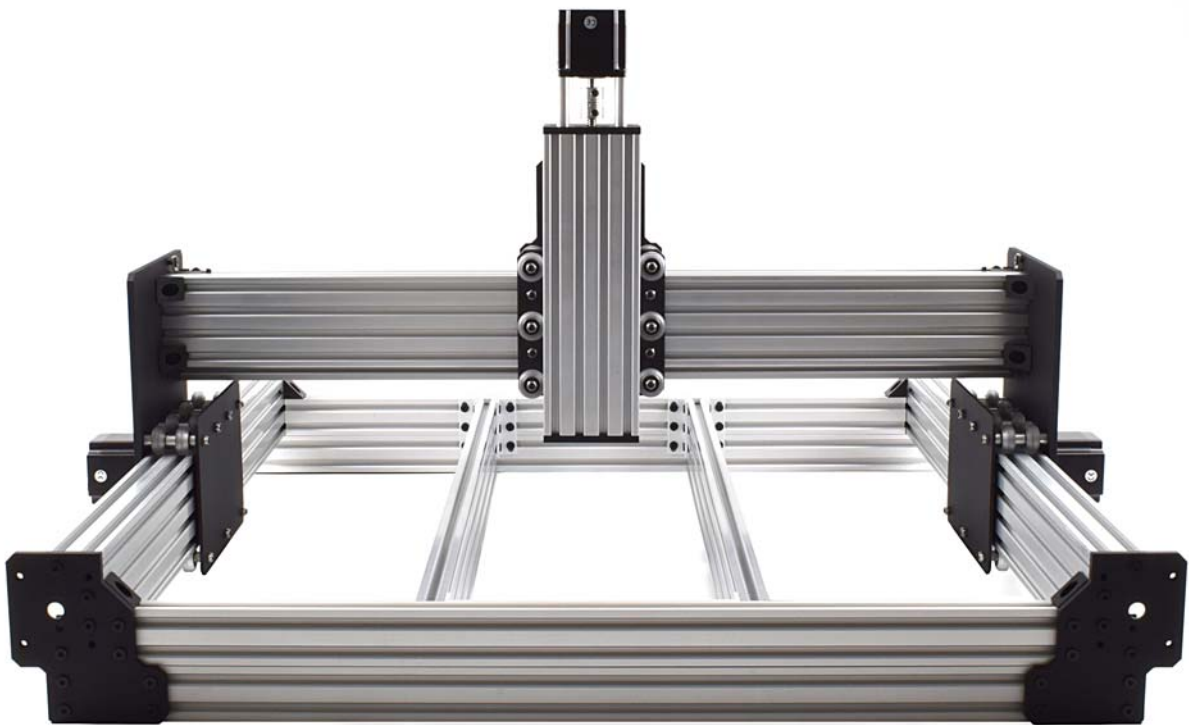


# WorkBee CNC

## Mechanical Assembly Instructions - Belt Driven





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# 1.0 Getting Started

## **1.1 About The Kit**

The WorkBee CNC is an offspring of the OX CNC Machine, our first venture into the hobby CNC Market. After that launch, we received a lot of feedback and customization requests, but many of these ideas were hard to incorporate into the existing design. Therefore we designed the WorkBee from the ground up to be the CNC Machine that everyone wanted - after you build and use the machine we hope that it is the machine you have always wanted, too!

The WorkBee wouldn't be possible without Mark Carew, Openbuilds, and the community that has spawned from this. The Openbuilds site has been a hub of discussion for our OX CNC Machine, and this is sure to continue with the WorkBee.

## **1.2 Check Product Contents**

The first thing you should do when you receive your kit is to check the contents against the list in Appendix A. For small parts, a few extra spares have been included. If anything is missing or damaged (or you have any other problems), please contact us at [sales@ooznest.co.uk](mailto:sales@ooznest.co.uk), and we will aim to resolve the issue as quickly as possible.

## **1.3 Tools Required**

The list below shows the main tools that are required to complete this build:

- 2.5mm Allen Key
- 4.0mm Allen Key
- 8.0mm Spanner
- Scissors or Wire Cutters

## **1.4 Notes on Assembly**

We recommend that you read through the whole manual before beginning the build, as this enables you to get a rough idea of how it all goes together. Before starting each step make sure you have studied the diagram and fully understand what you are doing. A PDF version of the manual is available on our website, allowing you to zoom in on the diagrams if needed.

When attaching parts, make sure they are properly squared and aligned, and everything should easily fit together. If a part is requiring significant force to attach, stop, take it off, re-read the instructions, and try again. Do not over tighten bolts, as you may strip the threads.

If you forget to insert a Tee-Nut when instructed, there is no need to undo any of the work you have done. We have included spare M5-Drop-In-Tee-Nuts in the kit for this situation. M5-Drop-In-Tee-Nuts do not have to be inserted from the end of the extrusion - simply place them in the V-Slot, then screw in the bolt. This will turn them, and engage them into the underside of the V-Slot.

This manual has been written for the construction of a 750 x 750mm belt driven version of the WorkBee. If you have a larger version, everything is exactly the same, except you will be working with longer V-Slot extrusions. Use the table below to convert the dimensions in this manual to the sizes for your machine.

### **Machine Size**

<u>500x750mm</u>	<u>750x750mm</u>	<u>750x1000mm</u>	<u>1000x1000mm</u>	<u>1000x1500mm</u>	<u>1500x1500mm</u>
20x40x415mm	20x40x665mm	20x40x665mm	20x40x915mm	20x40x915mm	20x40x1415mm
20x40x495mm	20x40x745mm	20x40x745mm	20x40x995mm	20x40x995mm	20x40x1495mm
20x40x500mm	20x40x750mm	20x40x750mm	20x40x1000mm	20x40x1000mm	20x40x1500mm
20x80x710mm	20x80x710mm	20x80x960mm	20x80x960mm	20x80x1460mm	20x80x1460mm
C-Beam-250mm	C-Beam-250mm	C-Beam-250mm	C-Beam-250mm	C-Beam-250mm	C-Beam-250mm
X-Axis C-Beam-500mm	X-Axis C-Beam-750mm	X-Axis C-Beam-750mm	X-Axis C-Beam-1000mm	X-Axis C-Beam-1000mm	X-Axis C-Beam-1500mm
Y-Axis C-Beam-750mm	Y-Axis C-Beam-750mm	Y-Axis C-Beam-1000mm	Y-Axis C-Beam-1000mm	Y-Axis C-Beam-1500mm	Y-Axis C-Beam-1500mm

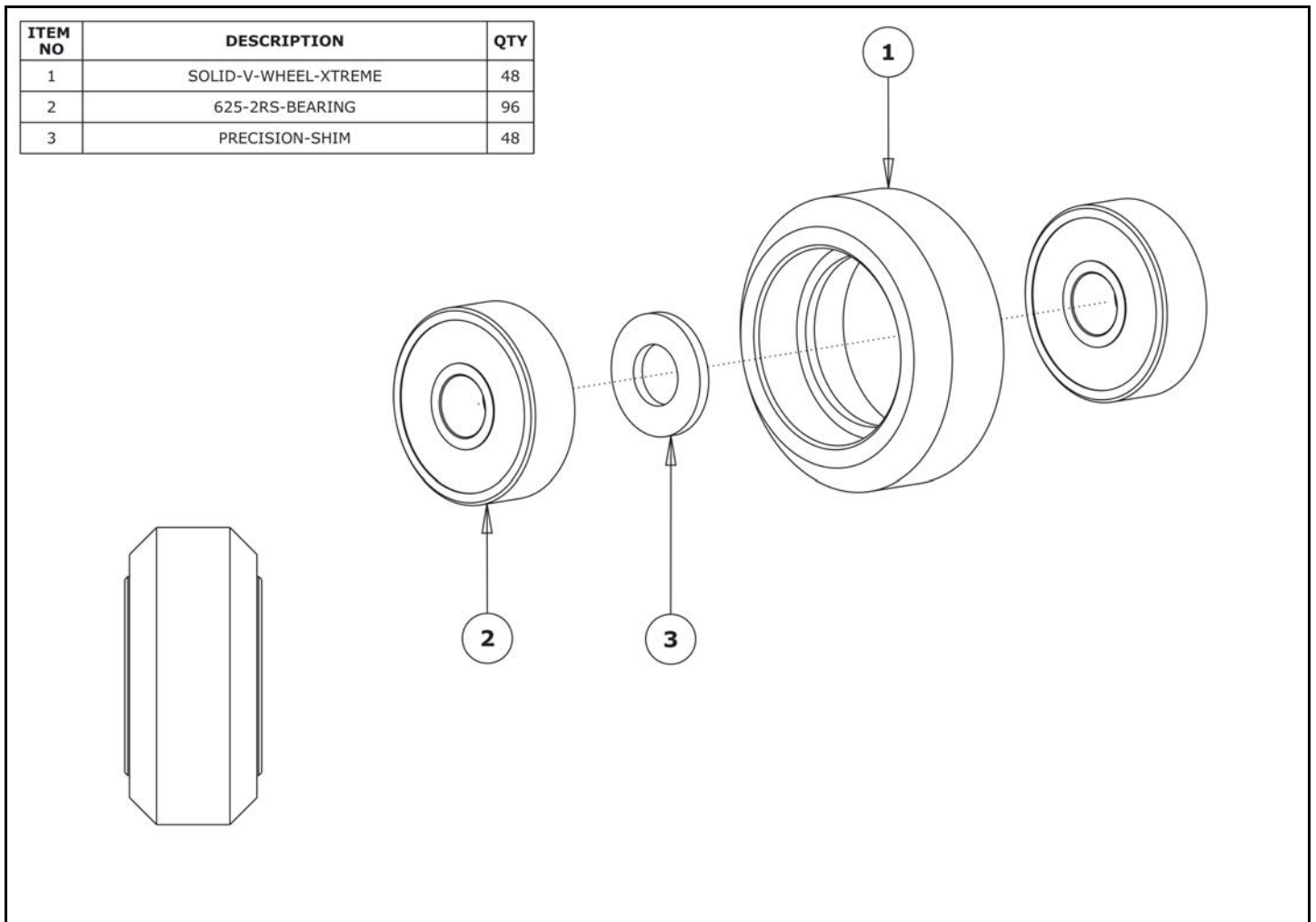
The WorkBee has two methods of supporting the spoiler board. Method 2 has the spoiler board 40mm lower than Method 1. With Method 1, the maximum depth of material that can be cut the whole way through is 27.0mm. If this is adequate for the intended use then stick with Method 1. If greater than 27.0mm cut depth is needed, then choose Method 2, which has 47.0mm of cut depth. Choosing Method 2 will give you 20mm of extra cut depth, however the Z-Axis will have to reach down further to cut thinner materials, so accuracy will be lost. These calculations are based on a 12mm spoiler board.

With Method 1, the extrusions rest directly on the work bench, so they are supported along their length. With Method 2 they are not resting on the workbench, instead they span from front to back. With Method 2 there will be two spare extrusions that can be used to support the spoiler board as seen in Section 2.7.3. Machine sizes with an X-Axis of 1000mm or greater have more than two spoiler board supports, therefore there will be 1 or 2 spoiler board support extrusions that you cannot carry out the process detailed in Section 2.7.3. We recommend placing the supported spoiler board supports down the middle, and the unsupported ones along the outer edge of the machine.

# 2.0 Assembly

## 2.1 Wheel Assembly

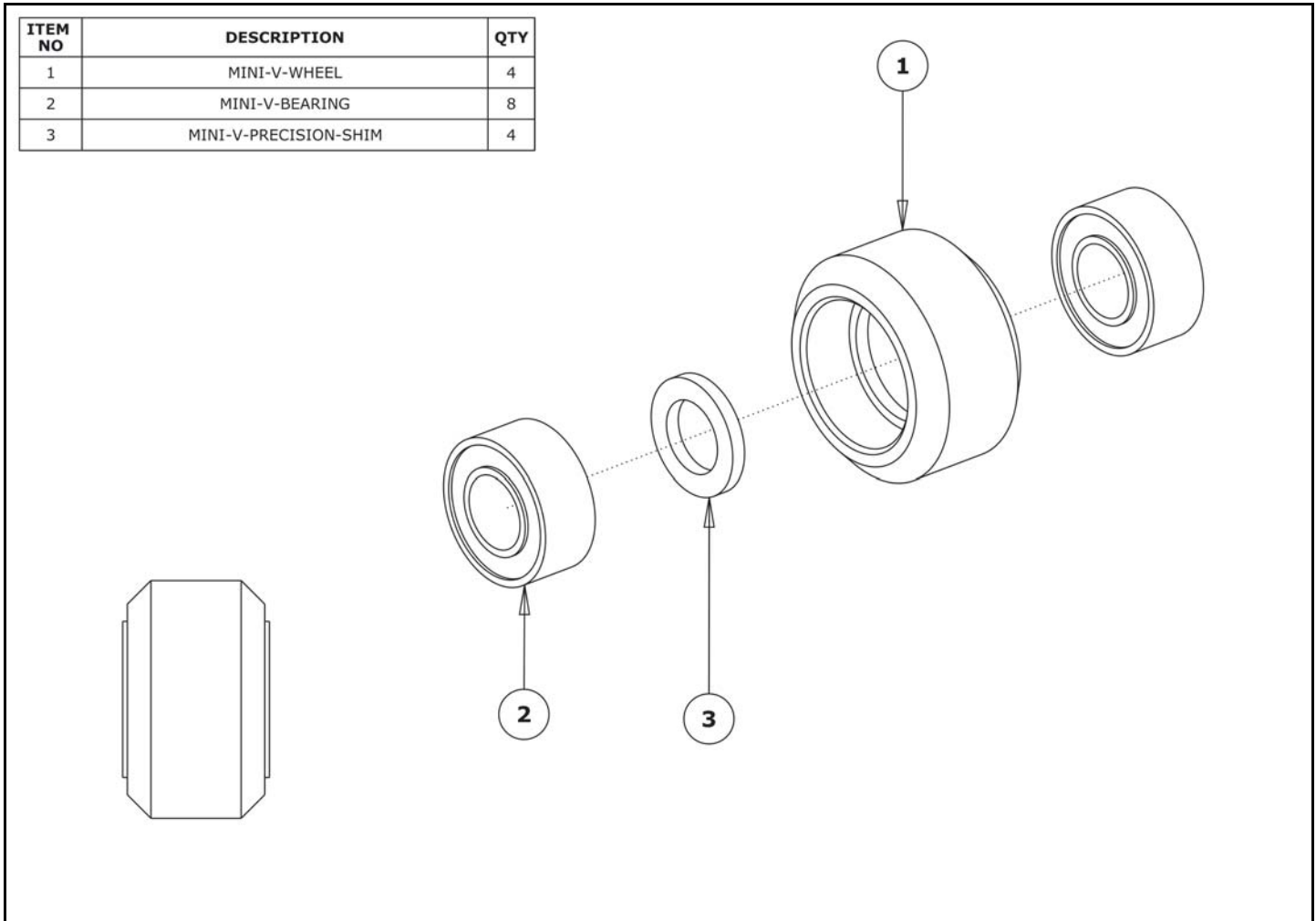
### 2.1.1 Solid V Xtreme Wheel Assembly



- A.** From the Solid-V-Wheel-Xtreme-Kit packet, with a Precision-Shim in between, insert a 625-2RS-Bearing into either side of the Solid-V-Wheel-Xtreme.
- B.** Repeat this for 48 Solid-V-Wheel-Xtreme-Kits. 49 kits are provided, do not assemble the spare one, this can be used for parts if any of the other packets are missing anything.
- C.** There will be 48 x Precision-Shims left over from the Solid-V-Wheel-Xtreme-Kits, these can be added to the Precision-Shim packet in the 'Brackets & Spacers' box for use later. The left over nuts in the Solid-V-Wheel-Xtreme-Kit packets can be discarded.



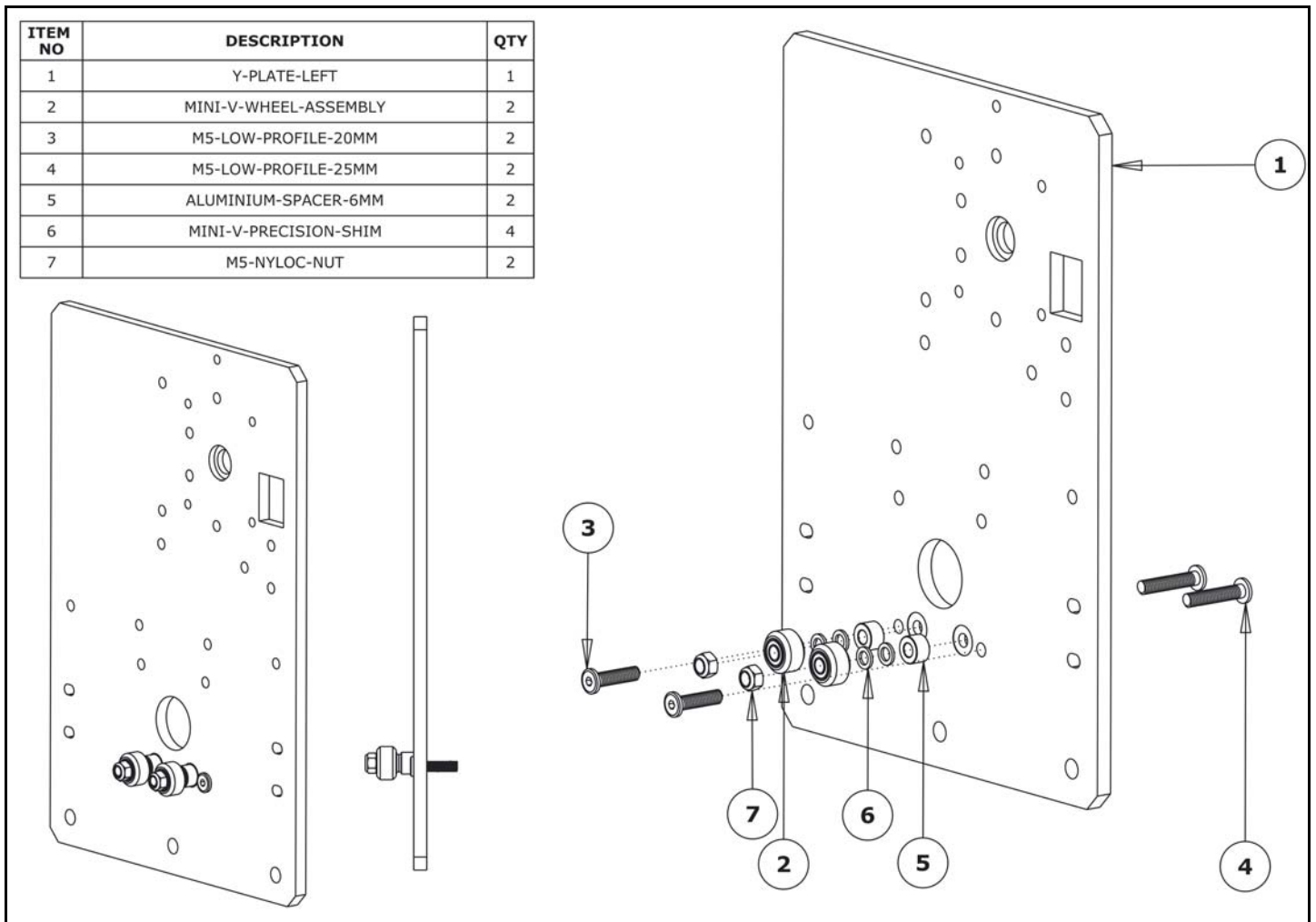
## 2.1.2 Mini V Wheel Assembly



- A. From the Mini-V-Wheel-Kit packet, with a Mini-V-Precision-Shim in between, insert a Mini-V-Bearing into either side of the Mini-V-Bearing.
- B. Repeat this for all 4 Mini-V-Wheel-Kits.
- C. There will be 4 x Mini-V-Precision-Shims left over in the Mini-V-Wheel-Kits, these can be added to the Mini-V-Precision-Shim packet in the 'Brackets & Spacers' box for use later. The left over nuts in the Mini-V-Wheel-Kit packet can be discarded.

