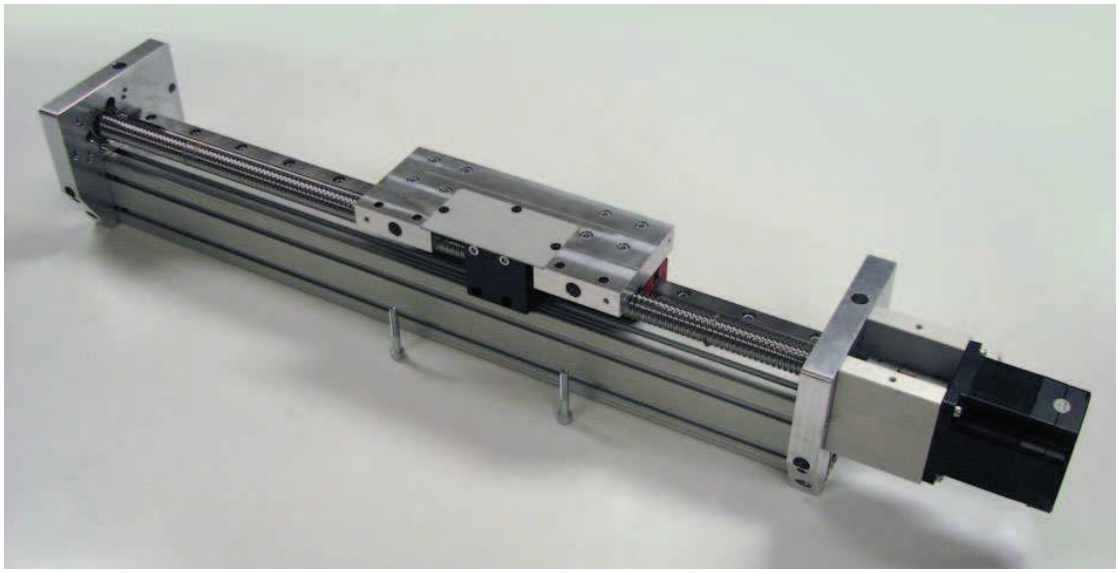
Chapter 6

Frame axis
"DCNC LSM ballscrew"



6.1 Introduction

This chapter outlines the assembly of the X axis, using a "DCNC LSM Ballscrew". Step by step it is explained which action should be performed.
This chapter consists of the following sections:

- 6.2 Considerations
- 6.3 Required tools
- 6.4 Preparations
- 6.5 Assembly
- 6.6 Frame axis checklist

6.2 Considerations

Please bear in mind that the used high precision parts and components require special care.

The most critical measures are listed below, and repeated during this chapter.

- Hiwin carriages contain multiple guidance balls. These balls will fall out when the carriage runs off the rails, leaving the Hiwin carriage unusable! Never slide Hiwin carriages off the end of the rails without the plastic tube to keep the balls in place, and never remove the plastic tube unless you intend to mount the Hiwin carriage onto a rail.
- Unless stated otherwise, do not tighten alignment sensitive parts such as rails, racks and Hiwin carriage mounts until the system is complete and ready for alignment.

6.3 Required tools

The required tools are listed below:

- Tap M8
- Allen Keys
- Open end or Ring Wrench 5 mm
- Magnetic stand, with Dial Gauge, or lever type gauge with dial indicator
- Ballbearing grease
- Loctite (medium strength for threads) or similar

6.4 Preparations

6.5 Assembly

- Tap M8 thread on both ends of the profile (8 holes in total), as indicated on the picture:

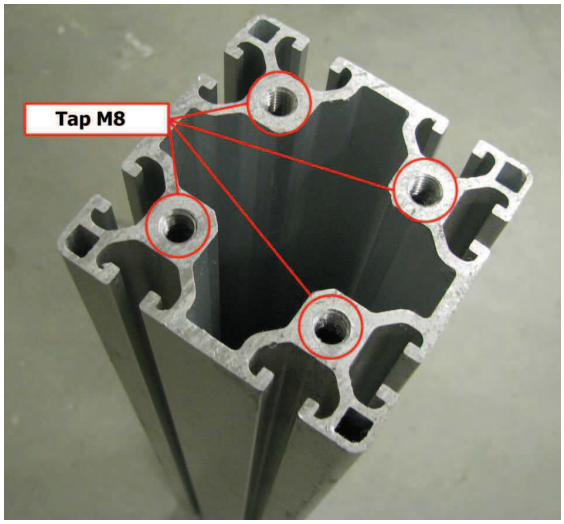


Figure 6.1:

- Clean the spindle with a soft and clean piece of cloth. An battery powered drilling machine makes this job easier, however, use it with care.
  WARNING: the edges of the spindle end can be sharp!

Figure 6.2:

- Clean the rails with a soft and clean piece of cloth.

Figure 6.3:

- Mount the M6 T nuts for the Hiwin rails in one of the slots

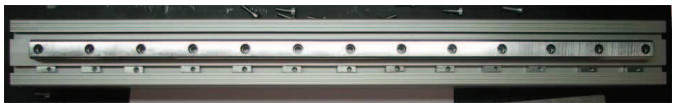


Figure 6.4:

- Place the Hiwin rail above the Tnuts. If you're building the second Frame Axis for the DCNC Router, make sure that the arrows on the rails point into the same direction.
- Fasten the supplied M4x20 bolts such that the bolthead is lower than the top of the rail, but not tightened; allowing the rail to move a little.

Figure 6.5:

- Center the rail on the profile.

- Remove an o-ring from one end of the aluminium tube. Move it down until the position as depicted:

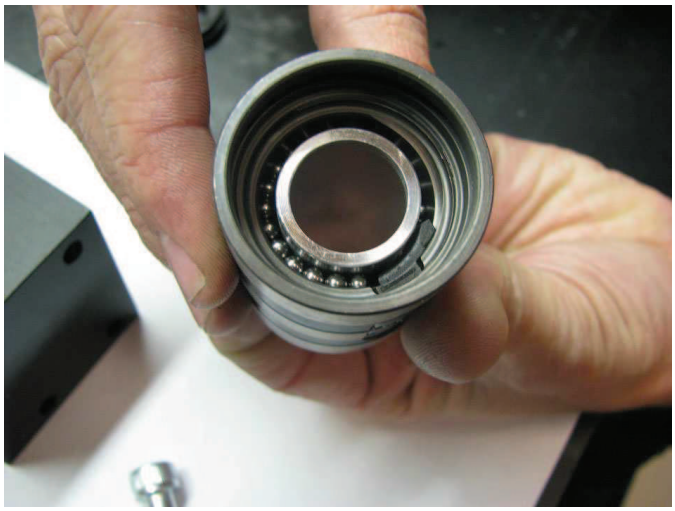


Figure 6.6:

- While holding the tube in place (important to avoid the balls from falling out!), press in a ballscrew wiper.

Figure 6.7:

- Move the tube up again and place the o-ring back onto the aluminium tube.

Figure 6.8:

- Remove an o-ring from the other end of the aluminium tube.

