Adjusting Backlash on Sherline handwheels

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What Is Backlash?

Backlash is the amount the handwheel can turn before the slide starts to move when changing directions. This is a fact of life on any machine tool, and on machines of this type it should be about .003" to .005" (.08mm to .12mm). As the leadscrew is rotated, one surface of the thread pushes on the saddle nut to move the saddle. As the direction of rotation is reversed, the thread must move a certain distance in the opposite direction before it contacts the other side of the saddle nut thread and begins moving the saddle in the other direction. Obviously, eliminating backlash would require both sides of the thread to be contacting the nut at the same time. This would cause excessive friction (wear) and make the handwheel very difficult to turn. On more expensive machines, "ball leadscrews" are used. They use a series of ball bearings running in a track to drive the carriage; however, they are very expensive to manufacture and one leadscrew could cost more than an entire Sherline machine, so they are not used on small machines. Therefore, backlash is not considered a "fault" with a machine tool but rather is simply a factor that must be kept properly adjusted and accommodated for in your use of the machine.

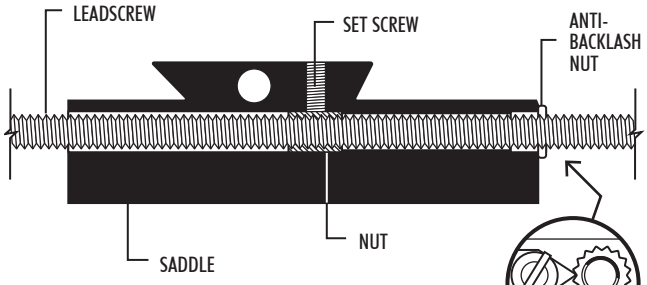
Taking Backlash into Account when Using Your Mill

Backlash must be allowed for by feeding in one direction only. Example: You are turning a bar to .600" diameter. The bar now measures .622" which requires a cut of .011" to bring it to a finished diameter of .600". If the user inadvertently turns the handwheel .012" instead of .011", he couldn't reverse the handwheel just .001" to correct the error. The handwheel would have to be reversed for an amount greater than the backlash in the feed screws before resetting the handwheel to its proper position.

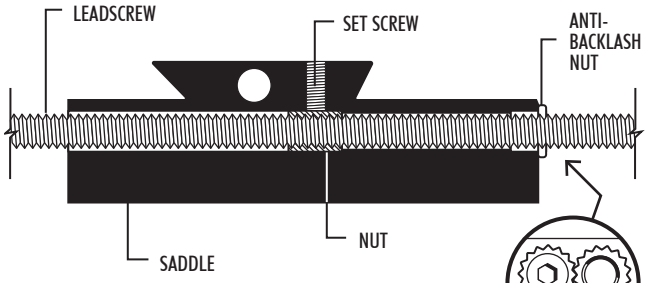
Adjusting for Excessive Backlash

Mill X- and Y-axes—Eventually, wear on leadscrew nuts can cause backlash to increase beyond the recommended .003" to .005" setting. Backlash on the X- and Y- axes of the mill may be reduced to a minimum by adjustment on the anti-backlash nuts. These brass nuts are located on the handwheel ends of the mill saddle where the leadscrew enters the saddle. The nuts are secured by slotted pan head screws which hold a lock that interlocks with teeth on the backlash nut. There are three versions of the lock. The earliest versions used a pointer to engage the teeth in the backlash nut to keep it from turning. The revised version used a second "gear" type circular lock to engage the backlash nut. This change was made to make the adjustment easier, as the gears remain constantly engaged during adjustment, whereas the pointer must be physically put back into engagement each time it is adjusted. The star gear and backlash nut have about 16 points. Because the mounting hole for the locking gear had to be moved slightly farther from the backlash gear to accommodate its larger size, the new system cannot be retrofitted to the old pointer style lock. The latest version works like the star gear, but the teeth are much finer and look like a knurled finish rather than large points. This further reduces play in the lock and the resultant backlash. This system can be retrofitted to the newer style star gear lock but not to the pointer style lock. (An upgrade is available as P/N 5011U/5111U.)

To adjust backlash, simply loosen the pan head screw that locks the pointer or star locking gear. Rotate the anti-backlash nut clockwise on the X-axis and counterclockwise on the Y-axis until snug. Replace the pointer in position and tighten the pan head screw. (The star gear system eliminates the need to replace the pointer, as it turns with the backlash nut as it is adjusted. With the anti-backlash nuts properly adjusted, the lead screws will turn smoothly and should have no more than the proper .003" to .005" of backlash.



Older Pointer Type Lock



Newer Star-Gear Type Lock

Figure 1—Types of backlash adjustment systems. A new lock now uses a star gear rather than the older style pointer to locate the anti-backlash nut, and a button head socket screw locks it in place. This system is easier to use, but the function is essentially the same. (The hole centers are different, which means the star gear cannot be used to replace the pointer on older models.) The lower drawing shows the older 16-point star gears. The latest system is similar but has more and finer teeth.

Mill Z-axis—Backlash on the Z-axis is adjusted by supporting the weight of the headstock with your hand while loosening the handwheel set screw. Lift up on the headstock, index the handwheel 90° to pick up a new spot on the shaft, push the handwheel down tightly against the thrust and retighten the set screw while still pushing the headstock upward with your other hand. If the Z-axis handwheel has the newer design with the support screw in the center, retighten the screw until it just starts to support the weight of the headstock. This will take some of the stress off the handwheel set screw and help it maintain adjustment longer without slipping downward. (Don't overtighten or the handwheel will become hard to turn.) To minimize the effect of Z-axis backlash, always approach your desired setting from the top by coming down rather than lifting the headstock into the desired position.

A new adjustable backlash system was developed for the CNC mill in 2004. It is standard now on all CNC mills, but it can be retrofitted to the manual mills as well. See P/N 4017Z/4117Z for a description and link to instructions for its installation and use.

Handwheel Adjustment

Lathe and Mill—The handwheels are secured to their corresponding leadscrew shafts by a small set screw in the side of the handwheel base. Check them periodically to make sure they have not been loosened by vibration. On the "zero" adjustable handwheels, you must first release the rotating collar by loosening the locking wheel. Then rotate the collar until you can see the set screw through the small hole in the side of the collar and adjust the screw as necessary.

If excessive backlash develops at the handwheel and thrust collar junctions, adjust by first loosening the handwheel set screw. Index (rotate) the handwheel so the set screw tightens on a different part of the shaft. (If you don't, it may tend to keep picking up the previous tightening indentation and returning to the same spot.) Push the handwheel in tightly while holding the mill saddle and retighten the handwheel set screw. Lathe handwheel backlash is adjusted in a similar manner.

