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2008

Router Tips, Tricks and Jigs

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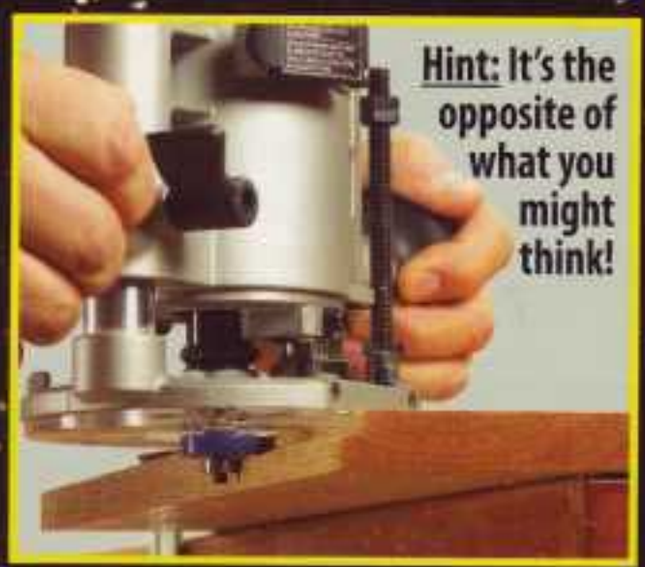
34 Time-Saving Jigs

THE Secret to Super-Smooth Router Cuts



Router Tables: Buy or Build the Best

Complete plans inside

Raised-Panel Doors Made Easy p.70

Better Homes and Gardens

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Basic to Beautiful: Grow Your Routing Skills

WHAT ROUTING HAS HELPED ME DO ON THIS PROJECT

A few months after I started woodworking in 1977, my parents gave me my first router—a 1/3-hp model—as a holiday gift. I used it to rout edges on some basic wall sconces and picture frames I was making.

Over the years as my skills developed, so did my routing abilities. I graduated from routing simple decorative (and sometimes burned) edges to creating air-tight joinery, floating breadboard ends, and grooves for exposed ebony splines. I also bought several routers, added a router table to my tablesaw extension, and bought dozens of carbide bits to tackle the numerous routing applications my more-involved projects called for. To give you an example, see the routing applications I incorporated into the Greene-and-Greene dresser mirror *above*.

Now, it's time to take you on the same journey. No matter what your present routing skills, this magazine will teach you more. We've included techniques, jigs, and tips all guaranteed to grow your skills and abilities.

Marlen Kemmet

Marlen Kemmet
WOOD® magazine Managing Editor

Better Homes and Gardens®

Best-Ever Router Tips, Tricks, and Jigs

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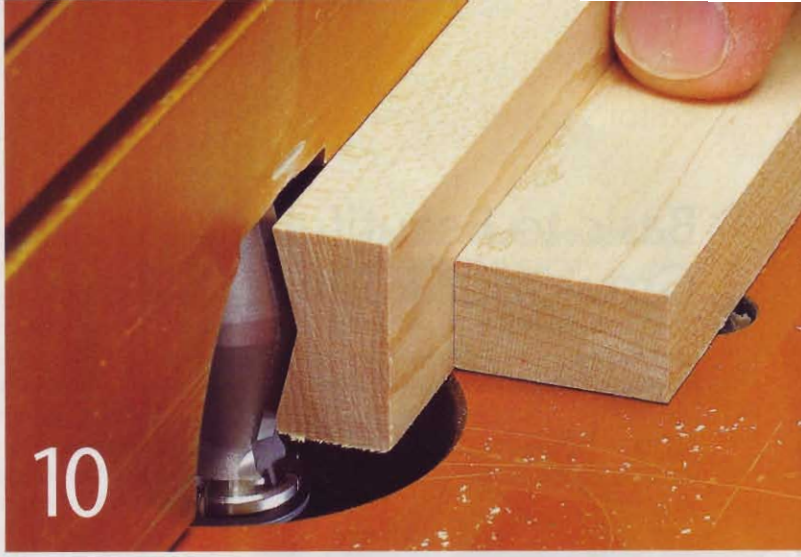

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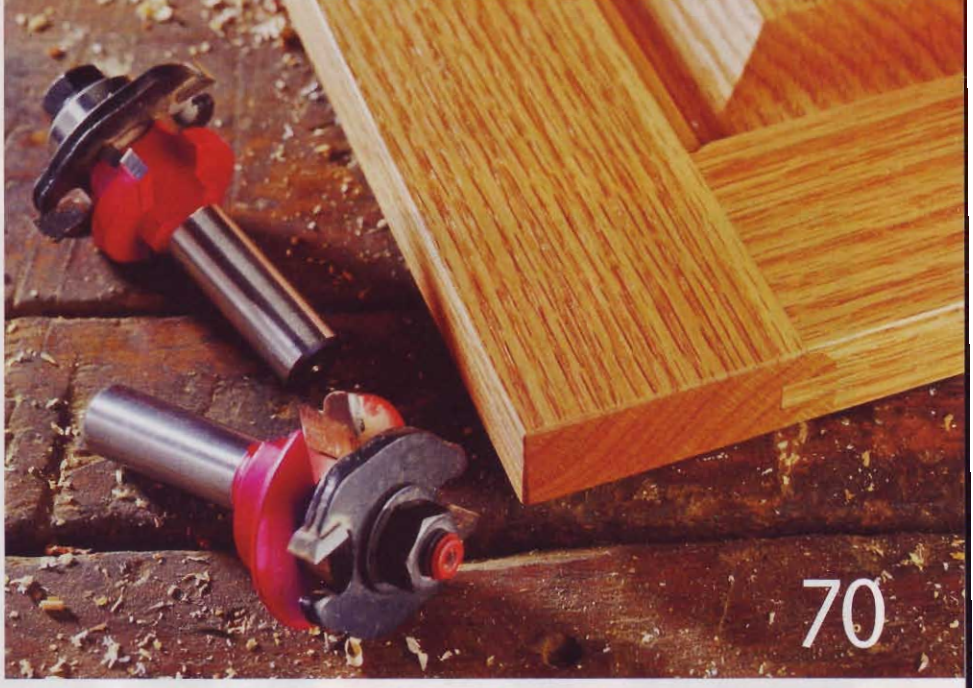
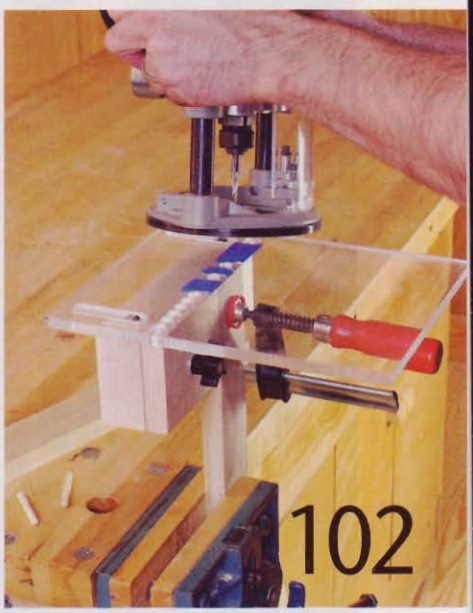
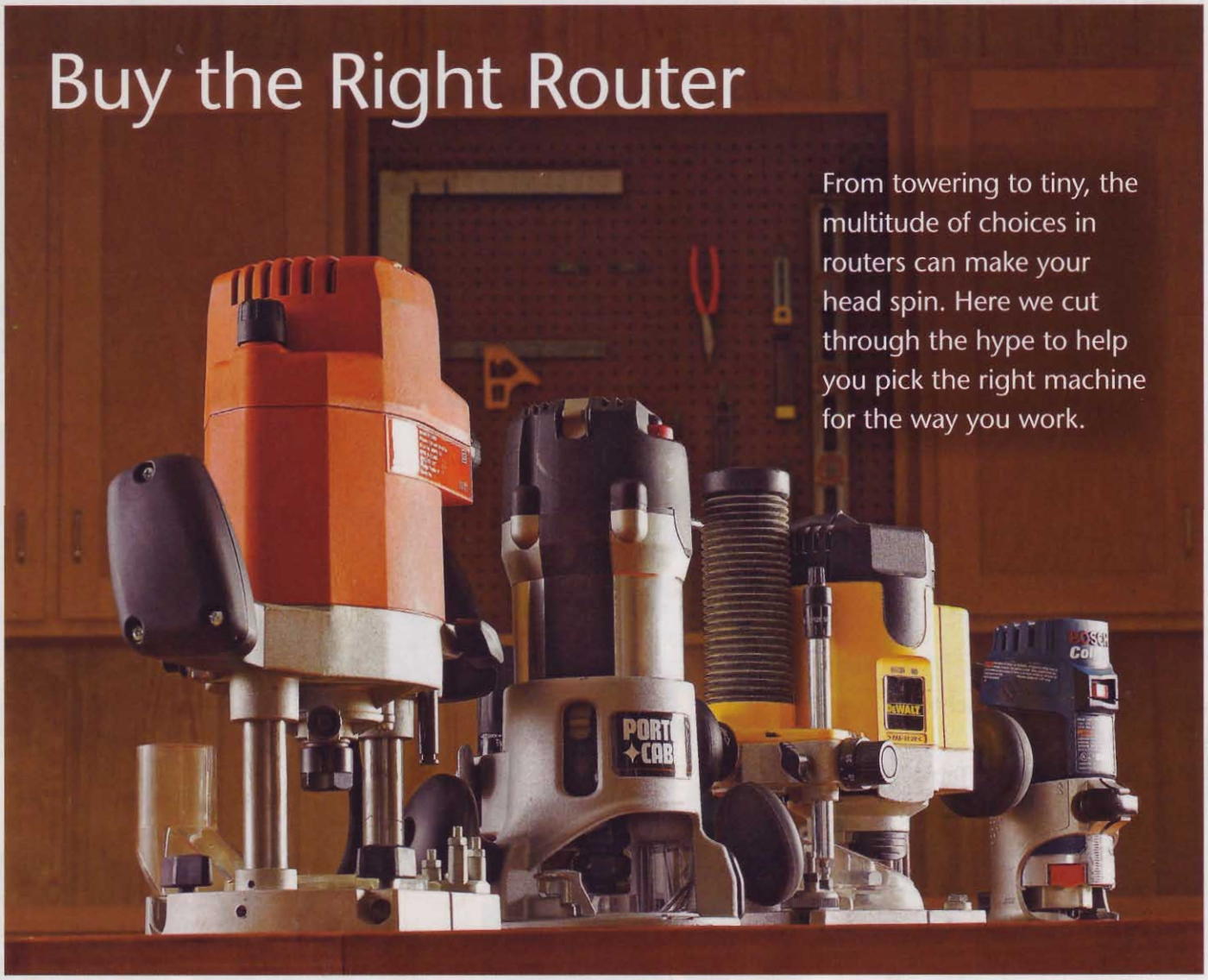




Buy the Right Router



From towering to tiny, the multitude of choices in routers can make your head spin. Here we cut through the hype to help you pick the right machine for the way you work.

Without question, the router is one of the most versatile power tools in a woodworking shop. It can joint edges; cut joinery (dadoes, rabbets, splines, mortises); and trim laminates and edge banding. And a router will shape the edges and ends of a workpiece in nearly any profile. However, no single type of router performs best for every woodworking task—or for every woodworker.

No wonder readers so frequently ask us, "What type of router should I buy?" Simple question...but not so simple to answer. Why? Because the answer depends on the type and complexity of the tasks you want to perform with the tool; how often you perform them; the materials you use; and, of course, your wallet. Over the next few pages, we'll give you the lowdown so you can decide what style and power class of router best fits your needs.

Deal makers and breakers

Although a basic motor-with-handles router was the norm a decade or two ago, today's woodworker demands more features. Features such as soft-start, variable-speed motors, and self-releasing collets make routers more versatile and easier to use. So, once you choose a type of router, decide how much you need each of these features:

■ **Power.** A 1½- to 2¼-hp router works well as a general-purpose machine, but if you'll often use bits larger than about 2" in diameter to make, say, raised-panel doors, consider a 3-hp-class machine. Remember that having a lot of horsepower doesn't mean you can just hog out as much material as you want; for safety and efficiency, it's best to take multiple lighter passes. More power does mean that heavier cuts will put less stress on you and the router.

■ **Variable speed.** Router bits have recommended speed limits, depending on their diameter. (The tips of a 2½" bit spinning at 21,000 rpm travel at 156 miles per hour; a 1" bit at the same motor speed moves only 62 mph.) Dialing down the motor increases safety with large bits and gives you better control. Also, variable speed allows you to slow the cutter speed on easily burnable woods like cherry.

■ **Electronic speed control.** Like cruise control for your router, this circuitry helps the router maintain constant

speed under varying workload. Without it, the motor can bog down and give a rough cut in dense woods.

■ **Soft start.** Router torque can really jerk the machine when it's powered up in handheld operations. Soft start ramps the speed up quickly, but minimizes that kick. This feature becomes even more important with the 3-hp-range machines, or if your router requires you to let go of a handle to reach the switch. Most machines with electronic speed control also have soft start.

■ **Collets.** Even if every bit you currently own has the same size shank, stick with a machine that has collets to accept both ¼" and ½" shanks, or at least offers the second size as an optional accessory. (Some small profile bits come only with ¼" shanks.) Collets described as "self-releasing" free the bit after one full turn of the collet nut, making bit changing easier. Steer clear of routers with integral collets, like the one shown at *right*; should a bit seize in that collet, you'll have to replace the entire router, not just the bit and collet.

■ **Dust collection.** This feature was once considered a luxury, but we now wouldn't own a router without a dust-collection port. Some come standard, some are optional, and some companies don't even offer them as accessories, so check it out before you buy. Usually a vacuum hose connects to a port mounted on top of the router base. This works fine for most applications, but if you routinely rout edge treatments, consider a router that accepts a below-the-base dust-collection port.

■ **Switch style/location.** You should be able to engage the switch without letting go of a handle, but some models still require this. A few switches are accessible from the top or bottom of the router, making them more adaptable to table use. Routers that twist to adjust bit height can relocate the switch every time you adjust the height, an inconvenience in router-table use.

■ **Handles.** Personal preference reigns here. You'll find base-mounted knobs and motor-mounted pistol-grip handles, and everything in between. Try several, looking specifically for good balance and sure control in handheld operation; if it doesn't feel right, keep shopping. For fixed-base routers, a D-handle base gives the greatest control in handheld operations, and usually has the power switch directly under your forefinger at all times. Some combo kits offer a D-handle base in addition to plunge and knob-style fixed bases.

COMPARING COLLETS

Some low-cost routers use an integral collet mounted to the end of the motor shaft. Most, however, have separate self-releasing collets. To use smaller bits, you'll either change to a separate ¼" collet or insert a reducer sleeve in the ½" collet.

TWO SWITCH STYLES, BOTH GOOD

The power switch should be within easy reach without letting go of the router. Porter-Cable's 890-series fixed-base router has a dual-position switch that works well both when handheld and inverted in a router table. Skil's trigger switch keeps power control literally at your fingertips for handheld use, but is more difficult to activate and lock when table-mounted.

Meet the Family

Before you can settle on a specific router, you need to first decide from among the four types shown *below*. And if it seems that you need more than one, buy the most versatile type—a plunge router—and add the other later.

Fixed-base Router

Power range: 1½–3¼ hp
Price range: $60–$340
Essentially a motor with handles to guide it, you set the bit depth on a fixed-base router by raising or lowering the motor within the base. On some, a threaded motor adjusts by simply twisting it; others use a height-adjustment knob. So, although the base isn't really "fixed," the cutting depth must be locked in before making a cut.
Pros: Simple adjustment; easiest to mount in jigs, fixtures, and tables; low center of gravity enhances control; most common style for router lifts; low maintenance.
Cons: Cannot easily or safely plunge the bit into a workpiece for routing mortises, stopped dadoes, etc.
What to look for: Microadjustability of cutting depth; ability to add optional bases (such as D-handle and plunge), guide bushings, and accessories; height adjustment accessible from the underside of the router for table use; adjustable or replaceable handles.

Plunge Router

Power range: 1¼–3¼ hp
Price range: $60–$400
Take the motor from a fixed-base router and mount it in a base with springs, and you have a plunge router. Because the motor slides up and down on spring-loaded posts, you adjust depth by unlocking the motor and pushing down on the handles to "plunge" the bit into the work. Plunged and locked, it functions like a fixed-base machine.
Pros: Easy to lower bit into work for mortises or stopped flutes and dadoes; ability to make multiple passes for deep cuts without additional setup; excels at sign-making.
Cons: Top-heavy; can be difficult to adjust bit height when table-mounted; plunge-depth mechanism can be difficult to learn for beginners.
What to look for: Ability to use guide bushings and other accessories; easy-to-use locking mechanism; precise, adjustable depth stop; ability to "zero out" depth stop for ease of setting cutting depth.

Combination Kit

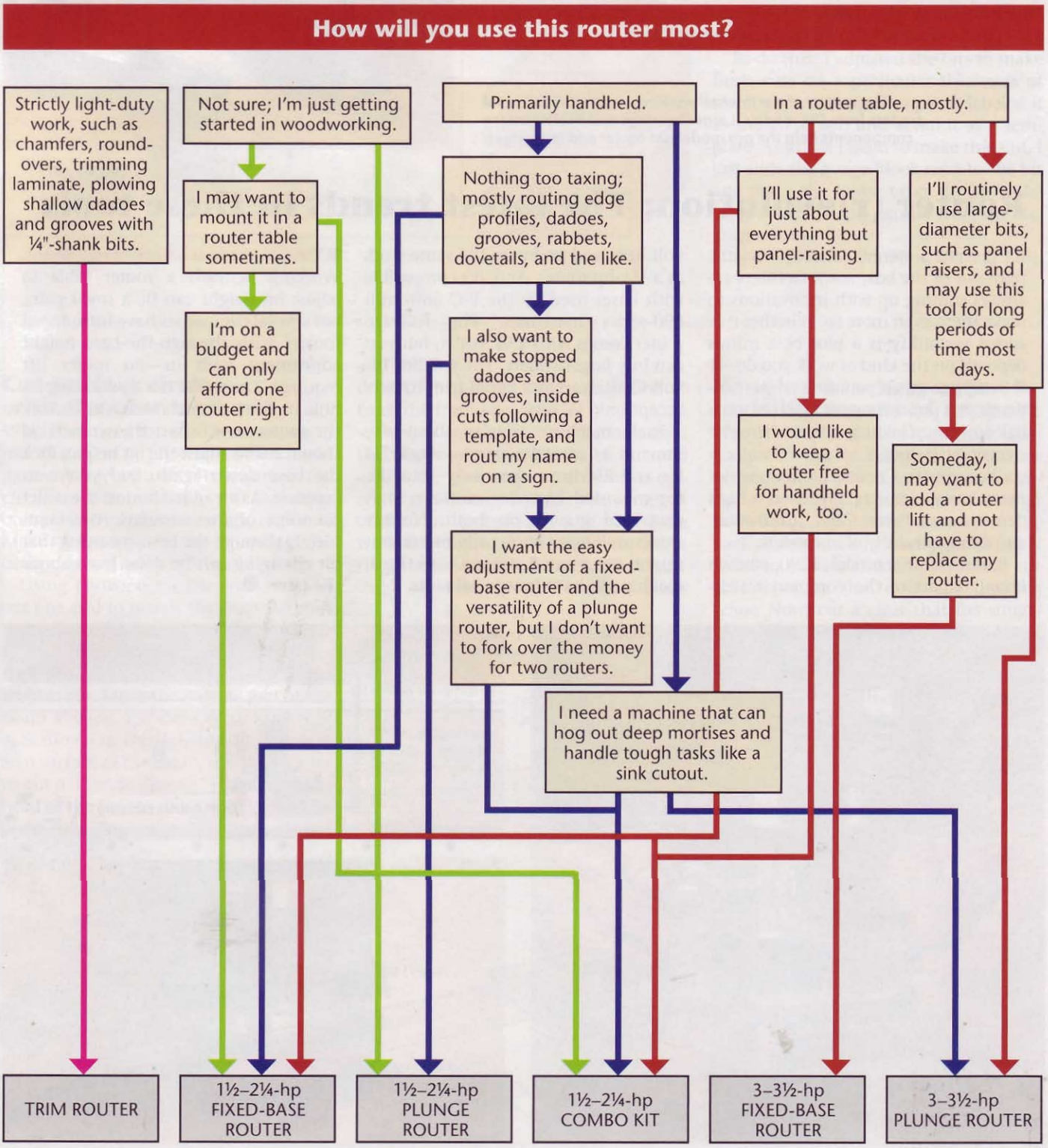
Power range: 1½–2¼ hp
Price range: $100–$300
A combo kit includes one motor that fits either a fixed or plunge base, both of which come with the kit. If a fixed-base machine suits most of your work, but you occasionally cut mortises or stopped dadoes, a combo kit may be an economical solution for you.
Pros: Almost like having a second router, but at a lower cost; fixed base can remain mounted in router table while you use the plunge base for freehand work.
Cons: Swapping bases can grow tiresome; if you need a high-power router for large-diameter bits (over 2") you won't find one here—most combo kits top out at only 2¼ hp.
What to look for: All the same things you'd want from either a fixed-base or plunge router.

Trim Router

Power range: 1 hp or less
Price range: $60–$100
Sometimes called laminate trimmers, these small fixed-base tools accept only ¼"-shank bits. Most trim routers don't have handles—you grip the motor itself. For light-duty work, such as round-overs, hinge mortising, chamfering, and (of course) laminate trimming, they're just the right size.
Pros: Lightweight and easy to handle; great for small work; inexpensive; specialized bases available for trimming.
Cons: Low power; can't use ½"-shank or large-diameter bits; depth adjustment limited (about 1" typical).
What to look for: Ability to use guide bushings; comfortable grip; low center of gravity.

Find the Right Router for You

Now that you know more about the different styles and feature of routers, it's time to decide which style and power class suits the way you work. This chart will lead you to the right machine.



Pro vs. DIY routers: Why pay the difference?

Higher-priced routers have more metal parts than plastic, higher power, and advanced features, such as built-in height adjustment, soft-start, variable speed, and interchangeable bases. They also cost more than routers without. That said, a low-cost router makes good sense if you use it only a few times a year. Less-expensive routers don't have components to stand all-day-every-day use and abuse. Many woodworkers start with a do-it-yourself (DIY) router, and then graduate to a pro router for more demanding tasks, such as regularly making raised door panels or hundreds of feet of profiled moldings.

The quality of the internal workings separates pro-level routers from DIY models. Larger bearings and beefier motor components help the pro model run cooler and last longer.

Router (r)evolution: The latest trends in these tools

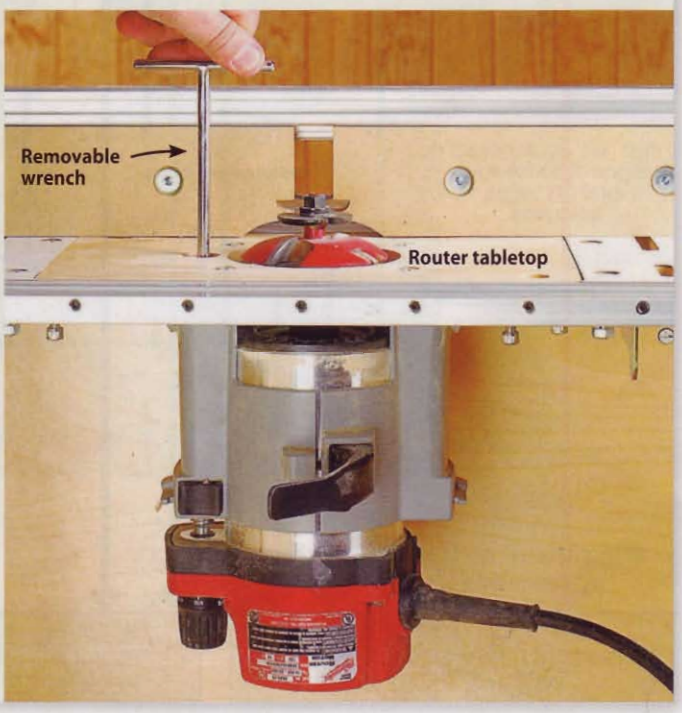
As if routers weren't already versatile right out of the box, manufacturers are always coming up with innovations to make them even more so. Whether this added versatility is a plus or a minus depends on the kind of work you do.

■ **Battery power.** If you use a router outdoors, at a poorly powered job site, on a balcony or scaffolding, or anywhere else electricity is tough to get, consider a cordless router. Choices are few, as not many manufacturers have seen a high demand, but Porter-Cable, Craftsman, and Ryobi currently offer models.

Porter-Cable's model 9290, shown *below*, is part of the company's 19.2-volt line, and performs the same work as a 1½-hp router. And, it's compatible with bases used by the P-C 680- and 690-series machines. The full-size router comes with a ¼" collet, but you can buy larger collets. The smaller 18-volt Craftsman and Ryobi trim routers accept only ¼" bits.

Each machine weighs about the same as its corded cousins—about 7¾ lbs and 2¼ lbs, respectively—but the top-mounted batteries create a high center of gravity on both. Neither works well as a shop's only router, but might be a good second (or third) machine to have for special tasks.

■ **Through-the-base bit-height adjustment.** Working beneath a router table to adjust bit height can be a royal pain, but several companies have introduced routers with through-the-base height adjustment built in—no router lift required. The router has an extra access hole in the base for a wrench. Unlock the router base, insert the wrench, as shown *below*, adjust the bit height, lock the base down again, and you're in business. As an added bonus, the collet on some of these routers rises completely through the base, meaning that bit changing can be done from above the table.



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Basic Router Operations

You're going to spend lots of time with these versatile machines, so develop smart routing habits from the start.

Router techniques vary depending on whether you use your router as a hand-held tool or as a table-mounted, stationary tool. Some basic cuts can be made with either type of operation, but advanced cuts usually require a table-mounted setup. Here are some handy tips for making basic cuts with either type of tool. In later chapters we'll take a closer look at which cuts work best for each type of operation.

Feeding the right direction

Bits rotate, so the router needs to move in the direction that feeds the stock into its rotation. By doing this, the thrust created by the rotational momentum pulls the bit into the workpiece and forces the router against the straightedge.

That's the safest way to rout, but not the only way. Routing in the opposite direction—called "climb cutting"—can reduce splintering when done with care, as shown *below* For information on safe climb cutting, see *page 76*.

Handheld router. When working outside edges, the bit turns clockwise as you look down, so feed the router in a *counter-clockwise* or *left-to-right* direction, as shown *below*. This also applies to round and curved parts. When working inside edges with a handheld router, feed the tool in a *clockwise* or *right-to-left* direction.

To make a handheld cut, first secure the workpiece to the bench. Hold the router in position with the bit away from the workpiece, switch on the power, then slowly slide the router until the bit contacts the work. Once you have full contact between the bit and workpiece, rout using a smooth, steady feed rate.

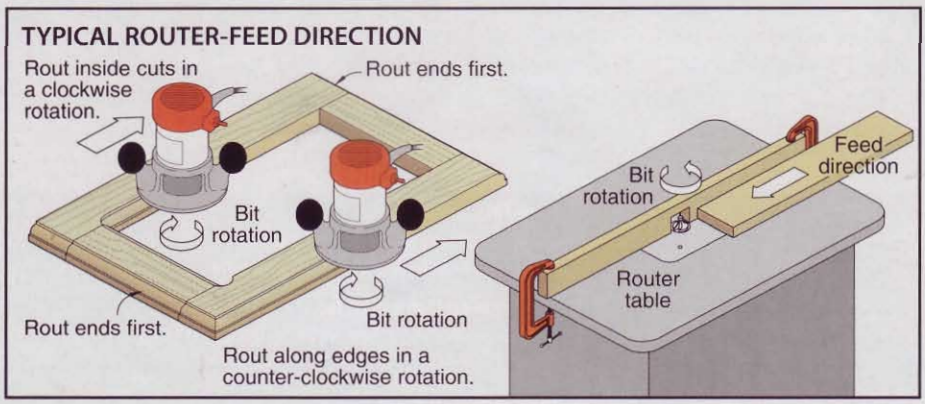
To avoid splintering, make cuts across the grain first, then cut with the grain. If making cross-grain cuts only, place a scrap backup block against the workpiece where the bit exits.

Table-mounted router. The bit rotates counterclockwise, so feed the workpiece from *right to left* along the fence with the workpiece in front of the bit and fence. (For safety reasons, never feed a workpiece between the bit and the fence.)

Finding the best feed rate

Feed rate, not to be mistaken as router bit speed, refers to the speed that you move the router along the workpiece or the workpiece along a spinning bit. The optimum feed rate will vary, depending on the kind of wood being worked, the router's power, the size and type of bit, and the depth and width of cut.

To learn the proper feed rate, listen to the router, watch the chips and sawdust, and check the finish on the workpiece. At the proper feed rate, the motor should sound like it's working under some load but not bogging down. Look for thin, uniform-sized shavings.



Climb-cutting the rabbet on the back of this frame reduces tear-out.

For a low-tech way to cut straight grooves and rabbets in larger boards, use a shop-made or commercial clamp-on straightedge.

Substituting smaller bearings will allow this rabbeting bit to make wider cuts. The smaller the bearing, the wider the cut.

With this circle-jig attachment, you can rout arcs and circles in large workpieces. The trammel becomes a router subbase.

Forced feeding may be detected as the usual high-pitched motor sound changes to lower, slower sound. It may cause excessive wood splintering ahead of the bit or scallop marks on the edge.

A high-pitch runaway motor sound may mean you're feeding the router too slow. Fine sawdust rather than nice shavings also suggests slow feeding.

Straightline cuts

Router cuts that extend from one edge of the workpiece to the other are *through* cuts. A *stopped* cut extends from one edge but stops short of the other. A blind cut stops short of both edges.

Straight cuts, such as rabbets, grooves, and dadoes, shown *below*, plus chamfers, mortises, and cut-offs, require a means to guide the router. These aides include straightedges, such as a straight piece of wood or metal, clamped to the workpiece so the router base edge slides freely along it, as shown *above*. Offset the straightedge enough to locate the cut, and clamp both the straightedge and workpiece to your bench. To upgrade a basic straightedge so it takes less time to position, attach a short piece across one end at 90° to make a T-square.

You also can use this technique to straighten, or "joint," the edges of boards you'll glue together to make panels. Clamp a straightedge to the top of the piece so it aligns with the edge of the workpiece. Rout the edge with a ½" straight bit. If the edge of the board is so uneven that the cut width exceeds ⅛" in some areas, first trim away most of the waste with a tablesaw or circular saw.

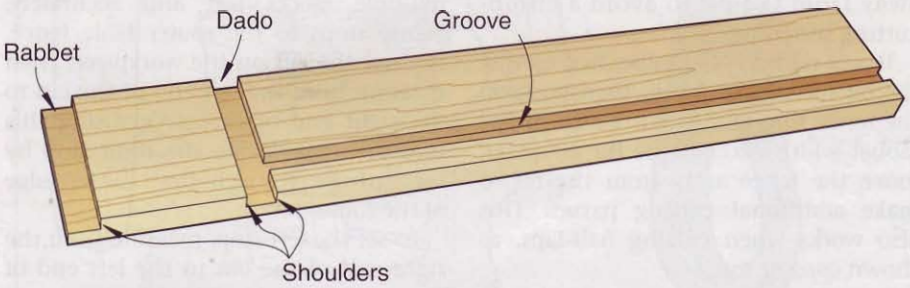
Piloted bits guide a router along the edge of a workpiece alone or with a curved or straight pattern. There's a ball bearing on the end of the bit, so the workpiece without a pattern must be thick enough to accept the cutter and bearing at the same time, as shown *opposite top*.

The bearing keeps the cut width consistent. It also duplicates the surface it rides against so the edge must be smooth to avoid transferring imperfections into the cut edge. Be aware that when edge-forming with a piloted bit, less than half of the router base will be supported, and at the corners, even less.

A bearing-guided rabbeting bit, like the one *above center*, can make rabbet joints and cut a recess to hold panels of wood or glass, and let in back panels on cabinets. It works on curved as well as straight parts, something your tablesaw or jointer can't do. To cut rabbets with a handheld router, mount a bearing of the diameter that will allow the bit to cut to the desired width. Then, set the bit to cutting depth. If the cut exceeds ¼" square, make multiple shallow cutting passes to reach final depth.

Some rabbeting bits include a 1¼"-diameter cutter and a ½" bearing for cutting ⅜"-deep rabbets, or a 1⅜"-diameter cutter and a ⅜" bearing for cutting ½"-deep rabbets. Expand the versatility of a rabbeting bit with a set of high-speed bearings like the ones shown *above center*.

3 COMMON ROUTER CUTS



A rabbet breaks the edge or end of a workpiece, while a dado doesn't. Grooves run from end-to-end on a workpiece, usually with the grain. "Stopped" versions of these cuts occur when you halt the router before completely reaching the edge or end.

Cutting circles and curves

To cut circles, rotate the router around a pivot point using a circle jig, trammel (shown *above*), pivot guide, or compass jig. A trammel serves as an extended subbase with a pivot point that is offset from the router bit. The farther the bit is from the pivot point, the larger the circle. Trammels can be made infinitely variable to cut circles of almost any diameter. You can buy circle jigs or make one, as shown on *page 107*.

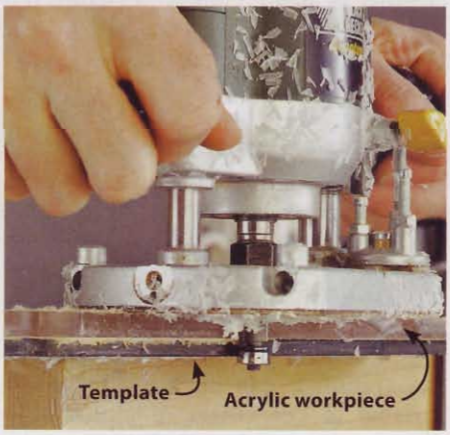
A knurled nut secures the template guide bushing to the bottom of the subbase.

Auxiliary subbases can be made any shape or size you want. They're simple to make from ¼"- or ⅜"-thick material, such as tempered hardboard, plywood, or plastic. Use the factory-supplied router subbase as a pattern to locate the mounting holes in the subbase.

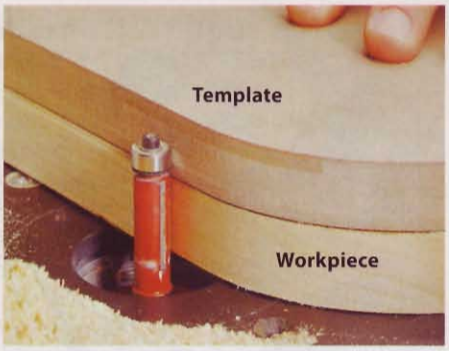
Template guide bushings, shown *above,* fit into the center hole of most subbases and guide a router around a template or pattern. The bit extends through the inside of the bushing and past the bottom of the router base. When routing, hold the guide bushing against the pattern edge.

Routing with a template

To route a workpiece using a handheld router, a bearing-guided bit, and a template, first saw the workpiece to within 1/16" of the shape of the template to reduce tear-out caused by removing too much stock. Double-face tape the template to the workpiece where the bearing can ride against the templae edge while the bit trims the workpiece. This can vary with different bits and whether you're routing on a table (*above center*) or with a handheld router (*below left*).



The bearing follows the template to copy the same shape in the acrylic workpiece.



Cutting across the grain can cause the bit to become grabby and may result in tear-out. Bandsaw your workpiece close to the pattern line to reduce the risk.

Templates can be made from a variety of materials, including tempered hardboard and thick plastic. The template must be thick enough for the bearing or guide bushing to fit against it without touching the workpiece.

Cutting on a router table

A good table converts a handheld router into a stationary machine capable of performing numerous additional tasks. Many woodworkers prefer to rout on a table because it's convenient and it allows more control over cutting operations, such as making the butterfly spline blanks shown *above right.*

On a router table, the fence serves as the straightedge. The bit and fence remain stationary as you move the workpiece along the fence.

Simple cuts on the table. All types of slot cuts, whether dadoes, grooves, rabbets, or sliding dovetails, can be made on a router table. For most jobs, use a bit the same diameter as the width of the groove. If you need a groove that's not a standard bit size, make two passes with a slightly smaller bit to get the necessary width. In this case, move the fence away from the bit to avoid a climb-cutting situation.

To cut rabbets on a table, first elevate the bit to cutting depth, then position the fence to establish cut width. If the rabbet width exceeds the bit diameter, move the fence away from the bit to make additional cutting passes. This also works when cutting half-laps, as shown *opposite top.*

For other slot cuts, many woodworkers prefer to use up-cutting spiral bits because (when inverted under a table) they pull the chips and dust down and out of the cut. Also, feed the workpiece with the crown down whenever possible (see *page 8*). Use feather boards or hold-downs to hold the workpiece against the fence and flat on the table.

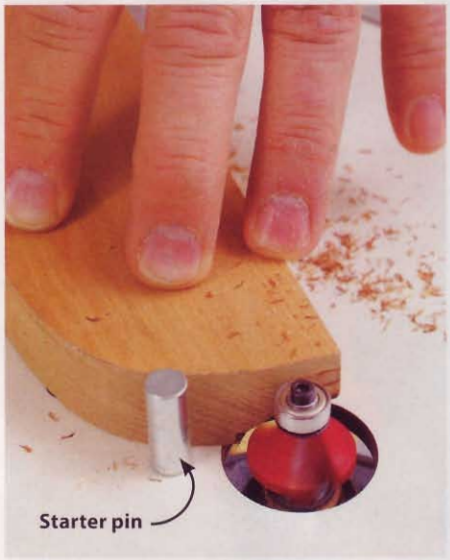
A router makes it easy to embellish your project with decorative effects, such as adding a butterfly spline to mitered joints.

Stopped cuts. Some stopped cuts, such as flutes and certain types of edge treatments (see photo, *opposite bottom*), can be made with a handheld router. In this type of cut, stopblocks are clamped to the workpiece to stop the cut at a specific spot, such as at the end of a rail.

Stopped cuts get a bit more tricky on a router table because the cut is made on the underside of the workpiece where you can't see it. See *page 63* for detailed illustrations and instructions for making stopped cuts on a router table.

Cutting multiple pieces. To rout multiple pieces fast and accurately, clamp stops to the router table fence. Lay out the cut on the workpiece, then measure from the left end of the cut to the right end of the piece. Using this measurement, locate the right stop by measuring to the right from the left edge of the router bit.

To set the left stop, measure from the right end of the cut to the left end of the workpiece. Use this measurement starting from the right edge of the router bit. Clamp the stops in place, place the



Brace your workpiece against the starter pin as you gently push it against the bit bearing.

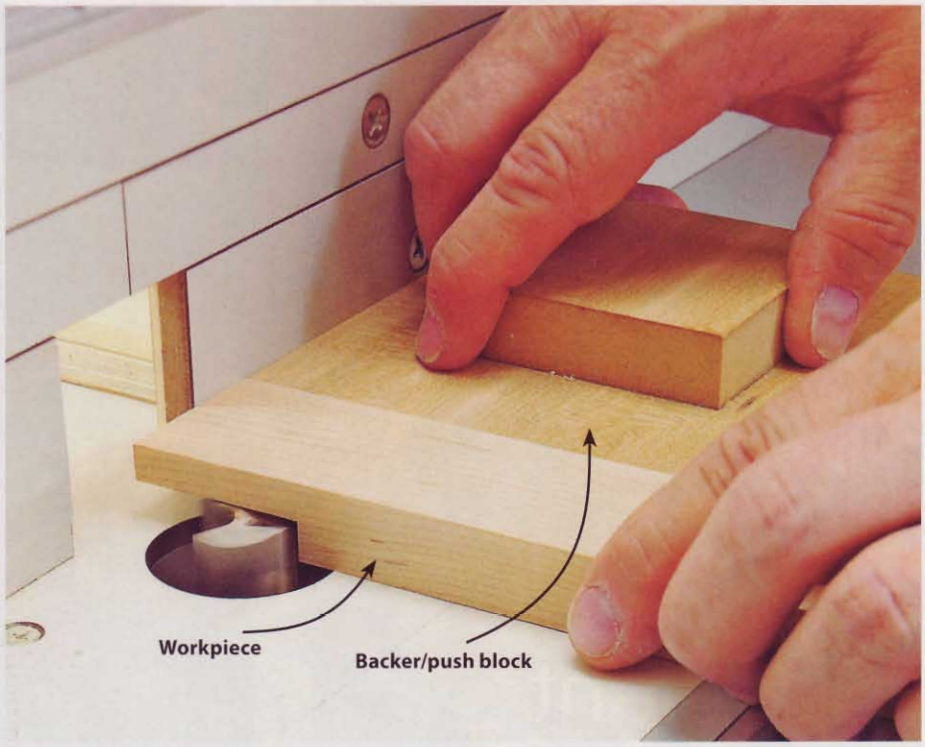
piece against the right stop, turn on the router, and ease the workpiece onto the spinning cutter. Now feed the piece to the left until it touches the left stop.

Jointing on a router. If your router table has a split fence, first align both fence sections with the front edge of the bit. Then, shim or move the outfeed side of the fence forward a distance equal to the thickness of the material you want to remove—typically 1/16". Lock the section in place. Feed the piece right to left and apply pressure against the outfeed side of the fence. For more information on jointing with a router, see *page 57.*

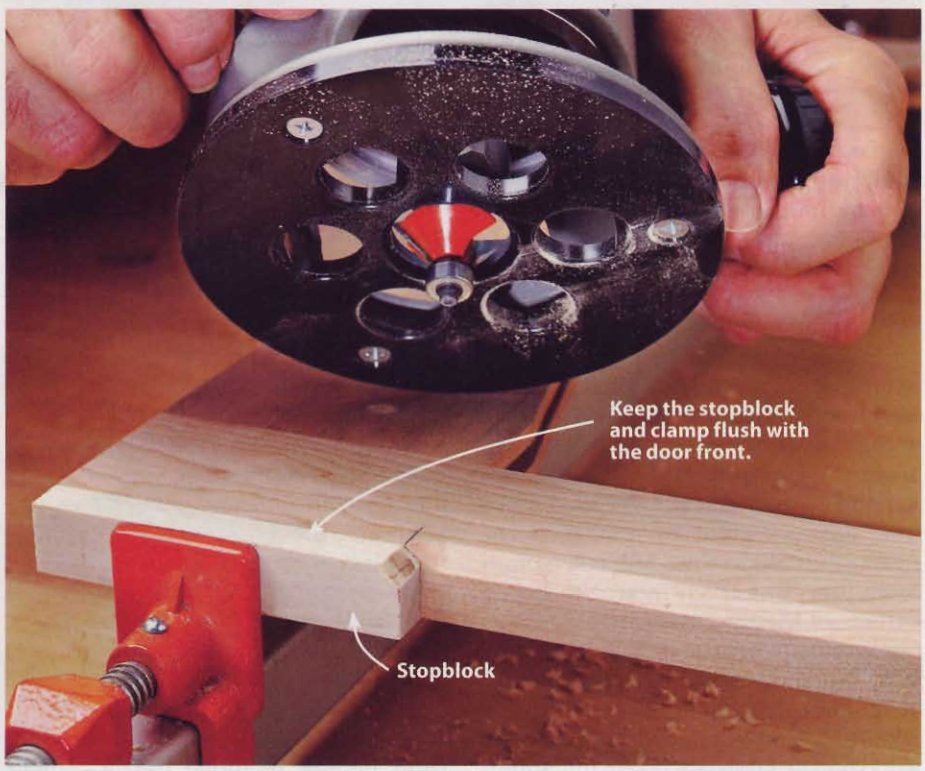
Edge profiles on curved parts. You can edge-form round or contoured pieces on a router table without a fence. It requires a piloted bit and a starter pin, as shown *above left*, or starting block to serve as a pivot point for the workpiece. To do this, first position the workpiece against the starter pin or block, then slowly rotate it into the cutter until it contacts the bearing. Feed the piece against the bit rotation. Draw it away from the bit when done.

The starter pin should be inserted into the table top an inch or two from the bit. You also can clamp a start block in about the same position on the table. Always clamp a guard over the bit so keep your fingers near the cutting edges (omitted *above* for photography).

Cutting wood joints. A wide variety of furniture-type joints can be cut with a router. Examples include tongue-and-groove, splined edge, mortise-and-tenon, half-lap and cross-lap, sliding dovetail, and numerous variations of the rabbet and dado. You can buy jigs to help cut joint parts. Many of them position the stock so the bit can be centered accurately and repeatedly. A few can be used to cut the parts. You can make many of these jigs and fixtures, as shown in Chapter 4, beginning on *page 102.*



Rabbet cuts for half-lap joints can be made on a router table. For cuts that are wider than the router bit, move the fence back from the bit and make several passes.



Stopblocks clamped to a door's inside edges stop the chamfer bit's pilot bearing, and also ensure a clean cut by preventing chip-out.

Spotlight On Router Safety

They're quick, easy, and versatile, but routers can be dangerous, too.

Routers propel a keen-edged bit at about 25,000 rpm. That's 15 to 25 times faster than an electric drill! This high speed, coupled with torque, can result in loss of control that at the least mars your workpiece. At the worst, it could result in injury. Here's how to avoid both.

Consumer Products Safety Commission statistics point to routers as the cause of accidents for 2,500 emergency-room users in a recent year. Nearly two percent of these accidents required hospitalization. Of course, those statistics scarcely stack up to yearly accidents attributed to the tablesaw—nearly 30,000. However, surgeons who face workshop injuries in operating rooms agree that routers generally inflict more difficult-to-repair wounds.

To help you get full enjoyment from your woodworking—and peace of mind while using your router—here's sound advice assembled from the safety professionals at the Power Tool Institute, a national trade association for tool manufacturers. We have also drawn from our own workshop experience here at *WOOD*® magazine.

Safety can be fashionable

Inside your shop, what you wear can directly contribute to your safety. So by all means, dress comfortably, but follow the rules.

- Always don safety goggles or prescription safety glasses with side shields, or a full-face shield. (Even with protection, always keep your face and eyes away from a spinning bit.)
- Wear hearing protection, even for short periods of router use. A router's screech can permanently damage your hearing. OSHA noise level charts indicate that a 105-dBA level (a special decibel measurement for noise) results in some hearing loss after only one hour's exposure. Routers typically produce from 105–110 dBA. And they really wail when a bit starts to dull!

The type of protection you choose must therefore have a high enough noise-reduction rating (NRR) to lower the router's ruckus to a safer plateau. So you'll need hearing protection with at least a 20 NRR to reduce the sound to an acceptable 90 dBA. (Hearing protection, from plugs to muffs, carry their NRR printed on the packaging.)

- Never wear gloves, loose clothing, jewelry, or dangling objects (including long hair) that may catch in rotating parts or accessories.

Now that you know how to dress for safety, here's how to get started with your router.

Proceed with caution

Your router may seem like a snap to operate, but looks can be deceiving. So before you begin cutting, become familiar with the router parts as diagrammed

in the owner's manual, then follow these precautions:

- When you change bits or set the depth of cut, don't just turn off your router; unplug it. And clear your worktable or router table of all tools and debris.
- Use the wrenches provided with your router to install router bits, and carefully read the owner's manual regarding the correct method.
- Be sure the cutter shaft is properly engaged in the collet. Usually, that means bottoming out the bit in the collet, then raising it 1/16". An improperly installed bit can come loose and be propelled at great speed in any direction.
- Flick the switch to the "off" position before you plug the router into the electrical outlet and when you unplug it.

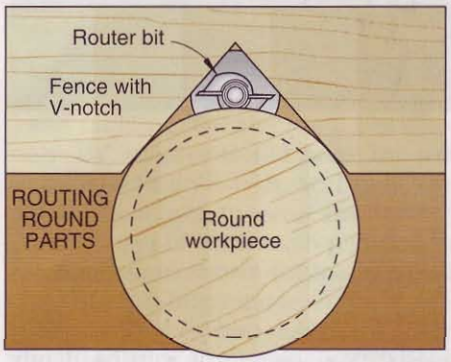
Now you're almost ready to rout. But there are still a few tips to follow.

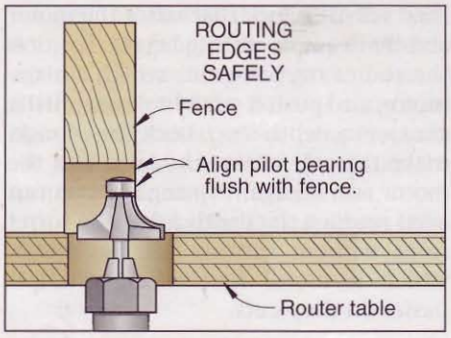
Beware: router in use

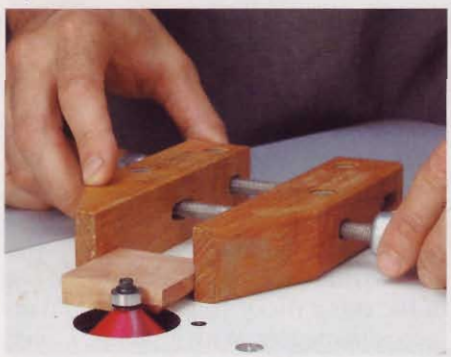
There isn't a power tool that compares with a router's usefulness when it's operated properly. However, few tools can surprise you more. So be prepared.

- Secure all clamping devices on your workpiece before doing any freehand routing, as shown at *top right*. Likewise, secure all fences and jigs before routing on a router table.
- On some types of cuts, table-mounted routers can pull your fingers into the bit. The drawings, *below,* show you two safe setups that avoid this possibility.
- If you use your router mounted in a router table, make sure the tool is tightly fastened in place, with guards in position and a pushstick and/or pushblock close at hand. When routing small parts, use a clamp like the one shown *below* to grip the part so you can keep your fingers away from the router.
- Always check to make certain that the router's clockwise rotation is cutting with the grain of the wood, or like a car that suddenly gains traction in the mud, it can leap. This will help you remember: In freehand routing, when you hold the router before you on the stock (the router should always move from *left* to *right*. On a router table, because the tool is inverted and the stock is directly in your hands, you move the stock from *right* to *left*. As an additional aid, mark a feed-direction arrow on your router table for a permanent reminder.

For handheld routing of small parts, clamp a scrap to your workbench, and apply cloth-backed, double-faced tape to the top. Press the part onto the tape for a secure hold during machining.







A wooden handscrew clamp serves as a safe "extension" of your hands, gripping the small part firmly while sitting flat on the table surface as you rout its edges.

- Keep your hands away from the cutter area when you plug the router in and turn it on.
- Because of the torque a router produces, keep a firm grasp with both hands *only* on the handles and gripping surfaces provided by the manufacture.
- If possible, always turn the cutter opening on the router away from your body while routing. If your router has a chip shield over the opening, see that it is properly and securely installed.
- Never use a dull bit. It adds to the router's workload, and if pushed, it may break and fly off.
- Never attempt to remove debris from a spinning router or bit with your fingers.
- For greatest control, allow the router to reach full speed before feeding it into the wood. Never begin routing with the bit in place against the wood, and never force a router into the wood when you're making a shaping cut.
- Keep the base of the router and its whirling cutter bit away from you when removing it from the workpiece. Let it come to a full stop before setting it down, and then always lay the router on its side clear of any clutter.
- Let the bit and collet cool after routing and before changing bits.

Written by **Peter J. Stephano**
Photograph: **King Au**
Illustrations: **Mike Henry; Kim Downing**

Plunge-Routing Basics

Learn what makes these verstile machines a step up from fixed-base routers.

Plunge routers date back to 1949, when they were first introduced in Germany by Elu, a company that was purchased by DeWalt. By the early-'80s, plunge routers became widely available in North America. Today, vendors offer more models of plunge routers than their fixed-base brethren. Many manufacturers also offer their most popular models in kits with interchangeable fixed and plunge bases. Use them both freehand, or attach one to a table.

Plunge router pluses

Its forte is making cuts on the interior surface (or *field*) of a workpiece for such tasks as mortising, stopped dadoes, inlay, and sign-routing. To make field cuts with a fixed-base machine, you need to tilt the spinning bit into and out of the cut, a tricky and sometimes dangerous maneuver. With a plunge router, the motor-and-bit mechanism slides up and down on two spring-loaded posts attached to the base.

First, you preset the cutting depth, then release a lock that raises the motor and bit to a non-cutting height. Position the router over the cut, switch on the motor, and push it straight down until it contacts a depth-stop. Lock the plunge, make the cut, release the lock, and the motor and bit again spring up. You can even readjust the depth using the turret stops without turning off the router, which is useful for making multiple passes on deep cuts.

Router ups and downs

Plunge routers make short work of some tricky cuts, but don't toss out your fixed-based router just yet. Here's why:

Plunge pros

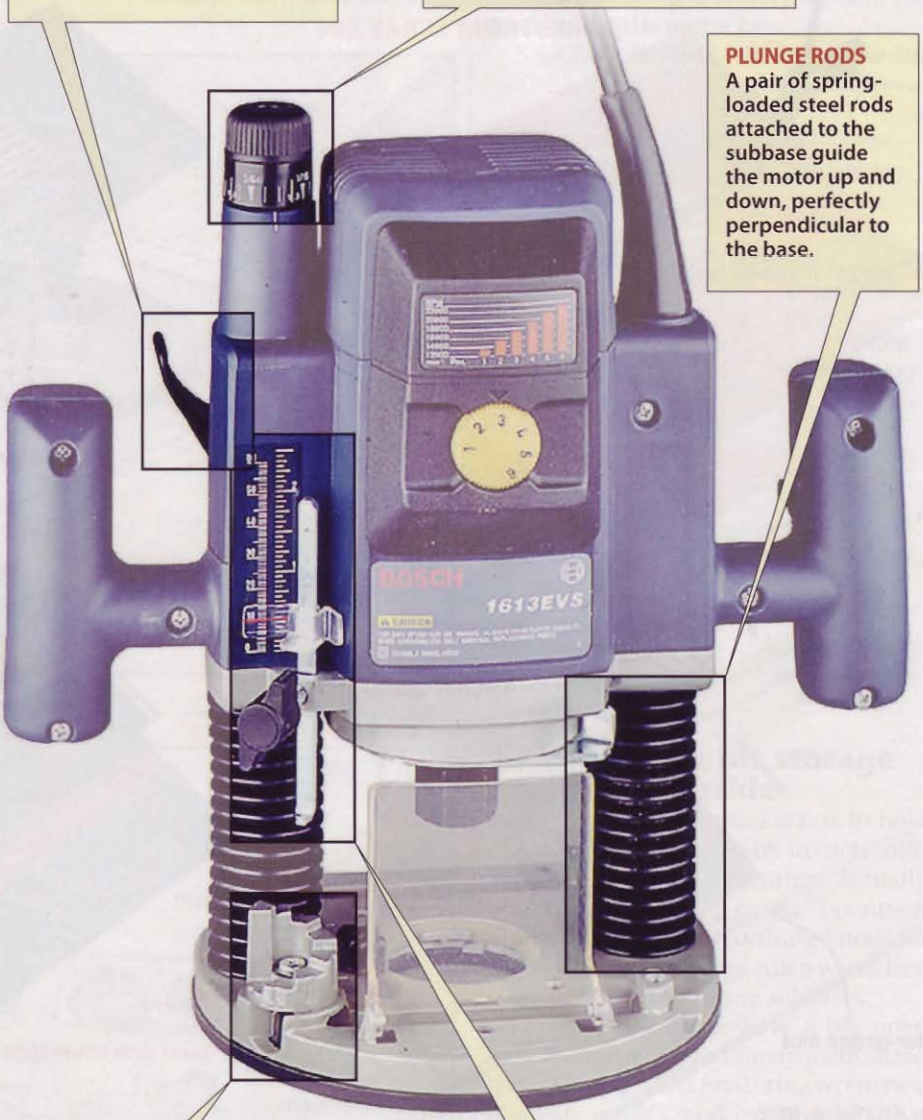
- A plunge router is safer than a fixed-base model because its bit protrudes only when cutting.
- Plunge routers typically offer more power—up to 15 amps—and most have variable-speed control, which fixed-base machines sometimes do not. These are major considerations if you plan to table-mount your router and work with large bits, such as panel-raisers.
- For a table-mounted router, the plunge router's depth-adjustment knobs control bit-height changes more precisely. To take advantage of this feature, you may need to extend your router height-adjustment knob. Several manufacturers include knob extensions with their plunge routers, or you can buy an extension for $20 or so.

Plunge cons

- Plunge routers cost and weigh more than fixed-base routers, and offer no advantage on edge cuts. If you'll make mostly edge cuts in your work, you may be better off purchasing a lighter and less expensive fixed-base tool.
- Not all plunge routers work well suspended upside down under a router table. Falling dust can gum up unshielded plunge-posts, which you'll need to clean periodically.
- When mounted in a table, adjusting the bit depth of some models is an awkward, two-handed operation. With others, removing the plunge mechanism springs, which makes it easier to raise a table-mounted router, requires dismantling the machine's motor housing—a procedure we don't recommend.

Anatomy of a Plunge Router

Although they perform many of the same duties, plunge routers look distinctly different than fixed-base routers. Beyond the motor, collet, and handles—parts common to both styles—a plunge router also has the following:



PLUNGE LOCK
Tripping a lever, or squeezing or twisting a handle, locks the bit's depth after it has penetrated the workpiece. Releasing the lock lifts the bit at the end of the cut.

MICRO-ADJUST
This feature fine-tunes the cutting depth with micrometer accuracy.

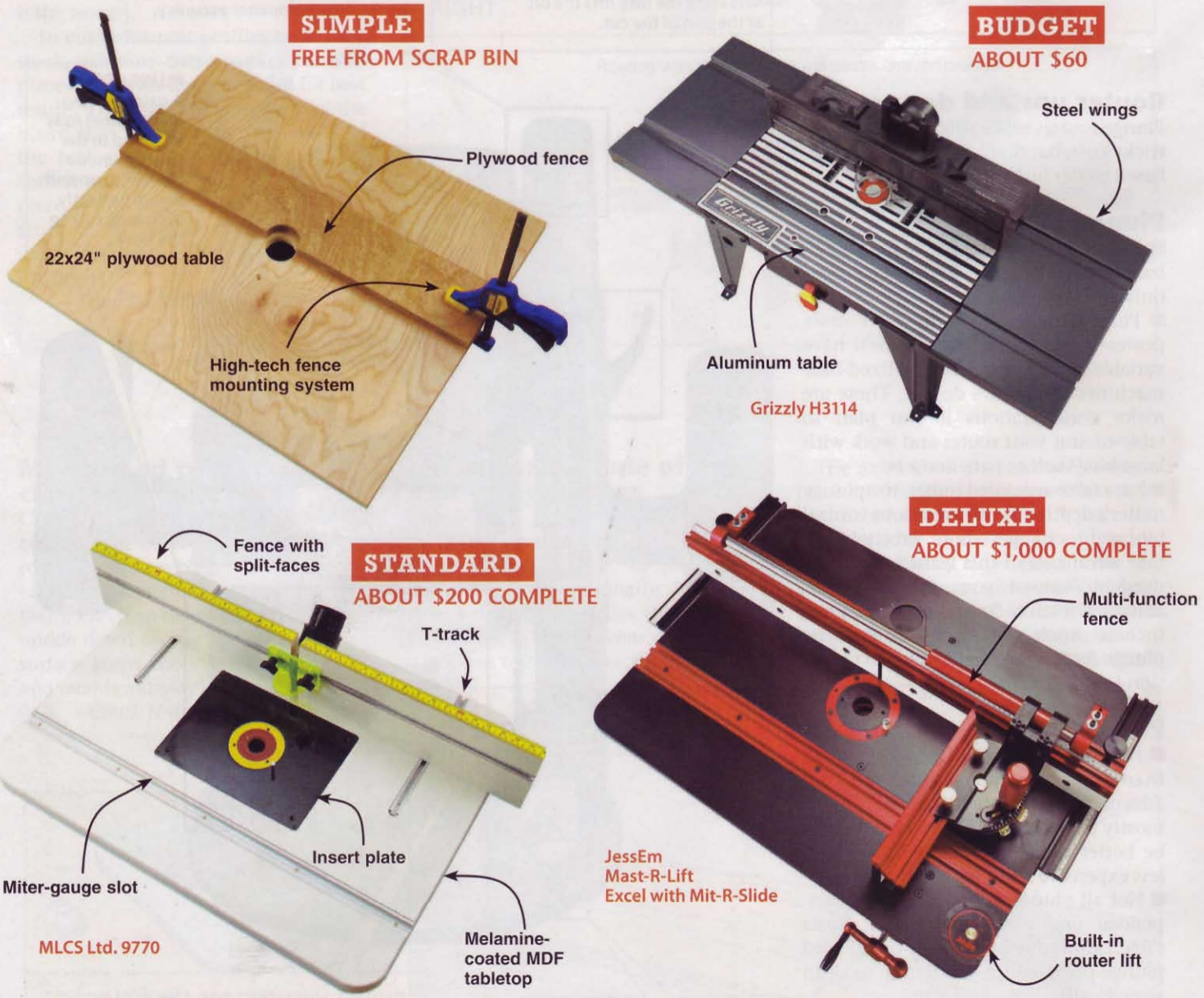
PLUNGE RODS
A pair of spring-loaded steel rods attached to the subbase guide the motor up and down, perfectly perpendicular to the base.

TURRET STOPS
For a project that requires progressively deeper cuts, such as deep mortises, you can preset the steps on a turret. Rotating the turret enables you to quickly step from one depth to the next.

DEPTH ADJUSTMENT ROD AND SCALE
Not all plunge routers offer a depth-of-cut scale, but all have an adjustable rod that helps you halt the plunge at a precise preset depth. With most plunge routers, you "zero" the tool by locking it at the work surface. Then you set an adjustable cursor to "0" on the scale. The scale tells you the depth of the dado, mortise, or other cut you'll be making.

From Simple to Deluxe—How to Choose a Router Table

Options and accessories abound for table-mounted routers. We'll sort out what matters most to help you pick the table setup that best suits your needs.



Woodworkers love their router tables—and with good reason. These useful accessories offer cabinet-shop capability for profiling an edge or cutting joints, and they make these tasks easy, accurate, and safe.

Not surprisingly, manufacturers have responded to woodworkers' appetite for router tables and accessories with an array of products—everything from basic tables to tricked-out machines with the features of a full-fledged spindle shaper. We've tried nearly all of them. To help you benefit from that experience, we've pooled our best advice on the subject so you can find and outfit a router table ideally suited to your shop size, routing needs, and budget.

5 Choices that make a difference

Choice 1: Get your work-surface needs on the table

Which router table to use—stand-alone, benchtop, or tablesaw-mounted—should be your first decision. Thankfully, you no longer need to choose a stand-alone model to get a full-featured router table. Today's benchtop and tablesaw-mounted versions offer all the bells and whistles you could ever want, as shown at *near right*.

It makes sense to replace your tablesaw extension table with a router table, as shown at *far right*, if you're tight on shop space. If your projects take you outside the shop, or if you'll only use a router table on occasion, go for a benchtop unit. You can stow it away or hang it on a wall to save space.

If you have the room, a stand-alone table provides the most versatility. Place the table on wheels, then position it wherever you want. A stand-alone (or benchtop) table can be set up for an operation and left without interfering with other tool operations.

Bottom Line: Space and portability may dictate your decision here, but if you have the room, opt for a stand-alone table. Besides maximizing your flexibility, a stand-alone table usually offers the widest range of tabletop sizes and the most storage and dust-collection options.

Bench Dog ProTop Contractor

This benchtop model offers an enclosed cabinet, multi-function fence, and an inset plate predrilled to fit almost any router.

Bench Dog ProMAX

This tablesaw-mounted router table shares all the amenities found on the manufacturer's stand-alone model.

Choice 2: Look at options in tabletop materials

Manufacturers make tabletops in a variety of materials. Most consist of a core made of medium-density fiberboard (MDF) covered with either plastic laminate or melamine. This combination produces a table that's flat, economical, and durable.

Channels that are cut into MDF will wear, so manufacturers often equip these tables with aluminum tracks to guide the miter gauge and fence. Know also that MDF can absorb moisture and swell if placed in particularly damp environments. Seal any exposed MDF to prevent such absorption.

Several manufacturers now offer tabletops made of phenolic resin, a rock-hard, stiff, and durable plastic. These tables come dead flat and boast immunity to moisture changes. Phenolic machines well, meaning you can mill a miter-gauge slot or slots for T-tracks or fence mounts directly into the tabletop. On the downside, phenolic tabletops cost 10 to 20 percent more than MDF.

If you prefer heavy metal, your tabletop options include aluminum, plate steel, and cast iron. These tables are ground smooth and flat, and are very durable. Typically, they're equipped with miter-gauge slots. Note that you'll have to keep rust off steel and iron versions. Aluminum tables won't rust, but can corrode. And uncoated aluminum may leave marks on wood.

Bottom Line: MDF ranks as our top choice for tabletops. These are priced right, durable, and sold in a variety of sizes. Plus, MDF cuts and machines easily if you want to modify the tabletop.

MLCS Ltd. #9595 Cast-Iron Table

Veritas Router Table Top #05J20.01 with fence #05J21.01

The cast-iron router table (*left*) resembles a tablesaw top. The plate-steel version (*right*) offers similar traits of flatness and heft, but has no miter-gauge slot.

Choice 3: Gauge your miter-gauge preferences

Router tables perform best at machining the edges of workpieces. So what if you need to rout across the end of a board? Most tables accomplish this with a built-in track that guides a standard miter gauge (which you supply). This slot often doubles as a handy place to mount accessories, such as feather boards.

Some router-table users prefer instead to use a shop-built miter sled that rides against the fence. With a sled, the workpiece stays square to the fence face whether or not the fence sits perfectly parallel to the miter-gauge slot.

Bottom Line: A miter-gauge maximizes flexibility, allowing you to dado and cut slots, even at an angle, such as when splining a mitered joint. A sled may raise the workpiece beyond the bit's cutting height.

Choice 4: Pick an insert

Most tables have an insert plate that fits into a rabbeted opening. The router bolts to the plate—which is typically made of phenolic, aluminum, or polycarbonate—using existing holes in the router base. You also can buy insert plates separately and fit them to your table.

A removable insert plate offers two advantages over bolting the router directly to a solid tabletop. First, at 1/4" to 3/8" thick, a plate allows greater cutting height than if the bit had to reach through a 1" or thicker tabletop. Second, a plate makes the router easily removable. You'll appreciate this when you need to change bits, as shown *below*.

The insert plate must sit flat and flush with the table surface. If it doesn't, your workpiece may catch on protruding edges. Make sure that either the tabletop or plate has jack screws or another leveling system to make the plate fit flush with the tabletop.

Some manufacturers design a slight crown into the plate. If the weight of the router flexes the plate, it forces it flat rather than creating a concave surface.

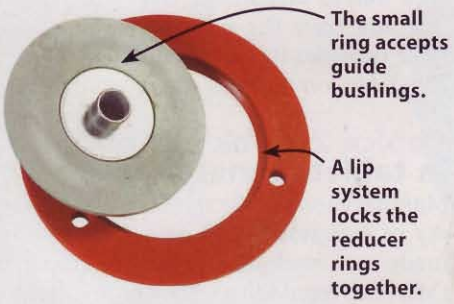
Because router bits range from less than 1/4" to more than 3" in diameter, choose an insert with interchangeable reducer rings to adjust the bit opening, as shown *below*.

Bottom Line: What plate material you choose is less important than getting one with reducer rings and a leveling system. These features cost extra, but are worth it. So is a table with a built-in lift. *(See example on page 18.)*

These three types of insert plates hold the router base firmly in place, remove easily for bit changing, and are thin enough to allow full cutting capacity. Each is made of material that resists sagging with weighty routers.

IT'S EASIER TO CHANGE BITS FROM ABOVE THAN BELOW

Lifting the router and insert plate out of the table (left) simplifies bit changing by allowing full access. If the router bolts directly to the table (right), a tilting top facilitates bit changes.



Reducer rings fit into the insert plate to safely support the workpiece.

Choice 5: Pick a fence

Unless you're using a bearing-guided bit, most router-table operations require a fence to guide the workpiece. To work properly, a fence has to measure flat from end to end, hold the faces square to the tabletop, and adjust easily.

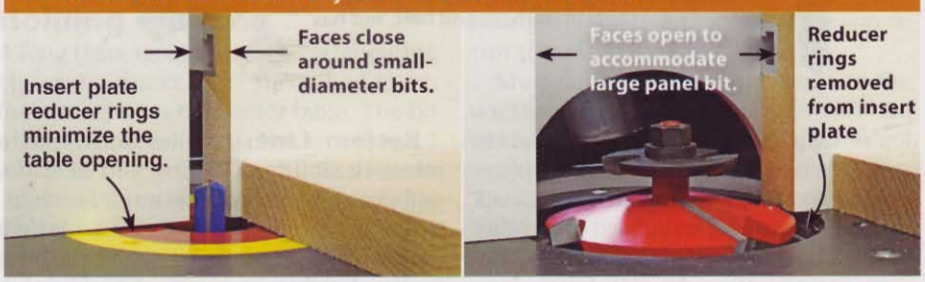
Split faces that open and close to change the size of the gap around the bit, as shown *below*, perform best. By allowing you to offset one face, the split faces on some fences allow you to joint board edges, as shown at *right*. This feature is handy if you don't have a jointer.

Beyond these basic functions, find a fence with T-tracks or other mounting points for such accessories as feather boards and stop-blocks, bit guards, and auxiliary jigs. If the fence doesn't come with a port to accept a vacuum hose, get one. By connecting to a shop vacuum or dust-collector hose, you can collect most of the dust and chips your router produces. Most commercial fences offer these features, as does the fence we designed on *page 94*.

Bottom Line: The best fences offer split faces, accessory-holding tracks, and a sturdy frame (usually extruded aluminum). Choose one that's at least as wide as your tabletop, and check the attachment system. Some require that you mount tracks in the tabletop; others clamp in place. A few can be mounted either way.

The outfeed side of some fences moves forward with spacers or adjustment screws for edge-jointing boards with a straight bit.

SLIDING FENCE FACES ADJUST TO SUIT ANY SIZE BIT



You can adjust sliding fence faces to fully support the workpiece on the infeed and outfeed sides of the cut, no matter what size bit you use. To get the best performance, always set the smallest gap possible around the bit.

How to Table-Mount Your Router

Whether you make a router insert plate or buy one, you can attach it to your tool and install it in your table with just a few easy steps.

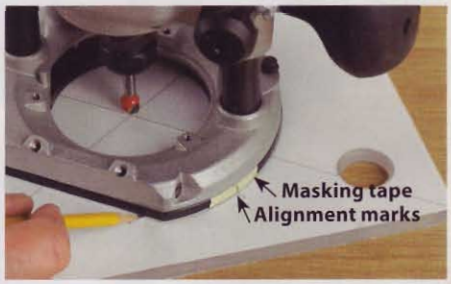
Precision counts when you mount a router under a table. Ideally, you want the router and its insert plate to lift out easily when necessary, and to stay solidly in position while you rout. If you're using a commercial insert or an insert-based router lift, proceed to the section titled "Cut the table opening," *opposite*. If you are making your own insert, start right here.

Prepare the insert

1 Buy a ⅜×12×12" piece of acrylic or polycarbonate plastic from a woodworking store or catalog. (Woodcraft carries acrylic [item 16L71] for $15.50 and polycarbonate [16L72] for $20.50. Visit woodcraft.com, or call 800-225-1153.) Either type works fine; acrylic is somewhat stiffer, while polycarbonate offers greater resistance to shattering. You can use the piece as is, or trim it to your preferred dimensions with a fine-tooth laminate- or plywood-cutting blade in your tablesaw. Check for squareness at every corner.

2 Chuck a 1" Forstner bit in your drill press, and drill a pair of finger holes near opposite corners of the insert to help with quick installation and removal. We centered ours 1½" from each of the adjacent sides. Ease the top and bottom edges of the holes, using a ⅛" round-over bit in your router.

3 With the protective covering still in place on the insert, use a pencil or marker to draw diagonal lines from opposite corners of the insert to find the center. Install a V-groove bit and position the router so the bit point contacts the center, as shown at *right*. Rotate the router so that the handles fit within the perimeter of the insert plate. Trace around the router's plastic subbase.

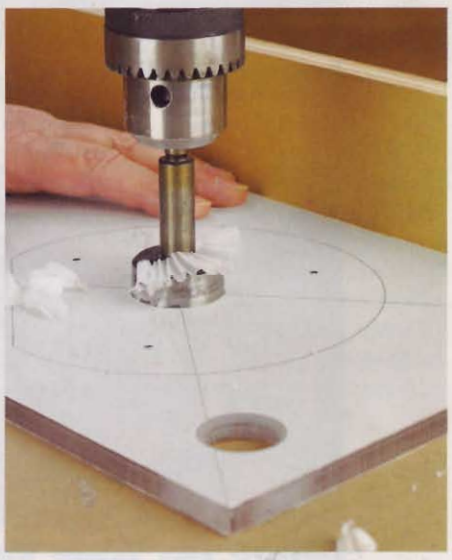


To position a round subbase on an insert, stick a piece of masking tape on it, mark it with the pencil, and make a matching mark on the plate, as shown here.

4 Remove the subbase from your router. Place two strips of double-faced tape on its face. Position it on the insert to match the traced outline. Using a self-centering bit, drill holes through the plate at each of the subbase mounting holes, as shown *below*.

Size the insert holes to match your router's mounting screws. After drilling through the insert, flip it over, and countersink the holes for flathead mounting screws, or counterbore them for panhead screws.

5 Select a Forstner bit with a diameter ⅛" larger than the largest router bit you intend to use. (We used a 1½" bit.) Chuck it in your drill press, and drill a

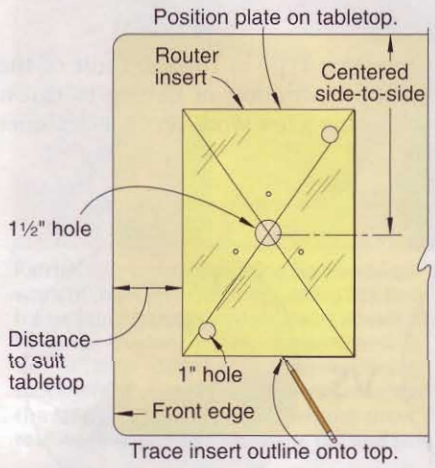


The less clearance between bit and insert, the better. For safety and convenience, make two or three inserts with different-size bit holes.

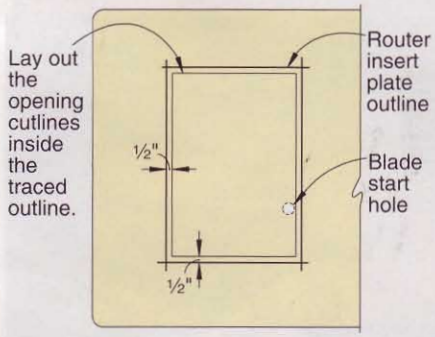
through hole at the previously marked centerpoint, as shown *below.*

Cut the table opening

1 Position the insert on your router table, centered from side to side, and far enough from the table's front edge to allow for a miter-gauge slot and an adequate work area. Trace around it with a pencil, as shown *below.*

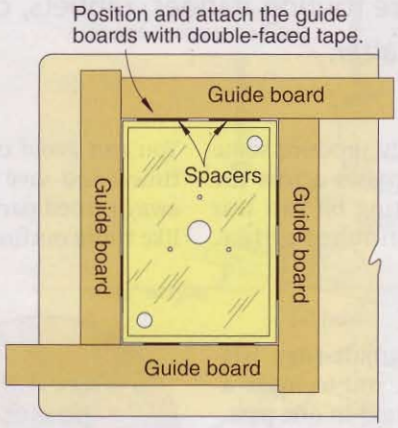


2 Draw lines ½" inside the insert outline to form a smaller rectangle, as shown *below.* These lines serve as cutting lines. Drill a start hole for your jigsaw blade, and carefully cut out the opening.



