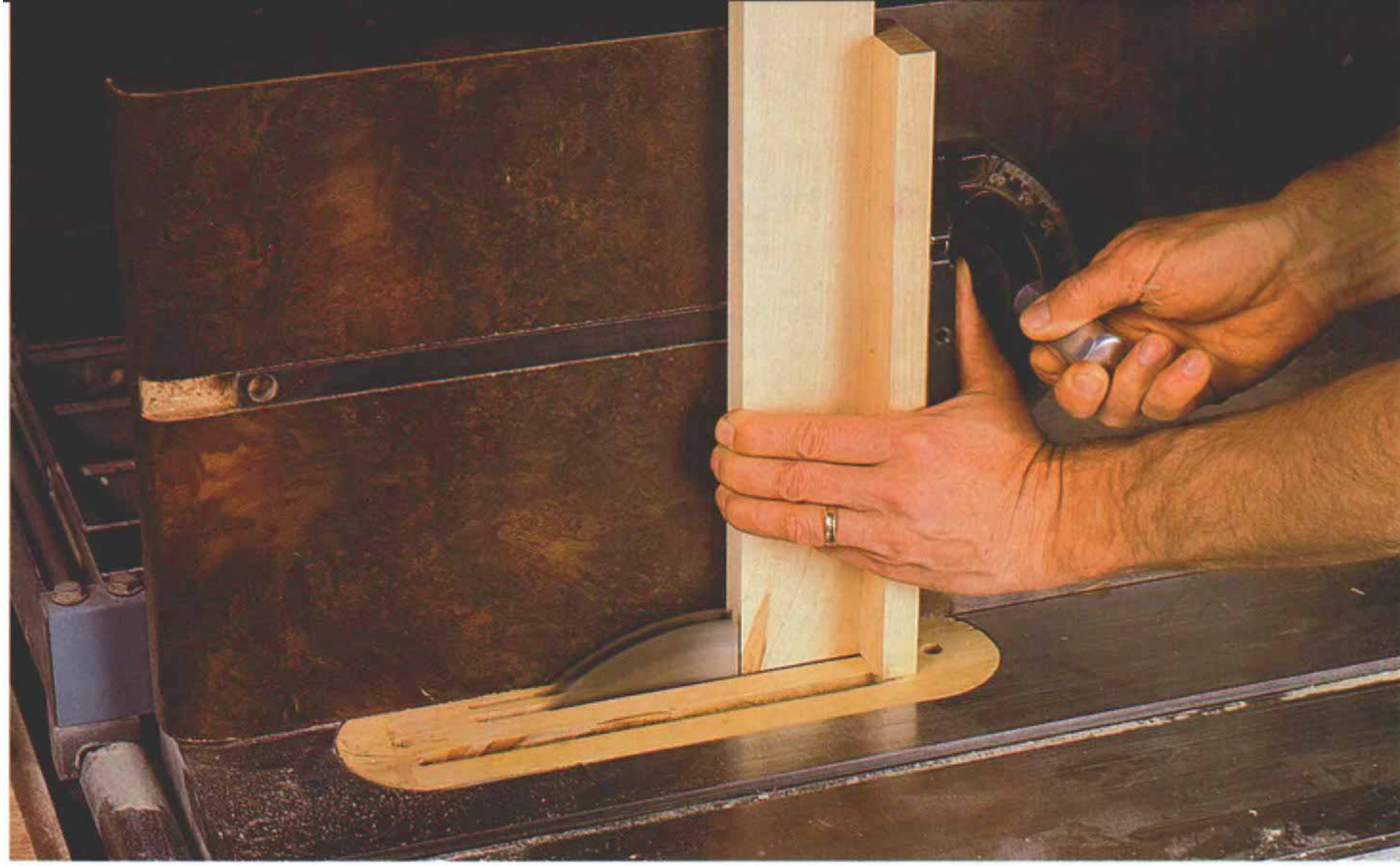


A double-blade tablesaw setup cuts tenons quickly *and accurately because both tenon cheeks are cut simultaneously. A tall, shop-made auxiliary fence, fitted with a regular miter gauge, supports and steadies the work. An upright backup board minimizes tearout.*

