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Shaker, Mission
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CUSTOM WOODWORKING

American Style

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& Country Projects

By the editors of Time-Life Books
and *Woodsmith* magazine

Time-Life Books, Alexandria, Virginia

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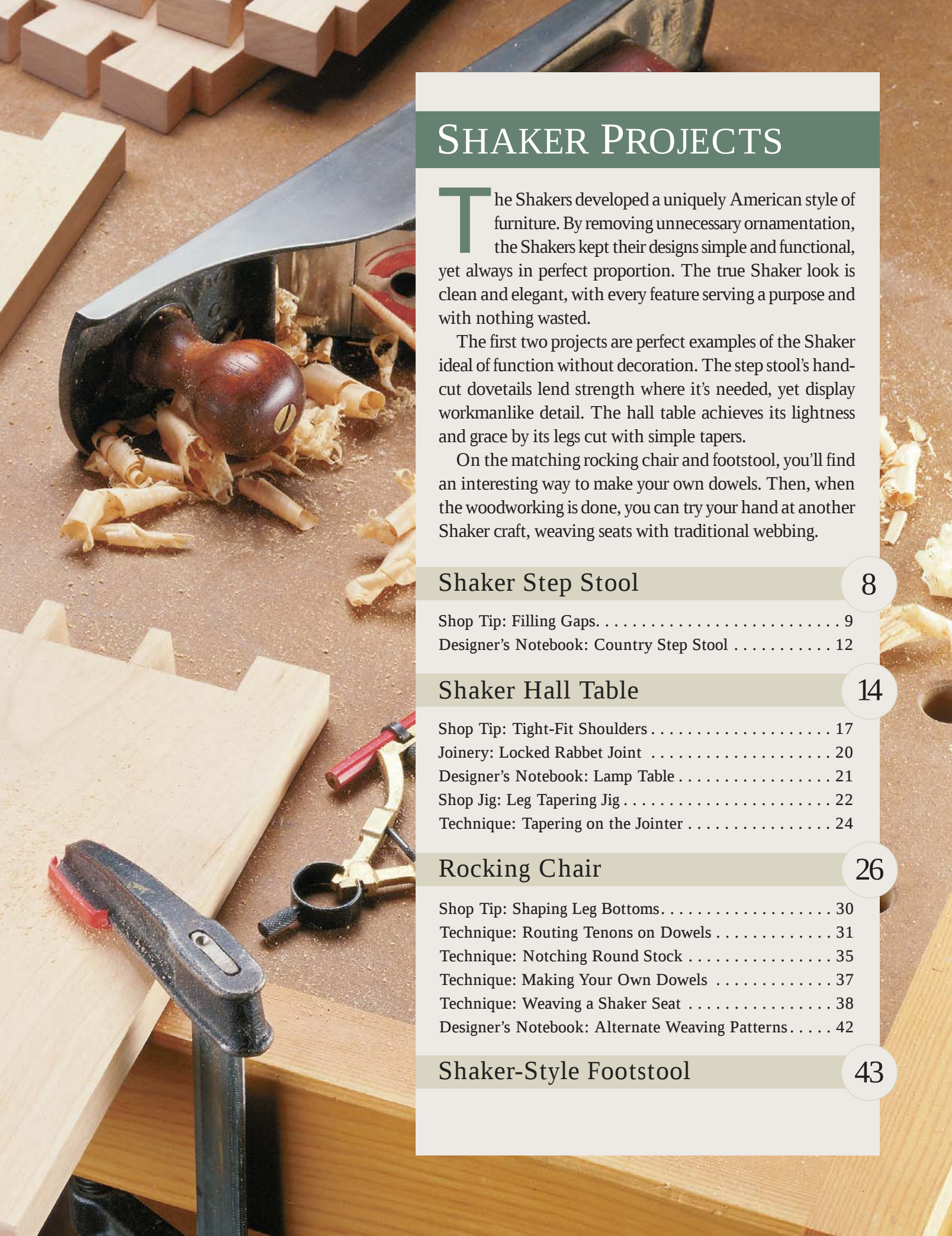


Oak Sofa Table



High-Back Bench





SHAKER PROJECTS

The Shakers developed a uniquely American style of furniture. By removing unnecessary ornamentation, the Shakers kept their designs simple and functional, yet always in perfect proportion. The true Shaker look is clean and elegant, with every feature serving a purpose and with nothing wasted.

The first two projects are perfect examples of the Shaker ideal of function without decoration. The step stool's hand-cut dovetails lend strength where it's needed, yet display workmanlike detail. The hall table achieves its lightness and grace by its legs cut with simple tapers.

On the matching rocking chair and footstool, you'll find an interesting way to make your own dowels. Then, when the woodworking is done, you can try your hand at another Shaker craft, weaving seats with traditional webbing.

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Shaker Step Stool

Made from cherry with hand-cut dovetails, this step stool has lots of Shaker touches in a small project. Or you can try your hand at our optional country version made of pine and using butt joints.



Shaker furniture is famous for its basic, uncluttered style, as well as its unquestioned utility. The step stool shown here is a classic example of Shaker design at its best. It's simple furniture that works.

DOVETAILS. The only decoration (if it can be called that) is the beauty of the wood and the dovetail joints.

And when you look closely, you'll see there are two types of dovetails. First, the treads of the steps are joined to the legs with traditional through-dovetails. Then, you'll see the braces at the front of each step (and also across the back) are secured to the legs with a variation

of this joint. Here, a half-dovetail joint adds a nice touch of craftsmanship. (If you've never cut dovetails by hand or need to brush up your technique, step-by-step instructions begin on page 120.)

ALTERNATE STYLE AND JOINT. With a few minor changes, the step stool can be built as a country-style stool. This version is put together primarily with butt joints and screws. Instructions for building this option are given in the Designer's Notebook on page 12.

MATERIALS. The step stool in the photo was made from cherry. I chose cherry for this project mostly because it's tight-grained so it's an excellent

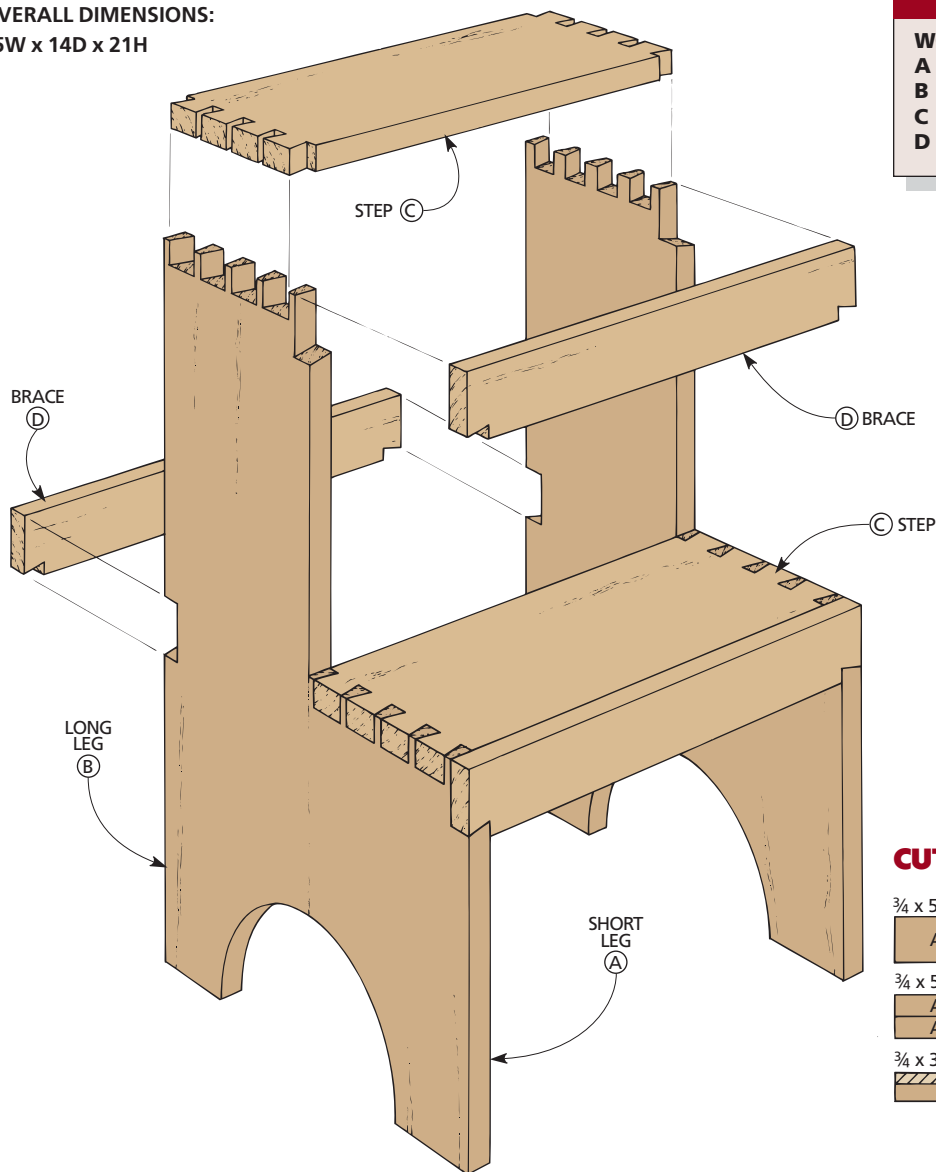
wood to work with hand tools. Also, the Shakers would likely have used cherry for this project. But just about any $\frac{3}{4}$ "-thick hardwood would be suitable.

FINISH. The stool shown above was finished with Danish oil, which is a mixture of tung oil or linseed oil and varnish. This provides a finish that's durable, but easy to touch up as the step stool gets scuffed from use.

There is also an unexpected benefit to choosing this finish. It provided a way to fill some of the slight imperfections you may have in the fit of the dovetails. To learn more about this, see the Shop Tip on the next page.

EXPLODED VIEW

OVERALL DIMENSIONS:
15W x 14D x 21H



MATERIALS LIST

WOOD

A	Short Leg (2)	$\frac{3}{4}$ x 7 - 10 $\frac{1}{2}$
B	Long Leg (2)	$\frac{3}{4}$ x 7 - 21
C	Step (2)	$\frac{3}{4}$ x 7 - 15
D	Braces (3)	$\frac{3}{4}$ x 2 - 15

CUTTING DIAGRAM

$\frac{3}{4}$ x 5 $\frac{1}{2}$ - 48 (2 BOARDS - 2 Bd. Ft. ea.)

A	B	C
---	---	---

$\frac{3}{4}$ x 5 $\frac{1}{2}$ - 48 (2 Bd. Ft.)

A	B	C
A	B	C

$\frac{3}{4}$ x 3 $\frac{1}{2}$ - 48 (1.3 Bd. Ft.)

D	D	D
---	---	---

SHOP TIP

Very few woodworkers can cut perfect dovetails every time. There are bound to be small voids no matter how hard you try. The trick is to fill these voids so they blend into the rest of the joint.

One solution is to apply a liberal amount of a Danish oil. Then while it's still wet, sand with 220 grit silicon carbide sandpaper.

While you sand, you'll create a slurry of sawdust and oil. As it accumulates, work this slurry into the gaps in the joint. Keep sanding until there's enough to fill the voids between the pins and tails.

The mixture will dry very hard, and it matches the end grain of the pins and tails almost perfectly.

Filling Gaps



LAYOUT

It's easiest to start this project by thinking of the legs as four separate pieces. There are two short legs (A) for the front and two long legs (B) for the back (*Fig. 1*). Later, a short and long leg are joined together to form each "stair-step" leg (*Fig. 3*). So I started by laying out the cuts to make the four legs and two steps (C).

GLUE UP. First, I cut two pieces for each leg, one 5" wide and one 2½" wide. These are edge-glued together (*Fig. 1*). (These pieces can be different widths as long as the glued up blank is a bit wider than 7".)

After the glue was dry, I planed the blanks flat. Make sure they're an even thickness, especially at the ends (where the dovetails will be cut).

After each blank was planed, I cut off one end square with the edges (leaving the other end rough, and a little long for now). Then I ripped them all down to the final width of 7".

DOVETAILS

The next step is to lay out the cuts for the dovetails in the legs and steps.

Since the tails can be made fairly wide, they're strong enough to support a person's weight. So the joints should be laid out with the tails on the steps and the pins on the legs.

Once I'd decided on the placement of the pins and tails, I figured their size (*Fig. 2*). The tails are five times wider than the pins to provide the strength needed on the steps.

However, there is one more thing to allow for when laying out the joint. Even though the width of each board is 7", the dovetails are laid out across a width of only 6¼". The extra ¾" on the front edge of each board allows for the thickness of the brace (added later).

PINS. The pins are laid out so the narrowest part is on the outside (face side) of each leg (Top View in *Fig. 2*). Then a bevel gauge is set to a 1:5 angle to mark the angles on the end of each board (Top View in *Fig. 2*).

After marking the cut lines, cut the pins as with any other dovetail joint — except the half pin on the front edge of each piece is left extra wide to allow for the notch for the brace (*Fig. 3*).

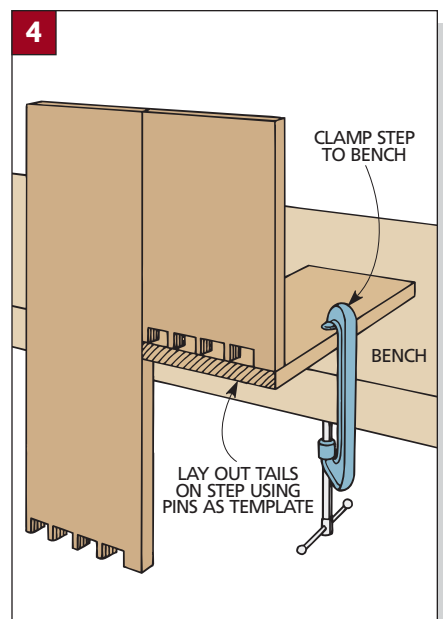
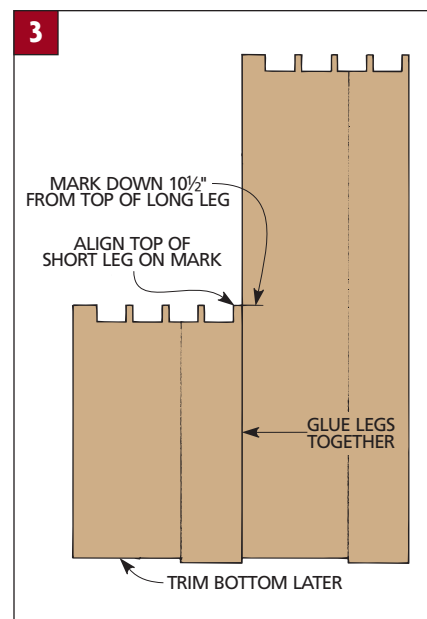
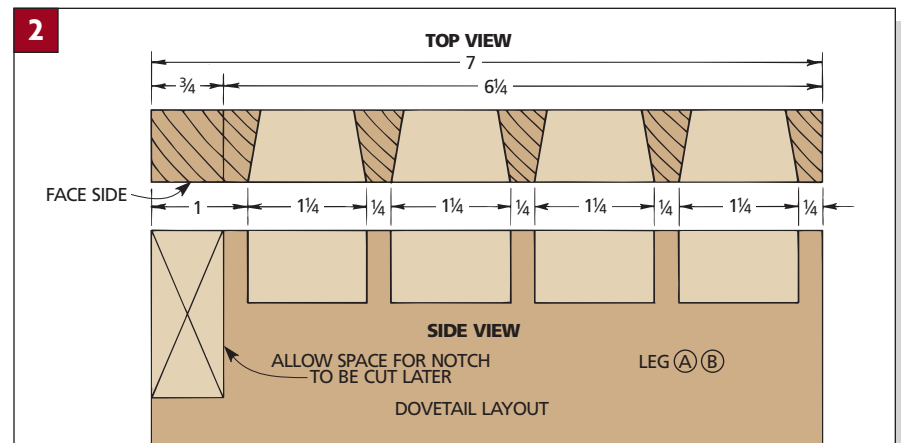
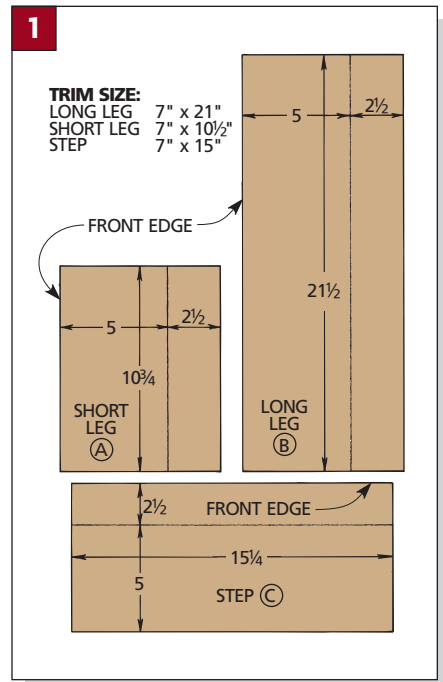
GLUE UP LEGS. Before marking the cut lines for the tails, I glued a short leg

to each long leg to form the stair-step legs (*Fig. 3*).

Although this makes laying out the tails a bit awkward (*Fig. 4*), there is a reason. If you glue the legs together first, you can plane this assembly, evening out any variation at the glue-joint line. Since you'll have to plane the whole surface, the thickness of the pins will change. When the pins are at their final thickness, then they can be used to lay out the tails. When marking the tails, make sure the steps are lined up with the back edge of the leg.

FINAL FITTING. Once the pins and tails are cut, go ahead and tap the joints together. The joints should be tight, and the assembled stool should be square.

Once everything fits, the bottom of the legs can be cut off square. Finally, to keep the stool from rocking on an uneven floor, a 4"-radius half-circle is cut on the bottom of each leg.



BRACES

Before gluing the legs and steps together, the braces (D) must be cut. There are three braces: one on the back to prevent racking and two at the front to reinforce the steps.

HALF-TAIL. All three braces are joined to the legs with half-dovetail joints. This amounts to a large half-pin notch in the front edge of each leg, and a matching half-tail on each end of the braces. I found it easiest to cut the half-tail first, then use it to lay out the notches.

To cut the half-tail, mark a 1:5 angle on only one end of each brace. This line starts $\frac{1}{4}$ " up from the bottom edge (Fig. 10a). Then mark a shoulder line equal to the thickness of the leg. Cut down the shoulder line with a dovetail saw and remove the waste with a chisel.

Before marking the shoulder line on the other end of each brace, first dry-assemble the legs with the steps. Then make sure the shoulder-to-shoulder measurement on the brace is equal to the distance between the legs (Fig. 5). Now you can mark the angle and cut out the V-notch.

HALF-PINS. Once the half-tails are cut, hold the ends of the brace against the front legs to mark the cut lines for the half-pin notches (Fig. 6). I used a dovetail saw to saw down both cut lines.

The half-pin notch on the back is cut a bit differently. After marking the cut lines (so they're even with the front brace), I made the two shoulder cuts to the depth of the notch (Fig. 8). Then I removed most of the waste with a coping saw, and cleaned up the cut with a chisel.

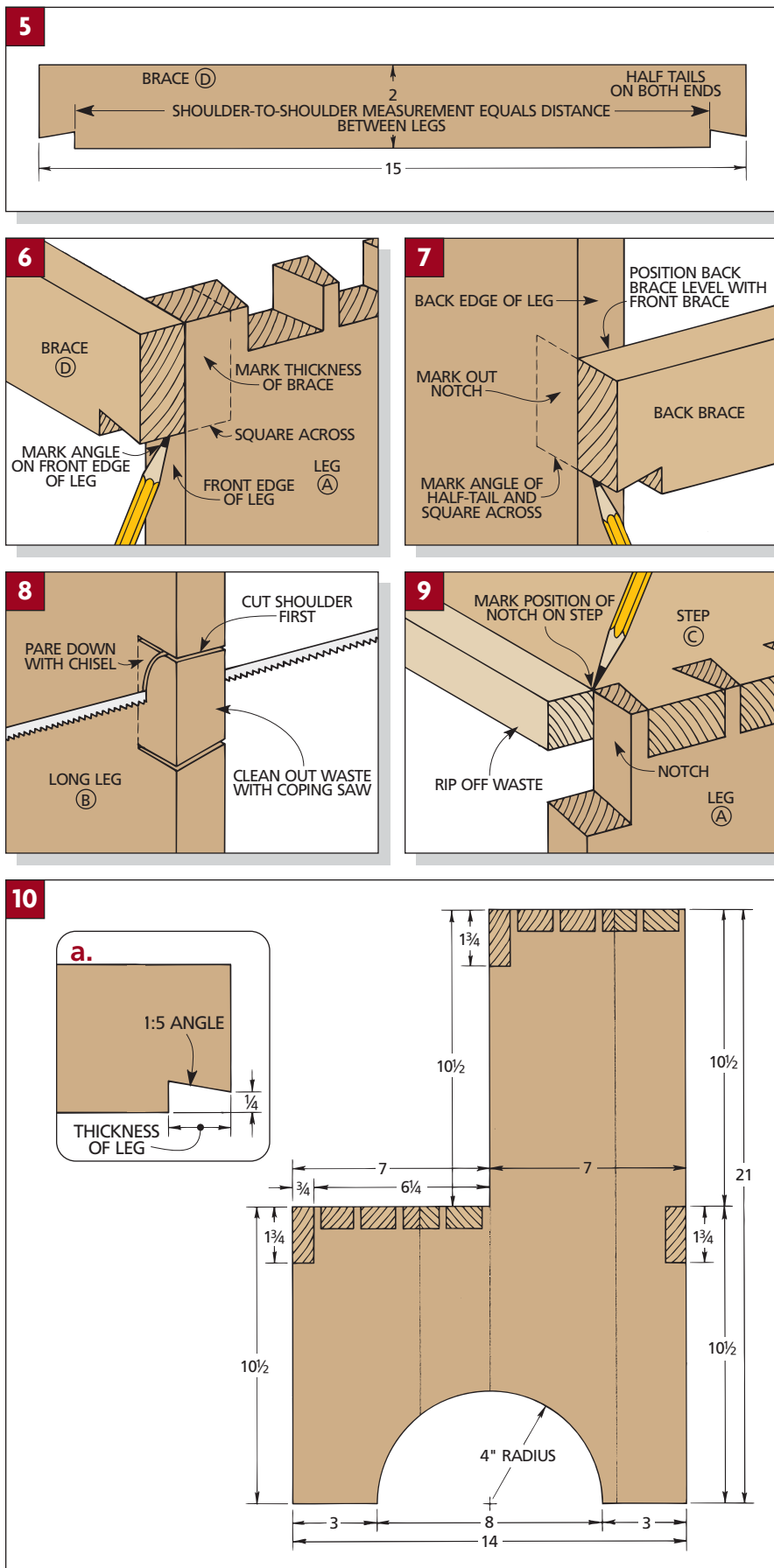
After the notches are cut, trim the front edges of the steps to final width (Fig. 9).

GLUE UP & FINISHING

After dry-assembling the stool to check the fit and for square, I glued everything together. I positioned the clamps on top of the tails to pull the joints tight. A piece of scrap under the legs provided a clamping surface across the half-circle cut-out.

Although it was nice to use hand tools for most of this project, I cheated a bit and used a belt sander to bring the pins flush with the surface of the steps.

FINISH. Finally, I finished the step stool with a Danish oil. ■



This country version of the step stool uses screws and butt joints instead of dovetails. For a real country look, try making it from pine and finishing it with milk paint.

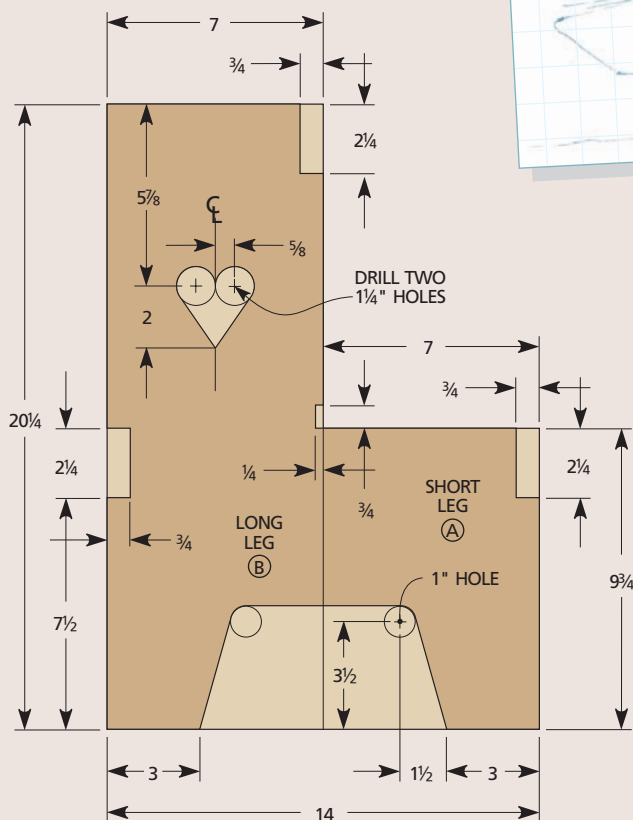
CONSTRUCTION NOTES:

■ Start by gluing up four panels a little long for the two short legs (A) and two long legs (B) (see drawing below). When the glue is dry, cut the panels to finished length. (The legs are not glued together to form the stairsteps until after some cuts are made in each piece.)

■ Next, cut $2\frac{1}{4}$ "-wide notches in each panel for the braces. One way to cut these is with a dado blade on the table saw. A tall auxiliary fence fastened to your miter gauge will help keep the pieces steady during the cut.

■ To lay out a $\frac{3}{4}$ "-wide notch for the bottom step in the long leg (B), set a short leg (A) next to a long leg with their bottom ends flush. The top of the short leg indicates the bottom of the step notch. Cut the notch $\frac{1}{4}$ " deep.

■ Now lay out the location of the heart cutout in each of the long legs.



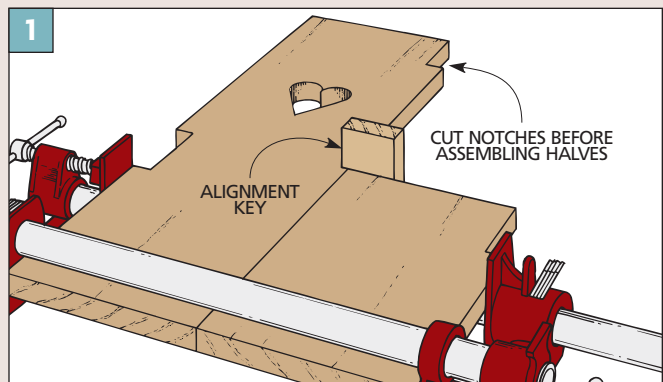
MATERIALS LIST

CHANGED PARTS

A Short Legs (2)	$\frac{3}{4}$ x 7 - $9\frac{3}{4}$
B Long Legs (2)	$\frac{3}{4}$ x 7 - $20\frac{1}{4}$
C Steps (2)	$\frac{3}{4}$ x 8 - 16
D Braces (3)	$\frac{3}{4}$ x $2\frac{1}{4}$ - 15

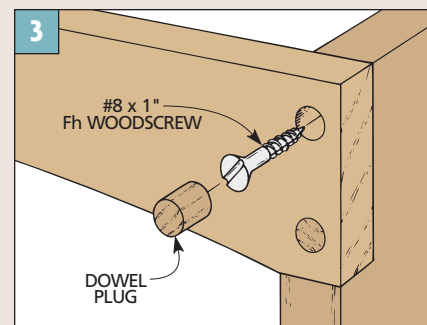
HARDWARE SUPPLIES

(12) No. 8 x 1" Fh screws
(8) No. 8 x $1\frac{1}{2}$ " Fh screws
(1) $\frac{3}{8}$ " dowel, 12" long

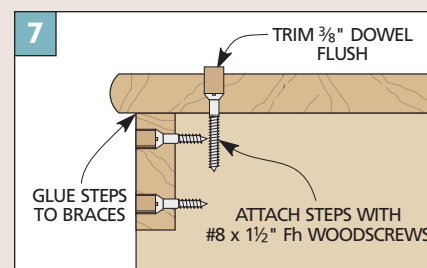
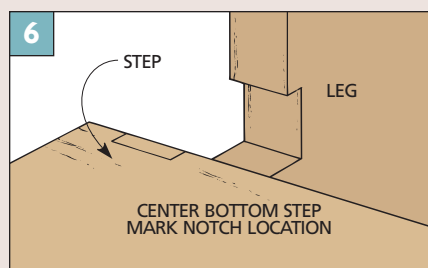
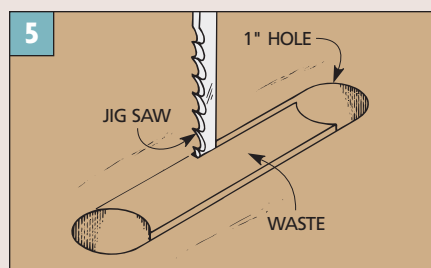
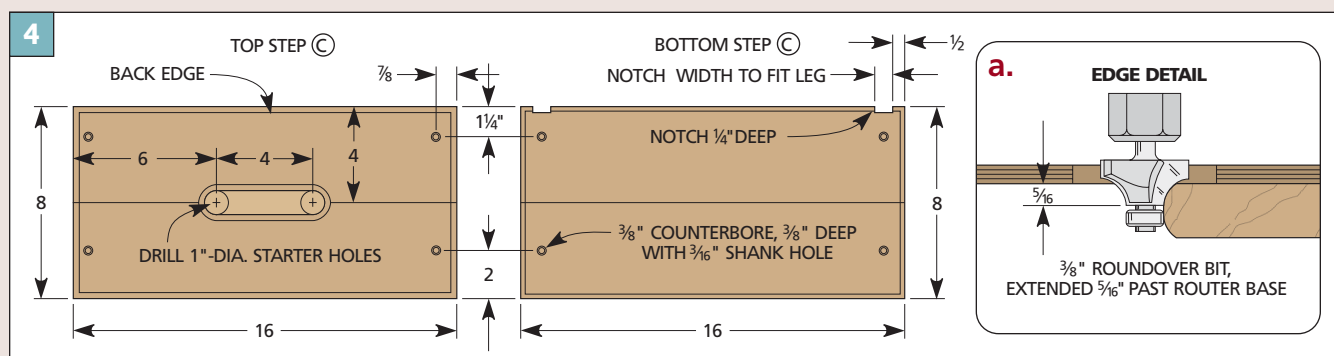


■ Next, fill each counterbore by gluing in a length of $\frac{3}{8}$ "-dia. dowel.

■ Now you can fasten the steps to the legs. Simply center a step on the frame. (There should be a 1/2" overhang on all sides.) Then drill counterbores, shank holes and pilot holes as you did for the braces. Finally, glue the steps to the braces and screw them to the legs using No. 8 x 1 1/2" Fh woodscrews (*Fig. 7*).



■ Finally, ease any sharp edges with sandpaper, then apply a finish. For a finish that stands up to lots of use, try polyurethane. For a more traditional country look, see the Finishing box about milk paint beginning on page 104.



Shaker Hall Table

The simple lines of this table hide the woodworking techniques that make it so rewarding to build. Even though there's a variety of joinery, it can all be cut on the table saw and router table.



This hall table is probably the most traditional Shaker project in this book. The tapered legs, a hallmark of Shaker design, lead up to the straight, uncluttered lines of the table.

The legs have a square taper that's cut on a table saw. It's a simple technique that's made even easier with a jig we show you how to build beginning on page 22. There's also a way to taper the legs on the jointer. Instructions for doing this begin on page 24.

JOINERY. The legs are joined to the front and side aprons with traditional mortise and tenon joints. If you haven't tried this type of joinery, it's not as diffi-

cult as it sounds. It can all be done on a router table (for the mortises) and a table saw (for the tenons).

DRAWERS. For the drawers, I used two variations of a locked rabbit joint. As its name implies, it locks the sides of the drawer to the drawer front and back. This makes it quite strong so the drawers can take years of use. This joint is also cut entirely on the table saw.

FINISH. I built this table out of cherry. One of the keys to success when finishing cherry is patience. It takes time for the wood to reach the rich red color that cherry is known for.

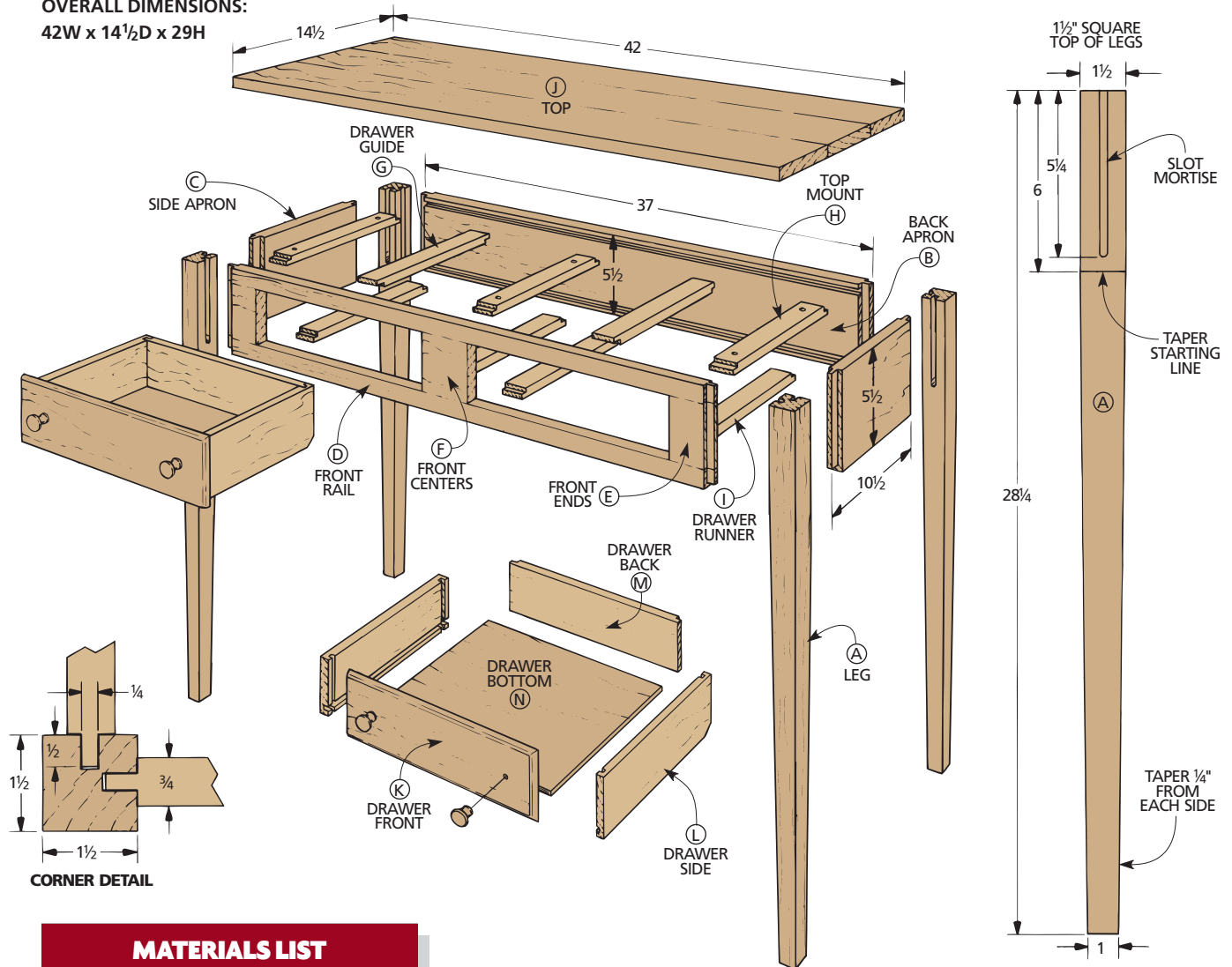
When it comes from the lumber-

yard, cherry is usually a light pink or salmon color. There's no need to stain it to get the dark color. As soon as the finish is applied, the wood will darken somewhat. With time (about six months) and continued exposure to sunlight, it will turn a rich, dark red. It's well worth the wait.

LAMP TABLE. In the Designer's Notebook on page 21, we show how you can make a lamp table companion piece (or two) by simply shortening the length of the table. And since the construction is so similar, it's easy to cut the parts for the lamp table while you're set up to cut pieces for the hall table.

EXPLODED VIEW

OVERALL DIMENSIONS:
42W x 14½D x 29H



MATERIALS LIST

TABLE

A Legs (4)	1½ x 1½ - 28¾
B Back Apron (1)	¾ x 5½ - 37
C Side Aprons (2)	¾ x 5½ - 10½
D Front Rails (2)	¾ x 1 - 37
E Front Ends (2)	¾ x 3½ - 2¾
F Front Center (1)	¾ x 3½ - 3½
G Drawer Guides (2)	¾ x 1½ - 10¾
H Top Mounts (3)	¾ x 1½ - 10¾
I Drawer Runners (4)	¾ x 1½ - 10¾
J Top (1)	¾ x 14½ - 42

DRAWERS

K Fronts (2)	¾ x 4¾ - 14¹¹⁄₁₆
L Sides (4)	½ x 3¾ - 10¾
M Backs (2)	½ x 2¹⁵⁄₁₆ - 13⁷⁄₁₆
N Bottoms (2)	¼ ply - 10⁵⁄₈ x 13⁷⁄₁₆

HARDWARE SUPPLIES

- (2) No. 6 x ¾" Rh woodscrews
- (6) No. 8 x 1¼" Rh woodscrews
- (6) ⅜" flat washers
- (18) ¾" brads
- (4) ⅝" brads
- (4) 1"-dia. cherry knobs w/ screws

CUTTING DIAGRAM

1½ x 3¼ - 60 (3.2 Bd. Ft.)



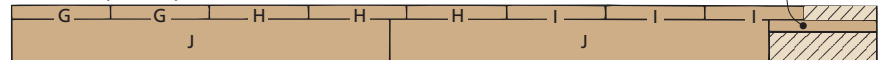
¾ x 5¾ - 60 (2.5 Bd. Ft.)



¾ x 6½ - 84 (3.9 Bd. Ft.)



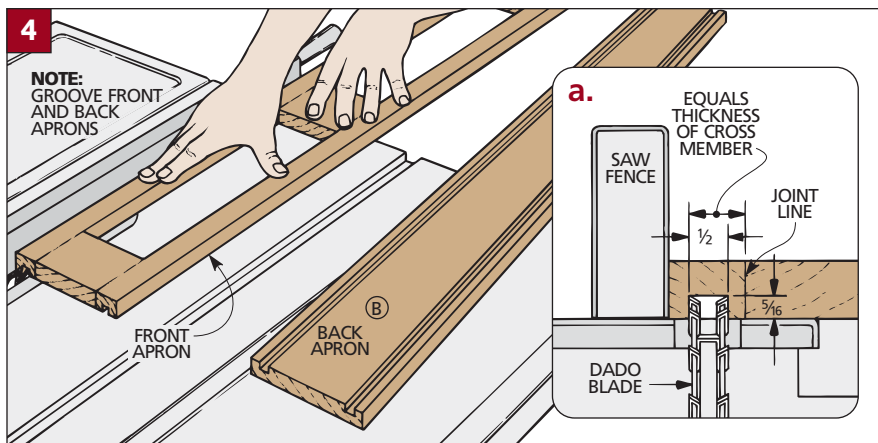
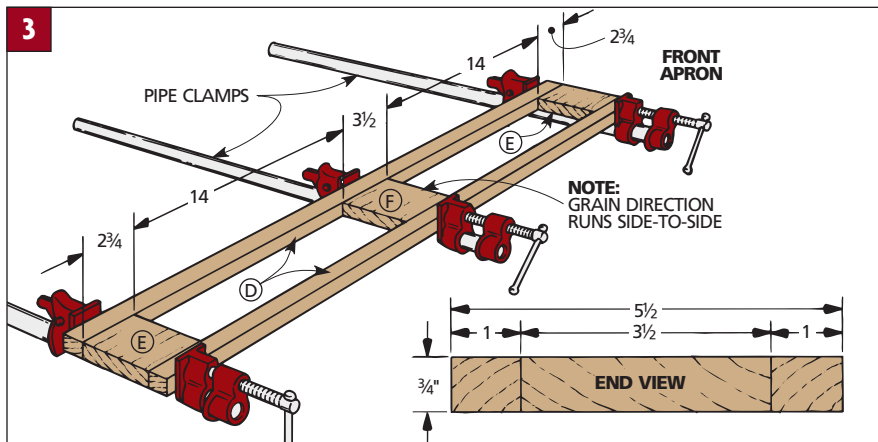
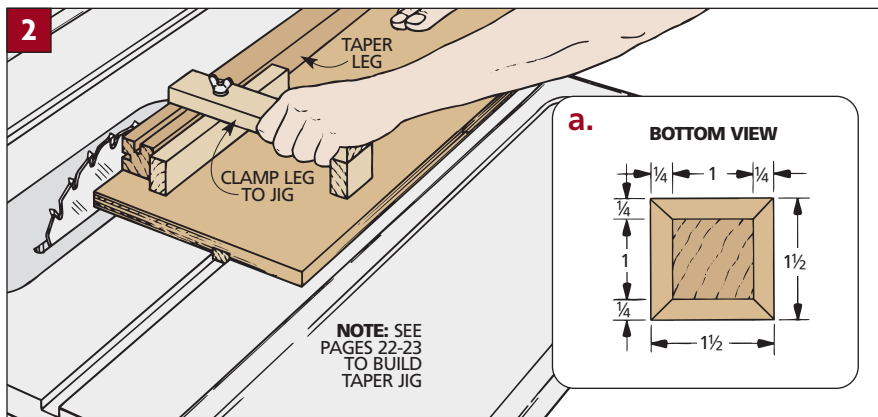
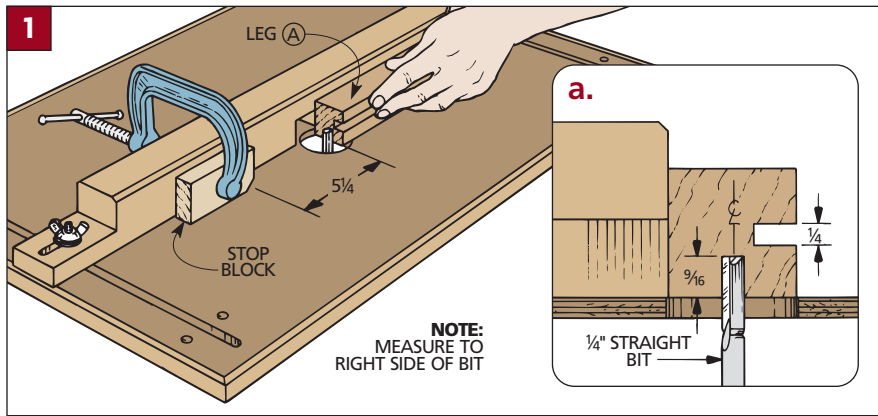
¾ x 6 - 96 (4 Bd. Ft.)



½ x 3¾ - 84 (2.1 Sq. Ft.)



NOTE: ALSO NEED ONE SHEET OF ¼" x 24" x 48" PLYWOOD FOR DRAWER BOTTOMS.



LEGS

This project starts by making the tapered legs and cutting the mortises in each of them.

Begin by cutting four leg blanks (A) to 1 1/2" square by 28 1/4" long (refer to the Exploded View on page 15).

MORTISES. After cutting the legs to size, mark two adjacent sides where the mortises will be cut. (It's best to cut the mortises before tapering the legs.) The mortises are easy to cut on a router table with a 1/4" straight bit.

To set up the router table for the mortises, start by raising the bit 9/16" high (Fig. 1a). Then move the fence until the bit is centered on the thickness of the leg.

The length of the mortise is set by clamping a stop block to the fence 5 1/4" from the right side of the bit (Fig. 1). Now you can cut the mortises on two adjacent sides.

TAPERS. After the mortises are routed, the next step is to taper all four sides of each leg. To cut the tapers, I used a sliding platform jig on the table saw (Fig. 2). (Instructions for building and using this jig begin on page 22. An alternate method of tapering the legs, using the jointer, is shown on page 24.)

Whatever method you use, the point is to cut a taper on each side of the leg that starts 6" from the top end and tapers down so the bottom end is 1" square. This means cutting 1/4" off each side (Fig. 2a).

APRONS

After the tapers are cut, the next step is to cut the front apron assembly. This consists of five pieces glued together to form two drawer openings (Fig. 3).

FRONT APRON. To make the front apron, start by ripping the top and bottom rails (D) 1" wide by 37" long.

To make the three dividers for this front assembly, rip a blank 3 1/2" wide. Then cut off two end dividers (E) 2 3/4" long, and a front center (F) 3 1/2" long. (This ensures that the grain runs the same direction as the rails.)

ASSEMBLE FRONT APRON. After cutting all five pieces for the front apron, glue and clamp the dividers between the top and bottom rails (Fig. 3). Make sure the center divider (F) is centered on the length, and the end dividers (E) are flush with the ends.

BACK AND SIDE APRONS. Next, cut the back apron (B) and side aprons (C). Start by ripping the stock for these pieces to a width of $5\frac{1}{2}$ ". Then cut the three pieces to finished lengths of $10\frac{1}{2}$ " for the sides, and 37" for the back. (The back apron should be exactly as wide and as long as the front assembly.)

GROOVES. To support and guide the drawers, cross members (G, H, I) fit into $\frac{1}{2}$ "-wide grooves cut along the inside faces of the front and back aprons (refer to Fig. 11 on page 18).

The positions of these grooves are critical. They have to be cut so that when the drawer runners (I) are mounted, they're flush with the top edge of the front apron's bottom rail (refer to Fig. 11c on page 18).

To set up the saw for this position, adjust the fence so the distance from the inside edge of the rail (the joint line shown in Fig. 4a) to the inside edge of

the dado blade equals the thickness of the stock for the drawer runner. (This means you need to measure from the joint line, not the rip fence.) Then cut the grooves in the front and back aprons (Fig. 4).

TENONS. Now tenons can be cut on the ends of the aprons to fit the mortises in the legs. I cut them on the table saw (Fig. 5).

The $\frac{1}{2}$ "-long tenon is formed by cutting $\frac{1}{2}$ "-wide rabbets on both faces of the apron (Fig. 5a).

Note: The tenon is $\frac{1}{16}$ " less than the depth of the mortise to allow a little glue relief at the bottom of the mortise.

To cut the tenons, I used a $\frac{3}{4}$ "-wide dado blade and moved a wooden auxiliary fence over the blade so only $\frac{1}{2}$ " was exposed (Fig. 5).

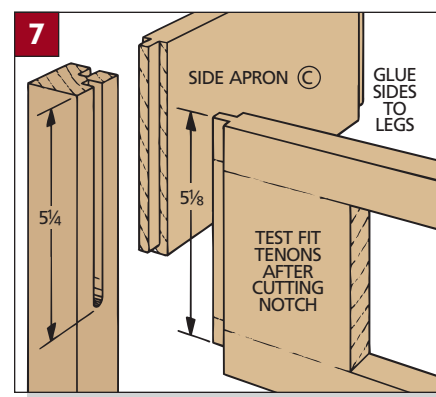
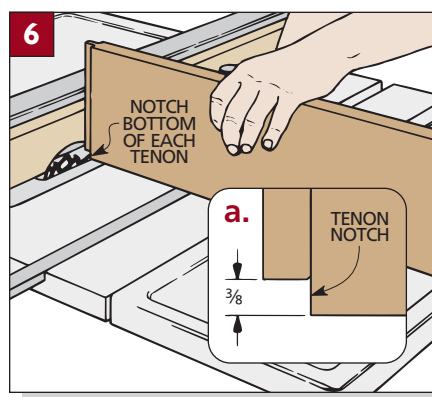
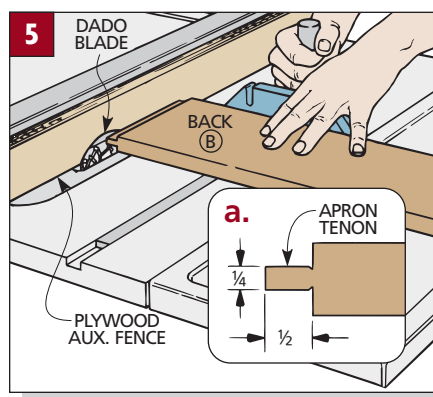
Sneak up on the final height of the blade by raising it and making a pass on both faces of a scrap piece until the

tenon fits the mortise. Once set, cut rabbets on both ends of all four aprons to produce tenons centered on the thickness of the stock.

Note: To get a tight fit against the leg, I used a chisel to slightly undercut the shoulders of each tenon. (See the Shop Tip at the bottom of this page for more on this.)

NOTCH TENONS. So that the top of each apron will sit flush with the top of each leg, the bottom end of each tenon has to be notched (Fig. 7). Since the mortises are rounded on the bottom, I cut the tenon a trifle shorter so I didn't have to square up the bottom of the mortise. This means cutting a $\frac{3}{8}$ " notch on the bottom of each tenon (Fig. 6).

END PIECES. To make assembly easier later, I glued a pair of legs to each side apron to produce two complete end units. But don't glue on the front or back aprons yet.



SHOP TIP

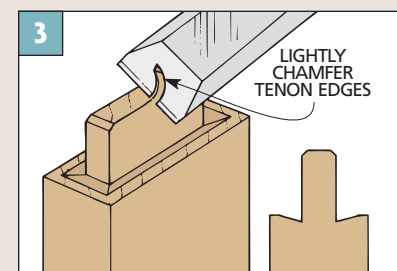
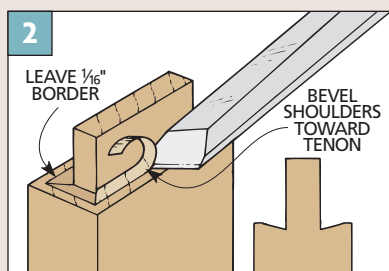
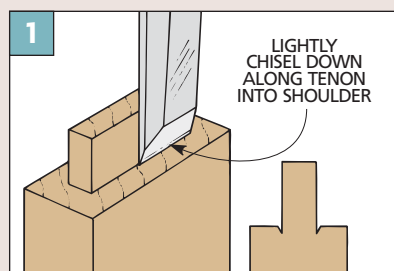
There's an easy way to make mortise and tenon joints fit together without gaps at the shoulders.

"Undercutting" simply means paring away the end grain $\frac{1}{64}$ " deep along the tenon's shoulders.

The trick is to undercut the area next to the tenon cheek, leaving at least $\frac{1}{16}$ " untouched along the outside edge of the shoulder. If you cut all the way to the edge, you'll have a gap and a loose joint.

Start by lightly pushing a chisel straight into the corner (Fig. 1). Do this all the way around the tenon. Then to remove the waste, angle the chisel in toward the cheek of the tenon (Fig. 2).

Also, to prevent the square ends of the tenon from pushing all the glue to the bottom of the mortise, lightly chamfer the ends (Fig. 3). This chamfer can be cut with a chisel or block plane.



Tight-Fit Shoulders

CROSS MEMBERS, TOP, & ASSEMBLY

Next, nine cross members are cut to fit between the front and back aprons. Two of these pieces mount above the drawers for drawer guides (G), three are top mounts (H) used to fasten down the table top, and four sit below the drawers as runners (I) (Fig. 10).

CUT TO SIZE. First rip enough stock $1\frac{1}{2}$ " wide to make the nine pieces. To determine their length, dry assemble the table. (It may be easiest to do this with the table upside down.) Measure the distance between the front and back aprons to get the shoulder-to-shoulder length of the cross members. Now add $\frac{1}{2}$ " to this measurement to account for a $\frac{1}{4}$ "-long tenon on each end.

After cutting the pieces to length, form the tenons by cutting a $\frac{1}{4}$ "-wide by $\frac{1}{4}$ "-deep rabbet at each end (Fig. 8).

DRAWER GUIDES. The two drawer guides (G) each have a $\frac{1}{8}$ "-wide groove cut down the center (Fig. 9a). This groove guides a pin that's mounted on the back of the drawer. The pin helps keep the drawer straight as it's pulled out of the carcass.

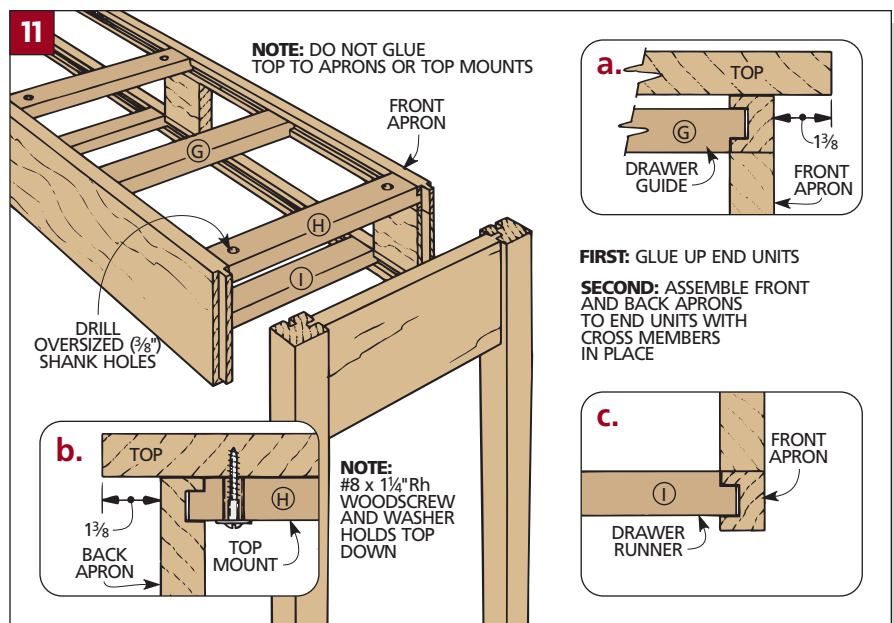
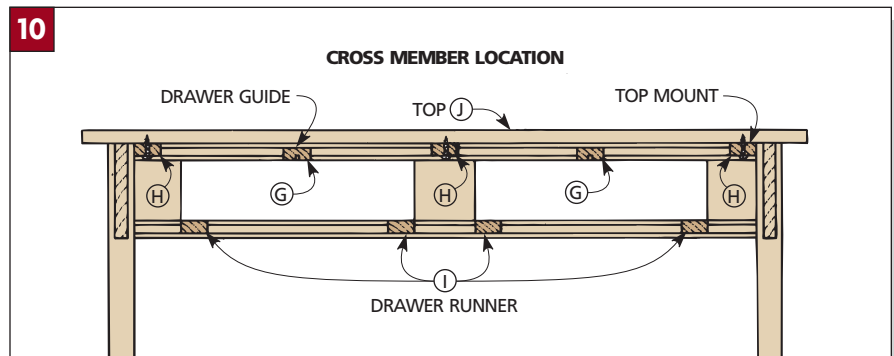
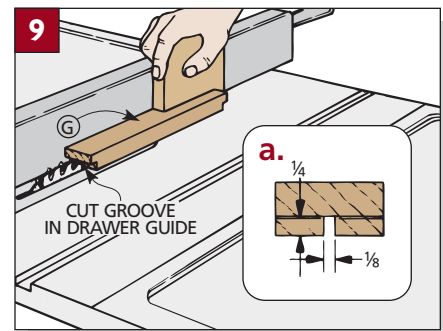
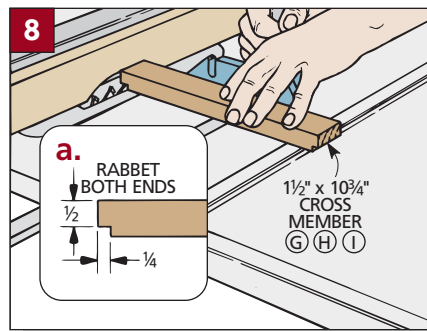
TOP MOUNT PIECES. To allow the table top to expand and contract, I drilled oversized shank holes ($\frac{3}{8}$ "-dia.) on the three top mounts (H) (Fig. 11b). These holes are centered on the width and drilled $1\frac{1}{4}$ " from each end on all three pieces.

TABLE TOP. Now glue up a blank for the table top (J). Then cut this blank to final size so it will overhang each of the side aprons by $1\frac{7}{8}$ " and the front and back aprons by $1\frac{3}{8}$ ".

ASSEMBLY. After the parts are cut, dry-assemble the table and check it for square. If everything is okay, glue and clamp the front and back aprons to the leg units. Make sure the cross members are in position but *not* glued in.

There's one important thing to watch as you position the cross members. The rabbets face down on the drawer guides (Fig. 11a), but up on the top mount (Fig. 11b), and drawer runners (Fig. 11c). Use $\frac{3}{4}$ " brads to tack *only* the top mounts (H) in place. The other cross members will be secured after the drawers are added.

Now center the table top on the aprons and screw (don't glue) it down to the top mounts (Fig. 11b). Use $\frac{3}{16}$ " washers under the screw heads.



DRAWERS

Once the table is assembled, all that's left to build are the drawers. The first step in making the drawers is to cut the pieces for each drawer to size.

FRONTS. The drawer fronts (K) are cut from $\frac{3}{4}$ "-thick stock. The length of each front is $\frac{11}{16}$ " more than the width of the drawer opening. This allows for a $\frac{3}{8}$ " lip on both ends ($\frac{3}{4}$ " total), minus $\frac{1}{16}$ " for clearance. As for the height of the drawer front, measure the height of

the opening, add $\frac{3}{4}$ " for the lips, and subtract $\frac{1}{16}$ " for clearance.

SIDES. The drawer sides (L) are cut from $\frac{1}{2}$ "-thick stock. Cut them to width (height) to match the height of the drawer opening, minus $\frac{1}{16}$ " for clearance. As for the length of the sides, measure the depth of the table (from the front of the drawer opening to the back apron). Then subtract about $\frac{1}{4}$ " from this measurement.

BACK. The backs (M) are cut to rough width to match the drawer sides

and to rough length to match the drawer front. (The backs are trimmed to final size later.)

LOCKED RABBET JOINT. After cutting the pieces to size, locked rabbet joints are cut to join the drawer sides to the fronts (*Fig. 13*). See the Joinery box on the next page for details on doing this.

A variation of the locked rabbet joint is used to join the drawer back to the sides. First, trim the back to final length. To get this length, measure the distance from end to end of the tongues on the drawer front. Cut the back to equal this measurement.

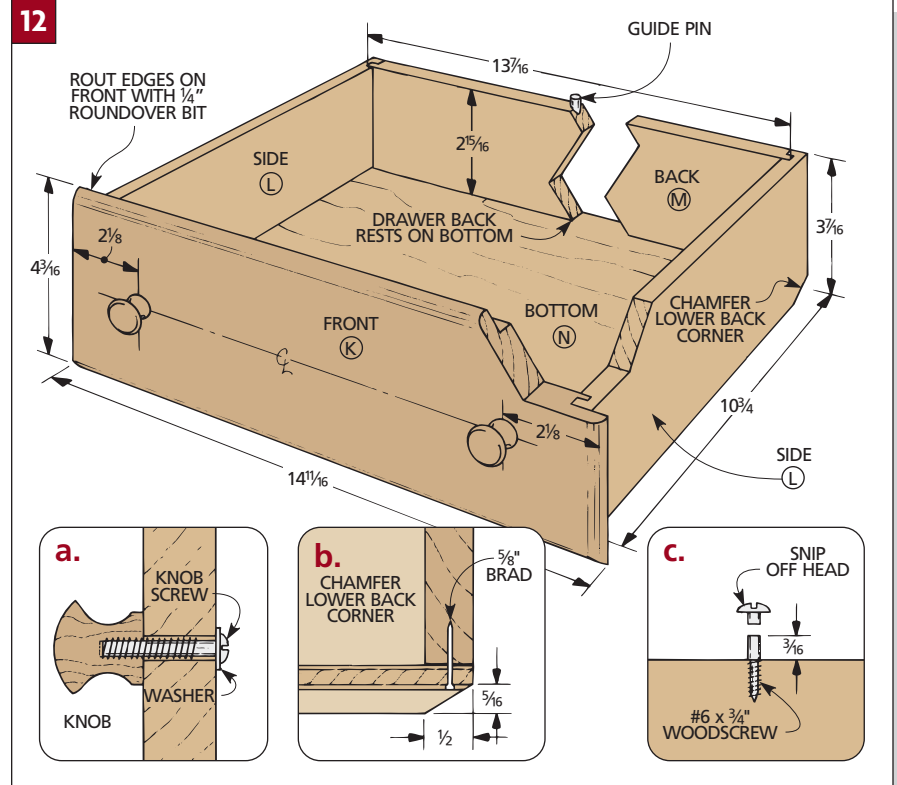
To cut the locked rabbet joint, first cut rabbets on both ends of the back to leave $\frac{1}{8}$ "-thick tongues (*Fig. 13*). Then cut a dado in each drawer side to accept this tongue.

DRAWER BOTTOM. Before the drawer can be assembled, a $\frac{1}{4}$ "-deep groove must be cut in the drawer front and sides for the plywood bottom (N). (No groove is needed in the back, since it rests on top of the drawer bottom.)

To locate the grooves, you need to measure from different points for the drawer front and the sides. On the drawer front, the top edge of this groove is located $\frac{1}{2}$ " up from the bottom edge of the lip (*Fig. 14*). On the drawer sides, it's $\frac{1}{2}$ " from the bottom edge (*Fig. 15*).

After the grooves are cut, dry-assemble the drawer and cut the drawer bottom to fit. Then trim the back to width so it rests on the plywood bottom.

COMPLETE DRAWERS. All the parts for the drawer are cut, but there are still a



few details to take care of before the drawers are done.

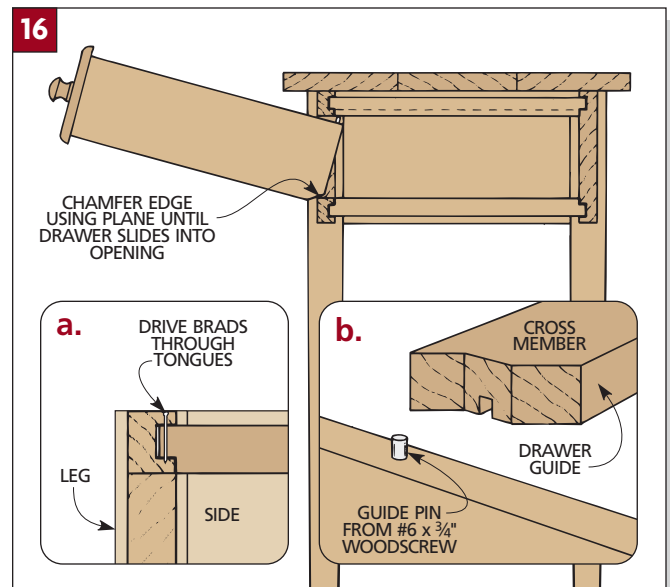
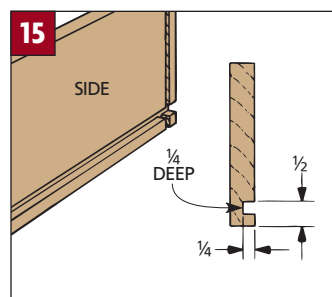
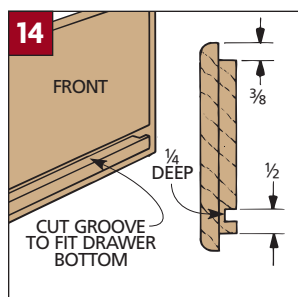
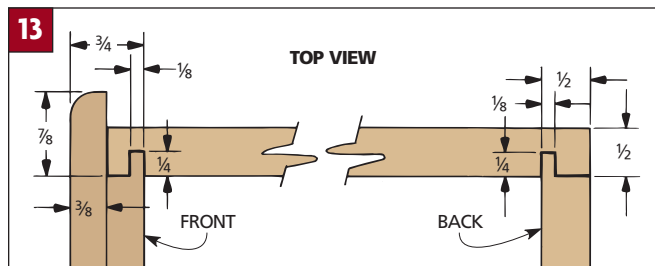
First, round over the front edges of each drawer front with a $\frac{1}{4}$ " roundover bit (*Fig. 12*). Now glue each drawer together, making sure it's square.

When the glue was dry, I added a guide pin on the top edge of the back (*Fig. 12c*). This pin is simply a No. 6 x $\frac{3}{4}$ " brass screw that's screwed part way into the back. Then I cut off the head to leave a guide pin.

One other detail is to cut a slight chamfer on the bottom back edge of the drawer so it can be tilted into the opening (*Figs. 12b and 16*).

Finally, for mounting the knobs, I drilled a $\frac{1}{4}$ "-dia. hole $2\frac{1}{8}$ " from each end of the drawer fronts (*Fig. 12a*).

SECURE CROSS MEMBERS. To finish the table, the drawer guides and runners need to be secured. To do this, remove the top and drawers and drive $\frac{3}{4}$ " brads into the tongues (*Fig. 16a*). ■



There are probably a dozen joints that can be used to join the four corners of a drawer. One of the easiest (and strongest) is a locked rabbet. It doesn't require any fancy equipment. All that's needed is a table saw and a combination blade to cut a flat-bottomed groove.

The version of the joint shown here is for a drawer that has a lipped edge all the way around the drawer front.

RABBETS. The first step is to cut rabbets (lips) on the top and bottom edges of the drawer front (Step 1).

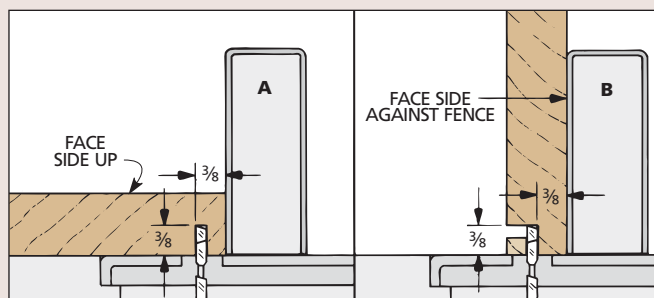
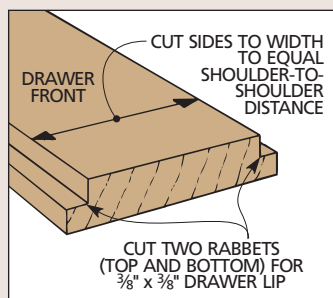
TONGUE. Then a tongue is cut on both ends of the drawer front. To do this, stand the drawer front on end and cut a groove on the end of the stock (Step 2). Then widen it to leave a $\frac{1}{8}$ "-wide tongue. (The $\frac{1}{8}$ " thickness of the tongue is based on the width of the kerf left by the saw blade.)

The tongue is completed by trimming it to a length of $\frac{1}{4}$ " (Step 3).

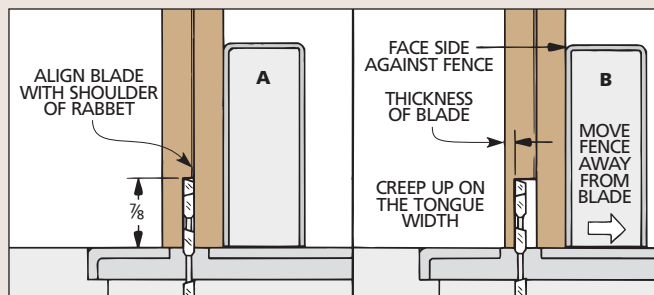
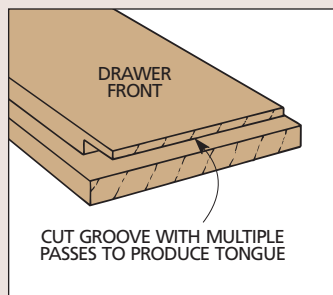
DADO. To complete the other half of the joint, a $\frac{1}{8}$ "-wide dado is cut on the inside face of the drawer side (Step 4).



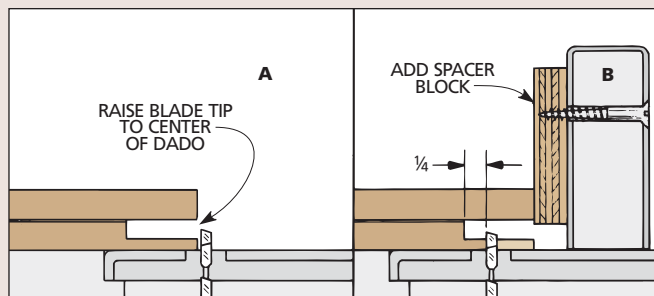
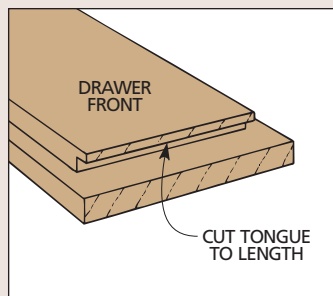
1 Cut the rabbets on the top and bottom edges. Set the blade $\frac{3}{8}$ " high and adjust the fence $\frac{3}{8}$ " from the outside of the blade. To complete the rabbet, set the fence $\frac{3}{8}$ " from the inside of the blade.



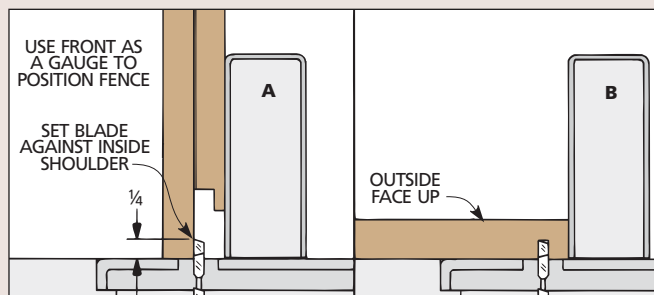
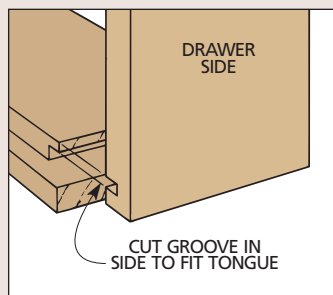
2 To cut the tongue, set the blade height to $\frac{7}{8}$ ". Then move the fence so the inside of the blade is on the shoulder of the rabbet. Make the first cut, and then move the fence away from the blade to leave a tongue the same width as the blade.



3 To cut the tongue to length, raise the blade so it just clears the tongue. Next, screw or clamp a spacer to the fence for the lip to ride against. (This will help prevent the waste piece from kicking back.) Then adjust the fence to leave a $\frac{1}{4}$ "-long tongue.



4 Now cut a dado in the drawer side to accept the tongue. Use the drawer front as a gauge. Raise the blade to a height equal to the length of the tongue. Then push the end of the side piece against the fence and cut the dado.



By simply shortening the length, the hall table becomes a lamp table with a single drawer. And because construction is so similar, it's easy to build this companion piece at the same time as the hall table.

CONSTRUCTION NOTES

■ The lamp table is built the same as the hall table. However, some pieces are cut shorter and there are fewer of other pieces (see the Materials List below).

■ The back apron (B) and front rails (D) are each cut to a finished length of $19\frac{1}{2}$ " (Fig. 1). The front center (F) is not needed in the front apron assembly.

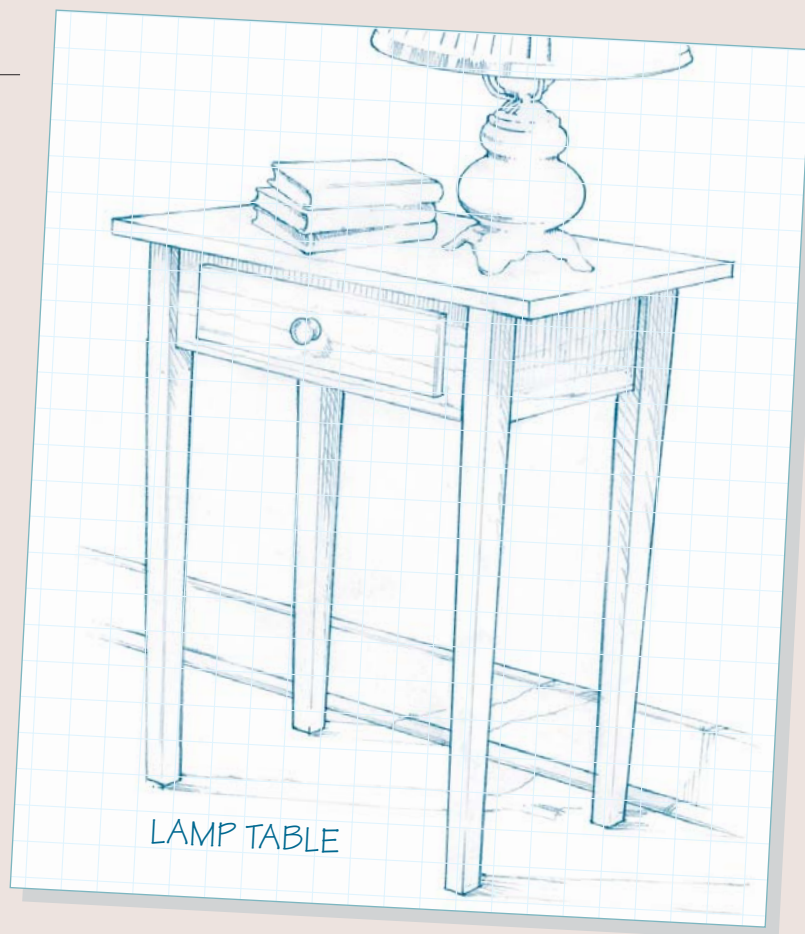
■ Cut only one drawer guide (G), two top mounts (H), and two drawer runners (I). Cut rabbets at each end of all these pieces as was done for the hall table. Also cut the groove for the guide pin in the drawer runner.

■ The table top (J) is cut to a finished length of $24\frac{1}{2}$ " (Fig. 1).

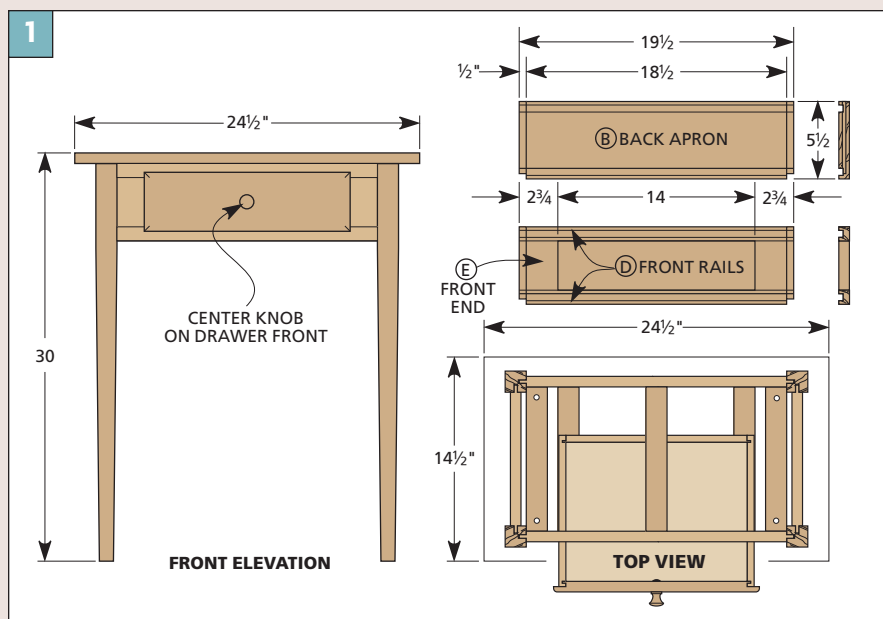
■ With only one drawer, you'll need just one drawer front (K), two drawer sides (L), one drawer back (M) and one drawer bottom (N). The drawer uses the locked rabbet joint and is assembled the same as the drawers for the hall table.

■ After the drawer is assembled, mount a single knob centered on the face of the drawer front (Fig. 1).

■ When assembling the table, the top mounts (H) set against the inside edges of the legs (Top View in Fig. 1).



LAMP TABLE



MATERIALS LIST

CHANGED PARTS

- B** Back Apron (1) $\frac{3}{4}$ x $5\frac{1}{2}$ - $19\frac{1}{2}$
D Front Rails (2) $\frac{3}{4}$ x 1 - $19\frac{1}{2}$
J Top (1) $\frac{3}{4}$ x $14\frac{1}{2}$ - $24\frac{1}{2}$

Note: Only need 1 each of parts G, K, M, N.
 Only need 2 each of parts H, I, L.
 Do not need part F.

HARDWARE SUPPLIES

(Note change in quantities)

- (1) No. 6 x $\frac{3}{4}$ " Rh woodscrews
 (4) No. 8 x $1\frac{1}{4}$ " Rh woodscrews
 (4) $\frac{3}{16}$ " flat washers
 (10) $\frac{3}{4}$ " brads
 (2) $\frac{5}{8}$ " brads
 (1) 1"-dia. cherry knob w/screw

SHOP JIG Leg Tapering Jig



When it was time to cut the tapers on the hall table legs, I was stumped at first. It was easy to make a jig to set the angle for the cuts on the first two sides of the legs. But then I'd have to take those angles into consideration when tapering the other two sides.

SLIDING PLATFORM

The jig I came up with is a sliding platform for the table saw. The great feature of this jig is that all you have to do is rotate the leg to taper the next side. The way the jig does this has to do with the centerpoint on the end of the leg. (More on how this works in a bit.)

For now, just mark the centerpoint on the bottom of the leg. To do this, draw lines on the bottom of the leg, connecting opposite corners (*Step 1*). At the point where the lines cross, drill a $\frac{1}{4}$ "-dia. hole with a brad point bit and push in a $\frac{1}{4}$ "-dia. dowel.

PLATFORM. To build the jig, start with a piece of $\frac{3}{4}$ " plywood about 9" wide for the platform (A). Cut it to a length of 31" (*Step 2*).

RUNNER. Next, cut a groove in the bottom of the platform and add a hardwood runner (B) that will fit your miter

gauge slot (*Step 2*). To determine the location of the groove, measure from your saw blade to the miter gauge slot and add 1". Cut the groove, then glue and screw the runner in place.

Finally, place the runner in the slot of the saw and trim off one edge of the platform (*Step 3*). This edge shows you *exactly* where the taper will be cut.

FENCES

The jig has two fences that help align the leg for each cut.

When a leg is mounted to the jig, the dowel slides into a hole in the rear fence (*Step 5*). After one side is tapered, the leg is rotated 90° to cut the next side. The dowel realigns the piece on the edge of the jig. But one of the problems I had was getting the hole in the fence in exactly the right position. Then I discovered a trick — actually two tricks.

REAR FENCE. First, cut the rear fence (C) to a width (height) to match the thickness of the leg. Then draw an "X" on the fence to match the pattern on the end of the leg (Detail in *Step 4*). Drill a $\frac{1}{4}$ " hole at the crosspoint.

The second trick has to do with mounting the fence to the platform. In

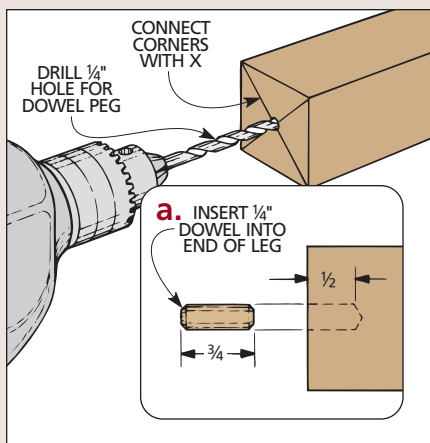
order to get a $\frac{1}{4}$ " taper on each side of the leg, the crosspoint on the rear fence has to be $\frac{1}{4}$ " closer to the path of the blade. So all you do is shift the whole rear fence so it extends $\frac{1}{4}$ " over the edge of the platform (*Step 4*).

SIDE FENCE. A side fence (D) mounted on the platform helps hold the top end of the leg. To position this fence, place the leg on the platform with the dowel mounted in the rear fence (*Step 5*). Then position the taper start line (near the top end of the leg) on the edge of the platform (*Step 6*). Now draw a line along the back edge of the leg to indicate the position of the side fence. Then screw the fence in place (*Step 7*).

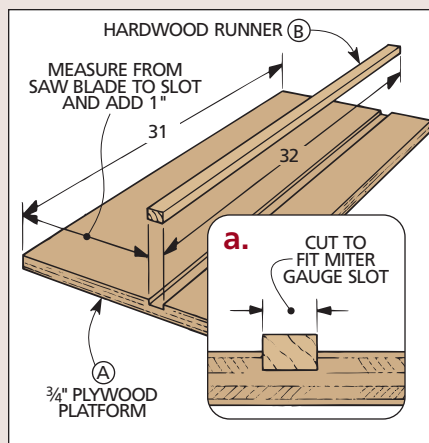
HOLD-DOWN. To complete the jig, add a hold-down clamp. You can make this with a few scraps of wood (E, F) (*Step 8*). However, I like the ease of using a quick-release clamp as shown in the photo. (See Sources, page 126.)

CUTTING TAPERS

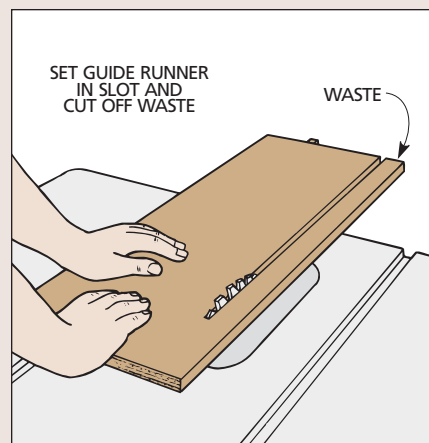
To cut the tapers on the leg, mount the leg on the platform and push it through the blade (*Step 9*). Then simply loosen the clamp, rotate the leg, and cut the next side.



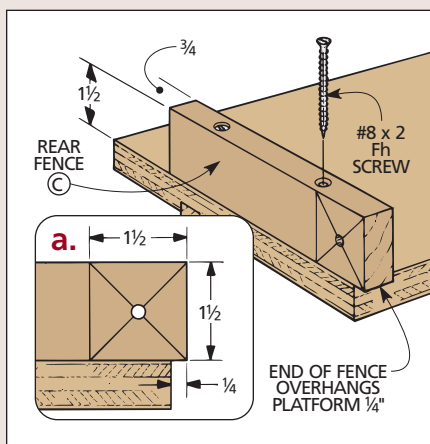
1 To find the center of the bottom of the leg, connect the opposite corners with an "X". Drill a $\frac{1}{2}$ "-deep hole at this point and insert a $\frac{3}{4}$ " length of dowel.



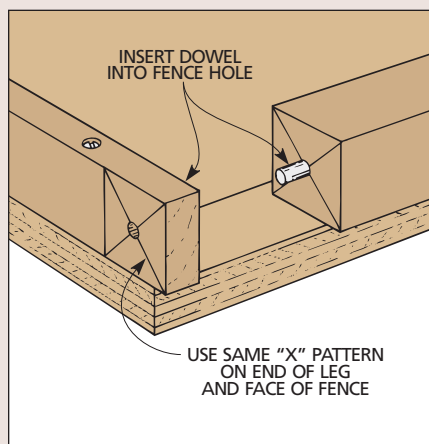
2 Use $\frac{3}{4}$ " plywood for the platform. Cut a $\frac{1}{4}$ "-deep groove in the bottom to hold a hardwood runner that fits your miter gauge slot.



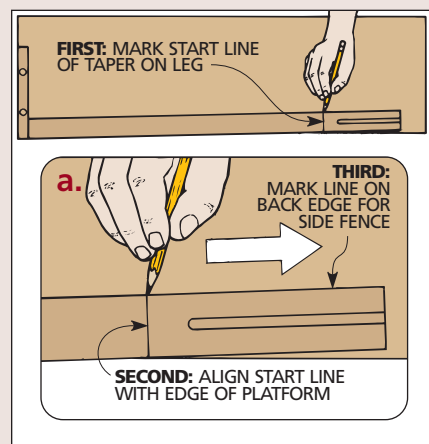
3 Put the runner in the miter gauge slot and trim the side of the platform. This gives you a reference edge that shows exactly where the blade cuts.



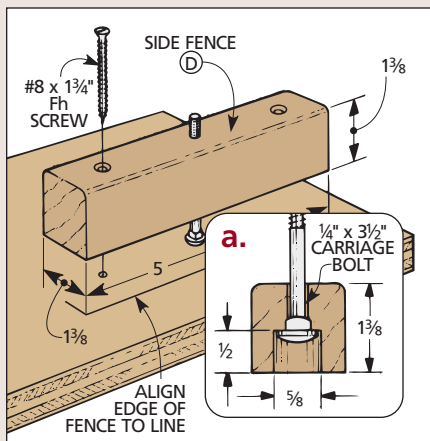
4 A rear fence the same width as the leg overhangs the edge $\frac{1}{4}$ ". Make an "X" on the end to match the "X" on the leg. Drill a $\frac{1}{4}$ "-dia. hole at the crosspoint.



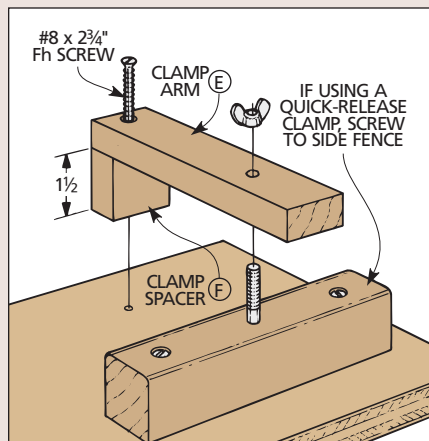
5 To position the side fence, first insert the dowel in the leg into the hole in the rear fence. (The dowel is trimmed off later to fill the hole in the leg.)



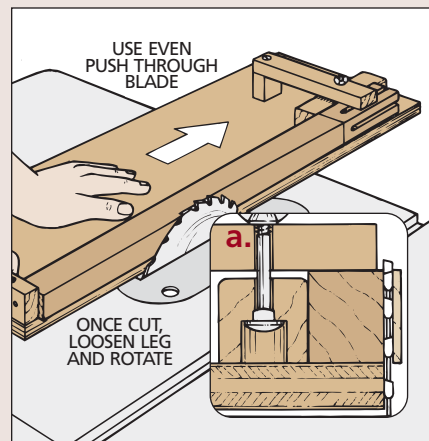
6 Next, mark the taper start line on the leg. Then place this line on the jig's edge. Mark the location of the leg's back edge onto the platform.



7 The side fence is shorter than the leg thickness. Align it with the line and screw it in place. Add a carriage bolt for a shop-made hold-down (next step).



8 Use scrap to make a simple hold-down clamp. Tightening the wing nut applies pressure. (If a quick-release clamp is used, the fence should be $1\frac{1}{2}$ " wide.)



9 To cut tapers, position leg on the jig and push the platform past the blade. Rotate the leg one-quarter turn to make next cut. Then repeat for other two cuts.

TECHNIQUE ... *Tapering on the Jointer*

Usually, you think of using a jointer to get a straight edge from one end of a workpiece to the other. But how about using the jointer to cut tapers? After all, a taper *is* a straight edge. It's just that it doesn't run the full length of the piece.

Another reason the jointer is an ideal tool for cutting tapers is that the jointer produces a clean, crisp cut that needs little (if any) sanding. And unlike a table saw, tapering on the jointer doesn't require any special jigs or complicated layouts. All you need is some masking tape and a pencil.

PROCEDURE

When cutting a long taper, like on the hall table, you don't taper the entire leg. Instead, there's a flat at the top where the leg is joined to the apron.

Note: Complete any joinery on the leg before it's tapered.

LOWER WORKPIECE. The basic idea behind tapering on the jointer is simple. Instead of starting the cut at the end of the workpiece, it's lifted up and the flat portion of the leg is pushed forward, past the cutterhead. Then the leg is lowered onto the cutterhead to start the taper. The trick is knowing where to lower the workpiece to start the cut.

REFERENCE LINES. To do this, I make two reference lines. One marks the start of the taper on the leg (*Step 1*). The other line indicates the front edge

of the jointer's outfeed table (*Step 2*). When the two marks align, the workpiece is lowered onto the jointer.

SNIPE. Since the workpiece is coming down at an angle, the knives will create a dished cut (snipe) at the beginning of the cut. To prevent this, I wrap two layers of masking tape around the leg (*Step 3*). This raises the workpiece above the cutterhead just enough to produce a smooth cut.

DEPTH OF CUT

Another thing to keep in mind is the depth of cut. This determines how many passes over the jointer you'll have to make to get the finished taper.

To plan the cut, start with the

amount of taper you want at the end of the leg and divide it by the depth of cut. For example, if your jointer is set for a $\frac{1}{16}$ " cut, four passes will cut a $\frac{1}{4}$ " taper.

But in practice, to allow for a cleanup pass, I adjust the infeed table so the cut is a hair ($\frac{1}{64}$ ") less. To do this, measure the gap between the infeed table and a straight stick laid across the outfeed table (see photo below).

CUTTERGUARD. Before making your first cut, it's a good idea to get a feel for opening the cutterguard with a workpiece. This takes some practice — with the jointer turned off. What I've found works best is to slightly raise the end of the workpiece off the table

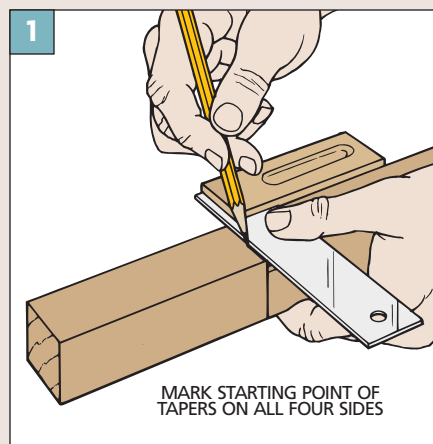
and use it to nudge the cutterguard open (*Step 4*).

CUT TAPER

With the setup complete, it's time to make some test cuts before moving on to the real leg pieces.

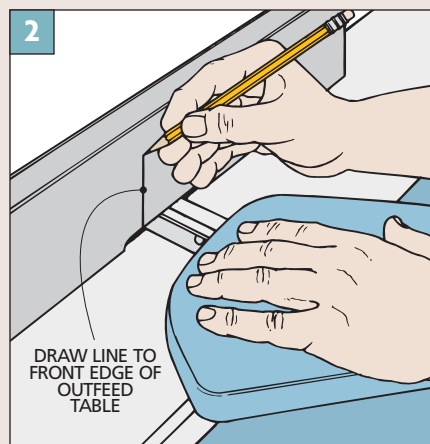
Measuring the Depth of Cut.

Place a straight piece of scrap on the jointer's outfeed table. Then measure the gap between it and the infeed table.



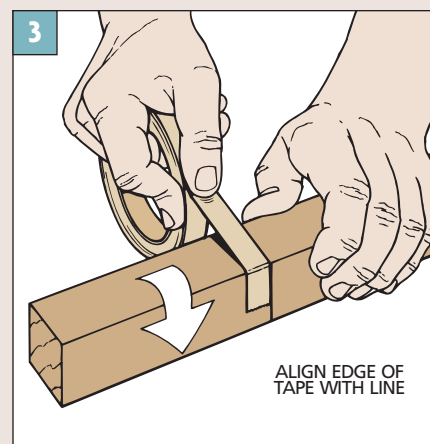
MARK STARTING POINT OF TAPERS ON ALL FOUR SIDES

Lay Out Tapers. Using a try square, lay out the starting point of the tapers around all four sides of the leg.



DRAW LINE TO FRONT EDGE OF OUTFEED TABLE

Mark Outfeed Table. Now make a pencil mark on the jointer fence to indicate the front of the outfeed table.



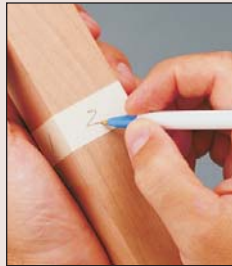
ALIGN EDGE OF TAPE WITH LINE

Add Tape. To prevent the jointer knives from making a "dished" cut, wrap two layers of masking tape around the leg.

TEST CUT. Once you get the feel of opening the cutterguard, check the setup by making a test cut. You should not have any snipe at the start or end of the cut.

Safety Note: Be sure to hook a push block over the end of the leg when you make the cut.

CUT TAPER. Now you're ready to taper the actual workpiece. Depending on the depth of cut, you'll need to make several passes on each side (Step 5). And since it can be easy to lose track of the cutting sequence, I just label the cutting order right on the masking tape (see photo above).

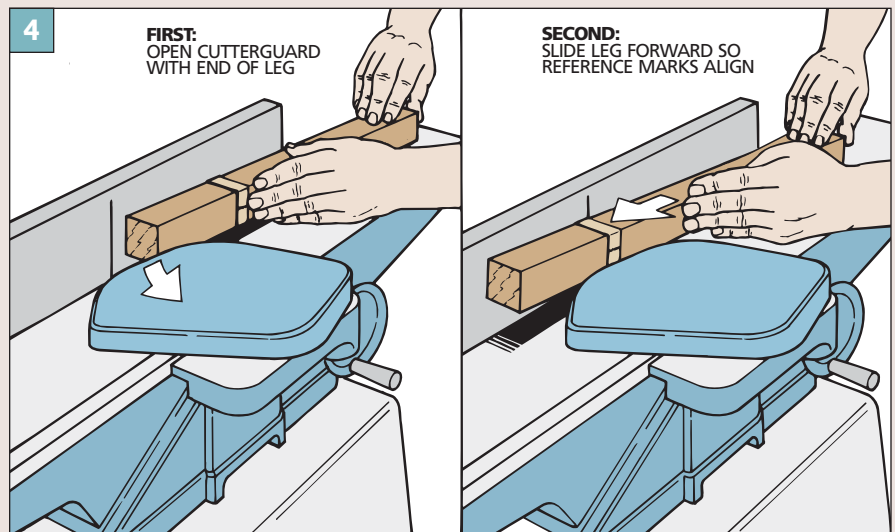


When it's time to taper the fourth side of the leg, you'll have a tapered face facing the fence of the jointer. If you press this face against the fence, the start of the taper will be angled. To prevent this, press the untapered top of the leg against the fence during the cut. This will leave a gap between the tapered face and the fence.

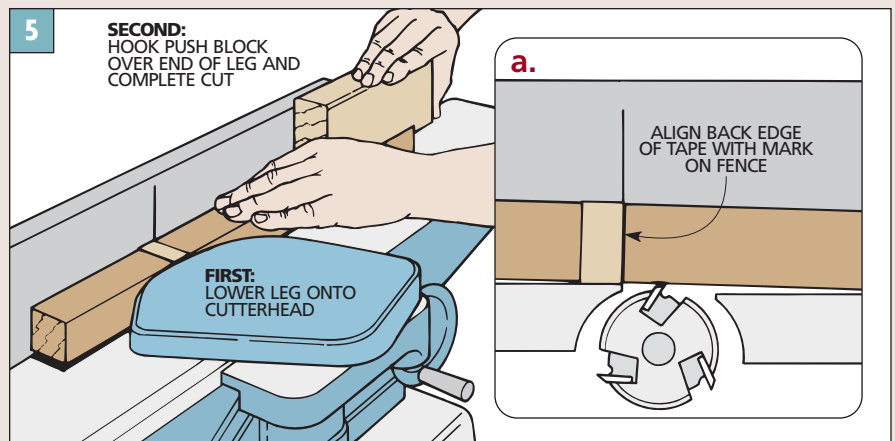
CLEANUP PASS. After the taper is cut on each side, all that's left to complete the job is to make one cleanup pass on each side. The goal is to take as light a pass as possible, yet still cut the taper right up to the layout line.

To do this, remove the tape and raise the infeed table until the knives just graze the line at the start of the taper (Step 6a).

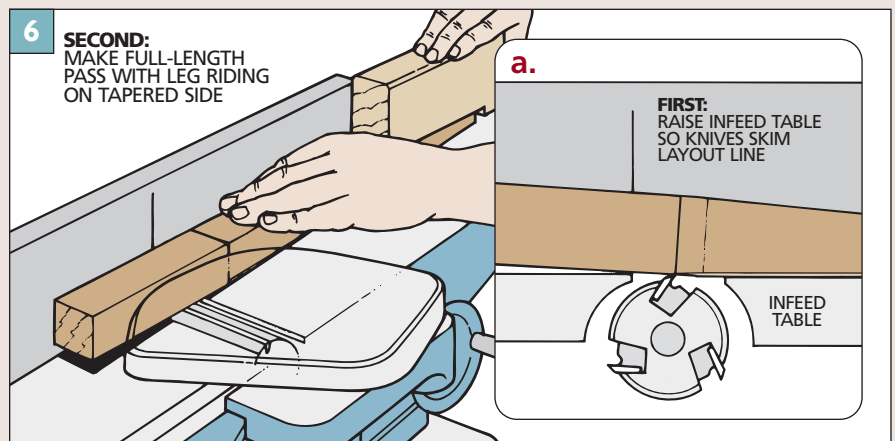
Finally, instead of lowering the workpiece onto the cutterhead, make a full-length pass with the leg riding on the tapered side (Step 6).



Position Leg. With the leg against the fence, raise the end slightly above the table. Now nudge the cutter guard open with the end of the leg and slide the workpiece forward until the reference mark on the leg aligns with the mark on the fence.



Begin Cut. When the back edge of the tape aligns with the mark on the fence, lower the leg down onto the cutterhead. Then hook a push block over the end of the leg and complete the cut.



Cleanup Pass. After the taper is cut, remove the tape. Then center the layout line on the workpiece across the opening in the jointer table. After raising the infeed table until the knives just graze the line, make a full-length pass.

Rocking Chair

While the heritage of this chair is distinctly Shaker, it's been updated with some modern techniques. And there's also one very old technique that may be new to you — weaving the seat and back.

This rocker looks just like an old-fashioned Shaker rocker. But while some of the clean lines and graceful curves are borrowed from the Shaker “classic,” some changes were made to the design.

DOWELS. For one thing, Shaker rockers included legs that were tapered and often given a slight bend. But you don't need a lathe or a steam box to build this chair. The legs and the rails that connect them are made from straight dowels that are $1\frac{1}{2}$ ", 1", and $\frac{3}{4}$ " in diameter.

SQUARE STOCK. But where do you find $1\frac{1}{2}$ "-dia. dowels — especially ones over 42" long? The solution is simple. You can make the dowels yourself. If you don't have a lathe, you can make the dowels with a router table and a few roundover bits. The technique is straightforward. (There's a separate article on making dowels on page 37.)

There was even an unexpected benefit to this. The chair requires two sets of holes along each leg. And because the seat is tapered front to back, these holes aren't 90° to each other. Working with store-bought dowels would have required a special holding jig. But with our method, the holes could be drilled in the square maple blanks before they were “turned” into dowels.

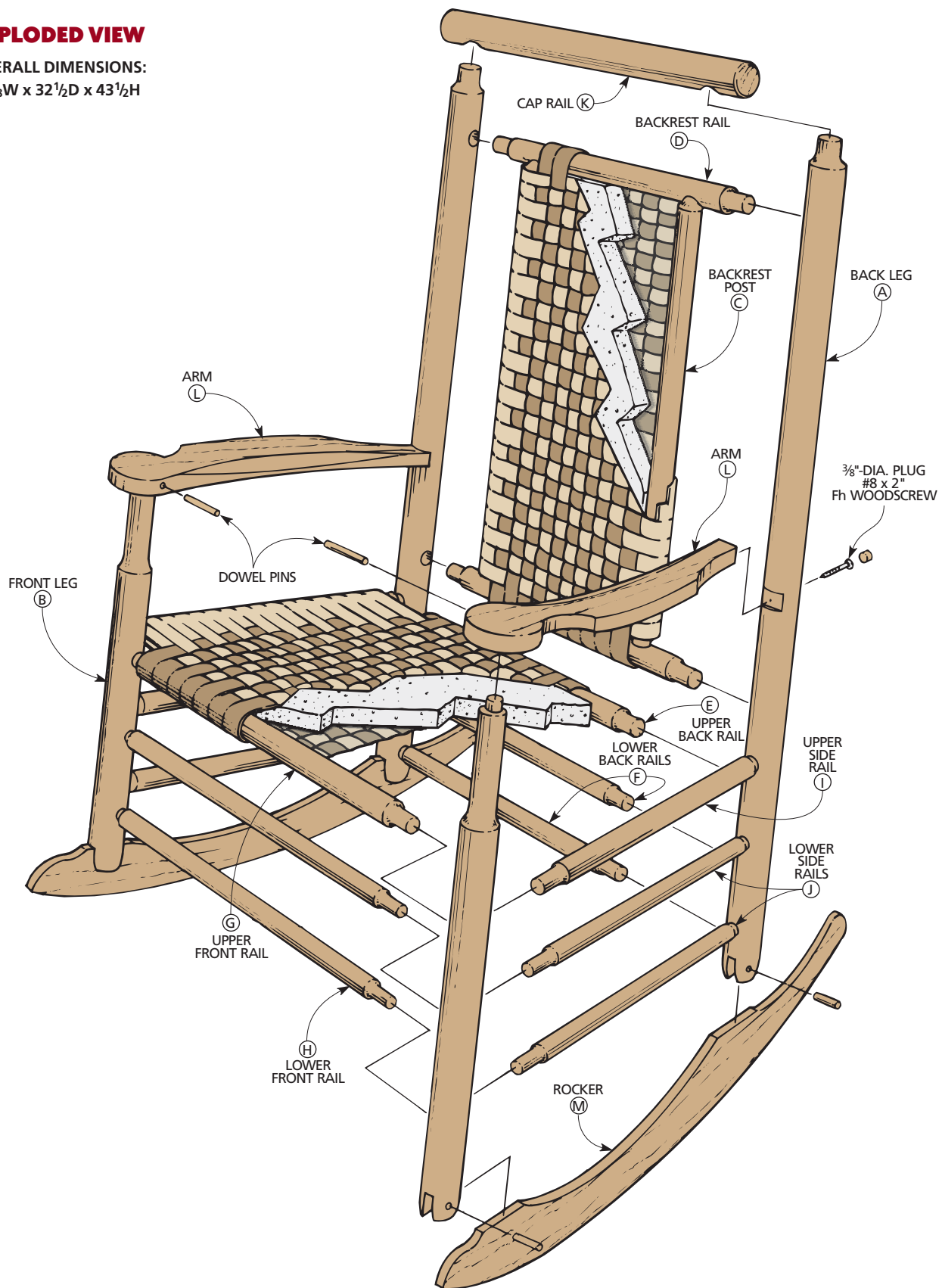
WEAVING. The woven seat is another common feature on Shaker rockers. And here I pretty much stuck to tradition — except for the stuffing between the two layers of webbing. I used a 1"-foam pad instead of what the Shakers used — horse hair. Other than that, the technique is the same. It's all explained beginning on page 40. Plus there are some alternate patterns you can weave into the chair back. These are shown in the Designer's Notebook on page 42.

FOOTSTOOL. We've also designed a footstool to go with the rocker. It uses many of the same techniques. That project begins on page 43.

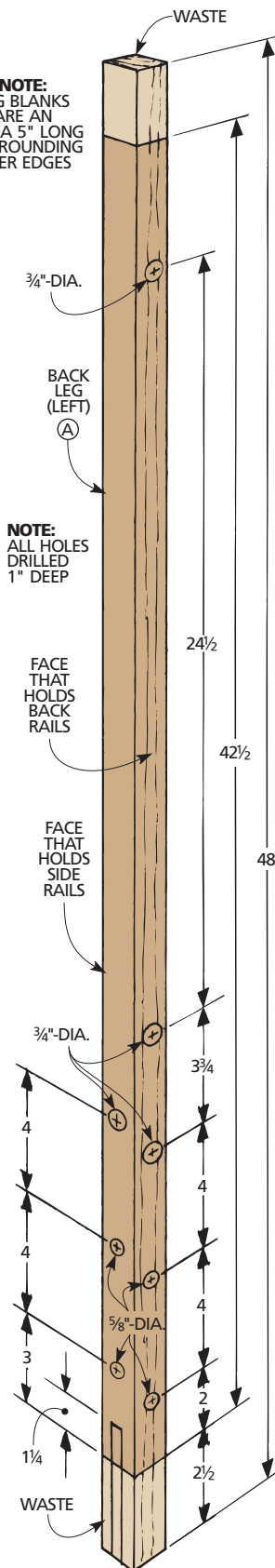


EXPLODED VIEW

OVERALL DIMENSIONS:
25³/₈W x 32¹/₂D x 43¹/₂H



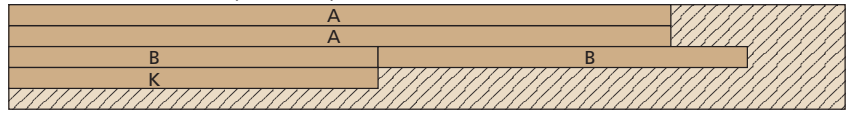
NOTE:
LEG BLANKS
ARE AN
EXTRA 5" LONG
FOR ROUNDING
OVER EDGES



NOTE:
ALL HOLES
DRILLED
1" DEEP

CUTTING DIAGRAM

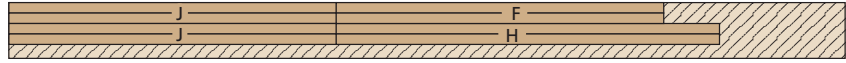
1 3/4 x 7 1/2 - 60 HARD MAPLE (6.25 BD. FT.)



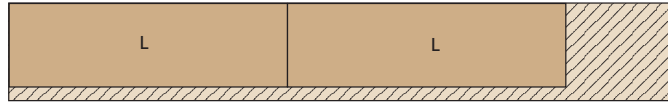
1 x 5 - 60 HARD MAPLE (2.6 BD. FT.)



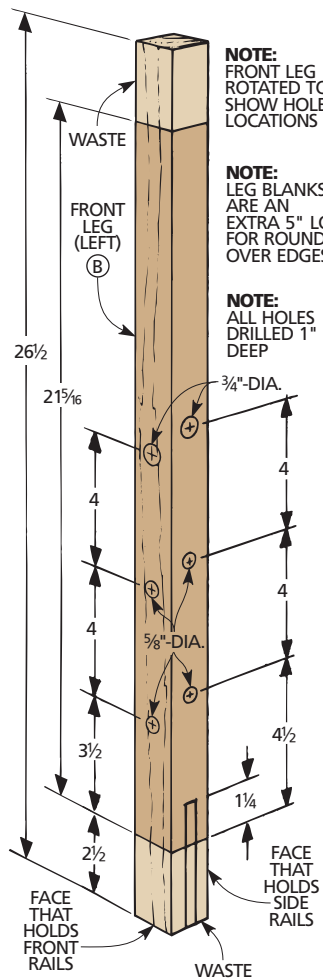
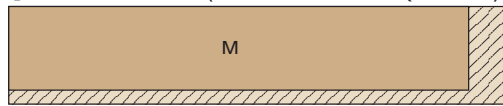
3/4 x 4 - 60 HARD MAPLE (1.7 BD. FT.)



3/4 x 5 - 48 HARD MAPLE (1.7 BD. FT.)



1/2 x 5 - 36 HARD MAPLE (TWO BOARDS @ 1.25 SQ. FT. EACH)



NOTE:
FRONT LEG
ROTATED TO
SHOW HOLE
LOCATIONS

NOTE:
LEG BLANKS
ARE AN
EXTRA 5" LONG
FOR ROUNDING
OVER EDGES

NOTE:
ALL HOLES
DRILLED 1" DEEP

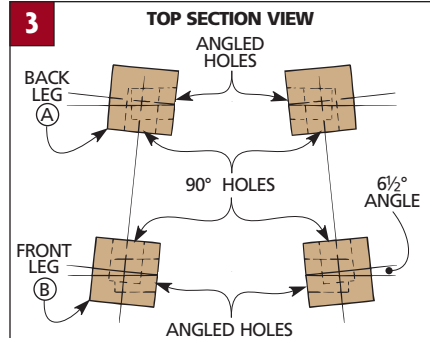
MATERIALS LIST

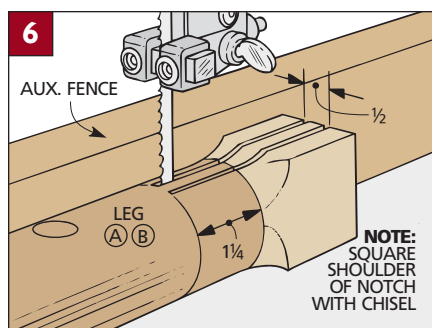
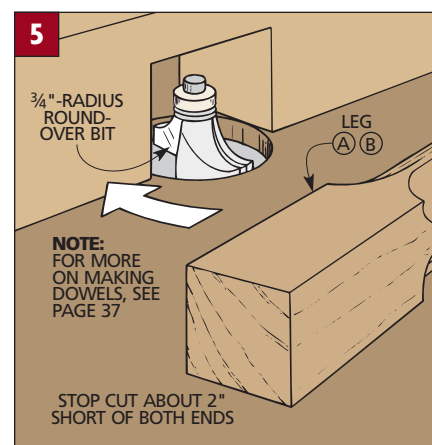
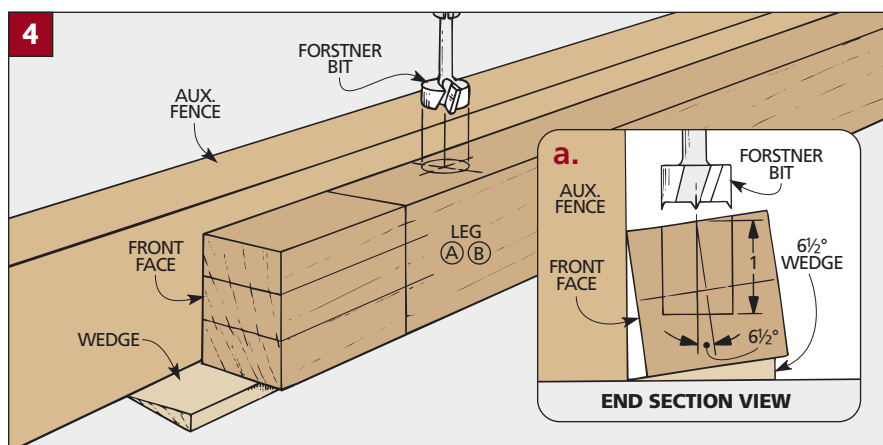
WOOD

A	Back Legs (2)	1 1/2 x 48 rgh.
B	Front Legs (2)	1 1/2 x 26 1/2 rgh.
C	Backrest Posts (2)	1 x 29 1/2 rgh.
D	Backrest Rails (2)	1 x 23 1/2 rgh.
E	Upper Back Rail (1)	1 x 23 1/2 rgh.
F	Lower Back Rails (2)	3/4 x 23 1/2 rgh.
G	Upper Front Rail (1)	1 x 27 1/2 rgh.
H	Lower Front Rails (2)	3/4 x 27 1/2 rgh.
I	Upper Side Rails (2)	1 x 23 1/2 rgh.
J	Lower Side Rails (4)	3/4 x 23 1/2 rgh.
K	Cap Rail (1)	1 1/2 x 21 1/2
L	Arms (2)	3/4 x 5 - 20
M	Rockers (2)	1/2 x 5 - 33

HARDWARE SUPPLIES

- (2) No. 8 x 2" Fh woodscrews
- (2) 3/4"-dia. flathead wood plugs
- (1) 3/16"-dia. dowel 6" long
- (1) 3/8"-dia. dowel 6" long
- (80 yds.) Cotton Shaker tape
- (8) 1/2"-long upholstery tacks
- (1) 1"-thick foam pad 18 x 20
- (1) 1"-thick foam pad 12 x 23





LEGS

To build the rocker, I began with the four square leg blanks. It may seem a bit odd to start off with square blanks when the legs are going to end up as dowels — but that's exactly how this project begins.

CUT TO SIZE. First cut four leg blanks $1\frac{1}{2}$ " thick and $1\frac{1}{2}$ " wide. Then the back legs (A) and front legs (B) can be cut to rough length — I sized mine an extra 5" longer than the finished length of the legs. (This may seem plenty long, but the extra length is needed when you round over the blanks to make dowels.)

LAY OUT BLANKS. The next step is to carefully lay out the finished length and the holes on the blanks (*Figs. 1 and 2*). First, I measured up $2\frac{1}{2}$ " from the end of each blank to mark what will be the bottom edge. Then measuring from this mark, I laid out the top end of each leg.

Next, mark the position of the holes for the rails. There are a couple things to keep in mind when doing this.

For one thing, you don't lay out the front (or back) legs exactly the same — they're mirror images of each other (*Fig. 3*). I found it helped prevent confusion if I labeled the end of each leg with its position on the chair (front left, front right, back left, back right).

Also, note that the positions for the side rail holes on the front and back legs are not the same. The holes in the back legs are $1\frac{1}{2}$ " closer to the bottom end. Later, when the chair is assembled with the rockers, this offset helps the chair tip back at a comfortable angle.

The last things to lay out are the notches for the rockers (*Figs. 1 and 2*). I drew them on both faces of the legs to help me keep things oriented.

DRILL HOLES. With the legs laid out, the next step is to drill the holes. First I drilled all the 90° holes for the side rails. Just keep in mind that there are two hole sizes. The holes for the upper side rails are $\frac{3}{4}$ " in diameter (*Figs. 1 and 2*). The lower rails require $\frac{5}{8}$ "-dia. holes.

The holes for the front and back rails are a little different. They're drilled at a $6\frac{1}{2}^\circ$ angle (*Fig. 3*). To do this, I just cut a wedge from some scrap to set the blank on (*Fig. 4*).

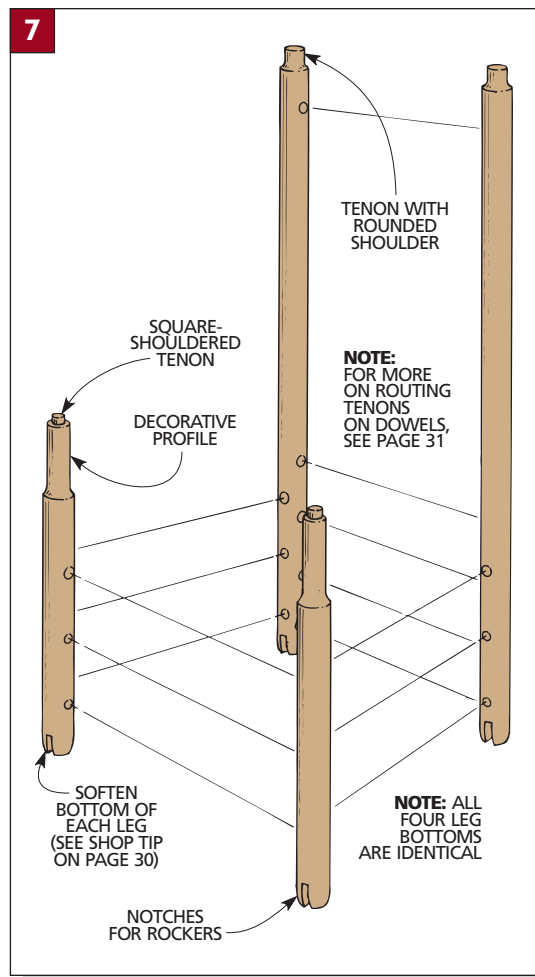
To avoid drilling these angled holes in the wrong direction, I marked the front face of each leg. Then make sure this face sets against the fence as you drill.

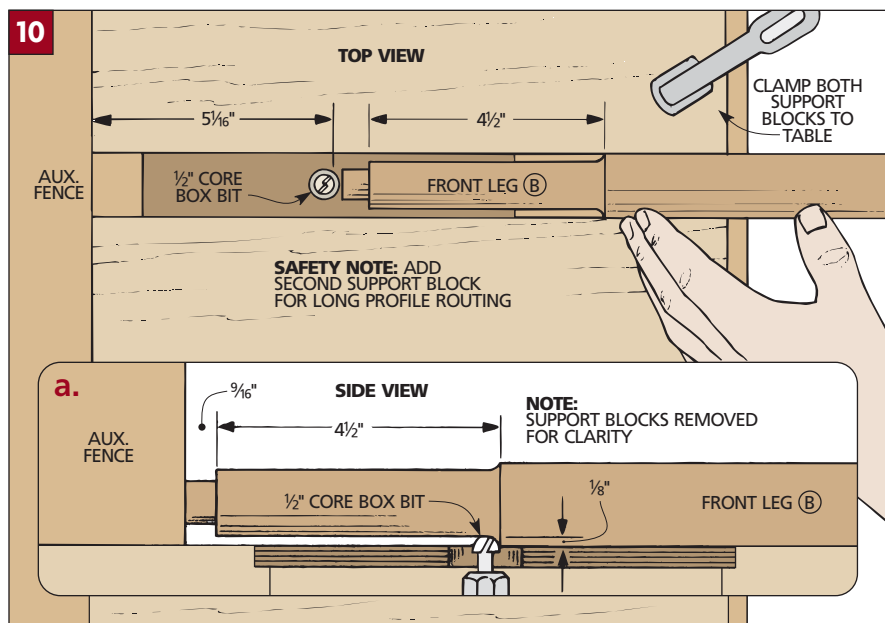
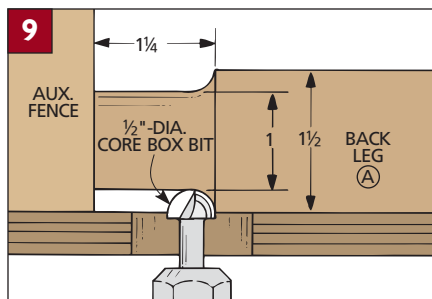
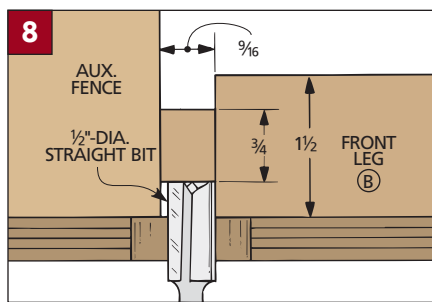
Note: Each back leg needs two additional $\frac{3}{4}$ "-dia. angled holes for the backrest rails (*Fig. 1*).

ROUND OVER EDGES. With the holes drilled, the next step is to use a $\frac{3}{4}$ " roundover bit in the router table to turn the square blanks into dowels (*Fig. 5*). For more information on how to do this, see the Technique box on page 37.

CUT NOTCHES. Now before cutting the dowels to final length, I cut the $\frac{1}{2}$ "-wide notches for the rockers on the bottom of each leg (*Fig. 6*). I used a band saw for this, cleaning up the top shoulder with a sharp chisel.

CUT TO LENGTH. Finally, the legs are ready to be cut to final length (*Figs. 1 and 2*). Cut carefully to the layout lines (though you may need to lay them out again since you've routed the edges).





CREATE TENONS. The only thing left on the legs is to shape the ends (refer to *Fig. 7* on the previous page). The top of each leg gets a round tenon. But they're not the same size or shape.

On the top of the front legs (B), a square-shouldered tenon provides solid support for the arms later. To do this, I used a straight bit to rout a $\frac{3}{4}$ "-dia. tenon $\frac{9}{16}$ " long (*Fig. 8*). (For more on routing tenons on dowels, see the

Technique box on the opposite page.)

The back legs (A) also have a tenon on the top that's created with the same routing technique. But this time, the 1"-diameter, $1\frac{1}{4}$ "-long tenon has a round shoulder that's created with a $\frac{1}{2}$ "-dia. core box bit (*Fig. 9*).

ROUT PROFILE. I also decided to "lighten" the top of the front leg (B) with a decorative profile. This $4\frac{1}{2}$ "-long profile is created just like the tenon on

each back leg (*Fig. 10*). But this time, the cut is shallower (only $\frac{1}{8}$ ").

Safety Note: Since this profile is so long, I added a second support board to the table. This kept my fingers a safe distance from the bit (*Fig. 10*).

TAPER LEGS. To complete the legs, all that's left is to soften the bottom end of each. This is easy to do with a file and a little sandpaper. (For more on this, see the Shop Tip below.)

SHOP TIP



To keep the legs of the rocking chair from looking too square and bulky, I shaped the bottom of each leg, see photo. The shape of the legs is really a cross between a taper and a roundover. It's more like a "contoured taper."

In addition to improving

the way the legs look, the tapers serve another purpose — they help to prevent the bottoms of the legs from splintering.

Although the tapers are shaped by hand, I found it helpful to draw some layout lines on each leg. To start with, I laid out the narrow end of the taper on the bottom of each leg. To do this, I simply traced around a twenty-five cent piece.

Each taper starts about an inch from the bottom of the

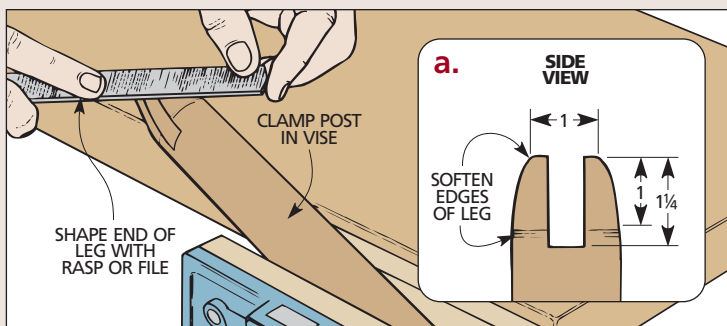
leg (see detail "a" in drawing). To mark this point, I used a pencil and a combination square to draw a line around each leg 1" from the end.

To shape the ends of the legs, first clamp the leg in a vise to hold it securely. Then use a file to rough

out the material between the two layout lines.

Note: The layout lines are a guide only — you'll still have to use your "eye" to refine the leg's shape.

After you've got the leg roughly shaped with the file, sand the profile smooth and round.



TECHNIQUE Tenons on Dowels

Cutting tenons on dowels is easy on a router table. And by using different bits, you can cut two kinds of tenons. Using a straight bit, you can cut square-shouldered tenons (left photo), and by using a core box bit, you can cut round-shouldered tenons (right photo).

On the rocking chair, almost all of the tenons have round shoulders. The only place you need square-shouldered tenons is on the tops of the front legs to help support the arms (*Fig. 1*).

The difference between these two types is more than skin deep. A square-shouldered tenon is like a traditional tenon in that its *shoulder-to-end* dimension is important. On the other hand, the round-shouldered tenon is more decorative. The tenon actually bottoms out in the mortise, so what's important is its *overall* length. This also means the tenon must be longer than the depth of the mortise. (On the rocker, for example, I cut 1 1/4"-long tenons for the 1"-deep mortises.)

PROCEDURE

The tenons are cut by pushing the end of the dowel into the bit.

SETUP. The dowel is guided by a support block clamped to the table (*Fig. 2*). When positioning the support block, make sure the dowel is centered over the bit (*Fig. 2b*).

Note: You'll have to reposition the support block when routing dowels of different diameters.

An auxiliary fence covering the router fence opening serves as a stop block to set the tenon's length (*Fig. 2a*).

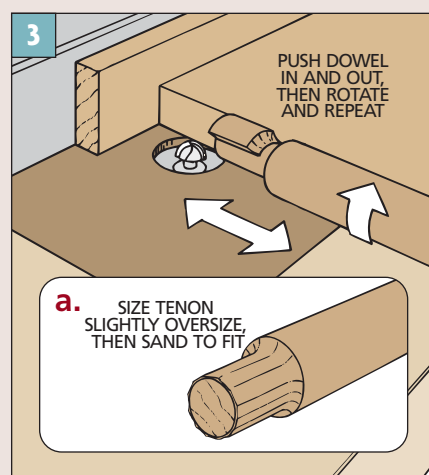
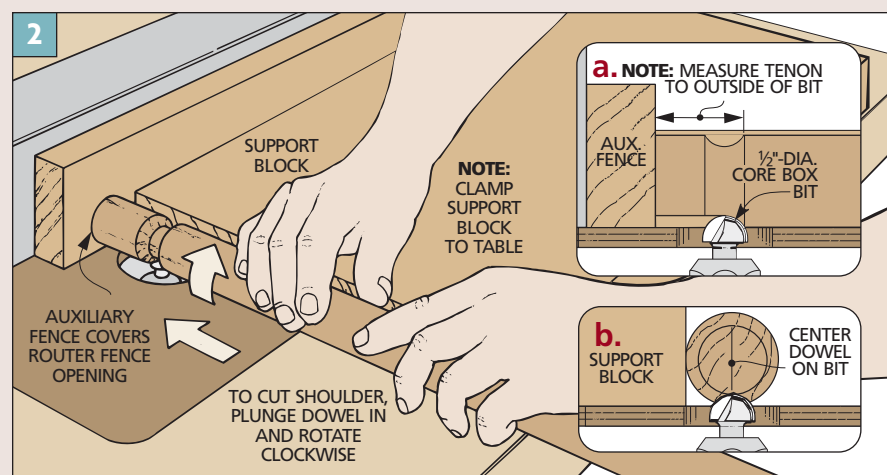
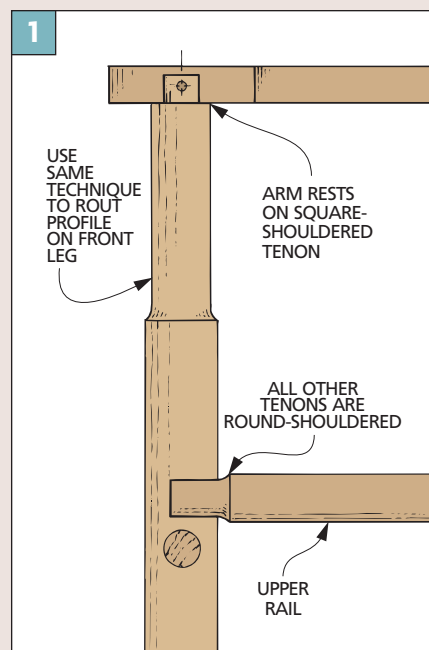


You'll need to sneak up on the final bit height, testing the fit of the tenon in the mortise. I like to leave the tenon just slightly oversize. Then it can be sanded for an exact fit (*Fig. 3a*).

TECHNIQUE. To rout a tenon, first hold the dowel against the support block, then push it into the bit until it butts into the auxiliary fence (*Fig. 2*). Now form the shoulder of the tenon by rotating the dowel clockwise. Then back the dowel out.

Next, remove the waste around the tenon in small bites (*Fig. 3*). Simply push the dowel into the bit and pull it straight out. Then rotate the dowel slightly and repeat this procedure until the tenon is formed.

This same procedure (with a second support block added) is used to cut the profile on the tops of the front legs (refer to *Fig. 9* on previous page).



CHAIR RAILS & BACKREST

Now that the legs are complete, it's time to connect them with the chair rails and the backrest. The backrest will be sandwiched between the back legs. And below that, on each of the four sides of the chair, there's a 1"-dia. upper rail that the cotton webbing wraps around and two $\frac{3}{4}$ "-dia. lower rails.

Though there are a lot of pieces here, the most efficient method is to make them all at the same time. That's because they all share many of the same techniques and setups.

CUT TO SIZE. Like the legs, I made all the backrest posts (C) and rails (D) and the back rails (E, F), front rails (G, H), and side rails (I, J) out of square blanks. The diameters and final lengths of all these pieces are given in *Fig. 11*.

DRILL BACKREST HOLES. Of the sixteen square blanks you just cut, only the two backrest rails (D) require holes. These have a $\frac{3}{4}$ "-dia. hole drilled $\frac{1}{2}$ "-deep and $3\frac{3}{16}$ " from each finished end

(*Fig. 13*). (Lay out the ends of the pieces first and then locate the holes.)

ROUND OVER EDGES. With these holes drilled in the backrest rails, you can round over the edges of all the pieces. This is the same process used on the leg blanks earlier. The only difference is the size of the roundover bits. For the $\frac{3}{4}$ "-dia. dowels, you'll need a $\frac{3}{8}$ "-radius bit, while the 1" dowels require a $\frac{1}{2}$ "-radius bit.

CUT TO LENGTH. After all the pieces have been routed, they can be cut to finished length. You'll want to pay special attention to the backrest rails. They should be cut so the holes you just drilled in them are equally spaced from the ends (*Fig. 12*).

The others can simply be cut to finished length. However, because the tenons on these pieces will bottom out in the mortises, it's important that the rails on each side of the chair are exactly the same length. To do this, I used a stop block clamped to an auxiliary miter gauge fence.

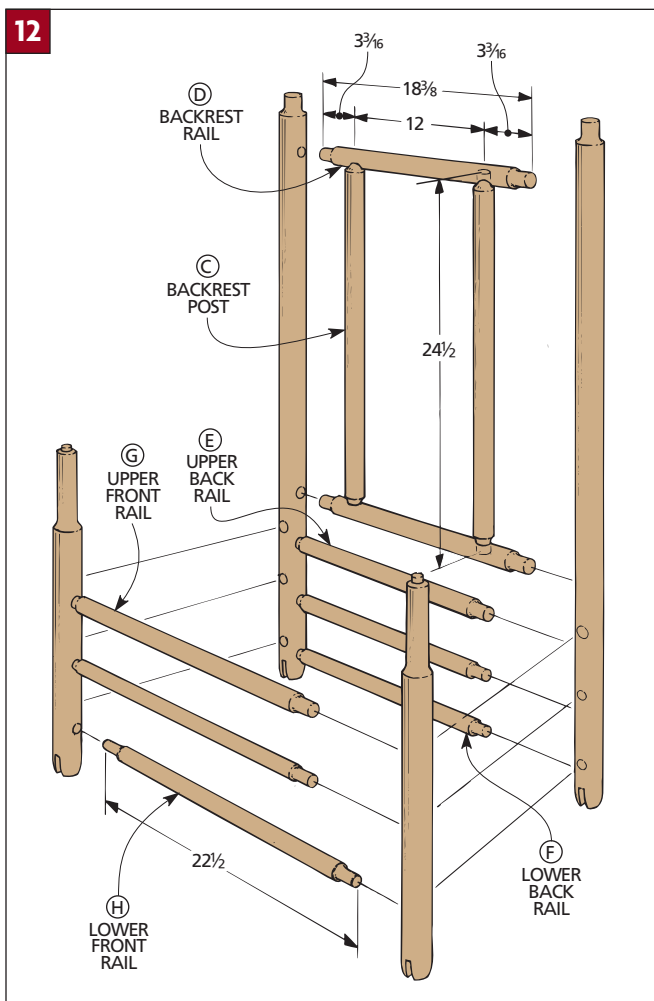
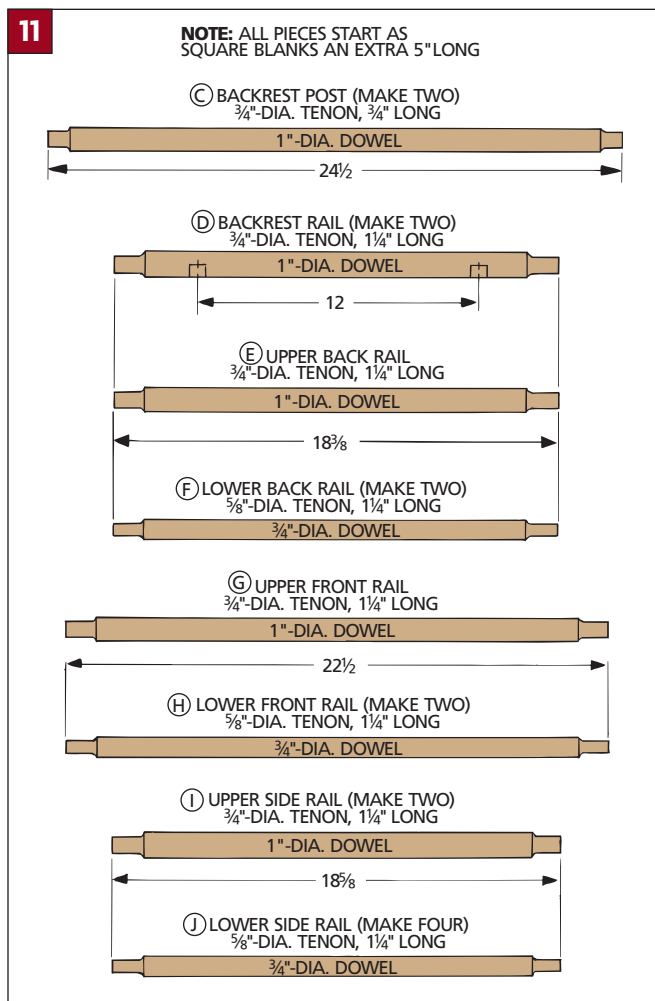
CUT TENONS. After the pieces have been cut and sanded smooth, the next thing to do is rout the round-shouldered tenons on the ends (*Figs. 11 and 14*). The only trick is cutting the correct-size tenons on each piece.

I started with the $\frac{3}{4}$ "-long tenons on the backrest posts (C). Set the core box bit to rout a $\frac{3}{4}$ "-dia. tenon. (Mine was $\frac{1}{8}$ " high.) But again for a good fit, sneak up on the height of the router bit.

Next, I cut the $\frac{3}{4}$ "-dia. tenons on the other 1" dowels (backrest rails D and upper rails E, G, and I). The height of the bit should be the same (but test it to make sure). However, you will need to adjust the fence so the tenons end up $1\frac{1}{4}$ "-long (*Fig. 14a*).

Finally, the tenons on the $\frac{3}{4}$ "-dia. pieces (the lower rails F, H, and J) can be routed. You'll need to lower the bit so it leaves a $\frac{5}{8}$ "-dia. tenon. (My bit was $\frac{1}{16}$ " high.)

Note: With the bit lower, you may need to reposition the fence slightly to end up with $1\frac{1}{4}$ "-long tenons.



ASSEMBLY

With all the tenons routed, the chair frame is ready to be assembled.

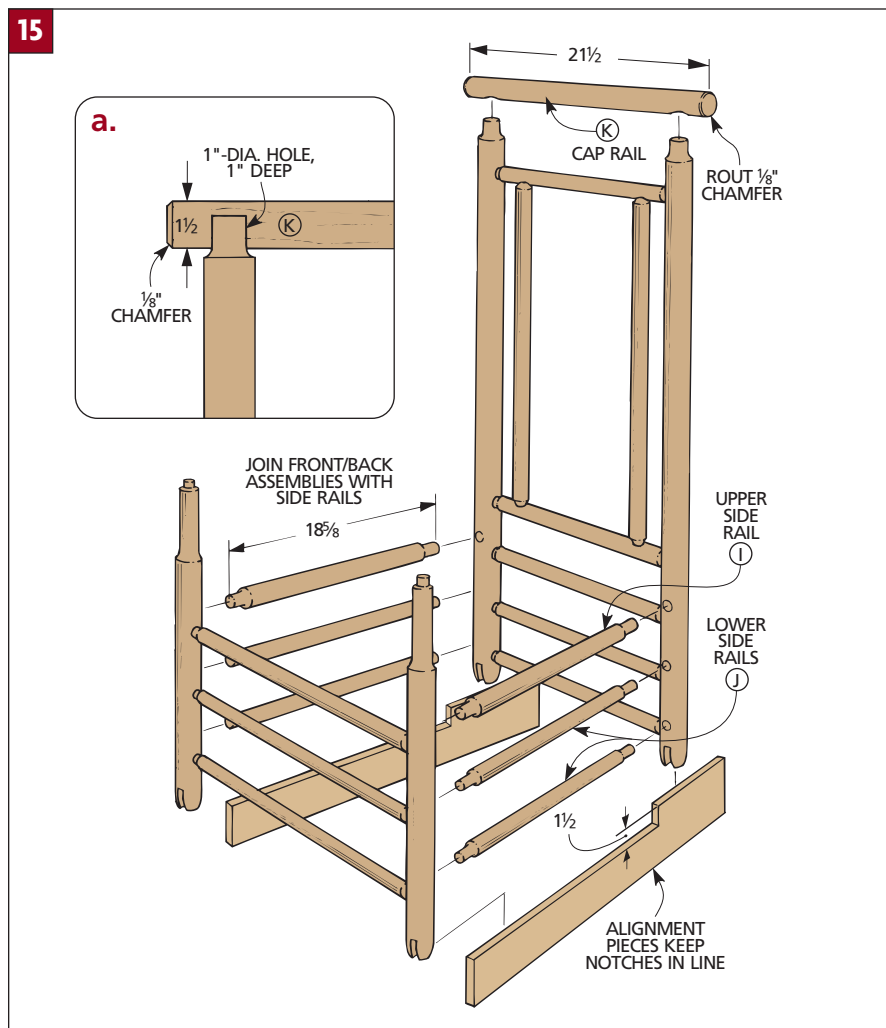
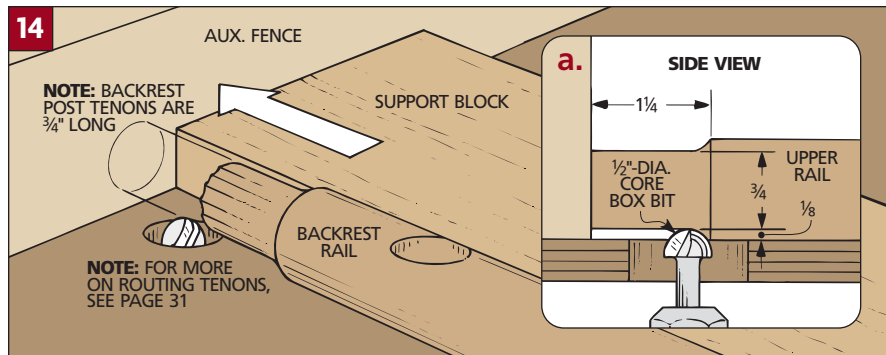
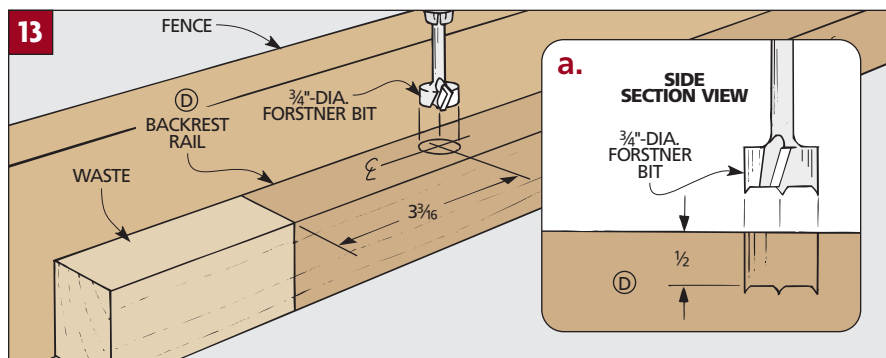
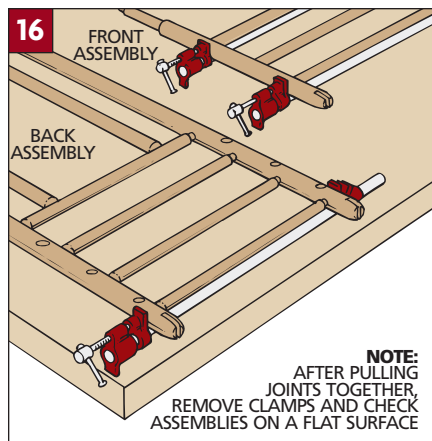
SUB-ASSEMBLIES. The first thing I did was to assemble the front and back sub-assemblies (*Fig. 12*). As with any assembly, your goal is to get them flat and square. But because you're working with dowels here, you can't approach them in the usual way.

I used clamps to pull each sub-assembly together (*Fig. 16*). Then I measured the width at the top and bottom of the legs. This will tell you if the legs are parallel or not. Then I removed the clamps and set the assemblies on a flat surface. If they were twisted, I flattened them out.

SIDE RAILS. When the glue is dry on both sub-assemblies, they can be joined with the side rails (*Fig. 15*). The key here is to make sure the notches for the rockers line up. So I created two temporary alignment pieces that were $\frac{1}{2}$ "-thick and had a $1\frac{1}{2}$ " offset. Then I placed them in the notches at the bottom of the legs while the chair was being assembled.

CAP RAIL. The last dowel to add is the cap rail (K) that fits over the top of the back legs (*Fig. 15*). I saved this rail until now because it's a different diameter than the other rails ($1\frac{1}{2}$ "). Also, I wanted to drill the holes to fit the tenons on the tops of the legs (*Fig. 15a*).

After the cap rail was rounded and cut to final length ($21\frac{1}{2}$ "), I routed a $\frac{1}{8}$ " chamfer on both ends of the piece. This is the same technique used to create the tenons on the other rails, except you use a chamfer bit and the piece stops against the bearing on the bit. After the chamfers are routed, the cap rail can be glued onto the back legs.



ARMS

At this point, all that's left to be added are the arms and rockers. I saved the rockers for last so the chair wouldn't rock while I was trying to add the arms.

CUT TO SHAPE. The arms (L) start out as a pair of $\frac{3}{4}$ "-thick blanks (5" x 20"). The first thing I did was to draw the shape of the arm on the blanks, see pattern below. (**Note:** Full-size patterns are available. See Sources on page 126.)

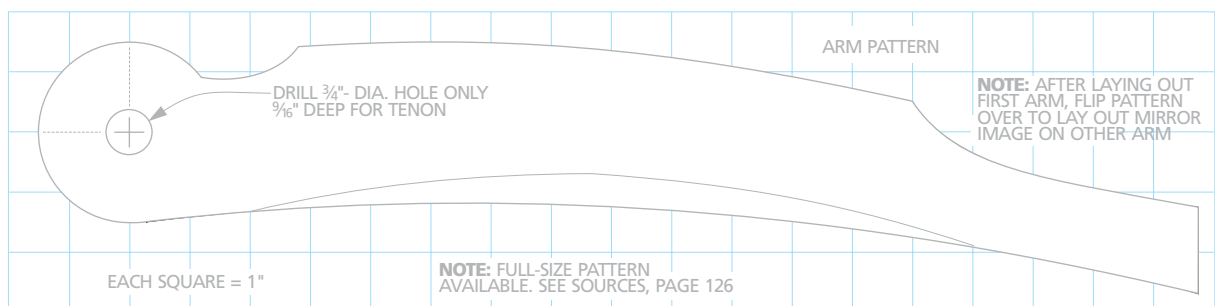
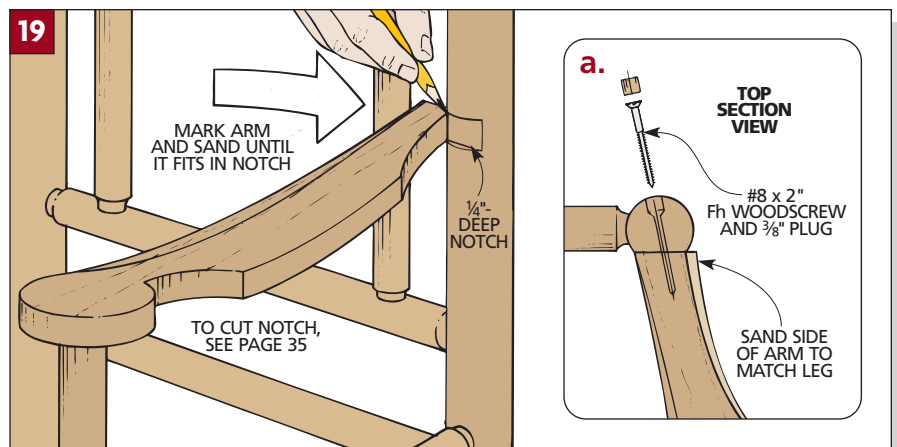
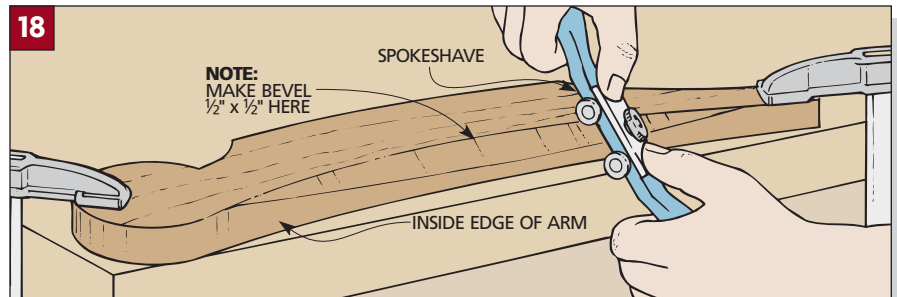
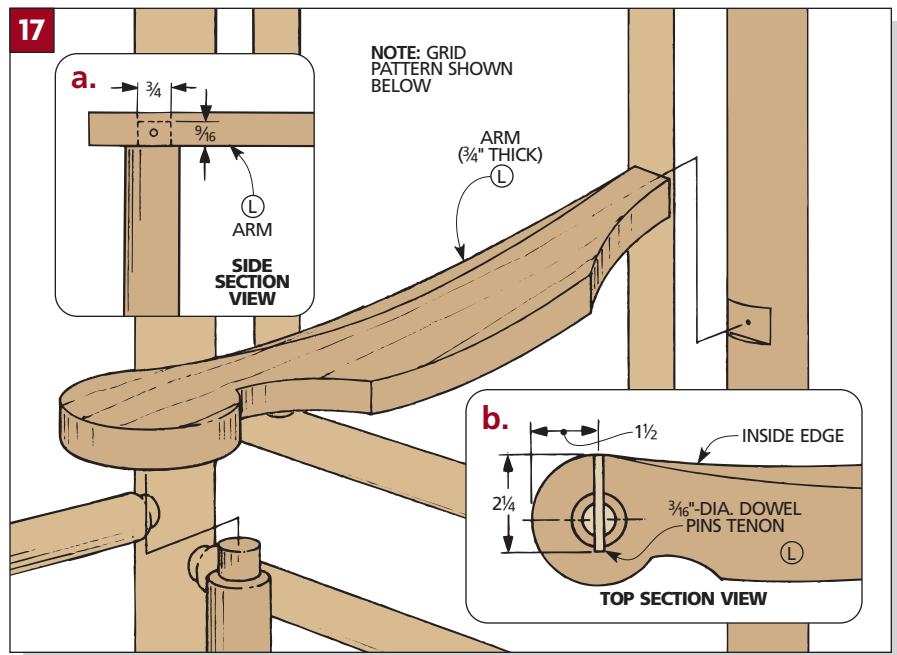
Before cutting the arms to shape, I drilled a $\frac{3}{4}$ "-dia. hole $\frac{9}{16}$ "-deep on the bottom face for the tenon on each front leg (*Fig. 17a*). Make sure you don't drill through the top face of the arm.

Next I used a band saw to rough out the arm. Then for most of the arm, I sanded up to the line with a drum sander and finished by hand sanding.

CREATE BEVEL. Before attaching the arm to the chair, I removed the sharp inside edge by creating a tapered chamfer that's $\frac{1}{2}$ " x $\frac{1}{2}$ " at its deepest point (*Fig. 18*). To do this, I drew the chamfer on the top face of the arm (refer to pattern). And I scribed a line $\frac{1}{2}$ " down from the top face. Then to do the chamfering, I used a spokeshave (though you could use a rasp for this).

ATTACH ARM. Now the arm is ready to be mounted to the chair. This is a little trickier than it looks. To give the arm plenty of support, I cut a notch in each back leg for the arm to rest on. (For more on this, see the Technique box on the opposite page.) Then I set the arm on the tenon on the front leg and sanded it in back until it fit snugly in the notch (*Fig. 19*).

After the arm fits in the notch, its outside edge can be sanded flush with the leg (*Fig. 19a*). Then it's pinned at the front inside edge with a $\frac{3}{16}$ "-dia. dowel (*Fig. 17b*). And in the back, the arm is secured with a No. 8 x 2" Fh woodscrew (*Fig. 19a*). (The screw is counterbored and plugged so it won't be visible.)



TECHNIQUE . . . Notching Round Stock

I didn't want the arms of the rocker to work loose, so I cut a notch in each back leg and let in the ends of the arms. But trying to lay out a square notch on a round dowel can be tricky.

TEMPLATE. To help lay out the notch accurately, I made a template with a shallow arc on one side. The arc matches the curve of the back leg so that you can trace the outline of the notch.

To make the template, I marked centerlines on a square block of wood and then drilled a 1½"-dia. hole through the center (Fig. 1). (This block should be the same thickness as the arms of the chair.) Then I cut the block in two pieces so I had a ¼"-deep arc in one piece (Fig. 1a).

SPACER BLOCK. To keep the arms of the chair flat, the notch needs to be positioned at the same height as the tenon on the front leg. To do this, first I cut a spacer block the

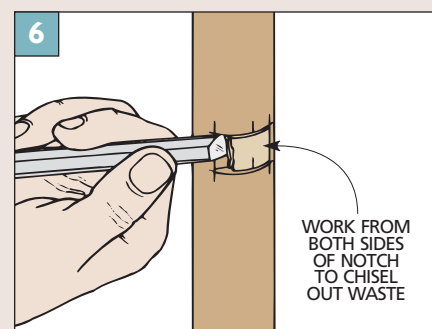
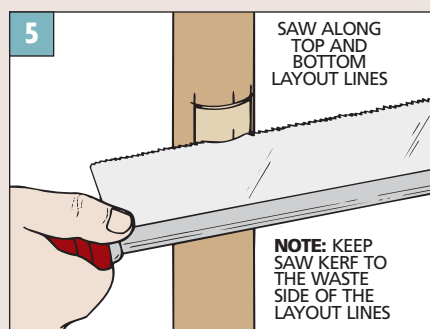
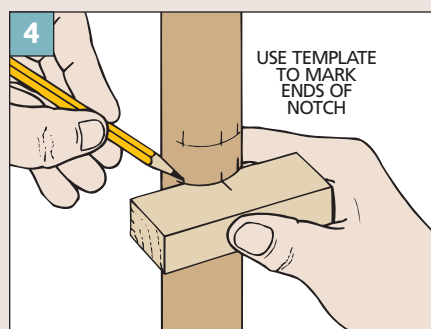
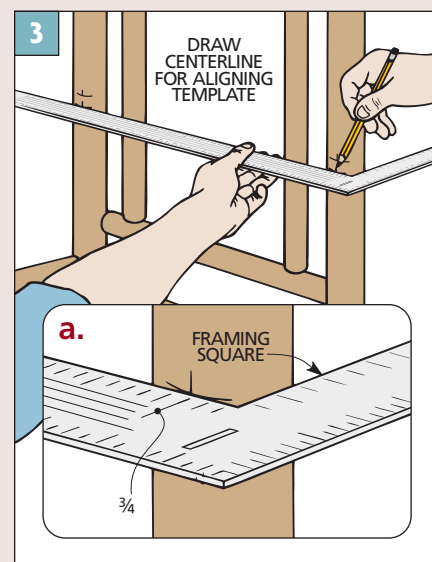
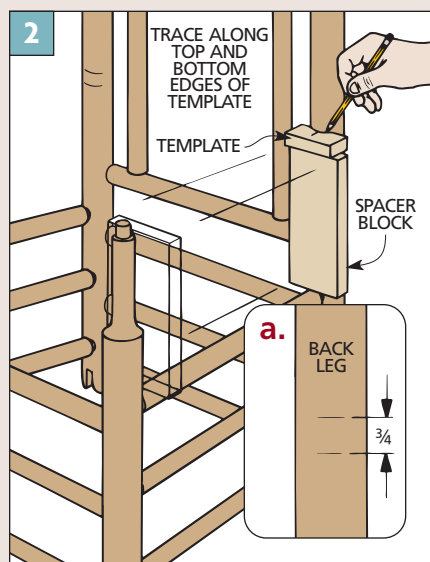
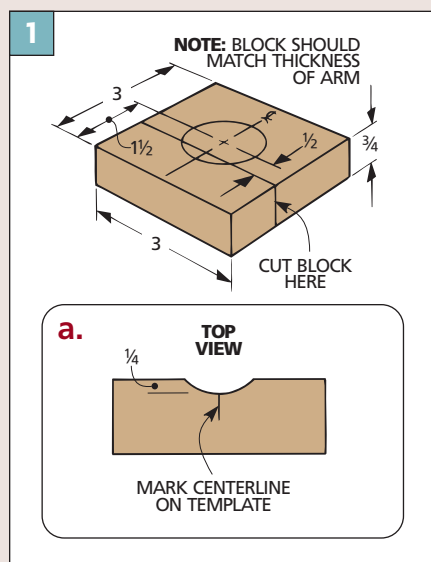


Then I just set the template against the back leg on top of this spacer block and traced along the top and bottom edges to establish the top and bottom of the notch (Figs. 2 and 2a).

LAYOUT. The next step is to lay out the ends of the notch. To do this, place a framing square across both back legs and measure in half the diameter of the leg (¾" in my case) (Figs. 3 and 3a). This will be the center of the notch. Make a mark at this point.

Now place the template against the leg again, lining up the center-point on the leg with the center-point on the template. Mark the ends of the template arc onto the leg to designate the ends of the notch (Fig. 4).

To cut the notches, carefully saw along the top and bottom layout lines with a hand saw (Fig. 5). Then chisel out the waste down to the end lines of the notch (Fig. 6).



ROCKERS

The rockers are curved like the arms, but they're much less work. They're simply cut to shape from $\frac{1}{2}$ "-thick stock and pegged to the legs.

CUT TO SHAPE. First, I cut two blanks to rough size (5" x 33") and taped them together with carpet tape. This way, you only need to draw the pattern on one blank (see pattern below). Then the rockers (M) can be cut out at the same time on the band saw and sanded smooth with a drum sander.

PEG TO LEGS. Now the rockers can be attached to the chair. To do this, I flipped the chair upside-down and set the rockers in the notches, making sure the legs were centered on the flat spots on the rocker pieces.

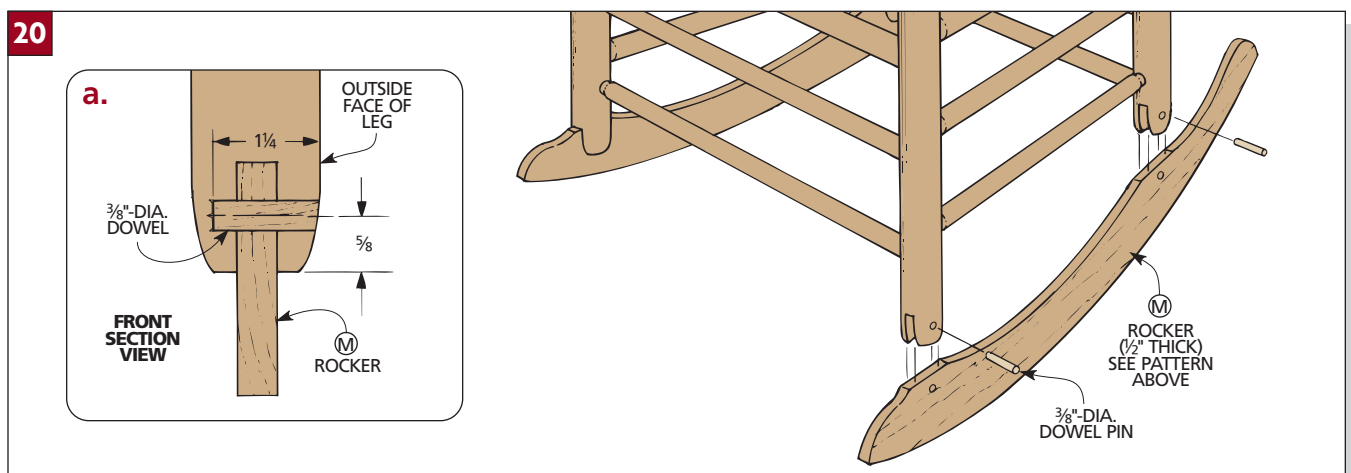
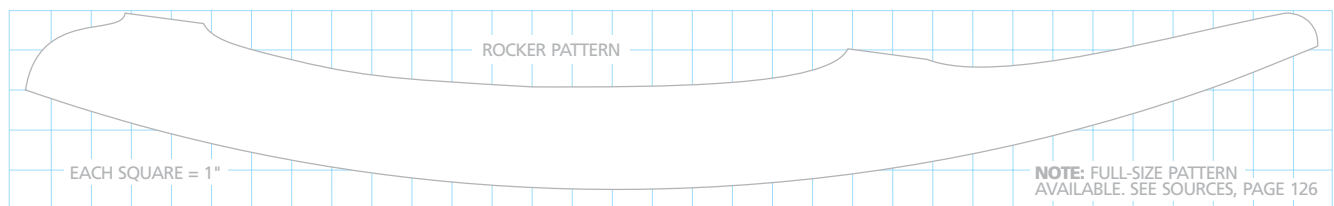
Next, I drilled a $\frac{3}{8}$ "-dia. hole $1\frac{1}{4}$ " deep through the outside face of each leg and through the rockers (*Fig. 20a*). This hole stops short of the inside face of the leg. (Use a brad point bit to get a clean hole.) And finally, I pinned the rocker with a $\frac{3}{8}$ "-dia. dowel.

FINISH & SEAT WEAVING

With the rocker built, there are still two things left to do: apply the finish and weave the seat. The round surfaces make it difficult to brush on even coats of finish, so I used a wipe-on oil finish.

After the finish had dried, I noticed a few runs and rough spots left by dust. These were easily removed with a light buffing with 0000 steel wool.

When you are satisfied with the finish, you can begin to weave the seat. Refer to the Technique article that begins on page 38. ■



TECHNIQUE... Making Your Own Dowels

Make your own dowels — why go through all the work? Well, there are quite a few reasons. For the rocker and footstool in this book, I had a hard time finding 1½"-dia. dowels, so making them was about my only option. Plus, I could build these projects out of any wood I wanted. I wasn't limited to what was "in stock."

Then while building the rocker, I ran into a couple other benefits. The real trick would have been steadying dowels while drilling the two sets of holes in each leg. But by starting with square stock, laying out and drilling the holes was a simple procedure.

Safety Note: The technique shown here will work for 1½"-dia. and larger dowels. If you try to make smaller dowels this way, the stock will vibrate too much as it passes over the bit.

PREPARING STOCK

The first step is getting your stock to the proper width and thickness.

MAKE SQUARE BLANKS. Before you can make a dowel, make sure the stock is square. Both the width and the thickness of the blank should match the finished diameter of the dowel. So for a 1½"-dia. dowel, for example, you'll need a 1½" x 1½" blank (Fig. 1).

The other thing about these blanks is that I don't rout to the ends (Fig. 2). Otherwise, the blank would tend to roll as the last edge was being routed. So to get the correct dowel length and still keep the ends square, I cut the blanks 5" longer than the final dowel length.

ROUNDING OVER

Once your stock is prepared, the next step is to set up the router table.

SET UP ROUTER TABLE. First, choose a roundover bit that's half the diameter of the completed dowel. (For a 1½"-dia. dowel, you'll need a ¾"-radius bit.)

When setting up the bit, the key is to get its cutting edge flush with both the top of the router table and the face of the fence, (Fig. 1a). If the fence isn't aligned or the bit is too high or low, you'll end up with small shoulders or large flat spots on the dowel — and this translates into quite a bit of sanding (something I like to avoid).



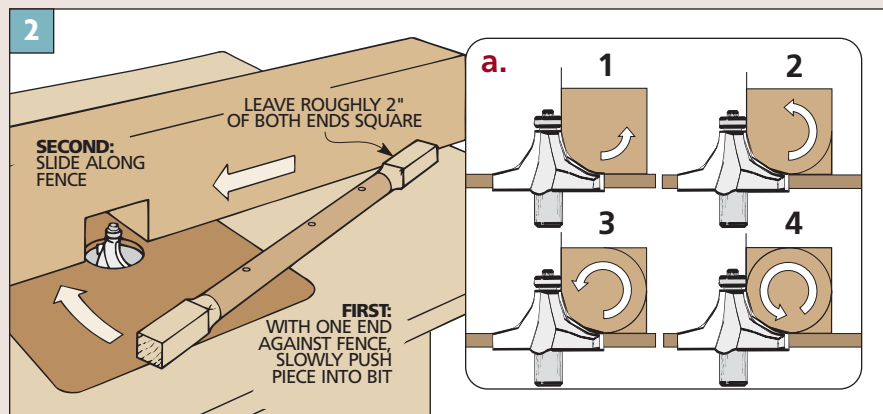
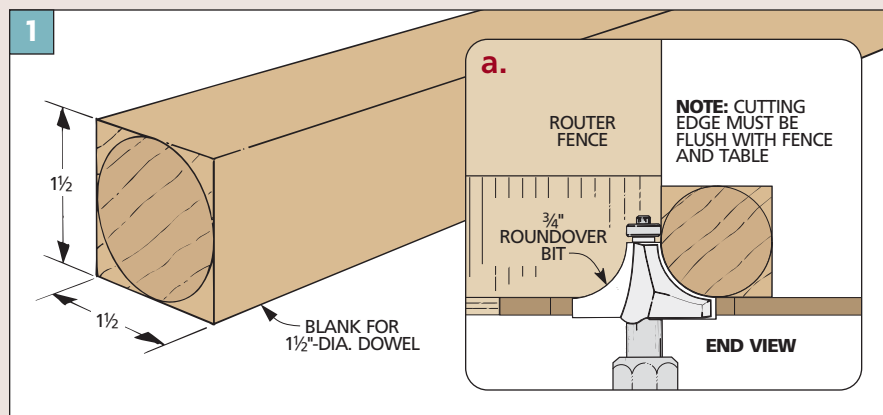
Note: One way to set the height of the bit is to place a rule across the opening in the fence and the table. With the router unplugged, turn the bit by hand — the cutting edge at the ends should just "tick" the ruler.

ROUND OVER EDGES. To round the edges, set the right end of the blank against the fence and pivot the other

end into the bit about 2" from the left end (Fig. 2). Then push the stock to the left, stopping 2" from the opposite end.

Now rotate the stock and rout the other three sides (Fig. 2a). Then cut the dowel to finished length.

Finally, no matter how carefully you set up the bit, you'll still need to sand some small, flat edges.



TECHNIQUE... Weaving a Shaker Seat

Weaving a seat isn't a typical woodworking technique. And frankly, I was a little bit nervous about getting it right. But after weaving the rocking chair and the footstool, I realized that there's not much to it. In fact, I'd have to say that Shaker-style weaving is downright easy. It doesn't require a lot of tools, materials, or a lot of time. So once your rocking chair or footstool has a few coats of finish and is dry, you can jump right in.

Of course, the best part is how great the project looks when you're done. Interesting color combinations can make a simple project striking. Or for a look that's more subdued, you can weave a project all in one color.

NEW TERMS

When weaving for the first time, there are a few new terms you'll have to get used to. For starters, the cotton webbing is called "tape," but it's not sticky. Plus, the tape has a different name depending on which direction you're working. I better explain.

WARP AND WEFT. The first piece of tape you work with is called the "warp" (Fig. 1). This isn't anything to avoid, as in woodworking. Instead, the "warp" is the long piece of tape that's wrapped around the front and back rails of a project (like on the seat of the rocker), or the top and bottom rails (as on the rocker's backrest).

The other piece of tape is called the



"weft" (or sometimes, the "woof"). This long piece is woven through the warp from left to right (Fig. 1).

GETTING STARTED

Now that you're familiar with the terms I'll be using, it's time to get started. The first thing to do is to get all the materials together. There are really only three things you need: cotton tape, a piece of 1"-thick foam pad, and a handful of upholstery tacks.

Note: There are several sources for the cotton tape and foam pad. Refer to page 126 for a list.

ESTIMATING THE TAPE LENGTH. To figure out how much tape is needed, you have to keep two things in mind. First, each seat or backrest will have two layers — the tape is woven around both the top and bottom (or front and

back) of the chair. (The 1" foam pad ends up between these two layers.) The second thing to keep in mind is that it's better to end up with too much tape rather than too little. Although tape can be spliced to make it longer, you don't want to risk having that splice show up in the middle of your pattern. (When ordering the tape, you can ask for help. All you'll need are the dimensions of your chair.)

To estimate the amount of tape you'll need, first measure one complete row by wrapping a string completely around the rails (Fig. 2). Then multiply this measurement by the number of rows

you'll end up with (I also add a few extra rows for waste — just to be safe). The number of rows will depend on the width of the tape. Most tape is 1" wide, which makes the math easy. But 5/8"-wide tape is available too.

The measurement you just arrived at is just for the warp piece of tape. Now you can follow the same procedure to estimate the weft piece.

WRAPPING THE WARP

When you have the weaving supplies in hand and the project has had several coats of finish applied to it, you can begin weaving the chair back.

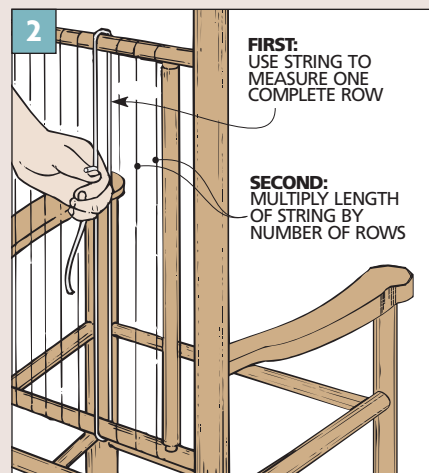
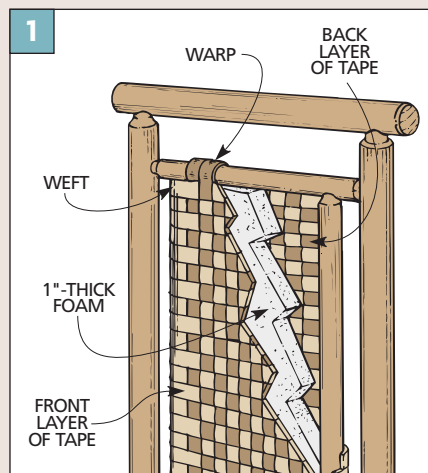
As I mentioned, the first piece of tape is called the "warp." It's one long piece that's wrapped around the top and bottom backrest rails of the chair.

(For the chair seat and the footstool,

MATERIALS LIST

WEAVING SUPPLIES

Cotton Shaker tape (1" wide)
1/2"-long upholstery tacks
1" thick foam pad
Tack hammer
Spring clamp
Needle nose pliers
Scissors
Needle and thread or 5-minute epoxy



the warp also covers the front and back rails. See page 41.)

Note: If you're using two colors for your chair it's best to use the darker color for the warp. On the seat, the front edge gets much more wear than the sides, so the darker color will help "hide" the dirt better.

SECURING THE TAPE. To begin wrapping the warp, the first thing to do is anchor it to the frame. I did this with a couple of 1/2"-long upholstery tacks.

The end of the tape should end up hidden as much as possible. So I tacked it to the inside edge of the backrest post on the side (not the rail on top or bottom) (*Step 1*). Though it isn't critical where you tack the tape, I like to tack it near the end of the rail. This way when hammering the tack in place, the rail has a little more support than if you were to tack it in the middle.

Now you can begin wrapping the tape around the rails, starting from the back (*Step 2*). Starting this way allows the tape to run straight up and down in front, which is what you want. This means the rows in back will angle just

slightly, but that's okay — you want to put your best face forward.

After weaving about halfway across the rails, I stopped and cut the foam pad to size (*Step 3*). Then I inserted the foam between the front and back layers of the warp (*Step 4*). When someone sits in the chair, this pad helps distribute some of the weight to the back layer of tape.

Once the last row of the warp is done

in front, wrap the tape around to the back and then up to the top of the side rail (*Step 5*). To keep the tape taut, clamp the tape to the cap rail (or wrap it around the rail a few times). Then tack the tape in place and trim off the excess.

While wrapping the warp, the one thing to avoid is pulling the tape too tight. It shouldn't sag, but if the tape is tight now, you'll have a harder time weaving the next layer — the weft.



1 Working from the back side of the chair, use an upholstery tack to secure the end of the tape along the bottom inside edge of the side rail.



2 Now wrap the tape around the top and bottom rails, positioning the tape edge-to-edge. Make sure the tape in front is perfectly vertical.



3 With half the tape wrapped, clamp it to a rail (refer to Step 4). Cut a foam pad to fit between the rails with a 1/2" gap around each edge.



4 With the tape still clamped, feed the foam between the two layers of tape. Continue to wrap the warp until you reach the opposite side rail.



5 After the last row is completed in front, wrap the tape around to the back and up to the top of the side rail. Tack it in place and trim the excess.

SPLICING THE TAPE

Depending on the roll of tape, you may need to splice two of the ends together. This is easy enough to do. Just make sure the splice weaves into the back (or bottom) layer so it's hidden.

The traditional way to splice tape is with a needle and thread (see left photo). But for the rocker, I used a five-minute epoxy (see right photo).



WEAVING THE WEFT

At this point, it's time to begin weaving the weft piece of tape through the warp. This is what creates the "checkerboard" look. (There are also a couple of additional weaving patterns you might want to try. See the Designer's Notebook on page 42.)

By the way, you don't have to use contrasting colors for the warp and the weft, as I did. With just one color of tape on the chair, the pattern will draw less attention to itself, but still add an extra bit of interest.

GETTING STARTED

Whatever pattern you choose to weave into your chair, weaving the weft begins the same way.

TACKING THE WEFT. Like the warp, the first thing to do is anchor the weft to the chair frame. But there's an important difference here. Instead of being tacked on the backrest post near the bottom, I secured the weft piece on the underside of the top rail (*Step 6*). (For the chair seat or the footstool, the weft

is tacked on the inside edge of the back rail near one of the legs.)

To do this, first move to the back of the chair (or flip it over if you're working on the seat) and weave the weft tape under and over the warp pieces from one end to the other (*Step 6*). Then push some of the warp pieces aside so you can tack the end of the weft piece to the backrest rail. (As you can see in *Step 6*, the small head on a tack hammer is especially useful for reaching into this tight space.)

WEAVING. Now it's time to weave the



6 Weave the tape across the back of the chair. Then push aside the warp pieces and tack the end in place.



7 Moving to the front, weave the tape over and under the warp pieces. Then repeat this on the back side.



8 At the start of each weft row, make sure you are weaving opposite the pattern of the row that's above it.



9 Stop occasionally to push the rows together, making sure those in front of the chair are straight.

rest of the weft. This piece is woven through the warp at both the front and back sides of the chair.

Unlike the warp, the weft can't be left in a roll. You have to pull all the tape through the warp (see the photo above). And because there ends up being a big pile of tape, I found it helped to feed the weft into a cardboard box. And after weaving a couple of rows, I also discovered another trick. Let the end of the tape hang over the edge of the box so you can find it easily.

You'll also find the tape gets pretty twisted in the process. The simple way to straighten it out is to force all the twists through the warp before the tape gets pulled to the very end.

While weaving the backrest, you'll be moving from the front side of the chair to the back as you weave the two layers. Pull each row tight as you complete it, though don't pull so hard that you bend the backrest posts.

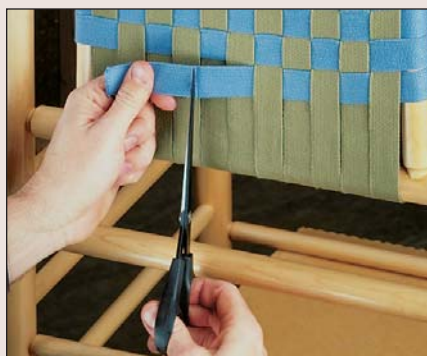
As you start each row, check that you're weaving a pattern that is opposite the row above it. You don't want to discover a mistake several rows later and have to undo your work.

Also, while weaving the weft, you want to push each row up against the one before it (*Step 9*). When you do this, make sure the rows on the front (or on top) are straight and square to the warp rows.

FINISHING UP

For most of the chair, weaving the weft over and under doesn't change. But when you get close to the end, there are some things to be aware of.

COMPLETING THE WEFT. As you weave the last few rows, you'll notice the weaving gets harder because the tape gets tighter. (Needle nose pliers come in handy here.) The weft should end on the back side of the backrest. Simply weave it as far as you can. Then pull a couple warp pieces aside and tack the tape to the backrest rail (Step 11). Now just cut off the excess and push the warp pieces back in place.



10 If you find yourself running short of tape and need to make a splice, try to position the cut so the splice will be hidden beneath a warp piece on the back or underside of the weave.



11 Complete the weft on the back side, weaving it as far as possible. Then to anchor the weft, move a couple of the warp pieces and tack the weft to the backrest rail. Move the warp pieces back.

WEAVING A TAPERED CHAIR SEAT

There's one big difference when it comes to weaving the rocker seat — unlike the parallel sides of the chair back, the seat tapers from front to rear.

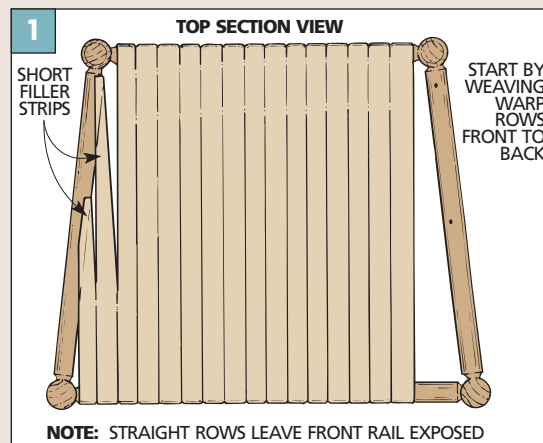
WARP PIECES. Like the backrest, the first thing to do on the seat is wrap the warp around the front and back rails (Fig. 1). But since the front is wider than the back, you can't cover the entire front rail. There's a little bit on each end that's exposed.

To cover these sections, add a couple short strips of tape to each side (Fig. 1 and Step 1). With the chair upside down, tack one end of the tape to the back inside edge of the side rail. Then wrap it around the front rail and tack it again to the inside edge of the side rail. That's all there is to it. But there are a couple other tips I can pass along.

When positioning the filler strips, it's important that they are as parallel as possible to the other warp pieces. I positioned the first strip near the back leg, but the second looked better when tacked near the middle (Fig. 1). Also, when trimming the tape, I tapered the top edge so it wouldn't cause the weft pieces to bulge.

WEFT PIECES. With the filler strips in place, you can weave the weft pieces. I put a strip of double-sided tape on the sides of the rails (Step 2). This does two things: It helps hold the tape as you're weaving. And later, it prevents the tape from slipping to the back.

While weaving, you can "ignore" the filler strips at first. Then after a few rows, they can be worked into the weaving pattern (Step 3).



1 To cover the front rail at each end, tack short filler strips to the inside of the side rails. Position the strips so they're parallel with the warp pieces.



2 Before weaving the weft, place a strip of double-sided tape on the outside of each side rail. Remove the tape backing as you weave each row.



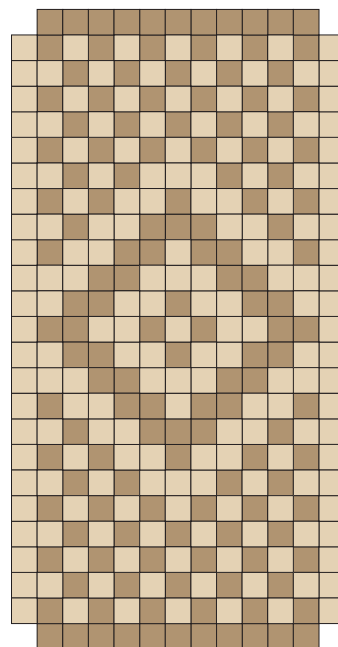
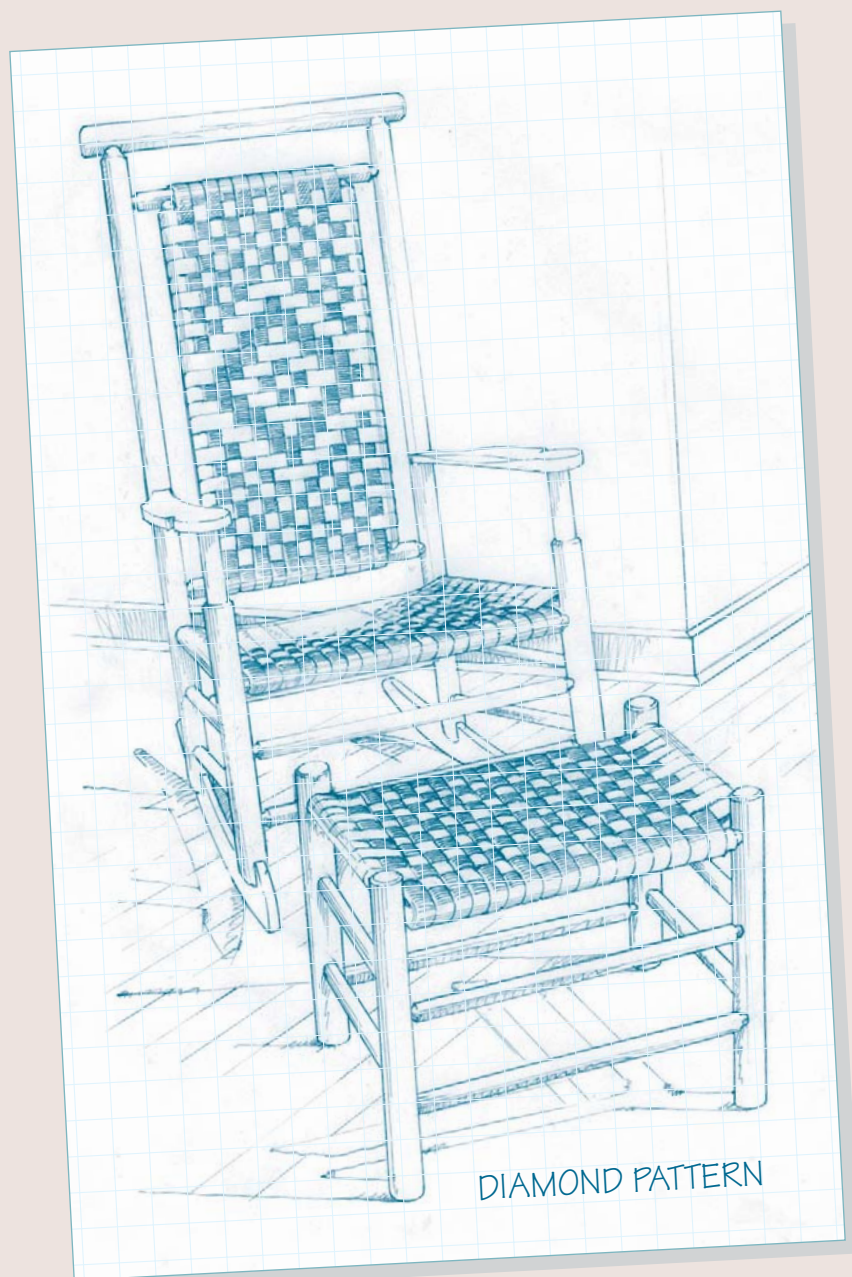
3 Weave over the filler strips on the sides for several rows. Then when it looks "natural," begin incorporating them into the weaving pattern.

Changing the pattern in the weave can give your chair a distinctive look. We offer a couple of different designs here, but you can easily design many more with just a sheet of graph paper.

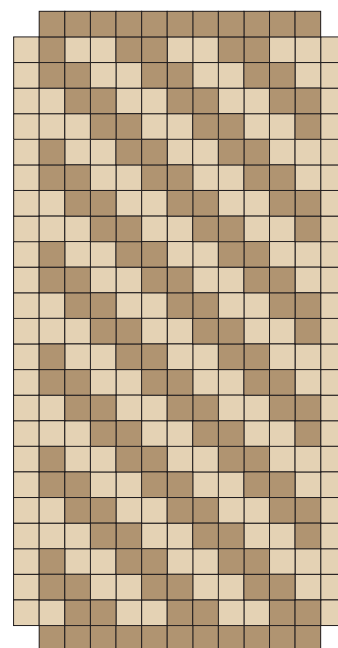
WEAVING PATTERNS

■ To weave the diamond pattern (top), there has to be an odd number of rows in the warp. **Note:** If you plan to weave the diamond on the chair seat or on the footstool, first resize the pattern by drawing it out on graph paper rather than experimenting on the project.

■ The herringbone pattern (bottom), is similar to the checkerboard. But instead of going over one row and under the next, weave over two rows, then under two rows. Pay special attention to the start of each row. Some begin with one over, then two under or vice versa. This pattern works well with an even or odd number of rows.



DIAMOND PATTERN



HERRINGBONE PATTERN

Shaker-Style Footstool

It doesn't take long to build this footstool to match the rocker. From making your own dowels to weaving the seat, these two projects share many of the same techniques.



From the start, I planned to build a footstool to go with the Shaker-style rocker on page 26. Besides being a nice place to rest your feet, the stool features many of the same techniques used to build the rocker. So if you'd like to practice some of these before you "work up" to the rocker, this is the perfect project.

MATERIALS. Since the idea was to match the footstool to the rocker, I used hard maple. In fact, since I knew I was going to build both projects, I bought the wood for them at the same time.

This allowed me to get the best match between the pieces.

CHERRY. Building the maple version only took a weekend, so I decided to make a second stool to give as a gift. This time I decided to use cherry (see inset photo).

I chose cherry for a couple of reasons. First, the Shakers frequently used this wood to build furniture. That's because it was readily available in the northeastern United States (where the Shakers settled).

Second, I really like the deep-red

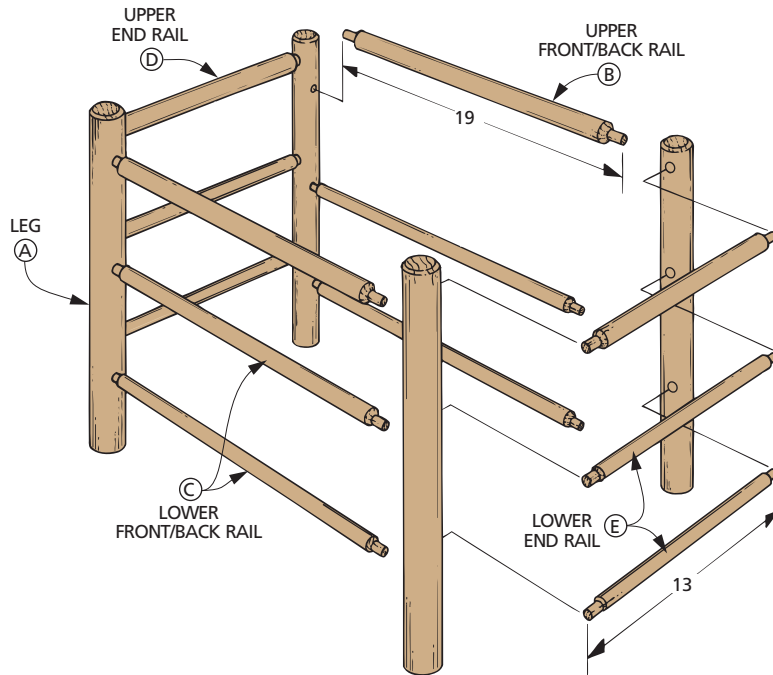
color cherry takes on as it ages. Although the Shakers frowned on unnecessary "frills" decorating their furniture, they did appreciate the natural beauty of the wood.

FINISH. And with that Shaker notion in mind, I used four coats of a wipe-on oil finish on both the maple and the cherry versions.

EXPLODED VIEW

OVERALL DIMENSIONS:

20½" W x 14½" D x 16½" H



MATERIALS LIST

WOOD

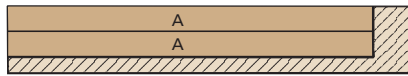
- | | |
|----------------------------------|---------------|
| A Legs (4) | 1½ x 21½ rgh. |
| B Upper Fr./Bk. Rails (2) | 1 x 24 rgh. |
| C Lower Fr./Bk. Rails (4) | ¾ x 24 rgh. |
| D Upper End Rails (2) | 1 x 18 rgh. |
| E Lower End Rails (4) | ¾ x 18 rgh. |

HARDWARE SUPPLIES

- (30 yds.) 1"-wide cotton Shaker tape
 (8) ½"-long upholstery tacks
 (1) 1"-thick foam pad, 12" x 17"

CUTTING DIAGRAM

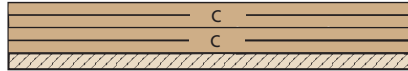
1¾ x 4 - 24 (Two Boards @ 1.3 Bd. Ft. Each)



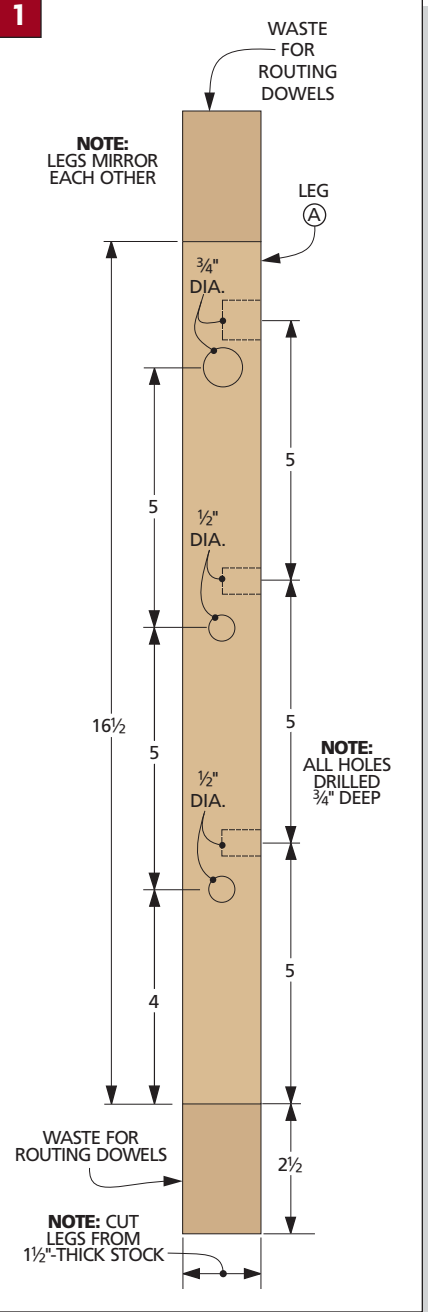
1 x 5 - 24 (1 Bd. Ft.)



¾ x 4 - 24 (.7 Bd. Ft.)



¾ x 4 - 24 (.7 Bd. Ft.)



LEGS

The legs start out as overlong square blanks. After holes are drilled, they are rounded over and then cut to length.

SQUARE BLANKS. To begin, I cut four legs (A) 1½" square (*Fig. 1*). The final length of these pieces will be 16½", but I cut mine 5" longer. (This extra length comes in handy when it comes time to rout the square blanks into round dowels.)

LAYOUT. The next step is to lay out

the locations of the finished top and bottom ends (the finished length of the legs), and the holes that will be drilled to hold the rails later. Just keep in mind that these legs aren't identical. They create two pairs that mirror each other. So after laying them out, stand the four legs up on end to make sure each set of holes aligns.

The first thing to do is to measure up from the bottom of each blank 21½" (*Fig. 1*). This will be the bottom end of the finished leg. To make sure you rout

far enough when rounding over the leg, make a mark around the blank at this point. Then lay out the top end of the leg, 16½" above this line, and make a second mark around the leg. And finally, mark on adjacent faces the locations of the six holes.

DRILL HOLES. Once the hole locations are marked, you can drill them. They are all flat-bottomed holes ¾" deep. But they're not all the same diameter. The top hole on each face is ¾" in diameter to match the tenon on the upper rail

(Fig. 1). The *bottom* two holes are $\frac{1}{2}$ " in diameter to fit the tenons on the lower rails. (I drilled these using Forstner bits in the drill press.)

ROUND OVER EDGES. At this point, the square leg blanks are ready to be “turned” into dowels. And to do this, I routed them on a router table using a $\frac{3}{4}$ "-radius roundover bit (Fig. 2). Each leg requires four “stopped” passes over the bit. See the Technique box on page 37 for more about this.

Once the square blanks have been turned into round legs, they can be cut to finished length ($16\frac{1}{2}$ "). This has to be done accurately, so the holes are aligned exactly from one leg to another.

Note: Routing the roundovers on the legs removed your original layout lines, so you'll have to measure again. Make sure you measure from the bottom end of each piece.

Then to complete the legs, I sanded them smooth and routed a $\frac{1}{8}$ " chamfer on each end (Fig. 3). This helps keep the ends of the legs from splintering.

RAILS

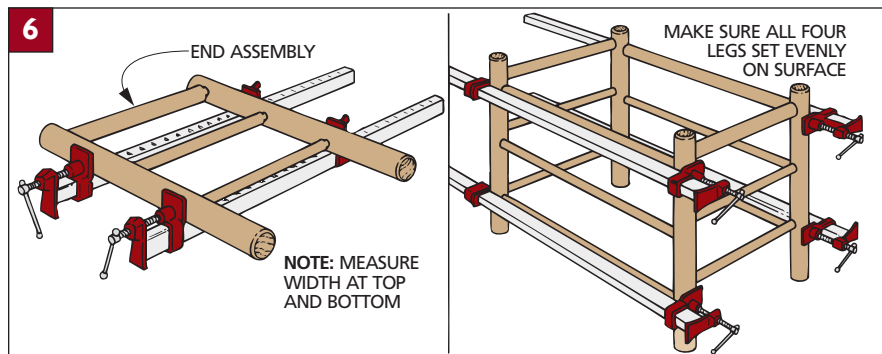
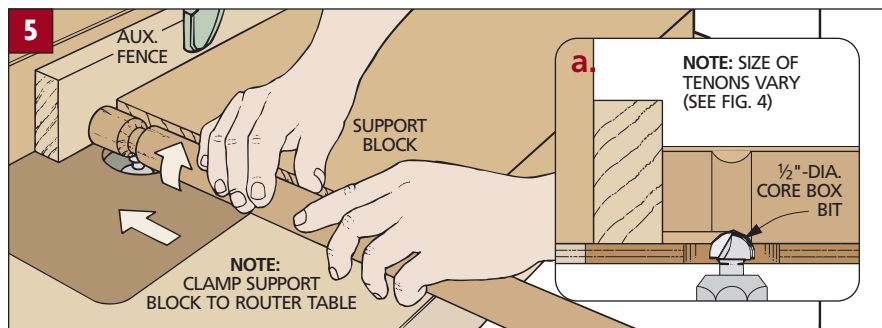
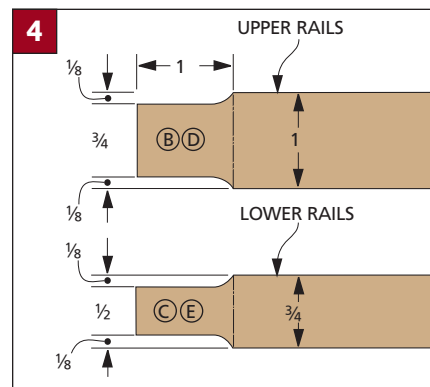
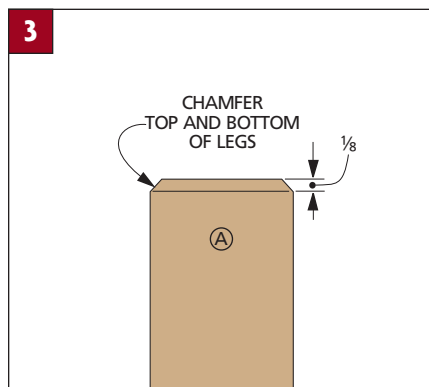
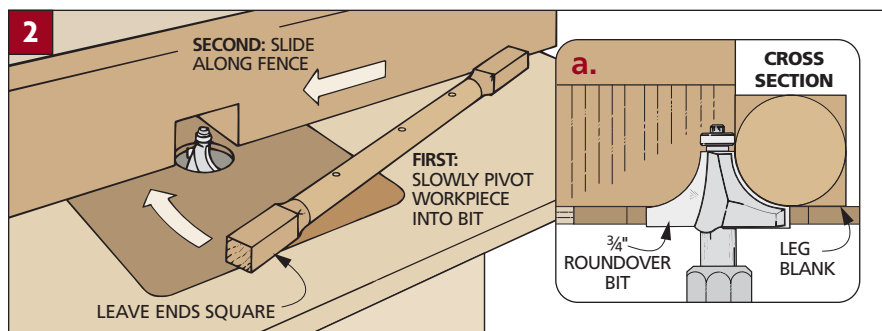
The front/back rails (B, C) and end rails (D, E) that connect the legs start out as square blanks that are 5" longer than finished length, just like the legs.

There are no holes to drill in these pieces, so the first thing to do is round over their edges. I used a $\frac{1}{2}$ "-radius roundover bit for the 1"-dia. upper rails (B, D) and a $\frac{3}{8}$ "-radius bit for the $\frac{3}{4}$ "-dia. lower rails (C, E).

Once the rails are rounded over, they can be cut to final length (19" for the front and back rails and 13" for the ends). Then I cut tenons on both ends of each piece using a $\frac{1}{2}$ "-dia. core box bit (Figs. 4, 5, and the Technique box on page 31). Even though there are two different diameters for the tenons, the height of the bit should be the same for both of them ($\frac{1}{8}$ "). But the important thing is that the tenons fit the holes in the legs. So it's a good idea to start with the bit slightly lower than $\frac{1}{8}$ " and sneak up on the final size.

ASSEMBLY

With the tenons cut, the frame of the footstool can be assembled. I glued up the end assemblies first (Fig. 6). With round mortises and tenons, it's easy for an assembly to get racked out of square.



So to make sure they weren't twisted, I set them on a flat surface. And I also measured the widths at the top and bottom of the assembly to make sure they were the same.

When the glue is dry on the end assemblies, they can be connected with the front and back rails (Fig. 6). To make sure the stool didn't rock, I made sure all four legs were resting on a flat

surface. (If the stool does rock, put a little bit of weight on it.)

At this point, the “woodworking” is done, so you can apply a finish to the footstool. (I wiped on four coats of an oil finish to match the rocker.)

To complete the footstool, you can weave the seat with cotton tape. Refer to the Technique box starting on page 38 for more on how to do this.





MISSION PROJECTS

Mission-style furniture should be simple and functional. Oak and cherry are the materials of choice, as they were in the early 1900s. These projects utilize a variety of hand and power tools to highlight contrasts in grain and the distinctive joinery.

A space-saving clothes tree, made of red oak, features distinctive and functional “Lincoln Log” cross pieces.

The sofa table is built entirely from quartersawn oak with traditional mortised spindles at either end.

Complementing the sofa table is a coffee table with a similar design. But this table has a beveled glass top and offers a simplified technique for making a series of mortises.

Finally, the cherry bookcase has characteristic through mortise and tenon joinery, ball-tipped hinges, and shop-built door pulls. It's a project that truly shows off your craftsmanship.

Hall Clothes Tree

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Shop Tip: Special Sanding Block 50

Oak Sofa Table

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Glass-Top Coffee Table

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Shop Tip: Adding Decorative Pegs 79

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Joinery: Through Mortise and Tenon 84

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Hall Clothes Tree

A special interlocking design brings this red oak hall tree together with a distinctive, Mission-style look. It also makes it strong and stable, without the need for a massive single “trunk.”



There's not much to this hall tree: posts, hooks, feet and cross pieces. But as simple as it is, working out the final design took quite a few revisions.

POST. For one thing, a hall tree requires a center post. A solid post would have been hard to find — and pretty heavy. Plus, it would've had a tendency to warp, particularly with seasonal changes in humidity.

I considered laminating the post from two or three pieces of thinner stock. But then there would have been visible joint lines running the length of the post.

INTERLOCKED JOINTS. So instead of a single, solid post, I decided on four narrower posts (each 1" thick). These posts are connected by the hooks, feet and some special cross pieces in an interlocking style (refer to the Exploded View on the opposite page).

This “Lincoln Log” approach lightened the weight of the tree, and also made it quite a bit more interesting to look at (and build). The exposed joints and contrasting grain give it a distinct Craftsman/Mission look.

HOOKS & FEET. With the post designed, next I worked on the hooks and feet. Of course, these pieces have to look right. But changing their size (and shape) also affected the stability and utility of the tree.

So I played with the shape and lengths of the pieces, trying to get a balanced look that worked well when coats, hats, and umbrellas were hung on it (see photo at left).

This required building several prototypes. But that wasn't a big deal; you don't have to cut any tenons on the inside edges of the hooks or feet. Instead, the pieces are simply sandwiched between the posts.

MATERIALS. The hall tree shown here was made from red oak. Oak was a popular material to use for Craftsman-style or Mission furniture, particularly in northern regions where it was abundantly available.

Oak is very hard and durable, and it planes well. And when finished with oil (as this project was) red oak can develop a rich, natural color — almost an orange hue.

Of course, you could also use nearly any other hardwood to build this project. And no hardware is needed, as the interlocking design makes it sturdy just with glue.

PATTERNS. Scaled-down grid patterns are shown for the top hooks, bottom hooks, and feet of the hall tree (see opposite page).

But if you prefer not to try to transfer these patterns to your workpieces, you can purchase full-size patterns. For more information, see page 126.

CUTTING DIAGRAM

1 x 5 - 60 RED OAK (2.6 Bd. Ft.)



NOTE: ALL PIECES CUT FROM 5/4 STOCK (PLANED 1" THICK)

1 x 4 - 84 RED OAK (2.9 Bd. Ft.)



1 x 5 - 84 RED OAK (3.6 Bd. Ft.)



EXPLODED VIEW

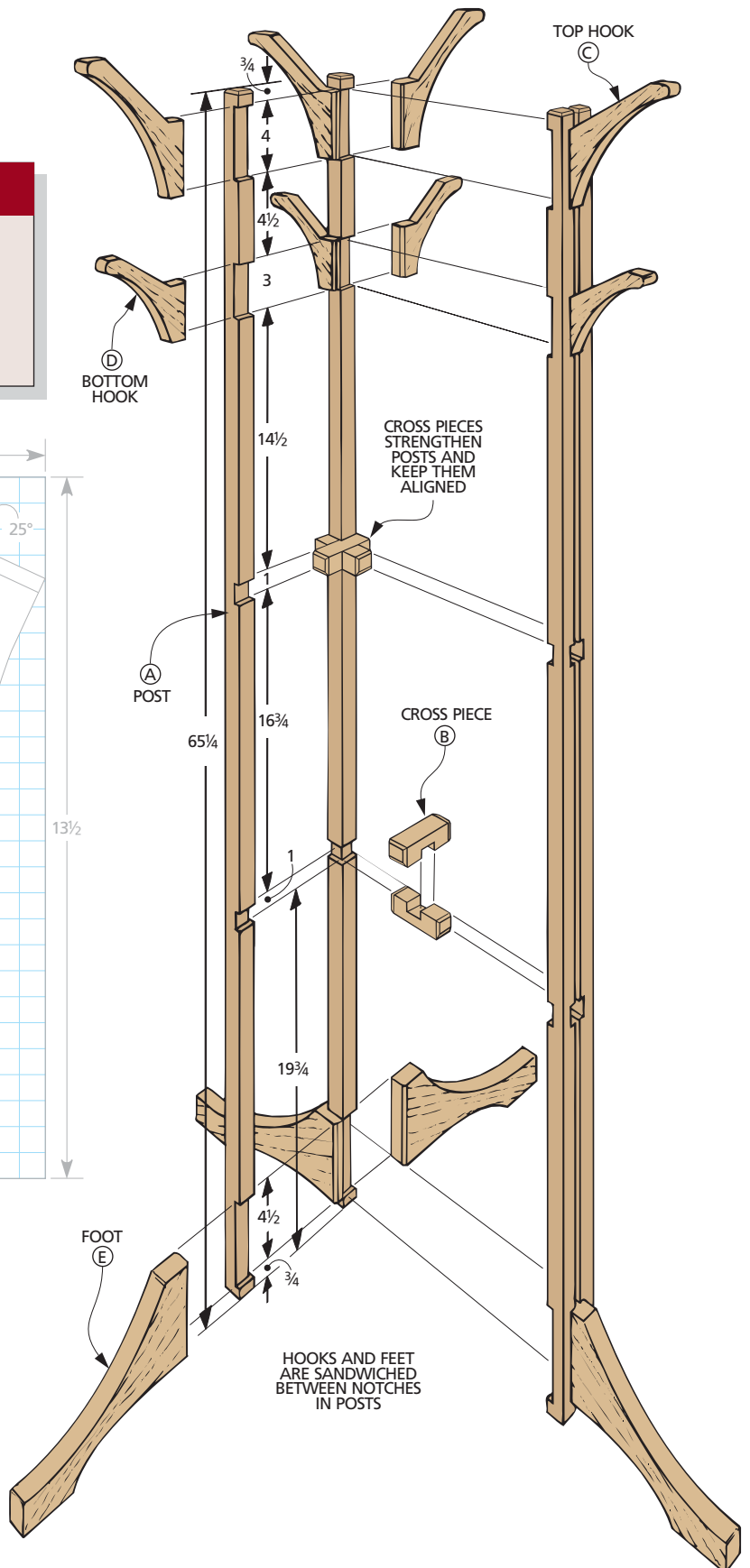
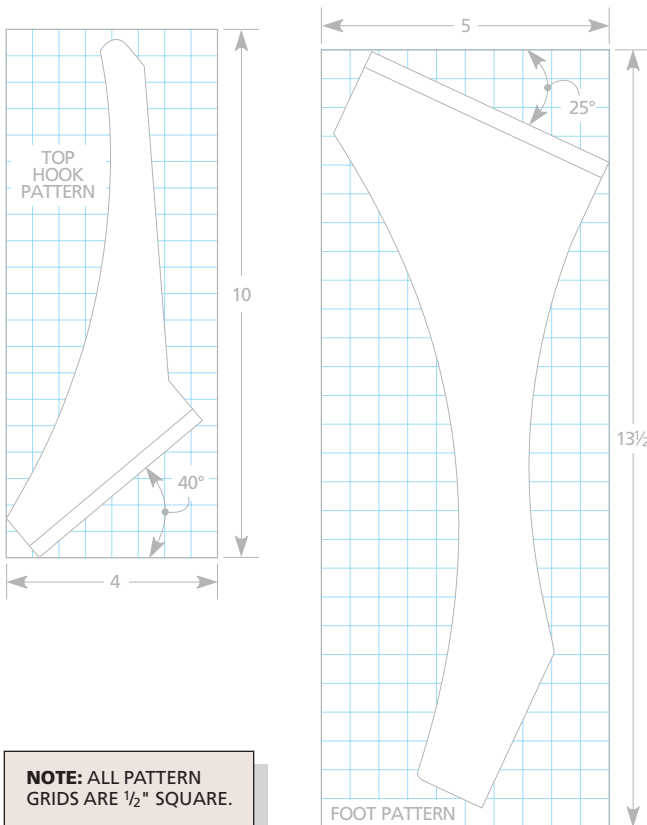
OVERALL DIMENSIONS:

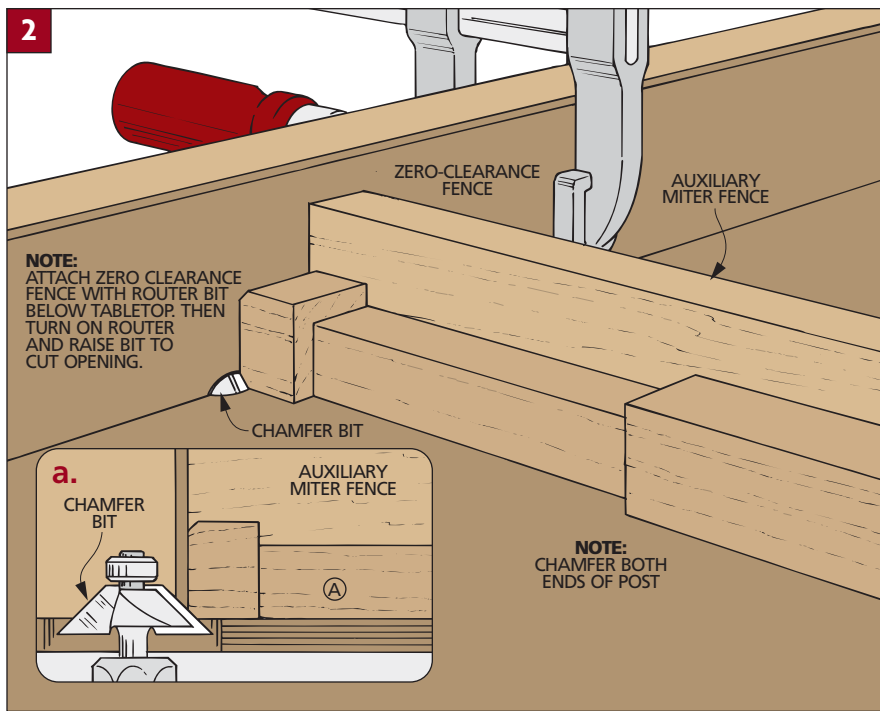
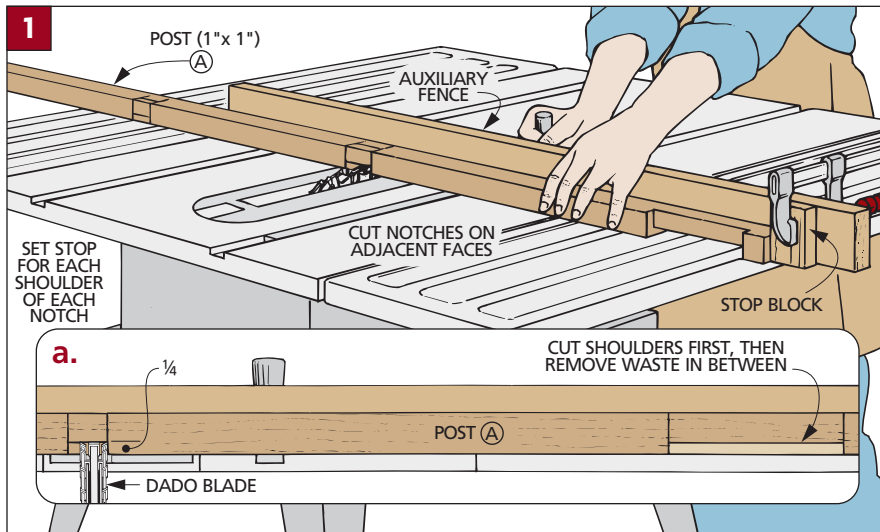
22³/₈W x 22³/₈D x 69³/₄H

MATERIALS LIST

WOOD

A Posts (4)	1 x 1 - 65 ¹ / ₄
B Cross Pieces (4)	1 x 1 - 3
C Top Hooks (4)	1 x 4 - 10
D Bottom Hooks (4)	1 x 4 - 8
E Feet (4)	1 x 5 - 13 ¹ / ₂





POSTS

To build this hall tree, I started with the “trunk.” This trunk is made up of four long posts (refer to the Exploded View on page 49). Each post has a series of notches cut on two adjacent faces. These notches hold the hooks, cross pieces, and feet.

To make the posts, I started with a 5"-wide blank of 5/4 stock planed 1" thick. Keep in mind when you're choosing and milling this blank that the straighter these pieces are now, the easier it will be to cut the notches and assemble the tree later.

CUT TO LENGTH. With the blank ready, I cut it to final length ($65\frac{1}{4}$ ") and ripped it into four 1"-wide posts (A) (see Cutting Diagram on page 48). This way, all the pieces will end up *exactly* the same length, which is important when it comes time to cut the notches.

CUT NOTCHES. With the posts cut to size, I began work on the notches. These are cut on the inside faces of each post (Fig. 1). And since they trap the hooks and feet, it's important that they line up across the four posts.

To do this, first I laid out the notches on a single post (see Exploded View). (Note that the top and bottom notches are the same distance from the ends of the post, but they're *not* the same length. The bottom notch is longer.)

With the notches laid out on one post, I set the dado blade to make a $\frac{1}{4}$ "-deep cut. And I added a long auxiliary fence to the miter gauge to support the piece (Fig. 1).

The trick to making sure that the notches are identical is to use a stop block (Fig. 1). After setting it to cut the

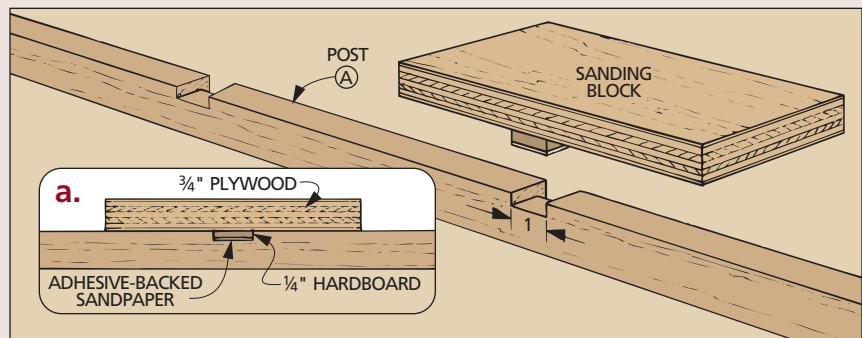
SHOP TIP

If the notches on the posts for the hall tree aren't smooth, you'll notice it when the hooks and feet are glued between them later.

So I created a simple sanding block out of plywood and $\frac{1}{4}$ " hardboard (see drawing).

The “handle” of the block spans the notches so their depth stays consistent and their edges aren't rounded over.

Special Sanding Block





first shoulder, I made two passes on each piece, rolling the post between passes so the notches ended up on adjacent faces.

When the first shoulder had been cut on all the posts, I moved the stop block to cut the second shoulder of the notch. After making this cut, any waste between the two shoulders can be removed with overlapping passes. Then I worked on the next notch, following the same procedure (*Fig. 1a*).

Note: Because of the length of the posts, you'll need to flip them around halfway through this process.

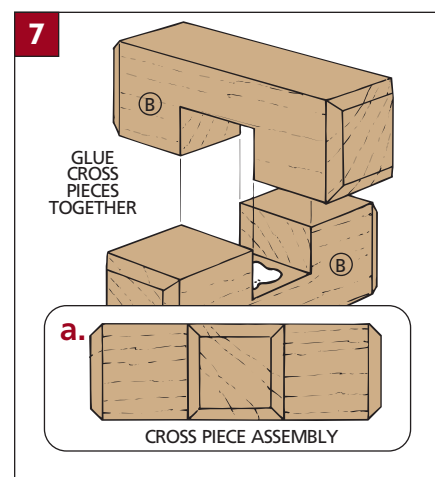
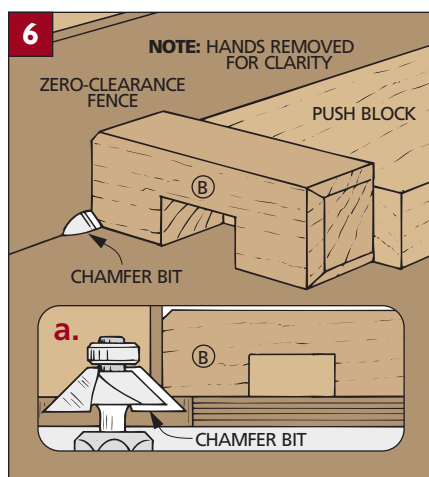
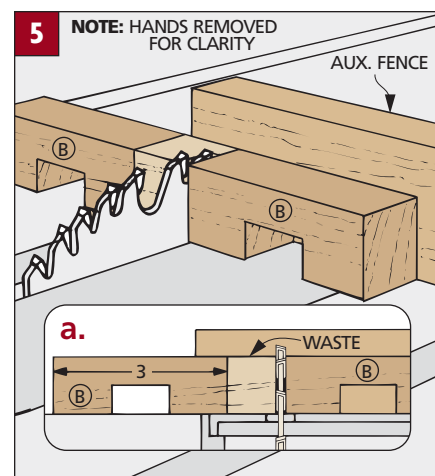
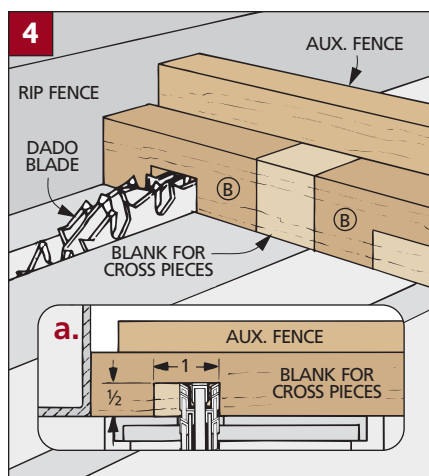
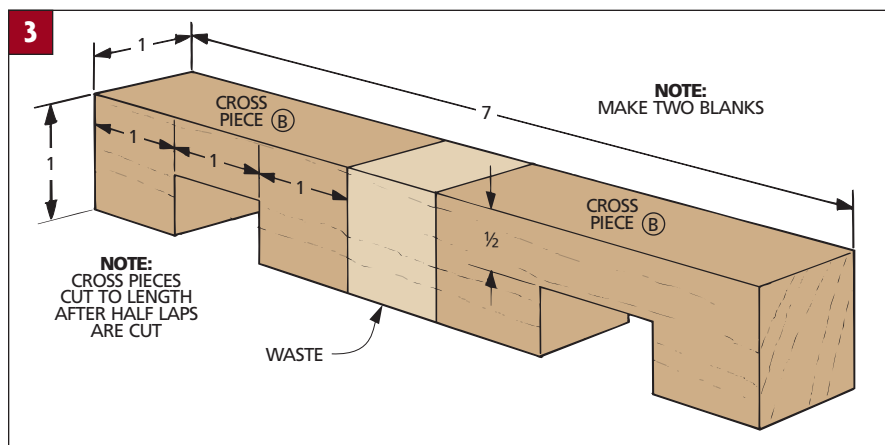
When the notches were cut, I noticed they had some shallow kerf marks left by my dado blade. I was concerned that these marks would be visible after assembly. So to remove them, I made a simple sanding jig (see the Shop Tip box on the opposite page).

CHAMFER ENDS. With the saw marks removed, all that's left is to chamfer the ends on the router table (*Fig. 2*). These pieces are so long that I was concerned about routing this chamfer, but I found that holding them flat on the table wasn't difficult, especially when using the miter gauge and an auxiliary fence to support the piece. But to keep the pieces from catching in the fence opening, I added a zero-clearance fence made of $\frac{1}{8}$ " hardboard with an opening sized to cut the chamfer (*Fig. 2*).

CROSS PIECES

With the posts completed, I started on the cross pieces. Each cross piece assembly consists of two individual pieces stacked together. They connect the posts in the middle so the spacing stays even (see photo above).

OVERSIZE BLANKS. The cross pieces (B) fit in the notches in the center of the post. (Mine were 1" x 1".) Their final length will be 3". However, since this is



a bit short to work with on the table saw safely, I started out with two 7"-long blanks (*Fig. 3*).

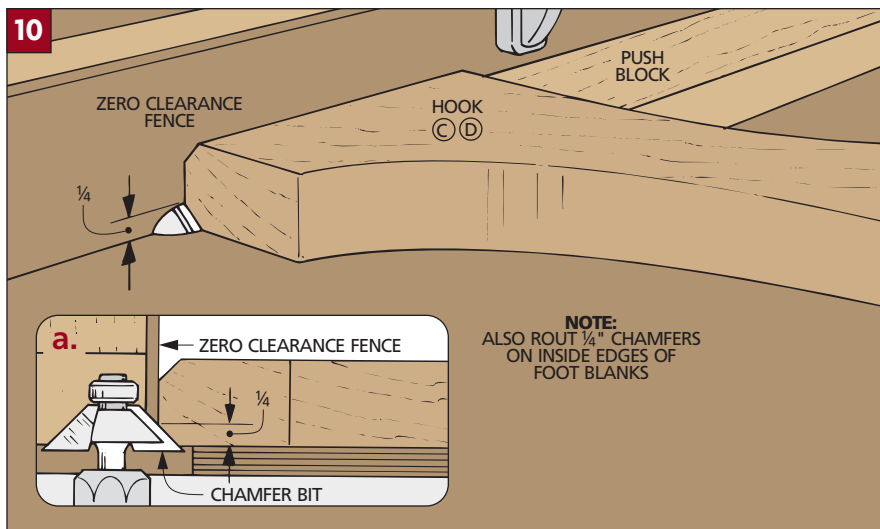
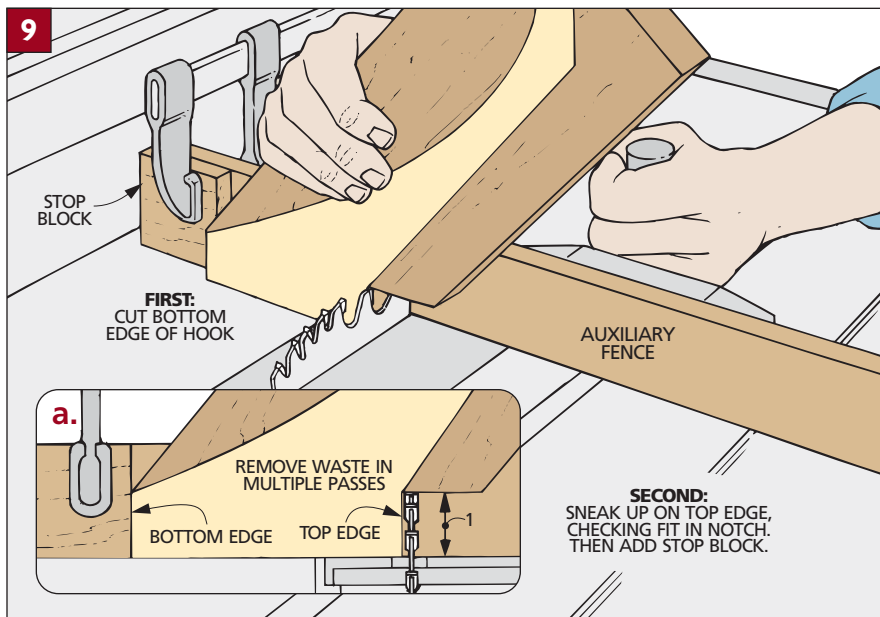
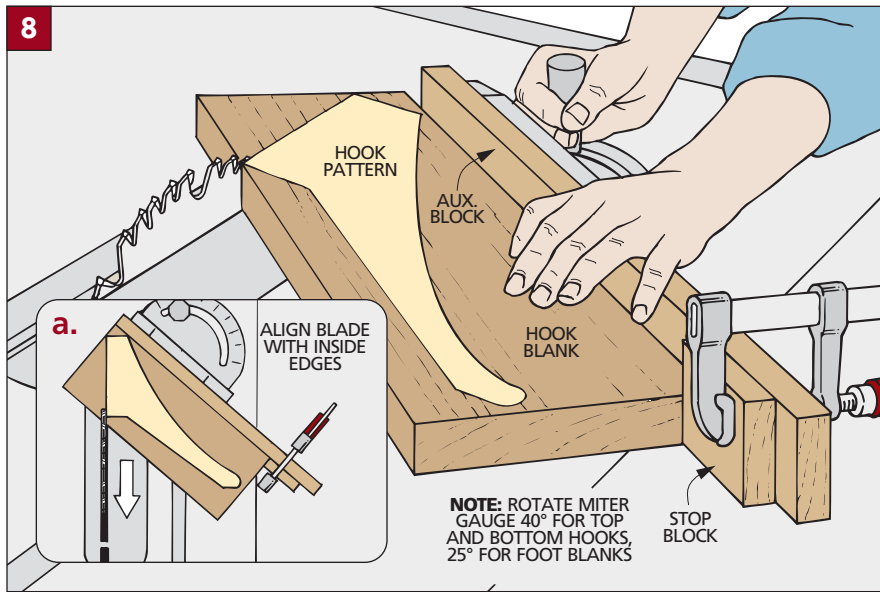
With the two blanks in hand, I cut a half lap near both ends of each so the cross pieces would overlap (*Fig. 4*). To support these blanks, I attached an auxiliary fence to the miter gauge and used the rip fence as a stop.

CUT TO SIZE. Now the blanks can be cut into four cross pieces (*Fig. 5*). (This

time, you can't use the rip fence as a stop, because the piece will kick back.)

Then all that's left is to chamfer the ends of the cross pieces (*Fig. 6*). Here again, I used the zero-clearance insert. But this time, I supported the pieces with a push block.

Now the cross pieces can be glued together and set aside until after the hooks and feet are made and the tree is ready to be assembled (*Fig. 7*).



HOOKS & FEET

The last pieces to make are the hooks and feet. There are twelve different pieces to make, but the procedure is identical (the only difference is the shape). The initial (straight) cuts are made on a table saw for accuracy, while the curved cuts are made on a band saw.

I started by cutting the blanks for the top (C) and bottom hooks (D) from 1"-thick stock. (Top hook blanks are 4" x 10"; bottom blanks are 4" x 8".)

PATTERN. With the blanks cut to size, I created patterns for the top and bottom hooks (see page 49). Then I mounted them to two of the blanks.

INSIDE EDGE. The next step is to shape the inside edge of each blank (the one that fits into the notches on the posts). This is a two-step process. First I angled the miter gauge and cut the inside edge of each piece (Fig. 8).

Note: Both hook blanks are cut with the miter gauge angled to 40°.

With the inside edge cut, next I cut the top and bottom edges so the hooks fit in the notches in the post. I cut the bottom edge first with the blank standing on the inside edge. (I cut the blank with the pattern first and then traced this cut on the other blanks.)

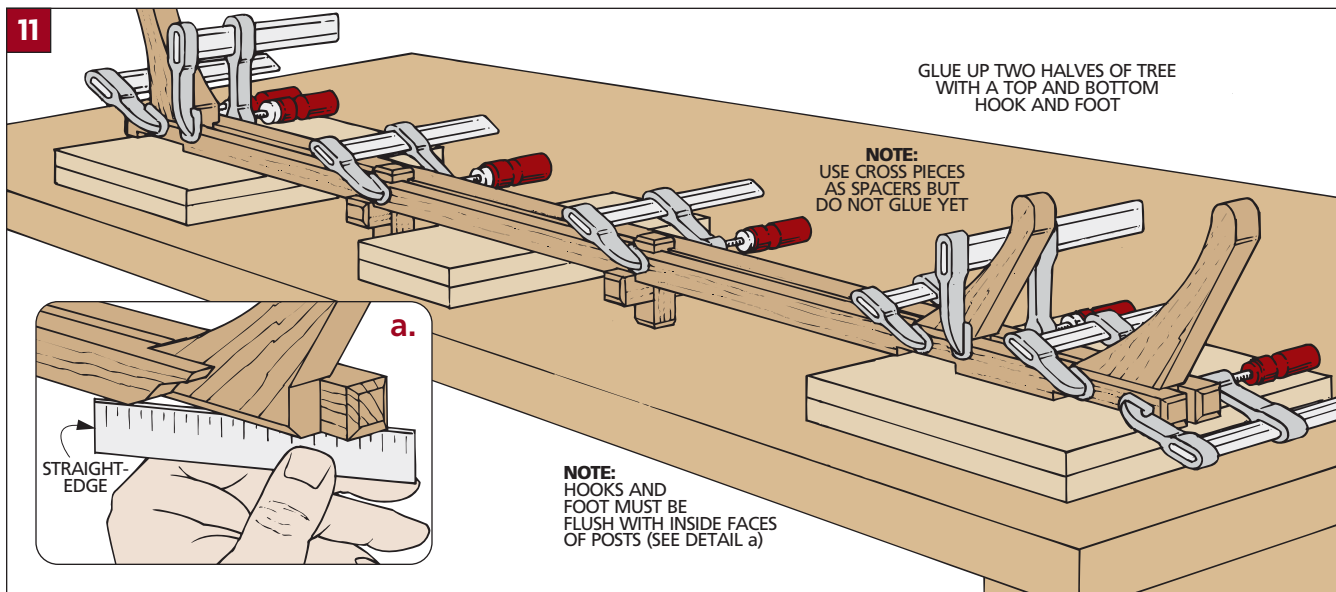
Next, I cut the top edge of the hook (Figs. 9 and 9a). Here, instead of following the pattern, you'll want to sneak up on the final height (width) of the piece so it fits snug in the notches in the posts. When it does, you can clamp a stop block to the auxiliary fence so all the other blanks will be identical.

Note: You'll need to reset the stop block for the other set of hook blanks.

CUT TO SHAPE. Now the rest of the pattern can be cut out. I cut oversize on the band saw and sanded up to the line. When this piece was complete, I traced it on the other blanks so they could be cut and sanded to match.

FEET. Next you can work on the feet (E). The procedure here is the same. The only differences are that the blank is larger (5" x 13 1/2") (see page 49) and to cut the inside edge, the miter gauge is rotated 25°.

CHAMFER INSIDE EDGE. When the feet are cut out and sanded, there's still one more step for both the hooks and feet. I routed chamfers on the inside edges of each piece (Figs. 10 and 10a). These 1/4" chamfers allow all four pieces to come together in the center.



ASSEMBLY

Now that the hooks and feet are complete, the hall tree can be assembled. Here it begins to look like a large “Lincoln Log” project. But fortunately, there’s not much to the assembly, if you take it in steps.

GLUE UP HALVES. The first thing I did was glue up one set of hooks (top and bottom) and a foot between two posts (*Fig. 11*). I used the cross piece assemblies to help keep the posts aligned. But

the important thing is that the inside edges of all the posts, hooks, and feet are flush (*Fig. 11a*).

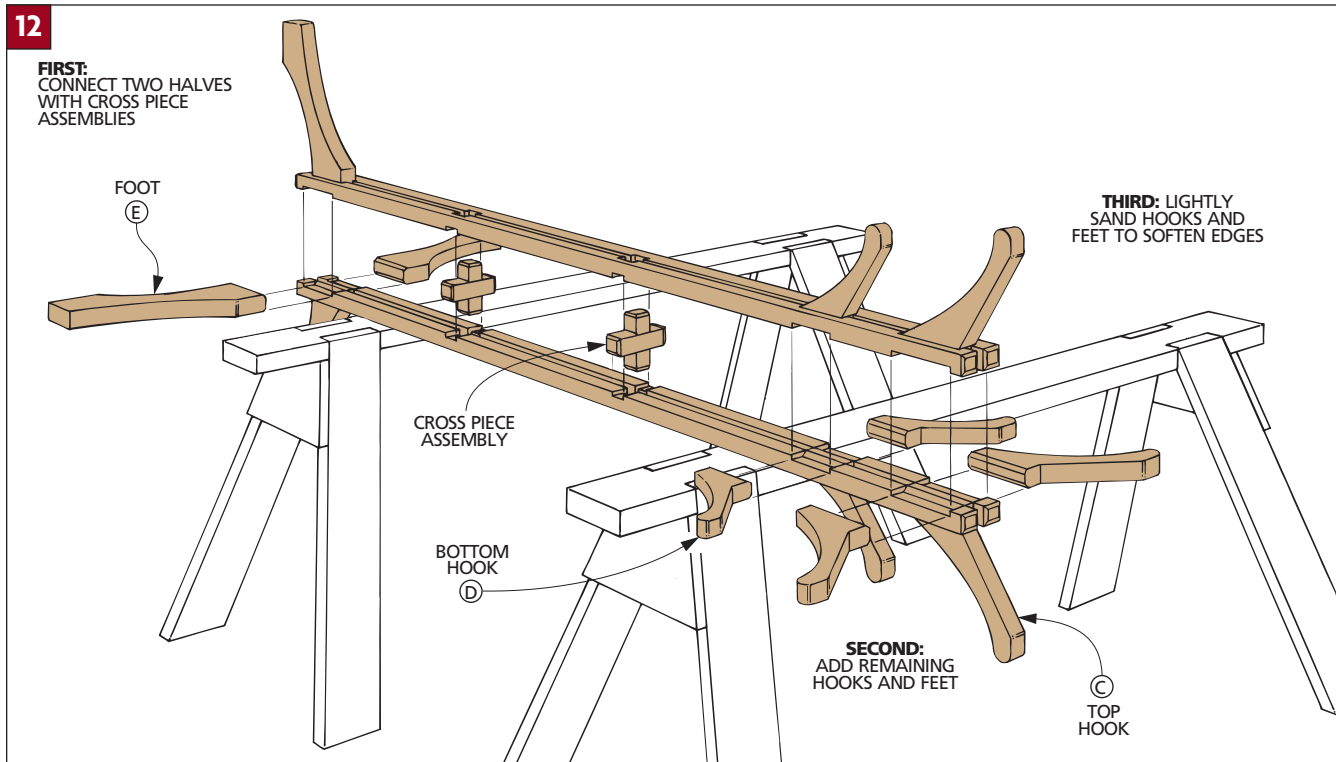
When one half is glued together, I did the same with the other. Then I connected the two halves by gluing the cross piece assemblies between them (*Fig. 12*).

Now the remaining pairs of hooks and feet can be glued into the notches (Fig. 12). I added one at a time, inserting it into the notch and clamping it tight.

Note: To prevent squeeze-out, apply glue only to the notches on the post.

After all the hooks and feet were in place, I checked to see if there was a shoulder at the bottom of the hooks. If there was, I sanded the hooks so they made a smooth transition into the posts. Then I softened all the “hard” edges on the hooks and feet.

FINISH. The last thing to do is apply the finish. Because of the tight spaces between the posts, a spray gun would work best. But if you don’t have a spray gun, you can do what I did. Wipe on about three coats of an oil finish. ■



Oak Sofa Table

Everything you'd expect of a Mission-style sofa table is featured in this project, including quartersawn oak, square spindles, and authentic mortise and tenon joinery.



Plywood or solid wood? That's the choice you have to make when a project includes wide panels, such as the top and shelf on this sofa table. Often, I choose plywood since it won't expand and contract with changes in humidity as much as solid wood.

But I chose solid wood on this table, for two reasons. I wanted to use quartersawn oak, typical of Mission (or Craftsman style) furniture, and quartersawn oak is hard to find in plywood. Also, beveling a plywood edge wouldn't work without hardwood edging.

WOOD MOVEMENT. Since solid wood was the best option, I needed a way to allow the panels to expand and contract.

This wasn't a problem with the top, or the front and back of the shelf. I used some simple Z-shaped fasteners. But the *ends* of the shelf were a concern.

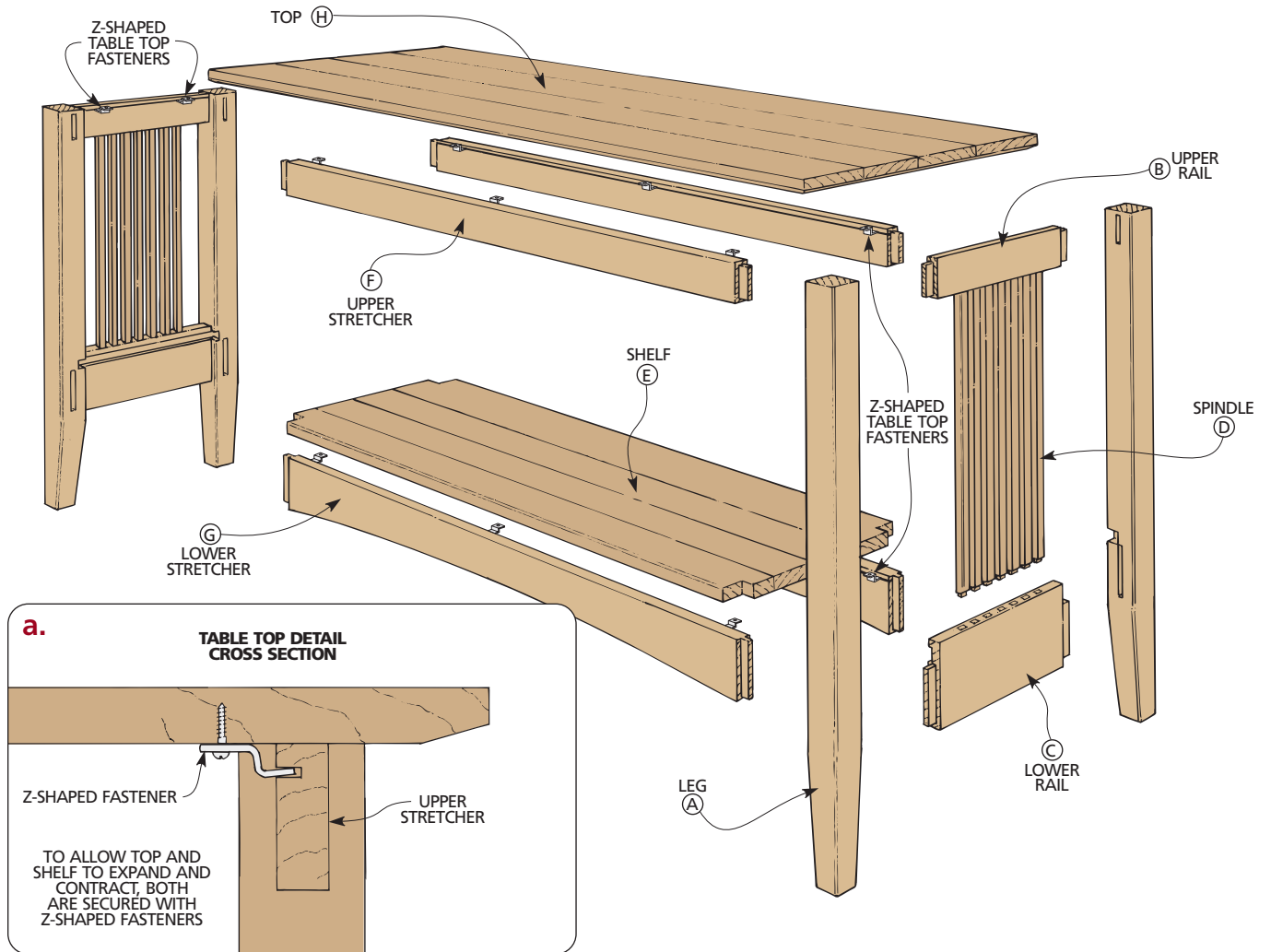
The problem is that the shelf fits between the legs, so when the panel expands, it will tend to push the legs apart, and when it contracts, there will be a gap. So I made a pocket for the shelf by extending the groove on the rails into the legs (see inset photo).



FINISH. I used a light cherry stain and topped it with two coats of an oil and urethane combination. Then I rubbed on paste wax and buffed it to a satin sheen.

EXPLODED VIEW

OVERALL DIMENSIONS:
50L x 17D x 28H



MATERIALS LIST

WOOD

A Legs (4)	1 $\frac{3}{4}$ x 1 $\frac{3}{4}$ - 27 $\frac{1}{4}$
B Upper Rails (2)	$\frac{3}{4}$ x 2 - 11 $\frac{1}{4}$
C Lower Rails (2)	$\frac{3}{4}$ x 4 $\frac{1}{8}$ - 11 $\frac{1}{4}$
D Spindles (14)	$\frac{1}{2}$ x $\frac{1}{2}$ - 15 $\frac{1}{8}$
E Shelf (1)	$\frac{3}{4}$ x 12 $\frac{3}{4}$ - 40
F Upr. Stretchers (2)	$\frac{3}{4}$ x 2 - 39 $\frac{3}{4}$
G Lwr. Stretchers (2)	$\frac{3}{4}$ x 3 - 39 $\frac{3}{4}$
H Top (1)	$\frac{3}{4}$ x 17 - 50

HARDWARE SUPPLIES

- (16) No. 8 x $\frac{5}{8}$ " Rh woodscrews
- (16) Z-shaped table top fasteners

CUTTING DIAGRAM

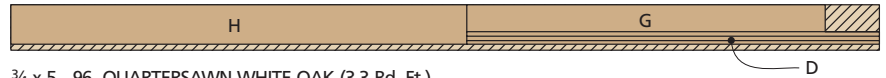
1 $\frac{3}{4}$ x 4 - 60 QUARTERSAWN WHITE OAK (3.3 Bd. Ft.)



$\frac{3}{4}$ x 4 - 84 QUARTERSAWN WHITE OAK (2 Boards @ 2.3 Bd. Ft. Each)



$\frac{3}{4}$ x 5 - 96 QUARTERSAWN WHITE OAK (2 Boards @ 3.3 Bd. Ft. Each)

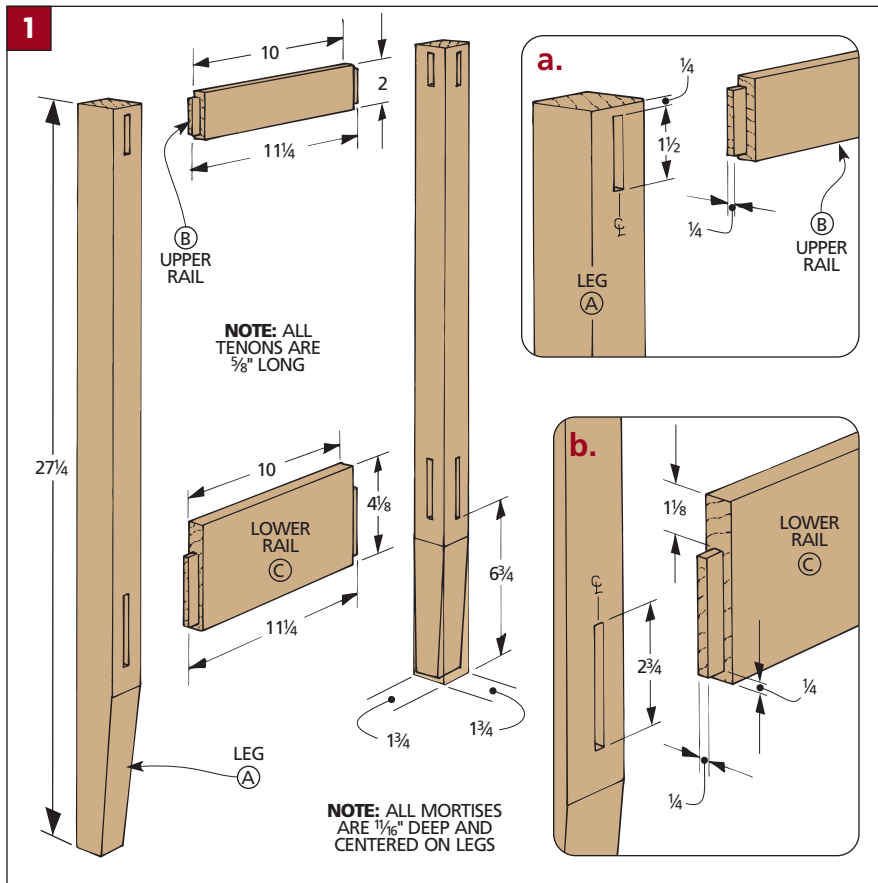


$\frac{3}{4}$ x 5 - 96 QUARTERSAWN WHITE OAK (3.3 Bd. Ft.)



$\frac{3}{4}$ x 5 - 96 QUARTERSAWN WHITE OAK (3.3 Bd. Ft.)





LEGS

To build the sofa table, I started by working on the legs.

With some projects, keeping all of the legs oriented correctly in relation to each other requires some mental gymnastics. But it's easy on this table since the four legs (A) are identical.

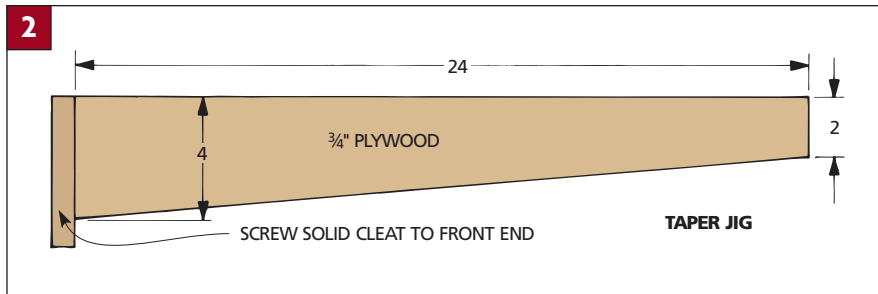
The legs are cut from 8/4 stock to a length of 27 1/4" and 1 3/4" square (Fig. 1).

MORTISES. Next, I made centered mortises for the rails and stretchers (Figs. 1a and 1b). To do this, drill overlapping 1/4"-dia. holes 11/16" deep on adjacent faces of the legs. Then square up the sides and ends with a chisel.

TAPERS. Finally, I tapered the inside faces of each leg (the same faces that the mortises are on). Start the tapers 6" up from the bottom end (Fig. 3a).

To do this, I made a jig for the table saw (Fig. 2). It's just a scrap piece with a tapered edge and a small cleat at one end. The jig acts as an angled spacer between the rip fence and the leg. You push the leg through the blade, and the cleat causes the jig to ride along (Fig. 3).

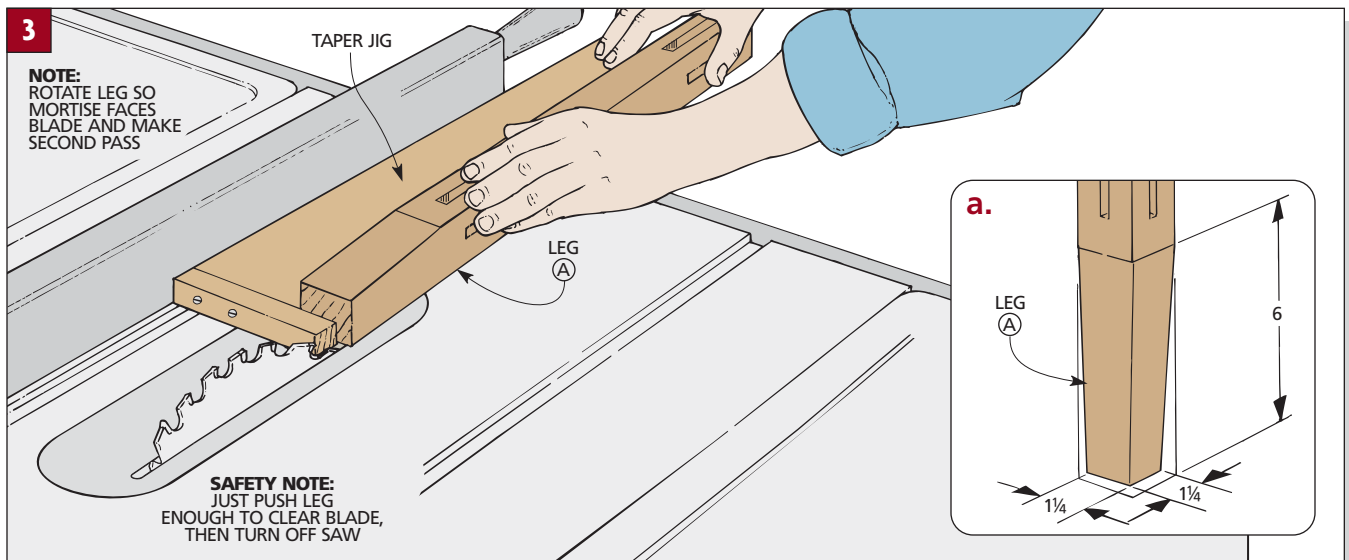
When one taper is cut, rotate the leg so the other mortised face is toward the blade and make a second pass.



RAILS

Now the legs can be set aside and work can begin on the rails that will join the legs at the ends of the table.

The upper and lower rails (B, C) are cut from 3/4"-thick stock and are the same length (11 1/4"). But the upper rail isn't as wide (2") as the lower one (4 1/8")



(Fig. 1). The extra width on the lower rail allows room for a groove to accept the shelf that's added later.

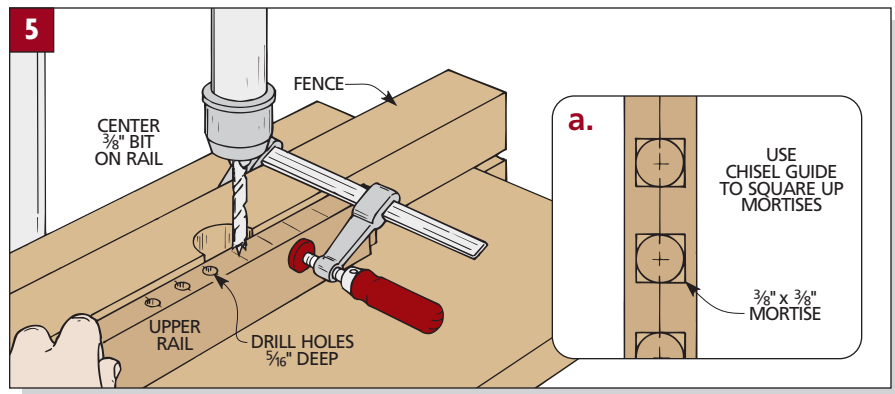
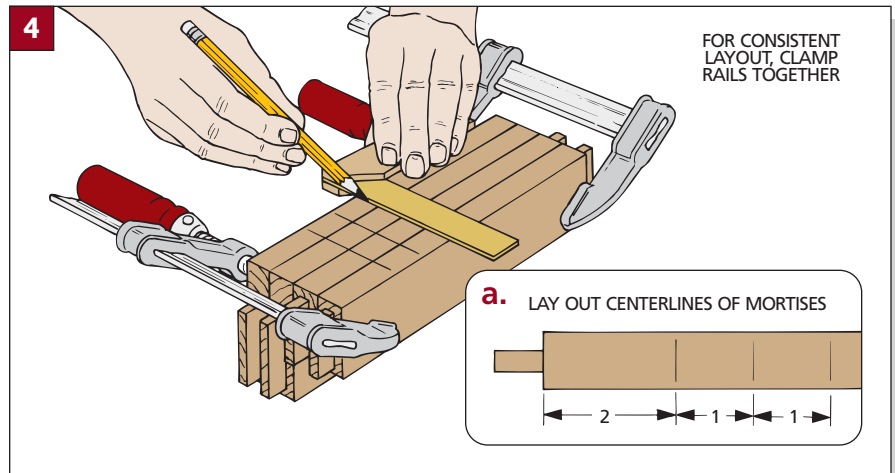
TENONS. After cutting the rails to final size, tenons can be cut on the ends of the rails. Since the tenons are centered, I cut them on the table saw with a dado blade, flipping the rails between passes to sneak up on the thickness.

Then I cut the shoulders on the tenons, which are all $\frac{1}{4}$ " except the upper shoulder on the lower rail (C). Here, it's $\frac{1}{8}$ " because of the shelf groove that's added later (Fig. 1b).

SPINDLE MORTISES. With the tenons cut, it's time to lay out the spindle mortises. There are seven mortises in each rail. For a good fit, these mortises should align between the top and bottom rails. To ensure this, I clamped the four rails together and marked the centers of all the mortises (Figs. 4 and 4a).

Next, unclamp the rails and set up the drill press to bore a $\frac{3}{8}$ "-dia. hole $\frac{5}{16}$ " deep that's centered on the thickness of the rail (Fig. 5). Then drill a single hole for each mortise.

Finally, I squared up the mortises with a chisel. To keep them identical, I made a chisel guide (see the Shop Jig below).



SHOP JIG Chisel Guide

Getting all the spindle holes on the sofa table rails squared up can be difficult. To speed up the process, I made a simple jig to guide my chisel.

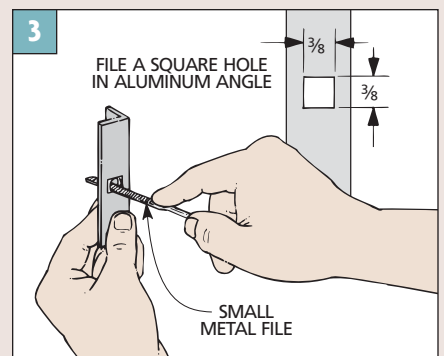
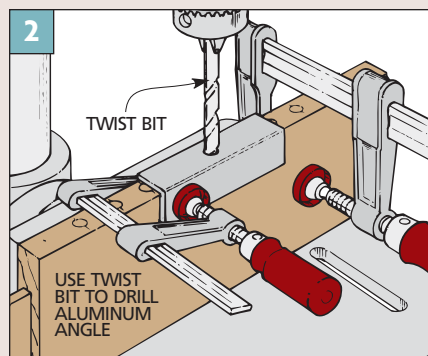
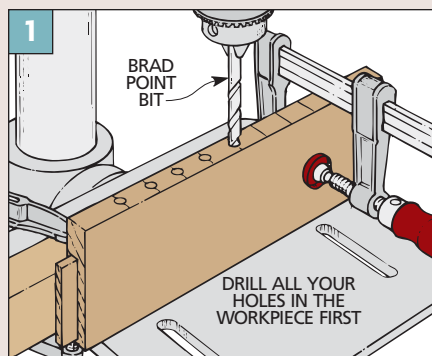
This jig is just a piece of aluminum angle with a square hole filed in the middle. The key to this jig is cutting the square hole so it's centered perfectly over the drilled holes in the rails.

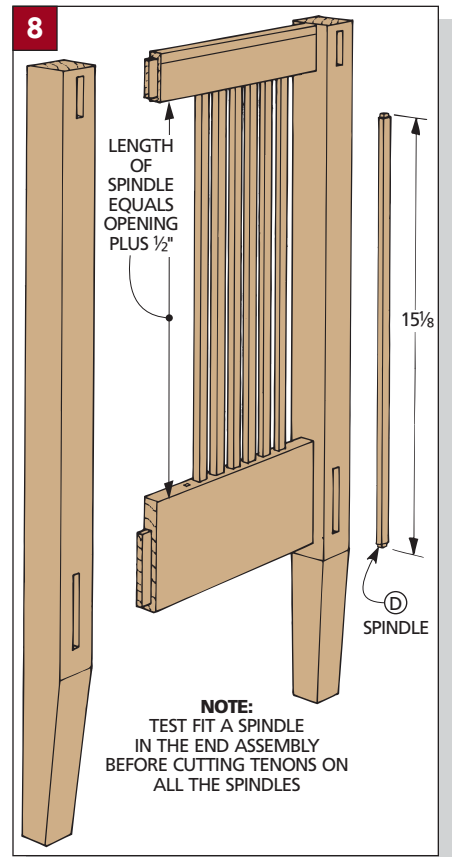
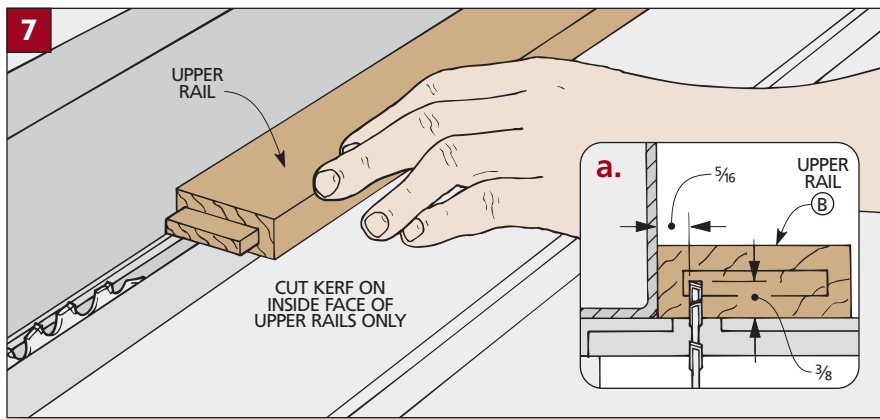
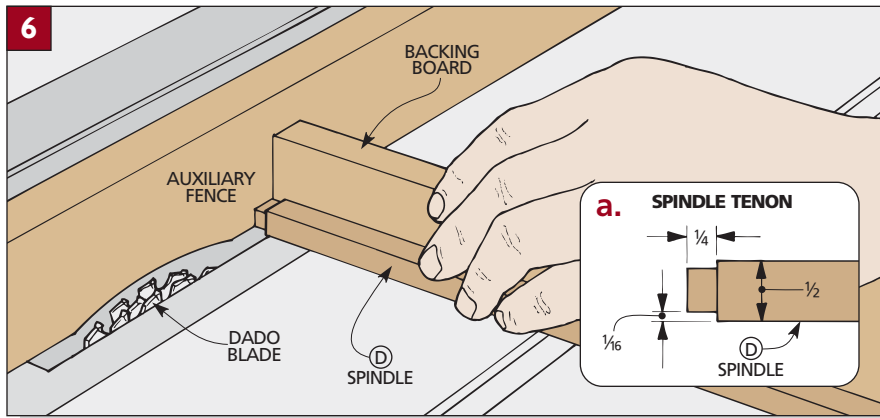
This is easy to do. Once the holes for the mortises are drilled (Fig. 1), clamp

the aluminum angle to the front of your workpiece (Fig. 2). Don't move the fence on your drill press, but change to a twist bit to drill the aluminum.

Now drill the hole and square it up with a small file until it's the size needed for the mortise ($\frac{3}{8}$ " x $\frac{3}{8}$ ") (Fig. 3).

To use the jig, position it over the holes and clamp it in place (see photo). The jig guides your chisel to cut mortises that match the spindle tenons.





SPINDLES

Once all the mortises in the rails are drilled and squared up, they are ready for the square spindles.

CUT TO SIZE. To find the length of the spindles, first dry-assemble the rails and legs into an end unit. Then measure the distance between the rails (refer to Fig. 8). This will give you the *shoulder-to-shoulder* distance of the spindles.

Now add $\frac{1}{2}$ " to this measurement to allow for the $\frac{1}{4}$ "-long tenons on each end. (My spindles were $15\frac{1}{8}$ " long.)

Next, to cut the spindles (D) to size, I began with $\frac{1}{2}$ "-thick stock cut to finished length. Then I ripped $\frac{1}{2}$ "-square spindles from the blank.

Note: It's probably a good idea to make a few extra spindles. This will help you set up the cut for the tenons.

TENONS. Once the spindles are cut to width, square tenons can be cut on their ends to fit the mortises in the rails. I like to do this on the table saw with a dado blade buried in an auxiliary fence. To do this, leave $\frac{1}{4}$ " of the blade exposed and raise it $\frac{1}{16}$ " above the table (Fig. 6).

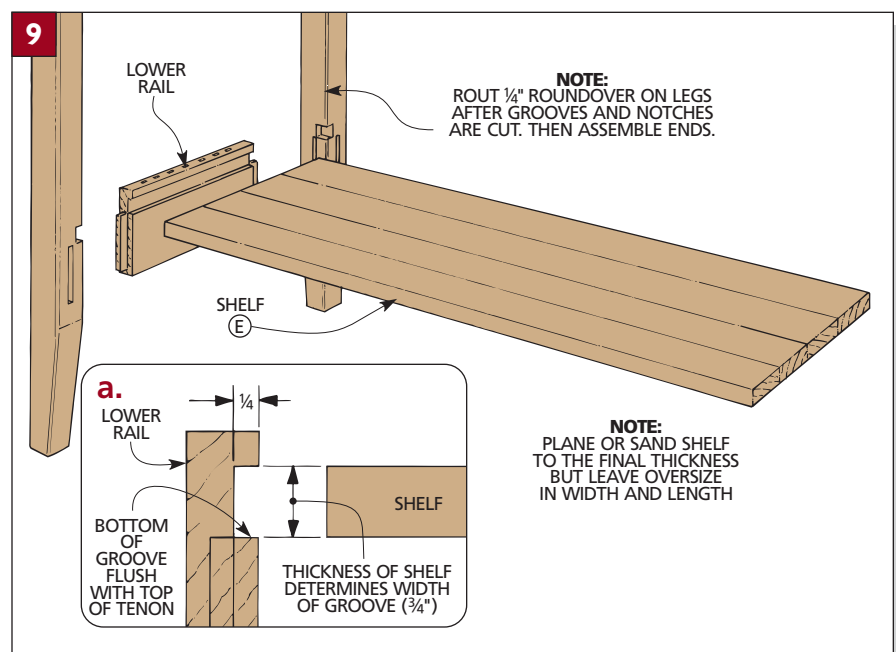
But before cutting tenons on all the pieces, start with a test piece and check the fit. This means more than just

trying the tenon in the mortise. It also means making sure the spindles fit between the upper and lower rails.

KERF IN RAIL. Now, to complete the upper rails (B), I cut a $\frac{1}{8}$ " kerf in each rail's top inside edge (Figs. 7 and 8). This is for the hardware used to attach the top panel later.

SHELF JOINERY

There's just a couple more steps before the end units of the table can be assembled. First, there has to be some way to hold the shelf in place between the ends. It's done a little differently than with the table top.



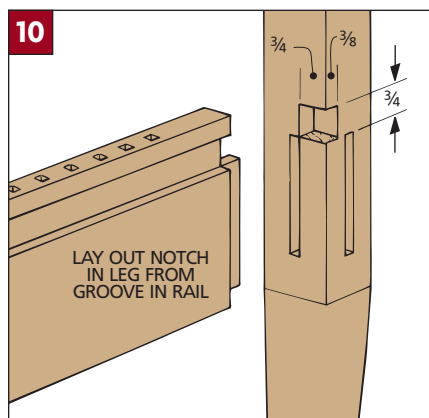
To support the shelf and prevent it from cupping, I cut a groove in the lower rails. Easy enough. But since the shelf will be notched to fit between the legs, I had to come up with a way to allow the panel to easily expand and contract. If it were just glued in the groove, the shelf would likely split or leave gaps with changes in humidity.

The solution is to extend the groove into the legs so there's a notch for the shelf to expand into (*Figs. 9 and 10* and the inset photo on page 54).

SHELF. Creating the groove for the shelf isn't difficult. But since the final thickness of the shelf (E) determines the width of the grooves, I glued the shelf up now and planed and sanded it down to final thickness (*Fig. 9a*). (You can leave it at rough width and length for now.)

GROOVE. After determining the thickness of the panel, the first step is to lay out the location of the groove in the rail. Mark the bottom edge of this groove so it will be flush with the top edge of the tenon on the rail (*Fig. 9a*). Then cut the groove $\frac{1}{4}$ " deep.

NOTCH. Now dry-assemble the legs and rails into an end unit again, and transfer the depth and height of the groove to the leg (*Fig. 10*). Then lay out the notch on the leg. Once the layout is complete, you can notch the leg. To remove most of the waste, I used my drill press to drill $\frac{3}{8}$ "-deep overlapping holes. Then I pared up to the layout lines with a sharp chisel (*Fig. 11*).



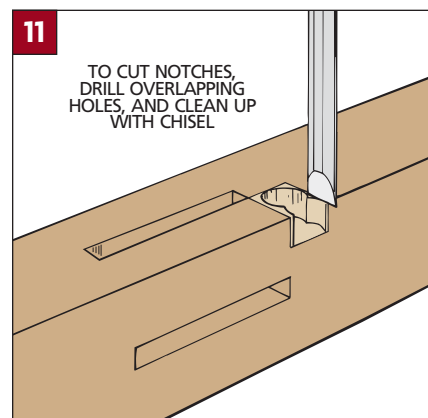
After all the notches are cut, you can test the fit of the shelf in the grooves and notches.

ROUND OVER LEGS. Once the shelf fits in the grooves and notches, there's one more step before the ends can be assembled. Use the router table and a fence to rout a $\frac{1}{4}$ " roundover on all four edges of the legs.

ASSEMBLE ENDS. At this point, the ends of the table can be assembled. I positioned the spindles in their mortises between the rails. Then I glued the legs to the rails.

STRETCHERS

Next, the stretchers (F, G) can be made (*Fig. 12*). They're cut to identical lengths ($39\frac{3}{4}$ "), but the upper stretchers are 2" wide, while the lower ones are 3" (*Fig. 12a*).

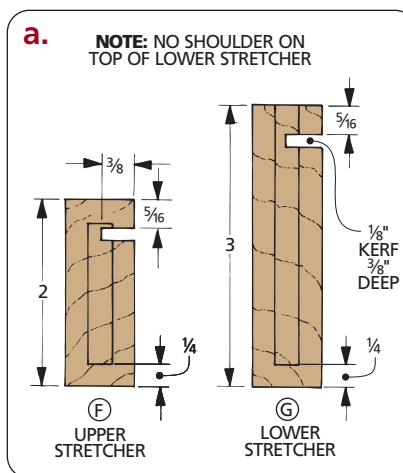
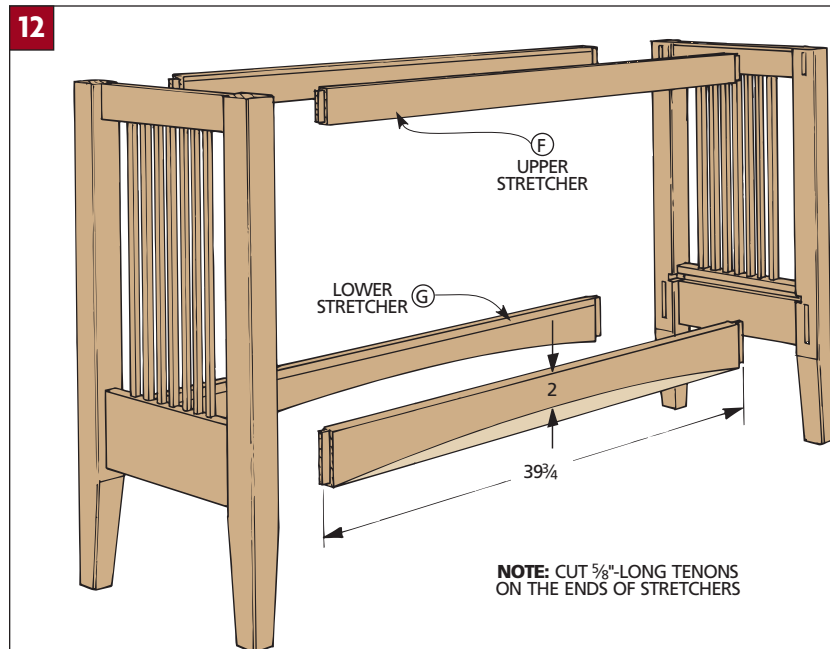


TENONS. Next, cut $\frac{5}{8}$ "-long tenons centered on the stretchers to fit the mortises in the legs. Note that the tenons on the lower stretchers don't have shoulders along their top edges. That's because the shelf sits directly on top and will hide any gaps.

KERFS AND ARCS. There are two more steps to complete the stretchers. First, the hardware that holds the shelf and top in place (refer to *Fig. 14a*) requires a kerf cut along the inside faces of the stretchers (*Fig. 12a*).

The second step is to lay out and cut an arc on the bottom of each of the lower stretchers (*Fig. 12*). This arc should be 2" down from the top edge of the stretcher at its highest point.

To lay out this arc, you can use a flexible straightedge, a couple of pointed scraps, and a pencil (refer to the Shop Tip box on page 65).



SHELF & TOP

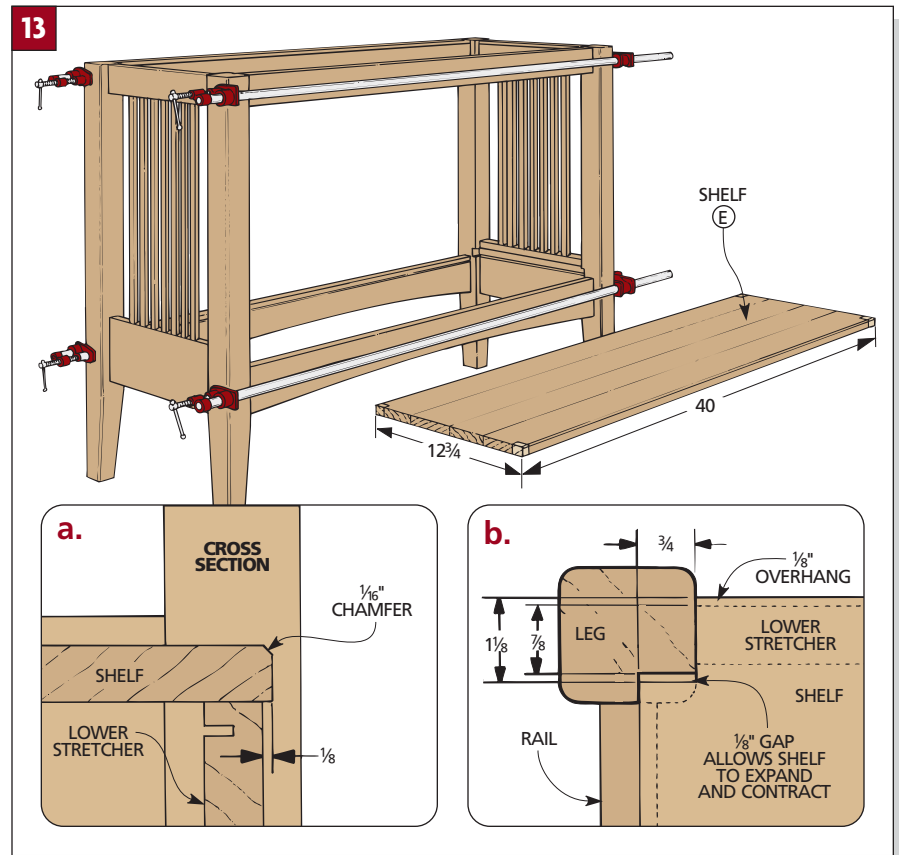
Before connecting the end assemblies with the stretchers, you need to cut the shelf panel to final size. To do this, you'll have to dry-assemble the table again (*Fig. 13*).

The overall length of the shelf equals the distance between the bottoms of the grooves in the rails. (Mine was 40" long.) The overall width equals the distance across the stretchers plus $\frac{1}{8}$ " overhang on each side (*Fig. 13a*). (Mine ended up $12\frac{3}{4}$ " wide.)

NOTCHES. After the shelf is cut to size, the corners need to be notched to fit around the legs (and into the notches in the legs) (*Fig. 13b*). To find the depth of the shelf notch, measure from the bottom of the groove in the rail to the inside edge of the leg. (Mine was $\frac{3}{4}$ ".)

The width of the notch is a little trickier. First measure from the outside edge of the stretcher to the edge of the notch in the leg ($\frac{7}{8}$ " (*Fig. 13b*)). Add $\frac{1}{8}$ " for the overhang on the outside of the stretcher. Then add another $\frac{1}{8}$ " for a gap inside the notch that allows the shelf to expand and contract. (My notch was $1\frac{1}{8}$ " wide.)

Note: It's a good idea to double-check your measurements before cutting the notches on the shelf. The length between the legs should equal the length between these notches. Then once the notches are cut, dry-assemble the table one last time to



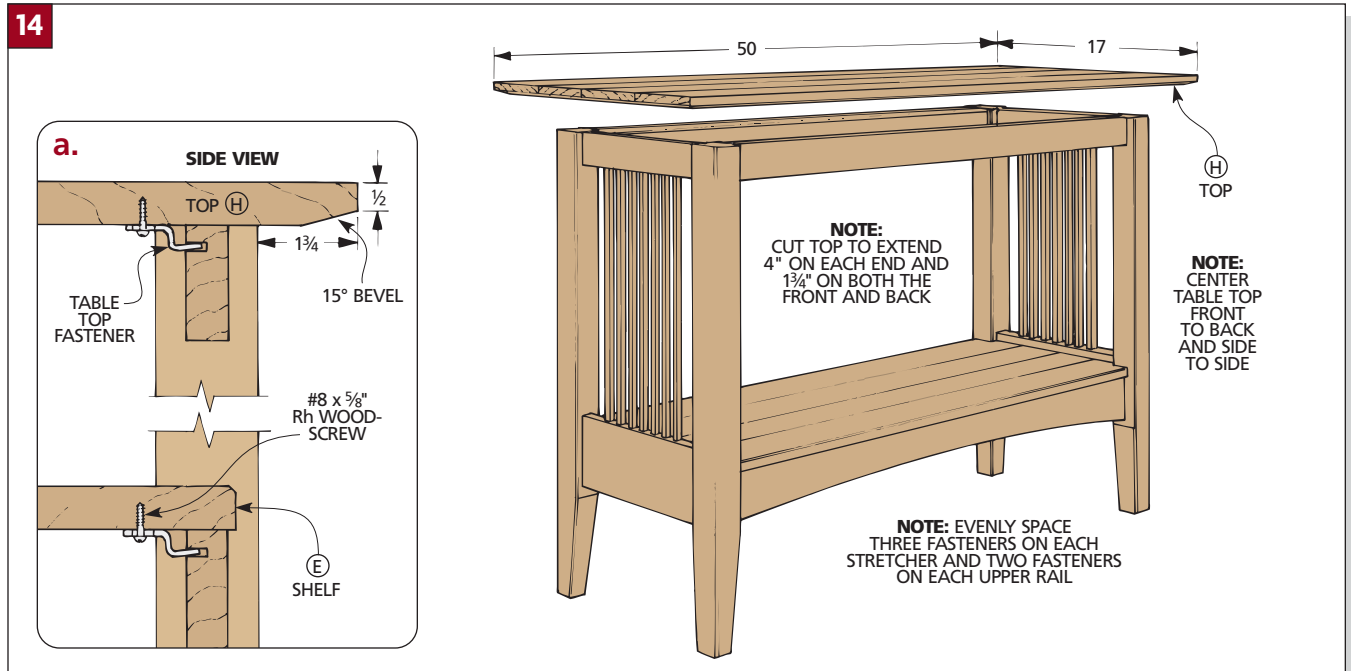
make sure everything fits.

ASSEMBLY. When everything fits, rout a $\frac{1}{16}$ " chamfer on the top edge of the shelf (*Fig. 13a*). Then glue up the table. (Don't glue in the shelf panel.)

TOP. Now all that's left is to add the top (H). Glue up a $\frac{3}{4}$ "-thick panel and

cut it to finished size (*Fig. 14*). Then rout a bevel around the bottom edge (see the Shop Jig on the opposite page).

Finally, to attach the top (and the front and back of the shelf), I used table top fasteners (*Fig. 14a*). These fit into the kerfs in the stretchers and rails. ■



Typically, I like to use a table saw to cut a bevel on a workpiece. But trying to bevel the bottom side of the sofa table top created a problem. It just wasn't safe to stand this large panel on end and use the table saw.

The solution was a shop-made jig that holds a router at an angle (Fig. 2). With a straight bit in the router, it's easy to rout the bevel.

Note: The flute length on the bit has to be long enough to cut the full width of the bevel. Mine was $1\frac{1}{4}$ " long.

JIG CONSTRUCTION. The jig consists of four pieces: a fence, a bit guard, a router base plate, and a handle (Fig. 1). To build the jig, start with the fence and



bit guard. First, cut a notch at the center of the fence to provide clearance for the bit. Then you can glue the bit guard and fence together.

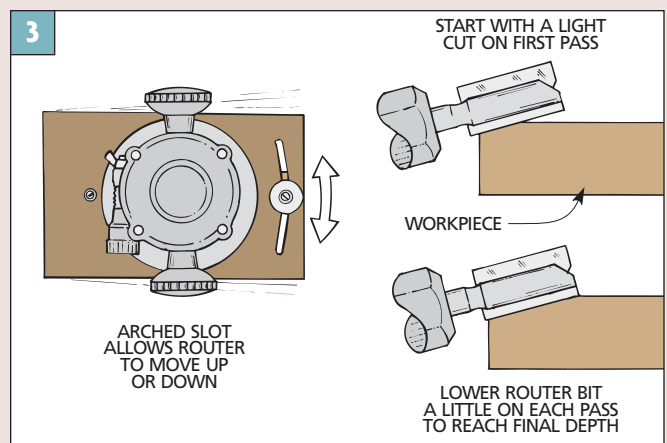
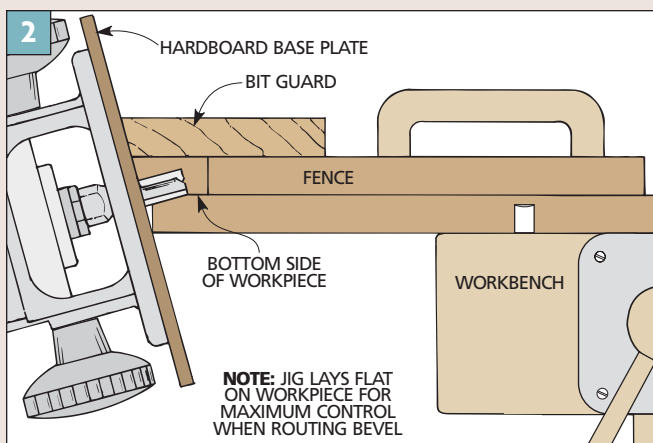
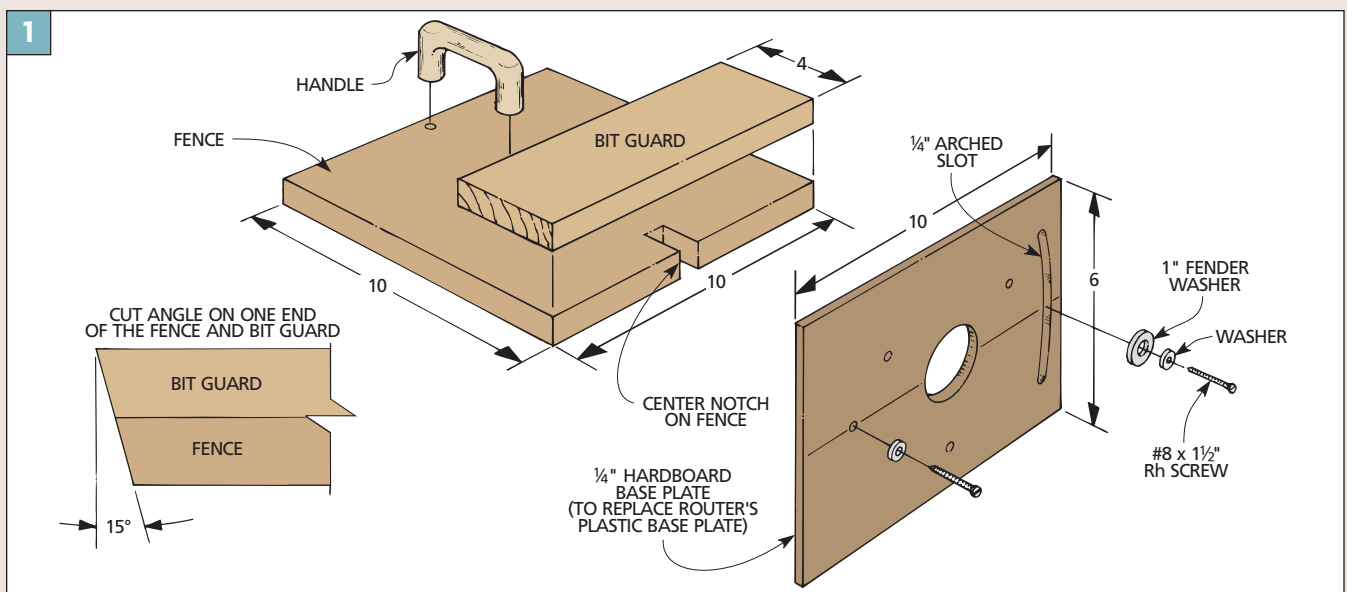
To make this jig work, simply cut an angle on one end of the fence and bit

guard that matches the bevel you need on your workpiece (15° for the sofa table). Then when you add the base plate, it tips your router to match the bevel. The $\frac{1}{4}$ " hardboard base plate is simply screwed into the fence. Finally, screw a handle to the fence.

SETTING DEPTH. Since this jig is designed to cut the bevel in several passes, you adjust the depth of cut by pivoting the auxiliary base (Fig. 3). An

arched slot allows the router to swing up or down to the required depth before locking it in position with a screw.

USING THE JIG. Start with the depth set shallow. Then increase the depth gradually until your bevel is complete.



Glass-Top Coffee Table

Made of quartersawn oak, this traditional Mission-style coffee table is enhanced with a beveled glass top and a series of narrow spindles. There's also an option for a solid wood top.



Drilling a round hole to create a mortise for a square tenon has always struck me as a bit odd. But aside from investing in an expensive machine for making mortises, the only solutions I could come up with in the past were to round the tenon or to square up the mortise with a chisel.

Now, if you're only talking about a few mortises, that's not a big deal. In fact, it's kind of relaxing. That's what I did for the spindles on the Sofa Table shown on page 54.

But on this coffee table there are 26 spindles, which means a total of 52 mor-

tises to drill and square up. You could spend the better part of a day on this part of the project alone.

So I decided to try something different this time around. The new procedure I came up with is both quick and accurate. (I'll give you a hint — it doesn't involve using a drill press or a chisel. See the Technique on page 70.)

GLASS TOP. But the mortises aren't the only feature of this table worth mentioning. The beveled glass top is also a little out of the ordinary.

Now at first, I was worried that the beveled glass top would look too

“modern” for this style of table. But actually, it complements the style by giving you a clear view of the spindles from just about any angle.

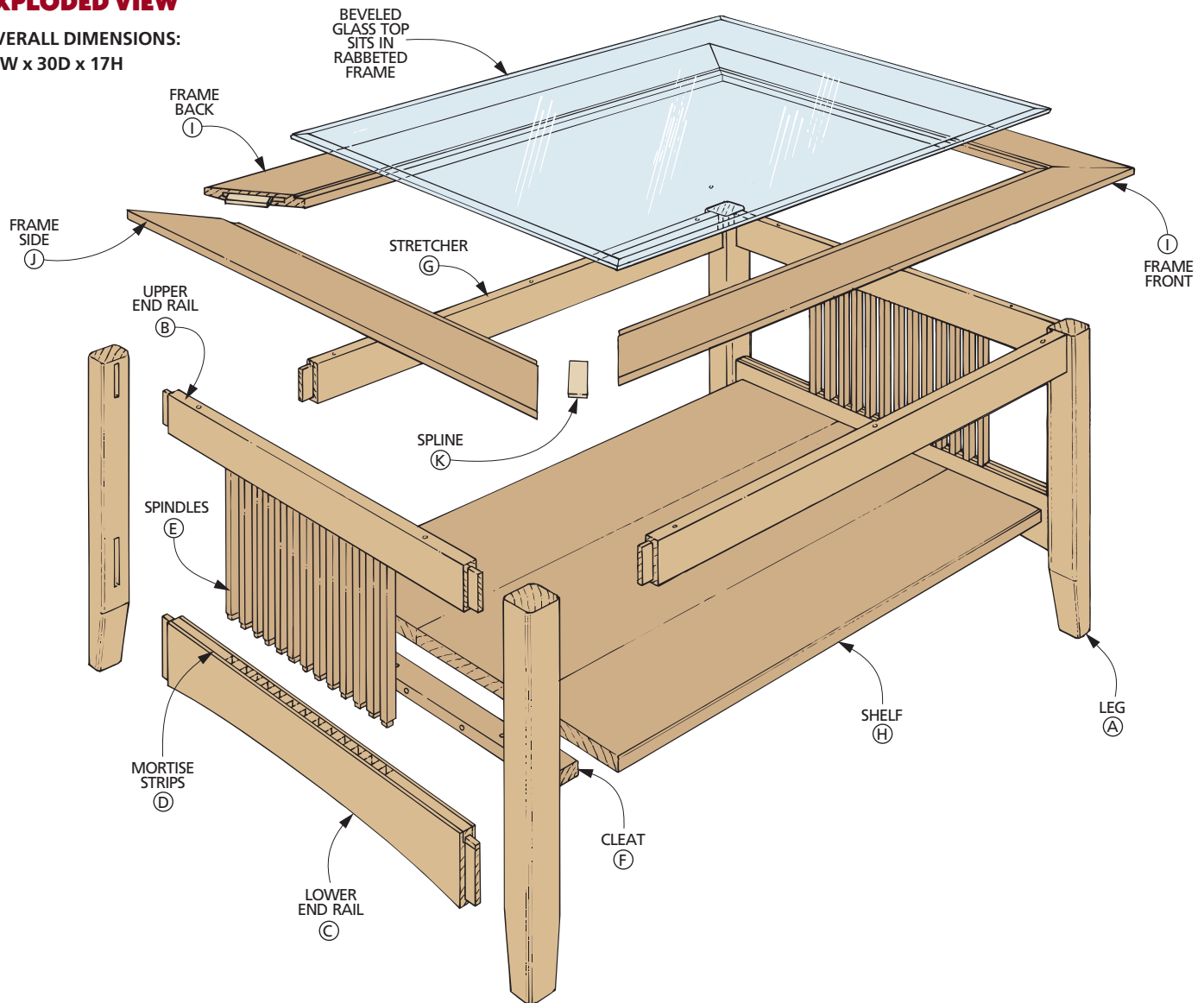
However, if you prefer the look of a solid wood top (that matches the one on the Sofa Table), we've included that as an option. See the Designer's Notebook on page 71.

MATERIALS. All the wooden parts for the table shown here are quartersawn white oak, a typical material for Mission-style projects.

No hardware is required for this table other than ordinary woodscrews.

EXPLODED VIEW

OVERALL DIMENSIONS:
38W x 30D x 17H



MATERIALS LIST

WOOD

A Legs (4)	1 $\frac{3}{4}$ x 1 $\frac{3}{4}$ - 16 $\frac{1}{4}$
B Upper End Rails (2)	$\frac{3}{4}$ x 2 - 24 $\frac{1}{2}$
C Lower End Rails (2)	$\frac{3}{4}$ x 3 - 24 $\frac{1}{2}$
D Mortise Strips (4)	$\frac{1}{2}$ x $\frac{3}{8}$ - 24 $\frac{1}{2}$
E Spindles (26)	$\frac{1}{2}$ x $\frac{1}{2}$ - 8 $\frac{1}{4}$
F Cleats (2)	$\frac{3}{4}$ x 1 $\frac{1}{2}$ - 17
G Stretchers (2)	$\frac{3}{4}$ x 2 - 32 $\frac{1}{2}$
H Shelf (1)	$\frac{3}{4}$ x 22 - 32
I Frame Fr./Bk. (2)	$\frac{3}{4}$ x 3 $\frac{1}{2}$ - 38
J Frame Sides (2)	$\frac{3}{4}$ x 3 $\frac{1}{2}$ - 30
K Splines (4)	$\frac{1}{4}$ x 1 - 1 $\frac{3}{4}$

HARDWARE SUPPLIES

- (1) $\frac{1}{4}$ " beveled glass, 24" x 32"
- (6) #8 x 1 $\frac{1}{4}$ " Fh woodscrews
- (18) #8 x 2" Fh woodscrews

CUTTING DIAGRAM

1 $\frac{3}{4}$ x 4 - 48 QUARTERSAWN WHITE OAK (2.7 Bd. Ft.)



$\frac{3}{4}$ x 5 $\frac{1}{2}$ - 84 QUARTERSAWN WHITE OAK (3.2 Bd. Ft.)



$\frac{1}{2}$ x 3 $\frac{1}{2}$ - 72 QUARTERSAWN WHITE OAK (1.8 Sq. Ft.)



$\frac{3}{4}$ x 5 - 60 QUARTERSAWN WHITE OAK (2.1 Bd. Ft.)



$\frac{3}{4}$ x 5 - 72 QUARTERSAWN WHITE OAK (Two Boards @ 2.5 Bd. Ft. Each)



$\frac{3}{4}$ x 4 - 84 QUARTERSAWN WHITE OAK (2.3 Bd. Ft.)



$\frac{3}{4}$ x 4 - 72 QUARTERSAWN WHITE OAK (2 Bd. Ft.)



END FRAMES

The coffee table is just two end frames joined by a top and shelf. And each end frame has a pair of legs, a pair of rails, and a row of spindles. I started building these frames by making the legs.

LEGS. The legs (A) begin as four squared-up blanks cut from $1\frac{3}{4}$ "-thick stock (Fig. 1). After cutting the blanks to length, I laid out the mortises for the rails on each leg (Figs. 1 and 1a).

You can't go wrong laying out the two mortises at the top of each leg — they're on adjacent faces. But when laying out the lower mortise on each leg, pay attention to the orientation of the legs. The right and left legs are mirror images of one another (Figs. 1 and 1a).

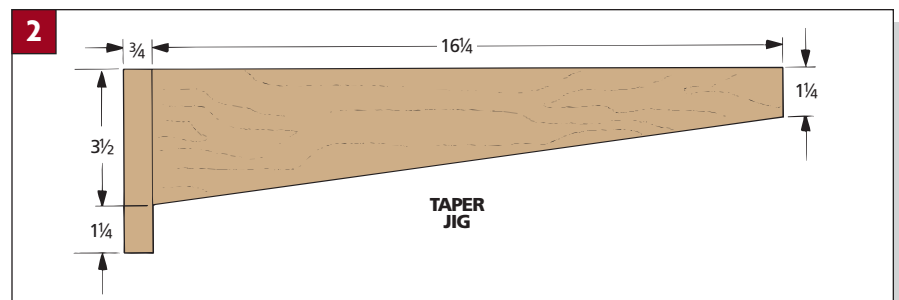
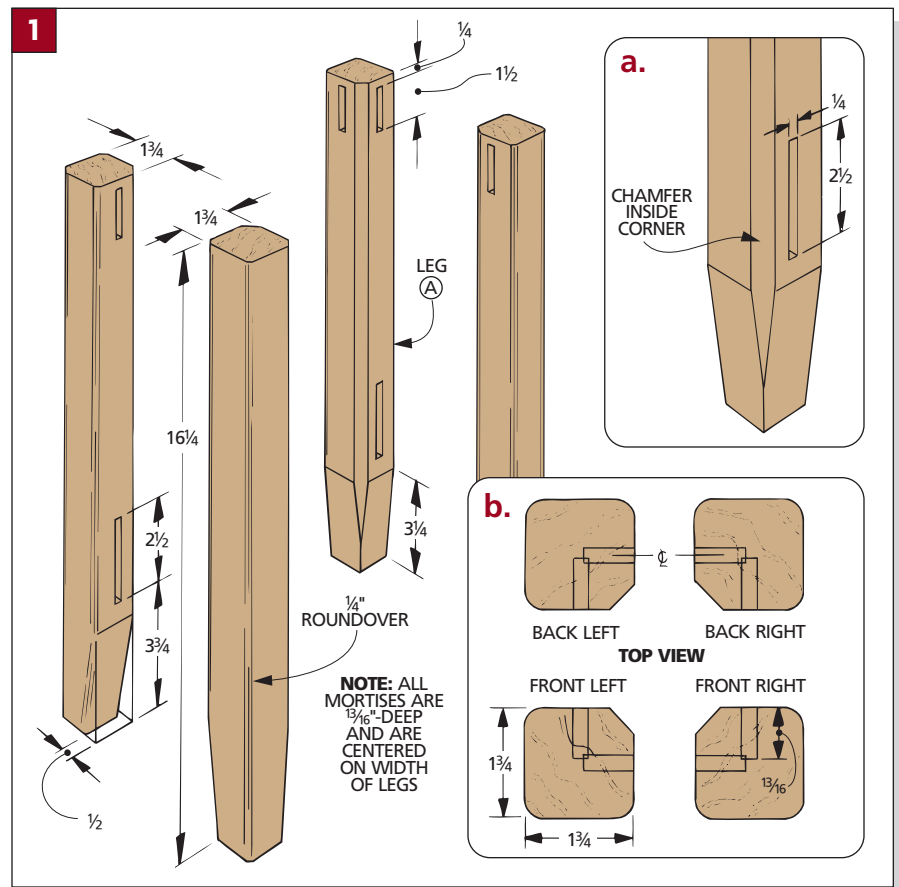
To make the mortises, I removed most of the waste by drilling a row of overlapping holes on a drill press. Then I used a chisel to clean up the sides.

Once the mortises are complete, the legs can be tapered and shaped. A table saw and a simple taper jig make quick work of the tapers on the inside faces of each leg (Fig. 3). The jig I used is just a piece of plywood with a hardwood cleat attached to one end (Fig. 2).

After cutting the tapers, I routed a chamfer on the inside corner of each leg on a router table (Fig. 4). But don't try to chamfer the tapered edge. Just push the leg straight through the router table — the chamfer will narrow to a point at the bottom of the leg (Fig. 1a).

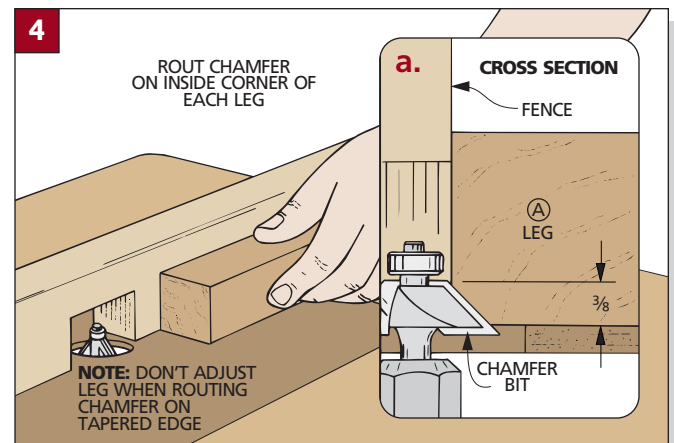
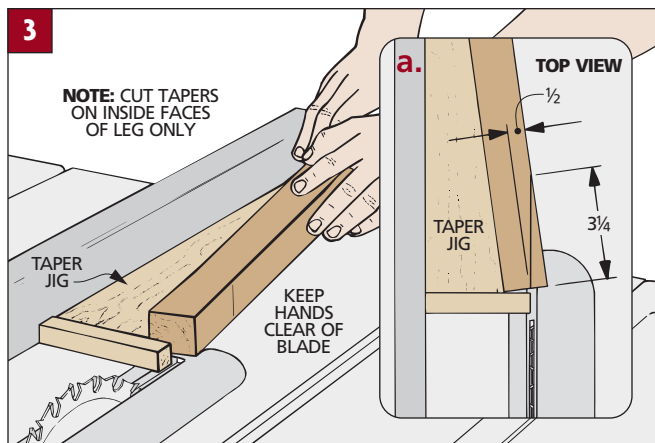
For the three outside corners of the leg, I wanted a softer look. So I routed $\frac{1}{4}$ " roundovers on the edges, again using the router table (Fig. 1).

Finally, to prevent the legs from splintering if the table is dragged across a floor, I rounded over the bottom edges of each leg slightly with sandpaper.



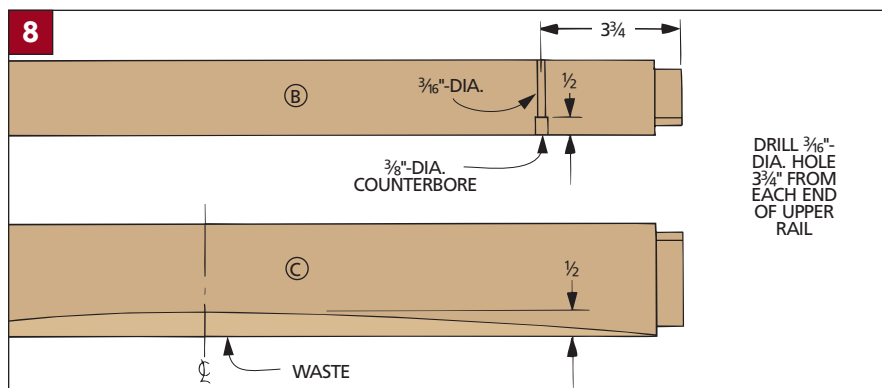
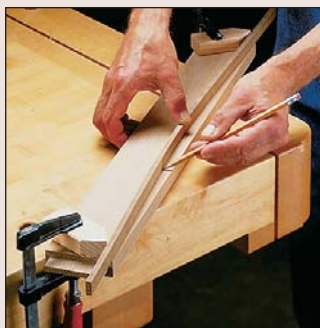
At this point, I put the legs aside and began work on the other parts of the end frames.

END RAILS. I cut the upper and lower end rails (B, C) to size from $\frac{3}{4}$ "-thick stock first. All the rails are $24\frac{1}{2}$ " long,



To complete the upper rails, I drilled counterbored shank holes in each rail (*Fig. 8*). These are for screws that fasten the top later. The shank holes are slightly oversize ($\frac{3}{16}$ "-dia.) to allow room for wood movement (especially if you build the solid wood top).

To flex the straightedge and lay out the arcs, clamp a couple of pointed scraps to the ends of the rails.



SPINDLES. The rails and legs are the main components of the end frames. But the spindles are what catch your eye.

Making the twenty-six spindles (E) isn't difficult, just a little repetitive. The spindles are first cut to size from $\frac{1}{2}$ "-thick stock (Fig. 9a).

Then the tenons on the ends of each spindle are cut with a table saw and dado blade, rotating each piece a quarter turn between passes (Fig. 9b). To keep the shoulders even and the shoulder-to-shoulder distance the same on each spindle, I used a stop block clamped to my miter gauge fence.

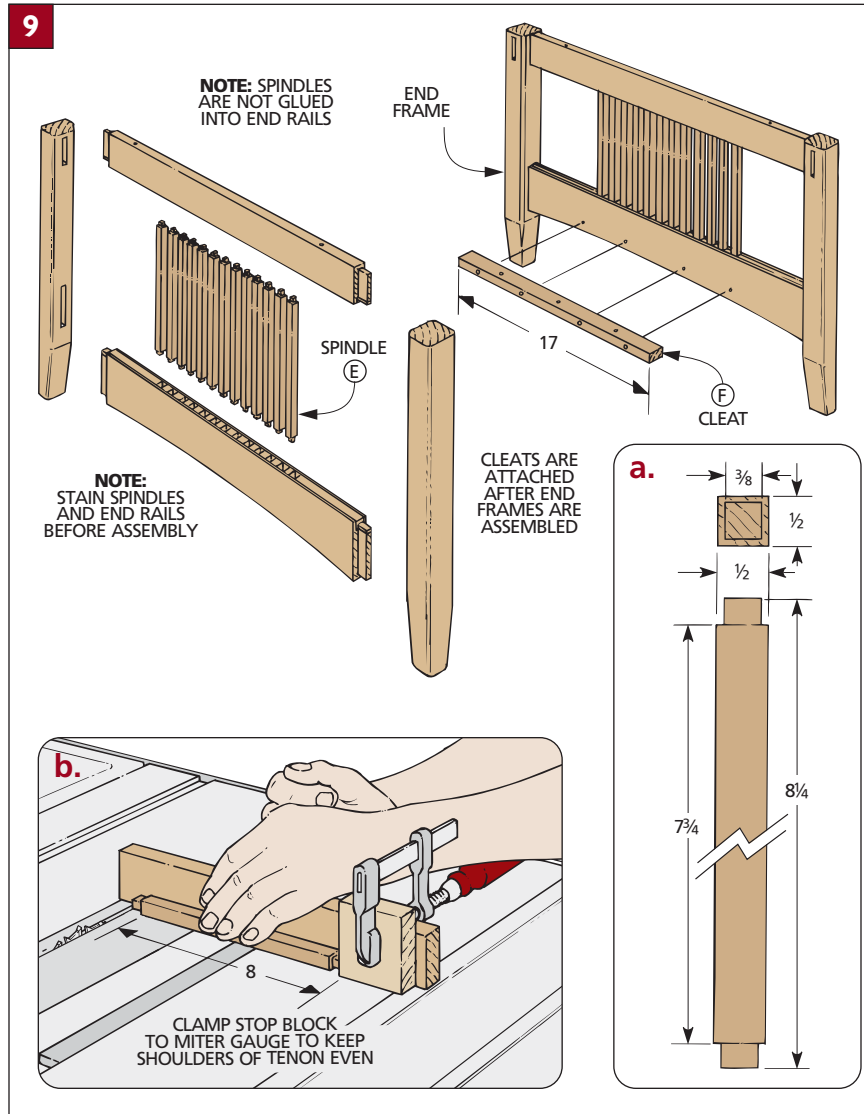
Normally you would glue up the end frames next. But because the spindles are so narrow and spaced so closely, I decided to stain them before assembly. I also stained the end rails. This way, I didn't have to worry about trying to work the stain in around the spindles after the table was assembled.

ASSEMBLY. Don't worry about trying to assemble all the spindles between the end rails before the glue sets up. The spindles aren't glued in place — they're captured between the rails.

I used a two-step procedure to assemble the end frames. First, I fit the spindles between the rails and held them in place with band clamps. Then I glued and clamped the legs to the rails (Fig. 10). Not having to worry about the spindles makes the gluing up process a lot easier.

CLEATS. After assembling the end frames, there's still one more piece to add to each frame — a cleat.

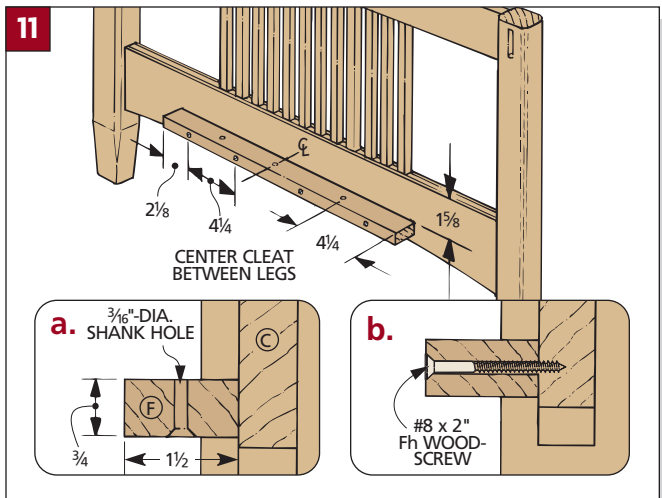
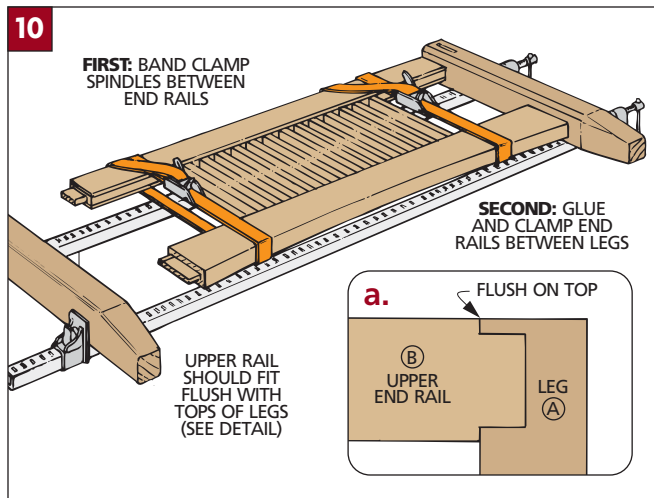
The cleat (F) is attached to the lower end rail of each frame to support a shelf (Figs. 9 and 11). These cleats are just narrow strips of $\frac{3}{4}$ "-thick stock.



Before attaching the cleats to the end frames, I drilled three $\frac{3}{16}$ "-dia. countersunk shank holes in each cleat for the screws that will be used to attach

the shelf (Figs. 11 and 11a).

Then I simply glued and screwed the cleats to the inside of the lower rails (Figs. 11 and 11b).



STRETCHERS & SHELF

With the end frames completed, you're more than halfway home. All that remains is to join the two end frames with stretchers and a shelf, and add a top. I made the stretchers first so I could assemble the base and take measurements for the shelf (*Fig. 12*).

STRETCHERS. Each stretcher (G) is cut from a piece of $\frac{3}{4}$ "-thick stock. A tenon is cut on each end to match the mortises in the legs (*Fig. 12a*).

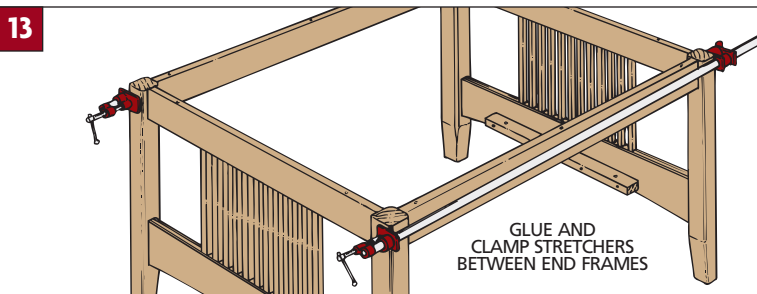
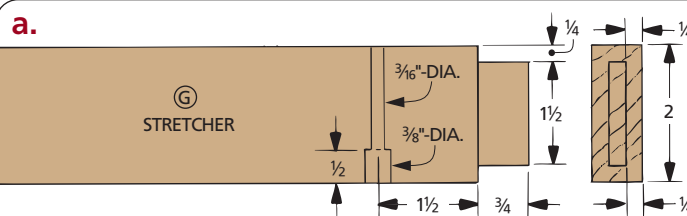
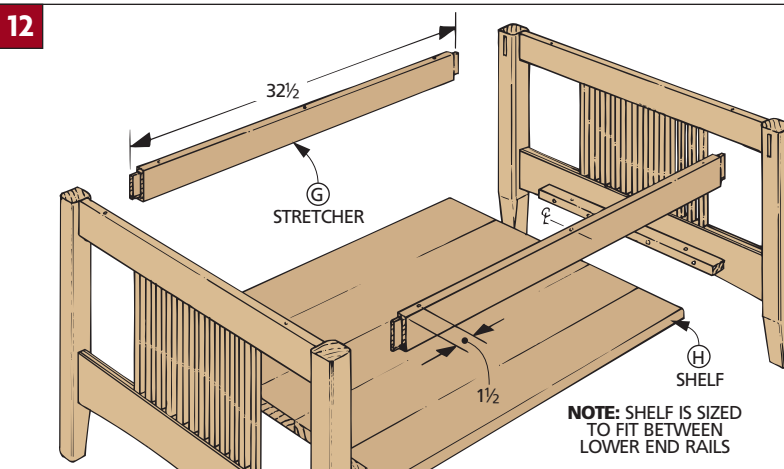
Like the upper end rails, each stretcher is drilled and counterbored for three screws that will be used to attach the top (*Fig. 12a*).

SHELF. Aside from holding books or magazines, the shelf (H) serves another purpose. It acts as a lower stretcher, tying the base of the table together. I made the shelf from an oversized, glued-up panel of $\frac{3}{4}$ "-thick stock.

Note: If you plan to build a solid wood top (see the Designer's Notebook on page 71) you may also want to glue up a panel for the top at this time.

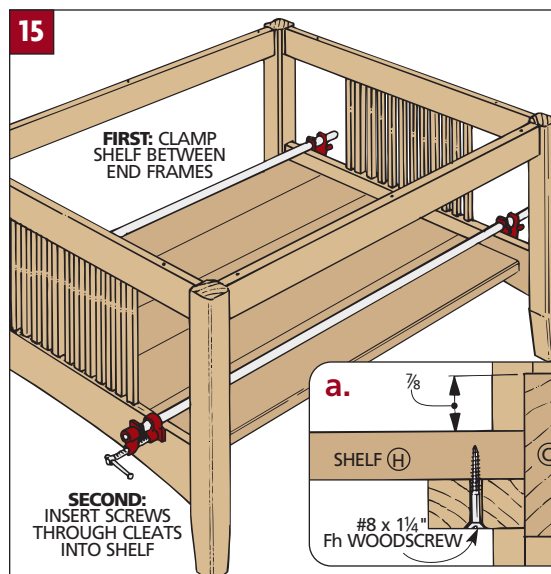
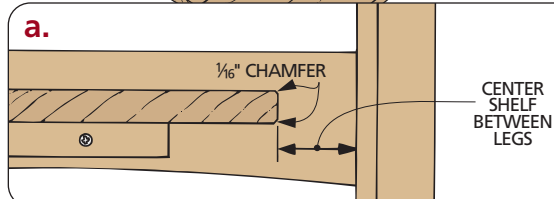
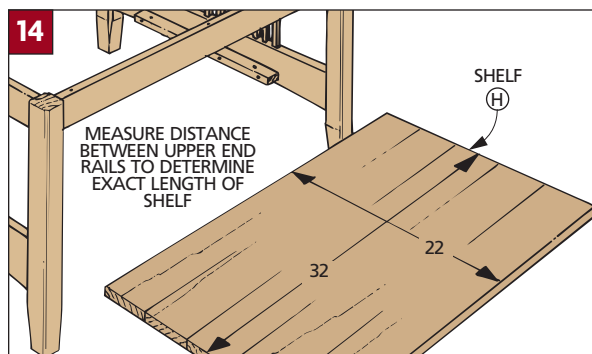
After gluing up the shelf, I ripped it to finished width (22") (*Fig. 14*). In order to determine the exact length, I measured the distance between the upper end rails (32" in my case). Then I trimmed the ends of the shelf to match this measurement.

Before attaching the shelf, I took the time to break the sharp edges by routing a small ($\frac{1}{16}$ ") chamfer along the front and back edges (both top and bottom) (*Fig. 14a*). (The ends of the shelf are not chamfered.)

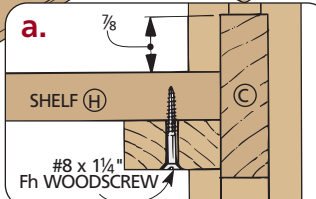


To attach the shelf, I placed it on the cleats and centered it front-to-back. Then, using clamps to pull the end

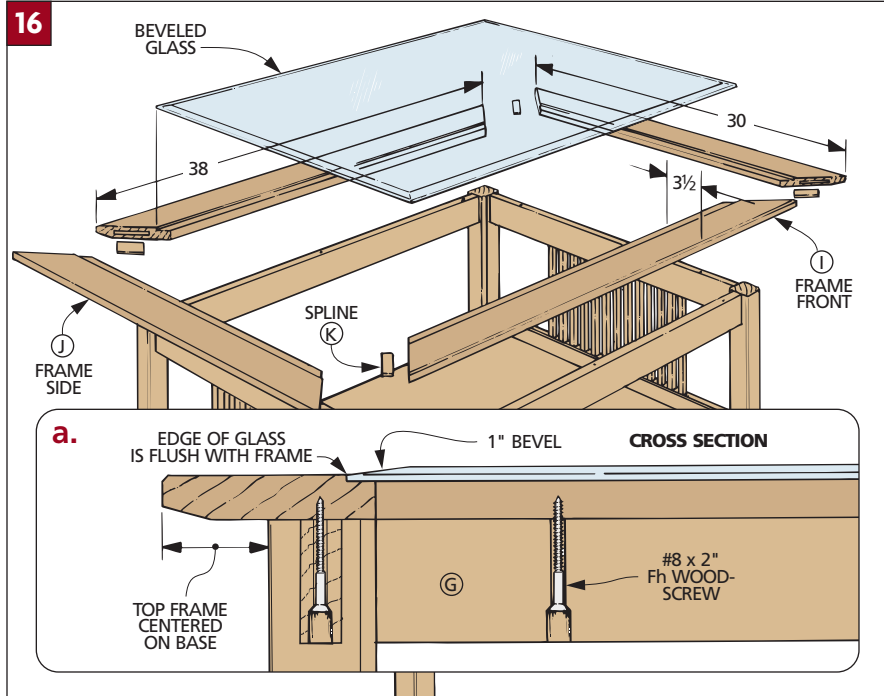
frames tight against the shelf, I drove screws up through the cleats into the bottom of the shelf (*Figs. 15 and 15a*).



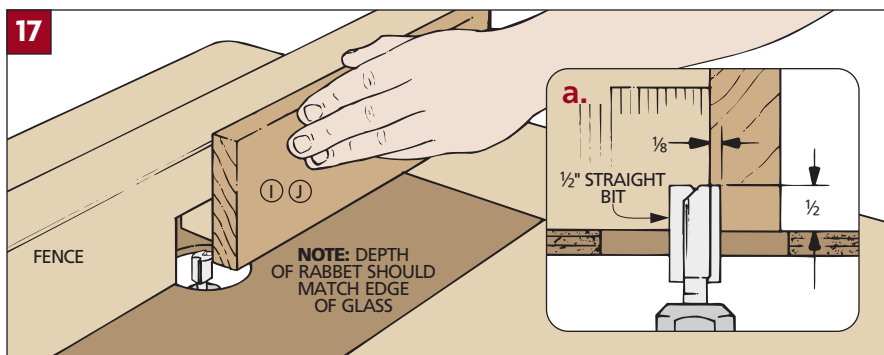
SECOND: INSERT SCREWS THROUGH CLEATS INTO SHELF



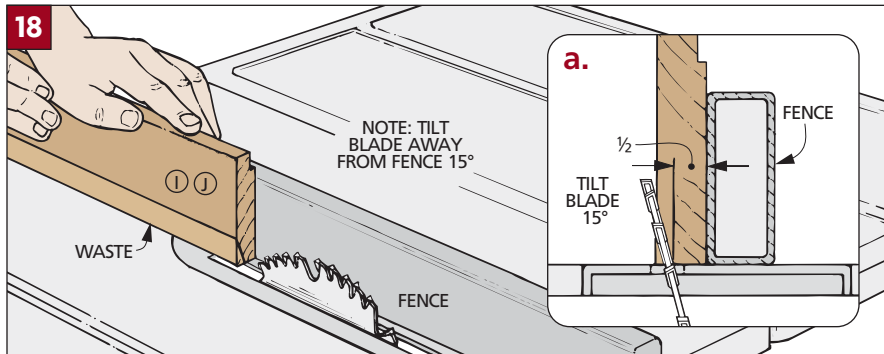
16



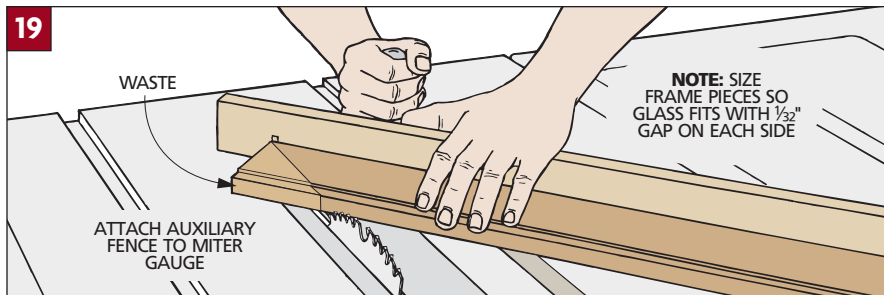
17



18



19



TOP

The top of the coffee table is something like a picture in a frame — a really big frame. But the “picture” in this case is a piece of beveled glass.

BEVELED GLASS. If you’ve never worked with beveled glass before, there are a couple of things you should know. First off, the piece of glass I used is fairly large ($\frac{1}{4}$ " thick and 24" x 32"). So don’t expect to simply run down to your local hardware store and find it in stock.

I had to order the beveled glass specially from a local glass shop, and it took a week to fill the order. Try looking in the yellow pages to find a glass shop in your area.

Another important thing to know about ordering glass is that the final measurements aren’t always exactly what you request. Because of the cutting and polishing process, the glass can vary as much as $\frac{1}{8}$ " from what you specify when you order it. But this isn’t a problem as long as you obtain the glass *before* you cut the top frame pieces to length.

The frame front/back (I) and frame sides (J) are cut from $\frac{3}{4}$ "-thick stock. They can be ripped to finished width ($3\frac{1}{2}$ "), but don’t cut them to length just yet. They will be mitered to length a little later.

Before mitering the frame pieces, I cut a rabbet on one edge of each piece (Figs. 17 and 17a). This rabbet creates a ledge for the glass top to rest on.

Note: The rabbet should be deep enough so the beveled edge of the glass will sit flush with the top surface of the frame ($\frac{1}{8}$ " in my case) (Fig. 16a).

Then to keep the outside edges of the top from looking too thick and heavy, I beveled the underside of each frame piece (Figs. 18 and 18a). I did this by running the pieces through the table saw on edge and then sanding off the saw marks.

After rabbeting and beveling the frame pieces, they can be mitered to length to fit the beveled glass (Fig. 19).

Note: To avoid making the opening for the glass too tight, allow a little extra ($\frac{1}{16}$ ") when figuring the length of the frame pieces.

SPLINES. To strengthen the miter joints, I added splines. But the splines serve another purpose as well. They help keep all the pieces even when gluing and clamping them together.



To cut the slots for the splines, I used a hand-held router and a slot-cutting bit (Figs. 20 and 20b). Just be sure to stop the slot short of the edges of the workpiece (Fig. 20a).

After routing these slots, I cut the $\frac{1}{4}$ "-thick splines (K) to fit. The thing to remember here is that in order to get a strong joint, the grain of the spline needs to run *across* the joint line of the miters (Fig. 20a).

ASSEMBLING THE TOP. Before gluing up the top, I dry-assembled the pieces and clamped them together with band clamps to check the fit of the beveled glass (Fig. 21).

But because I didn't want to take a chance on breaking the glass, I made a template out of hardboard the same size as the glass and used that to check the fit instead.

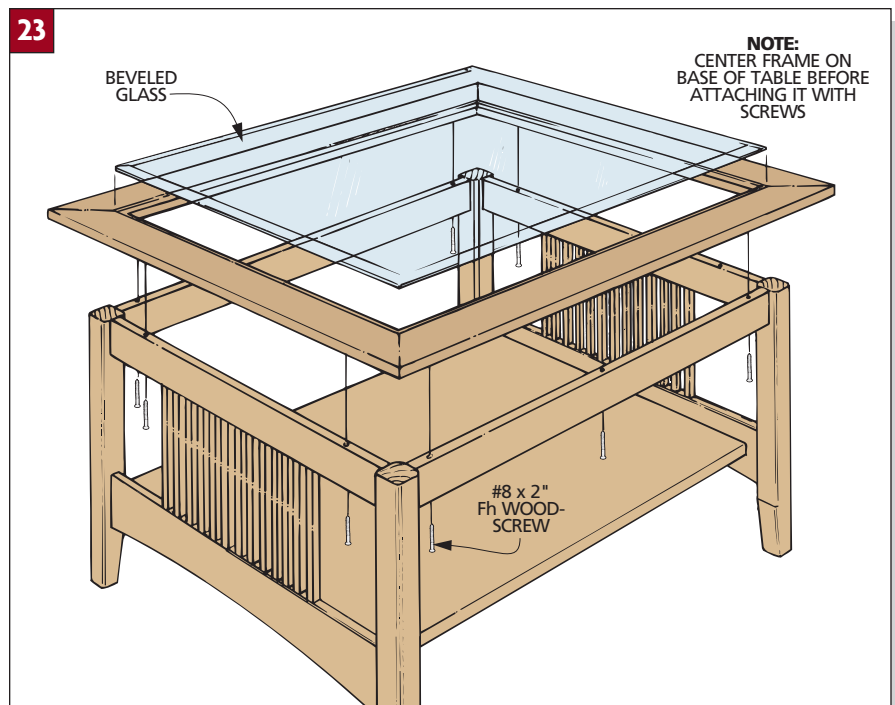
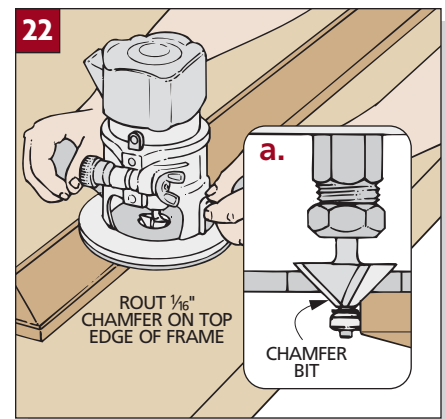
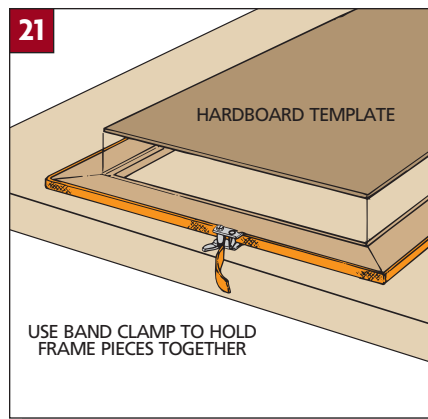
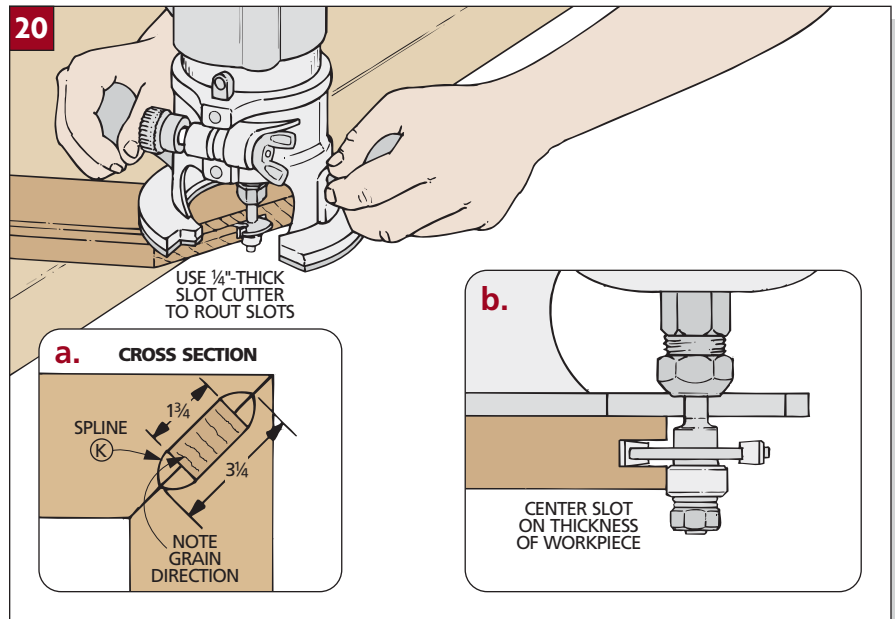
Once I was satisfied with the fit of the miters and the size of the glass opening, I glued up the top frame pieces and clamped them back together. Then I used the hardboard template to check the glass opening one more time with the clamps in place.

CHAMFER. As a final detail, I relieved the sharp edges by routing very small ($\frac{1}{16}$ ") chamfers all around the edges of the top (Figs. 22 and 22a).

To attach the top, I simply centered it front-to-back and side-to-side. Then I drove screws up through the counter-bored holes in the stretchers and upper end rails and into the top (Fig. 23).

FINISH. I stained the table with a light cherry stain and topped it with a tung oil and urethane combination finish. After drying, it was rubbed and buffed to a satin sheen with paste wax.

After the entire table was finished, I added the glass top.



TECHNIQUE Simple Mortises

Instead of making individual mortises for the spindles in the coffee table, I used a different approach. First I cut a groove on one edge of each end rail. Then I glued in a “mortise strip.”

GROOVES. There’s not much to making the grooves. I cut them in two passes, flipping each rail end for end between passes to ensure that the grooves will be centered on the thickness of the workpiece (Figs. 1 and 1a).

MORTISE STRIPS. The mortise strips are just narrow strips with notches cut in them. When glued into the grooves, they create mortises for the spindles.

But instead of trying to cut the notches in narrow strips, I started with a wide blank cut to the same length as the rails (24½”). After the notches are

cut, the blank will be ripped into strips. (I made the thickness of the blank equal the depth of the grooves in the rails.) If you want the strips to be nearly undetectable, you can make them from the same piece of wood as the rails.

NOTCHES. To cut the notches, I used a dado blade and a table saw. The trick is to keep the notches evenly spaced. To do this, I used a simple indexing jig.

To make the jig, clamp an auxiliary fence to the front of the miter gauge. Then cut a dado through the center of the blank and the auxiliary fence (Fig. 2).

To keep the notches evenly spaced, I glued an index key into the notch in the auxiliary fence (Fig. 2a). Then I readjusted the fence so the key was ⅝” from the edge of the blade (Figs. 3 and 3a).

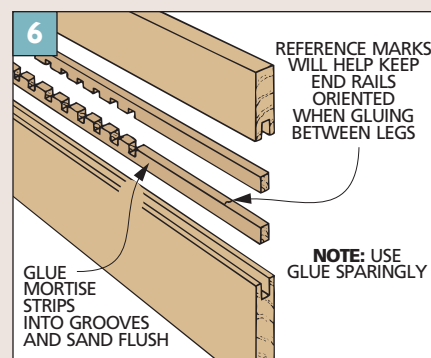
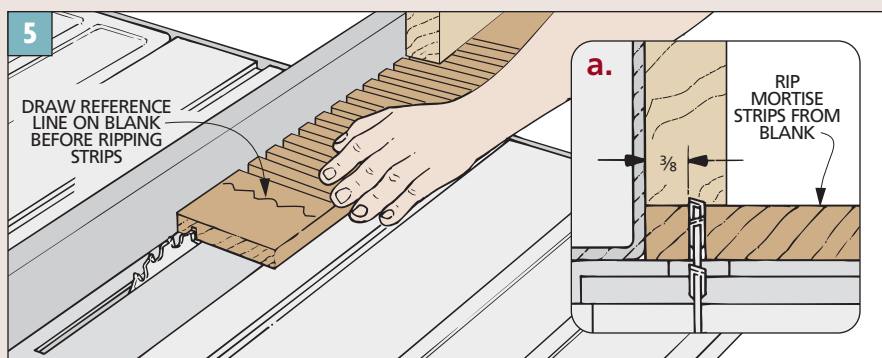
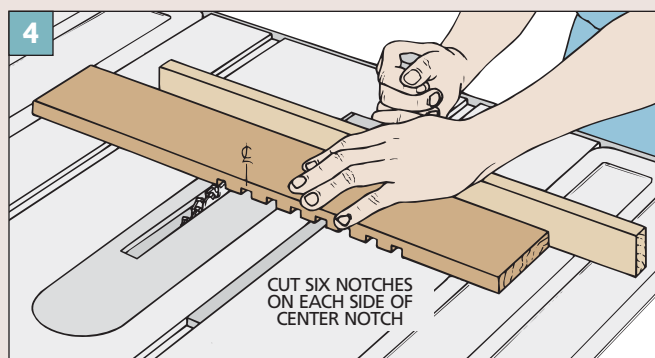
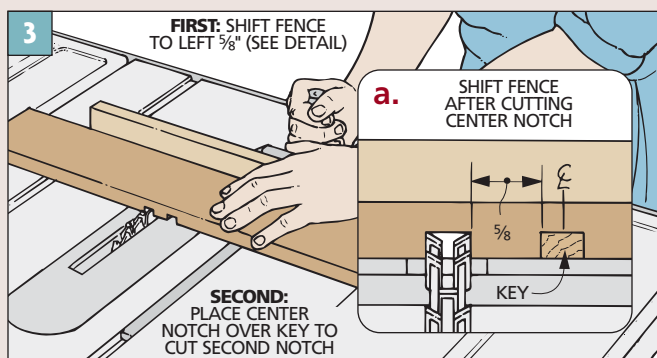
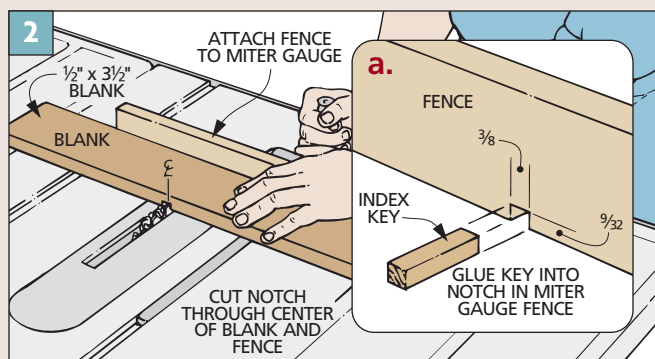
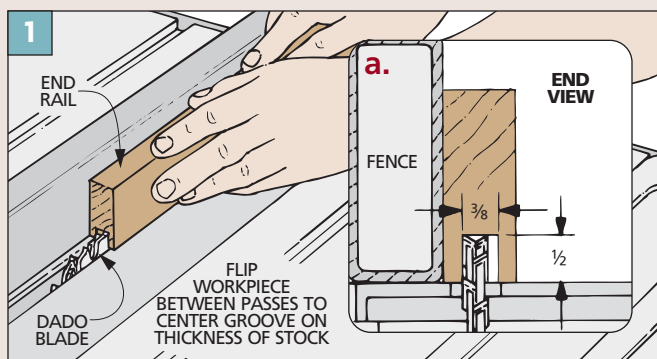
Next, I cut six more notches on one side of the center notch (Fig. 4). To do this, I simply placed each newly cut notch over the key to cut the next one.

After cutting the notches on one side, I turned the piece around and cut six notches on the other side of the center notch, following the same procedure.

Note: You should end up with a total of 13 notches.

RIPPING. Before ripping the strips, I drew a reference line on one end of the blank (Fig. 5). Later when the rails are glued between the legs, this line will help orient the end rails so the mortises align (Fig. 6).

Note: When gluing the strips into the rails, use a sparing amount of glue to avoid getting any in the mortises.



Replacing the frame and beveled glass top with a panel built from solid wood gives the coffee table a more traditional look. And it's a simple addition to build.

CONSTRUCTION NOTES:

■ If you prefer a more traditional look for your coffee table, you can build a solid wood top instead of the frame and glass one shown on page 62.

Note: This version also matches the Sofa Table on page 54, if you'd like to build both as a set.

■ To make the solid wood top, start by gluing up an oversized panel from $\frac{3}{4}$ "-thick stock (just like you did for the shelf earlier).

■ When the glue is dry, you can trim the panel to its finished dimensions of 30" x 38".

■ After the panel is cut to size, the bottom edges need to be beveled like the frame pieces for the glass top. But trying to stand a panel this large on edge and running it through the table saw could create numerous problems, even with a tall auxiliary fence.

So I used a bevel jig with a hand-held router to produce the same look. This jig is the same one used for the top of the Sofa Table. The basic construction and procedure for this jig are shown on page 61.

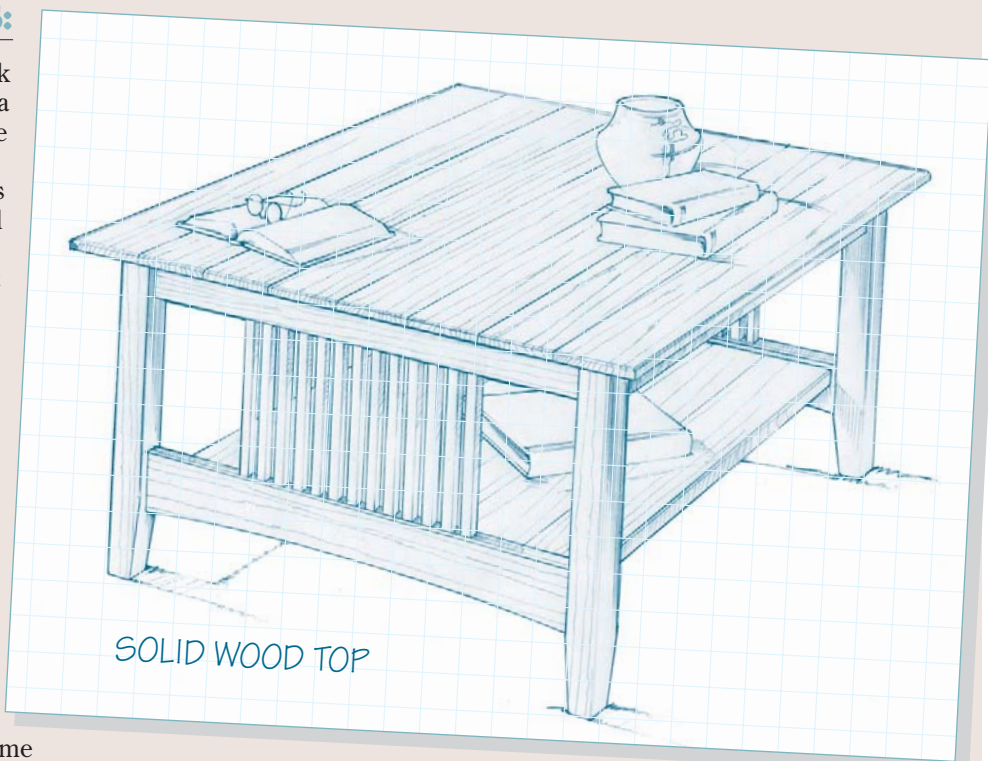
■ Since you're using a solid wood top instead of a frame, you'll need to allow room for the wood to expand and contract. To do this, you could use Z-shaped fasteners like on the Sofa Table

(see page 60). But this would require cutting kerfs in the upper end rails and stretchers, which could be visible if you ever wanted to switch to the glass top.

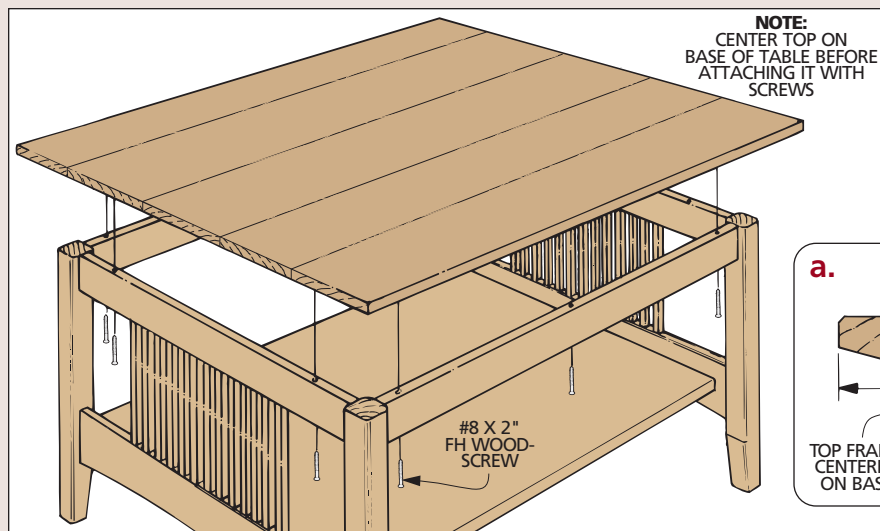
Instead, I made the counterbored holes in the rails and stretchers a little larger (almost like a slot) to allow the wood to move (see detail 'a' in drawing

below). Then you can center the top on the frame and screw it down.

Note: While the glass top provides a convenient surface for glasses and other items (since it won't mark or stain), the solid top may require some extra protection. So you may want to finish it with polyurethane.



SOLID WOOD TOP

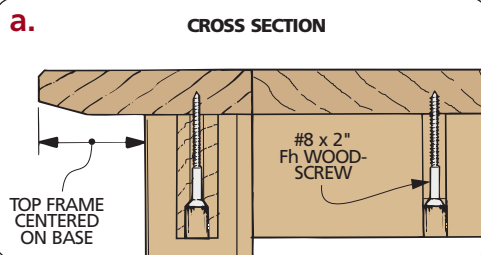


MATERIALS LIST

NEW PARTS

L Solid Top (1) $\frac{3}{4}$ x 30 - 38

Note: Do not need parts I, J, K, or beveled glass.



Mission Bookcase

Built with machinery and handwork, this cherry bookcase features through mortise and tenon joints for an impressive look. There's also an option for a shorter bookcase without the glass doors.

This bookcase is a good example of straightforward Mission-style furniture, with sturdy mortise and through tenon construction, square pegs, and shop-made door pulls.

When Gustav Stickley started designing furniture like this in the early 1900s, he had the “common man” in mind. Out with the ornate — furniture should be simple and functional. The result was the Mission style (sometimes called “Craftsman” style furniture).

MACHINE AND HAND TOOLS. But Stickley was not just concerned with design. Furniture also had to be built in the tradition of the master craftsman. His furniture was built with a combination of machinery and handwork.

That's what I like most about this bookcase. It's built in the same tradition. Heavy and repetitive tasks (cutting, planing, and drilling) can be done by machine, while the finer details (the through tenons, square pegs, and door dividers) require careful handwork. The whole process reflects Stickley's concern for quality and craftsmanship.

WOOD. You might be surprised to see that I used cherry to build the bookcase. Much of the Mission-style furniture was originally built out of quarter-sawn oak. But after doing a little research, I discovered that cherry was used by Stickley as well.

I thought the brass ball-tipped hinges I wanted to use would look good with the cherry, once the wood darkened to a deep brownish-red.

FINISH. To protect the bookcase, I brushed on four coats of a tung oil and urethane combination finish. While this isn't an authentic Mission finish, I did follow Stickley's technique in a way. I waxed the bookcase after the finish had set a few days (to give it time to cure).

I applied several coats of a high quality paste wax. The one I found was a mixture of carnauba and beeswax.

To apply the wax, wipe on a thin layer



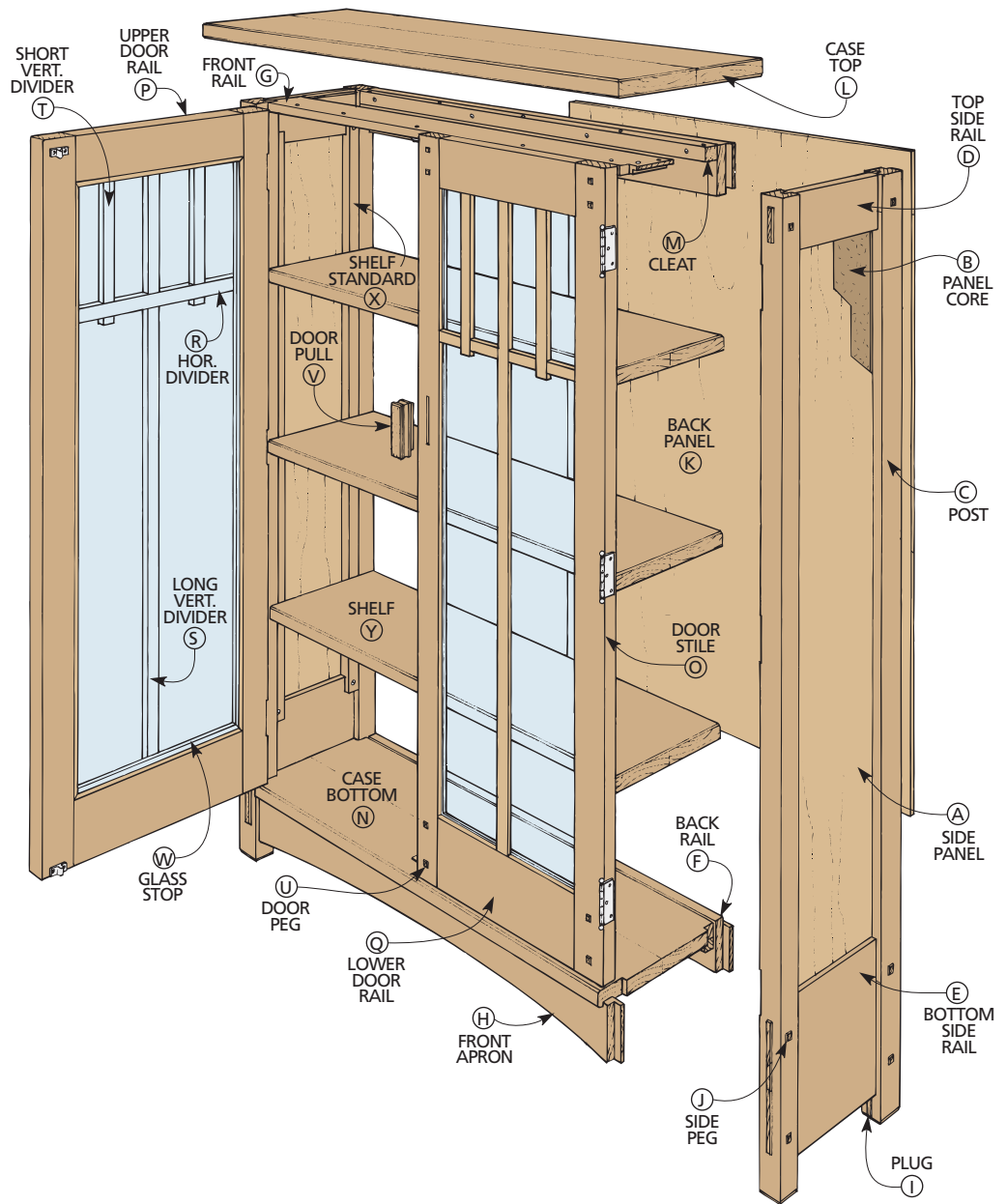
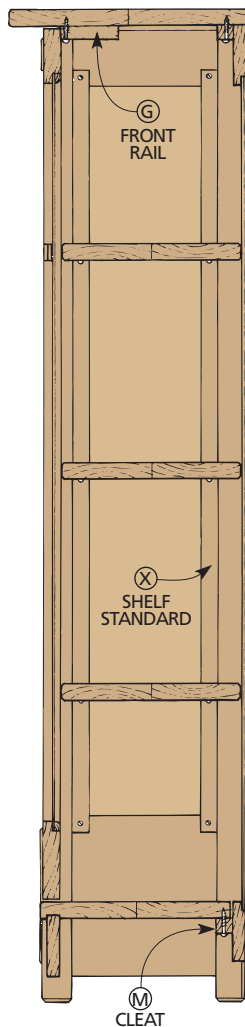
with a cotton cloth and let it dry for a few minutes. (Several thin coats are easier to apply than one thick one.) Then buff it to a shine with a clean cloth.

SHORT OPEN BOOKCASE. For a different look (and a simpler project), see the shorter bookcase without doors in the Designer's Notebook on page 87.

EXPLODED VIEW

OVERALL DIMENSIONS:
48W x 14D x 59H

a. CROSS SECTION



MATERIALS LIST

CASE

A Side Panels (4)	1/4 ply - 9 3/16 x 44 3/16
B Panel Cores (2)	1/8 hdbd. - 9 3/16 x 44 3/16
C Posts (4)	1 3/4 x 1 3/4 - 58
D Top Side Rails (2)	1 x 3 1/2 - 11 5/8
E Btm. Side Rails (2)	1 x 9 1/2 - 11 5/8
F Back Rails (2)	3/4 x 3 1/2 - 41 1/2
G Front Rail (1)	3/4 x 3 1/2 - 42 1/4
H Front Apron (1)	3/4 x 3 3/4 - 41 1/2
I Plugs (4)	3/8 x 1/2 - 2 5/16
J Side Pegs (12)	3/8 x 3/8 - 1 5/16
K Back Panel (1)	1/4 ply - 41 1/2 x 49 1/2
L Case Top (1)	1 x 14 - 48
M Cleats (2)	1 x 1 - 40 1/2
N Case Bottom (1)	1 x 11 1/4 - 41 1/4

DOORS

O Door Stiles (4)	1 x 2 17/32 - 51 7/8
P Upr. Door Rails (2)	1 x 3 1/2 - 19 1/8
Q Lwr. Door Rails (2)	1 x 5 - 19 1/8
R Horiz. Divid. (2)	1/2 x 1 - 15 7/8
S Long Ver. Divid. (2)	1/2 x 1 - 44 1/8
T Short Ver. Divid. (4)	1/2 x 1 - 11 5/16
U Door Pegs (16)	3/8 x 3/8 - 1 3/16
V Door Pulls (2)	3/4 x 1 1/8 - 4
W Glass Stops (1)	3/8 x 3/8 - 20 ft. rgh.

STANDARDS & SHELVES

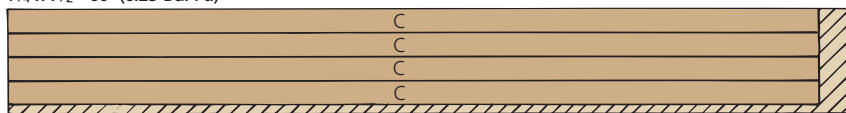
X Shelf Standards (4)	5/8 x 1 - 45 1/2
Y Shelves (3)	1 x 10 5/8 - 40 7/16

HARDWARE SUPPLIES

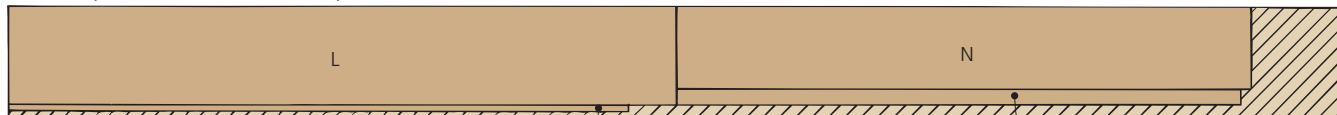
(8) No. 6 x 5/8" Fh woodscrews
(12) No. 6 x 1" Fh woodscrews
(23) No. 8 x 1 1/2" Rh woodscrews
(3 pr.) 2 1/2" x 2" ball-tipped hinges w/ screws
(4) Double-ball door catches w/ screws
(12) Shelf pins
(100) 5/8" wire brads
(2) 15 3/4" x 44" glass panes*
* Use 1/8" -thick tempered glass. Have the glass cut to fit the opening on the back of each door, minus 1/8" in both length and width, so it will fit easily.

CUTTING DIAGRAM

1 3/4 x 7 1/2 - 60 (6.25 Bd. Ft.)



1 x 8 - 96 (Two Boards @ 6.7 Bd. Ft. Each)



1 x 5 1/2 - 96 (Three Boards @ 4.6 Bd. Ft. Each)



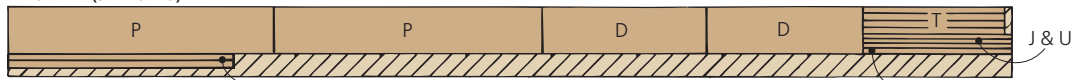
1 x 7 - 96 (5.8 Bd. Ft.)



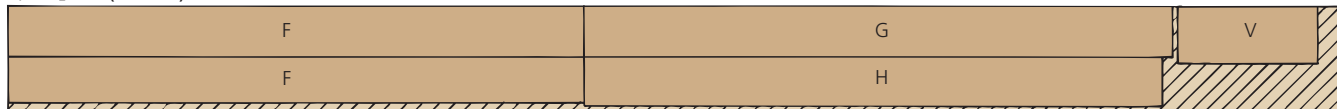
1 x 7 - 72 (4.4 Bd. Ft.)



1 x 5 - 72 (3.1 Bd. Ft.)



3/4 x 7 1/2 - 96 (5 Bd. Ft.)



NOTE: ALSO NEED ONE 4' x 8' SHEET 1/4" PLYWOOD, ONE 2' x 4' SHEET 1/8" HARDBOARD

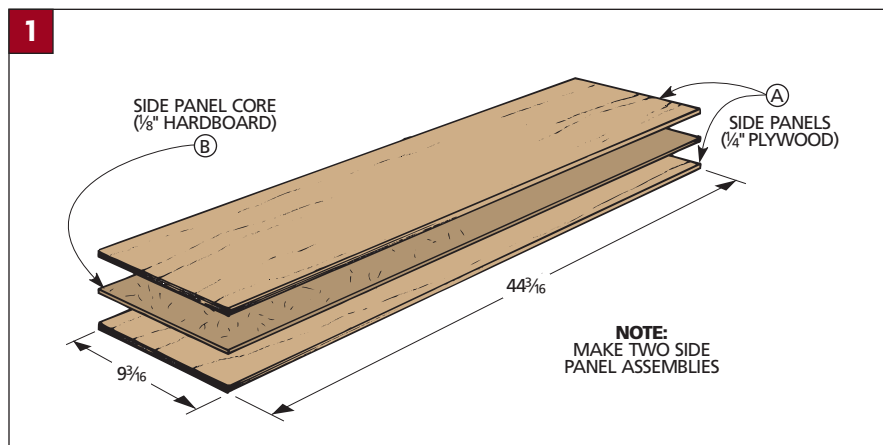
PANELS

To build this Mission bookcase, I started by making the framed side units. Each unit consists of two posts, two rails and a panel assembly (refer to *Fig. 2* on opposite page). I built up the panel assemblies first.

When making a framed panel, I generally use plywood for the panel. Unlike solid wood, plywood isn't drastically affected by changes in humidity.

I designed each side unit to have 1/2"-thick plywood panels with two good sides. (Both the inside and the outside of each panel will be seen when the project is completed.) Unfortunately, finding 1/2" cherry plywood with two good faces isn't easy. And it would also be quite expensive.

A simple solution to this problem was to cut two separate pieces of 1/4" cherry plywood to make each panel (*Fig. 1*). Then these side panels (A) can be set back-to-back so there are two good sides visible.



Note: All the plywood pieces for this project can be cut from one 4x8 sheet of 1/4" plywood.

But there's still a problem. Most 1/4" hardwood plywood is quite a bit less than 1/4" thick. The plywood I used was actually only a hair over 3/16" thick.

So, to get the panels closer to a thickness of 1/2" (they don't need to be exact

since you'll cut grooves to fit them later), I sandwiched a 1/8"-thick piece of hardboard between the panels to serve as a panel core (B) (*Fig. 1*).

Note: The three layers for each side panel could be glued together. But this is not necessary. The frames built around the panels will hold them together just fine.

SIDE UNITS

When the side panels are complete, a grooved frame can be built to fit around each side panel.

First, I cut all the pieces for both side frames (*Fig. 2*). The posts (C) are cut from $1\frac{3}{4}$ "-thick stock, and the top (D) and bottom side rails (E) from 1" stock.

GROOVES. The grooves in the posts and rails must match the thickness of the panel. And the grooves should be centered on each piece.

Since the posts and rails are different thicknesses, each requires its own setup to cut the grooves. Here, you have two options. You can reset the fence, or keep the fence in the same position but clamp a shim to it (*refer to Fig. 5*).

To find the thickness of this shim, figure the difference between the thickness of the posts and rails ($\frac{3}{4}$ " in my case). Then, divide this number by two. My shim ended up $\frac{3}{8}$ " thick (*Fig. 5*).

SETUP. To cut the grooves, I first mounted a $\frac{3}{8}$ " dado blade in the table saw and raised it $\frac{3}{8}$ " (*Fig. 3*). Then I set the fence so the blade was slightly off-center on the piece.

I cut each groove in two passes, flipping the board between each pass (*Figs. 3 and 4*). (Flipping the piece centers the groove.)

Note: Test the setup first with a scrap piece.

Once the groove is cut, check if the panel fits. If you need to, adjust the fence and make another test cut.

CUT GROOVES. When the test piece fits, cut the grooves on the four posts.

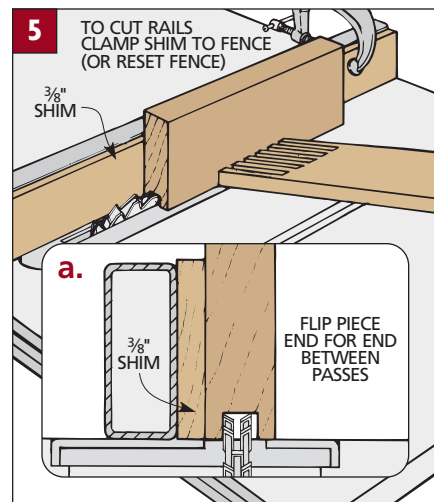
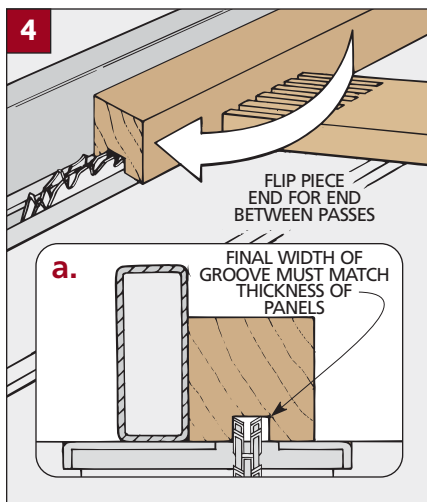
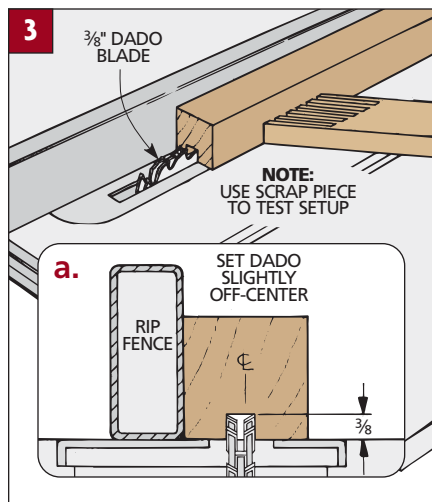
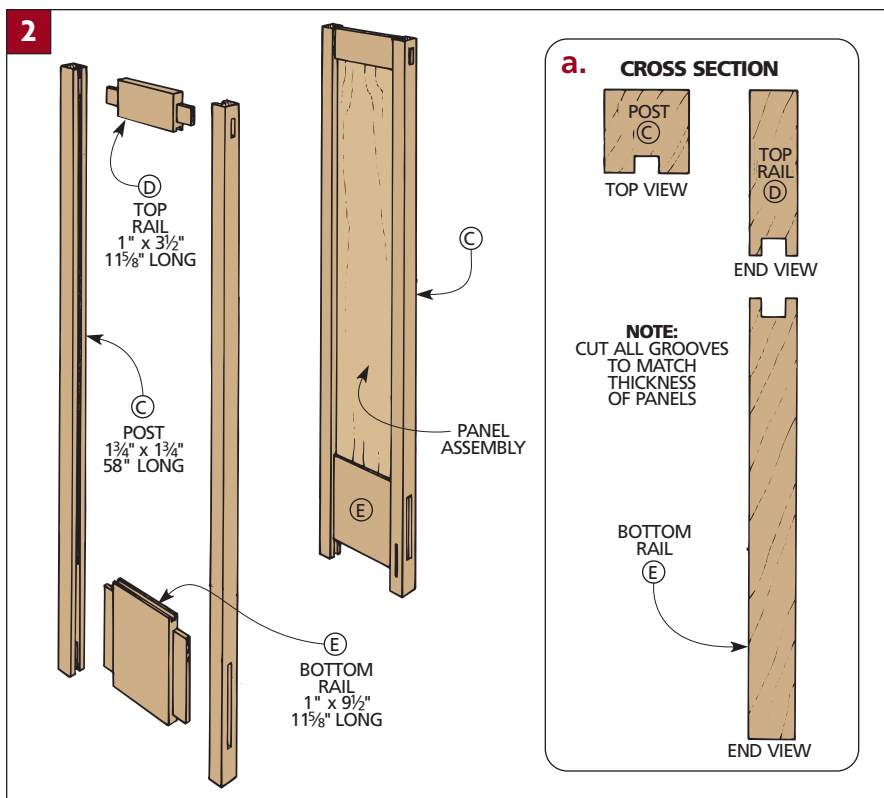
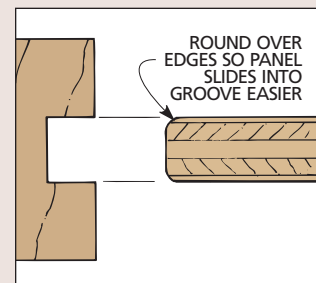
Next, to cut the grooves in the top and bottom rails, either reset the fence or add the shim (*Fig. 5*).

SHOP TIP.....Frame Assembly

When making framed panels, grooves are usually cut in the frame to fit the panel. But that doesn't mean it will go together easily.

If either piece is twisted or bowed, getting them together can be difficult.

To make it easier to assemble and avoid tearout on the edges of the grooves, I first round over the edges of the panel with a sanding block.





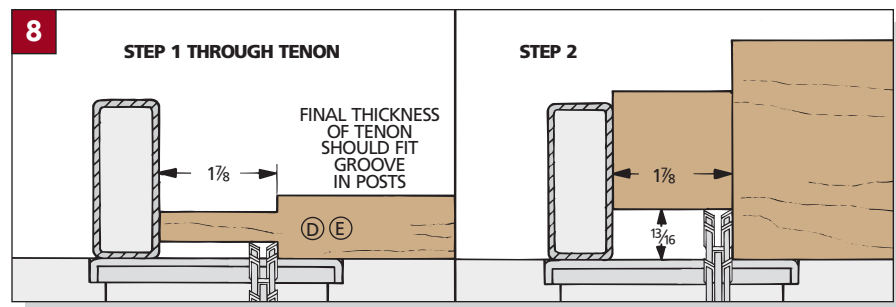
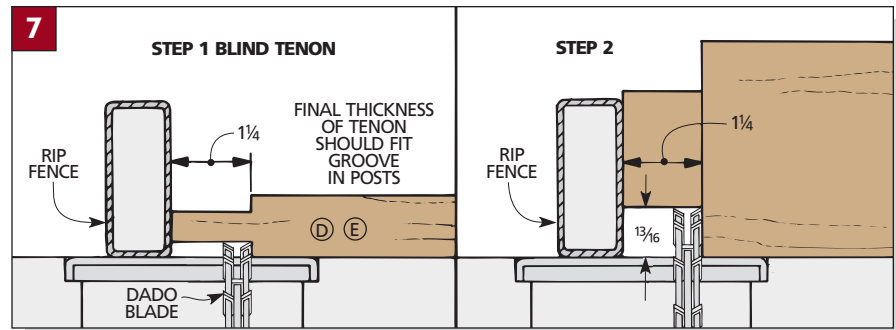
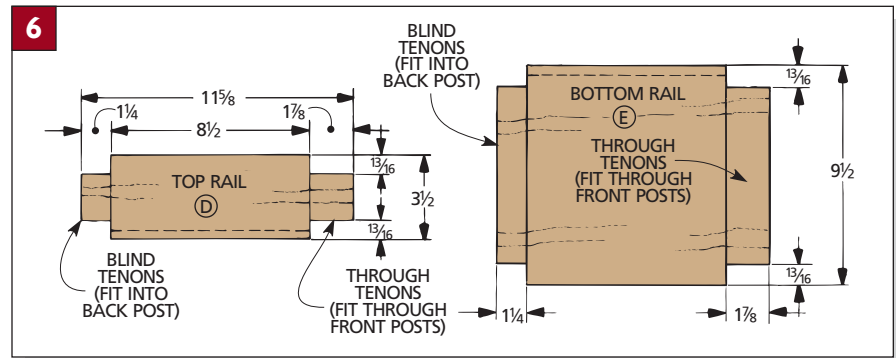
TENONS

The mortises and through tenons on the bookcase demand careful handwork, but you actually get to *see* the joint. (For more on this joint, see page 84.)

I usually start with the mortises, but this time I worked backwards. The tenons are cut first to fit the grooves cut in the posts. Like a mortise, the grooves act as a gauge for sizing the tenons.

TWO TENONS. There are two different length tenons on each rail (*Fig. 6*). On the front is a long tenon that fits through a front post. The tenon in back stops short in a typical (blind) mortise.

TWO STEPS. The setup for both rails is the same (*Figs. 7 and 8*). First, cut the cheek of the tenon (*Step 1*). (Test the fit with a scrap piece before cutting on the rails.) Next, set the piece on edge and cut the tenon to width (*Step 2*).



MORTISES

When all the tenons are cut, it's time to cut mortises in the posts. Again, there are two types of mortises: through and blind.

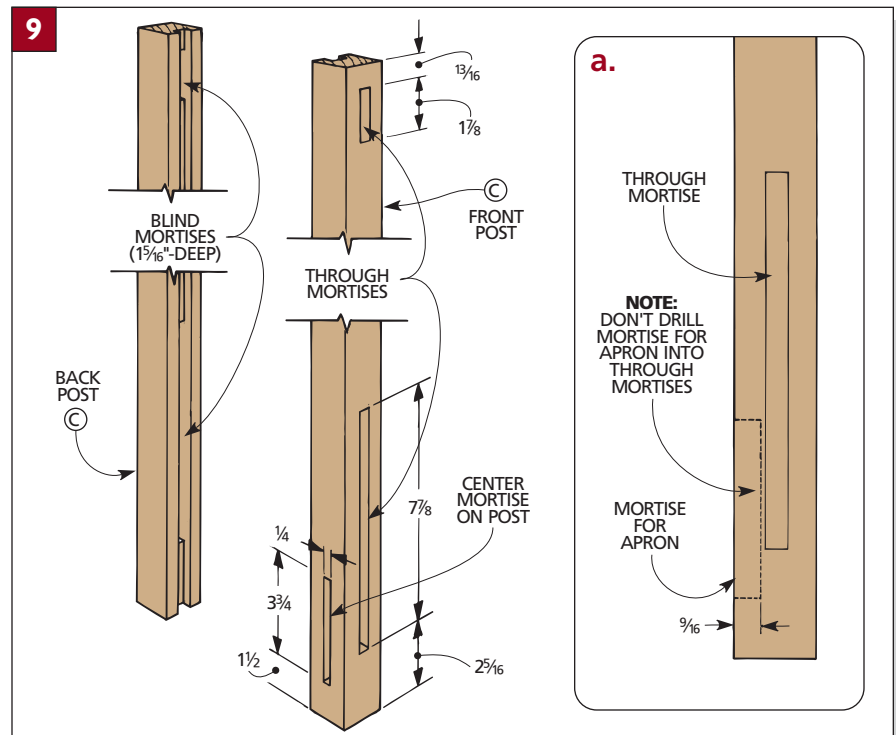
All the mortises are the same width as the grooves for the panels. This makes the setup easy. Just position the post so a 1/2"-dia. drill bit is centered in the groove. Then clamp a fence to the drill press table so it's against the post.

BLIND MORTISES. After laying out each mortise, I drilled the blind ones in the back posts first (*Fig. 9*). (Drill them 1 5/16" deep to allow 1/16" for excess glue.)

THROUGH MORTISES. When the mortises in the back posts are complete, drill mortises through the front posts.

Note: Drill these mortises halfway through from both sides to avoid chipout.

MORTISES FOR APRON. There's one more set of mortises to cut in the front posts. An apron that joins the front posts at the bottom requires 1/4"-wide by 9/16"-deep mortises (*Fig. 9*).



RAILS & APRON

Before the side units can be put together, there must be some way to connect them. So next I cut out the pieces that connect the units.

CUT TO SIZE. Begin by cutting two back rails (F) and a front rail (G) to size (Fig. 10). Then cut out a front apron (H).

Note: The width of this apron should match the mortises in the posts — the apron doesn't have a top or bottom shoulder (refer to Fig. 15a).

RABBETS. To hold these pieces, I rabbeted some of the side unit pieces. First, each top side rail (D) is rabbeted on the top inside edge to hold the front rail (Figs. 10b and 11).

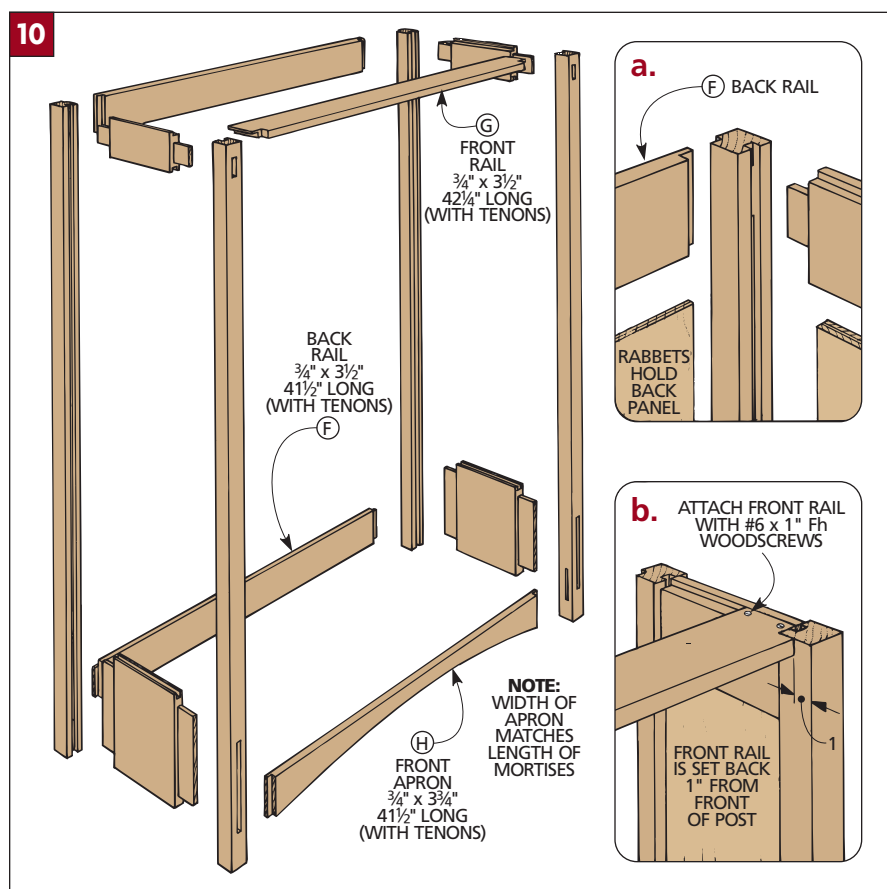
Then the two back posts (C) are rabbeted on the back inside edges to hold the back rail and the back panel (added later) (Figs. 10a and 12).

The back rails (F) also hold the back panel in place. So, I rabbeted the back edges of these rails too (Fig. 13).

Note: All these pieces don't end up identical — they're actually *mirrored*. So to keep them straight, mark the pieces before you cut the rabbets.

TONGUES. The next step is to cut tongues on the pieces that will connect the side units (Fig. 10). Rabbet the ends of the back rails (F) and the front rail (G) (Figs. 13 and 14). The tongues should fit the rabbets in the side pieces.

After these rabbets are cut, the front rail needs to be notched at the front cor-

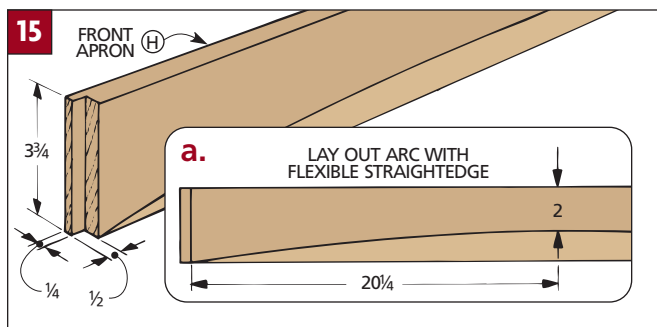
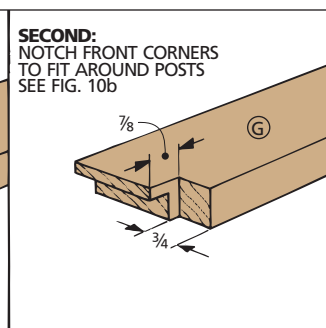
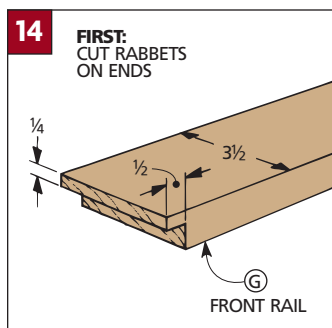
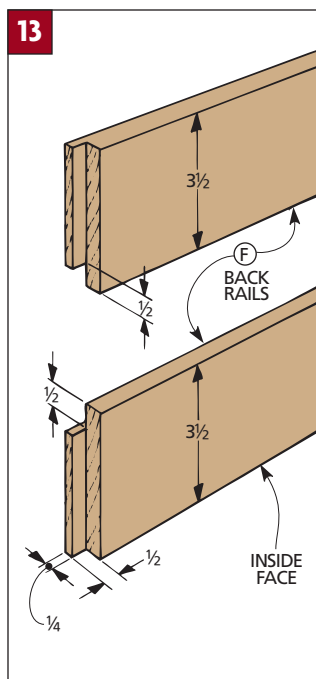
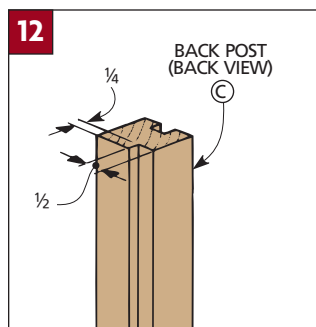
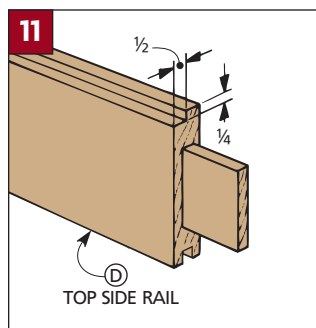


ners so it will fit around the front posts (Figs. 10b and 14). When in place, the rail should set back 1" from the front. This allows the rail to act as a door stop.

RABBET APRON. The last piece to rabbet is the front apron (H) (Fig. 15).

Again, you're creating tongues on the ends. But this time, they fit the mortises in the posts.

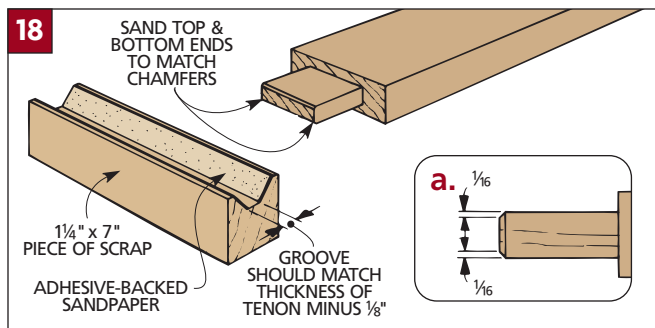
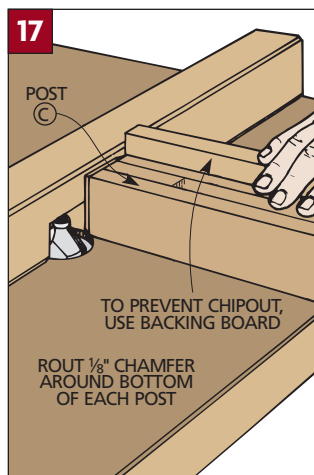
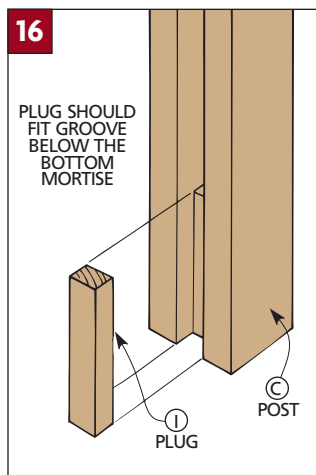
The apron also has a gentle arc on the bottom that can be laid out and cut at this time (Fig. 15a).



CASE ASSEMBLY

The bookcase is almost ready to be assembled. But first, I added some small details.

The first step is to fill the grooves at the bottom of the posts (Fig. 16). To do this, I cut a plug (I) to fit each groove.



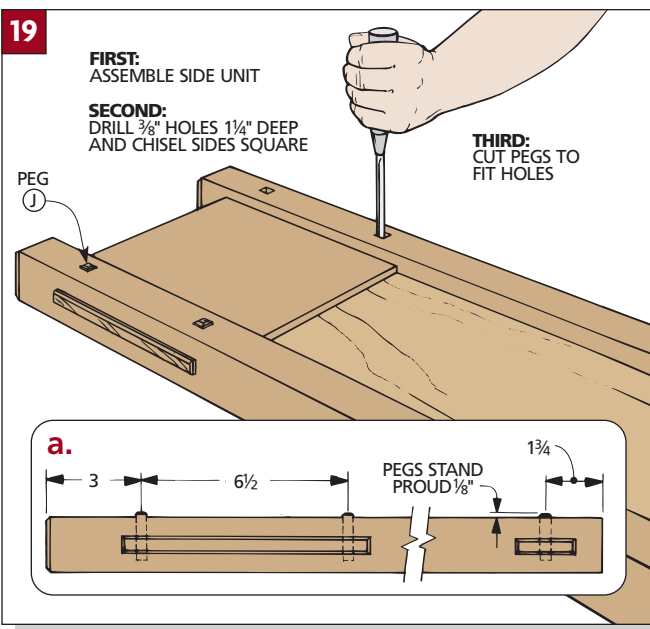
also helps minimize splintering if the case should ever be dragged across the floor.

Another thing I did was to sand

chamfers on the ends of *all* the tenons. This “dresses up” the through tenons, giving them a finished look. And on the tenons that fit the blind mortises, the chamfers allow room for excess glue.

SANDING BLOCK. There are a number of ways to chamfer the tenons. I decided to make a simple sanding block that chamfers both edges at the same time (Fig. 18).

To make the block, I cut a groove in a piece of scrap with the dado blade set $\frac{3}{8}$ " deep. The width should equal the thickness of the tenon minus $\frac{1}{8}$ ". This will create a $\frac{1}{16}$ " chamfer on both sides



SHOP TIP

Normally I like using a hand scraper and sanding block for scraping and sanding. But on a frame and panel, it can be hard to get right down into a corner with a scraper or typical sanding block.

Instead, I use two tools shaped for the job.

To scrape out a corner, I use a razor blade from a utility knife (Fig. 1). It works great for scraping away glue smudges and dried beads of glue.

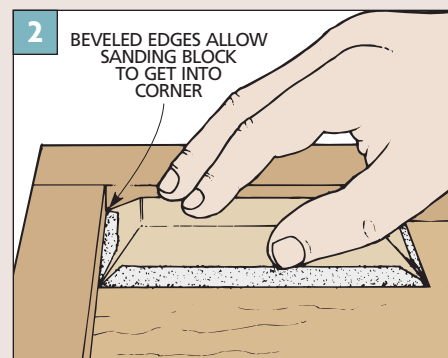
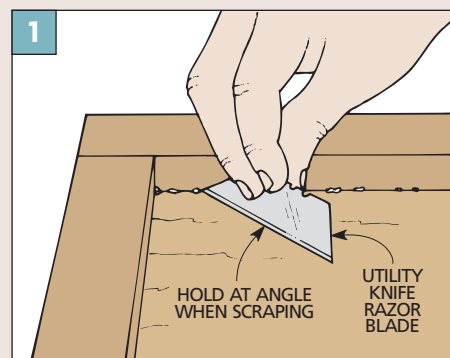
To use the razor blade, hold it at an angle and push

or pull it with the grain of the wood — just like a hand scraper. Never scrape *across* the grain. And always push or pull the

blade in the direction it's angled. (This way it won't cut into the workpiece.)

To sand a corner, I make a sanding block with

beveled ends and beveled sides (Fig. 2). The pointed ends allow me to get the sandpaper right up against the corner.



SHOP TIP

Once, a long tenon needed to be pinned in a mortise. But with improved wood glues, a peg just has to look good. Careful work is the key to this decoration.

The procedure is similar to cutting a mortise and tenon. Lay out the mortise on the outside face of the stile (Fig. 1). Then drill inside the marks to a consistent depth, and square up the corners of the mortise with a chisel (Fig. 2).

For the pegs, cut a long strip about $\frac{1}{32}$ " thicker than the width of the mortise. (You want a tight fit.) Then cut the pegs from it (Fig. 3).

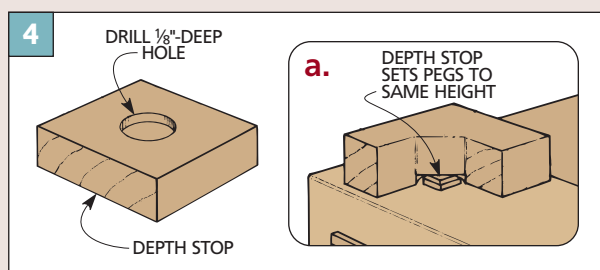
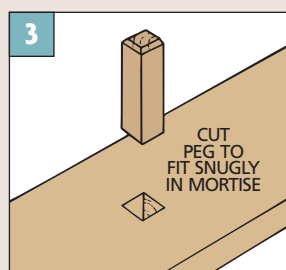
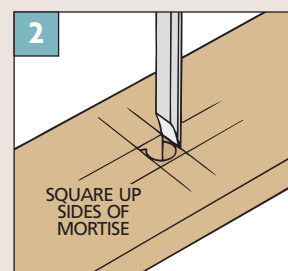
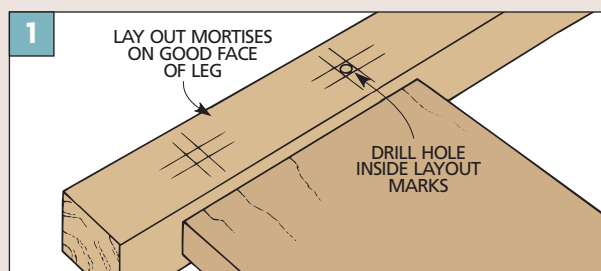
Sand the buried end of each peg to a taper, and sand a decorative chamfer

around the top end.

The pegs look best if they stick out $\frac{1}{8}$ " beyond the face of the frame. To

set the pegs at a consistent height automatically, I made a depth stop with a hole from $\frac{3}{4}$ "-thick

hardwood (Fig. 4). Then I spread glue in the holes, and used the stop to finish tapping in the pegs.



of the tenon (Fig. 18a). Next, I tilted the blade to 45° and beveled both sides of the groove.

To use the sanding block, stick adhesive-backed sandpaper on the beveled edges (or use standard sandpaper and rubber cement).

Then sand the tenons. Check them often to make sure the chamfers are consistent. After the tenon “bottoms out” on the block, sand the top and bottom ends to match, using a regular sanding block.

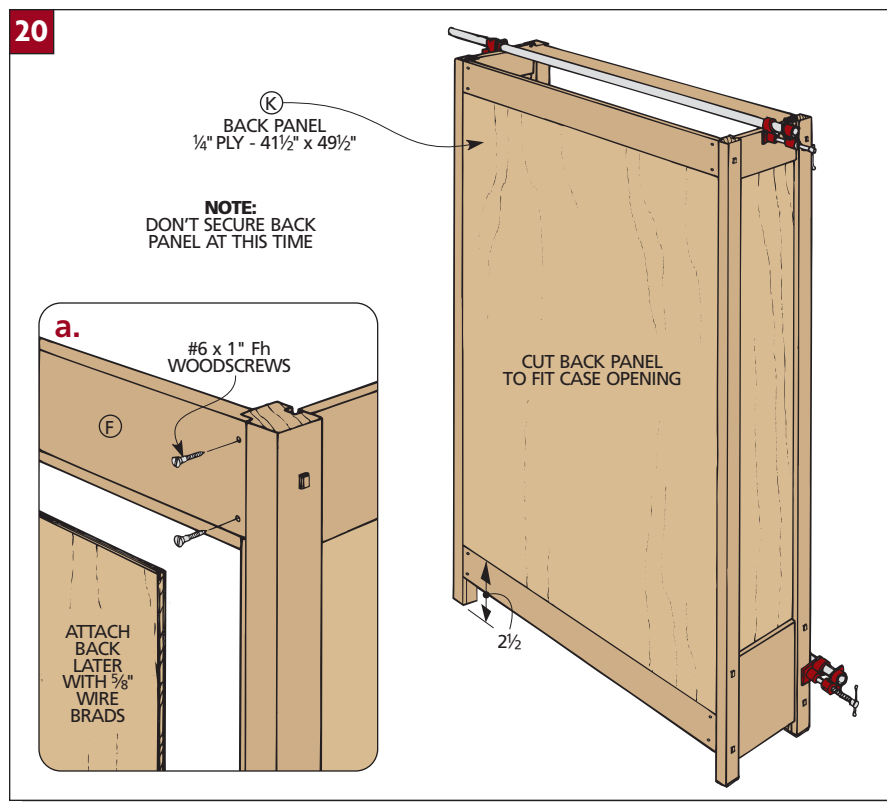
ASSEMBLE THE SIDE UNITS. To assemble the case, I began by gluing up the side units (Fig. 19).

PIN TENONS. After both side units are assembled, their tenons can be pinned (Fig. 19a and the Shop Tip box above). First, drill and square up the holes. Next, cut pegs (J) to fit them. Then glue the pegs in place so they stand $\frac{1}{8}$ " proud of the faces of the posts.

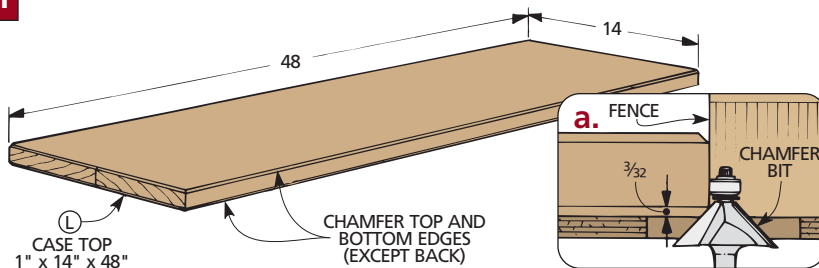
ASSEMBLE THE CASE. To connect the two side units, glue the front apron (H) between them and dry-assemble all the other rails (Fig. 20). After the front apron dries, remove each of the rails and drill shank holes and pilot holes. Then glue and screw them back in place (refer to Figs. 10b and 20a).

BACK PANEL. After the case is assembled, I cut a back panel (K) from $\frac{1}{4}$ " cherry plywood to fit in the rabbets in

the back of the case (Fig. 20). But don't nail the panel in yet. It's easier to work on the inside if it's not in place.



21



CASE TOP

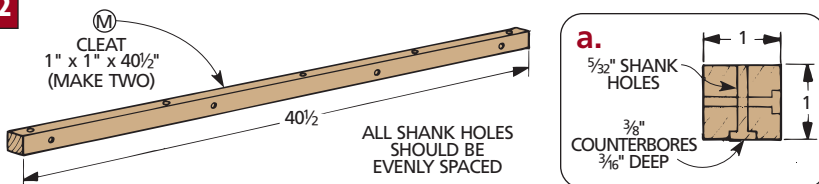
The next step is to add the case top and bottom. First, glue up enough 1"-thick stock to make both panels (Figs. 21 and 24). Now, cut the case top (L) 4" longer and 2" wider than the case (Fig. 21). Rout chamfers on the top and bottom edges (except the back) (Fig. 21a).

In the front, the case top is screwed to the front rail (refer to Fig. 23a). In the back it's secured with a cleat.

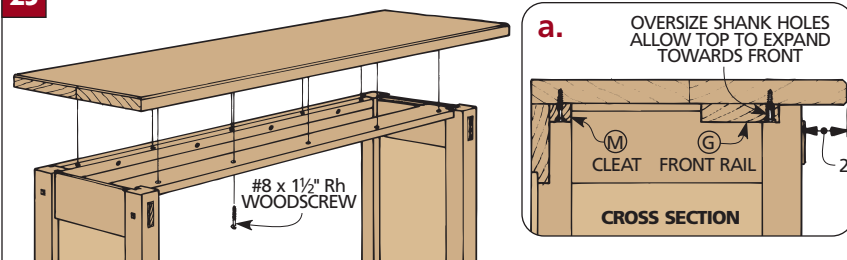
CLEAT. First, cut the cleat (M) to fit between the back posts (Fig. 22). (Make two — you'll use one for the bottom shelf later.) Then drill two sets of counterbored shank holes in the top cleat (Fig. 22a). One set is used to attach the cleat flush with the top edge of the back rail. The other will secure the top.

A 14"-wide top will expand and contract quite a bit with seasonal changes in humidity. So rather than fight it, I decided to allow the panel some freedom to move by drilling oversize shank holes in the front rail. This way, the case top stays flush with the back of the case, but it can still expand toward the front without splitting.

22

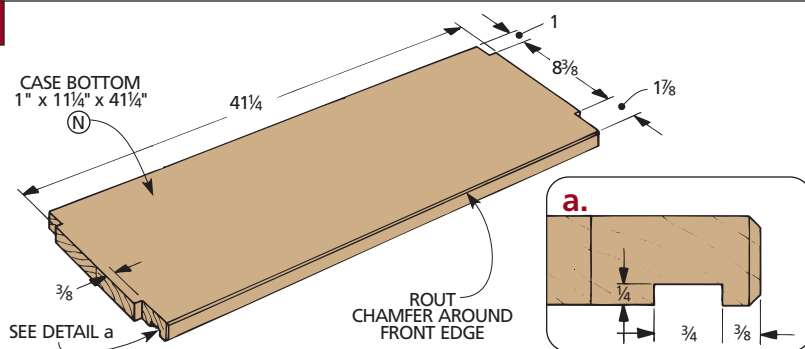


23



BOTTOM

24



The bottom of the case involves a bit more work than the top. Begin by cutting the case bottom (N) to fit between the side panels (A) (Figs. 24 and 25).

NOTCHES. To fit in the case, each corner must be notched (Fig. 25). The notches at the front corners are 1/8" wider (1 7/8") than the posts (Fig. 24).

The notches at the back are only 1" wide (Fig. 24). This creates a tiny gap so the bottom can expand toward the back (refer to Fig. 25a).

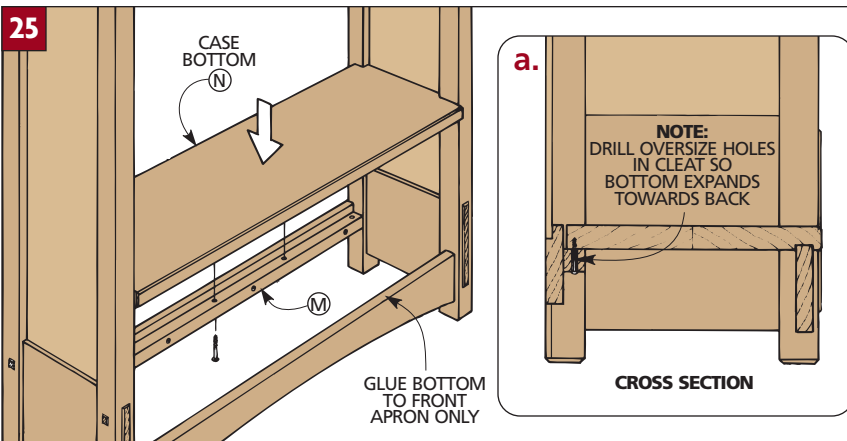
Note: To get a clean cut, I first scored the notches with a razor knife. Then I used the miter gauge with an auxiliary fence and cut them with the panel standing on edge.

GROOVE. The next step is to cut a groove on the case bottom to fit over the front apron (Fig. 24a). Then, rout a chamfer around the front edge.

CLEAT. Like the case top, the bottom requires a cleat (M) (Figs. 22 and 25). But there are two differences. First, the cleat isn't flush with the back rail. It's 1" down from the top.

Also, the shank holes should be slightly oversized to allow for movement (Fig. 25a).

25



DOORS

You might want to add the shelves next. But to position the top shelf so it hides behind the dividers in the doors, it makes sense to build the doors first.

FRAMES. To begin, cut 1"-thick door stiles (O) and upper (P) and lower door rails (Q) to fit the case opening (*Fig. 26*).

Note: The final size of both doors should allow a 1/16" gap between the case and the doors on all four sides.

The door frames are joined together with mortises and tenons (*Fig. 26*).

After each frame is assembled, rabbet the back for the glass (*Fig. 27*). Then chisel the corners square.

DOOR DIVIDERS. All the dividers in the doors are more for appearance than anything else. That's because the glass for each door is installed in one large piece — not individual panes.

To make the door dividers, first cut the 1/2"-thick horizontal dividers (R) and long vertical dividers (S) to fit between the rabbets in the frames (*Figs. 28 and 29*). Then cut the short vertical dividers (T).

HALF LAPS. The dividers are joined to the door frame and to each other with half laps (*Figs. 28a and 28b*). So first, I rabbeted the ends of all the pieces.

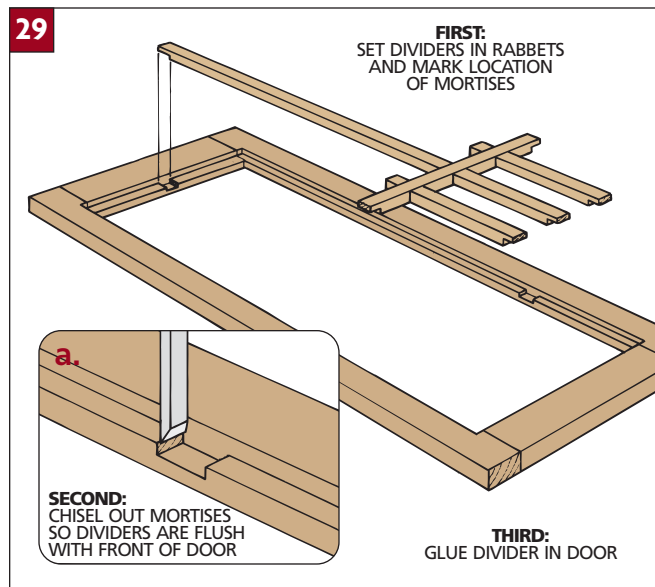
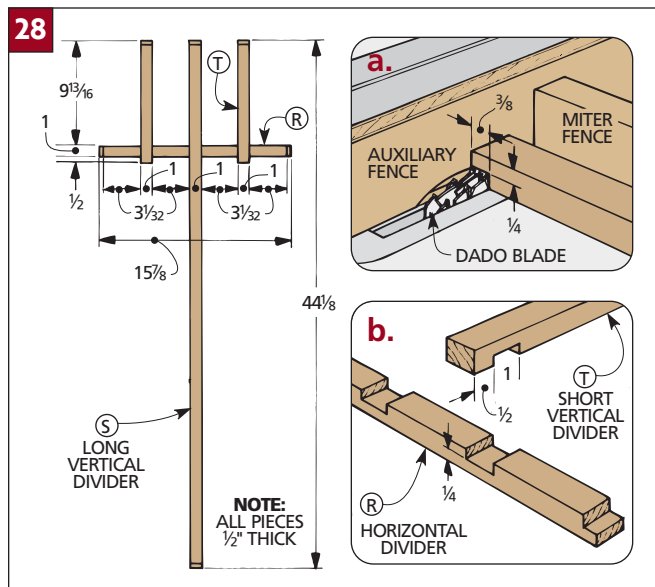
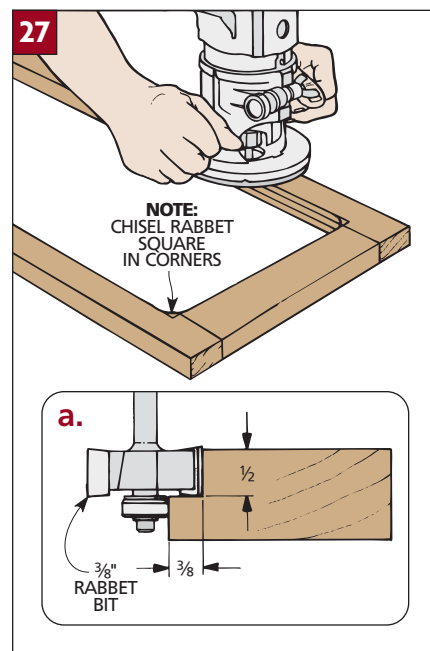
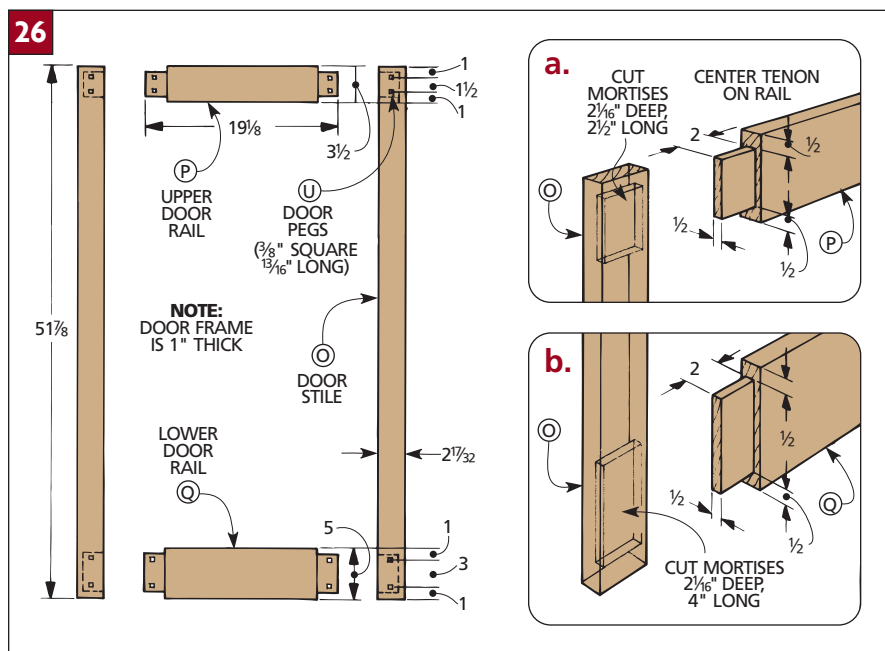
Note: Just rabbit one end of the short vertical dividers.

Next, I cut half laps in the horizontal dividers (*Fig. 28b*). Then I cut the mating half laps in the vertical pieces (on the face opposite the rabbet).

DIVIDER ASSEMBLY. Now, glue the dividers together. Then set the assembly in the rabbets in the door frame and mark the location of each divider (*Fig. 29*).

To get the assembly flush with the front of the door, you'll need to cut mortises in the rabbets (*Fig. 29a*). Once they fit, glue them in place.

PEGS. To complete the doors, pin each tenon with two door pegs (U) (*Fig. 26*). These are shorter than the side pegs, but still extend out $1/8"$.



DOOR INSTALLATION

At this point, the doors should fit with a $\frac{1}{16}$ " gap between the case and each door. The doors still need to be trimmed though — I didn't allow for any gap between them yet. I found it easier to mount the doors first. Then come back later and remove and trim them to create the center gap.

MOUNT HINGES. The ball-tipped hinges I used created a $\frac{1}{16}$ " gap when mortised and mounted flush with the posts and the doors.

To mount the hinges, first lay out their locations on the posts and the doors (*Fig. 30*). Then cut out most of the waste with a router. And clean up the shoulders with a chisel.

After drilling pilot holes, you can install the hinges and mount the doors in place (*Fig. 30b*).

TRIM DOORS. Now the center stiles of each door can be trimmed. To do this, determine how much needs to be trimmed to create a $\frac{1}{16}$ " gap. Then, to keep the doors identical, I removed them and planed the same amount off each door. (I used a hand plane, but a jointer will also work.)

ADD CATCHES. Next, reattach the doors and mount the catches to hold them closed. Since any door can have a tendency to twist, I installed double-ball catches at both the top and bottom of each door (*Figs. 30a and 30c*).

REMOVE DOORS. To add the door pulls and the glass, I found it easiest to remove the doors once again. But first, I marked the position of the horizontal dividers on the inside faces of the corner posts (*Fig. 30*). (Later, these marks will show you where to position the top shelf.)

ADD DOOR PULLS. At this point I added the door pulls. To do this, first I cut a mortise in the front of each door to accept a pull (*Fig. 31a*). Then I made my own door pulls (V) (see the Shop Tip box on the opposite page) and glued them into the mortises.

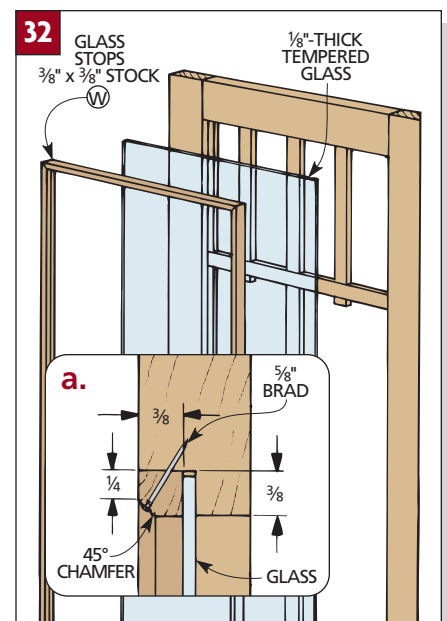
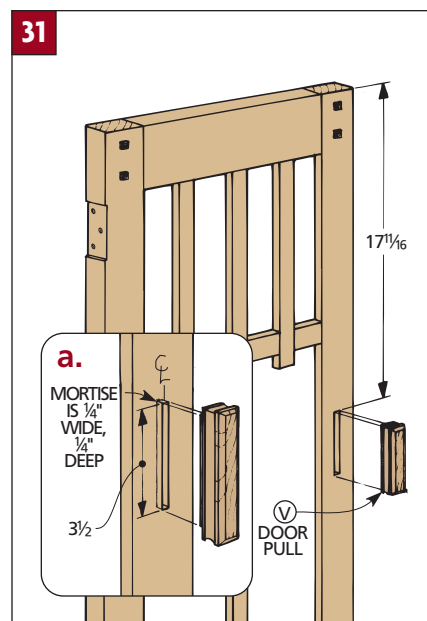
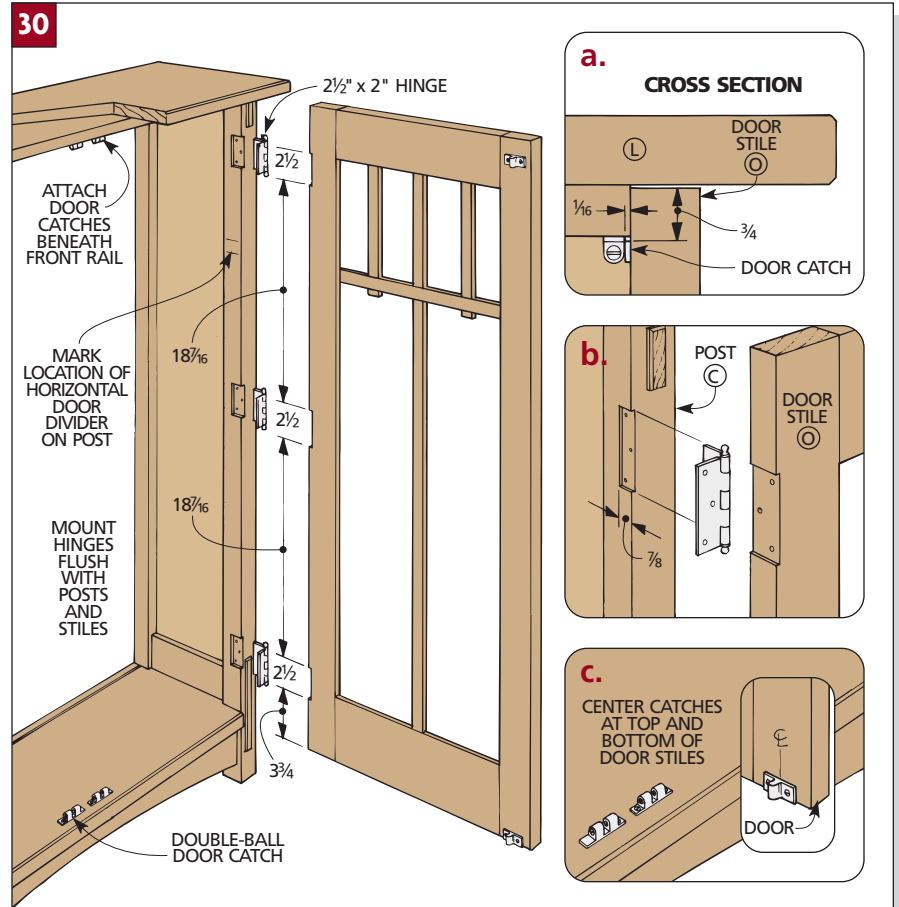
GLASS STOPS. All that's left to add to the doors is the glass. Of course you don't want to add the glass until after the case has been finished, but now is a good time to cut the glass stops (W).

The glass stops are cut to finished dimensions of $\frac{3}{8}$ " x $\frac{3}{8}$ ". Then a 45° chamfer is cut along one corner to provide a flat face to nail $\frac{5}{8}$ "-long wire brads into (*Fig. 32a*).

The safest way to make these glass stops is to start with an extra-wide ($1\frac{1}{2}$ ") blank and rout the chamfer first. Then come back and rip the pieces to final width ($\frac{3}{8}$ ") off the waste side of the blade.

The glass stops are mitered at the

corners (*Fig. 32*). It's tougher to remove mitered stops later, but they look better than butt joints. To determine the correct lengths, I find it's easiest to measure for each one individually and then creep up on the final cut until they just fit.



STANDARDS & SHELVES

At this point, you're almost done with the bookcase. The shelves are all that are left. They rest on spoon-style shelf pins that fit into shelf standards.

SHELF STANDARDS. To make the standards, start by cutting four $\frac{5}{8}$ "-thick shelf standards (X) to fit between the top and bottom side rails (Fig. 33).

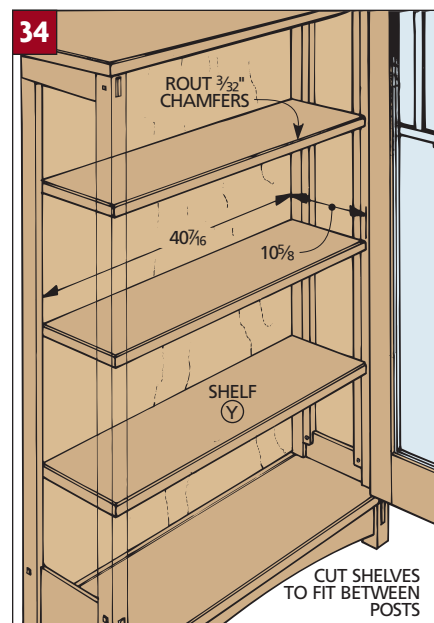
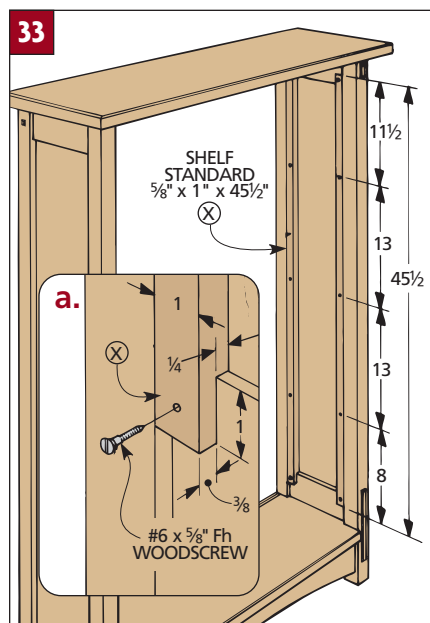
Note: Add 2" for the rabbets that will be cut on the ends.

Now, cut a 1"-long rabbet on both ends of each standard (Fig. 33a). Set the standards in place and mark the position of the top shelf (Fig. 34). (It should line up behind the horizontal door dividers.)

SHELF PIN HOLES. Before attaching the standards to the sides, drill the holes for the shelf pins (Fig. 33). (You can drill additional holes if you want. This will allow you to adjust the positions of the shelves later.)

SHELVES. For the shelves (Y), glue up three 1"-thick shelf blanks and cut them to length so they fit loosely between the corner posts ($\frac{1}{16}$ " less) (Fig. 34).

To determine the width of the



shelves, measure from the rabbet for the back panel to the back of the door. Then subtract $\frac{1}{8}$ ". In my case, this came out to be $10\frac{5}{8}$ ".

Note: The important thing is that the shelves aren't tight against the back of the door.

Finally, chamfer the top and bottom edges of the shelves and set each of them in place.

BACK PANEL. The last step on the bookcase before finishing is to install the back panel that you cut earlier. To do this, I used $\frac{5}{8}$ " wire brads.

SHOP TIP

Stickley's furniture company made all of its own hardware. While I didn't make my own hinges or door catches for the bookcase, I did make the wooden door pulls.

The pulls are cut from an extra-long blank of $\frac{3}{4}$ "-thick cherry (Fig. 1). The extra length makes the blank safer to work with.

The first step in shaping the pulls is to rout a chamfer around each end of the blank (Fig. 2).

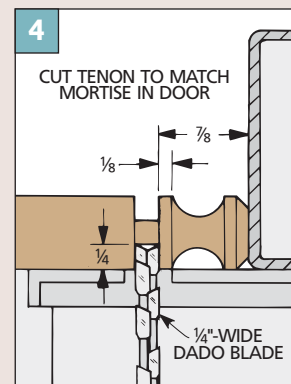
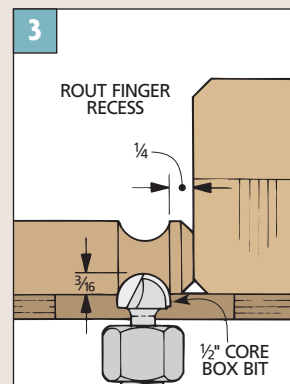
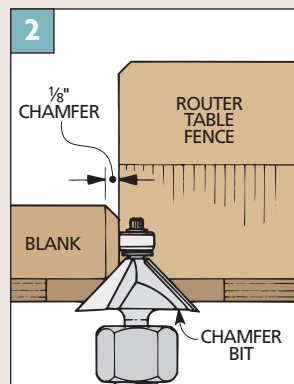
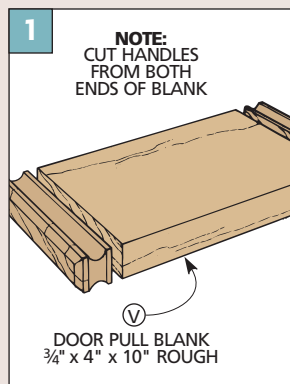
Next, rout a cove around each end using a $\frac{1}{2}$ "-dia. core box bit (Fig. 3).

Now, before cutting the pulls from the blank, form tenons to fit the mortises in the doors (Fig. 31a on the opposite page).

Since the tenon is in the middle of the blank and not at the end, this cut looks a little odd. Just cut or rout dados around the blank (Fig. 4).

All that's left now is to sand the pulls smooth and cut them from the blank.

Then glue them into the mortises in the doors.



Shop-Built Door Pulls

JOINERY *Through Mortise and Tenon*

One of the strongest joints you'll find on a project is a mortise and tenon. And a *through* mortise and tenon joint not only gives you a strong joint, but a decorative one as well.

When the tenon is glued into the mortise, the two fit together like the handle in the head of a hammer (see photo). The end grain on the tenon is a decorative contrast to the long grain on the sides of the mortise.

PERFECT FIT. The main reason for gluing a long tenon into an open mortise is usually appearance. And for the best appearance, the parts of the joint have to be cut perfectly.

If there are any gaps where the tenon comes out of the mortise, it will be apparent — but it probably won't be the look you were expecting. That's why I follow a specific sequence when cutting a through mortise and tenon.

SEQUENCE. Does that mean a through mortise and tenon joint is made differently than a traditional blind mortise and tenon? Not exactly. The mortise is usually cut first, then the tenon is cut to fit the mortise. So far, no difference. But because the fit of the joint is so important, I take a couple extra steps as is explained on the following pages.

Note: Sometimes there's a good reason to reverse the sequence and cut the *tenon* first. (The Mission bookcase is an example. Refer to page 76.) But the cutting operation is the same.

OPTIONS. Like an ordinary mortise and tenon joint, a through mortise and tenon joint has some options. For one, the leg is often thicker than the rail (see photo above and the drawing at right).

But this is primarily a design decision — the parts could just as well be the same thickness.

And how far beyond the leg should the tenon stick out? It could be flush to the outside of the leg (right in photo) or stand a little proud with chamfered edges (left in photo). Again, it's mostly a design decision.

Finally, a through mortise and tenon joint is often pinned with small wood pegs through the cheeks of the tenon (left in photo). In the past this was done to lock the tenon in the mortise to create a stronger joint. But with the improved glues available today, the



pegs are mostly for appearance. (See page 79 for more on installing pegs.)

HOW THE JOINT WORKS

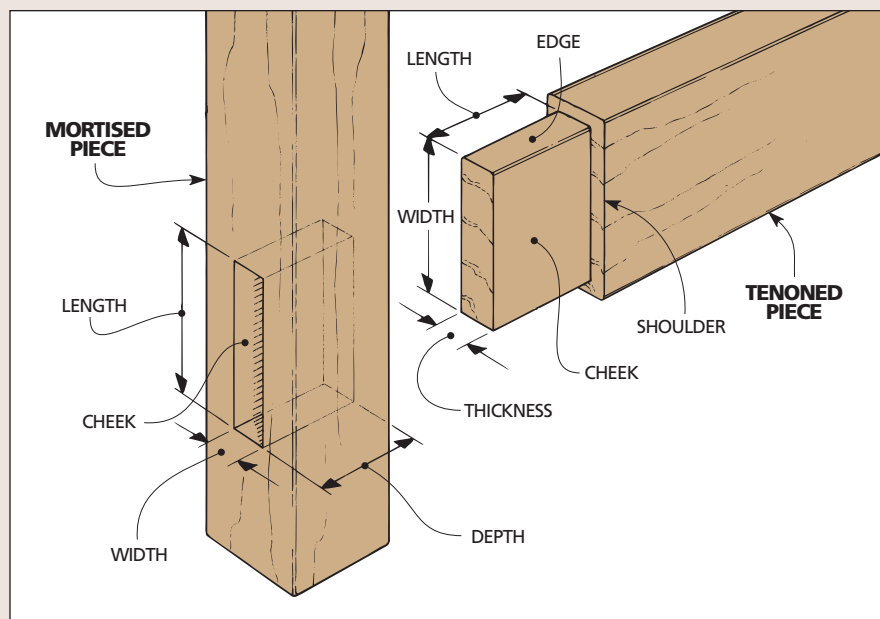
There's more to a through mortise and tenon joint than one piece of wood sticking through another. If the parts fit together properly, the joint is strong in several directions. And of course, it looks good too.

The load-bearing strength of the joint comes from the bottom edge of the

tenon resting in the bottom of the mortise (see drawing). It's what supports a panel in a frame or a top on a table.

The shoulders around the tenon give the joint resistance to racking and twisting — and hide imperfections.

Probably the strongest part of a through mortise and tenon joint is the fit between the cheeks of the tenon and the cheeks of the mortise. When properly glued, the bond between the cheeks of the two pieces will produce a joint that's practically unbreakable.



CUTTING THE MORTISE



The key to cutting a perfect through mortise is uniformity. The tenon opening should have very straight edges to fit tight around the tenon.

Here are a couple tips — and a guide — to make cutting a perfect mortise easier.

LAY OUT ENDS. I start by laying out (marking) the mortise on the *outside* face of the workpiece (*Step 1*). To do this, first use a try square and a sharp pencil to draw a line indicating the top and bottom edges of the mortise. Then use a square to extend these lines around to the opposite (inside) face.

MARK SIDES. Next, I mark the sides of the mortise. And for the most accuracy on the sides, I don't use a pencil. Instead, I make the marks using a chisel, a mallet and a shop-made guide

block (*Step 1*). (Again, make the marks on the face of the workpiece where the end of the tenon will show.)

The guide block I use is simply a squared-up wood block with a shallow rabbet cut along one edge. As simple as it is, the block is surprisingly helpful.

The block helps to mark a perfectly straight line for the sides of the mortise. And after the mortise has been roughed out with a drill bit, it helps hold a chisel straight up for cleaning up the mortise.

SETTING OUT. There's a trick I use to help ensure crisp, clean edges on a through mortise. The trick is called "setting out."

To set out a mortise, first chop straight down on the chisel holding the back of the chisel tight to the guide block (*Step 1*).

After marking the perimeter of the mortise, remove the guide block and make a second angled chisel cut that intersects with the first (*Step 2*).

Then remove all the little three-sided

slivers from the edges of the mortise.

Now you should be able to see the outline of a perfect through mortise. All that's left is to clean out the waste.

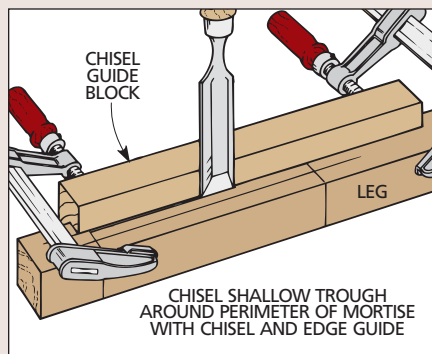
BORE HOLES. At this point the mortise could be chopped out by hand. But it saves a lot of time (especially for deep mortises) to rough out most of the waste using the drill press (*Step 3*).

To rough out the mortise, I use a Forstner bit *smaller* than the width of the mortise and drill a series of overlapping holes between the score marks.

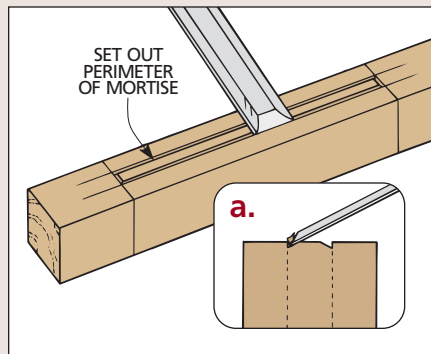
Note: For the cleanest mortise, bore halfway from each side (*Step 4*).

CHISEL CLEAN. The overlapping holes will leave a series of "ripples" in the mortise. To remove these ripples and also complete the mortise, I use a chisel and the guide block to pare the sides of the mortise (*Step 5*). (Again, work from both sides.)

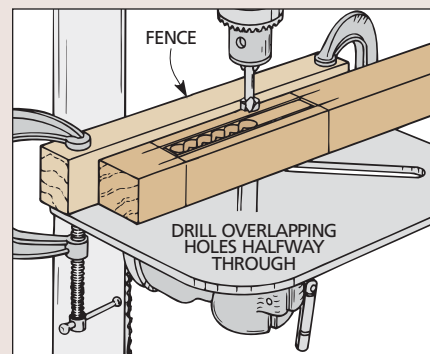
Finally, to insert the tenon more easily, I like to "back cut" the mortise slightly (*Step 5a*).



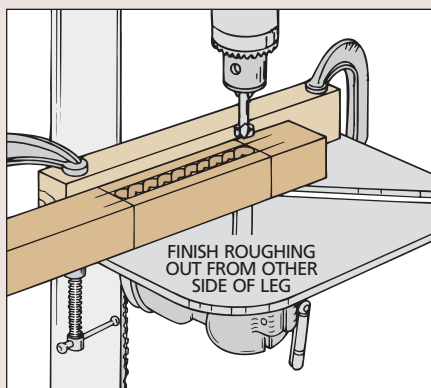
1 First mark ends of the mortise using a try square and pencil. Then make a block for marking the sides with a chisel.



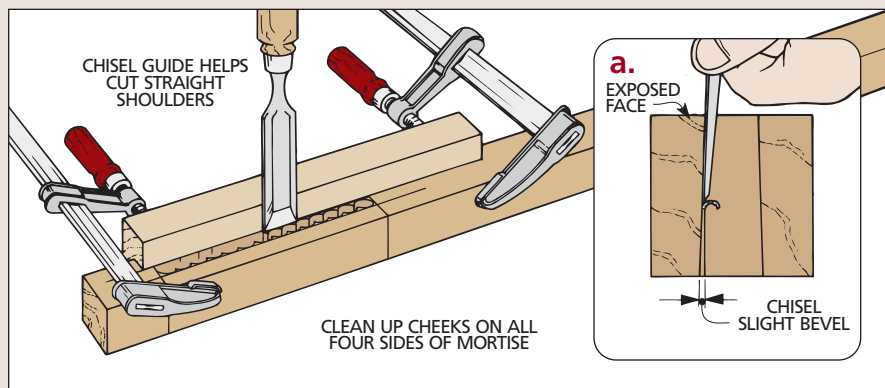
2 After scoring sides with a chisel, "set out" the mortise by chiseling a slight bevel inside score lines. Set out ends too.



3 Rough out mortise by drilling a series of holes inside the score lines. Use a Forstner bit smaller than the mortise.



4 Finish roughing out the mortise from the opposite side of the workpiece. But keep the same face against the fence.



5 Complete the mortise by chiseling the sides of the mortise smooth and flat. Use the guide block to keep the chisel

straight up and down. After cutting from both sides of the mortise, chisel a slight bevel from the good face.

CUTTING THE TENON



A tenon can come in any shape or size. But there's only one thing that counts — how well it fits in a mortise.

One of the easiest ways to cut a tenon is to use a dado blade in the

table saw. And to help set up the saw just right, I start by cutting a tenon on a test piece. (Use a piece of wood that's the same thickness and width as the actual workpiece.)

TEST THICKNESS. To begin work on the tenon, raise the dado blade and make a shallow cut across one end (*Step 1*). Then flip the piece and make a second pass on the opposite face.

Note: For the most control — and the cleanest cut — I cut tenons using the miter gauge with an auxiliary fence attached. This helps prevent chipout as the blade exits the workpiece.

Now check the test tenon in one of the completed mortises (*Step 2*). The idea is to sneak up on the height of the blade until the end of this short tenon fits the mortise perfectly — not too tight and not too loose.

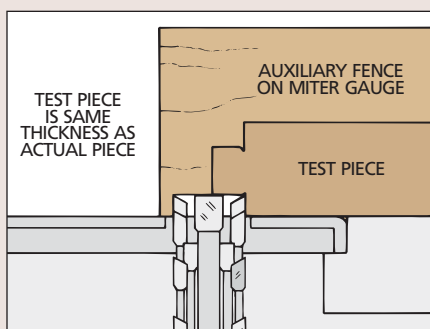
CUT CHEEKS. When the thickness of the tenon is set, the tenon can be cut to length (*Step 3*). To do this, I again use the miter gauge and auxiliary fence. But this time the rip fence on the table saw is used as a stop.

Position the rip fence so the distance between the outside of the dado blade and the fence equals the desired length of the tenon. Now, cut the tenon by making several passes over the dado blade for each cheek.

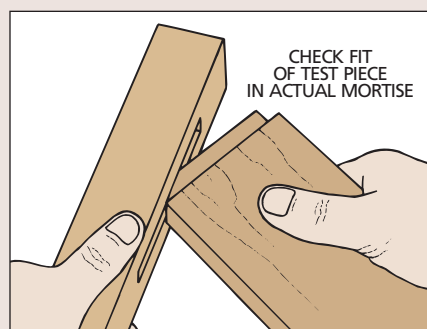
CUT SHOULDERS. The last thing to do is cut the tenon to the desired width. You may have to change the height of the dado blade to determine this width.

Note: Again, I test the height first by making cuts near the end of a test piece of the same width.

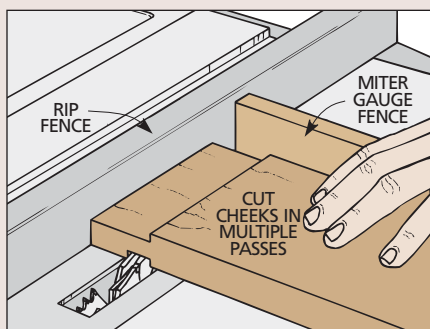
To keep the position of the tenon shoulder consistent all the way around the workpiece, I used the same fence setup as I did when cutting the tenon cheeks. The only difference is that the workpiece is stood on edge now as it passes over the blade (*Step 4*).



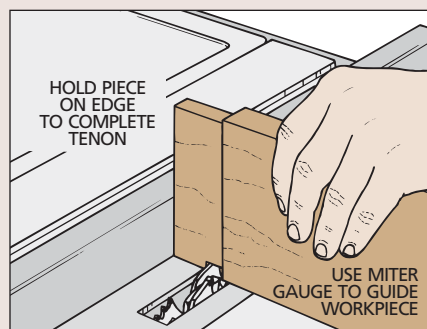
1 Begin cutting the tenon on a test piece. Sneak up on thickness of tenon by adjusting height of the dado blade.



2 Test the fit of the tenon in a mortise. If the tenon is too tight, raise the height of the dado blade and cut again.



3 When the blade is adjusted for the correct thickness, cut the tenon to the desired length. Use the fence as a stop.



4 Now the tenon can be cut to width. Don't move the fence, but the height of the blade may need to be adjusted.



Removing the doors and using blind mortise and tenon joints makes for a simpler version of the Mission Bookcase. The one shown here is also shorter than the original.

CONSTRUCTION NOTES:

■ The basic construction of this short open version is virtually the same as for the full Mission Bookcase. The main difference is that the size and number of some of the parts differ, and none of the hardware or parts for the doors are needed (see Materials List).

Note: The width and depth of this bookcase will remain the same, but the overall height will be 11" shorter (48").

■ First, the side panels (A) and panel cores (B) are cut to a length of $33\frac{3}{16}$ " (Fig. 1). (Their width is the same.)

■ To make this version simpler, you can use blind tenons on the fronts of the rails (D, E) identical to the ones on their backs (Fig. 1). This makes each rail slightly shorter (11").

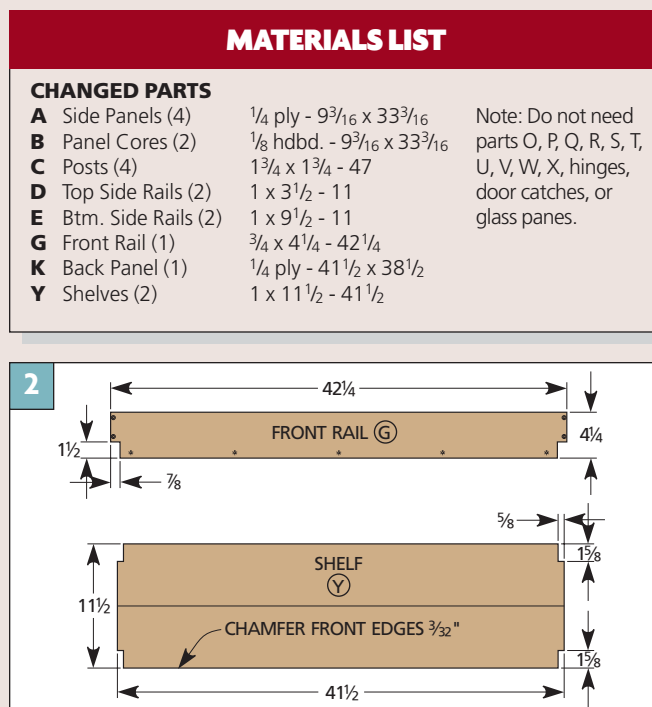
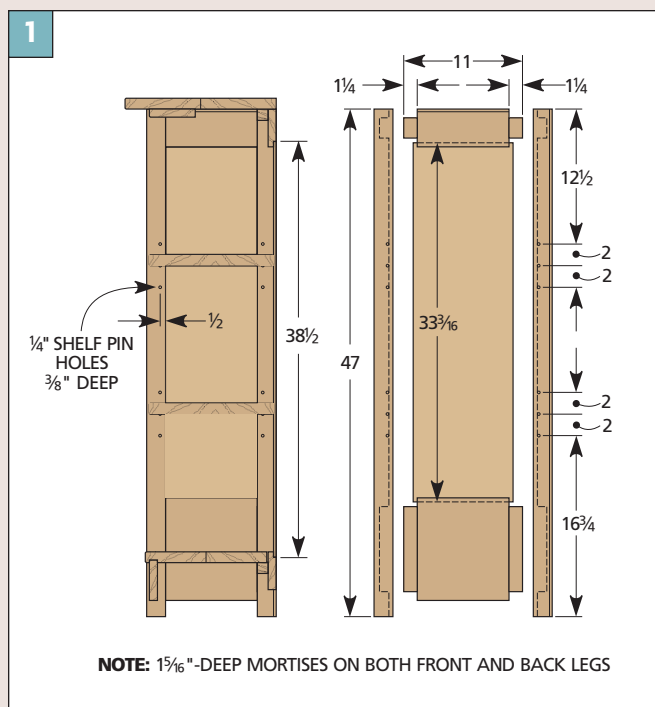
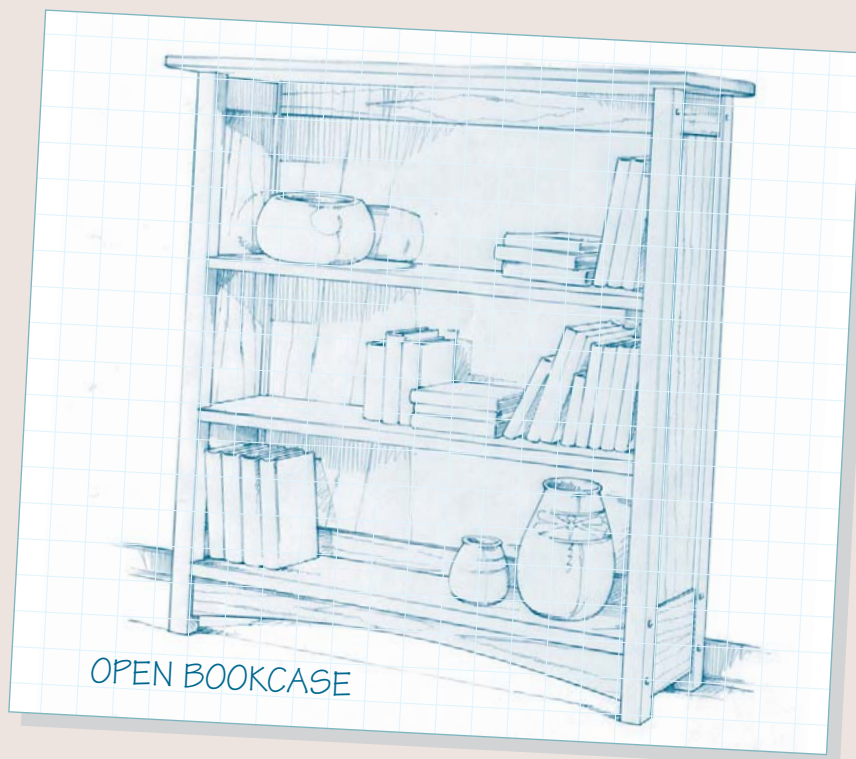
■ The posts (C) also need to be shortened for this design. They are now cut to a length of 47" (Fig. 1). And their mortises are shallower ($1\frac{5}{16}$ " deep) to accept the shorter tenons on the rails.

■ The back panel (K) is once again cut to fit the rabbets in the back of the case. (Mine ended up $38\frac{1}{2}$ " high.)

■ Finally, since there are no doors, the

front rail (G) and shelves (Y) are made wider to extend to the front of the bookcase (Fig. 2). The shelves will need notches on their front and back corners

(similar to those on the front rail) because the shelf standards (X) are removed (Fig. 1). Now you can drill shelf pin holes directly into the posts.







COUNTRY PROJECTS

The term “country” suggests a straightforward, practical style of furniture. Typically made from pine boards, it has a “down-home” feel.

So it may be surprising to see a coat rack made from oak. Its simple, decorative curves and traditional pegs give it a distinctly country look. There’s also a painted pine version.

Knotty pine is the perfect material for the high back bench and jelly cupboard. Both projects offer options that let you change the look without changing their charm.

But not all pine is knotty. Using clear pine for the dovetail chest highlights the hand-cut dovetails. Or for a different look, try the frame-and-panel version.

Coat and Glove Rack

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High-Back Bench

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Jelly Cupboard

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Dovetail Chest

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Coat and Glove Rack

Hang coats and mittens or cups and linens on this rack that features additional storage behind its door. Choose a finish that highlights the wood, or try one that turns your rack into an “instant antique.”



When I started building this project, I never considered hanging anything more than my coats and hats on it. But when a friend saw it, she insisted I build one for her. And she wanted to know if I could make it look like a well-used antique (more about that in a moment).

JOINERY. The construction of the coat and glove rack is very simple. The shelves both sit in dadoes in the sides and are then screwed in place. And the back pieces are screwed to the shelves.

DOOR. The only trick to this country coat rack is fitting the door. How do you get a uniform gap around each side? I started with the gap at the bottom — it's determined by the depth of the hinge mortises. Then after the bottom

gap is set, creating the other gaps is just a matter of trimming the door to size.

HANGING SYSTEM. The rack itself doesn't weigh that much, but when it's full of coats you want to know it will stay put. So the back is beveled and this bevel then locks into a mating cleat screwed to the wall (refer to the Shop Tip on page 94). It's strong and makes it easy to position the rack.

FINISHES. On the oak version shown here, I used an oil/varnish combination to let the wood grain show through.

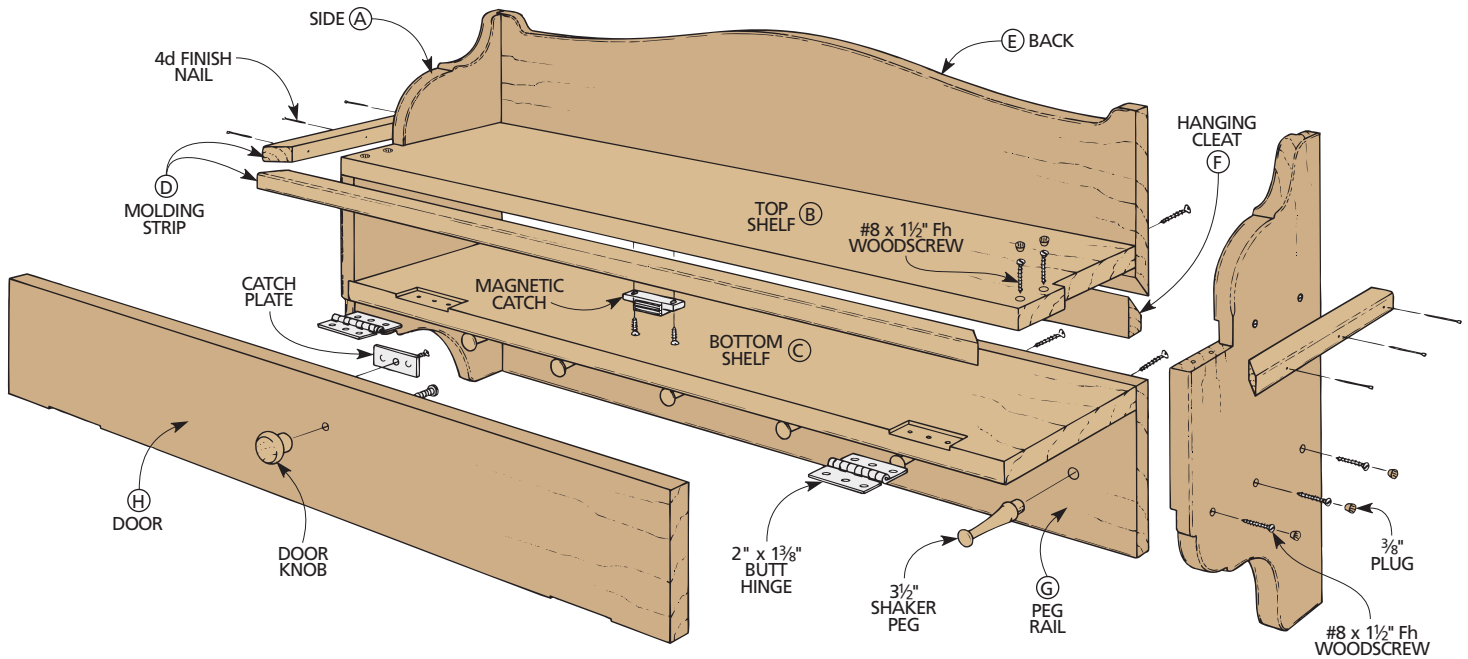
My friend wanted a more “country” look, so I built hers out of pine. And to make it a bit more rustic, I tried milk paint for a finish. (The Technique box

on page 104 tells you how to use milk paint.) Then, to make it look like it had seen years of use, I distressed the wood and finish. You can see the results (and learn more about doing this) in the Designer's Notebook on page 95.

HARDWARE AND PATTERNS. A hardware kit, as well as full-size patterns for the sides and the back, are available from *Woodsmith Project Supplies*. For more information, other sources, and finishing supplies, see page 126.

EXPLODED VIEW

OVERALL DIMENSIONS:
36W x 9D x 16H



MATERIALS LIST

WOOD

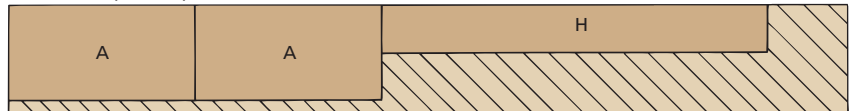
A Sides (2)	3/4 x 8 1/4 - 16
B Top Shelf (1)	3/4 x 7 1/2 - 34 1/2
C Bottom Shelf (1)	3/4 x 7 1/2 - 33 1/2
D Molding Strip (1)	3/4 x 3/4 - 60 rough
E Back (1)	3/4 x 7 1/4 - 33 1/2
F Hanging Cleat (1)	3/4 x 1 7/8 - 32
G Peg Rail (1)	3/4 x 6 1/4 - 33 1/2
H Door (1)	3/4 x 4 1/8 - 32 7/8

HARDWARE SUPPLIES

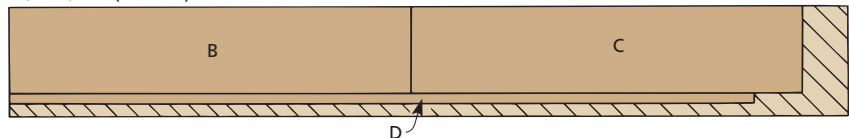
- (24) No. 8 x 1 1/2" Fh woodscrews
- (2) 2" x 1 3/8" butt hinges w/ screws
- (1) Magnetic catch and plate w/ screws
- (6) 3 1/2" Shaker pegs
- (1) 1" oak door knob w/ screw
- (10) 3/8" oak flat-top plugs
- (14) 4d (1 1/2") finish nails

CUTTING DIAGRAM

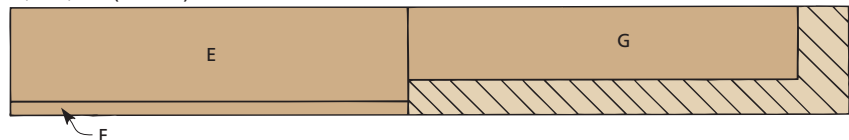
3/4 x 9 1/4 - 72 (5 Bd. Ft.)

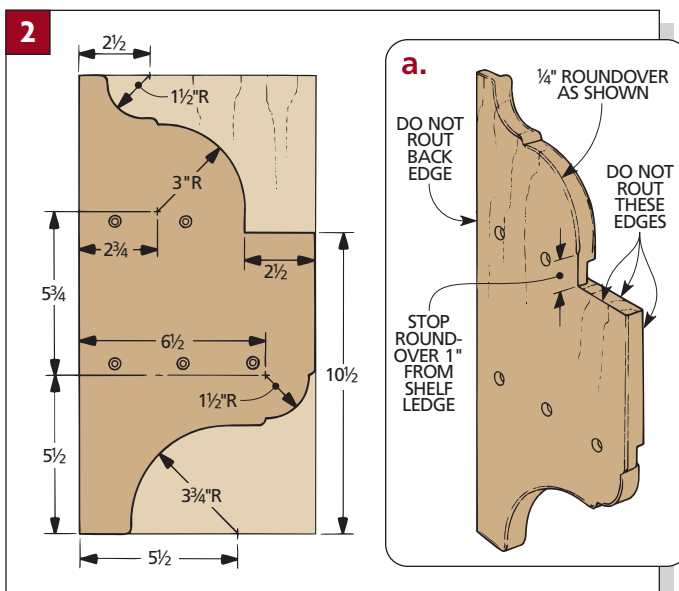
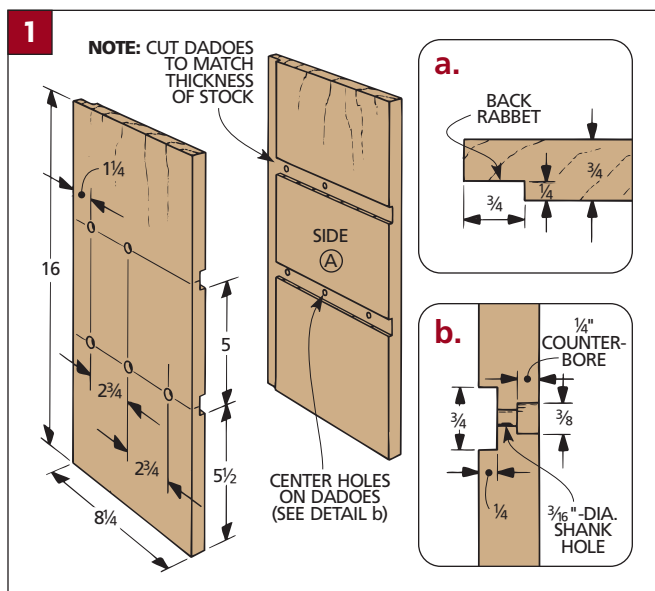


3/4 x 9 1/4 - 72 (5 Bd. Ft.)



3/4 x 9 1/4 - 72 (5 Bd. Ft.)





SIDES

The country coat rack is held together by the sides (A). Start by cutting two blanks roughly 8½" wide. Then cut them to a finished length of 16" (Fig. 1).

CUT DADOES. The shelves fit into ¼"-deep dadoes cut in the blanks (Fig. 1b). Position the first dado 5½" from the bottom edge, the second 10½".

CUT RABBETS. After cutting the dadoes, cut the rabbets for the back pieces. They're cut along the inside back edge of each blank (Fig. 1a).

Next, cut the side blanks to finished

width (8½") (Fig. 1). Doing this after cutting the dadoes cleans up any chipout. Just be sure to trim off the front edges — not the rabbeted edges.

SCREW HOLES. To screw the shelves to the sides, you'll need to drill ⅜"-dia. counterbores. They're centered on the width of each dado (Figs. 1 and 1b). (The counterbores are filled with plugs later.) Then, drill a ⅜"-dia. shank hole through each counterbore.

CUT SHAPE. To cut an identical shape on both sides (A), tape them together with carpet tape (dadoes facing in).

Now lay out the curved pattern on

one face and cut just outside the lines (Fig. 2). Then I used a drum sander and file to finish the shape.

ROUND OVER EDGES. To complete the sides, I routed ¼" roundovers on all the exposed edges except the back.

Note: To prevent gaps, don't round over the edges where noted in Fig. 2a.

SHELVES

With the sides complete, I began on the shelves. To make the top shelf look as if it extends through the sides, I added molding strips on the front and sides.

DESIGNER'S NOTEBOOK

SQUARE PEGS

■ If you want to add another interesting detail to the coat rack, try using square pegs instead of round plugs to fill the screw counterbores. The square plugs stand a bit "proud" of the surface.

■ To make square pegs, first cut a ⅜"-square blank to a rough length of 18".

■ Next, using a disc sander, shape each end of the blank to a slight pyramid (Fig. 1). Then cut off a peg about ⅜" long from each end.

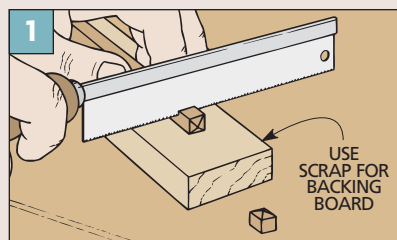
■ Repeat this procedure until you have enough pegs to fill all the holes.

■ The pegs will fit easier if you round their bottom edges with sandpaper.

■ Next, carefully square up the screw

holes using a small chisel (Fig. 2).

■ Finally, place a drop of glue in each hole and spread it around the sides of the hole. (A straightened paper clip works well for this.) Then gently tap the pegs in place.



CUT TO SIZE. To begin, rip the top shelf (B) and bottom shelf (C) to width. To find the width, measure the length of the lower dado on a side (A) (Figs. 3 and 4). Start from the shoulder of the back rabbet. (Mine were 7½" wide.)

Next, cut the bottom shelf (C) to length (33½") (Fig. 4). Then clamp the shelf between the two sides (A) and measure from the outside face of one side to the outside of the other. This will be the length of the top shelf (C) (34½" in my case) (Fig. 3).

TOP SHELF. The top shelf extends across the front edge of each side, so cut a notch out of each back corner (Fig. 3). The length of this notch equals the length of the top dado in the sides (A). (Again, measure from the shoulder of the back rabbet.)

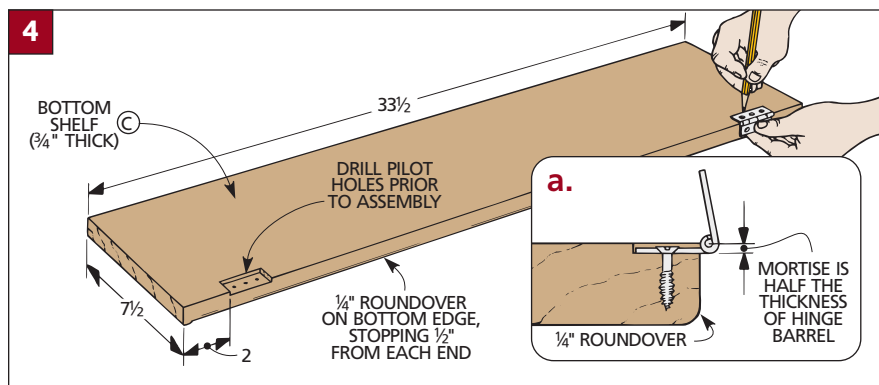
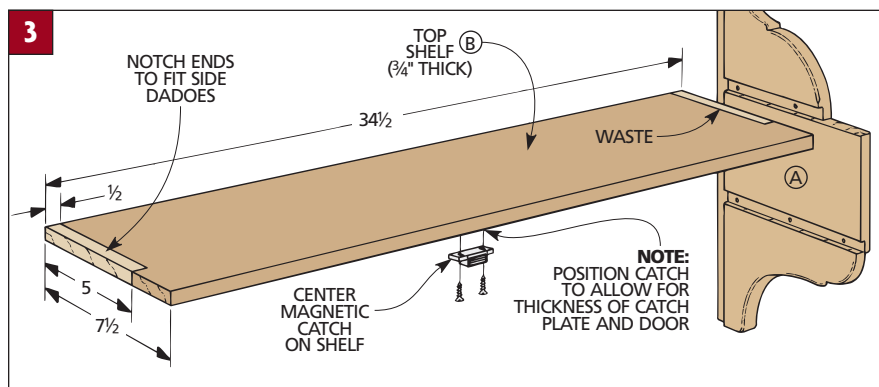
At this point, I drilled pilot holes for the door catch (Fig. 3). Inset the door catch a distance equal to the thickness of the door *plus* the catch plate. I attached the plate to the catch and positioned them ¾" in from the front edge.

BOTTOM SHELF. Next, I went back to the bottom shelf. First, lay out the locations of the hinge mortises (Fig. 4).

I wanted a uniform 1/16" gap around the door. If the hinges were mounted flush with the surface, the gap between the shelf and the door would be about 1/8". So I cut the mortise on the shelf a little deeper — to half the thickness of the hinge barrel (Fig. 4a).

After the mortises are cut, drill pilot holes for the screws. Then, round over the front bottom edge (Fig. 4a).

ASSEMBLY. At this point, dry-assemble the shelves (B, C) and sides



(A), and drill pilot holes into the shelves (Fig. 5). Then glue and screw the shelves between the sides.

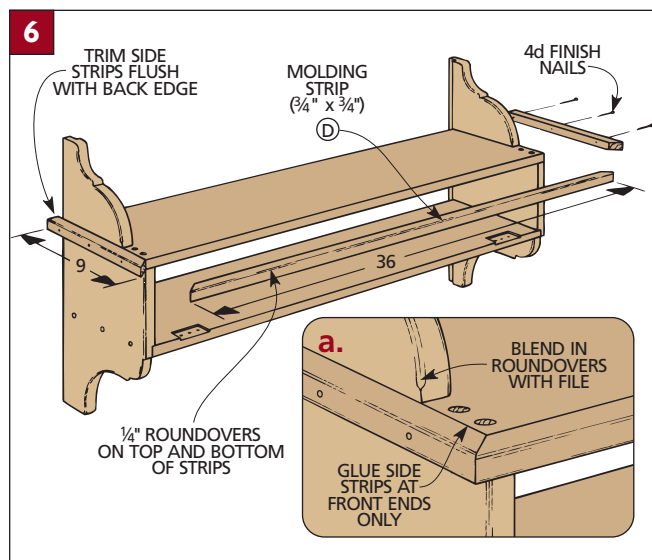
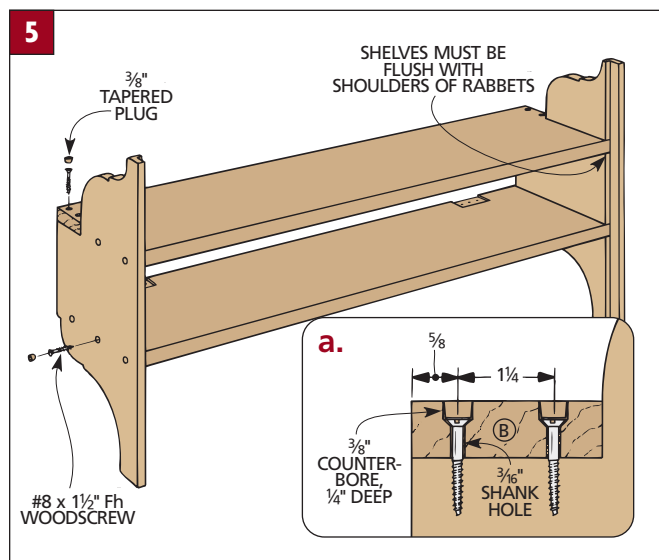
To prevent the top shelf from cupping at the front, I also drilled and screwed the shelf to the sides from the top (Figs. 5 and 5a). Then I plugged all the screw holes except those covered by the molding strips.

MOLDING. The molding strips cover the edges of the top shelf. (The thicknesses of each should match.) I started by rounding over the front edges of the

¾"-wide molding strips (D) (Fig. 6). Then I cut one 40"-long strip, plus two 10"-long strips.

For the best fit at the mitered corners, I cut the front piece first so the distance between the short points equals the length of the top shelf (Fig. 6).

After the front strip is glued on, miter the other strips to fit on the sides. But glue the strips only to the shelf, not the sides. Then nail the strips on with 4d (1½") finish nails (Fig. 6). This allows the sides to expand and contract.



BACKS

Instead of one wide back for the coat rack, it's two separate pieces. The gap between the pieces allows the coat rack to hang on a beveled cleat. See the Shop Tip at right for details.

BACK. The hanging cleat (F) is originally part of the back (E). Start by ripping the piece to a rough width of $9\frac{1}{4}"$. Next, cut it to length to fit between the rabbets in the sides (A). Then tilt the table saw blade to 45° and rip the back to a width of $7\frac{1}{4}"$ (Fig. 8). The waste piece is used for the hanging cleat.

CURVES. The next step is to lay out the curve on the back side of the back (E) (Figs. 7 and 8). Then rough out the curve with a band saw or jig saw. I used a drum sander to smooth up to the line.

PEG RAIL. The peg rail (G) makes up the lower half of the back (Fig. 10). To determine the width of this piece, measure from the top edge of the bottom shelf to the bottom of the side pieces ($6\frac{1}{4}"$) (Fig. 9). Like the back, it fits between the rabbets ($33\frac{1}{2}"$ long).

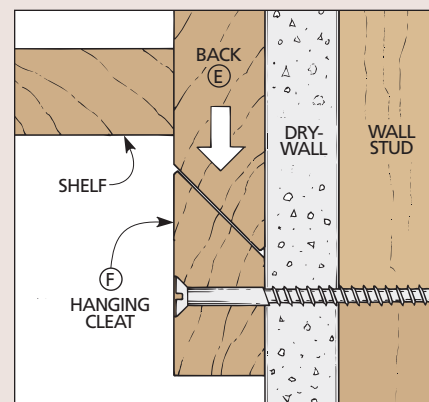
DRILL PEG HOLES. After the peg rail is cut to size, drill holes for the coat pegs

SHOP TIP Hanging System

Here's how the hanging system works. First, the back is cut to finished length. Next, a beveled cleat is ripped from one edge of the back. Then screw the cleat to a pair of studs in the wall.

After it's finished, hang the shelf on the cleat so the mating bevels interlock.

Note: This same system can be easily adapted for other styles of shelves or wall-hung cabinets.

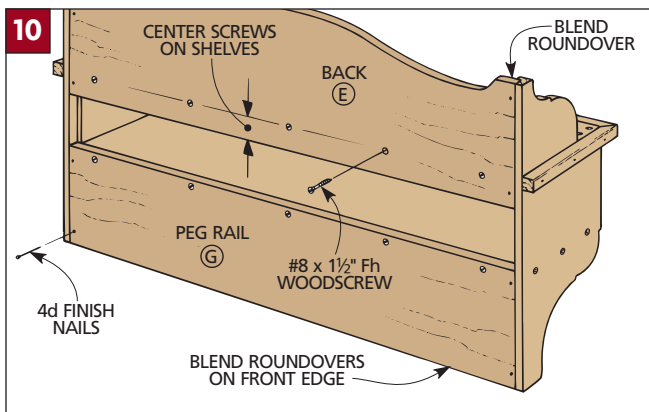
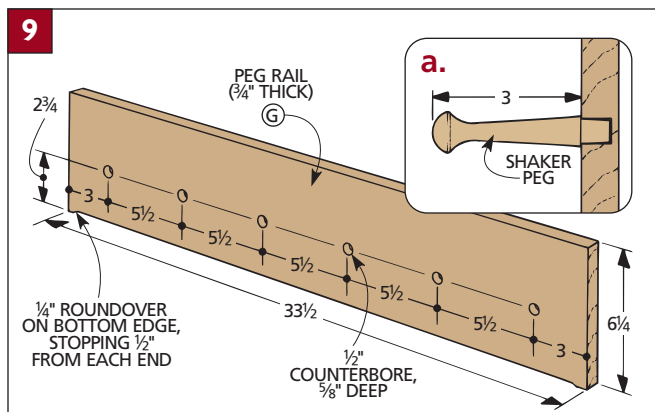
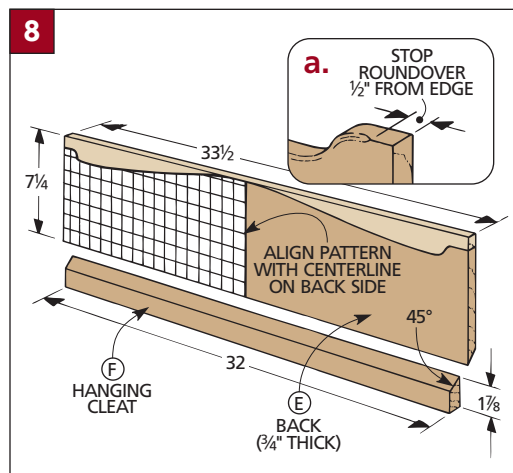
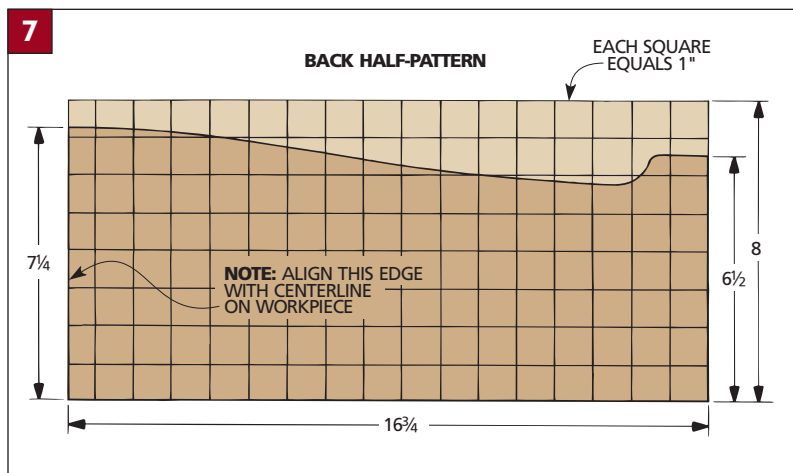


(Fig. 9). Center these holes on a line drawn $2\frac{3}{4}"$ from the bottom edge. Begin with a hole centered 3" from the end of the piece. Then drill the remaining five holes at $5\frac{1}{2}"$ intervals (center to center).

ROUT BACKS. Next, I routed a $\frac{1}{4}"$ roundover along the upper front edge of the back (E) (Fig. 8a) and the lower front edge of the peg rail (G) (Fig. 9).

Note: To prevent any gaps where the back pieces fit into the rabbets, stop the roundovers $\frac{1}{2}"$ from the ends of each piece.

ATTACH BACKS. Now, drill counter-sunk screw holes through the back pieces and into the shelves (Fig. 10). Then screw the top and bottom into the shelves. To hold the backs in tight, I nailed them into the rabbets as well.



Note: To avoid splitting the wood, I drilled pilot holes and used 4d finish nails, angling them slightly.

BLEND ROUNDOVERS. Some of the roundovers on the sides (A) and the backs (E, G) were stopped short so there wouldn't be gaps at the joints. Now that these pieces are assembled, you can finish rounding them over with a file (*Figs. 6a and 10*).

DOOR

All that's left is the door. It should have a consistent gap around each side. To get this, I cut the door to fit tight and trimmed it for an even gap later.

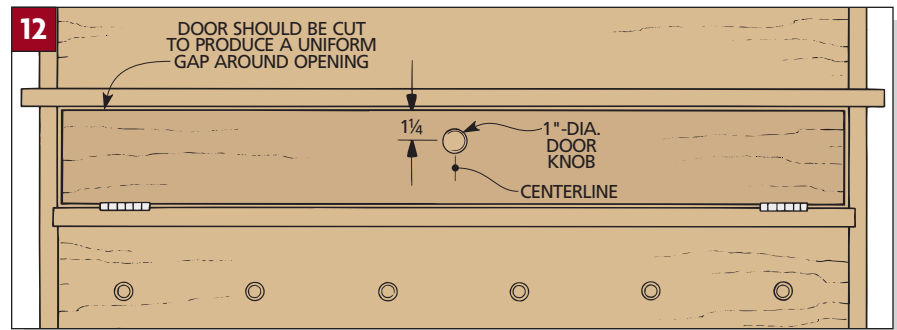
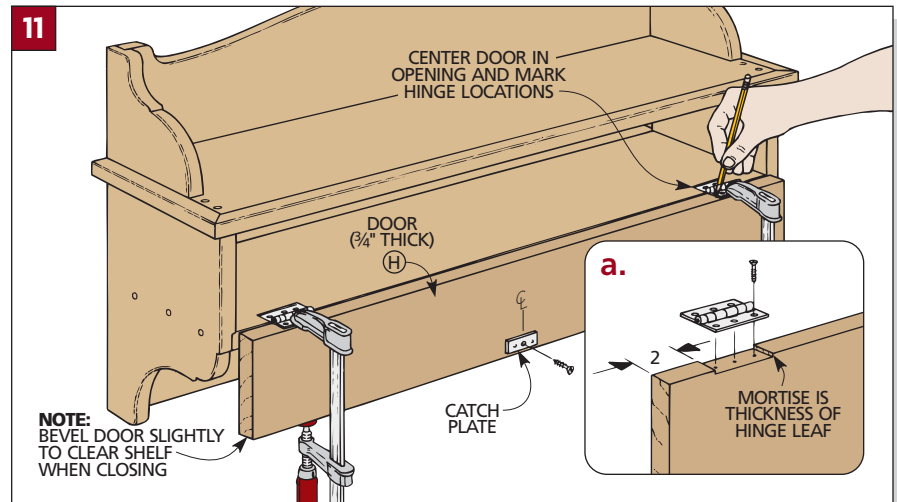
CUT DOOR. Start by measuring the opening and cut the door (H) to fit. Then rip it $\frac{1}{16}$ " narrower than the height of the opening so you can close the door when the hinges are mounted.

Now, screw the hinges to the bottom shelf. Then, clamp the door to them and mark their position (*Fig. 11*).

Note: The door should be centered across the opening.

CUT MORTISES. Next, cut the hinge mortises on the door edge (*Fig. 11a*). These mortises can be cut to the thickness of the hinge leaf.

TRIM DOOR. After mounting the door, measure the gap along the bottom and mark the door's top and sides so they'll have uniform gaps. Next, remove



the door and trim its top and sides. Then soften the edges with sandpaper.

Note: When trimming the top edge, cut a slight bevel so the inside edge of the door will clear the shelf.

DOOR KNOB AND CATCH. Finally, drill pilot holes for the catch plate and door knob (*Figs. 11 and 12*). Then apply a finish to the coat rack and mount the catch, pegs, and door knob.

DESIGNER'S NOTEBOOK



AGING/MILK PAINT

- For tips on applying milk paint, see the Finishing article on pages 104-105.
- To give the coat rack a worn appearance, sand some of the edges after painting, and round the corners that would get the most wear.
- To distress the wood and finish more, add dings and scratches. But do a little bit at a time — it can be overdone.



High-Back Bench

Choose from several options to make the bench you want. It can be built with or without storage under the seat, with your choice of designs in the back, and finished with a stain or milk paint.



Probably the first thing you notice about this bench is all the curves. And you may wonder how to cut these on such large panels. Actually, it's easy to do with a pattern, a jig saw, and a bit of sanding.

V-GROOVE. But there's another feature that helps give this high back bench its old-fashioned look. That's the V-groove between the boards in each panel. It highlights all of the joints — instead of hiding them.

I used two techniques to cut these grooves. Since the back of the bench is made up of individual boards that aren't glued together, the edges of the boards

are chamfered before assembly. Then they're held together with cleats.

But the seat and sides are glued-up panels. It's easier to cut these grooves after gluing up each panel. I did this on a table saw with the blade tilted to 45°.

WOOD. I used $\frac{3}{4}$ "-thick No. 2 Ponderosa pine for most of the bench, and straight-grained $1\frac{1}{2}$ "-thick stock for the supports under the seat.

FINISH OPTIONS. I actually built two benches just so I could try out a different finish on each of them.

The first bench (shown above) was stained to give the deep color that a hundred-year-old bench would have

acquired over time. To do this, I first applied a sealer to help the pine absorb the stain evenly. Then I used a 50/50 blend of a golden oak color mixed with a maple stain. For the top coat, I used two coats of a satin finish clear sealer.

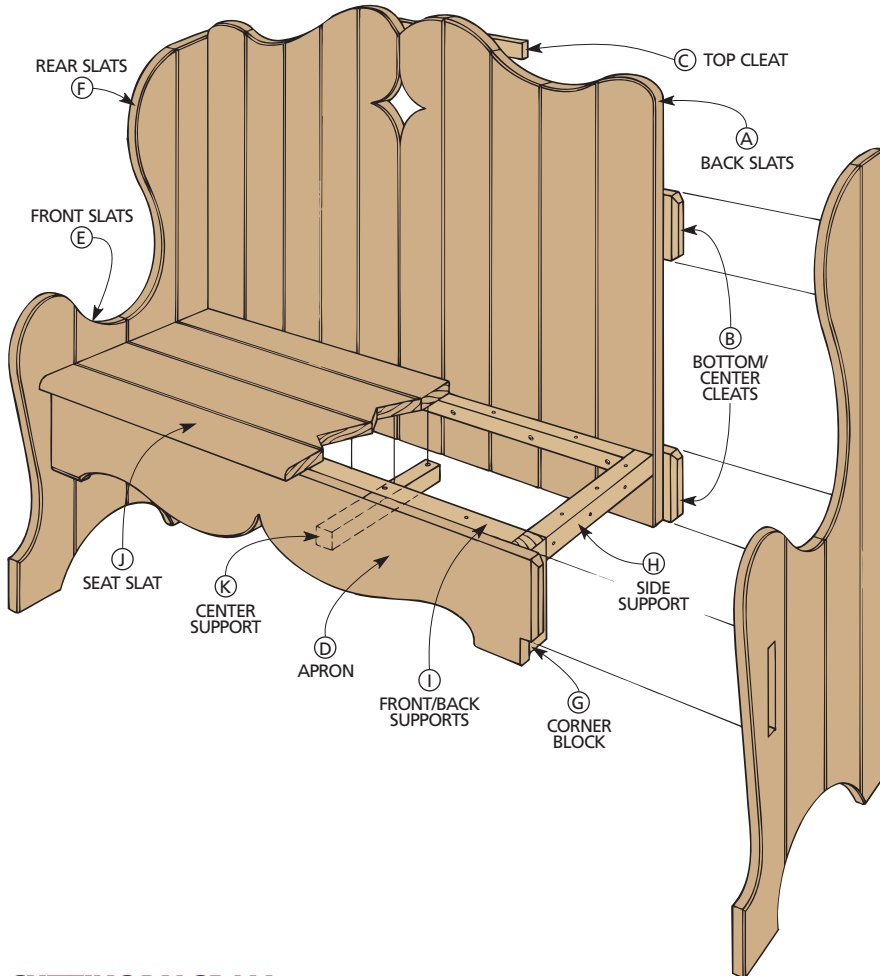
On the second bench, I used milk paint, a finish that's been used since colonial times. (You can see this bench on page 104.) After a bit of "distressing," this finish helps the bench look like an authentic antique.

DESIGN OPTION. To make your bench even more useful, the Designer's Notebook on page 102 shows how to build it with under-seat storage.

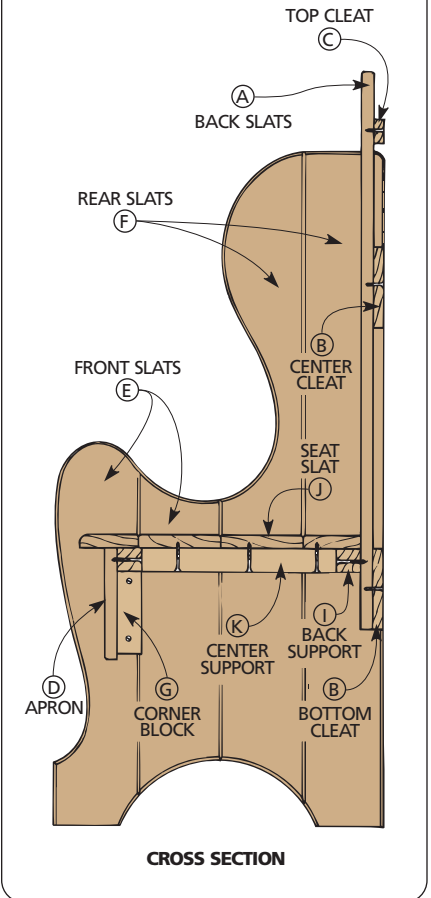
EXPLODED VIEW

OVERALL DIMENSIONS:

52W x 20D x 47H



a.



CUTTING DIAGRAM

$\frac{3}{4}$ x $5\frac{1}{2}$ - 72 (Five Boards @ 2.8 Bd. Ft. Each)



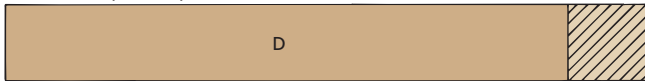
$\frac{3}{4}$ x $5\frac{1}{2}$ - 72 (Two Boards @ 2.8 Bd. Ft. Each)



$\frac{3}{4}$ x $5\frac{1}{2}$ - 72 (Four Boards @ 2.8 Bd. Ft. Each)



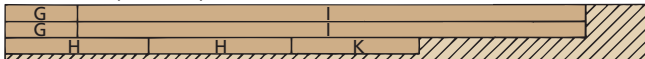
$\frac{3}{4}$ x $7\frac{1}{4}$ - 60 (3 Bd. Ft.)



$\frac{3}{4}$ x $5\frac{1}{2}$ - 60 (Four Boards @ 2.3 Bd. Ft. Each)



$1\frac{1}{2}$ x $5\frac{1}{2}$ - 60 (3.4 Bd. Ft.)



MATERIALS LIST

WOOD

A Back Slats (10)	$\frac{3}{4}$ x 5 - $34\frac{3}{4}$
B Btm./Ctr. Cleats (2)	$\frac{3}{4}$ x 5 - 52
C Top Cleat (1)	$\frac{3}{4}$ x $1\frac{1}{2}$ - 14
D Apron (1)	$\frac{3}{4}$ x 7 - 52
E Front Slats (4)	$\frac{3}{4}$ x 5 - 24
F Rear Slats (4)	$\frac{3}{4}$ x 5 - 42
G Corner Blocks (2)	$1\frac{1}{2}$ x $1\frac{1}{2}$ - $6\frac{3}{4}$
H Side Supports (2)	$1\frac{1}{2}$ x $1\frac{1}{2}$ - $13\frac{1}{4}$
I Fr./Bk. Supports (2)	$1\frac{1}{2}$ x $1\frac{1}{2}$ - 47
J Seat Slats (4)	$\frac{3}{4}$ x 5 - 50
K Center Support (1)	$1\frac{1}{2}$ x $1\frac{1}{2}$ - $11\frac{3}{4}$

HARDWARE SUPPLIES

(46) No. 8 x $1\frac{1}{4}$ " Fh woodscrews
(69) No. 8 x 2" Fh woodscrews

BACK

I started work on the bench by building the back. The back consists of ten slats supported by two cleats — much like a picket fence.

BACK SLATS. I ripped the ten back slats (A) to width from $\frac{3}{4}$ "-thick boards (Fig. 1) and cut them $34\frac{3}{4}$ " long.

Next, to give the bench a traditional look, I routed $\frac{1}{8}$ " chamfers on the long edges of each slat (Fig. 2a). (Don't chamfer the ends.)

BOTTOM AND CENTER CLEATS. To make the bottom and center cleats (B), first rip two boards 5" wide (Fig. 1). Then, cut them to length.

Note: The cleats are 2" longer than the combined width of all the back slats. In my case, they were 52" long.

The ends of the cleats serve as through tenons. To dress them up a little, I routed a $\frac{1}{4}$ " chamfer around both ends of each cleat (Fig. 2a).

BACK ASSEMBLY. Once the cleats are chamfered, the back can be assembled. To ensure the proper distance across the back, first position the two *outside* slats 50" apart measured from outside edge to outside edge (Fig. 2).

Next, place the bottom cleat on top of the two slats (Fig. 2). Then, adjust the position of the cleat so it overhangs the side of each slat by 1", and is flush with the bottom end of each slat.

Use only one screw at each cleat/slat point for now — you'll drive the second screw after the frame is square.

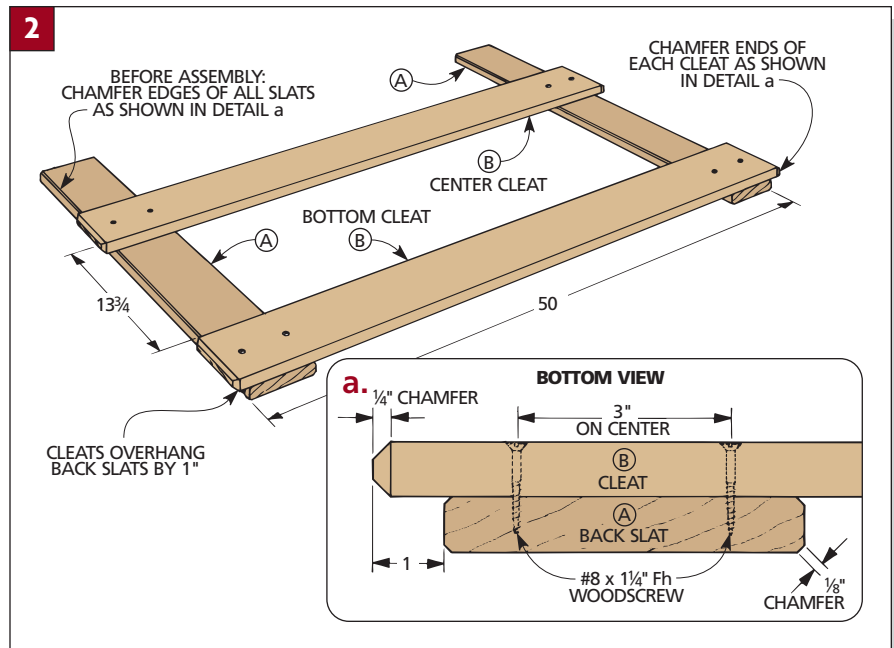
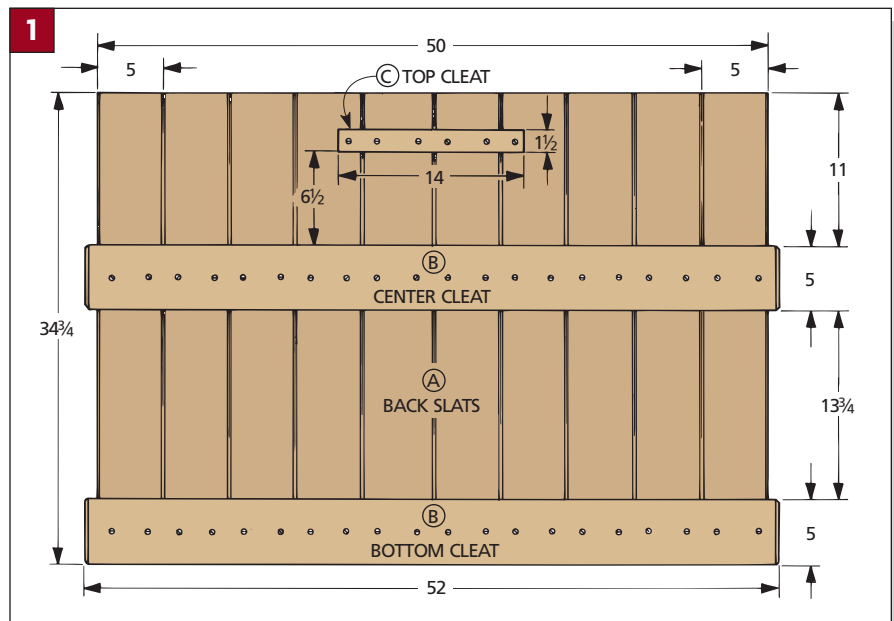
The center cleat can be attached the same way. Position it $13\frac{3}{4}$ " up from the top edge of the bottom cleat (Fig. 2).

Now, square up the frame and install a second screw at each joint. Then attach the remaining slats, working from the outside in. See the Shop Tip at right for a tip on doing this.

TOP CLEAT. Finally, cut a small top cleat (C) to size (Fig. 1). Later, this cleat helps support the two center slats after you've cut a design in the back. But before the cleat is screwed in place, the patterns in the back are laid out and cut.

SHAPING BACK

To add a bit of country flair to the back, I cut a double curve along the top edge and a diamond in the center of the back. (An alternate heart-shaped cutout is shown in the Designer's Notebook on the opposite page.)



SHOP TIP

Spacing Slats

If you build the bench in a dry shop, each 5"-wide slat may swell across its width by about 1%, or as much as $\frac{3}{64}$ " as the humidity increases. So attach them to the cleats with a gap this size between them.

To space the slats evenly and consistently, I used playing cards as spacers. The thickness of three cards is just about the right amount of space.



Note: You may have to trim the width of a few of the inside slats and rechamfer the edges.

BACK PATTERN. To shape the back as symmetrically as possible, first draw the half-pattern full size on a piece of $\frac{1}{8}$ "-thick hardboard to be used as a template (Fig. 3). Then cut and sand the hardboard template to finished shape.

SHAPING THE BACK. Now the pattern can be traced onto the back side of the back. To do this, trace around the template onto one half of the back. Flip the template over to the opposite half and trace it again.

Note: I worked from the back side because my jig saw cuts on the upstroke. This way, any splintering is hidden in the back.

CHAMFER EDGES. After the curved top edge and cutout have been cut, sand the edges. Next, rout a $\frac{1}{8}$ " chamfer on the front and back of the top edge and inside the cutout (Figs. 4 and 4a).

Because the router bit can't reach into the tight corners, I completed the chamfers with a file.

After you're through chamfering the edges, attach the top cleat (C) to the rear of the back, just above the cutout.

APRON

The next step is to cut an apron (D) that fits below the seat and between the sides. Cut the apron 7" wide from a $\frac{3}{4}$ "-thick board (Fig. 5). Then, cut the apron the same length as the back cleats (B). (In my case, 52" long.)

TENONS. Next, cut the notches to form a tenon on each end of the apron (Fig. 5a). These tenons will fit into mortises that are cut later into the side panels of the bench. To cut the notches, I raised the table saw blade 2" high and made a cut 1" from each end. Then, I removed the waste with a back saw.

After the tenons are formed, the end of each tenon is chamfered the same as the ends on the cleats (Fig. 5a).

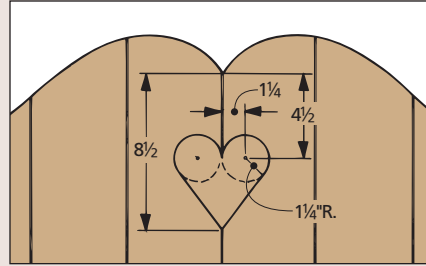
Note: Chamfer the bottom edge of the tenon with a back saw or file.

PATTERN. The apron can be shaped in

DESIGNER'S NOTEBOOK

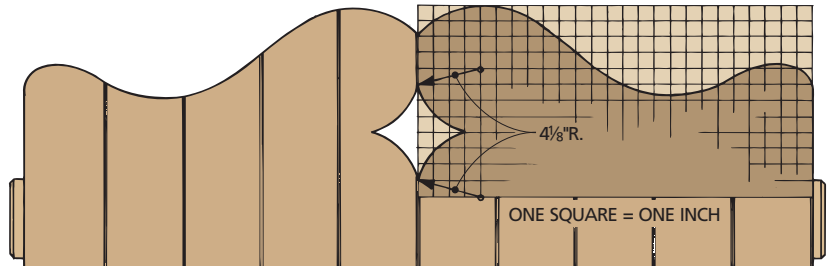
HEART CUTOUT

- Drill $2\frac{1}{2}$ "-dia. holes to make the curved top portion of the heart.
- Cut out the lower portion with a jig saw. Chamfer the edges. Complete the chamfer on the bottom point with a file.



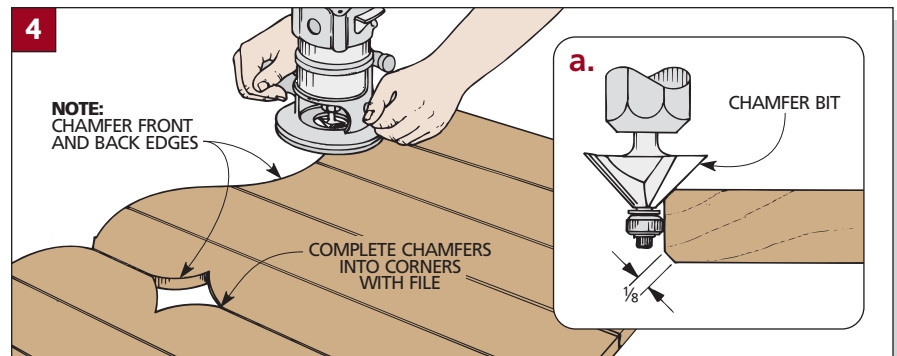
3

MAKE HALF-PATTERN
TEMPLATE FROM HARDBOARD



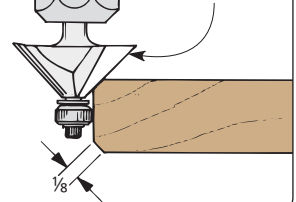
4

NOTE:
CHAMFER FRONT
AND BACK EDGES



a.

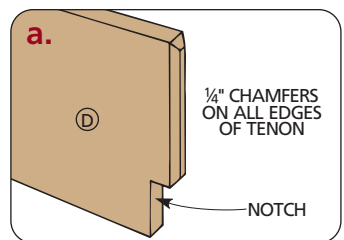
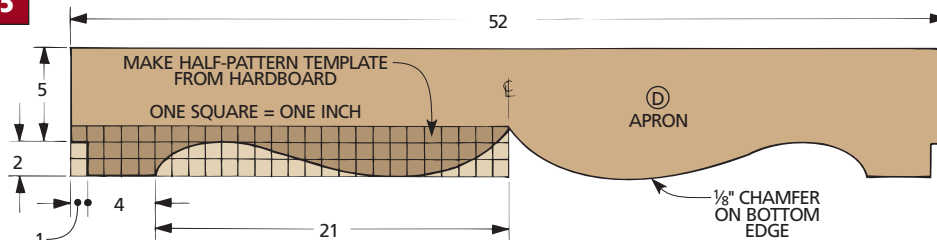
CHAMFER BIT



the same manner as the back. First, make a hardboard template (Fig. 5). Then trace the template onto the apron,

cut out the shape, and sand it smooth. Finally, rout $\frac{1}{8}$ " chamfers along the bottom edges of the apron.

5





SIDES

Next, work can begin on the two glued-up side panels.

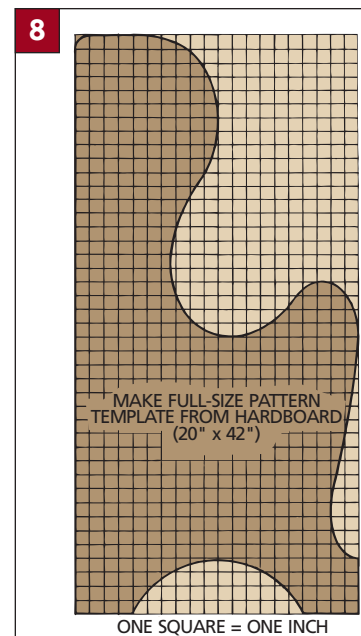
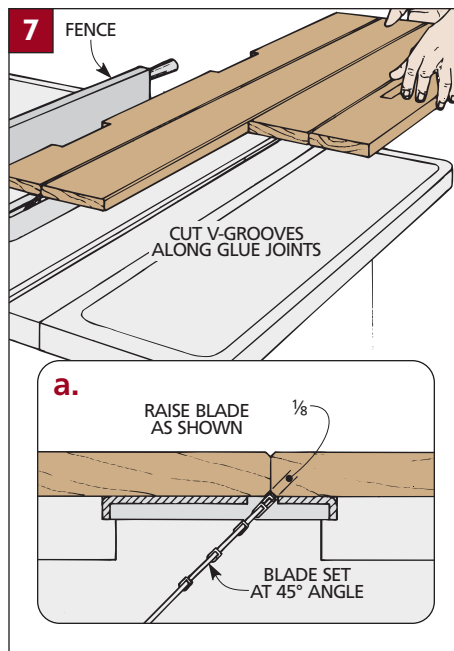
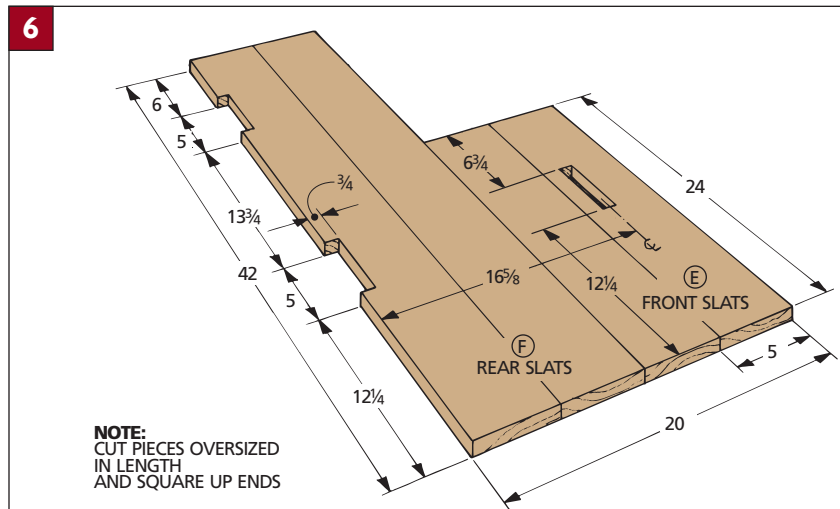
SIDE PANELS. Start by ripping enough $\frac{3}{4}$ "-thick stock to width for four front slats (E) and four rear slats (F) (Fig. 6). Then, rough cut the front slats 25" long and the rear slats 43" long.

Now, form each "L"-shaped side by gluing two front and two rear slats together (Fig. 6). Once the glue dries, sand them flat and cut them to final size.

NOTCHES. Now, lay out notches on the back edge of each panel for the back cleats (Fig. 6). I used a jig saw to cut the three edges on each notch a little short. Then I used a chisel to sneak up on their final size until the notches fit the cleats.

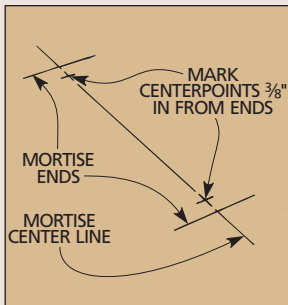
MORTISES. Next, lay out the location for each mortise to attach the apron (D) (Fig. 6). Then, cut each mortise to fit the apron tenons. (See the Shop Tip below for one way to do this.)

CUT V-GROOVES. To make the joints on the side panels look like those on the back, I cut V-grooves along each one.

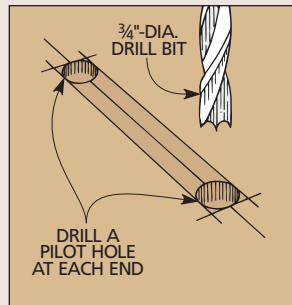


SHOP TIP

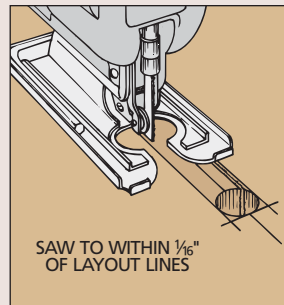
Mortises With A Jig Saw



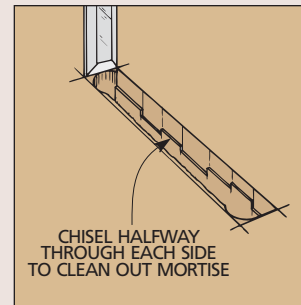
1 Lay out the mortise centerline, ends, and pilot holes $\frac{3}{8}$ " from each end.



2 Drill a $\frac{3}{4}$ " hole at each end. Use these holes to lay out edge of mortise.



3 Remove waste using a jig saw (or chisel). Cut to within $\frac{1}{16}$ " of all layout lines.



4 Chisel up to layout lines. To help prevent chipout, work from both faces.

To do this, I used a rip blade (because of the blade's flat-top profile) tilted to 45° (Fig. 7a). Before moving the rip fence to cut the next groove, flip the panel over to cut the opposite side of the joint.

CUT TO SHAPE. To complete the sides, make a pattern as you did for the back and apron (Fig. 8). Then chamfer all the edges *except* inside the notches (refer to Fig. 4a on page 99).

ASSEMBLY

Before making the bench seat, the side panels are glued to the back and apron.

To do this, first spread glue around the edges of the apron tenons. Then, insert the tenons into the mortises in the sides and clamp the assembly together (Fig. 9).

Note: Make sure the tenon shoulders are tight against the sides.

Now, lift the back into place, and slip the cleats into the side panel notches (Fig. 9). Then, drill and screw the cleats into the notches (Fig. 9a).

SEAT

Once the glue has dried, the final steps are building the seat support and seat.

SEAT SUPPORT. The seat support consists of a frame and center support made from 1½" x 1½" boards (Fig. 10). Begin by cutting two corner blocks (G) to a length of 6¾". Then, glue and screw them in place.

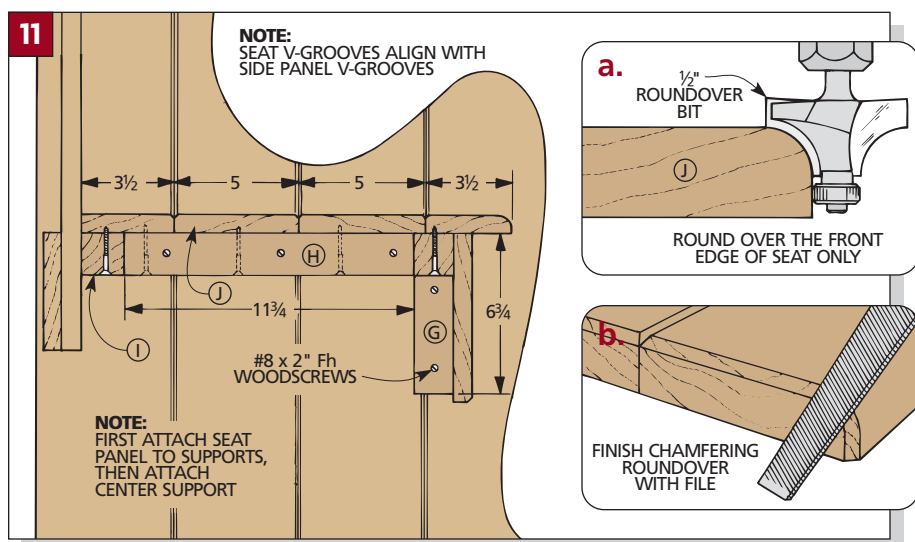
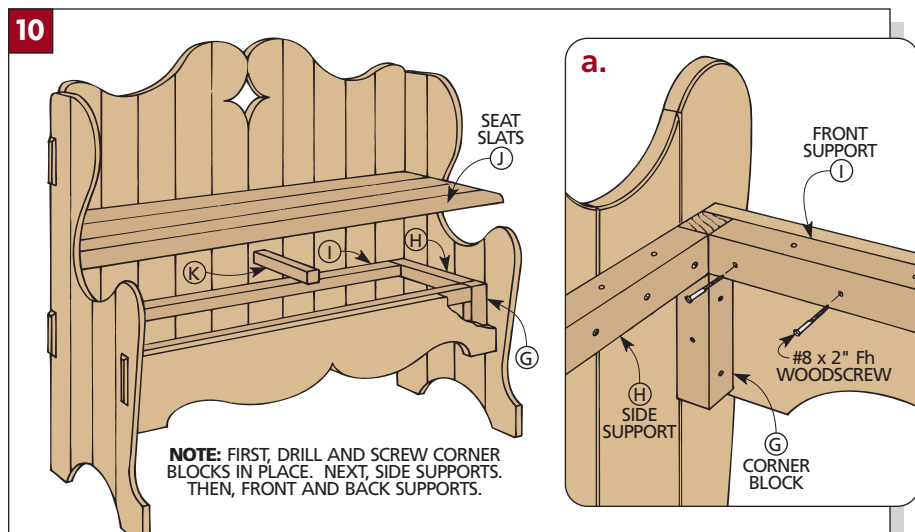
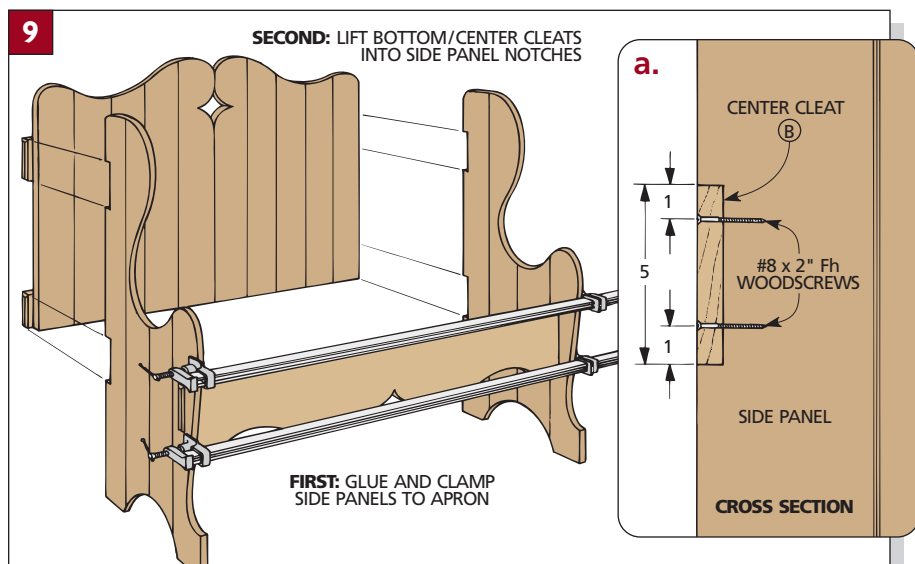
Next, cut two side supports (H) to fit between the back slats (A) and the corner blocks (G) (Fig. 10). Now, drill and screw (don't glue) the supports in place. The sides must be able to shrink and swell during changes in humidity.

Now, cut the front and back supports (I) to length (Fig. 10). Then, drill and screw them to the apron and back slats.

SEAT. To make the seat, first rip four ¾"-thick boards for the seat slats (J) to a width of 5" and slightly over 50" long (Fig. 11). Then, glue and clamp the boards together for the seat blank.

Once the glue has dried, cut the panel to fit between the sides. Next, cut V-grooves along all three glue joints. Then, rip the front and back slats to width until the V-grooves in the seat align with the side grooves (Fig. 11).

Next, rout a ½" roundover on the front edge of the seat (Fig. 11a). Then chamfer the top outside ends, and complete the chamfer with a file (Fig. 11b).



ATTACH SEAT. Now, drill and screw the seat supports to the seat (Fig. 11).

Finally, screw a center support (K)

to the bottom of the seat between the front and back supports (refer to detail 'a' in Exploded View on page 97).

DESIGNER'S NOTEBOOK

You can make the high-back bench more versatile by building a hidden storage area under the seat. To allow access to this compartment, the seat panel doubles as a hinged lid.

CONSTRUCTION NOTES:

■ For this bench, the back is built the same, except it's a bit longer (taller). So first cut the back slats (A) to width (5") and to a length of $37\frac{3}{4}$ " (Fig. 1).

■ Assemble the back with the bottom cleat (B) flush with the bottom edges of the back slats. Then position the bottom edge of the center cleat (B) $16\frac{3}{4}$ " from the top of the bottom cleat (B) (Fig. 1).

■ Now complete the back the same as for the regular bench.

■ Next, glue up two $5\frac{1}{2}$ "-wide boards to make a panel for the apron (D) (Fig. 2).

■ After cutting the apron to length (52"), a tenon is cut on each end, centered on the width of the apron (Fig. 2). To do this, first raise the table saw blade to just under 3". Then set the rip fence 1" from the *outside* of the blade as a stop. With the workpiece standing *on edge* against the miter gauge, make a pass on each end.

Sneak up on the final blade height, making a pass on each edge until the distance between the kerfs is 5". If your saw blade won't go high enough, use a hand saw to finish the cuts. Then remove the waste with a back saw.

■ Rout $\frac{1}{4}$ " chamfers on all the edges of the tenons.

■ Cut a V-groove along the joint line as shown in Fig. 7a on page 100.

■ To accept the bottom panel (added later) cut a $\frac{3}{4}$ "-wide groove $\frac{3}{8}$ " deep on the back face of the apron (Fig. 2). The top edge of the groove should align with the bottom of the tenon.

■ The apron pattern on this bench has shallower curves (Fig. 2). Lay out the pattern so it's below the groove.

■ The side panels have two differences from the regular bench. The mortises

for the apron and the notches for the bottom cleat are cut so their bottom edges are $9\frac{1}{4}$ " from the bottom edge of each side panel (Fig. 3).

■ Once the remaining notch and the V-grooves are cut in each side panel, you can assemble the sides with the back panel and apron.

■ Next, cut the side supports (H) to fit between the back panel and the apron (Fig. 4). Screw (don't glue) them to the sides. Then cut the corner blocks (G) to length to fit between the side supports and the top of the groove in the apron. Finally, add the back support (I).

Note: There is no front support.

■ Now you can glue up a panel for the bottom (M). When the glue is dry, cut it to length to fit between the side panels. Its width will be the distance from the back face of the bottom cleat (B) to the back of the apron, plus $\frac{1}{4}$ " (Fig. 7).

■ Slide the bottom panel into the groove in the apron. Align its rear edge with the

back face of the bottom cleat and screw and glue it to the bottom cleat (Fig. 7).

■ Cut two bottom supports (N) $14\frac{3}{4}$ " long. Butt them against the underside of the bottom (M), then screw (don't glue) them to the side panels (Fig. 7).

■ Cut three seat slats (J) and a hinge slat (L) to width (5") and to rough length.

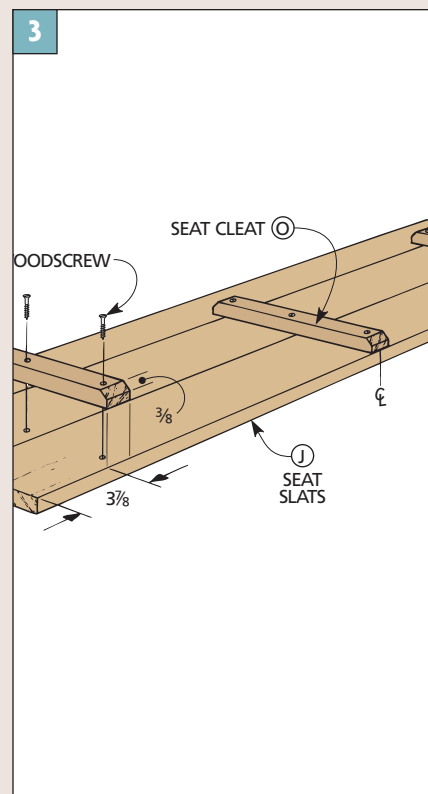
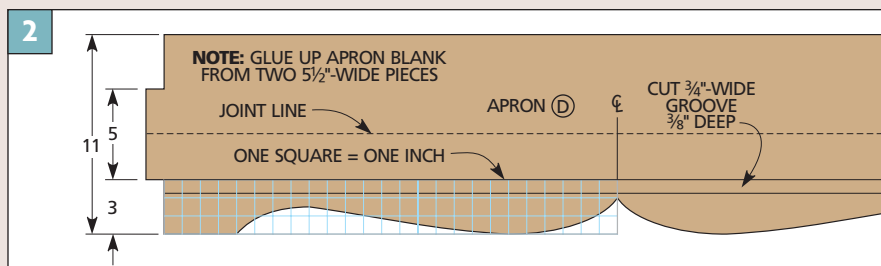
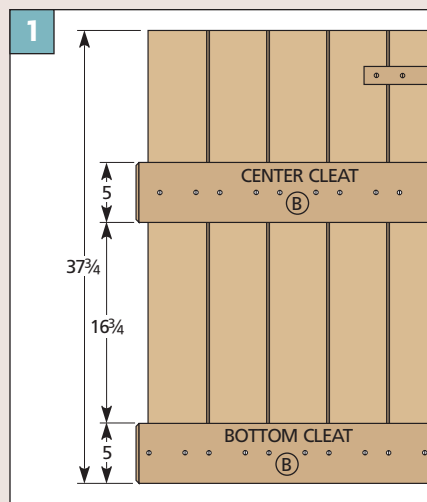
■ Glue up the three seat slats (J) to make the seat panel. When it's dry, cut it to finished length so it will fit between the side panels, less $\frac{1}{4}$ ".

■ Cut V-grooves along the glue joints and complete the edges of the seat as shown in Figs. 11a and 11b on page 101.

■ To match the seat panel, chamfer the *front* and *side* edges of the hinge slat and *rear* edge of the seat panel.

■ To position the hinges on the hinge slat (L), measure $3\frac{5}{8}$ " from each end (Fig. 5). Center the third hinge on the slat's length. At these positions, cut mortises the full depth of the hinges.

■ Center the hinge slat between the



MATERIALS LIST

CHANGED PARTS

- A** Back Slats (10) $\frac{3}{4} \times 5 - 37\frac{3}{4}$
D Apron (1) $\frac{3}{4} \times 11 - 52$
G Corner Blocks (2) $1\frac{1}{2} \times 1\frac{1}{2} - 6\frac{1}{2}$
H Side Supports (2) $1\frac{1}{2} \times 1\frac{1}{2} - 14\frac{3}{4}$
I Back Support (1) $1\frac{1}{2} \times 1\frac{1}{2} - 47$
J Seat Slats (3) $\frac{3}{4} \times 5 - 49\frac{3}{4}$

NEW PARTS

- L** Hinge Slat (1) $\frac{3}{4} \times 5 - 49\frac{3}{4}$
M Bottom (1) $\frac{3}{4} \times 16\frac{5}{8} - 50$
N Btm. Supports (2) $1\frac{1}{2} \times 1\frac{1}{2} - 14\frac{3}{4}$
O Seat Cleats (3) $\frac{3}{4} \times 2 - 11$

Note: Don't need part K, only one part I

HARDWARE SUPPLIES

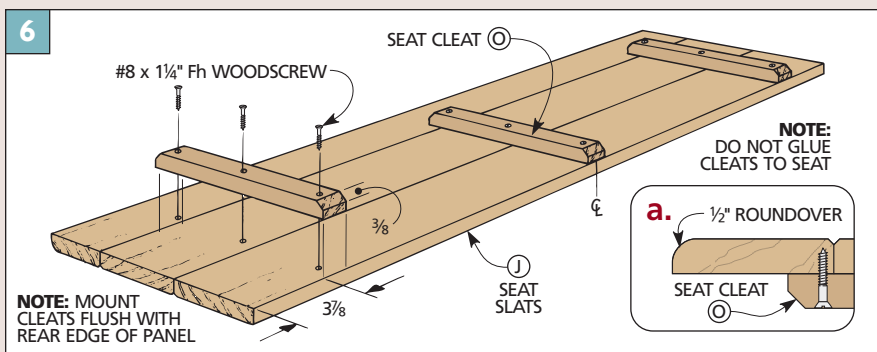
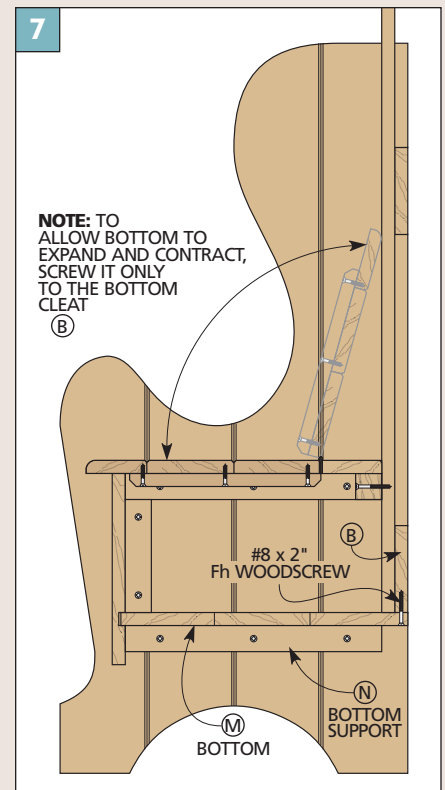
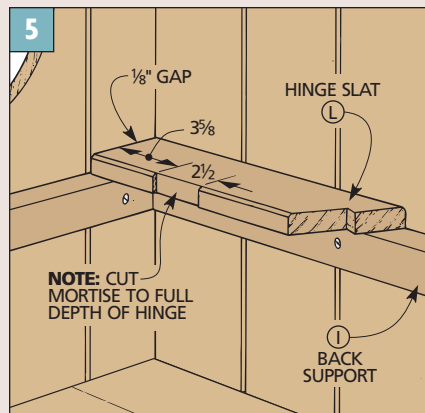
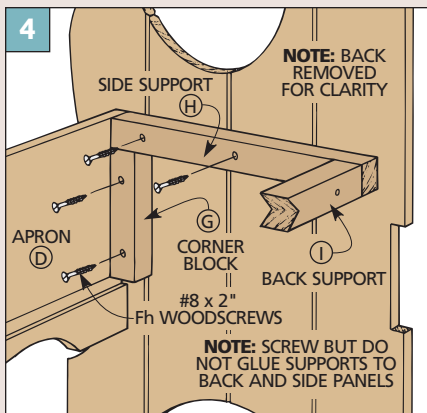
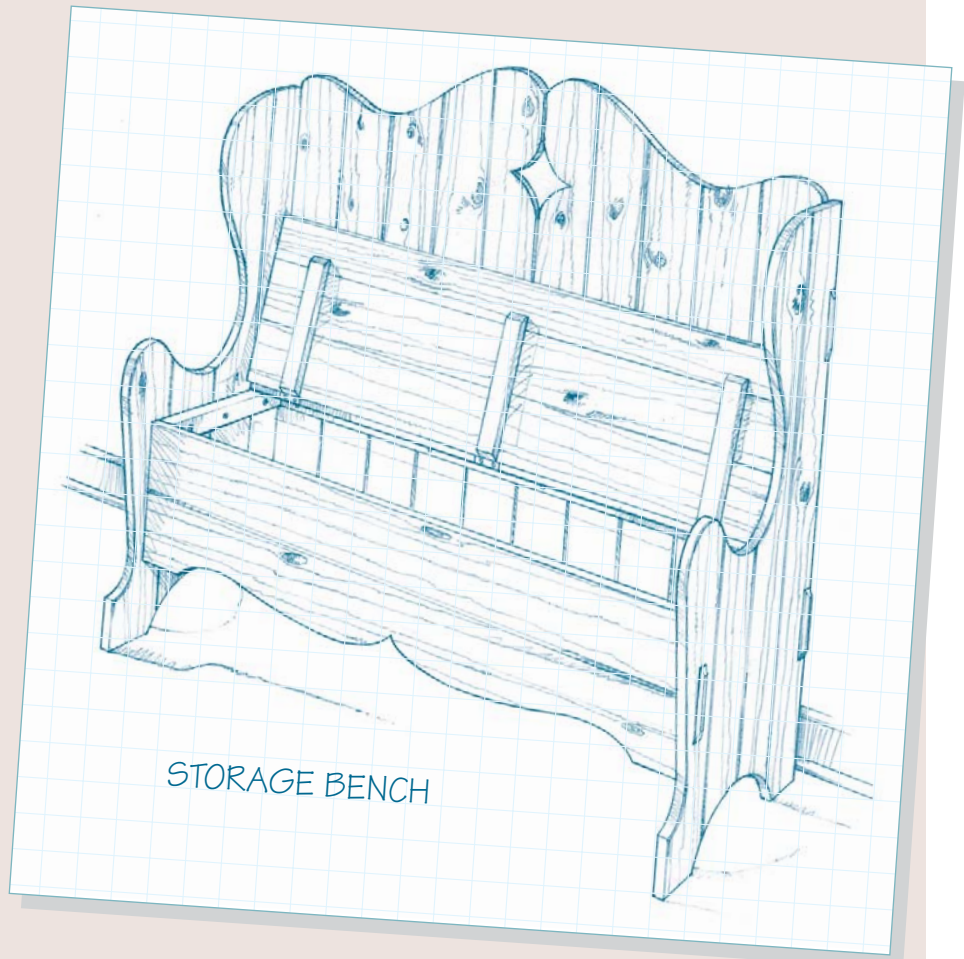
- (3) 1³/₈" x 2¹/₂" butt hinges
(55) #8 x 1¹/₄" Fh woodscrews
(42) #8 x 2" Fh woodscrews

sides. Glue it to the back support (I), tight against the bench back (*Fig. 5*). (Do not glue the slat to the back panel.)

■ Now cut three seat cleats (O). Their length is the distance from the front edge of the hinge slat to the inside edge of the apron, less $\frac{1}{4}$ ". Cut a $\frac{3}{8}$ " chamfer across each end (*Fig. 6*).

■ Mount a seat cleat $37/8$ " from each end of the seat (*Fig. 6*). Mount the third cleat centered on the seat's length. The cleats should be flush with the rear edge of the seat panel.

■ Screw the hinges to the rear hinge slat and then screw the seat panel in place.



FINISHING Milk Paint



How do you add 150 years of age and wear to a project in just a short time? Part of the secret is knowing what finish might have been used that long ago. A good guess would be milk paint.

PRE-MIXED POWDER. It's called milk paint because milk was one of the materials farmers used when they had to

make their own paint. But that doesn't mean you can run down to the grocery store and get a quart of 2%, then add a few ingredients to end up with milk paint. The pigments and ingredients can be found, but to be honest, it's a lot more convenient just to buy pre-mixed powder. (For sources, see page 126.)

MIXING PRE-MIX. All you have to do with the pre-mix is add together equal parts (by volume) of water and powder. I use a large, clean jar to mix in. A vigorous shaking (with the lid on) helps dissolve most of the powder.

To remove any powder clumps that weren't completely dissolved during the mixing, strain the solution through cheesecloth. If the clumps are left in the mixture, they will break open during brushing and powder will be smeared across the wood.

DIFFERENT RESULTS. One of the neat things about using milk paint is you can get different results by using different techniques as shown below. You can just brush it on and be done, or use antiquing steps to make a project look old and worn. (For the bench shown above, I used the "Aging" technique.)

APPLYING MILK PAINT

The easiest way to use milk paint is to simply brush on a couple of coats over bare wood. The result is a flat, dull color that has a rough texture once it's dried.

PREPARATION. Milk paint doesn't require a primer. After you've mixed up a batch of milk paint, just wipe the workpiece down with a damp sponge. This prevents the wood from drawing water

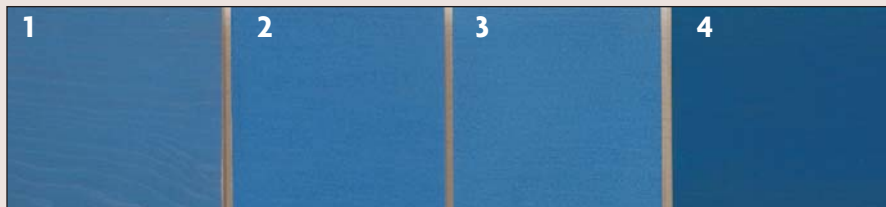
out of the first coat of paint, and it allows the paint to cure as it's drying.

PAINTING. With the wood still damp, brush on the first coat of milk paint with a stiff bristle brush. (Foam brushes can cause streaking.) Then allow the first coat to dry at least four hours.

If you want to completely cover the wood grain, apply a second coat of paint.

POLISHING. For a smoother, glossier surface, lightly rub out the finish with a nylon scouring pad. For a really polished surface, buff in a small amount of Danish oil with a soft rag.

Note: The oil will darken the milk paint, so it's a good idea to test it first on a hidden part of the project or on a sample piece of painted wood.



1. Apply the first coat of milk paint on bare, dampened wood.
2. When the first coat is dry, apply the second coat.
3. Let paint dry overnight, then smooth by buffing with a nylon scouring pad.
4. Polish with a light coat of Danish oil.

AGING

In Colonial days, a couple coats of milk paint were all that was required for a piece of furniture. With daily use, the paint slowly wore away and exposed some of the wood. And the more the piece was used, the more polished the paint and wood became.

AGED LOOK. To simulate this look, first apply a coat of stain over the bare

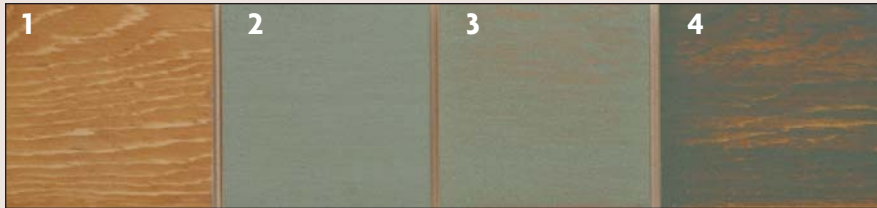
wood. Once the stain has dried, apply two coats of milk paint. Let the first coat dry before adding the second coat.

The next step is to simulate years of daily use. On the bench, I sanded areas that would have been rubbed on, sat on, and even scuffed with boots and shoes.

Using 180 grit sandpaper, lightly sand the selected areas down to the

stain — but don't sand through the stain to expose the bare wood. (If you do happen to sand through the stain, just touch up the area with more stain.)

POLISH. To remove the rough texture and flat, dull look of the milk paint, rub out the entire piece with a nylon scouring pad. Then buff in a coat of Danish oil to darken and polish it.



1. To simulate aged wood, apply one coat of stain over the bare wood.

2. Apply two coats of paint. Let each coat dry thoroughly.

3. Lightly sand through the paint to expose the stained wood below.

4. Rub out and polish with Danish oil.

LAYERING PAINT

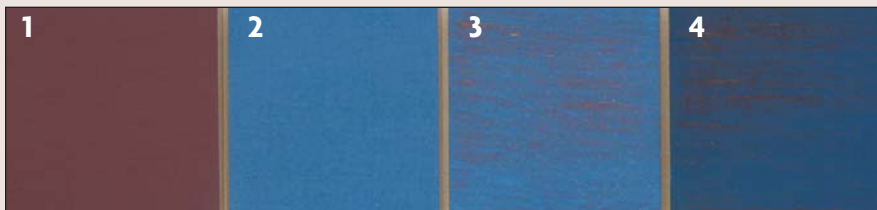
When a piece of furniture required a new coat of milk paint, sometimes a different color was used. And if the top layer was dinged or scratched, the underlying color would show through.

DINGS AND SCRATCHES. When layering milk paint, I like to give the piece a little “natural” wear first.

To do this, use the edge of a small file to make dings and scratches wherever they may have normally occurred. At first, there's a tendency to be cautious, but once you get started it's easy to get carried away — don't. When you're through distressing, stain the entire piece to simulate aged wood.

LAYERING. Once the stain is dry, apply the first coat of milk paint. When it's dry, apply the second color.

After the paint dries, rub out the entire piece with a nylon scouring pad to remove the paint's rough texture. Then create wear spots and polish the finish with Danish oil.



1. Apply the first coat of milk paint (red) on stained wood.

2. Apply the second coat of paint (blue) over the first color.

3. Lightly sand through the top color to expose the bottom color.

4. Polish with a light coat of Danish oil.

ANTIQUE CRACKLE FINISH

Milk paint left in the sun or elements would often dry out and “alligator.”

CRACKLE FINISH. To simulate this look, a special crackle gel is used. (For sources, see page 126.)

First, I stained the bare wood. Then I applied the first coat of milk paint.

Note: Only apply stain if you're going to create wear spots later.

Once the milk paint is thoroughly dry, brush the crackle gel on the paint.

Note: You may want to simulate where sunlight took its toll by only applying the crackle gel on places that may have been directly hit by sunlight.

Once the crackle gel has dried for two hours, apply the next color of milk paint. Don't brush this coat of milk paint

too much — the paint and gel may mix together into a messy sludge. Simply load the brush up with paint, then apply it in one smooth stroke. The “alligatoring” will appear as the paint dries.

POLISH. When the final coat of paint is dry, rub out the entire piece with a nylon scouring pad. Create wear spots (if desired) and buff with Danish oil.



1. Apply the first coat of milk paint (red) on stained wood.

2. When the first coat is dry, apply crackle gel. Allow to dry two hours.

3. Apply the second coat of paint (green) over the gel.

4. Polish with a light coat of Danish oil.

Jelly Cupboard

Back when jelly was made at home, a simple cupboard like this stored the finished product. But even a simple cupboard can still offer some interesting joinery and several options to “dress it up.”

Every fall, my grandma made home-made jelly. After each jar was sealed, it was set in a jelly cupboard similar to this one to cool.

I always liked the “down-home” look of that cabinet and tried to duplicate that appearance with this version.

JOINERY. The shelves in this cupboard could have been mounted on adjustable shelf brackets. But I did something different this time.

By gluing the shelves into dadoes in the cupboard sides, the shelves are permanently attached. This helps keep the cabinet from racking. So the shelves are both functional and structural.

The door frame is assembled with half-lap joints reinforced with dowel pins at the corners. This joint is easily cut on the table saw or router table.

TIN PANELS. The door holds four tin panels. The pattern punched in each one is decorative, but it also serves a practical purpose. The holes allowed air to circulate so moisture from the jelly wouldn't build up inside the cabinet.

And making these panels is easy. Just use a punch and follow a pattern. You can draw your own pattern or *Woodsmith Project Supplies* offers the patterns shown on the opposite page. See page 126 for more details.

The cupboard can also be built with wood raised panels instead of tin. The Designer's Notebook on page 113 shows how to make this option.

BACK SLATS. Ordinarily I use plywood for a cabinet back, but for a “country” project like this, plywood seemed out of place.

So I used solid pine — but not a glued-up panel. Instead, I cut rabbets on the slats for a “ship lap” joint. This allows them to expand and contract without pushing on the cupboard sides.

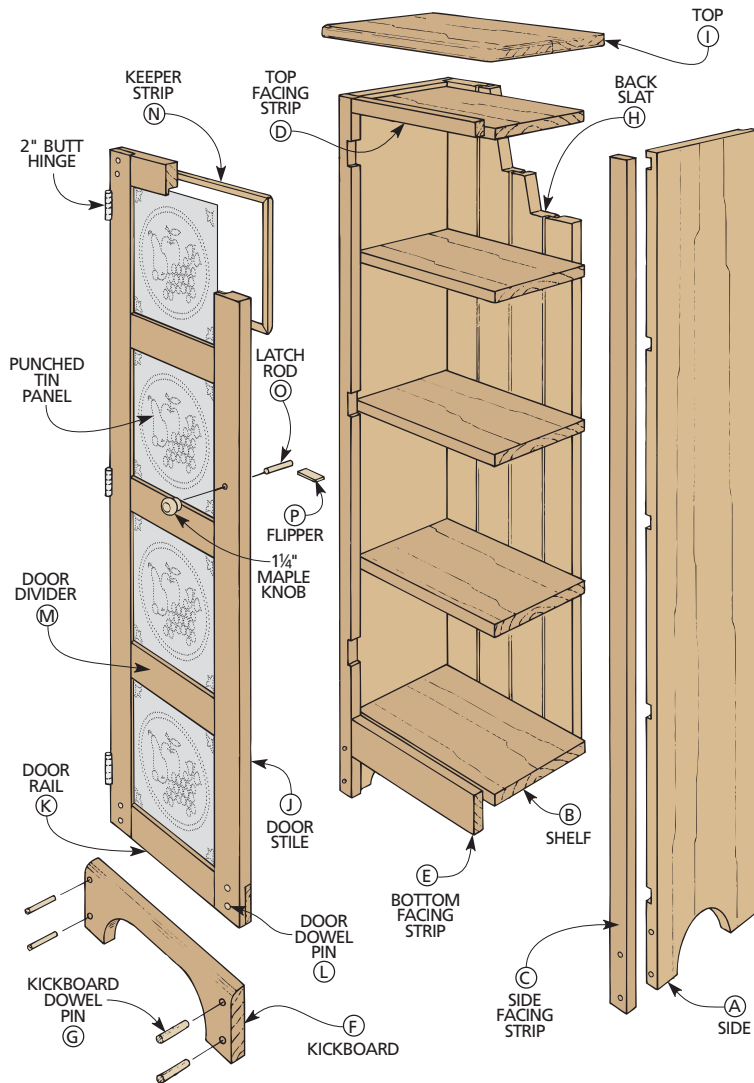
FINISH. To prevent a blotchy finish, I coated the pine with a sealer first. Then I stained it to make it look aged.



EXPLODED VIEW

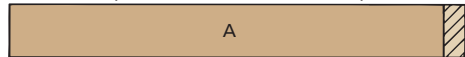
OVERALL DIMENSIONS:

20W x 12³/₄D x 58H



CUTTING DIAGRAM

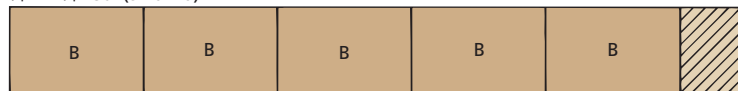
$\frac{3}{4}$ x 7 $\frac{1}{4}$ - 60 (Four Boards @ 3.3 Bd. Ft. Each)



$\frac{3}{4}$ x 11 $\frac{1}{4}$ - 60 (Two Boards @ 5 Bd. Ft. Each)



$\frac{3}{4}$ x 11 $\frac{1}{4}$ - 96 (8 Bd. Ft.)

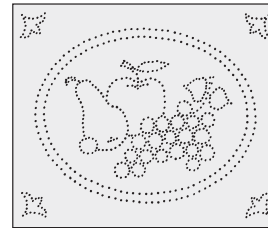


$\frac{3}{4}$ x 11 $\frac{1}{4}$ - 96 (8 Bd. Ft.)

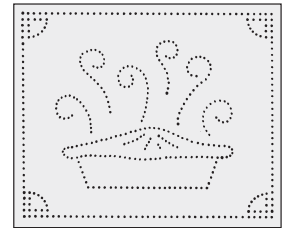


NOTE: PARTS G & L ARE CUT FROM AN 18" LENGTH OF $\frac{1}{4}$ " DOWEL. KEEPER STRIPS (N) ARE CUT FROM OVERSIZE BLANKS. CUT LATCH ROD (O) FROM $\frac{3}{8}$ " DOWEL. CUT FLIPPER (P) FROM SCRAP.

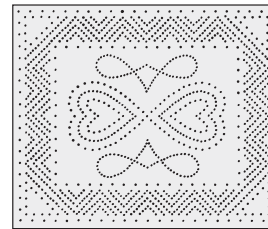
PUNCHED TIN PATTERNS (SEE SOURCES ON PAGE 126)



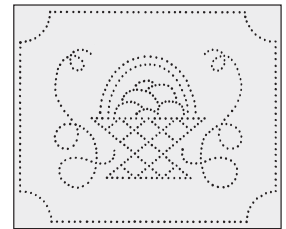
HARVEST FRUIT



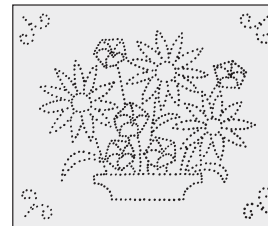
GRANDMA'S PIE



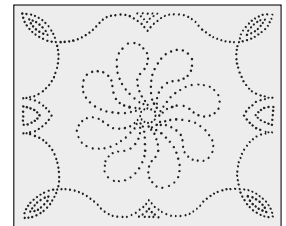
HEARTS ON A BLANKET



FRUIT BASKET



SPRING FLOWERS



DAISY SWIRL

MATERIALS LIST

CASE

A Sides (2)	$\frac{3}{4}$ x 11 $\frac{1}{4}$ - 57 $\frac{1}{4}$
B Shelves (5)	$\frac{3}{4}$ x 10 $\frac{1}{2}$ - 17 $\frac{3}{4}$
C Side Facing Str. (2)	$\frac{3}{4}$ x 1 - 57 $\frac{1}{4}$
D Top Facing Strip (1)	$\frac{3}{4}$ x 1 - 16 $\frac{1}{2}$
E Bot. Facing Strip (1)	$\frac{3}{4}$ x 2 - 16 $\frac{1}{2}$
F Kickboard (1)	$\frac{3}{4}$ x 5 $\frac{1}{2}$ - 18 $\frac{1}{2}$
G Kickbd. Dwl. Pins (4)	$\frac{1}{4}$ dowel - 2 $\frac{1}{4}$
H Back Slats (4)	$\frac{3}{4}$ x 4 $\frac{5}{8}$ - 51 $\frac{1}{4}$
I Top (1)	$\frac{3}{4}$ x 12 $\frac{3}{4}$ - 20

DOOR

J Door Stiles (2)	$\frac{3}{4}$ x 2 $\frac{1}{2}$ - 49 $\frac{5}{8}$
K Door Rails (2)	$\frac{3}{4}$ x 2 $\frac{1}{2}$ - 16 $\frac{3}{8}$
L Door Dowel Pins (8)	$\frac{1}{4}$ dowel - $\frac{3}{4}$
M Door Dividers (3)	$\frac{3}{4}$ x 2 $\frac{1}{2}$ - 12 $\frac{1}{8}$
N Keeper Strips (16)	$\frac{1}{4}$ x $\frac{1}{4}$ - 13 rough
O Latch Rod (1)	$\frac{3}{8}$ dowel - 1 $\frac{5}{8}$
P Flipper (1)	$\frac{1}{8}$ x $\frac{1}{2}$ - 11 $\frac{1}{16}$

HARDWARE SUPPLIES

(24) No. 8 x 1 $\frac{1}{2}$ " Fh woodscrews
 (6) No. 8 x 1 $\frac{3}{4}$ " Fh woodscrews
 (3) 2" x 1 $\frac{9}{16}$ " butt hinges w/ screws
 (4 pieces) 10" x 14" tin (rough size)
 (40) $\frac{1}{2}$ " wire brads
 (1) 1 $\frac{1}{4}$ "-dia. maple knob
 (20) 4d (1 $\frac{1}{2}$ "-long) square cut finish nails (optional)

SIDES & SHELVES

Back when cupboards like this were a common fixture in the kitchen or pantry, they would probably have been made of knotty pine. So to make this jelly cupboard look authentic, I used No. 2 common pine.

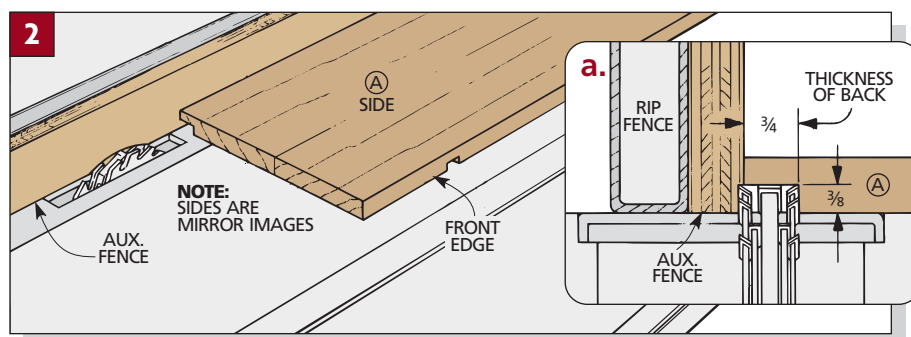
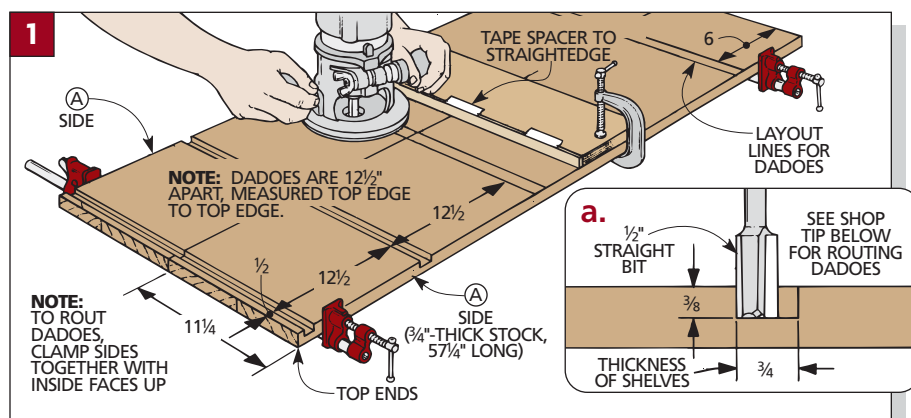
After letting the lumber dry out in the shop for two weeks, I started work on the sides of the cupboard.

CUT TO SIZE. In order to minimize the cupping that may occur with wide boards, I edge-glued each of the sides from two narrower boards. When the glue dried, I cut the sides (A) to a finished width of $11\frac{1}{4}$ " and finished length of $57\frac{1}{4}$ " (Fig. 1).

SHELF DADOES. Five shelves hold the sides of the cupboard together. The shelves are held in dados spaced apart evenly (Fig. 1). But there are a couple tricks to routing the dados in the sides and getting them to align after the cupboard is assembled.

First, I clamped both cupboard sides together with their top ends flush and the inside faces up (Fig. 1). Then I laid out the positions of the dados by measuring down from the top end.

To follow the layout lines for the dados, I guided the router against a straightedge clamped to the workpiece. And because the pine for the shelves was slightly less than $\frac{3}{4}$ " thick, I used a $\frac{1}{2}$ " straight bit in the router. I routed each dado to the correct width in two



passes by using a removable spacer against the straightedge (Fig. 1). (Refer to the Shop Tip below for details.)

BACK RABBET. After routing the dados for the shelves, a rabbet can be cut in each cupboard side for installing the back slats (Figs. 2 and 2a).

Note: To make sure the rabbets are routed along the correct edges (the sides are "mirror" images), it helps to

stand the sides up first and mark the edges to be rabbeted.

DECORATIVE CUTOUTS. The last cuts to make on the cupboard sides look simply to be decorative — but they also serve a purpose.

The semi-circular cutout at the bottom of each piece creates a pair of "feet." (Fig. 3). This allows the cabinet to "bridge" uneven spots in the floor.

SHOP TIP

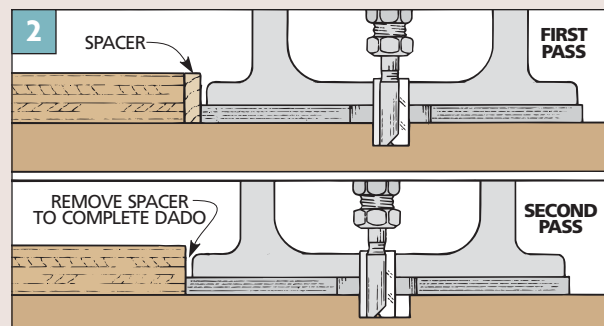
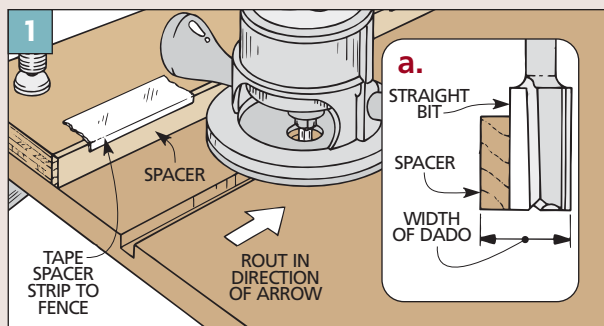
When cutting a dado in a large panel, I find using a hand-held router is easier than wrestling with a large panel on my table saw or router table.

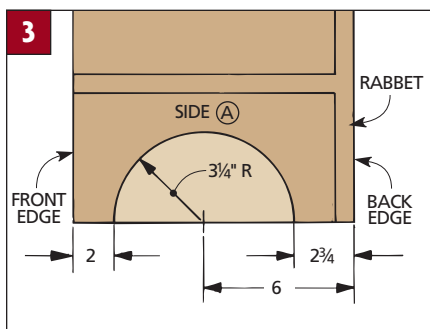
Since lumber is rarely the exact same thickness as the diameter of a router bit, I use a smaller bit and make two passes.

To do this, I set up a

fence with a spacer strip that determines the exact finished width of the dado. The width of the strip, plus the diameter of the router bit should equal

the finished width of the dado (Fig. 1a). After the first pass, remove the spacer. Then make the second pass to complete the dado (Fig. 2).





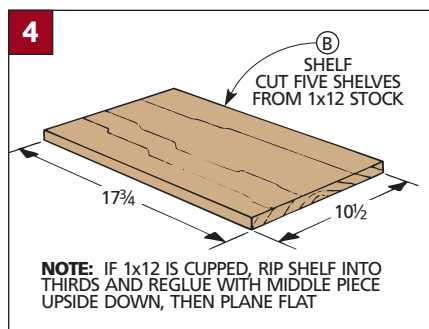
Note: Although the feet start out different widths, they'll end up the same after a facing strip is added to the front (refer to *Fig. 6* on page 110).

After laying out the arcs, I used a jig saw to cut just shy of the layout lines. Then I smoothed up to the line with a drum sander.

SHELVES. Next, I started on the shelves. I cut these from 1x12s. A single board this wide will often cup. If your stock is cupped, one way to flatten it is to rip each shelf blank into thirds. Then glue the blank together with the middle piece upside down. When the glue dries, plane the blank flat.

Now the shelves can be ripped to width so they're flush with the front edges of the sides and also the shoulders of the rabbets for the back slats (*Fig. 5*). Then cut the shelves (B) to finished length (*Fig. 4*). To determine this length, measure between the bottoms of the dados on the case sides.

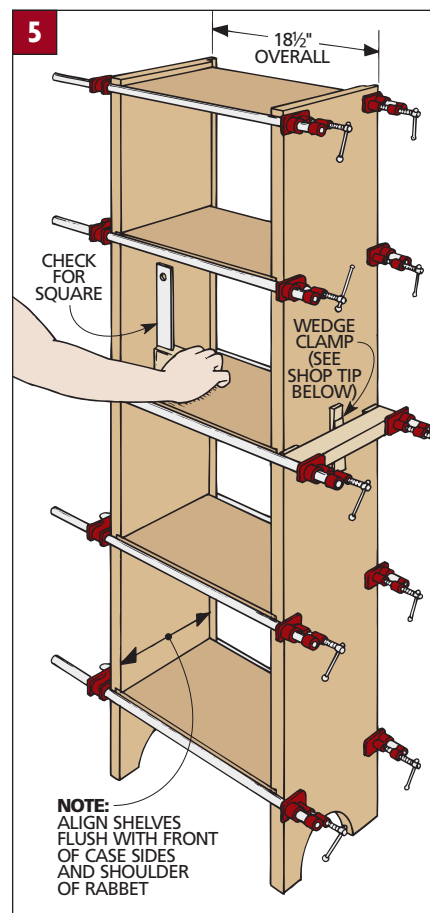
ASSEMBLY. Finally, the case can be



Square-cut nails are an authentic detail. To prevent splitting the wood, drill pilot holes before driving the nails. Then "set" the heads just below the surface with a punch before sanding the side.

assembled with the shelves glued into the dados (*Fig. 5*). The Shop Tip below shows one way to do this.

Note: Keep the shelves flush to the front edges of the sides (A).



If you don't have enough clamps (or for an authentic antique touch), you could assemble the case with square-cut nails (see the photo above). (For sources of these nails, see page 126.)

SHOP TIP

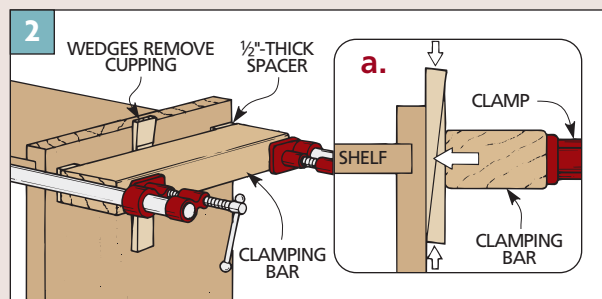
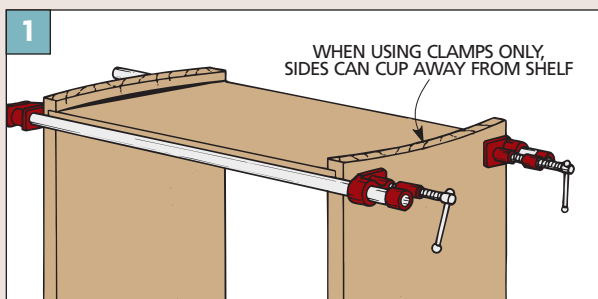
While dry-assembling the jelly cupboard, I ran into a problem. When the shelves were clamped between the sides, the centers of the side panels cupped out (*Fig. 1*).

I came up with a fix that uses opposing wedges. These wedges work against a clamping bar that "straddles" the sides (*Fig. 2*). This bar is simply a 2x4 block with a 1/2"-thick

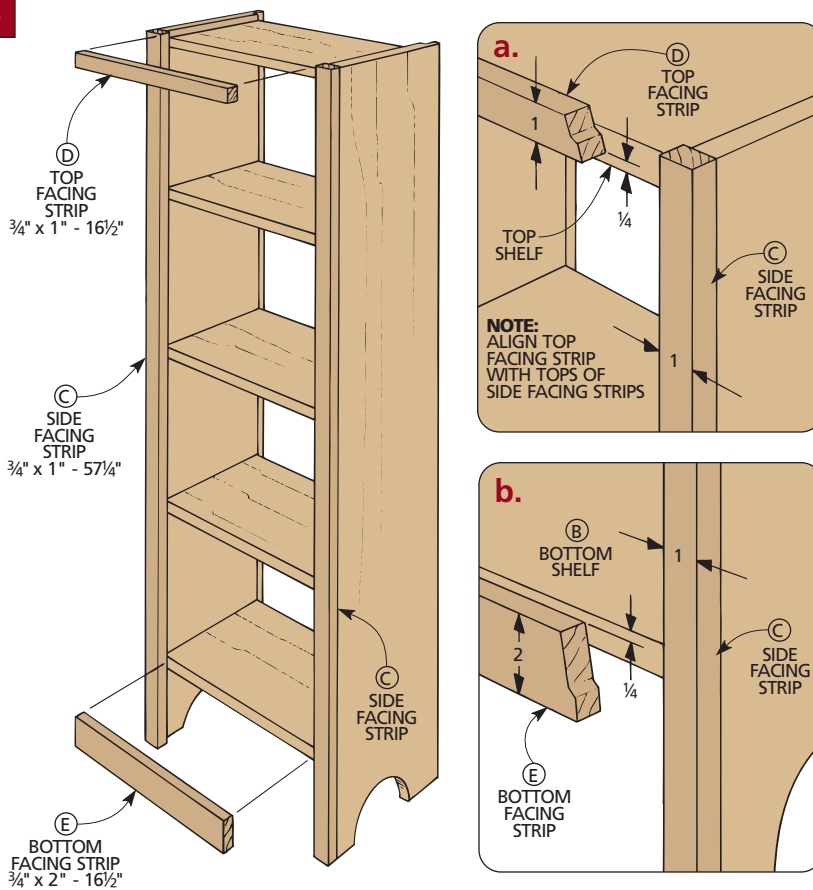
spacer glued on each end. I stuck the spacers to the side of the cabinet using carpet tape. Then I clamped the cupboard assembly together.

To force the center of

the side panel tight against the shelf, tap opposing wedges between the clamping bar and the sides until the shelf is completely seated in the dado (*Fig. 2*).



6



FACING STRIPS

To create a frame that surrounds the door, facing strips are added next.

The facing strips are attached to the front edges of the cabinet sides and to the top and bottom shelves (*Fig. 6*).

RIP TO WIDTH. First, I ripped two side facing strips (C) and one top facing strip (D) to a width of 1" (*Fig. 6*).

SIDE STRIPS. Now cut the side strips to the same length as the cupboard sides. Then glue these to the sides, flush with the outside edges.

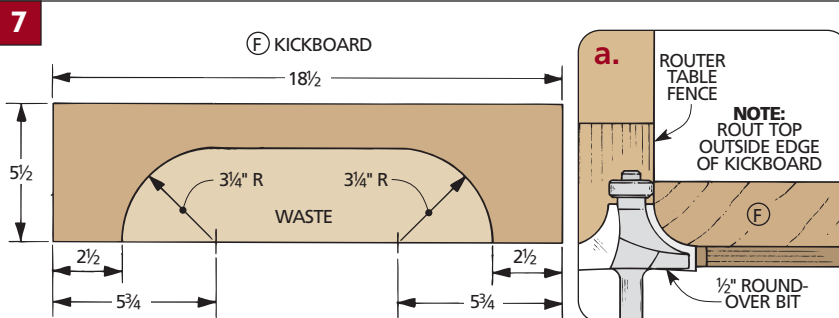
TOP AND BOTTOM STRIPS. Next, I ripped a 2"-wide piece for the bottom facing strip (E) (*Fig. 6*).

Then the top and bottom facing strips (D, E) can be cut to length to fit snugly between the side strips.

ATTACH TO CASE. Before gluing on the top and bottom strips, make marks on the top and bottom shelves to indicate where the strips should be glued on (*Figs. 6a and 6b*). By leaving $\frac{1}{4}$ " of each shelf edge exposed, a lip is created at the top and bottom of the door opening. These lips serve as stops for the door (attached later).

KICKBOARD

7



A kickboard at the bottom of the cupboard adds a decorative touch.

CUT TO SIZE. To make the kickboard (F), first rip a piece of $\frac{3}{4}$ \"-thick stock to a width of $5\frac{1}{2}$ \" (*Fig. 7*). Then cut it to length to match the width of the case.

ROUND OVER TOP EDGE. Next, to soften the transition between the kickboard and the lower facing strip, rout a $\frac{1}{2}$ \" roundover along the top outside edge of the kickboard (*Fig. 7a*).

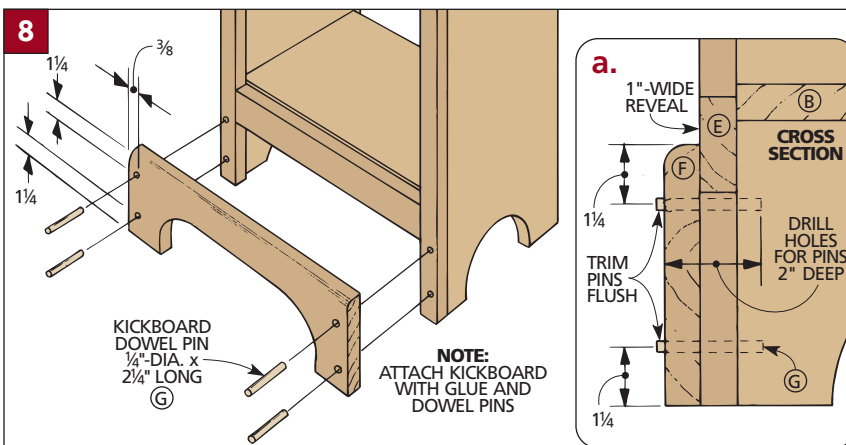
TOE OPENING. To make a toe opening on the kickboard, I used my jig saw to cut out a profile along the bottom edge (*Fig. 7*).

ATTACH TO CASE. Now the kickboard can be attached to the case. But I did this with dowel pins (G) (*Fig. 8*). First, clamp the kickboard to the case and drill two $\frac{1}{4}$ \"-dia. holes that go through the kickboard and facing strip into the cupboard side (*Fig. 8a*).

Then cut four lengths of dowel to fit in the holes.

Note: Cut the dowels so they stand proud of the kickboard when they're tapped into the holes (*Fig. 8a*). Then they can be trimmed and sanded flush after they're glued in place.

8



BACK & TOP

The back of the cupboard is made of individual slats to allow for plenty of expansion and contraction.

CUT TO SIZE. To make the back, start by ripping four back slats (H) from $\frac{3}{4}$ "-thick stock to the same width (Fig. 9). The finished width allows for a $\frac{1}{16}$ " gap between the installed slats (Fig. 9a).

Next, cut the slats to finished length so they extend from the top of the cabinet sides to the bottom of the lower shelf (Fig. 9).

SHIP LAPS. The ship lap joint is really just overlapping rabbets. The rabbets are cut to a depth half the thickness of the pieces ($\frac{3}{8}$ "), and to identical width.

Note: Cut rabbets on the *opposite* edges of the middle slats, but on just *one* edge of each outside slat (Fig. 9a).

ATTACH SLATS. Now the back slats can be screwed to the cabinet, keeping the gaps between them equal (Fig. 9a).

TOP. The top (I) is an edge-glued blank (Fig. 10). Cut it to finished size to allow for a $\frac{3}{4}$ " overhang at the front and sides (Fig. 10a) but *not* the back.

Next, rout $\frac{1}{8}$ " roundovers on the edges of the top, and sand a $\frac{1}{8}$ " radius on the corners. Now the top can be attached using woodscrews driven up from below (Fig. 10a).

DOOR FRAME

The door of the cupboard is a frame and panel unit. Its construction is the same whether you use tin or wood panels.

DOOR FRAME. To make the door frame, start by ripping two door stiles

(J) and two door rails (K) to finished width (Fig. 11).

Then, to determine the length of the pieces, measure between the facing strips and subtract $\frac{1}{8}$ " to allow for a $\frac{1}{16}$ " gap all around the door. Cut the frame pieces to finished length (Fig. 11).

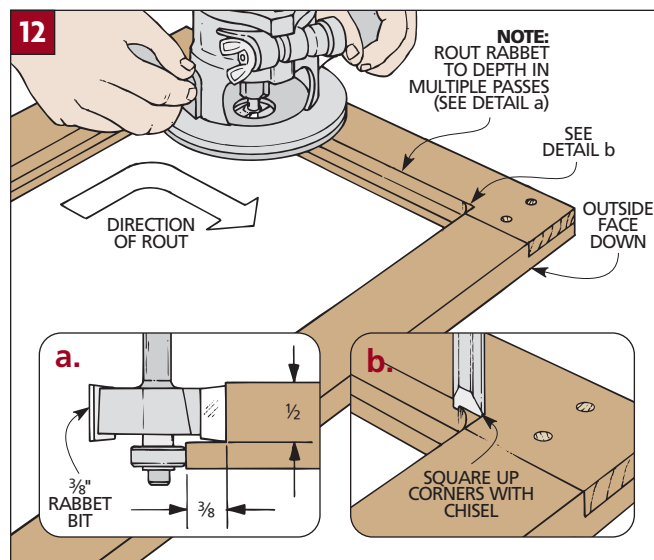
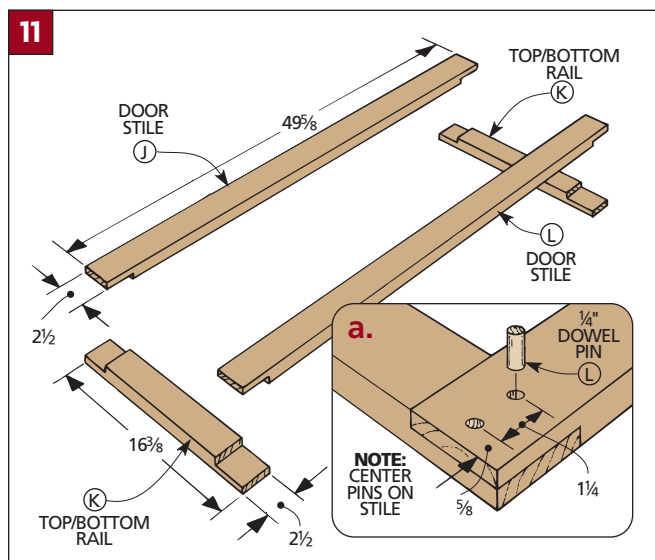
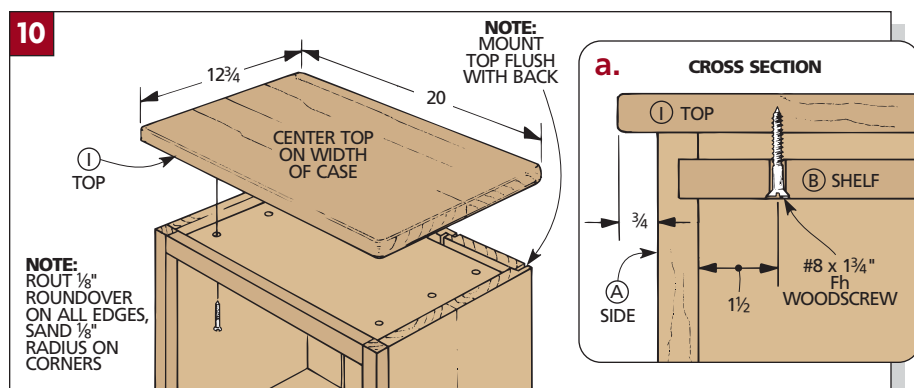
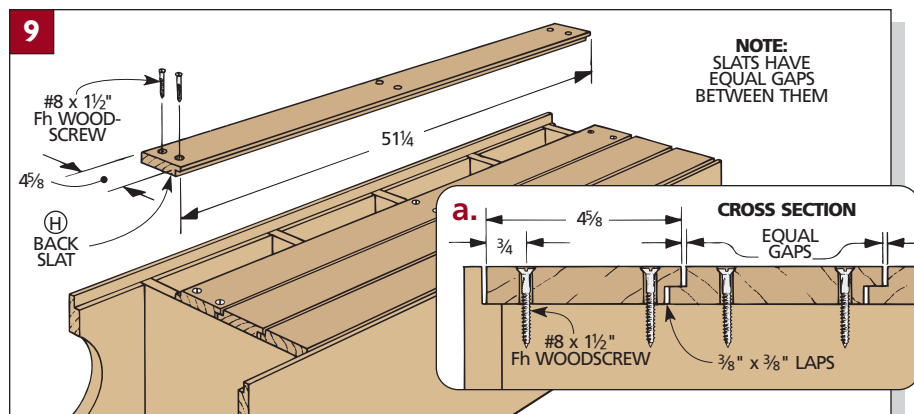
END LAPS. Now cut the end lap joints half the thickness of each of the mating pieces (Fig. 11a).

After the lap joints are cut, the frame can be glued and clamped together.

CORNER PINS. Next, I drilled two $\frac{1}{4}$ "-dia. holes through each corner of the frame for the dowel pins (L) (Fig. 11a). Then glue the pins into the holes and trim them flush with the frame.

RABBET. When the frame is assembled, rout a rabbet around the perimeter of the door opening in the back side (Figs. 12 and 12a). This creates a lip for the door panels.

When the rabbet is cut, square up the corners with a chisel (Fig. 12b).



When the frame of the door is complete, the dividers (M) can be built. The purpose of the dividers is to separate — and support — the door panels.

CENTER DIVIDERS. Start by ripping three blanks to finished width (Fig. 13). Then cut them to length to fit between the rabbets in the door frame.

TONGUES. The dividers are held in place by a short tongue on each end (Fig. 13). I used a dado blade to cut the rabbets that form the tongues (Fig. 14).

EDGE RABBETS. Now the dividers can fit flush down into the frame. But first, in order to completely support the panels, two more rabbets are needed on the edges of each divider (Fig. 15a).

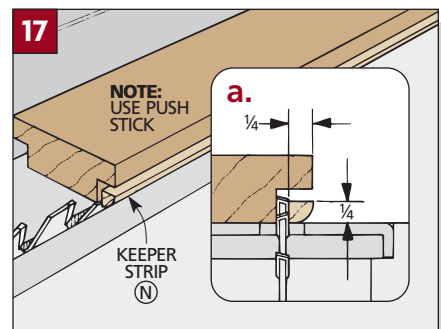
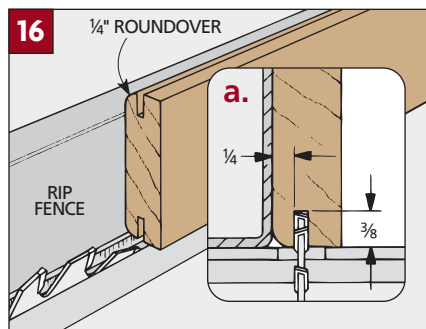
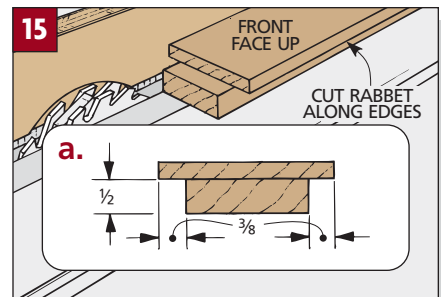
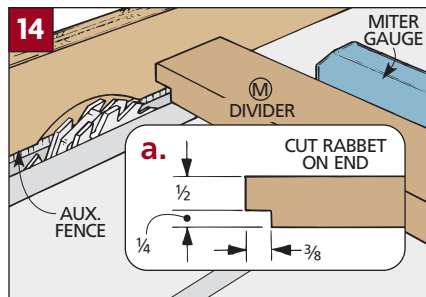
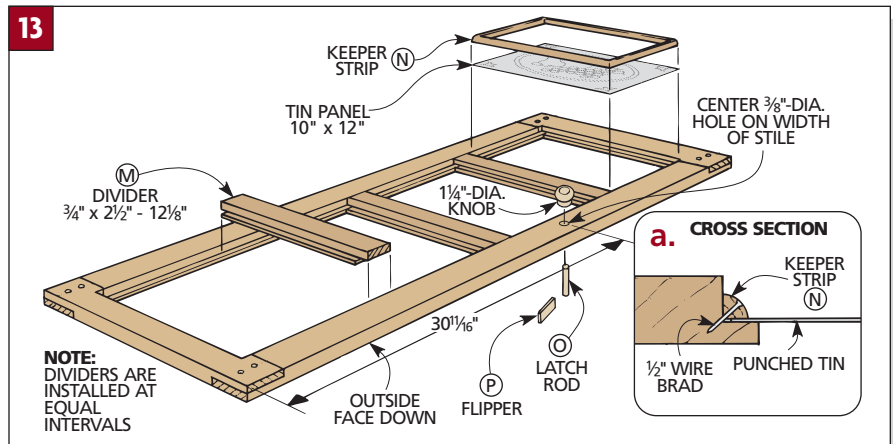
To cut these rabbets, I again used my dado blade (Fig. 15). Cut these with the front of the divider facing up.

KEEPER STRIPS. Once the dividers are glued in place, work can begin on the keeper strips.

The panels are held in place by small quarter-round keeper strips (N) that are nailed to the door frame (Fig. 13a). To make these keeper strips, first rout $\frac{1}{4}$ " roundovers on both edges of a blank (Fig. 16). Then set the rip fence $\frac{1}{4}$ " from the blade and cut a $\frac{3}{8}$ "-deep kerf on each edge. Finally, to separate a keeper strip from each edge, run the blank through the blade face down so the keeper strip falls to the waste side (Fig. 17). This prevents kickback.

TIN PANELS. To make the tin panels, tape your pattern to the tin blank, then fasten the blank to a hardboard backing board. Punch the holes by striking an awl with a hammer. Use softer strikes for smaller holes, heavier strikes for larger holes. When each panel is finished, trim it to size and secure it in the door (Fig. 13a).

MORTISES. After the panels are in place, the door is attached to the case. I used three 2"-long hinges and cut a

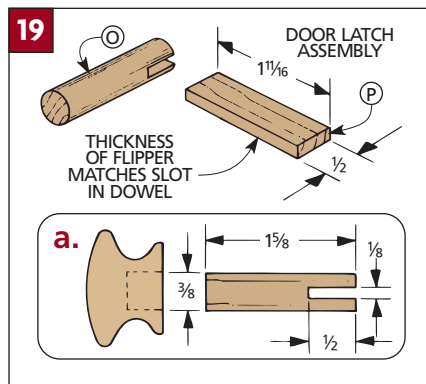
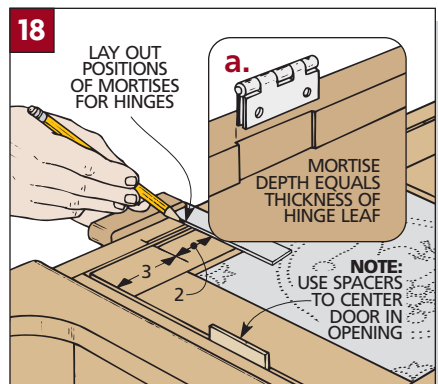


shallow mortise for each hinge in the door stile and the facing strip (Fig. 18a and the Exploded View on page 107).

DOOR KNOB. Next, I built a knob and latch assembly. To start, drill a $\frac{3}{8}$ "-dia. hole through the door stile (Fig. 13). Then drill a hole in the wooden knob to accept a length of dowel (O) (Fig. 19a).

A short "flipper" (P) fits in a slot in the end of the dowel (Fig. 19). When the knob is turned, the flipper will catch the facing strip and prevent the door from swinging open (see photo).

FINISH. Now the cupboard can be stained and finished. Since pine can stain unevenly, use a sealer first.



Before gluing the latch together, make sure it will rotate. If it doesn't, lightly sand the dowel until it does.

DESIGNER'S NOTEBOOK

Change the look of the cupboard just by using solid wood panels instead of punched tin. These raised panels can be made entirely on the table saw.

CONSTRUCTION NOTES:

- To make the wood panels (Q), glue up four blanks from $\frac{3}{4}$ "-thick stock.
- Measure the rabbeted openings in the back of the door frame. Cut the panels $\frac{1}{8}$ " less than these measurements to allow for a $\frac{1}{16}$ " gap all around (Fig. 2).
- To steady the panels, fasten a tall auxiliary fence to the table saw rip fence (Fig. 1). Then tilt the table saw blade 10° and raise the blade to $1\frac{3}{8}$ ".
- Cut the bevels in two passes, moving the rip fence slightly between passes. The first pass removes most of the waste. The second "skim" cut cleans up burn marks or blade swirls and creates the $\frac{1}{16}$ "-wide shoulder (Fig. 2).

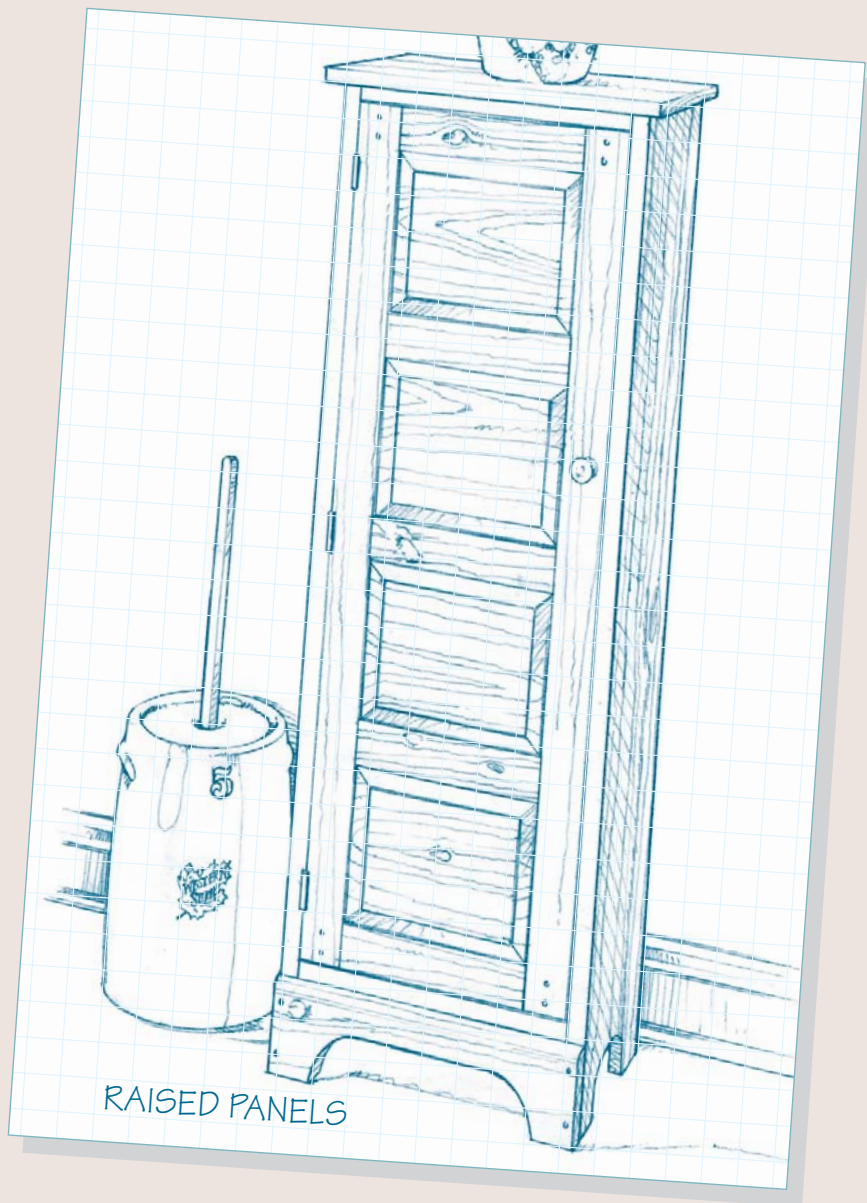
Note: Before moving the rip fence for the second pass, cut the bevels on all the edges of all your panels.

Cut across the end grain edges first. Then any chipout will be removed when the cut is made on the face grain edges.

- The tilted blade will slightly undercut the shoulder. To square it up, make a sanding block with a bevel on one edge that matches the bevel on the panels.

- To make a tongue on the edge of the panel, cut a $\frac{3}{4}$ "-wide rabbet $\frac{1}{4}$ " deep on the back edges (Fig. 2).

- Now, fasten the panels in the door with keeper strips (Fig. 2).

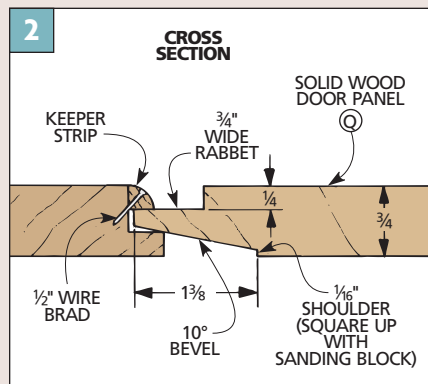
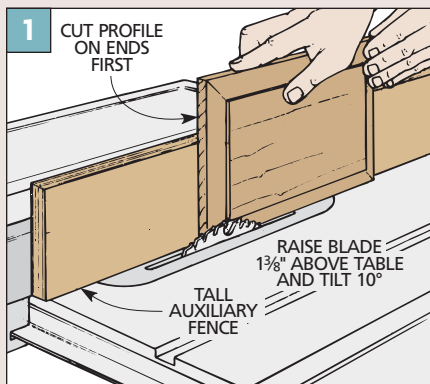


MATERIALS LIST

NEW PARTS

Q Door Panels (4) $\frac{3}{4}$ x $9\frac{7}{8}$ - 12

Note: Don't need tin panels



If a panel shrinks, an unfinished edge may be exposed. To prevent this, apply finish before mounting it in the frame.

Dovetail Chest

Hand-cut dovetails give this chest a traditional country look and also add strength to each corner. For a different look, try the frame and panel version. Both offer plenty of storage and a pull-out tray.



You don't want to rush hand-cut dovetails. They require careful, deliberate work. That doesn't mean they have to be perfect. After all, hand-cut dovetails aren't going to be machine-precise — especially when you're working with wide panels. But that fits the charm of this chest.

STEP-BY-STEP DOVETAILS. There was a time when I found the thought of cutting dovetails by hand rather intimidating. But that was before someone walked me through it step-by-step. So if you've never tried your hand at cutting this joint, we have complete, detailed instructions beginning on page 120.

FRAME AND PANEL OPTION. We also offer a frame and panel version of the chest. This style has a more formal appearance. Details on building this chest are in the Designer's Notebook on page 124.

TRAY. Both versions offer a lift-out tray. It rides on a couple of runners fastened to the front and back of the chest, so there's still storage below it.

The tray is built with a single wide tail at each corner. So even if you don't cut the dovetails for the chest, the tray offers a chance to try the technique on a smaller scale. It's sort of a "project within a project."

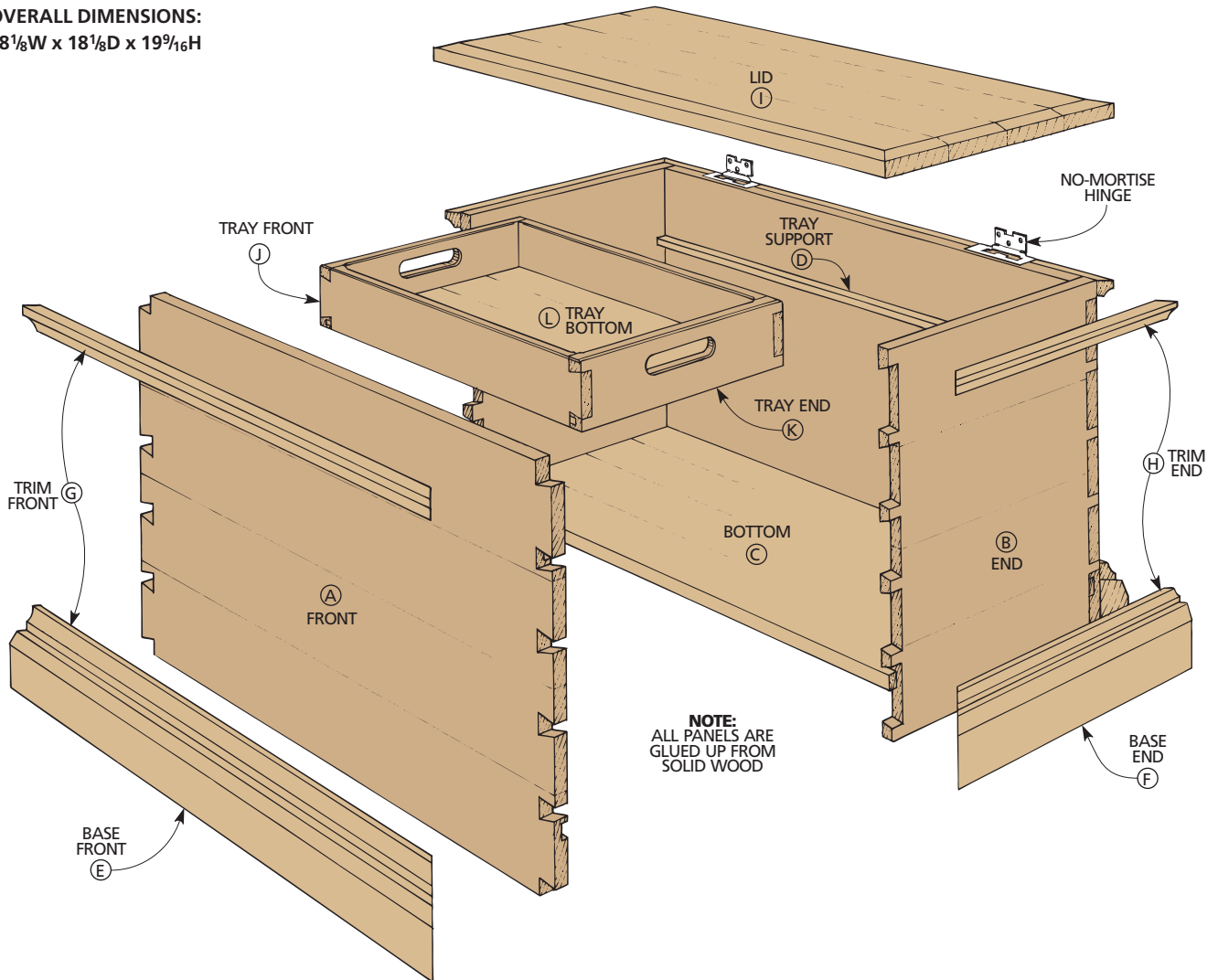
FINISH. I wanted a finish that would match the "antique" character of the chest. So I chose a finish that adds character to many antiques — shellac.

Shellac has been used on furniture a long time, and its color adds a natural warmth that's hard to get from an off-the-shelf stain.

Of course, many woodworkers think of shellac as a "delicate" finish. And while it may not match the durability of polyurethane, a lot of antiques finished with shellac have put up with years of wear. And it's not difficult to apply either. For step-by-step instructions, see the box on page 119.

EXPLODED VIEW

OVERALL DIMENSIONS:
38 $\frac{1}{8}$ W x 18 $\frac{1}{8}$ D x 19 $\frac{9}{16}$ H



MATERIALS LIST

WOOD

A Front/Back (2)	$\frac{3}{4}$ x 18 $\frac{1}{2}$ - 36
B Ends (2)	$\frac{3}{4}$ x 18 $\frac{1}{2}$ - 16
C Bottom (1)	$\frac{3}{4}$ x 15 $\frac{1}{8}$ - 35 $\frac{1}{8}$
D Tray Supports (2)	$\frac{3}{4}$ x $\frac{3}{8}$ - 34 $\frac{1}{2}$
E Base Frt./Bk. (2)	1 $\frac{1}{16}$ x 3 - 40 rough
F Base Ends (2)	1 $\frac{1}{16}$ x 3 - 20 rough
G Trim Frt./Bk. (4)	$\frac{1}{2}$ x $\frac{3}{4}$ - 40 rough
H Trim Ends (4)	$\frac{1}{2}$ x $\frac{3}{4}$ - 20 rough
I Lid (1)	1 $\frac{1}{16}$ x 18 - 38
J Tray Frt./Bk. (2)	$\frac{3}{4}$ x 3 $\frac{1}{2}$ - 24
K Tray Ends (2)	$\frac{3}{4}$ x 3 $\frac{1}{2}$ - 14 $\frac{3}{8}$
L Tray Bottom (1)	$\frac{1}{2}$ x 13 $\frac{1}{2}$ - 23 $\frac{1}{8}$

HARDWARE SUPPLIES

- (2) No. 8 x $\frac{5}{8}$ " Rh brass screws
- (1) 15" brass chain
- (1 pr.) 3" no-mortise hinges w/ screws

CUTTING DIAGRAM

$\frac{3}{4}$ x 5 - 96 (Four Boards @ 3.3 Bd. Ft. Each)



$\frac{3}{4}$ x 5 - 96 (Two Boards @ 3.3 Bd. Ft. Each)



$\frac{3}{4}$ x 5 - 96 (Two Boards @ 3.3 Bd. Ft. Each)



$\frac{1}{2}$ x 8 - 96 (5.3 Sq. Ft)



$\frac{5}{4}$ x 8 - 96 (Two Boards @ 6.6 Bd. Ft. Each)



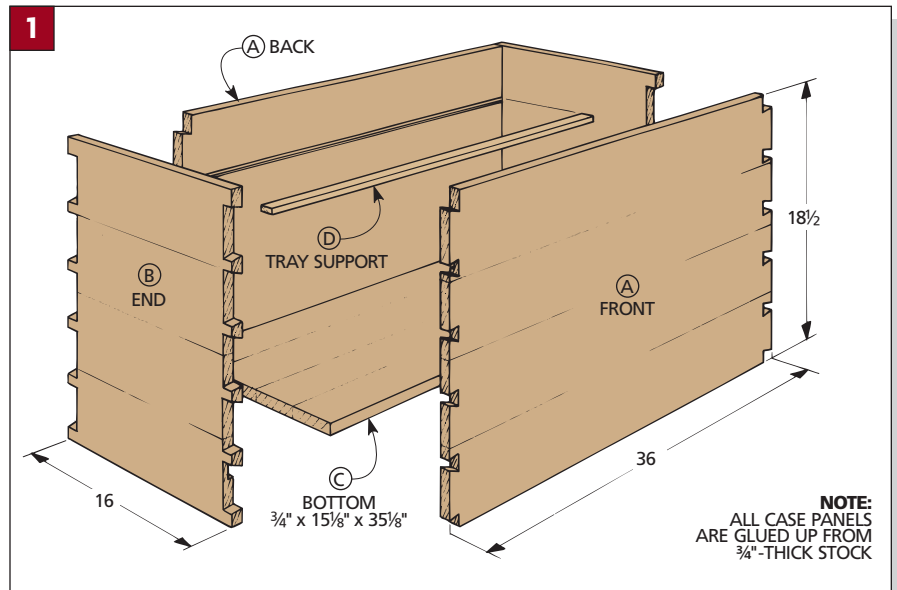
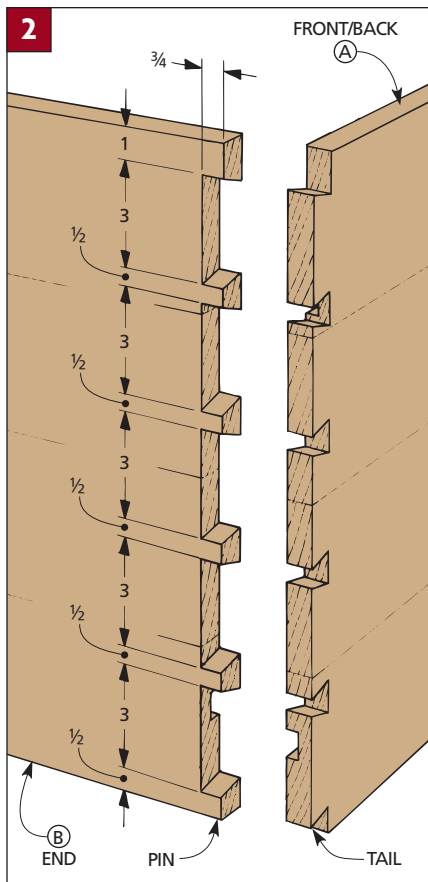
CASE

This dovetail chest starts out as you'd expect: gluing up oversized panels for each of the sides and for the bottom. There isn't anything unusual or difficult about these five $\frac{3}{4}$ "-thick panels. The important thing is that they are flat and that the four side panels are all the same thickness. This will make it much easier when it comes time to cut the dovetails.

After the panels are glued up, the next step is to cut the front/back panels (A) and end panels (B) to finished size (Fig. 1). (The bottom will be cut to size later.) I began by simply ripping each of these panels to width. But when cross-cutting, the long panels require some extra support. To do this, I added a long auxiliary fence to the miter gauge. This way, it's much easier to get the ends of the panels square to the sides.

DOVETAILS. After the panels are cut to size, work can begin on the dovetails. The dovetails are laid out $3\frac{1}{2}$ " on center (Fig. 2). This allows for 3"-wide tails and $\frac{1}{2}$ " pins.

Actually, not all the pins are $\frac{1}{2}$ ". The top one is a little wider (1"). But the extra width is covered by some molding



added later, so once the chest is completed, it looks the same as the other pins (Fig. 3).

With the layout finished, the pins and tails can now be cut.

Note: For step-by-step instructions on cutting dovetails by hand, see the Joinery article beginning on page 120.

GROOVES. When the dovetails are complete, there are some grooves to cut in the panels before you can assemble the case. I used a dado blade in the table saw to cut these.

The first two grooves are for the tray supports (added later). They are $\frac{3}{8}$ " wide, $\frac{3}{8}$ " deep, and cut on the inside faces of the front and back panels *only* (Fig. 4). I centered these grooves in one of the pin openings. This way the pins on the end panels will hide the grooves when the case is assembled.

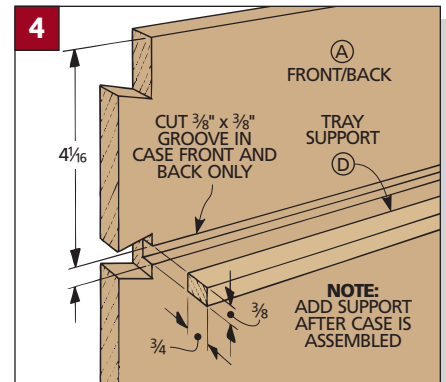
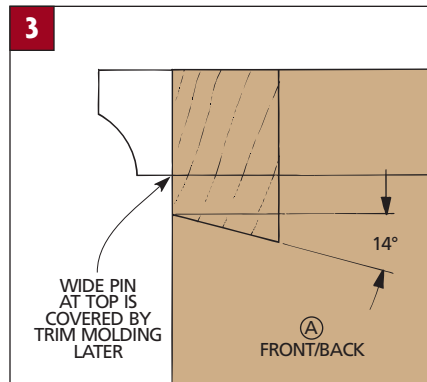
The other groove is for the bottom of the chest (Fig. 5). It's $\frac{3}{4}$ " wide, $\frac{3}{8}$ " deep, and cut in all four pieces. This groove cuts through a tail, so it'll be visible from the outside when the case is

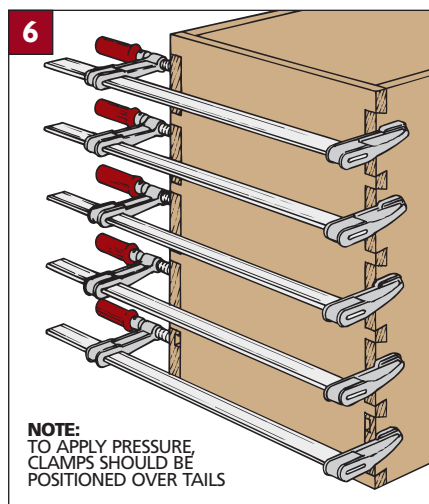
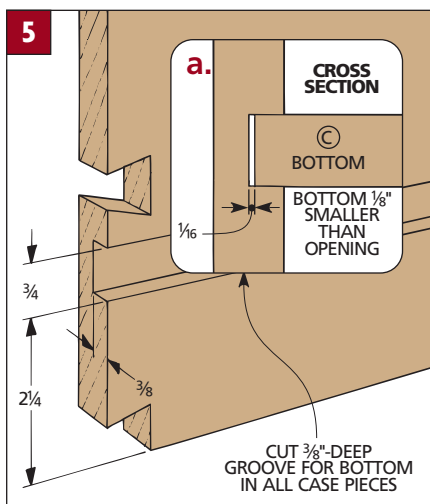
first assembled. But don't worry about this. Later, the groove will be covered by the molding that's fastened to the bottom of the case.

BOTTOM. Now it's time to begin work on the bottom panel (C). But to do this, first you need to dry-assemble the case. Then you can measure the case opening to determine the final size of the bottom (Fig. 1). Remember to include the depth of both grooves in this measurement.

Because the bottom is a solid wood panel and not plywood, it needs enough room to expand and contract with changes in humidity. To allow for this movement, I cut the bottom (C) $\frac{1}{8}$ " smaller than each dimension (Fig. 5a). (Mine was $15\frac{1}{8}$ " x $35\frac{1}{8}$ ".)

CASE ASSEMBLY. After the bottom panel is ready, you can glue the case together (Fig. 6). (But don't use glue on the bottom.) This takes quite a bit of time, so I used white glue. It sets up more slowly than yellow glue, so it gives you a little more time to work.





First, glue both end panels (B) to the front panel (A). Then slide the bottom panel (C) into the groove before adding the back panel to the assembly.

TRAY SUPPORTS. While the glue is drying, cut two $\frac{3}{4}$ "-wide tray supports (D) to fit in the grooves inside the case (Fig. 4). This time, I wanted the glue to set up fast, so I used yellow glue. That way, I didn't have to worry about using clamps. Applying a little hand pressure for a minute or two was all it took.

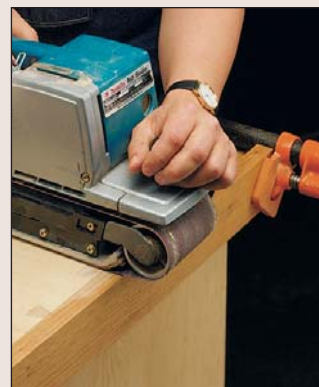
At this point, the case is essentially complete. But if there are pins or tails protruding, you'll need to sand them flush with the sides of the case (see the Shop Tip at right). If some pins or tails need more trimming than can be easily sanded, see the Shop Jig box below for one way to trim them down.

After the case is assembled and the corners are smoothed, all that's left to do is add the base molding, the trim molding, and the lid.

SHOP TIP

Sanding Flush

If the pins or tails (or both) stand proud of the side, one way to get them flush is to use a belt sander. However, it's easy to accidentally round over a corner. To prevent this, clamp a scrap piece across the end of the case flush with the panel the sander is riding on.



SHOP JIG

Flush Trim Jig

With this jig, a straight bit will trim any over-long pins or tails perfectly flush with the sides.

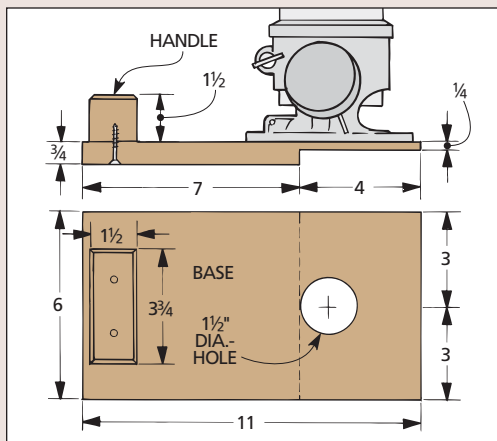
This jig replaces the plastic base of the router. That's because the edge of a regular base will run into the pins or

tails before the bit can get near enough to trim them flush. To solve that problem, this auxiliary base raises the router above the case side.

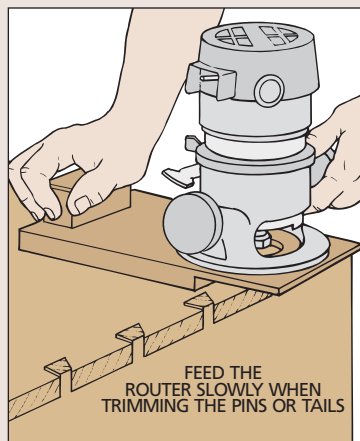
The base is simply a $\frac{3}{4}$ "-thick piece of stock with a wide rabbet cut on the bottom (Step 1).

To make the base stable, it's cut extra long (mine was 11"). And for added control, there's a block screwed and glued to one end for a handle. Use the plastic base from your router as a template to mark the mounting holes and the bit hole.

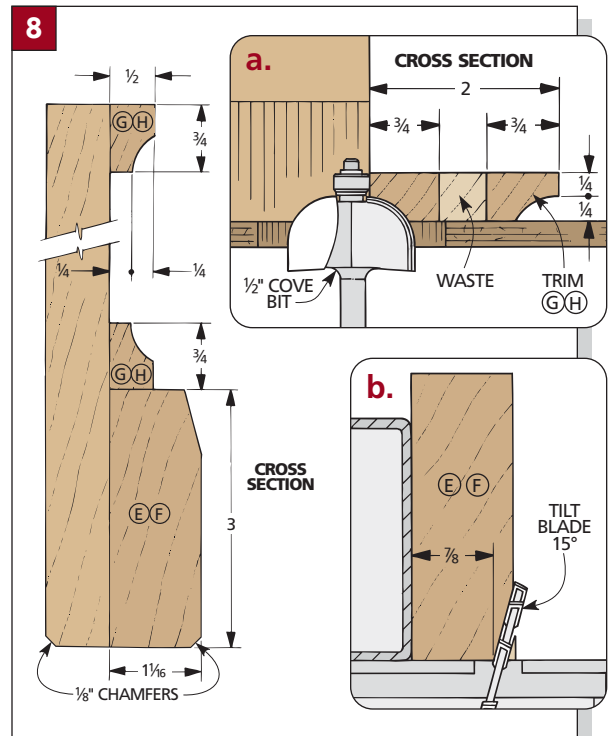
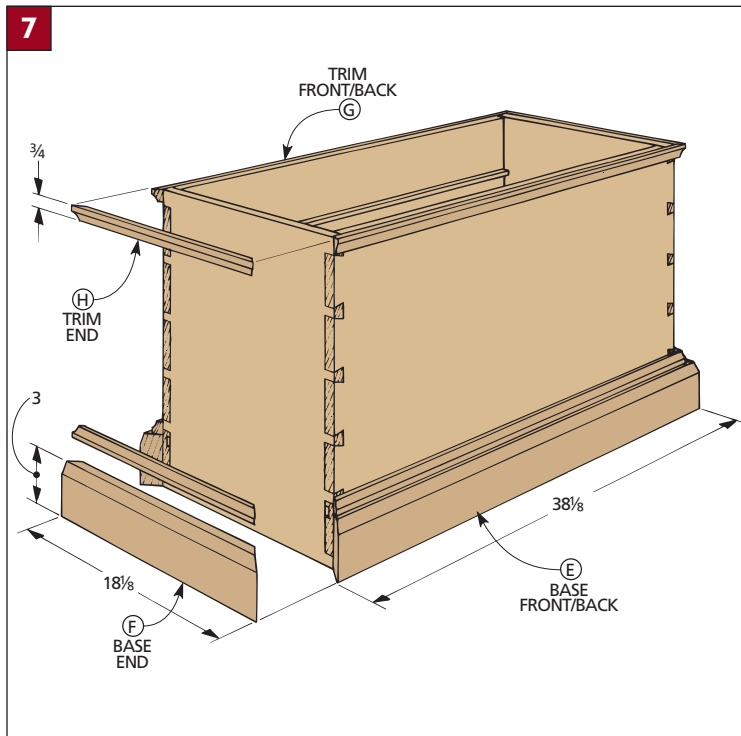
To use the jig, simply adjust the bit height so it trims the pins or tails flush (Step 2). To do this, set the jig on the case side. Then adjust the bit so it just barely grazes the side panel. Now, with the bit extended past the case, turn on the router. Move it onto the case and begin trimming. A slow feed rate will help prevent chipout.



1 First, build an auxiliary base from $\frac{3}{4}$ "-thick stock. A straight bit in the router trims the sides of the joint flush. The wide rabbet along the front of the jig provides clearance for the bit.



2 With the base on the case side, set the bit so it barely touches the case. Move the bit off the case, start the router, and trim the joint.



MOLDING

I've seen wide, thick base molding on some older chests, and I wanted the base on this chest to look the same. So instead of using $3/4$ "-thick stock, I cut the base pieces from $1\frac{1}{16}$ "-thick stock.

BASE. The base front/back (E) and base ends (F) are first cut to rough length from 3"-wide blanks. Next, cut a decorative chamfer along the top edge (Fig. 8b). I did this on the table saw with the blade angled 15° . Then to complete the base, miter the pieces to length and glue them to the case.

TRIM MOLDING. The next pieces to add are some strips of trim molding (Fig. 7). Some of this trim will sit on top of the base molding. The rest will end up flush with the top of the case.

To make the trim front/back (G) and

trim ends (H), start with blanks that are $1\frac{1}{2}$ " thick and 2" wide (Fig. 8a). Rout a $1\frac{1}{2}$ " cove along two edges. Then two $3/4$ "-wide (tall) trim pieces can be ripped from each blank. Miter the pieces to length and glue them in place. (The cove profiles should face each other.)

Finally, to prevent chipping the edge if the chest gets dragged across the floor, rout $1/8$ " chamfers on the bottom edges of the case and molding (Fig. 8).

LID

Now that the case is complete, I started work on the lid (Fig. 9). This means you'll need to glue up another panel. But this panel is $1\frac{1}{16}$ " thick.

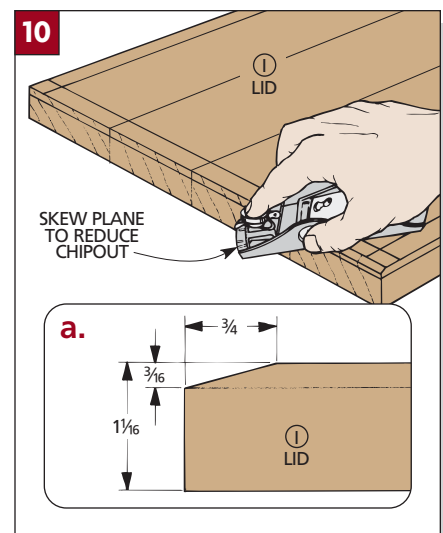
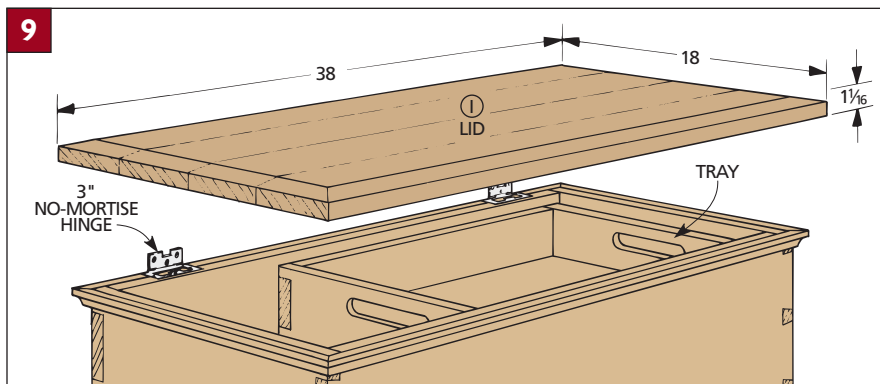
Since you lift the lid from the edges, I wanted it to overhang the case a bit. So to determine the size of the lid (I), mea-

sure the case (including the trim) and cut the lid panel 1" longer and wider.

CHAMFER. I also wanted the lid to have the same chamfer that's around the base. But the panel is too long to stand on end on the table saw. So I used a block plane to cut this.

Before planing, lay out the edges of the chamfer (Fig. 10). Then plane down to these lines, starting with the ends of the lid. To avoid chipout, skew the plane slightly so it shears off thin shavings.

HINGES. When the chamfer is cut, mount the lid to the case. To do this, I used a special "no-mortise hinge." It has an offset barrel and, as you'd expect,



doesn't require a mortise (*Fig. 11*). (See page 126 for sources of this hinge.)

To mount the hinges, first screw them to the case. Next, set the lid on top of the case and center it side-to-side and front-to-back. Then simply trace around the barrels of the hinges on the bottom of the lid. Now remove the lid and hinges. Then screw the hinges to the lid and reattach the hinges to the case.

LID SUPPORT CHAIN. The last thing to add is a 15"-long piece of brass chain to the inside of the case (*Fig. 11*). This prevents the lid from dropping back.

Safety Note: If children will be opening and closing this lid, you should protect their fingers by installing a lid support. (For sources, see page 126.)

TRAY

With the lid attached, the last step is to build a tray that fits in the case and slides back and forth on tray supports.

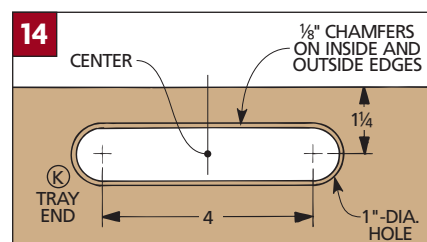
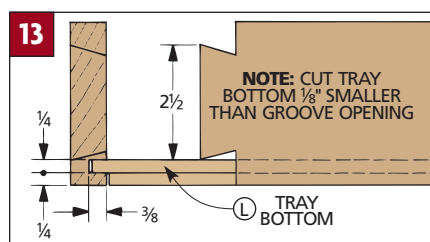
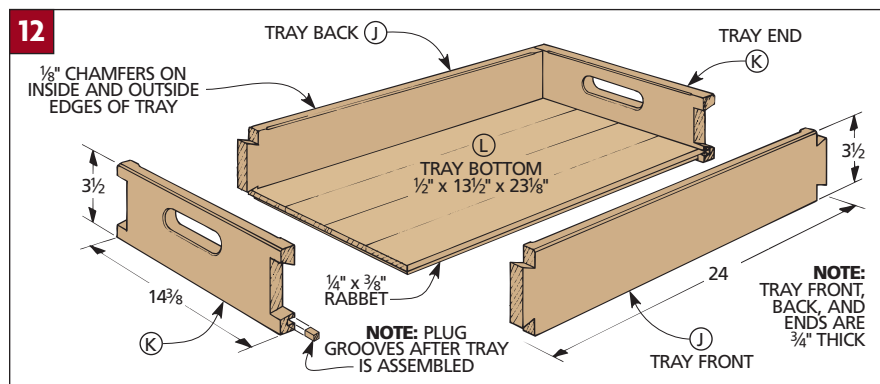
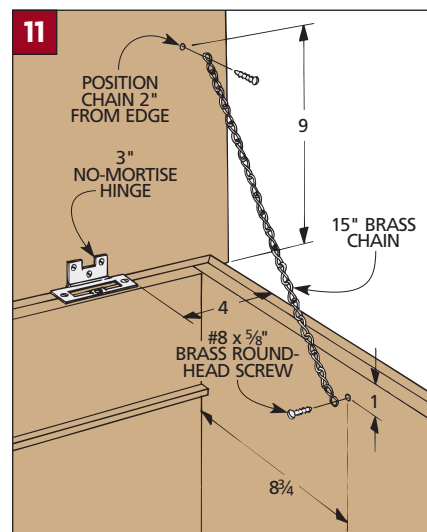
First, the tray front/back (J) and tray ends (K) are cut to finished size. Then to join these pieces, I cut the dovetails by hand (*Figs. 12 and 13*).

GROOVE AND BOTTOM. Next, I cut a $\frac{1}{4}$ "-wide groove $\frac{3}{8}$ " deep in each piece for the tray bottom (*Fig. 13*).

The tray bottom (L) is a solid wood panel, glued up from $\frac{1}{2}$ "-thick stock (*Fig. 12*). After the glue dried, I cut the bottom to finished size. The panel should fit inside the tray (including the grooves) minus $\frac{1}{8}$ ". Of course, a $\frac{1}{2}$ "-thick panel won't fit into a $\frac{1}{4}$ " groove. So I cut a $\frac{3}{8}$ "-wide rabbet along the bottom edge of the tray bottom to create a $\frac{1}{4}$ "-thick tongue (*Fig. 13*).

HANDLES. Next, I wanted to add some "handles" to the ends of the tray. These handles are simply slots drilled and cut in the end pieces (*Fig. 14*). To do this, first drill 1"-dia. holes to establish the length of the handle slot. Then clean out the waste between the holes with a jig saw. Now sand the handles and rout small chamfers on both the inside and outside edges. When that's done, the tray can be glued together.

FINAL TOUCHES. There are just two steps left. First, you want to chamfer the inside and outside edges so there are no sharp corners (*Fig. 12*). And finally, don't forget to plug the holes in the end pieces that were created by the grooves for the tray bottom (*Fig. 12*).



FINISHING TIP

To give the chest a warm, "aged" color, I used three coats of shellac.

The first coat was orange shellac. This gave the wood a nice, warm color — and it doesn't blotch like a pigment-based stain will.

Then to keep the color light, but still add more protection, I applied two coats of blonde shellac.

Shellac comes ready-to-use or in flakes that must be dissolved in alcohol. (See page 126 for sources.) Once dissolved, it begins to slowly deteriorate. So that I know it's

fresh, I mix my own from flakes.

Shellac is mixed in "pound cuts" — the number of pounds of flakes to a gallon of alcohol. I used a 2 lb. cut. But I only mixed up a pint at a time (which requires 4 oz. of shellac flakes). Don't worry about being precise. Just get it in the ballpark.

To apply shellac, I use a natural bristle brush. Don't work the finish too much with the brush. The shellac dries fast, so you can sand lightly after about three hours and apply another coat.



JOINERY..... Hand-Cut Dovetails

Which comes first, the pins or the tails? Frankly, you can cut them either way, but I like to start with the pins. There are some reasons for this, beyond the fact that it's how I was taught and how I've always cut them.

WHICH IS WHICH? But maybe I'm jumping the gun. After all, when you look at this joint, it can be hard to tell which is the tail and which is the pin.

The trick is to look at just the *face* of the board, not the ends (*Fig. 1*). Looking at the face of the panel with the tails, you'll see the tails flare out — like a dove's tail. And from the face of the pin panel, the pins look straight, sort of like box joints. The pins slide in between the tails, but unlike box joints, they can only slide in one direction. The angled sides act as wedges, so you can't pull them apart any other way. This wedge is what makes a dovetail joint so strong.

PINS FIRST. So why do I cut the pins first? There are a couple reasons. First, I think the pins are easier to cut. But it's also easier to cut them accurately. And if they don't end up perfectly square to the baseline, it's easy to clean them up so they are. This is important because after the pins are cut, you'll use them to lay out the positions of the tails. (Laying out the tails from the pins is also easier than marking the pins from the tails.)

STOCK PREPARATION

Regardless of which panel you start with, your first step is always going to be the same: stock preparation.

FLAT AND SQUARE PANELS. Whether you're dealing with narrow boards or wide panels, each piece must be flat and



smooth. In fact, all they should need is a little finish sanding. It's also important for the ends of the boards to be square to the edges.

ORIENTATION. When the panels are flat and square, the next thing to do is arrange the panels so the project will look its best when it's put together.

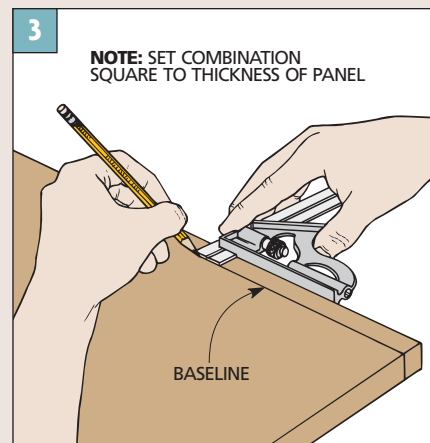
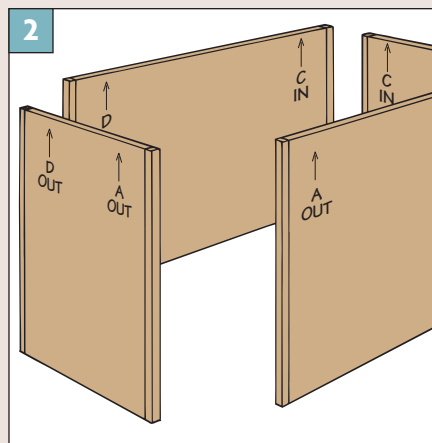
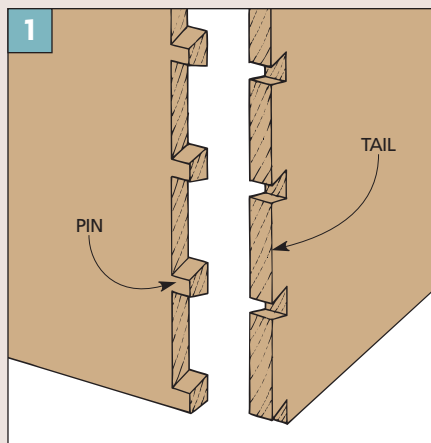
Once the panels are labeled, I label the outside and inside faces, as well as the top edges (*Fig. 2*). Also, it's a good idea to label adjoining corners with a letter. When you transfer the pins to the mating tail panels later, these labels can save you a lot of head scratching.

BASELINE. Finally, I use a combination square and a pencil to mark baselines around the ends of each panel

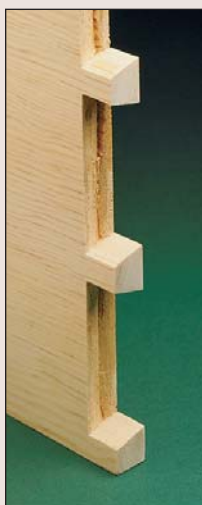
(*Fig. 3*). The baselines show where to stop cutting and are drawn on both faces (*Fig. 2*). (A razor knife can also be used to score the baseline into the panel.) Just set the adjustable square to the thickness of the panel. Then carefully run the square along the end of the panel while you mark the baseline.

Note: If you're working with small pieces, the easiest way to lay out the baseline is to use the boards themselves as a template. Stand up one board and place it against the end of the adjoining piece. Then simply trace around it.

Now that the panels are labeled and the baselines are drawn, you can begin work on the pins.



PINS: STEP-BY-STEP



When cutting the pins, there are three things to do: lay out the pins, make cuts on each side of them with a hand saw, and remove the waste between them.

LAY OUT. The first step is to lay out the position of each pin. (On the chest, the pins are on the end panels, B.) I start with the outside face of the

panel toward me (the face with the narrowest part of the pins) (Step 1).

Next, the layout can be drawn around to the inside face. To lay out the angles across the ends, I use a bevel gauge (Step 2). (Since the chest was softwood, I used an angle of 14°. In hardwood, I'd use an angle of 9°.)

When the pins are laid out, I always mark the waste sections (Step 3). This makes it harder for me to cut on the wrong side of the line.

CUTTING THE PINS. Now the pins can be cut (Step 4). Here, it's important to keep the saw straight up and down so the pin ends up square to the baseline.

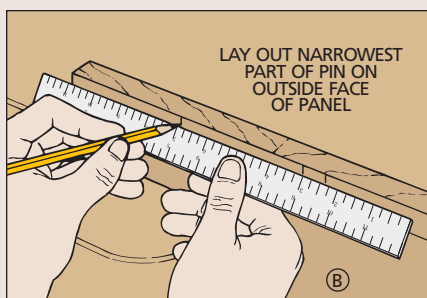
I keep the outside face of the panel toward me. This way, I can be extra careful with the good face. If I'm off the line a bit on the inside, it won't show.

REMOVING THE WASTE. When all the pins are cut, you can clean out the waste between them (Steps 5-7).

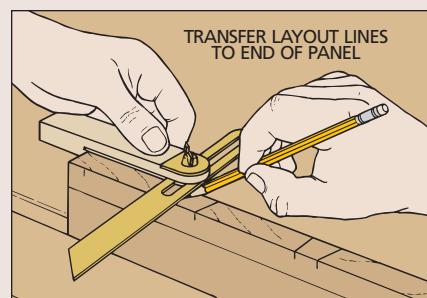
Here, I do two things. To ensure a clean, straight baseline, I clamp a backing board to the panel. But this board can shift out of position. Especially when you start pounding on the chisel with a mallet. So to prevent this, I begin by removing tiny "bites."

Another thing I do is undercut the shoulder (Step 6). That means after about 1/8" of waste is removed, I'll angle the top of the chisel slightly toward me when chopping out the waste. This way, it's easier to get a good, tight fit.

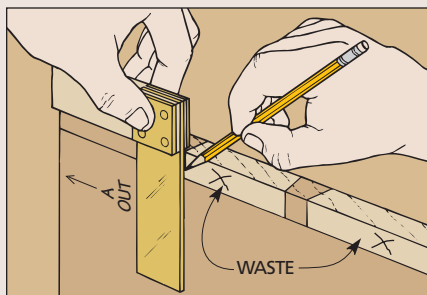
When all the waste is removed, you'll need to spend a little time cleaning up all the corners. And check that each pin is straight and square, making any adjustments if necessary (Step 8).



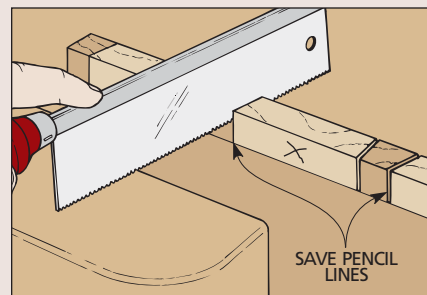
1 Secure the panel in a vise. Then, lay out the pins with the narrow part of the pin on the outside face of the panel.



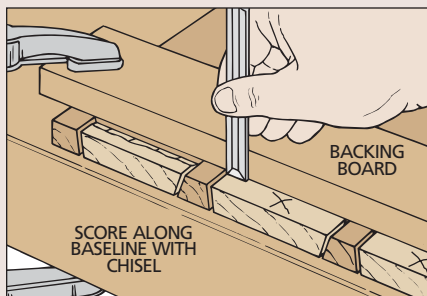
2 To lay out the pin angle on the end of the panel, hold a pencil on the mark, then bring a bevel gauge up to it.



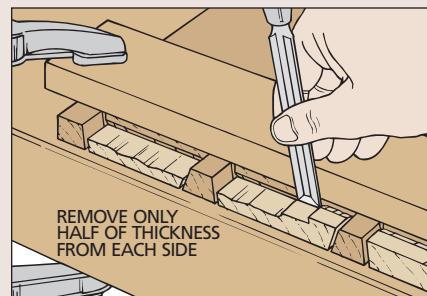
3 Use a square to transfer lines from the ends down to the baseline. Do this on both sides of the panel. Then, before cutting, mark the waste sections.



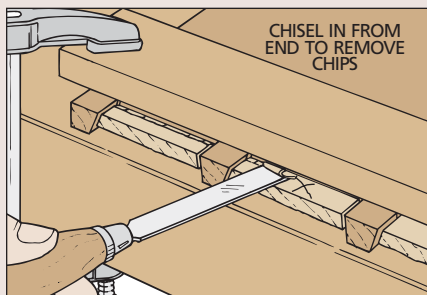
4 Use a fine-tooth saw to cut to the waste side of all lines. Stop when the kerf has reached the baseline on both sides. Don't cut past the baseline.



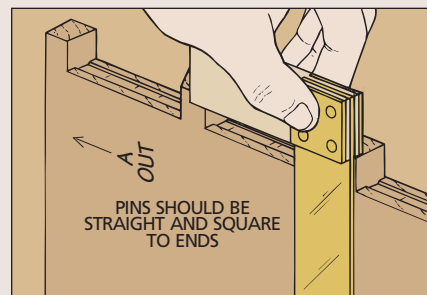
5 Now clamp a backing board along the baseline. This will help keep your chisel straight up and down. Next, use a sharp chisel to establish the shoulder.



6 To remove the waste, chop straight down. Then chip in from the end to remove tiny chips. After removing 1/8" of the thickness, start a slight undercut.

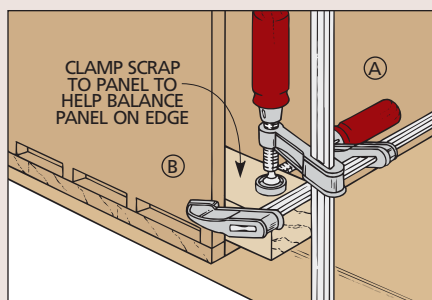


7 When half the waste is gone, flip the panel over and reposition the backer board. Repeat the procedure to remove the rest of the waste.

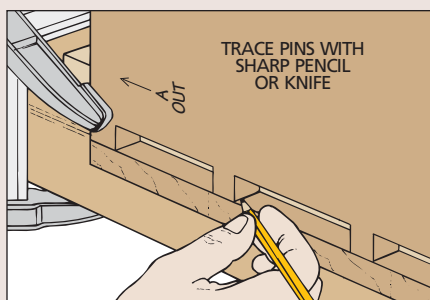


8 After cleaning up the corners with a chisel, make sure each pin is straight and square to the end of the panel. Use a chisel to true up any out-of-square pins.

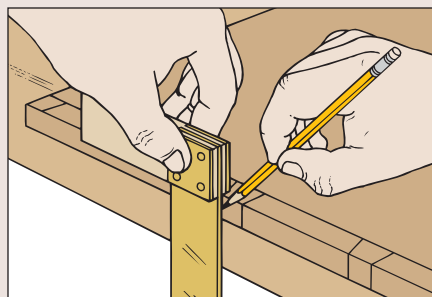
TAILS: STEP-BY-STEP



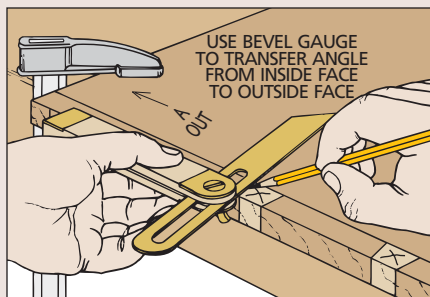
1 Lay out the tails from the pins. Set the tail panel inside-face up on the bench. Set the pin panel on top so edges align.



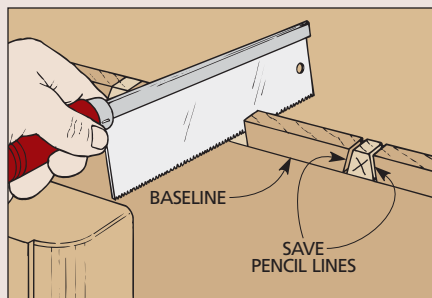
2 With the panels flush at both ends and the edges, trace the pins onto the tail panel. Use a sharp pencil.



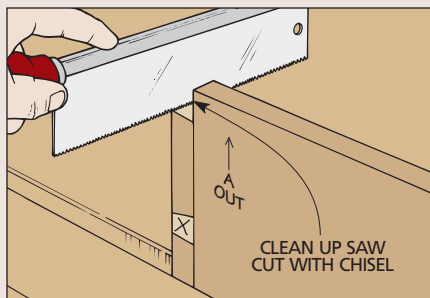
3 To extend the lines around the panel, draw parallel lines across the ends. To do this accurately, position the pencil, then slide the try square up to it.



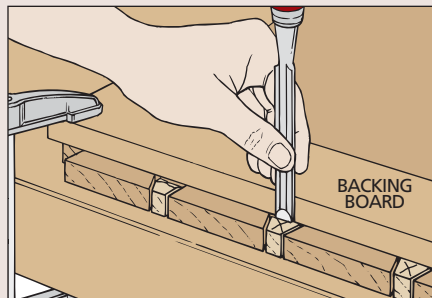
4 Transfer the angles on the inside face to the outside face. Adjust the bevel gauge to match the angle on the inside face. Then draw it on the outside face.



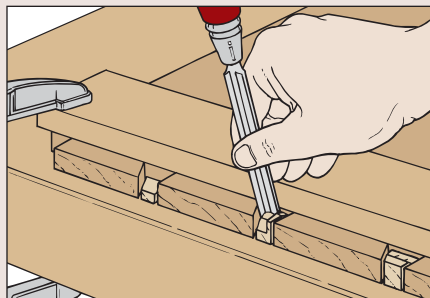
5 To form the sides of the tails, hold the saw at an angle and begin cutting, staying on the waste side of the line. Stop when the kerf reaches the baseline.



6 Remove waste at the top and bottom with a saw, cutting from the edges toward the first tail. Then clean up the cuts with a chisel.



7 Use a chisel to remove the waste between the tails. As with the pins, clamp a backing board to the panel and score the shoulder.



8 Remove half the thickness of the waste from one side of the panel. Then flip the panel over and repeat the process. Finally, test fit the joint.



After the pins are complete, it's time to work on the tails. I mark the tails directly from the pins. This way, they will match them perfectly.

LAY OUT. To lay out the tails, first set the tail panel on the workbench, with the inside face up. Then stand the pin panel on top so the panels form a corner. These two panels should be

flush at the ends and the edges, with both inside faces toward each other. (Here's where all that marking at the beginning helps.)

Note: To help the pin panel stand upright, I clamp a piece of scrap to it (Step 1). This also helps remove any slight cupping that may be in the panel.

Now that the tails are marked on the inside face, the lines can be transferred around the panel to the outside face (Steps 3-4). Drawing the straight lines across the ends of the panel is easy. But to transfer the angles to the outside face, you'll need to use the bevel gauge.

To be safe, I don't just draw the same angle I used to draw the pins. Instead, I check each angle on the inside face, adjust the bevel gauge if necessary, and then transfer this angle to the outside face. Then mark the waste areas.

CUTTING THE TAILS. When cutting the tails, the saw isn't straight up and down — it's angled (Step 5). This means starting the cut is a little trickier. The saw may tend to skate across the end, so I start more toward the waste side of the line. This leaves more clean-up, but the dovetails fit together better.

REMOVING THE WASTE. With all the kerfs cut, it's time to remove the waste.

But this time, use the saw to remove the waste sections for the pins at the top and bottom of the panel (Step 6). Then clean up the shoulders with a chisel.

Now you can clean out the rest of the waste between the tails using the same procedure used to clean between the pins (Steps 7-8).

FITTING & ASSEMBLY

Before the joint can be fully assembled, you'll likely have to do some fitting.

FITTING. To get the joint to fit, you'll probably need to remove a little material from either the tails or the pins. To see just where to remove this material, dry-assemble the joint as much as possible (see photo at right).

But don't force it. If you do, the pins at the top and bottom can split from the pressure. The goal is a final fit that can be dry-assembled with a few light taps.

With the joint dry-assembled as much as possible, you should be able to see where the joint is binding. And when you pull the joint apart, the tight spots will also be burnished slightly. To make these areas easier to see, I like to mark them with a pencil.

CHISEL. To remove a lot of waste, you can pare it away with a chisel (*Fig. 1*). This removes the wood quickly, but it's

also easy to remove too much material.

SANDING STICK. So I often use a little sanding stick (*Fig. 2*). I make one from a thin piece of scrap with some adhesive-backed sandpaper attached. I bevel the edges to match the angle of the tails so I can sand right into the corner.

ASSEMBLY. When all the joints fit, the case is ready to be assembled (*Fig. 3*). I use white glue when assembling a large case. It has a longer setup time than yellow glue, which helps with all the small faces that need to be glued.

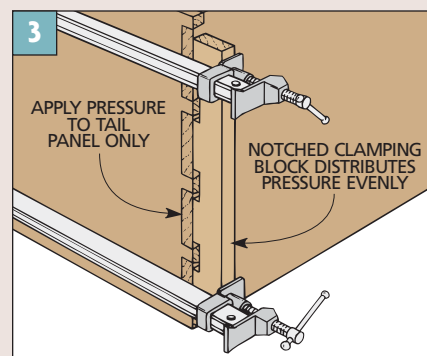
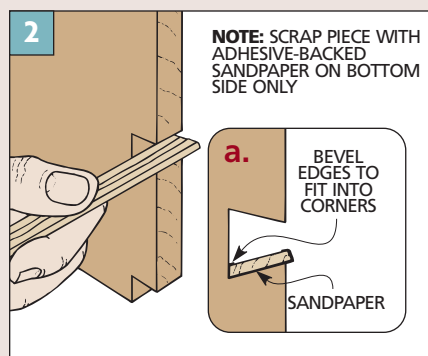
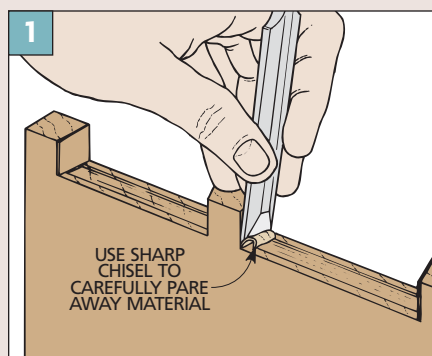
I usually apply glue just to the sides of the pins and tails. I don't bother gluing the baseline since it's end grain.

Clamping up dovetails usually takes a little preparation. To pull the joint tight, you only want to apply pressure to the tails (not the pins). You'll need a good number of clamps ready to go.

If you don't have many clamps, you



can distribute the clamping pressure evenly across the joint with a special clamping block (*Fig. 3*).



TROUBLESHOOTING

Even after the joint fits together, there may still be some work to do.

PROTRUDING TAILS AND PINS. One common problem is when either the tails or pins stick out. But this is easily corrected with a little sanding or

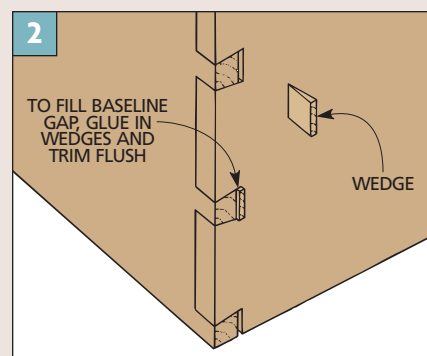
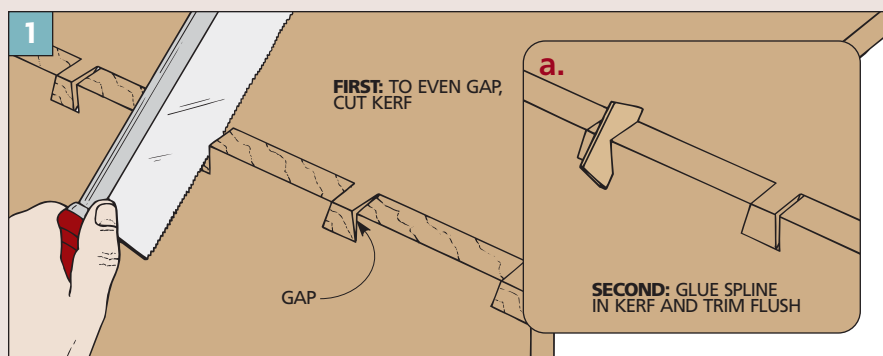
routing. Refer to page 117 for some ways to do this.

GAPS BETWEEN DOVETAILS. Gaps between a tail and a pin can be fixed with your hand saw and a spline.

The idea is to cut an even kerf

through the gap (*Fig. 1*). Then glue a spline in the kerf to "patch" it (*Fig. 1a*).

GAPS AT BASELINE. You may find a gap along the baseline of the tails. Here the cut was too deep. The solution is to use wedges to fill the gaps (*Fig. 2*).



DESIGNER'S NOTEBOOK

By using frame and panel construction for the sides, the chest takes on a more formal appearance. To complement this classic look, choose a hardwood such as oak, cherry, ash or walnut.

CONSTRUCTION NOTES:

■ Start by cutting all the rails and stiles (M, N, O, P, Q, R, S) to finished width and length (Fig. 1).

■ To accept the panels added later, cut $\frac{1}{4}$ "-wide grooves $\frac{1}{2}$ " deep centered on the thickness of each piece (Fig. 1). Also cut grooves on both edges of the front/back short stiles (N).

■ Cut $\frac{1}{2}$ "-long tenons on the ends of the rails (O, P, R, S) to fit the grooves in the stiles (Fig. 1). Also cut a tenon on each end of the front/back short stiles (N).

■ Use a dado blade in the table saw to cut a rabbet along one edge of each front/back long stile (M). This rabbet should be $\frac{3}{8}$ " deep and fit the thickness of the end stiles (Q) (Figs. 1 and 3).

■ Now dry-assemble each set of rails and stiles, and measure for the six panels. (Make sure the short stiles are centered in the front/back assemblies.) Measure each opening, inside edge to inside edge, and add $\frac{3}{4}$ " to each dimension. The assemblies for opposite sides should be the same width and length.

■ Glue up six $\frac{1}{2}$ "-thick blanks for the panels (T, U). Cut them to finished size after the glue dries.

■ To form the raised center on each panel, first fasten a tall auxiliary fence to the table saw rip fence. Raise the blade $1\frac{3}{8}$ " and tilt it 8° . Then position the rip fence $\frac{3}{16}$ " from the blade with the blade tilted away from the fence.

■ Cut bevels on all four edges of all six panels (Fig. 1). Cut the ends first, then the edges to clean up any tearout.

Safety Note: Use a zero clearance insert to help prevent the panel from tipping into the opening around the blade.

■ Use a beveled sanding block to remove blade marks and square up the shoulders of the raised panels.

■ Apply a finish before gluing the frame and panel assemblies together. Refer to the photo on page 113.

■ Now you can glue and clamp together the frame and panel assemblies. Do not use glue on the panels. Check that each assembly is flat and square.

■ Before gluing the chest together, two sets of grooves need to be cut. First, cut grooves on the inside faces of all four assemblies to fit the thickness of the bottom panel (C) (Fig. 4). The bottom

MATERIALS LIST

CHANGED PARTS

D	Tray Supports (2)	$\frac{3}{4}$ x $\frac{3}{8}$ - 34 $\frac{1}{2}$
K	Tray Ends (2)	$\frac{3}{4}$ x $3\frac{1}{2}$ - 13 $\frac{1}{2}$
L	Tray Bottom (1)	$\frac{1}{2}$ x 12 $\frac{5}{8}$ - 23 $\frac{1}{8}$

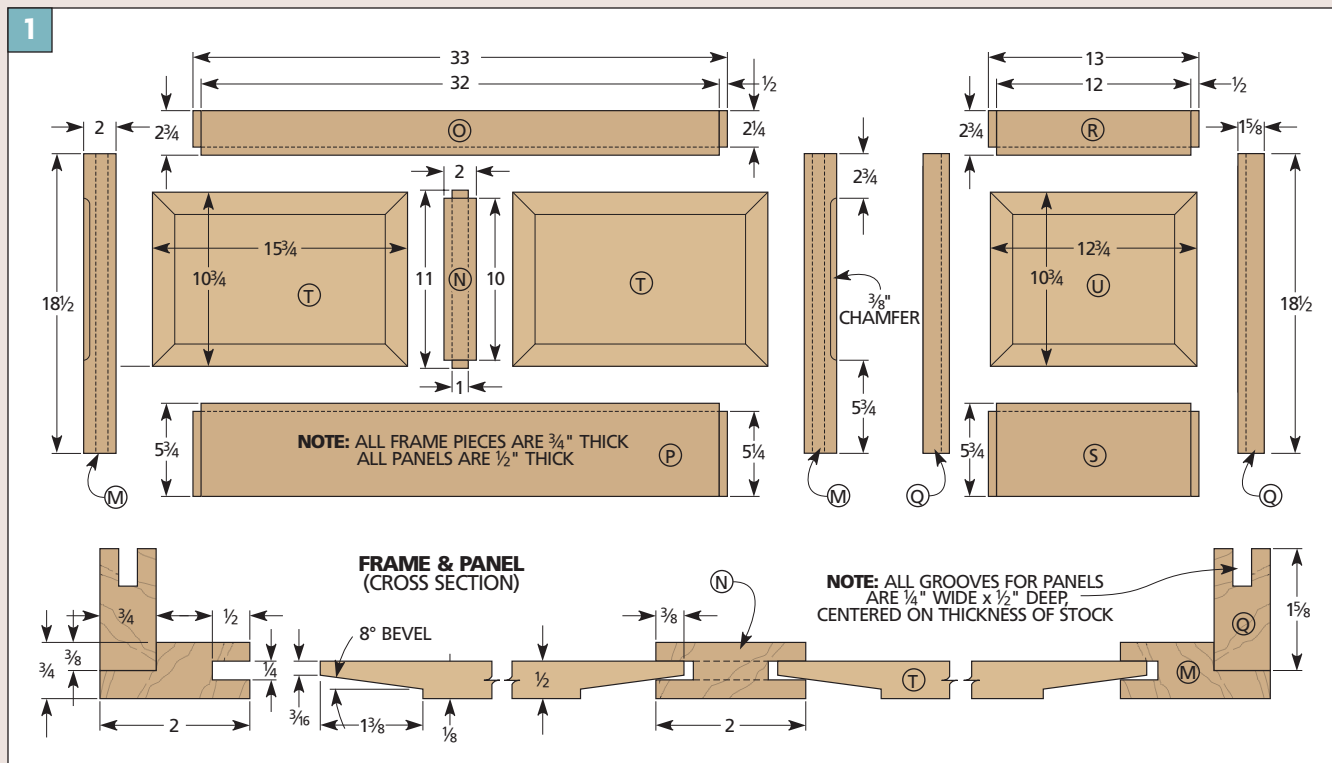
NEW PARTS

M	Fr./Bk. Long Stiles (4)	$\frac{3}{4}$ x 2 - 18 $\frac{1}{2}$
N	Fr./Bk. Short Stiles (2)	$\frac{3}{4}$ x 2 - 11
O	Fr./Bk. Top Rails (2)	$\frac{3}{4}$ x 2 $\frac{3}{4}$ - 33
P	Fr./Bk. Btm. Rails (2)	$\frac{3}{4}$ x 5 $\frac{3}{4}$ - 33
Q	End Stiles (4)	$\frac{3}{4}$ x 1 $\frac{5}{8}$ - 18 $\frac{1}{2}$
R	End Top Rails (2)	$\frac{3}{4}$ x 2 $\frac{3}{4}$ - 13
S	End Btm. Rails (2)	$\frac{3}{4}$ x 5 $\frac{3}{4}$ - 13
T	Fr./Bk. Panels (4)	$\frac{1}{2}$ x 10 $\frac{3}{4}$ - 15 $\frac{3}{4}$
U	End Panels (2)	$\frac{1}{2}$ x 10 $\frac{3}{4}$ - 12 $\frac{3}{4}$
V	Tray Runners (2)	$\frac{3}{8}$ x $\frac{1}{2}$ - 24

Note: Do not need parts A, B.

HARDWARE SUPPLIES

(8) #8 x $\frac{3}{4}$ " Fh woodscrews



edge of each groove is $2\frac{1}{4}$ " from the bottom edge of each assembly.

■ Now cut $\frac{3}{8}$ "-wide grooves $\frac{3}{8}$ " deep for the tray supports toward the top of the front/back assemblies *only* (Figs. 4 and 6). The top edges of these grooves are $1\frac{5}{8}$ " from the top edges of the front/back assemblies.

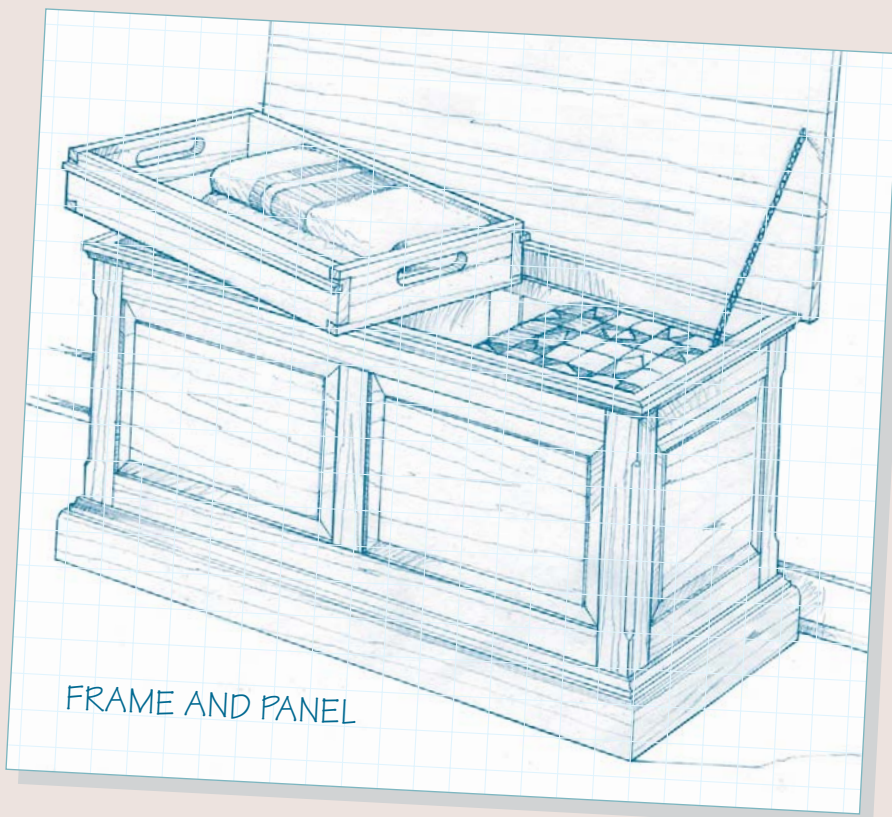
■ Next, dry-assemble the case and measure for the bottom panel. To do this, measure the opening, including the depth of the bottom grooves. Then subtract $\frac{1}{8}$ " from the width *only* to allow for expansion. Glue up a panel and cut it to these dimensions.

■ To keep the corners aligned during glue up, two screws are driven at each corner (Fig. 3). With the case dry-assembled, drill a pilot hole and a shank hole $\frac{3}{8}$ " from the top and bottom edge on each front/back assembly. (These will be covered by trim later.) Drive screws in to pre-thread the holes, then remove them.

■ Now it's time to assemble the case with the four sides and bottom panel. Apply glue to each joint (but not to the bottom panel) and assemble the case with the screws. Use clamps as well.

■ Rout a $\frac{3}{8}$ " stopped chamfer on the outside corner of each front/back long stile (M) (Fig. 1).

■ Cut tray supports (D) to fit into the grooves in the front and back assemblies and between the end assemblies.



Glue them in place (Fig. 6).

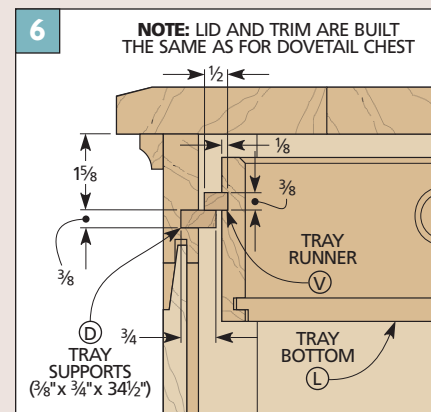
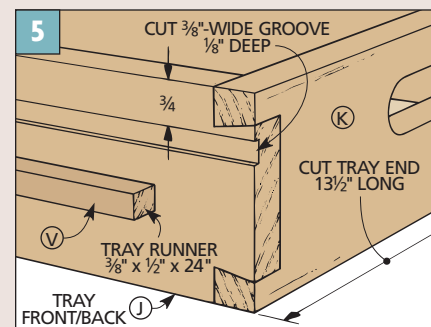
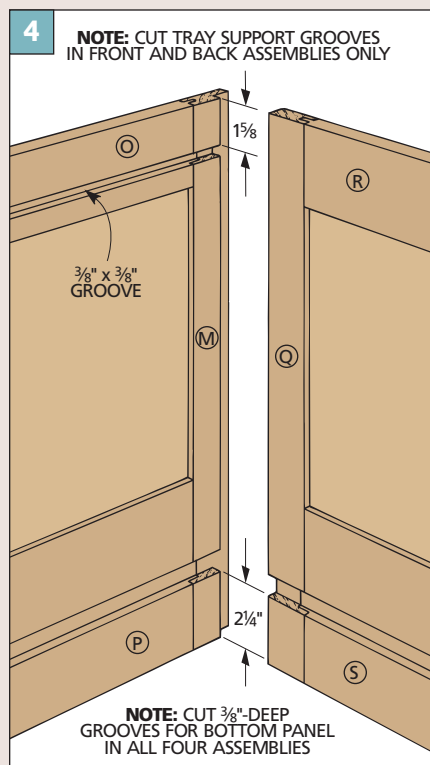
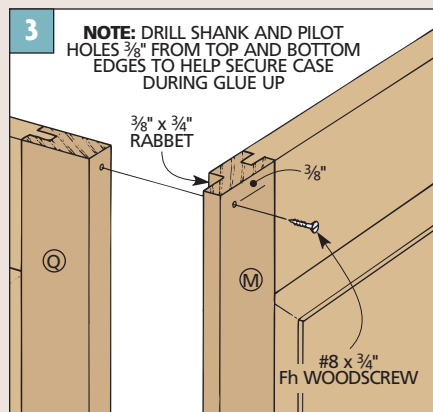
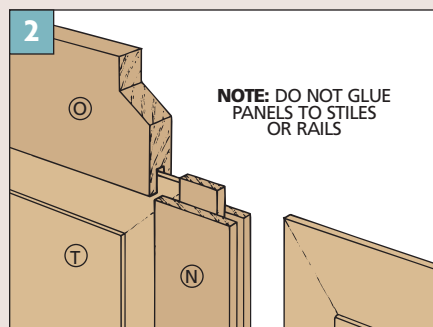
■ The tray is built the same as for the dovetail chest, except the tray ends (K) are $13\frac{1}{2}$ " long (Fig. 5). Refer to page 119 for details on building the tray.

■ After the tray is assembled, cut grooves on the front and back (J) to

hold tray runners (Fig. 5). These grooves are $\frac{3}{8}$ " wide and $\frac{1}{8}$ " deep.

■ Cut tray runners (V) to fit the grooves and glue them in place (Fig. 5).

■ To complete the chest, make and mount the trim and the lid the same as for the dovetail chest.



SOURCES

One of the first things we take into consideration when designing projects at *Woodsmith* is whether the hardware is commonly available. Most of the hardware and supplies for the projects in this book can be found at local hardware stores or home centers. Sometimes, though, you may have to order the hardware through the mail. If that's the case, we've tried to find reputable national mail order sources with toll-free phone numbers (see box at right).

In addition, *Woodsmith Project Supplies* offers hardware for some of the projects in this book (see below).

WOODSMITH PROJECT SUPPLIES

At the time of printing, the following project supply kits were available from *Woodsmith Project Supplies*. The kits include the items listed, but you must supply any lumber, plywood, or finish. For current prices and availability, call toll free:

1-800-444-7527

Hall Tree

(pages 48-53)No. 8005-144
This kit provides full-size patterns for the hooks and feet.

Mission Bookcase

(pages 72-87)No. 790-200
Includes the hinges, ball catches, screws, shelf supports and brads.

Coat and Glove Rack

(pages 90-95)No. 786-100
Includes full-size patterns for the back and sides, oak plugs, coat pegs, door knob, butt hinges and magnetic door catch.

Jelly Cupboard

(pages 106-113)
Hardware KitNo. 787-100
Screws, hinges, dowels for the pins and wooden door knob.

Tin Panel KitNo. 787-110
Four blank tin panels ready to be punched with your choice of patterns (see page 107), plus instructions on punching and aging tin.

KEY: TL04

MAIL ORDER SOURCES

Some of the most important "tools" you can have in your shop are mail order catalogs. The ones listed below are filled with special hardware, tools, finishes, lumber, and supplies that can't be found at a local hardware store or home center. You should be able to find many of the supplies for the projects in this book in one or more of these catalogs.

It's amazing what you can learn

about woodworking by looking through these catalogs. If they're not currently in your shop, you may want to have them sent to you.

Note: The information below was current when this book was printed. Time-Life Books and August Home Publishing do not guarantee these products will be available nor endorse any specific mail order company, catalog, or product.

THE WOODSMITH STORE

2625 Beaver Avenue
Des Moines, IA 50310
800-835-5084

Our own retail store filled with tools, jigs, hardware, books, and finishing supplies. Though we don't have a catalog, we do send out items mail order. Call for information.

WOODCRAFT

560 Airport Industrial Park
P.O. Box 1686
Parkersburg, WV 26102-1686
800-225-1153

www.woodcraft.com

Has all kinds of hardware including hinges, coat pegs, knobs and lid supports. They also carry a good selection of hand tools and accessories.

ROCKLER WOODWORKING & HARDWARE

4365 Willow Drive
Medina, MN 55340
800-279-4441

www.rockler.com

A great catalog of general hardware, specialty hardware, plus tool and shop accessories. It's also a good "idea-starter" for projects.

WOODWORKER'S SUPPLY

1108 North Glenn Road
Casper, WY 82601
800-645-9292

Z-shaped fasteners, power tools and accessories, hardware, shellac, milk paint and other finishing supplies, wood plugs and more.

CONSTANTINE'S

2050 Eastchester Road
Bronx, NY 10461
800-223-8087

www.constantines.com

One of the original woodworking mail order catalogs. Find cotton Shaker tape, hinges, tin panels, milk paint, and other finishing supplies.

TREND-LINES

135 American Legion Highway
Revere, MA 02151
800-767-9999

www.trend-lines.com

Another complete source for hinges, pegs, dowels, hardware, power tools and accessories.

MEISEL HARDWARE SPECIALTIES

P.O. Box 70
Mound, MN 55364
800-441-9870

In this plan-filled catalog, you'll also find pegs, lid supports, hinges, plus blank and pre-punched tin panels.

COUNTRY ACCENTS

P.O. Box 437
Montoursville, PA 17754
717-478-4127

A complete catalog of tin-punching supplies with pre-punched tin, punching tools, tin blanks and designs.

TREMONT NAIL COMPANY

P.O. Box 111
Wareham, MA 02571
800-842-0560

Over 175 years old and still making square nails the old-fashioned way.

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