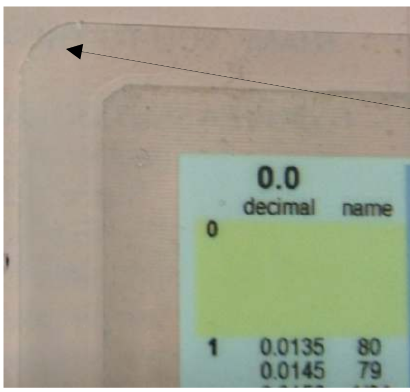
Cutting Corners, version 1

By R. G. Sparber

This article is intended for those new to the hobby of metal working. A lathe and a mill are employed in this project.

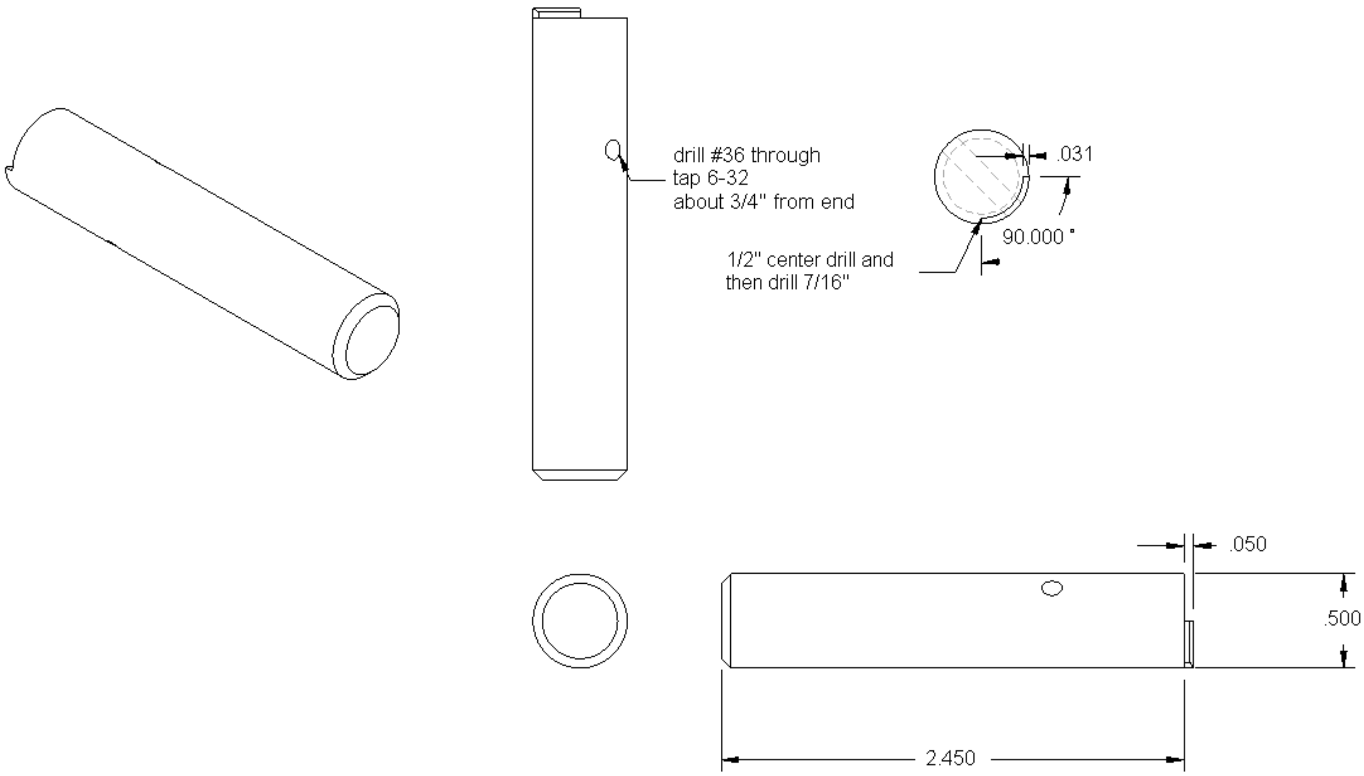


I recently bought a plastic laminator. It works great but I get square corners after I cut out pieces. I like rounded corners like you see here.

