

Hollow Spiral

Candle Holders

by Rick Christopherson

Hollow spiral turnings seem to have a mysticism about them. The complexity of their appearance makes it seem as though only the highly skilled craftsman could possibly take up the challenge. Although they look difficult, these hollow spiral candle holders can be made in a few hours, and most of the work is done with a drill press.

To make these candle holders, I started with a billet of mahogany 3" x 3" x 8" and turned it round. After shaping the top and bottom flanges, I reduced the diameter of the mid-section slightly. I also scooped out the top flange with a parting tool (Photo 1) to create a cradle for the candle. A little sanding now makes it easier to draw layout lines on the stock.

Laying out the spiral lines

The next step is laying out the spirals with a pencil. The most important thing to keep in mind in laying out the spirals is that the flutes not be so thin that they break during machining. Additionally, for aesthetic reasons, you don't want the flutes wider than the gaps between the flutes. Three factors control how thick or thin the flutes will be:

- The number of flutes,
- The size of the forstner bit used to rough out the spiral (the gaps), and
- The number of revolutions around the spindle each flute makes.

For candle holders of this size, I found that a four-flute design, cut with a 5/8" forstner bit, and a pitch of 7/8ths of a revolution was both appealing and not too thin.

To make drawing the spirals easier, draw a grid pattern first, and then draw the spiral layout lines at the intersections of the grid—like connecting the dots. The ratio between lengthwise grid divisions and circular grid divisions will determine how many revolutions the spirals will make.

The number of divisions around the spindle (lengthwise lines) needs to be a multiple of the number of flutes. If four flutes are used, the circumference of the spindle needs to be divided by 4, 8, 12, etc. divisions.



Dish Out the top flange with a parting tool to create a cradle for the candle.

To achieve the 7/8ths ratio, I divided the circumference into 8 segments and the length into 7 segments (Photo 5 shows the final grid and spiral).

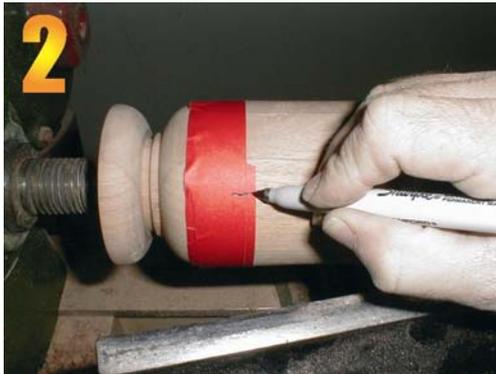
begin and end, then divide the space between into seven equal lengths using a ruler.

shown). If you are making them in pairs, you may choose to have one left-handed and one right-handed, but it may be more difficult to make them match.

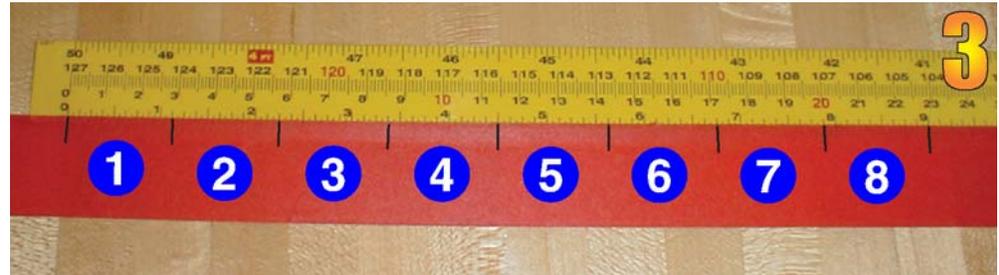
Right- Vs. left-handed spirals

Before you draw the spiral layout lines, decide which direction they should rotate. Like the threads of a screw, the spiral can be left-handed or right-handed. A left-handed spiral

With the grid drawn, use a flexible straightedge to draw the spiral lines (Photo 4). Remember to skip every other grid or you will end up with eight flutes instead of four.



Determine the circumference of the spindle by wrapping masking tape around it and drawing a line across the overlapping pieces.



Divide the masking tape into 8 equal segments, then transfer these marks back to the spindle.

