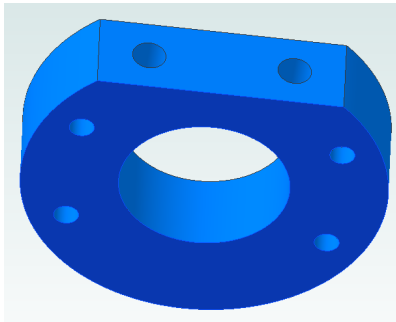# Fixturing a Semicircle on a Mill, version 1
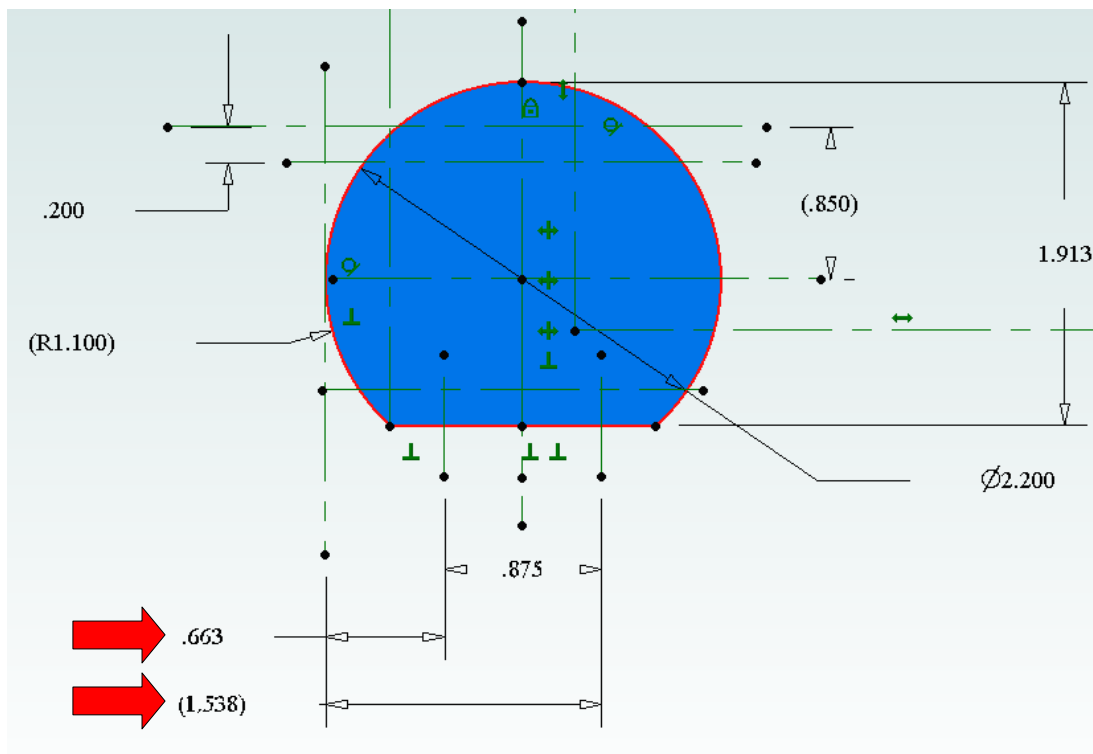
By R. G. Sparber

Copyleft protects this document.[1]

The challenge was to drill two holes in a flat that are within ±.002" of their designed locations.

If accuracy didn't matter, I could have eye-balled the edge of the flat to set my zero. Not good enough here.

Since the part was drawn using CAD, I had access to all dimensions. The two key values are the distance from the perimeter to each of the hole centers: .663 and 1.538.

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[1] You are free to distribute this article but not to change it.