Double-Blade Tablesaw Tenoning

Spacers and shims between blades make setup fast and accurate

by Mac Campbell

I operate a custom woodworking shop, making pieces individually designed for each client, so I can't take advantage of the profitable, repetitive operations that are the bread and butter of many production shops. Profits are important, though, and I wanted to apply assembly-line efficiency to my custom work. This lead me to standardize and streamline many common furnituremaking operations.

Joinery was an ideal first candidate for this standardization. Like many furnituremakers, I rely heavily on mortise-and-tenon joints. The components' sizes and the members to be joined may change, but the joints are all pretty much the same. After a little experimenting, I came up with an efficient, no-fuss system for cutting the tenons on the tablesaw using two blades separated by shims and spacers to cut both cheeks at once, as shown in the photo above. The precisely machined shims and spacers can be arranged in various combinations to produce tenons to fit any of the mortises I commonly use in my furniture. Once the blades are set, cutting the tenons is simply a matter of running the stock on end through the saw. An auxiliary fence and a miter gauge with a backup board increase the stability and safety of the cut and reduce tearout. Tenon shoulders are also cut on the tablesaw using a sliding crosscut box.

This system can quickly produce most tenons, even angled or stub tenons; plus, it offers several other advantages. First, it is predictable: Follow a series of easily repeatable steps, and the result is the same every time. Second, the resulting joints are structurally sound. And, finally, the system works despite the gremlins that inhabit a woodworking shop—the inevitable variations in stock thicknesses and working characteristics of different species don't alter the results.

Because the size of the mortise determines the exact tenon thickness, I cut the mortises first and then adjust my tenoning system to produce the proper tenons. Theoretically, you could calculate the mortise-and-tenon dimensions by measuring from the blades and bits you use, but in practice, the final settings are more easily determined by trial fitting the tenon to the mortise. It's also easier to set up for cutting the tenons if you have a mortise to help you align the blades and fence. The method for cutting the mortise—drill press, overarm router, plunge router or mortising chisel and mallet—is immaterial. What's most important is cutting the mortise the same way every time, using the same tool and the same setup.