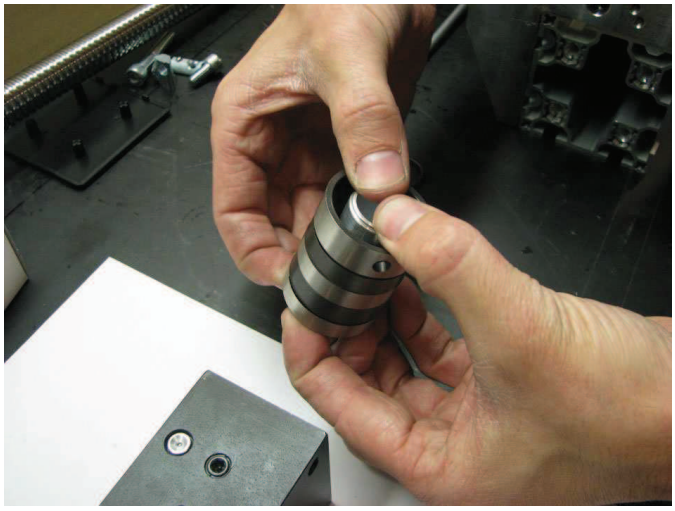


Figure 6.9:

- Move it down until the position as depicted:

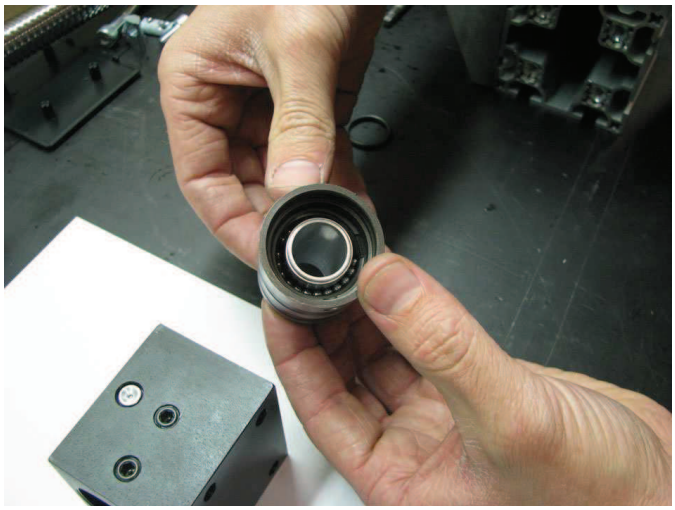


Figure 6.10:

- While holding the tube in place (important to avoid the balls from falling out!), press in a ballscrew wiper. Place the o-ring back onto the aluminium tube.

Figure 6.11:

- Remove the o-ring on the non grooved side of the aluminium tube and orient the ballnut near the threaded side of the ballscrew as depicted:

Figure 6.12:

- Place the ballnut over the threaded side of the ballscrew:

Figure 6.13:

- While holding the ballnut in place, bring the ballscrew into a vertical position. Use your thumb to rotate the ballnut onto the ballscrew while keeping the aluminium tube pressed onto the ballscrew:

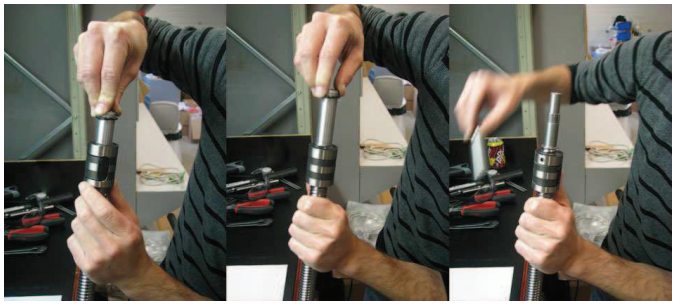


Figure 6.14:

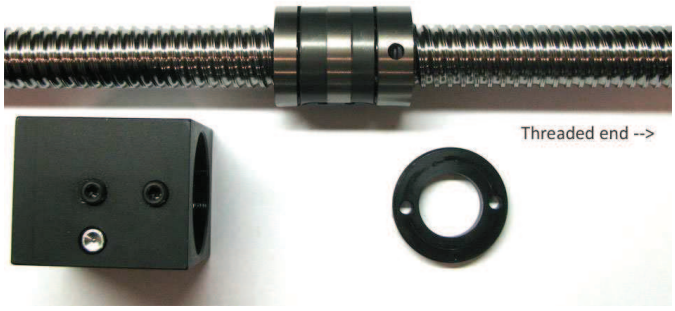


Figure 6.15:

- Put the spindle in front of you with the threaded end on the right side.

- Place the ballnut into the ballnut mounting block with the ballnut oriented, as depicted (hole aligned with the set screws):

Figure 6.16:

- Remove the set screw which is closest to the edge, and make sure the hole in the ballnut is aligned with the hole in the mounting block. Screw the set screw back in until it is just tightened, and then loosen it about 10 degrees. It is important to have it a little loose still!

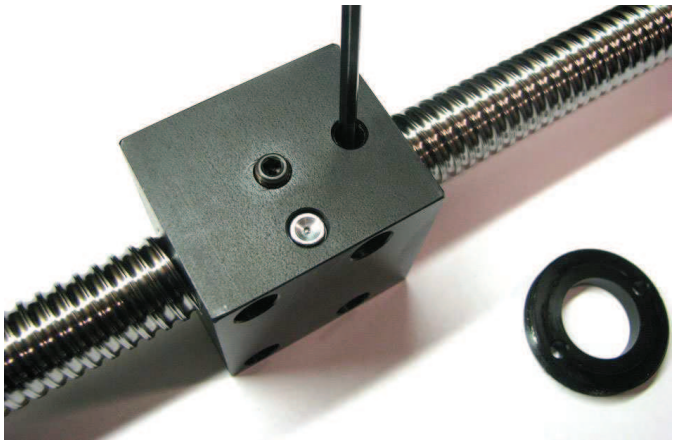


Figure 6.17:

- Screw the nut of the ballnut mounting block in by hand.

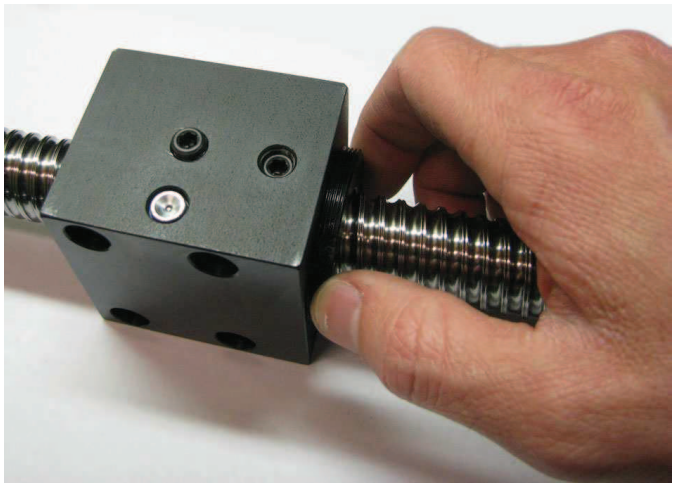


Figure 6.18:

- Tighten nut of the ballnut mounting block, using a tool like depicted:

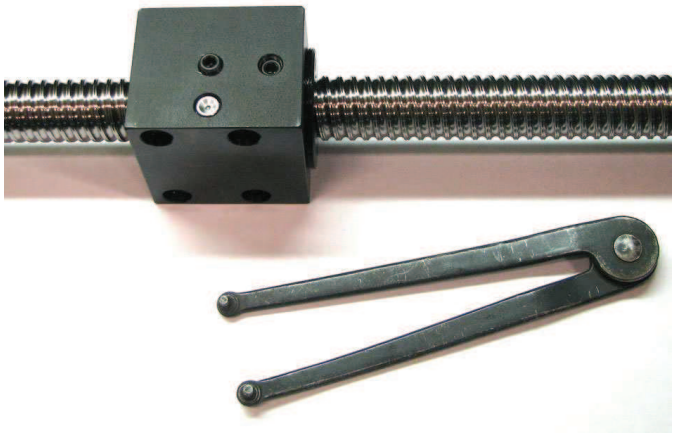


Figure 6.19:

