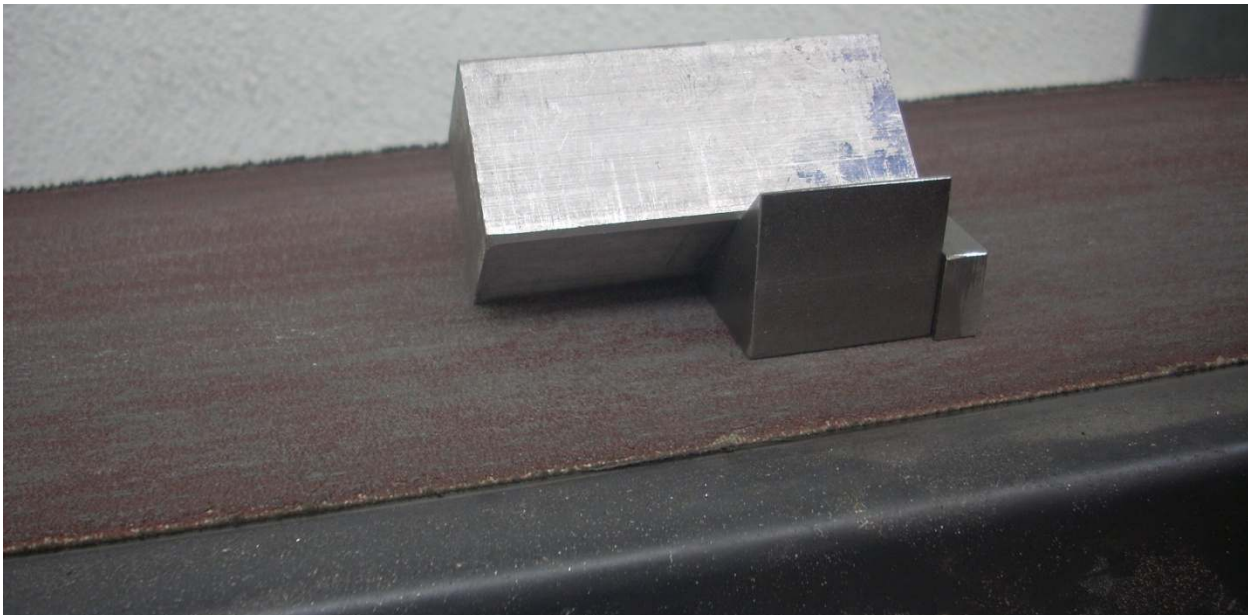


Another Bevel Fixture, version 1

By R. G. Sparber

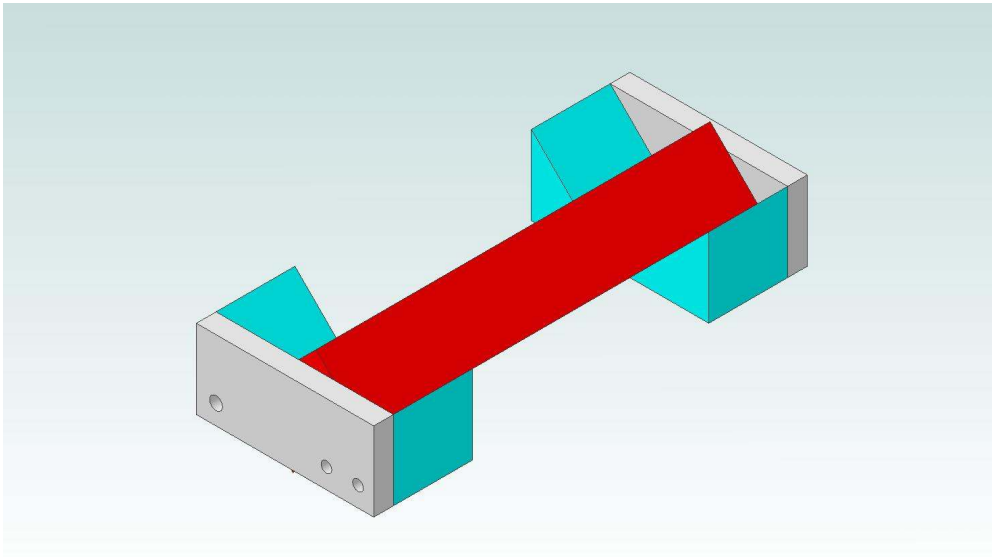
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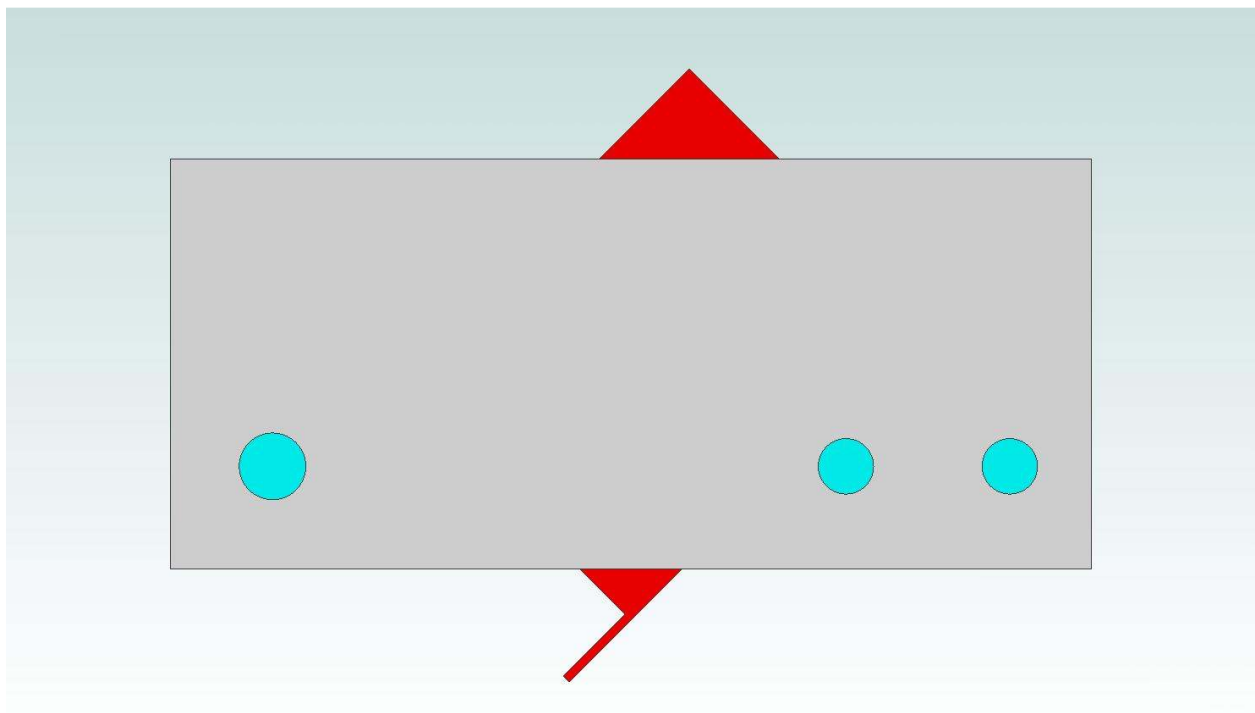
I thought I was done thinking about cutting bevels on blocks of metal but then this idea popped up. It uses my 4" belt sander to do the cutting. A cradle is used to align the block and set the width of the bevel.