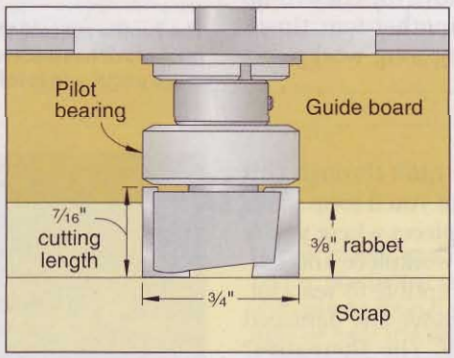
3 Now, prepare to rout a rabbet that will support the insert. Cut 5"-wide guide-board stock from flat ¾" material. Medium-density fiberboard (MDF) is a good choice. Crosscut five guide boards of equal length (you'll use one as a test piece); the length should be slightly more than the longest edge of the plate outline plus 5". Apply two long strips of cloth-backed, double-faced tape to the bottom of each of these guide boards.

Align your insert with the traced outline, and place the guide boards as shown *top center,* using single playing cards as spacers between the insert and the guide boards. These spacers create enough extra room to make your insert easy to set in place and remove, without allowing any significant movement while routing. Tap down on the guide boards with a rubber mallet or apply pressure with clamps to bond the tape firmly. Remove the insert.

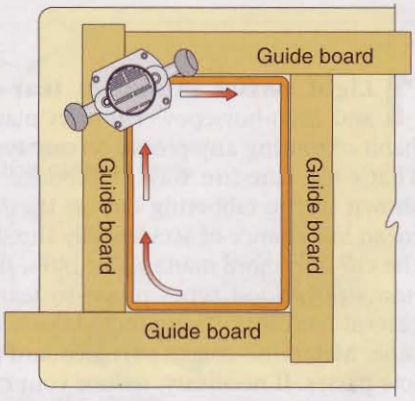


4 Next, affix your test guide board on a piece of scrap with double-faced tape, and then clamp the assembly to your workbench. You'll use this test piece to sneak up on the needed rabbet depth for an exact flush fit.

5 Install a pattern-cutting bit or dado-cutting bit in your router. Such a bit features a top-mounted pilot bearing, as shown *below.* The diameter of the bit determines the radius to be shaped at each corner of the opening, and the length of the bit must be appropriate to the planned depth of the rabbet and the thickness of the guide boards. For example, to make a rabbet ⅜" deep with ⅜" radiused corners, we used Woodline USA's WL-1011-D dado-cutting bit with a ¾" diameter and a 7/16" cutting length. Call 800-472-6950 to order this bit, priced at $16 plus postage.



6 With the router base resting on the surface of the guide boards, adjust the cutting depth to rout ⅛" deep into the tabletop. Then, working clockwise as shown at *top right,* guide the pilot bearing along the inside edge of the guide boards and begin to rout the rabbet. Also rout along the edge of your test piece, as shown at *bottom right.* Lower the bit ⅛", and make a second pass on both the router table and the test piece. Again lower the bit ⅛", but this time rout only partway along the test piece and hold the insert in that rabbet to check the fit. Adjust the depth if necessary, and test again. Repeat this process until the insert rests flush with the top of the test piece. Now, make a final pass on the router table for a perfect fit.



The insert must sit flush with the tabletop so workpieces don't catch as they move past the router. Using a test setup guarantees that you'll hit the correct rabbet depth.

Install the insert and router

1 Sand the corners of your insert so they match closely the radiused corners of your rabbet. Install the insert on your router, replacing the subbase mounting screws with longer ones if necessary. Make sure to buy screws with the same diameter and thread type as the originals.

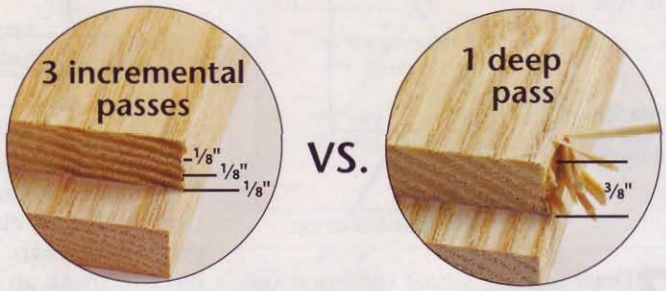
2 Peel off the guide strips around the table opening. Set the insert and router into it, and your router table is ready for action.

3 Ways to Eliminate Tear-Out

A clean cut is essential whether you're routing dadoes, rabbets, or decorative edges. Here's how to get the results you're after.

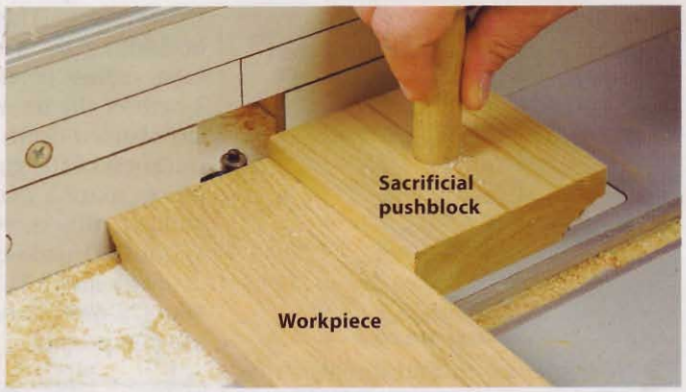
Your first attempts at routing will likely produce some undesirable side effects. As a router passes across the end of a workpiece, the rapidly rotating bit can tear away wood fibers on the edge, spoiling the finished surface. You can avoid or eliminate this type of mishap most of the time—and save yourself the frustration of having to throw away ruined parts—by adopting a few work-savvy techniques like those outlined below.

1 Light passes minimize tear-out. Carbide-edge bits and high-horsepower routers may tempt you to make a habit of routing any profile on any type of wood in one pass. That's the sure-fire way to produce tear-out, like the kind shown in the rabbeting cut on the *far right*. Shallow passes mean less chance of accidentally shredding an edge, so divide the cut into more manageable bites, like the ones used at the *near right*. Wood types prone to tear-out deserve especially careful handling. These include oak, ash, and some types of pine. Melamine-coated particleboard also benefits from shallow passes. If necessary, reduce your cutting depth to 3/32" per pass and slow down the feed rate.



Even without a backer board, dividing the cut into three passes of 1/8" each produced smooth edges in the rabbet on the left. The 3/8" rabbet on the right was cut in a single pass with no backing.

2 Blocks play a supporting role. Backing up your cuts makes as much sense when routing as when using a tablesaw. In both cases, you transfer the tear-out to a piece of scrap instead of your project parts. When routing, combine tear-out prevention with safety by using pushblocks to keep fingers a safe distance from spinning bits. With router pushblocks, because of the many different bit profiles, you need either lots of blocks or ways to reuse the same block. One solution: Make this sacrificial pushblock, shown at *right*, from a 4"-square piece of scrap that's been drilled to accept a dowel handle. Use it once, turn it 90°, and you have a fresh backing to use with your next bit, plus up to two more sides standing by. Make these blocks large enough and you can remove the chewed-up edges on your tablesaw and reuse them another four times. Larger blocks double as braces for keeping long workpieces perpendicular to your router-table fence.



The profile cut into the back edge of this pushblock shows that the pushblock has backed up one router bit already, but still has three more uncut edges left.

3 Plan your passes. You may need to think through this cutting sequence the first few times, but you'll soon make it a habit after seeing the results. On workpieces where you're routing all four edges, don't just spin the workpiece and cut. Edge grain near the ends is the most susceptible to tear-out, but cutting the ends first allows you to remove any damaged areas at the same time you rout the edges. The alternative? There is none. Cutting the edges first, as we did on the sample board shown at *right*, leaves profiles vulnerable to tear-out. If you're still having tear-out problems, use multiple passes and leave less than 1/32" of material for your final pass.

Avoid tear-out by cutting the ends first and then the edges.

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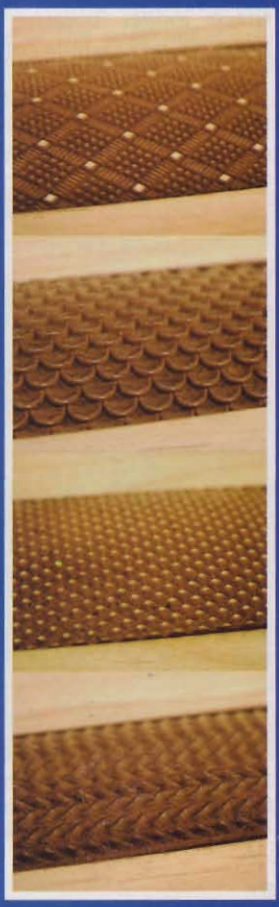

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20 Years in 08

Learn Not To Burn

Don't let router bits get you or your wood overheated.

Want to prevent those annoying burn marks that leave your routed edges black and your face red? Keep cool by putting the following tips to work.

Keep it clean

Ideally, you should wipe your bits clean after each use. Most of us, though, just drop them back in their holders and walk away. This allows resin and dust build-up, causing bits to heat faster and burn the wood.

If your bits are covered with sawdust, wipe them with a dry cloth. Remove any stubborn build-up with a blade-and-bit cleaner. The benefit: Clean bits stay sharp longer because excessive heat breaks down carbide cutters.

Stay sharp

A dull bit cuts poorly and builds up heat doing so. If you can run the cutter over your fingernail without shearing off a shaving, then the bit needs sharpening.

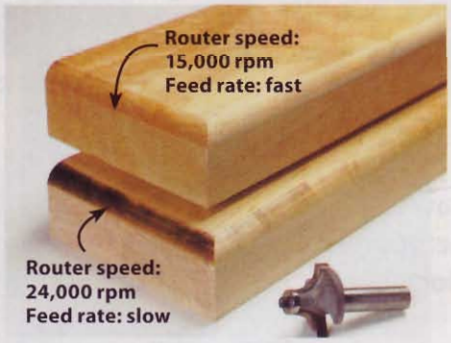
Remove pitch to keep bits cool. Diamond lapping stones (about $7 each) keep a keen edge between professional sharpenings.

To freshen up router-bit cutting edges with diamond lapping stones, hone only the flat surfaces. Count your strokes to make sure you remove the same amount of material from each cutter to keep the bit balanced. It only takes a half-dozen or so strokes with each stone. If that doesn't restore cutting ability, have the bit sharpened by a pro or replace it. For more bit maintenance tips, see *page 50.*

Set speed limits

Router bits spin up to 24,000 revolutions per minute (rpm). And most bits have two cutters, so they take up to 48,000 bites every minute. That's why bits and wood heat up in a hurry. To keep things cool, set your router speed according to the chart, *above right.*

Another way to keep heat in check is by controlling the rate at which you feed the bit into the workpiece. A slow rate creates more heat. Using a fast and consistent feed rate will keep the bit and wood cool.



We used the same router and dull bit to round over these maple pieces (cut from the same board). The results are quite different.

MAXIMUM ROUTER SPEEDS

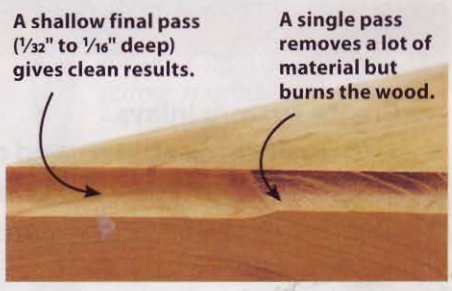
Bit Diameter	Max. Speed (rpm)
Up to 1"	Up to 24,000
1 to 1¼"	16,000 to 18,000
1¼ to 2¼"	12,000 to 16,000
2¼ to 3½"	12,000

Watch your woods

Some woods, such as oak, don't easily burn. Maple and cherry burn notoriously because of their density and the oils and extractives they contain. Among softwoods, pine can be troublesome in areas that contain pitch pockets. With these species, slow the router speed and increase feed rate to minimize burning.

Take it one step at a time

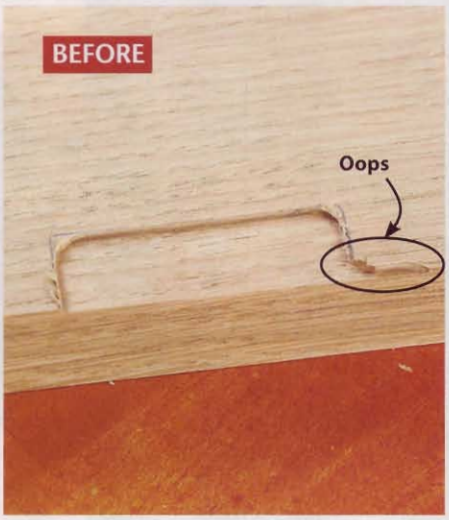
Powerful routers and sharp carbide-tipped bits are capable of hogging out large cuts in even the hardest of woods. But doing so stresses the bit, causes tear-out, and leads to burning. When removing more than ¼" of material, make multiple shallow passes, as shown *below.*



Even in burn-prone woods, such as cherry, making a shallow final pass keeps the bit and wood cool to eliminate most burns.

Make Router Miscuts Disappear

These five simple steps hide accidental gouges.



A bumped elbow, or just a slip of the hand, and there it is—a router miscut. Even with your best efforts, you can't always keep them from happening. One common example: You built cabinet doors, carefully measured and marked the hinge locations, and set the router bit to cut to the correct depth. Just as you complete the recess for the hinge mortise, the cord catches and you accidentally rout outside the marked lines. Is the door ruined? Absolutely not! A simple angled inlay creates a nearly seamless grain match guaranteed to restore the woodwork and a smile to your face.

SCRIBE THE AREA TO BE PATCHED

1 With a sharp knife and clamped straightedge, scribe a diagonal line outside of the mistakenly routed area. By scribing a long line that angles only slightly across the grain, the patch will effectively blend with the surrounding grain. Always avoid butt joints that cut across the grain—those patches will stick out like a sore thumb. Using a straight bit and a secured straightedge, carefully rout the area to the same depth as the mortise.

CUT A PATCH TO FIT THE RECESS

2 From matching wood, rip a strip slightly thicker than the recess depth. Align the grain of the strip and the workpiece. Then cut a patch slightly larger than the routed area. Test it in the recess for fit and grain match.

APPLY GLUE TO THE RECESS

3 Next, apply wood glue. Clamp the patch snugly with tape until the glue dries.

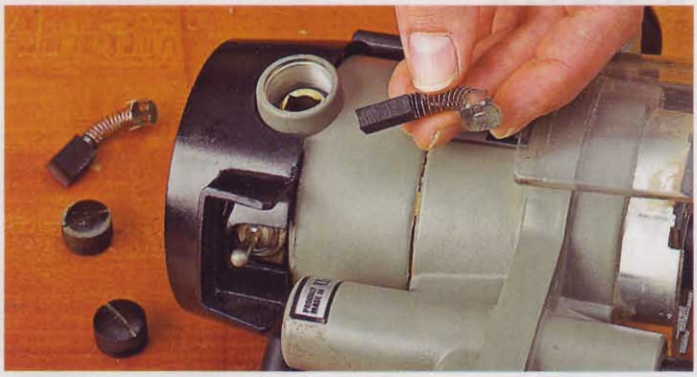
4 With the glue completely dry, remove the tape. Using a sharp block plane or sanding block, level the patch flush with the surrounding area.

TRIM THE PATCH FLUSH WITH THE SURFACE

5 Trim excess patch from the door edge and face (use a low-angle block plane). Then, using a sharp chisel, square the mortise. Test the fit of your cut by placing the hinge in the mortise.

Plunge-Router Care and Maintenance

10 top problems and how you can prevent them from happening



Replacing the carbon brushes that transfer power to your router is one of several simple fixes you can perform in your workshop.

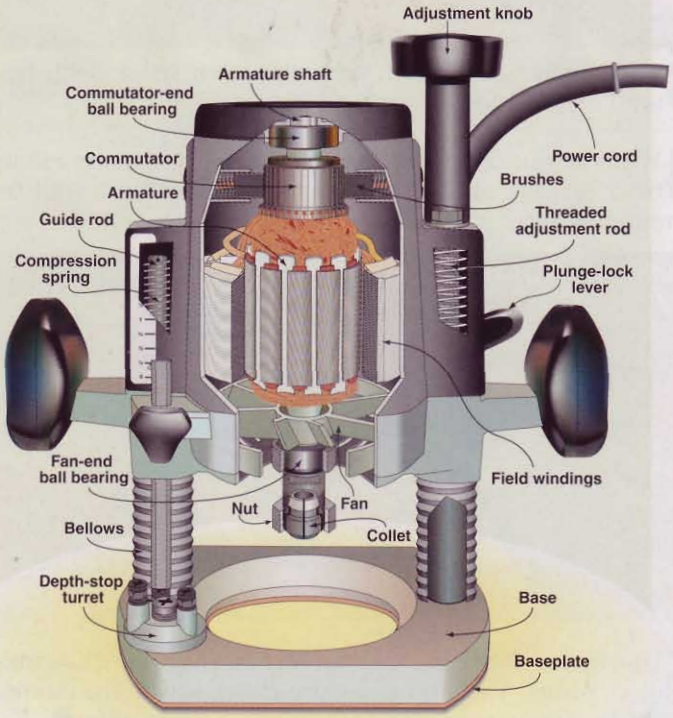
Considering their incredible versatility and flexibility, it is not surprising that the plunge router ranks as the favorite tool in many workshops. However, there's a price that comes with such popularity. After many hours of hard work, a few years of neglect, or perhaps an accidental fall off your bench, even the best-built router will need some TLC.

We narrowed the list of common plunge router problems down to 10. By learning what to look for, you can find and fix small problems or know when it's time to send your tool to the repair shop. Ignore these problems and you could cause serious damage to your router, your next project, or even yourself. Because "an ounce of prevention is worth a pound of cure," we've also suggested a few items (shown *below*) for you to use to help your router perform at its best for years to come.

continued on page 30

Tool tour

Your router may look a little different from this example, but it contains the same basic parts. We've given you an inside view to help you understand how everything works. Just realize that some manufacturers advise against tackling any repair that requires you to remove the housing. Whether the repairs are done at home or in a repair shop, make sure to use replacement parts made for the brand and model of your tool. Substitutes will void the warranty and may damage other parts within the tool.



Your clean-machine kit

You only need to invest in a few items to keep your router running like a top for years.

1. Air compressor or canned air. Blowing through the air vents removes dust before it smothers the motor or cakes up electrical contacts. (Vacuuming works, too.)

2. Graphite or Teflon-type lubricant. Dry lubricants offer slipperiness and rust resistance without sticky residue.

3. Wax. Works as both a cleaner for removing pitch, and as a lubricant for baseplates and guide rods. Apply sparingly, and then buff off excess with a dry cloth.

4. Toothbrush, brass brush, fine abrasive pad. Good for removing light rust or pitch, but use gently. Use Teflon-safe kitchen pads to clean collets and guide rods.

5. Pitch remover. Use to remove caked-on crud on the baseplate and guide rods, but be careful around electrical contacts, lubricated bearings, and plastic parts.

Sources

Brass collet brush set. No. 146736, $11.43. **Top-Cote lubricant.** No. 124624, 5.5 oz., $13.99. Woodcraft. Call 800-225-1153 or go to woodcraft.com. **Collet stretcher.** No. 9464 for ½" router bits, No. 9468 for ¼" router bits, $24.95. **Dead man foot pedal.** No. 9080, $21.95. MLCS. Call 800-533-9298, or go to mlcswoodworking.com.

Plunge Router Troubleshooter

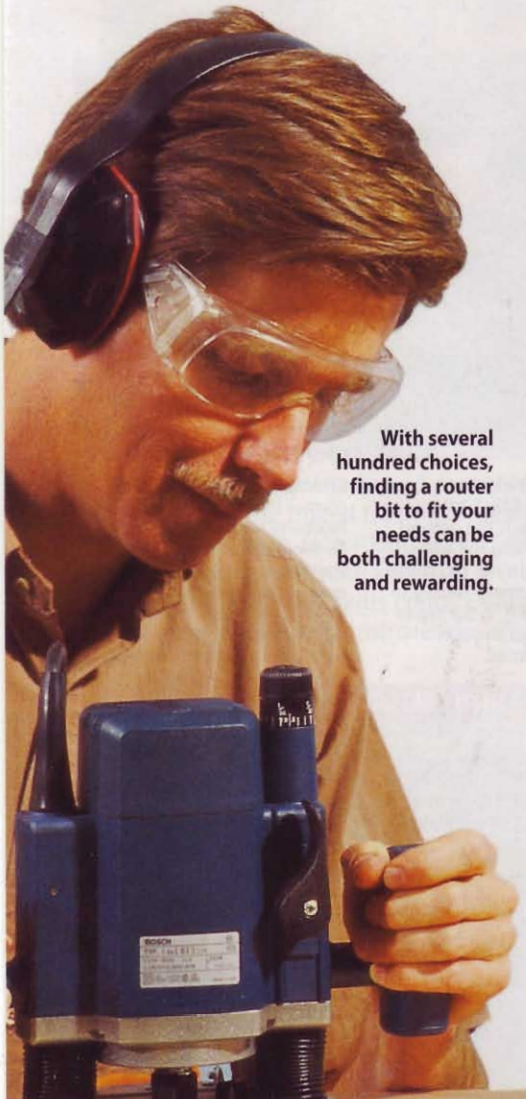
Problem	Diagnosis	Fix	Difficulty/Cost	Prevention
#1 Plunging Imperfections A smooth, comfortable plunge action makes for precise mortises and stopped cuts. A plunge action that stalls on the downstroke is annoying; one that sticks on the upstroke can be dangerous.  **Disassembling the plunge mechanism isn't always necessary, but doing so makes it easier to clean and lubricate all the parts.**	Release the plunge lock and then test the plunge movement. General sluggishness usually points to pitch build-up. If you feel a sticking point, inspect the guide rods. You're likely to find a dent left by a slipped wrench, or by that short "ride" off your bench.	General sluggishness: Clean guide rods with a toothbrush or fine abrasive pad. Lubricate bars with dry graphite or Teflon-type spray. Don't use too much. Apply lubricant to your cloth, and then wipe the guide rods. Sticky spots: File or sand off the burr. Finish up by lubricating both rods. **WARNING:** Don't use grease or oil; it attracts dust that eventually will build up and gum up the action.	Easy to Moderately Difficult/ Cheap ($0, assuming you already own some cleaning gear)	Wipe off pitch, dust, and chips before they build up. Keep the bellows clean and uncracked; they'll keep crud from reaching the rods in the first place. For table-mounted routers, periodically disassemble the plunge mechanism to completely clean out sawdust.
#2 Banged-Up Baseplate The baseplate, or subbase, is the bearing surface between the tool and your work. Sticky buildup can hang up your router in mid-cut and burn an edge. A deep scratch can leave a sharp burr that will mar delicate surfaces.	Flip your router and run your fingers across the working face of the baseplate. Pitch streaks and burrs are tough to miss. Minor scratches are acceptable, but the baseplate should feel slick and smooth.	Pitch build-up: If you can't erase the crud with paste wax and an abrasive pad, try pitch remover. Then wax the plate to make a smooth sliding surface. Burrs: Use a sanding block and 320-grit paper or a file to level any protrusions.	Easy and Cheap (Repairs $0; New baseplate, $0 if you make it yourself, otherwise $25) 	Make sure that nails and screws and other hardware items are countersunk below the surface before routing. Plan for future mishaps by using a shop-made baseplate, or keeping a spare handy, just in case. **Use 320-grit sandpaper to remove scratches and dings from your baseplate before they leave nasty scratches on your work. Finish up with a light coat of wax.**
#3 Trashed Baseplate Most factory baseplate openings are sized to hold guide bushings. However, a large-diameter bit can damage the retaining lip of the opening, making it too big to hold guide bushings.	You can't miss the smell of routed plastic. Plunging a large router bit into a baseplate's small opening results in tearing it up.	Replace the baseplate. **WARNING:** Make sure to use the correct screws. (When in doubt, contact the manufacturer.) The wrong screws will ruin the baseplate.	Easy and Cheap (Repairs $0; New baseplate, $0 if you make it yourself, otherwise $25)	Before turning on the router, take a test plunge. Invest in two baseplates: one for bushing-guided template work and another for big bits.
#4 Bits That Slip When a bit creeps out of the collet, regardless of how tight you torque the collet nut, you've got a problem. A slipping collet makes it impossible to rout a consistent cut and can damage the shanks of your bits. Even worse, it can fling the bit, creating a dangerous missile in your shop.	Dark marks, or rings, around the shanks of a bit are a solid sign that the bits are spinning slower than the motor. You can quantify collet wear by using a dial indicator to measure run-out, but first you should try wiggling the arbor to make sure it's not a bearing problem.	Remove pitch buildup or minor surface rust with a brass collet brush (see **Sources** on page 28). **WARNING:** Don't use sandpaper. The collet/bit fit depends on thousandths of an inch. Sanding the collet or bit shank can remove too much metal and prevent a secure grip.	Easy/Inexpensive (New collet, $18–$20) **Two rings on this bit's shank indicate a loose collet. This bit is toast. Sanding off the damage reduces the shank size and affects the collet's ability to get a good firm grip.**  Rings	Keep the collet clean. Minor dust and rust can cause major damage. Blow or brush the collet out each time you change bits. Sticking a bit out too far to make a deeper cut can increase leverage and widen the bottom portion of the collet. To prevent this "bell-mouthing," insert the shank as far into the collet as it will go, then back it out 1/16". Buy a collet stretcher (see **Sources** on page 28) to prevent overextending a bit.
#5 Frozen Collet Nut or Bit The reverse of bit slippage, a collet nut may lock onto the armature, or a bit may stick in the collet.	Try as you might, the bit refuses to come out.  **A quick tap can break a collet's death grip on your bit. Once removed, clean and lightly lubricate the collet nut.**	Give the wrench a light whack. Make sure you're turning the nut in the right direction. Be careful not to damage the bit or the plunge rods in the process.	Easy to Impossible, depending on how well the bit is stuck. If you think you might break something else in the process, take the tool to the repair shop. A new collet will cost around $20.	Do not overtighten the collet nut, or tighten the nut without a bit in place. To do so could permanently deform the metal. Clean threads with a toothbrush. Wipe on a thin coat of lubricant, and then wipe off any excess. **WARNING:** Do not lubricate the inside of the collet! If you do, it won't grip the bit.

Problem	Diagnosis	Fix	Difficulty/Cost	Prevention
#6 Plunge-Lock Slippage The plunge lock lever fails to hold its cutter depth. It turns without achieving the necessary grip; or worse, the router springs up in the middle of a cut.	With the router motor-end up, plunge the base halfway and lock it in place. If you have a router table, repeat the test base-end up. Any movement means a loose lock lever.	Check the guide rods first; make sure there's no residue. To tighten the plunge lock lever, remove the retaining screw, pull off the lock lever, and adjust the lock bolt. **WARNING:** Don't overdo it! Overtightening the lock bolt can affect the plunging action and may even mar the guide rods.	Easy/Inexpensive. (New lever assembly, $20) This isn't a complex fix, but the spring-loaded mechanism can be tricky for first-timers to adjust. It's a quick fix for the repair shop.	If it ain't broke, don't fix it. Most lock problems can be traced to earlier attempts at a quick fix when the real problem may have been dirty guide rods or a slipping bit.
	 **Mark a guide rod with pencil or tape to see if you have a lock lever that slips.**			
#7 Worn Brushes The brushes in your router are chunks of carbon that deliver current to the motor by brushing against the commutator. Over time and use, *they wear out.*	You may notice a decrease in power, see a shower of sparks, or detect an electrical smell. If the brushes don't have a wear limit mark, it's safe to assume that they're *nearly at the end if there's* less than ¼" of carbon. (Uneven wearing or chipped brushes may indicate a problem with the armature.) If one brush goes completely, the motor will shut down.	Remove the brush holder caps, take out the worn brushes, and insert the replacements. Replace both brushes at the same time, being careful not to crimp *the springs. After installing,* run the router for 20 minutes to give the new brushes a chance to seat themselves against the commutator. Some models conceal the brushes behind the motor housing. (Discussed *right.*)	Fairly Easy/Inexpensive (Brush set, $15)	Average brush life varies from 50 to 100 hours. Even if you use your router regularly, you won't need to check the brushes more than once a year; pros may do a check *every 6 months.*
				**Marks of a good tool are brush caps for easy brush access. However, some routers require removing the housing to do this. In this case, take the tool to a repair shop.**
#8 Worn Cords and Plugs Compared to other job-site tools, like circular saws, you're not as likely to accidentally cut the cord, but normal wear and tear still take their toll. At best, a damaged cord will kill your tool; at worst, it can kill you.	Check the cord. A cracked sheath, missing ground prong, or wires protruding where the cord meets the housing tells you it's time for a replacement.	Cord replacement.	Moderately Tricky/ Inexpensive ($12–$20). Failing to attach the ground wire, or pinching the wires under the housing, can make the tool potentially deadly to the user. Take it to the repair shop if you doubt your electrical abilities.	Choose routers with rubber cords—they maintain their flexibility longer than plastic. To avoid stressing the sheathing, wires, or connections, coil cords loosely, especially where they attach to the motor. Never yank a plug from the outlet or leave a plug where you could step on it.
	All power tools should be inspected for cracked cords and missing grounds. Replacement is cheaper than a trip to the ER.			
#9 Trigger Troubles More likely the result of a fall than mechanical failure, a switch that won't turn on or off deserves immediate attention.	The router fails to start or stop, or runs intermittingly.	The complexity of replacing a switch varies by model and manufacturer; if in doubt, take it to the repair shop. In the case of simple three-wire on/off switches, note the wire colors and locations before removing the old switch, and replace the new switch one terminal at a time. Be careful not to pinch the wires.	Somewhat Tricky (depending on the model)/ Moderately Inexpensive ($30 with labor).	Switches are tested to survive thousands of on-off cycles. You can minimize any further chance of problems by blowing out fine dust that can compromise the electrical contacts.
	**Three-wire switches aren't hard to replace, but some variable-speed routers have six wires. When in doubt, leave this repair to the pros.**			
#10 Bad Bearings High-rpm routers are tough on bearings; but unless you're working in a heavy-use commercial shop, you may never encounter a problem. Bearings are designed to run for 300–400 hours; the rule of thumb is to replace them with every other brush change.	Worn bearings may make a popping, cracking, or grinding noise. Feel for heat. Rubbing bearings can raise a router's temperature and may even make it too hot to handle. To check your initial diagnosis, unplug the router and turn the arbor by hand. Any perceptible drag, wiggle, or looseness signals trouble.	Bearing replacement.	Difficult/Moderately Expensive (about $50 with labor). Bearing replacement involves major disassembly. (They are press-fit onto the top and bottom of the shaft.) This job should be left to a repair shop.	Bearings wear out fast when they are not under load. Leaving the router on between cuts can be a problem with table-mounted routers. To avoid leaving the tool running, install a foot pedal (see **Sources** on *page 28*) to your router table so it's easy to switch off between cuts.

One key to successful routing is a well-rounded collection of bits—versatile workhorse bits plus specialty bits designed for your favorite projects.

Router Bit Selection Basics

A router bit accomplishes an incredible amount of work. Spinning at 24,000 rpm, a two-edged bit makes an unbelievable 930 cuts per second. No wonder it slices through wood like a hot knife through butter.



With several hundred choices, finding a router bit to fit your needs can be both challenging and rewarding.

It happens before you know it—bit by bit the collection builds. Fortunately with a router, the more bits you have, the more jobs you can do with it.

Reading a router bit catalog can make you feel a lot like the proverbial kid in a candy store. With hundreds of styles available, choosing the right one for size, shape, or material can be overwhelming. A basic understanding of router bits may help you save some of your hard-earned cash and and get maximum use of each bit.

It starts with the design

Bits share certain design similarities. Although there are a few made of solid carbide, most have a continuous steel body and shank made from one piece of steel, and one or more cutting edges. The cutters may be high-speed steel (HSS) or brazed tungsten carbide tips. Refer to the bit anatomy drawing on *opposite page* to identify those parts you may not be familiar with.

Today's bits are made on automatic lathes and computer-driven, multi-axis grinding machines. These machines do a remarkable job, and enable the manufacturers to produce designs that were not possible just a few years ago.

Shank size options

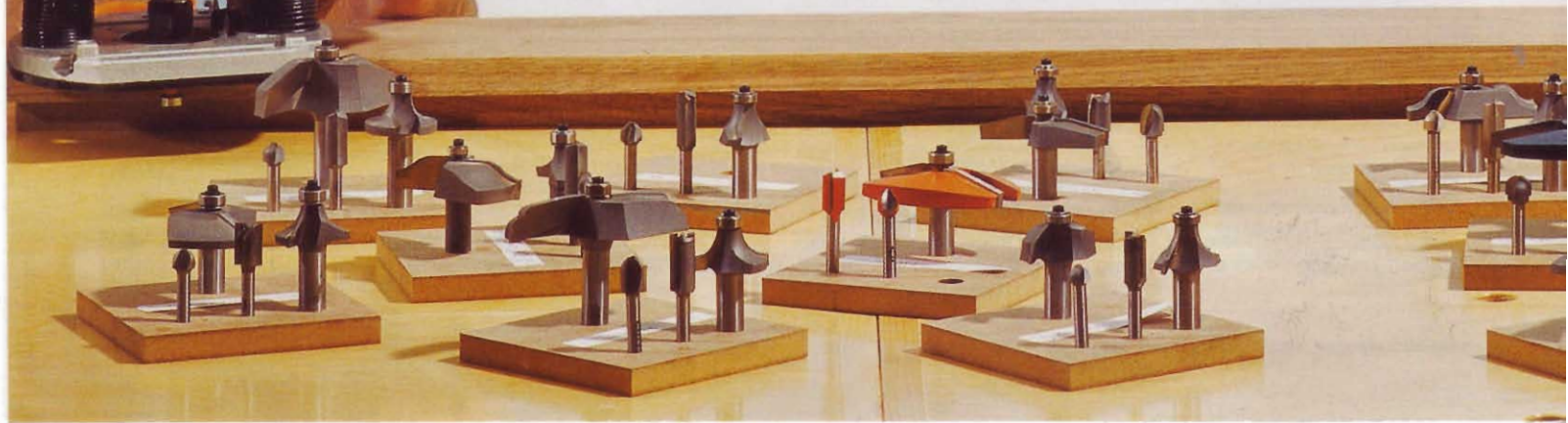
Routers can have either ¼" or ½" collets, or both. A ¼" collet only accepts bits with ¼"-diameter shanks. A ½" collet will accept bits with ½"-diameter shanks and with adapters, also will accept ¼" and ⅜" bits (not widely available). It's nice to have one that accepts both shank sizes, but many types of bits come in both ¼" and ½" shank sizes.

Although bits with ¼" shanks perform well, some experienced and professional woodworkers prefer ½" shank bits because they're bigger, stiffer, and stronger, and better able to resist vibration, flexing, and breaking.

Consider shank length, too. Generally, pick the bit with the shortest shank that will do the job to minimize the amount of bit exposed while you work.

Know your bit dimensions

Router bits have several critical dimensions. Besides shank diameter and length, you need to know the cutter diameter, cutter height (or length), cutter width, and overall bit length. On some, the cutter angle, radius, or bearing diameter also will be important. Profiles of bits and illustrations showing an exact image of the cut also help you visualize what the final cut will look like. Note the position of these dimensions on the illustration.



To pilot a bit or not

Unguided bits can be used for straight or contour cuts anywhere on a board, provided the router is guided by a straightedge or template. Guided bits have a pilot or bearing that controls the router without a straightedge. They can be used only along the edge of a board.

Most edge-cutting bits use ball bearings, typically located at the end of the shank on edge-forming bits, to ride against the workpiece edge. To eliminate edge burn, the bearings turn at your feed rate on the outside, but spin at router speed on the inside. You must put enough pressure on the router to hold the bearing against the workpiece. Otherwise, it may spin along with the bit, and burn the wood anyway.

Changing the bearing diameter will alter the cutting width and profile of the bit, which gives you several bits in one. To change a bearing, you need to remove the socket-head cap screw, located on the end of the shank. Loosening it requires an Allen wrench.

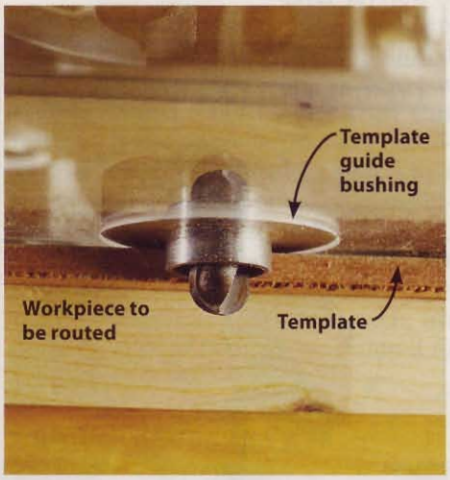
Many woodworkers use changeable bearings on rabbeting bits and slot cutters to change the rabbet width or the slot depth. Fitting a roundover bit with a smaller bearing converts it into a beading bit. The profiles of certain classical bits can be altered in this way, too. (See *page 40* for more information on how bearing size varies a bit's cutting depth.)

On pattern-cutting bits, the bearing is above the cutter. In use, the bearing follows the edge of the pattern or template and the cutter duplicates the pattern profile on the workpiece.

One alternative to piloted bits is a template guide bushing. These bushings look like hollow tubes that fit into the center hole of most router sub-bases and guide a router around a template or pattern. In use, the bit extends through the inside of the bushing and beyond the bottom of the router base. When routing, hold the guide bushing against the pattern edge. The larger the diameter of the bushing, the farther your bit will cut from the pattern.

How to judge bit quality

Today, virtually all manufacturers use tungsten carbide for their cutters. Carbide is an alloy of carbon and metal powders fused together, and harder than HSS. Carbide tips hold a cutting edge anywhere from 15 to 25 times longer. The extra hardness is particularly useful if you're planning to work hardwoods or any of the synthetic products like MDF or solid-surface materials.



This handheld router, equipped with a template guide bushing and core-box bit, is ready to tackle template routing. Allow for the thickness of the template to set bit cutting depth.

Not all bits are created equally—not even carbide bits. While carbide might be the all-around best, there will be differences in carbide thickness, grades of carbide used, and how the bit's body supports the carbide. You can see some of the things that make up quality, but not all of them.

For example, you can spot a skinny carbide tip that likely will disappear after just a couple of sharpenings. But when it comes to the grade of carbide used, you have no way of knowing what the manufacturer used. Very hard carbide maintains a sharp edge longer. But if it's too hard, the cutting edge may chip or nick more easily.

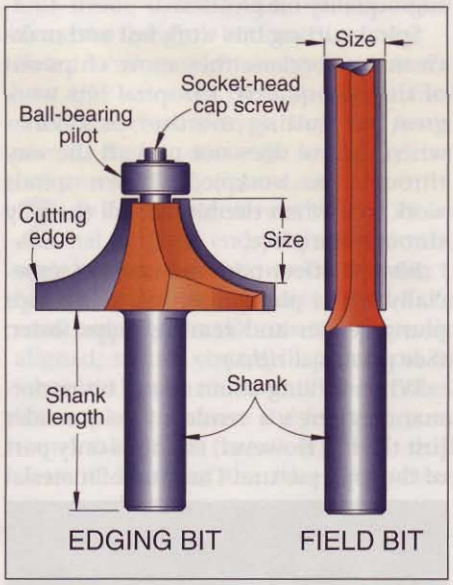
Carbide tips get brazed to the bit body during manufacturing. Tips should be fully supported by the bit body to minimize chances of the carbide breaking away. See carbide-tip bits and bit body in the drawing at *right*. The steel body should be turned smooth and without pits or cracks.

Check the edge grind of the carbide tip under a good magnifying glass if you have one—it should be glassy smooth. If you see or can feel grinding marks, the tips have not been finished properly and the bit should be rejected.

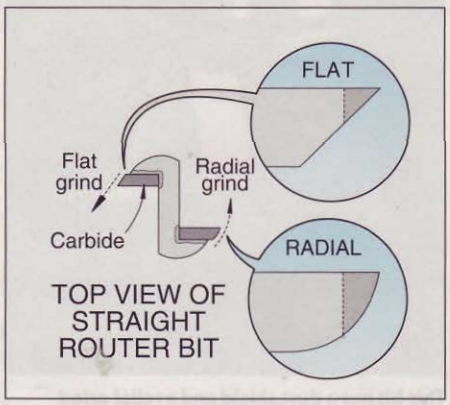
Anti-kickback adds safety

Anti-kickback bits provide an extra margin of safety. The design of this bit limits the depth of cut at each pass to about 1/16". Limiting the bite is especially beneficial on large diameter bits that take wide cuts because it lessens the risk of the bit grabbing a workpiece or throw-

A bearing on this flush-trimming bit rides along the pattern edge and cuts an identical edge on the piece above it. This setup is an excellent way to make finish-quality, duplicate workpieces quickly and without any extra work.



Bits have key components and dimensions that you can use to help identify them. Dimensions reference overall length; shank diameter and length; cutter length and width or diameter; and, on some bits, the cutter's angle or radius and bearing diameter.



A radial grind on the backside of the carbide leaves more mass behind the cutting edge to support the tip. It also prevents shrinkage in bit diameter when resharpening.

ing it. Their additional body mass also helps dissipate heat quicker, and it sometimes seems to make them run smoother. (See drawing at *right*.)

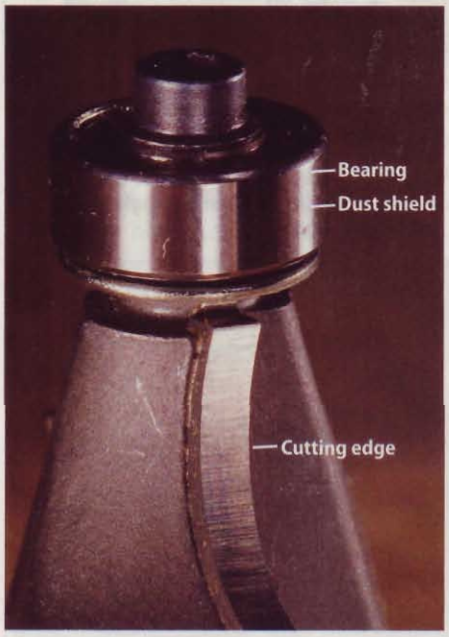
Shearing bits cut smoother

Differences between straight and shear flute cutters can be critical too. On a straight flute bit, the entire cutting edge contacts the work at the same time. By contrast, on a spiral flute, only a small portion of the cutting edge contacts the work at any time. This shearing action makes a smoother, finer cut finish with less power. Although this feature appears most evident on straight bits, you also can find spiral shear flutes on other high-quality bit profiles.

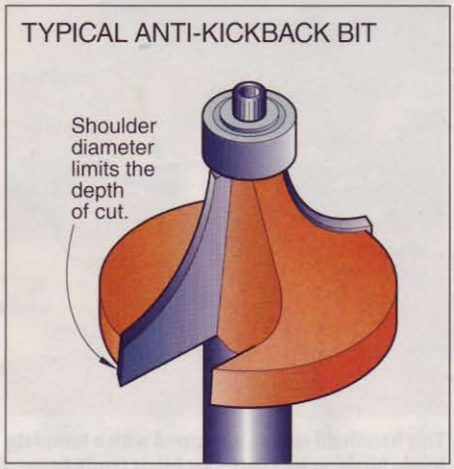
Spiral-cutting bits work fast and make clean cuts because they move chips out of the way quickly. Up-spiral bits work great for cutting mortises or cavities when the cut does not pass all the way through the workpiece. Down spirals work well when the bit cuts all the way through the piece.

Bit tips affect performance too, especially when plunge cutting. Some tips plunge easier and remove chips faster. (See photos at *right*.)

When talking about router bit performance, there's a tendency to consider just the bit. However, the bit is only part of the total picture. The kind of material you are working, the depth and width of the cut, the condition of the bit, and the speed that you move the router along the work (or feed the work past the bit) also make considerable differences.



This bit has a dust shield and a relief grind under the bearing. With a relief grind, you can switch to a smaller bearing and use this cutting surface. Less expensive bits may not have any relief grind.



Anti-kickback bits have a body shape that's designed to limit bite.

One of the worst things you can do to a router bit is to try and cut too much in one pass. Make it your rule to do multiple passes if you have to remove more than a ¼" square of material. Force feeding stresses the bit, makes it dull faster, and almost always produces poor cuts.

Speed limits for bits

A ¾"-diameter bit spinning at 22,000 rpm has a nice mundane tip speed of 49 mph. By comparison, the tip speed on a 2½"-diameter bit spinning at the same rpm will hit 164 mph. For bits ranging in size from ¼ to 3 or more inches in diameter, safe speeds vary anywhere from 10,000 rpm to 24,000 rpm. (For a given bit, check the packaging for the manufacturers' recommended speed limits.) Some suggest a 130 to 140 mph tip speed for optimum performance and operator safety. Although routers rely on high speed for their performance, large bits should turn at slower speeds to keep the tip speed slow enough to cut safely without burning the wood. For additional information on speed limits, see the bit-speed chart on *page 26*.

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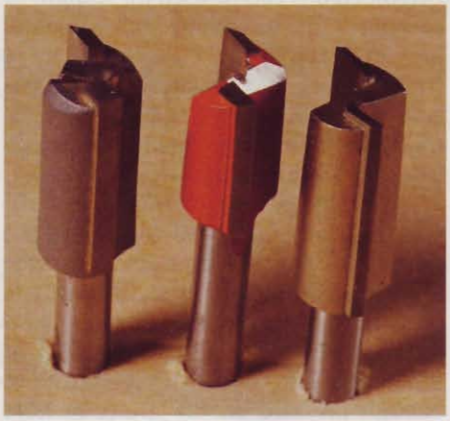
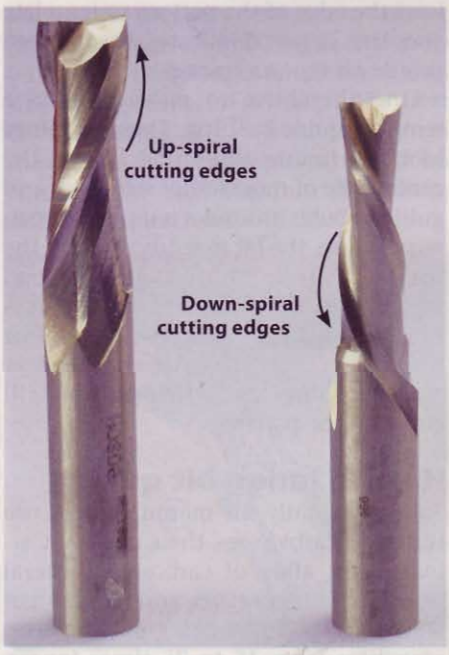


Cutters extend beyond the shank at the end of these three straight bits for more efficient and cleaner plunge cuts.

On core-box bits, look for a cleanly ground point on the bottom tip. Bits with steeper angles plunge easier, leaving a cleaner cut.



Spiral bits slice wood instead of chopping it. An up-spiral bit in a table-mounted router helps pull a workpiece down against the table.

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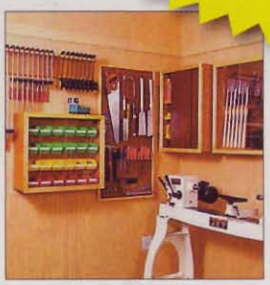

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BERTJA08

Must-Have Router Bits

You can buy a bajillion-bit set, but chances are these six work-horse cutters will do 90 percent of your routing work.

In the *WOOD*® magazine shop, we have nearly a hundred different router bits to choose from on a daily basis. But in reality, only a handful of them see regular use. Call these bits the "standards," the router bits no woodworker should be without. Regardless of your skill level, these are the six bits we suggest you buy first, and then add others as your skills and budget allow.

Yes, some cuts (such as keyholes) or edge treatments (such as an ogee) would be difficult to do without specialized bits. Buy those when you have a specific need for them.

Incidentally, if your router accepts ½"-shank bits, buy them from the get-go. They cost only a little more than their ¼" cousins, and are less prone to deflection under heavy use.

The Top Six bits

⅛" round-over

Hands down, we use this bearing-guided bit the most, primarily for breaking the sharp edges of solid-wood workpieces. The slight round-over softens the edges more uniformly than knocking them down with sandpaper.

Here's a case where a ¼" shank is perfectly acceptable because the bit removes so little material that it hardly strains. In fact, our ⅛" round-over bit has found a permanent home in a trim router, which accepts only ¼"-shank bits.

¼" round-over

Versatility makes this bit a star performer. It cuts a bullnose (in two passes) in ¾"-thick stock, and works well for shaping trim moldings, which are normally ½" thick. Properly set up in a router table, a ¼" round-over bit can make ½" dowels in any species, or bead the edge of a tabletop. We like to machine ¼" round-overs on the handholds of shop-built jigs and fixtures, making them more comfortable to grip.

½" straight with 1" cutting length

Use this bit in a handheld router for cutting dadoes and slots, or with an offset outfeed fence on your router table to edge-joint boards. We prefer the ½" diameter because we frequently cut dadoes for hardwood plywood when building cases, and two overlapping passes with a ½" bit will form a dado that fits ¾" plywood—actually 23/32" thick—better than a ¾" bit. If you rout box joints, ½"-wide fingers look good in ¾" stock.

What about the length? A 1" cutter lets you cut as deep as you're likely to ever need, yet still retracts deep enough into your router base to make shallow dadoes. Longer bits may or may not, depending on the router.

½" flush-trim with 1" cutting length

Solid-wood banding on a plywood shelf stiffens the shelf and hides its ugly edges. Cut the banding oversize, install it, and then trim it with a flush-trim bit to make the joint nearly invisible. Use the same bit and procedure to trim plastic laminate flush after it has been installed. We use a flush-trim bit nearly as often for copying hard-to-duplicate pieces, such as zero-clearance tablesaw inserts.

45° chamfer

Simple chamfering (cutting a bevel on the edge of a workpiece) makes a good edge treatment for classic furniture styles, such as Shaker and Arts & Crafts. Setup is less finicky than with a round-over bit, and the bearing always guides the bit or workpiece. You can make virtually any size chamfer with one bit—from just breaking an edge to beveling the entire length of a workpiece for a dead-on miter joint—by changing the cutting depth.

Rabbeting bit with bearing set

Use this bit wherever you need a rabbet along the edge of a workpiece, such as the art-and-glass area of a picture frame, or the inset back of a bookcase. A rabbeting bit also can create the tongue of a tongue-and-groove joint.

Rabbeting bit sets come with a number of various-size guide bearings for cutting different widths of rabbets. These bearings will fit on other bearing-guided bits to expand their versatility, too. For example, an undersize bearing on a ¼" round-over bit makes it a beading bit.

Other bits you'll want

Look at almost any furniture piece and you'll find examples of decorative treatments you can reproduce with your own router. Demand created by the popularity of portable routers has resulted in a broad variety of bits being made available. The bits on *pages 38-39* represent some of the basic styles that woodworkers find useful.

Edge-forming bits cut decorative profiles along the edge of a workpiece or cut one or both parts of an interlocking joint. Most have a pilot bearing on the end of the shank to ride along the edge of the workpiece to control cut width.

Field or surface-cutting bits have side and bottom cutting edges so they can cut into the surface of the workpiece and then be moved horizontally. They *don't have a guide bearing, so you'll need* a guide—straightedge, edge guide, or template guide bushing—to keep the router moving straight or accurate. Cuts may be decorative or functional.

Specialty bits perform unique routing tasks, either decorative or functional. The multi-profile bit, for example, combines an assortment of profiles in one stack. By changing its height in relation to the workpiece, you can cut an almost endless number of different profiles with it. A lock-miter bit, on the other hand, cuts a specific miter profile that's ideal for joining workpieces.

If you plan to work with plywood, you need to know about plywood bits. Plywood often is manufactured undersized, or thinner than nominal size. Put ½" plywood into a ½" dado and you'll get a poor fit. To help, some router bit manufacturers make undersized bits (7/32", 23/32", 11/32", and 15/32") for routing the thinner plywood.

Maximize your bit options

With your first router you won't need specific bits right off, but you probably will want to buy at least a few of these frequently used specialty bits for starters (sizes refer to the diamater of the bit's bite): ¼", ⅜", and ½" straight bits; ¼", ⅜", and ½" round-overs; 3/16", 5/16" and ½" cove; ¼" radius and 5/32" radius roman ogee; ¼" and ⅜" beading; and a ⅜" rabbeting bit with bearings.

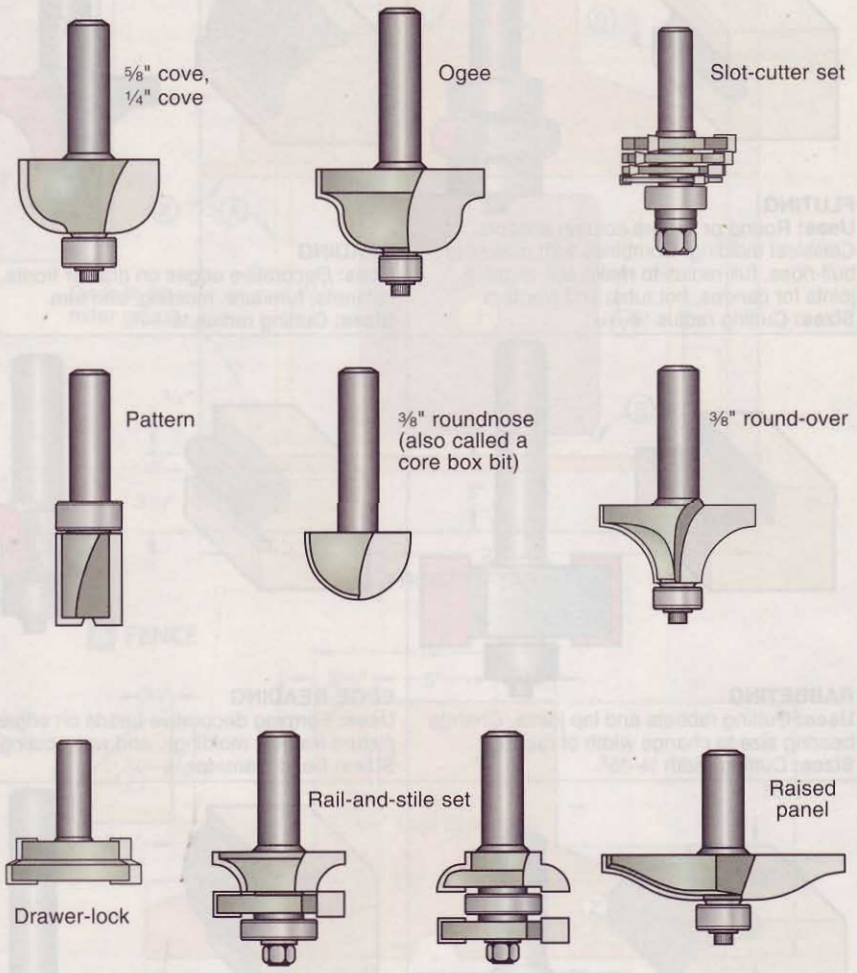
When you're ready to expand the list, add several spiral bits, a 14°–½" dovetail bit, a ¼" round-nose bit, a ½" mortising bit, and a 90°-¼" V-grooving bit. With this collection you will be able to make a wide variety of routing cuts.

Many companies offer sets of bits at substantial savings compared to what you'd pay if buying them individually. However, mentally subtract the bits you *aren't likely to use, and then calculate* the costs of those remaining to determine if the set remains a good buy.

Prices range from $60 to $160 on the six bits individually. The smaller sets cost about the same or more, but you get the bonus of the extra bits that you may or may not use. Figure the cost per bit of the bonus bits before making your decision. Remember, though, that you'll need to add the cost of the ⅛" and ¼" roundovers to fill out the set.

FLESH OUT YOUR SET

Got more money to spend? Here are the next 10 router bits we advise buying:



Router bit sources

Amana Tool Co. 800-445-0077 amanatool.com	Grizzly 800-523-4777 grizzly.com
Bosch Power Tools 877-267-2499 *boschtools.com*	Infinity 877-872-2487 *infinitytools.com*
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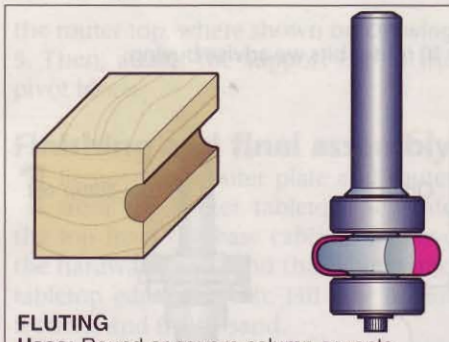
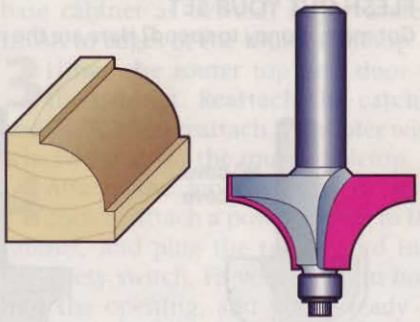
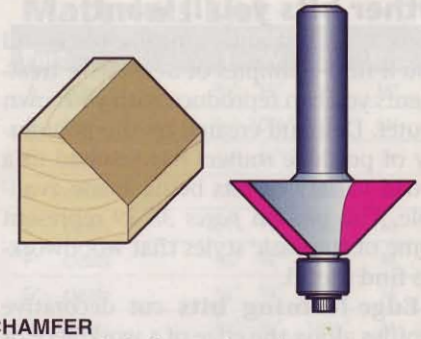


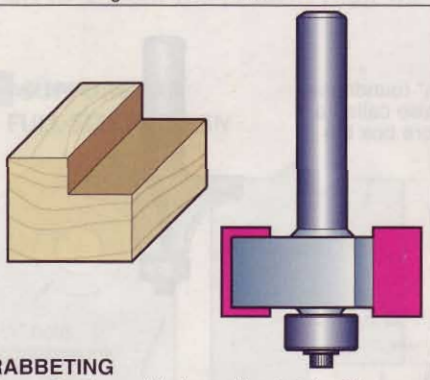
FLUTING
Uses: Round or square column accents. Classical molding. Combines with matching bull-nose, full-radius to make self-aligning joints for canoes, hot tubs, and planters.
Sizes: Cutting radius ⅛–3/16".



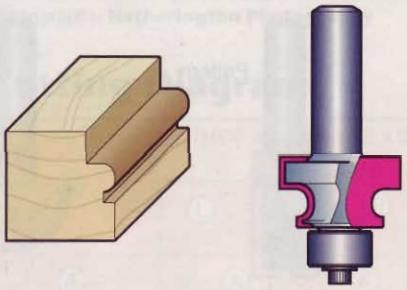
BEADING
Uses: Decorative edges on drawer fronts, cabinets, furniture, molding, and trim.
Sizes: Cutting radius ⅛–¾".



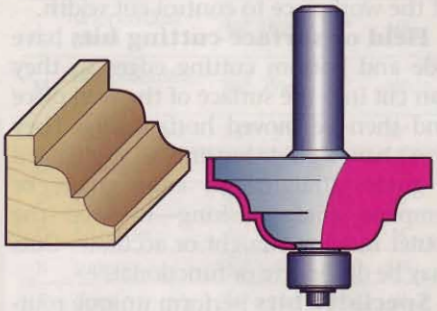
CHAMFER
Uses: Beveled edges on boards or laminates. Staved box and bowl construction.
Sizes: Cutting length ¼–1½"; Bevels range from 7° to 45°.



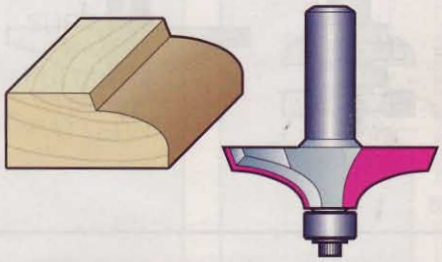
RABBETING
Uses: Cutting rabbets and lap joints. Change bearing size to change width of rabbet.
Sizes: Cutting width ⅛–½".



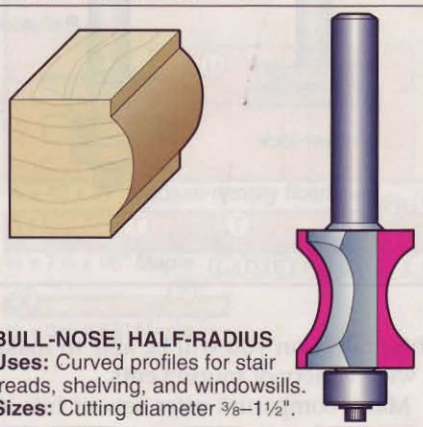
EDGE-BEADING
Uses: Forming decorative beads on edges of picture frames, moldings, and wainscoting.
Sizes: Bead diameter ⅛–¾".



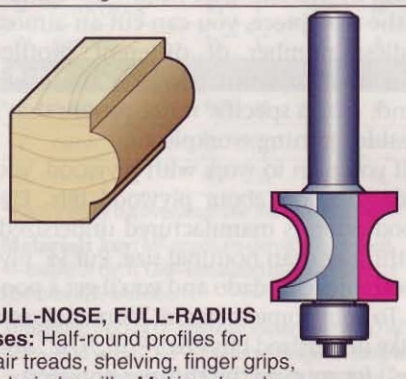
CLASSICAL
Uses: Decorative edges on furniture, shelving, and molding.
Sizes: Cutting width ⅜–½".



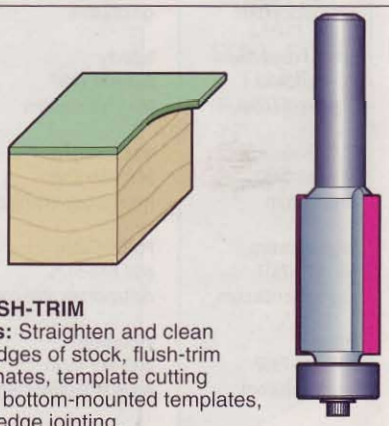
THUMBNAIL
Uses: Edge accent for tabletops, cabinet tops, chair rails, and hand rails.
Sizes: Cutting width 7/16–1".



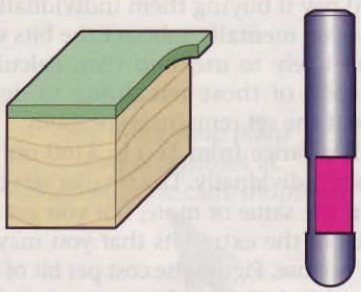
BULL-NOSE, HALF-RADIUS
Uses: Curved profiles for stair treads, shelving, and windowsills.
Sizes: Cutting diameter ⅜–1½".



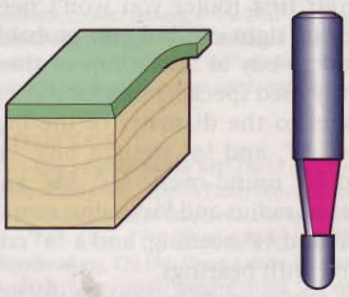
BULL-NOSE, FULL-RADIUS
Uses: Half-round profiles for stair treads, shelving, finger grips, and windowsills. Making dowels.
Sizes: Cutting diameter 3/16–1½".



FLUSH-TRIM
Uses: Straighten and clean up edges of stock, flush-trim laminates, template cutting from bottom-mounted templates, and edge jointing.
Sizes: Cutting diameter ¼–¾".

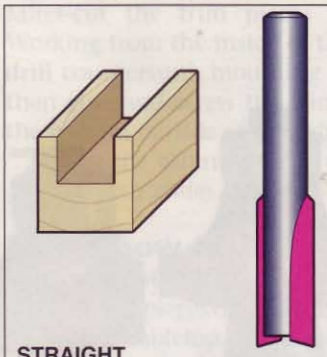


FLUSH LAMINATE-TRIM
Uses: Produce flush, square, and clean corners on plastic laminates, edge banding, and veneers.
Sizes: Cutting length ¼–⅜".

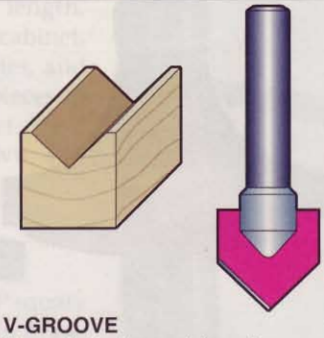


BEVEL LAMINATE-TRIM
Uses: Bevel edges on laminates, edge bandings, and veneers. Bevel angle normally 7°.
Sizes: Cutting length ¼".

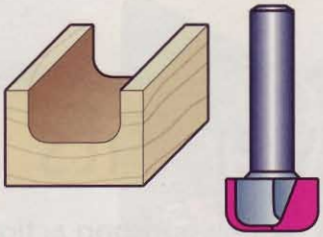
FIELD ROUTER BITS



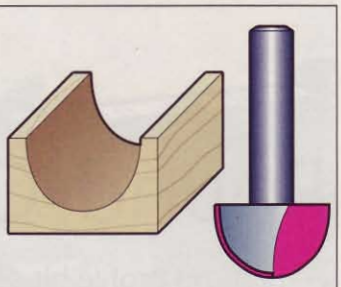
STRAIGHT
Uses: Rabbeting, mortises, inlays, dadoes, box joints, spline joints.
Sizes: Cutting diameter 1/16–1¾".



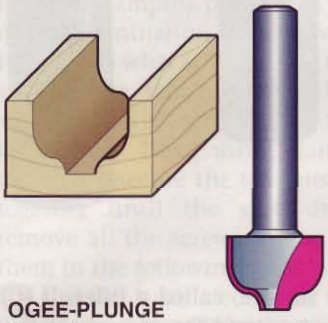
V-GROOVE
Uses: Lettering, veining, sign making, chamfering, decorative accents.
Sizes: Cutting diameter 1/8–1¾".



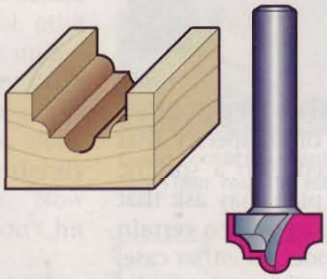
BOWL-AND-TRAY
Uses: Forming trays and shallow bowls.
Sizes: Cutting diameter 7/16–1¼".



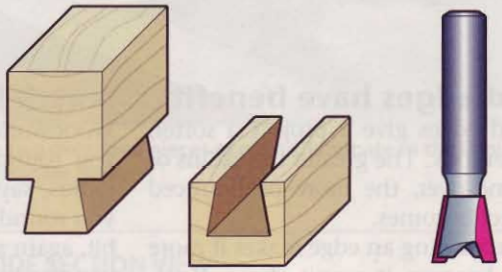
ROUND-NOSE/CORE-BOX
Uses: Fluting, veining, sign making, drawer-front finger pulls, decorative accents.
Sizes: Cutting diameter 1/8–2¼".



OGEE-PLUNGE
Uses: Decorative grooves, and edge molding with a straightedge or router table.
Sizes: Cutting diameter 3/8–1⅛".

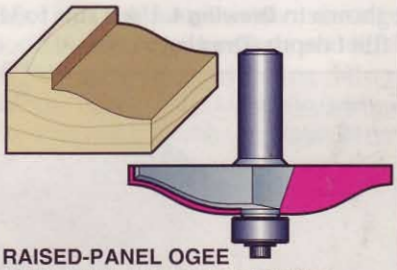


COVE-AND-BEAD PLUNGE
Uses: Decorative grooves, edge cutting with a straightedge or router table.
Sizes: Cutting diameter ½–¾".

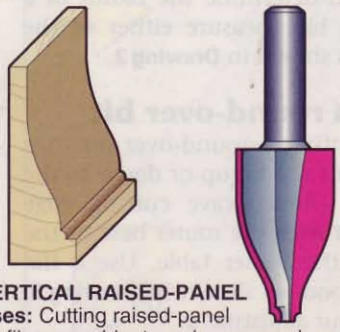


DOVETAIL
Uses: Decorative joints for drawers and boxes, sliding-drawer guides, sliding-dovetail joints for shelves, and chamfering.
Sizes: Cutting diameter ¼–1¼". Cutter angles 7°–18°.

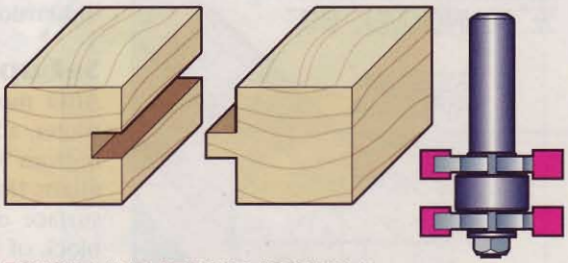
SPECIALTY ROUTER BITS



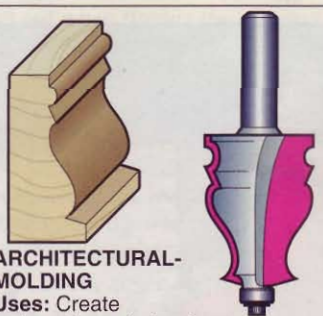
RAISED-PANEL OGEE
Uses: Cutting raised-panel profiles on cabinet- and passage-door panels. Use in a router table only. Requires special inserts in table to accept larger diameters.
Sizes: Cutting width 13/16–1½".



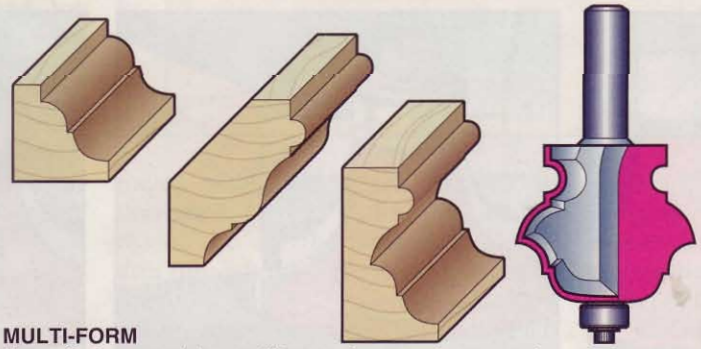
VERTICAL RAISED-PANEL
Uses: Cutting raised-panel profiles on cabinet- and passage-door panels. Use in a router table with fence. Can be used without table inserts.
Sizes: Cutting width:1–1⅝".



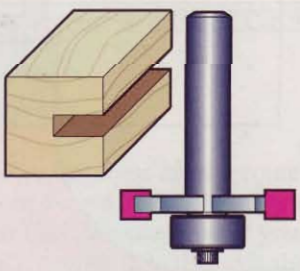
TONGUE-AND-GROOVE ASSEMBLY
Uses: Cutting tongue-and-groove joints for wall paneling, flooring, and panel doors. Making stub mortise-and-tenon joints. Vary bearing size to adjust depth of tongue.
Sizes: Most cut ¼" tongues and ⅜"-deep grooves.



ARCHITECTURAL-MOLDING
Uses: Create wainscoting, chair rails, crown, and other architectural moldings. Dozens of profiles to choose from. Use with router table only.
Sizes: Cutting height ⅞–2".



MULTI-FORM
Uses: Cuts several dozen different shapes using parts of the profiles or multiple passes. Use with router table only.
Sizes: Cutting height 1–1⅞".



SLOT CUTTER
Uses: Biscuit joinery, slots, lap joints, tongue and groove, and T-molding.
Sizes: Cutting height 1/16–¼".

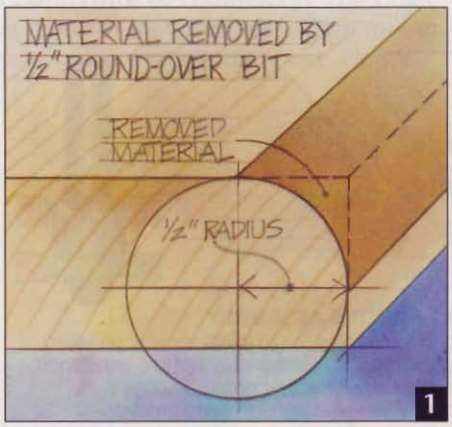
Round-Over Bits

Perhaps no profile bit sees more woodshop action than the round-over bit. Here are some basics on getting the most from this routing workhorse.

Round edges have benefits

Rounded edges give a project a softer, smoother look. The greater the radius of the round-over, the more pronounced this effect becomes.

Also, rounding an edge makes it more durable because it won't show dents, splinter, or lose its finish as easily as a sharp corner. Like a knife that loses its sharp edge, a rounded corner is more "friendly" to people or objects that come in contact with it.



Match bits to the projects

Woodworking plans often specify that you round over an edge to a specific radius, say ½". Or, a plan may ask that you round over the edge with a certain bit, again say a ½" model. In either case, you need a bit that leaves an edge in the shape of a quarter-round with a ½" radius (see **Drawing 1**).

Manufacturers classify round-over bits according to the radius they cut. So, a ⅜" round-over bit cuts a ⅜" radius, and so forth. To determine the radius of a round-over bit, measure either of the dimensions shown in **Drawing 2**.

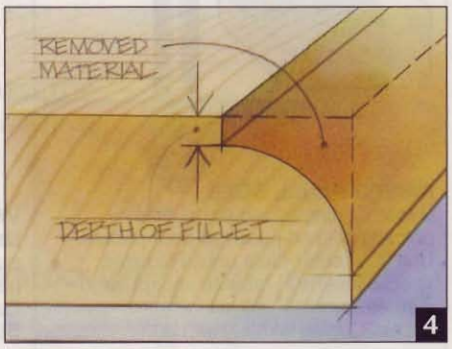
Set up a round-over bit

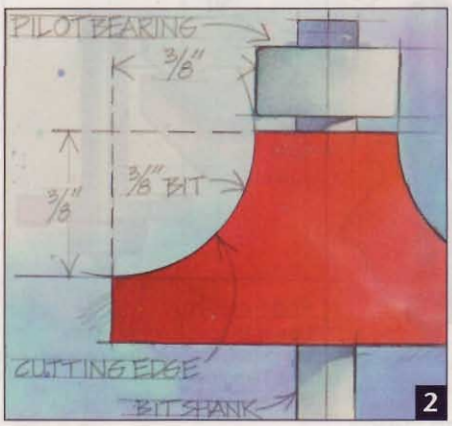
After mounting a round-over bit in a router, adjust the bit up or down so the bottom of the concave cutting edge aligns flush with the router base or the surface of the router table. Use a flat block of wood, as shown in **Drawing 3**, to check your adjustment.

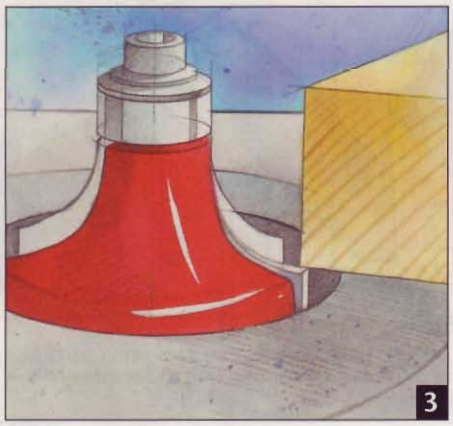
Before cutting your workpiece, test the cut on scrap stock. If the bit extends too far, it will cut a slight ridge into the workpiece surface, called a fillet. If the bit does not extend far enough, it will cut an incomplete radius.

