

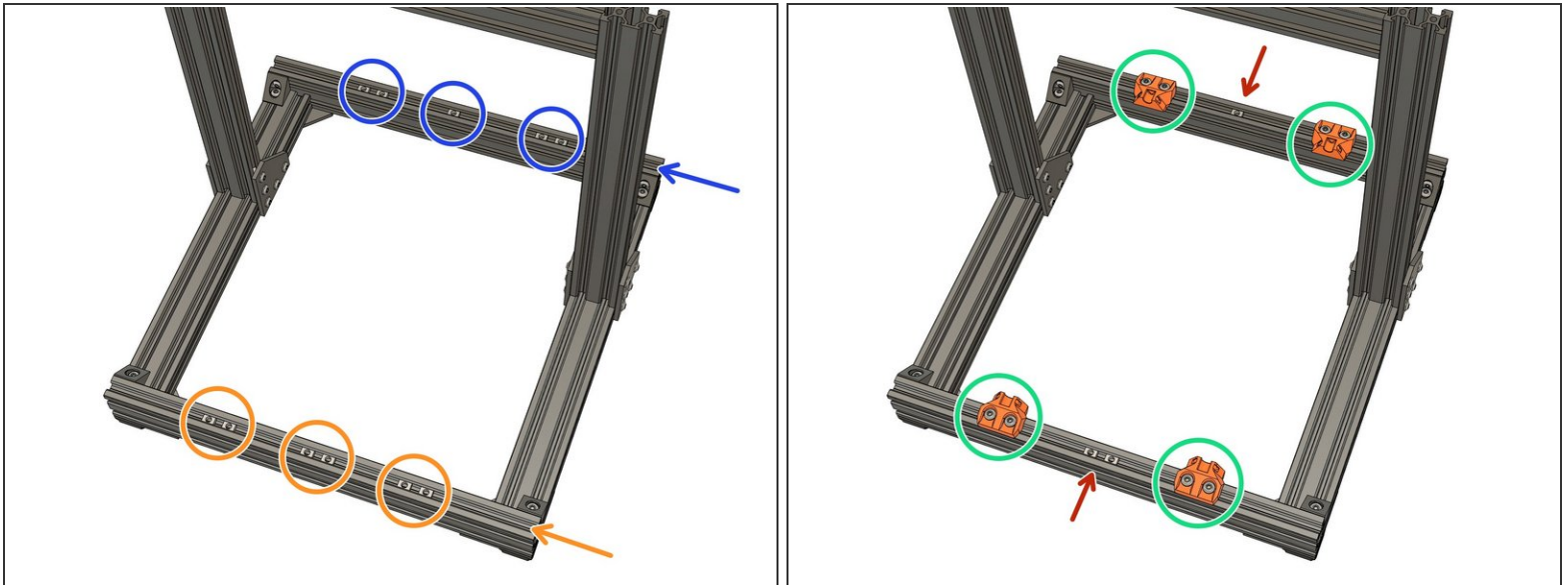
Bear Lab

05. Y axis motion

Written By: Grégoire Saunier

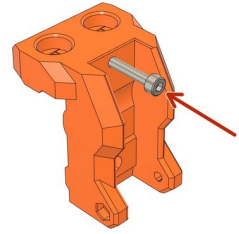
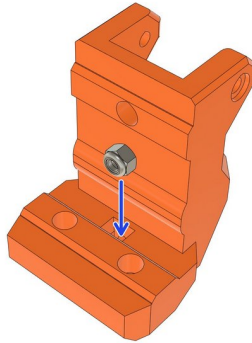
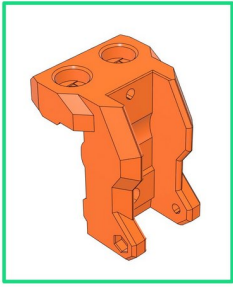


Step 1 — Install Y rod holders



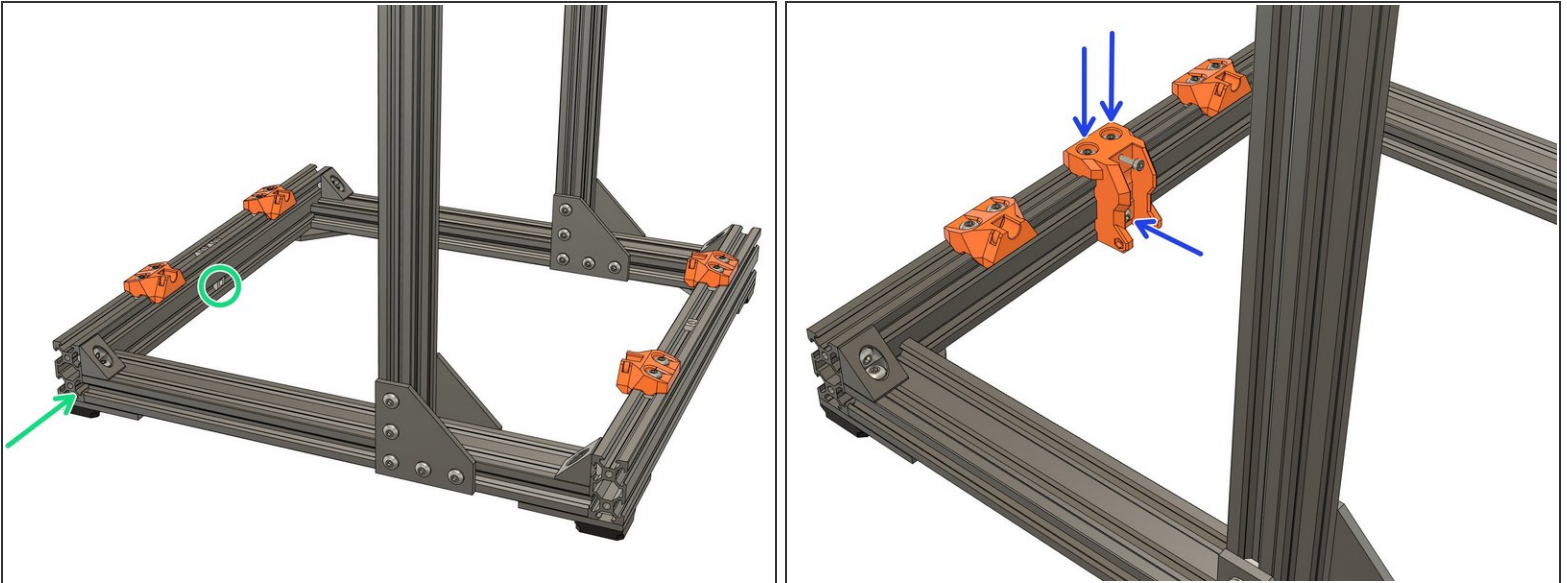
- Slide 6x t-nuts in the top channel of the front extrusion.
- Slide 5x t-nuts in the top channel of the rear extrusion.
- Attach 4x *y_rod_holders* to the frame, using 8x M5x12 screws, as shown. Tighten them just enough to prevent sliding, we will set the correct position later.
- Check that you have have 2x free t-nuts in the top middle of the front extrusion and 1x free t-nut in the top middle of the rear extrusion.

Step 2 — Prepare Y idler mount



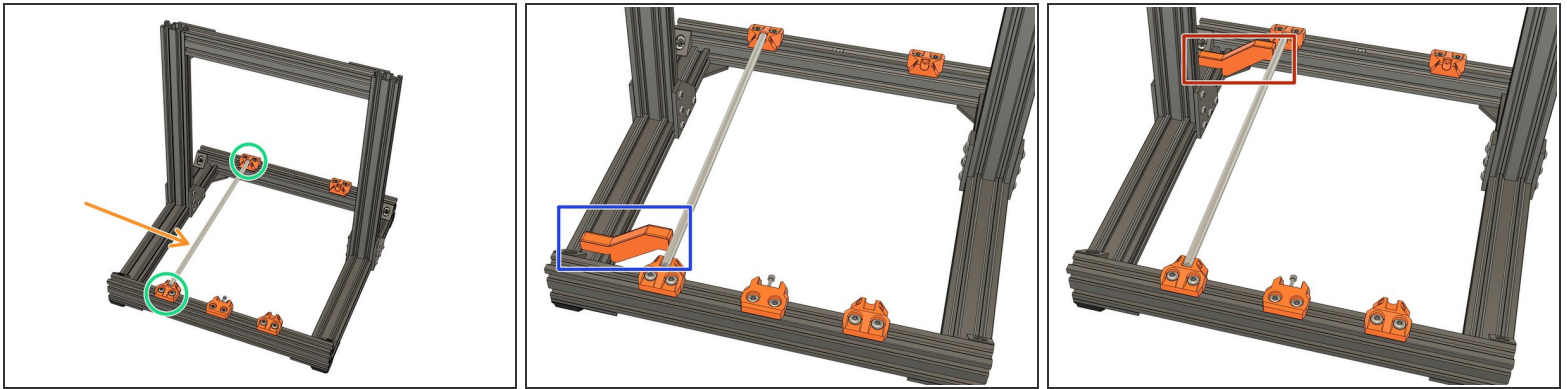
- Take the "y_idler_mount"
- Place 1x M3 locknut in the pocket at the back of the part, as shown. Ensure sure the locknut has been fully inserted (use an Allen key or screwdriver) and is correctly oriented.
- Thread 1x M3x25 screw through the front top hole and into the locknut. This will prevent you losing the locknut during the next steps.
- ❗ If you have trouble to thread the screw you can remove the M3 nylock. Then take the M3x25 screw and thread the M3 nylock all the way through. Then remove it from the screw and repeat this assembly. This will make it slightly easier to screw in.

Step 3 — Install Y idler mount



- Slide 1x t-nut in the lower channel of the front extrusion, as shown.
 - Using 3x M5x10 screws, assemble the *y_idler_mount*. Tighten them just enough to prevent the part from sliding. We will set the correct position later.
- ⚠ Do not fully tighten the part to the frame. We will adjust its final position when we align the belt path with the bed and motor.

Step 4 — Left smooth rod alignment



⚠ Take your time with this step, it could affect the alignment of the heatbed later.

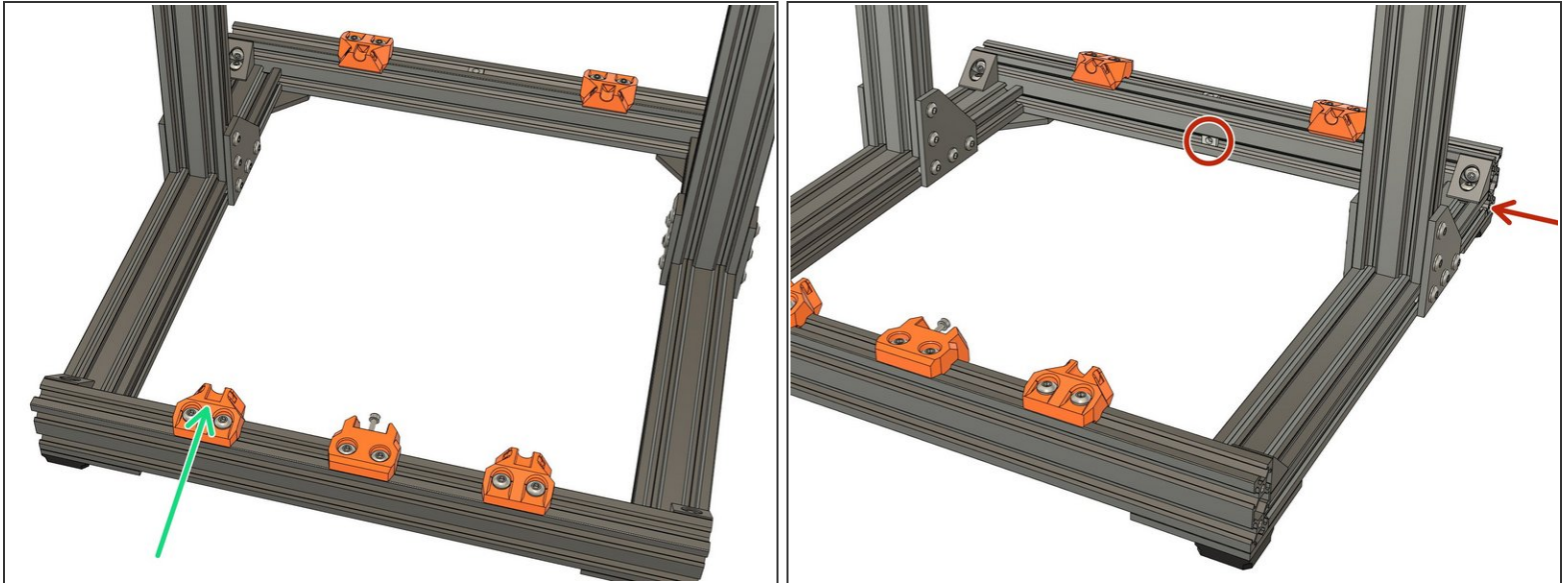
- Clip 1x Y smooth rod (330mm long) into the y-rod holders, on the left-hand side.
- Loosen the 4x M5x12 screws so that the *y_rod_holders* move easily.
- Using the *y_build_helper*, adjust the position of the front *y_rod_holder*. Once the alignment is correct, fully tighten the M5x12 screws.

