Pattern cutting is a shaper's strong suit—*To pattern-shape small parts, the author uses jigs with handles and clamps. Pattern cutting is one of four jobs where the author says a shaper outperforms a router and router table.*

Jobs a Shaper Does Best

Power and stability mean vibration-free cuts

by Lon Schleining

I'm convinced that a shaper—more than a router table—should find a home in every active woodshop. Sure, the shaper is well-suited for heavy work, like forming deep contours and complex profiles. In fact, I use the machine daily to make custom hand rails, balusters and other stair parts. But even straight moldings and ordinary light shaping (tasks normally delegated to a router table) can be handled safely and easily by the shaper, and with better results.

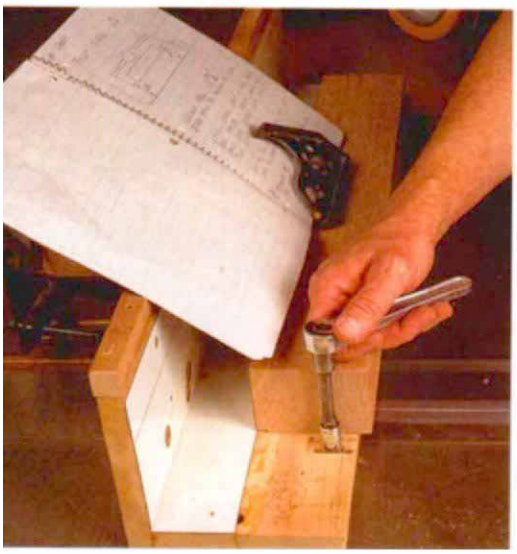
I use the shaper for four jobs: running straight molding, raising panels, pattern cutting (see the photo above) and doing radius work. Each job requires different tooling and setup. When the machine is molding, for example, you'd hardly recognize it as the same machine that raises panels. Spending time setting up each cut makes the shaper dependable and a pleasure to use.

I've gained confidence with the shaper because I do what it takes to make the machine safe (see the story on p. 47). I haven't skimped on tooling, accessories or jigs. And having an assortment of cutters, guards, jigs and a power feeder lets me shape items that I would otherwise have to buy from a millwork shop. Jigs, in particular, are great for holding and guiding small or awkward pieces (see the box on p. 48).

Shaper anatomy: more solid than a router table

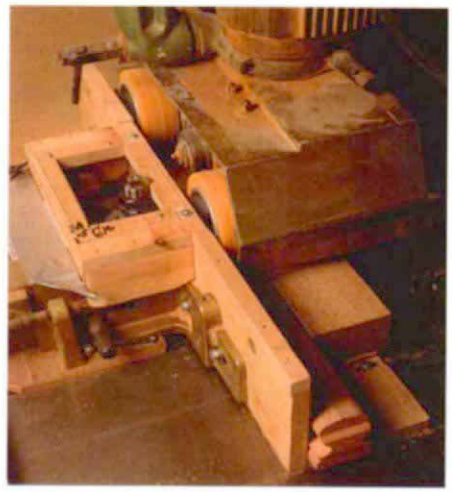
I've tried to do stairbuilding work using a heavy-duty router, but in the middle of a deep profile, I discovered that the router was straining to make the cut. It made me nervous routing with a 2½-in.-dia. bit that weighed several ounces. So I bought a shaper. When I put the same bit in the new

Photos: Alec Waters



Tunnel-shaped jig is better than a standard fence *for straight molding work. Lined with plastic laminate to minimize friction, the jig guides the work smoothly because there is only a few thousandths of an inch clearance. The author's checklist is in the background.*

Two ways to hold shaper cutters*—The spindle with collet (left) holds standard ½-in.-shank router bits; the 1-in.-dia. spindle with nut holds stacked wing cutters. The carbide-tipped router bits and two-piece cutter were custom made.*



Powerfeeder improves straight molding*—The author relies on a power feeder to run straight molding and hand rails. The feeder makes safe, even cuts. A Plexiglas guard over the cutter lets him see that the chips are being cleared out.*

machine, the cut was effortless, vibration-free and just felt a lot safer. A big bit for a router turned out to be a small bit for a shaper. I still use a router from time to time, but the shaper is my tool of choice whenever possible.

