


American   
Woodworker

# 10 weekend projects

## menu

- Rolling Pin
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- Contemporary Bookcase
- Keepsake Box
- Tablesaw Picture Frame
- Table Hockey
- Nesting Trays
- Teak Coffee Table
- Sliding Bookrack

# Rolling Pin



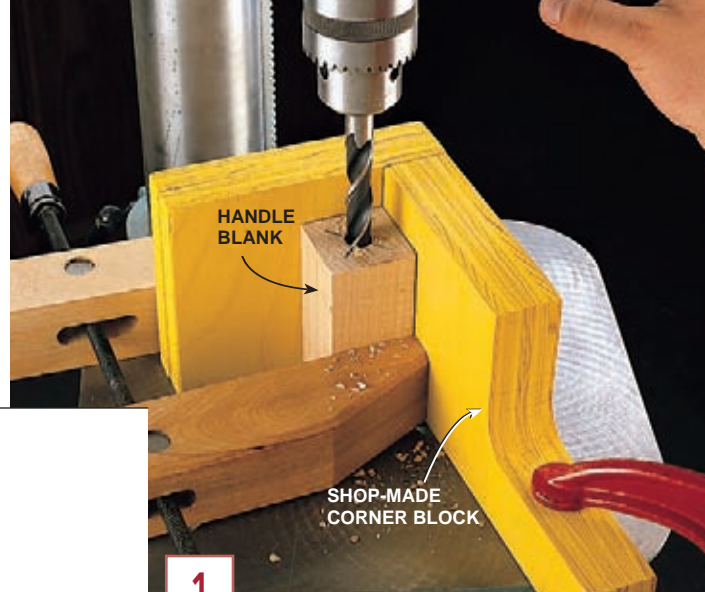
ONCE you get the hang of it, these rolling pins take only a couple of hours to make. The beauty of this project is that only a few tools are required and it offers several challenges, especially turning a true cylinder and drilling and aligning all the parts on the same axis. Follow our photo sequence and make a bunch of these rolling pins—they're great gifts.

## Woodturning

### Wood to Turn

Use “closed-grain” wood—cherry, maple, birch or beech—for the roller so food particles aren’t pushed into the wood pores. Don’t use exotic hardwoods—zebra wood, cocobolo, and others—for the roller because they can be toxic.

For other turned parts, use whatever scrap hardwoods you have around the shop.



1

### DRILL AXLE HOLES

Drill the blanks for handles, caps and one end of the barrel using a shop-made corner block. Drilling the holes before turning ensures that the holes will be centered.

Clamp the pieces firmly in the corner block to ensure the holes are vertical. Drill holes for the axle clamps and one end of the barrel with a 1/2-in. brad-point bit. **It’s crucial that the hole in the large roller is centered and vertical.** Use a 14mm brad-point bit or a 9/16-in. spade bit to drill the 4-in.-long axle hole in the handles.

### Tools and Supplies

Here’s what you’ll need:

- A 1/2-in. spindle gouge, a larger gouge for roughing out the main cylinder and a 1/4-in. parting tool.
- An outside calipers with at least a 3-in. capacity and well-rounded ends with absolutely no sharp edges.
- A 3-1/2-in. dia. disc of pine or poplar, 2- to 3-in. thick for the shop-made cone center.
- A 3-in. faceplate to mount and turn the cone center.
- A ball-bearing live center to hold blanks while turning. It should have a conical tip (see Sources, p. 34).
- A drill press for drilling holes in the blanks, plus a 1/2-in. brad-point bit and either a 14mm brad-point bit or a 9/16-in. spade bit.
- A 1-in. square piece of leather or thick fabric to protect the axle cap from the live center when turning.
- Mineral oil for the finish.

*continued on page 28*



## Woodturning



2

### MAKE THE ROLLER

Mount an 11-in.-long blank between centers on the lathe. Place the end you previously drilled on to the live center of the tailstock. Your driving center should be located on the opposite end of the blank's center.

Turn the blank into a cylinder using a gouge.

*continued on page 30*

## True Cylinders—with some help

With practice you can turn pretty true cylinders by eye and feel but until then, use calipers to help. Set your outside calipers to within 1/16 in. of the

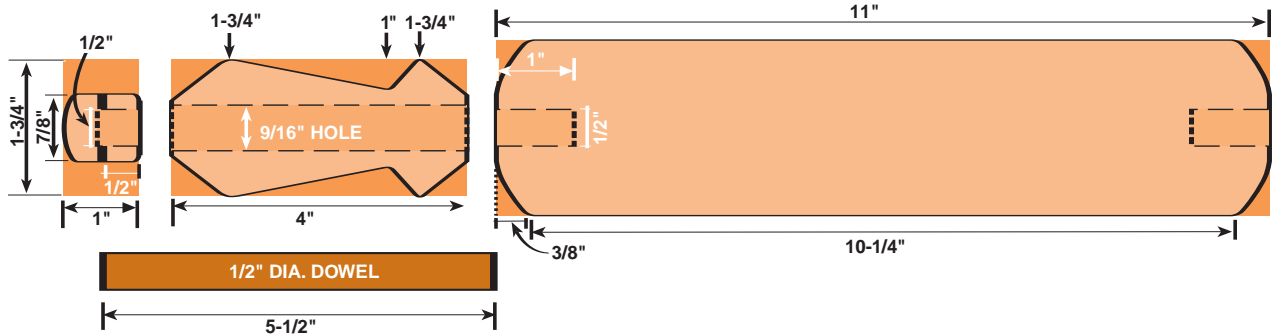


intended diameter of the cylinder. Using the calipers and a parting tool, turn down to the desired diameter at 4 or 5 points along the blank. Next, simply connect these with your roughing gouge to make a cylinder. To turn it by eye, sight along the top horizon—rather than watching the tool. Check your progress with a straightedge and calipers. Soften the corners of the roller using a small gouge. Remove the tool rest and proceed with sanding.

If you still need a little help in leveling the cylinder, try sanding with 80-grit paper over a back-up block at least 4-in. in length. After sanding with the lathe in motion, it often helps to remove “ringing” by sanding with the lathe off, but with the grain. This is especially helpful for the final sanding with 150-grit paper.



# Woodturning

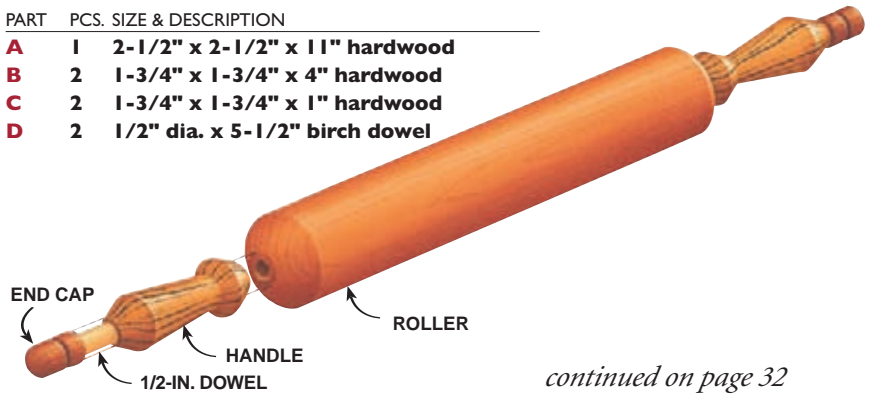


## SHOPPING LIST

ITEM	QUANTITY
2-1/2" x 2-1/2" x 12" hardwood (maple, cherry, birch or beech)	1
1-1/2" x 1-1/2" x 10" hardwood	1
1-1/2" x 1-1/2" x 4" hardwood	1
1/2" x 36" hardwood dowel	1
3-1/2" dia. disc, 2" to 3" thick	1
3/4" standard wood screws	4
14mm brad-point bit or 9/16" spade bit	1
1/2" brad-point bit	1
sandpaper (80-, 100-, 120-, 150-grit)	3 sheets
mineral oil	6 oz.

## CUTTING LIST

PART	PCS.	SIZE & DESCRIPTION
A	1	2-1/2" x 2-1/2" x 11" hardwood
B	2	1-3/4" x 1-3/4" x 4" hardwood
C	2	1-3/4" x 1-3/4" x 1" hardwood
D	2	1/2" dia. x 5-1/2" birch dowel



*continued on page 32*

## Woodturning



3

### MAKE A CONE CENTER

Turn a 2- to 3-in. thick, 3-1/2-in.-dia. disc of pine, poplar or other soft material into a cone to help hold the drilled handle parts. The exact angle of the cone isn't critical—between 60 and 80 degrees will work fine. To make the cone center, screw the disc onto a 3-in. faceplate using screws that penetrate the wood between 1/2 to 3/4 in.—try standard wood screws or better yet, #10 or #12 sheet metal screws. Turn the disc to a triangular point. Turn it like a bowl, moving the tool from the point of the cone towards the faceplate.



4

### MAKE THE HANDLES

Turn one handle holding it between your cone center and a conical live center. If the handle stops spinning while you're turning, crank the live center into the wood and take lighter passes with the gouge.

Use the handle you just turned as a pattern and turn a duplicate. Hold a pencil on the tool rest, as shown, to transfer high and low spots of the shape to the spinning wood. You may want to use your outside calipers to do a more exact sizing of the second handle to the first. Carefully sand both handles.

*continued on page 34*

## Woodturning

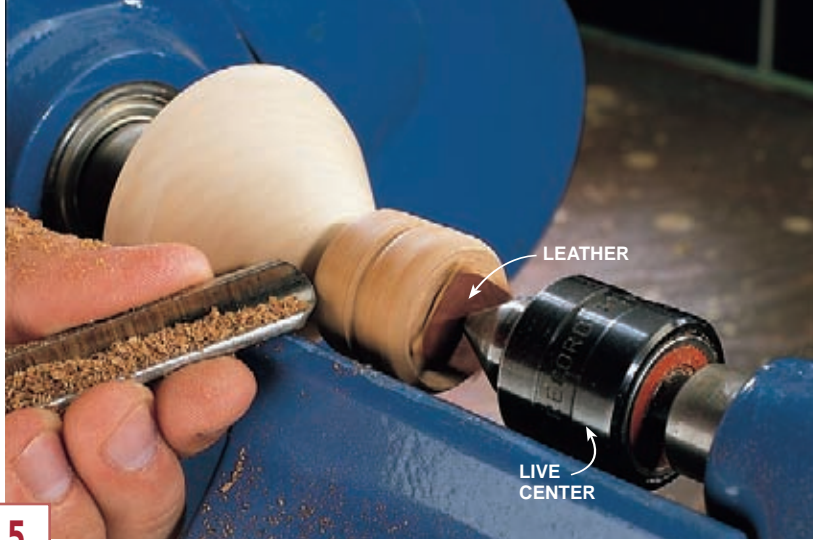
### SOURCES

#### CRAFT SUPPLIES

1287 E. 1120th St., Provo, UT  
84601; (800) 551-8876.  
Metal cone-tipped live center.

#### WOODCRAFT SUPPLY

210 Wood County Industrial Park,  
P.O. Box 1686,  
Parkersburg, WV 26102-1686;  
(800) 535-4482.  
14 mm brad-point bit, 11Y91, \$6  
1/2" brad-point bit, 12B18, \$6



5

### MAKE THE AXLE CAP

Mount the cap blank in the lathe between the wood cone and the live center. A piece of leather or thick fabric will keep the metal center from scarring the end of the cap. Turn the cap with rounded ends and a shallow, decorative groove made by rolling the gouge's cutting edge to make a slicing, semi-vertical cut.

6

### FINAL ASSEMBLY

When you're finished turning and sanding, return the roller to the corner block jig on the drill press and drill the 1/2-in. hole on the other end. Use the hole from your drive center to pilot the point of the brad-point bit. Glue the dowels into the roller, slide the handles over the dowels and glue the axle caps on the ends. Finish the whole thing with mineral oil and wax. **AW**





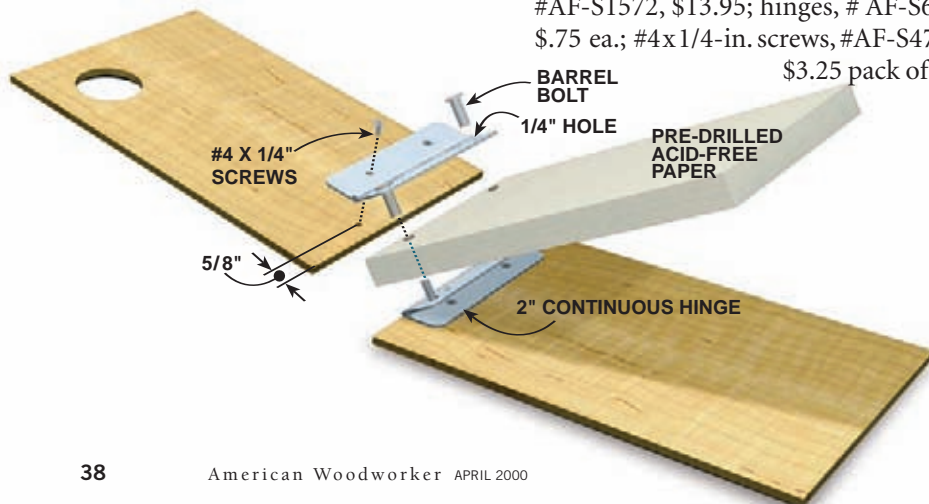
# Photo Album

Do you have a pile of photos waiting to be put in an album? We all do. That's why you can't go wrong making these distinctive photo albums for yourself or as gifts.

Figured wood makes an attractive cover. The first album in the photo was made from a 3 in. x 20 in. piece of tiger maple and the second from a single 6 in. x 10 in. piece of walnut. You can make larger covers (12-1/2 in. x 12-1/2 in.), but they are more likely to

warp. The walnut was resawn to make front and back covers. The maple was resawn and glued up to create book-matched covers.

The 9-1/4 in. x 5 in. acid-free paper pages come pre-drilled and are available from Anchor Paper, (800) 659-2127, #ZR301-213, \$6.50 plus s&h for 25 pages. The 2 in. x 24 in. continuous hinge and the brass barrel bolt connectors and screws are available from Van Dyke's Restorers, (800) 558-1234; barrel bolts, #AF-S1572, \$13.95; hinges, # AF-S6167, \$.75 ea.; #4x1/4-in. screws, #AF-S4739F, \$3.25 pack of 100.



## How To Make It

- 1.** Surface the covers to about 1/4 in. and chamfer the outside edges. (Optional: Use a 1-1/2-in. hole saw to cut a circular frame in the cover.)
- 2.** Sand and finish. We used a sealer coat of Super Blonde Shellac followed by two coats of water-borne polyurethane.
- 3.** Cut two 4-in. lengths of hinge (two 11-in. lengths for 12-1/2 in. x 12-1/2 in. covers) for each album and file a radius on the corners.
- 4.** Use the pre-drilled paper as a template to drill two 1/4-in. holes in one leaf of each hinge. File any rough edges smooth.
- 5.** Drill two 5/64-in. pilot holes 5/8-in. in from the back edge of each cover. Mount the hinges to the cover with #4 screws. (Nip off the ends of the screws if your covers are 1/4-in. thick or less.)
- 6.** Bolt the loose leaves of the hinges through the paper with the barrel bolts; add photos and enjoy.

By Dave Munkittrick

# Cantilevered Display Shelves

Strong, glueless joints support these elegant, cantilevered shelves.

**W**hatever you collect—rocks, porcelain, folk art or photos of your Schnauzer—it'll get the attention it deserves when displayed on these shelves. The simple design is wide open at the front and sides so nothing interferes with what's on display. The stepped-back shelves allow ambient light to flood each shelf.

If you're thinking of making some gifts for the holidays, consider these shelves. It's almost as easy to make a dozen as it is to make one. Best of all, these shelves knock down to five easy pieces and six little screws that can be boxed up and shipped to anyone on your list. If you're like me, building these shelves is a lot easier than writing a holiday letter!

## These shelves are:

- sturdy
- lightweight
- easily knocked-down for shipping
- fun to make
- easy to mass produce.

All the curves and tapers make the shelves look tricky to build. But, the joinery is simplified by making all the cuts on square stock before any of the curves and tapers are added. Most of the shaping is done on the bandsaw and tablesaw, followed by a little handwork

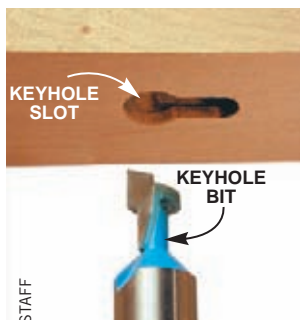
with a plane or power sander.

The shelves are locked into the supports with bridle joints. The bridle joints consist of dados that wrap around three sides of the support. Notches are then cut into the back of each shelf to fit the dados (Fig. B). The result is a strong, glueless joint that supports the shelf only at the back.

You'll need a planer, bandsaw, router, drill, belt sander or hand plane and a dado set for your tablesaw. Materials will run anywhere from \$25 in pine to \$125 in finer hardwoods, such as the figured maple we used here. You'll need about 7 bd. ft. of 4/4 stock for the shelves (this may be the perfect opportunity to use that beautiful board you've been saving for years!) and about 5 bd. ft. of 8/4 stock for the supports.

Start your shelves by cutting your stock according to the Cutting List on page 87. Machine the supports first (Photos 1 through 4) then fit and shape your shelves (Photos 5 through 11). Sand the completed shelves to about 220 grit.

For an easy-to-apply, durable finish we used a wipe-on polyurethane (see Sources, page 89). It goes on like any oil finish but dries fast and hard. For extra protection, apply a coat of paste wax after the oil dries.



Keyhole slots are a great way to hang shelves like this on a wall. They're strong, easy to make and the clean lines of the shelves are not disrupted by visible fasteners. Best of all, they don't require buying or fitting any hardware. But, you'll need a specially designed keyhole router bit to cut the slots (see Sources, page 89).

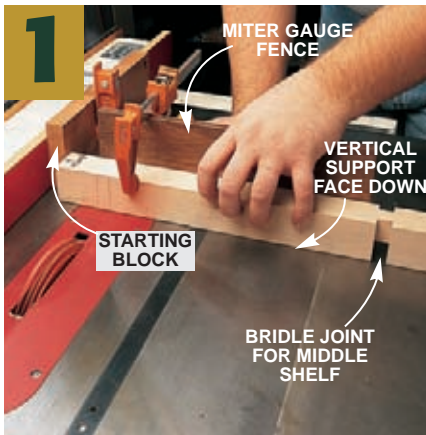
Keyhole slots are designed to fit over the head of a screw that's been fastened to the wall. The slot captures the screw head, holding the object securely to the wall.







# Make the Supports

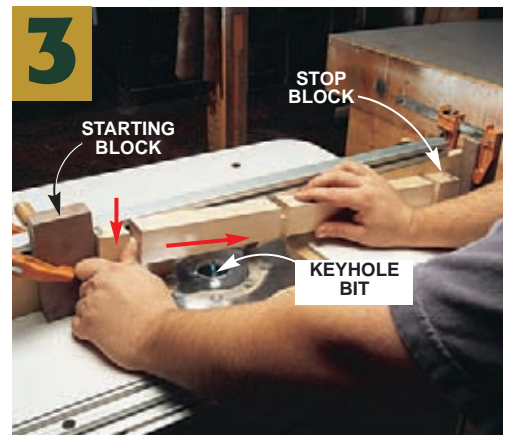


**1** Cut the deep dado on the front side of the support using a long miter gauge fence and a starting block. This is the first step in creating the bridge joint that locks the shelf onto the supports.

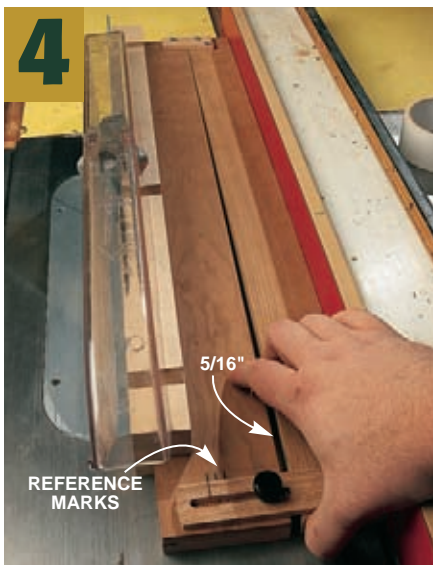
The blade guard must be removed for this cut. **Be careful.**



**2** Cut the two shallow dados on the sides of the supports after slipping a 3/8-in. spacer board under the workpiece. You must cut all the dados for each shelf before moving on to the next. That way you keep the same fence and blade setting for each cut, which guarantees perfect alignment of the dados on all three sides of the support.



**3** Cut a keyhole slot on the back of the supports using your router table and a keyhole bit (see Sources, page 89). Brace the top of the support against a starting block and lower the vertical support onto the keyhole bit until it rests flat on your router table. Slide the support forward against the stop block to finish the cut.

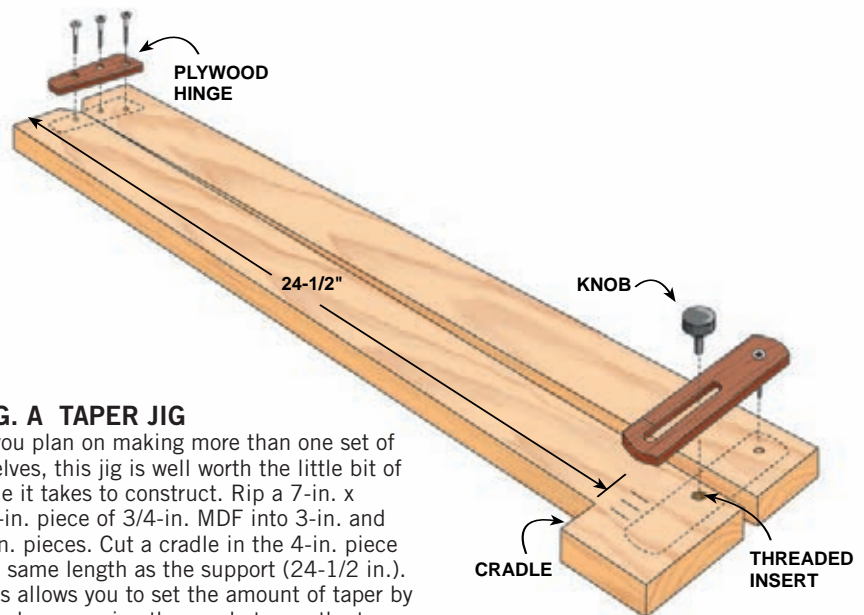


**4** Cut the tapers on the supports with a shop-made jig (Fig. A), or on a bandsaw. Taper the sides first.

- Set a 5/16-in. gap between the two halves of the taper jig for the first side cut.
- Set the gap at 5/8 in. for the second side cut.
- Move the fence 1/4-in. further away from the blade, set the gap at 3/4 in. and cut the front taper.
- Mark each setting on the jig for future reference.