⚠ Make sure the *y_build_helper* is correctly seated against the extrusion and is in contact with the smooth rod.

- Using the same *y_build_helper*, adjust and tighten the rear y-rod holder.

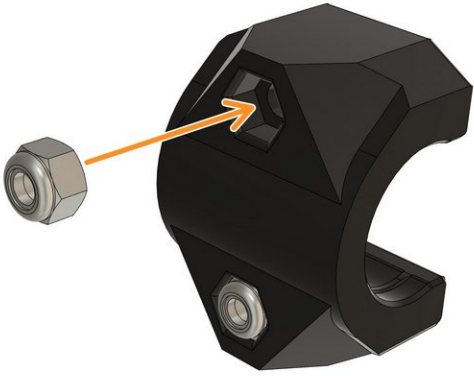
⚠ Carefully check the alignment of the front and rear of the smooth rods. You may need to repeat the adjustment to get them perfectly aligned.

Step 5 — Prepare for Y motor mount



- Remove the Y smooth rod you installed in the previous step.
- Slide 1x t-nut into the lower channel of the rear extrusion, as shown.
- ⓘ Be careful that this t-nut does not fall out during the following steps. (Remember the tape / Blu Tack tip)

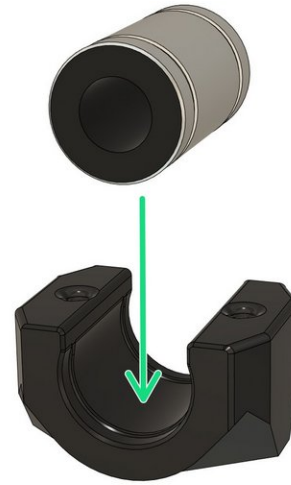
Step 6 — Prepare Y bearings



- ① We are now going to prepare a few parts that will be used later in this chapter. Let's start with the Y bearing holders.
- ① If you come from an Original Prusa MK3S+ you can reuse the black metal bearing clip instead of the printed ones and skip this step and the next one.
- Take the 3x *y_bearing_holder* and insert 2x locknuts in each of them, 6x locknuts in total (reused from your Original Prusa). Those locknuts need to be **reused** from your Original Prusa printer.
- We need to make sure that the locknuts are fully inserted in their pocket. To do this, take 1x M3x18 screw and 1x washer.
 - For each locknut in the *y_belt_holders*, insert the screw and tighten it against the washer, until the locknut is fully seated.
 - Remove the screw and washer and repeat for the 5 other locknuts of the bearing holders.

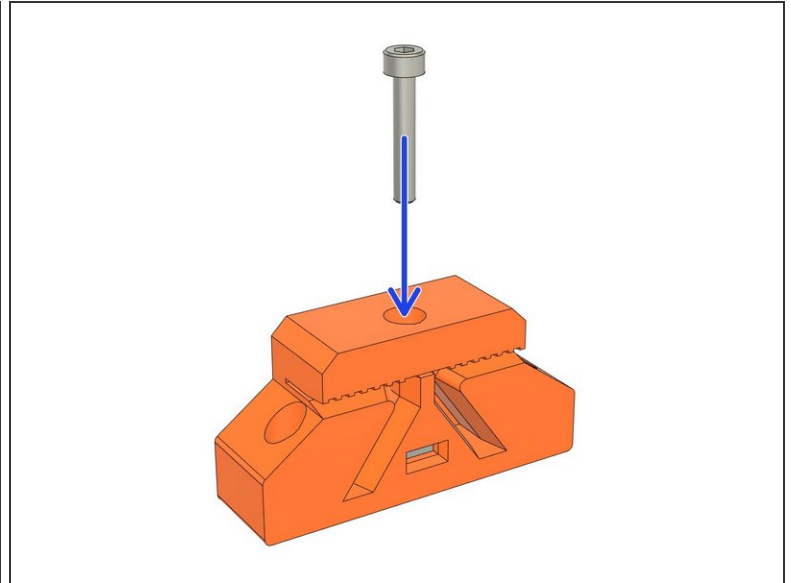
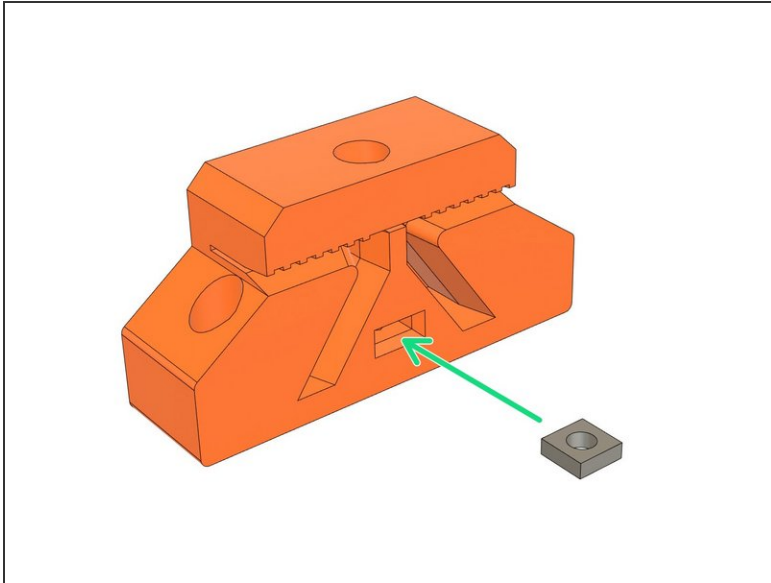
⚠ Make sure the 6x locknuts are fully seated in the bearing holders.

Step 7 — Prepare Y bearings



- We are now going to insert the LM8UU bearings in the 3x *y_bearing_holders*. When you place the bearings you need to ensure that the rows of ball bearings are at 45° as shown in the image.
- Insert the LM8UU bearings in the each of the 3x *y_bearing_holders*. Each bearing should be centred in the bearing holder. There are ridges in the plastic part which will align with the grooves in the LM8UU bearing.
- ⚠ Confirm that each bearing is aligned vertically as shown in the first image. It is very important to have all x3 bearings correctly aligned!
- Keep the 3x *y_bearing_holders* ready for use later in this chapter.

Step 8 — Prepare Y belt holder



i The part you use in this step, might look different to that shown in the instructions, depending on which Prusa variant you are building. However, the following instructions are the same for each variant.

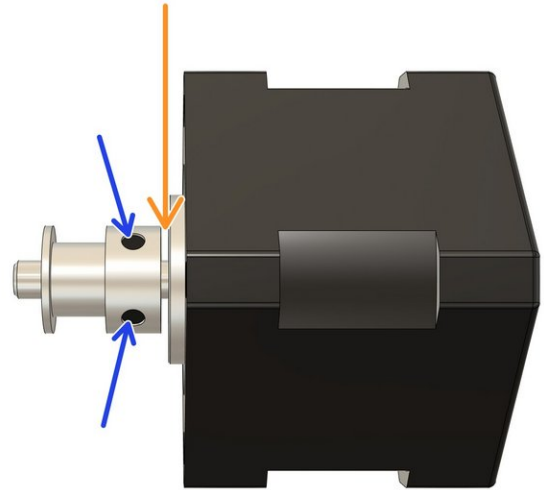
- Insert 1x square nut into the *y_belt_holder*, as shown.
- Thread in an M3x18 screw, from the top. Do not tighten it yet.
- Keep the *y_belt_holder* for later use.

Step 9 — Prepare Y idler tensioner



- Prepare the following parts:
 - 1x 20T idler with Y axis belt (650mm) looped around it.
 - 1x *y_idler_tensioner* printed part.
 - 1x dowel pin.
- Place the belt around the idler and insert it into the *y_idler_tensioner*.
- Insert the dowel pin from the right side. Make sure the dowel pin is fully inserted and does not stick out of the *y_idler_tensioner*
- Keep the *y_idler_tensioner* for use later.

Step 10 — Prepare Y motor



- Take the Y axis motor.
- Slide the 16T drive pulley on to the motor shaft, as shown. Make sure the pulley is not touching the motor (around 1mm of space between the motor body and drive pulley is enough).
- Make sure the grub screws are both tight, ensuring that one of the grub screws is tightened against the flat part of the shaft.
- Keep the Y motor for later use.

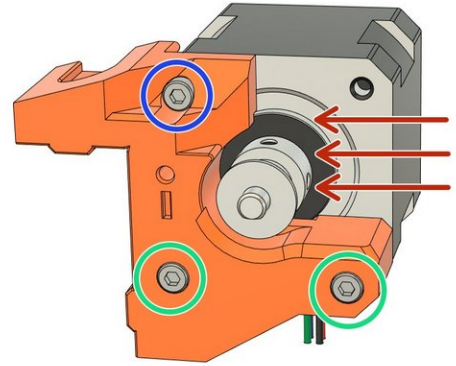
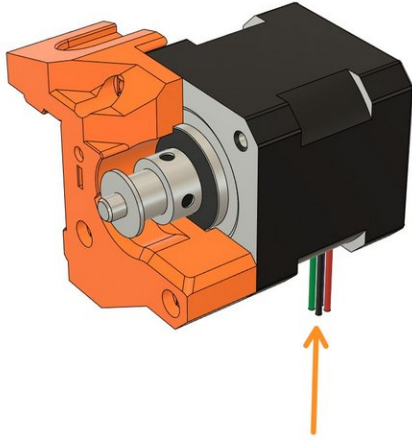
Step 11 — MK2(S) or MK2.5(S) steps



~~MK3(S)~~ MK2(S)
MK2.5(S)

- The next steps are for **MK2(S) or MK2.5(S) printers only**.
- If you have **MK3(S)** jump to [step 26](#).