I started by carefully cleaning my vise. Then I cleaned every bit of metal that will contact my part. The part was deburred and cleaned. One bit of swarf or a burr can throw my accuracy way off.
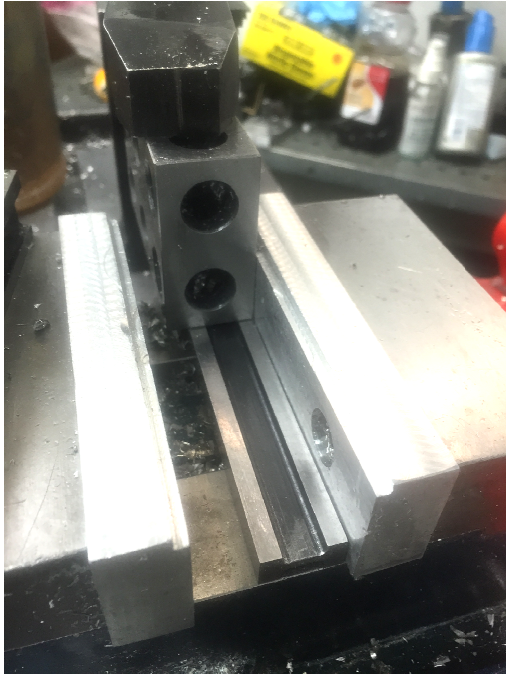
I started by placing a parallel down on my vise ways. Then I loosely clamped a 1-2-3 block on one end. The vise was lightly tightened to align the block. Then the hold down clamp was tightened.

I then had a horizontal and vertical reference surface.

The part was placed on top of the bottom parallel and touching the 1-2-3 block's vertical face.

Then a parallel was added to apply side force from the movable jaw.

A second parallel is under it to provide support.

I was then able to indicate off of the vertical surface of the block to pick up my X axis reference point.

The bottom parallel supports the part so drilling forces will not cause the part to slide down.

The part is a sliding fit as it contacts the 1-2-3 block and bottom parallel. Time to level the flat.

To get in the ballpark, I first put a digital protractor on the vise jaws and zeroed it. Then I put the protractor on the flat while pushing the part against the block. After rotating the part until I saw zero on the protractor, the vise was tightened slightly.
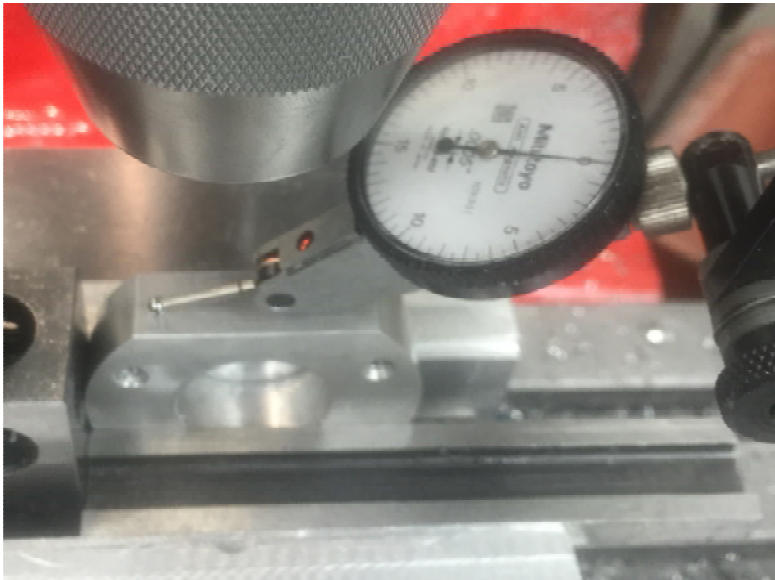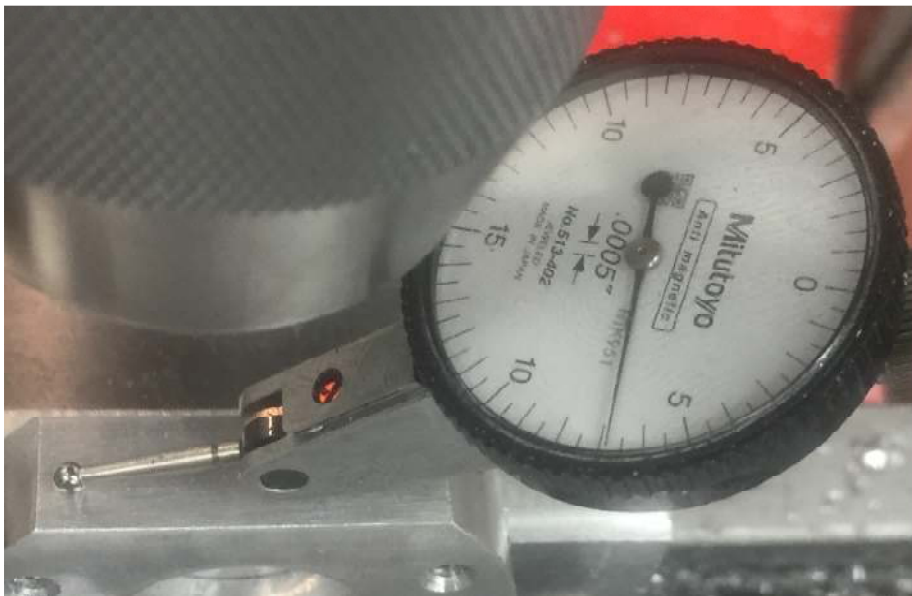

