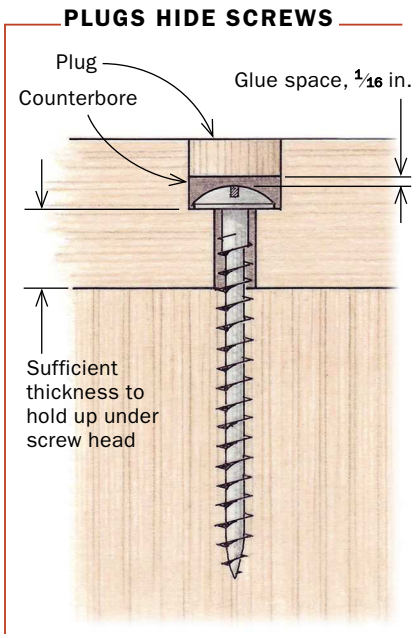
Using an appropriate-size combo bit saves steps, letting you make the clearance hole and countersink in one drilling (left). Before or after this step, use a smaller bit to drill the pilot hole (below).

Some purists will tell you there's no place for screws in woodworking. If they mean that screws can't replace a snug mortise-and-tenon or a seamless dovetail joint … OK. But the fact is, screws do the job—and do it well—in many woodworking applications. The trick is to select the right screw for the job, and to understand how to get the most holding power from it.

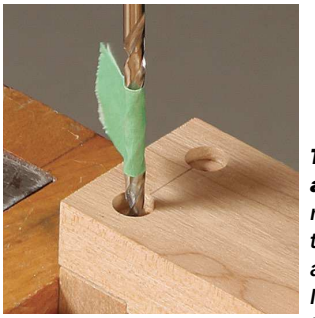
The basics

Most crucial to a screw's holding power is its resistance to being pulled out. The more thread surface in contact with the wood, the more resistance. So, to muscle up holding power, use a longer or thicker screw, one with a deeper thread pattern, or any combination of those properties. A thicker root (around which the threads are wound) also beefs up a screw's torsional strength, or resistance to twisting forces that can snap it, usually after its head hits the wood. To avoid this, choose the right screw, drill the right-size pilot hole, and don't overdrive. Set the power driver's clutch to a lower setting or make the last few turns by hand. Overdriving also spins

Counterboring



Use the counterbore bit first. *Drill deep enough for the plug plus 1/16 in. for glue buildup, but leave enough top board beneath the plug hole to support the screw head. Using a Forstner bit and masking tape helps ensure a straight-walled plug hole with a round, sharp rim.*



Two twist bits are next. *Drill the narrow pilot hole through both pieces, and then use the larger bit to widen the hole in the top board for clearance (top). Bring the joint home with screws, and tap in the glued-up plugs (bottom).*

the screw after it reaches full depth, reducing the wood fibers to a fluff and leaving the screw with no holding power.

Pilot holes—In woodworking, *always* drill pilot holes. Without them, screws simply push the wood fibers aside and can cause splitting. The general rule is to drill a pilot hole in the target piece that's the size of the screw's root. This is easy when using a rolled-thread screw, in which the root diameter is consistent throughout the length of the screw, tapering only at the tip. For a cut-thread screw, in which the root diameter gradually tapers toward the tip, optimal drilling requires a tapered drill bit.

Clearance holes—No matter how great a screw's holding power, the joint won't hold tight if the pieces being fastened are "jacked," or not drawn tightly together. That's where clearance holes come in. These are drilled through the top board (or piece to be fastened), allowing the head of the screw to pull that piece fast against the target board.

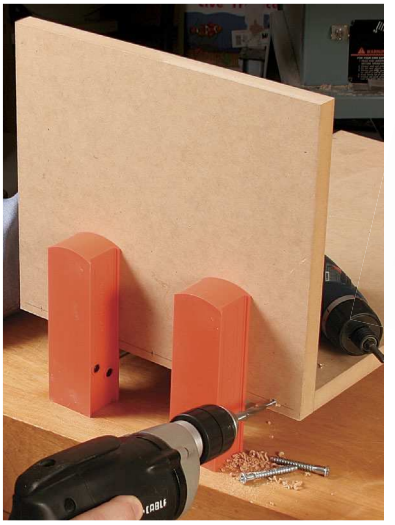
Dialing in a precise screw fit—Here's an easy way to confirm the pilot-hole and clearance-hole sizes for a batch of screws. This works for all screws and woods, but you need dial calipers ($21 for a 6-in. version from Grizzly; grizzly.com; product No. G9256) and a full set of drill bits, graduated by 64ths of an inch.

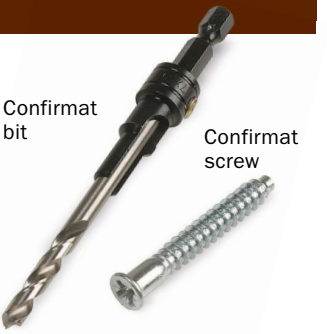
First, measure the root diameter of the screw by reaching into the space between threads. This is the diameter of the pilot hole. For very soft woods like pine, go down one bit size; for very hard

Special screws for sheet goods

Though wood movement is not a major concern, plywood and MDF are especially prone to end- and edge-splitting. This can leave the screws that fasten them with very little holding power.

Use deep, sharp threads in plywood. *Most screws won't hold well in the cross-layered fibers of plywood. Use Spax screws and Type-W drywall screws, especially when fastening into an edge such as a plywood cabinet shelf (right).*



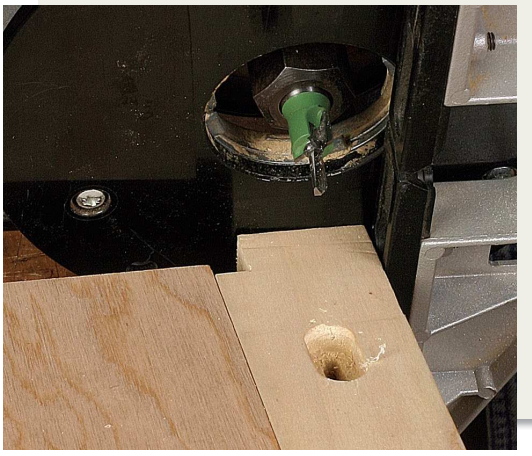


Special screws for MDF. *Medium-density fiberboard requires a shallow-threaded fastener with a substantial root diameter such as the Confirmat screw. A special bit allows you to drill the matching pilot hole, clearance hole, and countersink.*

Slotted holes

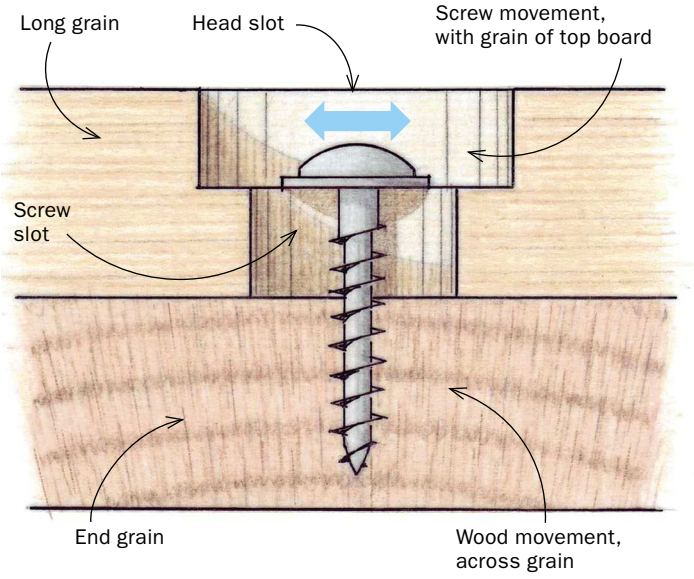
FLAT-BOTTOM BITS

The flat-bottom slot not only accommodates any screw with a flat-bottomed head, but it also allows you to add a washer, further ensuring freedom of movement over the wood surface.



Rout the slot. *With a screw-slot bit in his router, Settich plunges it into a bracket for a solid-wood cabinet top (top). The resulting slot (bottom) leaves ample room for the top to expand and contract.*

CROSS-GRAIN FASTENING



woods like maple, go up a size. Next, measure the outside of the threads. This is the diameter of the clearance hole. And if you need a counterbore (see next section), use a bit that matches the screw's head diameter—or the diameter of the plug that will cover the screw head.

Countersinking and counterboring—Beginners sometimes use the terms "countersinking" and "counterboring" interchangeably, but they are distinctly different processes. Countersinking chamfers the rim of a hole so that a flathead screw seats flush to, or slightly below, the surface of the wood. A counterbore is a hole with parallel sides, stopped partway through the top board. Sometimes you'll make one simply to extend the reach of a screw, but it's more commonly used to create a home for a plug to conceal the screw head.

Slotted holes allow movement—Solid wood's seasonal expansion and contraction is a concern that arises most often when fastening the tops of tables or cases. One common solution is to drill slotted screw holes in the cleats used to attach them. The slots allow the top to expand and contract across its grain while being held flat by the screws. Slotted holes work similarly for screws attaching solid-wood drawer bottoms.

Another common solid-wood screw application involves breadboard ends for table and casework tops. Screws in slotted holes hold the breadboard to the tongue but permit the top to freely change in width when the humidity changes. A screw-slot router bit is the perfect tool for most slotting applications (leevalley.com offers styles for either flathead or roundhead screws). □

Robert J. Settich is a writer, photographer, and woodworker in Gladstone, Mo. He is the author of Taunton's Complete Illustrated Guide to Choosing and Installing Hardware (The Taunton Press, 2003).

Biscuits
Fast and Versatile

They're great for solid wood and plywood

BY TOM BEGNAL

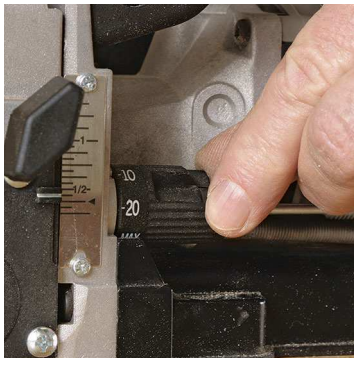
It will never match the beauty of a dovetail or the strength of a mortise-and-tenon, but for speed, accuracy, and ease of use, it's hard to beat the biscuit joint. Biscuit joints can be used on all wood products: solid wood, plywood, medium-density fiberboard (MDF), and particleboard. For this reason, they are great for cabinetry, which typically involves a mix of solid wood and sheet goods. Biscuits are a great way to join a plywood carcase and attach an assembled face frame. They also help keep things aligned when gluing solid-wood edging to plywood or assembling solid boards into a wide panel.

Biscuit joiner cuts the slots

A dedicated tool and an oddly shaped tenon combine to create a biscuit joint. At the heart of the process is a power tool called a biscuit joiner or a plate joiner. To make a joint, use the tool to cut a shallow slot in each of the mating parts. Then, after adding glue to each slot, insert a thin, football-shaped biscuit into one slot. A little more than half of the biscuit's width goes into the slot; the other half sticks out. To complete the joint, you just slip the mating slot onto the "tenon" and clamp the parts together.

The biscuit joiner has just four main parts: a motor, a blade that cuts the slot, an adjustable fence that aligns some types of cut, and a base that houses the blade

All about biscuits



Simple and efficient. *An adjustable stop on the joiner (left) controls the depth of cut to match each of the common biscuit sizes—0, 10, and 20. A biscuit swells in thickness (right) when wet glue hits it, helping to anchor the joint. So store biscuits in a sealed jar to keep out moisture.*

Photos: Steve Scott; drawings (facing page): Stephen Hutchings

and also can align cuts. The 4-in.-dia. blade looks like a miniature tablesaw blade. Unlike a tablesaw blade, however, the biscuit-joiner blade cuts horizontally. The kerf it creates, commonly called the slot, measures about ⅛ in., just wide enough to accept standard-thickness biscuits.

Thanks to a spring-loaded sliding "way" that connects the base and motor, you can butt the front of the base against a workpiece, start the motor, and push it forward. The spinning blade emerges from the front of the tool to cut a shallow arc-shaped slot in the workpiece. Release the forward pressure, and the springs push the motor back to retract the spinning blade safely into the base.

Expanding biscuits fill the slots

The second element in this joint is the biscuit. Made from beechwood or white birch that has been thoroughly dried, biscuits are compressed by machine to a consistent thickness. Standard sizes are No. 0, No. 10, and No. 20. The biscuit joiner has preset depth stops that match these sizes. For maximum all-around strength, the biscuits are cut so the grain runs diagonally.

When a biscuit comes into contact with moisture, it swells. So when you insert a biscuit into a glue-lined slot, the biscuit creates a snug fit and a tight joint. It is important to use only water-based glues such as common yellow PVA glue. Biscuits won't work with epoxy, cyanoacrylate ("super") glue, or polyurethane glues.

Use the fence or the base to locate the slot

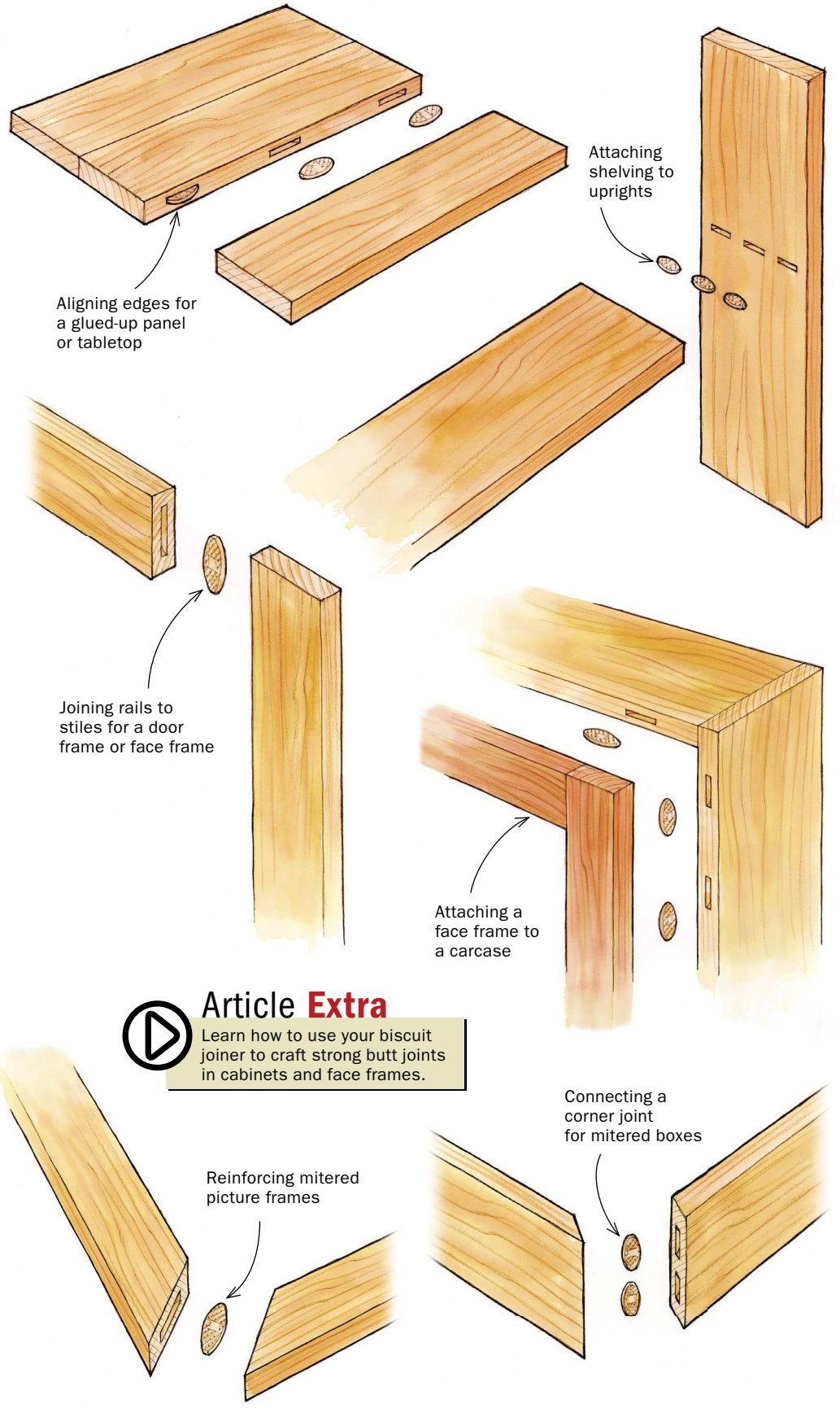
When using a biscuit joiner, you have two ways—the fence or the base—to register the slot in the workpiece. Each has advantages.

For extra flexibility, the adjustable fence lets you position the slot anywhere between 3/16 in. and 1 in. from the fence (if the biscuit is any closer than 3/16 in. to the surface of the workpiece, its swelling could create a bulge on the surface). Also, you can set the fence to cut slots in angled joints.

However, if all you want to do is center a slot on ¾-in.-thick stock, it's easier to register off the base. This is because the center of the kerf is located ⅜ in. from the bottom of the base. To create a slot in ¾-in.-thick stock, place the base and the stock on the same flat surface and make

A variety of uses

Biscuit joinery is useful in a wide range of applications, from aligning edge-glued boards to securing shelves to assembling and attaching frames, miters, and more.

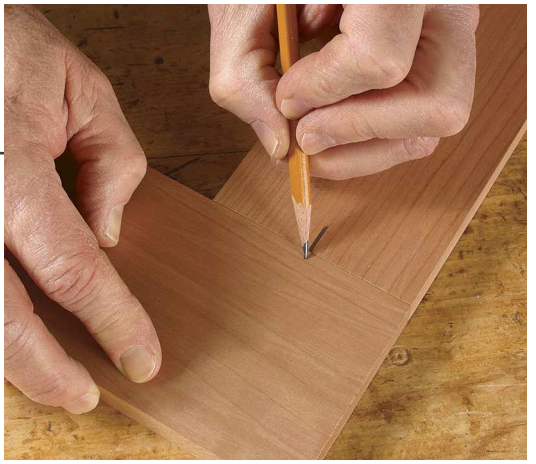


Article Extra

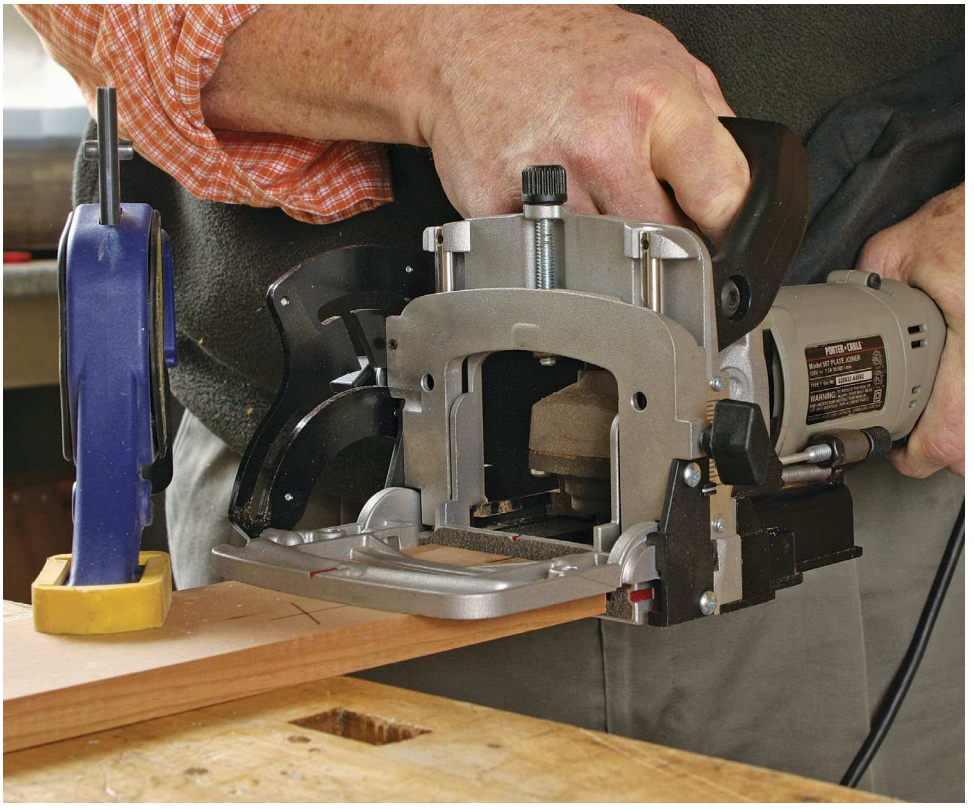
Learn how to use your biscuit joiner to craft strong butt joints in cabinets and face frames.

Reference off the fence

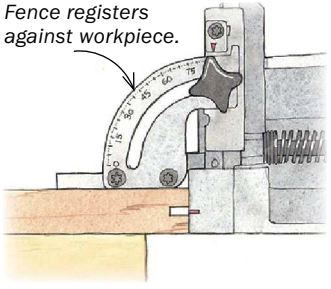
Using the fence to locate the cut lets you adjust the position of the biscuit slot to any point between 3/16 in. and 1 in. from the reference surface.



Layout is simple. *Just align the workpieces, then draw a line across the mating faces to mark the centerline of the biscuit.*



Center the cutter on the stock's thickness. *With the fence flat on the workpiece, adjust its height to locate the cut. To make the cut, simply align the joiner with the single layout mark, start the tool, and push the joiner's body forward.*



the cut. It's OK if the slot isn't exactly centered; just remember not to flip the parts when it comes time to glue them.

Cut and assemble a simple biscuit joint

With a biscuit joiner in hand, it takes just four steps to join a pair of ¾-in.-thick boards end to edge (see photos, left). This joint is useful for making light-duty door frames, especially when the panel is plywood or MDF. That's because plywood and MDF don't expand and contract with changes in humidity, so they can be glued in place to add strength to the frame.

Step 1: Align and mark—Align the boards as you want to see them joined, and use a single line to mark the biscuit centerline on the top face of both parts.

Step 2: Determine the biscuit size—Based on the width of the board, choose

ANGLE THE FENCE FOR MITERS

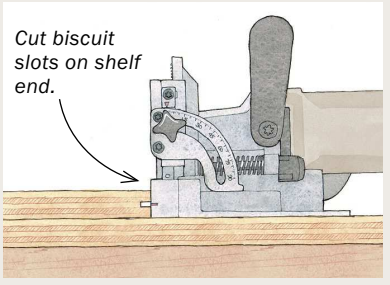
Setting the fence to 45° allows the joiner to cut a slot in the end of a mitered workpiece. Align the joiner for a cut toward the inside of the miter, so there is plenty of material in which to sink the slot.

Drawings, except where noted: Jim Richey

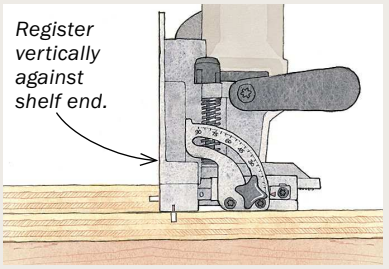
Reference off the base

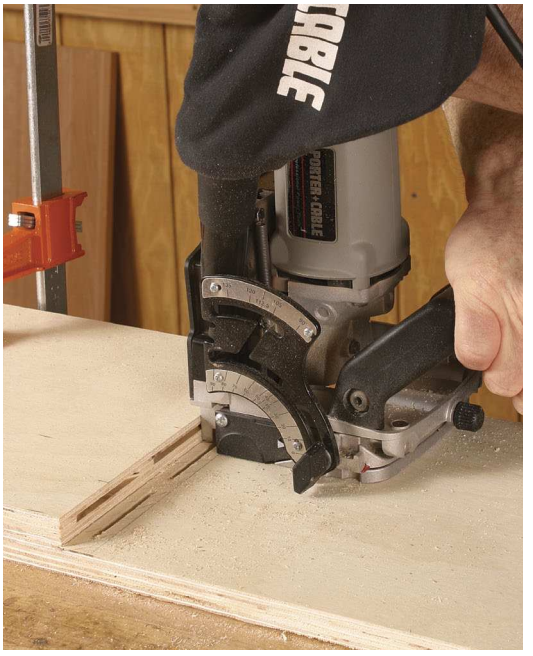
Registering a cut from the joiner's base always puts the biscuit slot 3/8 in. from the reference surface, or centered on 3/4-in. stock. This can make for quick biscuiting, as when attaching a fixed shelf to an upright.

Layout trick. *To start, mark out the shelf location on the case side and clamp the actual shelf along one of those lines. You are now set up to cut both sides of the biscuit joint.*



Just butt and cut. *With the joiner base on the side piece, cut the biscuit slots in the end of the shelf (above). Reposition the joiner so the base butts against the end of the shelf, and cut the mating slots in the side piece (below).*





the largest biscuit that it can accept. For the 3-in.-wide stock shown, No. 20 biscuits are a good choice.

Step 3: Cut the slots—Clamp one of the workpieces in place (never hold the workpiece by hand). Set the depth-adjustment knob for the No. 20 biscuit. Align the center-registration mark on the biscuit joiner with the biscuit-centerline mark made in step one. Start the motor and, with one hand on the top handle and one hand on the motor housing, push the motor toward the stock. Continue cutting until you reach the stop, and then allow the spring action to return the motor to the starting point. Repeat the process to cut a slot in the second piece.

Step 4: Apply glue—Use a small brush (I use a throwaway soldering brush) to apply a generous coat of glue to each slot. Be sure to coat the sides of the slots—that's where a lot of the glue strength comes from. Add glue to the biscuit and insert it into one of the slots, then attach the other piece and clamp them together. Don't answer the phone after the biscuit has been inserted into the first slot. By the time you come back, it will already have swelled enough that you won't be able to insert it in the second part of the joint. The only thing you can do then is let the glue dry, saw away the protruding part of the biscuit, and recut the slot. □

Tom Begnal is a woodworker in Kent, Conn.

Join the parts. *Apply glue to the slots and biscuits, then fit the shelf to the side pieces and add clamps.*

Dowels
Simple and Strong

Strategies for making sturdy furniture

BY ASA CHRISTIANA

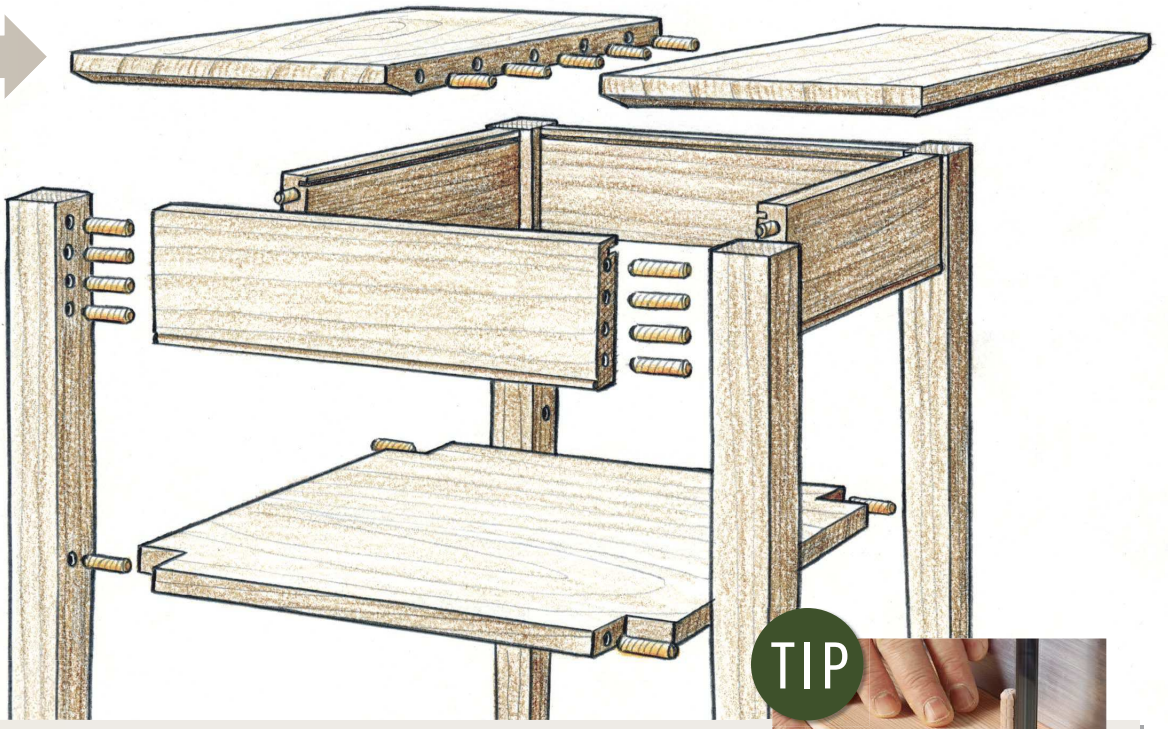
Article Extra
Learn how to build this table from start to finish in our online video series.

These humble pegs can do it all

1. ALIGN PANEL GLUE-UPS
Dowels seated in perfectly mated holes ensure a panel with flush surfaces.

2. A MORTISE-AND-TENON SUBSTITUTE
Multiple dowels act as slip tenons, mortised into both mating pieces with a large glue surface.

3. JOINTS IN TIGHT SPACES
A single dowel creates a hidden joint where traditional joinery would be cumbersome.



SECRETS OF SUCCESS

A good dowel joint depends on a snug fit between dowel and hole. Hardware-store dowels won't do, but good, cheap dowels are available from online woodworking suppliers.

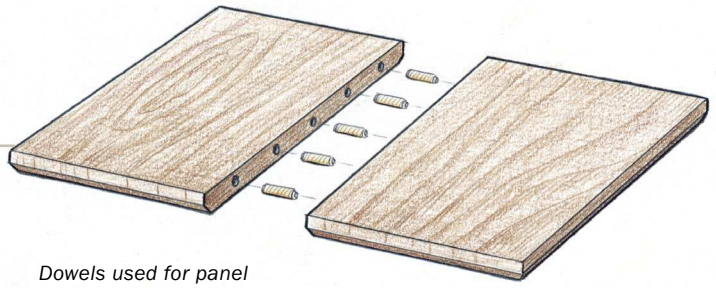
To drill accurate holes, use a brad-point bit. Its center spur prevents the bit from wandering and enlarging the hole. To keep mating holes aligned and ensure that the holes are square to the surface, you'll need a doweling jig. The $19 model from Rockler at left works with dowels of ⅜-in. diameter, a good all-purpose size.

For places where the jig can't go, a set of dowel centers is a smart accessory. These metal plugs (left photo, center) fit a hole precisely and transfer its location to the mating piece (see p. 39).

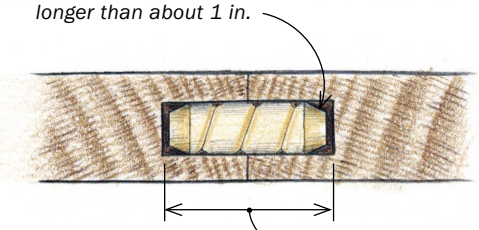
TIP

A lengthwise slit releases air and excess glue. To make the slit, use a simple bandsaw jig that holds the dowels vertically.

Glue up perfect panels

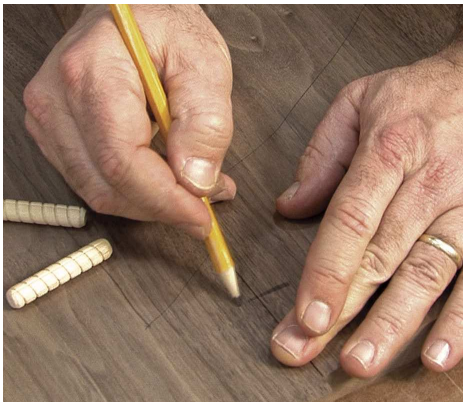


Dowels used for panel alignment need not be longer than about 1 in.



In this joint, the depth of each hole should be half of the dowel's length, plus 1/16 in. or so at each end to accommodate excess glue.

Set the depth. *Insert the drill bit into the doweling jig until the point protrudes to the desired depth. To create a simple depth stop, wrap a piece of painter's tape into a "flag" around the bit where it enters the top of the jig.*



Layout is simple. *Make a series of pencil marks squarely across each joint to locate the mating holes.*

Drill the holes. *Registration marks on the doweling jig align with your pencil marks to locate the jig. When the depth-stop flag begins sweeping chips from the top of the jig, you've reached the correct depth.*

In all of woodworking, no joint is as undervalued or underused as the one held together by the lowly dowel. Why? The answer lies in a mountain of broken chairs and cabinets. Decades of bad factory-made furniture have given the sturdy little peg a rickety reputation. But savvy pros know better. Dowel joints offer a simple, strong way to make fine furniture, and they often succeed where other joints can't.

Dowels are easy to use in part because they are cylindrical, meaning you can quickly create accurate holes for them using a handheld drill. As to strength, joint tests have shown that properly executed dowel joints are strong enough for all but the most demanding applications. This strength means you only have to make simple butt joints before drilling holes. And the best news, especially for beginning woodworkers, is that all you need is that drill, a couple of good drill bits, and an inexpensive jig. Here are my favorite ways to use dowels.

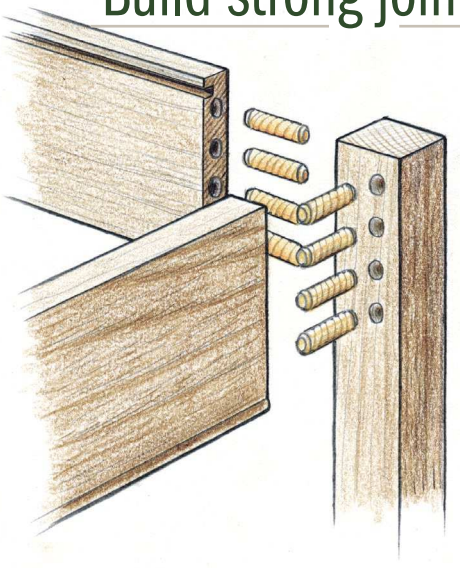
Align glued-up panels perfectly

Woodworkers often edge-glue several boards into a panel for a wide part like a door or tabletop. Dowels work well to keep the boards aligned so their surfaces stay flush.

To mark out for the joinery, draw tick marks across the joints, about 6 in. or 8 in. apart. Use these marks to align the doweling jig for drilling. This joint's strength comes from the long, edge-grain glue surface, so the dowels don't need to be numerous or large. I usually use 3/8-in.-dia. dowels, unless

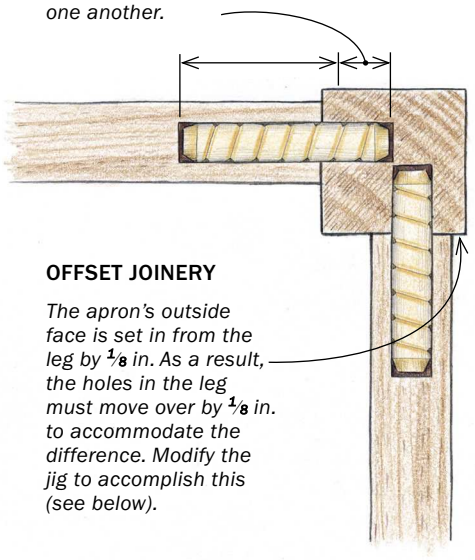
Photos: Steve Scott; drawings: John Tetreault

Build strong joints



HOLE DEPTHS DIFFER

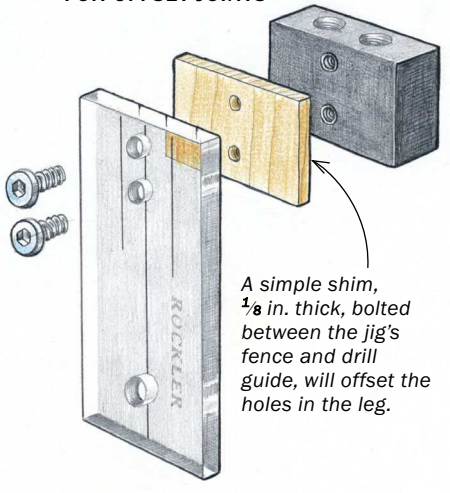
With a 2-in. dowel, the holes in the leg must be shallower to avoid interfering with one another.



OFFSET JOINERY

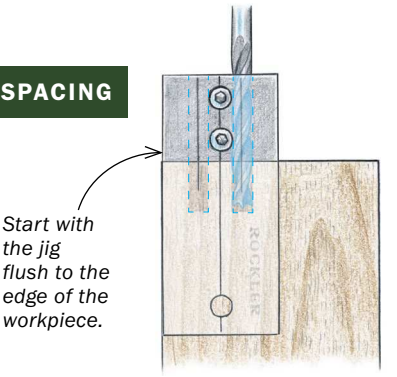
The apron's outside face is set in from the leg by ⅛ in. As a result, the holes in the leg must move over by ⅛ in. to accommodate the difference. Modify the jig to accomplish this (see below).

HOT-ROD THE JIG FOR OFFSET JOINTS

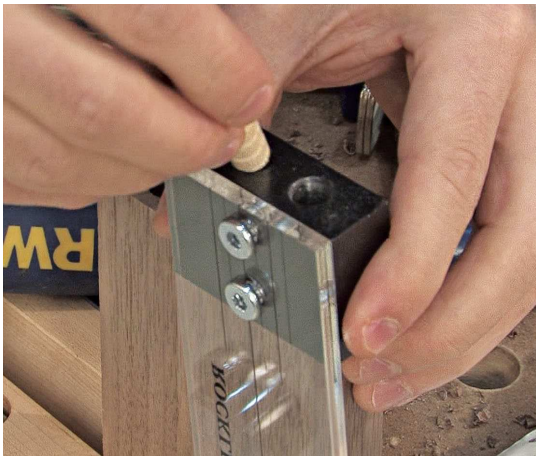


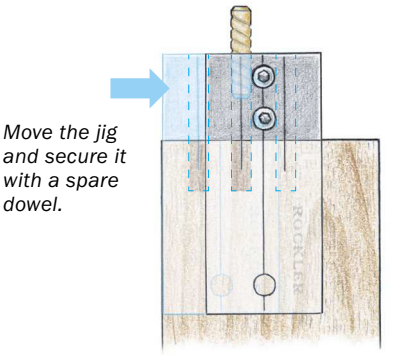
A simple shim, ⅛ in. thick, bolted between the jig's fence and drill guide, will offset the holes in the leg.

TRICK FOR ACCURATE SPACING

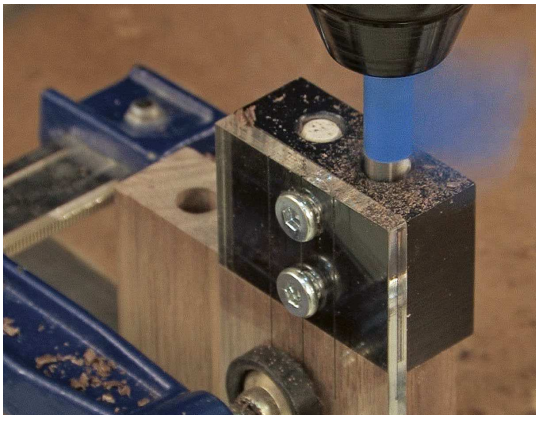


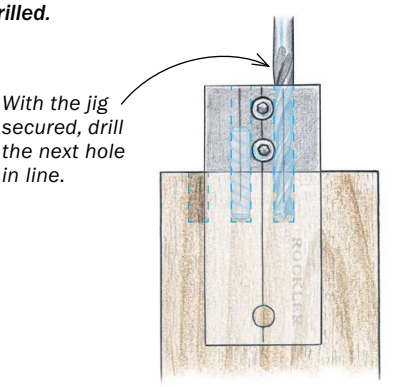
Drilling the first two holes. *Secure the apron in a vise and clamp the jig so its edge is flush with the top of the apron.*



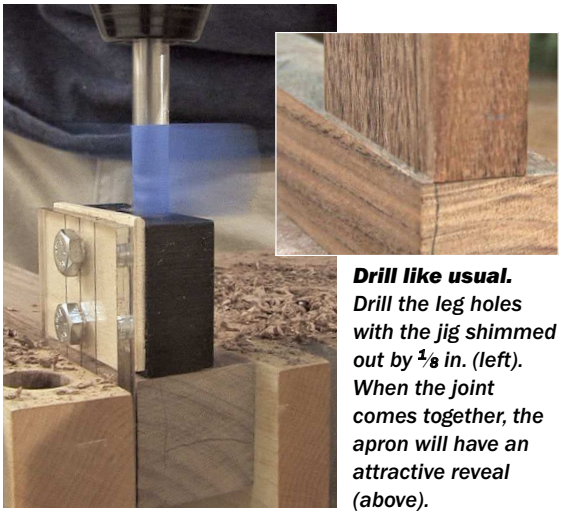


Move the jig over. *To continue the line of holes beyond the jig's reach, use a dowel to hold the jig in the last hole you drilled.*



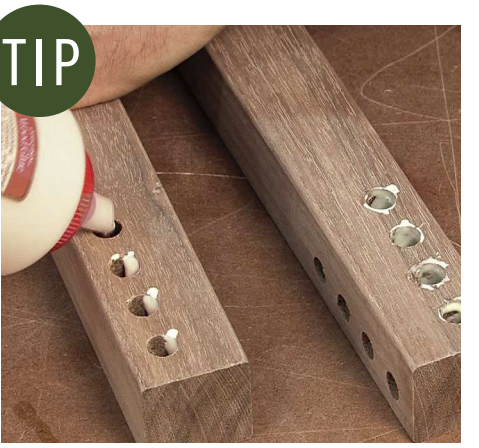


Drill and repeat. *With the jig secured, drill the next hole. Repeat as needed for a line of evenly spaced holes.*



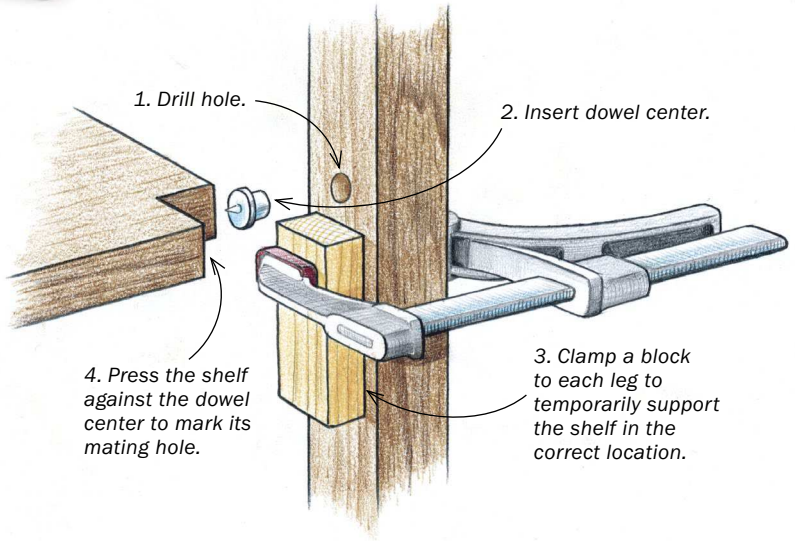
Drill like usual. *Drill the leg holes with the jig shimmed out by ⅛ in. (left). When the joint comes together, the apron will have an attractive reveal (above).*

TIP



The leg-to-apron joint derives no real strength from glue on the mating surfaces, so apply glue inside the dowel holes only.

Dowel centers solve tricky joints



the panel is less than ⅝ in. thick. Be sure to drill 1/16 in. or so deeper than needed to hold excess glue when the joint goes together. Also, when gluing any dowel joints, don't put glue on the dowel itself; the hole will scrape it off and create a mess. Instead, put glue in each hole and spread it with a small brush or stick.

Build sturdy tables, doors, and cabinets

Almost any joint that calls for a mortise-and-tenon—table bases, door frames, face frames—is a candidate for dowel joinery.

Because this joint relies exclusively on the dowels for strength, you need longer dowels—and more of them. A good rule for dowel size here is one-half the thickness of the workpiece, with ¾ in. or more extending into each hole. A ⅜-in.-dia., 2-in.-long dowel works great in most situations.

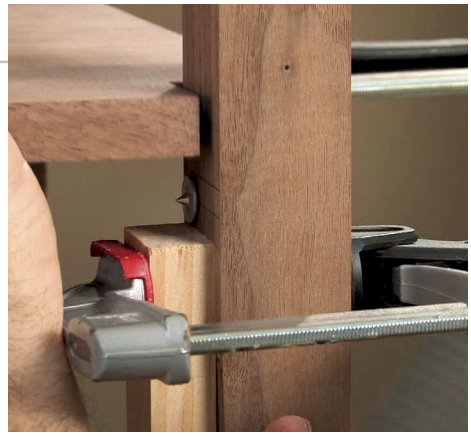
To ensure that the holes in the mating pieces line up accurately, start with the jig referenced along a common edge. In this case, use the top edge of the rail and the top of the leg, which will be flush when the pieces are assembled. Also, don't apply glue to the mating surfaces. The end grain won't add much strength and you'll get excess squeeze-out, which is best avoided.

Hide a joint where there's no room to hide

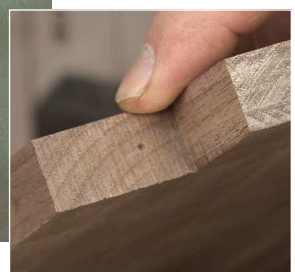
Furniture makers often draft an overall design for a piece first and sort out the joinery afterward. This allows creative freedom but can lead to situations where traditional joinery won't work.

One example is the lower shelf on the table shown on p. 36. Rest it on stretchers or cleats and it will look clunky. Traditional joinery would be difficult to execute or visually distracting. Dowels offer a clean solution. You can use the jig to drill the dowel holes in the table legs, but the jig won't work on the small notched corners of the shelf. Instead, dry-fit the legs to the aprons, and clamp a support block to each leg so that its top is level with the shelf bottom. Then insert a dowel center into each hole and rest the shelf on the blocks. A light mallet tap on the outside of each leg will press the dowel center's point into the shelf edge, marking for the mating hole. Now drill the dowel hole in the shelf edge. Again, place glue only in the dowel holes. □

Asa Christiana is Fine Woodworking's *editor.*



Locate the shelf. *A support block clamped to the leg holds the shelf in place.*



Tap once. *A light mallet tap drives the dowel center into the shelf edge (left). The dimple (below) locates the drill bit for a perfectly aligned hole.*

Drill the shelf edge. *Eyeball the drill and the edge of the shelf to make sure the hole is straight and square.*

BASIC **JOINTS**

Rabbets and Dadoes

How to cut them safely on the tablesaw

BY MARC ADAMS

The tablesaw can do more than make rip- and crosscuts. If you add a dado set and a few shop-made jigs and fixtures, it can become your favorite machine for cutting flawless joinery, too. The tablesaw offers an unmatched combination of accuracy, repeatability, speed, control, and endless jig potential.

