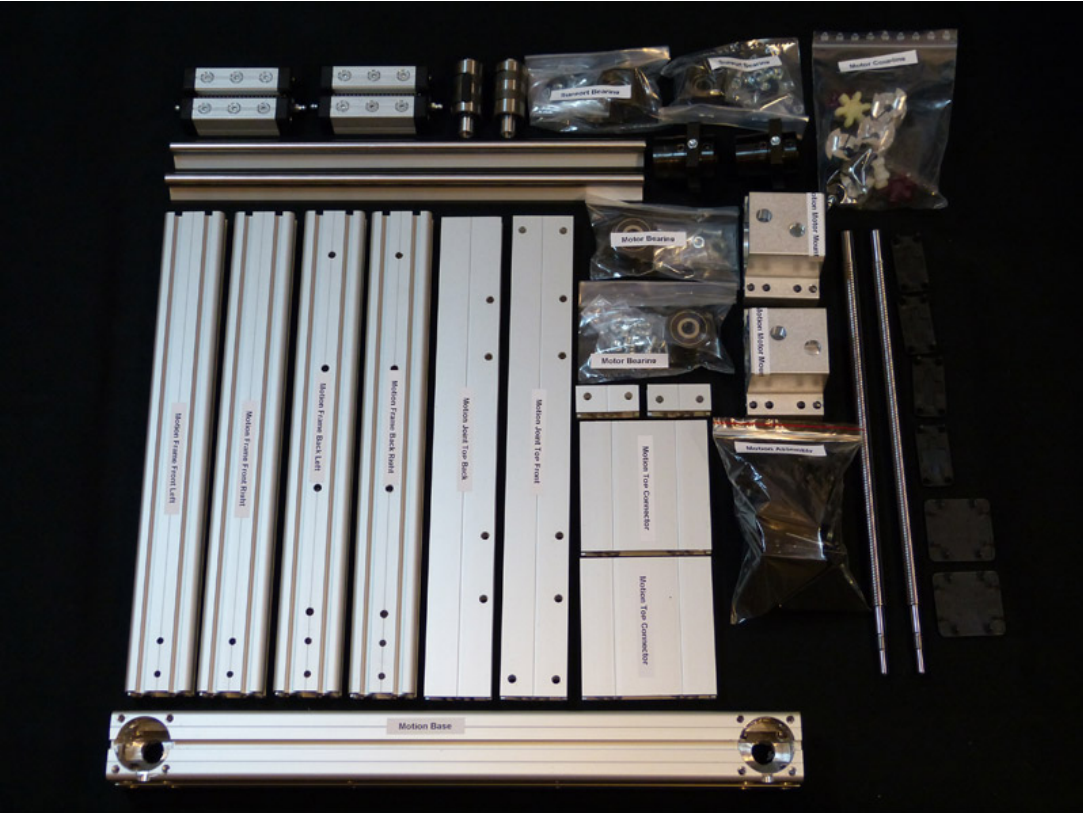


4 - Motion Assembly

Having a firm and solid machine is not enough. Each part must function properly and with no faults, to achieve the best result possible. The motion of the [Ilios Kit](#) is a crucial part for the entire 3D printing process. Besides putting the parts together, there are several options for you to tweak and adjust the machine as you need it. Going through these instructions, you shall find out how to adjust these features and how everything goes together. There is nothing better than assembling the machine you shall be working on, understanding how it all works and being able to fix or modify something without much help or support.

Step 1



2 x Slide Blocks

2 x Bearing Spindle Nuts

2 x Motor Bearings

2 x Support Bearings

2 x Spindle Nut Housings

2 x Motor Couplings

2 x Nema 23 Motor Mounts

2 x 2.5mm Spindles

1 x Nuts & Bolts Bag

2 x Slide Shafts

4 x 25x50mm Plastic Caps

2 x 50x50 Plastic Caps

1 x Motion Frame Front Left

1 x Motion Frame Front Right

1 x Motion Frame Back Left

1 x Motion Frame Back Right

1 x Motion Top Back

1 x Motion Top Front

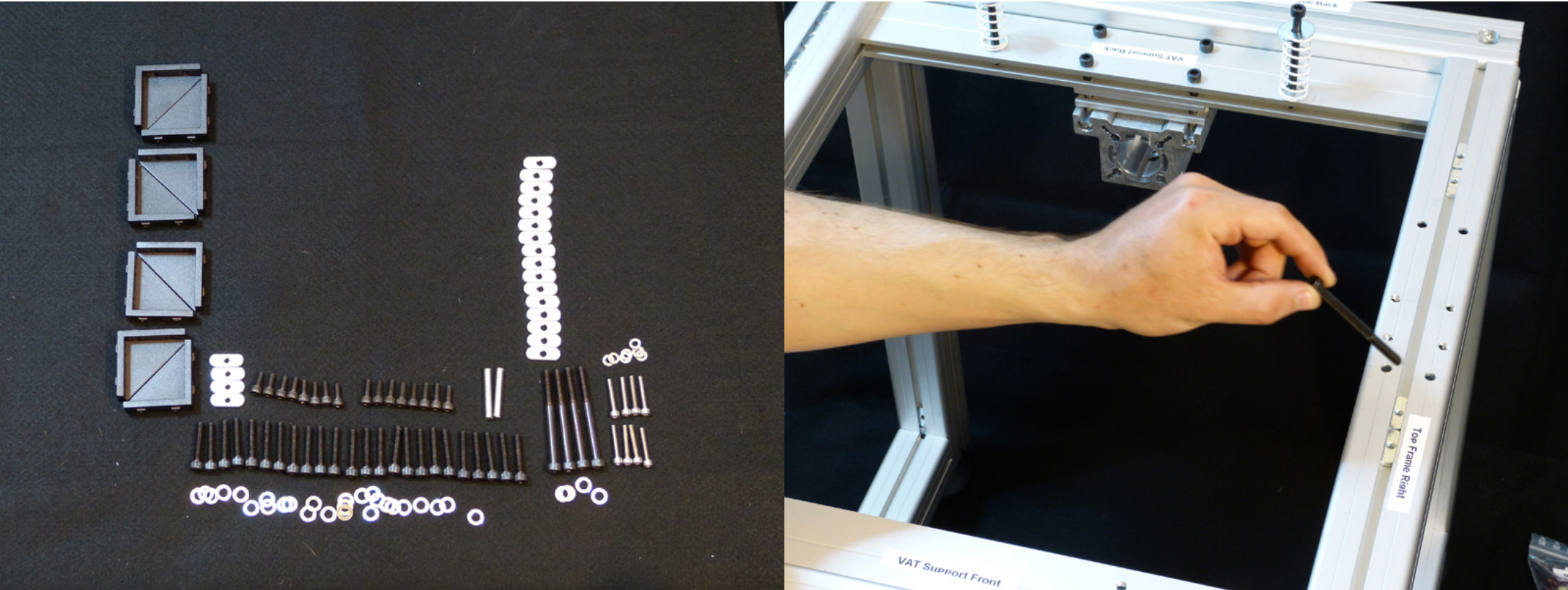
2 x Motion Top Connectors

2 x Motor Extension mounts

1 x Motion Base

Make sure that all parts needed for this assembly are in front of you and are found within the [Ilios Kit](#). Place everything on a clean working surface so that everything can be found easily and nothing is lost during the assembly.

Step 2



Lay out all the parts inside the Nuts and Bolts bag. There are many components in this assembly so it is recommended to have them organized while building. We begin with the installation of the main motion supports. There shall be 8 bolts which are longer than the rest. Use them for this part of the installation.



Don't forget to place a washer on these bolts, they spread the load more evenly and help keep the structure strong. Note how the Sliding Nuts on the main frame have been separated in pairs on each side. Do this now for later assembly. Place the bolts through the holes as shown on the picture. Note the orientation of the machine at this point. To help you better, note the 4 holes that form a square. This is where the bearing shall be and it should look towards the front of the machine.

Step 3



Now take the Front Motion Frame part (in the image it is the Left one)

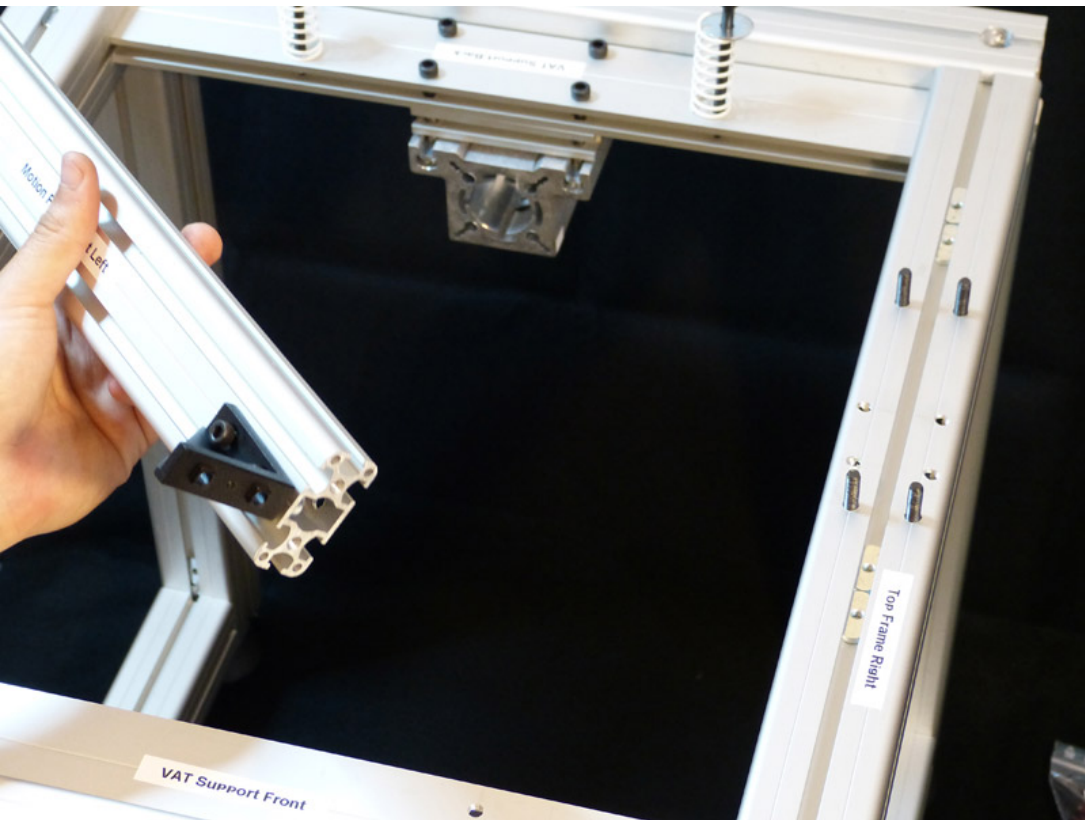
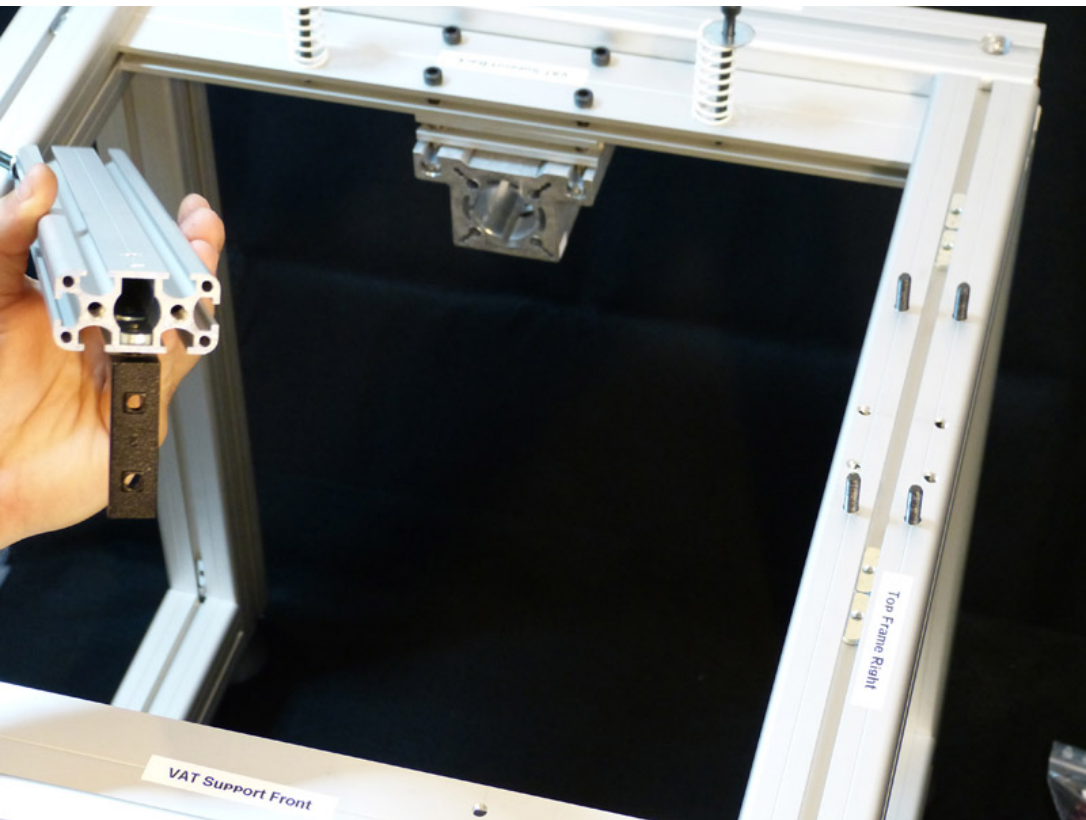
Select the Oval Sliding nuts with the 5mm thread (smaller hole than the 6mm) and the 5mm bolts. Note to use the longer bolts of the two types. (There shall be short and long 5mm bolts) The difference is small but noticeable.



Slide the Oval Nut as shown on the image. We shall be securing the corner brackets with them later on.

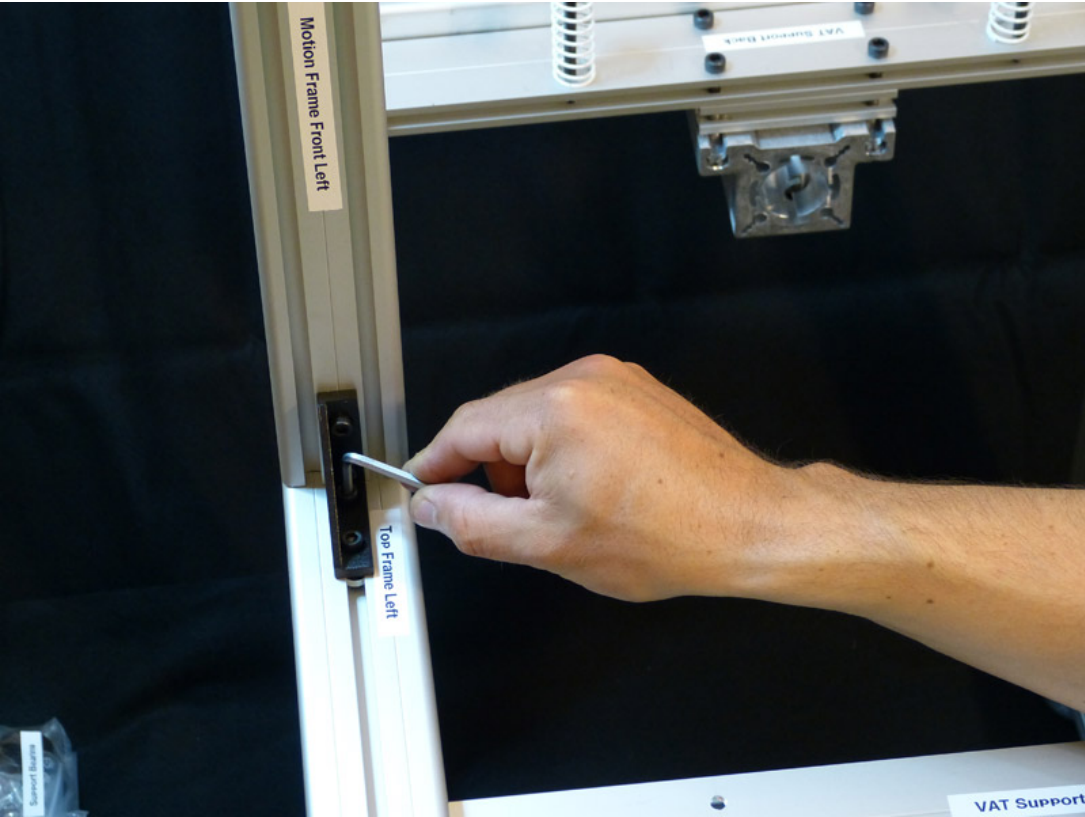
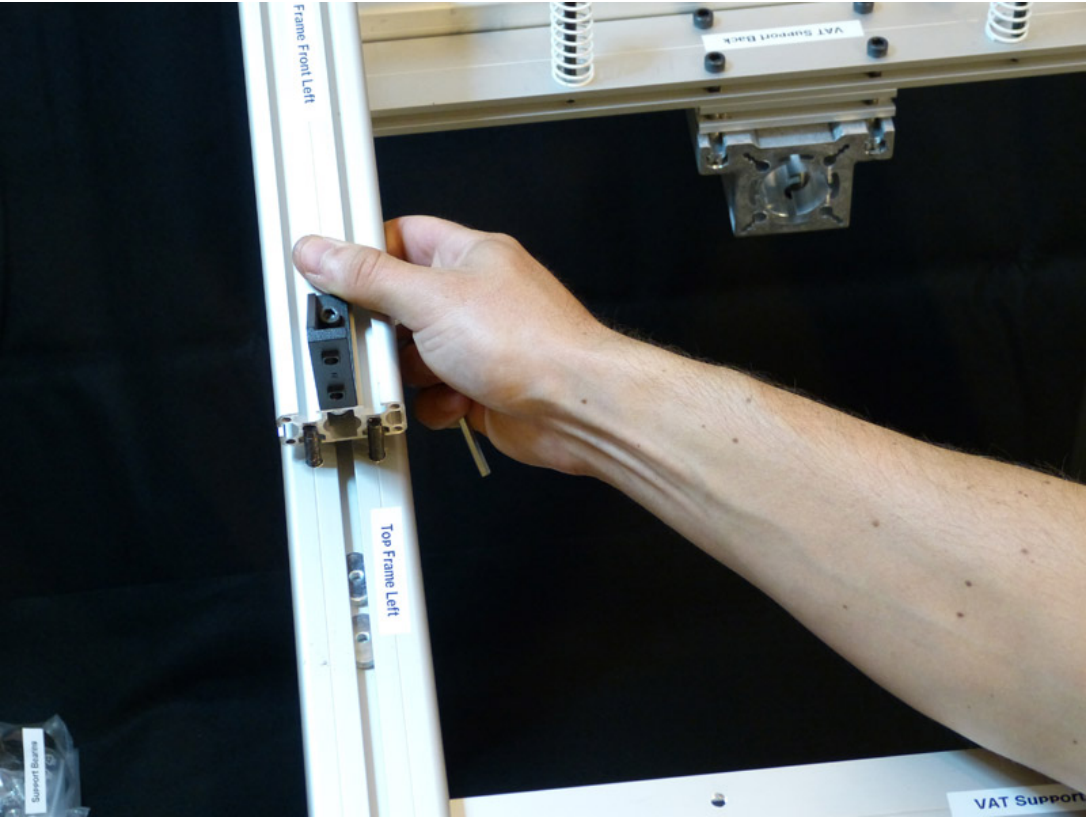
Choose a corner bracket and note the sanded off side. This is the side we shall be bolting.

4 - Motion Assembly



Bolt the corner as shown. Note that if you already see where this is going, the corner should have its edged wall looking outwards from the machine (this is for esthetics and doesn't matter mechanically)

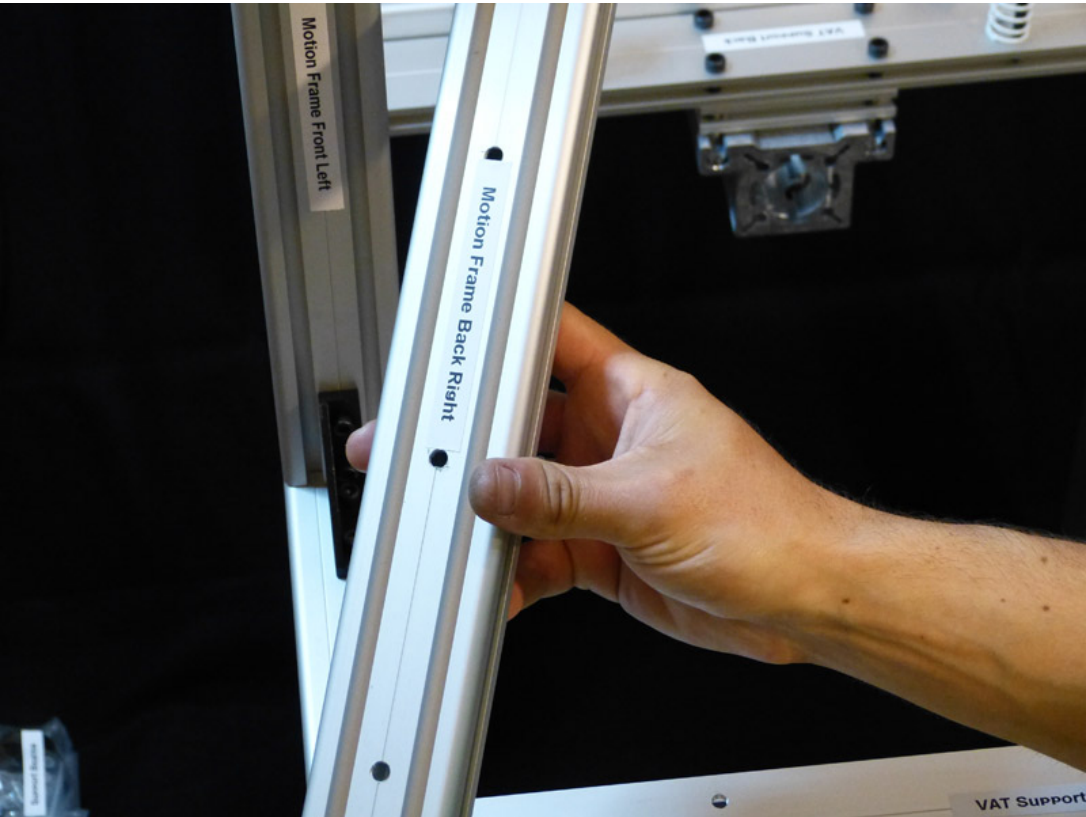
Note how the corner is flush with the edge of the part. This is important and although the alignment shall be accurate, make it as flush as you can by loosening the bolts and re tightening.



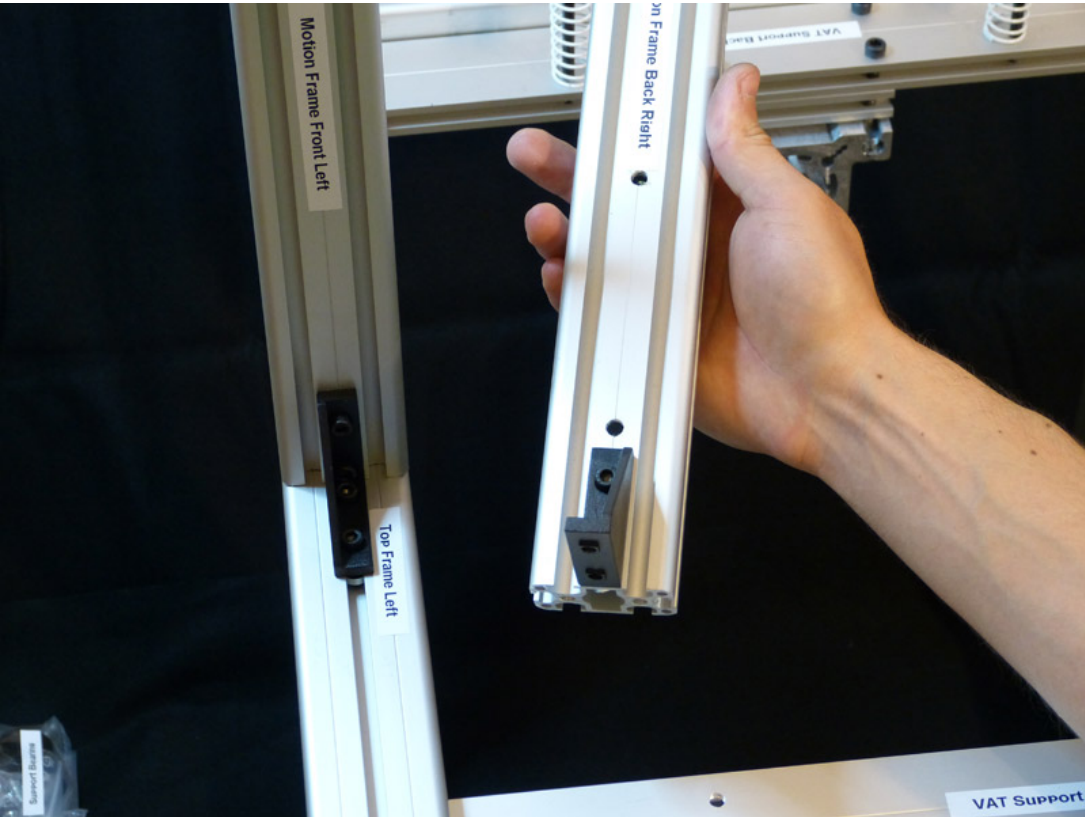
Align the frame part to the bolts and loosely bolt them but wait until you tighten the corner bracket to fully lock them in place. Note the holes on this part (There are none) and the place where this sits. Follow the labels to place them correctly.

Tighten the other side of the corner to the Sliding Oval nuts you placed in the slots earlier in the assembly. Note that the bolts may be HEX and Chrome and NOT Black in your bolts bag. This is normal and if purely done for practicality.

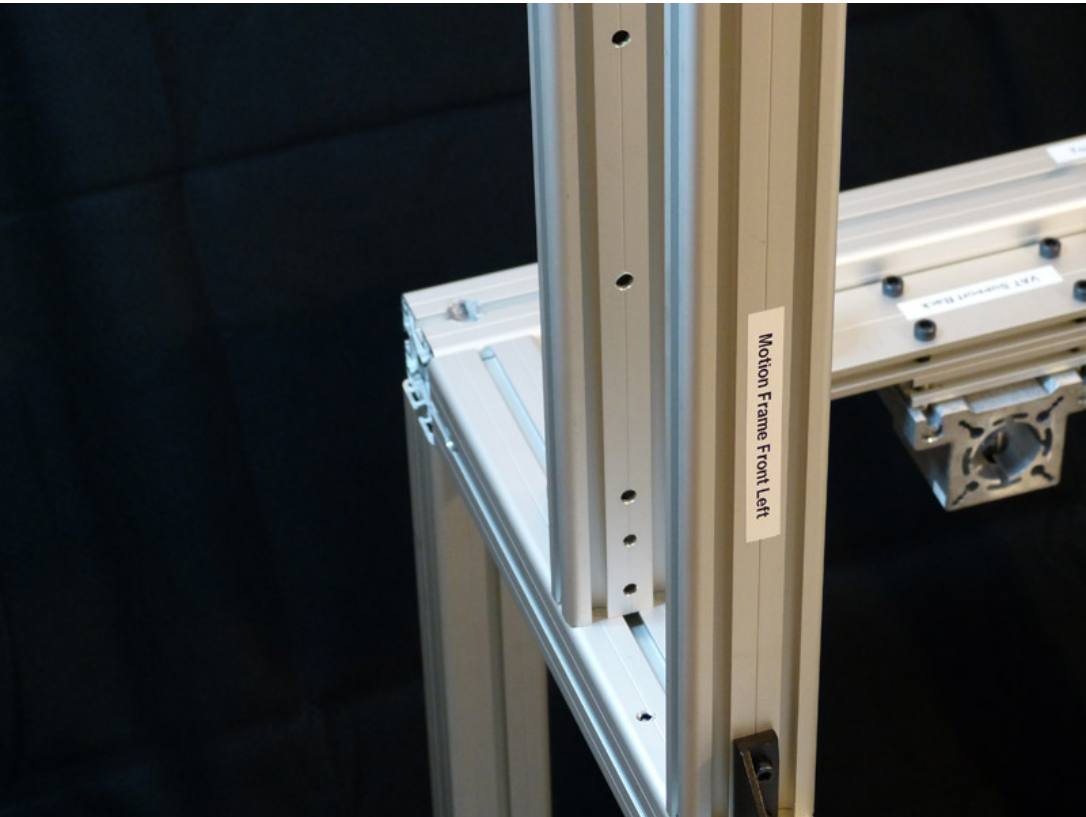
4 - Motion Assembly



Select the Back frame part and do the same process with it, attaching it to the back side of the main frame.



Add the corner as shown before and note that the corner wall is facing outwards from the machine (Esthetic reasons only)



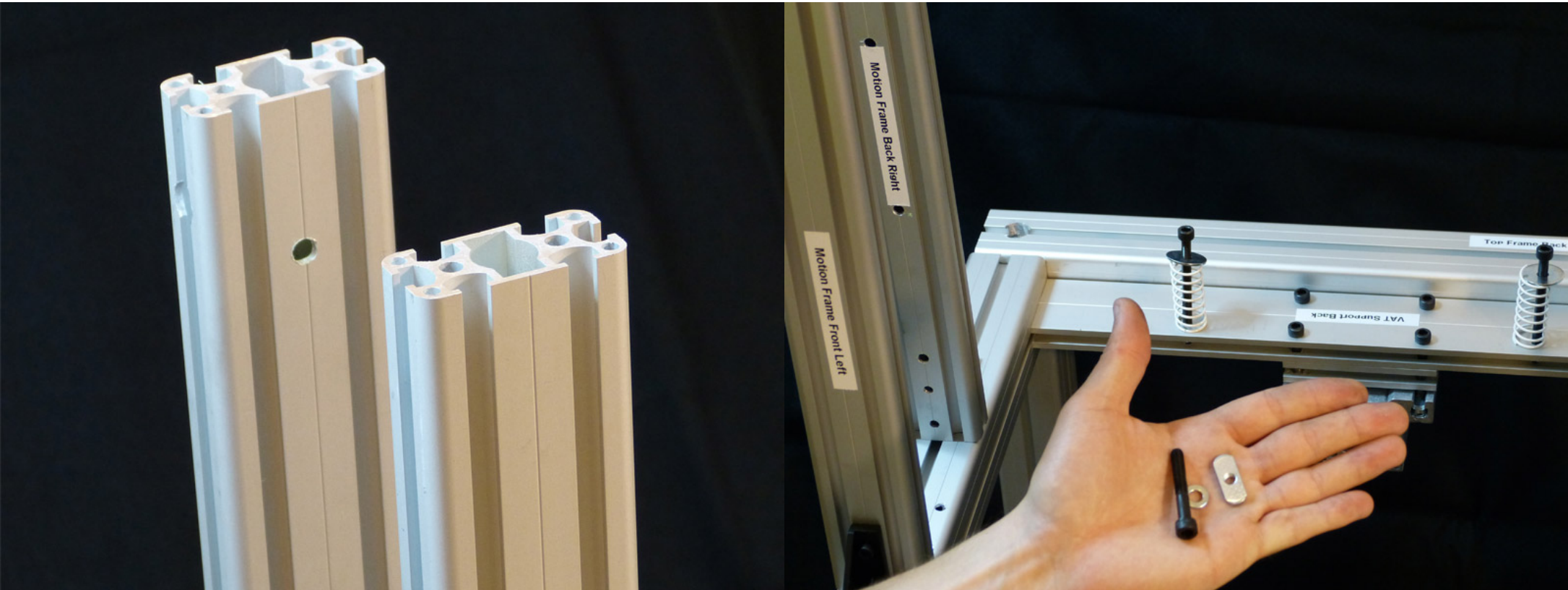
Look at the image to check your orientation and hole positions. Make sure your assembly looks exactly like on the image above.



The final assembly should look like shown here. Note all the holes once again and tighten everything down firmly.

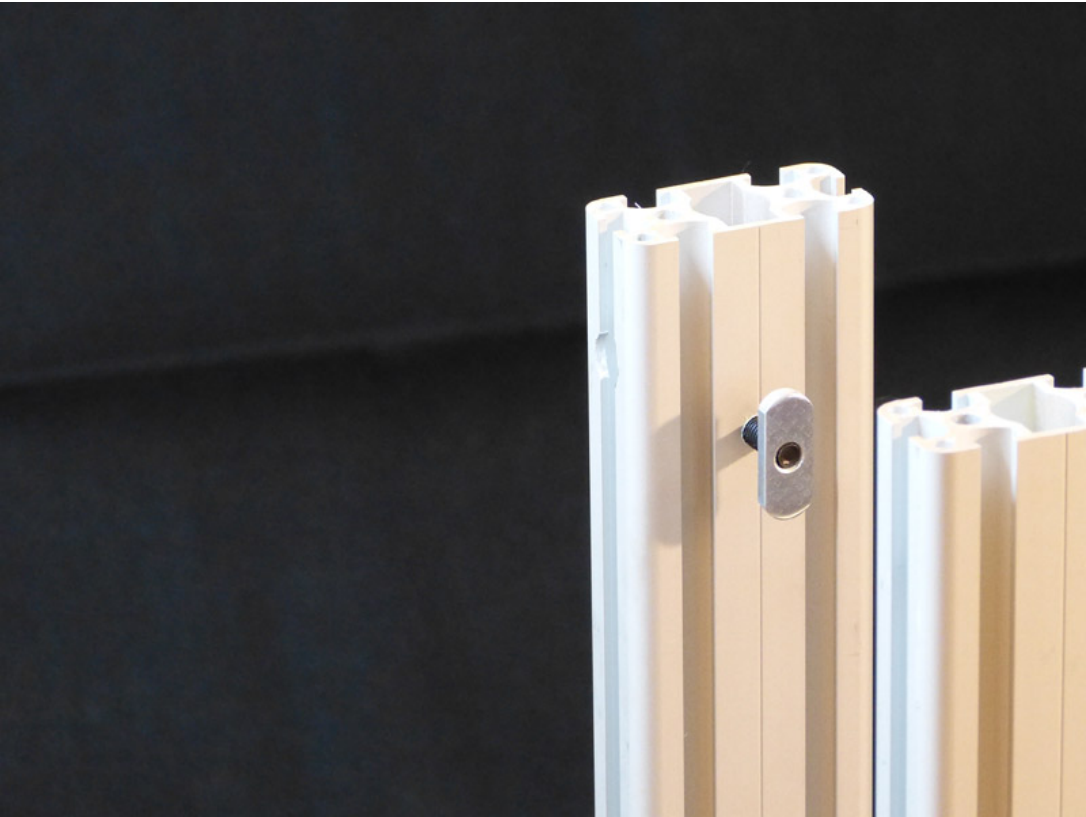
Step 4

4 - Motion Assembly

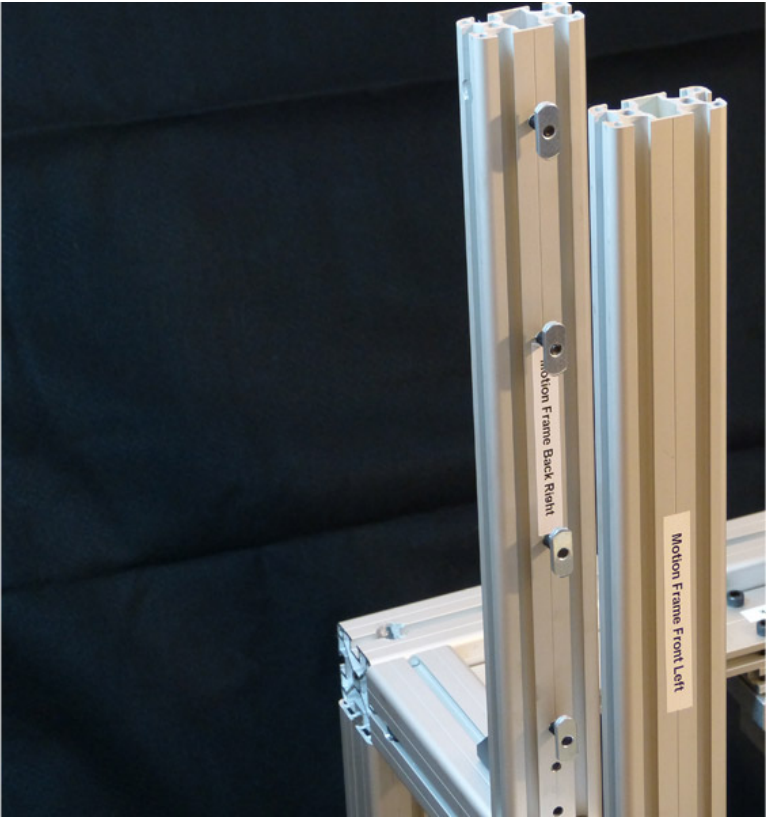


Please also note that the Back part has a larger opening for a bolt on the top side. Make sure this hole is facing away from the machine and its center.

Now choose the bolts, washers and nuts for the next assembly (they should be the same length with the remaining ones in your bag)

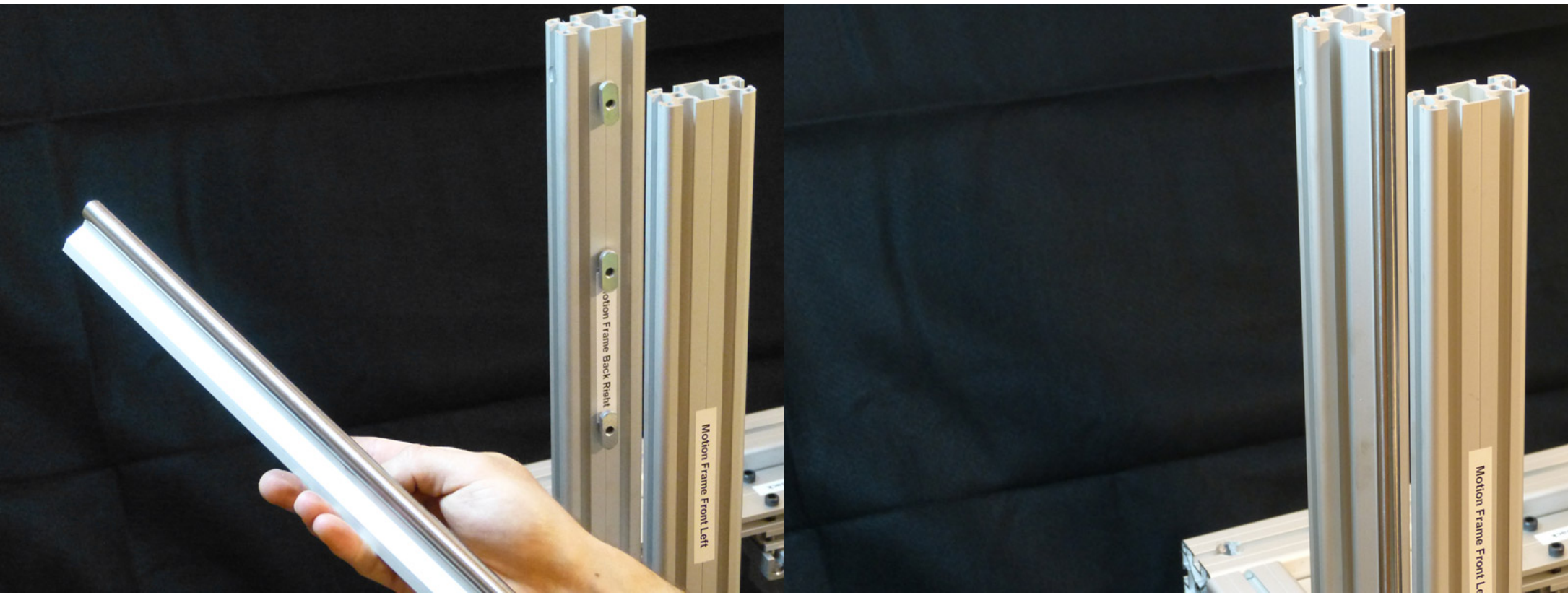


Place the bolt with the washer through the support and add a sliding nut (6mm) as shown in this picture.



Repeat the process for the remaining 3 holes on the part. This is where we shall be placing our slider for the motion.

4 - Motion Assembly



Take one of the sliding shafts as shown on the picture. Doesn't matter which side is up, since it is even all the way. Although these shafts are hardened, please take good care of them and keep them free of and dust or other contaminants.

Slide the shaft through the nuts with the help from the slot, located on the back side. The final result should look like on the picture above.

Step 5



Do the same steps for the other side of the assembly. Both shafts should be in place by now. Tighten the bolts but not too hard for now since it shall help you adjust the motion later on.

We shall now assemble the joints which shall hold together the two motion frame together. Select the Top Front Joint first. To distinguish it from the back on, note that the Front joint has more holes and they should all be facing up.

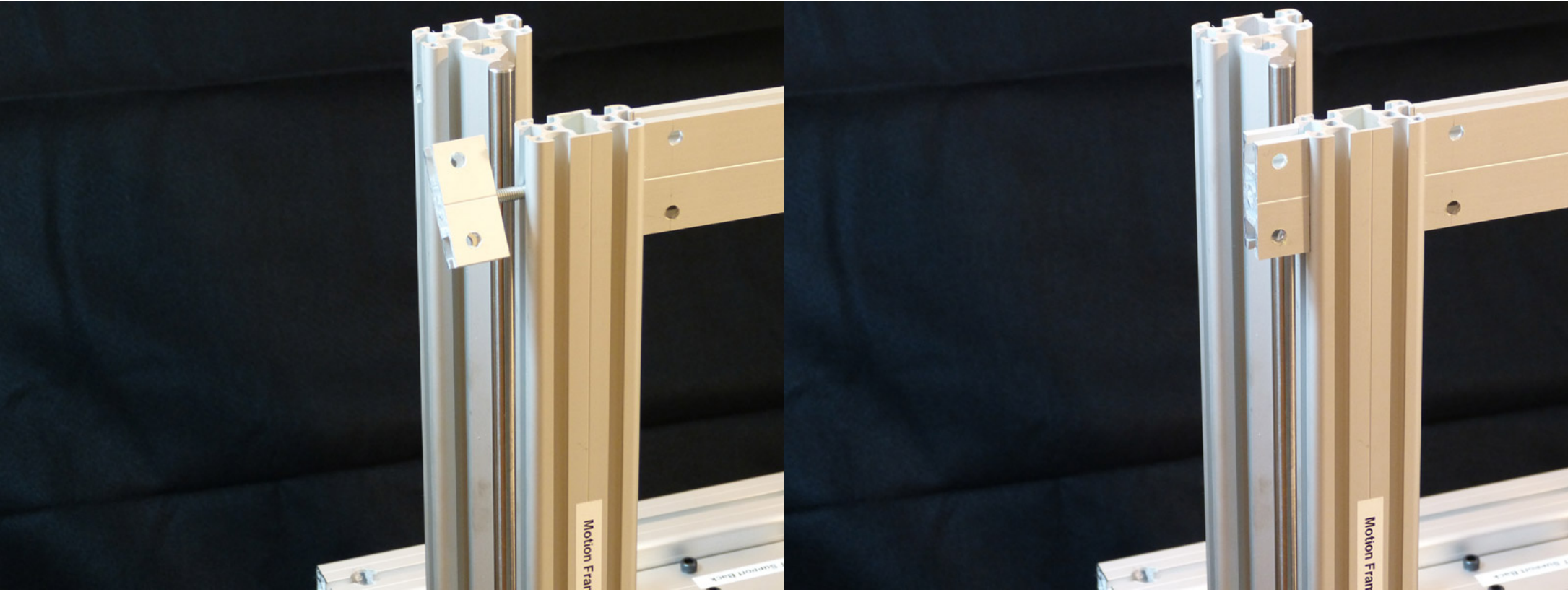
Note: If you acquired the [Complete Ilios HD Kit](#), you need to place a 5mm Oval Sliding Nut in the INNER (the one facing inside the machine) slot of the Left FRONT Motion Frame. This is done to later on, bolt the Home Sensor of the Lift Arm. Consult the [Electronics Assembly](#) tutorial for more details.

4 - Motion Assembly



Place it on the assembly as shown in the picture. It is held by simple tension for now so leave it there and prepare for the next step. Once again note the orientation.

Take the two smaller supports and thread the threaded shafts through them as shown. Note that the thread should begin where the holes are farthest from the center (as on the picture)

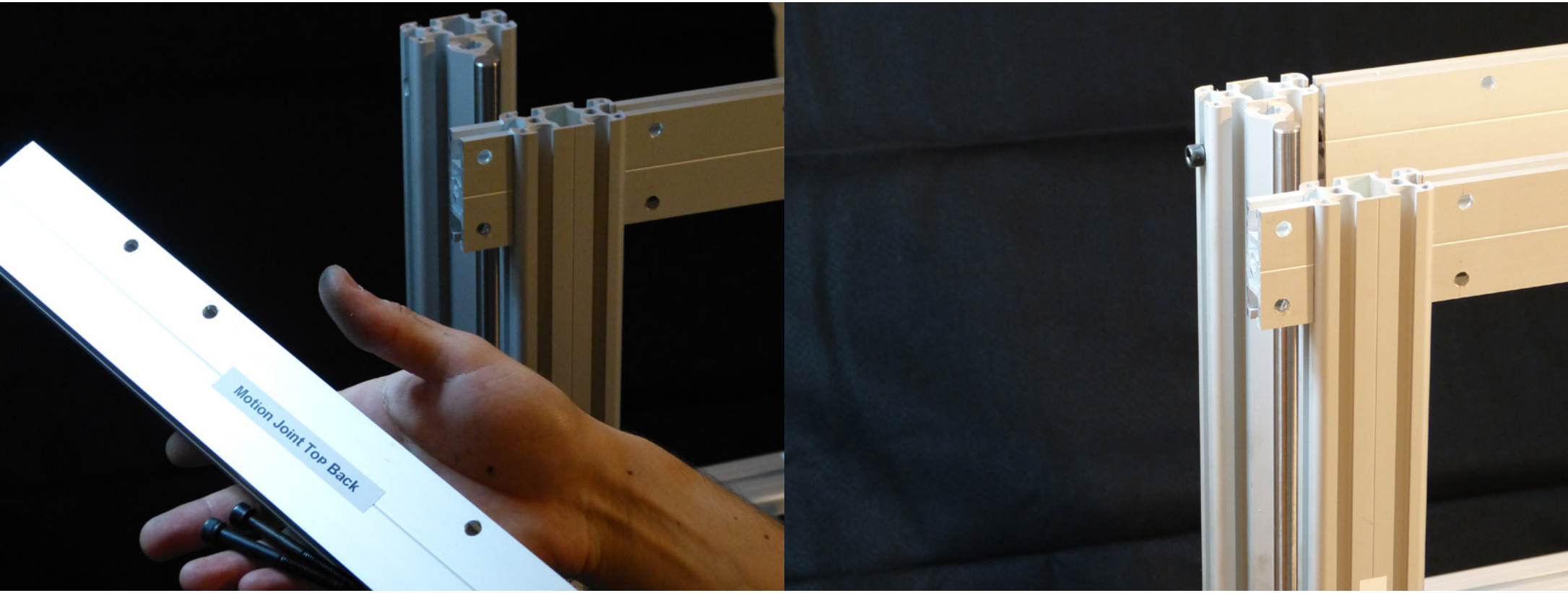


Screw the supports as shown on the image. These should be tightened to the frame. It doesn't matter which way is up or down so turn them until they are nice and tight.

Finished result should look like on the image above. Once again note that the distance of the holes is less on the outside of the assembly.

Step 6

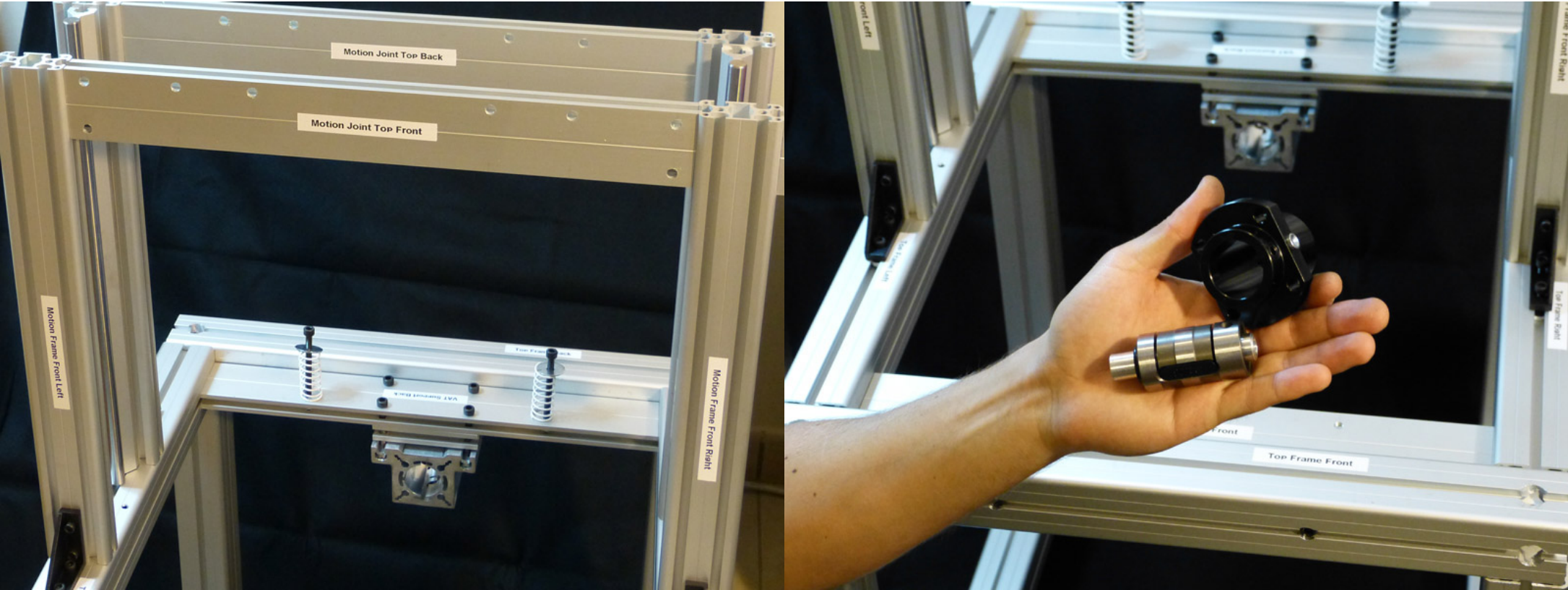
4 - Motion Assembly



Now take the Back Joint. It can be easily distinguished from the front one because it has less holes in it.

Place it between the frame supports and screw it as shown on the image with the longer bolts (6mm) Note that the hole is there to house the head of the bolt and should hide it completely.

Step 7

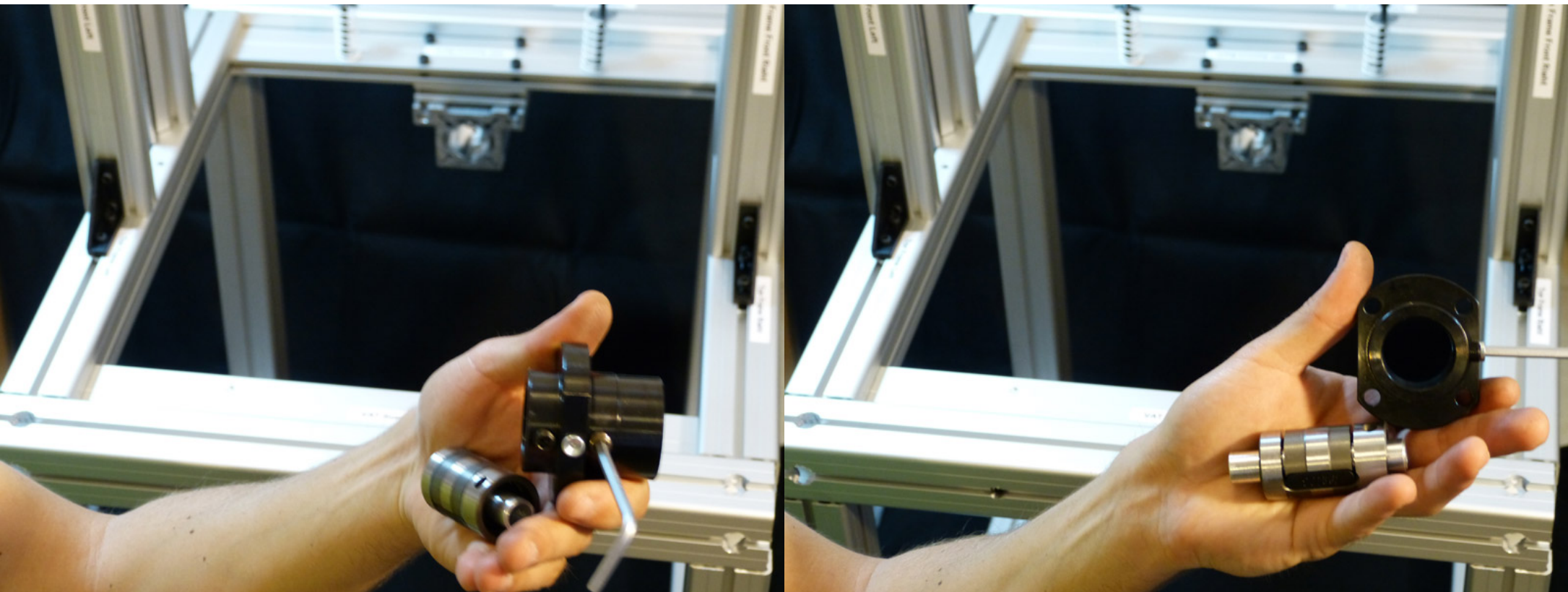


Both joints should look like on the image. Note their orientation and hole positions. The pictures are always facing the front of the machine (with an exception in few cases)

We shall be assembling the Spindle Nuts and housings now. DO NOT remove the aluminum cylinder from the ball bearing nut until you install the spindle. if you do, all balls shall fall out and you shall have a really bad day :) (Don't ask me how i know)

Note: Please read the [paragraph 9.5 \(Alignment\)](#) of the documentation to properly tension the spindle bearing.

4 - Motion Assembly



Unscrew the bolts in the housing so that they are not blocking the path inside it for the nut assembly. Once the bolts are unscrewed, the path should be clear. Note that this is a precision part and clearances shall be very tight.



Slide the nut into the housing. Note the hole on the nut it self, it should align with the outer bolt ans it shall secure it in place. Push the spindle nut all the way in and tighten the headless bolt so that it aligns the assembly and centers it as needed.

Step 8

4 - Motion Assembly



Repeat the process for the second housing and spindle nut. Once again, DO NOT remove the aluminum cylinders just yet.

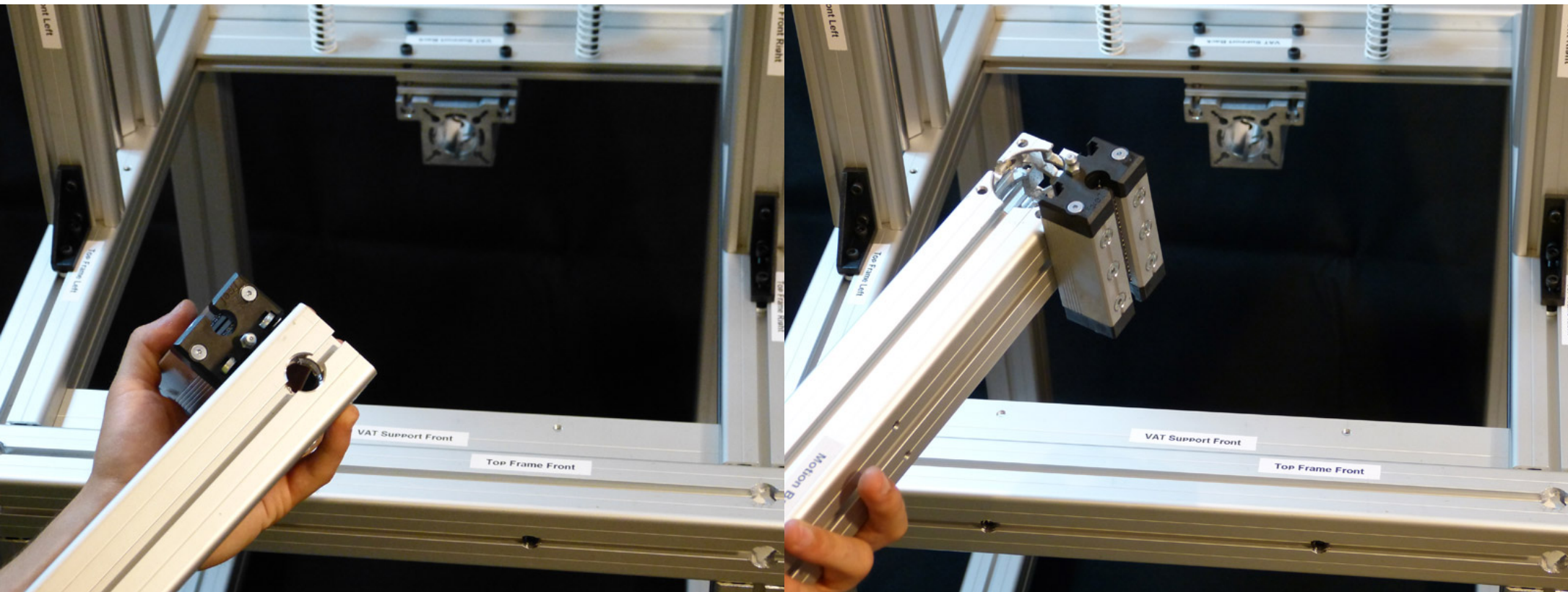
Take the Motion base from your parts and prepare to begin its assembly.



Take the 5mm Oval Sliding nut and the "shiny" 5mm bolt. The bolt shall be Torque head, so make sure you have the appropriate key for it.

Slide the nut through and loosely screw on the sliding nuts. Note that although there are 4 holes, only 2 shall be needed in our assembly. Also note the orientation of the Sliding Nuts as shown on the picture.

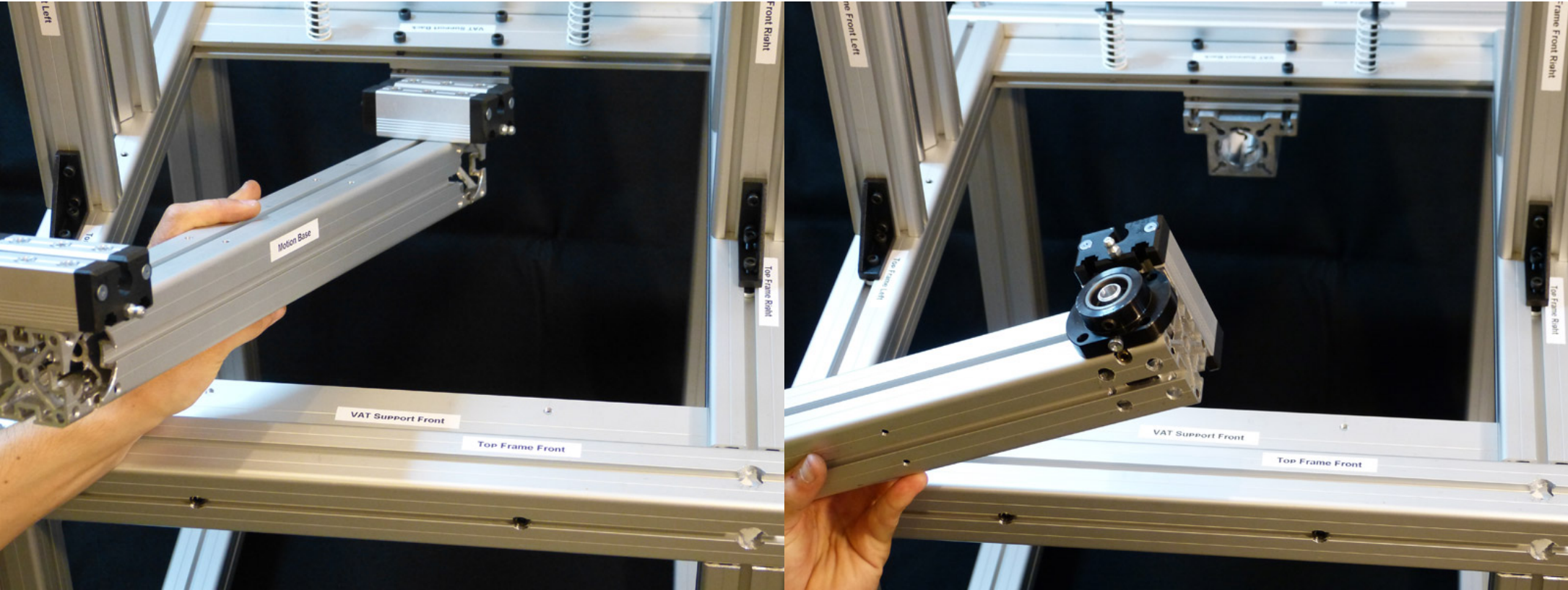
4 - Motion Assembly



Slide the Slider block through the Oval nuts and center it on the assembly. The centering is not very crucial and is only for esthetics but make it as center as you can by eye.

Tighten the bolts and you should have a result like shown on the image above. Note the orientation of everything in the assembly at this point.

Step 9

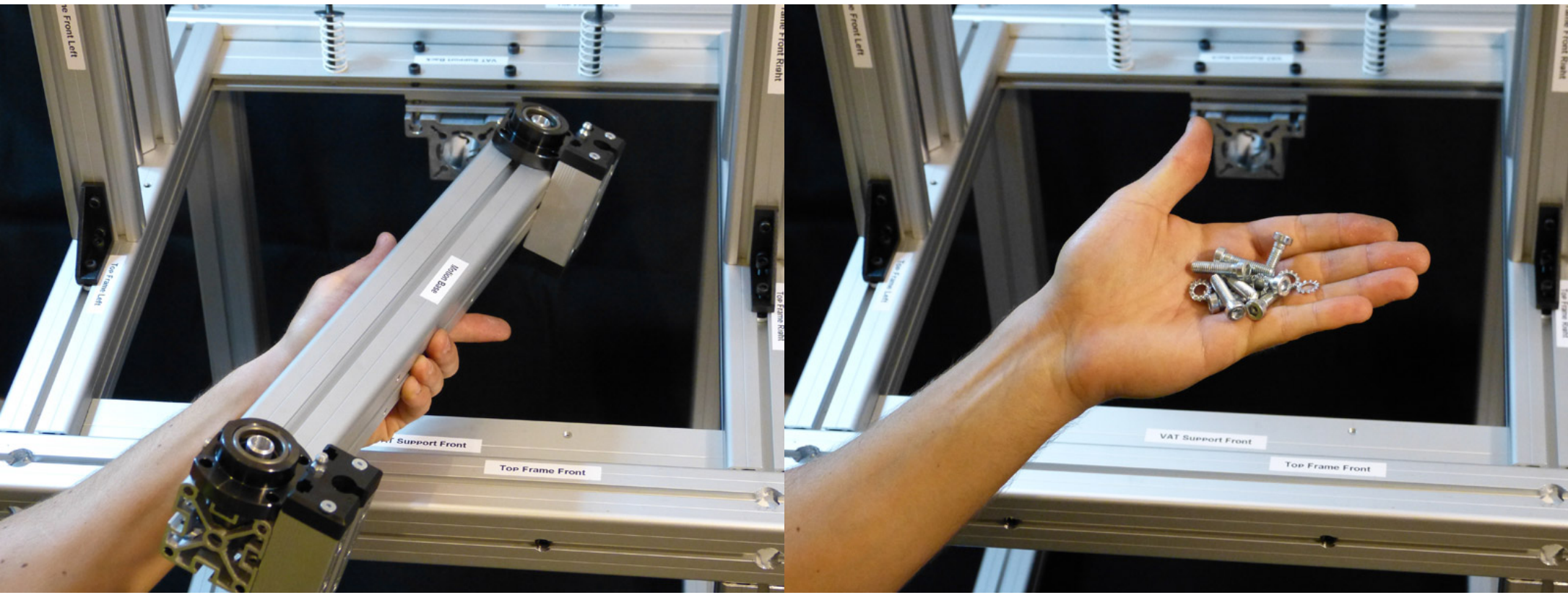


Repeat the process for the other side of the Motion Base. Both Sliding Blocks should look like on the image and be as center as possible. Also tighten the nuts once again for a firm grip of the part.

Take your assembled Spindle and Housing assembly and place it in the hole within the Motion Base. Note that there is a hole on one side of the Motion Base for the adjustment bolt and this is the correct orientation for it. The Fit might be tight but it is so, for the best accuracy possible.

REMOVE the BOTTOM rubber stopper from the Aluminum cylinder on the Spindle Nut now. You won't be able to take it out later. BE CAREFUL not to let the cylinder fall out.

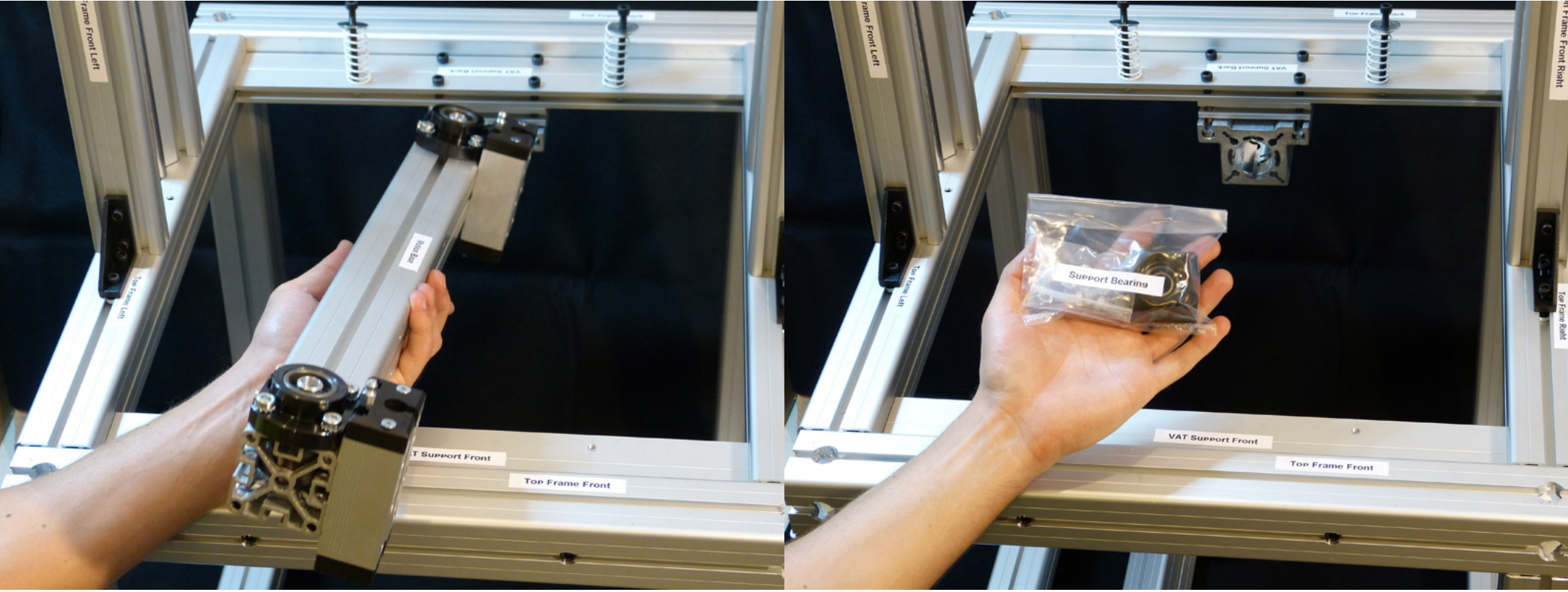
4 - Motion Assembly



Both assemblies should be in their position by now. Make sure they are pressed all the way into the Motion base. For ease of assembly you can remove the adjustment headless bolt from the Spindle Nut housing for now.

Take the bolts as shown on the image above. They are all the same length and are 6mm. Don't forget the washers as they shall ensure the bolts don't unscrew when vibrations are applied to the motion.

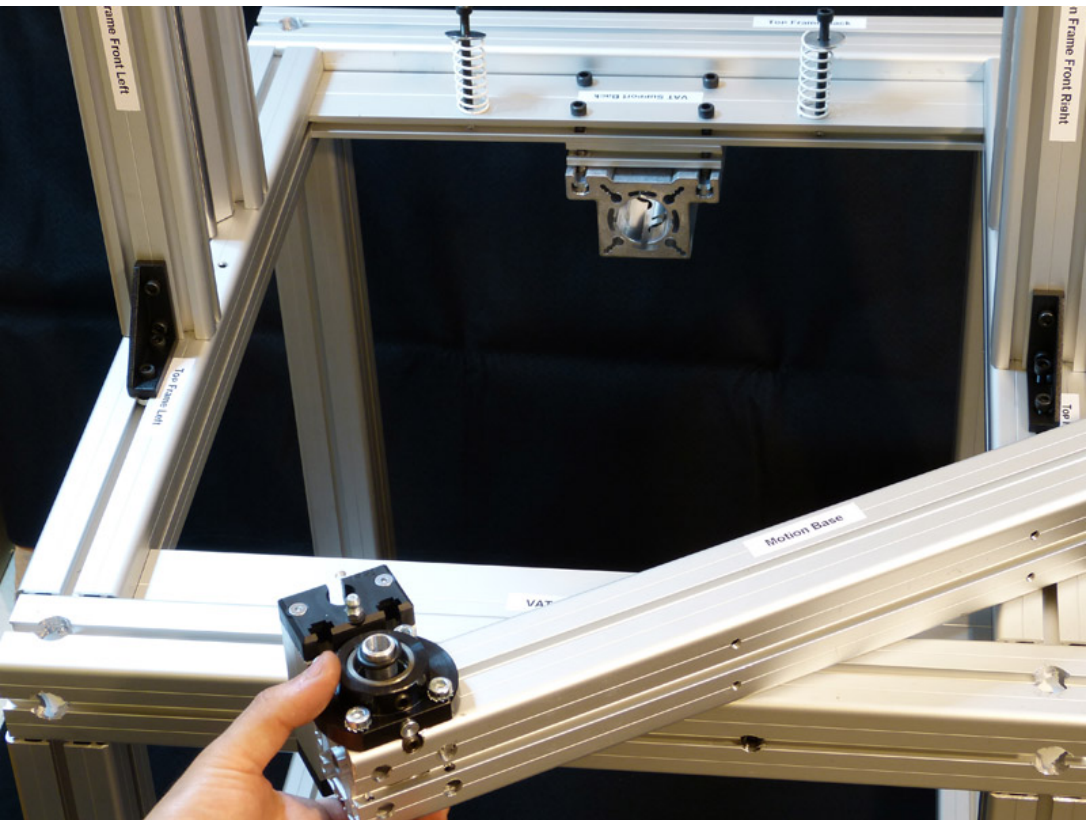
Step 10



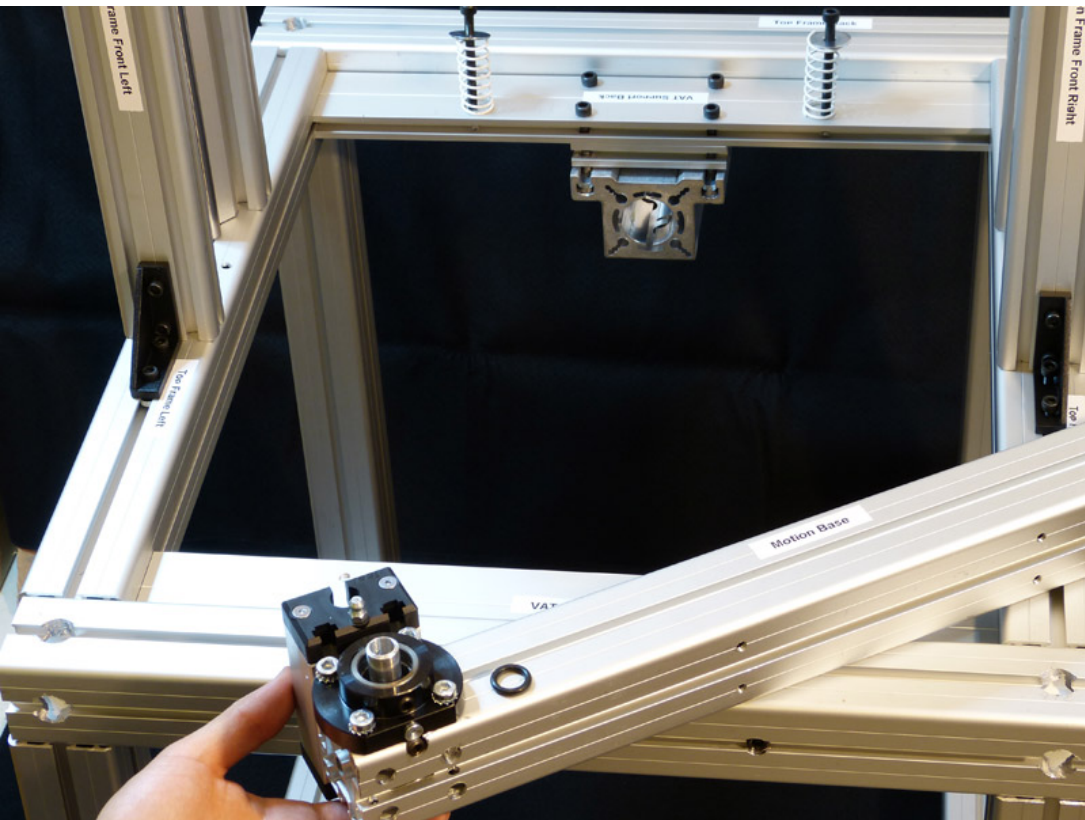
Bolt the Spindle Housing assemblies to the motion frame as shown in the image. The fit should be tight and firm, don't be afraid to tighten the bolts all the way.

Take a Support Bearing from your parts and open up the bag. We shall need it later in this step.

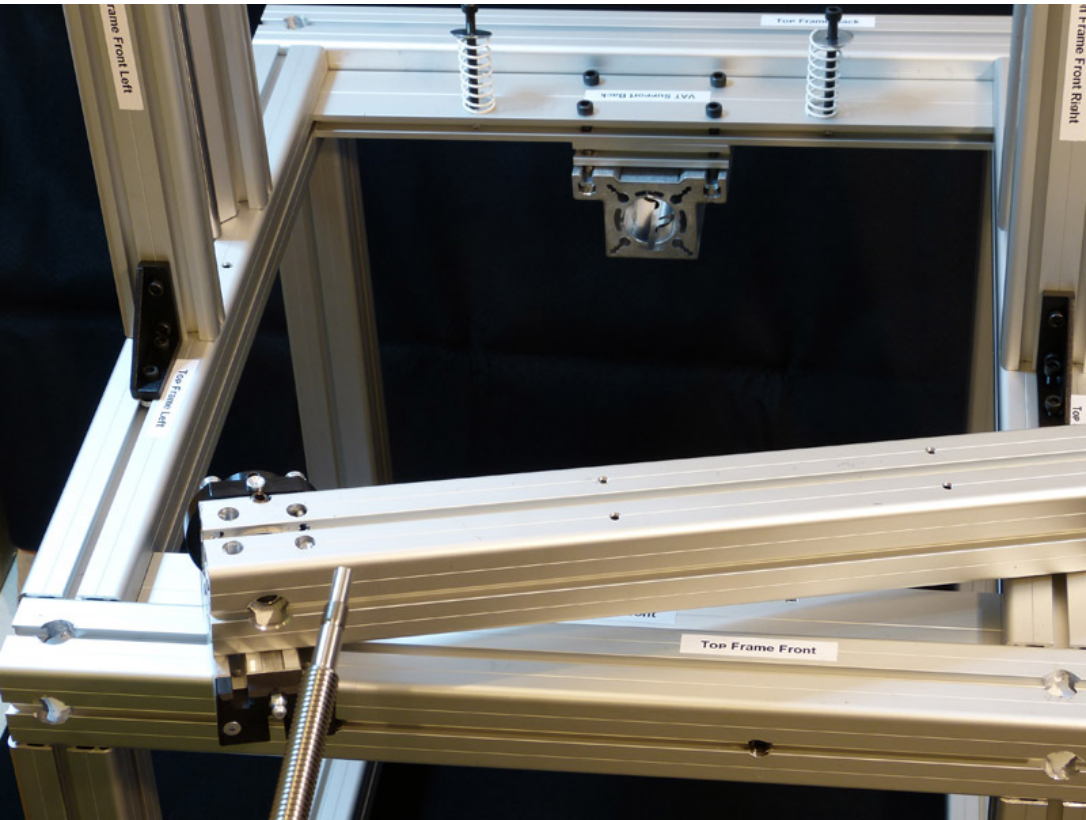
4 - Motion Assembly



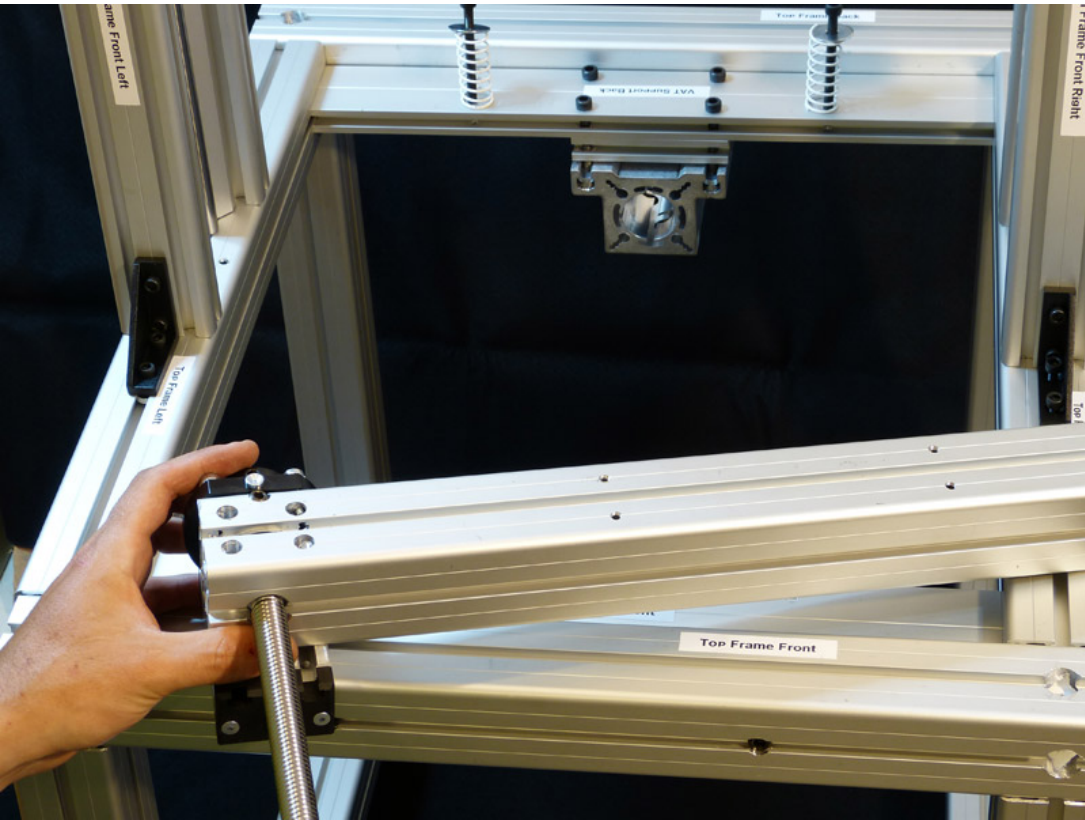
We shall begin installing the spindles now. Remember the rubber we removed from the bottom before. You can also remove the top rubber now from the cylinder on the spindle bolt. BE CAREFUL not to allow the cylinder to fall out.



Remove the top rubber if you want but you don't have to at this point since it shall come off with the cylinder later on in the assembly.

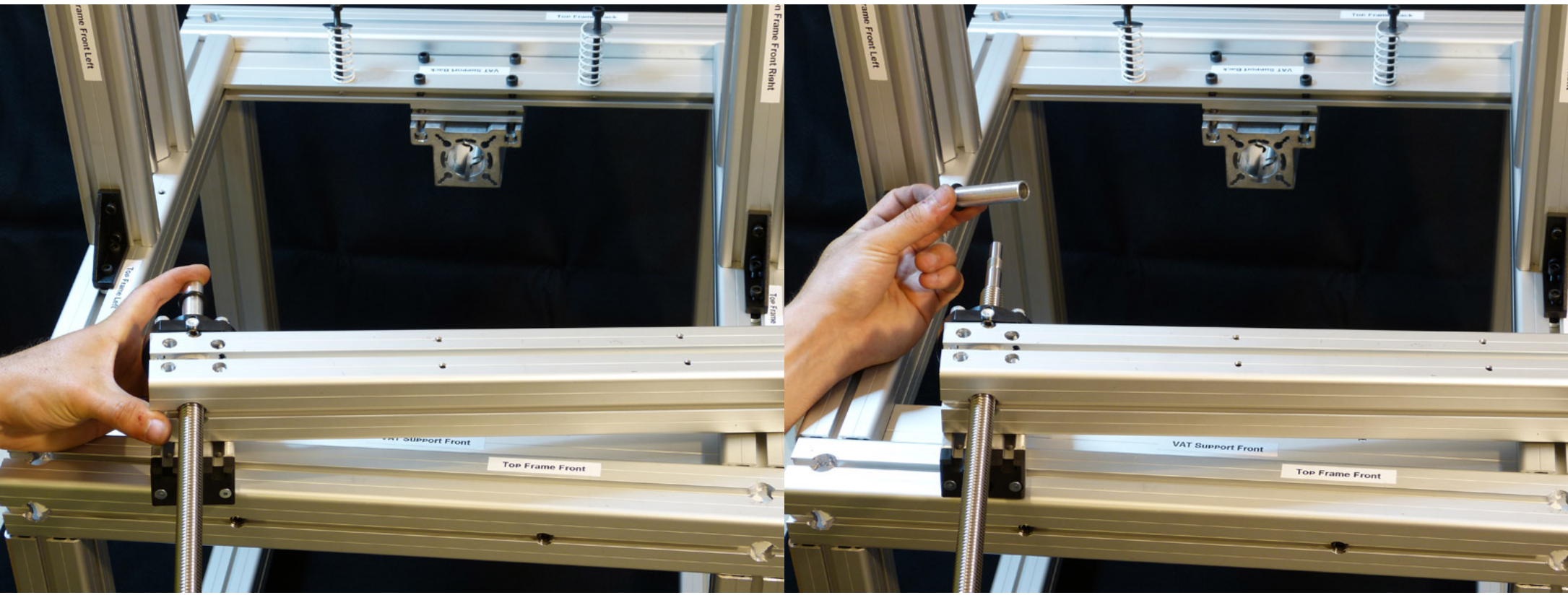


Take the spindle and note the high pitch thread on the correct side of the spindle. This is the side we shall be inserting first.



Hold down the Aluminum cylinder in the spindle nut and gently slide the spindle shaft INSIDE the cylinder. DO NOT push it through.

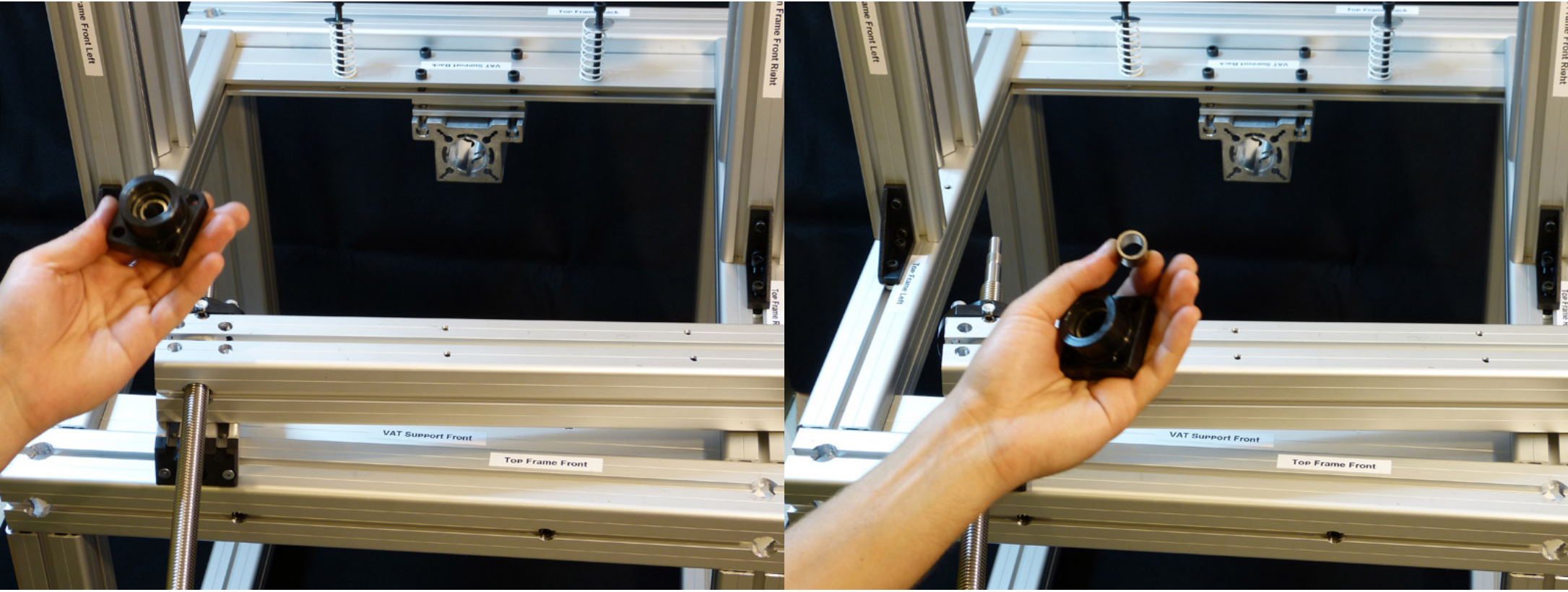
4 - Motion Assembly



Gently begin screwing the spindle into the Spindle Nut. Make sure the Aluminum cylinder is firmly pushed on the spindle while turning it.

Once the spindle is through and you can see large threads on the other side, you can remove the aluminum cylinder. We won't be needing it anymore.

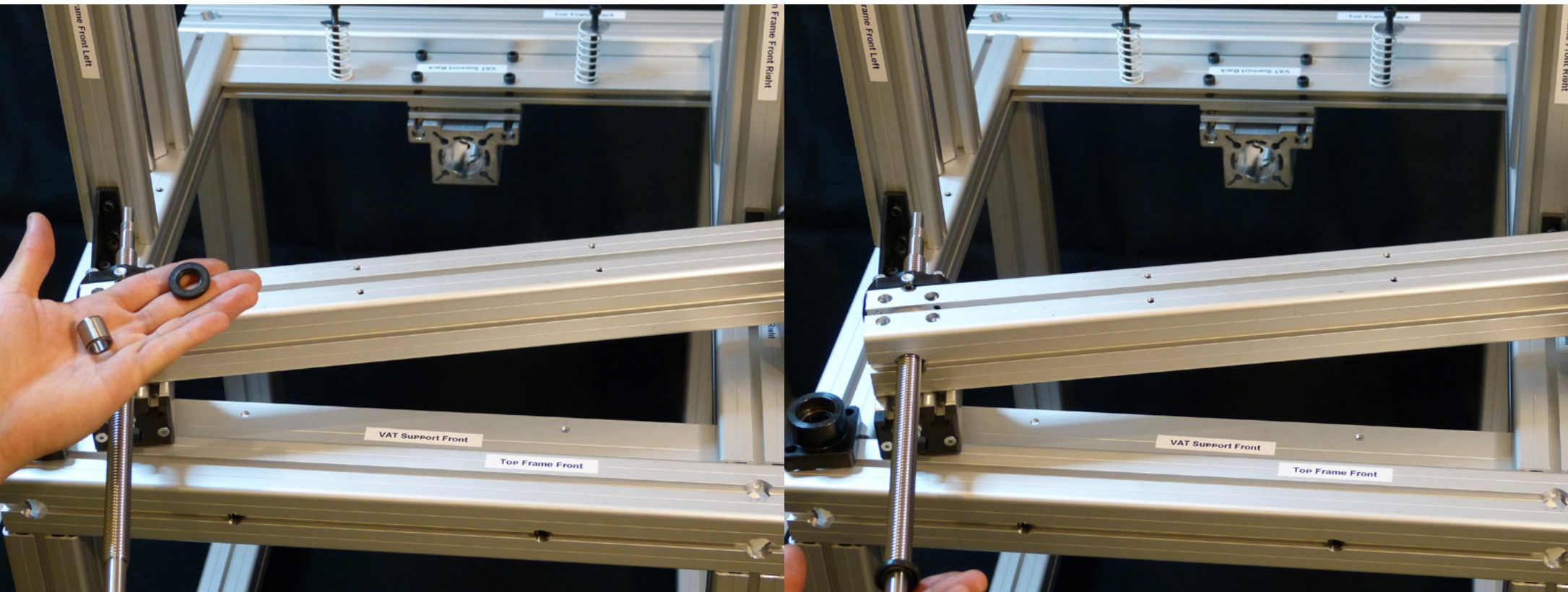
Step 11



Take the Support Bearing and note the smaller cylinder inside the bearing.

Remove this cylinder since we shall be placing it on the spindle.

4 - Motion Assembly



Before you go and insert the cylinder, take the rubber seal in the bearing bag and have it ready. It goes in first.

Slide the seal through. Make sure it goes all the way to the point where threads start. THEN install the Cylinder from the bearing. It shall be a TIGHT fit and may need some "gentle" persuasion to go in. The cylinder and the spindle should be FLUSH at the end.

Step 12

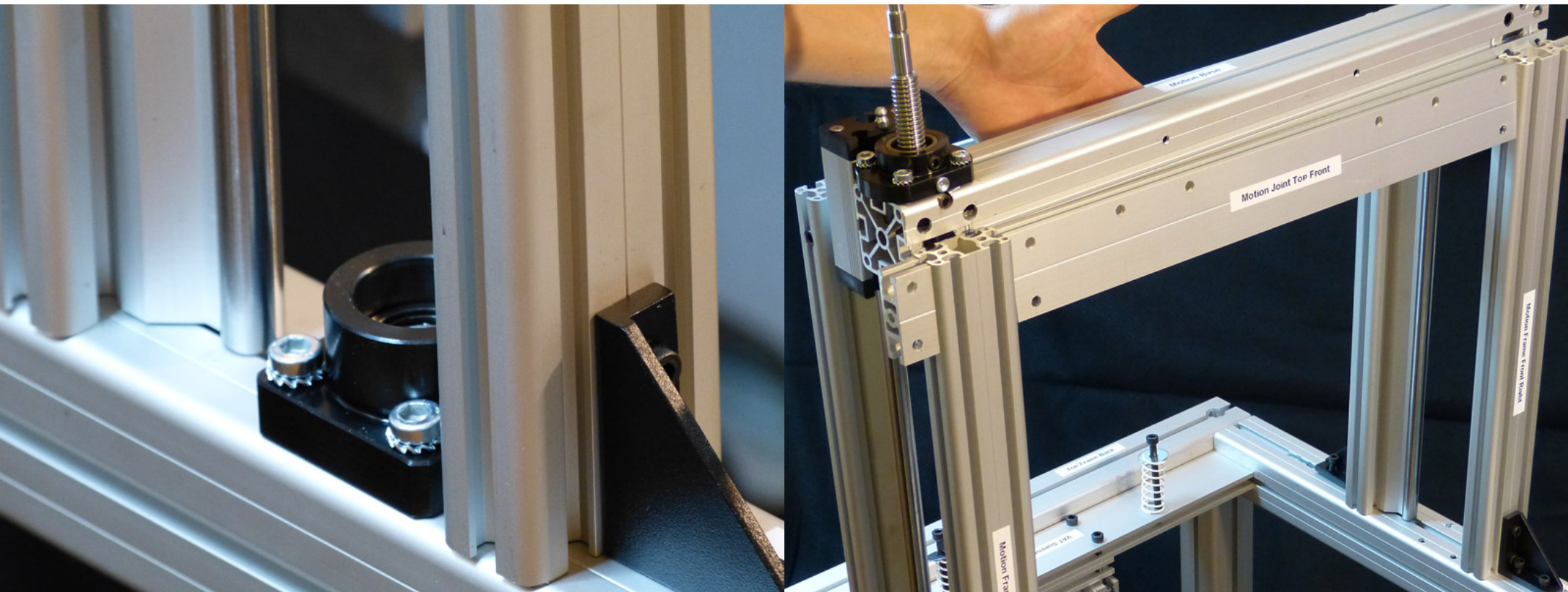


Place the support bearing on the frame as shown. We shall bolt it on but not tight, so that there is play and room to adjust it.

Take the 6mm bolts and their washers (included in the bag) and get ready to bolt the bearing to the frame.

Step 13

4 - Motion Assembly



Bolt the bearing to the frame but not too tight. We need some slack to let it move around for now.

Take the entire Motion Base assembly and slide it through the Sliding Blocks on the frame. Carefully keep sliding until it is all the way in.

Repeat steps 10, 11 and 12 for the other side of the Motion Base. Both spindle and their bearings should be in place at the end of this assembly.

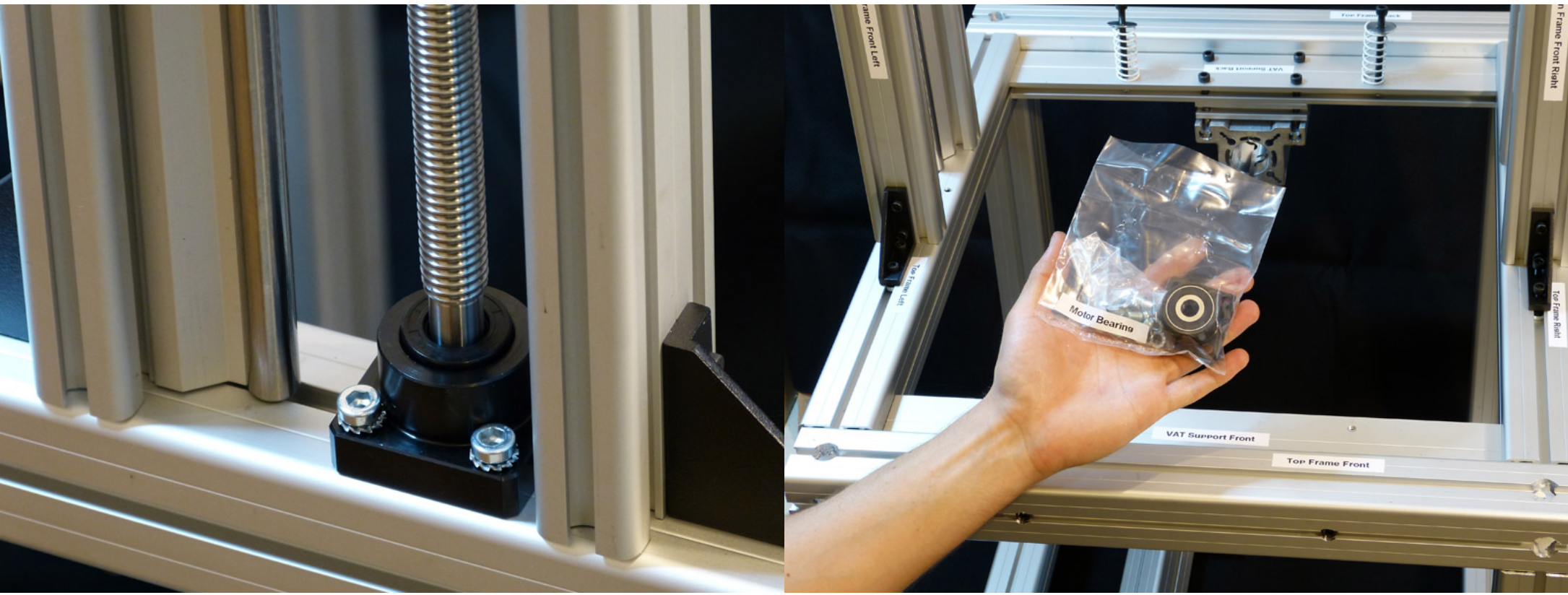


Push it down a bit until the first spindle touches the support bearing.

Note that the Cylinder we placed earlier on the spindle should go all the way into the bearing. Screw the spindle as needed and push the motion assembly down to mate it all the way in.

Step 14

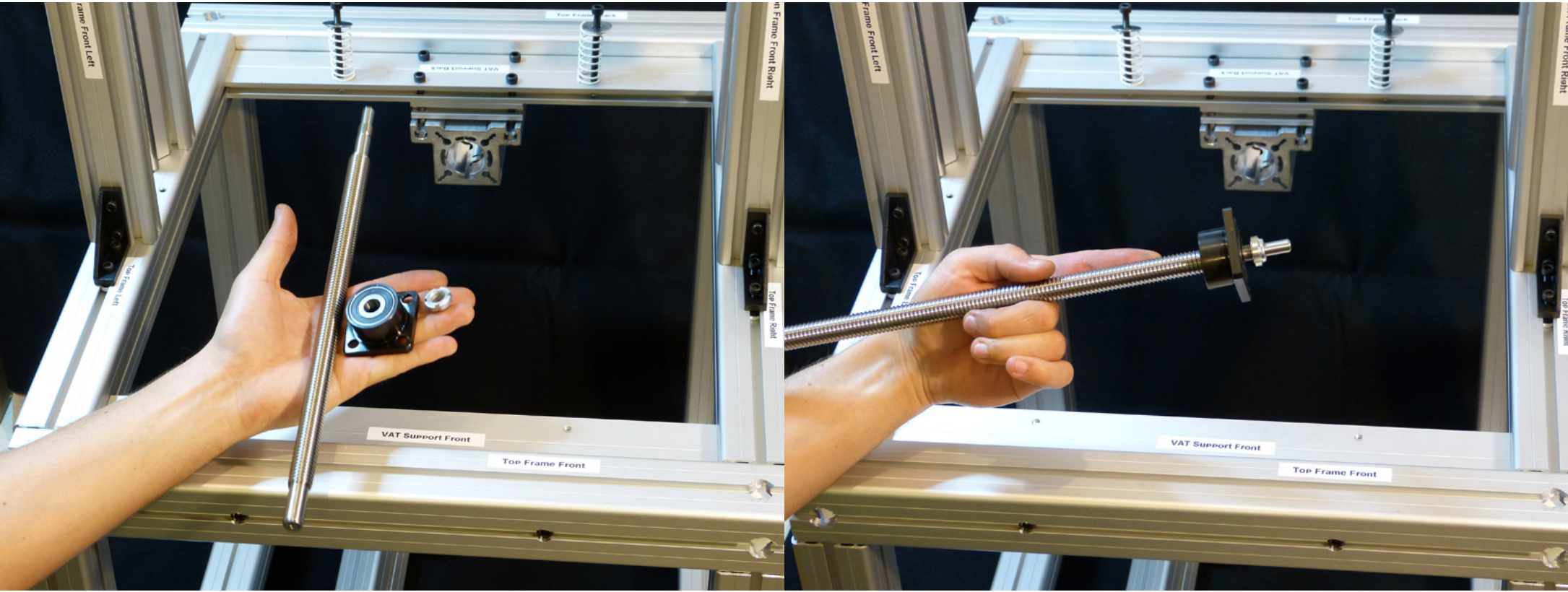
4 - Motion Assembly



NOTE that the rubber seal should be TOUCHING the start of the spindle and NOT have any space from the bearing left, meaning that the spacing as shown on the image above should NOT be left like that but pushed all the way in.

Prepare the Motor bearings. We shall be installing them next.
Open up the bag and lay out the parts on front of you.

Repeat these steps for the other side of the assembly and make sure both spindles are well inside the bearing. Screw the spindles in or out to adjust this distance.

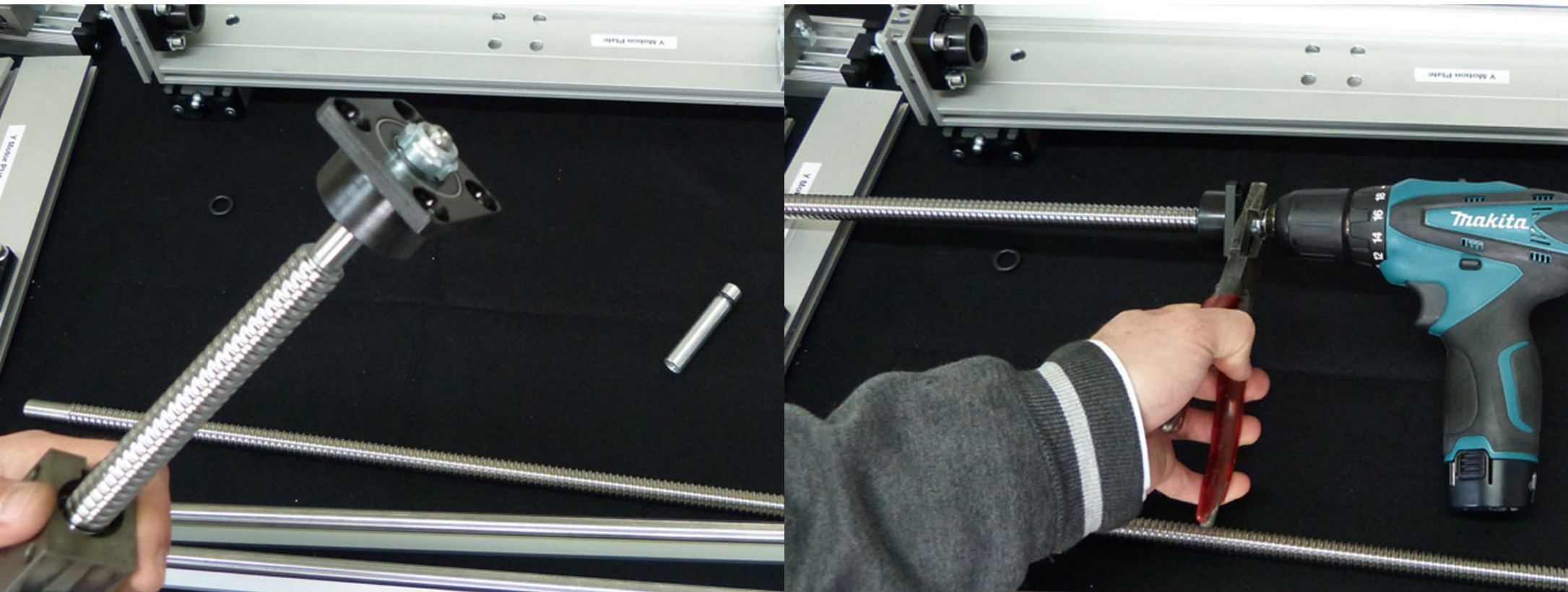


This image shows what you shall be mating together. The image shows the parts OUTSIDE of the assembly for reference reasons and for a better understanding on how they shall fit together.

Push the bearing onto the spindle as shown on the image above. It should go in all the way to the large threads. DO NOT hit the bearing on its sides as you may risk damaging it. The bearing should go in tight. Screw the Bearing NUT on the spindle to secure everything down firmly.

Note

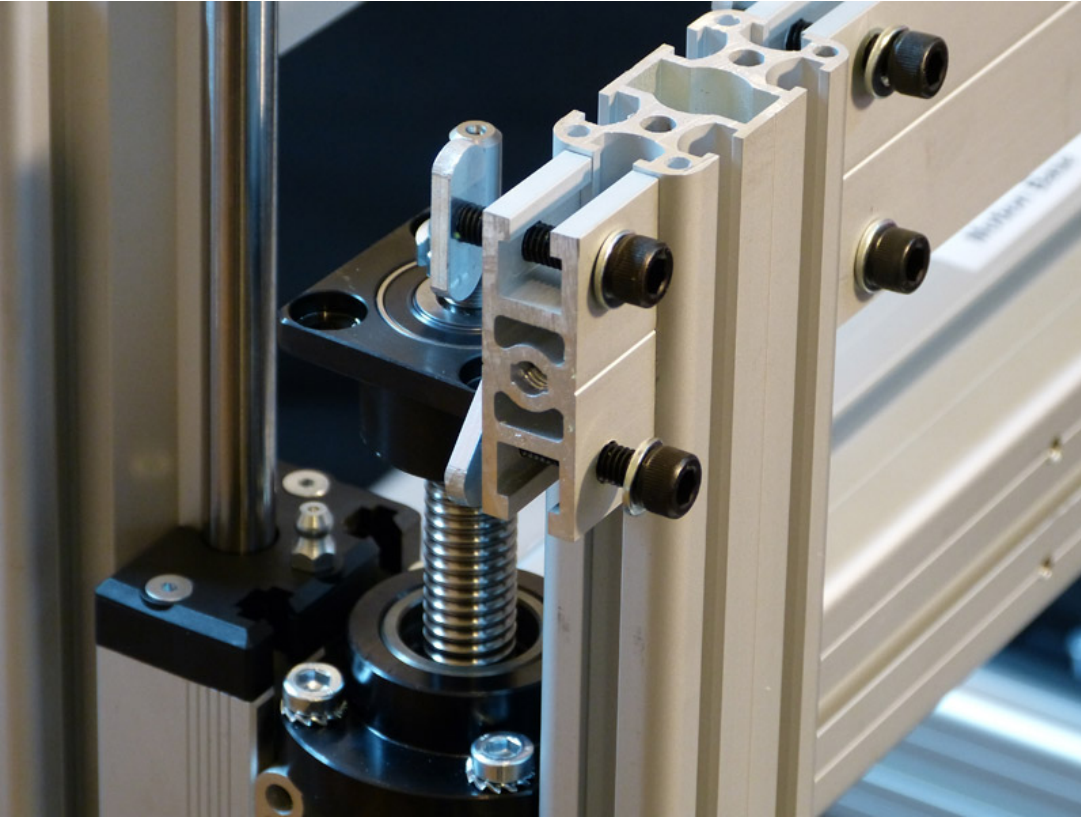
4 - Motion Assembly



You can see better how the spindle, the bearing and the bolt fit together. Check out the next image for a nice trick for fitting them together since the bolt has a nylon retainer, which makes it pretty hard to do otherwise.

Tighten the spindle in a small drill if you have one and by holding the nut with pliers, spin the spindle in the counterclockwise direction. This shall tighten it nicely without causing you a big headache later on.

Step 15

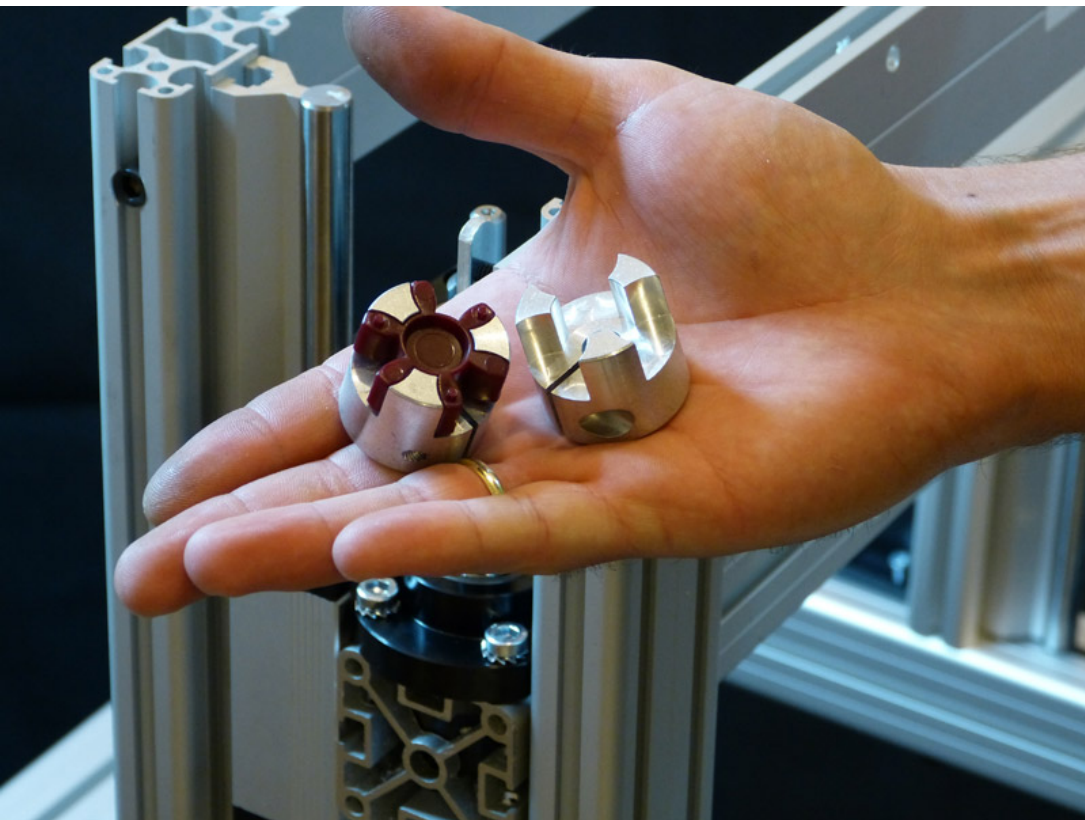
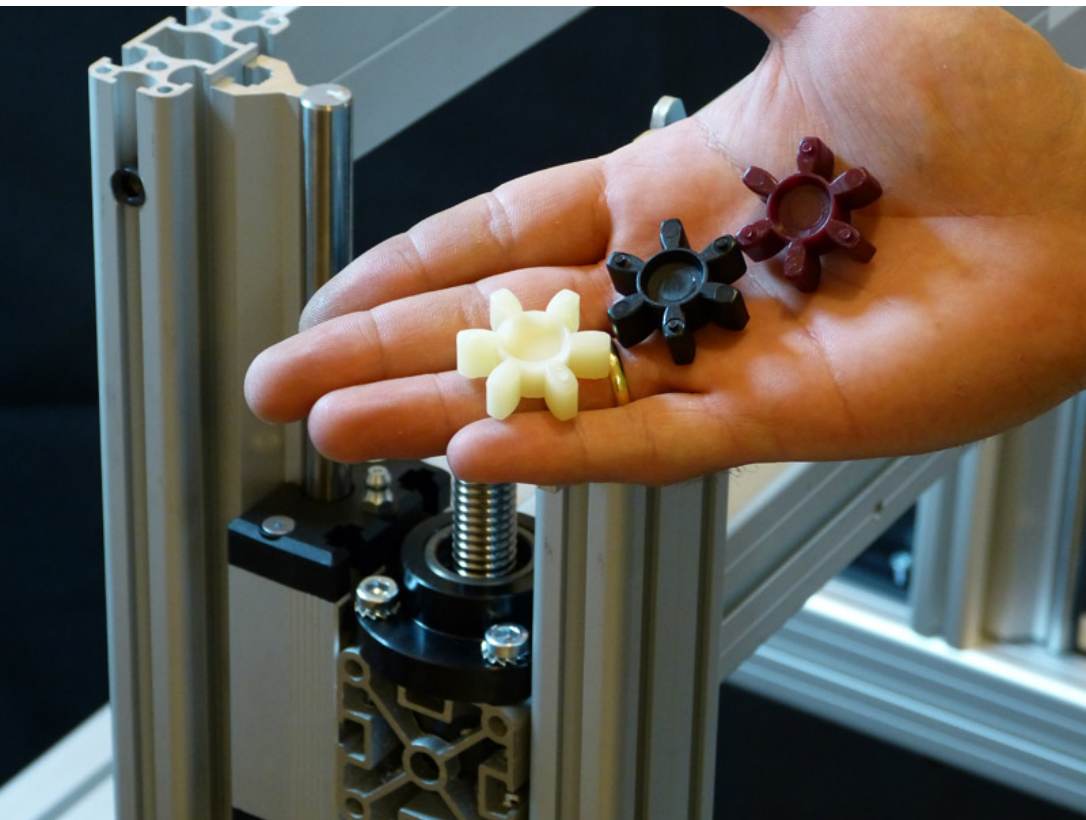


Use the Oval Sliding nuts and 4 bolts with their washers as shown on the image above. They shall hold the motor mount in place later on. Repeat the process on the other side of the machine.

Step 16

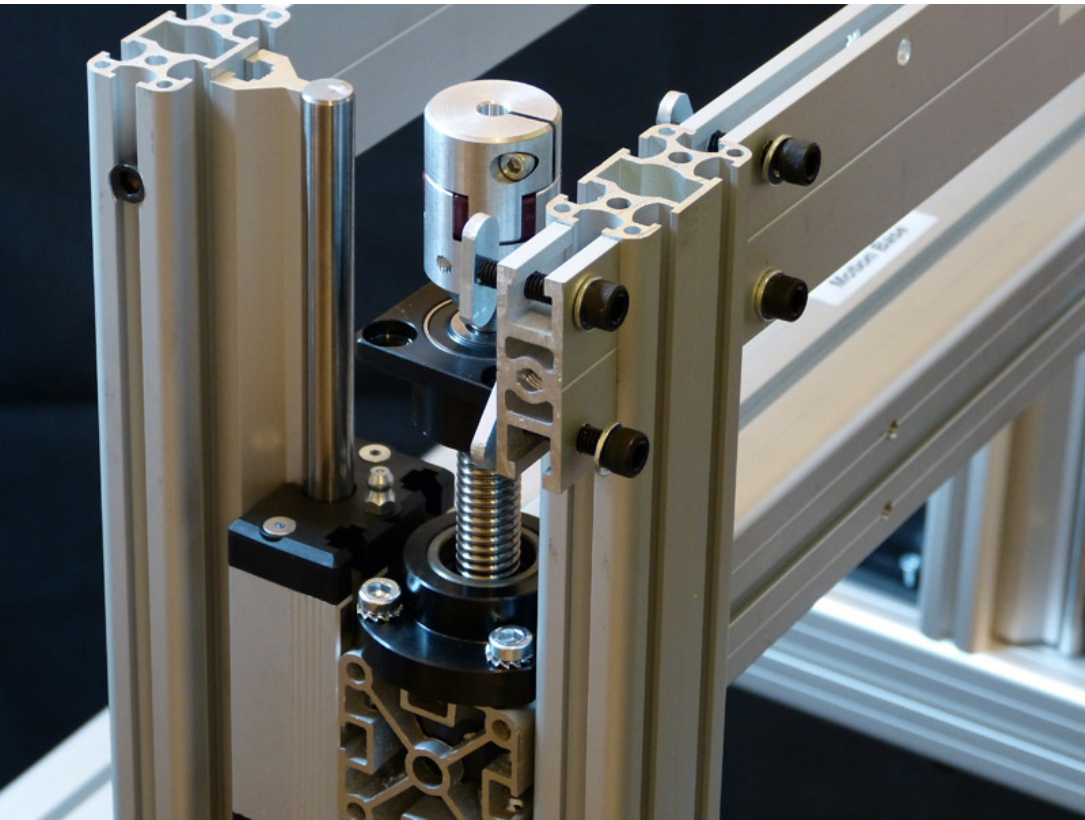


Take the Motor Coupling bag and prepare to assemble it as shown on the image above.



Inside you shall find 3 different couplings, starting from the softest and finishing with the hardest. If you don't know which one to use and you are doing this for the first time, use the Brown coupling since it is the hardest.

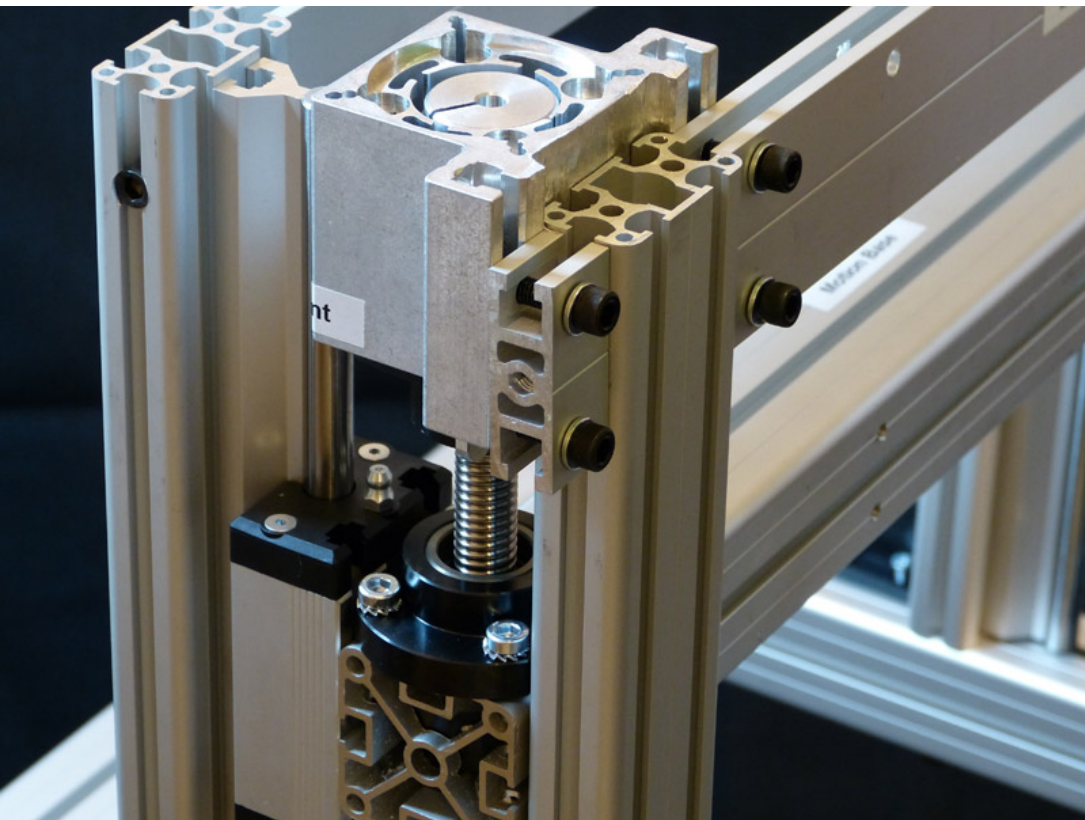
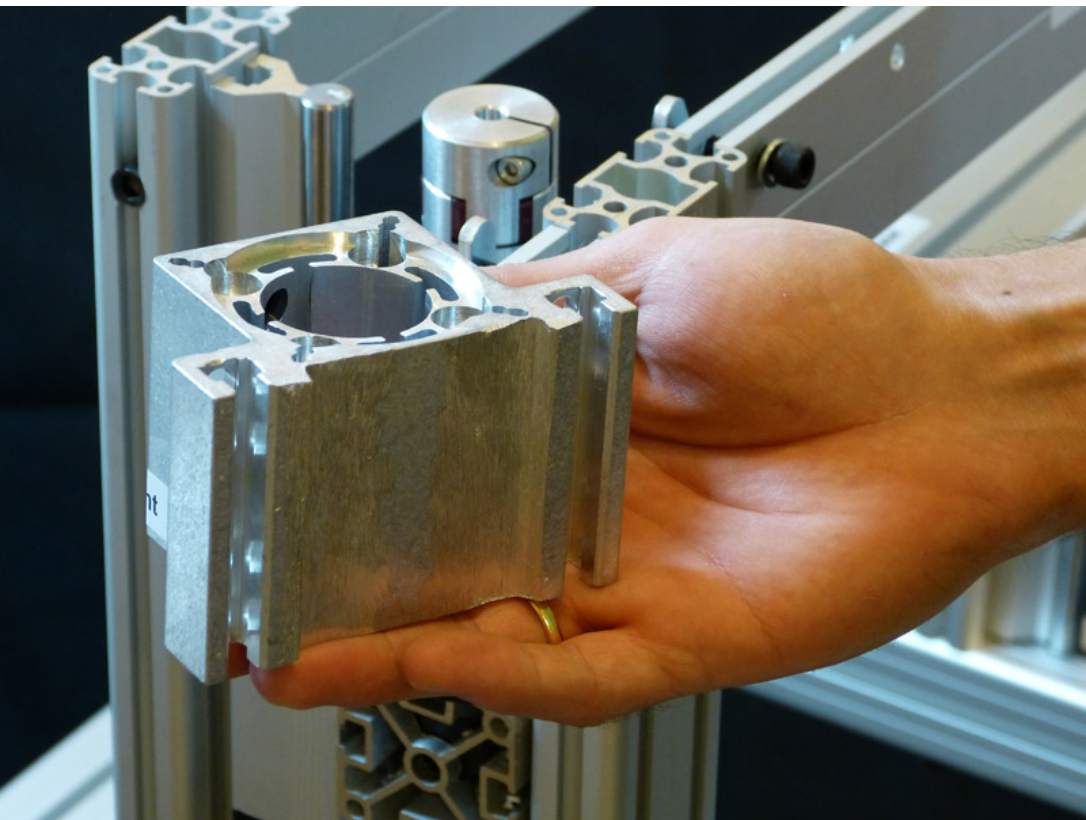
Insert the coupling as shown on the image above.



Attach the second half of the coupling and NOTE the orientation of the bolts. It is important since you shall be able to access them only in this orientation when the coupling is hidden within the motor mount. Place the screws on the coupling but don't tighten then yet.

Slide the coupling on the spindle shaft and tighten the end which mates to it. The coupling should go in all the way to the end (not all the way through)

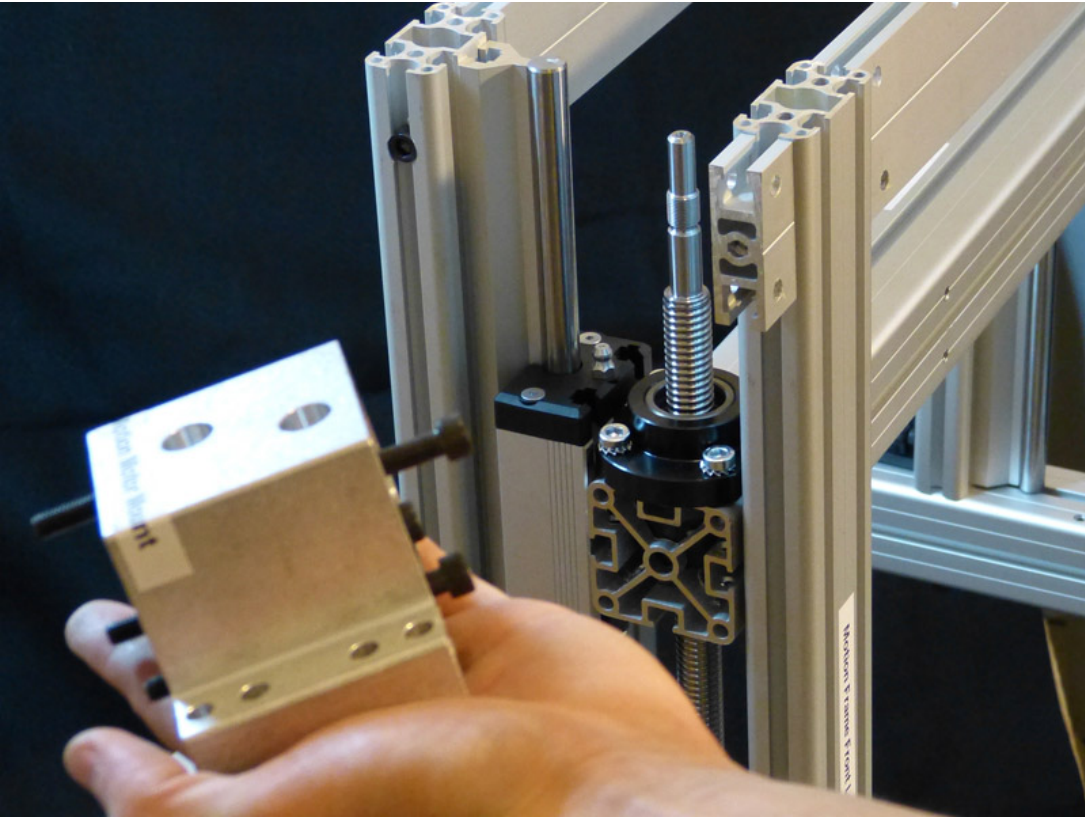
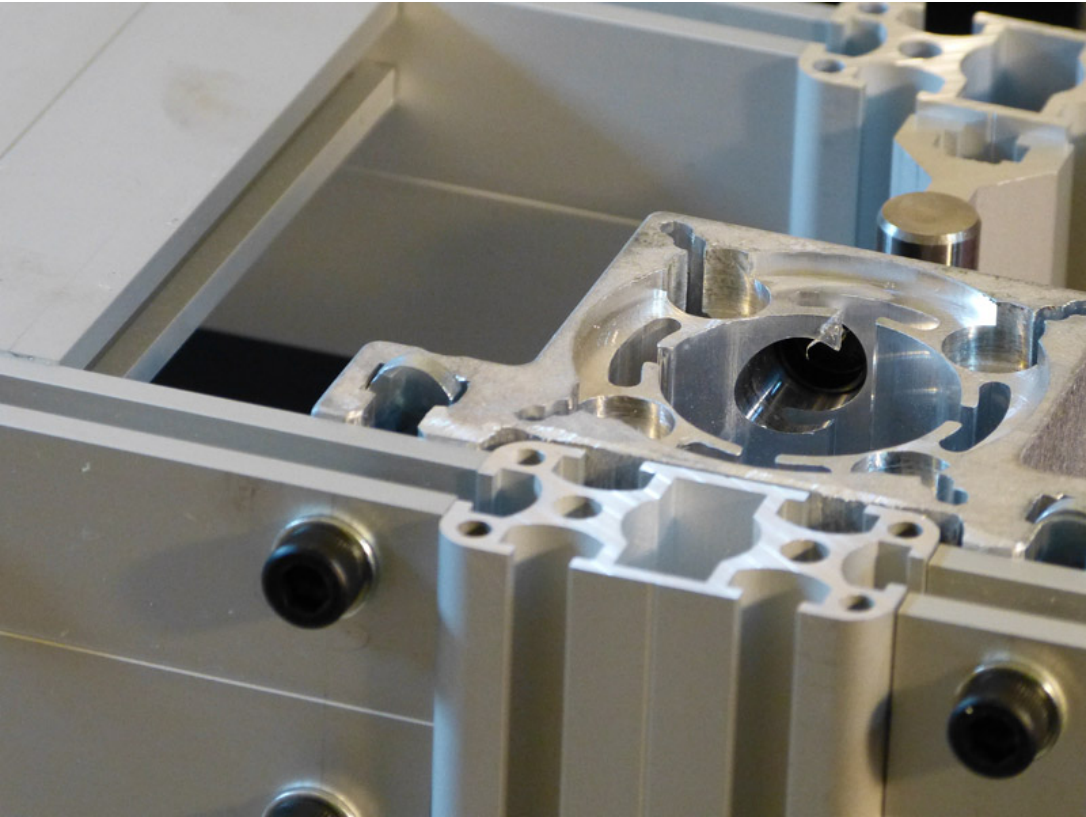
Step 17



Take the motor mount and note its orientation as shown on the image above. It is important you place it on the assembly in this orientation when tightening.

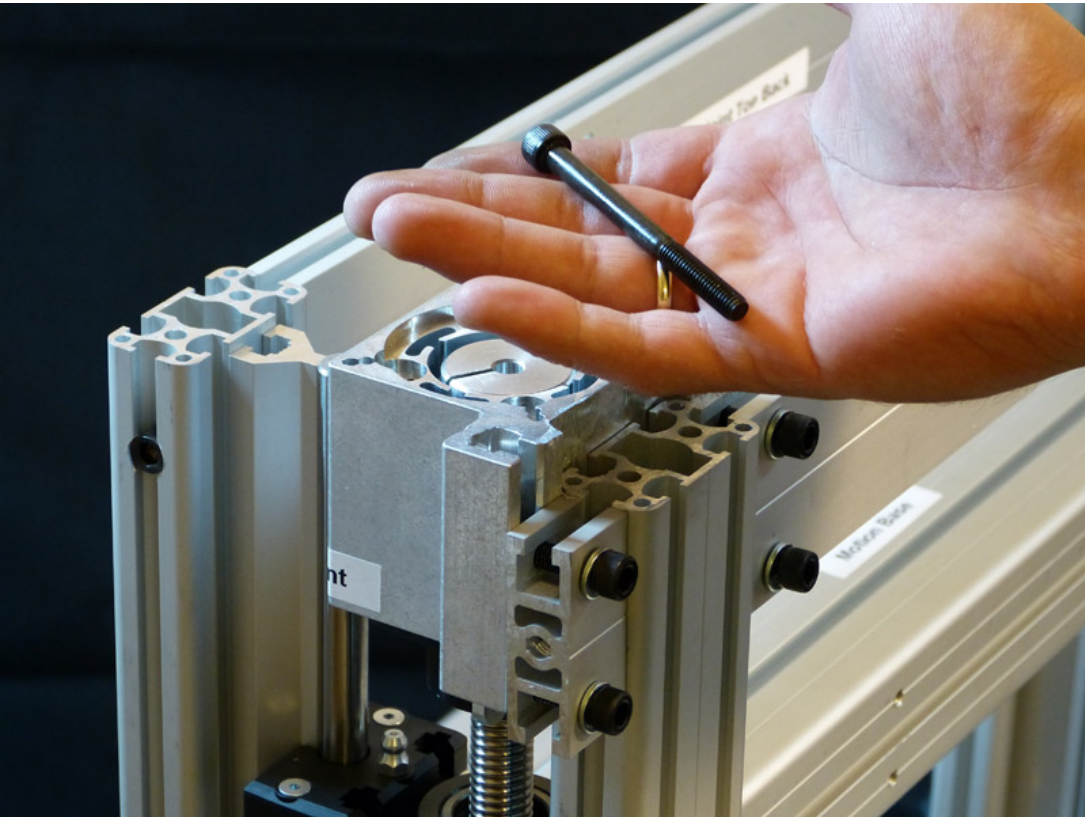
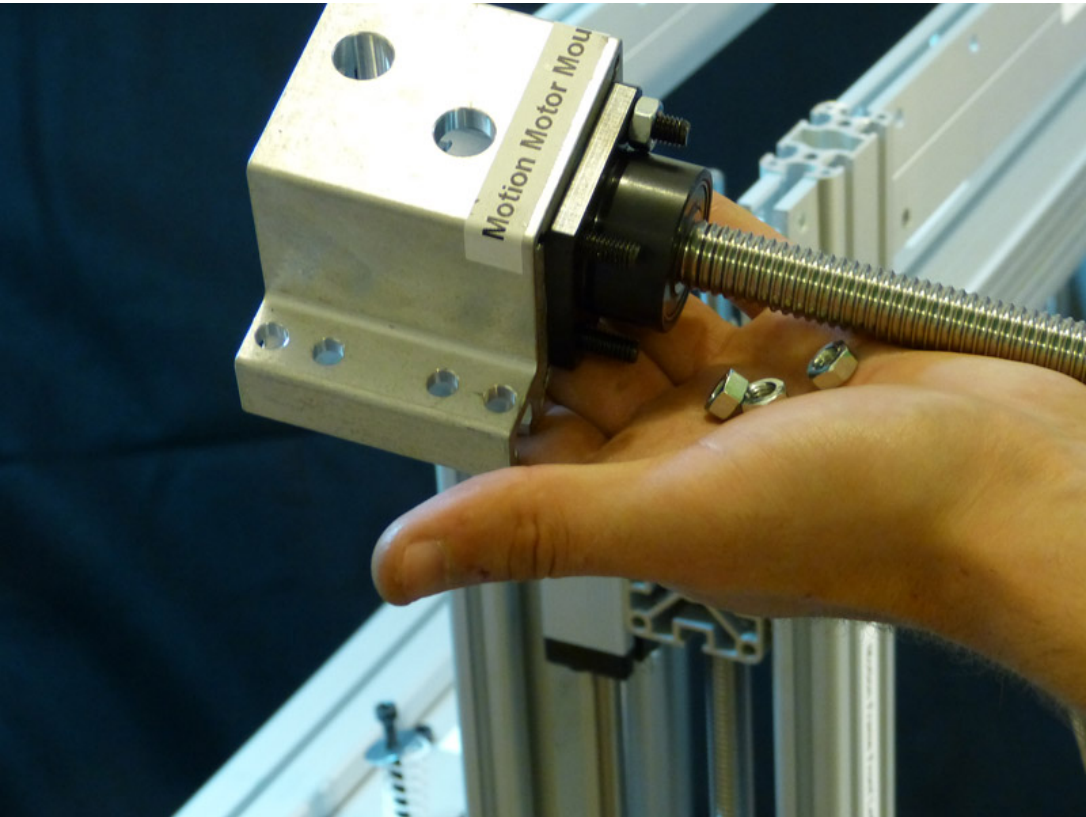
Slide the motor mount through the Oval Sliding nuts, which you installed earlier.

Step 18



Note that the Motor Mount should go as low as shown on the image above and should be FLUSH with the motion support. If this is not the case, make sure that your spindle is all the way in on the support bearing and the Motor Bearing is tightened until the end.

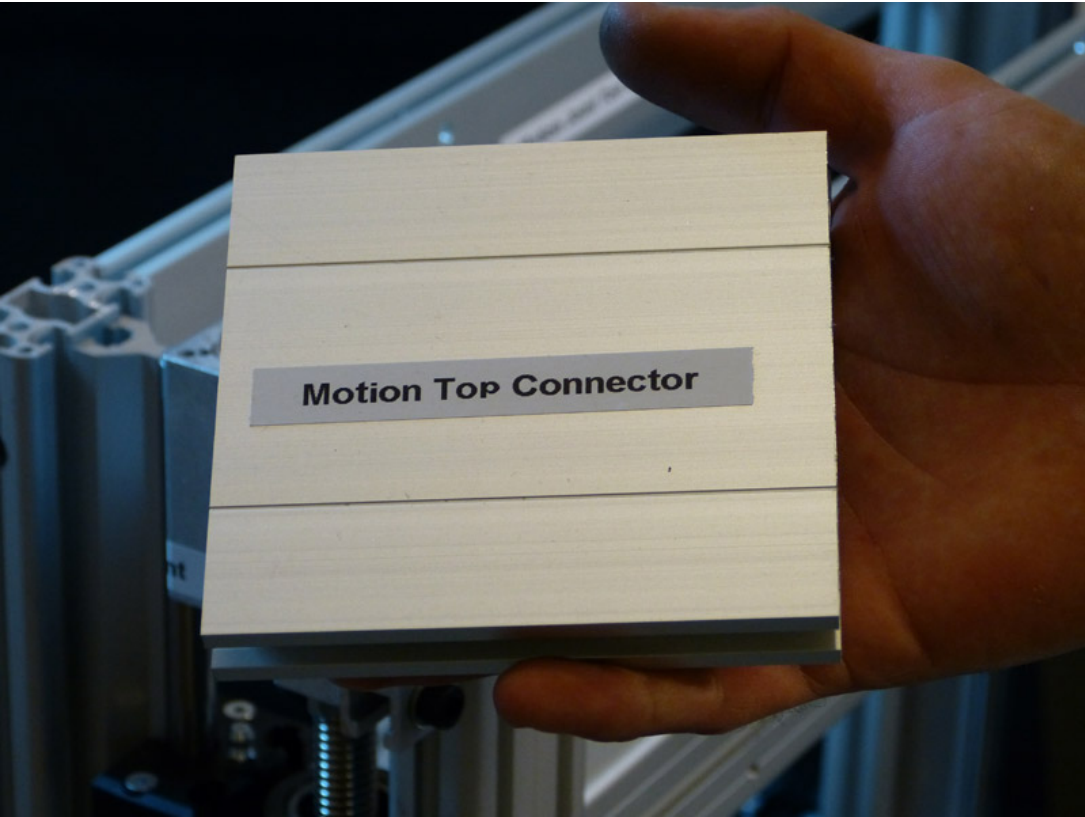
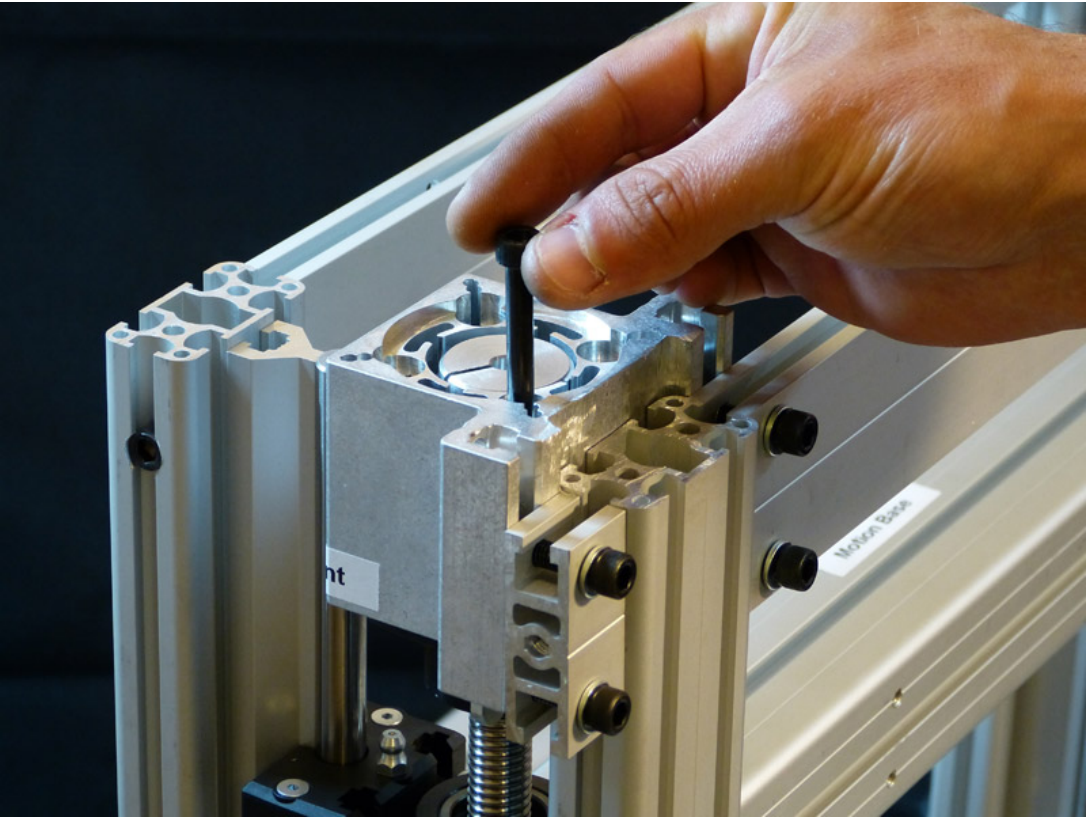
This image shows the Motor Mount outside the assembly for a better understanding about what to do next.



We shall be tightening the Motor Bearing to the Motor Mount as shown, with the help from the longest bolts, their nuts and washers (6mm)

Take the longest bolts as shown in the image above.

Step 19



Slide the bolts through the motor mount as shown and tighten on the other side of the Motor Bearing as it was demonstrated in the images above.

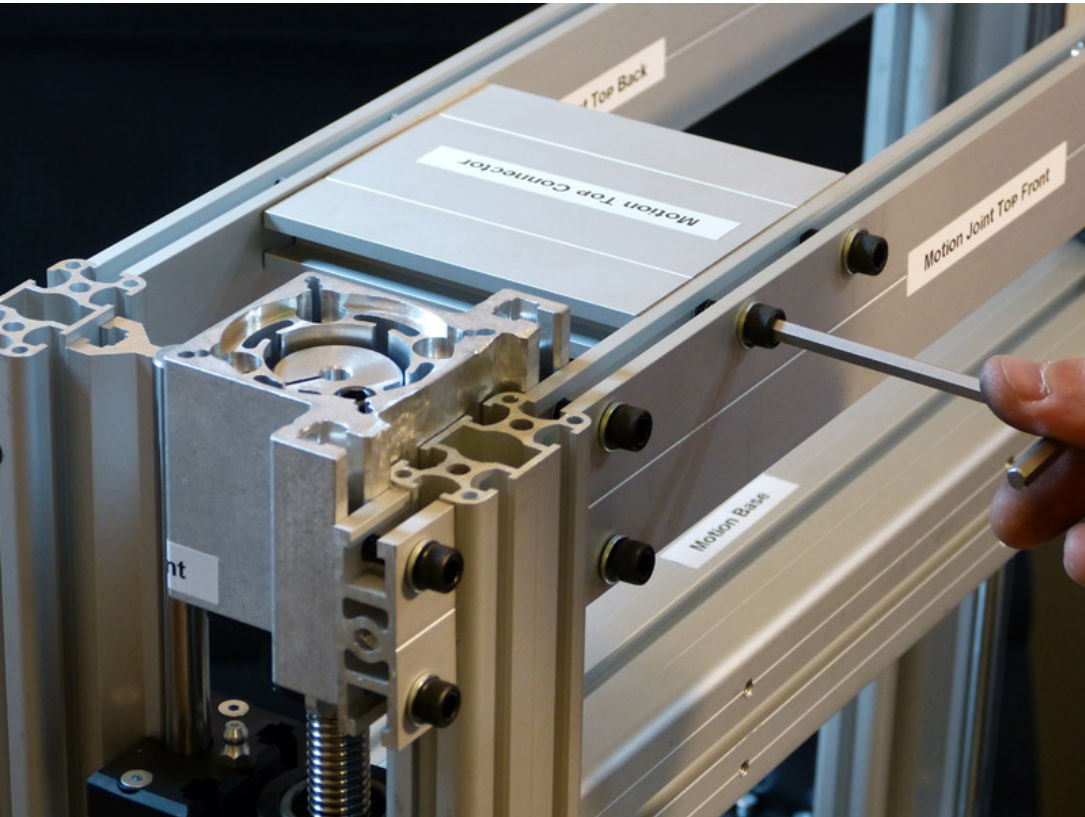
Now that we installed the motion of the machine, we can close it up and do the final securing of the frame. Use the Motion Top Connectors as shown on the image above.

Repeat this process on the other side of the assembly, so that both Motor Mounts are secured.

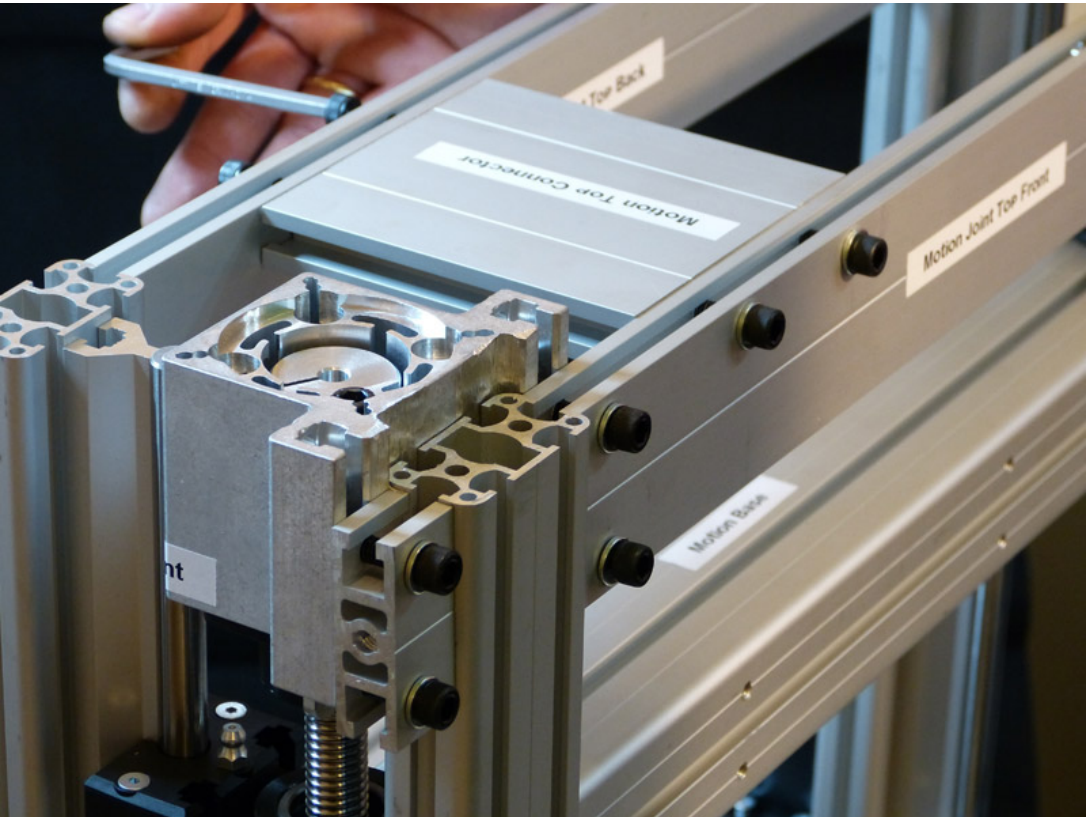
4 - Motion Assembly



Take the bolts and washers as displayed on the image and prepare to bolt them on.



Tighten the Front side first and make sure it is well tightened since this also aligns the motion support as needed.



Next, tighten the back side of the connector. Make sure that it is nice and tight so that the frame is as rigid as it can be.

Step 20



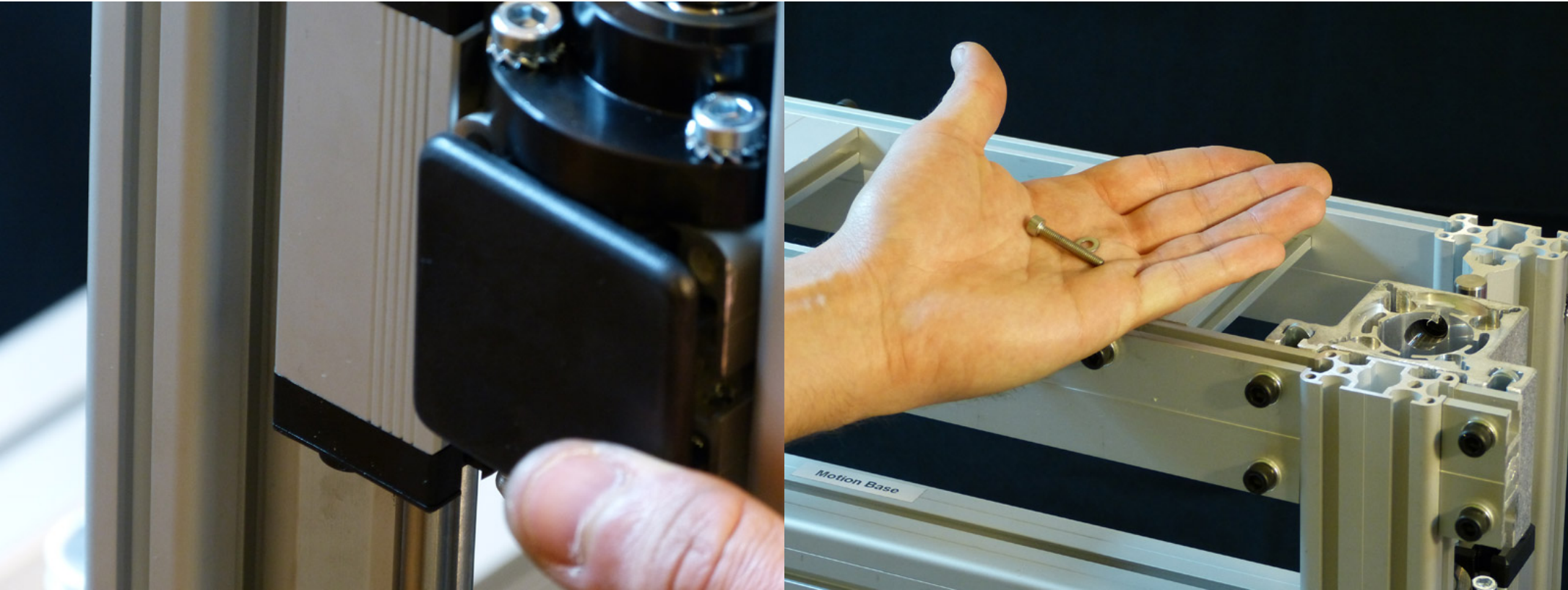
Repeat the process for the other side of the assembly, tightening the bolts as shown on the image above.



Now that the hard part is over, we can decorate the machine with the plastic caps, included in the kit.

Install the caps as shown. Note that you may need to Brake Off one or two supports on the plastic cap so that they don't conflict with the bolts inside the Motion Base.

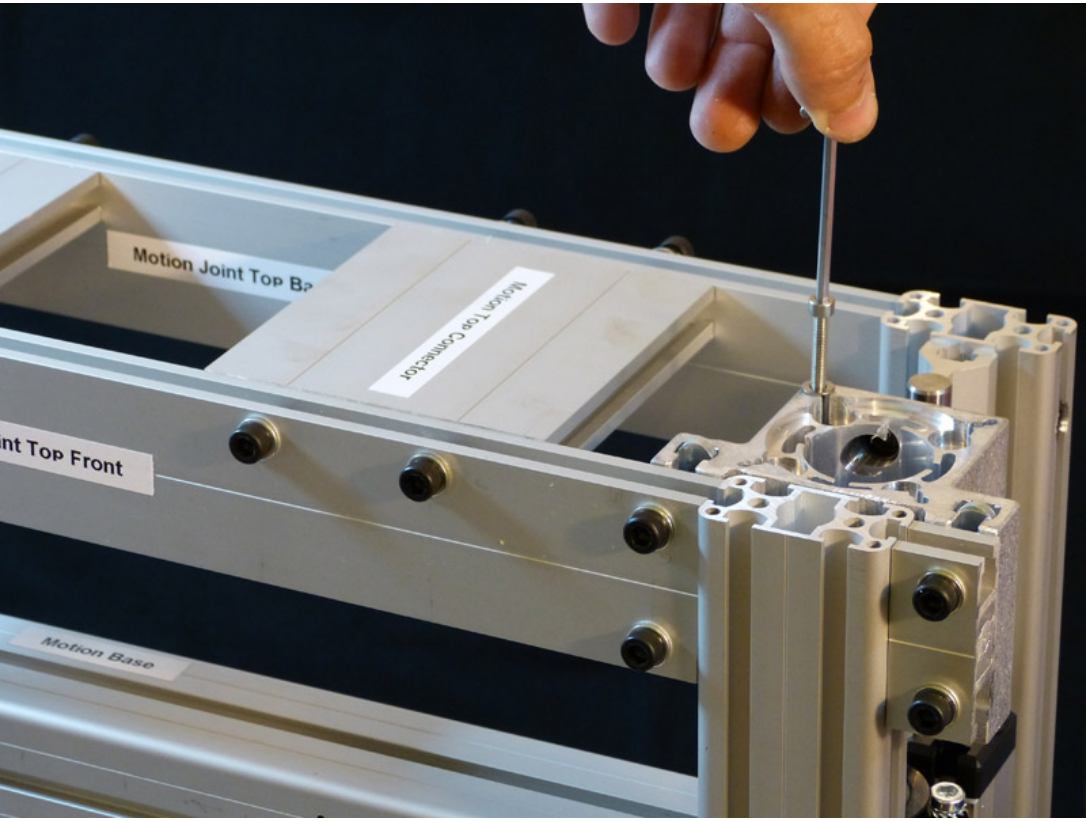
Step 21



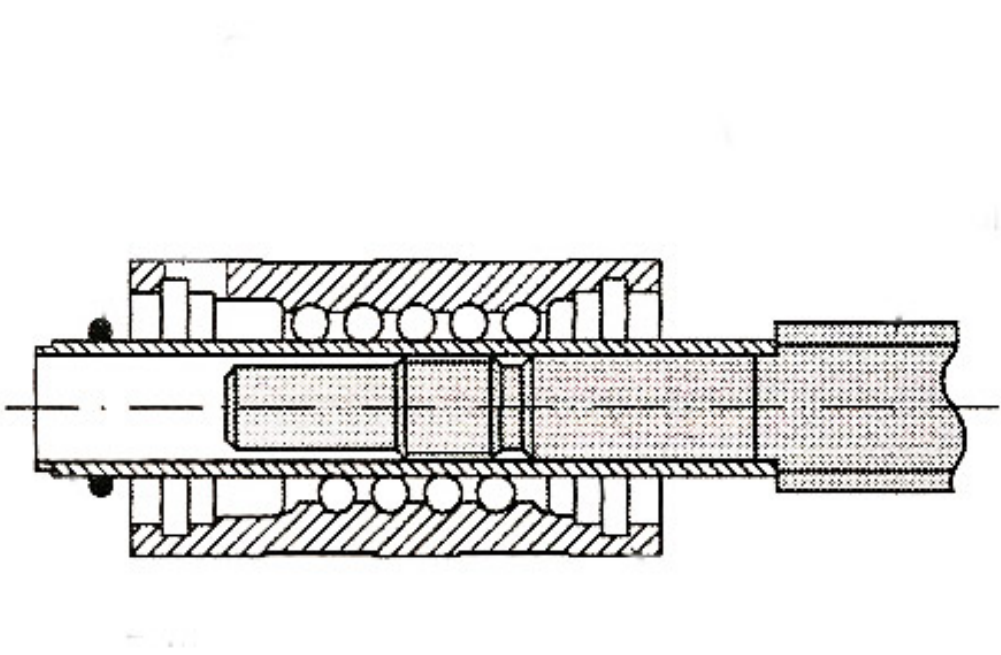
When the cap is on, it should look like on the image above.

You shall also find in the Nuts and Bolts bag the 8 Stainless Steel bolts and their washers for the motor mount. They are 4mm

NOTE



Screw them on for now but not tight and not all the way in. Since we shall have to remove them when the motors are to be installed.



This image demonstrates the Spindle assembly and how it mates with the Aluminum Cylinder, described i the above steps.