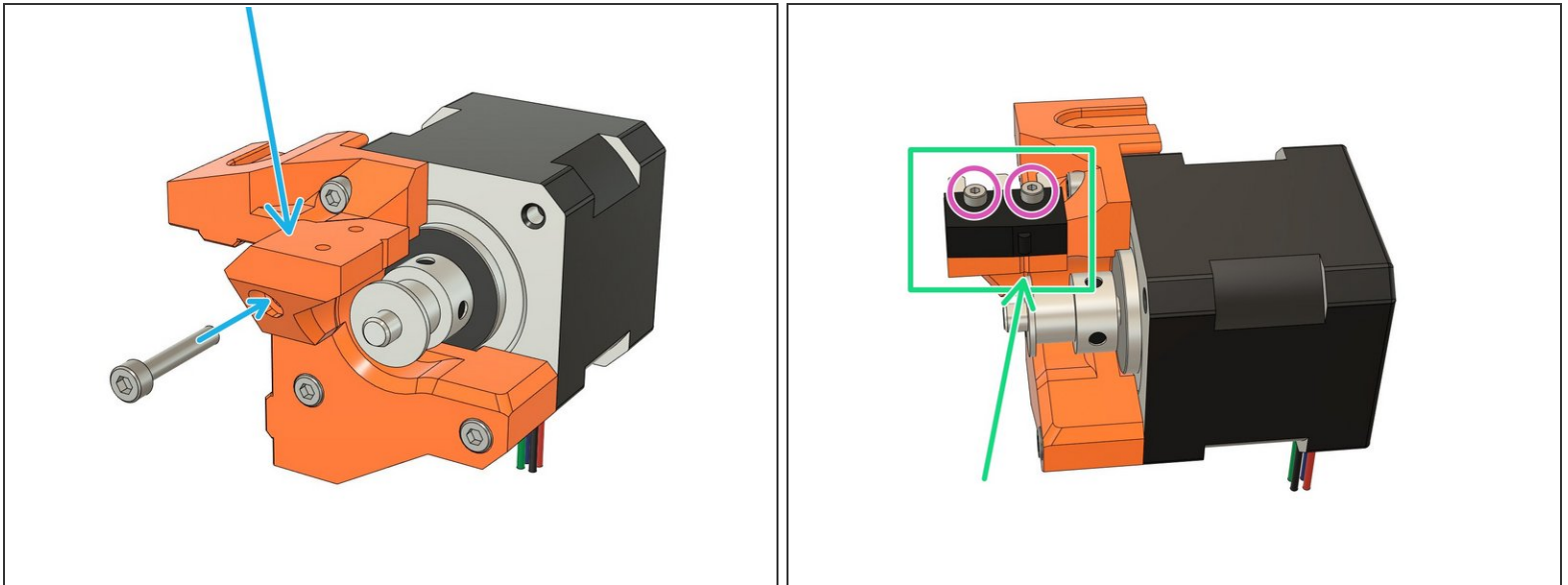
Step 12 — Y motor installation - MK2(S)/MK2.5(S)



- Place the Y motor on the *y_motor_mount* as shown in the first image. The cables must be orientated downward.
- Secure the motor with the following screws. Do not fully tighten them yet.
 - 2x M3x18
 - 1x M3x10
- Whilst pushing in the direction shown, fully tighten all 3 screws.

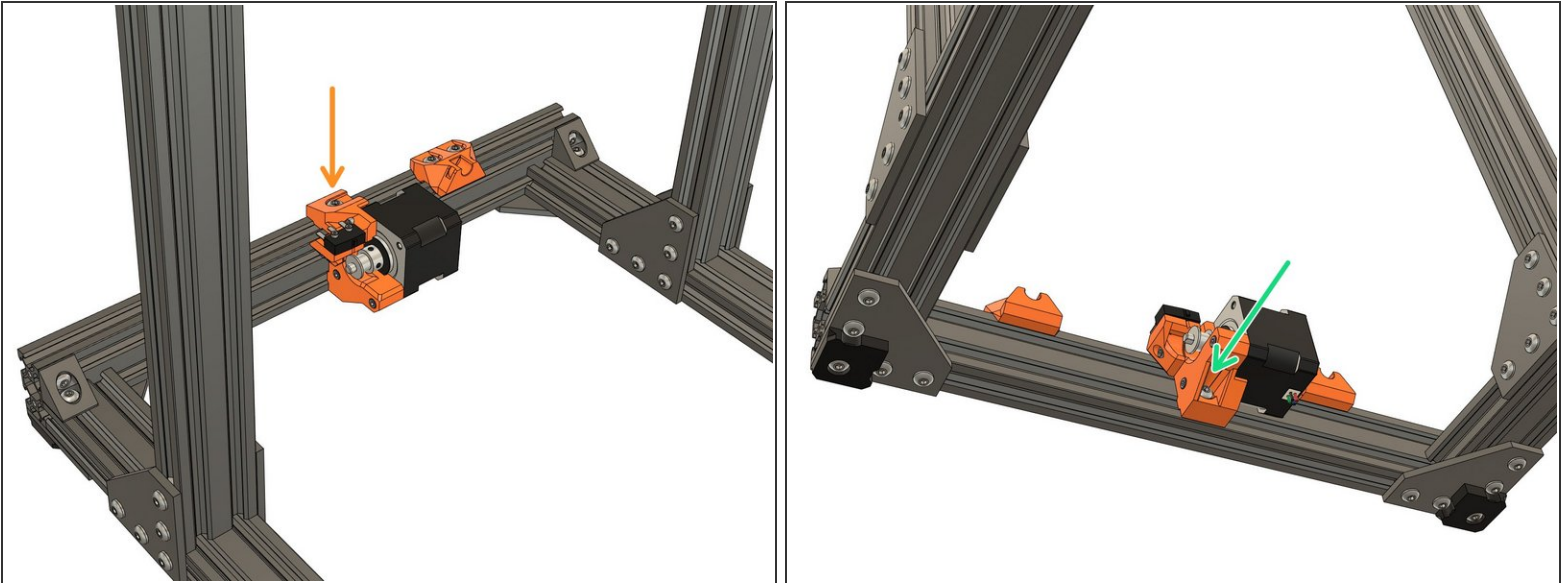
⚠ Check that the motor cables are oriented correctly.

Step 13 — Y motor installation - MK2(S)/MK2.5(S)



- Place the `y_motor_endstop_mount`, as shown, and secure it with 1x M3x18 screw.
 - Place the Y end stop on the `y_motor_endstop_mount` with the switch actuator aligned with the notch, as shown.
- ⚠ **Make sure the orientation of the switch is correct!**
- Insert and tighten 2x M2x12 screws to secure the end stop. **Do not over tighten these screws, otherwise you may damage the end stop.**
- ⓘ If it is too hard to tighten the M2 screws into the end stop mount, you may use a 1.5mm drill bit to clear the holes. Be careful that you do not break the drill bit.

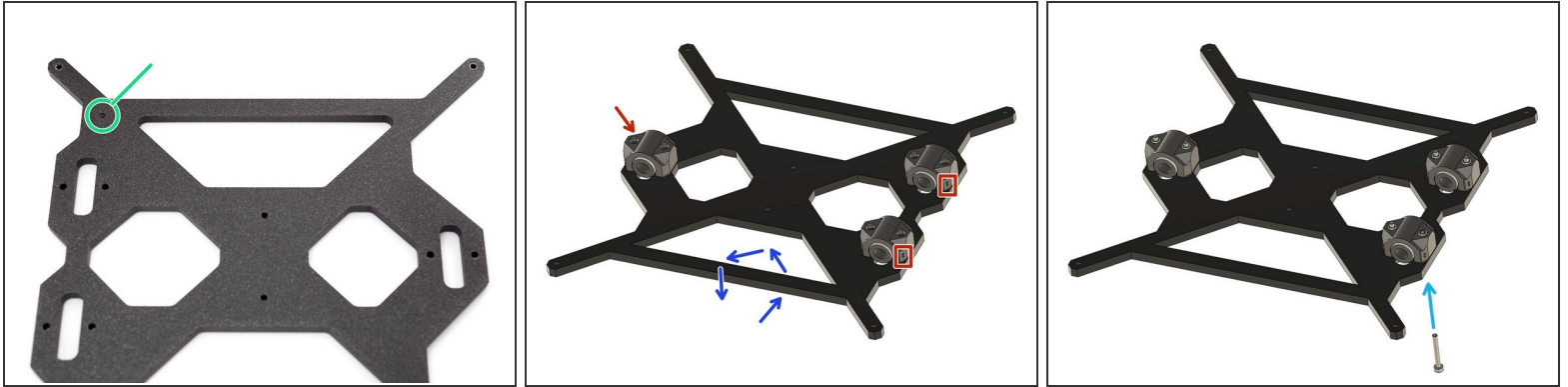
Step 14 — Y motor installation - MK2(S)/MK2.5(S)



- Install the *y_motor_mount* on the extrusions in the back. Do not fully tighten the screws. We will set the position in Step 19.
 - 1x M5x12 on top
 - 1x M5x16 on bottom

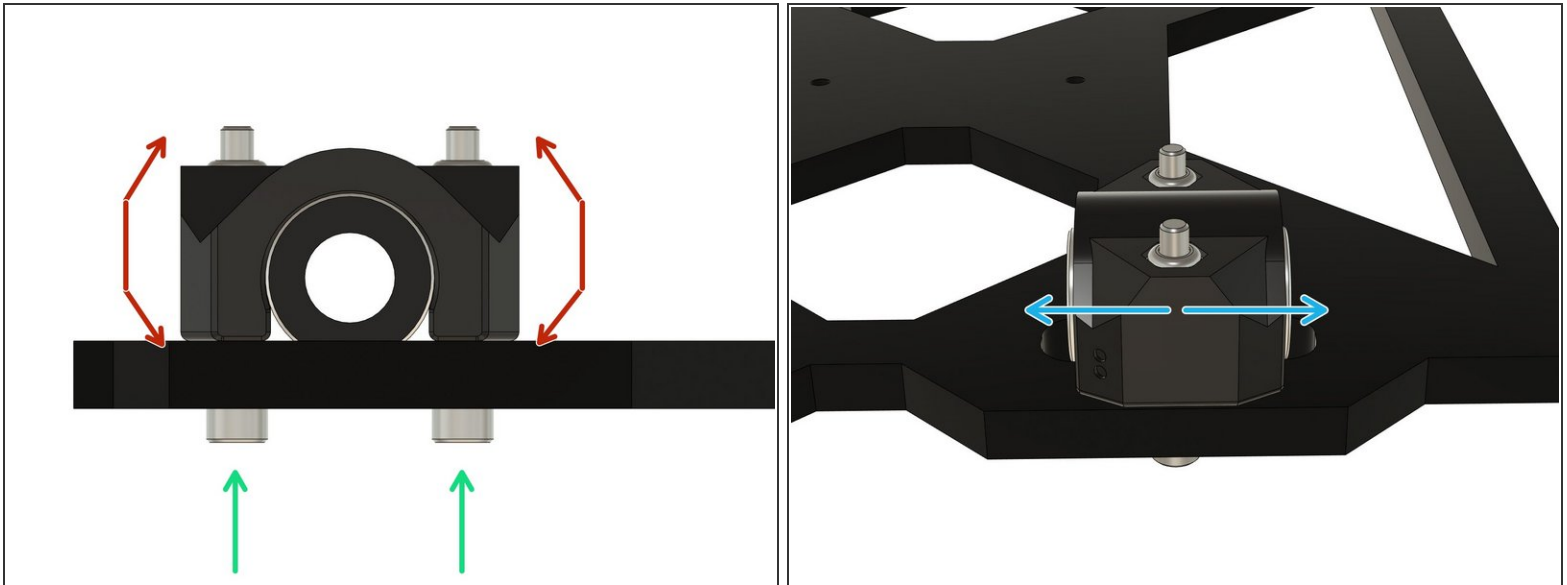
⚠ Always tighten the *y_motor_mount* screws **evenly, incrementally and in turn**. This ensures that the motor mount is properly square on the extrusions.

Step 15 — Y bearings installation - MK2(S)/MK2.5(S)



- Locate the marker of the Y carriage.
- Flip the carriage to have the marker facing the table (not visible anymore in the 2nd and 3rd image).
- The *y_bearing_holders* have **2 dots** printed on one of their corners. Place the 3x *y_bearing_holders* with the dots oriented as shown on the 2nd image.
⚠ Double check the orientation of the *y_bearing_holders*, this is important as you might have issues later with the heated bed.
- Secure the bearing holders with 6x M3x25 screws. Do **NOT** tighten them yet!

