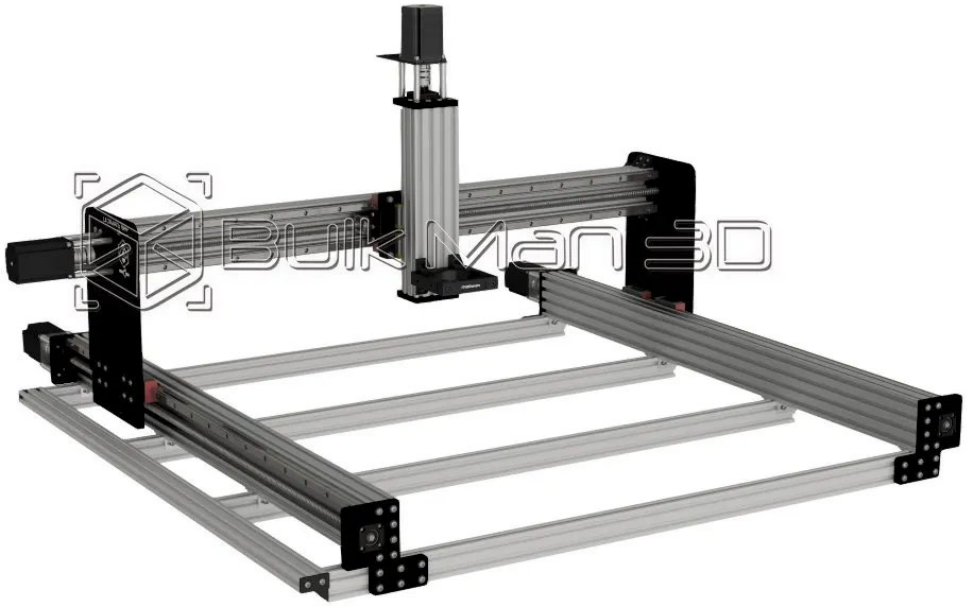
ULTIMATE Bee

Version 1.0

Mechanical Assembly Instructions



About the ULTIMATE Bee CNC Kit

After many CNC owners and members of the community approached us requesting a linear rail solution for their machine at an affordable price, our technicians worked hard researching different options available and ways we can improve on existing designs. Our technicians went back to the drawing board researching more improvements based on community input, the resulting machine is the **ULTIMATE Bee** CNC Machine.

The **ULTIMATE Bee** mainly distinguishes itself by having Ball Screws as a transmission system instead of the traditional ACME Lead Screw. The Ball Screw has high-efficiency levels, delivering more torque to the motor when compared to an ACME Lead Screw.

Please note that while we have spent a considerable amount of time and effort putting these instructions together, any errors and omissions are excepted (E&OE). If you find an error, please let us know so we can continually improve this resource for the community.

Unpack and Check All Components

Before starting any build, it is good practice to get organised. Start by unpacking all parts received and checking each part. If you find any parts missing please contact us as soon as possible.

Tools Required:

You will need the following tools:

- 3mm Allen Key
- 2.5mm Allen Key
- 2mm Allen Key
- Adjustable Wrench
- Screw Drivers
- Builder's Square
- Linear Rail Alignment Tool (Included)
- White Lithium Grease
- C-Clip Pliers
- Grease Gun

Pre-Assembly Notes

We recommend that you read through the whole assembly guide before beginning the build, as this enables you to get a rough idea of how it all goes together. Before starting each step make sure you have studied the drawing and fully understand the instructions. When attaching parts, if a part is requiring significant force to attach, stop, take it off, re-read the instructions and try again. Do not over tighten screws as you may strip the thread or head. If you have any questions regarding the build please contact us at **support@bulkman3d.com**, we are happy to help!

Assembly

The assembly instructions in this guide are for building the ULTIMATE Bee Mechanical kit.

1.0 Preparation

Before starting the assembly of any components it is important to understand the terminology used in the manual and the orientation of the machine. Refer to chapters 1.1 and 1.2 to better understand the parts used before starting.

It is recommended to clean and grease the bearing blocks. before installation. Please refer to chapter 1.3 for instructions on how to do this.

1.1 Machine Sections

When referring to the front or rear of the machine it is important to know the orientation.

The front of the machine is the end that has the Z-Axis facing it.

The rear of the machine is where the stepper motors are installed.

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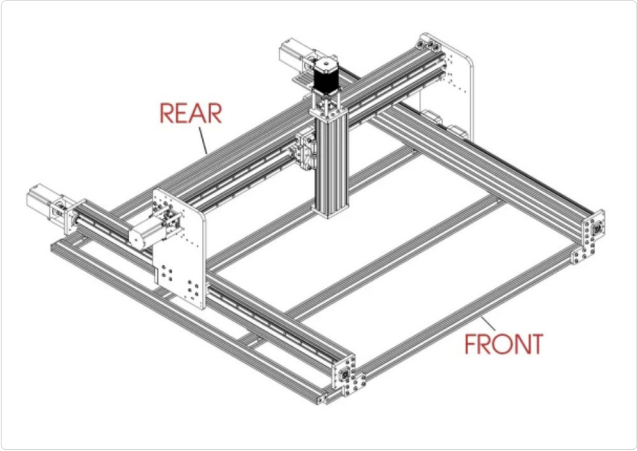

The Ball Bearing Nut is installed onto the moving gantry plate. The Ball Nut is secured to the Ball Nut Plate/Bracket.

The Fixed End of the transmission system is on the stepper motor end of the axis. This has the larger FK Bearing.

The Floating End of the transmission system is on the front of the machine. This has the corresponding FF Bearing.

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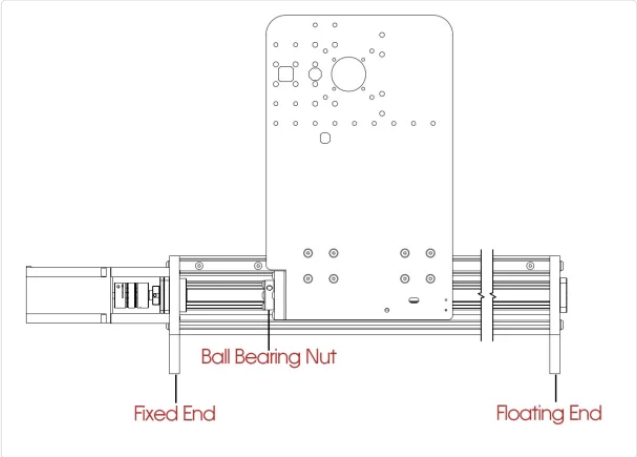

1.2 Getting To Know Some Parts

C-Beam is the aluminium extrusion that is 40mm x 80mm and when looking at it front on is in the shape of a "C".

Other profiles used are **2040** which is 20mm x 40mm and **4040** which is 40mm x 40mm.

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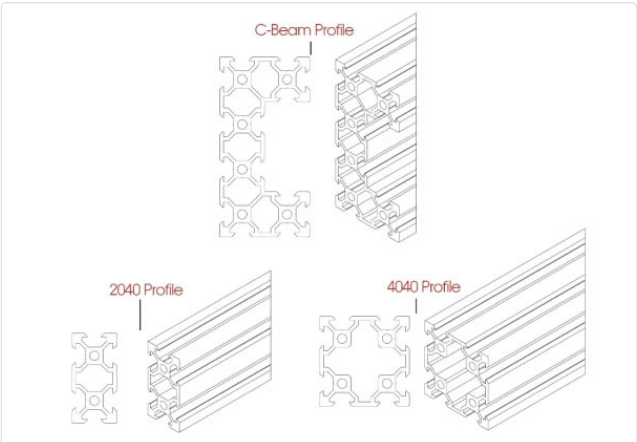

It is important to note some other aspects of the machine.

The **Diaphragm Coupler** is used to connect the ball screw to the stepper motor shaft.

The **HGH Bearing** is used on the Y-Axis and X-Axis. For machine ease of maintenance, always mount the bearings to have their grease nipples facing out.

The **MGN Bearing** is used on the Z-Axis.

There are 2 types of **Ball Nut Plate/Bracket** in the build. While the X, Y, A/2 axis uses the same **Ball Nut Plate/Bracket**, the Z-Axis uses a different design.

The **Ball Nut** should **never** be removed from the Ball Screw.

Each actuator on this build has one **FK Bearing (Fixed)** and one **FF Bearing (Floating)**.

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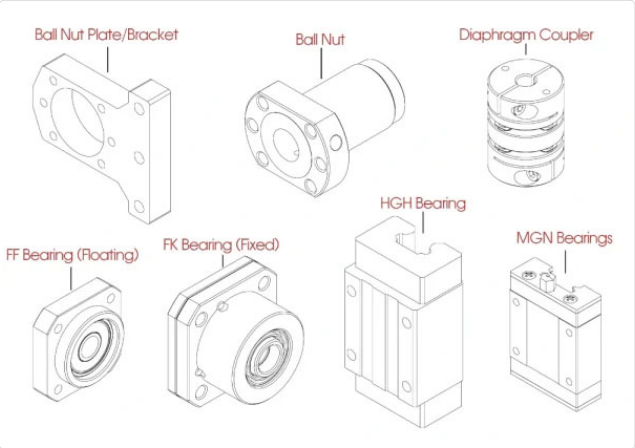

1.3 Clean And Grease Bearing Blocks

It is recommended to clean your rails and bearings before first use. The grease that the rails and bearings come with is “packaging grease” which inhibits rust and keeps the hardware in excellent condition before use. This “packaging grease” is recommended to be removed for best bearing and rail performance and can be removed by an alcohol-based cleaning agent such as methylated spirits or isopropyl alcohol.

1.3.1 Cleaning Procedure (MGN and HGR Bearing Blocks)

A. Acquire a small tub/container and fill it with the cleaning agent.

B. Add your bearing blocks and leave them to soak for about 30 minutes.

C. Occasionally run the bearing block retainer back and forth to cycle the ball bearings and ensure that the bearings are cleaned.

D. Take the bearing blocks out of the cleaning agent and leave them to dry. This may take a few hours.

E. Insert the grease nipple to one side of the bearing block.

Pro Tip: Don't let the retainer come out of the bearing block so to avoid losing the small ball bearings inside.

2.0 Y-Axis

It is recommended you read and understand all of the steps between 2.1 to 2.7 prior to starting the assembly.

T-Nuts need to be inserted into the channel of the V-Slot Extrusions for later steps and if missed will require steps to be disassembled again.

2.1 C-Beam And HGR Rail

Locate the C-Beam and HGR Rails used for your Y-Axis. If your machine size differs from X to Y, for example, if you purchased a 1000mm x 1500mm size, **the second length, which is 1500mm for this example, is the Y-Axis.**

2.1.1 HGR Rail Preparation

Item NO	Description	QTY FOR MACHINE Y-AXIS LENGTH			
		500MM	750MM	1000MM	1500MM
1	M4 x 14mm Socket Cap Head Screw	9	13	17	26
2	M4 Sliding T-Nut	9	13	17	26
3	HGR 15 Rail	1	1	1	1

A. Insert the M4 x 14mm Socket Cap Head Screw through the HGR Rail and thread the M4 Sliding T-Nut onto the end. 1/2 a turn on a Screw will suffice. We will tighten these later.

Pro Tip. Please note that the quantity of the M4 x 14mm Socket Cap Head Screw and M4 Sliding T-Nut will depend on Machine Size you have.

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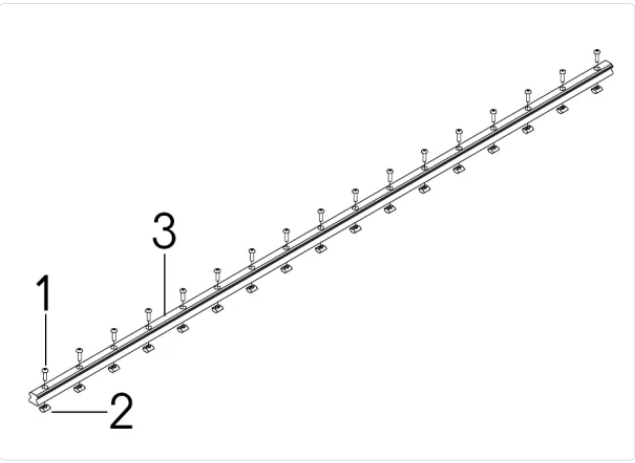


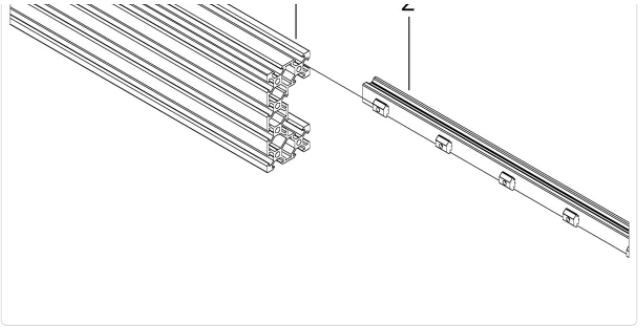
2.1.2 Attaching HGR Rail On The C-Beam

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	HGR 15 Rail	1

Click images to expand

A. Slide the HGR 15 Rail Assembly into the top channel of the “Open C” 80mm face on the C-Beam Extrusion as illustrated in the drawing.

Pro Tip: Sliding the HGR 15 Rails and M4 Sliding T-Nuts can be difficult, get another person to help you hold the rail straight while sliding the T-Nuts into the C-Beam.



2.1.3 Alignment Tool

Item NO	Description	Qty
1	Bulk Man Alignment Tool	1
2	HGR 15 Rail	1

A. Slide the Bulk Man Alignment Tool onto the HGR 15 Rail and move it closer to the end of the HGR 15 Rail. Tighten the M4 x 14mm Socket Cap Head Screw that was introduced in chapter 2.1.1.

B. Repeat the procedure by sliding the Bulk Man Alignment Tool and tightening all M4 x 14mm Socket Cap Head Screws close to it.

Pro Tip: Be careful with the amount of torque when tightening the M4 x 14mm Socket Cap Head Screws. Over tightening can strip the screw’s head or round the Allen Key tool.

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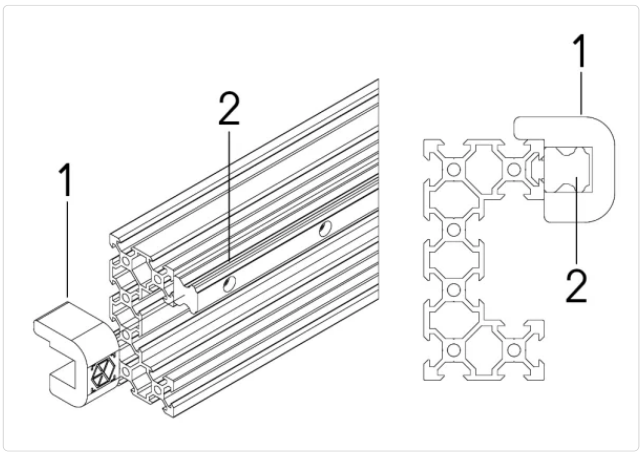

2.1.4 HGH Bearing Blocks

Item NO	Description	Qty
1	HGH 15 Bearing Blocks	2
2	HGR 15 Rail	1

A. Slide the 2x HGH 15 Bearings Blocks over the HGR 15 Rail.

B. To avoid losing any balls keep the retainer that comes with the packaging on the bearing block. When installing the bearing block onto the rail, use the rail to push the plastic retainer out of the block, this ensures the steel balls are under tension and have contact with a rail at all times.

Pro Tip: Although the drawing does not depict this, it is best practice to have the grease nipple facing outwards to allow easier access during maintenance.

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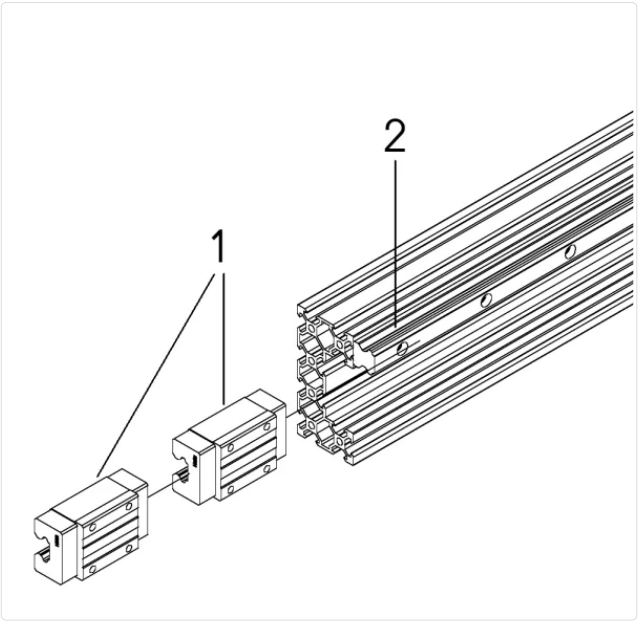


2.1.5 Inserting T-Nuts

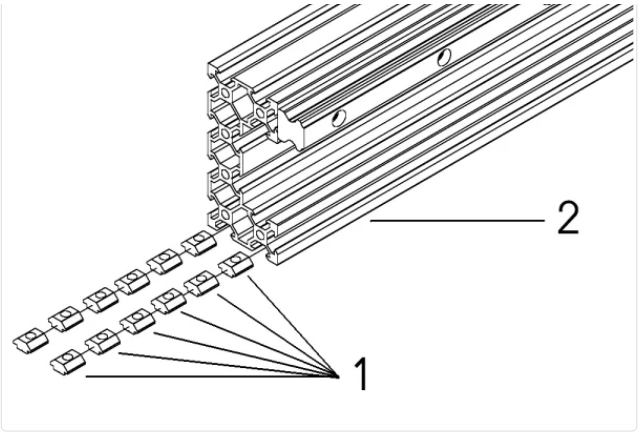
Item NO	Description	QTY FOR MACHINE Y-AXIS LENGTH			
		500MM	750MM	1000MM	1500MM
1	M5 Sliding T-Nut	12	12	12	20
2	C-Beam Extrusion	1	1	1	1

A. Slide M5 Sliding T-Nuts into the two lower channels on the 40mm face of C-Beam Extrusion as illustrated.

Pro Tip: Please note that the quantity of M5 Sliding T-Nuts will depend on Machine Size you have as

Click images to expand

shown in the table above.



2.2 Y-Plate

2.2.1 Y-Plate And Bearing Block

Item NO	Description	Qty
1	HGH 15 Bearing Blocks	2
2	Precision Shim M4	16
3	M4 x 16mm Button Head Screw	16
4	Y-Plate Left	1

A. Insert the M4x 16mm Button Head Screws through the Precision Shim M4 and Y-Plate Left and screw it on the HGR Bearings as per the image.

B. When securing the screws onto each bearing, start with the screw on the top left, tighten this screw by 1 turn. Then secure the screw on the bottom right, tighten this screw by 1 turn. Then secure the screw on the top right, tighten this screw by 1 turn. Then secure the screw on the bottom left, tighten this secure by 1 turn. Continue with this pattern securing all of the screws completely.

Note: The Precision Shim M4 is between the screw head and the plate.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 1/8th of a turn this will avoid overtightening.

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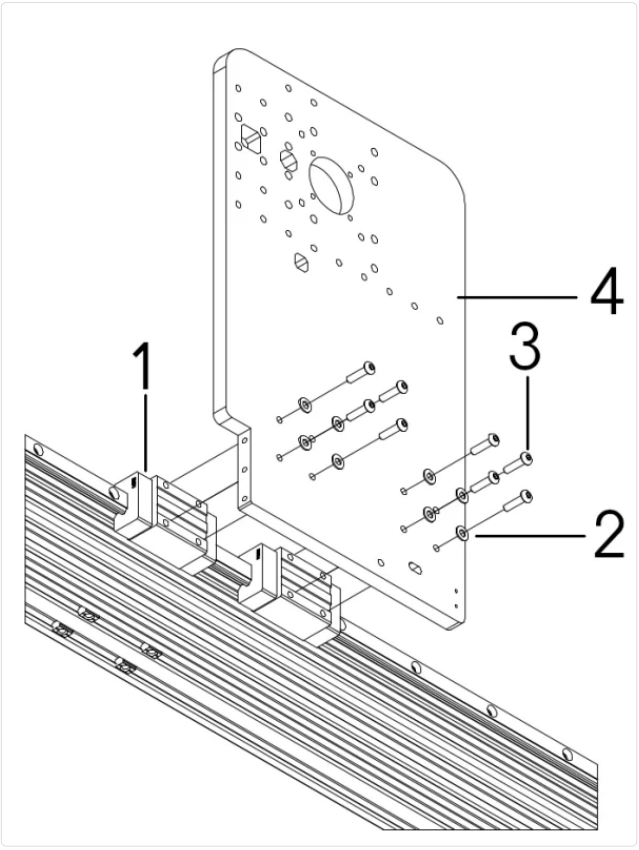

2.3 Ball Screw

2.3.1 Ball Nut And Ball Nut Plate

Item NO	Description	Qty
1	M4 x 20mm Button Head Screw	6
2	Ball Nut	1
3	Ball Nut Plate/Bracket	1
4	Ball Screw 1210	1

A. Insert the Ball Nut Plate/Bracket on the Ball Screw 1210.

B. By using 6x M4 x 20mm Button Head Screws, attach the Ball Nut Plate/Bracket on the Ball Nut.

Pro Tip: Under no circumstances should you remove the Ball Nut from the Ball Screw. The Ball Nut Ball Bearing mechanism is held only by the Ball Screw. Separating the Ball Nut from the Ball Screw will disassemble the Ball Nut and void the warranty of this part.

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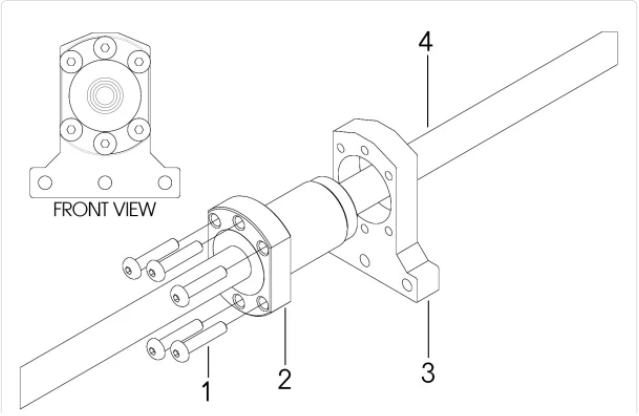

2.3.2 Ball Nut Plate And Y-Plate

Item NO	Description	Qty
1	M4 x 20mm Button Head Screw	3
2	Ball Nut Plate/Bracket	1
3	Gasket 50x10mm	1
4	Y-Plate Left	1

A. By using 3x M4x 20mm Button Head Screw, tighten the Ball Nut Plate/Bracket on the Y-Plate Left. Include the Gasket 50x10mm between the Ball Nut Plate/Bracket and Y-Plate Left. Secure the screws completely and then unscrew them by 2 turns.

