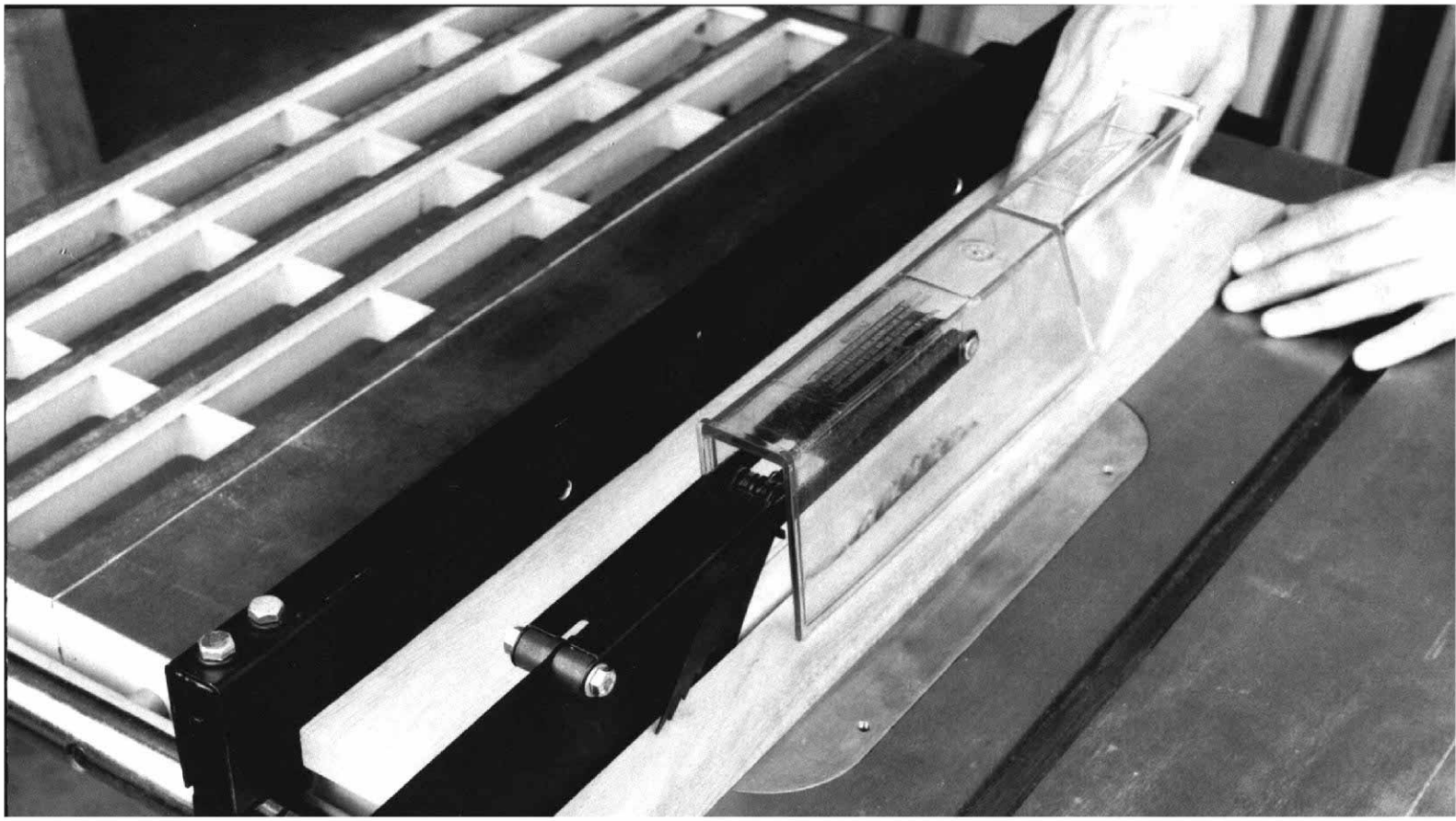


The tablesaw is both a saviour and a demon. *It's unmatched for accurately ripping stock to width or crosscutting pieces of nearly any size and also can be used to cut tenons, dadoes and finger joints. Unfortunately, the tablesaw also is responsible for many injuries, most of which could be avoided with blade guards and an understanding of the fundamentals of tablesaw use.*

Mastering the Tablesaw

There's a way to be safe in every cutting situation

by Mark Duginske

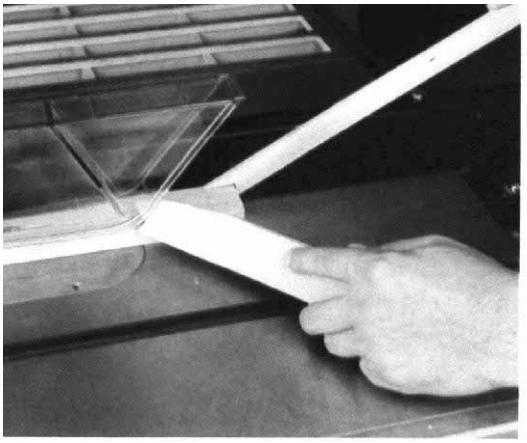
The tablesaw is the heart of most woodworking shops. With a standard blade, you can make virtually any straight cut, and when fitted with a dado head, the tablesaw is the tool of choice for cutting grooves, dadoes and rabbets. When equipped with shopmade jigs, the tablesaw is the most efficient tool for finger joints, tenons and even dovetails.

Although undeniably versatile, the tablesaw also has its dark side. It is probably responsible for more injuries than any other woodworking tool. Many of those injuries could be avoided if woodworkers used blade guards and splitters (see the sidebar on p. 93) and if they took the time properly to set up and to align the rip fence and miter gauge (see the sidebar on p. 90). But above all, for safe operation of a tablesaw, you must understand the fundamentals of ripping and crosscutting.