Next I mounted my finger Dial Test Indicator in my drill chuck. I zeroed it on the left side of the flat.
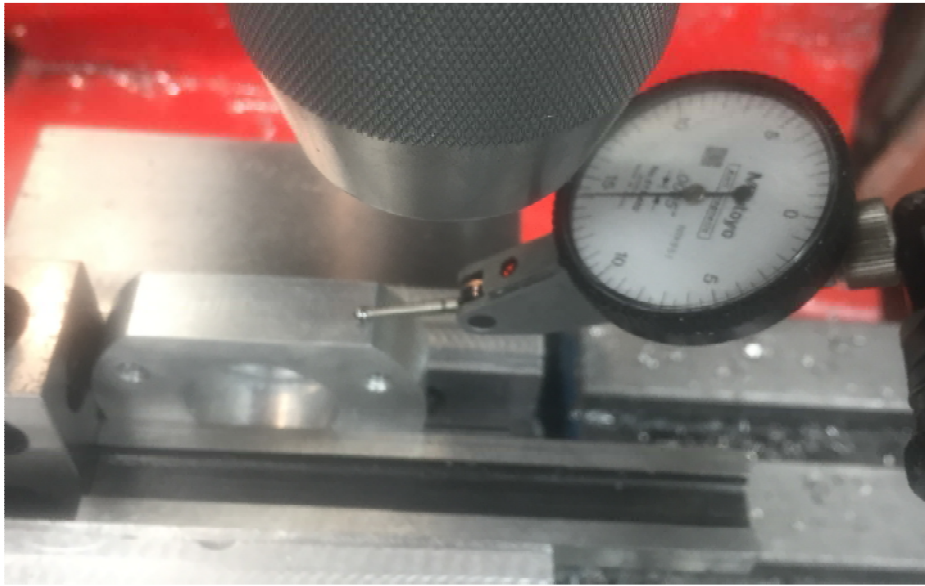
Then I moved the table so the finger was on the right side of the flat. The needled moved 0.014".

By slowly rotating the part against its reference surfaces with the vise providing a sliding fit, I rotated the part until the DTI read 0.007".

Going back to the left side of the flat the needle didn't move. The vise was then tightened.

I then had the part touching my 1-2-3 block and the flat level with respect to the mill table ways. All that is left is to pick up my references.

I mounted a piece of .250" drill rod in my drill chuck. In hindsight, I should have used a collet which has less runout.

The rod was moved until it contacted the vertical face of the block. By measuring the change in resistance between block and rod, it was easy to detect touchdown.