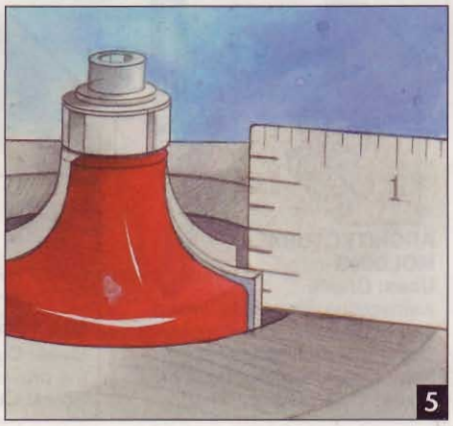
How to add a fillet

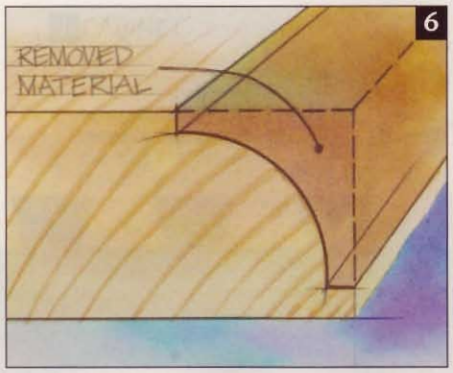
By extending the bit slightly, you can cut a round-over with a fillet like the one shown in **Drawing 4.** Use a rule to set the fillet depth (**Drawing 5**).











Round-over bits cut beads

By changing to a smaller pilot bearing, you can make a round-over bit cut a beaded edge like the one in **Drawing 6**. To change bearings, simply loosen the setscrew atop the bearing with a hex wrench, as shown in **Drawing 7**. A few bearings cost a lot less than dedicated beading bits!

Bit-buying pointers

You can buy round-over bits with radii ranging from 1/16" to 1¼". In the *WOOD®* magazine shop we make the greatest use of round-over bits with these radii: 1/16" (for "breaking" edges that need to look crisp and sharp, but feel smooth to the touch), ⅛", ¼", ⅜", and ½". We recommend that you purchase round-over bits with ½" shanks if the bit has a ⅜" or larger radius.

Written by **Bill Krier** with **Chuck Hedlund**
Illustrations: **Brian Jensen**
Photograph: **John Hetherington**

Rabbeting-Bit Bearing Sets

Turn one bit into a multi-purpose tool.

With a rabbeting bit like this one, you can make rabbet joints, cut rabbets for holding panels of wood or glass in doors and other frames, or inset back panels on furniture and cabinet carcases. Unlike the rabbets that you cut with a tablesaw or jointer, a rabbeting bit will follow curved edges, such as an arch-topped door. And, with a rabbeting bit you can cut along the inside edges of an already-assembled frame.

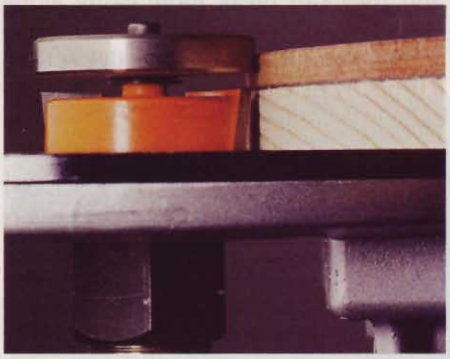
A typical rabbeting bit comes with either a 1¼"-diameter cutter and a ½" bearing for cutting a ⅜"-deep rabbet, or a 1⅜"-diameter cutter and ⅜" bearing for cutting ½"-deep rabbets. With either bit, you can greatly expand its versatility by purchasing a matching set of high-speed bearings like the ones shown *below*.

These bearing sets vary slightly by brand, but most consist of bearings in these outside diameters: ½", ⅝", ¾", ⅞", 1⅛", and 1⅜". Most of these sets mate with a 1⅜" rabbeting bit with a ⅜" bearing. With a set, you can cut rabbets in ½", 7/16", ⅜", 5/16", ¼", ⅛" depths. (The smallest bearing gives the deepest cut; the largest bearing can turn a rabbetting bit into a flush-trimmming bit.) (See photo at *right*). To cut rabbets at depths between these, remove the bearing completely and use the bit with a router table and fence.

You also can flush-trim veneers and plastic laminates, although the large-diameter bit and bearing will not allow you to trim tightly into inside corners.

To change bearings, loosen a screw atop the bit with a hexhead wrench (comes with the set). Place the bearing right side up when reassembling the bit.

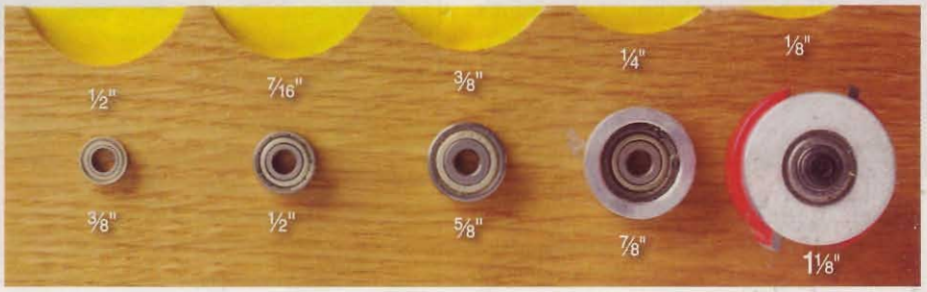
You can purchase bearing sets for rabbeting bits with ¼" or ½" shanks. We prefer bits with the sturdier ½" shanks when cutting ½"-deep rabbets.



Outfitted with the largest bearing (1⅜"), you can flush-trim workpieces less than ½" thick using a template. You also can flush-trim veneers and plastic laminates (except for tight inside corners).

RABBET DEPTH REFERENCE CHART

Sample of cutting depths made by combining a 1⅜"-diameter rabbeting bit with different-size bearings.

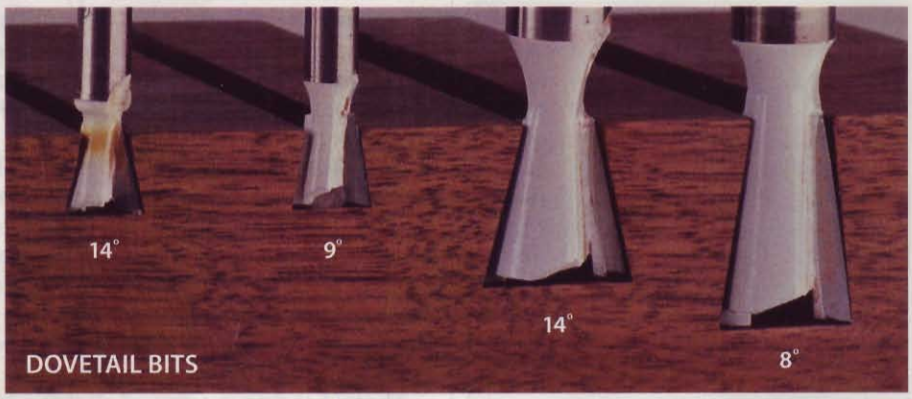


Dovetail Bits

For centuries, the hand-cut dovetail joint has stood as a testament to the quality of the case, box, or drawer that possessed it. These days, thanks to routers and dovetail bits, even a beginning woodworker can incorporate this joint to enhance the simplest projects.

Dovetail bits come in an array of cutting angles—usually 7–14°—and lengths (see photo, *right*), on both ½" and ¼" shanks. Generally speaking, the greater the cutting angle, the stronger the joint. But beware: The acute angles on the tails make them more fragile as the cutting angle increases, and they can break more easily along the grain.

Because of its opposing-wedge action, a properly fitted dovetail joint mechanically self-tightens. This means you can use it to eliminate fasteners, such as screws or nails. The result is a joint just as strong as one that's nailed or screwed, but you should still glue the joint.



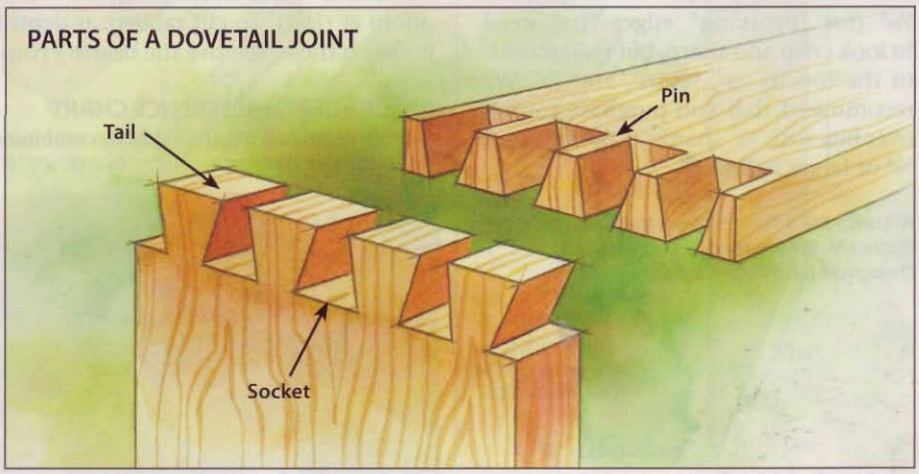
How to tell pins from tails

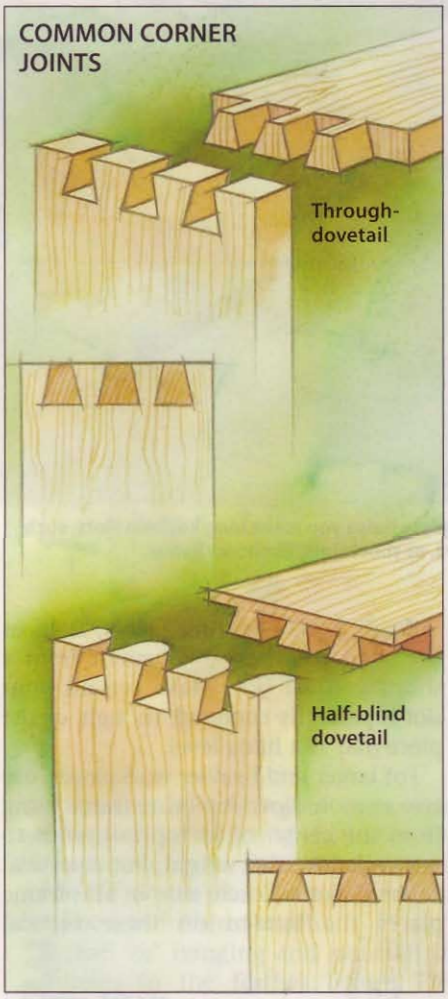
You'll see the three basic parts of every dovetail joint in the drawing at *right*. The *pin* is the part that fits into the *socket*, which is formed by two *tails*. Pins and tails are often confused, but there's an easy way to remember which is which. If you look at the face of the workpiece at the joint and see birdtail-shaped protrusions, those are tails; if you see rectangles, those are pins.

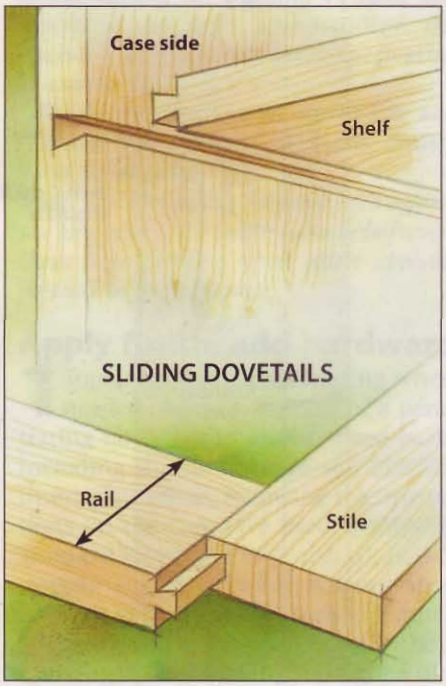
The tails bear the brunt of the joint's stress, so when planning your project, point the tails in the direction of the stress. For example, opening and closing a drawer creates front-to-rear stress on the drawer. Therefore, point the tails front and rear, which means cutting the sockets in the drawer sides.

In the *WOOD*® magazine shop we like to cut the sockets first, about 1/32" deeper than the thickness of the pins, using a dovetail bit in our router table. Then, using a straight bit, we form the pins, leaving them just a hair wider than the sockets. This lets us gradually remove more stock from the pins until we get a good fit. Once the joint is complete, we sand the tails flush with the pins.

Making well-fitting dovetail joints in boxes or drawers requires a high degree of precision. That's why you'll find a covey of commercial jigs on the market today, each designed to simplify cutting the pins and sockets with bearing- or bushing-guided bits. Less-expensive jigs make only half-blind joints, where the







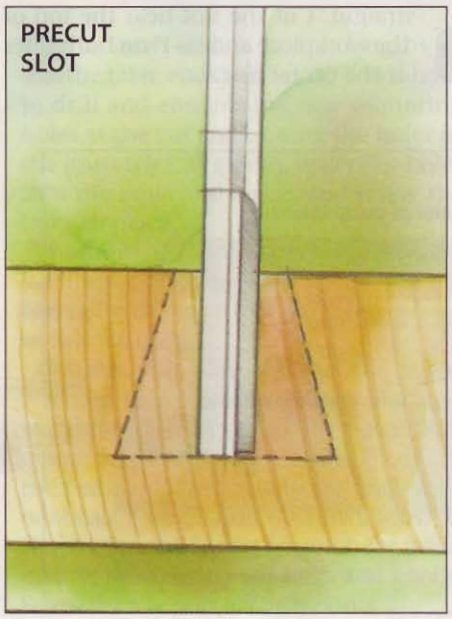
dovetails are visible only from one side of the joint. With pricier models, you can cut through-dovetails, where both sides show (see the *Common Corner Joints* drawing, *left*).

Beyond jigs: Let it slide

Even without the use of expensive jigs, you can use dovetail bits to make other strong and attractive joints. For example, use a long dovetail slot (socket) inside a bookcase or entertainment center, then machine a long tail on each end of a shelf, as shown *below left*. The resulting joint, besides adding beauty to the case, also keeps the case sides from bowing. And, if you don't glue the shelf in place, you can remove or replace it.

Or, use a sliding dovetail joint instead of a stub tenon for making rail and stile panels, as shown *below left*. You'll still want to glue the joint, but again, you won't need clamps for this assembly. Just be sure your panels are in place prior to gluing the frame.

One tip for cutting sliding dovetails: The tapered sides of the dovetail slot tend to trap chips in the slot as you cut. So precut the slot with your tablesaw, or a router and a straight bit, as shown *below*, to remove as much material as you can before routing the dovetail. If pre-cutting proves impractical, proceed slowly with the dovetail bit, backing it completely out of the cut frequently to clear chips and debris from the slot.

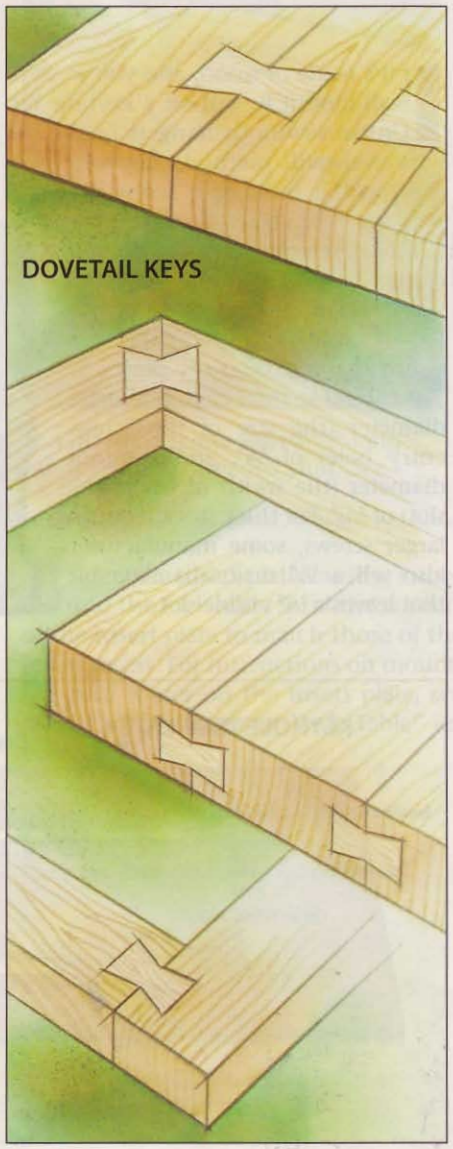


A couple more key uses

As you can see from the drawing *below*, dovetail keys add decoration and function to any number of joints. The *key* is an hourglass-shaped piece of stock, often made from a contrasting species, that creates a mechanical joint between two flat surfaces.

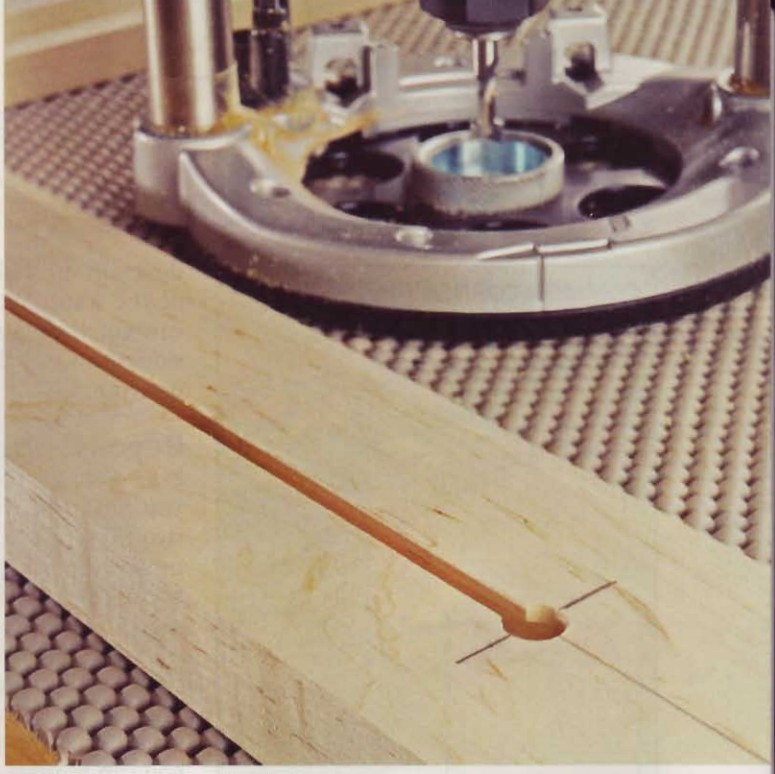
Before cutting the key sockets, mill a long key blank using the same dovetail bit. Then, set up the socket cuts in scrap to ensure a good fit. Slice individual keys from the blank (about 1/32" longer than the socket), assemble the joint, tap the keys into place, and then sand them flush with the workpiece.

Written by **Dave Campbell** with **Chuck Hedlund**
Drawings: **Brian Jensen**



Keyhole Bit

Certain wall hangings, like quilt racks, plaques, and display shelves, look and function better when flush-mounted to a wall. To accomplish that, try this wireless hanging technique. With the right bit, a plunge router, and our simple-to-use template, you'll master keyhole slots in minutes.



Our simple router template helps you make long keyhole slots, such as the slot shown *above*, or short slots, as shown *below*.

If it's made of wood, and you want to wall-mount it, call on a keyhole bit. Unlike sawtooth hangers or the old wire-over-nail method, keyhole slots capture the head of a screw driven partway into the wall, so you can firmly affix a picture frame, plaque, clock, or bracketed shelf without fear of it falling. And, without eyelets or hangers to get in the way, your workpiece hugs the wall.

A typical keyhole bit has a major diameter (the size of the screw-entry hole) of ⅜", and a minor diameter (the width of the visible slot) of 3⁄16". For thick stock requiring larger screws, some manufacturers also sell a ½" major-diameter bit that leaves a ¼" visible slot.

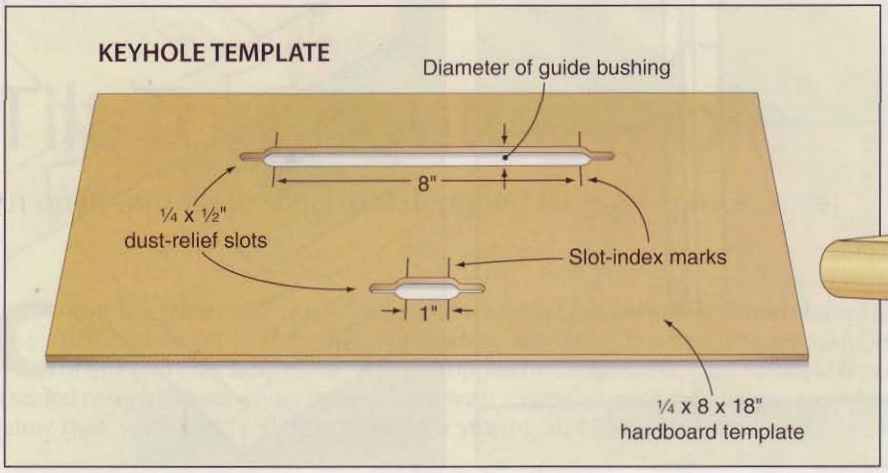
As you plunge the bit into your workpiece, it first creates the screw-entry hole. Moving the router with the bit lowered plows an inverted T-shaped slot to capture the screw head.

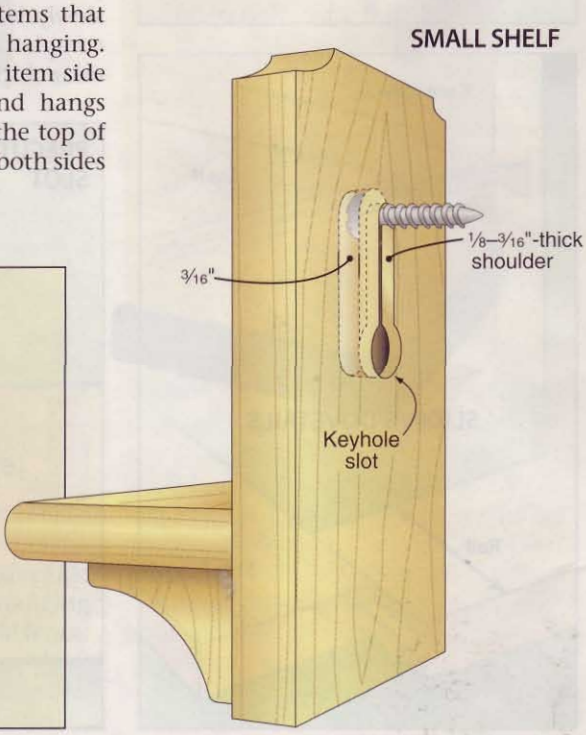
Up and down? Side to side?

Depending upon the type of wall-hanging you're working with, you can cut keyhole slots vertically (with the screw-entry hole at the bottom) or horizontally. Usually a horizontal slot works best for small, flat items that require only one screw for hanging. That allows you to slide the item side to side until it balances and hangs straight. Cut the slot near the top of the workpiece and ½–1" on both sides of the center line.

Small weight-bearing pieces, such as the shelf shown *below*, benefit from a short, vertical slot. Make certain your slot is perfectly centered, though, or the piece may not hang level.

For larger and heavier workpieces, use two or more slots. A picture frame hung from the center of its top rail tends to sag under its own weight, but a vertical keyhole slot in each stile of the frame places the burden on these vertical





frame members. In order for the frame to hang straight, both keyhole slots must end the same distance from the top of the frame, and the screws in the wall must be both level and the exact same distance apart as the frame's slots.

For long wall hangings, such as a bracketed shelf, where you want to make sure your mounting screws bite into a wall stud, we recommend a pair (or more) of long horizontal slots. Find the mounting location, drive the screws into the wall, then mark the screw locations on the back of the workpiece. Roughly center a long keyhole slot at each screw location, with all slots pointing in the same direction. With 8"-long slots, you can shift the workpiece up to 4" in either direction until it looks right.

Keep it straight, keep it even

If a horizontal keyhole slot runs downhill, or if a pair of vertical slots don't start and stop on the level, your workpiece will be out of kilter. We came up with a simple template, shown on the *previous page*, to avoid this problem.

Our template requires a ⅝" guide bushing (Porter-Cable part no. 42046), but you can use a different size. Just adjust the slot width accordingly. If your bushing protrudes more than ¼" beyond the router's base, you'll have to file or grind it down to length.

To make the template, first lay out the start and end points (the slot-index marks) of your slots on the hardboard with long, bold lines. You'll use these index marks for alignment purposes later. With a ⅝" Forstner bit loaded in your drill press, and a fence set 2" from the center of the chuck, bore a hole centered on each of your layout lines. Don't move the fence when you're done.

Now remove the waste between the holes. For the short slot, drill a series of overlapping holes with the Forstner bit, then file the edges of the slot smooth; for the long slot, use a ⅝" straight bit in our *router table*.

Finally, chuck a ¼" bit in your drill press, then bore and clean out the dust-relief slots. To use the template, follow the photos and instructions at *right*.

Written by **Dave Campbell** with **Chuck Hedlund**
Illustrations: **Tim Cahill**; **Lorna Johnson**

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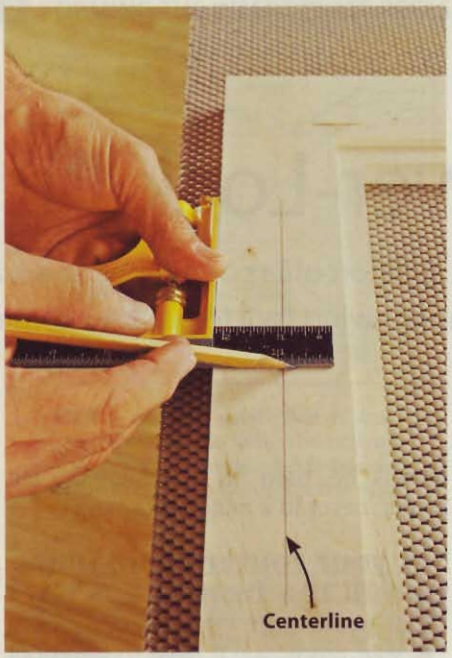
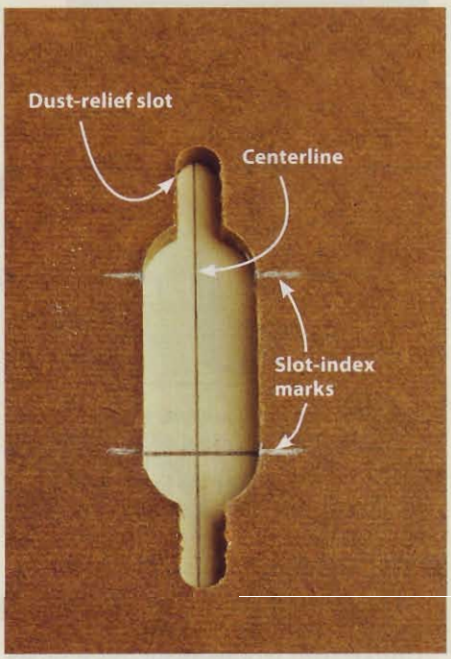
MASTER KEYHOLE SLOTS IN FOUR EASY STEPS



1 Mark the slot

Locate the keyhole slot by drawing a long centerline on your workpiece. Measure and mark the bottom end of the keyhole slot, as shown, with a short perpendicular line.



2 Index the template

Align the short line with the slot-index marks on the template, and center the long line in the dust-relief slots. Clamp the template to the workpiece, and set your plunge router's depth stop so the bit will leave a ⅛–3⁄16"-thick shoulder above the keyhole slot.

3 Rout the slot

With the guide bushing at the bottom of the slot (as the workpiece will hang) and the router on, plunge the bit into the workpiece. Guide it to the other end, backing out frequently to clear dust.

4 Remove the template

After finishing the cut, turn the router off and back it completely out of the cut. If you're going to hang the piece from two fasteners, mark the other slot and repeat the process.

Drawer-Lock Bit

This one-bit solution offers a number of advantages, making it a valuable time- and labor-saving tool for cutting corner joints.

The unique geometry of a drawer-lock bit creates a strong mechanical bond between perpendicular pieces. And the joint is not only functional and easily tailored to different drawer styles, but attractive as well.

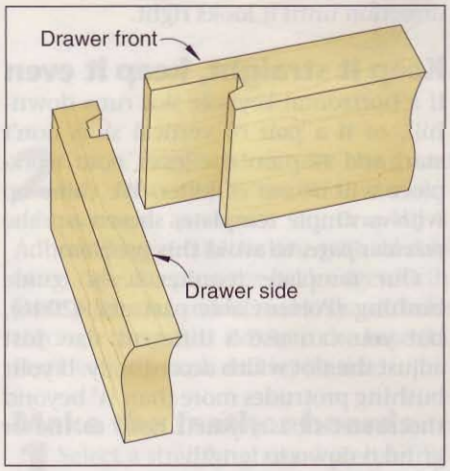
Unlike stub tenons made on a tablesaw, the wedge-shaped tenons created by a drawer-lock bit self-align both workpieces for a perfectly mating joint. Furthermore, once you've set the bit to the correct height for routing the drawer front, you need only adjust your router-table fence to make the mating cuts.

One safety note before we get into using this bit: A drawer-lock bit should always be used in a table-mounted router, never in a handheld router.

Set your router-table fence to mill the fronts

1 If your router table doesn't have a split fence, you'll need to build out the fence almost the full diameter of the bit. That's because most of the bit must be captured inside the fence when milling drawer or box sides.

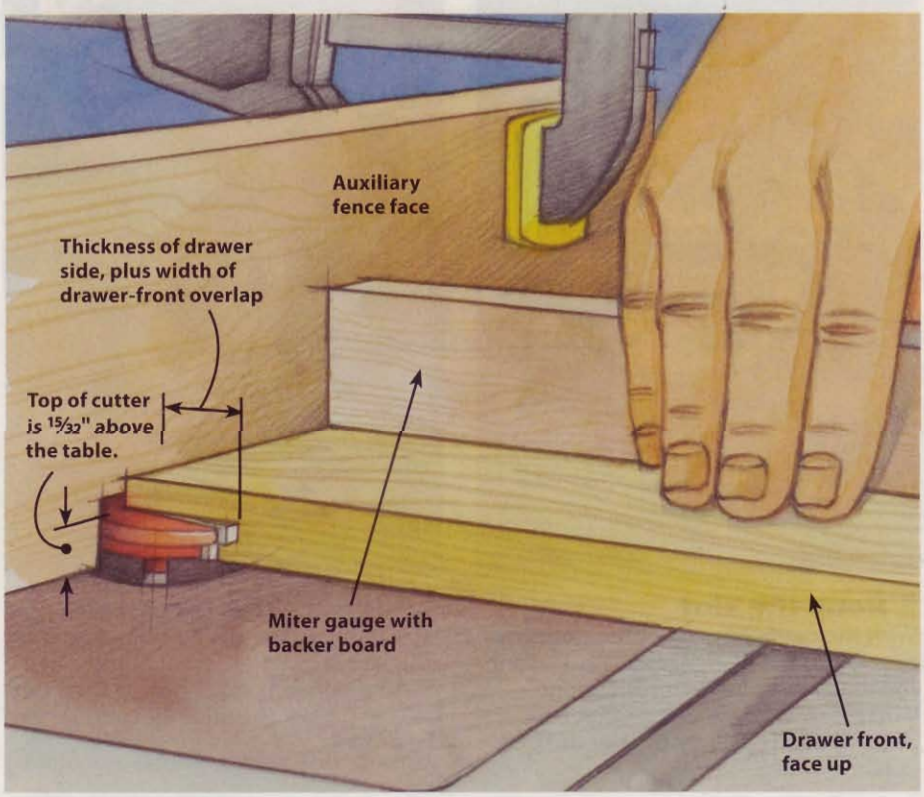
Close up the opening around the bit by making an auxiliary face for your router table fence. For our 2"-diameter bit, we cut a ⅝×2¼" dado in a scrap of ½" medium-density fiberboard (MDF).



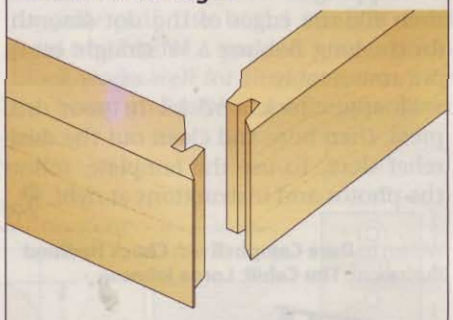
Then we clamped it to the router table fence with the dado centered over the bit, as shown at *left*.

2 Mount the drawer-lock bit in your table-mounted router, and set the top of the cutter so that it's 15⁄32" above the tabletop.

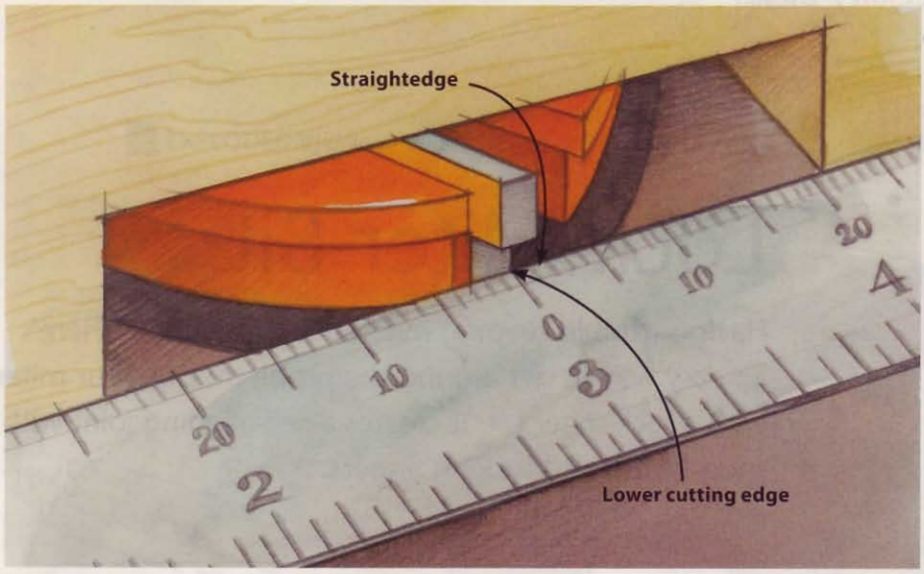
3 Calculate the fence position by adding your drawer front's intended

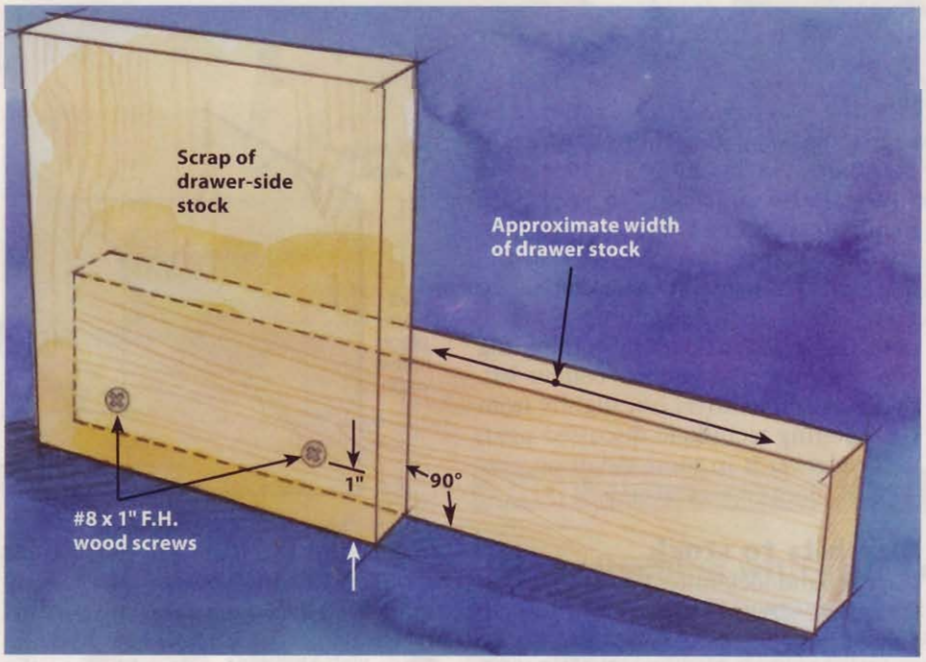


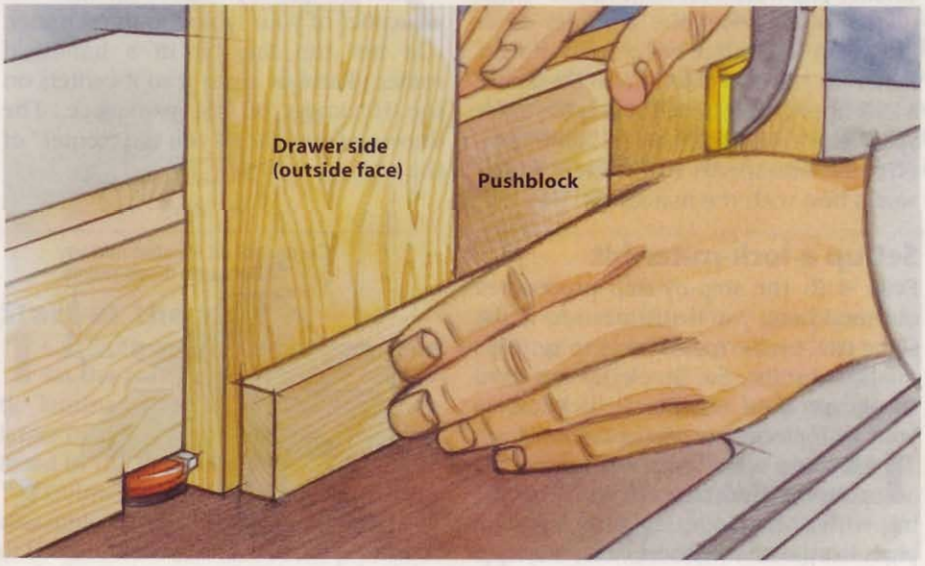
Lock miter joints offer similar advantages



Lock-miters offer similar strength from their interlocking parts, but create a mitered corner that shows no end grain. See *page 48* for how to make this joint.







overlap (if any) and the thickness of your drawer side. Position the router table fence that distance back from the upper cutting edge of the bit. For example, if your drawer front will overlap the sides by ⅜", and the sides are ½"-thick, put the fence ⅞" back from the lower part of the bit. For flush-mount drawers, or drawers to which you'll add a false front, place the fence only the thickness of the drawer side from the bit's lower cutting edge.

(You also could use this dimension for milling the drawer backs. But here in the *WOOD*® magazine shop, we like to cut the backs with the same overlap as the fronts, and then trim them to size. This ensures that the inside dimensions of the drawer remain constant.)

4 To prevent tearout while milling the fronts, attach a backer board to your miter gauge so that the backer board just touches the auxiliary fence face, as shown on the *previous page, bottom left.*

5 With your drawer front already cut to finished size, place it faceup on the router table. Keep one end of the drawer front against the router table fence and mill the workpiece using the miter gauge as a guide. Turn the workpiece around, keeping it face-up, and mill the other end. If you're making more than one drawer, machine all of the drawer fronts (and backs, if you like) using this setup.

Now, rout the sides

1 Without changing the bit height, move the fence so that it's flush with the lower cutting surface of the drawer-lock bit. We like to rotate the bit so the cutting edge is forward, then lay a straightedge against it for reference, as shown *top left.*

2 To prevent tear-out, make a pushblock from scrap and an extra piece of drawer-side stock (or scrap of the same thickness), as shown *middle left.* Make certain the two pieces form a 90° angle, and the screws are high enough to clear the bit's cutting path.

3 Cut the drawer sides to size. Stand the drawer side on end, placing the inside face against the fence. Use the pushblock, as illustrated at *left,* to guide the drawer side through the bit.

Written by **Dave Campbell** with **Chuck Hedlund**
Illustrations: **Brian Jensen**

Lock-Miter Bit

Having trouble keeping mitered joints aligned? Here's an easy way to get around the problem: Cut your miters with a lock-miter bit. It creates a self-aligning joint with snug-fitting interlocking fingers.

When to use this bit

By mitering the corners of boxes and columns, you can minimize the appearance of a joint line and eliminate the sight of end or edge grain altogether. However, without some form of reinforcement, such as biscuits or a spline, typical mitered joints have only fair strength, and can prove hard to align during gluing and clamping. The lock-miter bit overcomes these problems by nearly doubling the gluing surface of the joint, and by cutting interlocking "fingers" that self-align the joint. (See the photo at *left* of a column with contrasting woods.)

Column

End-joined boards

You also can use a lock-miter bit to make strong, self-aligning edge joints, or to "lengthen" a board by end-joining two workpieces as shown *bottom left*. This procedure differs just slightly from the mitering technique discussed next, and we cover it in more detail on *page 49*. (See "Join edges and ends.")

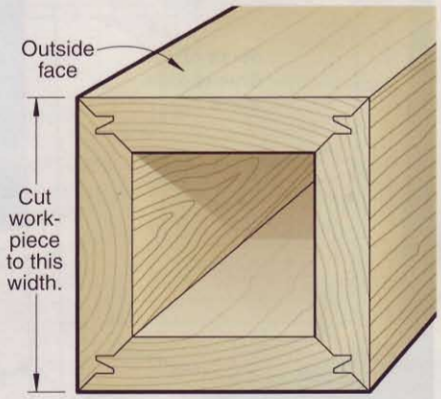
Size bits to stock

We've found lock miter bits available in two basic sizes: ¼"-shank, 2"-diameter version, and ½"-shank, 2¾"-models. The smaller bits work best with 7/16"–⅝"-thick materials. They require a router of at least 1 hp. The larger bits work well with materials ⅝"–1 1/16" thick. With these, use a 2–3 hp, variable-speed router or router speed control set at 10,000–12,000 rpm. (Test various speeds to find out which works best with the material.)

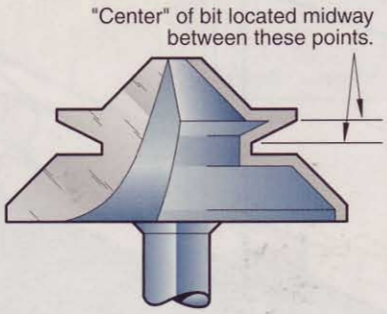
Set up a lock-miter bit

Even with the step-by-step procedures outlined here, you'll still need to make some trial-and-error test cuts to get top-quality results. So, stock up on two things: scrap of the exact thickness as your workpieces, and patience.

1 Machine all of your workpieces to uniform thickness. If you're working with sheetgoods, try to make your parts from the same sheet or from sheets produced in the same batch. Cut your workpieces to the finished width measured from the outside of one mitered corner to another as shown *above*.

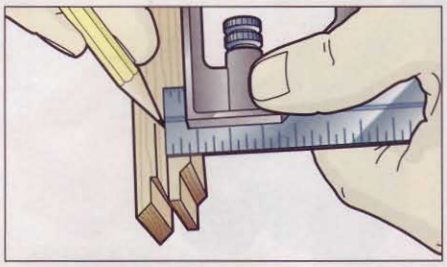


2 Secure the lock miter bit into the collet of your table-mounted router. (Do not use this bit in a handheld router.) Raise or lower it so it centers on the thickness of the workpiece. The drawing *below* shows you the "center" of the bit.



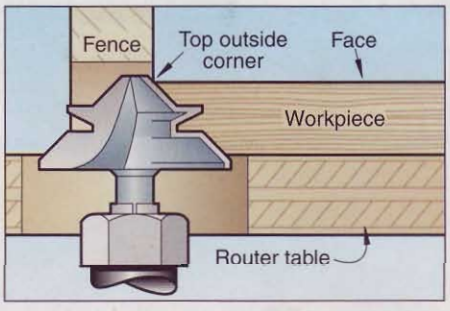
3 To double-check the height of the router bit, center your router-table fence directly above the router bit. Turn on the router and pass a piece of scrap (outside face up) through the bit.

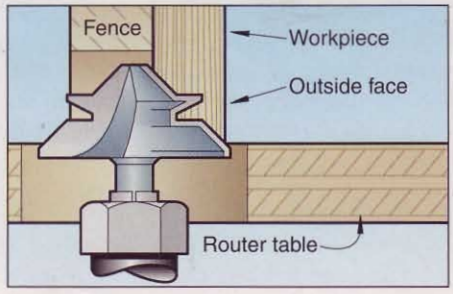
Note: *Use a large piece of scrap (at least 12" long and several inches wide). Make short test cuts into the scrap, then saw away the cut portion to preserve the large piece for more test cuts.*



Now, place a combination square as shown *above* onto either face of the scrap piece. Adjust its blade to reach the corner in the cut produced by one of the two "center" points on bit. Tighten the blade and make a pencil mark about 1" long on the edge of the stock. Now, place the square on the other face of the scrap piece and make another pencil mark that extends toward the corner made by the other "center" point of the cut. If the second mark aligns with this corner you can be sure the cut is centered.

4 To adjust the fence precisely, lay your scrap onto the table again, with its outside face up. Bring the fence forward so that the bit will cut exactly to the top outside corner of the workpiece as shown *below*. Make as many test cuts as necessary. The top corner of the workpiece should be sharp and straight, without any reduction in the width of the outside face side.





5 With the bit and fence precisely adjusted, place your workpiece outside face up onto the table, and cut one edge. Cut the opposite edge of the workpiece by positioning the workpiece vertically against the fence, with its outside face toward you (see *bottom left*).

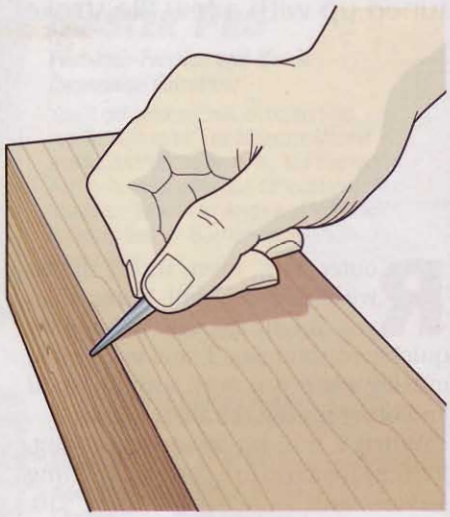
6 No matter how precise you are, after clamping the workpieces you may find that one of the outside edges of the miters may be off by just a hair. To solve this, use a nailset to gently roll over the overlapping edge as shown at *right*. Do this after the clamps come off, but before the glue dries completely hard. Avoid excessive glue squeeze-out, and sand away any after it hardens.

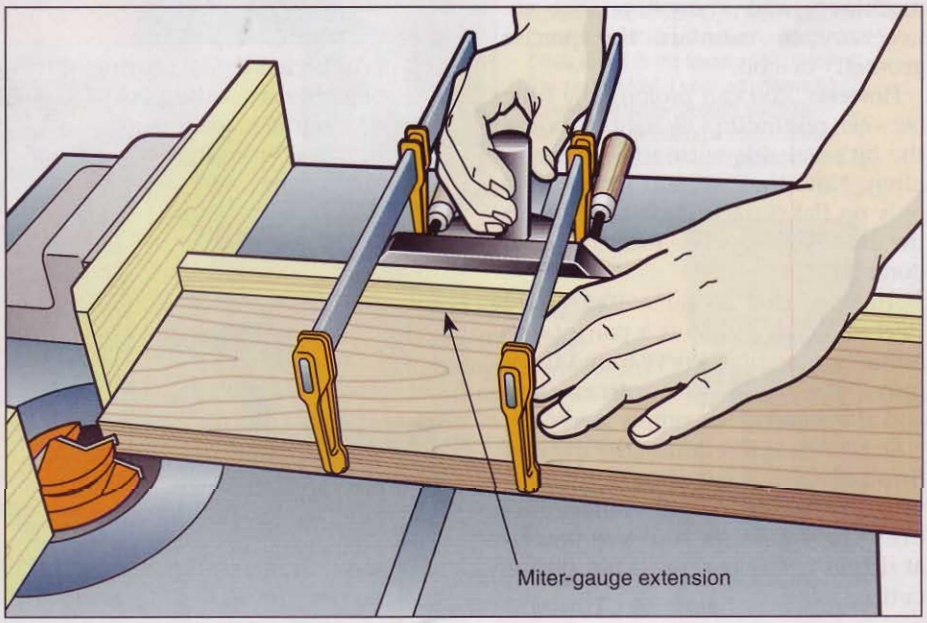
Join edges and ends

To set up for cutting strong and self-aligning edge and end joints, follow Steps 2–4. To cut workpieces for an edge joint, cut one edge with the workpiece top face up on the table. Then, cut its mating edge by placing another workpiece on the table, this time with its top face down. (We mark the top face with a pencil or piece of masking tape to avoid confusion.)

You follow the same procedure for cutting ends, but here you'll need to clamp the workpiece to a miter gauge. As shown at *bottom*, attach a miter-gauge extension to your miter gauge to support the workpiece. This helps prevent tear-out on the exit end of the cut. Slowly feed the end through the router bit to avoid a choppy cut or kickback.

Photographs: **John Hetherington**
Illustrations: **Kim Downing**; **Brian Jensen**





Sources for lock-miter bits:

CMT
800-531-5559
cmtusa.com

Eagle America
800-872-2511
eagleamerica.com

Freud
800-334-4107
freudtools.com

Grizzly Industrial
800-523-4777
grizzly.com

Infinity Cutting Tools
877-872-2487
infinitytools.com

MLCS
800-533-9298
mlcswoodworking

Porter-Cable
888-848-5175
deltaportercable.com

Woodline USA
800-472-6950
woodline.com

TLC for Router Bits

Let a pro do the resharpening, but between trips keep them tuned up with a few file strokes.

Router bits, even those tipped with carbide, dull faster than you might expect. It happens quickly in solid wood, and even more quickly when you work with plywood and other resin-filled sheet goods.

When a dull bit needs regrinding, it's time for a trip to a good sharpening service, which can set you back $10. Only a qualified professional has the machinery and know-how that are necessary to maintain the precise geometry of a bit.

However, you can prolong the time between regrindings by lightly honing the bit's flat side with a file every so often. Note that we said lightly, and only on flat surfaces. Don't mess with the bit's hook angles. Even the pros don't do that.

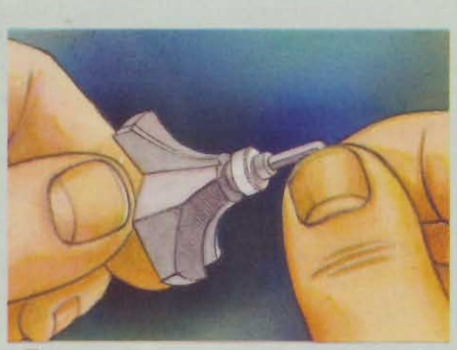
All you need to hone high-speed steel and carbide bits is a pair of diamond honing files. We've found them priced at $6 to $7 apiece in catalogs and at woodworking supply stores.

Start with a fine (600-grit) file and finish off with a super-fine (1,200-grit) version. Work carefully and don't overdo it. Follow the four-step process at *right* to keep your router bits on the cutting edge.

Time for the pros

You can hone a router bit five or six times, but eventually it needs professional grinding. The following tests will tell you if that time has come.

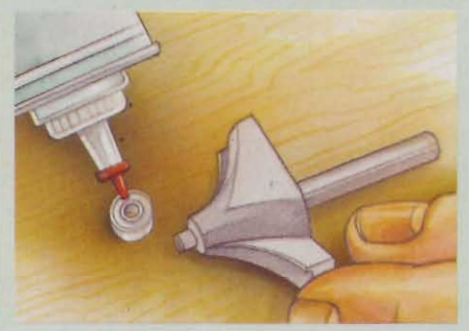
- Inspect the bit closely in good light.



1 If the bit has a pilot bearing, start by removing it. If the pilot is permanently mounted, make sure you keep the files away from it. A slight flat spot will ruin a pilot.

2 Next, remove pitch and resin, which can build up fast if you frequently rout softwoods. Apply lacquer thinner or commercial bit cleaner and scrub the bit with an old toothbrush.

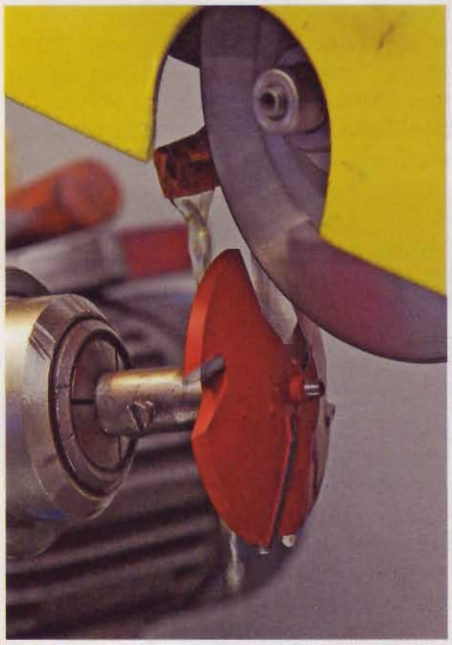
3 Begin honing just the flat faces with the fine file. Count the sharpening strokes or alternate the cutting edges every few strokes to ensure that they're honed equally. It's better to do too little honing than too much. You might be surprised by how quickly a diamond file cuts, even if you're sharpening carbide.



4 Finish sharpening with the super-fine file. Again, apply an equal number of strokes to each of the bit's flat faces and use only moderate pressure on each stroke. Lubricate the bearing with light oil and replace it. Also wipe the bit with oil to guard against rust that can pit polished surfaces.

Look for nicks or blunt spots on the cutting edge.

- Hold a fingernail against the cutting edge and gently rotate the bit. It should shave the nail with little effort.
- Run the bit through softwood, watch how it cuts, and check the smoothness of the surface it leaves.
- Check the chips. If they look more like sawdust than thin shavings, the bit needs professional help.



The universal tool grinder shown *above* is equipped with a divider plate to ensure that both sides of the bit get sharpened equally.

We visited Acme Tools' sharpening shop in Des Moines, Iowa, to see router bits being sharpened on professional equipment. Chad Hitsman, Acme's tool sharpener, shown *below*, uses a Moon's TG1 universal tool grinder equipped with a 400-600-grit diamond wheel to get the kind of results you see in the after photo at *right*.

Notice that Chad wears a dust mask and safety glasses, as shown *below*. He puts the bit in a chuck, *left*, turns a couple of cranks to line it up with the wheel, then works it back and forth with a hand wheel. A few minutes, and he's done. Prices vary widely depending on locale. Acme's charges are based on shank size ($6 to $8), or on the size of the profile—up to $12 for raised-panel bits.

Straight bits can be sharpened many times. Profile bits may need replacement after about four sharpenings because the profile changes each time.

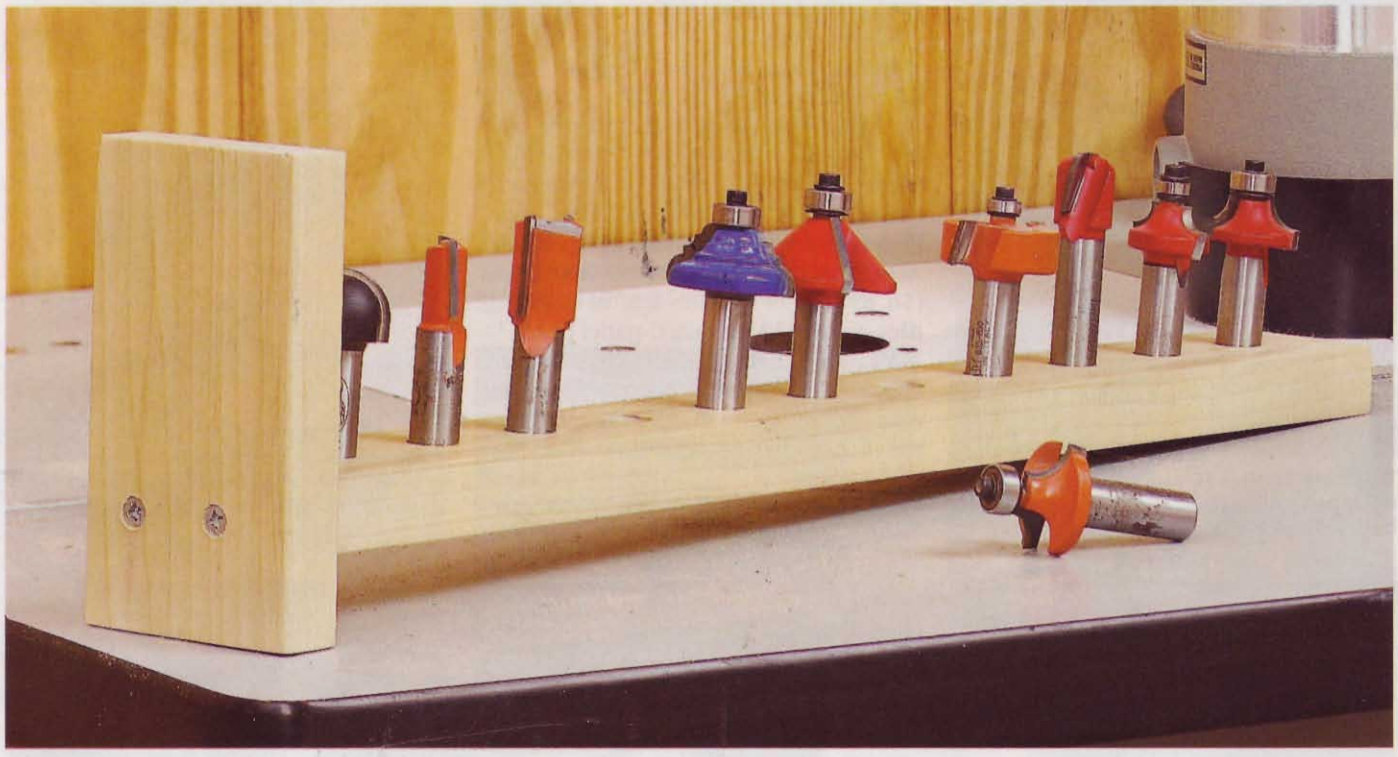
Written by **Jim Hufnagel** with **Jim Pollock**
Illustrations: **Brian Jensen**

BEFORE AND AFTER CLEANING AND SHARPENING

These bits from the *WOOD*® magazine workshop showed a lot of wear. Chad used a wire wheel to clean off all the residue before taking them over to the diamond-wheel sharpener.

More Ways to Increase Router Bit Life

Here's how to get more mileage and better cut quality from your router bits.

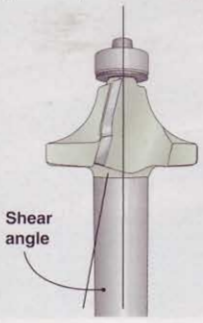


1 Clean bits of pitch and resin with lacquer thinner or a good bit cleaner. Lubricate the bearing often.

2 Never overload or abuse a bit. If the job calls for cutting away more than the equivalent of a ¼" square area, remove the extra waste by making multiple passes with light cuts.

3 For lots of heavy-duty routing, use ½"-shank bits if your router accepts them. They're stronger, stiffer, less likely to deflect and cause chatter, and easier to regrind.

4 Use bits with the shortest cutting edge and the largest cutting diameter that you have. When possible, select bits with high shear angles, as shown at *right*, and large-enough gullets to allow fast chip ejection—they will run cooler and stay sharp longer.



5 Use sharp bits. If you're burning wood, applying more than the usual feed force, or getting chattering while cutting, suspect a dull bit.

6 A router of 1½ hp or more will cut easier and won't heat up the bit as fast as a router with less power.

7 When mounting a bit, insert the shank into the collet and finger-tighten the lock nut. Twist the bit several turns to let it seat itself. Lock the bit with 80 percent of the shank captured in the collet. Do not insert the shank all the way to the bottom of the collet; allow a 1/16" gap.

8 Set your router speed to the bit's optimum rpm. Bits over 1" in diameter should be slowed to cut satisfactorily and not overheat.

9 Consider a two-cutter system. Do most of the rough cutting with one bit, then do the final cut with a new or freshly ground bit with low mileage.

10 Look for uneven cuts caused by extensive wear on a portion of the bit. This defect could produce poorly fitted joints. Sharpen or replace the offending bit.

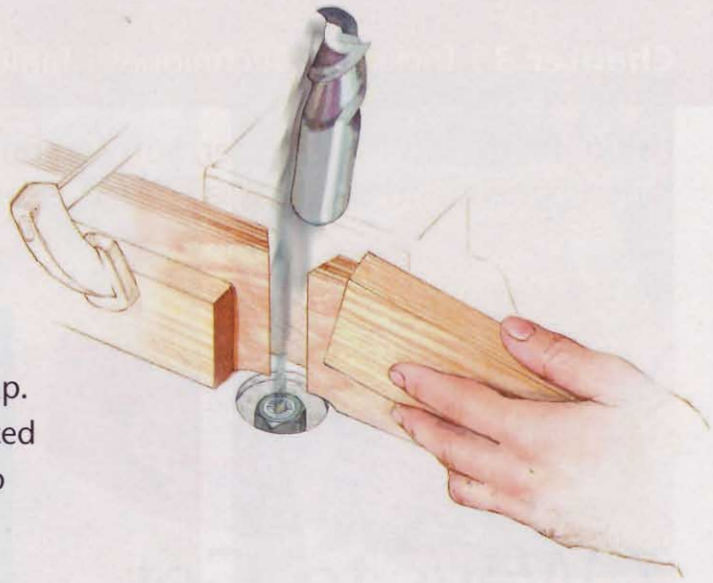
11 Clean and lightly oil bits after use. Smooth the shanks with fine emery cloth. Clean and check the collet frequently for wear.

12 Lubricate the ball bearings with light oil after each use.

13 Store bits so cutting edges and bearings do not get damaged or strike other bits, as shown *above*.

14 Buy the highest quality bits you can afford, especially for profiles you'll use regularly, such as straight bits or round-overs.

Watch Out for Loose Bits



This article is based on a reader's actual shop mishap. Timely advice from woodworkers who've experienced incidents like those that might happen in your shop can help you work more safely.

The incident

I was using my table-mounted router to cut mortises in cabinet face-frame stiles when suddenly the ¼"-diameter upcut spiral bit began to chatter loudly. Without shutting off the router, I lifted the stile off the table and immediately felt something tick me on the right cheek. I then shut off the router, and rubbed my cheek to check for what I thought was a splinter.

I didn't find anything but, through my peripheral vision, I saw something sticking out of my forehead between my nose and right eyebrow. Assuming it was a piece of wood, I grabbed it with my handkerchief and pulled it out. I couldn't believe it was the bit! I guess it had glanced off my cheek.

After covering the wound, I drove to a hospital. Although the bit had penetrated ⅝", an X-ray showed no sign of serious injury, so the opening was sutured.

The next morning, I checked the router and bit and found the nut tight on the collet and no sign of damage on the bit shank. I really don't know what caused the problem. The 12-year-old router now resides in a landfill, but I carry the bit with me every day as a lucky charm.

—Clark Mittan, Waldorf, Md.

The woodworker

With more than 40 years of experience, Clark is a professional woodworker specializing in cabinetry and housing restoration work in the District of Columbia and suburban Maryland.

The warning signs

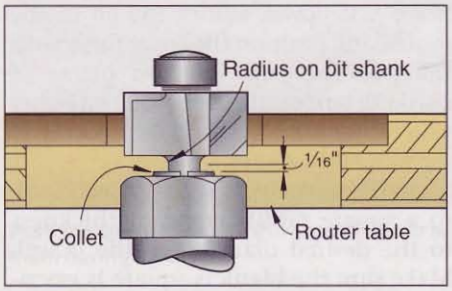
The chattering that Clark heard signaled that something was loose in the router, requiring immediate shutdown and inspection. Rather than lifting the workpiece, Clark realizes in hindsight that he should have held it in place to safely contain the bit while turning off the router. Also, he was not wearing safety glasses, which might have deflected the bit from his face and prevented a more serious injury if it had hit his eye.

The lessons

A loose router bit can become a dangerous projectile, as Clark learned, and it also can affect the accuracy of your cuts. Although it's not clear what caused Clark's bit to loosen, here are a number of things you can do to prevent this kind of problem.

- Use only sharp bits. Dull cutting edges increase force and stress on the bit and router collet, which can cause slippage.
- Before you install a bit, make sure the shank and collet are free of sawdust, grease, and other contaminants. Also, check the collet and bit shank for rust and damage, such as scoring, which can create burrs that prevent sufficient collet grip. If you see any corrosion or damage, replace the collet and/or the bit.
- When installing a bit that has a radiused transition area between the cutter and shank, insert the shank into the collet until it bottoms, then pull the bit out enough to clear the radius by about 1/16", as shown *below left*. This ensures that the collet clamps tightly around the shank.
- Using the router-supplied wrenches, tighten the collet nut firmly. Never tighten the nut without a bit inserted or you may damage the collet.
- Never exceed the maximum speed specified by the bit and router manufacturers. Use the chart *below* as a guide for speed based on bit diameter.

CLEARING A BIT-SHANK RADIUS



MAXIMUM ROUTER SPEED

Bit diameter	Max. speed (rpm)
Up to 1"	Up to 24,000
1 to 1¼"	16,000 to 18,000
1¼ to 2¼"	12,000 to 16,000
2¼ to 3½"	12,000

Note: Maximum speed of fixed routers is typically 24,000 rpm. When using bits larger than 1" diameter, we recommend using a variable-speed router.

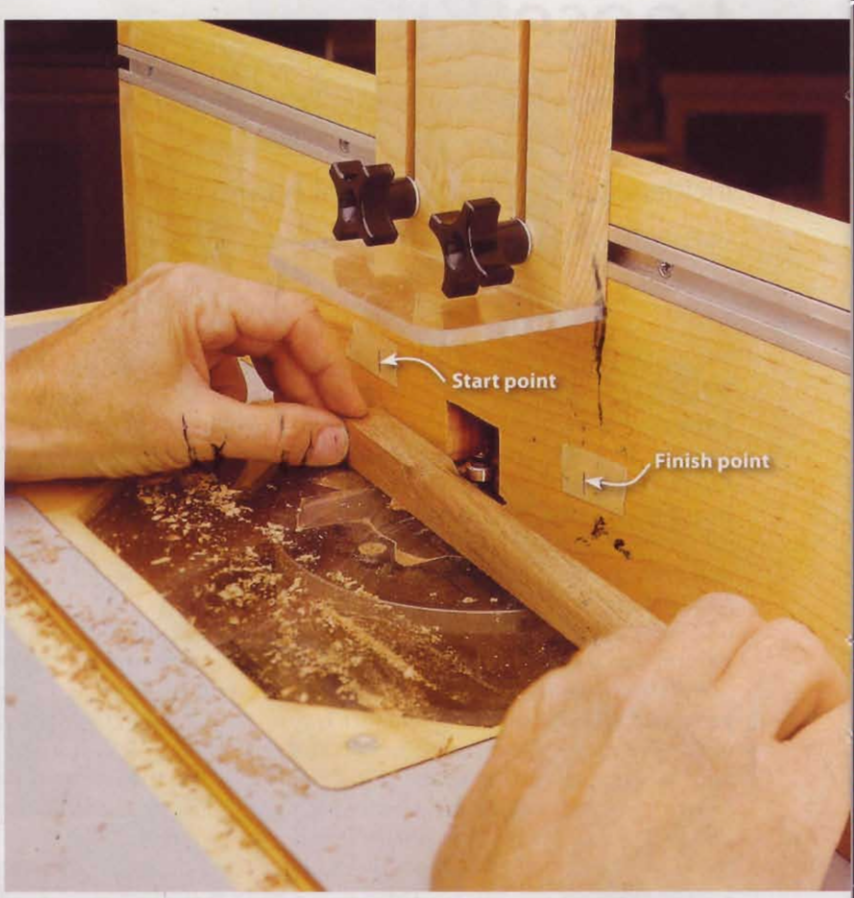
- When you need to remove a lot of material, make multiple shallow passes to minimize stress on the bit and collet.
- Listen to the router. If you hear it straining, you're probably removing too much material or feeding the workpiece too fast.
- When routing multiple pieces, occasionally shut off the router and measure the cut depth or the bit height to ensure it has not changed.
- Always wear eye protection and, whenever possible, use a bit guard.

Illustrations: **Roxanne LeMoine**; **Lorna Johnson**, **Melanie Powell**, **Studio in the Woods**

Using pointers in this chapter, you can put your router to work cutting dowels, slots, raised panels, and decorative edge treatments.

7 Ways to Get More from Your Router Table

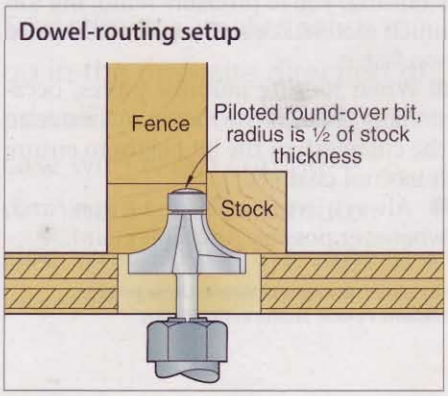
Whether you go with a floor model or a benchtop version, a router table improves both control and safety when cutting various kinds of parts.



We raised the guard for clarity in this photo. Keep it just above the workpiece when you're routing dowels, to ensure that your fingers stay clear of the spinning bit.

1. Want to Super-size Those Dowels?

Sometimes you need hardwood or big dowels that match the wood of your project, and standard stock doesn't fill the bill. Here's a router table technique that we've used for projects, such as quilt racks, and for handles on tool caddies and utility carts.



You'll need a round-over bit with the same radius as the dowel's radius. For example, use a ½" round-over bit to make a 1" dowel. Chuck the bit in the router, and position the fence flush with the pilot bearing. Put two pieces of masking tape on the fence, one on either side of the bit, and mark two points 3" from the bit's center.

On the tablesaw, rip each dowel blank to a square profile equal in thickness to the desired diameter of the dowel. Make sure the blank is square is essential to achieve the four identical quarter-round cuts you'll rout later. Crosscut the blank 6" longer than the length of the finished dowel.

Place your workpiece as shown in the drawing at *left*. Align the left end with the left-hand start point, where shown in the photo *above*, hold the end firmly against the fence, and begin routing any edge. Ease the workpiece into the bit, and move the blank across the bit until the right end reaches the right-hand finish point. Repeat the procedure for the three remaining edges. The flat surfaces left at each end not only prevent the blank from rotating, but also keep your fingers at a safe distance from the bit.

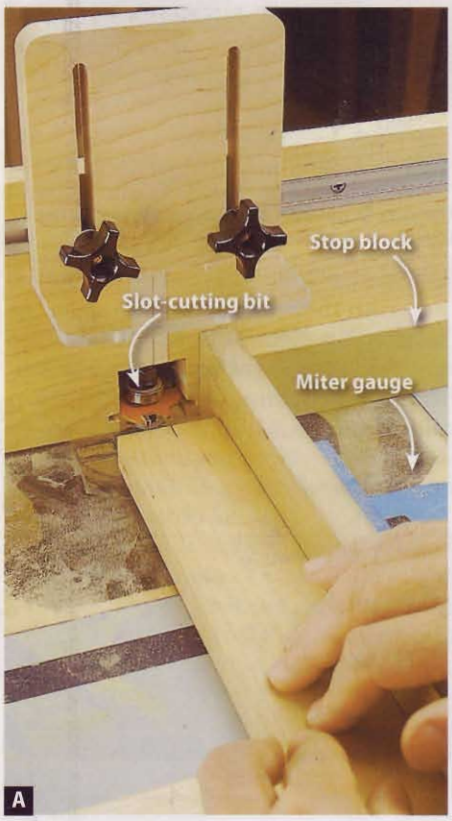
2. Sink Your Teeth into Some Biscuits

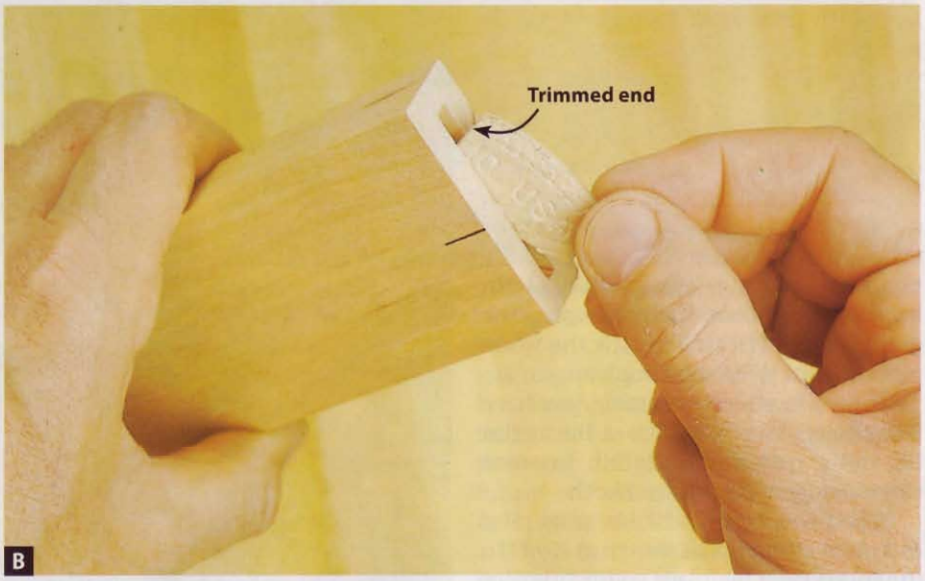
To cut biscuits on your router table, all you need is a slot-cutting bit that matches the standard biscuit thickness of 5/32" and a miter gauge with an auxiliary fence.

Every time you set up to make a joint, center the cutter on the thickness of your stock, and make a test cut to double-check. To further reduce the risk of misalignment, mark the face of each component, then keep that side up.

Plunging a workpiece into a standard slot-cutting bit produces a slot that's shorter than a standard biscuit. You can lengthen the slot by moving the workpiece and making additional cuts. However, if you're going to make only a few joints, it's quicker and easier to shorten the biscuits. Here's how to cut slots for a rail-and-stile frame.

Use a steel rule to align the face of your router table fence with the front of the bit's pilot bearing. Place a piece of masking tape on the fence above the bit. Then, use a square and a pencil to mark the center of the bit on the tape. Now, mark the center of a rail. Hold the length of the rail against your miter gauge, equipped with an auxiliary fence that nearly touches the router table fence, as shown in **Photo A**. Align the two center marks, and clamp a stopblock on the router table fence so it meets the back of the miter-gauge fence. Using the miter-gauge fence as a support, plunge the workpiece squarely into the bit. Cut until it contacts the bearing.

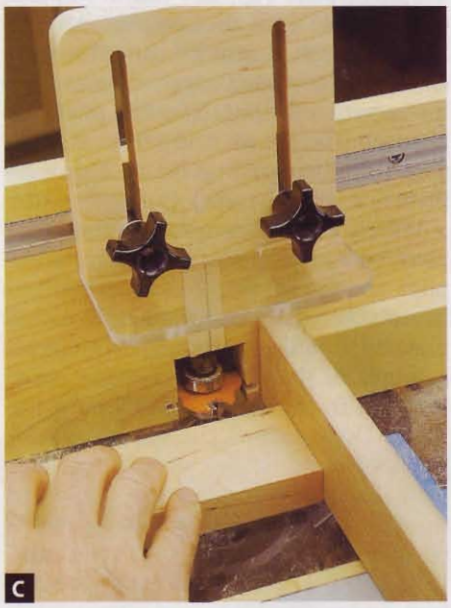




Mark a biscuit at both ends, making it slightly less than the slot length. Slice off the ends with a bandsaw. Test the fit, as shown in **Photo B**, to make sure that at least half of the biscuit's width slides into the slot.

To cut a matching slot on a stile, leave the miter gauge and stopblock in place. Carefully push the workpiece into the cutter, as shown in **Photo C**.

