

Created by Petar Crnjak , For more info visit :
<https://github.com/PCrnjak>

This is version 1.0 of this file.

This file will show you how to build Faze4 robot arm. All info about the project will be on my github: <https://github.com/PCrnjak>

Little bit about the arm. It was made with the idea of having high repeatability and low vibrations. A lot of other open source arms didn't have those requirements so I decided to build my own arm. This is fourth arm I made and thus the name Faze4. Whole build is based and designed around cycloidal gearboxes I designed. Actually the whole idea of arm came to be when I found that the gearboxes were relatively cheap and behaved good.

Arm has around 1000 parts so you will have to buy and print a lot of stuff. I printed mine with PETG, but I think PLA could work even better if you don't overheat the motors.

Some mistakes I made that you can avoid:

- -When printing parts try to reduce the weight as much as possible. You can probably print most parts with 25-50 max infill with 2-3 parameters. I printed most parts with 50-80 infill and that was a mistake. Print large parts with 0.3-0.35 layer height and smaller ones with 0.15-0.2.
- -There are a lot of large parts. Print them SLOW. I rushed some big parts and regretted that.
- -If I used 10 screws to screw one part it does not mean you need all of them, almost whole arm is overdesigned and you can probably half all screws for connecting parts.
- Most parts are attached by screws that make their own thread in plastic part. All step files will be available so you can check hole sizes and maybe adjust them for your printer. I printed on PRUSA i3 MK2S.
- Make sure cycloidal discs are **tight** but not **too tight** so they can't be rotated. It is hard to explain but when you print one you might immediately feel what is right and what is not.

Before you start extend EVERY wire for about 1.5 meters. Those that are on the tip of the arm should be extended for 1.5 and those on the bottom for less.

Next page is BOM and after that instructions start.

Use BOM in github for most updated parts !!!

Screws:		
diameter , lenght	Type	quantity
M2 5mm screw	philips pan head	3
M3 5mm screw	philips pan head	12
M3 4mm set screw	Hex	6
M3 25mm screw	philips pan head	64
M2 8 mm screw	philips pan head	8
M3 20mm screw	philips pan head	53
M3 10 mm screw	philips pan head	54
M3 15mm screw	philips pan head	54
M5 30 mm screw	Hex socket cap	13
M5 20 mm screw	Hex socket cap	27
M5 8 mm screw	Hex socket cap	12
M3 30 mm screw	philips pan head	52
M5 25 mm screw	Hex socket cap	8
M2 10-12 mm screw	philips pan head	7
M5 40 mm screw	Hex socket cap	10
M10 60 mm screw	Hex socket cap	4

Bearings:	
Type	quantity
Ball bearing 35x47x7	8
Ball bearing 3x8x4	200
Ball bearing 17x23x4	4
Ball bearing 15x28x7	6
Ball bearing 3x10x4	40
Ball bearing 50x67x7	8
Ball bearing 5x10x4	32
Ball bearing 5x16x5	13

