Rat Rig

01. Base Frame Assembly

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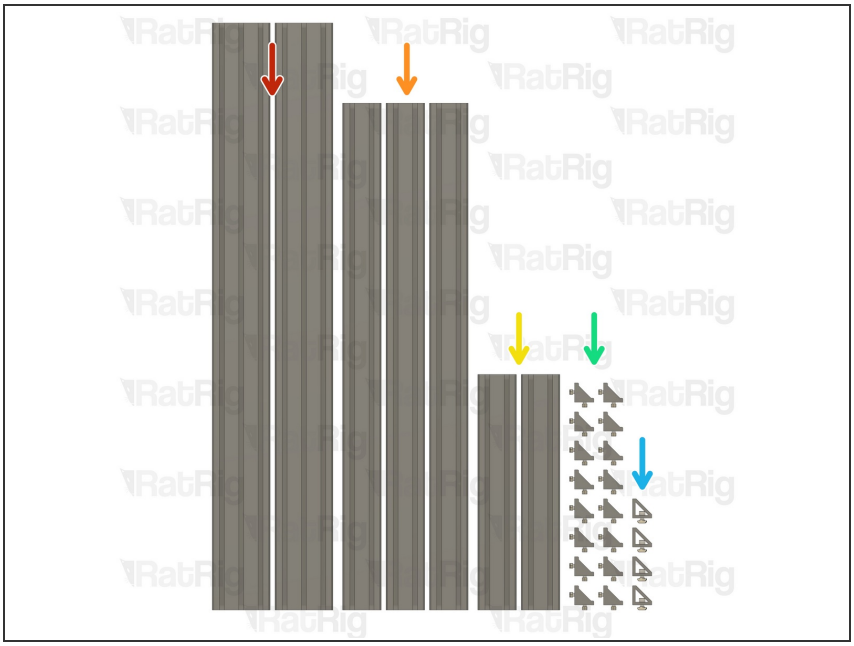
INTRODUCTION

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.

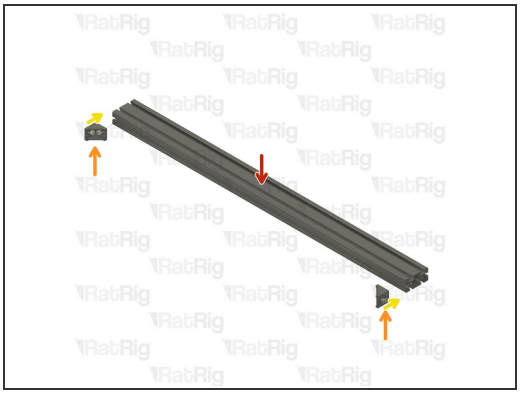
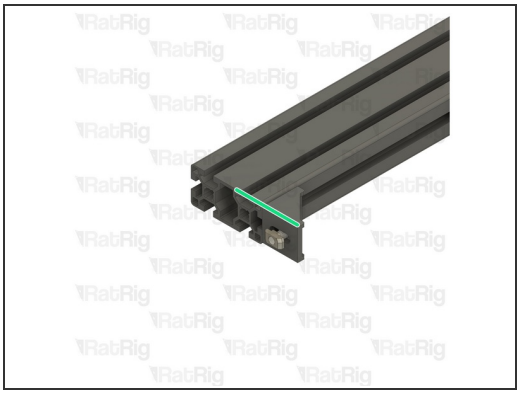
It is **strongly recommended** to assemble the base frame on a known flat surface (such as a solid table, work surface or similar). Assembling the frame on a carpeted floor, or other non-flat surface, can cause the finished frame to not be square. This can cause issues with quality and performance.

Step 1 — Prepare the machine base extrusions & brackets



- 2x 1216mm 40120 Extrusion
  - ⓘ 1716mm for the StrongHold PRO 1000x1500 or 1500x1500
- 3x 1050mm 4080 Extrusion
  - ⓘ 1550mm for the StrongHold PRO 1500x1500
- 2x 488mm 4080 Extrusion
  - ⓘ 738mm for the StrongHold PRO 1000x1500 or 1500x1500
- 16x 4040 cast corner assemblies
- 4x 4040 extruded corners assemblies for the spoilboard

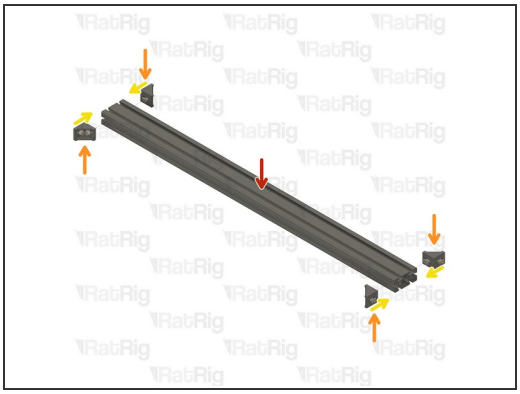
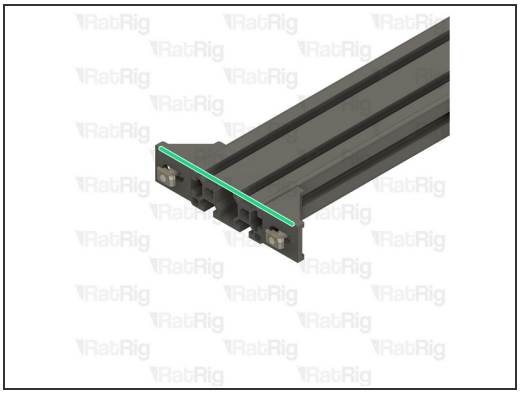
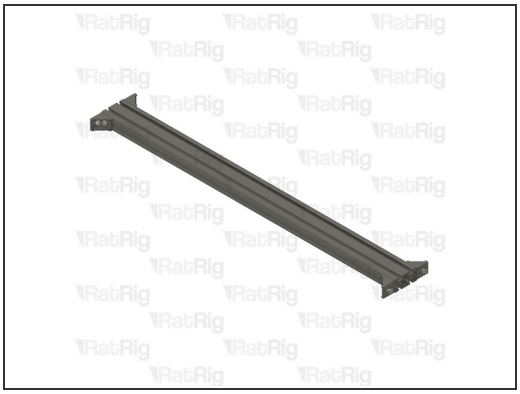
Step 2 — Assemble the front & rear 4080 extrusions


- 1050mm 4080 Extrusion
  - ⓘ 1550mm for the StrongHold PRO 1500x1500
- 4040 Cast Corner Assembly
- Install one corner assembly onto each end of the 4080 extrusion as shown. Tighten the M8x16 screw to secure them.
- Ensure the corner assemblies are flush and square with the ends of the extrusions after tightening the screws

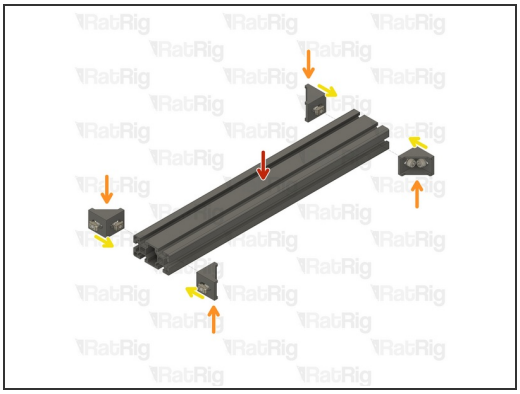
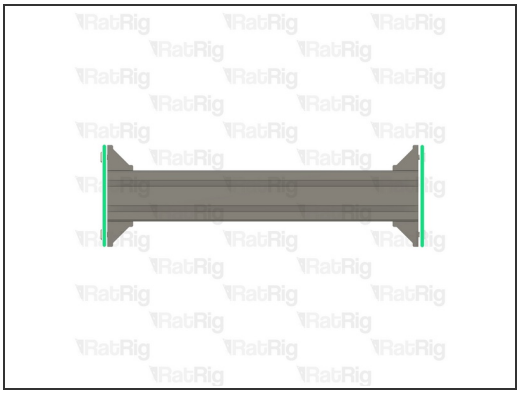
ⓘ Repeat these instructions for the second 4080 extrusion

Step 3 — Assemble the middle 4080 extrusion

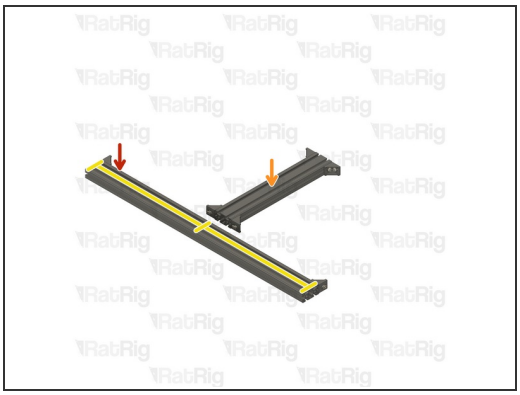
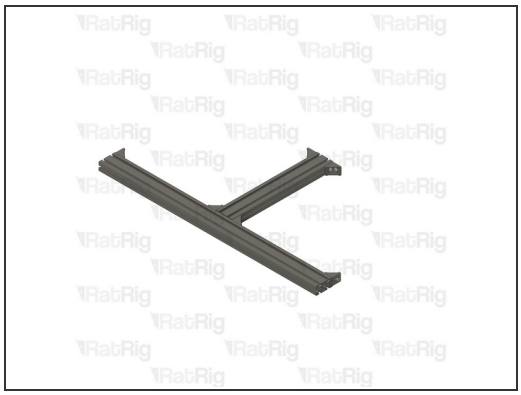
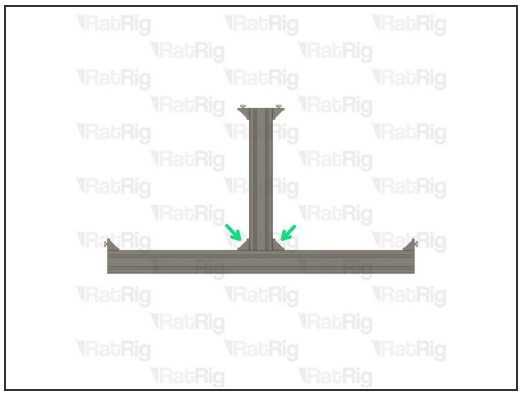
- 1050mm 4080 Extrusion
  - ⓘ 1550mm for the StrongHold PRO 1500x1500
- 4040 Cast Corner Assembly
- Install corner assemblies onto both sides of each end of the 4080 extrusion as shown. Tighten the M8x16 screw to secure them.
- Ensure the corner assemblies are flush and square with the ends of the extrusions after tightening the screws