Pro Tip: Do not leave the M4x 20mm Button Head Screws tightened completely. The final tightening will be done on the Tightening Chapter.

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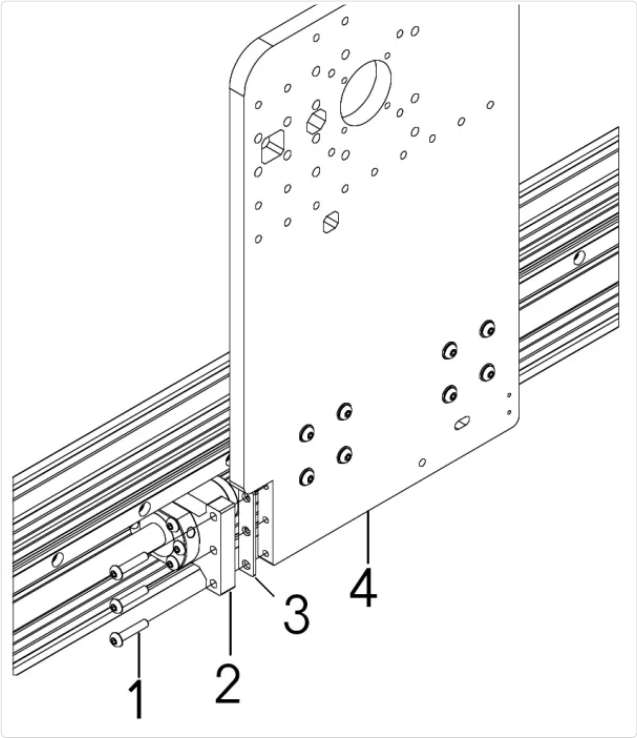

2.4 End Plates

2.4.1 End Plate (Fixed End)

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	M5 x 20mm Button Head Screw	6
3	Y End Plate – Fixed End	1
4	Precision Shim 10x5x1	6
5	Ball Screw 1210	1

A. Insert 6x M5 x 20mm Button Head Screws through the Precision Shim 10x5x1.

B. Secure the Y End Plate – Fixed End to the C-Beam using the screws.

Pro Tip: Align the C-Beam against the Y End Plate – Fixed End face. This will help your actuator system to have fewer parts that need to be aligned in Chapter 2.6.

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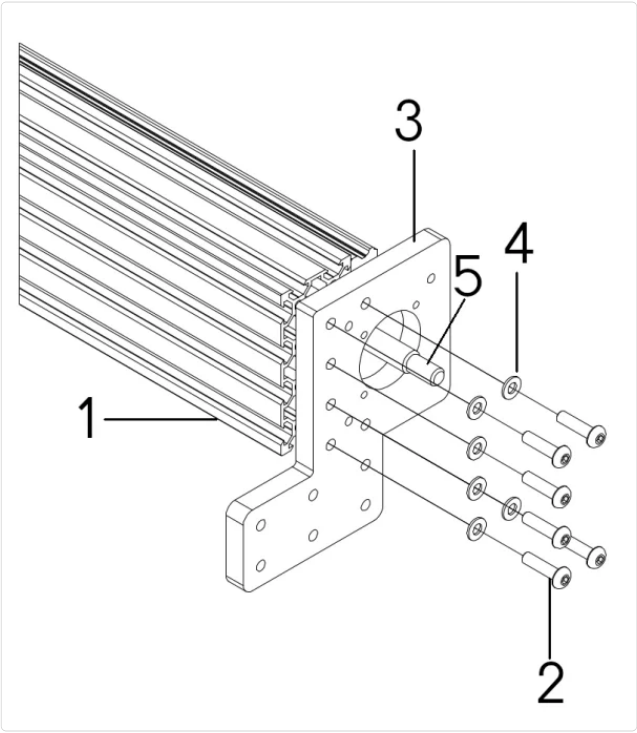


2.4.2 End Plate (Floating End)

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	Y End Plate – Floating End	1

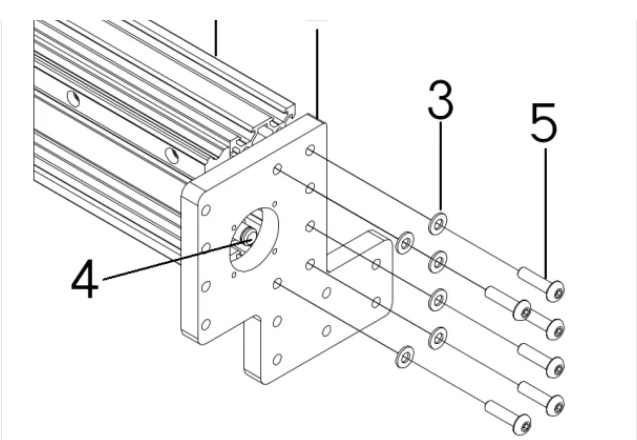
Click images to expand

3	Precision Shim 10x5x1	6
4	Ball Screw 1210	1
5	M5 x 20mm Button Head Screw	6

A. Insert 6x M5 x 20mm Button Head Screws through the Precision Shim 10x5x1.

B. Secure the Y End Plate – Floating End to the C-Beam as illustrated.

Pro Tip: Align the C-Beam against the Y End Plate – Floating End face. This will help your Actuator System to have fewer parts that need to be aligned on Chapter 2.6.



2.5 FK And FF Bearings

2.5.1 FF Bearing (Floating)

Item NO	Description	Qty
1	Y End Plate – Floating End	1
2	FF Bearing Block (Floating)	1
3	M3 x 12mm Button Head Screw	4

A. Insert the FF Bearing Block (Floating) through the Ball Screw.

B. Using 4x M3 x 12mm Button Head Screws, secure the FF Bearing Block (Floating) on the Y End Plate – Floating End.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 2 turns. This part will be fully tightened in chapter 2.7.

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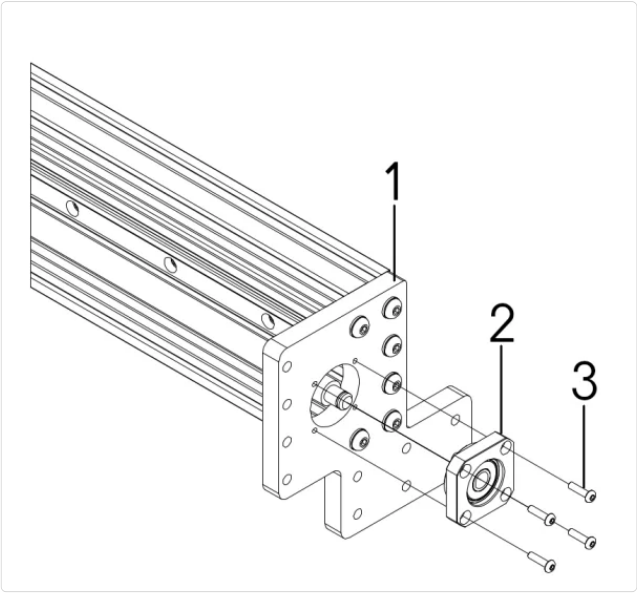

2.5.2 FK Bearing (Fixed)

Item NO	Description	Qty
1	Y End Plate – Fixed End	1
2	FK Bearing Block (Fixed)	1
3	M4 x 16mm Button Head Screw	4

A. Insert the FK Bearing Block (Fixed) through the Ball Screw.

B. Using 4x M4 x 16mm Button Head Screws, secure the FK Bearing Block (Fixed) on the Y End Plate – Fixed End.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 2 turns. This part will be fully tightened in chapter 2.7.

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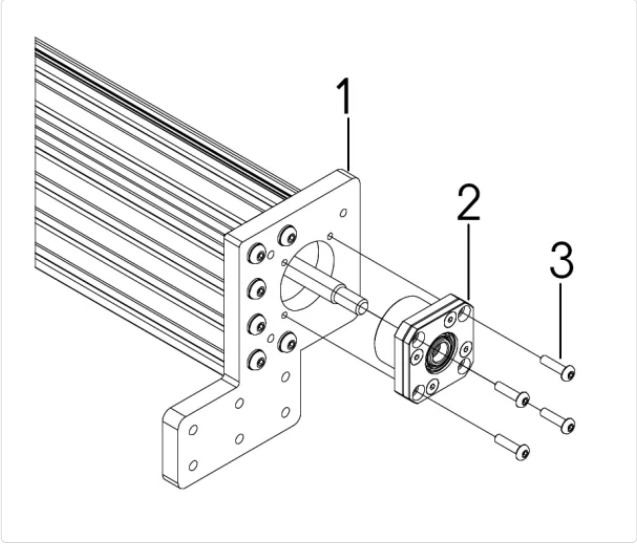

2.5.3 Lock Nut And Diaphragm Coupler

Item NO	Description	Qty

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1	FK Bearing Block (Fixed)	1
2	FK Lock Nut	1

A. By Hand, Screw the FK Lock Nut onto the Ball Screw's end which is located on Fixed End.

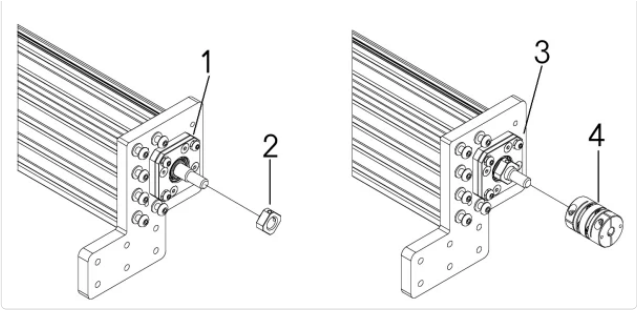
B. Tighten the Grub Screw located on the FK Lock Nut to secure the FK Lock Nut in place.

Item NO	Description	Qty
3	FK Bearing Block (Fixed)	1
4	Diaphragm Coupler	1

A. On the Ball Screw Fixed End, Insert the Diaphragm Coupler.

B. Tighten the Grub Screw located on the Diaphram Coupler to secure it on the Ball Screw.

Pro Tip: Grub Screws are very sensitive to the amount of torque when tightening. Avoid overtightening them as you may strip the screw's head or round the Allen Key tool.



2.6 Alignments

2.6.1 Tightening Ball Nut Plate

Item NO	Description	Qty
1	Ball Nut Plate/Bracket	1

A. Tighten the Screws on the Ball Nut Plate/Bracket as demonstrated in the illustration.

Pro Tip: Avoid overtightening. As the Gasket has minimum flexibility to fix misalignments on the system. Tightening it too much means that your system is less flexible to adjust to any misalignment.

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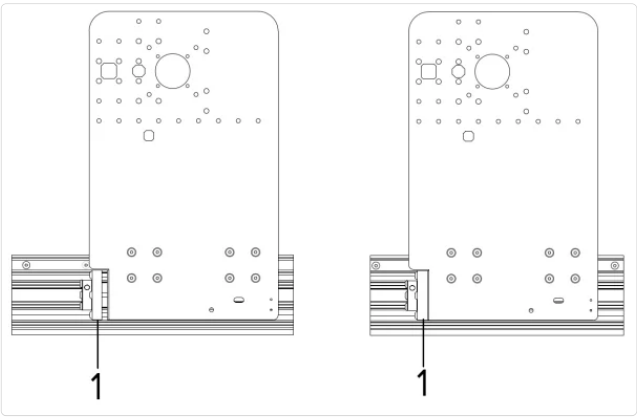

2.6.2 Fixed End

Item NO	Description	Qty
1	M4 x 16mm Button Head Screw	4

A. Move the Y-Plate Left towards the Fixed end of the Actuator as per image aside.

B. As the Y-Plate Left rests on the closest it can be from the Y-End Plate, secure the FK Bearing (Fixed) by tightening the 4x M4x 16mm Button Head Screws.

Pro Tip: The Closer the Y-Plate Left is from the Y End Plate – Fixed End, the better align your FK Bearing (Fixed) will be.

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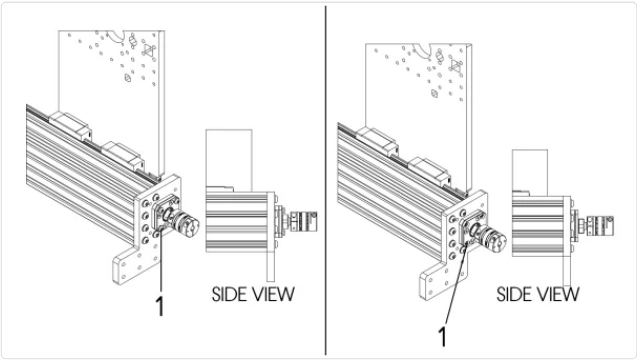

2.6.3 Stepper Motor

Item NO	Description	Qty
1	Y End Plate – Fixed End	1
2	Precision Spacer – 60mm	4
3	Stepper Motor	1
4	M5 x 75mm Cap Head Screw	4

A. First insert the M5 x 75mm Cap Head Screws through the Stepper Motor mounting holes and also through the Precision Spacer – 60mm, then secure them on the Y End Plate – Fixed End after aligning the motor shaft inside of the Diaphragm Coupler.

Pro Tip: Do not tighten the Grub Screw located on Diaphragm Coupler just yet.

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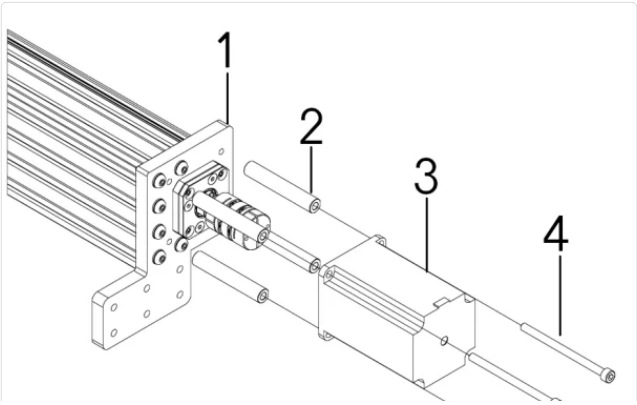

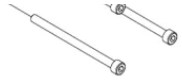

2.6.4 Floating End

Item NO	Description	Qty
1	M3 x 12mm Button Head Screw	4

A. Move the Y-Plate Left towards the Floating end of the Actuator as illustrated.

B. As the Y-Plate Left rests on the closest it can be from the Y End Plate, secure the FF Bearing (Floating) by tightening all M3x 12mm Button Head Screws.

Pro Tip: The Closer the Y-Plate Left is from the Y End Plate – Floating End, the better align your FF Bearing (Floating) will be.

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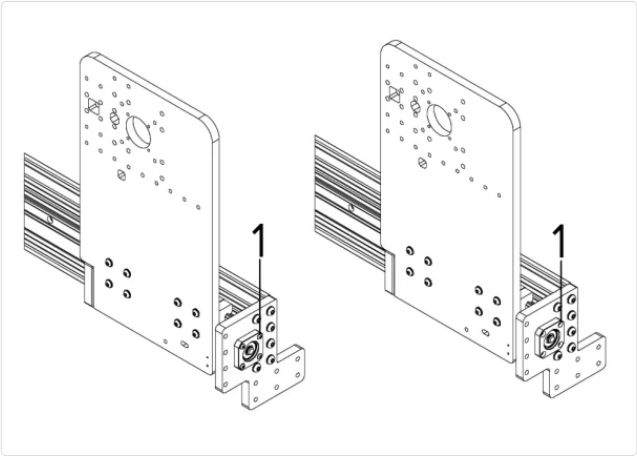
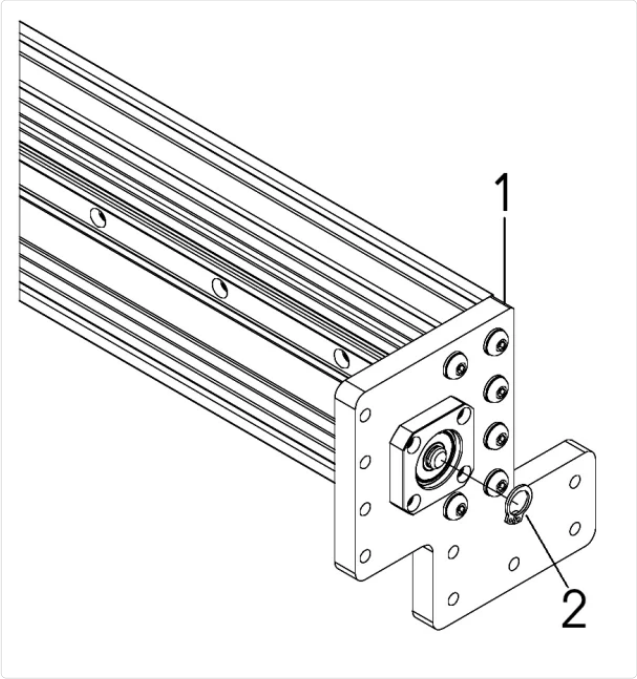


2.6.5 Clips

Item NO	Description	Qty
1	Y End Plate – Fixed End	1
2	Clips	1

A. By using C-Clip Pliers, insert the Clips on the Ball Screw Floating End as illustrated.

Click images to expand



2.7 Axis Complete

2.7.1 Completed Y-Axis

A. Repeat this chapter to assemble the other Y-Axis actuator. You should have two actuators that are a 'mirror' of each other.

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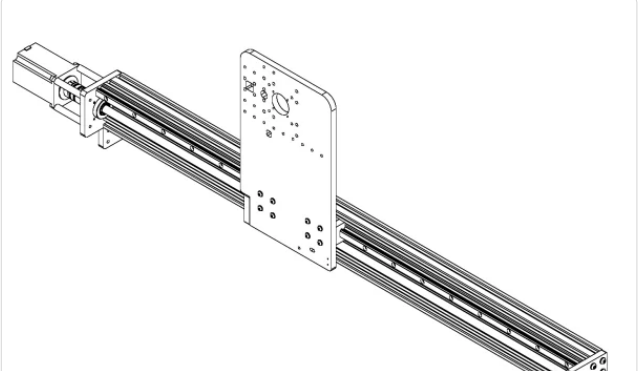
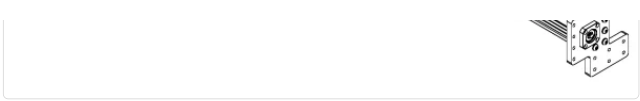
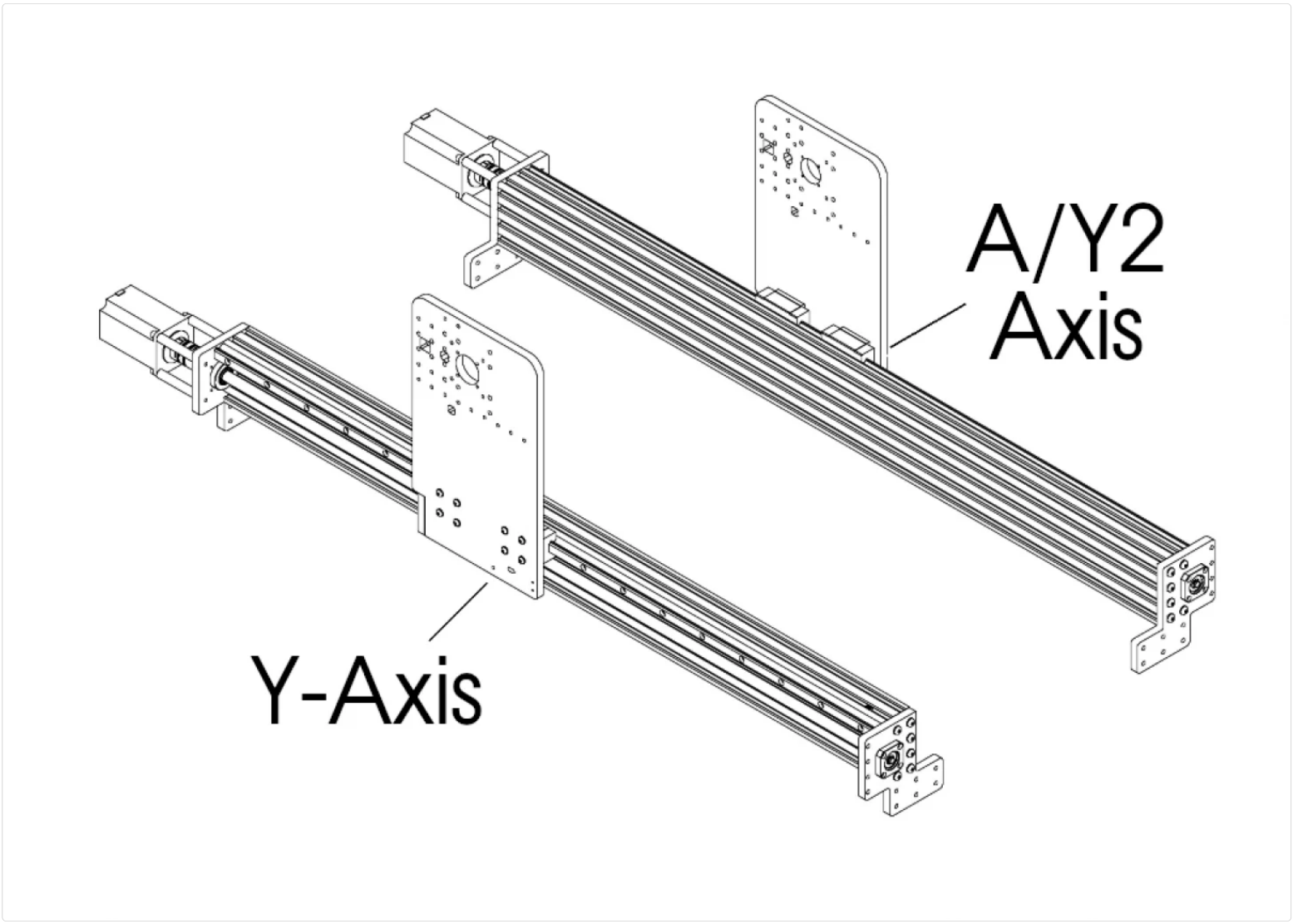




2.7.2 Completed Y And A/Y2 Axes



2.8 Y and A/Y2-Axis Lubrication

2.8.1 HGH Bearings

A. Lay the gantry on its side and locate the grease nipple on the HGH Bearing. As we previously recommended, the HGH Bearings Nipples should be installed facing out.