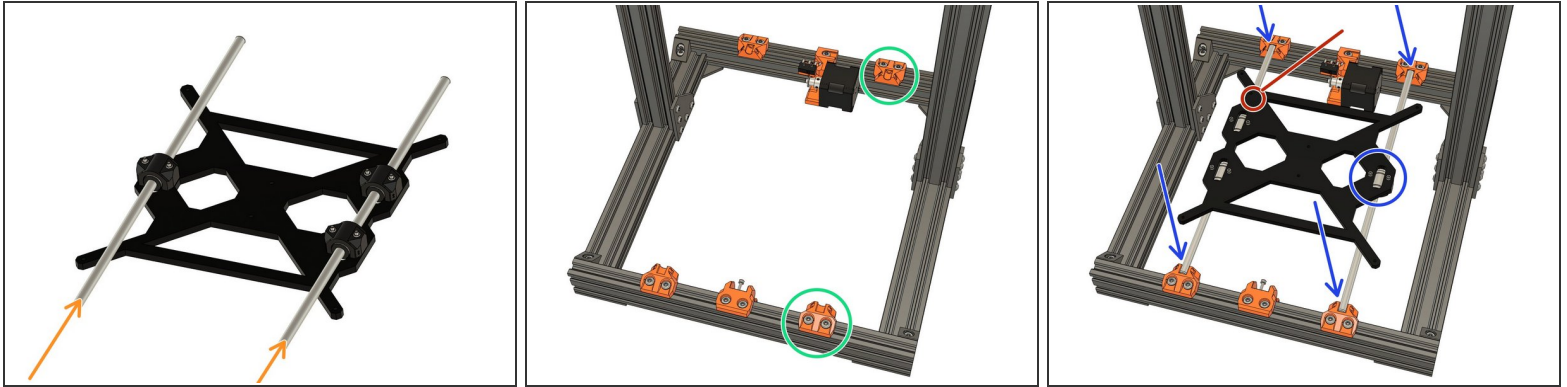
Step 16 — Y bearings installation - MK2(S)/MK2.5(S)



⚠ Take your time with this step. It is important that it is done correctly or it can cause issues later with your printer. Do not over-tighten the bearings or you may cause permanent damage to them.

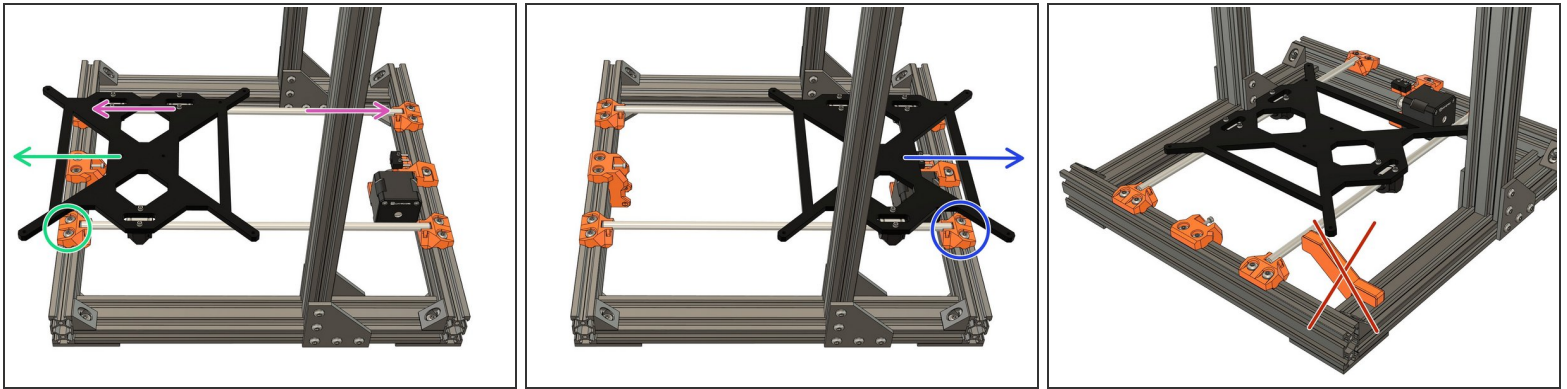
- Start tightening **evenly, incrementally and in turn**, the M3x25 screws. While tightening, test if the bearing can rotate in the directions shown by the red arrows. When it no longer moves, in this direction, **stop tightening** immediately.
- Check whether the bearings can slide along the slot.
 - If the bearing can slide: tighten **evenly, incrementally and in turn**, the M3x25 screws until you can't move it anymore. **Do not over-tighten!**
 - If the bearing is not moving anymore: continue to the next bearing.
- Repeat this step for the two remaining bearings.

Step 17 — Y smooth rods installation - MK2(S)/MK2.5(S)




- Gently insert 2x Y axis smooth rods (330mm long).
 - ⚠ You must not use any significant force whilst inserting the rods into the linear bearings.
 - ⚠ Don't rotate the smooth rods, the LM8UU bearings are not made to rotate.
- Loosen the M5 screws of the 2x right *y_rod_holders*. You should be able to slide them easily by hand.
- Clip the Y smooth rods and carriage assembly into the *y_rod_holders*. The Single bearing should be to the right.
- Verify the marker on the carriage is correctly positioned. If this is not the case, check that you have followed the previous steps correctly.
- ⚠ It is very important to have the LM8UU bearings correctly oriented as well as the marker or you will have issues later in the assembly.

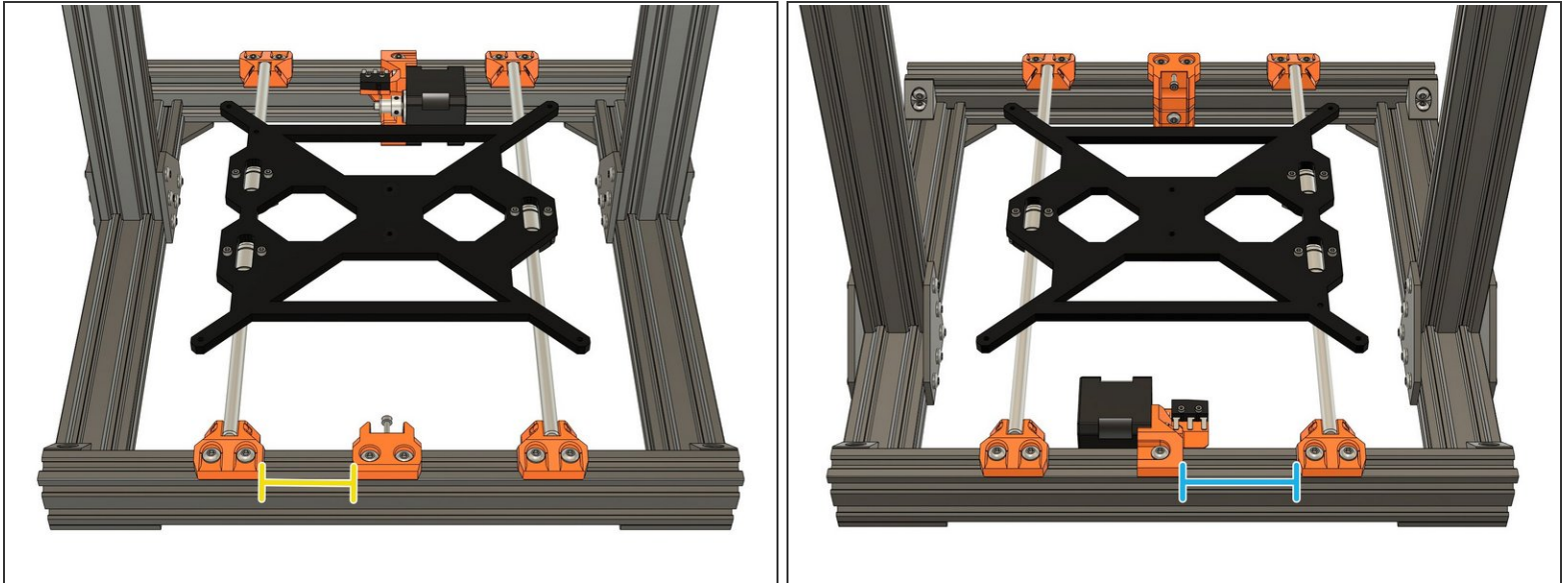
Step 18 — Right smooth rod alignment - MK2(S)/MK2.5(S)



 Take your time with this step.

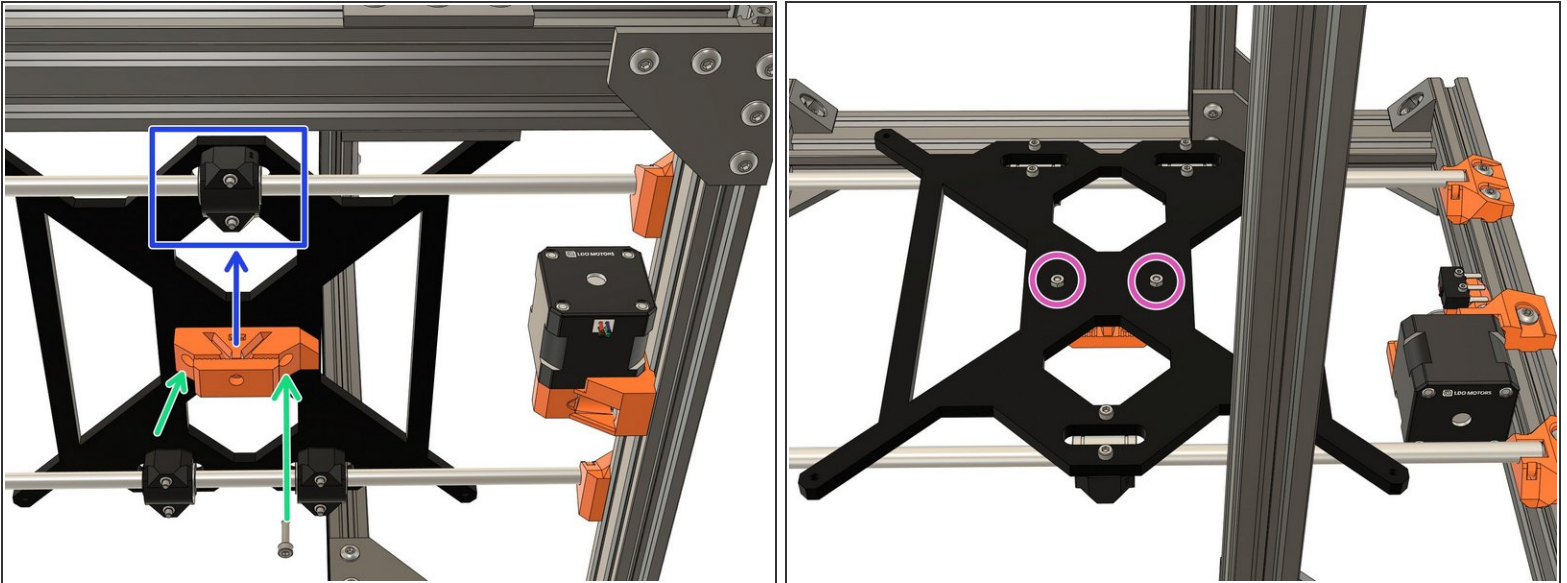
- Move the Y carriage, backwards and forwards along the whole length of the Y axis, at least 6 times. This will align the right smooth rod (single LM8UU side).
 - Move the Y carriage to the front and tighten the screws for the right-front *y_rod_holder* **evenly, incrementally and in turn**.
 - Move the Y carriage to the back and tighten the screws for the right-back *y_rod_holder* **evenly, incrementally and in turn**.
 - Never use the *build_helper_y* with the right smooth rod, it is made to **align left smooth rod only** (dual LM8UU side).
-  Tech tip: If you have a 200mm caliper you can measure the distance from the smooth rods directly on the metal. The spacing of the smooth rods is 170mm, the diameter of smooth rods is 8mm, which means the external spacing you should measure will be $170 + 2 \cdot 8/2 = 178\text{mm}$.