Step 4 — Assemble the central frame support (x2)

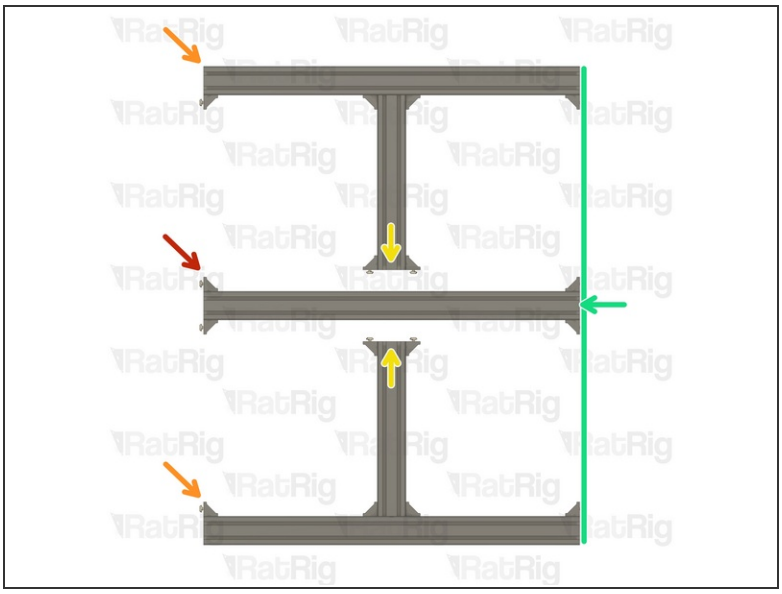

- 488mm 4080 Extrusion
  - ⓘ 738mm for the StrongHold PRO 1000x1500 or 1500x1500
- 4040 Cast Corner Assembly
- Install corner assemblies onto both sides of each end of the 4080 extrusion as shown. Tighten the M8x16 screw to secure them.
- Ensure the corner assemblies are flush and square with the ends of the extrusions after tightening the screws

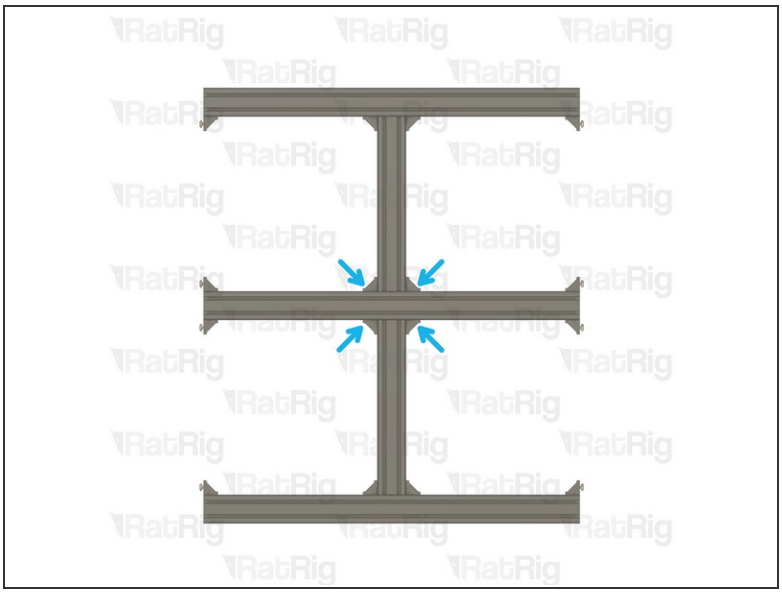
Step 5 — Assemble base frame ends (x2)

- Front / Back Assembly from **Step 2**
- Central Frame Support Assembly from **Step 4**
- Position the central frame support in the middle of the front or back assembly as shown
- Tighten the marked M8 cap head screws to secure the extrusions together
- ⓘ Repeat these instructions for the second base frame end

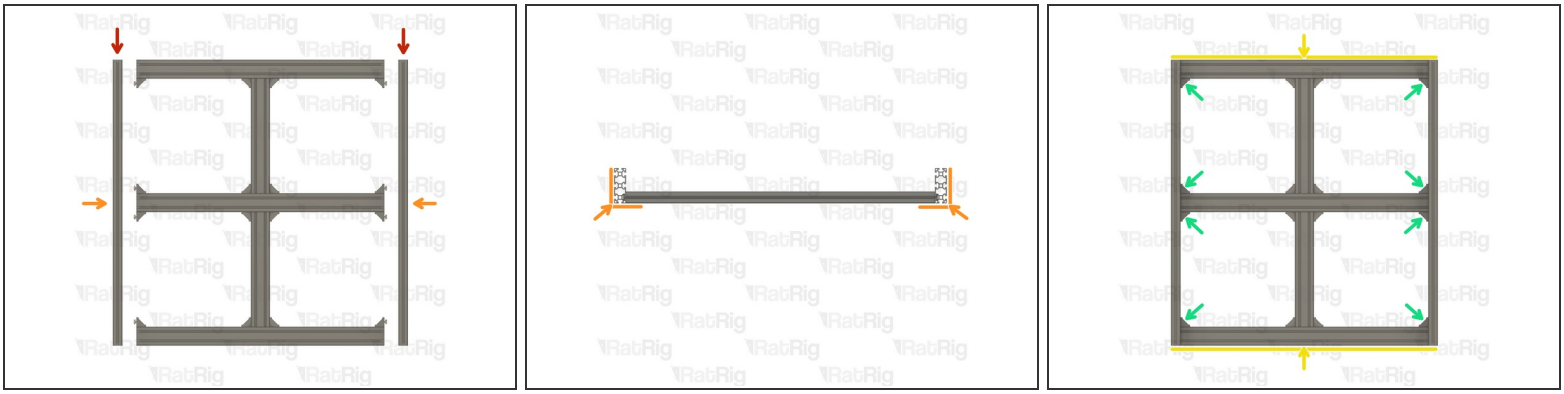
Step 6 — Assemble the base frame - Part 1





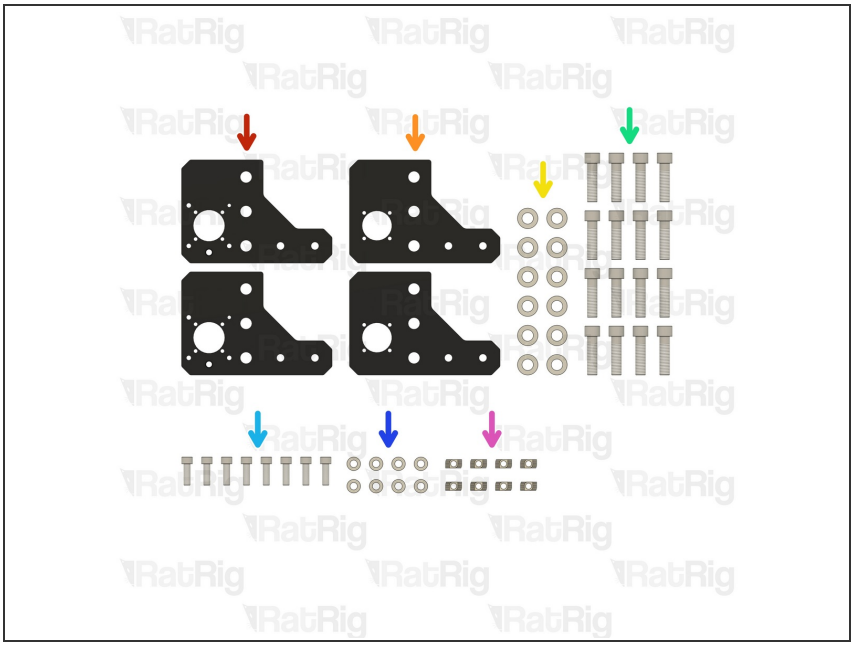
- Middle Assembly from **Step 3**
- 2x Assemblies from the previous step
- Position the three assemblies as shown
- Ensure that the ends of all three 4080 extrusions are aligned
- Tighten the marked M8 cap head screws to secure the extrusions together

Step 7 — Assemble the base frame - Part 2



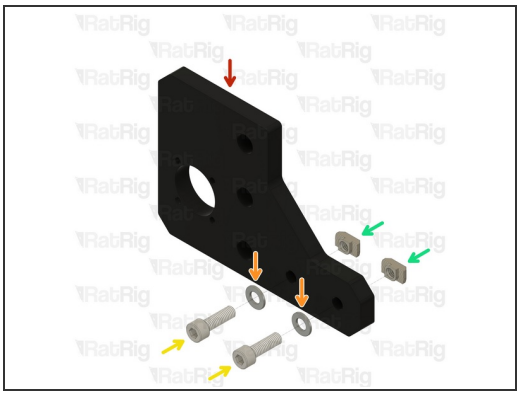
- 1216mm 40120 Extrusion
  - ⓘ 1716mm for the StrongHold PRO 1000x1500 or 1500x1500
- Align the each of the 40120 extrusions as shown
- Ensure that the ends of both 40120 extrusions are aligned with the ends of the frame
- Tighten the marked M8 cap head screws to secure the base together

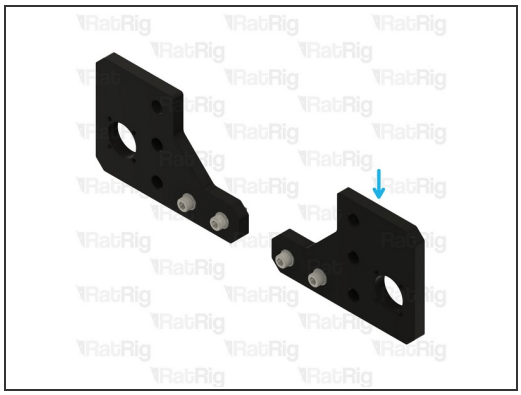
Step 8 — Prepare the base frame end plate parts



- 2x Rat Rig StrongHold PRO CNC - Motor Plate
- 2x Rat Rig StrongHold PRO CNC - Idler Plate
- 12x M12 Washer
- 12x M12x45 Cap Head Screw
- 8x M8x25 Cap Head Screw
- 8x M8 Washer
- 8x 4040 Drop-in T-Nut - M8

