Climb-Cutting Versus Chip-Cutting

By Rick Christopherson

So you've built this beautiful jewelry box. Now comes the moment to add the finishing touches, like routing a nice decorative profile around the top. ----Craaaack!----There goes a 3 inch long chip from the edge, destroying many hours of work.

You can prevent tearout when using a router; its just a matter of the feed direction. There are two choices when it comes to the feed direction with a router: *Climb-Cutting*, and *Push-Cutting*.

Push-Cutting

Push-cutting refers to the feed direction of your workpiece which opposes the rotation of the cutter head. Push-cutting is typically considered the "normal" feed direction because it is safest: the router

doesn't want to runaway on you. However, push-cutting has the greater tendency for tearout. As the carbide tip strikes the wood, the path of the cutter travel is **out** of the wood, and the deepest cut is in-line with the grain. The result, is that the carbide is cutting the wood on the *Exit Stroke*.

The drawback to this direction, is that it tends to tearout the wood more, because the wood fibers will easily split lengthwise. As the cutter catches each fiber, it tends to pull it away from the main body of wood.

At the same time as the wood fibers are being pulled <u>away</u> from each other, the cutter head is being pulled <u>deeper</u> into the main body of wood. If the cutter has a bearing, this direction of cut will have the tendency to force the router to ride into the bearing (or fence) more.

In the push-cut direction, chatter is reduced because the router bit is applying a steady inward force to the cut.

Climb-Cutting

Climb-Cutting is when the feed direction

of the workpiece is the same as the rotation of the cutter. The term *climb-cut* comes from the fact that the router bit has the tendency to climb into the cut, or if you can visualize it, "walk" its way down a board. This is what makes climb-cutting so dangerous: the router bit has more control over the feed rate than you do, and if you don't carefully control it, the router or workpiece will take off on you.

Putting aside the dangers, the primary benefit to climb-cutting is that there is less, or even zero tearout. This is because the carbide strikes the wood with the deepest portion of the cut cross-grained and **into** the wood. That is to say, the carbide is cutting the wood on the *Entry Stroke*, which is compressing the wood fibers versus pulling them apart.



Aside from wanting to climb its way down the board, another side effect of climb-cutting is that the bit will be pushed away from the wood. As the carbide enters the wood, the force of the tip striking the wood surface tends to push the wood away from the bit. This has two effects. First off, the cut will almost never be full depth on the first pass of the cut. Secondly, since the cutter tips keep pushing the bit away from the wood twice per bit revolution, you end up with more chatter. This chatter is caused from the cutter bouncing in and out as each knife strikes the wood.

Applying These Concepts

The First Pass

To reduce the tearout while routing, I make the first pass in the climb-cut direction. To prevent the router from running away on me, I make this pass rather light. Since the router bit is naturally pushed away from the wood during climb-cutting, making a light pass is automatic: I just don't apply as much inward force.

Furthermore, I use *friction* to control the feed rate, not muscle. When you try to muscle the router to control the feed rate, then you are relying on your *reaction*

The scalloped edges (chatter) are caused when the teeth of the bit push away from the workpiece.

time to compensate for changes in the feed rate. You can never react fast enough.

With friction, there is no reaction time needed, there is just a constant force opposing the climb. While holding the router's handle, the butt of my fist is pressed down firmly onto the surface of the wood. When starting or stopping a cut, I firmly plant my fist on the wood, and use the other hand to rotate into or out of the cut. This gives me very good speed control over a short distance. As I move down a long board, I just drag the edge of my fist (or even forearm) down the wood.

I won't climb-cut with a router bit that is too large to safely control. For larger bits that aren't too large, or anytime I don't feel completely in control, then I will plant my fist in one spot and make short, shallow strokes by rotating the router into the cut with the other hand.

Cleanup Pass

After the first pass, I make a cleanup pass in the chip-cut direction. This ensures that the route went full depth, and also removes the chatter marks left by the climb-cut. Because the majority of the material has already been removed, the direction that the carbide tips strike the wood is nearly parallel to the grain, and therefore, no chipping occurs. I also make this last pass with a fairly fast feed rate to ensure that there is no burning.

Using a Router in a Table When hand feeding stock through the shaper or table mounted router, <u>don't even consider climb-cutting</u>: It's a good way to lose a finger. You have no way to control the feed rate when you are moving the workpiece on a table. While you may think you can stop the piece from grabbing and taking off, you can't.

If you have a power feeder for the shaper/router table, then climbcutting is feasible, but still very dangerous. My shaper is setup to



do 95% climb-cutting, but I have a rather large power feeder (shown in the adjacent photo). The small "baby" power feeders, may not provide enough workpiece control for climb-cutting. <u>Regardless of your feeder size, this is still dangerous</u>. Never allow anyone to stand in the outfeed path.

Most of the time, I do not need a cleanup pass on the shaper, but the smaller the feeder, the more important this will be. If a cleanup pass is needed, you can either change the feed direction to chip-cut, or leave it in the climb-cut. I usually stay in the climb-cut direction.

Conclusion Don't perform any operation just because someone else has done it without problems. Regardless what you do, or how you do it, routers and shapers are dangerous tools. You <u>must</u> operate them with 100% confidence, but never let your respect for them drop either. Operate the tool with <u>respect</u>. Never, never, operate a tool when you have a "fear" of the tool, or operation. There is a thin line between respect, and fear. Don't cross that line, or you <u>will</u> be injured.