You can cut a slot in the other end of the stile with the same setup, but you have to flip the stock over, putting the face side down. If the slots are perfectly centered in the stock thickness, that will work fine. The alternative is to measure the distance from the center of the bit to the miter gauge, and then clamp a stopblock at that same distance to the left of the bit. Remove the miter gauge and right-hand stop, then cut a slot at the opposite end of the stile, still keeping the face side up.



STEP A: Your miter gauge, backed by a stopblock, provides a solid, square guide as you push the end of a rail into the spinning slot-cutting bit.

STEP B: Trim the biscuit ends, slip it into the slot, and test the fit before gluing. If a gap shows, take just a bit more material off each end of the biscuit.

STEP C: Your setup remains the same when you cut a biscuit slot for a stile. This slot will match perfectly the slot in the previously milled rail.

3. A Template Means Never Having to Say "Oops"

Let's say you want to make four table legs with matching curves. A table-mounted router and template enable you to produce as many identical legs as you want.

Using ¼" hardboard or medium-density fiberboard, make a template to the shape you want. Use a bandsaw or scrollsaw to cut close to the line on the template, then sand to it. Attach the template to your stock with cloth-backed, double-faced tape, orienting the grain for best effect. Bandsaw the workpiece within ⅛" of the template.

Turning to your router table, you have two choices for router bits—a flush-trim bit and a pattern-cutting bit. In some situations, you might need both.

A *flush-trim bit* has a ball-bearing pilot mounted at the tip, as shown at *right*. To use this type of bit, place your workpiece on the table with the template on top. Adjust the bit height so the pilot runs along the template's edge.

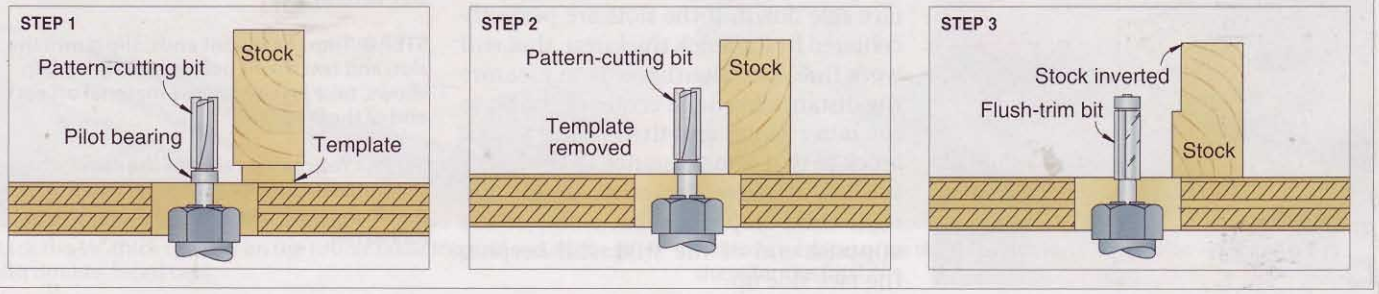
On *pattern-cutting bits*, the pilot sits between the shank and the cutter, as shown in the drawings *below*. Your template rests on the table.

Whichever bit you use, ease the workpiece into the bit until it contacts the pilot, then move the piece from right to left. If you've left more than ⅛" of excess material in some spots, trim it to size with a couple of shallow passes. Don't pause too long in any spot, or you'll burn the wood. Double-check the surfaces you've just routed before you remove the template. Sometimes another pass will smooth out a rough spot. Finally, slide a putty knife blade between workpiece and template, pop them apart, remove the tape, and you're done.

When making identical parts, it's easier to make the cuts faster and more accurate if you use a hardboard or MDF template and a flush-trim bit like the one shown here.

When you have a workpiece that's thicker than the cutting length of your bit, use a pattern-cutting bit and a flush-trim bit in the sequence shown in **Steps 1, 2,** and **3**. Make one pass with the pattern-cutting bit, template side down. Remove the template, then make another pass with the pilot bearing riding on the surface you just machined. Finally, flip the workpiece over and use the flush-trim bit, with the pilot bearing riding on the previously milled surface.

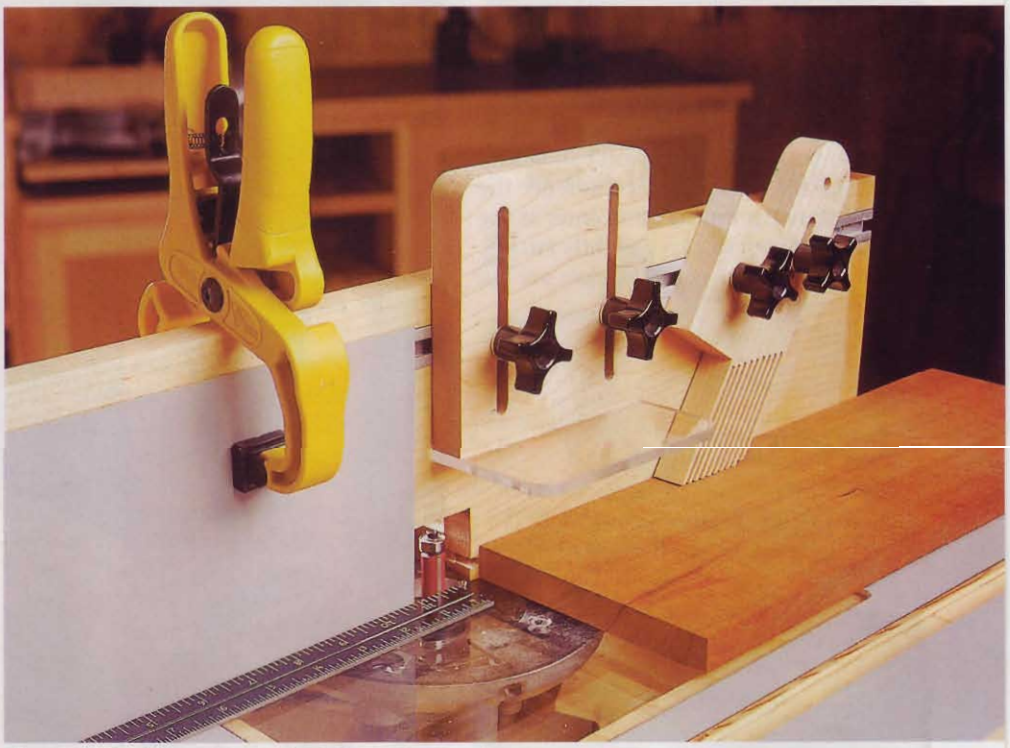
How to handle extra-thick stock



4. Make Your Router Think It's a Jointer

We added an edge-jointing function to our router-table fence by simply clamping a piece of plastic laminate on the left-hand, outfeed end of the fence. Use sandpaper to ease the edge nearest the router bit, so it won't catch your workpiece as the board slides past. As seen at *right*, we used a steel rule to align the laminate with the cutting edge of a straight bit mounted in the router.

Set the bit high enough to trim the entire edge of the board in one pass. Then, turn on the router, and move the board across the table from right to left. You'll remove 1/16" with each pass, and leave a perfectly straight, square edge. Repeat the procedure with a second board, and the two pieces can be glued together without a gap anywhere.



Place your laminate piece at the left-hand edge of the bit-clearance notch in the router table fence. The rigid router fence will keep the laminate from flexing.

5. Add Custom Plates to Your Table

Clamp your insert-plate blank and a backer board to your drill-press table, centered under the bit of your holesaw. Drill slowly, and you'll get a clean cut.

Router-table work goes smoother and more safely when the hole in your insert plate is only slightly larger than the diameter of the bit. You can buy a plate with removable rings to fit different router-bit diameters, which gets you close enough in most situations—or you can make a custom plate to match a bit exactly. Use Baltic birch plywood for the least expensive plate, or choose polycarbonate for a clear plastic plate. You can buy a 12×12" piece of 3/8" polycarbonate for $20.50 from Woodcraft. Call 800-225-1153 to order part number 16L72.

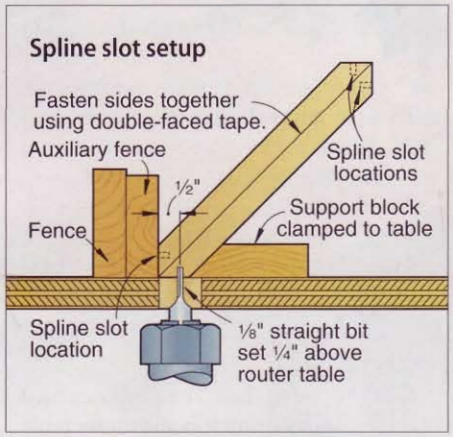
Place the insert plate faceup on a flat surface. Remove the subbase from your router, and adhere it to the plate, face up, with double-faced tape. Be sure it's centered, and oriented so that your router will be convenient to operate once it's mounted under the table. Select a drill bit the same size as the holes in the subbase, and chuck it in your drill press. Using the holes in the subbase as guides, drill matching holes through the insert plate. Remove the subbase, and countersink all the holes.

Now, attach the insert plate to your unplugged router and place it flat on your workbench. Chuck a 1/4" drill bit in the router, and lower it until the bit touches the insert plate. Turn the collet by hand to mark the centerpoint.

Remove the insert plate from the router. Chuck a holesaw or adjustable circle cutter in your drill press to cut a center hole of the diameter needed, as shown at *left*.

6. Keep that Miter in Line with a Spline

To rout slots for hidden splines, use a straight bit, two stopblocks, and a simple support block. Set your ⅛" straight bit to project ¼" above the router table. Clamp an auxiliary fence to your router table fence so your workpiece won't slide into the bit-clearance notch. Set this fence the same distance from the bit's center as the thickness of your stock, or slightly farther. In the drawing *below*, spline slots are cut in ½"-thick pieces.



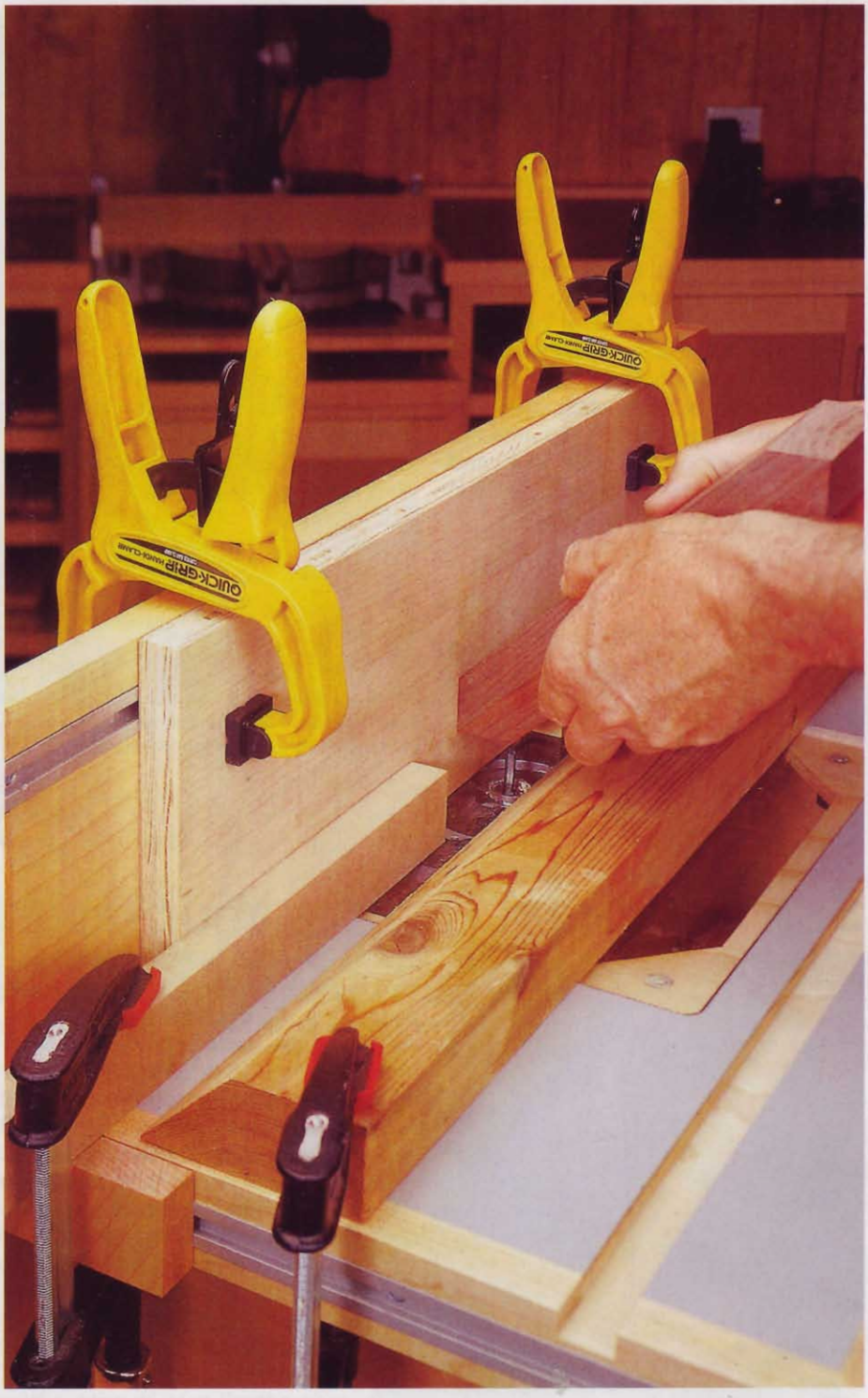
Miter-cut your box sides to length. Take the two ends of the box, or the front and the back, place them face-to-face, align the edges, and join them with cloth-backed, double-faced tape.

Bevel-rip a scrap piece at 45° to make a support block. Hold the taped-together assembly in the corner formed by the router table and fence, and use it to place the support board parallel to the fence. Clamp both ends of the support board to the router table.

Now, mark the ends of the planned slot on the workpiece. Use those marks, matched with the cutting edges of the bit, to set stopblocks on the fence to the left and right of the bit.

Turn on the router, hold the workpiece firmly against the fence, and lower it onto the spinning bit, as shown at *right*. Keep the right side of the workpiece against the right-hand stopblock. Carefully slide the workpiece across the table to the left-hand stopblock, and raise it straight up the fence.

After cutting the slots, cut matching splines. Hardboard and plywood work great for this, or you can cut splines from the same wood used for the box. In that case, the grain of the splines should run in the same direction as the sides, to avoid problems with wood movement.



Cutting a spline slot is simple with this setup. Start at the right-hand stopblock, lower the workpiece onto the support block, and slide it to the left stopblock.

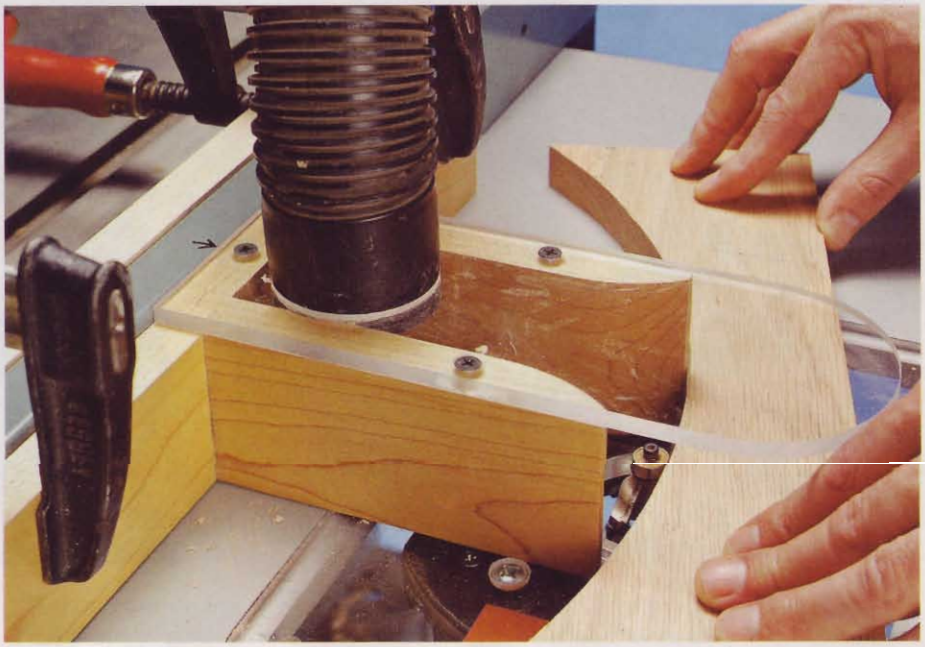
7. When Cutting Curves, Use a Freehand Guard

Like a fence, a freehand guard helps you safely feed workpieces into a router bit and collects wood shavings as you rout. But unlike a fence, a freehand guard, like the one shown at *right*, helps you rout workpieces with curved edges. This type of guard works only with router bits that have pilot bearings. Here are two different ways to rout curved edges with this invaluable helper.

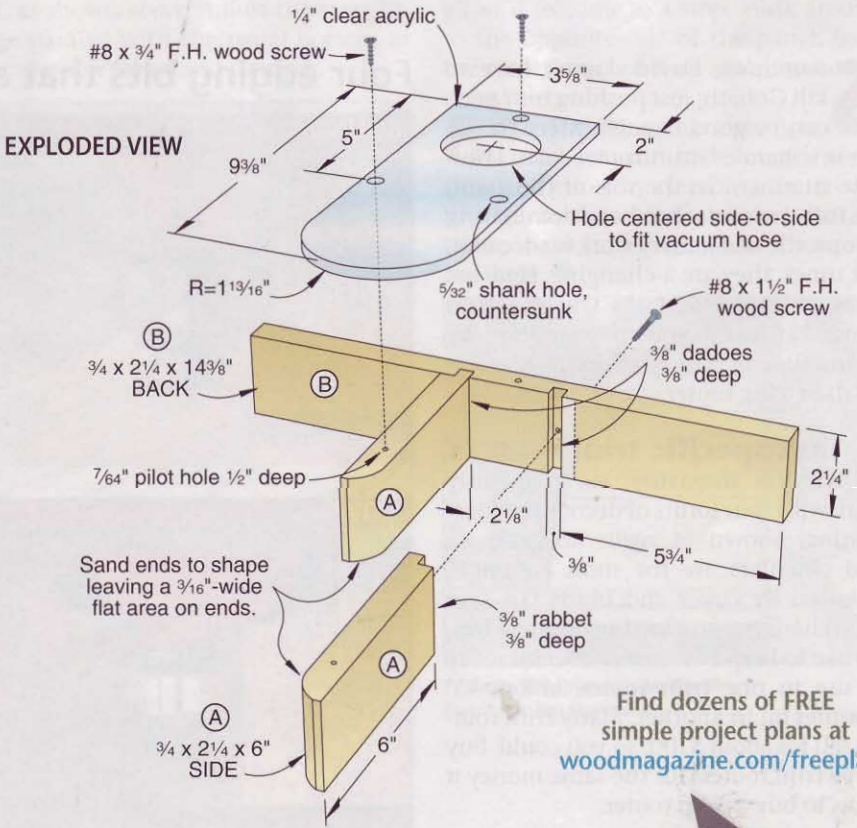
For an edge that's gently curved, clamp the freehand guard to your fence, then adjust it forward and back to accommodate your workpiece. To start a cut, hold the workpiece against the *guard's starting point, and slowly pivot* the workpiece into the bit. When the workpiece makes contact with the pilot bearing, remove the hand pressure against the starting point and rout the entire edge.

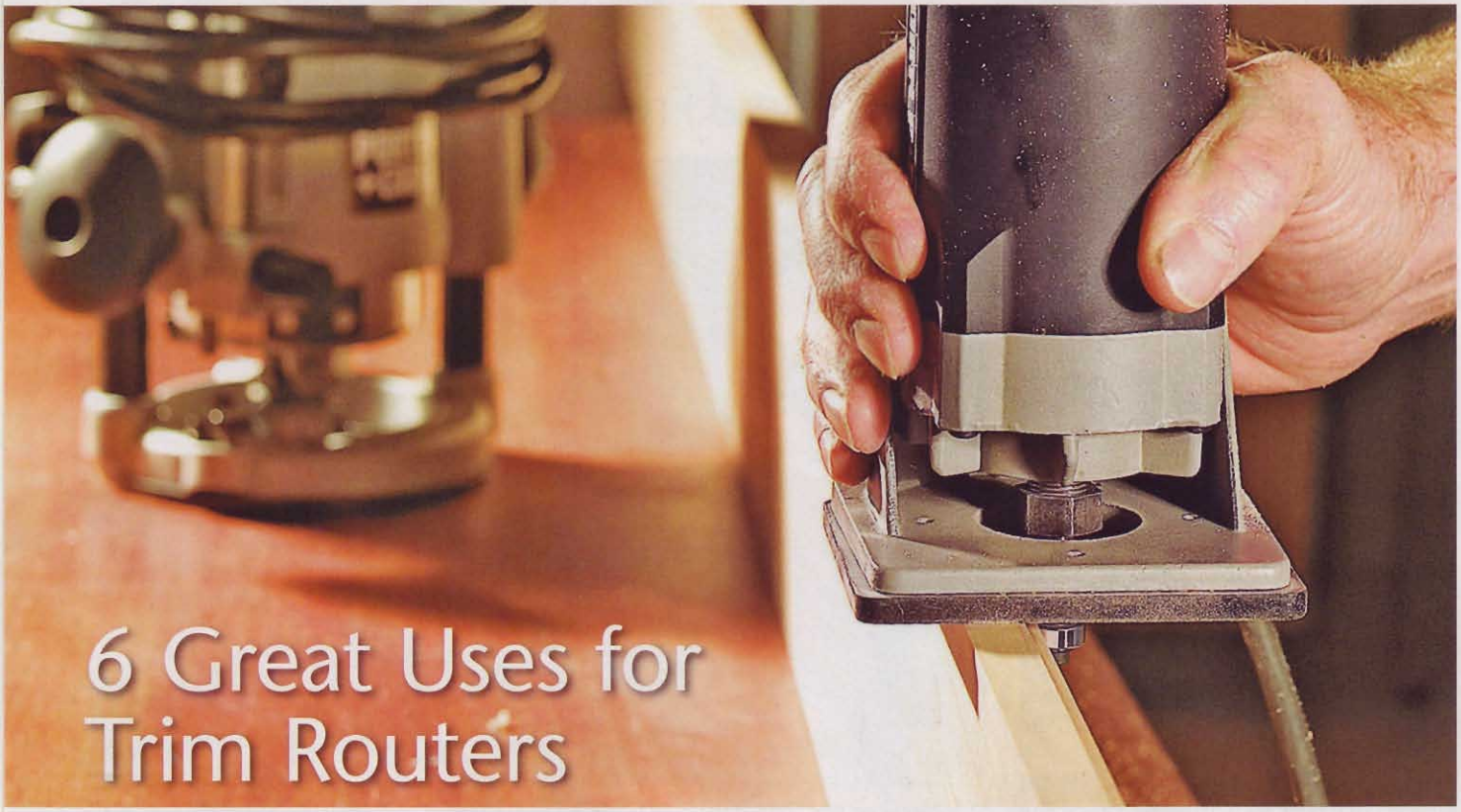
For an edge with more exaggerated curves, like that shown *below*, move the guard back slightly and work directly off the piloted bit.

Beyond its basic uses, a freehand guard like this one, with an acrylic shield, excels as an effective chip-collection hood. More important, it lets you safely see your work during the routing operation without worrying about particles flying into your eyes.



Side pieces on this build-it-yourself freehand guide extend perpendicular to the fence to help guide the curved edge of a workpiece past the router bit. The clear-plastic top aids in collecting chips and wood shavings as you work.





6 Great Uses for Trim Routers

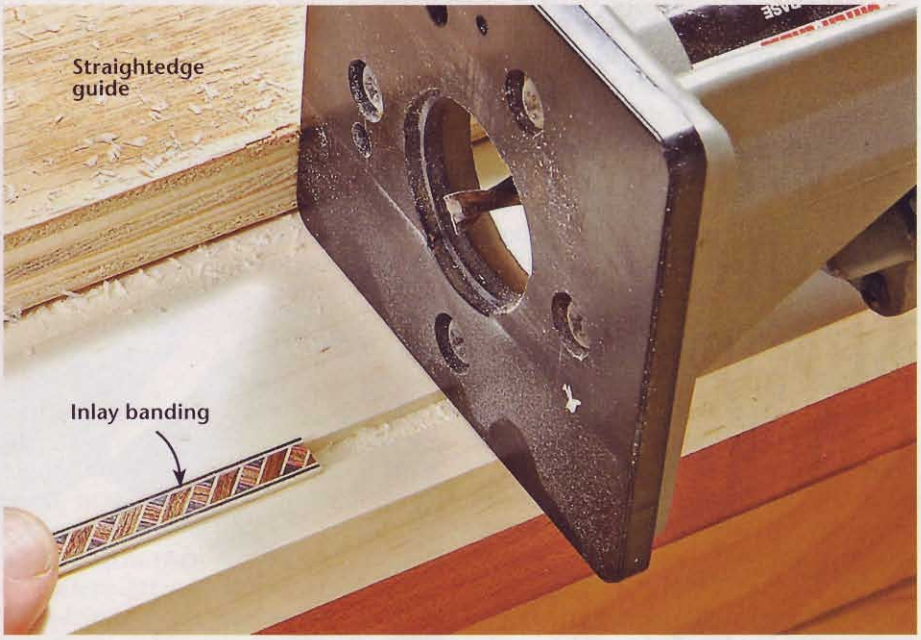
Don't let a trim router's small package fool you: These one-handed wonders have emerged from the shadows of their full-size cousins to earn their keep in your workshop.

Sometimes, David doesn't have to kill Goliath; just pushing him aside can be good enough. Meet David, the one-handed trim router (aka: laminate trimmer). In the role of the giant, the full-size router has been dominating fine profile and joinery work for decades. But times, they are a-changing. Here are some examples of tasks where a trim router can assist you in your shop by saving time or money or doing jobs better than a big router.

1 Task-specific trim routers

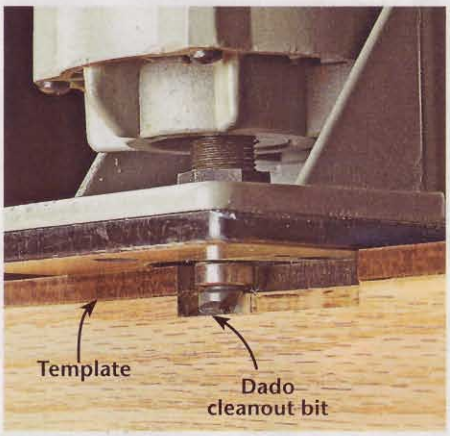
At *WOOD®* magazine, we frequently work with four forms of decorative edge-routing, shown at *right*: Round-overs and chamfers are the most common, followed by coves and beads. To save time changing and setting up these bits, we like to keep a ⅛" round-over bit ready to use in one trim router, and a 45° chamfer bit in another. Many trim routers sell for about $100, so you could buy three trim routers for the same money it takes to buy a 3-hp router.

Four edging bits that are perfect for trim routers



2 Perfect flutes

Make quick work of routing flutes by installing a round-nose or core-box bit in your trim router. When you don't have a detachable edge guide (standard on some small routers, optional for others), these routers' small bases allow you to set a straightedge close to the cutting area. Those with square subbases follow that straightedge perfectly (*above*) to cut the flutes with no worries.



3 No-tip hinge mortises

Using a trim router for routing shallow hinge mortises proves a no-brainer. A full-size router can tip or wobble when you balance it on a workpiece edge (a door, for example). But a trim router, with its narrow base, light weight, and low center of gravity, makes the job easy. Use a template with a top-bearing dado cleanout bit with a small cutterhead (*above*). Square up the corners, if needed, with a chisel.

4 No-fuss inlay grooves

Decorative inlays (*above*) add craftsman-like quality to projects. Using a trim router helps you get into tighter, narrower surfaces—such as aprons attached to table legs. Follow a straightedge or attach an edge guide to the router's base to ensure dead-straight grooves. Use a straight bit or downcut spiral bit.

5 Butterfly patches

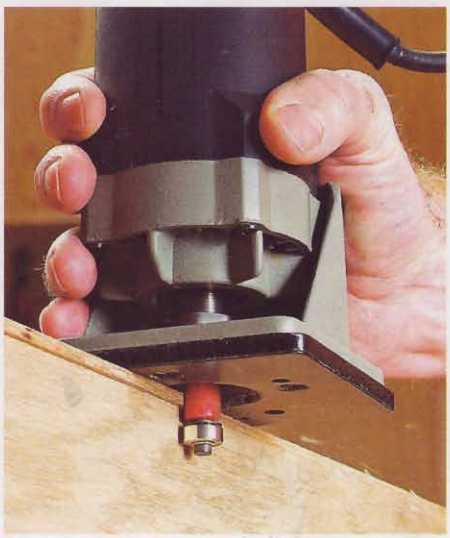
A butterfly (or similar decorative patch) is one of our favorite patches for flaws such as unsightly knots or splits. Use a trim router to remove the material, and to cut out the patch. A trimmer works great following a template with a top-bearing bit or guide bushing. When freehand routing (*right*), the trim router, using a straight bit or downcut spiral bit, feels like an extension of your hand. Cut out the butterfly first, trace its pattern over the flaw, then cut away the recess starting in the middle and gradually routing toward the lines. Cut crisp inside corners with a chisel.

6 Oh, and one more thing...

Yes, trim routers still do an exceptional job of flush-trimming laminate, veneer edge banding, and solid-wood edging (*right*). Bearing-guided flush-trim bits prove best for this task. Rout in a climb-cutting fashion (for edging ¼" thick or less) to avoid grain tear-out.

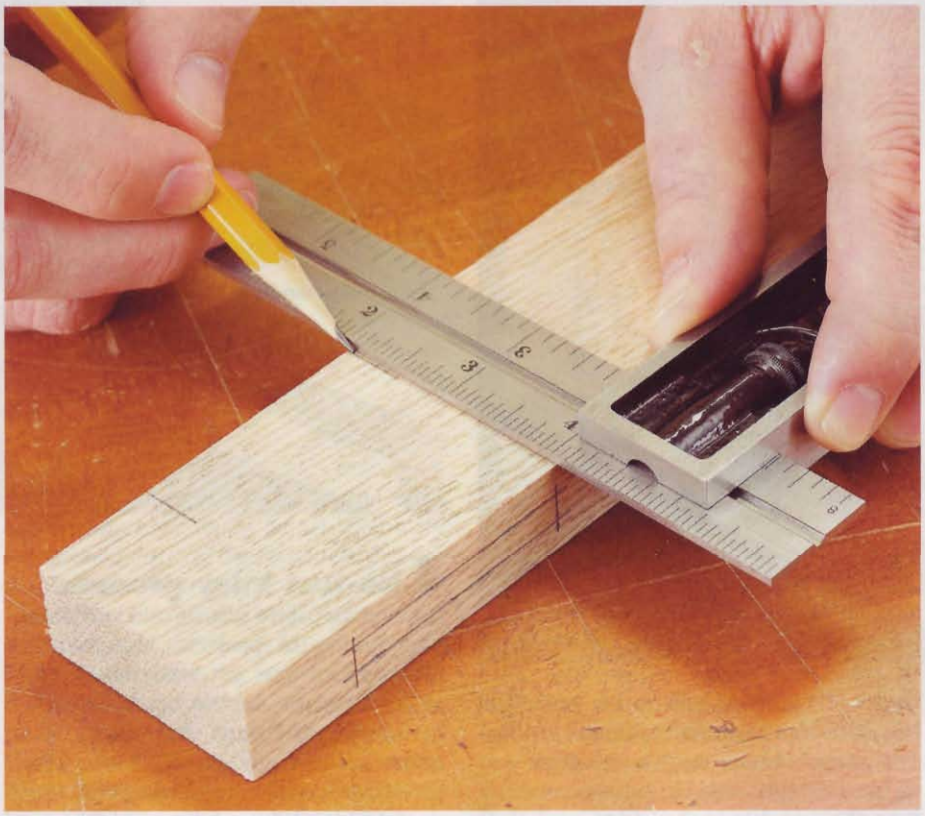
Source

Dado cleanout bit: #5382 (½"-large diam. ¼" shank), $20, MLCS, 800-533-9298 or mlcswoodworking.com



2 Ways To Rout Stopped Cuts

With the help of a table-mounted router, you can quickly and precisely cut parallel slots or rabbets into a workpiece. And, with either procedure shown here, you can precisely stop those cuts workpiece after workpiece.



First, a few basics

Many different router-bit profiles work well for making stopped cuts. Just a few of them: V-groove bits for one or more parallel veins, round-nose or "core-box" bits for cutting flutes, and dovetail bits for sliding-dovetail joints.

Most of the time, you'll use a straight or spiral bit to make square-walled cuts with flat bottoms. Depending on the application, you might be cutting a groove, rabbet, or mortise. For simplicity's sake, we'll refer to these cuts as "slots."

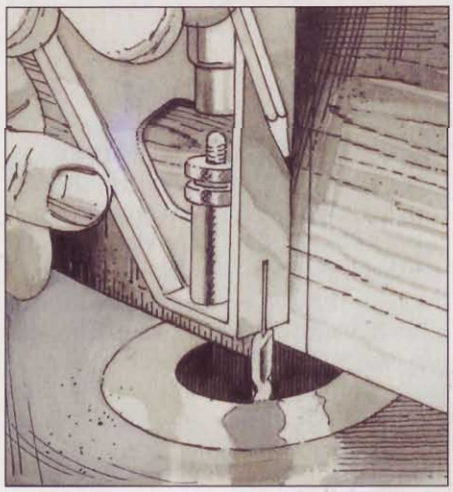
For both of the procedures described here, start by doing two things. First, adjust the height of the router-table bit for the necessary cutting depth. (For deep mortises you may need to set the bit at a low height and make the cut in a series of progessively deeper passes.) Then, depending on where you want the cut to fall on the width of the workpiece, set the fence the necessary distance from the bit.

A fast, low-tech procedure for single workpieces

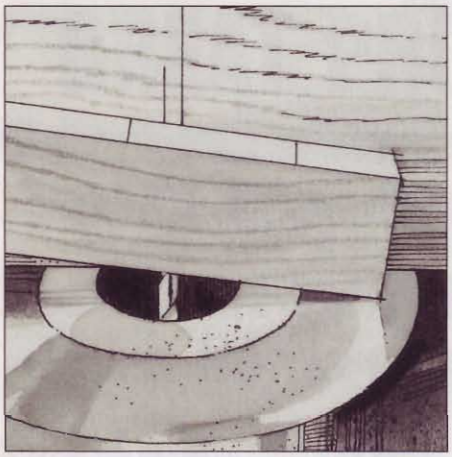
When you have just a few workpieces to machine, and the length and position of your slots can vary by up to 1/16" or so, try this quick-and-easy way to make your stopped cuts.

1 Mark the position of the cut on the workpiece (*above*). Then, transfer the location of the end marks of the cut to the adjoining surface of your workpiece. Next, transfer the marks to the surface opposite the surface to be cut.

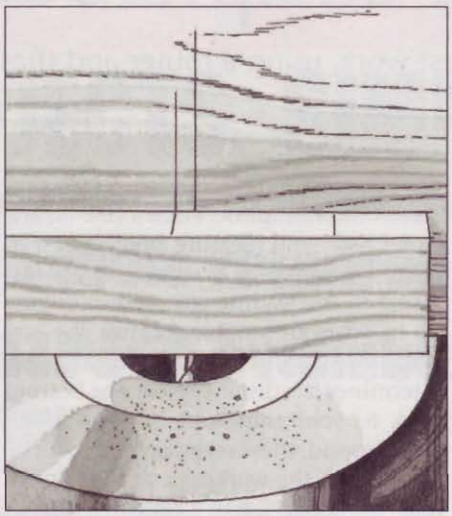
2 Use a square to mark the diameter of your router bit onto the router-table fence, as shown *below*. Rotate the router bit so that when you butt the square up to it, you mark the full cutting diameter.



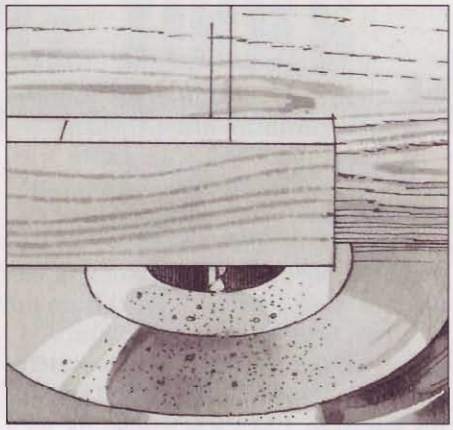
3 Turn on the router and place the workpiece against the fence, with its left end suspended and its right end resting on the router table, as shown *below*. Now, slowly lower the workpiece completely onto the router bit, with the left mark of the workpiece about ½" to the left of the left mark on the fence.



4 Slide the workpiece to the right so the left mark on the workpiece and left mark on the fence align, as shown *below*. This short, so-called "climb cut" goes opposite of typical feed direction, so go slow for safety *and* accuracy.



5 Now, slide the workpiece from right to left until the right marks on the workpiece and fence align, as shown *below*. Then, slide the workpiece about ½" to the right and lift the workpiece straight up, being careful to keep it in firm contact with the fence. On slots more than 1" deep, switch off the router before removing the workpiece.



Get on-the-money results with multiple pieces

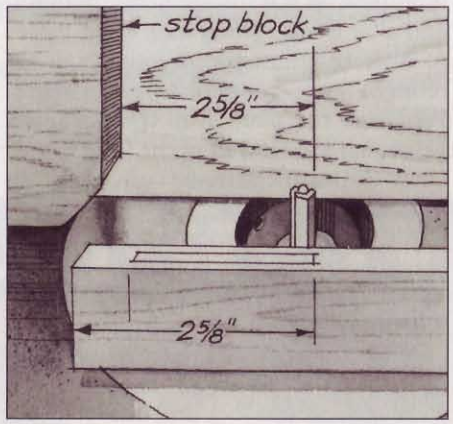
For fast and extremely accurate results with multiple workpieces, take a few minutes to position and clamp two stopblocks to the router-table fence. You can make the stopblocks from scrapwood. Just be sure to notch one corner of each block. This provides a place for sawdust to go so that your workpieces firmly contact the stopblock.

1 On a piece of scrap the same length as your workpiece, mark the position of the slot. Now, measure from the left end of the slot to the right end of the scrap. Use this distance to locate a stopblock on the fence, measuring to the right from the left edge of the router bit. For example, the left end of the mortise shown *below* is 11⅝" from the right end of the scrap. So, we clamped the stopblock 11⅝" from the left edge of the router bit.

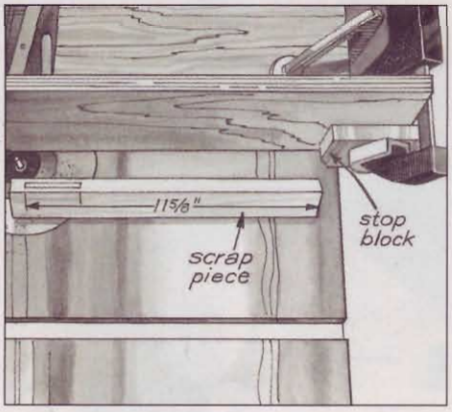
2 On the same piece of scrap wood, measure from the right end of the mortise to the left end of the scrap (2⅝" in the example shown at *right*). Use this measurement to position and clamp the left-side stopblock. As shown at *right*, we set the left-side stopblock exactly 2⅝" from the right edge of the router bit.

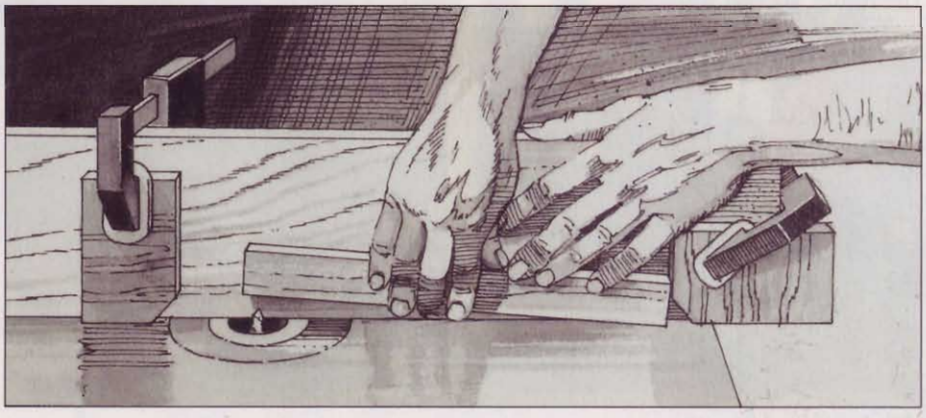
3 Start the router and place the scrap piece against the right-side stopblock, as shown *below*, and lower the piece onto the bit. Slide the piece left to the left-side block, then slide it back and forth to ensure a complete cut. Lift it straight up and measure the position of the slot. Adjust the stopblocks as necessary before cutting your workpieces.

Some workpieces may be too long to rout using your current router-table fence. In that case, either make a longer fence, or attach stopblocks to the workpiece and cut the slots with a handheld router outfitted with an edge guide.



Written by **Bill Krier** with **Jan Svec**
Illustrations: **Jim Stevenson**





Fancy Flutes, Simple Setup

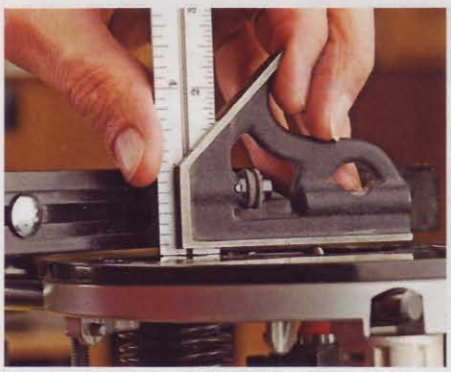
Add impressive details to your finest work, using a router and these tips.

Traditional detailing on cabinets and furniture often includes the classic look you can create with parallel, round-bottomed grooves called flutes. Because these grooves do not exit at the ends of the workpiece, we call them "stopped" flutes. As a design element, they set your work apart from the ordinary, yet they're easy to make.

Successful fluting starts with careful planning and layout. For example, for the 2¾"-wide stile shown here, we used a ¼" core-box bit to make four flutes approximately ¼" wide and 1/16" deep, leaving ¼" of flat surface between flutes, and a ½" border along each edge. Pieces of different dimensions might call for more or fewer, wider or narrower flutes. Whatever the plan, keep the flat intervals equal to or less than the flute width. Draw full-scale samples on paper to arrive at a handsome design.

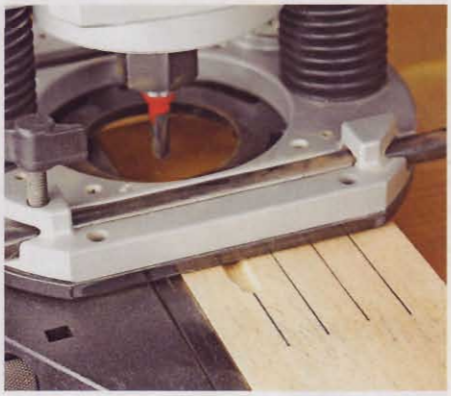
For best results with stopped flutes, you'll need a plunge router so you can smoothly lower and raise the bit at the beginning and end of each flute. You'll also need an adjustable edge guide. Keep each set of stopped flutes aligned at the ends with a startblock and a stopblock.

1 First, set the depth of your cut. To do this, extend the blade of a combination square 1/16", and lock it in place. With the router in its plunge mode, hold the blade end on the router base, and adjust the bit to make contact with the square's head, as shown *below*. Now, set the router's depth stop.



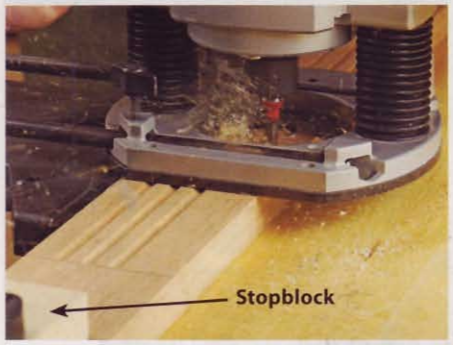
2 Mark the ends of your planned flutes on the workpiece. Place a rule on the router base, and measure from the bit to the edge of the base, as shown *below*. Measuring to the leading edge tells you how far to set your stopblock from the top mark. Measuring to the trailing edge determines the distance from the bottom mark to your startblock. If your router base is round, these measurements will be equal. Place the workpiece at the edge of your workbench, and clamp the blocks and workpiece in place.

3 On a piece of scrap the same width as your workpiece, lay out and mark the locations of your flutes. Now, set your router edge-guide fence to make the first flute. The distance from the fence to the bit center equals the distance from the scrap edge to the nearest mark. Test the setting by routing into the scrap piece, as shown *below*. When it's centered on the mark, rout the first flute. (If your router base is round, and block-to-flute distances are equal, flip the workpiece around, and rout the flute nearest the opposite edge.)



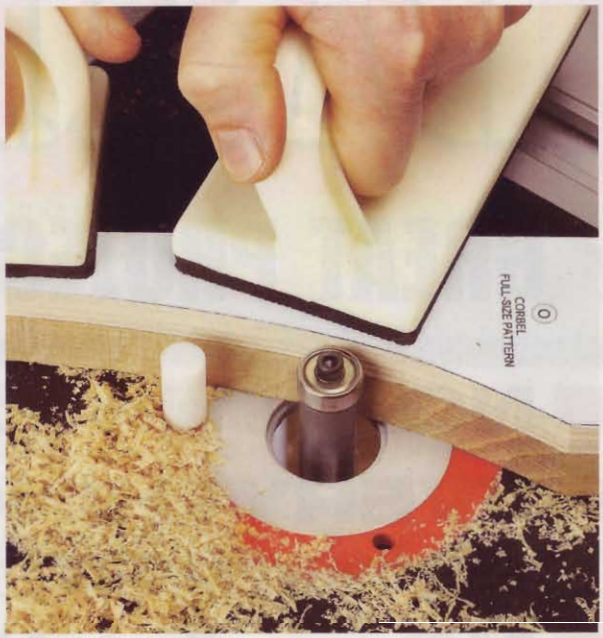
4 Cut a wood spacer to match the distance between marks on your scrap template. Clamp the router to your workbench. Loosen the edge-guide fence, and slip the spacer between it and the workbench, as shown *below*. Tighten the fence, remove the spacer, unclamp the router, and then double-check the setting on your scrap. Rout the second flute on your workpiece. Repeat this step for each flute, using the same spacer. (If your router has a round base, and you cut two flutes in **Step 3**, flip the workpiece after cutting this third flute, and rout the fourth one.)

5 When you rout a flute (see *below*), butt the router base against the startblock, plunge to the preset depth, and immediately move the router forward. Rout until the base contacts the stopblock, and immediately allow the plunge mechanism to pop up. Quick entry and exit prevents hard-to-remove burn marks on the wood.



Fast, Accurate Template Routing

From machining to bit selection, here's the quick way to make identical parts.



When you need several copies of curved parts, such as the corbels for a mission furniture project, consider pattern routing. Using a template and a router bit designed to follow it, you'll speed through the drudgery of making duplicate parts without sacrificing quality. By keeping a battery of templates, you also can save time on projects you decide to build more than once.

Start the job on paper

The shape for your template can come from a magazine pattern, a part from an existing piece of furniture, or a design you draw. If you start from scratch, work out the curve or curves on paper using a lead-core, flexible-curve ruler (available through art supply or woodworking stores); a French curve; an extra-long profile gauge; a compass; or any object that serves as a tracing model for the shape you want to cut.

Of course, pattern-based templates have their limits. A router bit can't reproduce a sharp inside angle or inside curve with a radius less than the radius of the bit. Either avoid those details in your design or plan to complete them using other tools, such as a scrollsaw or bandsaw, after you've routed the rest of the shape.

Begin with a paper pattern. Cut out its straight lines using a knife and straightedge. Use scissors to cut curves roughly ½" outside of the marked curved lines.

Make the template

Tempered ¼" hardboard makes an economical template, but we prefer ½" Baltic birch plywood. Both materials are free of voids—a vital feature for smooth routing—but the extra thickness of the Baltic birch plywood gives the router's bearing ample surface to roll along.

Spray-adhere the paper pattern to the rigid template material, matching the straight edges wherever possible to reduce the amount of cutting required.

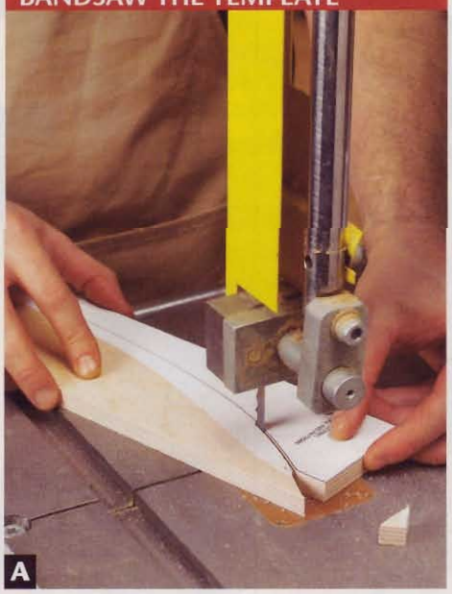
Bandsaw the pattern curves, as shown in **Photo A**. We used a ½" blade, cutting 1/16" outside the cutline. Rely on a scrollsaw if your design includes curves that are too tight for a bandsaw blade.

If you don't have an oscillating spindle sander, install a sanding drum with 80-grit sandpaper on your drill press. Double-check that you have a 90° angle between the drum and the drill press table. Sand the curved template edges to the paper pattern lines [**Photo B**].

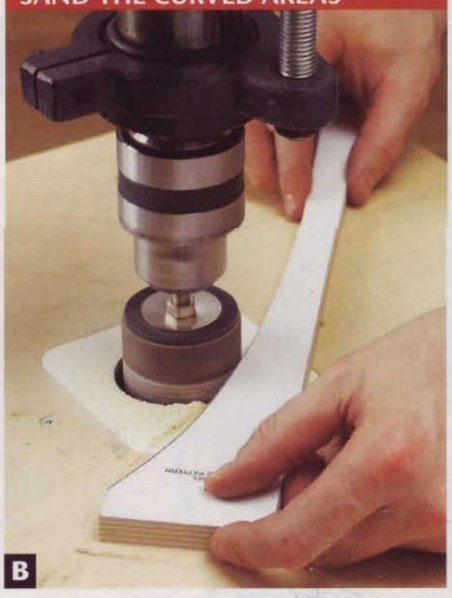
Get ready to rout

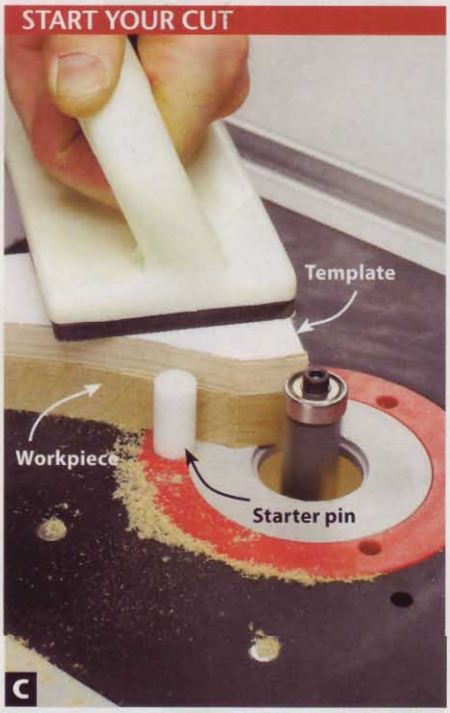
Trace the shape of the finished template onto your workpiece, aligning straight edges wherever possible. Using a bandsaw, rough-cut your workpiece to 1/16–⅛"

BANDSAW THE TEMPLATE



SAND THE CURVED AREAS





from the edge of its finished form to reduce the amount of material your bit will need to remove.

Using double-faced tape, adhere the template to the workpiece and align straight edges where possible. Whether the pattern will go on the top or bottom of the piece depends on whether you're routing freehand or on a table, and on your choice of bits.

As seen on the chart *below*, you have several bit choices for pattern routing. On flush-trim bits, the bearing mounts to the end. On a pattern bit, it's between the shank and the cutters. You'll get the highest quality sand-free edges with spiral- or sheer-cutting bits.

Use your router table when working with small or narrow parts. A flush-trim or pattern bit will work here, but the flush-trim's top-mounted bearing is best because a pattern bit exposes the spinning cutter above the workpiece. For pieces too large or awkward for the router table, use a handheld router.

Shape the parts

Adjust the height of the router bit so its bearing rides on the center of the template's edge with the bit's cutting edge spanning the thickness of your workpiece. Don't worry, the bit won't cut into the template; its cutting diameter is sized to match the bearing.

A starter pin placed as near as safely possible to the bit [**Photo C**] will help brace your workpiece as you feed it into the bit. For small pieces, use pushblocks to keep the template firmly against the bearing while protecting your fingers, as shown in the top photo on *page 66*.

Feed the workpiece in a steady, fluid motion along the piloted bit. By cutting the end grain sections first, you can reduce the chance of tear-out on the remaining edges of the workpiece.

After routing each part, peel the template and double-faced tape away from your workpiece. Remove any adhesive using paint thinner. Sand any fine splinters or machine marks if needed.

Flush-trim and pattern bit sampler

Bit Type	Flush-trim	Spiral flush-trim (upcut)	Spiral flush-trim (downcut)	Downshear flush-trim	Combination upcut/downcut	Double bearing flush-trim	Pattern
Size Ranges	⅜–⅞" dia.; ½–2" cutting length	⅛–1⅛" dia.; ⅜–2½" cutting length	¼–½" dia.; ⅜–2" cutting length	½–¾" dia.; ½–2" cutting length	¾" dia.; 1⅛–1⅝" cutting length	½–¾" dia.; 1–1¼" cutting length	5⁄16–2" dia.; ½–2" cutting length
Pattern Location on Workpiece	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: either Handheld: either	Table: bottom Handheld: top
Comments	Adequate for most work. As with all carbide bits, look for micrograin carbide.	Cutters slice at an angle for a smooth cut; upcut bits work best for table-mounted routers.	Steep spiral makes smooth slices, especially in laminated materials, such as plywood; downcut versions work best for handheld routing.*	Cutters slice at an angle for a smooth cut; downshear is best for handheld work while available upshear versions are best for table work.	Slices through thin veneers of plywood with less chipping on both faces.†	One bit works on both handheld and table-mounted routers for either pattern routing or flush-trim work such as laminates.‡	Top bearing lets template be attached atop a workpiece for handheld routing.

Hard-to-find bits: *from MLCS (800-533-9298, mlcswoodworking.com); † from Woodhaven (800-344-6657, woodhaven.com); ‡ from Eagle America (800-872-2511, eagleamerica.com)

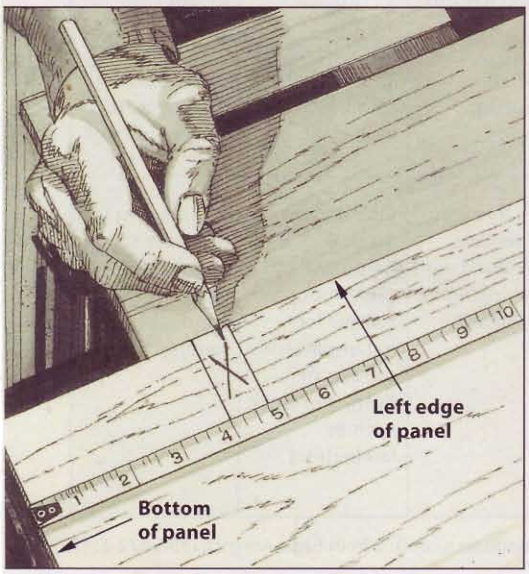
Rout Consistently Spaced Dadoes

Put these basic techniques to work when building furniture and cabinets.

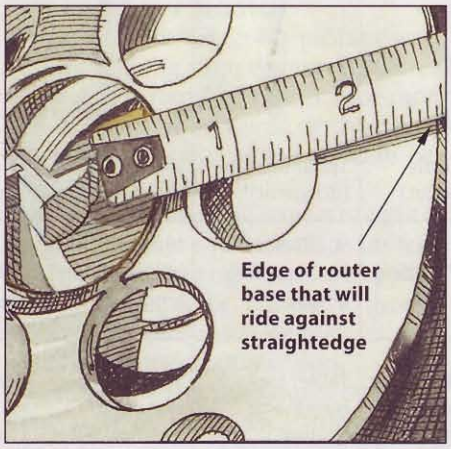
Many projects, such as bookcases and display cases, require precisely spaced dadoes in their sides for accepting shelves and dividers. If you need help in this area, this section provides a surefire way of routing dadoes that align perfectly.

1 The secret to dead-on dadoes lies in using a straightedge and a story pole. We sized these for working with a ¾×48×96" sheet of plywood, but you can build yours smaller if you don't typically handle full-sized sheet goods. After making these fixtures, read on for directions on how to use them to cut your dadoes.

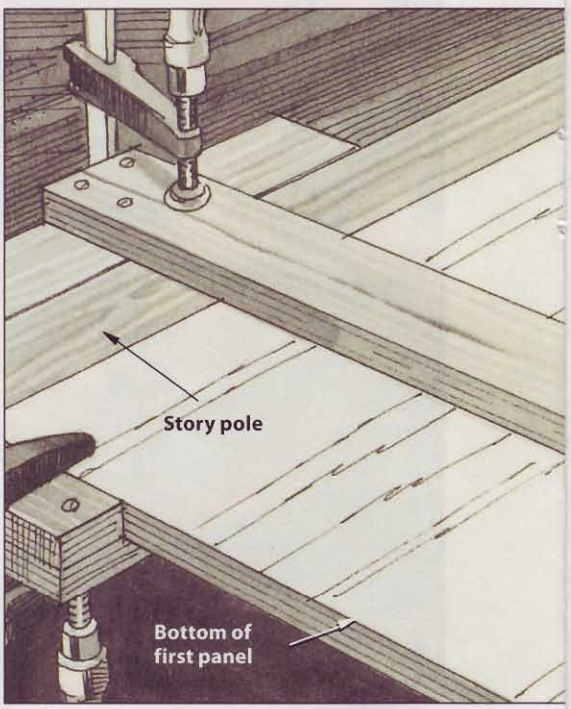
2 Mark the position of the dadoes on the face of the workpiece, along the left edge as you stand at the bottom end of the panel, as shown *below*. Measure from the bottom of the panel, and double-check your accuracy.



3 Using a straight router bit the same width as the dado, adjust the bit for the correct cutting depth (one-third the thickness of your panel). Now, measure the distance from the bit's cutting edge to the edge of the router base, as shown *below*. Your router bit may not be centered within the base, so measure to the point on the base that will ride against the straightedge in the coming steps. Mark this point on the top side of the base with a piece of masking tape.

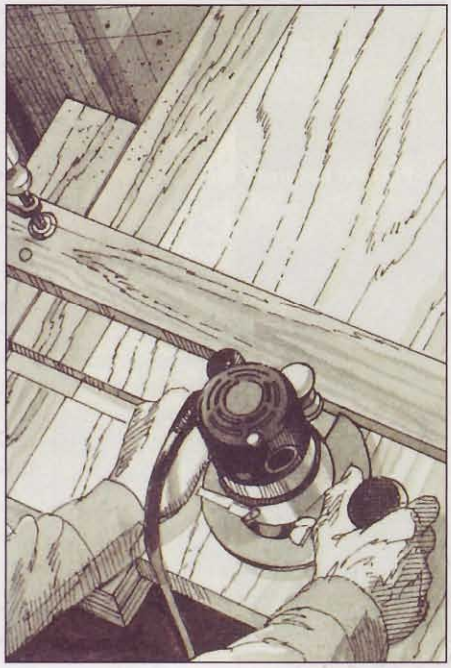


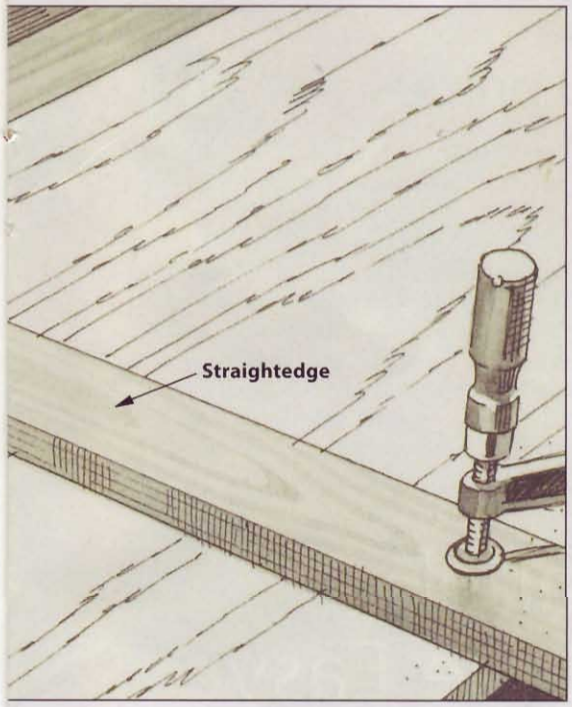
4 Clamp your story pole along the marked edge of the panel, as shown at *top right*. Using the bit-to-edge-of-router base measurement you made in **Step 3**, position the straightedge this distance from the layout line closest to the panel bottom. Measure the distance between the straightedge and the bottom end of the panel along both sides of the panel to make sure the straightedge is parallel with the panel's bottom edge. Clamp one end of the straightedge securely to the panel, and the other end to the story pole.

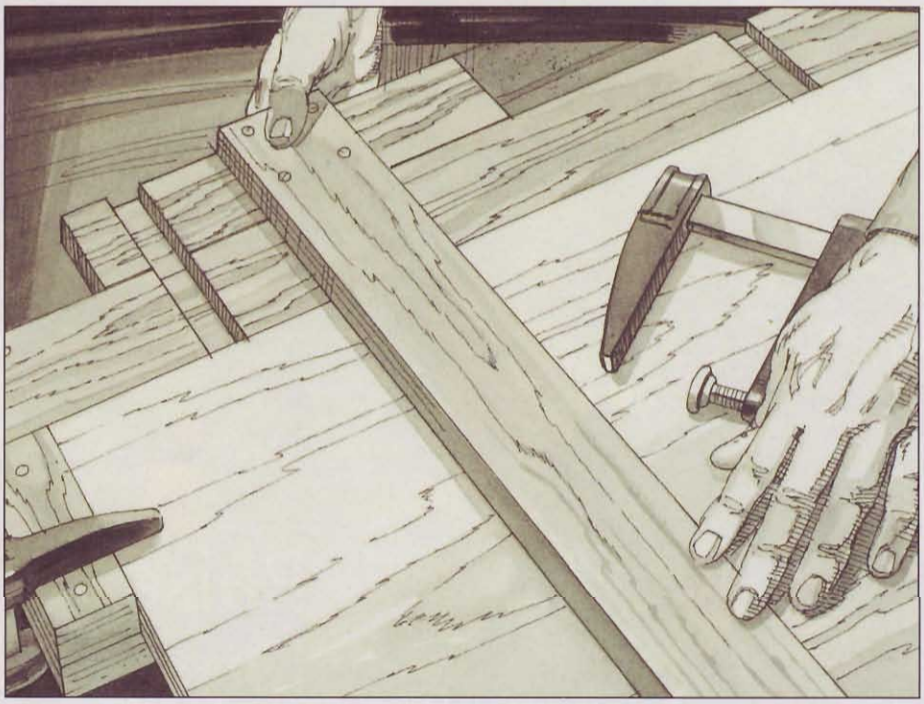


5 Make the cut by moving the router from left to right while standing at the bottom of the panel facing the straightedge, as shown *below*. Moving the router in this direction helps keep it against the straightedge. The router will tend to wander from the straightedge if you move it from right to left.

Also, remember to keep the marked spot of your router's base against the straightedge. You might get inconsistent results if you don't follow this rule.





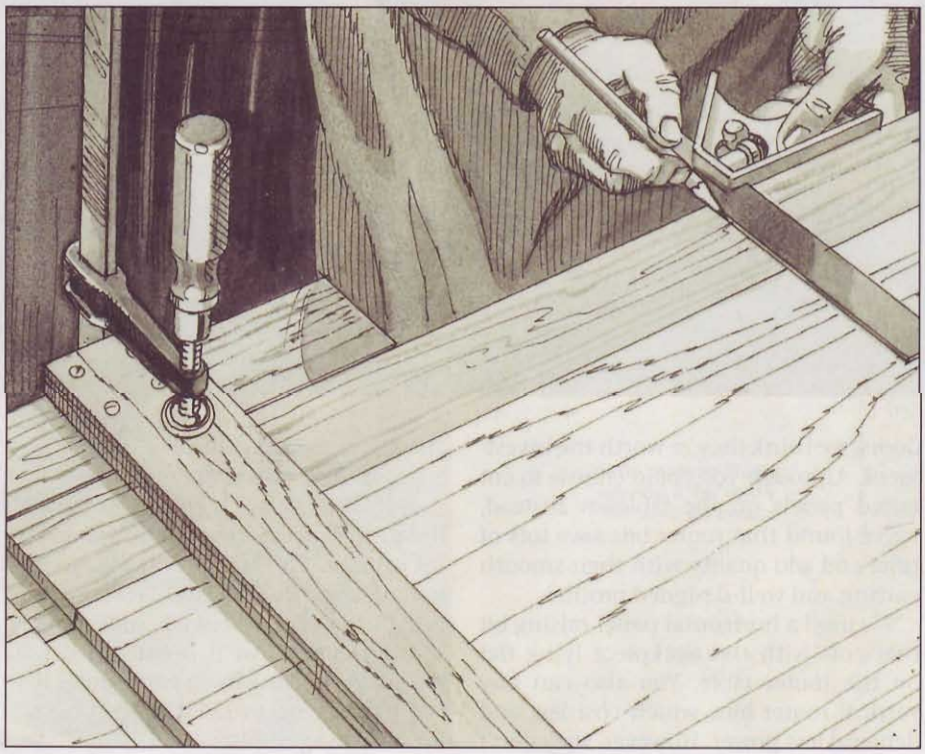


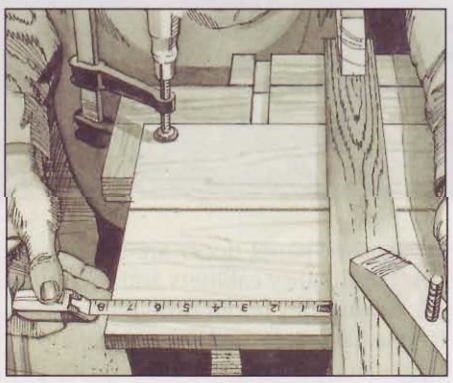
6 For subsequent cuts on this panel, extend your layout lines onto the story pole with a square, as shown *below*. To position the straightedge, align the cut in the head of the straightedge with the extended marks on the story pole. Before making the cut, remember to adjust the straightedge so that it's parallel with the bottom end of the panel.

7 After completing your first panel, the story pole provides a cutting guide for all matching panels. You just clamp the story pole to the left edge of the panel and align the cut in the straightedge head with the story pole cut, as shown *above*. Adjust the straightedge parallel with the panel bottom as described in **Step 4** and clamp it.

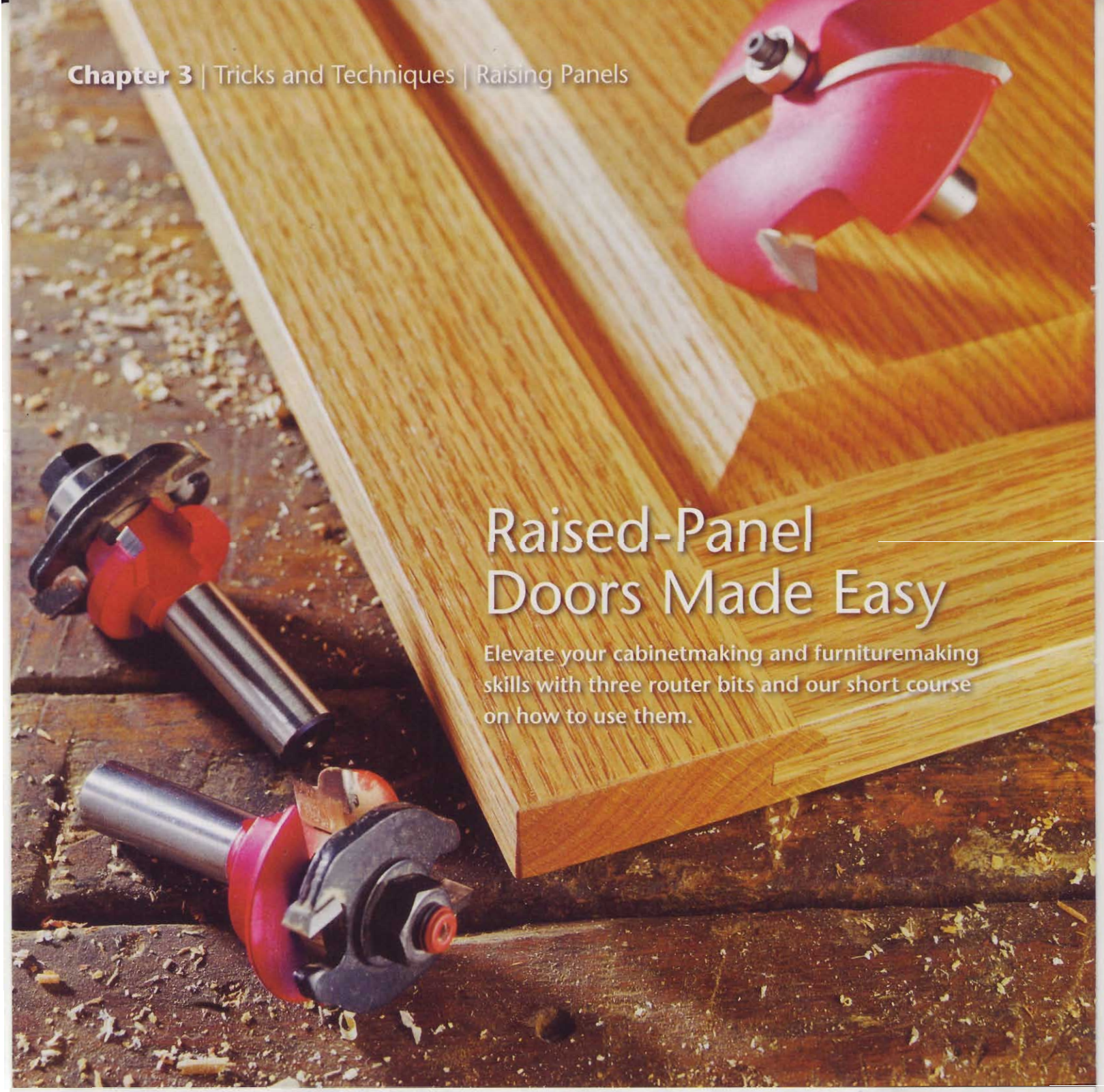
When cutting dadoes in the middle of wide panels you may find that you cannot reach all the way across the panel. At these times, turn the router off about halfway through the cut, holding it firmly against the straightedge as you allow it to come to a stop. Walk around to the opposite side of the panel, back the router up, turn it on again, and complete the cut.

8 When cutting narrow panels or boards, you can save yourself some time and effort by clamping them edge to edge, as shown *below*. Before cutting them, make sure the ends of the panels are flush.





Written by **Bill Krier** with **Jim Boelling**
Illustrations: **Jim Stevenson**



Raised-Panel Doors Made Easy

Elevate your cabinetmaking and furnituremaking skills with three router bits and our short course on how to use them.

Raised-panel doors are a hallmark of quality cabinets and furniture, and they're not difficult to make. If you have a variable-speed, 1½-hp or bigger router and a router table, you need only buy a set of three router bits designed for the task.

The bits could cost well over $100. Still, if you plan to make or remodel several cabinets, or construct a special piece of furniture featuring raised-panel doors, we think they're worth the investment. Although you could choose to cut raised panels on the tablesaw instead, we've found that router bits save lots of time and add quality with their smooth cutting and well-designed profiles.

We used a horizontal panel-raising bit that cuts with the workpiece lying flat on the router table. You also can buy vertical router bits, which cost less and demand less power. However, they don't allow you to raise a panel with a curved edge, as the horizontal cutter does.

In this article, we'll guide you through the process of making a door for a typical cabinet. The same techniques apply to building a door or panel for a piece of furniture, or traditional wall panels. Along the way, we'll point out details that have nothing to do with router bits, but everything to do with getting the most striking results.

Two bits for the door frame....

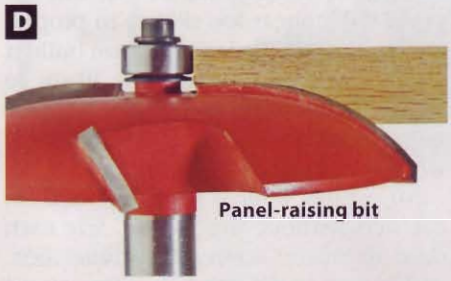
A set of panel-making router bits makes it easy to build professional-quality cabinet doors. One bit cuts the coped shape at the ends of the rails; one cuts the sticking shape to match; and one cuts a raised field on the panel.

Choose a cool profile

We chose a rail, stile, and panel set from Freud (item #97-102). You can order it from toolcrib.amazon.com for $150, and from other sources. This set contains a coping bit to cut the ends of the rails, a sticking bit to cut a matching profile and panel-holding groove on the inside edge of each rail and stile, and a 3½"-diameter bit that "raises" the panel with a gently sweeping cove. All three bits have ½" shanks, which we strongly recommend for this operation.

See **Photos A, B,** and **C** for the shapes made by our rail-and-stile cutters, and how the results mate together. **Photo D** shows one of the many panel-raising bit profiles available. Choose the one you like best, or the one that matches the style of your home's existing cabinetry.

... and a third for the panel



This large-diameter bit cuts the cove profile that "raises" the panel.

Select the best stock

A great door depends on great lumber. You want wood that shrinks and swells as little as possible, and resists warping. Rift-sawn or quartersawn lumber fills the bill.

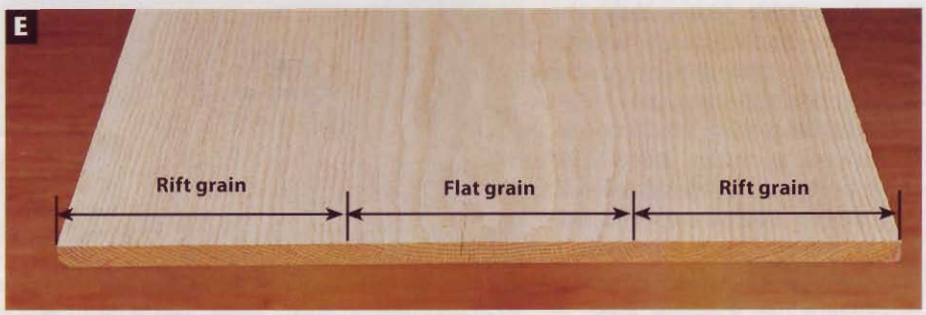
Go through the stack of boards at your lumber supplier, and look at the end grain on each one. Select the ones with grain lines running straight from face to face, not from edge to edge or in a semicircle. These prime boards also feature straight face grain, which played an important role in our door, as you'll see. You might find quite a bit of variation in one wide board [**Photo E**]. In that case, elevate your work above the ordinary by selecting the straight grain lines for your doors. The cathedral grain won't go to waste; use it for less visible cabinet parts or other projects.

Once you've found a good board, don't just chop it into convenient lengths. Take one more big step toward master craftsmanship by cutting each individual piece with the straightest grain possible [**Photo F**].