Driven by a belt and dampened by lots of cast iron, a shaper just coasts through most lumber. Like a router table, a shaper has a cutter sticking up through a hole in a worktable. And many of a shaper's setups will be familiar to you if you've used a router table. But that's where the similarities end. A shaper is more solid and more powerful than a router table. Though a shaper turns at less than half a router's speed, the shaper produces a superb cut because there is less vibration. There are two reasons for this. First, most shapers weigh almost as much as a cabinet-model tablesaw (about 450 lbs.). Second, in most shapers, the cutter is fixed to a 1-in.- or 1¼-in.-dia. spindle, which is much more rigid than a ½-in.-dia. router bit shank.

Unlike a router table, where a router is inverted, the shaper is designed to be used with the cutter sticking up. In a router table, the motor sits directly below the cutter where lots of dust goes.

In a shaper, the motor is off to the side. Both my router and shaper are rated at 3 hp, but the router motor will develop the rated horsepower only in a theoretical scenario where power is measured in terms of wattage; the shaper delivers 3 hp at continuous speed and torque.

A shaper's spindle bearings, which are separate from the motor, are much larger than a router's, so the shaper will feel much more solid and stable. Another plus with the shaper is that the cutter rotation can be reversed, so cutters may be inverted in certain situations (I'll tell you more about that later). Also, with a shaper, you can move the spindle up and down with a handwheel and then lock the setting. This makes tiny height adjustments easy and precise—something that's difficult to do with a router table.

Accessories and tooling increase a shaper's capabilities

My Powermatic shaper has a single-phase 220v motor and two speeds: 7,000 and 10,000 rpm. The machine's 30-in.-wide table is thick enough that I can drill and tap holes in it to mount jigs and a power feeder. The shaper came with an adjustable fence with a dust port. The fence is split, so the outfeed and infeed sides can be offset, like a jointer's tables. This is essential when you're removing the entire edge of your material.

I rarely use the fence alone because I like to bolt on an auxiliary fence for most operations. The machine also came with a miter gauge that runs in a slot, like a tablesaw's, but I never use the miter gauge because I prefer using a fence.

My shaper has three spindles: a solid 1-in. spindle and stub spindles, ½ in. and ¾ in. dia. I use the 1-in. spindle for heavier work, the ¾-in. spindle for smaller cutters and rarely, if ever, the ½-in. spindle. Wing cutters (with either three or four wings) or safety cutters (also called antikickback cutters) will slide over the spindle. I also can stack a combination of these cutters, spacers (collars) and shims to produce complex profiles. (For more on this, see *FWW* #69, pp. 51-53.) A keyed washer and a locknut hold the cutters on the spindle.

Changing cutters is more involved on a shaper than a router, but you can buy a collet for the shaper (see the top right photo on this page), which lets you run ½-in.-shank router bits that interchange readily. Despite the shaper's slower speed, I've found that router bits run fine. You also can use cutterhead tooling, or insert tooling, in a shaper, where the knives are locked in the head by a setscrew, an alignment pin or a V-groove. With cutterhead tooling, you can replace and swap knives, and you can grind a blank to make a custom profile. For my work, however, I'm only comfortable shaping with wing cut-

With a shaper, safety comes first

Not far from my shop there is a cabinetmaker who wears an oak apron when he's shaping. Even experienced woodworkers are edgy around shapers. But being cautious is wise. A hard thing to learn is taking enough time to be safe. When shaping, I put safety before speed and before cost.

Double-check the tooling: The biggest fear with a shaper is thrown cutters. I spoke with a guy who had to duck behind his tablesaw when the piece he was shaping kicked a knife loose. As it enlarged the hole in the shaper's top, he said it sounded like a 747 coming in on its belly. Fearing a fire from all the sparks, he slithered back over to the machine to turn it off. From that story, I've learned to do three things to minimize the risk of loose tooling. First, I don't use slip knives. I use only wing cutters, safety cutters or router bits. Second, I recheck the tightness of every cutter I install. Third, and most important, I take light cuts while feeding the stock slowly.