## Tip

Mark the top, bottom and face of each support. It's easy to get disoriented machining the stock when it's square (see Oops!, page 88).



**FIG. A TAPER JIG**

If you plan on making more than one set of shelves, this jig is well worth the little bit of time it takes to construct. Rip a 7-in. x 30-in. piece of 3/4-in. MDF into 3-in. and 4-in. pieces. Cut a cradle in the 4-in. piece the same length as the support (24-1/2 in.). This allows you to set the amount of taper by simply measuring the gap between the two halves of the jig. Use 1/4-in. plywood to make the hinge and slide. Add a knob and a threaded insert to secure the slide (see Sources, page 89).

Cut all the joints while the stock is square, then add the curves and tapers.

FIG. B EXPLODED VIEW

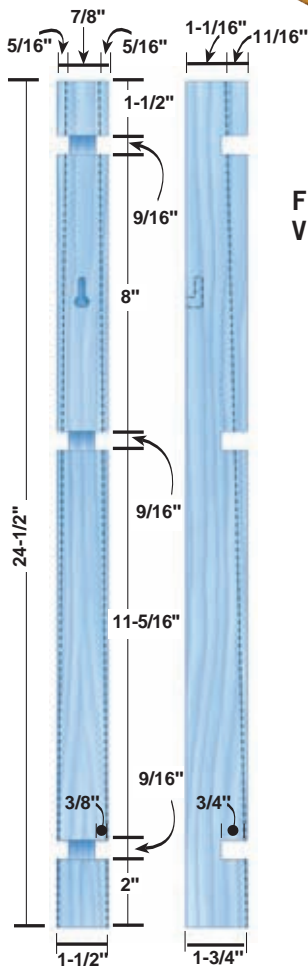
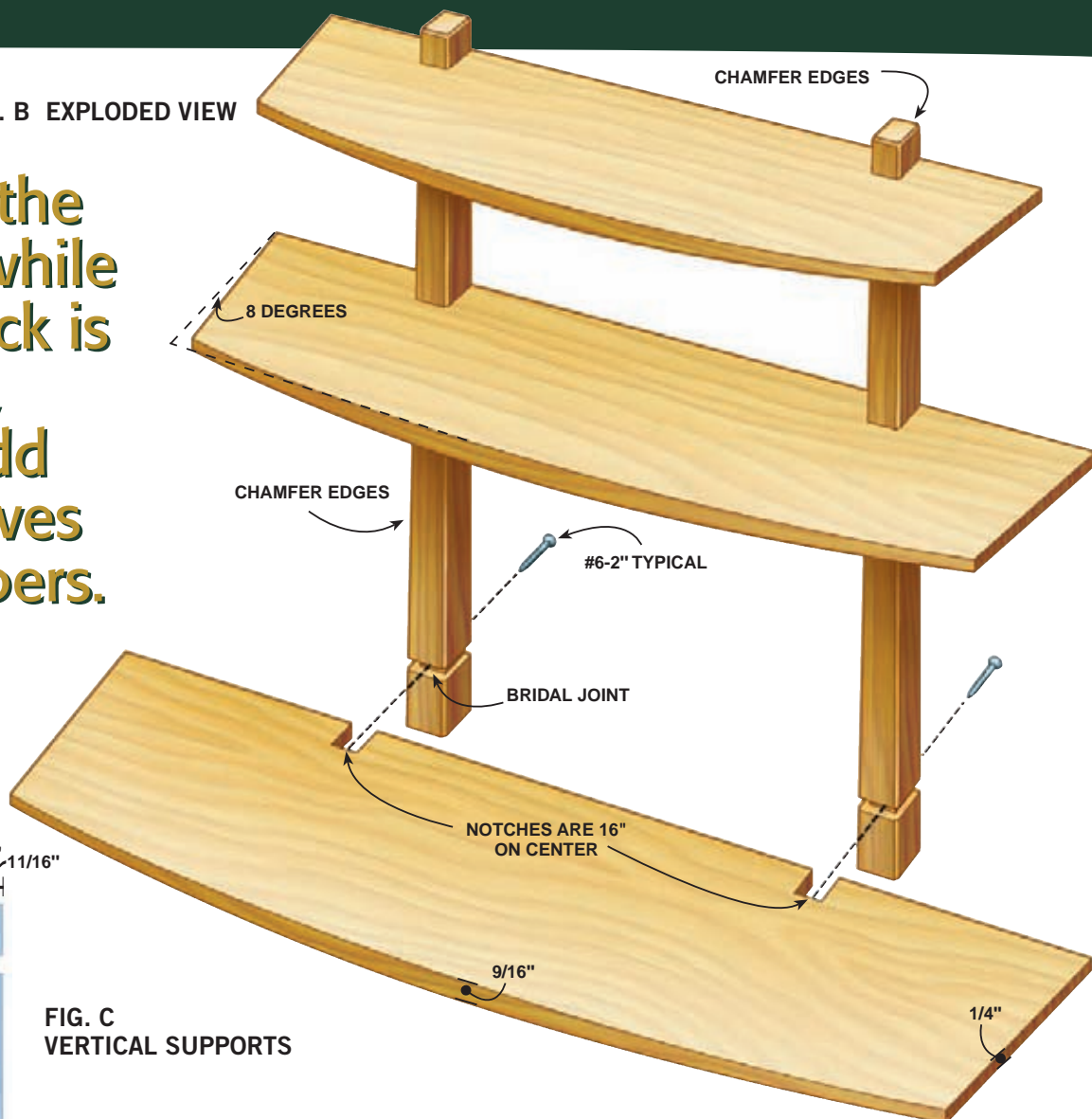


FIG. C VERTICAL SUPPORTS

### CUTTING LIST

Overall Dimensions: 24-1/2" H x 36" W x 8" D

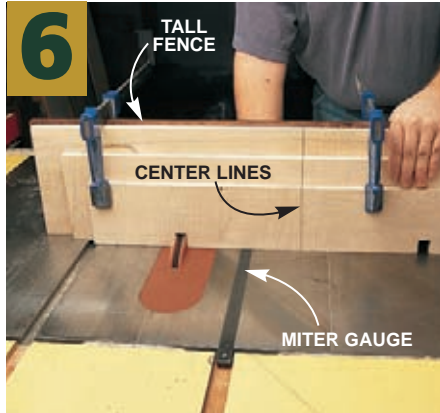
Part	Name	Qty.	Dimensions	Material
A	vertical supports	2	1-1/2" x 1-3/4" x 24-1/2"	8/4 hard or soft maple
B	bottom shelf	1	9/16" x 8" x 36"	4/4 figured soft maple
C	middle shelf	1	9/16" x 6-1/4" x 31-3/4"	4/4 figured soft maple
D	upper shelf	1	9/16" x 4-1/2" x 28-1/4"	4/4 figured soft maple



# Make the Shelves



**5** **Plane the shelf stock** to fit the dados in the supports. Use some scrap to determine the proper planer setting. Try for a slightly tight fit to allow for sanding.



**6** **Cut the notches in all the shelves at once.** First, make test cuts on scrap to determine the proper width and height settings for the dado blade. Mark the center of each shelf and lay out the notches on the small shelf. Align the shelves in a stack held together with double-faced tape. Clamp the stack to a tall fence fastened to your miter gauge and make your first cut. Reposition the stack, clamp and make the second cut.

The blade guard must be removed for this cut. **Be careful.**

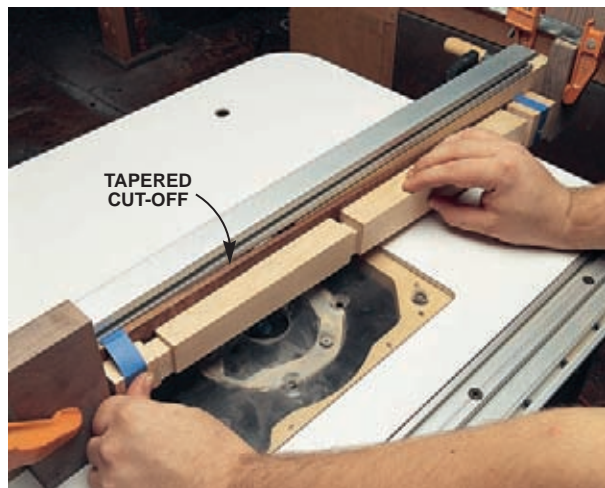


**7** **Drill and countersink pilot holes** for the screws after dry fitting the shelves.

## Oops!

Oh man, what a moron! I cut the keyhole slots at the *bottom* of the supports instead of the top. Now what do I do?

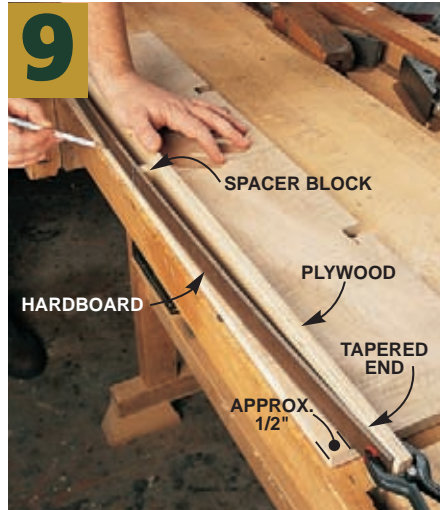
The slots are normally cut when the supports are still square, but now they're tapered. If I cut new slots with the tapered sides I'll end up with angled slots. Fortunately, the solution was sitting right in my scrap bin. I fished out a cut-off leftover from tapering the supports and taped it back in place. That gave me the square edge I needed to reference against the fence. Then I cut the slots where they belong, at the top. Maybe I'm not such a moron after all!







**8** **Taper the ends of each shelf** on the bandsaw. You want to remove a 1/4-in.-thick wedge that ends about 1-1/2 in. from the notch. Use a block of wood as a guide to keep the shelf perpendicular to the table. Stick the block to the shelf with double-faced tape.



**9** **Lay out the curve on the front edge** of each shelf. Clamp a 1/4-in. hardboard strip on the ends of a 40-in.-long piece of wood or plywood and add a 3/4-in. spacer block in the middle. Taper the ends of the plywood to create a fair curve. Cut the curve on the bandsaw.

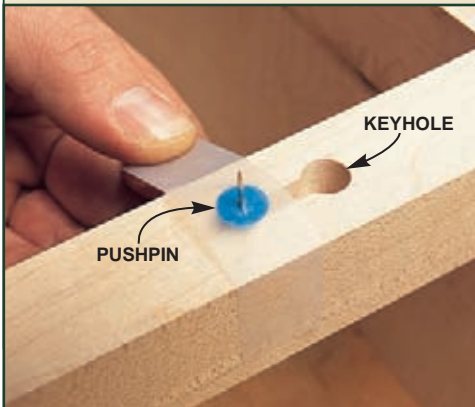


**10** **Cut an 8-degree angle on the shelf ends** using a miter gauge on the tablesaw.

## Tip

### Installation

Keyhole hangers are about as strong a wall-mounting system as you can get. But getting two screws spaced perfectly on your wall, without leaving multiple puncture wounds, can drive a grown man to tears. After the scars of my first attempt healed (on my ego as well as the wall), I came up with a solution. Take two of those little plastic pushpins for bulletin boards and slide them into the keyholes. Hold them in place with a little tape. Set a small level on the shelf. Position the shelf on the wall, check for level, and push. Voila! The pins mark the exact spot. Hanging the shelves just became a no-brainer. *AW*



**11** **Shape the bottom taper** (grid area) with a hand plane or power sander. The object is to create an even 1/4-in. thickness across the ends and a sweeping curve on the front of the shelf (Fig. B). Take care not to remove any material around the notch or you'll ruin the fit of the shelf to the support.

### Sources

McFeely's  
(800) 443-7937  
www.mcfeelys.com  
Keyhole bit, #10.24.15; \$15  
Threaded insert for jig, #3004-EZ  
1/4 in. - 20; \$8/25 pack  
Three-point knob, #JK-0429,  
1/4 in. - 20; \$1.

Highland Hardware  
(800) 241-6748  
www.highlandhardware.com  
Double-faced tape, #10.01.51,  
3/4 in. x 36 yards; \$10  
1 qt. satin wipe-on poly, #19.31.04;  
\$11  
1 lb. Briwax clear, #19.49.70; \$15.

MacBeath Hardwood  
(800) 479-9907  
www.macbeath.com  
Hard maple support blanks, 1-3/4 in.  
x 1-3/4 in. x 36 in.; \$11 each  
Figured soft-maple stock, \$6/bd. ft.  
for regular grade to \$15/bd. ft. for  
AAAA.

# CONTEMPORARY BOOKCASE

The credo of many great 20th-century architects was "Form Follows Function." And for this bookcase, it certainly does. The strong shelves are supported in a straightforward fashion by equally strong uprights. No decoration, no superfluous details, not even a back to mar its perfect geometry.

For you, the woodworker, this bookcase has beauty of a different kind. The joinery is amazingly simple: Long threaded rods are concealed inside the pieces and tie the whole bookcase together. There are no angles to cut, no mortises, no traditional joinery of any kind. And finishing is a breeze because all the parts are finished separately before they're put together. You can buy all of the wood and hardware at a home center for less than \$200.

For tools you'll need a tablesaw, dado blade, jigsaw, sliding miter saw, planer, jointer, drill press, hand drill, router and router table. If you don't have a sliding miter saw for the wide crosscuts (Photo 11) use a tablesaw sled instead. See AW #75, page 38 for information on building a tablesaw sled.

*Fresh, clean lines,  
simple, strong  
construction, and a  
design you can modify  
to fit any room.*

BY RANDY JOHNSON



Follow the photos for construction details.





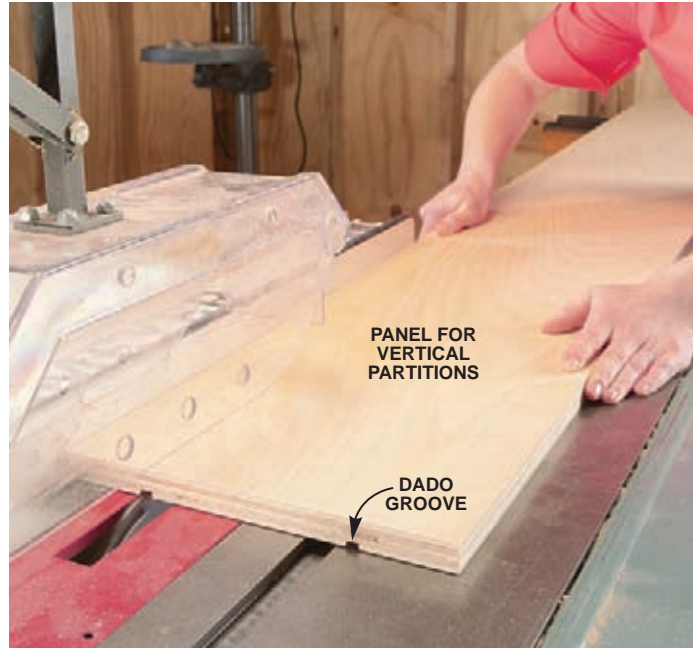


# LAMINATE THE PLYWOOD

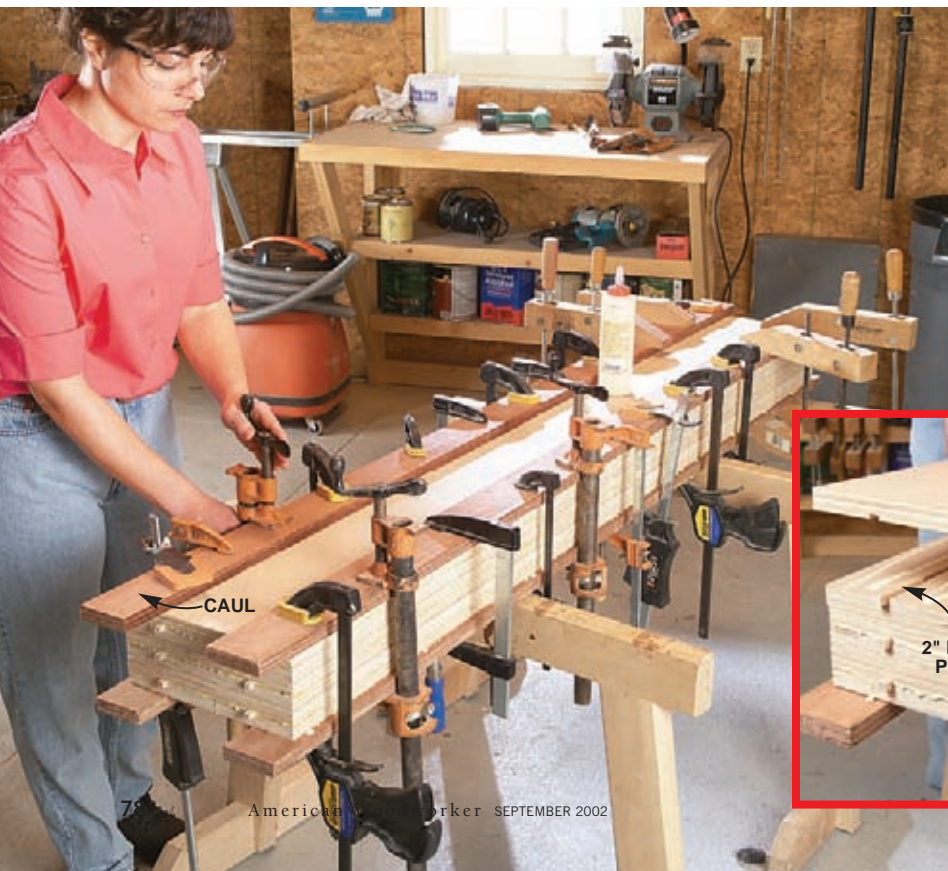
The backbone of this bookcase is the laminated plywood parts. They make it strong and stiff and give it the look of solid wood. The laminations also provide an easy hiding place for the threaded rods that hold the parts together.



**1** Cut all the plywood parts oversize. Leave the plywood for the vertical partitions (parts L, M and R) as long panels. The individual vertical partitions are cut to final width and length later. Add 1/2 in. to the width and length of the shelves (parts A) which are also cut to final size later.



**2** Make room for the threaded rods that hold the parts together by dadoing grooves into the backside of the vertical partition panels (parts L, M and R). See Fig. B for the placement of these grooves. When the panels are sandwiched together, these grooves create the holes for the threaded rods.

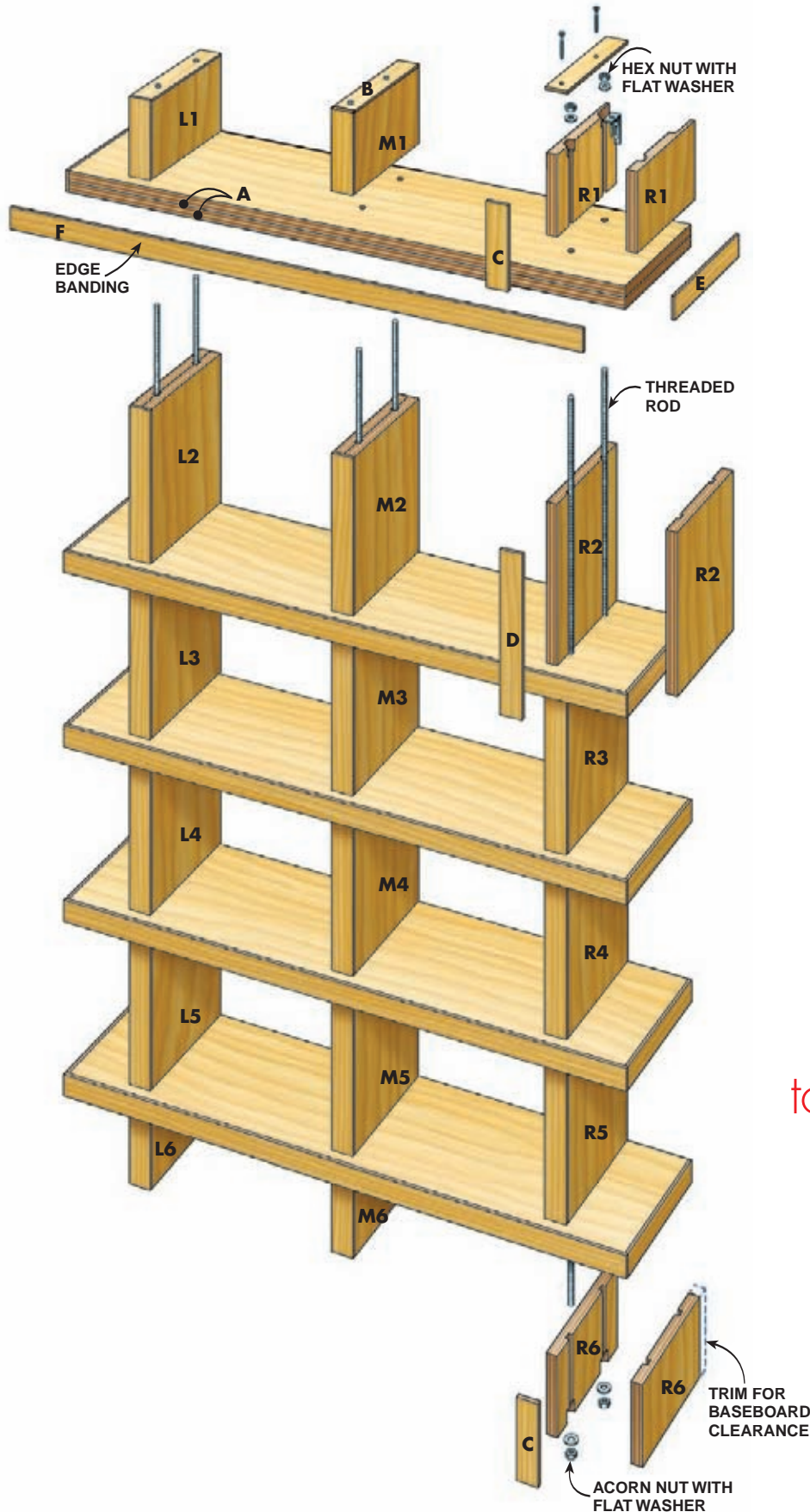


**3** Glue together the panel halves for the vertical partitions (parts L, M and R). We glued up all three pairs at once to help keep them flat. This is a big glue up, so use a slow-drying glue (see Sources, page 108). Use 5/16-in.-square wood pegs at both ends to keep the panels aligned. The pegs get drilled out later. Use clamping cauls to protect your plywood. If you don't have enough clamps, you can precut your panels in half and glue them up as shorter sections. (Use square alignment pegs in both ends of these shorter panels, too.)