To produce joint-quality cuts, both across the grain and with it, you'll need two types of blades. You can stick with your normal combination blade; a clean one cuts better. For wider notches in wood, whether rabbets, dadoes, grooves, tenons, or lap joints, I use an 8-in. stack dado set. Quality is very important here. You need a high-quality set that cuts clean edges and flat bottoms.

A dado set's inside and outside blades have angled teeth designed to eliminate tearout at the edges of the cut. A variety of chipper blades go between, allowing ¼-in.- to ⅞-in.-wide dadoes. Thin shims go in to fine-tune the width, if necessary. Be aware that dado sets take big cuts and can cause underpowered saws to bog down, and that the shorter arbors on some portable saws won't allow the full stack to be used.

The cool thing about learning the fundamental joints, like dadoes and rabbets, is that the same techniques work for many others, such as laps, tongues, and bridle joints. In fact, the design of a tablesaw invites a host of joints and jigs. This article is just the beginning. Soon you'll be calling this versatile machine "the variety saw," like I do.

Marc Adams's woodworking school in Franklin, Ind., is one of the largest in the world. Go to MarcAdams.com for a course listing.

Article Extra

See all of these techniques in motion, including how Adams builds a crosscut sled, in our members-only video series.

Two kinds of blades do it all

DADO SET

For many joinery cuts, you'll need a good dado set. Get the best stack-type dado set you can afford. It should cut slots with clean edges and flat bottoms.

COMBO

A basic combination blade is fine for grooves. For the cleanest cuts, buy a good one and keep its teeth free of pitch.

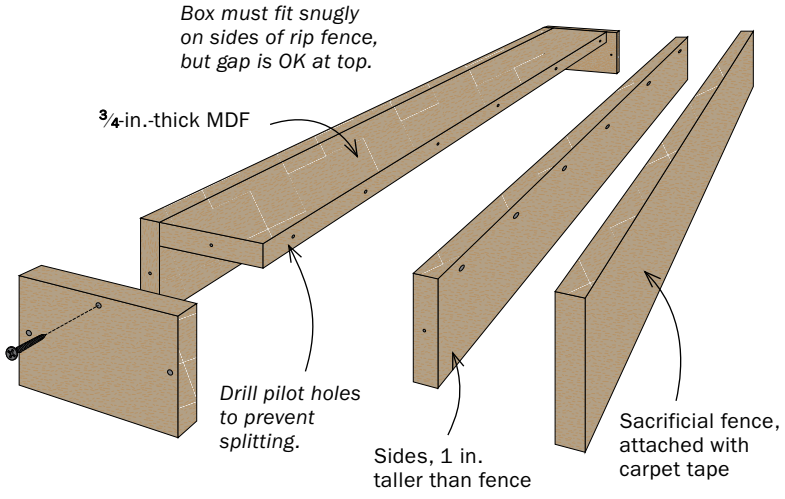
Photos: Asa Christiana; drawings: Kelly J. Dunton

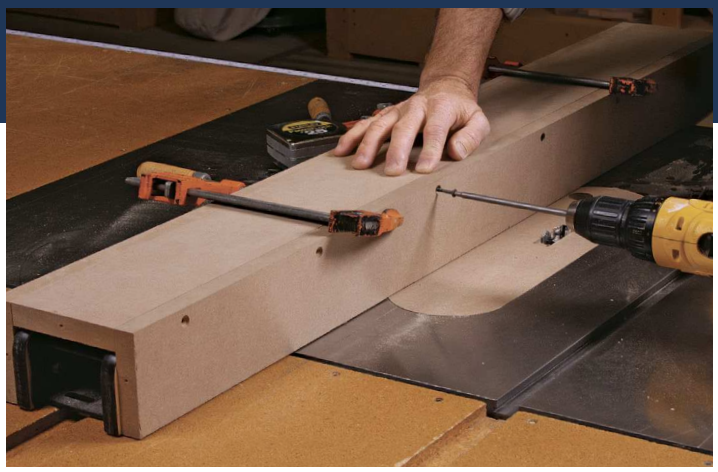
Accurate rabbets

To cut rabbets, you should bury the dado set in a sacrificial rip fence. This makes it easy to adjust the width of the rabbet: You simply nudge the fence a bit instead of fine-tuning the width of the dado stack.

But a sacrificial fence can be hard to clamp to the short sides of a standard rip fence without the clamps getting in the way. My solution is to build a simple MDF box that fits snugly over the fence, and then tape the sacrificial piece to that. The box allows the sacrificial fence to be removed and replaced easily, on either side, so it works with the fence on either side of the blade. And a single piece of MDF can be positioned four different ways to extend its use.

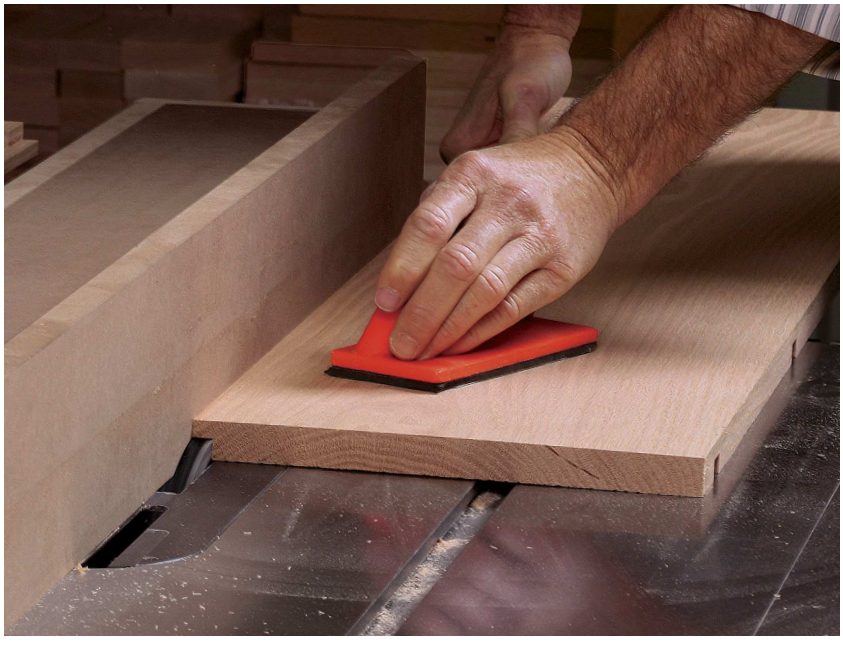
BUILD A BOX TO BURY THE BLADES





How to get a snug fit. *Cut the sides 1 in. taller than the rip fence, and long enough to allow clearance for the lever at the end. Clamp the sides in place to measure for the top plate and attach it as shown. Drill pilot holes to prevent splitting. Keep the clamps on as you screw on the end caps.*

Add the fence and bury the blades. *Use thick carpet tape to attach a tall MDF fence (above), then move the fence over the top of the dado set and bring the spinning blades up into it (left), only as high as needed.*



Fast, accurate rabbets. *Whether the rabbets are along the edge (left) or end of a workpiece (above), you can run the workpiece against the fence. But you'll need a zero-clearance throat plate to prevent tearout when working across the grain. Push pads do a good job controlling the workpiece, but you'll need to support narrow workpieces with the miter gauge.*

The simple groove

Ride the fence. *Adams makes grooves with a single blade, making multiple cuts for wider grooves. A long push stick gives better downward pressure and control.*

Grooves are the easiest joint to cut. Since they are aligned with the grain, you can use the rip fence to guide the workpiece. I normally use my combo blade, adjusting the fence and taking multiple passes for a wider groove. If the bottom needs to be dead flat, you can also use your dado set.

The advantage of the single blade is that it lets you use a riving knife or splitter to prevent kickback.

In any case, always use a push stick or push pads to maintain good control while keeping your fingers safe (you can't see the blade until it exits the board). Pay special attention to keeping the workpiece flat at the point of contact.

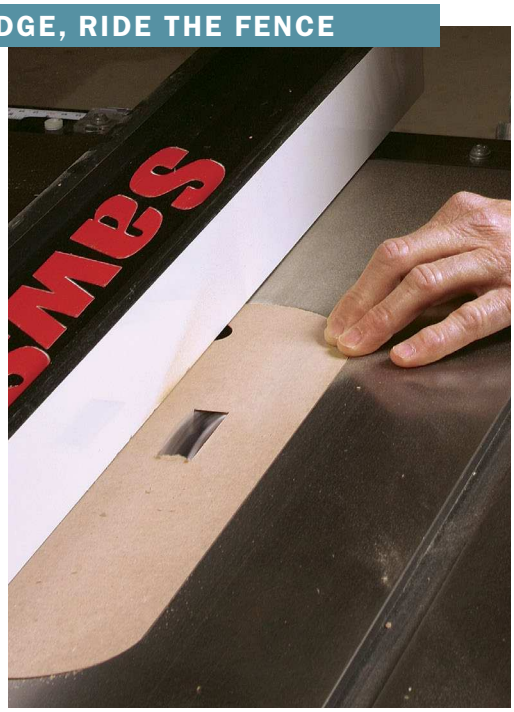
Use a push pad for short pieces. *On these shorter drawer sides, a push pad, lined with rubber and/or sandpaper, gives better control.*

Clean dadoes

A dado is a groove cut across the grain and is usually sized precisely for a second piece to fit into. Since dadoes are crosscuts, tearout can be a problem without a zero-clearance surface below the cut. If the back edge will show, you'll need zero clearance there, too. You can use a variety of fences to make a dado cut safely, but it depends on the size of the workpiece and location of

NEAR AN EDGE, RIDE THE FENCE

Tame tearout. *You'll need to make a fresh throat plate to prevent tearout. Insert a blank one, position the rip fence to hold it down without getting in the way of the blade, and then bring the dado set up through it.*



Push pad stars again. *A push pad works better than a push stick to keep a big panel down on the table and tight to the rip fence.*

the dado. On wide workpieces with the dado close to the end of the piece, you can run the stock against the rip fence.

But the crosscut sled is my favorite tool for dadoing, because it carries pieces with excellent control and great accuracy. That control is especially important because you can't use a splitter or riving knife in conjunction with a dado set on most saws. A crosscut sled also accepts all types of stops.

IN THE MIDDLE, USE A SLED

Refresh your crosscut sled. *To prevent tearout on a sled, tape down a piece of ¼-in.-thick MDF (above). Do the same on the fence (right), and then cut a zero-clearance slot through both.*

TIP

CARPET TAPE GRIPS BETTER

To add holding power to jigs, Adams uses double-sided carpet tape with mesh inside. It is thicker and far stronger than the thin plasticky type.

Why the sled is best. *A crosscut sled controls workpieces of almost any size, and is a must for the middle dadoes on these long bookcase sides. A hook-style stop offers a long reach and is easy to attach.*

Pinned Rabbets Perfect for Drawers

Strong and attractive, these joints are a great alternative to traditional dovetails

BY HENDRIK VARJU

Beautiful and strong, hand-cut dovetails are the favorite drawer joint of many woodworkers. But they take a lot of time to make and a lot of skill to master. If you're not a slave to tradition, there are other joints nearly as strong and beautiful that can be made in a fraction of the time.

To me, the best alternative is a drawer with pinned rabbets at the front, and dadoes to hold the back in place. All of the joinery is cut quickly and easily at the tablesaw. My customers have never complained. In fact, they find the clean, crisp lines attractive and comment that the drawer doesn't look mass-produced.

I'll show you how to make the drawer with a ¾-in.-thick front, ½-in.-thick sides and back, and ¼-in.-thick bottom, but the same techniques can be used to make smaller or larger drawers.

Making parts in the right order ensures tight joints

To make these joints strong and gap-free, cut the rabbets and dadoes first, and then mill the parts to fit them. If possible, make the parts from quartersawn lumber, which is more stable than flatsawn. The joints will be stronger and the drawer will fit better through the seasons because the parts will move less.

Plane the front to thickness and cut it to length, but keep it 1/16 in. over the final width (height). Cut the sides to final length and width, leaving them a bit thicker than needed; they will be trimmed to final thickness after the drawer has been glued together. You'll fit the back to the drawer as you make it, so leave it oversize for now.

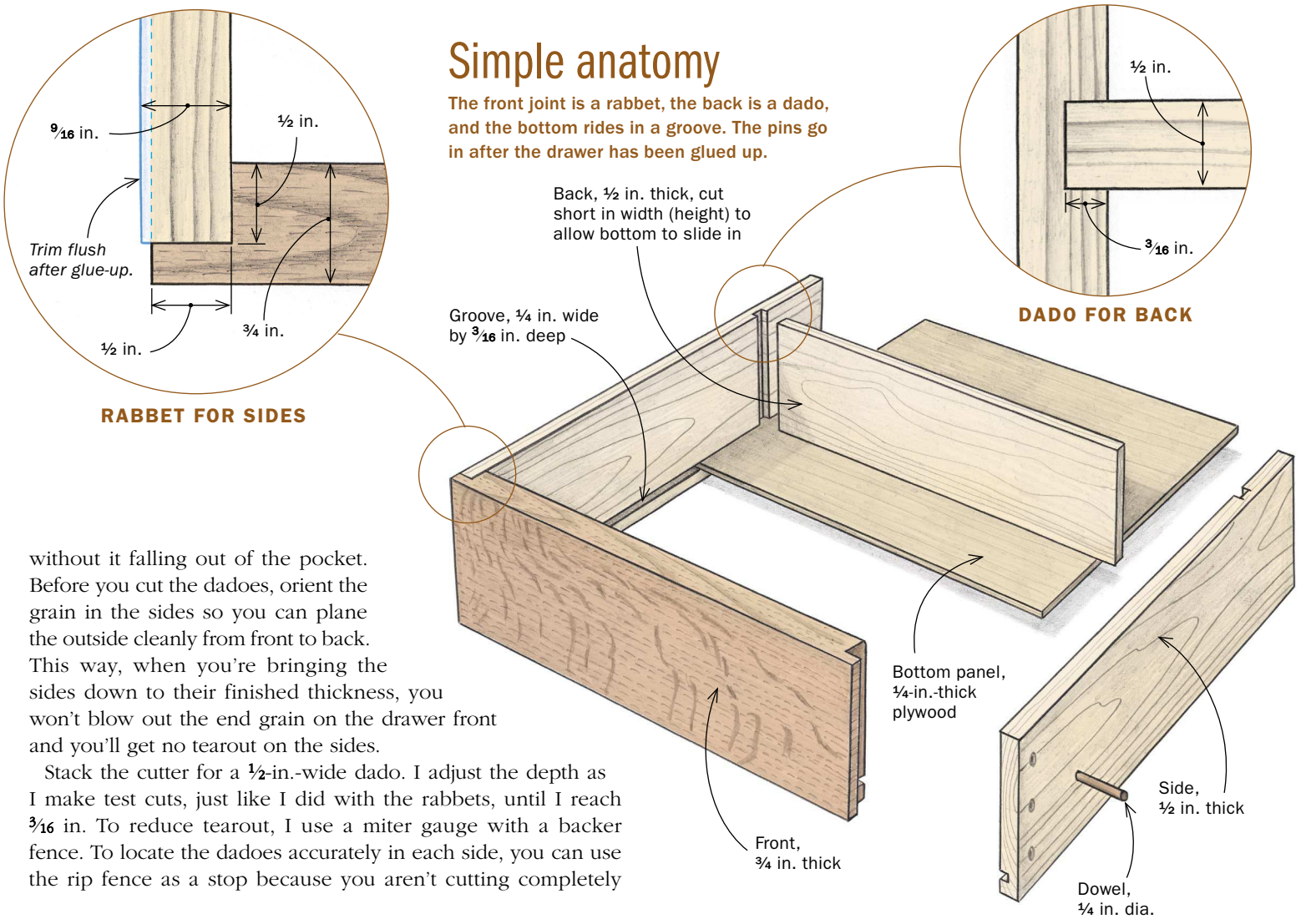
Use a sacrificial fence to cut rabbets

I cut the rabbets on the drawer front with a dado set stacked wider than the rabbet, burying the extra width in a sacrificial fence. Dado cutters are designed so that the outer blade cuts slightly deeper than the chippers to help prevent tearout. It's barely noticeable on the inside of the rabbet but it creates a gap on the outside of the rabbet after the joint is glued. Burying the cutter in a sacrificial fence eliminates the gap.

Mark the rabbet on one end of the front. Set the blade low, make a test cut, and raise the blade a bit. Make a second cut, and repeat until the cutter reaches the layout line. Then cut the rabbet on the opposite end.

Extralong sides let drawer open all the way

After the rabbets have been cut, it's time to cut dadoes in the sides to hold the back. I locate them 2 in. from the back, which creates an extension that lets you open the drawer completely



without it falling out of the pocket. Before you cut the dadoes, orient the grain in the sides so you can plane the outside cleanly from front to back. This way, when you're bringing the sides down to their finished thickness, you won't blow out the end grain on the drawer front and you'll get no tearout on the sides.

Stack the cutter for a ½-in.-wide dado. I adjust the depth as I make test cuts, just like I did with the rabbets, until I reach 3/16 in. To reduce tearout, I use a miter gauge with a backer fence. To locate the dadoes accurately in each side, you can use the rip fence as a stop because you aren't cutting completely

FAST TABLESAW JOINERY

A tablesaw makes quick work of the rabbets, dadoes, and grooves. And the saw's accuracy translates into tight-fitting joints.

Rabbet the front. *For clean results, bury the dado set in a sacrificial fence, and put another sacrificial fence on the miter gauge to back up the cut.*

Cut the dado for the back. *Restack the dado set to ½ in. wide and sneak up on the full depth. Clamp the workpiece to the miter gauge to keep it from drifting.*

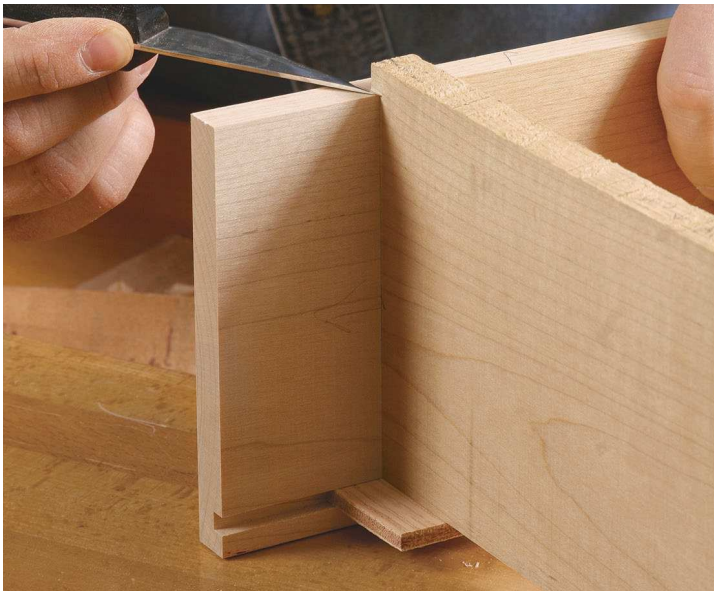
Use a standard blade for the groove. *Stacking a dado cutter to match the thickness of the plywood bottom is a fussy task; two passes over a combination blade cuts the groove quickly.*

Photos: Matt Kenney; drawings: John Tetreault

DADOED BACK ADDS STRENGTH

Mill the back and cut it to size after the dadoes and grooves have been cut. The snug fit strengthens the drawer and helps keep it square.

Don't trust your ruler. *The best way to know when the back is the right thickness is to test its fit in the dado after each pass through the planer.*



Find the height. *Place the back in its dadoes, supporting it with offcuts from the bottom. Now you can mark its height accurately.*

through the sides and leaving a cutoff trapped between fence and blade.

Fit the back to the drawer

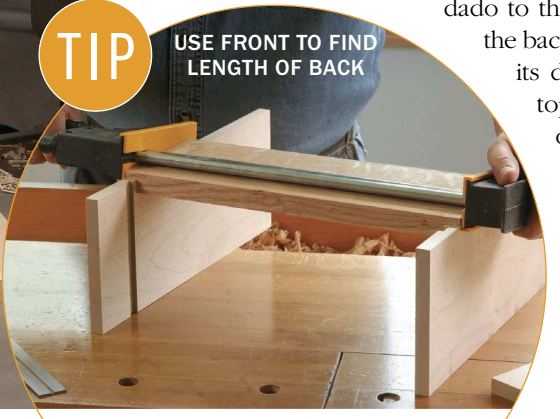
After cutting the dadoes, plane the back to thickness, testing its fit as you go. Before cutting the back to its final width (height), cut the grooves for the bottom. The back sits on the drawer bottom, and the groove shows where that will be.

I make drawer bottoms from ¼-in.-thick plywood and use a standard-kerf blade to cut a 3/16-in.-deep groove ¼ in. from the bottom of the sides and front. Set the rip fence to make the first cut, and groove the front, sides, and a test piece. Adjust the fence for the second cut. Run the test piece through and check to see if the drawer bottom will fit into it. The plywood should move in the groove, but without slop. Adjust the fence if needed, and finish grooving the front and sides.

For the drawer to end up square, the back must be precisely the right length. To get an accurate measurement, clamp the front—with the top edge of the sides in the rabbets—between the sides just in front of the dadoes. This ensures that the sides are the correct distance apart. Measure from the bottom of one dado to the bottom of the other. Cut the back to length, then slide it into its dadoes until it reaches the top of the groove; put some offcuts from the bottom into the groove to make this easier. Mark the back and cut it to final height.

TIP

USE FRONT TO FIND LENGTH OF BACK



Clamp the front between the sides to ensure that they're spaced accurately. Then measure for the back.

The front was left 1/16 in. oversize in height so that the drawer bottom groove could be cut in it and the sides at the same time. Trim that 1/16 in. off the bottom so that there's a consistent gap all the way around the front. Then drill holes for pulls or knobs. Sand the inside faces of the front and sides, and both faces of the back. The edges will be cleaned up after assembly.

Jointer trick perfects the rabbet joint

I glue the back into its dadoes first, because the joint will hold itself together as I work on the rabbets at the front. Spread glue on the rabbets, avoiding the groove for the bottom. Then slide the drawer front onto the sides. This forces any glue squeeze-out toward the outside of the drawer, which makes for easier cleanup. Insert offcuts from the drawer bottom into the groove and align the front with the sides. Clamp the joint from side to side, then front to back. Pull out the offcuts and let the glue dry overnight.

The next day, take the drawer to the jointer and carefully plane the sides until they're just a few thousandths of an inch too thick. Take that last bit off with a handplane.

Pin rabbets for strength and a custom look

The pins are what make this simple drawer strong and stylish enough for fine furniture. With the sides planed flush, lay out

GLUE UP, THEN TRIM DOWN

Varju lays out everything he needs, from clamps to cauls, before he begins.

Four clamps for the rabbet. *Two go side to side and two go front to back. Varju uses small cauls to get pressure on the joints without the clamp heads interfering with one another.*

TIP USE OFFCUTS FOR ALIGNMENT

Before applying glue, place offcuts from the drawer bottom into the corners of the grooves to align the front with the sides.

the pins, making sure to locate the bottom pin above the drawer bottom. It looks best if the top and bottom pins are an equal distance from the edge and you use an odd number of pins. Also, I match the pins to the drawer front. As for the diameter of the pins, ¼ in. looks right if the drawer front is ¾ in. thick or thinner.

Bore the holes at the drill press. Go through the sides and ¾ in. into the front. Cut the pins 1½ in. long. Squeeze glue into the holes and spread it around the walls. Pound the pins into the holes. After the glue has dried, cut them close with a saw and trim them flush with a block plane. Sand the sides and the front.

Cut the bottom and fit the drawer

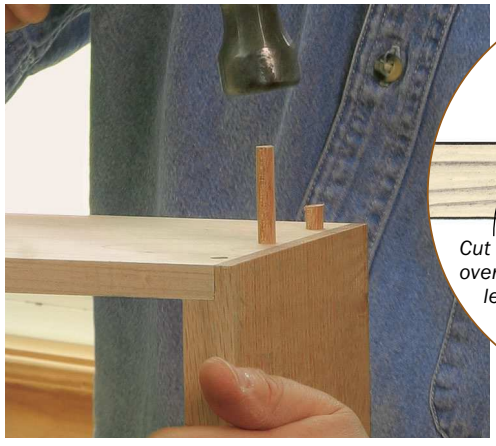
Next, cut the drawer bottom to size and slide it in from the back. About 1/32 in. of clearance per side ensures it won't get wedged in. Two or three small screws hold the panel to the underside of the drawer back. For a solid-wood bottom, the clearance is the same at the sides, but align the grain so that wood movement occurs front to back. Also, elongate the screw holes at the back.

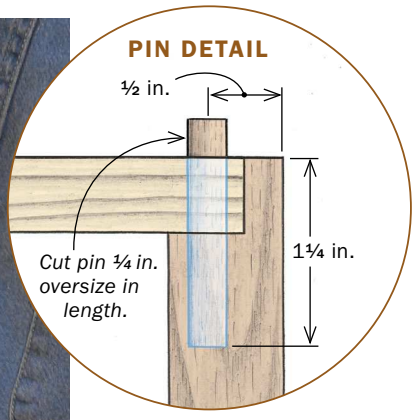
Finally, plane the top and bottom edges of the sides to fit the drawer into its pocket, but don't take too much off the bottom or the gap around the front will become uneven. □

Hendrik Varju operates Passion for Wood near Acton, Ont., Canada.

PINS ADD STRENGTH AND BEAUTY

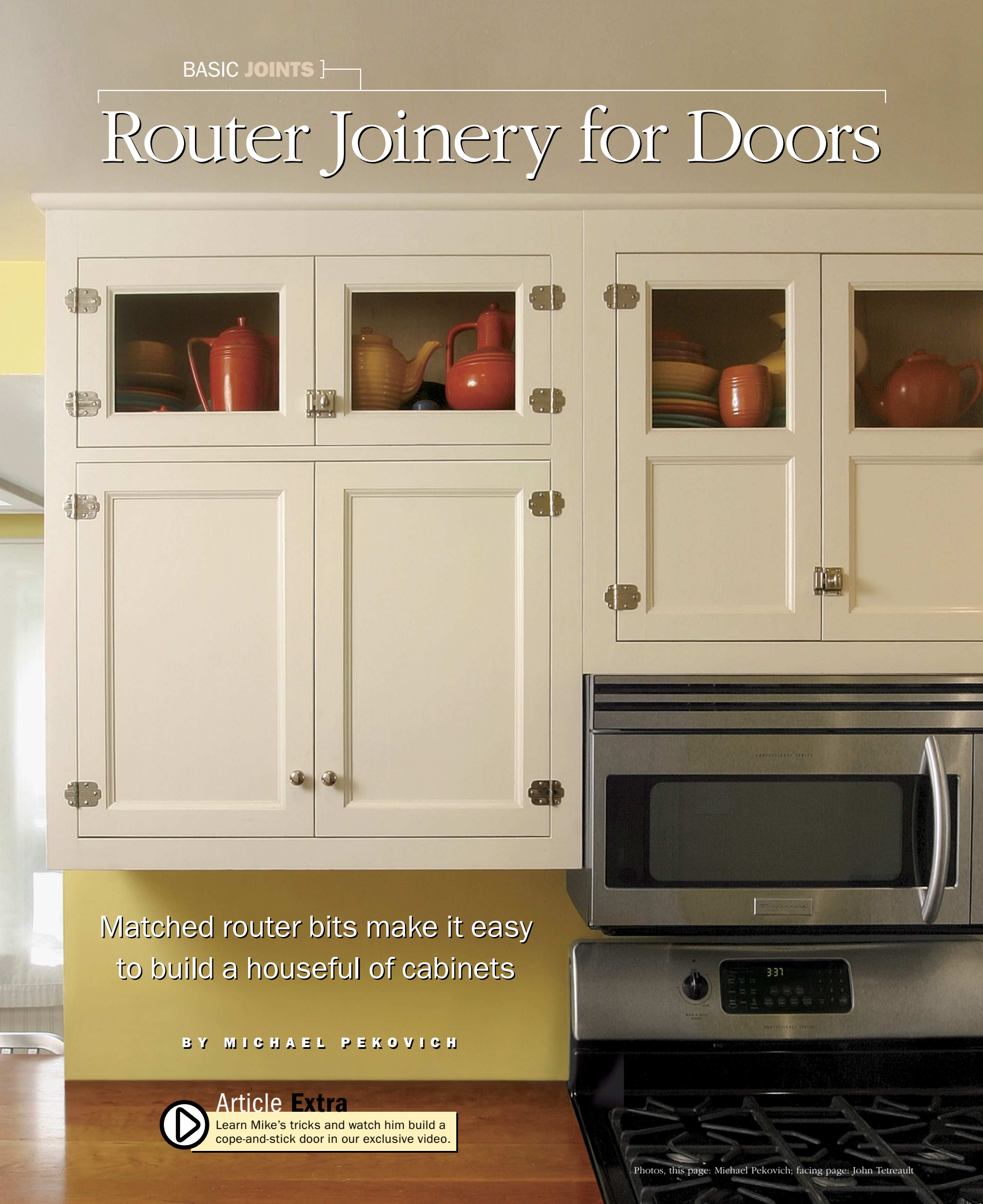
Hang the drawer on the drill-press table. *This is more stable than lowering the table and standing the drawer on it.*





Leave pins proud, then trim them flush. *Cut them about ¼ in. longer than they need to be. This reduces the chance you'll strike the drawer sides with the hammer. A good flush-trimming saw will do the job without marring the drawer. Or you can saw the pins a bit proud, and bring them flush with a block plane.*

Router Joinery for Doors



Matched router bits make it easy to build a houseful of cabinets

BY MICHAEL PEKOVICH

Article Extra

Learn Mike's tricks and watch him build a cope-and-stick door in our exclusive video.

Photos, this page: Michael Pekovich; facing page: John Tetreault

This past summer, during the remodeling of my kitchen, I was faced with the task of making 31 cabinet doors. I needed speed and simplicity, so I broke out my router table and a set of cope-and-stick router bits. These bit combinations allow you to rout door frames quickly, in two steps. The first bit routs a profile and panel groove on the inside edge of all the frame parts. The second bit is a mirror image of the first, routing a coped profile and a stub tenon on the ends of the frame rails.

What you create is not a traditional mortise-and-tenon joint. But done right, it gives you a cabinet door that's just as strong. The key is to use a flat panel of plywood or medium-density fiberboard (MDF) that's glued in place—not a raised panel, which is designed to float. All in all, I was able to build all 31 doors in the course of a weekend, from milling lumber to finish sanding.

Different types of cope-and-stick bits are available, with an array of profiles from simple thumbnails to more ornate ogees (see sidebar, right.) In general, these bits are designed for ¾-in.-thick doors, but there are cope-and-stick bits available for stock ½ in. or thinner.

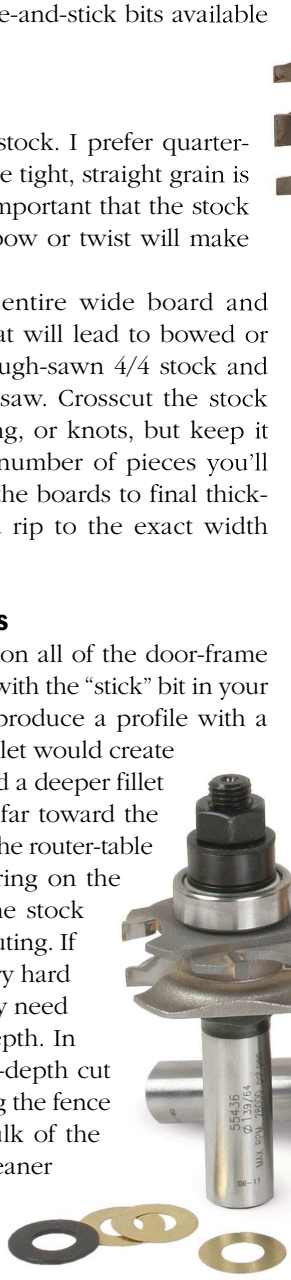
Start with straight, square stock

I began by milling the door-frame stock. I prefer quarter-sawn or rift-sawn boards because the tight, straight grain is both good-looking and stable. It's important that the stock be straight and square. Any slight bow or twist will make fitting the door a nightmare.

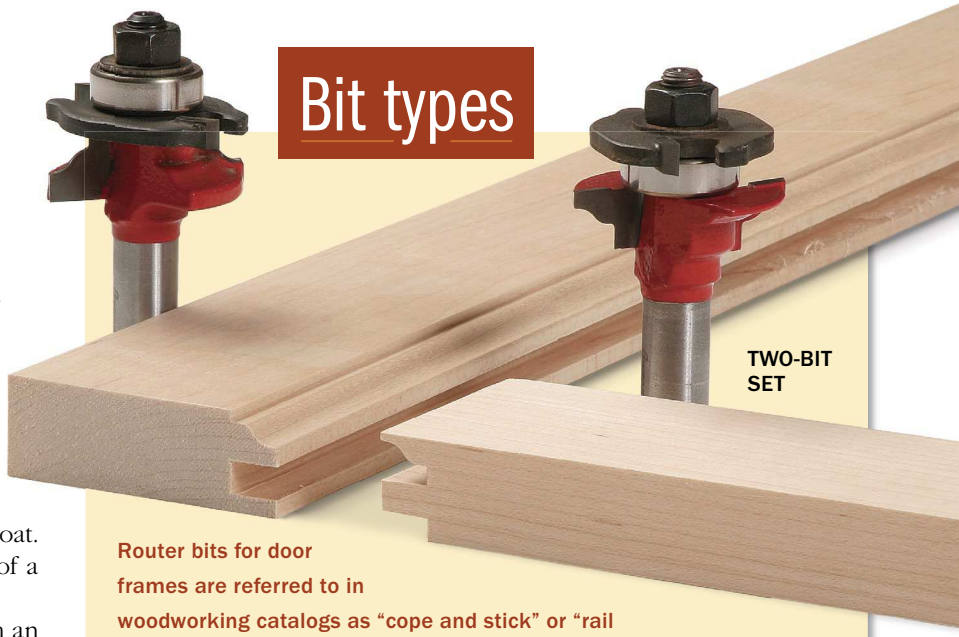
Don't be tempted to flatten an entire wide board and then rip the frame parts from it; that will lead to bowed or twisted stock. Instead, start with rough-sawn 4/4 stock and rip the parts oversize on the bandsaw. Crosscut the stock to remove any serious twist, bowing, or knots, but keep it as long as possible to reduce the number of pieces you'll have to rout. Then joint and plane the boards to final thickness (mine finished at ¾ in.), and rip to the exact width on the tablesaw.

Rout the edge profile on all pieces

Now you can rout the edge profile on all of the door-frame pieces while they are still long. Start with the "stick" bit in your router. Adjust the height until you produce a profile with a 1/16-in. fillet at the top. A shallower fillet would create a weak upper portion of the joint and a deeper fillet would locate the panel groove too far toward the back, creating a thin rear wall. Align the router-table fence precisely with the guide bearing on the bit. Attach featherboards to hold the stock against the table and fence when routing. If you're using a smaller router or a very hard wood such as oak or maple, you may need to take two passes to reach final depth. In that case, set up for a three-quarter-depth cut and rout all the stock before adjusting the fence for the final pass. Removing the bulk of the waste on the first pass will yield a cleaner surface on the second.



Bit types



TWO-BIT SET

Router bits for door frames are referred to in woodworking catalogs as "cope and stick" or "rail and stile" bits. Their function is to rout a profile and a panel groove on the inside edge of the frame parts and to cope the ends of the rails to fit that profiled edge. The bit style I use consists of a pair of matched bits (above). Another style of bit that is available is a stacked bit (left), in which the cutters necessary for each profile are included on a single bit. The stacked style does away with bit changing and may be more convenient for occasional use, but the two-bit style can be used with two dedicated routers for a better production setup. Both styles range from $80 to $150. A less-expensive alternative is a reversible bit, with cutters that are reconfigured on a shaft for each cut. These sell for $80 to $100, but I don't think the savings is worth the inconvenience.

STACKED SINGLE BIT

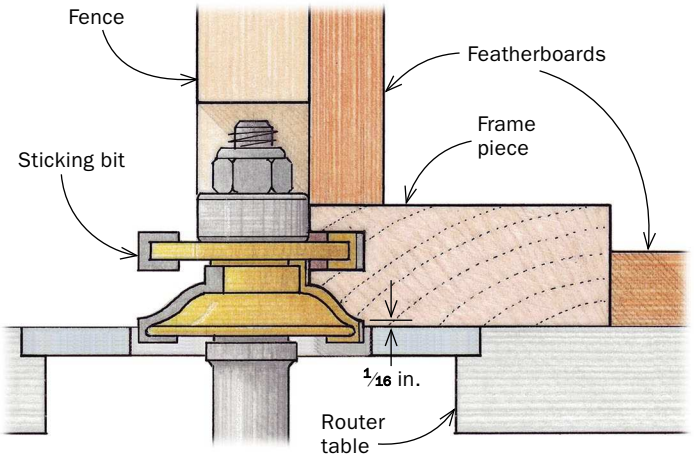
ADJUSTABLE BIT FOR PLYWOOD PANELS

Most bit sets cut a ¼-in. groove in the stiles and rails. And that works fine for MDF panels, which are a true ¼ in. Unfortunately, veneered plywood typically measures less than that and will leave an unsightly gap. One solution is an adjustable bit set, made by both Freud and Amana. These feature a pair of stacked cutters that can be adjusted from 3/16 in. to 9/32 in. for ¼-in. plywood by installing or removing shims. It took me about a half hour to set up the bits, but the resulting fit was precise. At $160 to $180, an adjustable set is worth it if you work with plywood.

ADJUSTABLE BIT SET

1 Rout the profile

Make the edge profiles first. *Even before the frame pieces are cut to size, rout their edge profiles to accept the panel. Do this in one or two passes, using the sticking bit.*



Use a story stick for crosscutting

Once the edges have been profiled, it's time to cut all the parts to final length. Instead of a tape measure, I made a "story stick" to record the width and height of the case openings, along with the number of doors that fit in the opening. For cases with two doors, I measured the width and marked the halfway point.

I then used the story stick to set up the tablesaw for crosscutting. I started with the stiles, which run top to bottom in the case opening. First I clamped a stop block to the rip fence in front of the blade, to prevent the stile from binding between the blade and the fence during cutting. Then it was simply a matter of aligning the mark on the story stick with the blade and setting the fence so that the stop block was flush with the end of the stick. Cut the stiles, making sure to mark the door number on each piece.

Cutting the rails to length is a bit trickier. Because they fit between the stiles, you must account not only for the width of the stiles but also the depth of the stub tenons. This can lead to some head-scratching, but I found a simple method that let me dispense with the math. First, make a setup block that is equal to the width of the two stiles minus the depth of the panel grooves. Use this setup block in conjunction with the story stick to quickly dial in the right dimensions for the rails. Because rails are usually short, use a stop block clamped to the crosscut-sled fence to set the length. Again, align the mark on the story stick with the blade; then rest the setup block on the story stick flush with the end, and

2 Cut the stiles

Put away your tape measure. *Mark the door-frame length and width measurements on a thin "story" stick. You'll transfer the marks directly to the tablesaw.*

Clamp a stop block to the rip fence. *Use the story stick to set the rip fence for crosscutting the stiles.*

Photos, except where noted: Charlie Reina; drawings: Vince Babak

pencil a line on the sled to mark the end of the rail. Clamp the stop block at the line and cut the rails.

A sled for end-routing

With the parts cut to length, it's time to install the coping bit and profile the ends of the rails. Do not try to run these rails against the router-table fence without additional support; the pieces are too narrow to stay square against the fence. Instead, use a simple plywood sled fitted with hold-down clamps to run the stock squarely and safely across the bit. But before setting up the sled, cope the long edge of an extra piece of frame stock to make a special backing block. This piece will marry with the profiled edge of the rail stock and prevent tearout. When the other end of the rail is routed, the trailing edge will be flat, and a flat backer block will suffice.

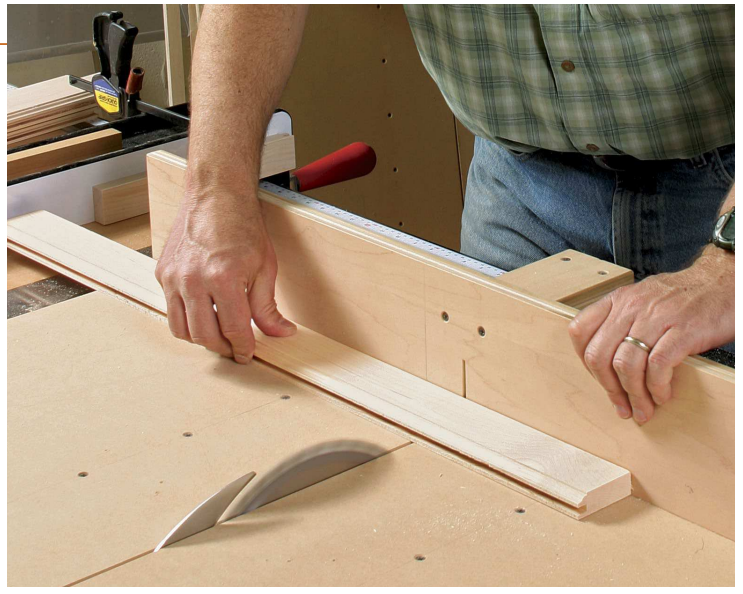
After the backing block is made, clamp an offcut in the sled and take a test cut. Adjust the bit's height until the two pieces are flush. Start with the flat edge against the sled fence and cope the first end. Then rotate the rail, insert the backing block into the panel groove, and cope the second end.

Make the panels undersize in width

With the frames complete, all that's left to do is to size the panels. I made them 1/16 in. narrower than the length of the rails. This is to accommodate the slight amount of seasonal movement (yes, even MDF moves), and to make sure the panel allows the frame parts to seat fully during glue-up. The panels' length equals the stile length minus the setup-block length. The MDF I used fit very snugly into the panel groove, so I knocked the panels' corners off quickly with a block plane. (Unlike plywood, which is thinner than its nominal thickness, MDF measures out on the mark.)