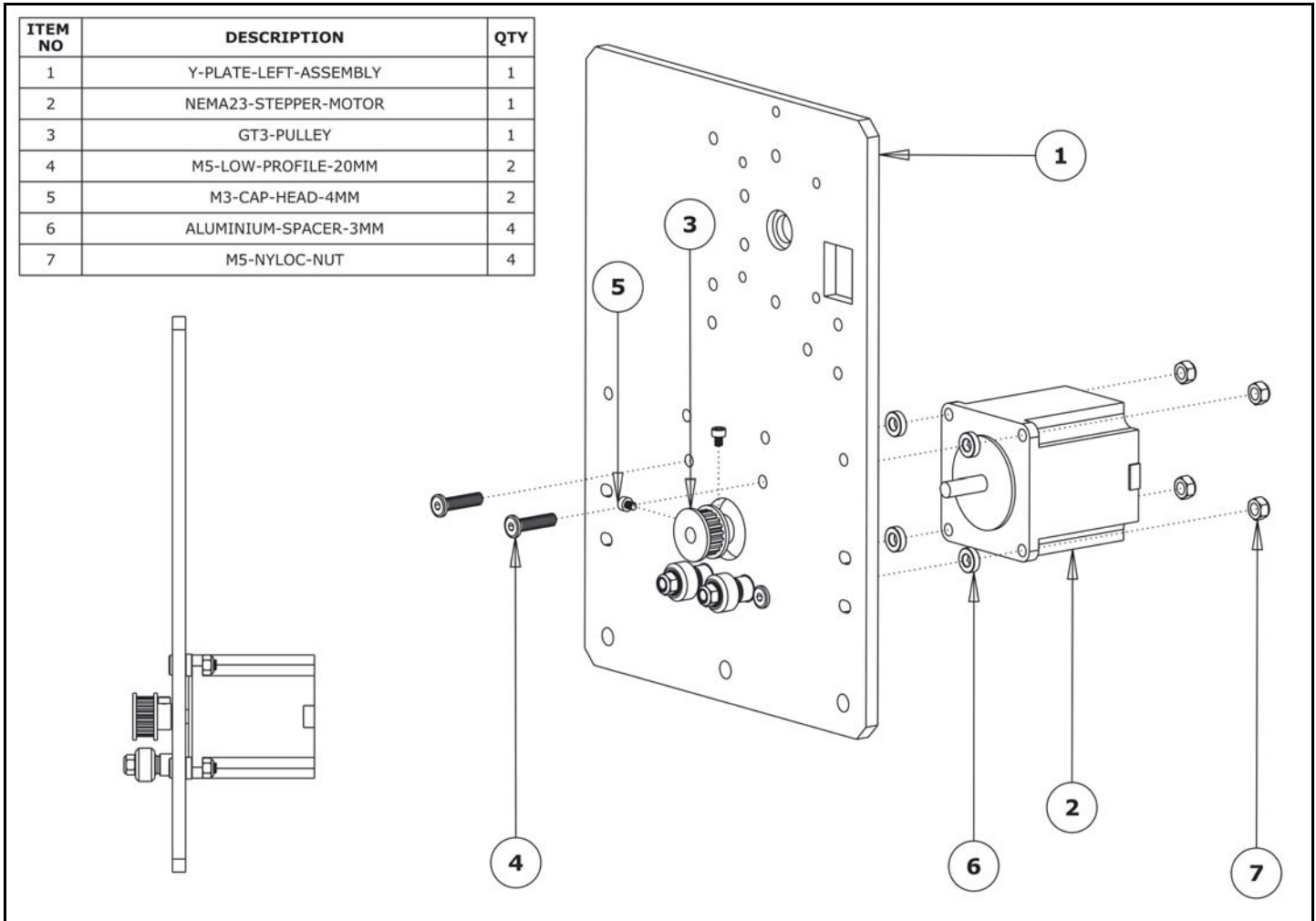
## 2.2 Y-Plate Assembly

### 2.2.1 Belt Idlers



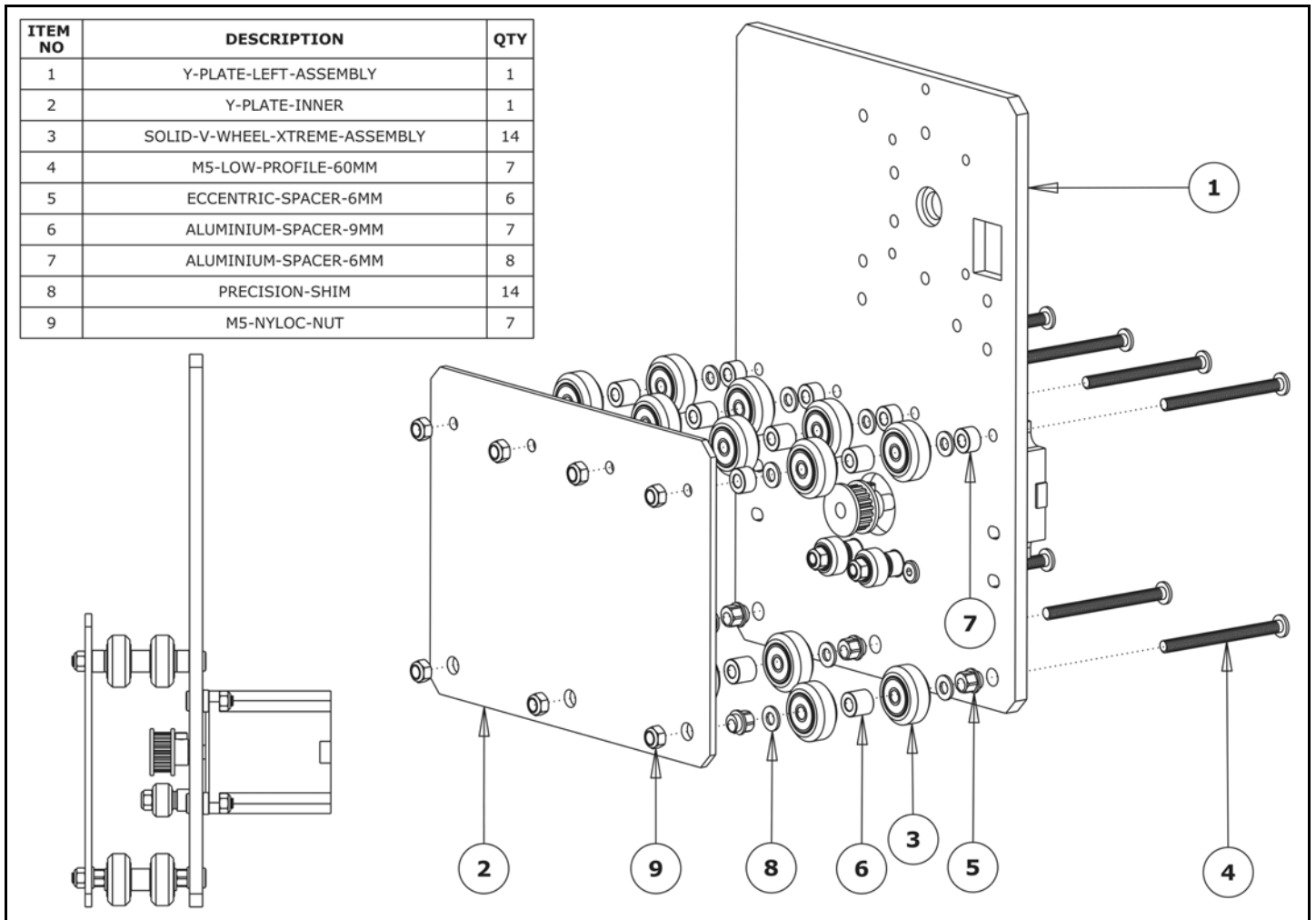
- A.** With the Y-Plate-Left in the orientation seen above, insert 2 x M5-Low-Profile-25mm Bolts from the back side through the only two holes that are inset.
- B.** Next to each M5-Low-Profile-25mm bolt in Step A, you can see that there is a non-inset hole. From the front, insert a M5-Low-Profile-20mm Bolt through each of these holes. These M5-Low-Profile-20mm Bolts will be used in the next section to attach the NEMA23-Stepper-Motor.
- C.** On to each M5-Low-Profile-25mm bolt in Step A, place 1 x Aluminium-Spacer-6mm, 2 x Mini-V-Precision-Shims, 1 x Mini-V-Wheel-Assembly and a 1 x M5-Nyloc-Nut in this order. Tighten the whole assembly; insure that the Mini-V-Wheels still spin freely.

## 2.2.2 Stepper Motor



- A.** Attach a NEMA23-Stepper-Motor to the Y-Plate-Left using 4 x M5-Low-Profile-20mm Bolts (two should have been already inserted in Step 2.2.1.B) and 4 x M5-Nyloc-Nuts. Make sure you place an Aluminium-Spacer-3mm in-between the NEMA23-Stepper-Motor and the Y-Plate-Left on each M5-Low-Profile-20mm Bolt. The NEMA23-Stepper-Motor should be orientated so that the wire side is facing towards the back of the Y-Plate-Left (the side closest to the small rectangle opening).
- B.** Attach a GT3-Pulley to the NEMA23-Stepper-Motor shaft using 2 x M3-Cap-Head-4mm Bolts. One of these bolts should be tightened on to the flat portion of the NEMA23-Stepper-Motor shaft. The toothed section of the GT3-Pulley should be centralized to the Mini-V-Wheel-Assembly's attached in Step 2.2.1.C.

## 2.2.3 Y Wheels & Y-Plate-Inner

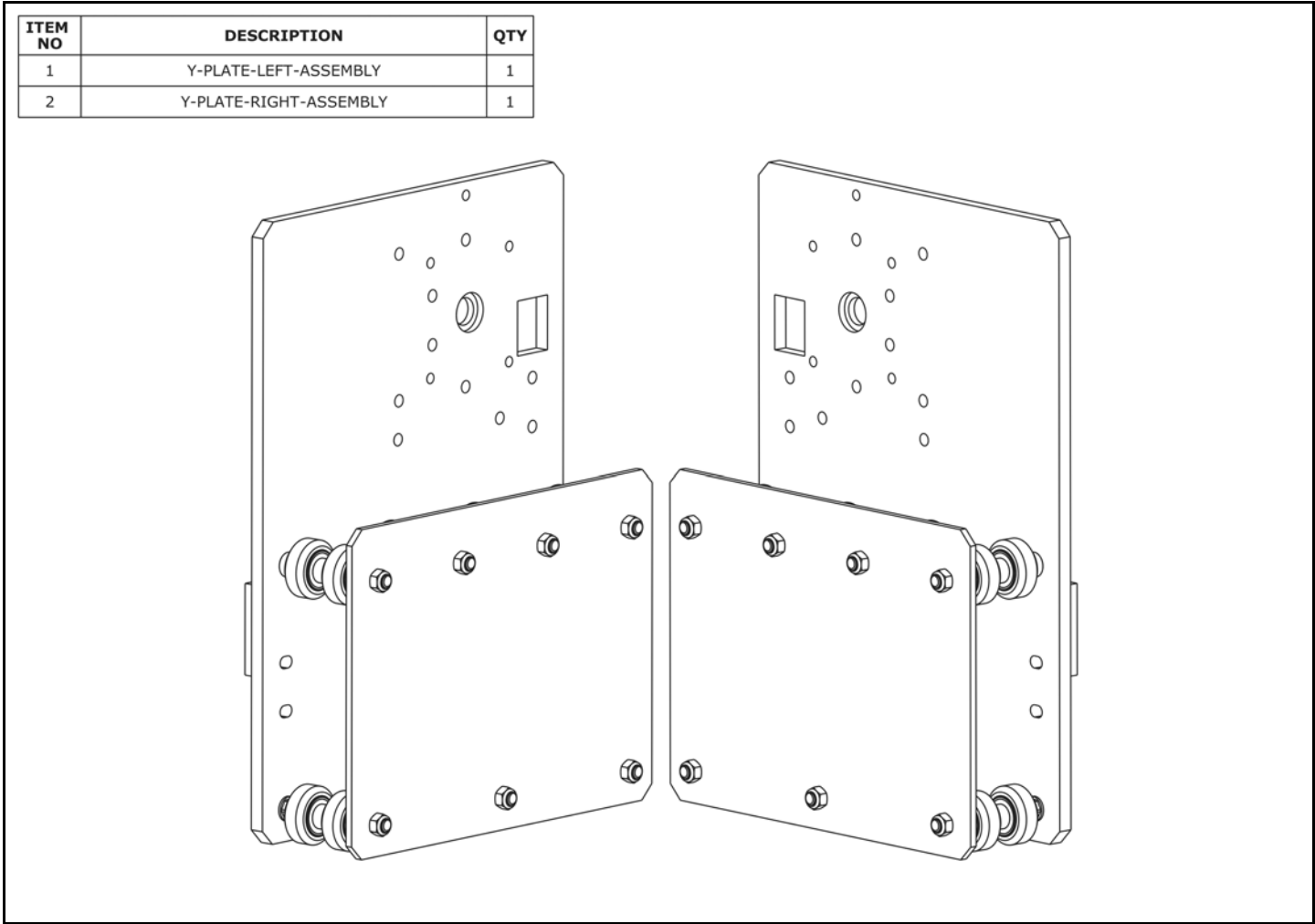


- A. First attach the bottom right wheel set - insert a M5-Low-Profile-60mm bolt through the Y-Plate-Left-Assembly from the back. On to this bolt, add an Eccentric-Spacer-6mm, Precision-Shim, Solid-V-Wheel-Xtreme-Assembly, Aluminium Spacer-9mm, Solid-V-Wheel-Xtreme-Assembly, Precision Shim, and a Eccentric-Spacer-6mm in this order. Next, add a Y-Plate-Inner onto the top of this assemblage, and then slightly thread on a M5-Nyloc-Nut. The rounded portion of the Eccentric-Spacer-6mm should be inserted into the hole on either the Y-Plate-Left-Assembly or Y-Plate-Inner (depending on which side it is on).
- B. Repeat Step A for the other two wheel sets on the bottom row. For the top row, repeat Step A for the 4 wheel sets, however for these sets use Aluminium-Spacer-6mms instead of Eccentric-Spacer-6mms.
- C. Once all of the wheels are attached the M5-Nyloc-Nuts can be tightened down. Ensure that the Solid-V-Xtreme-Wheels can still rotate freely. On the hexagonal portion of the Eccentric-Spacer-6mm, there will be one face that is marked with '6mm'. Using a spanner, adjust each Eccentric-Spacer-6mm so that this face is facing downwards. Doing this maximizes the gap between the top and bottom row of wheels.
- D. Run any piece of C-Beam extrusion in between the two rows of wheels. Initially, the C-Beam will wobble between the wheels. Turn the assembly upside down so the C-Beam is sitting on the row of wheels with the Aluminium-Spacer-6mms. Starting with an outside pair of wheels, adjust both Eccentric-Spacer-6mms down onto the C-Beam Extrusion until there is a small amount of friction between both wheels and the C-Beam Extrusion. When adjusting the pair of Eccentric-Spacer-6mms ideally they should be adjusted identically. However, sometimes one will need to be adjusted

slightly more than the other to get both wheels engaged with the C-Beam extrusion. Repeat this for the other outside pair of wheels, and then again for the middle pair.

- E.** Slide the C-Beam extrusion back and forth through the wheels. This should require a small amount of force, and all wheels should spin as it rolls. Also check there is no wobbling of the extrusion. Once happy, double check the tightness of the M5-Nyloc-Nuts.

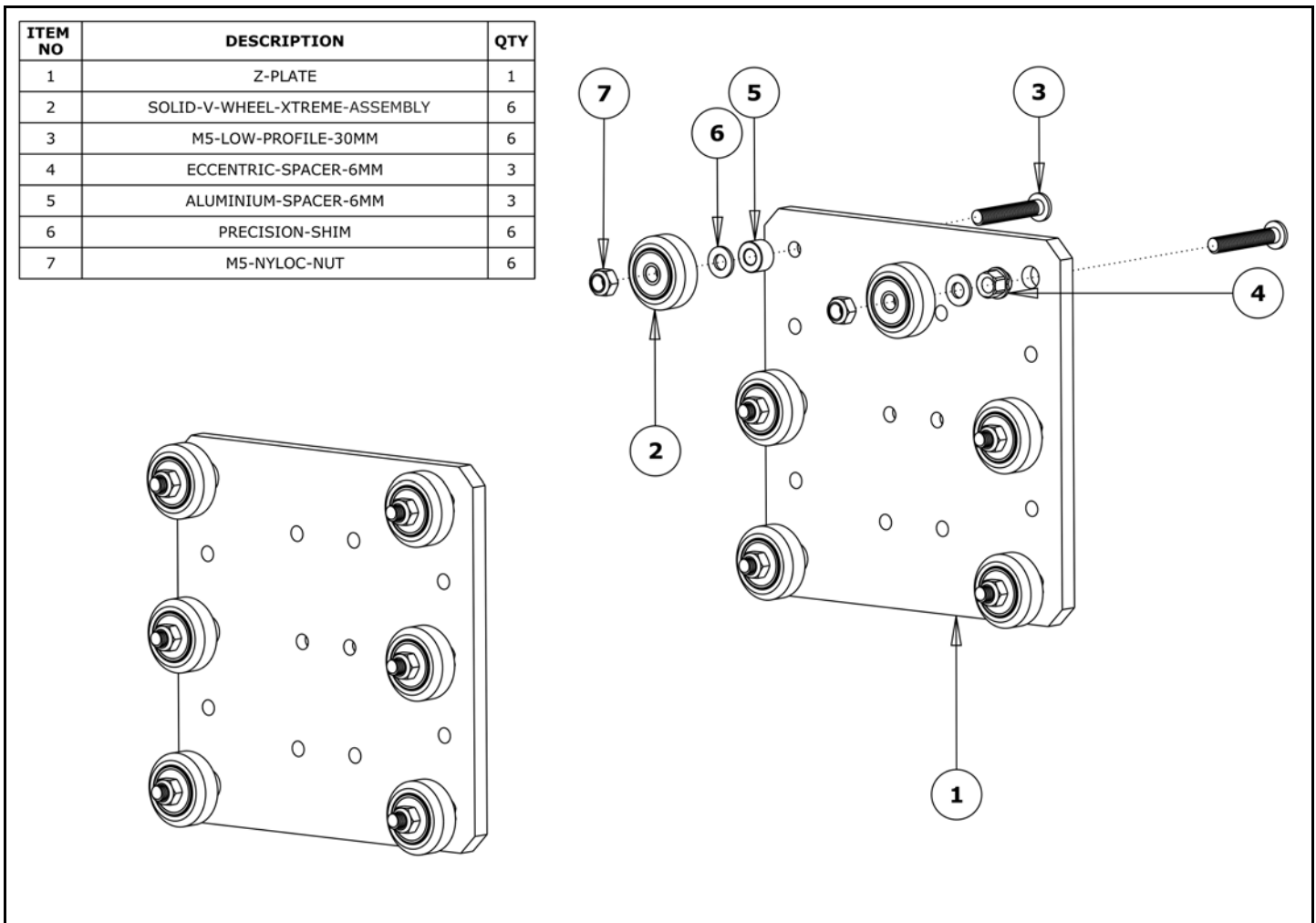
2.2.4 Repeat



A. Repeat Section 2.2 for the Y-Plate-Right. As seen above, it should be a mirror image of the Y-Plate-Left-Assembly.

## 2.3 X-Carriage Assembly

### 2.3.1 Z Wheels

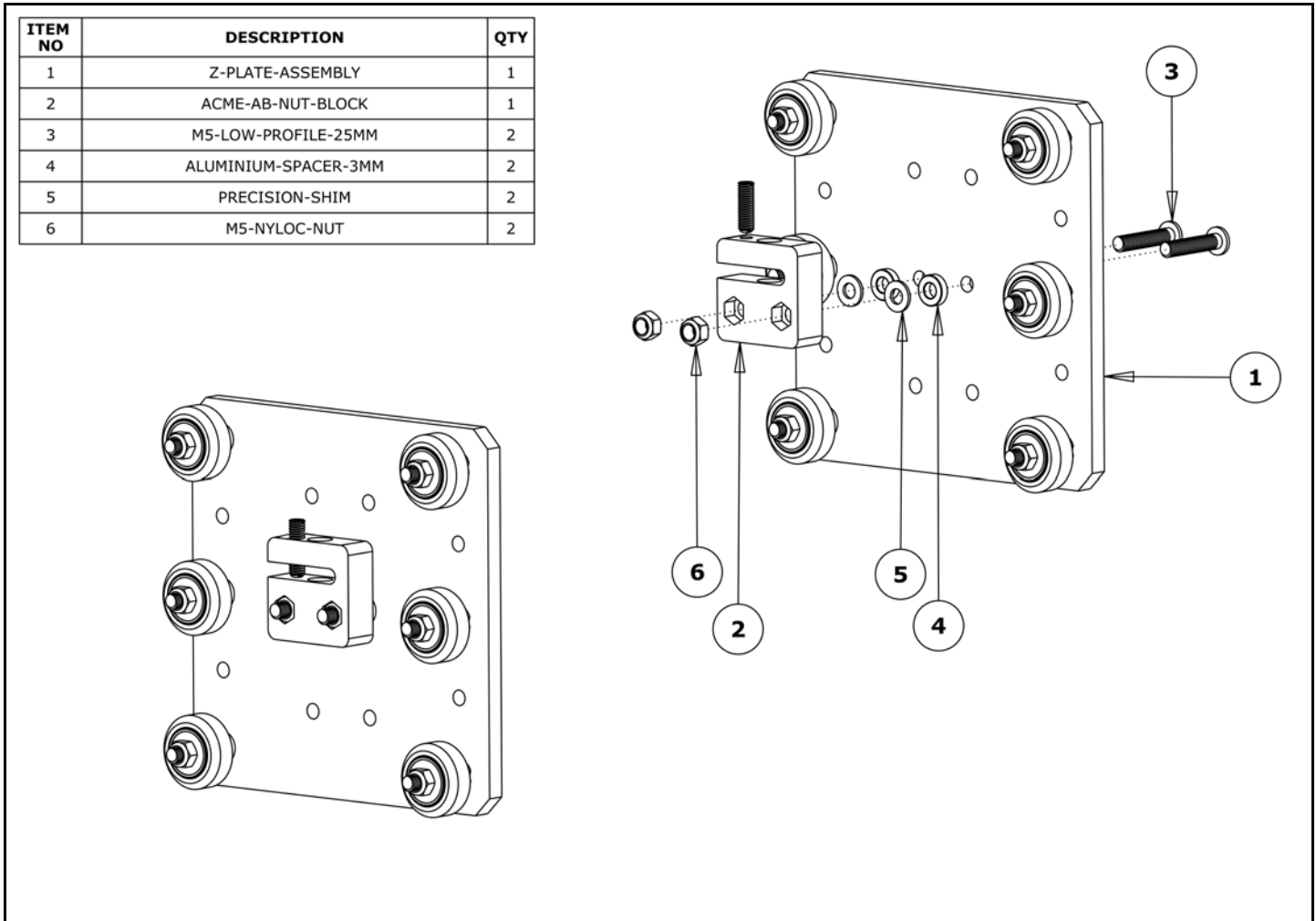


- First attach the top right wheel, insert a M5-Low-Profile-30mm through the Z-Plate from the back (the back is the side with the insets). On to this, add an Eccentric-Spacer-6mm, Precision-Shim, Solid-V-Wheel-Xtreme-Assembly and a M5-Nyloc-Nut in this order. The rounded portion of the Eccentric-Spacer-6mm should be inserted into the hole on the Z-Plate. The assembly can be tightened, ensuring the Solid-V-Xtreme-Wheel can still rotate freely.
- Repeat Step A for the other two wheels on the right row. Repeat Step A for the 3 wheel sets on the left row, however for these sets use Aluminium-Spacer-6mms instead of Eccentric-Spacer-6mms.
- On the hexagonal portion of the Eccentric-Spacer-6mm, there will be one face that is marked with '6mm'. Using a spanner, adjust each Eccentric-Spacer-6mm so that this face is facing to the right. Doing this maximizes the gap between the left and right row of wheels.
- Run any piece of C-Beam extrusion in between the two rows of wheels. Initially the C-Beam will wobble between the wheels. Turn the assembly so the C-Beam is sitting on the row of wheels with the Aluminium-Spacer-6mms. Starting with an outside wheel, adjust the Eccentric-Spacer-6mm down onto the C-Beam Extrusion until there is a small amount of friction between the wheel and the C-Beam Extrusion. Repeat this for the other outside wheel, and then for the middle wheel.