Step 9 — Assemble the front idler plates

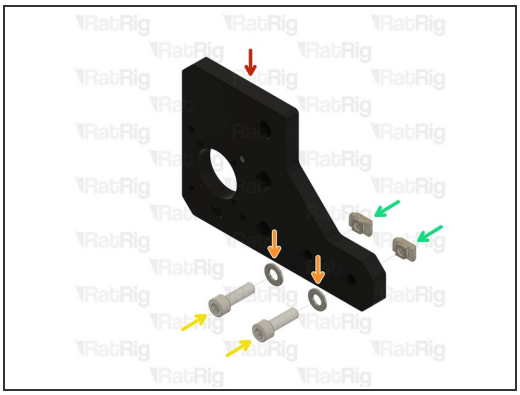
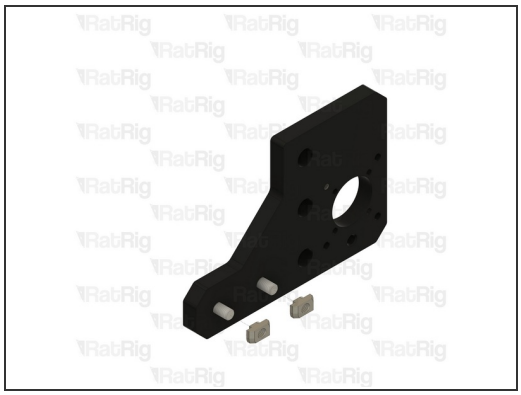
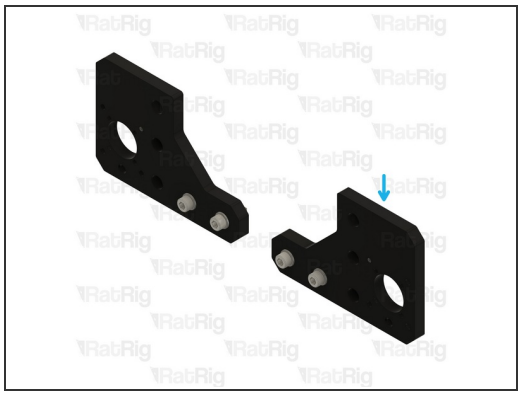




- Rat Rig StrongHold PRO CNC - Idler Plate
- M8 Washer
- M8x25 Cap Head Screw
- 4040 Drop-in T-Nut - M8
  - ⓘ Loosely thread a 4040 T-Nut onto each of the M8x25 screws. Do not tighten them at this point.
- Repeat these instructions for the second idler plate as shown

ⓘ Set these assemblies aside until **Steps 11 & 12**

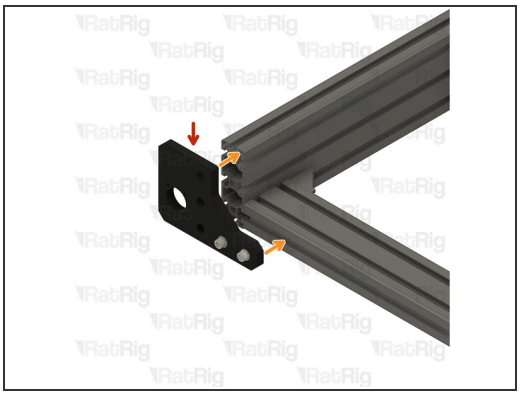
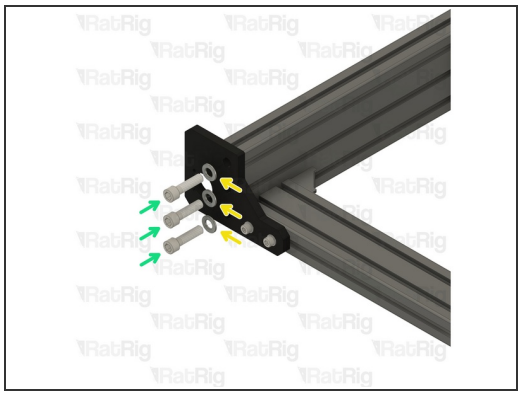
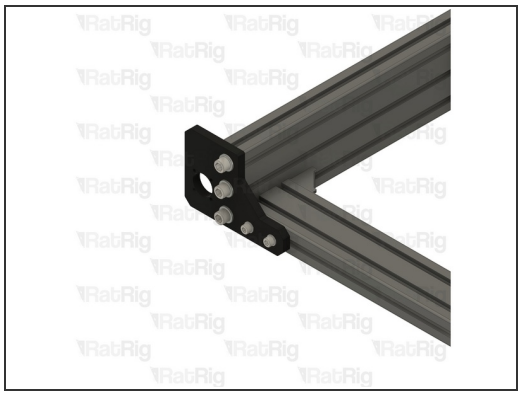
Step 10 — Assemble the rear motor plates

- Rat Rig StrongHold PRO CNC - Motor Plate
  - ⓘ The motor plates have additional holes compared to the idler plates
- M8 Washer
- M8x25 Cap Head Screw
- 4040 Drop-in T-Nut - M8
  - ⓘ Loosely thread a 4040 T-Nut onto each of the M8x25 screws. Do not tighten them at this point.
- Repeat these instructions for the second motor plate as shown

ⓘ Set these assemblies aside until **Steps 16 & 17**

Step 11 — Install the front left idler plate

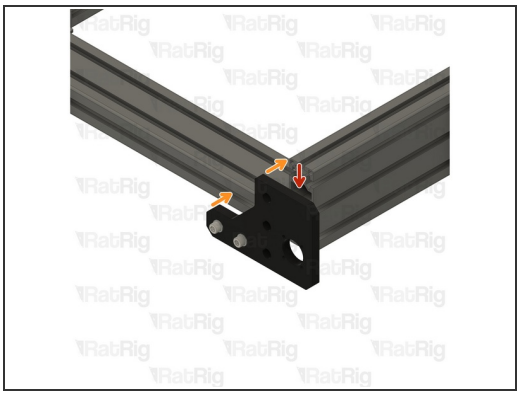
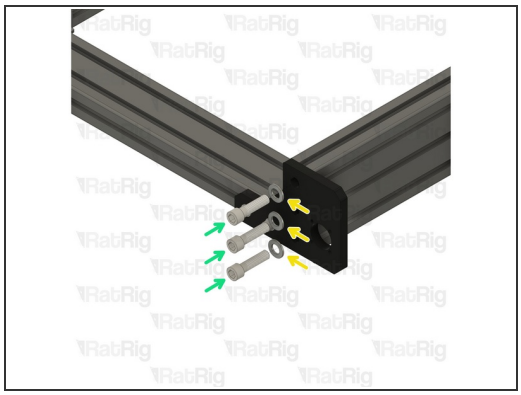
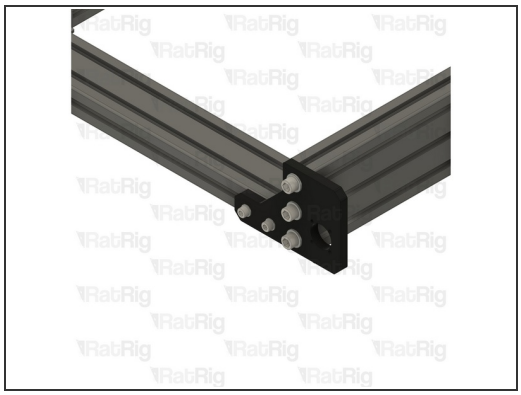




- **Left** idler plate Assembly from **Step 9**
- Align the idler plate assembly with the base frame as shown
- M12 Washer
- M12x45 Cap Head Screw

ⓘ 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 or M8 cap head screws at this point

Step 12 — Install the front right idler plate

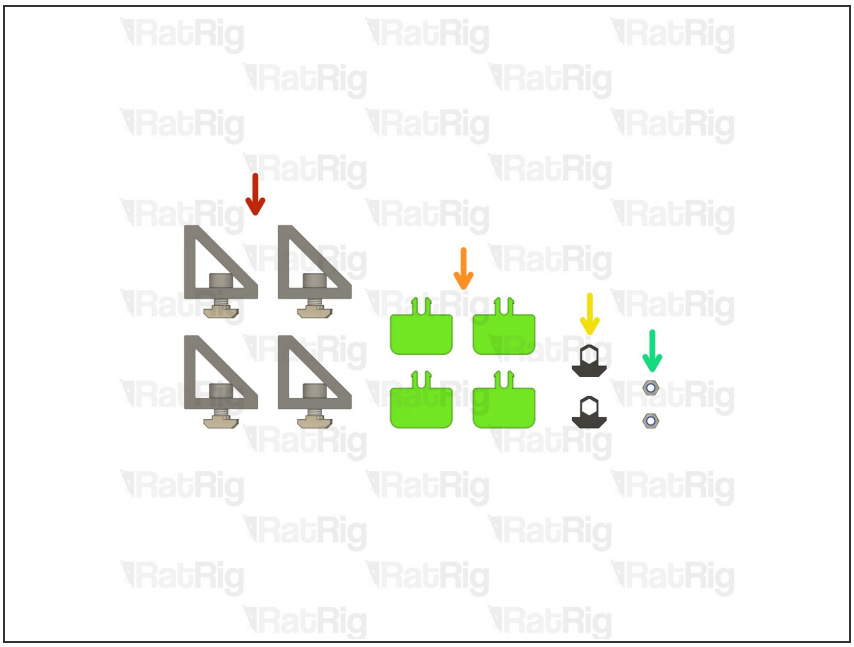




- **Right** idler plate assembly from **Step 9**
- Align the idler plate assembly with the base frame as shown
- M12 Washer
- M12x45 Cap Head Screw

ⓘ Place an M12 washer on to each M12x45 cap head screw and loosely screw them through the plate and in to the extrusion