Step 19 — Y axis parts positioning - MK2(S)/MK2.5(S)



- Set the *y_idler_mount* and *y_motor_mount* position as following:
 - 47mm for the *y_idler_mount*.
 - 61.5mm for the *y_motor_mount*.
- ⓘ We will adjust these positions, if necessary, after the belt is in place and tensioned.

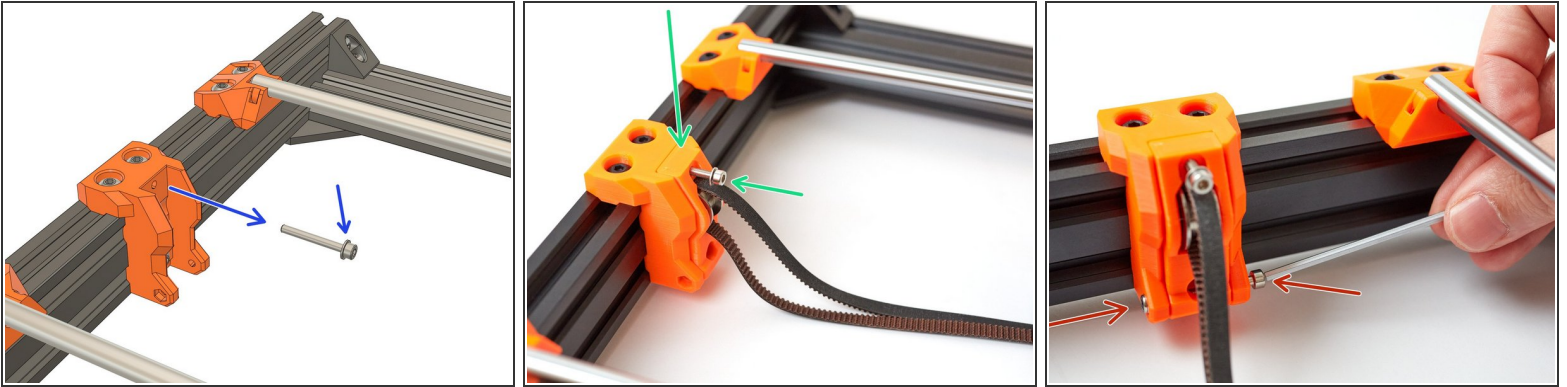
Step 20 — Y belt holder installation - MK2(S)/MK2.5(S)



- Install the *y_belt_holder* under the Y carriage. The grooves should face the single bearing side.
- 2x M3x12 (reused from your original Prusa).
- 2x M3 hex nut. Note that these nuts will be removed when installing the heated bed, they are only temporary.

⚠ Check the orientation of the *y_belt_holder*.

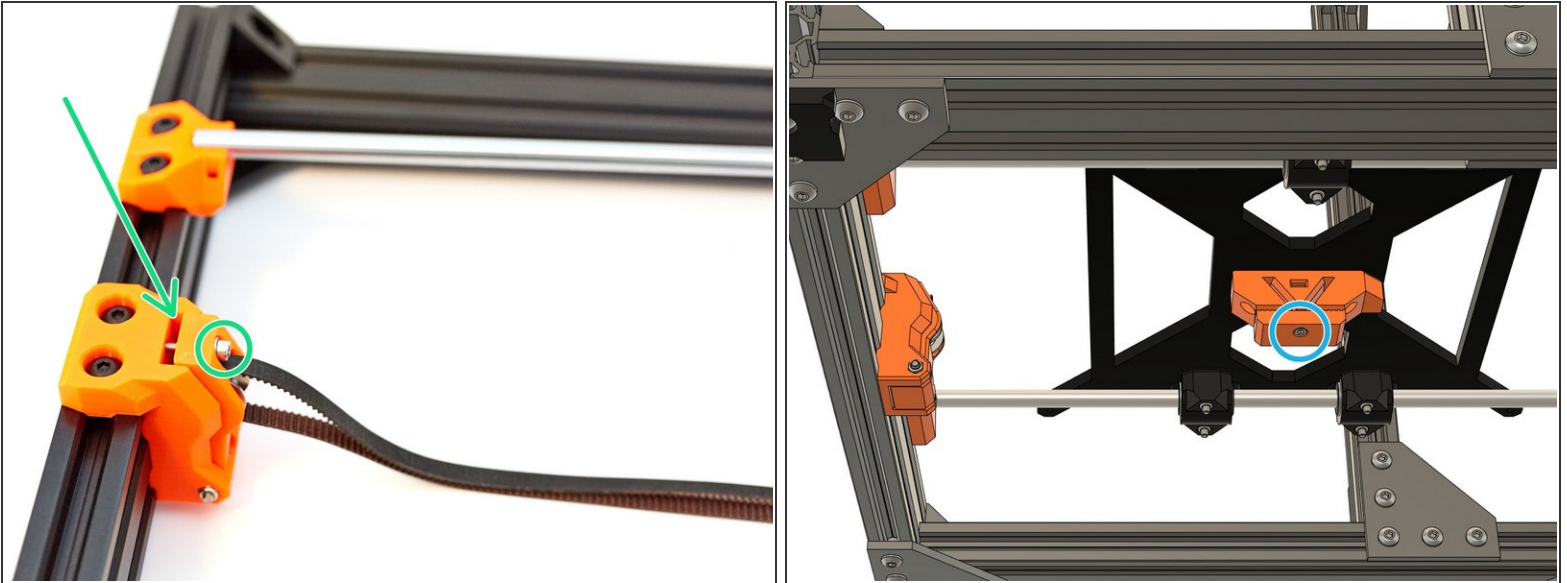
Step 21 — Y idler tensioner installation - MK2(S)/MK2.5(S)



- Remove the M3x25 screw, used during installation, from the *y_idler_mount* and **add a washer** to the screw.
- Insert the *y_idler_tensioner* into the *y_idler_mount* and reinsert the M3x25 screw with its washer.
- Insert an M3 locknut into the left side of the *y_idler_mount* and thread an M3x30 screw from the other side. Use this screw to help seat locknut correctly, in the part. Do not over-tighten this screw, the *y_idler_tensioner* should move with almost no resistance.

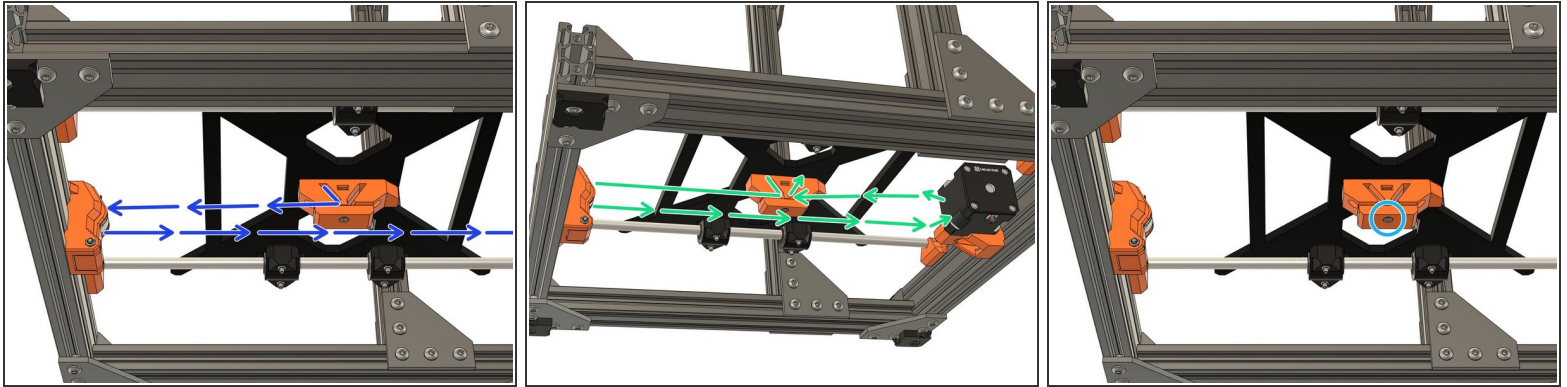
⚠ Confirm you have a washer on the M3x25 tensioning screw.

⚠ Check that the *y_idler_tensioner* can move with almost no resistance.

Step 22 — Y belt preparation - MK2(S)/MK2.5(S)

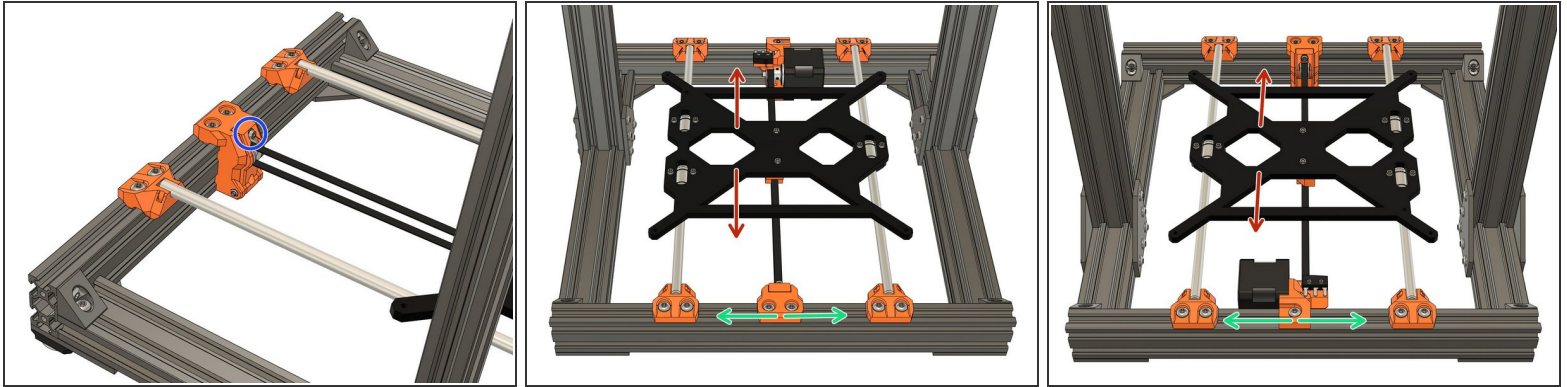
- Unscrew the idler tensioner screw until there is a small gap (around 3mm).
- Unscrew the clamp of the *y_belt_holder* to help the insertion of the belt in the next step.