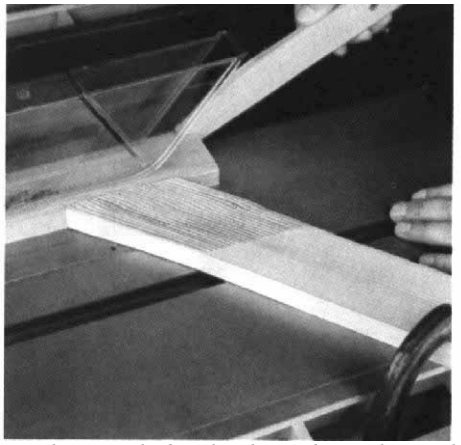
Using the rip fence

The rip fence is a straight edge aligned parallel to the blade that slides along a bar at the front of the saw table. When the fence is locked to the bar, the distance between the blade and the fence determines the width of cut. To rip safely and accurately, the workpiece must lie flat on the table with a straight edge against the rip fence. If the edge is not straight, joint it straight before making the cut or make a jig to hold the wood securely while making a straight cut. One option is to screw or nail a wooden straight edge to the workpiece. If the wood is not flat, face-joint it to establish a flat surface or position the workpiece so that it doesn't rock during the sawcut. Never rip a badly twisted board because it will bind and may kick back. Sometimes you can salvage a badly twisted piece of wood by cutting it into smaller lengths first.

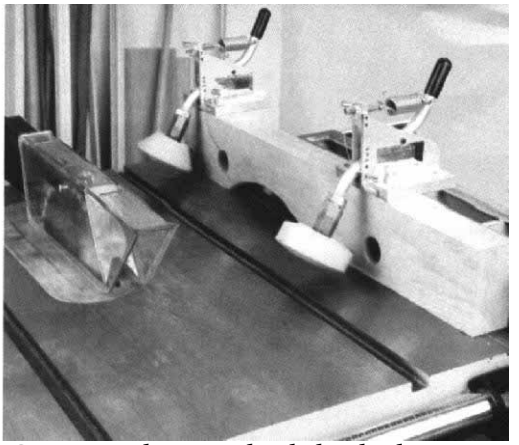
To ensure that the fence locks parallel to the blade, always adjust the fence toward the blade rather than away from it, and then apply pressure on the front of the fence before it is locked in place. Periodically, check the alignment of the fence to the blade by measuring from the fence to the front of the blade and then to the back



Use two push sticks *to rip narrow stock. To avoid kickback, don't allow the push stick that applies the side pressure to move past the front of the blade.*



A shopmade featherboard *can be used to hold the workpiece against the fence while the stock is guided past the blade with a push stick.*



Commercial spring-loaded wheels *attach to a fence or to a board mounted on the fence and hold the work both down on the table and against the fence.*

of the blade. The distance should be no more than 1/64 in. greater at the back of the blade. A faster and more accurate way to check whether the blade and fence are parallel is with sliding wedges, as shown in figure 1 below. To accommodate different width workpieces, make pairs of wedges for each of the following widths: 6 in., 9 in., 12 in. and 18 in. For cutting widths wider than 18 in., you can use more than one pair of wedges.

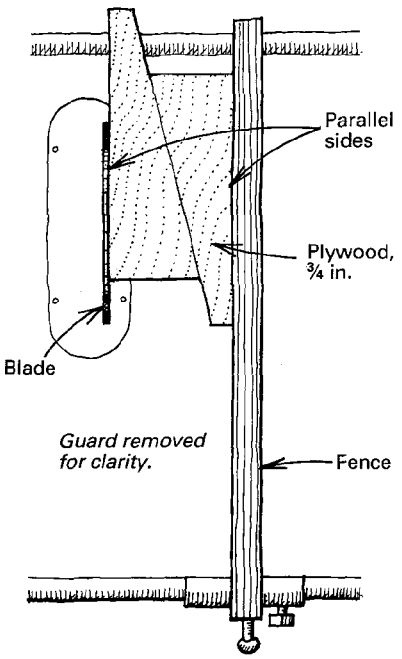
Ripping on a tablesaw

Before making either a ripcut or a crosscut, raise the blade so that the highest sawtooth is positioned about 1/4 in. above the work. With carbide-tipped blades, the entire carbide tip on the highest tooth should be above the work. The guard should be in place and functional.

Most woodworkers prefer to rip with the fence to the right of the blade, so the illustrations show it in that position. If you prefer the fence on the left side of the blade, reverse the arrangement. Never stand in line with the sawblade. Stand to the side of the saw opposite the fence, as shown in figure 2. This position may seem awkward at first, but it is a good habit to form because it may keep you out of the way of a violent kickback someday.

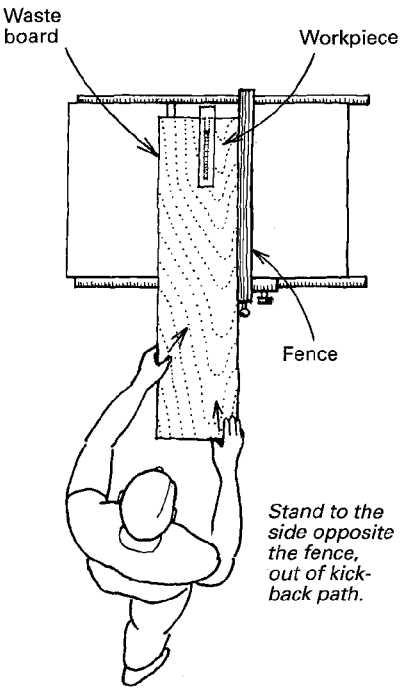
Start by pushing the work along the fence with both hands, applying forward pressure on the workpiece with your right hand and sideways pressure against the fence with your left, as shown in the photo on the previous page. As you near completion of the cut, continue to push the workpiece past the blade with your right hand, but remove your left hand from the work. It's a good idea to have your pushing hand in contact with the fence to en-

Fig. 1: Testing for parallelism



Slide the pair of wedges between the blade and fence to test if they are parallel.

