

Rat Rig

02. X-Axis Gantry Assembly

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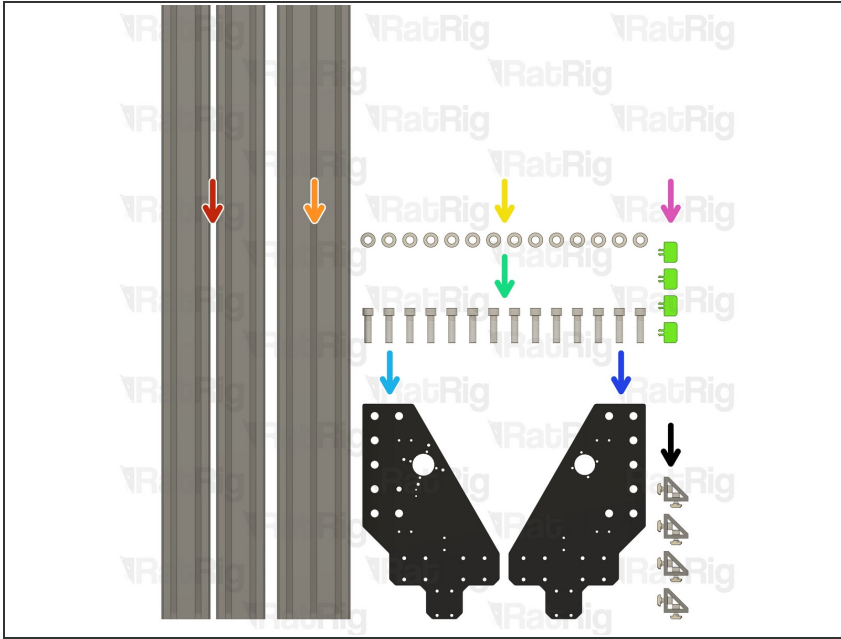
INTRODUCTION

Please note: This guide is based upon building a 1000x1000 StrongHold PRO.

Measurements for the 1000x1500 and 1500x1500 machine sizes are provided in the relevant steps.

It is **strongly recommended** to assemble the X-axis gantry on a known flat surface (such as a solid table, work surface or similar). Assembling on a carpeted floor, or other non-flat surface, can cause the finished gantry to not be square. This can cause issues with quality and performance.

Step 1 — Prepare the X-axis gantry extrusions & plates



- 2x 1216mm 4080 Extrusion
(1716mm for the StrongHold PRO 1500x1500)
- 1x 1216mm 40120 Extrusion
(1716mm for the StrongHold PRO 1500x1500)
- 14x M12 Washer
- 14x M12x45 Cap Head Screw
- 1x Rat Rig StrongHold PRO CNC - XY Joiner Plate Left
- 1x Rat Rig StrongHold PRO CNC - XY Joiner Plate Right
- 4x sh_pro_hg25r_end_spacer
Printed Part
- 4x 4040 Extruded Corner Assembly
(For the gantry)

Step 2 — Assemble the X-axis gantry frame - Part 1

- 1216mm 4080 Extrusion
 - ① 1716mm for the StrongHold PRO 1500x1500
- 1216mm 40120 Extrusion
 - ① 1716mm for the StrongHold PRO 1500x1500
- Position the three extrusions as shown to form a "C" shape as shown

Step 3 — Assemble the X-axis gantry frame - Part 2

- 4040 Extruded Corner Assembly

- Slide each 4040 corner assembly in to the inner channel as shown

- ① Position the 4040 corner assemblies based upon the following measurements:

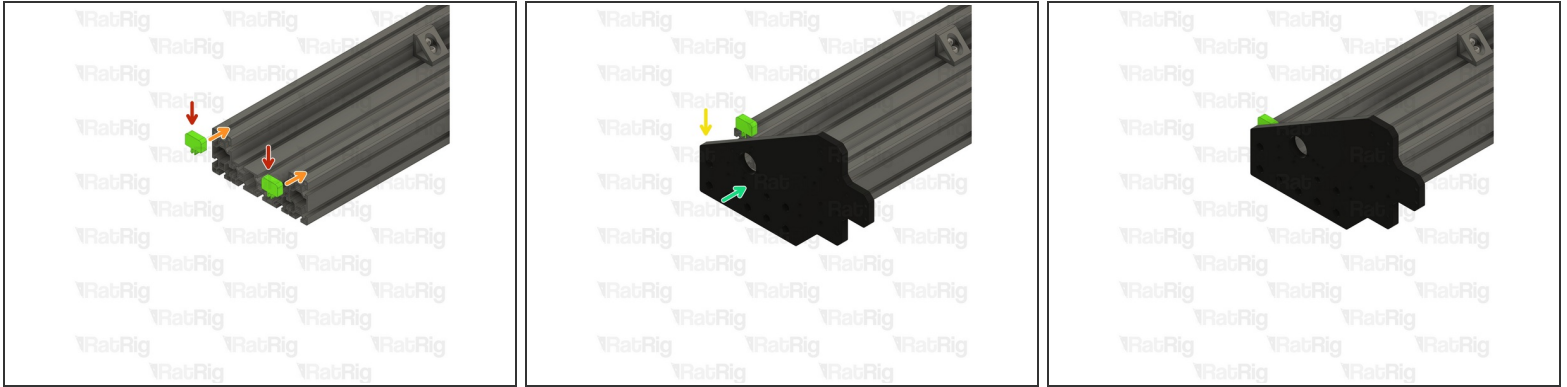
- ① 1000x1000 or 1000x1500:

- 380mm

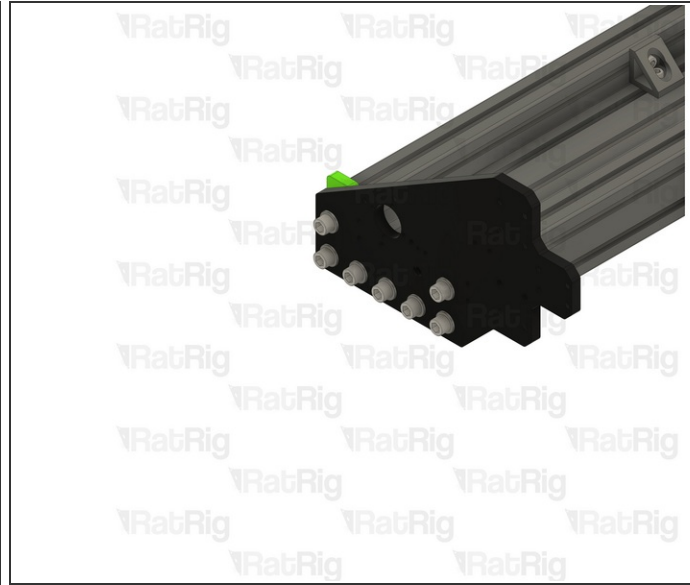
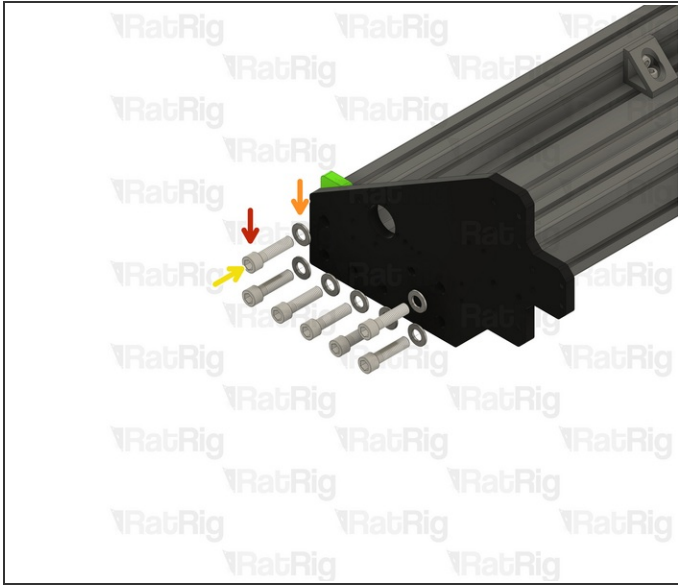
- ① 1500x1500:

- 550mm

⚠ Do not tighten the corner assemblies at this point, this will be done after squaring the assembly

Step 4 — Assemble the X-axis gantry frame - Part 3

- sh_pro_hg25r_end_spacer Printed Part
- Insert two sh_pro_hg25r_end_spacer printed parts in to the 4080 extrusions as shown
- Rat Rig StrongHold PRO CNC - XY Joiner Plate Left
 - ⚠ Verify you are installing the correct plate on the left side. The left plate has additional holes not found on the right one.
- Align the XY Joiner plate with the end of the gantry assembly

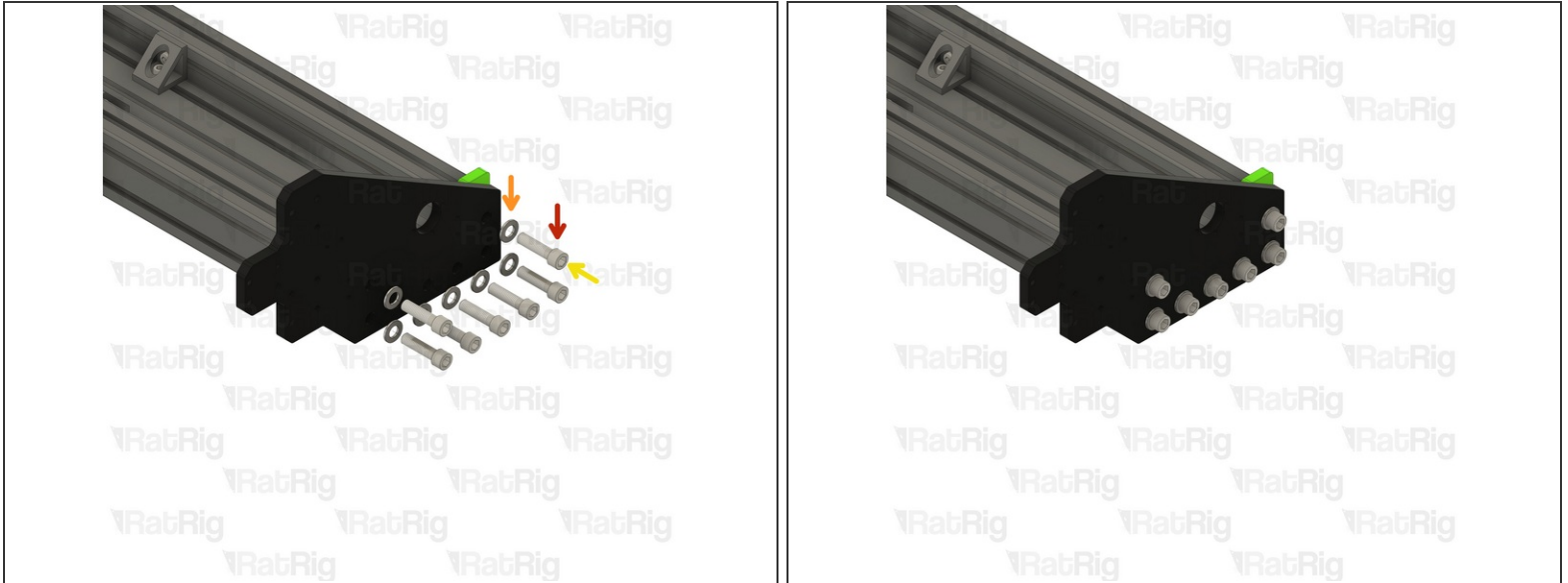
Step 5 — Assemble the X-axis gantry frame - Part 4