How to keep it all square

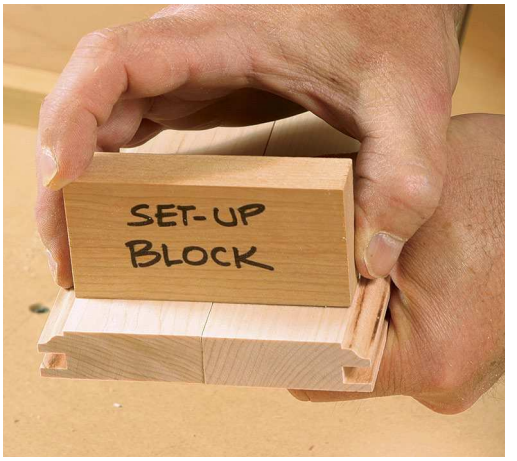
Gluing up cope-and-stick doors is a challenge. One concern is that the stub tenons could slide along the panel groove,



Cut all the stiles. *Lead with the profiled edges to keep them free of chipout. A well-made crosscut sled keeps the cuts square.*

3 Cut the rails

Cutting the rails requires an extra step. *Start by cutting a block to the width of two rails minus the combined depth of their grooves. When you subtract this distance from the door width, you'll get the correct length of the rails.*

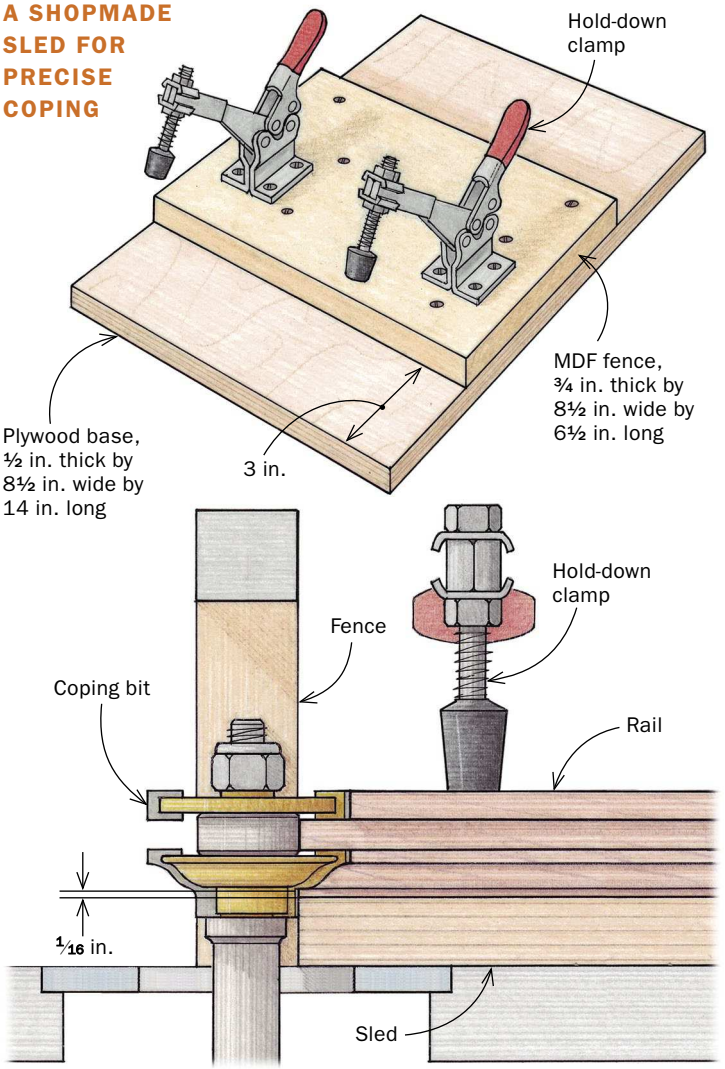


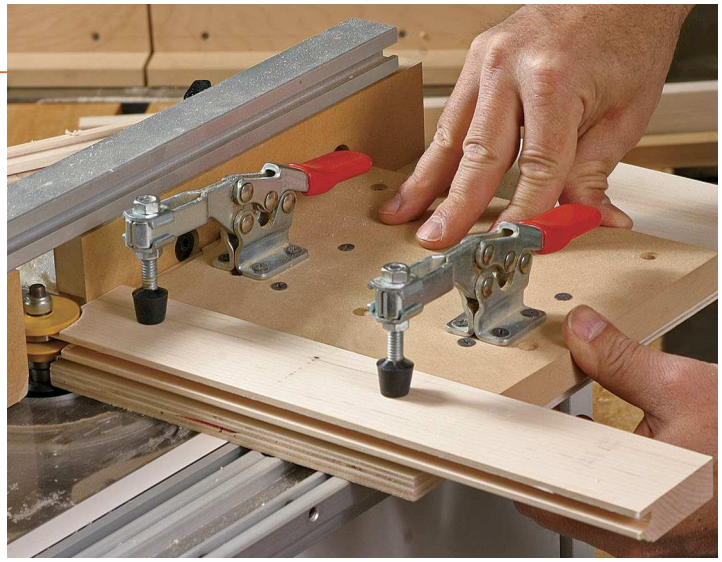
Use the block to set up the cut. *With the story stick's door-width mark aligned with the sawblade, use the block to draw a line on the sled fence.*

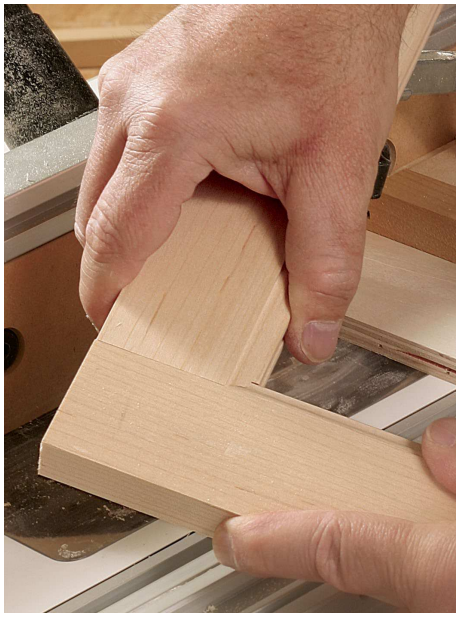
Cut the rails. *With a stop block clamped at the line, you can cut all the rails to a precise and uniform length for a specific door size.*

4 Cope the rails

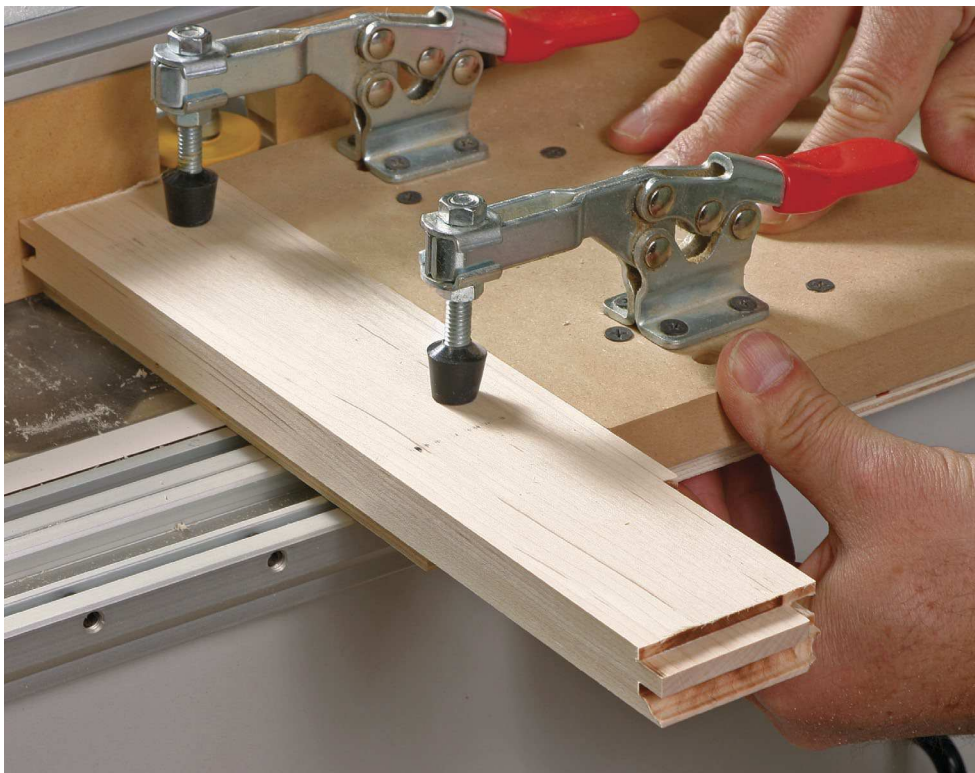
A SHOPMADE SLED FOR PRECISE COPING







Profile the rail ends. *Switch to the coping bit and use the sled to keep the rails square and secure for their end cuts. After making test cuts to ensure the faces will be flush (left), begin by coping the rail with the flat edge against the fence (above).*



Back the profile with its mate. *Before coping the opposite end, run a short length of scrap past the coping bit to make a backer block for the rail's profiled edge (above). With the backer block mated behind the piece, cope the second rail end (right).*

Mark and glue one stile. *After marking the location of the panel on one of the stiles, apply glue inside the entire length of the stile's groove. The panel will be glued to the stiles only.*

making it difficult to glue up the parts square. Or, the panel could fit so tight that it seizes up on contact with the glue, making it very difficult to square up the parts. Fortunately, this procedure eliminates both potential problems. I installed the panel in a stile groove first, then slid the rails on, and finally, added the second stile.

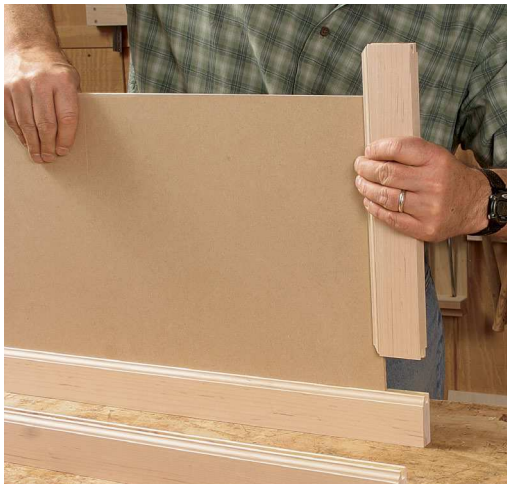
To position the panel correctly, mark its location on the stile by holding a rail in place and marking the width of its tenon. Apply glue along the panel grooves of the stiles only. Then apply glue to the coped ends of the rails. If there is glue in the rail grooves, they won't slide along the panel. Install the panel, making sure it's fully seated. Then push a rail onto the panel, fully seating it, and slide it down onto the stile. Install the second rail in the same manner, using the panel to align the rails parallel to each other and square to the stiles. All that's left is to install the last stile.

Once that's done, clamp along the entire joint. Be careful not to apply too much pressure across the panel, because it's slightly narrower than the rails, and the stiles could bow inward. Use a straightedge to make sure the stiles are flat with the rails. The short tenons provide little resistance against flexing upward. □

Michael Pekovich is Fine Woodworking's *art director, and a longtime professional furniture maker.*

5 Assemble the panels

Placing the panel is key. *Line up the panel precisely between the layout marks, and push it down to the groove bottom. This will keep the rest of the assembly square.*



Attach the rails. *After applying glue to the leading end of one rail, slide it down the panel edge and fit its stub tenon into place in the stile groove. Do the same with the second rail. Complete the assembly by gluing on the last stile.*

Check and clamp. *Before tightening the clamps, use a straightedge to make sure the panel is flat in all directions. Adjust the clamps if necessary, and tighten.*

Box Miters

Clean results and easier glue-ups

BY DOUG STOWE AND DAVID HYATT

The box, or standing, miter is an uncomplicated woodworking joint. Or so it seems. The ends of each side are cut at 45° to create a box. But cutting those corners perfectly square and then gluing up the box so that they remain square is not easy.

If your blade angles are slightly off, you'll have a hard time getting a joint with no gaps. Then you might chase your tail trying to troubleshoot the setup, all the while making your box smaller with each cut.

And even if you cut perfect corners, gluing up the box presents its own challenges. You must keep those slippery glue surfaces from sliding around as you apply clamping pressure. To top it off, you have to keep the entire assembly square as you clamp.

In this article you'll see two solutions from veteran woodworkers. You may be surprised that both use similar glue-up techniques that rely on tape as clamps. Doug Stowe, a renowned boxmaker in Arkansas, first gives his tips on making small mitered boxes. David Hyatt, a woodworker in Vancouver, Canada, follows with tips on how to handle big boxes for cabinetry. With both of their takes, you'll be well-prepared to tackle box miters of any size.

Big or small, miters handle it all

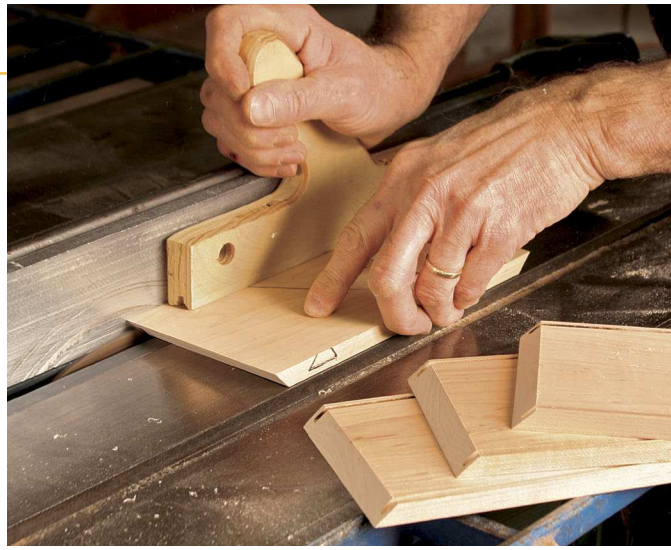
Both Doug Stowe and David Hyatt present methods of cutting and assembling miters for large and small boxes. Stowe's techniques (pp. 55–57) are great for small, solid-wood boxes (right), with continuous grain matches. Hyatt's methods (pp. 58–60) are great for larger plywood cabinets (above).

Photos: staff; drawings (pp. 55, 57): Christopher Mills

Miters for small boxes

MAKE THE SIDES

Sled adds precision. *With the tablesaw blade at 45°, Stowe uses a crosscut sled to trim one end of each resawn piece (left), ensuring that the ends are square to the edge. With a stop block clamped to the fence of the sled (right), the opposite sides of the box are sure to end up the same length.*



Groove the sides. *Using the tablesaw rip fence to guide the stock, cut a shallow groove along the top and bottom edges of the four sides to accept the top and bottom of the box. For safety's sake, use a push stick.*

I've been making and selling boxes since the 1970s, and this one has always been a favorite. The sides are cut from one board to make a continuous grain match all around the mitered corners. The top and bottom float in grooves cut in the sides and help stabilize a tricky miter glue-up.

A continuous-grain look requires resawing the sides from one board and then laying out the parts to achieve the best look. Once that's done, you can cut the parts to length and miter them.

Sled and stop blocks ensure tight miters

To cut the front, back, and ends to length, I use a miter sled on the tablesaw with the blade tilted to 45° for all the mitering cuts. The procedure shown is for a left-tilt saw; for a right-tilt saw, make all the cuts from the opposite side of the blade.

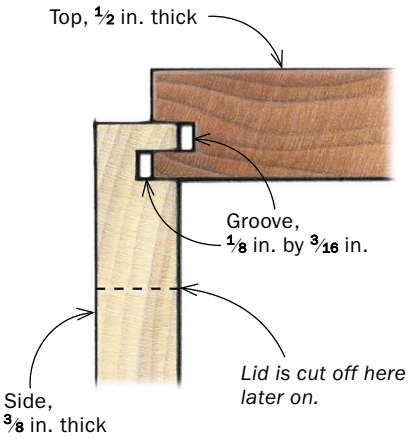
With the outside face of one of the resawn halves against the sled table and the top edge against the sled fence, position the stock to trim about ⅛ in. or so off one end. This cut also squares the end. Repeat on the other resawn half.

Now add a stop block to establish the length of the part. Turn the stock over, slide the freshly trimmed end of the resawn half against the stop block, and make a cut to create the first side piece. Repeat on the second resawn half. Finally, reposition the stop block and cut the two remaining side pieces.

Article Extra

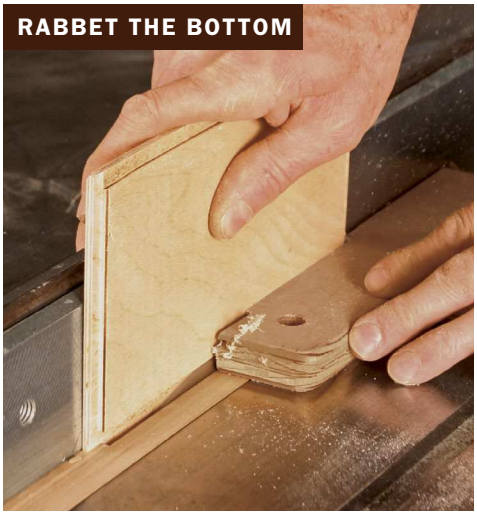
Learn how to get continuous-grain layout across your mitered boxes.

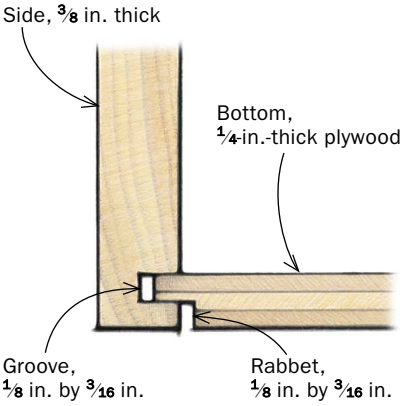
GROOVE THE TOP



Same setup, different part. *Without changing the tablesaw setup used for the side grooves, cut a groove on all four edges of the top.*

RABBET THE BOTTOM





Still the same. *Without touching the tablesaw setup, you can cut the rabbet on all four edges of the bottom.*

NO-CLAMP ASSEMBLY

Tape the sides. *Butt the ends of the side pieces together so the grain flows continuously from one piece to another, then use packaging tape to hold the four parts together. A single piece of tape will do at each joint.*

Add glue and wrap it up. *Apply yellow glue to each miter (above), making sure all the surfaces are covered. Slip the top and bottom pieces into the grooves in one of the face pieces (below), then wrap the other sides around them.*

For this box, the top and bottom sit in grooves cut in the sides. Once you have those parts cut to size (add ¼ in. for the groove), go ahead and cut the grooves in the sides for them, as well as the rabbet in the bottom and the groove in the top. Fortunately, all three cuts are made with the same tablesaw setup (see p. 55).

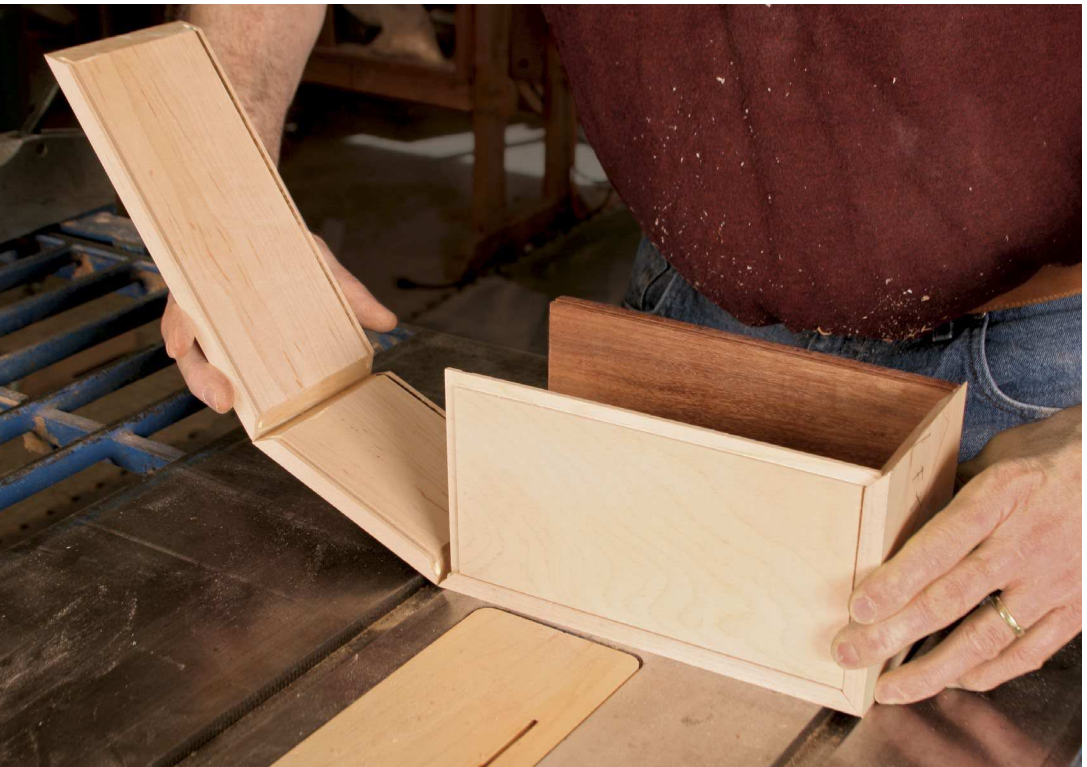
Assemble the box

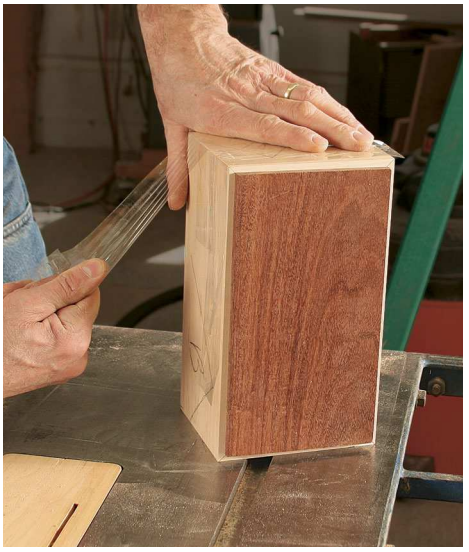
It's best to sand the inside surfaces of the sides, top, and bottom before assembly. Now, arrange the sides—end-to-end and in the order they will wrap around the box—on a flat surface, outside face up. Apply a strip of tape to join the four parts together. I prefer clear packaging tape, as it gets a good grip and allows me to see how the corners fit. With the tape in place, acting like a hinge, you can temporarily assemble the sides, top, and bottom to form the box and make sure everything looks OK.

Reopen the box, and start assembly by spreading glue (I use yellow glue) on the mitered surfaces. Miters absorb a lot of glue, so apply an even coat to both sides of the joint. Now it's just a matter of rolling the taped sides around the top and bottom. In the process, four flat sides transform into a box. Now add more tape, as needed, to pull each of the corners tight. Check that the box is square and that each edge is perfectly aligned. Also make sure the top panel and the bottom are centered in the sides. Let the glue dry overnight.

Another simple sled for the splines

Splines add strength, and they look good, too. To cut the slots for the splines, I use the tablesaw with a rip blade that cuts a ⅛-in.-wide kerf. This blade produces a kerf with a flat bottom that fits the square shape of the splines better than the shallow V-shape you get from typical crosscut or combination blades.

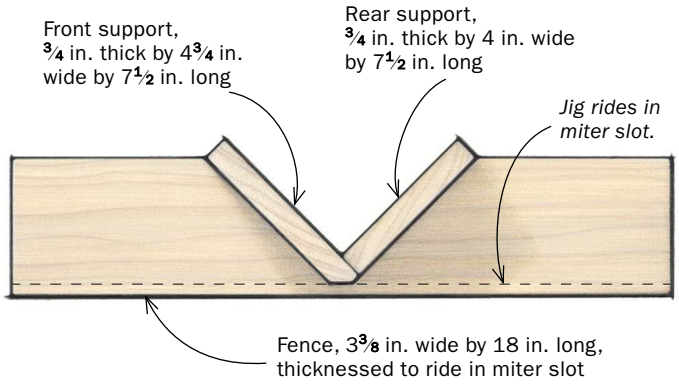




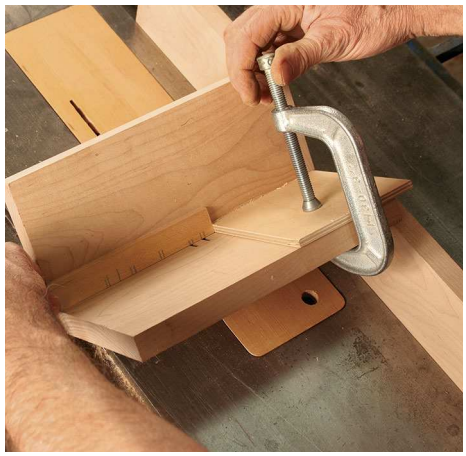
Close the deal. *Stowe stretches additional pieces of tape across the joints to close any gaps.*

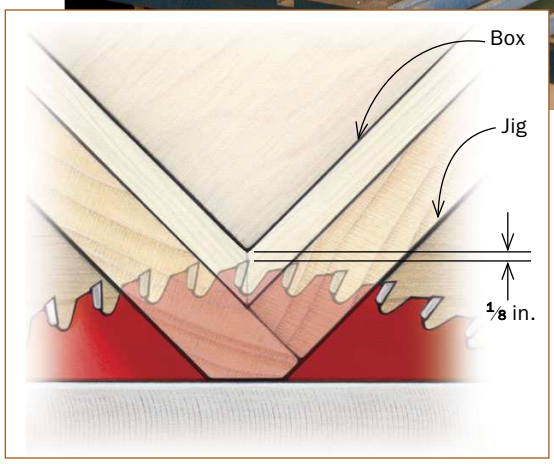
SPLINES ADD STRENGTH AND STYLE

A slot-cutting jig makes it easy to run the assembled box over the blade at a perfect 45° angle.



Story stick dials in setup. *Use a pencil to mark the slot locations on one corner of the box, then transfer the locations from the box to a thin, narrow stick. After that, use the stick to position a stop block on the jig.*





Cut the slots. *With the jig riding in the miter slot, make the first cut. Slot all four corners before moving the stop block for the next spline location.*

I use a jig to support the box at 45° to the table. To create the most glue area for the splines, set the blade to a height that cuts the slot just short of the inside corner of the box.

With the slots cut, you can move along to making the miter splines. To make the spline stock, I simply thickness-plane material down to the width required and then use the tablesaw to rip ⅛-in.-thick slices from the stock. Add a coat of glue to each spline and slot, then slip in the splines. Make sure that each one is fully seated at the bottom of the slot. A few light taps with a mallet can help. When the glue dries, I sand the splines flush.

Slip in the splines. *After planing the spline stock to fit and cutting out little triangles, add glue to the slots and splines and slide them into place.*

Instant lid on the tablesaw

I use the tablesaw to cut the lid from the box, leaving a thin web of material between the lid and the box. Place the box next to the sawblade, then raise the blade about 1/32 in. less than the thickness of the sides. Position the rip fence so the blade establishes the correct thickness of the lid. Make all four cuts while holding the bottom of the box against the rip fence.

Use a knife to separate the lid from the base, then sand away the material that remains.

Sand the splines flush. *Stowe uses a stationary belt-sander to quickly sand the splines flush to the sides of the box. A block plane would also work.*

Doug Stowe builds furniture and boxes in Eureka Springs, Ark.

Miters for case work

Simple on a left-tilt saw. *Here, the thin point of the first miter runs against the rip fence.*

Many woodworkers are familiar with the miter joint as used in picture frames or on a solid edging that wraps around a tabletop. However, this joint is also a useful and attractive means of joining the body of a cabinet. Whether constructed from plywood or solid stock, this clean, simple joint shows no core or end grain, and can be particularly appropriate in enhancing clean lines on furniture.

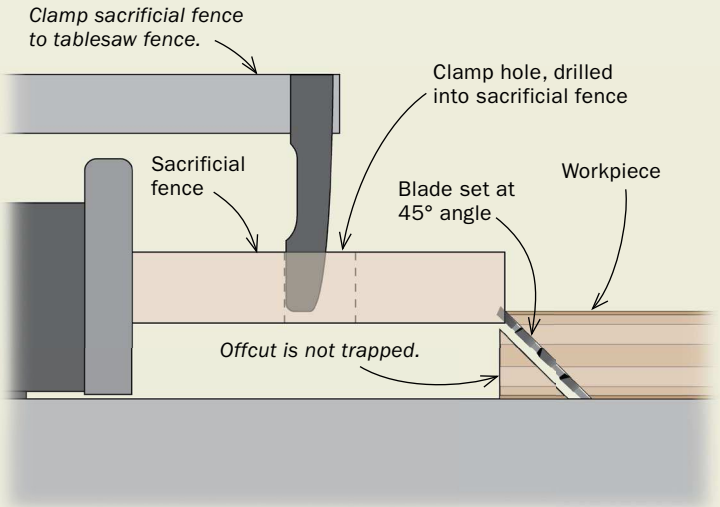
Unlike many woodworking joints, the carcase miter with its long, straight cuts lends itself to easy production with a variety of power tools. Although the joint can be reinforced with splines or biscuits, accurately cut mitered surfaces are strong enough for most locations using glue alone.

Tablesaw makes fast miters

The fastest and easiest way to cut miters is on a tablesaw. Use a sharp blade and a slow, steady feed rate to reduce burning and tearout. Be vigilant about the last few inches of the cut; it is easy to twist the workpiece slightly and make a curved edge that will not fit properly with its counterpart. Also, make sure that the workpiece is pressed down firmly on the tablesaw. If the workpiece is at all warped,

RIGHT-TILT SAWING WITH A SACRIFICIAL FENCE

A simple auxiliary fence and a precision setup make it safer and easier to cut case miters on a right-tilt tablesaw.



Using a right-tilt saw. *When cutting the miter on the second side, to prevent the thin point of the first miter from burrowing under the rip fence, attach a sacrificial fence and cut the miter as shown. Hyatt uses a rubberized glove for better control.*

Drawings (pp. 58, 60): Kelly J. Dunton

USE THE TAPE TRICK FOR EASY ASSEMBLY

Tape the sections. *With the inside of the carcase face down, stretch masking tape across the joints to draw them together. A straightedge at the top aligns the sections.*

Flip the boards over. *To turn over the sections together, clamp a strip of wood on each side of the top edge.*

Glue the miters. *Tape the areas adjacent to the inside of the miters to make squeeze-out easy to remove. Apply glue with a roller.*

Assemble the carcase. *With the base or back installed, roll up the sections and tape closed the remaining corner. Stand the piece on a flat surface and check for squareness.*

it will be difficult to cut a good joint.

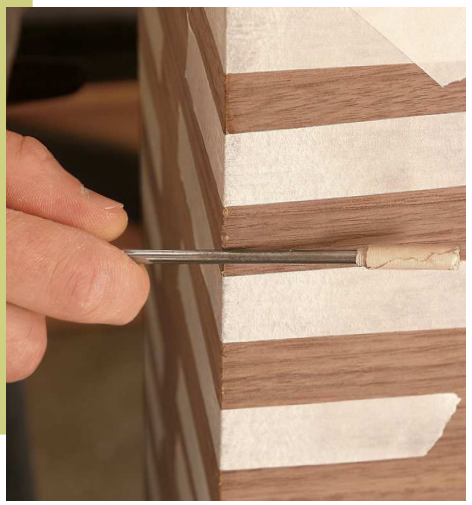
If you own a left-tilt saw, cut the workpiece roughly to size, tilt the sawblade to 45°, and cut the first miter with the inside of the workpiece face down. Then simply spin the workpiece 180° so that the mitered cut is against the fence. Make a series of cuts until the blade cuts the top of the workpiece to the correct width, and complete the cut.

On a right-tilt saw, the procedure is slightly different. You could just relocate the rip fence to the left of the blade, but there isn't as much capacity on that side for wide workpieces. To cut miters safely with the rip fence in normal position, first cut the piece to its finished width, then tilt the blade and cut the first miter with the inside of the workpiece face up. If you then turn the workpiece 180° and run the sharp, mitered edge along the rip fence, that edge will try to burrow under the edge of the fence. At best you will get an inaccurate cut; at worst, kickback.

The best solution is to run the edge you are mitering against the rip fence. This will let you cut with the inside of the workpiece face down. To make this cut safely, clamp a sacrificial fence of MDF to the rip fence, positioning the MDF so that its bottom surface is about ⅛ in. below the top of the workpiece. Then draw a pencil line along the edge of the MDF fence at the level where the top of the workpiece will make contact. Adjust the position of the rip fence and the height of the blade

Case work continued

SAVE THE CORNERS



Reinforce the corners. *While the glue is soft, run the shaft of a screwdriver up and down the edge to round over the corners slightly. This closes small gaps and makes veneered corners less prone to catching and tearing.*

Peel off the tape. *After the glue has set, remove the tape. Pull it across the grain to lessen the chances of pulling away wood fibers.*

to a setting where the cut just meets that pencil line. This should ensure that the miter extends the full thickness of the workpiece, but doesn't reduce its width. You will want to make test cuts on a spare piece. With this setup, the offcut will fall away freely under the sacrificial fence.

Assemble the carcase by rolling it up

The best way to assemble a mitered box or carcase is by gluing it all at once. Like Doug Stowe, I use tape to assemble my mitered boxes. I use masking tape because it has some stretch, which helps bring the large miters together. Place the four components in line in the sequence front/side/back/side, with the top edges toward you and the outside face up. Use a straightedge to align the top edges and slide the panels together so that the sharp edges of the miters are touching.

Tape together the three touching joints by stretching short pieces of masking tape across them to create tension, and draw the seam together tightly. To make the assembly stiff enough to flip over to expose the faces of the miters, clamp a strip of wood on each side of the top edge of the panel. With the inside of the carcase now face up, insert any bottom or back piece and do a dry run by rolling up the sections. If all is well, lay the sections open again, and run strips of masking tape along the inside edge of each miter joint. The tape will be carefully peeled away after the glue has begun to solidify, removing almost all squeeze-out.

Use a small roller or brush to apply glue to both sides of each miter. Then slowly roll up the assembly and apply masking tape to the final, untaped joint. Set the assembly on a flat surface and check that it is square. Stubborn joints can be drawn together with band clamps.

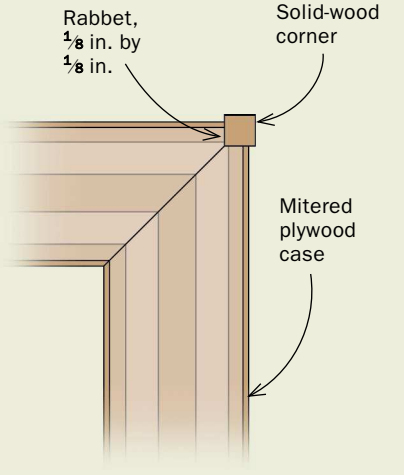
Reinforce vulnerable corners

Plywood veneer lends itself to miter joints because they conceal the core, but the outside corner of veneered surfaces can chip or sand through easily. There are two ways to overcome this problem. You can use a burnishing tool or screwdriver shaft to round over each corner (see top left photo, above). Or you can rabbet the corners and glue a solid-wood strip into each one (see photos below).

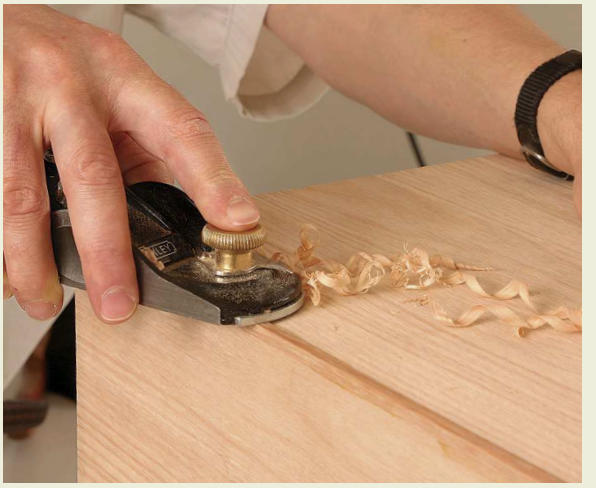
David Hyatt is a woodworker near Vancouver, B.C., Canada.

SOLID-WOOD CORNER FOR ADDED DURABILITY

To strengthen a mitered corner, a strip of solid wood can be inlaid into it. For an almost invisible joint, use the same species as the sides.



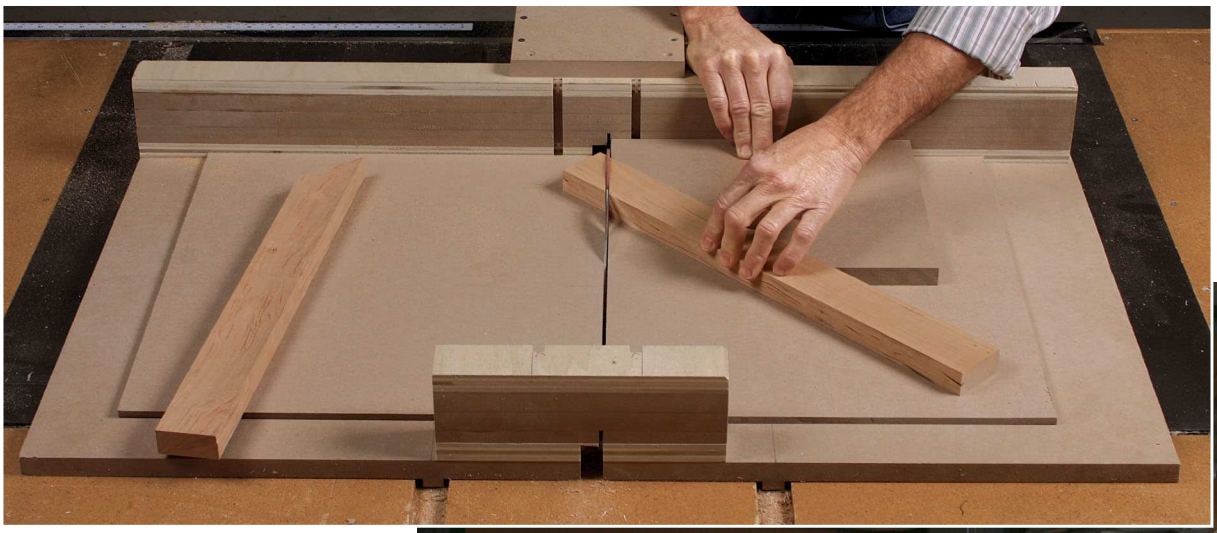
Rabbet the corner. *Cut a 1/8-in.-sq. rabbet in each corner using the tablesaw or router.*



A solid-wood corner. *Plane and sand the strip of wood flush with the veneered sides. The corner can then be slightly rounded without risk of cutting through the veneer.*

Frame Miters

Picture frames, face frames, doors, and more



BY MARC ADAMS

The most common type of miter is the flat type used to join frame pieces. They often surround a plywood panel to make a door or a tabletop and are used for picture frames, too.

The challenge with flat miters is the wide cut, which makes it hard to end up with a 90° corner and no gaps. If you rely on your miter gauge, you will struggle with accuracy and repeatability. That's why I cut them on my crosscut sled using a simple 45° fence. You use the sled to make the fence, too, and the whole process is easy; it can even be used to cut standard moldings.

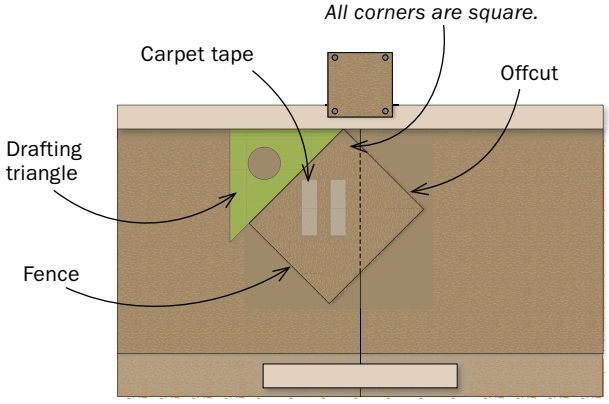
In this case, with flat stock and zero-clearance below the blade, you could keep the fence in one position for all of the miter cuts, simply flipping the pieces to miter the second side. But if the front of

Tight miters on a crosscut sled

MAKE AN ACCURATE FENCE

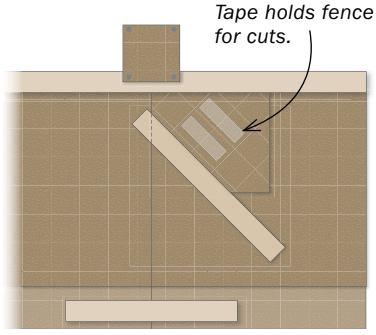
Start with a perfectly square piece of MDF and use your crosscut sled to turn it into an accurate 45° fence.

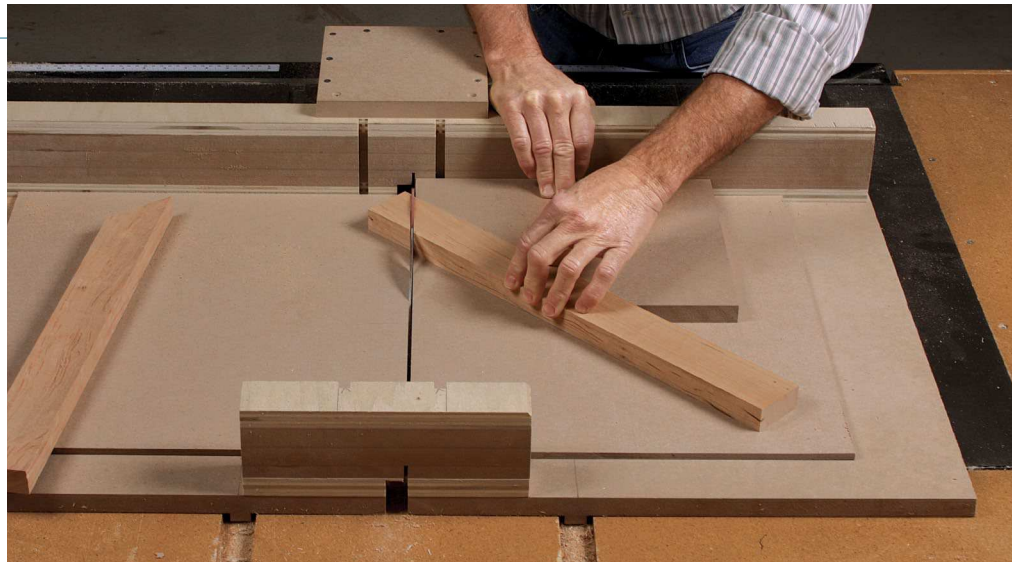
Easy to make. *Use a 45° drafting triangle to position the MDF fence on the sled. Use carpet tape to hold it down, but keep the triangle in place as you cut, to be sure the workpiece doesn't shift.*



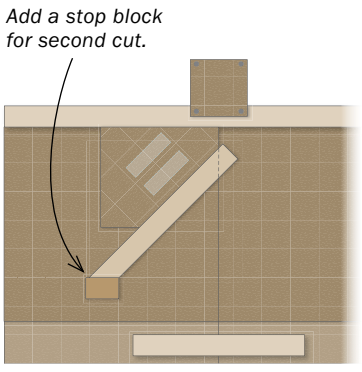
HOW IT'S USED

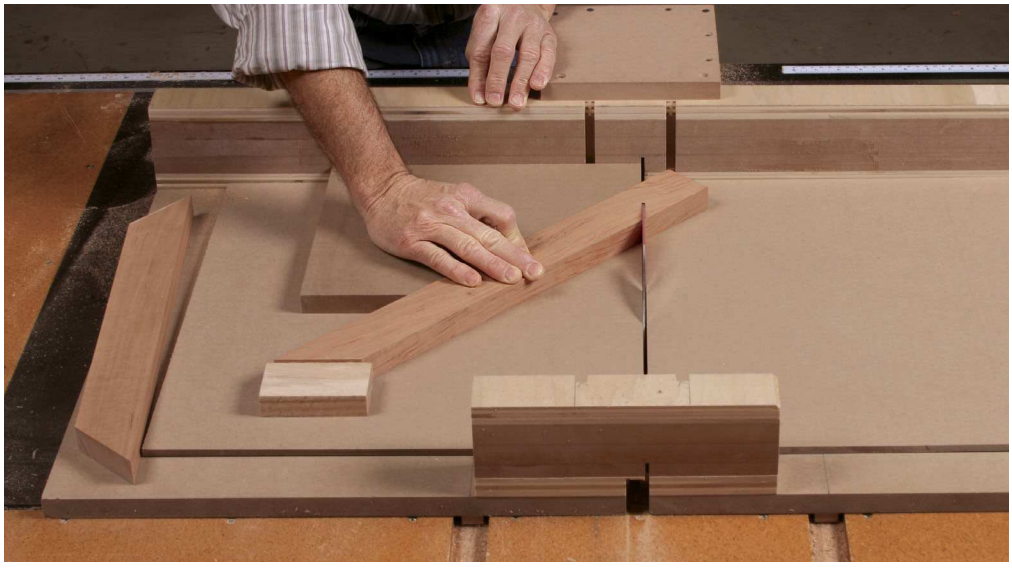
Miter one end of each workpiece. *Put the fence on the left or right, pressing it down very firmly on the carpet tape, and then use it to miter one end of each workpiece. Hold the workpiece firmly to be sure it doesn't drift.*





Switch sides. *Flip the fence over to set it up on the other side. This time you'll need a stop to set the final length of each piece, but that's as simple as taping a block to the sled. The miters should come out perfect.*





Photos: Asa Christiana; drawings: Kelly J. Dunton

Strengthen miter joints with splines

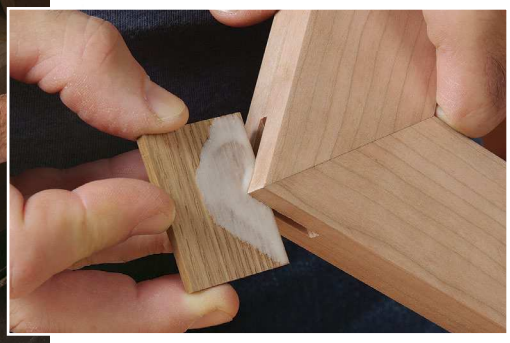
the stock is molded or you are getting chipout on the bottom edge, you'll want to flip the fence to the other side of the blade when cutting the second end of each piece, in order to keep the same side up.

Aside from accuracy, what I love about this setup is how easy it is to attach a stop: You just tape it down.

Flat miters are not known for being strong, so it's important to reinforce them in some way to keep them together over the long term. Some folks use biscuits, and they work OK, but my favorite technique is to assemble the mitered frame and then glue visible splines in the corners afterward.

To do that, you must cut a slot in each corner after the frame is glued together. To cut the slots, I make a cradle jig from MDF that holds the frame at 45°. The jig rides against the rip fence and guides the frame through the blade (see photos and drawings, right). □

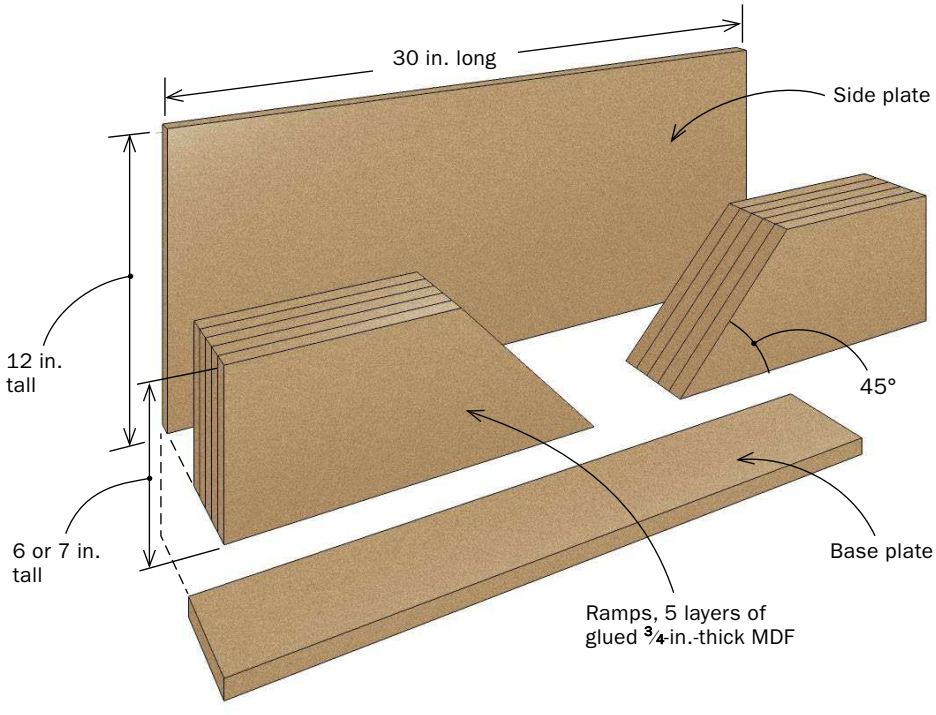
Marc Adams owns one of the largest woodworking schools in the world, in Franklin, Ind. Go to marcadams.com for a course listing.