This is also the time to glue and clamp the plywood for the shelves (parts A).

**Fig. A** Exploded View of Bookcase



**A STRONG,  
SIMPLE DESIGN  
WITH LOTS OF  
POSSIBILITIES**

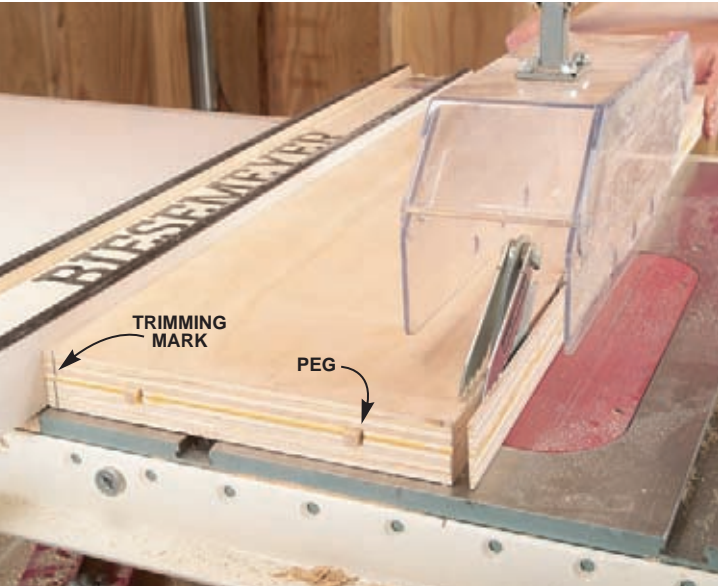
This bookcase is extremely strong and sturdy, thanks to double-layered plywood construction and hidden threaded assembly rods. This knockdown, modular design can easily be modified so you can make a bookcase to fit any room in your house.

Individual labels on all the parts make it easy to rematch the wood grain during final assembly.



# MARK AND CUT THE PARTS

Carefully mark and label the individual vertical partition parts. We used a special labeling system that makes it easy to rematch the grain during final assembly.

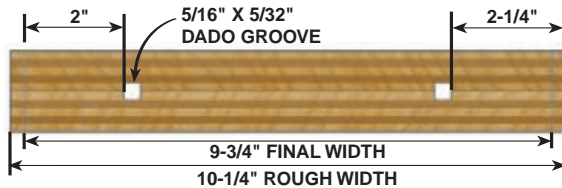


**4** Trim the glued-up panels to final width. Measure and cut carefully so the holes are equally spaced from each trimmed edge (Fig. B). Scrape off any glue drips from the plywood edges before cutting to prevent the drips from hanging-up on the saw fence. Also, this is the time to trim the plywood shelves to final width.

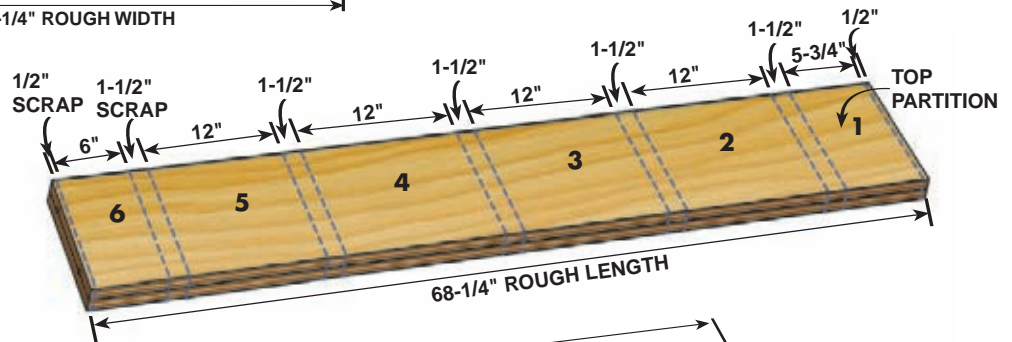


**5** Label the individual vertical partitions (parts L, M and R) on the long panels. The markings help you rematch the grain during final assembly. Use the letters L, M and R for left, middle and right and number from the top down. The double lines represent the location of the shelves and will be cut away when the sections are sawn apart.

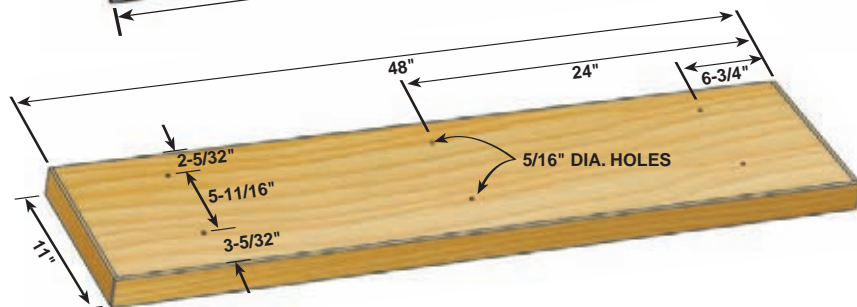
**Fig. B** End View of Vertical Partitions



**Fig. C** Layout for Vertical Partition Panels

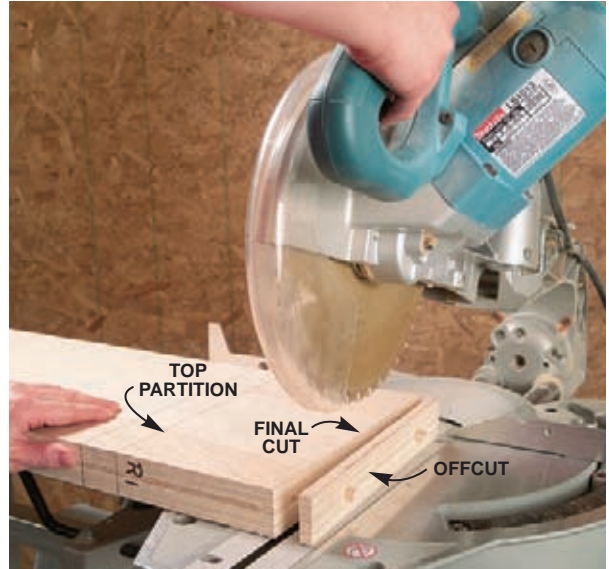


**Fig. D** Drilling Layout for Shelves



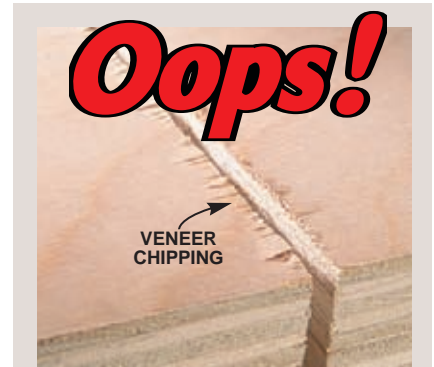
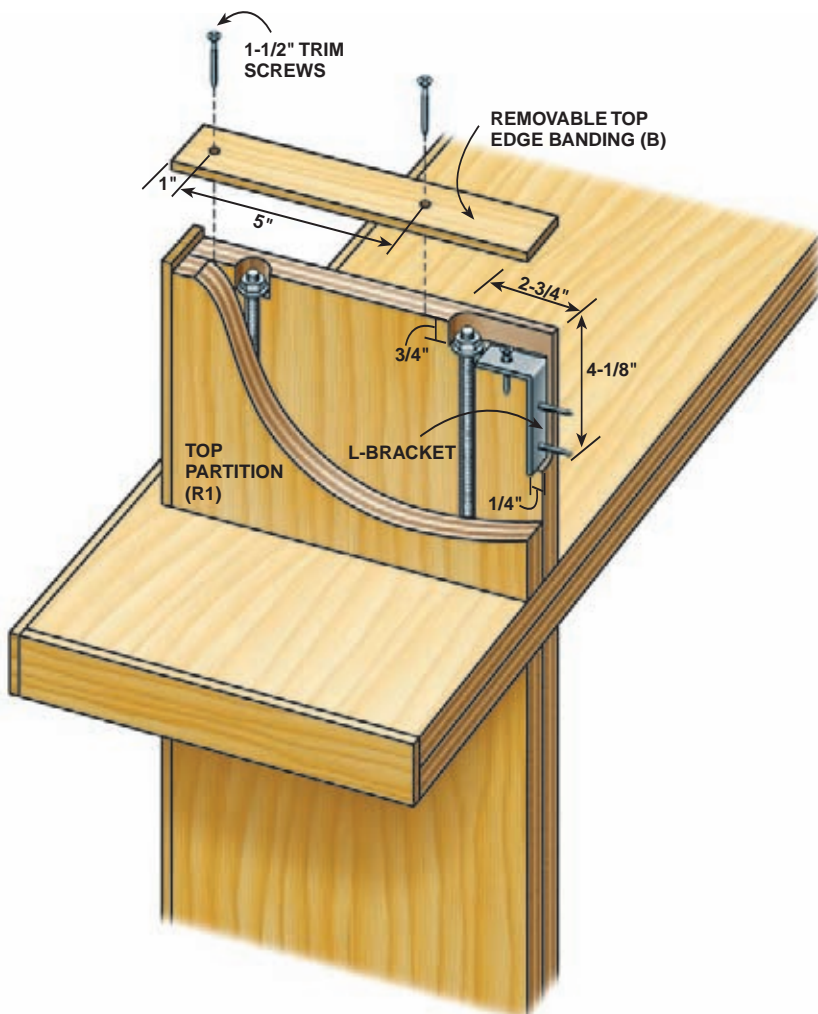


**6** Rough cut the long panels into two parts so they're easier to handle and edge band. Use spacer blocks to provide clearance for your jigsaw blade. Your sliding miter saw would also work for this rough cutting.

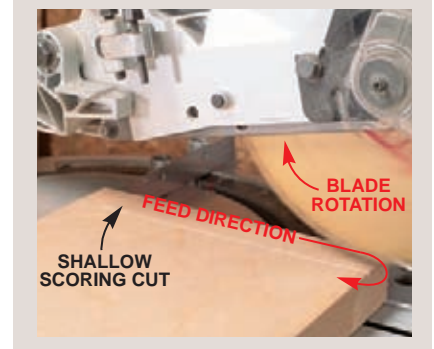


**7** Trim the top end of the vertical partitions to final length (parts LI, MI and RI). Cut the glued-up shelf panels (parts A) to final length at this time also. A sliding miter saw is a great tool for this job because it's quick and accurate. Prescore the plywood to reduce veneer chipping (see Oops!, below).

**Fig. E** Cut-Away Detail of Top Partition



Don't let chipped plywood veneer ruin a good day in the shop. Take preemptive action by prescoring the top side of your plywood. Make the scoring cut about 1/8-in. deep on the pull stroke and then, with a return push stroke, complete the crosscut. This reduces or eliminates most veneer chipping.



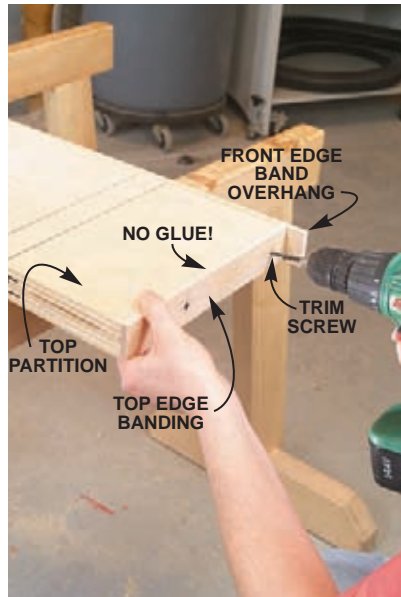


# EDGE BAND THE PLYWOOD

Edge banding covers the edges of plywood and makes the panels look almost like solid-wood planks. Make the 1/4-in.-thick edge banding by resawing 3/4-in. thick by 1-3/4-in.-wide lumber in half. Remove the saw marks and reduce the stock to 1/4-in. thickness with a planer.



**8** Edge band the fronts of all the partition-panel sections (parts L, M and R). Overhang the edge banding about 1-in. beyond the top end of parts LI, MI and RI. This overhang is trimmed after the next step. Use a caul to protect the edge banding and spread out the clamping pressure.



**9** Attach the top edge banding (part B, Fig. E) with two small trim screws (see Sources, page 108). DO NOT GLUE. Then trim the overhanging front edge banding flush, using a handsaw.

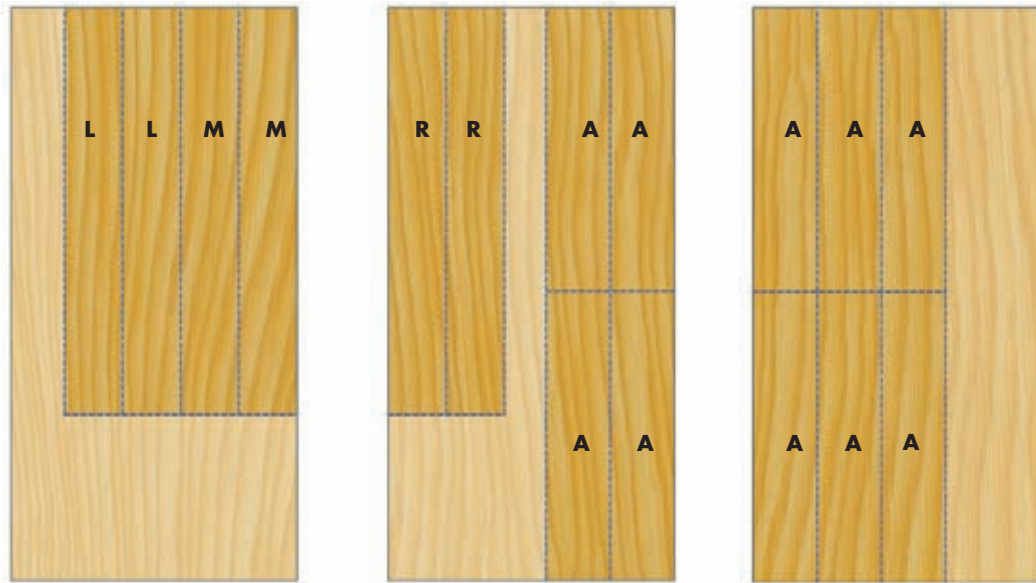


**10** Flush trim the front and top edge banding on the vertical partitions (parts L, M and R).



**11** Crosscut all the vertical partitions (parts L, M and R) to final length.

**Fig. F** Plywood Layout



# Make it Big or make it Small

**W**ant to fill your whole wall (even around a window!) with enough storage for a whole library? You can do that!

The shelves of our bookcase can easily be made longer than 8 ft. by staggering the plywood pieces when you glue them together. If you measure carefully you'll even be able to hide the joints under the vertical partitions. Use a biscuit joint below the window openings to keep the vertical partitions lined up.

Need a small bookcase? No problem. You can make this bookcase smaller, too. You can even edge band both sides of the shelves and use the unit as a room divider. Just be sure to fasten it to the floor.

You can also make it low, with a piece of glass on the top for a contemporary sofa table. For a low design, skip the trim screws in the top edge banding (parts B) and just glue it on. When it comes time to assemble, epoxy the



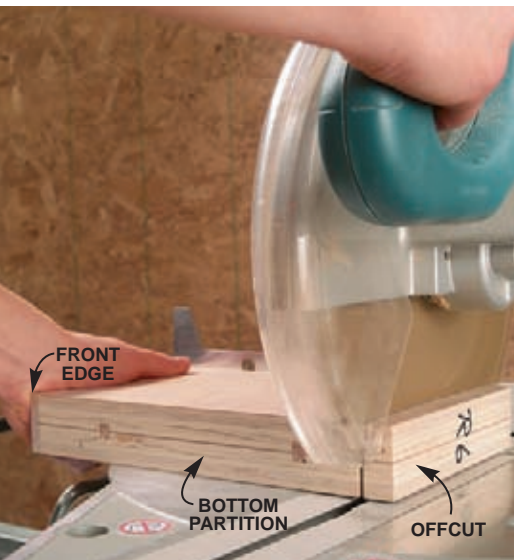
threaded rods into the square holes in the bottom of the top partitions. Then assemble and fasten the parts together,

from the bottom, with regular hex nuts.

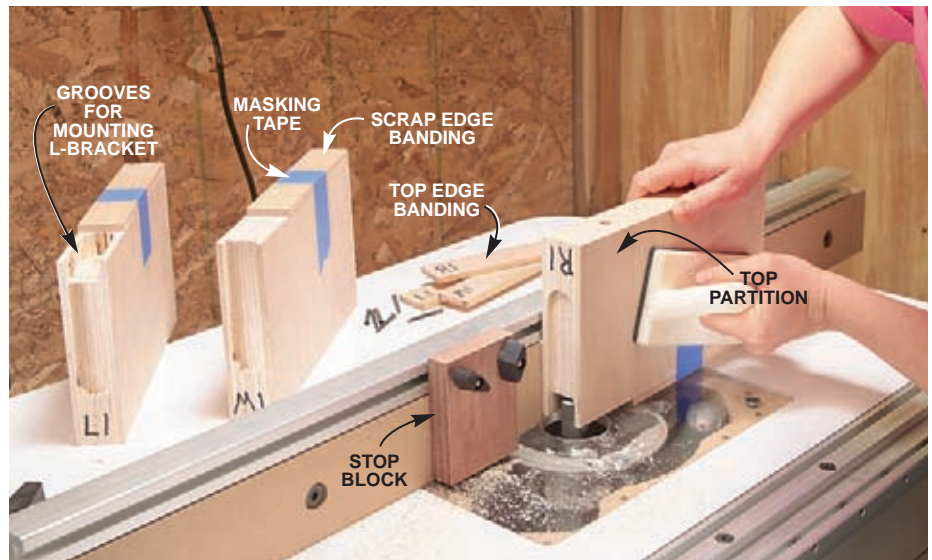


# ROUT, DRILL AND ASSEMBLE

Use your router to cut the grooves that house the hidden assembly and mounting hardware. Then counterbore for the nuts and washers, and drill the shelves for threaded rods. Assembly is a breeze—just slip the parts together and tighten the nuts.



**12** Trim off  $\frac{3}{4}$  in. of the back edge of the bottom partitions (parts L6, M6 and R6). This provides clearance for your wall's baseboard so the bookcase stands flush against the wall. Make sure to re-label the backs of the bottom partitions (L6, M6 and R6) with their location markings.



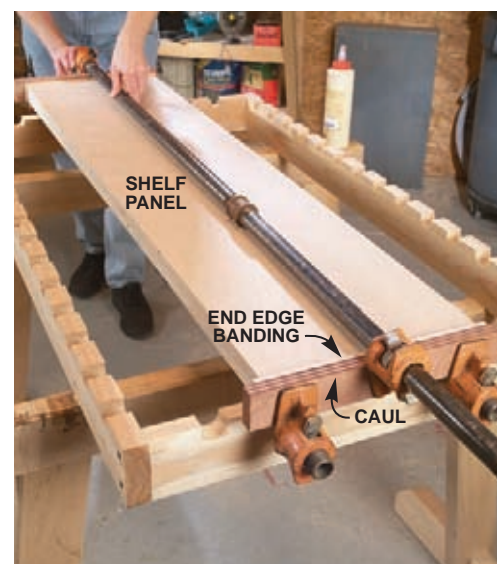
**13** Rout the grooves for the wall-mounting brackets into the top partitions (parts L1, M1 and R1, see Fig. E for details). First remove the top edge banding strips (parts B) and replace them with short pieces of scrap edge banding. These temporary pieces are needed as spacers because the front edge banding overhangs the top edge. They are left short so they don't interfere when routing the groove. Use a 1-in.-diameter straight bit for the routing. Cut the deeper top groove in two or three passes.



**14** Drill holes for the assembly nuts and washers. Drill into the center of the square wood pegs that are glued into the panels. Only the top and bottom partitions (parts L, M and R) receive these large holes.



**15** Ream out the square holes in all of the vertical partitions (parts L, M and R) with a long drill bit (see Sources, page 108). This removes any dried glue, wood splinters and remaining wood pegs.