There are two ways to set the width of the bevel. One is to cut a test block and measure the flat. Then adjust the spacing of the wedges until you are satisfied. A second way is calculate what you want and then indirectly set the flat by measuring and adjusting. This latter method with details of the derivation can be found in the appendix.

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The complete idea is to make two fixtures so long pieces can be aligned properly. For now I have made just one to prove to myself that it works.



Here is a front view. The red block, with an exaggerated burr on it, sticks out the bottom of the fixture. When placed on the belt sander, this entire corner is removed. A little of the bottom of the fixture will also be removed. To compensate for this tool wear, I can make the single clearance hole on the left oversize or even elongated.

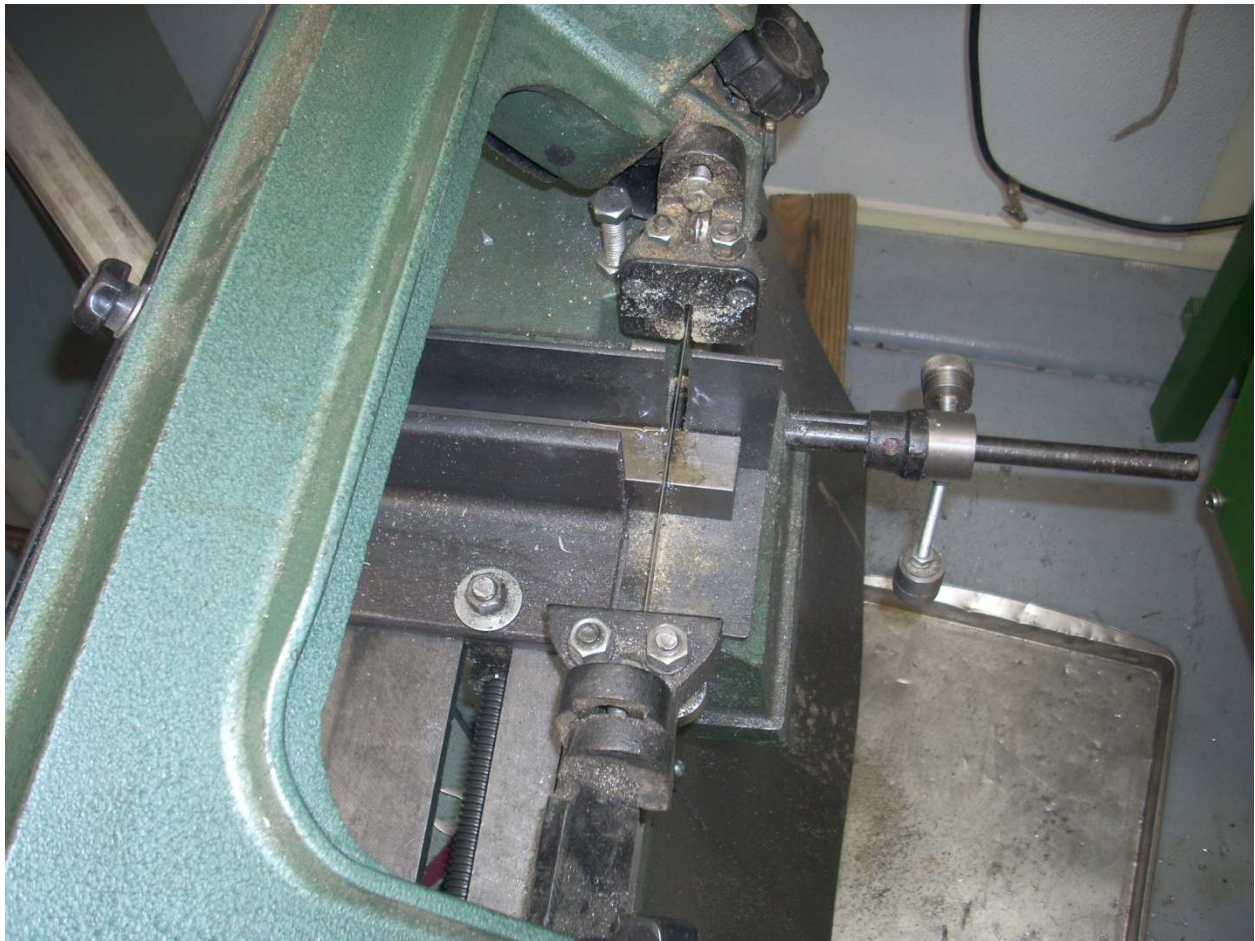
My journey started by just thinking about simple ways to cut a bevel on the corner of a block of metal. Once I had a rough idea worked out, I used Alibre[®], my 3 Dimensional Computer Aided Design tool to draw it up. The pictures on my computer screen helped me refine the idea and convince me it was worth making in my shop. The picture could not tell me if it really worked.



I enjoy working in my shop but not just to waste time and make scrap. Before I dull an end mill on a block of steel, I wanted a level of confidence that the idea would work.

It is hard to beat scrap wood for fast prototypes.