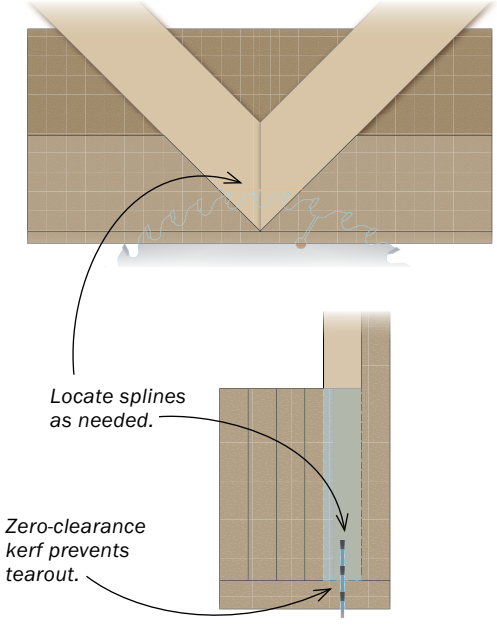


Easy splines. *The jig holds both frames and boxes safely as you cut clean slots through the corners (left). Plane a contrasting wood to fit the slots, glue in the splines with the long grain running across the joint (above), cut off the waste, and then plane and sand the splines flush.*

MAKE A CRADLE JIG

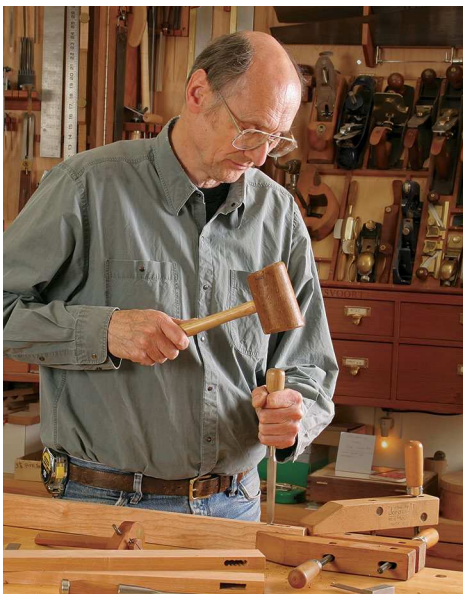
Glue five layers of MDF together, joint the bottom flat and straight, and cut through the block at 45° on the miter saw. Then just reverse the pieces to create the two ramps, and glue them to a base and side plate to create a square, solid jig.





Low-Tech Mortising

Drilling and chopping works in any shop



BY CHRISTIAN BECKSVOORT

Many woodworkers cut mortises by drilling away much of the waste with a drill press, then cleaning up what remains using a bench chisel. The technique is popular because it doesn't require a special machine or jig. It's a challenge, though, mainly because the chiseling process is slow and easily goes awry.

I've been building furniture full time for more than 30 years, and I still use drilling and chiseling to make many of my mortises. But I've managed to refine the process to just a few surefire steps.

The tools are simple. After removing most of the waste using the drill press, I use a mortising chisel to square an end and lever away—in one shot—most of the waste. A bench chisel quickly cleans up what's left.

This method delivers clean, accurate mortises, and quickly. Including the drill-press work, I can finish a ⅜-in.-thick by 1½-in.-wide by 1½-in.-deep mortise in about 4 to 5 minutes. By the way, if you don't have a drill press, use a doweling jig and handheld drill to remove the waste accurately.

Mortise chisel is the star

A bench chisel is ideal for a lot of applications, but it's not the best choice to clean up the waste after drilling a mortise.

When driving a bench chisel with a mallet to square the end of the mortise, the chisel tends to twist. That's because the blade is relatively thin and the edges are beveled, so there is little side support. Typically, you'll need to start and stop the cut several times to keep it on track. And chances are it won't be as clean a cut as you'd like.

It's also challenging to keep a bench chisel square when cleaning up the sides. So the mortise may not end up straight and smooth. Plus, compared to my method, it's slow.

The solution is a mortise chisel. They come in two basic types: One has a blade with a rectangular cross-section (parallel sides), and the other has a blade with a trapezoidal cross-section (tapered sides). You want the rectangular one. A rectangular mortising chisel won't twist easily as you bang it with a mallet to square the end of the mortise. And because the corners of the chisel meet at sharp right angles, you get a shearing cut when you lever it forward. That means much of the sidewall waste can be removed in one quick motion.

In addition, while bench chisels are normally sharpened to 25°, most mortising chisels are sharpened to 30°. That means the sharpened edge is less likely to fracture when levered.

Photos: Tom Begnal; drawings: Christopher Mills

Step 1 SCRIBE LINES SHOW THE WAY

Scribe the sides. *After marking the location with a pencil, use a marking gauge to scribe each side of the mortise, stopping at the pencil lines.*

Last, mortising chisels are thicker and longer than bench chisels. That adds stiffness and leverage, making them better suited to the forceful levering action.

It takes just four steps to cut any mortise. But first, make sure your chisels are sharp.

Keep in mind that this technique requires that the mortise and the mortising chisel are the same width. That means if you want a ⅜-in.-wide mortise, you need a ⅜-in.-wide mortising chisel. I find that three different chisel widths—¼ in., ⅜ in., and ½ in.—cover almost any mortise I need.

SOURCES OF SUPPLY

PARALLEL-SIDED MORTISE CHISELS

Lie-Nielsen Toolworks
lie-nielsen.com

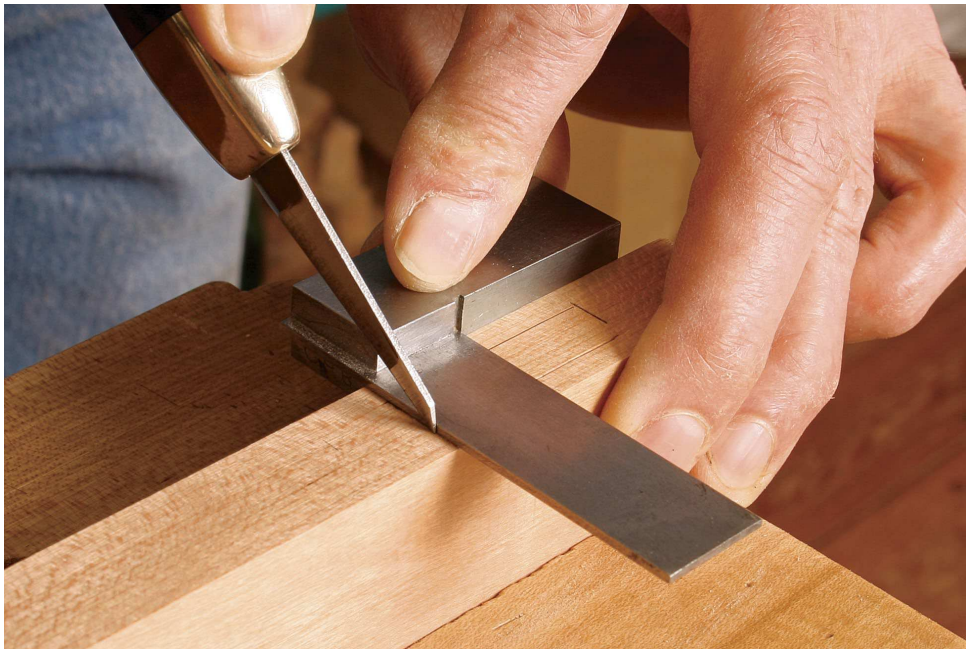
Sorby
woodcraft.com

Layout is critical

Begin by carefully laying out and marking the length and width of the mortise. Use a sharp pencil to mark the ends. Then use a marking gauge to cut the two scribe lines for the sides. Now, with a square and a marking knife, cut scribe lines at the mortise ends. The cut lines are important: When you slip the sharpened edge of the chisel into them, they align it perfectly for the start of the cut.

Drill out the waste

Now you're ready to start removing waste wood to create the mortise. You could remove all the waste with the mortise chisel, but it's a lot faster to remove most of it by drilling a series of holes. Plus, drilling makes it easier to maintain a consistent depth along the length of the mortise.



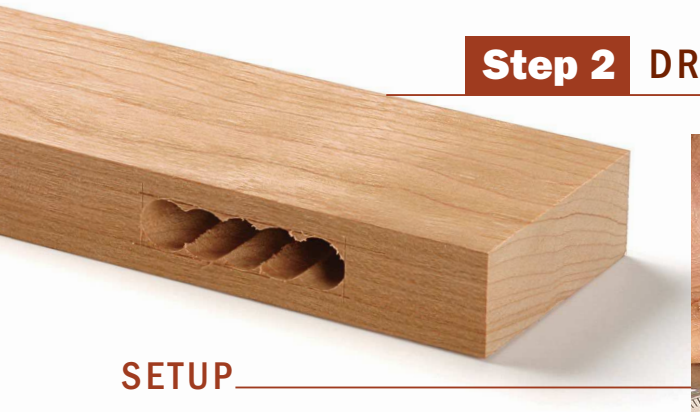
Scribe the ends. *To complete the layout, use a knife to scribe a cut line at each end of the mortise.*

I put the drill press to work here. Either a brad-point or Forstner bit works fine. Both of these bits let you drill overlapping holes to remove the maximum waste from the mortise. Just be sure that the bit diameter is the same as the mortise width, and position the fence carefully so that all the holes are bored dead-center into the mortise.

Start by drilling the first hole at one end of the mortise, and then do the same at the other end. After that, drill as many non-overlapping holes as possible. Then cut

Tip

Keep the mortise at least ¾ in. away from the end of the workpiece. Otherwise the end-grain at the end of the mortise could blow out when you drive in the chisel.



Step 2 DRILL THE WASTE

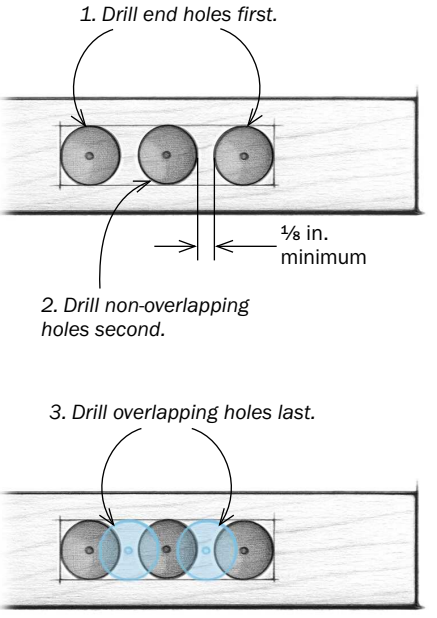
SETUP

Drill press does the grunt work. *Use a bit that matches the mortise width. Clamp a fence to the table to ensure that the bit drills into the center of the piece.*

Dial it in. *After drilling a single hole in the test piece, use a dial caliper to make sure the hole is centered.*

DRILLING SEQUENCE

Drill the end holes and 'tweeners. *With the stock against the fence, drill a hole at each end of the mortise. In between, drill as many non-overlapping holes as possible (left), leaving ⅛ in. between holes. Then drill overlapping holes, anchoring the center spur in the material between each hole to help keep the bit from drifting.*



overlapping holes as needed to remove most of the remaining waste.

Plunge and lever

With most of the waste drilled out, mark the depth of the mortise on the chisel blade. Place the tip of the cutting edge into the scribe line on one end with the bevel facing away from the end. Make sure the chisel is plumb. Also, with thin stock, it's a good idea to clamp the sides of the stock at the mortise so it won't split.

Now, use the mallet to pound the chisel to the full depth. Keep the chisel plumb as you go (see tip, facing page).

Once you reach the full depth, lever the chisel forward, toward the opposite end of the mortise. This is where the rectangular chisel pays big dividends. Because the chisel sides are parallel, their leading edges slice away—in one quick motion—a good portion of the waste at one end. Repeat the cut-and-lever technique on the opposite end. If the wood is hard, use both hands and lean into the chisel a bit.

Just a bit of cleanup left

You now have only a small triangular section of waste in the middle of the mortise. Since this is mainly a paring operation, use a normal, bevel-edged bench chisel. Simply start at the top of the waste triangle and carefully pare down to the bottom. Use the mortise chisel to clean up what remains. □

Christian Becksvoort builds furniture in New Gloucester, Maine (chbecksvoort.com).

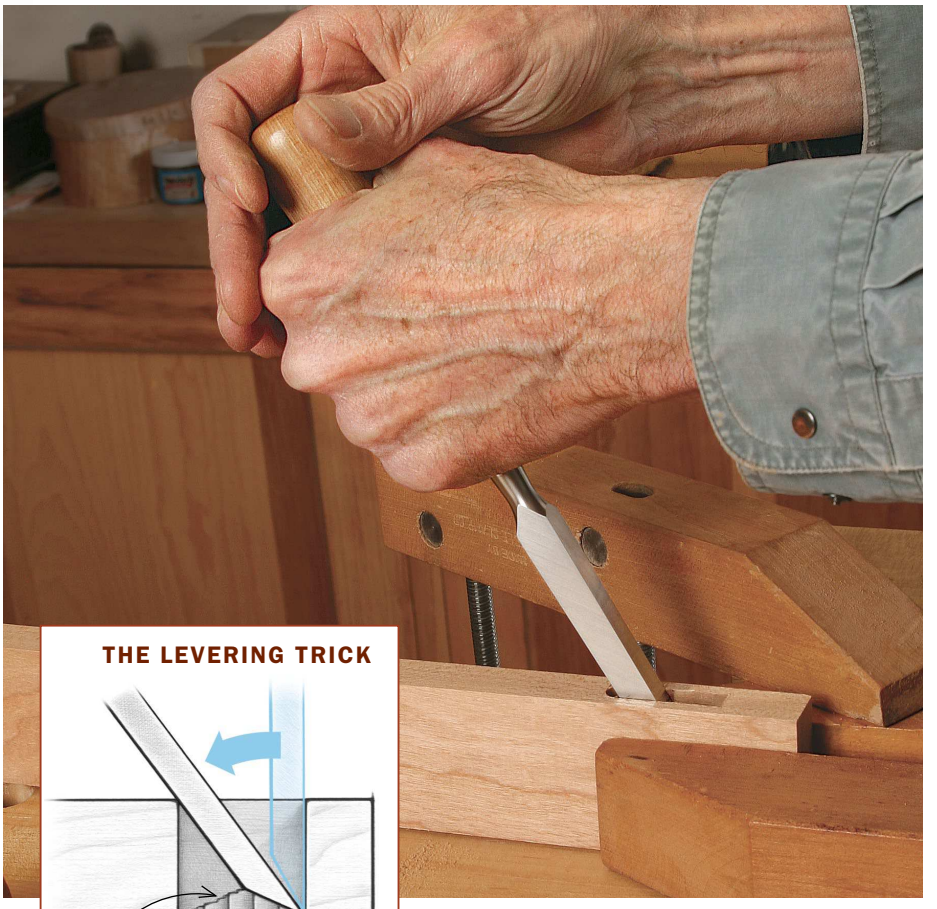
Tip

No drill press? Use a doweling jig. It's nearly as fast and just as accurate as a drill press.

Step 3 THE MORTISE CHISEL TRICK

Mark the depth. *Use a permanent marker and a square to mark the mortise depth around the blade of the chisel.*

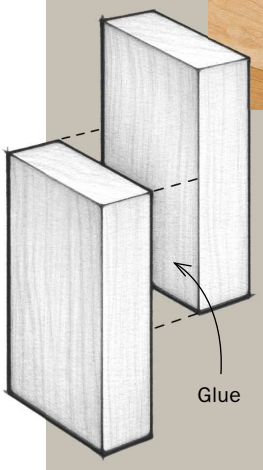
Drive the chisel. *Place the tip of the chisel into the cut line on one end of the mortise (bevel facing away from the end), then use a mallet to drive it to the full mortise depth.*



THE LEVERING TRICK

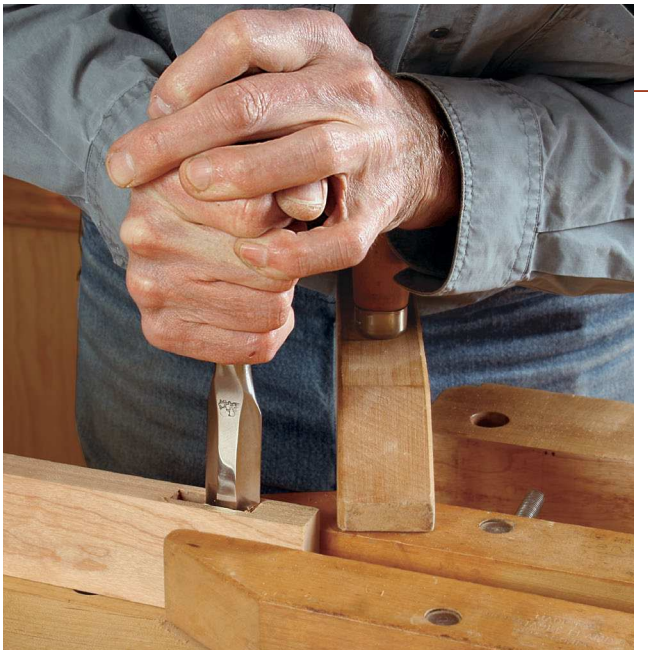
Small triangle of waste remains after levering from both ends.

Lever the chisel toward the opposite end of the mortise. *As you do, the square corners of the mortise chisel shave a good part of the waste stock. Repeat from the other end. The levering trick removes all but a small triangle of waste (see drawing, left).*



Tip

If keeping the chisel plumb is a problem, clamp a block of wood to the workpiece. Hold the blade against the block and you can drive the chisel knowing it's aligned perfectly.



Step 4

FINISH WITH A BENCH CHISEL

Clean out the last of the waste. *A bench chisel removes the remaining triangle. Elapsed chiseling time for both the mortise and bench chisels: one to two minutes.*

Faster Mortises by Machine

Hollow-chisel mortisers require some setup

BY ROLAND JOHNSON

A mortiser, also called a hollow-chisel mortiser or mortising machine, cuts mortises remarkably quickly and accurately. Indeed, this machine can cut a typical leg-to-apron mortise in well under a minute. Benchtop models are most common, although larger, freestanding machines also are available.

On the downside, mortisers define the word finicky. If yours isn't set up and used correctly, you'll wonder why you bought one.

Fortunately, mortiser-induced headaches can be treated with relative ease. Simply follow the steps outlined here, and you'll find that quick, clean, and accurate mortises become the norm, not the exception.

A sharp chisel and bit are a must

A mortiser won't work effectively when the bit and chisel are dull, so keep both parts sharpened (see photos, opposite page). No need for a lot of tools, just a chainsaw file, a round and a flat slip stone, a little sandpaper, an abrasive pad, and some honing oil. Don't expect a brand-new bit and chisel to be adequately sharp. Almost all I've seen needed extra attention out of the box.

Hone the outside faces of the chisel—I begin sharpening by honing the four outside faces of the chisel. To ensure an adequately flat honing surface, I use spray adhesive to mount P400- and

KEYS TO SUCCESS

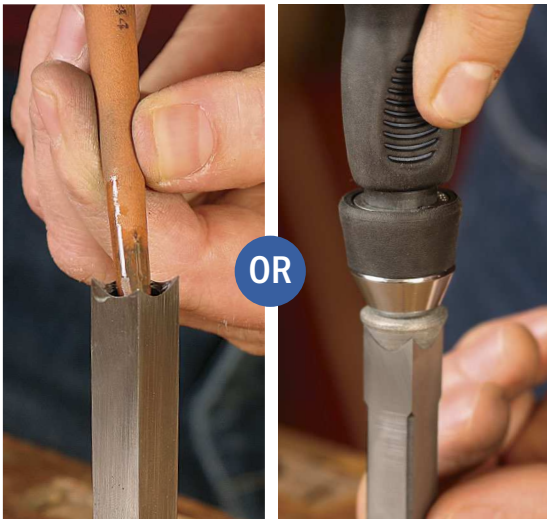
Mortisers require extra attention, but the payoff makes it all worthwhile. Don't ignore any of these steps.

Photos: staff

Cutters need sharpening

Like any cutting tool, a mortising chisel and bit must be sharp to work well. A few minutes spent sharpening pays many dividends.

Smooth the outside surfaces of the chisel. *A chisel with rough outside faces can't be sharpened and won't be easy to plunge and retract. Use fine sandpaper on a flat surface to smooth all four sides.*



Hone the bevels. *A little work with a round slip stone (left) or a special, cone-shaped, diamond-coated abrasive (right) produces fresh, sharp edges that ensure a cleaner cut. Use a flat slip stone to remove the burr that results.*

P800-grit sandpaper to a granite plate. A piece of plate glass glued to ¾-in.-thick hardwood plywood also makes a good flat surface.

To reduce clogging, I spend time tuning up the bore. The smoother the bore, the easier it is for chips to slide up the auger bit. I use a chainsaw file to remove any internal burrs or machining grooves. A small, round, tapered slip stone works well for cleaning up the ejection slot.

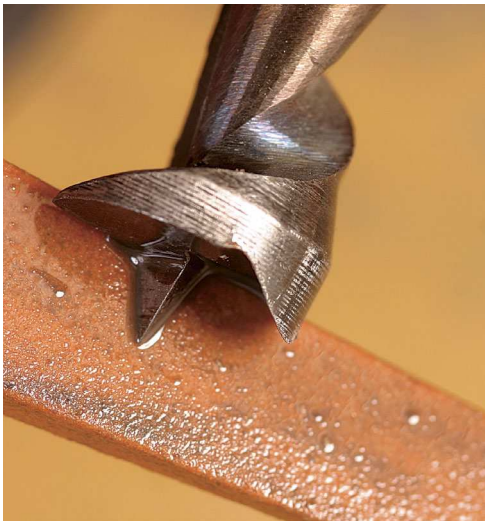
Hone the bevels—A round slip stone is all that's needed to hone the bevels. Keep in mind that not all mortiser chisels have the same bevel angle. Clico, a British manufacturer, and Asian and Japanese sourced chisels use a 60° bevel angle, while Forest City, a U.S. maker, uses a 45° bevel.

With the shank of the chisel secured in a vise, place the stone flat against a bevel and work it back and forth with a light touch. Be sure to wet the stone first with a few drops of honing oil. To avoid creating a groove, keep the stone moving from side to side along the bevel and don't stay in one spot for more than a few strokes. Try to remove about the same amount of material from each bevel.

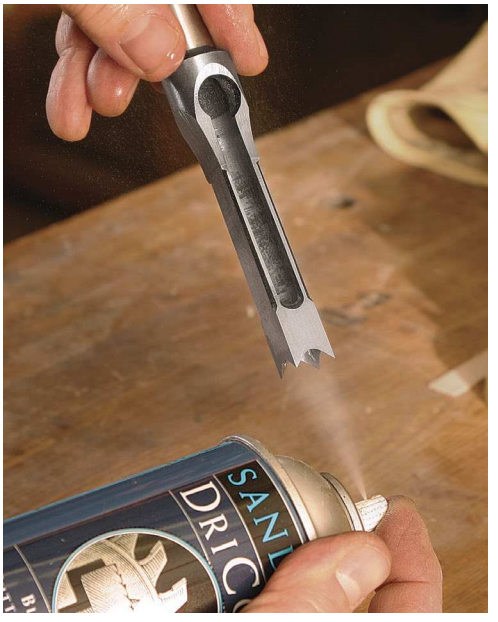
If you prefer a process that's somewhat less fussy, there is a special cone-shaped tool (available from rockler.com) that allows you to sharpen all four 60° bevels at once. If the chisel has a 45° bevel, tilt the cone and sharpen only a portion of the bevel at a time.

Honing the bevels will produce a burr along the outside edge of the chisel. To remove it, hold a flat slip stone flat against the outside face of the chisel and drag the stone lightly toward you.

Sharpen the bit—Depending on the manufacturer, the auger-style drill bits for mortiser chisels are either a single spur/flute brad point or a double spur/flute without a centering point. I find that the single spur/flute with its higher-helix flute evacuates chips faster than the double-flute bits. But any type you use must be sharp and burr-free.



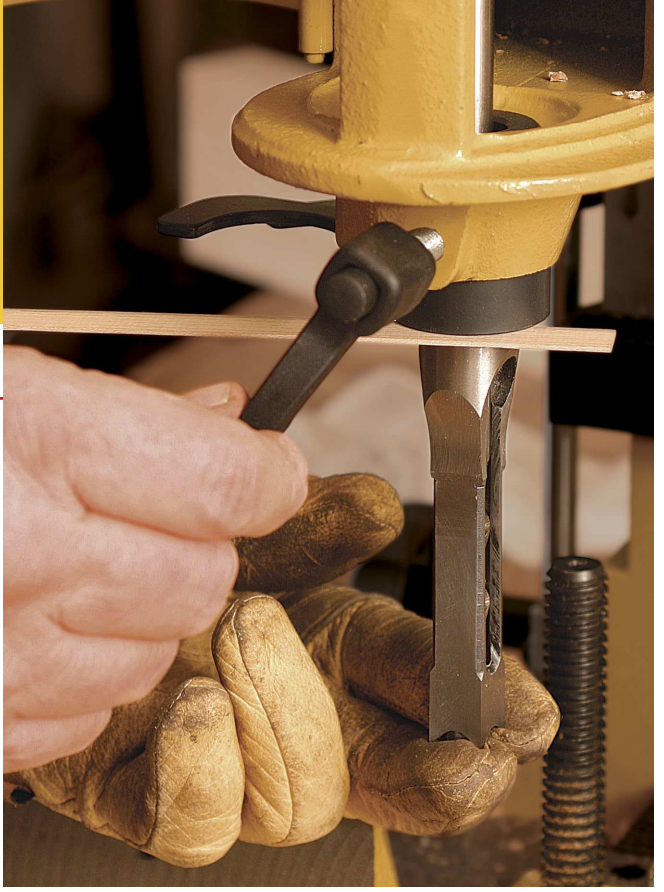
Sharpen the bit. *Use a flat slip stone to hone the bit in two places: the spur and the cutting edge. If your bit has a centerpoint (not all do), hone each of the three facets of the point, too.*



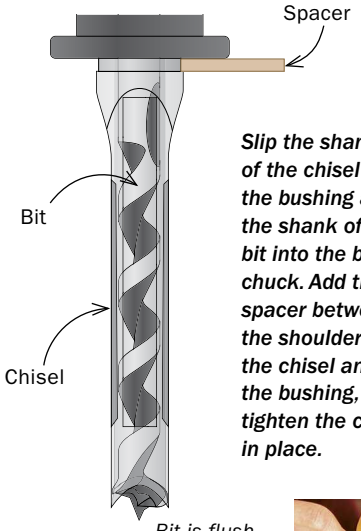
Add some lubricant. *To help reduce friction during cuts, spray both the chisel and bit with dry lubricant after sharpening. Later on, when cutting mortises, an occasional squirt of lubricant on the chisel and bit will fight friction.*

Set the right gap

A sharp chisel and bit are not the end of the story. The two parts must be installed correctly to minimize friction and maximize chip removal.



1 TIGHTEN THE CHISEL IN THE BUSHING

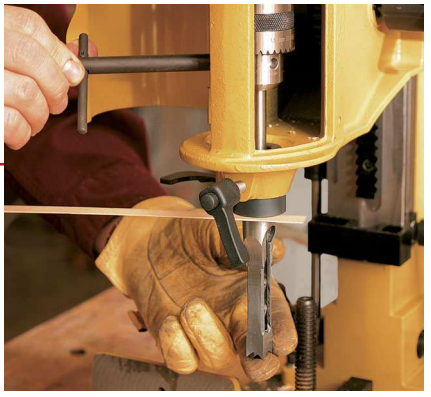


Slip the shank of the chisel into the bushing and the shank of the bit into the bit chuck. Add the spacer between the shoulder of the chisel and the bushing, and tighten the chisel in place.

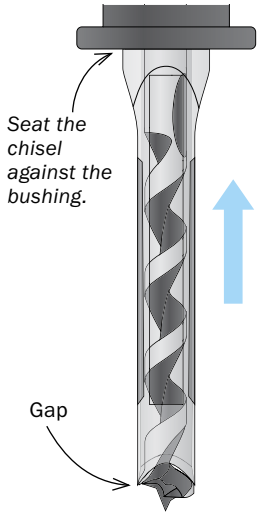
Bit is flush with chisel.

2 TIGHTEN THE BIT IN THE CHUCK

While holding the spur of the bit about flush with the points of the chisel, tighten the shank of the bit in the drill chuck.



3 NOW READJUST THE CHISEL



Remove the spacer and raise the chisel until it butts against the bushing. A squaring board ensures that the chisel is square to the fence. Tighten the locking knob.

In an auger-style drill bit, all the cutting gets done in just two places: at the spurs and at the flutes. So that's where you need to sharpen. If the bit has a brad point, I usually sharpen the point, too. The machining process at the factory sometimes leaves ridges or burrs at the transition area between the spurs and flutes. Use a slip stone to smooth any you find. After that, polish the flutes with a medium-grit abrasive pad to create a slick route for the chips to follow.

Install the chisel and bit correctly

The installation of the chisel/bit in the mortiser should follow a precise sequence. If you do it properly, the chips will eject easily and the hole will be square to the workpiece.

Determine the gap—When installing the chisel and bit, it's important to have the proper gap between the chisel bevels and the end of the bit. I vary the gap based on the size of the chisel and the material. Softwood typically produces large chips that can clog the chisel quickly. Large mortise chisels and bits also make large chips, even in hardwood. I like to leave a 1/16-in. to 3/32-in. gap when using small (1/4 in. and 5/16 in.) and medium (3/8 in.) bits in hardwood. A little more clearance, about 3/32 in. to 1/8 in., is adequate for small and medium bits in softwood. For large bits (1/2 in. and larger) in hardwood and softwood, a full 1/8-in. gap works best. These clearances aren't carved in stone, so if you find the going tough or your chisel plugging frequently, try increasing the gap between the chisel and bit.

Set the gap—Knowing the gap that's needed, you can go ahead and install the bit and chisel. Be aware that the points on the chisel are very sharp, so use care. I usually wear a leather glove on the hand supporting the chisel and bit.

First, rip a piece of scrap stock to the thickness of the intended gap to use as a spacer. Then place a short length of board on the mortiser table to forestall any damage to the points of the chisel or the cutting flutes on the bit should either be dropped.

Insert the bit into the chisel. Then slip the shank of the bit into the bit chuck and the shank of the chisel into the mounting bushing. (Some machines require a sleeve sized to fit the chisel shank.) At the same time, place the spacer between the shank of the chisel and the bushing. Then tighten the chisel. After aligning the spur of the bit with the chisel points, tighten the bit.

To complete the gap-setting procedure, remove the spacer and raise the chisel until the shoulder is seated tight to the bushing. Tighten the chisel, and the offset will be correct.

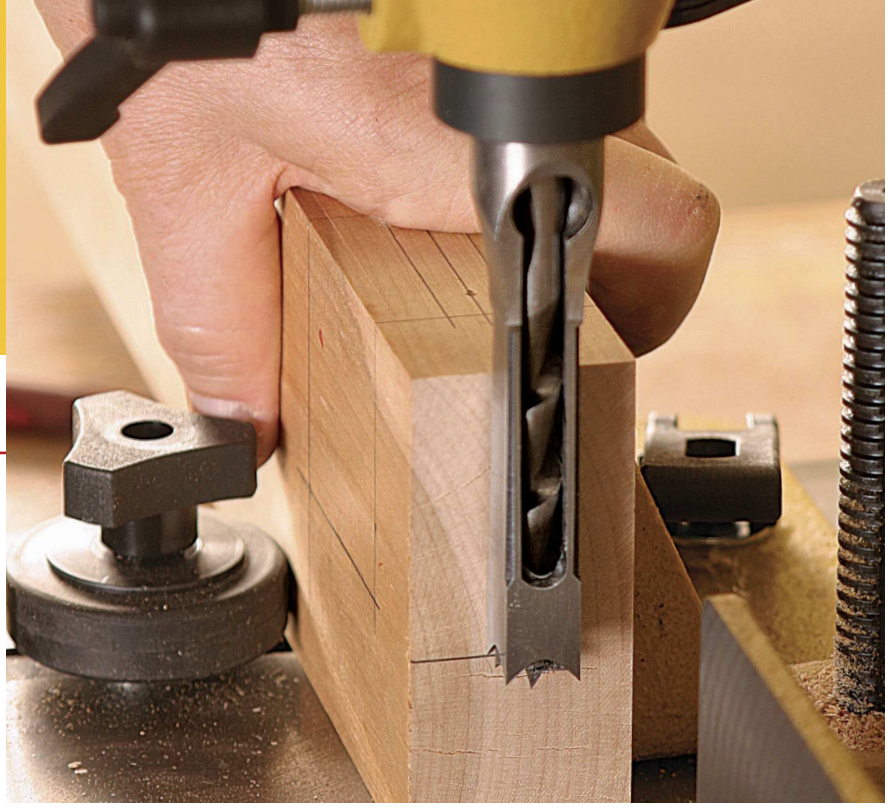
The chisel must be parallel to the fence—Slip a flat piece of wood—I call it a squaring board—between the fence and

Drawings: Kelly J. Dunton

Start cutting mortises

With the chisel/bit sharpened and installed, the general setup procedure is over. Now make the final machine adjustments for the mortise you want and follow a specific cutting sequence.

1 SET THE MORTISE DEPTH



After marking the mortise depth on the end of the workpiece, lower the chisel and bit to the marked line and set the depth stop on the machine.

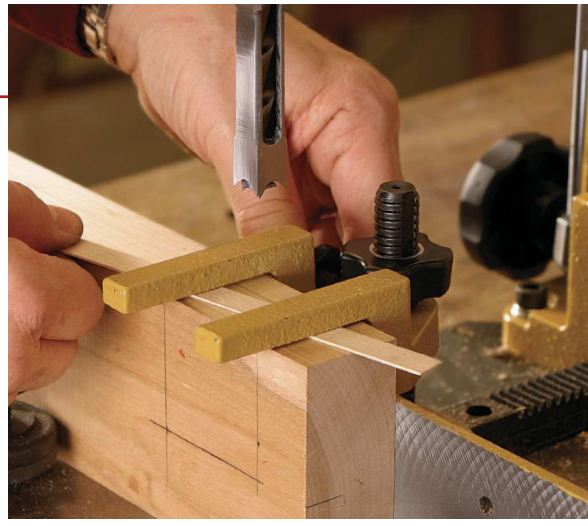
the chisel. Next, loosen the fence and chisel and, keeping its shoulder tight to the mortise-head, rotate the chisel and pull the fence forward until the chisel sits flat against the board. Then tighten the chisel.

Square the chisel to the table—Make sure the centerline of the chisel is square to the table in two directions: front to back and side to side. Use a square to do the checking. Don't panic if all's not well. Most mortisers have the mortising head and support column mounted to the table with bolts. It's a simple matter to loosen those bolts and shim (I use automotive alignment shims) the appropriate side of the column base to get the chisel square to the table.

Square the fence to the table—When the fence isn't square to the table, the mortise won't be square either. Check it with a square. If it's off more than say, 0.005 in. over 3 in., you'll need to shim the fence bracket where it attaches to the base or add a wooden fence that can be shimmed or beveled to square.

Hold-downs keep the workpiece on the table—Position the hold-down so that there is just enough clearance to allow the workpiece to slide under the hold-down without binding. I use a 1/64-in.-thick strip of stock as a spacer.

2 ADJUST THE HOLD-DOWN



A thin, wood spacer creates a slight clearance between the top of the workpiece and the hold-down, making it easy to slide the workpiece sideways.

Avoid overlapping cuts

In the first cut by a bit and chisel, all four faces of the chisel will get equal support, so the bit is sure to stay square to the table throughout the cut. But if the next cut overlaps the first so that one side is unsupported, the chisel will tend to bend slightly toward that unsupported side. That causes the outside of the bit to rub against the inside of the chisel, which leads to friction, heat, and noise.

To avoid the overlap problem, make a pair of cuts, one on each end of the mortise. Then make a series of unconnected cuts to begin to remove the waste stock in between the ends. Leave a little less than a bit's width between these cuts. That way, the chisel is always fully supported. After that, go back and make cuts as needed to clean up the mortise. □

3 CUT EACH END OF THE MORTISE FIRST

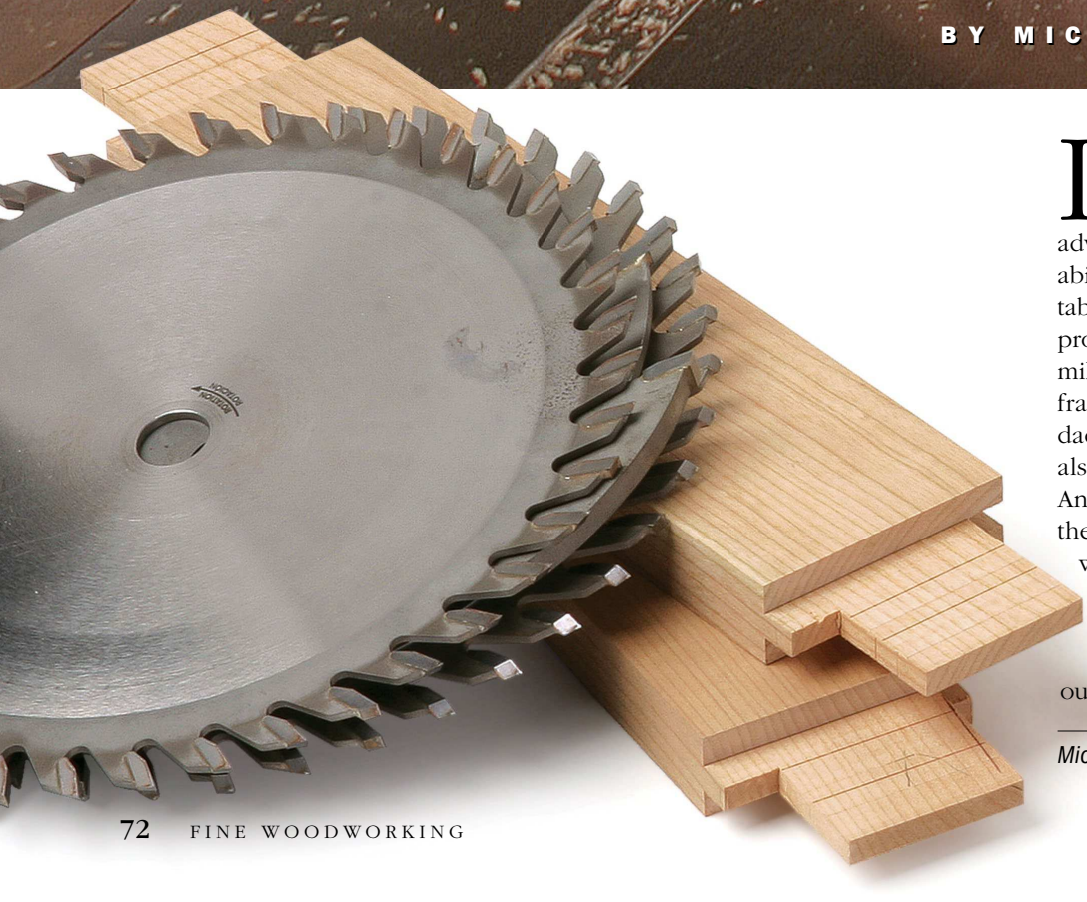
Make two cuts, one at each end of the mortise (left). Then make a series of cuts, leaving a web of wood in between each cut. Last, make cuts (above) to clean out the webs.

Roland Johnson is a woodworker in Sauk Rapids, Minn.

Cut Tenons with Your Dado Set

Fastest path to perfect results

BY MICHAEL PEKOVICH

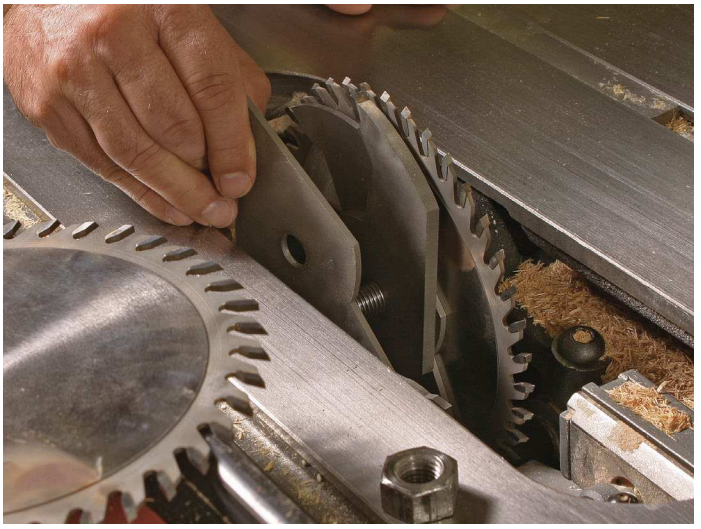


I've tried various methods of cutting tenons: by hand, on the bandsaw and the tablesaw, and even with a router. Each method has advantages, but for speed, accuracy, and repeatability, nothing beats using a dado blade on the tablesaw. It takes a few minutes to get set up, a process that requires a handful of scrap pieces milled to the exact thickness and width as the frame parts. But once the setup is done, the dado blade not only removes stock quickly, it also cuts the cheek and shoulder in one pass. And because the stock lies flat on the saw table, the tenon is guaranteed to be parallel to the workpiece and consistent in thickness. Plus, all the tenons end up exactly the same size. As you'll see in the next couple pages, the process is not difficult, and the results are outstanding.

Michael Pekovich is FWW's art director.

Photos, this page (left): Michael Pekovich

SET UP THE SAW



Install the dado blade. *Pekovich uses a sharp, high-quality dado set to make tenons, forming the shoulders and the cheeks in just a few quick passes.*

Prepare the miter gauge. *A good dado blade should leave a chip-free shoulder, but a backing fence on the miter gauge is needed to prevent any chipout on the back end.*

DIAL IN THE THICKNESS

Set the blade height. *Place a mortised frame part next to the blade and raise the blade until it's just below the mortise. This should yield a tenon that's too thick—a good starting point for a series of test cuts in scrap.*

Sneak up on a snug fit. *Raise the blade in small steps and remove stock from both faces of your test piece. Stop when you can just get a corner of the tenon into the mortise. Don't leave the tenon too thick. This only creates more fine-tuning—and more chances for error—later.*

MAKE THE CUT

The fence controls the tenon's length. *Use a combination square to set the fence position.*

It's time to cut tenons. *To avoid chipout at the end of the tenon, start at the end and work toward the shoulder. Maintain downward pressure on the stock to keep it flat on the tablesaw top. After you've cut the entire face, check for an even cut and take a second pass if necessary.*

CUT THE HAUNCH

OK, a tiny bit of layout. *This frame joint requires a haunched tenon, one with an extra bump to fill in the panel groove on the end of the stile. Mark a tenon with the depth of the panel groove (above). Use this mark to reset the tablesaw fence before cutting the outside shoulder. Once the setup is dialed in, the workpieces can be run over the dado set as a group to cut all of the haunches at once (right).*

TRIM TO FIT

Use the saw marks as a guide. *Keep an eye on the score marks created by the dado blade while you trim the tenon. If some disappear before others, it means that you are tapering the tenon, which will lead to a twisted door.*

Trim to fit using a shoulder plane. *Before trimming the whole tenon, be sure there isn't a thick portion just at the tenon end. Trimming from the tenon's rear face keeps the front face of the workpiece aligned with the rest of the frame.*

Photos, except where noted: Steve Scott

Best Way to Fit Tenons

Machines will get you close, but only a handplane will deliver a piston fit

BY CHRIS GOCHNOUR

A lot of woodworkers cut tenons with a tablesaw, thinking it will be fast and dead-on, only to get frustrated when their "precise" setup results in ill-fitting cheeks or misaligned shoulders. Truth is, it's hard to cut perfect-fitting tenons using a tablesaw, a router, or a bandsaw. A better approach is to cut the tenon close and dial in the fit using hand tools. But is there one that's best for the job?

To find the answer, I compared shoulder planes, rabbet block planes, fillister planes, and bullnose planes. All are essentially planes designed to cut into corners, leaving crisp, square edges and removing material methodically in a way that power tools cannot.

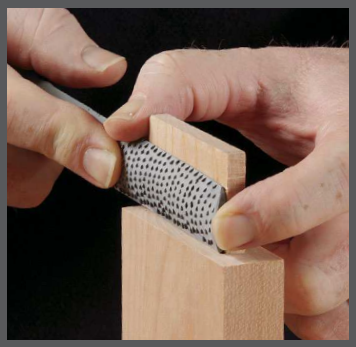
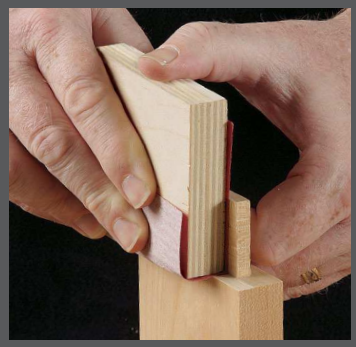
What to look for in a tenon trimmer

For a plane to be effective at trimming tenon cheeks and shoulders, it must have some basic characteristics. First, it must be adept at cross-grain and end-grain cuts, so it should have a low cutting angle. Precision manufacturing also is critical, and the way the blade aligns with the body is important for peak performance. The blade

Why planes work better

Shoulder planes and rabbet block planes reach into corners and remove material methodically in a way that power tools cannot, and they're more precise than files, sandpaper, or chisels. With each one, the blade should project slightly beyond the side (about 0.002 in.—the thickness of a sheet of paper) for best performance. If it doesn't project enough, the plane is pushed away from the corner and won't remove stock evenly.

Wrong tools are hard to handle


You may be tempted to file, sand, or chisel your way to perfect tenons. But these methods are inconsistent. Files and sandpaper tend to round over the work, especially in the corner, and it's difficult to control a chisel over a longer surface without creating a taper.

Photos: staff

Trim a tenon for a perfect fit

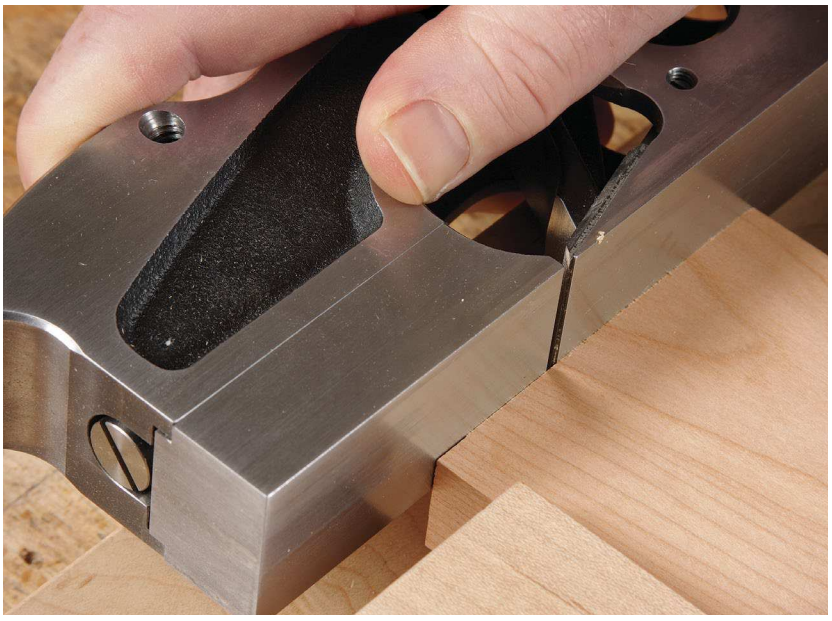
The key to achieving a piston fit is working methodically. Cut the tenon on the tablesaw (or other machine), and then carefully trim the shoulders and cheeks with a shoulder plane and rabbet block plane.