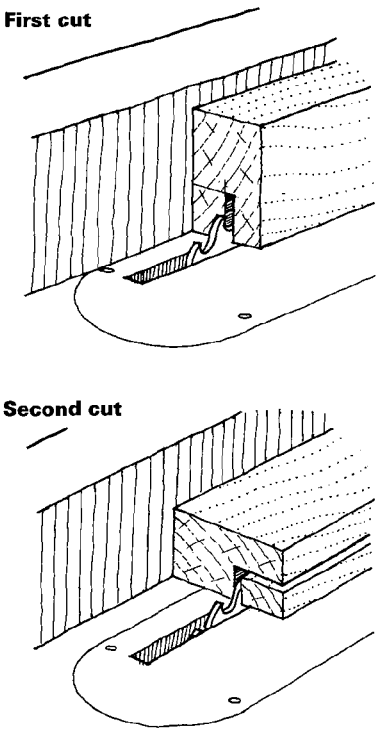
Fig. 2: Techniques for ripping



Push into fence with left hand.

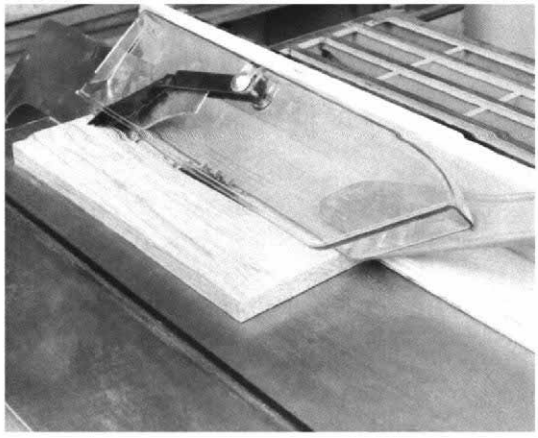
Advance work forward with right hand.

Fig. 3: Sawing rabbets

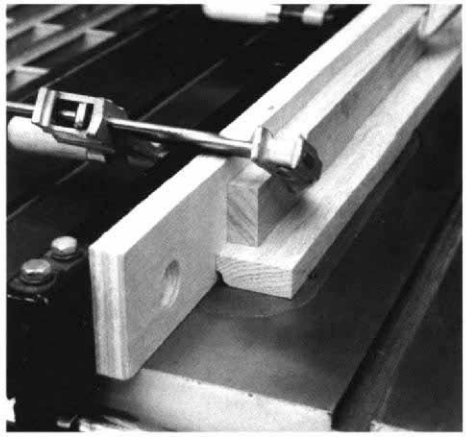


Second cut separates waste to form rabbet. Be sure waste is not trapped between blade and fence.

Photos: author; drawings: Vince Babak



A low, L-shaped auxiliary fence *provides clearance for your hand and the push stick when ripping narrow pieces and when tilting the blade.*



When rabbeting or cutting molding, *use an auxiliary fence that has an arc cut in it to house the unused portion of the cutter. Clamp a hold-down board to thefence.*

sure that your hand is as far away from the blade as possible.

The left hand should not touch the waste board at the completion of the cut, and you should never reach past the front of the blade with your left hand. Resist the temptation to try to control the workpiece or the waste piece at the back of the blade. If you fumble with the wood at the conclusion of a cut, an accident might happen: A kickback could pull your hand into the back of the blade.

Long boards must be supported at the back of the saw. A support keeps the board from falling off the table or from binding between the blade and guard or fence. Stand-alone roller units and fold-down roller systems that attach to the back of the saw are available. An auxiliary table is a good option, too—if you have the floor space. Both rollers and auxiliary tables are commercially available, or you can build your own. The simplest solution is a sheet of plywood on a pair of sawhorses.

Sawing rabbets safely—Although a rabbet can be cut with a dado blade or with multiple passes over a standard blade, it is often faster to make two intersecting cuts to remove the waste (see figure 3). When taking the second cut, which separates the waste, make sure the waste piece is on the side of the blade opposite the fence. If the waste were between the blade and the fence, it could bind and eject backward with lightning speed.

Push sticks—If the distance between the blade and the rip fence is less than three inches, always use a push stick rather than your hand to guide the workpiece past the blade. As a new push stick begins to pick up the inevitable war wounds, you really start to appreciate it. Push-stick designs are quite varied, but all have a notch that hugs the corner of the workpiece and that allows you to push the workpiece forward while also holding the back of the workpiece down on the table.

Before ripping a board, set the push stick on the saw table to the right of the fence. When there's about six inches left to cut, pick up the push stick with your right hand and complete the cut. However, when picking up the push stick, be sure your left hand is behind the workpiece; never let go of the workpiece with both hands, or the force of the blade will pitch it back at you.

On narrow boards, finish the cut with two push sticks, as shown in the top left photo on the facing page: one stick for sideways pressure and one for forward pressure. Never allow the push stick that applies the side pressure to move past the front of the blade because you would be applying side pressure on the blade, which could cause a kickback. For short boards, you may want to make a long-nosed push stick that holds down the front of the board (see figure 4). This kind of push stick counteracts the upward force from the back of the blade, which tends to lift the board off the table.