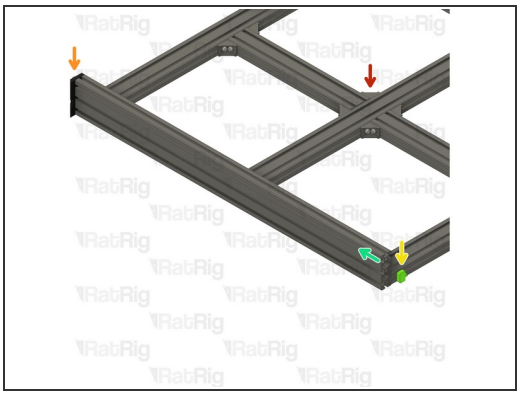
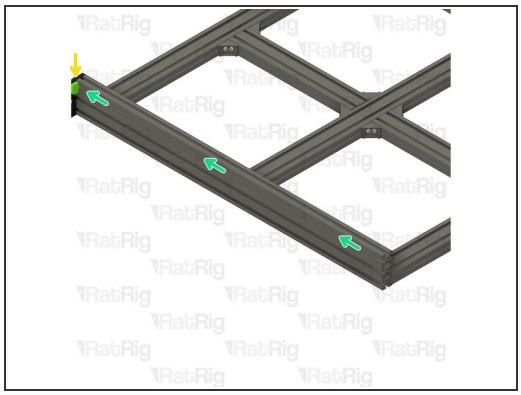
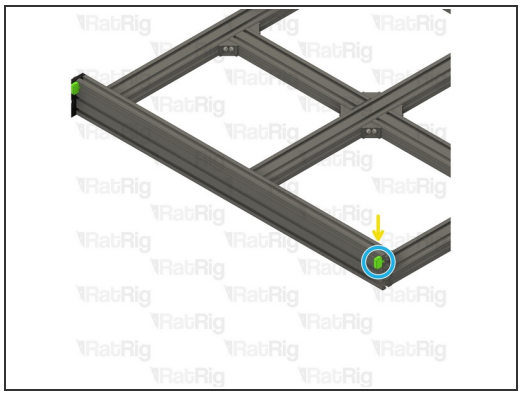
⚠ Do not fully tighten any of the M12 or M8 cap head screws at this point

Step 13 — Prepare the Y-axis printed parts & brackets



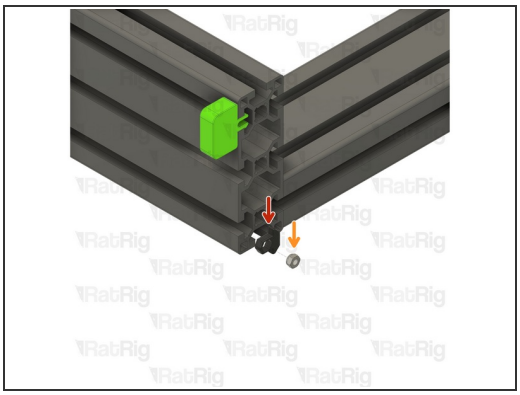
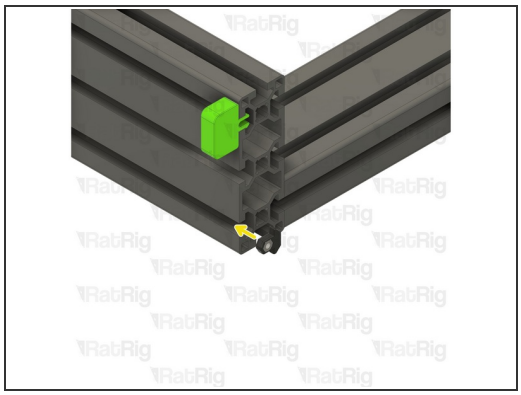
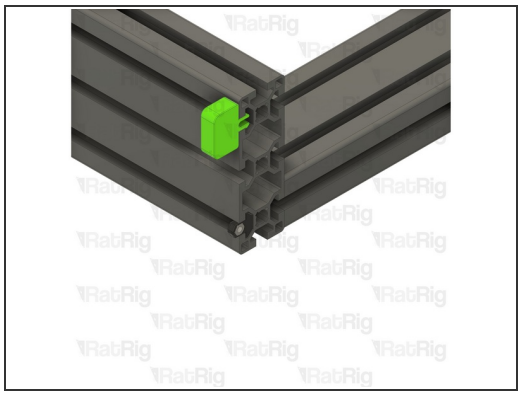
- 4x 4040 Extruded Corner Assembly (For the spoilboard)
- 4x sh_pro_hg25r_end_spacer Printed Part
- 2x sh_pro_y_motor_nut_holder Printed Part
- 2x M5 Nylon Locking Hex Nut

Step 14 — Install the linear rail spacers

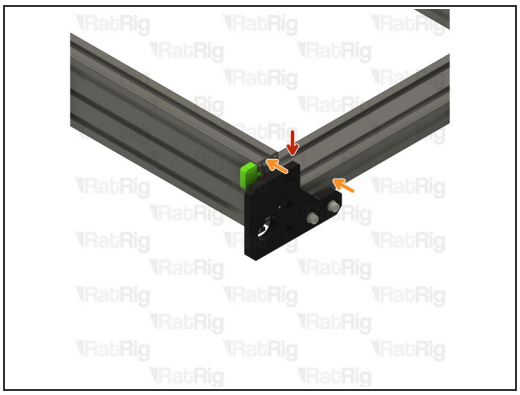
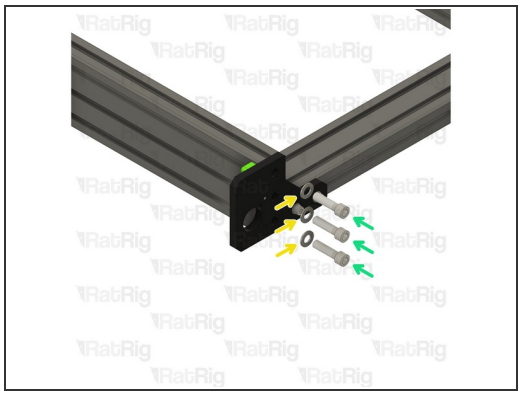
- Base frame assembly
- **Front right** idler plate assembly
- sh_pro_hg25r_end_spacer Printed Part
- Insert the sh_pro_hg25r_end_spacer printed part in to the 40120 extrusion slot as shown. Slide it along the extrusion until it rests against the idler plate.
- Insert a second sh_pro_hg25r_end_spacer printed part in to the 40120 extrusion slot as shown, but leave this one at the open end.

Step 15 — Install the extrusion nut holder

- sh_pro_y_motor_nut_holder Printed Part
- M5 Nylon Locking Hex Nut
  - Insert the M5 nylon locking hex nut in to the printed part
  - ⚠ The blue nylon ring in the nut should face away, as shown
- Insert the nut holder assembly in to the 40120 extrusion as shown

Step 16 — Install the rear right motor plate

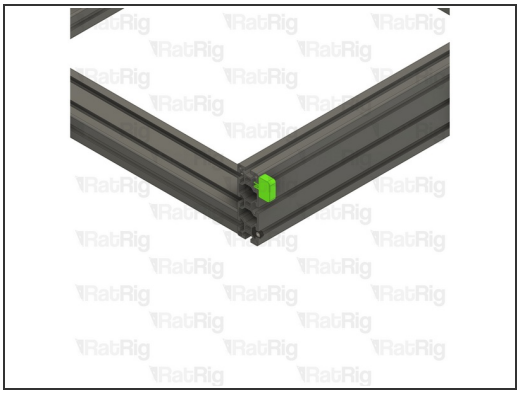
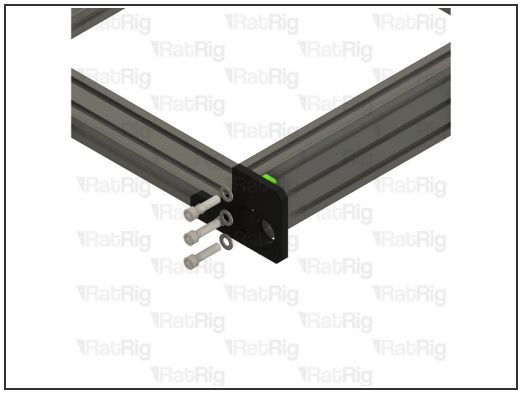




- **Right** motor plate assembly from **Step 10**
- Align the motor plate assembly with the base frame as shown
- M12 Washer
- M12x45 Cap Head Screw

ⓘ Place an M12 washer on to each M12x45 cap head screw and loosely screw them through the plate and in to the extrusion

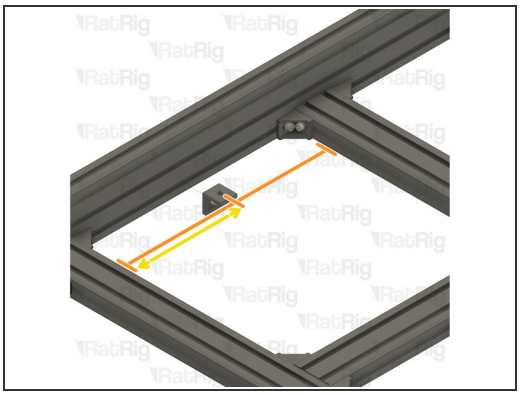
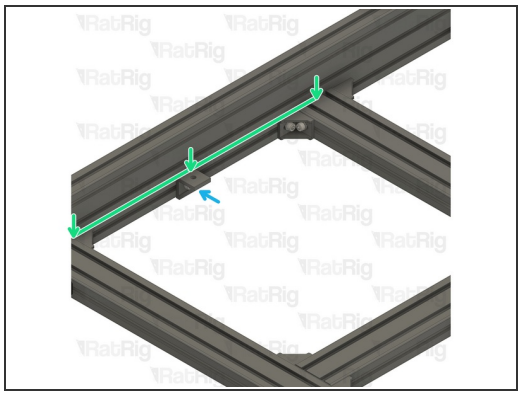
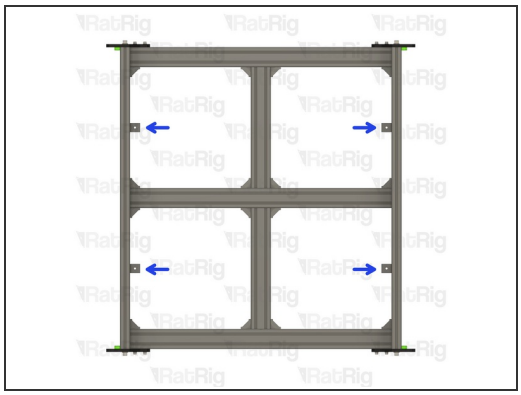
⚠ Do not fully tighten any of the M12 or M8 cap head screws at this point