Modifications add a safety net: I added some extra safety features to the machine when it came out of the crate. I added a cord with a plug and did not wire the machine directly to a circuit. I keep my shaper unplugged, except when I'm running it. When I'm changing cutters or have my hands in the shaper's innards, I drape the disconnected cord where I can see it.

A kill switch offers security, *so the author built this foot-controlled off switch. He also keeps the spindle-reversing switch taped, so he doesn't change the cutter rotation inadvertently.*

I made a foot-operated kill switch, which is a hinged paddle that contacts the off button (see the photo above). I can hit the paddle while keeping both hands in position, my body upright and my eyes on the cutter. Another improvement was tensioning the shaper's belt, so it will slip if a workpiece gets jammed.

Use the right setups and stay focused: Making the job comfortable is one shaper-safety item that's frequently overlooked. Besides wearing eye and ear protection, I make sure I have good footing. I collect old rubber door mats to use as non-skid pads.

I always pick the appropriate spindle speed for the cutter diameter (large cutters require slower rpms). Where possible, I shroud the cutter with a guard or a power feeder. If I'm using the fence, I keep the gap in it as small as practical, and I use a table insert ring sized to the cutter.

When shaping, I keep my hands well out of the cutter's reach. Because I always use either a jig or a starting pin, I am never free-handing work into the cutter. When feeding stock, I shape end grain first. I work against the cutter rotation (unless I'm climb-cutting with a feeder), and I stay out of the line of a kickback. I do not shape stock that has knots or pieces that are too short or too thin.

During shaper setup and use, I keep the shop door locked and the phone answering machine on. When my attention is drawn away from my work, I write down the next step and tape the note to the machine before I take care of the problem. When I return, I take a few extra moments to re-focus, and I don't hesitate to postpone a tricky or unfamiliar job if something doesn't feel right. That's usually when I'm about to make a mistake. —*L.S.*

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ters, router bits and safely cutters.

In my shop, the shaper sits alongside a central work station, so I have ample infeed and outfeed area. I built a platform for the shaper, so it is at the same height as the work station table. Because I don't use the miter gauge, I rotated the machine 90° clockwise from its conventional position. This orientation offers better access to the controls and makes changing tooling easier. I also bolted the machine to the floor and to the work station to reduce vibration. With the shaper secured, I can apply pressure without worrying that it will move. To keep the work area and my lungs clear, I have a 1,000-cu.-ft.-per-minute (cfm) dust collector that keeps up with most of the waste. For every jig, I make a dust pickup boot from a coffee can or standard metal heating duct.

Checklists and other precautions

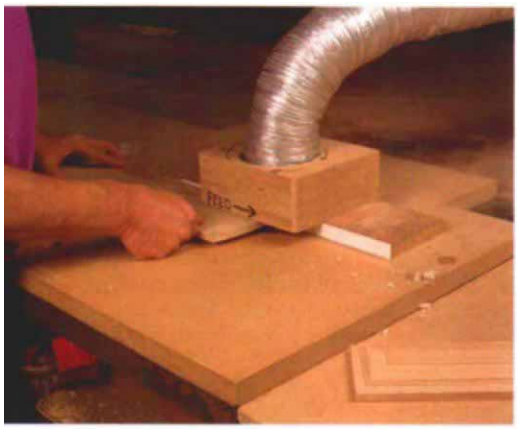
Pilots use checklists every time they land an aircraft or take off in one. I also use checklists when shaping (see the photo at left on the facing page). Remembering to tighten the spindle nut, just like remembering to drop the landing gear, is too important to leave to memory alone. In a quiet moment, I write down the sequence of an operation. I include everything from locking the height adjustment to counting the pieces after a run. Each time I make a setting that I plan to use again, I make sketches and jot down the dimensions in my notebook. When I quit for the day, I mark where I have left off.