Featherboards—A featherboard is a shopmade device that is clamped to the saw table or rip fence and that applies sideways or downward pressure to the workpiece. Featherboards not only hold the piece against the rip fence, or down on the table, they also prevent kickback. When used to apply sideways pressure to keep the workpiece against the rip fence, the featherboard should be clamped to the table so that light pressure is applied just in front of the sawblade. No pan of the featherboard should extend past the front of the blade, or it will pinch the waste board against the blade's side. I prefer softwood featherboards with the "feather" cuts spaced about ¼ in. apart to provide flexi-

Fig. 4: Push-stick design

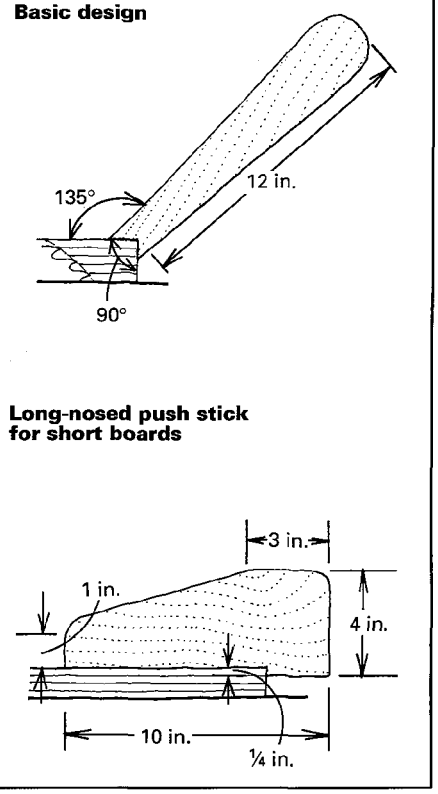
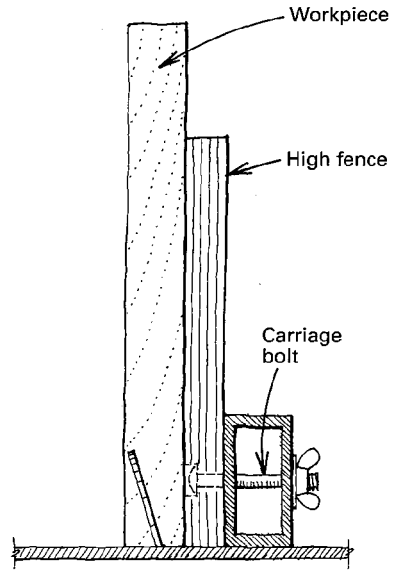


Fig. 5: The high fence



A high fence is used when cutting the edge of a board.

bility and to allow some latitude for adjustment. You can use a featherboard and a push stick together, as shown in the center photo on p. 88 or two featherboards in tandem: one clamped to the table and one to the rip fence.

Wheel hold-downs—Commercial spring-loaded wheel hold-downs attach to a fence or a board mounted to the fence (see the top right photo on p. 88). The spring tension is adjustable for the height of the workpiece, and the wheels rotate in only one direction to provide protection from kickback. Although hold-downs are purchased in pairs, I like to install just one at the back of the saw. The single hold-down controls the wood at the back of the saw and allows me to use a push stick at the front.

Auxiliary fences

The sawblade must not come in contact with the metal fence, so it's a good idea to make a wooden fence that protects both the blade and the stock rip fence. Most standard fences are drilled so you can easily attach a wooden fence with bolts or screws. It's best if the auxiliary fence is made of plywood or another manufactured product that won't warp. If you use solid wood, choose quartersawn rather than flat-sawn wood because it's more stable. Finish both sides to prevent warping, and apply plastic laminate to provide a good wear surface. Wax the fence often.

Occasionally, the metal fence is twisted. By attaching a wooden fence and shimming it with paper, you can make the set-up perfectly straight and accurate. Check the relationship of the fence to the table with a square, and check its straightness with a straight edge.

A standard auxiliary fence that covers your stock fence will serve you well for most cutting operations, but there are some special cuts that require different types of auxiliary fences.

High fence—When running a board on edge through a tablesaw (such as when beveling raised panels, as shown in figure 5 on the previous page) it's safest to use a high plywood fence to support the work. Position the fence and raised panel so that the blade tilts away from the fence. If you are making a cut that separates a small piece, it should not be captured between the blade and the fence.

Low fence—Although you should always tilt the blade away from the fence when ripping a bevel or a chamfer, this is not always possible. When you must bevel a piece with the blade tilted toward the fence or when ripping any narrow piece between the blade and fence, it's a good idea to use a low, L-shaped fence. This fence can be a separate two-piece fence or a board that is attached to your standard auxiliary fence. Because the workpiece is trapped between the fence and the blade, a kickback is likely, so use a long push stick to move the workpiece completely past the blade. The low fence gives you

Start by aligning the miter gauge and rip fence

To ensure safe and accurate cuts, you must make sure that the rip fence and miter gauge (used for crosscuts) are set up properly and in alignment with the blade and the miter-gauge slots. Because you'll be using the miter gauge to check the alignment of the blade to the miter-gauge slots and of the rip fence to the blade, you will first need to make sure the miter gauge is set up properly.

Fit bar to slot: The miter-gauge bar usually fits too loosely in the table slot to yield accurate crosscuts. To adjust the bar to fit more snugly, dimple the side of the bar with a center or prick punch. The dimples expand the metal around each indentation, effectively making the bar wider. The bar should slide smoothly along the length of the slot without hanging up and without side-to-side play.

Square miter head: Square the head of the miter gauge to its bar. To do this, I lay pennies in the miter-gauge Slot to elevate the bar slightly. I loosen the lock knob on the protractor head, butt the handle of a combination square against the bar of the miter gauge and then align the protractor head with the blade of the square. Although you may be tempted to square the miter head to the sawblade, it won't do you any good until you align the blade to the miter-gauge slots.

