Centering a Rotary Table

Using the Centerline function of a DRO, Version 2

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Before you can use a Rotary Table on a mill, its center of rotation must be aligned with the spindle's center of rotation. Many means exist with varying degrees of ease and accuracy. In most cases, you start with a rough alignment. My favorite method is to mount a spud in the spindle and a modified dead center in the RT's tapered hole. This can get the center of rotation of the RT to within about 0.02" of the center of rotation of the spindle. For some jobs, this is plenty good.

But if you want better results, then it is common to fix a Dial Test Indicator onto the spindle and indicate the pin set in the center of the RT. This works very well although it can be a bit time consuming if you are trying to get it as close to perfect as possible.

Now, with a solid DTI support, a good quality DTI, and a bit of patience, you can get the alignment to within +/-0.0002". If that is what you need, then stick with the DTI. But if you can accept an error of +/-0.0005", then a DRO can be used and it should speed up the process.

I own a DRO which has a centerline function. It finds the halfway point between my present position and the zero point on a given axis. For example, say I am at the

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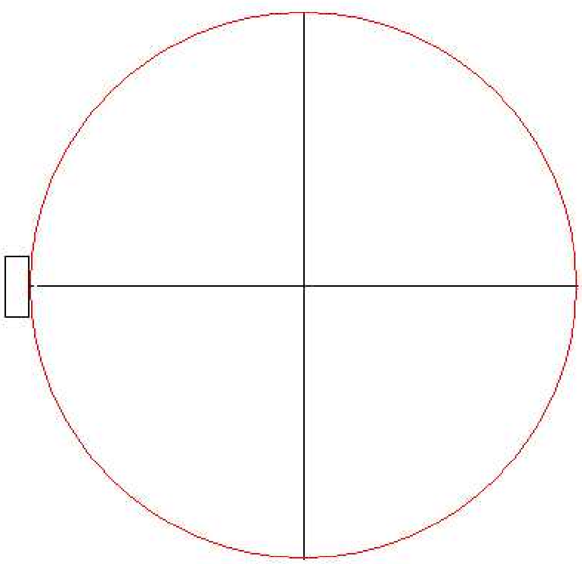
location X = 2.0000”. I run the centerline function and the display changes to X = 1.0000”. Move to X = 0 and you are at the centerline point. Doesn't sound very impressive until you start to use it. The following procedure does not need the centerline function. You just need to be able to read off the mill table's XY position and be able to divide by 2.

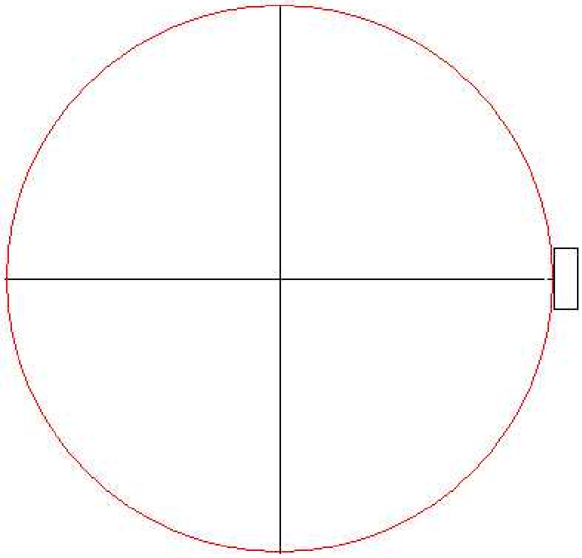
There is one potential problem with using a center pin. The goal is to align the center of rotation of the RT with the spindle, not the pin to the spindle. Are you sure that center hole is really located correctly? Are you sure it is absolutely free of swarf which can offset the pin?

The true test of alignment is to focus on the actual rotation of the RT. First lets look at theory. The center of rotation of the RT is commonly seen as the center of a pin placed in the tapered center hole as shown above. It is very likely that this is correct but if you really want to be picky, the center of rotation is a point equal distant from a point on the RT that has been moved through 360 degrees.