- M12x45 Cap Head Screw
- M12 Washer
- Place an M12 washer on to each M12x45 cap head screw and loosely screw them through the plate and in to the extrusion

⚠ Do not fully tighten any of the M12 screws at this point

Step 6 — Assemble the X-axis gantry frame - Part 5

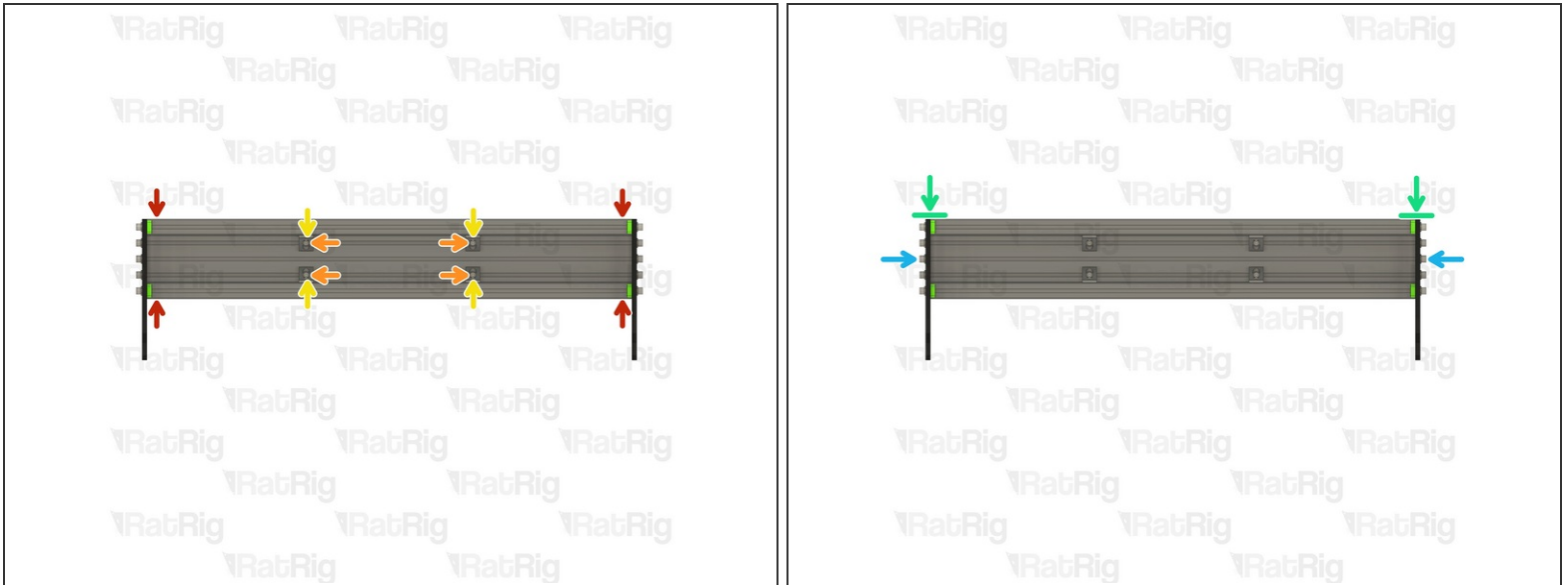
- sh_pro_hg25r_end_spacer Printed Part
- Insert two sh_pro_hg25r_end_spacer printed parts in to the 4080 extrusions as shown
- Rat Rig StrongHold PRO CNC - XY Joiner Plate Right
- Align the XY Joiner plate with the end of the gantry assembly

Step 7 — Assemble the X-axis gantry frame - Part 6

- M12x45 Cap Head Screw
- M12 Washer
- Place an M12 washer on to each M12x45 cap head screw and loosely screw them through the plate and in to the extrusion

⚠ Do not fully tighten any of the M12 screws at this point

Step 8 — Ensure the X-axis gantry is square



i Before continuing with the assembly, the gantry must be squared and all screws full tightened

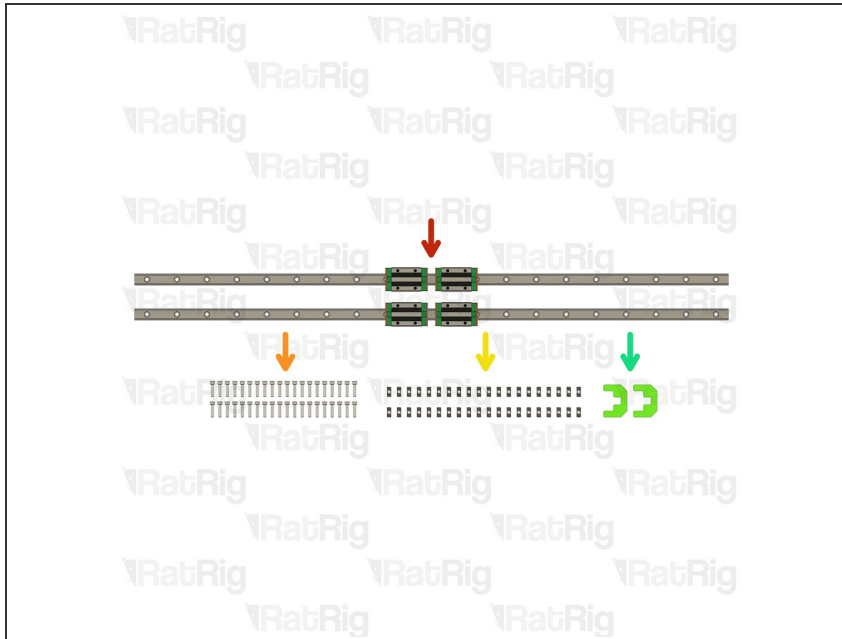
- Ensure the three extrusions are pressed together with no gaps. If clamps are available, the extrusions can be optionally clamped together for the remainder of this step. **If using clamps, make sure they are positioned as low as possible.** Do not deform the "C" shape of the extrusions!
- Tighten the four marked M8x16 screws in the extruded brackets to secure them to the rear 40120 extrusion. Check that the measurements mentioned in **Step 3** are maintained

⚠ Verify there are no gaps between the extrusions, and that the extrusion ends are aligned

- Fully tighten the remaining four M8x16 screws in the extruded brackets
- Using an engineers square, or a flat edge, check that the side plates are flush with the extrusions at the top of the gantry
- Fully tighten all fourteen M12x45 screws on both ends of the gantry to secure everything together

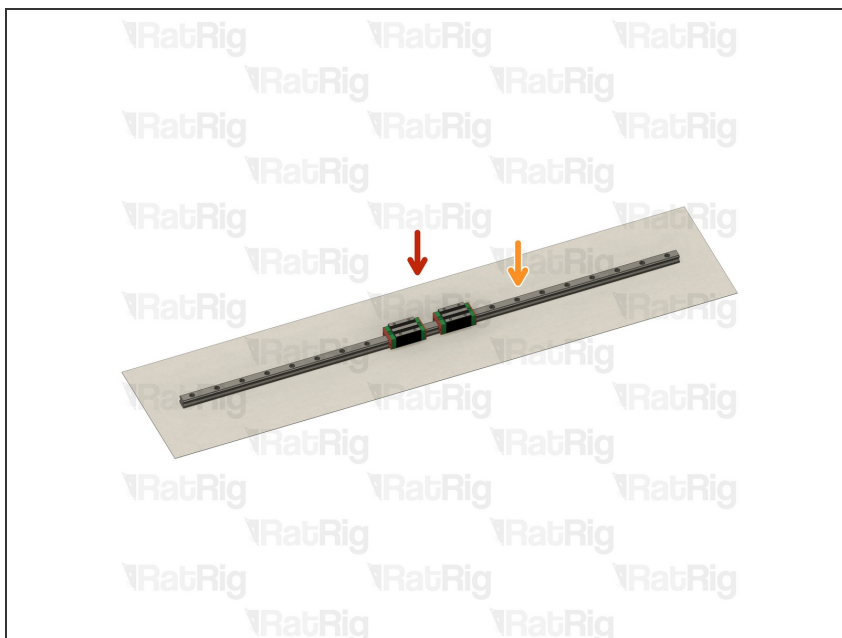
⚠ Verify that all parts of the X-axis gantry assembly are still correctly aligned and adjust as necessary

Step 9 — Prepare the X-axis linear rails



- 2x 1190mm HG25 Linear Rail with 2x Carriages
- ① 2x 1690mm for a 1500x1500 machine
- 40x M6x25 Cap Head Screw
- ① 56x for a 1500x1500 machine
- 40x 4040 Drop-in T-Nut - M6
- ① 56x for a 1500x1500 machine
- 2x align_4080_hg25 Printed Part

Step 10 — Unpack and prepare two HG25 linear rails



⚠ The linear rails are supplied with a protective oil coating on them. It is **strongly recommended** to prepare

your work surface with paper towels and to wear disposable gloves.

- Paper Towels

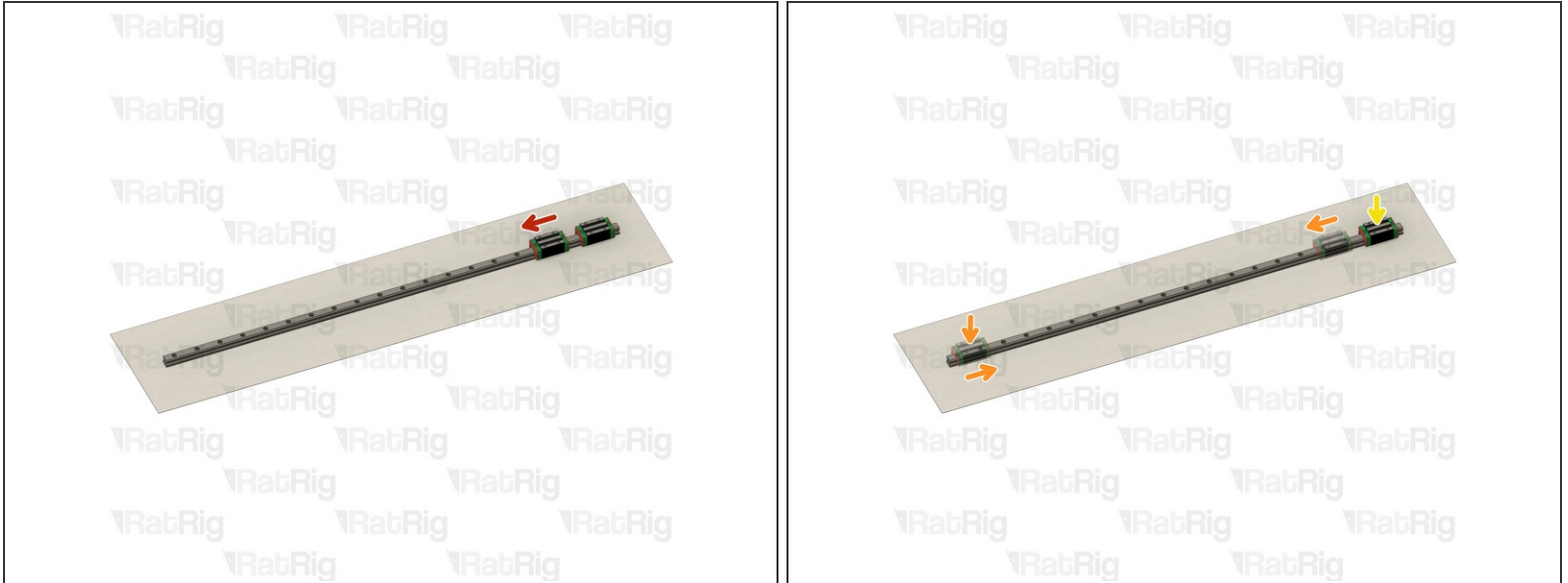
- Linear Rail

- ⓘ Carefully open one end of the linear rail packaging and remove the rail. Place the rail upon the paper towels and dispose of the packaging

- ⚠ The oil on the rails protects them from rusting. Make sure not to remove all of the original oil during preparation.