Anatomy of the standardized tenon

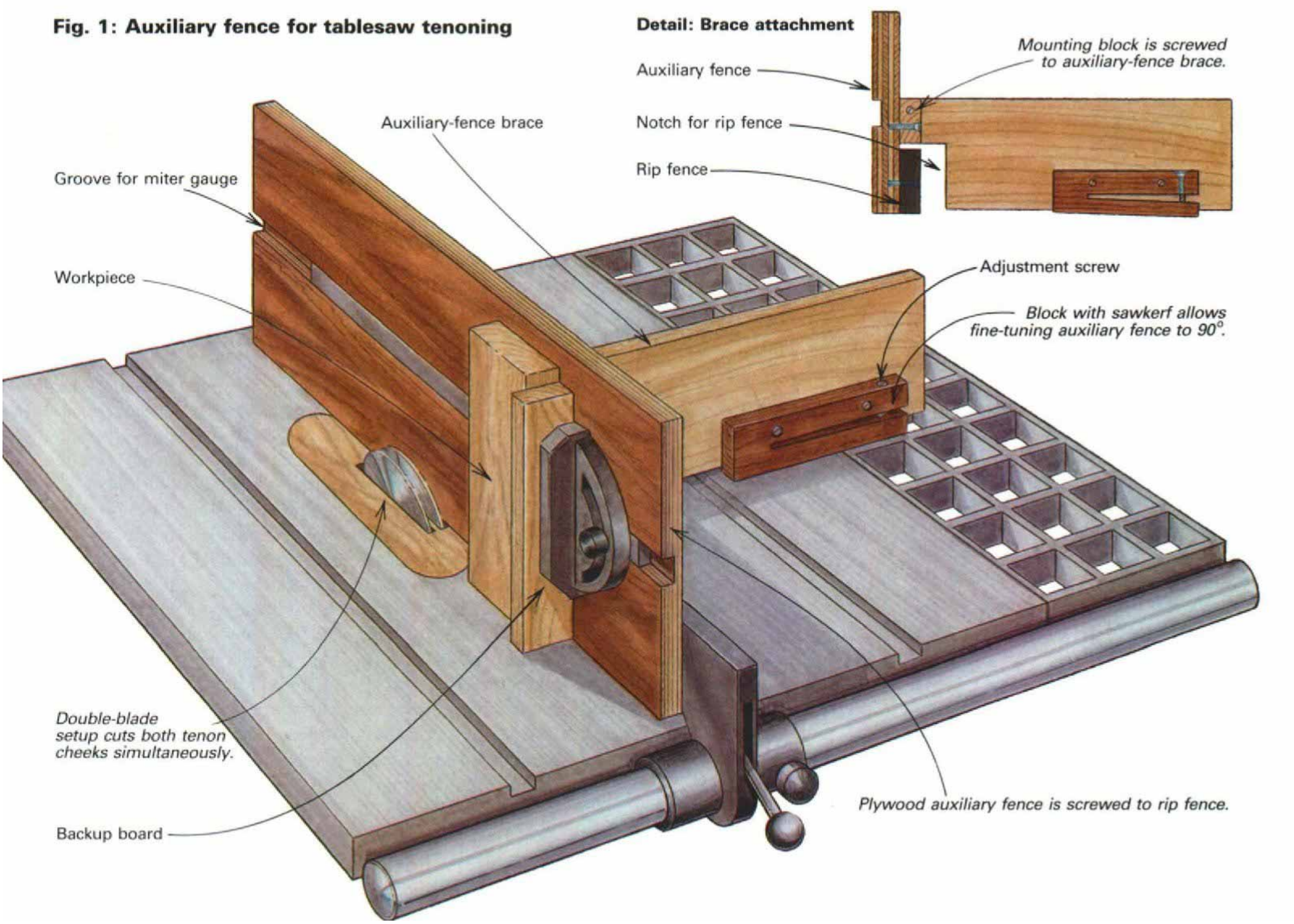
Before cutting the mortise and tenon, let's look at the joint itself. For my standard, four-shouldered tenon, the ideal thickness equals half the thickness of the stock. Thus, for ¾-in.-thick stock, the tenon should be ⅜ in. thick. This half-the-thickness rule is not carved in stone but rather is a guideline. For an open mortise and tenon, or bridle joint, the tenon should be one-third of the stock thickness. Because most of my tenon work is in ⅝-in. to l-in.-thick stock, I decided on a standard tenon thickness of ⅜ in. (As long as it is equal to or greater than that of the tenoned piece, the thickness of the mortised piece makes no difference.) There's no comparable rule of thumb for the width of the tenon, so I decided to make it 1 in. narrower than the stock it is cut from, leaving a ½-in. shoulder on each side. The length of the tenon is more difficult to standardize because it depends on the width of the mortised part. I rarely use a tenon more than 1½ in. long and almost never more than 2 in. long, which is my mortising bit's maximum-cutting depth.

Blades for cutting tenons

The sawblades I use for tenoning are steel, hollow-ground planer blades. These blades are thin because their teeth have no set, so it doesn't take an extraordinary amount of motor power to cut the tenons. Since the stock is run vertically over the saw to cut the tenons and these endgrain cuts are extremely hard on sawteeth, it is important to keep the sawblades sharp. My solution is to keep two sets of blades; I use one set while the other is being sharpened. I also have all the teeth ground straight across, as many rip blades are ground, rather than the usual alternate top bevel. This helps extend the life of the blades. I have tried carbide blades (they stay sharper longer) but couldn't eliminate the severe flutter in the blades, which destroyed the accuracy of the system. If I get any vibration with the hollow-gound blades, I rotate the blades slightly and retighten them 011 the arbor; this usually fixes the problem. Blade life can be maximized by feeding the stock as smoothly and as quickly as possible without bogging down the blade speed.