How to Check the Amount of Mechanical Backlash on Your Mill

1. Mount a test indicator in your headstock. Bring it into position to touch a side of the mill table (or fixture which is mounted to the mill table).
2. Move the table to load the indicator in one direction. In the following picture we have loaded the indicator and stopped at "0" (See Photo 1).

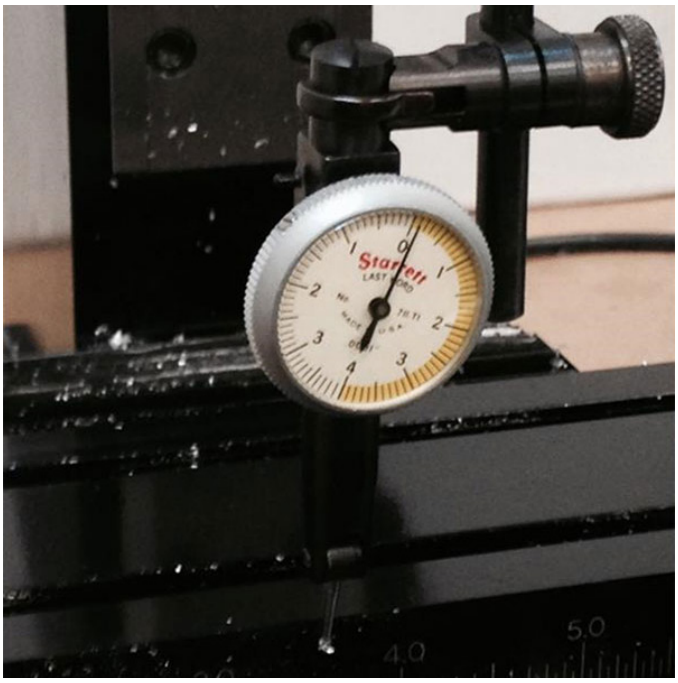


Photo 1

3. Now push or pull the table in the opposite direction of the loaded direction.

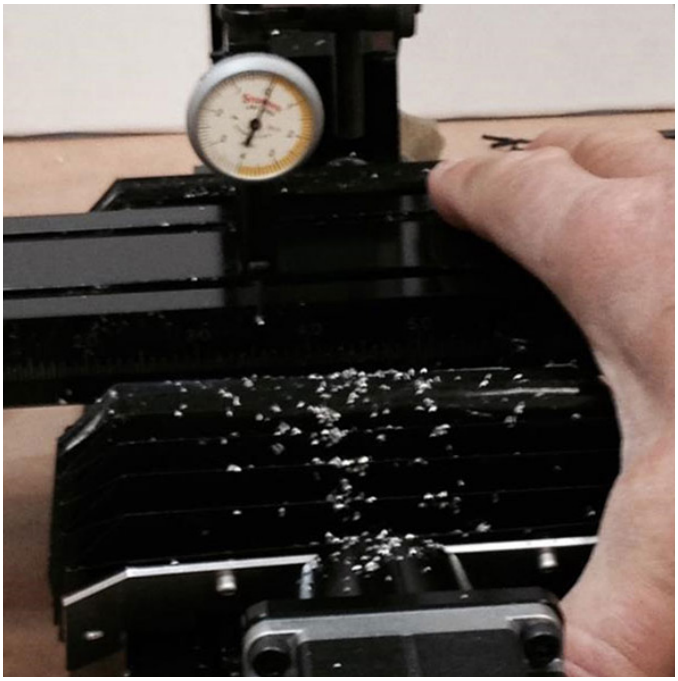


Photo 2

4. In the following picture the indicator moved .0015 to .002. This represents the amount of total mechanical backlash in the Y-axis. This represents the total combined movement of the screw, saddle, and table (See Photo 3).

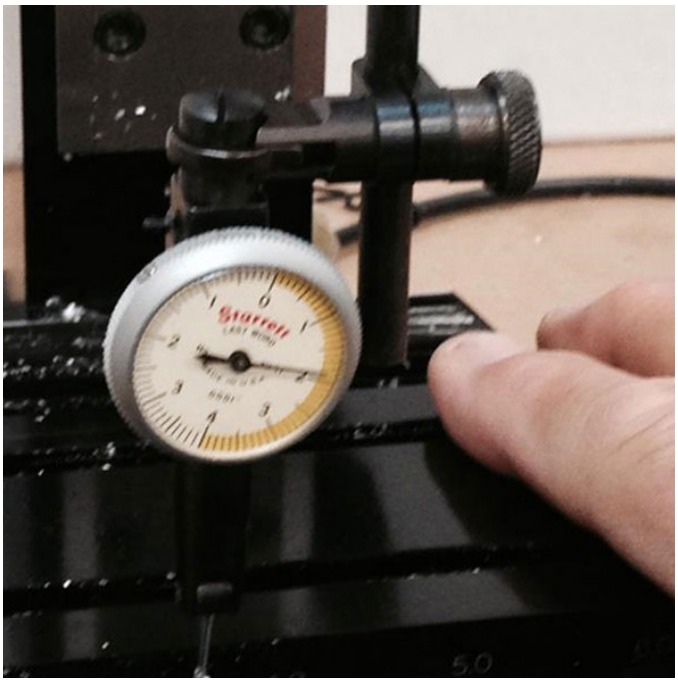


Photo 3

The most accurate place to locate the indicator to check the backlash in the slide screw is directly on the mill saddle (See Photo 4).

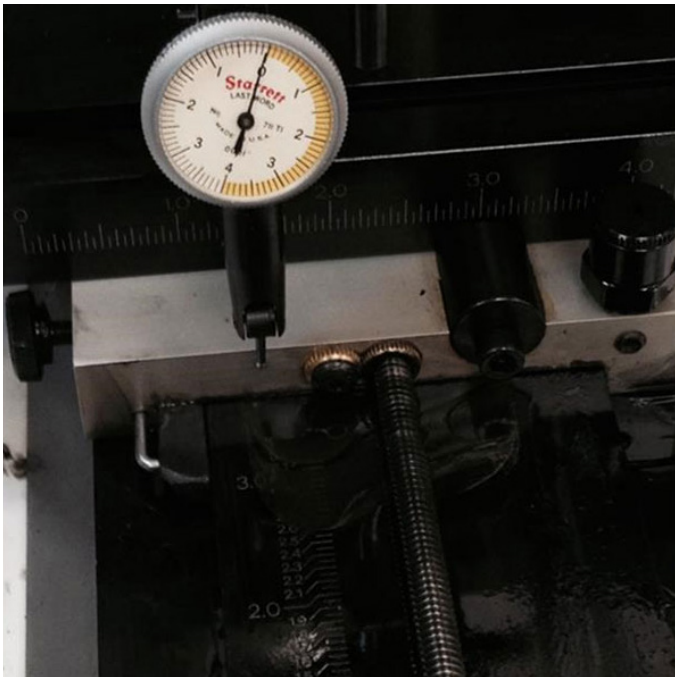


Photo 4

Use an Allen wrench to loosen the cap screw (See Photo 5).