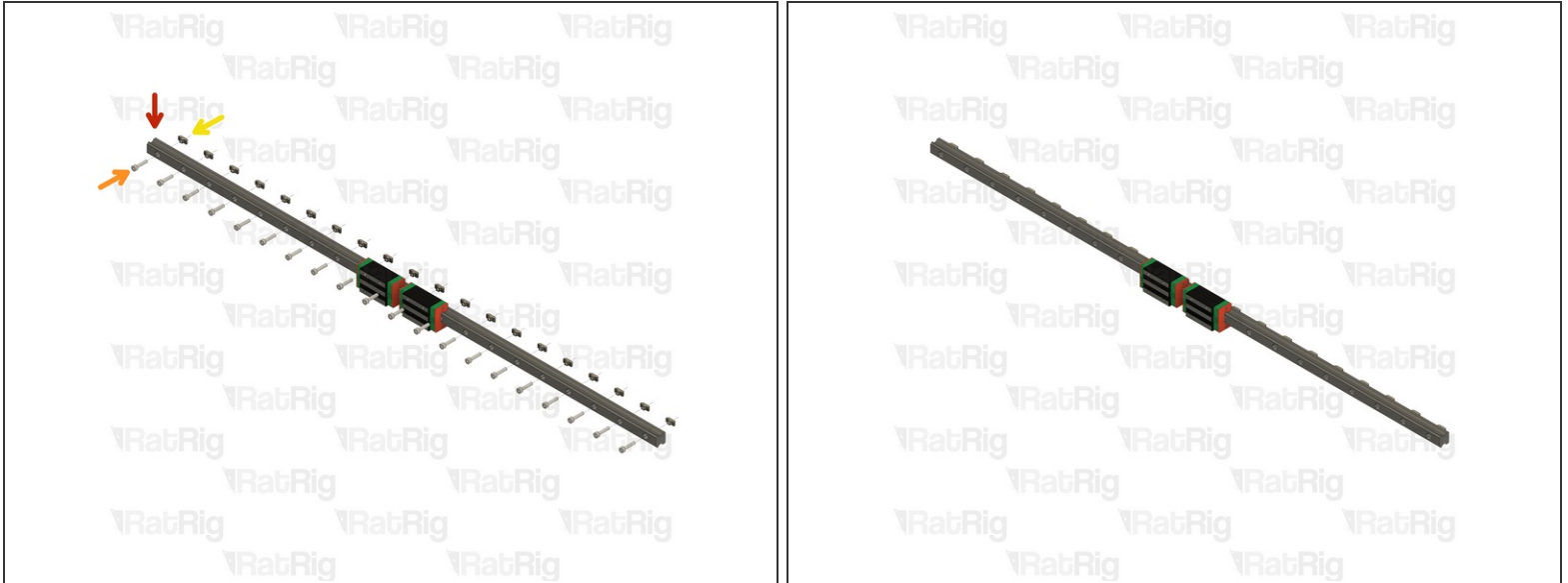
- ⚠ The linear rail carriages are not interchangeable. Do not try to use a carriage on a different linear rail than the one it was supplied with.

Step 11 — Inspect & test the HG25 linear rails



- With the rail still on the absorbent paper towels, carefully and slowly move the carriage from one end of the rail to the other
 - ① Both carriages should move smoothly over the entire length of the rail
- ⚠ Small changes in resistance are normal, but the carriage becoming very hard to push, or binding completely are not
- Repeat the previous test whilst applying a small amount of force downwards on the carriage
 - ① The carriage will likely travel more smoothly when applying a downwards force, this is normal
- Repeat the process to check the second carriage on the rail
- ⚠ If the carriage does not move smoothly, or binds completely, refer to the [Linear Rail Troubleshooting Guide](#)

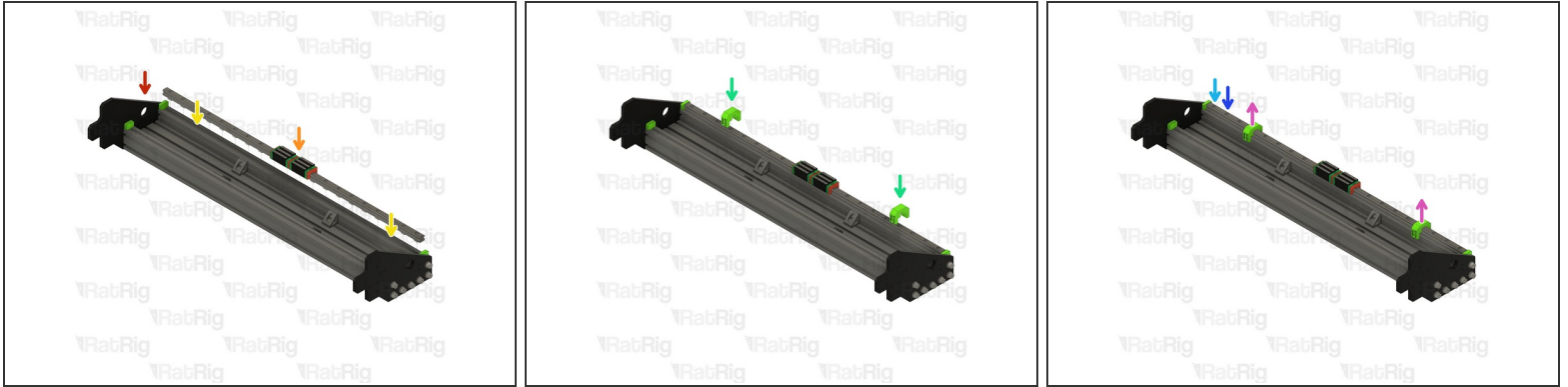
Step 12 — Assemble the HG25 linear rails



⚠ Do not allow the linear rail carriages to leave the end of the rail at any point

- HG25 Linear Rail
- Insert an M6x25 cap head screw in each of the holes on the linear rail
- Loosely thread a 4040 T-Nut on to each of the M6x25 screws
- ① Repeat these instructions for the second linear rail

Step 13 — Install the top HG25 linear rail

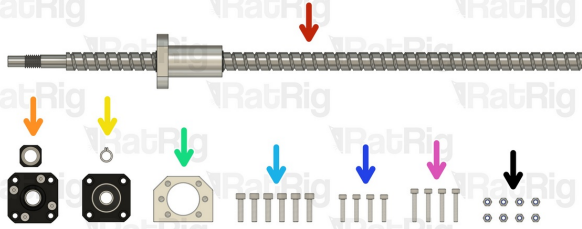


- StrongHold PRO X-Axis Gantry Assembly from **Step 8**
- HG25 Linear Rail Assembly from **Step 12**
- Insert the linear rail into the slot of the 4080 extrusion, between the 3D printed spacers
- Install the two HG25 4080 alignment tools as shown, this will make sure the linear rail is positioned correctly
- Tighten every other M6x25 screw, starting from one end
- Tighten the remaining M6x25 screws, starting from the same end as before
- Remove the HG25 40120 alignment tools

Step 14 — Install the bottom HG25 linear rail

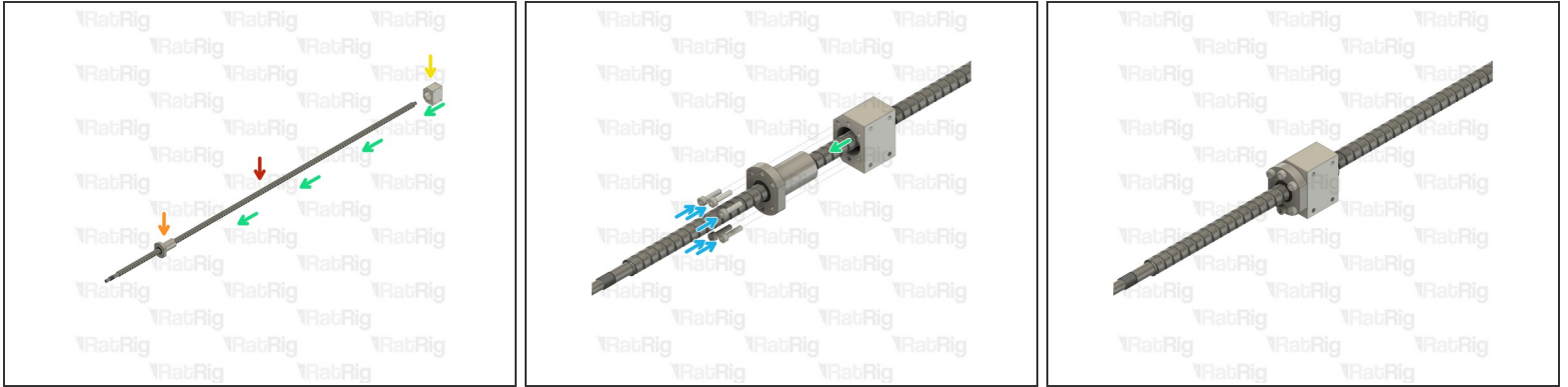


- ① Repeat the instructions in the **previous step** to install the second HG25 linear rail to the X-axis gantry assembly

Step 15 — Prepare the X-axis ball screw parts

- 1x 1280mm 1610 Ball Screw
(1780mm for a 1500x1500 machine)
- 1x FK12 Ball Screw Mount & Ball
Screw lock nut (Packaged with the
FK12 mount)
- 1x FF12 Ball Screw Mount & Circlip
(Packaged with the FF12 mount)
- 1x 16mm Ball Screw Block
- 6x M5x20 Cap Head Screw
- 4x M4x20 Cap Head Screw
- 4x M4x25 Cap Head Screw
- 8x M4 Nylon Locking Hex Nut

Step 16 — Assemble the X-axis ball screw



- 1280mm 1610 Ball Screw (1780mm for a 1500x1500 machine)

i Unpack and remove all protective packaging from the ball screw

- Ball screw nut

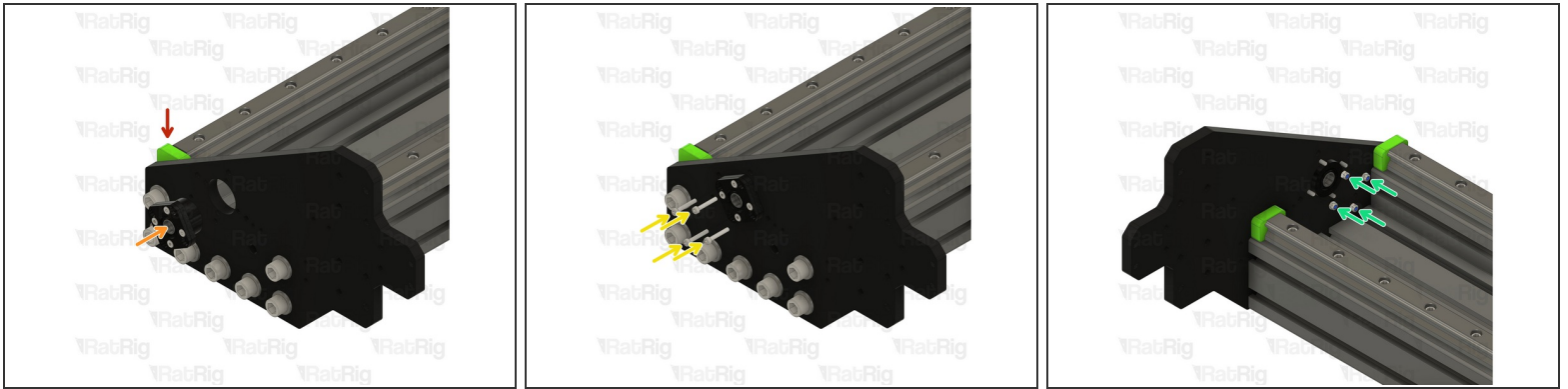
⚠ Do not allow the ball screw nut to reach the end of the ball screw

