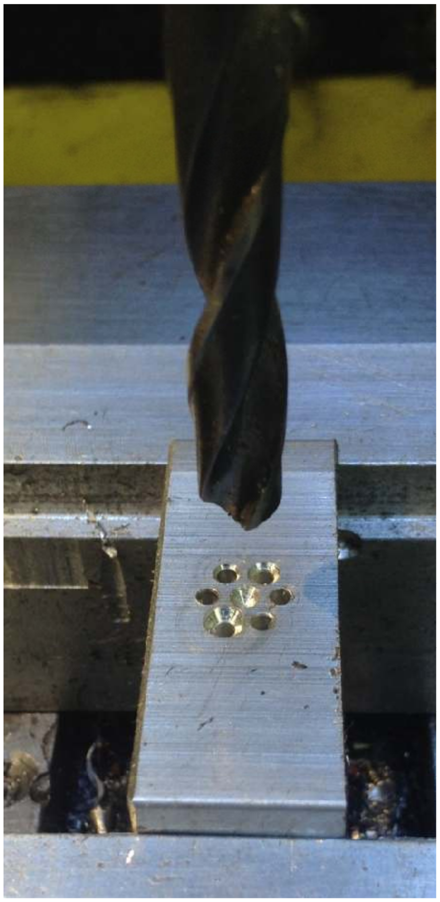
Drilling a Hexagonal Hole, version 1.2

By R. G. Sparber

This is a ¼" hex shank Phillips screwdriver bit snuggly fit into a hole I ***drilled*** in a block of aluminum. It was a lot easier than I expected and is only a drilling operation. No filling is needed.

I will first present just the shop work. Then I will explain, for those that have a math inclination, how it was figured out.

For this trick to work, the hole has to go all the way through the workpiece.



The first step was to locate the center of the hexagonal hole. Using a 1/8" diameter spotting drill, I cut a shallow cone at this location. I could have done this last but felt that it would be a good sanity check to be sure my other holes were in reasonable locations.

With the drill chuck at the center of my hexagonal hole, I moved to it to the right by 0.112". I then used my spotting drill to cut a shallow hole. This was followed by drilling through with a 1/16" drill.

I then moved back to the center and continued on so I was 0.112" to the left. I again drilled with the spotting drill followed by the 1/16" drill.

The next hole was 0.057" to the left and 0.098" back from the center. This was followed by a twin hole 0.057" to the right and 0.098" back.

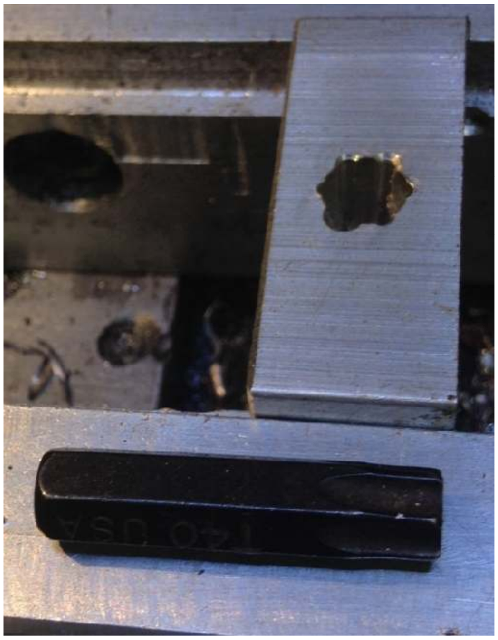
The last set of holes were drilled 0.098" in front of the center and to the right and left of center by 0.057". As so often happens to me, the last hole was screwed up a little. I went too deep with the spotting drill.

This gave me the 6 holes shown above.

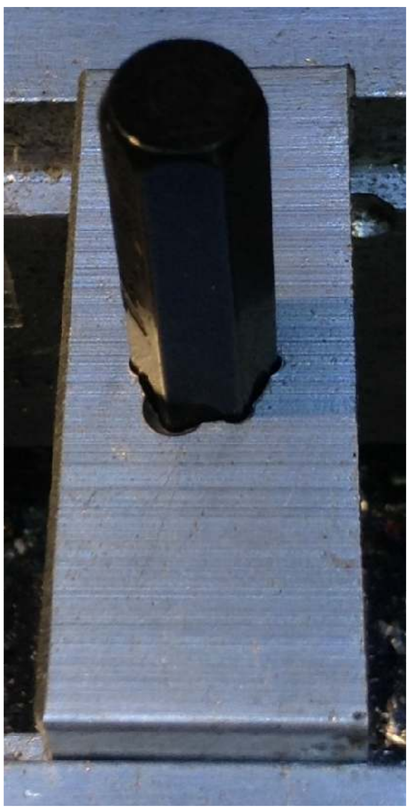
Moving back to the center, I used a ¼" drill to make the final hole.