Step 23 — Y belt installation - MK2(S)/MK2.5(S)



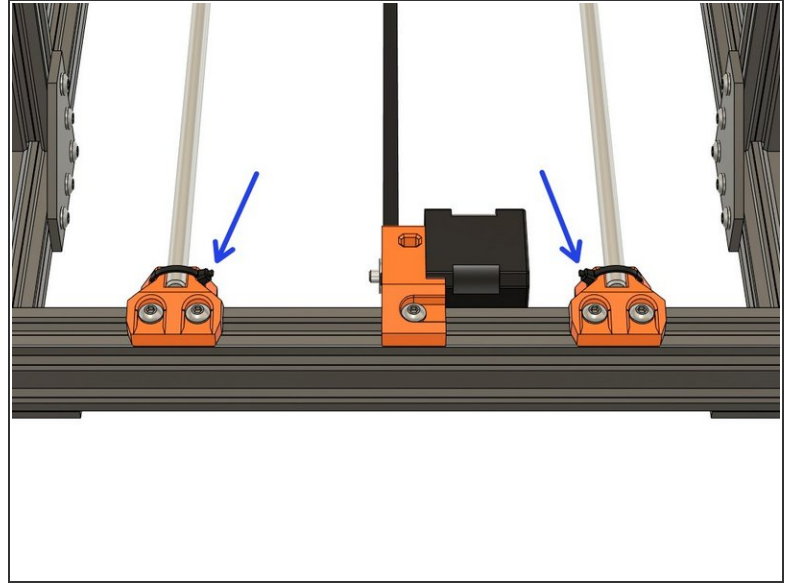
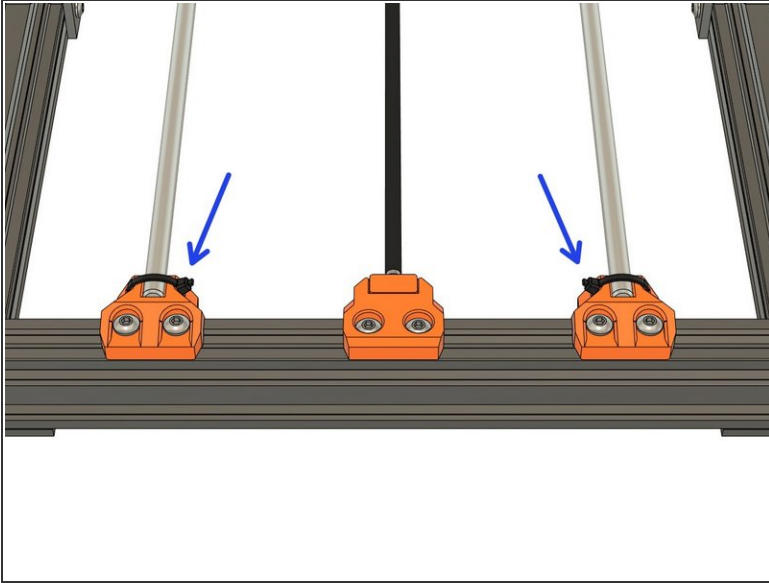
- Insert the top section of the belt into the left side of the *y_belt_holder*. If necessary, use a small slotted screwdriver to help insert the belt. The belt should be inserted to the full depth of the groove.
- ⚠ Make sure the belt teeth are correctly oriented according to the shape of the *y_belt_holder*.
- Continue to route the belt around the Y motor pulley and finish by inserting the belt into the *y_belt_holder*. The belt should have almost no tension, it will be adjusted later.
- ⓘ If the belt is too long to fit inside the *y_belt_holder* you can trim the excess.
- ⚠ Verify that the belt is fully inserted into the slot.
- Tighten the M3x18 screw to secure the belt.

Step 24 — Y axis parts position refinement - MK2(S)/MK2.5(S)



- Apply a light tension to the belt to remove any slack. Do not over-tighten the belt or adjustments will be impossible.
- ❗ We will adjust the belt, to the correct tension, in a later step.
- Adjust the position of *y_idler_mount* and *y_motor_mount* using their M5 screws. Try to have the belt riding centred as best as possible on the pulley (motor side) and the idler (tensioner side).
- It is important to move the Y carriage back and forth along the whole axis between each adjustment.
- ⚠ Remember that when you tighten the *y_idler_mount* and *y_motor_mount* screws you must do so **evenly, incrementally and in turn**. If you don't do this you may cause those parts to be misaligned.

Step 25 — Zip ties installation



- Secure the Y smooth rods with 4 zip ties. Note the orientation of them.

Step 26 — Next chapter



- Congratulations you have finished this chapter :)
- Go to the next chapter: [06. Z axis motion](#)

Step 27 — MK3(S) steps

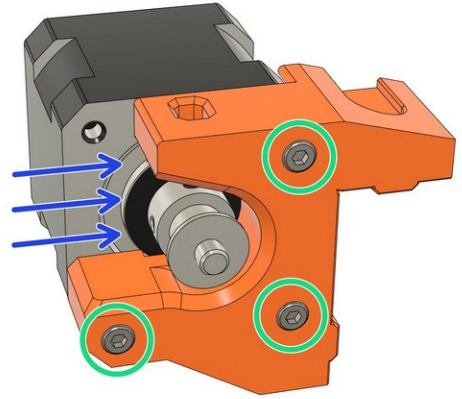
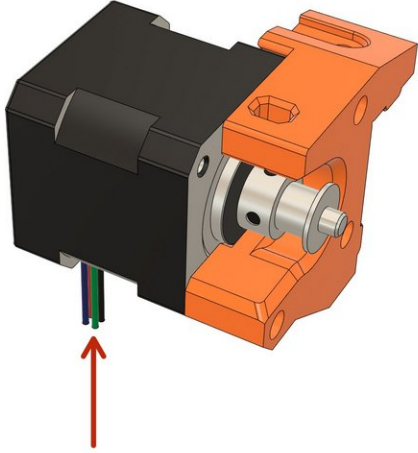


MK3(S)

~~**MK2(S)**~~
~~**MK2.5(S)**~~

- The next steps are for **MK3(S) only** until the end of this chapter.
- If you are building a **MK2(S)** or **MK2.5(S)** jump to [step 38](#).

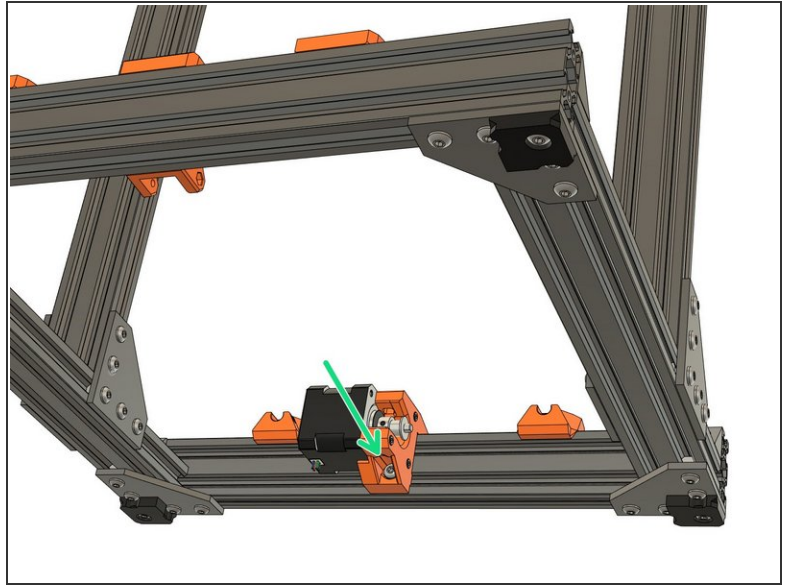
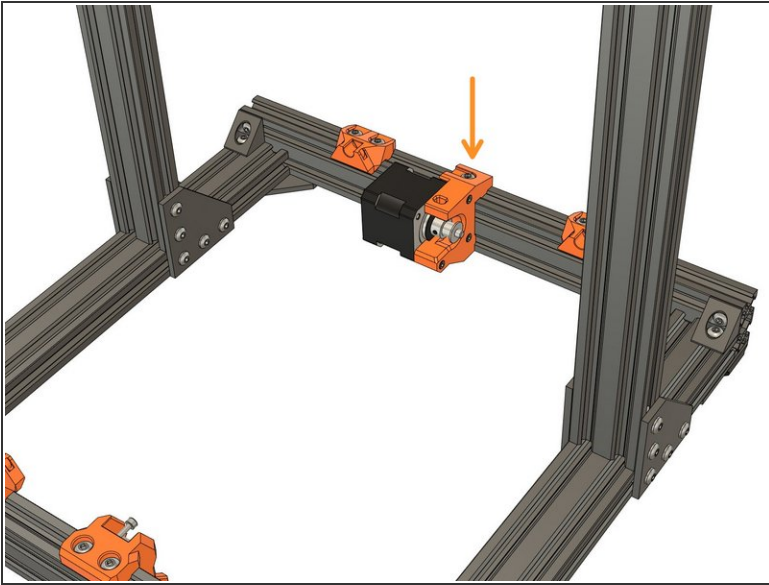
Step 28 — Y motor installation - MK3(S)



- Place the Y motor on the `y_motor_mount` as shown on the first image. The cables must be orientated downward.
- Secure the motor with 3x M3x18 screws. Do not fully tighten them yet.
- Whilst pushing in the direction shown, fully tighten all 3 screws.

⚠ Check that the motor cables are oriented correctly.

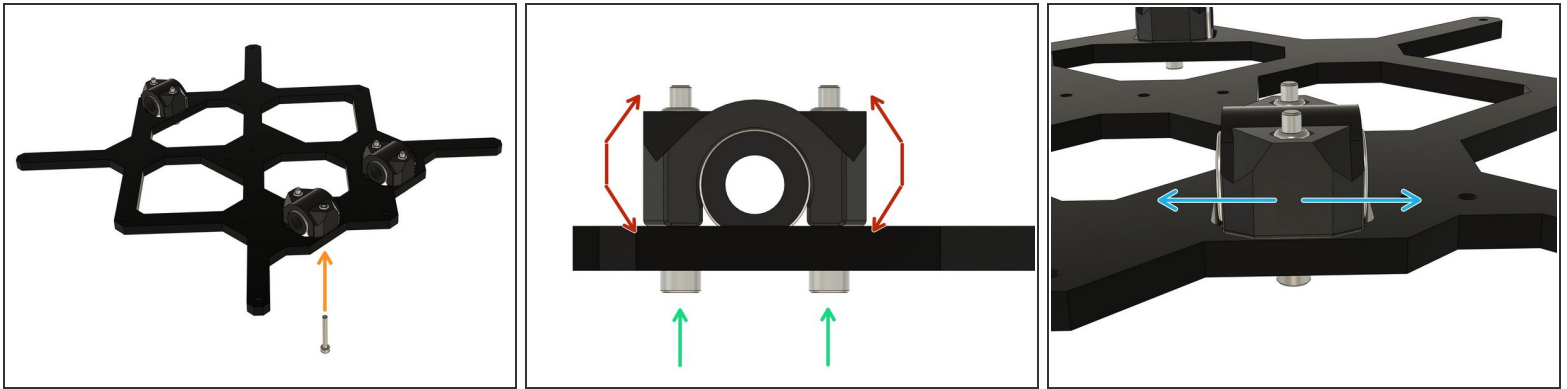
Step 29 — Y motor installation - MK3(S)



- Install the *y_motor_mount* on the extrusions in the back. Do not fully tighten the screws. We will set the position in a later step.
 - 1x M5x12 on top.
 - 1x M5x16 on bottom.

⚠ Always tighten the *y_motor_mount* screws **evenly, incrementally and in turn**. This ensures that the motor mount is properly square on the extrusions.

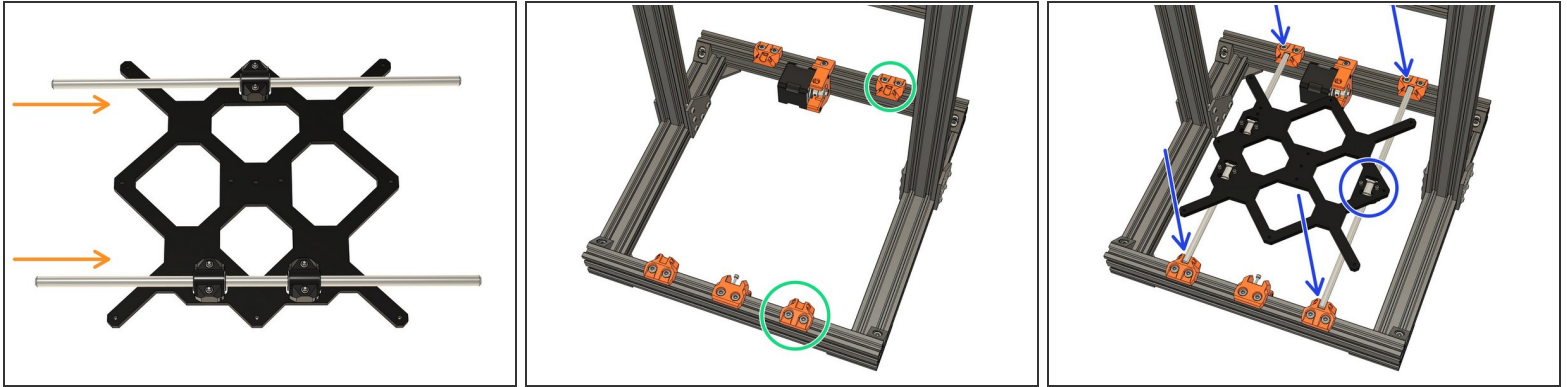
Step 30 — Y bearings installation - MK3(S)



⚠ Take your time with this step. It is important that it is done correctly or it can cause issues later with your printer. Do not over-tighten the bearings or you may cause permanent damage to them.