Here you see some heavily reused wood cut into a pair of wedges. The support bar is heat glued in place. As crude as this model looks, it did a good job holding the piece of scrap aluminum. I'm ready to make one out of Cold Rolled Steel.



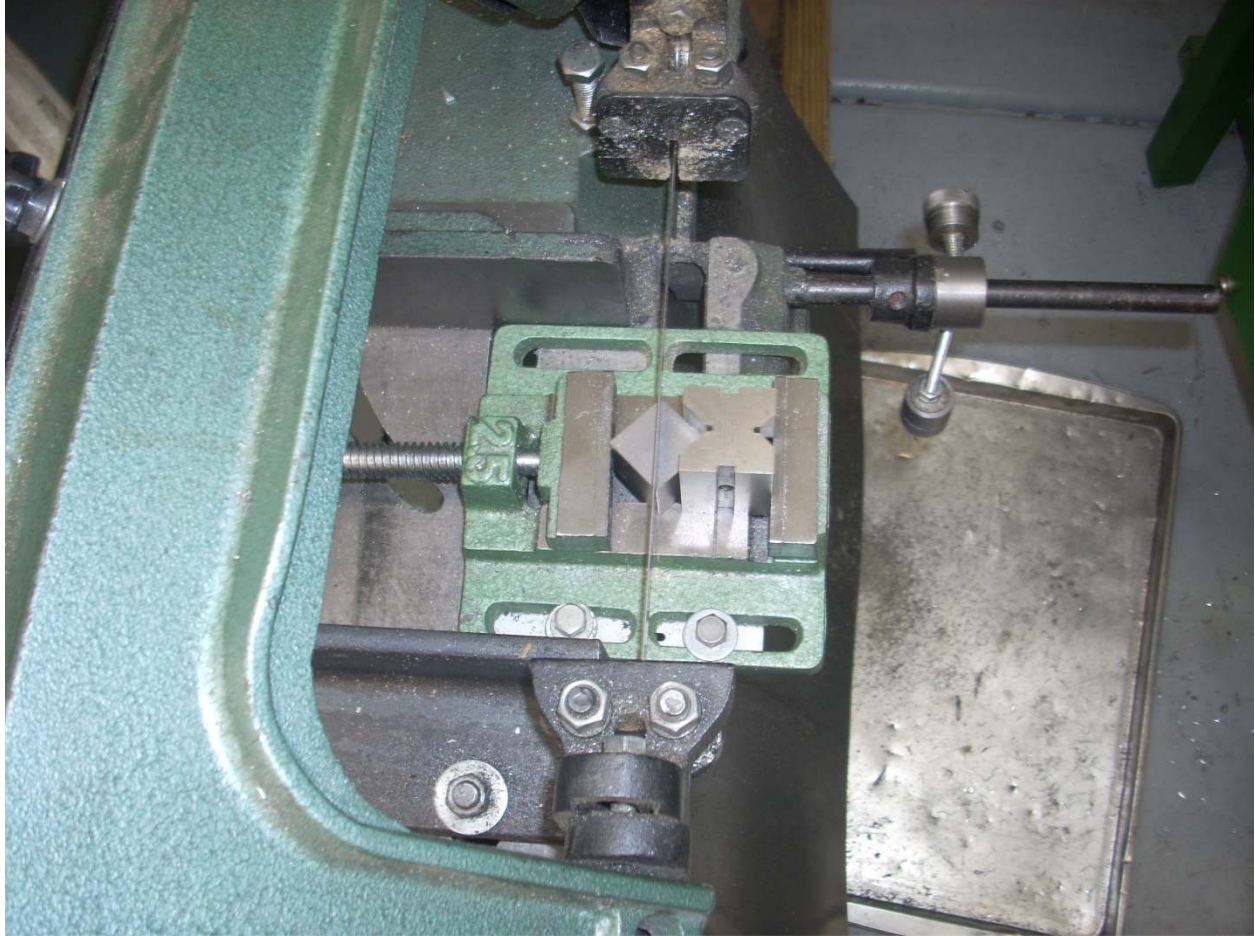
I sawed off about 1.05" of 1" x 1" CRS.



I then side milled one of the cut faces to make it square with the existing faces of the bar stock. Note the piece of scrap aluminum on the other end of the vise to support the movable jaw.

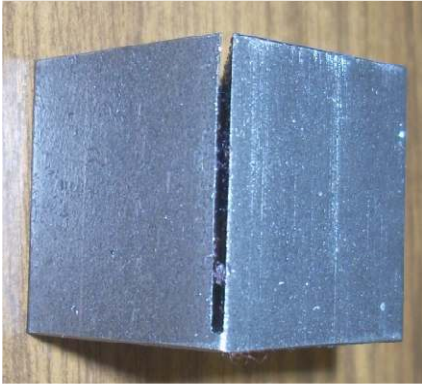


The side milled end is now down on my softjaws and I end milled the top face to an overall height of 1". The dimensions are not critical but the block should be square.



Next I clamped my perpendicular vise into my bandsaw. It holds my part so I can saw it corner to corner. A V block is used to set the angle approximately at 45°.

This arrangement is useful but limited. The deeper the saw cut, the more the perpendicular vise squeezes the kerf closed. Care must be taken not to cut all the way through as the blade will likely bind.



I removed the block with about 0.1" left to cut. The top of the kerf had bent in and I used a screwdriver to pry it open again.



I just hand guided the last bit of metal which is down on the platen.



I then had two wedges with a minimum of waste.



I placed the two wedges in my V block and clamped it in my mill vise. The clamping surface is smaller than I like so I took light cuts.

You may notice that I did not put a block on the right side of the jaws. I wanted maximum clamping force and hoped that the movable jaw would still hold if slightly rotated.

