I'M HOOKED!

Shop-built tool excels at slicing endgrain

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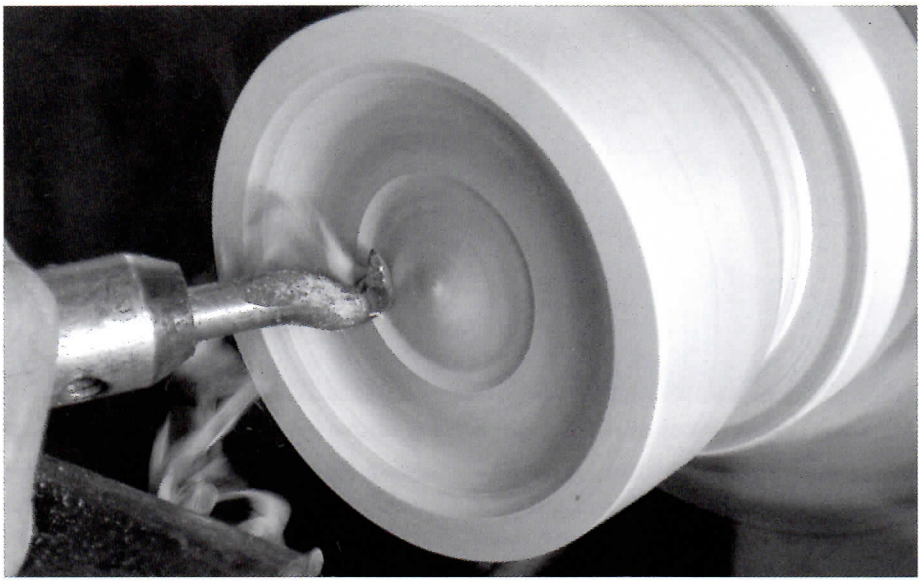
I like to turn small boxes, so I spend a lot of time hollowing out the endgrain. I have used scrapers, gouges and ring tools with some success, but never came up with a technique that let me consistently turn a thin-walled box and finish the inside without much sanding.

Alan Lacer's rotations at the San Antonio symposium and at the 1998 Texas Turn or Two convinced me the hook tool was the answer and gave me the confidence to try some basic blacksmithing.

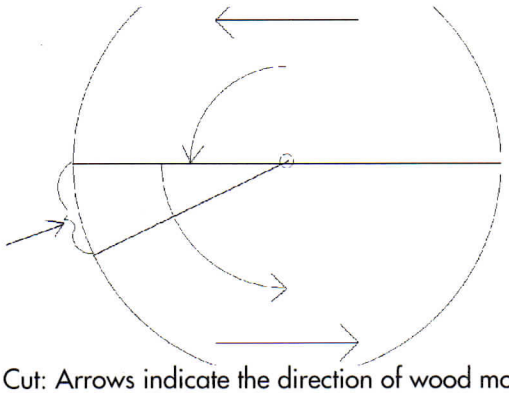
I made dozens of hooks before I eliminated my bad practices. In the meantime, I became a student of my failures, and I began to understand why hook tools – which seem so simple and maneuverable – give people so much grief. That knowledge led me to modify the tools I grind, and in this article I'll discuss ways to make the hooks more versatile and less likely to catch.

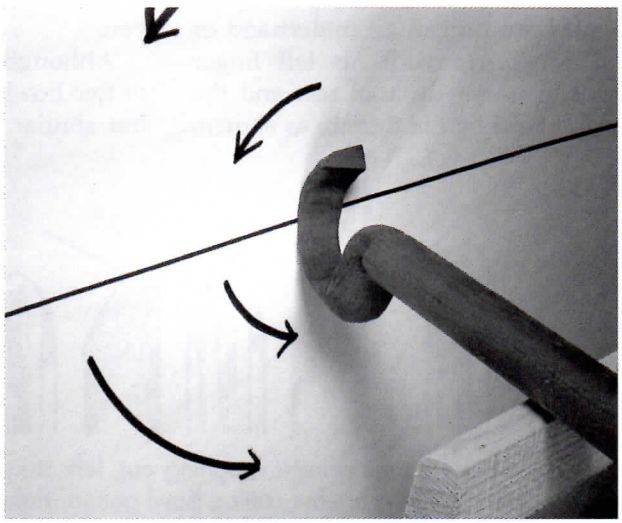
The first thing that I learned is that it is imperative that the bevel stay in contact with the piece, once the cut is initiated (what most turners call rubbing the bevel).