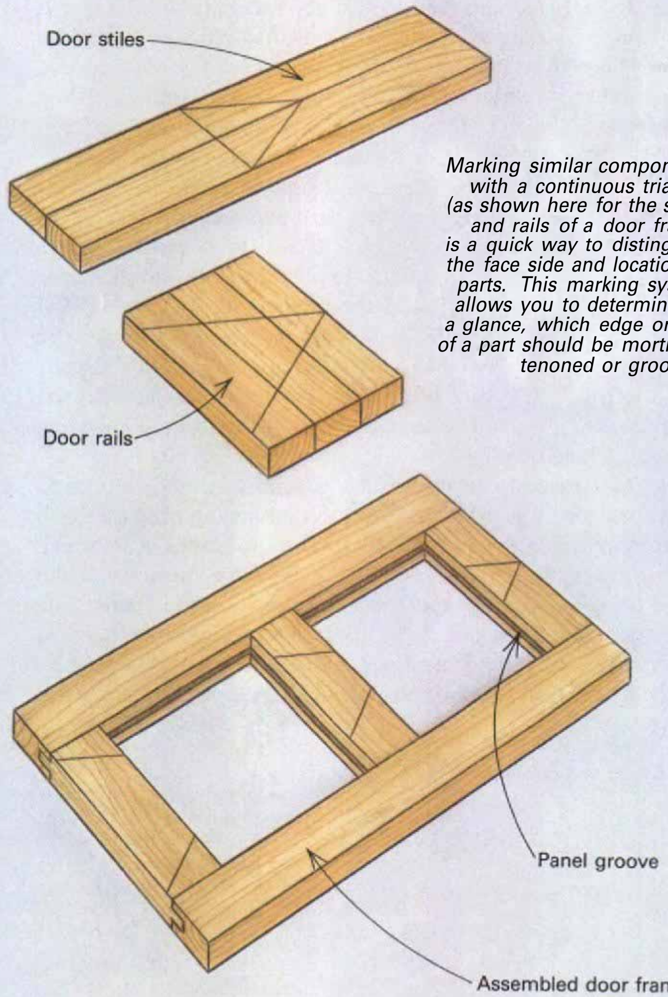
The distance between the blades, which determines the thickness of the tenon, is controlled by the combination of spacers and shims installed on the saw arbor between the blades. A local machine shop made my spacers: Each is the same diameter as the flange on my saw arbor and has a ⅝-in. hole in the center. The spacers are ¼ in., ⅛ in. and ¹⁄₁₆ in. thick. For fine-tuning the thickness of tenons, I have several small squares of hard-brass shim stock in thickness of .005 in., .010 in., .015 in. and .025 in. A ⅜-in. tenon, for

Fig. 1: Auxiliary fence for tablesaw tenoning



Photos: Alec Waters; drawings: Mark Sant'Angelo

Fig. 2: Triangle marking



Marking similar components with a continuous triangle (as shown here for the stiles and rails of a door frame) is a quick way to distinguish the face side and location of parts. This marking system allows you to determine, at a glance, which edge or end of a part should be mortised, tenoned or grooved.

The auxiliary fence can be adjusted so it's exactly 90° *to the saw table by means of a spring-like block screwed to the fence's brace. A kerf partially across the block provides enough flexibility to tip the fence by driving a single screw in or out.*

example, requires a ¼-in. and a ⅛-in. spacer between the two blades.

Using two blades at once requires a new table insert for the saw. I made one from ½-in.-thick birch plywood, with four ⅜-in.-long #5 screws in the bottom side to level it exactly to the saw table. To install the table insert, retract the blades completely below the surface of the table, and then place the plywood in the opening and level it by adjusting the four screws. Now place the rip fence over the edge of the insert to hold it down. Turn on the saw, and raise the blades to maximum tenon-cutting height.