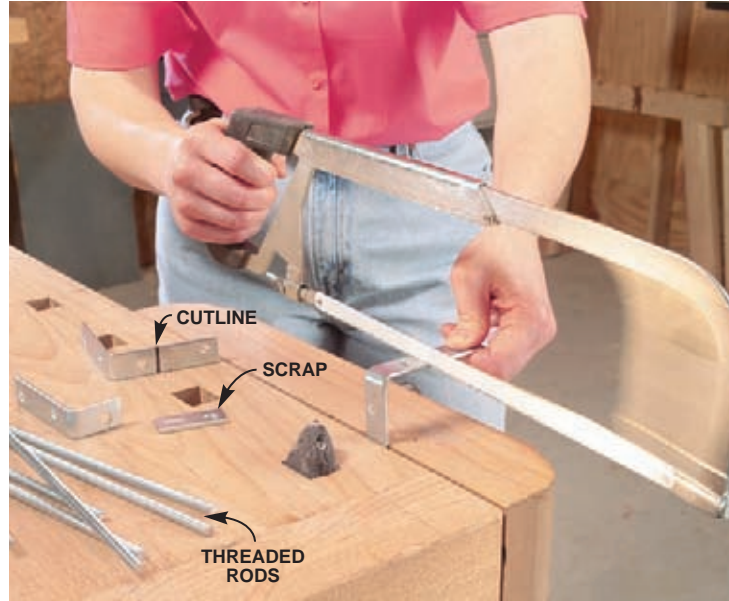


**16** Edge band the shelves (parts A). Start with the ends (parts E) and then add the front edge banding (parts F). Trim any overhanging edge banding with a handsaw and flush trim the long edges with a flush-trim bit in your router.



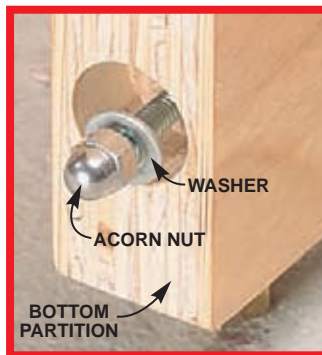


**17 Drill holes for the threaded rods in the shelves.** Lay out these holes carefully and use a drill press to ensure that the holes go straight through the shelves. See Fig. D for the layout dimensions. After all the parts for the bookcase are fabricated, do a final sanding. Then apply a clear finish of your choice. Finishing prior to final assembly is a lot easier than brushing or spraying all those inside corners once the bookcase is put together.



**18 Saw the mounting L-bracket and threaded rods to length.** The length of the short leg on the mounting angle is not critical, just cut it off about 1/4-in. beyond the first hole.

**19 Assemble the prefinished bookcase on the floor.** Lay the parts on their backs and slide them onto the threaded rods. Start with the bottom partitions and shelves and work your way to the top. The acorn nut at the bottom acts as a bolt head and makes tightening a lot easier. After sliding all the parts together, put a regular hex nut and washer on the top end. Lightly tighten the parts using a socket wrench at each end. The vertical partitions should self-align, but if you notice one that's slightly out of alignment, give it a little bump until it's lined up. When everything is perfectly aligned, do a final tightening.



# ANCHOR IT TO THE WALL

It's important to anchor this bookcase (like all tall bookcases) to the wall. Bookcases tend to be unstable, and adding books and such can make the situation even worse. Once an unanchored bookcase starts to fall, there's little stopping it. Always anchor bookcases and other tall furniture to the wall, especially if small children are around.



**20** Mark the inside of the groove on the wall after standing the bookcase against it.



**21** Attach the L-brackets to the wall with screws and wall anchors (see Sources, page 108). Align the top of the L-bracket 5/8-in. down from the top of the pencil marks.



**22** Screw the L-bracket to the bookcase. If you're setting your bookcase on carpet you should leave the screw head sticking up about 1/4-in. above the L-bracket. This allows the bookcase to settle into the carpet. Once you've secured the L-brackets to the bookcase you can screw the top edge banding strips (parts B) back in place.

AW

Brackets hold the bookcase to the wall and are totally hidden.

## CUTTING LIST

Overall dimension 48" wide x 67-1/4" tall x 11" deep

Part	Name	Qty.	Dimensions TxWxL	Material
A	Shelf parts	10	3/4 x 10-3/4 x 47-1/2	Birch Plywood
B	Top edge banding for top partitions	3	1/4 x 1-1/2 x 9-3/4	Birch
C	Front edge banding for top and bottom partitions	6	1/4 x 1-1/2 x 6	Birch
D	Front edge banding for center partitions	12	1/4 x 1-1/2 x 12	Birch
E	End edge banding for shelves	10	1/4 x 1-1/2 x 10-3/4	Birch
F	Front edge banding for shelves	5	1/4 x 1-1/2 x 48	Birch
L1,M1,R1	Top partition parts	6	3/4 x 9-3/4 x 5-3/4	Birch Plywood
L,M,R, 2-5	Center partition parts	12	3/4 x 9-3/4 x 12	Birch Plywood
L6,M6,R6	Bottom partition parts	6	3/4 x 9 x 6	Birch Plywood
Hardware	1/4 -20 threaded rod	6	66-1/4 long	
	Hex nuts	6	1/4-20	
	Cap nuts	6	1/4-20	
	Flat washers	12	For 1/4" rod	
	Metal angles	3	3/4 x 3	
	Wall anchors	6		





# Keepsake Box

By Mac Wentz



As the holidays approach, my thoughts turn to how I can weasel out of gift shopping. And this year I have the perfect scheme: While the malls are jammed with poor saps, I'll be in my shop blissfully building these boxes for everyone on my list.

When they marvel at the elegant keyed joinery at the corners, I won't mention how fast and easy these boxes are to make. Making the jigs and resawing lumber takes a few hours, but once you're set up you can churn out three or four boxes in a day. There's no need to mention how cheap the materials are either. If you stick with common species like oak, cherry or maple, each box will cost only \$10 to \$15.

### Tools and Materials

The box shown at left is made from 3/8-in.-thick wood, so I used a bandsaw for resawing and a planer to take the wood to final thickness. For more information about resawing, check out "Bandsaw Resawing," AW #81, August 2000, page 46.

If you don't have a bandsaw and planer you can also mail order 3/8-in. wood (see Sources, page 57). You'll also need a



tablesaw, belt sander, router table, 1/8-in. and 3/4-in. straight router bits and some 3-in. spring clamps.

### Start With Grain Selection

Grain pattern has a big influence on the appearance of a small project like this box, so don't just rip up boards and leave it to chance. Begin by making paper windows that let you preview the look of the box parts (Photo 1). I generally use finer, straighter-grained material for the ends and sides and a more dramatic pattern for the top. This is not a hard and fast rule, so experiment until you get something you like. Grain pattern for the bottom isn't critical, since it doesn't show. For the keys I use a different color wood so they contrast with the box.

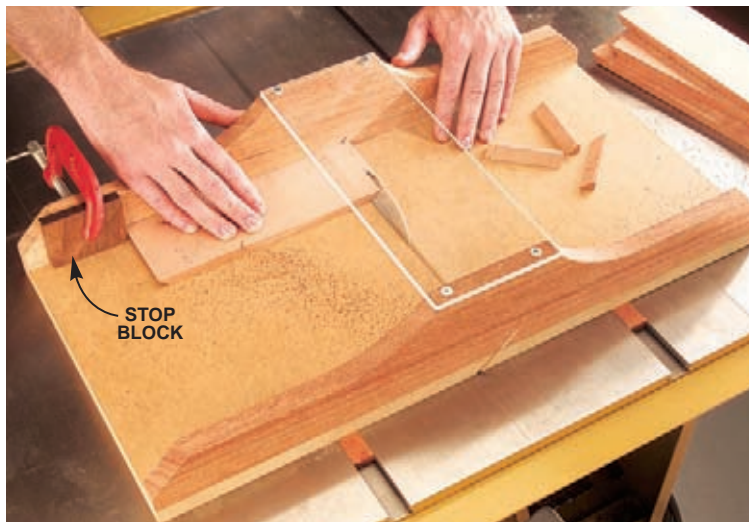
### Cut the Sides

I strongly recommend you miter the box sides on a tablesaw using a tablesaw sled (Photo 2). The every-time accuracy of a well-made tablesaw sled is hard to beat. In fact, I built a small one just for building these boxes. For more information on making a sled, see "The Ultimate Shop-

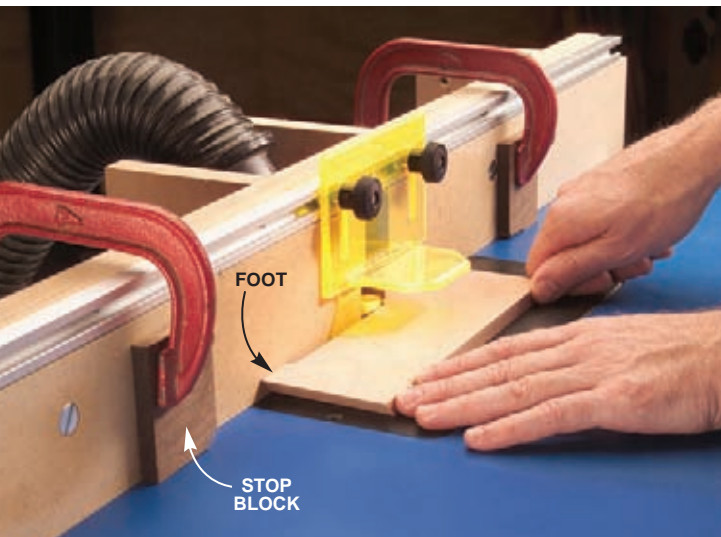
## Build them in bunches and avoid gift shopping this year



**1** Lay out the box parts exactly where you want them using a paper window. The window helps you see the grain patterns for each part before you cut them to final size.



**2** Miter the box ends and sides on your tablesaw with the help of a tablesaw sled. Miter one end of all the pieces first. Then clamp a stop block to the sled when cutting the other ends.



**3 Create feet on the sides and end** by using a 3/4-in. straight bit in your router table. Set up a pair of stop blocks to limit the length of the cut. To prevent the grain from chipping out at the feet, make three passes, raising the bit about 1/8 in. after each pass.

Built Crosscut Sled,” AW #75, October 1999, page 38 (for reprints, see page 3). Cut the parts for the ends and sides and make an extra set to test your machine setups later on.

Next cut the dados in the ends and sides for the bottom (Fig. A, page 55). The dados should be wide enough to provide an easy fit for the bottom.

Now select two ends and two sides that have the least attractive grain and mark them “GP” for guinea pig. These GP parts are the first to go through each step in the

machining process and hopefully the only ones to suffer from setup mistakes. Beginning with the GP parts, rout the relief in the bottom of the ends and sides to form the corner feet using a 3/4-in. straight router bit in your router table (Photo 3).

*Clamping jigs take the panic out of the gluing and assembly process.*

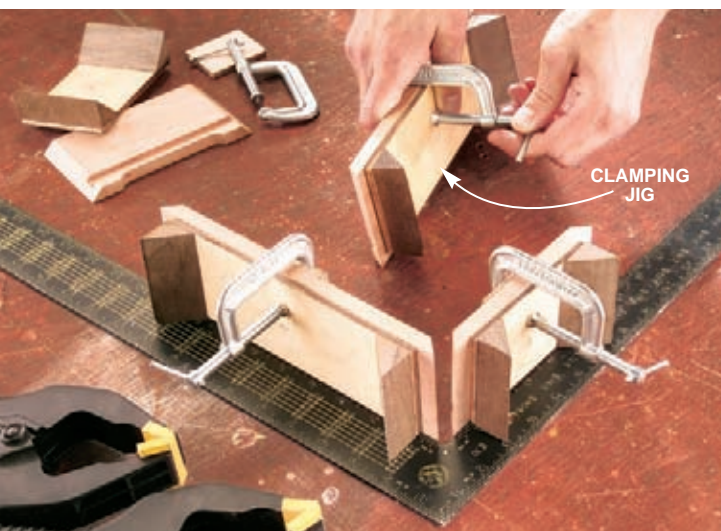
### The Bottom and Top

Cut the bottom for the box next. The bottom is about 1/16-in. undersize to give it some room for expansion. Next cut the top but don’t cut the rabbets until the box is assembled. That way you can custom fit the top for a snug-but-not-too-snug fit.

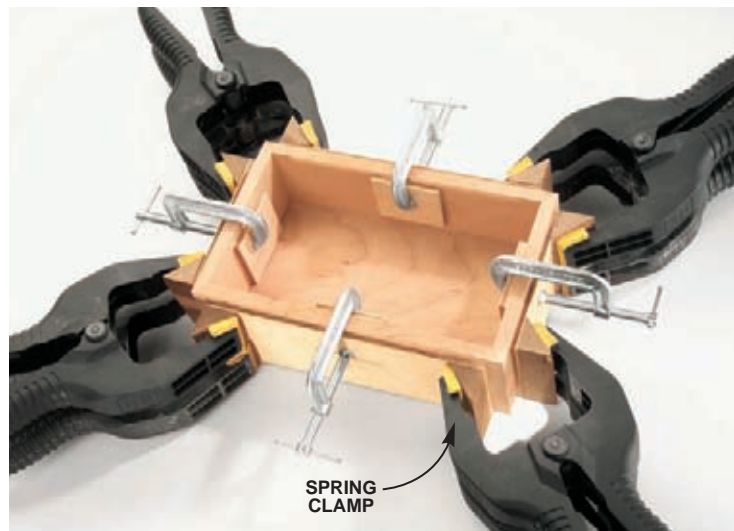
### Clamping Jigs Make Glue-Up a Cinch

Assembling the box begins by making a set of clamping jigs. They are simply made from scraps of 1/4-in. plywood that have 45-degree beveled blocks glued to them (Photo 4). Make them 3/4-in. shorter than the outer dimensions of the box so they don’t interfere with assembly. The advantage of these clamping jigs over other clamping methods is that you can deal with each joint independently, avoiding the frantic rush of trying to align, clamp and square all the corners at once.

Do a full dry assembly to make sure the jigs and box parts come together correctly. Then disassemble the box and sand the bottom and the inner surfaces of the ends and sides. Add the jigs, glue and spring clamps to the miters

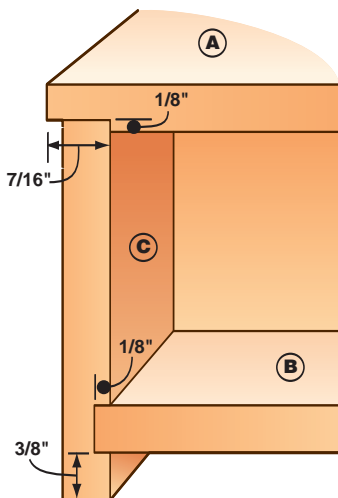
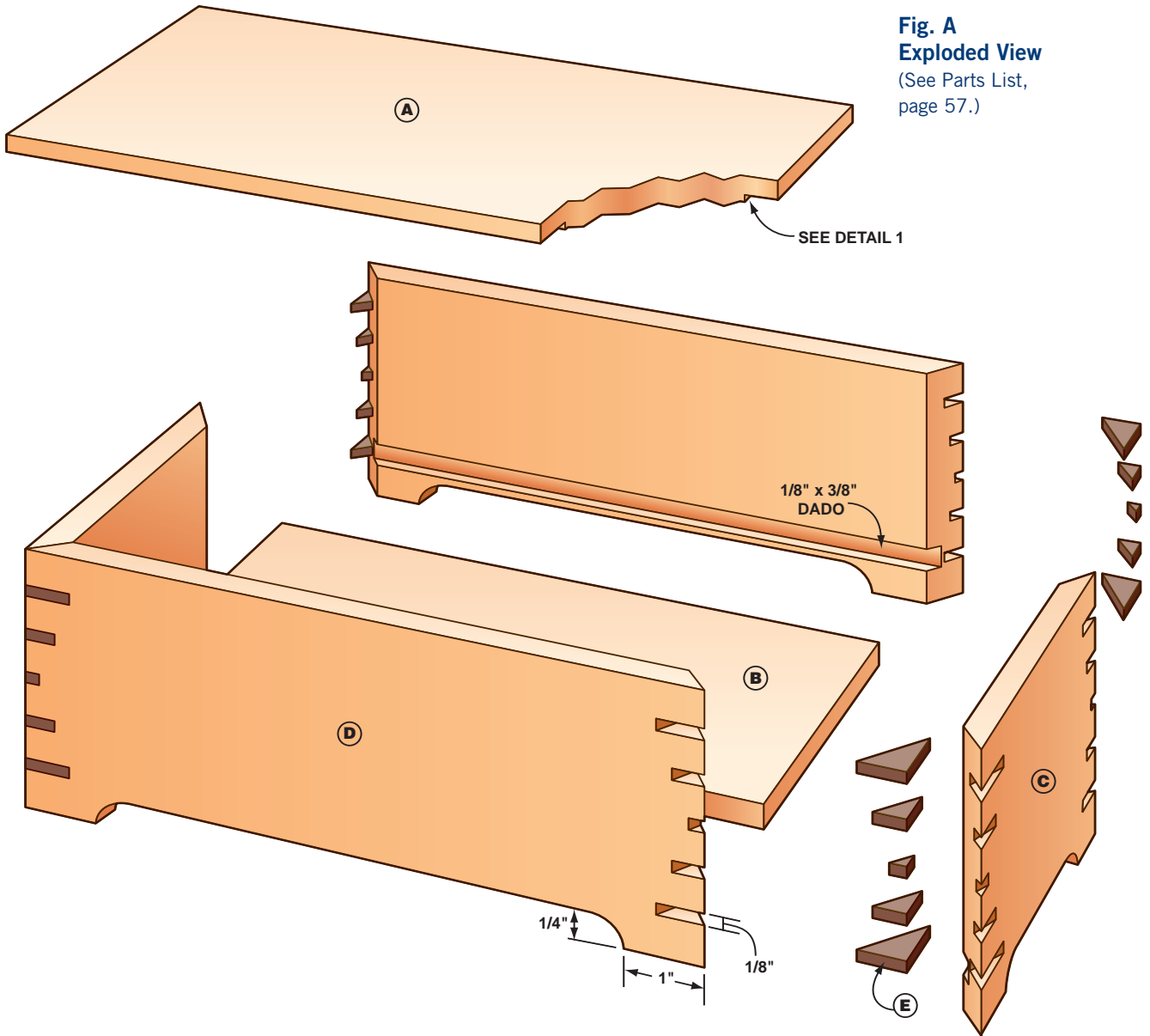


**4 Attach clamping jigs** to the ends and sides of the box. The jigs are a bit shorter than the parts so they don’t interfere with the joint during assembly.

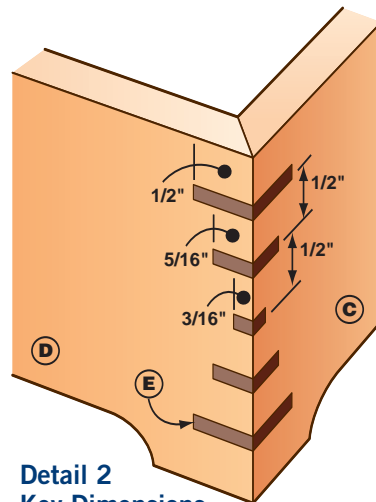


**5 Add spring clamps to one corner at a time.** Square the parts by adjusting the position of the spring clamps. Let the glue set for a few minutes before adding the bottom and the last side. Double-check that all the parts are square.

**Fig. A**  
**Exploded View**  
 (See Parts List,  
 page 57.)



**Detail 1**  
**Lid and Bottom Detail**



**Detail 2**  
**Key Dimensions**



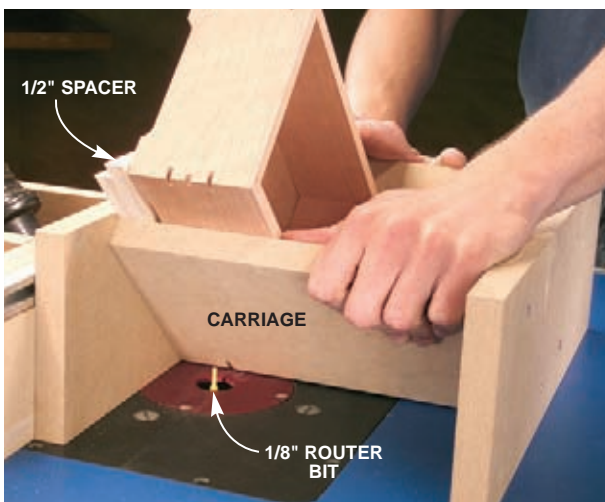


**6** If the box rocks, level the feet on a sheet of 80-grit sandpaper. The top of the box can be leveled in the same way, if it needs it. Follow up with finer grits.

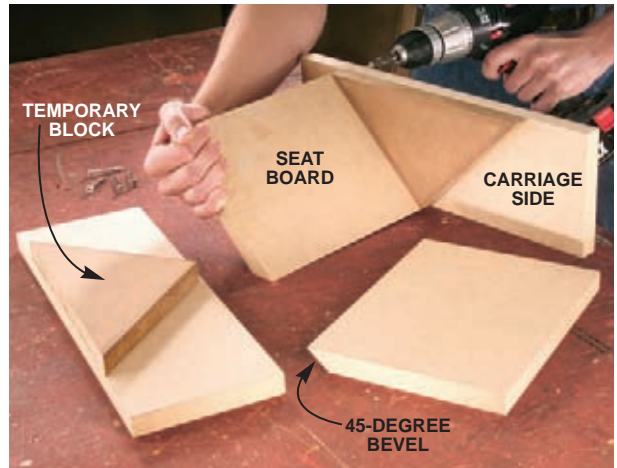
(Photo 5). Assemble a guinea pig box too, using the GP parts. Once the glue is dry you can level the feet (if they need it) on a piece of sandpaper (Photo 6).

### Cutting Slots With a Carriage

To cut slots through the box corners, build a carriage that holds the box at a 45-degree angle as it passes over the 1/8-in. router bit. The carriage is just four pieces of plywood or MDF. See the Parts List, page 57, for dimensions. The two seat boards have a 45-degree bevel on the bottom edge (Photo 7). For stability and safety, I like a carriage that's wider than the box.