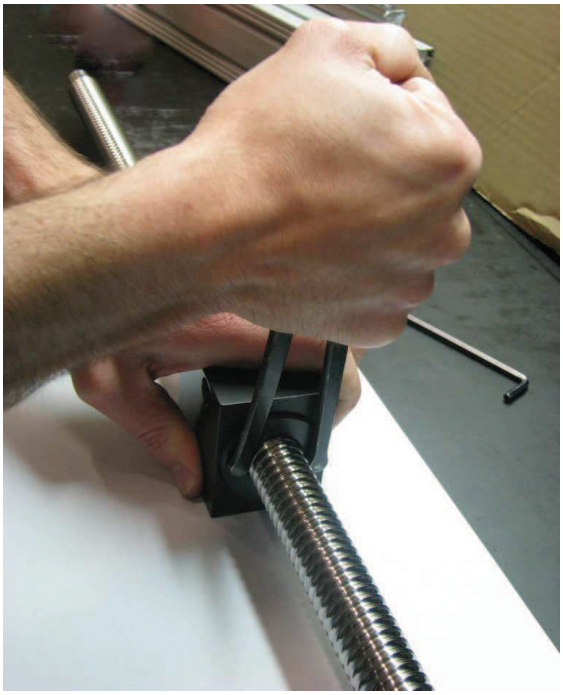


Figure 6.20:

- Tighten the set screw as depicted:

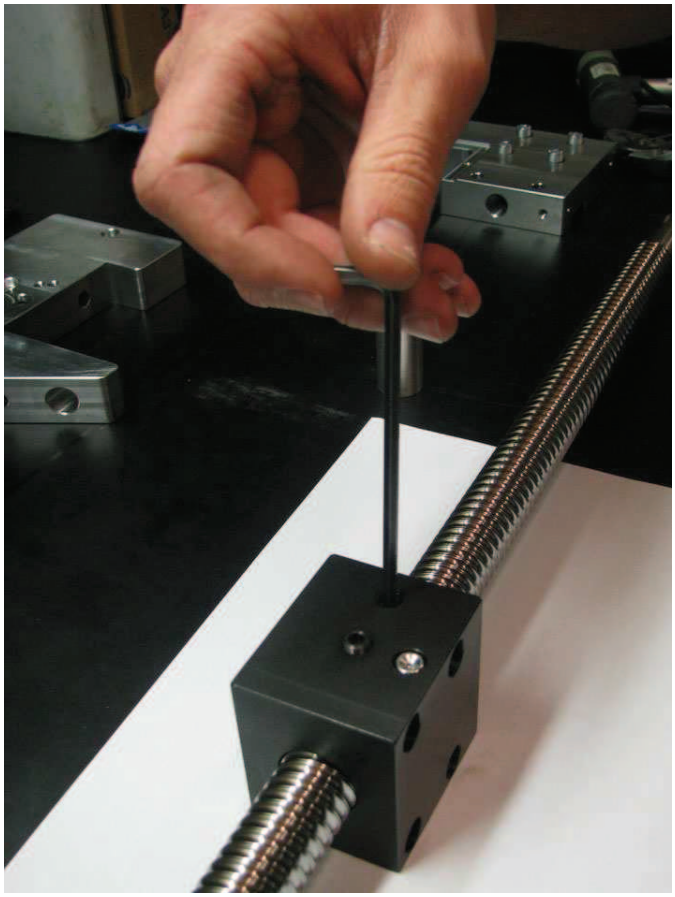


Figure 6.21:

- Adjust the other set screw to set the ballnut tension. Use one hand to feel the smoothness of the rotation of the ballscrew and the other to adjust the set screw. When the ballscrew rotates difficult, or with a 'stick-slip-effect', the ballnut tension is too high and the set screw should be loosened a bit. The ballscrew should rotate smoothly with as much tension as possible, because this will minimize the play. Overtightening will cause excessive wear.

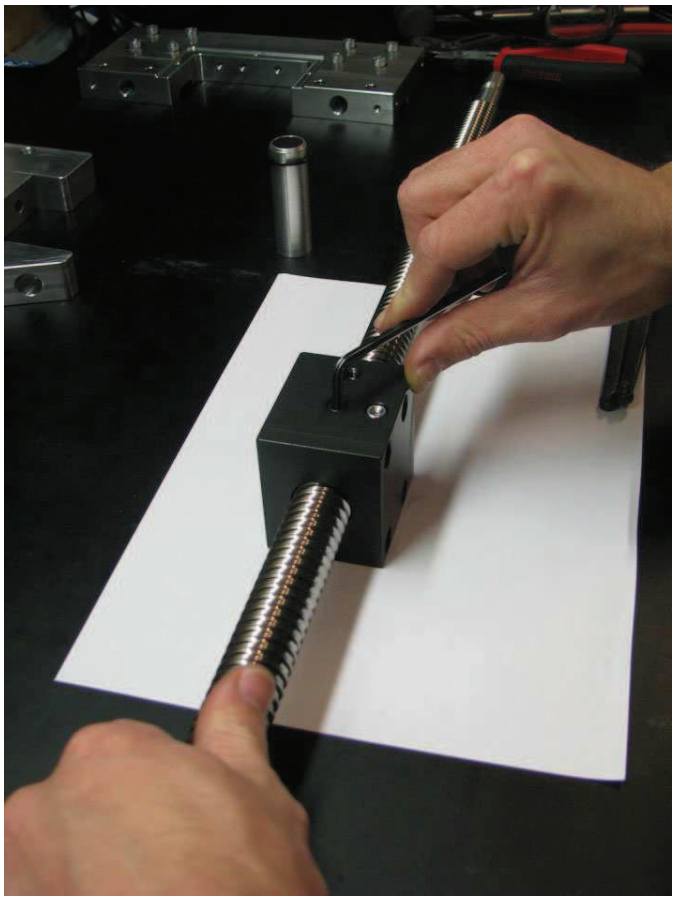


Figure 6.22:

- Loosely (tighten, then untighten 10 degrees) mount the ballnut onto the slideplate using DIN 912 M6x50.