If I had not gone so deep with the spotting drill, the result would have looked better. No matter, I will use the other side for my bragging picture.

The hole is very close to done. I just need to press a bit through it.



I located a hex bit that had a ¼" Torx end on it. The part is still in my mill vise.



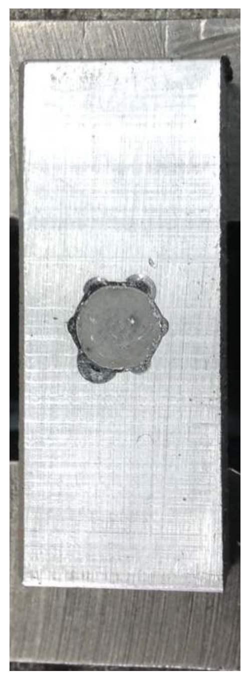
The bit easily drops into the hole. I then used the mill's quill to gently press the bit into the hole until it was snug.

The workpiece and bit were then transferred to my bench vise. I used a large nut to provide room for the bit to move through the hole. The steady and square pressure of the closing vise jaws prevented any misalignment.

Nuts were added on the right as the bit moved through the workpiece. When the top of the bit was flush with the workpiece, I drove it out with another bit.

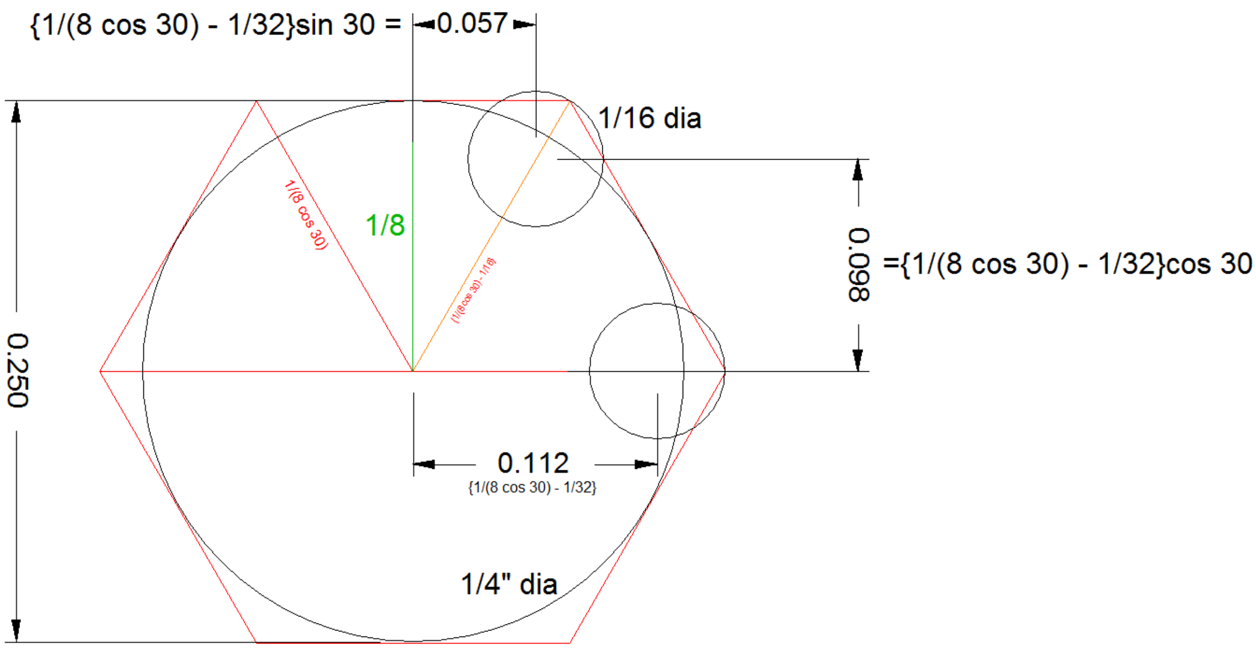
The resulting hole had a few burrs but looked reasonable.

A quick pass on my belt sander and I was done.



Using aluminum as the workpiece made the task of pressing the bit through rather easy. Steel would be more difficult and might require a cutting edge on the end of the bit.

