CUTTING THREADS USING THE CLOUGH42 ELECTRONIC LEADSCREW

Introduction

You might well have read my write up (per my blog) on how I implemented the Clough42 Electronic Leadscrew on my Myford Super 7 Large Bore lathe. While I have been successfully using the ELS as an automatic feed, I had put off attempting screw thread cutting. You know how it is. Screw cutting is nagging at you to try, but it is on the 'too difficult' pile pending other more interesting jobs. There is always something else to do so you kid yourself it is justified to put it off until another day. Well another 'lockdown' day dawned and I decided today was the day.

I should admit that I have never cut a thread on a lathe. It always seemed too complicated to get the right setup on the gear train. My lathe has an imperial leadscrew and I wanted to cut metric threads. Hence the investment in the ELS which seemed like a headline solution. I now faced a learning curve.

First of all, I had to learn the basic technique(s) of how to cut a thread on a lathe. I would have to decide what tool to use and then potentially proceed to destroy some metal.

I have the 'Workshop Engineers Workshop Manual' by Geo. H. Thomas and in Chapter 12 he goes into detail on screw cutting. From his text it seems there are two techniques. The first one is a plunge technique which depends on using the cross slide to incrementally feed the tool into the workpiece. The second technique leaves the cross slide fixed and feeds the top slide into the workpiece while set at an angle of half the thread angle (in practice GHT recommends feeding at a slightly less angle than this - half a degree or so).

Tooling wise I had an index tool holder that could take inserts for 55 degrees (Imperial) or 60 degrees (Metric) profiles. No tool grinding would be needed.

The complication, which is very clearly explained by the Clough42 video (#7 in the ELS series), is that if you want to cut a Metric thread on an Imperial leadscrew you need to keep the half nut engaged all the time. (The half nut is the engagement mechanics to connect the carriage to the leadscrew and make it move automatically). This is unlike an Imperial cut where you disengage the half nut after every cut, move the carriage back and then use the thread indicator to tell you when to re-engage in sync with the leadscrew. Imperial is easy on an Imperial lathe … allegedly.

If you are to keep the half nut engaged then you must be able to reverse the leadscrew feed in order to track the carriage back to the start of the thread cut while maintaining leadscrew sync.

I could see three ways of doing this.

I could use the mechanical reverser on the lathe spindle or I could use the Clough42 control panel forward/reverse button or I could use my Newton Tesla VFD speed controller forward/reverse facility. The results from these methods were surprising.

I recommend you watch James' video on his testing of metric threading. There are other videos on YouTube that focus on more conventional lathe based screw cutting such as the one by Ade Swash.

Set Up

Here is a general shot of the set up. The half nut is engaged (by the lower lever) and the carriage is locked with the leadscrew. The top slide is set to just under 30 degrees. The cutting tool insert is symmetrically perpendicular to the workpiece.

1 I have a piece of 8mm brass in the chuck. I have a 60 degree insert in the tool post that is perpendicular to the workpiece. I have the cross-slide set to 29.5 degrees (ish).

2 I cut a trough at the finishing position of the thread as a run out location. I cut this to a depth of 1mm.

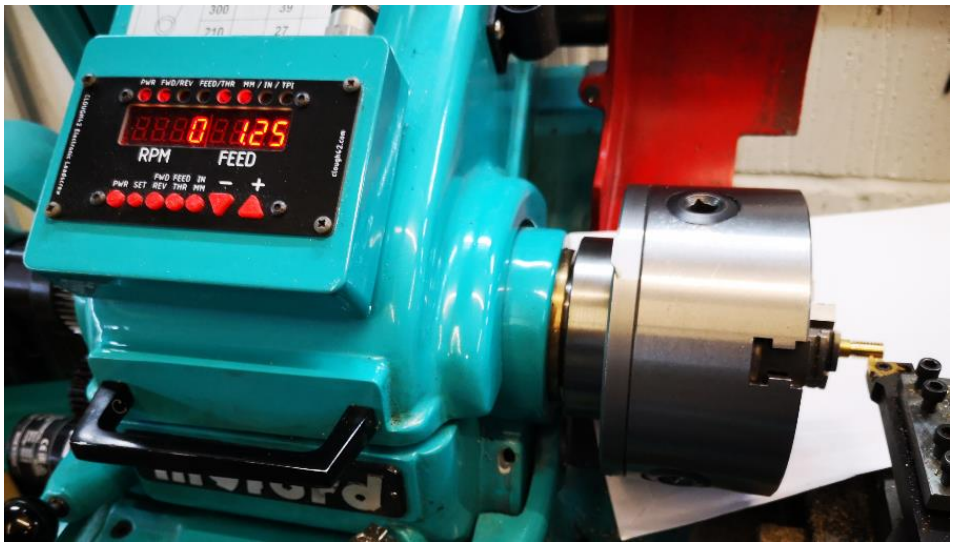
3 I paint the brass area that is to be threaded with a black Sharpie pen.

4 I set the spindle speed to a very slow value (my reaction time is not as quick as it was).

5 I set the top slide so the tool is just in contact with the workpiece and zero the Y DRO.

6 I move the tool away from the workpiece and back along the X direction clear of the workpiece.

7 I set the ELS to Forward/Metric/1.25.



8 I move the tool back to Y0 and engage the clutch on the lathe and then close the half nut.

9 The tool moves along the X plane and engages with the workpiece to leave a fine line in the Sharpie ink.

10 As the tool enters the trough at the end of the cut, reaction time willing, I disengage the clutch but leave the half nut engaged.