Step 17 — Install the linear rail spacers & rear right motor plate

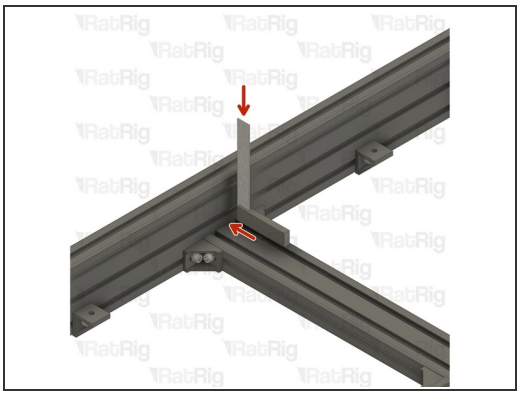
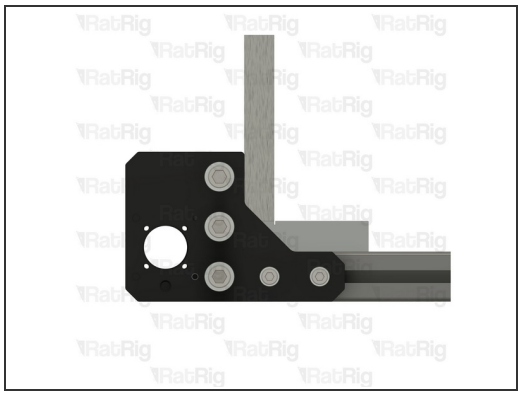
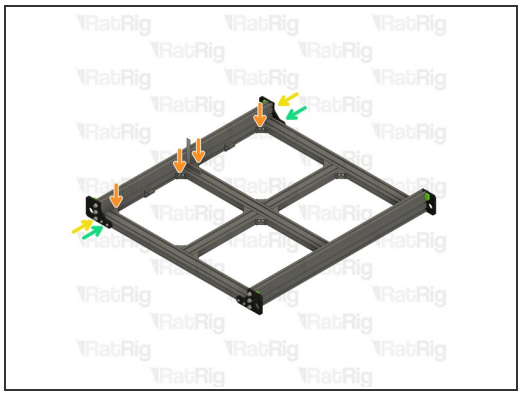

ⓘ Repeat the instructions in **steps 14, 15 & 16** to assemble the other side of the base frame

Step 18 — Install the spoil board brackets

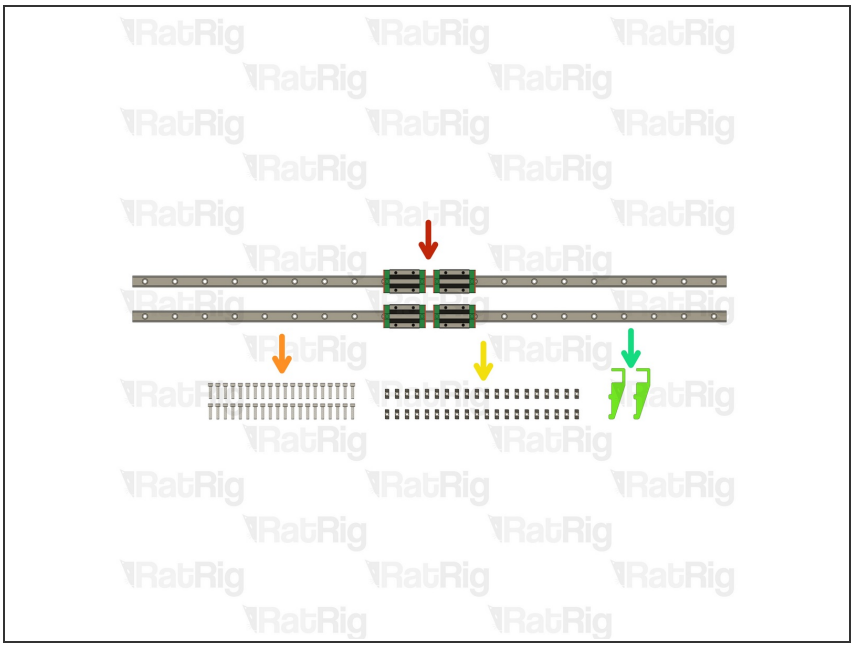
- 4040 extruded corner assembly (For the spoilboard)
- Position the 4040 extruded corner assembly in the middle of the extrusion gap as shown
- The displayed measurement should be:
  - ⓘ 244mm for StrongHold PRO 1000x1000
  - ⓘ 369mm for StrongHold PRO 1000x1500 or 1500x1500
- Ensure that the top of the extruded corner assembly is flush with the top of the 4080 extrusions
- Fully tighten the M8 cap head screw to secure the extruded corner assembly to the frame
- Repeat the above instructions for the remaining 3 extruded corner assemblies

Step 19 — Ensure the base frame is square

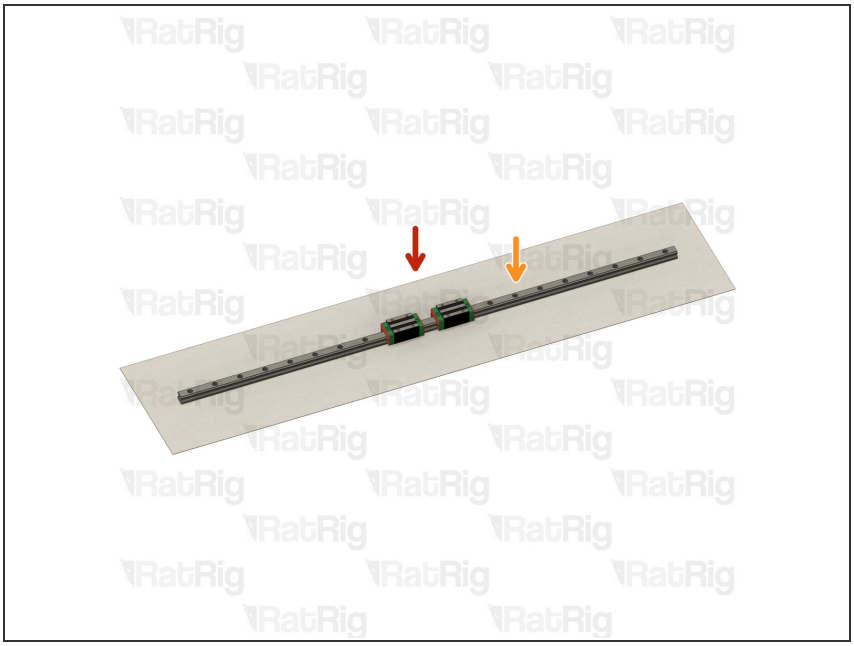
- Before continuing with the assembly, the frame must be squared and all screws full tightened
- Using an engineers square, check that the side 40120 extrusions are square to the extrusions forming the base
- On each side, tighten all of the following screws whilst continuing to check that the side extrusion remain square with the base:
  - 4x M8x16 within the cast corners connected to the base
  - 6x M12x45 on the motor and idler plates
  - 4x M8x25 on the motor and idler plates
- Once one side is fully secured and squared, proceed to repeat the process on the other side
- After tightening all screws, **check the entire frame** once more for squareness. Correcting any issues now is easier than once the assembly is complete!

Step 20 — Prepare the Y-axis linear rails



- 2x 1190mm HG25 Linear Rail with 2x Carriages
  - ⓘ 2x 1690mm for a 1000x1500 or 1500x1500 machine
- 40x M6x25 Cap Head Screw
  - ⓘ 56x for a 1000x1500 or 1500x1500 machine
- 40x 4040 Drop-in T-Nut - M6
  - ⓘ 56x for a 1000x1500 or 1500x1500 machine
- 2x align_40120_hg25 Printed Part

Step 21 — Unpack and prepare two HG25 linear rails



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

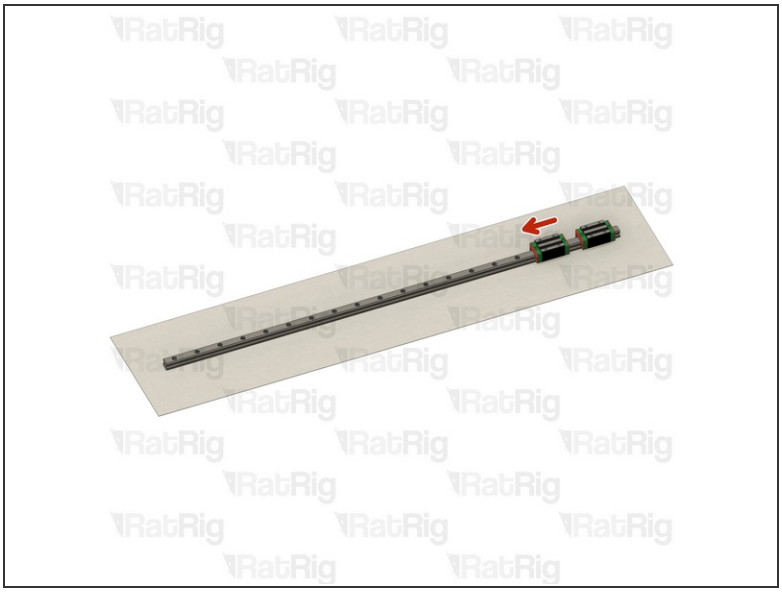
prepare your work surface with paper towels and to wear disposable gloves.