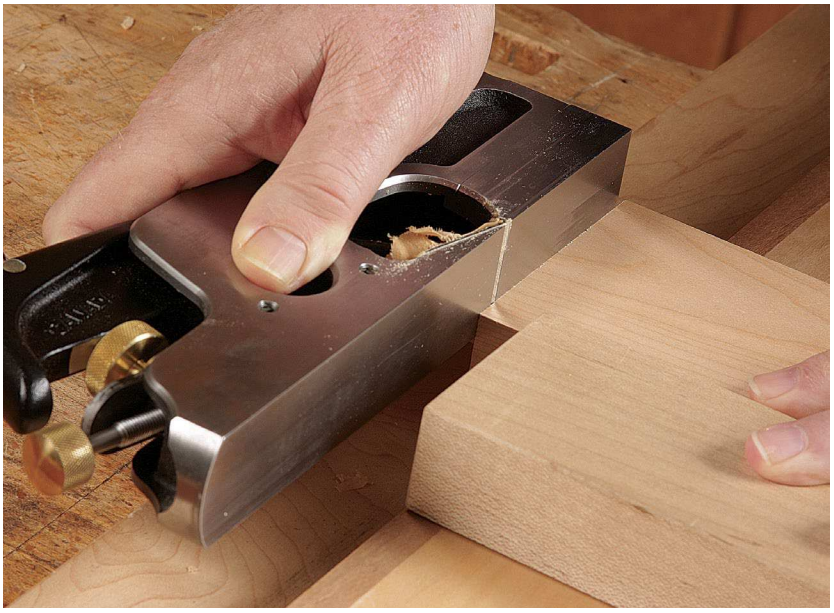
TIP HOW TO DIAL IN MACHINE CUTS

To reduce the amount of hand-trimming you need to do, cut the tenon close enough that a corner just fits into the mortise. Subsequent handwork will be quick.

SHOULDERS

Lower the step. *One of the most common problems with a tablesawn tenon is a step (right), or uneven shoulder that leaves a visible gap in the joint. To fix it, take a light pass with the shoulder plane (below), toward the step, starting near the middle. Take progressively longer strokes until the step is almost gone.*





Then level the shoulder. *Once the step is almost gone, go back in the other direction. One advantage of the shoulder plane is that you can pull it easily toward you. One or two passes should do the trick.*

should silhouette the body accurately, projecting slightly (about 0.002 in.—the thickness of a sheet of paper) beyond each side and parallel with the sole to achieve the desired amount of cut. If the blade projects excessively from the side of the plane, it will dig into and mark the joint's side. If it doesn't project enough, the plane is pushed away from the corner and produces a sloping or wandering cut.

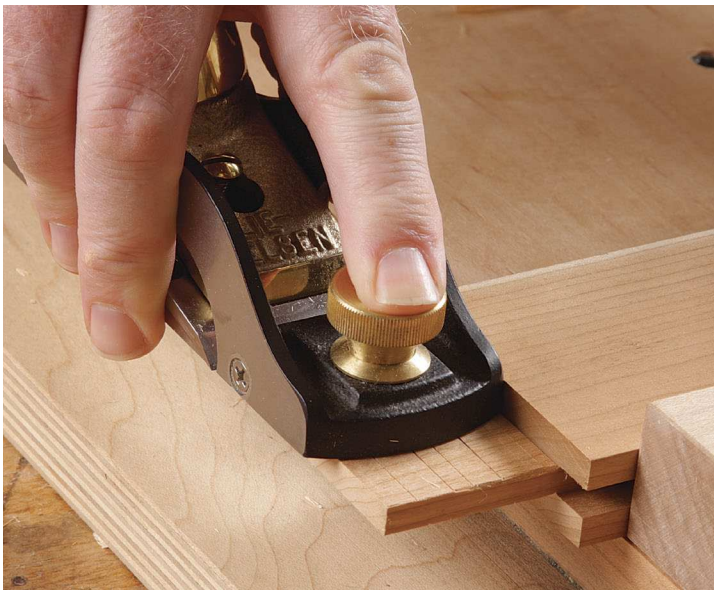
The sole of the plane should be flat and the plane sides should be perfectly square to the sole. The blade should hold up to the rigors of end-grain planing. As with any handplane, the depth and lateral adjustments should be easy and should hold. Finally, since these planes may be used in multiple positions, the body should be comfortable to grip with one or two hands.

The right planes for the job

I used all of the planes on tablesawn tenons to fine-tune the shoulders and cheeks, a job that involves tricky end-grain and cross-grain work. The stock was cherry, and the tenons were ¼ in. thick

CHEEKS

A wide berth. *To trim long tenons with a shoulder plane (right) requires overlapping passes, which could taper the tenon if you're not careful. The wider rabbet block plane (below) is more efficient and helps ensure a flat surface.*



by 4 in. wide by 1¼ in. long. I judged the planes based on the test, as well as on their fit and finish and ergonomics.

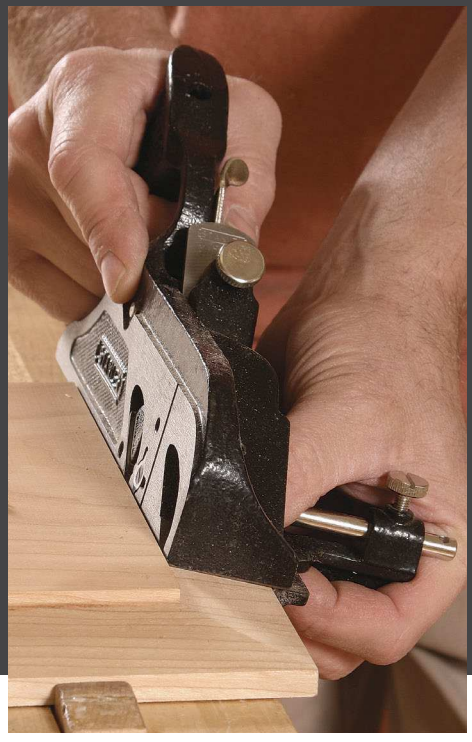
After all the testing, bullnose and fillister planes fell out of contention (right) while shoulder and block rabbet planes rose to the fore. With their low cutting angle, both of these planes handle end-grain and cross-grain cuts. And they're made for use with one or two hands, so you can hold them in a number of positions to handle any trimming job. I'd recommend buying a shoulder plane first, and adding a rabbet block plane later. □

Chris Gochnour is a professional furniture maker in Salt Lake City.

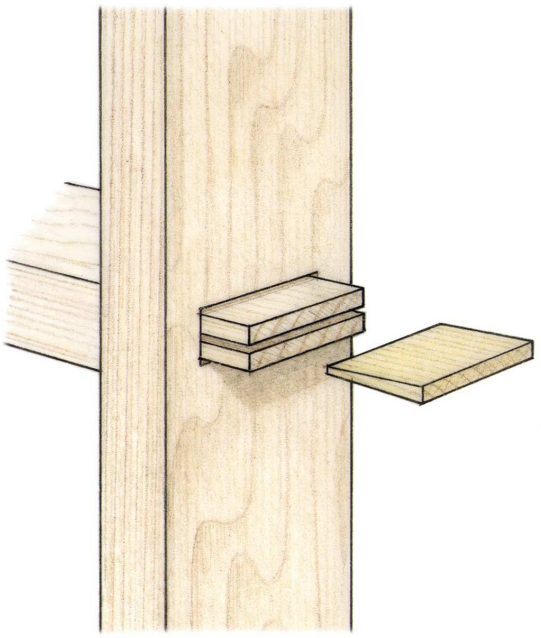
FILLISTER AND BULLNOSE PLANES DON'T MAKE THE CUT

Bullnose and fillister planes are not designed to trim tenon cheeks and shoulders. The bullnose plane has too short of a nose and does not register properly to start a cut. The fillister is really a joint-*making* tool, made for cutting rabbets and raised panels. It's not designed to be used on its side for trimming shoulders, and it's too long to use with one hand, a necessary trait for trimming tenons with the workpiece supported on a bench hook.

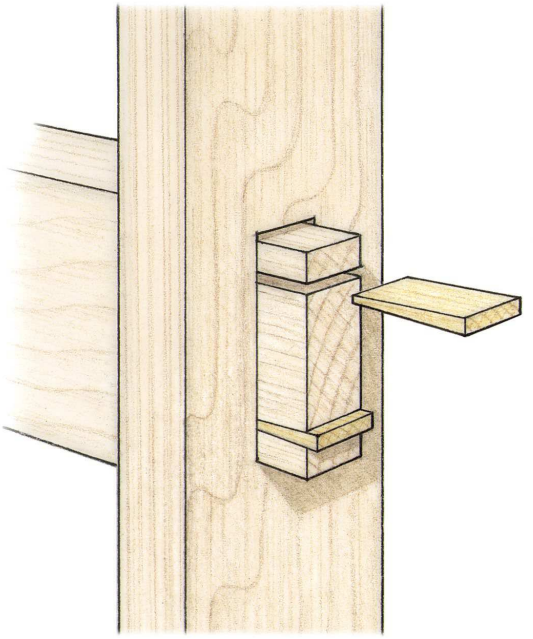
Stub nose is a problem. *The short nose of a bullnose plane doesn't give you much room to register the tool on a tenon, so you could inadvertently round over the edge as you work.*



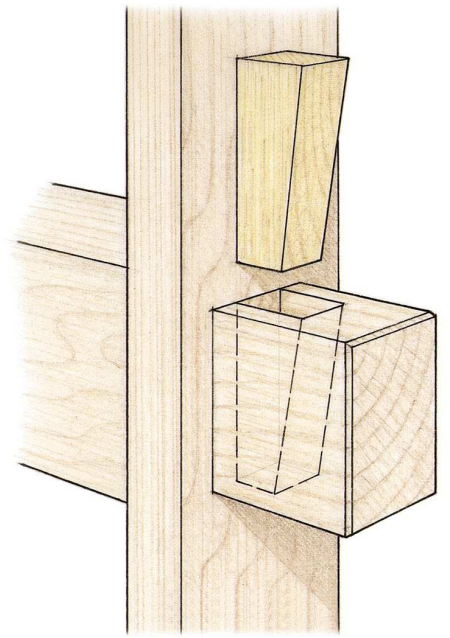
Better for raised panels. *With its long body and a two-handed grip, the fillister plane can work for trimming wide tenons on breadboard ends. However, it is better suited for creating joints, such as rabbets, and for raising panels by hand (left).*



SINGLE FIXED WEDGE



DOUBLE FIXED WEDGES



SINGLE LOOSE WEDGE

MORTISE & **TENONS**

The Mighty Wedge

Fixed or loose, wedged joinery adds strength and style

BY JOHN NESSET

Since antiquity, wedges have served as an important means of joining wood. Low-tech but effective, they are useful and attractive, evoking a rustic past when life (we like to think) was simpler and more straightforward. Like dovetails and other exposed joinery, wedges convey a sense of solid, honest craftsmanship, even to the uninitiated. A whole book might not be enough to detail every application for the mighty wedge, but I'll cover the two major types in their basic single and double forms. From there, you can derive other variations.

Wedges fall into two general categories: fixed and loose. Both types are driven into through-tenons to reinforce the joint. Fixed wedges generally are driven into the end grain of a tenon, reinforced with glue, then trimmed flush. They are appropriate where the wedge can work loose. Loose wedges are driven into a mortise that goes crossways through a protruding tenon. Loose wedges are not glued or fastened, so they must be oriented so that gravity and/or friction will keep them in place. They are used for two reasons: to create a knockdown joint and for decorative effect.

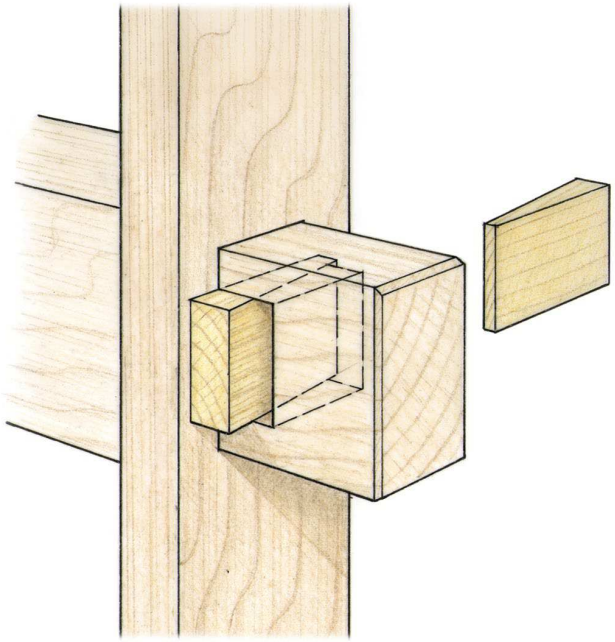
Wedges and grain alignment

Whichever wedge type you choose for your project, you must take into account grain direction. The hard-and-fast rule is that a wedge must be oriented in the mortise so that it applies pressure against the grain, not across it. As young Abraham Lincoln demonstrated in his famous fence-building project, pressure applied across the grain splits the wood. In the case of fixed wedges, this fact of life will determine whether you need a single wedge or double wedges (see the drawings on the facing page).

A single fixed wedge

It's worth spilling some extra ink about this first type of wedge, as it will illustrate many of the general principles for all wedged

Photos: Asa Christiana; drawings: Vince Babak



DOUBLE LOOSE WEDGES

joints. For example, for any of these wedged joints, start with a carefully fitted, square mortise and tenon. For a fixed wedge (or wedges), leave the tenon just a little long, so it protrudes from the mortise ¼ in. or so.

The magic angle is 5°—The most important thing to know about single wedges, fixed or loose, is to cut them at an angle of 5° or less. In this range, friction alone will hold the wedge to the tenon. Also, if the two halves of the tenon are bent too far by a thick fixed wedge, they will be weakened at the base, thus weakening the joint. Of course, wedges driven into the end grain of a tenon will be subjected to pressure (from racking forces and seasonal expansion and contraction) that would overwhelm friction alone, which is why the bond should be strengthened with glue.

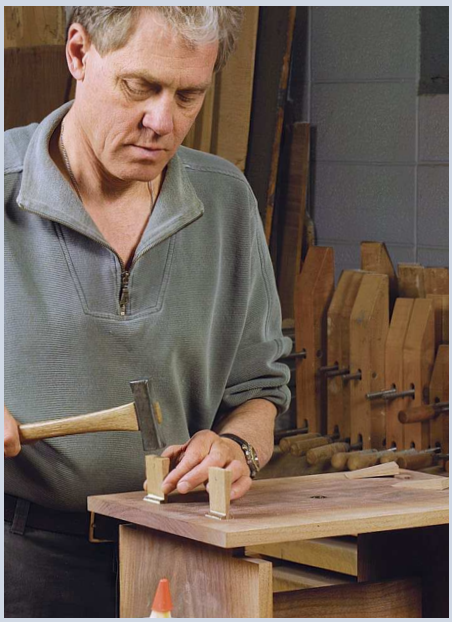
Angle the mortise and slot the tenon—I like to cut a flare into the mortise to accommodate the wedging action, creating a dovetail of sorts and locking the joint. But often it is quite acceptable not to angle the mortise. In this case, just use a thinner wedge—cut closer to 2° or 3°—to increase the pressure against the sides of an already snug mortise.

A 5° angle works well for single fixed wedges, spreading each half of the tenon outward 2½° (see drawing, p. 80). The top of the mortise wall should be angled on each side to accommodate the wedging action. This offset is laid out on the edges of the mortise, on the outside face of the workpiece.

To chop the angled mortise wall, first pare away the edge of the mortise, steadily creeping back toward the scribe line and down toward the bottom edge of the mortise. The goal is to reach the line and the bottom edge at the same time with a straight surface in between. Use the edge of the chisel to check the cut for flatness.

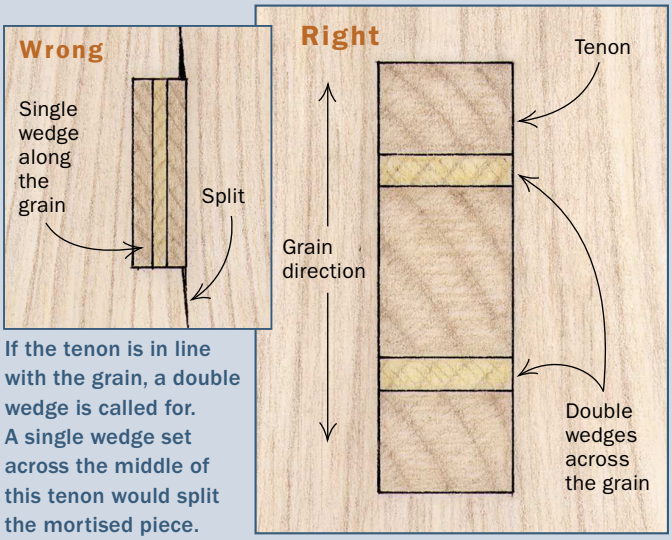
Next you'll want to saw a thin kerf in the tenon to receive the wedge. A handsaw leaves the right size slot. But before sawing this slot, drill a hole a little larger than the kerf through the tenon where the base of the slot should end up: about ⅛ in. from the

Orient wedges to avoid splitting



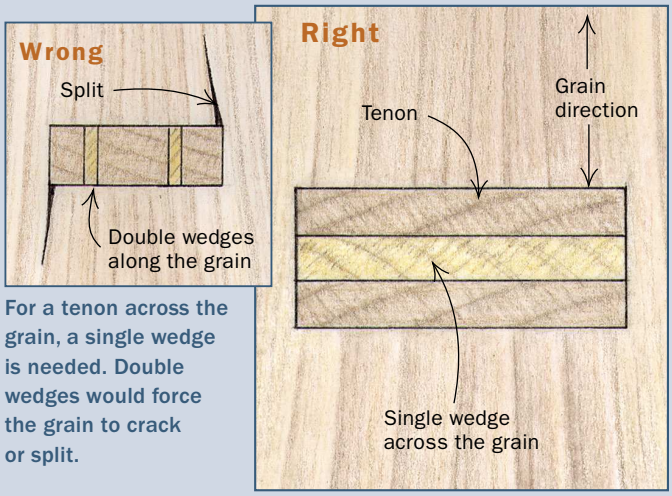
A wedge must push the tenon against the end grain of the mortised piece to avoid splitting the wood. So the orientation of the tenon—along the grain or across the grain—determines the number and orientation of the wedges.

TENONS ALONG THE GRAIN



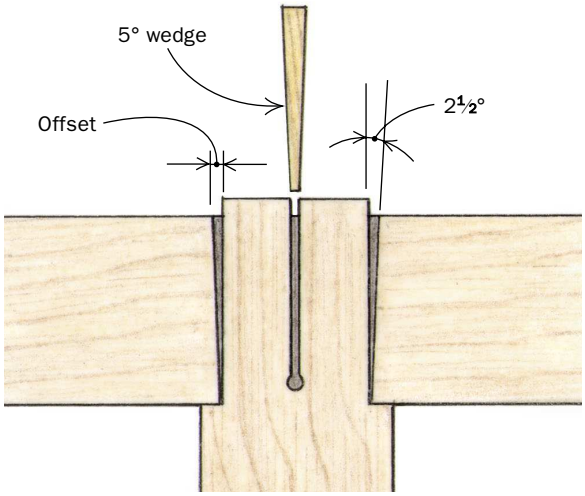
If the tenon is in line with the grain, a double wedge is called for. A single wedge set across the middle of this tenon would split the mortised piece.

TENONS ACROSS THE GRAIN



For a tenon across the grain, a single wedge is needed. Double wedges would force the grain to crack or split.

FIXED WEDGES ARE GLUED IN PLACE

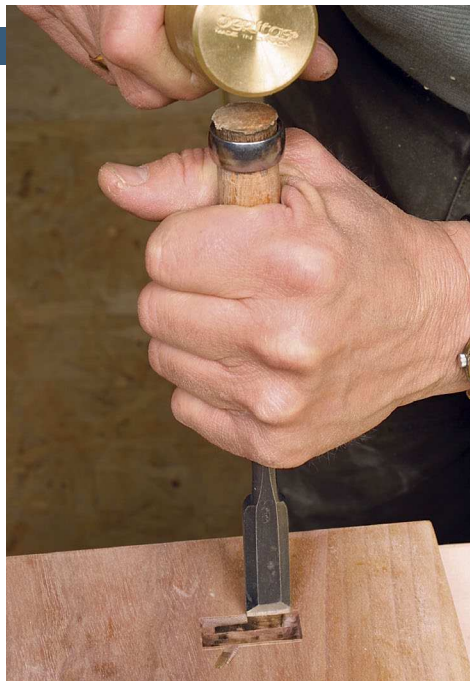


SINGLE FIXED WEDGE

A 5° wedge requires each face of the mortise to be angled at 2½°. Draw a cross section of the joint to determine the amount of offset at the top of the mortise.

ANGLE THE MORTISE

Lay out the offset of the angled mortise. *After determining the offset at the top of the mortise, scribe lines to indicate where the angled cuts begin (above). Work steadily back toward the scribe line (right) and down toward the bottom edge of the mortise.*



Drill a hole to prevent the tenon from splitting. *Clamp the workpiece vertically in a handscrew. Then drill a hole through the width of the tenon.*

PREPARE THE TENON FOR WEDGING

Saw a kerf down to the hole. *A handsaw leaves an appropriately narrow kerf in the tenon.*

A trick for a clean, flush joint. *After glue-up, plane the tenon flush. To prevent tearout, score a line around the base of the tenon.*

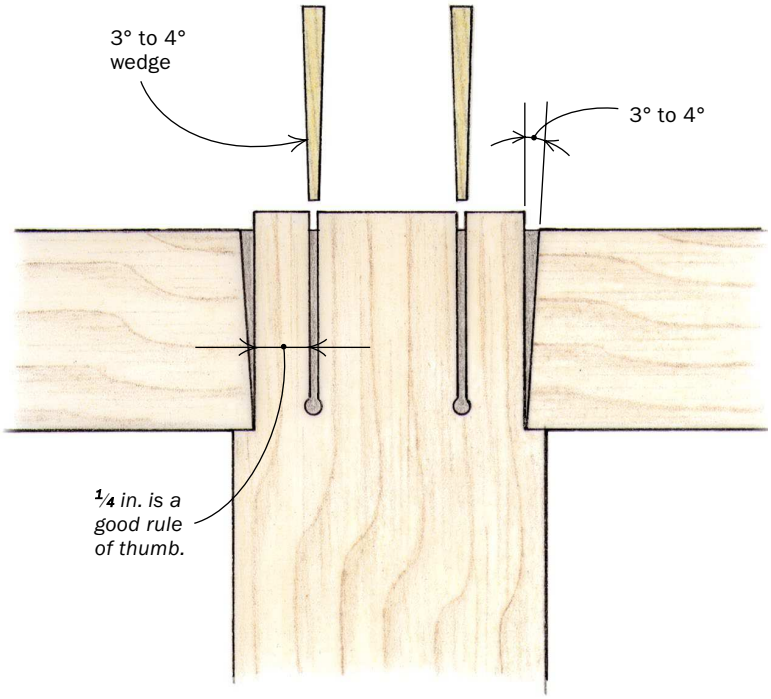
tenon's shoulder. This hole helps prevent the tenon from splitting beyond the slot when the wedge is driven in.

Wedge basics—When choosing the wood for a fixed wedge, avoid very soft species such as pine, basswood, or redwood. Instead, steer toward species such as yellow poplar, maple, and elm, which will stand up to hard pounding without splitting. Use straight-grained wood for the same reason. If you use an oily wood like ebony, clean it thoroughly with acetone immediately prior to gluing.

Cut the wedge exactly as wide as the tenon. Then lay out the appropriate wedge angle and saw it any way you like. Handplane it if the cut is rough. The thickness of the wedge will be determined by where you crosscut it. To allow for the wood to compress slightly, you should add a bit to the overall thickness. There is an easy way to do this: Square off the bottom of the wedge at a point where it is a hair (roughly 1/32 in.) thicker than the sawkerf.

Sharpen the squared edge to a point to make it easier to start in the slot. Then square off the thick end of the wedge at a point where it will protrude from the top of the tenon.

Driving in a wedge—Assembling and gluing-up fixed-wedge joints can be a nerve-wracking process. I often clamp the



DOUBLE FIXED WEDGES

Each wedge in a double array displaces its end of the tenon by the full thickness of the wedge.

Angle the ends of the mortise. *The layout and chopping techniques are the same as when angling a mortise for a single fixed wedge.*

Sometimes clamps are needed. *Nesset uses clamps to keep the tenon shoulders snug and square while he drives home the wedges.*

assembly to keep the joint square and tight while I pound home the wedges.

Do a test-run first, making sure that clamps won't come undone when you start waling away with the hammer. Drive in the wedge slightly to check its fit. Then pull apart the joint and apply glue to all surfaces, including some inside the sawkerf and on both faces of the wedge at its narrow end. Then insert the wedge and drive it in with a hammer. The hammering sound will change when the wedge is home, and you should see the tenon halves press tightly against the walls of the mortise.

If the wedge is wider than the head of the hammer that you're using, protect the wedge head with a block of wood as you drive it home. Be careful to hold the block square as you pound on it. When the glue dries, trim the protruding wedge and tenon flush.

Double fixed wedges

With a few additional considerations, the procedures for single fixed wedges apply to double fixed wedges. Like single wedges, double wedges are used in through-tenons both to add strength and to give a decorative touch, but double wedges are oriented across the tenon, making them much narrower.

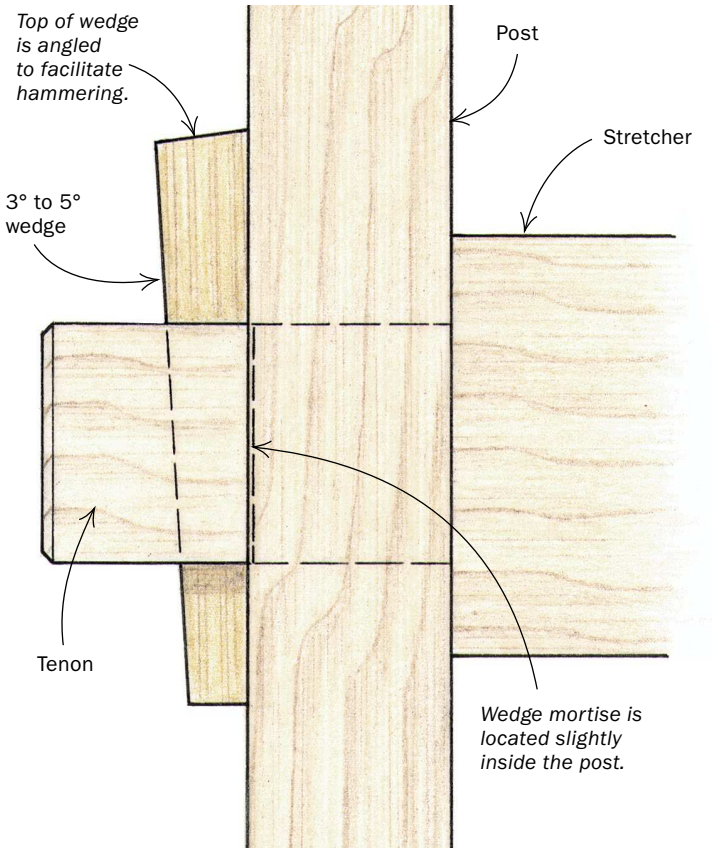
I use a 3° or 4° angle for double wedges, which is the same amount the tenon sections will bend and the mortise wall will be angled (see the drawing above).

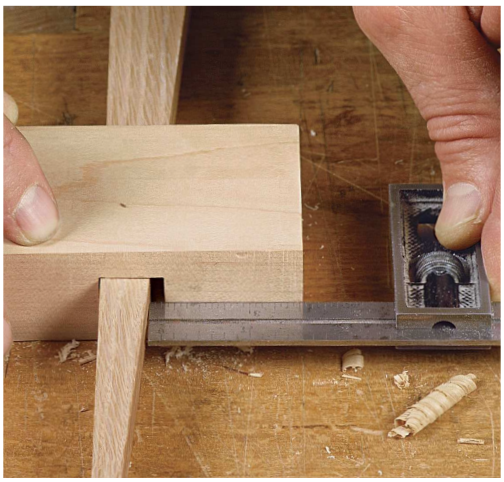
Basically, the wedges go in near the ends of the tenon. But exactly where to place them is a factor of how flexible the wood is. They should not be so close to the ends that the bent pieces will be weak at their base, but they should not be so close to the

LOOSE WEDGES CAN BE DISASSEMBLED

SINGLE LOOSE WEDGE

This wedge should be oriented vertically so that gravity pulls the wedge downward when the joint wiggles, tightening it. One side of the wedge mortise is angled to match the wedge.

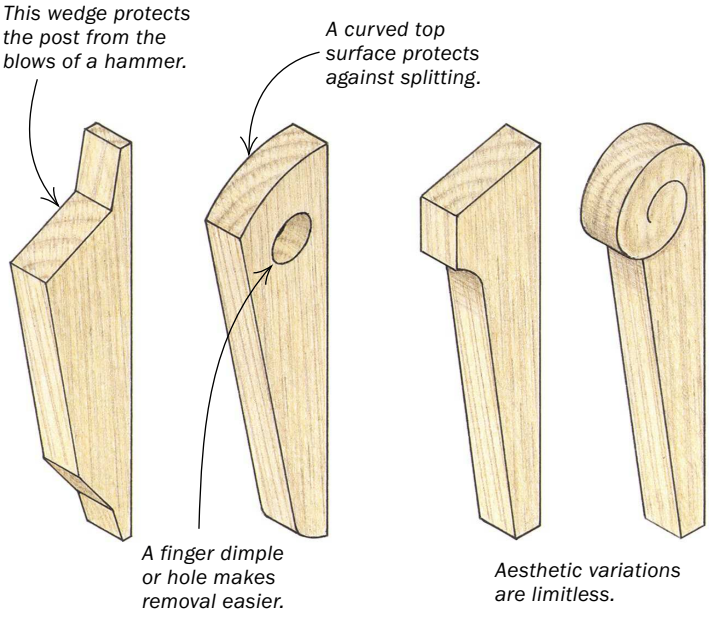




Another method for laying out the mortise angle. *First chop a square mortise through the tenon and make the wedge stock. Insert the wedge and measure the gap at the loose end. That gap is the same amount that the mortise must be offset to match the wedge angle.*

LOOSE WEDGES ADD STYLE

There are many possible variations on the loose wedge, some functional, all decorative.



center that the outer pieces won't spread easily. A good rule of thumb is ¼ in. from the end of the tenon.

Drive in the wedges equally, each a little at a time. Otherwise, the wedges will look uneven when the tenon is trimmed flush.

Loose wedges can be single or double

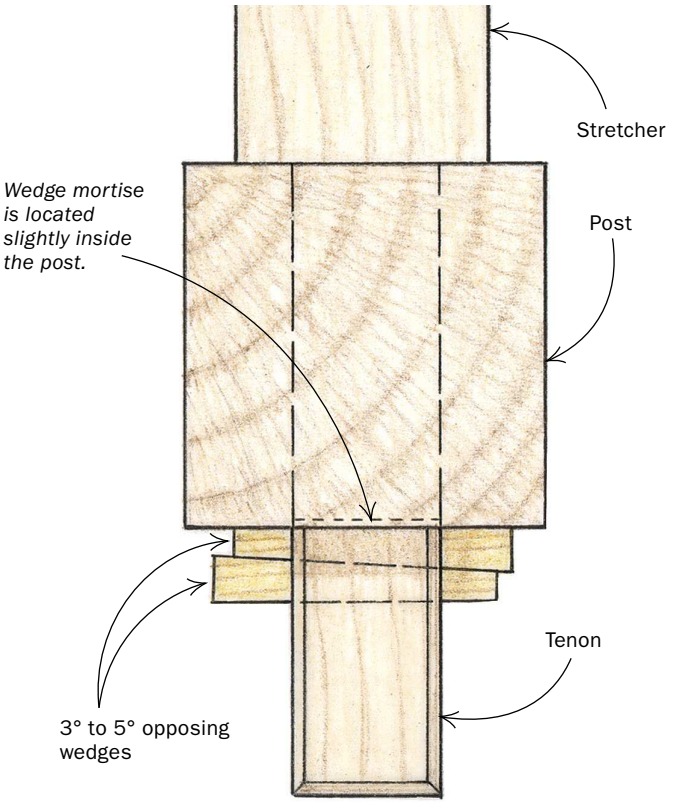
As I said earlier, loose wedges offer a greater decorative effect and a sturdy knockdown joint, suitable for a trestle table, a bed frame, or the base of a workbench, among other applications.

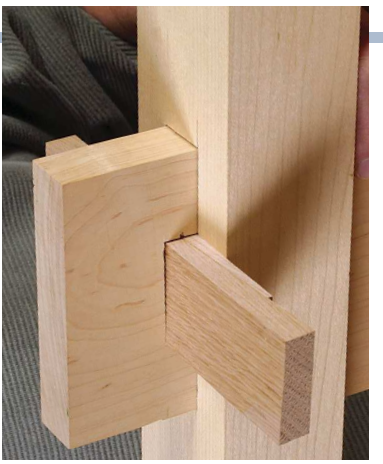
Many of the principles that apply to fixed wedges also apply to loose ones. The 5° limit holds true, and the wedging action must apply pressure against the end grain of the mortised piece. However, unlike fixed wedges, which are driven in with the grain of the tenon, loose wedges are driven in perpendicularly to the grain. As a result, they should be made from wood as hard or harder than the stock that they wedge to minimize compression against the end grain.

Single and double loose wedges are oriented differently. The single loose wedge generally is oriented vertically, allowing gravity to work in its favor. Double loose wedges, on the other hand, are oriented horizontally in a square mortise, wedging against

DOUBLE LOOSE WEDGES

This type is used when the tenon is too tall to hold a long vertical wedge. The wedge mortise is horizontal and is left square because it holds two opposing wedges. Gravity won't tighten the wedges, but the mortise is easier to cut.





Try the fit, looking for gaps. *The wedges may need light planing to adjust their fit in the mortise.*

Then mark them to length. *These wedges will end just inside the edge of the post.*

each other. An occasional tap might be necessary to retighten the joint.

The familiar trestle base offers a typical application—connecting the long stretcher to the posts—for either type of loose wedge. A long, shouldered tenon at each end of the stretcher goes through the post, protruding sufficiently from the other side to accommodate a mortise for a wedge or wedges.

Start with a square, snug mortise and tenon, and a square mortise for the loose wedge(s).

Single loose wedge is vertical—Single wedges, with their thick ends sticking up in plain sight, often are stylized for greater decorative effect (see the bottom drawings on the facing page).

For the single wedge, cut a square mortise vertically through the protruding tenon. Then angle the mortise face that is farthest from the post to match the wedge. I usually go with an angle of 3° to 5°. Cutting a taper into the wall of this long, narrow mortise is trickier than tapering the short mortises for fixed wedges, but the technique is the same. Lay out the offset on the wider end of the mortise, and begin removing the corner, working back toward the bottom edge and your layout line. Check the mortise wall often with a small straightedge to make sure you are keeping it straight. A mortising chisel will work better than a paring chisel, tracking along a straighter line as you chop downward.

It's important to have clean, square corners inside the wedge mortise; otherwise, the wedge will catch and could split the tenon.

Double loose wedges are another solution—If the tenon is just too tall or thin for a long vertical mortise, use double loose wedges oriented horizontally. Double loose wedges work by locking against each other as well as against the mortise. One wedge is inserted from one side and one from the other, and both are driven in until the two angled faces lock. Orientation is horizontal instead of vertical because the bottom wedge would work loose and fall out in a vertical configuration. With each edge of the wedges and the edges of their mortise neatly chamfered, the double wedge makes a useful, strong, and attractive joint.

I cut double loose wedges at a similar angle as singles, but I leave them thinner than single wedges when cutting them to length. This way, the two wedges can fit in a smaller, neater-looking mortise. Double wedges also are usually wider than single loose wedges, to offer more friction between their faces. □

John Nesset is a furniture maker in Minneapolis, Minn.

MORTISE & **TENONS**

The Pegged Joint, Exposed

A complete guide, from flush to proud to drawbored

BY MATTHEW TEAGUE

I seldom cut mortises and tenons—whether in doors, leg-to-apron joints, or on breadboard ends—without pegging the joints. Driving a wood peg through a mortise and tenon not only strengthens the joint, but it also adds a decorative element that I've come to depend on in most of my designs. Because I lean toward joinery that is honest and exposed, using pegs makes the construction process transparent. If you see pegs, you can bet that they're more than ornamental, and you can tell at a glance how the piece is held together.

Reinforcing a joint in this manner involves driving a hardwood peg through the mortise and tenon (though I've seen the same technique used on other types of joinery, including box joints and dovetails). Structurally, the peg strengthens the mechanical connection between mortise and tenon—often to the extent that glue isn't necessary. Aesthetically, the peg can add a subtle or bold detail to your work.

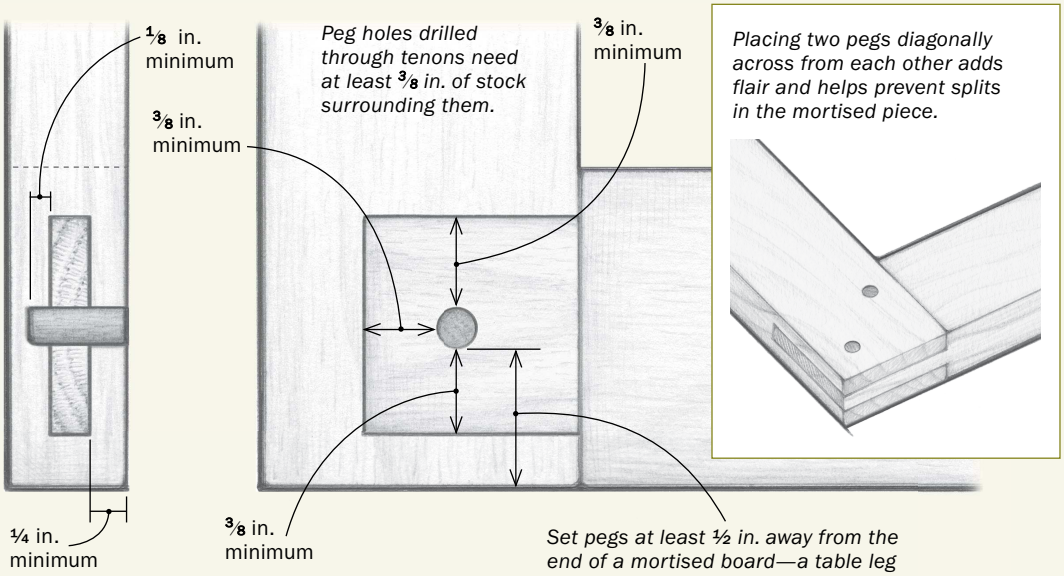
Most of the time, I drive pegs into a mortise-and-tenon joint that has already been assembled. But with proper planning, pegs also can be integral to the assembly process, exerting their own clamping pressure. This method, called drawbored pegging, calls for some

Layout and design

LOCATE PEGS SMARTLY

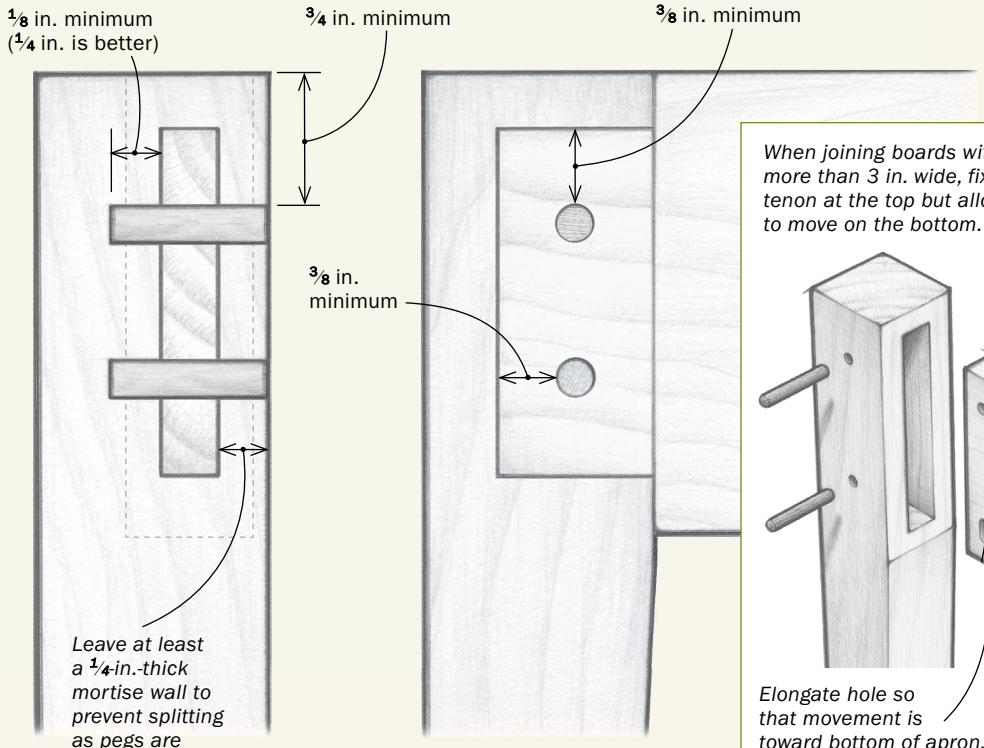
Wood pegs create tenacious mortise-and-tenon joints that will never pull apart. For maximum strength, be sure there's sufficient tenon stock above and below the peg as well as toward the front of the tenon. Leaving too little wood in these areas could result in a split when the joint is stressed.

IN FRAME JOINERY



Placing two pegs diagonally across from each other adds flair and helps prevent splits in the mortised piece.

IN APRON-TO-LEG JOINERY

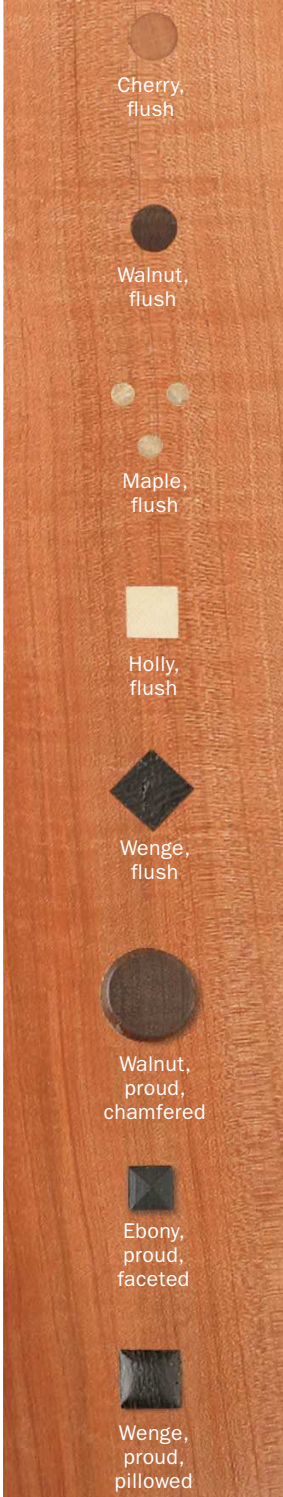


When joining boards with tenons more than 3 in. wide, fix the tenon at the top but allow it to move on the bottom.

Elongate hole so that movement is toward bottom of apron.

A PALETTE OF PEGS

Against a cherry backdrop, you can see the stunning effects you can achieve by varying the wood, shape, and size of the pegs.



Photos, except where noted: Thomas McKenna; this page: John Tetreault; drawings: Christopher Mills

Pegged-joint basics

Driving wood pegs into mortise-and-tenon joints adds strength and visual appeal to furniture. Typically, the joint is glued up before pegs are installed, but you don't have to wait for the glue to dry before adding pegs. You might want to leave the clamps on, though.

Mark out the peg locations. *Draw the outline of the tenon on the mortised stock. Locate the pegs' center points, then define them with an awl so that the drill bit won't wander.*

Drill peg holes. *Attach a tape "flag" to the drill bit, and stop drilling when the flag knocks the chips away. Drill perpendicular to the workpiece to avoid tearout.*

Buy pegs or make your own

You can buy dowel stock for pegs, but you'll have more design options if you make your own from hardwood scraps in your shop or from purchased pen blanks, which come in a variety of exotic species (see Sources, below). Start with a ¾-in.-sq. blank. Set the tablesaw fence and the blade height based on the size of the pegs you're cutting. If you're making ⅜-in. pegs, set the fence to ⅜ in. but leave the blade height just shy of ⅜ in. Using a push stick at the end of each cut, rip along each corner of the blank, adjusting the blade height until only a sliver holds each corner together (top photos, right). Eventually, you'll be able to peel away the strips. To make round pegs, place the square strip in a V-grooved trough and plane away equal amounts of stock at the corners (bottom photo).

Square pegs on the tablesaw. *Set the fence to match the peg width and set the blade height to just under that measurement. Use a push stick at the end of each cut, and raise the blade until only a sliver of material holds the peg stock to the blank. Then peel away the strips.*

Make 'em round if you want. *With the blank set in a V-grooved trough, use a block plane to remove the corners, rotating the blank as you go.*

SOURCES OF SUPPLY

Hardwood dowels and pen blanks

rockler.com
woodworker.com
woodcraft.com

Photos, this page (bottom left): John Tetreault

Drive pegs home. *The pegs will go in easier if you chamfer the bottom edges (inset). Use a metal hammer to drive in the pegs. Stop when the hammer tone deepens; it means the peg has bottomed out.*

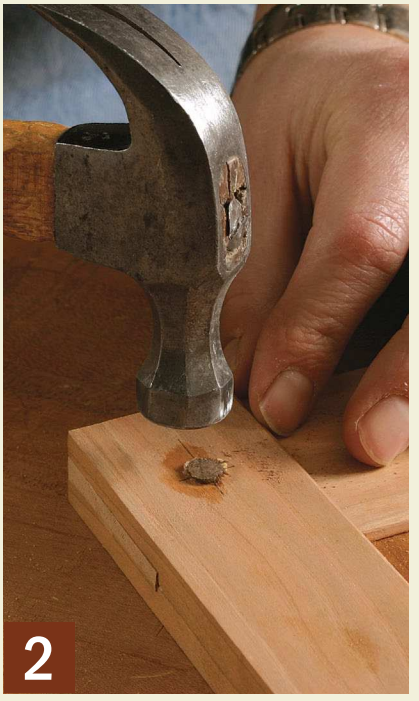
drilling and layout work before assembly (for details, see p. 85). Both methods make for bombproof joints, and the techniques are relatively simple.