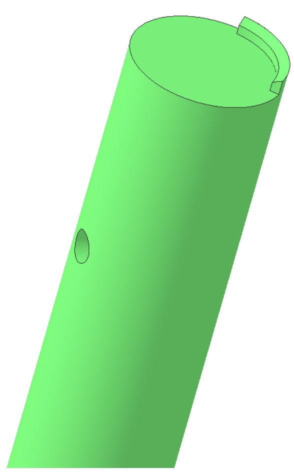
My article explains how to make a punch that will cut these round corners.

Here is the finished punch placed up against a V block. The V block performs two functions. First, it aligns the corner of the plastic directly below the punch. And second, it holds the punch in the right position.

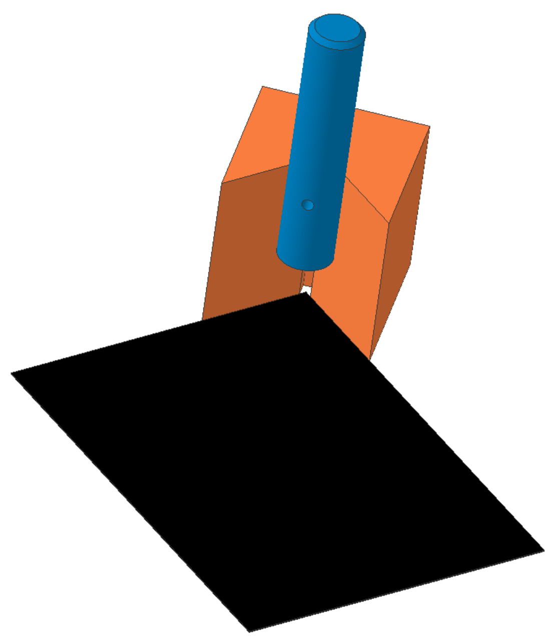
If you look closely, you will see a hole in the side of the punch. A 6-32 set screw is in there. This screw fits into the bottom of the V in the block to align the punch to the corner of the plastic.



I made the punch from W-1 drill rod. This material already has a nice finish and machines well. I could have hardened the end of the punch but so far it seems to be holding an edge.



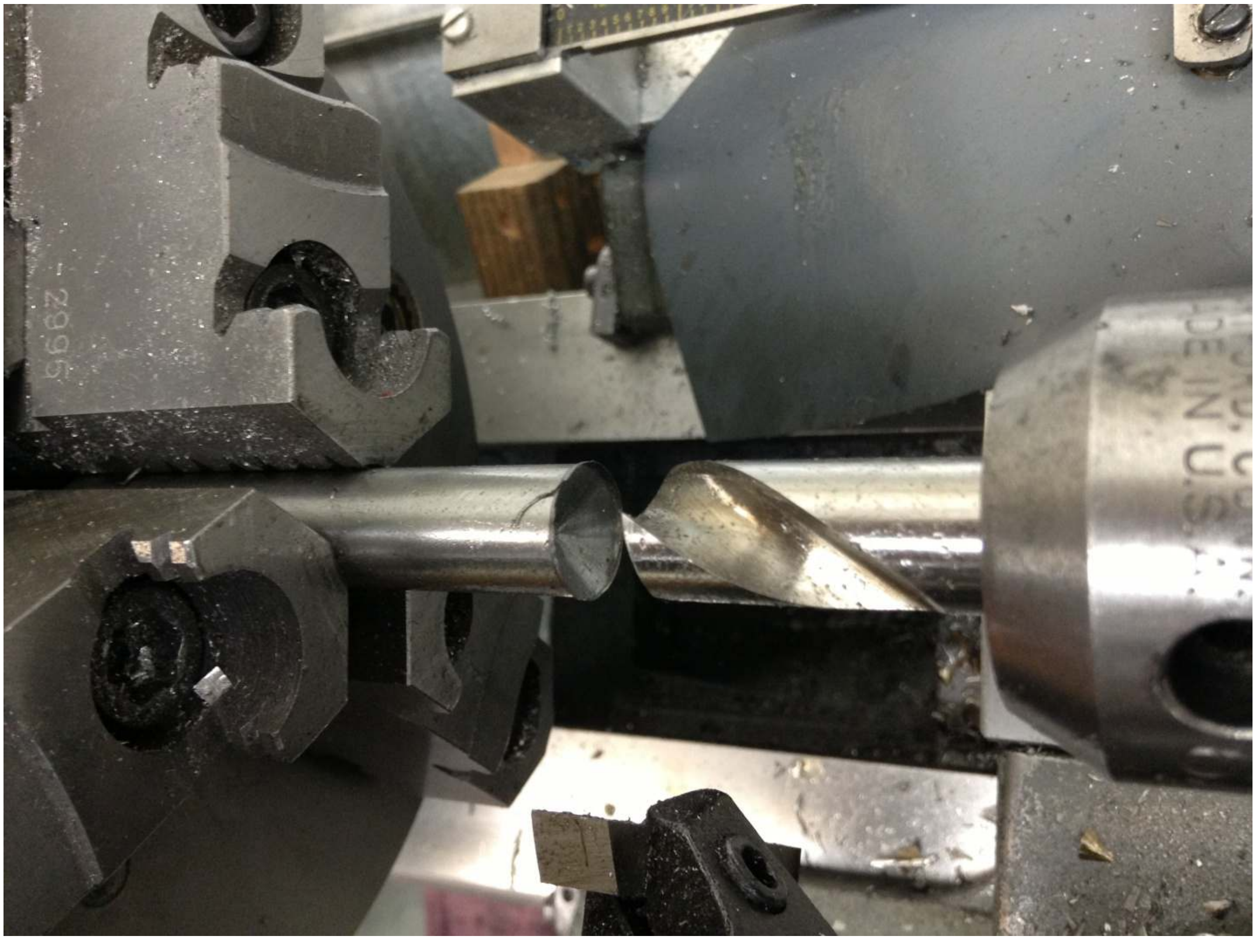
The cutting edge is a 90° sliver. The set screw hole has been aligned to bisect the cutter. This puts the corner of the plastic to be cut in the center of the cutting edge.