The second thing was that it is important to understand the direction the wood moves with respect to the cutting edge. If we hold the cutting edge perpendicular to the tool rest, a hook tool will only cut if the tool is held below the level of the tool rest and below the center of rotation of the piece. Above this line the wood is moving from right to left and passing over the cutting edge from the back. Below this line the wood is moving from left to right and moving into the cutting edge. The best cutting area is a small pie-shaped area just below the center line. If the tool is moved too far below this area, then the main force of the shaving will not push down on the tool rest, but it will push the tool sideways on the tool rest. If, however, you rotate the tool clockwise a few degrees (ex-

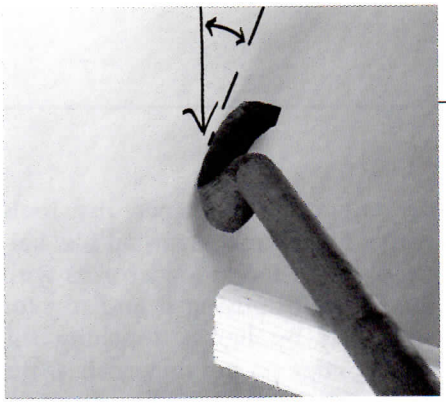


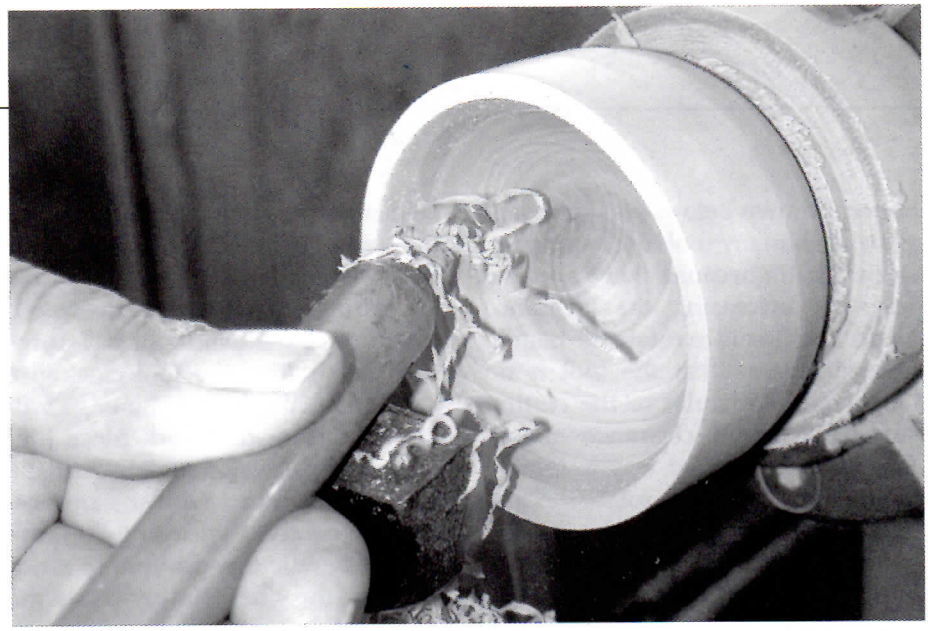
If the shaving is too thick, and you experience noise and vibration, push the tool handle away from you to make a smaller shaving. The author recommends exerting only light pressure on the tool and running the lathe at 400 to 800 RPMs.





Geometry of the Cut: Arrows indicate the direction of wood movement as blank spins; the most effective cutting area is slightly below center, where the wood moves into the edge. Rotating the edge a few degrees clockwise, as shown right, moves the optimal cutting area so the tool can cut along the centerline





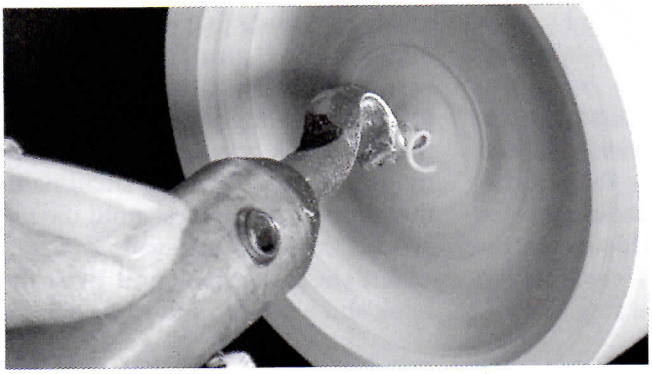
To move from the bottom up the side of a vessel rotate the handle clockwise and push the handle away from you as you pull the tool up the wall. Keeping the angle between the cutting edge and the wood less than 45° generally is a good approach for most cuts.

pose the cutting edge to the wood), you also rotate the optimal cutting area so that the tool can cut effectively along the centerline.