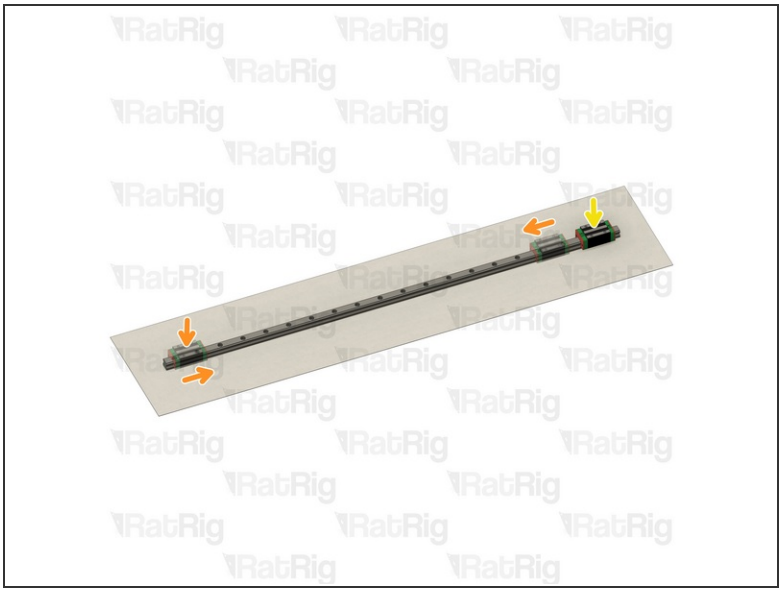
- Paper Towels
- Linear Rail
  - Carefully open one end of the linear rail packaging and remove the rail. Place the rail upon the paper towels and dispose of the packaging

⚠ 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 22 — Inspect & test the HG25 linear rails

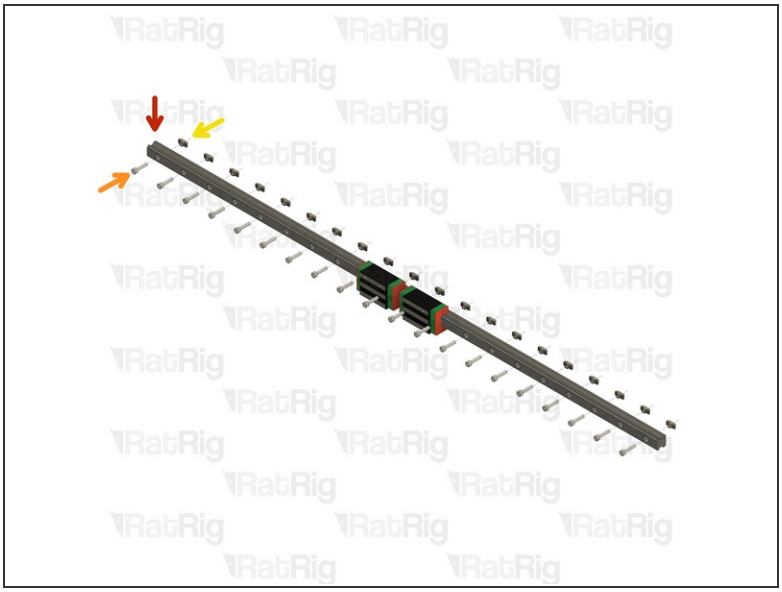




- With the rail still on the absorbent paper towels, carefully and slowly move the carriage from one end of the rail to the other
  - ⓘ Both carriages should move smoothly over the entire length of the rail
  - ⚠ Small changes in resistance are normal, but the carriage becoming very hard to push, or binding completely are not
- Repeat the previous test whilst applying a small amount of force downwards on the carriage
  - ⓘ 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 23 — 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 to each of the holes on the linear rail
- Loosely thread a 4040 T-Nut on to each of the M6x25 screws

ⓘ Repeat these instructions for the second linear rail

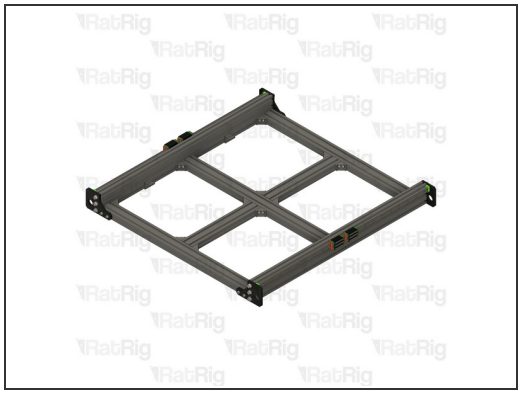
Step 24 — Install the HG25 linear rails - Part 1



- StrongHold PRO base assembly from **Step 19**
- HG25 Linear Rail assembly from **Step 23**
- Insert the linear rail in to the top slot of the 40120 extrusion, between the 3D printed spacers
- Install the two HG25 40120 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

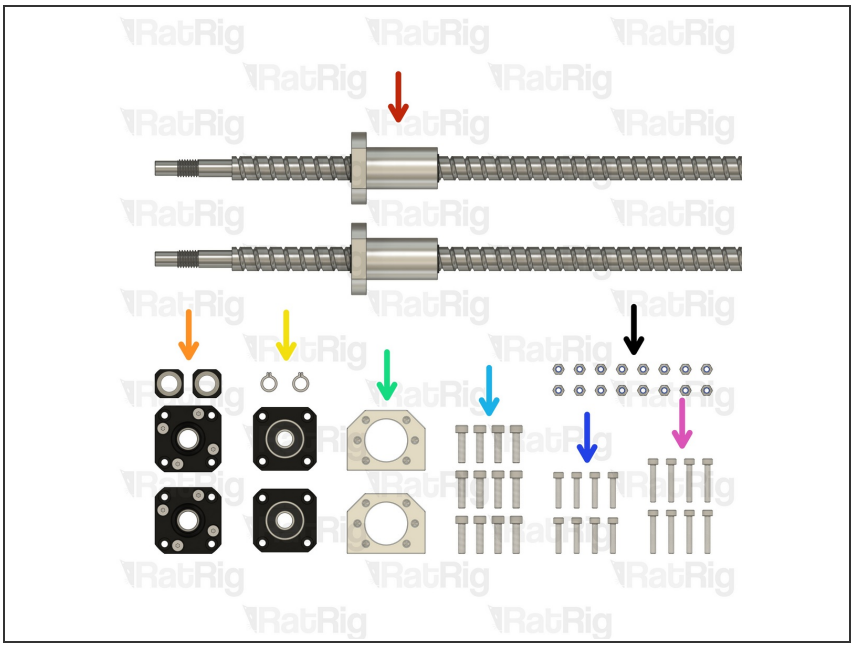
Step 25 — Install the HG25 linear rails - Part 2





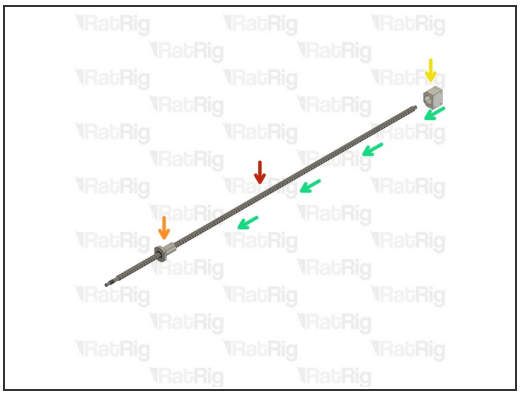
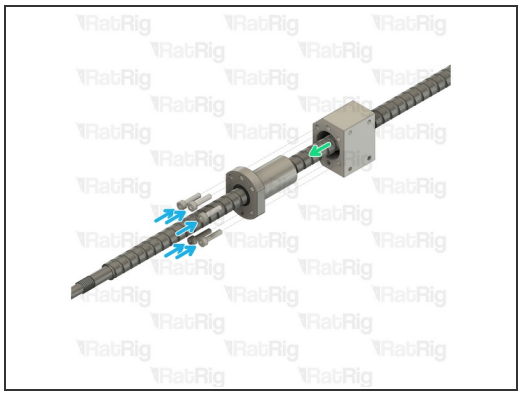
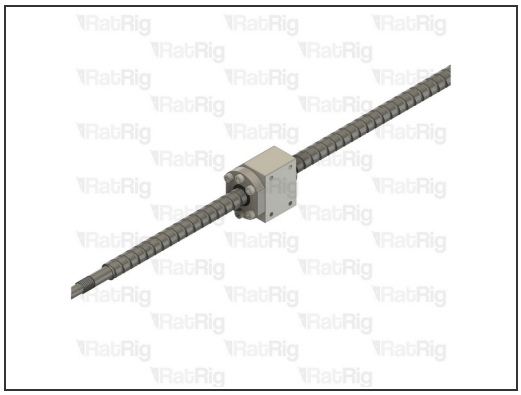
ⓘ Repeat the instructions in the **previous step** to install the second HG25 linear rail to the base assembly

Step 26 — Prepare the Y-axis ball screw parts



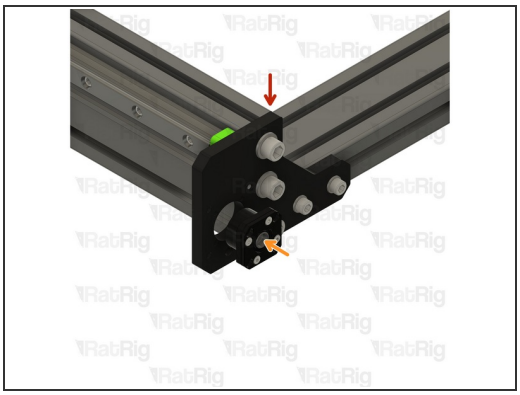
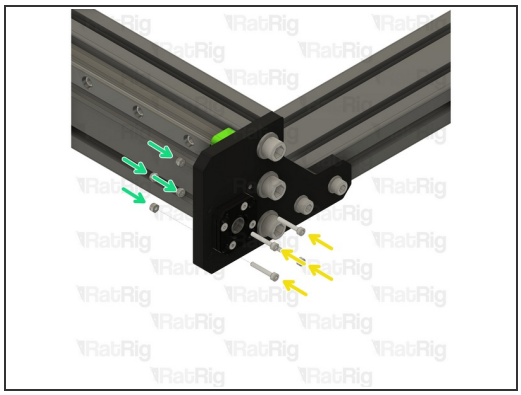
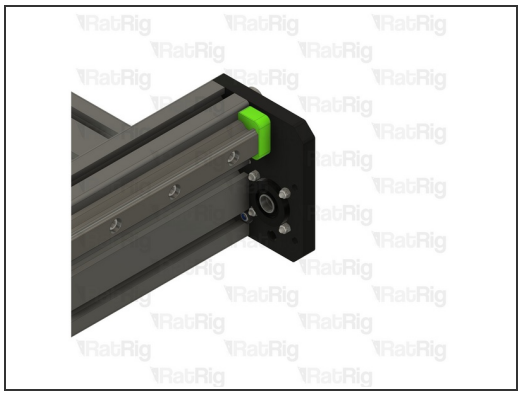
- 2x 1280mm 1610 Ball Screw (1780mm for a 1000x1500 or 1500x1500 machine)
- 2x FK12 Ball Screw Mount & Ball Screw lock nut (Packaged with the FK12 mount)
- 2x FF12 Ball Screw Mount & Circlip (Packaged with the FF12 mount)
- 2x 16mm Ball Screw Block
- 12x M5x20 Cap Head Screw
- 8x M4x20 Cap Head Screw
- 8x M4x25 Cap Head Screw
- 16x M4 Nylon Locking Hex Nut