The first step was to cut off a 2 ½" long piece of the drill rod. I used a chunk of paraffin wax as my cutting "fluid".

With the workpiece mounted in my 3 jaw chuck, I squared up the end and cut the bevel. The bevel looks nice plus prevents the top from mushrooming out from hammer blows.

The part is turned end for end. The second end is then squared up.



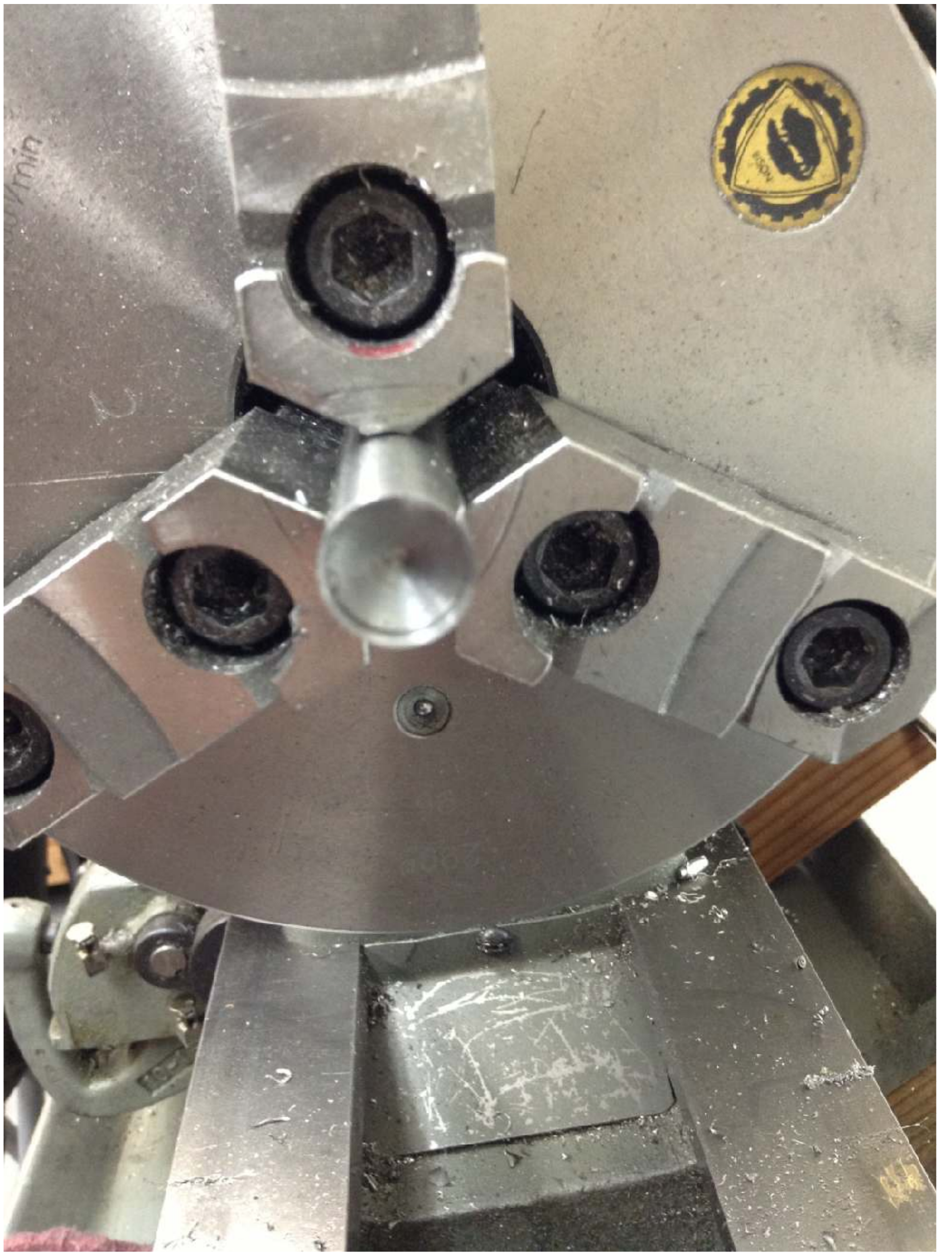
Next I used a ½" spotting drill to shape my cutting edge. Just feed in until there is no flat on the end of the stock. Not shown in the picture is the liberal use of cutting oil.