Align blade to miter-gauge slots: To test for this alignment, raise the blade as high as it will go, and clamp a 15-in.-long 1x3 to the miter gauge. Crosscut this test piece and unplug the saw. Now, slide the miter gauge with the test piece still clamped to it next to the front of the sawblade. Rotate the blade by hand-turning the belt or using a motor pulley. Don't grab the blade because your hand may deflect it. As you rotate the blade, one or two teeth will rub against the wood harder than the others and make a louder sound. Mark those teeth, and slide the test piece to the back of the blade. The same teeth should rub against the blade at the back and make the same sound. If the sound is the same, the table slot and the blade are aligned, and you will not have to adjust. If you get a different sound at the front and the back, the distance between the blade and the slot will have to be increased or decreased accordingly.

Realigning the blade to be parallel to the miter slot is fairly straightforward. On typical contractor saws, you simply loosen a few bolts and rotate the trunnions relative to the table. When doing so, you must be sure that the two trunnions stay in alignment. For a complete discussion of this, see my article, "Tuning-Up Your Tablesaw," in *FWW* #78 (Sept./Oct. 1989), or consult your owner's manual. On larger cabinet-shop saws, just loosen the bolts that hold the table to the cabinet, and rotate the table slightly.

After making a slight adjustment, repeat the sound test with the saw unplugged. When you are satisfied, tighten the bolts, plug in the saw and make another test cut. It may take several attempts, but stay calm and take your time.

Rip-fence alignment: In theory, the rip fence should be perfectly parallel to the blade. In practice, however, it's best if the fence is slightly canted away from the back of the blade. This prevents the wood from binding between the blade and the fence, particularly if the workpiece warps slightly as it is ripped.

You can set the rip fence with the same test piece you used to check for crosscut alignment. First, lower the sawblade below the table, and loosen the bolts that lock your fence's angle relative to the guide rail. Then move the miter gauge with the test piece to the front of the saw, and lock the rip fence against it. Tighten the bolts, but not all the way—allow for slight movement at the back end of the fence with firm pressure. Now, slide the test piece forward until it's over the back of the saw's throat plate. There should be about 0.015 in. (about 1/64 in.) clearance between the piece and the fence. To gauge the amount of clearance, slide a feeler gauge or a dollar bill folded over twice between the fence and the test piece. Finally, tighten the fence bolts, and recheck the settings before making a test cut. —*M.D.*

more room to manuever your hand and the push stick past the blade (see the top left photo on p. 89).

Short fence—An auxiliary fence that extends the entire length of the rip fence makes it easier to cut sheet goods. Because they are dimensionally stable, pinching or spreading after the cut is not usually a problem. However, when cutting solid wood, there is always the possibility that the wood will either pinch together or spread apart during the cut. The splitter that is standard equipment on most guards is designed to eliminate the problem of the wood pinching the back of the blade. A short auxiliary fence will eliminate the problem of the wood spreading apart after it's cut. The short fence should end at the back of the blade to allow space for the wood to spread without forcing the workpiece away from the fence. A short fence also makes a good stop when crosscutting multiple small pieces to the same length using the miter gauge (see figure 6 below). In this case, the fence should only extend to the front of the blade, so you can bump the workpiece into the fence at the beginning of the cut, but not have the cutoff trapped between the fence and blade at the end of the cut.

Dado and molding fence—The dado blade and the molding head often cut the edge of a board, which means that the cutter or blade is near the fence. The auxiliary fence for these cuts should have an arc-shaped recess to provide clearance to house the cutter. Because of the danger of kickback, you should never cut a rabbet or make a molding with the workpiece between the fence and the cutter. Molding heads and dadoes require more downward pressure than a regular blade, so it's a good idea to add a hold-down strip to the wooden fence for rabbeting and molding, as shown in the top right photo on p. 89. Always cut the molding profile on the edge of a wide board, and then rip the desired width of molding from it.

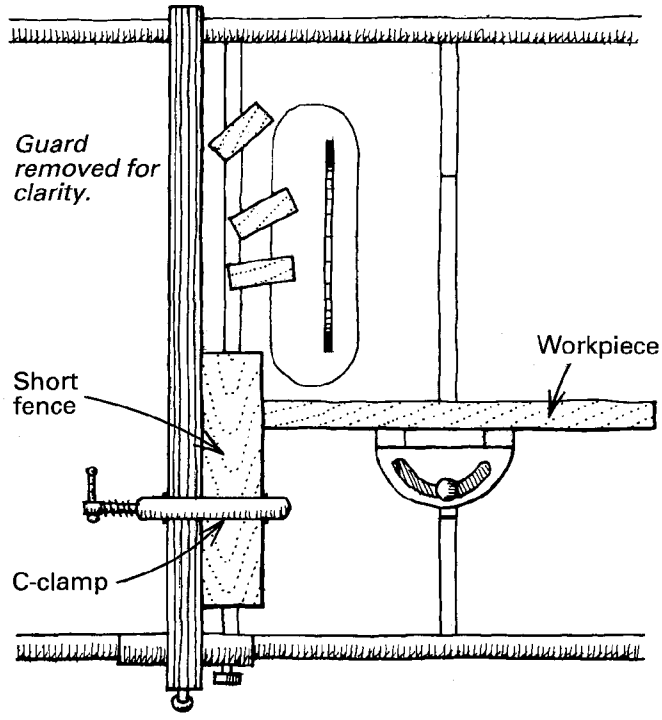
Crosscutting with the miter gauge

The miter gauge is an adjustable protractor that slides in the miter slot and supports the work as it is crosscut. The face of the miter gauge remains square to the bar for square and bevel crosscuts but is angled in relation to the blade for miter and compound-miter cuts.