Step 27 — Assemble the Y-axis ball screw (x2)

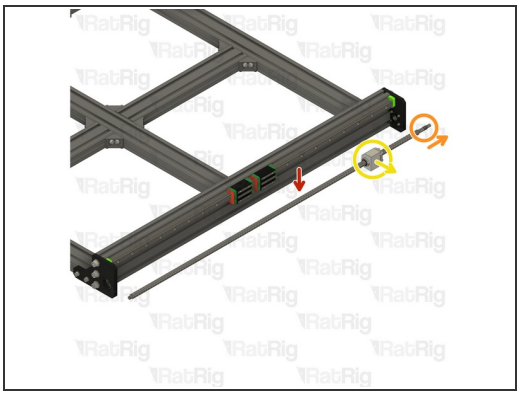
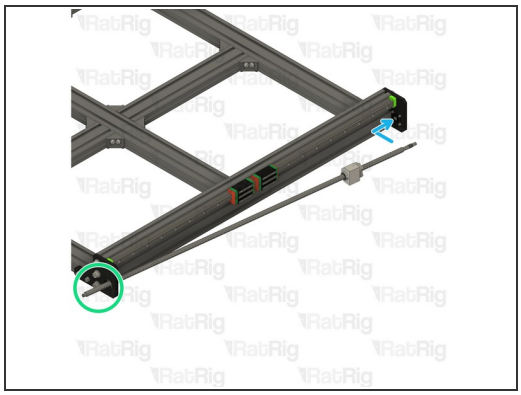
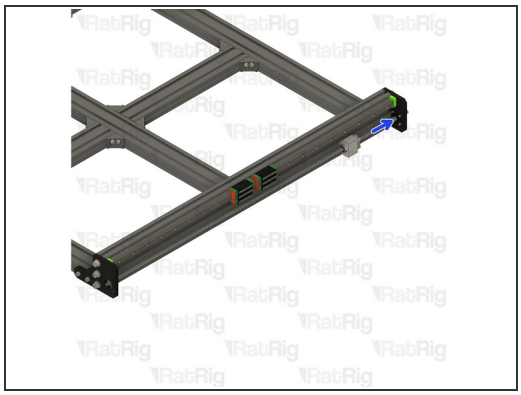
- 1280mm 1610 Ball Screw (1780mm for a 1000x1500 or 1500x1500 machine)
- ⓘ Unpack and remove all protective packaging from the ball screw
- Ball screw nut
  - ⚠ **Do not allow** the ball screw nut to reach either end of the ball screw
- 16mm Ball Screw Block
- Install the ball screw block onto the ball screw nut as shown
- 6x M5x20 Cap Head Screw
  - ⓘ Install an M5x20 screw through each hole in the ball screw nut and into the ball screw block. Fully tighten each screw

Step 28 — Install the rear right ball screw support

- Base frame assembly - rear right corner
- FK12 Ball Screw Mount
  - Insert the FK12 ball screw mount in to the motor plate as shown
- M4x25 Cap Head Screw
  - Insert an M4x25 screw through each of the four holes in the FK12 mount and through the motor plate
- M4 Nylon Locking Hex Nut
  - Install an M4 locking hex nut on to each M4x25 screw and tighten fully

Step 29 — Install the right Y-axis ballscrew - Part 1

- 16mm Ball Screw Assembly from **Step 27**

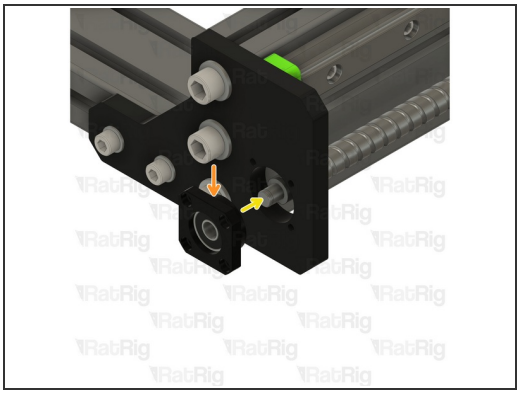
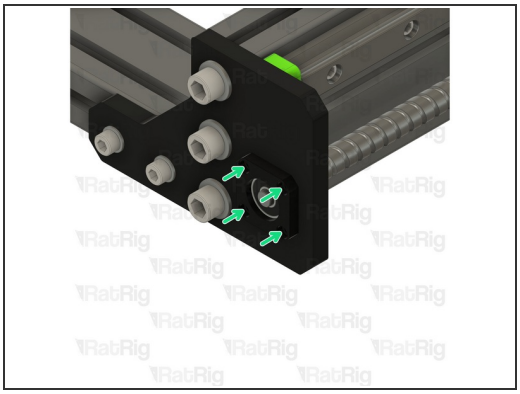
ⓘ Position the ball screw assembly so that:

- 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 frame** assembly

- Carefully feed the non-threaded end of the ball screw through the open hole in the idler plate
- 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

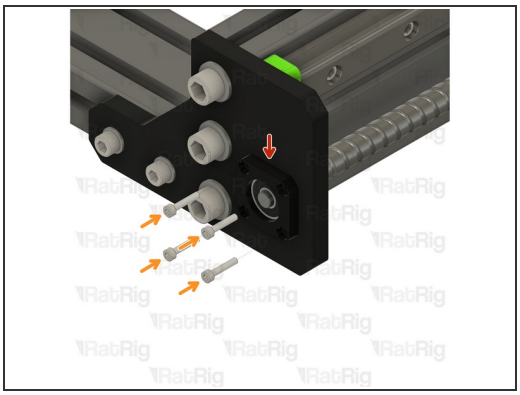
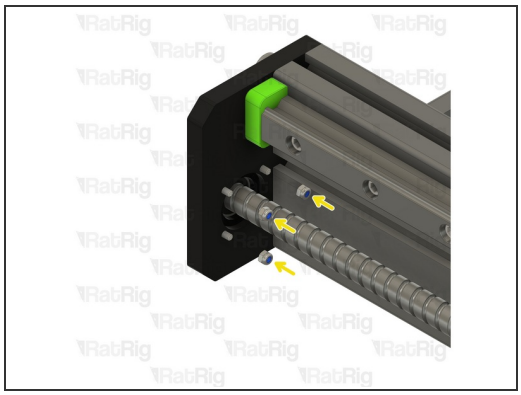
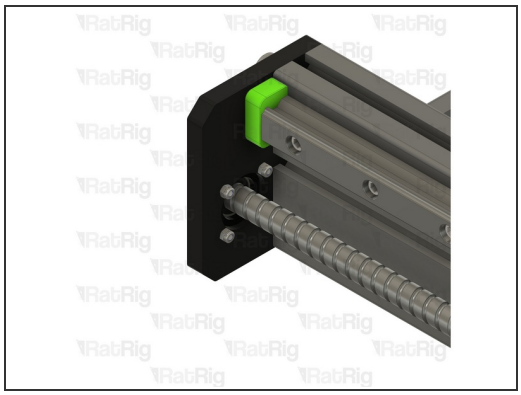
⚠ The ball screw is a precision fit into the FK12 mount. **Do not force the ball screw in to the mount.** When correctly aligned, it should slide in with little effort

Step 30 — Install the right Y-axis ball screw - Part 2

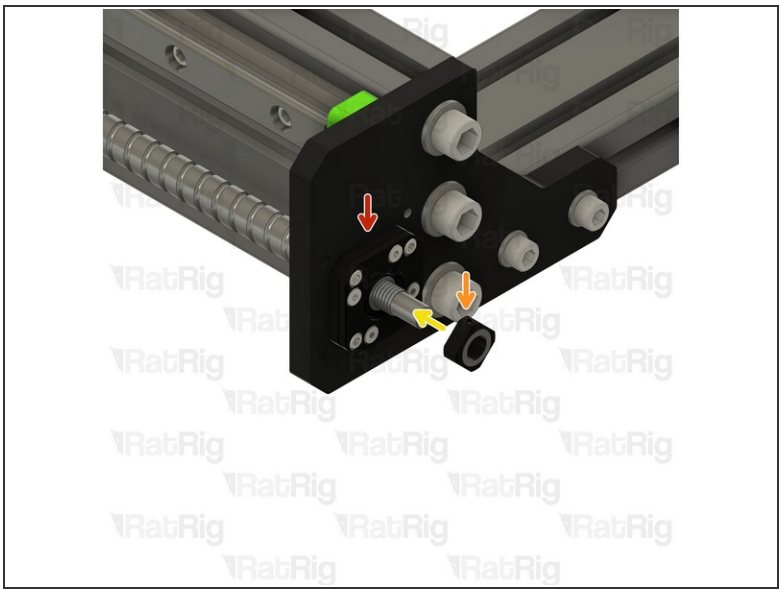
- ⓘ Check that the ball screw is fully inserted in to the FK12 mount before proceeding
  - ⓘ There should be no gap between the end of the ball screw thread and the back of the FK12 mount
  - The screw threads on the end of the ball screw should be visible as shown
- FF12 Ball Screw Mount
- Install the FF12 ball screw mount on to the free end of the ball screw and into the opening on the idler plate
- ⚠ The ball screw is a precision fit into the bearing inside the FF12 mount. **Do not force the ball screw into the bearing**. When correctly aligned, it should slide in with little effort
- Fully insert the FF12 ball screw mount into the opening in the idler plate
  - ⓘ There should be no gap between the FF12 ball screw mount and the idler plate