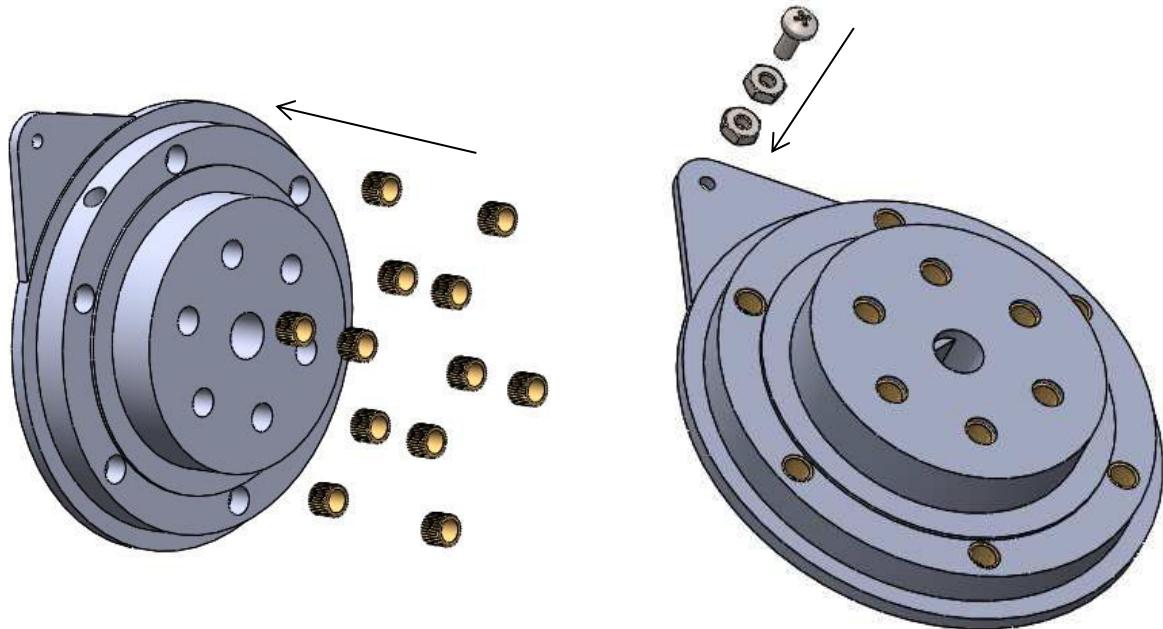
Other:	
Name	quantity
M3 4mm brass inserts	12
M2 nuts	2
M3 nuts	6
Inductive sensor	2
M8 nuts (usually included with sensor)	4
Nema 14 L=33mm w/19:1 gearbox	1
Nema 17 Bipolar 12V 42x42x40mm	2
Pneumatic bulkhead connector 4mm xM12 thread	2
M12 nuts	4
4mm pneumatic tube	1
Micro limit switch	3
HTD 5M 430 mm timing belt 10 mm wide	1
Nema 23 Bipolar 0.9deg 2.8A 2.5V 57x57x56mm	1
J4 belt	1
Nema 23 Bipolar 4A 2.26V 57x57x84mm	1
M5 nuts	15
M10 nuts	4
Roller limit switches	2
Nema 23 Bipolar 1.5A 5.4V 57x57x56mm	1
HTD 5M 490 mm timing belt 10 mm wide	1

Total not 3d printed parts :	764
Total 3d printed parts :	197
Total parts	961

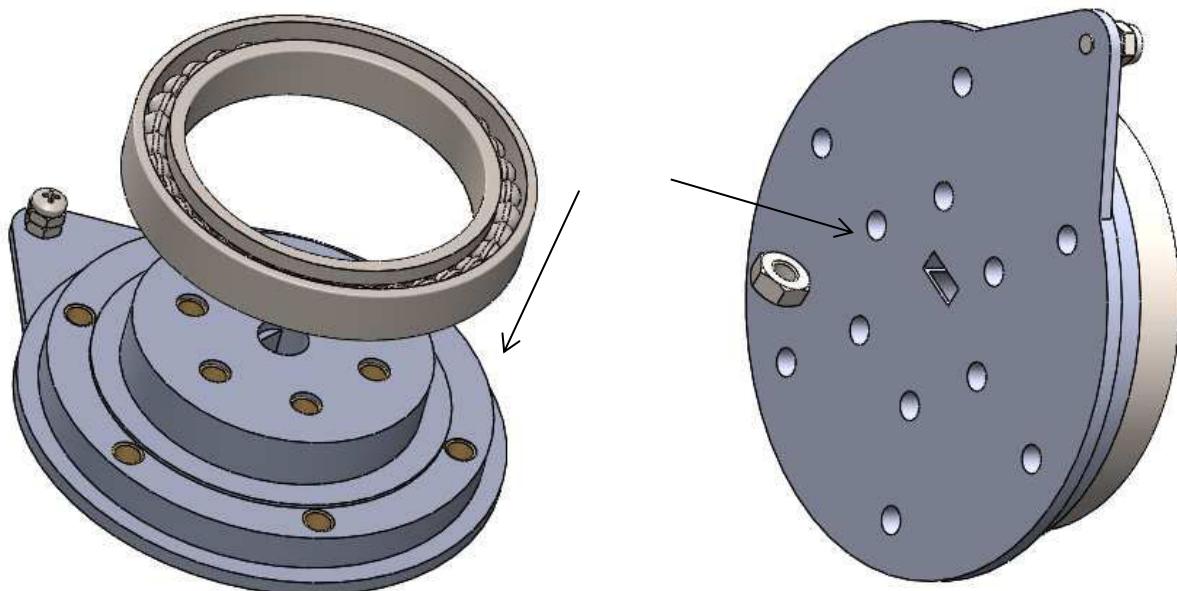
3D Printed parts:	
Name	quantity
Joint 6 Output shaft	1
Wrist case	1
Wrist cover	1
Forearm main case	1
J5 ring rollers	12
11:1 cyclo disc	4
Eccentric shaft J5	1
Servo gripper plug	1
joint 5 output shaft	1
joint 5 output spacers	10
joint 5 switch trigger	1
Forearm top cover	1
J5 28 teeth pulley	2
Joint 4 output shaft	1
Joint 4 motor case	1
J4 ring spacers	12
Eccentric shaft J4	1
J4 cyclo output shaft	1
joint 4 output spacers	10
Joint 4 top cover	1
Joint 3 main case	1
Joint 3 cover	1
15:1 cyclo disc	4
Joint 3 ring spacers	32
Joint 3 eccentric shaft	1
Joint 3 output shaft	1
Joint 3 top cover	1
Joint 4 offset	1
Joint 4 limit switch cover	1
Joint 4 pulley 28 teeth	1
26 teeth Joint 4 pulley	1
Fork	1
Fork_motor	1
Fork_wires	1
Joint 3 limit trigger	1
Joint 2 main case	1
Joint 2 cover	1
Joint 2 eccentric shaft	1
Joint 2 cyclo disc	2
Joint 2 ring spacer	28
Joint 2 output shaft	1
Joint 2 top cover	1
Rotating base wires	1
Rotating base motor	1
Joint 1 output shaft	1
Joint 1 main case	1
Joint 1 cover	1
Joint 1 ring spacers	32
Joint 1 eccentric shaft	1
Joint 1 cyclo output shaft	1
Joint 1 top cover	1
Main base	1
36 teeth pulley	1
Ball bearing retainer	1
Shaft blocker	1
Forearm motor lid	1
Forearm wires lid	1
Elbow lid	1
Upper arm lid	1
Rotating base lid	1