Lubricating oil enables two metal surfaces in close contact to slide past each other easily. Cutting oil causes these same two surfaces to stick together. So when you use cutting oil, the cutter is better able to tear off a thin layer of the work piece.

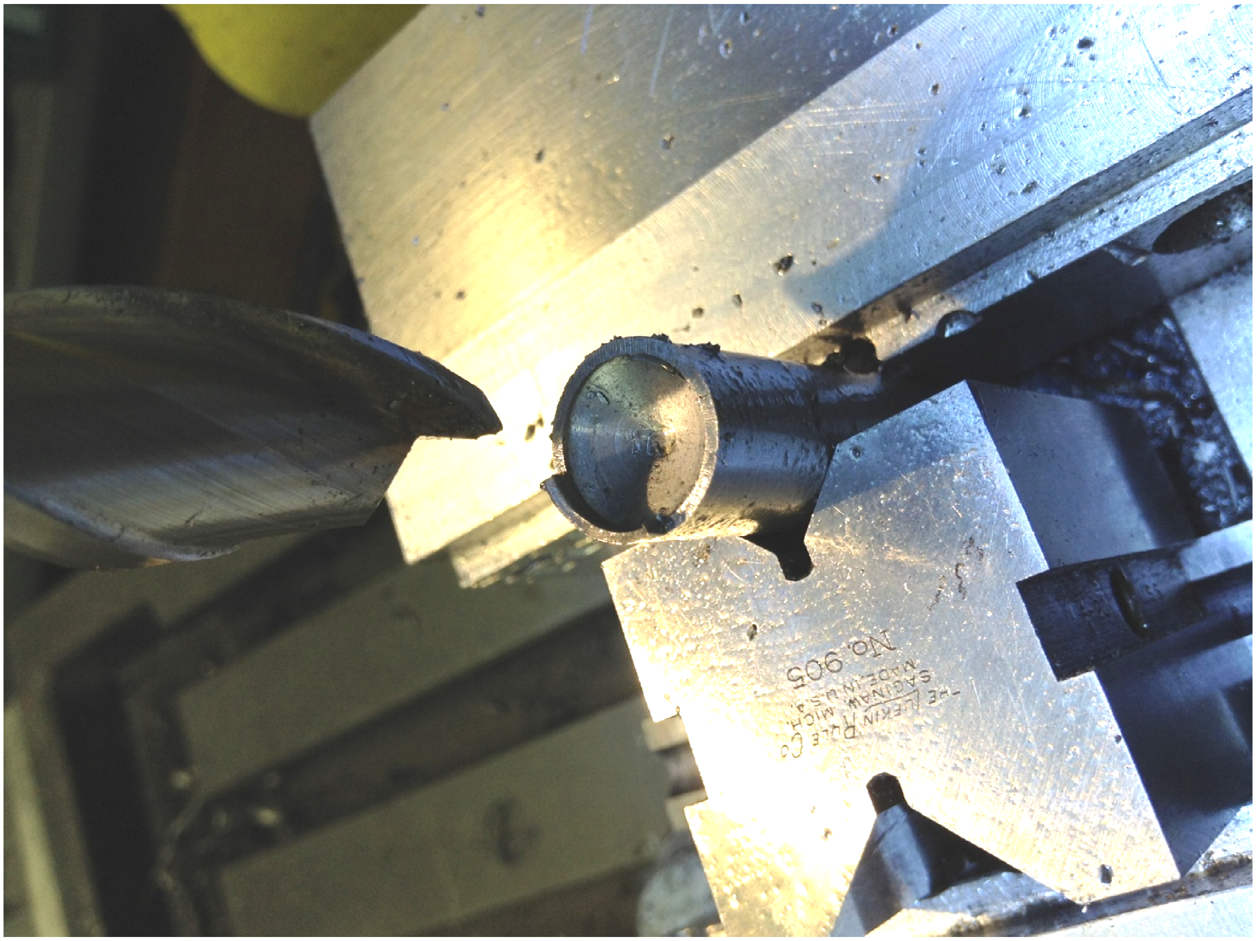
Next I fed in a 7/16" drill a bit more than 0.05".