Begin by dividing the circumference of the spindle into eight radial divisions. To do this, wrap a piece of masking tape around the spindle and draw a line across the overlapping pieces (Photo 2).

When the tape is laid out on the workbench, the distance between the resulting two lines will be equal to the circumference of the spindle. Divide the tape into eight equal segments (photo3).

Wrap the tape back around the spindle and transfer the marks to the wood. Use the lathe's tool rest as a straightedge and extend the lines across the length of the spindle.

To divide the length of the spindle, determine where you want the flutes to

(Note that when laid flat there are 9 lines, but only 8 divisions. When transferred back to the spindle, there will be 8 lines and 8 divisions because the beginning and ending points are the same.)

is much easier to make than a right-handed spiral.

With a left-handed spiral, you will be cutting across the grain during machining. But with a right-handed spiral, the machining is into the edge of the grain. Cutting into the edge of the grain will result in a rougher surface, more tearout, and be more prone to grabbing your work. If you are only making one candle holder, I recommend making the spiral left-handed (as

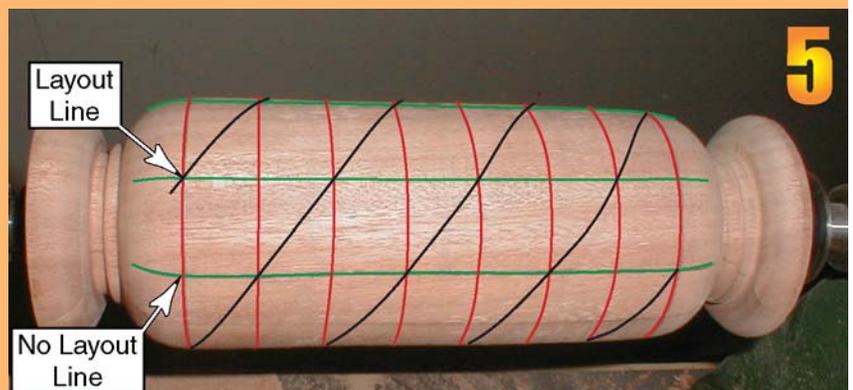


Use a flexible straightedge to draw the spiral layout lines.

Spiral Layout Lines

The figure to the right shows the final layout lines for the spiral (colorized for clarity). Note that every other intersection is skipped when drawing the spiral lines.

- Green = 8 Radial Divisions (8 lines)
- Red = 7 Longitudinal Divisions (8 lines)
- Black = 4 Spiral Layout Lines



Making the drillpress carriage

The secret to the simplicity of this project is drilling precisely through the center of the turning. A drillpress carriage guarantees this. The carriage is made from a piece of scrap lumber that is approximately twice the length of each candle holder, and a 90° V-notch is cut down the length of the carriage using the tablesaw (photo 6). The carriage is clamped to the drillpress table and centered under the tip of the drill bit.

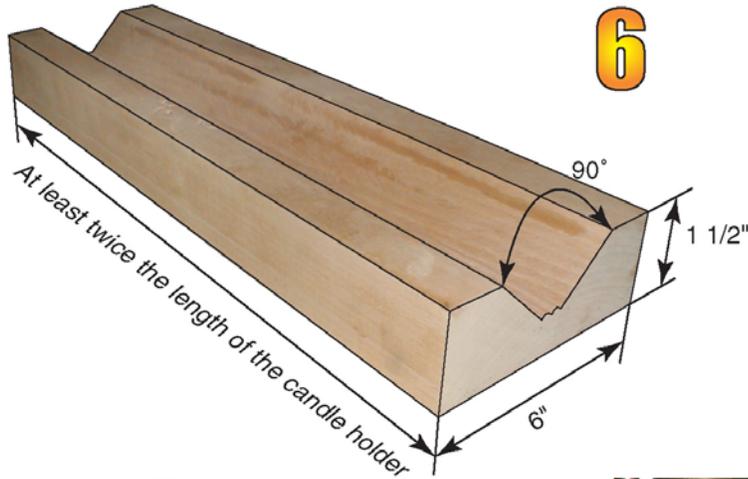
Roughing out the spiral

A forstner bit in the drillpress will machine out clean and straight bores through the candle holder. Each hole passes through the center axis of the spindle, but by rotating the spindle slightly between holes, they form the spiral.