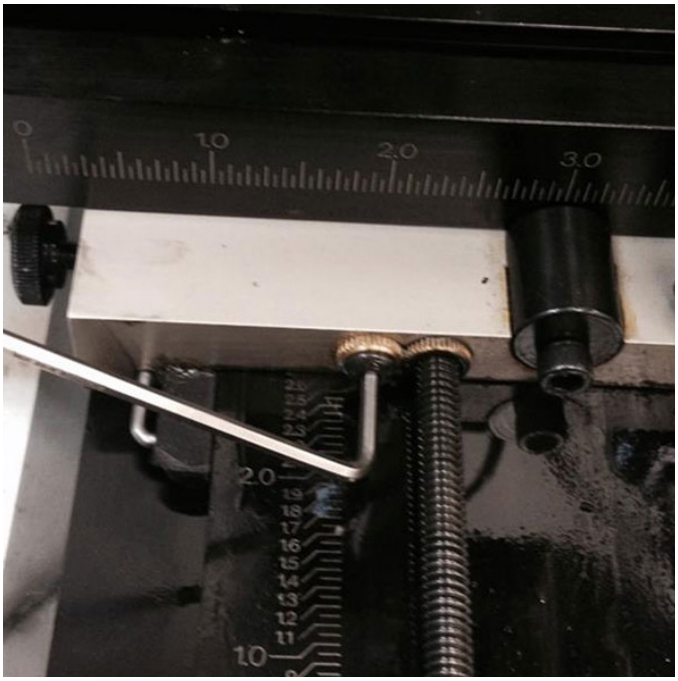


Photo 5

Then use a small screw driver to adjust the backlash nut. Place the screw driver tip in one of the knurls and lightly tap it (See Photo 6).

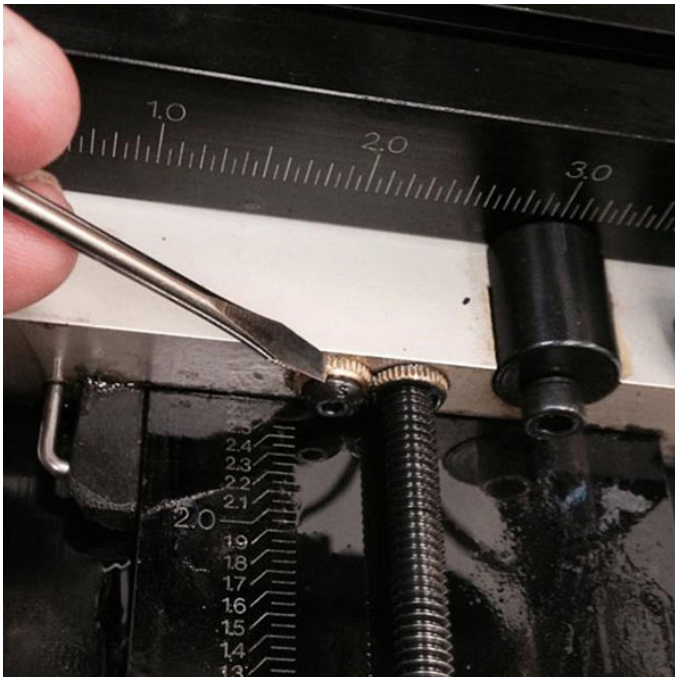


Photo 6

After the backlash adjustment the amount of backlash was .0002-.0003 in the mill saddle (See Photo 7).

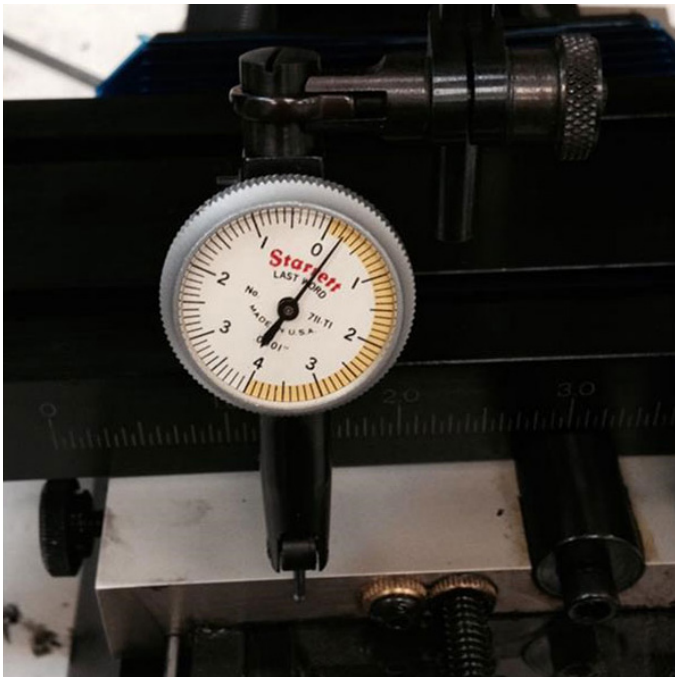


Photo 7

On manual machines most of this backlash is in the clearance between the "shoulder on the screw adapter," the "thrust washer," and the "handwheel." These three parts are sandwiched together and there is always going to be a slight gap between these parts or the assembly will not turn (at least .001-.0015) (See Photos 8-11).

Photo 8

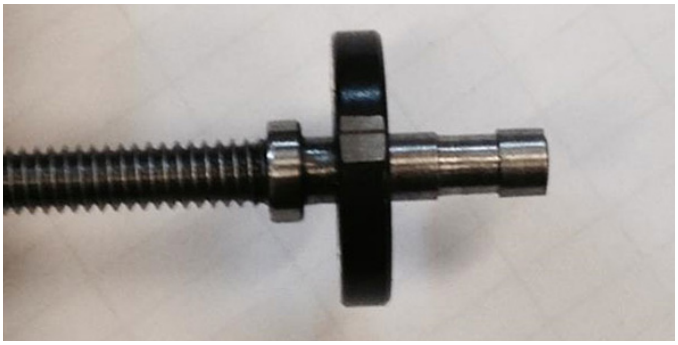


Photo 9

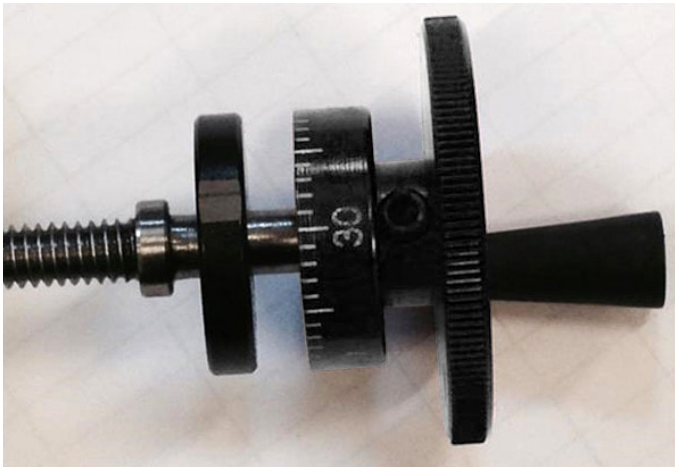


Photo 10

Photo 11

5. In order to check the backlash in the X-axis, you do the same procedure as the Y-axis. First zero the indicator and when force is exerted on the table the indicator moves .0015 (See Photos 12-13).