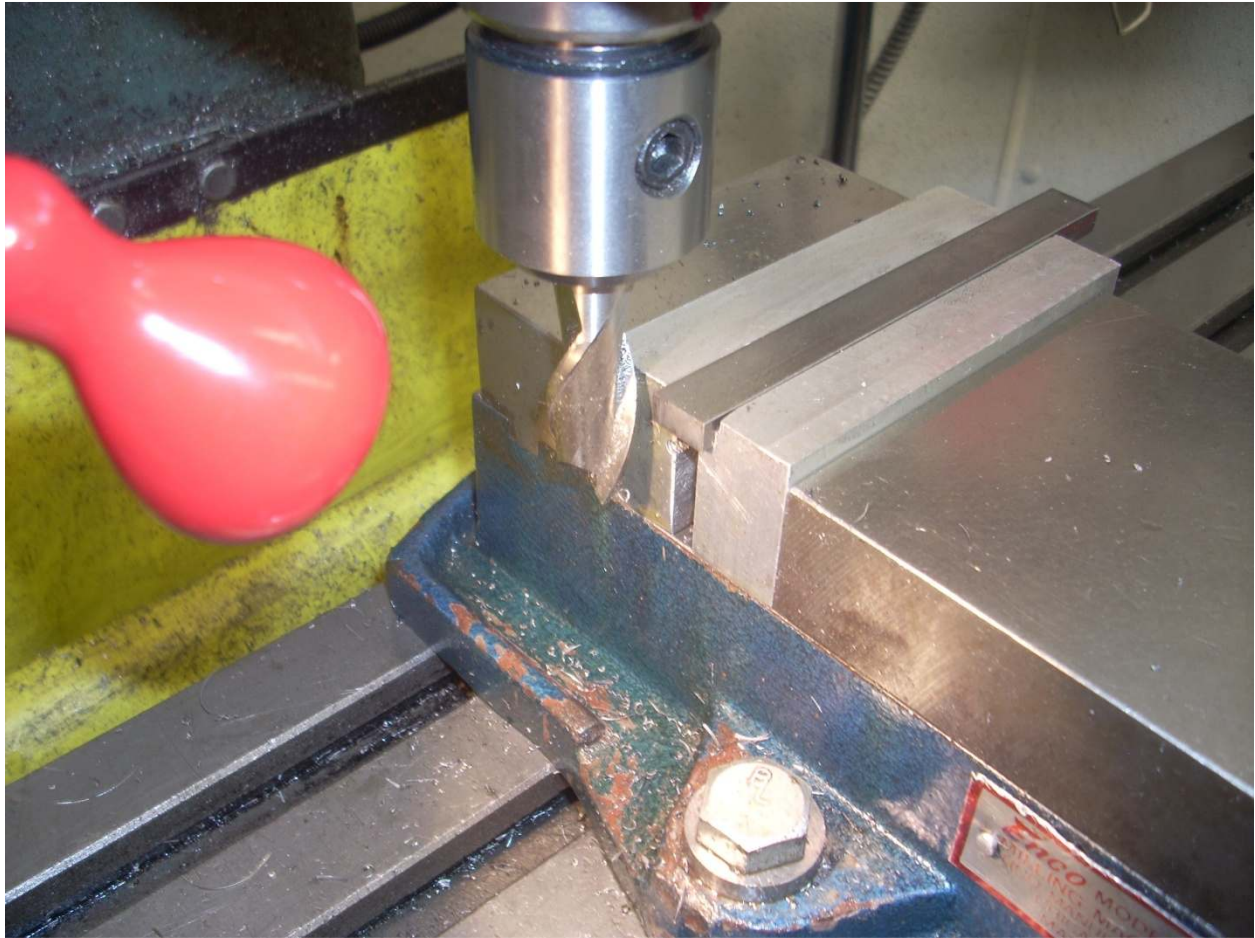


I chose to take my first light cut down the center of the part. I am removing the most material but the forces are balanced so the risk of having the wedges tilt is minimized. Subsequent cuts were narrower and more likely to cause tipping.

Off to the left side of the picture is my new IKEA LED light. Works well.

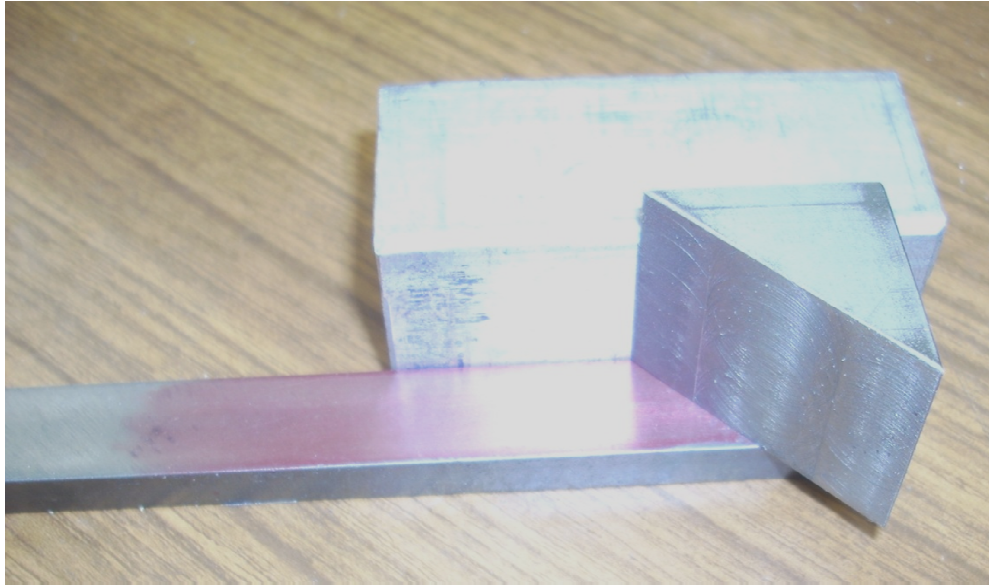


Well, I got away with the marginally clamped parts and the surface looks good.



The support bar is next. I'm truing up the end here.

I changed the design once I looked in my scrap bin. This 0.500" bar was the best fit to what I wanted to build.



I used my block of scrap aluminum to align the bottom of the support bar with the bottom of the first wedge. Using a scribe, I marked the slope on the bar.

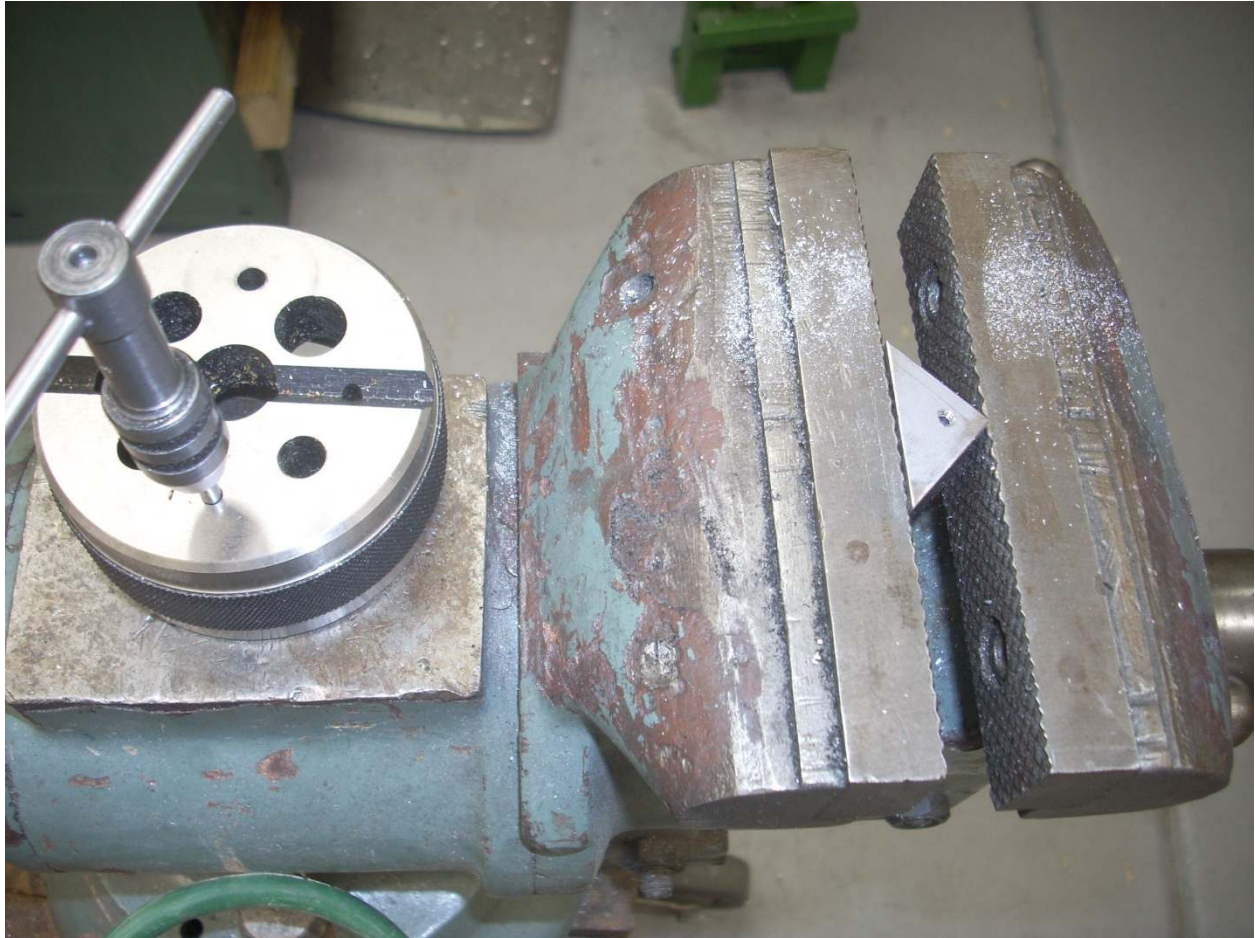


I then decided to use 6-32 screws based on the room I had for holes. From past experience I knew that 0.2" is a reasonable distance from an edge. I used my layout punch to mark the hole locations.

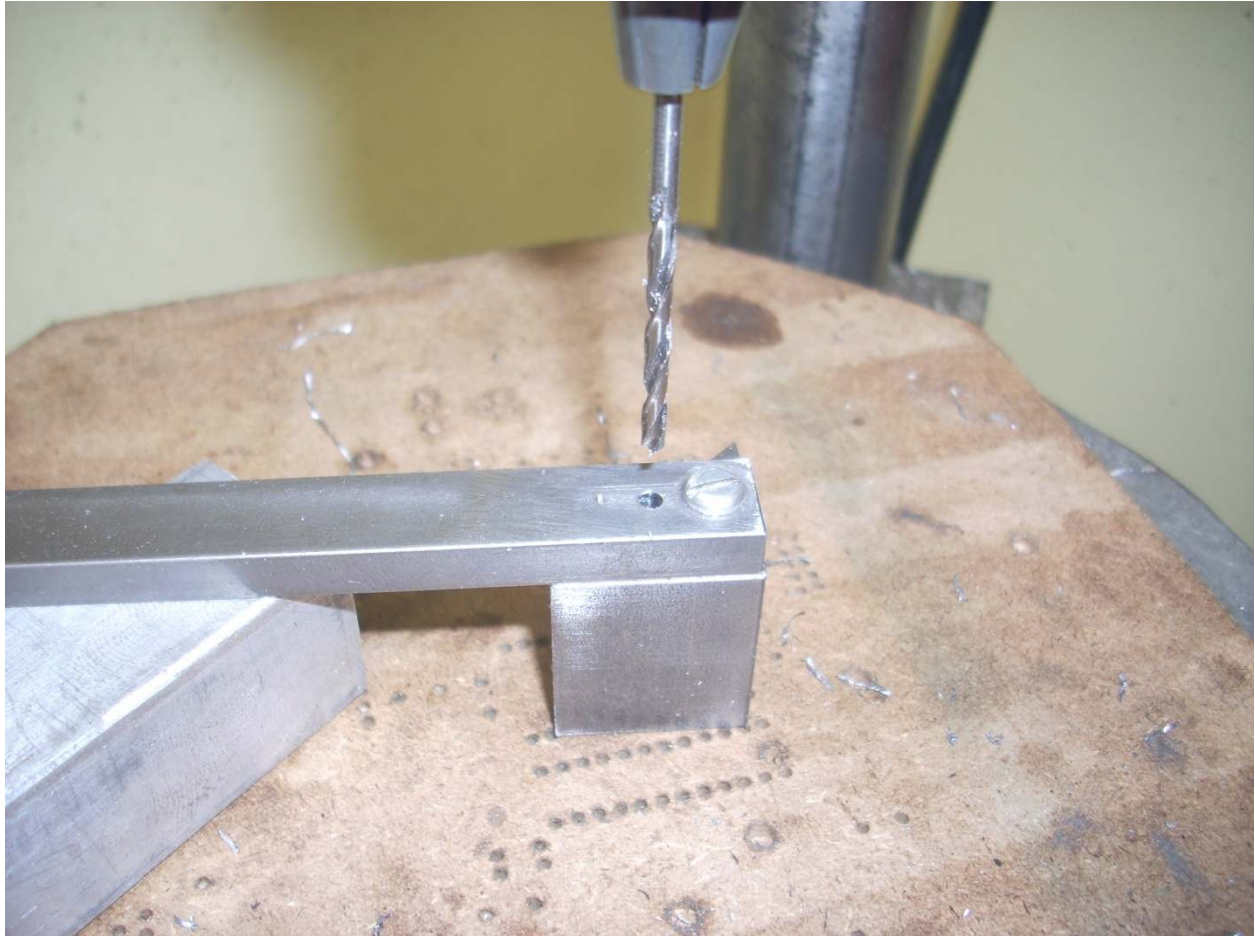


Using the tap drill for a 6-32 screw, I knocked two holes in the support bar on my Gingery drill press.

I forgot to take a picture of how I match drilled through the support bar and into my first wedge.

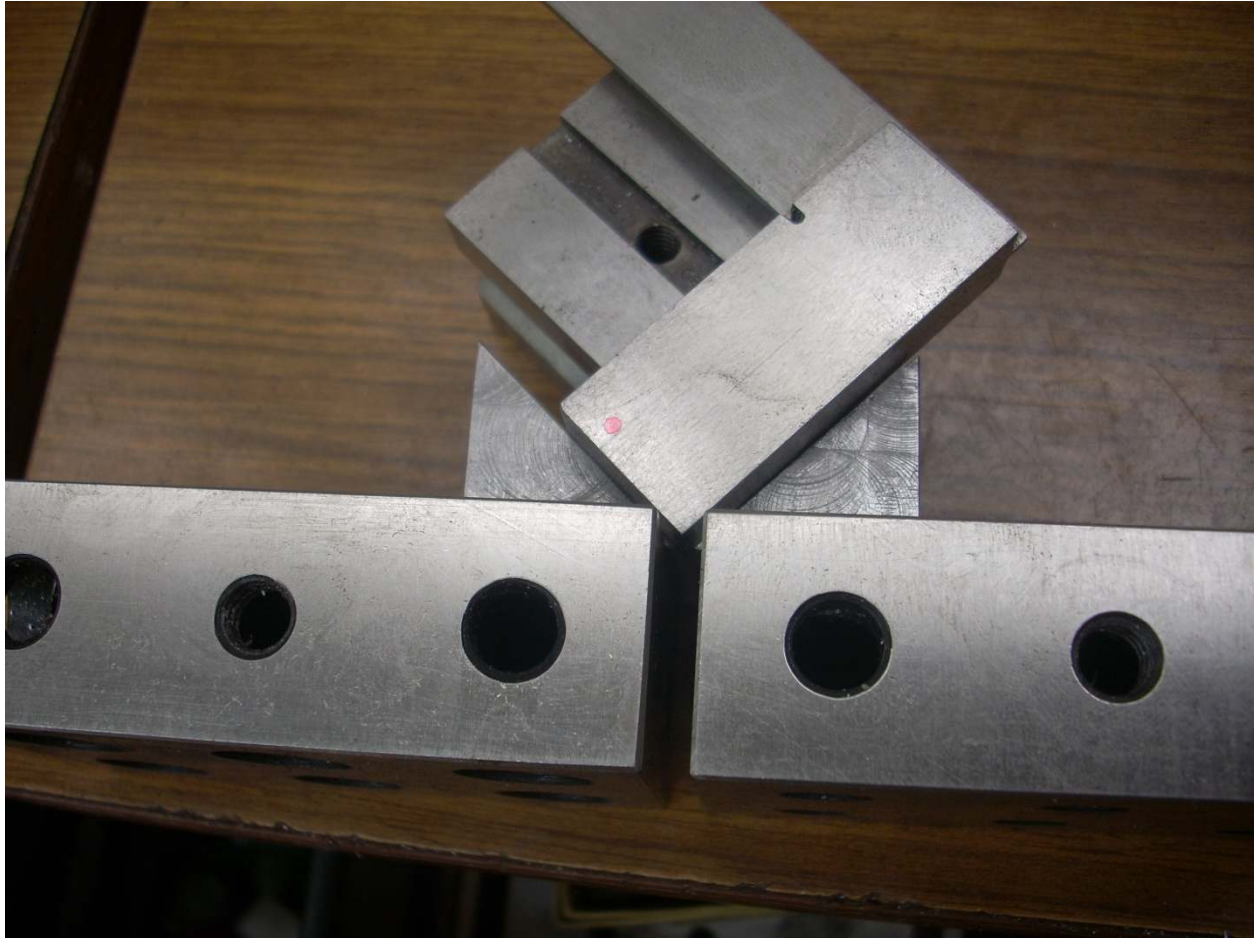


I used a bench block and a 6-32 spiral tap to thread my first hole in the wedge. The pilot hole was drilled extra deep to accept the swarf given off in the tapping process. Hand taps eject swarf out of the hole while spiral taps push it down in the hole. However, a sharp spiral tap lets me feed down the hole without backing out to break the swarf which is very nice.



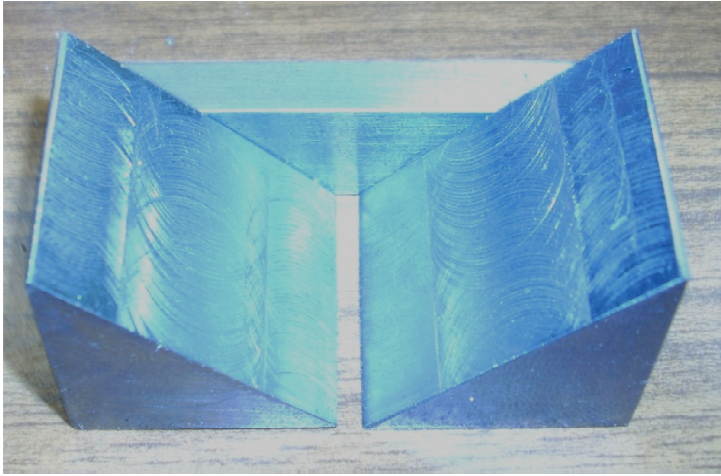
After securing the support bar to the first wedge with a screw, I matched drilled the second hole with my tap drill. Then I ran my 6-32 tap in the wedge and drilled a through hole in the support bar.

The second wedge is attached in a similar way except I decided to use a single screw. The through hole was drilled oversized to permit gap adjustment.



I got an idea of how far apart to place the wedges by using ground blocks and a square.

After securing the second wedge, I cut the support bar to fit.

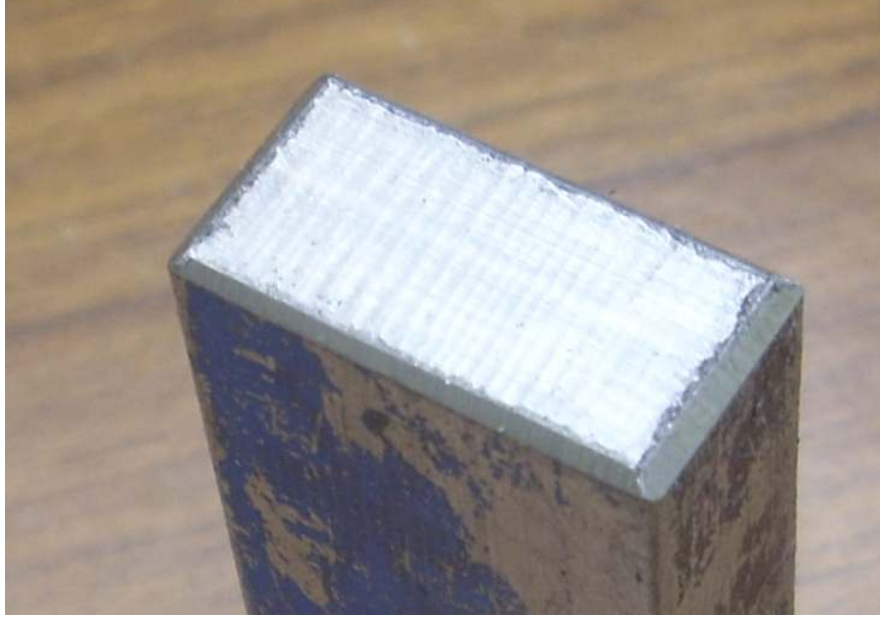


The fixture is ready for trial.



With the belt moving, I placed the block of aluminum in the fixture and lowered the assembly down. The belt made short work of the corner and give a uniform bevel.

Minimize the generation of burrs by always sanding along the line of the bevel as shown above.



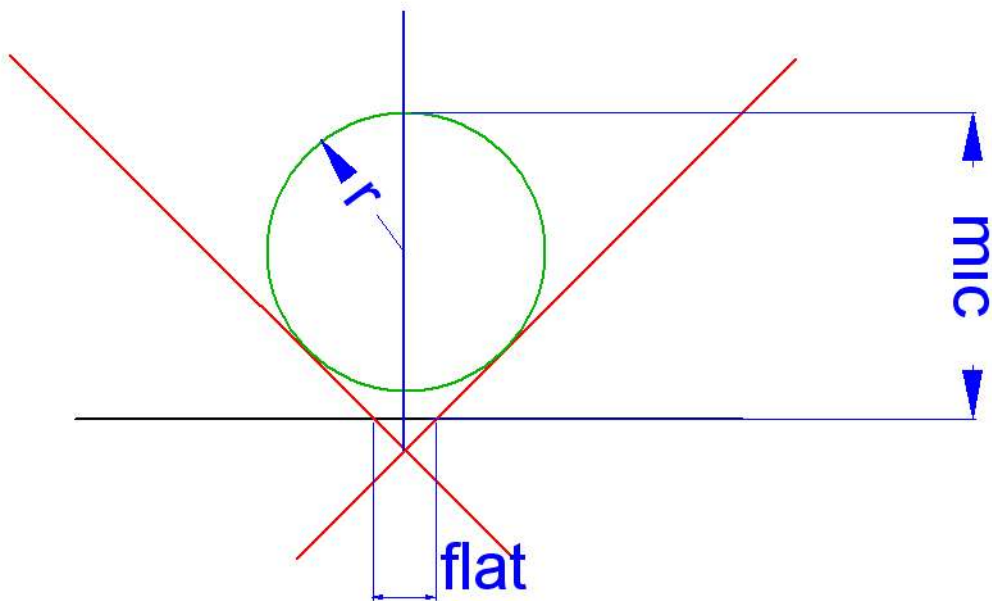
The bevels came out uniform although I still have burrs on some of the 4 edges. This was caused by holding the block perpendicular to the motion of the belt. So lesson learned: always sand along the edge.

I welcome your comments and questions.

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Appendix: Setting the Width of the Flat



Place a piece of round stock in the fixture and mic the distance from the top of the round stock to the bottom of the fixture. Then use one of the following equations to either calculate the expected flat width or to set a desired flat width.

$$\text{flat} = (4.828 \times r) - (2 \times \text{mic reading}) \quad (\text{equation 1})$$

$$\text{mic reading} = \frac{(4.828 \times r) - \text{flat}}{2} \quad (\text{equation 2})$$

Example 1: What is the flat I can expect given I mic 0.567" and am using a rod $\frac{1}{4}$ " in radius?