Straight-grain rails and stiles seem to flow naturally around a door. We recommend straight grain for the panels, too. It lends a high-end, architectural-quality look.

We used red oak for this article because it's a popular cabinet choice and its prominent grain lines emphasize the difference in appearance between straight grain and random "cathedral" grain. Check out the two versions in **Photo G**. When you look at oak cabinets in a retail outlet, you see lots of figure, especially in traditional-style cabinets, and maybe you prefer it that way.

In a piece of cardboard, cut out a "window" the same size as the part you need to make. When you see the grain you want, outline it with chalk.



Here you see rift grain and flat grain within one 18" board. Plan to use the rift grain for visible parts and the flat grain elsewhere.

Two variations on red oak: The panel on the left was made with well-matched straight grain; the one on the right offers a more common appearance.

Plan and cut carefully

We built an overlay door for a standard-sized wall cabinet, a common situation. We planed 4/4 stock to ¾" for our rails and stiles, and ripped them to 2¼" in width, a dimension that looks good, feels solid, and allows enough room for any style of hinge. You might choose a width anywhere from 1½" to 2½". Pick stock that's perfectly flat for the rails and stiles.

The door itself should fall between 9" and 18" in width. If it's too narrow, the panel will appear too skinny in proportion to the rails and stiles. If you build it wider than 18", you're more likely to have trouble with twisting. The door must be absolutely flat to look good when it's closed.

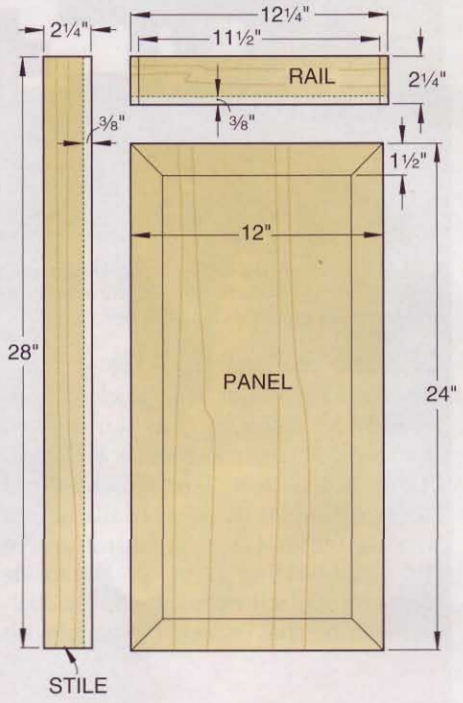
An overlay door is typically used on cabinets without face frames. Size each door to nearly cover the cabinet box, and plan for a ⅛" gap between each set of adjoining doors.

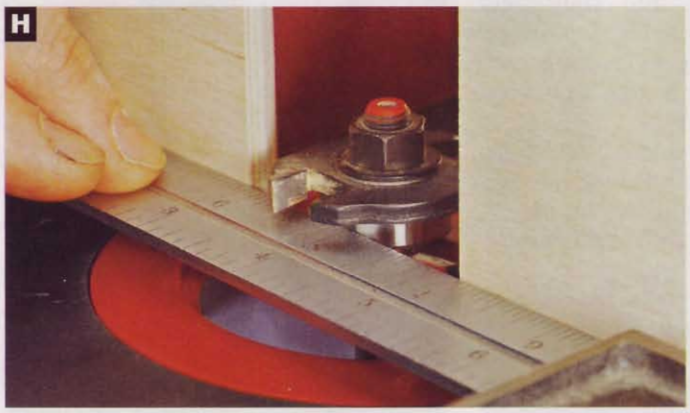
The sample door in **Drawing 1** will help you keep track of the slots and coped rail ends as you figure the dimensions of your door. Check your crosscutting setup for accuracy before you cut the pieces to length because the rails must be perfectly square for good results. Prevent chip-out with an auxiliary fence on your miter gauge or a sacrificial piece of straight stock on the back fence of your crosscut sled. For faster, more accurate routing, cut an extra rail and an extra stile to use when setting bit heights.

To make the panel, choose boards with compatible color and figure, and plane them to a thickness of ½". When fitted in place, the panel surface will sit flush with the front of the frame.

Joint the edges of the boards, then glue and clamp them together to make a slightly oversize blank. After the glue dries, cut the panel to allow for a ⅛" gap all around as it sits in the grooves of the rails and stiles. This gap accommodates the spacers described in "No-rattle panels," *page 75*. If you choose not to use spacers, you still must leave the same gap to allow for wood movement.

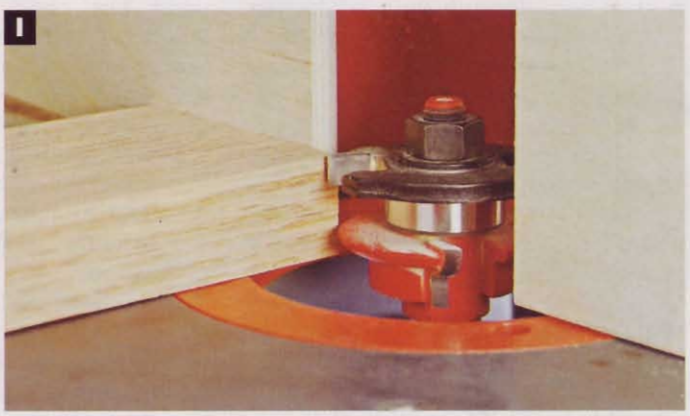
1 TYPICAL DIMENSIONS





H

Align the pilot bearing and the fence before beginning to rout. This step ensures a smooth cut with no dips.



I

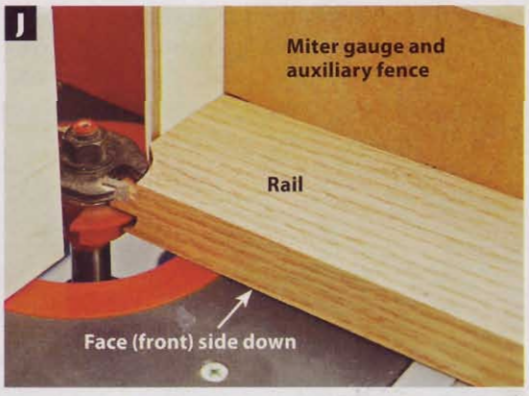
For the rail-end cuts, set the height of the coping bit by eye. Place the top of its slotting cutter just proud of the workpiece.

Rout the rail ends

With your router mounted in a table, install the coping bit. It's the bit with a pilot bearing sandwiched between the two cutters. Hold a straightedge against the router table fence, and slide the fence until the straightedge contacts the pilot bearing [**Photo H**]. Make sure the fence sits at a right angle to the miter gauge; butt a piece of scrap against the fence at one end, clamp it to your miter gauge, then slide the miter gauge along the fence. The scrap should maintain contact all along the fence.

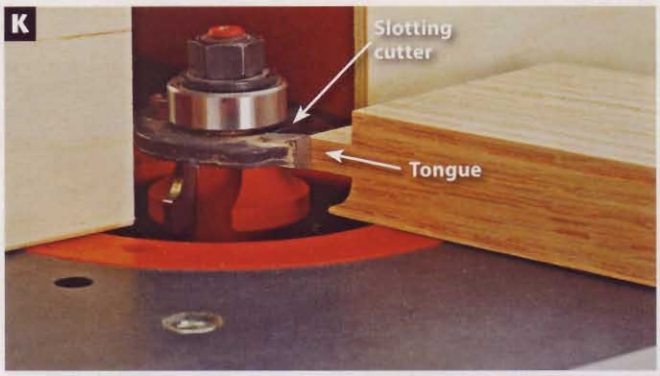
Use your test rail to set the height of the bit [**Photo I**]. Place your test rail face side down on the table, one edge flat against the miter gauge auxiliary fence and one end touching the router-table fence. Hold the workpiece firmly against the auxiliary fence and down on the table, and rout the profile.

Check the test cut for a smooth, consistent shoulder about 1/16" thick on the face side of the rail. The rabbet on the opposite side will be about ¼" deep. Run another test, if necessary, and when you're satisfied, make a set-up piece to keep for future projects. Now, rout both ends of each rail [**Photo J**].

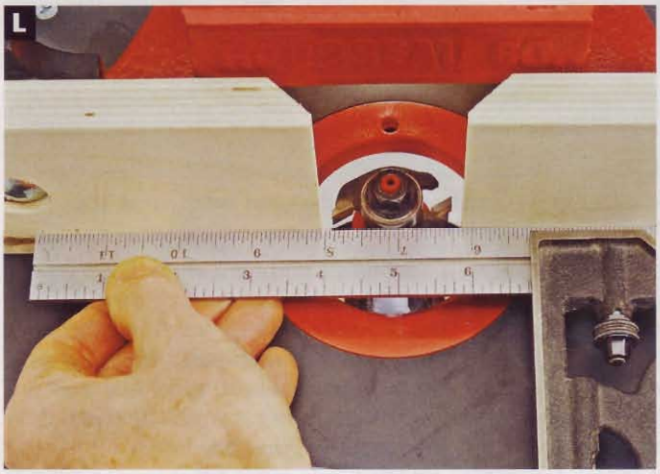


J

Keep the rail square to the router-table fence with your miter gauge auxiliary fence. The auxiliary fence also prevents chip-out.



Use the coped end of a rail to set up the sticking cuts. Match the slotting cutter to the tongue, and if the curved profiles don't mate, re-shim the bit with a thin metal washer.



Again, line up the pilot bearing of the sticking bit and the router table fence to ensure an accurate depth of cut.

Make the long-grain cuts on all four frame pieces. Your fingers are close to the bit, so be sure to keep your right hand at the outside corner as you push.

Now, the inside edges

Remove the coping bit and install the sticking bit (the one with the pilot bearing on top) in your router. In one pass, this bit makes the frame look better by rounding over the edge next to the panel, while also cutting the groove to receive the panel. Using one of the rails that you just routed, determine the height by matching the slot-cutter with the tongue on the rail end [**Photo K**]. Align the fence and bearing with a straightedge [**Photo L**].

Place your extra stile face-side down against the router table fence, and make a test cut, as shown in **Photo M**. Check its fit with the already routed rail. Place both pieces flat on your workbench or tablesaw top, face sides up, and check the resulting joint with your fingertips. You want a perfectly smooth joint because anything less means a lot of sanding after assembly, possibly ruining the profile. So do as many tests as it takes to get it right, and then cut and label a set-up piece for future reference. See the **Shop Tip** *below* for another way to save your settings.

If you can't get a perfect fit with the rails and stiles, you may have to adjust the bits themselves with very thin, washer-like, metal shims. Shims allow you to fine-tune the height of the profile cutters or the location of the tongue on the rail-end bit. Our bits came pre-shimmed from the factory, with extra shims held under the nut at the end of each bit. Write down each step if you do any shimming, so you know the original arrangement as well as each adjustment that you make. When your test joints are right, rout the inside edge of all four frame pieces.

SHOP TIP

Make your bits self-aligning

Wouldn't it be nice to keep your rail-and-stile profile cutters permanently aligned with one another, avoiding all those test cuts every time you use them? Our master craftsman, Chuck Hedlund, came up with a way to do just that.

Slip a ½" stop collar onto the shank of each bit, and tighten it in place against the cutter body, as shown at *right*. Install the first bit into your router, and proceed to find the right height. Unplug the router, loosen the set screw on the collar, let it slide down to the collet, and retighten the set screw. Without changing the router height, do the same with the second cutter. The next time you use the cutters, use a saved set-up profile to set the router height for the first cutter, and the second cutter will match automatically.

Look for stop collars at your home center or hardware store, or buy a seven-piece set that includes one ½" collar from Woodcraft. Call 800-225-1153 to order item number 142562 for $8.

For safety, Freud recommends that you place at least 80 percent of a router bit's shank inside the collet. We achieved that with collars that are 5/16" thick.

Time to raise the panel

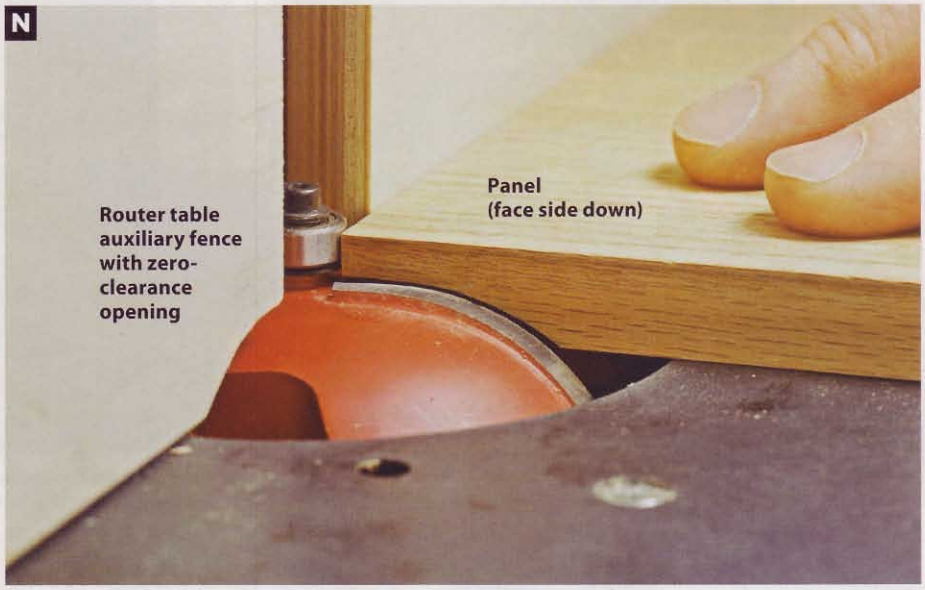
For the final step in the milling process, we used a panel-raising bit that measures 3½" in diameter. The large diameter means that it cuts more wood per revolution than the average bit, its outer edge travels faster than most, and it demands extra clearance in the table and fence.

For safety and efficiency, use a variable-speed router with at least 1½ hp. That's enough power to do the job, and running it at a low speed is safer.

Even if you have a split fence that opens wide enough to accommodate the bit, it's safer to shape a smaller opening in an auxiliary fence. A wide gap causes problems if the workpiece slips into it.

To add an auxiliary wood fence, cut a piece of straight wood to size, and mark the shape of the bit on it. Cut the opening on the bandsaw, and sand it smooth. Attach the auxiliary fence to the existing fence, and check the bit clearance.

Align the bearing and fence, and make a test cut [**Photo N**]. If the router bogs down, adjust the fence so that the bit cuts less than the full width of the profile on the first pass. Then realign the bearing and fence for a full-width cut.



Remember that the test pieces for this cut must be the same thickness as the panel. The tongue should fit snugly into the rail and stile grooves.

Shape the complete profile in another pass, then test the fit of the panel tongue in the groove of a rail or stile. It should slide in easily. If you have to force it into the groove, raise the bit. If it rattles in the groove, lower the bit. When you find just the right fit, rout the profile on the panel. Rout both ends first, then do the long sides; the long-grain cuts will shave off any minor chip-out from the end-grain cuts. On each pass, press down on the workpiece as you rout, making sure that the shoulder around the panel field is a consistent depth.

How to use spacers

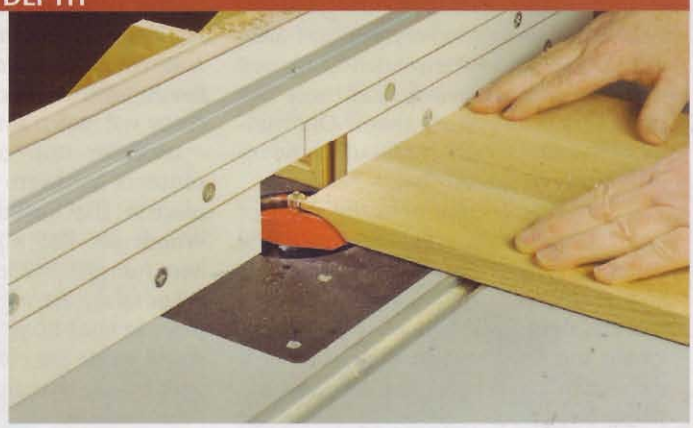
Managing the depth of cut can be accomplished in two ways. Changing the height of the bit no more than ⅛" each pass takes extra time measuring and readjusting the bit. A better way relies on spacers to change the depth of cut on each pass. When using this quick and easy method, the bit needs to be set only once. That fact alone eliminates the possibility of error and is the method we chose here. You can make spacers from most any sheet material in the shop. Hardboard, plywood, MDF, even plastic laminate (for thin spacers) work well. We made four spacers from ⅛" Baltic birch plywood totaling ½" in height. (Most panel-raising bits remove ½"–⅝" material to achieve the final profile.)

To size the spacers to your situation, cut the pieces the same length as your router table. Then measure the distance from the front of the router table to the middle of the opening in the router plate and rip them to that measurement.

Next, cut out a half-circle relief area for the raised-panel bit. To do this, measure the diameter of the bit and add ½" to allow for safe clearance around the bit. Using a compass, draw the half-circle centered on the inside edge of each spacer. Bandsaw or scrollsaw out the half circles. Sand the sawn edges smooth.

SPACERS GIVE YOU A BETTER WAY TO ADJUST CUTTING DEPTH

Stack the ⅛"-thick spacers on the router table top and secure them with double-faced tape.



Remove a spacer after making each cut until you've removed all of them for the final cut.

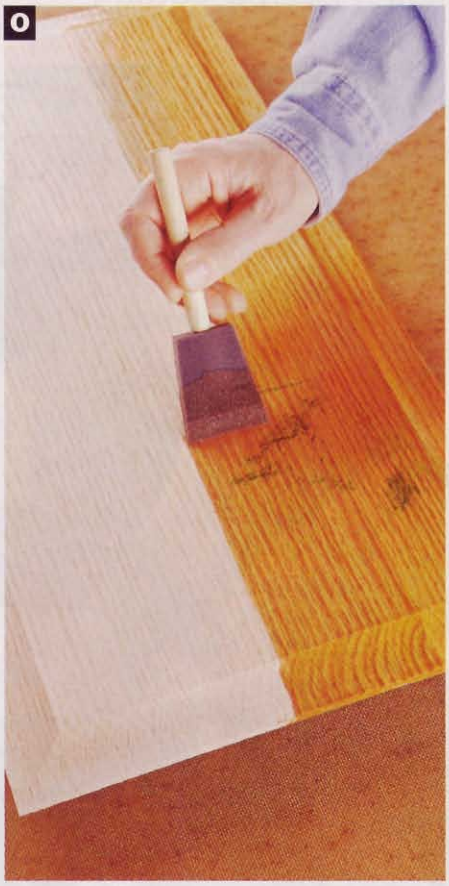
Stain the panel

With the door parts milled, you're ready to prepare for assembly. You allowed for wood movement in the solid panel, during the planning phase. Carry through by installing spacers, as described in "No-rattle panels," *below*, and by staining the panel [**Photo O**], if stain is part of your finishing plan. Stain the back first, then place the panel on a support while you stain the face.

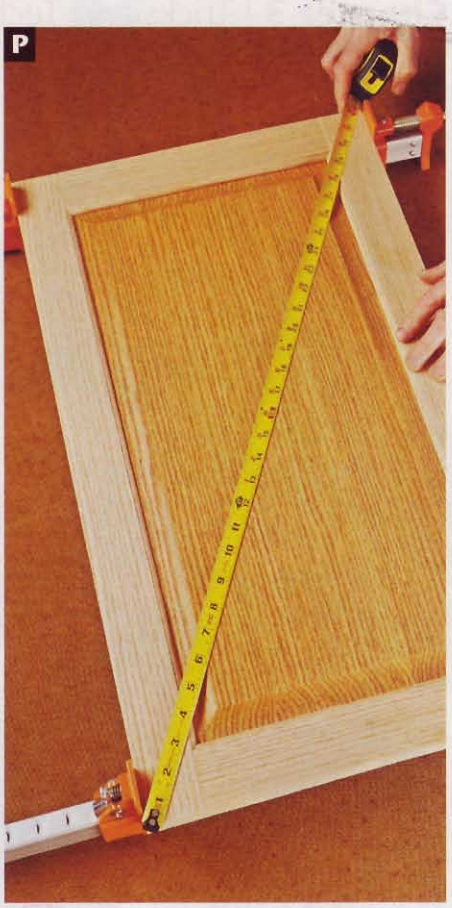
By staining the panel before assembly, you ensure that the stain completely coats the tongue of the panel. If you waited until after assembly, areas of the tongue might remain unstained, and could become visible when the panel shrinks in dry weather. Don't stain the rails and stiles just yet, however. If stain got onto the gluing surfaces, it could prevent the glue from adhering properly.

After the stain on the panel dries, insert the spacers, and apply yellow glue to all of the surfaces that you milled on the rail end. Use only a light coating near the inside edge to keep squeeze-out away from the panel; even a weak bond there could cause problems.

Assemble the door, and place it on two bar or pipe clamps, located to apply pressure across the width of the door at each end. Measure diagonally between both pairs of opposing corners [**Photo P**], to make sure the door is square. The two measurements should be equal. If not, loosen the clamps, angle them slightly to pull the frame into alignment, and retighten. Let the glue dry before staining the frame.



If you plan to stain your cabinet door, do the panel before assembly. The clear topcoat can wait until after assembly.

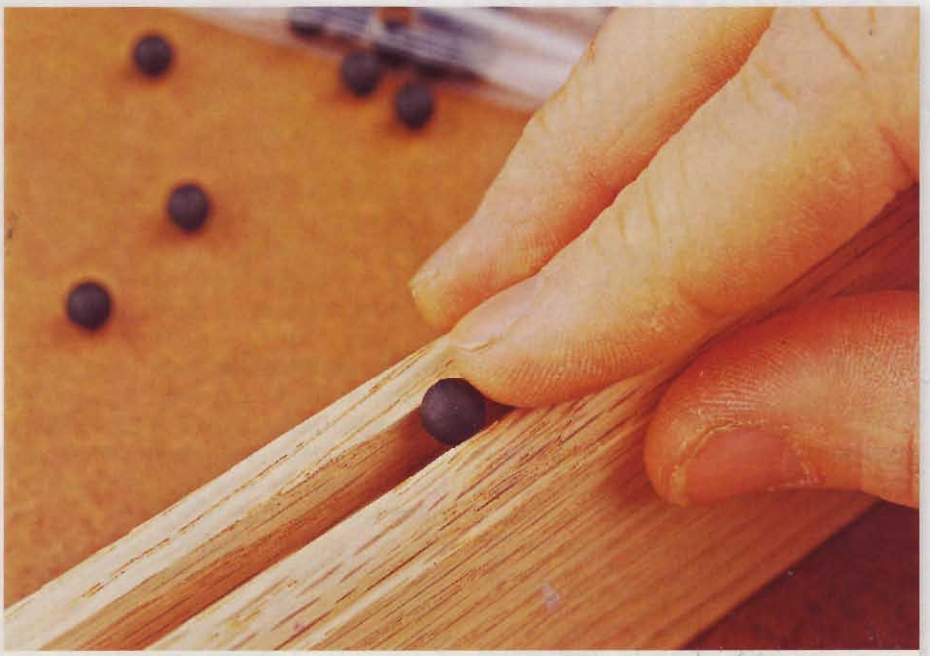


When you cut the rail ends square, and accurately match the coped and sticked profiles, assembly becomes almost automatic.

Written by **Jim Pollock** with **Chuck Hedlund**
Illustrations: **Roxanne LeMoine**; **Tim Cahill**

No-rattle panels

Solid-wood panels must have room to move, as they absorb moisture in humid weather, and lose it in dry times. But if you simply leave a gap, you wind up with a door that rattles and sounds poorly made. You can use various kinds of plastic foam to fill that gap, but we like "Space Balls." These firm rubber spheres, about ¼" in diameter, do the job quickly and neatly. Woodcraft sells a package of 100 for $6; call 800-225-1153 to order item number 142284. Use two Space Balls on each side and each end of a small door, or three per side on a bigger one. They'll compress when the panel expands, and return to full size as it shrinks, holding it tightly in its grooves all the while.



Push the Space Balls into the grooves as far as you can with your finger. The panel will seat them during assembly.

Climb Cut to Minimize Tear-Out

Sometimes, it makes sense to go in the opposite direction of prevailing wisdom. Such is the case with climb cutting—running a handheld router clockwise around the edge of a workpiece.

Smoother edges

As shown in the drawings *opposite bottom*, when you feed a router in the "typical" (counter-clockwise) direction, the bit's cutting edges lift the grain of the workpiece. But, in a climb cut, the bit pulls the grain down as its cutting edges enter the workpiece.

So, with a climb cut you don't get the splintering that you often get with a bit fed counter-clockwise. And, climb cutting has a burnishing effect on the wood, leaving an exceptionally smooth routed surface. For those reasons, we climb cut most of the time we rout an edge with a handheld router.

How to make a climb cut

Climb cutting takes a little getting used to, so practice this technique with small router bits and scrap softwood. Remove no more than ⅛" of stock per pass when using small bits, and remove only about 1/16" of stock when using larger bits, such as ½" cove bits. Use sharp bits, and never climb cut with bits over 2" in diameter.

Note: *When you climb cut, your router will want to run away from you, so hold on firmly with both hands. The workpiece should be clamped down—not simply sitting on a router mat.*

Because a climb-cutting bit does not tend to pull into the workpiece, you don't have to lower your bit to increase its cut for each successive pass. Simply set the bit to its full cutting depth and remove a little more stock with each cutting pass. You'll be surprised at how quickly you can rout edges with this "freehand" technique, and how much control you have over the process, provided you take light cuts.

Although you get little splintering with a climb cut, it still makes sense to follow the traditional wisdom of routing the ends of a workpiece before you rout the edges. If you see some "fuzzing" of the grain when you climb cut, you probably have a dull bit. (Some woods, such as butternut and willow, will fuzz even with sharp bits.)

When not to climb cut

Under many circumstances, it still makes sense to rout in a counterclockwise direction. That's because a bit fed that way tends to "pull" into the workpiece, template, or straightedge that you guide it against. This tendency to "hug" whatever you guide the router against serves you well when it's essential that the router not wander off course. For example, when cutting a dado, or the groove for holding a tambour door in the example *right*, the cut must follow its guiding edge exactly.

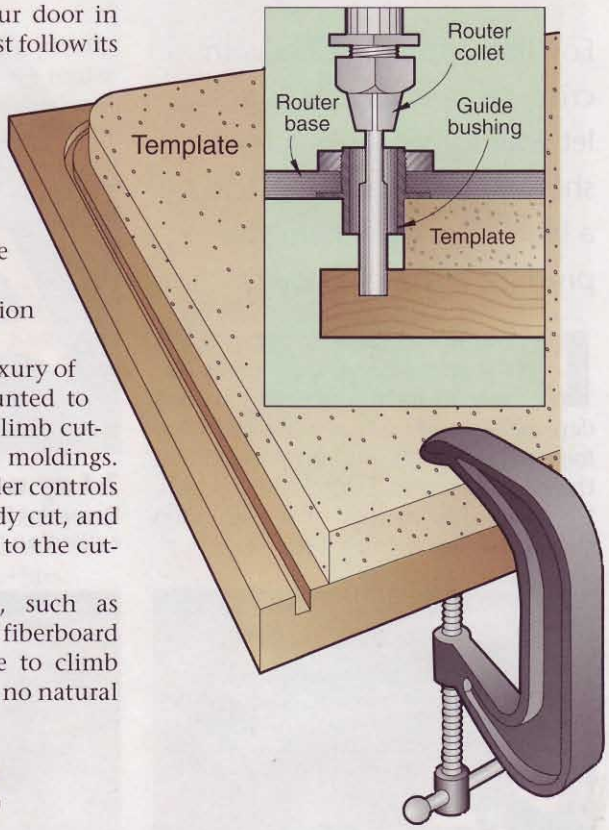
And, remember to always feed a workpiece in the typical right-to-left direction when using a router table. If you try to climb cut, the bit will pull the workpiece away from you, creating an unsafe situation, not to mention poor-quality cuts.

However, if you have the luxury of owning a power feeder mounted to your router table or shaper, climb cutting produces silky-smooth moldings. That's because the power feeder controls the workpiece for a rock-steady cut, and your hands never come close to the cutting edges.

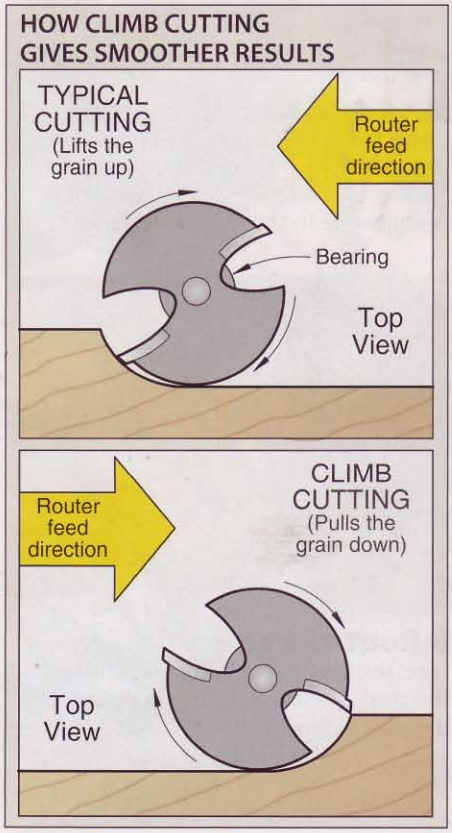
With synthetic materials, such as Corian or medium-density fiberboard (MDF), there's no advantage to climb cutting. These materials have no natural grain that might tear out.

Written by **Bill Krier** with **Chuck Hedlund**
Illustrations: **Kim Downing**; **Brian Jensen**

TAMBOUR DOOR ROUTING TEMPLATE: AN EXAMPLE OF WHEN NOT TO CLIMB CUT



HOW CLIMB CUTTING GIVES SMOOTHER RESULTS



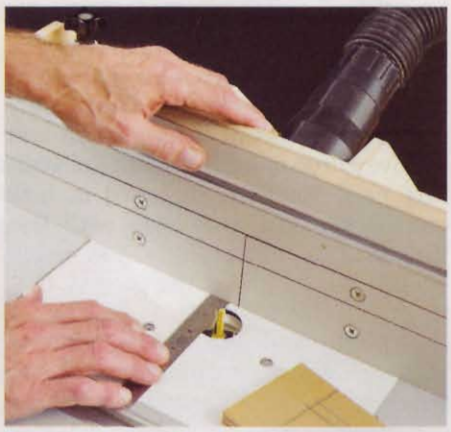
When climb-cutting with a handheld router, limit yourself to bits or cuts that remove only 1/8" of material or a slight profile, such as this round-over bit. To remove more material than that, make multiple passes, deepening the cut on each pass.

Forming Perfect Slots

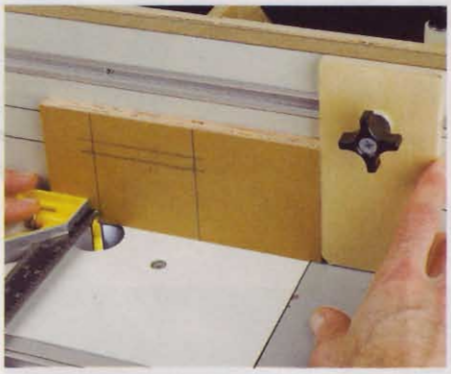
For arrow-straight slots with crisp, clean ends and edges, let your router table, a few shop-made accessories, and a little know-how help you produce on-target results.

Drilling end holes and sawing out the waste between them is one way to form a slot. But success depends on your unwavering ability to follow the straight cutlines connecting the end holes with a scrollsaw or jigsaw. Here's a better method that eliminates the risk of wandering off course.

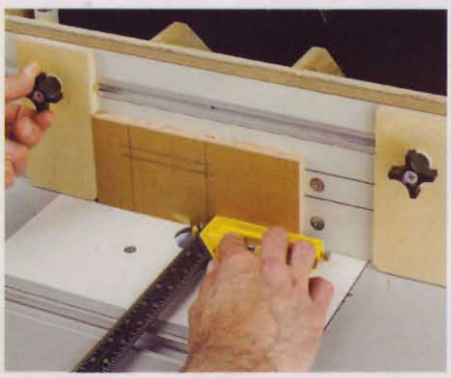
1 Lay out the slot
Draw slot boundary lines on the part, extending the end lines to the edges.



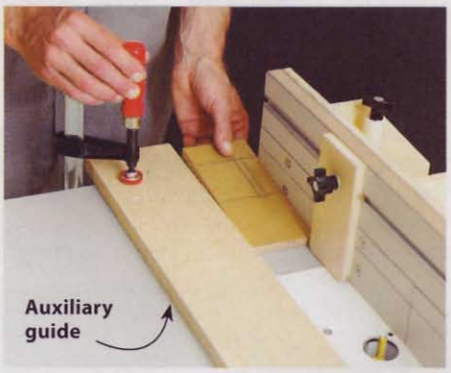
2 Postion the fence
Chuck a slot-size bit in the router. Place the fence to center the bit in the slot.



3 Set the right stop
Align the slot left end line with the left edge of the bit. Position and secure the right stop.

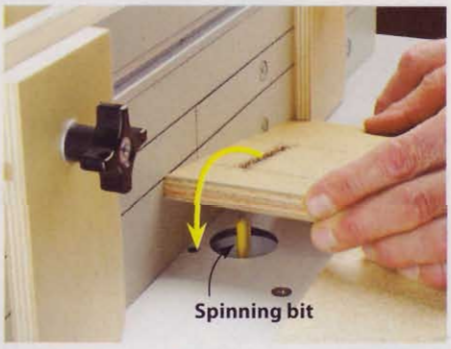


4 Set the left stop
Align the slot right end line with the right edge of the bit. Position and secure the stop.

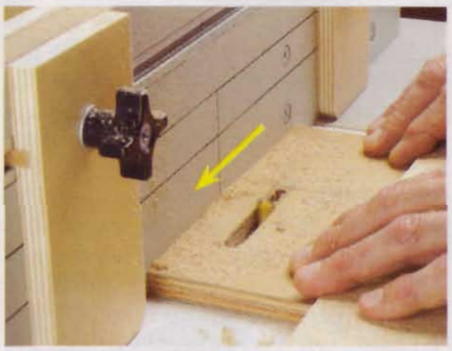


5 Add an auxiliary guide
Using the part width to gauge the distance, clamp an auxiliary guide parallel to the fence so the part slides easily between the guide and fence.

6 Drill out the waste
Using a bit ⅛" smaller than the slot width, drill overlapping holes inside the layout lines. Drilling an undersized rough slot lets you rout a clean finished-size slot in one easy pass.



7 Make a plunge cut
With the right end of the workpiece touching the right stop, lower it onto the spinning bit.



8 Rout the slot
Feed the part to the left until it hits the stop. The auxiliary guide keeps the part in line.

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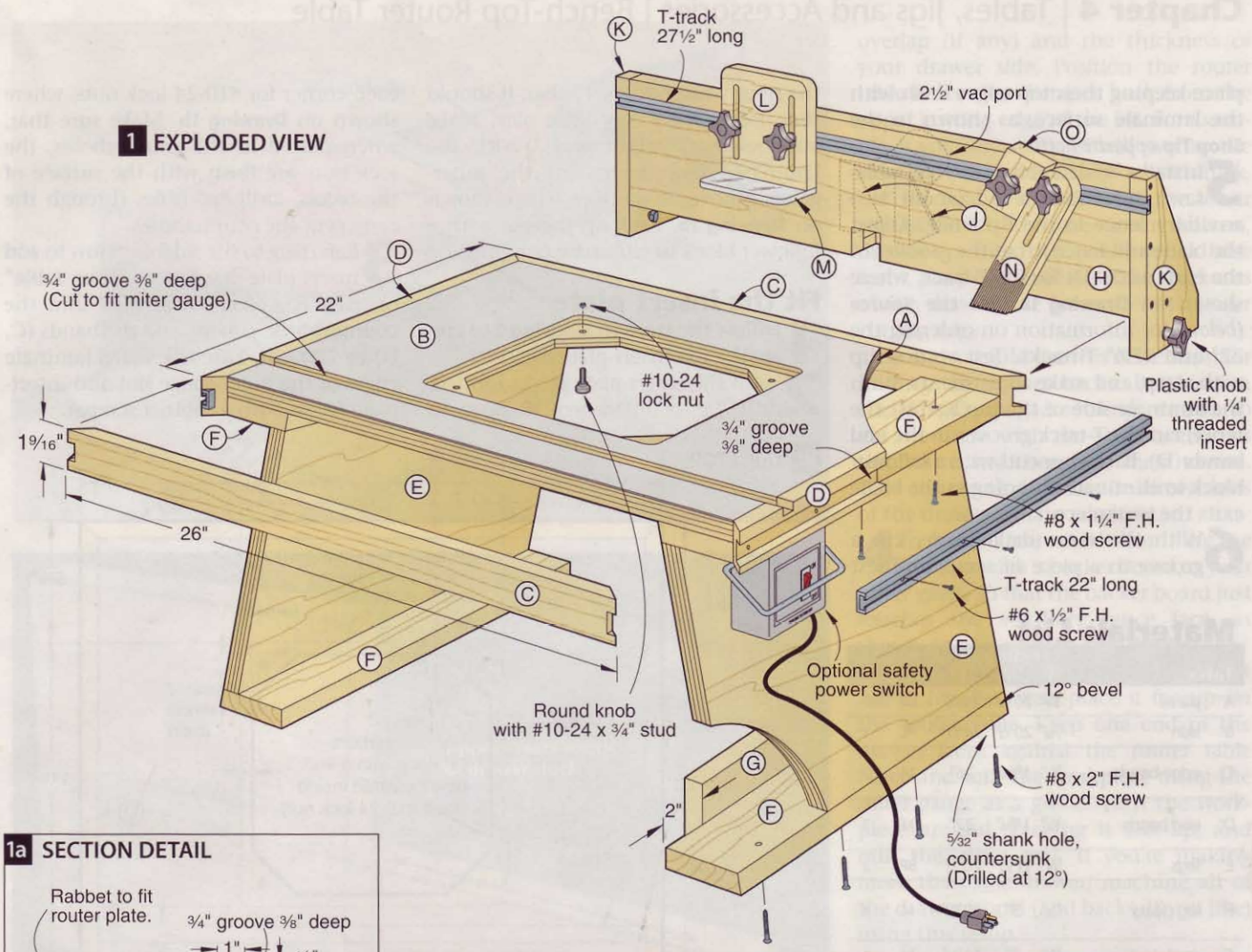
BERTTJ08

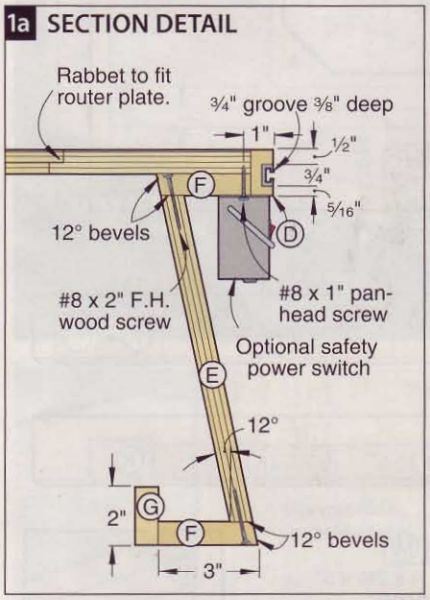
Once you've mastered the basics, step up your routing repertoire with these easy-to-build shop helpers. Each one is shop-tested to help you make faster, cleaner cuts.

Full-Service Benchtop Router Table

Why this project belongs in your shop:

- You can put it together in a weekend for less than $100 plus the cost of your own wood.
- Its fence adjusts in a flash and locks into a T-track with the quick twist of two knobs.
- A T-track built into the fence makes for lightning-fast and solid positioning of homemade featherboards and a bit guard.
- Insert-plate levelers ensure a perfectly aligned tabletop.
- The built-in dust-collection port keeps debris at a minimum.
- It's easily portable, weighing only 36 pounds (without router), and you can grip the tabletop edges for comfortable carrying.





SHOP TIP

Flush-trimming with your tablesaw

When applying plastic laminate to a part like the router-table top's panel, start with oversize pieces of plywood and laminate. Apply contact cement to the laminate and the plywood. Position the laminate just shy of one edge and end of the plywood, as shown in the photo. Run these edges, free of overhanging laminate, against your tablesaw fence first when trimming the top to its finished size. Cutting both plywood and laminate at the same time avoids router flush trimming.

Start at the top

1 Cut both a piece of birch plywood for the panel (A) and a piece of plastic laminate for the skin (B) an inch larger in length and width than the sizes listed in the **Materials List.**

2 Following the directions on the can, apply contact adhesive to the back of the laminate and face of the plywood. Bond the laminate to the plywood, holding the laminate about ⅛" back from one edge and one end of the plywood, as shown in the **Shop Tip** *above*. Apply pressure with a rubber roller.

3 With the exposed end and edge of the plywood against your tablesaw rip fence, trim about ¼" off the panel's opposite end and edge, cutting through both the plywood and laminate. Now with the just-trimmed end and edge in turn against the fence, cut the panel/skin (A/B) to finished size.

4 Cut the edge bands (C) and the end bands (D) to width, but about 1" longer than the lengths listed. Miter-cut them to fit around the top, as shown on **Drawing 1**. Glue and clamp them in

place keeping their top edges flush with the laminate surface, as shown in the **Shop Tip** *opposite bottom*.

5 Install a ¾" dado blade in your tablesaw, and attach a tall (about 10") auxiliary fence to the rip fence. Adjust the blade and fence to cut the grooves in the end bands (D) for the T-track, where shown on **Drawing 1a**. See the **Source** (*below*) for information on ordering the 22" and 27½" T-tracks. Test your setup with scrap, and make adjustments. With the laminate side of the top against the fence, cut the T-track grooves in the end bands (D). Back your cuts with a follower block to eliminate chipping as the blade exits the workpiece.

6 With the same dado blade, cut a groove in a piece of scrap, and test the fit of your miter-gauge bar. It should slide freely with very little play. Make any necessary adjustments. With the laminated face down, cut the miter-gauge groove in the top, where shown on **Drawing 1b**. Back up the cut with a follower block to eliminate chipping.

Fit the insert plate

1 Follow the steps in **Drawing 2** to create the top insert-plate recess.

2 With the insert-plate recess formed, drill 7/16" counterbores ¼" deep in each corner for #10-24 lock nuts, where shown on **Drawing 1b**. Make sure that, when placed in the counterbores, the lock nuts are flush with the surface of the recess. Drill 3/16" holes through the centers of the counterbores.

3 Referring to the sidebar "How to add insert-plate levelers to your table" on *page 85*, epoxy lock nuts into the counterbores. Finish-sand the bands (C, D) to 220 grit. Ease the sharp laminate edges of the miter-gauge slot and insert-plate recess with a cabinet scraper.

Materials List

Table		FINISHED SIZE T	W	L	Matl.	Qty.
A*	panel	¾"	20½"	24½"	BP	1
B*	skin	1/16"	20½"	24½"	PL	1
C*	edge bands	¾"	1 9/16"	26"	M	2
D*	end bands	¾"	1 9/16"	22"	M	2
E*	legs	¾"	11½"	20½"	BP	2
F*	leg cleats	¾"	3"	20½"	M	4
G	cord cleat	¾"	2"	16½"	M	1
Fence						
H*	fence	¾"	6"	26 31/32"	M	1
I*	fence base	¾"	3"	26 31/32"	M	1
J	vac port mounts	¾"	2½"	3⅛"	M	2
K	fence brackets	¾"	4¾"	7½"	M	2
Guard & Feather Board						
L	guard base	¾"	5"	5"	M	1
M	guard	¼"	2¾"	5"	A	1
N*	feather boards	¾"	1¾"	8"	M	2
O	jam blocks	¾"	1¾"	3"	M	2

*Parts initially cut oversize.

Materials key: BP–birch plywood, PL–plastic laminate, M–maple, A–acrylic.

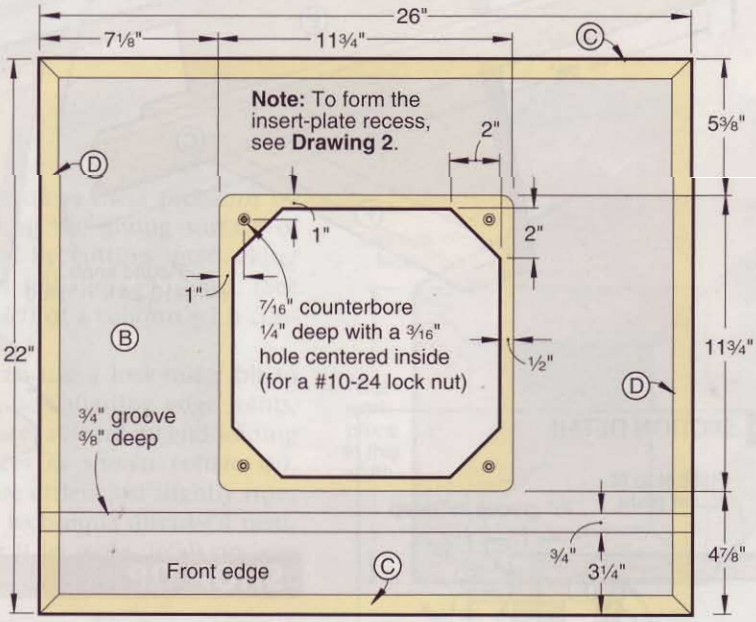
Supplies: #8×1¼" flathead wood screws, #8×1½" flathead wood screws, #8×2" flathead wood screws, #8×1" panhead screws, #8×1" brass flathead wood screws (2), ¼" SAE flat washers, contact adhesive, 5-minute epoxy, #10-24 locknuts (4), ¼" hexhead bolts 1½" long (8), #6×½" F.H. wood screws.

Source

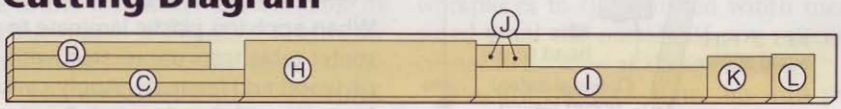
Hardware: Knobs with ¼" threaded inserts #60766 (8); round knobs with #10-24x‡" studs #60996 (4); 36" T-track #10598 (1); 24" T-tracks #10597 (2); 2½" vac port #46519 (1)⅜×11-⅞"× 11-⅞ " acrylic insert plate #10541 (1). Hartville Tool, 800-345-2396, or hartvilletool.com.

Switch: Safety power switch no.141938, $39.99 plus shipping, from Woodcraft. Call 800-225-1153 to order.

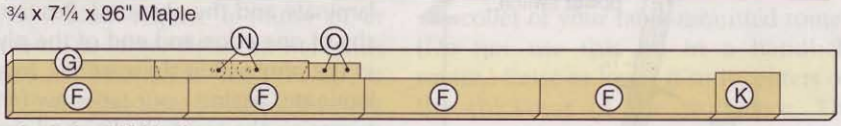
1b TABLETOP



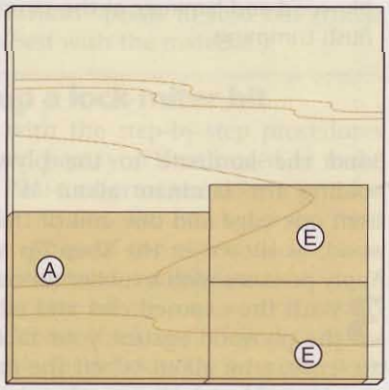
Cutting Diagram



¾ x 7¼ x 96" Maple

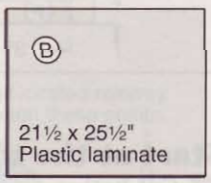


¾ x 7¼ x 96" Maple



¾ x 48 x 48" Birch plywood

¼ x 2¾ x 5"
Acrylic



Build a sturdy base

1 Cut the legs (E) and leg cleats (F) to length, but about 1" wider than listed. Tilt your tablesaw blade 12°, and bevel-rip the edges of the legs and leg cleats, where shown on **Drawing 1a.** Cut the cord cleat (G) to size.

2 Glue and clamp the leg cleats (F) to the legs (E). Drill pilot and countersunk shank holes through the leg cleats into the legs. Drive in the screws, and remove the clamps. Glue and clamp the cord cleat to the leg cleat. Finish-sand the leg assemblies to 220 grit.

Note: *When storing the router table, coil the router and switch cords and stow them under the table, wedging them between the leg and the cord cleat.*

3 Place the top assembly upside down on your bench. Glue and clamp the leg assemblies to the top. Drill pilot and countersunk shank holes through the leg cleats into the top. Drive in the #8× 1¼" flathead screws.

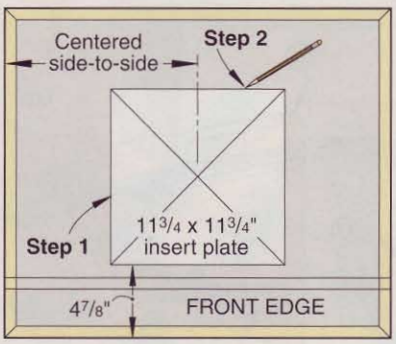
Build an accurate fence

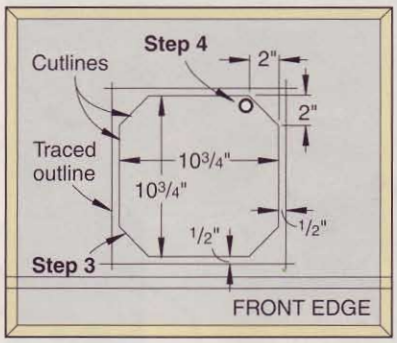
1 Forming straight, square edges is essential for making a straight fence. Start by cutting the fence (H) and the fence base (I) ½" wider and 1" longer than the sizes listed. Joint one edge of each board. Next set the fence on your tablesaw 1/32" over the finished width, and rip the parts. Set your jointer depth to 1/32" and joint the freshly cut edge. Check the length of your tabletop and add 1/32" to the depth. Cut the fence and fence base to this length. (The added 1/32" allows the fence to slide easily.) Bandsaw centered 1½×1½" bit-clearance notches in both parts. Glue and clamp the fence and fence base together.

2 Cut two ¾×4¾×7½" blanks for the fence brackets (K). Fasten the two blanks together with double-faced tape. Mark the diagonal cut and the location of the ¼" hole on the top blank, where shown on **Drawing 3a.** Bandsaw and sand to the marked line, and drill the hole. Separate the brackets.

3 Glue and clamp the fence brackets (K) to the fence (H/I), making sure the bracket edges are flush with the fence face. Drill pilot and countersunk shank holes through the brackets into the fence, where shown, and drive in the screws. With your dado blade adjusted to the width of the T-track, cut the dado in the fence (K/H/K), where shown on **Drawing 3.** Finish-sand the fence assembly to 220 grit.

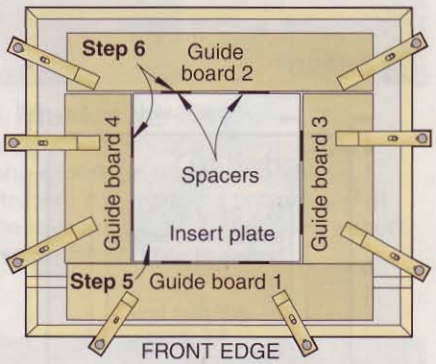
2 FORMING THE INSERT-PLATE RECESS

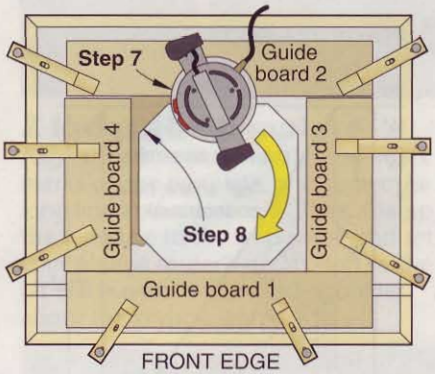




STEP 1 Trim the insert plate to size, and position it 4⅞" from the tabletop front edge and centered side-to-side.
STEP 2 Trace the outline of the plate onto the tabletop.

STEP 3 Lay out and mark the opening cutlines inside the traced outline.
STEP 4 Drill a blade start hole, and use your jigsaw to cut the opening.



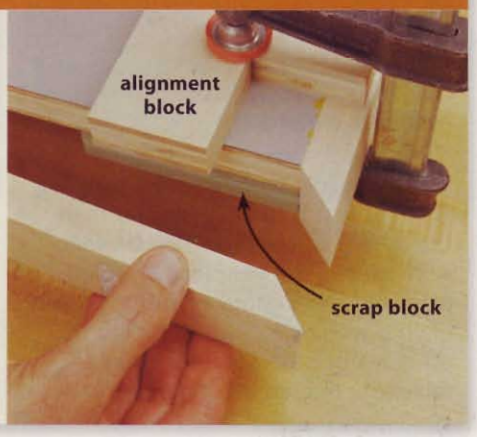


STEP 5 Secure the insert plate inside traced outline with double-faced tape.
STEP 6 Clamp the guide boards around the plate, spacing each board away from the plate with business-card shims.
STEP 7 Remove the insert plate and shims. Chuck a straight bit with a top-mounted pilot bearing (pattern bit) into a handheld router. With its base resting on top of the guide boards, adjust the router to cut ⅛" into the tabletop.
STEP 8 Guiding the bit pilot bearing along the inside edges of the guide board, begin routing the recess. Make additional passes, lowering the bit each time until you reach a depth of about 1/32" greater than the thickness of the insert plate.

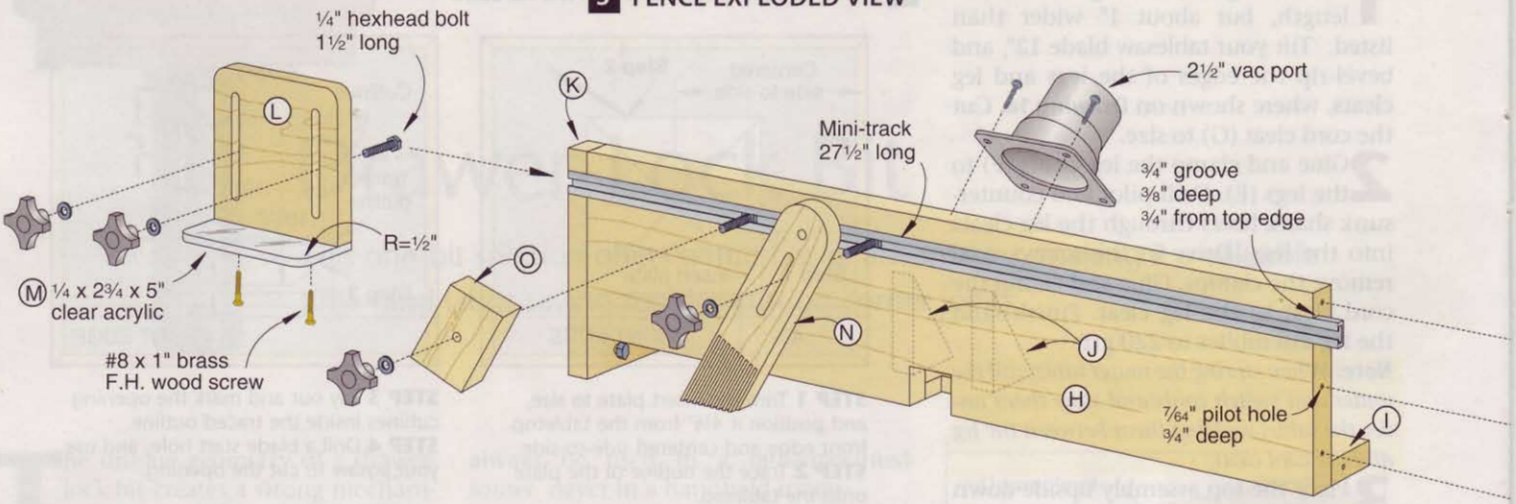
SHOP TIP

Keep your banding flush and corners aligned

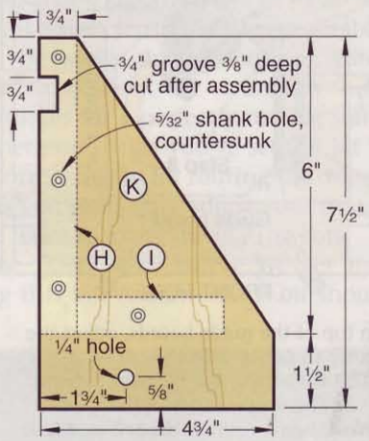
Make alignment blocks by cutting 2×2" notches out of four 4×4" pieces of ¾" plywood. (The notches let you see the mitered corners). Clamp them to the top, as shown in the photo. Use scrap blocks underneath the top to space the clamps away from the banding. Now, glue and clamp the banding to the top, keeping it tight against the alignment blocks.



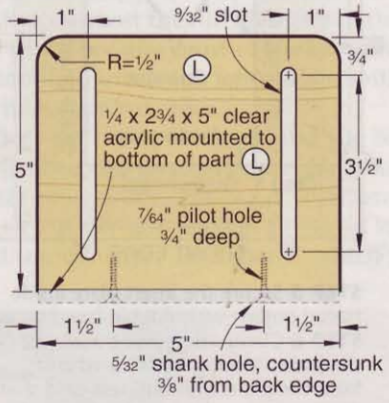
3 FENCE EXPLODED VIEW



3a FENCE BRACKETS



3c GUARD



4 Cut the vac port mounts (J) to the size and shape shown on **Drawing 3b**, *opposite*. Dry-position the mounts to check their locations with your vac port. Glue and clamp the vac port. Glue and clamp the mounts in place. With the glue dry, use the port to mark the mounting holes and set the vac port aside. See the **Source** for ordering the port used here.

SHOP TIP

Make our self-gauging feather board

Here's a quick way to set your feather board to apply the proper pressure. Trim the first feather ⅛" shorter than the others, where shown on **Drawing 4.** When you use your feather board, place this short gauging feather on top of your workpiece. Now, keeping the other feathers parallel to the router-table top, tighten the mounting knob.

Now, get your guard up

1 Cut the guard base (L) to size. Sand the ½" radii on the top corners, where shown on **Drawing 3c**. To form the mounting slots, drill 9/32" holes where shown, draw lines from hole to hole, and scrollsaw along the lines. Finish-sand the base to 220 grit.

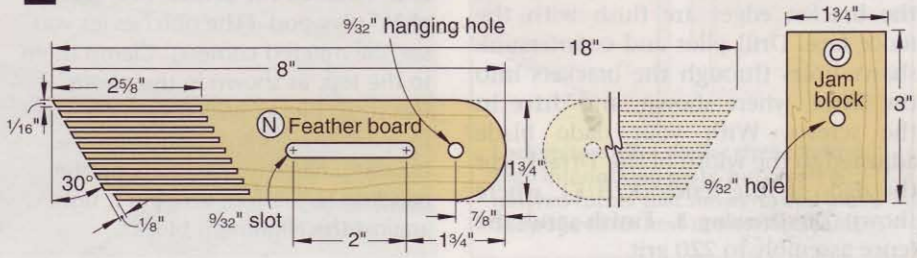
2 Cut ¼" acrylic to size for the guard (M). Disc-sand ½" radii on the outside corners, as shown on **Drawing 3**. Adhere the guard to the base with double-faced tape, keeping the back edges flush. Drill pilot and countersunk shank holes through the guard (M) into the base (L). Remove the guard, and set it aside.

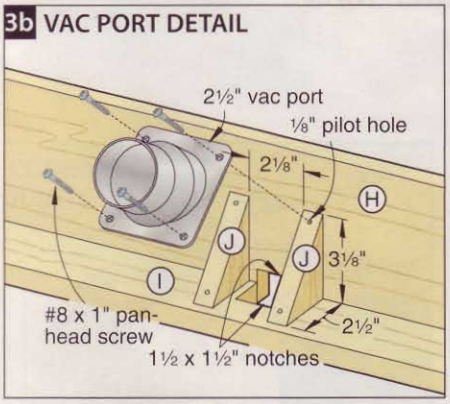
Make the feather boards

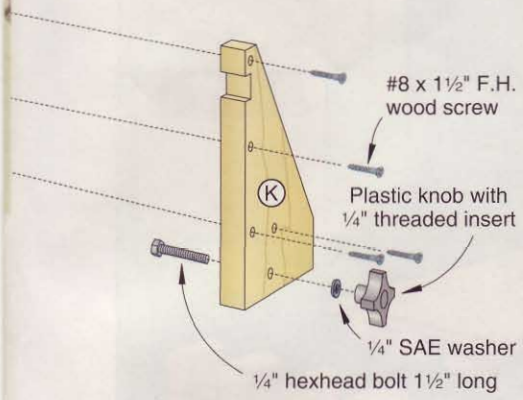
1 Select a straight-grained piece of ¾"-thick maple, and cut a ¾×2×18" blank for the feather boards. Using your tablesaw and miter gauge, trim 30° angles on both ends of the blank, where shown on **Drawing 4**. Mark angled lines across the width of the blank, 2⅝" from each end, then mark the radius ends of the feather boards.

2 Install a regular (⅛" wide) blade in your tablesaw and raise it 2" high. Set the rip fence 1/16" from the blade. With the long edge of the blank against the fence, cut in to the marked line, then *carefully* pull the board straight back from the blade. A padded jointer push-block works well for this operation. Flip the board end for end and repeat. Reset

4 FEATHER BOARDS & JAM BLOCKS

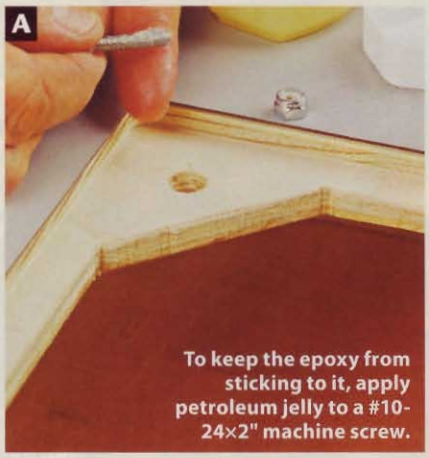


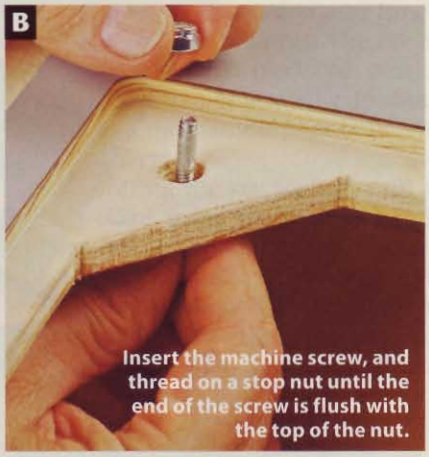




How to add insert-plate levelers to your table

Adjusting your router-table insert plate perfectly flush with the top is as easy as installing lock nuts in the corners of the plate recess. Once you've drilled counterbored holes to accept #10-24 nuts in all four corners, follow these four simple steps to install the levelers.





When the epoxy hardens, replace the 2"-long machine screw with a ½"-long one. For no-tool adjustment, use a knob with a ½"-long threaded stud. See **Source** for our knob source.

the fence at ¼" and repeat the cut on each end. Repeat cutting the feathers at 3/16" intervals up to 1¾". With the fence set at 1¾", lower the blade to 1", and cut the blank to finished width.

3 Drill 9/32" hanging and slot-starting holes in the feather boards (N), where shown on **Drawing 4**. Mark and scrollsaw the slots, and bandsaw the rounded ends. Finish-sand the feather boards to 220 grit.

4 Cut the jam blocks (O) to size and drill the centered 9/32" holes. Finish-sand them to 220 grit.

Note: *The jam blocks are positioned against the long edge of the feather boards to prevent them from pivoting when you're applying pressure to the workpiece.*

Apply finish, add hardware

1 Touch up the finish sanding where needed. Apply two coats of a penetrating oil finish to all the wood parts, including the miter-gauge slot and the insert-plate recess, following the instructions on the can. (We used McCloskey Tung Oil Finish. An oil finish is easier to reapply after the finish is worn than paint or varnish. It also seals the miter-gauge slot and insert-plate recess without building up and making too tight a fit.)

2 Hacksaw T-track to the lengths of the table ends and fence. You'll have to drill and countersink new mounting holes at the cut ends. Using the holes in the mini-track as guides, drill pilot holes into the table and fence, and screw the track in place.

3 Mount the optional switch, where shown on **Drawings 1** and **1a**. See the **Source** for the source of the safety power switch we used.

4 Screw the guard (M) to the guard base (L) with #8x1" brass flathead wood screws. Attach the assembled guard, feather boards, and jam blocks to the fence and the fence to the table with hexhead bolts, washers, and knobs, as shown. See the **Source** (*page 82*) for information on ordering the bolts and knobs. Screw the vac port to the mounts.

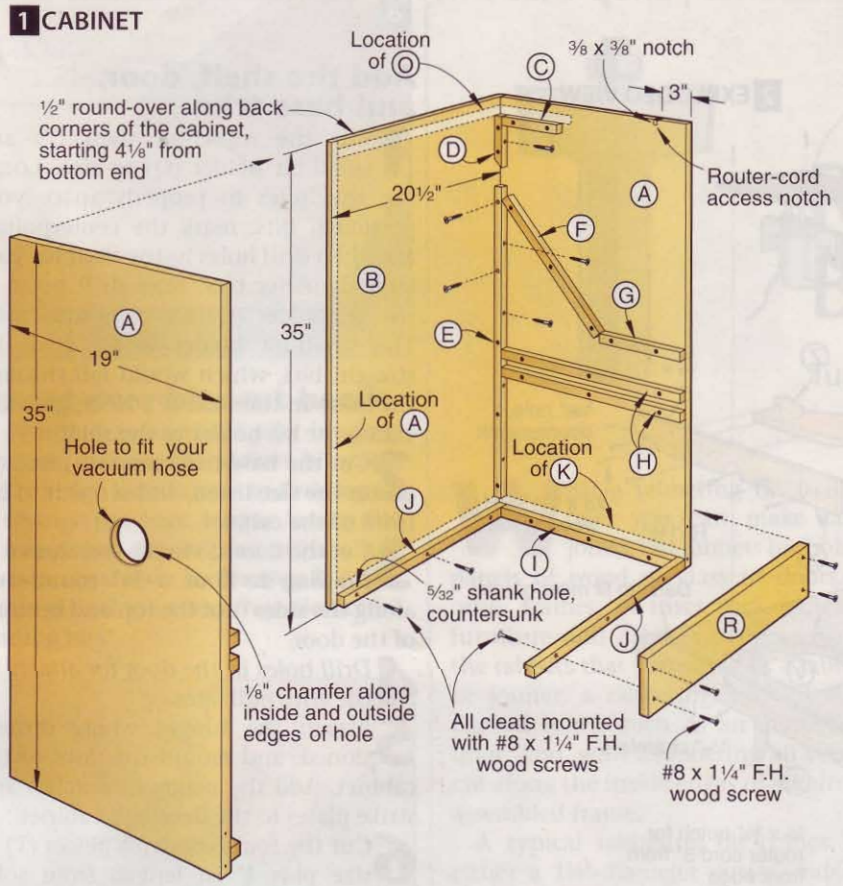
5 Screw the insert-plate leveling knobs into the lock nuts. Sand the corners of the insert plate to match those of the insert recess. For instructions on mounting your router on the insert plate, see "Add Custom Plates to Your Table" on *page 57.*

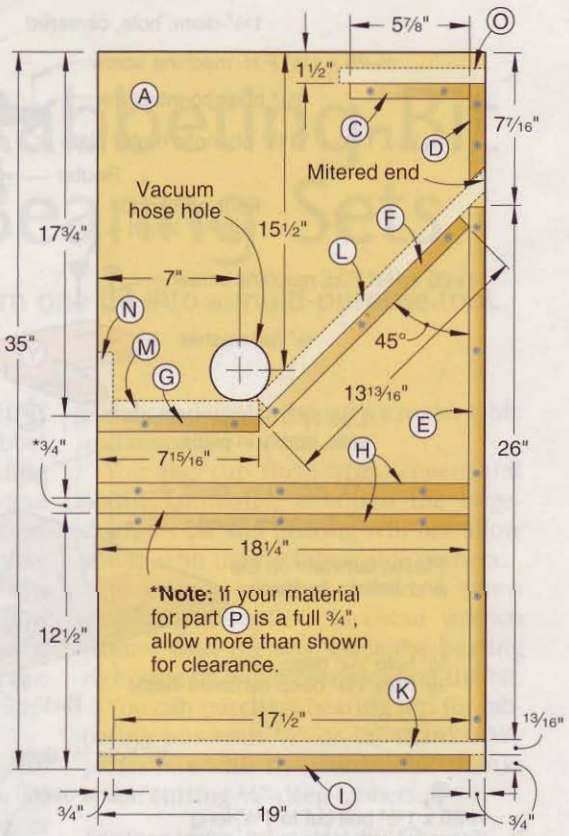
Written by **Raymond L. Wilber** with **Chuck Hedlund**
Project design: **Chuck Hedlund**
Illustrations: **Roxanne LeMoine; Lorna Johnson**

Tilt-Top Router Table

An open-and-close shop tool designed for your convenience

Count the features of this fully loaded router table, and you'll quickly conclude that you've got to have one. For starters, the table flips up for easy changing of bits and checking bit height. It's topped by an accurate, easy-to-build fence. A sealed compartment underneath, fitted with a vacuum port, takes care of sawdust. Below that, you'll find a slide-out shelf for storing all kinds of bits and accessories.





First, build the cabinet

1 Cut the cabinet sides (A) and back (B) to the sizes listed in the **Materials List** from ¾" medium-density fiberboard (MDF). As noted on the **Cutting Diagram** on *page 92*, MDF measures 1" wider and longer than regular 4×8' sheet goods.

2 Using **Drawings 1** and **1a** for reference, mark the centerpoint, and cut the vacuum hose hole in the left-hand side panel (A) to fit your vacuum hose. (We drilled a blade start hole, and cut the hole to shape with a jigsaw.) To prevent chipping, rout a ⅛" chamfer along the inside and outside edges of the hole.

3 Mark and cut a notch in the right-hand side panel for the cord from the router to exit the cabinet.

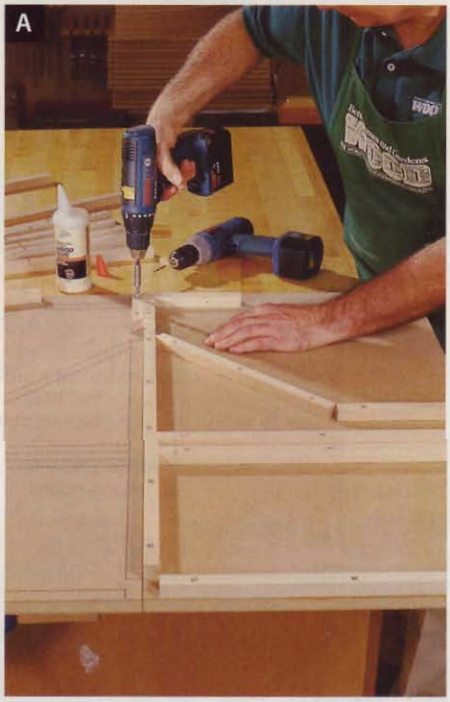
4 From ¾" solid stock (we recommend maple, poplar, or birch), cut the ¾×¾" cleats (C–J) to the lengths listed in the **Materials List**.

5 Next, mark the locations of the cleats on the inside face of each side panel (A), as shown in **Drawings 1** and **1a.** Then, drill countersunk mounting holes in the cleats, and screw them in place, as shown in **Photo A**.

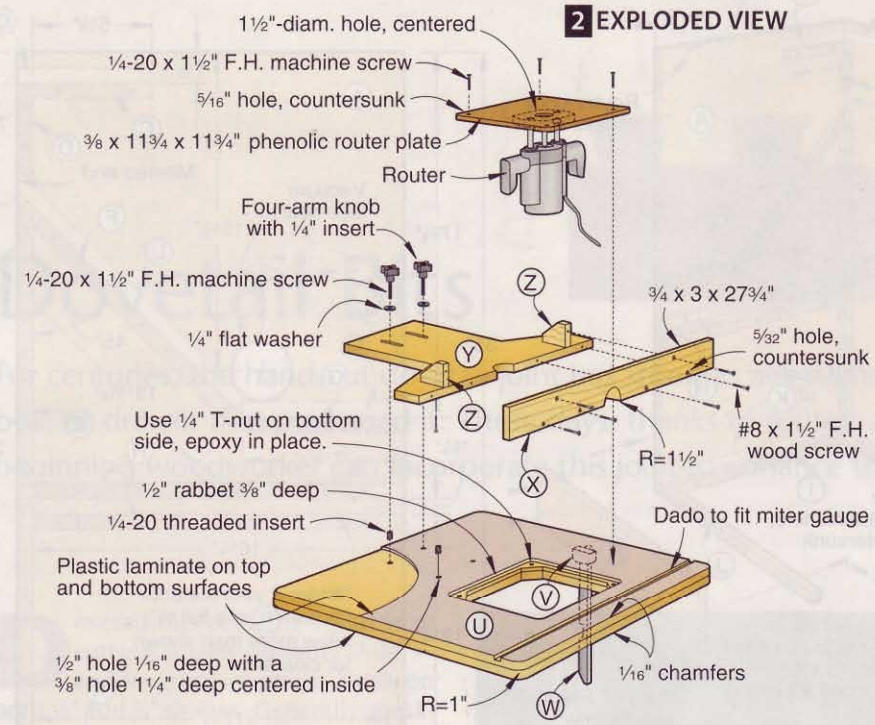
6 Cut the bottom (K), dust-chute pieces (L, M, N), and support (O) to size from MDF. For a tight fit, miter-cut one edge of part L and one end of each D.

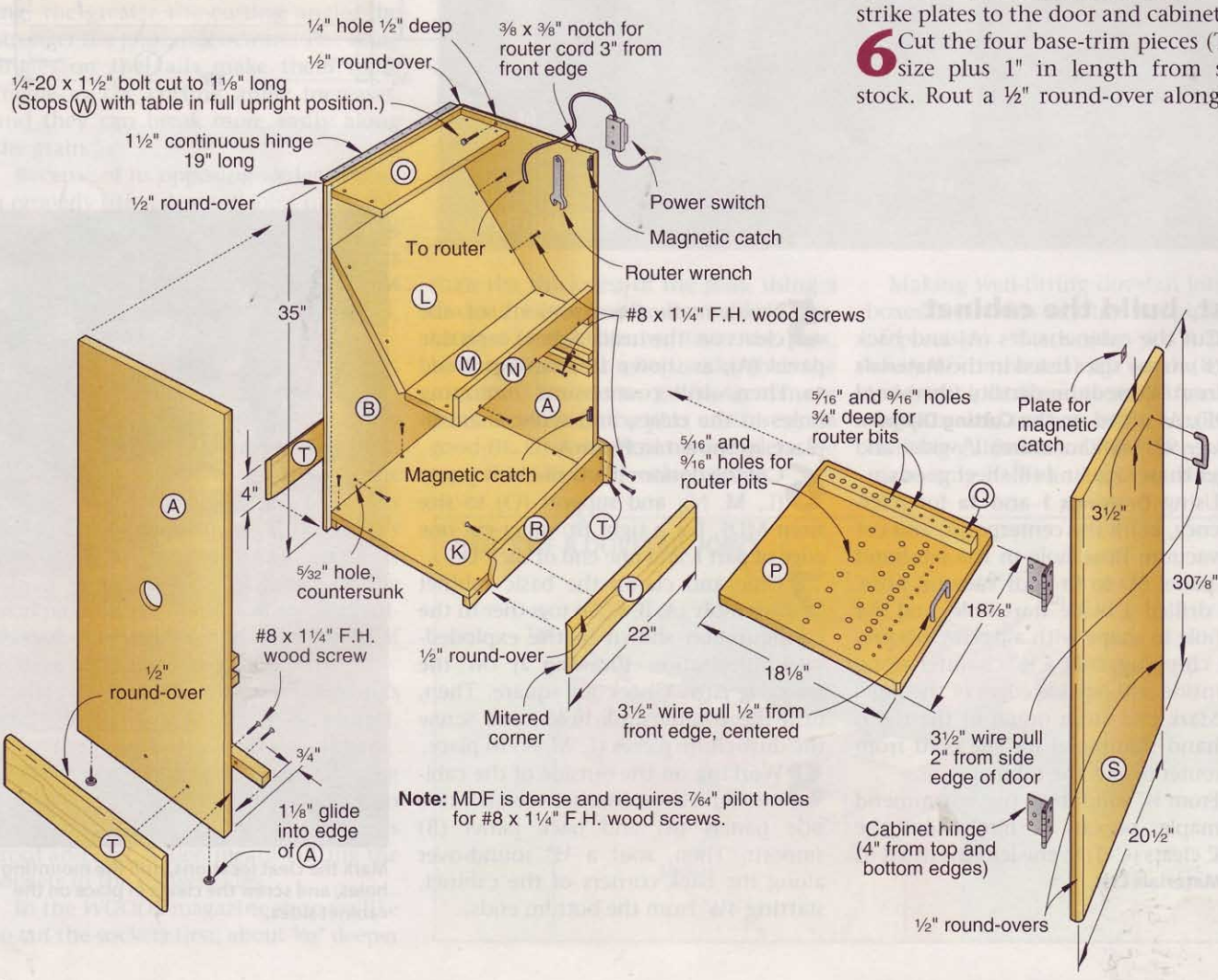
7 Glue and clamp the basic cabinet assembly (A, B, K, O) together in the configuration shown in the exploded-view illustration **[Drawing 2]** on the *following page*. Check for square. Then, drill the countersunk holes, and screw the dust-chute pieces (L, M, N) in place.