Wrist Assembly

Step1



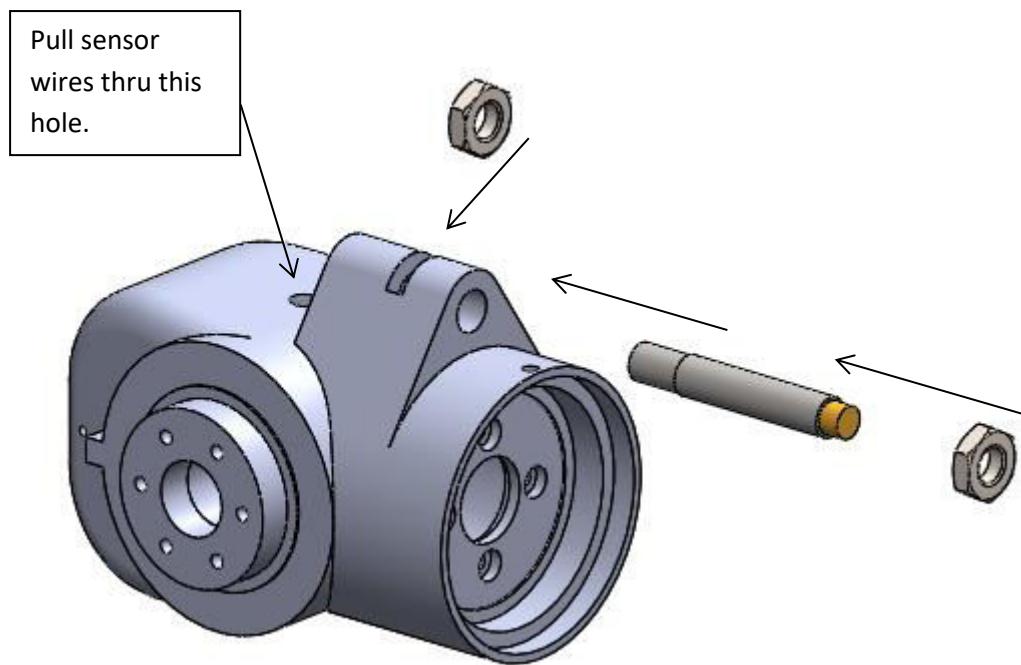
Part	Quantity	Position	Notes: To insert brass inserts you need to heat them up . I recommend using soldering iron . Place insert on heated tip of soldering iron and slowly press it down in the hole. Push them so they dont peak above the plastic.
Joint 6 Output shaft	1	1	
M3 4mm brass inserts	12	2	
M2 5mm screw	1	3	
M2 nuts	2	4	