Make light cuts, and take your time— A shaper is capable of cutting in a single pass, but I only do so when I'm using a power feeder and forming relatively modest profiles. For most shaping, I use a series of light cuts, which are easier on the machine, and they get me used to the process. Instead of taking a chance of ruining a piece by hogging all the way in one pass, I take an initial pass and then clean up with light subsequent passes.

My shaper fence adjusts outward for progressively deeper straight-run cuts (see

Use jigs for safe and consistent shaper work—*Schleining built a jig to shape a profile on the side of a hand-rail piece. Secured vertically in a holder, the piece is rotated with a handle past the cutter. The shaper is turned 90° from its normal position.*

Inverted panel raising is safer—*Because Schleining likes to keep work between his hands and the cutter, he prefers to raise panels with the bevel facing down. The auxiliary table and guard also shield the cutter.*



Shaper jigs put you in control

Shapers require more hold-downs, guides and stops than other machines. I've spent half a day setting up an operation that takes just a few minutes.

To build jigs, I use Finnish birch plywood because it wears well and is strong. I use ¾-in. plywood to make jig bases. To hold a workpiece, I prefer toggle clamps because they grasp and release easily, and the tension can be adjusted. I integrate a cutter guard and a dust hookup into most jigs.

For small pieces, I make the jig oversized and put handles on it (see the top photo). I also make the part longer than it needs to be. To keep the work from being yanked out, I screw the end of the piece where it won't be near the cutter.

I never get tired of seeing perfect contours emerge from jigs. When I'm done with a jig, I hang it on the wall, where it's always handy. —*L.S.*

the photo at left on p. 46). For raised panels, I elevate the cutter into the piece in stages. When pattern cutting and doing radius work, I also increase the depth of cut in steps. First I bandsaw close to my lines to minimize how much the shaper has to cut. Then I use a flush cutter followed by the profile cutter. Graduated bearing sizes let me make deeper and deeper cuts.

Straight runs: shape with a fence and a power feeder

For straight shaping runs, I always use a power feeder. To me, a shaper isn't complete without one. The immediate benefit of the feeder is that the stock moves past the cutter at a constant rate. Chatter and burn marks are gone because the stock feeds without hesitation due to changes in hand positions, which are harmful, repetitive motions anyway.

A power feeder offers other advantages. When the feeder is set slightly askew, the stock will hug the fence. Because the wheels apply constant down pressure, there is little chance of a kickback, and boards that are bowed stay flat on the table. The power feeder hovers over the cutting area, so it shields me from flying chips (see the bottom right photo on p. 46). Most important, though, is that a power feeder keeps my hands far away from the cutting action.

The jig I use to form straight molding (see the photo at left on p. 46) resembles a tunnel. Its opening is two or three thicknesses of paper wider than the stock I'm running. This allows .010 to .015 in. clearance, so the stock slides without binding. I line the tunnel with plastic laminate, and I lubricate it with TopCote. The key here is to have all the blanks milled consistently. I use a portable planer to thickness the stock, and I mill a couple of pine blanks at the same time so that I can test the shaper's setup. The roof of the jig is the power feeder.

Panel raising

The conventional way to raise panels on a shaper is to run the panel face up (see the drawing on the facing page). Panel-raising cutters are designed to run above the work. There are several reasons for this. First, a panel tongue will always fit its intended groove in the frame. Even if the panel is cupped, the thickness of the tongue will be cut just undersize, which means that it will still fit. Second, with the panel facing up, it won't get scratched on the table. Third, the operator can watch the cutter do its work.

Despite all these good reasons, however, I prefer to raise panels face down when I can. With the cutter below the work, I feel safer. Here's how I do it:

I invert a panel-raising wing cutter and set it up so that most of it is below the surface of the shaper table for the initial pass. If the hole in the table is too small to allow the cutter to descend below the surface, I put down a plywood auxiliary table.