- 16mm Ball Screw Block

- Install the ball screw block onto the ball screw nut as shown

- 6x M5x20 Cap Head Screw

i Install an M5x20 screw through each hole in the ball screw nut and into the ball screw block.
Fully tighten each screw

Step 17 — Install the X-axis ball screw support

- X-Axis Gantry Assembly - **Left Side**

- FK12 Ball Screw Mount

- ① Insert the FK12 ball screw mount in to the left plate as shown

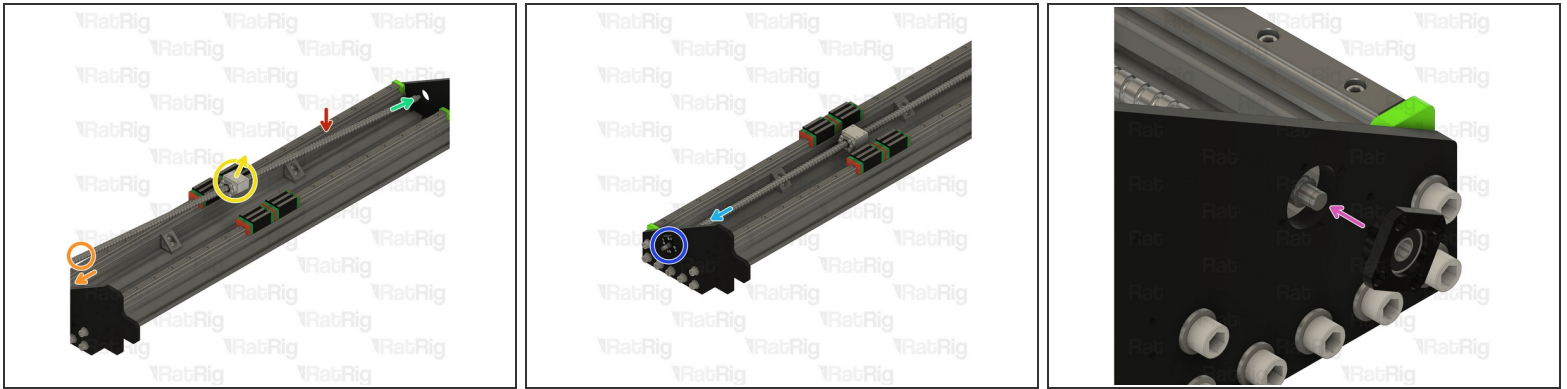
- M4x25 Cap Head Screw

- ① Insert an M4x25 screw through each of the four holes in the FK12 mount and through the left plate

- M4 Nylon Locking Hex Nut

- ① Install an M4 locking hex nut onto each M4x25 screw and tighten fully

Step 18 — Install the X-axis ballscrew - Part 1



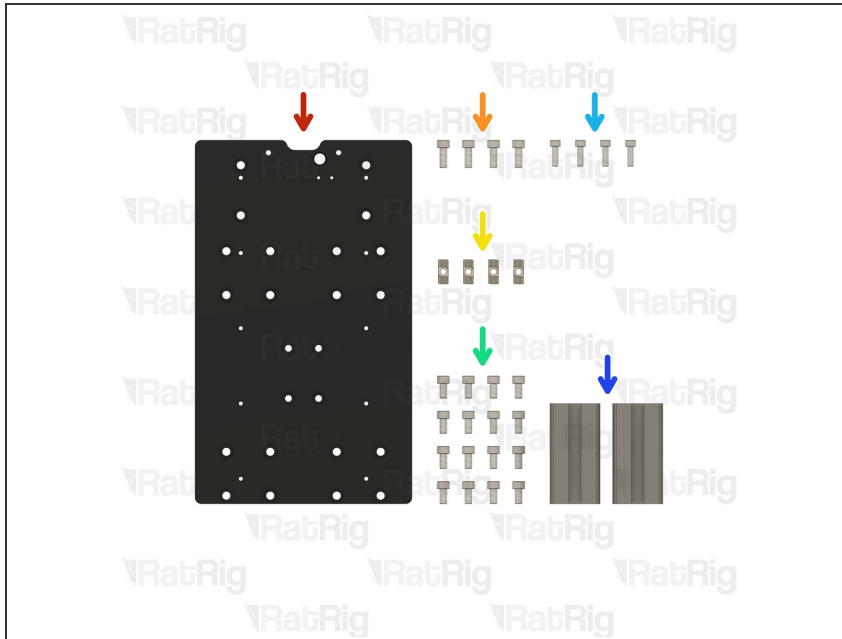
- Position the ball screw assembly (from **Step 16**) so that:
 - The **end with the thread faces towards the FK12 mount**
 - The **side of the ball screw block with the screw holes faces away from the X-axis gantry assembly**
- Carefully feed the non-threaded end of the ball screw through the open hole in the right plate on the gantry
- Align the threaded end of the ball screw with the hole in the FK12 mount
- Whilst supporting the full length of the ball screw, insert the threaded end through the hole in the FK12 mount
- ⚠ The ball screw is a precision fit into the FK12 mount. **Do not force the ball screw in to the mount.** When correctly aligned, it should slide in with little effort
- Install the FF12 ball screw mount onto the free end of the ball screw and into the opening on the right plate

Step 19 — Install the X-axis ball screw - Part 2

- FF12 Ball Screw Mount
- M4x20 Cap Head Screw
 - ① Insert an M4x20 screw through each of the four holes in the FF12 mount and through the idler plate
- M4 Nylon Locking Hex Nut
 - ① Install an M4 locking hex nut onto each M4x20 screw and tighten fully

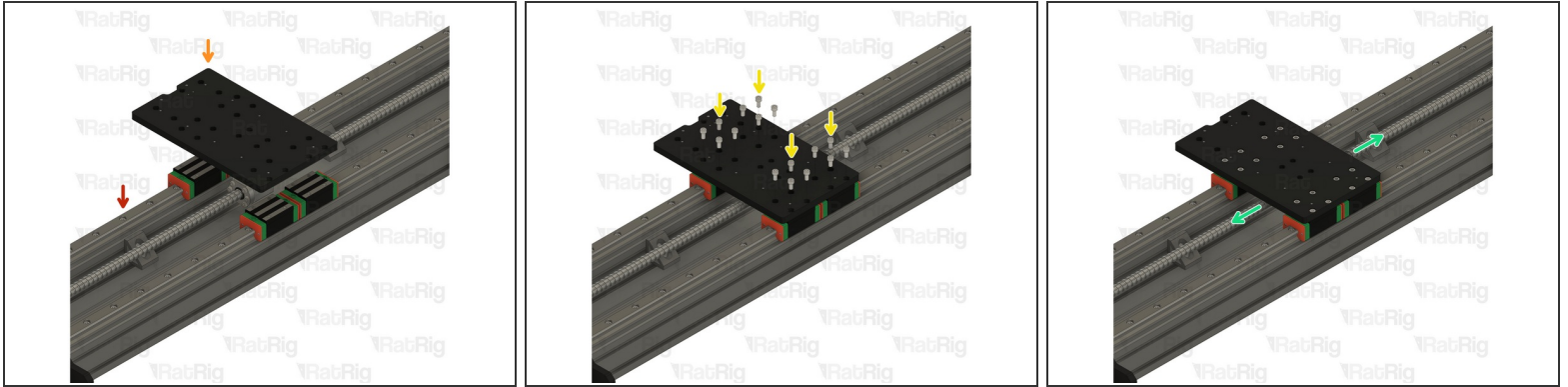
Step 20 — Install the ball screw retaining nut

- FK12 Ball Screw Mount
- Ball Screw Lock Nut
 - Fasten the ball screw lock nut on to the exposed end of the ball screw as shown
- When the ball screw lock nut is fully tightened, use a 2mm hex key to tighten the grub screw within the lock nut. This will prevent the lock nut from loosening

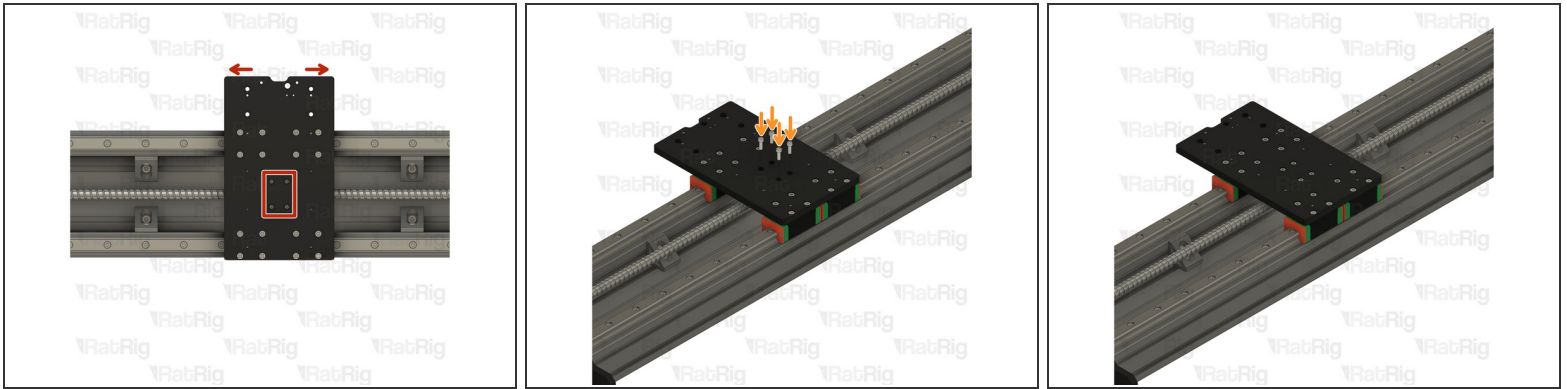
Step 21 — Prepare the XZ joiner plate & parts

- 1x Rat Rig StrongHold PRO CNC - XZ Joiner Plate
- 4x M6x16 Cap Head Screw
- 4x 4040 Drop-in T-Nut - M6
- 16x M6x12 Cap Head Screw
- 4x M5x16 Cap Head Screw
- 2x 80mm 4040 Extrusion