- Secure the bearing holders with 6x M3x25 screws. Do **NOT** tighten them yet!
- Start tightening, **evenly, incrementally and in turn**, the M3x25 screws. While tightening, test if the bearing holder can rotate in the directions shown by the red arrows. When it no longer moves, in this direction, **stop tightening** immediately.
- Check whether the bearings can slide along the slot.
 - If the bearing can slide: tighten **evenly, incrementally and in turn**, the M3x25 screws until you can't move it anymore. **Do not over-tighten!**
 - If the bearing is not moving anymore: continue to the next bearing.
- Repeat this step for the two remaining bearings.

Step 31 — Y smooth rods installation - MK3(S)



- Gently insert 2x Y axis smooth rods (330mm long).

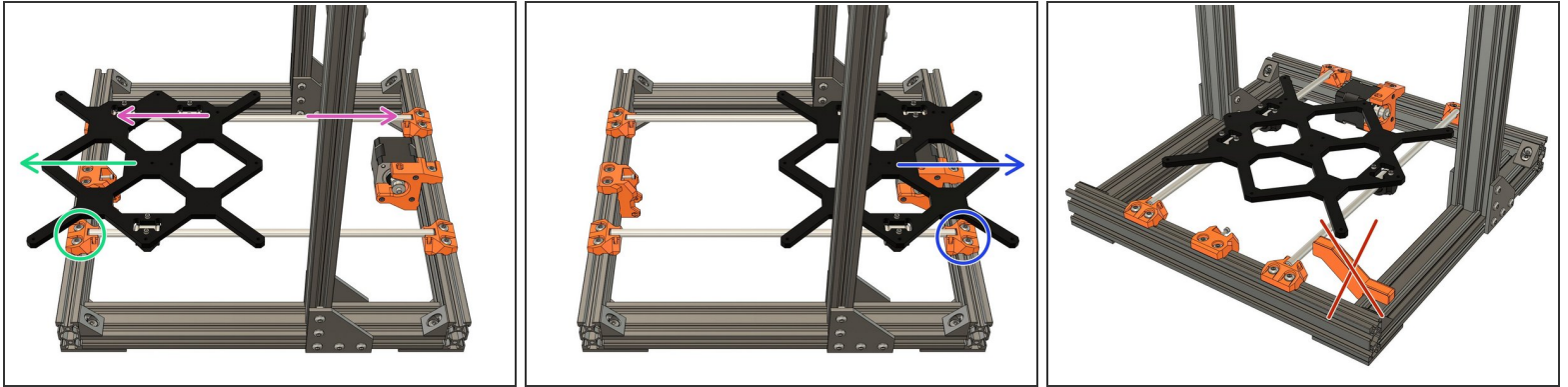
⚠ You must not use any significant force whilst inserting the rods into the linear bearings.

⚠ Don't rotate the smooth rods, the LM8UU bearings are not made to rotate.


- Loosen the M5 screws of the 2x right *y_rod_holders*. You should be able to slide them easily by hand.
- Clip the Y smooth rods and carriage assembly into the *y_rod_holders*. The Single bearing should be to the right.

⚠ It is very important to have the LM8UU bearings correctly oriented or you will have issues later in the assembly.

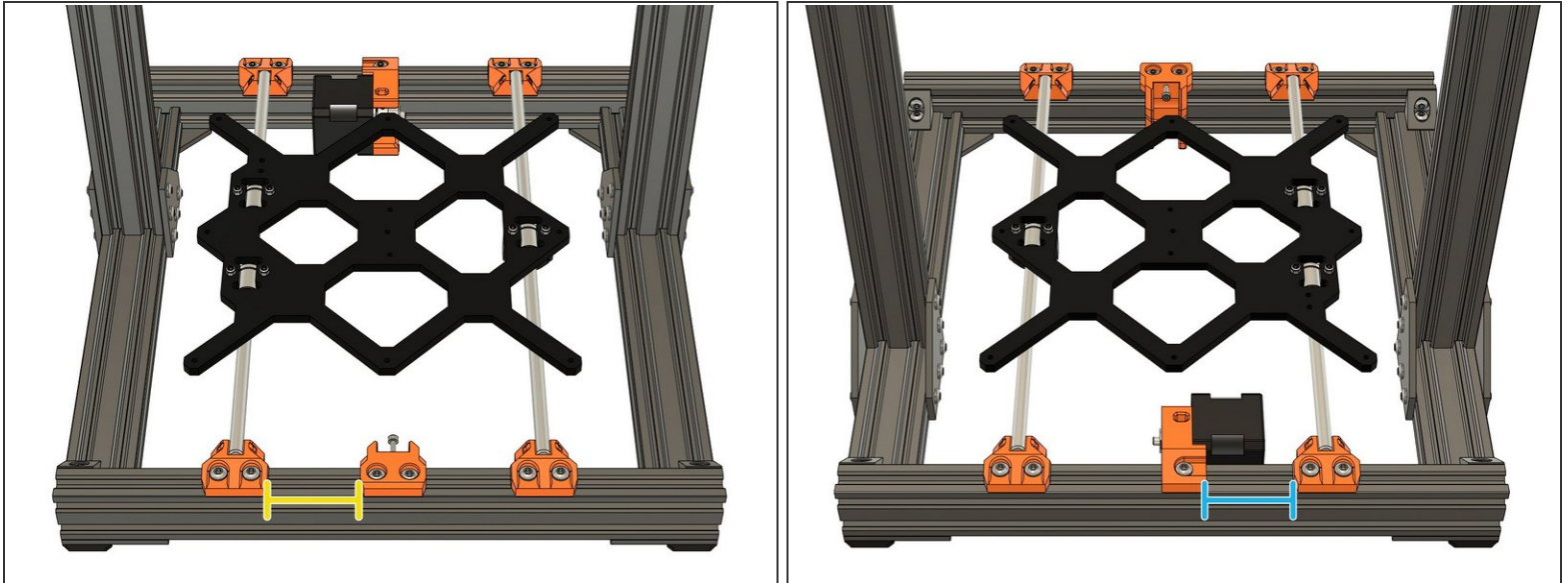
Step 32 — Right smooth rod alignment - MK3(S)



 Take your time with this step.

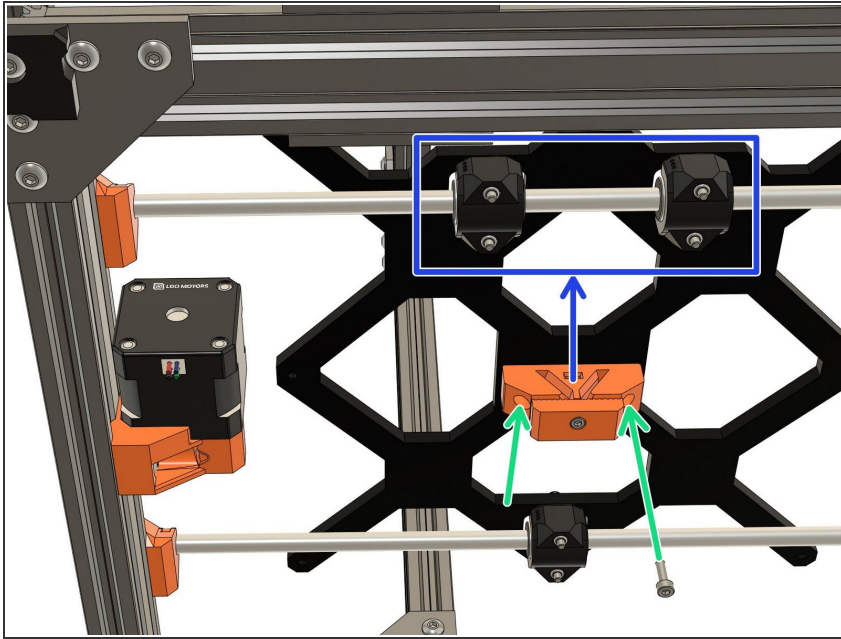
- Move the Y carriage, backwards and forwards along the whole length of the Y axis, at least 6 times. This will align the right smooth rod (single LM8UU side).
 - Move the Y carriage to the front and tighten the right-front *y_rod_holder* **incrementally**.
 - Move the Y carriage to the back and tighten the screws for the right-back *y_rod_holder* **evenly, incrementally and in turn**.
 - Never use the *build_helper_y* with the right smooth rod, it is made to **align left smooth rod only** (dual LM8UU side).
-  Tech tip: If you have a 200mm caliper you can measure the distance from the smooth rods directly on the metal. The spacing of the smooth rods is 170mm, the diameter of smooth rods is 8mm, which means the external spacing you should measure will be $170 + 2 \cdot 8 / 2 = 178\text{mm}$.

Step 33 — Y axis parts positioning - MK3(S)



- Set the *y_idler_mount* and *y_motor_mount* position as following:
 - 51mm for the *y_idler_mount*.
 - 48mm for the *y_motor_mount*.
- ⓘ We will adjust these positions, if necessary, after the belt is in place and tensioned.

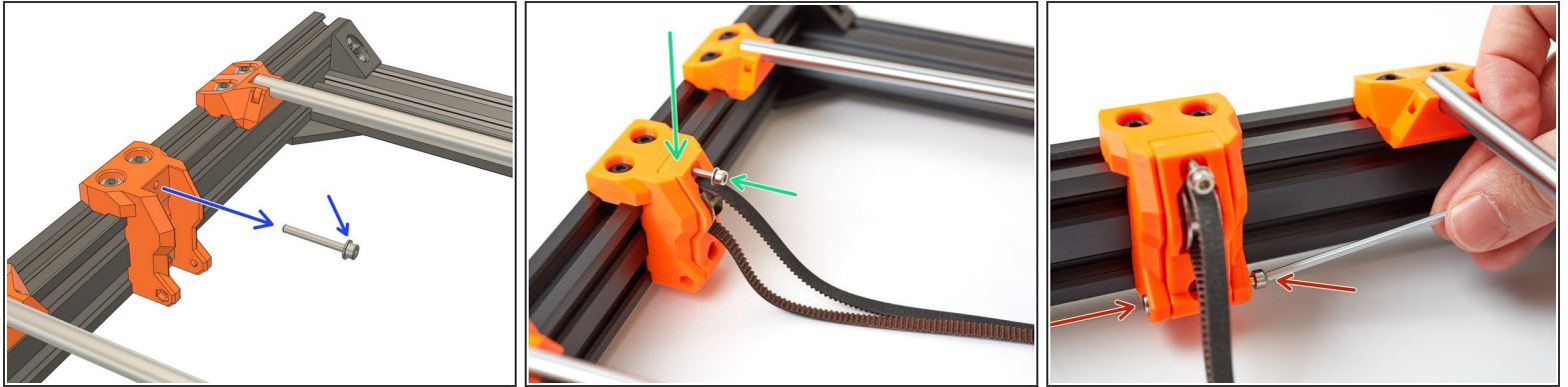
Step 34 — Y belt holder installation - MK3(S)



- Install the *y_belt_holder* under the Y carriage with 2x M3x10 (reused from your original Prusa). The grooves should face the dual bearings side.

⚠ Verify the orientation of the *y_belt_holder*.