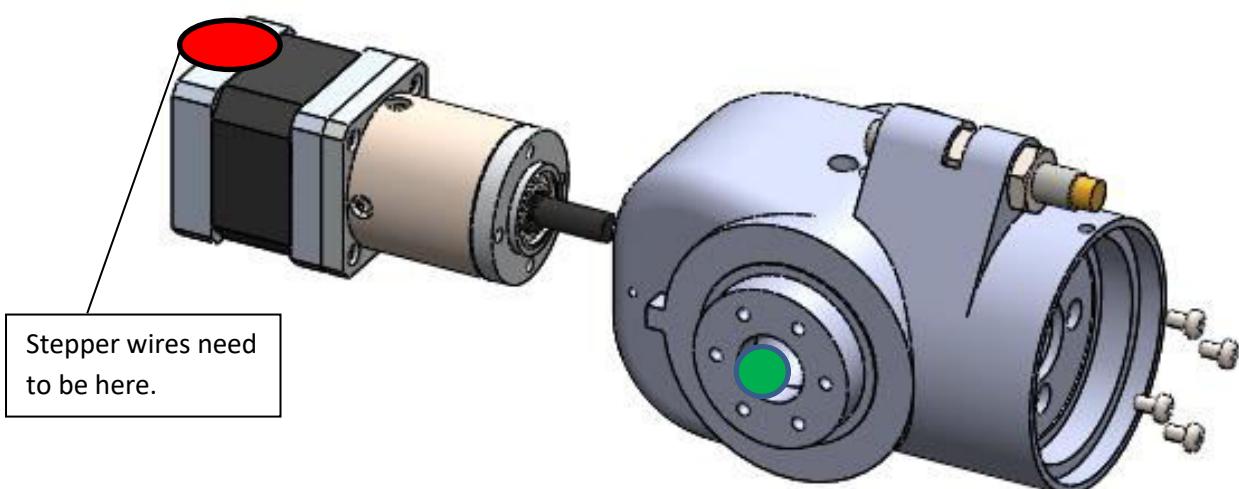
Part	Quantity	Position	Notes:
Ball bearing 35x47x7	1	1	
M3 nut	1	2	

Wrist Assembly

Step2



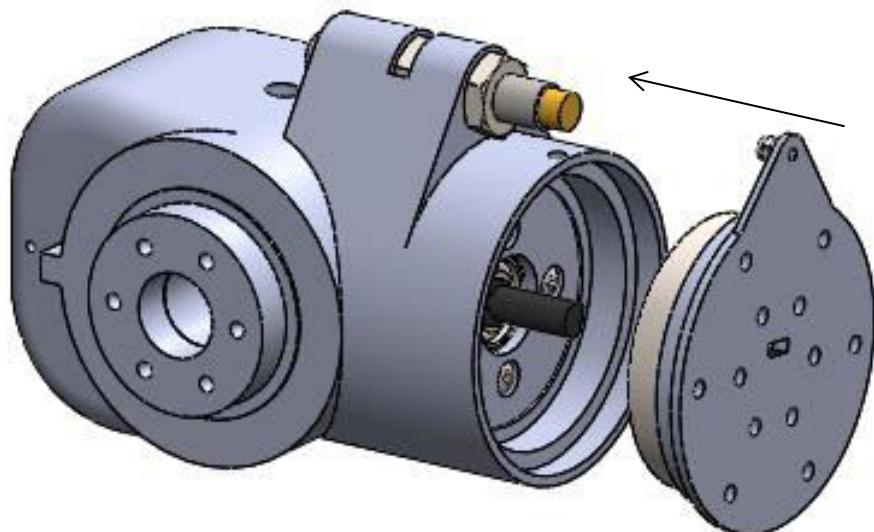
Part	Quantity	Position	Notes:Dont tighten nuts too much . We will need to adjust sensor soon. (Both M8 nuts should be included with inductive sensor)
Wrist case	1	1	
Inductive sensor	1	2	
M8 nuts	2	3	