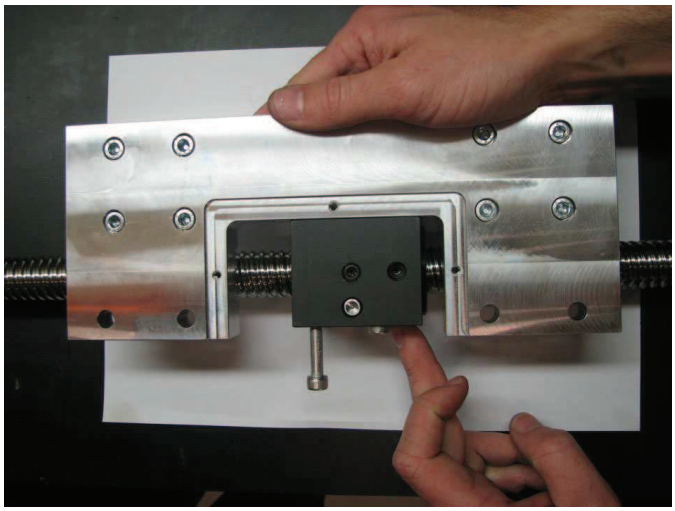


Figure 6.23:

Figure 6.24:

- Tighten 3 m5x10 bolts into two bearing blocks as depicted:

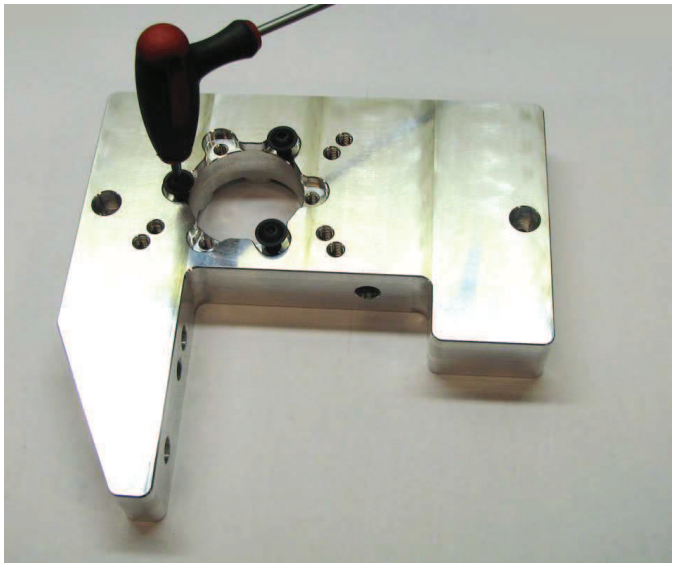


Figure 6.25:

- Press the bearing into the bearing blocks using a vice or a bearingpress.

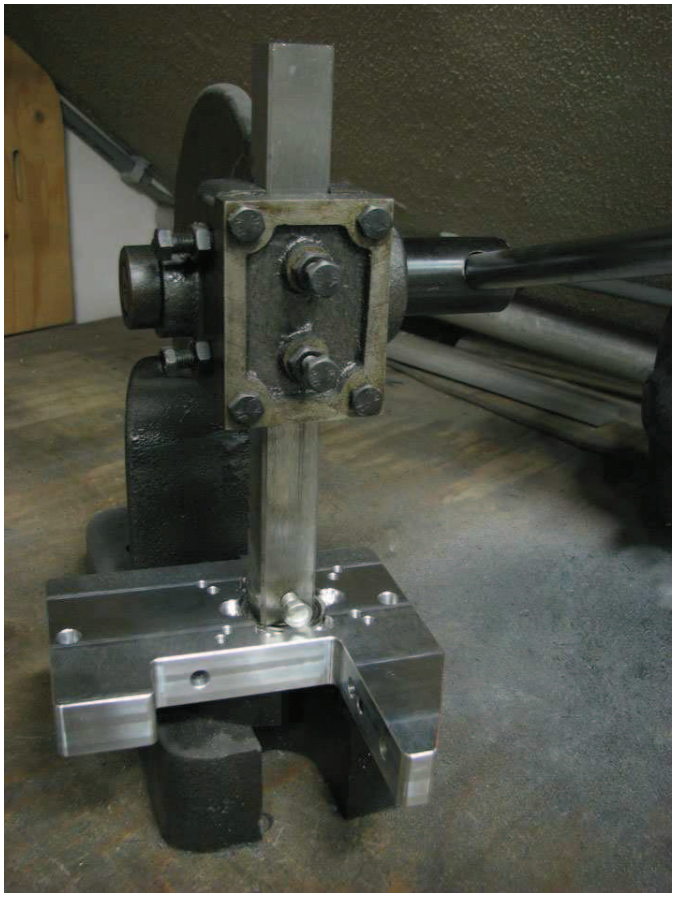


Figure 6.26:

- Tighten 3 m5x10 bolts into the other side of the bearing blocks as depicted:

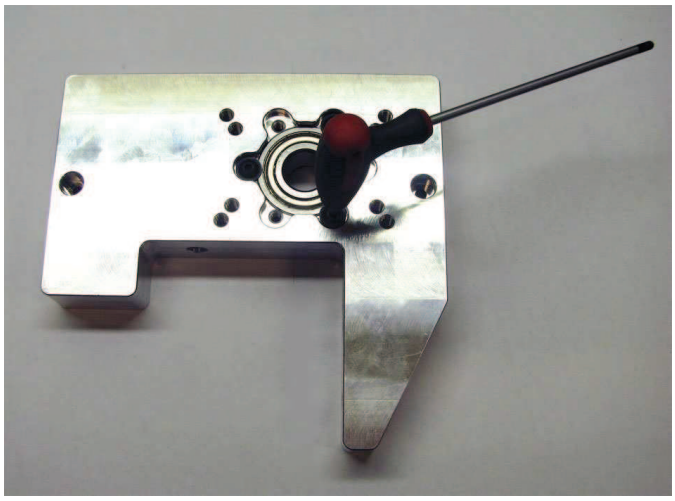


Figure 6.27:

- For mounting the two bearing blocks onto the profile we need 6 M8 Tnuts, 2 DIN 912 M8x50 bolts, 4 DIN 912 M8x16 bolts and two M8x10 setscrews:

Figure 6.28:

- Place the Tnuts into both ends of the profile as depicted (the threaded holes should be facing outward):

Figure 6.29:

- Place bearing blocks onto the profile and tighten the DIN 912 bolts:

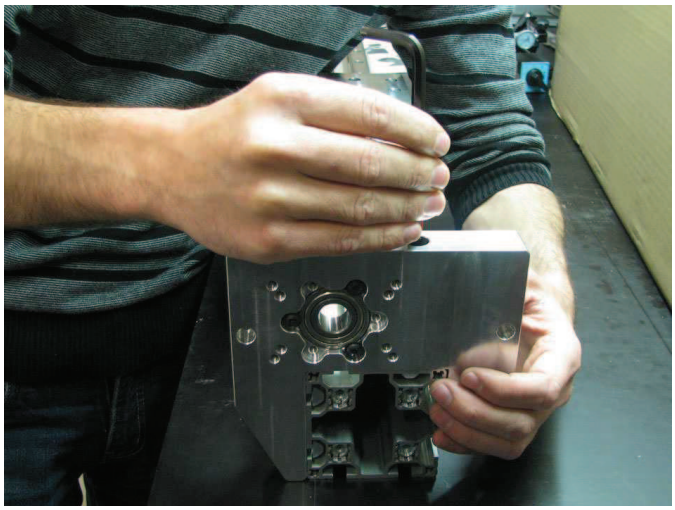


Figure 6.30:

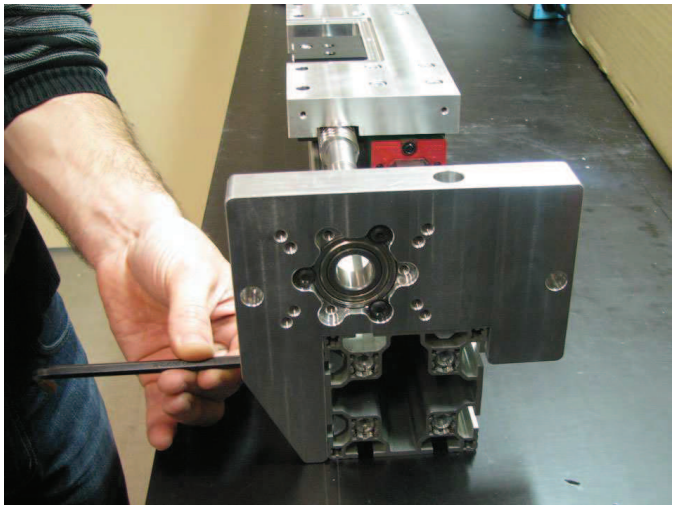


Figure 6.31:

- Place the spacer onto the threaded end of the ballscrew.