Initiating the cut

To initiate a cut you begin near the center of rotation. Bring the bevel in contact with the wood, rotate the tool handle clockwise about 10° (expose the cutting edge to the wood), tilt the handle toward you (increase the clearance angle or the distance from the bottom of the cutting edge to the wood) while pulling the tool toward you, then tilt the handle away from you to control the thickness of the shaving. If you want a flat bottom: pull the tool toward you while keeping the angle of the tool handle constant. If the shaving is too thick then you will experience some noise and vibration. Minimize this by pushing the tool handle away from you to make a smaller shaving, as shown on the previous page.

As you get farther from the center, you may have to rotate the shaft of the tool clockwise a little to eliminate vibration caused by the changing angle of the wood meeting the cutting edge. If you want a round bottom or a curve from a flat bottom to the side, rotate the handle of the tool clockwise and push the handle away from you while you pull the tool up the side of the vessel, as shown above right. Both of these moves will decrease the clearance angle, which allows you to cut curved surfaces or change the direction of the cut. The comfort level of the position determines the amount of each move that you make. Any position that is comfortable and keeps the angle between the cutting edge and the wood at less than 45 degrees is fine, as shown top left. Small finishing cuts are best made with smaller angles between the wood and the cutting edge. The important thing is to keep the bevel in contact with the wood during the transition from bottom to side.



Rotate the tool 180° so the cutting edge points to the center of rotation to remove the center nub.

The bump on the bottom that forms at the center of rotation can be removed easily by rotating the tool 180° so that the cutting edge points to the center of rotation, as shown at left. Bring the bevel in contact with the work along the centerline and open the face of the tool by rotating the tool counter-clockwise a few degrees. Now make small cuts by moving the tool toward the center until the high spot is removed or a slight concave shape is achieved. Rotate the tool back to the normal position and make a final cut to smooth the transition between the two cuts, as previously described .

One reason people have trouble with hook tools is that they expect them to act like bowl gouges. The basic difference is that as we cut from the lip of the vessel to the bottom the shavings are pushing the gouge against the inside wall of the vessel and down on the tool rest. The vessel wall keeps the tool from sliding sideways off the tool rest.

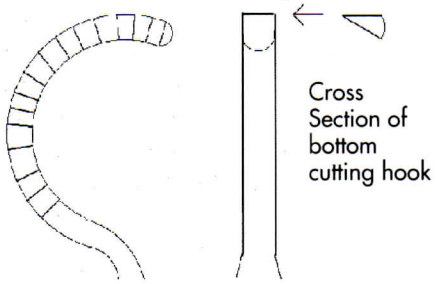
On the hook tool the forces are rotated by 90°. The bevel is still keeping the tool in place but that force is along the tool shaft and the bevel is the only thing preventing the shavings from pulling the tool out of your hand. That's why riding the bevel is so important.

Developing my own design

My original hook for cutting a flat

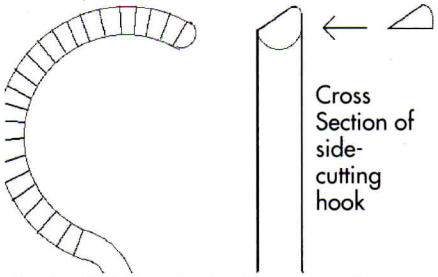
bottom, shown below, was more aggressive than my tool for shaping the sides. That's because there are two ways of increasing the clearance angle. The first is to rotate the handle toward you so that the tool is no longer perpendicular to the cutting surface (a small clearance angle). This is in fact a good way to initiate the cut, but you must rotate the tool handle back perpendicular to the cutting surface or the tool will dig into the work. You can also increase the clearance angle by rotating the shaft clockwise a few degrees and tilting the handle up slightly. This move can often lead to a catch.

My tool for shaping the sides, shown at right, is more user-friendly; it has only one way to increase the clearance angle – by pulling the handle toward you. If you rotate the shaft of this tool clockwise, the bevel pushes the cutting edge away from the inside of the bowl and decreases the clearance angle. If you rotate the tool counter-clockwise, you increase



the clearance angle but you also move the cutting edge into a more neutral cutting position (cutting edge parallel to the wood movement) and this rarely leads to a catch.