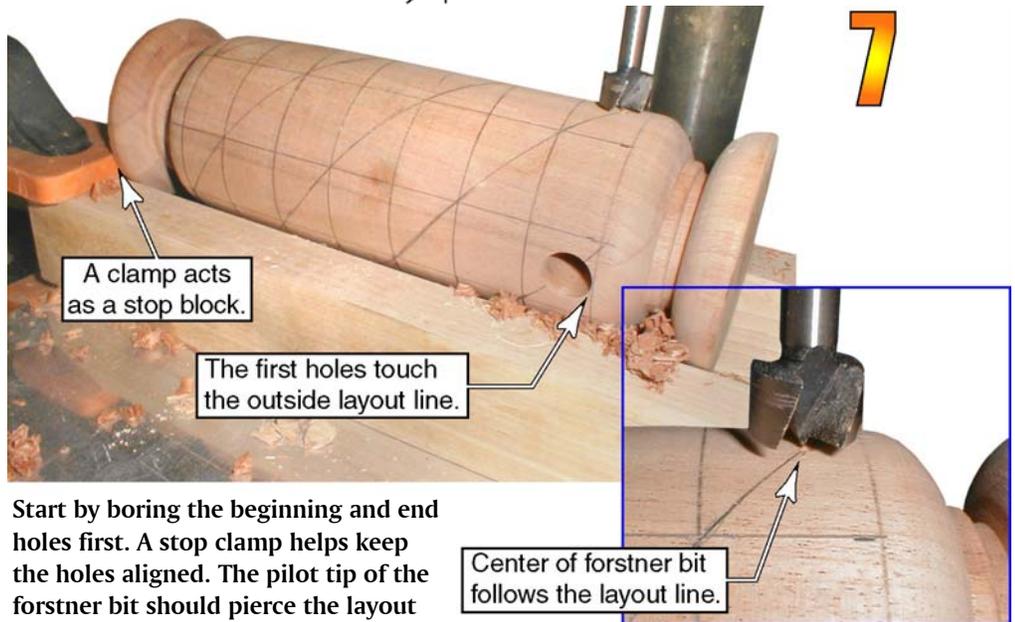
I find that boring the holes at the ends of the spirals first works best. I position the clamp holding the V-carriage to the drillpress so it also acts as a stop block (photo 7). The outside edge of the forstner bit lines up with the first and last layout lines, and the center point of the bit is directly over the spiral layout line.

With the spindle resting in the V-carriage, align the center of the forstner bit on the layout line. Plunge the bit into the wood to a depth just slightly past half-way. Don't drill all the way through, just in case your layout lines are not perfectly aligned with one another. (Photo 8)

Follow the spiral layout line down the length of the spindle until you reach the opposite end. Do the same for each of the spirals.



The V-notch carriage keeps the spindle centered under the drillpress. It should be long enough to allow for full spindle movement plus enough for clamping it to the drillpress.



Start by boring the beginning and end holes first. A stop clamp helps keep the holes aligned. The pilot tip of the forstner bit

Center of forstner bit follows the layout line.

Bore overlapping holes down the length of the spiral lines by rotating the spindle in the drillpress carriage. Note how the tip of the forstner bit creates a hollow cavity in the center of the spiral.



These candle holders also have a couple of big brothers. To make these 4" by 4" spirals, I mounted the drillpress on a carriage that rolls across the lathe bed.

Cleaning up the rough spirals

After the spirals are roughed out with the forstner bit, you need to smooth the rough edges left by the forstner bit. Unfortunately, finding a sanding drum for the drillpress with a diameter small enough to fit inside the flutes is not always easy. They are out there, but if you don't feel like searching for one, or you don't feel like burning through several sanding sleeves, you can use the side of a twist drill bit to hog off a lot of material.



Smooth the rough-cut spirals. If you don't have a sanding drum small enough to fit the spiral, you can use the side of a drill bit. Make sure you work in a clockwise direction for better control.

