Frame-and-Panel Doors Made Easy

Cope-and-stick router bits are quick but tricky. Here's how to get perfect results

BY MICHAEL PEKOVICH

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

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

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

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

Start with straight, square stock

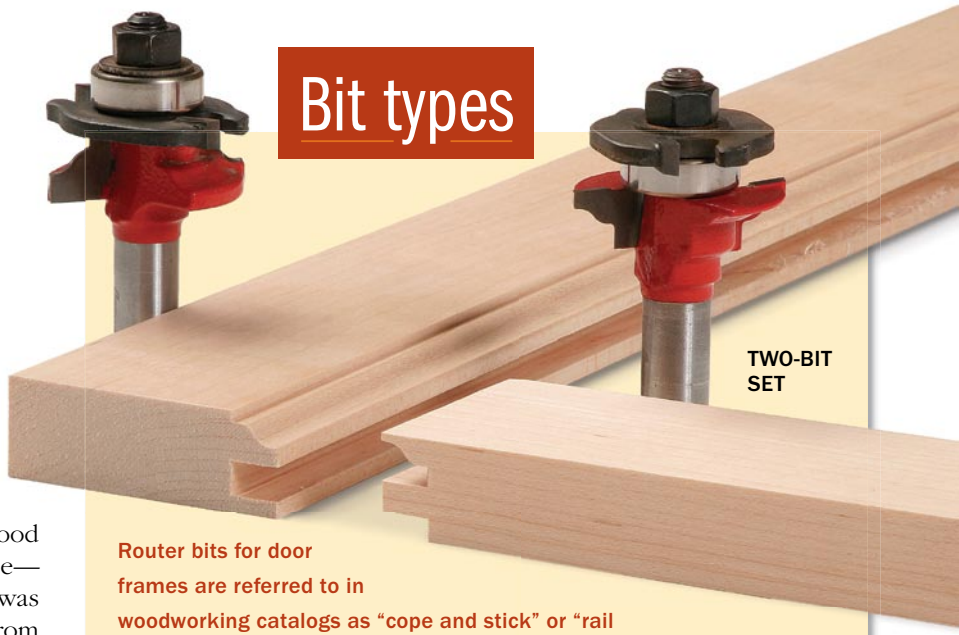
I began by milling the door-frame stock. I prefer quarter-sawn or rift-sawn boards because the tight, straight grain is both good-looking and stable. It's important that the stock be straight and square. Any slight bow or twist will make fitting the door a nightmare.

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

Rout the edge profile on all pieces

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

Bit types



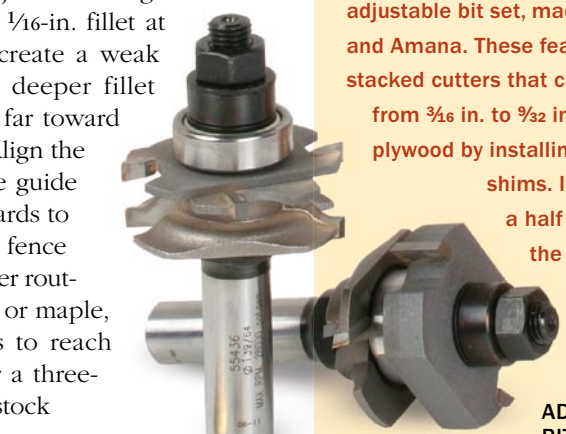
TWO-BIT SET

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

STACKED SINGLE BIT

ADJUSTABLE BIT FOR PLYWOOD PANELS

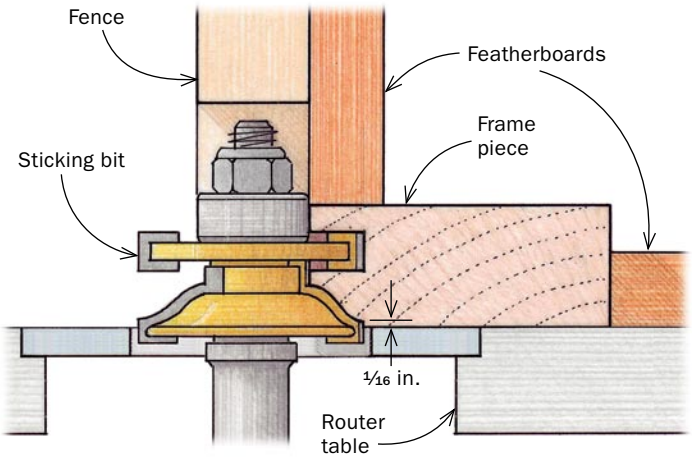
Most bit sets cut a ¼-in. groove in the stiles and rails. And that works fine for MDF panels, which are a true ¼ in. Unfortunately, veneered plywood typically measures less than that and will leave an unsightly gap. One solution is an adjustable bit set, made by both Freud and Amana. These feature a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