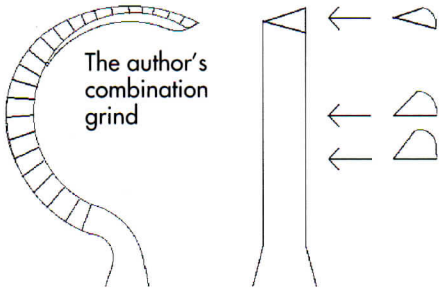
Since I couldn't make a flat bottom with this tool, I decided to forge a hook tool that had characteristics of both of my tools – user friendly and able to cut both flats and curves. On the "combination grind" I developed, the cutting edge is on the inside of the hook, like the side cutting hook, but the bevel angle varies from about 10° at the tip to about 45°. This tool, shown right, will not cut when held with the shaft perpendicular to the work surface. The handle must be tilted about 10 ° toward you for the cutting edge to contact the wood. If you raise the handle or if you rotate the shaft of the tool clockwise more than 20°, the cutting edge will be lifted from the work piece (decrease the clearance angle). Once the bevel is in contact with the surface, you can control the cutting by moving the handle toward you. In order to shape the sides, simply rotate the



shaft of the tool clockwise and swing the tool handle away from you while you pull the tool up the side of the vessel. It is possible to make a transition from the bottom to the side by rotating the tool clockwise and swinging the tool handle away from you in one smooth move. You can control how aggressively the tool cuts by swinging the tool handle in or out. The important thing to remember is to always keep the bevel in contact with the wood and the angle between the cutting edge and the wood rotation less than 45°. By rotating the shaft of the tool and swinging the handle toward you or away from you, you can easily control this. The real safety feature of this tool is that it is not possible to rotate the tool shaft clockwise 90° and keep the cutting edge on the wood, if you keep the tool handle close to parallel to the floor. (This maneuver will generally lead to a catch with a bottom cutting tool or a ring tool.)

Filing a hook

Hook tools must be very sharp, or they will be hard to use and will tear the endgrain. I sharpen my tools with a fine diamond rat-tail file. I always give a tool a few strokes with the file before using it and test for sharpness by lightly touching the cutting edge on my fingernail. If the tool slides on your fingernail, it needs sharpening. If the edge catches



on your nail, it is sharp. If I feel resistance in cutting, I test the sharpness and resharpen, if necessary.

Making a hook tool

Forming a hook tool is simple, as shown in the sketch on the next page.

1. Start with O-1 (oil-hardening) drill rod ($^1/_4$ - $^3/_8$-in. diameter).

2. Grind the two sides flat about 1 inch back from the tip to form a tang. With $^1/_4$-in. stock grind to about a thickness of $^3/_{16}$-in.

3. Heat the end with a Mapp gas or Acetylene torch until it glows with a deep orange color and bend into a "J" using needle nose pliers.

4. Reheat the hook and bend at the base of the curve to form a "?" shape. At this point it may be necessary to shape the inside to a round shape of either $^1/_4$ or $^3/_8$ in. This is done by placing a hardened steel bolt or rod in a vice, heating the hook and placing the hook around the bolt and lightly tapping it with a small hammer. Repeat the process until the desired "?" shape is achieved.

5. Reheat the hook and twist the hook end a little as shown in step 5.

Grinding the bevel

1. Grind the bevel by holding the tool parallel to the floor and tilted at

a slight angle (about 10°). As you grind, hold the tool in this position while you rotate the shaft clockwise to about 20°. Continue this routine until the bevel has almost been ground to the inside edge of the hook. There will remain material from the point where you have been grinding to the tip of the hook that can be removed simply by lifting up on the shaft to form a smooth rounded curve to the end of the hook. Be sure to maintain the 10-degree angle from perpendicular while removing excess material.

2. After step 1, start with the tool parallel to the floor, with the shaft tilted 10 degrees from the perpendicular and rotated clockwise 20 degrees. Begin grinding while rotating the tool to about 45 degrees and swinging the tool to the left to about 50 or 60 degrees. Try to make a continuous smooth bevel through this arc. Repeat step 2 until the bevel almost reaches the inside of the hook.

3. Use a flat file to smooth any imperfections in the bevel and a round file to clean up the inside of the hook At this point the inside of the hook and the bevel should meet to make a knife edge.