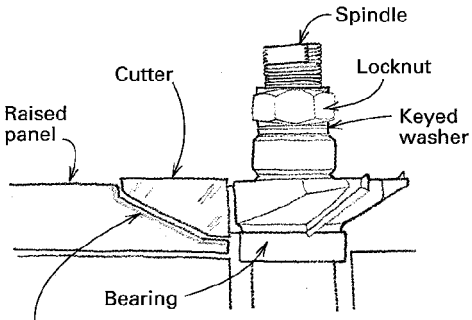
With the cutter inverted, the shaper must run in reverse, which means I take a few extra precautions. I position a guard well over the cutter. And I draw arrows on the jig to show feed direction and rotation (see the photo at left). There also is the possibility that the spindle nut could loosen due to the rotation, but I prevent this by using a keyed washer under the nut. I check the nut occasionally just to make sure. Finally, I loosen the red tape I keep over the reversing switch and drape it to remind me that the cutter is turning opposite its normal way.

Pattern cutting

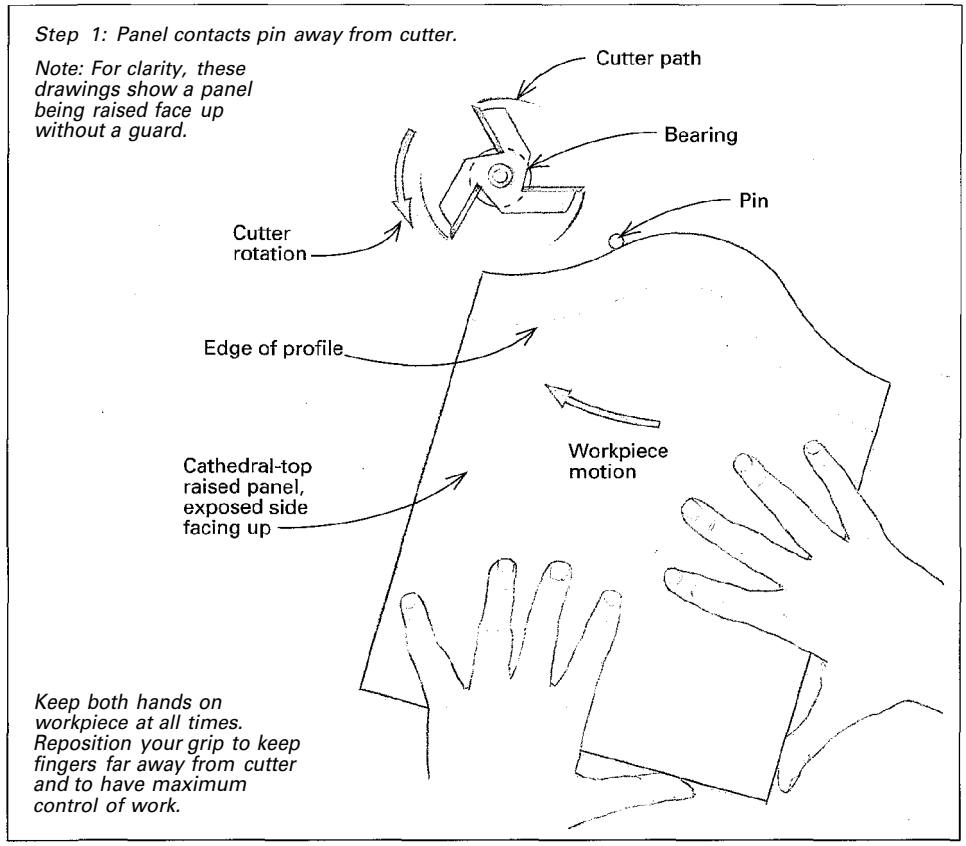
For contouring curved parts, it's hard to beat a pattern-cutting jig and a shaper. Pattern cutting requires a guide bearing or rub collar above or below the cutter to ride along a pattern. The pattern can be the stock itself or a plywood or scrapwood template (see the photo on p. 45). As for the cutters, I usually start with a flush-cutting bit. Next I use a profile cutter and shape in stages of depth.