My center of rotation of the rod is now 0.125" from the reference surface. I raised the rod, moved over this amount, and zeroed my X axis Digital Read Out.
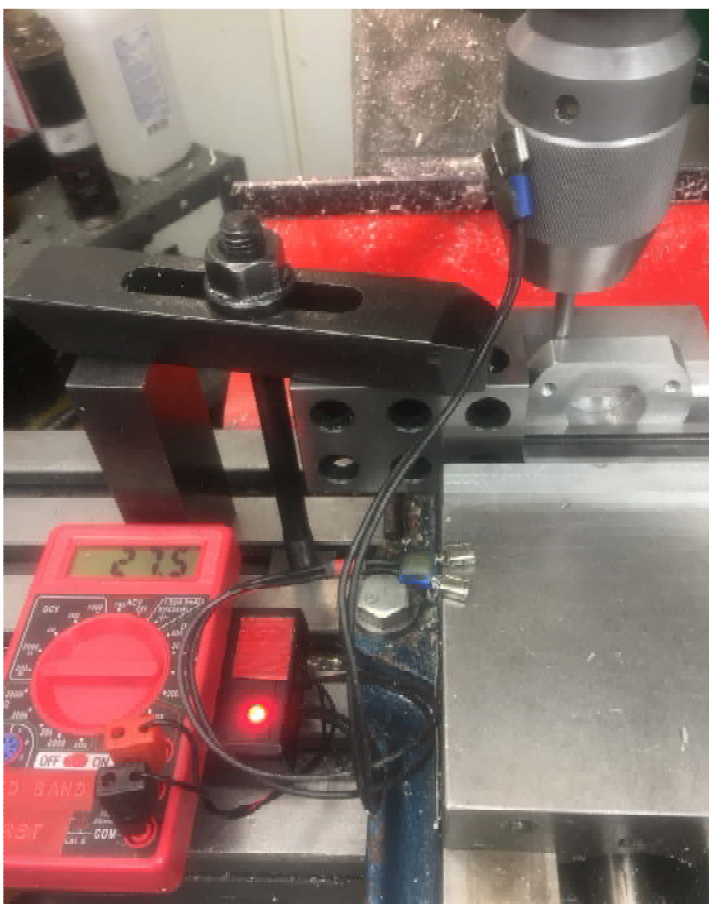
I used the same procedure to pick up my Y axis zero. This time the rod touched the back of the part.

You can see my milliohm meter connected between the vise and drill chuck. Before touchdown, the meter read "1" with blanks to the right indicating an out of range-high condition. At touchdown, it jumped down to 27.5 milli ohms.

I again raised the rod, moved over by 0.125", and set my Y axis zero.

My origin has now been accurately set as per the drawing on page 1.
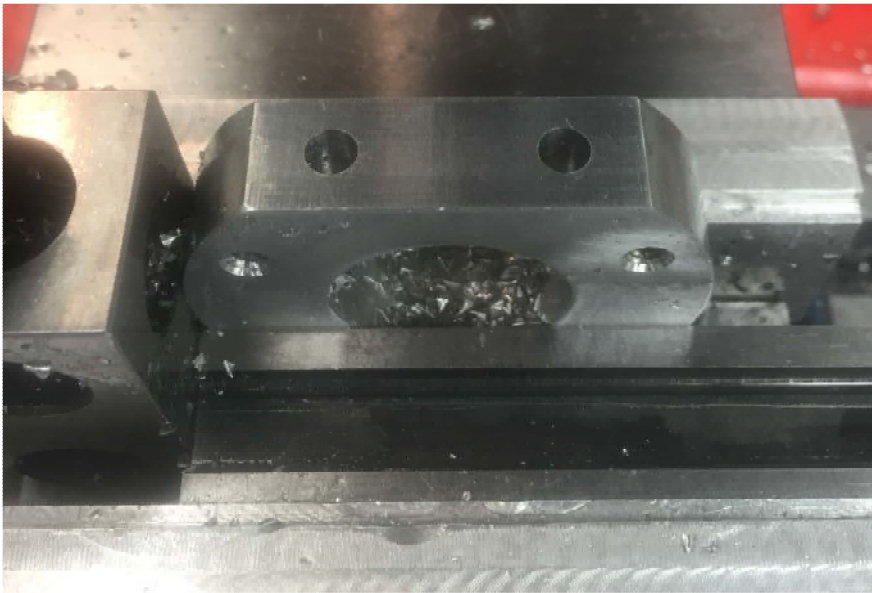
My first hole is at X = 0.663", Y = 0.250".

The second hole is at X = 1.538", Y = 0.250".

The holes were drilled and tapped for ¼-20. A trial assembly was done and the screws went in with no binding. After a careful cleaning of the fixture, I finished my second part.

With just two parts to drill, using the DTI to set the flat level was fine. If I had more to do, then, in hindsight, I probably would have put the 1-2-3 block on end and used a second 1-2-3 block or a small square to get the flat level.

I welcome your comments and questions.

If you wish to be contacted each time I publish an article, email me with just "Article Alias" in the subject line.

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