B. Attach the grease gun to the grease nipple and apply the grease. The grease should squirt out of the bearing.

C. Repeat this for all HGH bearing blocks.

2.8.2 Ball Screw

A. Lay the gantry on its side and locate the grease nipple on the Ball Nut.

B. Attach the grease gun to the grease nipple and apply the grease. Some grease will squirt out of the back of the ball screw wiper seal.

C. Run the gantry by hand back and forth multiple times. This will lubricate the rail and circulate the grease on all the bearings and ball screws, ensuring even lubrication.

3.0 Base/Spoiler Board

It is recommended that you read all chapters 3.1-3.5 **prior** to beginning the assembly.

3.1 Spoiler Board T-Nuts And Brackets

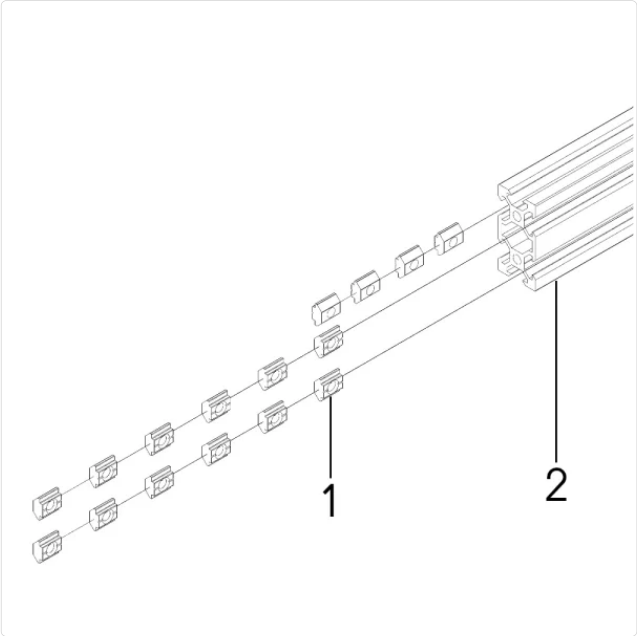
3.1.1 Inserting T-Nuts – Front and Rear

Click images to expand

Item NO	Description	Qty
1	M5 Sliding T-Nut	16
2	2040 Extrusion	1

A. Slide the M5 Sliding T-Nuts into the 2040 Extrusion channels as illustrated. 6 in each channel of one face on the 40mm side. 4 in the top channel of the other face on the 40mm side.

B. Repeat the process for a second 2040 Extrusion.



3.1.2 Attaching Brackets – Front and Rear Extrusions

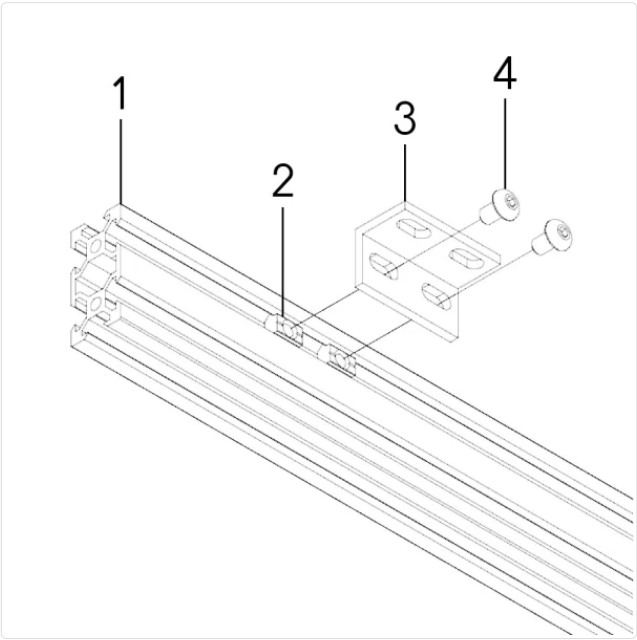
Click images to expand

Item NO	Description	Qty
1	2040 Extrusion	1
2	M5 Sliding T-Nut	2
3	L2 Brackets	1
4	M5 x 8mm Button Head Screw	2

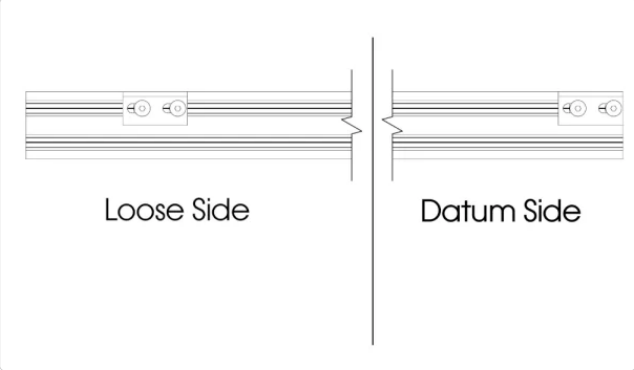
A. On the face that we have inserted **4x M5 Sliding T-Nuts** on the previous step, use 2x M5 x Button Head Screws to secure the L2 Bracket. Note that on the L2 bracket the holes are in different positions. The holes that are closer to the bend on the bracket is the face that is secured to the extrusion.

Important: Do not completely tighten the M5x8mm Button Head Screws on the Loose Side. The Position of the Brackets on the Loose side will be determined later by the length of the X-Axis Extrusions.

B. Repeat the same procedure on the same face of the 2040 extrusion, but on the opposite end as illustrated below.



Click images to expand



Important: Illustrated above, the Brackets on the Datum side is attached flush with the end of the 2040 Extrusions.

C. Once you have built 1x 2040 Extrusion with 2 brackets, repeat the process to build the second 2040 Extrusion.

Leave these extrusions to one side, we will use them soon.

3.1.3 Inserting T-Nuts - Middle Sections

Click images to expand

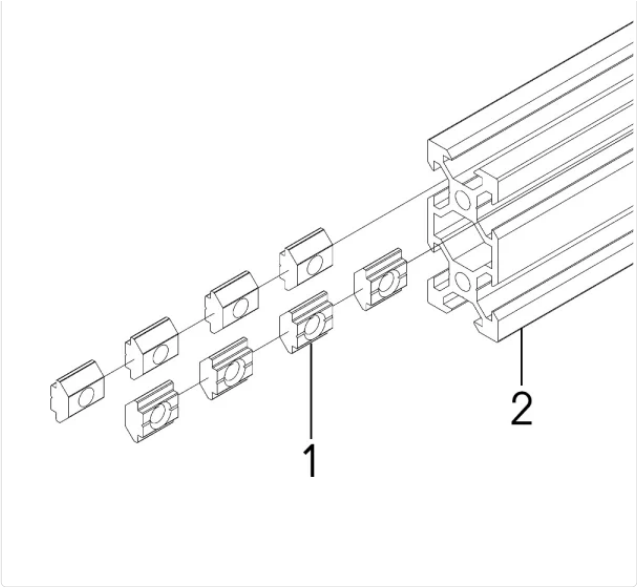
Item NO	Description	Qty

1	M5 Sliding T-Nut	8
2	2040 Extrusion	1

A. Slide 4x M5 Sliding T-Nuts into each side on the top channels of the 40mm face as illustrated.

Important: The quantity of middle sections will depend on the machine size you have.

- For Machines up to 1000×1000, you will have 2 middle section extrusions
- For Machines 1000×1500 and 1500×15000, you will have 3 middle section extrusions.



3.1.4 Attaching Brackets - Middle Sections

Click images to expand

Item NO	Description	Qty
1	2040 Extrusion	1
2	M5 Sliding T-Nut	2
3	L2 Brackets	1
4	M5 x 8mm Button Head Screw	2

A. On the face that we have inserted 4x M5 Sliding T-Nuts on the previous step, use 2x M5 x Button Head Screws to secure the L2 Bracket on each side of the 2040 Extrusion. Note that on the L2 bracket the holes are in different positions. The holes that are closer to the bend on the bracket is the face that is secured to the extrusion.

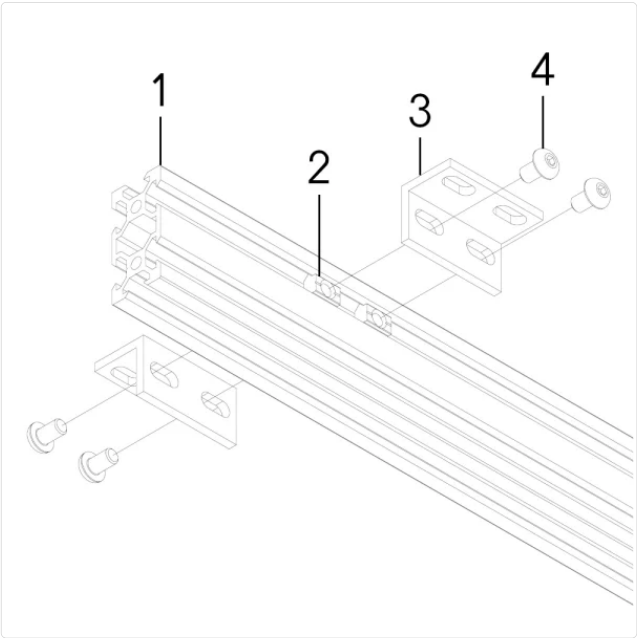
B. Repeat the same procedure on the same face of the 2040 extrusion, but on the opposite end as illustrated in the second image.

Important: As the second image aside shows, the Brackets on the Datum side is attached flush with the end of the 2040 Extrusions. The bracket on the Loose Side is yet to be set.

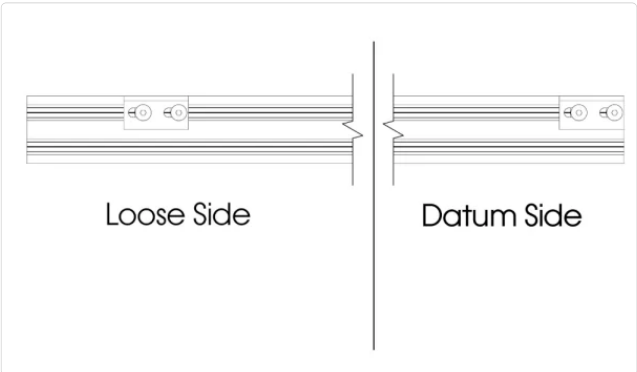
Important: Do not completely tighten the M5x8mm Button Head Screws on the Loose Side. The Position of the Brackets on the Loose side will be determined later by the length of the X-Axis Extrusions.

C. Once you have built 1x 2040 Extrusion with 4 brackets, repeat the process to build for the other Middle Extrusions according to the statement below.

- Machines up to 1000×1000, you will have 2x 2040 Extrusions in the middle section.
- Machines that are 1000×1500 and over will have 3x 2040 Extrusions in the middle section.



Click images to expand



3.1.5 Spoiler Board Preparation Complete.

Click images to expand

Note that the Datum Side is on the right, these brackets are all flush with the end of the extrusion. The brackets on the left are still loose and will be positioned later according to the X-Axis assembly.

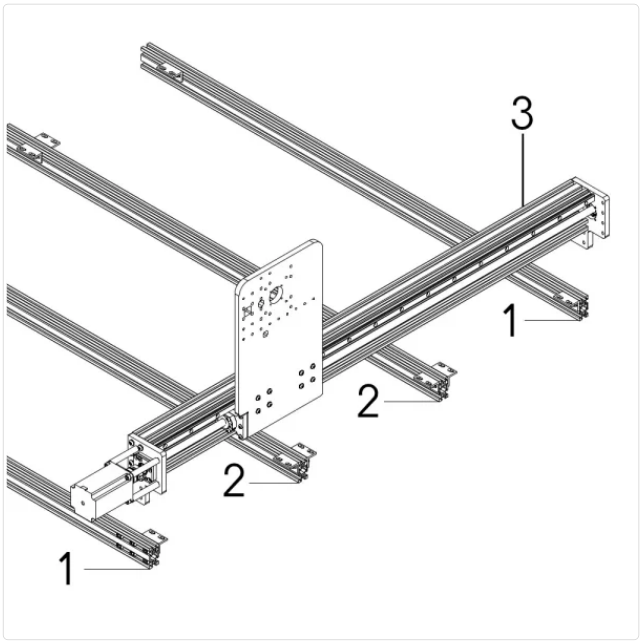
3.2 Spoiler Board Datum Side

3.2.1 - Attaching A/Y2-Axis to Datum Side.

Item NO	Description	QTY FOR MACHINE Y-AXIS LENGTH			
		500MM	750MM	1000MM	1500MM
1	2040 Extrusion – Front and Rear	2	2	2	2
2	2040 Extrusion – Middle Sections	2	2	2	3
3	A/Y2-Axis	1	1	1	1

A. Position the A/Y2-Axis on the Datum Side of your Spoiler Board as shown on the image aside.

Click images to expand



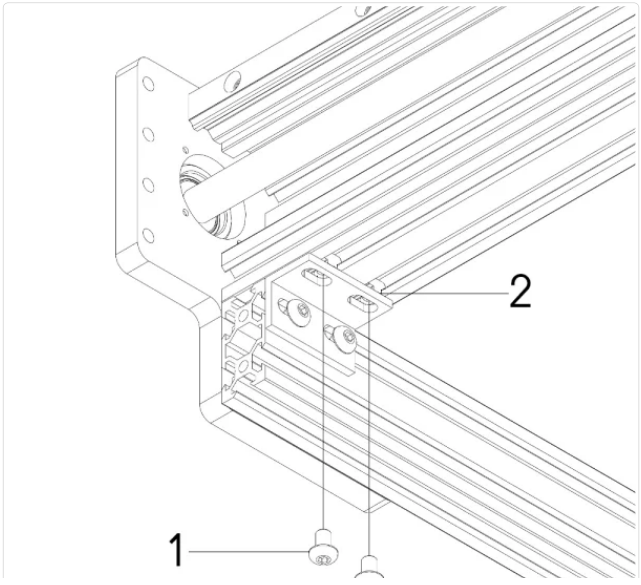
3.2.2 - Attaching Front (Floating)

Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	2
2	L2 Brackets	1

A. Slide the Sliding T-Nut that was previously inserted on the bottom channels of the A/Y2-Axis C-Beam towards the floating end, and then use them to attach the M5 x 8mm Button Head Screw Screws, securing the L2 Brackets.

Important: Ensure to mount the A/Y2-Axis C-Beam flush with the bracket and consequently with the end of the 2040 Extrusion. The Datum Side must be the reference for the whole machine.

Click images to expand



3.2.3 - Attaching Middle Sections to A/Y2-Axis.

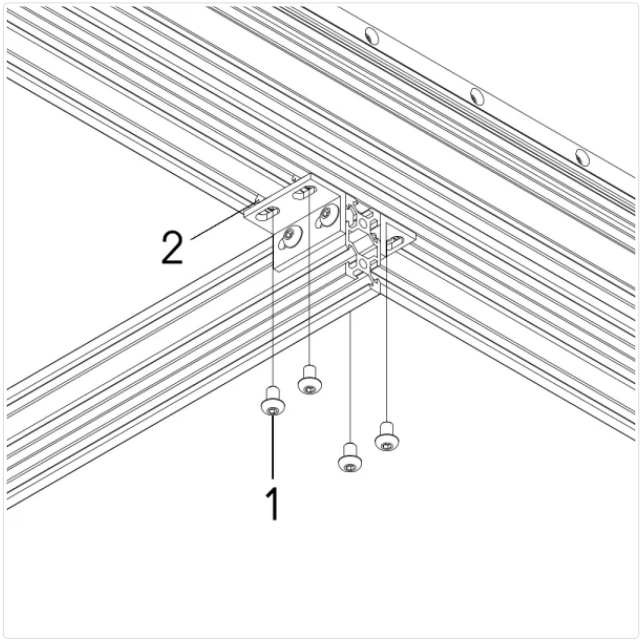
Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	2
2	L2 Brackets	1

A. Slide the Sliding T-Nut that was previously inserted on the bottom channels of the A/Y2-Axis C-Beam, and then use them to attach the M5 x 8mm Button Head Screw Screws, securing the L2 Brackets.

B. Repeat the previous step for all middle sections that would be attached to the Datum. Spacing between each section should be equally spaced from the front and rear of the machine.

Important: Ensure to mount the A/Y2-Axis flush with the bracket and consequently with the end of the 2040 Extrusion. The Datum Side must be the reference for the whole machine.

Click images to expand

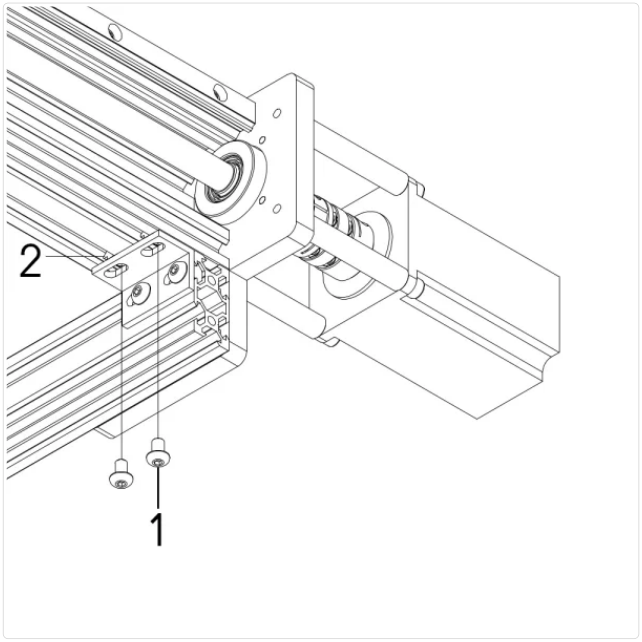


3.2.4 - Attaching Rear (Fixed)

Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	1
2	L2 Brackets	2

A. Slide the Sliding T-Nut that was previously inserted on the bottom channels of the Y-Axis C-Beam towards the Fixed end, and then use them to attach the M5 x 8mm Button Head Screw Screws, securing the L2 Brackets.

Click images to expand

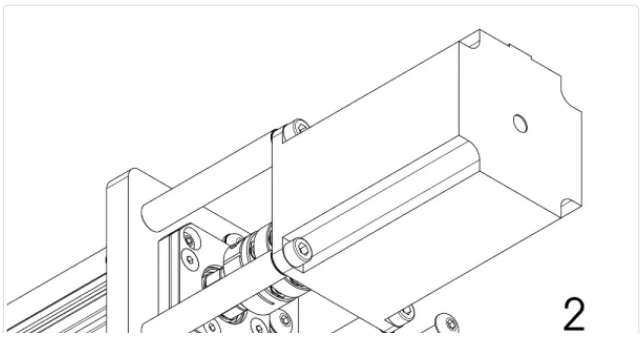


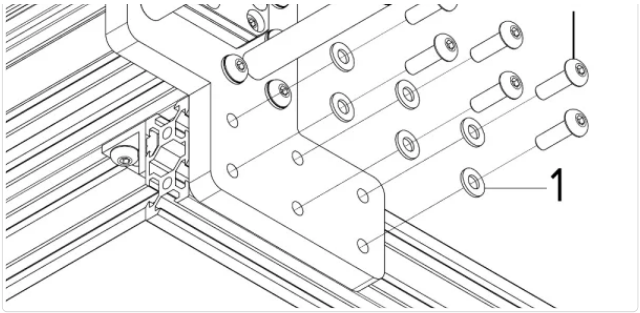
3.2.5 - Attaching Rear Extrusion to Y-End Plate - Fixed End

Item NO	Description	Qty
1	Precision Shim 10x5x1	6
2	M5 x 16mm Button Head Screw	6

A. Use the Sliding T-Nuts that were inserted on the 2040 Extrusion in Chapter 3.1.1 to attach the Y-End Plate – Fixed to the 2040 Extrusion (Rear).

Click images to expand



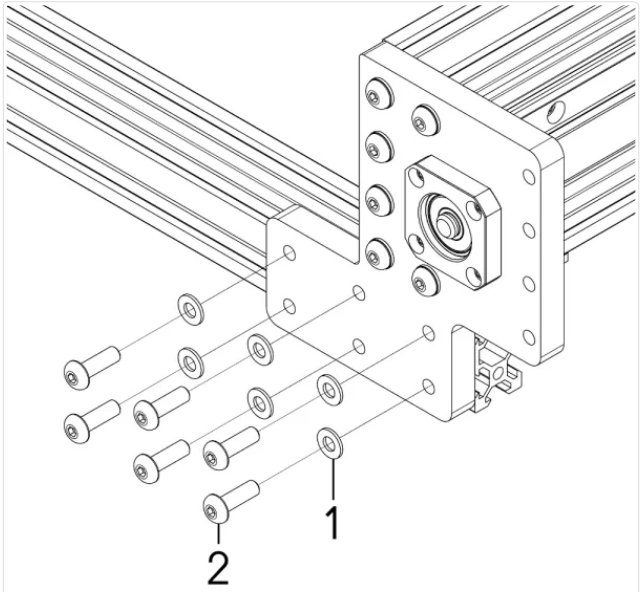


3.2.6 - Attaching Front to Y-End Plate - Floating End

Item NO	Description	Qty
1	Precision Shim 10x5x1	6
2	M5 x 16mm Button Head Screw	6

A. Use the Sliding T-Nuts that were inserted on the 2040 Extrusion in Chapter 3.1.1 to attach the Y-End Plate – Fixed to the 2040 Extrusion (Front). Note there is a Precision Shim between each screw and the plate.