I will use equation 1:

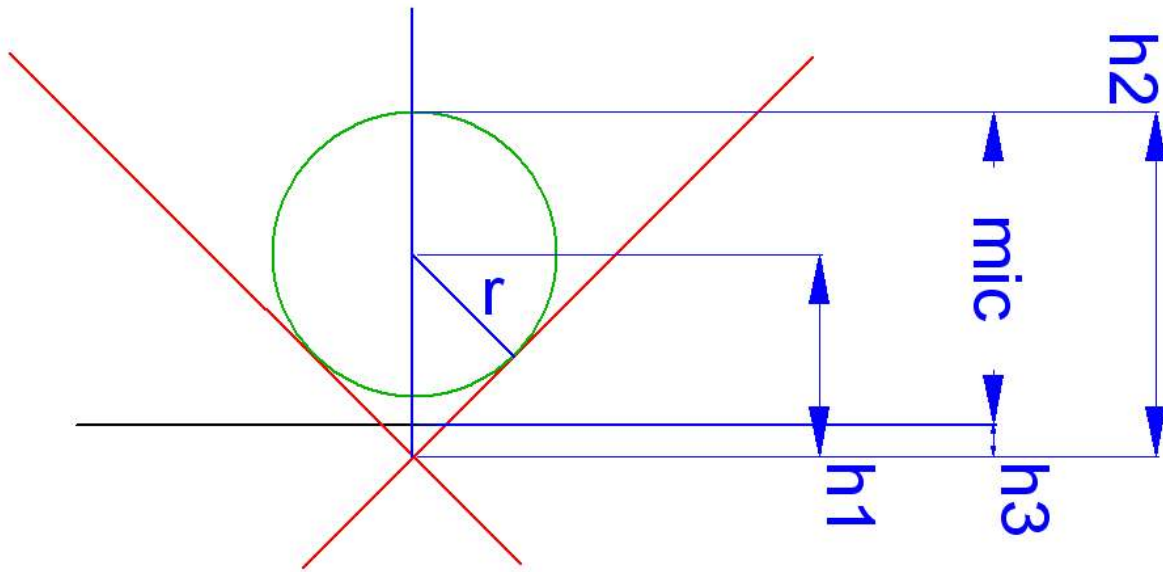
$$\text{flat} = (4.828 \times 0.25") - (2 \times 0.567") = 0.073"$$

example 2: I want to adjust my wedge spacing to get a 0.03" flat using a rod of $\frac{1}{4}$ " radius.

I will use equation 2:

$$\text{necessary mic reading to get the desired flat} = \frac{(4.828 \times 0.25) - 0.03}{2} = 0.589"$$

Equation Derivation



Assumptions:

1. The V formed by the two wedges is exactly 90°
2. The round stock has a uniform radius of r

Distance h_1 is the hypotenuse of a right triangle with opposite leg r and two 45° internal angles. I can write

$$\sin 45^\circ = \frac{r}{h_1} \quad (\text{equation 3})$$

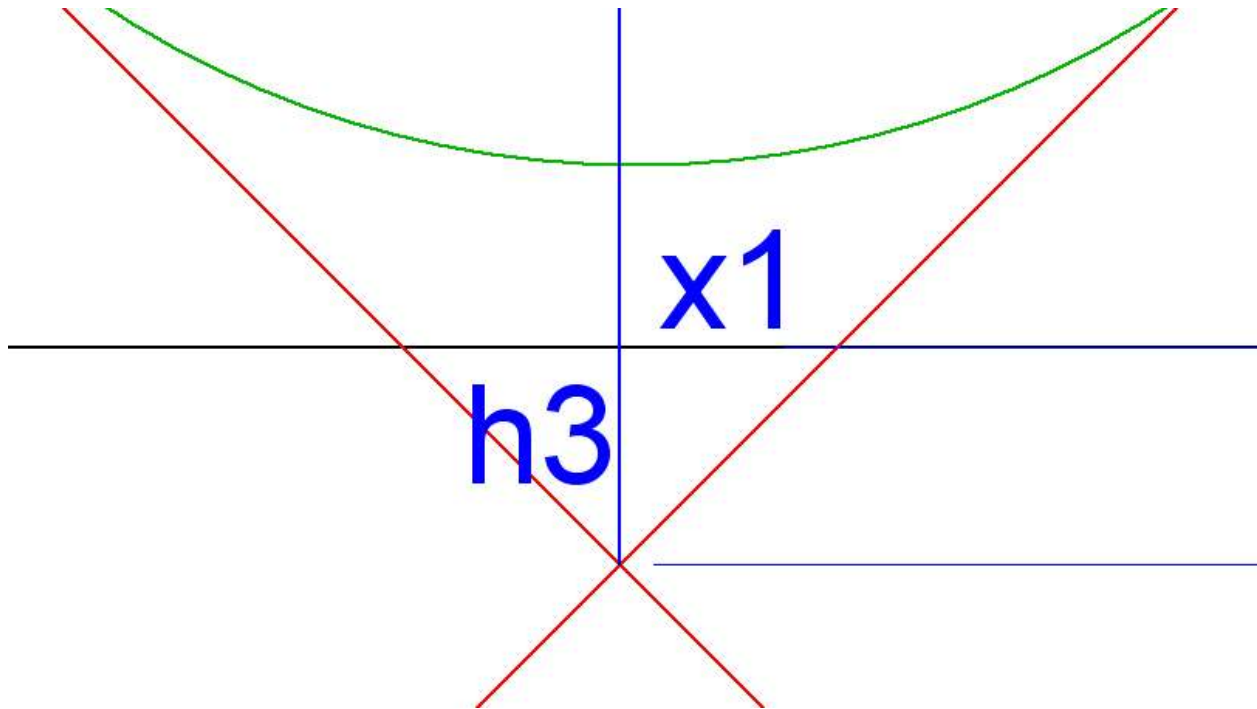
I therefore know that $h_1 = 1.414 \times r$.

Distance h_2 is h_1 plus r so I can say

$$h_2 = h_1 + r = (1.414 \times r) + r = 2.414 \times r \quad (\text{equation 4})$$

Distance h_3 is $(h_2 - \text{mic})$ so I can say

$$h_3 = h_2 - \text{mic} = (2.414 \times r) - \text{mic} \quad (\text{equation 5})$$



Looking closely at the area to be cut off, I have a right triangle with a base x_1 , equal to half of the flat width, and a rise equal to h_3 . The internal angles are all 45° . I can say

$$\tan 45^\circ = \frac{x_1}{h_3}$$

which reduces to

$$x_1 = h_3 \quad (\text{equation 6})$$

My flat equals twice x_1 so I can say

$$\text{flat} = 2 \times x_1 = 2 \times h_3$$

From equation 5 we know that $h_3 = (2.414 \times r) - \text{mic}$ so we have

Flat = $2 \times (2.414 \times r) - \text{mic} = (4.828 \times r) - (2 \times \text{mic})$ which is equation 1. Equation 2 is equation 1 rearranged.