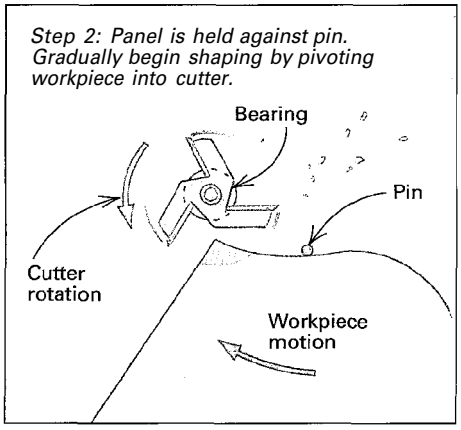
Shaping with a starter pin

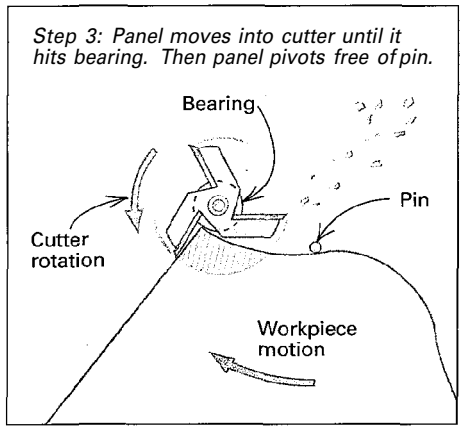
A shaper makes short work of cutting the profile on a raised panel. To start the cut, the workpiece is held against the pin (see Step 1) and rotated gradually into the cutter. The panel stays in contact with the pin (Steps 2 and 3) as it moves into the bearing. When the bearing supports the work and is no longer spinning, the workpiece may be pivoted, so it's free of the pin (Step 4).

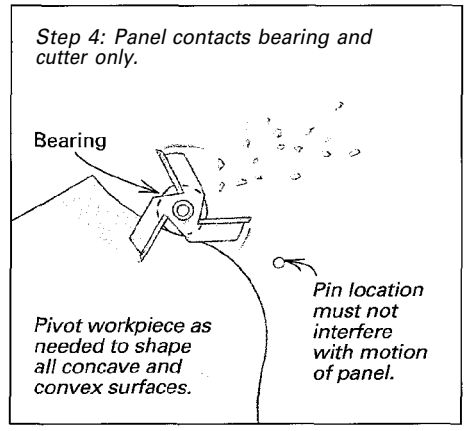


Blue line represents profile of cutter.









Using on-ramps, off-ramps and starting pins—Usually, when I use a guide bearing, I make the pattern-cutting jig with an on-ramp and an off-ramp. The ramps are just extra pieces of wood that contact the bearing before the work and stay in contact after the work has exited the cut. The ramps allow the cutter to ease into the work and exit it smoothly without abrupt transitions. Often, I'll build the on-ramp into the end of the actual workpiece. Both ramps need to project far enough to contact the bearing while leaving the work clear of the cutter. If I can't use a jig, I use a starting (fulcrum) pin to control the cut. This pin is inserted into a hole in the table close to the cutter. The drawing above shows how a curve-top panel for a cabinet door is run using a starting pin.

Radius work

Shaping a radius is easier than it looks. For large vertical-axis radii, I use a jig that looks like a segment of a wagon wheel laid flat on the shaper. I rotate the jig about a pivot point, so the workpiece moves past the cutter.

The setup for a horizontal-axis radius is shown in the top photo on the facing page. The jig sits upright on the table, and the pivot point is actually above the cutter. I have slotted holes in the workpiece holder, so I can slide it closer to the cutter for gradually deeper cuts. An outboard fence on the right side of the jig prevents the work from being pulled out of its holder.

The pay off

One day, when I was using a horizontal radius jig, the cutter somehow dislodged the piece of oak I was shaping. The motor was running, even though the cutter had stopped. I held onto the jig with both hands. Reaching out with my left foot, I hit the paddle switch, turning the machine off. I breathed again. The jig and my safety precautions had paid off. □

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Drawings: Kathleen Rushton