Ideally, this gives me an outer lip with a thickness equal to the difference in radius between the work piece and the drill

$$lip\ thickness = 0.250'' - \frac{7''}{32} = 0.031''$$



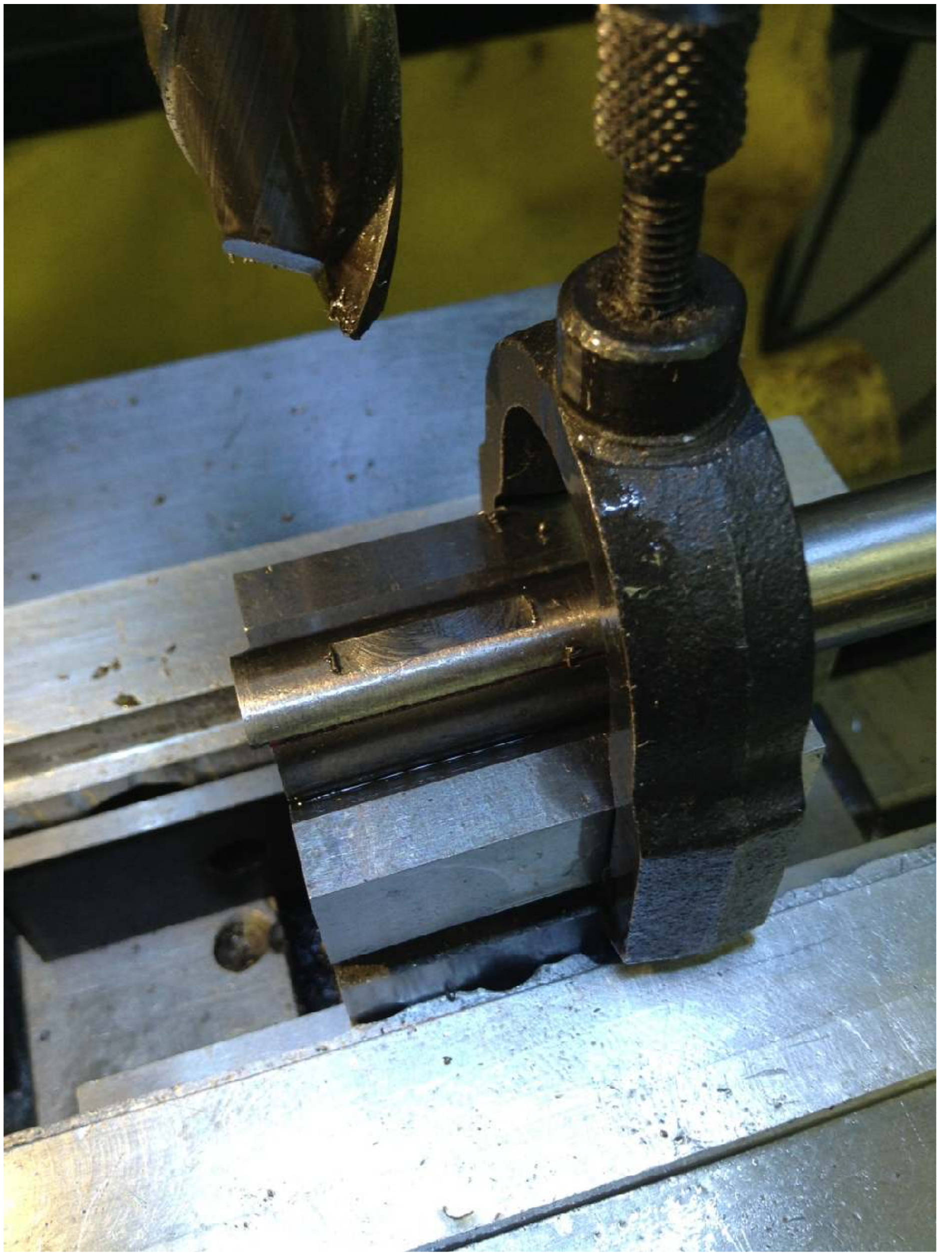
The result looked like this. I had formed a cutting edge with a uniform thickness at is root.