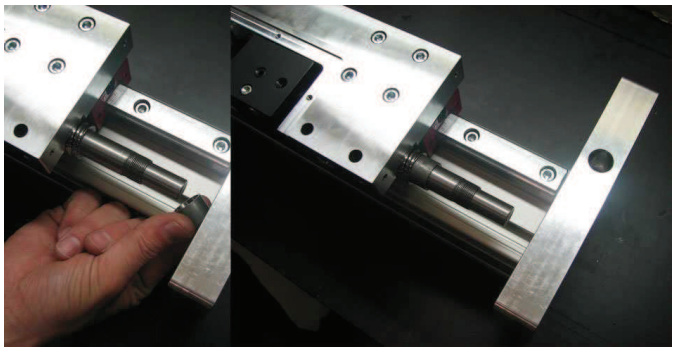


Figure 6.32:

- Slide the ballscrew into the bearing block.

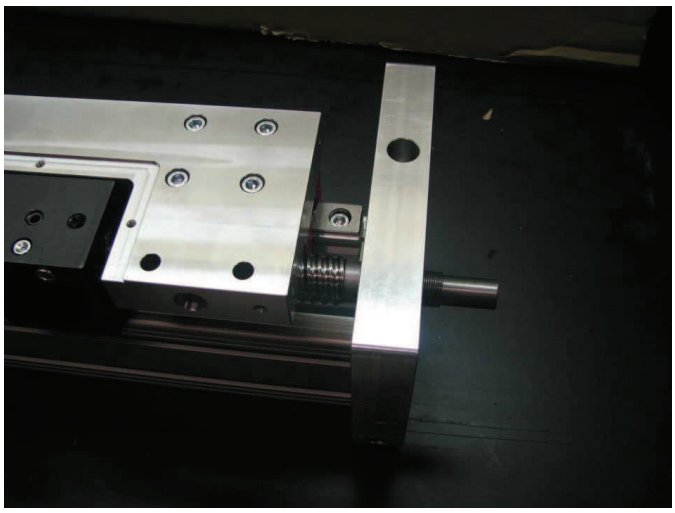


Figure 6.33:

- Loosely mount the second bearing plate onto the other profile end.

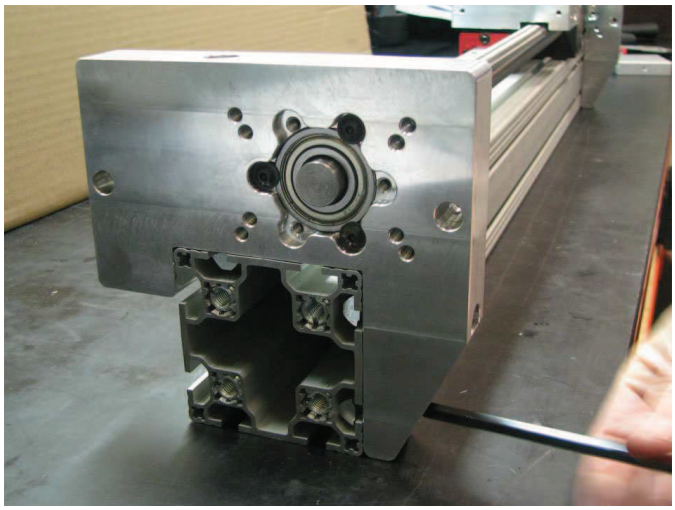


Figure 6.34:

- Place the spacer onto the threaded end of the ballscrew

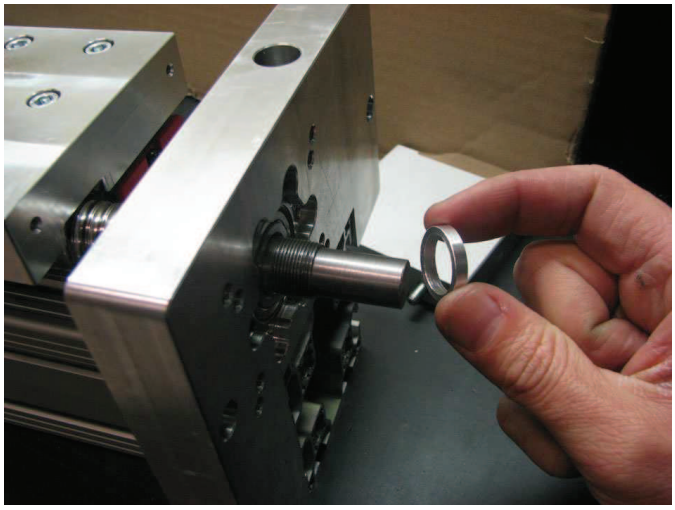


Figure 6.35:

- Screw the ballscrew locking nut (M10x0.75) onto the ballscrew by hand as far as it goes.

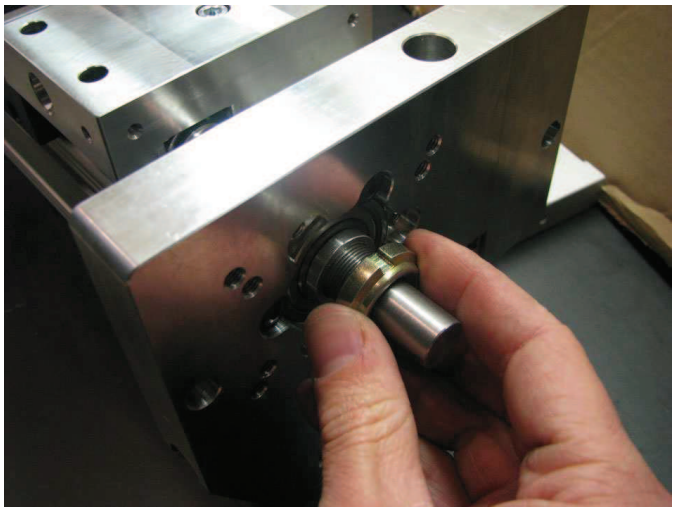


Figure 6.36:

- Check if the spindle is swinging after tightening the M10x0.75. If the spindle is swinging loosen the nut a bit to decrease pressure on the spindle. Over-tightening can cause the spindle to swing even if the spindle itself is perfectly straight
- Mount a coupler onto the ballscrew as depicted:

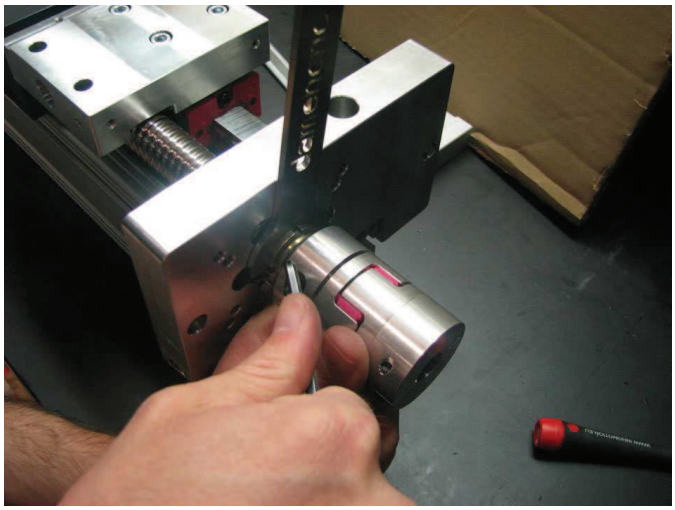


Figure 6.37:

- Use the DamenCNC key to tighten the ballscrew locking nut while holding the coupler to stop the ballscrew turning.