Click images to expand



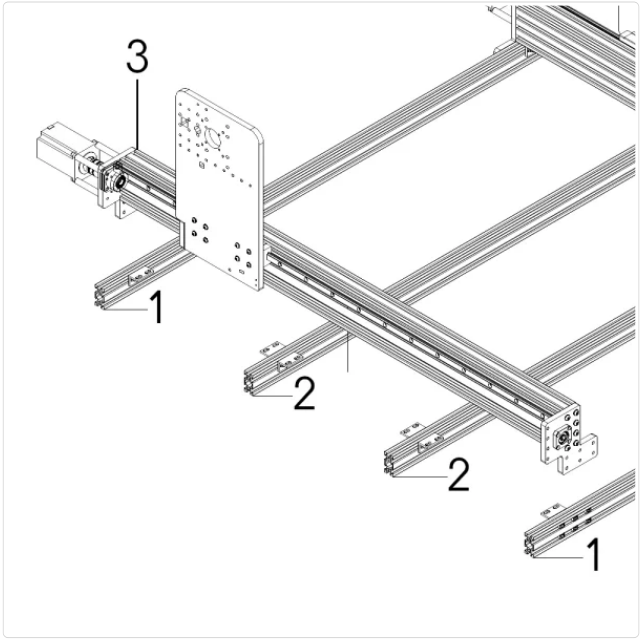
3.3 Spoiler Board - Loose Side

3.3.1 - Placing Second Y-Axis on the Loose Side.

Item NO	Description	QTY FOR MACHINE Y-AXIS LENGTH			
		500MM	750MM	1000MM	1500MM
1	2040 Extrusion – Front and Rear	2	2	2	2
2	2040 Extrusion – Middle Sections	2	2	2	3
3	Y-Axis	1	1	1	1

A. Position the Y-Axis on the Loose side of your Spoiler Board as shown on the image aside.

Click images to expand



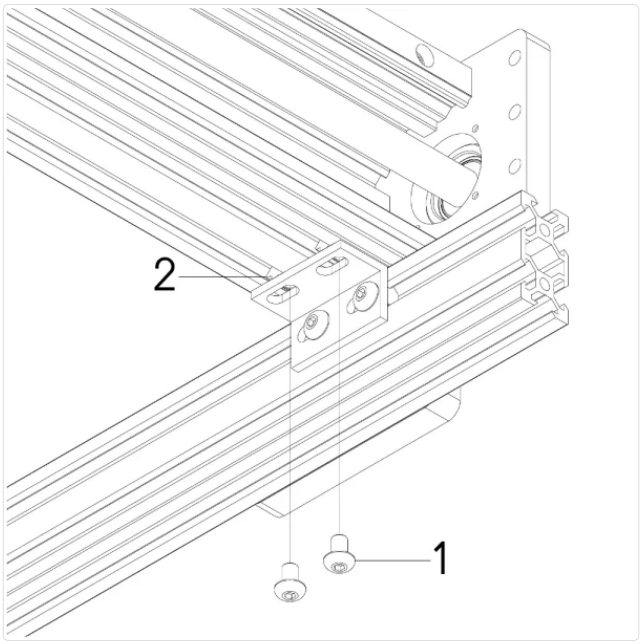
3.3.2 - Attaching Front (Floating)

Click images to expand

Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	2
2	L2 Brackets	1

A. Slide the Sliding T-Nut that was previously inserted on the bottom channels of the Y-Axis C-Beam towards the floating end, and then use them to attach the M5 x 8mm Button Head Screw Screws, securing the L2 Brackets.

Important: You can completely tighten the Brackets to the C-Beam Extrusion, however, leave the other 2x M5 x 8mm Button Head Screws that were previously secured to the 2040 Extrusion untightened.



3.3.3 - Attaching Middle Sections to Y-Axis.

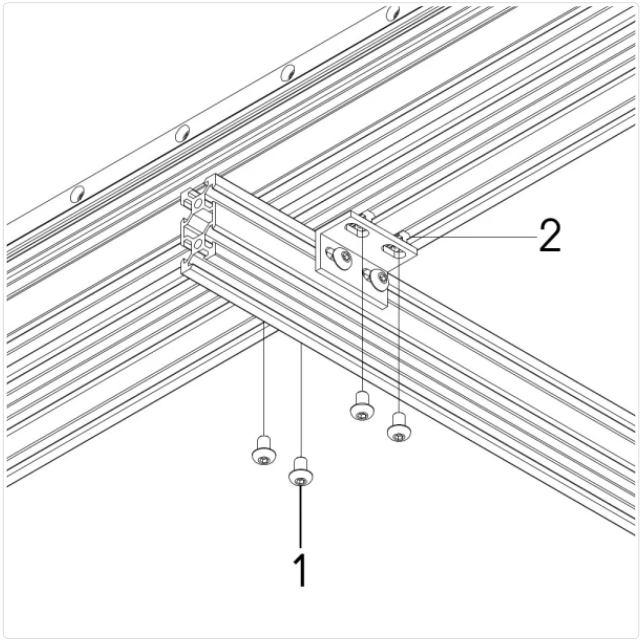
Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	2
2	L2 Brackets	1

A. Slide the Sliding T-Nut that was previously inserted on the bottom channels of the Y-Axis C-Beam, and then use them to attach the M5 x 8mm Button Head Screw Screws, securing the L2 Brackets.

B. Repeat the previous step for all middle sections that would be attached on the Loose side of the Spoilerboard. Ensure the spacing of these middle sections matches the spacing on the other side.

Important: You can completely tighten the Brackets to the C-Beam Extrusion, however, leave the other 2x M5 x 8mm Button Head Screws that were previously secured to the 2040 Extrusion untightened.

Click images to expand



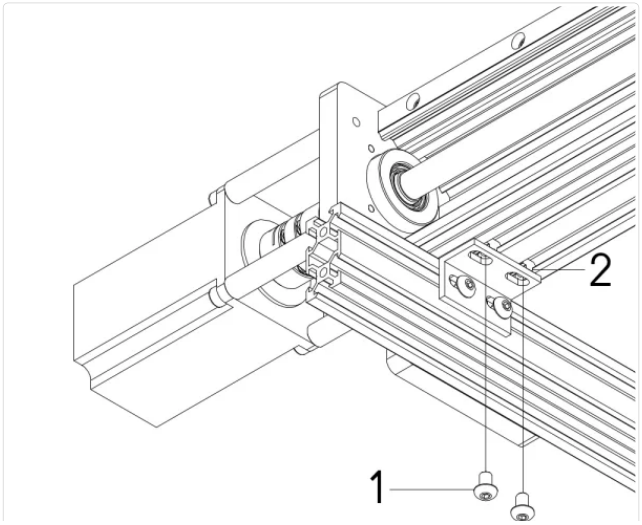
3.3.4 - Attaching Rear (Fixed)

Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	2
2	L2 Brackets	1

A. Slide the Sliding T-Nut that was previously inserted on the bottom channels of the Y-Axis C-Beam towards the Fixed end, and then use them to attach the M5 x 8mm Button Head Screw Screws, securing the L2 Brackets.

Important: You can completely tighten the Brackets to the C-Beam Extrusion, however, leave the other 2x M5 x 8mm Button Head Screws that were previously secured to the 2040 Extrusion untightened.

Click images to expand



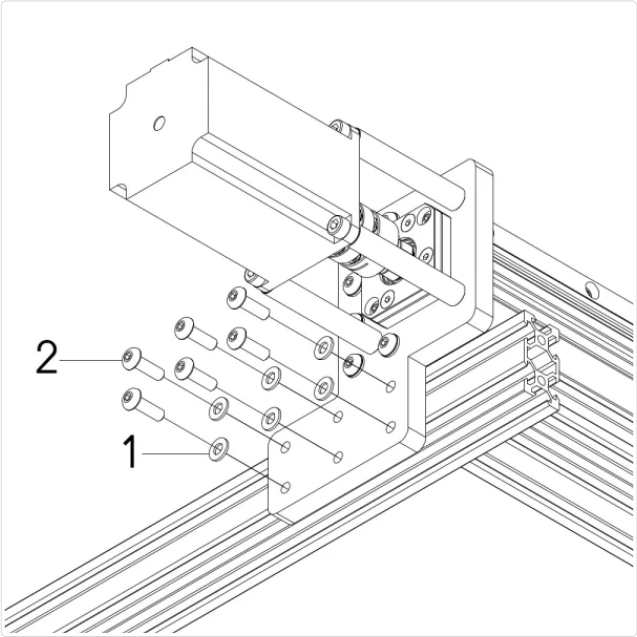
3.3.5 - Attaching Rear Extrusion to Y-End Plate - Fixed End

Item NO	Description	Qty
1	Precision Shim 10x5x1	6
2	M5 x 16mm Button Head Screw	6

A. Use the Sliding T-Nuts that were inserted on the 2040 Extrusion in Chapter 3.1.1 to attach the Y-End Plate – Fixed End to the 2040 Extrusion (Rear). Note there is a Precision Shim between the Screw and the Plate on each Screw.

Important: As the final position of the is unknown until the X-Axis is added to the build, do not entirely tighten the M5 x 16mm Button Head Screws.

Click images to expand



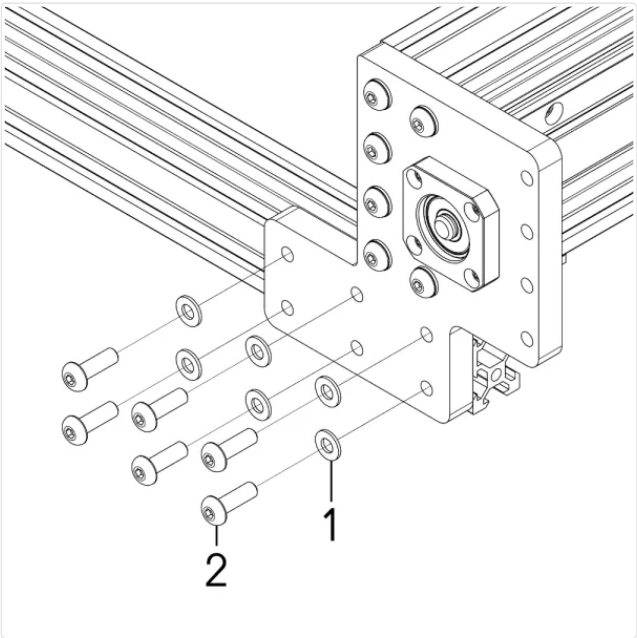
3.3.6 - Attaching Front to Y-End Plate - Floating End

Item NO	Description	Qty
1	Precision Shim 10x5x1	6
2	M5 x 16mm Button Head Screw	6

A. Use the Sliding T-Nuts that were inserted on the 2040 Extrusion in Chapter 3.1.1 to attach the Y-End Plate – Floating End to the 2040 Extrusion (Front). Note there is a Precision Shim between the Screw and the Plate on each Screw.

Important: As the final position of the is unknown until the X-Axis is added to the build, do not entirely tighten the M5 x 16mm Button Head Screws.

Click images to expand



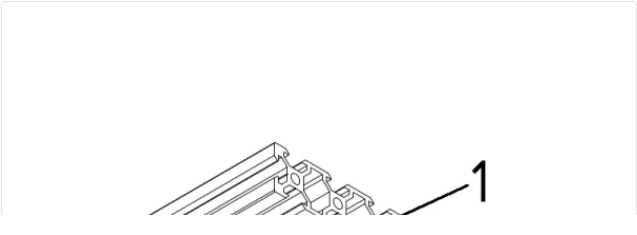
3.4 - Drag Chain Support

3.4.1 - Attaching Bracket

Item NO	Description	Qty
1	2060 Extrusion	1
2	M5 Sliding T-Nut	1
3	90-Degree Bracket	1
4	M5 x 8mm Button Head Screw	1

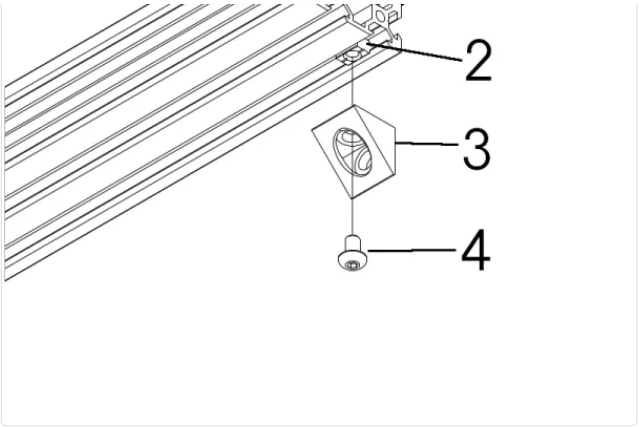
A. Slide an M5 Sliding T-Nut into the 2060 Extrusion channel, and then use an M5 x 8mm Button Head

Click images to expand



Screw to secure the 90-Degree Bracket onto the 2060 Extrusion.

B. Repeat the previous step to add another 90-Degree Bracket on the other end as per the other side.

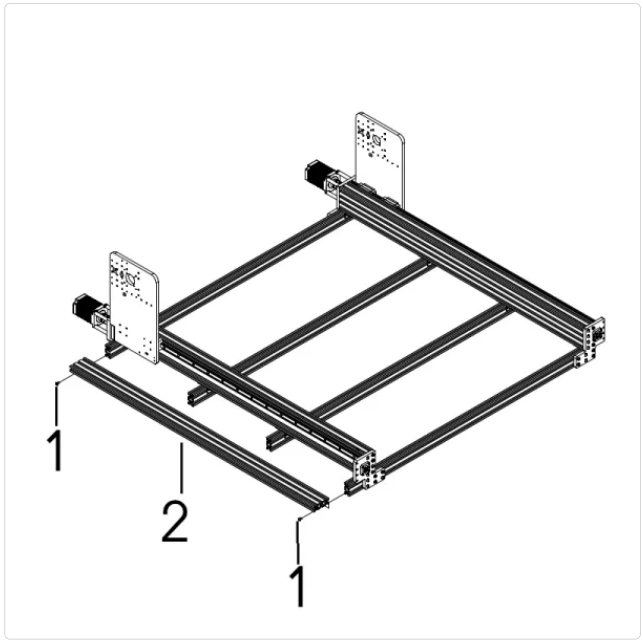


3.4.2 - Securing to Spoiler Board.

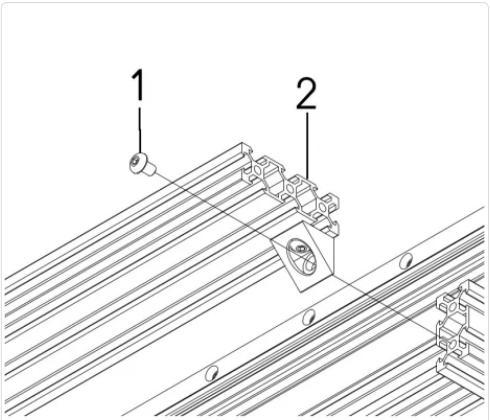
Item NO	Description	Qty
1	M5 x 8mm Button Head Screw	2
2	2060 Extrusion	1

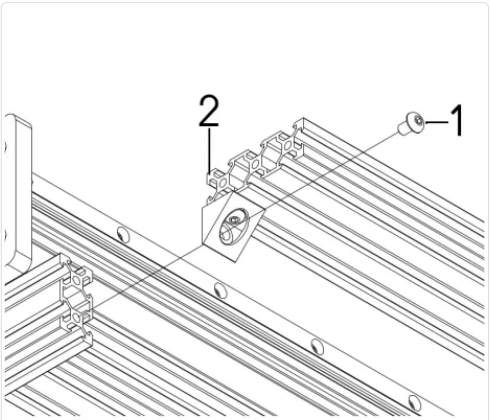
A. Insert the M5 x 8mm Button Head Screw through the brackets attached in the previous step and then secure the 2060 Extrusion on the Spoilerboard by both ends as illustrated.

Click images to expand



Click images to expand



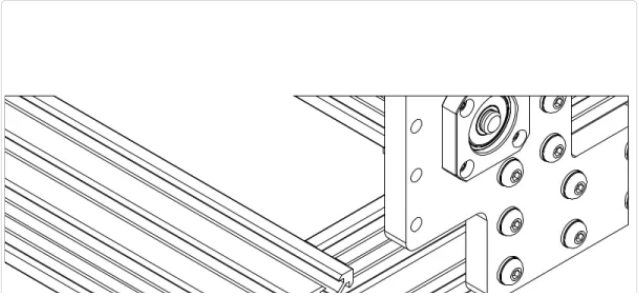


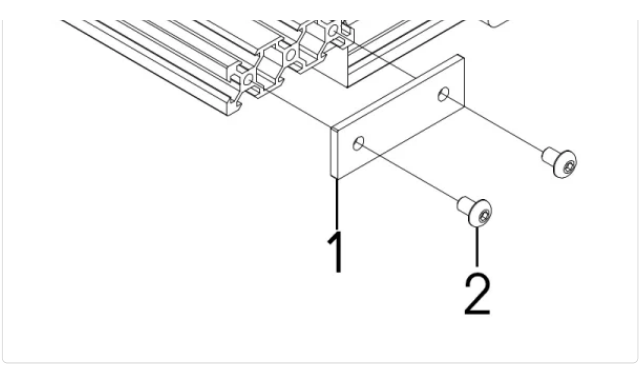
3.4.3 - End Caps

Item NO	Description	Qty
1	End Cap – 2060	1
2	M5 x 8mm Button Head Screw	2

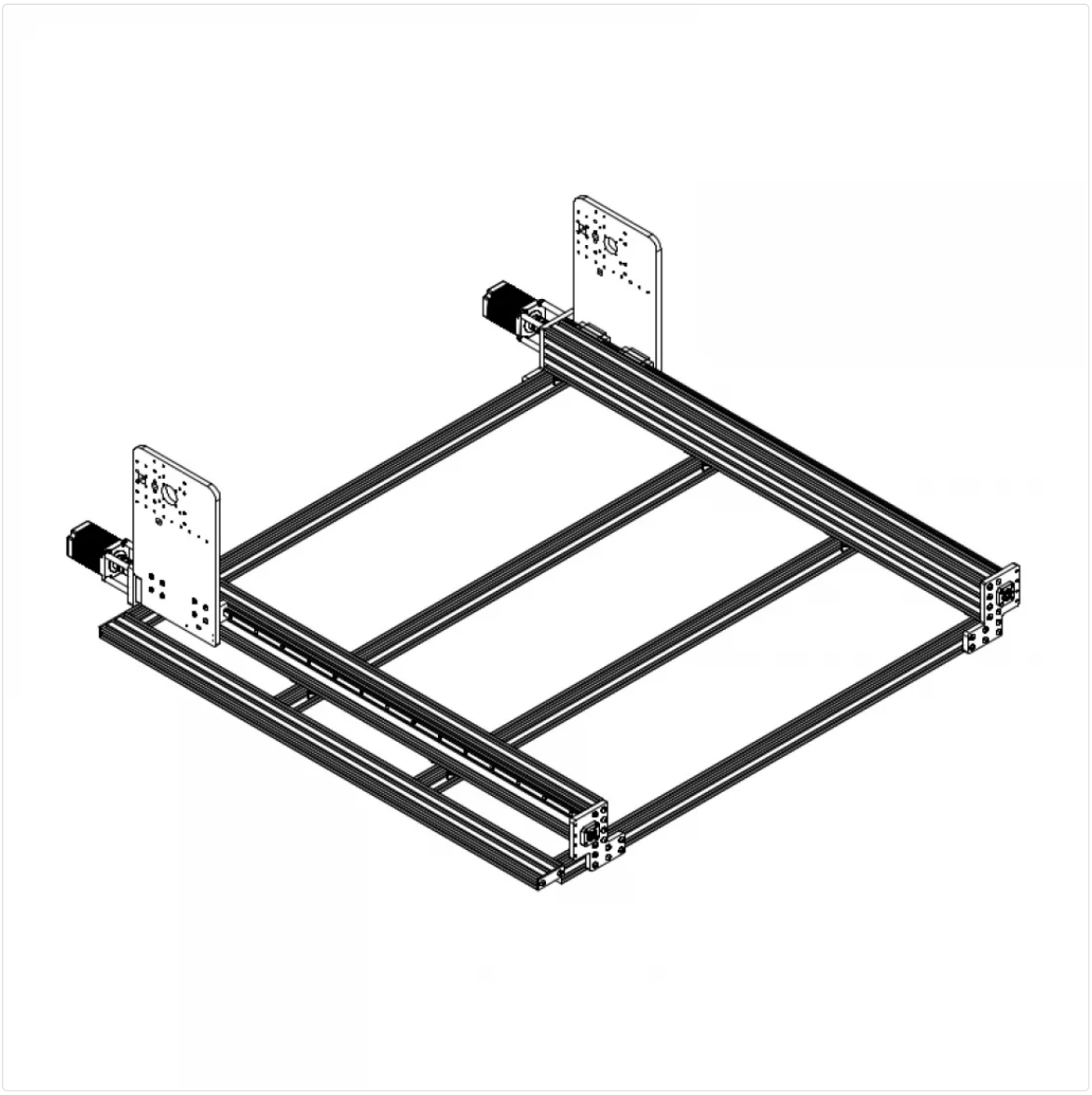
A. As a final touch, secure the End Cap – 2060 to the end of the Spoiler Board Support Extrusion as per the image aside.

Click images to expand





3.5 Spoilerboard Complete



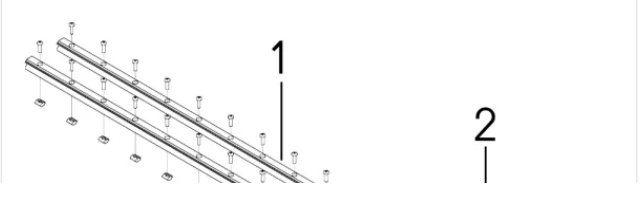
4.0 X-Axis

4.1 C-Beam and HGR Rail

4.1.1 HGR Rail preparation

Item NO	Description	QTY FOR MACHINE X-AXIS LENGTH			
		500MM	750MM	1000MM	1500MM
1	HGR 15 Rail	2	2	2	2
2	M4 x 14mm Socket Cap Head Screw	18	26	34	52
3	M4 Sliding T-Nut	2	2	2	2

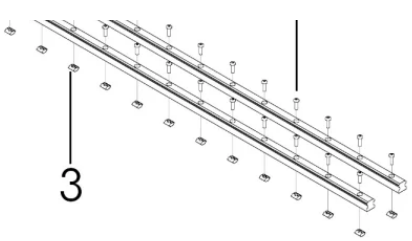
Click images to expand



A. Insert the M4 x 14mm Socket Cap Head Screw through the HGR Rail and thread the M4 Sliding T-Nut onto the end. 1/2 a turn on a Screw will suffice. We will tighten these later.