To crosscut, press the workpiece against the face of the miter gauge and down onto the miter bar. After making sure your fingers are clear of the blade, advance both the gauge and the wood into the blade. Most people prefer the left miter slot for crosscutting, but either slot works. When the blade is angled, use the slot opposite the direction of the tilt.

Use both hands to control the wood and the gauge, and hold the wood tightly against the face of the gauge so that it doesn't slip during the cut. Once the wood is cut into two pieces, stop the forward movement of the miter gauge, and pull the wood and the miter gauge backward to the front of the saw. As you back up the

Fig. 6: The short fence as a cutoff stop block



The workpiece should touch the short fence at the beginning of the cut, but not at the end.

Fig. 7: Making dadoes with the two-stop system

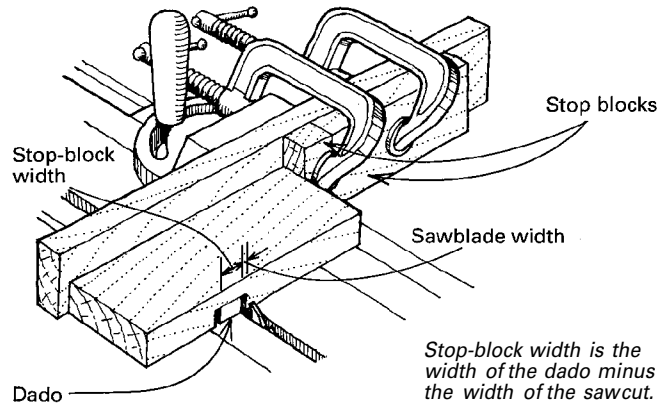
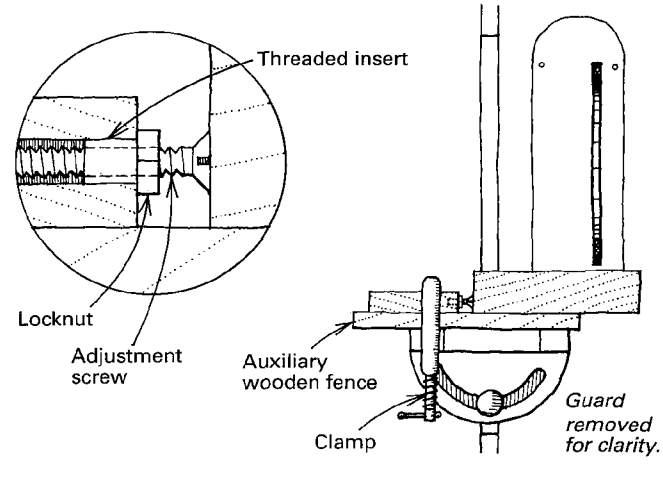


Fig. 8: A shopmade microadjustable stop



wood and the gauge, maintain the same pressure that you used as you cut; relaxing too soon can cause accidents. Never touch a cutoff piece while the saw is running. A safety precaution when cutting small pieces: Clamp them to the miter gauge.

The auxiliary miter fence—Most miter gauges have holes so that a wooden fence can be screwed to the face of the miter head. A longer auxiliary fence gives the workpiece more support. Use plywood for the auxiliary fence because it is more dimensionally stable than solid wood. Let the fence extend past the blade, and then crosscut it to establish the exact location of the sawblade (see the bottom right photo).

Marking the work—When making individual crosscuts, it's best to mark the edge of the board because the edge contacts the blade first. Then the workpiece can be positioned, so the mark lines up with an outside tooth of the sawblade. Alternatively, you can scribe a line on the back of the board and align it with the sawcut on the auxiliary fence.

Miter-gauge stops—A stop block clamped to the wooden fence automatically measures the required length of board. This simple technique offers both efficiency and accuracy, particularly when you need several pieces exactly the same length. Keep gentle pressure against the stop as the wood is fed into the blade. After the cut is made, maintain the pressure against the stop as the wood and miter gauge are being retracted to lessen the likelihood of contact with the blade.

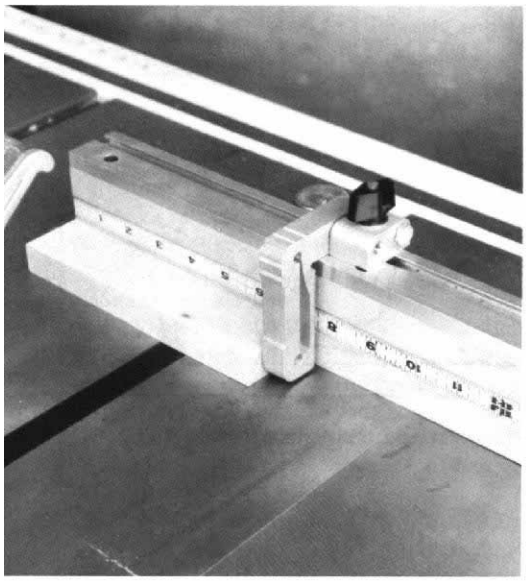
Dual stops—Sometimes it may be desirable to have several precise stops. For example, when cutting several boards that must first be squared up and cut to exactly the same length, two stop blocks are efficient. The stop nearer the blade is the finish stop; the stop farther from the blade is the rough stop. If your miter gauge doesn't have hinged stops, two wood pieces clamped to the fence work almost as well. Cut a piece of wood about 2 in. long for the finish stop, and clamp another piece opposite the blade for a rough stop. When you need to use the rough stop, just unclamp the finish stop block.

Another job for the two-stop system is to make the two outside cuts of a dado with a standard blade instead of a dado head (see figure 7 on p. 91). The first stop locates the right edge of the dado and the second stop, which must be as wide as the dado minus the width of the sawkerf, determines the dado's width. Once these two cuts are made, the waste in between can be removed in several passes.

