

The physics of machine safety

TO CUT SAFELY, STAY FOCUSED ON THE FORCES EXERTED BY THE SPINNING BLADE OR BIT

BY TODD BRADLEE

It was only after many years of working wood—and one big scare—that I began to think seriously about machine safety and developed a real understanding of the forces at work when a spinning blade or bit cuts a piece of wood. In this article I'll show you how to compensate for those forces and control the workpiece as you work at the tablesaw, bandsaw, jointer, drill press, and router table.

My awakening came 17 years into my career. I began working as a carpenter at 18, and I saw some pretty frightening things on job sites. Carpenters seem fond of running

Tablesaw

The tablesaw presents the most complex challenge to maintaining control. You must keep the workpiece moving forward, flat on the table, and pressed against the fence. Failing to do any one of these three things can result in serious injury. Fortunately, a pair of hands and a push stick are all you need to combat those forces and stay in control. Past the blade, the workpiece engages the splitter, which helps keep the board against the fence.



Two-handed technique. Your left hand, anchored near the edge of the table, applies downward pressure and keeps the workpiece against the fence. Push the workpiece through the blade with your right hand (above). To keep your right hand well clear of the blade, start using a push stick when your hand reaches the table (left).

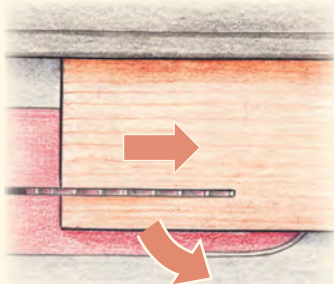
Cutting forces

Back side of blade lifts workpiece off table.

Rotation of blade pushes workpiece back.



If the feed pressure is not in line with the force exerted by the blade, another force comes into play, causing the workpiece to pivot away from the fence.



HOW TO CONTROL THEM

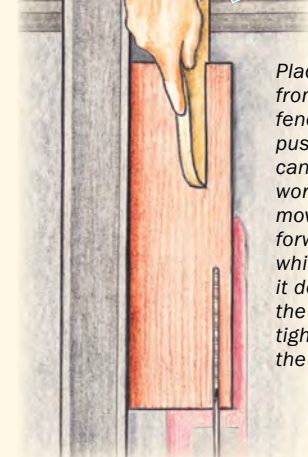
Push workpiece into blade.



Apply downward and lateral pressure with off hand.



Placed out from the fence, a push stick can keep a workpiece moving forward while holding it down on the table and tight against the rip fence.



Bandsaw

As it cuts, a bandsaw blade exerts downward force that pushes the workpiece onto the table. This is fine as long as the part you are cutting is flat. Things get a bit tricky when the workpiece is curved and only contacts the table at one point. If you keep that point of contact right in front of the blade, you'll be OK. When cutting thin slices from a board, use a push stick to protect your hand in case the blade wanders from the cut and out of the board.

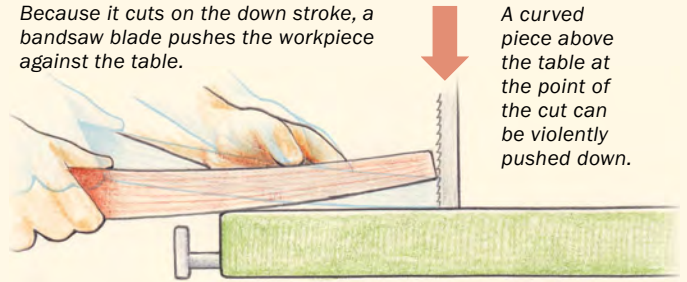


CURVED WORK

Exploit blade's motion to improve control. The blade forces the workpiece onto the table. Keep the point of contact right in front of the blade, and the downward force will help steady the workpiece.

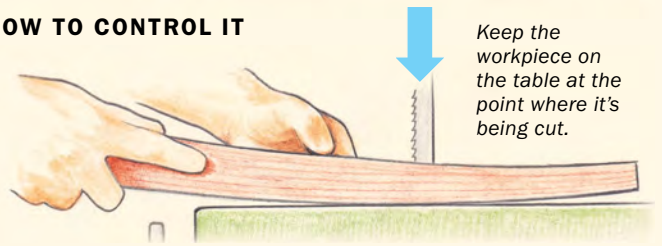
Cutting force

Because it cuts on the down stroke, a bandsaw blade pushes the workpiece against the table.

