

7 POPULAR
Woodworking PRESENTS TIPS, TRICKS & EXPERT ADVICE

JANUARY 2008

ESSENTIAL GUIDE TO **ROUTERS**

JIGS, JOINTS & SKILLS
Everything You Need to
WORK LIKE A PRO

BONUS:
The Complete
7-Chapter Guide to
**ROUTER
MASTERY**

**12 BEST
ROUTER JIGS**
Boost Your Accuracy

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ON THE COVER

Routers do more than just decorate edges. Used correctly, a router can be a joinery powerhouse as well.

PHOTO BY AL PARRISH

Essential Guide to

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Woodworking Essentials:

This series of articles from a veteran woodworker and teacher covers all the bases of router use. From choosing and setting up a tool, to making intricate and complex joints, to selecting the right bit for the job, this guide will give you a good start and keep you routing in the right direction.
by Nick Engler

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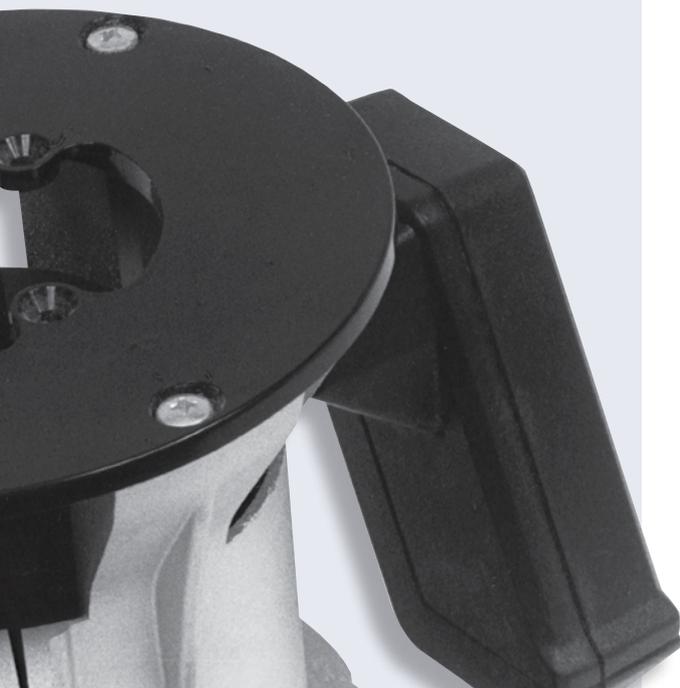
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by Glen D. Huey



JANUARY 2008

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Tip of the Iceberg

Learn router basics from the pros, then discover Titanic techniques that improve your work.

Occasionally I'll meet someone who works wood as a hobby, creates fine projects in his or her shop and does so without using a router. I wonder how that's possible. How can someone become an accomplished woodworker without using a router?

I've used routers for years and for many different operations. And there is so much more to be learned.

The most-known use for routers, the place where nearly everyone begins, is creating decorative edges. And you can do so much more, including mortise-and-tenon joints, cut the pins and tails of dovetail joints and make cabinet doors using cope-and-stick router bits. Just about any profile or joint you make in the shop can be made using a router. And that's just the tip of the iceberg.

Once you delve into routing you'll develop the desire for additional routers. In fact, some woodworkers are proud of the number of routers on their shelf – as if it's a testament to the amount of work they can accomplish in any given week. While that's debatable, the sure thing is they'll work quicker due to not having to change router setups at every turn.

Reading the articles in this issue will increase your knowledge of the router and its accessories and, we hope, increase your woodworking abilities as a result.

The heart of this issue, "Woodworking Essentials," is a compilation of router sub-

jects by Nick Engler originally published in seven installments. Nick is an accomplished woodworker, author and teacher. He's mastered many areas of woodworking including routing and using router accessories. His vast knowledge is presented in a casual, easy-to-understand way. Whether you're a beginner or an accomplished router guru, you'll benefit from Nick's years of router experience.



Also in this issue, author Michel Theriault explains the need for and techniques for making router guides, including an offset base template and a flush-trimming template (the addition of his shopmade system makes the router even more valuable to your woodworking). Jim Stuard demystifies cope-and-stick router bits so you can make

doors that are strong and beautifully detailed. And if you have a Workmate folded up in the corner of the shop, Steve Shanesy shows you how to put it back to use with a shop-made router table. Plus, we've included a couple stories on creating dovetail joints using your router.

This special router issue will open your eyes to the many uses of the router and catapult your routing techniques to the next level. **PW**

Glen D. Huey
Senior Editor

PUBLISHER & GROUP EDITORIAL DIRECTOR

Steve Shanesy

EDITOR Christopher Schwarz

x1407 ■ chris.schwarz@fwpubs.com

ART DIRECTOR Linda Watts

x1396 ■ linda.watts@fwpubs.com

SENIOR EDITOR Robert W. Lang

x1327 ■ robert.lang@fwpubs.com

SENIOR EDITOR Glen D. Huey

x1293 ■ glen.huey@fwpubs.com

MANAGING EDITOR Megan Fitzpatrick

x1348 ■ megan.fitzpatrick@fwpubs.com

PHOTOGRAPHER Al Parrish**CONTRIBUTING EDITORS**

Adam Cherubini, Bob Flexner, Troy Sexton

F+W PUBLICATIONS INC.**CHAIRMAN & CEO** David H. Steward**CFO** John Speridakos**VP, MANUFACTURING** Barbara Ann Schmitz**EXECUTIVE VP, INTERACTIVE MEDIA** John Lerner**DIRECTOR, IT** Mike Kuehn**F+W PUBLICATIONS, INC.**
MAGAZINE GROUP**VP, CONSUMER MARKETING** Sara DeCarlo**DIRECTOR, BUSINESS PLANNING** Tom Wiandt**CONFERENCE DIRECTOR** Sara Dumford**CIRCULATION DIRECTOR** Linda Engel**NEWSSTAND DIRECTOR** Susan Rose**DIRECTOR, DIGITAL MEDIA SOLUTIONS** Michael Kushner**PRODUCTION COORDINATOR** Katherine Seal**ADVERTISING****ADVERTISING DIRECTOR** Don Schroder

331 N. Arch St., Allentown, PA 18104

TEL. 610-821-4425; FAX 610-821-7884

d.schroder@verizon.net

DISPLAY AND CLASSIFIED ADVERTISING
SALES COORDINATOR

Nancy Miller

TEL. 513-531-2690 x1228

nancy.miller@fwpubs.com

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

We've got the router bits and accessories that you are looking for.

Here are 7 of the over 400 router bits that we carry.



Stanley #55 Molding Router Bits

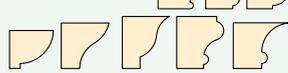
A stunningly complex yet incredibly versatile tool used to make a near limitless variety of moldings, the Stanley Tools #55 Universal Combination Plane was largely produced during the first 60 years of the 20th century. Many of the unique moldings it produced still exist in buildings but are not easily reproduced, making repairs and restoration efforts difficult. With these bits, you can now produce many of the same moldings you could have done with a #55. Based on 23 of the blade profiles that are most difficult to reproduce, they can be used alone for simple moldings or in combination for more complex profiles. All have 1/2" dia. shanks and a 3/4" minor cutting diameter. For some, this allows use of a 1/2" I.D. by 3/4" O.D. shank bearing (not included) when cut depth control is desired.

Made in Taiwan, all our router bits have CNC-ground tungsten-carbide inserts. The bodies have a non-stick coating for easy resin removal, and most are double flute for a smooth cut. Each includes a friction-fit bit holder.

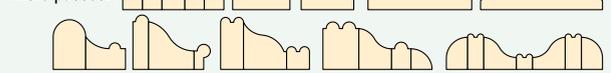
A. Beading Bits

	A	B	Rad.	
16J55.61 •	7/8	1/4	1/16	\$18.80
16J55.62 •	15/16	5/16	3/32	\$20.40
16J55.63 •	1	3/8	1/8	\$21.40
16J55.64 •	1 1/16	7/16	5/32	\$22.80
16J55.65 •	1 1/8	1/2	3/16	\$23.50
16J55.66 ••	1 3/16	9/16	7/32	\$24.90
16J55.67 ••	1 1/4	5/8	1/4	\$27.60
16J55.68 ••	1 3/8	3/4	5/16	\$32.50

Profiles made in one pass.



Profiles made in two or more passes.



B. Quarter Hollow Bits

	A	B	Rad.	BB	
16J55.71 •	1 17/32	1/2	13/32	•	\$27.60
16J55.72 •	2	23/32	5/8	•	\$37.80

E. Grecian Ogee Bits

	A	B	C	
16J55.86 •	1 5/32	1/2	13/64	\$23.40
16J55.87 ••	1 7/16	3/4	1 1/32	\$27.60
16J55.88 ••	1 1/2	1	3/8	\$34.90

C. Reverse Ogee Bits

	A	B	C	Rad.	BB	
16J55.81	1 3/8	1/2	5/16	1/4	•	\$26.60
16J55.82 •	1 11/16	3/4	15/32	7/16	•	\$35.20
16J55.83 •	1 13/16	1	17/32	31/64	•	\$37.80

F. Round with Bead Bits

	A	B	Rad. 1	Rad. 2	
16J55.91 ••	1 1/2	2 1/32	3/32	3/8	\$30.60
16J55.92 ••	1 7/8	7/8	7/64	9/16	\$37.80

D. Roman Ogee Bits

	A	B	C	Rad.	BB	
16J55.84 •	1 1/2	5/8	3/8	3/8	•	\$30.60
16J55.85 •	1 13/16	7/8	17/32	9/16	•	\$36.90

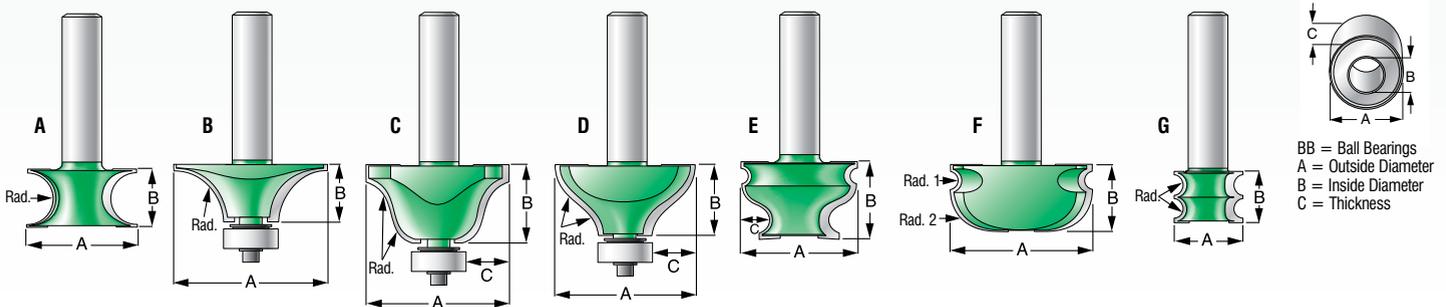
G. Reeding Bits

	A	B	Rad.	
16J55.93 •	7/8	7/16	1/16	\$21.40
16J55.94 •	15/16	9/16	3/32	\$22.00
16J55.95 •	1	1 1/16	1/8	\$23.40

- Bits marked with this symbol include bearing 16J95.08.
- Bits marked with this symbol accept shank bearing 16J95.09 (sold separately).
- For better safety, bits marked with this symbol should be used only in a router table equipped with a fence and not used free hand.

Bearing	A	B	C	
16J95.08 •	3/4	1/4	5/16	\$4.90

Shank Bearing	A	B	C	
16J95.09 •	3/4	1/2	3/16	\$7.50



For more details on these bits and to see our complete line of router accessories, call to request a free 300-page woodworking tools catalog or visit us online.

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ROUTER Table-Mate

Everything you'd want in a router table for just \$50 and a long weekend in your shop.

Commercially made router tables are everywhere these days. Some of them come with more gizmos and gadgets than a '59 Edsel. By the time you tally up all the add-ons, the price approaches a medium-duty shaper. Here's my short list of "must-have" features for a good router table:

- A table the size of a carrier deck.
- Compact design so it can store easily.
- A stout fence that's long and easy to adjust.
- Easy bit-height adjustment with no stooping.
- Great dust collection.
- A \$50 price tag.

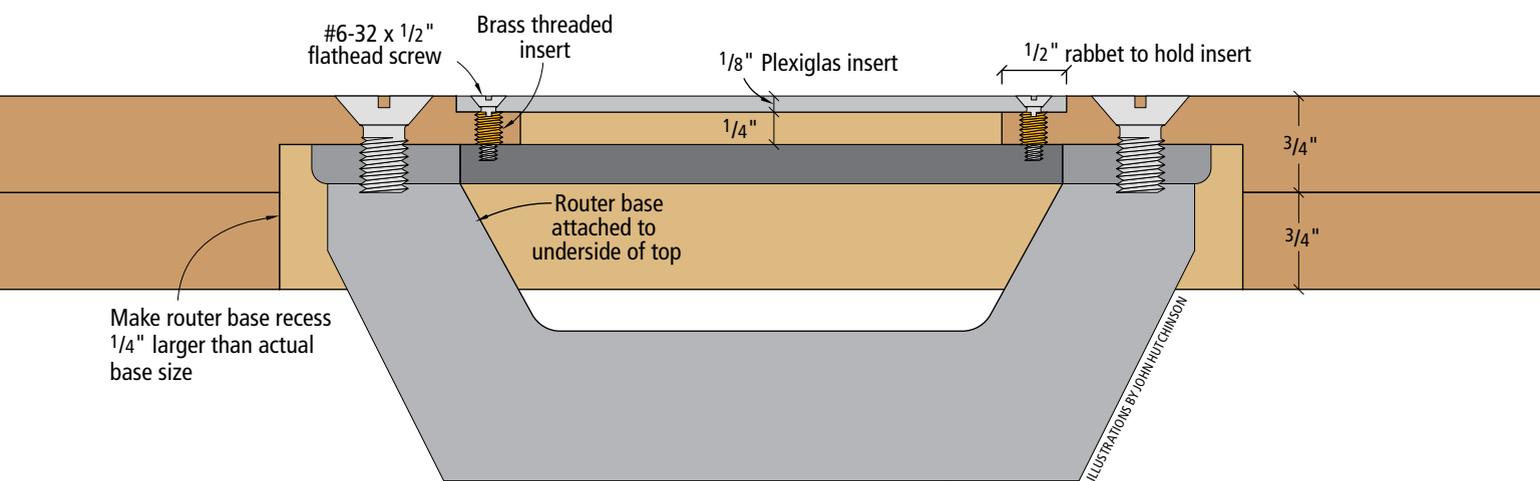
With all these features in mind, I hit on the idea of using my folded-up Workmate stored under the stairs. Can't I just make a top for it? Then I remembered the great idea from Nick Engler in Chapter 7 of the Woodworking Essentials section in this issue. Nick made the top of his router table tilt up for easy adjustments. Bingo. Now my Work-

by STEVE SHANESY

Steve is the publisher of *Popular Woodworking*. You can contact him at steve.shanesy@fwpubs.com.



PHOTOBYVAL PARRISH



Make router base recess 1/4" larger than actual base size

mate/router table goes right back under the stairs and takes up only another 1 1/2" of space, the thickness of the router tabletop. You can also use this router table without a Workmate. A simple pair of sawhorses will suffice.

Customizing Your Table

While the fence is generic to any router-table setup, the table needs to be customized for your needs. You may have a different brand router than I do, so you will have to relieve the underside of the table to accommodate the shape of your tool. You'll also have to locate the mounting holes for the base to suit your router. You may prefer a different table height. If you are below average height, you'll want the make the angle at which the table props up less steep.

The top is made from two pieces of 3/4" birch plywood that are glued together and banded with 3/4"-thick solid birch. Before gluing anything together, it's best to work on the top plywood piece. Since you must rout out the underside of this top piece where the router base will be mounted, do it before gluing the two sheets together. The hole in the bottom sheet can be simply cut with a jigsaw.

First, lay out where you want your router base to be mounted

and find the exact center of the base. I put the centerpoint on my table 8" in from the back edge and centered right to left. So once the point is established, drill a 1/16" hole straight through to the other side. You'll need this location for work later on.

Now set up a router with a circle-cutting jig (see page 90) and a 1/2" straight bit. Set the bit so it will cut to a depth that will leave a 3/8" thickness in the plywood top. Cut a circle (assuming your router has a round base) on the underside of the top that is approximately 1/4" larger in diameter than the router base. Place the circle jig's indexing pin in the center hole you drilled. Rout the circle and the remaining waste inside the circle.

Next, turn the plywood piece

over. Use your center hole and circle jig to cut a 1/8"-deep circular rabbet or ledge for your plastic inserts to fit into. The insert diameter is 4 3/4". But before you use this insert size, check the size of your router's base. You may need to make a smaller-diam-

eter insert based on the size of your router base. The router I mounted in the table is a massive Porter-Cable 7518. I made the insert hole size large enough to accommodate the largest diameter router bits.

Now make the hole the router



A larger base for the router was the ticket for bridging the open areas left by routing out the plywood for the router's base. It was also used as a small circle-cutting jig for the tabletop and plastic inserts. Use the same cutter and it's easy to keep track of dimensions for cutting inside or outside circles.

ROUTER TABLE-MATE



As you assemble the fence, make sure it is square along its length. Be sure and check it again after it is clamped up.



Break in your router table by milling the slots in the fence subfront that will allow the fence faces to adjust into or away from the router bit. Lay out the stop/start lines and plunge cut the slots.

bits pass through. Leave a ledge about $\frac{1}{2}$ " wide all around for the removable inserts to rest on.

Now take the second piece of plywood and jigsaw the cut to accommodate the router base. Also, make any cuts necessary to allow for your router base's

handles. When done, glue the two sheets together. Keep the edges flush.

When the glue is dry, trim the top to finished size on the table saw. Now prepare some stock for the solid-edge banding. Miter the corners and glue the band-

ing on. Make sure it is flush to the top. When dry, sand everything flush, then rout a roundover profile on the top edge.

Tabletop Inserts

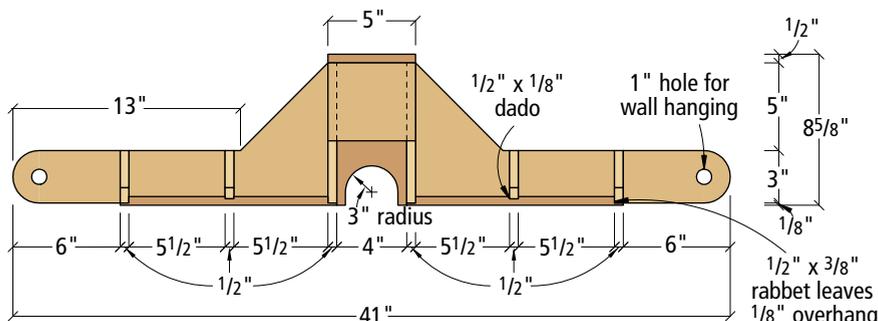
Make the round tabletop inserts from $\frac{1}{8}$ " acrylic. I made three

inserts to cover most of the router-bit sizes I'd encounter. First set the circle jig to cut a circle that is the same size as the insert hole. Set your router to make an outside cut instead of an inside cut. To rout the acrylic, just drill a hole to accommodate the circle-cutting jig's pin or nail.

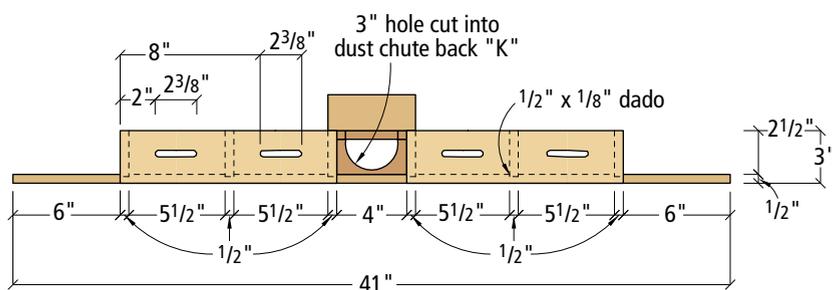
The three hole sizes I made in the inserts were 1", $1\frac{3}{4}$ " and $2\frac{3}{4}$ ". The smaller holes were drilled using hole saws but the larger size required the circle-cutting jig.

Complete the Top

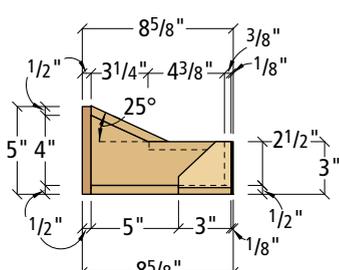
To fasten the inserts to the table, install three threaded inserts in the rabbet. I used inserts for a $\frac{6}{32}$ flush machine screw. Once installed, transfer their locations



Plan



Elevation



Profile

to the acrylic inserts, then drill and countersink the plastic.

Next, make a new piece to replace the rear board on the Workmate's table. The homemade board is narrower and allows the router to swing up unencumbered. Cut the board to the dimensions given in the materials list and locate holes that match those in your existing Workmate. The new board is slightly shorter than the original. Install the Workmate connecting hardware and place the board in the furthestmost connecting hole of the Workmate.

On the underside of the router tabletop you'll need to install a piece of $\frac{1}{2}$ " material where the stick that supports the top in the open position locks in place. I used a $\frac{3}{4}$ " dowel for a prop stick and drilled an oversized hole on a 25° angle in the block to nest it.

As mentioned earlier, the length of the prop stick will depend on how tall you are. On the end of the stick opposite the 25° angle, drill two holes that

intersect each other to allow the stick to pivot in two directions, side to side so that it can be lowered when not in use and angled to allow you to tip it forward when propping the tabletop. Use a stout wood screw, a #10 or #12, to connect the prop stick to the edge of the new shop-made top board.

Next use a pair of hinges to connect the top to the Workmate's front board. Locate them about 4" in from each end.

Now Make the Fence

Keep in mind the most important factor in making the fence is that it is straight and square to the table. It could be shimmed later, but you'll be fussing with it forever.

Start by laying out the full-size shape of the bottom piece on the material you'll actually use. Be sure you have a true, straight edge for what will be the front.

Go ahead and lay out where the dados will be cut, including where the half-round throat opening for the router will be.

It's best to do the layout by first establishing the center of the length of the fence and working out from there. When done, cut the back shape. It need not be pretty.

Next cut out the two subfronts for the fence. Install your dado blade on the table saw to cut the thickness of the Baltic-birch plywood.

Now set the dado blades to make a $\frac{1}{8}$ "-deep cut. While holding the front edge of the fence bottom against the slot miter

gauge, cut the six dados, following the layout lines already marked. When done, cut the center dado on the subfronts making sure it locates precisely where the dado in the bottom falls.

Next raise the dado set to cut $\frac{3}{8}$ " deep and run the rabbets on the ends and bottom of the fence subfronts. Remove the dado and cut the fence ribs and pieces that make up the dust collection chute. Use the diagram for the shape. Before assembling the fence, cut the half



Inside view of the dust chute from the rear including the plastic 4" to 3" dust-collection hose adapter. Rout the 3" hole for the adapter with the circle-cutting jig or use a "fly cutter" in your drill press.



Once the tabletop is hinged to the Workmate's front board, it's easy to locate the positions for the prop stick and stick bracket. Note the shop-made replacement board for the Workmate top.

ROUTER TABLE-MATE

circle in the fence bottom for the throat opening, then use a rasp to slope the back edge for more efficient dust evacuation.

Assemble the Fence

Be careful when you assemble the fence to make sure it goes together square. First dry fit all the parts to be sure you have a good fit. Then glue the ribs and dust chute sides to the bottom, making sure all the edges are flush to the front edge. If you have a brad nailer, set these in place with a couple short brads. Glue the fence subfronts to the bottom and ribs. Clamp front to back until the glue dries.

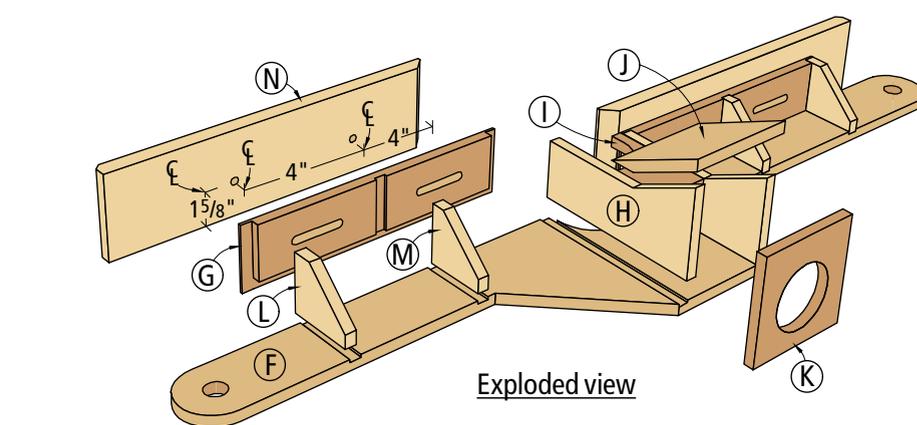
Now cut the three remaining dust chute parts: the top, angled top and back. Cut a half circle in the top similar to the one in the fence bottom.

After the glue in the fence assembly has dried, glue the dust chute top in place. Afterward, install the angled top and the back piece. The angled top requires a steep angle cut on the lower edge to seat down to the flat top. I cut this angle on my band saw. The back of the chute requires a hole for dust collection. The chute is set up to take a 3" hose or a fitting that reduces a 4" hose to a 3" hose. I used a "fly cutter" in my drill press to make the 3" hole. To complete the assembly of the dust chute, screw the angled top, then the back in place.

Use Your New Router Table

Now use your router table to mill the slots in the fence's subfronts that allow the fence fronts to slide left to right.

Set your router in the table with a $\frac{3}{8}$ " straight bit. Make a temporary fence from a straight piece of scrap and clamp it to the tabletop. Use the fence diagram for setting the distance. Cut the 2"-long slots in the center of the



ROUTER TABLE AND FENCE

NO.	LET.	ITEM	DIMENSIONS (INCHES)			MATERIAL
			T	W	L	
2	A	Tabletop	$\frac{3}{4}$	23	35	Birch ply
1	B	Top edge banding	$\frac{3}{4}$	$1\frac{1}{2}$	11 ft.	Solid birch
1	C	Workmate board	$\frac{3}{4}$	4	$27\frac{3}{8}$	Any hardwood
1	D	Prop stick	$\frac{3}{4}$	$18\frac{3}{4}$		Dowel stock
1	E	Prop bracket	$\frac{1}{2}$	$1\frac{1}{2}$	4	Baltic birch
1	F	Fence bottom	$\frac{1}{2}$	8	41	Baltic birch
2	G	Fence sub fronts	$\frac{1}{2}$	3	$12\frac{1}{2}$	Baltic birch
2	H	Dust chute sides	$\frac{1}{2}$	$4\frac{1}{8}$	8	Baltic birch
1	I	Dust chute top	$\frac{1}{2}$	4	5	Baltic birch
1	J	Chute angled top	$\frac{1}{2}$	5	$4\frac{3}{4}$	Baltic birch
1	K	Chute back	$\frac{1}{2}$	5	5	Baltic birch
2	L	End ribs	$\frac{1}{2}$	$2\frac{5}{8}$	3	Baltic birch
2	M	Mid ribs	$\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{5}{8}$	Baltic birch
2	N	Fence adjust. front	$\frac{3}{4}$	4	16	Any hardwood

HARDWARE

- 3 • 6/32 threaded inserts and $\frac{1}{2}$ "-6/32 screws
- 4 ea. • $\frac{3}{8}$ " x $1\frac{1}{2}$ " roundhead machine screws, star washers, flat washers and wing nuts
- 1 pr. • medium-duty loose-pin hinges
- 1 • 12" square acrylic, $\frac{1}{8}$ " thick.
- 1 • switched plug strip

openings between the ribs.

Make the adjustable fronts from a tight-grained hardwood such as maple. Be sure the material is flat and straight. Cut the two pieces to the lengths given. Make bevel cuts on the ends as shown in the diagram. Carefully locate the hole locations where the $\frac{3}{8}$ " machine screws attach the fronts through the slots in the subfronts. Drill and countersink the holes. For attachment, I used the screws along with star washers, flat washers and wing nuts.

The last detail is to cut a small piece of acrylic as a "window" on the top of the dust chute into the router opening area below. **PW**



Attach the fence faces using $\frac{3}{8}$ " roundhead machine screws, a star washer, flat washer and wing nut. I tried using hex-head bolts but switched to screws because a screwdriver can be used and makes a more secure attachment with less trouble.

HOUSED

Dovetails

A super-slick trick to make a super-strong and traditional joint.

The housed dovetail joint is mechanically sound, historically correct for 18th-century casework and a hallmark of fine craftsmanship. It provides an accurate means of locating drawer dividers and runners, and is quite useful when making shelves. If you can mill stock straight and square, control your stock thickness, make dados and operate a router, then you can make this joint. When assembling case pieces or shelves, you will have little need for glue, screws or nails.

Dados alone have little mechanical strength, but with the addition of a dovetail socket and dovetail tenon, the joint is properly aligned and quite strong. This joint allows cases to be made without face frames.

When the housed dovetail joint is used for shelving, the shelves are prevented from cupping because the shelves are

by **GEOFFREY AMES**

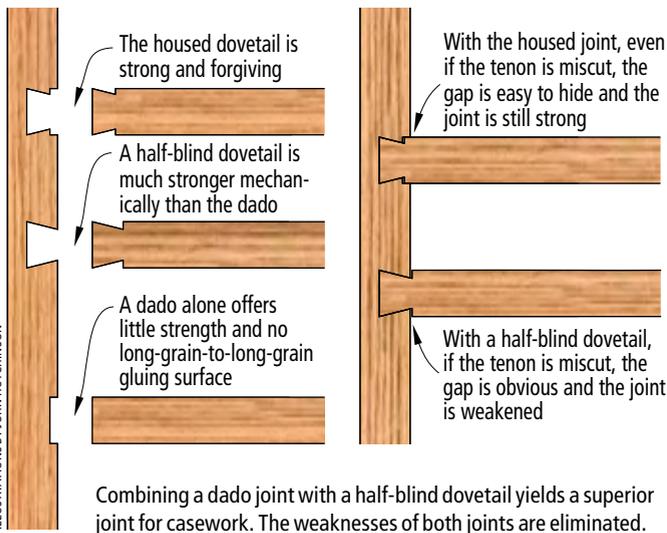
Geoffrey builds 18th-century period furniture and teaches at the Homestead Woodworking School in New Market, N.H.



PHOTO BY AL PARRISH

HOUSED DOVETAILS

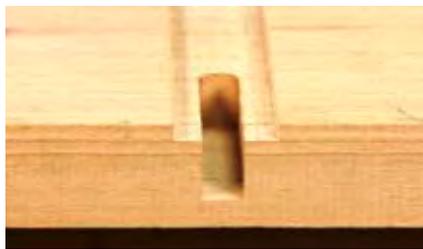
ILLUSTRATIONS BY JOHN HUTCHINSON



The $\frac{3}{4}$ " outside-diameter guide bushing must be reduced in length to protrude less than $\frac{1}{8}$ ". This modification allows the base of the router to lay flat on the workpiece.



The first step is to mill all of the dados to a depth of $\frac{1}{8}$ " with a $\frac{3}{4}$ "-diameter straight router bit.



Use the modified guide bushing and a $\frac{3}{8}$ " straight bit to prepare the socket for cutting the dovetail.



Use the same guide bushing and a $\frac{3}{4}$ " dovetail bit to finish the dovetailed part of the joint.

held flat in the straight, shallow dados.

Much of my work replicates 18th-century case pieces such as chests and highboys. For years, I made furniture by laying out the housed dovetail joinery, carefully handsawing, then chiseling the dovetail sockets. This slow and inefficient process tested my patience enough that I began my search for a quicker, more accurate method.

I like to make the housed dovetail joint with a dado roughly $\frac{1}{8}$ " deep. The dado is used to align and strengthen drawer runners or shelves. By housing the shoulders of runners or shelves, the joint doesn't invite gaps like a half-blind dovetail joint will, as seen in the drawing.

Searching for a Solution

As I tried out different methods, I built numerous sleds and

edge guides, but my only success required the use of a sled and two matching routers – one fitted with a $\frac{3}{4}$ " O.D. straight bit, the other with a $\frac{3}{4}$ "-14° dovetail bit.

My search for a simple solution led me to milling all the dados prior to routing the dovetail sockets. But aligning the dovetail bit with the dado was not possible because a standard $\frac{3}{4}$ " guide bushing was too deep for the $\frac{1}{8}$ "-deep dado, and the $\frac{3}{4}$ " dovetail bit interfered with or would shear the guide bushing. Then it occurred to me that what I really needed was a shorter guide bushing.

Get a standard $\frac{3}{4}$ " O.D. Porter-Cable router-guide bushing and reduce the protruding guide to slightly less than $\frac{1}{8}$ ". You can cut the excess off with a hacksaw, and then file or grind the cut edge smooth.



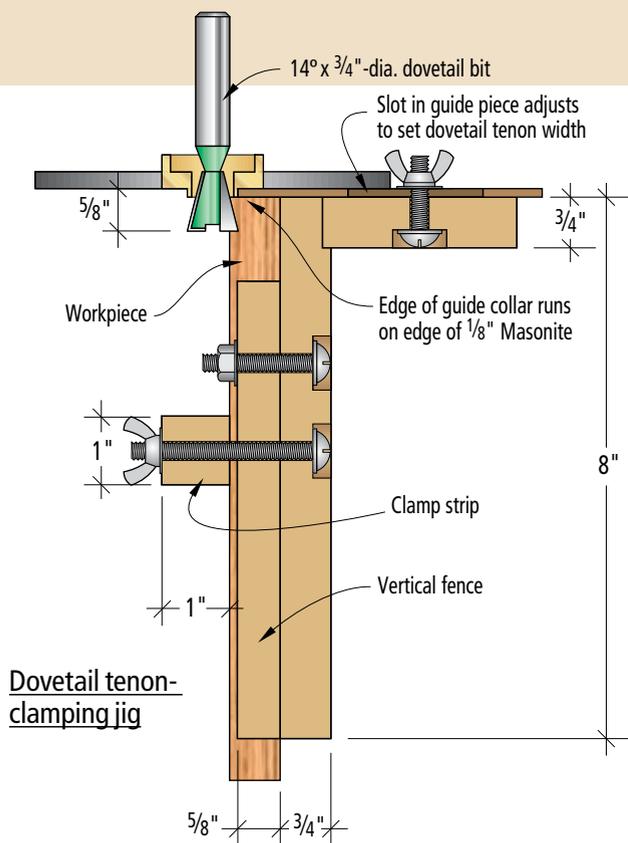
As you slide the router along the edge, the guide bushing and dovetail bit will enter the dado together.

Now you can set up your router with the modified guide bushing and a $\frac{3}{4}$ "-14° dovetail bit as seen in the photo above. The bottom edge of the dovetail bit should protrude a bit less than $\frac{1}{2}$ " below the guide bushing, for a total depth of about $\frac{5}{8}$ ". Be sure your stock is thick enough to prevent routing through your workpiece. I recommend using

$\frac{13}{16}$ " or $\frac{7}{8}$ " stock for case sides. The drawing at the top of this page shows the proportions and appearance of the finished housed dovetail.

A Simple Formula

To successfully make the housed dovetail joint there are a few milling, tooling and setup requirements. The dado must



Dovetail tenon-clamping jig

be a minimum width of $\frac{3}{4}$ " to allow a $\frac{3}{4}$ " guide bushing to ride into the dado to create the dovetail socket. The dados should be slightly deeper than the depth of your modified guide bushing. The stock thickness for the drawer dividers or shelves of your case should be identical to the width of your dados.

After milling all the dados with a $\frac{3}{4}$ "-diameter straight router bit, set up the router with the modified $\frac{3}{4}$ " guide bushing and a $\frac{3}{8}$ "-diameter straight bit. Clearing out the socket with this bit first will reduce the amount of material the dovetail bit will have to remove at the next stage.

When you have pre-cut all the sockets, switch your router setup to the dovetail bit. Securely clamp your workpiece to your bench, lock your router bit's depth and turn on your router. The photos in the middle of the facing page show the sequence of the cuts you need to make.

The router is slid along the face of the case side, from left to

right. The dovetail bit and the guide bushing locate the dado and enter the dado at the same moment. Keep the router base firmly down on the case side and carefully guide the router into and out of the socket without lifting the tool from the work.

Slide the router up to your stop line then retract. If you turn off the router while it is in the socket the dovetail bit may be pulled down and ruin your work. Cleaning out the socket with a $\frac{3}{8}$ " bit prior to routing the dovetail socket helps prevent this. You'll likely experience some tear-out where the router exits the socket. Make your workpiece about $\frac{1}{8}$ " wider than the finished dimension to allow for edge cleanup. Any tear-out is easily removed by a few passes over the jointer.

On to the Matching Tenon

Of course the dovetail socket requires a matching dovetail tenon. With an easy solution to making the female part of the joint, I looked for an equally sim-



This clamping jig lets me quickly make the tenons without adjusting the router setup. The work is clamped vertically below the Masonite guide piece.



The secret to this jig is the $\frac{1}{8}$ "-thick Masonite guide piece. This matches the depth of the dado, so the only adjustment needed is to move the guide piece in or out to establish the finished width of the dovetail tenon.

ple method to cut the dovetailed tenons on the end of the drawer divider or shelf. I came up with this jig that uses the same $\frac{3}{4}$ "-14° dovetail bit and router setup.

The common method used to create dovetail tenons is to mount the same dovetail bit used to rout the sockets in a router table and run the long narrow dividers vertically, twice at each end. This method is precarious and shaky at best. An alternative is a horizontally mounted router, but my method uses a simple and easy-to-make jig as seen above.

When setting up the vertical dovetailing jig, make some trial passes on scrap the same thickness as your workpiece so that the top of the bit barely touches the top edge of the board. Move

the jig top in or out to adjust the tenon thickness to match the $\frac{3}{4}$ " width of the socket.

The $\frac{1}{8}$ "-thick Masonite on the top of the jig is equal to the depth of the dado cut in the side of the case. With the base of the router on top of the Masonite, and the edge of the bushing against the edge of the Masonite, the tenons can be made without changing the router setup.

The stock used for the drawer dividers and runners should be milled to precisely the same thickness as the dados. This housed-dovetail system is based on $\frac{3}{4}$ " tooling. Consequently, the dados, dividers, runners or shelves should be uniform, flat and straight. Good stock preparation is absolutely essential for good results. **PW**

THE \$22

Dovetail Jig

You don't have to be a master craftsman or have deep pockets to cut perfect half-blind dovetails.

Seems to me that most people think there are only two ways to cut half-blind dovetails: by hand or with a jig that can cost as much as \$300. As someone who makes a lot of custom furniture, I can tell you that neither method has ever worked well for me. Sure, the size and spacing of hand-cut dovetails are easily customized, and it's nice to sometimes work in a quiet shop. But the handwork just takes too long when time is money. Dovetail jigs, on the other hand, are fast. But the size of your drawers is dictated by all but the most expensive jigs on the market.

That's why I've come up with a method that's fast enough to use in a professional furniture shop but allows you to space the tails almost anyway you want. The price? Only \$12 for a template guide and \$10 for a carbide-tipped dovetail bit (you'd have to buy both for a dovetail jig, anyway). I've probably made

by **TROY SEXTON**

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



more than 500 drawers using this method, and if you own a router, table saw and band saw you can make them yourself this way this weekend.

In a nutshell, here's how it works. While you're ripping your drawer pieces to width, rip an extra piece of scrap to use as a template. Use a dado stack in your table saw to cut notches on one end of the template. One

notch for each tail. Clamp the template to the back side of your drawer front. Install the template guide and dovetail bit in your router, set the depth and run the router in and out of the notches. Congratulations. You've just cut the pins.

Now use the pins to lay out the tails on one drawer side. Cut the tails on your band saw. It's simple work. Occasionally you'll then

have a little fitting to do, but after a little practice your dovetails will fit snugly the first time.

Get Started

When you're doing this for the first time, keep in mind that all the measurements and settings I'm about to give you apply to drawers with $\frac{3}{4}$ "-thick fronts and $\frac{1}{2}$ "-thick sides. Use a template guide in your router (a common $\frac{11}{16}$ " or $\frac{3}{4}$ " will work fine) and a $\frac{1}{2}$ "-diameter dovetail bit with sides that slope 14° . See the "Supplies" box at the end of the article for ordering information.

Begin by making the template. They're real easy to make. So easy, in fact, that I've got dozens of them for almost every size drawer I need. While you're ripping out your drawer parts, rip an extra piece of $\frac{5}{16}$ "-thick stock for the template. Check the depth of your bushing because the thickness of your template needs to be slightly thicker than the depth of

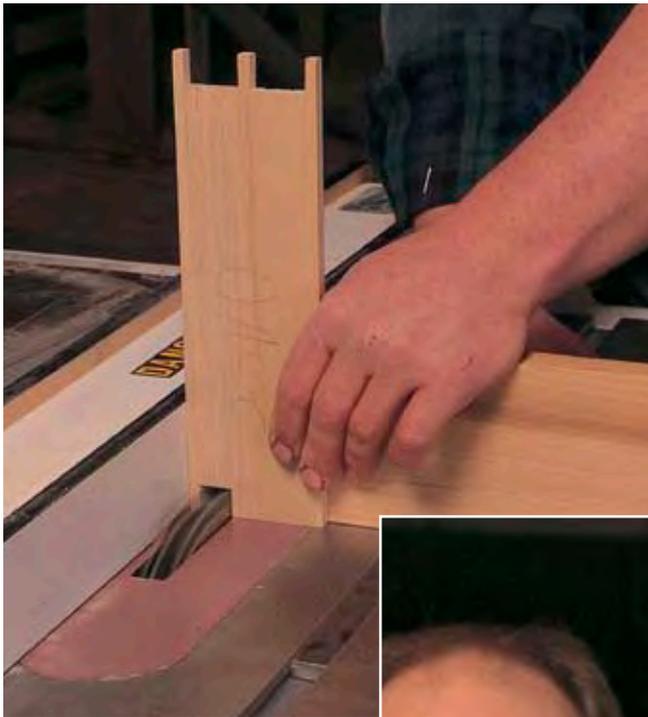
your bushing. For this particular drawer, my sides were 3" wide.

Now go to your table saw and set up a dado stack. Don't worry about how wide the dado cut is, the idea here is to get a feel for how this system works. You'll see how to fine-tune the tails after you make a few templates. Set the height of the dado stack to $\frac{11}{16}$ ". Now set your table saw's fence so there's $\frac{1}{4}$ " of space between the fence and blade. Using your miter gauge and a piece of scrap attached to it, run the template on end as shown in the photo.

Turn the template around and run the other side of the template. Now move the fence away from the blade and remove more material from the template until you have three teeth on the template, each $\frac{1}{4}$ " wide as shown in the photo.

Cut the Pins

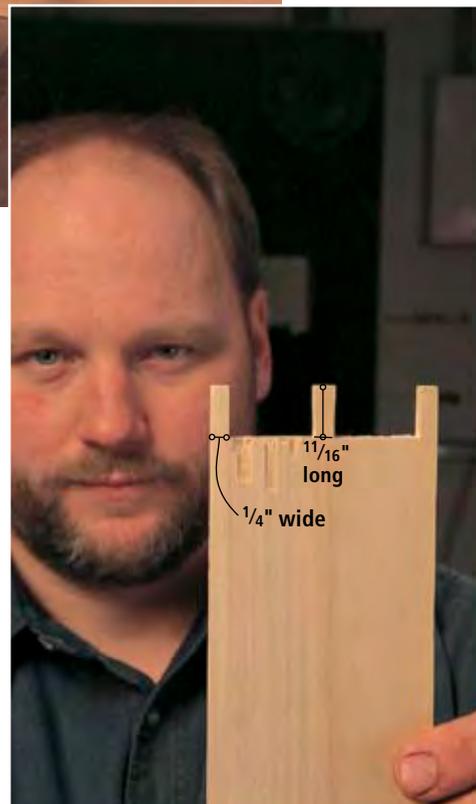
Now cut the pins in the drawer front. Put the drawer front face-



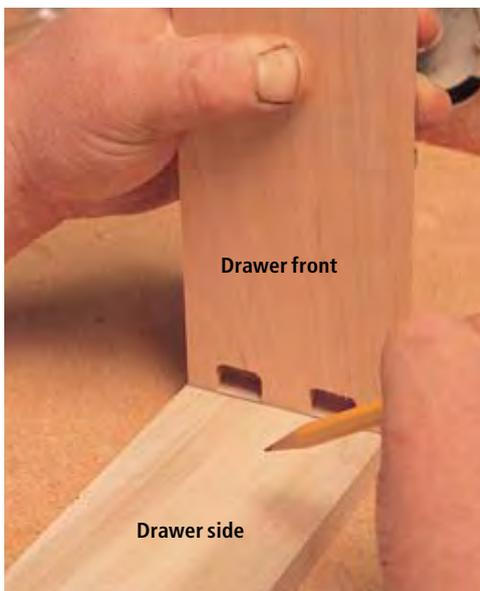
(Above) A dado stack in your table saw is all you need to make the template for routing the pins. Don't worry too much about tear-out on the backside of the work. It's just a template.