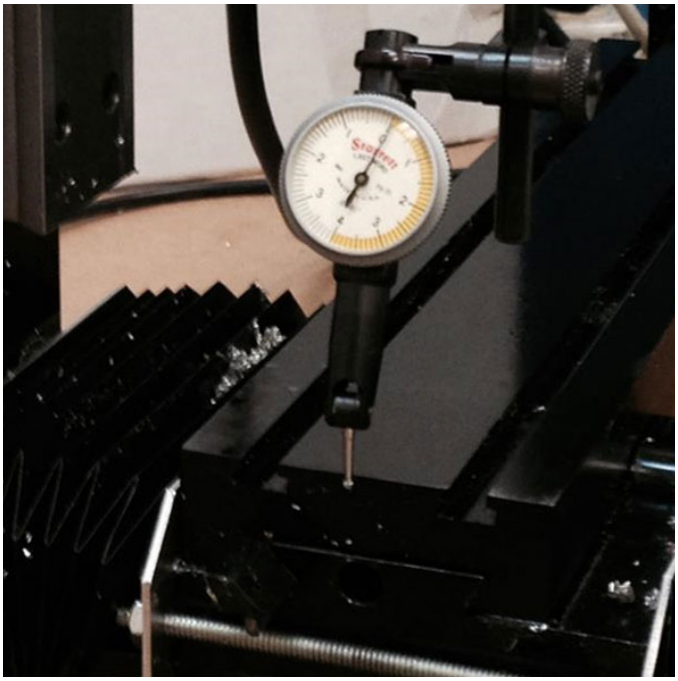


Photo 12

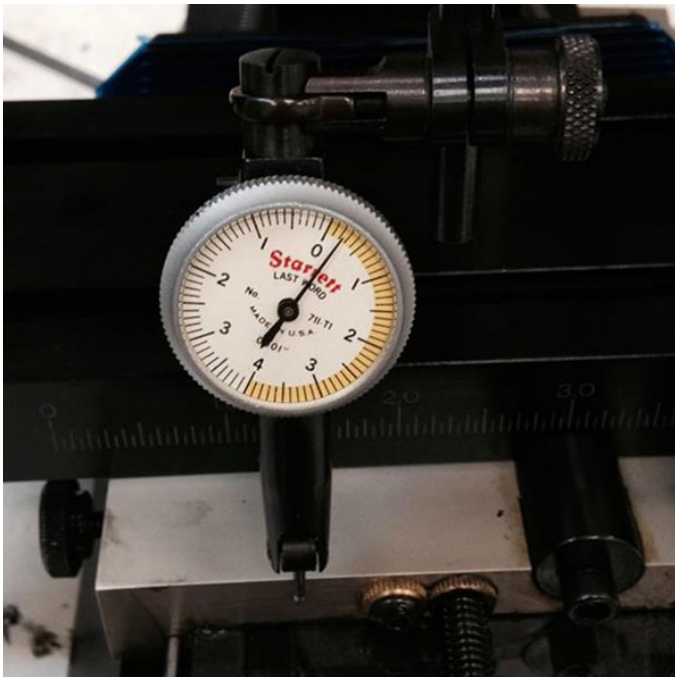


Photo 13

Checking the Slide Nut for Movement

1. For the Y-axis, the set screw that holds the slide nut in place is located on the top of the mill saddle shown circled in the Photo 14 below.

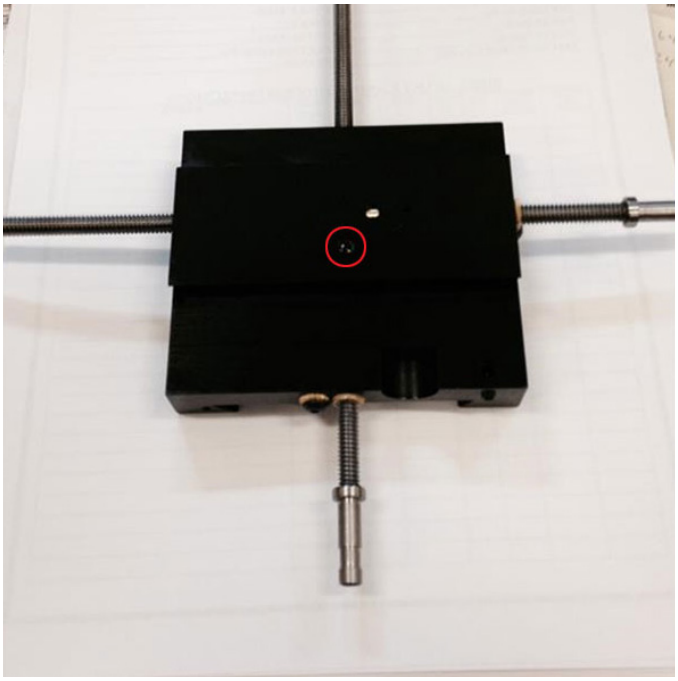


Photo 14

In order to get to this set screw, you must move the mill table to the far right. You can move it far enough to gain access without removing it, but you must stop as soon as the set screw becomes visible, or you will unscrew the X-axis screw from its slide screw nut, which is also inside the mill saddle (See Photos 15-16).