ADJUSTABLE BIT SET

1 Rout the profile

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



final pass. Removing the bulk of the waste on the first pass will yield a cleaner surface on the second.

Use a story stick for crosscutting

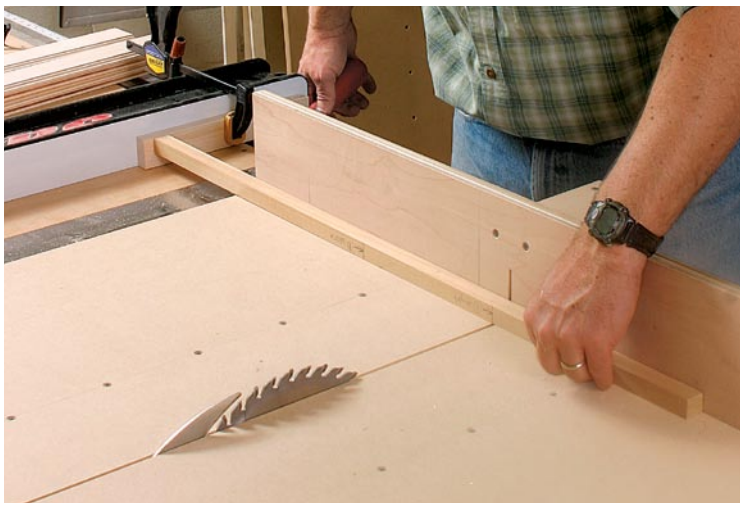
Once the edges have been profiled, it's time to cut all the parts to final length. Instead of a tape measure, I made a "story stick" to record the width and height of the case openings, along with the number of doors that fit in the opening. For cases with two doors, I measured the width and marked the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

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

Cutting the rails to length is a bit trickier. Because they fit between the stiles, you must account not only for the width of the stiles but also the depth of the stub tenons. This can lead to some head-scratching, but I found a simple method that let me dispense with the math. First, make a setup block that is equal to the width of the two stiles minus the depth of the panel grooves. Use this setup block in conjunction with the story stick to quickly dial in

2 Cut the stiles

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



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

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

the right dimensions for the rails. Because rails are usually short, use a stop block clamped to the crosscut-sled fence to set the length. Again, align the mark on the story stick with the blade; then rest the setup block on the story stick flush with the end, and pencil a line on the sled to mark the end of the rail. Clamp the stop block at the line and cut the rails.