(Right) When you finish making the template, here's what it should look like. For this 3"-wide drawer, I made two notches. Each of the teeth is $\frac{1}{4}$ " wide. You can make the notches almost any width you want. The spacing can be varied by using a smaller template guide in your router.

(Far right) Here you can see how the bushing rides against the template, while the bit cuts the pins. When you cut your pins be sure to stand in front of the work so you can better see what you're doing. I stepped aside for the photo.



THE \$22 DOVETAIL JIG



Now lay out the tails by tracing around the inside of your pins. A sharp pencil is key.

Cutting the tails on a band saw is a breeze once you get the hang of it.

SUPPLIES

- Bushings are available from many catalogs. Woodcraft carries several universal bushings that fit a wide range of routers. Price of the bushing: \$8.50. The lock nut costs \$3.50.

Woodcraft
800-225-1153
or woodcraft.com

- Carbide-tipped dovetail bits ($\frac{1}{2}$ " diameter, 14° slope) are available from almost every woodworking catalog and home center. Expect to pay about \$10 on average, and a little more from specialty bit manufacturers.

Prices correct at time of publication.

down on your bench. Line up the template on top of it and clamp the two together to your bench. Install the bushing in your router and then the dovetail bit. Set the bit's height to $\frac{3}{4}$ " (including the bushing on the router's template guide). Different depths will work. I use $\frac{3}{4}$ " because the amount of carbide on my dovetail bit suits that depth perfectly. Cut the pins by running the router in and out of the notches.

Cut the Tails

The hard part is now done. Unclamp your drawer front and place it on top of its mating drawer side as shown in the photo. Using a sharp pencil, trace the outline of the tails onto the drawer side. Cut the tails using your band saw or coping saw. Be sure to cut outside the lines for a tight-fitting joint. If necessary, pare the tails with a chisel. Then comes the moment of truth.

Let me say that after a couple attempts the truth won't hurt so much, so don't get discouraged. I think you can now see how easy it is to customize the



After a while you'll have enough templates to cut dovetails for almost any drawer.

location and size of your tails. Use a smaller-diameter bushing and you can make your tails even closer together. This will require some trial and error on your part. Basically, the outside

teeth will have to be slightly wider than $\frac{1}{4}$ ". And if you make different-sized notches in your template, you'll produce drawers that are impossible to make with a \$99 dovetail jig. Best of

all, you can stop planning your projects around a jig, and you'll be cutting dovetails fast enough to have some hope of finishing your project when you actually thought you would. **PW**

COPE-AND-STICK Joinery

Learn to set up and use a matched set of router bits to create doors that are strong, easy to make and beautifully detailed.

Cope-and-stick joinery today is all about tungsten carbide. But the origins of this important door-joinery method are rooted in the world of moulding planes, chisels and backsaws. A little history is in order as to the origin of the terms “cope” and “stick.” According to Graham Blackburn, a noted author on woodworking and its history, frame-and-panel construction came into its own back in the 14th and 15th centuries. Different methods evolved for joining a rail and a stile together and capturing a panel. The object is, of course, to circumvent wood movement and make stable panels and doors for furniture.

When the frame required a profile on the inside, it was made with moulding planes. This is

by **JIM STUARD**

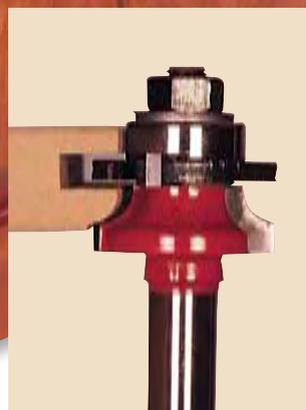
Jim is a former associate editor of *Popular Woodworking* magazine and professional woodworker.



PHOTO BY AL PARRISH



Cutting the cope on the rail's end.



Cutting the stick.

COPE-AND-STICK JOINERY

referred to as a “stuck” moulding. As in, it’s not an applied moulding; it’s “stuck” on or made on the existing edge, hence the term “stick.” The rail and stile were joined using a mortise-and-tenon joint with a miter on the moulded edge, where the rail and stile met. This is commonly referred to as a “mason’s miter.” “Coping” comes from its actual definition: “to deal with a problem.” In the case of rail-and-stile joinery, the problem was dealing

with the stuck edge. The solution was to make an opposite of the stuck profile that fit over the edge, filling the profile.

With the advent of mechanization in the 19th century, different, faster methods had to be devised to join those pesky rails and stiles. Enter high-speed cutting tools. They could be set up to make thousands of feet of stuck moulding, then the opposite of the cutter could be made to cut the cope on the rail ends.

Which Bit is Right for Me?

You can still make cope-and-stick doors using moulding planes, but most people use a router in a router table. Router-bit catalogs are filled with cope-and-stick bits that are priced anywhere from about \$50 to \$150. Essentially there are three types of bits from which to choose. The least expensive is what is called a reversible cope-and-stick cutter. This single bit has two cutters, a bearing and shims to adjust it. You cut the stick part of the moulding, then you disassemble the bit and stack the pieces in a different order to cut the cope. These are decent entry-level bits, but keep in mind that disassembling the bit can be a hassle, and you have to remember exactly how many shims go between each part or your joints won’t fit. Also, wear on the cutter is doubled, necessitating resharpening more often.

The other “single-shank” solution is the non-adjustable combination bit. This one-piece bit is basically a chunk of metal on a 1/2" shank. It has a bearing

on top and bottom. You cut the stick part of the moulding with the top section of the bit, then you raise the bit to cut the cope. The only drawback to these bits is that they are a little long and will exaggerate any runout problems you might have with your router or collet.

Last, but not least expensive, is the matched set of bits. In a matched set, each bit has a fixed cutter close to the shank, a bearing and another matched cutter. These bit sets have advantages over the other sets. When they’re sharpened, it’s just a matter of proper shimming to get them back to an airtight fit. There are two separate sets of cutters, giving them longer life between sharpenings. They’re relatively shorter than combination bits so they’ll be more stable in a router. And once you get them set up, you won’t have to take them apart until they’re resharpened. The only real drawback is that they are usually the most expensive solution.

Which bit is right for you? If you make an occasional door,



Setting up and using a cope-and-stick set of bits is relatively easy after the shimming is done. First, make sure the bearing on the bit is flush with the fence on the router table. Flushing the bearings makes sure that the profiles will match up. Use a straightedge that spans the two fences and tap the fence flush to the bearing. If possible, close the fence faces so there’s approximately 1/8" clearance on both sides of the cutter.



Using featherboards to keep your stock in place, press the stock into the fence and down onto the router table. Which profile you cut first isn’t critical. Use test cuts to get your bits in the ballpark. I cut the stick first. For door construction, you can cut your stock to finish length, but I prefer to leave the stiles a little long for trimming later.



Next, cut the cope profile on the ends of the rails. Make sure to use a backing piece (sometimes called a “cope block”) of scrap. Because of the usual narrow width of a rail and the force of a router, the rail can easily be pulled into the bit. Hold the rail tightly to the cope block to avoid this. It’s not necessary to push the entire setup through the cutter, just the rail ends. Once the front of the push block is touching the outfeed fence, gently pivot it away from the fence from the outfeed side.



Once you’ve got rails and stiles that are sized properly, fit the parts using light clamp pressure and take the measurements for the panel. Leave a 1/8" gap all around to allow for seasonal expansion. Run the panel on the router by pressing it flat to the table. Cut the end-grain sides first, then the long-grain sides. Make the cut in several passes, adjusting the height of the panel cutter after each pass. If you’re using a big panel cutter such as the one shown, you’ll want to slow the bit’s speed (if you have an adjustable-speed router).

use a single-shank solution. It's cheaper and you won't be sharpening the bit any time soon. If there are a lot of doors in your future or you just want a setup that will last a long time, a real time-saver is having two bits in two tables and running all your stock at once. The price differences between one-bit and two-bit sets is around \$20 to \$50 dollars, depending on the manufacturer and quality. **PW**



The three types of cope-and-stick bits. On the left is a matched set of cutters. One bit for the stick; another for the cope. In the center is a non-adjustable combination bit. You change from cope to stick by changing the height of the router. On the right is a reversible bit. After cutting the stick profile, you disassemble the bit and rearrange the pieces to cut the cope.

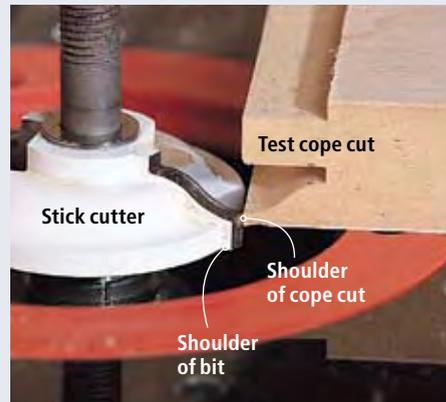
THE EASIEST WAY TO SET UP A TWO-BIT SET

If you're one of those people who plunked down your hard-earned dollars on a two-piece bit set, you may test it out and find that the joint isn't tight or aligned. Some sets require some fine-tuning upon arrival. Here's how it's done:

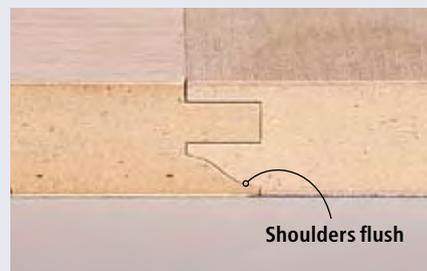


Get familiar with the parts. Many two-bit sets work great right out of the box; others make joints that are too loose or too tight. You can fix the problem, but you're going to have to disassemble the bits to adjust the cutters. Plan on this taking an hour or two of your time. It's a pain, but remember you won't have to do this again until you get your bits resharpened.

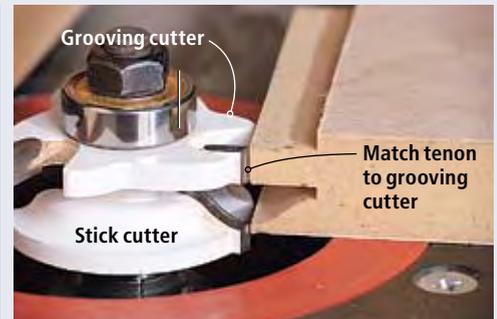
The easiest way to take these bits apart is to chuck them into a router. Use a wrench on top of the bit to loosen the cutters as you hold the bit in place with one of the router wrenches on the collet. Two-bit sets have a fixed bottom cutter, a bearing and a grooving cutter that are separated by thin shims. To get your two-bit set (or your reversible set) working you're going to have to figure out which shims go where for a perfect fit.



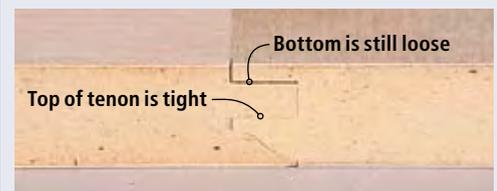
1 Align the shoulders. Start by chucking the cope cutter in a router and make a test cut on a piece of scrap. I use MDF for setup because it is made up of small particles that have no grain direction. This gives accurate, highly visible test cuts. Cut the cope leaving about $\frac{1}{16}$ " on what will be the top shoulder of the cut. Next, chuck the stick cutter into the router and remove the grooving cutter, bearing and shims. Start the alignment process by placing the shoulder cut of the sample cope cut up against the fixed cutter in the stick bit and matching shoulder heights by raising or lowering the router (see the photo above).



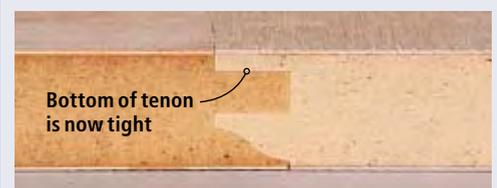
RESULT: Flush shoulders. At this point the joint made by these cutters would be pretty sloppy, as shown in the photo above. You can see, however, that the cut is flush on the shoulder (bottom) of the joint, which is the point of this important first step.



2 Tighten the top of the tenon. The next step is to tighten up the joint between the tenon and the cope. Using your test cope piece as a guide, mount the grooving cutter and shim it as best as you can to match the tenon on the test cope piece.



RESULT: Top of tenon is perfect. After shimming the grooving cutter, you'll get a tight fit on the cope and the top of the tenon. Keep a test cut from the stick cutter. This is the finished, shimmed setup for the stick cutter.



3 Shim the cope cutter. Remove the stick cutter from the router and chuck up the cope cutter. It also has a grooving cutter on top that needs to be shimmed to get the bottom of the tenon to fit snugly. Disassemble the bit and shim the grooving cutter so it is flush with the bottom of the tenon on the stick test piece. Now your joints should be tight. — JS

WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

1

Fixed-base Router

The router is perhaps the most versatile tool in your shop. You can rout not only decorative shapes, but also many joints.

Reduced to its simplest form, the router is a motor and a shaft with means of holding interchangeable bits. Once you understand that, using the router becomes a much simpler task. But first, you should know what all those other parts are, and why they're there.

Types of Routers

When you look for a portable router, you will find that they can generally be classified into four categories:

■ The Basic Router

Sometimes called a fixed-base router, this is just a motor mounted on a base. Most offer 1/2- to 3/2-horsepower

motors, and their collets will accept router bits with 1/4" or 1/2" shanks. The bases are usually 6" in diameter. This is the router we will be discussing here.

■ The Laminate Trimmer

A scaled-down version of the basic router, this has a smaller motor and base. It has a 1/4" collet and is used for trimming laminates and veneers, and is especially handy when you are balancing the tool on thin or narrow workpieces. It's also useful for chores that require finesse, as opposed to strength. Some laminate trimmers come with interchangeable bases that let you work in tight areas or will allow you to rout at an angle, which no full-size router can.

■ The Rotary Tool

This lets you use very small bits and accessories for more delicate work.

It's a carving or engraving tool (such as a Dremel) that can be mounted in a router base accessory. It usually has interchangeable collets for 1/16" or 1/8" shanks. The small size lets you rout inlays, cut mortises for small hardware, make delicate joints or do other jobs where a standard-size router would be too clumsy or difficult to balance.

■ The Plunge Router

This does all the things that the basic router can do, plus it makes "plunge cuts." Its motor is mounted on two spring-loaded slides above the base, which let you position the motor above the work, push the bit into the wood and begin cutting. The plunge router excels at cutting joints, such as mortises. *[Editor's Note: We focus more on the plunge router in Chapter Two.]*

PRO TIP:

Back-routing (climb-cutting)

Occasionally you must back-rout a piece to reduce tear-out on figured wood. This means you cut with the bit's rotation, instead of against it. It's much more difficult to control your work this way, so be sure to take shallow cuts and feed very slowly. Keep the router and the work steady, making sure you don't let the bit chatter.



TIPS & TRICKS

PRO TIP:

The Need for Speed

Despite a popular misconception, speed controllers will not harm universal motors (the type of motor found in all routers and most hand-held power tools). However, they can ruin induction motors. If you buy an in-line speed controller, be sure you use it for your portable power tools only.

GREAT TIP:

A Better Bit Goes a Long Way

You should put as much, if not more, care and consideration into choosing bits as you would the machines that run them. After all, it's not the router that does the actual cutting – it's the bit. A mediocre router outfitted with a better-than-normal bit will cut a lot better than the world's greatest router with a mediocre bit.

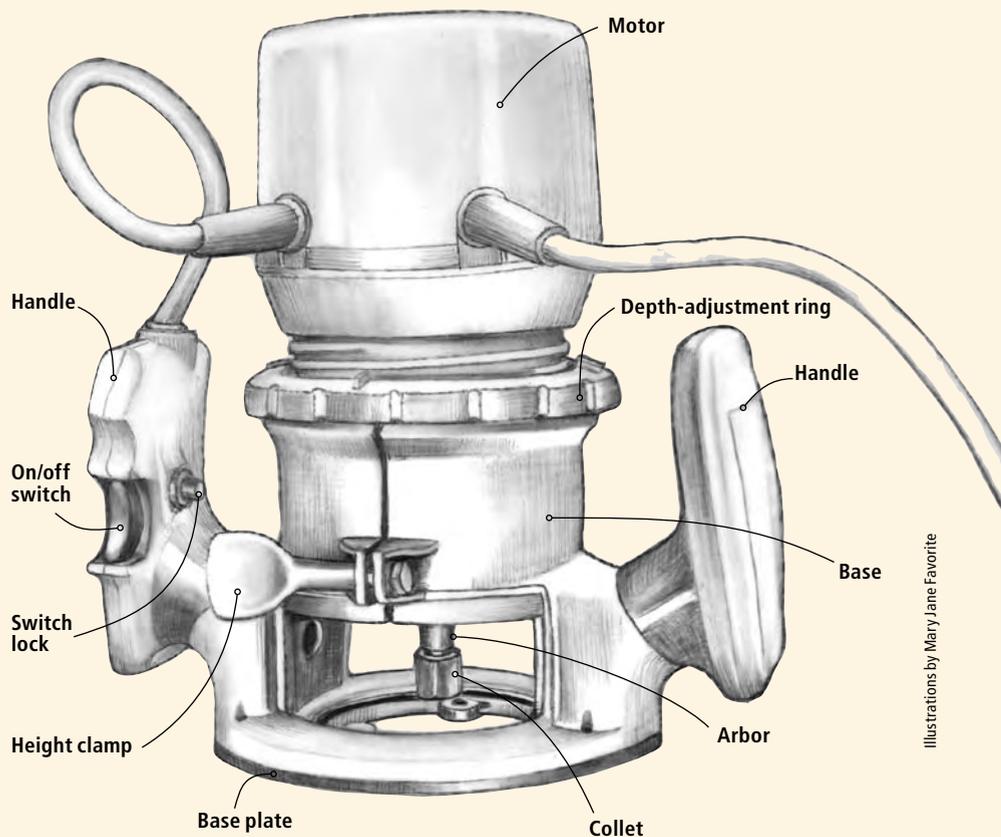
GREAT TRICK:

Offset Baseplates Keep Your Router from Tipping Over

Even with half of the router base in contact with the wood surface, it can be difficult to keep the tool from tipping. When you must hang the router over an edge, as when routing an edge detail, make sure you attach an offset baseplate to the router's base. Keep the offset portion of the plate over a solid surface and press down on it as you work, thereby steadying the tool.



Photo courtesy of Patrick Warner, patwarner.com



Illustrations by Mary Jane Favorite

The bulk of the router is its motor. An arbor protrudes from the bottom of this, and the end of the arbor is fitted with a collet to hold a bit in place. These three pieces are mounted in a base, which incorporates a depth-adjustment ring to raise or lower the motor, and a height clamp to secure it in position – these clamps differ for the plunge router, as you'll see in the next chapter. A router also has handles so it can be guided, with a nearby on/off switch. This entire assembly rests on a removable plastic base plate or sole.

Router Features and Capabilities

No matter what kind of router you opt for, there are several features you need to understand that are important in the operation of the tool:

■ Collet

Although it might seem small and insignificant, the collet is crucial – a poorly designed one might let the bit slip, ruining the cut. To compensate, many woodworkers overtighten the collet, which only aggravates the problem. Overtightening makes the bits hard to mount and dismount, and can cause excessive wear on your tool.

To avoid this, make sure you get a router with a good collet. You can judge if a collet will give you problems by learning how it works. A collet is a split or segmented collar at the end of the arbor that holds the shank of the bit. Tightening a nut squeezes the collar around the shank, locking the bit.

Generally, the more segments on a collet the better, because these make the collet more flexible so it can get a better grip on the bit shank, as you can see in the drawing at right. Routers with multiple-segment collets tend to be a bit more expensive, but the potential headaches they eliminate are well worth it.

Some routers have split arbors, rather than collets. Either way, the same rule applies: the more segments, the better.

Collets come in three standard sizes – $\frac{1}{4}$ ", $\frac{3}{8}$ " and $\frac{1}{2}$ ", which is the measure of the inside diameter. Most router bits have $\frac{1}{4}$ " or $\frac{1}{2}$ " shanks. If you want to take full advantage of all the bits available, you should look for a router with interchangeable collets.

Some routers have only $\frac{1}{2}$ " collets, but come with split bushings so you can insert to adapt them to hold $\frac{1}{4}$ " and $\frac{3}{8}$ " bits. This is OK, but not as desirable as interchangeable collets.

■ Power

The type of woodworking you want to do with the router will determine the horsepower you need. If you just want to make a few occasional mouldings and joints, a 1-horsepower router should be more than sufficient. On the other hand, if you expect to do a lot of routing or if you want to use bits with large flute diameters, you should look at 2- or 3-horsepower models.

■ Speed

Most single-speed routers operate between 20,000 and 30,000 rpm. This is adequate for bits with flute diameters of 2" or less. But larger bits should run at slower speeds; otherwise they'll overheat and burn the wood.

If you intend to use large bits often, it might be wise to invest in a variable-speed tool or a method of altering the speed, such as a rheostat or an electronic speed controller. Rheostats reduce the line voltage, which lowers both the speed and the available torque – the ability of your router to do serious work.

Electronic speed controllers, on the other hand, have a feedback mechanism that boosts the available torque at low speeds, which means the tool is less likely to bog down or quit when the

going gets tough. Neither speed-altering device works with soft-start routers.

■ Height Adjustment

Most basic routers can be raised or lowered up to 2". If you think you'll need more movement than this, you'll want to look at the plunge router. But whichever router you choose, consider the ease and accuracy with which you can change the height. Because you'll be changing the height quite often, you'll want to make it as easy as possible on yourself.

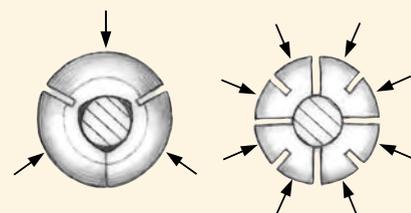
On some basic routers, the motor housings are threaded in the base so you can screw them up or down. This allows you to make minute height changes accurately. But in some respects, this arrangement is a pain in the neck. Because some on/off switches revolve with the motor, you never quite know where the switch is. And if you mount the router to a table or a stationary jig, the cord can quickly become twisted.

Switches mounted on handles or heights that adjust without spinning the motor remove this concern.

■ Configuration

For this, you just have to ask yourself how the router feels to you:

Is it too heavy or too light when you are holding it and working with it?



Three segments – three contact points

Multiple segments – many contact points



Collets with just two to three segments (left) don't squeeze router-bit shanks evenly. In fact, they make contact at just a few points. Collets with multiple segments (right) are more flexible and make contact all the way around the shank, which helps keep the bit from slipping.

Can you reach all the controls without taking your hands off the handles?

Is it well-balanced or does it seem top-heavy and ready to tip?

Does the shape of the base help you see what you're cutting or is your workpiece hidden by the base or baseplate?

Will the size/shape of the base help or hinder your work?



Router bases come in a variety of sizes and shapes. The round base found on many basic routers (left) is useful for most operations, but may be slightly inaccurate when following a straightedge. If the base isn't perfectly round or perfectly centered on the router bit, turning the base (riding against the straightedge) during operation can change the distance from the bit. The D-shaped plunge-router base (middle) has one straight side so you can accurately follow both straight and curved templates without concern of changing the distance to the bit. The laminate trimmer (right) has a square base with rounded corners, so you can follow straight and curved templates no matter how you turn it. You can buy an accessory base for the fixed-base router that has a straightedge, too.

TIPS & TRICKS

PRO TIP:

The Bigger They Are, The Harder They Work

The larger the diameter of the bit, the more the router has to work to turn it. Just because you can fit a 3½"-diameter panel-raising bit in your 1½-horsepower router doesn't mean the motor has the proper torque to use that bit efficiently. If the router isn't equipped to handle the torque load for that size bit, the motor could heat up and burn out.

GREAT TIP:

A Bit of Help for the Collet

To help position a bit in a collet, stretch a rubber O-ring around the shank to serve as a depth indicator. When the bit is inserted, the O-ring will prevent the bit from dropping down too far in the collet.

GREAT TRICK:

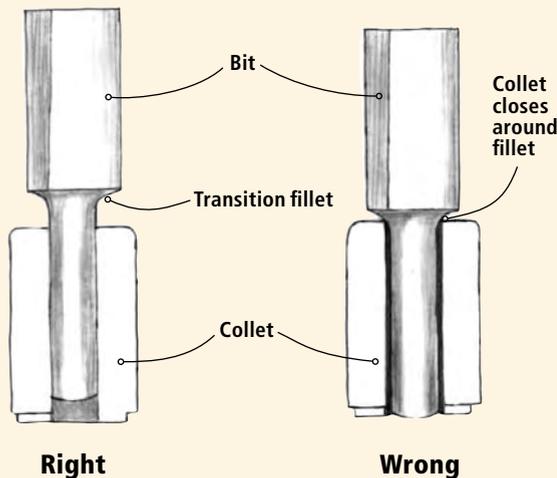
Platforms Help with Mortises

If you are routing a large mortise or removing stock from the interior of a board, your router could become increasingly difficult to balance as you cut away more of the supporting surface. This is even more of a problem with smaller-base routers such as a laminate trimmer. To compensate for this, use a platform (attached to the router base as a sub-base) to form an oversized router sole – this will span the gap between the sides of the recess and keep the router from tipping in or dropping entirely into the gap.

GREAT TIP:

Bottom-cleaning Bit Will Improve Your Planing

If you do a lot of planing with your router, invest in a bottom-cleaning bit. Normally used to smooth the bottoms of mortises, it's available in diameters up to 1½" and cuts a wider swath than an ordinary straight bit.



The shank of the bit must be inserted far enough into the collet for the collet to get a solid grip. If possible, the entire length of the collet should contact the shank. However, don't insert the bit so far that the collet closes around the transition fillet – the portion of the bit where the shank ends and the flutes begin. If the bit is positioned incorrectly – inserted either too far or not enough – the collet may not grip the shank securely and the bit may creep out of the collet when you rout.

Routing Rules

The first step in using any tool is to make sure it is properly aligned and adjusted.

For the router, there are only two things you need to check. If you're using it as a portable tool, check the depth of cut (the distance the bit protrudes beneath the baseplate) and the position of the guide (if there is one). If your router is mounted in a jig, check the depth of cut (the distance the bit protrudes past the mounting plate) and the position of the fence (if there is one).

Once you've adjusted your router, you'll need to keep a couple things in mind as you work:

- Before you turn the router on, make sure the bit is properly mounted and the collet is secure. When changing the bits, know that you might have to clean dust out of the collet. A dirty collet won't grip router bit-shanks as well.

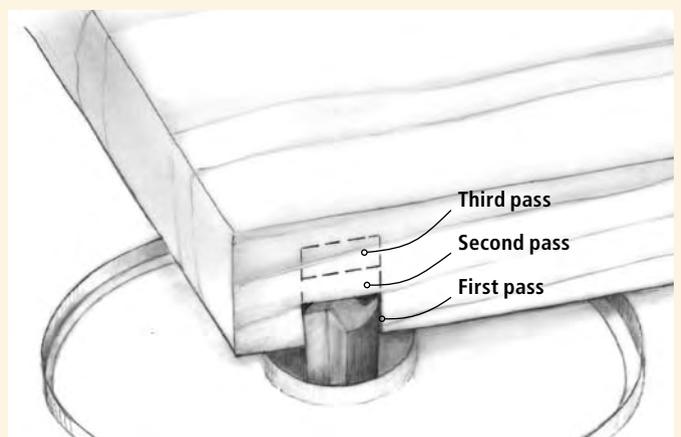
- Make several test cuts to check your setup; if a job requires several different setups, make sure you have enough test pieces at each subsequent stage to carry you through the entire procedure.

- Remove only a small amount of stock with any single pass. Set your depth of cut to take shallow cuts, usually ⅛" or ¼" deep. The illustration below explains this concept in more detail.

- Keep the router moving as steadily as you can while you cut. If you pause in the middle or move too slowly, friction will cause the bit to heat up and burn the wood. However, if you feed the router too quickly, it will leave scallops or mill marks in your piece.

- Cut against the rotation of the bit whenever possible, as shown in the drawing at right. If you use a fence or a straightedge, use the rotation to help keep the work (or the router) against it.

Never "hog" the cut when using a router – the tool is designed to remove only small amounts of stock at any one time. If you need to make a deep cut, rout your piece in several passes, cutting just ⅛" to ¼" deeper with each pass. Generally, the harder the wood, the less you should remove with any one pass.



- Take note of the wood grain direction and rout with the grain as much as possible. When you must rout across the grain, back up the wood where the bit will exit. This prevents the bit from tearing and chipping the wood.

Guiding the Router

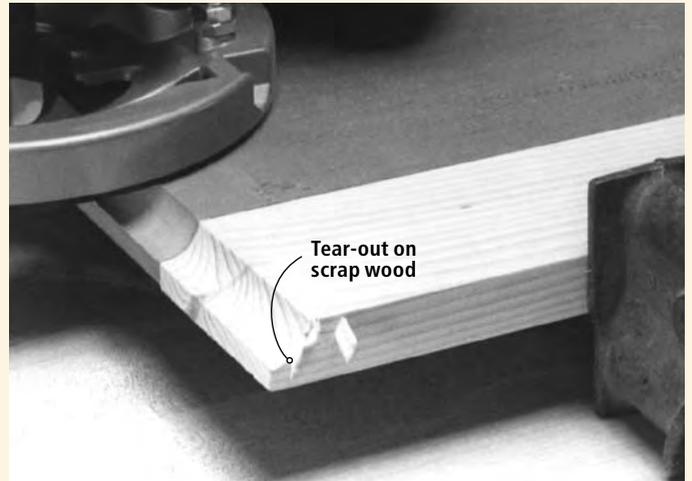
In addition to those rules, here are some extra tips on guiding the router. You can use these whether you're routing hand-held or with a jig:

- Always hold the router firmly with both hands. Be prepared for the initial jerk when you start it up – that annoying momentary wrench can be difficult to control on some of the more powerful routers. You may want to buy a router with a “soft-start” motor to eliminate this unnerving tendency – but we think that once you start using your router more often, you'll get used to this and become more comfortable.

- A router motor, like any other spinning body, generates lots of centrifugal force, which is the force that draws a rotating body away from the center of rotation, caused by the inertia of the body. Because of this, your router will resist any effort to cut in a straight line.

If your project requires you to rout across the end grain, clamp a scrap to the edge of the board where the bit will exit.

This will prevent splintering and tear-out. If routing all four edges of a board, start with a cross-grain edge so the long-grain pass will remove any tear-out.

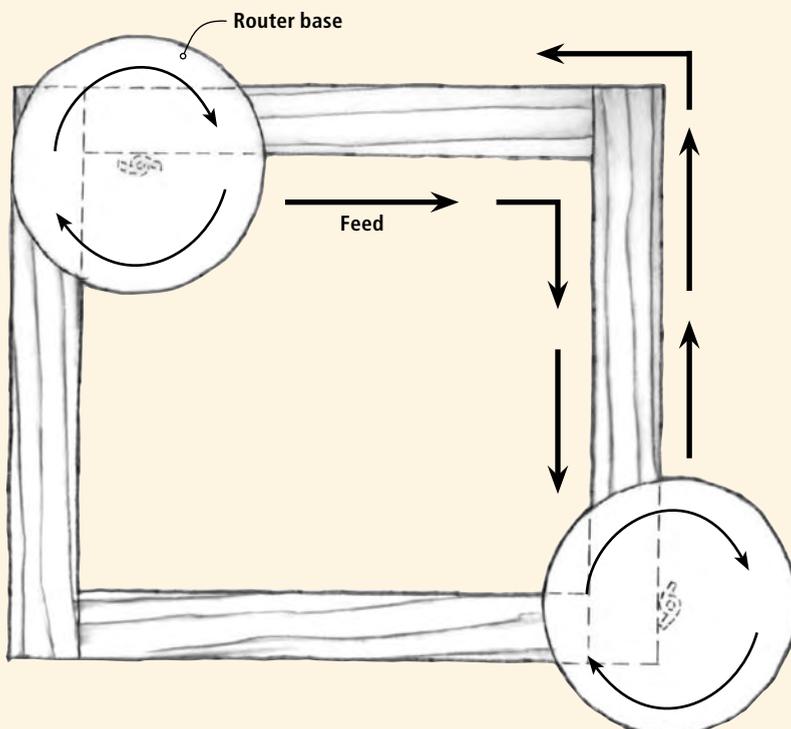


As you push it along, it will want to drift to one side or the other, so you have to exert some force against your guide or edge to keep it tracking correctly.

- Make sure the router base is properly supported. When used hand-held, routers are top-heavy. If the workpiece is too narrow, it may be hard to balance the router. A good tip to help you with this is to clamp a wide scrap piece to the work (doubling its thickness in many cases) to provide additional support.

- It's not usually a good idea to rout

freehand (with the router unguided). The cuts won't be very accurate, and the router will try to pull itself all over the workpiece. There are four things you can use to help you guide the router while you cut – a bearing bit, which has a ball bearing guide or bushing to guide the cut; a guide collar, which attaches to the router's base and follows a surface with the bit protruding through it; an edge guide, which is really just a small fence that attaches to the router's base; or a straightedge clamped to your workpiece.



Whenever possible, cut against the rotation of the router bit – this will help control the router. If you rout with the rotation, the router or the workpiece will try to pull itself out of your hands. To make sure you're routing against the rotation, just remember that the bit rotates clockwise when the router is used right-side up. To rout the inside of a piece, move the router clockwise within the perimeter; when routing the outside, move it counterclockwise. Treat fences and straightedges as if they were the outside of a workpiece – envision yourself cutting counterclockwise around these guides.

There is one application for routing with the rotational direction. This is known as “climb-cutting” or back-routing. While this action demands better control of the router by the operator, climb-cutting can reduce tear-out when routing highly figured or irregularly grained woods. You must be very comfortable with router use before attempting this.

TIPS & TRICKS

GREAT TIP:

Loose Tenons for Easy Joints

Instead of cutting perfectly fit mortise-and-tenon joinery on your workpieces, all you have to do is rout two matching mortises – then make a loose tenon to complete the joint. A single loose tenon (easily fit to both mortises) bridges the two mortises. As long as you get a good fit, this joint will be as strong as a traditional mortise-and-tenon joint.

GREAT TRICK:

Keep That Piece Clamped Down Tight



Whenever you're routing something, make sure that either your workpiece or your router is stable and secure – they can't both move. If you choose to move the router across the work, clamp the work to your bench. If a clamp interferes with the operation, rout up to it and turn the router off. Then move the clamp to an area on the workpiece that you've already cut and resume routing.

GREAT TRICK:

Back Up Your Work When Using a Miter Gauge

Tear-out when routing in end grain can be a real problem. In a router table, when using a miter gauge to rout across the wood's grain, always use a piece of scrap placed behind the workpiece to prevent tear-out at the exit point.

Using a Straightedge or Fence

The difference between a straightedge and a fence is all in how you hold the router. A straightedge guides a hand-held router over the work, while a fence guides the work over a table-mounted router. [Editor's Note: We will focus on the router table in Chapter Three of this series.]

Whether using a straightedge or a fence, keep whatever is moving pressed firmly against it. Feed the work or the router slowly and steadily – do not pause or speed up if you can help it.

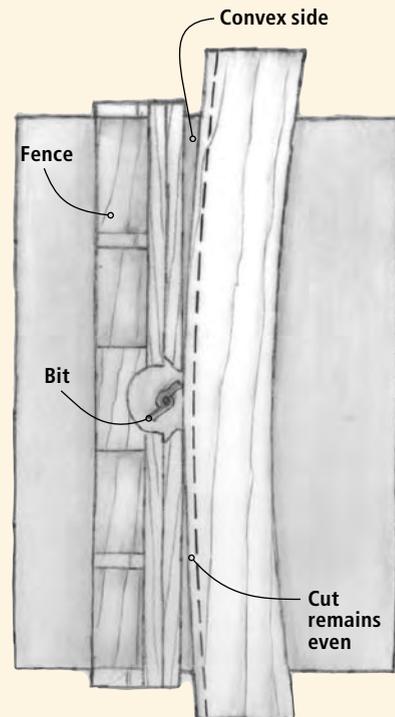
Here are other things to remember:

- Make sure the straightedge or the fence is straight and flat. Otherwise, the cuts won't be accurate.
- Always read the warp or bow in a board before routing (see illustrations at right). Keep the convex surface against the fence or straightedge as you cut it.
- If the router sole is circular, paint a spot on the edge of the base plate. Keep the spot turned toward you and away from the straightedge as you rout. The bit is seldom perfectly centered in the base plate. If you allow the router to turn as you follow the straightedge, the cut will not be perfectly straight.

A Gauge Will Help

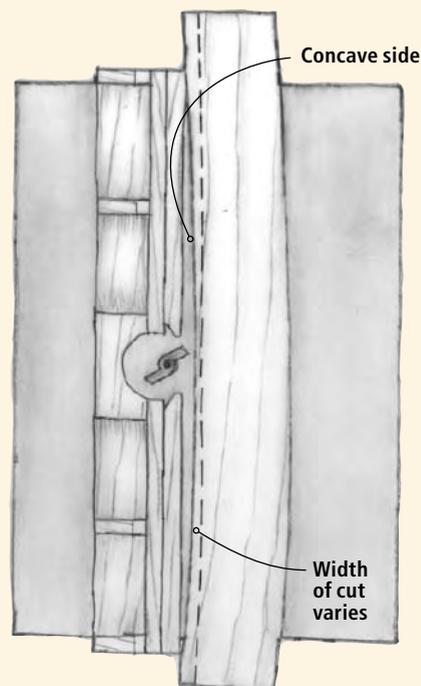
When guiding the router with a straightedge, make a gauge to help position the straightedge when setting up the cut. To make a gauge the proper width (the distance from the router bit to the base edge), stick a thin piece of hardboard to a scrap piece with double-faced tape, flushing one long edge of both pieces. Position your straightedge against the flushed edges. Mount the bit you plan to use in the router and rout along the straightedge and through the hardboard. The strip of hardboard now functions as your gauge for that setup.

Then just lay out the cut you want to make on the work. Position the straightedge on the work parallel to the edge of the cut and offset it the width of the gauge by using your gauge piece to guide you. Secure the straightedge to the work and make the cut, keeping the router firmly against the straightedge.



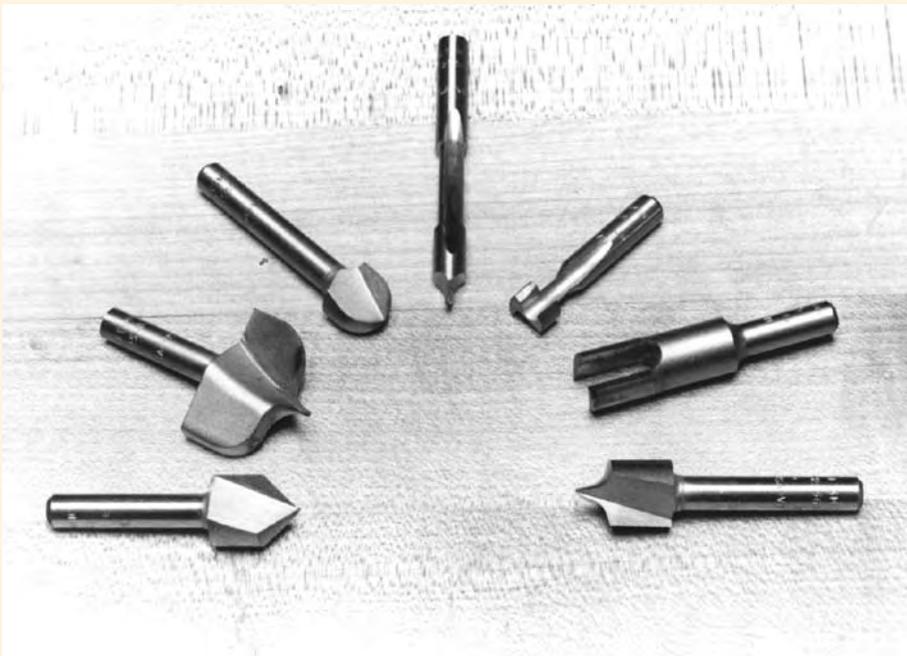
Yes

If your workpiece is warped or bowed – even slightly – keep the convex side of the bow against the fence or straightedge as you cut. The width of the cut will remain the same from one end of the board to the other.



No

If you turn the concave side toward the fence, the cut will be narrower toward the middle of the board than it will be at the ends.



Most unpiloted router bits have either top-cut or point-cut flutes – flat or pointed cutting edges on the ends of the flutes as well as the sides. This feature lets you cut downward into the stock to make grooves, mortises and other cuts in the interior of a workpiece. For example, a point-cut beading bit (far right) lets you cut quarter-round and half-round shapes in the surface of a piece, not just on the arrises and corners.

Selecting Bits

There are an enormous number of router bits available, many more than can be shown here. But all these cutting accessories can be organized into four simple categories: decorative, used to cut moulded shapes; joinery, which are used to make woodworking joints [Editor's Note: We focus more on joinery and joinery bits in Chapter Four of this series]; trimming/cutting, which are used to trim or cut various materials; and utility, which are used to do all three of these tasks.

The cutting edges of the bits are called flutes. Most router bits have two symmetrical flutes, although there are some with one, three or four.

When selecting which bit to use, know that you have a range of diameters to choose from. Router bits vary from a diameter of $\frac{1}{16}$ " up to $3\frac{1}{4}$ ". Some bits, particularly straight bits, are available with different types of flutes for cutting various materials.

When it comes to the material the bit is made from, almost all bits these days are made out of tungsten carbide. A few years back, most bits were made out of high-speed steel (HSS), which was cheaper and easier to make. But now, tungsten carbide is pretty much the only

kind that's available. The flutes of most carbide cutting tools are tipped or faced with carbide, while the bulk of the tool is HSS. Carbide is brittle and won't be as sharp as HSS, but it lasts up to 15 times longer than HSS bits.

Custom Router Bits

If you find yourself looking for a specific kind of router bit and can't seem to find it anywhere in your woodworking supply store or catalogs, check this out – you can have custom router bits made to your specifications. These are a little more expensive, but if you use them continually, they could be worth the money.

Some places where custom bits are available include:

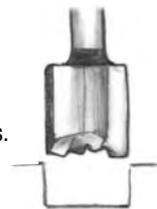
- Freeborn Tool Co.:
800-523-8988 or freeborntool.com
- Ridge Carbide Tool Co.:
800-443-0992 or ridgecarbide.com
- Router Bits Online:
800-821-8378 or routerbitsonline.com
- Whiteside Machine Co.:
800-225-3982 or whitesiderouterbits.com
- Carbide Specialties Inc.:
800-678-3313 or carbidespecialties.com
- North American Products:
800-634-8665 or naptools.com

A BIT OF ADVICE

A router bit consists of a cylindrical shank (usually $\frac{1}{4}$ " or $\frac{1}{2}$ " in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series, we will be providing a closer look at a many of the most common (and some specialized) bits that you can use with your router.

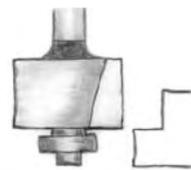
Straight Bit

The most basic groove-forming bit will give you clean grooves and dados. Diameters range from $\frac{1}{16}$ " to $1\frac{3}{4}$ ".



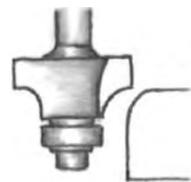
Rabbet Bit

An often-used bit for edge-forming. Change the bearing size to vary the width of the rabbet. The carbide height is usually $\frac{1}{2}$ ", with the various bearings making rabbets possible from $\frac{5}{16}$ " to $\frac{1}{2}$ " wide.



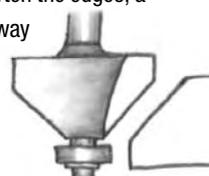
Roundover Bit

This is a great bit for quickly changing the appearance of any project. Depending on the radius of the roundover used ($\frac{3}{16}$ ", $\frac{1}{4}$ " and $\frac{3}{8}$ " are common), a sharp edge can be softened or almost entirely rounded over. Add a smaller bearing, and the roundover bit becomes a beading bit.



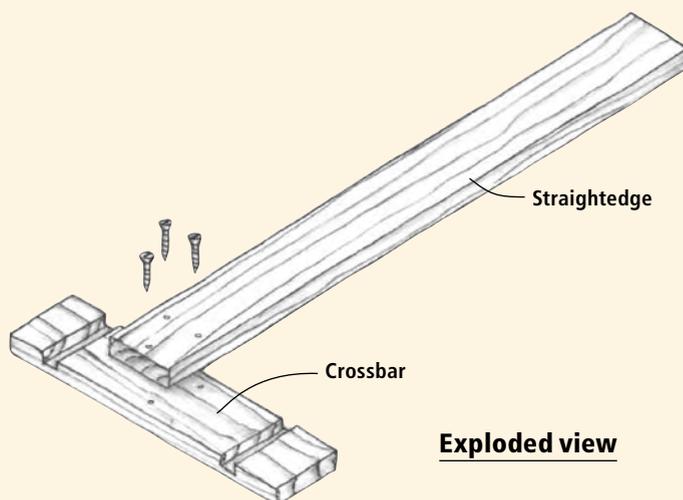
Chamfer Bit

If you prefer a less-rounded appearance but still want to soften the edges, a chamfer bit is the way to go. Commonly available in 15°, 30° and 45° bevels.

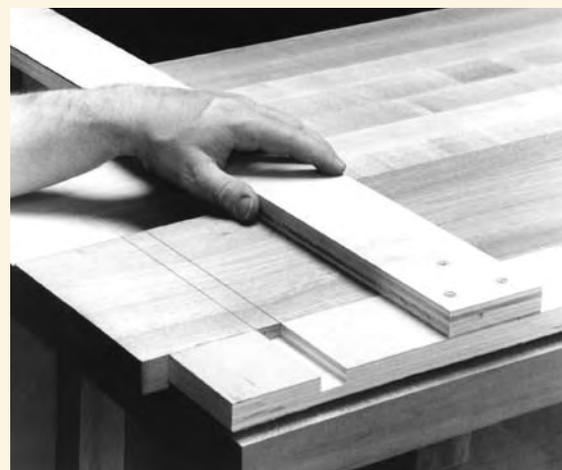
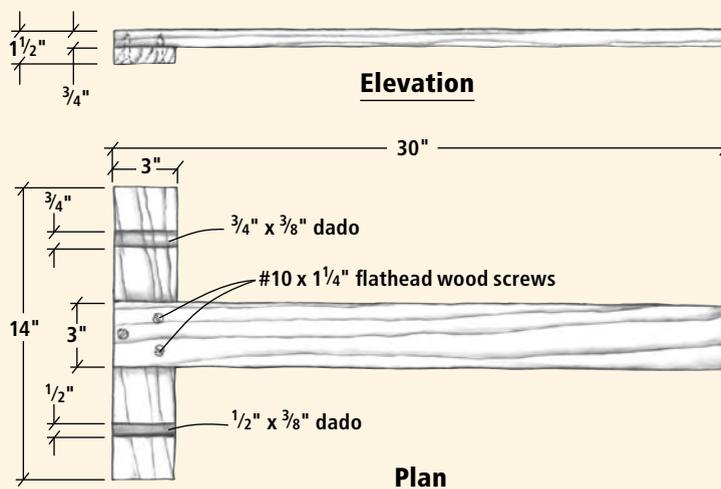


T-square Router Guide

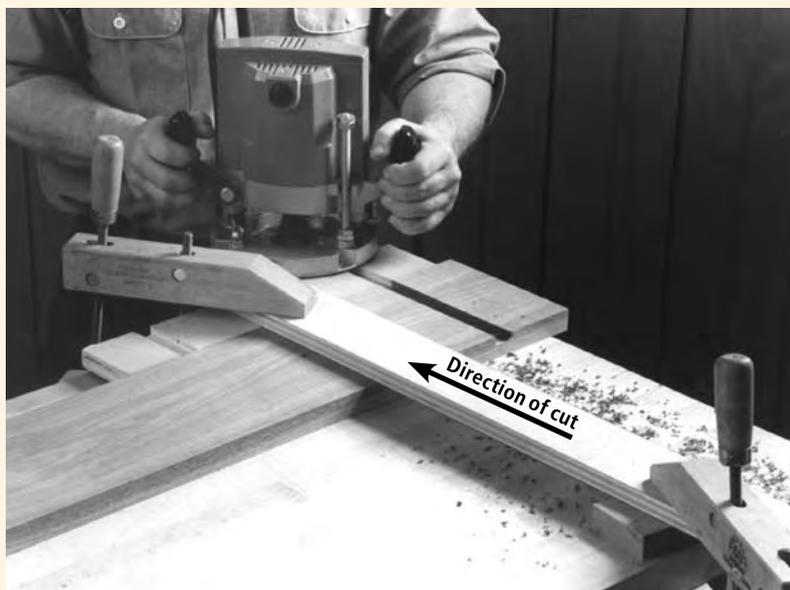
When using a hand-held router to cut dados, grooves and rabbets, the part of the setup that eats most of your time is positioning the edge guide or straightedge. This T-shaped jig simplifies that chore – just use the short crossbar to instantly position the longer straightedge. **PW**



Exploded view



Before you can use this jig, you must cut dados in the crossbar – one on either side of the straightedge. Place the jig over a large wooden scrap and butt the crossbar against an edge. Clamp the jig to the scrap and cut the dados with a straight bit, keeping the router pressed against the straightedge. **NOTE:** Once you have cut these dados, you can only use the jig with that particular router and that bit. The dados won't line up with different tools.



Lay out the joints on the workpiece. Place the jig across the wood, butt the crossbar against an edge or end, and line up one of the dados with the layout lines. Then clamp the jig to the workpiece and cut the joint using the straightedge to guide the router, just as you did when you made the dados in the crossbar.

WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

2

Plunge Router

While a fixed-base router is a very versatile tool, there are still some operations that require different abilities. This is where a plunge router proves valuable.

For example, some operations require you to rout the interior of a board without cutting in from the edge. When you rout a mortise, it's best to first make a small hole in the interior of the workpiece, then enlarge it. To make this starter hole, you must lower – or “plunge” – the bit into the wood. While you don't need a plunge router to do this (woodworkers have been plunging with fixed-base routers for years), it does make the operation safer and can be accomplished with greater precision.

The main difference between plunge and fixed-base routers (which are discussed in Chapter One of this series) is that plunge routers can make interior and stopped cuts much more easily. The plunge-base motor is mounted on two spring-loaded posts above the base, which let you position the motor above the work, then lower the bit straight down into the wood and begin cutting.

PRO TIP:

How Much is Enough?

To make sure the collet is safely gripping a router bit, insert $\frac{3}{4}$ " of the length of a $\frac{1}{4}$ "-shank bit into the collet and insert a full 1" of every $\frac{1}{2}$ "-shank bit.

Similar to fixed-base routers, plunge-base routers are available in multiple sizes and powers. Most will accept both $\frac{1}{2}$ " and $\frac{1}{4}$ " collets.

Choosing the Right Size For Your First Router

Plunge routers are available in two main sizes: either a 2-horsepower (or slightly less) or a 3-hp (or slightly more) model.

Most larger plunge routers have found happy homes in router tables (*we will discuss router tables in Chapter Three*), and that's where they belong. They're honestly too large for convenient hand-held routing operations. They can be used this way, but the smaller plunge router is more likely the better choice for hand-held routing.

The smaller plunge routers are easier



TIPS & TRICKS

PRO TIP:

Use Ball-bearing Guided Bits Instead of Pilot Guides to Protect the Wood



You may still find a few piloted router bits out there, but ball-bearing router bits are far superior, and have all but replaced the older design. Upkeep is easier on the ball-bearing design because all you have to do is add a little lubrication from time to time.

GREAT TIP:

Make Sure You Use Plenty of Protection

Always wear eye and ear protectors when routing. The need for eye protection should be obvious – the router throws wood chips everywhere. But the need for ear protection is just as necessary. A high-speed router motor generates high-frequency noise, which will damage your hearing a tiny amount with each exposure. You won't notice any loss after just one routing session, but over time your hearing will grow noticeably worse.

GREAT TIP:

Make Sure You Get Good Up-and-down Movement

When plunging, some routers will jam if you grasp only one handle, which is OK because you should always use two hands. But if pushing both handles does not result in a smooth glide to full extremes, you should pass on that router.



There is quite an array of router choices. At left, originally designed as a laminate trimmer, this smaller router is used very effectively for a variety of applications. Offering good power and using standard $\frac{1}{4}$ "-diameter bits, it offers many of the benefits of a larger router with easier maneuverability and convenient size. Kits for the trimmers offer fixed- and beveling-base options. The standard fixed-base router in the $1\frac{1}{2}$ -horsepower range (middle) will accept $\frac{1}{4}$ " and $\frac{1}{2}$ " bits and do almost everything you could need out of a router. The plunge router in the $2\frac{1}{2}$ -hp range (right) is able to do everything a fixed-base router can do and more, with extra torque for larger profile work such as frame-and-panel doors.

to use hand-held and will provide an astonishing amount of power for almost all operations. Today's plunge routers often come equipped with variable speed. This is good because the larger-diameter bits cut better when run at slower speeds. Also, many variable-speed routers now offer a type of turbo-boost called electronic feedback control. This feature allows the motor to maintain the revolutions per minute when the router is in use, meaning there's no slowing or stalling during a cut.

So smaller is best when the tool is used outside of a table and larger is likely better for router-table use.

Choosing the Right Size For Routing Specific Projects

As mentioned above, certain diameter bits perform better at certain speeds. While variable speed can give you a certain amount of leeway in your routing abilities, there are places where the size of your router makes a difference.

In particular, when performing any process that removes a large amount of material in a single pass, a larger plunge

router will better meet your needs. This also will indicate that the operation is best performed in a router table. These operations include rail-and-stile applications for doors, panel-raising for doors and frame-and-panel cabinetry, and large profile work, such as in crown moulding, base moulding or banisters.

In fact, the design of the tool will help you make that decision, too. Most smaller plunge routers will not have an opening in the base that is large enough to accommodate a large-profile bit. If the bit won't fit, you've probably grabbed the wrong router for the application.

Height-adjustment Features

With fixed-base routers, the depth of cut usually is set and adjusted manually by sliding the motor up and down in the base. Some motors will rotate to adjust the height, while others slide straight up and down. When the height is set, the motor is locked in the base and the work proceeds. With plunge routers, the depth of cut also is set by sliding the motor in the base, but there are a variety of ways to set, adjust and fine-tune that height.



The 1½-hp router (left) has a base opening that is sized for bits appropriate to that size motor. The larger plunge router (right) has a 3-hp motor, appropriately sized for larger bits for panel raising or large profiles. This base has a larger opening to accommodate those bits.

Because the plunge router is designed to slide out of the cutting position and then return to the proper depth with a plunge, a repeatable and reliable depth stop is required. The most common and simplest repeatable depth stop on plunge routers is called a “turret stop.”

A height-adjustable rod is mounted to the motor housing and aligned parallel to the direction of the plunge. Mounted to the base is a rotating dial with usually three (but this can vary) stepped-height stops. The depth rod is plunged against the lowest position for the proper height, then locked in place. The other two stops come into play when you are making deep cuts in multiple passes to reduce the strain on the bit and the motor by

taking no more than a ¼"-deep cut at one time.

There are a variety of designs for the plunge-rod/depth-stop arrangement, but turret depth stops are the most common height-adjustment system. Many newer plunge routers also offer fine adjustment to the depth setting.

This is accomplished either by adding a fine-thread screw mechanism to the depth rod or by adding a fine-thread screw adjustment to the top of one of the depth rests on the stop itself. Fine adjustment can be very helpful during the initial depth setup, as you frequently can find yourself fighting a balancing act between gravity and the tension of the plunge springs to get the setting right.

The fine-adjustment feature also makes plunge routers a good choice for edge routing and profile work, applications typical for a fixed-base router. In fact, many woodworkers when faced with using only one router (thankfully that's not too often) will choose a plunge router, since it is more versatile.

But can't a fixed-base router be used to make plunge cuts? Sure, but it's not recommended. It's a hazardous operation because the base is supported on only one tiny edge while you tip the tool to plunge. If all you have is a fixed-base router, there are ways to get the job done, but for most people who will be making more inside cuts, it's well worth it to get that plunge router.



The fine-adjustment knobs make the depth as accurate as possible.



The turret stop is the most common depth stop in plunge routers.

Should You Buy Two Routers?

Considering the versatility of a plunge router, why should anyone buy a fixed-base router? Simply put, with fewer moving parts and a less-complicated depth adjustment, it's a simpler tool. A fixed-base router is best used for making edge cuttings of a single depth, while the plunge router is built for depth changes and is best for multi-depth interior cuts, such as mortises.

Certainly, a plunge router can be modified or placed in a jig for nearly any cut that you'd want a fixed-base router to do, but that doesn't always make sense. When in doubt, just keep it simple and, in the best of all worlds, both a fixed-base and a plunge router should find a home in your shop.

TIPS & TRICKS

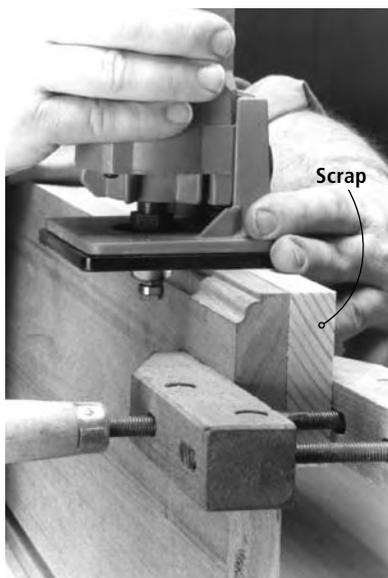
PRO TIP:

Precise Setups with Feeler Gauges

One of the difficulties when setting up your plunge router for a cut is fine-tuning the setting in small increments. The most precise way to change your setting is to use a set of automotive feeler gauges. These thin strips of metal are marked with their precise thicknesses. When you want to adjust your bit up .005", simply place the appropriate feeler gauge between your turret depth stop and the tool's adjustment rod. Plunge the tool and lock it in place. Remove the feeler gauge and move the adjustment rod down until it contacts the turret depth stop again. Bingo. Now your cut is .005" shallower.

GREAT TRICK:

Use a Thick Scrap to Keep Your Router in Balance



If you're routing the thin edge of a workpiece (such as when mortising), or if the workpiece is too narrow to balance the router easily, clamp a thick scrap to the work to provide more support.

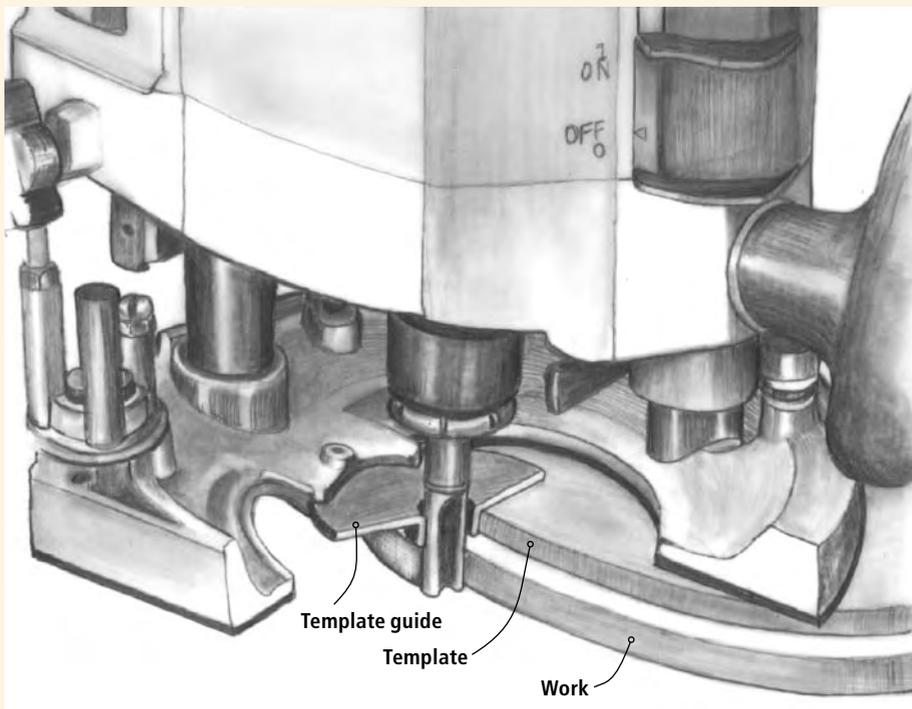


Illustration by Mary Jane Favorite

Template guides are designed to follow templates. As the guide traces the shape of the template, the bit cuts a similar shape in the workpiece. The routed shape is a little larger than the template, depending on the relative diameters of the bit and the template guide.

Base-mounted Fences and Template Guides

Base-mounted guides are available as accessories for most fixed-base and plunge routers. The guide follows the edge of the wood and you can use it rather easily. Instead of holding both router handles, grasp one handle and hold the end of the guide with your other hand. As you cut, keep the guide pressed firmly against the edge of the workpiece. Then just feed the router slowly and easily for a smooth cut.

Template guides attach to the base or sole of the router and follow a straight or contoured edge. These round guides surround the bit and the bit protrudes out through the hole. When using template guides, make sure the bit does not rub the inside of the collar. That wear could ruin both the bit and the collar. Also, keep the guide pressed firmly against the edges of the template as you cut.

Don't forget the most simple of router guides – a straightedge clamped to the material you're cutting. This can be a simple piece of scrap found in your shop



Most base-mounted guides will follow either straight or contoured edges, depending on the shape of the guide. Here, a straight guide – which looks like a small fence – rides along the edge of a board.

or one of a number of commercially available guides that have built-in clamping, making their use a lot easier.

How to Rout a Mortise

Routing a mortise with a plunge router is an easy operation. First mark the location of the mortise and set up whatever guide system you choose. Your guide system can be as simple as an edge guide, as shown on the previous page, or a jig, as shown in the photo at the bottom.

Begin the mortise by making a starting hole. Just position the bit over the work, then push down. Next, enlarge (or elongate) the hole to complete the mortise by moving the router.

Cutting a mortise with the standard fixed-base router is more difficult because you must “rock” the bit into the workpiece before you can complete the cut. You also can cut a mortise with a table-mounted fixed-base router, but the procedure requires careful layout work. You have to mark both the router table and the workpiece to know when to start and stop cutting. That’s why the plunge router is perfect for this job.

Other Applications

Along with mortising, there are some other operations that plunge routers are ideally suited for:

■ Circles and Ellipses

Because cutting these pieces is usually a multi-stage task, the plunge router works best because it can be lowered in stages to make the cuts. You could use a fixed-base router, but it usually takes up more time, or even a band saw, which can be more efficient but won’t give you the precision or finished quality of a plunge router.

A mortising template can be nothing more than a hole cut in a piece of plywood or particle-board. The size and shape of the hole depends on the size and shape of the mortise you wish to cut, the diameter of the template guide in your router and the diameter of the bit you are using. When you make the template, cut it large enough to support the router base. You also may want to fasten it to one or more mounting boards to help position the template and provide an easy way to clamp it to the workpiece.



To rout a mortise with a plunge router, clamp a straightedge or guide to the workpiece and adjust the depth stop. (You also may use a base-mounted guide attached to the router.) Position the router over the work, holding the base against the straightedge (or the guide against the work). Release the height clamp and push the bit into the wood.

■ Deep or Large Cuts

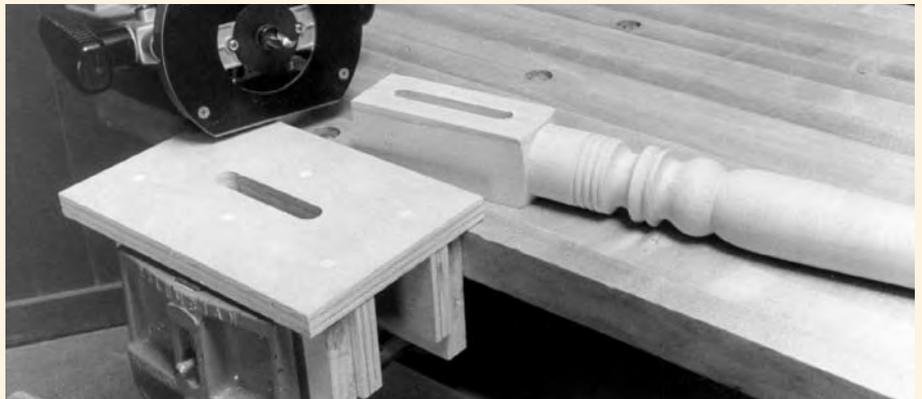
If you have a deep cut that is going to be more than one pass or is larger than your bit, break out the plunge router. Even if it means building up support on the outboard side of the router’s base to prevent tipping, it’s almost always better to use the plunge router.

■ With a Router Table

Plunge routers are the most popular choice with a table because there are more options in the 3-hp range than fixed-base routers. They’re also relatively inexpensive, but there are some problems to be aware of. Because the router’s motor is inseparable from the rest of the tool, you can’t change the bit easily if the tool is fixed to the tabletop.



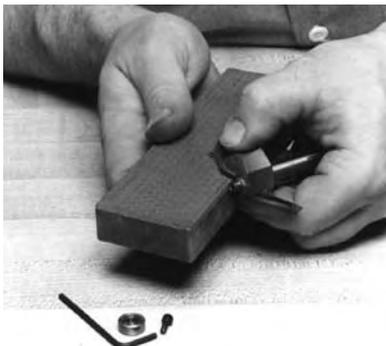
The depth stop will halt the bit at the proper depth. Secure the height clamp and rout the mortise, keeping the router against the guide.



TIPS & TRICKS

PRO TIP:

Sharpen Cutting Flutes by Using a Diamond Stone



If your cutting edges seem dull, touch up the carbide flutes on a diamond stone. Sharpen only the inside (flat) surfaces of the flutes, leaving the outside (curved) edges alone. If you try to sharpen those, you might change the diameter of the bit.

GREAT TIP:

Wax That Tool; Don't Worry About Wax on Wood

There is a common misconception that if you wax a woodworking tool the wax will rub off onto the wood and interfere with a finish. This is not true, as long as you buff the wax after it dries. Once buffed, the layer of wax remaining on the tool is only a few molecules thick – enough to protect and lubricate the metal but not enough to ruin the finish.

GREAT TIP:

Remove Your Plunge Springs When Routing in a Table

One of the most frustrating things about using a plunge router in a router table is that the plunge springs work against you as you try to increase the height of the bit. Many plunge routers allow you to easily remove the springs. Give it a try.

Router Maintenance

Like many modern portable power tools, the router is a mostly maintenance-free tool. There are, however, a few things you must do to keep it in good working order. In particular:

- Keep the motor free of dust. Use compressed air or a vacuum to clean out the housing. Otherwise, the dust will get into the bearings – even permanently sealed bearings – and cause them to wear prematurely. The dust also can damage the commutator (a part of the router's universal motor that conducts current) and field of the motor.

- Keep the collet dust-free. Dust in a collet is the most common cause of bits slipping. If you don't keep it clean, the collet also can show wear prematurely.

- Replace the collet immediately if it shows signs of wear. A worn collet damages the shanks of router bits, and this may ruin the motor shaft, requiring you to replace the entire armature.

- Wax and buff the base plate and the surfaces of the tool that slide together (such as the plunge bars). This simple act will help these parts move freely and keep the router gliding smoothly across the work.

- Specifically with the plunge router, you need to make sure that the plunge bars and sleeves are correctly aligned. If the router is dropped, these parts might need to be inspected. In some routers, the return springs are inside the plunge bars; in others, the spring is fitted externally. Either way, the springs need to be

seated properly and cleaned regularly.

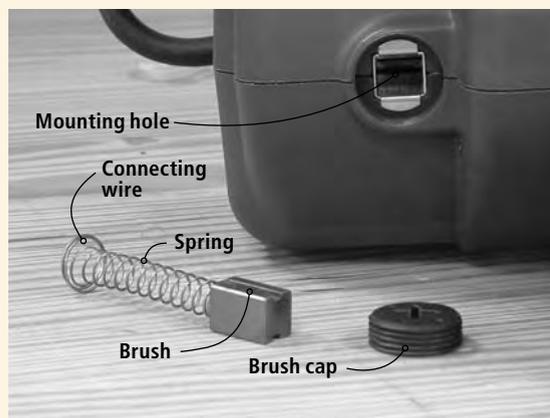
- Brushes are blocks of carbon that ride and wear against the commutator in all router motors as part of the motor function. Over enough time, the brushes can wear down enough to require complete replacement. Some, but not all routers, make this a simple task by making the brushes accessible from the outside of the router housing.

Sparking from the motor that is only getting worse is a good indicator that it may be time to replace the brushes. This usually is a simple task that requires removing the brush cover, removing the brush, spring and wire, and inserting a new brush. Properly aligning the brushes and leaving proper “play” in the spring will ensure a good fit.

There likely will be a short period where sparking will continue as the new square brush shapes itself to the surface of the round commutator, but after that there should be no problem.

- Many switches included on routers today are sealed against dust. This makes maintenance on them unnecessary. If you happen to have an older or less-expensive router, you may want to take a look at the switch occasionally as well. After unplugging the router it's simple enough to remove the switch from the housing and use a soft toothbrush to clean any accumulated dust from the switch and the switch terminals. Compressed air is another option for cleaning out the switch. Put things back together and you're ready to go.

At right is the motor's brush with spring and connecting wire, the cap and the hole in the housing where the brush goes. You can see that the surface of the brush is slightly concave to form to the cylinder of the commutator. When replacing a brush that is already broken in, the shape should be properly oriented to match the motor's round commutator.



A BIT OF ADVICE

Bit Maintenance

Clean and maintain the router bits, not just the machine itself. After all, a bit is the most important part of your routing system. Here are some tips:

- After each use, remove dust and built-up pitch. Then polish the shaft with a piece of steel wool or 3M Scotch-Brite. This will not affect the diameter of the shaft – the tool materials are a lot harder than steel wool and Scotch-Brite.

- If there are any burrs or galling (rough spots) on the shaft of the bit, sand the entire shaft smooth with emery cloth. Carefully check the collet for dust or any signs of wear. Burrs and galling are sure signs that the bit has slipped while you were cutting.

- Lubricate pilot bushings and bearings after every one to two hours of use. Wax and buff the bushings. Apply a dry lubricant, such as powdered graphite, to the bearings. Do not use oil or sprays; these mix with sawdust, forming a gummy paste that can ruin the bearing.

Using Guided Bits

A guided bit has either a ball bearing or a pilot to guide the cut. These follow the surface of the work (or a template) to keep the width of cut consistent, just as when using a base-mounted guide bushing.

Usually they're mounted to the ends of the flutes, but some are positioned between the shank and the flutes (called "over-bearings").

When using guided bits:

- Remember that the guide is meant to follow the contour of the board.



To remove the pitch from a router bit, soak it in lacquer thinner or spray it with oven cleaner. Give the solvent a moment or two to work, then wipe off the bit with fine steel wool.

When you set the depth of cut, the guide must solidly contact the wood surface.

- Anticipate the curves and corners of your work to keep the guide pressed firmly against the board's edge.

- Treat the guide as if it were a small straightedge or fence when trying to decide which way to move the router or feed the work. With a hand-held router right-side up, cut counterclockwise around the outside of your workpiece. (With the router mounted upside down in a table, feed the work clockwise around the bit.)

- The diameter of the guide controls the width of the cut. Some guided bits have interchangeable bearings for you to change the diameter, but not all do, so make sure you're prepared for this.

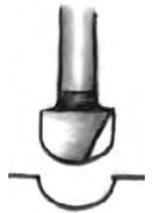


For best results, use guide bearings, rather than pilots or pins, which turn at the same speed as the bit and rub the edge of the workpiece. The friction causes them to heat up and burn the wood. Bearings turn independently of the bit and won't rub or burn the wood.

A router bit consists of a cylindrical shank (usually $\frac{1}{4}$ " or $\frac{1}{2}$ " in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series, we will be providing a closer look at a many of the most common (and some specialized) bits that you can use with your router. These four bits are great for making interior patterns.

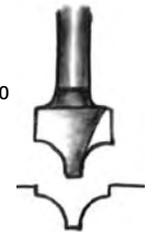
Round Nose Bit

Provides a perfect radius groove and is most commonly associated with producing fluted millwork, signs and decorative designs in cabinet doors.



Beading Bit

A bead is different than a roundover in that it has a shoulder that transitions into the round. Used for decorative edges, it can be used on one side (often with a bearing guide) or two sides to make a double bead.



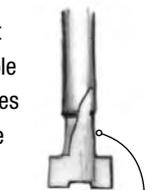
V-groove Bit

This decorative bit allows you to cut deep or shallow grooves by adjusting the cutting depth. Ideal for making signs and adding decorative accents to furniture and plaques.



Keyhole Bit

This is a very specialized bit that allows you to cut keyhole openings for hanging pictures and plaques. Perfect for use in plunge routers.



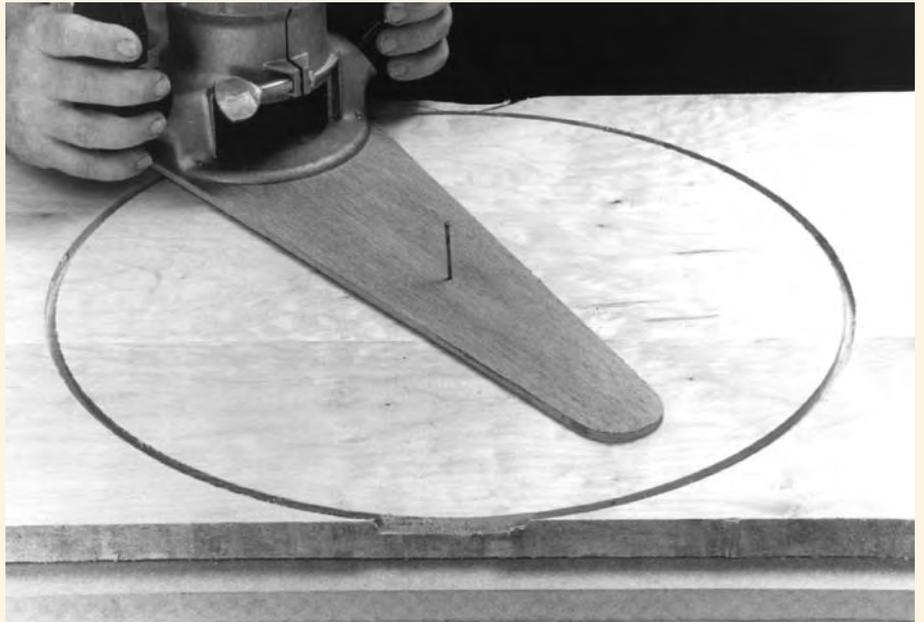
Cuts access hole and space for the nail or screw head

Cuts space for the shank

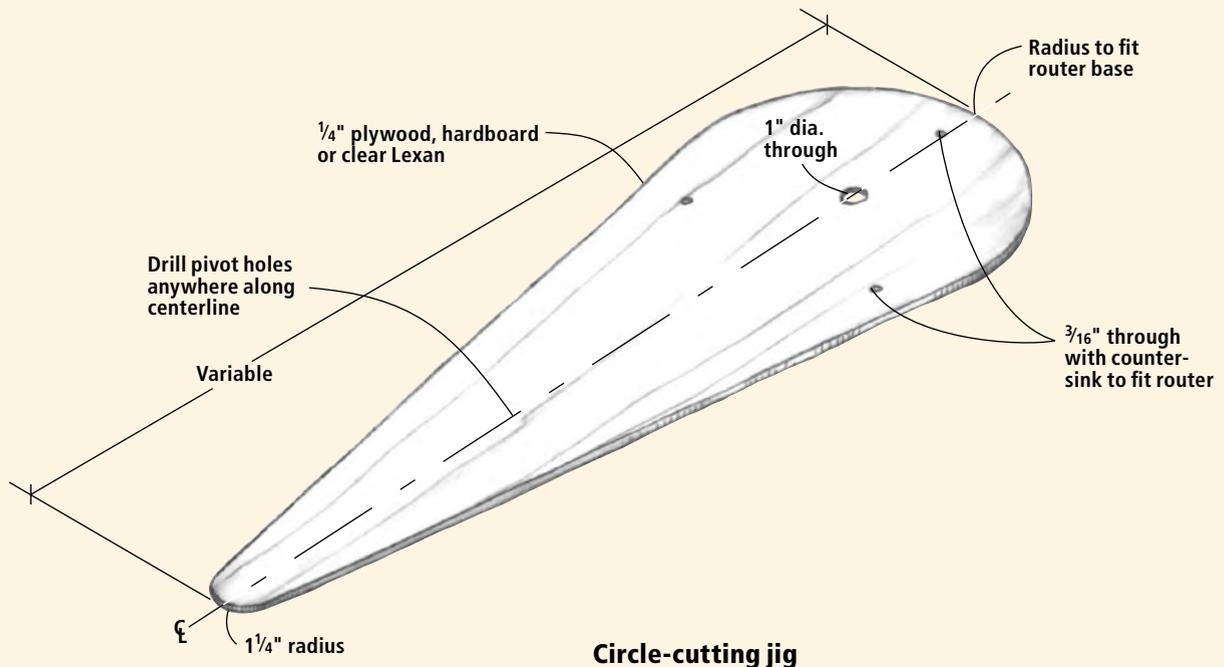
Circle-cutting Jig

Many woodworkers use a router, a straight bit and a circle-cutting jig to make circles. And, naturally, there is an easy-to-build and easy-to-use jig that will help you make these perfect pieces. This jig is just an elongated router sole that you can attach to your hand-held router's base. Make the jig from plywood, hardboard or a clear acrylic, such as Lexan.

To cut a circle, drive a nail or screw into the workpiece to make a pivot – make sure you drive the pivot nail into the bottom or inside surface of the workpiece, because you don't want the hole to show on the assembled project. Then just drill a hole in the small end of the jig, place the hole over the pivot and swing the router around the pivot.



The distance from the pivot hole to the nearest edge of the router bit determines the diameter of the circle. Put a scrap of plywood under the workpiece so you don't cut into your workbench.



Circle-cutting jig

WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

3

The Router Table

After you've worked with a hand-held router for some time, you'll find that many operations are easier and safer if you pass the workpiece across the bit instead of the other way around. This is especially true when routing small pieces or when making many identical cuts. For these tasks,

holding the tool stationary by mounting it in a table or a jig is a good idea.

There are two common ways to mount a router: vertically beneath the work or horizontally beside the work, as shown in the illustration on the next page. Each position offers unique advantages, and there are a number

of tools and jigs available that will hold the router in each position. You can purchase or make many different router-mounting jigs and accessories, but the most versatile is the router table. This device holds the router vertically beneath the work, with the bit protruding up through a hole in the table – all you have to do is rest your workpiece on the table's top and guide it over the bit.

There are many commercial router tables on the market, as well as several you can make from a kit. You can make your own from scratch pretty easily. A homemade router table may be a better option in the long run for a number of reasons:

- You can build it to fit whatever kind of router you already own.
- You can make it suit whatever available space you have in your shop.



PRO TIP:

Rout End-grain Edges First To Avoid Any Tear-out

When routing profiles on four edges of a rectangular or square piece, start with an end-grain edge first. If the end of the cut tears out, the following pass on the long-grain edge will most likely remove the torn-out corner.

TIPS & TRICKS

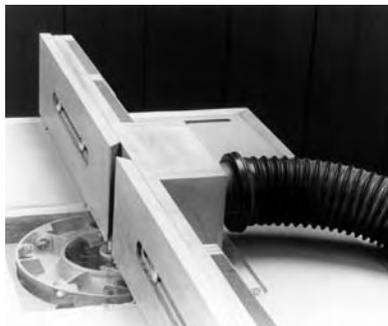
PRO TIP:

Titanium-coated Bits Don't Burn Wood When Sharp

Manufacturers sometimes coat the cutting edges of large, carbide-tipped router bits with a gold-colored titanium alloy and claim the bits can be used safely without reducing the routing speed. This is true to an extent. Titanium-coated carbide can be honed to a much sharper edge than the uncoated variety. While the cutting edges remain razor-sharp, the bit will cut cleanly at high speeds without leaving burn marks. But as soon as the edges dull or load up with pitch, the bit will burn the wood.

GREAT TIP:

Dust Collector Keeps Table's Mess to a Minimum

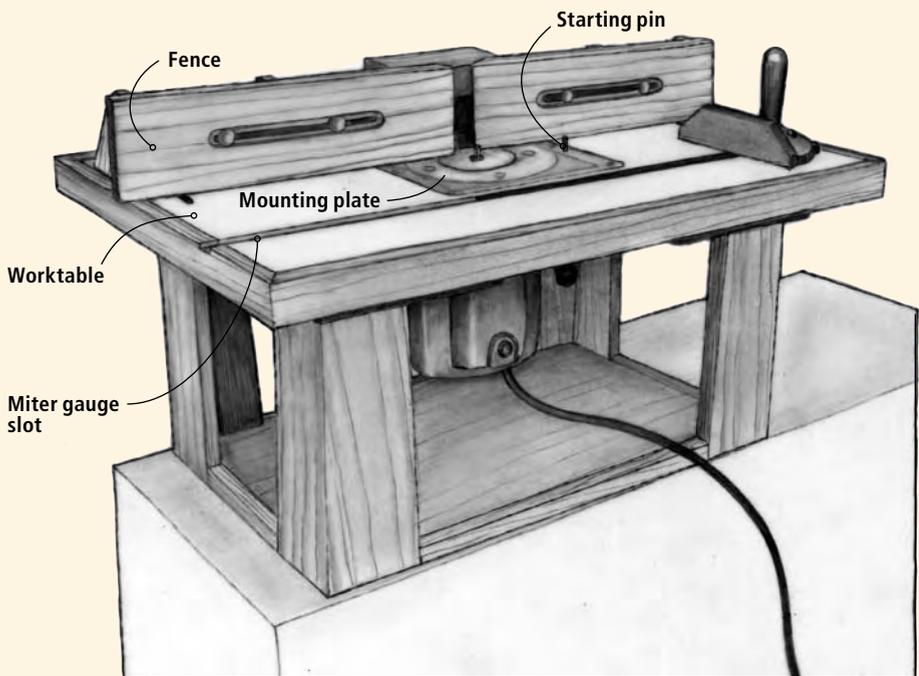


If possible, make sure your router table has a dust collector to minimize airborne dust as you work. On the table seen here, the collector is part of the fence.

GREAT TRICK:

Mount a Power Switch Closer to Table's Front

When a router is mounted in a table, it might be hard to reach a power switch. To solve this problem, mount a combination switch/outlet near the front of the table and wire it to control the power to the outlet. Plug your router into the outlet and use the switch to turn it on and off.



Illustrations by Mary Jane Favorite

■ If you don't have room for a stand-alone table, you can customize other fixtures already in your shop to hold a router. A workbench, a table saw or a radial-arm saw all can pull double-duty as a router table.

[Editor's Note: Check out our plans for how to adapt a Workmate to be used as an inexpensive and accurate router table on page 8 of this issue.]

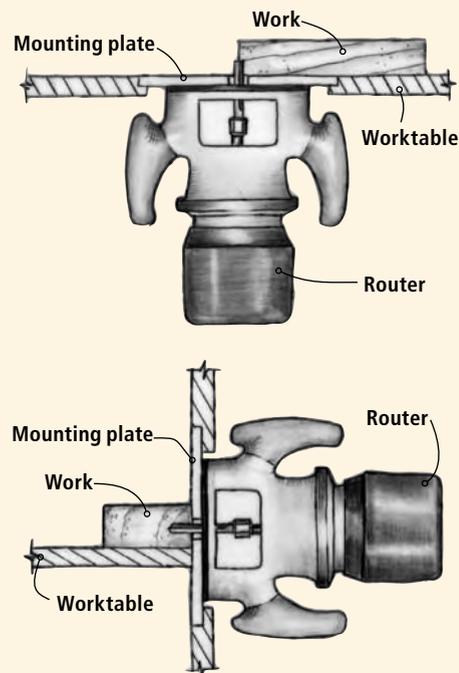
What Router is Best with a Table?

Choosing which type of router to use in a router table has been the subject of debate for many years. When the plunge router first entered the marketplace, it quickly became the router of choice for table use, offering more precise height adjustment than fixed-base routers.

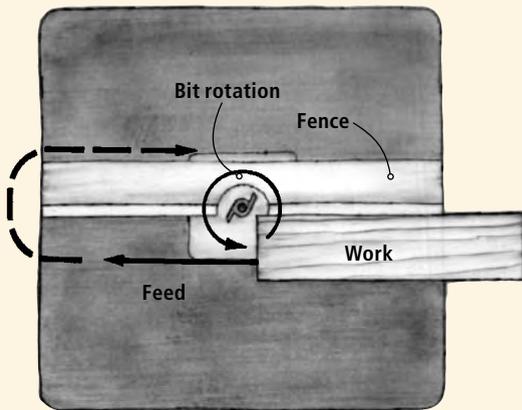
One problem that arose was when the return spring on plunge routers pushed against the height adjustment, making it a difficult process. It didn't take long for woodworkers to remove the spring from their plunge routers to make the adjustment easier. Some manufacturers (including Bosch and Triton) recently have addressed that problem themselves by offering plunge routers that enable users to "defeat" the return spring.

Another difficulty router tables presented was the need to reach under the table to make height adjustments, change bits and actually turn the router

on and off. This led to removable plates in the tabletops to which the routers were attached. Rather than crawling under the table, the router and plate could be lifted free from above the table. These plates soon became even more helpful with the addition of built-in



There are two common ways to mount a portable router and hold it stationary. You can mount it vertically under the work (top) or horizontally beside the work (bottom).



When a router is vertical under a table, the bit spins counterclockwise when viewed from above. Whether cutting the edge or interior of a workpiece, feed clockwise around the fence.

height adjustment. The router-lift plates make it possible to fine-adjust the height of a more-affordable fixed-base router from above the table, providing the best of both worlds.

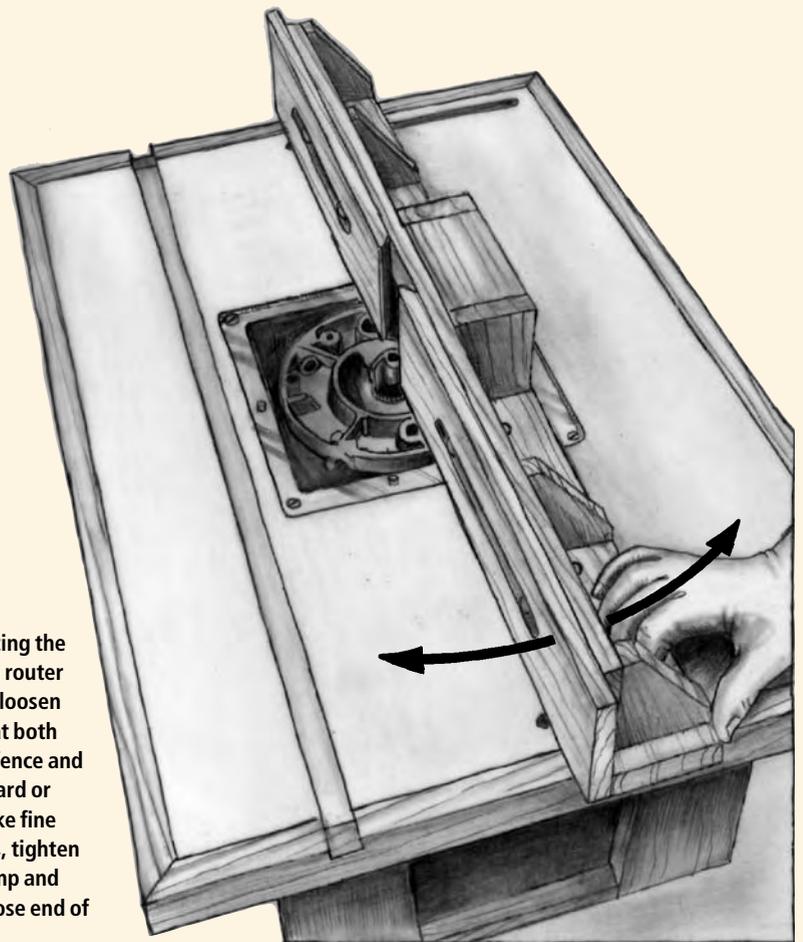
Some of the newest fixed-base and plunge routers now offer built-in, through-the-base height adjustment. This makes the router lifts obsolete, though they're still the best option for older (as well as many of the newer and less-expensive) router models.

This brings us back to the question of what router to use in your table. A 1½- to 2-horsepower router can be used successfully in a table, but it will limit you to small- or medium-diameter bits. In general, it makes more sense to use a 2½- to 3-hp router in a table to maximize the benefits of the table.

The other strong recommendation is to outfit your router table with a variable-speed router. Because your table will support a larger-motor router, you can successfully use large-diameter bits. To get the best performance from these bits, they should be run at slower speeds, so a variable-speed router will give you optimum performance in your table, whether using smaller grooving bits or panel-raising bits for making doors.

That said, with the variety of table-friendly routers and router lifts available, it's impossible to recommend either a plunge or a fixed-base router as best for use in a table. You'll need to determine what your budget will allow and

When adjusting the position of a router table fence, loosen the clamps at both ends of the fence and slide it forward or back. To make fine adjustments, tighten just one clamp and move the loose end of the fence.



take into consideration what routers you already own. With all the choices currently available, there's no reason you shouldn't be able to buy or build a router table that allows you to adjust and operate the router from above the table surface. It's up to you to choose how you assemble the hardware.

A Look at Router Lifts

Router lifts are available in a number of varying designs, ranging from a retrofit kit to replace the spring in a plunge router, all the way to heavy-duty mounting platforms that include the table plate. Prices range from \$100 to \$400, so you should know what you're getting into before you spend any money.

Ultimately, the router lift should adequately support the router underneath the table without any concern of deflection or slipping. Deflection will cause the bit you are using to deviate from a 90° angle to the table, ruining the cut. The lift also should adjust the height smoothly in measurable and repeatable increments, and not interfere with the table surface. Most lifts that are

on the market are designed for use with fixed-base routers, which is fine, but you should choose a router with variable-speed control to take maximum advantage of the larger motor and available larger-diameter bits.

Some lifts also will allow you to change bits from above the table. These lifts raise the router high enough through the tabletop (while not running) to use both wrenches (or one wrench and a shaft lock). This is a great feature and highly recommended.

Using the Router Table

When using a router in a router table, you will need to pay extra attention to the tool's feed direction. When your router is mounted upside down under a table, the bit spins counterclockwise (as viewed from above). Whether you are cutting the edge or the interior of a workpiece, imagine that you are feeding it clockwise around the fence – right to left as you face the fence.

The rotation will help keep the board pressed against the fence, making it safer to make the cut. When using a fence,

TIPS & TRICKS

GREAT TRICK: **Scrap Piece Helps When Routing Narrow Work**



When routing the end of a narrow workpiece on a router table, use a large square scrap to guide it along the fence. The scrap not only holds the work perpendicular to the fence, it also backs up the wood so it won't tear out at the end of the cut.

GREAT TIP: **Keep Your Hands Away With Small Workpieces**



If a workpiece is very small, your hands may come too close to the router bit as you rout it. In this case, you have two choices – you can rout the work with a portable router using a commercially available foam rubber “routing pad” or double-stick tape to hold the work, or you can rout a portion of a larger workpiece and cut a small piece from it, as seen above.

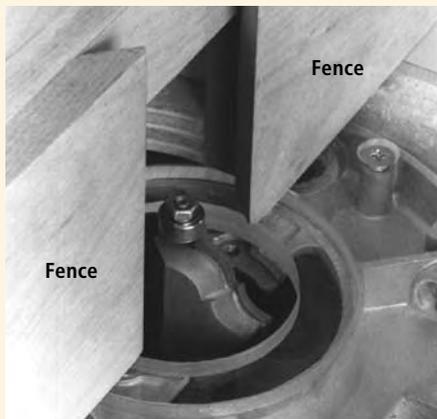
GREAT TIP: **Slide Smoothly With Wax**

To help the table slide more smoothly, wax and buff the table surface, the fence faces, the miter gauge bars and the grooves for any miter fixtures.

you also need to check that the router is properly aligned and adjusted in the table. There are two things you need to check – the depth of cut (the distance the bit protrudes past the mounting plate) and the position of the fence.

Other things to remember when using a router table with a fence include:

- Keep the workpiece pressed firmly against the fence to ensure you get as straight a cut as possible.
- Feed the work slowly and steadily – do not pause, if you can help it.



When properly used, a fence guides the work and also protects you from the bit. Even when using a bit with a bearing guide, align the fence faces even with the front edge of the bearing and adjust the fence gap as tightly against the bit as possible.

■ Let the fence surround the unused portion of the bit.

■ Whenever practical, use featherboards, push sticks and push blocks to guide the work along the fence.

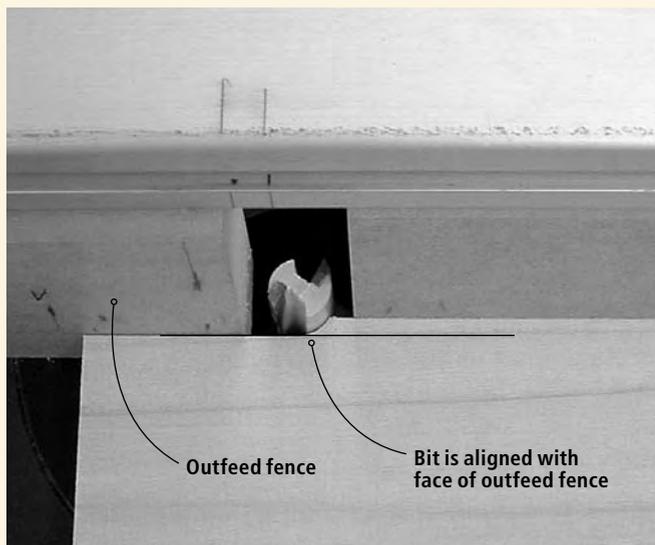
A router table also can be used without a fence. In these cases, a starting pin and a bit with a bearing or a template guide attached is used. This operation is similar to using a hand-held router with a similarly guided bit, but the table operation makes it safer and easier to use larger-profile bits.

The starting pin provides an extra bearing point to allow you to rest against two points while routing, adding an extra level of safety. When using the router table in this setup it's even more important to maintain proper safety and hand clearance from the exposed bit.

Doubles as a Jointer

Speaking of fences, it would be a large oversight not to mention using a router table as an edge-jointer. Some commercially available router-table fences give you the option to adjust the face of the outfeed table forward slightly (by as much as $\frac{1}{8}$ ") to offset the fences.

With a straight router bit aligned tangentially to the face of the outfeed side of the fence, you can run wood across the fence and straighten or thin edges just as you would on a jointer.



By offsetting the outfeed fence (moving it forward $\frac{1}{16}$ " or $\frac{1}{8}$ "), a router table can be used as an efficient edge-jointer. The face of the outfeed fence is aligned with the furthest point of the straight bit and, as the wood passes the bit, the outfeed fence supports the cut.

If your fence assembly isn't designed to have offset fences, you can achieve the same effect by building up the face of the outfeed table with a piece of laminate or thin plywood. Adjust the outfeed face to match the bit and you're ready.

Featherboards and Stop Blocks

Two useful accessories for the router table are featherboards and stop blocks.

- Featherboards are most often thought of as safety devices, and they certainly are, but they also help ensure an accurate cut from the bit. For safety, a featherboard's angled fingers allow the wood to pass the bit and then applies pressure in the same direction you are feeding your work to make it nearly impossible for the piece to kick back (which is when the material is thrown toward the user by the force of the spinning bit). A pair of featherboards used in the horizontal and vertical planes of the router table, as shown in the photograph below, add excellent safety.

Often when using larger-diameter bits in a single pass, the tendency of the bit is to push the material away from it, causing irregular, rippled or shallow cuts. Using a pair of featherboards will keep the workpiece pushed tightly against the fence, table and bit, providing an accurate, smooth and repeatable cut.

- When using a router table, the bit is buried in the wood during the cut and you can't see when or where the cut



You also can use a fence as a stop to prevent creep. However, the fence must be precisely parallel to the miter-gauge slot and you must be feeding the workpiece with the rotation of the bit to pull the piece against the fence.

begins or ends. When making a stopped cut of any type (groove or profile), you need to know the stopping and starting points to make an accurate cut.

One way to determine those points is to make a pencil mark on the fence identifying the infeed and outfeed sides of the bit. This helps, but it isn't a positive assurance of accuracy.

That's where stop blocks come in handy. By mounting some adjustable blocks to the fence (using either integral T-tracks or a clamp on the fence) you can be sure you'll always stop and start in exactly the correct spot.

Using a Miter Gauge

A miter gauge is a simple way to ensure you get square cuts on the ends of thin stock when using a router table. Just place the stock against the face of the gauge and feed it past the bit as if it was the blade on a table saw.

But there is an important difference – the rotation of a saw blade helps hold the work against the gauge; the rotation of the router bit pulls the wood sideways, making it “creep” across the gauge to the right as you cut.

When not using a fence, there are several things you can do to prevent this:

- Mount an extension (a long, auxiliary face) on the miter gauge and clamp the work to this.
- Clamp a stop to the miter-gauge extension and butt the workpiece against the stop.
- Position a fence beside the miter gauge and let the end of the board ride along the fence as you cut.
- Tape #80-grit or #100-grit sandpaper to the miter gauge face with double-stick tape. Or use adhesive sandpaper.

It's also a good idea when crosscutting material on the router table to use a backing board against the face of the miter gauge. This will significantly decrease tear-out on the workpiece and add some more stability.

When using a fence, attach featherboards to both the fence and the table to keep the workpiece properly positioned. Featherboards provide firm, even pressure and prevent the piece from kicking back toward you. Also use push sticks and push blocks to feed the workpiece, keeping your fingers out of danger.



TIPS & TRICKS

PRO TRICK:

Need Good Dowels? Just Make Your Own



By rounding over the four arrises of a square workpiece (where the edges and faces meet), you can make your own dowels on a router table. The width and thickness of the workpiece should be precisely twice the radius of the bit. As you rout the four edges, leave about 2" of stock uncut on either end of the piece to keep the work stable on the router table.

GREAT TIP:

Drawers Help Maximize Space in Your Table



If you're making your own router table, you can choose either a portable benchtop version or take advantage of the extra storage space in a floor model by adding drawers to store all your bits and any useful jigs and accessories.

Making a Mounting Plate

If you buy a router table, many will come with a mounting plate – a thin, flat sheet to which you attach the router base. The plate is needed to mount the router in any stationary jig, including the table.

If you're making your own table, or if the one you purchased doesn't come with a mounting plate, don't worry – making the plate is rather straightforward. All you have to do is cut the material to size, drill a few holes and screw the plate to the jig or table. However, you must make several informed decisions as you fashion this simple part.

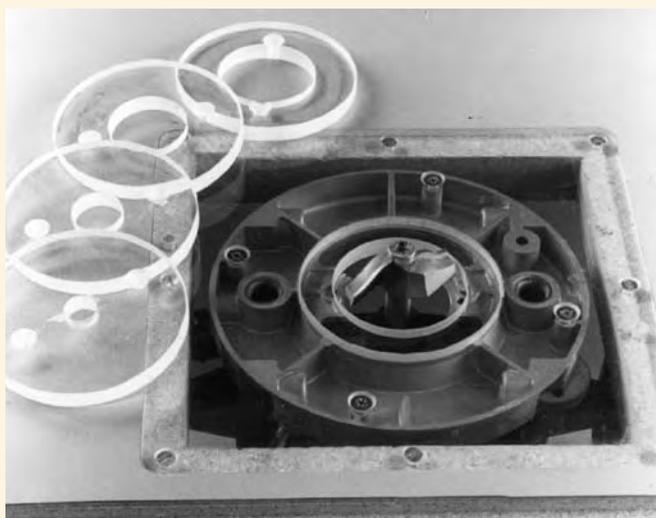
- The material from which you make a mounting plate must be strong enough and dense enough to absorb the vibrations of the router, but thin enough so it won't restrict the depth of cut. You should be able to cut and drill the material easily, and it should be transparent so you can see what's going on beneath it. There is really only one material that fulfills all these requirements – transparent plastic. I suggest you use ordinary acrylic plastic that's rather inexpensive. Some structural plastics are super-strong, but too flexible. Acrylic is more rigid. I suggest using a 1/4"-thick sheet for routers up to 1 1/2-hp and a 3/8"-thick sheet for more powerful routers.

- For safety and accuracy, there should be as little space as possible between the work surface and the router bit where it

protrudes through the plate. However, bits can range in size from 1/16" to 3/4". So what can you do? I suggest you drill the opening about 1/4" larger than the largest bit you own, then make several inserts to fit the opening. Use the same transparent material that the mounting plate was made from and just drill a different diameter hole in the center of each insert so you have a variety to choose from.

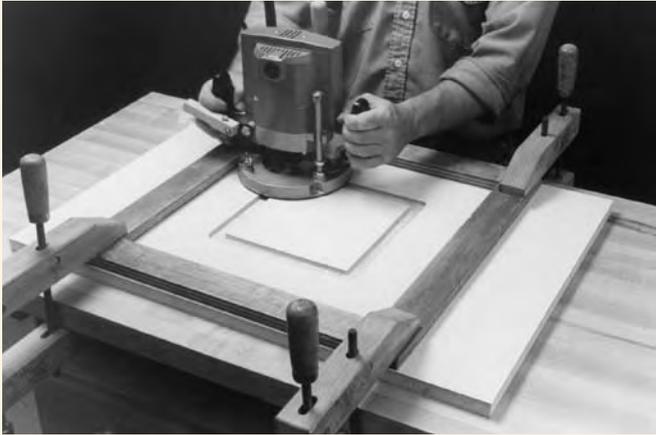
- Once you make these inserts, you're going to need to fashion some way to hold them in place. Some router bases have metal or plastic flanges to mount guide bushings. If your router is so equipped, you can use these flanges to support and secure the inserts. If your router doesn't have built-in flanges, attach a plastic ring under the mounting plate. The inside diameter of this ring should be 1/2" smaller than the diameter of the mounting plate to create a ledge to support the inserts.

- To cut an opening in the table's work surface for the mounting plate, first rout a square groove in the surface. Clamp a wooden frame to the table to guide the router and cut the groove so the depth matches the thickness of the mounting plate. (Make this groove about 1/32" smaller than the circumference of the plate; later, you can sand or file the edges of the plate to get a perfect fit.) Then make the router opening by cutting around the inside edges of the

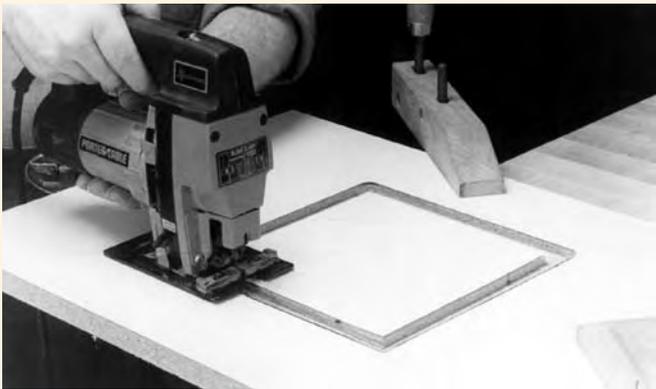


Because router bits can range in size from 1/16" to 3/4", you should drill the plate's opening about 1/4" larger than the largest bit you own. Then you can make several inserts out of the same acrylic you used for the plate.

A BIT OF ADVICE



To cut the work surface for the mounting plate, first rout a square groove. Clamp a frame to the table to guide the router and cut the groove as deep as you want the thickness of the mounting plate.



Next, make the router opening by cutting the inside edges of the groove with a jigsaw. This groove will then form the ledge to hold the plate.

groove with a jigsaw. When the waste falls away, the groove will form a ledge to hold the mounting plate.

■ You can attach the mounting plate in the opening with several screws. Don't leave it loose, because you don't want it to shift as you work.

■ The work surface should be thick enough to permit you to attach the mounting plate securely – short screws may vibrate or pull loose. If the work surface is less than 1¼" thick, build up the area immediately beneath the mounting plate by gluing a hardwood frame to the table.



Screws work great to attach the mounting plate in the opening, but make sure you do it tightly – you don't want anything shifting while you work.

A router bit consists of a cylindrical shank (usually ¼" or ½" in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series, we will be providing a closer look at many of the common and specialized bits that can be used with your router. The three bits shown below are great for use with the router table.

Crown-moulding Bit

Designed to make complicated profile shapes in one pass, a crown-moulding bit is a perfect choice for a router table

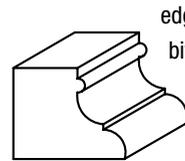


because of its size and the quantity of wood likely to be run.



Table-edge Bit

Because the bit is designed to remove a lot of material in one pass (and run a lot of material at one time) a router table offers power and control for many



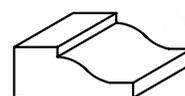
edge profile

bits. Table-edge bits are large and require more power and control.



Raised-panel Bit

Another large bit perfect for router tables is a raised-panel bit for making doors and frame-and-panel cabinetry. The one shown here is a horizontal bit, but vertical bits also are available.

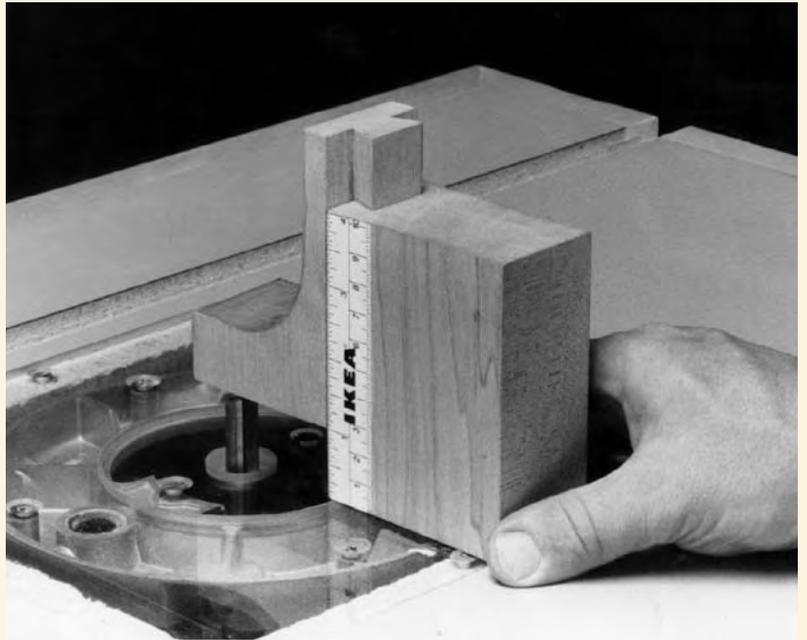


Height Gauge

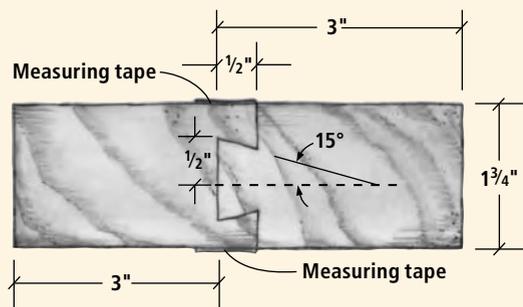
Sometimes you need three hands to adjust the depth of a cut on a router – one to raise or lower the motor, one to secure the height clamp and one to hold the measuring device. And if the router is in a table, you may need to be extremely flexible to scrunch down and read the rule.

This simple shop-made height gauge eliminates the need for one of those extra hands and most of the contortions. The gauge is stable enough that it does not have to be held and the scale can be read accurately from most angles. You can use the gauge with the arm facing down to measure heights of less than 3" or with the arm up for heights between 3" and 6". This gauge also can be used with a shaper, table saw, dado cutter or any other tool or accessory in which the blade or cutter protrudes through a worktable or fence.

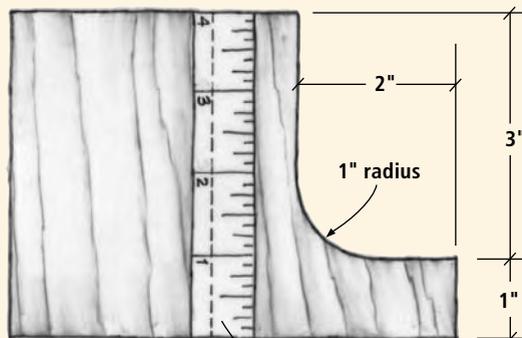
You also can use the gauge to measure the position of a fence in relation to the bit. Just set the gauge and hold it against the fence with the arm encompassing the bit. Then move the fence until the side of the bit touches the arm. **PW**



To use the gauge, set it to the desired height. Place it on the router sole or mounting plate with the arm over the bit. Raise or lower the bit until it touches the arm.

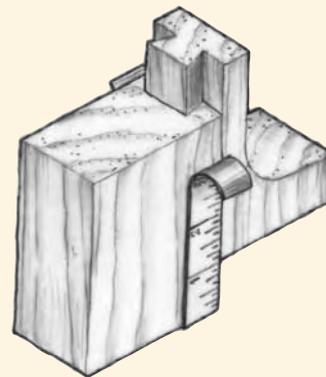


Top view



Side view

1"-4" measuring tape
(3"-7" on reverse side)



Exploded view

WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

4

Router Joinery

Although routers were originally designed to create moulded shapes, they can be excellent joinery tools. In fact, they're better in some ways than table saws, professional-quality mortisers or dado cutters when it comes to cutting joints. There are several reasons routers have an advantage:

- **Simplicity:** Setting up hand-held or table-mounted routers is rather straightforward. Tools dedicated to joint-making such as hollow-chisel mortisers are more complex and require more time to set up. Sure, it could be worth the effort to use a mortiser if you're planning to make dozens of duplicate joints. But if all you want to cut are a few mortises and tenons, for example, a router will save you loads of time.

- **Versatility:** You can make a greater variety of joints with a router

than with any other joinery tool. No matter if you have a fixed-base or plunge router, you can cut more types of joints than with any other kind of tool.

- **Accuracy:** There isn't a more precise joinery tool. You may find tools just as accurate, but none that surpass the router. Because routers cut quickly, they leave a smooth surface, meaning joints fit better and bonds are stronger.

There are some disadvantages to using your router for joint-making, and I'd be remiss if I didn't mention them:

- Most routers won't stand up to continual cutting as well as heavy-duty woodworking machinery.

- Because you can't make deep cuts in a single pass on a router, it may take you longer to rout some joints than it would to use a mortiser or dado cutter.

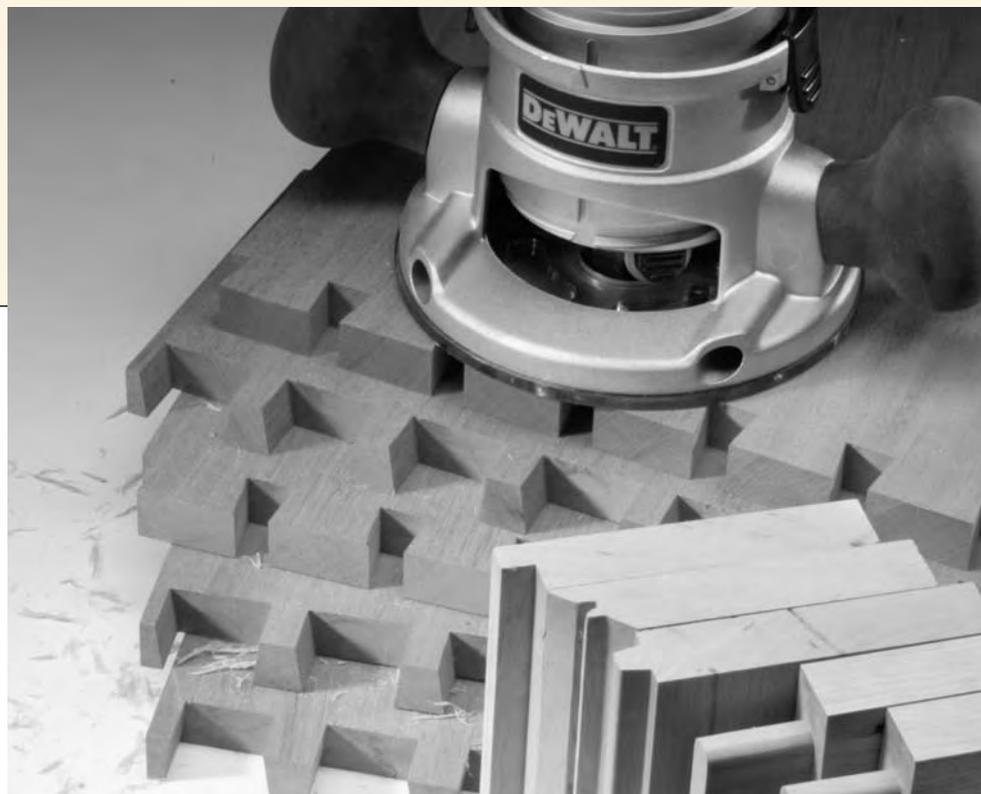
- Depending on the joint you want to make, you may be limited by the sizes and configurations of available bits.

These shortcomings are, however, minor. Routers are indispensable joinery tools in any workshop.

PRO TIP:

Dehumidifier Can Make Your Tenons Fit Tighter

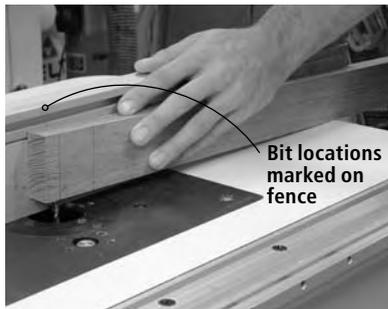
Woodworkers who use mortise-and-tenon joints sometimes keep a dehumidifier in their shop to make it drier than the surrounding environment. Once in the shop, wood shrinks slightly. Then, when a completed project is returned to normal humidity, the tenons swell in the mortises, making the joints tighter.



TIPS & TRICKS

PRO TRICK:

Tilting Pieces to Create Stopped Cuts



Stopped grooves or dados can be made safely on the router table by first marking the bit location (both sides of the bit profile) on the fence, then carefully lowering and raising the piece for the cut using the end of the board opposite the cut as a fulcrum.

PRO TIP:

No Templates Needed If You Copy an Existing Piece

To reproduce a shape quickly and precisely without making a template, just use an existing part to make copies. Adhere the shaped part to the stock with double-stick tape and, using either a pattern-cutting or flush-trim bit, cut the stock while tracing the shaped part with the bearing. However, because the bit won't cut inside corners that are smaller than the bit diameter, you'll have to cut these with a band saw or scroll saw.

GREAT TIP:

Mortising Bits are Worth Taking the Plunge For

Some manufacturers offer so-called mortising bits. They look like a standard straight bit with one difference: They have an additional small cutter at the end of the bit. This type of bit allows you to plunge directly into your work, instead of wiggling the bit as you plunge, which is typical with a standard straight bit.

Rabbets, Dados and Grooves

You can make the most basic woodworking joints – rabbets, dados and grooves – using a simple fixed-base router and an inexpensive set of straight bits.

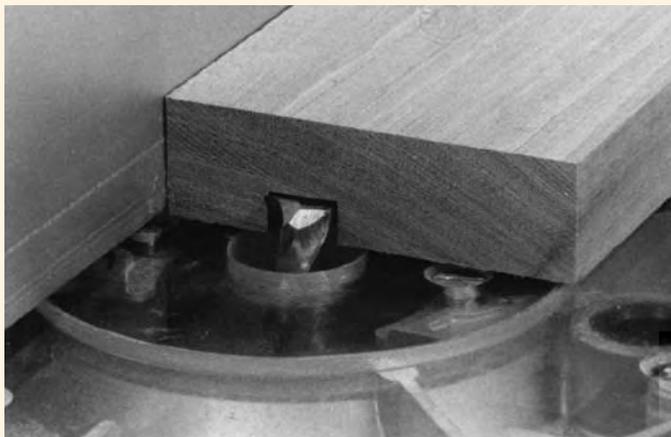
Rabbets (and the simple tongues for tongue-and-groove joints) are produced easily with a router. While you may need a variety of rabet sizes, a single rabbeting bit can accomplish them all. By purchasing a rabbeting bit with interchangeable guide bearings, the width of the rabet can be changed quickly by selecting and installing a different diameter guide-bearing on the bit.

Rabbeting can be accomplished safely using a router freehand or in a table. For rabbeting smaller pieces (such as with frames or door mullions) I recommend using a router table. In a table, you can use a simple straight bit to cut the rabet, or you can use a rabbeting bit with a bearing guide. Even though you may think the bearing guides make a fence

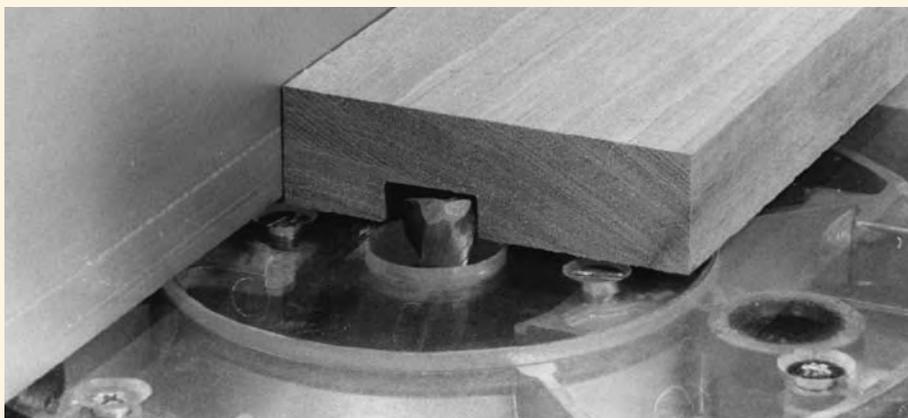
unnecessary, you still should use one to limit the amount of bit exposed and to help guide the pieces. Align the fence with the outside edge of the bearing for a seamless process. For improved accuracy and safety, use a featherboard to hold the material against the fence and table.

As mentioned earlier, a rabet also can form the tongue for a tongue-and-groove joint. The tongue can be flush to one side of a board (for offset raised-panel doors) or the tongue can be centered on the board. Essentially, the tongue is just a long tenon. Run the groove first, then simply size the tongue to fit in that groove.

Many dados or grooves can be made with a straight bit that is sized to accurately make the joint with a single-width pass. To make a dado or groove that's a non-standard size, choose a cutter that's slightly smaller than the width of the joint and cut the joint in two passes, as shown in the photos below.



When routing dados and grooves, the joint ordinarily will be the same width as the bit. If you need to make a joint of a larger size, first make a cut that's somewhat narrower than the joint needed (left), then move the fence or straightedge to make a second cut (below), enlarging the joint to the desired width.



Because most basic joints are cut parallel or perpendicular to straight edges, you must guide the router or the work in a straight line. The best way to do this is to use an edge guide, straightedge, fence or miter gauge. You also can use a shop-made jig, such as the T-square Router Guide (which is featured on page 34 in Chapter One of this series).

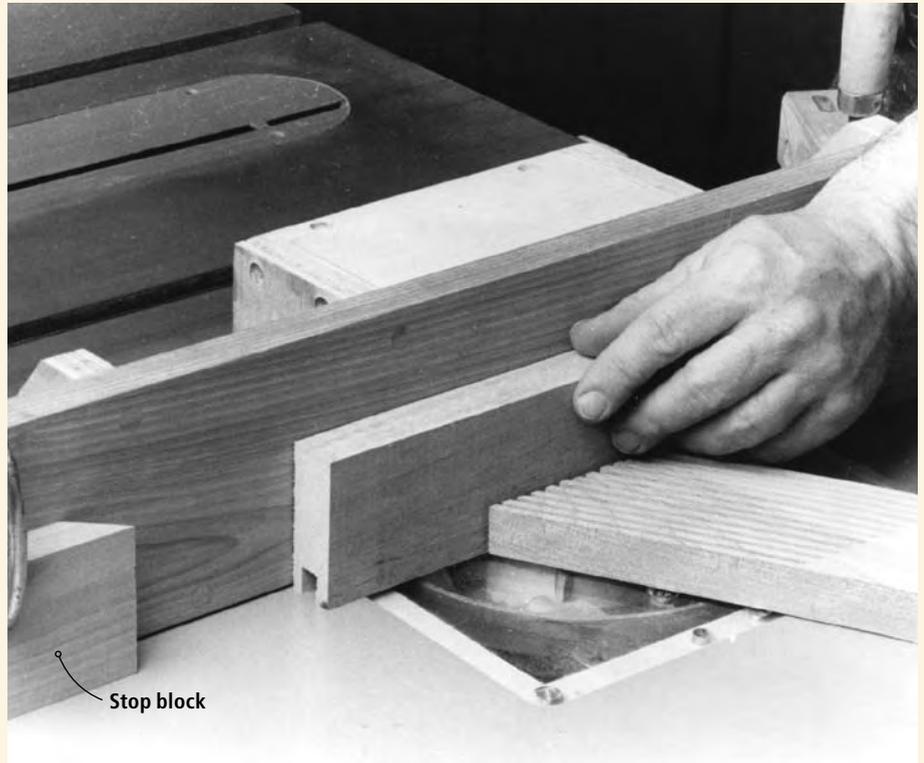
If the joint is blind (which means it stops before running through the board) at one or both ends, attach stops to the workpiece or the guides to automatically halt the cut. The location of these stops depends on where the joint is to be cut in the board. For example, to cut a blind groove that stops 6" from the ends of the board, clamp a stop to the outfeed side of the fence 6" from the router bit.

Now, if the joint is blind at both ends, you can determine the distance between the two stops by adding the length of the board to the length of the joint and subtracting the router bit's diameter. (For example, if you want to cut a 4"-long double-blind groove in a 10" board with a $\frac{3}{8}$ "-diameter straight bit, position the stops $13\frac{5}{8}$ " apart.)

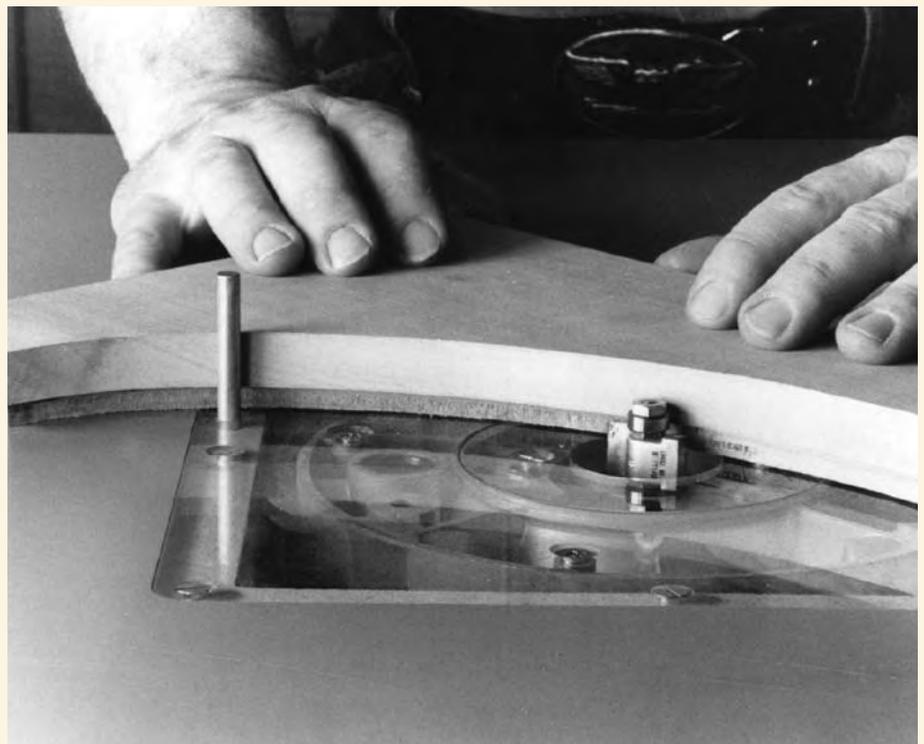
But what if the rabbet must follow a contour? Well, there are a couple choices, but the only bit that makes good sense for making contoured rabbets is a bearing-piloted rabbeting bit.

For a contoured groove, a different approach will likely be necessary. The answer this time is a guide bushing (also called a template guide) and a template. Because a guide bushing is slightly wider than the diameter of the bit, the contour cut by the router will not be the same size as the template. For inside curves and corners, the contour will be smaller; for outside ones, it will be larger.

There always will be a small gap between the edge of the template and the nearest side of the cut because of the different diameters. To determine the width of this space, subtract the diameter of the bit from the outside diameter of the collar and divide by two. (For example, if you cut a contoured groove with a $\frac{5}{8}$ "-diameter collar and a $\frac{1}{2}$ "-diameter bit, the distance between the template and the groove will be $\frac{1}{16}$ ".)



When cutting blind joints – rabbets, dados and grooves that are closed at one or both ends – use a stop block to halt the cut at the blind ends. Note that the end of the stop block is mitered. This prevents sawdust from being trapped between it and the stock, where the dust might interfere with the accuracy of the cut.



When cutting a joint in a contoured edge, use a guided-bearing bit to follow the contour. A bearing-guided rabbeting bit will neatly cut a rabbet in an irregular edge, while a spline cutter will likewise make a groove in an irregular edge a simple task.

TIPS & TRICKS

PRO TIP:

Let the Wood Get Acquainted With its New Surroundings

When you first purchase lumber, bring it into your shop and let it sit untouched for a few weeks before you use it. This will give the moisture content of each board a chance to reach equilibrium with its new environment. If you cut a board while its moisture content is in flux, the wood may expand or contract unevenly, ruining the fit of your joints and distorting the project.

GREAT TRICK:



Connect the Dots to Keep Cutting in Straight Lines

The bit does not always fall in the exact center of a round router base. Because of this, the cut won't be accurate if the router turns while you're guiding the base along a straightedge. The accuracy also may be spoiled when you remove and replace the base plate. To avoid this, put a spot of paint on the edges of the router and base plate, one above the other. Keep these spots toward you as you rout, and align them each time you reattach the base plate.

GREAT TIP:

Watch Your Tenon Widths

As a rule of thumb, most woodworkers limit the width of mortise-and-tenon joints (where the wood grain must be glued perpendicular to its mate) to 3". Once you exceed 3" wide, you will need to use double tenons.

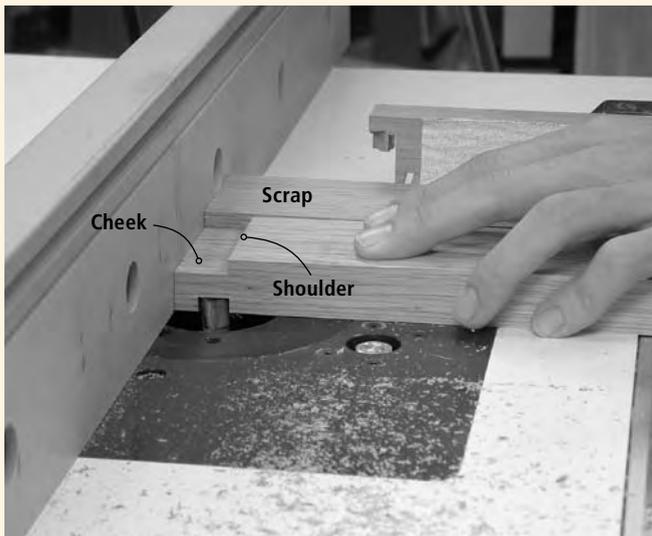
Mortises and Tenons

To make a mortise and its matching tenon, you must combine several techniques. Although it may seem complex, a mortise-and-tenon joint is just a combination of several basic joints. After all, a mortise is simply a groove that's blind at both ends, and a tenon is made by cutting two or more rabbets in the end of a board.

The trick to cutting precise mortises and tenons is to make the cuts in the proper order. Most experienced woodworkers agree that it's easiest to cut the mortise first, then fit the tenon into it.

To make a mortise, you must bore a starter hole and expand it to the dimensions needed. There are several ways to do this using a fixed-base or a plunge router, either hand-held or in a table. However, when you make mortises for mortise-and-tenon joints, you usually want to make several mortises in several different workpieces, all the exact same size and shape. The easiest way to accomplish this is with a simple template.

As a general rule, mortises should be about one-half to one-quarter the width of the material they're made in. So a mortise in a $\frac{3}{4}$ "-wide piece of wood should be $\frac{3}{8}$ " to $\frac{1}{4}$ " wide, with a $\frac{3}{16}$ " to $\frac{1}{4}$ " shoulder on either side of it. The depth of the mortise should be no less than $\frac{3}{4}$ " to ensure a good joint, but 1" or slightly more usually is a good idea.



To make a tenon, cut two or more rabbets in the end of the board – these rabbets will become the cheeks and shoulders of the tenon. To fit the tenon to the mortise, cut the tenon just a bit large, then slowly raise the bit, shaving away a paper-thin layer of stock on each cheek until you get the fit you're after. Guide the cuts with the miter gauge, using the fence as a stop.

The simplest form of template is a piece of plywood that has a hole in it that is the exact size of the mortise you wish to rout. Just clamp the template directly onto your work and then form the mortise using a straight bit that has a bearing above the cutting flutes. There are a variety of ways to make the template, from making plunge cuts on a board with a table saw to edge-gluing four pieces of wood together and leaving a gap in the middle that is the size of the mortise. All work just fine.

When cutting the mortise, first plunge straight down across the entire area you wish to waste away. Then, with the router fully plunged, follow the template's edge with your bearing to complete the mortise to its finished size. (See below for how to cut the tenon.)

Dovetails

There are three basic dovetail joints: half-blind dovetails, through dovetails and sliding dovetails. The router is the only power tool that can create them all, using a special dovetail bit.

Both half-blind and through dovetails are most easily made using accurate templates. These can be purchased (there are many commercially manufactured ones) or you can make your own.

Through dovetails require two passes and two matching templates. These tem-

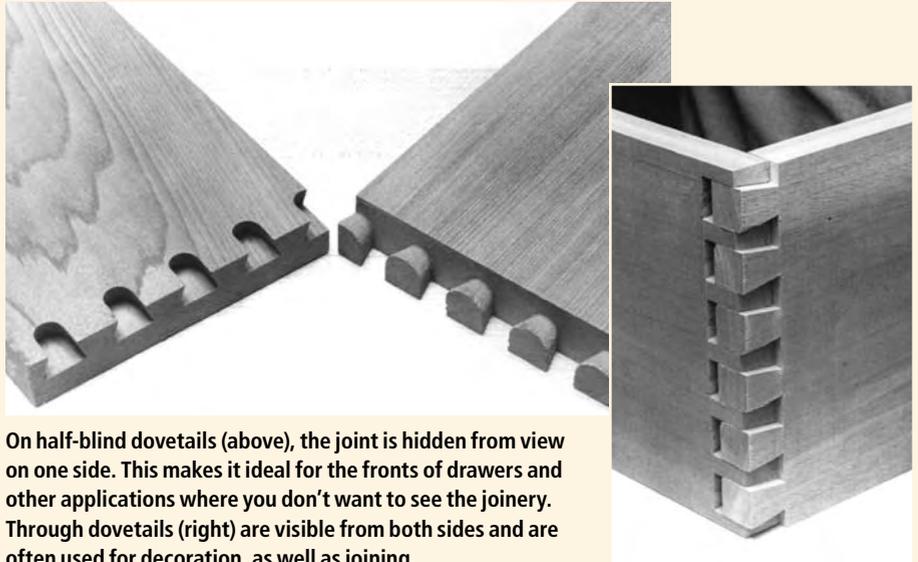
plates are less common than half-blind dovetail templates and, because of the precision required to make them, can be much more expensive.

Sliding dovetails require no special equipment, other than your router, router table and dovetail bit.

To make a sliding dovetail, first rout a dovetail slot the same way you would rout a dado or groove. Because of the bit shape, however, you must cut the full depth in one pass. Next, cut a dovetail tenon to fit this slot – this must be cut on a router table. The slot, on the other hand, can be cut using a hand-held router. Leave the depth of cut unchanged from the setup you used when routing the slot. Then pass a board by the bit, cutting one face. Then turn the board around and cut the other face. These two cuts form the dovetail tenon.

To assemble the joint, just slide the tenon into the slot. If necessary, adjust the fit by trimming a little stock off the tenon's cheeks, either with your router, a small plane or simply with sandpaper.

To rout a half-blind dovetail joint, secure both of the adjoining boards in the template. The "tail" board is held vertically, so its end is flush with the top surface of the horizontal "pin" board. Cut both the tails and the pins in one pass with a dovetail bit, using a guide collar to follow the template.



On half-blind dovetails (above), the joint is hidden from view on one side. This makes it ideal for the fronts of drawers and other applications where you don't want to see the joinery. Through dovetails (right) are visible from both sides and are often used for decoration, as well as joining.



When using a fixed through-dovetail template you can't change the size and position of the tails and pins. Rout the tails first, using the tail template, a guide collar and a dovetail bit. Then you can switch to the pin template and a straight bit. Fit the pins to the tails by moving the template forward or back on its holder. This will change the size, but not the location, of the pins.



TIPS & TRICKS

GREAT TRICK:

Need a Hinge? Just Add a Hole to Finger-jointed Boards

To make a wooden hinge, roundover the ends of two boards with a roundover bit (the radius of the bit must be half the thickness of the boards). Cut finger joints in the rounded ends and assemble the joint. At the center of the rounded ends, drill a hole through the interlocking fingers and insert a wooden or metal dowel to serve as a pivot.

PRO TRICK:

Two Jigs are Better than One, Especially for Dovetails

Many woodworkers keep two dovetail fixtures in their shops – one for half-blinds, one for everything else. For example, I make frequent use of two commercial dovetail-routing setups. In one, I have an inexpensive half-blind dovetail jig and an old router with the necessary guide collar and dovetail bit installed and set. Because I rout more half-blind dovetails than any other dovetail joint, this saves me lots of time. Then, when I need to rout through dovetails or other special dovetail joints, I just use my other jig.

GREAT TIP:

Just a Little Bit off the Top, Even when Routing Mortises

When routing deep mortises, remember to make the cut in several passes, routing no more than $\frac{1}{8}$ " with each pass. If the wood is very hard or tends to chip and splinter, it's better to rout in $\frac{1}{16}$ " passes. Also, use a spiral straight bit to help clear the chips from the mortise as you cut. This is especially important when you're using a hand-held router and the bit is positioned over the work because the chips tend to fall down into the mortise and clog it.

Coped Joints

Perhaps the easiest way to make a joint with a router is to cut a "coped" joint, where both adjoining surfaces are shaped. The most common example of this is on cabinet doors where the rails (the horizontal pieces) meet with the stiles (the vertical pieces). Each joint surface is a mirror image of the other, so the two surfaces mate perfectly.

This has two advantages: The shape of the joint aligns the adjoining parts so the surfaces are flush and the corners are square, and the shape increases the gluing surfaces and strengthens the joint.

Coped joints require special router bits that can be pretty expensive. There are three types of bits, and each must be used in a different manner:

- **Single bit with one cutter:** The male and female cutters are on the same bit, making it a long piece of tooling. You raise and lower the bit in the table to change which set of cutters are in use.

- **Single bit with interchangeable cutters:** You switch from the male to the female cutter by disassembling the bit and changing the orientation of the cutters. There are small shims involved so you need to keep those in the right place as you assemble the bit each time.

- **Two bits:** There's one bit for cutting the male part of the joint and a second for the female. This is usually the most expensive route.

There is another type of bit used for assembling boxes that routs the joinery on both edges. The drawer-lock joint – one example of these – is shown below.

Loose-tenon Joints

Along with all the joints we have discussed so far that require joinery parts cut on the mating pieces, there are a number that use an extra piece to form a loose-tenon joint. The three most common are the true loose-tenon joint, the spline joint and the biscuit joint.



A drawer-lock joint requires only one bit and one setup. However, instead of reversing boards face for face as you cut them (as in the finger glue joint), you must cut the drawer front with the face of the workpiece against the router table, then cut the drawer side with the face against the fence. Adjust both the depth of cut and the position of the fence so the members fit together properly.

A BIT OF ADVICE

The true loose tenon is exactly what it sounds like. Rather than making a mortise in one piece and a tenon on the other, both pieces have mortises. A third piece (often made in a long stock piece and cut to length) becomes a double-sided tenon, connecting the two mortises. The strength is essentially the same as it is in a mortise-and-tenon joint, but the process is perfect for use with a router, and it is quick and accurate.

The mortises are made as described earlier and can be left rounded on the ends, as created by the bit. The tenon is made from a piece of stock planed and ripped to fit the mortises. Next the four arrises are rounded using a roundover bit in your router to make a perfect fit in the mortises. Then you simply crosscut the tenon to fit the mortises.

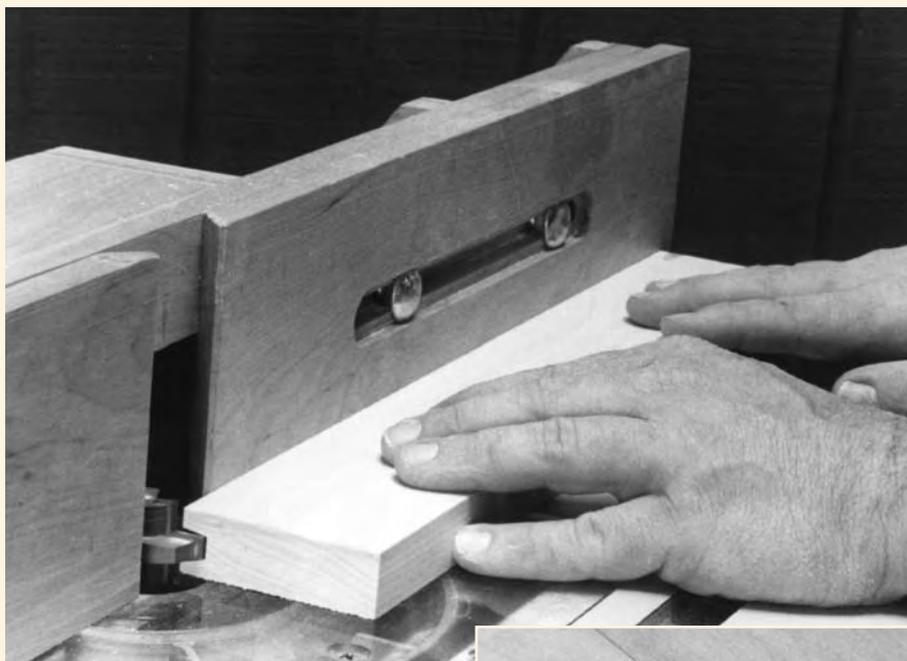
Spline and biscuit joints are cousins to each other. The spline joint requires a groove (usually about $\frac{1}{4}$ " wide) that you run the entire length of the two pieces

to join together. This can be an edge-to-edge joint or an edge-to-face joint. It doesn't matter.

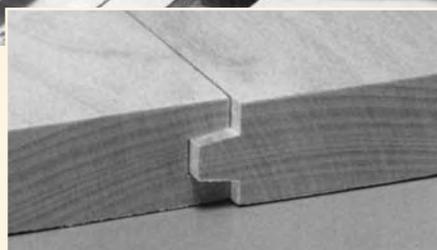
A special router bit called a spline-cutting bit is used to cut the groove. As with a rabbeting bit, the spline cutter uses interchangeable bearing guides of different diameters to adjust the depth of cut. A router table's fence also can be used to adjust the depth.

With the mating grooves cut, just glue a spline in place. The spline can be made from $\frac{1}{4}$ " plywood or solid wood, depending on your preference. Again, the spline should be slightly less wide (deep) than the groove to allow some room for glue squeeze-out.

Biscuits follow the same concept, except the spline cutter is used to cut shorter grooves and commercially available biscuits are used to bridge the joint. In essence you've replaced the need to buy a \$150 biscuit joiner with a \$20 router bit – not too bad.



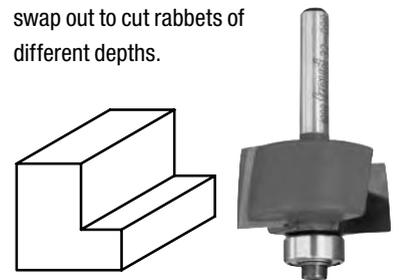
A tongue-and-groove joint requires two matching bits. Rout a groove in one edge of each of the workpieces, then change bits and rout a tongue in the other edge. You must carefully adjust the depth of cut for the second cut to match the first so the faces of the adjoining boards will be flush.



A router bit consists of a cylindrical shank ($\frac{1}{4}$ " or $\frac{1}{2}$ " in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series, we will be providing a closer look at many of the common and specialized bits that can be used with your router. These three bits are great when using your router for joinery.

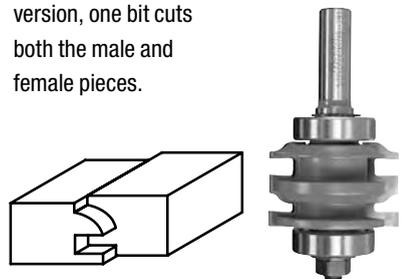
Rabbeting Bit

This handy bit usually comes with a set of different-sized bearings that you can simply swap out to cut rabbets of different depths.



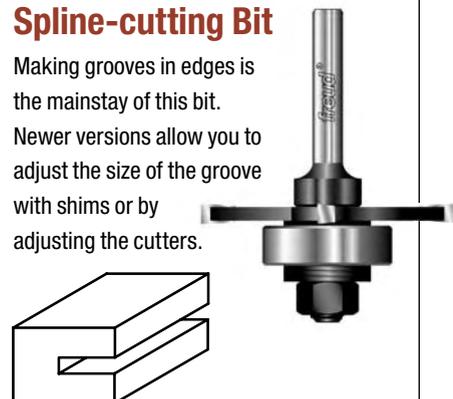
Cope-and-stick Bit

Making decorative frame-and-panel assemblies is a snap with this bit. There are three versions that have different ways of approaching the same operation. In this version, one bit cuts both the male and female pieces.



Spline-cutting Bit

Making grooves in edges is the mainstay of this bit. Newer versions allow you to adjust the size of the groove with shims or by adjusting the cutters.



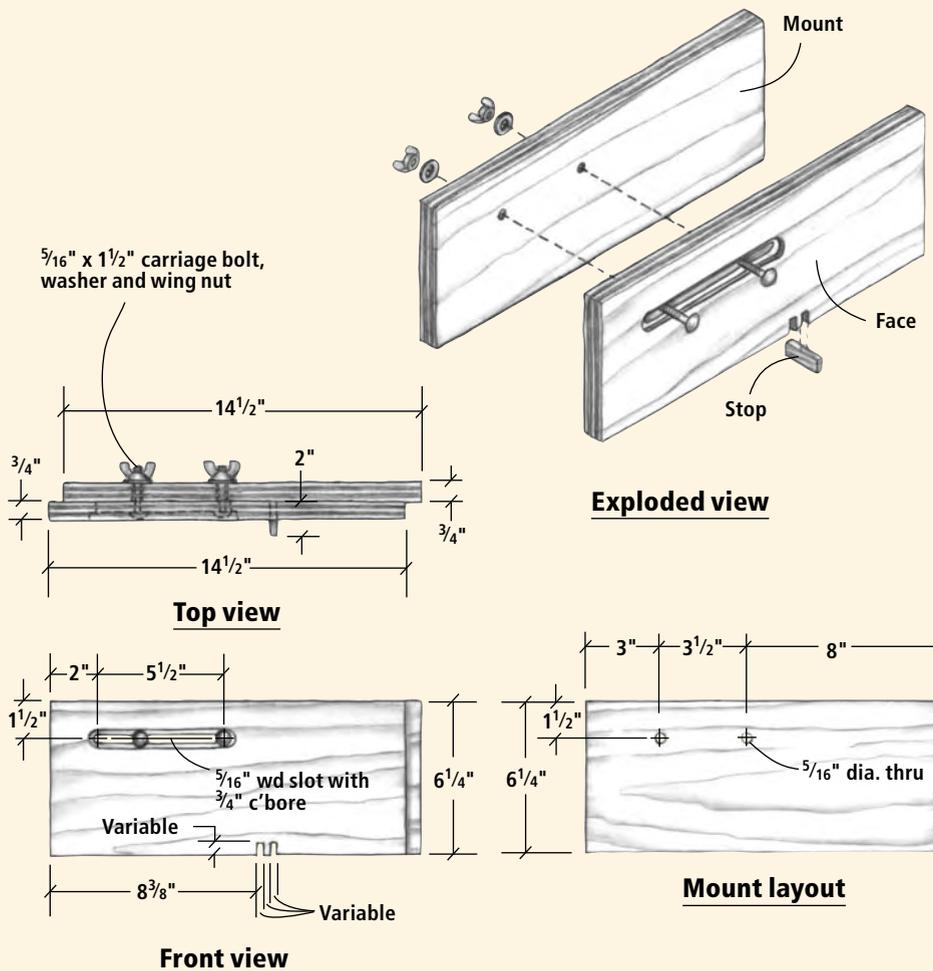
Finger-joint Jig

This jig will evenly space notches as you cut them, allowing you to make perfect finger joints. It's designed to mount on any miter gauge and will work great on your router table with a straight bit (or, if you're so inclined, you also can use it on your table saw).

Make the face and the mount from cabinet-grade plywood and the stop from hardwood. If you wish, you can make several different faces, each with a different-sized stop. This will enable you to cut different sizes of finger joints. **PW**



To use the jig, screw or bolt the mount to a miter gauge. Loosen the wing nuts that secure the face to the mount and slide the face sideways until the stop is the proper distance away from the bit. When the stop is positioned properly, tighten the wing nuts.



WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

5

Use Your Router to Build Boxes & Drawers

Woodworkers have been building boxes for at least 5,000 years. For much of that period, boxes were made using a single chunk of wood with the insides dug out to create a cavity. That's because up until about 600 or 700 years ago, turning trees into boards was an extremely expensive process – the boards had to be hand-sawn (or rived) from logs, then smoothed with planes. Consequently, only the very rich owned furniture made from boards. Most people simply found suitable logs and chopped or burned away the insides when they needed a box.

The invention of the water-powered sawmill in 1328 caused a revolution in woodworking, including the art of making boxes and drawers. The sawmill made it possible for everyone to own boxes made out of sawed lumber, and woodworkers began to build storage units from more than just one board.

PRO TIP:

Read Grain Direction To Get a Jump on Expansion

When you make a drawer with a solid-wood bottom, the grain direction should run from side to side so the drawer bottom will expand front to back. If the bottom were to expand side to side, it would press the drawer sides out, making the drawer bind or stick in its opening.

This multi-board box remains a rather practical and popular method of construction. While the joinery isn't much of a concern when making a one-piece box, it becomes paramount once you begin building boxes and drawers from multiple boards.

With the advent of multi-board drawer construction, a variety of woodworking planes and saws were developed

with box and drawer joinery as their sole purpose. As power tools started to replace hand tools (or at least become a serious option for many woodworkers), the router took over many of the box and drawer joinery duties. In this chapter, I'll take a look at a number of joints that can be created with a router to help you build furniture, drawers and many other boxes.



Grain can run any direction with plywood bottom

TIPS & TRICKS

PRO TIP:

Drawer Sides Can Extend Past the Back

Some traditional and modern drawer designs call for the sides to extend $\frac{1}{4}$ "- $\frac{1}{2}$ " beyond the back of the drawer. This makes the drawer simpler to build and slightly stronger than if the sides are merely flush with the back. For inset drawers, the back ends of the sides often serve as stops to keep the drawer from being pushed in too far. The sides also make more stable stops than the back. Should the back cup or warp, the drawer may protrude from its case slightly. Should the sides cup, the position of the drawer won't be affected.

PRO TRICK:

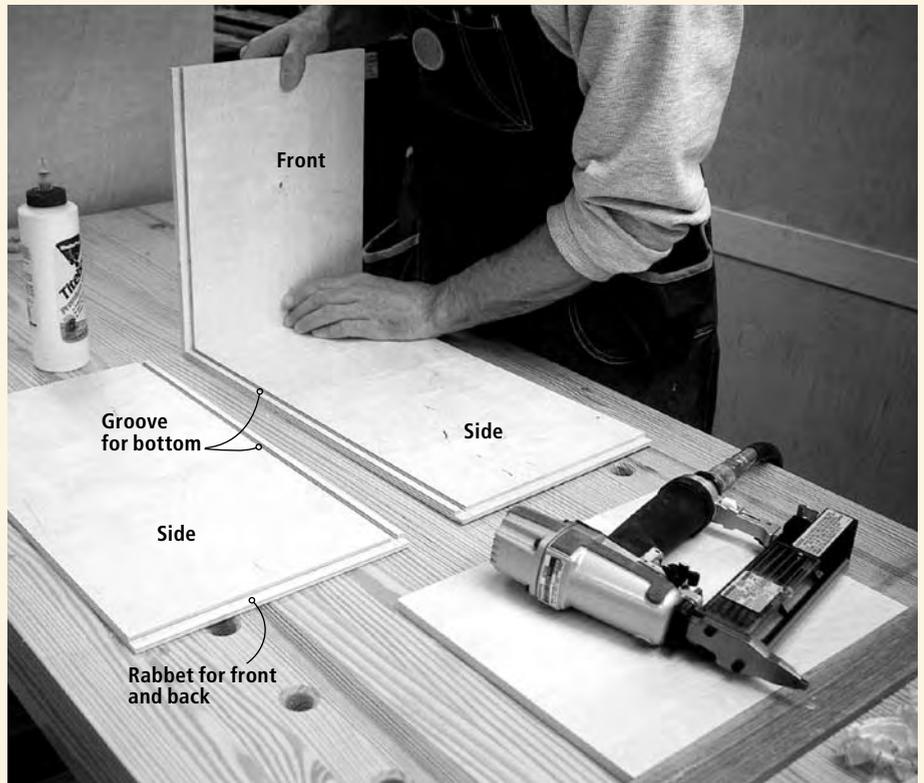
Size Drawers to Holes, Then Plane Them to Fit

Make the drawers precisely the same size as the drawer openings. They'll be too big to work properly, but you can use your handplane or belt sander to take just a little bit of stock from the outside surfaces to get a perfect fit.

GREAT TRICK:

It May Take some Time, but Rout Cavity in Many Passes

If you're making a one-board box with your router, make sure you rout out the cavity in several passes, cutting no more than $\frac{1}{8}$ " deeper with each pass until you reach the desired depth. Begin by routing the circumference of the cavity, keeping the pilot bearing pressed against the pattern. Then move the router back and forth to clean out the waste in the middle of the cavity. (This technique is used only for small boxes these days – usually jewelry boxes with an odd or organic shape to them.)



This drawer box is made pretty easily with rabbets. The front and back rest in $\frac{1}{2}$ "-wide x $\frac{1}{4}$ "-deep rabbets in the side pieces. The bottom slides into a $\frac{1}{4}$ "-wide x $\frac{1}{4}$ "-deep groove in the sides and front. The back is $\frac{1}{2}$ " shorter than the front to allow the bottom to slide in.

Corner Joints

A variety of joints formed by routers can be used to attach the rigid corners of boxes and drawers. The best choice of joint will depend on how the box or drawer will be used:

- Will it be a strictly utilitarian storage unit or will it be decorative as well?
- Will it see light duty or will it be subjected to heavy use?
- Will it remain stationary or will it be moved from place to place?

No matter what you decide to use your box or drawer for, we've got the joint for you. Here are some of the most common corner joints [many of these joints were discussed further in Chapter Four of this series]:

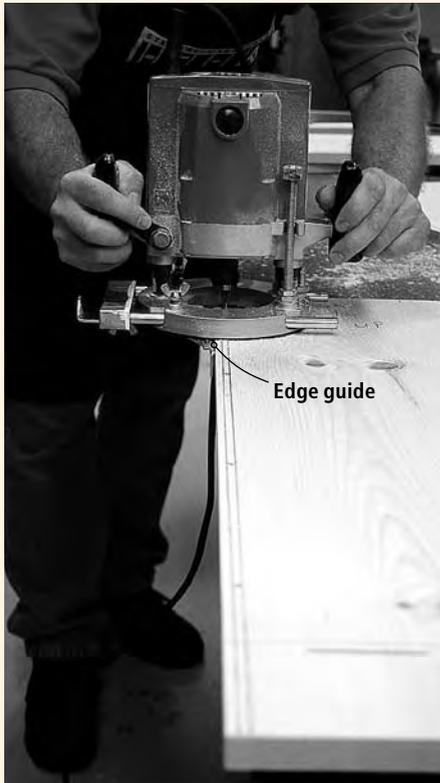
- **Butt Joints:** These are usually reinforced with screws or glue blocks and work well for light-duty, utilitarian boxes. No routers are necessary here. It's the simplest and weakest corner joint.

- **Rabbets and Grooves:** These look similar to butt joints when assembled,

but they are strong enough to be used for medium-duty utilitarian boxes. Rabbets of many sizes are formed easily using a rabbeting bit in a hand-held or table-mounted router. Rabbets and grooves also can be made with a straight bit in a hand-held router if you use a base-mounted edge guide. If the router is in a table, the fence guides the wood to quickly form the rabbets or grooves.

- **Miter Joints:** These are a more aesthetically pleasing option, hiding the end grain on the adjoining boards so that all you see is uninterrupted face grain. However, these are comparatively weak and are best suited for light-duty projects unless reinforced with biscuits or splines (which we will discuss in greater detail next). Routers seldom are used to form miter joints, and are used instead to reinforce and decorate them.

- **Splined Miters:** These are much stronger than regular miters and can be used for medium- or heavy-duty decorative boxes. The splines can be hidden or



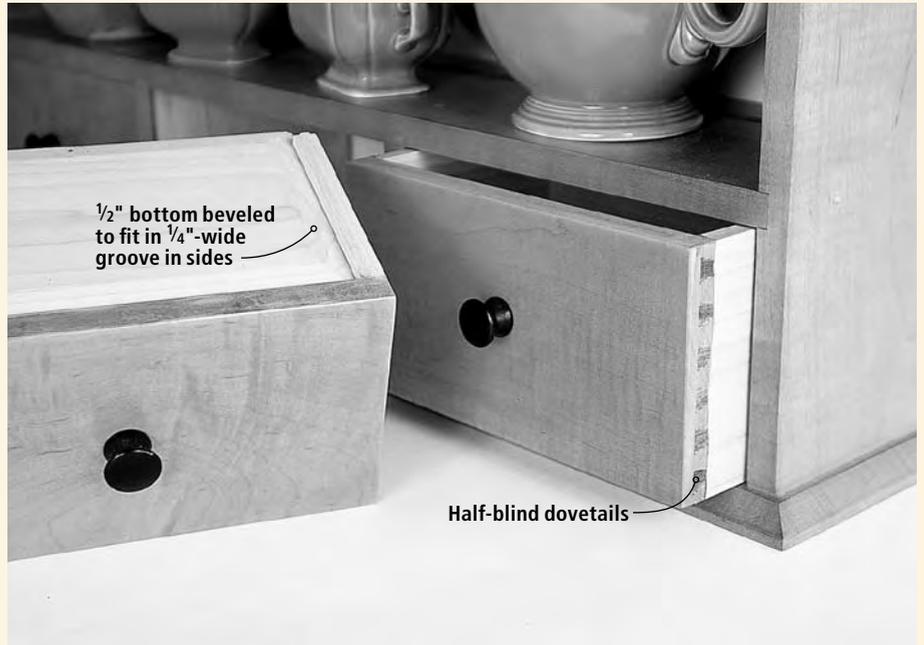
Edge guide

Rabbets and grooves are pretty easy to make with a hand-held router. Here you see a router cutting a 1/4"-deep groove with a 1/4" straight bit and an edge guide.

visible, depending on your project's style. They can be made with hand-held or table-mounted routers using a spline-cutter bit, which is essentially a tiny table-saw blade with the shaft of the bit serving as an arbor. Available as many bits of different thicknesses or one bit with adjustable thicknesses, these are very versatile router accessories.

■ **Finger Joints:** Also known as "box joints," these are strong enough to qualify for heavy-duty boxes and drawers. The interlocking tenons create a vast gluing surface that holds firmly. These were once considered strictly utilitarian (many packing crates in the late 19th and early 20th centuries were made using finger joints), but in recent years they have been used in decorative applications as well. These joints are best formed with a table-mounted router using a straight bit and a miter gauge or a specially made jig.

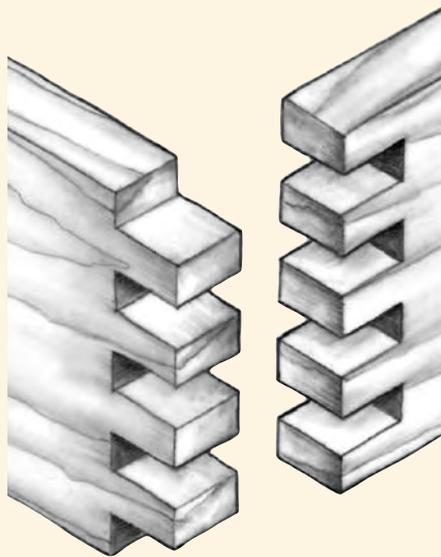
■ **Through dovetails:** The strongest of all common joints for boxes and draw-



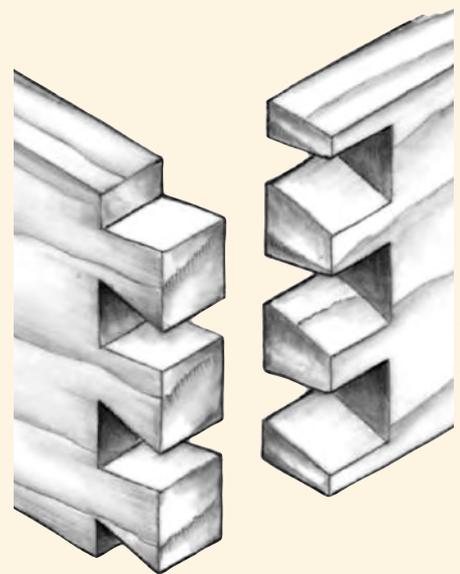
1/2" bottom beveled to fit in 1/4"-wide groove in sides

Half-blind dovetails

The drawer bottom in the drawer shown at left is 1/2" thick but is beveled to slip into a 1/4" groove, a traditional drawer construction method. Also, you can see the half-blind dovetails connecting the side with the front in the drawer at right.



Finger joint



Through dovetail

ers, these are suitable for heavy-duty projects. Similar to finger joints, through dovetails were once thought of as utilitarian, but today they are used just as much for decorative pieces. Routers make quick work of dovetails using specialized bits and jigs to make precise and tight joinery.

(Note: While some people will use contrasting colors or species of wood

when making finger joints and dovetails to make the joinery stand out, just as many want to use the same type of wood for both parts of these joints to make them look more subtle.)

All of these joints can be used to make standard boxes or the more-common open-topped boxes we use every day – known more commonly, of course, as drawers.

Illustrations by Mary Jane Favorite

TIPS & TRICKS

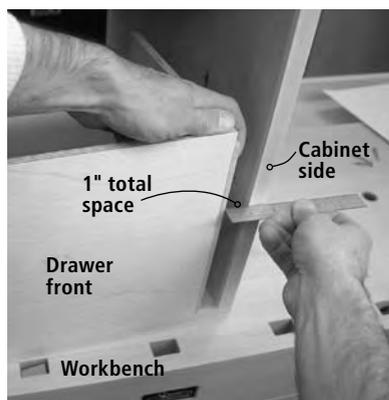
GREAT TRICK:

Tape Helps You Fit Fabric

To fit a fabric lining in a drawer (for storing silverware, jewelry etc.), first cover the bottom surface of the material with double-sided tape and cut the pieces to size with scissors or a utility knife. The tape will stiffen the fabric, making it easier to cut and fit. To install the lining, just peel the paper backing off the tape and press the fabric in place for your bottom.

PRO TRICK:

If Your Drawer has Slides, Key Measurement is Width



When building drawers with slides, the most critical dimension is the width of the assembled box. If you're off by more than $\frac{1}{32}$ ", the slides won't work. It pays to mock up an assembled drawer to get the fit just right. Standard drawer slides usually need $\frac{1}{2}$ " of space between the drawer and case, so shoot for a drawer that's 1" narrower than the total case opening.

PRO TIP:

Finishing Might Not Always be a Good Idea

Think about what you will be storing in the drawers before you decide to finish the interior surfaces. Many finishes, especially boiled linseed oil, emit an odor long after they've cured, and they may impart chemical smells, especially to clothing.

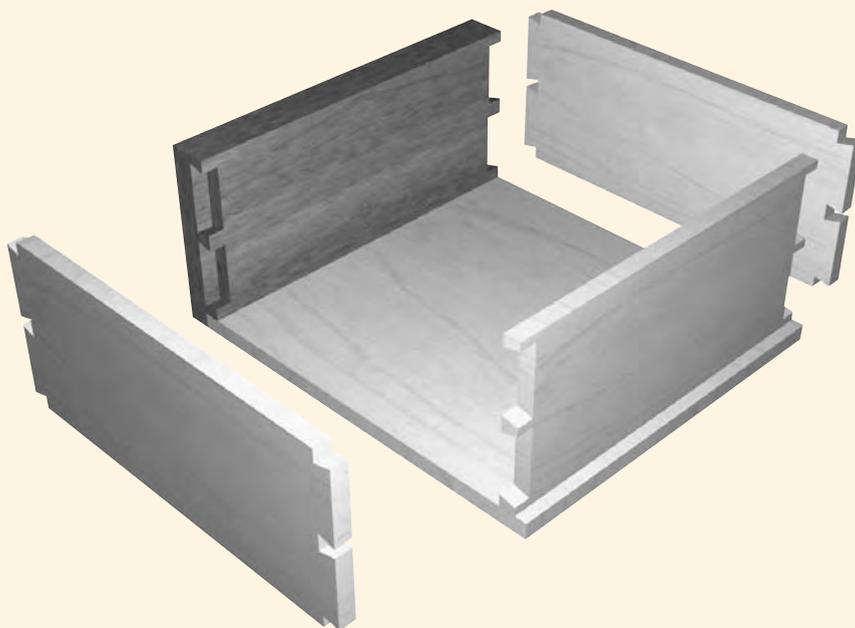


Illustration by John Hutchinson

Construction of small drawers can be simple. This drawer for a spice box uses half-blind dovetails to mate the front with the sides and through dovetails to mate the back with the sides. The bottom is tacked to the sides and back using brads.

Making Drawers

As mentioned earlier, a drawer is a box without a lid that slides in and out of a larger box, chest or case. Most drawers have five parts – a front, a back, two sides and a bottom.

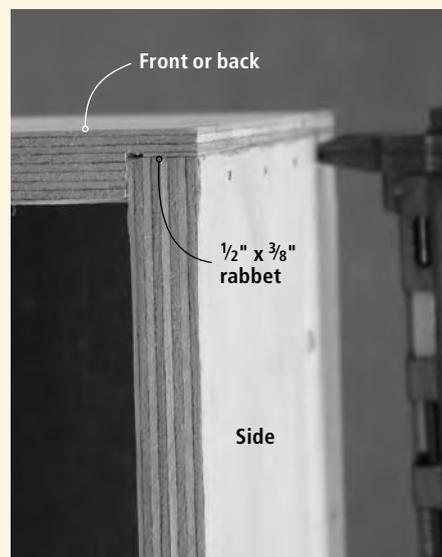
Drawers are classified according to how the fronts and faces fit their openings. They can be "inset" within the opening, they can "overlay" the face frame or front edges of the case, or they can be rabbeted or "lipped" so that only the lips overlap the case.

To a large degree, drawers are made the same way as the cabinets that hold them. The front, back and sides are arranged to expand and contract in the same direction and are joined rigidly at the corners. The bottom usually floats in a groove in the sides, free to move independently so its shrinking and swelling won't affect the overall drawer structure.

But there are significant differences between drawers and boxes. Typically, a drawer must withstand more punishment than a box. As you push or pull a drawer in and out, there is a good deal of stress placed on the corner joints. And because the drawer handles or pulls are attached to the front, most of this stress is concentrated on the front corners.

Consequently, drawers commonly are built with extremely strong joints at the front corners, while the back corners and the bottom are assembled with much simpler joinery.

There is another reason people opt to use different joints at the front of the drawer – traditionally, the drawer faces looked a lot like solid boards or panels in



Joining drawer sides to the front and back can be as simple as cutting a rabbet. Then you can use glue and nails to complete the joint.

a frame. So, the front joinery had to be hidden when the drawer was closed.

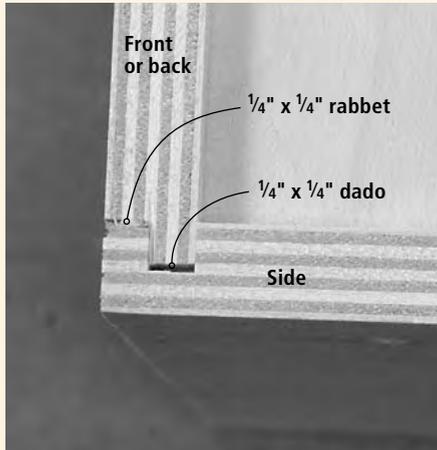
The joints listed below are common router-made joints used in drawer joinery [many of these joints also were discussed in Chapter Four]:

■ **Reinforced Rabbets:** These are sufficient for light-duty drawers (shown below in the inset drawer). Just rabbet the drawer front, then secure the sides in these rabbets with glue, nails, screws or pegs. This joint also is frequently used to mate the drawer back and sides.

■ **Lock Joints, or Tongue-and-rabbit Joints:** These work well for light- or medium-duty drawers. Cut dados in the drawer sides, and a tongue is formed when you cut a rabbet in the drawer front and back. Then insert the tongue in the dados. This joint (seen in the photo above right) can be used for the front and back joint in drawers, providing extra strength over a reinforced rabbet. Made using rabbeting, spline or straight router bits, these joints are a mainstay in commercial drawer joinery.

■ **Sliding Dovetails:** These are strong enough for medium- and heavy-duty drawers. Simply cut a dovetail groove in the drawer front with a dovetail bit in your router, then cut matching tenons in the sides and slide them together. It's unlikely to be used for any drawer joinery other than attaching drawer fronts.

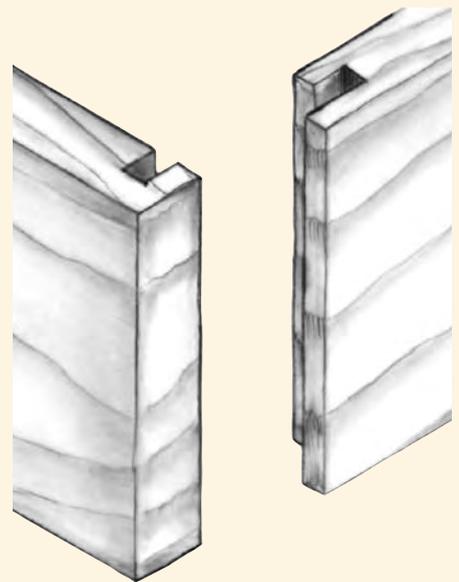
■ **Half-blind Dovetails:** These are the traditional choice when you need



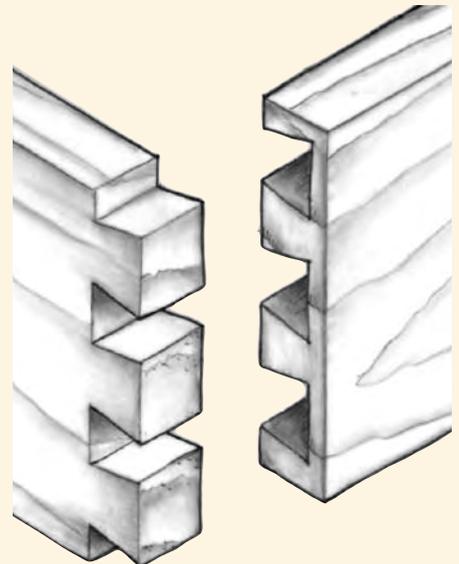
A simple and very common drawer joint in commercial furniture is the tongue-and-rabbit (or dado-and-rabbit) joint. It's made by simply running a dado in the drawer sides and then rabbets on the drawer fronts and backs. Both operations are best made with a router in a table.

heavy-duty drawers. The interlocking tails and pins offer an enormous amount of strength and they are relatively easy to make with a store-bought jig. Because they are "half blind," they meet the requirement for being invisible with the drawer closed.

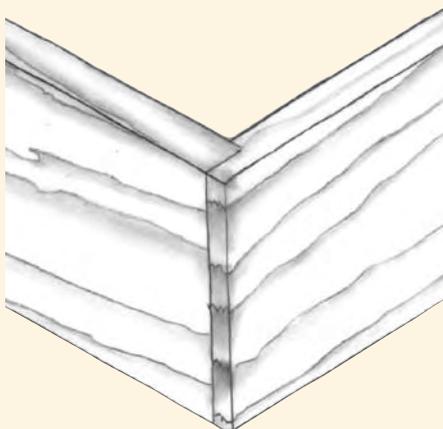
■ **Through Dovetails:** These are a close cousin to the half blinds. While they are easier to create, these joints will be visible from the front of the drawer. Because of this, a through dovetail is often used for the back joinery in a drawer, while the more complicated half-blind dovetail adorns the front.



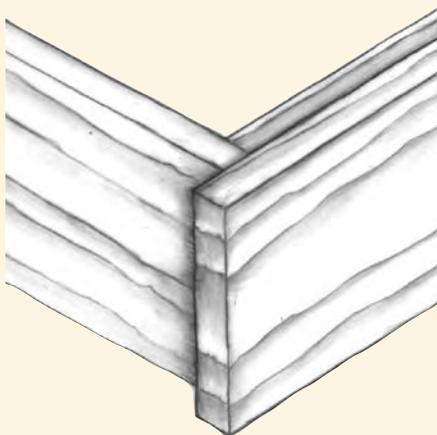
Half-blind tongue-and-rabbit



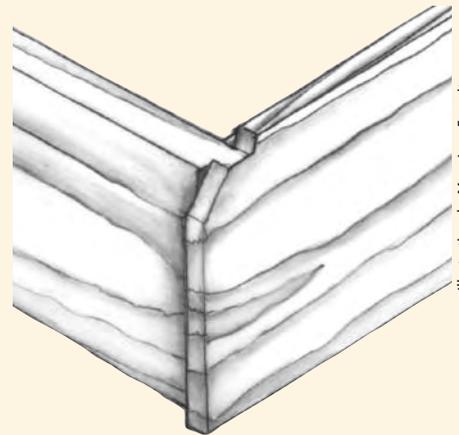
Half-blind dovetail



Inset drawer



Overlay drawer



Lipped drawer

Illustrations by Mary Jane Favorite

TIPS & TRICKS

PRO TIP:

Plunge Router is Great When Cutting Box Cavities

When selecting a straight bit for cutting box cavities, look for one designed to be used with a plunge router. On these bits, the flutes protrude below the body of the bit so it can be used for boring as well as side-cutting. This makes it easier to rout a starter hole. Then simply enlarge the starter hole to make the cavity. Some bits are intended solely for side cutting. Their flutes are almost flush with the bottom of the bit, making it difficult to plunge the bit into the stock. Also, these bits will burn the bottom of the cavity.

GREAT TIP:

Work Loose when it's Cold, Tight when it's Warm

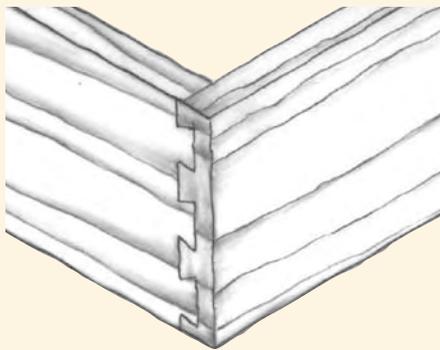
If your doors or door frames are made from solid wood, fit them loose in winter (when the wood has shrunk) and tight in summer (when the wood has expanded).

PRO TRICK:

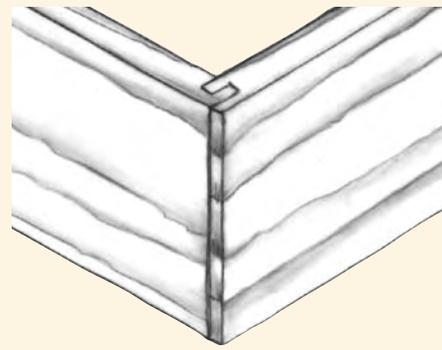
Fake Out Your Family with False Fronts for Drawers

When making overlay or lipped drawers, fitting the drawer can be much easier if you use a false (or faux) front on your drawer box. After you complete the drawer box and install it in the carcase, just apply a false front (either with screws or glue).

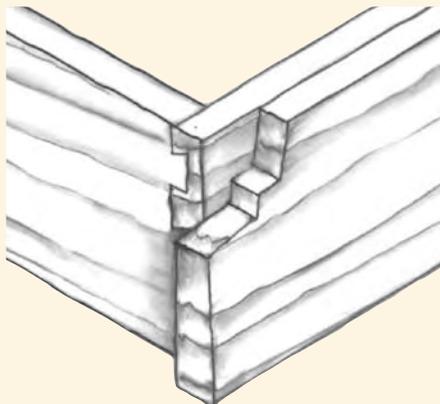
Only the front needs to be fit to the cabinet opening, not the drawer. Double-sided tape makes a good temporary bond while you're fitting the fronts, and it will definitely make fitting your drawer fronts easier.



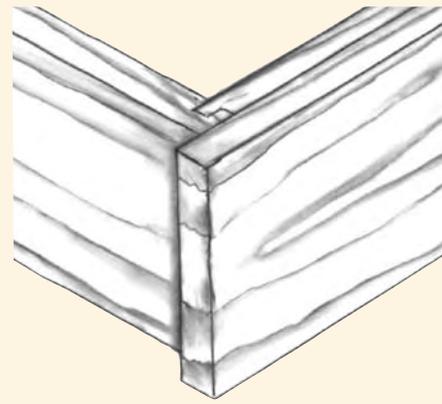
Half-blind dovetail



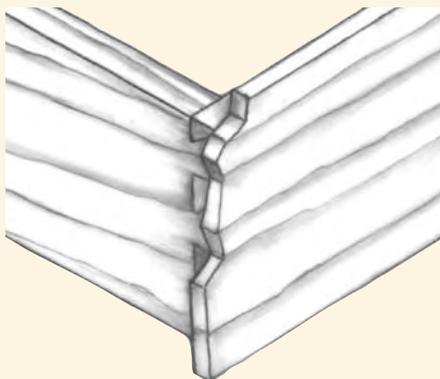
Half-blind tongue and rabbet



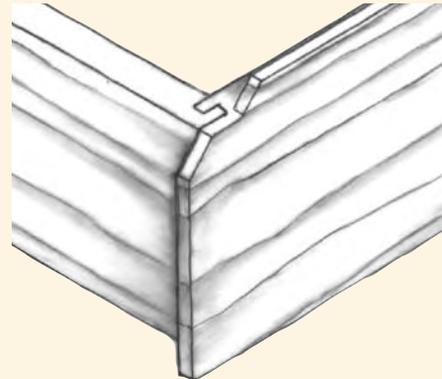
Half-blind dovetail with overlay false front



Tongue and rabbet with overlay false front



Lipped half-blind dovetail



Lipped tongue and rabbet

Joining the Bottom

The final piece of joinery in a drawer is finding a way to hold the bottom in place in the sides, front and back. Because the bottom usually floats, your choice of joints is more limited when looking to attach this piece.

Traditional solid-wood bottoms originally were made from $\frac{1}{2}$ " material and the edges were beveled or raised similar to the center section on a raised-panel

door. This allowed the bottom to be captured in a relatively narrow groove ($\frac{1}{4}$ " or so) without losing any strength in the bottom. Raised-panel and straight router bits in a table-mounted operation make this joinery safe and fairly easy.

With today's wood technologies, $\frac{1}{4}$ " plywood often is used to create very strong drawer bottoms with no extra milling required.

On many boxes and drawers, the bot-

tom is captured in a groove that is cut in the inside surfaces of the front, back and sides. Just slide the bottom into the grooves at the same time you assemble the box, making sure you don't get any glue in the grooves. Once the glue has had time to dry, the bottom will be permanently locked in place.

One common variation in drawers is to cut a groove in just the drawer front and sides, cutting the back narrower to stop at the top of the bottom groove. This allows you to slide the bottom into place after the drawer is assembled. Then the bottom is tacked in place on the drawer back. With less mess and haste while the glue is drying, this method also gives you a chance to square the drawer to the bottom.

Another drawer-bottom joint can be made by cutting grooves into small strips of wood, then gluing the strips to the inside surfaces of the drawer. The kind of drawer bottom that rests in grooved slips is sometimes called a "French bottom."

Or, if the drawer is particularly wide – so wide that a thin bottom might sag – you can divide the bottom into two or more sections with grooved dividers, also called "muntins."

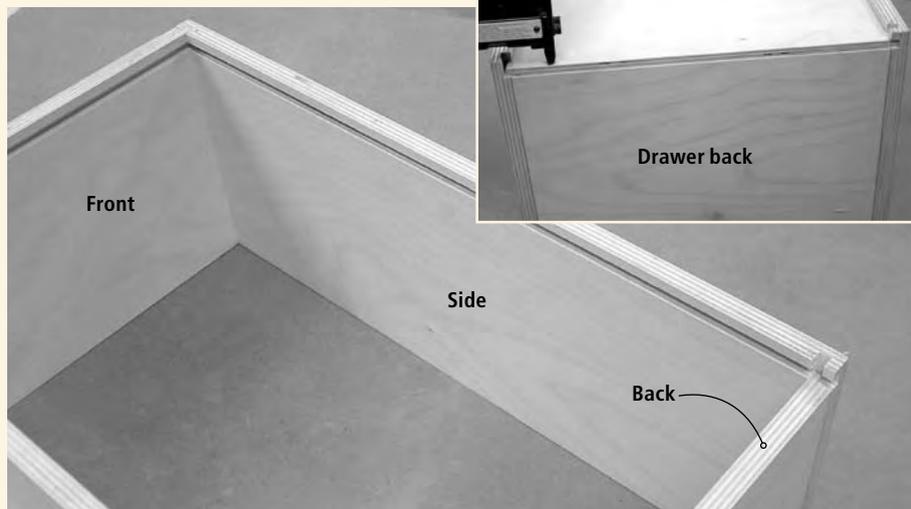
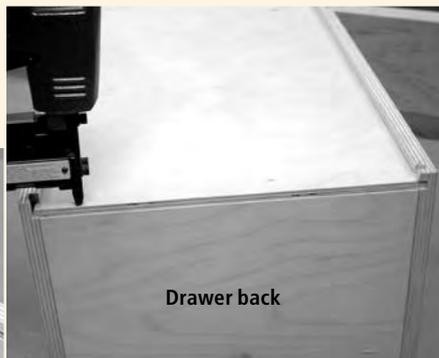
If your project requires a removable bottom or if you must install the bottom

after the rest of the parts are joined, you can rest the bottom on ledges or cleats, or you can screw it to the bottom edges of the box in some cases.

(Note: When you are fitting a solid-wood bottom in your drawer, you must remember to leave space for expansion. How much space depends on the width of the bottom. The rule of thumb is to allow $\frac{1}{4}$ " for every 12" across the grain with plain-sawn wood and $\frac{1}{8}$ " with quartersawn wood.)



Traditional drawers used raised panels made of solid wood for the bottoms. These are easily made on a router table with a raised-panel bit, then fit into a groove in the drawer sides.



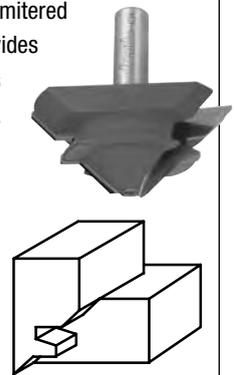
A simple drawer bottom is easily made from $\frac{1}{4}$ " plywood. The sides and front of the drawer are grooved with a straight router bit, $\frac{1}{4}$ " up from the bottom edge. The back is held short at the top of the groove. With the bottom slipped into the groove (shown in the inset photo), you can square up the drawer, then nail the bottom in place into the drawer back.

A BIT OF ADVICE

A router bit consists of a cylindrical shank ($\frac{1}{4}$ " or $\frac{1}{2}$ " in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series, we will be providing a closer look at many of the common and specialized bits that can be used with your router. These bits are great when using your router to make boxes and drawers.

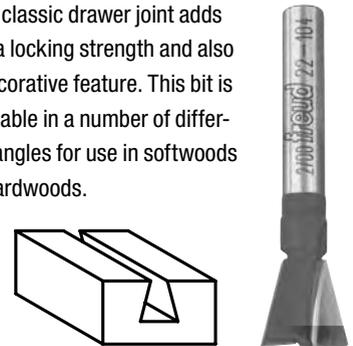
Lock-miter Bit

An excellent joint for mitered drawers, this bit provides extra gluing surfaces and locking strength. The same bit creates both joining edges by cutting one board vertically and the other horizontally with the same setup.



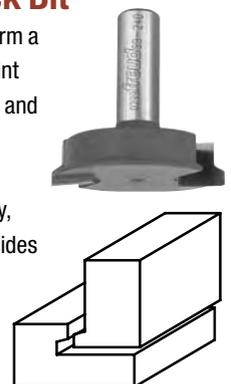
Dovetail Bit

This classic drawer joint adds extra locking strength and also a decorative feature. This bit is available in a number of different angles for use in softwoods or hardwoods.



Drawer-lock Bit

This bit lets you form a stronger rabbet joint between the sides and front of a drawer. The drawer fronts are cut horizontally, while the drawer sides are cut vertically against the fence of a router table.



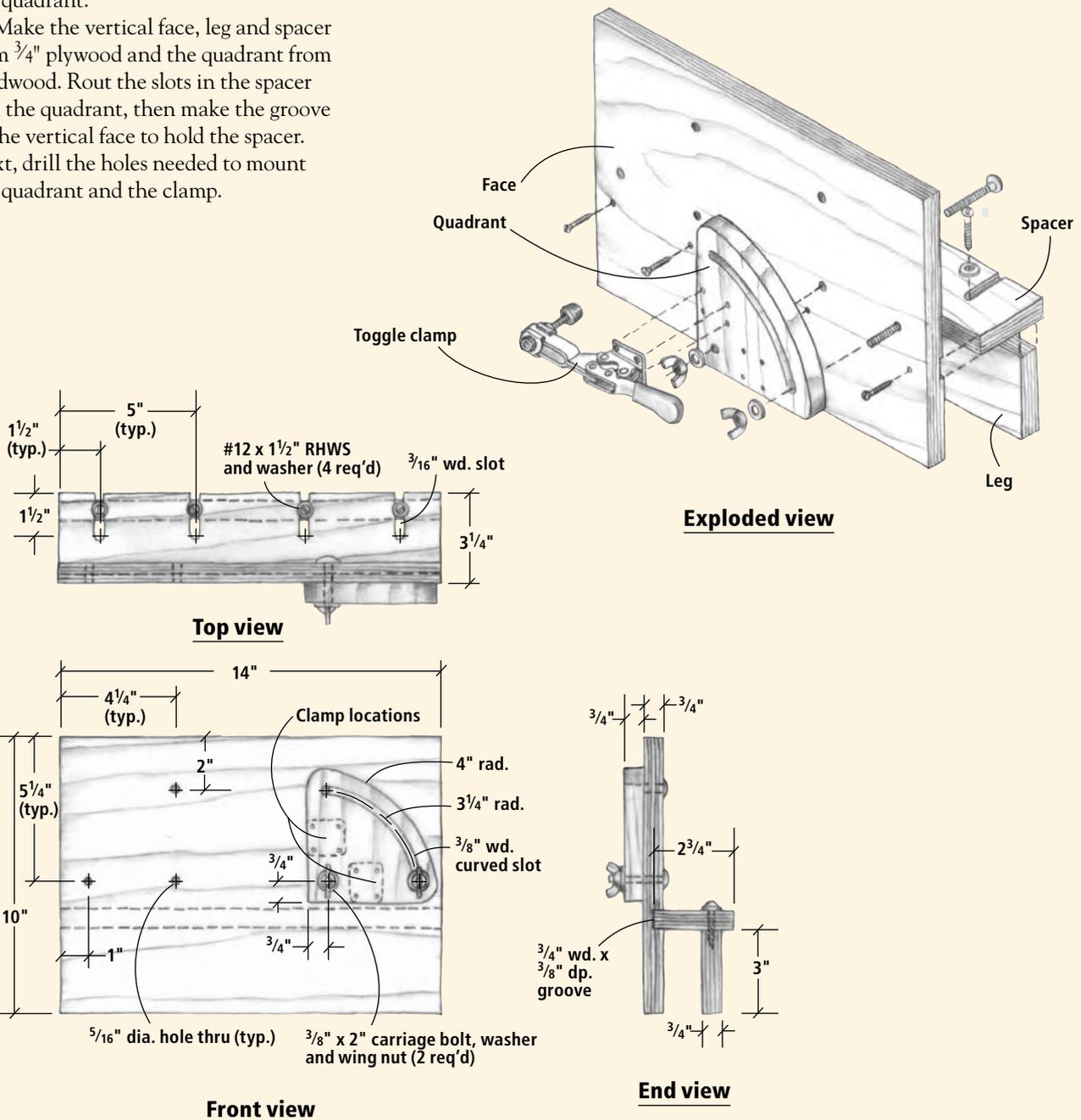
Tenoning Jig

A tenoning jig holds a workpiece vertically to make a cut in its end. This particular jig rides along the router table fence; the workpiece rests against a quadrant and a clamp secures the workpiece to the vertical face of the jig. You can adjust the angle of the workpiece between 45° and 90° by rotating the quadrant.

Make the vertical face, leg and spacer from 3/4" plywood and the quadrant from hardwood. Rout the slots in the spacer and the quadrant, then make the groove in the vertical face to hold the spacer. Next, drill the holes needed to mount the quadrant and the clamp.

Glue and screw the spacer to the face. Secure the quadrant to the face with carriage bolts, washers and wing nuts. (Note that there are six mounting holes and the quadrant can be attached in four different positions.)

Attach the leg to the spacer with roundhead wood screws and washers. Then adjust the gap between the leg and the face to fit your router table fence, then tighten the wing nuts and you're ready to go. **PW**



WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

6

Edge & Surface Treatments

Routers were developed to cut moulded shapes in wood. Although their workshop role has expanded (greatly) during the last century to include joinery and other operations, moulding is still what they do best. They remain the chief woodworking tools for edge and surface “treatments” – cutting decorative shapes.

Before we get into the techniques for making decorative moulded shapes, let’s review these shapes and how they’re combined. In many woodworkers’ minds, this is muddy water. Open any tool catalog to the router-bit section and you’ll find whole pages of shapes, all in a jumble. But don’t worry. There is some order to this chaos.

Despite the profusion of moulding bits, there are really only three shapes in decorative woodworking:

- Bead (convex curve)
- Cove (concave curve)
- Flat (straight line)

Every moulding, no matter how complex, is comprised of beads, coves and flats. If you had only three router bits – one for cutting beads, one for cutting coves, one for cutting flats – you could still produce any shape of moulding, no matter how intricate the shape.

Basic Moulded Shapes

Of course, there’s a little more to it. Each of these three main categories is subdivided into a few basic moulded

shapes that can be cut with a common bit. All mouldings are variations or combinations of these basic shapes, shown on the following page.

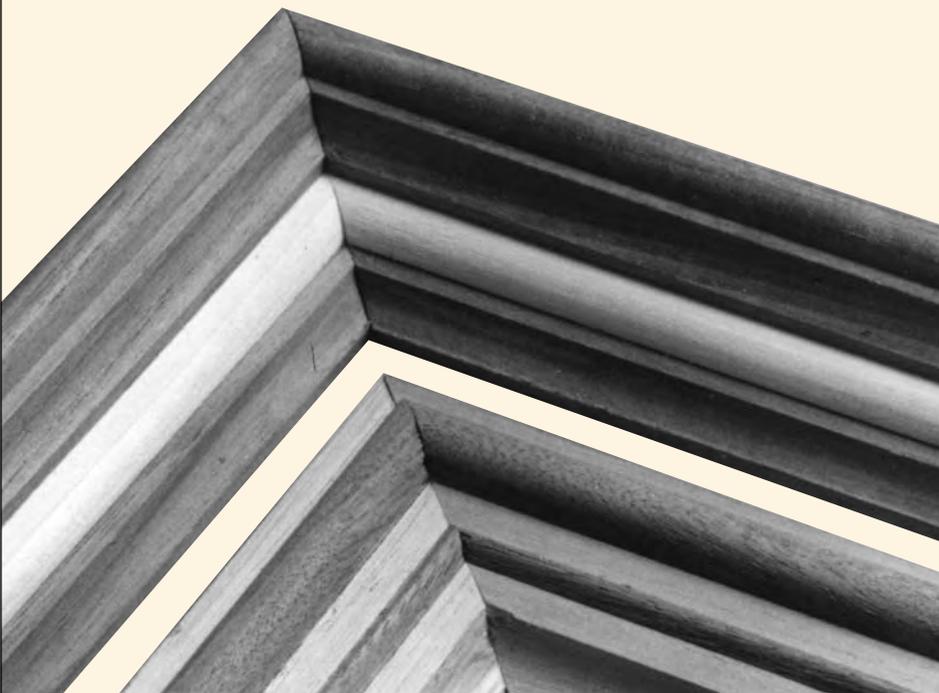
There are no hard and fast rules dictating how you combine these shapes or how you use them. However, you may find these guidelines useful:

- Consider where people will stand when viewing the shapes and present these features at an angle that makes them easy to be seen and enjoyed.
- Vary the shapes in a complex moulding – don’t just repeat the same shapes over and over. The classic bead moulding, which incorporates a cove and a bead, has been a favorite of cabinetmakers for hundreds of years – you

PRO TIP:

Safe Small Profiles

Small ($\frac{1}{2}$ " wide or less) profiles and edge treatments can be dangerous to run. To avoid this, use a two-step process. By preparing a slab of wood the appropriate thickness of your profile (let’s call it a $\frac{1}{2}$ " x 10" x 24" piece of cherry) you can safely run the profile on one long edge, then head to the table saw to safely cut off the thin edge piece. Then head back to the router table and repeat the process. It adds a couple steps, but it also adds safety.



TIPS & TRICKS

PRO TRICK:

Two Sides of Grooves Make Pretty Decorative Panels



Cut a set of grooves in a board that are parallel to each other. Make each groove a little more than half as deep as the board is thick. Then turn the board upside down and cut another set of grooves at an angle to the first set. Where the grooves intersect, they will create openings. The size, shape and spacing of these openings depends on the size, shape and spacing of the grooves.

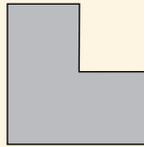


PRO TRICK:

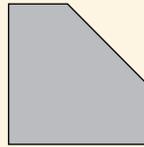
Simple Cockbeading



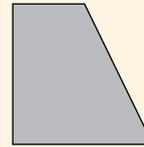
Cockbeading is a simple edge detail that can dress up doors, drawers and much more. But cutting this detail on a door panel can be a lot of work. The simple option is to run a quantity of 1/8"-thick hardwood through your router table adding a bullnose detail to one edge. Then, simply glue this edging to your panel. Presto – simple cockbeading.



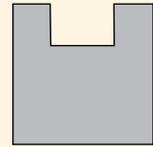
FILLET OR LISTEL
Use straight bit



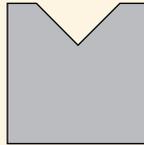
CHAMFER
Use chamfering bit or V-bit



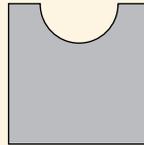
BEVEL
Use chamfering bit or V-bit



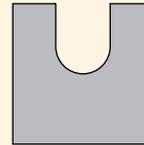
FLAT-BOTTOM GROOVE
Use straight bit



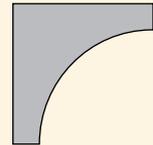
V-GROOVE
Use V-bit



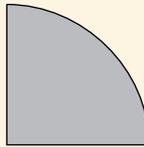
FLUTE
Use fluting bit



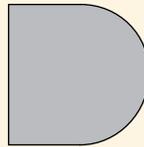
ROUND-BOTTOM
Use fluting bit



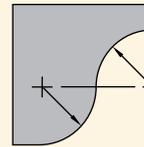
COVE OR CAVETTO
Use cove bit



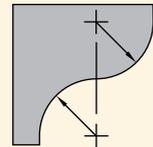
QUARTER-ROUND BEAD
Use roundover bit



HALF-ROUND BEAD OR ASTRAGAL
Use beading bit for small beads, nosing or roundover bit for large beads



CYMA RECTA
Use ogee bit (centers of curves are aligned horizontally)



CYMA REVERSA
Use ogee bit (centers of curves are aligned vertically)

Basic moulded shapes

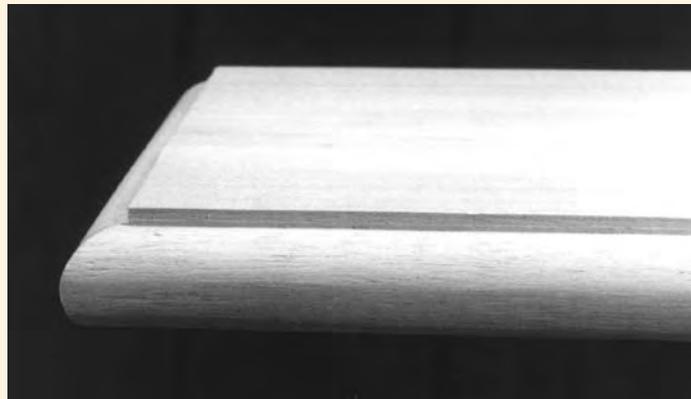
hardly ever see a moulding with a double cove or a double bead.

- To make mouldings more dramatic, use sharp, crisp transitions between the shapes. Make the curves and flats meet at distinct angles, or you can use fillets to separate shapes.

- If the structural strength of the piece is important, use simpler shapes. Once you have designed a mould-

ing, you need to plan how you'll make it – what bits to use, how many passes you'll need to make, etc.

Then, consider how to incorporate the moulded shapes in the project you're building. You have two choices: You can cut the shapes into the surfaces of the structural parts, or you can make separately shaped parts (mouldings) and apply them to the piece.



This tabletop will see a lot of use, so the woodworker who made it cut a thumbnail moulding in the edge. This relatively simple shape preserves the strength of the edge, while a more complex shape would weaken it and the edge would soon show the wear.

Each of these choices has trade-offs. If you make applied mouldings, you may not be able to match the wood grain and color of the larger piece, but you can use moulding to disguise seams and joints. If you cut the shapes in a large structural piece, you don't have to worry about matching the wood, but you do have to worry if the shape will weaken the piece. Choose whichever moulding design works best for the piece.



When you're ready to shape your workpiece, first cut the end grain along the ends ...



... then cut the long grain along the edges.

Cutting With the Router

Woodworkers usually shape the edges of a piece. The reasons for this are both aesthetic and practical. Because the edges often trace the outline of the project, shaping the edges emphasizes and enhances the design. Also, the edges are easier to cut than the faces.

The technique for routing moulded edges is simple and straightforward; there's little here that hasn't already been explained in previous chapters. However, a few additional considerations are worth mentioning.

Before you rout a shape in a straight edge, make sure that the edge is as smooth and even as possible. Joint it and remove all the mill marks. If the edge is contoured, make sure all the curves are "fair" – smooth and even. Because one of the purposes of a moulded shape is to emphasize the edge, the shape also will emphasize any imperfections in the edge.

When you're ready to shape the piece, cut the ends (end grain) first, then cut the edges (long grain).

Cut the large parts with a hand-held router, and cut the smaller parts on a router table. With very small parts, leave them attached to a larger board, rout the edge of the board, then cut the parts free. This last technique is particularly important when making mouldings. Most mouldings, when ripped to their final dimensions, are too slender to rout safely. The cutting action of the router may actually tear the thin stock apart.

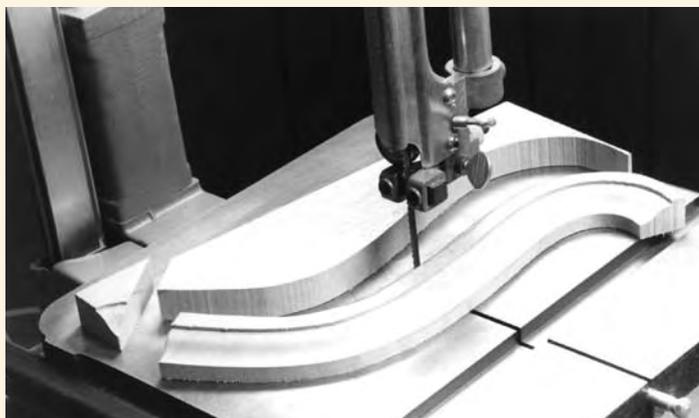
If you use a large bit such as a panel-raising bit, slow down the speed of the router. The larger the bit, the slower you should run the router – otherwise the



To make an applied moulding or picture-frame stock, cut the shape you want in the edge of a wide board, then rip it to the proper thickness, which I'm doing here on my table saw. Don't try to rout a shape in narrow stock – it may chip, splinter or kick back at you.



This safety consideration also applies to making curved mouldings, such as a classic "gooseneck" moulding. Cut the inside curve in the wide moulding stock, sand it so the curves are fair, then rout the shape in the edge.



When you've shaped the inside edge of the stock, you can cut the outside edge to free the moulding from the piece, as I'm doing here with my band saw.

TIPS & TRICKS

PRO TIP:

Subtle Refinement

Edge treatments don't have to be complicated to be effective. A simple roundover bit or chamfering bit in the right locations can soften the look and feel of a piece of furniture, adding an extra level of elegance as long as you don't overdo it. And either of these bits work well with a bearing guide in an easy-to-manage trim router.

GREAT TRICK:

Keep That Piece Clamped Down Tight



Whenever you're routing something, make sure that either your workpiece or your router is stable and secure – they can't both move. If you choose to move the router across the work, clamp the work to your bench. If a clamp interferes with the operation, rout up to it and turn the router off. Then move the clamp to an area on the workpiece that you've already cut and resume routing.

GREAT TIP:

Back-routing (Also Known as Climb-cutting) Can be Tough

Occasionally you must back-rout a piece to reduce tear-out. This means you are cutting with the bit's rotation, rather than against it. It's much more difficult to control your work this way, so be sure to take shallow cuts and feed very slowly. Keep the router and the work steady, making sure the bit doesn't chatter.

bit may burn the wood. If you can't vary the speed of the router, you shouldn't use bits larger than 2" in diameter. Even bits larger than 1½" can be troublesome.

Surface Treatments

In addition to cutting edges, you can create a variety of decorative shapes in the face of your workpiece. Surface treatments can be cut pretty easily with either a hand-held or a table-mounted router fitted with either an unpiloted or a point-cut bit.

The most common surface decoration is a simple groove – flat-bottom, round-bottom or V-bottom. If the groove is straight, use a straightedge, fence or miter gauge to guide the cut. If the groove is irregular, you'll want to use a guide collar and a template.

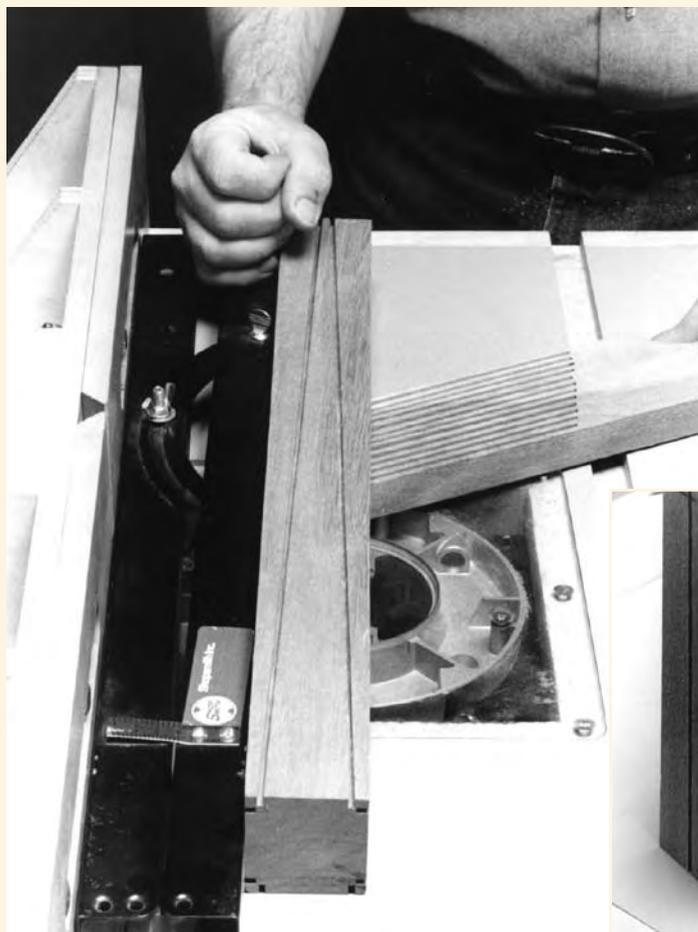
For decorative grooves with a more-complex geometry, you can make mul-

tle passes – or use a more-complex bit. For example, by making multiple parallel passes with a point-cut roundover bit (sometimes called a "beading" bit), you can form cockbeads and reeds. Or, you can make cuts with a veining bit or a round-nose bit to create flutes. Also, a point-cut ogee bit will rout a wide groove with a double-ogee shape.

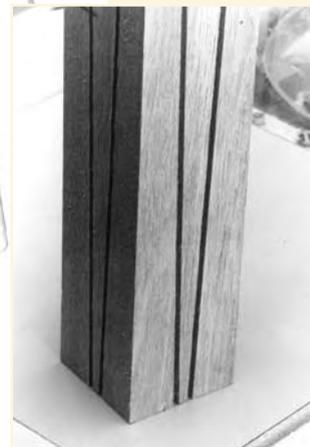
Making Complex Mouldings

When you produce complex mouldings, you often make multiple cuts, combining edge and surface treatments. It isn't difficult, but there are tricks to help you.

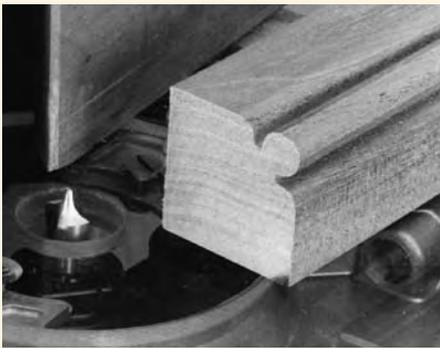
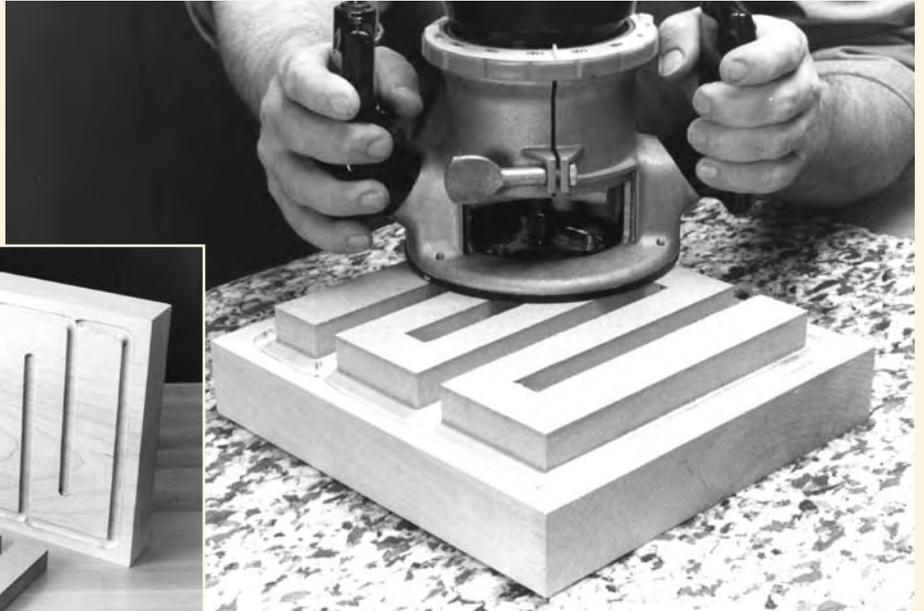
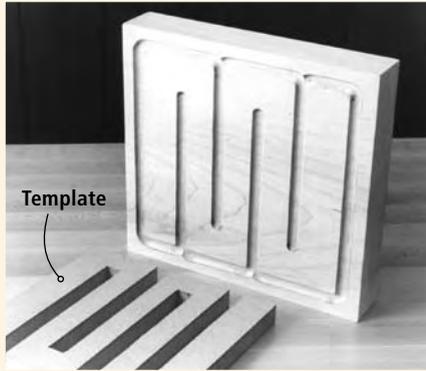
- First, you will need to decide which router bits to use to cut the different shapes. Often this is more of an art than a science. There may be three or four bits in your selection that will produce a single shape. Knowing which one will work best is a matter of experience.



When cutting straight grooves, you can use a variety of jigs to get a decorative effect. Here, a tapering jig produces a pattern of angled grooves in a table leg. The grooves create the impression of a tapered leg, even though it's straight.



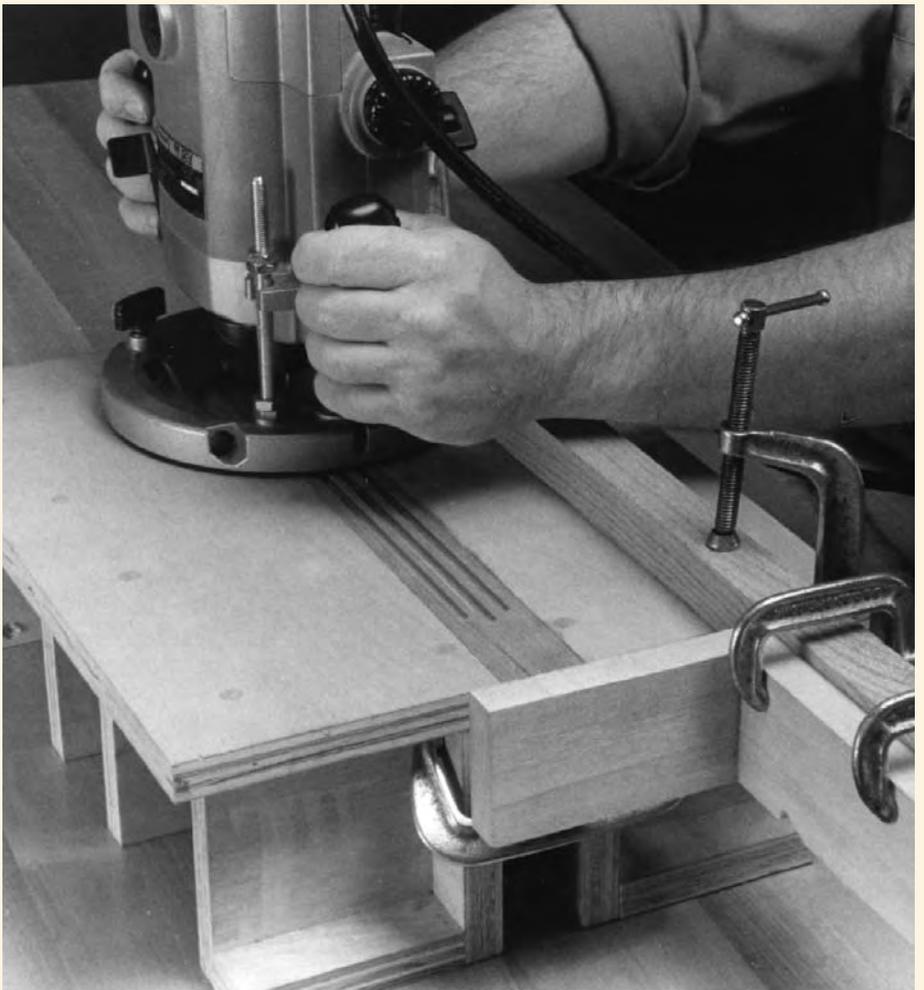
Some surface grooves are simultaneously decorative and practical, such as the groove around the perimeter of this cutting board. Not only does it collect liquids, but the groove also adds visual interest to an otherwise uninspiring piece. To make this groove, cut a template from hardboard and secure it to the cutting board with double-stick tape. Then you can cut the groove using a guide collar and core-box bit, keeping the collar firmly pressed against the template.



Make multiple passes with a beading bit to create decorative reeds and beads in the surface of a board. Because the beading bit is actually a small point-cut quarter-round bit, each pass cuts a 90° arc – one-quarter of a circle. Half-round beads require two passes. The corner bead or reed on this table leg requires three passes because it is three-quarters round.



Point-cut bits with a complex shape, such as this pilotless ogee bit, cut a broad groove with an interesting shape. The sides of the grooves are mirror images of each other.

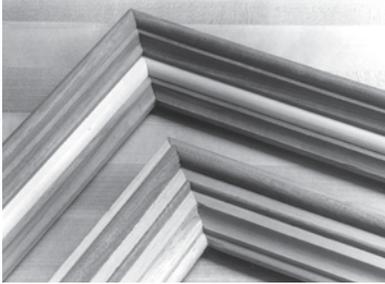


A flute is just a half-round groove – the opposite of a half-round bead. Often, it's blind at one or both ends. Use a veining bit to cut the flute and a straightedge to guide your router. If the flute is blind, it helps to have a plunge router. Attach stops to the straightedge to halt the cut when the flute is the correct length.

TIPS & TRICKS

PRO TRICK:

Layers Can Help if You Want Complex Mouldings



Instead of making multiple passes to create a complex moulding, just glue up several simpler shapes. The easiest way to do this is to “lamine” the shapes – or build them up in layers. But you can also “join” the shapes by cutting dados, rabbets or grooves in the moulding stock, then glue smaller strips of wood in these joints. The strips that you glue together don’t have to be the same species – you can use contrasting wood, if you want.

GREAT TIP:

How Much is Enough?

To make sure the collet is safely gripping a router bit, insert $\frac{3}{4}$ " of the length of a $\frac{1}{4}$ " shank bit into the collet and insert a full 1" of every $\frac{1}{2}$ " shank bit.

PRO TIP:

Bits Pull Double Duty

Most edge-profile router bits are designed to be run in a specific orientation to the edge. However, if you’re looking for an unusual alternative, you should think in a different dimension. By running the wood past the bit in a vertical rather than horizontal attitude, the profile is changed subtly. And you get two profiles out of one bit.

■ Second, when you know which bits you’re using, carefully plan the cuts. Each cut should leave enough stock to adequately support the workpiece during the next cut. If possible, make small cuts before large ones, and remove stock from the interior or middle of the surface before taking it from the sides.

■ Third, when you make each cut, use constant, even pressure to feed the work (or move the router) and keep it firmly against the guides. If the pressure isn’t constant or if the work wanders slightly, the cut may not be even. If the problem continues over several passes, there may be considerable variation in the moulded shape along the length of the board.

■ Fourth, always make more moulding than you think you’ll actually need, because if you run short, it will be difficult to reproduce the exact same setups you went through.

Inlaying Banding

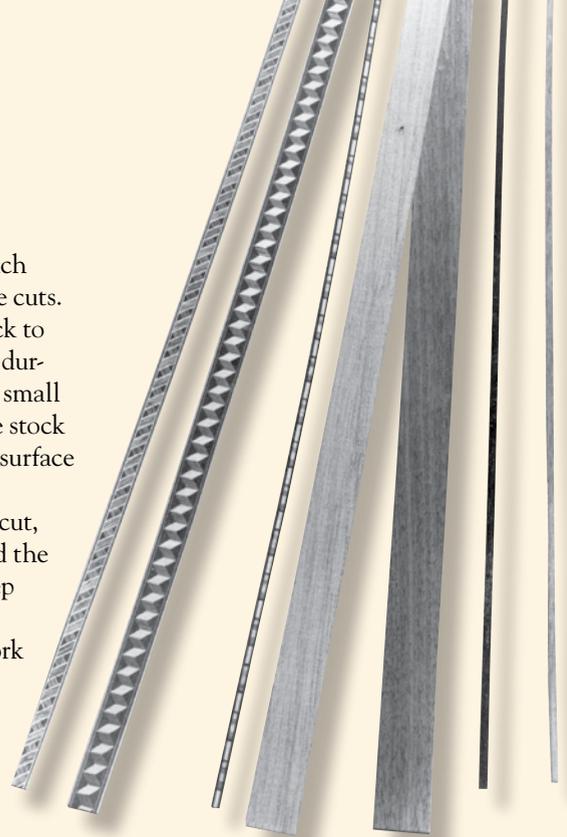
You can decorate wooden surfaces by cutting shallow mortises and filling them with inlaid strips of veneer, patches of marquetry and parquetry, slabs of mother-of-pearl, strands of wire, colored epoxy and so on.

Because these inlaid objects often are small and intricately shaped, cutting mortises to fit them requires precision. Not only must the shape be correct, the depth must be accurate and absolutely uniform. That’s why one of the best tools for making these small cuts is the router.

Perhaps the simplest type of decorative inlay is the inset wood banding. These simply are ribbons of wood sliced from a board or a sheet of veneer.

They also may be made up of several contrasting colors of wood, forming long strips of marquetry (designs that are made with multiple pieces of wood arranged with the long grain showing) or parquetry (multiple-piece designs with the end grain showing). They are usually straight, but they also may be curved.

To inlay straight banding, first measure its width and thickness. Then rout



Some banding inlays simply are thin pieces of wood ripped from boards or cut from sheets of veneer. You can make these simple bandings in your workshop, using a saw or a knife. Other inlays can be intricate pieces of marquetry. These are made by arranging different colors of wood in geometric patterns, gluing them together and slicing them into long ribbons. You can make these yourself, too, if you have the patience. There are, however, many ready-made marquetry bandings available from mail-order suppliers if you don’t.

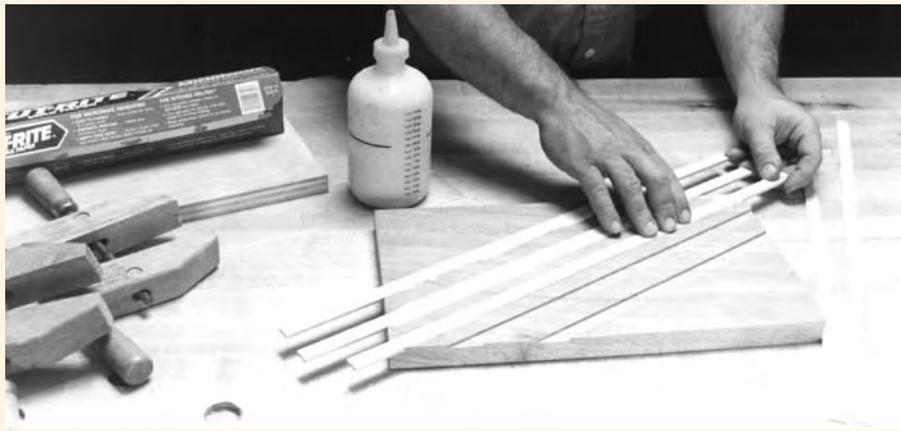
a shallow rabbet, dado or groove to fit it, using either a hand-held or a table-mounted router. After cutting the recess, just glue the banding in place. For more details, check out the photos at right.

If the inlaid materials are fairly thick, you’ll want to rout a recess that is slightly shallower than the inlay is thick. This will make the inlay “proud” when you glue it in place – meaning it will protrude slightly above the surface of the wood. After the glue dries, scrape or sand the inlay flush with the surface.

If the inlaid materials are thin, you risk sanding through them if you mount them proud, as explained above. Instead, you will need to rout the recess to precisely the right depth. Use dial calipers to measure the thickness of the inlay, then carefully adjust the router’s depth of cut to match.

A BIT OF ADVICE

Cut recesses for banding with the same setup you would use to cut simple rabbets, dados and grooves. If the workpiece is small, cut it on your router table using a fence to guide the board. If the workpiece is too large to handle on the table, use a hand-held router and clamp a straightedge to guide the router. Either way, a straight bit is the best choice.



Next, test-fit the banding in its recess. When you're satisfied with the fit, spread glue in the recess and press the banding in place. Wipe away any excess glue, place a piece of wax paper or plastic wrap over the banding and clamp a straight, thick board to the piece over the covering. The board helps distribute clamping pressure evenly, and the covering keeps it from sticking.



When the glue is dry, remove the board and the covering, then scrape away any glue that remains on the surface. But be careful – you don't want to scrape through the banding.



When inlay materials are thick, you can rout a recess to make the inlay "proud," then sand it flush. When inlay materials are thin, you risk sanding through them if you mount them proud. Instead, use calipers to measure the inlay thickness, then adjust the depth of cut to match.

A router bit consists of a cylindrical shank ($\frac{1}{4}$ " or $\frac{1}{2}$ " in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series, we will provide a closer look at many of the common and specialized bits to use with your router. These bits are great when using your router to make edge and surface treatments.

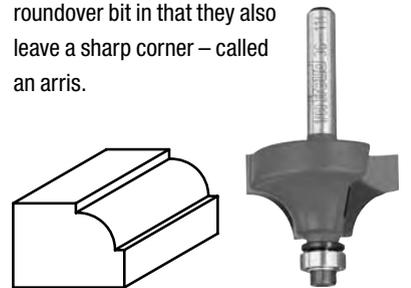
Panel-raising Bit

This bit combines two small wings (which cut downward to shear the top edge) with two large wings (which shear upward for a smooth finish). It's ideal for creating decorative tops and should be used in a router table.



Beading Bit

These bits add an attractive profile to furniture and millwork. They are different from a roundover bit in that they also leave a sharp corner – called an arris.



Tabletop Bit

This bit, designed with sharp curves, helps you generate a strong, uplifting edge, creating a bold effect on all kinds of furniture.



Dado & Rabbet Jig

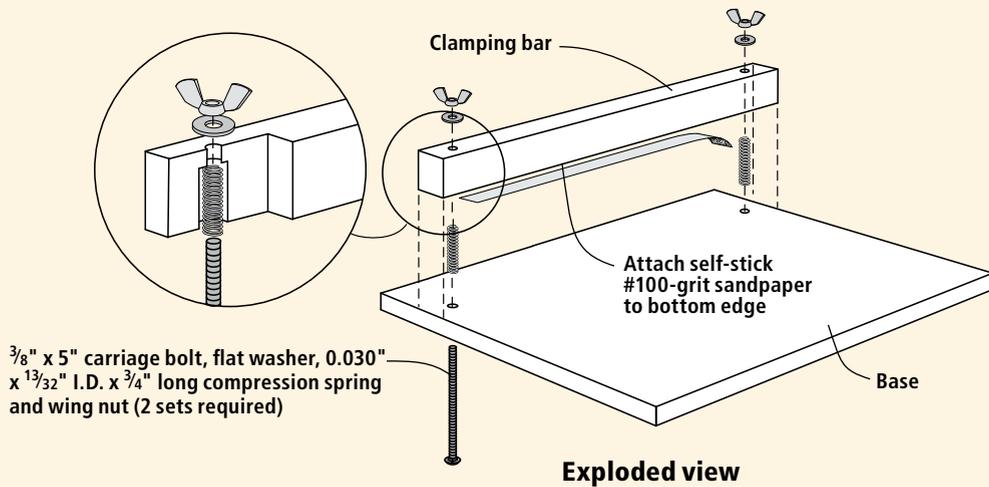
This jig simplifies the setup and the operation necessary to make repetitive cuts. Just lock the board between the base and clamping bar, then guide the router along the bar. The stock doesn't move, so you don't have to worry about controlling a large piece of wood, and the straightedge doubles as the clamp, so the setup is very simple.

The jig is just two pieces of wood (a base and a clamping bar) with the sizes

determined by your needs. Make the base from $\frac{3}{4}$ " plywood and the clamping bar from a hard, dense wood such as oak or maple. The bar should be fairly thick so it doesn't bow when tightened. I crowned the top and bottom surfaces of my clamping bar, making it $\frac{1}{32}$ " to $\frac{1}{16}$ " thicker in the center than at the ends. Even though the bar flexes, the clamping pressure remains even.

To use the jig, position the stock on

the base under the clamping bar. To do this quickly and accurately, it helps to make a positioning gauge from a scrap of thin plywood or hardboard. Lock the bar down on the base and place the scrap so that one edge rests against the side of the bar. Rout all the way through the scrap, creating a strip about as long as the bar. The width of this strip is the distance from the edge of the router to the bit's cutting edge. **PW**



Use the positioning gauge to align the stock underneath the clamping bar. The edge of the gauge indicates the inside edge of the cut.



This jig also is a timesaver for making identical cuts in multiple parts. To make multiple identical cuts, such as the cheeks and shoulders of tenons, clamp a short fence to the base to position the parts.

WOODWORKING ESSENTIALS

BY NICK ENGLER

CHAPTER

7

Advanced Techniques For the Router

The router is an amazing tool that can mimic many of the other tools in your shop, including the table saw, the shaper, the jointer and even the planer. But it's also capable of amazingly delicate profile work, complicated joinery for any type of furniture you can imagine and shaping perfect circles and ovals. For the truly creative woodworker, the router is an excellent tool for making intricate inlay work normally performed by skilled hands alone.

Two things make these and other advanced router techniques possible: jigs and specialty bits. I've devoted more space than normal in this chapter to

some of my favorite router jigs because of this. Spending the time to make one (or all) of these fixtures will open up a new world of opportunities for you. I'm sure you can quickly think of many other ways to use these jigs for your woodworking than just the techniques I've mentioned here.

The specialty bits are a different story. In many cases they can be expensive, such as a rail-and-stile set for making raised-panel doors. Each set often creates only one style of door profile. But if you think about the effort involved to create those profiles in a way other than

with a router, you'll quickly see the benefit to purchasing this pricey bit set.

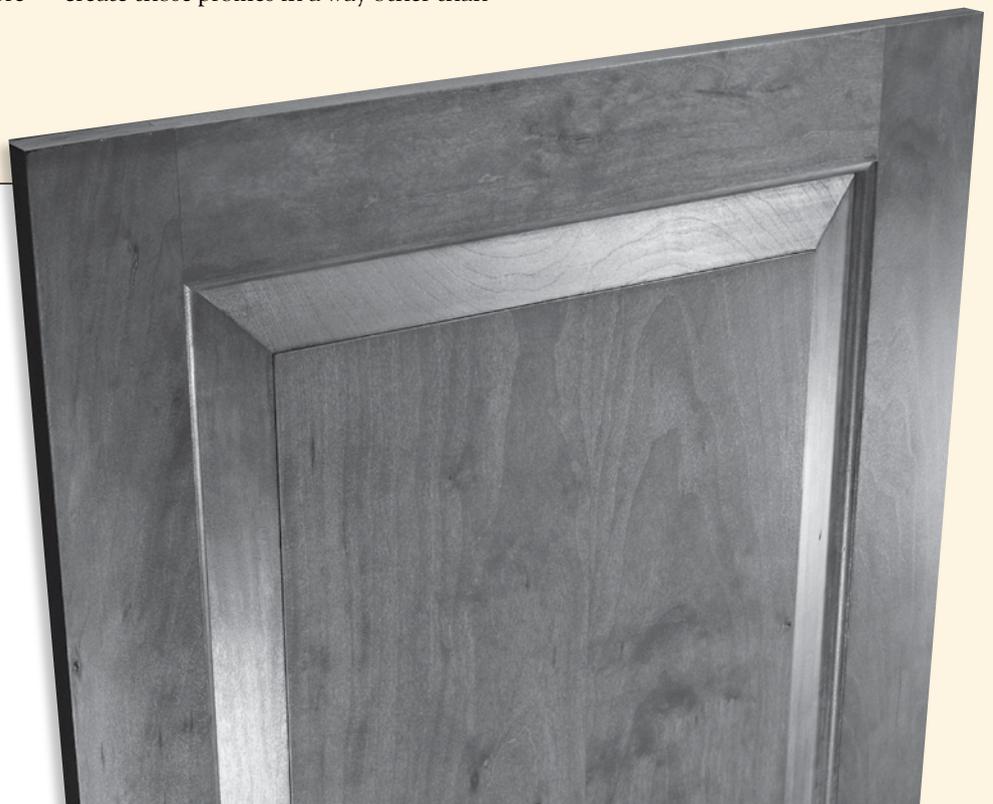
There are other specialty bits that can create multiple profiles with a single bit, and I've listed some to consider in the "A Bit of Advice" section. These also will be able to adapt to your specific woodworking applications.

But please – feel free to try new ideas. If you combine the tilting router table shown with any of the specialty bits, you've made it easier to change the bits, and added a new dimension to your woodworking.

PRO TIP:

Rattle-free Doors

With a solid-wood raised-panel door such as the one shown here, it's important to leave a little room in the grooved frame to allow for panel expansion because of changes in humidity. That's smart, but the extra space can make the door rattle. By adding a strip of rubber tubing or weather-stripping foam in the groove prior to glue-up, the panel won't shift unnecessarily, but the tubing will compress, allowing the panel to expand.



TIPS & TRICKS

GREAT TRICK: Use a Push Block When Routing Smaller Pieces



When cutting small pieces on a router table, be careful to keep your hands and fingers clear of the bit. You may wish to secure the stock to a push block or a large scrap with double-stick tape (as shown above) to rout it safely.

PRO TIP: Use Bearings to Get Perfect Fence Alignment

When setting up a bearing-guided bit in a router table during an operation that uses the fence, the bearing isn't a necessary part of the procedure, but it's still useful to help you set the fence. After adjusting the proper height of the bit for your cut, use a straightedge held against the bit's bearing to align the fences perfectly. In fact, if you don't align the fences correctly, the bearing can protrude past the fence faces, causing your work to ride away from the fence in the middle of your cut.

Rule Joint

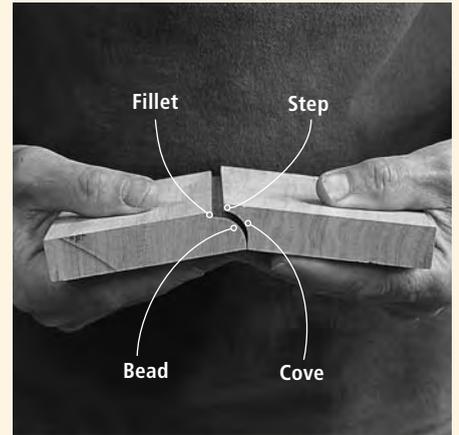
A rule joint is not so much a joint as it is two decorated, mated edges between a tabletop and a drop leaf. Cut a bead and a fillet in the tabletop, then cut a matching step and cove in the drop leaf.

When the table is assembled, the bead will show when the leaf is down. When it's up, the joint will close and the surfaces will be flush.

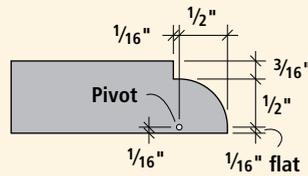


You can rout a rule joint using a simple cove bit. The bit height should leave a flat to match the mating profile's bead.

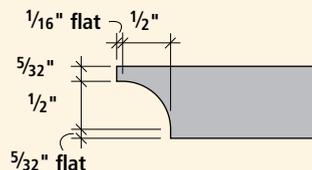
The trick to making a rule joint is not as much in shaping the edges as it is in installing the drop-leaf hinges. Each hinge must be mortised into the wood so that its pin is at the center of the arc described by the mating cove and bead. Just fasten the long leaf of the hinge to the drop leaf, then fasten the short leaf to the tabletop and you're done.



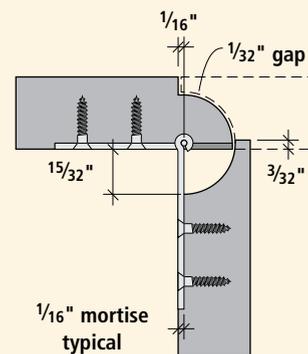
When both rule joint profiles are correct, the pieces should nest together with the top surfaces flush and a very small gap between the profiles.



Top detail



Drop-leaf detail



Hinge detail

A great application for the rule joint is to install drop-leaf table hinges. You just need to make sure you think before you act. What seems normal – just placing the hinge barrel where the leaf and top meet, like a door to a stile – is totally wrong. As with all hinges, the location of the pivot point is the ultimate concern. With the drop-leaf hinge, the pivot point (the center of the pin) must be centered on the radius of the matching profiles.

Illustration by John Hutchinson

Rail-and-stile Joint

Rail-and-stile joints require two matched router bits and are normally used to join the shaped surfaces of frame members. Rout the sticking portion of the joint – the portion with the shape that you want to see – in the inside edges of the stiles and rails. Use a fence to guide the stock when routing straight edges, and rely on the pilot bearing only when routing contoured edges.

Rout the coped portion of the rail-and-stile joint in the ends of the rails only. Use a miter gauge to help feed the stock past the bit. To keep the board from chipping out as you finish the cut, back it up with a scrap piece.

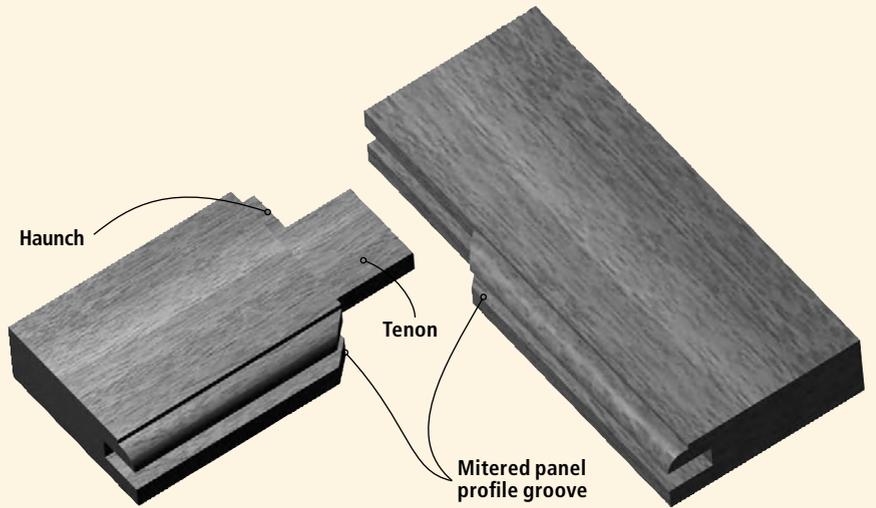
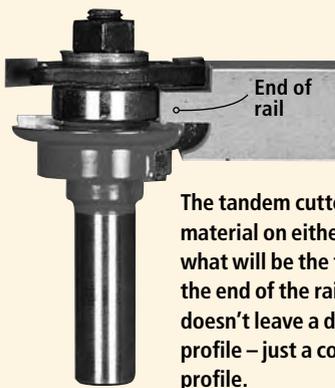
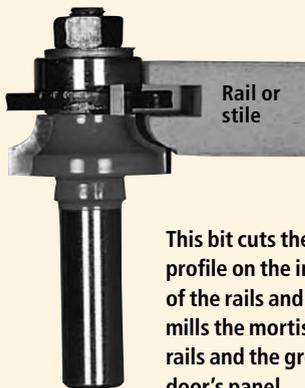


Illustration by John Hutchinson

This door shows a complex version of a rail-and-stile joint. The haunch fills the groove left by the bit. Also, the decorative moulding is mitered at the corner for a classy finish.



The tandem cutters remove material on either side of what will be the tenon on the end of the rail. This bit doesn't leave a decorative profile – just a cope for the profile.



This bit cuts the decorative profile on the inside edges of the rails and stiles, and mills the mortise for the rails and the groove for the door's panel.

Common Multiple-cut Mouldings

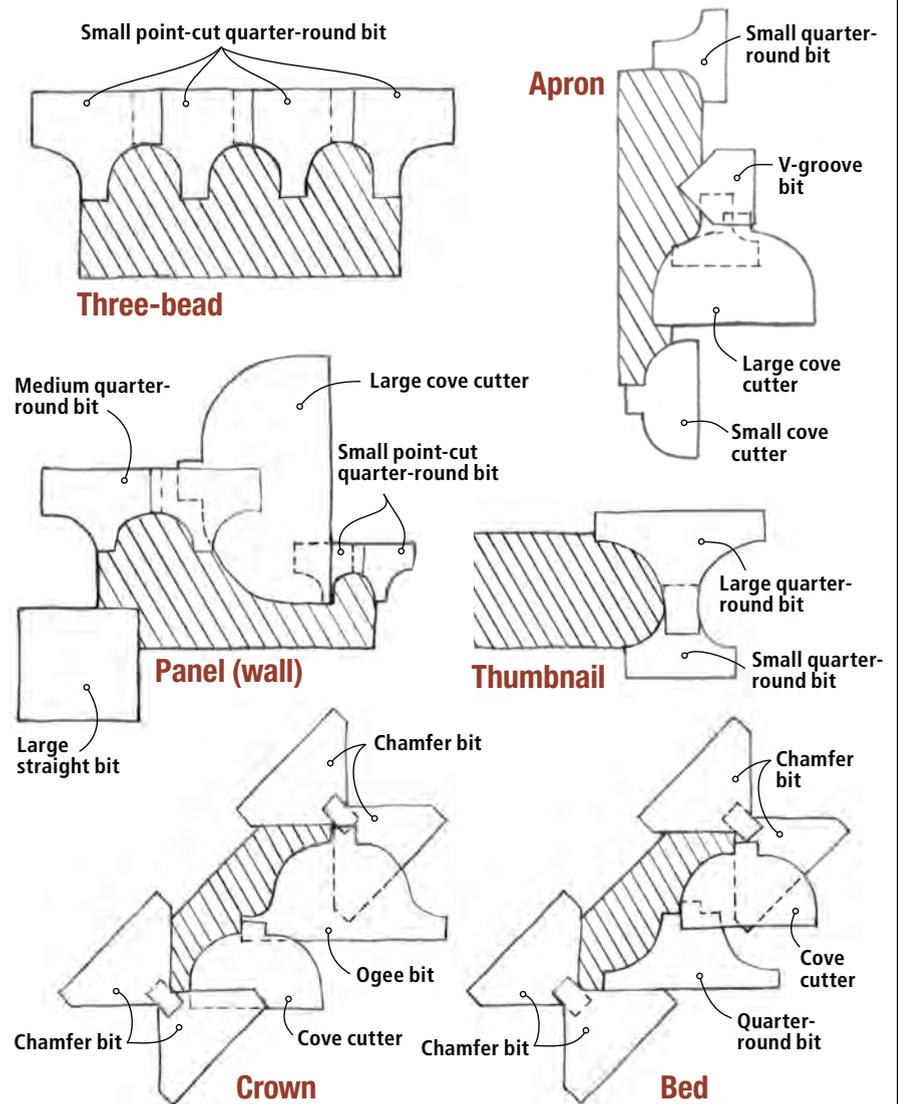
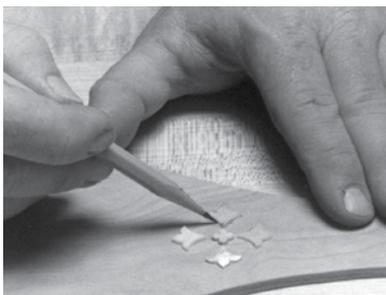


Illustration by Mary Jane Favorite

TIPS & TRICKS

INLAY TIP:

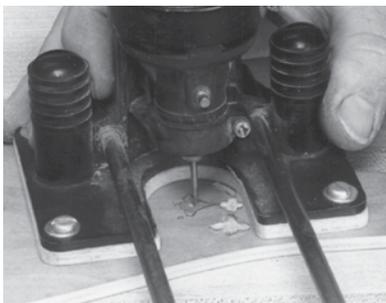
Small Inlay? Sticky Solution



To inlay a shape, first trace the outline on the wood surface. This can be a difficult task, particularly if the design includes several small shapes. To keep wooden shapes from shifting as you trace around them, stick them to the surface with double-stick tape. To keep hard, dense materials in place, glue them to the wood surface with white (polyvinyl resin) glue. The adhesive won't hold the inlays in place permanently, but it will secure them long enough to trace the outline.

INLAY TIP:

Precision in a Small Package



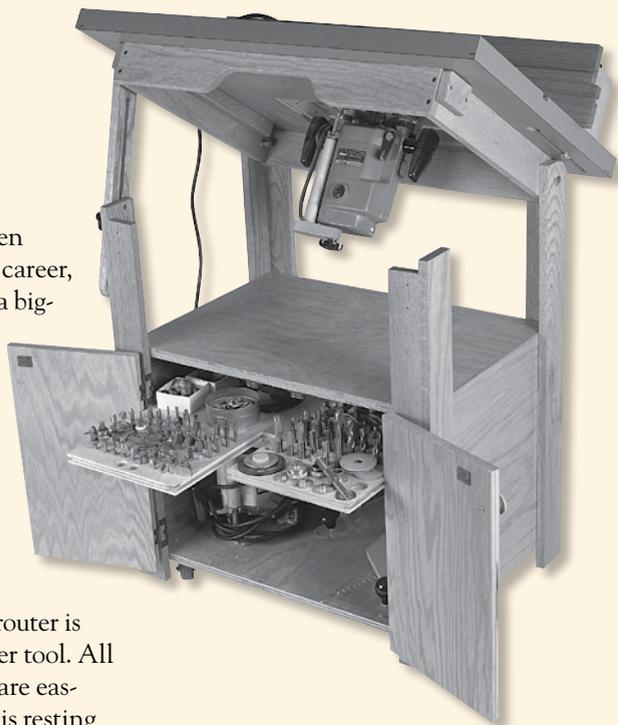
Rout the inlay recesses with a straight bit and a hand-held router. It's easier to work with small bits rather than large ones. Not only can you cut intricate details with small bits, but they also are easier to control. You may want to work with a small router rather than a large one, because small routers give you better visibility and are easier to control. However, even with a small bit and a small router you may find it difficult to rout a line freehand. For this reason, stop cutting just short of the outline and finish the job with carving tools.

Tilting Router Stand

I've designed more than a dozen whiz-bang router tables in my career, each one supposedly packing a bigger bang than the last. But what finally dawned on me a few tables ago is this: What makes the fixture truly useful has less to do with the tabletop than the stand it rests on.

Whether you build or buy a router table, you're faced with the same dilemma. The router is designed to be a portable power tool. All the controls and adjustments are easily accessible when the router is resting upright on a workbench. Bolt it to the underside of a table to convert it to a stationary tool and suddenly it is a lot less cooperative. Many of us spend a lot of time on our knees in front of our router table, fumbling underneath to change bits and adjust the depth of cut. A woodworker I know calls this "praying to the router god."

Some woodworkers solve this problem by mounting the router to a plate that rests in a rabbet, then removing the plate when they need to get at the router. Unfortunately, the sides of the rabbet

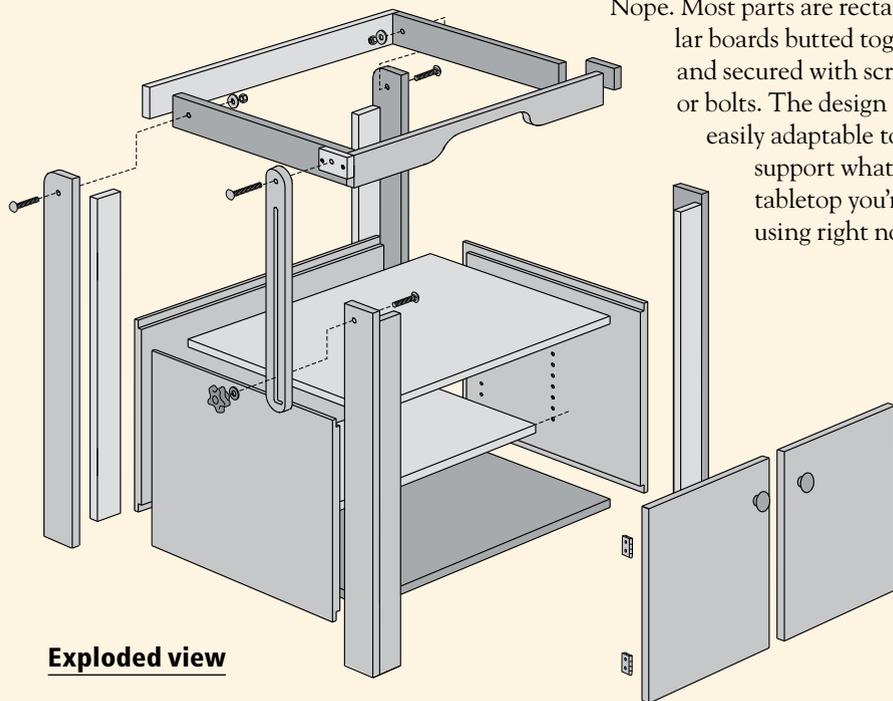


tend to wear as you pop the plate in and out. As the plate becomes loose in its rabbet, new problems arise with safety and accuracy.

A tilting router stand makes the router easily accessible and lets you secure the router to the table. The table swings up like the lid of a chest, exposing the router and bringing it up to a comfortable working height. You can change bits and make adjustments to the tool while standing upright.

Of course, to get this amazing convenience you'd have to build a complex mechanism and a special table, right?

Nope. Most parts are rectangular boards butted together and secured with screws or bolts. The design is easily adaptable to support whatever tabletop you're using right now.



Exploded view

Illustrations by Mary Jane Favorite

You simply need to change the width and depth of the stand to fit.

Begin with the frame under the table. It should be about 6" smaller side to side and 4" smaller front to back than your router table top. If the table has slots on it to mount the fence, make sure that the frame members won't cover these slots or interfere with the fence movement.

Also give some thought to how you will attach the table to the frame. I used two long cleats, one on each side. However, brackets, table clips and pocket screws work equally well.

The legs should hold the table at countertop level (roughly 36"). My router table is part of a "work island" – the table saw, workbench and router table all are

at the same level. So I cut the legs on my table a fraction of an inch longer than what the drawings show.

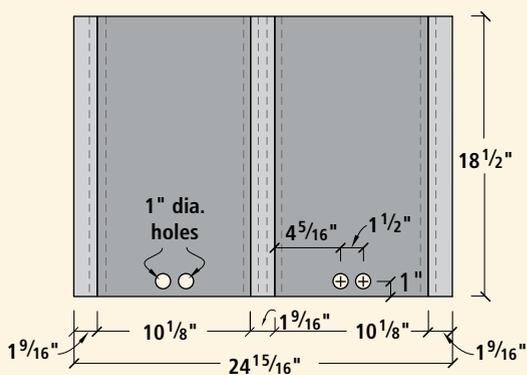
A plywood box is screwed to the legs below the table to brace the legs and provide storage for router accessories. There must be adequate room between the top of the box and the bottom of the router table to fit the router when the collet is fully retracted into the router base. I mounted simple plywood doors on the front legs to enclose the box and keep some of the sawdust out.

The most complex part in the table is the support arm. It has an L-slot – a long slot with a little hiccup at one end. I made the "hiccup" first, drilling a few overlapping holes to create a short slot.

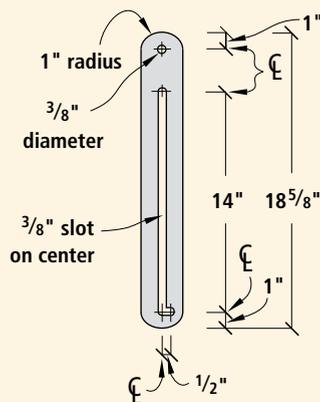
I routed a long slot perpendicular to the short one, then cleaned up the edges of the short slot with a file. When mounting the support arm to the stand, the short portion of the slot faces front.

To help organize all my router bits and collars, I mounted two sliding shelves to the fixed shelf inside the storage box. You don't need to buy expensive hardware to get the sliding action. Make narrow hardwood rails to guide the shelves, then cut matching grooves in the sliding shelves and fixed rails. Glue splines in the grooves in the rails, then glue the rails to a fixed shelf. Fit the sliding shelves to the splined guides, enlarging the grooves in the edges and sanding a little stock from the bottom faces so the shelves slide easily. Wax the grooves in the shelves to help them move smoothly. I drilled holes and mounted dowels in the sliding trays to help organize the bits and accessories and keep them in place. The shelves slide all the way out of the storage box so you can use them as a caddy or tray to carry the bits.

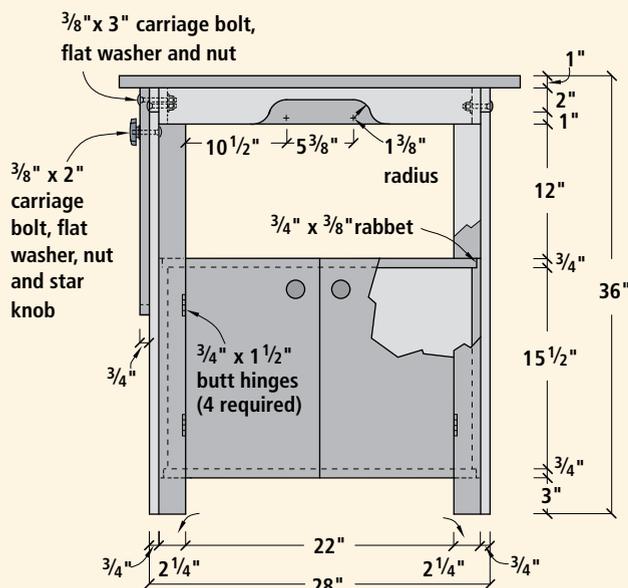
To raise the top of the router table, lift it all the way up and push down near the bottom of the support arm to slip the locking bolt into the short portion of the L-slot. Tighten the knob to make sure the top doesn't slam down unexpectedly.



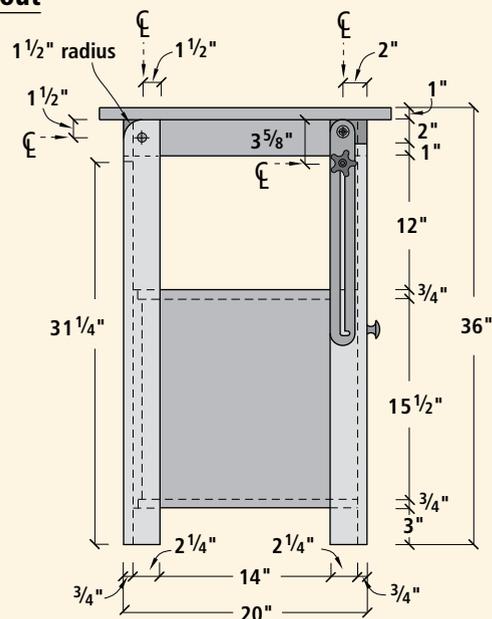
Plan of sliding shelves



Support-arm layout



Elevation



Profile

TIPS & TRICKS

INLAY TIP:

Hand Tools for a Crisp Look

After using a power tool to do much of the inlay work, trim up to the line with carving chisels. Use gouges to cut the curved portions of the shape, and use a skew chisel to cut straight edges and corners. Then clean out the waste with dogleg chisels and a small router plane.

INLAY TIP:

Slow Sand to Smooth Finish



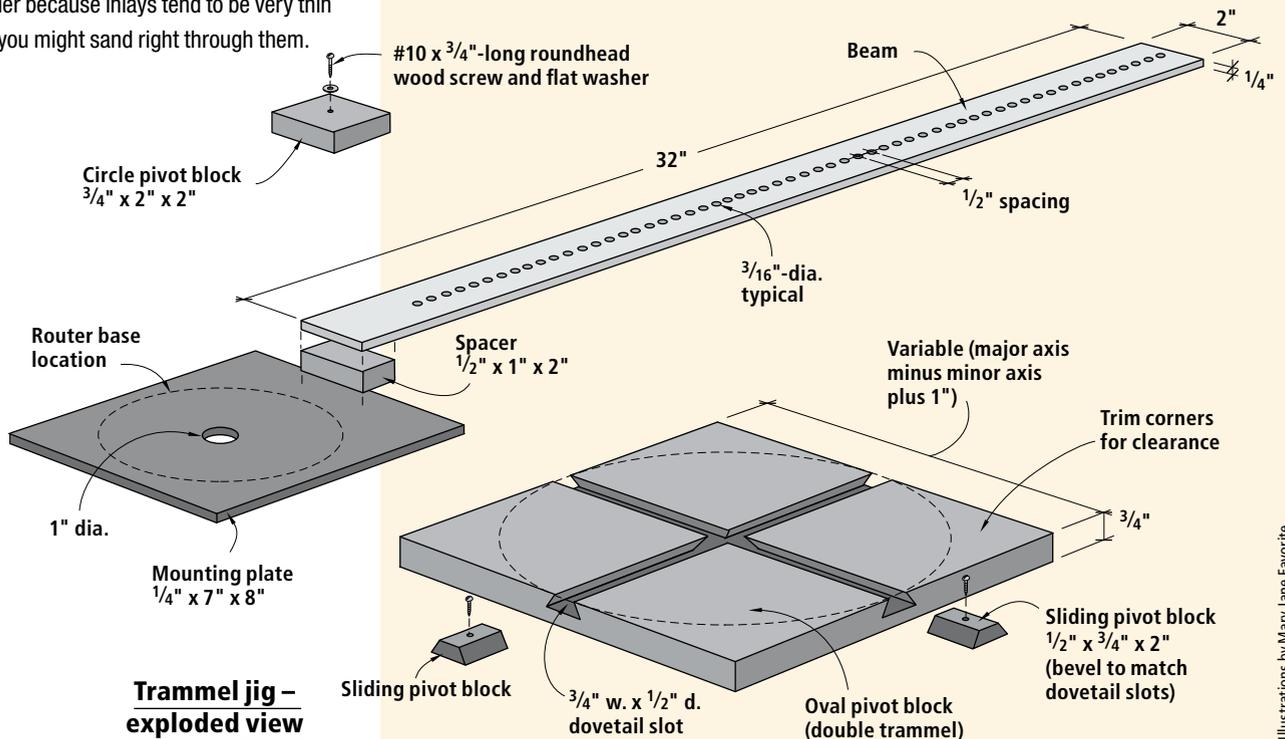
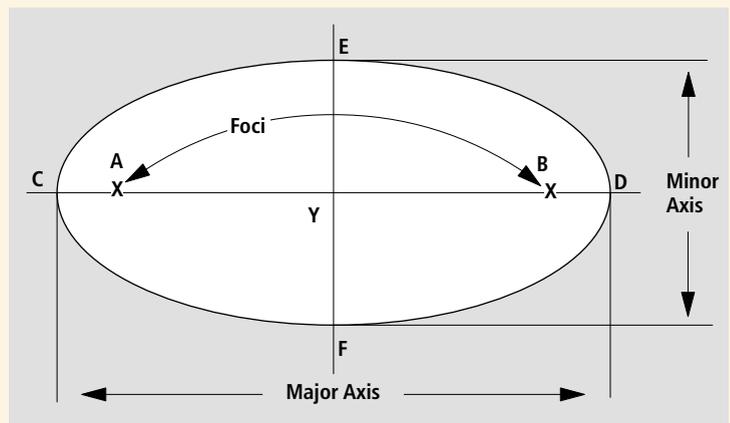
After gluing the inlays in, let the glue dry completely before you scrape away the excess. If the inlay is proud, hand-sand it flush with the surface. Don't use a power sander because inlays tend to be very thin and you might sand right through them.

Routing Ovals

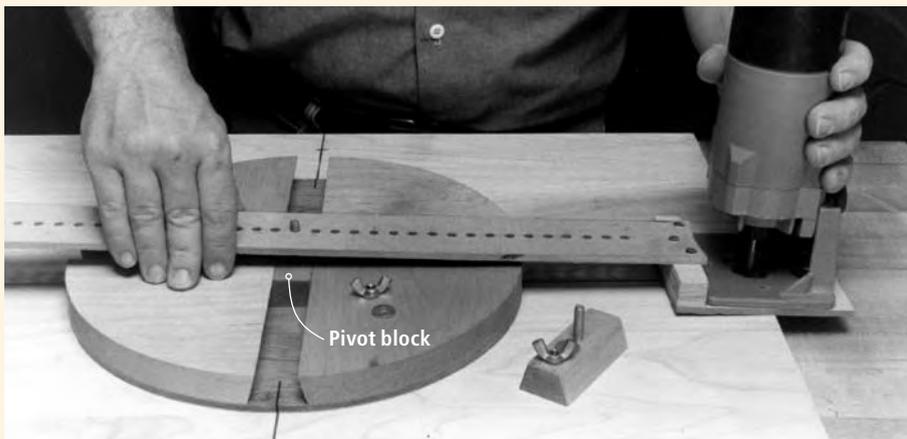
While circles have a constant radius, ovals don't. The radius of an oval or an ellipse is greatest along the major axis (the length of the oval) and smallest along the minor axis (the width of the oval). Ovals also have two pivot points, each of which is called a focus. See the drawing below for more details.

The technique for routing an oval relies on the same principle as routing

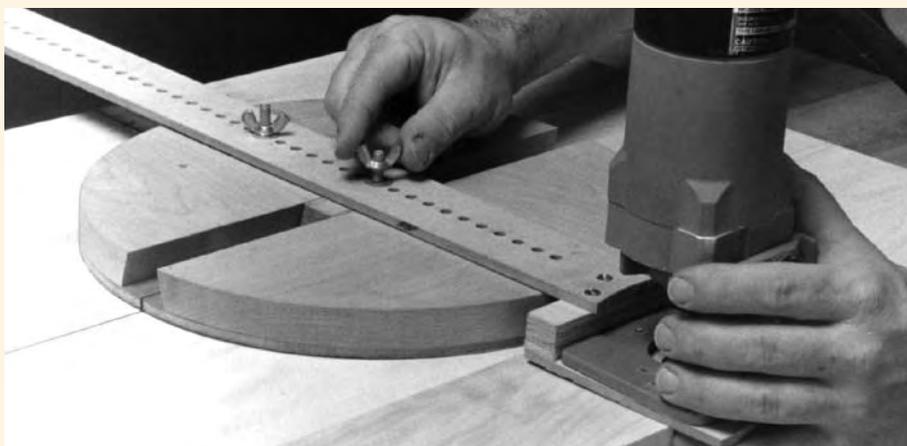
a circle, but you must swing the router around both pivots or foci. To do this, make a double trammel – a beam compass with two moving pivots – on which to mount the router. This jig works in the same fashion as a folk toy you might have come across that has a crank handle that describes an ellipse as you turn it. By substituting a router for the handle, you can rout perfect ovals.



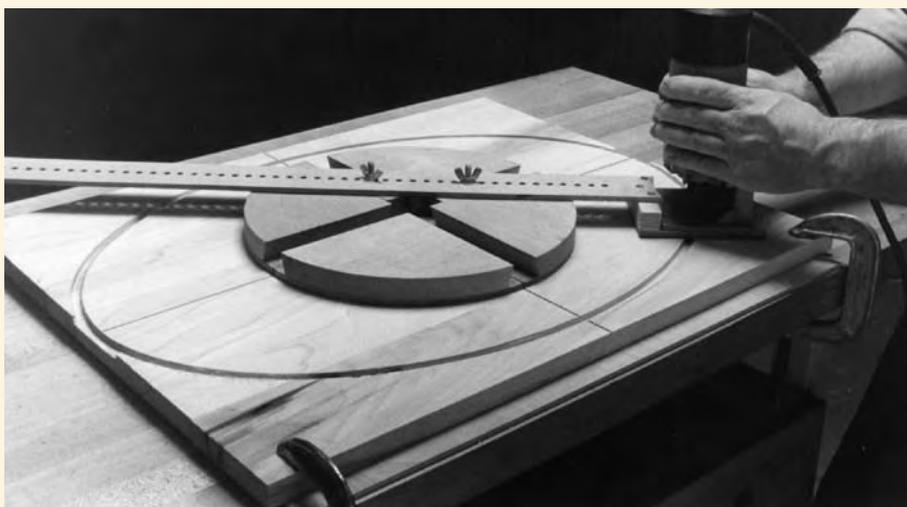
Illustrations by Mary Jane Favorite



Before you rout an oval with a double trammel, decide the length of the major and minor axes, then mark them on the workpiece. Center the double-trammel pivot block over the point where the major and minor axes cross (Y), aligning one sliding pivot with the major axis and the other with the minor axis. Stick the pivot block to the workpiece with double-faced tape. Mount the router on the beam, align it with the major axis and position the router so the bit is at one end of the axis. Center the minor pivot (the pivot that moves along the minor axis) over point Y and fasten the beam to it.



Swing the beam 90°, aligning it with the minor axis, and position the router so the bit is at the end of that axis. Center the major pivot over point Y and fasten the beam to it. The beam should now be fastened to both pivots. To check the setup, swing the router once around the pivots with the power off. The bit should pass over the ends of the major and minor axes.



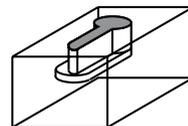
To cut the oval with this double-trammel jig, swing the router around the pivots, pulling gently outward. This slight tension will take any play out of the mechanical system as the pivots slide back and forth in their grooves. Make the cut in several passes.

A BIT OF ADVICE

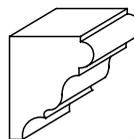
A router bit consists of a cylindrical shank ($\frac{1}{4}$ " or $\frac{1}{2}$ " in diameter) and one or more flutes or cutting wings, usually comprised of a piece of carbide brazed to the metal body of the bit. Throughout this series we have provided a closer look at many of the common and specialized bits to use with your router. The bits shown here are great when using your router for some of the more advanced applications.

Keyhole Bit

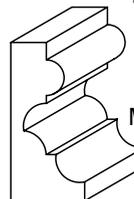
For hanging a project flush to the wall, a keyhole bit is the answer. It plunges into the wood, then plows a channel, perfectly sized to slip over a screw head.



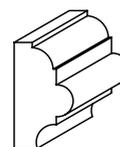
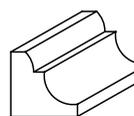
Multi-profile Bit



One bit does it all. By adjusting the height and the distance to the fence, this one bit cuts a variety of profiles.

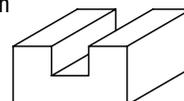


Mix and match the shapes. The options are limited only by your imagination and the jigs you can use.



Upspiral Bit

At first you may say this bit just plows grooves. Not true. The spiraling flutes of this bit also remove the waste from the groove, keeping the cut clean and keeping the bit from overheating and working harder than necessary.



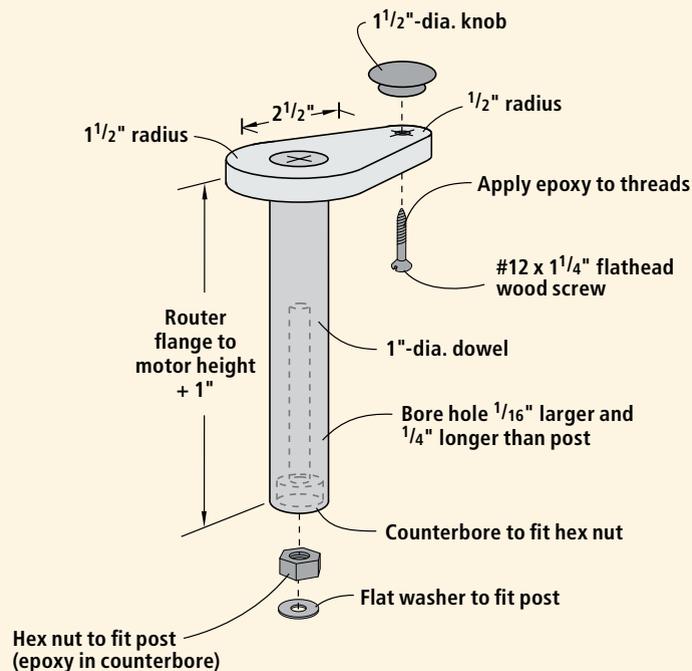
Router Crank

If you use a plunge router with your router table, this little gizmo takes all the frustration out of setting the depth of cut. Just thread it onto the post, then crank the router up and down as needed.

There's an accessory on the market very much like this, I know. But it has a simple knob at the top and takes a lot of wrist action to raise or lower the router. You'll find the crank action much faster and more comfortable. When used with the tilting router stand I built for my shop, it helps create a truly user-friendly stationary routing system. **PW**



The crank fits most plunge-style routers and helps greatly when the tool is positioned upside-down in a router table, such as the tilting router table discussed earlier.



Exploded view

REAL-WORLD

Router Test

A woodworking pro takes on 9 router kits to find his favorite.

I'm a full-time professional woodworker, so I need my tools to be reliable. And I absolutely hate to waste time. I make money when I'm doing something to a piece of wood, not when I'm adjusting a tool. When the editors asked me to test two-base router kits I agreed to bring them into my shop and put them to work, but on my terms.

Most of the magazine tool reviews I read seem kind of silly. I don't need a chart comparing motor amperage draw and I don't care to see a router rigged up with weights and pulleys. I want to know what it's like to hold the tool and cut wood with it.

When the nine routers arrived in my shop, I put them to work, comparing them side by side. I looked at what was important to me, and I tried to push them to their limits. Any

by TROY SEXTON

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



PHOTO BY AL PARISH

REAL-WORLD ROUTER TEST



Spindle locks sound convenient, but they all had problems. The Ridgid (left) was easy to operate, but in the way when changing bases. The DeWalt was difficult to press in.



The large cast wrench of the Milwaukee (right) made for easy bit tightening. The thin stamped wrench of the Makita (left) tended to slip off the nut.

of these routers will do typical router work. I was looking for the one I would want to keep, and those I'd avoid.

I compared the most common tasks first. What was it like to change a bit? Was it easy to reach the switch? Did the motor vibrate too much and was the plunge mechanism easy to use? Then I looked at the finer points, the little things that make a router easier or better to use.

Bit Tightening

Tightening the bit in the collet is to me one of the most important design considerations. Every professional woodworker I know has had a router bit move in the collet while it's in use—a dangerous and maddening situation. I want to be sure that the collet is tight on the bit, and I want bit changing to be painless.

There are two systems in use. The first employs two wrenches, and the second uses one wrench and a button that locks the tool's spindle. I prefer the two wrenches because I can easily get the bit as tight as I want it. The spindle-lock systems are convenient because you need only one wrench, but I think it's difficult to get a lot of torque on the nut due

to the way your hands are positioned while depressing the spindle lock. The spindle locks also show wear and tear quickly; the hole can become egg-shaped and the button can break or stick. All the routers in the test with spindle locks showed some wear after testing.

Among all the routers, the Milwaukee is the best of the group when it comes to bit changing, with two large nuts and two cast wrenches that are the

same size and length. This lets me tighten or loosen the collet by squeezing the two wrenches in one hand. The wrenches and nuts are also sized to make aligning them incredibly easy. Next easiest were the Bosch and the Craftsman. They both have nice wrenches that are easy to align and don't slip, but they were harder to torque down because one wrench was smaller to fit on the motor shaft rather than on a second nut.

The Hitachi is similar to the Bosch but its wrenches are stamped metal rather than cast. The Makita also comes with stamped wrenches. It has one thin nut and one thick nut, which makes it hard to get the wrenches on the nuts and tighten them without slipping.

The Freud had the easiest-to-reach spindle-lock location, but the nut can only be tightened using the spindle lock. The Porter-Cable, DeWalt and Ridgid all



The switch on the DeWalt is in an easy-to-locate and easy-to-operate position.



For some switches, such as on this Makita, it's necessary to remove one hand from the router to turn it on or off.

have either a second nut or flat areas on the motor shaft so the collet can be tightened with two wrenches if that's your choice, or if the spindle lock wears out.

Switch Operation

I think of routing as a two-handed operation, and I want to be able to reach the switch while both my hands are on the router. The DeWalt had the most convenient switch; I barely had to move my thumb to flip the toggle switch. The Milwaukee, Bosch and Craftsman were almost as good; I only had to stretch my hand a little to reach the switch.

The Freud switch is in a good location, but the switch was difficult to move. The Hitachi and Makita have the switch on top of the motor housing, which requires you to take one hand off the router to operate it. The Porter-Cable and Ridgid also require taking one hand off the router to reach the switch, and these were also stiff.

Vibration

Excessive vibration can be a sign of poor motor quality, and can lead to lack of control, user fatigue and poor cut quality. I placed each router on my bench and watched for movement like in the electric football game I had when I was a kid. I held each one and felt for vibration, and also compared the vibration I felt while routing.

The Milwaukee was the clear winner and was a pleasure to work with. The Ridgid and Freud were close, followed in order by the Makita, Hitachi, DeWalt, Porter-Cable and Bosch. The Craftsman had the most vibration.

Changing Bases

When changing the router motor from one base to the other, I want the process to be quick, simple,

obvious and solid. The Milwaukee was my favorite on this point; there was no confusion about which way to place the motor, and it clamped down in both bases without hassle.

The Hitachi, Bosch, Craftsman, DeWalt and Porter-Cable were almost as easy. With these routers there was a bit of aligning and some twists here and there before locking the motor in place, but I encountered no major problems.

With the Freud and the Ridgid, things were more complicated. With these, the spindle lock must be depressed to remove the motor from the base. If these are mounted in a table, there are two steps to release the motor.

The Makita is the only one of the group without a clamp to hold the motor to the base. It locks in its plunge base by loosening or tightening a Phillips-head screw.

Plunge Action and Locks

A router's plunge mechanism needs to work smoothly and without noticeable play. I want the plunge spring to be strong enough to raise the motor completely. The Porter-Cable, DeWalt and Milwaukee were the best on these points.

The Bosch and Craftsman were smooth in action, but the springs felt a little weak. The Makita and Hitachi weren't quite as smooth as the others, but had strong springs. The Ridgid and Freud were noticeably sloppy in their plunge action.

The plunge lock holds the plunge depth, and it's often engaged while the router is running so it's important that it be simple and safe. There are two different types of locks used by routers in the test.

The Milwaukee, Makita, Bosch, Craftsman and Hitachi release the lock when you press



One feature can get in the way of another. To change bases on the Ridgid and Freud routers, the spindle lock must be depressed.



Location and direction of the plunge-release lever is also important. Some, such as the Milwaukee shown here, release when pushed down. Others lock when the lever is pushed down.

down on the lever. The DeWalt, Porter-Cable, Ridgid and Freud engage the lock when you push down on the lever.

With the lever-down-to-release routers, the motion stops when you release the lever, but you need to pull the lever completely up to lock the plunge action. If the lock isn't com-

pletely engaged, it is possible for the router to drop as it is pushed into the work.

I prefer this method because when the lever is released during a plunge cut, the action stops. But other woodworkers prefer the second system because there is no intermediate, partially locked position. If you already own a

(continued on page 88)

TWO-BASE ROUTER KITS

Bosch

877-267-2499
boschtools.com



The Bosch wasn't the winner, but there weren't many complaints. It's a solid tool that performed well. Bit tightening and depth adjustments were good, and the fixed base can be adjusted from above in a router table. It has a solid, well-balanced feel in hand-held use, and the plunge action was smooth, but the spring is weaker than some of the routers tested. There is an adjustable nut on the stop rod for precise depth adjustments in plunge mode. The dust collection was among the best; the fitting was easy to attach, and it could exit on either side of the router.

Likes

- Smooth plunge action
- Excellent micro-adjustments
- Easy bit and base changes
- Good balance and control
- Good dust collection

Gripes

- Wood knobs on fixed base
- Soft spring on plunge base

Craftsman

800-549-4505
craftsman.com



(Editor's note: As of press time this kit was discontinued, but may still be available in some outlets.)

While this appears to be a clone of the Bosch, there are differences that don't offset the difference in price. The Craftsman had the most motor vibration of any in the test, and it seemed some corners were cut in the quality and accessories. The Craftsman base plate was made of a flexible plastic that allowed sawdust to pack between the base plate and the router base.

Likes

- Plunge action and adjustments
- Good bit tightening and wrenches

Gripes

- Above average motor vibration and noise
- Lack of vacuum attachment and template guide

DeWalt

800-433-9258
dewalt.com



The DeWalt had good ergonomics and a low center of gravity. The short motor housing helped with control when mounted in the fixed base, and didn't take much space when mounted in a table. The plunge action was smooth and the threaded nut on the end of the plunge rod depth stop made fine-tuning settings a breeze. The handles were nicely shaped and rubber coated, and the switch was in a great location and operated easily. The through-the-post vacuum dust collection worked well and kept the hose out of the way. There is no provision for adjusting the bit height from above the table.

Likes

- Switch location and operation
- Good balance and control
- Plunge base micro-adjustment
- Good ergonomics

Gripes

- Awkward spindle-lock system
- Noticeable motor vibration
- No above-table height adjustment

Freud

800-334-4107
freudtools.com



The above-the-table adjustment feature operated smoothly, and the motor ran with little vibration. The lever to release the plunge was in an odd position and difficult to get tight. Once released, the plunge action was sloppy. The depth-stop adjustment on the turret was decent, but required extra tools to make adjustments.

This router also required depressing the spindle lock to change bases. There is no second nut or flat on the spindle, so two wrenches cannot be used instead of the lock.

Likes

- Above-table height adjustment
- Little motor vibration

Gripes

- Sloppy plunge action
- Spindle lock interferes with base changes
- Difficult to operate switch

Hitachi

800-829-4752
hitachi.com/hpt



If style is important to you when choosing power tools, then this router has some appeal. If substance is more important than style, you might want to take a closer look. Of the features I looked at, the large base plate was the only item rated above average.

Motor vibration, ergonomics, plunge operation and base changing were decent, but nothing to write home about. Changing bits was difficult, and the height adjustment in the fixed base had a lot of play. It also had the same switch placement issues as the Makita.

Likes

- Template guides included
- Extra-large clip on motor clamp

Gripes

- Coarse fit and adjustments of fixed base
- Hard to find/reach switch

Makita

800-462-5482
makita.com



The Makita worked well as a plunge router, with smooth action, a well-placed release lever and some nice adjustment features. There aren't any frills to the fixed base; the height adjusts by a threaded motor housing and there is no above-the-table depth adjustment.

Motor changes between bases are easy, but to lock the motor in the plunge base you need a Phillips-head screwdriver. This was the only router in the test to require a separate tool for this task. It was hard to align the wrenches on the nuts when changing bits.

Likes

- Plunge base action and lever
- Plunge base micro-adjustments

Gripes

- Extra tool required to lock motor to plunge base
- Switch location can be hard to reach

Milwaukee

800-729-3878
milwaukeetool.com



This router ran the smoothest and had the easiest bit-changing. The switch and other controls were easy to locate and operated well in either hand-held mode, or inverted in a router table. Changing the motor from base to base was simple and obvious, and the innovative micro-adjustments worked great in all configurations.

The few things I didn't like were all related to the round base plate. I prefer one with at least one straight edge for locating the tool on a straightedge fence. The base plate attaches to the router with Torx drive screws, and the screws to attach a fence (not included with the kit) and the vacuum attachment are mounted on the bottom of the base plate. These are minor inconveniences however, not deal breakers.

Overall, the quality feel, ease of use and smooth operation and performance put this router ahead of all the others.

Likes

- Overall design, easy to operate
- Least motor vibration
- Easiest bit changes
- Switch location and above-table height adjustment

Gripes

- Use of Torx screws
- Round base plate
- Accessory screws located below base plate

Ridgid

866-539-1710
ridgid.com



The Ridgid is smooth and powerful in operation and it's the only router in the test with a light that shines on the bit. It also has a cord light to indicate when the tool is plugged in. Visibility is good as the base has a lot of open area. The plunge-depth adjustment is threaded instead of a turret.