Next stop was the mill. I cut off all of the end except for a 90° segment. The depth is about 0.05".

If this procedure is new to you, see the appendix for details.

I used an adjustable parallel under the lip of the punch to align it on my V block. I was then ready to drill my set screw hole and have it centered on this cutting edge.



I still had my end mill mounted so first cut a flat in the flank of the workpiece. This made it easier to verify I was on center.

After drilling and tapping, I adjusted the set screw so it extended out the side of the workpiece with the cutter. Then the punch was placed in the V block and the set screw adjusted to prevent any rotation.

I placed the plastic to be cut on a piece of scrap Medium Density Fiberboard (MDF). The corner of the plastic was aligned in the V.

A small magnet was placed on top of the V block. It holds the punch to the V block making the assembly easier to use.

Then the punch was placed in the V. A quick tap with a ball peen hammer is all it takes.

The result is a rather nice corner.

So here is one case where you can be proud of cutting corners…

I welcome your comments and questions.

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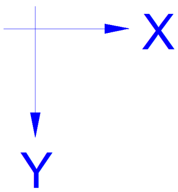
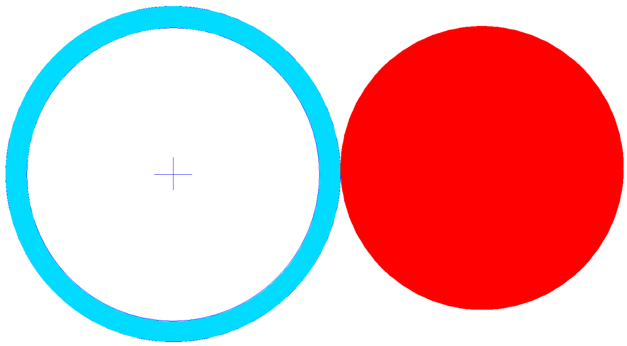
Appendix: Milling the Punch's Cutting Lip

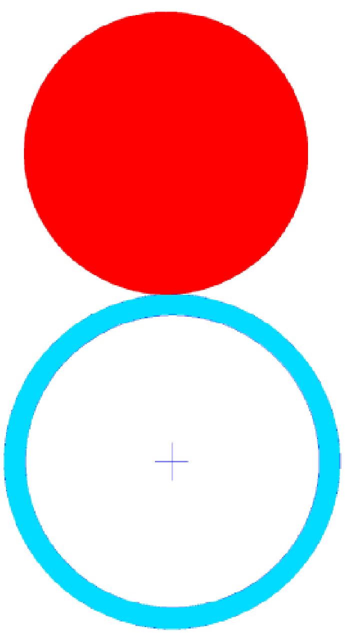
Here is one way to cut the end of the punch.



All pictures are top views as if you could see through the head of the vertical mill and look down. My X axis is horizontal on the page and my Y axis is vertical on the page. The Z axis, not shown, would be into the page.