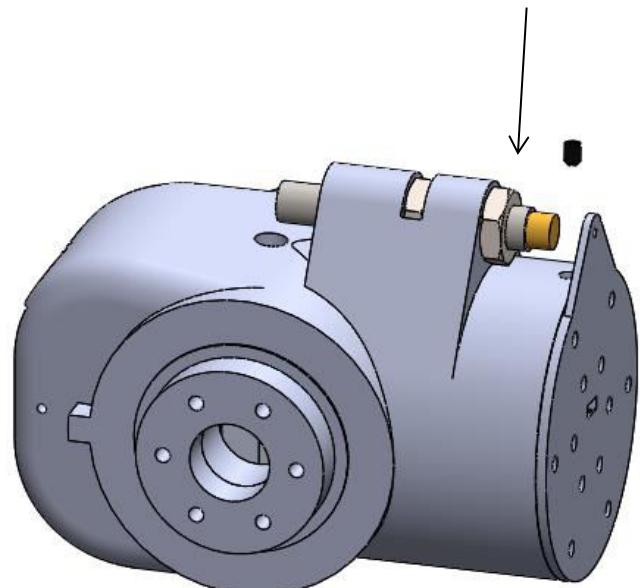
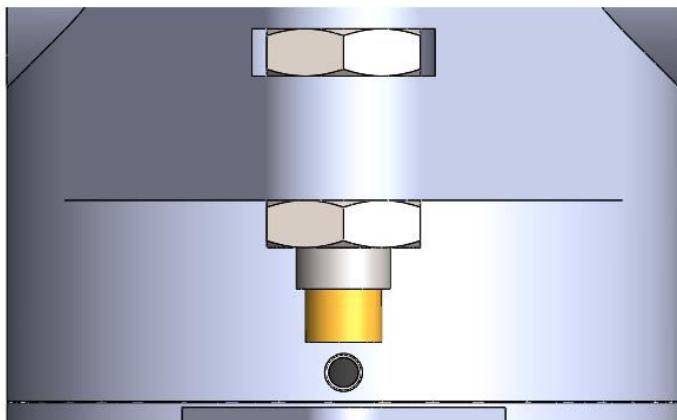
Part	Quantity	Position	Notes: One of tricky parts now is to route stepper wires and sensor wires thru channels in 3d printed part and make them come out of this hole (marked green).If you routed wires screw motor to case with 4x M3 screws.
M3 5mm screws	4	1	
Nema 14 ,19:1 gearbox motor	1	2	

Wrist Assembly

Step3



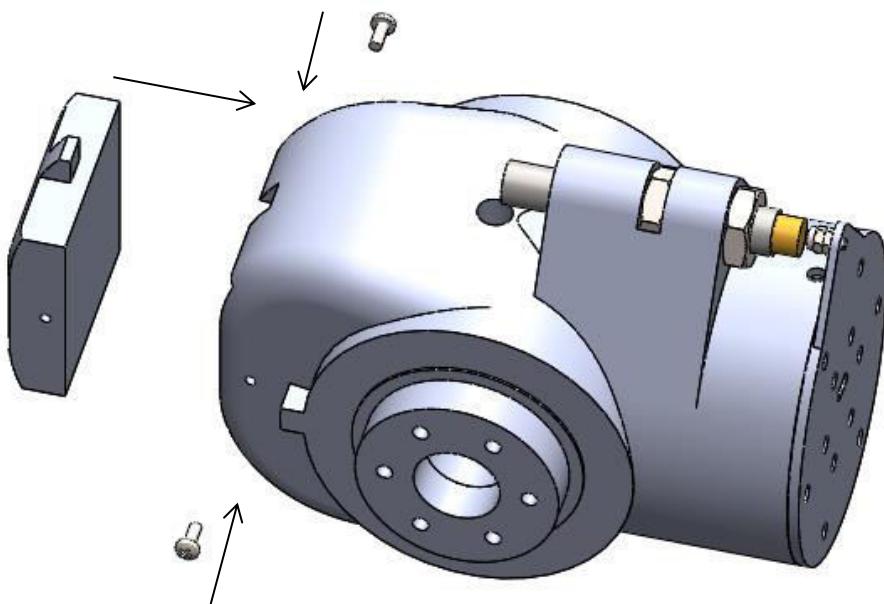
Part	Quantity	Position	Notes: Attach output shaft to shaft of the gearbox. make shure to align both flat ends of shafts.