Step 22 — Install the XZ joiner plate - Part 1

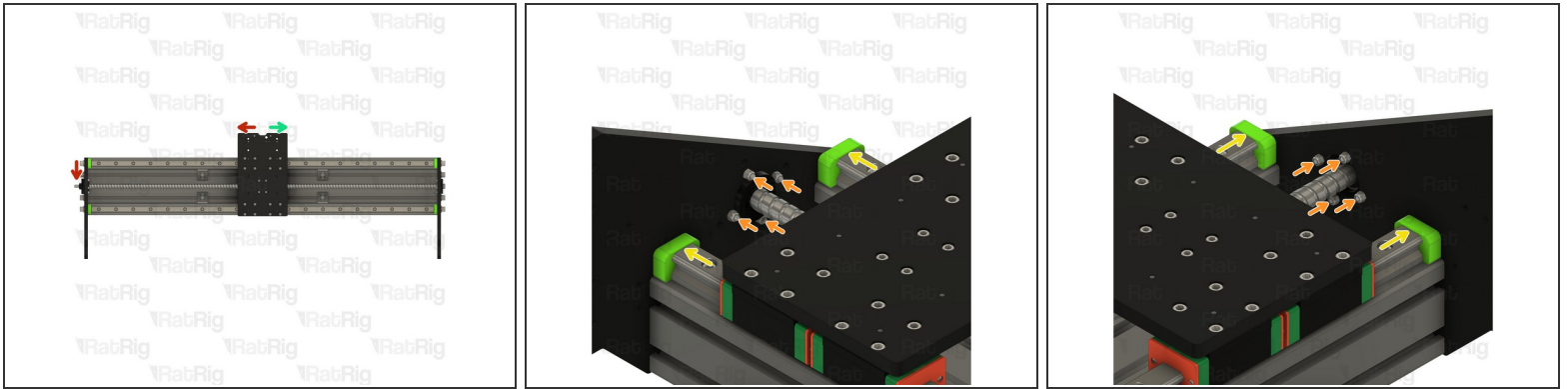


- X-Axis Gantry Assembly
- Rat Rig StrongHold PRO CNC - XZ Joiner Plate
- ① Position the HG25 linear rail blocks so that the holes align with those on the XZ joiner plate
- M6x12 Cap Head Screw
- ① Install an M6x12 screw through each hole in the plate, and in to the HG25 linear rail carriage below
- Before fully tightening the M6x12 screws, check that the X-axis moves over its entire length without binding
- ① Tighten each screw slightly and then re-test the smoothness of the X-axis. Repeat this until all sixteen screws are fully tightened, securing the plate
- ⚠ If the X-axis binds or becomes tight, check that the lower rail is aligned correctly. Loosening the screws securing the lower rail to the 4080 extrusion and using the X-axis to align the lower rail can help.

Step 23 — Install the XZ joiner plate - Part 2

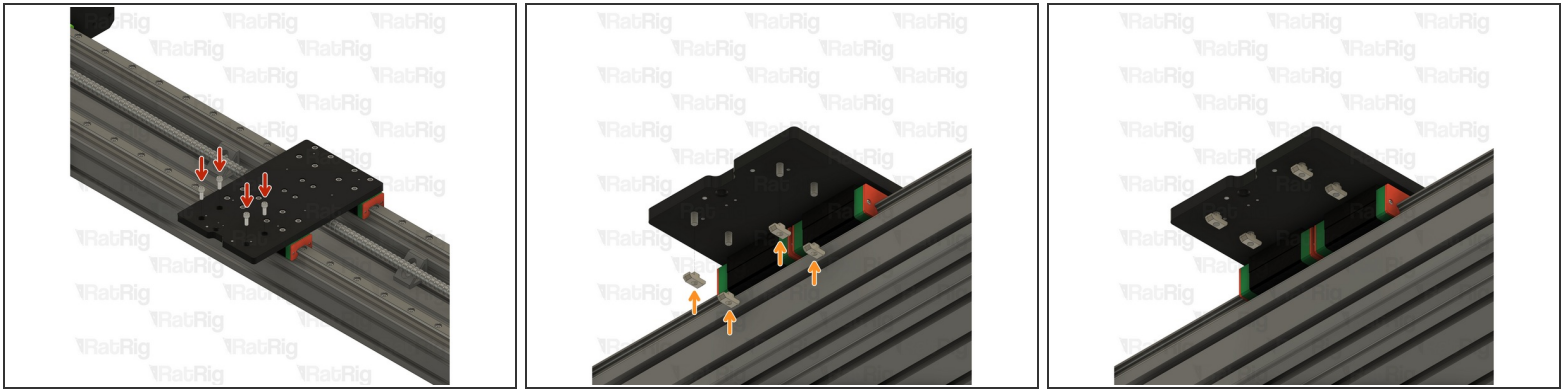
- Align the X-axis so that the screw holes in the ball screw block are visible through the marked holes in the plate
- M5x16 Cap Head Screw
 - ① Install each of the four M5x16 screws through the plate and secure them in to the ball screw block

Step 24 — Check the X-axis ball screw alignment

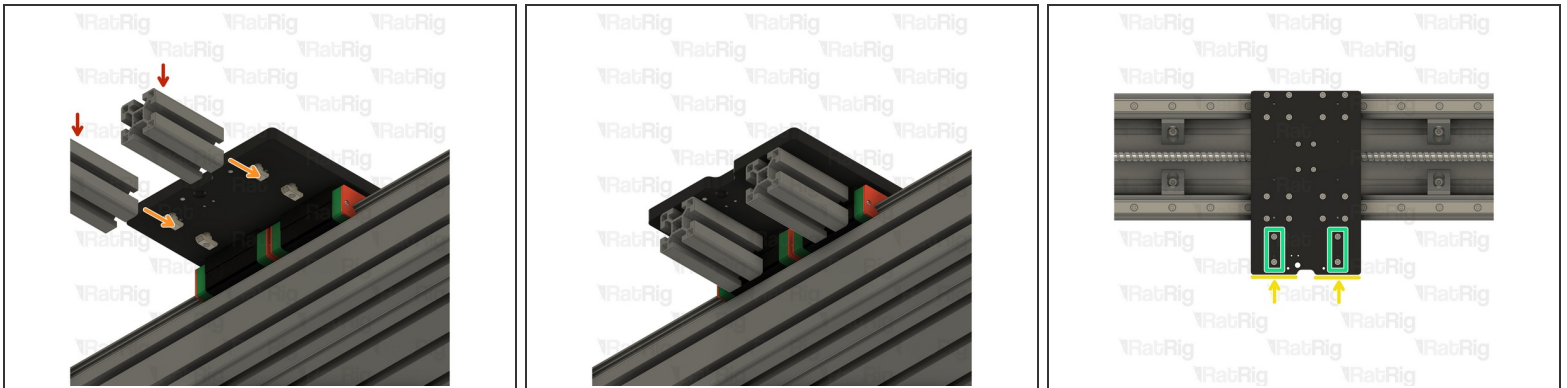


⚠ It is important to verify that the X-axis ball screw is fully aligned before continuing

- Move the X-axis all the way to the left side by rotating the ball screw
 - ⓘ If the X-axis becomes tight and difficult to move as it approaches the left end, do the following:
 - Loosen all four of the M4x25 screws securing the FK12 mount in place
 - Move the X-axis fully to the end
 - ⓘ Re-tighten all four of the M4x25 screws on the FK12 mount
- Move the X-axis all the way to the right side by rotating the ball screw
 - ⓘ If the X-axis becomes tight and difficult to move as it approaches the right end, repeat the above instructions to adjust the FF12 mount

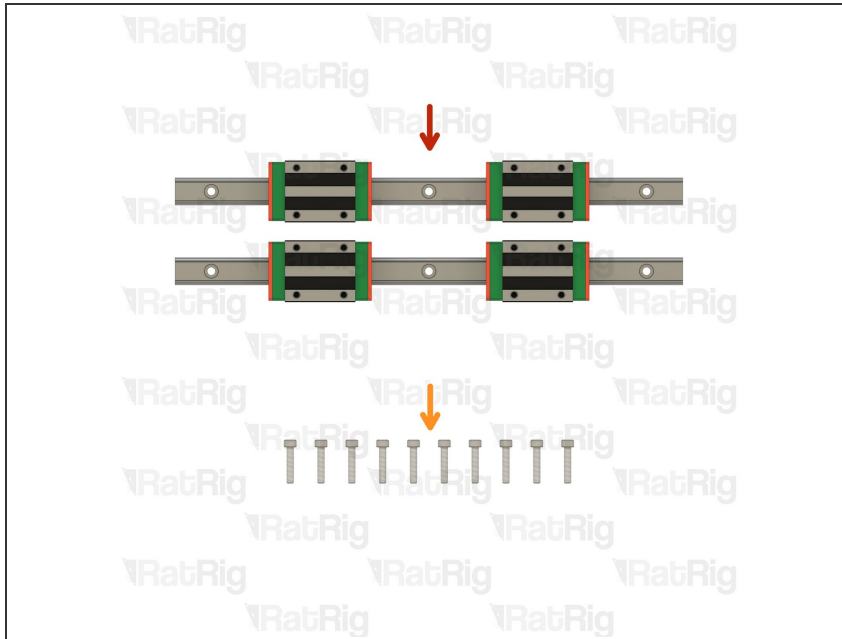
Step 25 — Install the Z support extrusions - Part 1

- M6x16 Cap Head Screw
- 4040 Drop-in T-Nut - M6
- ① Loosely thread the 4040 T-Nuts on to the M6x16 screws. Do not tighten them at this point.

Step 26 — Install the Z support extrusions - Part 2

- 80mm 4040 Extrusion
- Position each 4040 extrusion as shown, ensuring that the tapped end of the extrusion faces away from the gantry
- Check that the end of each extrusion is flush with the XZ joiner plate
- Tighten each of the M6x16 screws to secure the extrusions to the XZ joiner plate

Step 27 — Prepare the Z-axis linear rails



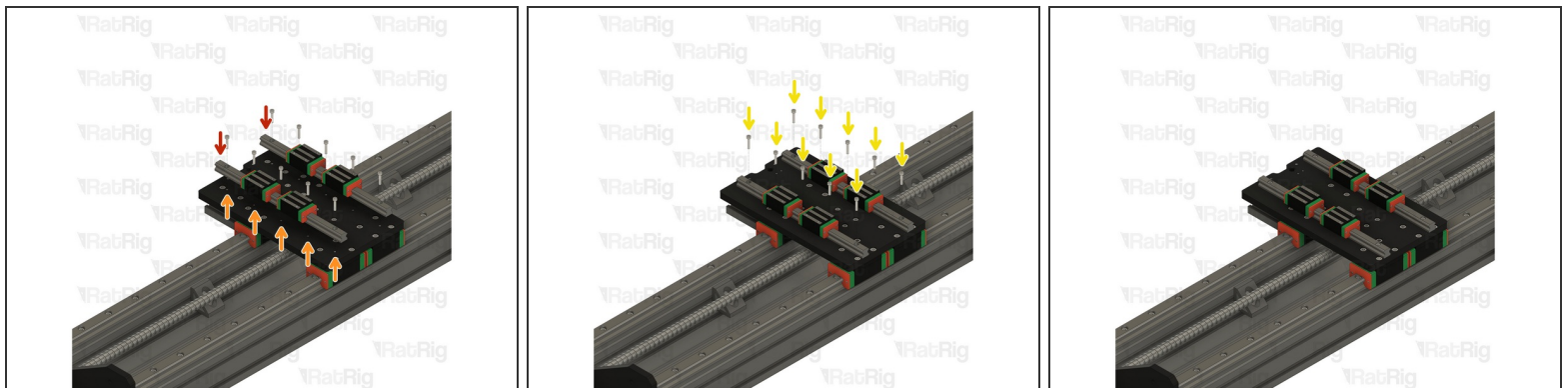
- 2x 280mm HG15 Linear Rail with 2x Carriages

- 10x M4x20 Cap Head Screw

ⓘ Unpack and test the HG15 linear rails as previously instructed in **Steps 9 & 10**

⚠ The linear rail carriages are not interchangeable. Do not try to use a carriage on a different linear rail than the one it was supplied with.