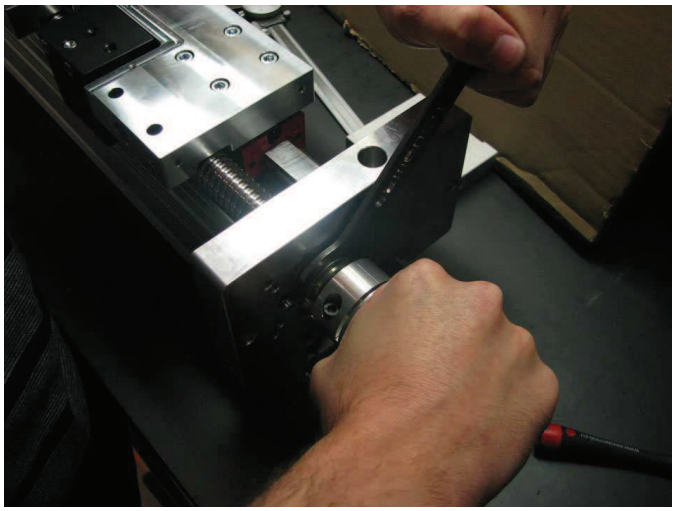


Figure 6.38:

- Move the slideplate to the end of the profile until it touches the bearingblock. While pressing the slideplate and the bearingplate together with one hand, tighten the top and the side bolts of the bearingplate.

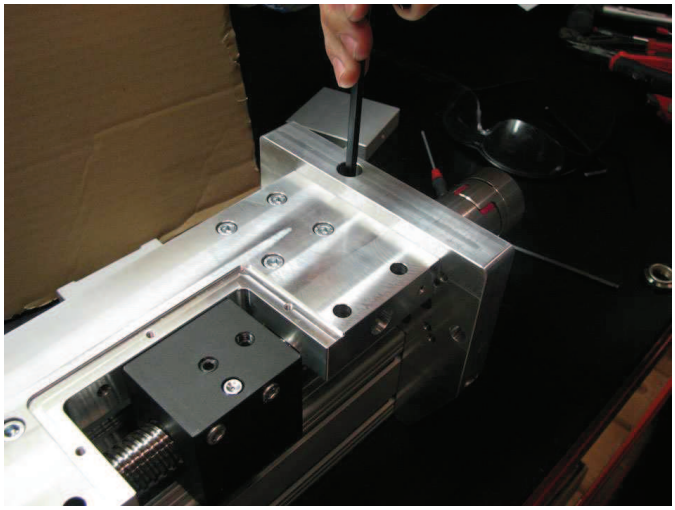


Figure 6.39:

- While still pressing the slideplate against the bearingplate, tighten the two ballscrew mounting block bolts.

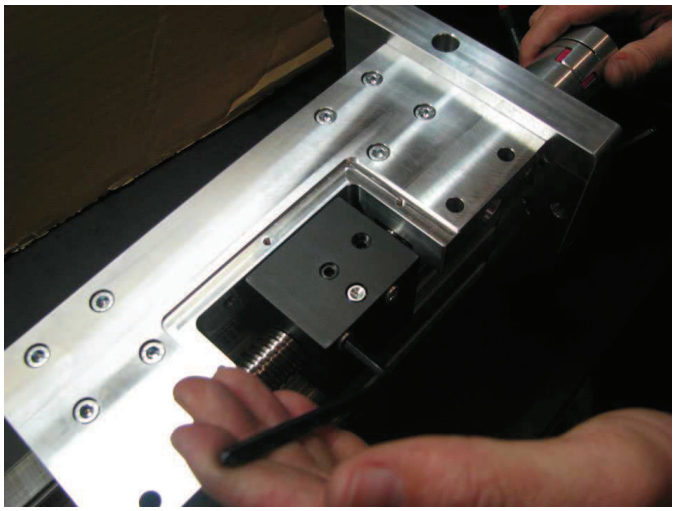


Figure 6.40:

- Move the slideplate to the other side of the profile.

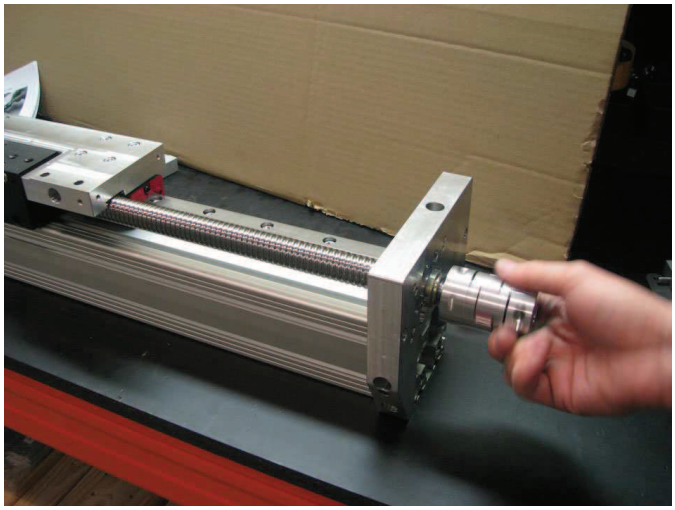


Figure 6.41:

- While pressing the slideplate and the bearingplate together with one hand, tighten the top and the side bolts of the bearingplate.

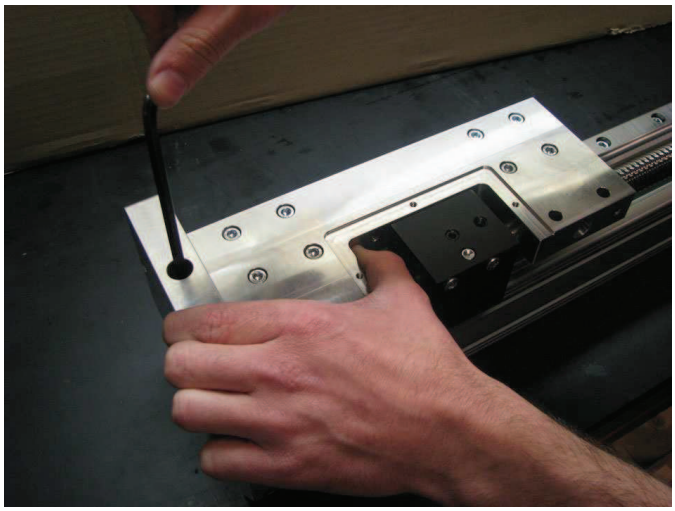


Figure 6.42:

- Place the endcaps onto one (assuming you have to still slide in universal connectors as explained in chapter 6 Joining the frame axes "DCNC LSM ballscrew" and the machine frame) side of the profile.