Let the furniture dictate the peg form

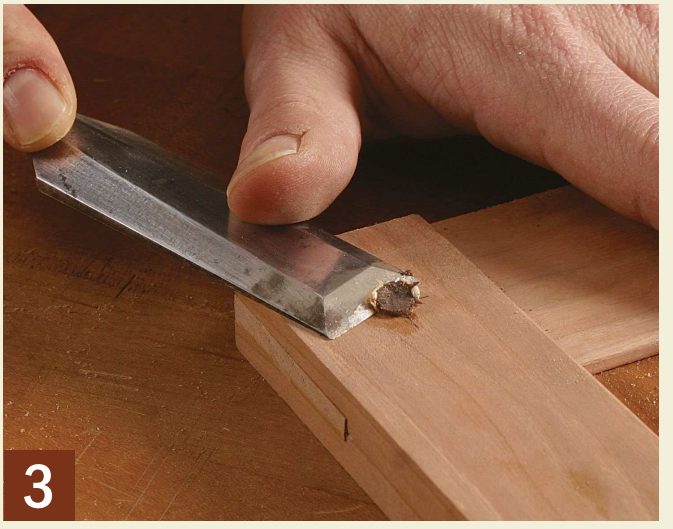
Pegs can be designed to suit most furniture styles. For starters, you can make them round, square, flush, or even proud and faceted (for an assortment of peg styles, see the photo on p. 85). Then there is the species of wood. Because the end grain of the pegs is exposed and will darken with an applied finish, they will offer contrast in some form. For a more subtle appearance, cut the pegs from the same primary wood you're using on the project. To pump up the contrast, choose pegs of a darker or lighter species. I often use walnut to add a darker accent to cherry designs. Ebony is dense and strong, and the near-black color offsets mahogany or walnut well. On occasion, especially if I want a more contemporary look, I'll use pegs of a lighter color: holly pegs in a mahogany door, for instance.

Regardless of your design, choose a dense and strong hardwood peg that is as strong as, or stronger than, the material you are pegging. On a few occasions, I have pegged joints with a softer

TRIMMING PEGS FLUSH

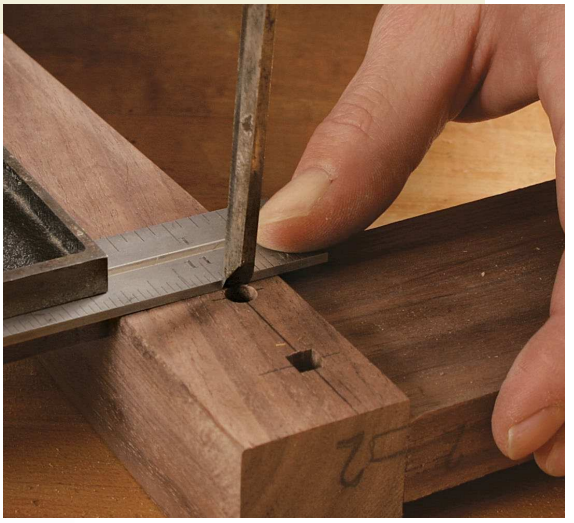


1. *Use a handsaw to trim the peg almost flush. Place a shim under the saw to protect the workpiece.*
2. *Dampen the peg with water, then mash it a few times with a hammer, causing the head to mushroom slightly. The water softens the fibers and mashing helps spread the peg to fill any gaps.*
3. *Pare the peg flush using a chisel. Rest the chisel flat on the work surface. Slowly work your way around the outside of the peg and toward the middle to avoid tearout as you finish the cut.*

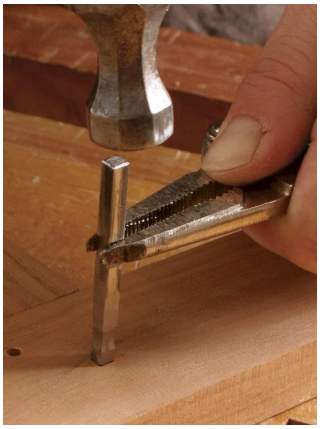


Square pegs stand out

Square pegs can add visual interest and are often appropriate stylistically, as in Arts and Crafts furniture. After drilling the peg holes (see p. 86), square up the top third of each hole.



Use a chisel that matches the peg width. *Create a square opening at the top of the hole that tapers down about half the depth. A combination square will help guide the chisel at the start of the cut.*



Square holes in a jiffy. *A punch made from key stock available at hardware stores can be used to square up holes. Match the stock to the width of the pegs, and grind it as shown. Tap the tip into the hole (right) until you reach the relieved section, using pliers to keep the punch steady.*

wood, but in these cases the pegs are simply a design element—not a means of strengthening the joinery.

Maximize strength without sacrificing appearance

There's more to pegging a joint than the appearance. It's also important to get as strong a mechanical connection as possible. A few factors come into play here: the size, placement, and number of the pegs.

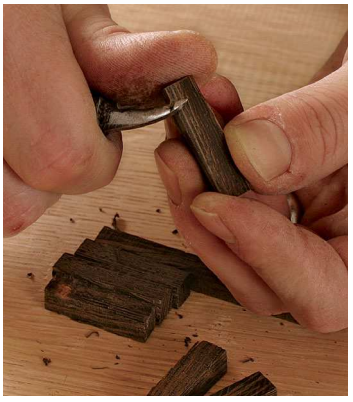
Without calling in the engineers, you can determine the size of the peg by considering the joint you're reinforcing and the desired effect. In general, I use pegs between 3⁄16 in. and 3⁄8 in. dia. That said, even smaller decorative pegs of 1⁄8 in. dia. would not be out of place on a delicate box, and 1⁄2-in. pegs might work better on a beefy trestle base.

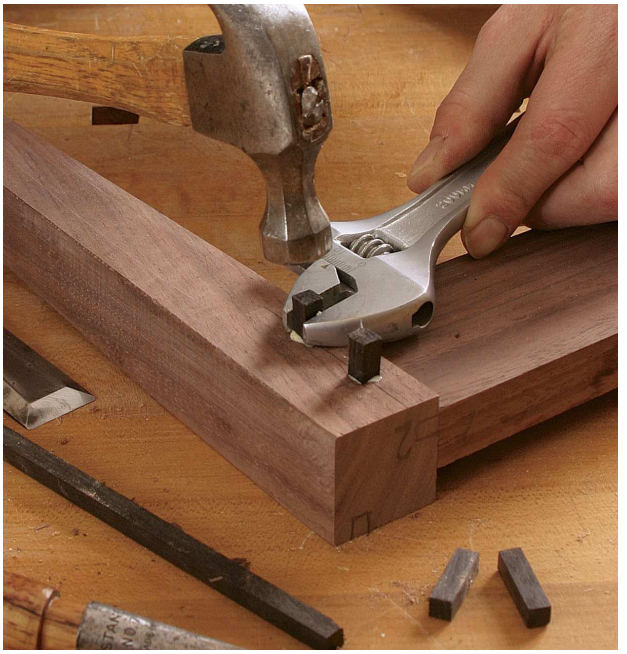
Position pegs so that neither the mortised nor the tenoned stock splits as the peg is driven home (see drawing, p. 85). You also may use multiple pegs to secure wide mortises and tenons, such as those on table apron-to-leg joints. In these cases, double pegs help strengthen the joint and lend the design a more balanced appearance.

Drill peg holes first

Whether you're installing round or square pegs, start by choosing a bit that closely matches the peg size. Just make sure the bit isn't much larger than the peg stock. If you're drilling into softer stock, you can make the hole about 1⁄32 in. smaller than the peg stock because the primary wood will offer a little give. But you may need to whittle the bottom two-thirds of the peg to get it to fit the hole. Shoot for a snug fit, but not so tight that the peg could split either the mortised or tenoned stock. Different woods react differently, so test the fit on scrap pieces.

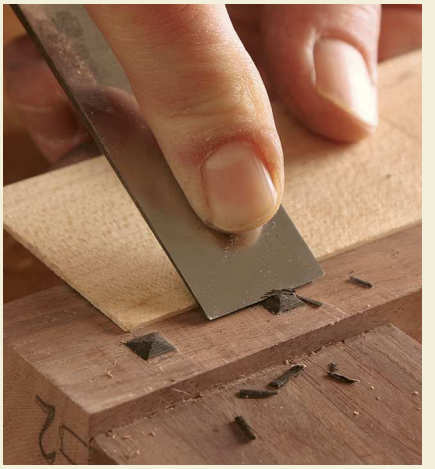
Before gluing the mortise-and-tenon joint, transfer the mortise/tenon location around to the face of the stock and then mark out the center point of the peg locations.





Whittle the bottom of the pegs and drive them home. *Round over the bottom two-thirds of the peg using a small knife or chisel (above). Use an adjustable wrench to help guide the peg and keep it aligned square when driving it in (right).*

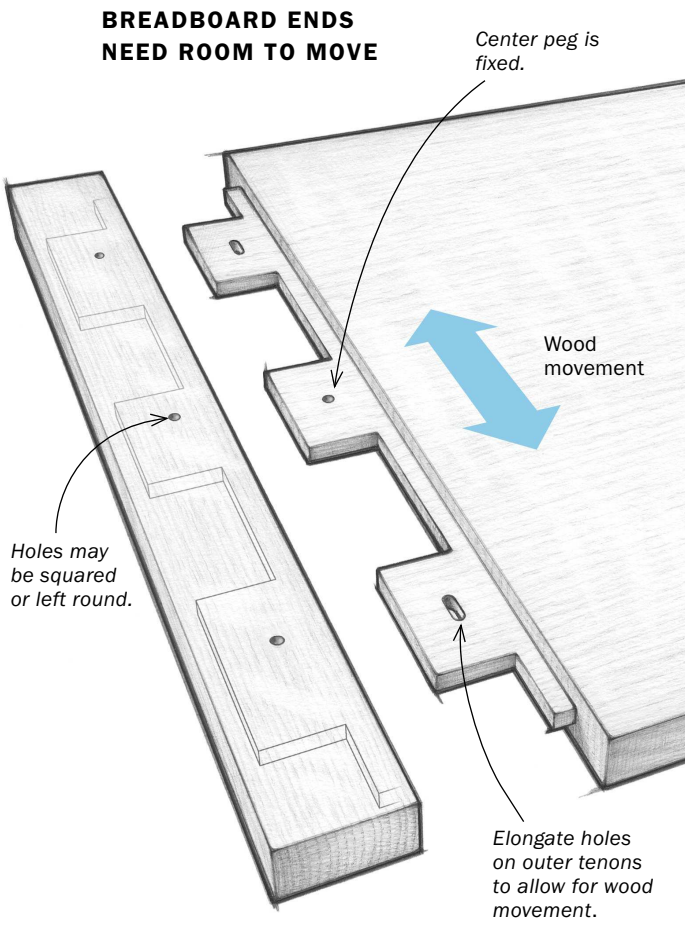
FACETING PEGS



How pyramids are made. *With the chisel bevel side down and resting on a thin shim, lever the blade upward. For clean results, try to facet each side in one pass.*

Pegged breadboard ends never loosen

Pegging the breadboard ends of a tabletop is a great way to reinforce that joint. But you must allow for wood movement by elongating the outermost peg holes.



Clamp and drill, then widen the outermost tenon holes. *With the breadboard ends clamped to the tabletop, drill the holes for the pegs at their marked locations. Again, flag the bit to gauge the drilling depth (left). Remove the breadboard end, use the drill to elongate the holes in the outer tenon, then clean up the holes with a chisel (right).*

Drive the pegs. *Glue the breadboard ends to the tabletop, being sure the holes in the breadboards align with the holes in the tenons. Clamp them in place, and tap the pegs home.*

If you are pegging an exposed mortise and tenon, such as a bridle joint, you can mark the locations after glue-up.

Simply drill at the center points all the way through the tenon and about ⅛ in. to ¼ in. beyond. On thinner stock, common on door frames, ¼ in. is not always possible. In these cases, simply drill about a third or half of the way into the opposite wall of the mortise—just make sure the back wall of the door stock isn't thinner than about ⅛ in. Use a piece of tape attached to the bit to control the depth, and keep the drill perpendicular to the workpiece. On smaller workpieces, using a drill press guarantees perpendicular holes. If your design calls for square pegs, you'll need to square up the top third of the hole using a chisel (see photos, facing page).

Metal hammer will sing as you tap in pegs

Both round and square pegs need a little prep work before you drive them home. After cutting the pegs to length—they should be about ⅜ in. longer than

the depth of the hole—ease the edges on the bottom of the pegs using sandpaper, a chisel, or a small knife. Doing so allows you to drive the peg into the hole without splitting or damaging any parts, and gives excess glue a place to go when you drive the pegs home.

Once both hole and peg are prepped, place a small drop of glue in the hole and apply a thin layer to the lower third of the peg. To drive the peg home, use a small metal finishing hammer. Its light weight won't stress the stock you're pounding, and the tone of the metal hammer will deepen as the peg bottoms out in the hole. Once the peg bottoms out, stop hammering or you'll risk cracking the stock.

Trim pegs flush or leave them proud

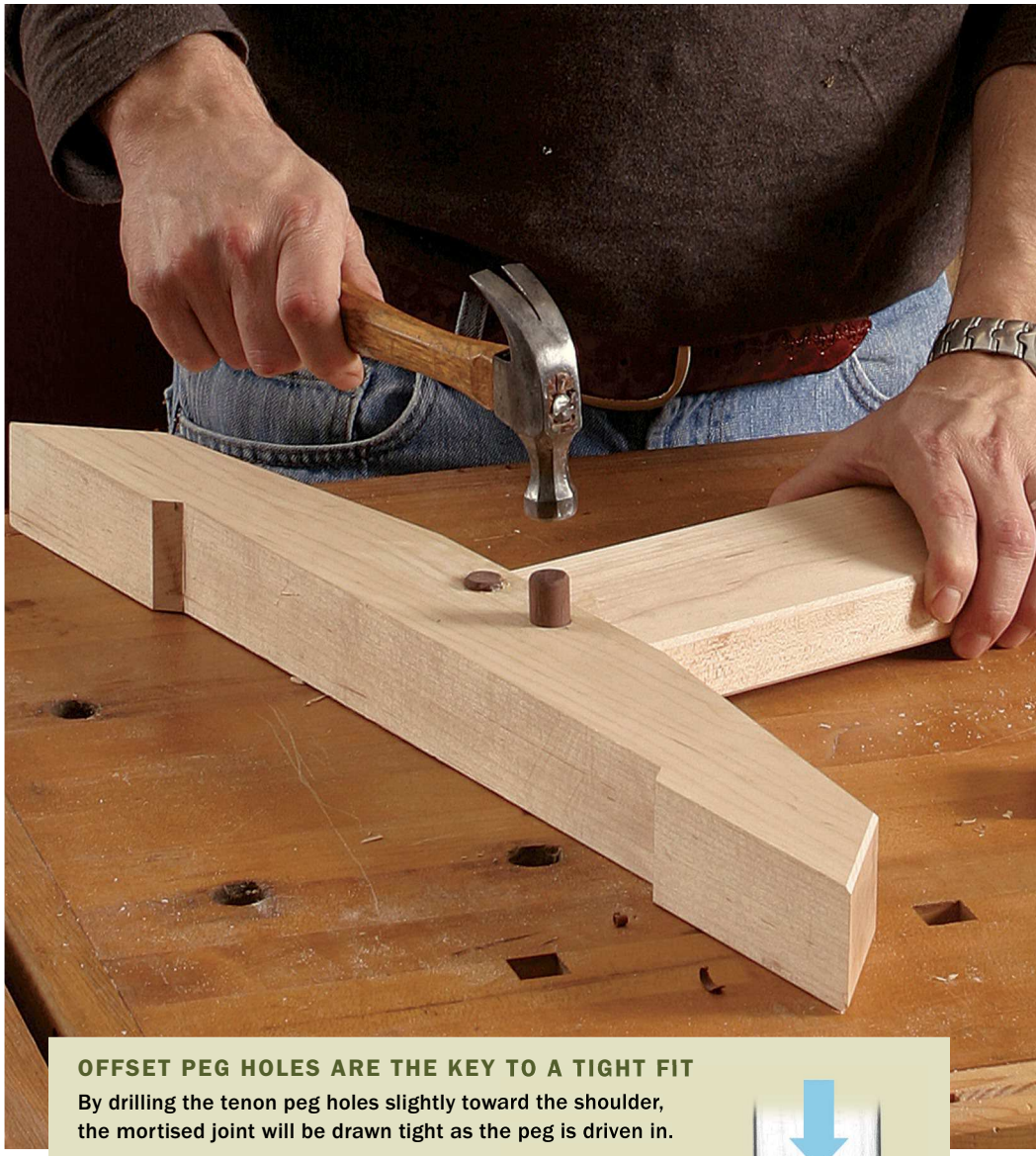
You can trim pegs flush (see p. 87), but leaving them proud of the surface they're driven into is a good way to accentuate the joinery even more. I often leave small pegs about 1/16 in. proud, larger ones a little more. After installation, the exposed end of the peg can be softened with sandpaper, chamfered with a chisel or plane, or, my favorite, faceted.

The first few times I tried to use faceted pegs, I made it a lot more difficult than necessary. Brian Boggs, a well-known chairmaker in Kentucky, taught me a better way. Simply drive the peg into place as usual, then wait for the glue to dry. To cut the pegs to a consistent size, use a shim whose thickness matches the desired projection of the peg, and register the saw against it as you trim the pegs to length.

To cut the facets, use a chisel that's wider than the peg, and hold it bevel-side down against the surface adjacent to the peg. Working in from one side at a time, use the bevel as a lever to angle the blade upward as you cut toward the center. To prevent denting or scarring the surface you're bearing against, place a thin shim between the chisel's bevel and the surface of the wood. You'll have the best luck if you cut each facet in a single sweep of the chisel—every time you stop to realign the chisel, you're left with a small ridge on the peg's pyramid top that will have to be cleaned up. Before working on a project, practice the technique on a scrap peg and joint. □

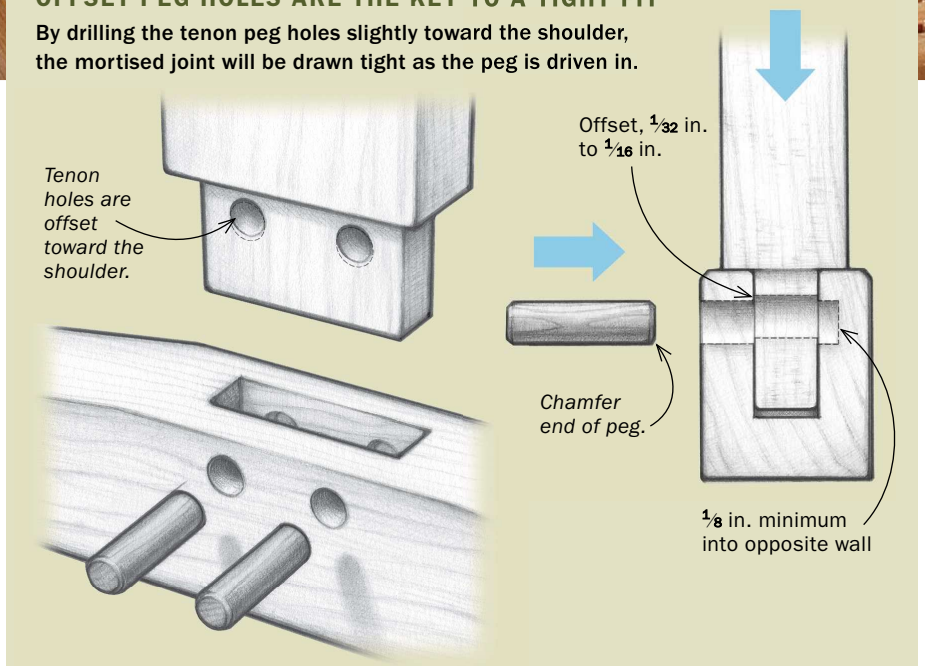
Matthew Teague is a writer and a woodworker in Nashville, Tenn.

Drawbored pegs pull joints tight



OFFSET PEG HOLES ARE THE KEY TO A TIGHT FIT

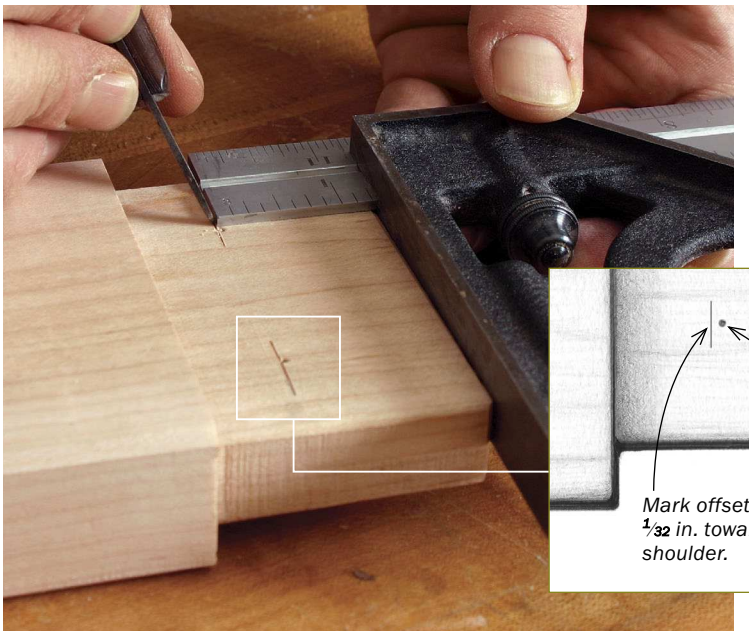
By drilling the tenon peg holes slightly toward the shoulder, the mortised joint will be drawn tight as the peg is driven in.



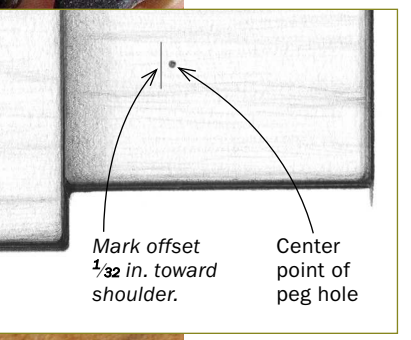
Drill the mortised piece. *Go through one side and partway into the other. Use a Forstner bit for a clean cut.*

Mark the tenon. *With the joint reassembled and clamped together, mark the center point of the hole. An easy way to do this is to insert a Forstner bit into the hole and tap lightly.*

No matter what kind of peg you use or how you adorn the top, drawboring adds significant strength to the joint and helps to pull the pieces tight as the pegs are driven home. It even will allow you to forgo clamps and glue at assembly, which is especially handy when you don't have clamps long enough to handle large assemblies like the stretchers on a long dining table. Drawbored pegs are drilled in two steps. After dry-fitting the tenon into the mortise, take apart the joint and drill through the mortised stock. Clamp the joint together again, then mark the hole's center point on the tenon. Disassemble the joint and scribe a line slightly inset from the center point toward the shoulder of the tenon (middle photo, right). For softer hardwoods like cherry or walnut, offset the holes about 1/16 in.; for harder woods like oak or hard maple, make the offset about 1/32 in. Now drill through the tenons at the inset marks. Chamfer one side of the peg or round over the end dramatically so that the peg seats itself in the offset hole without butting against the tenon face (see drawing, facing page). As the peg is driven home, the mortised stock will pull snug against the tenon shoulders.



Scribe the offset. *Use a combination square and a knife to offset the hole 1/32 in. to 1/16 in., depending on the hardness of the materials.*



Drill through the tenon. *Align the tip of the Forstner bit so that it engages the offset line. If you need to drill multiple holes, using a fence helps ensure consistency.*

Article Extra

Watch Teague assemble a drawbored mortise and tenon.

Straightforward Joinery for

Three basic techniques are the bridge to more beautiful furniture

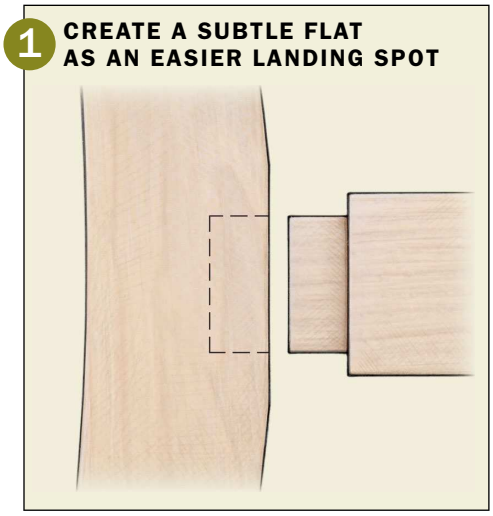
BY JEFF MILLER

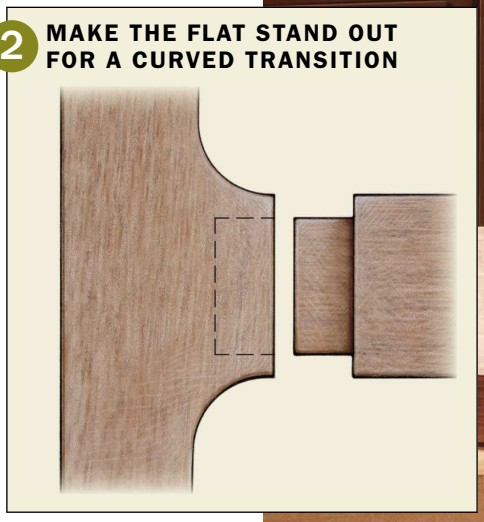
My first saw was a bandsaw, so from the very beginning of my woodworking career, I found myself working with curves. If you've only been a straight-shooter until now, you'll find that curves not only open up a world of design possibilities, but they also offer plenty of chances to expand your repertoire of woodworking skills: from laying out eye-pleasing shapes to cutting and smoothing those shapes, or even bending them (with steam or by lamination).

What stops most people, however, is the prospect of cutting and fitting joinery on these curved parts. But you shouldn't let that stop you from experimenting with curves in your designs. I'll show you three techniques that I've used over the years with great success. There's nothing exotic or difficult about them, and once you see them in action, you'll soon be adding graceful curves to your own work.

Creating a flat spot on the curve

The simplest way to join two pieces when one of them is curved is by leaving or creating a flat area on the curved

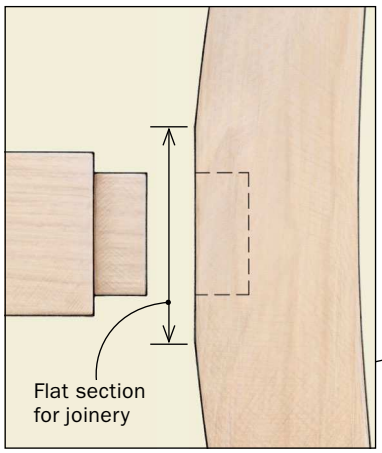




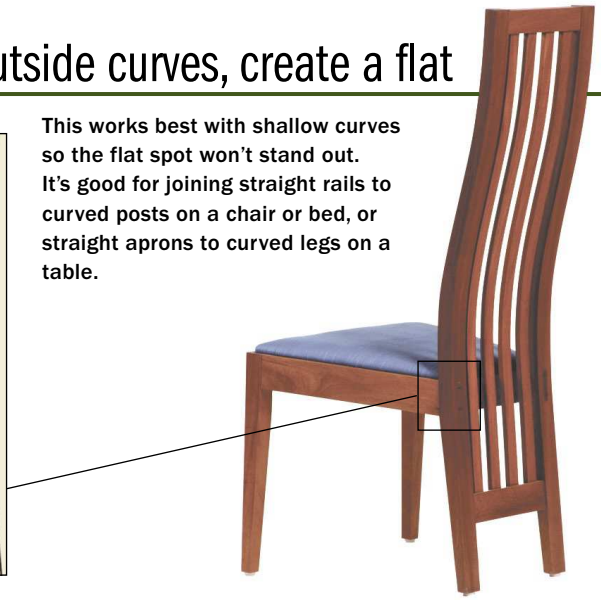
Photos, except where noted: Steve Scott; drawings: Christopher Mills

Curved Work

OPTION ONE For shallow, outside curves, create a flat

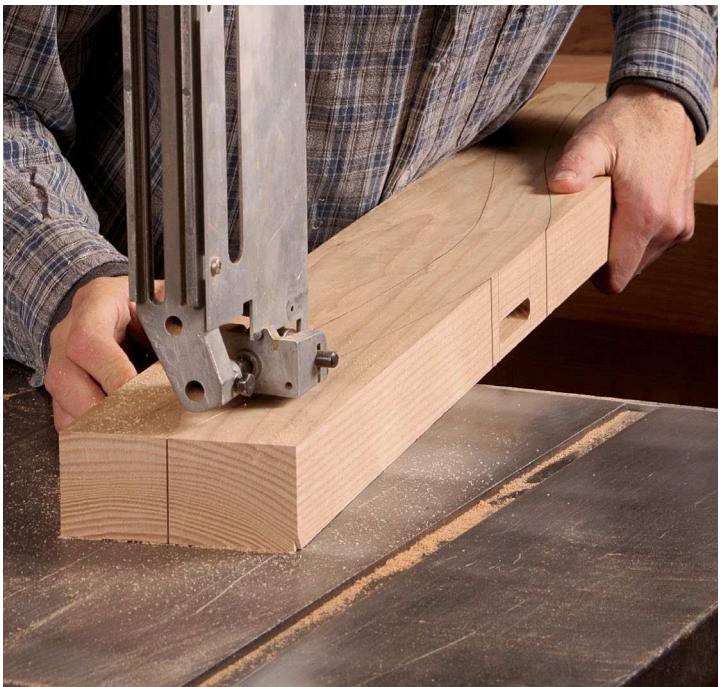


This works best with shallow curves so the flat spot won't stand out. It's good for joining straight rails to curved posts on a chair or bed, or straight aprons to curved legs on a table.



LEAVE A FLAT SECTION IF YOU CAN...

The easiest flat. *Leave a section of the stock's square edge intact when cutting the workpiece to shape. Mark the flat's boundaries on the pattern and let that section hang over the stock's edge when tracing the layout.*



Saw the piece to shape. *But before bringing the work to the bandsaw, go ahead and cut the mortise—a task that's much easier while the stock is still square.*

work where the mortise is to be cut. If you are cutting the curved piece out of square stock, it's easiest to locate and cut the mortise while the workpiece is still square. Then you can leave the area around the joint flat when cutting the curve. The tenon on the mating rail can then be cut and fitted just as for any other mortise-and-tenon joint. When creating the flat, be sure to extend it ⅛ in. or so beyond the rail both above and below the joint to accommodate any expansion across the width of the rail. When the piece is glued up, you can sand lightly to ease the transition from flat to curve, leaving about 1/16 in. flat.

Things get more challenging if you're cutting several identical parts from square stock. If you want to minimize waste, you'll need to "nest" the layout of the parts and cut them all out before doing anything else. This means you'll then have to create the flat—and cut the mortise—in an already curved part. I have a great solution for this. I make a simple jig that holds the work while I create the flat spot and then cut the mortise.

Clamp the curved piece into the jig so that the area to be flattened projects above the jig's fence. Now you can create the flat spot, using a handplane to remove the projecting material and bring the part flush with the top of the fence. To use the jig with a router, screw on a top plate to support the router. Use a spiral upcut bit or a straight bit, set to cut flush with the top of the jig's fence. The first cut should be a clockwise pass around the area to be flattened; this is a climb cut to avoid tearout.

To mortise with the same setup, equip a plunge router with a fence that will ride along the back of the jig. Adjust the fence to locate the mortise on the thickness of the workpiece. Rout between the layout lines in shallow passes (perhaps 1/32 in. of added depth per pass) until you reach the desired depth.

Create a flat that stands proud

Some designs call for seamless curves that flow from one part to the next, regardless of whether the parts themselves are curved.

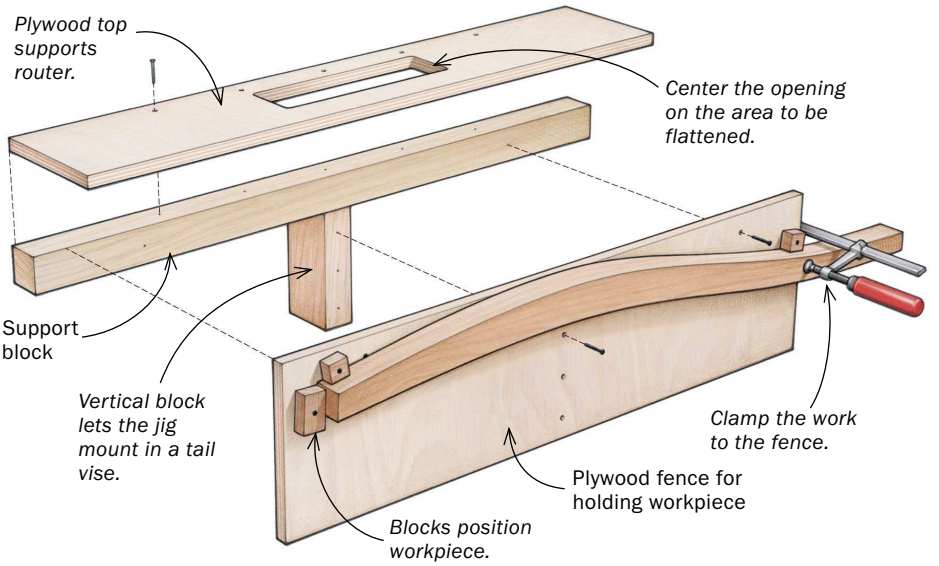
In these cases, don't shape the curve, or much of it anyway, on the end of

...OR ROUT A FLAT ON NESTED PARTS

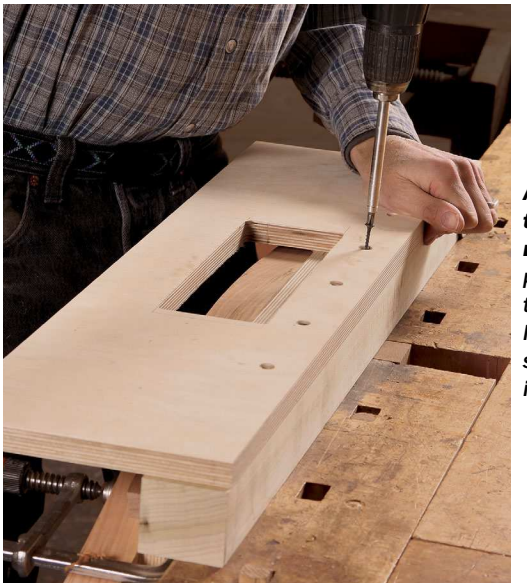
"Nesting" curved parts saves material. *However, it also makes it impossible to leave a precise flat when sawing each part. So Miller uses a simple jig to shape the flat afterward.*

SIMPLE JIG CAN FLATTEN AND MORTISE

The assembly is based on a piece of thick, wide stock screwed to a vertical plywood fence so the mating edges are flush.

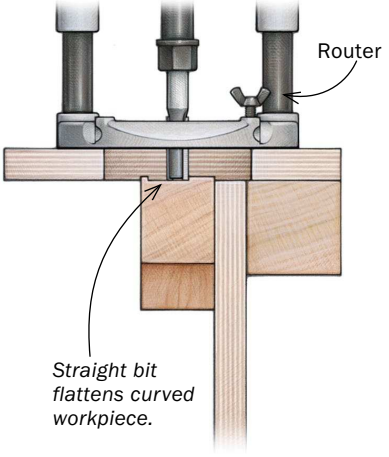


Hold the jig in a bench vise. *The workpiece clamps to the jig's fence. Three hardwood stops locate the workpiece so that the section to be milled protrudes above the fence.*



Add a top plate to support the router. *Use ¾-in. plywood and make the plate opening larger than the desired flat by 1½ in. in each direction.*

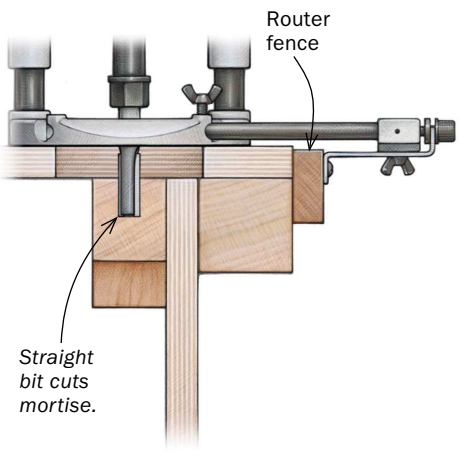
1. ROUT THE FLAT

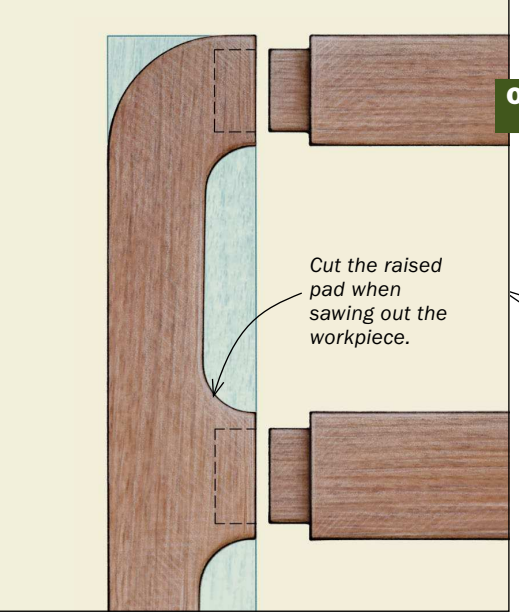


Rout the workpiece flush. *Set the bit depth even with the top of the jig's fence.*

The same jig lets you mortise, too! *Attach the router's fence to guide it and locate the mortise.*

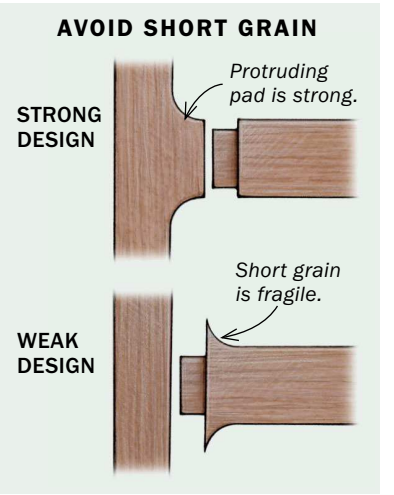
2. ROUT THE MORTISE

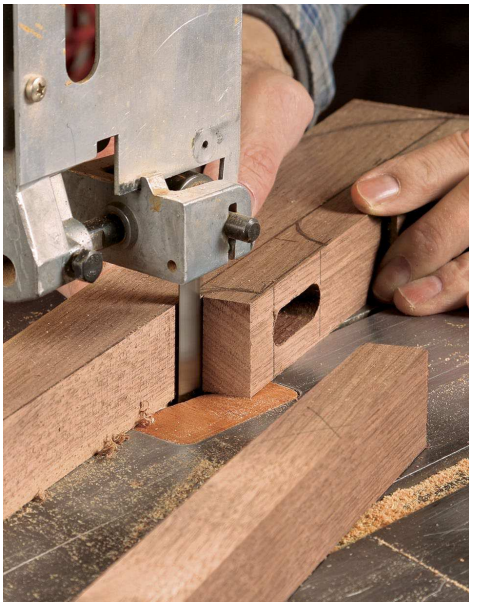




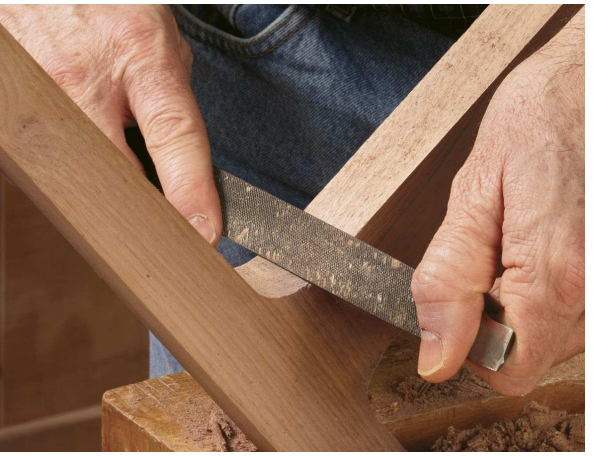
OPTION TWO For flowing curves, add a pad

For curves that flow into each other, there is a right way and a wrong way. This table by Chicago furniture maker Chris Bach shows how it should be done.

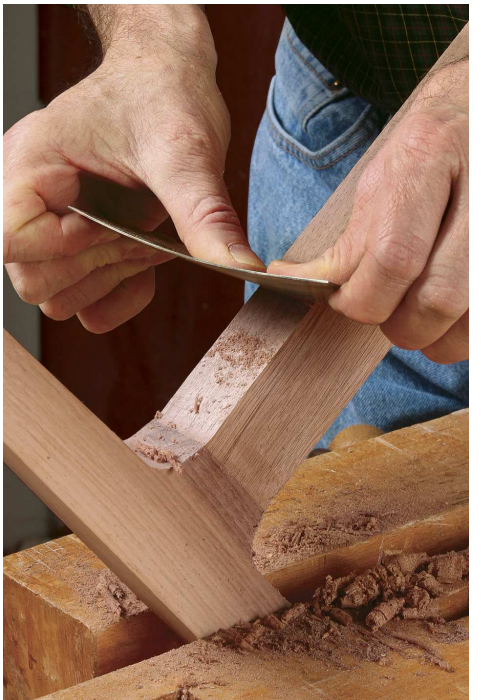




Cut the joint while the stock is square. *Then saw the shape as shown, making sure that the flat surface is ⅛ in. or so wider than the rail.*



Finish by hand. *After the joint is glued, remove the excess material and create a smooth transition using a round or half-round wood rasp (above), followed by a card scraper (right).*



the tenoned piece. The outer tips of the curved ends will consist of very fragile short-grained stock. Instead, leave a raised area on the mortised part, and form the transitional curves there. Just rough them in, and then refine the transitions after gluing the joint together. A well-known example of this technique can be seen on the leg-to-rocker joints of a Sam Maloof rocking chair.

Here's a final point to consider when using this type of joinery: It makes a lot of sense to use quartersawn wood for the rail. This is because, after the joint has been smoothed to seamlessly flow together, seasonal expansion and contraction of the rail across its width could create minor misalignment between the parts. Quartersawn stock, which moves less across its width than flatsawn material, will minimize this problem.

Match the shoulders to the curve

When you're joining a tenoned part like a chair's crest rail or a table apron to a concave section of curve, it won't work to create a flat spot on the curve. The simplest approach is to scribe the tenon shoulders on one piece to exactly match the curve of the adjoining piece. By the way, this is another instance where a quartersawn rail is a good idea. Excessive wood movement can cause gaps to appear in a scribed joint, because expansion or contraction will actually change the curvature of the shoulder.

The task of cutting the mortise and tenon is roughly the same as before. You can use the jig again to cut the mortise, although you may need to use a curved

Photo of table: Kristiina Wilson

offcut as a brace between the jig and the workpiece to help hold the work squarely when clamping.

The real trick in this technique lies in shaping the tenon shoulders to tightly hug the curve of the mating part and create a gap-free joint. This process will be simpler if, when cutting the tenon, you angle the tenon shoulder so that it generally follows the direction of the curve to which you'll be scribing. You can do this with a tablesaw tenoning jig, clamping the workpiece in the jig against a precut wedge. Cut the tenon to normal length to fit in the mortise.

Start the scribing process by inserting the tenon fully into the mortise. Next, use a marking knife to ride along the curved workpiece and scribe a line into the shoulder of the mating part. It's ideal if the scribed line is made with a single-bevel knife so that the straight side of the cut is toward the shoulder—this will leave a very crisp edge to pare toward. Facing the knife that way often will create the offset you need to transfer the full curve to the shoulder, while ultimately shortening the tenoned part as little as possible. But you can use a shim of some kind (an automotive feeler gauge or a small scrap of wood) to increase the scribing offset for deeper curves.

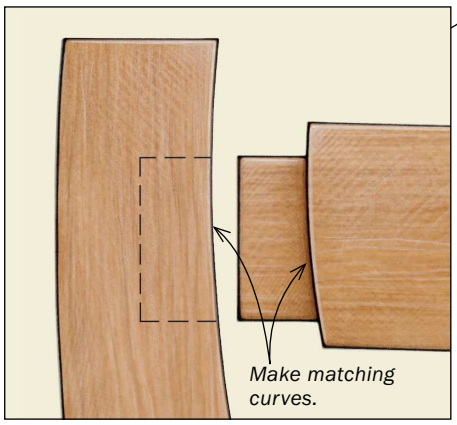
The paring requires a very sharp chisel with a flat back. Nibble a little bit away at a time, until you are just one or two paring cuts away from the scribe line. Now put the chisel's edge right in the scribed line and pare down. The easiest way to keep the cut perfectly on your line is to make each cut after the first one with only the leading quarter of the chisel, registering the rest of the chisel against the existing shoulder. A gentle twist of the chisel, applying a little extra force against the existing shoulder, should keep you from inadvertently crossing the line. It also helps to undercut the shoulder a little. Just be careful not to do that at the corners, where undercutting from one side will leave unsightly gaps on the adjacent face.

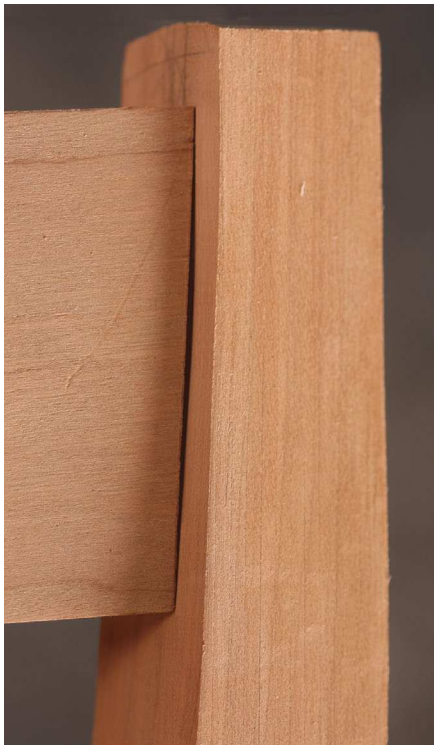
As you trim back the shoulders, you might also need to trim the tenon length back so the final depth is about 1/32 in. less than the depth of the mortise. This leaves room for excess glue. □

Jeff Miller teaches woodworking at his studio in Chicago and around the country.