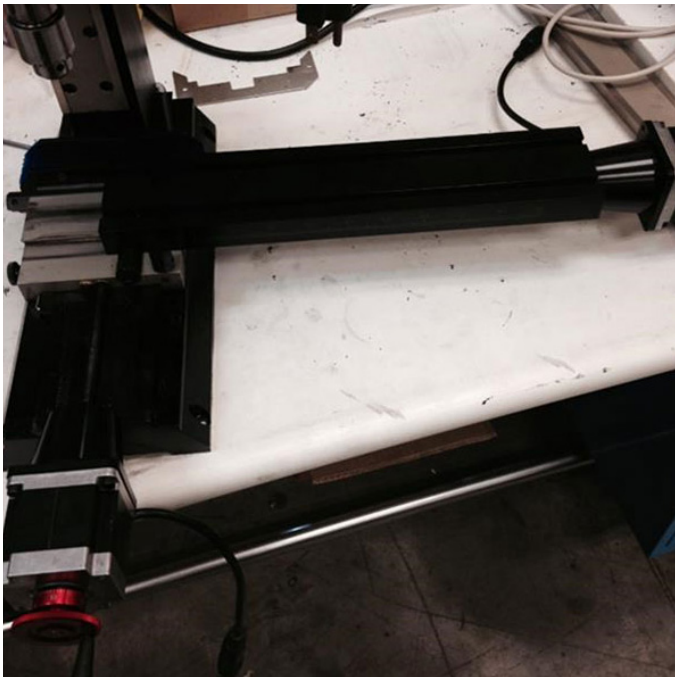


Photo 15

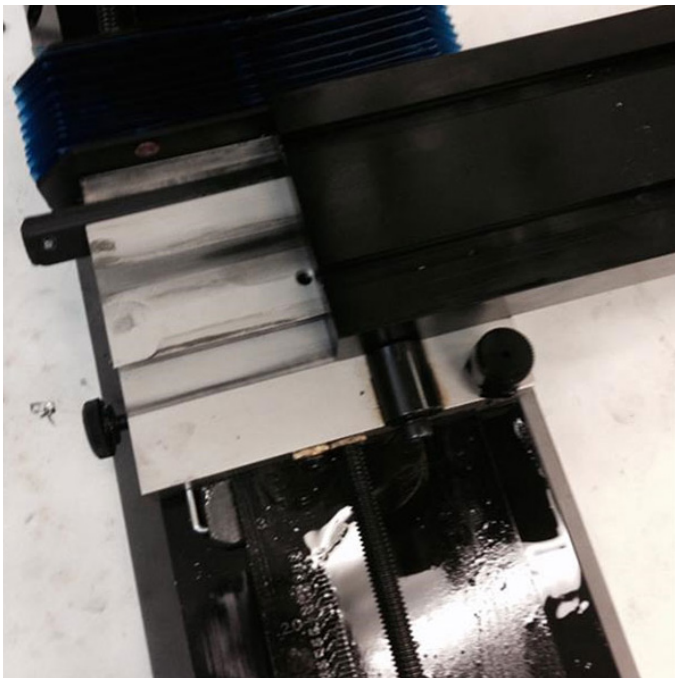


Photo 16

Use an Allen wrench to loosen the set screw. Was the set screw tight or loose? If it was loose, then the slide screw nut may have been moving. If it was tight, then the nut is most likely not the problem (See Photo 17).

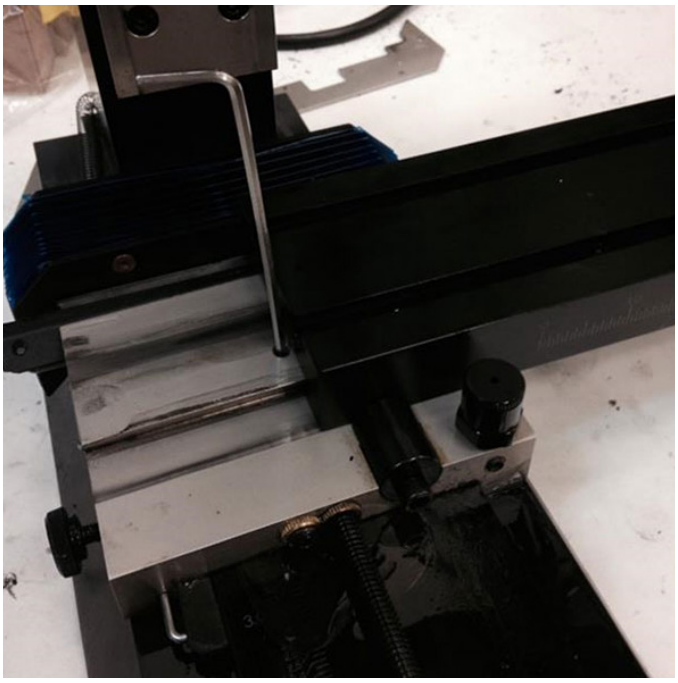


Photo 17

If it was loose, loosen it a bit more. Then loosen the pan head screw on the anti-backlash adjustment. Now, with both set screws loose, first push hard on the mill saddle towards the column. This will force the slide screw nut that is in the saddle against the shoulder in the hole that it should be located against. Then tighten the set screw in the top of the mill saddle. **NOTE:** This set screw should be tight, "but not too tight," or you may damage the slide screw. Now adjust the backlash nut as described earlier. Tighten the backlash pan head screw and recheck the amount of mechanical backlash again.

The X-axis is done the same way, except that you must remove the mill saddle from the mill base to gain access to the X-axis set screw which is on the bottom of the mill saddle (See Photo 18).

Photo 18

Indicator Tip Angle for Checking the Z-Axis Backlash

When checking the backlash in the Z-axis, your indicator tip should be as close to straight or 90 degrees as possible. If it is at any angle between 0 and 90 your measurements will be inaccurate (See Photo 19)!

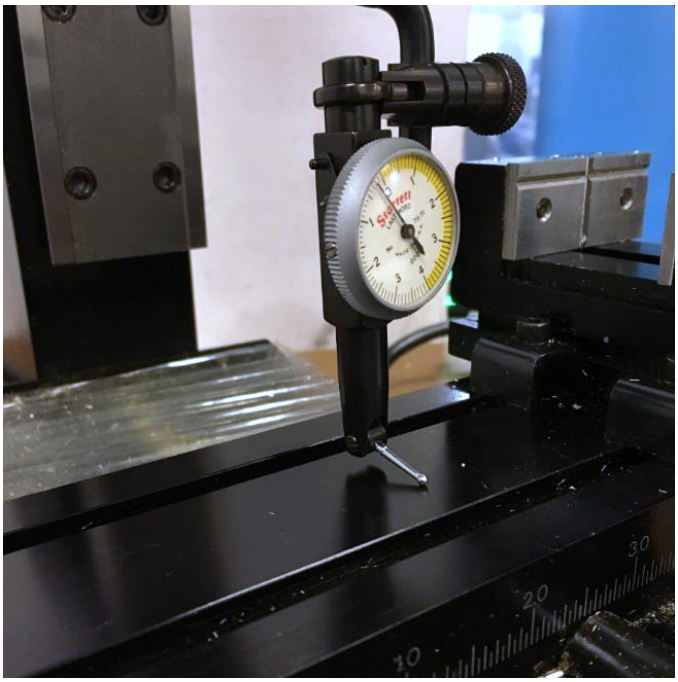


Photo 19

Backlash in the Z-Axis

To remove the mechanical backlash in the Z-axis, we are going to use the wood block method (see Photo 20).