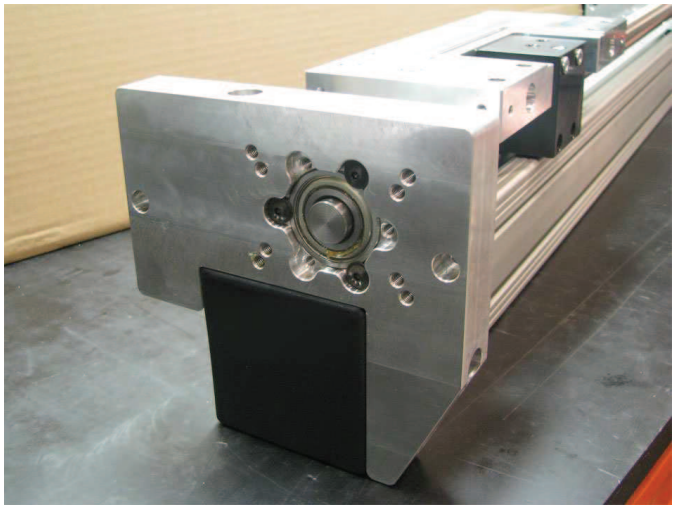


Figure 6.43:

- Put grease onto the ballscrew.

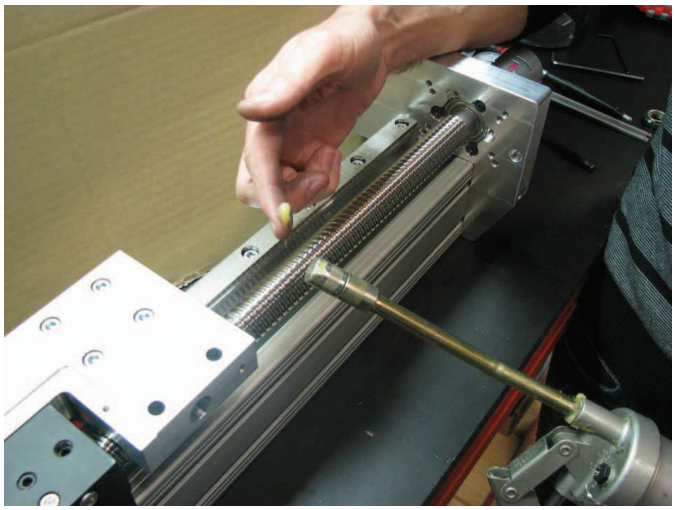


Figure 6.44:

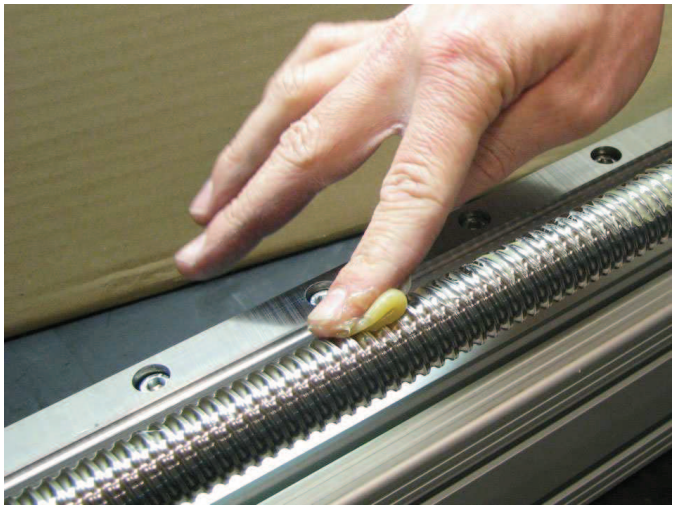


Figure 6.45:

- Move the slideplate back and forth to spread the grease evenly.

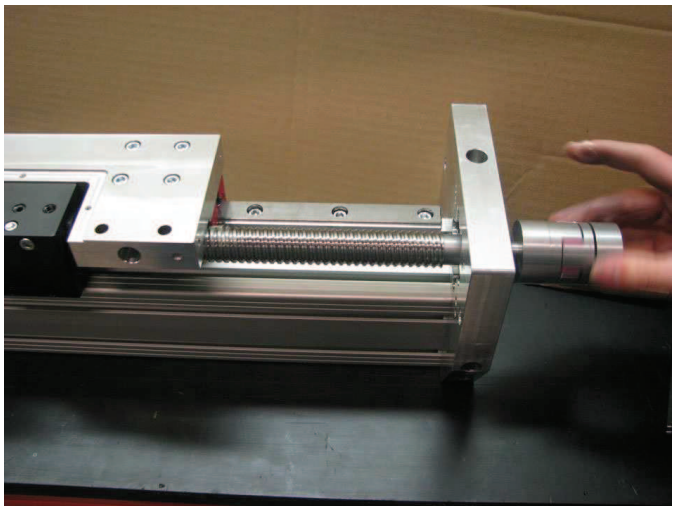


Figure 6.46:

- Repeat the process to spread grease on the ballscrew at the other side of the slideplate.

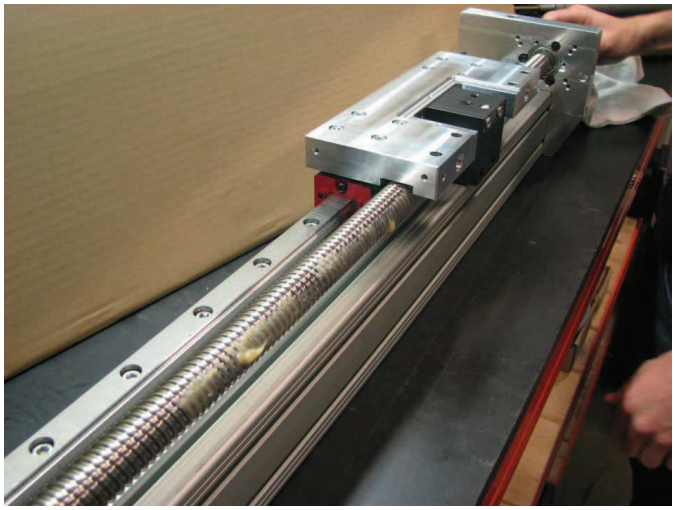


Figure 6.47:

- Use two bolts to mount one motor mount onto the bearingplate.

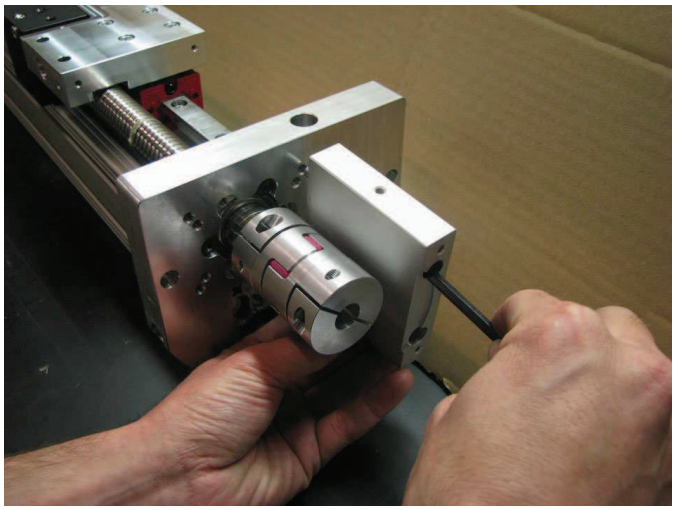


Figure 6.48:

- Loosen the coupler and move it against the ballscrew locking nut. Retighten the coupler.