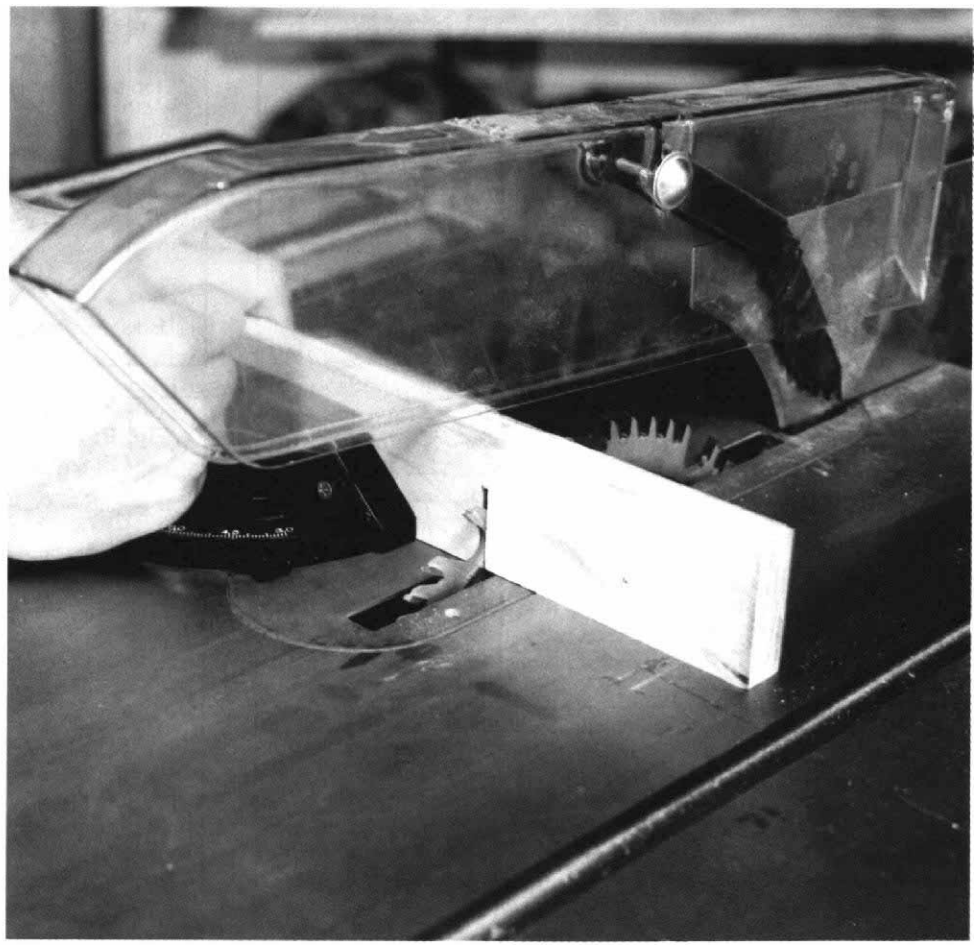
Microadjustable stops—For very precise work, it's essential to be able to make very fine adjustments of the stops. One low-tech approach is to put paper shims between the rough stop block and the finish stop block. A dollar bill or sheet of typing paper is 0.004 in. thick, a dollar bill folded twice is about 1/64 in.

Another technique is to make a block that has a threaded insert and an adjustment screw, as shown in figure 8 on p. 91. Every full turn of a ¼-in., 20 threads-per-inch machine screw adds or subtracts 0.05 in. to the length of the stop block. The locknut makes this measurement reliable for repeated operations. □

Mark Duginske is a contributing editor to Fine Woodworking. *This article was adapted from his new book,* Mastering Woodworking Machinery, *published by The Taunton Press, 63 S. Main St., P.O. Box5506, Newtown, Conn. 06470-5506.*

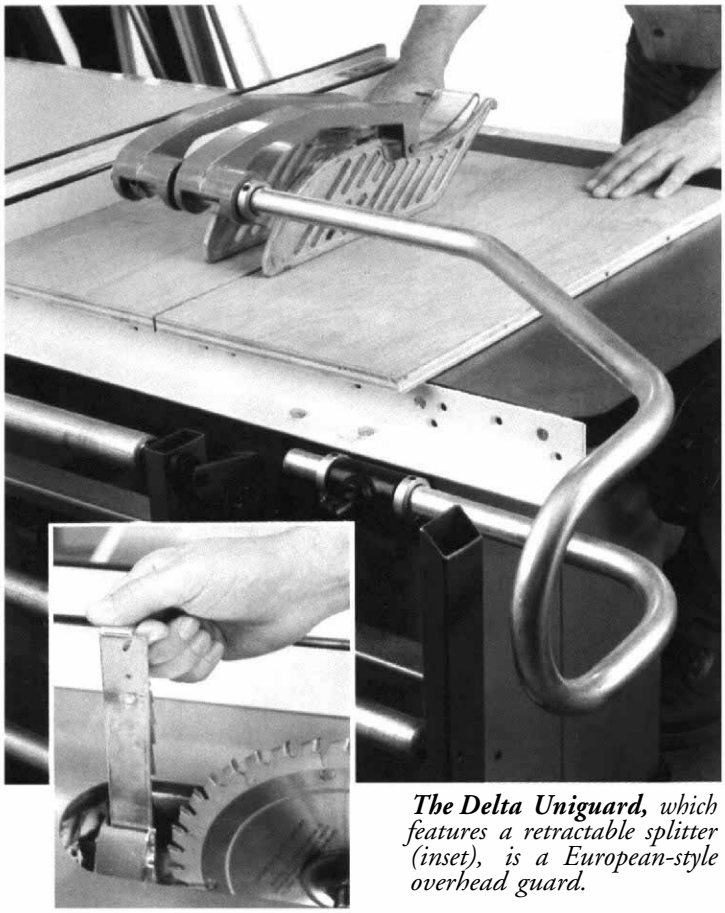


Some after-market miter gauge fences, *such as the FasTTrack shown above, have flip-up stops like those that have been standard equipment on European saws for years.*