B. Repeat this for all 2 lengths of Y-Axis HGR 15 Rails.

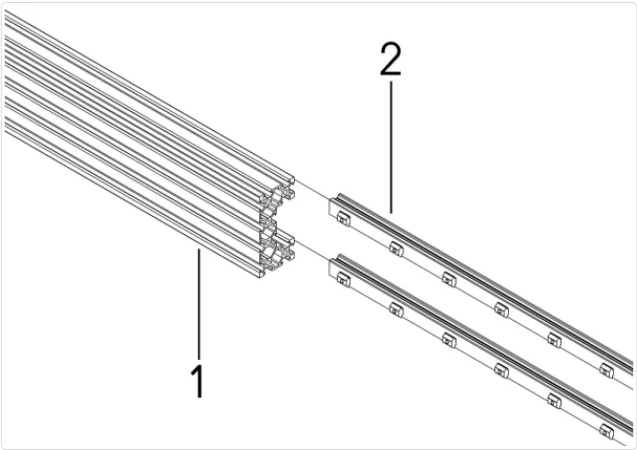
Pro Tip. Please note that the quantity of the M4 x 14mm Socket Cap Head Screw and M4 Sliding T-Nut will depend on Machine Size you have.



4.1.2 Attaching HGR on the C-Beam

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	HGR 15 Rail	2

Click images to expand



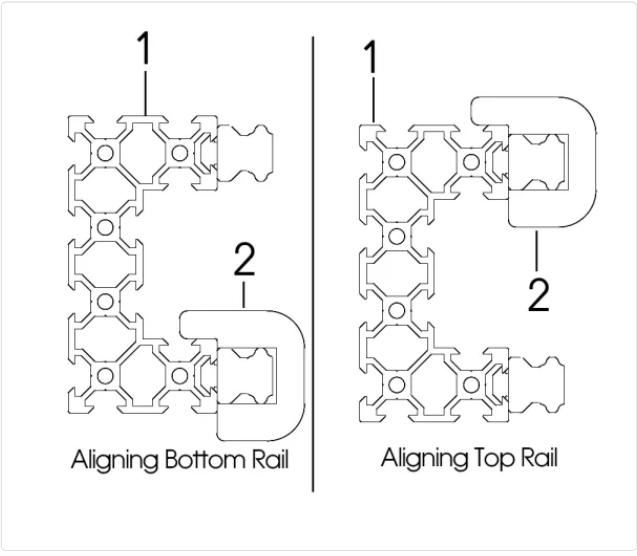
A. Slide both HGR 15 Rail Assemblies into the top channel of the 80mm face on the C-Beam Extrusion.

Pro Tip: Sliding the HGR 15 Rails and M4 Sliding T-Nuts can be difficult, get another person to help you hold the rail straight while sliding the T-Nuts into the C-Beam.

4.1.3 Alignment Tool

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	Alignment Tool	1

Click images to expand



A. Slide the Alignment Tool onto the HGR 15 Rail and move it closer to the end of the HGR 15 Rail. Tighten the M4 x 14mm Socket Cap Head Screw that was introduced in chapter 2.1.1.

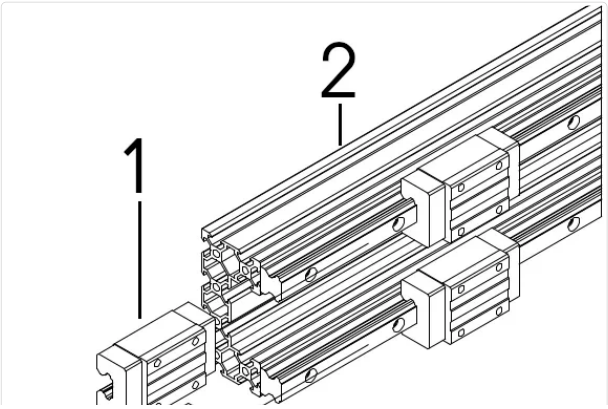
B. Repeat the procedure by Sliding the Bulk Man Alignment Tool and Tightening all M4 x 14mm Socket Cap Head Screws close to it.

Pro Tip: Be careful with the amount of torque when tightening the M4 x 14mm Socket Cap Head Screws. Over tightening can strip the screw's head or round the Allen Key tool.

4.1.4 HGH Bearing Carriage Blocks

Item NO	Description	Qty
1	HGH 15 Bearing Blocks	4
2	C-Beam and With 2x HGR 15 Rails	1

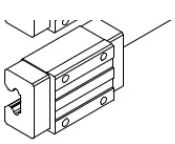
Click images to expand



A. Slide 2x HGH 15 Bearing Blocks Per Rail as per image aside.

B. To avoid losing any ball bearings keep the retainer that comes with the packaging on the bearing block. When installing the bearing block onto the rail, use the rail to push the plastic retainer rail out of the block, this ensures the steel balls are under tension and have contact with a rail at all times.

Pro Tip: Although the drawing does not depict this, it is best practice to have the grease nipple facing outwards to allow easier access during maintenance.



4.1.5 X-Plate And HGH Carriages

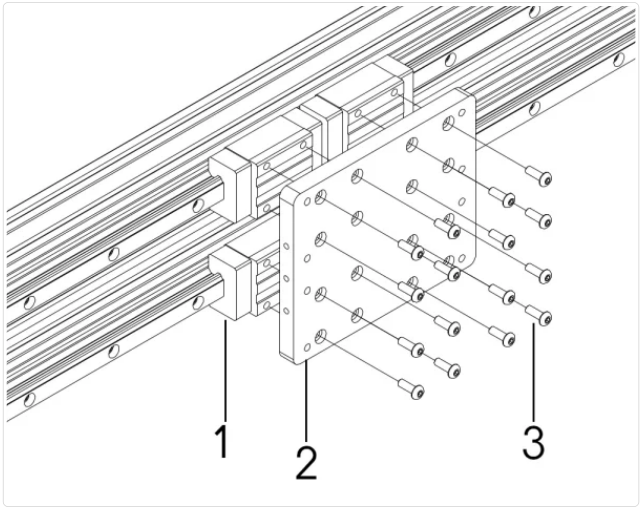
Item NO	Description	Qty
1	HGH 15 Bearing Blocks	4
2	X Plate	1
3	M4 x 12mm Button Head Screw	16

A. Secure the X Plate to the 4x HGH 15 Bearing Blocks by using M4 x 12mm Button Head Screws as depicted in the illustration.

B. When securing the screws onto each bearing, start with the screw on the top left, tighten this screw by 1 turn. Then secure the screw on the bottom right, tighten this screw by 1 turn. Then secure the screw on the top right, tighten this screw by 1 turn. Then secure the screw on the bottom left, tighten this secure by 1 turn. Continue with this pattern securing all of the screws completely.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 1/8th of a turn this will avoid overtightening.

Click images to expand



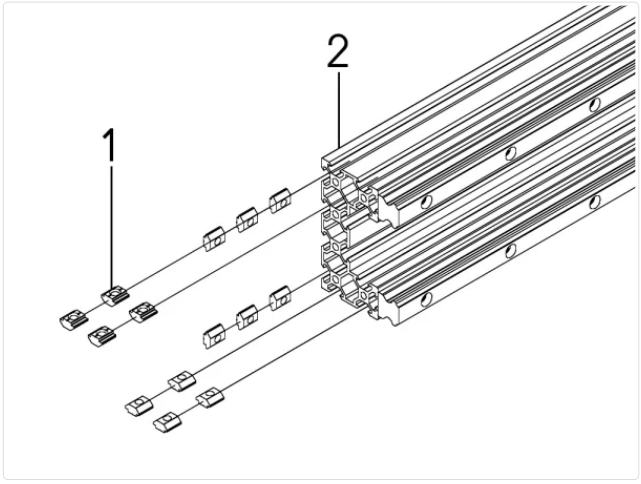
4.1.6 Insert T-Nuts on C-Beam Extrusion

Item NO	Description	Qty
1	M5 Sliding T-Nut	14
2	C-Beam Extrusion	1

A. Slide 4x M5 Sliding T-Nuts into the top and lower channels of the C-Beam Extrusion (2x M5 Sliding T-Nuts into each Channel).

B. Insert 6x M5 Sliding T-Nuts into the back face of the C-Beam. 3x M5 Sliding T-Nuts for the top channel and 3x for the lower channel.

Click images to expand



4.1.7 Insert T-nuts on 4040 Extrusion

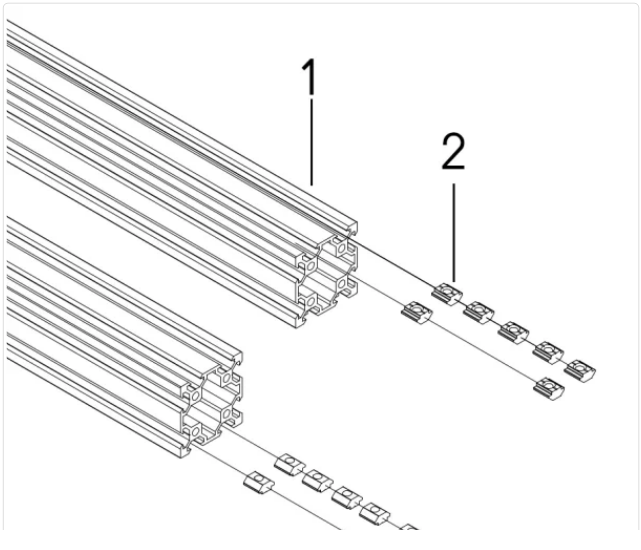
Item NO	Description	Qty
1	4040 Extrusion	1
2	M5 Sliding T-Nut	14

A. Insert 7x M5 Sliding T-Nut on the top face of the the 4040 Extrusions as illustrated.

B. Insert 7x M5 Sliding T-Nut on the bottom face of the 4040 Extrusions as illustrated.

Important: The illustration shows the **same** 4040 Extrusion on 2 different occasions. Each Machine has only 1x 4040 Extrusion.

Click images to expand



4.2 Extrusions and Y-Plates

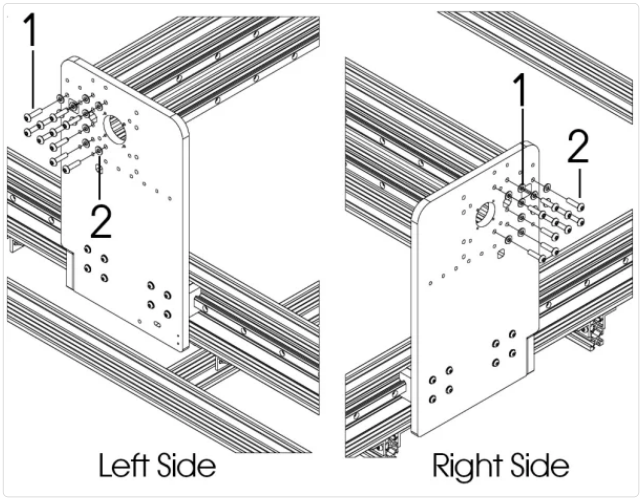
4.2.1 C-Beam and 4040 to the Y-plates

Click images to expand

Item NO	Description	Qty
1	M5 x 20mm Button Head Screw	10
2	Precision Shim 10x5x1	10

A. Insert 10x M5 x 20mm Button Head Screws through the Precision Shim 10x5x1 And then secure the C-Beam and 4040 Extrusion on the Y-Plate (Left Side) as illustrated.

Pro Tip: Attaching the X-Axis Extrusions on the Y-Plate can be difficult, get another person to help you hold the Extrusions while you secure it.



Item NO	Description	Qty
1	Precision Shim 10x5x1	10
2	M5 x 20mm Button Head Screw	10

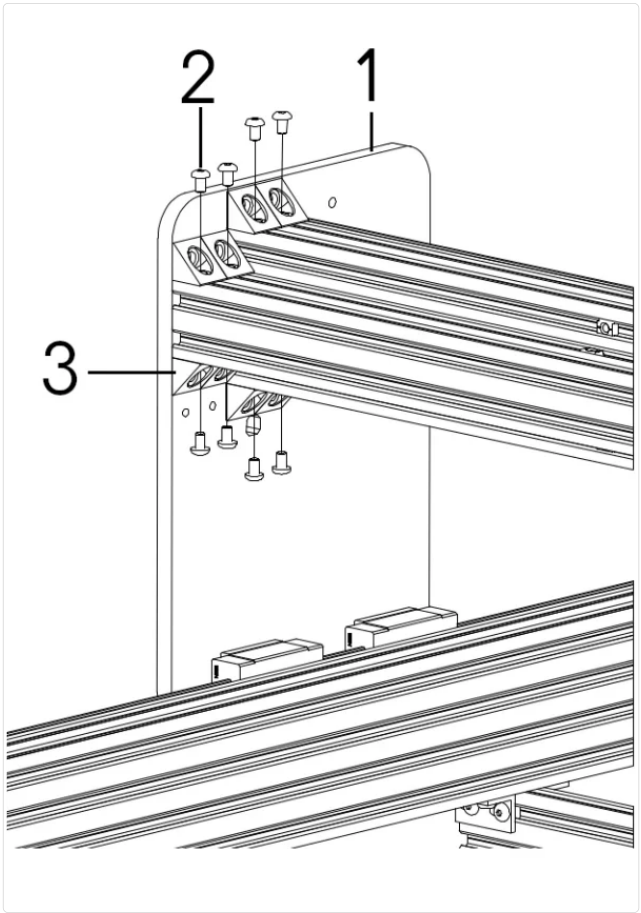
B. Insert 10x M5 x 20mm Button Head Screws through the Precision Shim 10x5x1 And then secure the C-Beam and 4040 Extrusion on the Y-Plate (Right Side) as illustrated.

4.2.2 Brackets to Y-Plate

Click images to expand

Item NO	Description	Qty
1	Y-Plate Right	1
2	M5 x 8mm Button Head Screw	8
3	Bracket 90-Degree Angle	8

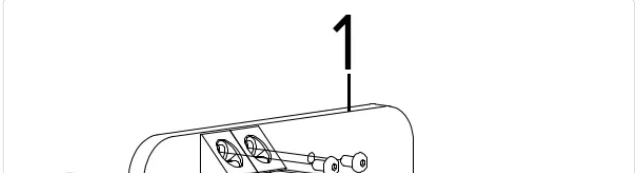
A. Slide the M5x Sliding T-Nuts that was inserted in earlier chapters and then use 8x M5 x 8mm Button Head Screws to attach the bracket onto the C-Beam and 4040 Extrusion as illustrated.

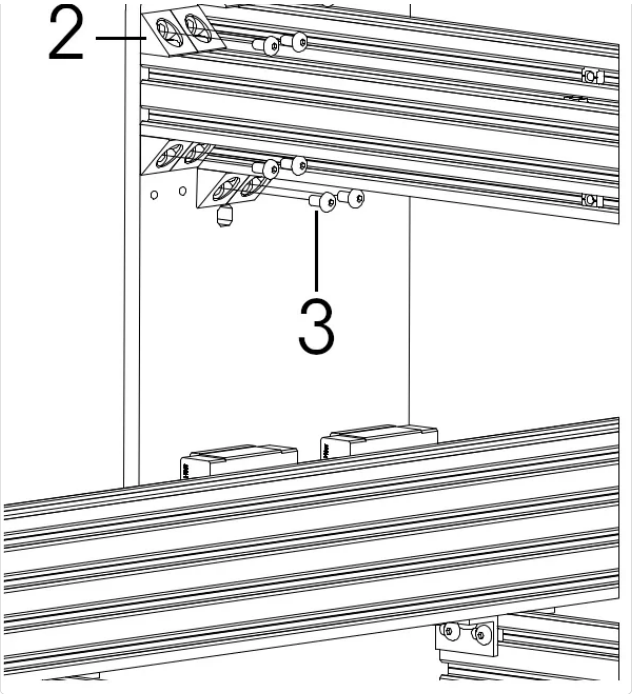


Click images to expand

Item NO	Description	Qty
1	Y-Plate Right	1
2	Bracket 90 Degree Angle	8
3	M5 x 10mm Button Head Screw	8

B. Use 8x M5 x 8mm Button Head Screws to attach the brackets to the Y-Plate as illustrated.





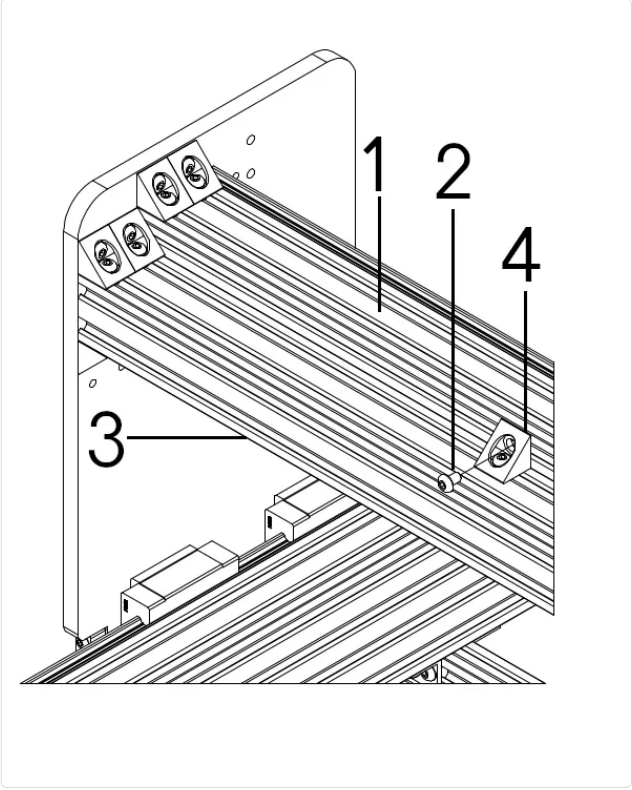
4.2.3 C-Beam and 4040 - Brackets

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	M5 x 8mm Button Head Screw	1
3	4040 Extrusion	1
4	Bracket 90-Degree Angle	1

A. Slide the M5 Sliding T-Nut that was inserted in earlier chapters on the C-Beam. The M5 Sliding T-Nut should be positioned a 1/3 of the extrusion length.

B. With an M5x 8mm Button Head Screw, secure the Bracket 90-Degree Angle on the back to the C-Beam Extrusion.

Click image to expand



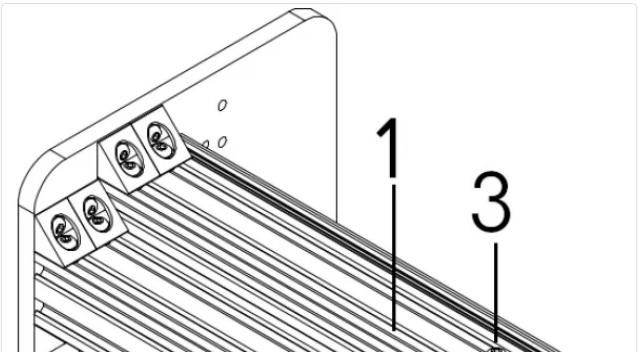
Item NO	Description	Qty
1	C-Beam Extrusion	1
2	4040 Extrusion	1
3	M5 x 8mm Button Head Screw	1
4	Bracket 90-Degree Angle	1

C. Slide the M5 Sliding T-Nut that was inserted in earlier chapters on the 4040 Extrusion. The M5 Sliding T-Nut should be positioned where the Bracket 90-Degree Angle is.

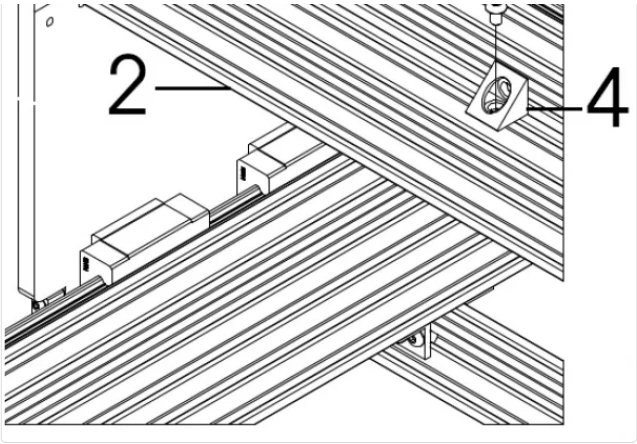
D. With an M5x 8mm Button Head Screw, secure the Bracket 90-Degree Angle on top of the 4040 Extrusion.

E. Repeat steps A, B, C and D using the image below as a guide of where all the brackets should be

Click image to expand



positioned. At the end of these steps, the C-Beam and 4040 will be secured together by 6 brackets, 3 on top and 3 on the bottom.



4.3 Ball Screw

4.3.1 Ball Nut And Ball Nut Plate

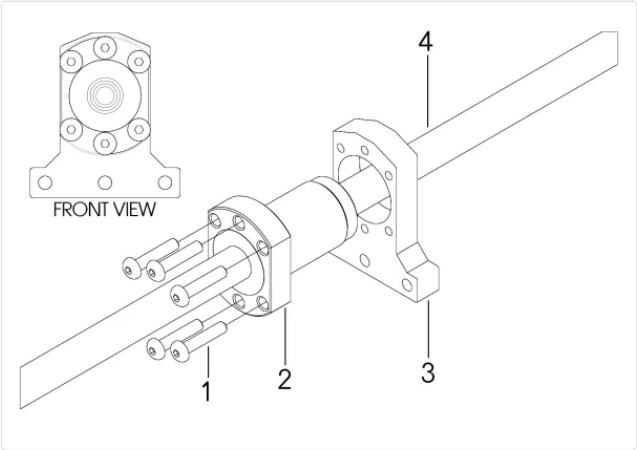
Item NO	Description	Qty
1	M4 x 20mm Button Head Screw	6
2	Ball Nut	1
3	Ball Nut Plate/Bracket	1
4	Ball Screw 1210	1

A. Insert the Ball Nut Plate/Bracket on the Ball Screw 1210.

B. By using 6x M4 x 20mm Button Head Screws, attach the Ball Nut Plate/Bracket on the Ball Nut.

Pro Tip: Under no circumstances should you remove the Ball Nut from the Ball Screw. The Ball Nut Ball Bearing mechanism is held only by the Ball Screw. Separating the Ball Nut from the Ball Screw will disassemble the Ball Nut.