NOTE: You can also use this method on the Y-axis.

1. Move your table as close to the column as possible.
2. Place a wood block on the mill table, preferably on the center section of the table.

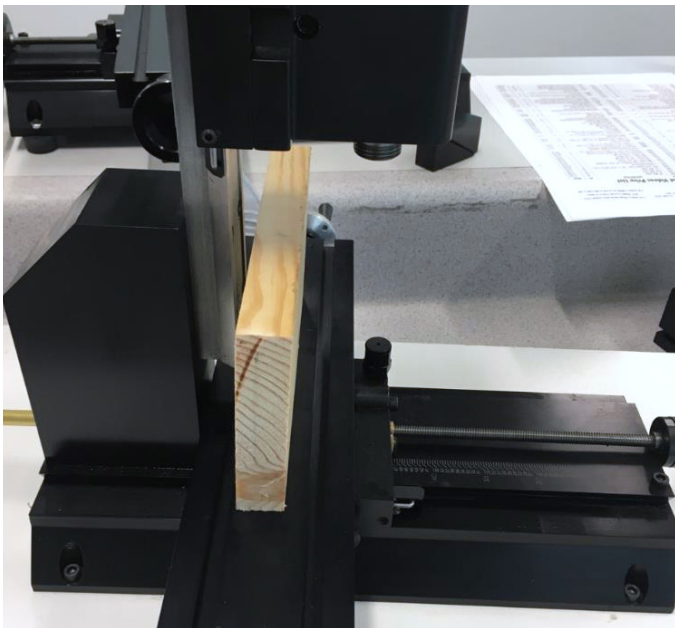


Photo 20

3. You also want the wood block to locate on the saddle or the bottom of the headstock where it mounts to the saddle. You do not want the block to make contact on an area of the headstock that is further away from the column.
4. Lower the head until it makes contact with the block (see Photo 21).

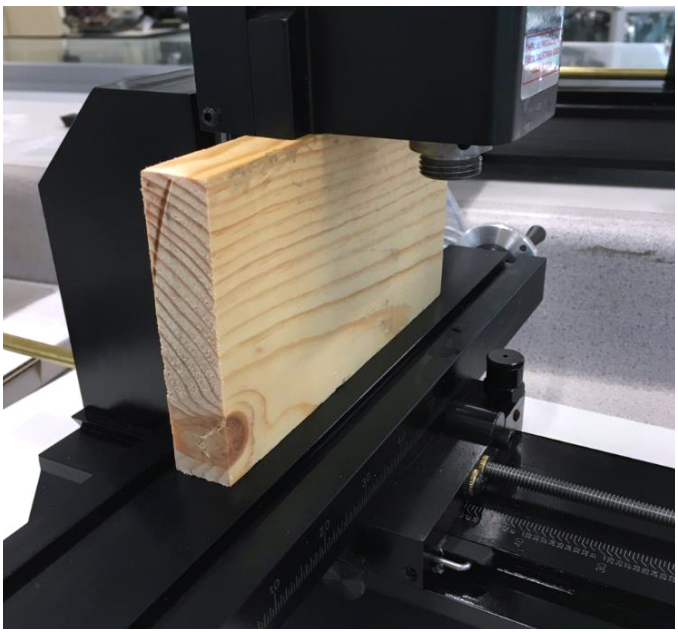


Photo 21

5. Once you have made contact with the block, turn the handwheel a bit more to load the end of the leadscrew and the washer against the end of the lead screw support. This will effectively remove the backlash between the saddle nut and the leadscrew support (see Photo 22).

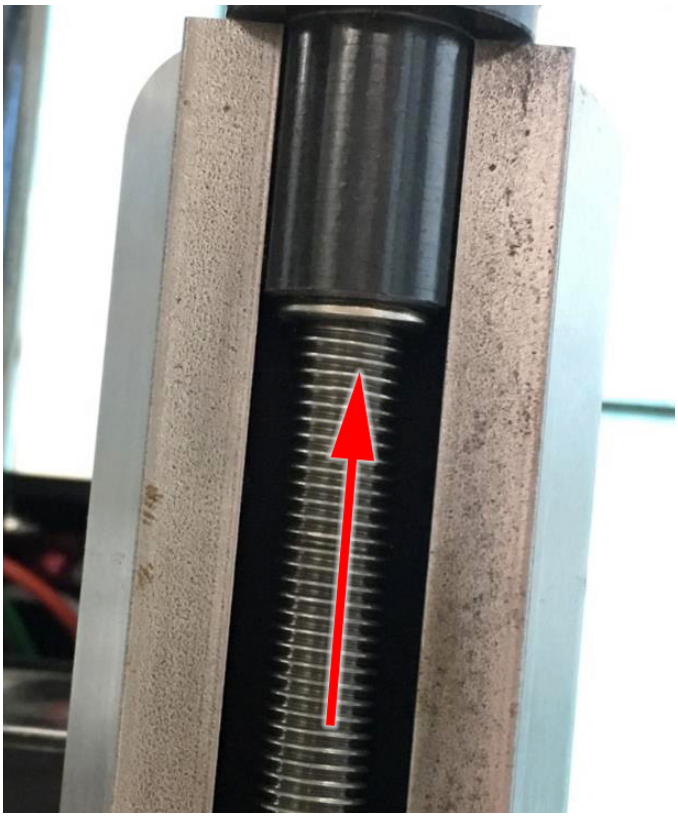


Photo 22

6. Now loosen the set screw in the hand wheel. Then turn the handwheel 90 degrees so the set screw will bite into a fresh area of the lead screw collar. Now push down on the handwheel and then tighten the set screw (see Photo 23).

Photo 23

7. Now move the headstock up and then down to see how tight the handwheel/leadscrew assembly is. If it is too tight, you will need to do the above procedure again with less pressure on the block.
8. Put the indicator back in the spindle and check your backlash again. In order for the handwheel/leadscrew assembly to work properly, you will have .001" - .002" backlash. The closer to .001" with smooth movement, the better.

Backlash Adjustment on the Lathe Crosslide

First, does your lathe have the new "crosslide anti-backlash" on the lathe saddle? If it does, great. If not, you will want to purchase this: http://sherline.com/product/40950-cnc-lathe-crosslide-anti-backlash-upgrade-kit/ (See Photo 24).