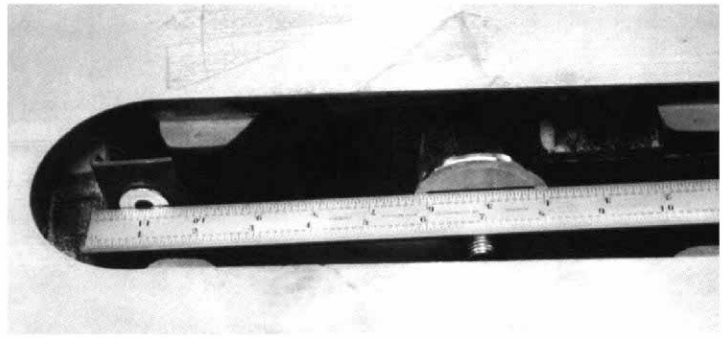


A plywood auxiliary fence *screwed to the face of the miter head increases its surface area and supports the workpiece. If you let the fence extend past the blade and then cut it off as shown at right, you can then use the sawkerf to align pieces that you are crosscutting.*

Don't dump your saw guard, adjust it

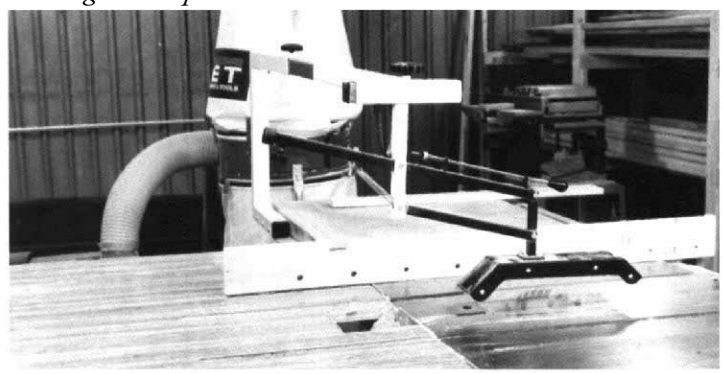


The Delta Uniguard, *which features a retractable splitter (inset), is a European-style overhead guard.*



When mounting a North American-type guard *where the mounting bracket is actually the splitter, the mounting bracket must be perfectly aligned with the arbor flange.*

The Biesemeyer overhead guard *can be installed on any tablesaw and features an alarm that sounds if a cut is attempted without the guard in place.*



Tablesaw manufacturers spend hundreds of thousands of dollars to develop safety guards, but no tool guard is a guarantee of safety-constant vigilance is always your best safety equipment.

The saw guard: Most tablesaws sold in North America are equipped with a cage guard, which is a see-through plastic or metal guard with a sheet-metal spine that also serves as a splitter to keep the kerf from closing and pinching the blade (see the photo on p. 87). The spine is connected to the saw in two places, directly behind the blade and to the back trunnion, which allows the guard to tilt when the blade is tilted. A toothed antikickback mechanism hangs from the guard and rides on the workpiece.

This type of guard offers protection against kickback while also keeping your fingers away from the blade, but it is unwieldy in some situations. For example, it's hard to rip narrow pieces, or slide a push stick past the guard if the fence is close to the blade. And sometimes when crosscutting thick stock, the workpiece will wedge under the antikickback teeth. In addition, because the splitter is part of the cage guard, the entire guard must be removed when making a cut that does not sever the board, such as a dado or rabbet cut. The guard must also be removed when the "workpiece is held vertically against the fence, such as when cutting tenons with a jig. Because these guards are time-consuming to remove and replace, they are often left off the tool, in spite of the operator's and manufacturer's best intentions.

The Delta Uniguard, as shown in the photo above, is similar to overhead guards found on many European saws. The splitter used with this type of guard is a small piece of metal that is attached to the back trunnion. Sometimes the splitter is entirely independent from the guard, and in other cases, the guard is mounted on top of the splitter. The Delta splitter is retractable, so it can be pulled up when needed and pushed out of the way below the table's surface for partial cuts (see the inset photo at left). These guards can be easily lifted out of the way for cuts that require more clearance and replaced just as easily afterward.

When either type of guard is removed, you should take a few minutes and devise a method to keep your hands from coming in contact with the blade. For example, when tenoning with the workpiece upright against the fence, simply clamping a 4x4 to the saw table alongside the blade will make it nearly impossible for you to drop your hand into the blade should something go wrong.

Optional guards: You can purchase high-quality guards to retrofit older machines. Most of these guards are similar to the overhead European design. The Biesemeyer guard (see the bottom right photo), for example, is a suspended guard with an alarm that rings if the guard is not in place during a sawcut. The Brett guard is clear plastic and also functions as a hold-down. Either guard can be wired into the switch, so you can't start the saw if the guard isn't in place.

Adjusting the guard and the splitter: The guard and splitter must be perfectly adjusted, or they will make the tablesaw more difficult and dangerous to operate. On North American-style guards, the flange, splitter and guard bracket must lie in the same plane as the blade, as shown in the top right photo. When mounting this type of guard, leave the adjustment nut on the back support loose while you check the alignment of the blade and the guard plate (splitter) using a straight edge, then make the final adjustment of the back support and tighten the guard in place. Finally, check that the guard plate is square to the table. *—M.D.*