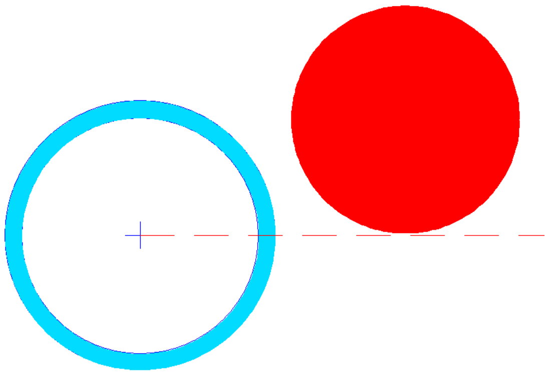


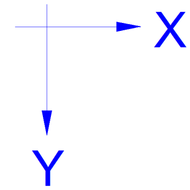
On the far left is an end view of the partially finished cutter. The blue is the cutting edge. On the right is the end mill. I started, with the machine off, by touching the end mill to the side of the workpiece. I then set my X axis to zero.



Next I moved the end mill to behind the workpiece and just touched down. Then I set my Y axis to zero.

The final step in establishing the starting position of the end mill was to set the Z axis. This was done by moving the end mill over the cutting edge of the work piece. Then I carefully lower it down until they touch. Set the Z axis to zero.





The end mill was moved along the X axis to the right of the workpiece. Then it was moved along the Y axis a distance equal to the radius of the work piece minus about 0.01". And finally, the end mill was lowered down by about 0.04".

I set the RPM of the cutter using the approximate equation of

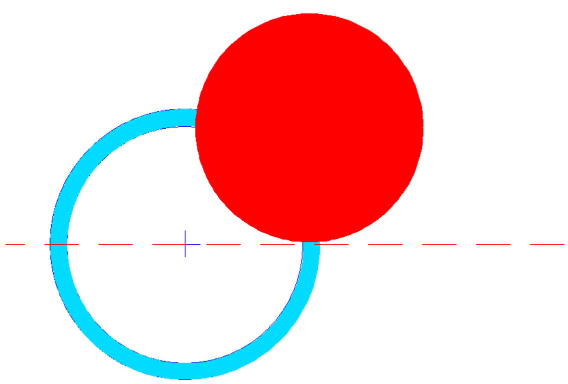
$$RPM = \frac{SFM \times 4}{dia}$$

Where SFM is surface feet per minute and dia is diameter in inches.

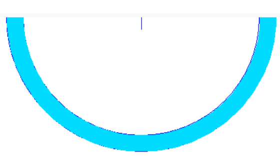
Since this is steel, I used a SFM of 100. The end mill has a diameter of 5/8". This gives me

$$RPM = \frac{100 \times 4}{(\frac{5}{8})} = 640$$

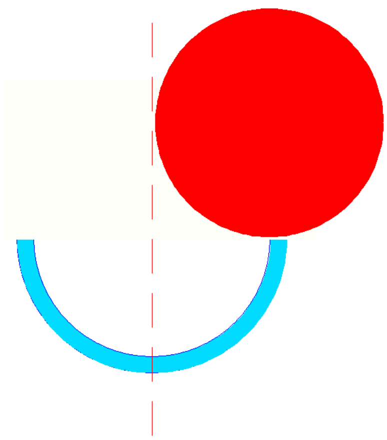
This speed is slow for a money making machine shop but works fine in my hobby shop.



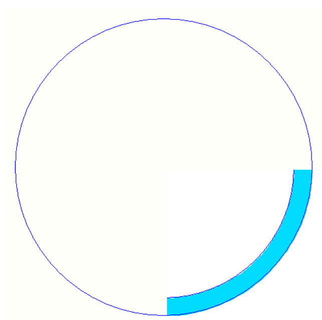
With the mill running at this RPM, I feed the cutter along the X axis. Note that I am 0.01" away from the final cut surfaces. This let me perform my "roughing cut". After feeding all the way across, I moved the cutter along the Y axis so I am right at the dashed red line plus feed down on the Z axis so I am 0.05" below my zero point. I then removed only 0.01" of material and took my "finish" cut.



I was left with half of the cutting edge. The mill was then turned off.



The end mill was then moved along the X axis until it's left face was about 0.01" from the red center line shown here. The end mill's Z axis was raised up so the depth of cut was back to a roughing cut, 0.04" from zero. I then started the mill and feed along the Y axis to remove half of the remaining lip. The end mill was then fed along the X axis to be right on the center line and advanced down the Z axis to a depth of 0.05" to perform my finish cut.



The result was a 90 ° segment of the original cutting lip.