Click images to expand



4.3.2 Inserting Ball Screw into the X-Axis

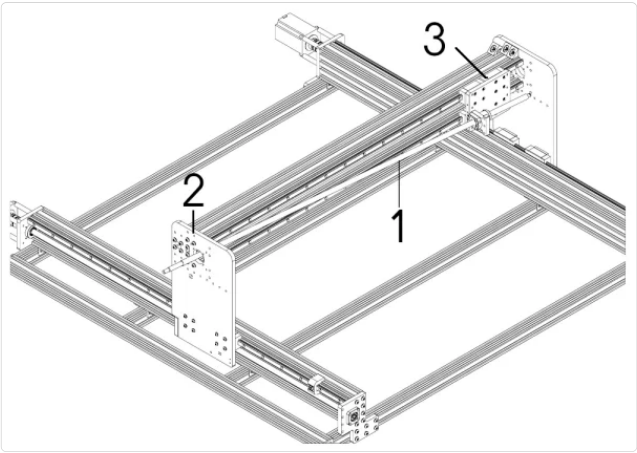
Item NO	Description	Qty
1	Ball Screw 1210	1
2	Y-Plate Left	1
3	X-Axis Gantry	1

A. Move the X-Axis Gantry as close as far as you can from the Y-Plate Left.

B. Insert the Ball Screw through the hole in the Y-Plate Left.

Pro Tip: As illustrated, you can only insert the Ball Screw 1210 through the Y-Plate Left when inserted at an angle.

Click images to expand

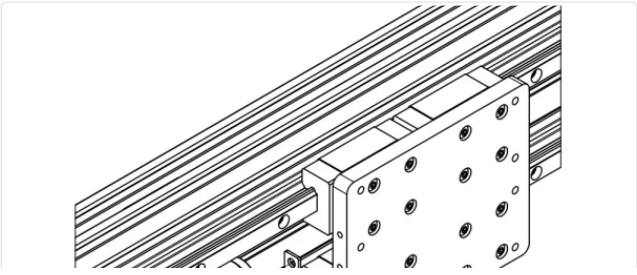


4.3.3 Ball Nut Plate and X-Plate

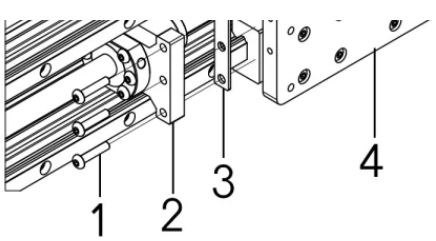
Item NO	Description	Qty
1	M4 x 20mm Button Head Screw	3
2	Ball Nut Plate/Bracket	1
3	Gasket 50x10mm	1
4	X-Axis Gantry	1

A. By using 3x M4 x 20mm Button Head Screw, tighten the Ball Nut Plate/Bracket on the Y-Plate Left. Include the Gasket 50x10mm between the Ball Nut Plate/Bracket and X-Axis Gantry.

Click images to expand



Pro Tip: Do not tighten the M4x 20mm Button Head Screws completely. The Final Tightening will be done on the Tightening Section in this Chapter.



4.4 FK And FF Bearings

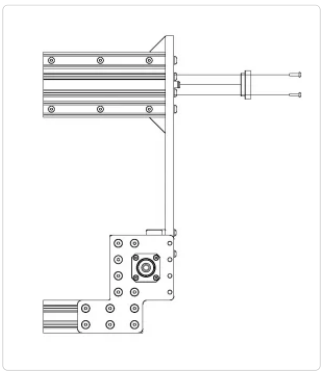
4.4.1 FF Bearing (Floating)

Item NO	Description	Qty
1	Y-Plate Right	1
2	FF Bearing (Floating)	1
3	M3 x 12mm Button Head Screw	4

A. Insert the FF Bearing Block (Floating) through the Ball Screw.

B. Using 4x M3 x 12mm Button Head Screws, secure the FF Bearing Block (Floating) on the Y End Plate – Floating End.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 2 turns. This part will be fully tightened later.



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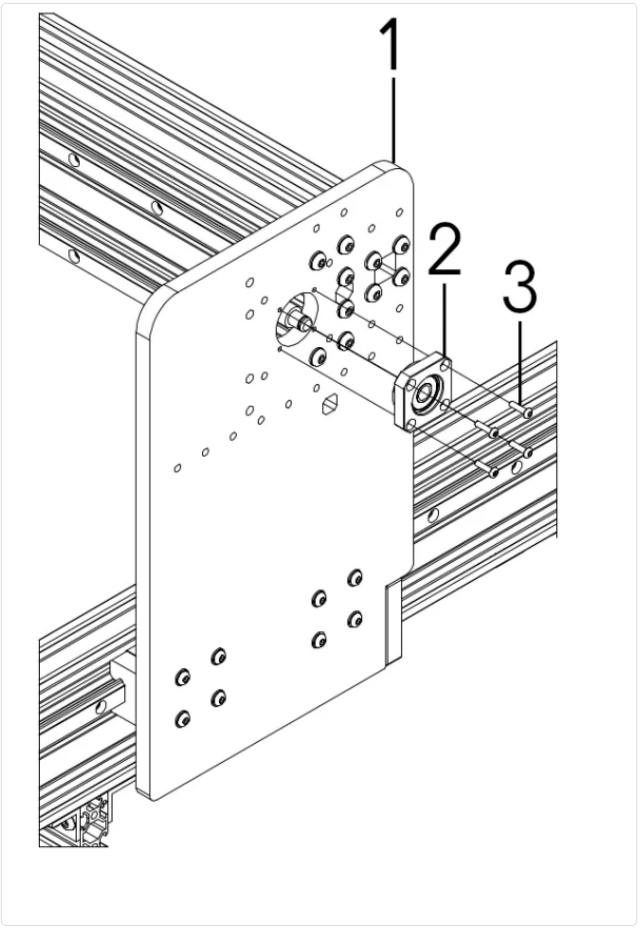


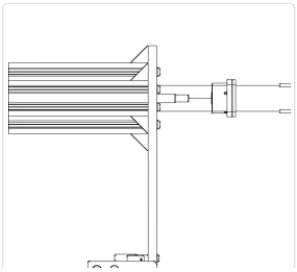
4.4.2 FK Bearing (Fixed)

Item NO	Description	Qty
1	Y-Plate Left	1
2	FK Bearing (Fixed)	1
3	M4 x 16mm Button Head Screw	4

A. Insert the FK Bearing Block (Fixed) through the Ball Screw.

B. Using 4x M4 x 16mm Button Head Screws, secure the FK Bearing Block (Fixed) on the Y-Plate Left.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 2 turns. This part will be fully tightened at the end of this chapter.



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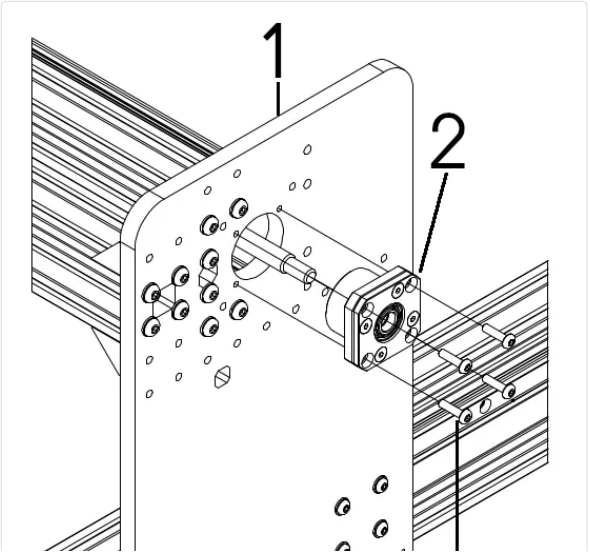
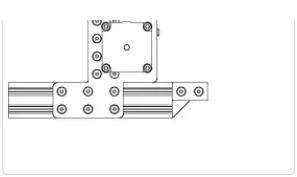
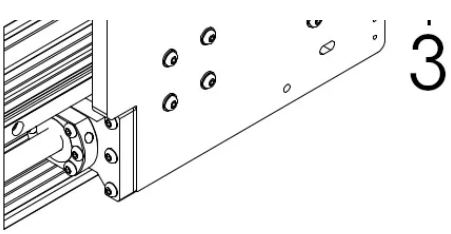






4.4.3 Lock Nut And Diaphragm Coupler

Item NO	Description	Qty
1	Y-Plate Left	1
2	Ball Screw 1210	1
3	Ball Screw Nut	1

A. By Hand, Screw the FK Lock Nut onto the Ball Screw's end which is located on Fixed End.

B. Tighten the Grub Screw located on the FK Lock Nut to secure the FK Lock Nut in place

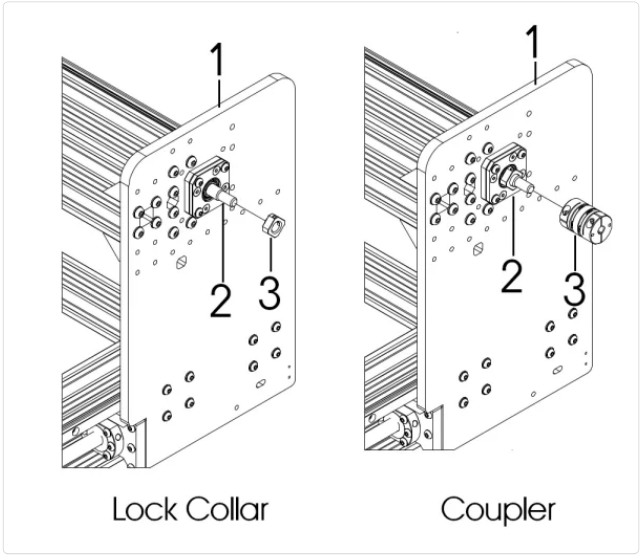
Item NO	Description	Qty
1	Y-Plate Left	1
2	Ball Screw 1210	1
3	Diaphragm Coupler	1

C. On the Ball Screw Fixed End, Insert the Diaphragm Coupler.

D. Tighten the Grub Screw located on the Diaphram Coupler to secure it on the Ball Screw.

Pro Tip: Grub Screws are very sensitive to the amount of torque when tightening. Avoid overtightening them as you may strip the screw's head or round the Allen Key tool.

Click images to expand



4.5 Alignments

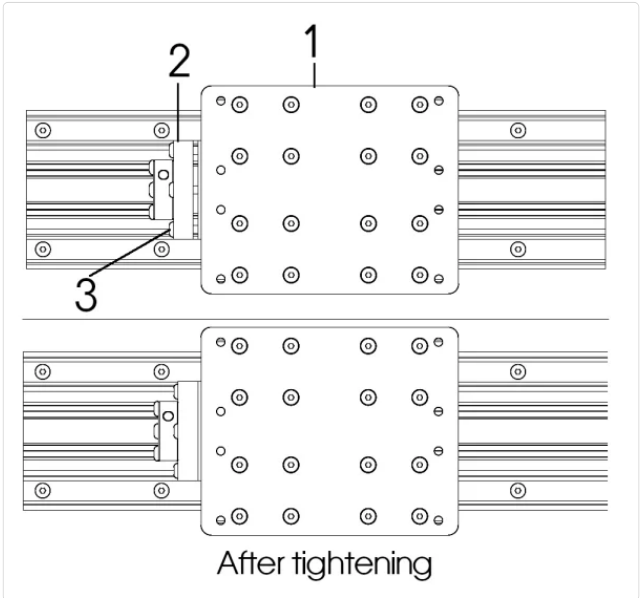
4.5.1 Tightening Ball Nut Plate

Item NO	Description	Qty
1	X-Axis Gantry	1
2	Ball Nut Plate/Bracket	1
3	M4 x 20mm Button Head Screw	3

A. Tighten the Screws on the Ball Nut Plate/Bracket as demonstrated in the illustration.

Pro Tip: Avoid overtightening. As the Gasket has minimum flexibility to fix misalignments on the system. Tightening it too much means that your system is less flexible to adjust to any misalignment.

Click images to expand



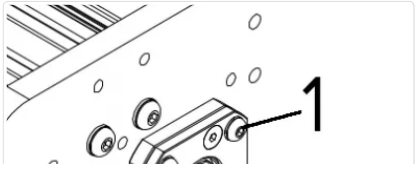
4.5.2 Fixed End

Item NO	Description	Qty
1	M4 x 16mm Button Head Screw	4
2	FK Bearing (Fixed)	1

A. Move the X Gantry towards the Y-Plate Left (where the FK Bearings and Stepper Motor are).

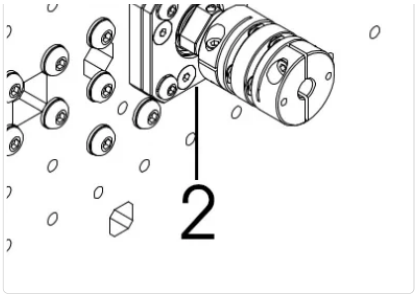
B. As the X Gantry rests on the closest it can be from the Y-Plate Left, secure the FK Bearing (Fixed) by

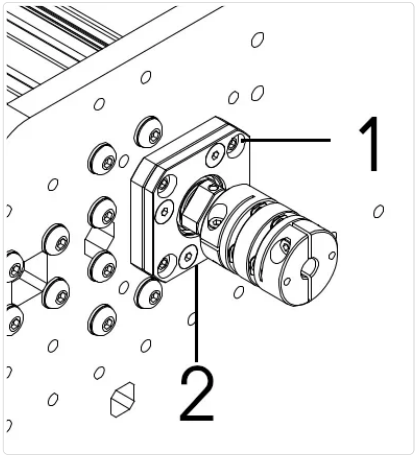
Click images to expand



tightening the M4x 16mm Button Head Screws.

Pro Tip: The Closer the X Gantry is from the Y-Plate Left, the better aligned your FK Bearing (Fixed) will be.





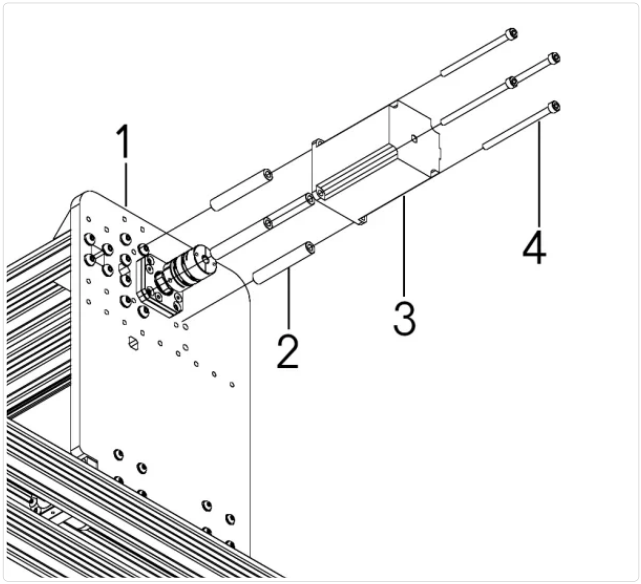
4.5.3 Stepper Motor

Item NO	Description	Qty
1	Y-Plate Left	1
2	Precision Spacer – 60mm	4
3	Stepper Motor	1
4	M5 x 75mm Cap Head Screw	4

A. First insert the M5 x 75mm Cap Head Screws through the Stepper Motor mounting holes and also through the Precision Spacer – 60mm, then secure them on the Y-Plate Left after aligning the motor shaft inside of the Diaphragm Coupler.

Pro Tip: Do not tighten the Grub Screw located on Diaphragm Coupler just yet. We will need to manually move the gantry at the end of this chapter.

Click images to expand



4.5.4 Floating End

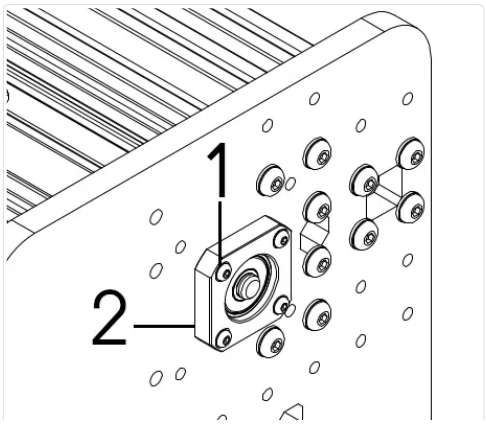
Item NO	Description	Qty
1	M3 x 12mm Button Head Screw	4
2	FF Bearing (Floating)	1

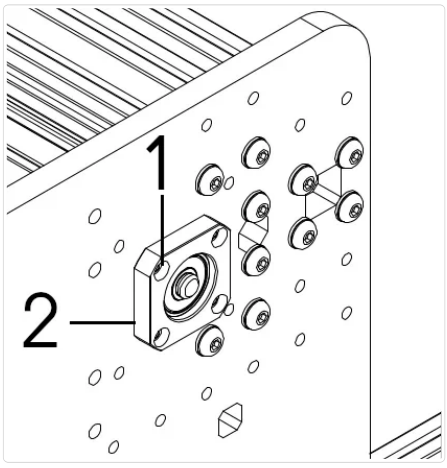
A. Move the X Gantry towards the Y-Plate Right (where the FF Bearing is)

B. As the X Gantry rests on the closest it can be from the Y-Plate Right, secure the FF Bearing (Fixed) by tightening the M3x 12mm Button Head Screws.

Pro Tip: The Closer the X Gantry is from the Y-Plate Right, the better aligned your FF Bearing (Floating) will be.

Click images to expand



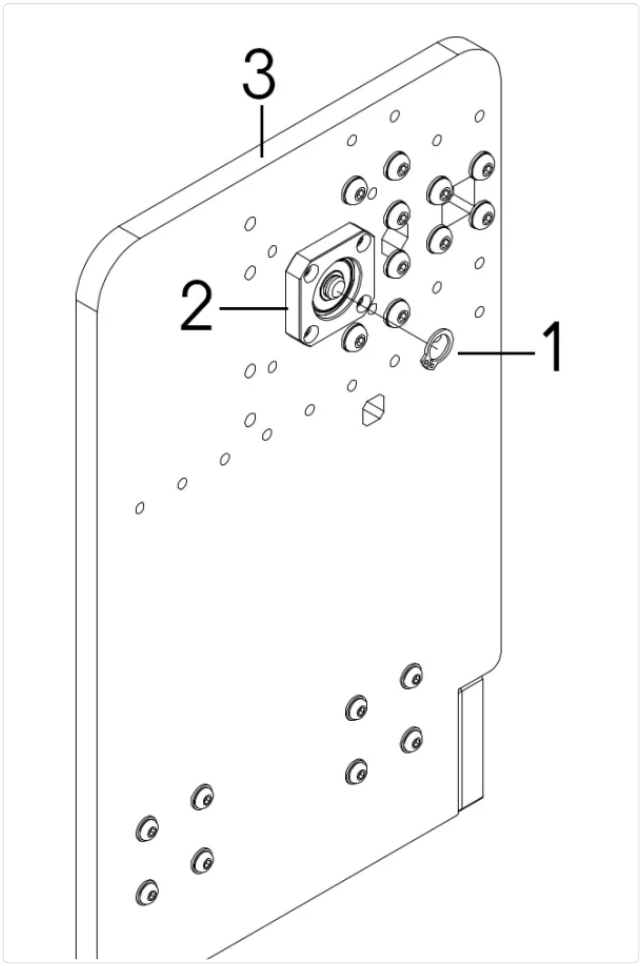


4.5.5 Clips

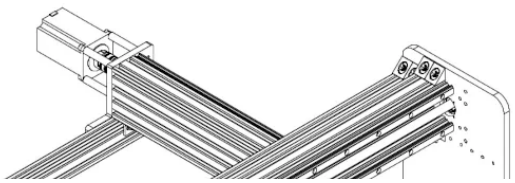
Item NO	Description	Qty
1	C-Clip Retaining Ring	1
2	FF Bearing (Floating)	1
3	Y-Plate Right	1

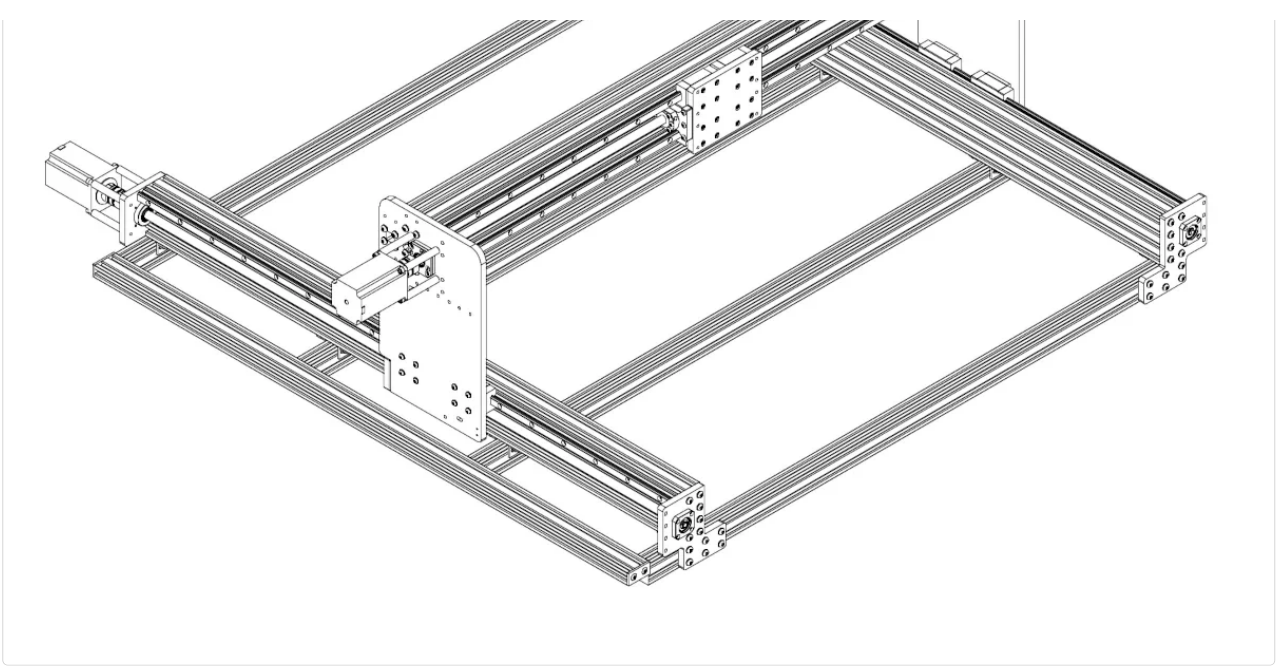
A. By using C-Clip Pliers, insert the Clips on the Ball Screw Floating End as illustrated.