- E. Slide the C-Beam extrusion back and forth through the wheels. This should require a small amount of force, and all wheels should spin as it rolls. Also check there is no wobbling of the extrusion. Once happy, double check the tightness of the M5-Nyloc-Nuts.

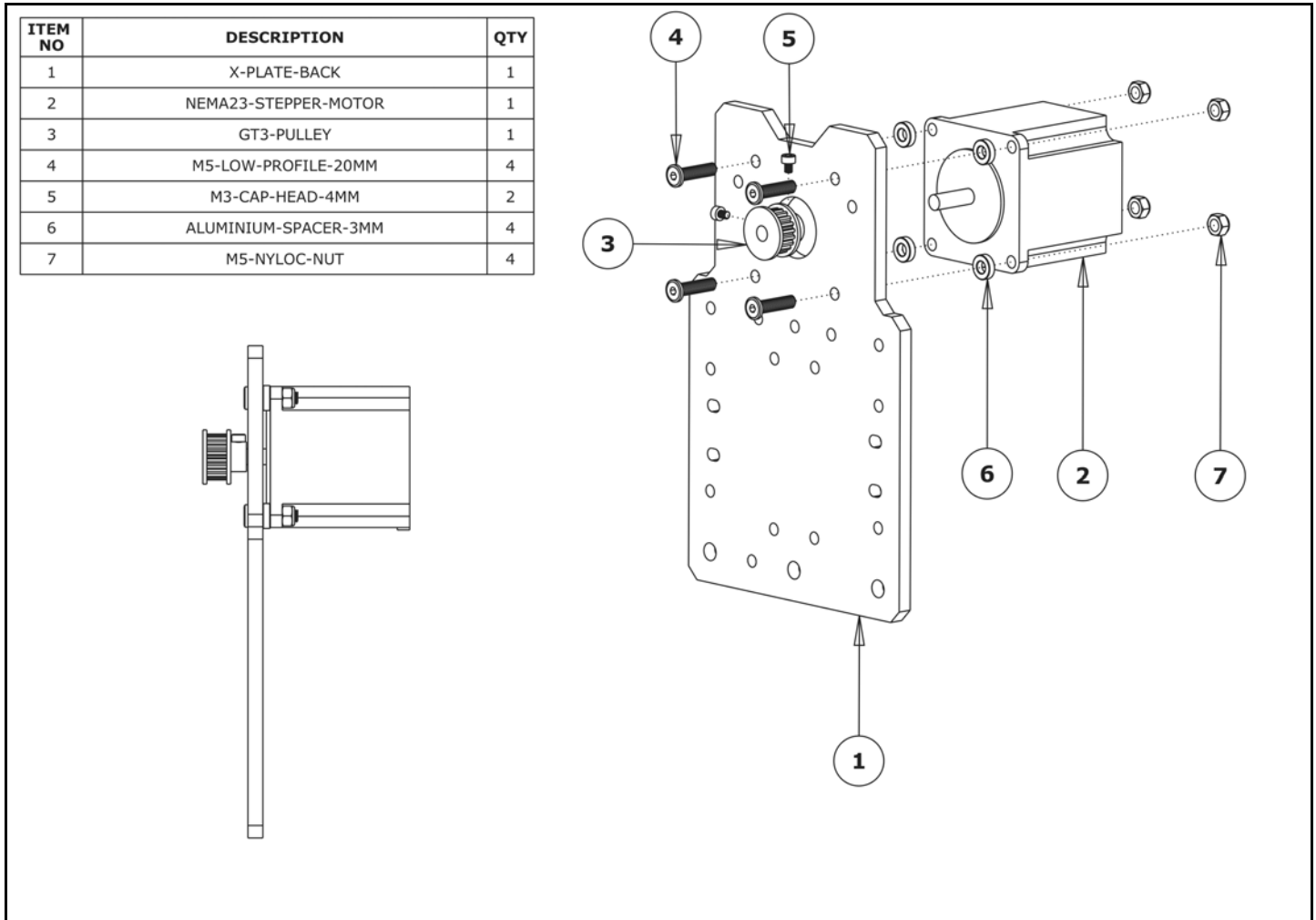


### 2.3.2 ACME Nut Block



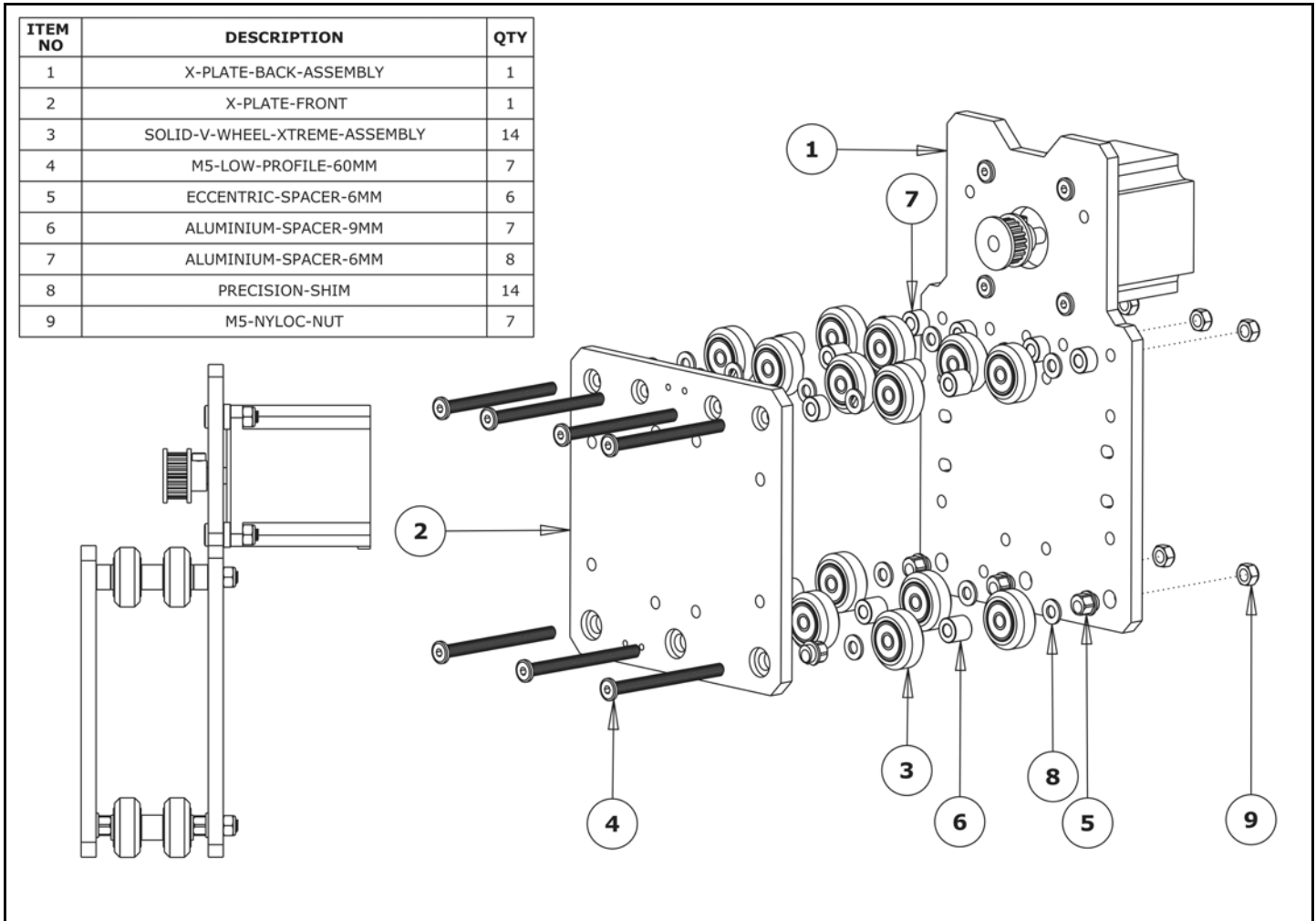
- A.** Attach the ACME-AB-Nut-Block to the Z-Plate using 2 x M5-Low-Profile-25mm bolts. In-between the ACME-AB-Nut-Block and Z-Plate on each bolt there should be an Aluminium-Spacer-3mm and a Precision-Shim.
- B.** With the set screw provided with the ACME-AB-Nut-Block, screw it into the smaller threaded hole on the top until it is just before the point of touching the surface on the opposite side of the gap. The set screw will later be used to remove any back lash from the system.

### 2.3.3 X Stepper Motor



- A.** Attach a NEMA23-Stepper-Motor to the X-Plate-Back using 4 x M5-Low-Profile-20mm Bolts and 4 x M5-Nyloc-Nuts. Make sure you place an Aluminium-Spacer-3mm in-between the NEMA23-Stepper-Motor and the X-Plate-Back on each M5-Low-Profile-20mm Bolt. The NEMA23-Stepper-Motor should be orientated so the side that the wire is coming from is facing downwards.
- B.** Attach a GT3-Pulley to the NEMA23-Stepper-Motor shaft using 2 x M3-Cap-Head-4mm Bolts. One of these bolts should be tightened on to the flat portion of the NEMA23-Stepper-Motor shaft. The final position of the GT3-Pulley along the shaft will be adjusted later.

### 2.3.4 X Wheels & X-Plate-Front

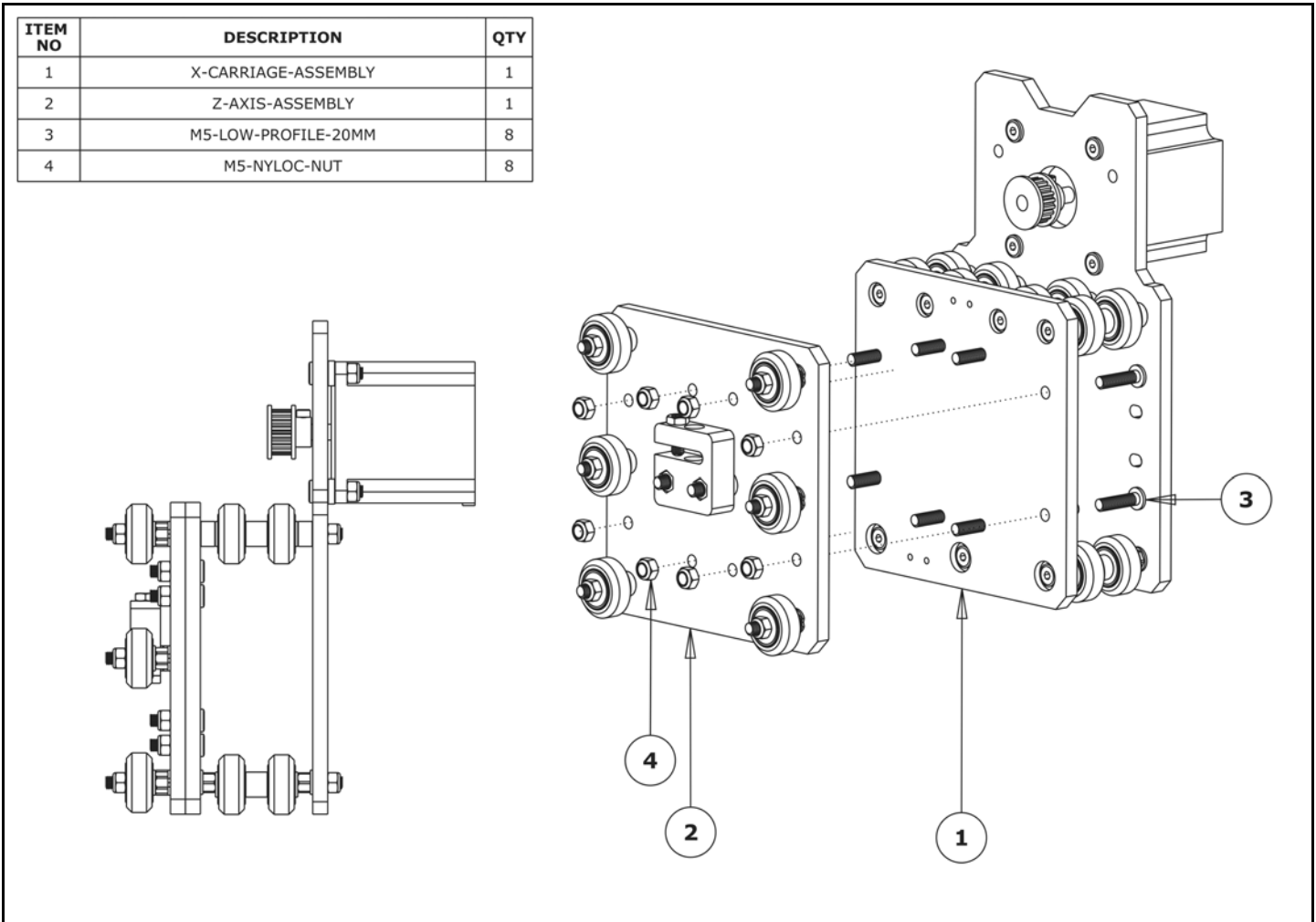


- A.** If you have the full kit version of the WorkBee, now would be a good time to complete Section 2.1.2 of the Assemble Limit Switches & Route Wires manual under the Electronics Assembly heading on this page: [https://learn.ooznest.co.uk/c/Assembling\\_Your\\_WorkBee](https://learn.ooznest.co.uk/c/Assembling_Your_WorkBee). Access to the threaded holes is much easier now before the plate is assembled.
- B.** First attach the bottom right wheel set - insert a M5-Low-Profile-60mm bolt through the X-Plate-Front through the side with the insets. On to this, add an Eccentric-Spacer-6mm, Precision-Shim, Solid-V-Wheel-Xtreme-Assembly, Aluminium Spacer-9mm, Solid-V-Wheel-Xtreme-Assembly, Precision Shim, and an Eccentric-Spacer-6mm in this order. Next add the X-Plate-Back-Assembly onto the top of this assemblage, and then slightly thread on a M5-Nyloc-Nut. The rounded portion of the Eccentric-Spacer-6mm should be inserted into the hole on either the X-Plate-Front or X-Plate-Back-Assembly (depending on which side it is on).
- C.** Repeat Step A for the other two wheel sets on the bottom row. For the top row, repeat Step A for the 4 wheel sets, however for these sets use Aluminium-Spacer-6mms instead of Eccentric-Spacer-6mms.
- D.** Once all of the wheels are attached the M5-Nyloc-Nuts can be tightened down. Ensure that the Solid-V-Xtreme-Wheels can still rotate freely. On the hexagonal portion of the Eccentric-Spacer-6mm, there will be one face that is marked with '6mm'. Using a spanner, adjust each Eccentric-Spacer-6mm so that this face is facing downwards. Doing this maximizes the gap between the top and bottom row of wheels.
- E.** Run any piece of C-Beam extrusion in between the two rows of wheels. Initially, the C-Beam will wobble between the wheels. Turn the assembly upside down so the C-Beam

is sitting on the row of wheels with the Aluminium-Spacer-6mms. Starting with an outside pair of wheels, adjust both Eccentric-Spacer-6mms down onto the C-Beam Extrusion until there is a small amount of friction between both wheels and the C-Beam Extrusion. When adjusting the pair of Eccentric-Spacer-6mms ideally they should be adjusted identically. However, sometimes one will need to be adjusted slightly more than the other to get both wheels engaged with the C-Beam extrusion. Repeat this for the other outside pair of wheels, and then again for the middle pair.

- F. Slide the C-Beam extrusion back and forth through the wheels. This should require a small amount of force, and all wheels should spin as it rolls. Also check there is no wobbling of the extrusion. Once happy, double check the tightness of the M5-Nyloc-Nuts.

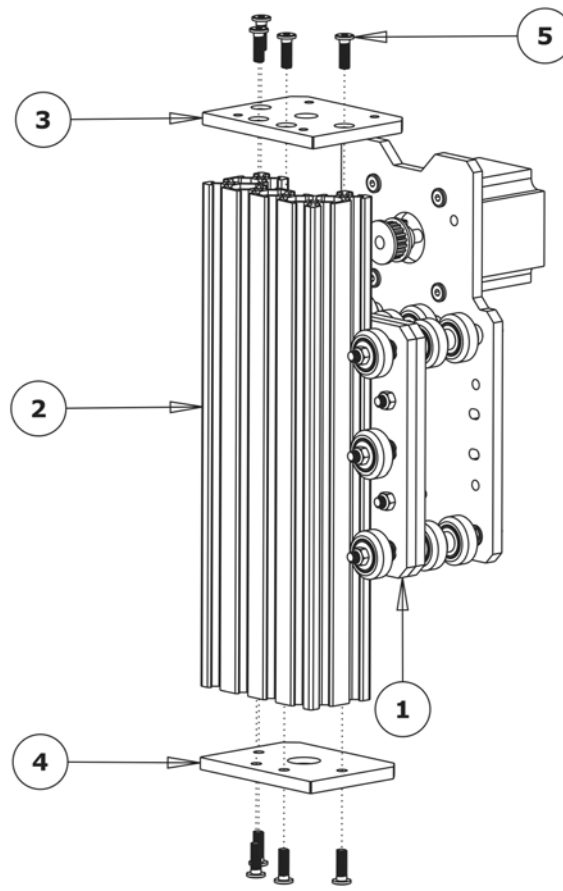
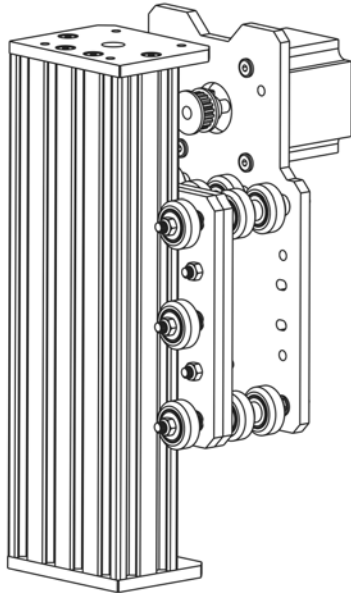
## 2.3.5 X & Z Mating



- A.** Mate the Z-Plate-Assembly to the X-Carriage-Assembly in the orientation seen above. Use 8 x M5-Low-Profile-20mm bolts and 8 x M5-Nyloc-Nuts to secure the two assemblies together. Make sure the Z-Plate-Assembly is square to the X-Carriage-Assembly. The allen key can be inserted through access holes on the X-Plate-Back to gain access to the bolt heads.

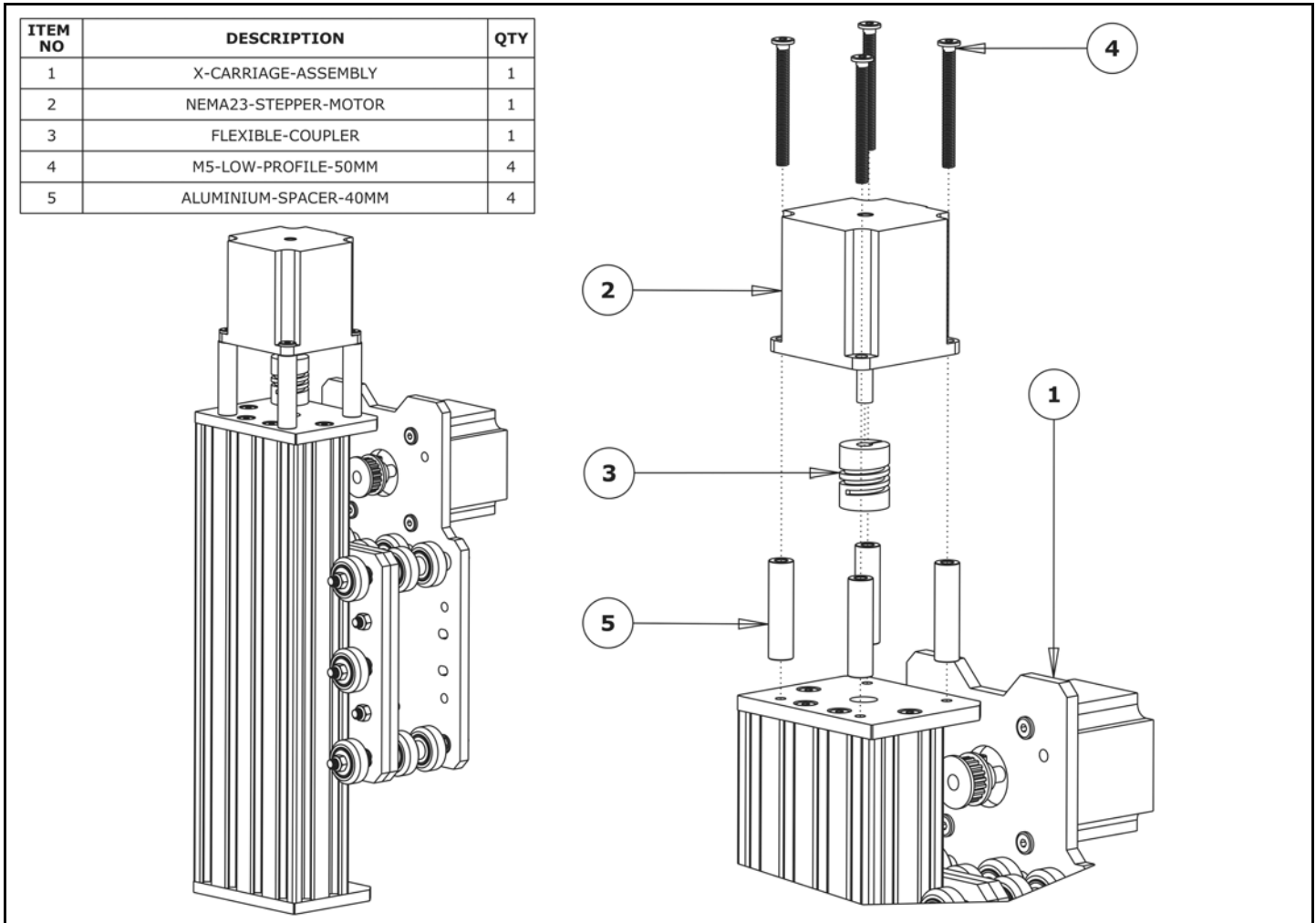
## 2.3.6 Z Extrusion

ITEM NO	DESCRIPTION	QTY
1	X-CARRIAGE-ASSEMBLY	1
2	C-BEAM-250MM	1
3	Z-END-MOUNT-MOTOR	1
4	Z-END-MOUNT-BOTTOM	1
5	M5-LOW-PROFILE-15MM	8



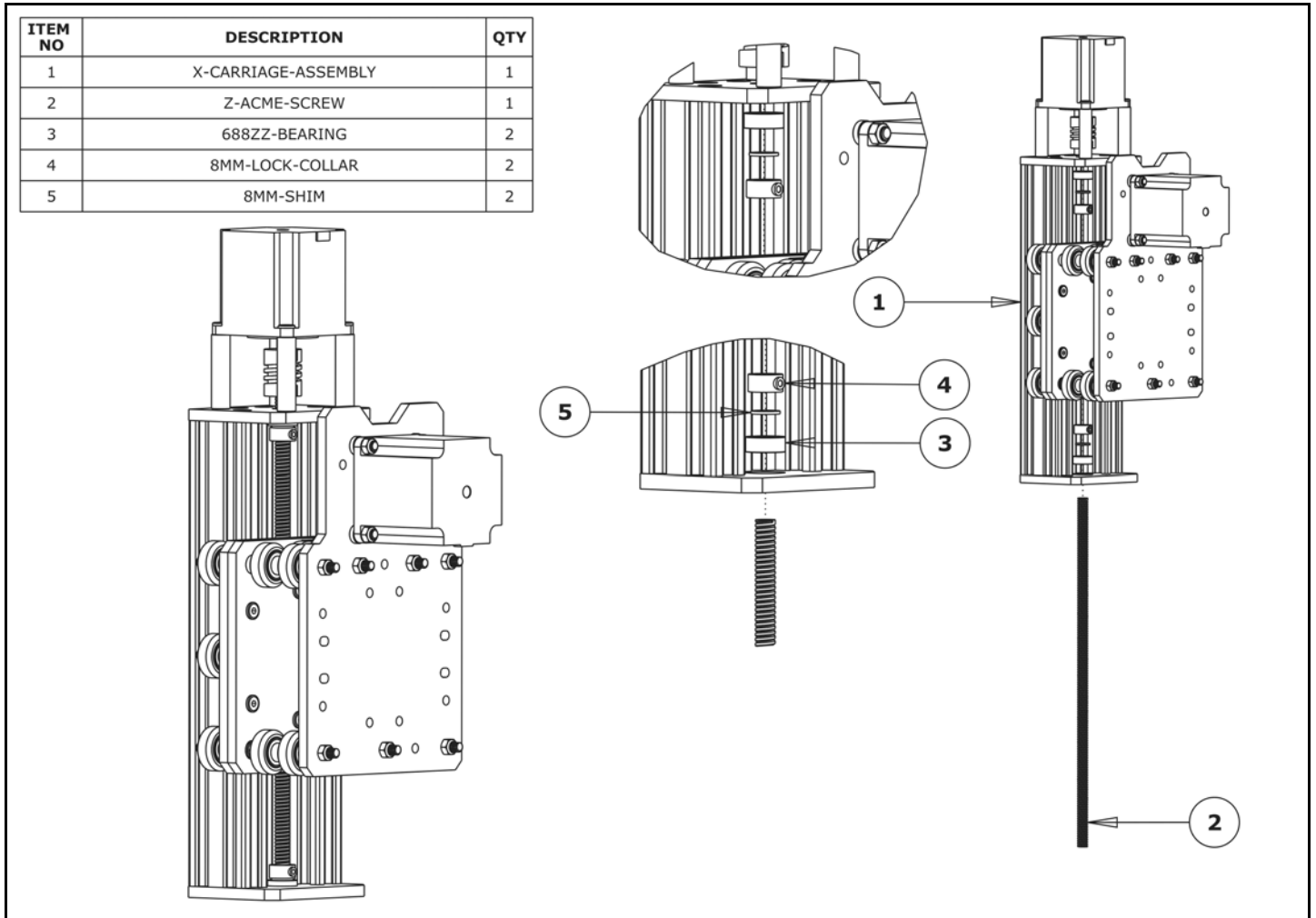
- A.** Slide the C-Beam-250mm through the Z-Wheels on the X-Carriage-Assembly. Attach the Z-End-Mount-Motor and Z-End-Mount-Bottom using 8 x M5-Low-Profile-15mm bolts. Tighten the Z-End-Mount-Motor bolts fully. For the Z-End-Mount-Bottom, tighten the bolts fully, and then loosen by a single full turn (the reason for this will become clear later).

### 2.3.7 Z Stepper Motor



- A. Slide the 1/4" side (the side with the smallest hole) of the Flexible-Coupler onto the shaft of the NEMA23-Stepper-Motor. Don't tighten it down at this point.
- B. Attach the NEMA23-Stepper-Motor to the threaded holes on the Z-End-Mount-Motor using 4 x M5-Low-Profile-50mm bolts and 4 x Aluminium-Spacer-40mm's. Orient the NEMA23-Stepper-Motor so that the wire is towards the back of the X-Carriage-Assembly.

### 2.3.8 Z ACME Screw



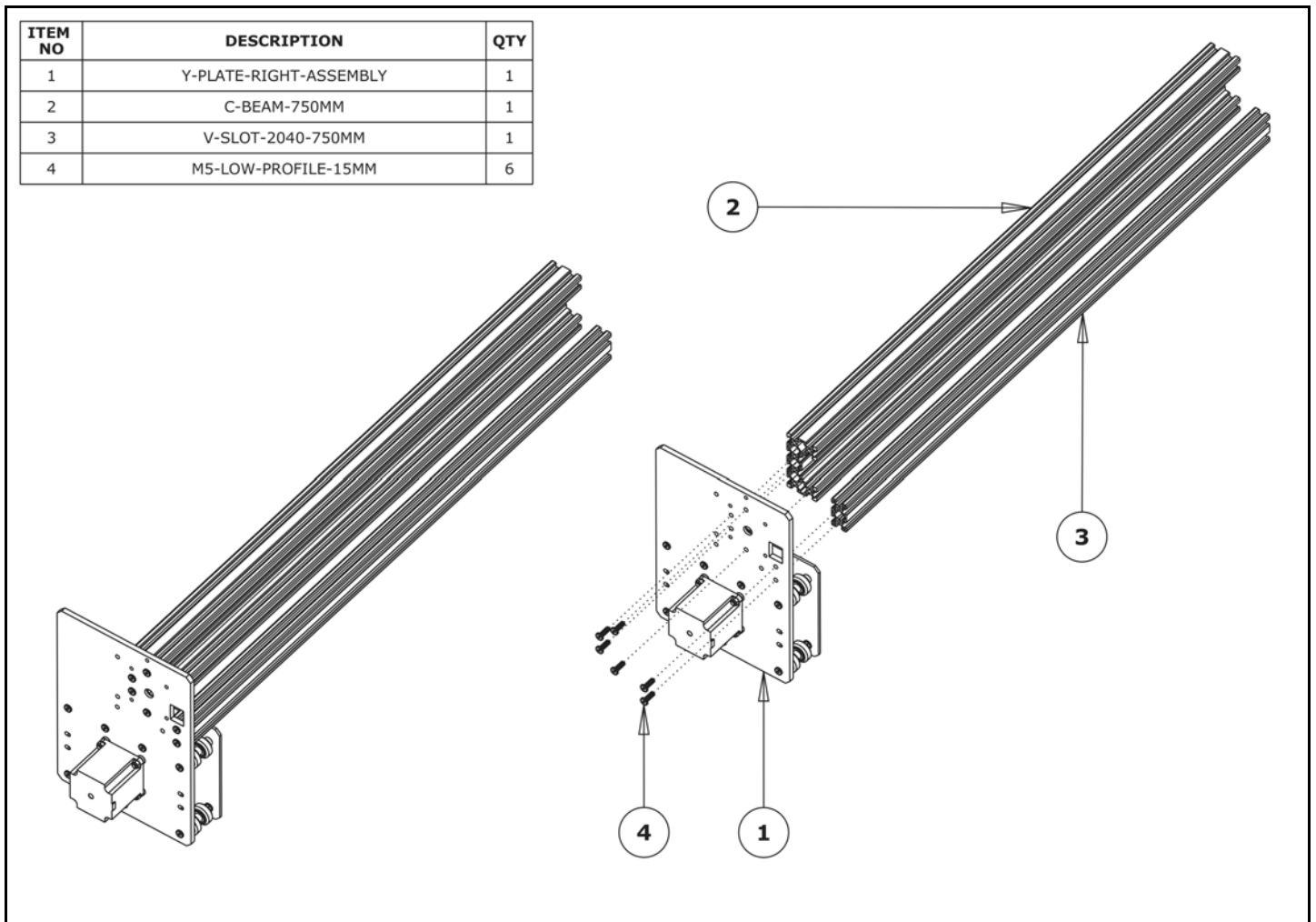
- A. Slide the Z-ACME-Screw through the bottom of the Z-End-Mount-Bottom. Then slide on a 688ZZ-Bearing, 8mm-Shim, and a 8mm-Lock-Collar in this order. Make sure the flat side of the 8mm-Shim is against the 688ZZ-Bearing.
- B. Next, thread the Z-ACME-Screw through the ACME-AB-Nut-Block, it may be hard to thread the Z-ACME-Screw through the ACME-AB-Nut-Block for the first time. Once through, slide on a 8mm-Lock-Collar, 8mm-Shim, and a 688ZZ-Bearing in this order. Make sure the flat side of the 8mm-Shim is against the 688ZZ-Bearing.
- C. Fully thread through the Z-ACME-Screw until it is touching the NEMA23-Stepper-Motor shaft. Position the Flexible-Coupler so it is half on the Z-ACME-Screw and half on the NEMA23-Stepper-Motor shaft. Once in position, tighten the screws on the Flexible-Coupler, making sure one is on the flat portion of the motor shaft.
- D. Slide the 688ZZ-Bearing in Step B up the Z-ACME-Screw until it seats in the inset on the Z-End-Mount-Motor, then slide up the 8mm-shim onto the bearing, and finally slide up 8mm-Lock-Collar so it is firmly against the 8mm-Shim and lock it in place using the grub screw on the side.
- E. Repeat Step D for the parts in Step A, but this time lock them into the inset on the Z-End-Mount-Bottom.
- F. In Section 2.3.6 Step A, locate the four M5-Low-Profile-15mm bolts that were left a full turn from tight. These can now be fully tightened. Doing this will remove any play that may be present from Step D & E in this section.
- G. Firmly hold the X-Carriage-Assembly, and check for any up and down play in the C-Beam-250mm. If there is any, this is due to backlash in the ACME-AB-Nut-Block. The



set screw which was inserted in Section 2.3.2 Step B into the ACME-AB-Nut-Block can be screwed downwards to remove this. Do not over tighten this, as it can make the Z-ACME-Screw difficult to turn. You can test this by rotating the Flexible-Coupler by hand. It should require a small to medium amount of force. This will need to be re-checked once the router is attached, and periodically checked when in use.

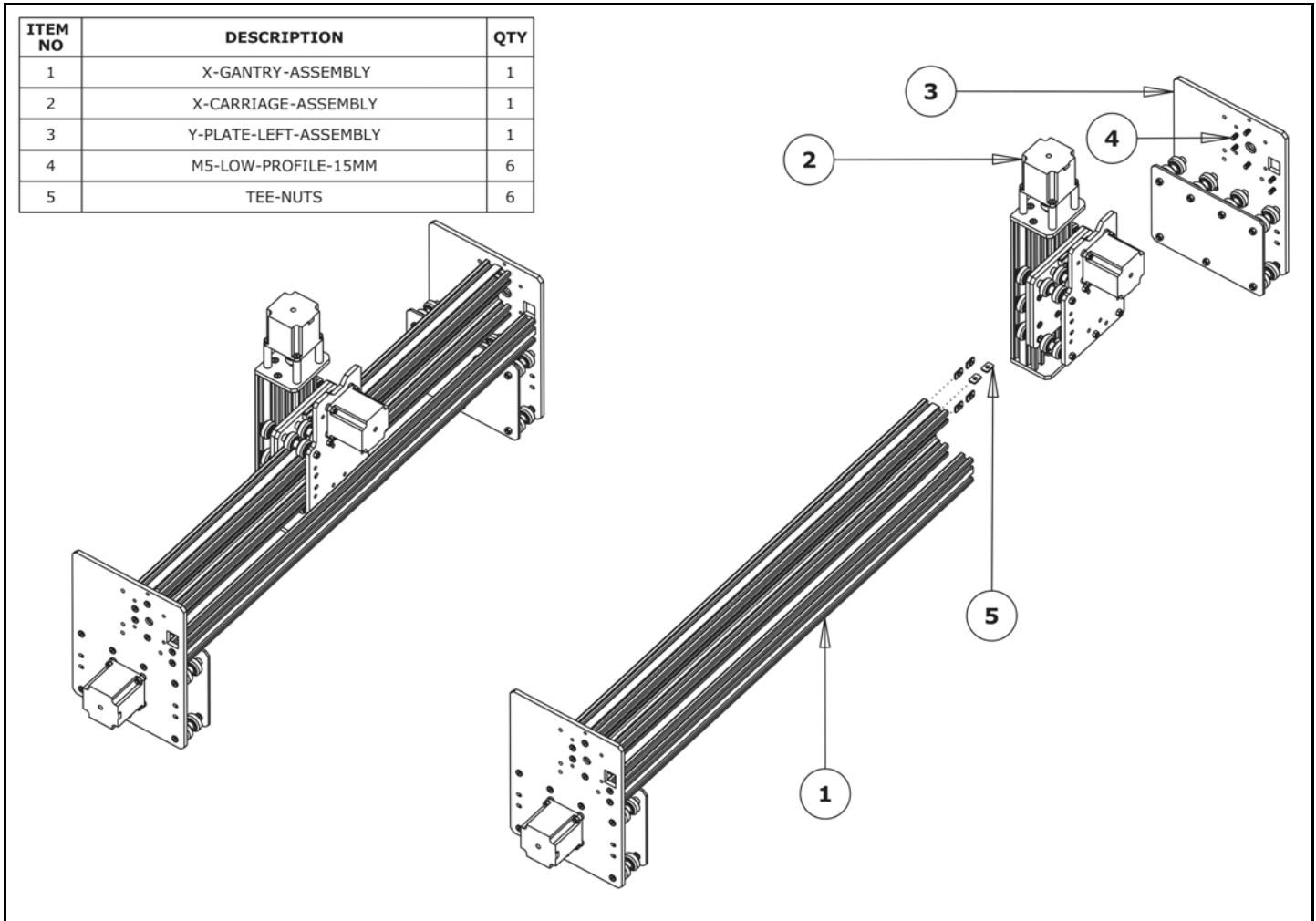
## 2.4 X-Gantry Assembly

### 2.4.1 Extrusions



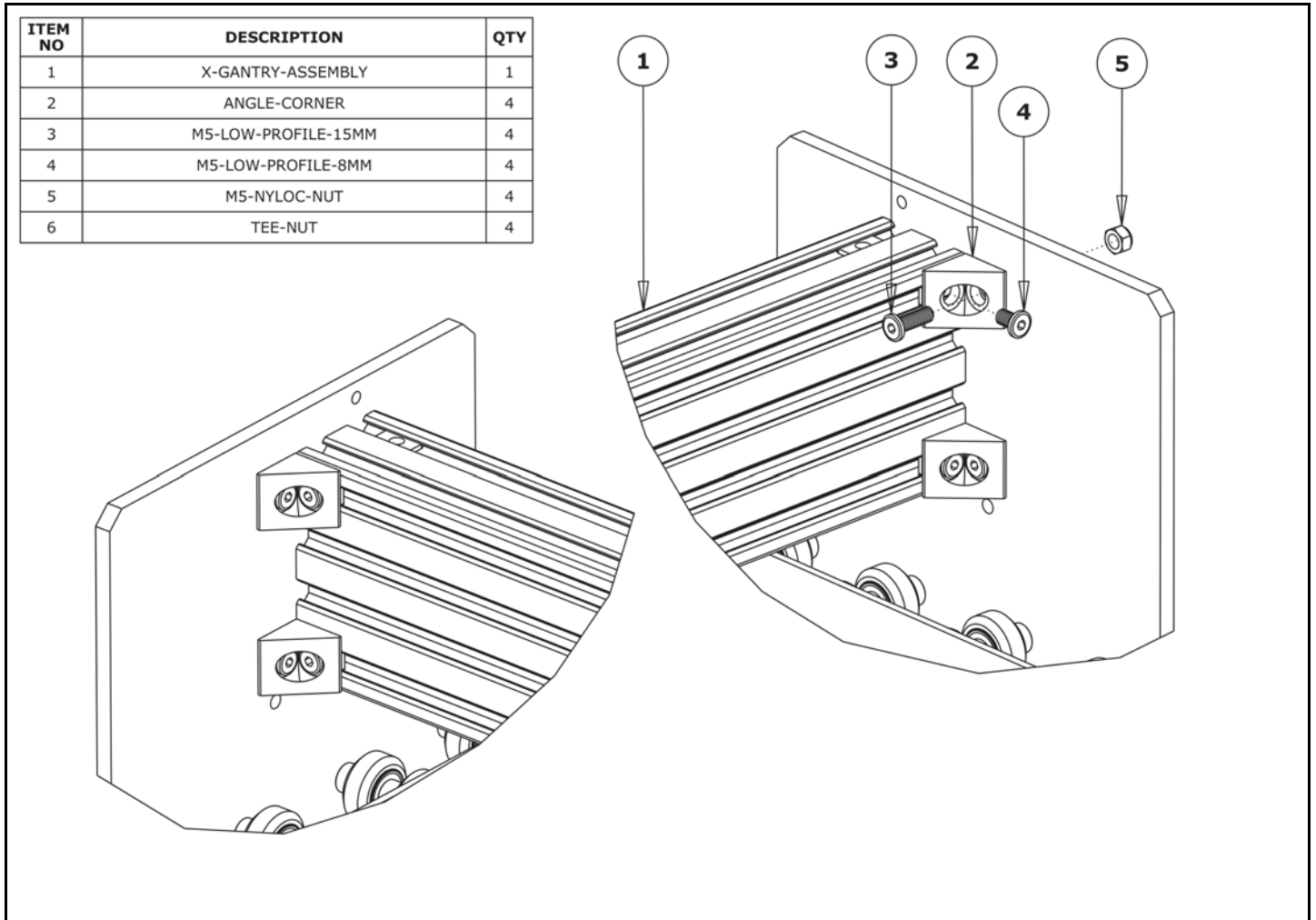
- A.** Attach the V-Slot-2040-750mm to the back two holes on the Y-Plate-Right-Assembly using 2 x M5-Low-Profile-15mm bolts.
- B.** Attach the C-Beam-750mm to the four non-threaded holes on the Y-Plate-Right-Assembly shown above using 4 x M5-Low-Profile-15mm bolts.

## 2.4.2 X-Carriage & Y-Plate-Left Assembly



- A.** Before the Y-Plate-Left-Assembly can be attached, Tee-Nuts need to be inserted. The Tee-Nuts should be inserted so that the flat face is facing outwards. Insert 2 x Tee-Nuts in to the front facing top slot, 2 x Tee-Nuts in to the front facing bottom slot and 2 x Tee-Nuts in to the top facing back slot on the C-Beam-750mm.
- B.** Slide the X-Carriage-Assembly onto the C-Beam-750mm in the orientation seen above.
- C.** Repeat Section 2.4.1 for the Y-Plate-Left-Assembly.
- D.** Place the X-Gantry-Assembly on a flat table, and check that it is flat and square. If it isn't, loosen the M5-Low-Profile-15mm bolts and re-adjust.
- E.** Recheck the bottom Eccentric-Spacer-6mms on the X-Carriage-Assembly to make sure they are touching the rail, there is no wobble, and that the X-Carriage-Assembly runs smoothly along the whole length of the C-Beam-750mm.

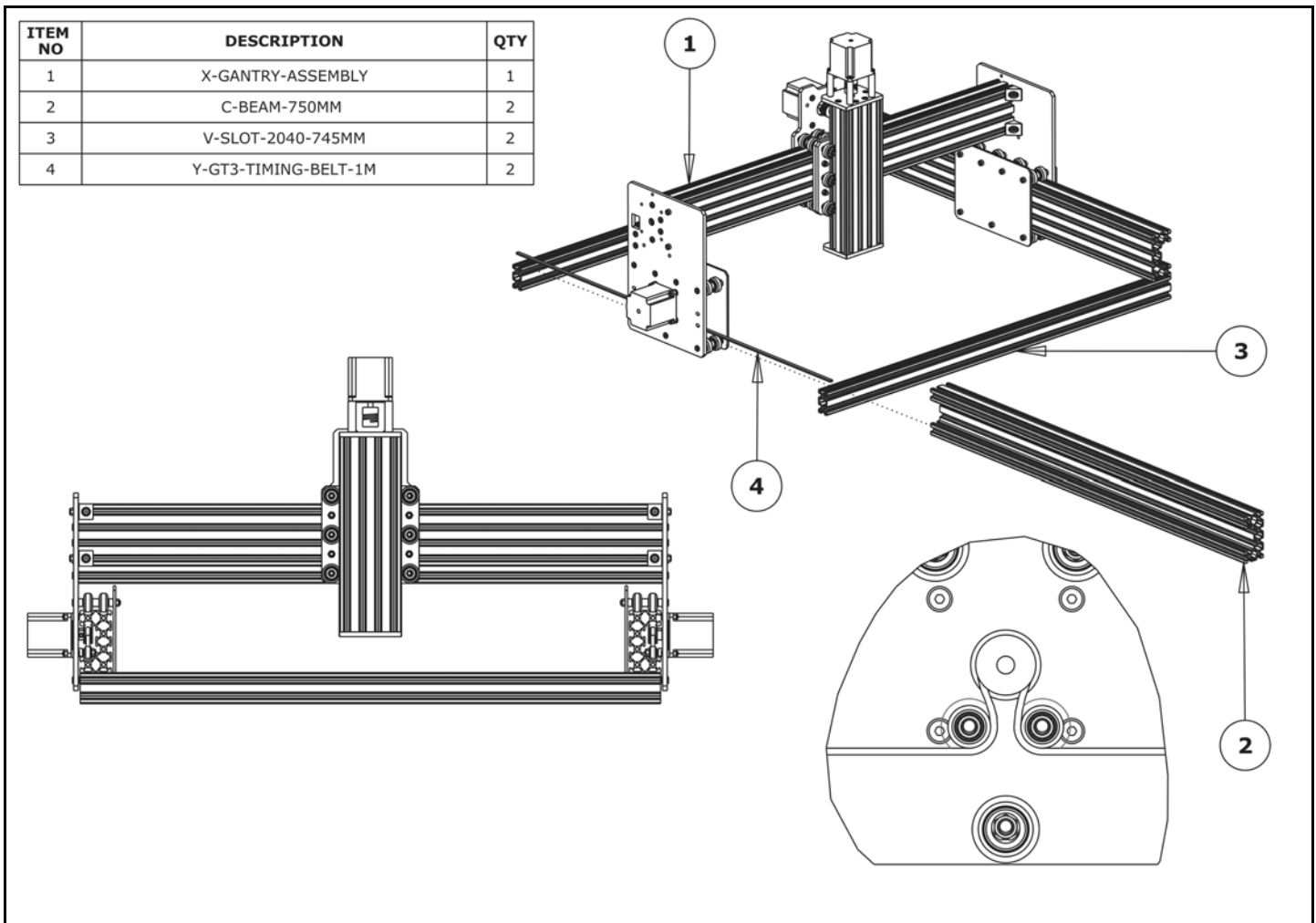
### 2.4.3 Angle Corners



- A.** Attach an Angle-Corner to the Y-Plate-Right-Assembly & the front facing top slot of the C-Beam-750mm. A M5-Low-Profile-8mm screws into the Tee-Nut previously inserted, and a M5-Low-Profile-15mm goes through the Angle-Corner and attaches to a M5-Nyloc-Nut on the outside of the Y-Plate-Right-Assembly.
- B.** Repeat Step A for the other 3 Angle-Corners in the positions shown above.

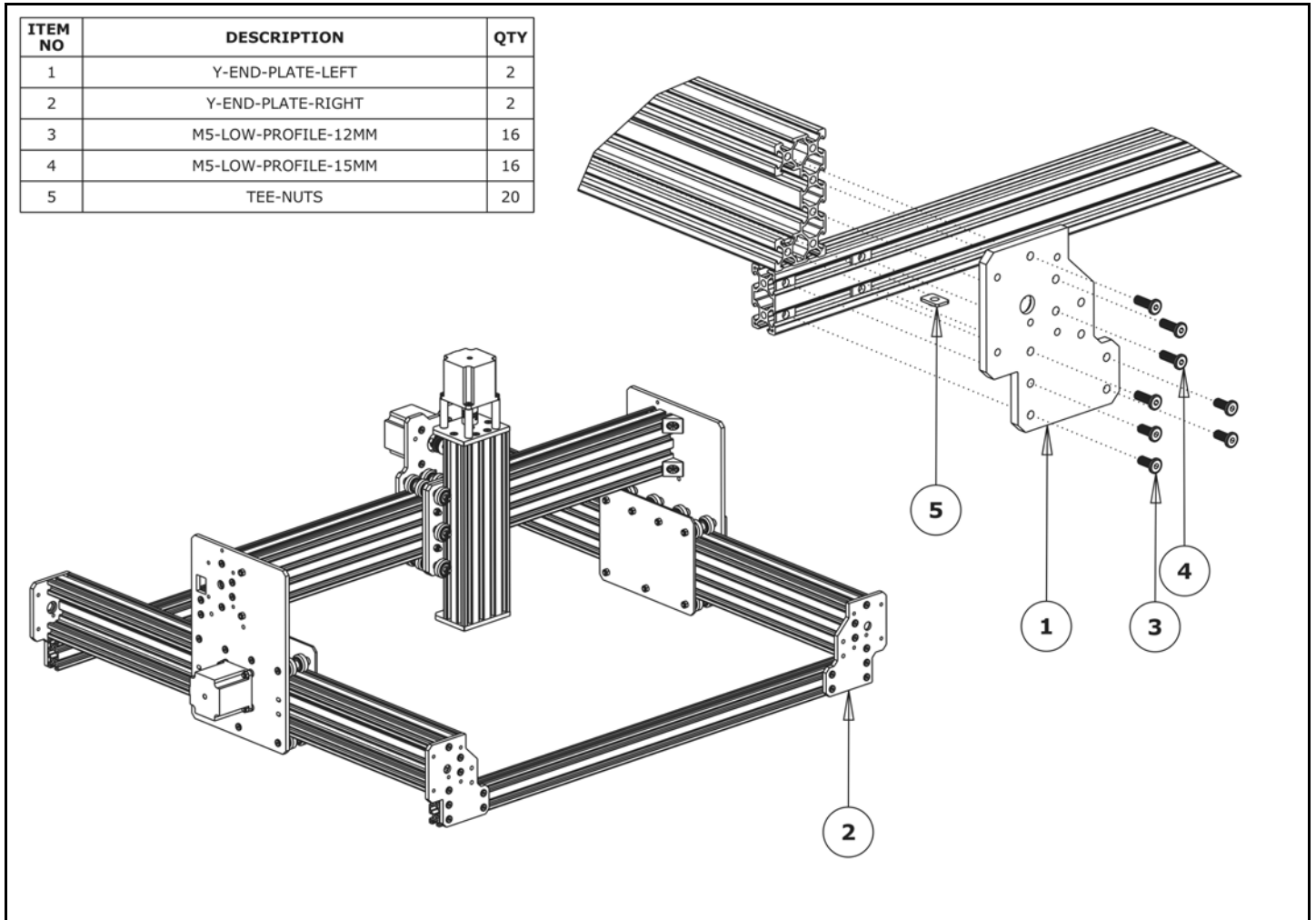
## 2.5 Base Assembly

### 2.5.1 Y Extrusions



- A.** Feed a Y-GT3-Timing-Belt-1m around the GT3-Pulley, and under the Mini-V-Wheel-Assemblies as seen in the bottom right image above. The teeth of the Y-GT3-Timing-Belt-1m should be engaged with the tee on the GT3-Pulley. Do this for the Y-Plate-Left-Assembly and Y-Plate-Right-Assembly. Position the belt so there is roughly equal lengths each side of the Mini-V-Wheel-Assemblies.
- B.** Slide a C-Beam-750mm through each set of wheels on the X-Gantry-Assembly. The belt in Step A should be fed through the 'C' channel of the C-Beam-750mm.
- C.** Rest the ends of the C-Beam-750mm on 2 x V-Slot-2040-745mm's. The ends of the extrusions should be flush with the sides of each other.

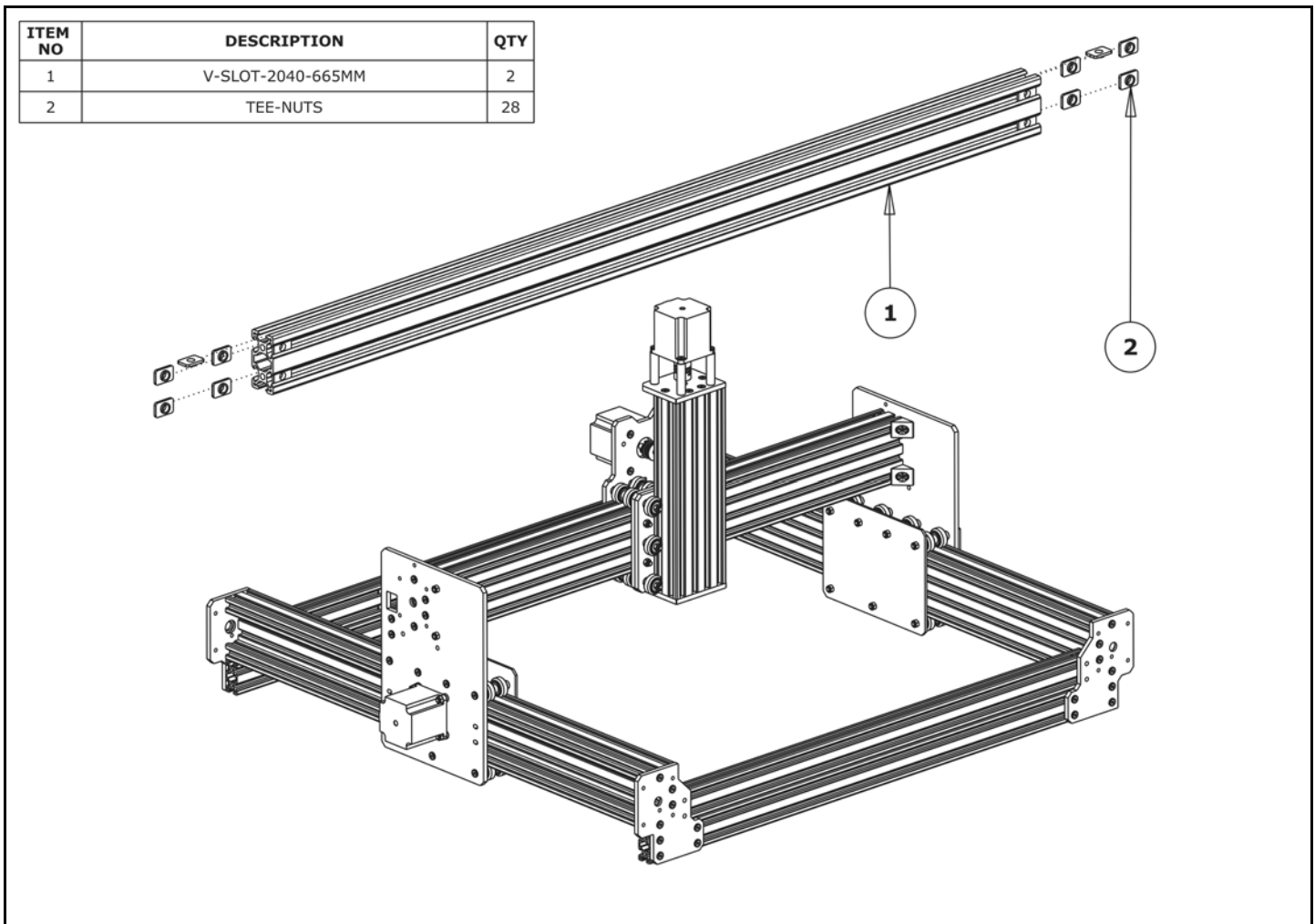
## 2.5.2 End Plates



- A. Insert a Tee-Nut into the upward facing slot inside the 'C' Channel of the C-Beam-750mm.
- B. Slide the X-Gantry-Assembly to the front, and attach a Y-End-Plate-Left to the front left corner, first using 4 x M5-Low-Profile-15mms, which screw into the tapped holes on the C-Beam-750mm.
- C. Next slide 2 x Tee-Nuts into the front facing top and bottom slots of the V-Slot-2040-745mm. Adjust the Tee-Nuts so they line up with the holes on the Y-End-Plate-Left.
- D. Secure the Y-End-Plate-Left to the V-Slot-2040-745mm using 4 x M5-Low-Profile-12mms. Ensure the end of the V-Slot-2040-745mm is flush with the side of the C-Beam-750mm.
- E. Square the base, and repeat Steps A,B,C & D for the Y-End-Plate-Right on the opposite end of the front V-Slot-2040-745mm. If possible, get a second person to hold the base square while tightening the bolts.
- F. Slide the X-Gantry-Assembly to the back. Square the base, and repeat Steps A,B,C, D, & E for the back V-Slot-2040-745mm.

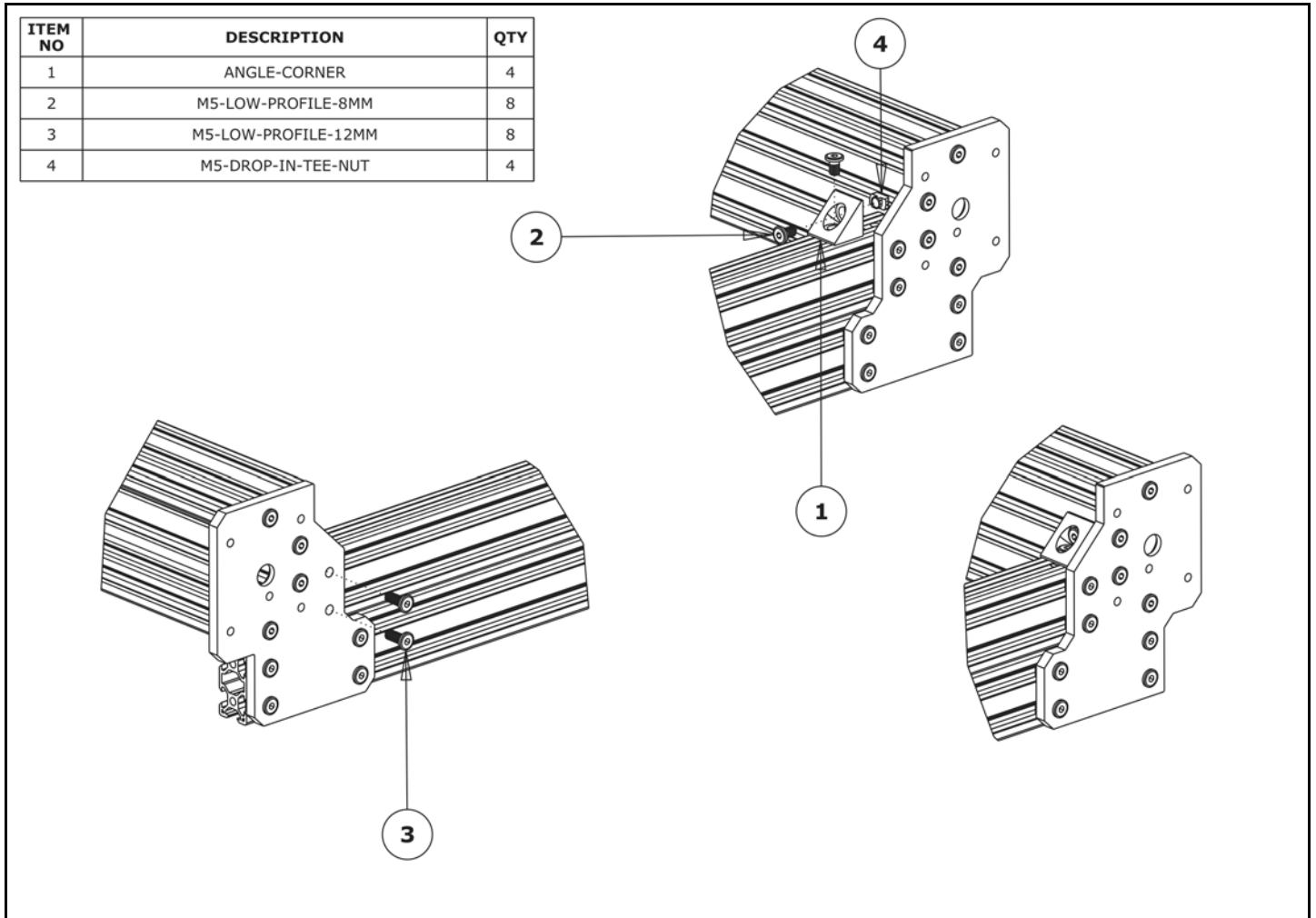
## 2.6 Spoiler Board Support Extrusions - Method 1

### 2.6.1 Build Up Extrusions



- A.** With a V-Slot-2040-665mm in hand, designate which sides are the top facing and outward facing. On the outward face, insert 2 x Tee-Nuts in both the upper and lower slots. On the top face, insert 2 x Tee-Nuts.
- B.** If you have a machine with a 750mm X-Axis, on the inward face, insert 4 x Tee-Nuts in both the upper and lower slots. 6 x Tee-Nuts for a 1000mm X-Axis, and 8 x Tee-Nuts for a 1500mm X-Axis.
- C.** Insert the V-Slot-2040-665mm in between both C-Beam-750mm's so it sits on top of the front V-Slot-2040-745mm. The outward face should be against the Y-End-Plates.
- D.** Repeat Steps A, B & C for the back V-Slot-2040-665mm.

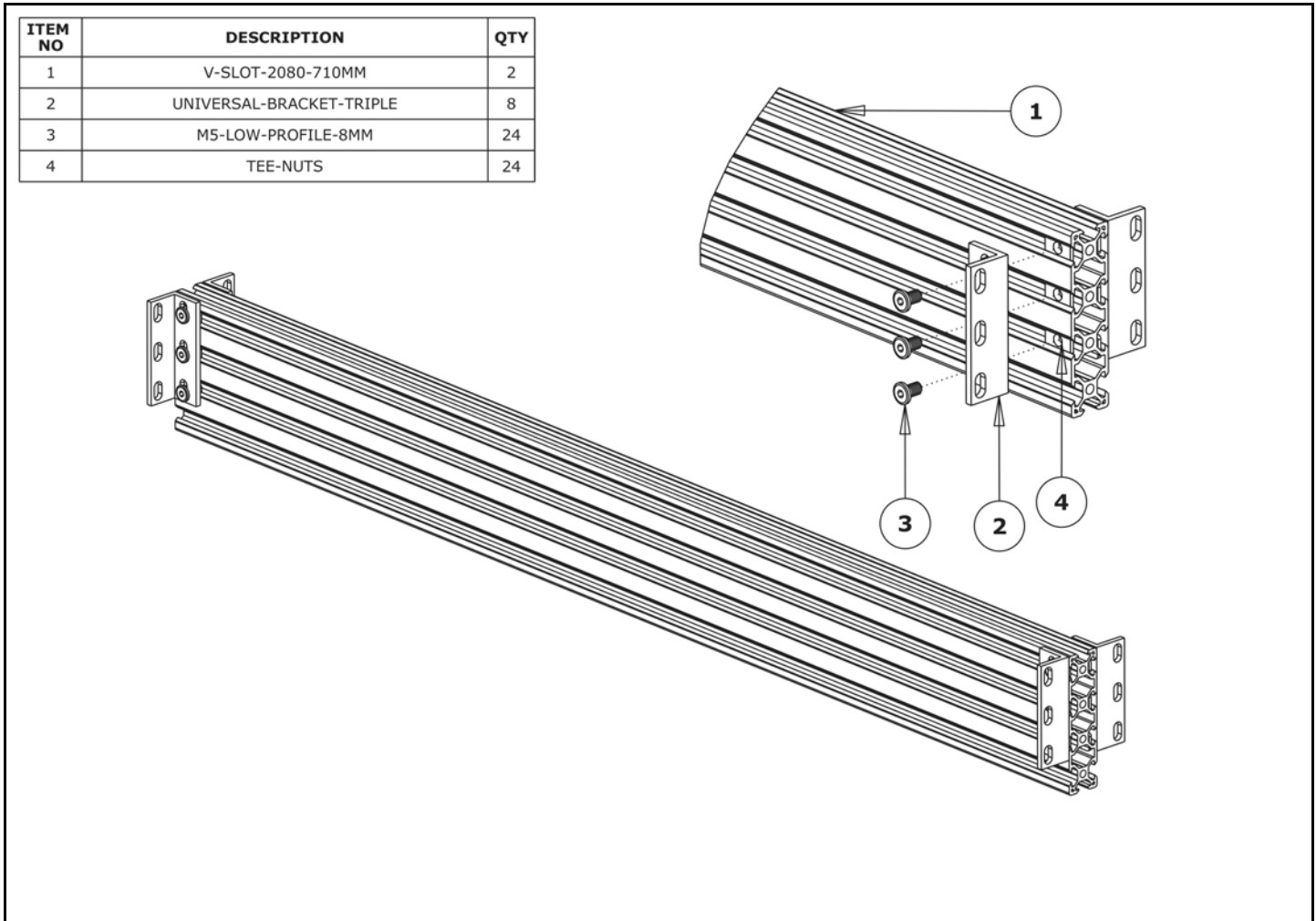
## 2.6.2 Y-End-Plate Final Bolts & Angle Corners



- A.** Align the Tee-Nuts in Section 2.6.1 Step A with the two holes on the Y-End-Plate-Left. Use 2 x M5-Low-Profile-12mm bolts to secure the extrusion. Repeat this step for the other 3 x Y-End-Plates.
- B.** Attach one side of an Angle Corner to the inside face of the right hand C-Beam-750mm using a M5-Low-Profile-8mm bolt and a M5-Drop-In-Tee-Nut. Attach the other side to the V-Slot-2040-665mm using a M5-Low-Profile-8mm bolt and a Tee-Nut that was inserted into the top face in Section 2.6.1 Step A. Secure the Angle-Corner tightly in the corner between the C-Beam-750mm and V-Slot-2040-665mm while the machine is held square.
- C.** Repeat Step B for the other 3 corner joints between the C-Beam-750mm and V-Slot-2040-665mm rails.

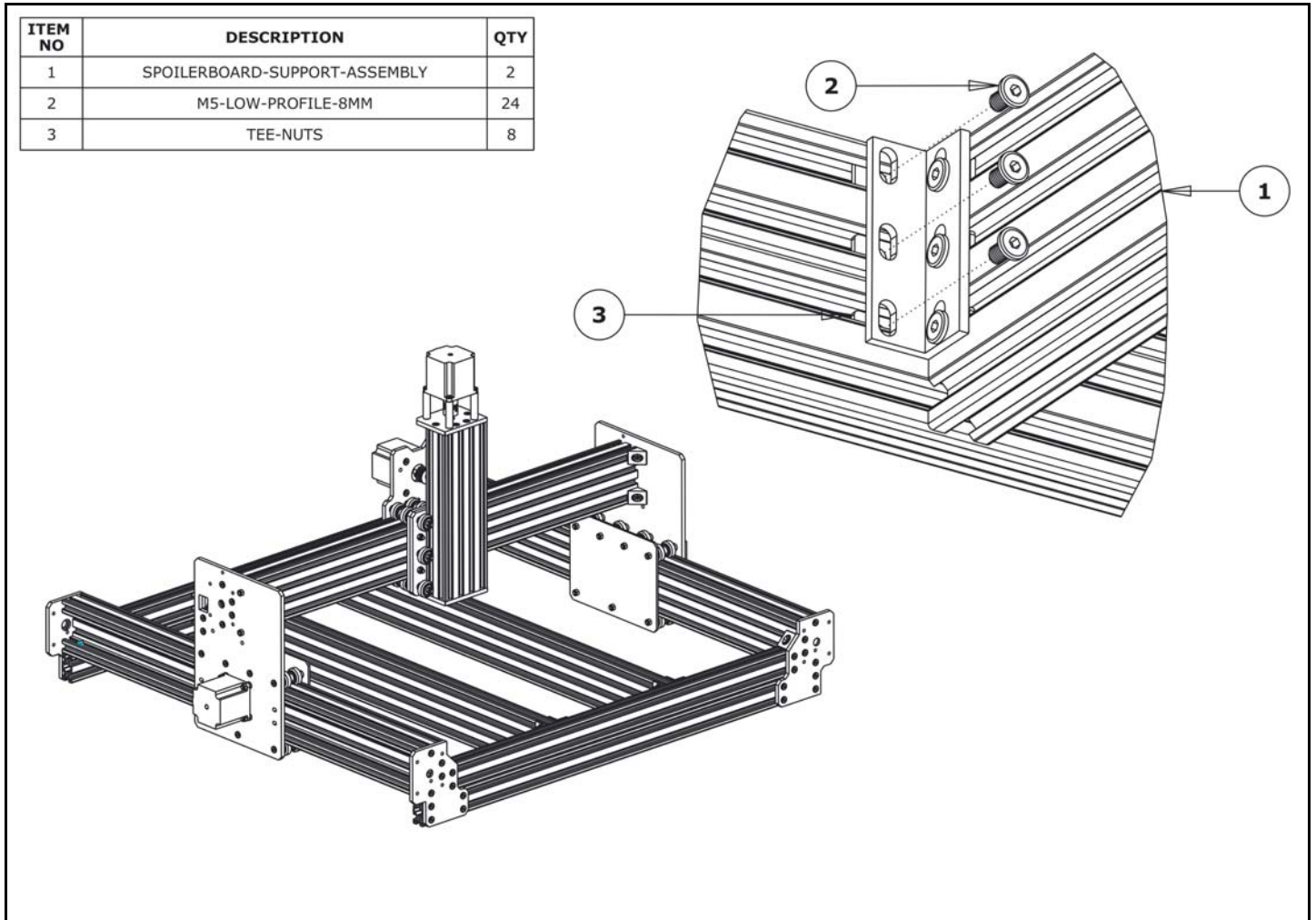


### 2.6.3 Spoiler Board Support Brackets



- A. Insert 3 x Tee-Nuts into the top 3 slots of the V-Slot-2080-710mm
- B. With a Universal-Bracket-Triple in hand, notice that the holes down one side are not the same distance away from the corner edge as the holes on the other side. The side with the holes closest to the corner edge should go against the V-Slot-2080-710mm. With the top of the Universal-Bracket-Triple flush with the top of the V-Slot-2080-710mm, secure it using 3 x M5-Low-Profile-8mm's.
- C. 3 more Universal-Bracket-Triples need to be attached to the V-Slot-2080-710mm as shown above, repeating Steps A & B.
- D. If you have a machine with a 750mm X-Axis repeat Steps A, B, & C for one more V-Slot-2080-710mm. 2 more times for a 1000mm X-Axis, and 3 more times for a 1500mm X-Axis.

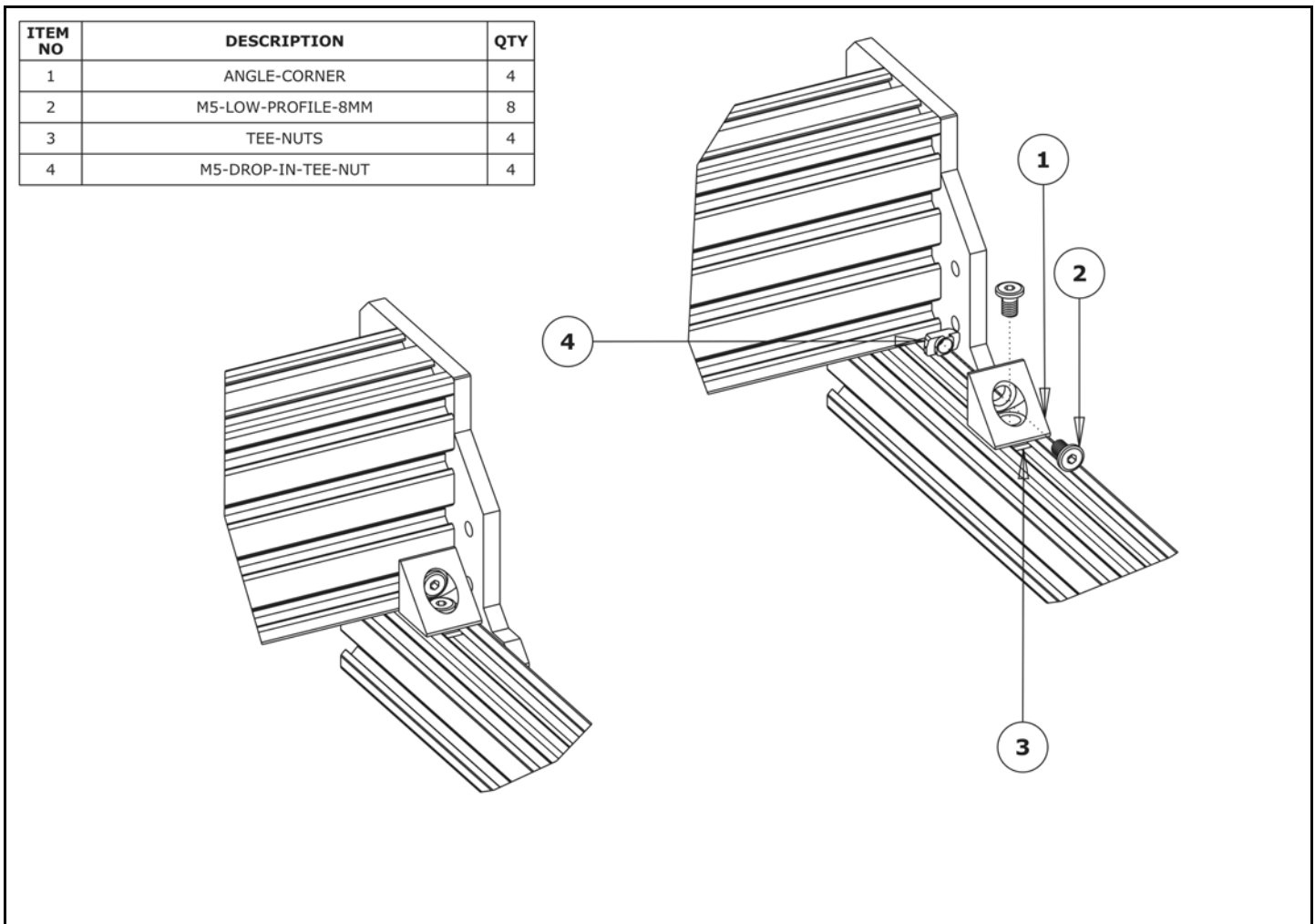
## 2.6.4 Attaching Spoiler Board Supports



- A.** If you have a machine with a 750mm X-Axis insert 4 x Tee-Nuts in to the top slot on the inward face on both the front and back V-Slot-2040-745mm's. 6 x Tee-Nuts for a 1000mm X-Axis, and 8 x Tee-Nuts for a 1500mm X-Axis.
- B.** The Spoilerboard-Support-Assemblies should be evenly spaced along the X-Axis of the machine. For a machine with a 750mm X-Axis, from the inside edge of the Angle-Corner make two marks, one 209mm in, and another 418mm in. Do this on both the front and back V-Slot-2040-665mm's. 219mm spacing for a 1000mm X-Axis, and 275mm spacing for a 1500mm X-Axis.
- C.** Bring the previously assembled Spoilerboard-Support-Assemblies down in between the front and back sides with the Universal-Bracket-Triple towards the top, and line up the center of the V-Slot-2080-710mm's with the center marks made in Step B.
- D.** Line up all the previously inserted Tee-Nuts in Step A and in Section 2.6.1 Step B with the holes on the Universal-L-Brackets-Triple's, and secure the Spoilerboard-Support-Assembly using 12 x M5-Low-Profile-8mm's on each Spoilerboard-Support-Assembly.

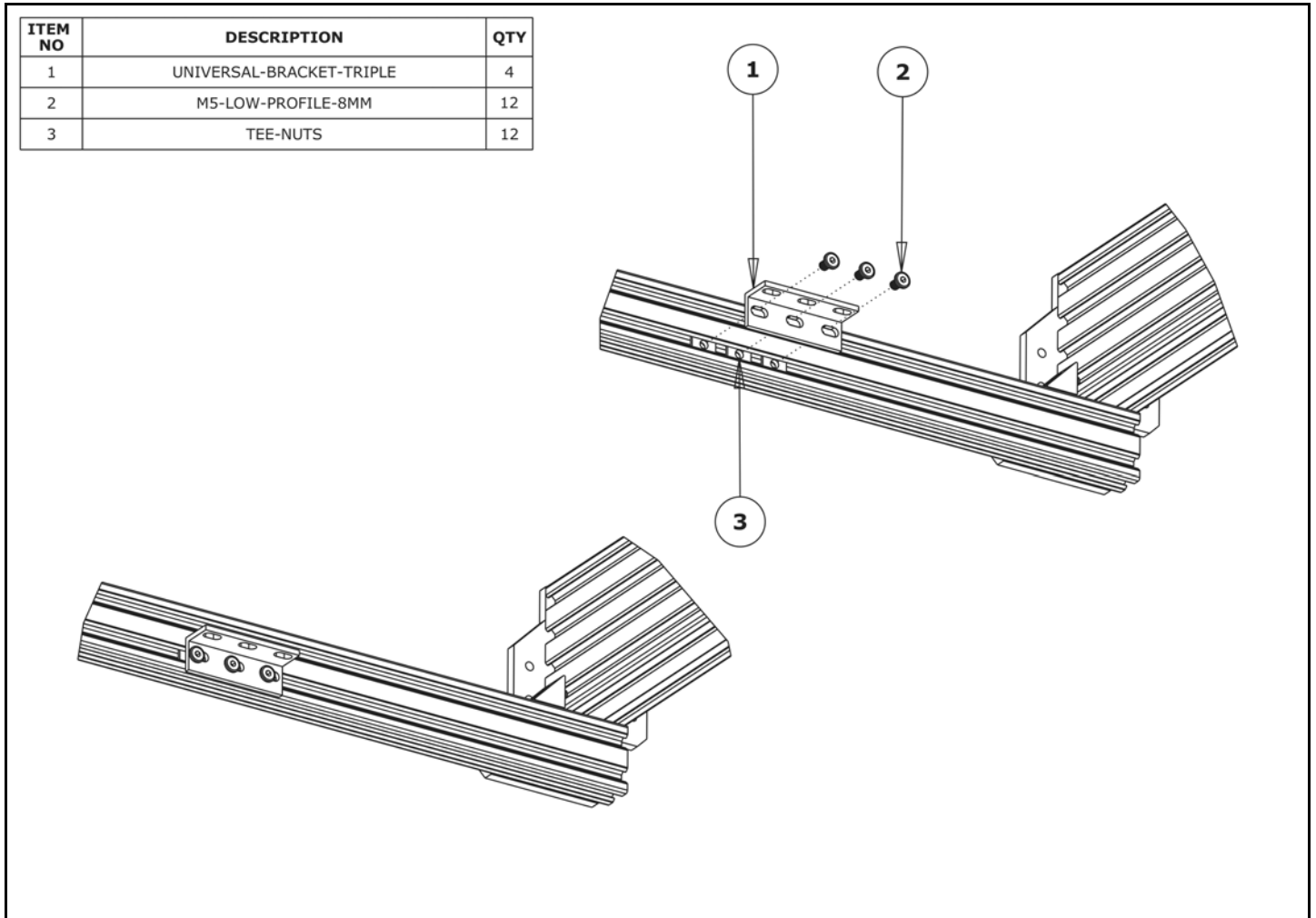
## 2.7 Spoiler Board Support Extrusions - Method 2

### 2.7.1 Angle Corners



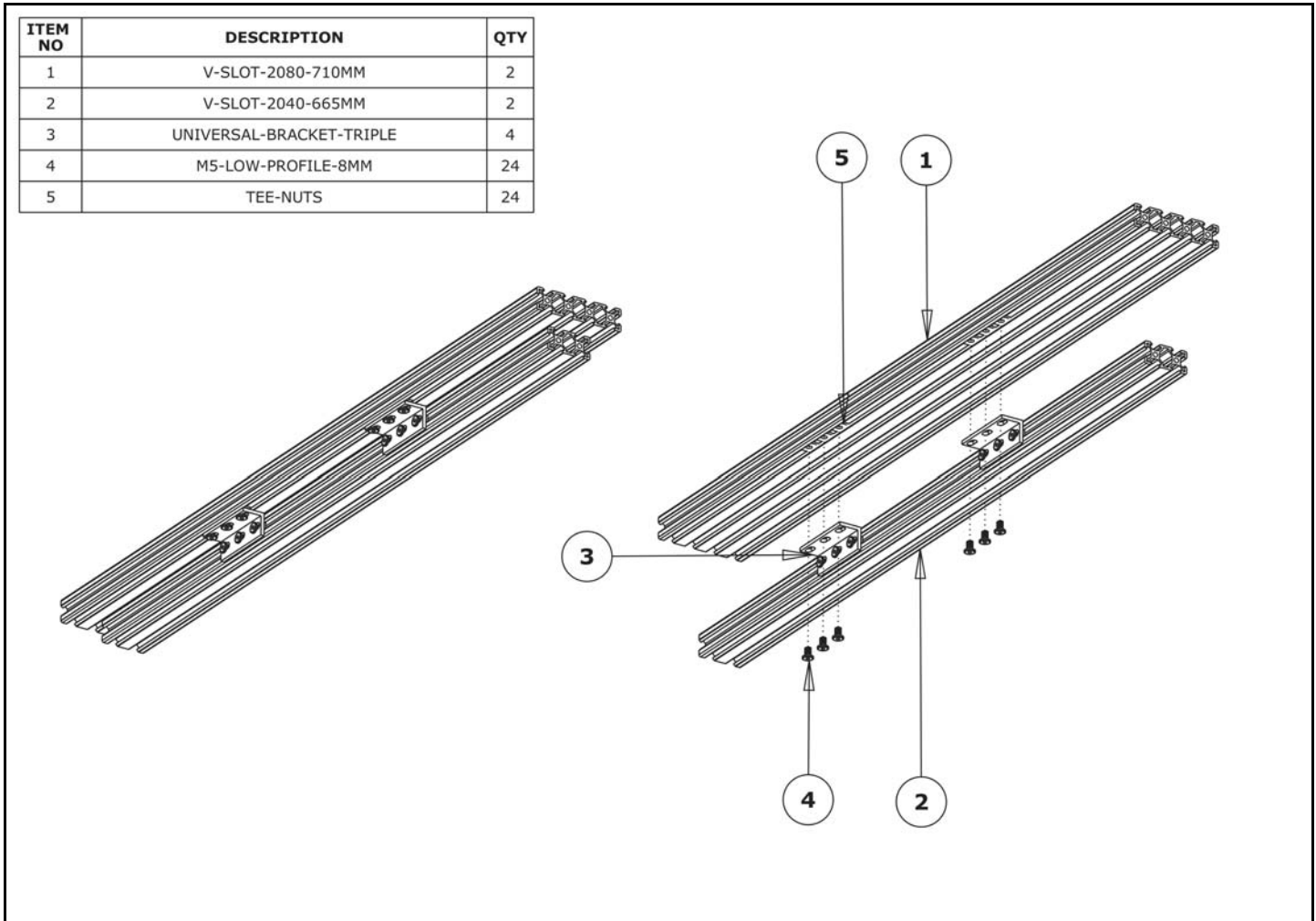
- A.** Attach one side of an Angle Corner to the inside face of the right hand C-Beam-750mm using a M5-Low-Profile-8mm bolt and a M5-Drop-In-Tee-Nut. Attach the other side to the V-Slot-2040-745mm using a M5-Low-Profile-8mm bolt and a Tee-Nut that can be inserted from the end of the V-Slot-2040-745mm. Secure the Angle-Corner tightly in the corner between the C-Beam-750mm and V-Slot-2040-665mm while the machine is held square.
- B.** Repeat Step B for the other 3 corner joints between the C-Beam-750mm and V-Slot-2040-745mm rails.

## 2.7.2 Spoiler Board Support Brackets



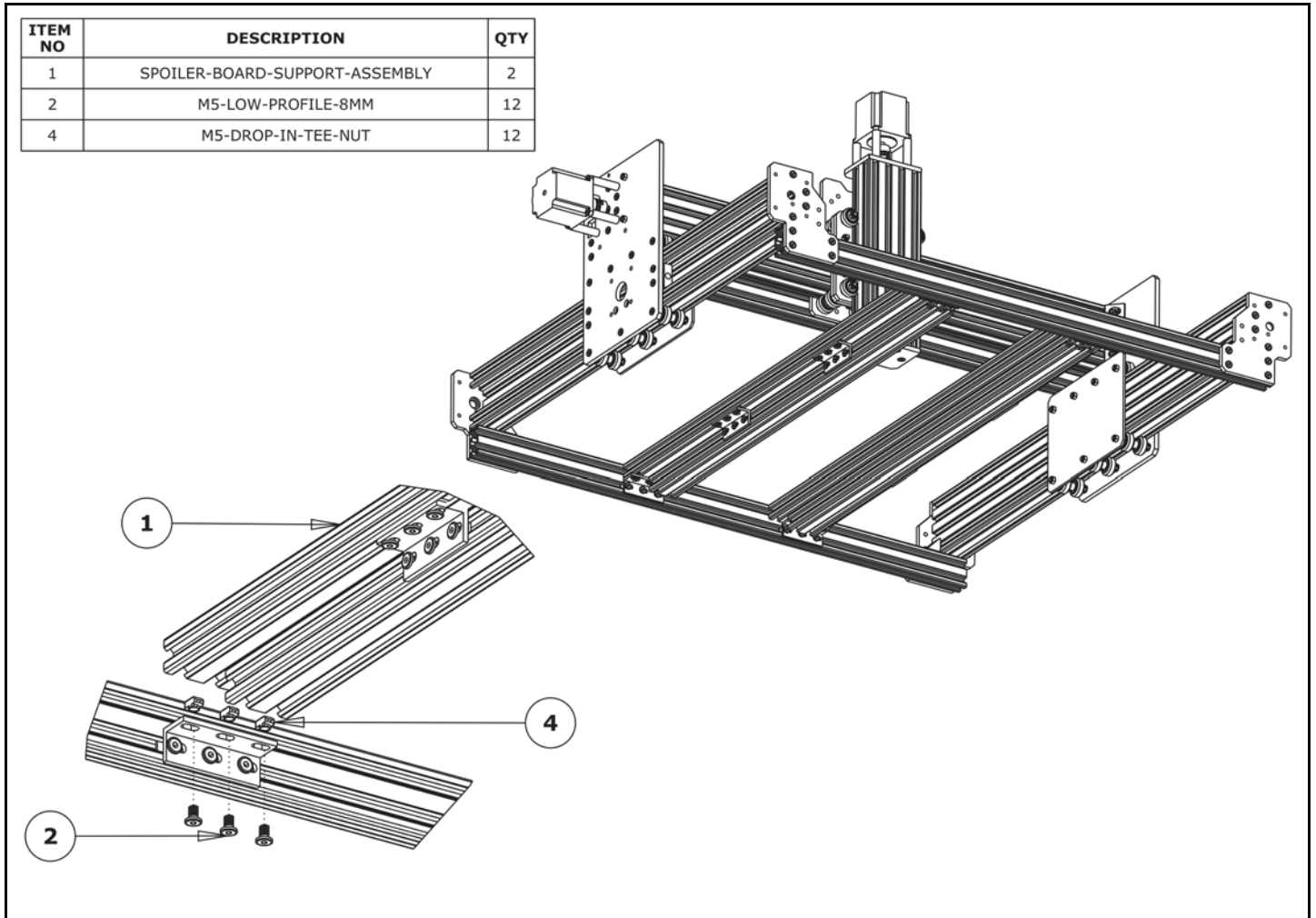
- A. Insert 3 x Tee-Nuts into the bottom slot of the V-Slot-2040-745mm.
- B. With a Universal-Bracket-Triple in hand, notice that the holes down one side are not the same distance away from the corner edge as the holes on the other side. The side with the holes closest to the corner edge should go against the V-Slot-2040-745mm. With the bottom edge of the Universal-Bracket-Triple flush with the bottom of the V-Slot-2040-745mm, secure it using 3 x M5-Low-Profile-8mm's to the Tee-nuts in Step A.
- C. If you have a machine with a 750mm X-Axis, repeat Steps A & B so there is 2 Universal-L-Bracket-Triples front and back, at 209mm spacing. 3 x Universal-L-Bracket-Triples front and back, at 219mm spacing for a 1000mm X-Axis. 4 x Universal-L-Brackets front and back, at 275mm spacing for a 1500mm X-Axis.

### 2.7.3 Spoiler Board Support Assembly



- A. Insert 6 x Tee-Nuts into the left facing slot of the V-Slot-2040-665mm.
- B. With a Universal-Bracket-Triple in hand, notice that the holes down one side are not the same distance away from the corner edge as the holes on the other side. The side with the holes closest to the corner edge should go against the V-Slot-2040-665mm. With the bottom edge of the Universal-Bracket-Triple flush with the bottom of the V-Slot-2040-665mm, secure it using 3 x M5-Low-Profile-8mm's. There should be 182mm between the Universal-Bracket-Triple and the end of the V-Slot-2040-665mm. Attach another Universal-Bracket-Triple, 182mm away from the other end.
- C. Insert 6 x Tee-Nuts into the furthest left bottom facing slot of the V-Slot-2080-710mm.
- D. Attach the other side of the Universal-Bracket-Triples in Step B along with the V-Slot-2040-665mm to the V-Slot-2080-710mm using 6 x M5-Low-Profile-8mm's. At each end there should be 22.5mm between the end of the V-Slot-2040-665mm and the end of the V-Slot-2080-710mm. If you have a machine with a Y-Axis larger than the X-Axis, the 22.5mm spacing can be ignored, just center the V-Slot-2040-665mm.
- E. Repeat Step A - D for the other V-Slot-2040-665mm and V-Slot-2080-710mm. This sections only needs to be carried out twice for all X-Axis sizes.

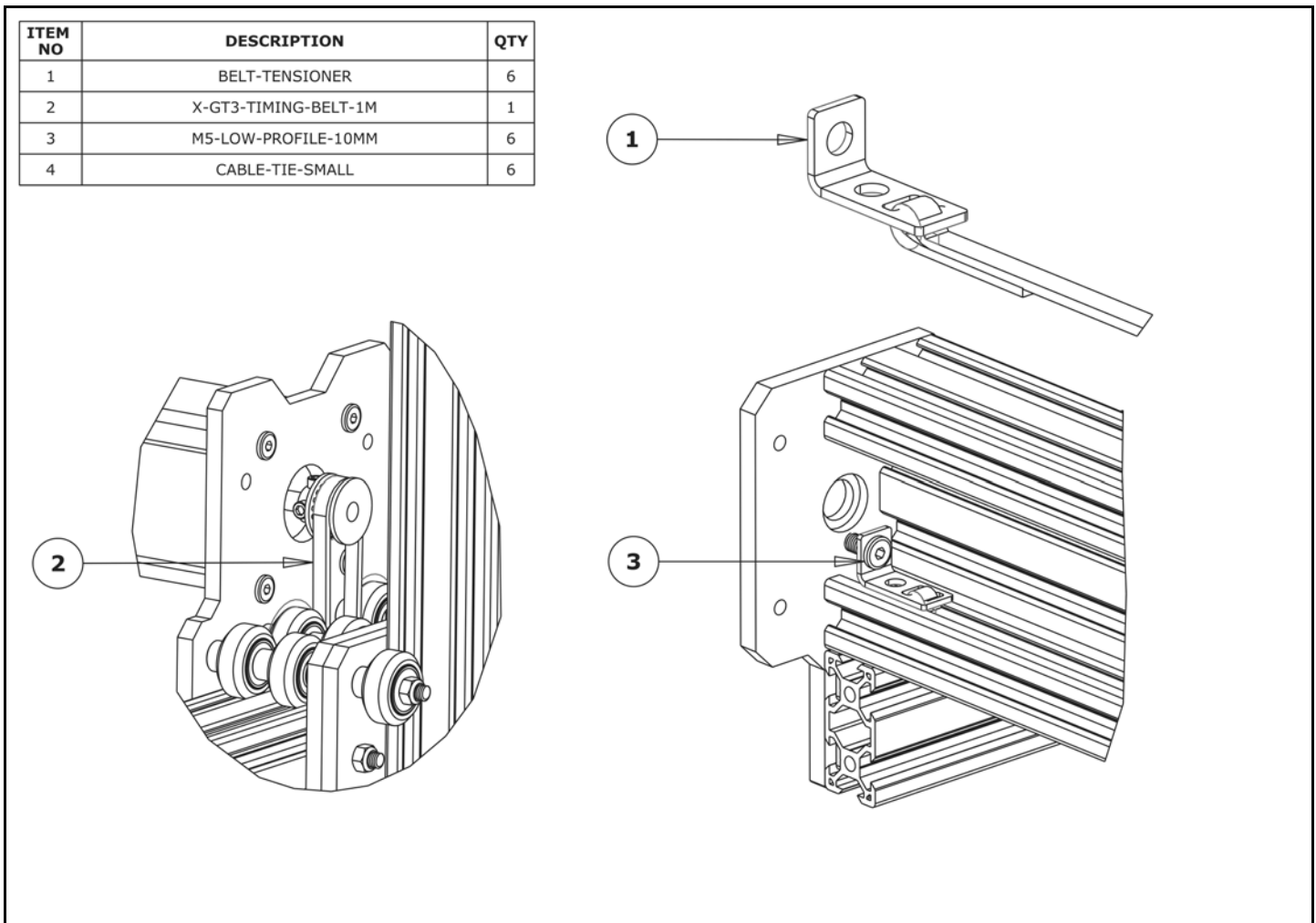
## 2.7.4 Attaching Spoiler Board Supports



- A. Through all three holes on each Universal-Bracket-Triple attached in Section 2.7.2, attach a M5-Low-Profile-8mm bolt with a slightly screwed M5-Drop-In-Tee-Nut on the end.
- B. Bring the Spoiler-Board-Support-Assemblies down onto the central two sets of Universal-Bracket-Triples aligning the M5-Drop-In-Tee-Nuts with the slots. Tighten the M5-Low-Profile-8mm's to secure the Spoiler-Board-Support-Assemblies.
- C. If you have an X-Axis with a 750mm X-Axis, the assemblies in section 2.7.3 will take up all Universal-L-Bracket-Triple sets. For a 1000mm X-Axis there will be one set left empty, attach the left over V-Slot-2080 to this set. For a 1500mm X-Axis there will be two outer sets left empty, attach the two left over V-Slot-2080's to these sets.

## 2.8 Timing Belts & Finishing Details

### 2.8.1 Belt Tensioners

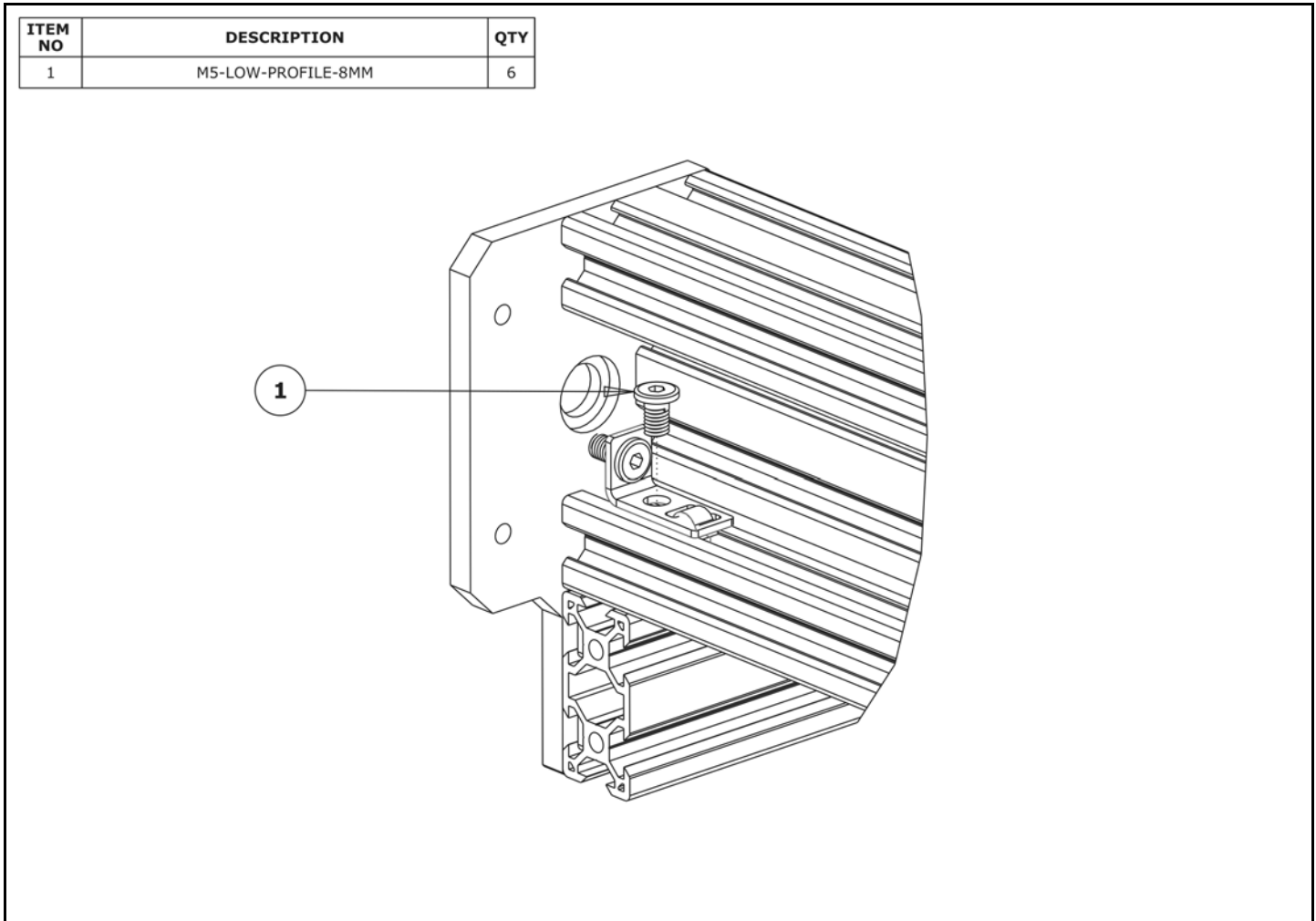


- A.** With one of Y-GT3-Timing-Belt-1m inserted in Section 2.5.1 wrap one end around a Belt-Tensioner (as shown above). The best method is to go up, over, and then back onto itself so that the teeth engage with each other. Secure using a Cable-Tie-Small, going around both sections as close as possible to the Belt-Tensioner. Cut the excess belt off - a couple of teeth from the Cable-Tie-Small.
- B.** Next, using a M5-Low-Profile-10mm attach the Belt-Tensioner to the threaded hole on the Y-End-Plate at that end of the belt. Only screw this bolt in two full turns, as this will be used to tension the belt later. Ensure the Tee-Nut inserted in Section 2.5.2 Step A is underneath the hole on the Belt-Tensioner.
- C.** Do the same for the other end of the Y-GT3-Timing-Belt-1m in Step A, however this time you need to pull through as much excess belt as possible, before wrapping it around the tensioner. To gauge where the Belt-Tensioner needs to go on the belt, put the belt tensioner in the same position as if doing Step B above, then pull the belt along the extrusion. and then roughly mark where it reaches the slots on the belt tensioner. Then continue with Step A and B, wrapping it around at the point marked.
- D.** Repeat Step A, B & C for the other Y-GT3-Timing-Belt-1m inserted in Section 2.5.1.
- E.** In Section 2.3.3 Step B the GT3-Pulley was attached to the X-Axis NEMA23-Stepper-Motor but not secured. Secure it now so that the toothed section of the GT3-Pulley is centered with the back slot of the C-Beam-750mm. Then, repeat Step A, B & C for the

X-GT3-Timing-Belt-1m, this has not been inserted yet, so first wrap it around the GT3-Pulley and under the wheels each side as shown above.



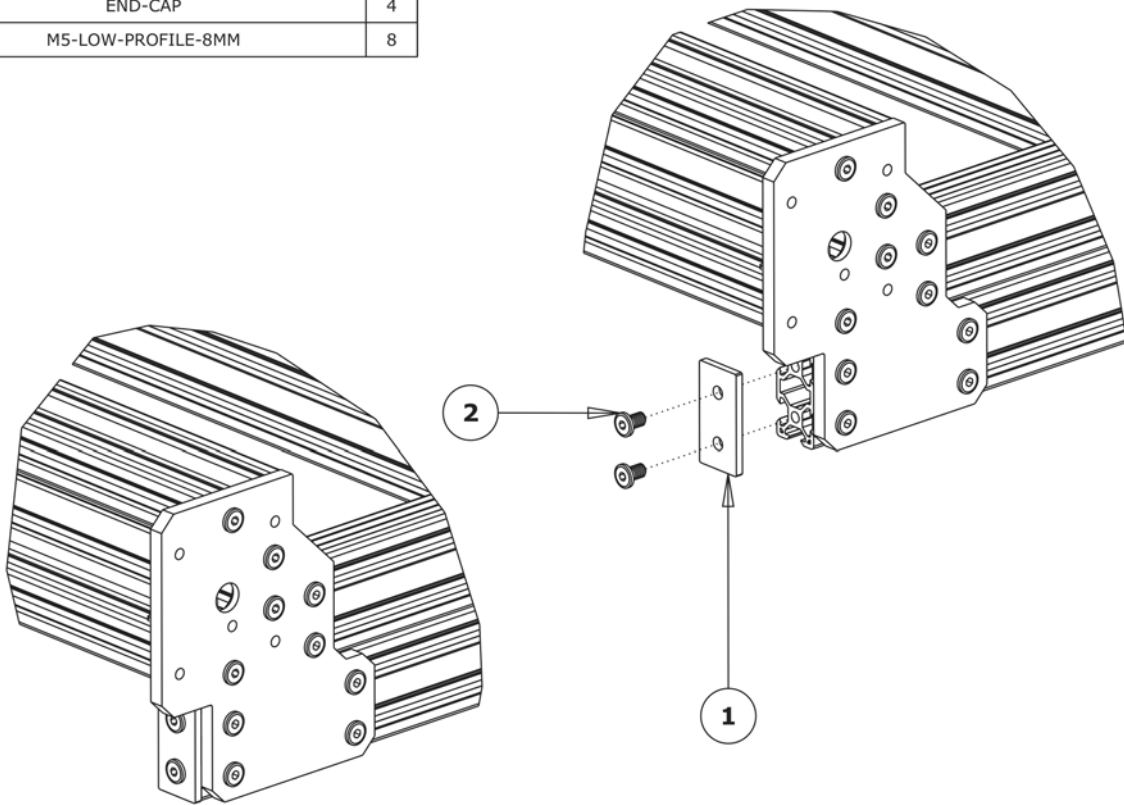
## 2.8.2 Belt Tensioning



- A.** For one of the Y-Axis belts, screw a M5-Low-Profile-8mm bolt through the belt tensioner and into the Tee-Nut (which should have been positioned in Step B in the previous section). Do not tighten it. Do this for both Belt-Tensioners on this axis.
- B.** The M5-Low-Profile-10mm bolts inserted in the previous Section Step B are used to tension the belt. The exact tension needed is hard to explain, but if it is too loose the machine could skip steps and it won't be accurate. Too much and it risks bending the motor shaft or causing premature wear. It should be tensioned enough so that the belt is just on the point that it can be plucked with an audible tone. At this point do not add anymore tension.
- C.** Once happy, tighten the M5-Low-Profile-8mm bolts in Step A, as these will hold the tensioner in position. Check that the axis still runs freely with light-moderate force, and there are no bite points. If there are, this is most likely a result of the GT3-Pulley being out of alignment with the center of the track. This would need to be checked and adjusted.
- D.** Repeat Step A, B & C for the other two belts.

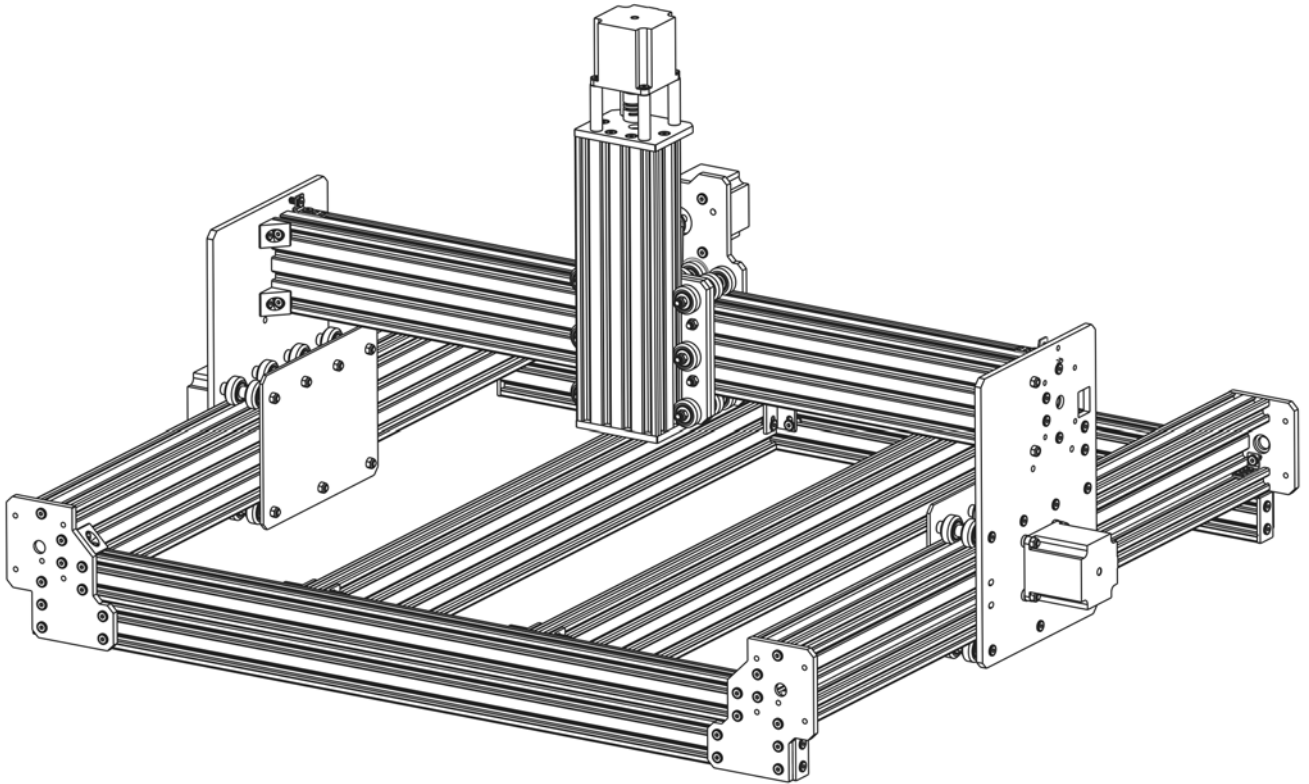
### 2.8.3 End Caps

ITEM NO	DESCRIPTION	QTY
1	END-CAP	4
2	M5-LOW-PROFILE-8MM	8



- A. Attach an End-Cap to front left end of the V-Slot-2040-745mm using 2 x M5-Low-Profile-8mm bolts.
- B. Repeat this for the other 3 x End-Caps on the other bare ends of the V-Slot-2040-745mms.

## 2.9 Complete



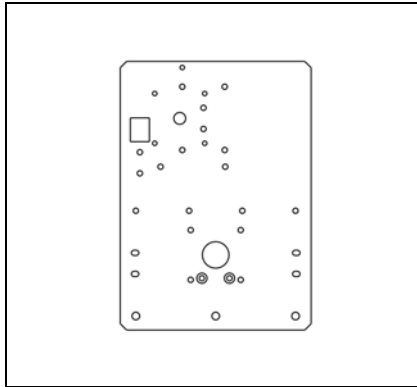
Congratulations! You have completed the mechanical assembly of the WorkBee CNC. We hope you have enjoyed the build and will continue to bring your WorkBee to life!

# 3.0 Appendix

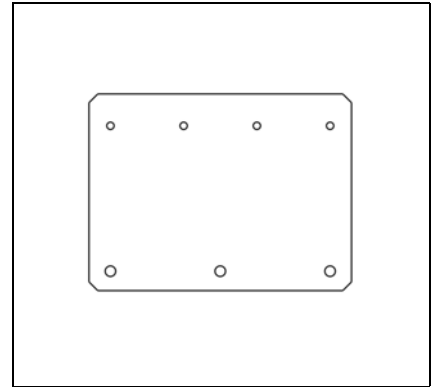
## 3.1 Appendix A - Kit Contents

### Plates

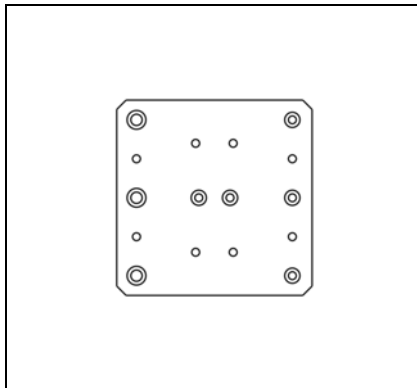
1 x Y-Plate-Left  
1 x Y-Plate-Right



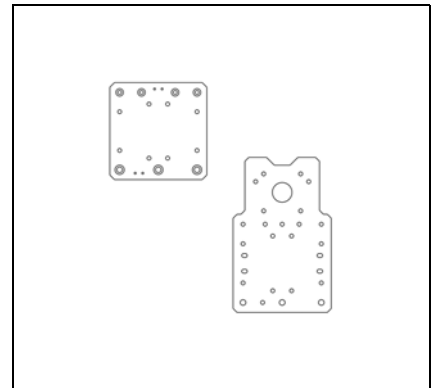
2 x Y-Plate-Inner



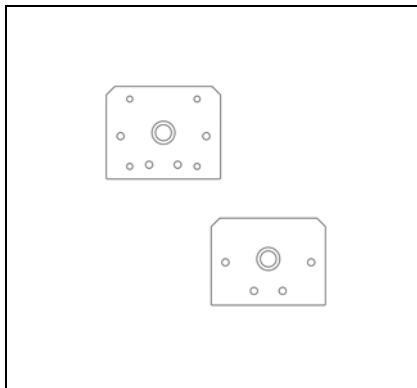
1 x Z-Plate



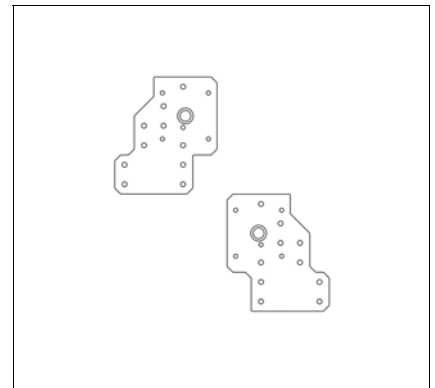
1 x X-Plate-Front  
1 x X-Plate-Back



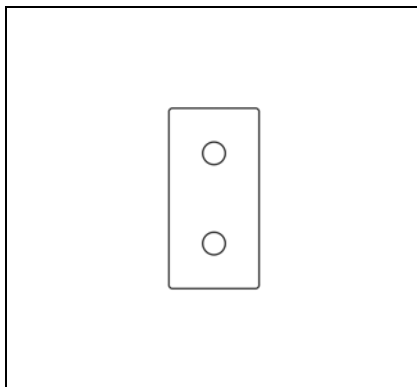
1 x Z-End-Mount-Motor  
1 x Z-End-Mount-Bottom



2 x Y-End-Plate-Left  
2 x Y-End-Plate-Right

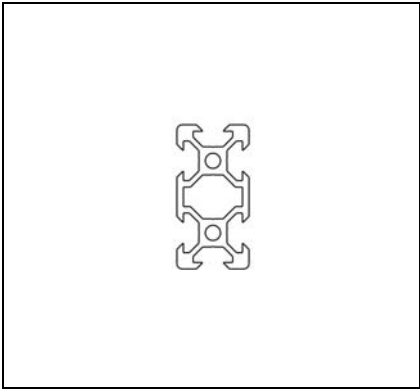


4 x End-Cap

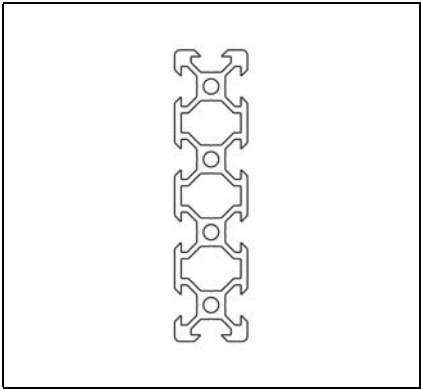


**Extrusions**

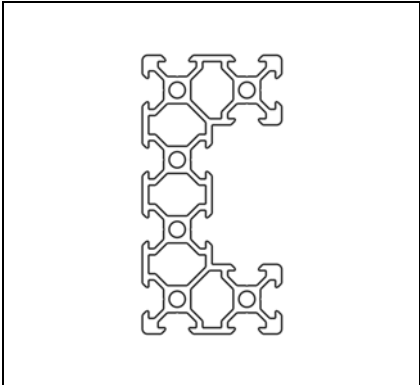
2 x V-Slot-2040-665mm  
2 x V-Slot-2040-745mm  
1 x V-Slot-2040-750mm



2 x V-Slot-2080-710mm

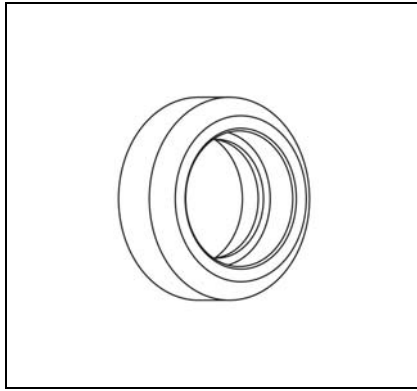


3 x C-Beam-750mm  
1 x C-Beam-250mm

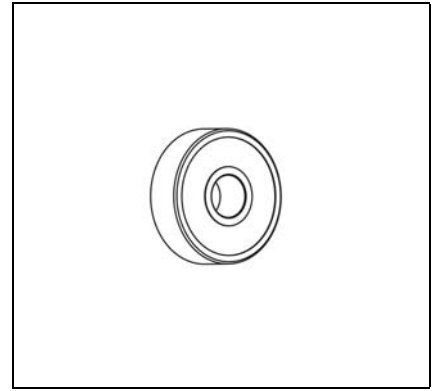


# Motion Components

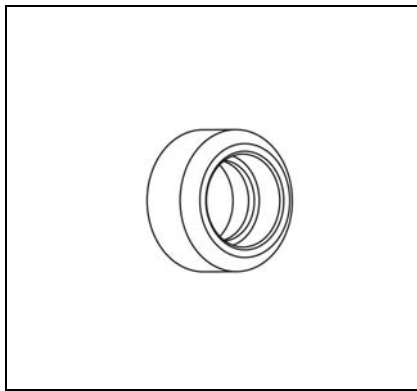
49 x Solid-V-  
Xtreme-Wheel-Kit



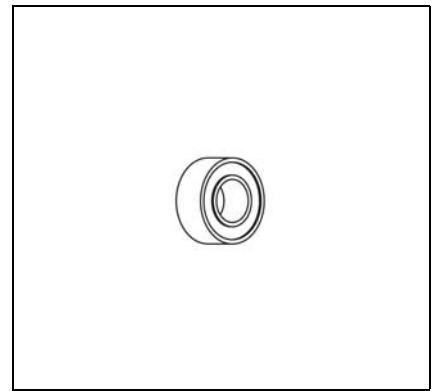
98 x 625-2RS-  
Bearing (Included  
in Solid-V-Wheel-  
Xtreme-Kit packet)



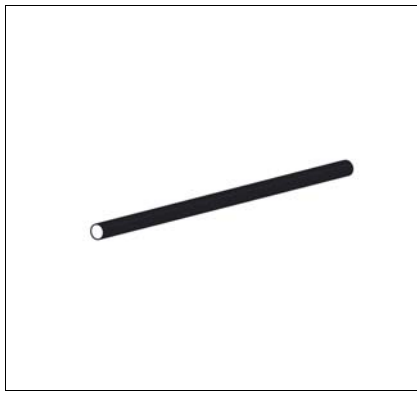
4 x Mini-V-Wheel-  
Kit



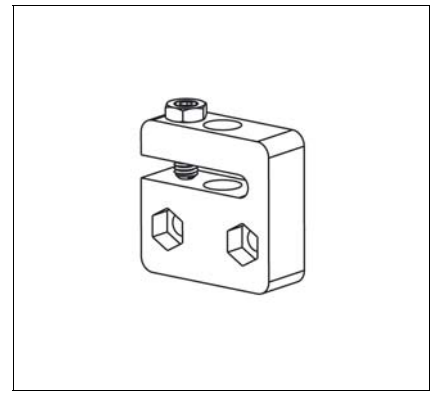
8 x Mini-V-Bearing  
(Included in Mini-V-  
Wheel-Kit packet)



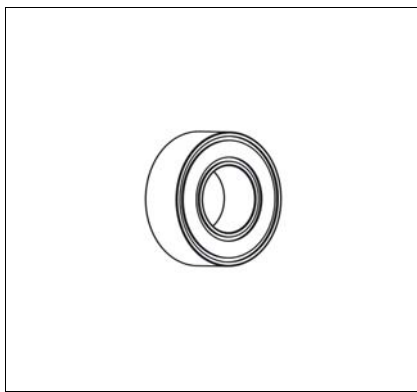
1 x Z-ACME-Screw



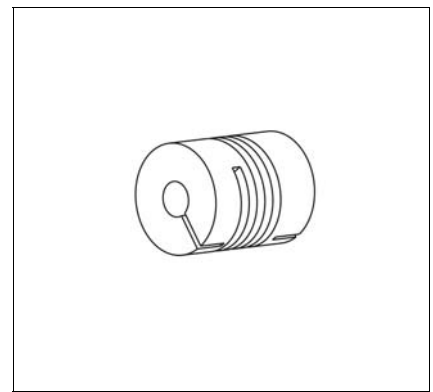
1 x ACME-AB-Nut-  
Block



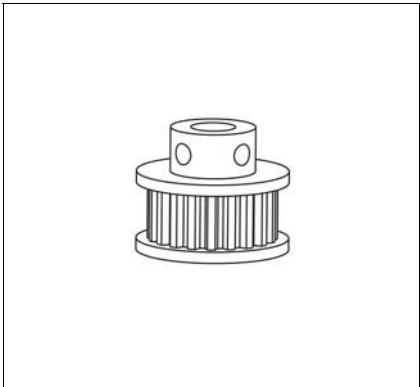
2 x 688ZZ-Bearing



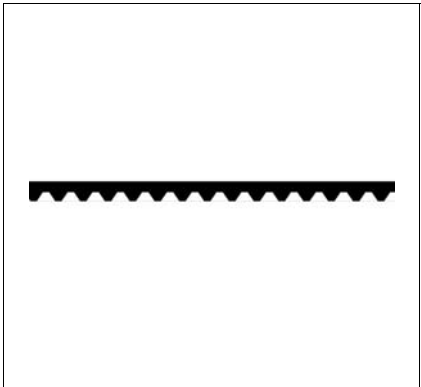
1 x Flexible-Coupler



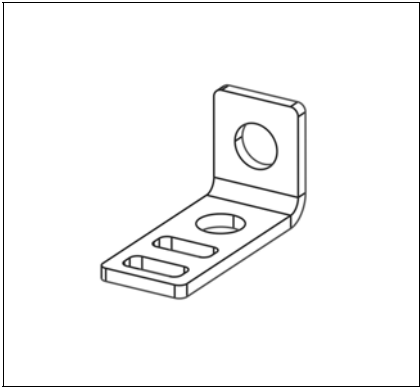
3 x GT3-Pulley



1 x X-GT3-Timing-Belt-1m  
2 x Y-GT3-Timing-Belt-1m



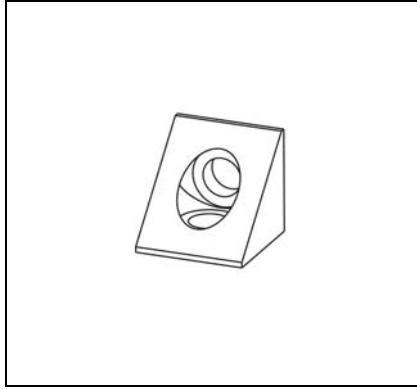
6 x Belt-Tensioner



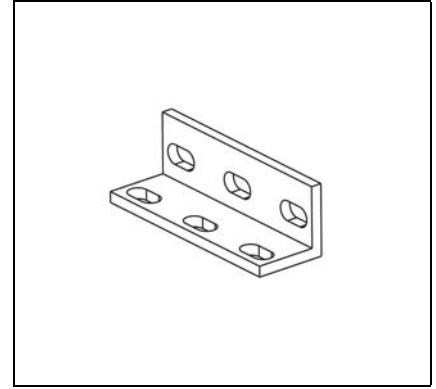


## **Brackets & Spacers**

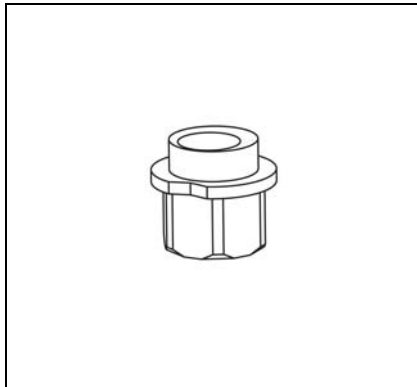
8 x Angle-Corner



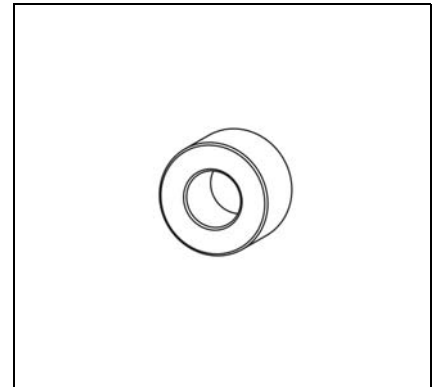
8 x Universal-Bracket-Triple



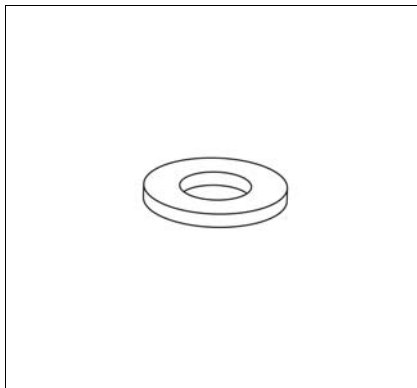
21 x Eccentric-Spacer-6mm



14 x Aluminium-Spacer-3mm  
31 x Aluminium-Spacer-6mm  
21 x Aluminium-Spacer-9mm  
4 x Aluminium-Spacer-40mm

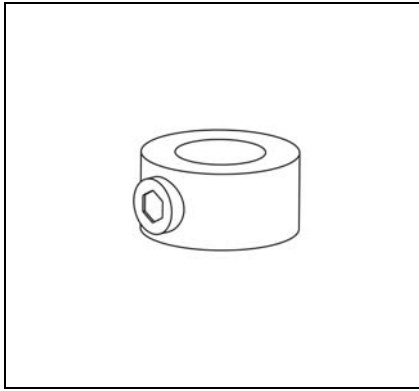


104 x Precision-Shim (98 Included in Solid-V-Wheel-Xtreme-Kit packet)  
2 x 8mm-Shim  
12 x Mini-V-Precision-Shim (8 Included in Mini-V-Wheel-Kit packet)

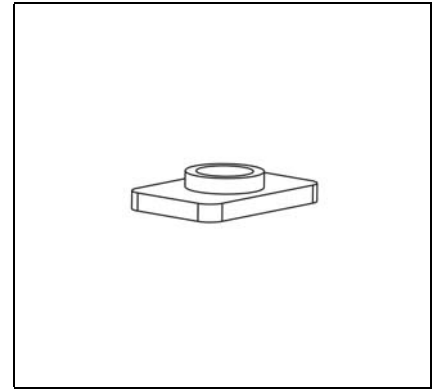


## Hardware

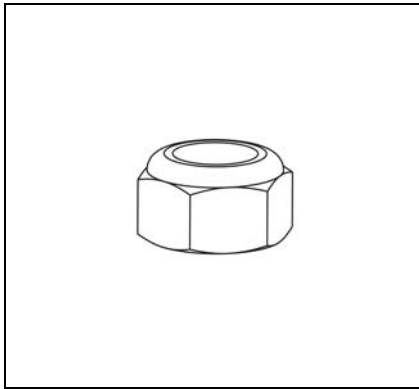
2 x 8mm-Lock-Col-  
lar



86 x Tee-Nuts

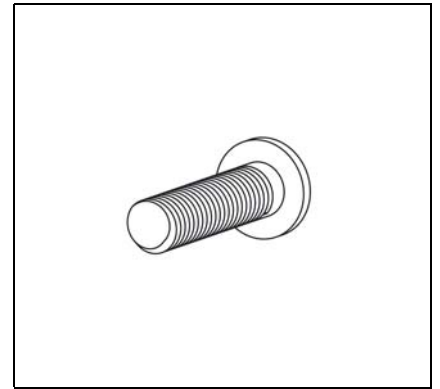


57 x M5-Nyloc-Nut

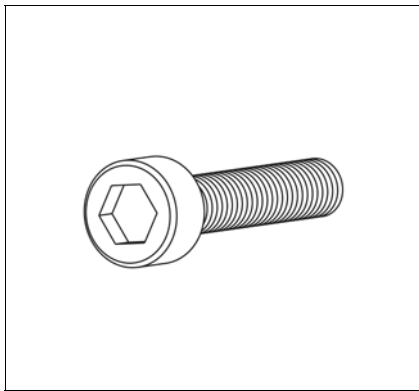


M5-Low-Profile:

74 x 8mm  
6 x 10mm  
24 x 12mm  
40 x 15mm  
20 x 20mm  
6 x 25mm  
6 x 30mm  
4 x 50mm  
21 x 60mm



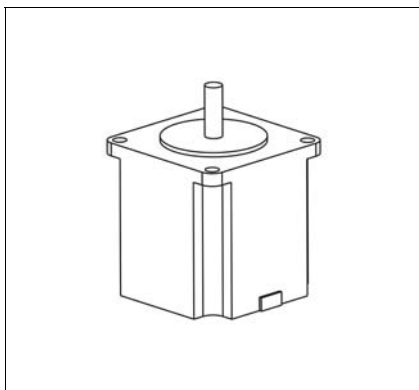
6 x M3-Cap-Head-  
4mm



12 x Cable-Tie-  
Small



4 x NEMA23-Step-  
per-Motor (With  
Wires)



50 x M5-Drop-In-  
Tee-Nuts