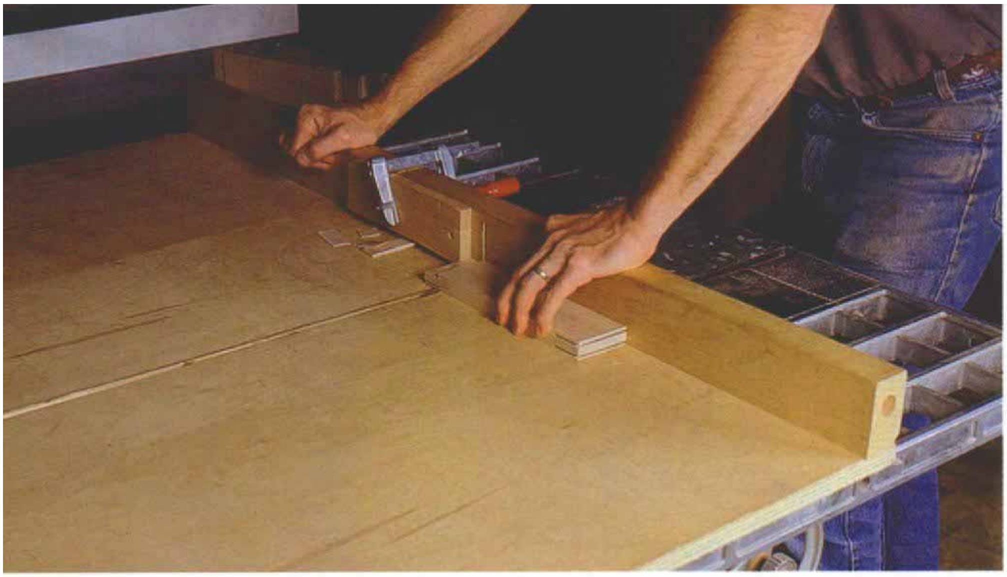
Auxiliary fence for endgrain cuts

You can buy tablesaw tenoning jigs for cutting stock held on end, but I prefer a shop-built auxiliary fence, as shown in the photo on p. 72, because the workpiece doesn't have to be clamped in place during each pass over the saw. As you can see in the photo, the fence has a slot running parallel to the saw table to accept a standard miter gauge. With the blade fully raised, the fence must be tall enough so that the lower edge of the miter gauge clears the blade by a couple of inches and still has its base fully supported by the fence. The fence pictured here is 13 in. high, with the slot 7 in. from the bottom. Because it is absolutely essential that the cheeks of the tenon are parallel to the face of the stock, I made my fence adjustable for squareness with the table. This adjustment is simply a brace on the back of the fence set at just under 90°. The brace shown in the photo below has a kerf partially across it, making it flexible enough to be moved by an adjustment screw until it's square to the table. This adjustment should be checked every time the fence is used.

Once the fence is screwed to the rip fence and squared to the table, place the miter gauge in the slot and hold it there. Next, screw a piece of scrap to the miter gauge to serve as a backup board to minimize tearout. The backup board should be long enough to seat firmly against the miter gauge and sit solidly on the saw table. Any wood will do as long as it's flat and accurately dressed. I hold the gauge in the slot as I push it and the workpiece past the blade.