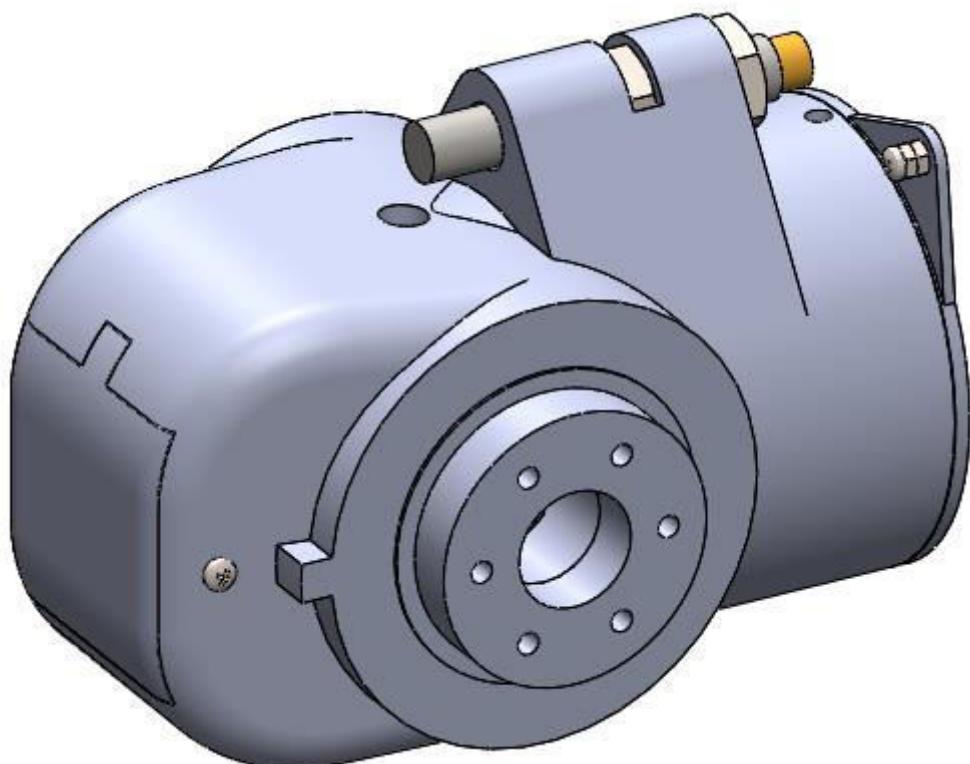
Part	Quantity	Position	Notes: Remove M2 screws with nuts from output shaft. Unscrew sensor so you can see the hole on the 3d printed wrist part. Now align that hole and one on the output shaft. Insert set screw and tighten it up. Return M2 screw and nuts and adjust sensor so it is really close to the screw but not touching it
M3 4mm set screw	1	1	