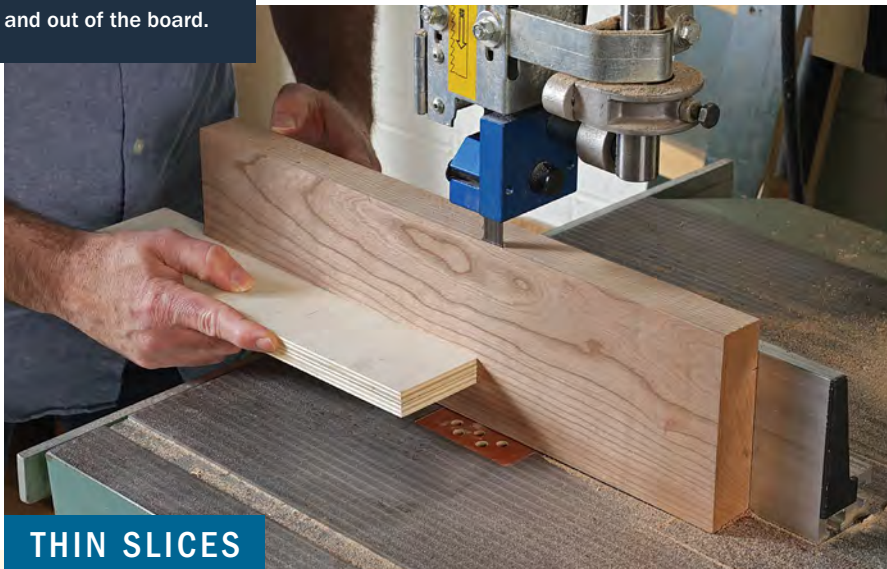


A curved piece above the table at the point of the cut can be violently pushed down.

HOW TO CONTROL IT



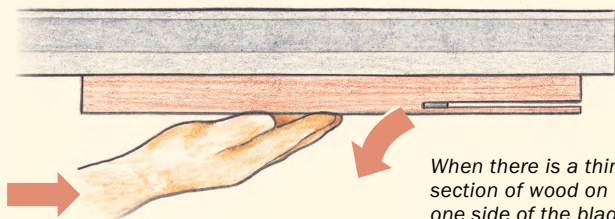
Keep the workpiece on the table at the point where it's being cut.



THIN SLICES

Beware of wandering blade. When ripping or resawing, a blade cutting near the surface of a workpiece can quickly veer off course and out of the wood, so use a push stick.

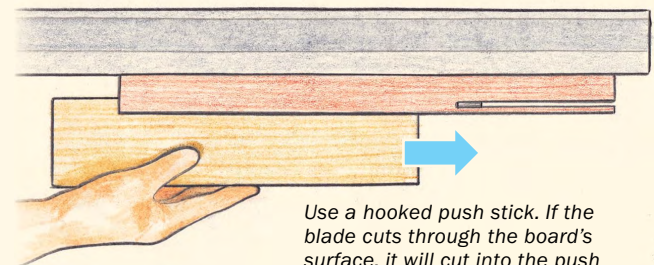
Cutting tendency



Using your hand to push a workpiece through the bandsaw puts it in the line of fire.

When there is a thin section of wood on one side of the blade, the blade can deflect from the cut.

HOW TO COPE WITH IT



Use a hooked push stick. If the blade cuts through the board's surface, it will cut into the push stick rather than your hand.

blades within an inch or two of their fingers. After 14 years in the building trades, I was burned out but unscathed.

Having found inspiration in some custom furniture I had seen, I began to design and build furniture. Three years later, at age 35, my right hand was pulled into a tablesaw blade by a kickback. The blade nicked the tip of one finger, but otherwise I was unhurt. I was very fortunate, but luck doesn't last, so I began to study the machines I used daily. I wanted to understand how they cut, so I could use them more safely.

Todd Bradlee, who began using power tools at age 12, is a professional furniture maker in Bishop, Calif.

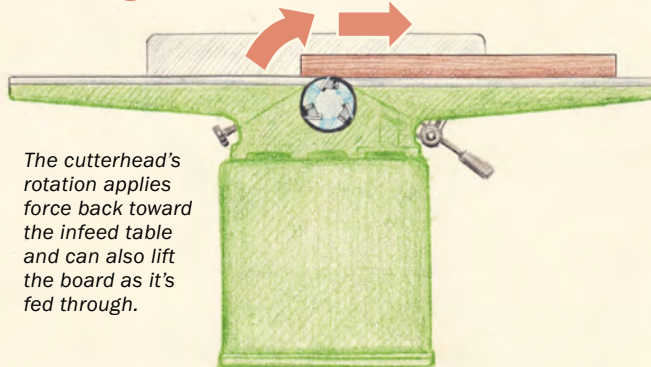
Jointer

As it spins toward the infeed table, a jointer's cutterhead pushes the workpiece back toward you as you feed it toward the knives. At the same time, the cutterhead exerts upward pressure on the workpiece. That's two forces you must counteract to maintain control. Press down with your left hand while using your right hand, with the help of a push stick, to push the workpiece forward.



Press down and push. Use your left hand to keep the board flat on the jointer's table while pushing it forward with your right hand.