Theory



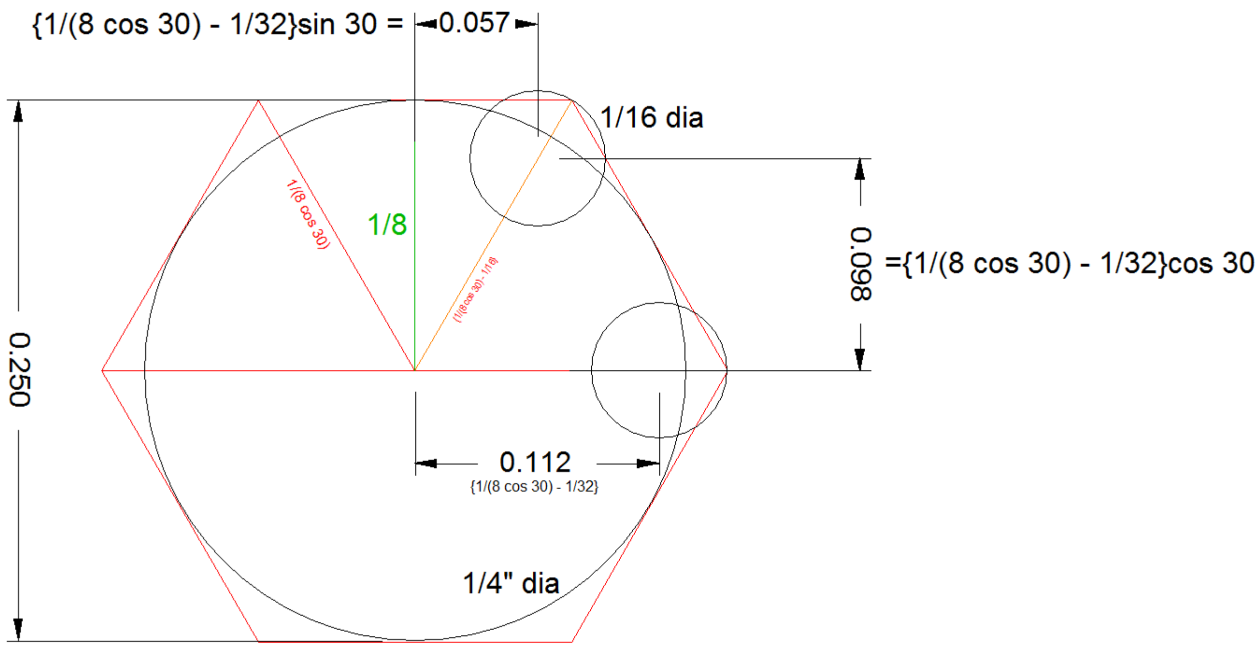
The smallest drill I own in my fractional set is a 1/16". I could have used a number drill but it would have been more difficult to drill deep holes and the benefit would have been small.

The red outline is my finished shape. Lots of right triangles here. The top-right hole can be located by seeing that the point of the outline is on the 1/16" circle. The center of this circle is on a line starting at the center of the hex hole and extending out to the point. Moving back from the point by the radius of this circle puts us at the center of the 1/16" circle.

The flat to flat distance is 1/4" so the distance from the center of the hexagonal hole to a flat is half of that, 1/8". There are 6 flats so the angle formed by lines extending from the center to the ends of each flat must be 360°/6 = 60°. From the 1/8" line to the line going to a point is half of this, or 30°. I therefore have a right triangle with a base of 1/8" and an angle of 30°. I can figure the hypotenuse using the cosine:

$$h = \frac{\left(\frac{1}{8}\right)}{\cos 30°}$$

$$h = \frac{1}{8 \; X \; \cos 30°} \qquad (1)$$



The center of my 1/16" circle is 1/32" from the point so the distance from the center of the hexagonal hole to the center of the 1/16" hole is