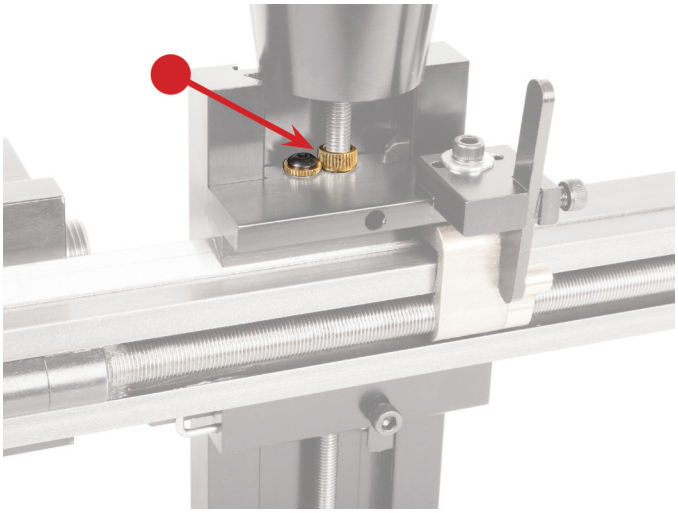


Photo 24

Screw, Thrust Collar, and Handwheel Assembly

There are two places where backlash occurs. The saddle nut and screw, and the gaps on either side of the thrust collar between the handwheel and the collar and the screw shoulder and the thrust collar.

In order to get rid of the spaces between the parts in this assembly, you must pinch them together while you are tightening the set screw in the handwheel (See Photos 25-26).

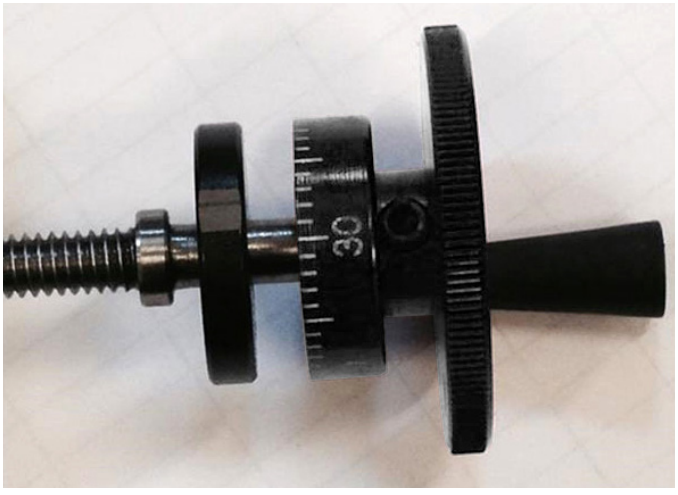


Photo 25

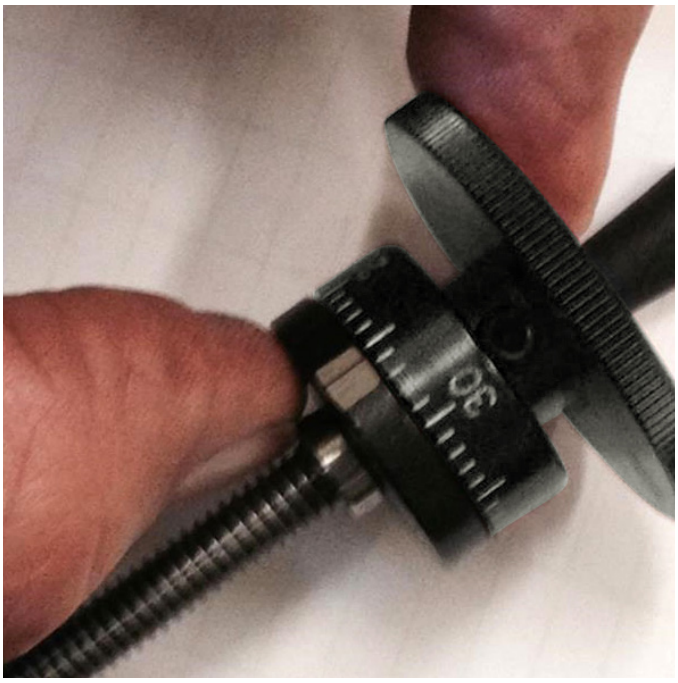


Photo 26

This is done by pulling the crosslide towards the handwheel while simultaneously pushing the handwheel toward the crosslide. This pinches the collar of the screw and the handwheel onto the thrust collar. There needs to be about .001 - .0015 play in this assembly, or the handwheel will be too tight to turn.

The following picture shows a bottom view of pulling the crosslide and the handwheel together to pinch the thrust collar, and then tighten the set screw in the handwheel. The same thing can be accomplished by mounting a tool post on your crosslide and the pulling on the tool post and the handwheel to pinch the thrust collar (See Photo 27).

Photo 27

As for the special screw adapter, here is an easier solution to get rid of the backlash between the screw collar, thrust collar, and the handwheel.

1. Buy or make two washers. One large #10 washer (ID .225, OD .500). One small 5-40 washer (ID .150, OD .375) (See Photo 28).

Photo 28

2. Tighten the set screw (P/N 40520) in the handwheel (See Figure 2 and Photo 29).

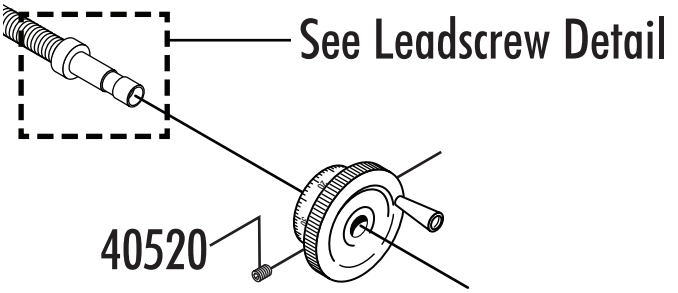


Figure 2

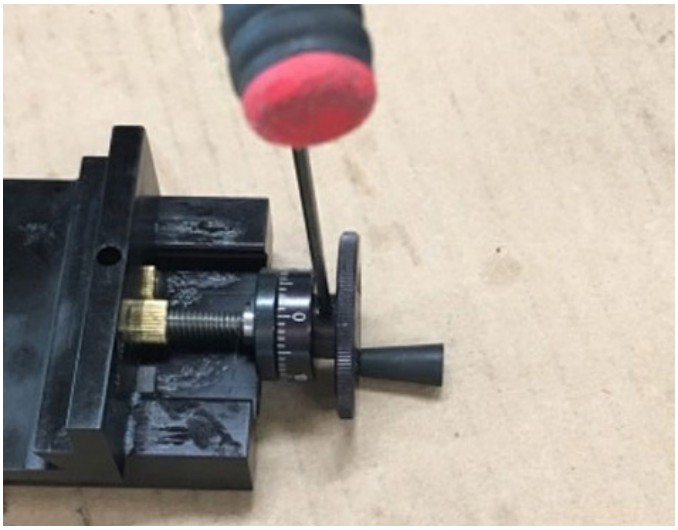


Photo 29

3. Break loose the 5-40 screw (P/N 40310) that holds the screw adapter (P/N 40290) onto the end of the leadscrew. Remove the screw (See Figure 3 and Photo 30).