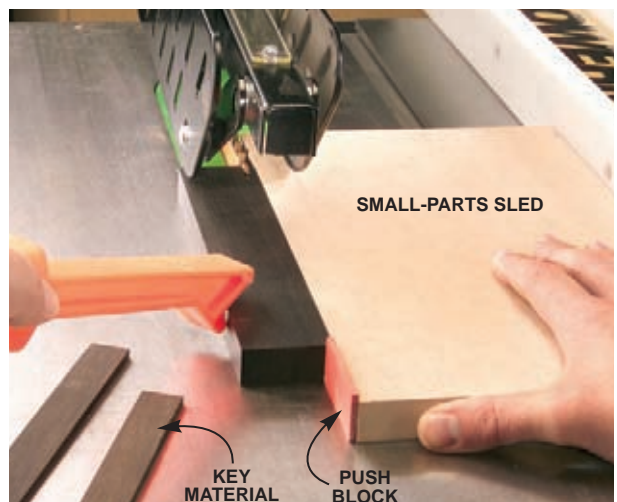


**8** Rout the key slots through the mitered corners. Cut the center slots first. Then raise the bit for the slots next to the center slot and add a 1/2-in. spacer to position the box for these slots. Finally add a second spacer and raise the bit for the top and bottom slots and cut them.



**7** Build a carriage to support the box while cutting the corner slots for the keys. Screw temporary 90-degree blocks to the carriage sides and use the blocks to position the seat boards so their beveled ends just touch. Remove the 90-degree blocks before using the carriage.

Assuming your carriage is made from 3/4-in. material, set your router table fence 2-1/4-in. from the center of the 1/8-in. router bit (see Sources, page 57). This will position a slot right in the middle of the box. Cut all four middle slots. Then use a 1/2-in. spacer board to reposition the box for the next set of slots (Photo 8). Use a second spacer board for the final set of slots. Using spacer boards eliminates the need to move the router table fence for each set of slots. You will, however, have to reset the height of your router bit for each set of slots and this may require some trial and error testing. This is where the guinea pig box comes in handy.



**9** Saw wood strips for the keys using a small-parts sled; simply a rectangular scrap with a small block glued to one corner. Use a zero-clearance insert for this job to prevent the strips from falling down into the saw next to the blade.



**10** Cut the triangular keys with a bandsaw or small handsaw. Lay out the triangles on the wood strip as shown here. This way the grain will run in the same direction for all the keys.

### Cut, Glue and Sand Keys

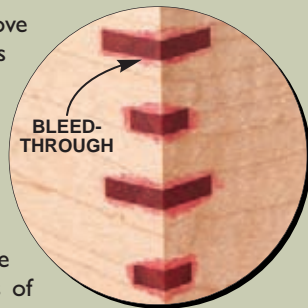
Rip the 1/8-in.-thick key material using a small-parts sled on your tablesaw (Photo 9). Cut scrap material first, readjusting the fence until you end up with key material that slips smoothly into the slots in the corners of the box. Make sure to use a zero-clearance insert to prevent the strips from falling down into the saw next to the blade. For more information on zero-clearance inserts, see “Soup Up Your Shop,” AW #91, December 2001, page 41 (for reprints, see page 3).

Cut the key material into triangles with your bandsaw or a small handsaw (Photo 10). Cut the triangles about 1/8-in. oversize. When gluing the triangles in place, use glue sparingly and make sure you fully seat each key into its slot (Photo 11).

Sanding the keys flush with the box sides is fun because you finally see

**Oops!**

One of the things I love about making boxes is that I can experiment with exotic woods without spending a bundle. But unfamiliar woods can lead to unexpected problems. When I gave this box a coat of spray lacquer, the red padauk keys bled into the surrounding finish, making a pink mess. So I sanded off the lacquer and tried again. Two very light coats of lacquer, about 10 minutes apart, sealed the padauk and I was able to follow up with a normal coat about 20 minutes later. Lesson learned: When trying a new wood I test the finish on my guinea pig box first.



the decorative effect. It's also scary because it's easy to mess up a mitered corner or gouge a side of the box. My tool of choice for this operation is a belt sander mounted upside down on my bench and equipped with a 120-grit belt. To prevent gouging make sure to keep the box parallel with the sanding belt when sanding.

### Finishing Touches

All the boxes shown in this article got a final sanding with 180-grit sandpaper followed by a couple coats of spray lacquer. Spray lacquer is available at hardware stores for about \$7 per can. One can is enough for three or four boxes.

PARTS LIST Overall dimensions: 5-5/8" W x 3-1/4" H x 9-1/8" L				Final Dimension		
	Part	Name	Qty	T"	W"	L"
	A	Lid	1	3/8	5-5/8	9-1/8
	B	Bottom	1	3/8	4-15/16	8-7/16
	C	Ends	2	3/8	3	5-1/2
	D	Sides	2	3/8	3	9
	E	Keys	20	1/8	varies	varies
	<b>Carriage for routing keys</b>					
	Seat boards	2	3/4	6	8	
	Sides	2	3/4	5	10	

### Sources

Grizzly, (800) 523-4777  
www.grizzly.com  
1/8" router bit, #C1693, \$13  
3" spring clamps, #G3305,  
\$5 each on orders of 4 or more.

Sloan's Woodshop, (888) 615-9663  
www.sloanswoodshop.com  
3/8" lumber, \$6 to \$8 per 7" x 24" pc.  
of domestic hardwoods; more for exotics.





# tablesaw picture frame

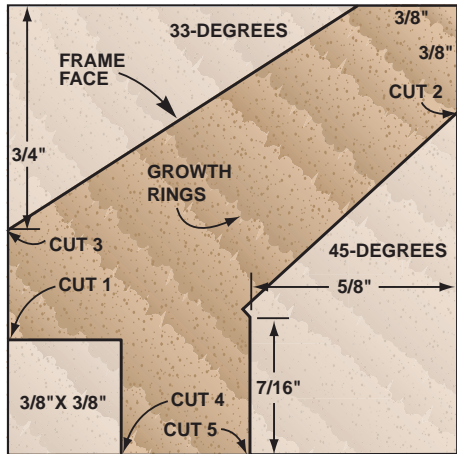
Safely make shaper-quality molding  
on your tablesaw without fancy jigs.

*by Eric Smith and Richard Tendick*

**T**his how-to story has a picture-perfect ending. In fact, you might want to round up some spectators for applause in the final steps. Richard Tendick has developed a safe, simple technique to help you make narrow, complex picture-frame stock using nothing more than a tablesaw. That's right, there are no routers or specialized jigs and sleds to make, either. With Richard's system, you actually glue the frame before the final cut. The fun comes when the frame is cut loose from the square stock.

Richard's molding also simplifies assembly. Mitering and gluing odd-shaped picture frame molding can be a struggle. With this technique, the frame is mitered and glued when the stock still has its square profile. That makes building a picture frame much easier.

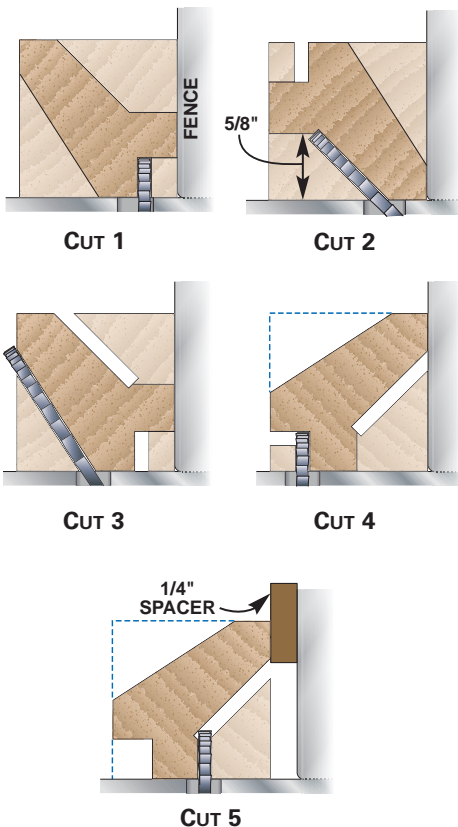
**FIG. A**  
**PICTURE FRAME PROFILE CUTS**



Five rip cuts create the picture frame profile. The first four cuts are made with most of the 1-1/2-in. square piece still intact. That means plenty of wood is riding against the tablesaw bed and fence—no rocking or pinching to worry about as you push the stock through.

When you plan your cuts, make sure the face of the frame is cut roughly perpendicular to the growth rings. This yields straight grain that flows smoothly from miter to miter.

**Note:** All profiles are shown from the outfeed end of the saw. For this project, we used a right-tilt tablesaw with the fence moved to the left of the blade. Reverse all diagrams for a left-tilt saw.



**PROJECT REQUIREMENTS AT A GLANCE**

**Materials**

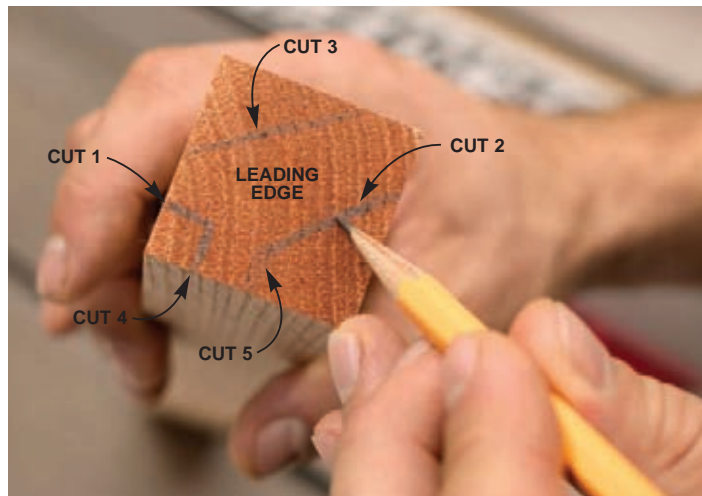
1-1/2-in. square oak  
stair balusters, \$2.50 per ft.  
Band clamp, \$10.

**Tools**

Tablesaw  
Stock miter gauge  
Drill  
Sander

**GRAIN AND COLOR ARE IMPORTANT**

This technique requires 1-1/2-in. square stock. For a frame to look good, the grain must flow smoothly around all four pieces (see “Oops,” below) and the color must be consistent. Choose clear, straight-grained wood for your frame stock. It’s best if you can cut the frame stock from a single length of wood. Buy extra wood for test cuts. We found 1-1/2-in. square oak stair balusters sold at home centers to be an excellent source for frame stock.



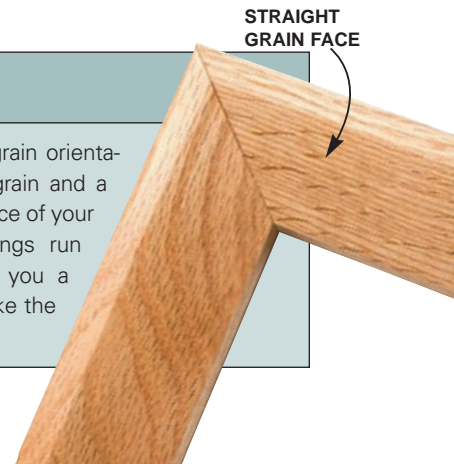
**1** Sketch the saw cuts on the leading end (the end that goes into the saw blade first) of the frame stock before you start cutting.

**SET UP FOR THE CUTS**

1. Rough-cut the frame stock to a few inches over the finished dimensions for cutting on the tablesaw.
2. Sketch the cuts on the end of each piece for orientation (Photo 1; Fig. A). All cuts start at the same end, so if you find yourself reversing the piece, something is wrong. Pay attention to grain direction! (See Fig. A and “Oops.”)
3. Cut spacer strips 3/8, 5/8 and 3/4 in. wide by 18 in. long. You’ll use these for setting the fence and saw blade height for some of the cuts.

**Oops!**

At first we didn’t pay attention to grain orientation. The result was mismatched grain and a bad-looking corner. Make sure the face of your frame is positioned so the growth rings run perpendicular to it. This will give you a straight-grained face, which will make the corners match better.

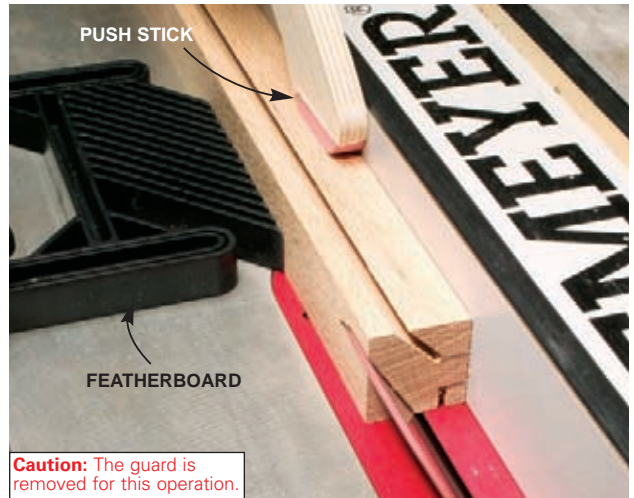


EDITOR: DAVE MUNKITTRIK • ART DIRECTION: PATRICK HUNTER AND SARA KOEHLER • PHOTOGRAPHY: MIKE HABERMANN • ILLUSTRATION: FRANK ROHRBACH



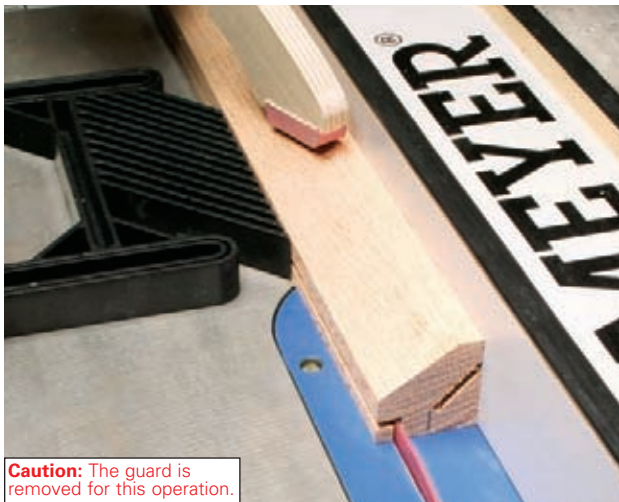


**2** Use spacer sticks to set the fence and blade height for Cut 2. With the blade at 45 degrees, use the 3/8-in. spacer to set the fence. When the teeth center on the 5/8-in. spacer's upper corner, you've reached the blade height.



**Caution:** The guard is removed for this operation.

**3** Tilt the blade 33 degrees to make Cut 3. Use a 3/4-in. spacer to set the fence. A featherboard and a rubber-tipped push stick make the cut smooth and safe.



**Caution:** The guard is removed for this operation.

**4** Make Cut 4 on the side of the blade away from the fence to prevent kickback. This also allows the stock's large sides to bear against the fence and table for greater stability.



**5** Sand off saw marks on the frame's face. The molding can be pinched in a vise to hold it steady.

### MAKING THE SAW CUTS

4. Set the blade to make a 3/8-in.-deep cut and make Cut 1 (Fig. A, page 70).

5. Set the blade and fence for Cut 2 (Photo 2) and make the cut.

6. Make Cut 3 with the blade tilted to 33 degrees. Set the blade just high enough to poke through the wood about 1/4 in. (Photo 3).

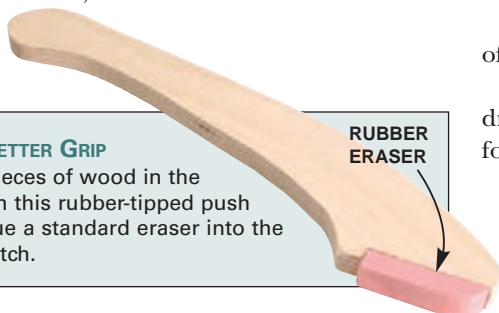
7. Make Cut 4 to create the rabbet that holds your picture, matte and glass (Photo 4). Set the fence and blade height using Cut 1 as a reference.

### SANDING, MITERING AND GLUING

8. Sand the frame before cutting the miters (Photo 5). It's a lot easier than sanding into the corners of an assembled frame.

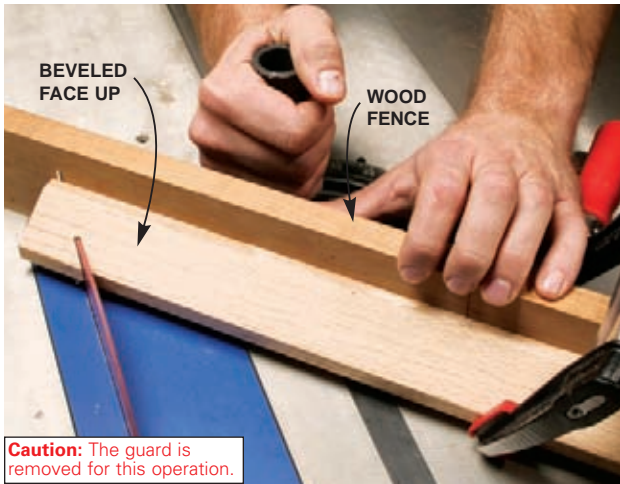
9. Before you cut the miters, take a 1/2-in.-thick slice off your stock. Save the slice for setting up the last cut.

10. Attach a long subfence to the miter gauge. Use a drafting square to set the gauge at 45 degrees. (see "Tips for Perfect Miters," AW #108, July 2004, page 62).



#### TIP: GET A BETTER GRIP

Hold small pieces of wood in the tablesaw with this rubber-tipped push stick. Just glue a standard eraser into the push stick notch.



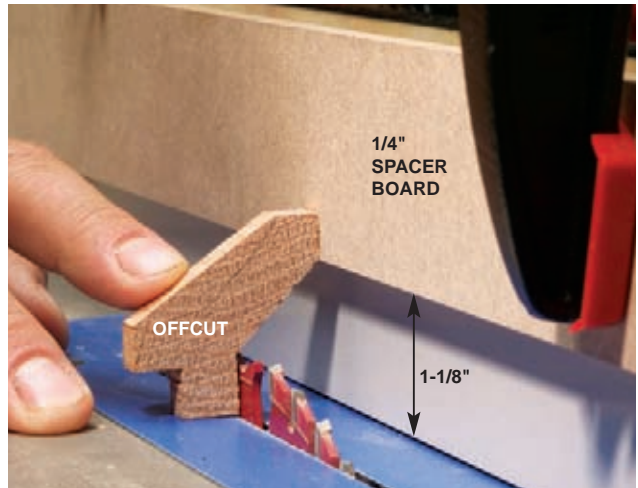
**6** Make the first miter cuts to the left of the blade. Clamp the stock face up to a wooden fence attached to the gauge. The end being cut should angle toward you. Make this cut on all four pieces.



**7** Make the second miter cut on the right side of the blade. Clamp a stop block to the fence so the frame's parallel sides will be exactly the same length.



**8** Glue and clamp the mitered frame together. A band clamp is perfect for the job. The clamp's metal plates hang on each corner of the frame to help position the band and protect the wood.



**9** Set up your tablesaw for the final cut using a cross section of the frame stock as a guide. Clamp a 1/4-in. spacer to the fence just above the offcut to create a gap between the offcut and the fence to prevent kickback.

11. Cut the miters (Photos 6 and 7). (If you make a lot of picture frames, you may want to build our simple miter sled found in AW #96, October 2002, page 84.)

12. Test-fit the frame with a band clamp before gluing to check for tight-fitting joints.

13. Glue the frame together, spreading a heavy coat of glue over the entire miter (Photo 8). Yes, that includes the part that will eventually be cut off. Wipe off excess glue with a damp rag.

### THE FINAL CUT (THE FUN PART!)

14. Set up the tablesaw for Cut 5 (Photo 9).

15. Make the final cut on all four sides of the frame (Photo 10).

16. Lift the frame from its four-sided offcut (Photo 11). (You may want an audience for this step.)

17. If the inner frame doesn't fall away from the offcut immediately, don't panic. Ours didn't (and of course, we panicked). It turned out that despite our best efforts, the blade was set a hair too shallow. All we had to do was push down gently on the frame to break that sliver of wood and release the offcut.

### FINISHING TOUCHES

18. Reinforce the corners with 1-in. wire brads (Photo 12). Pre-drill the holes with a No. 60 wire gauge bit or clip the head off a brad and use that as a bit. You may need to use a mini-chuck if your drill doesn't hold a bit that small (see Q&A, AW #107, May 2004, page 8). We don't recommend using a nail gun for this step—it's too easy to blow a nail out of the face of the frame. The nail would be hard to extract, and the result-





**10** Make Cut 5 on all four sides of the frame. The offcut won't release from the frame until all the cuts are complete.



**11** Lift the frame out of the offcut. If your last cut was a bit shallow, you may need to push down in spots to separate the frame from the offcut.



**12** Drill pilot holes for a couple of 1-in. brads to reinforce each miter joint. Keep the brads on the back of the frame where they won't be seen.

ing damage, difficult to repair. With a drill, if you accidentally drill a hole in the wrong spot, it's easy to hide with filler.

19. Sand the outside of the frame and fill the nail holes. Stain as desired and finish with at least two coats of varnish or polyurethane. **AW**

# table hockey

by Randy Johnson

It's fast,  
it's wild—  
go for the goal!

PHOTOGRAPHY: RAMON MORENO • ILLUSTRATION: FRANK ROHRBACH

ART DIRECTION: EVANGELINE EKBERG •

Looking for a great holiday gift project? This table hockey game is a blast to play, even for adults, and it's so simple, you can make it even if your gift-building time is running short. It's made from easy-to-get materials, and the finish is all water-based, so it goes on quickly.

It's basically a shallow box, made from 3/4-in. hardwood (we used oak) with a playing surface of 1/2-in. birch plywood. Add some small pieces of mesh fabric (available from a fabric store) for the goals, a couple of strategically placed goalie blocks, a pair of sticks and a puck, and you're ready to play. Have fun!