Note that because your sanding drum or drill bit is a smaller diameter than the original forstner bit, you need to re-center the drillpress carriage. See the side bar on page 5

Regardless which tool you use to smooth the edges, you will need to reposition the carriage slightly off-center to compensate for the difference in diameter of the cutting tool (see the sidebar on page 5). If you use a sanding drum, set the drillpress speed to its lowest setting

To clean up the edges, slowly rotate the workpiece past the sanding drum or drill bit while keeping it centered in the V-carriage. You may find it easier to smooth down the sharp crowns first and gradually smooth the whole edge after-

Shaping the flutes to final form

Get out your sandpaper and grease up your elbows, because the fun is about to begin—well that's assuming you love sanding.

The final step before finishing is shaping the flutes so they are smooth and have rounded edges. All of this can be done with sandpaper, but for a quicker solution, check out the Sidebar, "Cheating the Corners" on p. xxx.

You will notice that the inside edges of the flutes are nearly razor sharp. The first step is to knock down these edges and smooth the side walls of the flutes. Strips of cloth-backed sandpaper are ideal for this task. I remounted the spindle back into the lathe so I didn't have to hold it, and pulled the sandpaper back and forth across the flutes (Photo 10). Finish up by rounding over the outside corners of the flutes.

When you are done, you will be amazed at how much of a conversation piece these candle holders are. I can't promise that you will have a beautiful woman come over and model them in your hot tub, but I can assure you people will ask how you made them.

(Boy, if her husband's reaction to that photograph is anything like my wife's, I'm a dead man!)



Smoothing the hidden areas of the spiral can be the most difficult. A spool of emery cloth from a plumbing supply store can be a lifesaver.

to avoid burning the sandpaper. If you use a drill bit, increase the drillpress speed enough to eliminate chatter. The drill bit should have aggressive margins (that's the cutting edge along the length of the bit), and the web will act like anti-kickback limiters.

ward. Make sure you hold the workpiece firmly, and always work in a clockwise direction (photo 9). When the flutes are fairly smooth, you can speed up the feed rate to knockdown the high spots.

A Note About Tool Diameters

When you change the diameter of your cutting tool, you must relocate the drillpress carriage to compensate. If you don't, the cutter will create a new profile to the sides of the flute.

Not being one who is fond of tedious sanding, I decided to use a router bit to round over the corners of the flutes. My first attempts at this failed because I didn't realize that the diameter of the router bit would affect how the bit followed the spiral. The cutting edges of the router bit would either "lead" or "lag" the bearing of the bit as it followed the spiral, and this made the bit cut too deep in one direction, and not deep enough in the other direction (see photos to the right).

What I didn't immediately realize is that this also affects the sanding drum too. On the first prototype I made, I ended up making the flutes narrower than expected because I over sanded them. This is because I undercut the flute on one side, and over-cut the flute on the other side. (They no longer pointed directly toward the center.)

The bottom line is that when you change the diameter of the cutting tool, you need to reposition the V-carriage to compensate in order to keep the cutting edge in line with the radial lines of the workpiece.

It is important to note that when you shift the carriage, you are doing so for only one side of the flute (all lefts or all rights). You need to reposition the carriage for both left- and right-hand passes.



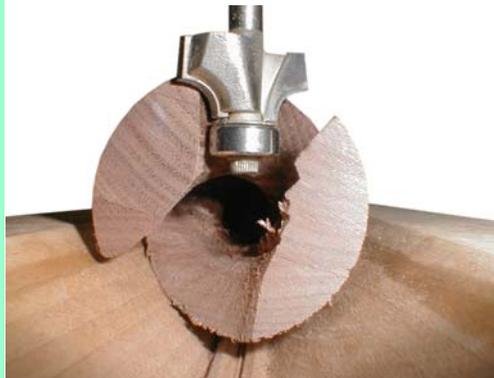
Sanding Undercut: If the carriage is too far to the right of center, the sanding drum will undercut the flutes, and they will be too steep.

Router Bit Undercut: In the case of the router bit, the bit won't cut the edges at all.



Sanding Over-cut: If the V-carriage is too far to the left of center, the sanding drum will over-cut the flutes, and they will be narrower than expected.

Router Bit Over-cut: In the case of the router bit, the bit will cut too deep and the edges will not be rounded.



Proper Alignment: With the carriage shifted slightly off-center to compensate for cutter diameter, the cutter (or sanding drum) will follow the original profile of the forstner bit.

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