Step 28 — Install the Z-axis linear rails

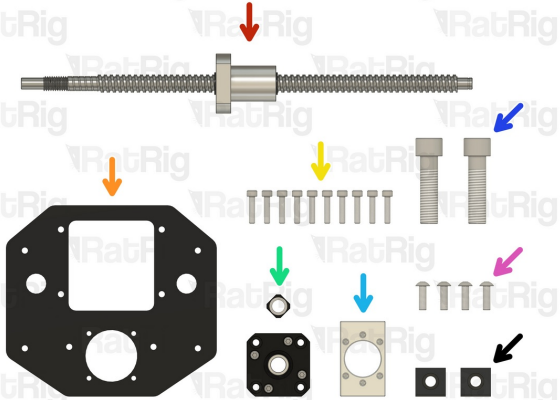


- HG15 Linear Rail

- Align the holes in the linear rail with the screw holes on the XZ joiner plate

- M4x20 Cap Head Screw

ⓘ Insert a screw into each hole on the linear rail and fully tighten them in to the XZ joiner plate

Step 29 — Prepare the Z-axis transmission parts

- 1x 300mm 1204 Ball Screw
- 1x Rat Rig StrongHold PRO CNC - Z Top Plate
- 10x M4x18 Cap Head Screw
- 1x FK10 Ball Screw Mount & Ball Screw lock nut (Packaged with the FK10 mount)
- 1x 12mm Ball Screw Block
- 2x M12x45 Cap Head Screw
- 4x M5x16 Button Head Screw
- 2x 90 Degree Corner Connector

Step 30 — Assemble the Z-axis transmission - Part 1

- Rat Rig StrongHold PRO CNC - Z Top Plate
- FK10 Ball Screw Mount
 - ① Position the FK10 mount in to the Z top plate as shown, aligning the holes with the threaded holes in the plate
- M4x18 Cap Head Screw
 - ① Insert and tighten all four M4x18 screws through the FK10 mount and in to the plate
- ⚠ Do not over tighten the M4x18 screws as doing so can damage the screw threads in the aluminium

Step 31 — Assemble the Z-axis transmission - Part 2

● 90 Degree Corner Connector

● Position each 90 degree corner connector with the marked hole, in the orientation shown

● M5x16 Button Head Screw

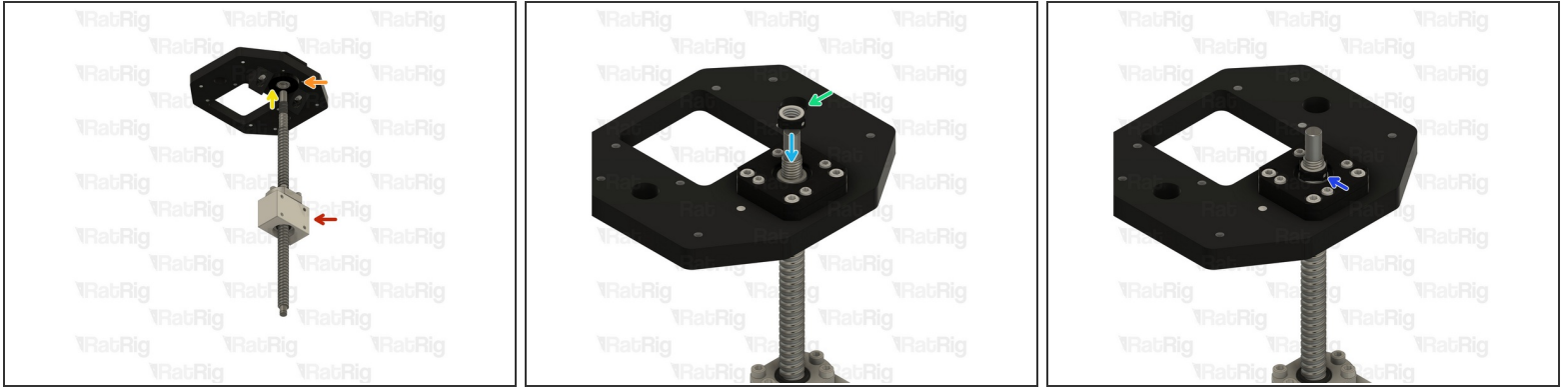
❗ **Secure each 90 degree corner connector with an M5x16 screw**

⚠ **Do not over tighten the M5x16 screws as doing so can damage the screw threads in the aluminium**

Step 32 — Assemble the Z-axis ball screw

- 300mm 1204 Ball Screw
- 12mm Ball Screw Block
- Install the ball screw block onto the ball screw nut as shown
- 6x M4x18 Cap Head Screw
- ① Install an M4x18 screw through each hole in the ball screw nut and into the ball screw block.
Fully tighten each screw

Step 33 — Install the Z-axis ball screw



- 300mm 1204 Ball Screw Assembly

- FK10 Ball Screw Mount

- Insert the threaded end of the ball screw through the hole in the FK10 mount

⚠ The ball screw is a precision fit into the FK10 mount. **Do not force the ball screw in to the mount.** When correctly aligned, it should slide in with little effort

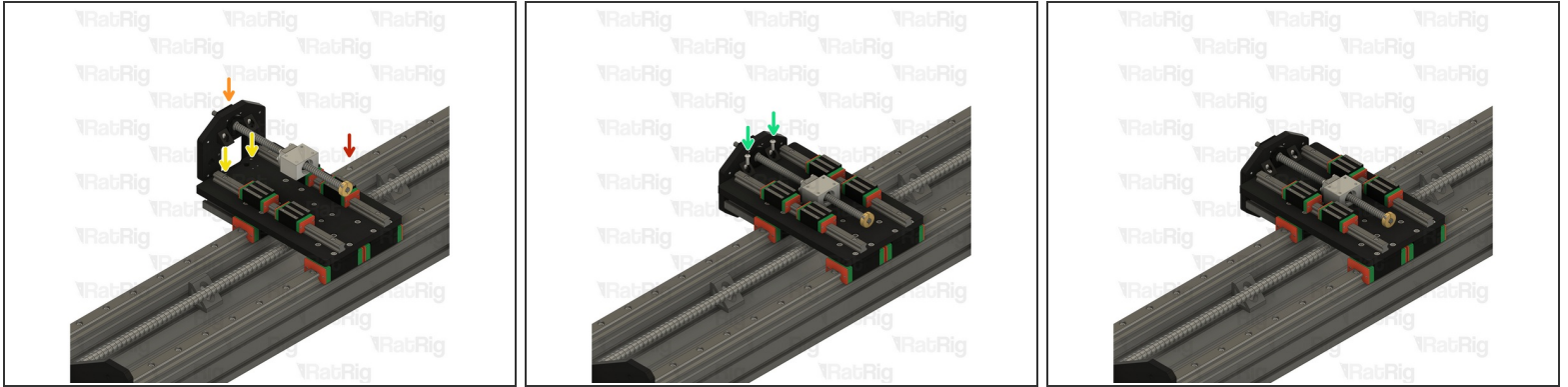
- Ball Screw Lock Nut

- Fasten the ball screw lock nut on to the exposed end of the ball screw as shown
- When the ball screw lock nut is fully tightened, use a 2mm hex key to tighten the grub screw within the lock nut. This will prevent the lock nut from loosening

⚠ From this point forward, **make sure that the ball screw nut remains near the middle of the ball screw.** Allowing the ball screw nut to reach the end of the ball screw will cause **permanent damage** to the ball screw

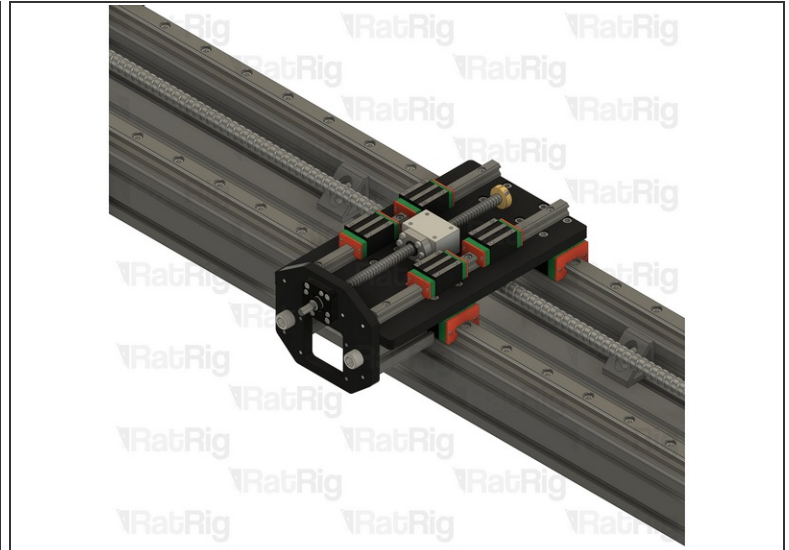
Step 34 — Install the ball screw lock collar

- 8mm Clamping Lock Collar
- Install the lock collar on to the end of the ball screw as shown
- M3x12 Cap Head Screw
- ① Fully tighten the M3 screw in the lock collar to secure it to the ball screw

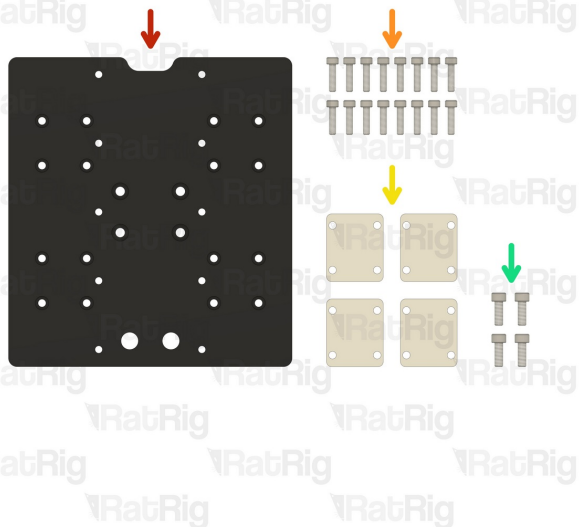
Step 35 — Install the Z-axis transmission assembly - Part 1

- StrongHold PRO X-Axis Gantry Assembly from **Step 27**
- StrongHold PRO Z-axis Transmission Assembly from **Step 33**
- Position the Z-axis transmission assembly as shown, aligning the 90 degree corner connectors with the indicated holes
- M5x16 Button Head Screw
- ① Fasten each 90 degree corner connector to the XZ joiner plate with an M5x16 screw

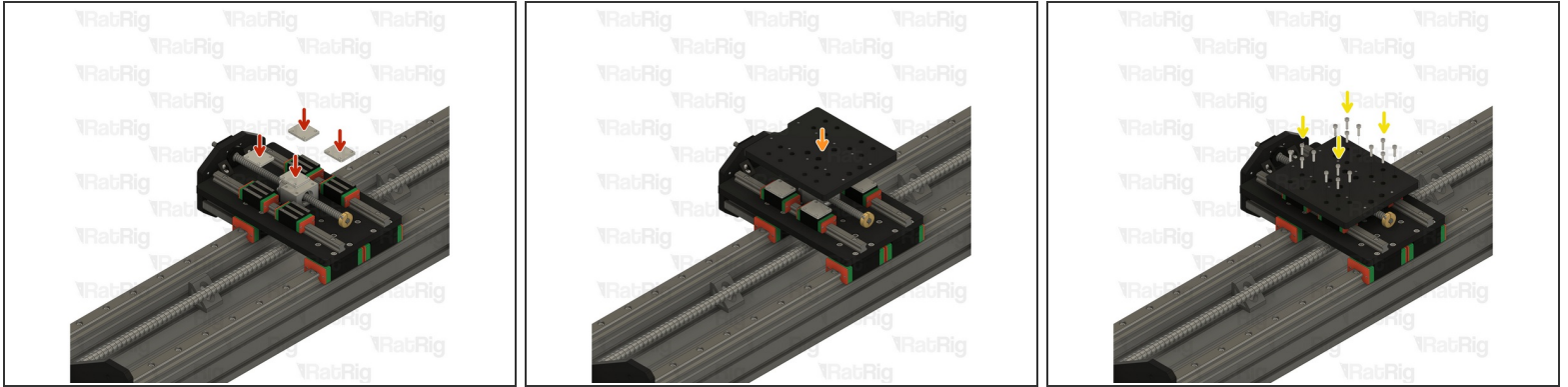
⚠ Do not over tighten the M5x16 screws as doing so can damage the screw threads in the aluminium