8 Working on the outside of the cabinet, sand the joints between the two side panels (A) and back panel (B) smooth. Then, rout a ½" round-over along the back corners of the cabinet, starting 4⅛" from the bottom ends.



Mark the cleat locations, drill the mounting holes, and screw the cleats in place on the cabinet sides.





Note: MDF is dense and requires 7/64" pilot holes for #8 x 1¼" F.H. wood screws.

Add the shelf, door, and base trim

1 Cut the router-bit shelf (P) and small-bit holder (Q) to size. Locating the holes to properly space your particular bits, mark the centerpoints, and then drill holes in the shelf for your large-diameter bits. Now drill holes in the bit holder (Q) for your small bits. The small-bit holder works great for straight bits, which would fall through the holes in the shelf (P). Next, glue and clamp the bit holder to the shelf.

2 Cut the base-trim support piece (R) to the size listed, and screw it to the front of the cabinet.

3 Cut the door (S) to the size shown in **Drawing 2.** Rout a ½" round-over along the sides (not the top and bottom) of the door.

4 Drill holes in the door for attaching the wire pull later.

5 Attach the hinges where dimensioned, and mount the door to the cabinet. Add the magnetic catches and strike plates to the door and cabinet.

6 Cut the four base-trim pieces (T) to size plus 1" in length from solid stock. Rout a ½" round-over along the

top outside edge of each trim piece. Miter-cut the trim pieces to length. Working from the inside of the cabinet, drill countersunk mounting holes, and then glue and screw the trim pieces to the bottom outside of the cabinet.

7 Turn the cabinet upside down, and nail four glides in place.

Here's how to add the tilting top

1 Cut two pieces of ¾" MDF 29" square for the tabletop (U), shown in **Drawing 3**, and detailed in **Drawings 5** and **6**.

2 Glue and clamp the two pieces together face-to-face. To achieve uniform clamping pressure in the center of the lamination, drill several pilot holes from what will become the underside of the tabletop, and then drive several #8×1¼" screws into the upper lamination. Next, using clamps along the edges, secure the two pieces tightly together until the glue dries. Now remove all the screws so you won't hit them in the following steps.

3 Cut the laminated router top (U) to finished size (28" square), radiusing the corners at 1".

4 Cut two pieces of plastic laminate to 30" square. Apply contact cement to all mating surfaces, and adhere the laminate to both surfaces of the tabletop (U). Use a rubber roller to ensure a good bond between the laminate and MDF.

5 Using a flush-trimming bit, rout the edges of the laminate flush with the edges of the tabletop **[Photo B]**.

6 Cut or rout a dado in the top (U) where dimensioned to form a slot that fits your miter-gauge guide bar.

Cut the table insert into the top

Note: *We secured the router plate to the tabletop with screws and T-nuts so that the plate (with the router attached) can't fall out when tipping the tabletop back. See* ***Sources*** *on* page 92 *for the router plate and hardware.*

1 The router plate (see **Sources**) is listed as a 12"-square plate, but actually measured a bit less. Using a tablesaw, cut adjoining edges to square up the plate, then trim it to 11¾" square.

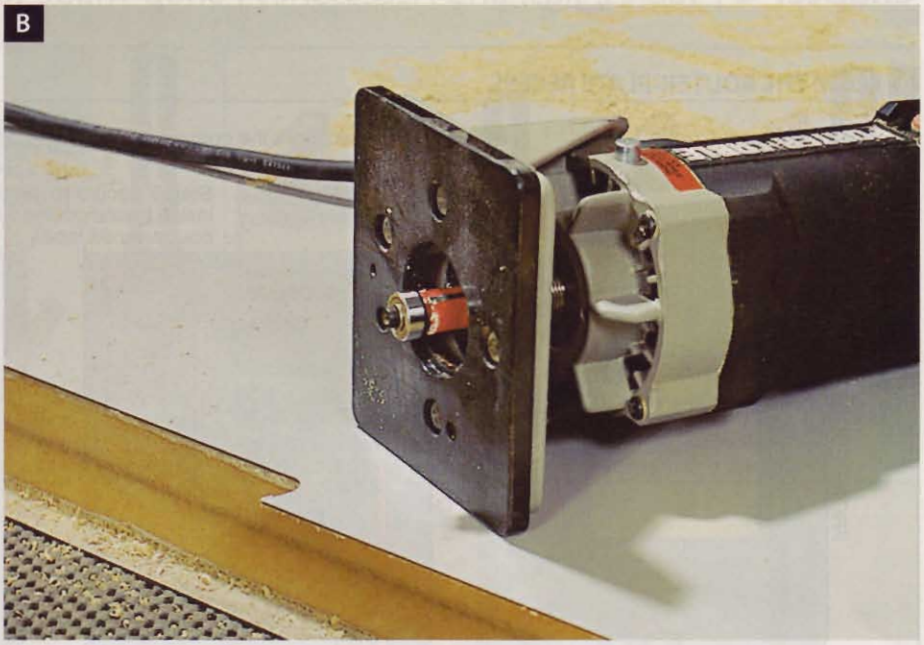
2 Use the seven steps, listed in **Drawing 4**, to form the router-plate recess in the top (U).

3 Mark the centerpoints, and then drill 5⁄16" holes in the corners of the router plate, where dimensioned in **Drawing 7.** Fit the router plate in the recess, and use the holes as guides to drill through the corners of the recess in the top (U).

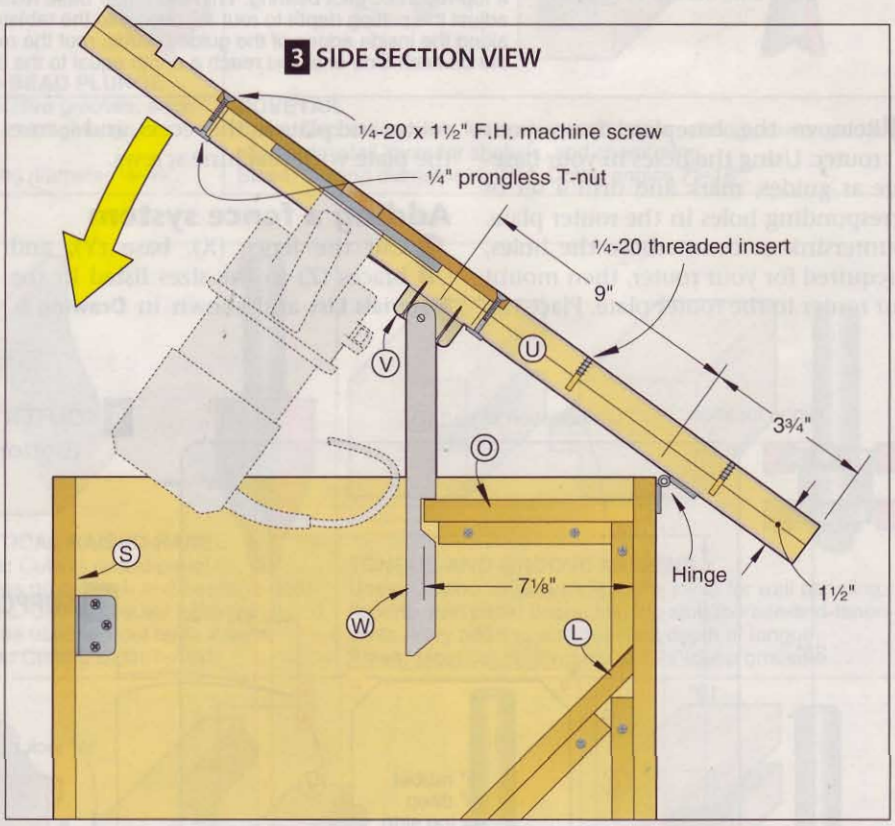
4 Epoxy a ¼" prongless T-nut into each 5⁄16" hole on the underside side of the router tabletop.

5 Mark the centerpoint on the router plate. Now, bore a 1½" hole (or one slightly larger than the diameter of your largest-diameter router bit) through the center of the router plate.

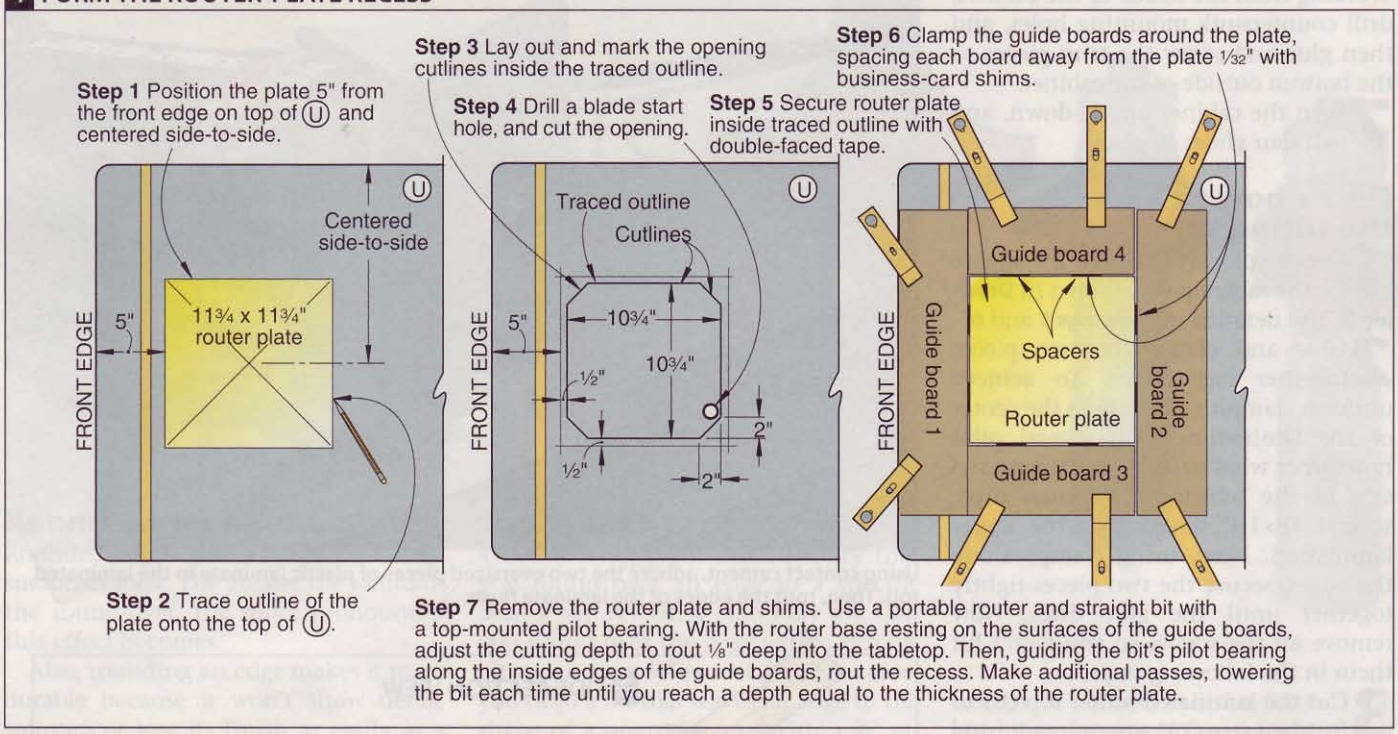
6 Countersink the 5⁄16" holes in the router plate for the ¼-20×1½" flathead machine screws.



Using contact cement, adhere the two oversized pieces of plastic laminate to the laminated top. Then, rout the edges of the laminate flush.



4 FORM THE ROUTER-PLATE RECESS

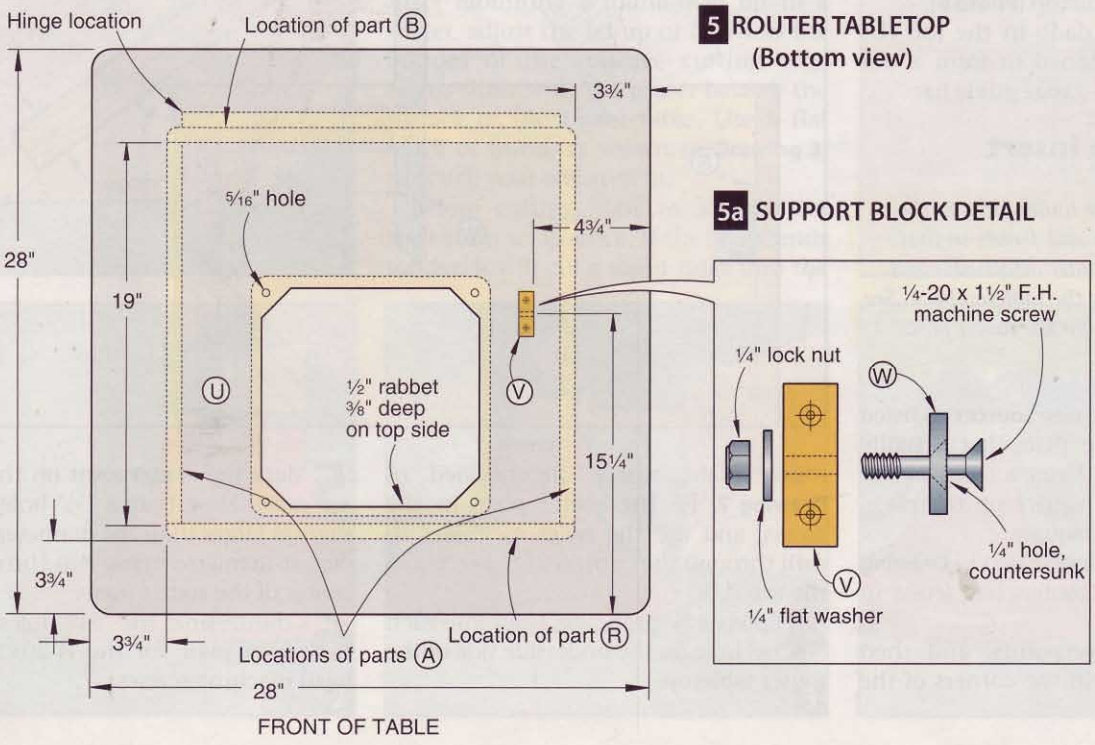


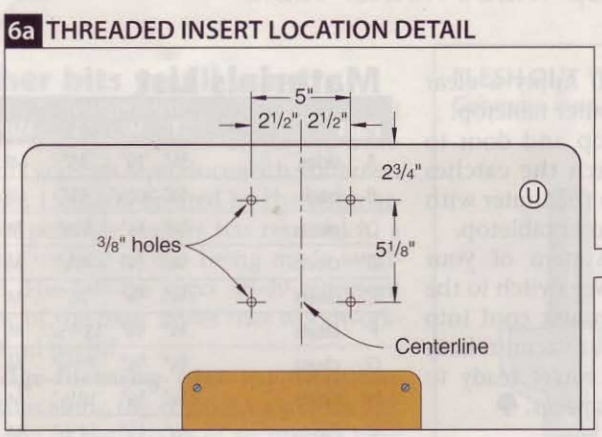
7 Remove the baseplate from your router. Using the holes in your baseplate as guides, mark and drill a set of corresponding holes in the router plate. Countersink or counterbore the holes, as required for your router, then mount your router to the router plate. Place the router and plate in the recess, and secure the plate with machine screws.

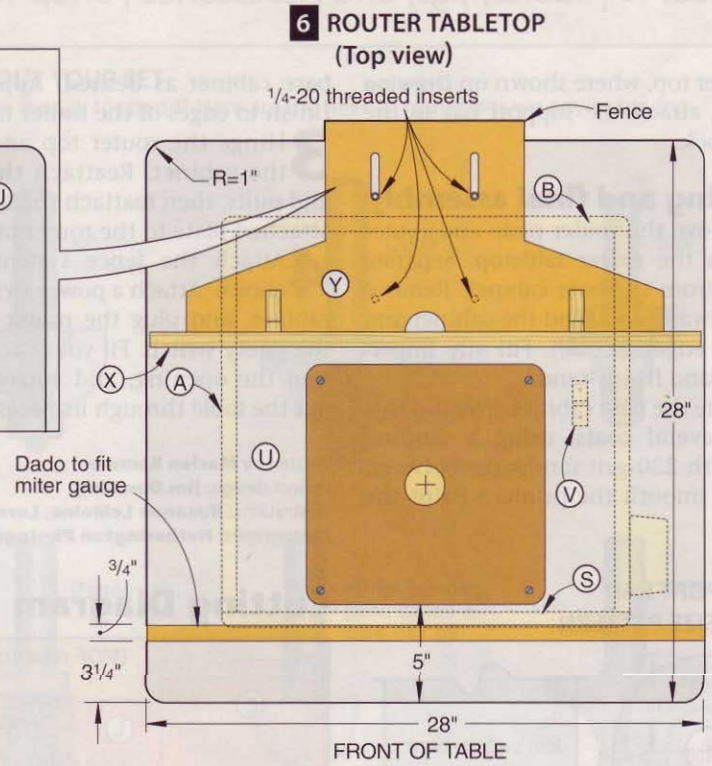
Adding a fence system

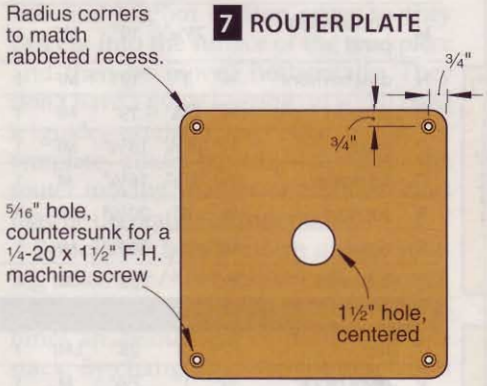
1 Cut the fence (X), base (Y), and braces (Z) to the sizes listed in the **Materials List** and shown in **Drawing 8**. Cut the mounting slots in the base (Y), where shown.

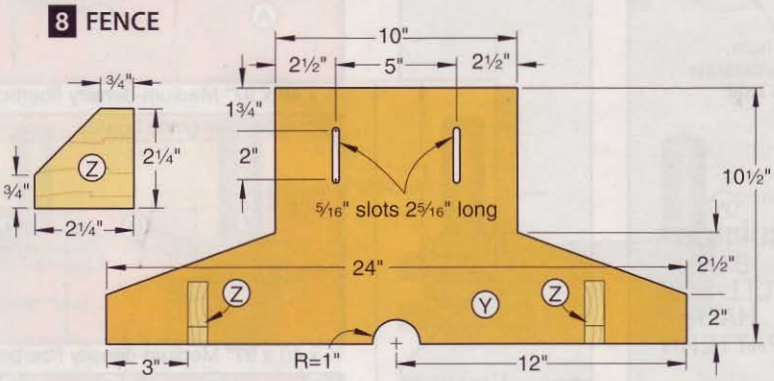
2 Lay out and cut the 1"-radius bit-clearance openings in the fence and base. Now glue and screw these parts together, and add the braces to form the completed fence assembly.

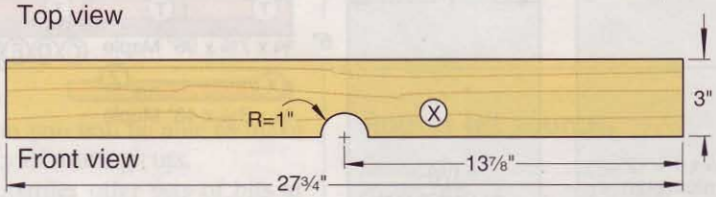


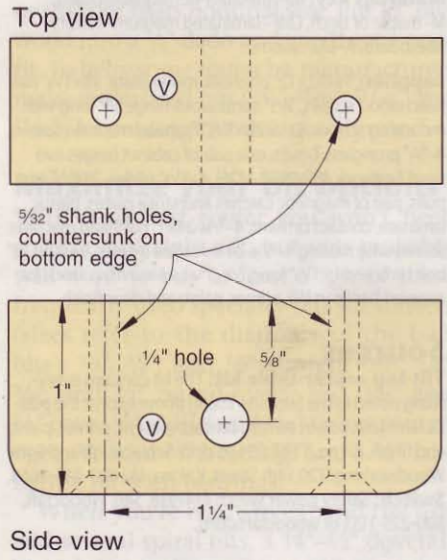












3 Mark the centerpoints for the four holes for the threaded inserts on the router top (U), where dimensioned in **Drawing 6a**.

4 Drill a ½" hole at each marked centerpoint just through the laminate (1⁄16" deep). (We used a Forstner bit to make this recess.) Switch bits, and drill a ⅜" hole 1¼" deep centered in the Forstner bit spur hole in each ½" hole.

5 Double-nut a bolt, and use it to drive a threaded insert into each hole.

Now attach the tabletop support

1 From ¾" maple, drill the holes and cut the pivot block (V) to shape, as dimensioned in **Drawing 9**.

2 Transfer the support bar (W) pattern from **Drawing 10** to ¼×1" aluminum bar stock. Cut the piece to shape, and drill a ¼" countersunk hole through one end where marked.

3 Drill pilot holes, and glue and screw the pivot block (V) to the bottom of

the router top, where shown on **Drawing 5.** Then, attach the support bar to the pivot block.

Finishing and final assembly

1 Remove the router plate and router from the router tabletop. Separate the top from the base cabinet. Remove the hardware, and sand the cabinet and tabletop edges smooth. Fill any imperfections and finish-sand.

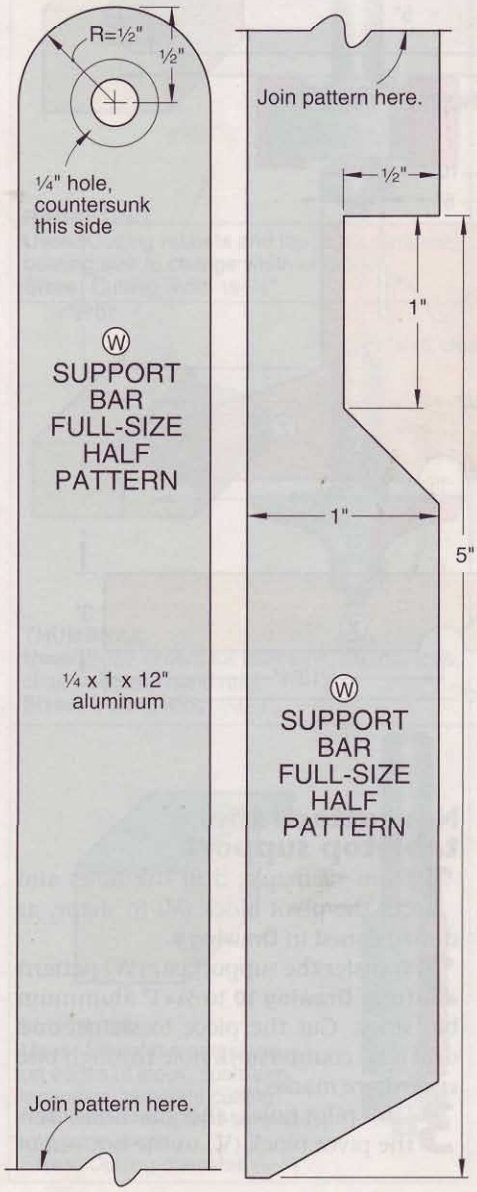
2 Prime the base cabinet. (We did this in several coats, using a sanding block with 220-grit sandpaper between coats to smooth the primer.) Paint the base cabinet as desired. Apply a clear finish to edges of the router tabletop.

3 Hinge the router top and door to the cabinet. Reattach the catches and pulls, then reattach the router with attached plate to the router tabletop.

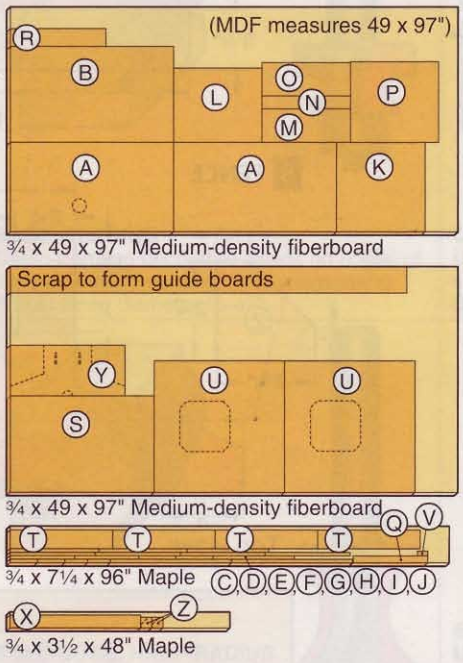
4 Attach the fence system of your choice. Attach a power switch to the cabinet, and plug the router cord into the safety switch. Fit your vacuum hose into the opening, and you're ready to put the table through its paces.

Written by **Marlen Kemmet**
Project design: **Jim Downing**
Illustrations: **Roxanne LeMoine; Lorna Johnson**
Photographs: **Hetherington Photography**

10 SUPPORT BAR FULL-SIZE PATTERN



Cutting Diagram



See more shop plans and accessories at woodmagazine.com/shoptools

Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
A	sides	¾"	19"	35"	MF	2
B	back	¾"	20½"	35"	MF	1
C*	cleats	¾"	¾"	5⅞"	M	2
D*	cleats	¾"	¾"	4⅞"	M	2
E*	cleats	¾"	¾"	26"	M	2
F*	cleats	¾"	¾"	13 13/16"	M	2
G*	cleats	¾"	¾"	7 15/16"	M	2
H*	cleats	¾"	¾"	18¼"	M	4
I*	cleats	¾"	¾"	17½"	M	2
J*	cleats	¾"	¾"	19"	M	2
K	bottom	¾"	19"	19"	MF	1
L	slopped dust panel	¾"	15⅞"	19"	MF	1
M	bottom dust panel	¾"	7 3/16"	19"	MF	1
N	dust bin front	¾"	3"	19"	MF	1
O	support	¾"	7⅛"	19"	MF	1
P	shelf	¾"	18⅛"	18⅞"	MF	1
Q	bit holder	¾"	1½"	16¾"	M	1
R	support	¾"	4"	20½"	MF	1
S	door	¾"		30⅞"	MF	1
T*	base trim	¾"	4"	22"	M	4
Router Table						
U*	top	1½"	28"	28"	LMF	1
V	pivot block	¾"	1"	2¼"	M	1
W	support	¼"	1"	12"	A	1
Fence						
X	fence	¾"	3"	27¾"	M	1
Y	base	¾"	10½"	24"	MF	1
Z	braces	¾"	2¼"	2¼"	M	2

* Parts initially cut oversized. See the instructions.

Materials key: MF–medium-density fiberboard, M–maple or birch, LMF–laminated medium-density fiberboard, A–aluminum.

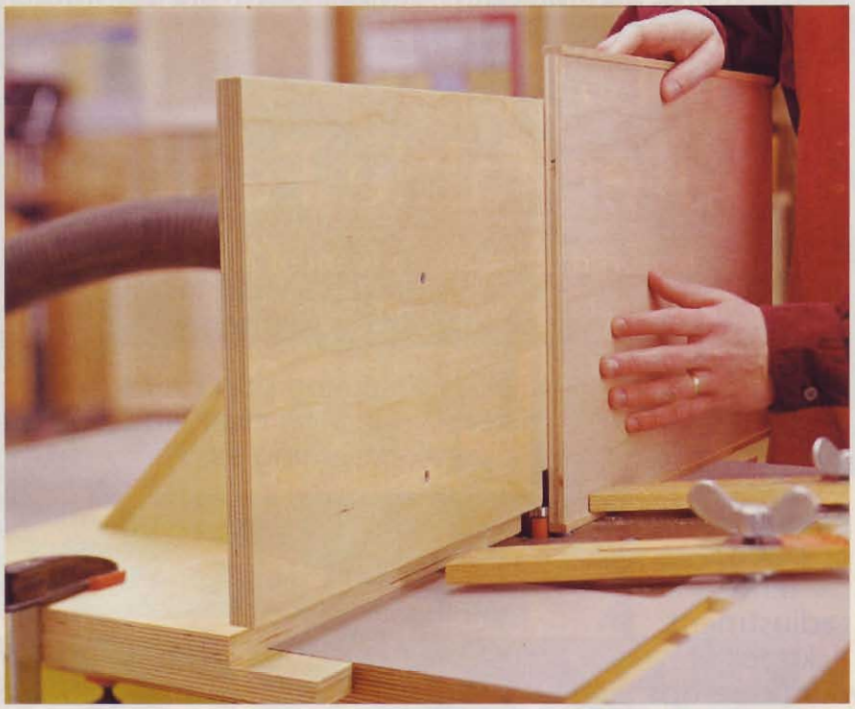
Supplies: ⅜x12x12" phenolic router plate, #8x1¼" flathead wood screws, 1½" continuous hinge 19" long with mounting screws, 4–¼-20x1½" flathead machine screws, 4–¼" prongless T-nuts, one pair of cabinet hinges (we used Amerock #BP-5988-M26), 4–1⅛" glides, 2–3½" wire pulls, pair of magnetic catches and strike plates, plastic laminate, contact cement, 4–3/16-24x1" panhead machine screws with mating 4–3/16-24 threaded inserts, ¼-20x1½" bolt trimmed to 1⅛" long, ¼x1" aluminum bar stock for support bar (part W), primer, paint, and clear finish.

Sources

Tilt-top router-table kit: The kit contains everything noted in the Supplies listing *above* except the plastic laminate, power switch, contact cement, primer, paint, and finish. Kit no. TTRT, $54.95 ppd. Schlabaugh and Sons Woodworking, 720 14th Street, Kalona, IA ; 800-346-9663.
Switch: Safety power switch #141938, $40, Woodcraft, 800-225-1153 or woodcraft.com.

Flush-Trimming Fence

Build this simple router-table setup to put a finished edge on plywood panels.



While building the carcase for a cabinet, *WOOD®* magazine master craftsman Chuck Hedlund had to do a lot of flush trimming on the solid-wood edging that he added to dress up the plywood panels. He needed a foolproof way to get the job done. A handheld router with a flush-trim bit works, but it's easy to tip the router accidentally and gouge the edging and plywood. Chuck solved the problem with the router-table-mounted fence, shown *above right*.

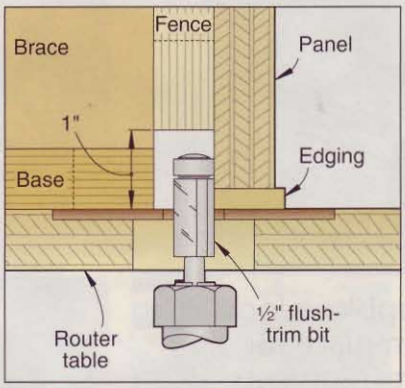
Made of ¾" plywood, the fence sits perpendicular to the table, as shown in the **Side Section View** at *right*. The lower edge of the fence is mounted 1" above the router-table surface, so it accommodates edging up to ¾" thick.

To build the project, cut its identically sized fence and base to 11¾" wide. Measure your router table to determine the length. Then cut matching notches in the base and fence, positioned to align with the bit hole in your table. Two triangular braces hold the base and fence together. The cleats at each end help position the assembly on your table.

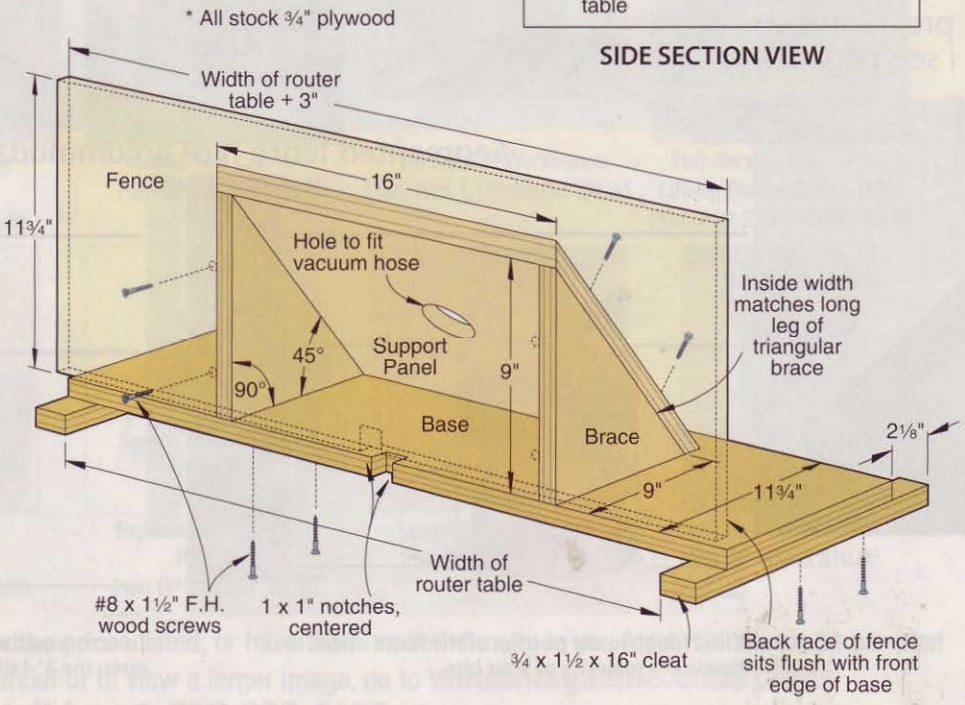
Chuck also added a support panel to the braces that stiffens the entire assembly. A hole cut into the support accepts a shop-vacuum hose to collect chips.

To use the fence, install a flush-trim bit in your table-mounted router. Align the fence face flush with the bit pilot bearing, and clamp the fence down. Hold the edged plywood firmly against the fence as you make each pass, and the edging will come out perfectly flush every time.

Written by **David Stone**
Project design: **Chuck Hedlund**
Illustrations: **Roxanne LeMoine; Lorna Johnson**



SIDE SECTION VIEW



Do-it-All Router-Table Fence

This full-featured fence and a team of accessories make an unbeatable workshop combination.

Dust collection port helps keep your shop clean and you breathing easy.

Extensions put the fence-adjustment knobs at your fingertips.

Aluminum T-track makes attaching accessories a snap.

Stopblock locks in place for precision cuts, see *page 99.*

Easy-to-build bit guard and other accessories, see *pages 98–100.*

Segmented fence face accommodates all bit sizes.

The 2"-high lower portion of the fence opens to house the majority of your bits.

To accommodate tall bits, such as this crown molding cutter, open the 1"-tall center portion.

Is an ordinary fence limiting the performance of your table-mounted router? Now you can move your routing into the big leagues with this feature-packed upgrade. To add flexibility, the fence is designed to attach to a router table in just about every imaginable way. Use threaded inserts, T-track, or simply clamp the ends to your router table. If the fence is for a router table built into your tablesaw extension, an optional cleat enables you to clamp it to the tablesaw rip fence.

Jointer, see *page 98*

A jointer face quickly straightens edges or removes saw marks for edge-gluing.

Start with the fence body

1 From ½" plywood (we used Baltic birch), cut the upright (A) and base (B) to the sizes listed on the **Materials List**. Adjust a dado blade to the thickness of your ½" plywood, and cut ⅛"-deep dadoes across the widths of the parts, where shown on **Drawing 1**.

Note: *If your router table already has threaded inserts or T-track for mounting and securing a fence, make sure the location of the braces does not interfere with it.*

Because these dadoes house the braces (C) [*see page 96*], they must align perfectly. Position the tablesaw rip fence as a stop 4" from the blade and, using the miter gauge to steady the parts, cut all four of the outside dadoes. Reposition the fence 11" from the blade and cut the four inside dadoes. Cut the ½" rabbet along the upright's bottom edge.

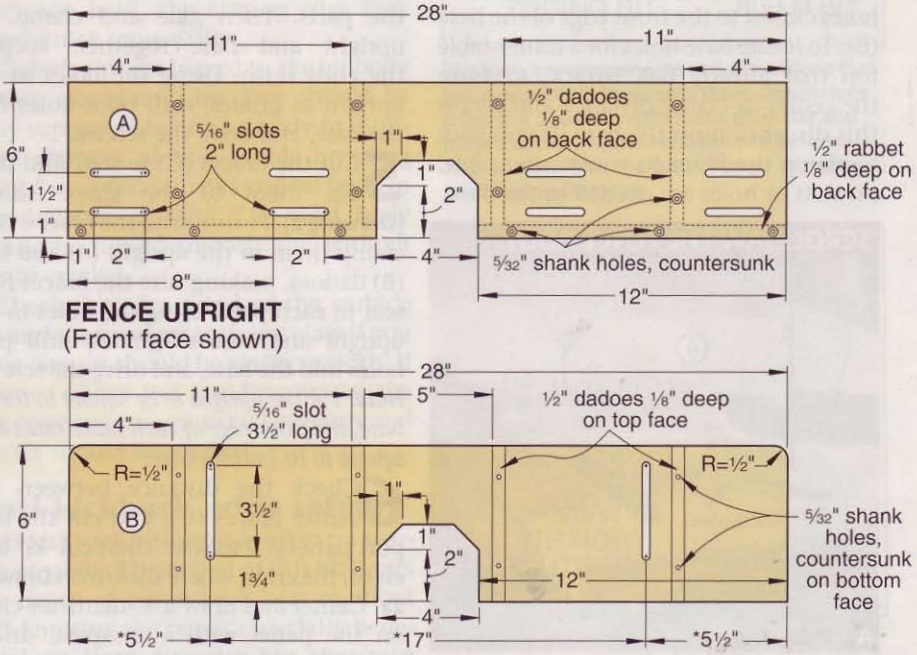
Note: *For the upright to be square to the base after assembly, the dadoes and rabbet must be uniform in depth. Make two passes over the blade to ensure the bottoms of your cuts are completely cleaned out.*

2 Lay out the centers of the 5/16" holes that form the ends of the slots in the upright (A), where shown on **Drawing 1**. For the movable face parts F and G to work properly, the slots must be perfectly aligned, so use your drill press and its fence to align the bit and drill the holes. If you plan to secure the fence to your router table with threaded inserts, drill slot-end holes in the base (B), where

Mounting options for all

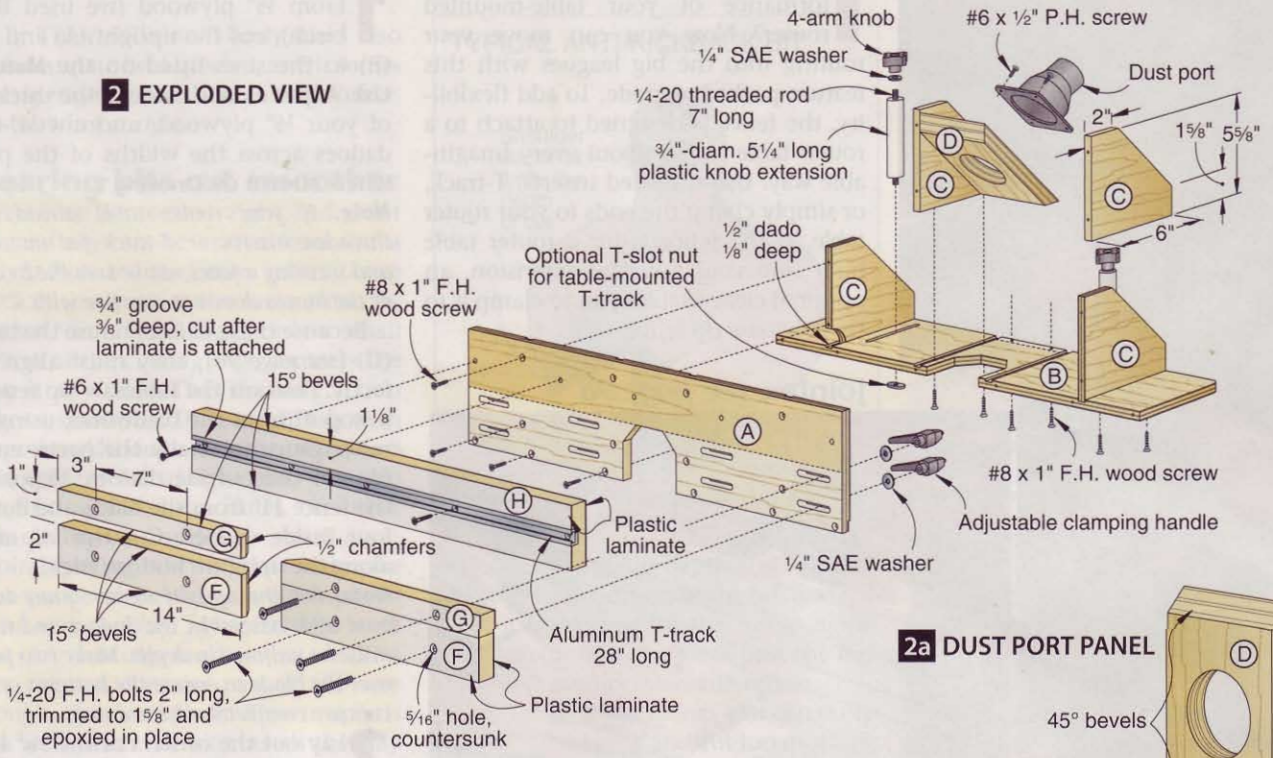
Fence-mounting options include threaded inserts, T-track, and clamps. For a saw-table-mounted router, clamp it to the rip fence.

1 FENCE BODY PARTS

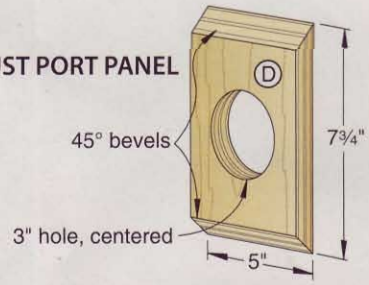


Note: *If your router table already has threaded inserts or T-track, space the slots or holes to match. See the instructions.

2 EXPLODED VIEW



2a DUST PORT PANEL



shown. To locate base slots for a router-table top that already has threaded inserts, measure the center-to-center distance and center this dimension on the base. Now form the slots [**Photo A**]. To machine perfect slots with a table-mounted router, see *page 78*.

If you plan to install T-track in your router-table top, drill only the slot-end holes closest to the front edge of the base (B). To locate base holes for a router-table top that already has T-track, measure the center-to-center distance and center this dimension on the base. If you plan to clamp the fence to your router table, no slots or holes are needed in the base.

SCROLLSAW THE FENCE BODY

With the slot-end holes drilled, draw tangent lines connecting each pair of holes, and scrollsaw or jigsaw the slots.

3 Lay out the bit clearance cutouts in the upright (A) and base (B), where shown on **Drawing 1**, and scrollsaw or jigsaw them to shape. Then sand ½"-radii on the rear corners of the base.

4 Using your drill press, drill countersunk holes in the upright (A) and base (B) centered on the dadoes and rabbet, as shown on **Drawing 1**. Finish-sand the parts. Then glue and clamp the upright and base together, keeping the ends flush. Using the holes in the upright as guides, drill pilot holes into the base, and drive the screws.

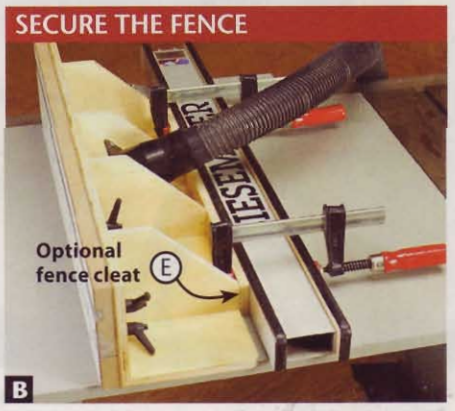
5 Cut the braces (C) to size, and then cut them to the shape shown [**Drawing 2**]. Finish-sand the braces. Now clamp them in the upright (A) and base (B) dadoes, making sure the braces fully seat in each part. Using the holes in the upright and base as guides, drill pilot holes into the base, and drive the screws.

Note: *For the upright to be square to the base, the front edge of each brace must be square to its bottom edge.*

6 Check the distance between the center braces (C), and cut the dust port panel (D) to size. Then cut 45° bevels on the ends, where shown on **Drawing 2a**. Center and draw a 3"-diameter circle on the panel with a compass, drill a blade start hole inside the circle, and saw out the hole. Finish-sand the panel. Now apply glue to the bevels and clamp the panel in place between the braces, with its top edge flush with the top edge of the upright (A).

7 If you will be clamping the fence to your tablesaw rip fence for use with an extension-table-mounted router [**Photo B**], measure the height of the rip fence, cut the optional fence cleat (E) to size, and finish-sand it. Clamp the cleat to the braces (C), where shown on **Drawing 3**. Drill countersunk holes through the cleat and into the braces, and drive the screws.

SECURE THE FENCE



For a tablesaw-extension mounted router, adding the optional cleat (E) allows you to clamp the fence to the tablesaw rip fence.

Make the segmented face

1 For the fence faces (F, G, H), cut two pieces of plastic laminate and a piece of ¾" medium-density fiberboard (MDF) to 7×29". (We used Formica brand laminate in no. 464 Graystone color.) Adhere the laminate to both sides of the MDF with contact adhesive. True one edge and one end of the laminated blank on your tablesaw. Then cut the lower face (F), center face (G), and upper face (H) to size. Using a 15°-bevel laminate trimming router bit, bevel the ends and edges of the parts.

2 Cut ½" chamfers on the inside ends of the lower face (F) and center face (G), where shown on **Drawing 2**. Then drill 5/16" holes in the parts. Countersink the holes so the head of a ¼" flathead bolt is slightly below the laminate surface.

Note: *The holes are oversize to allow room for epoxy when permanently mounting the bolts in the faces (F, G).*

3 Install a ¾" dado blade in your tablesaw and cut a ⅜"-deep groove for the aluminum T-track in the upper face (H). Fit the track in the groove, ends flush with the upper face ends. Using the predrilled holes in the track as guides, drill shank holes through the upper face.

Add finish and assemble

1 Cover the plastic laminate surfaces with masking tape. Then apply a clear finish to all the parts. (To adequately seal the MDF edges of the fence faces, we brushed on four coats of satin polyurethane, sanding with 220-grit sandpaper between coats. We finished the fence body with two coats of aerosol satin polyurethane, sanding between coats.) Remove the masking tape.

2 Cut 2"-long flathead bolts to 1⅝", as indicated on **Drawing 2**. To protect the plastic laminate from excess epoxy, cover the holes in the faces (F, G) with plastic packing tape. Cut around the countersinks with a utility knife. Epoxy the bolts in the holes {**Photo C**}. When the epoxy cures, remove the tape. Use a chisel to pare any excess epoxy that protrudes beyond the plastic laminate surface.

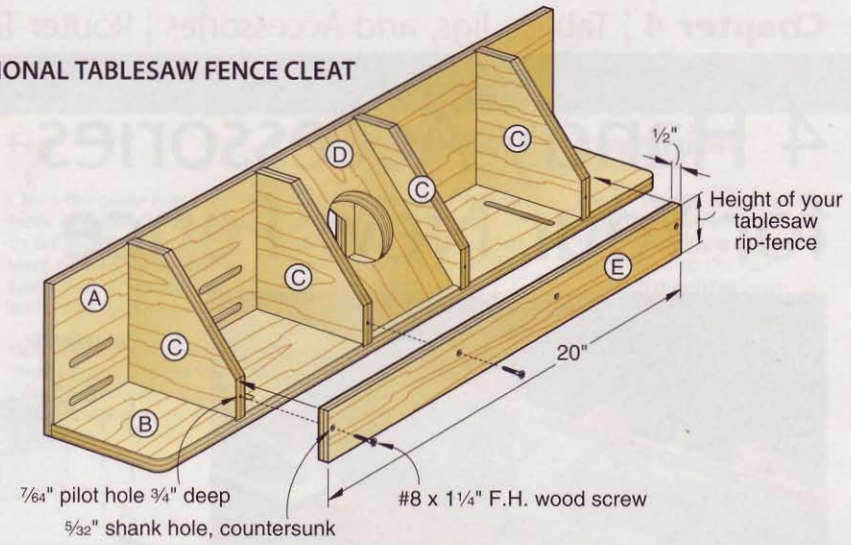
3 Clamp the fence body to a flat surface. Insert the lower face (F) and center face (G) bolts in the slots in the upright (A). Insert business or playing cards between them as spacers, [**Photo D**], and secure the faces with washers and adjustable clamping handles. (See lower right portion of **Drawing 2**). Now position the upper face (H) on the center face, and insert card spacers between them. Make sure the ends of the upper face and upright are flush, and clamp the face to the upright. Fasten the upper to the upright, {**Photo D**}.

4 Position the dust port over the hole in the dust port panel (D). Using the holes in the port as guides, drill pilot holes into the panel, and screw the dust port in place.

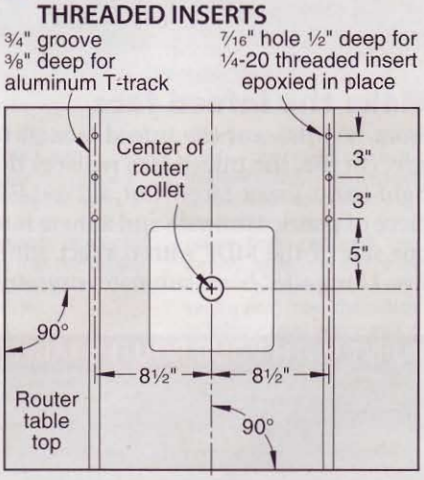
5 If needed, install T-track or ¼-20 threaded inserts in your router table top, where shown on **Drawing 4**.

6 To clamp the fence to a router table equipped with T-track or threaded inserts, first cut two pieces of ¼-20 threaded rod 7" long. For T-track, thread the rods into the raised-collar side of the T-slot nuts so 1/16" protrudes from the bottom of the nut. Slide the nuts into the tracks and drop the fence down over the rods. Slip the plastic knob extensions onto the rod and add washers and four-arm knobs. (See upper right portion of **Drawing 2**.) Tighten the knobs enough to secure the fence. Now fill the knob recesses with epoxy, fixing the threaded rods in place. For threaded inserts, thread the rods ⅜" into the inserts. As with the T-track, add the fence, knob extensions, washers, and knobs. Tighten the knobs and add epoxy.

3 OPTIONAL TABLESAW FENCE CLEAT

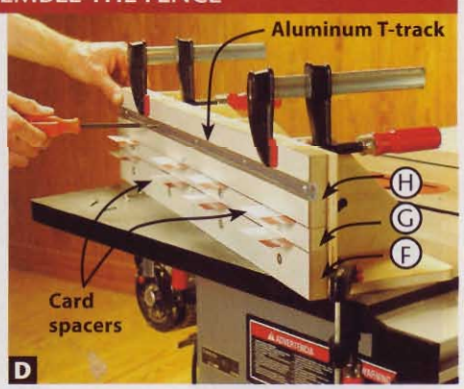


4 INSTALLING T-TRACK OR THREADED INSERTS



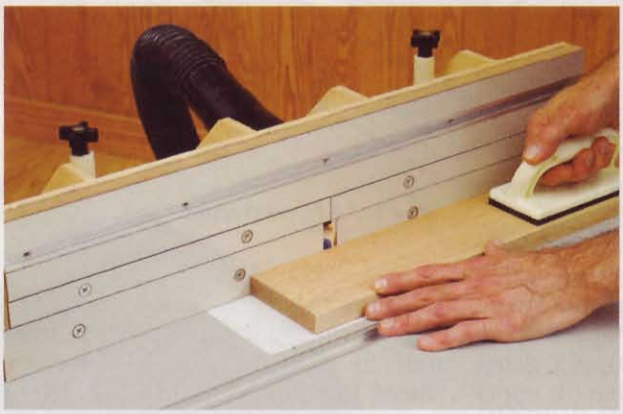
EPOXY BOLTS TO THE FACES AND ASSEMBLE THE FENCE

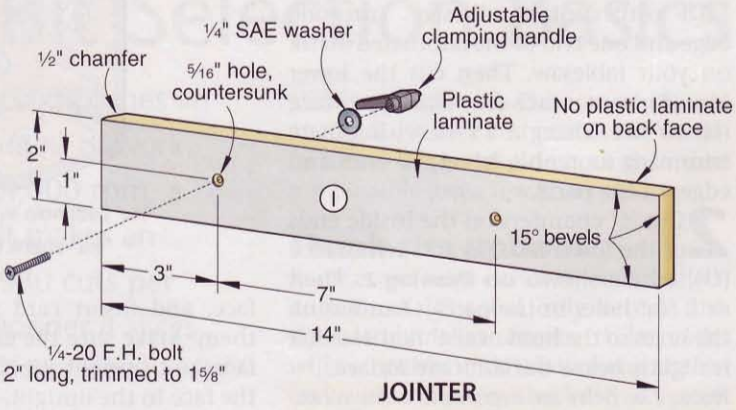
Apply epoxy to the bolt shanks, and insert them into the holes. Snug the bolts in place with washers and nuts, making sure they are perpendicular to the surface. When the epoxy cures, remove the nuts and washers.



With card spacers between the fence faces (F, G, H), install the T-track in the upper face (H). Using the holes in the track and face as guides, drill pilot holes into the upright (A), and drive the screws.

4 Handy Accessories for Your New Fence





1 Jointer insert helps you straighten edges

Make the infeed face

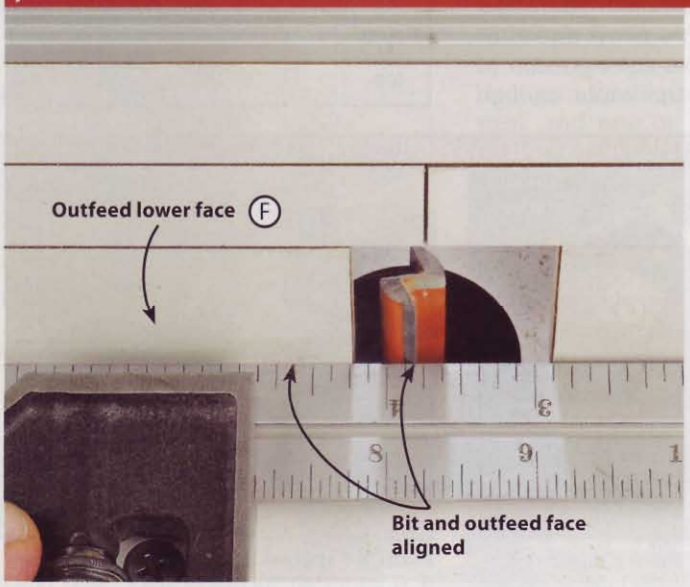
From ¾" MDF, cut the infeed face (I) to size. (In use, the infeed face replaces the right-hand lower face.) Cut a 2½×14½" piece of plastic laminate and adhere it to one side of the MDF with contact adhesive. Using a 15°-bevel laminate trimming bit, trim the excess laminate. Cut a ½" chamfer on one end of the infeed face, where shown on the drawing *above*.

As you did when making the lower faces, drill 5/16" countersunk holes in the infeed face. Mask the laminate and apply polyurethane. Trim two 2"-long flathead bolts to 1⅝" and epoxy them in place.

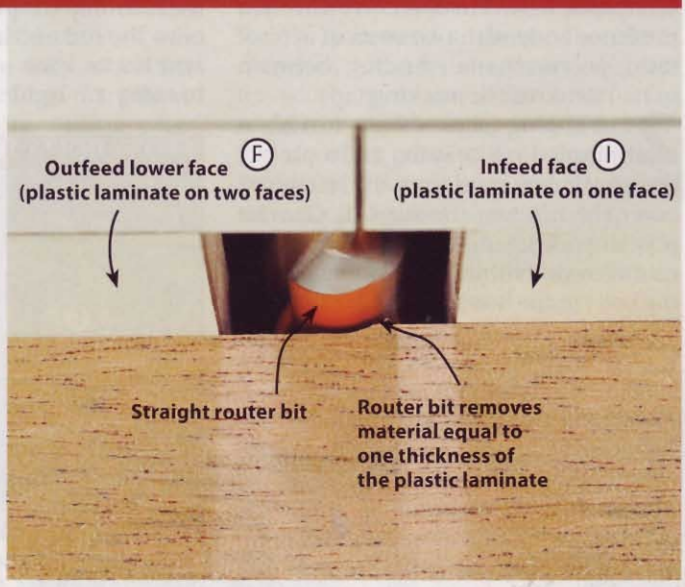
Jointing with your fence

To joint an edge on your router table, remove the right-hand lower fence face (F) and replace it with the infeed face (I). Then chuck a straight router bit in the router and align the left-hand lower fence face (F) with the bit, as shown *below left*. Now slide the infeed face (I) to within ⅛" of the bit and secure it with washers and adjustable clamping handles. Make test cuts and fine-tune the fence position by loosening one end and lightly tapping it forward or backward with a mallet to precisely align the bit with the outfeed face. Joint your stock, as shown *below*.

JOINT WITH YOUR ROUTER TABLE FENCE



Position the left-hand (outfeed) lower fence face (F) ⅛" from the cutting edge of the bit. Using a straightedge and moving the fence, align the fence face with the bit. Then clamp the fence in place.



Slide your stock along the infeed face and into the bit. Because the jointer has plastic laminate on only one side, the bit removes stock equal to the thickness of the laminate.

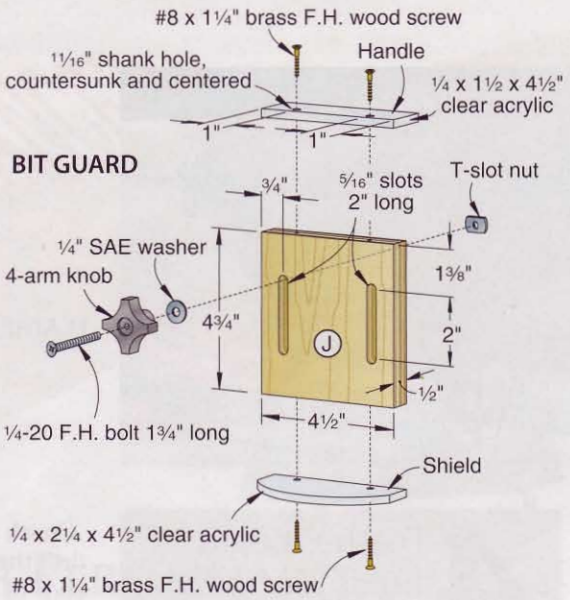
2 Adjustable bit guard protects fingers and deflects chips

Cut and assemble the parts

Cut the guard body (J) to size. As you did when slotting the fence upright (A), drill 5/16" holes, as shown at *right*. Then connect the holes with tangent lines and saw out the slots. Finish-sand the body and apply a clear finish.

From 1/4" clear acrylic cut a 1 1/2×4 1/2" piece for the handle, and a 2 1/2×4 1/2" for the shield. Make a pattern for the shield and adhere it to the shield blank with spray adhesive. Bandsaw and sand the curve. Drill countersunk holes in the handle and shield, where shown. (The holes are oversize to prevent cracking the acrylic.) Sand the edges of the handle and shield smooth.

Centering the handle on the body, and aligning the straight edge of the shield flush with the back face of the body, use the holes as guides and drill pilot holes. Remove the masking sheet from the acrylic, and screw the parts to the body.



Thread two 1 3/4"-long flathead bolts into two 4-arm knobs, leaving the bolt heads protruding 1/2" from the top of each knob. Then apply epoxy under the bolt heads and drive them in all the way. With the epoxy cured, slip washers on the bolts, insert them in the slots, and thread on T-slot nuts with the raised collars toward the knob.

Keeping your fingers safe

To use the bit guard, slide the T-slot nuts into the T-track, and center the shield over the bit. Grasp the guard by the 1/4" acrylic handle, adjust its height to clear the stock you will be routing, and tighten the knobs.

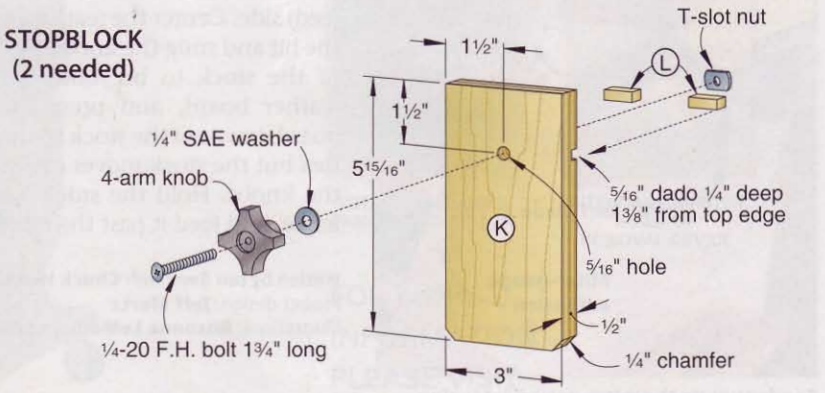
3 Locking stopblocks enable precise stopped cuts

Make the bodies and cleats

Cut two stop bodies (K) to size. Then cut a 5/16" dado 1/4" deep in the back of each one, where shown on the drawing. Drill a 5/16" hole centered in the dadoes and on the width of the bodies. Now cut 1/4" sawdust-relief chamfers on the bottom corners. Finish-sand the bodies.

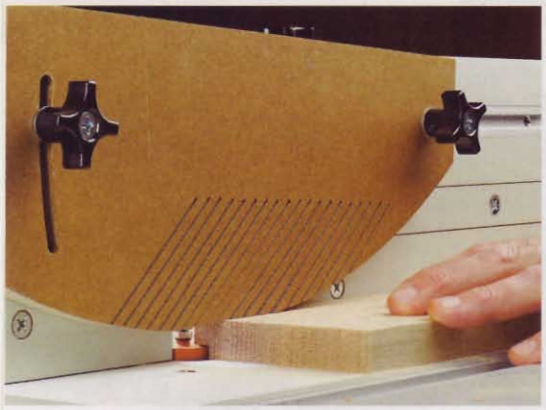
Resaw and plane a 5/16×1/2×10" blank for the cleats (L), checking its fit in the stop body dadoes. Cut the cleats to length, and glue and clamp them in the dadoes with the ends flush with the edges of the stop body. Apply a clear finish.

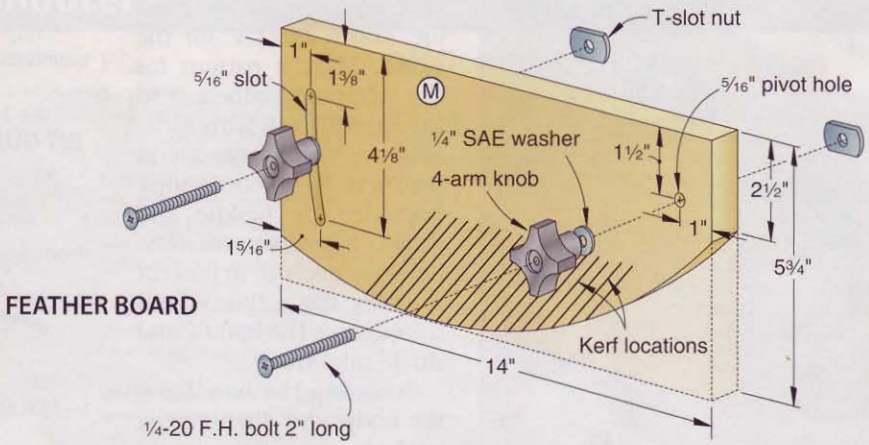
Epoxy 1 1/4" flathead bolts into two 4-arm knobs. Install a knob and washer in each of the stopblocks and secure them with T-slot nuts.



Making stopped cuts

To use the stopblocks, slide the cleats (L) and T-slot nuts into the T-track. Using a ruler, position the stopblocks the required distance from the bit, and tighten the knobs. For a good example of these stopblocks in action, see the article on *page 78*.

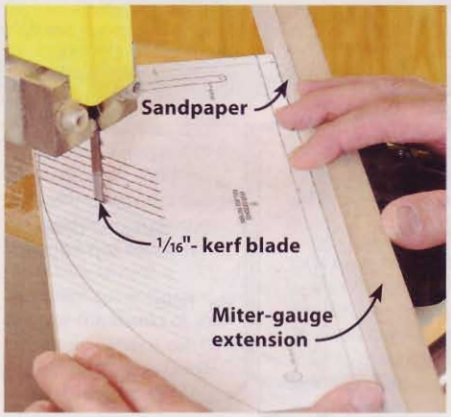




4 Feather board holds pieces for consistent cuts

Machine the MDF blank

Cut a piece of ¾" medium-density fiberboard to the size listed. Then mark the centerlines of the three holes and draw a curve for the bottom similar to the one shown at *top right*. Install a blade in your bandsaw that cuts a 1/16" kerf. (We used a ½" resawing blade.) Cut the feathers, as shown *below*.



Sandpaper on the miter gauge extension prevents slipping. Adjust the miter gauge to 45°, and saw evenly spaced feathers.

Chuck a 5/16" bit in your drill press and drill the pivot hole and the holes at the ends of the curved slot. Then scrollsaw the slot and bandsaw the curved edge of the feather board. Apply a clear finish.

Epoxy 2" flathead bolts into two 4-arm knobs, as directed in the instructions for the bit guard on *page 99*. Install the knobs and add T-slot nuts, where shown *above*.

Applying the pressure

Mount the feather board on the fence by sliding the T-slot nuts into the T-track, positioning the pivot hole on the right-hand (infeed) side of the bit and the curved slot on the left-hand (outfeed) side. Center the feather board over the bit and snug the knobs. Slide a piece of the stock to be routed under the feather board, and press the feather board down on the stock so the feathers flex but the stock moves easily. Tighten the knobs. Hold the stock against the fence, and feed it past the bit.

Written by **Jan Svec** with **Chuck Hedlund**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine; Lorna Johnson**

Materials List

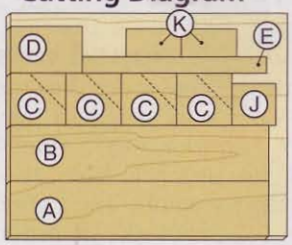
Fence		FINISHED SIZE T	W	L	Matl.	Qty.
A	upright	½"	6"	28"	BP	1
B	base	½"	6"	28"	BP	1
C	braces	½"	5⅝"	6"	BP	4
D	dust port panel	½"	5"	7¾"	BP	1
E	optional fence cleat	½"	†	20"	BP	1
F*	lower faces	¾"	2"	14"	MDF	2
G*	center faces	¾"	1"	14"	MDF	2
H*	upper face	¾"	3"	28"	MDF	1
Jointer						
I	infeed face	¾"	2"	14"	MDF	1
Bit guard						
J	guard body	½"	4½"	4¾"	BP	1
Stopblocks						
K	stop bodies	½"	3"	5 15/16"	BP	2
L*	cleats	5/16"	½"	¾"	M	4
Feather board						
M	feather board	¾"	5¾"	14"	MDF	1

†Height of your tablesaw rip fence. See the instructions.

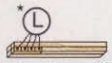
*Parts initially cut oversize. See the instructions.

Materials key: BP–Baltic birch plywood, MDF–medium-density fiberboard, M–maple.
Supplies: Contact cement, epoxy, spray adhesive.
Blade and bit: Stack dado set, 15° bevel laminate-trimming router bit.

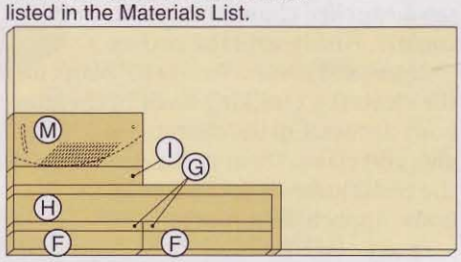
Cutting Diagram



½ x 24 x 30" Baltic birch plywood



¾ x ¾ x 10" Maple
*Plane or resaw to the thickness listed in the Materials List.



¾ x 24 x 48" Medium-density fiberboard

Sources

Hardware kit: 24x30" plastic laminate, ¼" clear acrylic, ¼-20 four-arm knobs (8), ¼" SAE flat washers (16), ¼-20 flathead bolts 2" long (12), ¼-20 flathead bolts 1¾" long (4), T-slot nuts (8), #6x½" panhead screws (4), #6x1" flathead wood screws (5), #8x1" flathead wood screws (26), #8x1¼" brass flathead wood screws (4), ¾" T-track 28" long (1), ¾"-diameter 5¼"-long plastic knob extensions (2), ¼-20 threaded rod 7" long (2), dust port (1). Kit no. RFT, $124.95 ppd. Schlabaugh and Sons, 720 14th St., Kalona, IA 52247. Call 800-346-9663 or go to schsons.com.

Wood kit. All the ½" Baltic birch plywood, ¾" medium-density fiberboard, and maple needed to build the router table fence and accessories. Kit no. LP-11 $19.95 ppd. Schlabaugh and Sons, see *above*.

At-the-Ready Router Rest

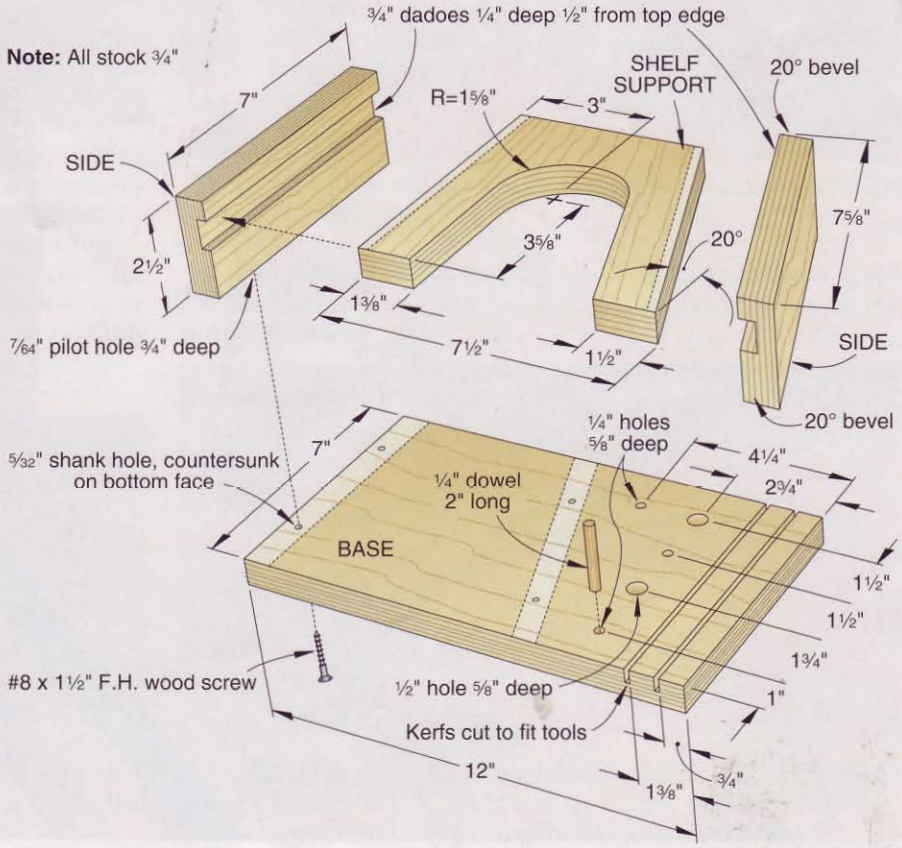
This simple support offers you convenience and time savings.

Wasting valuable time waiting for your router bit to stop spinning before you set the router down? Would you like your router wrenches and bits near the project you're working on for a speedy change? Solve both concerns with this handy plywood router caddy. Place your powered-down router into the U-shaped opening in the shelf support to shelter the still-turning bit safely away from both your worktop and your hands.

To build this simple project, cut the pieces to the sizes noted on the drawing. Then, cut or rout a ¾" dado ¼" deep in the side pieces where shown. Drill the router-bit shank holes, and cut the kerfs in the base to customize it to organize your bits and wrenches. Drill countersunk mounting holes, and assemble the pieces. A 2"-long section of dowel in the base works nicely to hold an extra collet. Add a clear finish, if desired.