The tool should have the profiles shown on the previous page when the rough shaping is finished. The cross section at the tip of the tool should make about a 10° angle from the perpendicular. The side of the hook (a point 90° from the tip of the tool) should make about a 45° angle from the perpendicular. Grind the outer edge of the hook until the bevel is about $^1/_8$ in. from the cutting edge to the non cutting edge. Since the bevel is so important, it is critical that its non-cutting edge be rounded and polished so that it won't scratch a curved surface.

Heat treating

Before heat treating the hook tool, use a hack saw and cut a groove around the drill rod at the point that will be the final length of the tip, about 1.75 in. Leave a small piece of metal connecting the tip and the rod. After heat treating and sharpening it will be easy to break off the tip. Also grind a flat spot near the end of the tool that fits into your tool holder for the set screw to hold the tip securely. The flat ground spot should be on the same side as the sharp edge of the hook tool. This will keep the set screw away from the tool rest while you are using the tool.

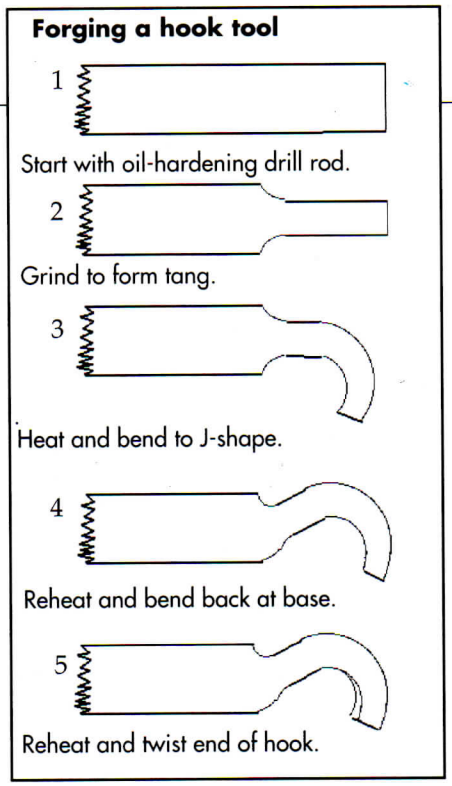
1. Heat the rod with a MAPP gas or an acetylene torch and let the temperature slowly move up the rod until the tip loses its magnetic property. Test the tip with a magnet until there is no sign of magnetism.

2. Plunge the rod into an oil container and move it as if you were stirring a pot. Boiled linseed oil or olive oil work fine. Use a fireproof metal can for the quenching oil.

3. Break the tip from the rod and place the hook tool in an oven, a Barbeque grill or in a deep fryer set at 300° F for about 10 minutes.

This will temper the tip to a hardness (and toughness) of 63-65 R.C. The tool is ready to be sharpened and used.

Forging a hook tool



Sharpening

Mount your hook tool in your tool holder or clamp it in a vice. Begin by making sure that the bevel is either flat or slightly hollow ground. Use a sharpening stone or a diamond file to clean up any imperfections in the bevel surface. Round off and polish any sharp edges on the non-cutting edge of the bevel. A sharp corner can scratch the cleanly cut surface.

After the bevel has been ground, hone the inside of the hook tool with a round diamond file until a sharp edge develops. Create a small micro-bevel by sharpening at a slightly steeper angle than the inside of the hook. Sharpen until the hook passes the fingernail test described earlier.

Congratulations, you are finished and are ready to use the tool. This tool should make a nearly glass-like smooth cut that requires little or no sanding. If you feel torn fibers, check to make sure that you have a flat bevel (no rounding at the cutting edge) and a sharp edge.

Tool holder

A tool holder can be made by drilling a $^1/_4$ (or $^3/_8$) inch hole in the end of a $^5/_8$-inch mild steel rod (either cold roll or hot roll will work). The cadmium plated round steel bars available at most hardware stores in 3-foot lengths work just fine. Drill a small hole about $^1/_2$-to-$^3/_4$-in. back from the end of the bar and tap it to accept a set screw. Turn a tool handle from some scrap hardwood and make a tenon to fit a ferrule made from a piece of pipe or tubing (copper, brass, iron or stainless steel all work fine). Drill a $^5/_8$-in. hole in the end of the tenon and epoxy your rod into the tool handle.

You're ready to turn.

Raul Pena is a turner in Camp Verde, TX and president of the Hill Country Turners chapter of the AAW. Photos and drawings by the author.