Step 36 — Install the Z-axis transmission assembly - Part 2

- M12x45 Cap Head Screw
- Insert one M12x45 screw through each hole in the Z top plate and secure in to the 4040 extrusion
- ⓘ Fully tighten both M12x45 screws
- ⓘ Check all four previously installed M5x16 button head screws are fully tightened as well

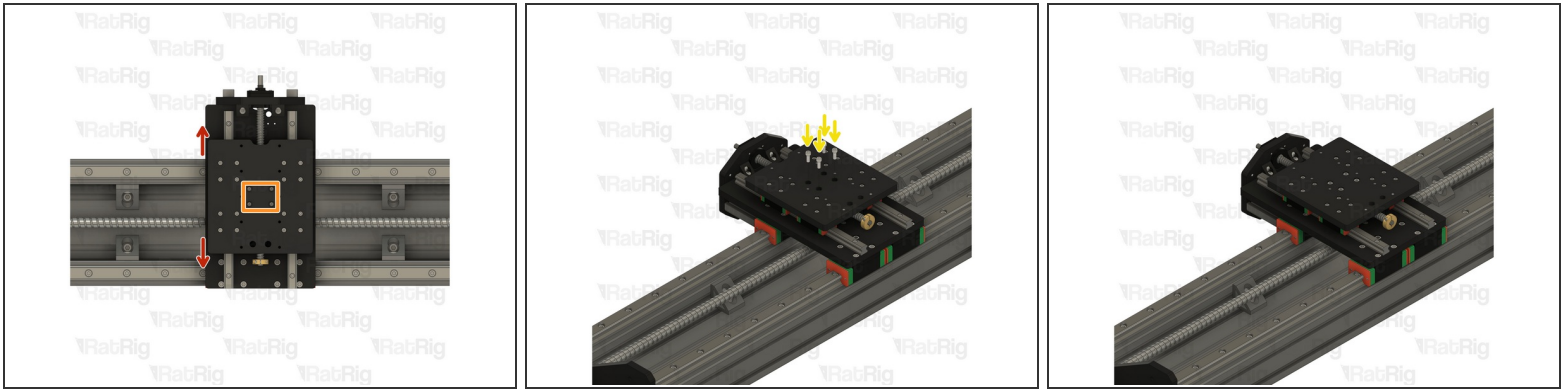
Step 37 — Prepare the Z-axis parts

- 1x Rat Rig StrongHold PRO CNC - Z-Axis Plate
- 16x M4x16 Cap Head Screw
- 4x Rat Rig StrongHold PRO CNC - HG15 Spacer
- 2x M5x14 Cap Head Screw

Step 38 — Install the Z-axis plate - Part 1

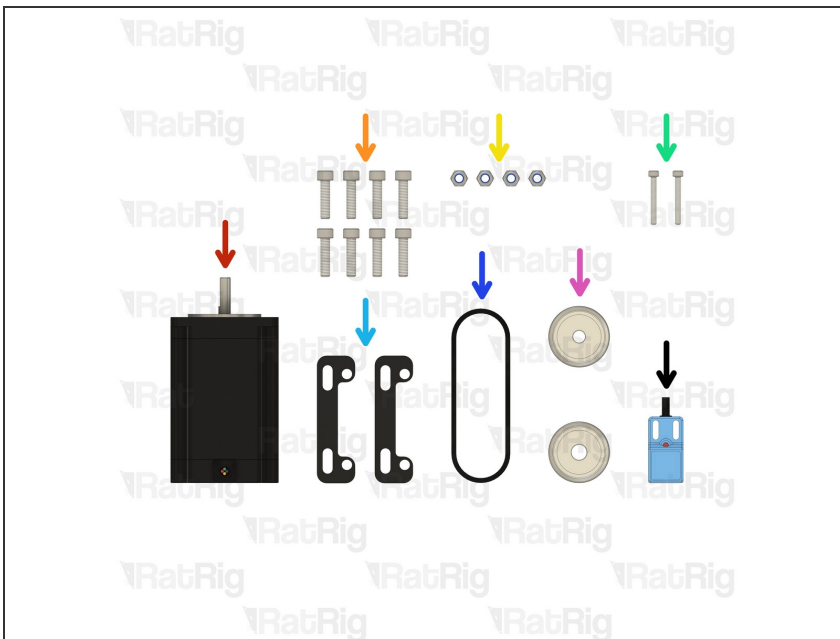
- Rat Rig StrongHold PRO CNC - HG15 Spacer
 - ❶ Place one spacer on top of each HG15 linear rail carriage
- Rat Rig StrongHold PRO CNC - Z-Axis Plate
 - ❶ Place the Z-axis plate on top of the spacers and adjust the carriage positions so that all 16 holes are aligned
- M4x16 Cap Head Screw
 - ❶ Insert each M4x16 screw through the Z-axis plate, the HG15 spacer, and thread them in to the linear rail carriage
 - ❶ Fully tighten all the M4x16 screws

Step 39 — Install the Z-axis plate - Part 2

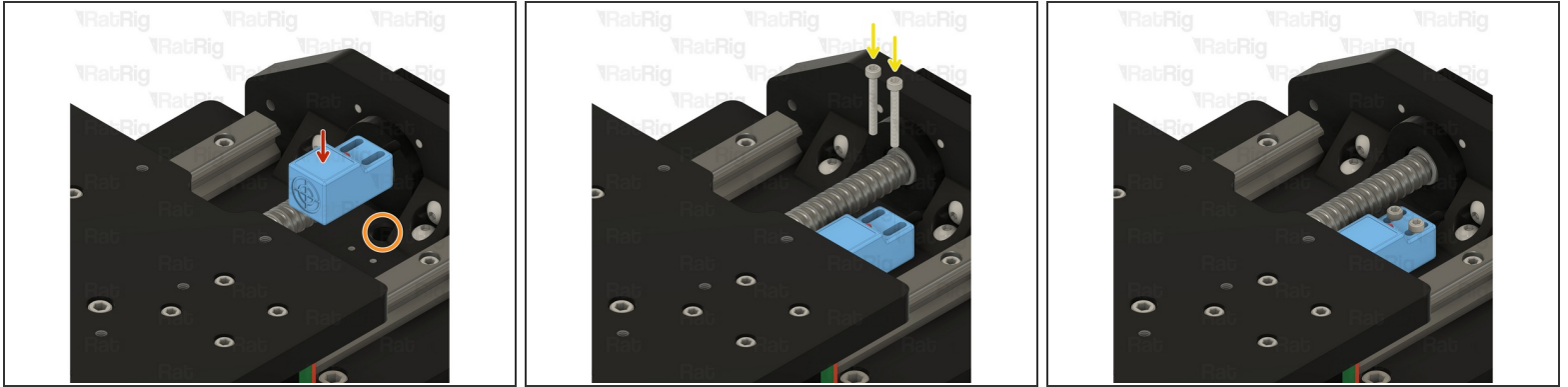


- Before proceeding, check that the Z-axis moves smoothly
- Align the marked holes in the Z-axis plate with the holes in the 12mm ball screw nut block below
- M5x14 Cap Head Screw
 - ① Insert each M5x14 screw through the Z-axis plate, and thread them in to the ball screw block
 - ① Fully tighten all four M5x14 screws

Step 40 — Prepare the Z-axis transmission parts

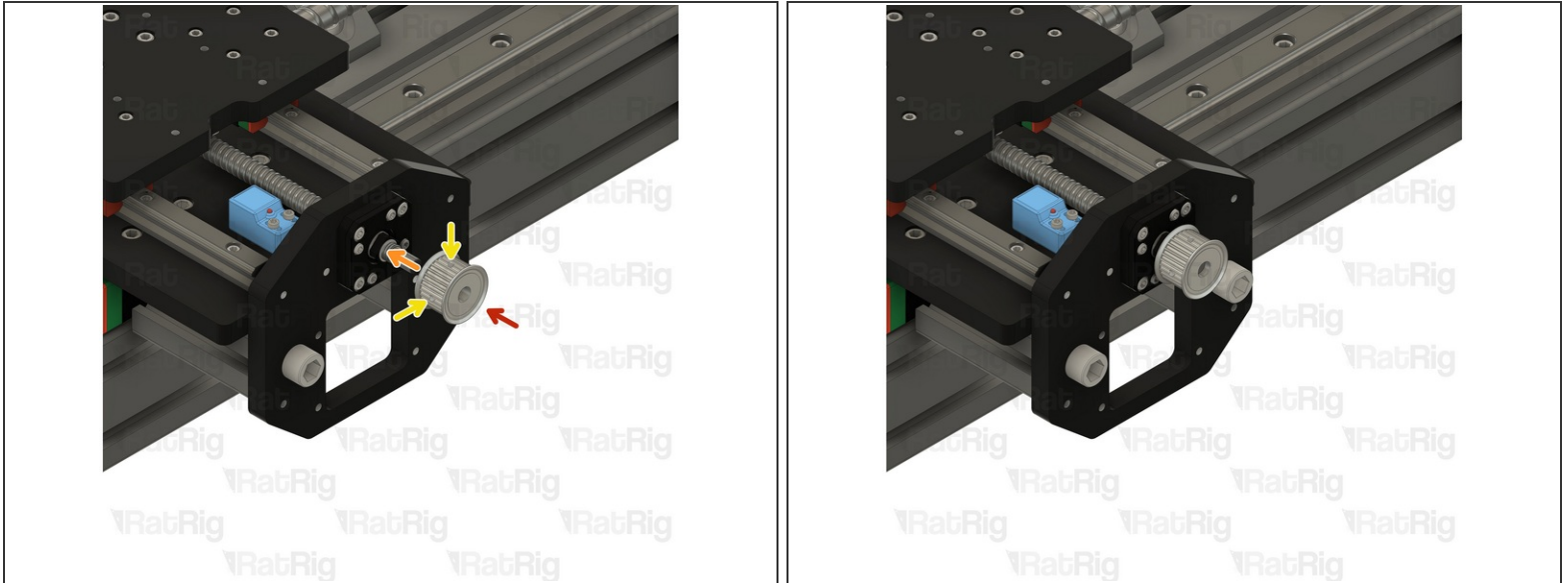


- 1x NEMA23 Stepper Motor
- 8x M5x20 Cap Head Screw
- 4x M5 Nylon Locking Hex Nut
- 2x M3x25 Cap Head Screw
- 2x Rat Rig StrongHold PRO CNC - NEMA23 Plate
- 1x HTD3M 180mm Belt Loop
- 2x HTD3M Drive Pulley (1x 6.35mm Bore & 1x 8mm Bore)
- 1x SN04-N2 Proximity Sensor

Step 41 — Install the Z-axis endstop

- SN04-N2 Proximity Sensor
 - Pass the end of the proximity sensor cable through the marked hole
 - M3x25 Cap Head Screw
 - ① Insert each M3x25 screw through the proximity sensor and thread them in to the M3 holes on the XZ joiner plate
- ⚠ Do not over tighten the M3x25 screws as doing so can damage the proximity sensor or the screw threads in the aluminium**