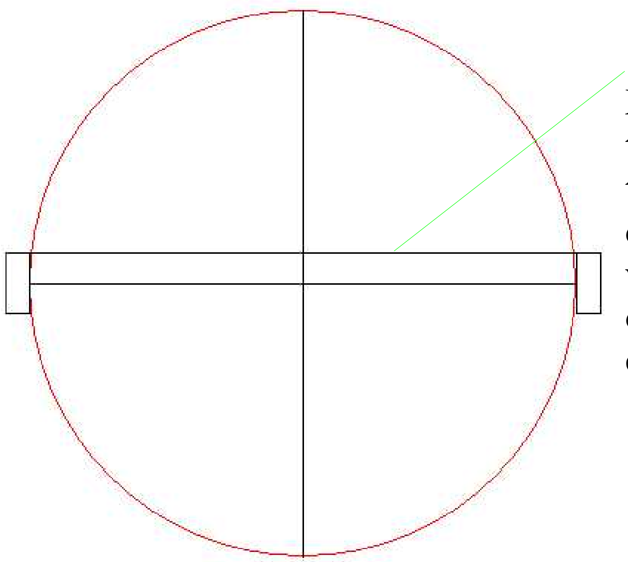
Say I attach a block to the surface of the RT[2] and set the angle to 0 degrees. I then define the block's inner face as X = 0 with an Electronic Edge Finder connected to my DRO. I would do this by moving the EEF from near the center of the RT out to the block. When the EEF contacts that inner face of the block, I set my zero for the X axis.

2 I am using a block here because my mill is not large enough to access the perimeter of the RT's table along the Y axis.

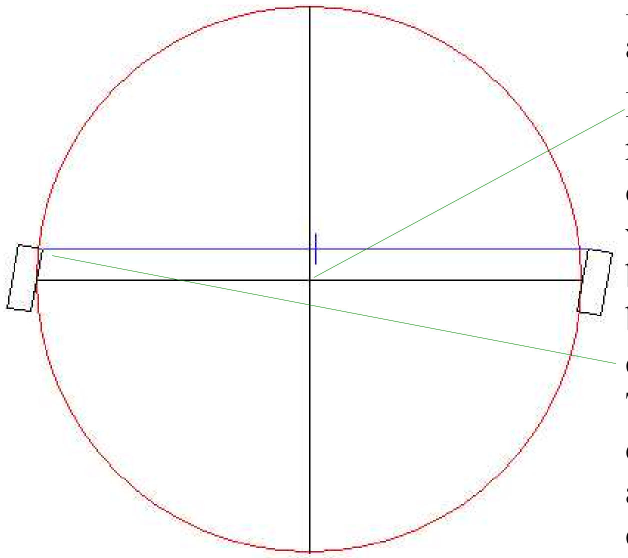


Next I crank the RT until the block is at 180 degrees. If my Y location is exactly at the center of the RT, then when I touch down on that same inner face of the block, I will be at a distance equal to the diameter of the circle inscribed by the block minus the diameter of the EEF probe. I don't care about either diameter. But if I now run the centerline function, I will see how far back to crank the X axis to end up at the center of rotation of the RT along the X axis.

There is one potential hitch here. Recall that I had to assume that I was right on the Y centerline of the RT. That is unlikely, at least for starters. Lets see what happens when I'm not exactly on the Y centerline.

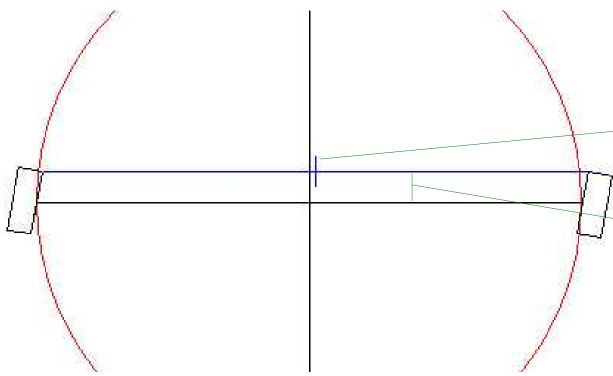


Here I am moving along a line parallel to the X axis but with a non-zero Y value. If, and this is a big if, the block face is perpendicular to the X axis, then Y misalignment of my line does not matter. In fact, if the block is 2" wide, I can be off by 1" and still find the point on the X axis which is aligned with the RT's center of rotation.



In the real world, the block cannot be perfectly aligned so lets look at an extreme case.

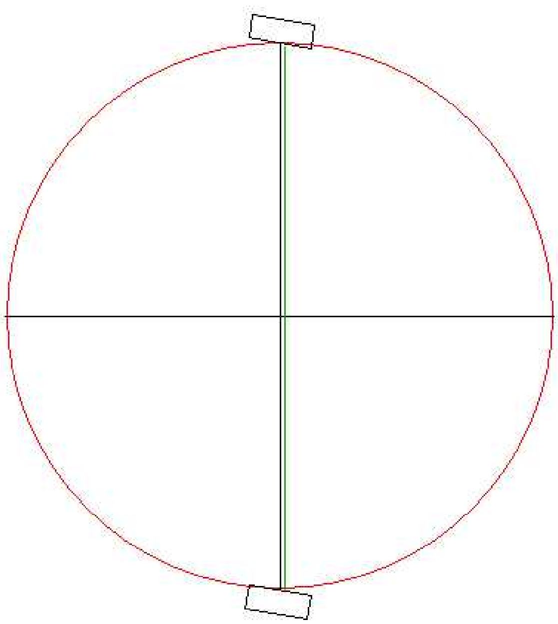
If I am running my EEF through the center of rotation of the RT, then block misalignment does not matter. However, it is more likely I will not be on this line so consider the case of being above that line. As I touch down on the block while at 0 degrees (on the left), I hit the corner which is closest to the center of the RT. Then I crank the RT until the block is at 180 degrees. Now I will hit the corner furtherest away from the center. I end up with a centerline error that is not zero.



But notice that the

X centerline error I get is much smaller than the

Y centerline error. If I now repeat this process along the Y axis, my X axis error will be much smaller.



I now have a Y axis centerline very close to true. By repeating the X axis centerline again, I will get it closer. You can repeat this process as many times as needed to get to the limits of the DRO's repeatability and accuracy.

Now, you may be thinking, what a hassle to go back and forth so many times. That is true. The answer is to align the block carefully in the first place. Then you only need to run one centerline for each axis.

Time to visit my shop. My EEF is held in my drill chuck. In hindsight, I realize this is not a very good choice because the drill chuck has a Total Indicated Runout of a few thou. I will switch to a collet for better accuracy.

My center hole is clean so could be used for the alignment. However, note that the diameter of this hole is much less than the diameter of the circle to be inscribed by the block. This means that EEF alignment is more critical with the center hole. I did try to do alignment using the cut out in the table but could not get all of the swarf out.

My block has been intentionally set at an angle in order to test out my theory. It would not take much effort to cut a ridge in the bottom of the block so it aligns with one of the T slots. I was able to do a fairly decent alignment job by sighting along one of the cut circles.

I start out with the EEF roughly centered on the RT. The tool offset is set to center.

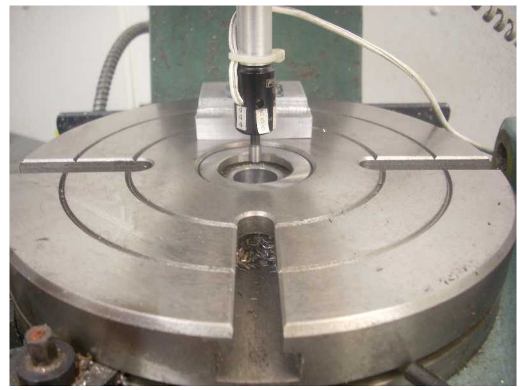
On this alignment run I placed the block by eye so it its inner face was fairly parallel to the T slot under it. I also turned the RT so the block was fairly parallel to the Y axis.

The EEF was then moved to contact the block and the RT angle noted.

The RT was then turned 180 degrees. My EEF has just come in contact with the block. The distance traveled divided by 2 is the center of the RT along the X axis.

The process is repeated for the Y axis. Here you see the EEF coming in contact with the block as it has been moved to 90 degrees. At touch down, the Y axis is zeroed.

Note that the block has been set fairly close to the center of the RT. I have limited range on my Y axis so moving the block out from the center of the RT does not work. I just can't reach it. My milling is mostly along the X axis so this is not a problem except at set up.



The block is now moved 180 degrees and the EEF again moved to touch it. The displayed distance divided by 2 is the center of the RT along the Y axis.

So how good was my alignment using a DRO? I put in my pin and DTI. The mill table was moved until the DTI showed I was aligned within 0.0005”. I then looked at my DRO display and and saw that my X axis had been moved by 0.001”. My Y axis was not moved at all. I repeated the test and this time found that no movement in the X or Y axes was needed.

This is far from a true test of accuracy but does demonstrate that using the centerline function has promise and may give you acceptable results. If you are *really* lazy but pushed for time, drive the RT with an electric screwdriver fitted with a socket. That speeds things up a lot. It does, however, wear out the gears. If this is an issue with you, disengage the drive and move the table directly. It won't give you as accurate an angular position but is probably fine.

Acknowledgement

I wish to thank Larry Gill for reviewing this document. Any typos you find now are from my fiddling after he was done. Thanks to Martin on the Yahoo group Mill_Drill for improvements to Version 2 of the article.

I welcome your questions and comments. Only through the community can we improve this article.

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