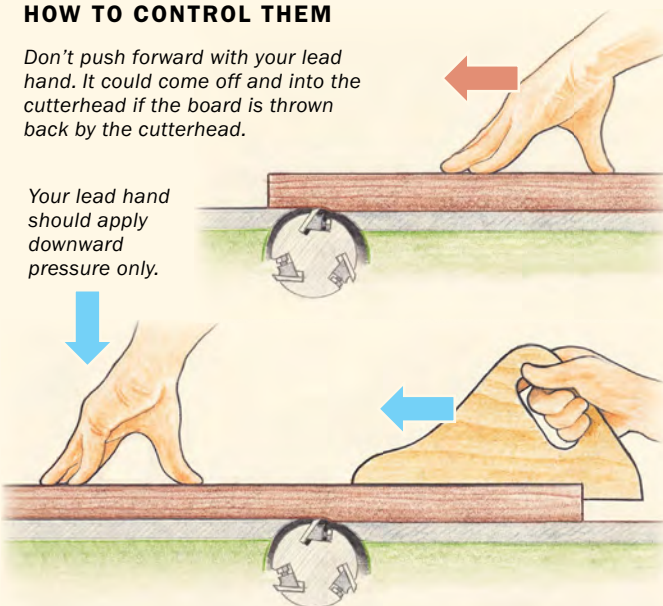
Cutting forces



The cutterhead's rotation applies force back toward the infeed table and can also lift the board as it's fed through.

HOW TO CONTROL THEM

Don't push forward with your lead hand. It could come off and into the cutterhead if the board is thrown back by the cutterhead.



Your lead hand should apply downward pressure only.



Keep pressure near the cutterhead. After the board is 6 in. to 12 in. past the cutterhead, let it pass under your left hand, but continue to apply downward pressure.

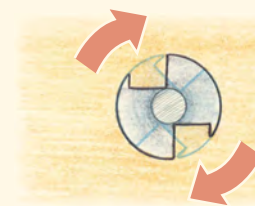
Drill press

Not as obviously dangerous as a tablesaw or bandsaw, the drill press can still ruin an otherwise fine day. When the spinning bit punches through the bottom of a workpiece, it can rip that workpiece from your hand, driving it into the column, or worse, your hand or body. Clamp the workpiece to the table or hold it against a fence to prevent the bit's rotational force from spinning it out of control.

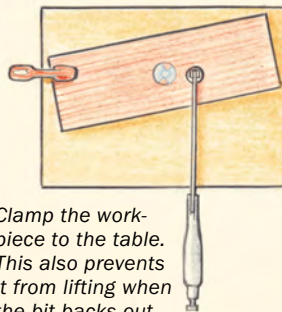


Cutting force

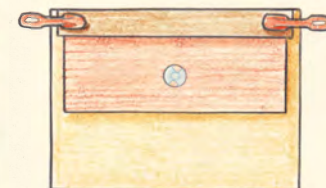
At the drill press, all of the force is rotational, and the bit can spin the workpiece.



HOW TO CONTROL IT



Clamp the workpiece to the table. This also prevents it from lifting when the bit backs out.



A fence attached to the table stops rotation, too.



Two ways to prevent spinning work. A clamp with a deep throat applies stabilizing pressure right next to the bit (left), and keeps the workpiece from spinning or lifting from the table as you back out the bit. A fence clamped to the drill-press table prevents it from spinning as well (above).

Router table

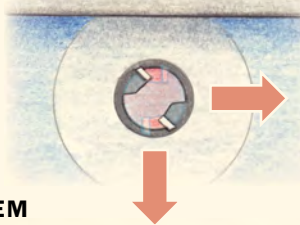
Always feed the workpiece against the bit's rotation. At the router table, this means it travels from the right to the left across the table. This counteracts the bit's rotational force, allowing you to keep the workpiece under control. Because the bit also exerts force toward the back of the table, you should use a fence. The bit will push the workpiece against the fence, helping you to stabilize it during the cut.



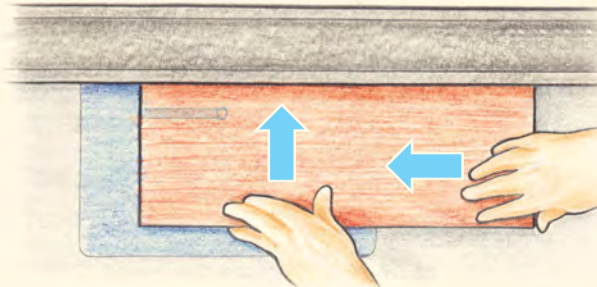
Two hands, one fence, plenty of control. No downward pressure is needed, but use your left hand to press the workpiece against the fence. Once again, your right hand feeds it through the cut, counteracting the force of the bit.

Cutting forces

If fed from left to right, a board is pushed away from the fence and pulled away from you.



HOW TO CONTROL THEM



Instead, always feed from right to left, using your left hand like a featherboard, holding the workpiece against the fence in front of the bit, while pushing it through with your right hand. For narrow pieces, use a push stick or a push pad.