Step 42 — Install the Z-axis drive pulley



- HTD3M Drive Pulley - 8mm Bore
- Install the HTD3M drive pulley on to the exposed end of the 1204 ball screw
- 2.5mm Grub Screw

⚠ If the drive pulley does not easily slide on to the ball screw, check that **both** grub screws on the pulley are clear of the bore

ⓘ Tighten both 2.5mm grub screws to secure the drive pulley to the ball screw

Step 43 — Assemble the Z-axis stepper - Part 1



- NEMA23 Stepper Motor
- Pay attention to the orientation of the stepper motor wiring / connector
- Rat Rig StrongHold PRO CNC - NEMA23 Plate
- M5x20 Cap Head Screw
- M5 Nylon Locking Hex Nut

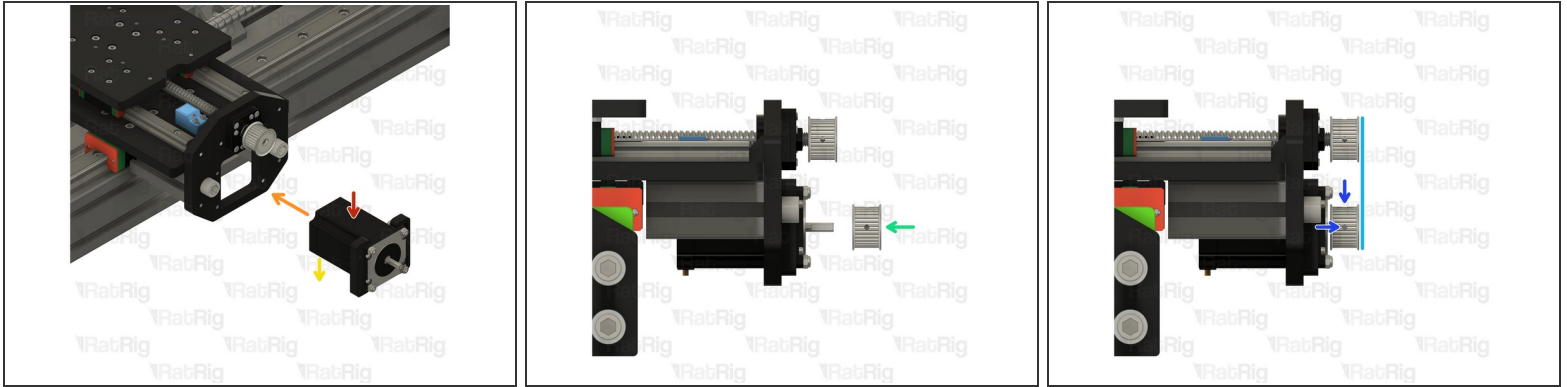
i Insert each M5x20 screw through the NEMA23 plate, through the NEMA23 stepper motor mounting hole and secure with a locking nut

Step 44 — Assemble the Z-axis stepper - Part 2

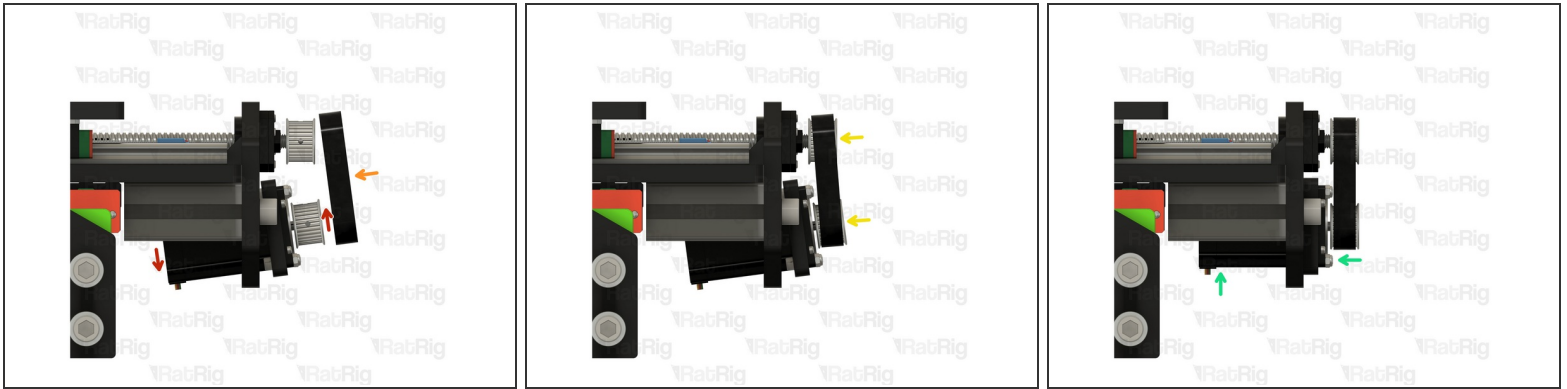


i Repeat the instructions in the **previous step** to install the second NEMA23 plate

Step 45 — Position the Z-axis stepper & install the drive pulley

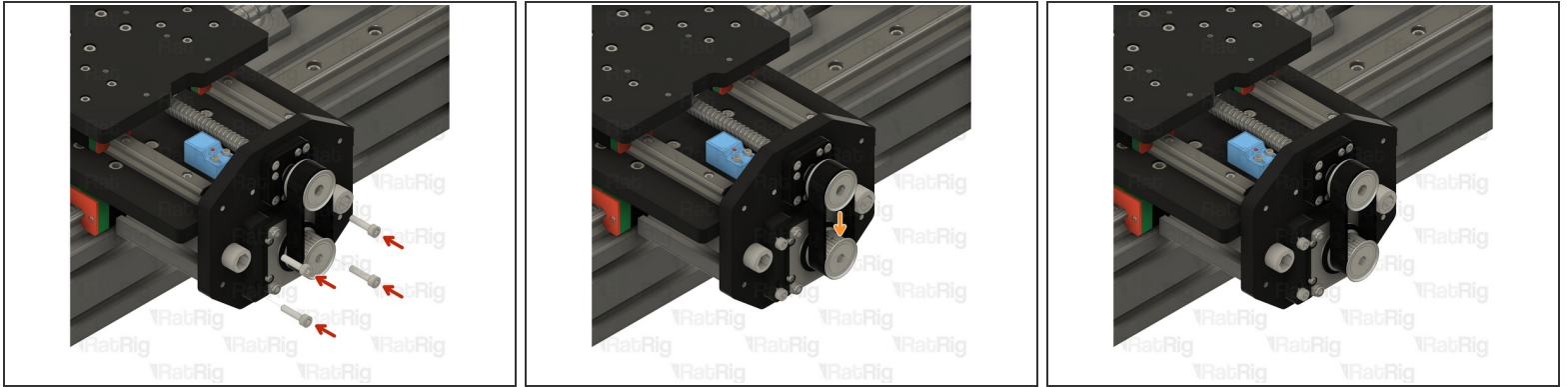


- NEMA23 Stepper Assembly
- Insert the NEMA23 assembly through the hole in the Z top plate as shown
- Make sure the stepper motor wiring / connector faces towards the back of the X-axis gantry
- HTD3M Drive Pulley - 6.35mm Bore
- Align the HTD3M pulley on the NEMA23 shaft so that it is level with the HTD3M pulley on the ball screw
- ⚠ If the drive pulley does not easily slide on to the NEMA23 shaft, check that **both** grub screws on the pulley are clear of the bore
- Fasten both 2.5mm grub screws to secure the drive pulley to the ball screw
- ⚠ Verify the both HTD3M drive pulleys are still aligned. Adjust the position of the NEMA23 pulley if required

Step 46 — Install the Z-axis drive belt

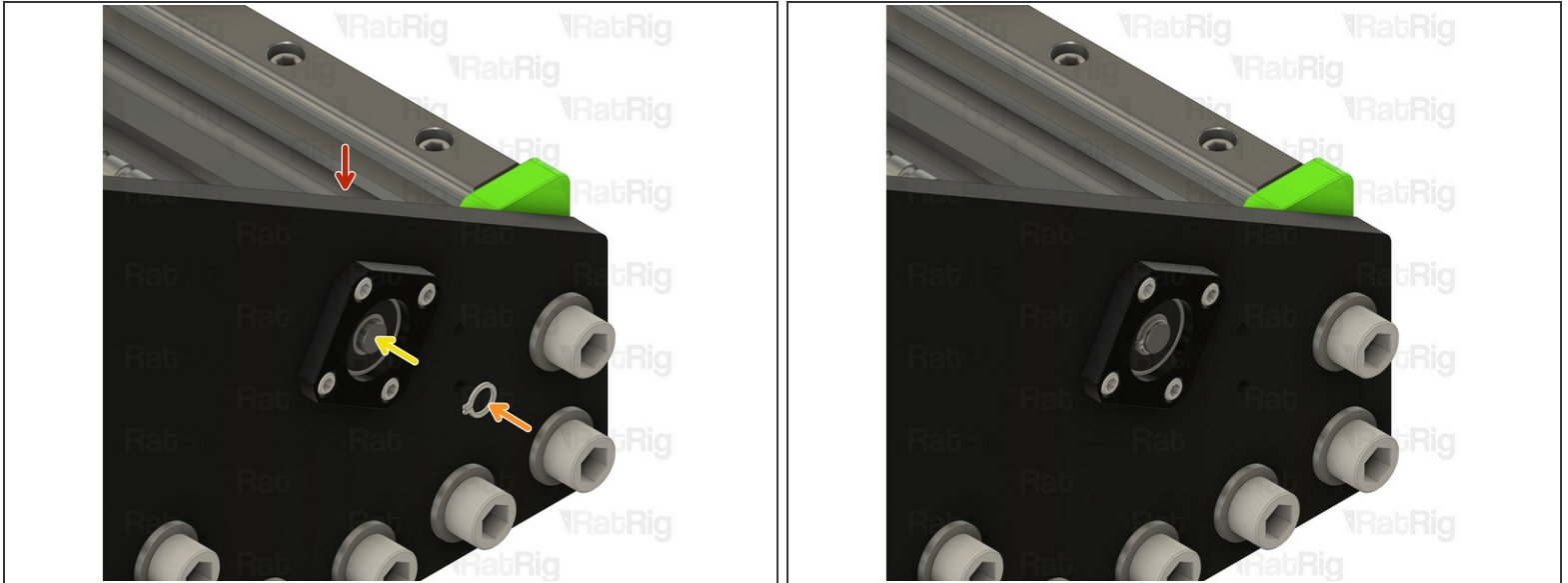
- Tilt the NEMA23 stepper assembly as shown
- HTD3M 180mm drive belt
- Install the HTD3M drive belt on to both pulleys
- Allow the NEMA23 stepper assembly to return to the original position

Step 47 — Secure the Z-axis stepper motor



- M5x20 Cap Head Screw

- ① Insert one M5x20 screw through each hole in the NEMA23 brackets as shown. Do not fully tighten the screws yet
- Apply a small amount of downwards force on the NEMA23 assembly to tension the HTD3M drive belt
- ① Whilst applying tension to the belt, fully tighten all four M5x20 screws to secure the NEMA23 assembly in place

Step 48 — Install the ball screw circlip

- StrongHold PRO X-Axis Gantry - Right Side
 - FF12 Circlip
 - Using a pair of circlip pliers, install the circlip on to the end of the ball screw
- i** Make sure the circlip seats fully in the groove on the ball screw

Step 49 — Next guide

- Continue with the next guide: [03. X-Axis Gantry & Stepper Installation](#)