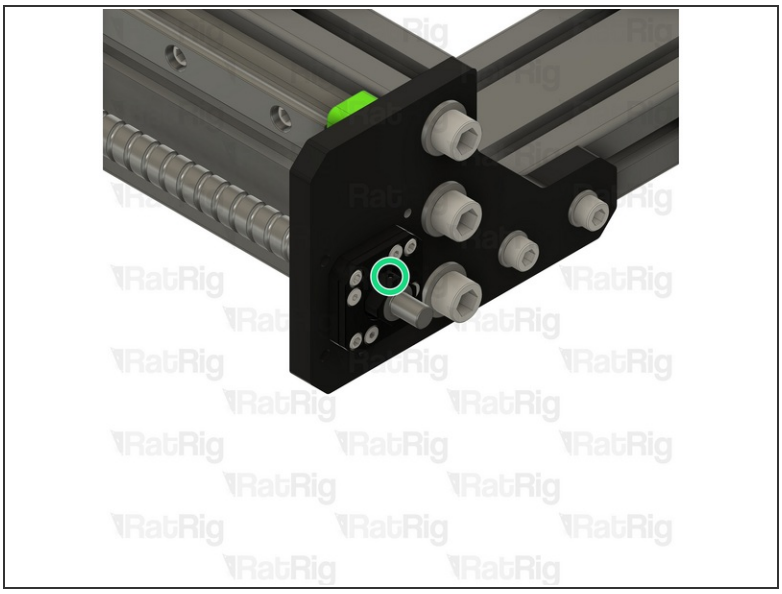
Step 31 — Secure the front right ball screw support

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

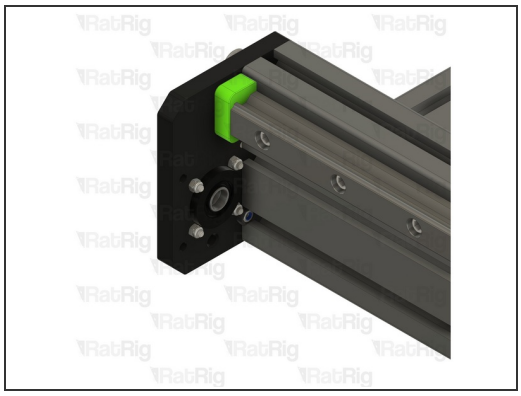
Step 32 — Install the ball screw retaining nut

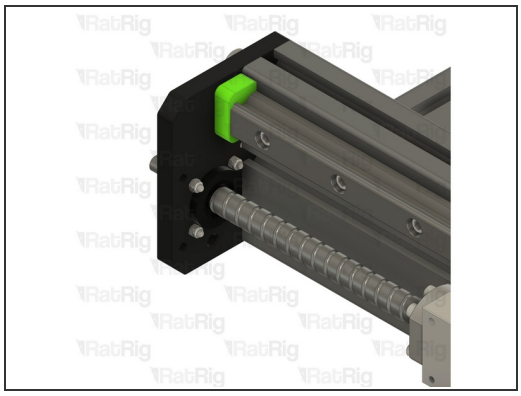




- FK12 Ball Screw Mount
- Ball Screw Lock Nut
  - Fasten the ball screw lock nut on to the exposed end of the ball screw as shown
- When the ball screw lock nut is fully tightened, use a 2mm hex key to tighten the grub screw within the lock nut. This will prevent the lock nut from loosening

Step 33 — Install the left Y-axis ball screw - Part 1



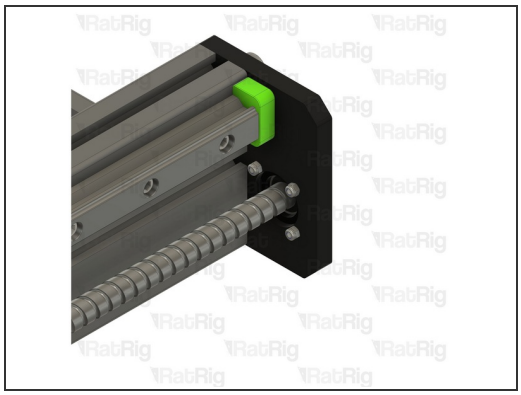


ⓘ Repeat **steps 28 & 29** to install the left FK12 mount and ball screw

⚠ Remember to fully support the length of the ball screw until both ends are secured

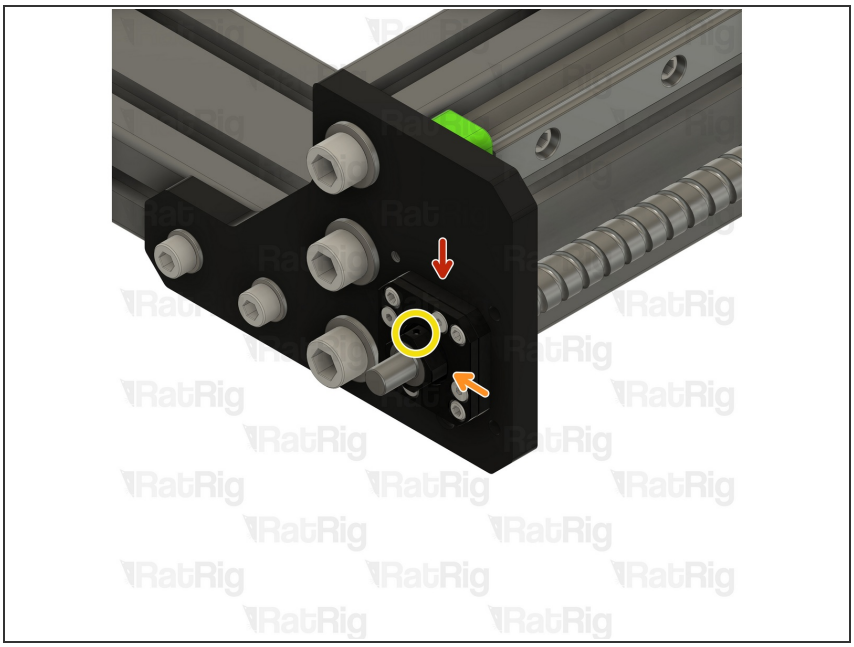
Step 34 — Install the left Y-axis ball screw - Part 2





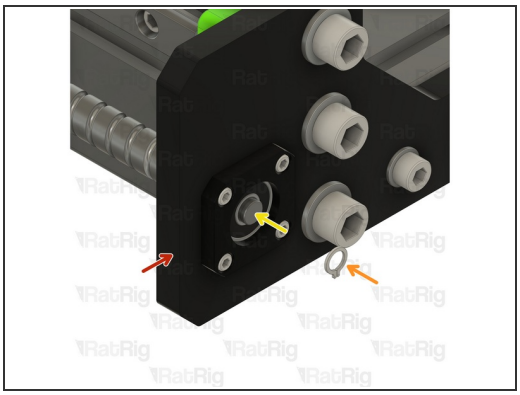
ⓘ Repeat **steps 30 & 31** to install the left FF12 mount to the idler plate, securing the left ball screw

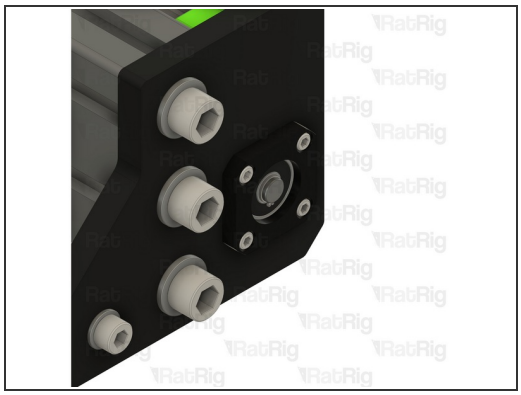
Step 35 — Install the left ballscrew retaining nut



- 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

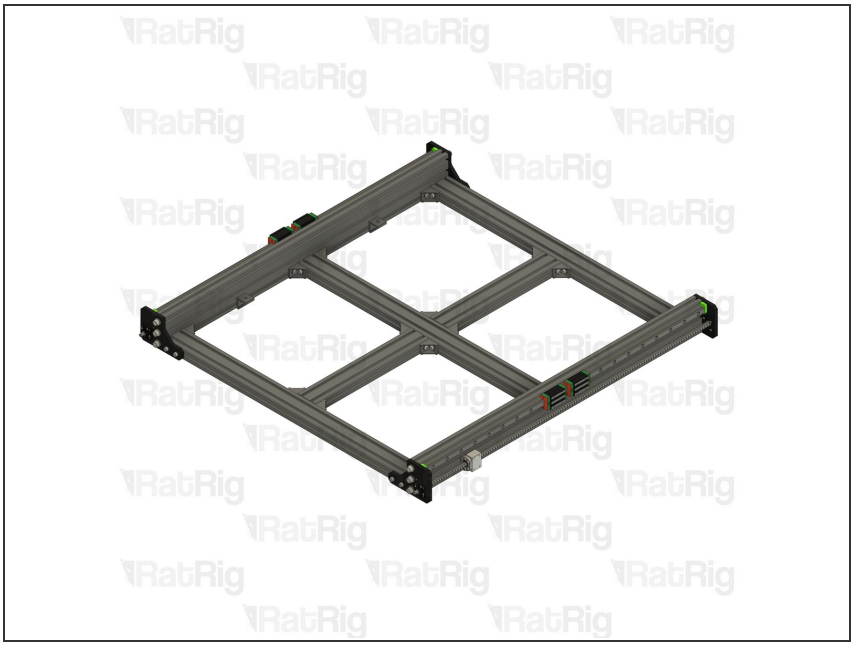
Step 36 — Install the ball screw circlips





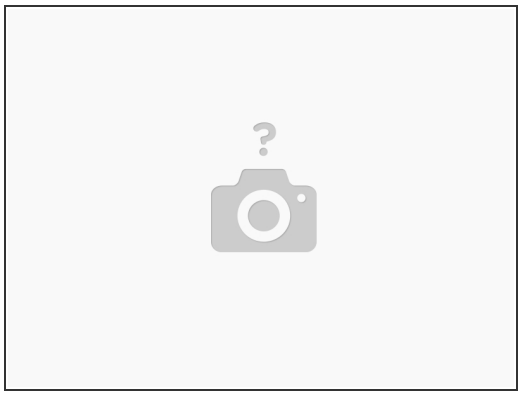
- StrongHold PRO Front Left Corner
- FF12 Circlip
- Using a pair of circlip pliers, install the circlip on to the end of the ball screw
- ⓘ Make sure the circlip seats fully in the groove on the ball screw
- ⓘ Repeat the instructions to install the circlip on the right side ball screw

Step 37 — Test the ball screw installation



- Test each of the ball screws by rotating them and checking that they rotate smoothly
- Double check that all fasteners used on the ball screws and mounts are fully tightened
- Check each ball screw for smooth movement once again, before proceeding to the next step

Step 38 — Next guide



- Continue with the next guide: 02. X-Axis Gantry Assembly