Project design: **Chuck Hedlund**
Illustration: **Roxanne LeMoine**

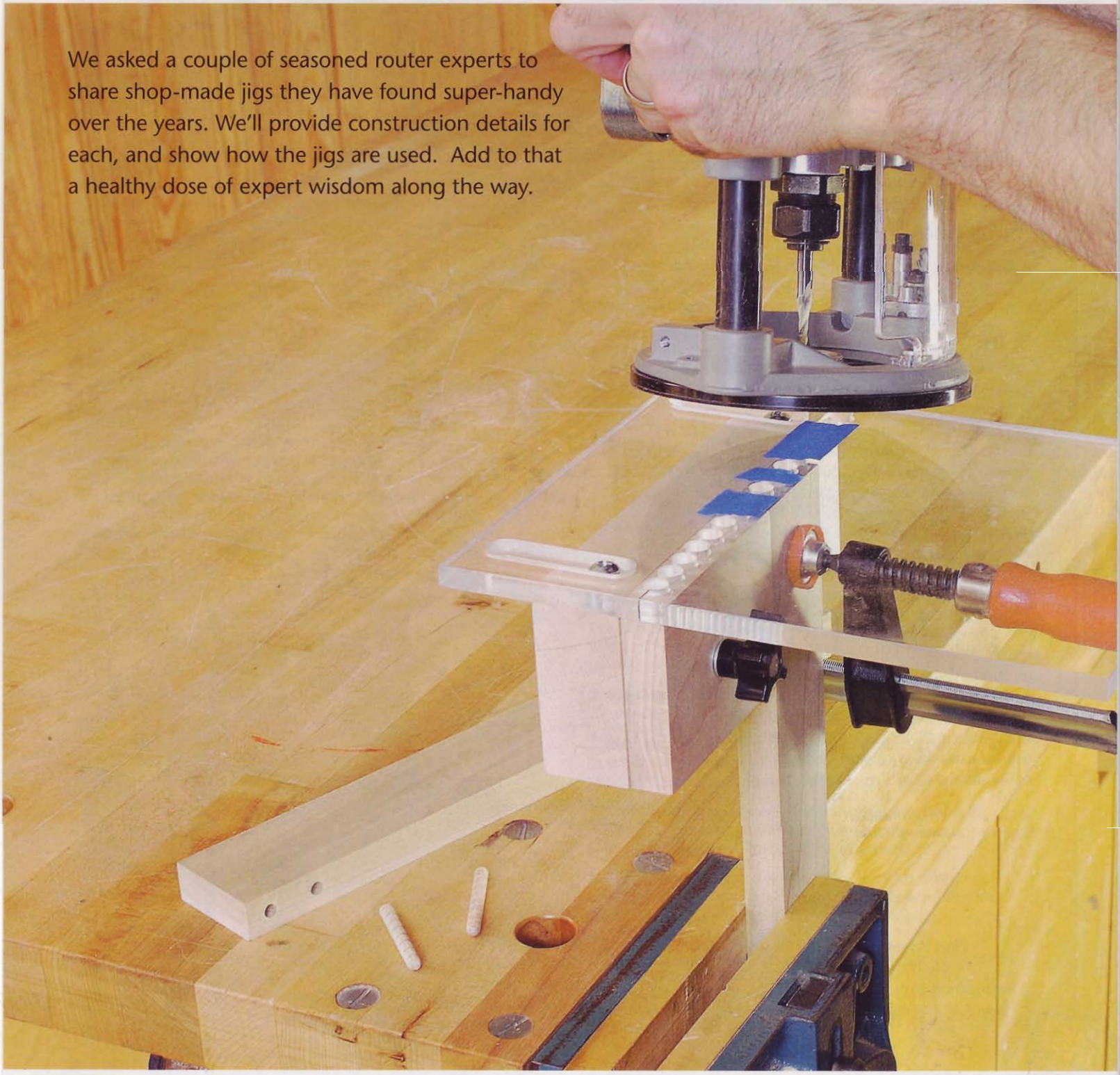
EXPLODED VIEW



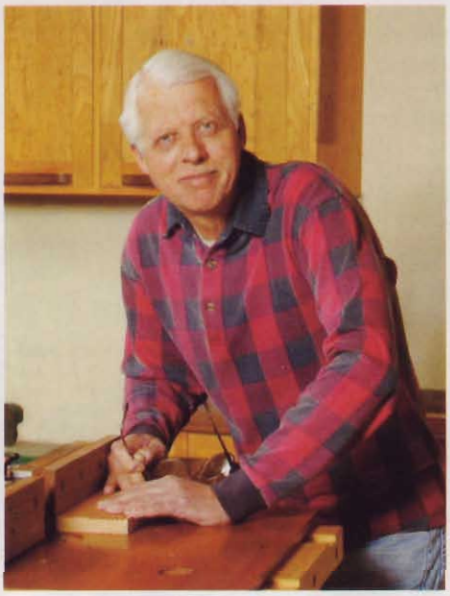
Find dozens of FREE simple project plans at woodmagazine.com/freeplans

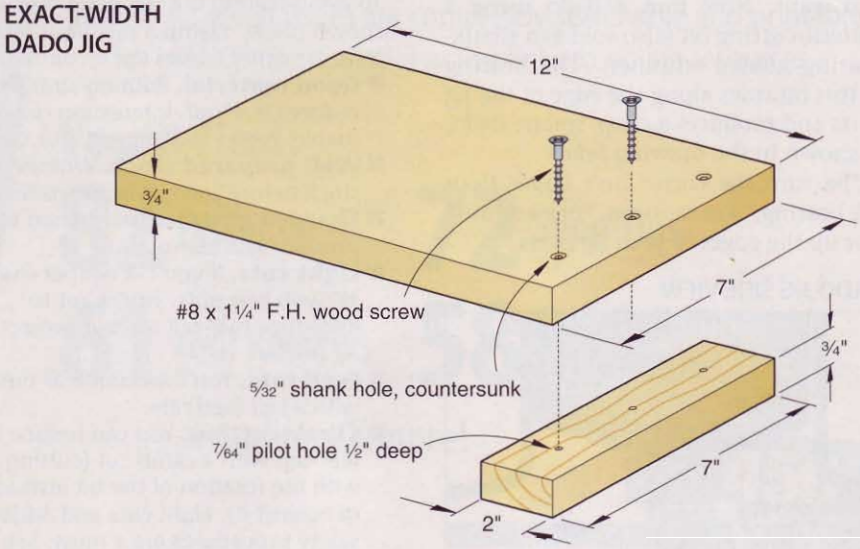
Must-Have Jigs From 2 Router Experts

We asked a couple of seasoned router experts to share shop-made jigs they have found super-handy over the years. We'll provide construction details for each, and show how the jigs are used. Add to that a healthy dose of expert wisdom along the way.



Pat Warner's Two-Part Dado Jig





In addition to writing four router books, Pat Warner has designed specialty router bits and developed a collection of inexpensive, disposable, single-flute mortising bits.

Why you need this jig

"Accuracy in routing requires attention to detail—and not much sophistication," Pat notes. This Californian's simple jig helps match dado width to shelf thickness. Using Pat's jig, we set up a dado cut in less time than it takes to equip a tablesaw with a dado set.

How to build Pat's jig

You'll need to assemble two of the jigs, shown *above*. (We cut two pairs of jigs, one from ¾"-thick plywood and another using medium-density fiberboard (MDF). If you plan to make dadoes 10" or longer, build additional pairs with the top pieces at least 12" long or more.

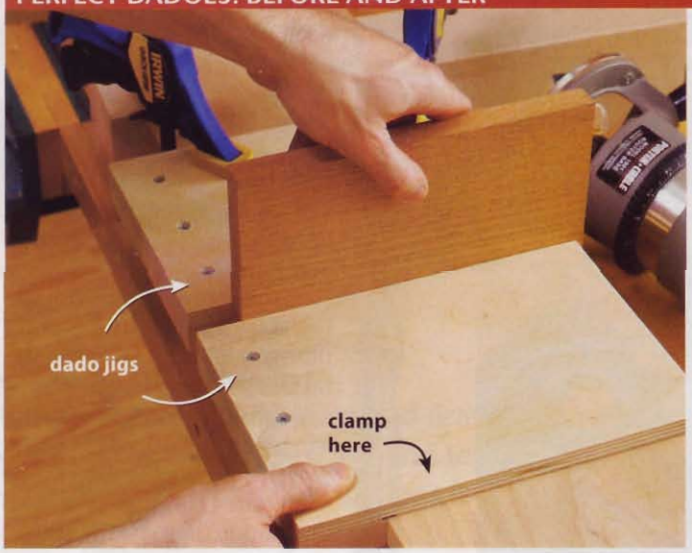
Put the two-part jig to use

Before you begin cutting dadoes, you'll need a sample of the stock that the dado will ultimately hold in your project. Here's one key to a snug dado: Go through each sanding step you plan to follow until your sample piece reaches its finished thickness.

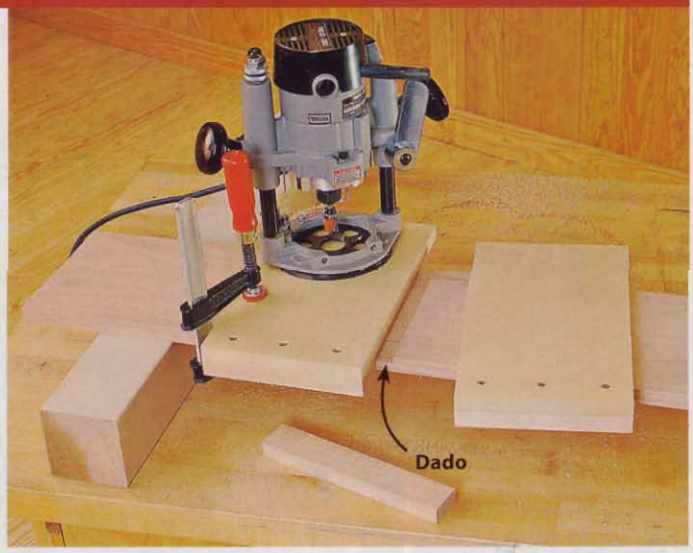
For this example, we're cutting a dado in the side of a cabinet for a shelf. Position the two-part jig where you plan to cut the dado; then snug the sanded shelf scrap between the parts, as shown in the photo *below left*. Next, clamp both parts firmly in place at the edges away from the gap to keep the clamps from interfering with the router.

After removing the sample (save this piece for future reference), set your

PERFECT DADOES: BEFORE AND AFTER



After locating the dado position, place a piece of finish-sanded scrap between the jig's two sliding parts. Then clamp the parts to the workpiece.

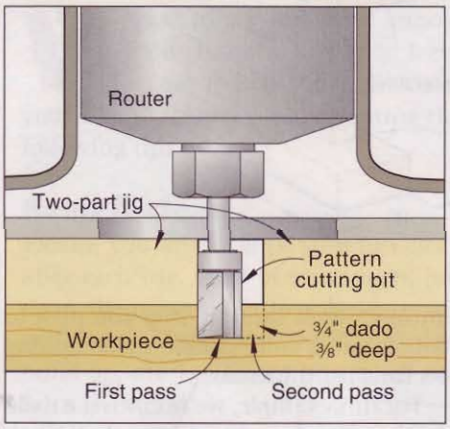


If the dado is too snug (sometimes caused by a pattern-cutting bit that's smaller than the bearing), shim out the shelf scrap with a sheet or two of paper, adjust the jig parts, and rout again.

router cutting depth equal to the thickness of the jig parts plus the depth of cut you want. Now rout a dado using a pattern-cutting bit (also sold as a shank-bearing guided trimmer). The bearing of this bit rides along the edge of the jig parts and produces a crisp, square dado, as shown in the drawing *below*.

"Be sure the cutter isn't larger than the bearing," Pat cautions, "or else you'll tear up the edges of your jig parts."

DADO JIG SIDE VIEW

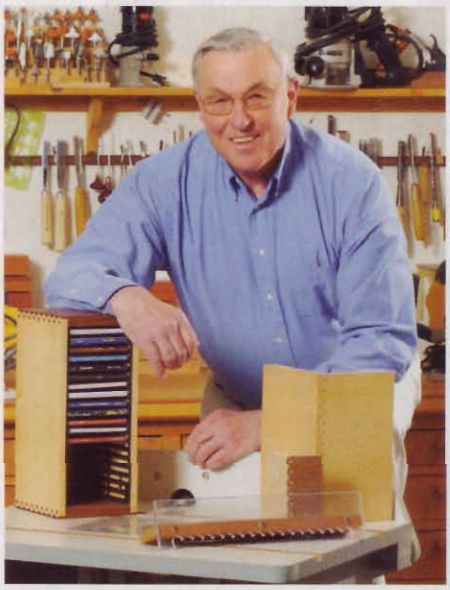


Keys to avoiding tear-out

To avoid tearing out the edge of your workpiece as you finish your cut, as shown *below*, clamp a sacrificial piece of scrapwood to the edge of your work. Here are other tactics Pat recommends to reduce tear-out:

- **Good material.** Routing straight-grained, properly seasoned hardwood reduces tear-out. Interesting grain patterns, including bird's-eye and quilted maple, have visual appeal, but create more routing challenges.
- **Well-prepared stock.** Wherever possible, eliminate cups and bows in your stock before you get to the routing steps.
- **Sharpen cutters.** Well-honed bits produce less tear-out.
- **Light cuts.** If you cut deeper than ⅜" with one pass, you're apt to introduce tear-out to your project. ⅛" is ideal.
- **Feed rate.** You'll worsen tear-out with a fast feed rate.
- **Climb-cutting.** You can reduce tear-out with a climb cut (cutting with the rotation of the bit instead of against it). Light cuts and added safety procedures are a must. See the instructions on *page 76*.
- **Cut end grain first.** Because end grain is more apt to tear out, rout it first. Then rout edge grain and clean up any tear-out.

Patrick Spielman's Multi-Hole Doweling Jig



Patrick Spielman of Fish Creek, Wisconsin, authored more than 75 woodworking books. His original *Router Handbook* sold more than a million copies. Before Patrick passed away in 2004, he shared with us his multi-hole doweling jig.

Why you need this jig

In addition to positioning dowels for most doweling joints (we found the jig especially useful for face-frame joinery), this is a great jig for aligning shelf-support pins.

Dowels provide extra mechanical strength when joining end to edge grain, but they're quicker to make than hand-cut dovetails.

The dowel joint is pretty much foolproof, and with this jig, you can take the joint further and have the dowels come through the other side.

Two-piece guide bushings easily attach to your router base.

The 2" counterbored slots in the ⅜"-thick plastic jig make Patrick's jig versatile. The adjustable, removable stop will help you precisely position face stock.

How to build Patrick's jig

Follow the drawing, *opposite top*, to build the jig. Lay out and drill the ⅝" holes as accurately as possible in the plastic. (We used a drill press for this step.)

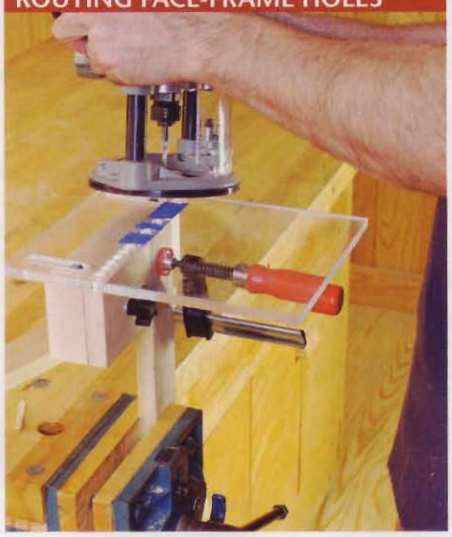
Put the jig to use

With a guide bushing in your router, dowel holes always line up regardless of how accurately you spaced the ⅝" holes for your jig. For this type of plunge routing, use upcut spiral bits (shown at *left*).

To position the jig and router to make identically spaced dowel holes in the face frame stiles and rails, see the two illustrations *opposite*.

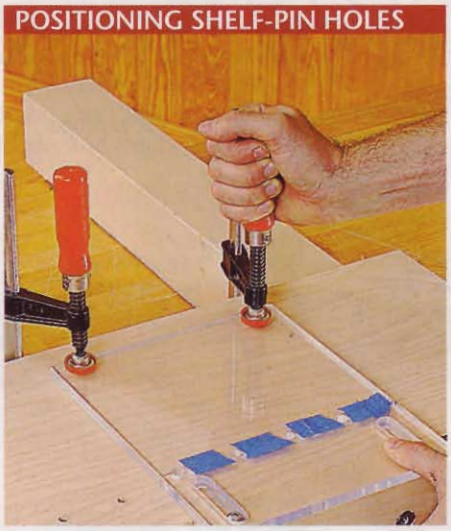
Upcut spiral router bit

ROUTING FACE-FRAME HOLES



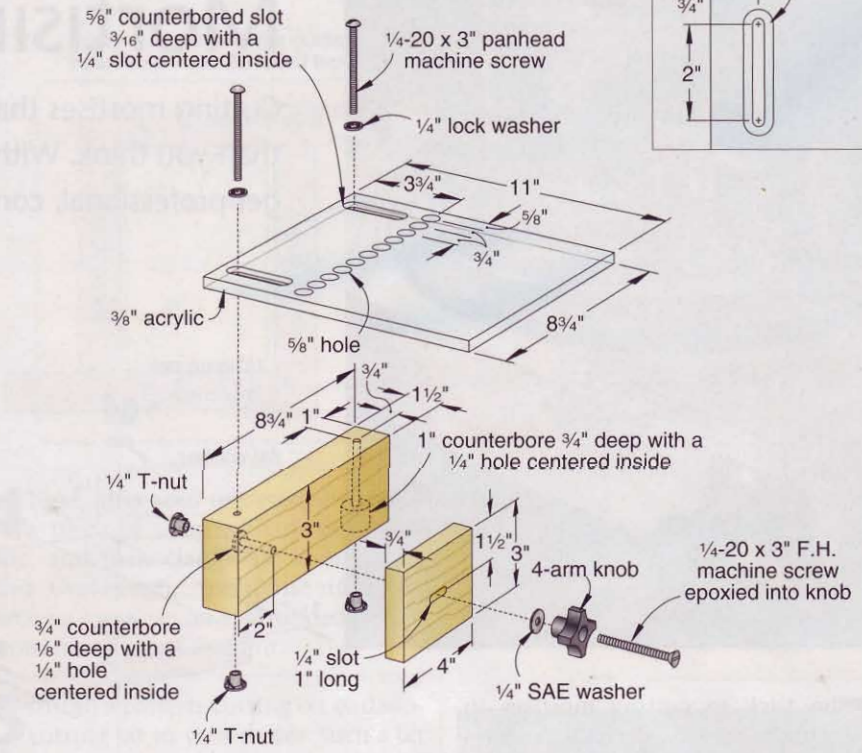
Patrick Spielman's doweling jig makes quick work of doweling tasks, including the face frame joinery (end to edge grain) *above*. The 5/8" guide-bushing hole is compatible with 1/4", 5/16", or 3/8" dowel pins. The positioning block ensures quick, accurate alignment of the stock. Illustrations, *below right*, show routing dowel-pin holes in the rail and stile.

POSITIONING SHELF-PIN HOLES

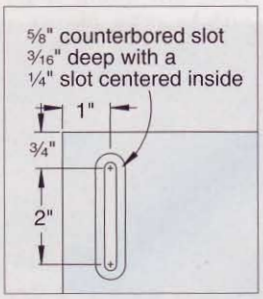


Originally designed for doweling, this jig also helps you make evenly spaced holes for shelf pins. To avoid goofs, tape over holes you won't use. (Spacing of 1 1/4–2" between holes works well in most applications.)

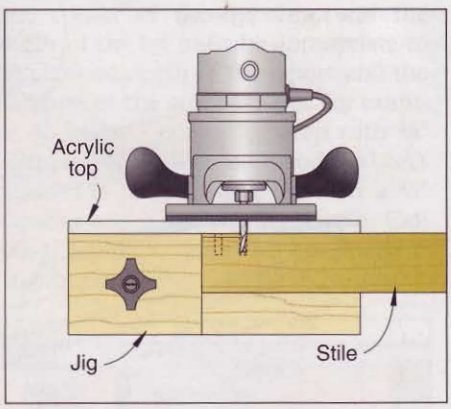
DOWELING JIG



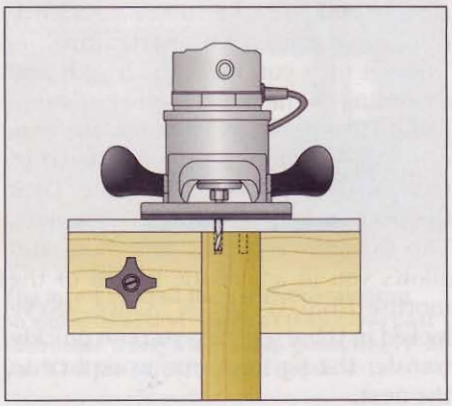
SLOT DETAIL



CUTTING HOLES ON STILE EDGES



CUTTING HOLES ON RAIL ENDS

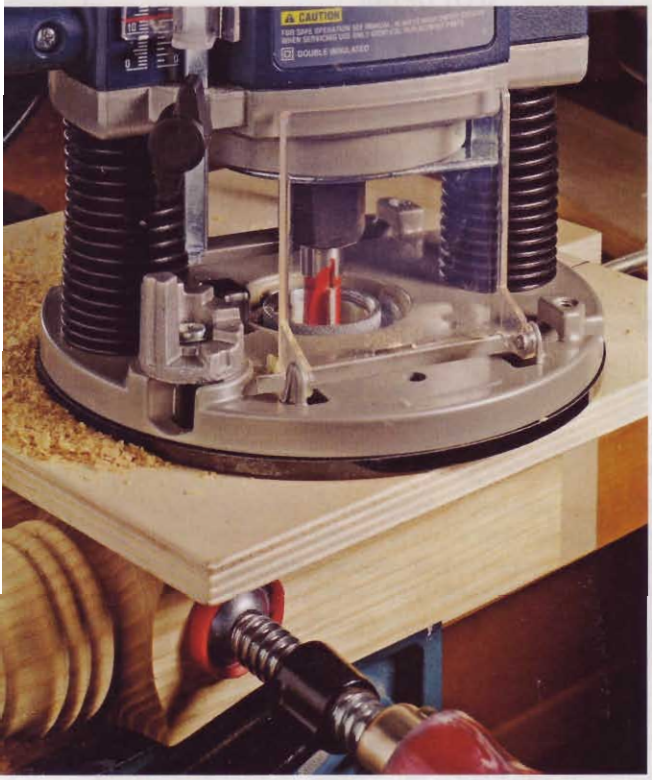


Pick the best plastic for jigs

Drawing on more than 35 years experience working with routers, Patrick designed several jigs incorporating plastic parts. We built Patrick's jig from 3/8" polycarbonate because it's commonly available at hardware stores and home centers. However, he used 1/2" polycarbonate, a thickness that's tougher to find.

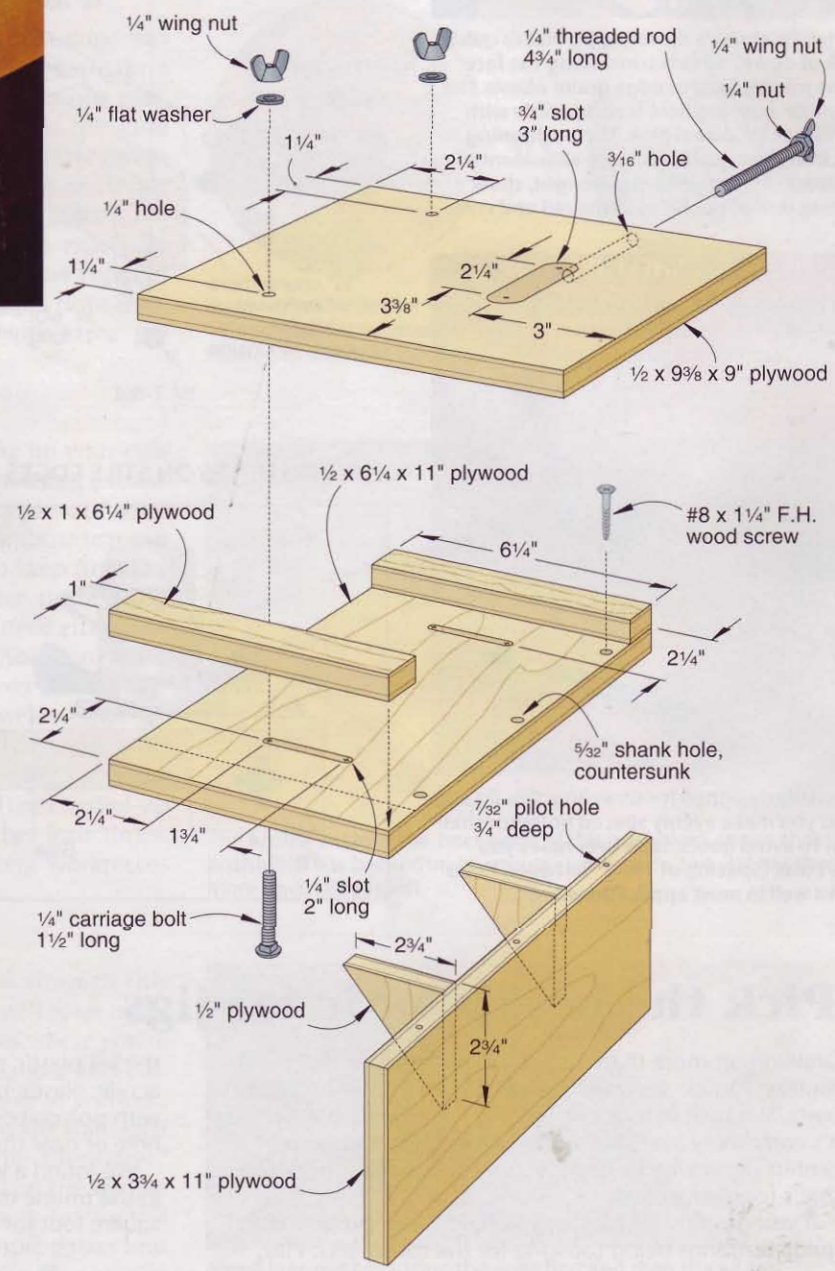
If you can find 1/2" plastic, you have fewer problems with guide bushings being too long for the router bits. Plus, thicker plastic makes it easier to rout adjustable slots. Avoid acrylic plastic because it's brittle. You'll have fewer problems with polycarbonate plastic cracking or breaking around a hole or near the edge.

We found a local polycarbonate supplier under "plastics" in the phone directory. The local price was about $2.90 per square foot for 3/8"-thick polycarbonate cut to order.



Mortising Jig

Cutting mortises that match perfectly is easier than you think. With this adjustable jig, you can get professional, consistent results every time.



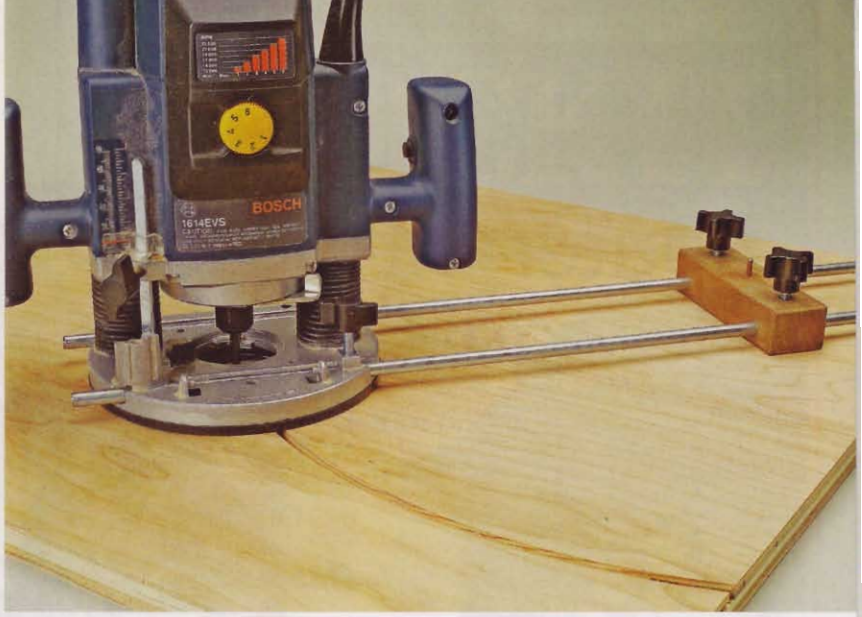
The trick to cutting mortises in table legs is to precisely position the mortise on each leg and to make each mortise exactly the same length. Build the mortising jig as shown at *right*, and you'll be able to cut identical ½"-wide mortises time after time.

To set up a cut, mark the length and centerline of the mortise on your workpiece. Clamp the workpiece to the base of the jig so the mortise is centered in the slot on the sliding top plate. Lock the plate into place with the wing nuts. The threaded rod acts as a stop, and allows you to adjust the length of the mortise from ½" to 2¼". Once you've locked in these settings, you can quickly transfer the jig from one workpiece to the next.

Now, fit your router with a ¾" guide bushing and a ½" straight or spiral-flute bit. (For the cleanest cuts, use an up-cut spiral for solid wood; a down-cut spiral with plywood and veneers.) Insert the guide bushing at one end of the jig slot, turn on the power, plunge, lock, and guide the router to the other end. Deep mortises will require two or more passes—no sweat, thanks to your plunge router turret stops. Just take time between passes to clear chips from the previous pass.

2 Ways to Cut Circles

Use the jig to make compact discs. Use the trammel to cut large circles and arcs.



Here are two ways to help your plunge router get around. With the disc-routing jig, shown *below right*, you can combine different bits and bushings to cut any diameter disc from 2⅛ to 6" in ⅛" increments.

Make the template as shown, using a fly-cutter in your drill press. Because the size of the template holes must be exact, test each cut in scrap first. To avoid chip-out in the finished cuts, cut the holes to about half of their depth, then flip over the template, place the center bit in its hole, and complete the cut.

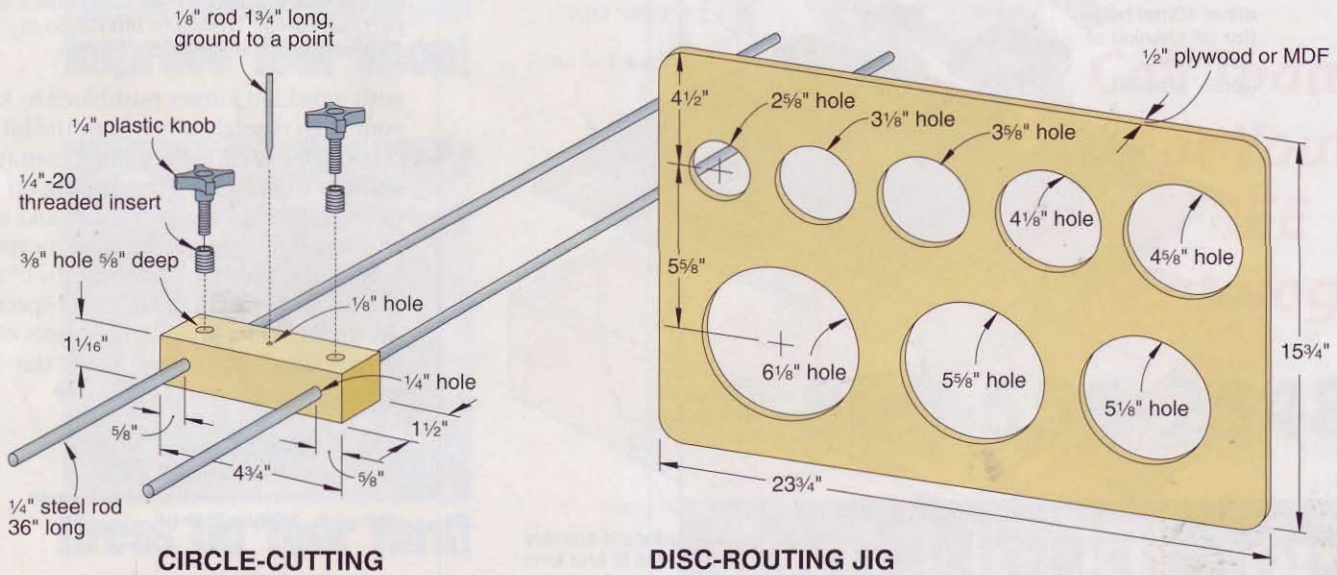
For routing larger circles and arcs, build and outfit your router with the circle-cutting trammel, shown *below left*. This jig cuts circles up to about 72" in diameter. Its two steel rods slide into the router's subbase, as shown *above*.

Set the radius of your arc or circle by measuring from the cutting edge of the bit to the center pin on the jig, and lock in the radius using the threaded knobs. Insert the pin into a predrilled hole at the center of the workpiece, and use the trammel like a giant compass. With thicker or harder stock, you may need to make progressively deeper cuts.

Leery about drilling a center hole that might mar the finished side of your project? Drill and cut from the back or underside of the workpiece.

Bushing and Bit Combinations

FOR THE 2⅝" HOLE			FOR THE 4⅝" HOLE		
Hole	Bushing	Bit	Hole	Bushing	Bit
2⅛"	¾"	¼"	4⅛"	¾"	¼"
2¼"	⅝"	¼"	4¼"	⅝"	¼"
2⅜"	⅝"	⅜"	4⅜"	⅝"	⅜"
2½"	⅝"	½"	4½"	⅝"	½"
FOR THE 3⅛" HOLE			**FOR THE 5⅛" HOLE**		
Hole	Bushing	Bit	Hole	Bushing	Bit
2⅝"	¾"	¼"	4⅝"	¾"	¼"
2¾"	⅝"	¼"	4¾"	⅝"	¼"
2⅞"	⅝"	⅜"	4⅞"	⅝"	⅜"
3"	⅝"	½"	5"	⅝"	½"
FOR THE 3⅝" HOLE			**FOR THE 5⅝" HOLE**		
Hole	Bushing	Bit	Hole	Bushing	Bit
3⅛"	¾"	¼"	5⅛"	¾"	¼"
3¼"	⅝"	¼"	5¼"	⅝"	¼"
3⅜"	⅝"	⅜"	5⅜"	⅝"	⅜"
3½"	⅝"	½"	5½"	⅝"	½"
FOR THE 4⅛" HOLE			**FOR THE 6⅛" HOLE**		
Hole	Bushing	Bit	Hole	Bushing	Bit
3⅝"	¾"	¼"	5⅝"	¾"	¼"
3¾"	⅝"	¼"	5¾"	⅝"	¼"
3⅞"	⅝"	⅜"	5⅞"	⅝"	⅜"
4"	⅝"	½"	6"	⅝"	½"



CIRCLE-CUTTING TRAMMEL

DISC-ROUTING JIG

Router-Bit Storage

Organizing and storing router bits and accessories is as easy as 1-2-3.

Most router-bit storage systems force you to guess how many bits you'll add to your arsenal in the coming years. Dave Campbell, *WOOD®* magazine's Deputy Editor, neatly sidestepped that dilemma by designing this modular storage system that fits in any drawer and grows to meet your expanding bit collection. A 1-2-3 progression of block sizes maximizes the number of possible arrangements. Dave set aside one large square, and drilled it to hold rotary-tool bits.

To build your modular storage, rip ¾" MDF (medium-density fiberboard) into 1¼"-, 2½"-, and 3¾"-wide strips, then crosscut them into squares. Drill centered, slightly oversized holes for easy bit removal; 17/64" and 13mm holes for ¼"- and ½"-shank router bits; and 7/64" and 9/64" holes for 3/32"- and ⅛"-shank high-speed rotary tool bits.

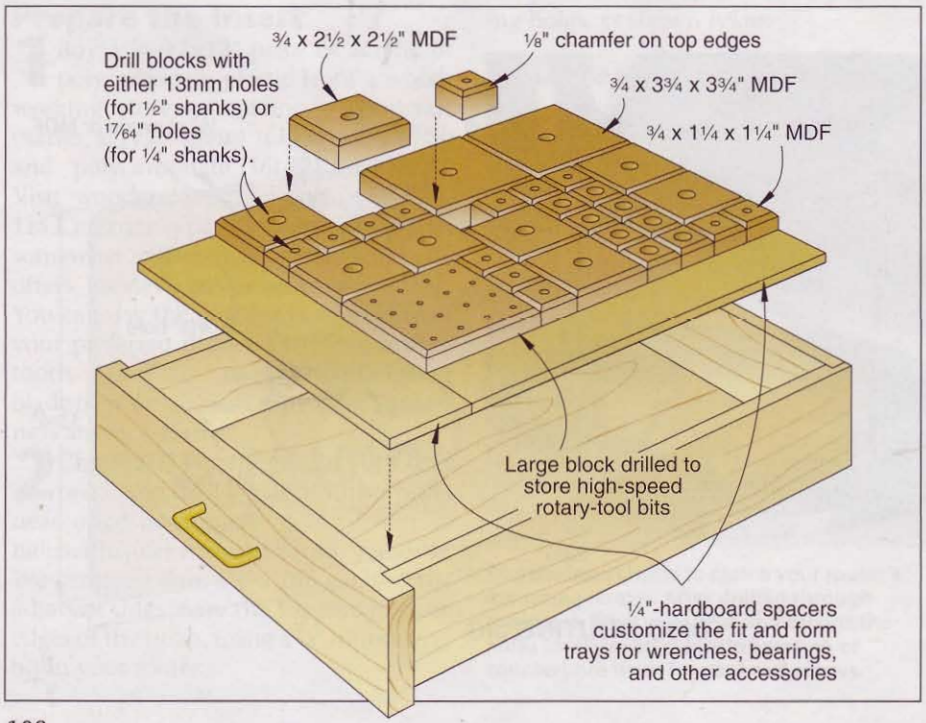
Note: *Finding a 33/64" bit to drill oversized holes for the ½" shanks is unlikely. Commonly used to install metric hardware, a 13mm bit is a widely-available substitute.*

Slightly countersink the hole edges. Chamfer the block top edges on your table-mounted router. Hold the parts with a padded jointer pushblock to keep your fingers safely away from the bit.

Pour Danish oil into a small container and dip the blocks. After wiping off the excess oil with a rag, dry the blocks on a window screen propped on sawhorses.

With the finish dry, arrange the blocks in your drawer. Fill in the extra space in the drawer with snug-fitting pieces of ¼" hardboard. You can use these tray-like spaces for storing accessories.

To add versatility to this system, simply bore holes into the module(s) of your choice and glue in craft magnets. They hold small steel parts just great. Thanks to Jeff Hilton of Mission Viejo, California, for this tip.



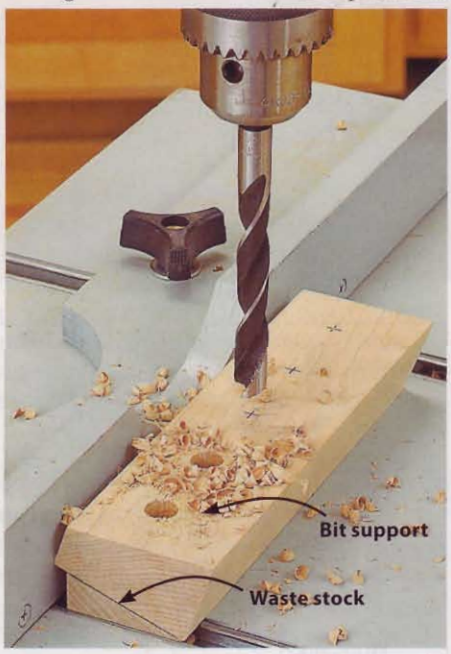
Written by **Robert J. Settich**
Project Design: **Dave Campbell**
Illustration: **Roxanne LeMoine**; **Lorna Johnson**
Photographs: **Douglas E. Smith**

Router-Bit Holder and Profile Display

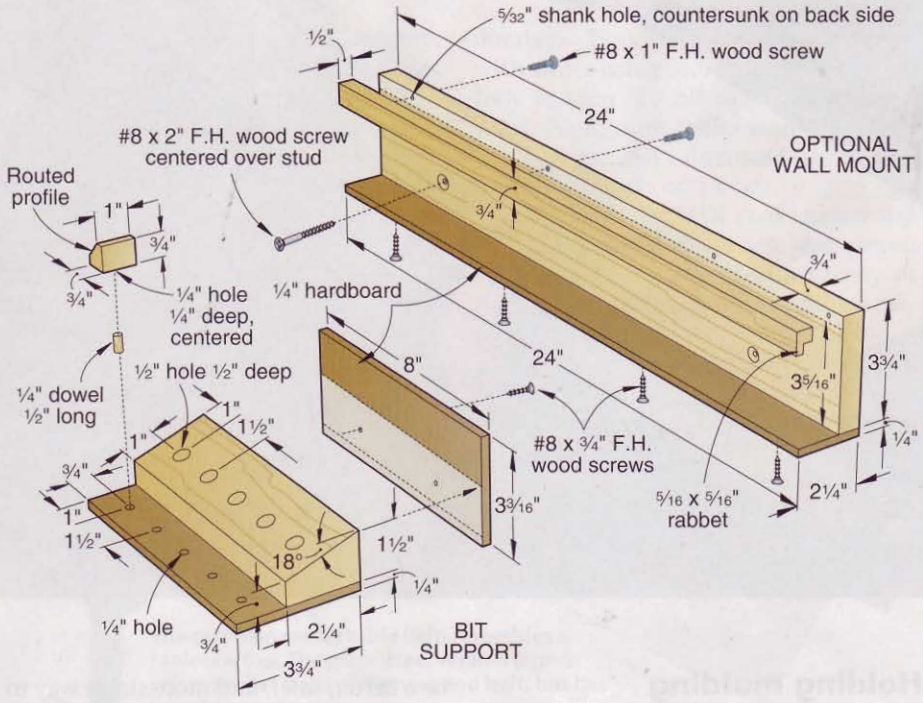
The best edge treatment is but a glance away.

See instantly what profile each of your router bits creates by building this handy bit display with matching profiles. You can set the bit support on your workbench or build the optional wall mount and secure it to a vertical surface. The bit support shown at *right* measures 8" long, but can be lengthened to hold more bits and profiles. Add 1½" for each additional bit you wish to display. For large-diameter bits, such as a panel raiser, you'll need to lengthen it even more. For smaller-diameter bits, an extra inch per bit should suffice. We built our wall mount extra long for adding more bit supports in the future.

To form the angled bit support, start with a piece of 1½×2¼×8" stock. Using a pushstick for safety, bevel-rip it at 18°, and use cloth-backed, double-faced tape to stick the two pieces together in the configuration shown in the photo at *left*. Then drill ½" holes ½" deep into the support, and separate the support from the scrap.



Stick the waste stock to the bit support, and drill the ½" holes.



To create a profile for each bit you'll house in the bit support, cut blanks 8" long, and drill a ¼" hole centered side to side and ½" from one end. Now, rout each 8"-long blank with a different bit. Crosscut a 1"-long section from each blank, and glue in a piece of ¼" dowel ½" long in the previously drilled hole. The profiles can be removed from the base so you can hold them up to an edge needing routing. It also gives you the flexibility to replace bits and move them as future needs dictate.

Project design: Kevin Boyle

Shop-Tip Roundup

Working smarter with your router is partly a matter of devising clever shortcuts and eliminating annoying little bugaboos. Here's a wide-ranging collection of tips from other woodworkers intent on honing their routing skills.

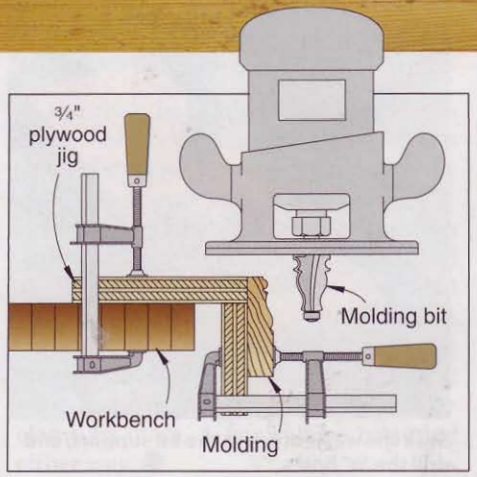
Holding molding

A long time ago, I bought a 2¼" molding bit for my router, but I never had much luck using it on my router table. The bit made irregular cuts in the wood and I just didn't feel safe using it.

Several months ago I decided to build a playhouse. All the doors and windows needed to be trimmed out, and since I didn't want to spend a lot of money on precut moldings, I decided there had to be a better, safer, and more stable way to run this bit.

My solution was to rip boards to the width that I need, then clamp each one to the front edge of a jig clamped to my workbench, as shown *above* and at *right*. Then, I rout the boards in several passes. This gives me beautiful finished moldings, and I was able to sand them before unclamping them from the jig.

—Patricia Kaufman, Lewiston, Idaho



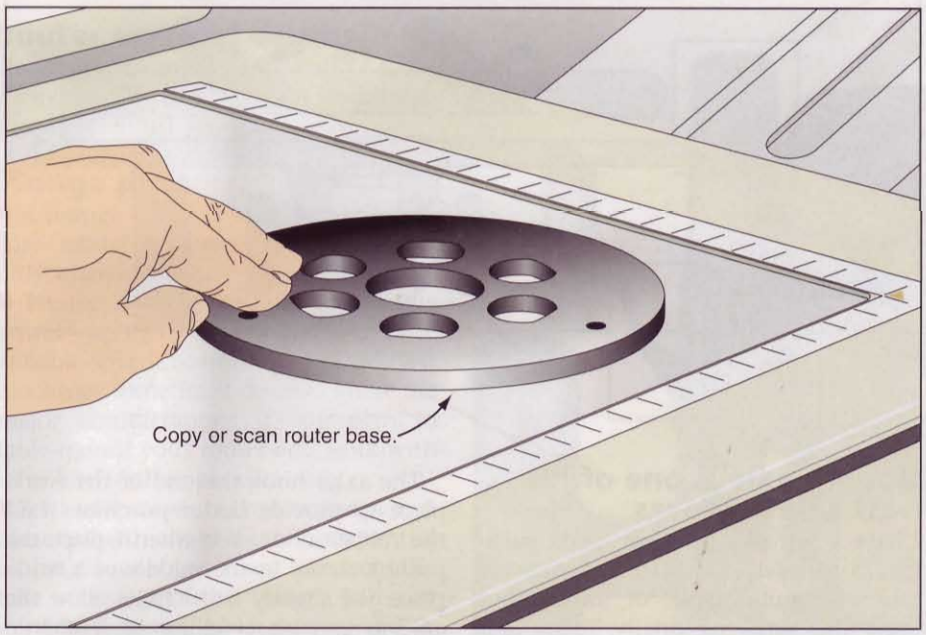
Get hole layout right by making copies

The tough part of attaching shop-made jigs and fixtures to a router is drilling the mounting holes to match up with the holes in the router base. I found an easy way to make a pattern of the router-base hole layout: Copy the router base on a photocopy machine.

After making the copy, check it against the tool base to make sure it's exactly the same size. (Some copiers are off by a few percent, so you may need to adjust the copier enlargement or reduction factor.) Once I have the pattern, I tape it or trace it onto my jig and drill the holes in the right places the first time. I sometimes need to reverse the pattern or make a mirror-image copy, depending on the way I plan to use the pattern.

I also make patterns using my computer's scanner. After scanning the base plate, I can flip the pattern with my drawing software if I need to. I can use the same software to mark exact centers in the holes. I stored the pattern file so I can print one out whenever I need it.

—Matt Besser, Urbandale, Iowa

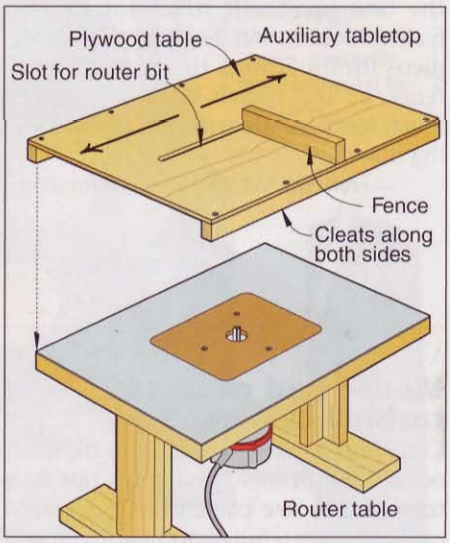


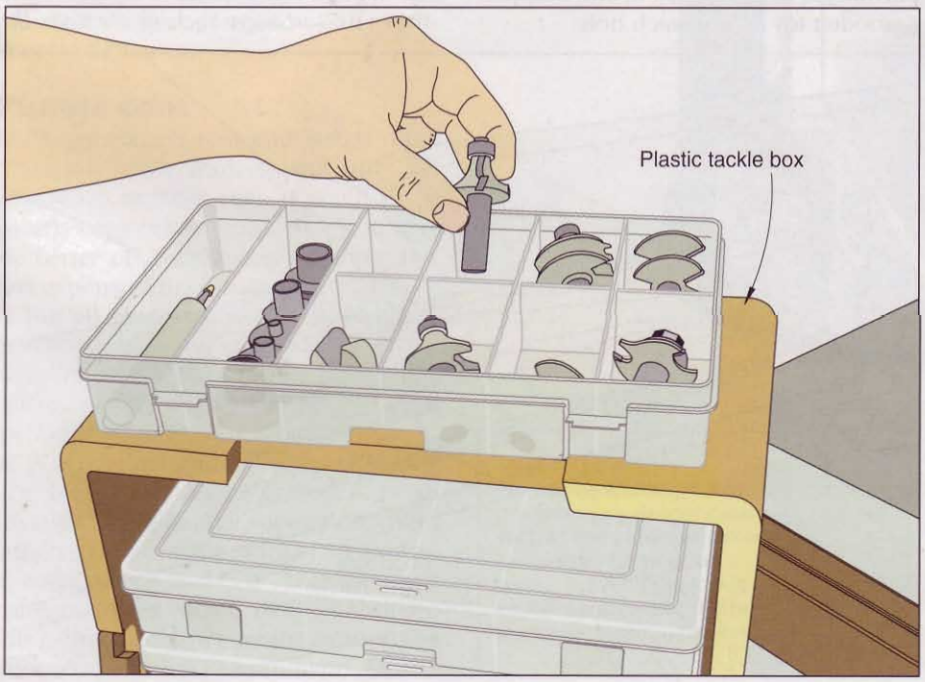
No router-table miter slot? Try an auxiliary tabletop

Sometimes you need to rout across the end of a narrow workpiece. If you have a miter slot in your router table, you'd simply use a miter gauge. But what if you don't have a slot? You could index off the router table itself.

Build an auxiliary tabletop to straddle the router table and attach a fence to it as shown *below*. To rout across the end of a piece of stock, slide the table to the right, put the stock against the fence, and slide both the auxiliary top and the stock across the router bit.

—Chuck Hedlund, WOOD® *magazine master craftsman*





Simple router bit storage anyone can tackle

I use a plastic fishing tackle box to hold my router bits, with one bit in each compartment to protect the cutters. Actually it's more of a "routing center" because it holds pretty much everything I need for several routers: bearings, Allen wrenches, and screws for mounting subbases.

Larger tackle boxes have a big open area beneath the compartmentalized trays. That's perfect for storing wrenches, template guides, and oversize bits that won't fit into the compartments. Some boxes even have enough room below to stow a trim router. My advice: Buy a big box and fill 'er up!

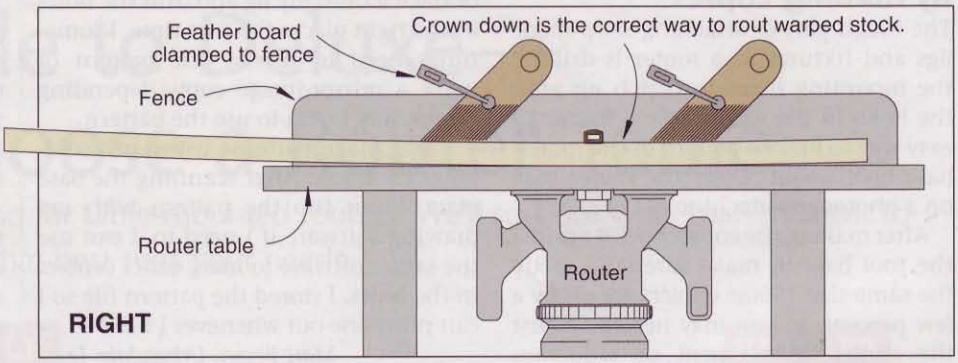
—Wayne Van Coughnett, New Milford, Conn.

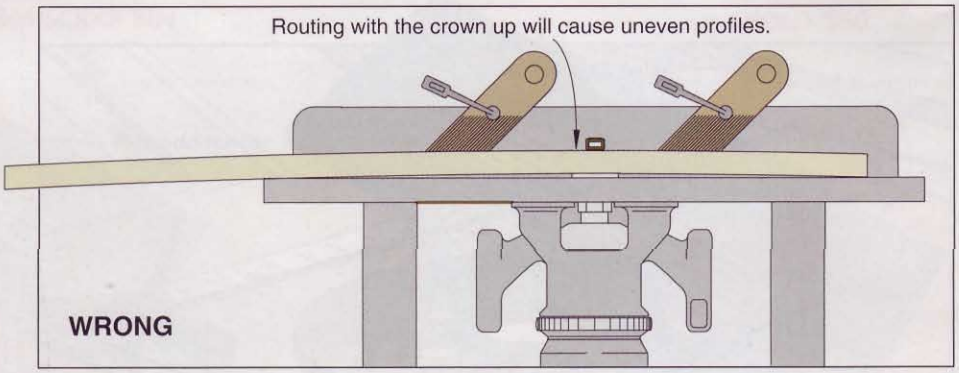
Table-rout long parts "crown down"

When molding long workpieces on a router table, the workpiece must be held flat against the table and fence for the router bit to cut a consistent, smooth profile. Even with the help of feather boards, bowed workpieces can cause fits because they won't lie flat. Narrow stock, which nearly always has some bow in it, is the worst.

To cut consistent profiles on bowed stock, examine these workpieces and place them with the bow down for best results. This takes the spring out of the board that occurs with the crown of the bow up. You'll still want to use feather boards, but holding the workpiece firmly against the tabletop and fence at the router bit will require much less pressure with the crown facing down.

—From the WOOD® *magazine shop*

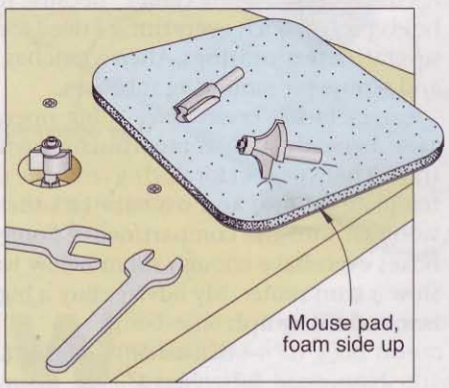




Mouse pad protects carbide cutters

Carbide is a hard, long-lasting material, but it's also brittle. The carbide tips on a router bit or saw blade can be damaged easily if not carefully handled. To protect them, I keep an old computer mouse pad upside down on my bench. The spongy surface keeps the cutting surfaces safe and retards rollaway router bits.

–Chuck Hedlund, WOOD *magazine master craftsman*

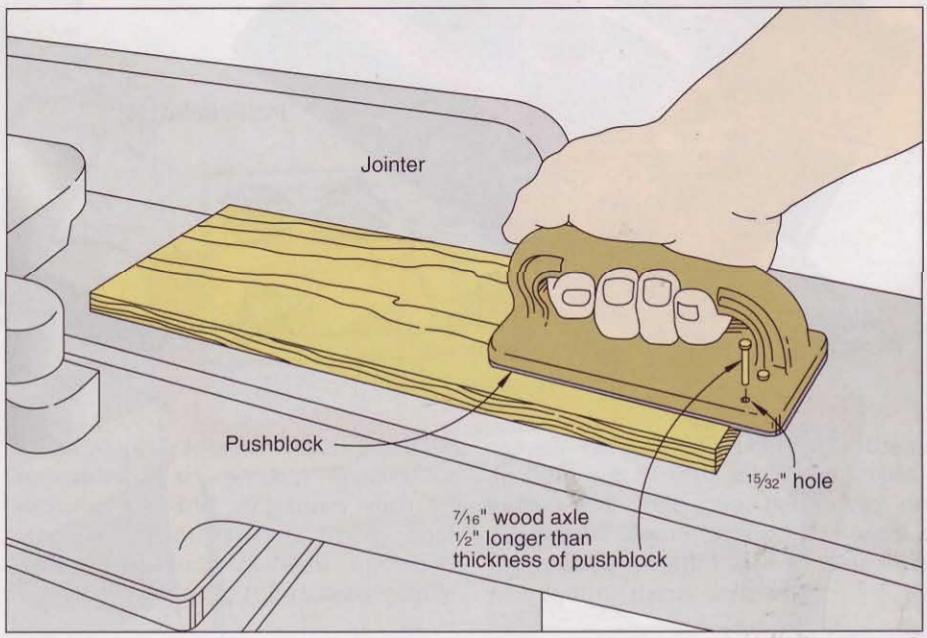


Double-axle is one of his best safety moves

I have a pair of rubber-bottomed pushblocks to safely move stock across my tablesaw, router table, or jointer, but even they slip occasionally. To prevent this, I drilled two holes through each pushblock, as shown *below*, and dropped a wooden toy axle in each hole.

The axles hook the end of the workpiece to provide better purchase than the rubber alone. Yet, when I place the pushblock flat in the middle of a workpiece, the slightly larger holes allow the axles to rise without falling out. If I should accidentally nick or cut an axle, they cost only about 5 cents apiece to replace.

—George Yochem, De Kalb, Ill.



Rout parallel slots to perfection

I volunteered to make a tally board for my bridge club, and my plan to use sliding dovetails for each player's name block seemed so simple. To lessen the strain on my router and prevent the dovetail slot from packing with dust, I decided to precut the slots with a straight bit, then rerout them with a dovetail bit. But how could I ensure dead-on repeatable spacing for 20 slots?

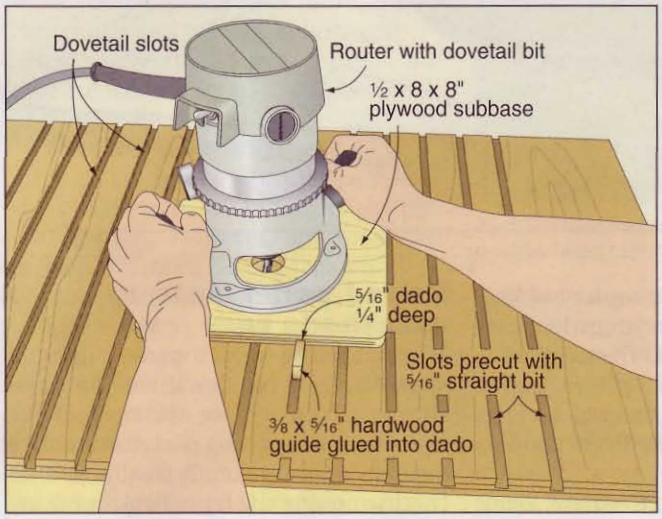
To solve the dilemma, I fashioned a subbase for my router from ½" birch plywood, with a ⅜×⅝" hardwood guide dadoed in place on the bottom, as shown in the drawing *below*. The distance between the guide and a ⅝" straight bit mounted in the router equals the intended spacing between the slots.

I routed the first slot with a ⅝" straight bit in my table-mounted router, then used the same bit in my handheld router, with the subbase guide in the first slot, to rout the second slot. The second slot guided the router for the third slot, and so on, until I had cut all the slots that would be needed.

Next, I switched to my dovetail bit, and set the cutting depth so as to not widen the original ⅝" slot. I used the second slot to dovetail the first slot, then rerouted the remaining slots into dovetails, using the adjacent slot as a guide.

The jig worked like a champ, saved me a lot of time over alternative methods, and the results were flawless. Before you try this, you'll need to make some test cuts to figure the precise relationship between cutting depth, dovetail-bit angle, and straight-bit diameter to make sure the slots will work for your project.

—Charles Hoffman, Ellicott City, Md.



How to safely rout along a narrow edge

Here's a simple way to support your router when machining the edge of a part in an assembly. Clamp a 1½"-wide scrap (a 2×2 works great) of the needed length to the part, flush with the edge, as shown. The scrap provides additional support for the router base to ride on, allowing you to keep the router stable and make a straight cut.

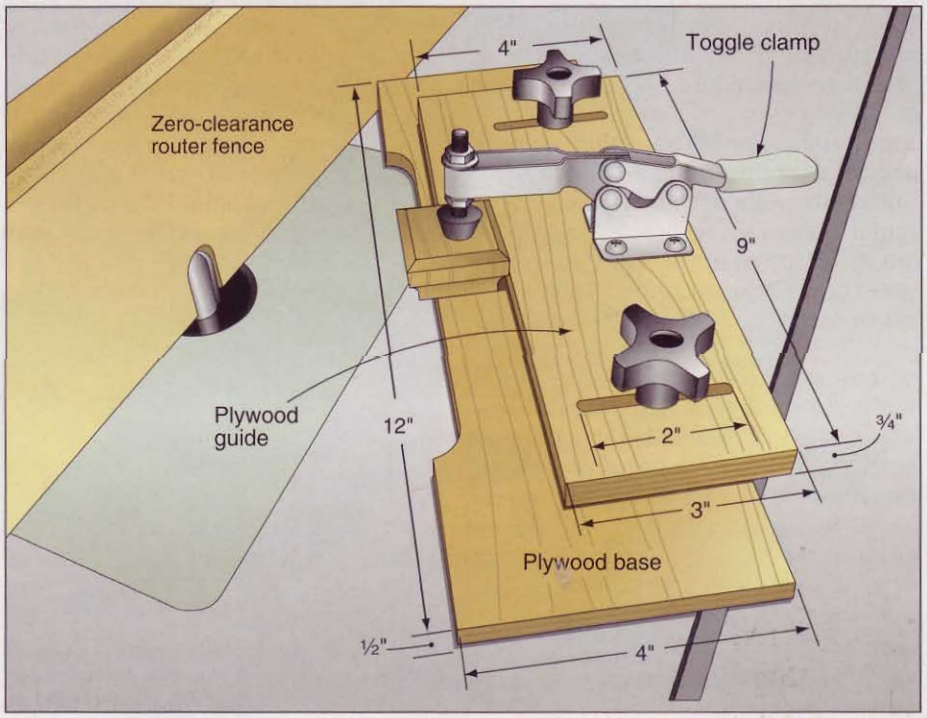
—From the WOOD® *magazine shop*

Jig makes it safe to rout small pieces

My table-mounted router seemed ideal for shaping ¾" stock into knobs for a box I was building, but the small blanks—only 1½" square—would make the job hazardous to my hands. So I built the jig, shown at *right*, to secure the blanks.

I cut scraps of Baltic birch plywood to the dimensions shown for the jig's base and sliding L-shape guide. To make the jig adjustable, I cut two slots in the guide and attached it to the base with knobs screwed into threaded inserts in the base. A toggle clamp holds the workpiece firmly against the base and the guide. I routed the front edge of the base, as shown, to clear the bit; I then set up the appropriate bit and a zero-clearance fence on the router table to machine the knobs.

—Bob Lasley, Broken Arrow, Okla.

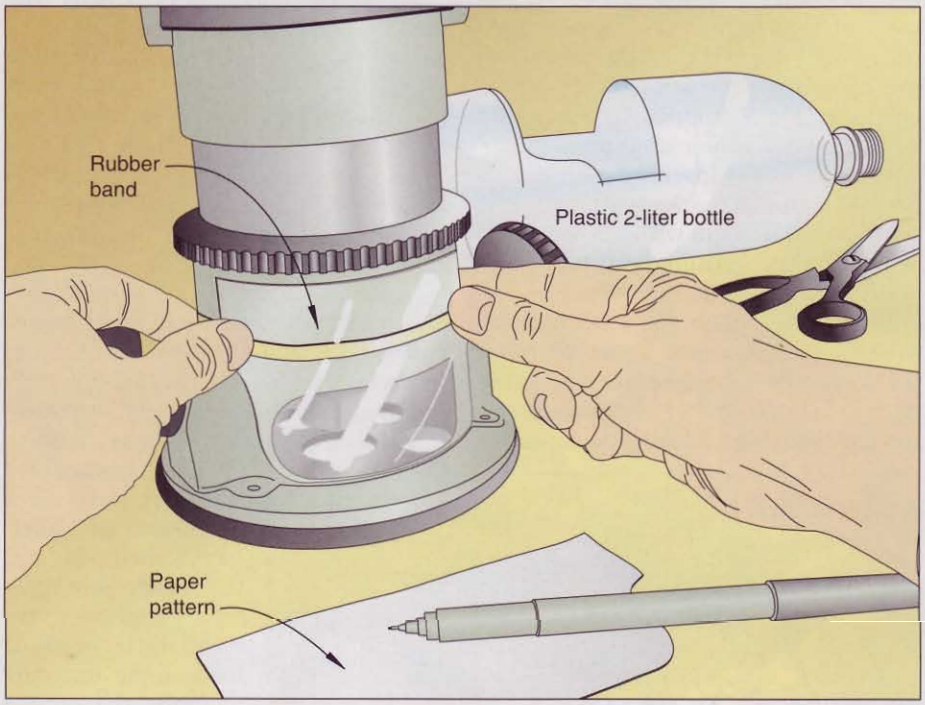


Soda bottle dust shield

My router didn't come with a dust shield around the base, so every handheld routing operation created a blizzard of chips on my clothes. When I sat down with a soft drink to ponder a solution, I suddenly found it right before my eyes.

I sliced a 2"-wide strip of clear plastic from near the bottom of the 2-liter soda bottle, cut it to cover the opening in my router, and secured it to the machine with a stout rubber band, as shown. (It helps if you make first make a paper pattern, especially when fitting the new "window" around handles or other obstructions.)

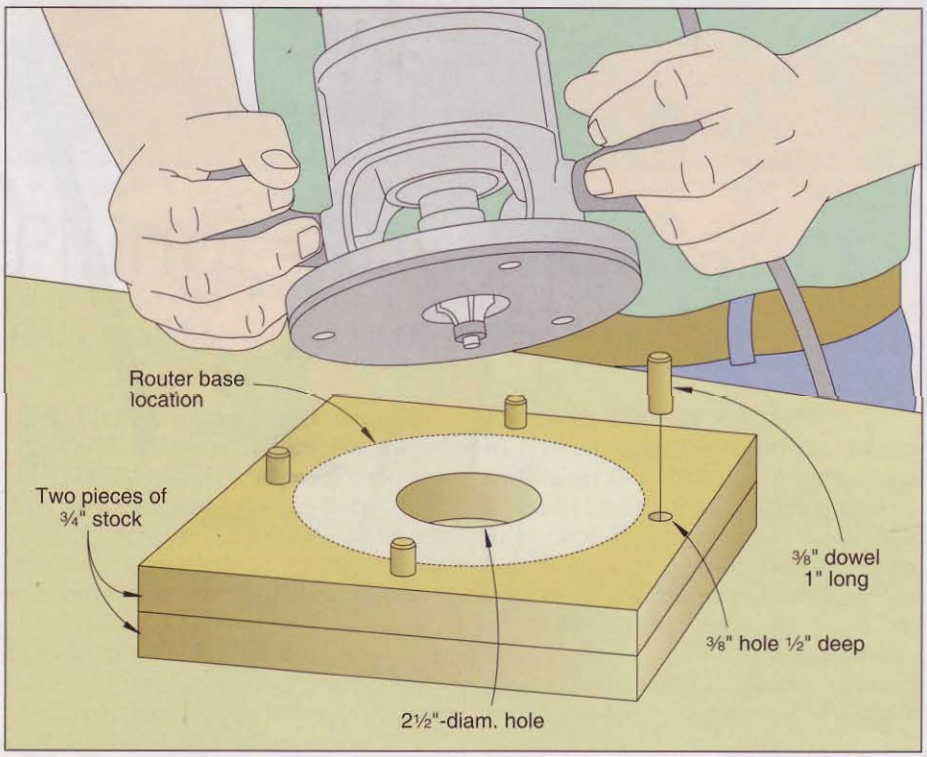
—Russell Dieter, Omer, Mich.



Router holder keeps you safe while the bit slows down

Call me impatient, but I don't like waiting for my router to come to a stop after I turn off the power. Just laying it on its side during the wind-down doesn't seem very safe—the spinning bit could catch part of a project or clothing, or me! With this in mind, I built the simple router-holding jig shown *below*. I glued together two pieces of ¾"-thick stock, then drilled a center hole through both pieces to give the bit plenty of room to spin. I added dowels to keep the router from wandering off the holder.

—John Bachman, Crossville, Tenn.

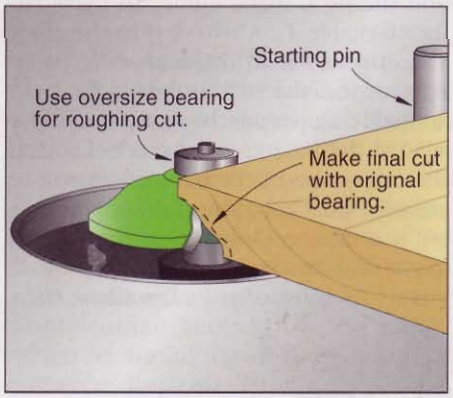


Raised-panel cleanup cuts made easy

When routing raised panels using a large-diameter bit, you'll cut safer and cleaner if you remove the bulk of the waste in one roughing pass, then make a dead-on cleanup cut. Typically, you do this by moving the fence back or raising the bit between cuts, but here's a simpler way that even works with curved or arch-topped panels.

Using a starting pin in your router table and the bearing that comes with your raised-panel bit, perfect the cutting depth in scrapwood. Now, without changing anything else, replace the bearing with a slightly larger bearing and make the roughing cut on your workpiece. Reinstall the original bearing and make your final cleanup cut.

—Warren Johnson, Matthews, N.C.



Tenons, anyone?

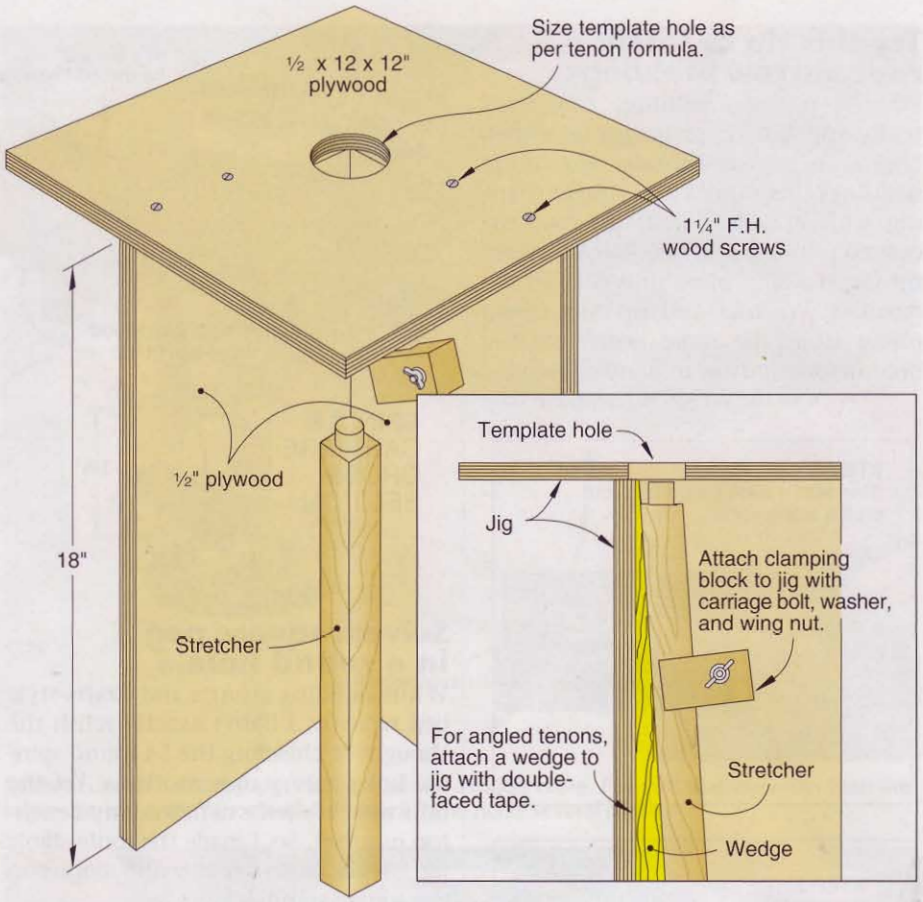
Recently, I had to put round tenons on the ends of several square chair stretchers. To complicate the operation, the stretchers had to fit into legs that splayed 10°. Here's the solution I came up with.

Build the jig, *right*, out of ½" plywood, making sure the sides are perpendicular with each other and the top. Don't bore the template hole yet. Attach a clamping block with a carriage bolt and wing nut to the jig where shown. (For angled tenons, I also affixed a wedge that matches the splay angle of the chair leg, as shown in the inset drawing.)

On the first stretcher, lay out the tenon, then clamp it into the jig, transferring the tenon centerlines to the bottom of the jig. Remove the stretcher and bore a small hole through the jig top at that center mark.

To calculate the diameter of the template hole, add the diameters of the tenon, your router guide-bushing, and your router bit. Cut the hole in the top of the jig, clamp a stretcher into the jig with the clamping block, then rout the tenon to length, making progressively deeper cuts.

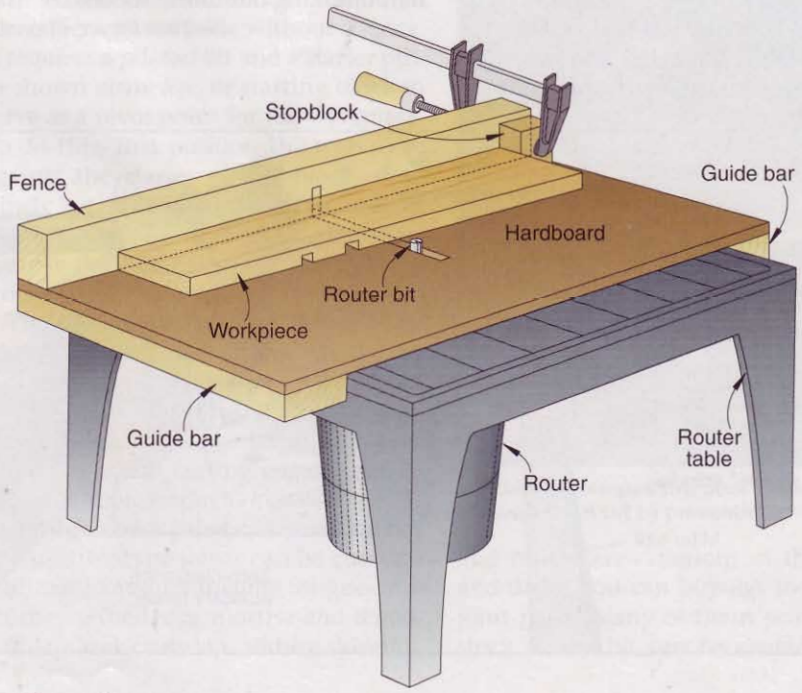
—Tom DelVecchio, Jamestown, N.C.



Sliding tabletop eases dado routing

Routing dadoes—grooves across the grain—can be challenging, especially on narrow stock. Securing the workpiece, spacing the dadoes, and guiding the router straight over the stock become even tougher on small workpieces.

A sliding top for your router table makes dado-routing a walk in the park.



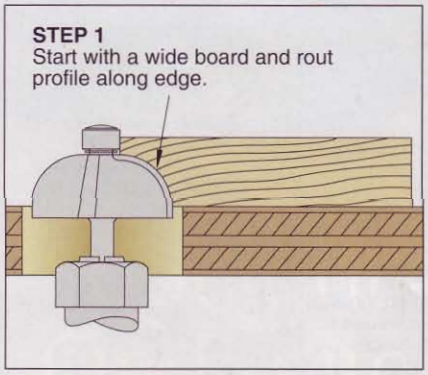
To build a sliding tabletop, start with a piece of ⅛"-thick tempered hardboard as wide as the front-to-back dimension of your router table and about 4" longer than the end-to-end distance. Attach a 1×2 guide bar across each end on the underside, locating them so the hardboard slides freely from front to back on the table without excessive side play. Chuck the straight bit for dadoing into the router, and push the hardboard sliding tabletop into it, cutting a slot about halfway across the hardboard. Notch a 1×2 fence to clear the bit, and then mount it at the back of the sliding top, perpendicular to the slot. Now, to rout dadoes easily and accurately, clamp the stopblock firmly against the fence and slide the tabletop across the bit. Add indexing blocks made of scrap wood to the fence for repeat cuts.

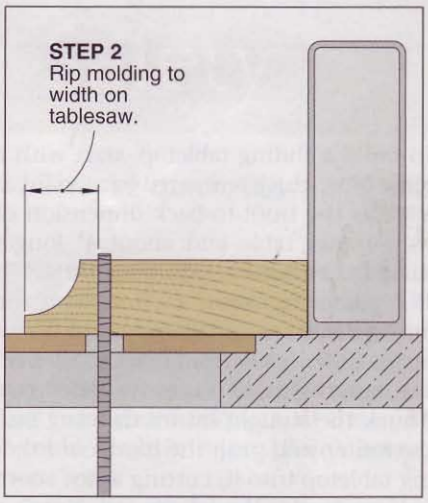
—C. E. Rannefeld, Decatur, Ala.

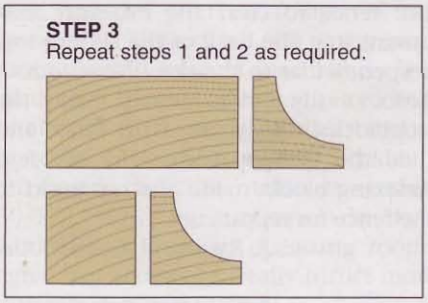
Try this tip to safely rout narrow moldings

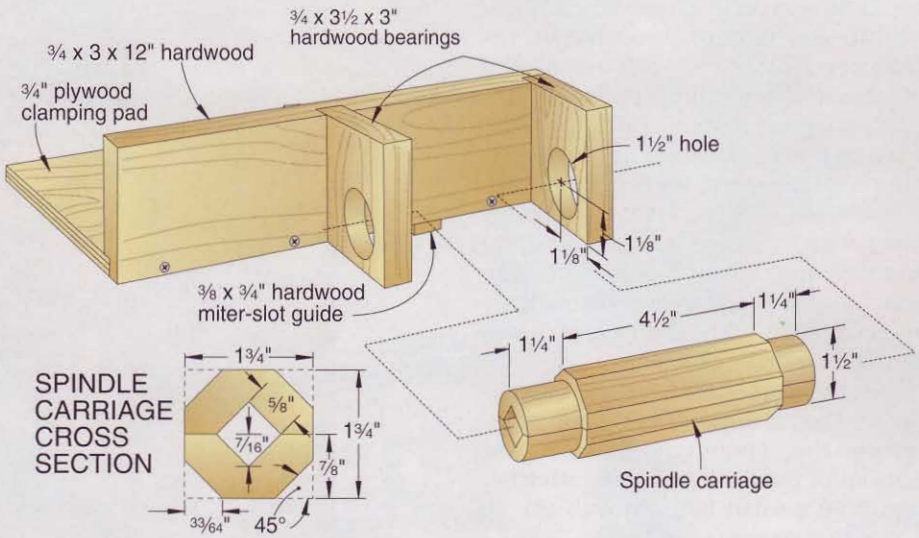
Routing narrow moldings can be a tricky, and sometimes dangerous, undertaking. we've found a safer way to cut moldings that's quick and simple. Starting with a wide board, we rout the desired profile along one edge. Then we rip the molding piece to width on the tablesaw. We rout and rip subsequent pieces from the same board until it becomes too narrow to handle safely.

—From the WOOD® *magazine shop*









Solved: square peg in a round hole

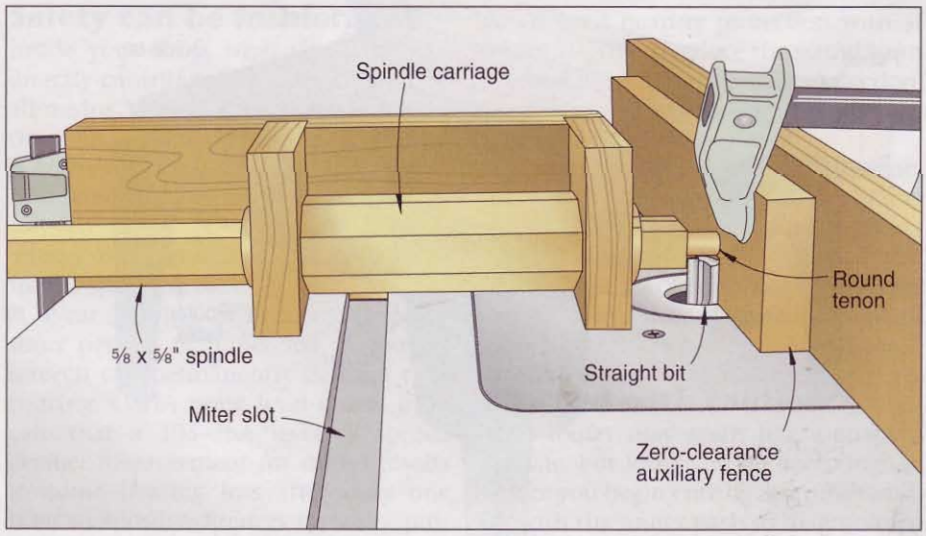
While building an Arts and Crafts-style bed recently, I didn't exactly relish the thought of chiseling the 54 round spindle holes into square mortises. Yet the rails were too wide to fit into my benchtop mortiser. So, I made the router-table jig, shown *above*, to cut round tenons on the square spindles.

The heart of the jig is the spindle carriage, which I made by first cutting a right-angled V-groove in a 14½"-long piece of ⅞" hardwood. After crosscutting the grooved piece into two 7" lengths, I glued them together and beveled the edges as shown in the Spindle Carriage Cross Section drawing. Finally, I went to the lathe, turned each end of the carriage to 1½" in diameter, and mounted the carriage into the bearing assembly.

To use the jig, I attach a zero-clearance auxiliary fence to my router-table fence, and set a straight bit to cut the length and diameter of the tenon. Next, I position the jig in my router-table miter slot so that the spindle carriage is centered on the router bit, and clamp it to the tabletop. Then, I fire up my router, insert a scrap of spindle stock into the carriage, and gently plunge it into the spinning bit until the stock touches the auxiliary fence. One complete clockwise rotation of the carriage rounds off the spindle.

Finally, I test-fit the round tenon in a rail hole, and adjust the bit height, if necessary, to fine-tune the fit. Once satisfied, I switch to the actual spindles and start cranking out round tenons.

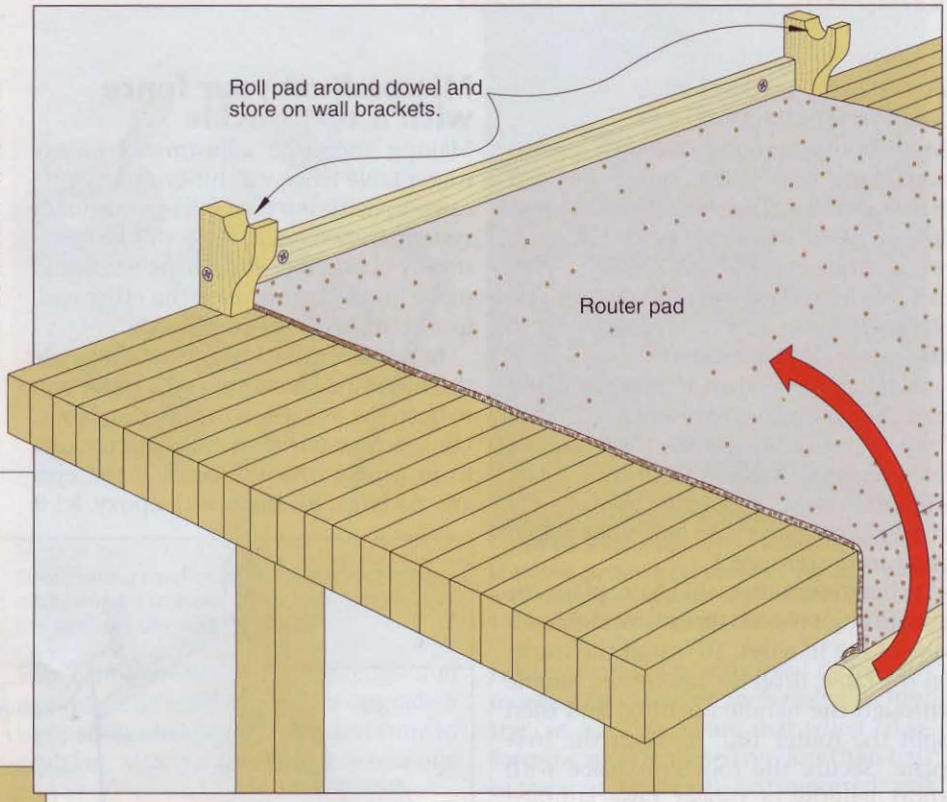
—Tom Freyer, Phoenix

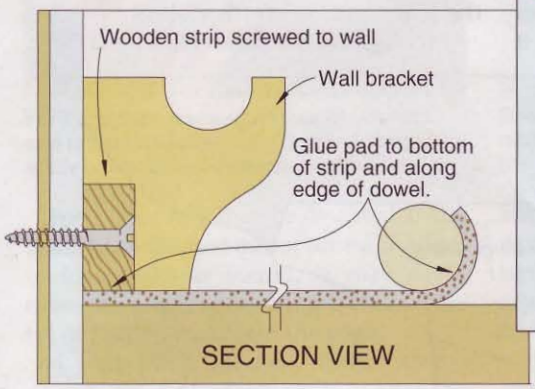


Roll-and-tuck router-pad storage solution

To keep my router pad at the ready when I need it (and out of the way when I don't), I built the simple system shown at *right*. A 1" dowel attached to the loose end provides just enough weight to keep the pad taut as it hangs over the front of the bench. When I'm done, I simply roll the router pad around the dowel and hang it on the wall brackets.

—Jim Teixeira, Edgartown, Mass.

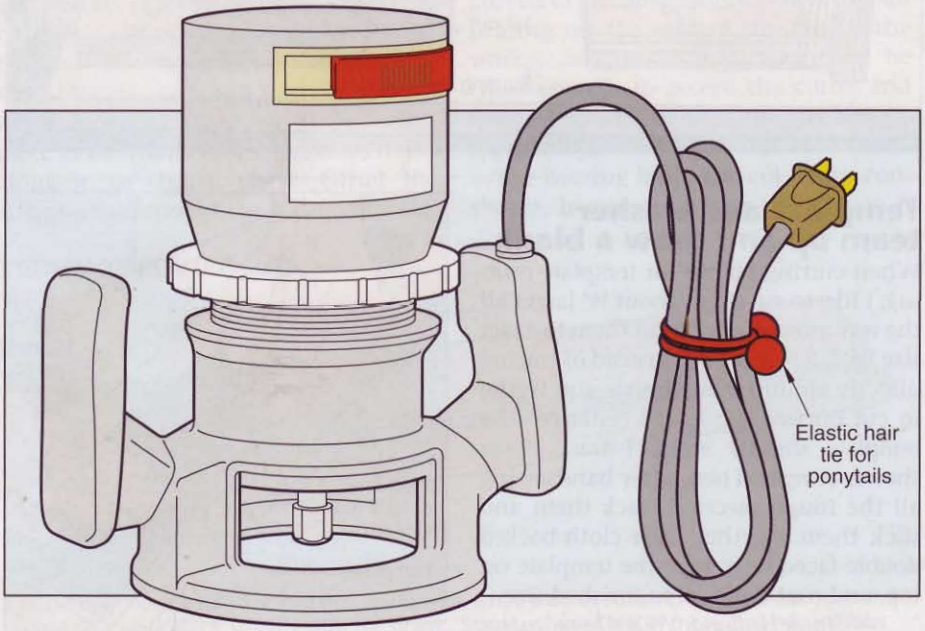


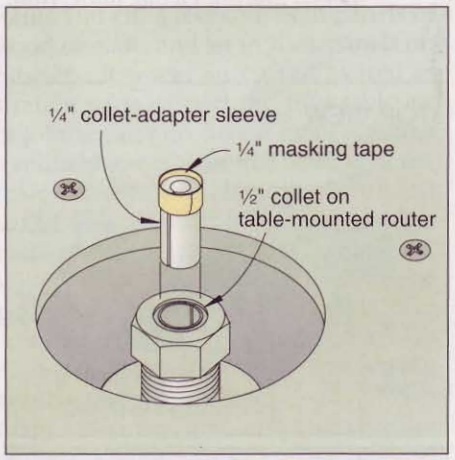


They hold ponytails or power cords

I like to keep my portable power tools out of their cases and on a shelf, where they're readily accessible. But I don't like dealing with all of those tangled power cords. I found a simple solution at the department store: elastic hair ties, the kind that girls use to hold ponytails in place. They're inexpensive, they work great, and the bright colors make them easy to spot on a cluttered benchtop.

—Sonny Rains, Carbondale, Colo.





Collar on collet adapter stops the drops

It used to drive us nuts every time we used the ¼" sleeve adapter in the table-mounted router. Invariably, the darned thing would drop too low into the ½" router collet, and we ended up upending the router or removing the ½" collet to fish out the adapter.

To save our sanity, we fashioned a narrow collar out of masking tape, as shown in the drawing *above*. It only takes a few wraps of tape to keep the adapter from slipping through.

—From the WOOD® *magazine shop*

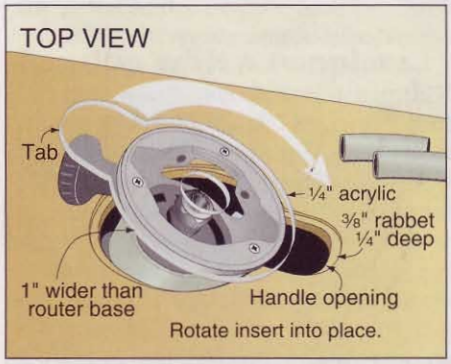
A clearly superior subbase for routers

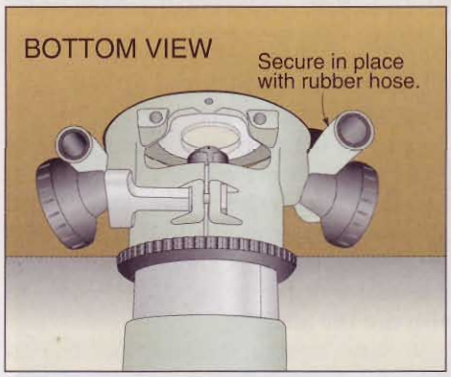
My shop-made router table has one big advantage over other tables—I don't have to remove the subbase when changing between freehand work and table work. That's because the ¼" clear acrylic subbase I made for handheld use also sits securely in a ⅜" rabbet ¼" deep in the router table opening.

Make the base plate 1" larger in diameter than the router base and add a tab at least ½" wider on all sides than the side handles, as shown in the drawing *below*. (This tab makes it possible to insert the router from above and keeps the router itself from spinning.)

When mounting the base plate, be sure to align the tab directly underneath one of the handles. To install the router in the table, drop the uncovered handle through the handle opening, and then spin the router 180° to align the base plate. Secure the router in place with short lengths of rubber hose jammed between the handles and the underside of the table.

—Robert Martin, Picture Butte, Alta.





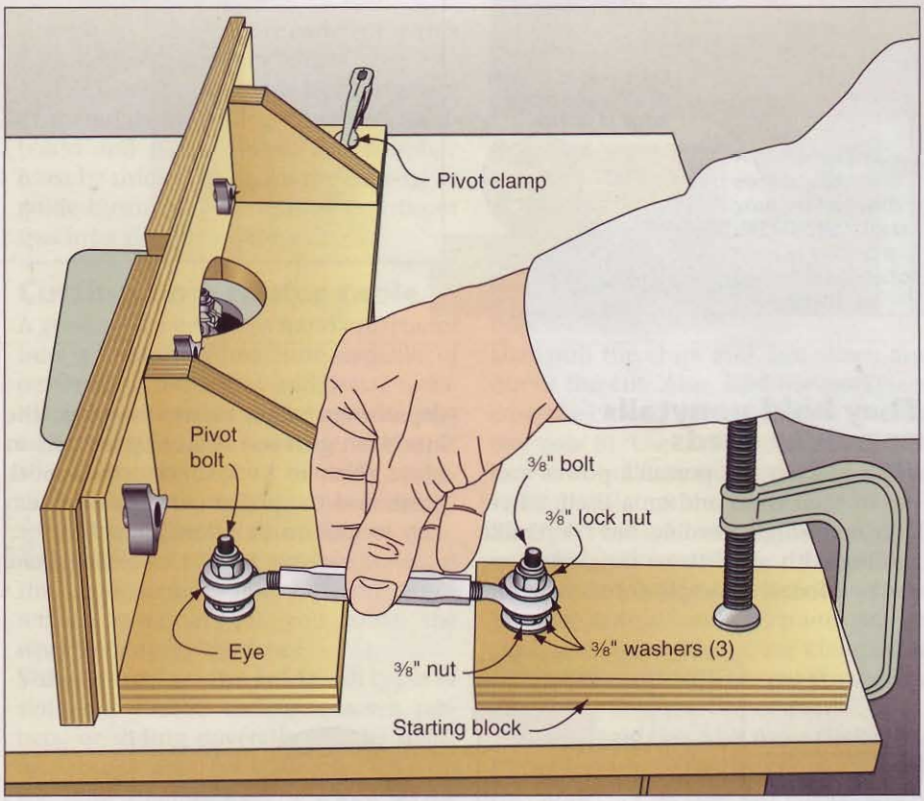
Microadjust your fence with a turnbuckle

Making superfine adjustments to my router table fence was hit-or-miss until I came up with my own microadjustment system, shown *below*. With this system, I simply clamp one end of the fence and make fine adjustments to the other end, fore or aft, with the turnbuckle.

To add a turnbuckle to your fence, use the hardware shown to add a pivot bolt to both the fence and the starting block. Use a turnbuckle with eyes large enough to fit snugly over the bolts. If the eyes are too large, fill them with epoxy, let it cure, and then drill out the epoxy to fit the bolts. Use a washer on each side of the eye, and tighten the assembly together.

The turnbuckle works best on the "push" stroke, so always make final adjustments by driving the fence away from the starting block to take out any slack in the threads. To ensure that the fence doesn't move once you've got it perfect, clamp the turnbuckle end of the fence down. When not in use, you can leave the pivot bolt and eyes in place and remove the turnbuckle. Then store the fence and the starting block.

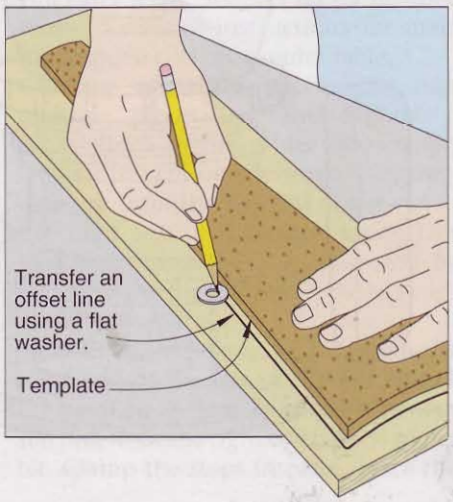
—Wayne Donovan, Kansas City



Template and washer team up and draw a blank

When cutting blanks for template routing, I like to cut them about ⅛" larger all the way around, then trim them to exact size with a pattern bit. Instead of tracing directly around the template and trying to cut outside the line, I "enlarge" the template slightly while I trace it, as shown at *right*. Then, after bandsawing all the rough pieces, I stack them and stick them together with cloth-backed double-faced tape, tape the template on top, and rout them all to finished size.

—Chuck Hedlund, WOOD® magazine master craftsman

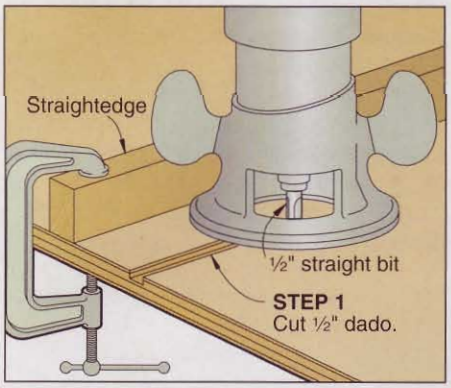


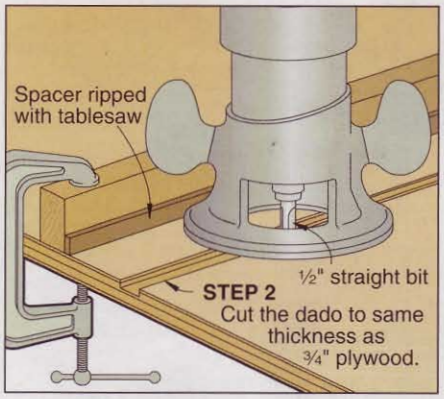
Routing accurate dadoes for plywood

If you've ever cut a ¾" dado for ¾" hardwood plywood, you've ended up with a sloppy joint because the plywood is actually thinner than that. We get much better results using a spacer like the one shown *below*.

First, we clamp a straightedge to a scrap piece of plywood and rout a dado with a ½" straight bit. Next, we measure the actual thickness of the wood going into the dado, and subtract ½". We plane or rip a strip of wood to this thickness to make the spacer.

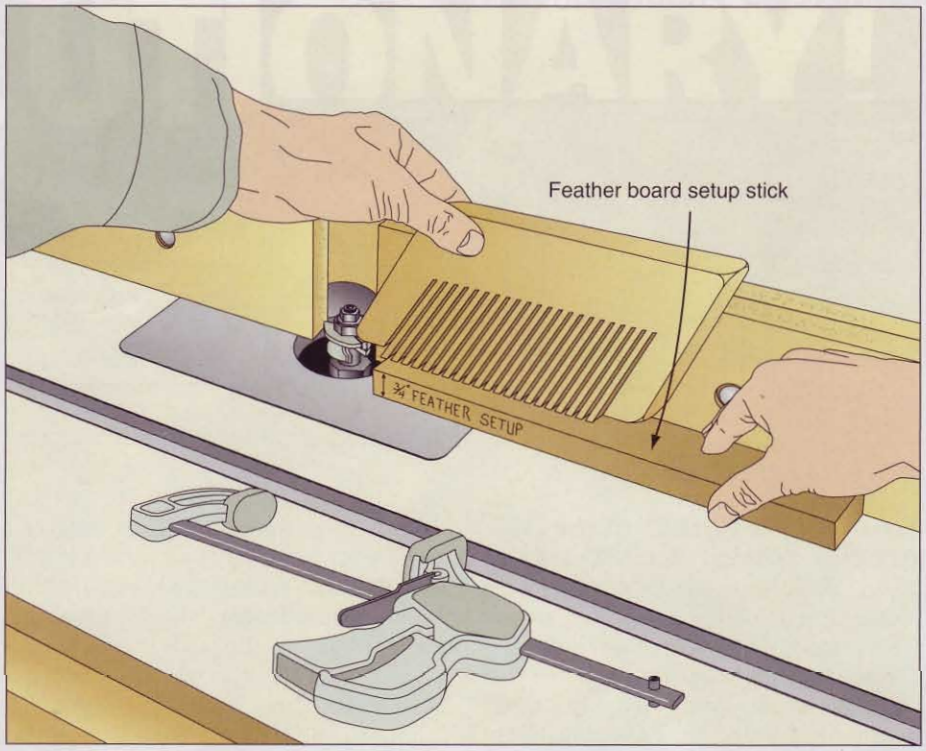
Laying the spacer next to the straightedge, we make another pass with the router and test-fit the joint. This should give you a perfect fit.





To rout the dado in the actual workpiece, we mark the critical edge of the dado (the edge that must measure exactly) on my workpiece. Then, we clamp the straightedge to the workpiece so that the first pass routs the critical edge. Finally, we lay the spacer in place and make the second pass.

—From the WOOD® *magazine shop*



No-brainer setups for feather boards

Feather boards add both safety and consistency to many cuts on the router table and tablesaw. But there's a fine line between too much and too little pressure, and finding that line used to drive me half nuts. That was before I made a few feather-board setup sticks from scraps of hardwood.

After perfecting the feather-board tension for a ¾"-thick workpiece, I made a setup stick by planing down a scrap of stock a little at a time until it just slid easily under that feather board. Then, I labeled the stick so I'd know which thickness of material it works for.

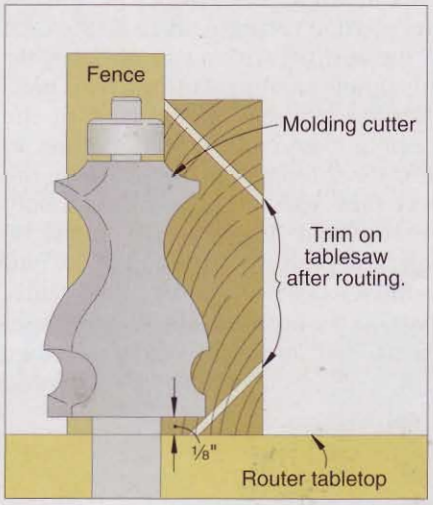
Now, when I need to set the feather board, I simply slide the appropriate setup stick against the fence, stand the feather board on top of it, as shown *above*, and clamp the feather board to the fence. The setup stick also ensures that the feather board stays parallel to the table top, applying uniform pressure along its length.

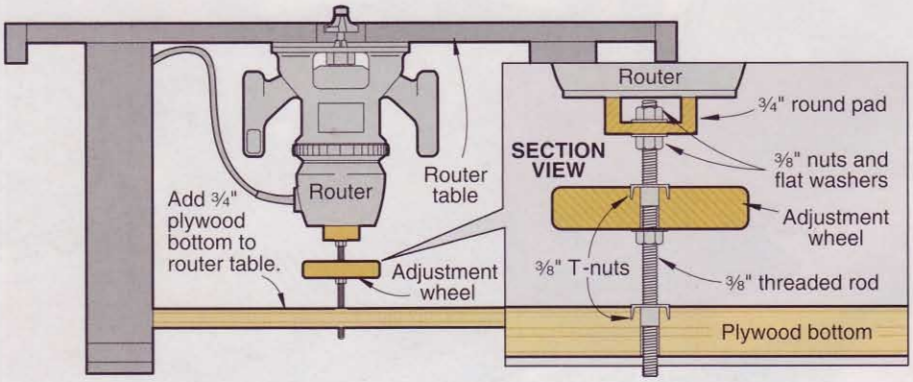
—John Ducey, Lawrence, Kan.

Do-it-yourself crown molding: rip, rout, & bevel

I like to make my own moldings using a full-profile molding bit. For crown molding, I first rip my blank ¼" wider than the final width, then rout the profile on my router table with the bit raised ⅛" above the tabletop, as shown at *right*. The square corners (and a pair of feather boards) keep the stock snug against the fence and tabletop through the cut. Finally, it's back to the tablesaw, where I bevel-cut the waste away.

—Dick Rose, Portland, Maine





T-nuts and wheel offer precise router elevation

Trying to raise or lower a router in a router table usually requires three hands. It's hard to hold all the pieces together as you set the height accurately. Gain that third hand by putting your table-mounted router on the adjustment device shown *above*, which allows you to dial in your elevation changes with incredible precision. Start with a piece of ¾" stock and cut out the round pad that the router rests on. Use a Forstner bit to bore a ¾"-diameter hole ½" deep in the center. Then, drill a ⅜" hole clear through the center.

Insert the threaded rod into the hole in the pad and secure it as shown with a pair of washers and nuts. Make the threaded rod long enough to raise and lower your router about 2" when it's sitting in the table. Next, secure the wooden adjustment wheel just above the middle of the rod using a nut, washer, and T-nut as shown. Glue the T-nut to the threaded rod with epoxy.

Finally, install a plywood base about 3" up from the bottom of your table legs, insert a T-nut in the base, and screw the bottom of the threaded insert into the T-nut. Now, when you turn the wheel, the whole assembly rides up or down in the T-nut in the plywood base. By using a threaded rod with 16 threads per inch, you move the router 1/16" for every full turn of the wheel, 1/32" for a half turn, and so on.

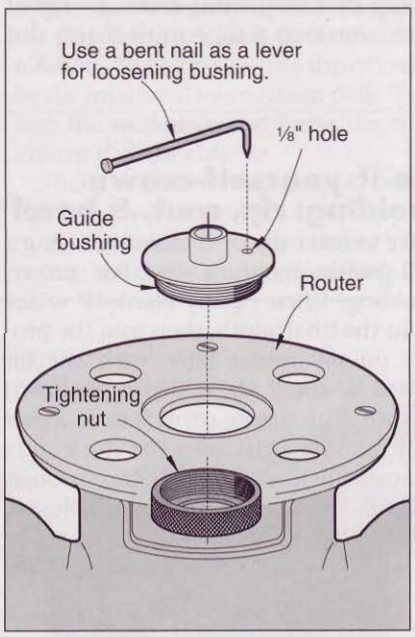
—Duane Abels, Vancouver, Wash.

Bent nail protects your router guide bushing

Template guide bushings for your router can jam tight after just a little use. If you can't unscrew yours with your fingers, and you don't want to rough up the edge of the bushing with a pair of pliers, try this simple technique using a bent nail.

Drill a ⅛" hole on the edge of the bushing close enough to the center to clear the threads underneath. Then, the next time your bushing sticks, simply insert a bent finishing nail in the ⅛" hole, and push the other end of the nail counterclockwise against the center shaft on the bushing. The leverage from the nail will loosen the bushing easily.

—Henry Borger, Brooksville, Fla.



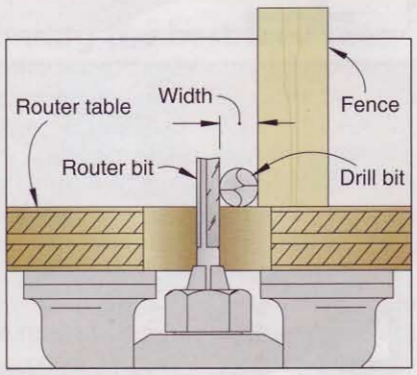
Drill bits provide perfect measurements

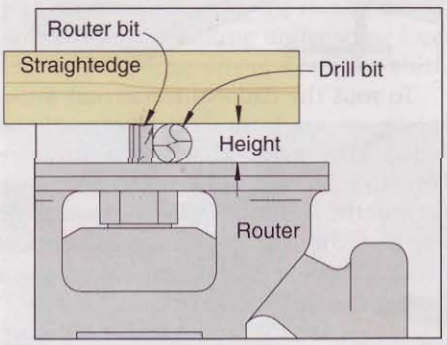
When setting the distance from a router bit to the fence on your router table, a drill bit can often provide you with a more accurate guage than any ruler in your shop. For example, if you need a ¼" space, hold the shank of a ¼" twist-type drill bit against the router bit, as shown *below*, and move the fence in until the drill bit fits snug against both surfaces.

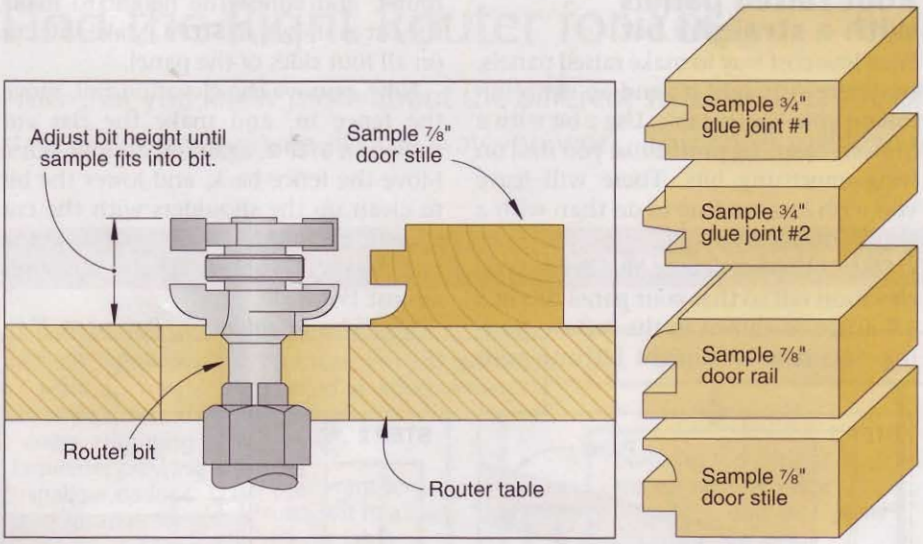
Don't, however, push the fence in so tight that you can't remove the drill bit. Rather, adjust the fence until the drill bit drags lightly on both the router bit and the fence when you withdraw it (much like you would use a spark-plug feeler gauge).

You also can use this technique for setting the height of a router bit. Place a straightedge across the top of the bit, as shown at *bottom*, and adjust the height of the router bit until the drill bit fits snugly between the router base or tabletop and the straightedge.

—Ed John, South Sioux City, Neb.







Speedy router-bit setup

Setting up router bit sets to cut cabinet rails and stiles or glue joints requires making cuts that are exact opposites in order for the surfaces of the boards to be flush. I found that getting perfectly mated joints was easy once I created guage blocks.

To do this, I adjusted the bits to make flush cuts on a particular thickness of stock, then cut an extra piece, labeled it as shown at *left*, and saved it as a template. Anytime I need to make that cut, I just slide the guage block next to the bit and move the router up or down in the table until the bit profile matches the guage block.

—Patrick Grashorn, Gilcrest, Colo.

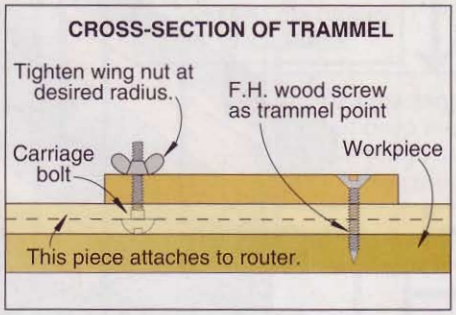
Cut perfect circles with a router trammel

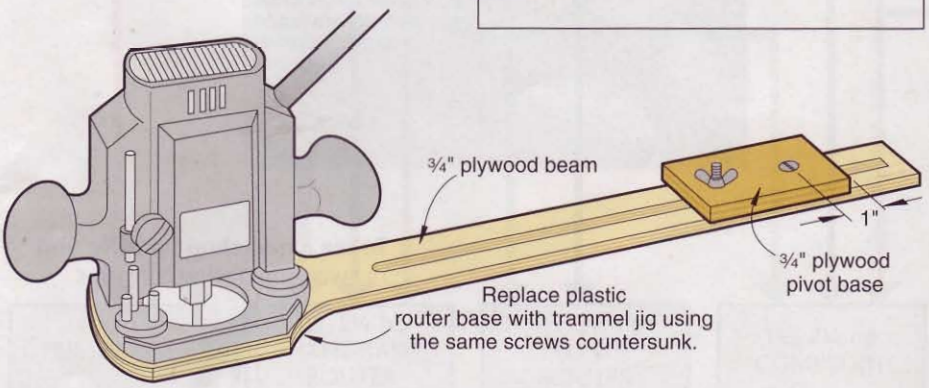
When you need to cut a big arc or wheel out of a sheet of plywood, a hand-held jigsaw will leave a less-than-perfect circle. With a trammel jig, you can whip out perfect circles or rings anytime. Make your own jig by adapting the design shown *below* to fit your router.

Using plywood for the trammel, cut out one end to match the shape of your router base. For length, construct the jig so the beam measures about 12" longer than the radius of the largest circle you wish to cut. Make the narrow part of the beam 4" wide, and cut a 3/8" slot through it as shown in the drawing. On the bottom surface of the beam, use your router to cut a 1"-wide groove 3/8" deep for the head of the bolt to slide in. Next, cut the pivot base from the 3/4" plywood and drill a 3/8" hole for the carriage bolt 1" from the front edge.

Drive a screw through the base into the center of the circle to be cut and adjust the base until your router is correctly positioned. Tighten the wing nut on the carriage bolt, and rout your circle with a straight bit. If you're cutting a ring, cut the outside diameter first.

—Wilton Elwick, Texarkana, Texas



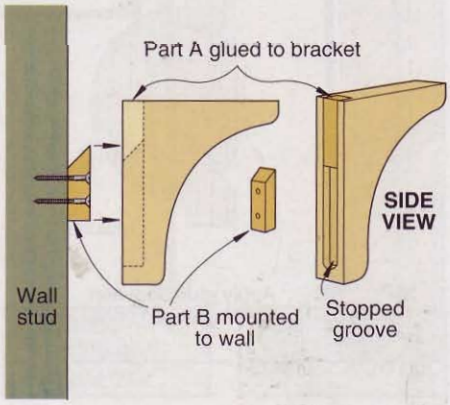


Hanging brackets with invisible means of support

Wooden display shelves look great, especially on wood-paneled walls. But how do you anchor them to the walls without a lot of metal hardware showing? Rout a stopped groove centered in the back of your shelf brackets, and use that space to make a hidden cleat. Rout the groove where shown in the drawing *below*. Now, cut a cleat that fits snugly into the groove and flush with the back edge of the bracket.

To complete the cleat, cut it in half at a 45° angle; screw the bottom, part "B", to the wall; and glue the top, part "A", to the bracket shown. Slip the bracket over the wall-mounted section of the cleat and you have a strong and completely invisible support.

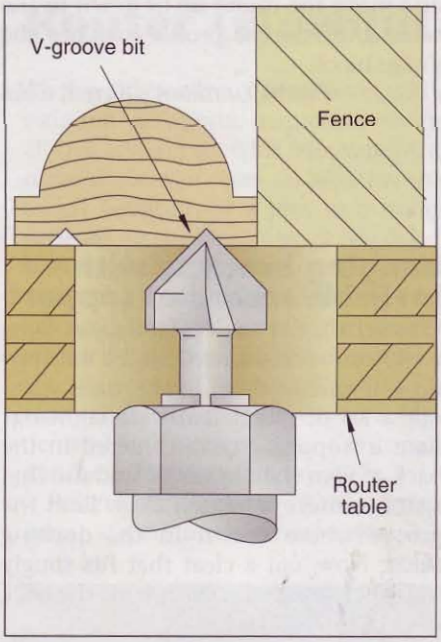
—Joseph W. Mott, Binghampton, N.Y.

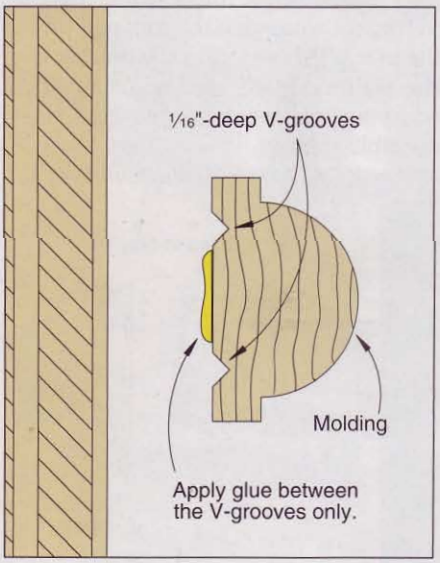


V-grooves keep squeeze-out in check

When I glue trim molding in place, I don't want any glue squeeze-out because it's impossible to clean it out of molding crevices. To stop glue squeeze-out, I use a V-groove bit in my table-mounted router to cut shallow grooves in the back side of the molding, as shown *below.* Then, I apply a thin bead of glue between the grooves. When I install the molding, any excess glue collects harmlessly in the grooves.

—Chuck Hedlund, WOOD® magazine master craftsman





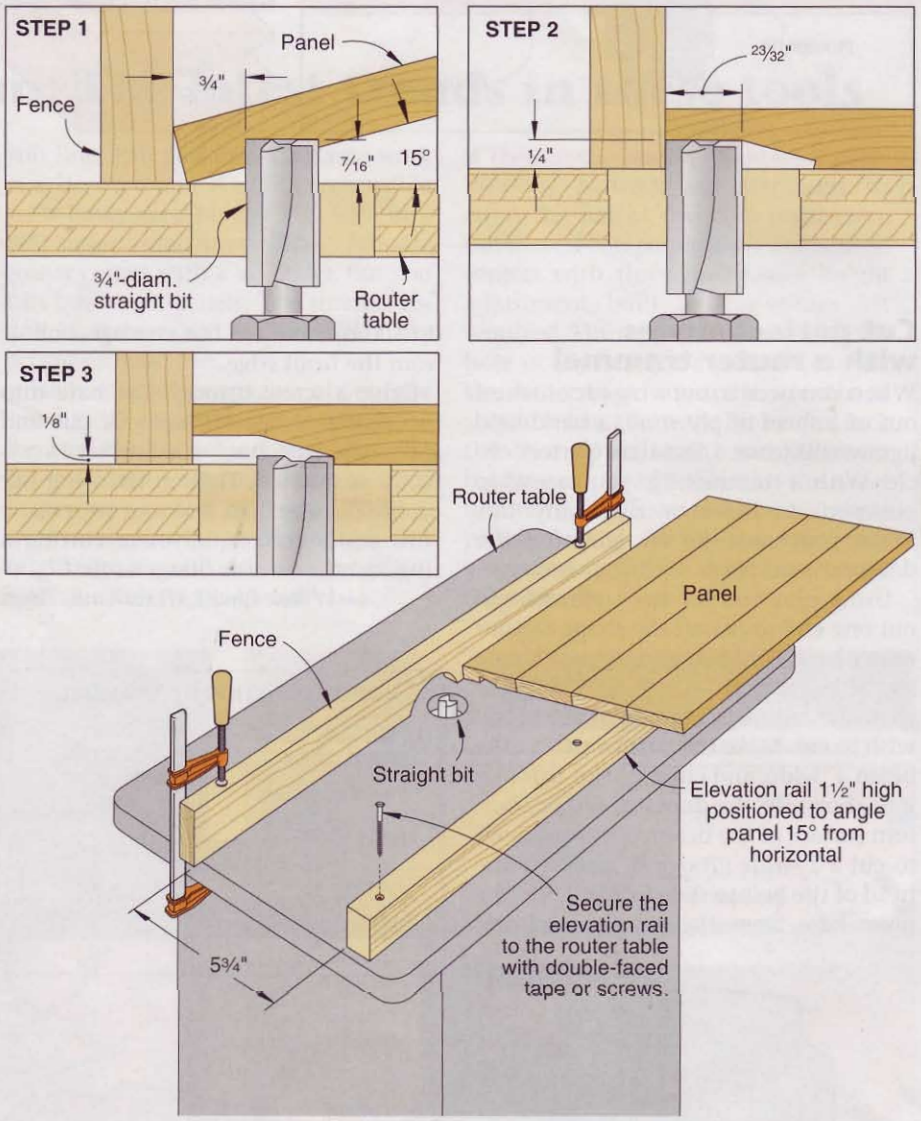
Rout raised panels with a straight bit

For a low-cost way to make raised panels, try using a straight bit and an elevation rail on your router table. Use a bit with a bottom-cleaning profile like you find on hinge-mortising bits. These will leave you with less sanding to do than with a regular straight bit.

Start by positioning the fence and elevation rail so that your panel tilts at a 15° angle, as shown in the *bottom* drawing. Secure a ¾" straight bit into your router, and adjust the height to make the cut as shown in **STEP 1**. Make this cut on all four sides of the panel.

Now, remove the elevation rail, move the fence in, and make the flat cut shown in **STEP 2**, again on all four sides. Move the fence back, and lower the bit to clean up the shoulders with the cut shown in **STEP 3**. Now, you've got a raised-panel profile that measures almost 1½" wide.

—Richard Colman, Sr., Boscawen, N.H.



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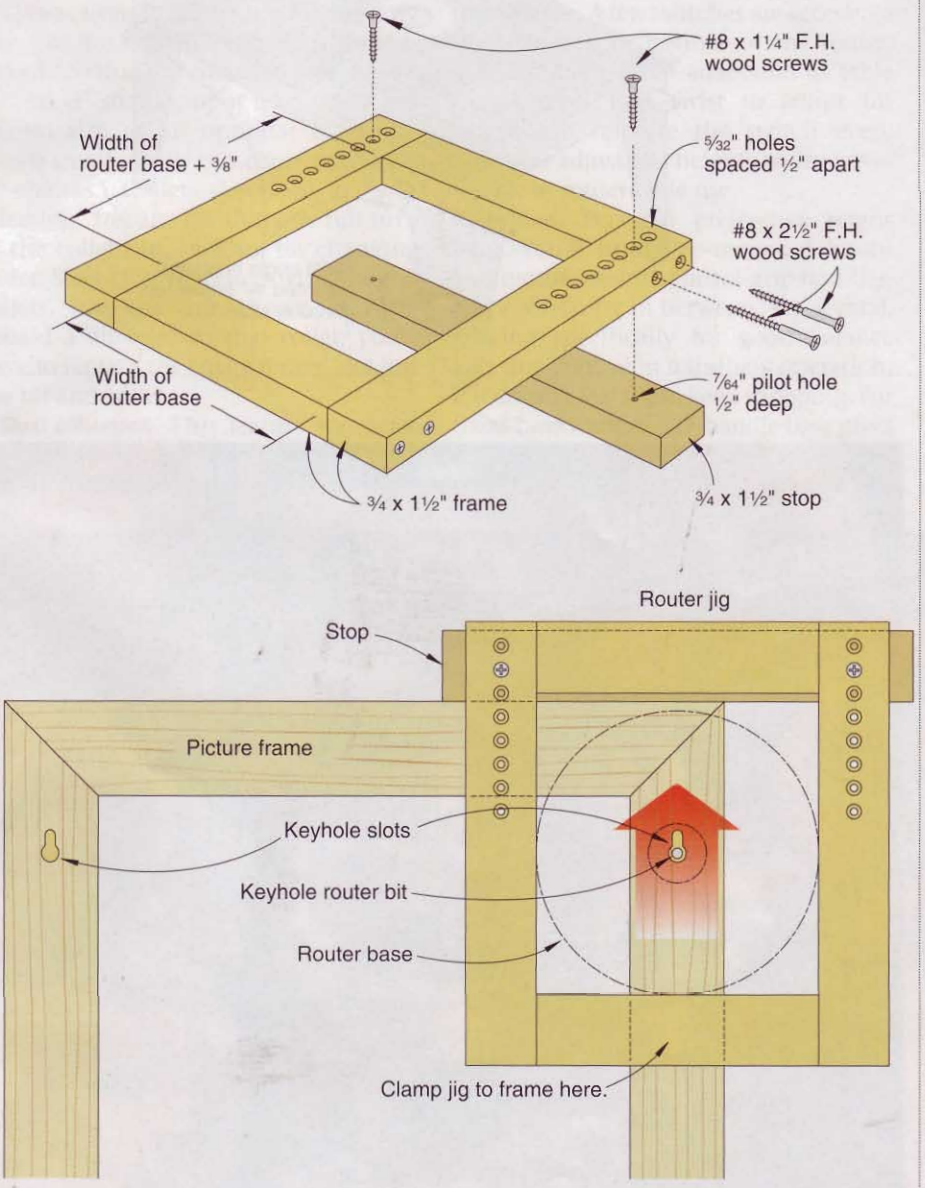
With this jig, matched keyhole slots are a lock

Aligning two keyhole slots on a mirror frame or shelf used to frustrate me. If the holes weren't the same distance from the top of the frame, I found myself offsetting the wall hangers to compensate for the crooked keyholes.

To make the cuts consistent, I fashioned the router jig shown *below* from ¾" stock. The movable stop allows me to bore slots as far as 8" from the top of the frame. Once the stop is set, I simply center the jig on one of the vertical frame pieces and clamp it in place. Using my plunge router (with keyhole bit) in the near end of the jig, I plunge, slide my router along the jig until it contacts the far end, then back out of the cut. I then clamp the jig to the other vertical frame piece without moving the stop, and repeat the process.

— Don Thomas, Defiance, Ohio



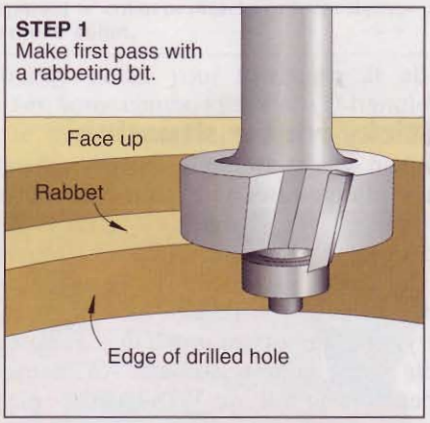
Enlarge a hole of almost any shape accurately

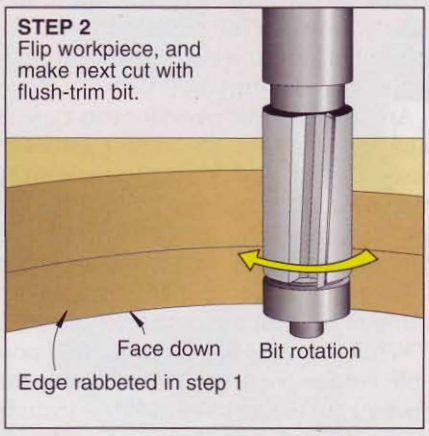
Have you ever cut a hole in a workpiece only to find it needed to be just a little bit bigger? Here's a way to resize that opening while still keeping its shape.

Let's say you need to enlarge a hole diameter by ½". Install a rabbeting bit in your router using the bearing for a ¼" rabbet (¼" on both sides of the hole yields a total enlargement of ½"). Rout a rabbet around the hole as deep as you can while still keeping the router bit's bearing in contact with the edge of the hole. Finally, flip the workpiece over and finish the cut using a flush-trim bit, with the bearing riding on the rabbet you cut first.

My rabbeting bit limits me to ½" rabbets maximum, so I can enlarge almost any hole by 1". If I need more, I simply repeat the rout-flip-rout-again process until the hole is sized the way I want it.

—David Kantor, East Meadows, N.Y.



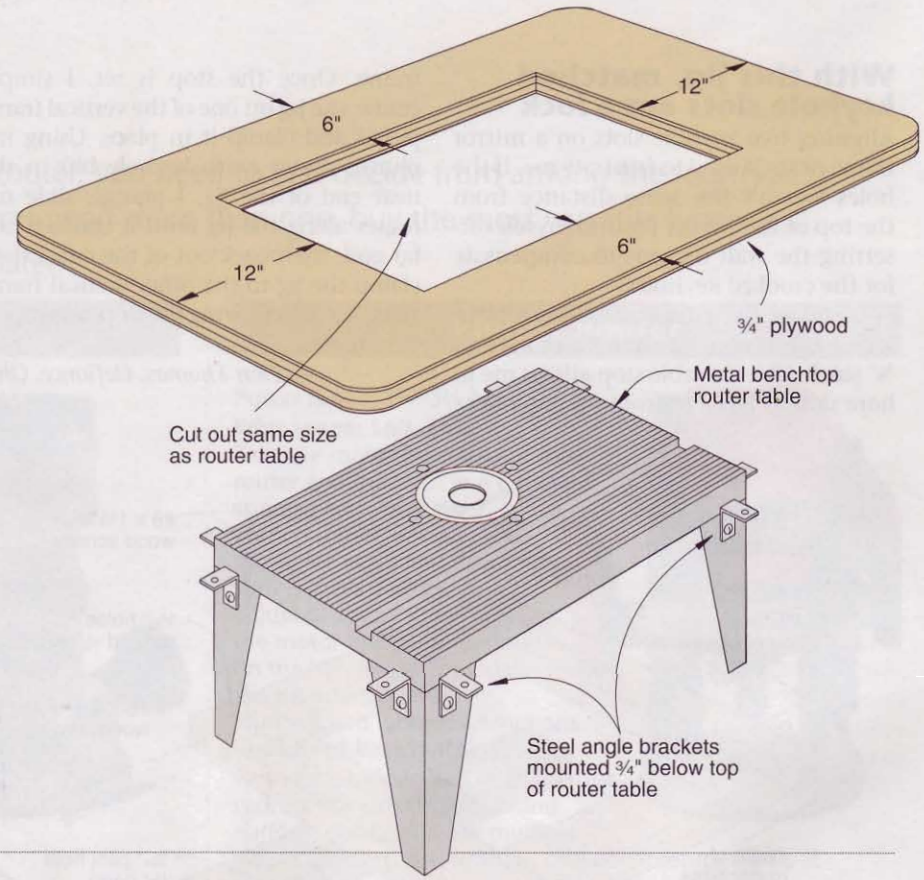


Auxiliary top boosts router table capacity

My benchtop router table works just fine for most of my projects. But I occasionally need a larger work surface to help support large workpieces. To meet those needs and still work in my small shop, I built a laminate-covered auxiliary top that adds 12" of width and 24" of depth to my existing router table.

I turned the metal benchtop unit upside down on the larger top to mark the table's location. Using a jigsaw, I cut out the hole for the router table. Right-angle brackets, bolted to the router table, support the auxiliary top and keep it flush with the regular tabletop. Two screws at opposite corners hold the top in place. When I don't need the larger top, it slips off and stores where it will be out of the way.

—Ann Clausen, Racine, Wis.



Sticky router situation

When you're swapping between fixed and plunge bases on a multi-base router kit, fine sawdust (especially from MDF) packed in the motor's spiral grooves may make it difficult to remove the motor from the plunge base. Start by trying to remove as much dust as possible using compressed air. An aerosol penetrating oil or WD-40 also may loosen up the jam, although you'll later have to remove all lubricant from the motor housing and base to avoid attracting more contaminants.

Another possible cause for this type of jam: Transferring the motor between bases may have accidentally nicked the motor housing, raising a burr that keeps the housing from turning inside the base. If you spot a small nick or raised sliver of metal, carefully remove it with a fine mill file or a piece of sandpaper.

While you're at it, check for other possible contaminants that may cause the housing to stick in its base. These include errant dabs of glue on the motor housing or wood chips in the grooves.

—from the WOOD® *magazine shop*

Make mirror-image slots in a jiffy

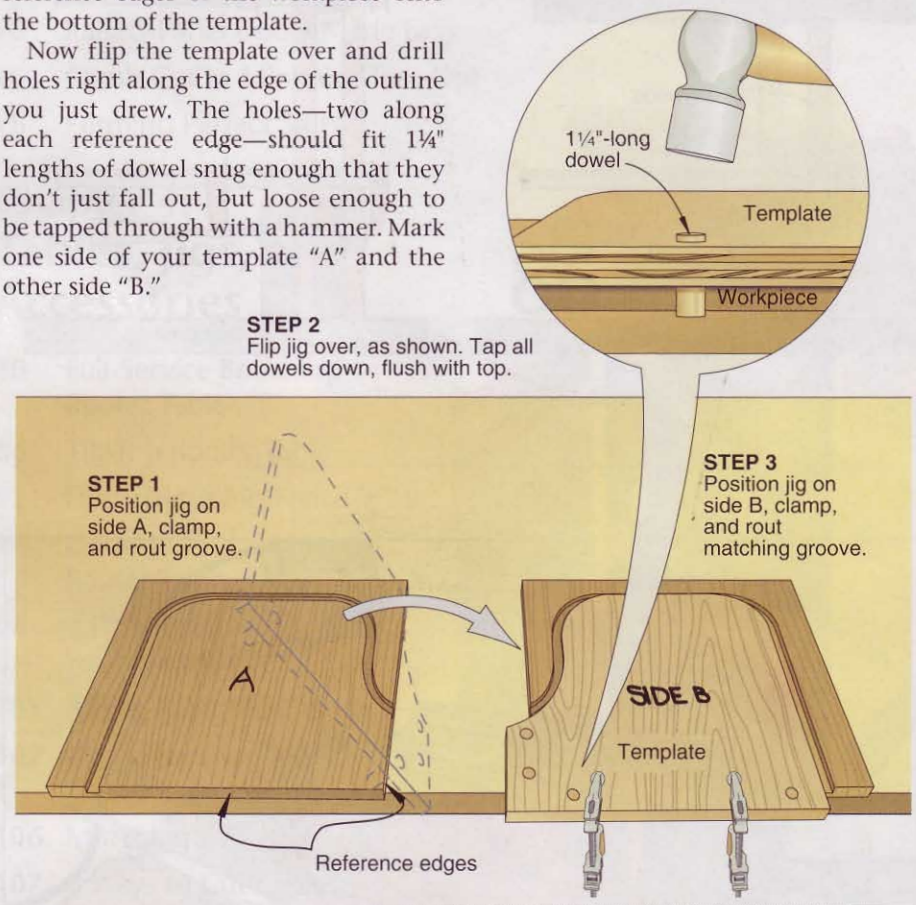
If you've ever tried cutting slots that mirror one another (for example, the tambour-door tracks on a rolltop desk), you know it can be tricky to get them right. Here's how to make perfectly mating mirror-image slots.

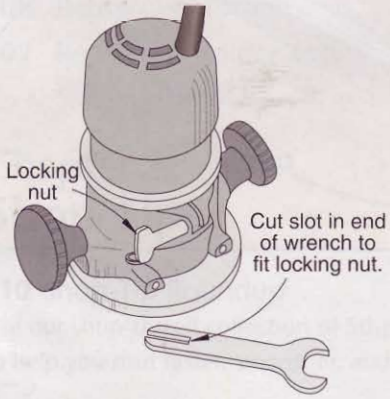
Make a template for the slots using ¾" medium-density fiberboard (MDF), leaving enough extra material on two edges to register the template, as shown in the drawing *below*. With the template in position on your workpiece, trace the reference edges of the workpiece onto the bottom of the template.

Now flip the template over and drill holes right along the edge of the outline you just drew. The holes—two along each reference edge—should fit 1¼" lengths of dowel snug enough that they don't just fall out, but loose enough to be tapped through with a hammer. Mark one side of your template "A" and the other side "B."

To use the jig, install a pattern bit in your handheld router and set the cutting depth. (Don't forget to add the thickness of the template.) Tap the dowels so that they're flush with the "A" side of the template, clamp the template to the workpiece ("A" side up) so that the dowels register against the workpiece, and rout the groove. Now, flip the template to the "B" side, tap the dowels flush again, register and clamp the jig to the mating workpiece, and rout.

—Gary Burman, Monroe, Iowa





Cut a slot in your wrench to loosen a tough nut

If you can't get enough of a grip to loosen the height-adjustment locking nut on your router, try this trick. Cut a slot in the handle of one of the collet wrenches, as shown. Size the slot to fit the locking nut on your router. Now, you won't have to resort to pliers—the right tool will always be near at hand.

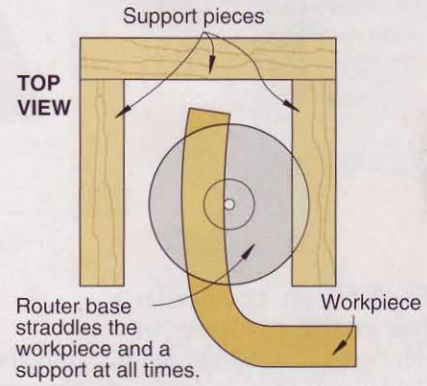
—Jack E. Battalia, M.D., Portland, Ore.

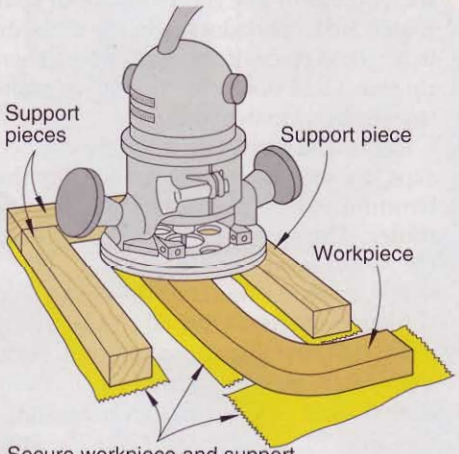
Scrapwood shapes give router needed support

Edge-routing narrow, curved workpieces becomes a challenge without a router table. The router keeps tipping, digging the bit into your work and spoiling it.

Gain more control over your router by adding some strategic support. From scrapwood the same thickness as your workpiece, cut straight or curved supporting pieces about 1" wide. Arrange them around your workpiece as in the example shown *below*, and then rout away. With the router riding on both the workpiece and the supports, you'll avoid nicked edges and chewed-up corners. Be sure to make the supports the same thickness as the workpiece. If you use double-faced tape to hold the workpiece in position, for instance, use it to hold your supports, too.

—Alex Polakowski, Skokie, Ill.

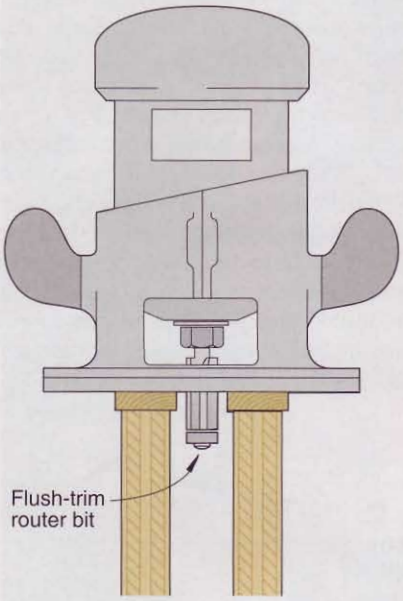


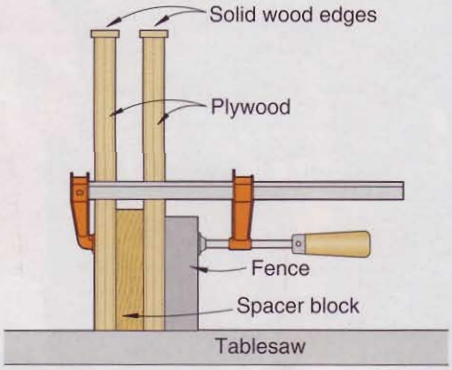


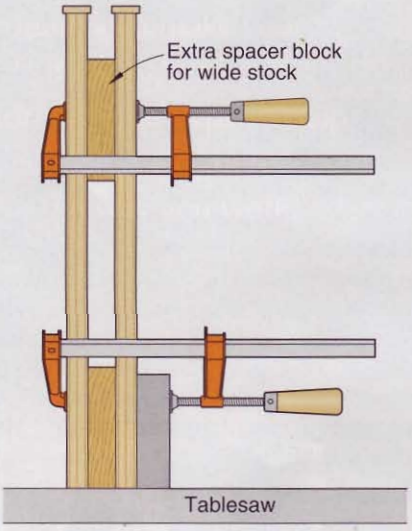
Stabilize workpieces when trimming edging

After I've added solid wood edges to plywood and need to trim them, I use a router with a flush trim bit. To keep the router from wobbling on the ¾" edge or having to make and store some kind of jig to balance the router, I simply do two or more at a time. As shown *below right*, I clamp the plywood pieces onto my tablesaw fence with a spacer block between each pair. This way, the router sits on at least 2¼" of edge. To stabilize wider pieces, I clamp an additional spacer near the top. If the plywood is too large to clamp securely to the fence, I clamp it directly to the table and work sideways.

—Karl Siefert, Philadelphia







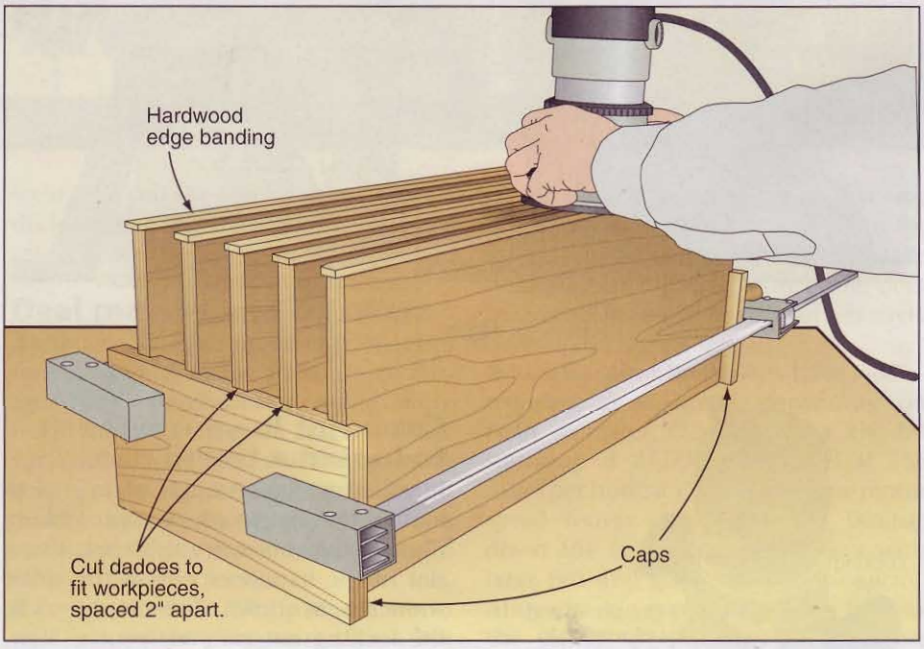
Fast flush-trimming for multiple pieces

Here's another way to quickly trim the solid-wood edge banding on plywood shelves yet still give good support for your router. First, cut dadoes to fit the shelving in a single piece of scrap plywood, then rip that piece down the middle to make two perfectly matched caps.

Clamp the shelves between the dadoed caps, as shown at *right*, then trim the banding with a flush-trim bit in your router. The shelves on either side keep the router from tipping.

If your router wants to tip as you rout the outer shelves, trim all of the inside edges first, then unclamp the caps, swap the outside shelves with a pair of inside shelves, and trim the remaining edges.

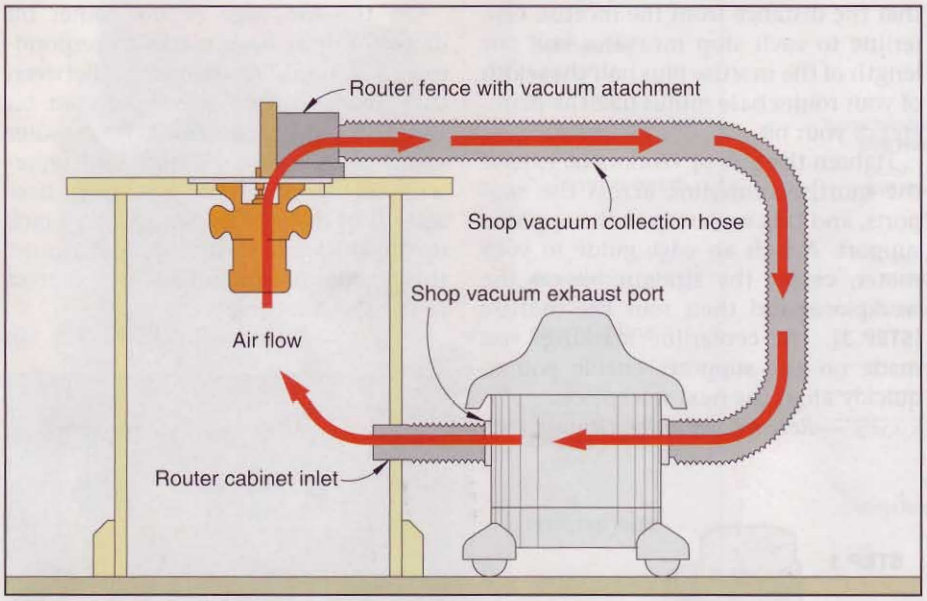
—Ike Evans, Coralville, Iowa



Shop vacuum exhaust helps clean, too

When I built my enclosed router cabinet, I made the compartment right under the router airtight except for an air inlet in the side of the cabinet and the router bit opening. Using an extra piece of vacuum hose, I connected the exhaust port of my shop vacuum to the cabinet inlet so the exhaust air blows up and out through the router bit opening. The extra boost from the exhaust forces wood chips toward the collection hose, which attaches to the fence by the router bit, and helps keep the tabletop clean.

—Robert Field, Springfield, Ohio



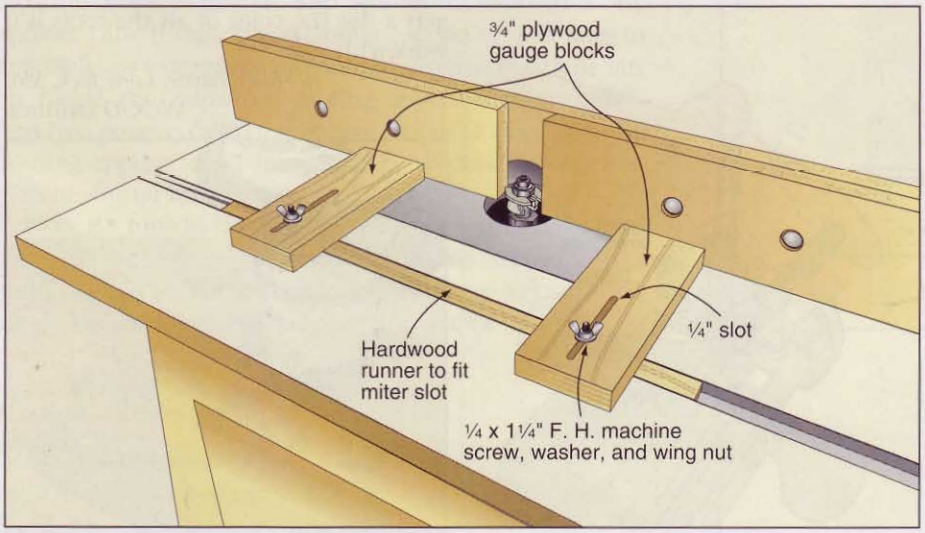
Gauge blocks for faster rail-and-stile setup

When routing rails and stiles on my router table, it takes time to reset the fence flush with the guide bearing and parallel to the miter slot every time I swap bits. The jig shown *below*, however, allows me to instantly repeat the setup.

After perfecting the fence location and locking it in place, I loosen the wing nuts on the jig, set it in the miter slot, slide the blocks up to the fence as shown, and tighten the wing nuts. Finally, I remove the jig, and begin routing.

If you don't have a miter slot in your router table, you can still use the jig. Just make the gauge blocks longer and guide the hardwood runner against the front edge of the tabletop.

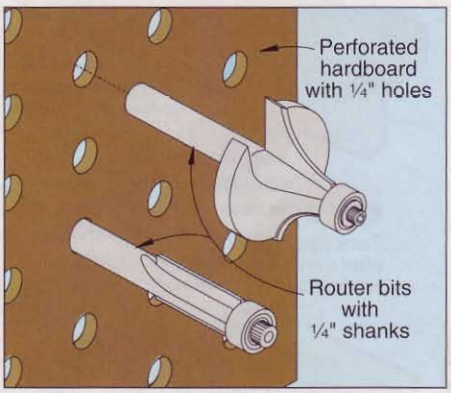
—John Passamonte, Merritt Island, Fla.



Store router bits on perforated hardboard

When using multiple router bits to create fancy profiles, the bits tend to clutter up your work area unless you take the time to put them back in a case or holder. If you're using router bits with ¼" shanks you can simply slip the shanks into the holes of any empty section of perforated hardboard with ¼" holes. The shank of the router bit will fit snugly and the bits won't fall out. If you use ½" shank bits, you can drill a few ½" holes in your hardboard near where you do most of your routing. Space these holes far enough apart that the cutters on your bits don't touch.

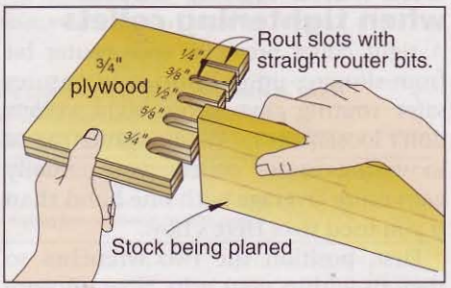
—from the WOOD® *magazine shop*



Routing a gauge prevents planing problems

Anyone who has planed down stock to different thicknesses knows the frustration of planing material too thin. To prevent this, I created an accurate thickness gauge by routing and labeling ¼", ⅜", ½", ⅝", and ¾" notches in a piece of plywood. It's proved faster and more accurate than a ruler.

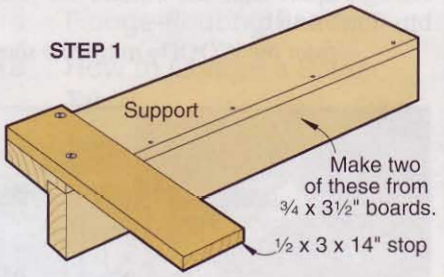
—Mark Liska, Manitowoc, Wis.

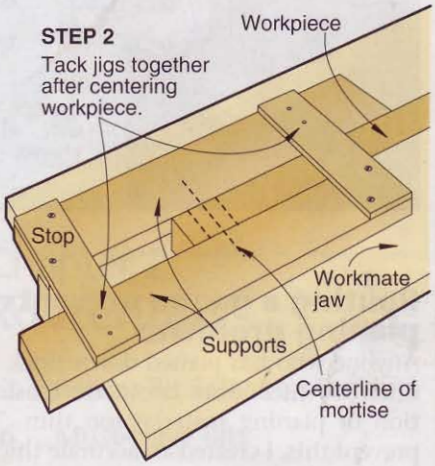


Pull out all the stops when you rout multiple mortises

You need a lot of mortises, but you don't own a mortising attachment for your drill press. And you don't want to spend hours chopping mortises by hand.

Use a plunge router and the jigs shown here to cut mortises as fast as you can rout them. Glue and screw together two jigs as shown in **STEP 1**. Make them about 4" longer than your base plus the length of the mortise.

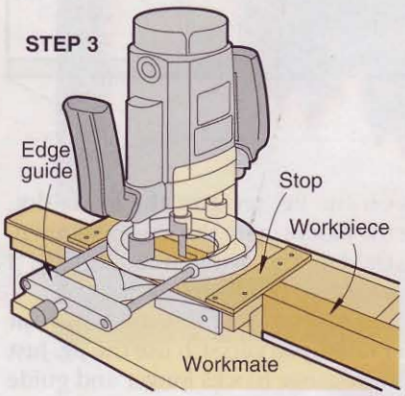




Turn the jigs so the stops face in opposite directions, and loosely position them in a bench vise or Workmate. Slide the board to be mortised between the jigs, with the centerline of the mortise as shown in **STEP 2**. Align the two stops so that the distance from the mortise centerline to each stop measures half the length of the mortise plus half the width of your router base minus half the diameter of your bit.

Tighten the vise or Workmate, extend the mortise centerline across the supports, and tack each stop to the opposite support. Attach an edge guide to your router, center the straight bit on the workpiece, and then rout the mortise [**STEP 3**]. The centerline markings you made on the supports enable you to quickly align the next workpiece.

—Ronan Cambridge, Ottawa, Ont.

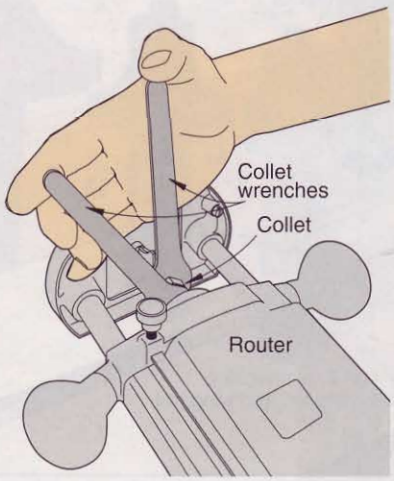


One hand works better when tightening collets

A tight collet prevents your router bit from slipping up or down, and ensures safer routing. But those tight collets don't loosen easily. When tightening or loosening router collets, you actually gain more leverage with one hand than if you used two. Here's how.

First, position the two wrenches so they fit within your grip. Now, squeeze the wrench handles together to tighten or loosen the collet. This way you won't bang your knuckles together.

—from the WOOD® *magazine shop*

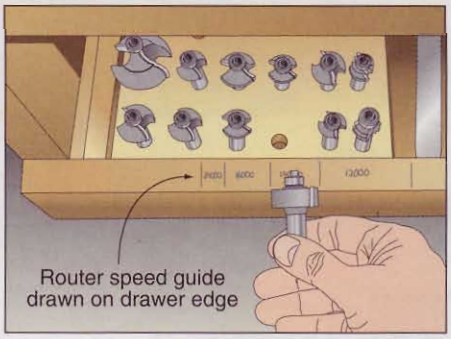


Speed guide adds purpose to router bit storage

In the *WOOD®* magazine speed chart (see *page 26*), you listed the correct speed range to use for router bits of various diameters. This guide gave me an idea.

On the top edge of my router bit drawer, I drew hash marks corresponding to various bit diameters. Between these marks, I wrote the appropriate bit speed from your guide. If your router speed control shows letters that represent the speeds, write the letter here instead of the speed.) Now, when I pick up the bit I want, I simply hold it against this guide to determine the correct router speed setting.

—Kevin Greene, Baskerville, Va.



Color-code tools and jigs

Like many people, I've accumulated several routers, all with various wrenches and accessories that fit only a particular machine. To eliminate the confusion over which accessory goes with which tool, I color-code them by painting a small dot of the same color on a router and all of its accessories. If a jig or accessory works with more than one router, it gets a dot the color of all the tools it'll work with.

—Bill Thorne, Lone Jack, Mo.
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