After setting up the auxiliary fence and miter gauge, you are ready to adjust the blade spacing. This only needs to be done once for each set of blades, spacers and bits, although you should recheck the system each time the sawblades or the router bit used for mortising is sharpened. Trial and error is the most efficient method here. Cut a few mortises in several pieces of scrapwood; then insert spacers and shims between the two blades until they'll cut a tenon to match the mortises. In my setup for ⅜-in.-thick tenons, this would mean installing the two sawblades with a ¼-in. and ⅛-in. spacer in between (because the teeth have no set, spacing the blade bodies ⅜ in. apart makes the teeth ⅜ in. apart). With the blades set to produce the desired tenon length, cut the cheeks on a piece of scrap. For convenience, this scrap should not be wider than the desired tenon. At this point, I usually just bandsaw the shoulders to remove the waste because shoulder alignment is not important for a test piece. Then I check the tenon thickness in the mortise. You'll probably have to adjust blade spacing with shims to get a good fit. Keep playing with the setup until the tenon fits smoothly and snugly; you shouldn't have to hammer it in place. (Remember that a fit that is too tight will wipe away all the glue during assembly and leave you with a wonderfully machined joint that doesn't last.) Once you have found the right combination of spacers and shims, mark them clearly in case you want to cut the same tenons in the future.

Once everything is aligned and tested, you are ready to put this whole process to work. All of your stock should be marked for correct joinery orientation. The triangle marking system shown in figure 2 above does this quickly and clearly (for more on triangle



Trim tenon shoulders *on the tablesaw with a sliding, plywood crosscut box. A stop block clamped to the fence ensures that all the shoulders will be cut identically.*

Tenons can be trimmed to width *on the bandsaw (below left). A piece of wood clamped to the saw table behind the blade stops the tenon stock before the blade reaches the shoulder. The plywood fence clamped to the saw table sets the tenon width and guides the workpiece as it's pushed into the blade.*

If tenons are to mate *with routed mortises, you should roundover the tenon's corners to ensure a snug fit.*

marking see *FWW on Boxes, Carcases, and Drawers,* pp. 30-31). To ensure uniform placement, mortises and tenons must be referenced from the face side. Mark and cut all the mortises first; then cut all the tenons. If you have tenons of varying lengths, cut the shortest ones first so that the backup board will block the tearout on all tenons. Before changing the saw setup, double check that all tenons have been cut because it's easy to miss one in a large job. The best way to prevent problems is to keep all pieces neatly stacked; an uncut tenon stands out clearly.

Crosscutting tenon shoulders

With all tenons cut, remove the tenoning blades and install a fine-tooth cutoff blade on the saw. Using a sliding crosscut box (see *FWW #89,* pp. 72-75), clamp a stop block to regulate the shoulder cuts, as shown in the top photo above. This stop should be raised above the base of the crosscut box, allowing the waste to slide underneath, thus reducing the danger of any scraps binding against the blade. Once the tenon cheeks are cut free (again, stack all the pieces neatly and make sure that all cuts have been made), raise the blade, and, without changing the stop block, make the remaining two shoulder cuts on the edges of each tenon.

The quickest and safest way to trim the tenons to width is with the bandsaw. My auxiliary fence for this job is a square of ¾-in. plywood sized to extend just to the front of the sawteeth, as shown in the photo at left above. A stop glued to the bottom of the plywood fits against the front edge of the saw table when the assembly is clamped down. Adjust the fence so that the combined waste piece and the sawkerf equals the desired shoulder size. Clamp a scrap to the rear of the table to stop the cut just short of the tenon's shoulder. Make two very shallow cuts, one on each edge, and check the resulting tenon width; adjust the fence if necessary. Once the fence is properly set, trim all tenons to width.

If you routed the mortises, the next step is to round the tenon corners to fit. If you cut the mortises with a hollow chisel or regular chisel, this step is not necessary. I round the corners with a carpenter's coarse wood file (see the photo at right above) after clamping the stock upright in a bench vise. Alternately, I've tried squaring the mortises with a mortising chisel, but I found it a slower process. Whichever method you prefer, perform the necessary trimming, and your joinery is completed.

Once this system is set up, it can be expanded to a variety of applications. The angled tenons common in chair work, for instance, are easily handled by simply tilting the arbor of the saw to the desired angle. Even compound-angle tenons can be cut by tilting the arbor and resetting the miter gauge. This system ensures that the tenon and the mortise will be well matched; the applications are limited only by your imagination.

Mac Campbell builds custom and reproduction furniture in Harvey Station, N.B., Canada, and is a regular contributor to FWW