Step 35 — Y idler tensioner installation - MK3(S)

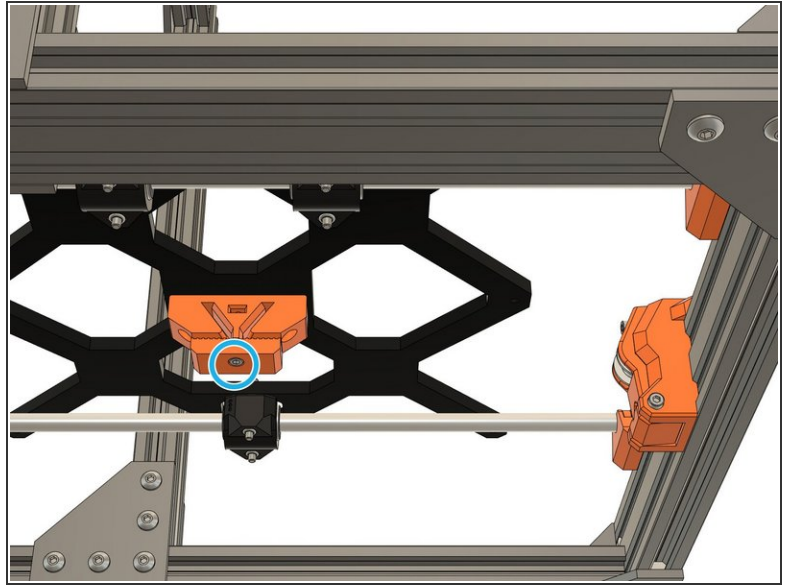
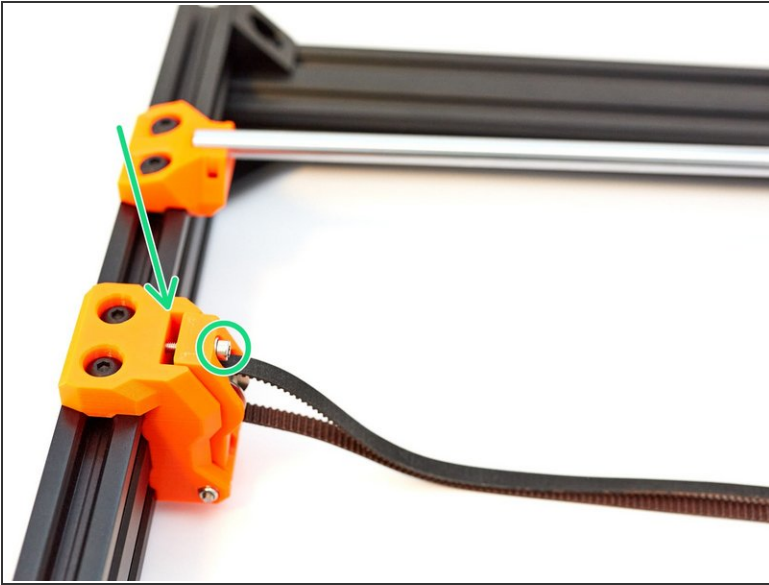


- Remove the M3x25 screw, used during installation, from the *y_idler_mount* and **add a washer** to the screw.
- Insert the *y_idler_tensioner* into the *y_idler_mount* and reinsert the M3x25 screw with its washer.
- Insert an M3 locknut into the left side of the *y_idler_mount* and thread an M3x30 screw from the other side. Use this screw to help seat locknut correctly, in the part. Do not over-tighten this screw, the *y_idler_tensioner* should move with almost no resistance.

⚠ Confirm you have a washer on the M3x25 tensioning screw.

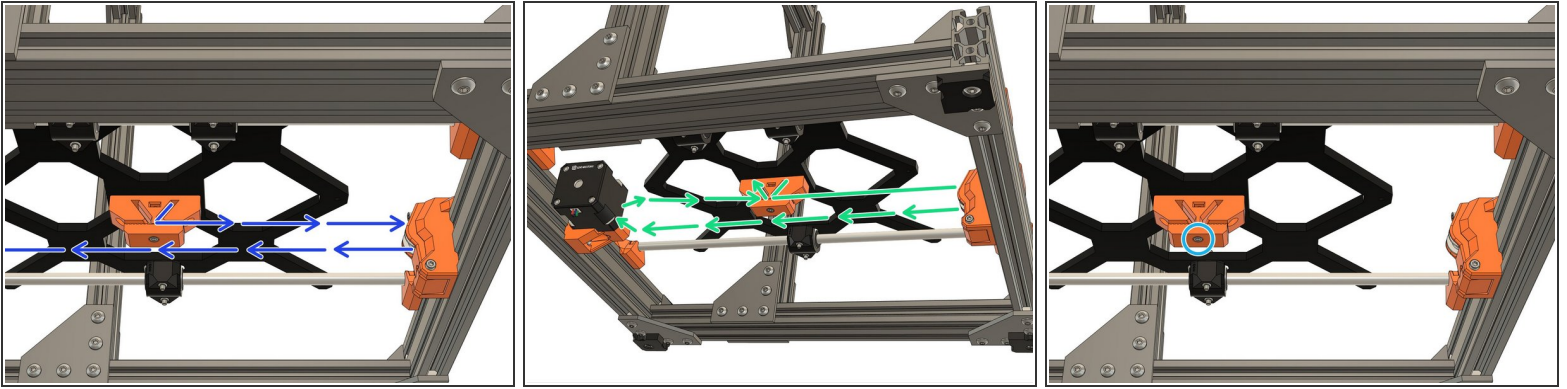
⚠ Check that the *y_idler_tensioner* can move with almost no resistance.

Step 36 — Y belt preparation - MK3(S)



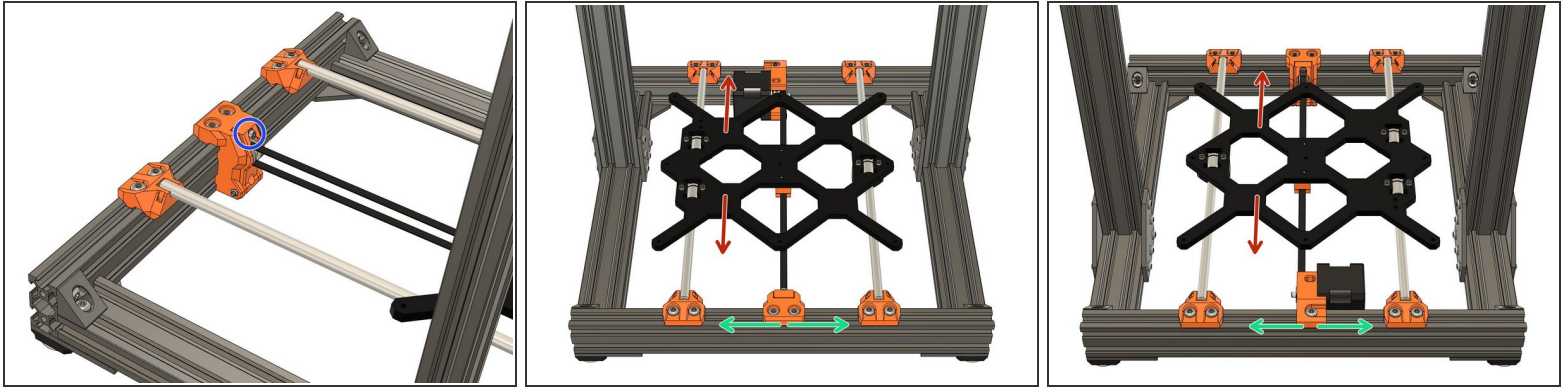
- Unscrew the idler tensioner screw until there is a small gap (about 3mm).
- Unscrew the clamp of the *y_belt_holder* to help the insertion of the belt in the next step.

Step 37 — Y belt installation - MK3(S)



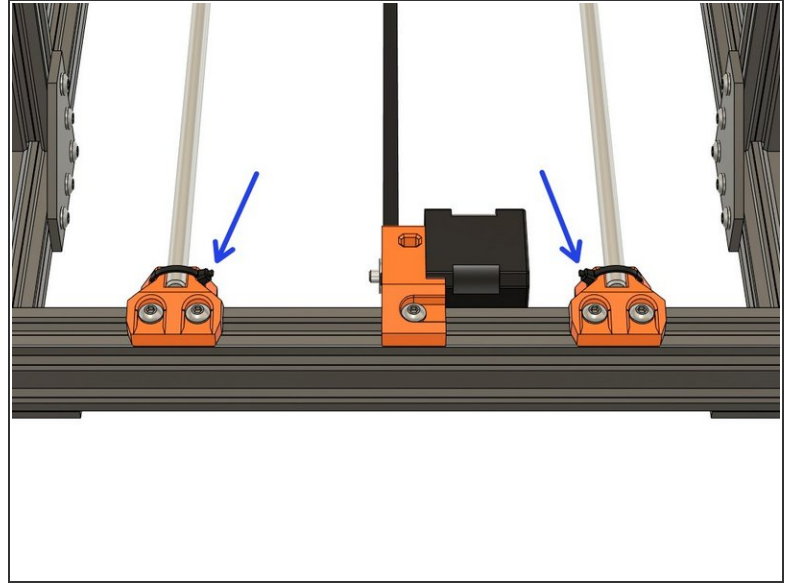
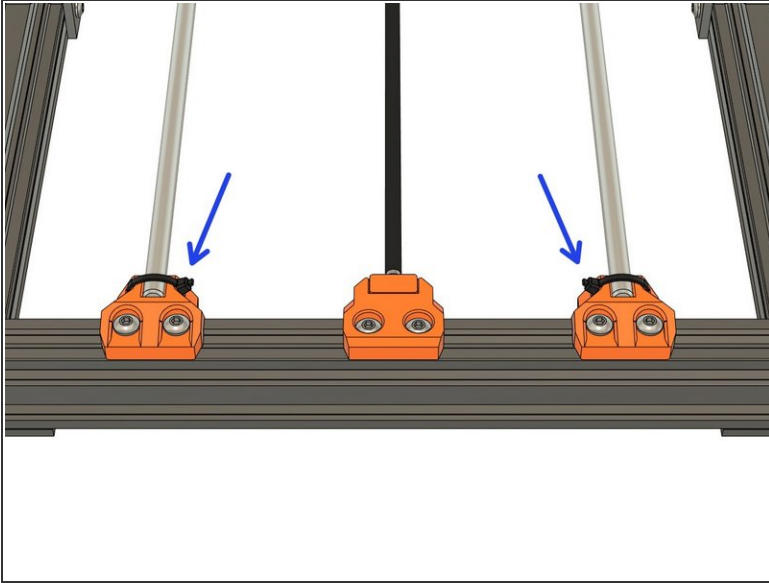
- Insert the top section of the belt into the left side of the *y_belt_holder*. If necessary, use a small slotted screwdriver to help insert the belt. The belt should be inserted to the full depth of the groove.
- ⚠ Make sure the belt teeth are correctly oriented according to the shape of the *y_belt_holder*.
- Continue to route the belt around the Y motor pulley and finish by inserting the belt into the *y_belt_holder*. The belt should have almost no tension, it will be adjusted later.
- ⓘ If the belt is too long to fit inside the *y_belt_holder* you can trim the excess.
- ⚠ Verify that the belt is fully inserted into the slot.
- Tighten the M3x18 screw to secure the belt.

Step 38 — Y axis parts position refinement - MK3(S)



- Apply a light tension to the belt to remove any slack. Do not over-tighten the belt or adjustments will be impossible.
- ❗ We will adjust the belt, to the correct tension, in a later step.
- Adjust the position of *y_idler_mount* and *y_motor_mount* using their M5 screws. Try to have the belt riding centered as best as possible on the pulley (motor side) and the idler (tensioner side).
- It is important to move the Y carriage back and forth along the whole axis between each adjustment.
- ⚠ Remember that when you tighten the *y_idler_mount* and *y_motor_mount* screws you must do so **evenly, incrementally and in turn**. If you don't do this you may cause those parts to be misaligned.

Step 39 — Zip ties installation



- Secure the Y smooth rods with 4 zip ties. Note the orientation of them.

Step 40 — Next chapter



- Congratulations you have finished this chapter :)
- Go to the next chapter: [06. Z axis motion](#)