Click images to expand



4.6 X-Axis Complete





4.7 X-Axis Lubrication

4.7.1 HGH Bearings

A. Attach the grease gun to the grease nipple and apply the grease. The grease should squirt out of the bearing.

C. Repeat this for all HGH bearing blocks.

4.7.2 Ball Screw

A. Attach the grease gun to the grease nipple and apply the grease. Some grease will squirt out of the back of the ball screw wiper seal.

B. Run the gantry by hand back and forth multiple times. This will lubricate the rail and circulate the grease on all the bearings and ball screws, ensuring even lubrication.

C. Now that you have your Axis well lubricated and running smoothly, you can tighten the Grub Screw on the Diaphragm Coupler securing it to the motor shaft.

Chapter 5: Z-Axis

5.1 C-Beam and MGN Rails

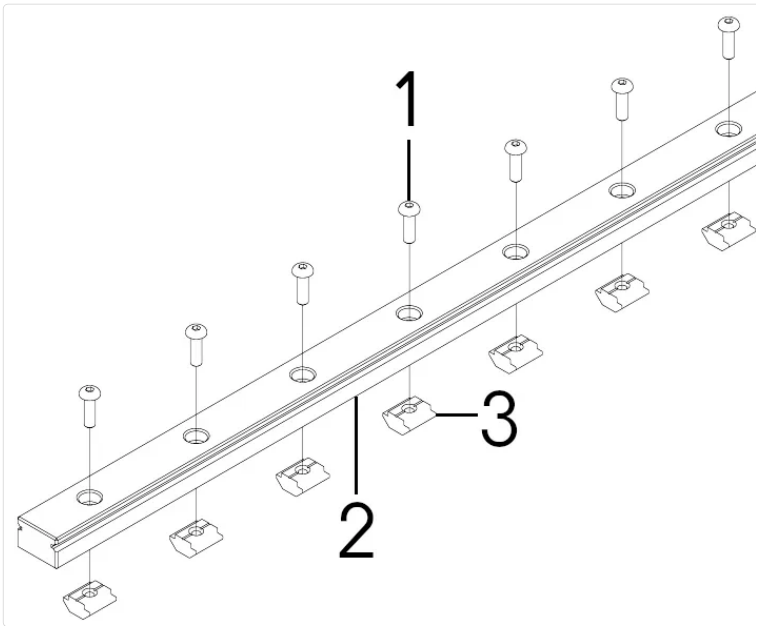
5.1.1 MGN Rail Preparation

Item NO	Description	Qty
1	M3 x 10mm Button Head Screw	8
2	MGN15 Rail	1
3	M3 Sliding T-Nut	8

A. Insert the M3 x 10mm Button Head Screw through the MGN Rail and thread the M3 Sliding T-Nut onto the end. 1/2 a turn on a Screw will be sufficient. We will tighten these later.

B. Repeat the previous step for the second MGN Rail.

Click images to expand



5.1.2 Attaching MGN Rail on the C-Beam

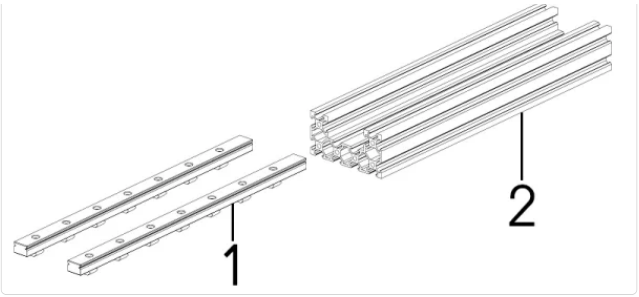
Item NO	Description	Qty

Click images to expand

1	MGN 15 Rail	2
2	C-Beam Extrusion	1

A. Slide the MGN 15 Rail Assembly into the top channel of the “Open C” 80mm face on the C-Beam Extrusion as illustrated in the drawing.

Pro Tip: Sliding the MGN 15 Rails and M3 Sliding T-Nuts can be difficult, get another person to help you hold the rail straight while sliding the T-Nuts into the C-Beam.



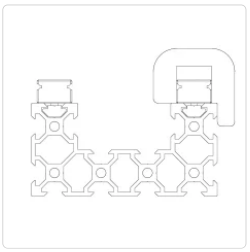
5.1.3 Aligment Tool

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	Alignment Tool	1

A. Slide the Alignment Tool onto the MGN15 Rail and move it closer to the end of the MGN 15 Rail. Tighten the M3 x 10mm Button Head Screw that was introduced in this Chapter.

B. Repeat the procedure by sliding the Alignment Tool and tightening all M4 x 14mm Socket Cap Head Screws close to it.

Pro Tip: Be careful with the amount of torque when tightening the M4 x 14mm Socket Cap Head Screws. Over tightening can strip the screw’s head or round the Allen Key tool.



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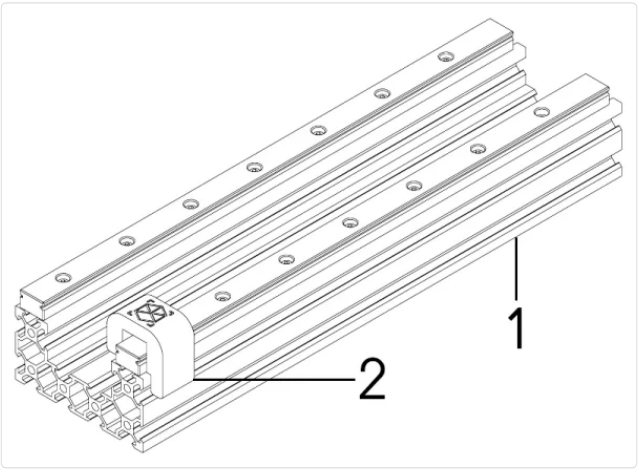


5.1.4 MGN 15 Bearing Blocks

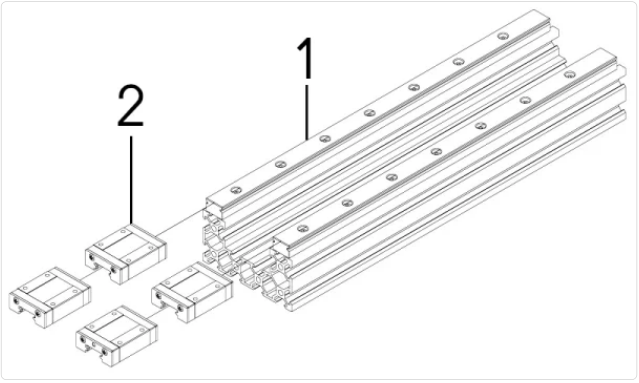
Item NO	Description	Qty
1	MGN 15 Rail	2
2	MGN 15 Bearing Blocks	4

A. Slide 2x MGN 15 Bearing Blocks Per Rail as per image aside.

B. To avoid losing any ball bearings keep the retainer that comes with the packaging on the bearing block. When installing the bearing block onto the rail, use the rail to push the plastic retainer out of the block, this ensures the steel ball bearings are under tension and have contact with a rail at all times.

Pro Tip: Although the drawing does not depict this, it is best practice to have the grease nipple facing outwards to allow easier access during maintenance.

Click images to expand



5.2 Z-Plate

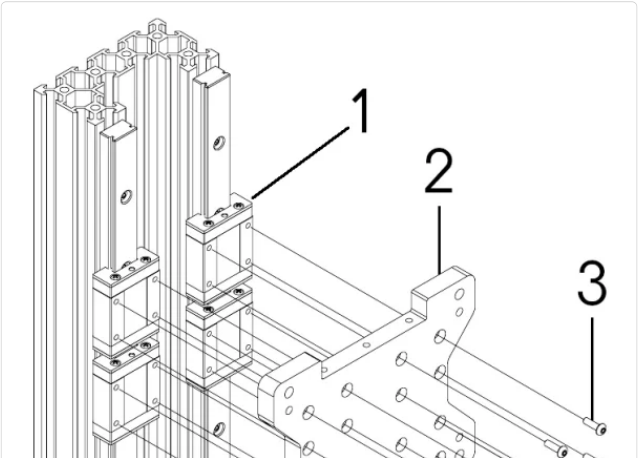
Item NO	Description	Qty
1	MGN 15 Bearing Blocks	4
2	Z-Plate	1
3	M3 x 10mm Button Head Screw	16

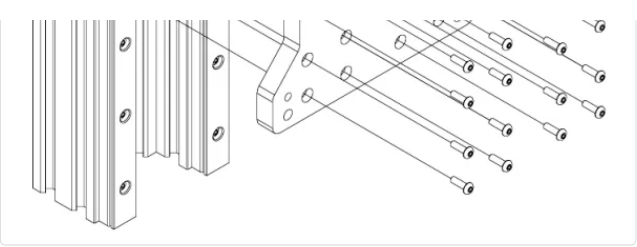
A. Insert the M3 x 10mm Button Head Screws through the Z-Plate and screw it on the MGN Bearings as illustrated.

B. When securing the screws onto each bearing, start with the screw on the top left, tighten this screw by 1 turn. Then secure the screw on the bottom right, tighten this screw by 1 turn. Then secure the screw on the top right, tighten this screw by 1 turn. Then secure the screw on the bottom left, tighten this secure by 1 turn. Continue with this pattern securing all of the screws completely.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 1/8th of a turn. This will avoid overtightening.

Click images to expand





5.3 Ball Screw

5.3.1 Ball Nut and Ball Nut Plate/Bracket

Item NO	Description	Qty
1	M4 x 16mm Button Head Screw	5
2	Ball Nut	1
3	Ball Nut Plate/Bracket	1
4	Ball Screw 1204	1

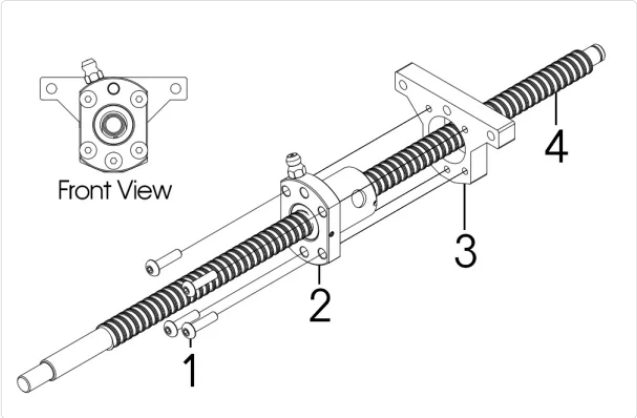
A. Insert the Ball Nut Plate/Bracket on the Ball Screw as illustrated.

B. By using 5x M4 x 16mm Button Head Screws, attach the Ball Nut Plate/Bracket on the Ball Nut.

Note: Use the front view below to refer to the location of the screws.

Pro Tip: Under no circumstances should you remove the Ball Nut from the Ball Screw. The Ball Nut Ball Bearing mechanism is held only by the Ball Screw. Separating the Ball Nut from the Ball Screw will disassemble the Ball Nut and void the warranty of this part.

Click images to expand



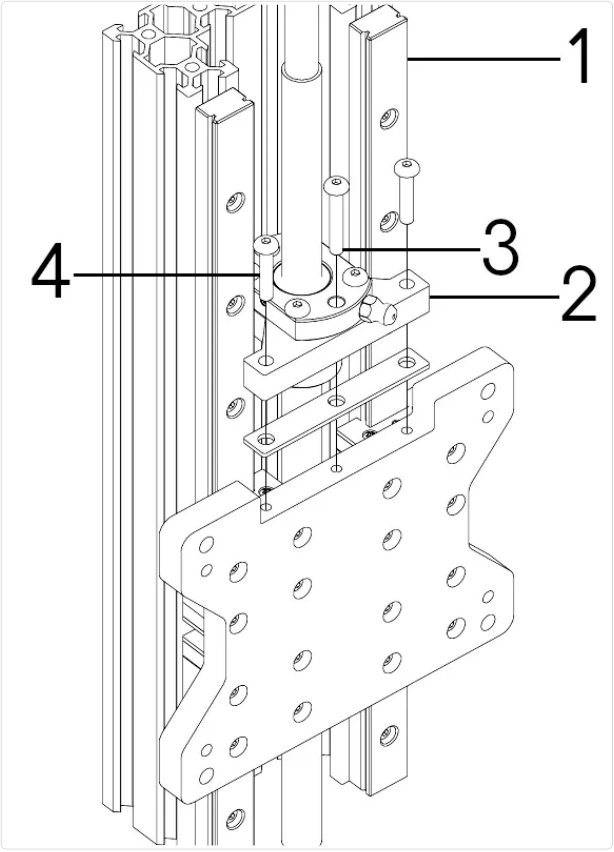
5.3.2 Ball Nut Plate And Z-Plate

Item NO	**Description**	**Qty**
1	C-Beam Extrusion	1
2	Ball Nut Bracket/Plate	1
3	M4 x 25mm Button Head Screw	1
4	M4 x 20mm Button Head Screw	2

A. By using 2x M4x 20mm and 1x M4 x 25mm Button Head Screws, tighten the Ball Nut Plate/Bracket on the Z-Plate. Include the Gasket 50x10mm between the Ball Nut Plate/Bracket and Z-Plate. Secure the screws completely and then unscrew them by 2 turns.

Note: The longer M4 x 25mm Button Head Screw is inserted in the middle hole.

Click images to expand



5.4 End Plates

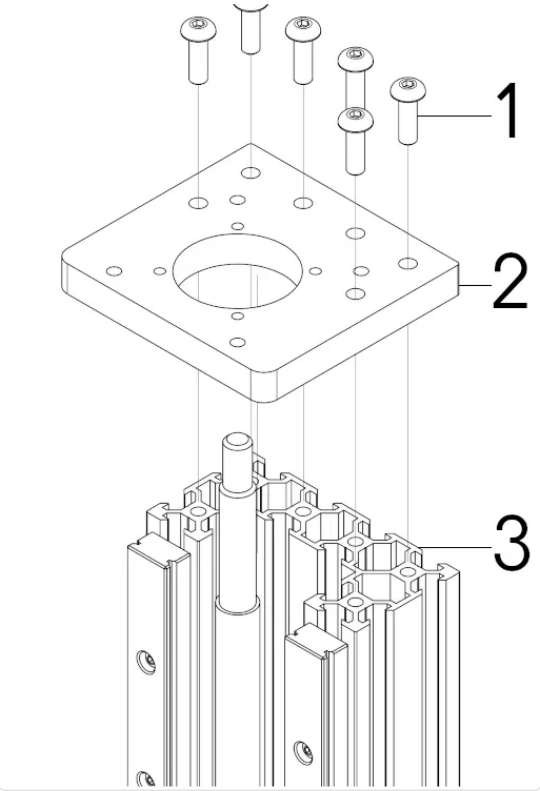
5.4.1 End Plate (Fixed End)

Item NO	**Description**	**Qty**
1	M5 x 16mm Button Head Screw	6

Click images to expand

2	Z Top Plate	1
3	C-Beam Extrusion	1

A. Using 6x M5 x 16mm Button Head Screws, secure the Z Top Plate to the C-Beam Extrusions.

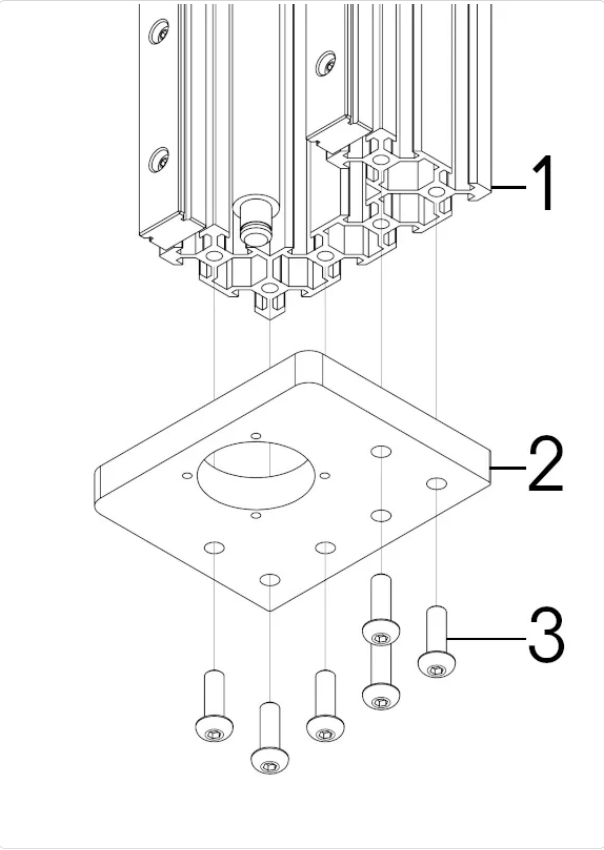


5.4.2 End Plate (Floating End)

Item NO	Description	Qty
1	C-Beam Extrusion	1
2	Z Bottom Plate	1
3	M5 x 16mm Button Head Screw	6

A. Using 6x M5 x 16mm Button Head Screws, secure the Z Bottom Plate to the C-Beam Extrusions.

Click images to expand

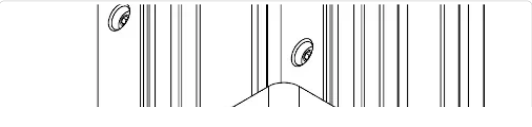


5.5 FK And FF Bearings

5.5.1 FF Bearing (Floating)

Item NO	Description	Qty
1	Z Bottom Plate	1
2	FF Bearing Block (Floating)	1

Click images to expand

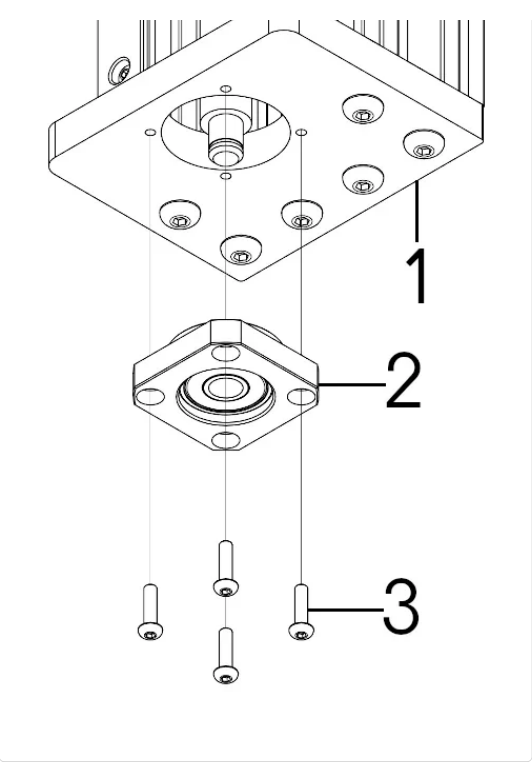


3	M3 x 12mm Button Head Screw	4

A. Insert the FF Bearing Block (Floating) through the Ball Screw.

B. Using 4x M3 x 12mm Button Head Screws, secure the FF Bearing Block (Floating) on the Z Bottom Plate.

Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 2 turns.



5.5.2 FK Bearing (Fixed)

Item NO	Description	Qty
1	FK Lock Nut	1
2	M4 x 16mm Button Head Screw	4
3	FK Bearing Block (Fixed)	1
3	Z Top Plate	1

A. Insert the FK Bearing Block (Fixed) through the Ball Screw.

B. Using 4x M4 x 16mm Button Head Screws, secure the FK Bearing Block (Fixed) on the Z Top Plate.

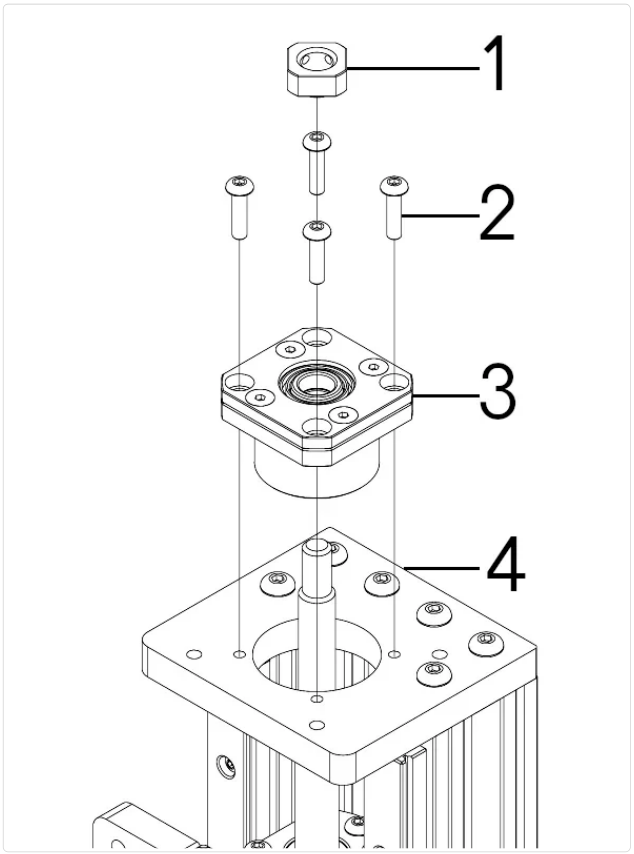
Pro Tip: When tightening the screws, tighten all screws completely and then loosen them 2 turns.

C. By Hand, Screw the FK Lock Nut onto the Ball Screw's end which is located on the Fixed End.

D. Tighten the Grub Screw located on the FK Lock Nut to secure the FK Lock Nut in place.

Pro Tip: Grub Screws are very sensitive to the amount of torque when tightening. Avoid overtightening them as you may strip the screw's head or round the Allen Key tool.