The biggest problem with this router is the placement and operation of the spindle lock. To change bases, the lock must be depressed. This complicates the change and requires two steps for removal.

Likes

- Light illuminates bit
- Vibration-free operation
- Above-table height adjustment

Gripes

- Spindle lock interferes with base changes
- Switch placement

Porter-Cable

888-848-5175
porter-cable.com



The Porter-Cable has some features that are ahead of others in the test, but it also has some quirks. In addition to an above-the-table height adjustment, it was the only router in the test that provided a way to lock or unlock the motor to the base from the top.

It has a solid feel to it with nicely shaped rubber-coated handles and the motor had plenty of power with little vibration felt. The plunge mechanism is smooth in operation, with a powerful spring. The spindle lock is in an awkward location, and it was difficult to hold in. The micro-adjustments on the plunge turret use a Torx-head screw, and the adjustments on the fixed base had some backlash.

Likes

- Handle shape and ergonomics
- Solid feel with little vibration
- Above-table height adjustment and lock
- Smooth plunge action

Gripes

- Spindle lock hard to use
- Backlash in height adjustment
- Torx screws for fine plunge setting

REAL-WORLD ROUTER TEST

(continued from page 85)

plunge router, and are looking for a second, choosing one that releases in the same way will help you avoid confusion.

Most of the plunge levers were in an easy-to-access position. The lever on the Freud was awkwardly placed, and required the use of a finger as well as a thumb to operate the lever.

Depth Adjustments

I'm a perfectionist, so I need a simple and reliable way to change the depth of cut to make that final, half-a-hair adjustment. I get frustrated if there is enough play in the mechanism due to coarse threads, or if there's enough sloppiness to make the bit move more than I expect when I reverse direction.

Rating the fine adjustments on these tools is difficult because not all the routers tested use the same mechanism in each of the three possible configurations (plunge base, fixed base and fixed base in a router table).



The Milwaukee's fine adjustment on its fixed base was the favorite of the routers tested.

There are two basic systems used with the fixed bases. The first, found on the Bosch, Craftsman, Freud, Milwaukee, Porter-Cable and Ridgid, employs a threaded rod that's adjusted with the thumb and forefinger.

The other system, used by DeWalt, Hitachi and Makita, has large coarse threads that spiral around the motor hous-

ing. Twisting the motor in the base raises and lowers the motor. Both systems worked well with the fixed bases in this test.

The Milwaukee latch system was the most user-friendly; the base didn't move when I locked it down. The Bosch, Craftsman and Ridgid moved slightly when locking the base.

On the Freud router, the

adjustment knob is longer than it needs to be, and keeps the top of the router off the table if you flip it upside down to change or adjust the bit. The Porter-Cable adjustment had some play in it, about a half-turn, before engaging when changing directions. The Hitachi sits loosely on its threaded motor housing, and it can drop when the motor latch is released.

Mounted in a router table, the threaded rod adjustments work a little better than the threaded motor housing. The Bosch, Craftsman, Milwaukee, Ridgid, Freud and Porter-Cable can be adjusted from above the table with an accessory tool. The Porter-Cable also includes a motor latch that can be engaged from above the table.

Above-the-table adjustment sounds like a good idea, but the access to the adjustment can easily fill with dust and you still need to bend down to see the bit and, except for the Porter-Cable, lock and release the motor base's grip on the motor.

When set up as plunge routers, final cutting depth is set with a depth-stop rod, and a turret for making stepped cuts. The Bosch,



Above-the-table adjustments aren't always as easy as they seem – the hole to reach the screw can fill with debris, and you'll likely need to bend down anyway to see the edge of the bit.



Routers without a fine-thread adjustment on the fixed base have coarse threads on the motor housing. Depth of cut is set by twisting the base in the motor housing.



Several of the routers offered above-the-table depth adjustment, but the Porter-Cable is the only one with an above-the-table motor latch.



A fine-threaded nut at the end of the plunge rod makes fine-tuning depth settings simple and precise.

Craftsman and DeWalt have a threaded knob at the bottom of the stop rod, a great way to tweak the final depth setting.

The Milwaukee has a unique thumbscrew and stop rod that works almost as well. The other routers all make fine adjustments by adjusting a screw or screws on the turret. The Makita and Porter-Cable have three fixed stops, and three adjustable screws on the turret.

The Hitachi is similar, but with only one adjustable screw on the turret. The Ridgid turret has no fixed stops, but the single base turret is threaded for making final depth adjustments.

Vacuum Attachments

All of the routers tested included an attachment to hook up a vacuum for dust collection except the Craftsman, Hitachi and Makita. The DeWalt and Porter-Cable channel the dust and chips up one of the plunge columns to a hose connection at the top of the motor.

This keeps the hose out of the way better than the rest, which require a clear plastic attachment with the hose connection close to the base of the router. The Bosch

and Freud attachments can be mounted in either direction, but the Ridgid and Milwaukee only mount in one location.

Performance will vary depending on the type of cut you're making and the depth of the cut. There wasn't a significant difference between any of the routers we tested in performance, but I liked the through-the-column style because it kept the hose from interfering.

And the Winner Is ...

The Milwaukee 5616-24 was the clear winner. It was smooth and powerful with a combination of design features that separated it from the others. Every feature I looked at had a quality feel to it, and the designers obviously did their homework to create an integrated system that was user-friendly.

The Bosch, DeWalt and Porter-Cable were close behind and would be good, useful choices if they have a feature you prefer, or if you find one at a bargain price. During the testing period for these tools, prices varied as different brands went on and off sale, so shop around to get the best bang for your buck. **PW**



Some routers require a separate attachment for dust collection. The Bosch, shown here, can mount a hose in two different locations.



The Porter-Cable, as well as the DeWalt have the dust collection attachment at the top of the column, a more convenient location.

TWO-BASE Router Kits

BRAND & MODEL #	PRICE*	SPEED RANGE (RPM)	PLUNGE LOCK	PLUNGE BASE ADJUSTMENT	FIXED BASE ADJUSTMENT	SPINDLE LOCK
Bosch 1617EVSPK	\$208	8,000-25,000	Up=lock	Threaded stop	Adj. knob**	No
Craftsman 1617-12†	\$199	8,000-25,000	Up=lock	Threaded stop	Adj. knob**	No
DeWalt DW618PK	\$199	8,000-24,000	Down=lock	Threaded stop	Motor thread	Yes-opt.
Freud FT1702VCE	\$200	10,000-23,000	Down=lock	Turret screws	Adj. knob**	Yes
Hitachi KM12VC	\$160	8,000-24,000	Up=lock	Turret screws	Motor thread	No
Makita RF1101KIT2	\$224	8,000-24,000	Up=lock	Threaded stop	Motor thread	No
Milwaukee 5616-24	\$249	10,000-22,000	Up=lock	Adj. stop rod	Adj. knob**	No
Porter Cable 893PK	\$259	10,000-23,000	Down=lock	Turret screws	Adj. knob**	Yes-opt.
Ridgid R2930	\$199	10,000-23,000	Down=lock	Threaded turret	Adj. knob**	Yes-opt.

* Prices correct at time of publication. Router kits are often sale priced. Prices ranged between \$160 and \$259.

** These routers also are adjustable from above when used in a router table.

† As of press time, this kit was discontinued, but may still be available in some outlets.

SHOP-MADE

Router Guides

For a few dollars worth of acrylic and some hardware, you can add a versatile and valuable system to your router at a fraction of the cost of aftermarket guides.

The router is one of the most versatile tools in any woodshop. With the addition of this shop-made modular router base system, it will be even more valuable.

The router base system starts with a special offset base (a good thing by itself) that's designed to accept other router accessories without having to remove your router from the base. It takes less than a minute to switch accessories, which include: a circle-cutting jig, an edge guide and a flush-trimming attachment. An additional extension increases the reach of both the circle-cutting jig and the edge guide.

The Individual Pieces

The circle-cutting jig cuts circles from 2½" to 20" in diameter simply by sliding the aluminum circle guide along the channel in

by MICHEL THERIAULT

Michel Theriault is a Canadian who writes and works wood for a hobby. He's published more than 130 articles in Australia, Britain, Canada and the United States. His full-time job is in facilities management, managing a portfolio of buildings.





By swapping a few pieces of hardware, you can use this system as either a small (above, top) or large (above) circle-cutting jig, or simply as an edge guide.

PHOTOS BY AL PARRISH

the offset base. With the extension added, you can expand the circle-cutting capacity up to a full 56" diameter.

The edge guide works with any router that has the offset base attached. With it, you can adjust the edge guide from 0" to 7" from the center of the bit. Using the countersunk wood screw holes, you can add a larger wooden fence that's flush and below the edge of the guide. With the auxiliary wooden fence in place, the extension increases the maximum width of the edge guide to up to 20" from center.

The flush-trimming attachment added to the bottom of the offset base allows a straight bit to extend down (flush with the bottom of the attachment) to easily trim screw plugs, solid-wood edging and joints flush to the surface. The 90° angle on the base allows you to reach into tight corners.

Making the Templates

The key to making accurate parts is to make a template first out of 1/2"-thick MDF, then cut out the 3/8"-thick acrylic pieces using the MDF template to guide your router. Even if you make only one set of router guides, this method will give you a high quality shop-made jig in the end.

I used 1/2" MDF for the templates because it's stable and easy to work with. The 1/2" allows enough thickness for the bearing on your router bit to ride against when cutting.

Each base piece has its own template. The offset base is made to comfortably fit most routers with 6"-diameter bases. If your router is larger, simply increase the diameter of the large end and lengthen the offset base by the amount necessary.

Offset Base Template

The offset base template requires a piece of MDF approximately 7" x 13" to allow for waste.

Using the diagrams as a guide, find the center by measuring in 3 1/2" from one long edge at each end and make a mark. Join these marks to give you the centerline. Next, measure and make marks at 1", 6" and 9 1/4" in from one end. Using a compass, draw a 1"-radius circle from the 1" mark to define the small end. Then make a 3 1/4"-radius circle from the 9 1/4" mark to define the other end.

Using a ruler, draw a straight line on both sides so that it touches the edge of both circles. This forms the basic shape of the base. Next, drill a 1/8" hole at the 1" and 6" marks you previously drew.

Using a jigsaw or band saw, cut out the template, keeping just outside the line. Once the template is cut out, you should smooth all the cut edges with a sanding block.

To finish the offset base template, use a 2"-diameter hole saw to drill the 2" hole at the 9 1/4" mark, centered in the large end of the offset base. Save the plug that comes out of the hole – it will be useful for centering the offset base when mounting it to your router's base. If you don't have a hole saw, you can cut this hole out with either a jigsaw or a scroll saw.

Flush-trimming Template

The flush-trimming template is made using the offset-base template. Attach a rectangular flush-trimming template blank to the offset base template with double-sided tape so that it overhangs the small end and trim the blank to within 1/4" of the template on your band saw. Use a 1/2" pattern

SHOP-MADE ROUTER GUIDES



After transferring the template pattern to the template material, it takes only a minute to rough-out the shape on the band saw. Cut as close to the line as you can to keep clean-up to a minimum.



For the interior holes in the template, hole cutting saws, Forstner bits or spade bits will do the job. Make sure you back up the template to avoid blowout on the backside of the workpiece.



With everything cut, bored and sized appropriately, the last step is to clean up the edge so that it's smooth. A block and sandpaper can do most of the work, but an edge sander (if available) will be much quicker.

router bit with a top-mounted bearing in your table-mounted router to shape the outside edges of the template.

Next, drill $\frac{1}{4}$ " holes through the flush-trimming template at the 1" and 6" locations, using the holes in the offset base template as a guide. Find the center of the 2" hole and mark that location. Follow the diagrams to draw two lines at right angles to each other, meeting at the center of the 2" hole. At the intersection, drill a hole slightly larger than the size of bit you will be using for flush cutting. Finally, cut along the two lines with a band saw or jigsaw and smooth with a sanding block.

Edge-guide Template

To make the edge-guide template, first cut a rectangular piece of MDF 6" wide by 8" long. This is longer than needed so you can drill the 1" radius cutout. To make the cutout, measure 3" in from the long edge and 5" from the end and make a mark. Cut a 2"-diameter hole with a hole saw, or other appropriate saw, at the mark. To finish the template, use your table saw or chop saw to cut the scrap

from the end through the center of the 2" hole you just cut.

Measure and mark for the three holes as shown in the diagrams at right and drill all three holes with a $\frac{1}{4}$ " drill bit, then sand all the edges smooth with a sanding block.

Extension Template

For the extension template, start with a piece of MDF $2\frac{1}{2}$ " x 21". Choose one of the ends as a reference and make a mark in the exact center at 1", $4\frac{1}{2}$ ", $6\frac{1}{4}$ " and $19\frac{3}{4}$ " from the reference end. Using a compass, draw a $2\frac{1}{2}$ "-diameter circle at the $19\frac{3}{4}$ " mark as shown on the drawing.

Cut out the round end of the template using a jigsaw or band saw. Drill a $\frac{1}{4}$ " hole at each of the other marks as shown.

Making the Offset Base

All of the bases are made from $\frac{3}{8}$ "-thick (except for the slider piece which is $\frac{3}{16}$ "-thick) acrylic, such as Lexan or Plexiglas. These can be commonly found at a local plastics store. Check the phone book in your area.

Before cutting the outer shape of the offset base, the slots need to be routed into the acrylic

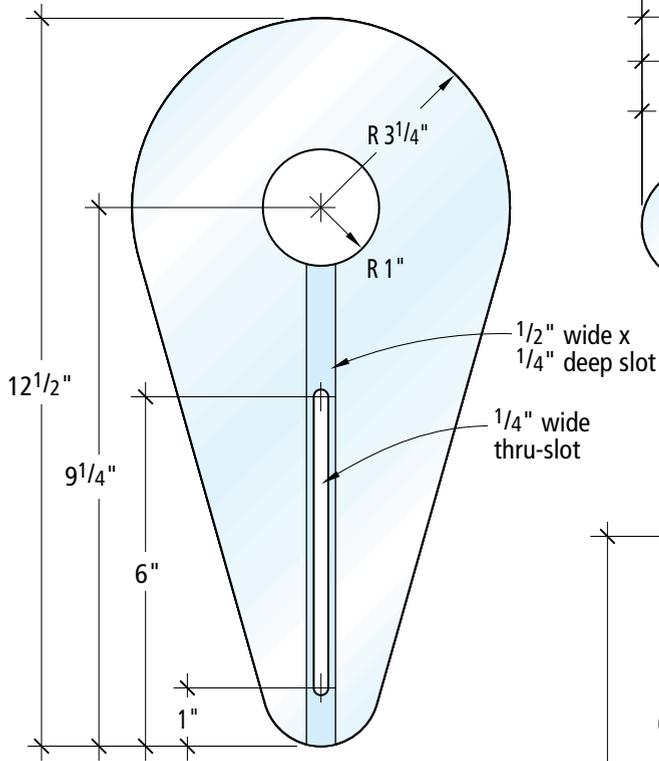
WORKING WITH ACRYLIC

Acrylics (such as Lexan or Plexiglas) are very easy to cut with common woodworking machinery, such as table saws, scrollsaws, band saws and routers. The single biggest problem is melting from an overheated cutter, so be aware of the feed rate and the heat generated when you are cutting acrylic. As well, the shavings will be heavily static charged and can make quite a mess. Don't use a dust collector when cutting acrylic.

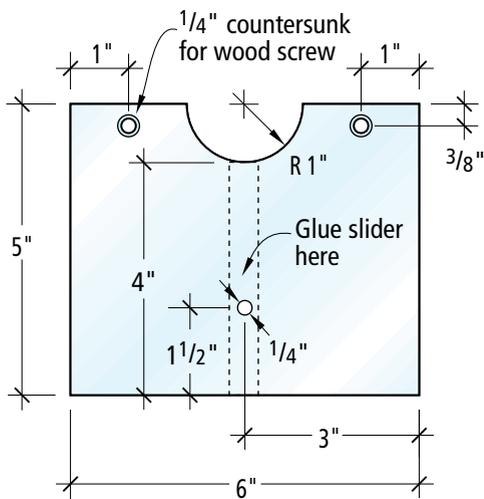
When routing acrylic, you should use carbide-tipped bits because acrylic is very abrasive. Keep the feed rates fast enough so the cut is smooth, without excessive heat build-up. When routing the channels, such as those in the offset base and the extension, take light cuts and keep the feed rate fast, to reduce the possibility of melting.

Cut edges are very sharp, so ease or break them with fine sandpaper, a file or even a roundover bit. You can also improve the look of cut edges by running a butane torch over the edge quickly to melt the edge slightly and remove the fine sandpaper and cutter marks.

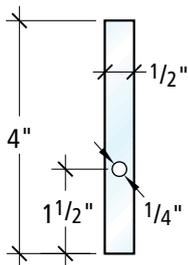
Gluing acrylic requires a special glue (available from a plastics supply company) that literally melts the acrylic pieces together. —MT



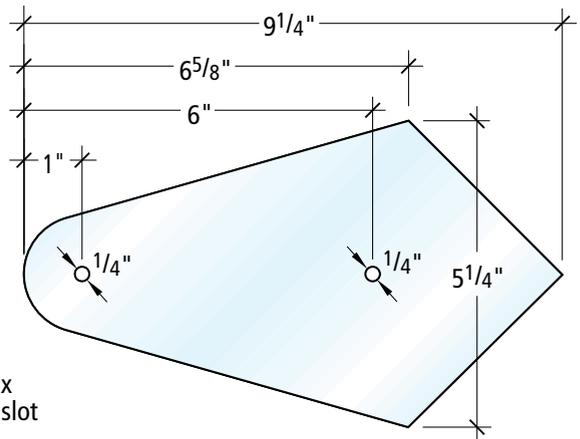
Offset base



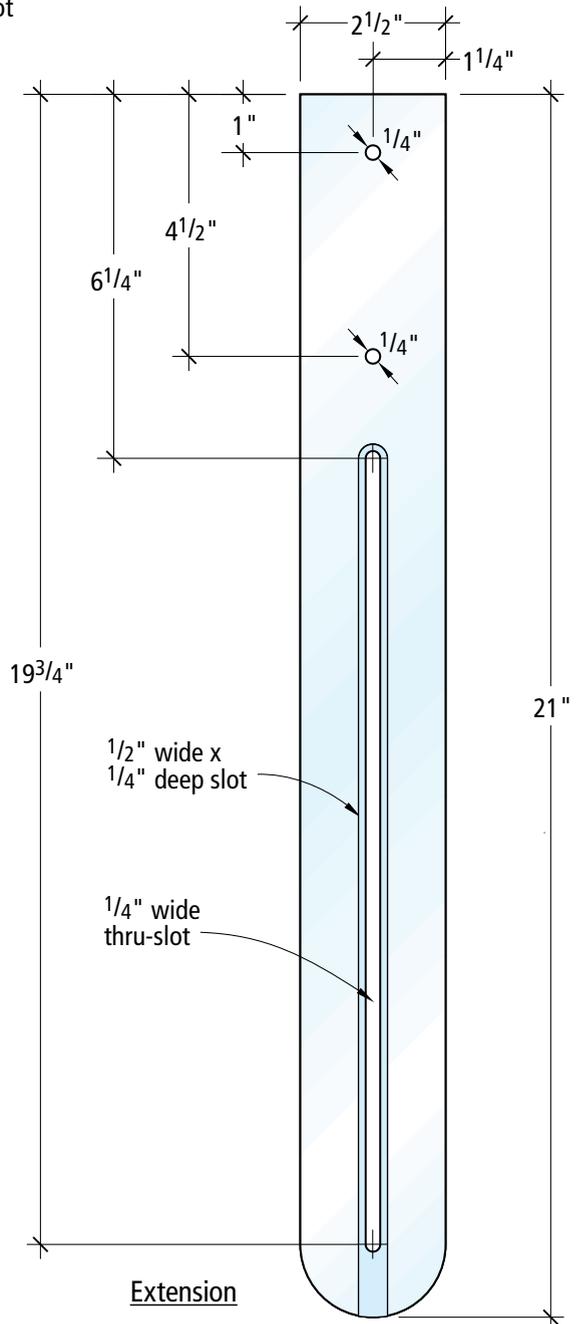
Edge guide



Slider



Flush-trimming attachment



Extension

SHOP-MADE ROUTER GUIDES

while it is still rectangular. Start by measuring 1", 6" and 9 $\frac{1}{4}$ " from one end and make marks at the center of the piece. These are reference marks for routing the slots. The first slot is $\frac{1}{2}$ " wide and $\frac{1}{4}$ " deep and goes from one edge to the 9 $\frac{1}{4}$ " mark.

If you aren't able to find $\frac{3}{16}$ " acrylic for the slider piece, $\frac{1}{4}$ " can be used, but you'll either need to make this $\frac{1}{4}$ "-deep groove slightly deeper, or recess the slider strip into a corresponding groove in the edge guide.

Using a $\frac{1}{2}$ " router bit in your table-mounted router, set the

fence 3 $\frac{1}{4}$ " from the center of the bit. Run the groove in two $\frac{1}{8}$ " passes, feeding the blank into the bit until it reaches the 9 $\frac{1}{4}$ " mark on your work.

Without moving the fence, replace the $\frac{1}{2}$ " bit with a $\frac{1}{4}$ " spiral carbide bit and set it $\frac{1}{2}$ " high. If you have to remove the fence to change the bit, mark its exact position and set the fence back to the mark after changing the bit. It's important that the $\frac{1}{4}$ " slot is centered in the $\frac{1}{2}$ " slot.

Turn on the router and position the blank over the bit at the 1" mark. Slowly lower the blank

onto the bit until it cuts all the way through, then carefully feed the blank into the bit until you reach the 6" mark.

With the slots cut, apply double-stick tape to one side of the template and, using $\frac{1}{4}$ " bolts through the holes in the template, position the template onto the acrylic blank so that the two $\frac{1}{4}$ " holes in the template line up with the $\frac{1}{4}$ " slot in the acrylic. Trim the acrylic on the band saw, then use the template bit to trim the base to the template.

Next, drill a $\frac{5}{8}$ " or larger hole through the acrylic inside

the 2" hole in the template in order to rout the 2" hole with the template bit already set in your table.

Finally, round over the bottom edges of the offset base with a $\frac{1}{8}$ " roundover bit and sand all the sharp edges of the acrylic with fine sandpaper.

The Flush-trim Attachment

Use the same steps as used on the offset base to trim the flush-trimming template to the acrylic blank. Using the $\frac{1}{4}$ " holes in the template as a guide, drill $\frac{1}{4}$ " holes through the flush-trimming base. Knock off the sharp edges with fine sandpaper, then countersink the $\frac{1}{4}$ " holes on one side of the acrylic to accommodate the flathead bolts.

Making the Extension

Similar to the offset base, the slots need to be routed into the blank before you use the template to cut the final shape. Choose a reference end and measure 6 $\frac{1}{4}$ " and 19 $\frac{3}{4}$ " from the end, scribing a small mark centered on the blank to use as reference marks when you rout the slots. The first



With the template carefully attached to the acrylic, use your band saw to rough-out the shape of the jig itself. Leave a little extra, but don't leave so much that the router won't be able to clean it up easily.



After cutting an adequately sized starter hole with a drill bit, a bearing-guided flush-cutting bit does a nice job of shaping the interior holes to match the template.



Using the same bearing-guided flush-cutting bit, the outside of the jig is trimmed neatly to the template.



I used a bearing-guided roundover bit to soften the bottom edges of the jigs to protect the wood from scratches and to protect the slightly fragile edges on the jig itself. For the rest of the edges, sandpaper works fine.

SUPPLIES

Most items available from:

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

- 1 • pkg. of 10 nylon washers
#00M40.23, \$1.35
- 1 • 2 $\frac{1}{4}$ " pentagon knob
#00M50.01, \$1.25
- 3 • 1 $\frac{1}{8}$ " wing knob
#00M51.01, \$1.40
- 1 • 1" clamping knob
#00M56.21, \$1.40

Other necessary supplies:

- 3 • 1" hex-head bolts ($\frac{1}{4}$ "-20)
- 1 • 1 $\frac{1}{4}$ " hex-head bolt ($\frac{1}{4}$ "-20)
- 2 • 1" flat head bolts ($\frac{1}{4}$ "-20)
- 1 • $\frac{1}{8}$ " x $\frac{3}{8}$ " rolled steel pin

Prices correct at time of publication.

slot is $\frac{1}{2}$ " wide and $\frac{1}{4}$ " deep and goes from the end opposite the reference end to the $6\frac{1}{4}$ " mark. Then follow the offset base steps to cut the slots.

With the slots cut, mount the template to the acrylic base and trim the material using first the band saw, then the template bit, breaking the edges with sandpaper afterward.

Making the Edge Guide

Attach the edge-guide template to the acrylic blank and follow the same procedures as before to trim the blank using the band saw and a pattern bit in your router. Using the $\frac{1}{4}$ " holes in the template as a guide, drill $\frac{1}{4}$ " holes through the edge guide. Remove the template and break the sharp edges with fine sandpaper. Then countersink the two $\frac{1}{4}$ " holes on the top of the guide to accommodate wood screws.

Cut a strip of $\frac{3}{16}$ " acrylic slightly under $\frac{1}{2}$ " wide on your table saw and then cut it 4" long. Place the strip in the slot on the extension or offset base and drill the $\frac{1}{4}$ " hole using the $\frac{1}{4}$ " slot as a guide to ensure it is centered. Using a square, carefully glue the strip to the top of the edge guide



Running the grooves for the mounting hardware in both the offset base and the extension is a two-step router table operation. The $\frac{1}{4}$ "-deep stopped groove is run first, using the router table fence to locate the slot in the center.

using acrylic glue. Make sure that the two holes line up by inserting a $\frac{1}{4}$ "-20 bolt in the two holes.

Making the Circle Guide

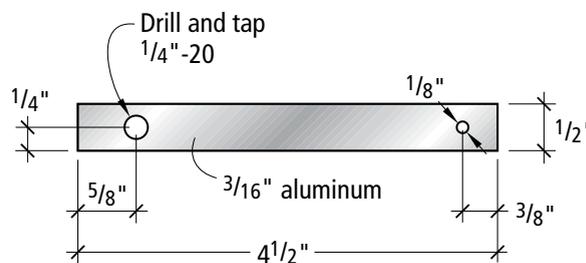
The circle guide is made from aluminum, brass, wood or acrylic. First, cut the bar to length. Test the fit in the slot on your offset base. It should slide easily, but not have too much play in it. File the width to fit, and test again.

Next, measure and mark for the two holes as shown. The hole $\frac{5}{8}$ " from one end will be tapped to accommodate a $\frac{1}{4}$ "-20 bolt. Drill the hole with a $1\frac{5}{64}$ " drill bit, then use the $\frac{1}{4}$ "-20 tap to

make the threads. Drill the other hole with a $\frac{1}{8}$ " drill.

Carefully position a rolled steel pin over the $\frac{1}{8}$ " hole and hammer it into position until the top side is flush with the bar. When using the circle guide, a

small brad nail can be slipped through the rolled steel pin, then tapped into the wood being cut at the center point. Or, you can drill an $\frac{1}{8}$ " hole and use the rolled pin itself for your pivot point. **PW**



Circle guide

ATTACHING YOUR ROUTER

It isn't critical that the offset base be positioned exactly centered over the router bit, however it should be as close as possible.

Because the hole pattern of each router is different, you will have to use your existing router plate to locate the holes for drilling. The simplest way is to remove your existing router plate and position it on top of the offset base. Keep track of the hole pattern in the router base relative to the handles and make sure they are lined up so that one handle is facing away from long end of the offset base, but ensure that the other handle will not get in the way of the circle jig's knob.

Center the offset base by eye and scribe the locations of the holes. If you saved the plug from the hole saw, you can wrap masking tape around the plug until it fits snugly into the hole in the offset base, and use the center hole for better accuracy when lining up the baseplate holes.

Next, drill the holes the required diameter and countersink them as necessary. Depending on the thickness of your original baseplate and the length of the original bolts, you may need to purchase longer bolts in order to attach the new offset base to your router. — MT



The through-groove is cut afterward, again using the fence as a guide. You may be able to switch bits in the router without moving the fence and keep everything perfectly centered. If not, double-check the through-groove's location.

SHAPERS AND Router Tables

Though these two tools look similar, each has advantages and disadvantages that a woodworker must consider when choosing which to buy.

Having trouble deciding between a router table and shaper? I'm sure you've heard many of the arguments: Isn't a table-mounted router really a small shaper? Doesn't the shaper have more power? How about cost? Let's take a look at these issues as well as some of the other pros and cons of each machine so that you can decide for yourself.

Anatomy

Shapers and table-mounted routers do appear similar, and they are in many ways. Both have a broad, flat top with a hole in the center for the cutter. Underneath the top is a motor for spinning bits or cutterheads at high speeds. Additionally, each machine has a fence that locks to the table to safely and effectively guide the workpiece past the spinning cutter or bit. Most of the operating principles are the same. Both machines can

by **LONNIE BIRD**

Lonnie Bird (lonniebird.com) is author of "The Shaper Book" (The Taunton Press). He builds period furniture and conducts woodworking seminars in Dandridge, Tennessee.



PHOTOS BY ALPARRISH

produce mouldings, rabbets and a variety of other profiles on straight or curved stock.

But like other stationary power tools, shapers are real production machines. The average shaper weighs in at 500 pounds, or approximately one quarter of a ton. This mass, coupled with a large spindle, bearings and induction motor, enable the shaper to breeze through heavy cuts, such as a raised panel, that bog down even the most powerful routers.

But besides the obvious dif-

ferences in size and power, there are some other significant differences, too, that will affect the capabilities of each machine and how they will perform in your shop. For example, shaper cutters are bored to fit the spindle of the machine, but router bits have a metal shank that fits into the collet of a router.

What's the difference? Shaper cutters can be inverted or mounted upside down; the spindle rotation can be reversed and you can feed the stock from the opposite direction. This is

an important feature that will allow you to shape profiles on wide, thick and odd-shaped stock. Shaping from either direction also allows you to cut with the grain, rather than against it, resulting in a smoother surface on the workpiece.

Another significant difference is that the spindle of a shaper is much longer than the shank of even the tallest router bits. The extra length will enable you to use tall cutterheads for shaping wide, flat profiles such as ogee

crown mouldings for furniture and architectural woodwork. In comparison, router bits are vertically challenged by the relatively short length of router-bit shanks. Even so, the largest routers don't have the heavy-duty bearings and horsepower to support and drive large bits through heavy cuts like a shaper.

Comparing Horsepower

Horsepower obviously has a direct relationship on the size of cut a machine can produce. A typical $\frac{3}{4}$ "-spindle shaper comes equipped with a 3-horsepower (hp) motor. Although it's true that large routers also have motors rated at 3 hp or perhaps even greater, they're still no match for the same size shaper. Why? The difference lies in the type of motor. Large stationary woodworking machines such as shapers use induction motors that are designed to produce their rated horsepower continually under heavy loads. They will push large cutterheads through dense stock all day long.

However, most portable power tools such as routers use universal motors that will produce their rated horsepower only for short bursts before they overheat and shut down. Fortunately, today's routers are designed with thermal overload protectors that cut power to the motor before it burns out. If you've ever run large cove cutters or panel-raising bits in your router table, you've probably stalled the motor a few times from overworking it.

Although you can avoid overheating your router by taking multiple light passes until you've reached the full depth of the profile, an average shaper can shape most profiles such as a raised panel in one pass. In contrast, a router table will typically require three to five passes to shape a panel edge, depend-



SHAPERS & ROUTER TABLES



One of the advantages of the shaper is that its motor can run in reverse. This allows you to adapt to wood where the grain runs in a different direction. It also helps with wide, thick or odd-shaped stock.

Even the smallest shapers (those with a 1½-horsepower motor) are powerful enough to raise a panel in one pass. Most routers would need to perform this operation in three or more passes.



ing on the density or hardness of the wood. When shaping long runs of mouldings or a number of raised panels for kitchen cabinet doors, the time saved with the shaper is significant. And in fact, you'll even notice a difference when shaping smaller profiles as well; the shaper powers through any cut more efficiently and smoothly.

With its large spindle and plenty of raw power, the shaper is clearly the best choice for production runs and large, heavy cuts. But a table-mounted router has several distinct advantages over the shaper, too. Let's take a look at some of these advantages.

Versatility

Although a table-mounted router is no match for a shaper in size and horsepower, it makes up for it in versatility. For example, a table-mounted router can be used for plunge cuts when shaping flutes and grooves, whereas shapers can't. That's because shapers use a spindle nut to secure the cutterhead but routers use a collet to secure the bit. In fact, this feature allows manufacturers to produce a whole array of router bits that cut on the end, such as corebox and straight bits.

However, as I mentioned earlier, size is also another important difference between the two machines. Although the smaller scale of a router and router bits is sometimes its greatest weakness, many times it's also its greatest strength. The small size of router bits and their guide bearings enable you to make a variety of cuts that are difficult or impossible to make with a shaper. Let's look at a few examples.

Shaping Small Stock

Because of its smaller size, the router table is by far the best tool for safely and effectively shaping

small stock. And with the enormous variety of router bits available, diminutive details that are difficult to produce with a shaper are created easily with the router table. If you flip through the pages of any router-bit catalog you'll see dozens of small profiles that simply are not available for the spindle shaper.

Additionally, the smaller diameter of router bits allows you to use a much smaller fence opening on the router table, which decreases the chance of a short workpiece dropping into the bit and being spoiled.

Remember: Whenever the workpiece is small, it's important to follow all the manufacturer's safety precautions and use the appropriate jigs to distance your hands from the spinning bit. The jig can be as simple as clamping the work to a backup board attached to the miter gauge.

Shaping Tight Contours

The small size of a router table and router bits can also be a tremendous advantage when shaping curved stock. Although both the router table and the shaper excel at shaping curved moulding, legs and other details, shaping tight contours is where the router table outperforms the shaper. Because of the small cutting diameter, router bits will shape curved edges of tight contours where the large diameter of a shaper cutterhead simply can't reach. In fact, the cutting diameter of many router bits is no greater than the shaper's spindle diameter alone.

Inside Corners

Many furniture details include sharp, distinctive inside corners at the intersection of profiles. And because both shapers and routers leave an inside corner rounded, the shaped detail must be carved by hand to be com-

pleted. But compare the small-diameter guide bearings to the large guide bearings on a shaper and you'll see that you'll do far less handwork if you shape the intersection with a router.

That's because the small diameter of the guide bearings on router bits allows the cutting edges to reach deeper into the corner and shape more of the profile, leaving less hand work.

Comparing the Cutting Geometry

Have you ever noticed that router bits sometimes have a tendency to burn or tear out the surface of the stock? As a general rule, shapers will cut smoother than a router table with less machining defects. And although there are several factors that contribute to surface quality when machining (such as the hardness of the wood, the type of grain and feed rate), the geometry of the cutterhead or bit plays a major role. Because of the large diameter of shaper cutterheads, manufacturers have more room to design the cutting geometry for the best performance. Specifically, the rake angle of the cutting edge dramatically affects the smoothness of the

surface. The rake angle is created by the face of the cutter as it intersects an imaginary line that starts at the center of the cutter and intersects the tip of the cutter. Although there isn't one perfect angle that works for all species of wood, a rake angle of approximately 30°, found on most shaper cutterheads, works extremely well.

However, because of their small diameter, there isn't room on the body of a router bit. As a result, when compared to shaper cutterheads, many router bits cut with more of a scraping action. Besides the surface quality, a key indicator of the cutting geometry is the chips that are produced. While shaper cutterheads produce light, fluffy shavings similar to a handplane, router bits produce chips and dust. That's why, when all other factors are equal, I'll choose to use my shaper over the router table.

Cost Comparison

For most of us, price is an issue whenever we consider a new tool. In this category, the router table is the winner, hands down. Although in recent years shapers have become more affordable, the machine's cutters can be



The tall spindle on a shaper allows it to be used with taller cutters, such as crown moulding cutters. Even with this large stile-and-rail cutter installed, you can see how much spindle is still available.

expensive. And remember, it's the cutters or bits that give these machines their versatility.

Although a combination blade works well on the table saw for a variety of cuts, each cut you make on a router table or shaper requires a router bit or cutters for that specific purpose.

Making a Choice

Clearly, there is no winner in the shaper vs. router contest. Although the tools are very similar, the router table and shaper each have distinct characteris-

tics that give them advantages over the other. That's why I have both in my own shop. But if you're just starting out, I suggest that you begin with a large router table equipped with a router of at least 3 hp.

By owning a router table, you'll have an extremely versatile tool. At the same time, you'll be learning to use a shaper because the techniques for using the two are nearly identical. Later on, if you want to make large mouldings or need production capacity, consider adding a shaper. **PW**



One of the big advantages of router tables is that they can sneak into tight corners a shaper cannot. The ogee profile on this piece will need to be finished up with carving, but this cut would be almost impossible on a shaper.



Another advantage of router tables is that you can cut directly above the bit, such as with this fluting shown here. Making this cut on a shaper requires a trickier setup.

WHAT'S NEW IN Routing

Routing innovations push the tool's usefulness to new heights.

During the past few years there have been a number of innovations that opened our eyes in the world of routing. There's a new router design that just might make your current fixed-base router a little jealous, an accessory that has the ability to turn a trim router into an accurate micro-adjustable plunge router, and a new router-bit design that doubles the number of cutting edges to produce a near-flawless cut, add to the already numerous tasks tackled with a router.

We think these innovations are worth a close look and that you'll find a place to use them in your woodshops.

Trimmers: Not Just For Laminate Anymore

Trim routers have been a mainstay in the laminate industry for years. But as these one-handed tools have acquired more features and power, they have migrated into woodworking shops. With

by **GLEND. HUEY**

Glen is a senior editor of *Popular Woodworking*, a published author and host of the Woodworker's Edge DVD series. Contact him at 513-531-2690 x1293 or glen.huey@fwpubs.com.



PHOTO BY AL PARRISH

the release of the Bosch Colt, we think your fixed-base router is going to get a little jealous.

Bosch upgraded and redefined its line of trim routers to make them more durable and convenient for woodworking operations. The base is beefier and offers an easier fine-depth adjustment (one revolution is $\frac{3}{64}$ "), while still maintaining

parallelism to the bit. So, you quickly get your depth really close, then dial it in perfectly. A slick thread bypass feature makes coarse height adjustments simple as well. And an overmolded contoured grip improves the tool's comfort when in use.

The Colt is a 5.7-amp tool with a soft-start motor that is rated at 1 horsepower. Horse-

The Bosch Colt is small enough to fit comfortably in your hand and powerful enough to give your current router a day (or week) off.

power ratings aside, the pint-sized tool packs real punch. Need to round over a table edge? No problem. Need to trim patterns flush? This tool and its small base will get you in tight places your big router could never go.

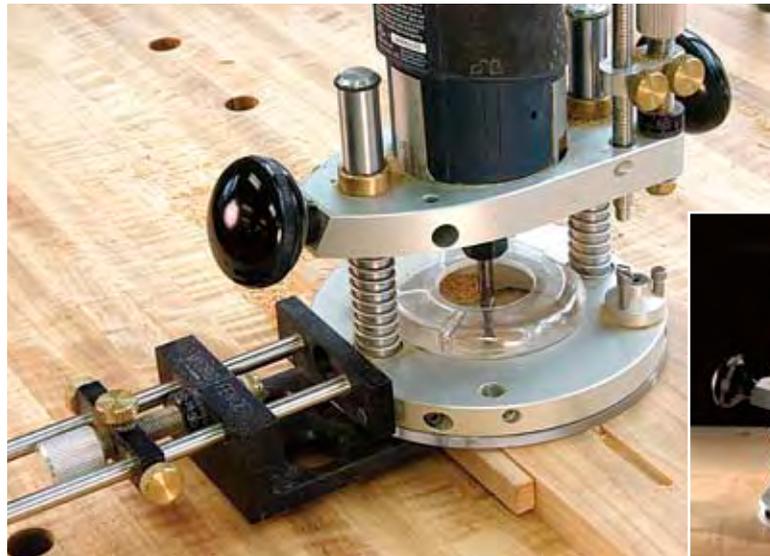
In fact, we think your fixed-base router might get a vacation once the Colt lands in your shop. It has enough power to do any chore that a $\frac{1}{4}$ "-shank bit up to $1\frac{5}{16}$ " in diameter can handle, including hinge mortising and even dovetailing. We tested the variable-speed model, the PR20EVSK (\$111), with speeds

between 16,000 rpm to 35,000 rpm, though there is a single-speed model available, the PR10E (\$94).

Other great features: There's a collet lock for one-wrench bit changes, and the top of the tool is flat so it sits firmly on your bench during bit changes. And the tool's power cord is nice and long. This Colt has earned a permanent stall in our stable.

A Precision Plunge Base

You don't hunt squirrels with an elephant gun, and you don't always need a large plunge router. This router plunge base from Microfence (Three-Axis Mill, \$399.95) is the tool we reach for when precision and visibility are more important than brute power. With a Porter-Cable 310 or Bosch Colt and the Microfence edge guide you can make extremely precise adjustments in



Micro-fine adjustments of the Microfence three-axis mill turn your trim router into a precision cutting instrument. Bring on the inlay.



any direction. (Using a model-specific adapter ring, the base also accommodates the older Bosch 1608; DeWalt 670; and RotoZip, or with an adapter "cup" the base accommodates several high-speed rotary tools including

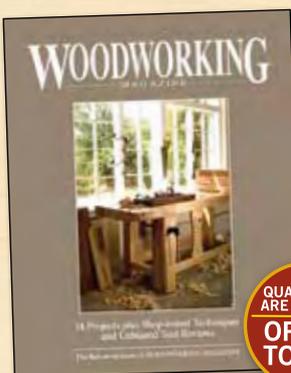
Dremel, Proxxon and Foredom.) Microfence Three-Axis Mill is a joy to use, and is extremely well made. We had so much fun testing this tool we found ourselves looking for any excuse to use it. We've made inch-deep mortises

for face frames, as well as shallow mortises for hinges.

In addition to the precise adjustments and smooth operation, the ability to see what is happening is another feature we've come to appreciate. Used

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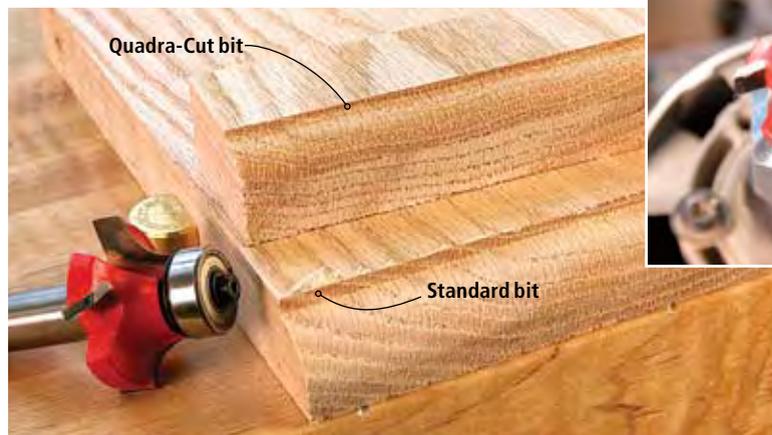
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WHAT'S NEW IN ROUTING

without the edge guide, you can see the bit well enough to waste the background in a carving or between the pins of half-blind dovetails. The small LED light is quite effective, as is the dust collection shroud.

Swiss-watch precision and smooth operation are combined in a package that is easier to compare to fine German sports cars than to other wood-working tools. (800-480-6427 or microfence.com)



The finished cut using Freud's Quadra-Cut router bit is not the least bit fuzzy. The downshear cut is the reason.

New Router Bits Cut Twice as Well

While many router-bit manufacturers have improved their cutters with better carbide and closer manufacturing tolerances, Freud took a leap forward in 2007 with its new Quadra-Cut bits.

As you might have guessed from the product's name, the Quadra-Cut bits have four car-

bide cutters instead of the usual two. The additional cutters are pitched in a different direction. Two of the carbide cutters have an upshear angle to remove most of the stock, then a pair of downshear cutters make a final cut, finishing the profile. The result: These new router bits remove material efficiently and eliminate the fuzzy edges produced

by profile router bits when cutting across the grain.

Freud offers these bits with 1/2" shanks and only in select profiles (20 as of press time). Because of the mass needed for these additional cutter wings, the stronger shank is a requirement. According to Cliff Paddock, director of new product development, "The new Quadra-Cut

bits are an industry first, soon to be the industry leader."

Freud officials say the Quadra-Cuts will cost on average about 10 percent more than the company's two-cutter bits. New profiles are being added to the Quadra-Cut line—we think they're worth waiting for. Check with your current Freud router-bit supplier for profiles and details. **PW**

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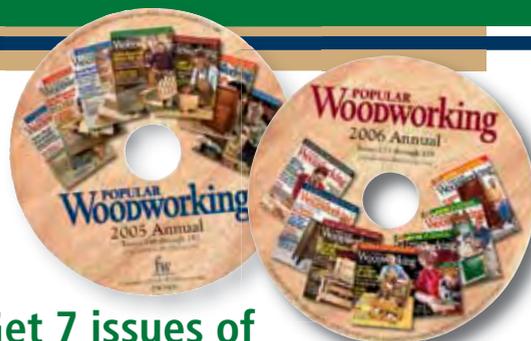
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