## PROJECT REQUIREMENTS AT A GLANCE

### Power tools:

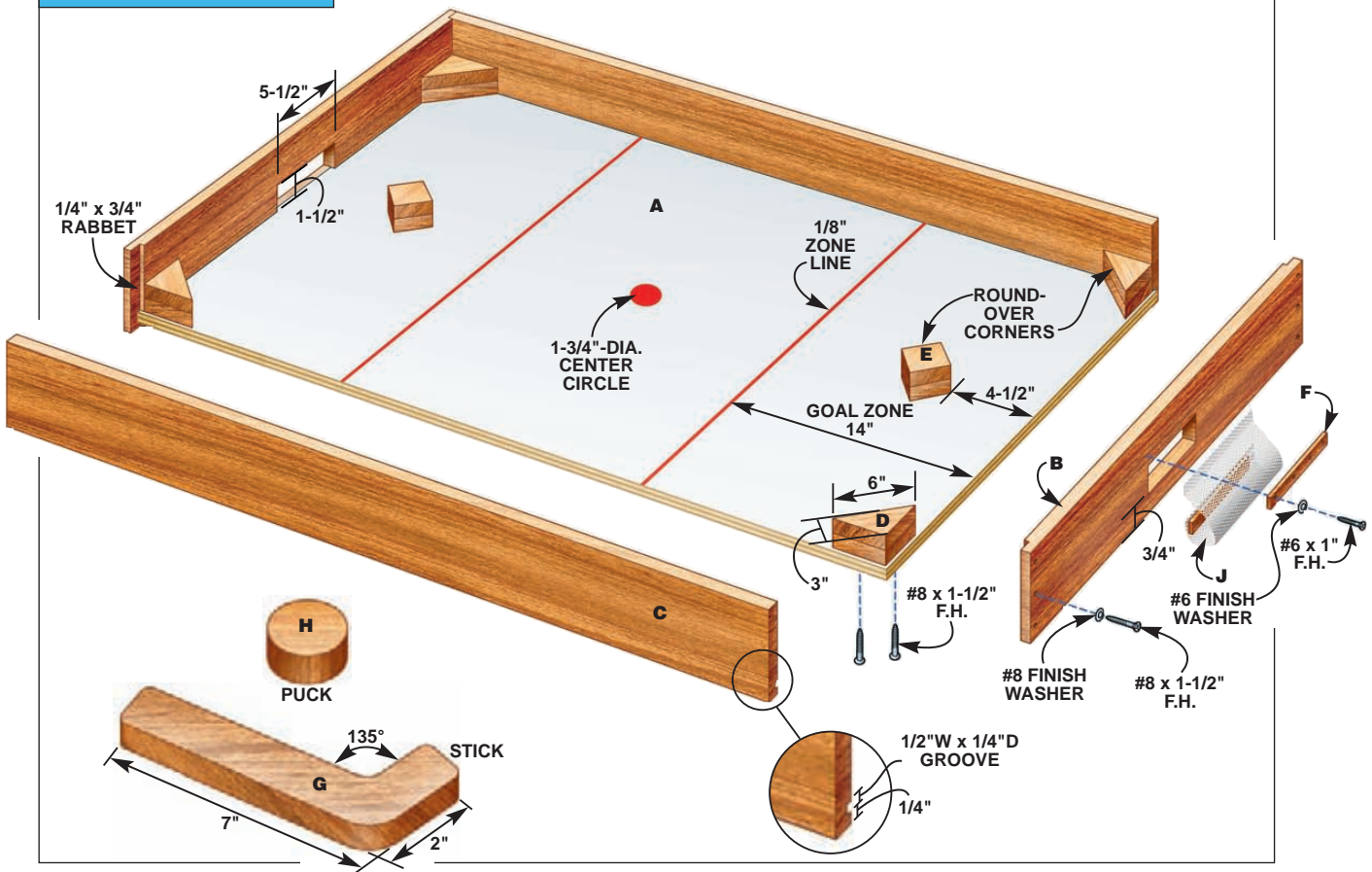
Tablesaw  
Dado blade  
Jigsaw  
Drill  
Sander

### Materials:

1/2-in. birch plywood  
3/4-in oak lumber  
Stain  
Paint  
Varnish

Total cost: About \$75

FIGURE A EXPLODED VIEW



## CUTTING LIST OVERALL DIMENSIONS: 4-1/4" T x 32" W x 48" L

Part	Name	Qty.	Dimensions (T x W x L)	Material	Notes
A	Bottom	1	1/2" x 31" x 47"	Birch plywood	
B	Ends	2	3/4" x 4-1/4" x 32"	Oak	
C	Sides	2	3/4" x 4-1/4" x 47"	Oak	
D	Corner blocks	4	1-1/2" x 3" x 6"	Oak	Cut from two pieces of 3/4" x 3-1/2" x 24" lumber glued together.
E	Goalie blocks	2	1-1/2" x 2" x 2"	Oak	Cut from two pieces of 3/4" x 2-1/2" x 18" lumber glued together.
F	Net boards	4	1/4" x 3/4" x 7-1/2"	Oak	
G	Sticks	2	1/2" x 2" x 7"	Oak or birch plywood	
H	Pucks	2	1/2" T x 1-3/4" dia.	Oak or birch plywood	
J	Nets	2	7-1/2" H x 7-1/2" W	Mesh fabric	

## How To BUILD IT

1. Mill the end and side boards (B, C) to final size and cut the grooves for the bottom panel (A, Fig. A, page 88).

2. Cut the rabbets in the end boards (Photo 1). Use an auxiliary wood fence so you can run your dado blade right next to it. This setup also allows the auxiliary fence to serve as a guide when you cut the rabbets.

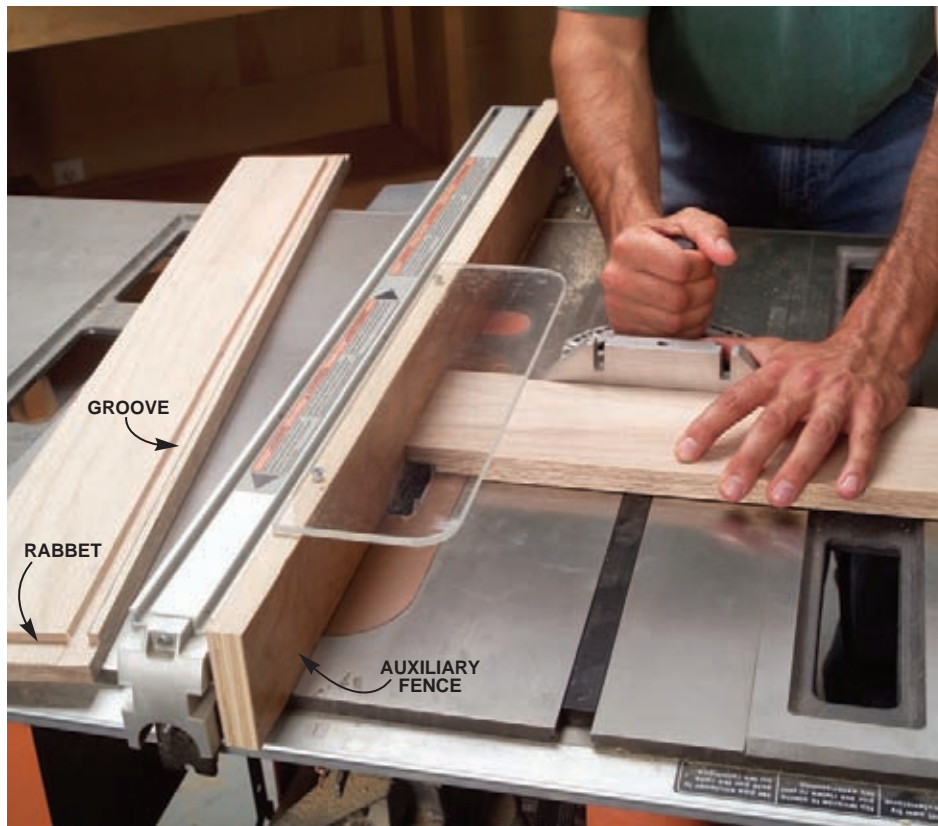
3. Cut out the opening for the goals using a jigsaw or scrollsaw (Photo 2).

4. Glue and clamp together two layers of 3/4-in. lumber for the corner blocks (D). Wipe off any glue that squeezes out. When the glue is dry, rip the board to 3 in. wide for the corner blocks. Make the goalie blocks (E) the same way.

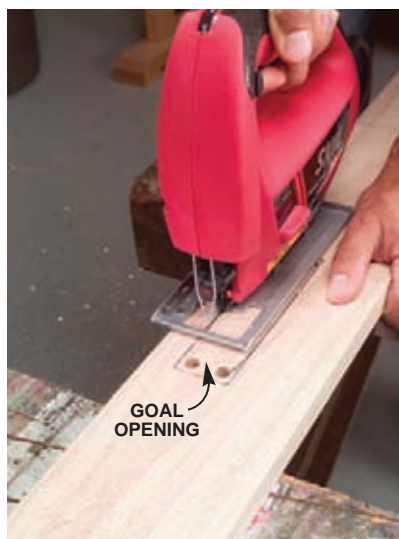
5. Cut the corner blocks and goalie blocks to final size (Photo 3) using your miter saw or tablesaw. You'll notice that the glued-up lumber stock is much longer than actually needed. This extra length gives you more to hold for safer mitering and crosscutting. Cut the net boards (F).

6. Use your bandsaw or scrollsaw to saw the sticks (G) and pucks (H) from either oak lumber or birch plywood. Make a couple extra pucks, so you won't have to take a time-out if a puck flies off the table and rolls under the couch.

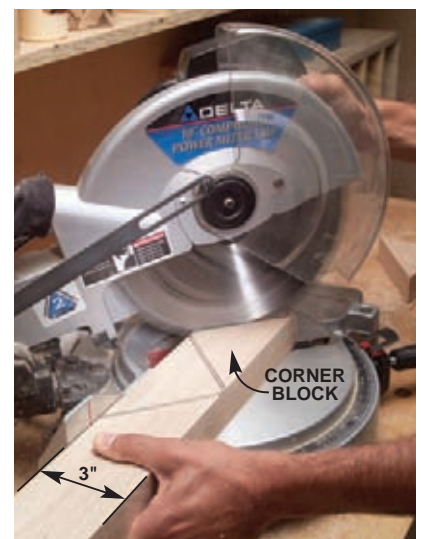
7. Sand and finish all the parts. We used water-based stain, paint and finish (see Sources, page 90). Water-based finishes tend to raise the grain after they are applied, which makes a rough finish. To prevent this, raise the grain first with a moist sponge. After the wood dries, do your final sanding. Then apply the stain to all the parts. When the blue stain on the bottom panel is dry, tape off and paint the zone



**1** Cut rabbets in the end boards, so the corners are strong enough to take abuse. Use an auxiliary fence to protect the main fence from damage. A 1/2-in. groove at the bottom edge houses the plywood playing surface.



**2** Saw goal openings with a jigsaw. Holes near each corner make starting the cuts and turning the corners easy. Smooth the inside of the goal opening with a file or sanding block.

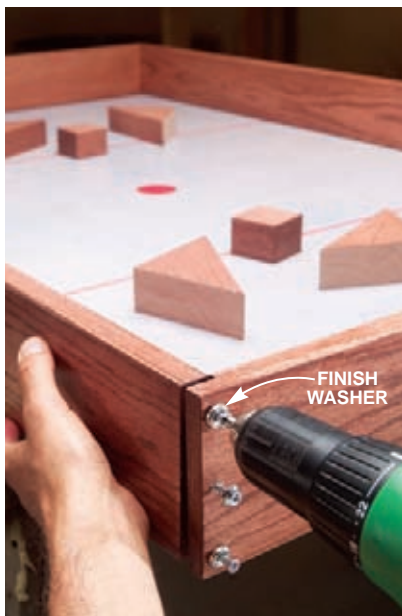


**3** Cut the corner blocks from glued-up 3/4-in. boards. These blocks keep the puck from getting trapped in the corners and allow interesting bank shots.

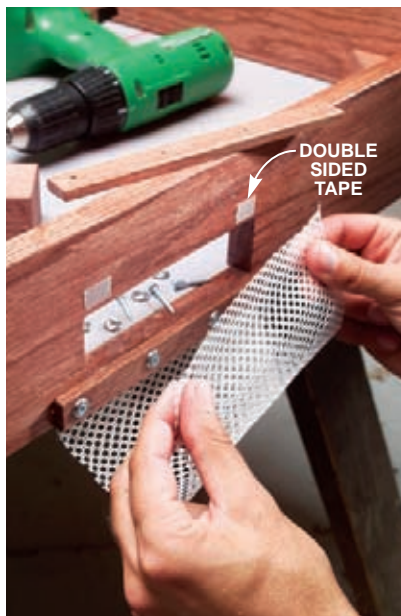




**4** Finish all the parts before you assemble them. After the blue stain on the bottom panel is dry, tape off and paint the zone lines and the center circle.



**5** Assemble the parts with flat head screws and finish washers. Finish washers provide extra bearing surface for the screw heads and don't require countersinking.



**6** Attach the goal netting with the net boards and screws. Leave the net open on the sides to make it easy to retrieve the puck. You're ready to play!

lines and center circle (Photo 4). Finally, brush on the clear topcoat finish.

8. Assemble the hockey table with screws and finish washers (Photo 5). Drill shank and pilot holes in the sides to prevent splitting the wood or stripping the screw heads.

9. Attach the netting (J) over the goal openings with the net boards

(F). The bottom net board goes inside the net and the top net board goes outside the net (Photo 6). Hold the netting in place with a bit of double-sided tape during assembly. You can substitute almost any kind of fabric for the netting, if you wish.

10. Attach corner and goalie blocks (D, E) with screws from the bottom.

It's game time! Go for the goal! **AW**

## TABLE HOCKEY RULES

You can play table hockey two ways. The first is free play. Players start with the puck on the center circle and both hit it around until a goal is scored. The only limit is that a player may not play the puck within the goal zone of the other player (see Fig. A). If the puck flies off the table during play, return it to the center circle and resume playing.

The second way to play is to take turns. Each player takes a predetermined number of shots. Two swings per player is common, but the exact number is up to you. You can handicap a better player by giving him or her fewer swings than a less experienced player. The entire rink area is open for play. If a puck is knocked off the table, it's turned over to the other player, who then gets to take one additional shot during his or her turn. Of course, it's also fun to make up your own rules!

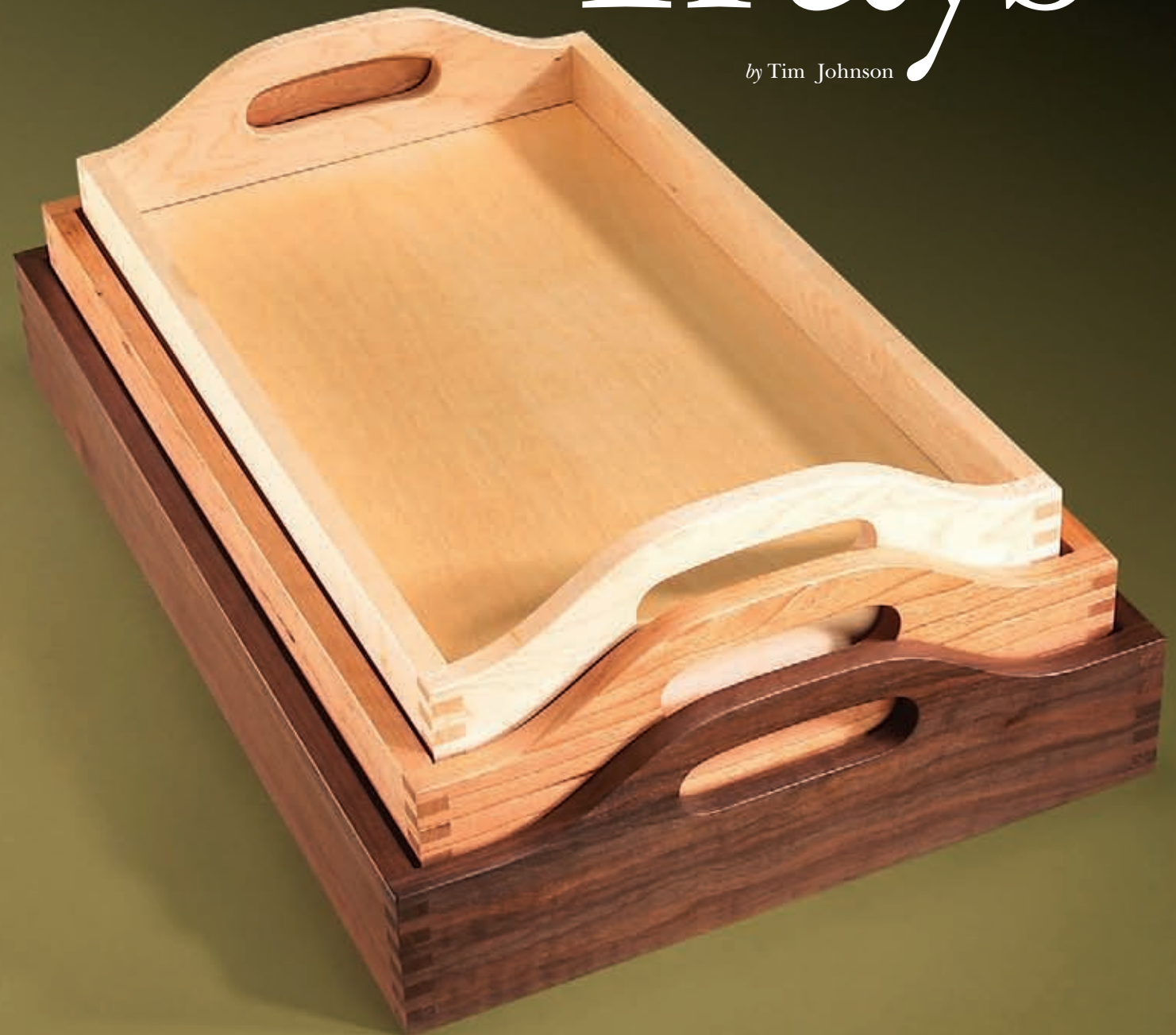
## SOURCES

Minwax  
(800) 523-9299, [www.minwax.com](http://www.minwax.com)  
Available at home centers.  
Winter Sky water-based stain, \$7 per quart  
Rose Wood water-based stain, \$7 per quart  
Polycrylic water-based clear satin finish, \$8 per quart.

Rust-Oleum  
(800) 553-8444  
[www.rustoleum.com](http://www.rustoleum.com)  
Apple red latex paint, \$4 per half pint.

# Nesting Trays

by Tim Johnson





# Eye-catching and practical, these handy carryalls are sure to please.

Here's your chance to cut lots of corners and still get great-looking results. These sturdy trays are easy to build, thanks to their simple box joints and template-routed curves. You don't need a super-equipped shop, just a tablesaw with a dado set, a router table and a drill press. You've probably saved enough scrap pieces from other projects to build the trays and the jigs, but even if you buy lumber and plywood, you can make this trio of trays for less than \$60.

## CUT THE BOX JOINTS

1. Prepare your stock, including extra pieces for test-cutting. Cut blanks for the ends (A1, B1 and C1, Fig. A, page 67) and sides (A2, B2 and C2) to length, but leave them 1/8 in. oversize in width. All the ends must be squarely cut.

2. Arrange the pieces for each box and then mark the bottom edge of every one. When you cut the box joints, these marks will correctly orient the pieces in the jig.

3. Box-joint jigs index the workpiece for cutting sockets. (Photo 1). Cutting a series of sockets creates the pins. To make the joint, one piece has pins where the mating piece has sockets (see "Tablesaw Box Joints," page 69).

4. Cut test box joints to dial in a precise fit. This is fussy work, because the tolerances are tiny. The pieces should slide together without binding or rattling. The best jigs have built-in adjustment systems.

5. Cut all the box joints. On the end-piece blanks, cut sockets only as far as their curved profiles dictate. The side-piece blanks are oversize, so you'll have to make an extra pass to complete the top sockets.

## ROUT THE ENDS

6. Use the end profile of the large tray (A1, Fig. C, page 67) as a pattern when you make the routing jig (Fig. B, page 67). First, transfer the curved edge profile to the jig's base. Then drill 1-in.-dia. holes with a Forstner bit to establish the ends of the handle hole. Finish rough-cutting the handle hole with a jigsaw. Then rough-cut the edge profile.

7. Smooth the edge profile using an oscillating spindle sander or a sanding drum in your drill press. Install a 3/4-in.-dia. spindle or drum to smooth the handle hole.

8. Use a large end-piece blank to position the jig's fence. Each end has six pins. Fasten the fence so the top pins are flush with the base's curved profile.

9. Install the stops after centering the large end-piece blank. Mount the toggle clamps (see Sources, page 67).

10. Draw edge profiles and handle holes on all the end blanks after installing them in the jig. Make spacers (W, X, Y and Z, Fig. B) to position the medium and small blanks.

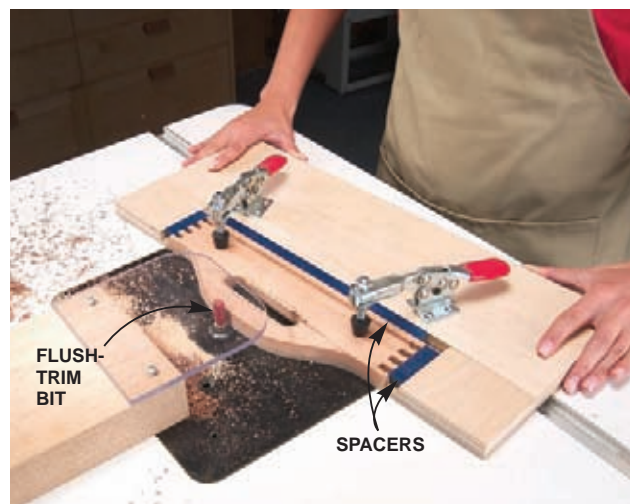
11. Rough-saw all the curved profiles about 1/16 in. away from the pattern lines. To rough out the handle



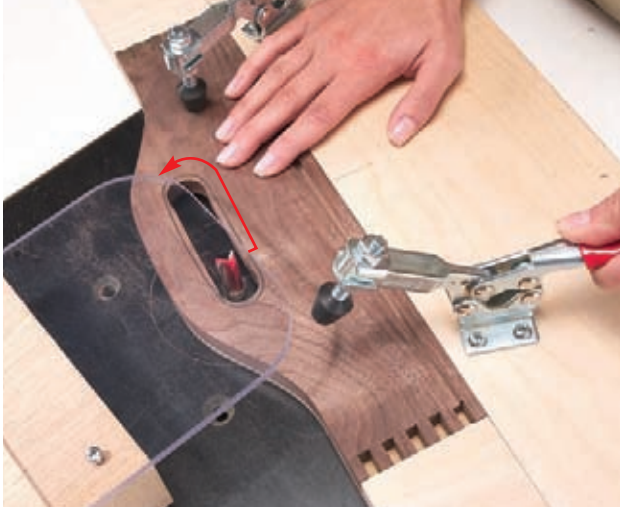
The ends of the trays match, so you can comfortably carry all three.