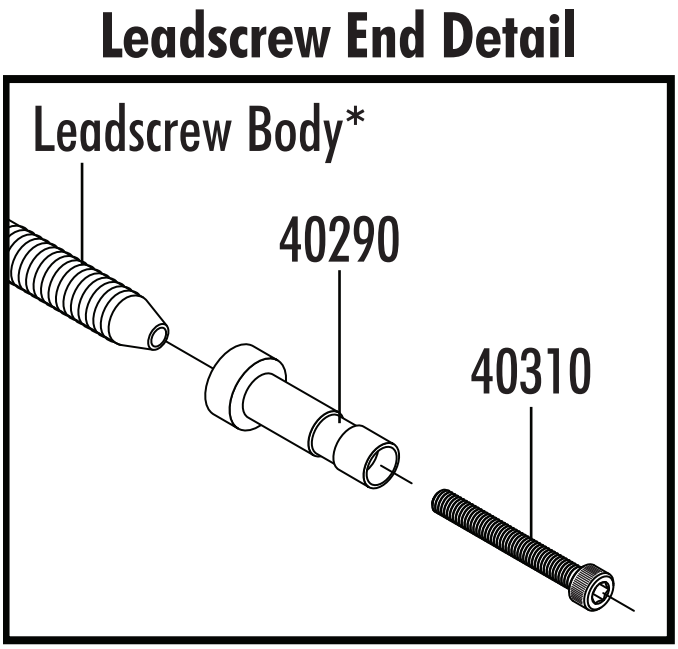


Figure 3

Photo 30

NOTE: Before you tighten the handwheel set screw for the final adjustment, "you must rotate the handwheel so the set screw picks up on a clean area of the screw adapter!" If the set screw is still located on the original "screw indentation," the indentation will pull the handwheel back to the original position. This means that there will be no change in the backlash amount.

4. Place the large washer onto the end of the handwheel so the ID is centered on the end of the screw adapter (P/N 40290). Place the 5-40 washer on top of it. Then screw the 5-40 screw back in (See Photos 31-32).

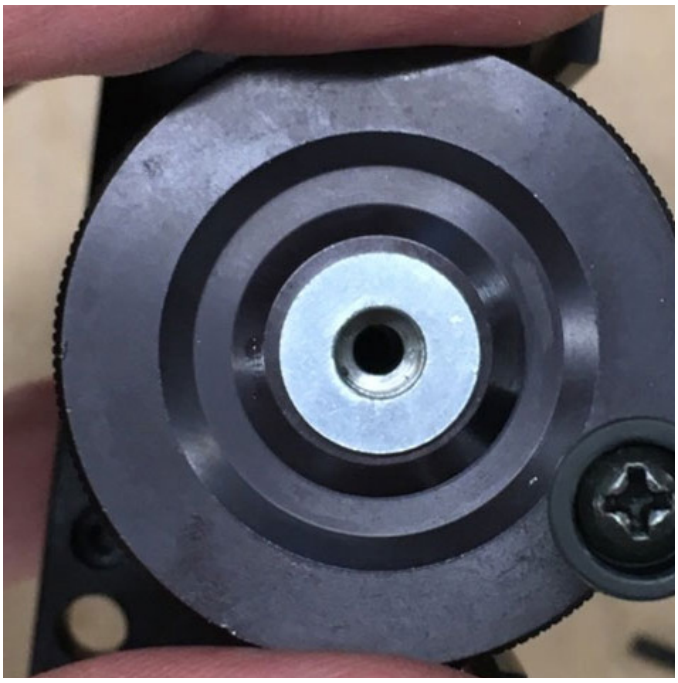


Photo 31

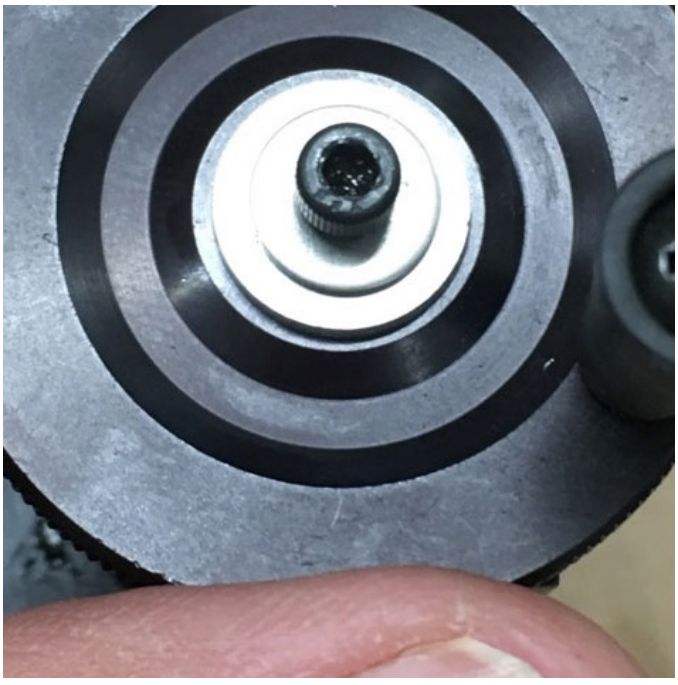


Photo 32

5. Now lightly tighten the 5-40 set screw while keeping the washers centered
6. Now break the handwheel set screw loose.
7. Now tighten the 5-40 screw to pinch the screw adapter collar and the handwheel together to remove the backlash.
8. Now tighten the handwheel set screw (See Photo 33).

Photo 33

9. Now remove the 5-40 screw and the washers.
10. Replace the 5-40 screw and tighten the screw adapter back onto the lead screw (See Photo 34).

Photo 34

NOTE: You must hold the crosslide in place when the 5-40 screw is being threaded into the lead screw, or the lead screw will turn with the 5-40 screw. Once the 5-40 screw is snug, then hold onto the handwheel and tighten the 5-40 screw down hard.

11. Turn the handwheel several full revolutions. There

shouldn't be any slop. If anything the assembled fit will be too tight. Turn the handwheel enough to move the crosslide a couple inches in each direction and see if the friction between the parts frees up a bit. If it does, you're set with the least amount of backlash possible. If it is still too hard to turn, or if there is a tight spot at the same place on each revolution of the handwheel, you will need to go through the steps above and tighten the 5-40 screw a bit less with the washers in place.

Thank you,
Sherline Products Inc.