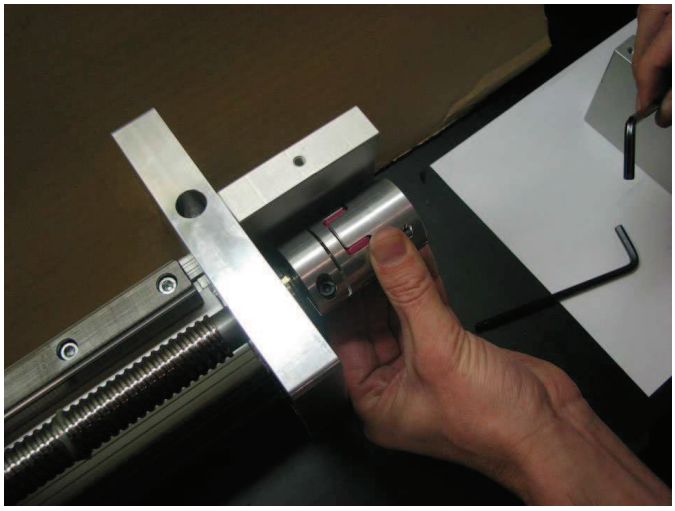


Figure 6.49:

- Use two bolts to mount the second motor mount onto the bearingplate.

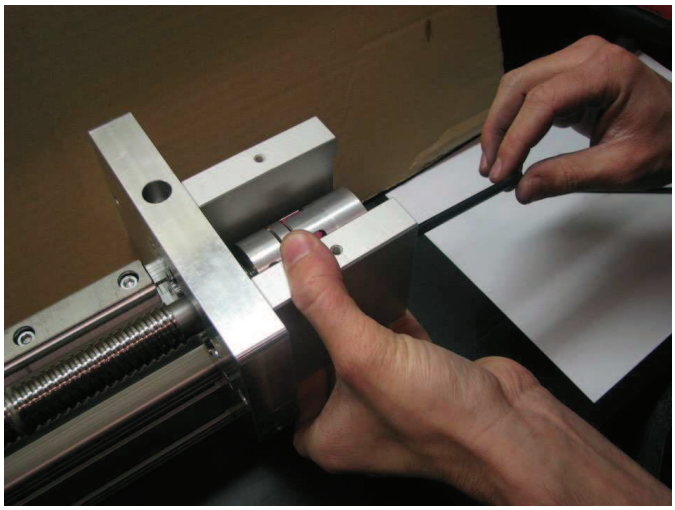


Figure 6.50:

- While holding the motor in place, tighten the coupler bolt on the motor side.

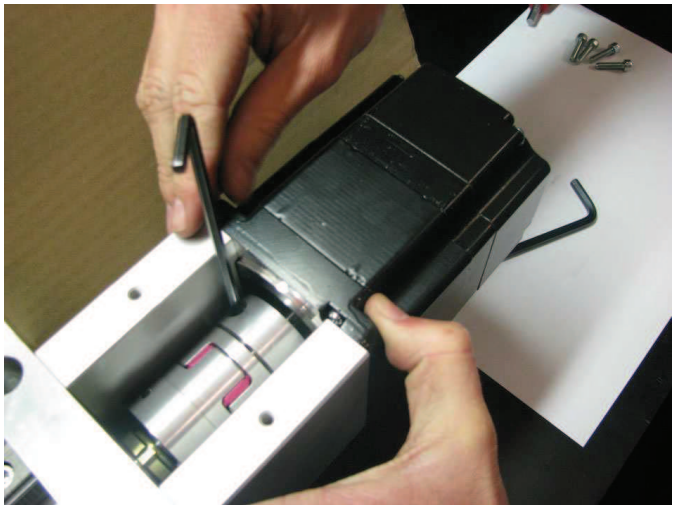


Figure 6.51:

- Tighten the 4 motor bolts.

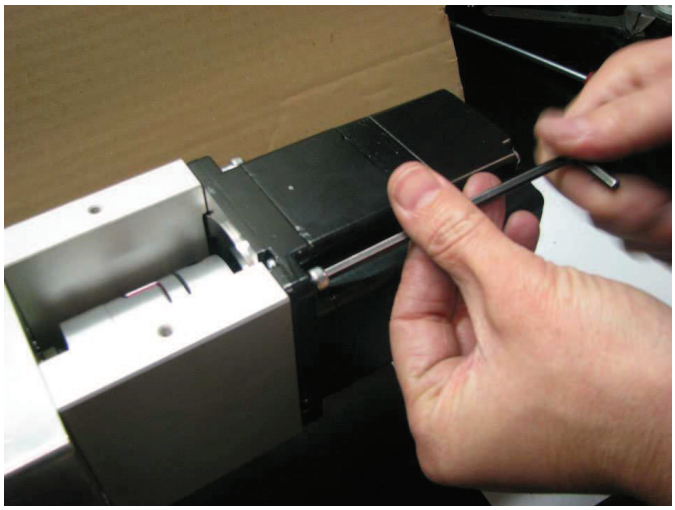


Figure 6.52:

- Place the 'SlidePlate DustcoverTOP' onto the sliding plate and fix it with 3 ISO7389 M4x10 bolts.

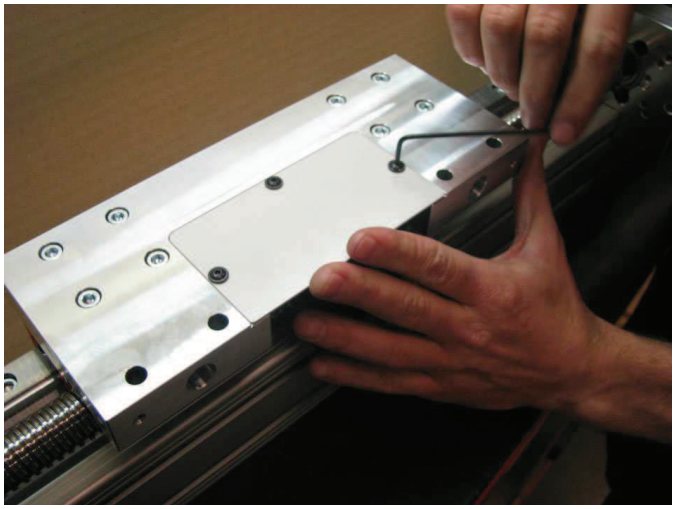


Figure 6.53:

- The DCNC LSM ballscrew axis is now finished.

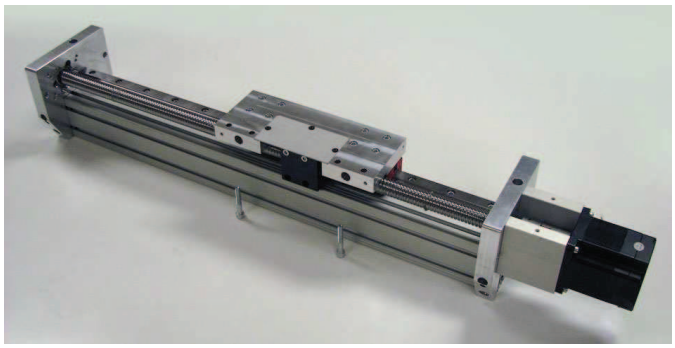


Figure 6.54: