

# Reducing X and Y Axis Backlash on a RF-30 Mill/Drill, version 1.1

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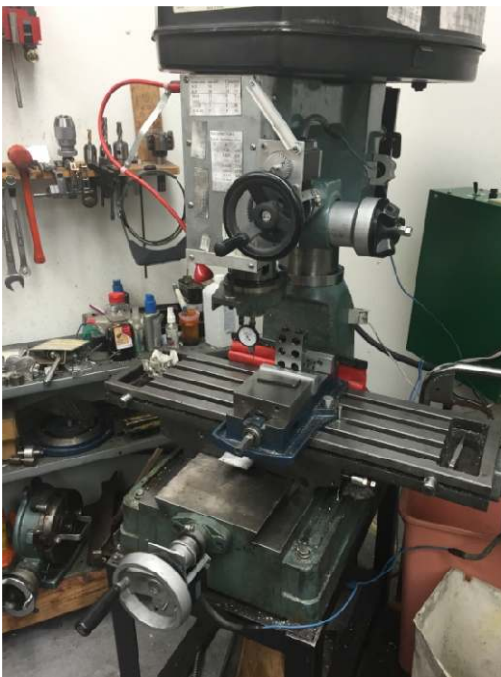
By R. G. Sparber

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## Conclusion

My X axis backlash went from 0.038 inches down to 0.006 inches. My Y axis backlash went from 0.037 inches down to 0.013 inches.

## In the Beginning...



"Wow! .038" backlash is terrible." That was the opening comment from Dan Mauch of the mach1mach2cnc Yahoo group. Of course, he was absolutely right. Never bothered me when I was manually machining but as I continue to get CNC to work on my RF-30, it has become a problem.

Where does backlash come from? Most people quickly point to the take up nut that engages with the leadscrew. It has an adjustment that can take out wear and keep backlash "reasonable". However, there is a second source of backlash that is not as obvious and turned out to be much larger: play in the thrust bearings.

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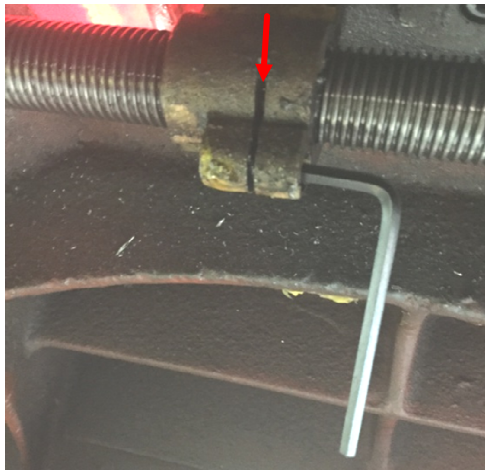
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## Background

Plenty of knowledgeable people in the Mach1/2 group urged me to replace my X and Y lead screws with ballscrews. Ballscrews have far less backlash than leadscrews.

At least at this time, I would rather see how far I can push the existing leadscrews. I know they can't be as tight as ballscrews but I do have plenty of room for improvement.

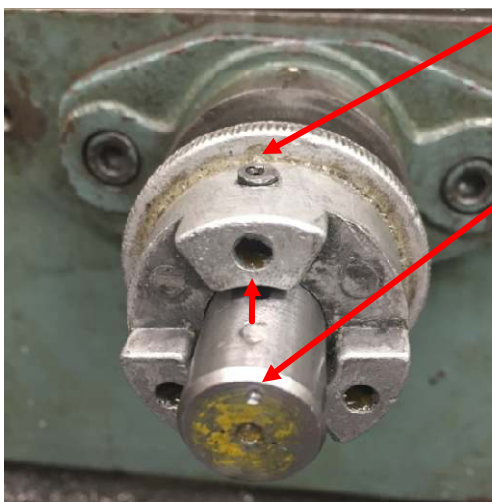
## Y Axis Backlash Reduction



Start with the easiest to make adjustment: the take up nut. My support frame is open so I just needed to lay on my back and look up. Do be sure that the gap in the nut is free from swarf before tightening the screw.

I was using lithium grease on my leadscrews but have now replaced it with spindle oil. Maybe this will help reduce random error. Don't know yet.

When I tested the Y backlash, it had not improved very much. It was then that I realized that the bearing might be a second source of backlash.



The roll pin that secures the spline hub to the shaft must have been match drilled. This means that if the spline hub is not aligned correctly, the hole will not line up exactly and the roll pin will bind up. Here you see a punch made in the end of the shaft. A second punch mark should have been made on the spline hub. Oh well. Do as I say, not as I do.

After driving out the pin with a soft face mallet, the spline hub was removed.



The spline hub has a recess on the back side. At the bottom of the recess is the contact area for the bearing. It is not possible to directly insert a feeler gage to measure the needed shim thickness. Although I didn't do it, the smart approach here would have been to measure the movement of the shaft before the hub was removed. Then use a shim to equal this play.

I had 0.037 inches of backlash so figured I could take back 0.02 inches with shims. Not very scientific but that is what I did. Here you see two 0.010 inch thick shims on the shaft. These shims will crowd the outer thrust bearing and reduce play.

I must have gotten lucky because I had to press in on the spline hub while driving down the roll pin. My guess of 0.02 inches of shims was about right after all.

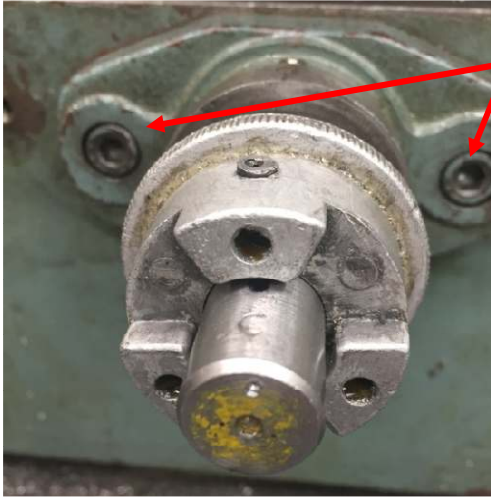


The roll pin is then driven back in place. If you can't drive it in with a soft face hammer, check for hole alignment. Do not just go out and get a bigger hammer.

I then ran the table over the full range of the Y axis to verify it did not bind. If the nut was too tight, I would have to loosen it slightly and give up some of the backlash improvement.

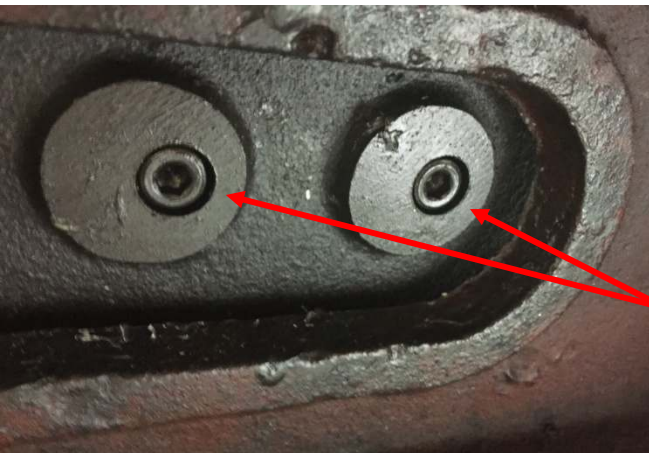


## X Axis Backlash Reduction



In order to access the X axis take up nut, it is necessary to remove the Y axis leadscrew. Start by removing the flange screws.

Then turn the Y axis leadscrew clockwise until it comes out of the mill's base. This is a left hand thread.



With the Y axis leadscrew removed, you have easy access to the two bolts that secure the X axis take up nut. This assumes you have access to the underside of the mill.

Remove the two screws being careful not to let the split washers fall off the screws. Set aside.



Remove the spline hub from the left end of the table by driving out the roll pin. The same suggestion stands: make marks in both the hub and shaft before removing anything.

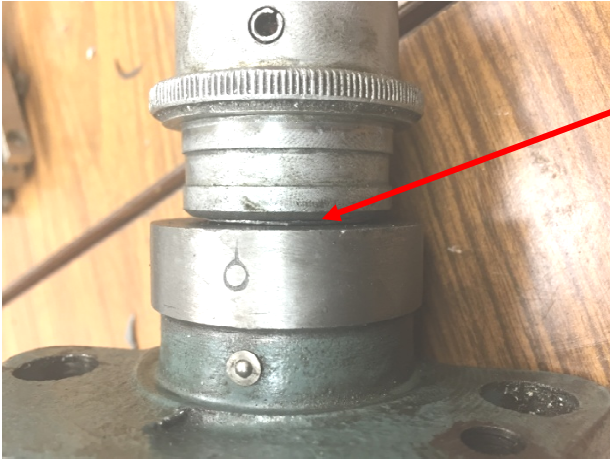


Remove the two screws from the right side bearing flange. You should then be able to pull the leadscrew assembly out.



With the leadscrew assembly on your bench, it is easy to access the take up nut. I tightened mine almost to the limit because there was so much wear from 25 years of use. I also didn't want to have to pull this assembly out again just to snug up this screw one more time.

As long as you do not turn the leadscrew, the assembly will slide back into place under the table and the mounting holes for the nut will line up with the base.



I put two 0.01 inch shim washers on the X axis the same as I had done on the Y.

Slide the X axis leadscrew assembly back under the table. With your hand under the left side of the table, you can intercept the end of the leadscrew and guide it into the left side bearing. Then run in the bolts that secure the take up nut. And finally, put back the screws that secure the right bearing support.

The final check was to run the table over the full range of the X axis to verify it did not bind. If a problem was discovered, the nut would be loosened slightly.

My X axis backlash went from 0.038 inches down to 0.006 inches. My Y axis backlash went from 0.037 inches down to 0.013 inches.

## Acknowledgments

Thanks to Dan Mauch for inspiring me to look closer at my backlash. Thanks to Steve Blackmore for educating me on ballscrews. Thanks to Malcolm Parker for pointing out that I did not discuss running the table over the full range to verify there was no binding.

Thanks to Bob Sanders for pointing out the correct way to select the spacers.

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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