OPTION THREE Inside curve? Scribe a shoulder

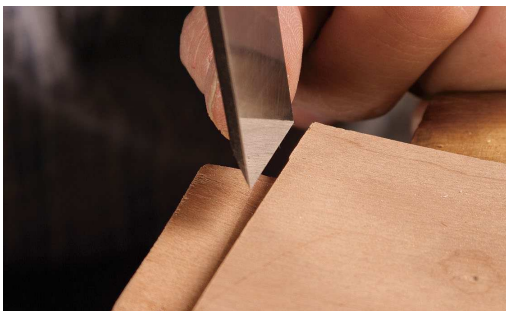
This technique creates tight joints between two pieces when one of them is a concave curve.





A curved shoulder starts on an angle. *When cutting the tenon, angle the shoulders to follow the arc of the curved mating piece. Aim for a close fit to minimize the paring.*

Mark the shoulder. *An automotive feeler gauge hugs the curve when transferring the layout to the shoulder. Use a wood scrap for a wider gap.*



Pare to the scribe line. *Nibble away most of the waste, then seat the chisel in the scribe line and pare straight down. Use overlapping cuts, advancing only a quarter of the blade with each new stroke.*

Bring the joint home. *You may need to shorten the tenon slightly to allow the shoulder to seat completely. With the shoulder pared carefully, the joint should come together with no gaps.*

Layout Basics

Design dovetails for strength and style

BY CHRIS GOCHNOUR

Striking a perfect blend of form and function, dovetail joints add great interest and detail while enhancing the structural integrity of a case, box, or drawer.

Cutting dovetails can become second nature after plenty of practice with saw and chisel. Dovetail layout, on the other hand, is where I see students get frustrated. Here are the key steps in laying out a basic through-dovetail joint, with tips on creating an attractive joint that is sturdy enough to last generations.

How to balance aesthetics and strength

Several factors go into the design of a dovetail joint. These include the size and spacing of the tails and pins, and the slope of the tails (see drawings, below).

Most dovetail joints begin and end with a half-pin on the outside, with the rest of the space subdivided into multiple pins and tails. This creates plenty of long-grain glue surfaces as well as mechanical strength to tie the elements together.

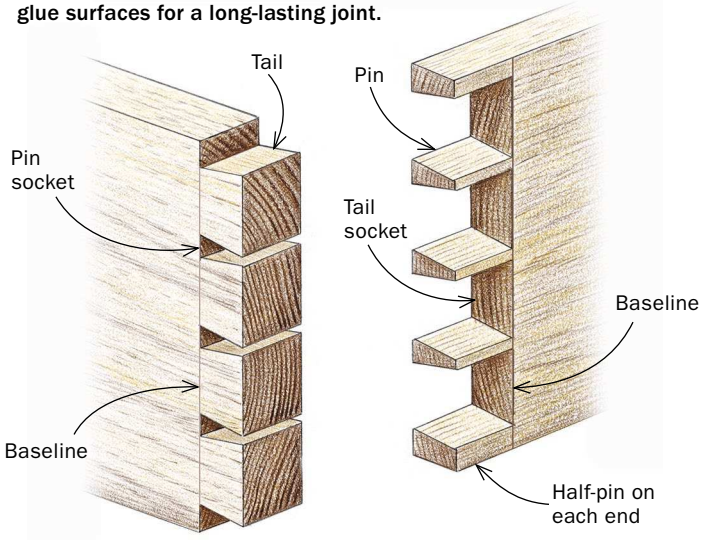
A common practice is to span the joint with pins and tails of equal proportions. Although it's structurally very sound and typical of machine-cut dovetails, this joint has little design appeal. A better method is to span the joint with tails that are larger than the pins (see right drawing, below). This is a common practice with hand-cut dovetails and also can be done on the bandsaw or tablesaw, as well as with the better machine-dovetail systems.

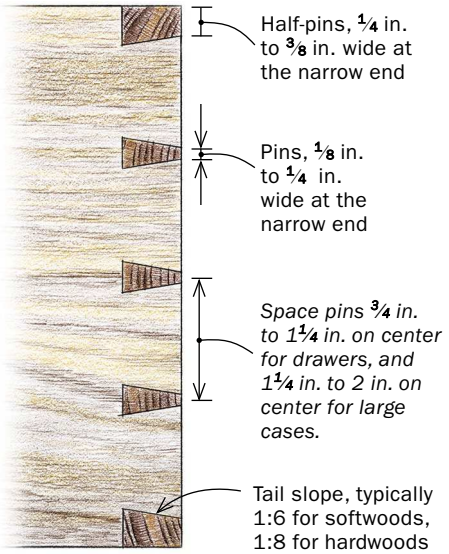
I recommend sizing the half-pins on the outer edges from ¼ in. to ⅜ in. at their narrow end. Interior pins range from ⅛ in. to ¼ in. wide and can be spaced anywhere from ¾ in. to 2 in. on center, depending on the application.

Last, it's important to choose an appropriate slope, or angle, for the tails. That slope is what draws the pin board up tight

Anatomy of a strong joint

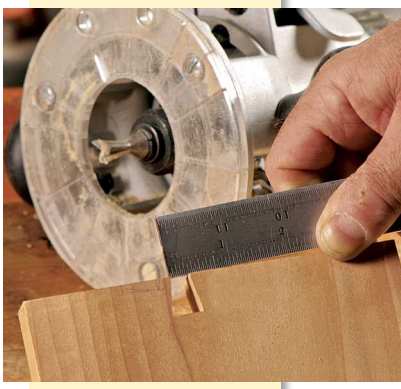
Dovetails provide not only mechanical strength as the pins and tails interlock, but also plenty of long-grain-to-long-grain glue surfaces for a long-lasting joint.





PIN AND TAIL DIMENSIONS

TIP



Sizing pins for router-cut dovetails. *If you plan to cut dovetails with a router, the minimum pin width will be dictated by the diameter at the base of the bit.*

Set the tail spacing

Gochnour lays out and cuts the tails first. His method uses the narrowest dimension of the pins, and simple math, to divide the tail board evenly.

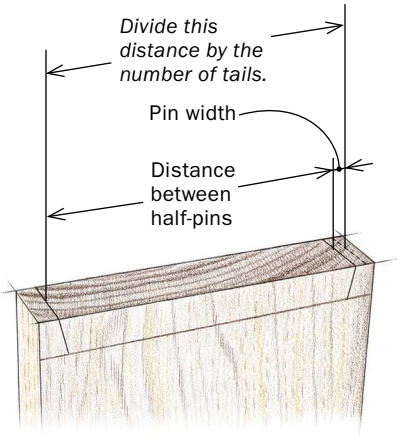
1 ***Mark the pin width.*** *Stack both tail boards in the vise. After laying out half-pins, mark the pin width on one end.*

during assembly. More slope pulls the joint together efficiently; too little slope may require clamps or other aids to pull the joint together, much like a box or finger joint requires clamping pressure in two directions. Partly a matter of preference, the traditional ratio is 1:6 for softwoods and 1:8 for hardwoods; the reason being that the fibers of softwoods can compress more easily and therefore require a bit more angle to ensure that the pins are drawn tight to the tail board.

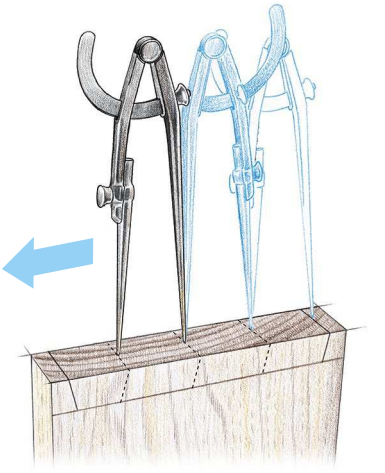
Keep the layout process simple

When laying out dovetails, use as few steps as possible. Begin by marking out the orientation of the pin and tail boards: inside and outside faces, top and bottom, front and back. Remember that tail boards generally make up the sides of drawers and cases, and the fronts and backs of chests; pin boards are usually the fronts and backs of drawers, tops and bottoms of cases, and ends of chests.

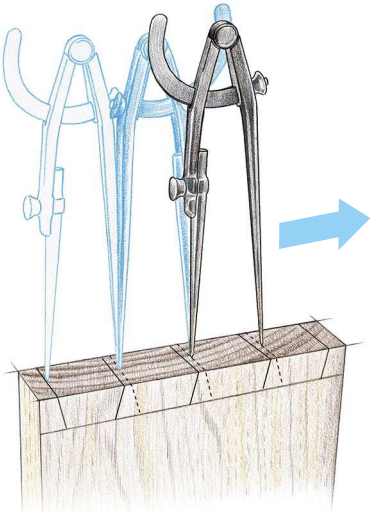
Scribe baselines—With the orientation of the tail board and the pin board established, scribe the baselines on both boards using a marking gauge. Set the gauge to the exact thickness of the pin board and scribe the tail board on both faces and edges. Setting the gauge to the pin board's exact thickness means there are no proud pins to interfere with clamping and leaves little to trim flush after glue-up.



2 ***Measure from the half-pin mark on one end to the pin-width mark on the other.*** *Divide that distance by the number of tails; adjust the dividers to this dimension.*



3 ***Mark the left edges of the tails.*** *Place one point of the dividers on the right half-pin line and walk the dividers across the end grain.*

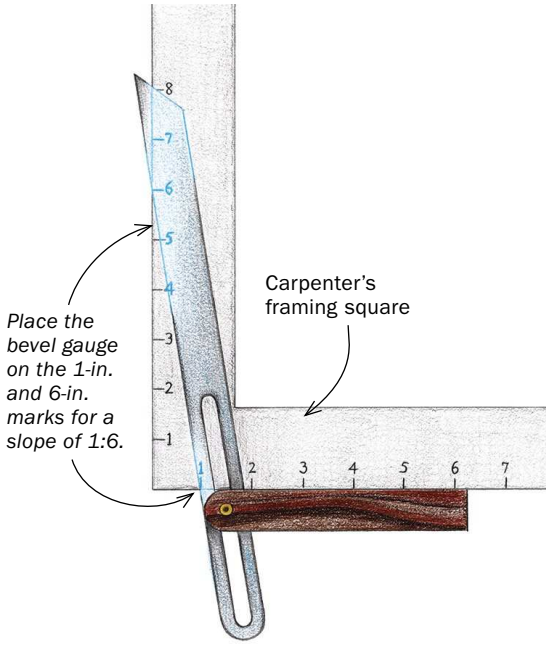


4 ***Mark the right edges of the tails.*** *Repeat the process beginning from the left half-pin line.*

Photos, except where noted: Thomas McKenna; photo (top left) and drawings: John Tetreault

Mark the tail board

Mark the widths of the tails on the end. *Set the pencil point into the depressions from the points of the dividers, slide a square up to the pencil point, and draw lines across.*



Set a bevel gauge to the desired slope. *Lay a bevel gauge across a carpenter's framing square to set the slope.*

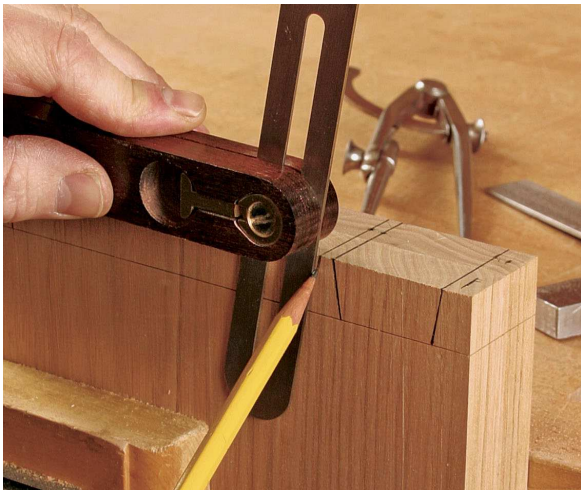
After scribing the tail board, scribe the inside and outside faces of the pin board in the same way.

Determine tail spacing—Though some woodworkers will argue that it's best to lay out and cut the pins first, I prefer to work the tails first for a few reasons. First, I can lay out and cut more than one tail board at a time. Second, I find it easier to align, hold, and transfer the tails to the pin board because the pin board can be held securely in a vise and the tail board can lay horizontally, easily registering on the pin-board ends. Last, any adjustments or fine-tuning during assembly will be done to the pins, and it is much easier to trim and fit the open, right-angled pins than the tight, angular confines of the tails.

Clamp both tail boards in a shoulder vise so that they are 2 in. to 3 in. above the benchtop and square to it. Measure and mark the half-pins across the ends of the boards and perpendicular to the faces. Now divide the tails based on the number that you want and the pin sizes between them (see drawings and photos, p. 98).

For example, say you want four tails with 3/16-in.-wide pins and two 3/8-in. half-pins. Lay out the half-pins 3/8 in. from both edges, then make a mark on the end of the tail board 3/16 in. past the half-pin mark on the right side (this distance is based on the width of the full pins). Then measure from that mark to the half-pin mark on the left side. Say that distance equals 6 1/2 in. Because you want four tails, divide the 6 1/2 in. by 4, which equals 1 5/8 in. Now adjust a set of dividers with the points 1 5/8 in. apart.

Lay one point of the divider on the right half-pin and walk it across the board end until you pass the half-pin on the left. If your math has been done correctly, the divider



Mark the tails on the face. *Use the bevel gauge to help draw in the tails on the face of the board.*

TIP

Saddle markers speed the process. *A dovetail saddle marker allows you to draw the lines on the end and face of a board in one step and with one tool. These jigs come with preset slopes, or you can make one based on your preference.*

Mark the pin board

Use the tail board to mark out the pins. *Line up the baseline of the tail board with the inside edge of the pin board. Now use a marking knife to transfer the tail locations clearly to the pin board.*

should be 3/16 in. past this mark. Now put one of the divider points on the left half-pin mark and walk back across the board end to the right.

Mark out the tails—The divider technique will leave a series of impressions spaced appropriately, in this case 3/16 in. apart. Place a sharp pencil in each impression, slide a square up to the pencil, and square a line across the ends of the boards.

Next, set a bevel gauge to the appropriate slope (see drawing and photo, opposite) and mark the face of the tail board. A dovetail saddle marker can be handy here because it allows you to draw the two lines across the top and down the face quickly and without misalignment. Dovetail saddle markers generally come with one of two slope ratios, 1:6 or 1:8, and are available from a number of sources, such as leevalley.com.

Now you're ready to cut the tails and remove the waste. The end-grain cuts must be absolutely perpendicular to each face of the board. Otherwise, during the next step the information transferred from inside the boards will not match the outside, causing problems.

Transfer layout to the pin board—With the tails laid out, cut, and pared, secure the pin board in the shoulder vise, with its outside facing you and its end 2½ in. to 3 in. above the benchtop.

Place the tail board with the outside face up on the end of the pin board. Use a spacer to keep the tail board level (see photo, above). Line up the baseline of the tail board with the inside edge of the pin board. If the tail's baseline overlaps the pin board's inner edge, the tails will be too tight. If the baseline is proud of the pin board's inner face, the pins will be too small, resulting in a loose joint.

Holding the tail board securely—use clamps if needed—knife in the tails clearly on the pin board. Extend the marks down the pin board's face to the baseline. Now you are ready to cut the pins and complete the joint. □

Chris Gochnour is a professional furniture maker in Salt Lake City.

HAVE FUN WITH DOVETAIL LAYOUT

Mastering the basics of dovetailing opens the doors to many design options, allowing you to increase the strength of the joint as needed or add visual pop. Each of these designs works with the layout process described in this article.

ADD PINS AND TAILS

This joint has enough pins to ensure that the joint is sound, but not so many that the joint is laborious to execute. The 1:6 slope of the tails ensures that the pin board is drawn up tight during assembly.

INCREASE THE SLOPE OF THE TAILS

This joint has a unique visual appeal and a great ability to draw the pins up tight. It also leaves a lot of short grain on the tails, creating a potential weak spot.

ADD PINS AT THE ENDS

The outer edges of a joint are the most susceptible to failure. Fortifying the edge with an extra pin is a great way to strengthen this potentially weak corner. It looks good, too.

ALTERNATE TAIL WIDTHS

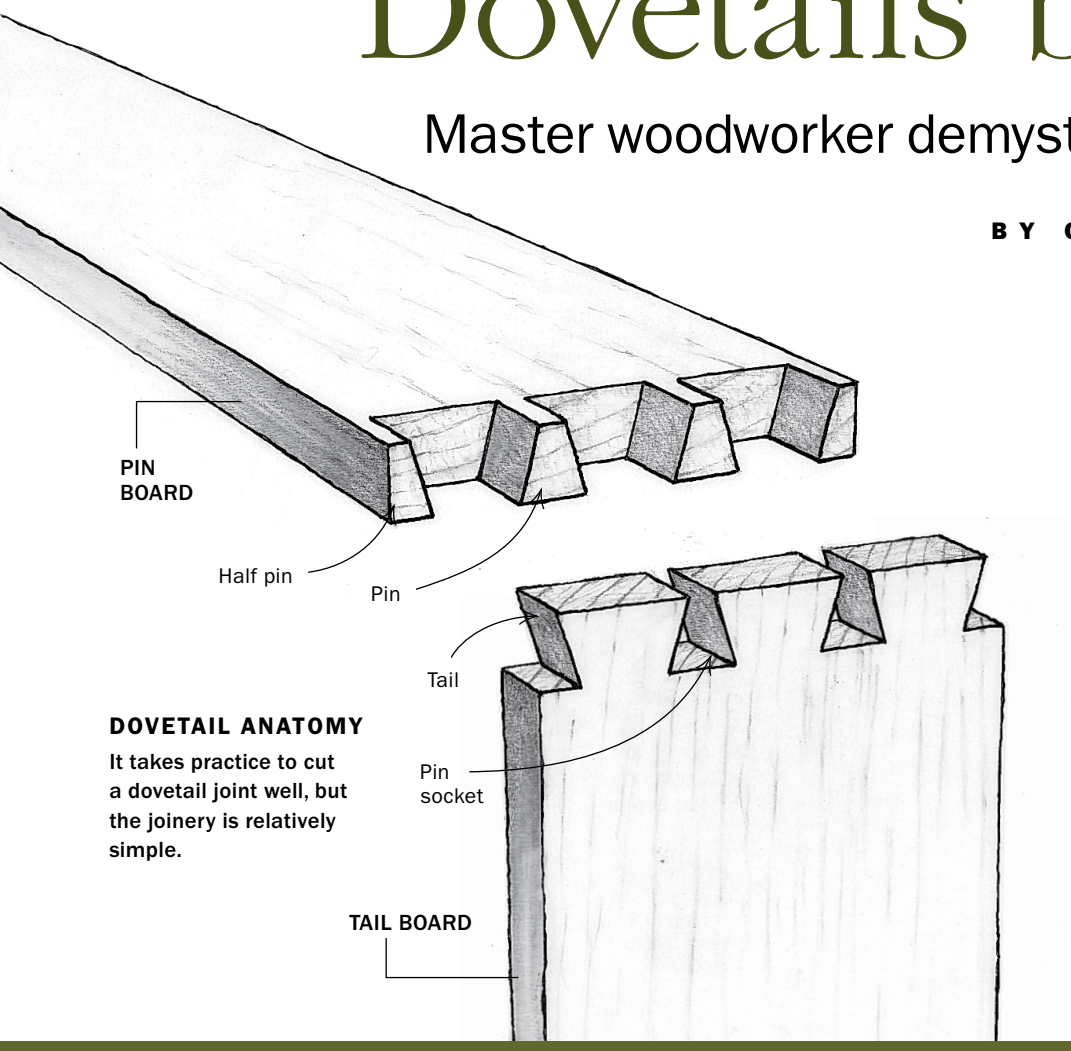
The sky is the limit in what can be done to capitalize on both the form and the functional aspects that the dovetail joint affords the craftsman.

Photos (this page, right): John Tetreault

Dovetails by Hand

Master woodworker demystifies this classic joint

BY CHRISTIAN BECKSVOORT



DOVETAIL ANATOMY

It takes practice to cut a dovetail joint well, but the joinery is relatively simple.

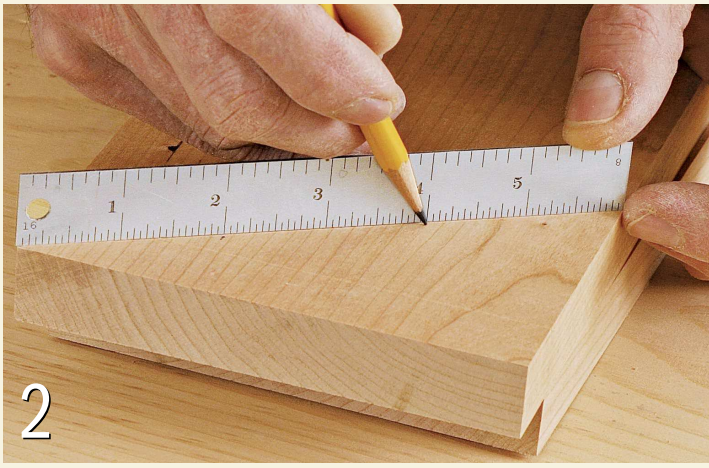
Woodworkers have dozens of ways to join boards together, but few of them offer the eye-appeal and strength of a through-dovetail joint. Perhaps more than any other joint, the through-dovetail is the one most associated with fine woodworking.

A lot of woodworkers shy away from through-dovetails, thinking they are too time consuming and difficult to make. Certainly, there's no getting around the fact that it's faster to make a butt, rabbet, or splined joint. And a through-dovetail exposes lots of cut lines that must be straight and tight-fitting, so the fear factor is easy to understand.

But the dovetail need not be an impossible dream. Using the technique shown here, you'll be making dovetails as

Lay out and mark the tails

Use a marking gauge to scribe a baseline on both sides of the boards. *If you are joining boards of the same thickness, you need only one setting—the thickness of either board. When the pin board and tail board are different thicknesses, the thickness of one determines the baseline for the other.*



Lay out centerlines for the pin sockets on the tail board. *For a board with two pins, Becksvoort divides the board into thirds, as shown. There's also a half-pin at each end.*

Drawings: Christopher Clapp; photos: Tom Begnal

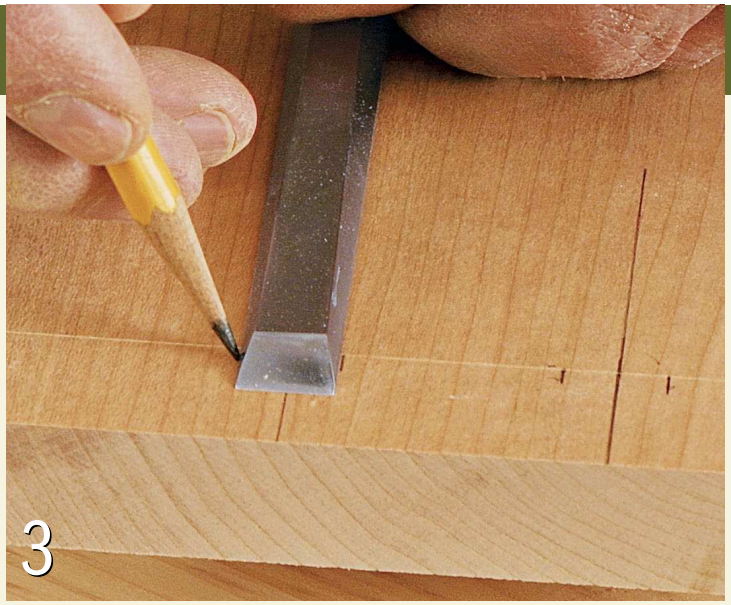
Don't fear the dovetail. *Sure, you can cut dovetails with a machine. But hand-cut dovetails are an opportunity for makers to put their signature on a piece, adding a personal touch.*

routinely as any other woodworking joint.

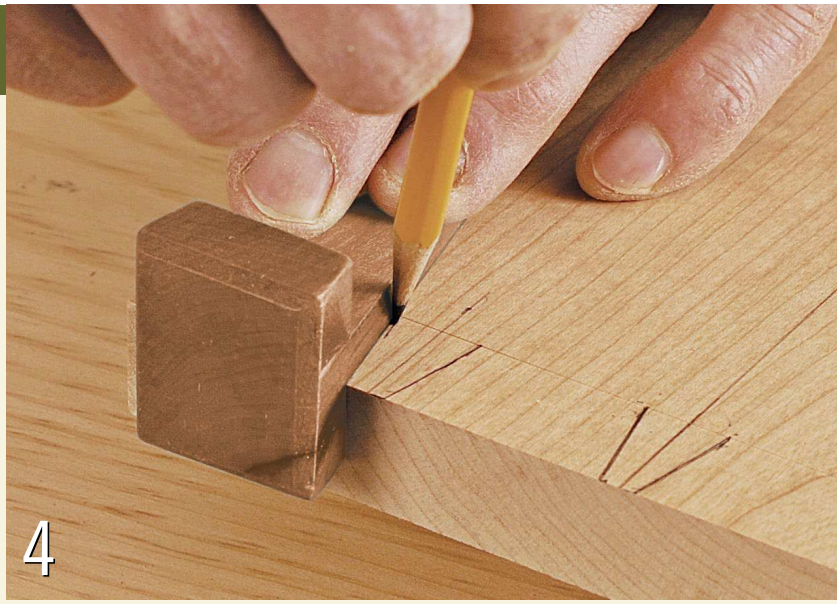
It takes only two types of tool to cut dovetails, a dovetail saw and a few chisels. The sawblade should be thin and stiff. For most dovetails, I use one with 14 teeth per inch (tpi).

Before committing project stock to any dovetail cuts, it's a good idea to practice the process on scrapwood. It will help you get a better feel for the tools and the way they cut. And you'll begin to recognize the special satisfaction that results when tails and pins slip snugly together to create a perfect joint.

Christian Becksvoort builds furniture in New Gloucester, Maine (chbecksvoort.com). Vincent Laurence and Tom Begnal also contributed to this article.



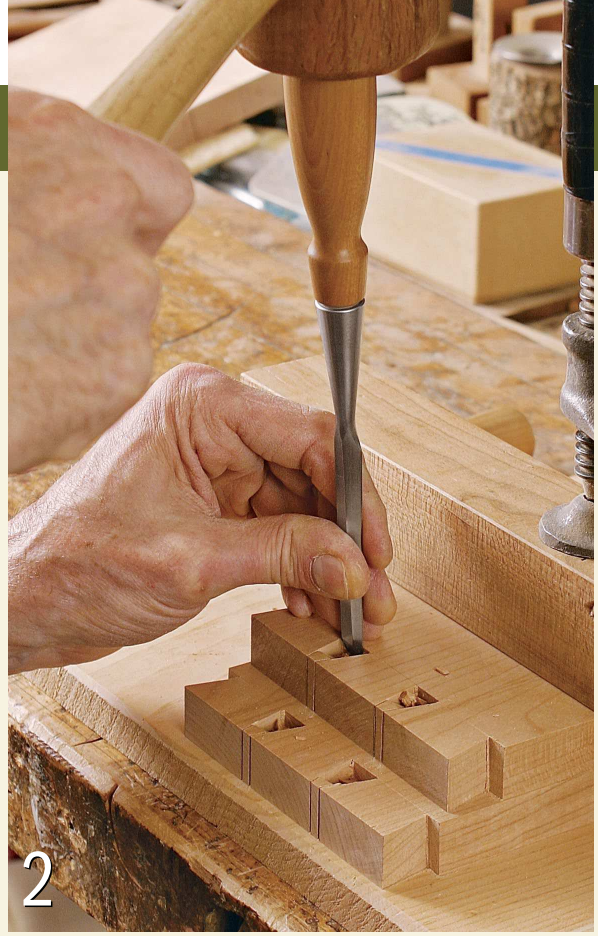
Use a chisel to determine the width of the pin sockets. *This makes chopping the sockets much more efficient. Place the chisel over the centerline, and use a pencil to mark each side. Then mark out the half-pin sockets on the ends.*



Mark the angles of the pin sockets with a dovetail gauge or a bevel square. *Then transfer these lines across the end grain. After that, tape the two tail boards together, so you can cut pin sockets on both at the same time.*

Cut and chop the tails

Cut the tails. *Use a handsaw with a fine blade to make cuts to the baseline. Remember to cut on the waste side of the line. Also, cut the two half-pin sockets during this step. Clamping two boards together allows Becksvoort to cut two sets of tails at once.*

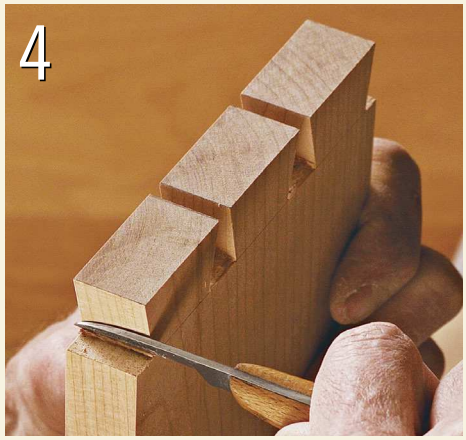


Chop out the waste with a chisel. *Start by creating a small groove on the waste side of the baseline. Then chop alternately downward at a slight angle (2) and in at a sharp angle (3).*

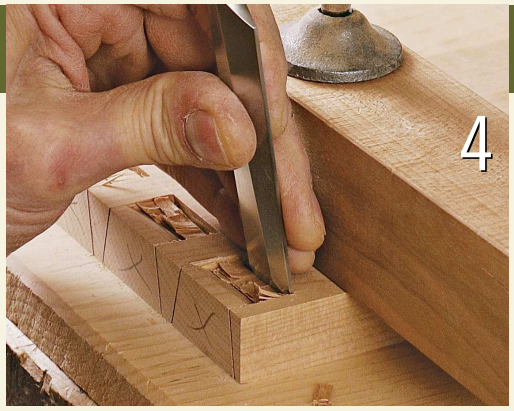
Mark and cut the pins

Use the tail board to lay out the pins. *Clamp the pin board into a vise, and set the tail board perpendicular to it. Make sure the edges of both boards are flush, and be sure the inside edges of all the sockets align perfectly with the inside corner of the upright board. Apply pressure to the top board, and mark the dovetails with a sharp knife (1). Extend the pin marks down the side of the pin board using a pencil and a small square (2). Cut down to the baseline on the waste side of the line (3).*

Cut halfway through, then flip the boards. *Don't chop in from the end of the board yet. Keeping the corner intact prevents tearout when the waste is removed from the center of the socket. Once you've chopped about halfway through the joint, flip the boards over and repeat. This time, though, chop from the end.*



Clean the corners. *Use a knife to clean the corners in each of the sockets.*



Chop out the waste between pins. *Clamp the boards so that their inside faces are up (4). This prevents the chips from becoming wedged between the pins when you finish chopping out the waste from the other side. When you're about halfway through, turn the boards over and re-clamp. As with the tail boards, once you've flipped the boards over, you can chop in from the end. Pare to the line with a knife (5).*

Test-fit the joint. *If you've cut and pared right up to the lines, the parts should fit like they were made for each other, a snug friction fit that comes together with a light tapping of your fist.*

DOVETAILS

Dovetails on the Tablesaw

Make perfect through-dovetails every time

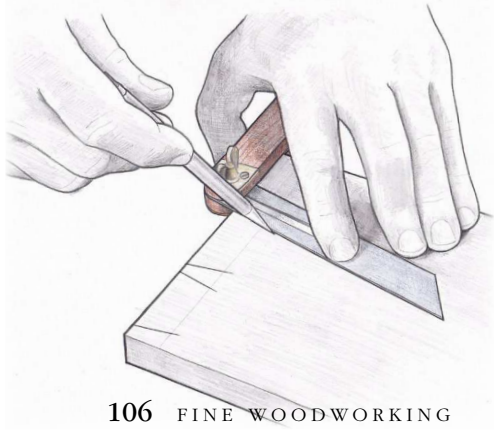
BY GREGORY PAOLINI

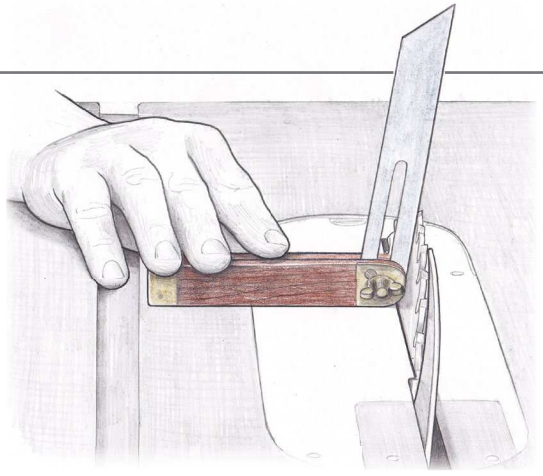
It takes an awful lot of practice to cut dovetails by hand and to do it well. Your sawcuts should be straight, at a consistent angle, and square to the board's face. And you can't cut into the baseline. Later, when you're paring and attempting to make up for bad sawcuts, you can make things much worse.

There are ways to cut dovetails that bypass those challenges. With a router and jig, you'll get straight and square tails and pins that have consistent angles. Unfortunately, they won't look as nice as hand-cut dovetails. It's difficult

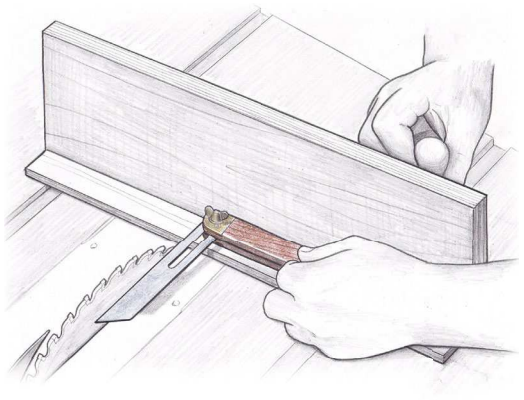
BEVEL GAUGE GUIDES THE WAY

To take advantage of the tablesaw's accuracy, you need to set it up precisely. Using a bevel gauge is the secret.





Mark the tails, setting the gauge at your favorite dovetail angle (left). Paolini likes 10°. Then use the same bevel-gauge setting to angle the blade (above) to cut the tails.

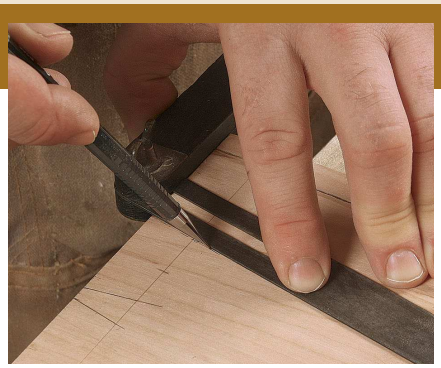


With the blade at 90°, angle the miter gauge for the pins. Don't change the setting on the bevel gauge, and the pins are sure to match the tails.

Photos: Matt Kenney; drawings: John Tetreault

Angle the blade to cut the tails

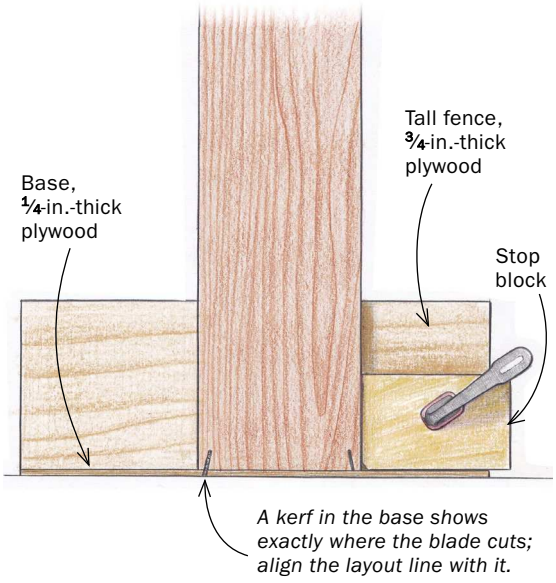
The tablesaw locks in the cutting angle and a stop block allows you to make eight cuts from a single layout line. So all you need to do is lay out the tails at one end of one board.



Scribe the baselines, then lay out the tails. *Scribe all the boards (left), wrapping the marks around the edges on the tail boards. You can space the dovetails any way you want (right), but they should be symmetrical around the centerline.*

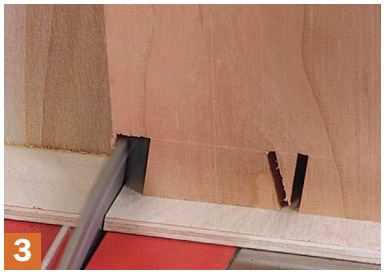
Angle the blade. *Make sure the bevel gauge's setting hasn't changed and that it's flat against the blade's plate, coming up in a gullet between teeth.*

GET ACCURATE WITH AN AUXILIARY FENCE AND STOP BLOCK

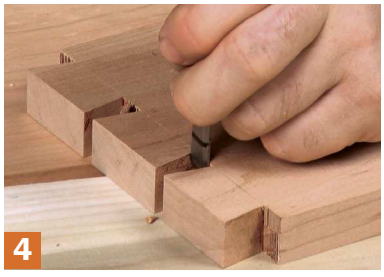


Four cuts from a single setup. *Flip the board to make two mirror-image cuts, then rotate it end for end to make the same two cuts on the opposite end. When you've done the same with the second tail board, you've made eight cuts without moving the stop block.*

The mirror effect. *As you work across the board, moving the board (and stop block) to a new layout line and making all four cuts each time, you naturally begin to cut the second side of every tail.*



Nibble the ends. *A few eyeballed cuts knock off most of the waste at the ends.*



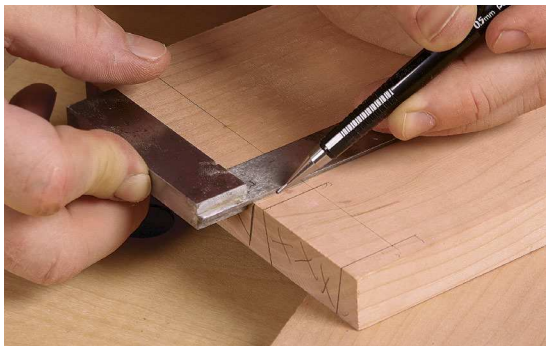
Clean out the waste. *After defining all of the tails at the tablesaw, cleanup goes quickly. Work to your scribe lines.*

Angle the miter gauge for the pins

Move the blade back to 90°. One side of every pin is cut with the miter gauge angled in one direction. Angle it in the other direction to cut the second side.

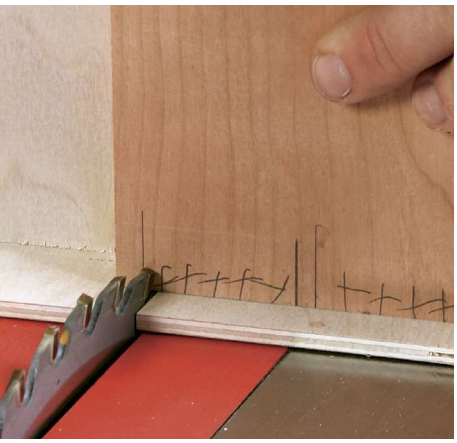
CUT THE FIRST SIDE OF THE PINS

Transfer the tails to the end grain. *Do this on all your boards. Paolini uses a 0.5mm mechanical pencil because of its very fine line.*



Wrap the line onto the face grain. *You can't see the end grain when the board is standing on the auxiliary fence, so you'll need these lines to align the board for cutting.*

Adjust the miter gauge. *Use the bevel gauge, still set to the angle used for the tails. Paolini attaches a new auxiliary fence so that the kerf for this cut doesn't overlap the one used for the tails.*



Don't cut into the pencil line. *If you do, the pin will be too narrow and you'll have gaps in the joint. Take advantage of the zero-clearance kerf, aligning the board so that the pencil line is right next to the kerf, but not in it.*

to reproduce the wide tails and narrow pins that make the hand-cut version so appealing.

However, there is one power tool in your shop that excels at cutting straight and square, and can easily maintain the same angled cut for both tails and pins: the tablesaw. What's more, because tablesaw blades are no more than ⅛ in. thick, you can reproduce hand-cut dovetail spacing, too.

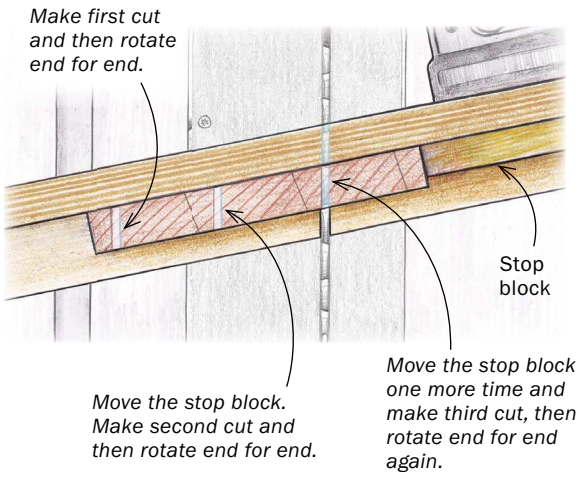
Of course, because both the tails and the pins are cut at the tablesaw, you're limited to through-dovetails. That's great for case joints and the back joints on a drawer, but what about the half-blind dovetails we all use to join the drawer front to the sides? No problem. For a machine method to cut half-blinds, see "Half-Blind Dovetails in Half the Time," p. 110.

Use a rip blade and auxiliary fence

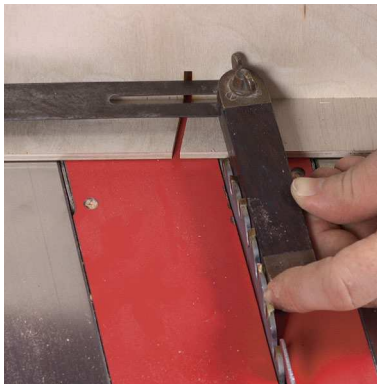
To cut dovetails this way, you need only your stock miter gauge and a blade. I use a rip blade because these are ripcuts and because it has a flat-top grind, which leaves a flat shoulder when I cut the pins, with no paring needed. However, any standard blade will leave a bit of material between tails, so you'll still have some paring to do. If you're going to cut dovetails

MAKE ALL THE CUTS YOU CAN

You can't flip the board this time to make a mirror-image cut on the same end, but you can invert it. Keep the same face out.



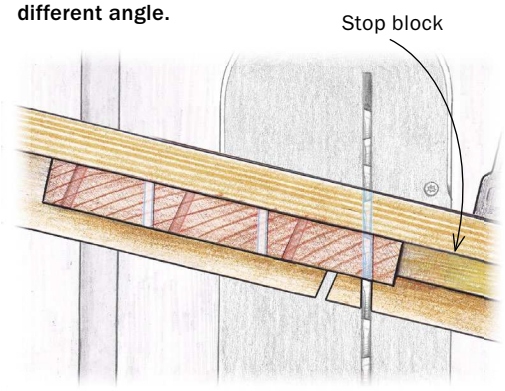
CUT THE SECOND SIDE OF THE PINS

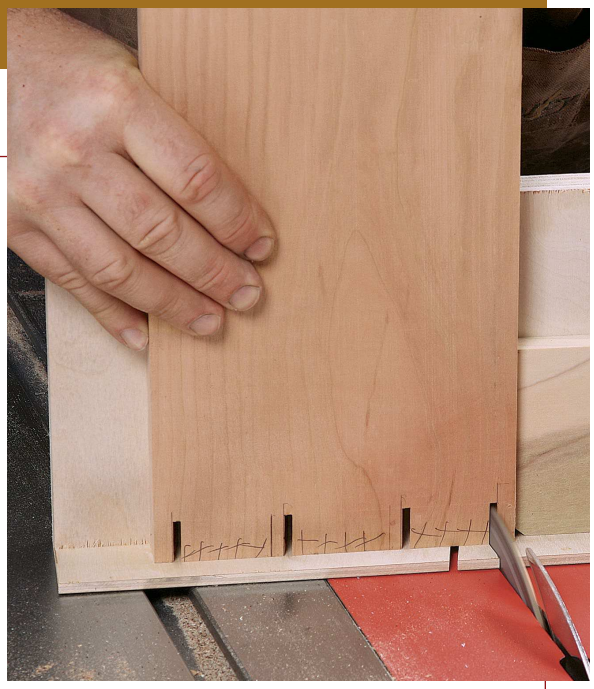


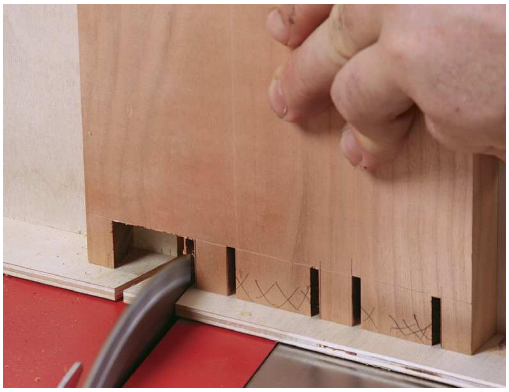
Reset the miter gauge. *There's no way around it to cut the second side of the pins. Be sure the bevel gauge is still locked into its original setting.*

OPPOSITE ANGLE FOR SIDE TWO

This is just like cutting the first side of the pins, except the board goes through the blade at a different angle.







Nibble the waste by eye. *Most of the waste can be cut out with the fence at the second setting, but you'll need to move it back to the first setting to get all of the waste.*

this way all the time, get a blade with the teeth ground to match the dovetails' slope. Any saw-sharpening service can do it. Use it for the tails and you won't have any paring to do in the corners, either.

You also need two L-shaped fences for the miter gauge—one for the tails and one for the pins. They should be at least twice as long as the drawer sides are wide, so the sides always have support as you move them to cut the pins and tails. After the fence is attached to the gauge and a kerf is cut into it, it's easy to align layout lines with the kerf so the blade cuts exactly where you want it to. □

Gregory Paolini is a professional furniture maker and teacher near Asheville, N.C.

Article Extra

Watch a video demonstration of Paolini's technique.