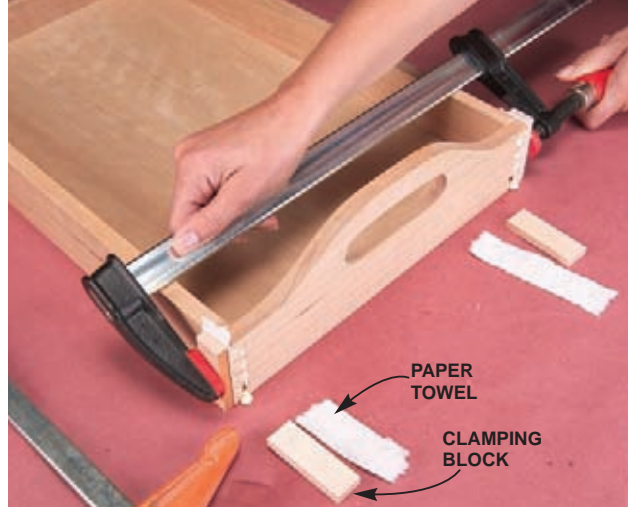
Great-looking box-joints are easy to make. I used a shop-made jig and my tablesaw, but these sturdy joints can also be cut on a router table or with a dovetailing jig.



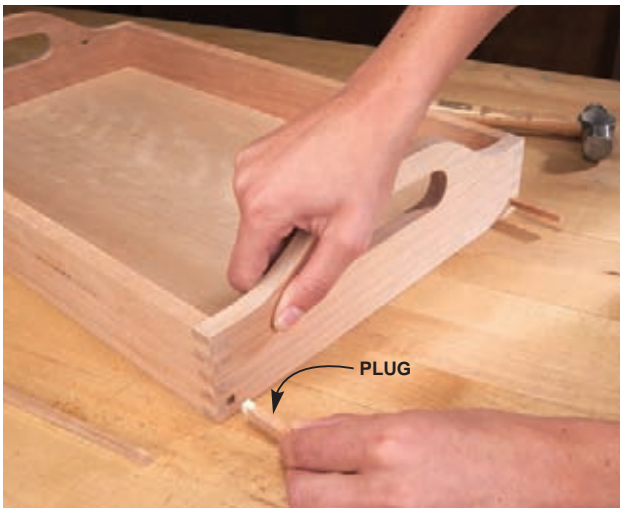
Route the curved ends of all three boxes using the same jig (Fig. B, page 67). The large box's ends exactly fit the opening. Spacers center the ends of the medium and small boxes, so the profiles and handle holes all match.



**3** Rout the handle holes after making sure the workpiece is securely held. With the router unplugged, center the bit inside the roughsawn opening. Hold the jig steady so the bit spins freely when you power up. Then rout counterclockwise.



**4** Protect the end grain when you glue the tray together. Paper towels absorb squeezed-out glue, so it doesn't soak deeply into the wood. Because of the towels, the clamping blocks knock off easily after the glue has dried.



**5** Fill holes left by the bottom grooves with end-grain plugs. Once cut and sanded flush, they'll match the end-grain pins.



**6** Level the sides and ends with a block plane or by sanding.

holes, drill 7/8-in.-dia. holes and use a jigsaw to saw out the waste.

**12.** Rout the edge profiles with a top-bearing flush-trim bit (Photo 2). Then rout the handle holes (Photo 3).

## ASSEMBLE THE TRAYS

**13.** Saw grooves for the plywood bottoms (A3, B3 and C3). On the side pieces, the grooves align with the top of the first pin (Fig. A). On the end pieces, they align with the top of the first socket. Because 1/4-in.-thick plywood is often undersize, you can't use a dado set. Use your regular blade and make two passes. Adjust the fence between passes to widen the groove.

**14.** Assemble the boxes without glue to make sure everything fits. Rip the sides to stand 1/32 in. above the ends.

**15.** Disassemble the boxes for sanding.

**16.** Glue the boxes together. Spread a thin layer of glue on all the pins and sockets. Use a brush and glue with an extended open time. Squeeze a thin bead of glue into the grooves for the bottoms, too.

**17.** Clamp each box using blocks to fully seat the joints

(Photo 4). Make sure the boxes are square.

**18.** After the glue has dried, remove the clamps and knock off the blocks. Dampen any paper that remains attached; after about a minute, it'll scrub right off. Check for any remaining glue—the moisture makes it turn a ghostly white color. Simply scrub the surface to remove it. Use a chisel to remove any glue inside the tray.

**19.** Cut plugs (D) and fill the holes in the ends of the trays (Photo 5).

**20.** True up the sides and ends (Photo 6).

## SPRAY ON THE FINISH

**21.** Go over the boxes again with fine sandpaper; the grain will be raised in any area that has been wet. Slightly round all the sharp corners, especially those around the handle holes.

**22.** For small projects like this one, I prefer aerosol finishes. Spray on at least two light coats. Let the finish dry and sand lightly between each coat. Urethane finishes provide the best protection.



# PROJECT REQUIREMENTS AT A GLANCE

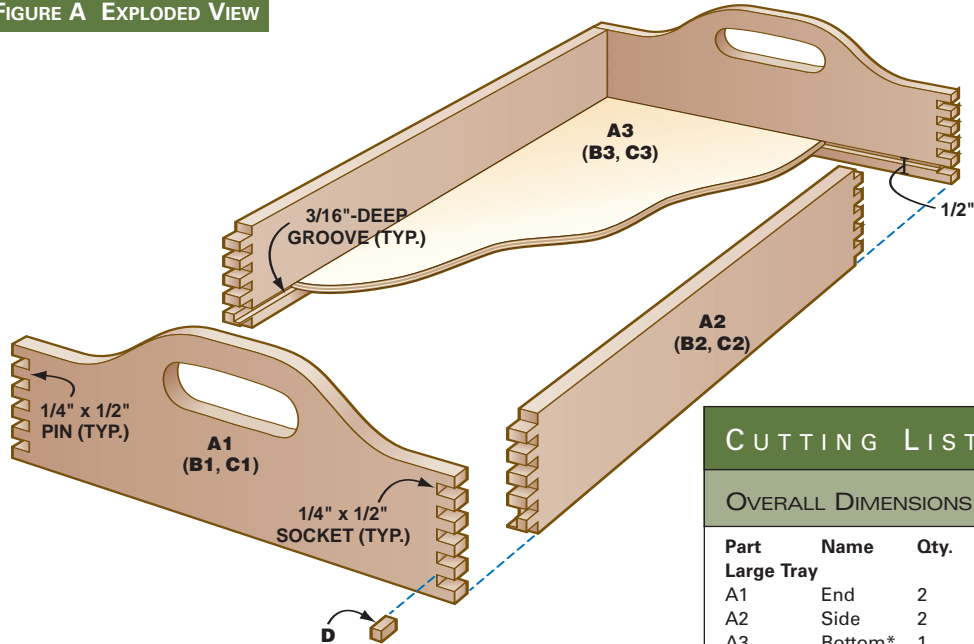
## Materials:

18 lineal ft. of 1/2-in.-thick x 5-in.-wide hardwood lumber  
 One-quarter sheet 1/4-in. hardwood plywood  
 One-half sheet 1/2-in. Baltic birch plywood (for jigs)  
 Wood glue

## Tools:

Tablesaw, dado set, router table, drill press, jig saw, 3-in.-dia. and 3/4-in.-dia. sanding drums, 1-in.-dia. and 7/8-in.-dia. Forstner bits, 1/2-in. flush-trim router bit with top-mounted bearing, block plane, assorted clamps  
**Cost:** About \$60

FIGURE A EXPLODED VIEW



## CUTTING LIST

OVERALL DIMENSIONS: 4-1/4" x 13" x 20"

Part	Name	Qty.	Dimensions
<b>Large Tray</b>			
A1	End	2	4-1/4" x 13" x 20"
A2	Side	2	1/2" x 2-3/4" x 20"
A3	Bottom*	1	1/4" x 12-11/32" x 19-11/32"

<b>Medium Tray</b>			
B1	End	2	3-3/4" x 11-3/4" x 18-3/4"
B2	Side	2	1/2" x 2-1/4" x 18-3/4"
B3	Bottom*	1	1/4" x 11-3/32" x 18-3/32"

<b>Small Tray</b>			
C1	End	2	3-1/4" x 10-1/2" x 17-1/2"
C2	Side	2	1/2" x 1-3/4" x 17-1/2"
C3	Bottom*	1	1/4" x 9-27/32" x 16-27/32"

D	Plug	12	Cut to fit
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<b>Routing Jig</b>			
W	Medium end spacer	2	1/2" x 5/8" x 2-1/2"
X	Medium bottom spacer	1	1/2" x 1/2" x 11-3/4"
Y	Small end spacer	2	1/2" x 1-1/4" x 2-1/2"
Z	Small bottom spacer	1	1/2" x 1" x 10-1/2"

\* Plywood

FIGURE B ROUTING JIG

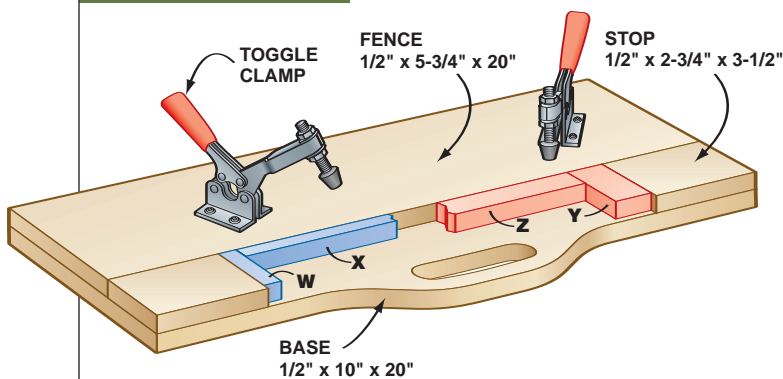
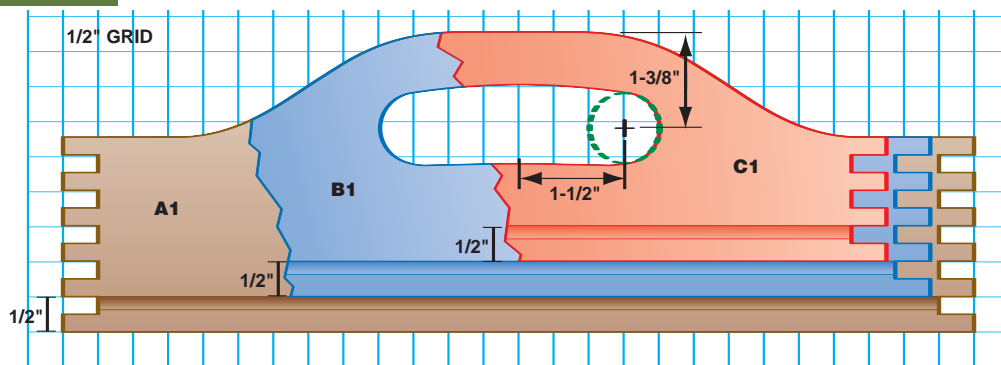


FIGURE C END PROFILES



Sources Highland Hardware, (800) 241-6748, www.highlandhardware.com 1/2-in. top-bearing flush-trim bit, #101461, \$24. Toggle clamp, 2-3/8-in. reach, #166105, \$7. Extended open-time wood glue, 1 pt., #165026, \$8.

# teak coffee table

A retro table with sleek lines and soft edges

by Bruce Kieffer



**W**ith the resurgence of the mid-century Modern style in furniture, I thought I'd have some fun with this classic little coffee table. I used teak because it was the wood of choice for the Danish Modern style in the 1960s and 1970s. The same can be said for the round tapered legs and the soft, rounded edges and corners on the top.

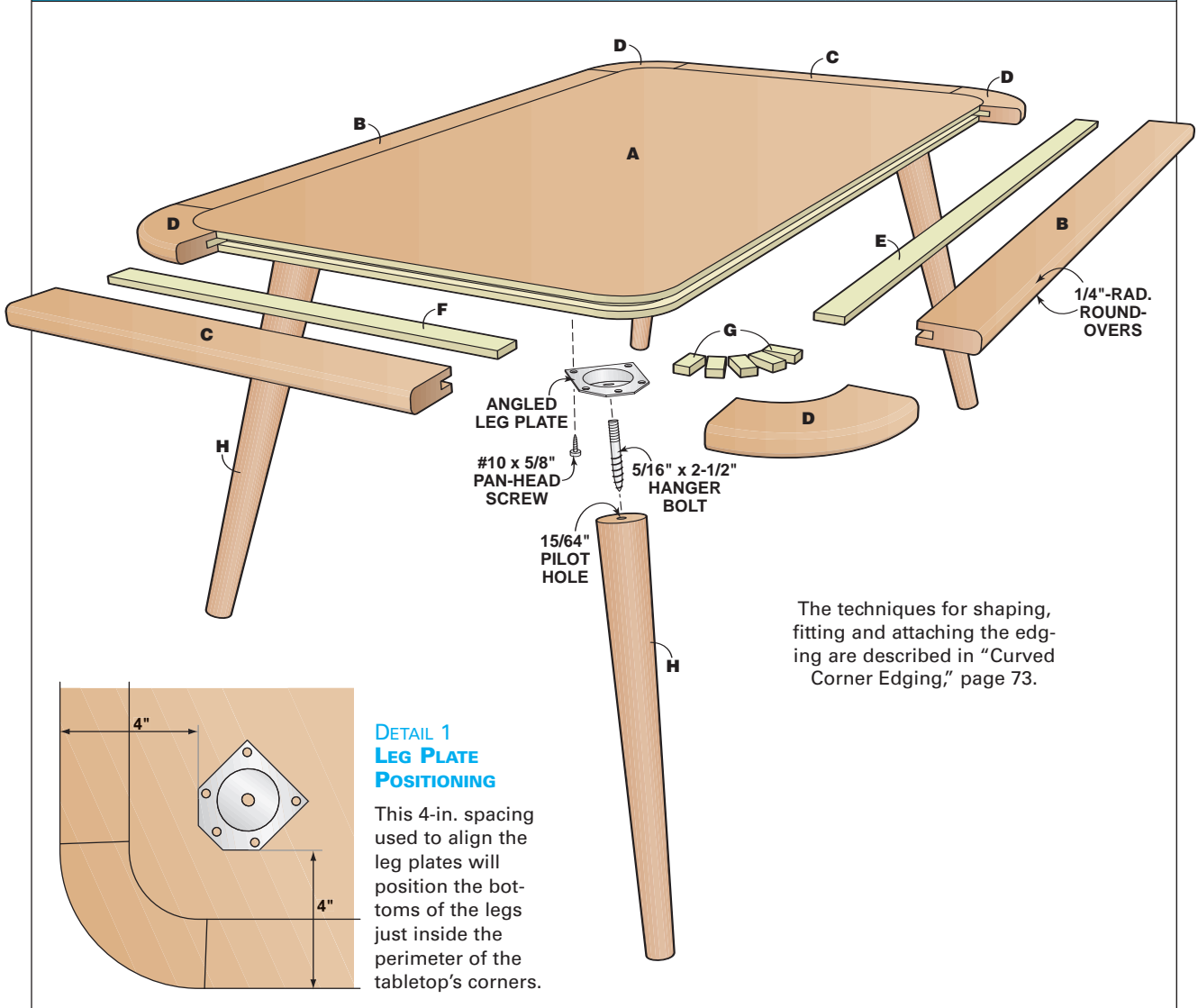
The impressive, curved, solid-wood edging on the table looks more difficult to make than it is (see "Curved Corner Edging," page 73). After the top is done, building the rest of the table couldn't be easier. Just turn four round tapered legs, attach them directly to the table with screw-on leg plates and you're done.

I'll show you a nifty turner's technique for ensuring an even taper on each leg. If you don't own a lathe, an alternative to turning is to make square tapered legs and use a 1/2-in. round-over bit on all four edges. Use a block plane and sandpaper to complete the round shape of the leg.

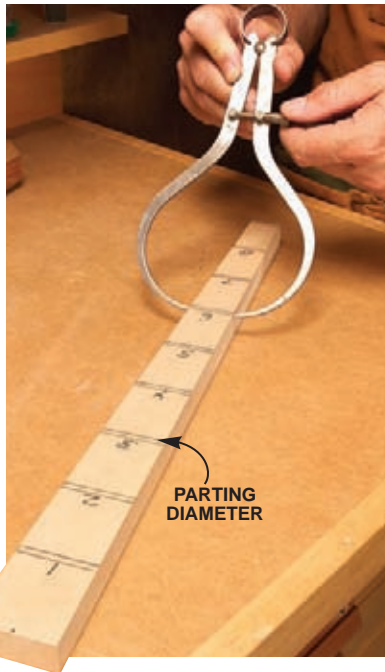


PROJECT REQUIREMENTS AT A GLANCE		CUTTING LIST OVERALL DIMENSIONS: 24"D x 40"W x 18-3/4"H																																				
<b>Materials:</b> 5 bd. ft. of 4/4 teak 4 bd. ft. of 8/4 teak One sheet of 3/4-in. x 24-in. x 36-in. teak plywood 2 bd. ft. of 4/4 poplar One pint of clear satin varnish  <b>Tools:</b> Tablesaw, lathe, router, 3/4-in.-dia. flush-trim bit, 1/4-in. x 1/2-in. slot-cutting bit, 1/4-in. round-over bit, finish sander, calipers, roughing gouge, 1/8-in. parting tool and a square, wide nose scraper  <b>Hardware:</b> Four 5/16-in.-dia. x 18-thread x 2-1/2-in.-long hanger bolts Four screw-on angled leg plates 20 No. 10 x 5/8-in. pan-head screws  <b>Cost:</b> \$300		<table border="1"> <thead> <tr> <th>Material</th> <th>Part Name</th> <th>Qty.</th> <th>Dimensions</th> </tr> </thead> <tbody> <tr> <td>3/4" teak plywood</td> <td>A Tabletop</td> <td>1</td> <td>3/4" x 20" x 36"</td> </tr> <tr> <td>4/4 teak</td> <td>B Long edging</td> <td>2</td> <td>3/4" x 2" x 31-5/8" *</td> </tr> <tr> <td></td> <td>C Short edging</td> <td>2</td> <td>3/4" x 2" x 15-5/8" *</td> </tr> <tr> <td></td> <td>D Corner edging</td> <td>4</td> <td>3/4" x 5-1/4" x 6-3/4"</td> </tr> <tr> <td>4/4 poplar</td> <td>E Long splines</td> <td>2</td> <td>1/4" x 1-15/16" x 31-1/2"</td> </tr> <tr> <td></td> <td>F Short splines</td> <td>2</td> <td>1/4" x 1-15/16" x 15-1/2"</td> </tr> <tr> <td></td> <td>G Corner splines</td> <td>20</td> <td>1/4" x 1-15/16" x 1/2"</td> </tr> <tr> <td>8/4 teak</td> <td>H Leg blanks</td> <td>4</td> <td>1-7/8" x 1-7/8" x 18-1/2" **</td> </tr> </tbody> </table> <p>* Cut 1/4 in. longer and 1/4 in. wider and then trim to fit.            ** Finished size is 18 in. long.</p> <p><b>Sources</b> Woodworkers Source, (800) 423-2450, www.exoticwoods.net Teak, 4/4, \$22 a bd. ft. Teak, 8/4, \$22 a bd. ft. • Buck Woodcraft, (305) 743-4090, www.buckwoodcraft.com Teak plywood, 3/4 in. x 24 in. x 36 in., \$66. • Lee Valley and Veritas, (800) 871-8158, www.leevalley.com Screw-on angled leg plates, 5/16 in. x 18 thread, #00H33.80, \$3 for a package of four. • Woodcraft, (800) 225-1153, www.woodcraft.com Hanger bolts, 5/16 in. x 18 thread x 2-1/2 in., #130238, \$2 for a bag of 10. • Local lumberyard Poplar, 4/4, \$3 a bd. ft. • Local paint store Clear satin varnish, \$5 a pint.</p>	Material	Part Name	Qty.	Dimensions	3/4" teak plywood	A Tabletop	1	3/4" x 20" x 36"	4/4 teak	B Long edging	2	3/4" x 2" x 31-5/8" *		C Short edging	2	3/4" x 2" x 15-5/8" *		D Corner edging	4	3/4" x 5-1/4" x 6-3/4"	4/4 poplar	E Long splines	2	1/4" x 1-15/16" x 31-1/2"		F Short splines	2	1/4" x 1-15/16" x 15-1/2"		G Corner splines	20	1/4" x 1-15/16" x 1/2"	8/4 teak	H Leg blanks	4	1-7/8" x 1-7/8" x 18-1/2" **
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**FIGURE A EXPLODED VIEW**



**1** Make round tapered legs quickly and consistently with the help of a simple taper gauge. Set your outside caliper to the parting diameters marked on this leg taper template.



**2** Cut the grooves with a parting tool. Hold the caliper in the groove as you cut. You know you've reached the right diameter when the calipers pass through the groove. The bottom of each groove marks the profile of the tapered leg.