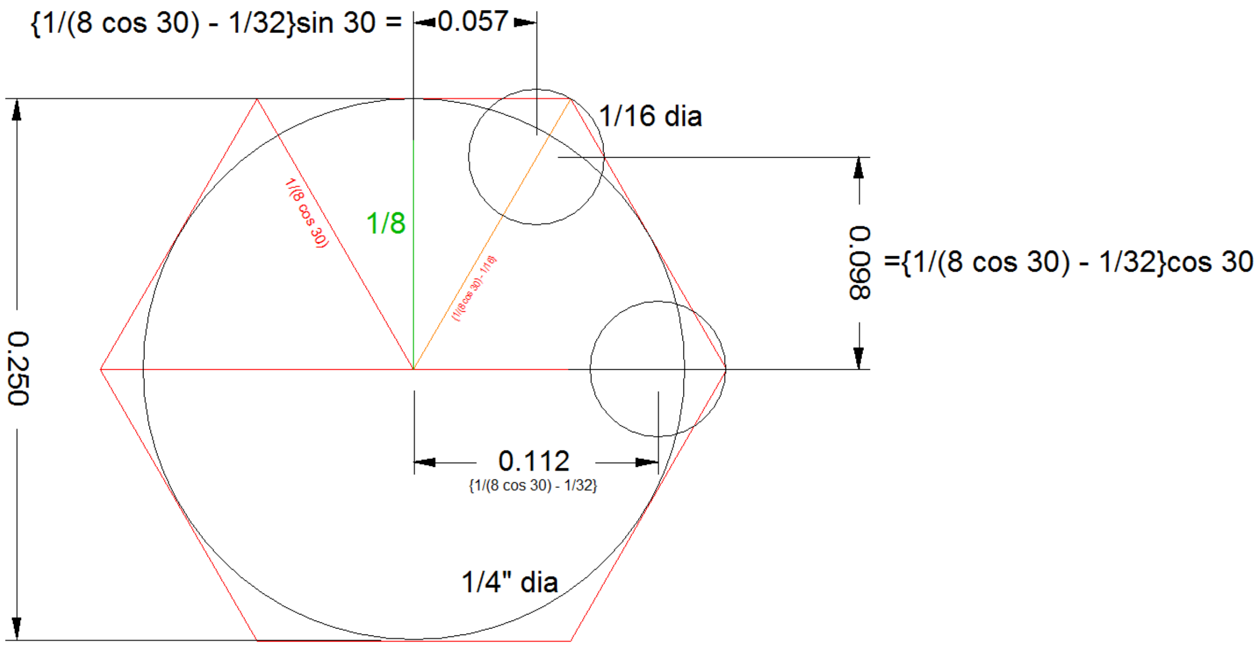
$$\frac{1}{8\ X\ \cos 30°} - \frac{1}{32} \qquad (2)$$

I again use trig to translate this location to XY coordinates. For the X axis, it would be the hypotenuse times the sin of 30°: is

$$\left\{\frac{1}{8\ X\ \cos 30°} - \frac{1}{32}\right\} \times\ \sin 30° = 0.057" \qquad (3)$$

For the Y axis it is the hypotenuse times the cosine of 30 °:

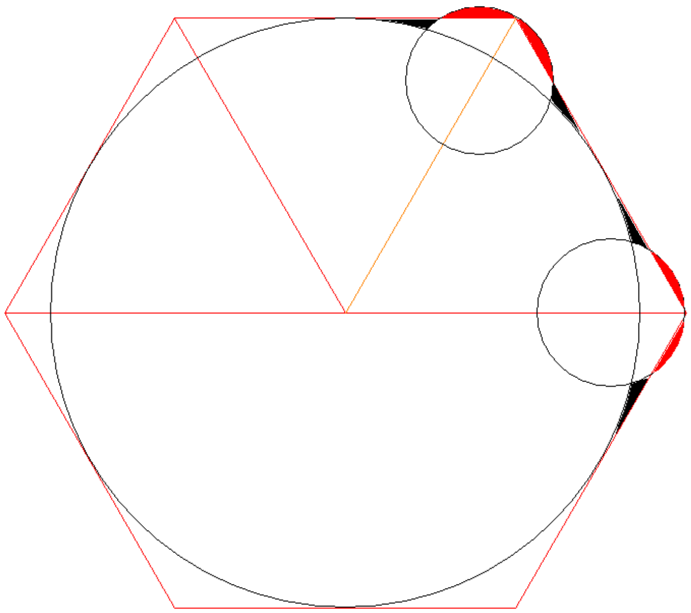
$$\left\{\frac{1}{8\ X\ \cos 30°} - \frac{1}{32}\right\} \times\ \cos 30° = 0.098" \qquad (4)$$



By varying the sign of these two numbers I have the location of the top and bottom two holes. The two holes on the X axis are just the hypotenuse

$$\frac{1}{8\,X\,\cos 30°} - \frac{1}{32} = 0.113" \qquad (2)$$

The figure shows 0.112" so there must have been some round off error in there.



So, how did we do? The black area is the metal that must be shaved off by driving the bit through the hole. The red area is slop in the hole where there should be metal but the 1/16" drill took too much. Using a smaller diameter drill will reduce the red areas but will also increase the black areas.

Thanks to John of the Yahoo group mill_drill for finding errors in my equations.

I welcome your comments and questions.

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