Payoff is perfect joints. *After cleaning up the baseline of the pin board with a file, the joint should come together square, without gaps, and without much persuasion.*

Half-Blind Dovetails in Half the Time

Get the hand-cut look with the speed and consistency of machines

BY STEPHEN HAMMER

Zip, zip. *A simple jig delivers accurate and uniform tails every time. You also get narrow pins and variable spacing.*

No wasted time. *The router is much faster than a chisel and mallet, and it guarantees uniform depth.*

Clean up and enjoy. *After a few minutes of paring, the joint goes together without any trials or tribulations.*

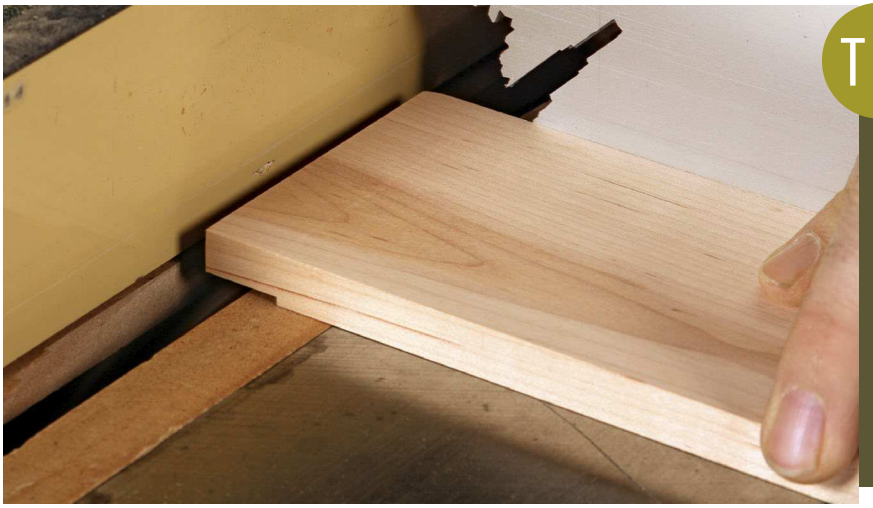
No joint says "handmade" more than half-blind dovetails with delicate pins, so I use them on drawers as one way to distinguish my furniture from the furniture churned out by factories. However, because traditional techniques for making dovetails rely heavily on hand tools, they can eat up a lot of shop time. Time is something a professional furniture maker can't waste, so I developed a method for cutting the joint with a bandsaw and a router. It gives me the best of both worlds. I get the refined look of a hand-cut joint, but I achieve it with the speed and consistency only power tools can offer.

I start by cutting the tails at the bandsaw, using an incredibly simple jig—it's really just a tapered board with a stop—to hold the drawer side. It slides against the fence and lets me cut every tail quickly and with a consistent slope. Then I cut the pins with a handheld router and a straight bit, working freehand right up to the scribe lines. Only the corners of the pin sockets are left to clean up with a chisel, and fitting the joint takes only a bit of paring. Even if you're not as worried about time as I am, you'll enjoy perfect joints with very little fuss.

DOVETAIL LAYOUT IS SIMPLE

Because you'll be using the bandsaw jig on the following page to cut the tails, you need to lay out the tails just once.

Mark the length of the tails. *Use a marking gauge with a knife-type cutter to scribe all four sides. Do this on all the drawer sides. By the way, Hammer turned his pin gauge into a knife gauge by filing a bevel on the pins.*



TIP

RABBET THE SIDES FOR EASY ALIGNMENT

Use a dado blade to cut a shallow rabbet on the inside face of the drawer sides, right up to the scribe line. This will make it easy to align the parts when marking the drawer front later.

Cut tails with a bandsaw, not a backsaw

First, use a marking gauge to scribe shoulders on all four sides. I use a "cutting gauge" with a sharp knife because a cut shoulder line is one of the telltale signs of hand-cut dovetails. It also is more precise than a pencil line and serves as a guide for your chisel when you're paring down to the line.

Then cut a shallow rabbet, about 1/16 in. deep, across the inside faces of the sides, under the tails. I use a dado set in my tablesaw, setting the fence so that it cuts right up to, but not past, the shoulder line. There are three reasons for the rabbet. First, a clean shoulder on the inside contributes to the overall attractiveness of the joint. Second, the rabbet's shoulder helps to align the side to the front when you transfer the tails. Finally, the shoulder also can be used as chisel guide when you're paring away the last bit of waste between the tails.

Next, lay out the spacing for the tails—you only need to do this on one of the sides. The

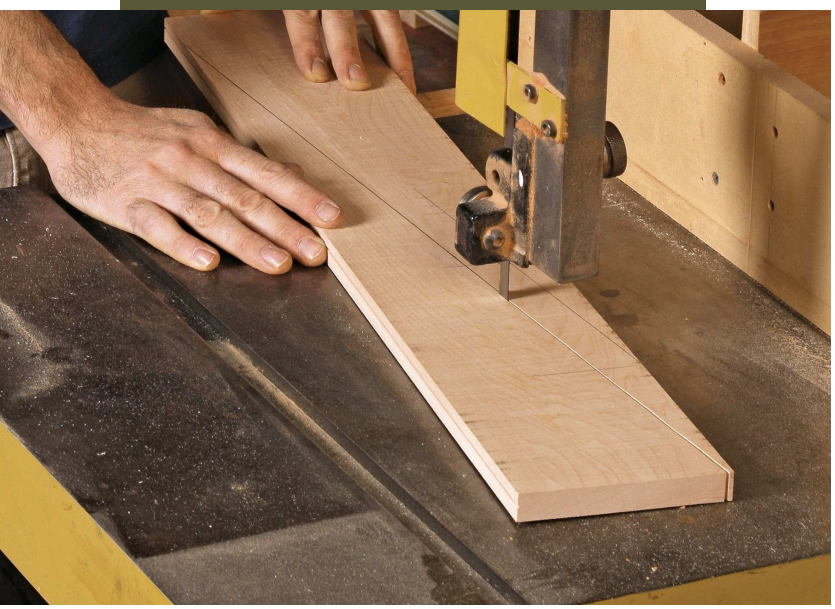
Now lay out the tails. *Do it on one drawer side only. You'll use that piece to line up the cuts for all of the others.*

Photos: Matt Kenney; drawings: John Tetreault

BANDSAW THE TAILS IN MINUTES

You could cut the tails freehand at the bandsaw, but you'd have to lay out every workpiece and then risk straying from the line. Hammer uses a tapered jig that rides against the rip fence to ensure perfect cuts on stacks of drawer sides.

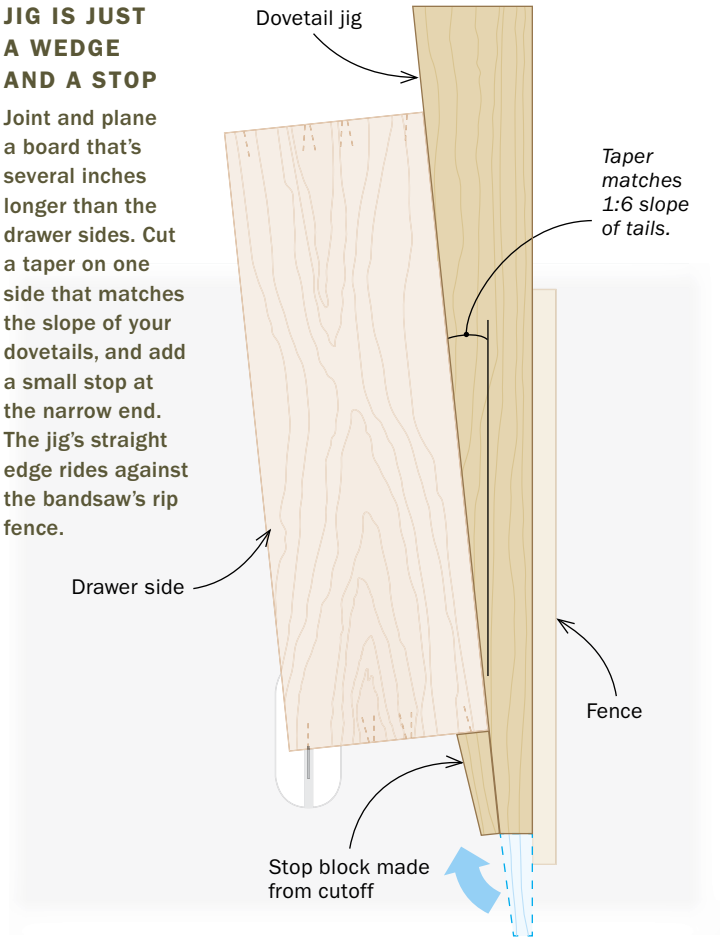
MAKE THE BANDSAW JIG



Taper the jig to match the tails. *It should be several inches longer than the drawer sides.*

JIG IS JUST A WEDGE AND A STOP

Joint and plane a board that's several inches longer than the drawer sides. Cut a taper on one side that matches the slope of your dovetails, and add a small stop at the narrow end. The jig's straight edge rides against the bandsaw's rip fence.

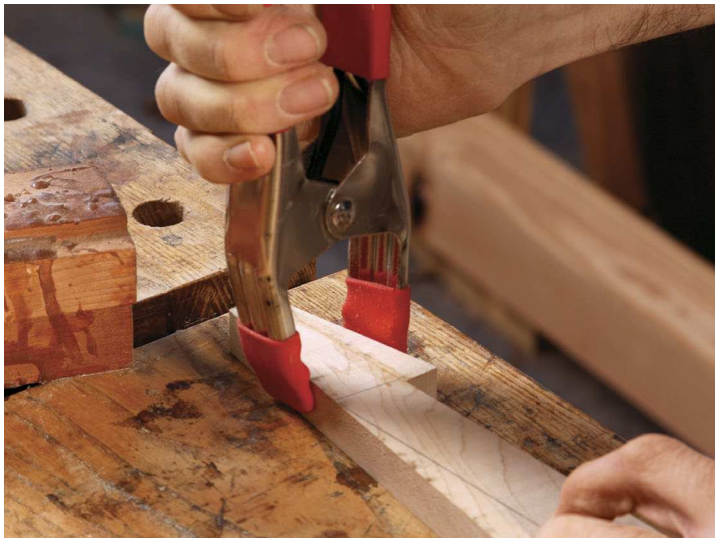


tail cuts are made using a jig that's guided by a fence. Use the marked board to set the fence, and all the other unmarked boards can be cut using the same settings.

The jig that holds and guides the drawer sides is nothing more than a piece of wood that is straight on one side and tapered on the other side to match the slope of the tails. Make sure it is sturdy enough to be used over and over again. I use a 1:6 slope for my tails, which gives them a traditional look. Lay out the taper on a board at least 2 in. or 3 in. longer than the drawer sides and then cut it at the bandsaw. Clean it up on the jointer or with a handplane, then glue on a stop at the narrow end of the board.

Before using the jig, adjust the bandsaw's fence to compensate for the blade's drift. Place the jig against the fence

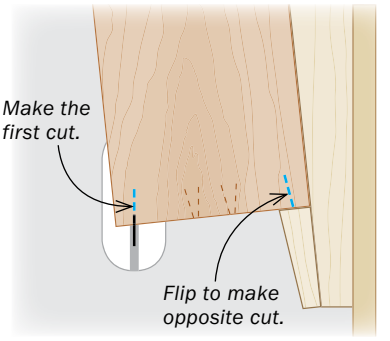
Joint the taper for a clean edge. *It's fast and accurate. You also could use a handplane.*



Glue on a stop. *Put it at the narrow end, which leads into the blade, so that the jig can handle drawer sides of any length.*

PUT THE JIG TO WORK

You need to reposition the bandsaw fence only three times to make all six cuts—on both ends of the drawer side, if desired.

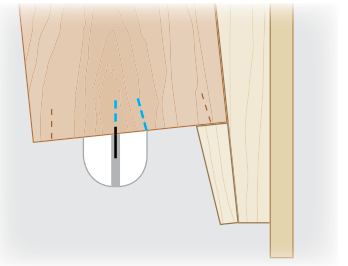


First position. *Set the fence and cut down to the shoulder (left). Flip the board for a second cut (right). And make the same cuts on your other drawer sides before moving the rip fence for the next cut.*

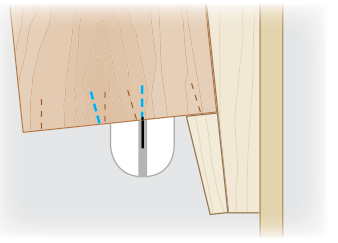
and put the marked drawer side in place, making sure that it is against the stop. Set the fence so that the bandsaw blade lines up with the first tail cut from the edge of the drawer side. You'll make two cuts with the fence in this position, one on each side of the drawer side. Make the first cut, pushing the jig and side together. Then flip over the drawer side and make the first cut in from its other edge. Now make the same two cuts on the drawer's other side.

If you are doing multiple drawers, make the tail cuts on every drawer side before adjusting the fence for the next cut. Put the marked drawer side in the jig so that you can see your layout lines, adjust the fence, and make the first cut on the next tail in. Flip the board and make the next cut. Continue to adjust the fence and make cuts. At first, you're cutting one side of the tails, but when you pass the middle you begin to cut the other side of the tails.

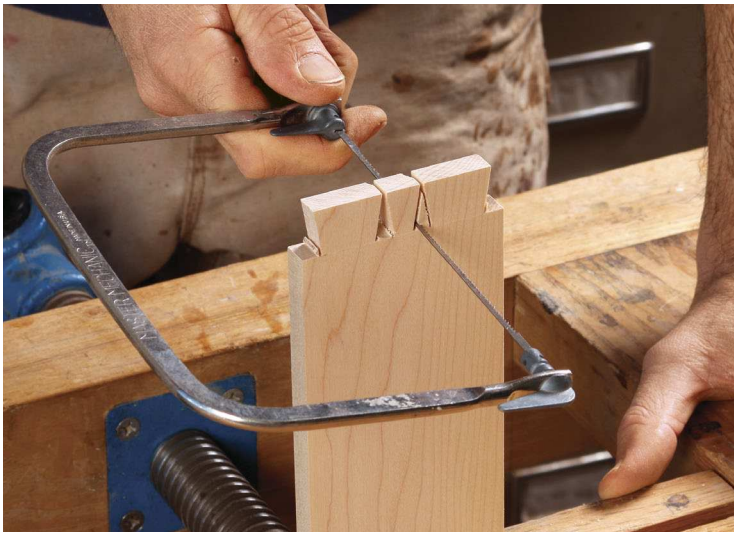
After all of the tails are cut, remove the waste between them with a coping saw, leaving about 1/16 in. of waste above the shoulder line. Use a chisel to pare it away. Pare first from the outside, starting in the scribed shoulder

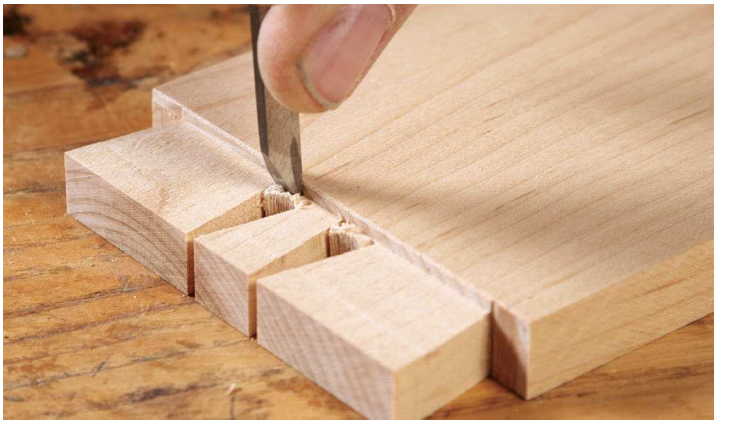


Move the fence. *Cut one side of the center tail and then flip the board for the second cut.*



Final cuts. *Move the rip fence one more time for the last tail cuts.*

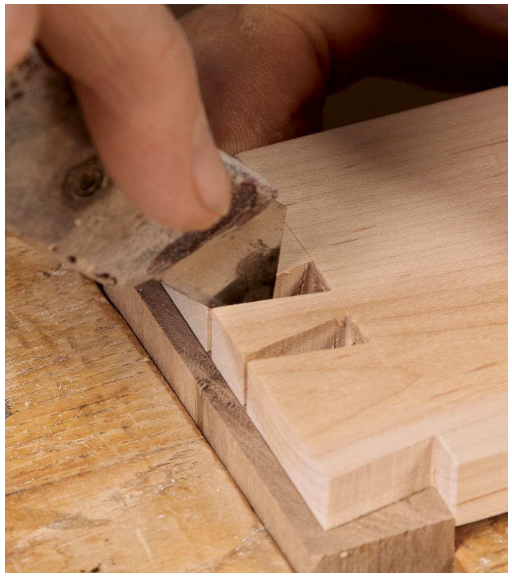




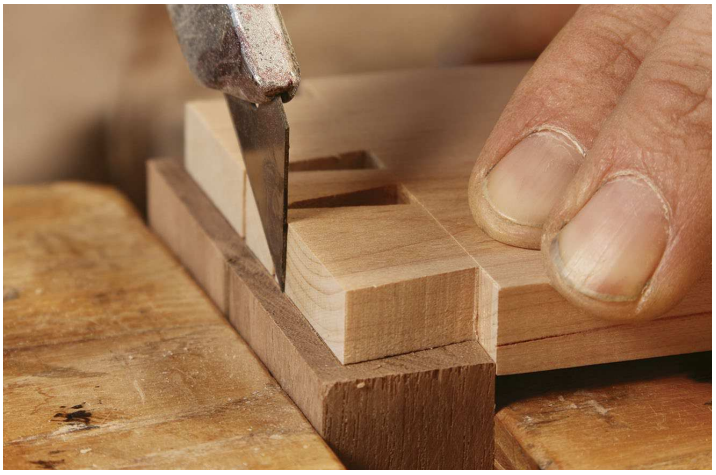
Clean out the waste with a coping saw. *There really is no faster way to get the job done (left). Leave just about 1/16 in. for paring. Pare from both sides, starting on the outside face. On the inside face, you can use the rabbet's shoulder to guide the chisel (above).*

POWER THROUGH THE PINS WITH A ROUTER

If there's one thing machines do better than hand tools, it's the grunt work, like removing the waste between pins. Not only does a router do it with ease and efficiency, but it also is very accurate.



Transfer the tails. *Hammer clamps the drawer front in a vise and pushes the rabbeted underside against it. The side doesn't move and the transfer is dead accurate (right). Mark the length, too. Taking it directly from the drawer side (below) is more accurate and easier than using a marking gauge.*



line and chopping straight down. Don't worry, there isn't enough waste to force the chisel into the shoulder. Stop before you go all the way through, and finish the job by paring from the other side, using the shoulder of the rabbet as a guide.

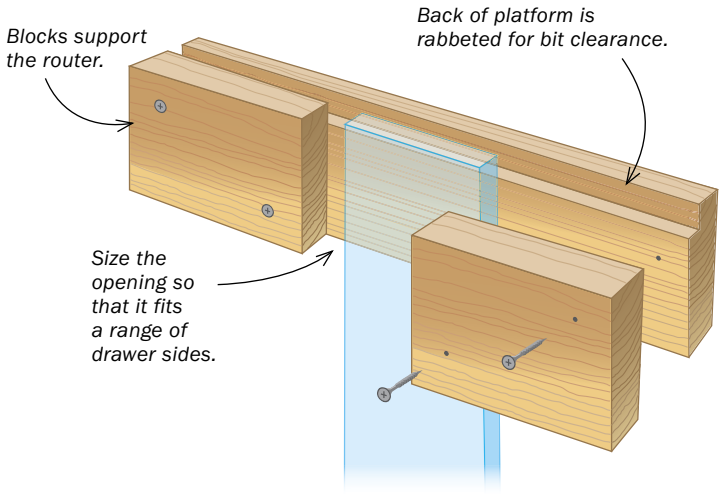
With the waste removed, transfer the tails to the drawer front. I use a marking knife because it's more accurate than a pencil, but I darken the lines with a pencil to make them easier to see. Next, use a marking gauge to mark the depth of the pins on the inside face of the front. Set the gauge directly from the thickness of your tails.

For pins, a router is mightier than the chisel

After you're done laying out the pins, you are ready to rout away the waste between them, using a ¼-in.-dia. straight bit. Make sure the bit is sharp; it will be easier to control. To improve the router's stability as I rout the pins, I clamp a simple jig to the drawer front and then clamp the jig into my shoulder vise. Set the bit depth so that it reaches the shoulder line you marked with the gauge earlier.

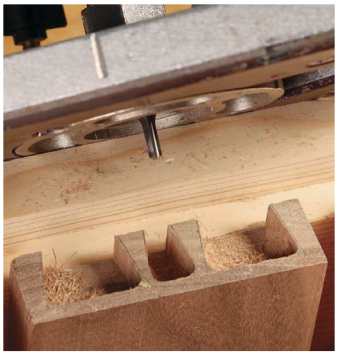
MAKE A PLATFORM FOR ROUTING

There is no way you could balance a router on the end grain of a board and rout accurately. Make this three-sided jig and clamp it to the drawer front to create a large surface for the router to ride on. The back rabbet prevents you from routing into the jig as you move from socket to socket.

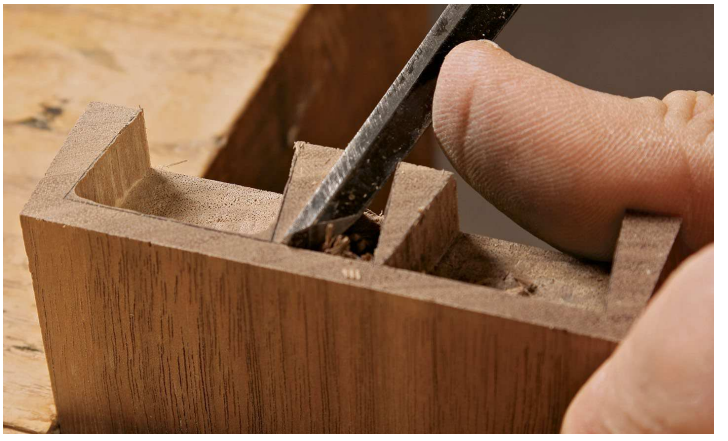


Router jig is easy to set up. *Use your benchtop to bring the top of the jig level with the drawer front. Then clamp it in place.*

Set the plunge depth. *After zeroing out the bit, place a tail between the stop and the turret on the base for an accurate setting.*



Rout freehand. *The jig offers enough surface area to keep the router stable. Shine some light into the work area to improve visibility (left). After a bit of practice, Hammer discovered that he could rout right up to the layout lines without any trouble (above). It helps that long grain is easy to rout.*

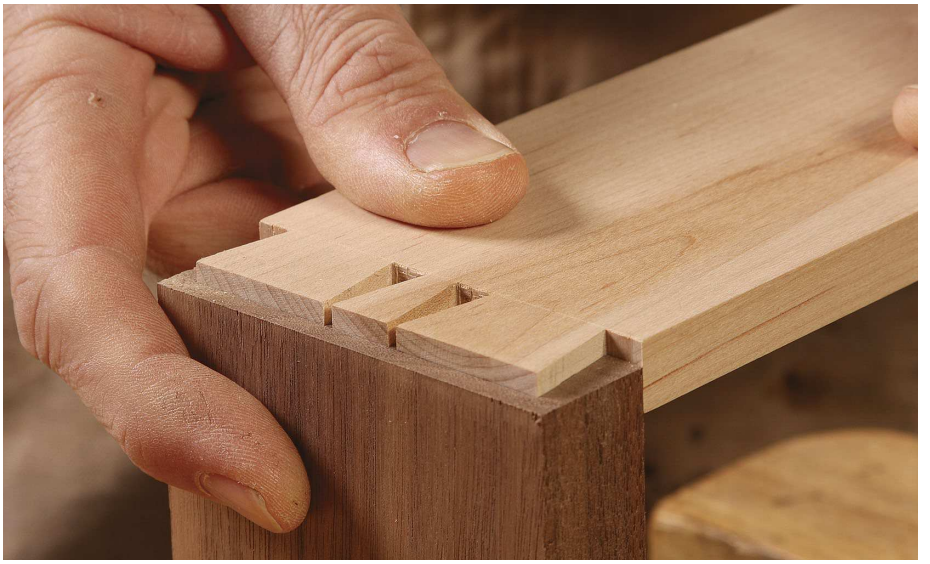


Tips for clean paring. *Pare down the back first. It's easier to get a straight cut with the workpiece and chisel vertical than with the workpiece horizontal on the bench. On the pin walls, work across the grain (right). Use a chisel wide enough to pare the entire wall in one pass.*

Rout the first socket, cutting as close to the layout lines as possible. Rout the remaining sockets in the same manner.

After the waste has been removed, clean up the sockets with a chisel. Again, because there is so little waste left, you can place the chisel right on the shoulder and pare straight down. Test the joint's fit, paring the pins as needed (but that shouldn't be much) until it comes together. □

Stephen Hammer designs and makes furniture in New Britain, Conn.



Check the fit. *The joint should come together without any trouble. But if it doesn't, pull it apart, pare carefully, and try again.*

fast fixes

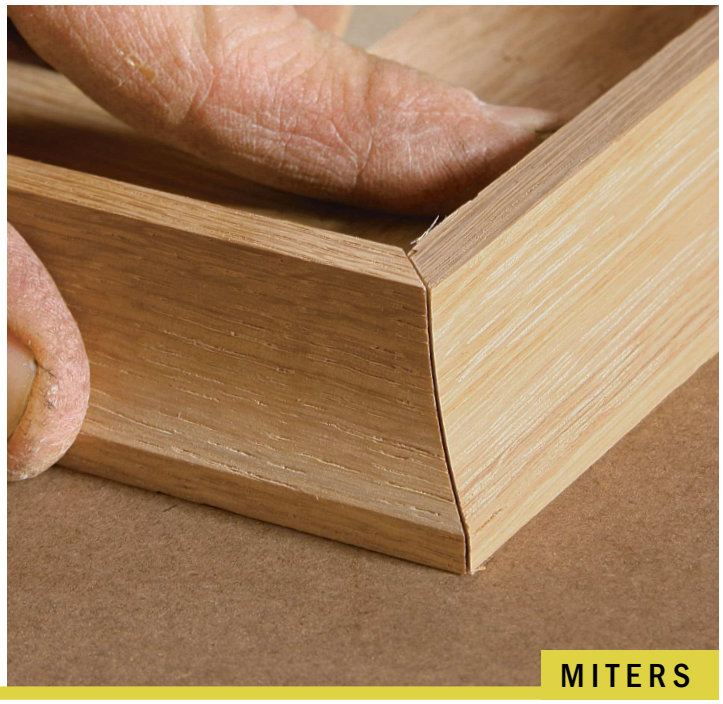
Pros share their favorite saves

Despite our best efforts to cut perfect joinery, mistakes happen. While these mistakes may or may not affect the look of a piece, they most certainly have an impact on its strength. No matter whether it's the result of poor layout, a missed machine setup, or an errant chisel stroke, you're faced with the dilemma of living with the mistake, fixing it, or scrapping the workpiece and starting over. Of the three options, most woodworkers would try to fix the mistake. But how do you know the best approach?

Fortunately, *Fine Woodworking* magazine has access to some of the best woodworkers in the country, so we asked a few pros to reveal some of their best fixes for joinery mistakes. As you can see here, the pros have a bunch of tricks up their sleeves.

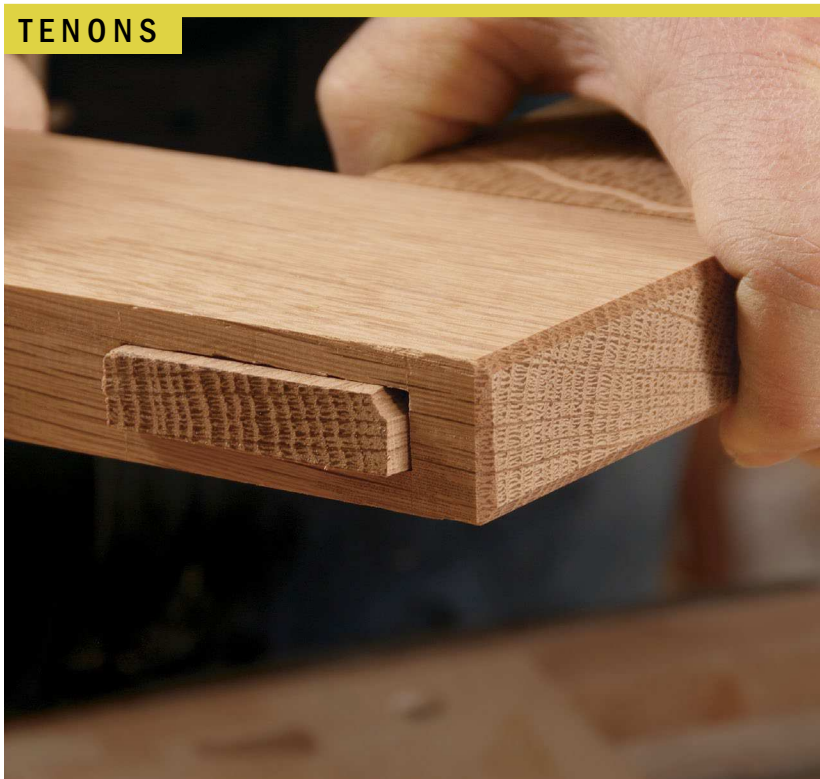
Compiled by FWW *staff.*

DOVETAILS



MITERS

TENONS



Obvious mistake. *Even a small dovetail gap can be a big eyesore on a cabinet case.*

Solutions for gappy dovetails

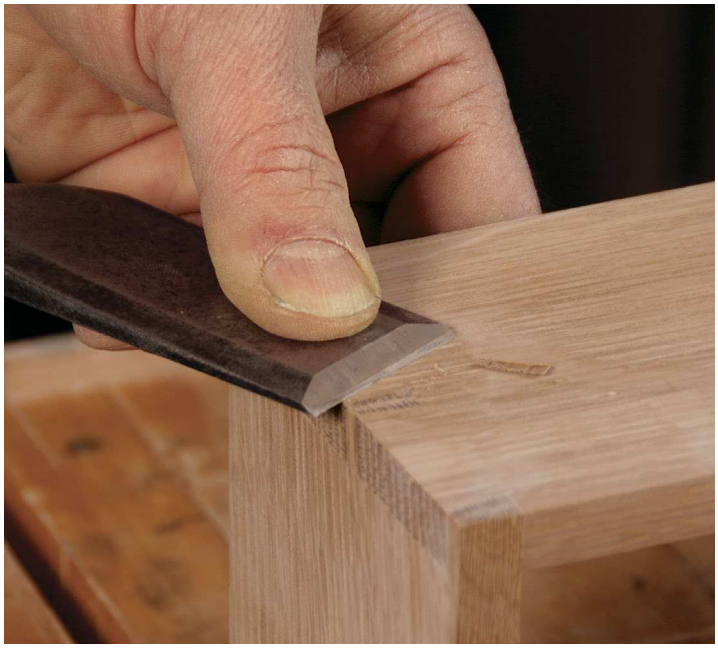
ANGLED SHIM FOR THROUGH-DOVETAILS

A common mistake when hand-cutting through-dovetails is to cut on the wrong side of the scribe line, which leaves a small but noticeable gap between the pin and tail when the piece is glued up. A surefire solution is to fill the gap with a thin shim that's the same wood species as the project. Widen the gap first, glue in the shim, then trim it flush.

—Michael Pekovich is FWW*'s art director, and a prolific furniture maker.*

Widen the gap. *A slight gap can be hard to fill. To make it easier, widen it slightly with a dovetail saw, angling the saw and cutting to the baselines of both the pins and tails.*

Insert the shim. *Chop the bottom of the strip at an angle so it will fit the widened gap, then glue it in place. Be sure to orient the end grain of the strip in line with that of the tail board.*



Trim it flush. *After the glue dries, use a wide chisel to slice the shim flush.*

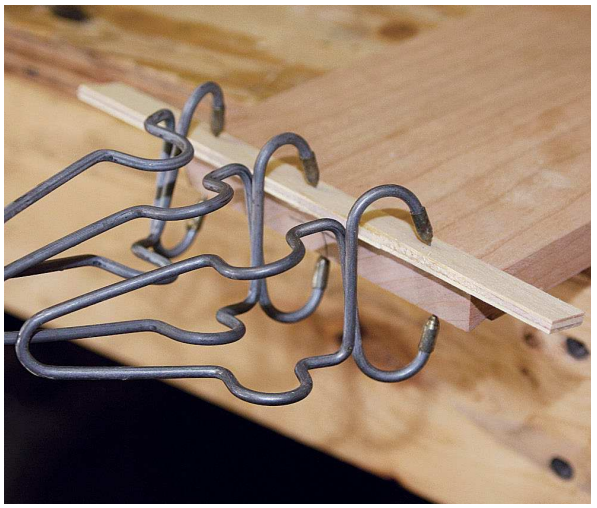
Loose key. *If your router-table fence is misaligned, you'll end up with an unsightly gap on a sliding dovetail.*

Dovetails continued

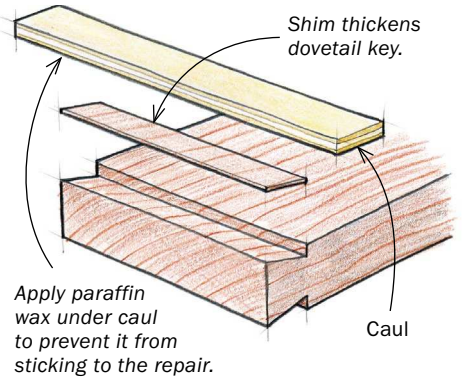
WIDE SHIM FOR A LOOSE SLIDING DOVETAIL

This fix came to me while I was working on a wall shelf made with sliding dovetails. As always, I'd set up the router-table cuts using test pieces and verified the fit. But after I finished routing the dovetail keys, I discovered that I was off by a little more than 1/16 in. Yikes! Turns out that I'd not tightened down my fence sufficiently, and it shifted slightly as I made the cuts. Fortunately, I came up with a fix that was pretty quick and easy. I filled the gap with a piece of thick veneer, glued along the face of the key. Be sure to run the grain in the same direction. Then I re-routed the joint to get a tight fit.

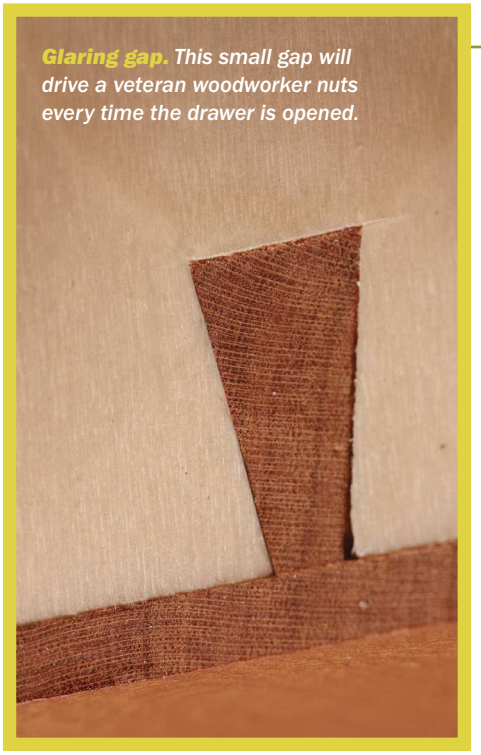
—Greg Brown is a furniture maker in New Hampshire.



Spring into action. *Glue a piece of veneer or a thicker shim to the face of the dovetail key. Brown uses spring clamps and a thin caul to ensure a good glue bond across the width.*



Tight joint. *After re-routing the shimmed key, it fits perfectly.*

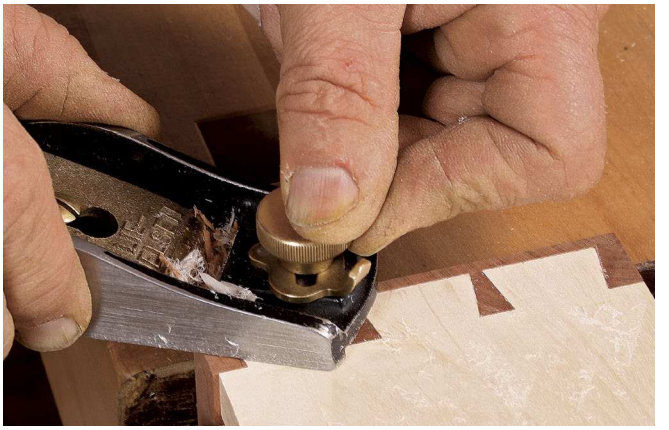


Glaring gap. *This small gap will drive a veteran woodworker nuts every time the drawer is opened.*

TAPERED SHIM FOR HALF-BLINDS

Here's a simple way to fix a gap in a half-blind dovetail. Use end-grain shims that closely match the color and grain pattern of the pin. This fix is slightly different from the through-dovetail fix on p. 117, which uses a triangular, flat shim. Because there's no way to widen the gap cleanly, and it's trapped by the edge of the drawer front, I taper the shim to create a wedge that is easier to put in. I tap it into the gap with a hammer, then trim it flush.

—Garrett Hack is a contributing editor.



Drive it home. *Put glue on the tip of a shim and tap it in place (above). Saw off the excess and trim it flush (right).*

Photos: staff; drawings: John Tetreault

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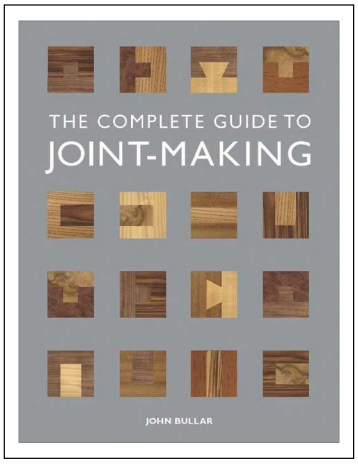

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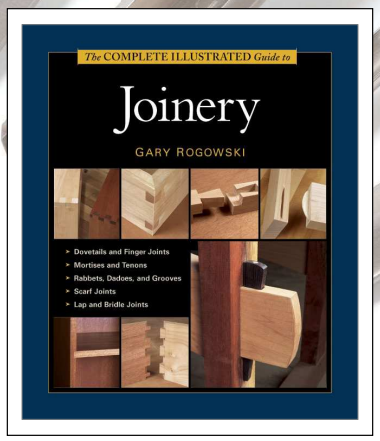

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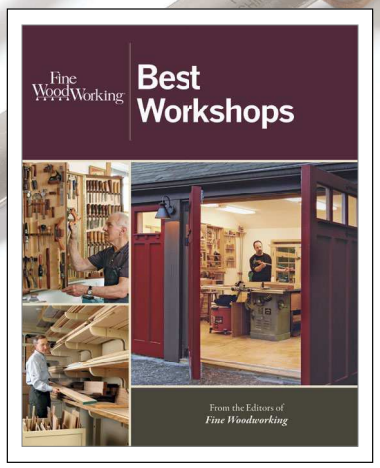

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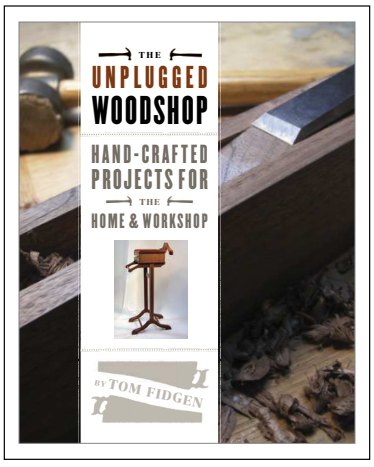

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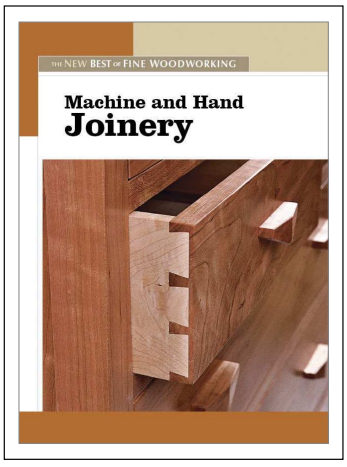

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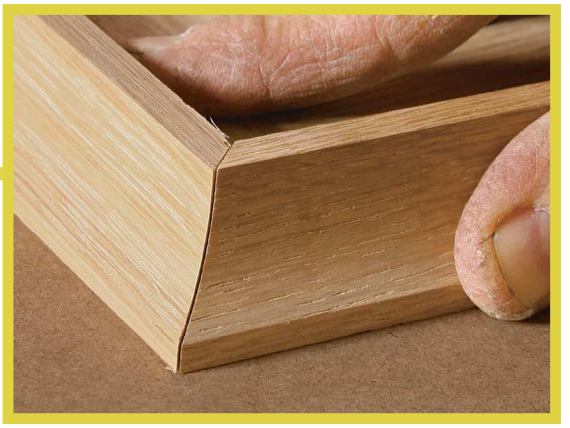
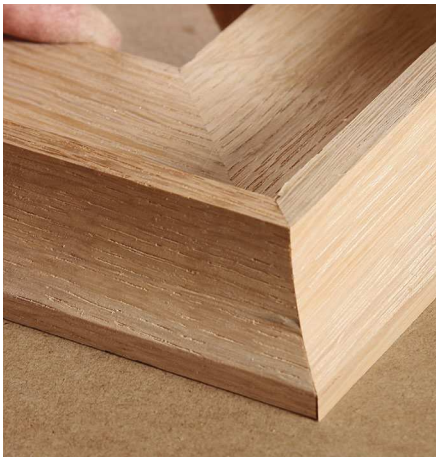
When miters don't meet



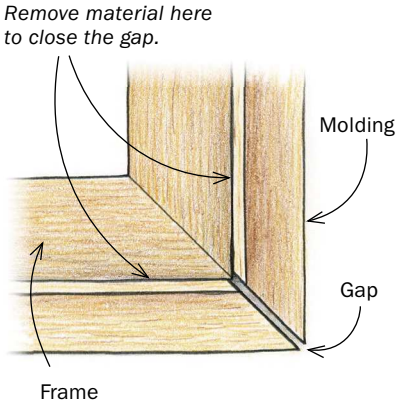
When trimming the miters on moldings, it's easy to take off too much from one end, leaving a small gap. Instead of cutting a new piece of molding, you can fix the pieces you have. Simply take a very light jointer pass off the back face of the molding (a handplane will work too). This has the effect of lengthening the distance between the miters, giving you one more chance to close the gap.

—Will Neptune is a furniture maker in Massachusetts.

Joint the back. *Run the back of the molding over the jointer, taking a shallow cut. Be sure to use push blocks. If the molding is too small for a safe jointer pass, use a handplane.*



Tight miter. *Taking material off the back brings the miter together.*



Fatten up a thin tenon

It's easy to trim too much from a tenon, creating a loose fit in its mortise. There is an easy fix, which I learned from Phil Lowe. You just glue veneer to the tenon cheek and try again. First partially assemble the joint and look for a gap to see which face of the tenon is undercut (shimming the wrong face can mess up the alignment of the parts). Now resaw a strip of veneer just a bit thicker than the gap. Glue it on, using a small caul to get even pressure and a tight glueline, and then trim the tenon again to creep up on a perfect fit.

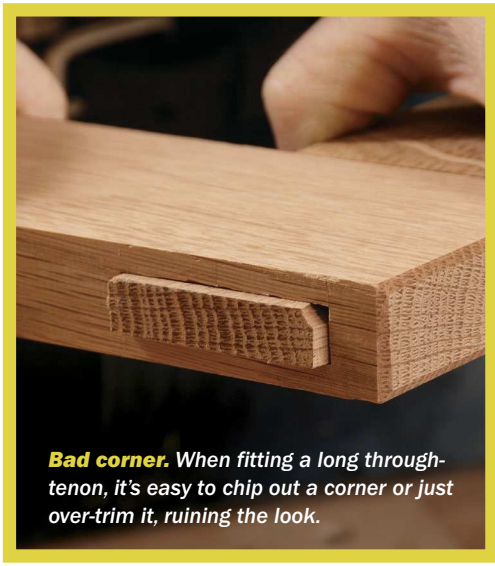
—Tom McKenna is managing editor, and Phil Lowe runs the Furniture Institute of Massachusetts.

A little off the top. *Trim the edges of the veneer flush, and then plane the fattened tenon until it fits.*

Hanging tight. *A perfect fit is one where the joint stays together when you hold it in mid-air.*

WOODWORKERS MART

Cap a bad through-tenon



Bad corner. *When fitting a long through-tenon, it's easy to chip out a corner or just over-trim it, ruining the look.*

Make a cap. *Mill a slip tenon for a snug fit in the outside of the mortise. Then cut off a piece long enough to meet the end of the real tenon.*

Top it off. *Trim back the damaged tenon, then glue in the cap over the tenon for a seamless repair.*

A through-tenon is an attractive detail, but it's easy to end up with a gap or chipped corner while you're fitting the extralong tenon. A simple fix is to cut back the bad tenon and then cap it. The cap can either be flush or protruding, depending on the style. Start by cutting a slip tenon for a snug fit in the mortise. Then trim the damaged tenon back so that it's about ¼ in. shy of the outside end, and insert it fully into the mortise. Cut the cap long enough to bottom out against the internal tenon, especially if it is designed to protrude evenly. Now you can glue in the real tenon and add the cap on the outside. If it is a chamfered cap, be sure to do that beforehand.

—Michael Pekovich

Replace a tenon completely

Bad shoulder. *Get an offset tenon wrong and the problem is obvious. But even this can be fixed without starting from scratch.*

It's all too common to orient an offset tenon backwards on a rail, creating a big step on the finished frame. But it's not a fatal error. You can simply slice off the miscut tenon, cut a big stopped groove in the rail, and slide in a slip tenon. This fix works for bad tenons of all kinds. Here's how to do it.

Install a dado set on the tablesaw equal to the tenon thickness. Set the height for the width of the tenon and use the rip fence to locate the dado set in the rail thickness. Feed the rail in far enough to cut a reasonable-size pocket—stop the cut just after you reach the apex of the blade. Turn off the saw and wait for the blade to stop. Make a slip tenon that fits snug in the curved pocket. Cut it to length and glue it into the rail. When the glue dries, clean up the bottom edge and fit the new tenon to its mortise.

—Will Neptune

Remove the tenon altogether. *Cut off the tenon at the shoulder.*

Clear a path for a new one. *Use a dado set to plow a groove where the tenon should have been.*

Curved piece fits right in. *Mill a slip tenon for a snug fit in the groove, with one end curved to match the arc of the blade. You can use the blade to trace the arc.*

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