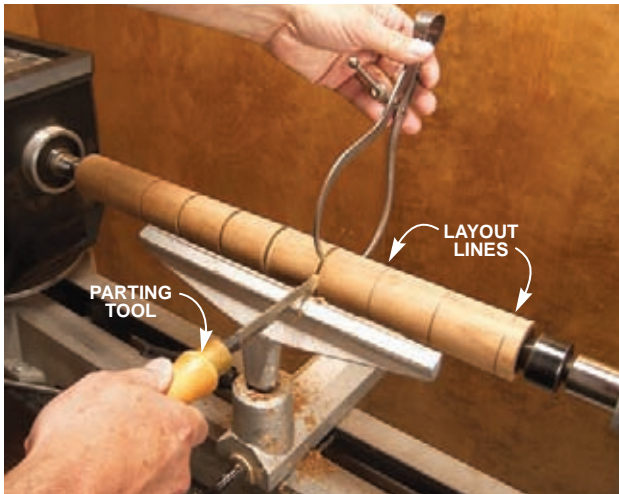
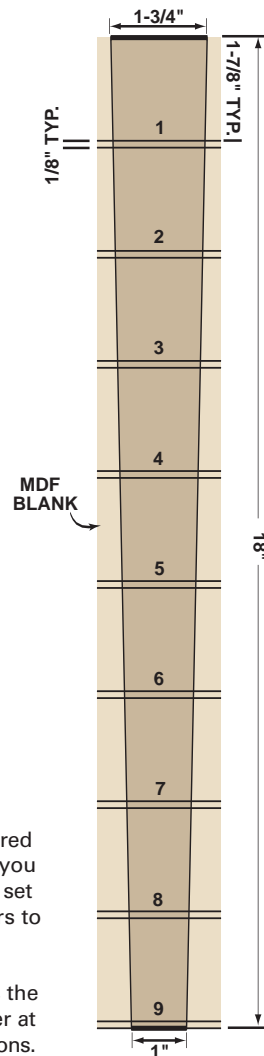


FIGURE B LEG TAPER GAUGE



The numbered lines allow you to instantly set your calipers to the proper width. Each line defines the leg diameter at given locations.

## MAKE THE TOP

**1.** Cut the tabletop (A, Fig. A, page 70), edging pieces (B, C and D) and splines (E, F and G) to size. Shape, fit and attach the edgings to the top as described in “Curved Corner Edging,” page 73.

**2.** Rout the round-over edges and finish-sand the top. Be careful on that veneer—it’s paper thin.

## TURN THE LEGS

**3.** Mill the leg blanks (H) and cut them 1/2 in. extra long. The extra length is used to hold the leg at the tailstock end of the lathe. You’ll cut it off after the leg is turned.

**4.** Before you turn the legs, make them hexagonal by chamfering the corners on a bandsaw or tablesaw. Removing the waste gives you a head start on turning squares into cylinders.

**5.** Mount a leg blank between the centers of your lathe. Turn the blank to a 1-3/4-in.-dia. cylinder with a roughing gouge.

**6.** Make a leg taper gauge from some MDF scrap (Photo 1; Fig. B, above). Lay out the leg taper and the 1/8-in.-wide parting diameter lines and cut the tapered profile on the bandsaw. Now you have a quick reference gauge for setting your calipers.

**7.** Turn on the lathe and hold up the gauge to the leg. With a pencil, transfer the parting lines from the gauge to the blank.

**8.** Use a parting tool and calipers to cut each groove to the proper depth (Photo 2).

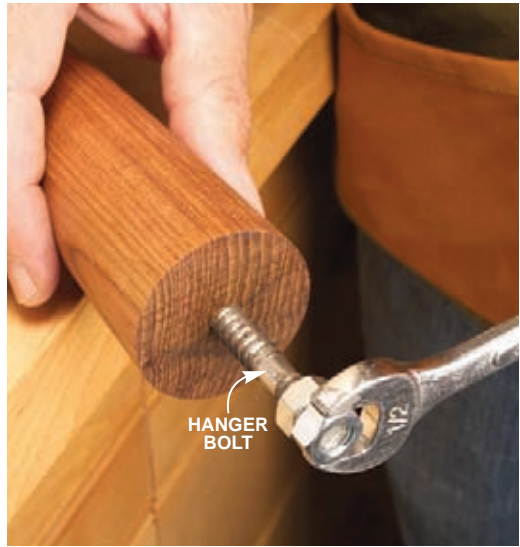
**9.** Rough out the tapered shape of the leg using the bottom of the grooves as a depth guide (Photo 3). Finish shaping the leg using a wide, square nose scraper.

**10.** Smooth the leg with sandpaper and a sanding block. Part the leg deeply at the bottom. Use a handsaw to remove the bottom waste. Hand-sand the leg with the grain to remove cross-grain scratches.





**3** Clear out the waste between the grooves with a roughing gouge. Finish the leg with a wide, square nose scraper and sandpaper.



**4** Screw a hanger bolt into the end of each leg. First, jam two nuts together on the end of the hanger bolt using a wrench on each nut.

## ASSEMBLE THE TABLE

**11.** Drill 15/64-in. pilot holes in the legs and insert the hanger bolts (Photo 4).

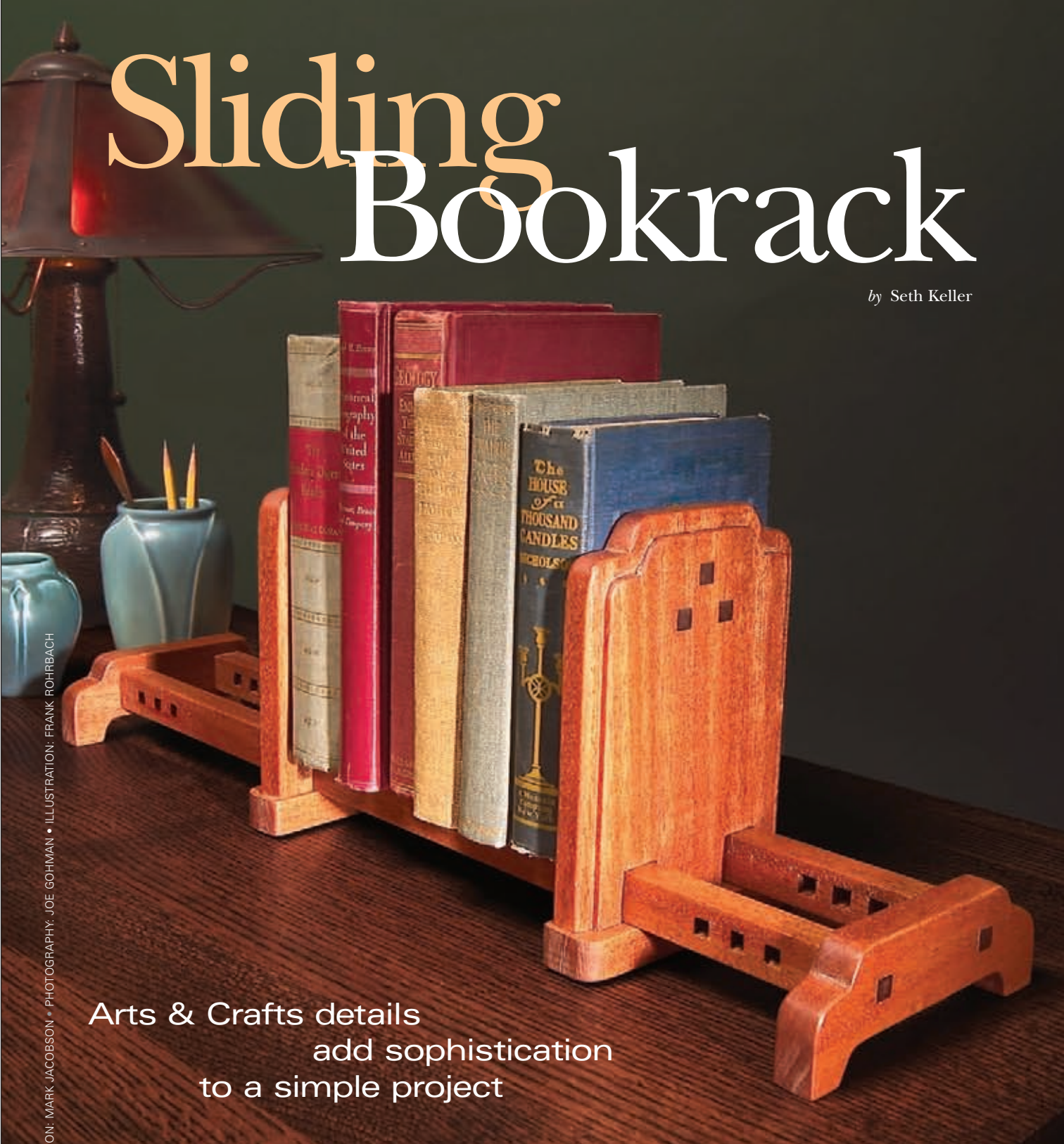
**12.** Mount the angled leg plates (Fig. A, Det. 1, page 70). You may need to drill shallow relief holes in the underside

of the table to accommodate the ends of the hanger bolts.

**13.** Apply two coats of clear satin varnish to the teak. Let the finish cure, thread the legs into the leg plates and you're done.

# Sliding Bookrack

by Seth Keller



Arts & Crafts details  
add sophistication  
to a simple project

EDITOR: TOM CASPAR • ART DIRECTION: MARK JACOBSON • PHOTOGRAPHY: JOE GOHMAN • ILLUSTRATION: FRANK ROHRBACH

**I've** always admired the work of Greene & Greene, two architects who designed Arts & Crafts homes and furnishings in the early 20th century. Their detailing is exquisite. I love the softened edges, pegged joinery, square motifs and overall lightness of their work. When I needed bookends to hold some special volumes, I

turned to these gifted artists for inspiration.

This bookrack works on a very simple principle: friction. The bookends are adjustable, sliding on two rails to hold any set of books. But when you push the ends up to the books, they tilt slightly and bind against the rails. They're locked in place. When you pull a book out, the ends are released and free to slide again.



# PROJECT REQUIREMENTS AT A GLANCE

FIGURE A EXPLODED VIEW

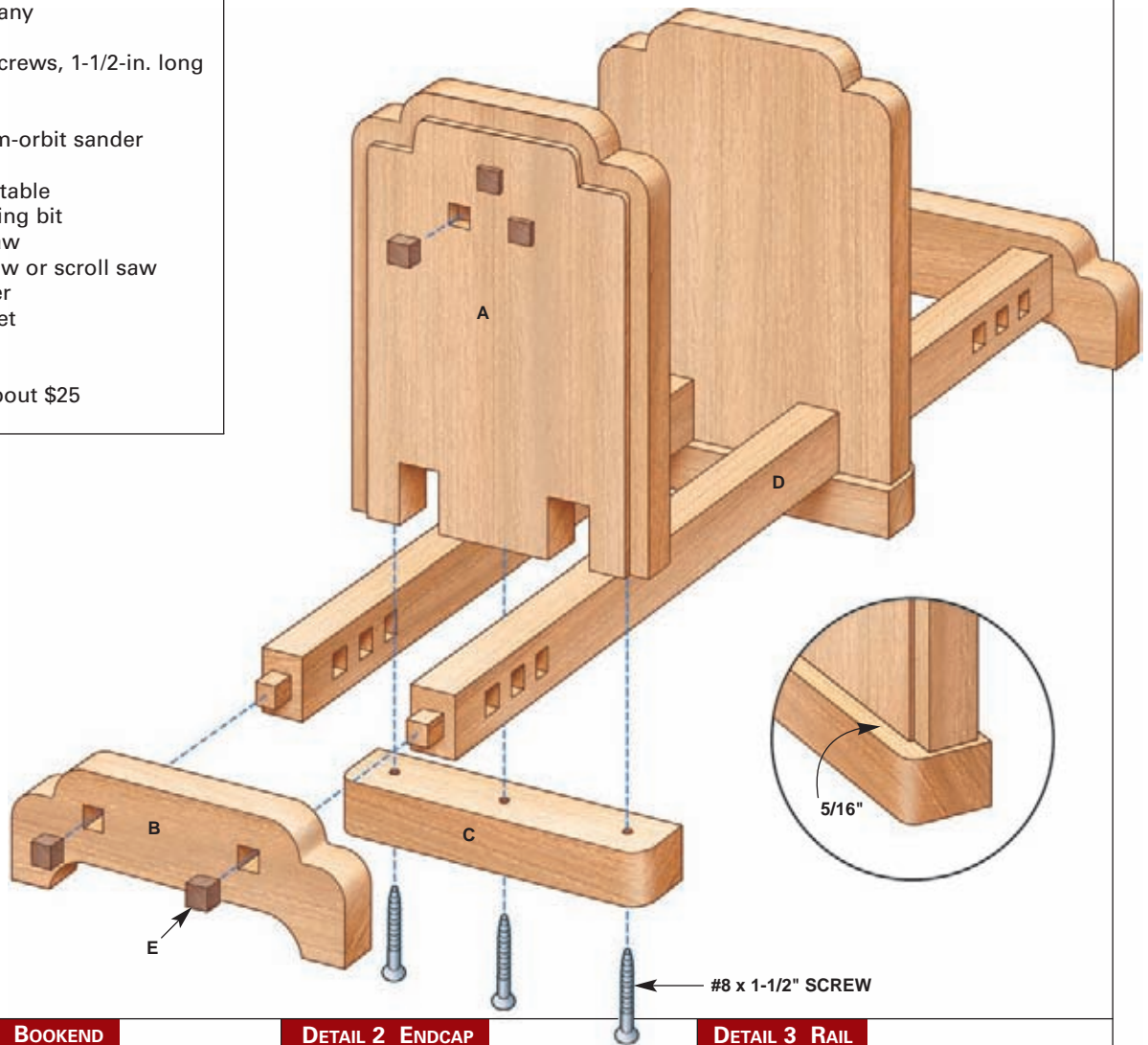
## Materials

Mahogany  
Walnut  
No. 8 screws, 1-1/2-in. long

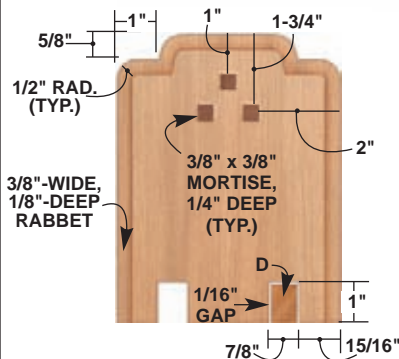
## Tools

Random-orbit sander  
Router  
Router table  
Rabbeting bit  
Tablesaw  
Bandsaw or scroll saw  
Mortiser  
Dado set  
Planer

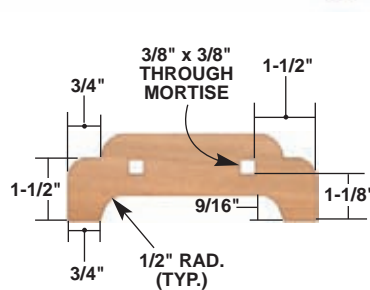
Cost about \$25



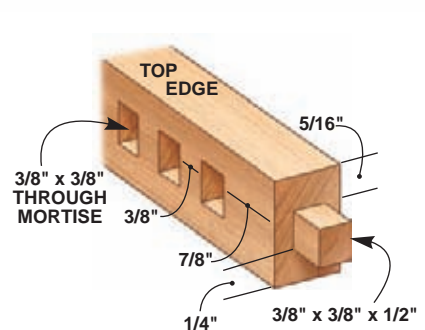
### DETAIL 1 BOOKEND



### DETAIL 2 ENDCAP



### DETAIL 3 RAIL



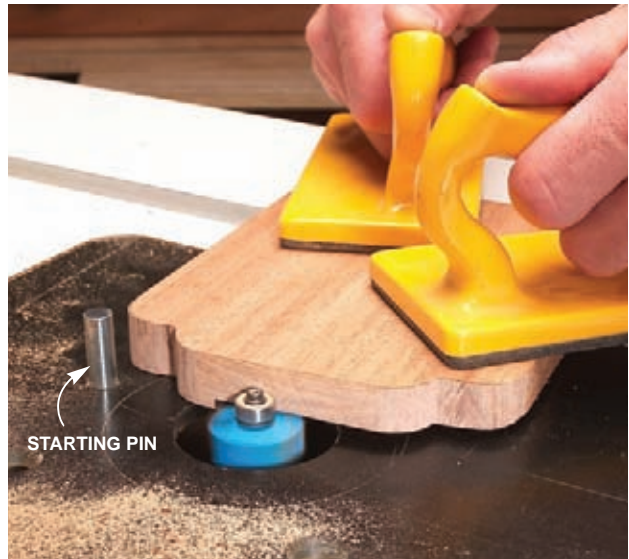
## CUTTING LIST

OVERALL DIMENSIONS: 7-13/16"H x 6-1/8"W x 23-1/2"L

Part	Name	Qty.	Material	TH x W x L
A	Bookend	2	Mahogany	3/4" x 5-1/2" x 7"
B	Endcap	2	Mahogany	3/4" x 2-1/8" x 6-1/8"
C	Base	2	Mahogany	3/4" x 5-3/4" x 1-1/4"
D	Rail	2	Mahogany	3/4" x 15/16" x 23"
E	Pegs	10	Walnut	3/8" x 3/8" x 1/4"



**1** Begin by sawing the sliding bookends and other curved pieces. You can cut two at the same time. Hold the pieces together with double-stick tape.



**2** Rout a stepped profile on the bookends using a rabbeting bit. To safely begin the cut, pivot the workpiece against a starting pin. Once started, you can ride on the bit's bearing.

## MAKE THE PARTS

1. Mill the bookends (A), endcaps (B) and bases (C) to final size. Mill the rails (D) an extra 1/8 in. thick.

2. Cut the bookends, endcaps and bases on the bandsaw (Photo 1; Fig. A, page 46). Sand the sawn edges. Use 100-, 120- and 150-grit sandpaper.

3. Rout the bookend profile with a 3/8-in. rabbeting bit (Photo 2; Fig. A, Detail 1). Raise the bit in 1/16-in. increments to avoid tear-out. Use a chisel to square the rabbet's inside corners.

4. Cut shallow mortises into the bookends (Fig. A, Detail 1). Cut through mortises in the endcaps and rails (Photo 3; Fig. A, Details 2 and 3).

5. Plane the rails to final thickness (Photo 4).

6. Cut tenons on the rails using a dado set (Fig. A, Detail 3).

7. Make pegs (E) from 3/8-in.-thick square blank. Cut the pegs to length with a Japanese pull saw, dovetail saw or bandsaw.

## ASSEMBLE THE BOOKRACK

8. Glue and clamp the rails and endcaps. Work on a flat surface. Check the assembly for wobble before you set it aside to dry.

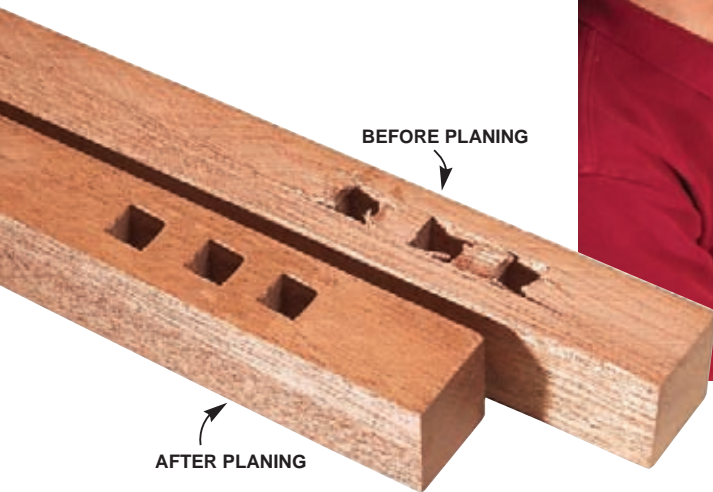


**3** Cut square holes through the rails using a mortising machine. Some tear-out on the back is inevitable, even with a sacrificial board under the rail, but you'll remove it in the next step.

9. Glue pegs (E) into the bookends and endcaps (Photo 5). Leave the pegs proud by at least 1/16 in. Scrape excess glue from around the pegs before the glue dries.

For small projects,  
the beauty is in the details.

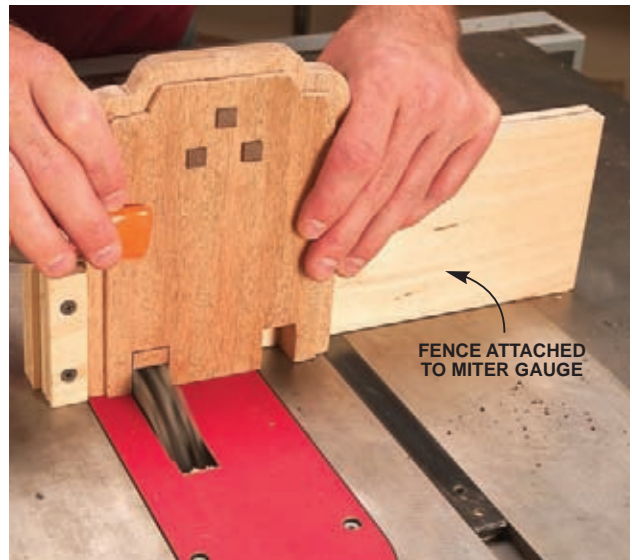




**4** Plane the rails to final thickness. Place the torn-out sides facing up. They'll come out perfectly smooth.



**5** Glue walnut pegs into the square holes. The heads of the pegs should be slightly proud of the surface. Round over their sharp corners with sandpaper after the glue is dry.



**6** Cut slots in the bookends. Their spacing is critical for the bookends to slide smoothly on the rails. Assemble the base first; then mark each slot's position directly from the rails.

**10.** Use 180-grit sandpaper in a random-orbit sander to round the edges of the pegs.

**11.** Mark the positions of the bookend slots directly from the rail and endcap assembly. Cut the slots using your miter gauge and a tall auxiliary fence (Photo 6). Make multiple passes, raising the blade 1/4 in. with each cut.

**12.** Predrill the bases and bookends. Screw these parts together on the rail and endcap assembly and test their fit. There should be a little play so the bookends will slide. Disassemble the bases and bookends for finishing.

**13.** Sand with 180- and 220-grit sandpaper to gently

round the edges of the bookends, endcaps, rails and bases. Don't sand the bookends' bottom edges.

**14.** Apply the finish. I used a mixture of cherry and medium-walnut Danish oil to achieve a beautiful warm tone, and wiped on two coats.

**15.** After the finish is dry, apply a coat of paste wax over every surface and rub out with #0000 steel wool to an even sheen. This is an essential step. The wax lubricates the rails, allowing the bookends to slide smoothly.

**16.** Screw the bases to the bookends and load the rack with books.