11 I measure the thread spacing witness mark scribed in the Sharpie ink and check it against a M8 thread.

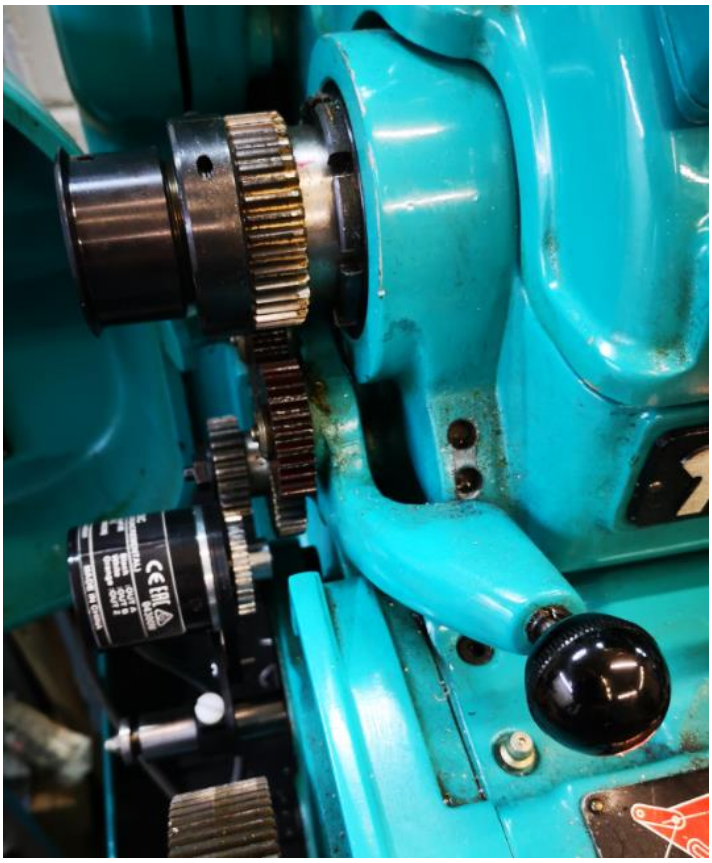
12 I back off the tool in Y to clear the workpiece.

13 I now have three options to reverse the X axis.

I can either mechanically reverse the chuck feed or reverse the ELS or reverse the speed controller. I try each method in turn while keeping the half nut engaged. After reversing the tool back to the start of the thread, I reverse the direction ready for a new pass and engage the clutch to give forward motion. I watch where the tool marks Sharpie painting on the workpiece.

The lathe mechanical reverser and the ELS create a separated, out of sync, cut line in the Sharpie ink. The speed controller-based reverse accurately over cuts the original witness mark line.

Thinking about this, the lathe reverser is where I have chosen to drive the ELS encoder. (See image overleaf). The reverser has two tumble gears that are toggled depending on the direction required. As these are hinged in and out, they impinge on the encoder gear and cause it to rotate a few teeth each time. This must affect the ELS tracking calculation. A better plan would be to have had a direct drive from the back of the spindle. A re-think of the coupling will be needed if I want to use this method for reversing …. but …. the engagement between forward and reverse has always never been smooth and often needs a slight rotation of the chuck to fully engage properly. I think this is always going to be fraught and I should discount it as a method. It works fine for non-sync automatic feed activity so maybe leave well alone.



The ELS reverse facility action accuracy depends on the belt coupling from the stepper to the leadscrew. On inspection my belt was a little slack and the gear on the stepper is not running perfectly true. I need to remedy these issues and retry this method.

Using the Newton Tesla speed controller stops and starts the spindle and leadscrew with no backlash and gives a perfect result delivering an accurately over scribed thread witness mark.

Cutting the Thread

Plunge Method

After the above experiments I will opted to use the Newton Tesla speed controller as my back and forth controller.

After each pass along the brass rod I increment the tool further into the workpiece in Y using the cross slide. When I get to the run-out trough, I do not touch the top slide setting and simply reverse the speed controller. The tool will now run back in the previous cut. (This will probably be frowned upon and cause groans). I repeat this process of a slightly deeper cut on each pass until I cannot see any black Sharpie ink remaining. Once this is the case, I try a M8 nut on the thread. I still leave the half nut engaged throughout this process so I can make further fine cuts until the nut runs freely on the thread.

Looking at the finished thread it appears symmetrical and of a good shape. The nut glides down it.

Top Slide Method

The theory with this method is that the top slide having been set at half the thread angle allows the tool to be incrementally engage deeper into the workpiece at an angle of 30 degrees with each pass This method only uses adjustments on the top slide. Rather than cut deeper at one position it is cutting deeper incrementally at the top slide angle into the thread valley. This reaches a point where the tool will cut into the rear of the next thread valley wall to create the full thread shape.

I could not get a satisfactory result using this method and further investigation is needed as Geo Thomas infers that this is a superior method.

Comment on Re-Syncing

While undertaking these tests I sometimes had a senior moment and disengaged the half nut when I arrived in the end of the cut trough. Panic set in. However, it is possible to reset the sync.

With the clutch disengaged and spindle stopped, engage the half-nut in any position it will allow along the workpiece threaded section. By using both the top slide and cross slide 'wiggle' the cutting tool to sit snuggly in one of the threads as cut so far. Once you have this set as best you can judge, back off the Y axis to clear the workpiece and restart the cutting process while keeping the half-nut engaged.

Conclusion

I have miraculously cut a thread on my lathe. This is my first success and I am pleased with the result.

I need to investigate the other methods of reversing the carriage with the half-nut engaged as I am sure these can be improved.

I need to investigate why the top slide cutting method is giving me such disastrous results. This could be a misunderstanding by me of the process.

Thank you, James, for the inspiration, motivation and hardware design to allow this new skill to be aquired.