Click images to expand



5.6 Alignments

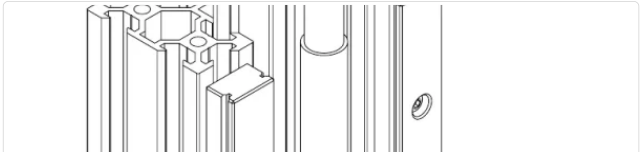
5.6.1 Ball Nut Plate/Bracket

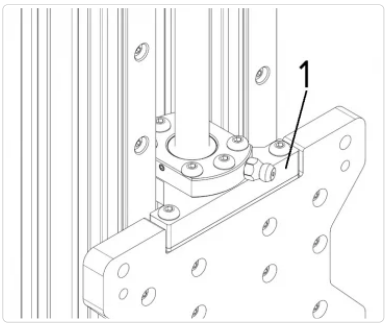
Item NO	Description	Qty
1	Ball Nut Plate/Bracket	1

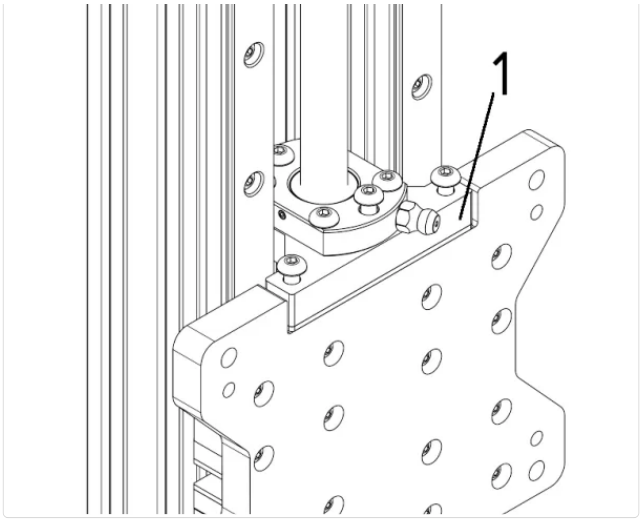
A. Tighten the Screws on the Ball Nut Plate/Bracket as demonstrated in the illustration.

Pro Tip: Avoid overtightening. As the Gasket has minimum flexibility to fix misalignments on the system. Tightening it too much means that your system is less flexible to adjust to any misalignment.

Click images to expand



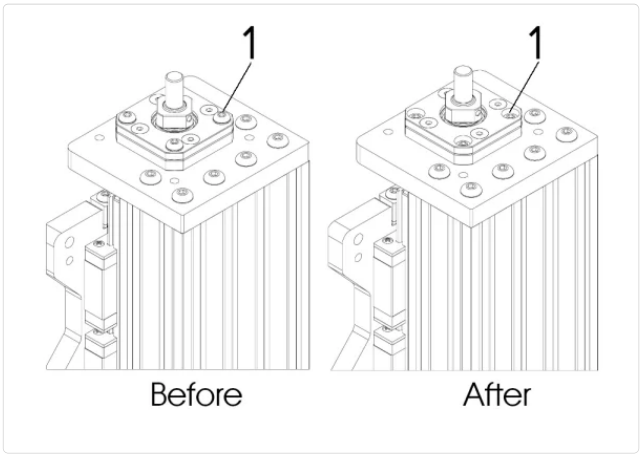




5.6.2 Fixed End

Item NO	Description	Qty
1	M4 x 16mm Button Head Screw	4

Click images to expand



A. Move the Z-Gantry towards the Fixed end of the Actuator as illustrated.

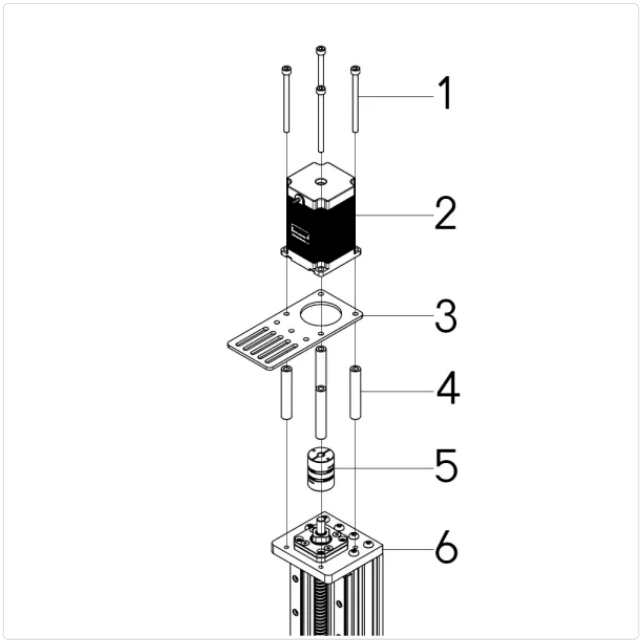
B. As the Z-Gantry rests on the closest it can be from the Fixed End of the actuator, secure the FK Bearing (Fixed) by tightening the 4x M4x 16mm Button Head Screws.

Pro Tip: The closer the Z-Gantry is from the Fixed End of the actuator, the better aligned your FK Bearing (Fixed) will be.

5.6.3 Stepper Motor

Item NO	Description	Qty
1	M5 x 70mm Cap Head Screw	4
2	Stepper Motor	1
3	CDC Mount NEMA23 Plate	1
4	Metric Aluminum Spacer 57mm	4
5	Diaphragm Coupler	1
6	Z Top Plate	1

Click images to expand



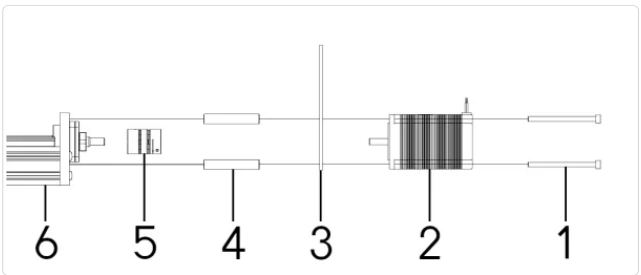
A. On the Ball Screw Fixed End, Insert the Diaphragm Coupler.

B. Tighten the Grub Screw located on the Diaphram Coupler to secure it on the Ball Screw.

Pro Tip: Grub Screws are very sensitive to the amount of torque when tightening. Avoid overtightening them as you may strip the screw's head or round the Allen Key tool

C. Insert the M5 x 70mm Cap Head Screws through the Stepper Motor mounting holes, CDC Mount NEMA23 Plate and the Precision Spacer – 57mm, and then secure them on the Z Top Plate after aligning the motor shaft inside of the Diaphragm Coupler.

Pro Tip: Do not tighten the Grub Screw located on Diaphragm Coupler just yet.



5.6.4 Floating End

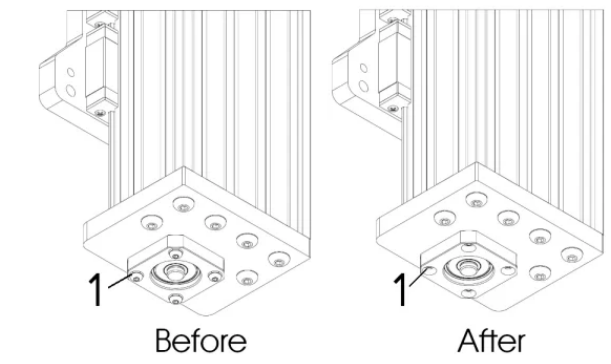
Item NO	Description	Qty
1	M3 x 12mm Button Head Screw	4

A. Move the Z-Gantry towards the Floating End of the Actuator as illustrated.

B. As the Z-Gantry rests on the closest it can be from the Floating End of the actuator, secure the FK Bearing (Fixed) by tightening the 4x M3x 12mm Button Head Screws.

Pro Tip: The closer the Z-Gantry is from the Floating End of the actuator, the better aligned your FF Bearing (Floating) will be.

Click images to expand

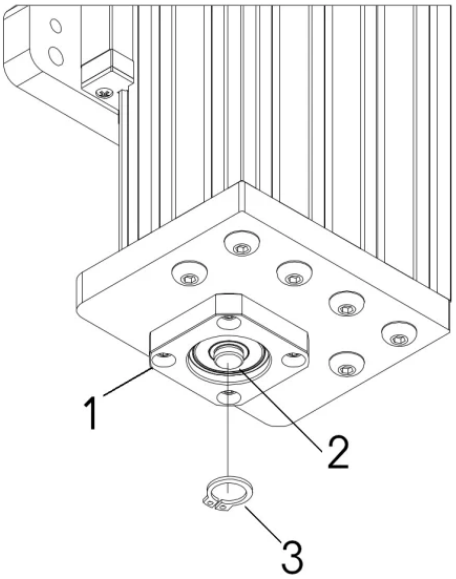


5.6.5 Clips

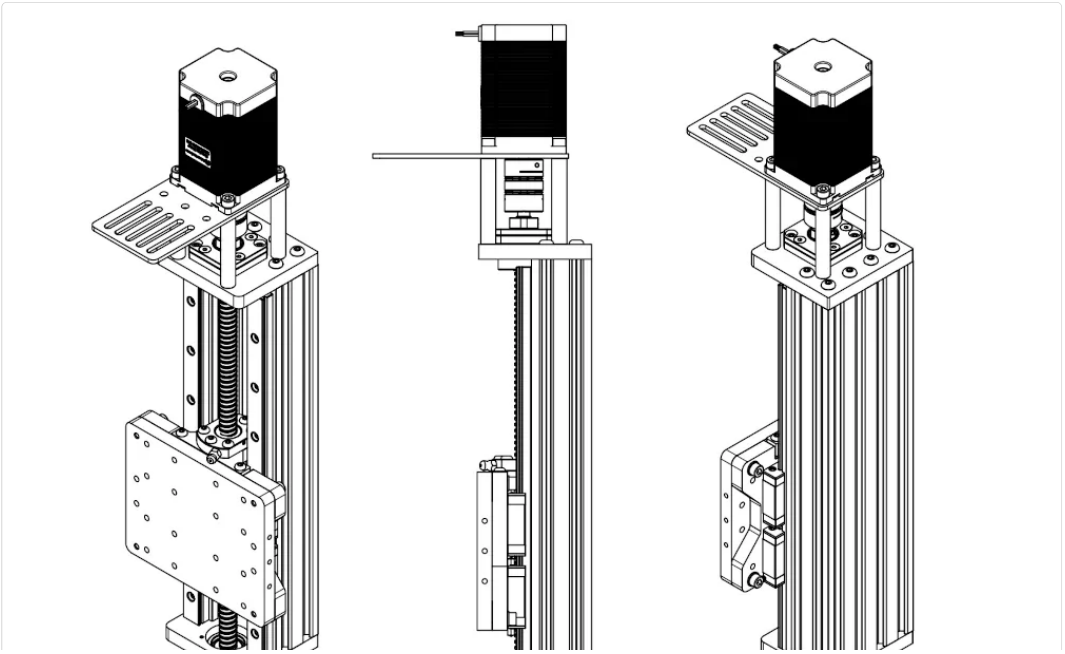
Item NO	Description	Qty
1	FF Bearing (Floating)	1
2	Ball Screw 1204	1
3	C-Clip Retaining Ring	1

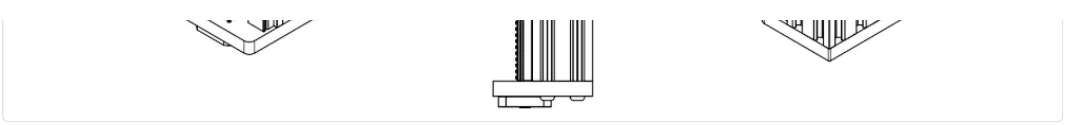
A. By using C-Clip Pliers, insert the Clips on the Ball Screw Floating End as illustrated.

Click images to expand



5.7 Z-Axis Complete





5.8 Z-Axis Lubrication

5.8.1 MGN Bearings

A. Apply white lithium grease directly to the MGN 15 Rails.

For continuous care, please read the chapter: 8 Care And Maintenance

5.8.2 Ball Screw

A. Lay the gantry on its side and locate the grease nipple on the Ball Nut.

B. Attach the grease gun to the grease nipple and apply the grease. Some grease will squirt out of the back of the ball screw wiper seal.

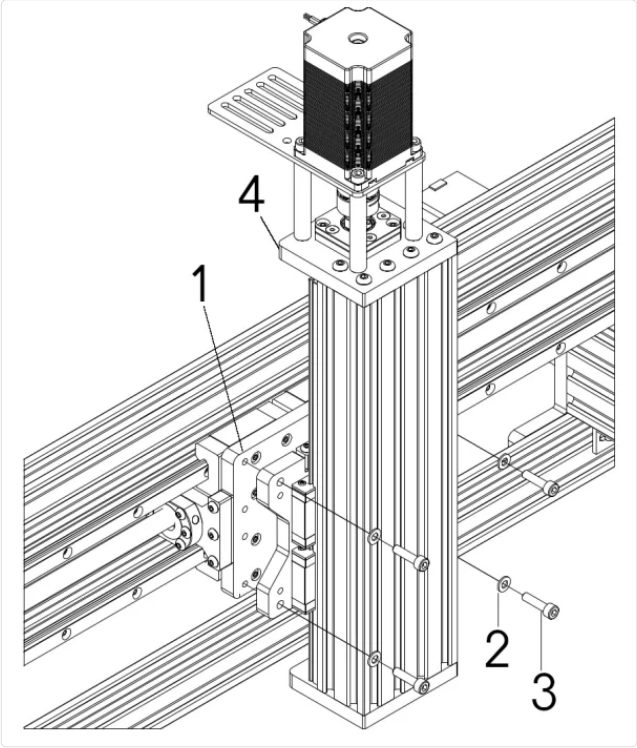
C. Run the gantry by hand back and forth multiple times. This will lubricate the rail and circulate the grease on all the bearings and ball screws, ensuring even lubrication.

5.9 Mating X and Z Axes

Item NO	Description	Qty
1	X-Gantry	1
2	Precision Shim 10x5x1	4
3	M5 x 20mm Cap Head Screw	4
4	Z-Axis Actuator	1

A. First, Insert the M5 x 20mm Cap Head Screw through the Precision Shim 10x5x1 and then Secure the Z-Gantry Plate on the X-Gantry Plate.

Click images to expand



6.0 Commissioning

6.1 Introduction

At this stage, the loose side distance on the Spoiler Board is defined by the X-Axis. As we proceed with the commissioning, we will start to tighten the Brackets L2 and Y-End Plates early introduced in Chapter 3.0.

The X-Axis Extrusion will pretty much dictate the position for the Loose side on the Spoiler Board. Going thoroughly through the next steps will help you to ensure Y-Axis parallelism and also perpendicularity for your machine.

For each step, before tightening, we recommend placing one face of a Builder's Square on the Spoilerboard's Extrusion, while the other face of your Builder's Square mates against the Y-Axis' C-Beam Extrusion. This will ensure perpendicularity between planes.

6.2 Squaring Your Machine

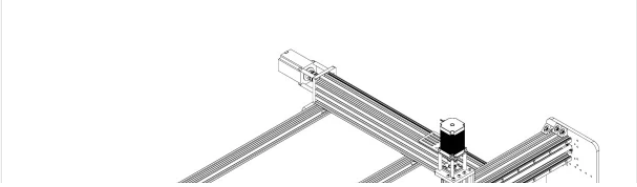
6.2.1 - Front

Click images to expand

A. Ensure that all parts connected to the Spoiler Board brackets can move on the Loose Side. The Loose side has to be able to self align as we perform the next steps.

B. Move the Y-Axis towards the front of the machine as per the illustration. Ensure to move your Y-Axis as close as you can from the front of your machine.

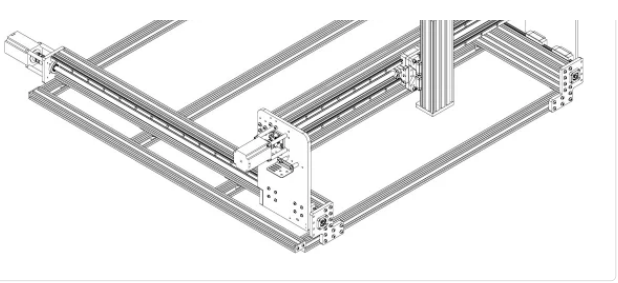
C. Place one face of a Builder's Square on the Spoilerboard's Extrusion, while the other face of your Builder's Square mates against the Y-Axis' C-Beam Extrusion and then tighten the screws that secure the Y-End Plate to the front of the machine.



If you are unsure of what screws to tighten, please refer to Chapter 3.3.6.

D. Tighten Screws that secure the Bracket L2 to the Front 2040 Extrusion. Please refer to Chapter 3.3.2.

Important: Ensure to use a reliable Builder's Square for this process. Using a poor quality tool will negatively impact your CNC's results later on.



6.2.1 - Rear

Click images to expand

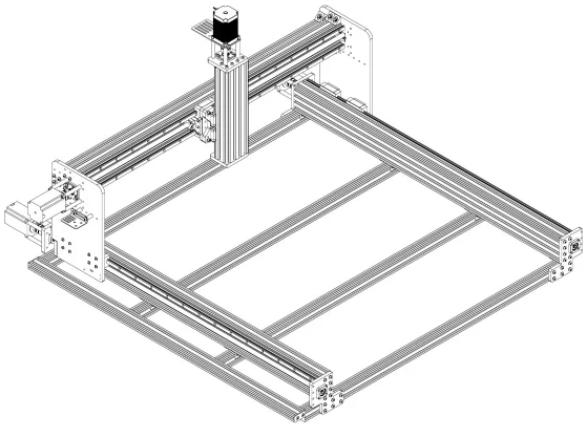
A. Ensure that all parts connected to the Spoiler Board brackets can move on the Loose Side. The Loose side has to be able to self align as we perform the next steps.

B. Move the Y-Axis towards the rear of the machine as per the illustration. Ensure to move your Y-Axis as close as you can from the rear of your machine.

C. Place one face of a Builder's Square on the Spoilerboard's Extrusion, while the other face of your Builder's Square mates against the Y-Axis' C-Beam Extrusion and then tighten the Screws that secure the Y-End Plate to the rear of the machine.
If you are unsure of what screws to tighten, please refer to Chapter 3.3.5.

D. Tighten Screws that secure the Bracket L2 to the rear 2040 Extrusion. Please refer to Chapter 3.3.4.

Important: Ensure to use a reliable Builder's Square for this process. Using a poor quality tool will negatively impact your CNC's results later on.



6.2.2 Middle Sections

Click images to expand

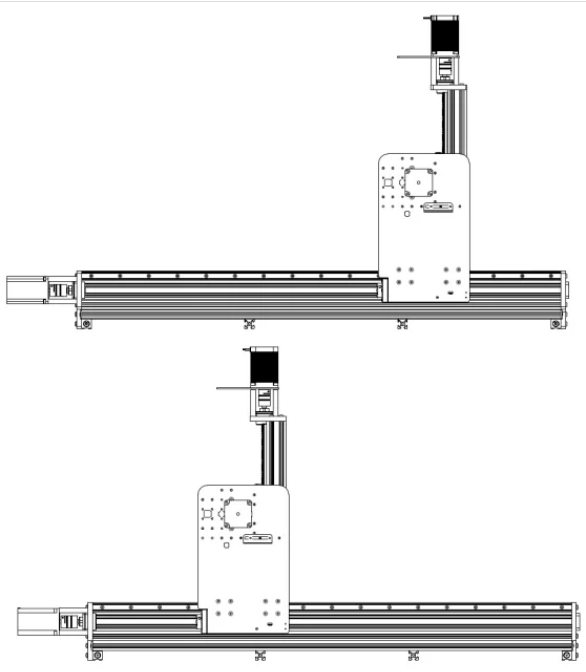
A. Ensure that all parts connected to the Spoiler Board brackets can move on the Loose Side. The Loose side has to be able to self align as we perform the next steps.

B. Move the Y-Axis towards the first middle extrusion as per the illustration.

D. Tighten Screws that secure the Bracket L2 to the rear 2040 Extrusion. If you are unsure of which bracket needs to be tightened, please refer to Chapter 3.3.3.

E. Move the Y-Axis towards the second middle extrusion as per the second illustration.

F. Tighten Screws that secure the Bracket L2 to the rear 2040 Extrusion. If you are unsure of which bracket needs to be tightened, please refer to Chapter 3.3.3.

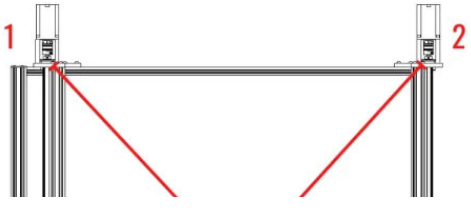


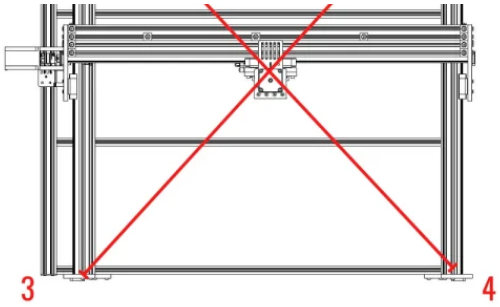
6.3 Taking the Measurements

Click images to expand

A. Measure the distance between **1** and **4** and compare it with the distance between **2** and **3.**

The distance acquired with the measurements above should be very similar. Good results are between 1mm to 2mm. If you have achieved better results by measuring the diagonals, you have Squared your machine well. Although if you have found a larger deviation, we recommend redoing chapter 6.2.





7 Care And Maintenance

To avoid downtime, we recommend preventive maintenance for your CNC. It is always best to keep it clean and well lubricated at all times.

We recommend performing three types of maintenance for these machines: Preventive Maintenance, Usage-Based Maintenance and Condition-Based Maintenance. While we can guide you through the preventive maintenance, the Usage-Based and the Condition-Based Maintenance are up to the User's discretion.

Preventive Maintenance

Daily Care

- In case you have a Water-Cooled Spindle: Check for water circulation in the water container.
  For a water-cooled spindle, we also recommend getting a flow indicator for ease of inspection or a flow switch connected to the Pause in your controller to avoid your spindle getting damaged.

  Water-Cooled Spindle Care: Always have distilled water in your spindle and in case you live in areas of low temperatures capable of freezing the water, we recommend adding an Anti-Freezing agent to the distilled water.

Weekly

- By using an air compressor and small brush, clean all areas with accumulative dust.

Monthly

- Clean Rails and Ball Screws with a microfiber cloth soaked alcohol-based cleaning agents such as methylated spirits or isopropyl alcohol.
- Lubricate Ball Screws by using a Grease Gun.
- Lubricate HRG and MGN Rail by using a Grease Gun.

Quarterly

- In case you have a Water-Cooled Spindle: Replace water and clean water reservoir with Baking Soda, Vinegar and Bleach. After the Cleaning procedure is done, Dry the reservoir with a microfiber cloth and fill up the reservoir with distilled water.
- Inspect Limit Switches and Screws.

Annually

- Cleck for "play" sign on the bearings and Ball Screw Nuts.
- Check for loose Electrical Electronics wires and connectors.

Pro Tip:

As a CNC Machine owner, to avoid downtime, it is always recommended to have spare parts of items in your kit that can't be easily found locally.

8 Credits