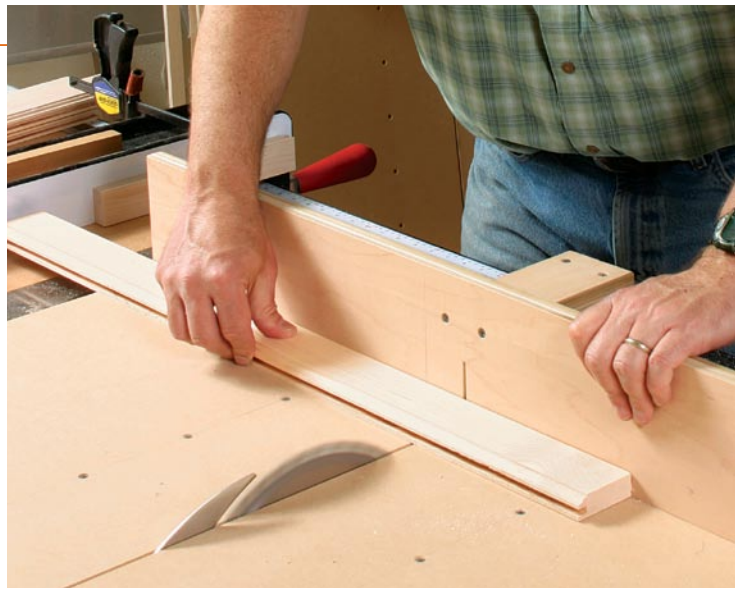
A sled for end-routing

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

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

Make the panels undersize in width

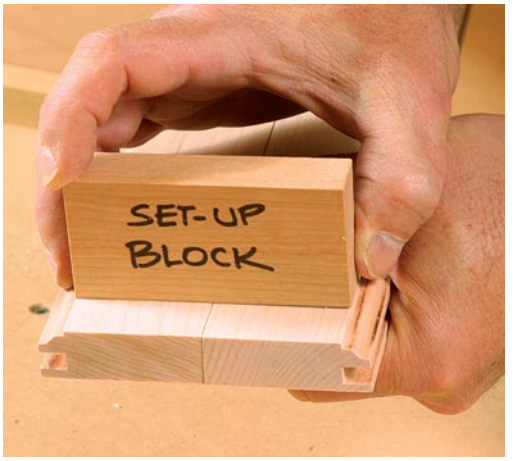
With the frames complete, all that's left to do is to size the panels. I made them 1/16 in. narrower than the length of the rails. This is to accommodate the slight amount of seasonal movement (yes, even MDF moves), and to make sure the panel allows the frame parts to seat fully during glue-up. The panels'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



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

3 Cut the rails

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

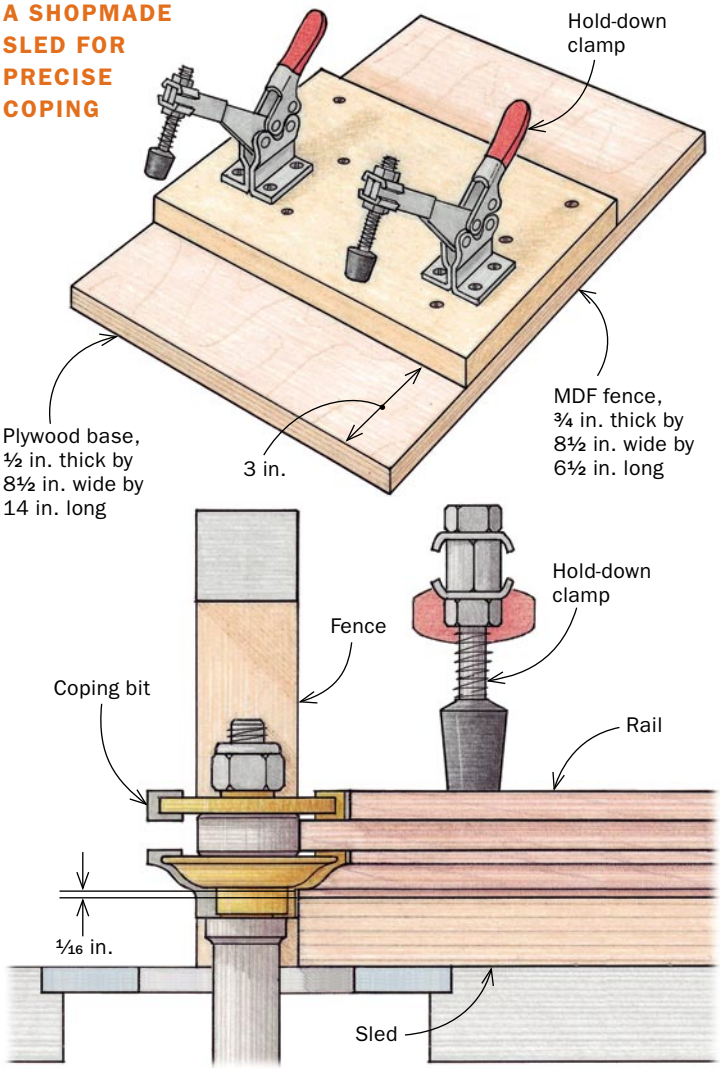


Use the block to set up the cut. *With the story stick's door-width mark aligned with the sawblade, use the block to draw a line on the sled fence.*

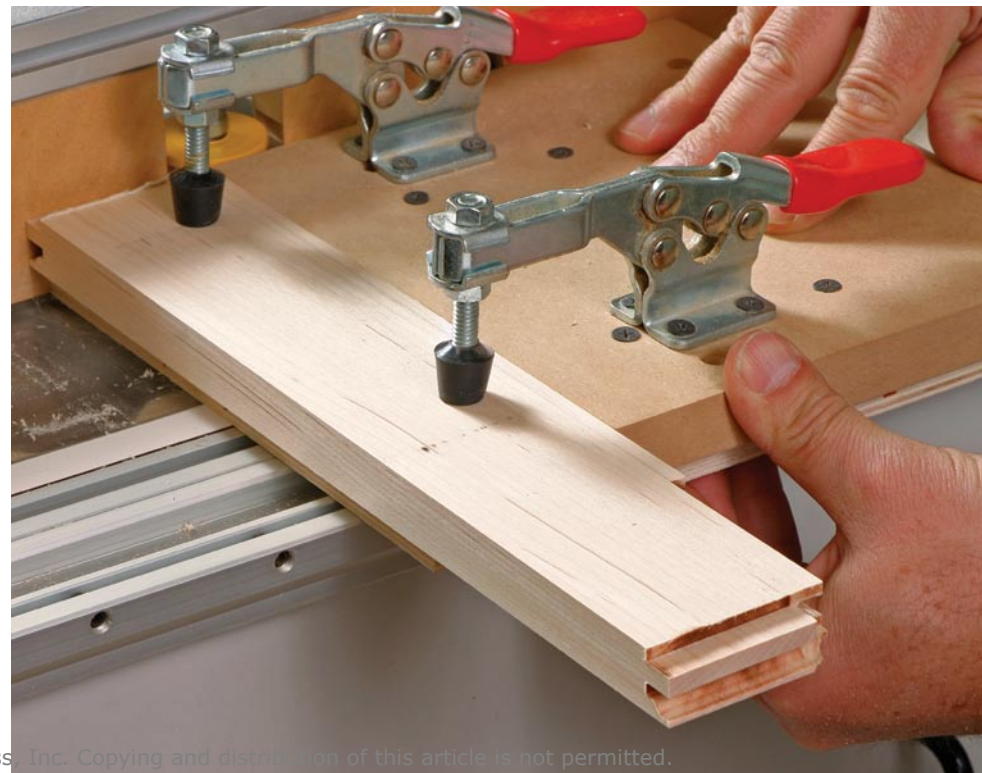
Cut the rails. *With a stop block clamped at the line, you can cut all the rails to a precise and uniform length for a specific door size.*

4 Cope the rails

A SHOPMADE SLED FOR PRECISE COPING



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



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

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

block plane. (Unlike plywood, which is thinner than its nominal thickness, MDF measures out on the mark.)

How to keep it all square

Gluing up cope-and-stick doors is a challenge. One concern is that the stub tenons could slide along the panel groove, making it difficult to glue up the parts square. Or, the panel could fit so tight that it seizes up on contact with the glue, making it very difficult to square up the parts. Fortunately, this procedure eliminates both potential problems. I installed the panel in a stile groove first, then slid the rails on, and finally, added the second stile.

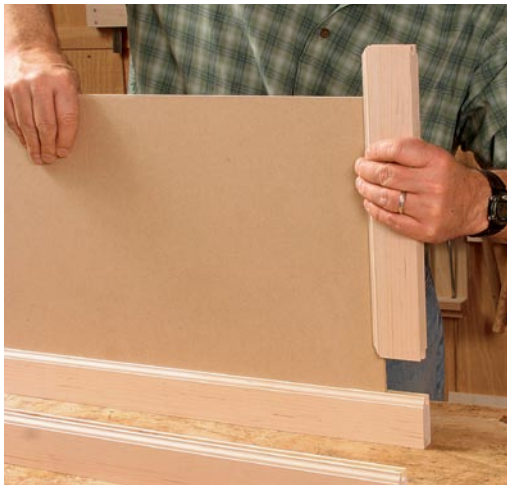
To position the panel correctly, mark its location on the stile by holding a rail in place and marking the width of its tenon. Apply glue along the panel grooves of the stiles only. Then apply glue to the coped ends of the rails. If there is glue in the rail grooves, they won't slide along the panel.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

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

Michael Pekovich is Fine Woodworking's *art director.*

5 Assemble the panels

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



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

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