Wrist Assembly

Step4

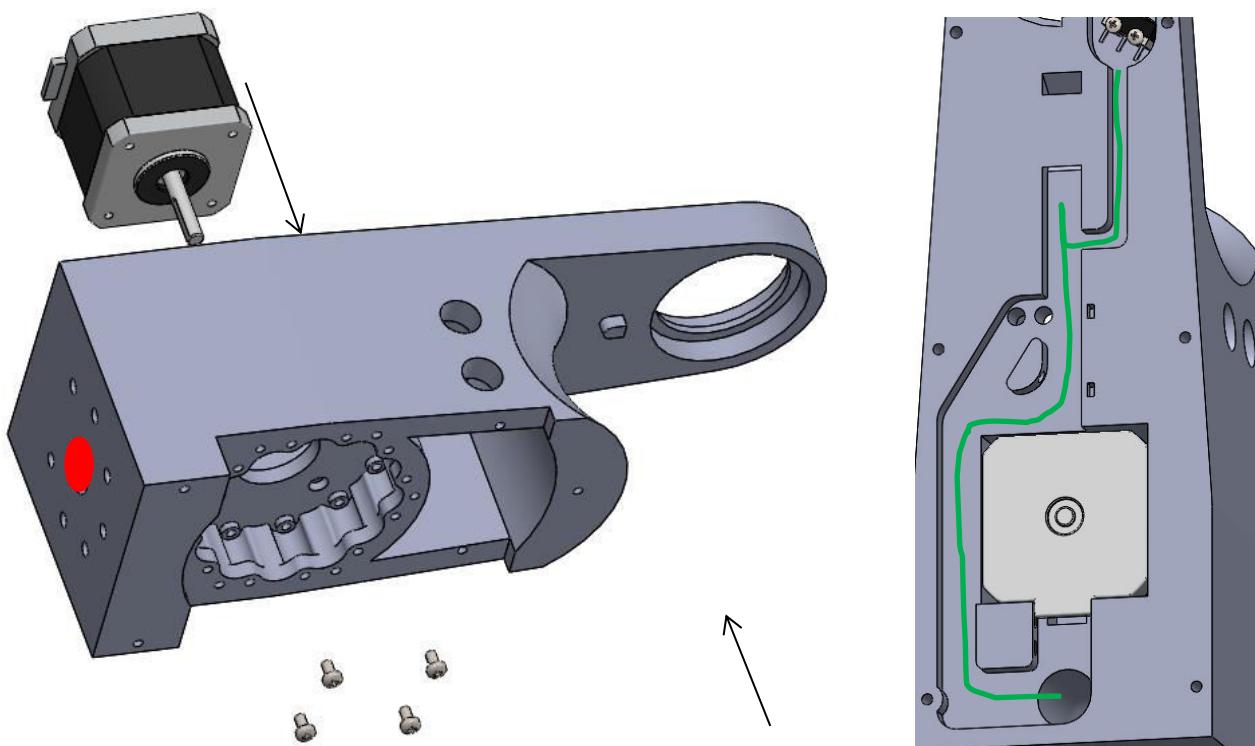


Part	Quantity	Position	Notes: Insert lid and then screw it with M2 screws.
Wrist cover	1	1	
M2 5mm screw	2	2	



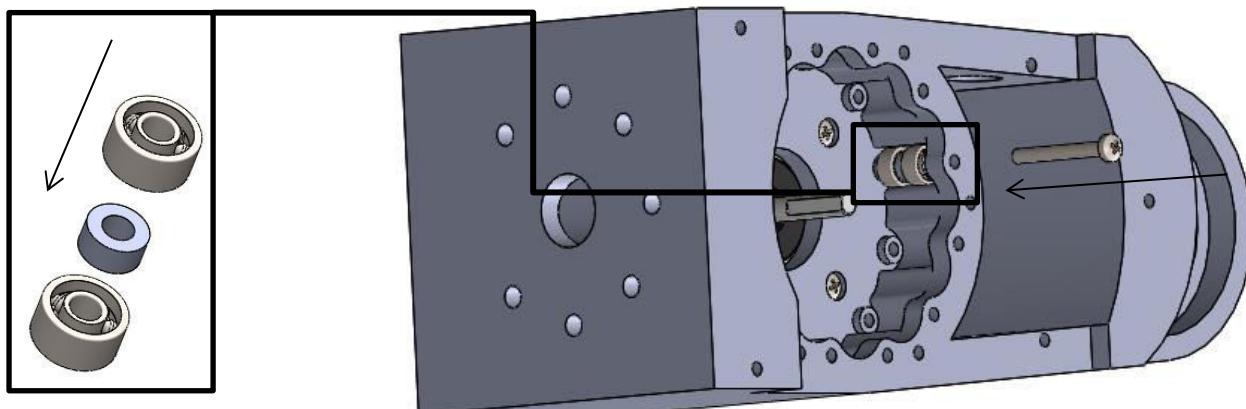
Forearm assembly

Step1



Part	Quantity	Position	Notes:
Forearm main case	1	1	
Nema 17 stepper	1	2	
M3 5mm screws	4	3	Attach stepper so that the side where wires go out is turned towards hole marked with RED. Also pull stepper wires thru that hole. Also all other wires and pipes used in this build will have to be pulled thru that hole. They should go thru channels marked in green.

Roller pin assembly



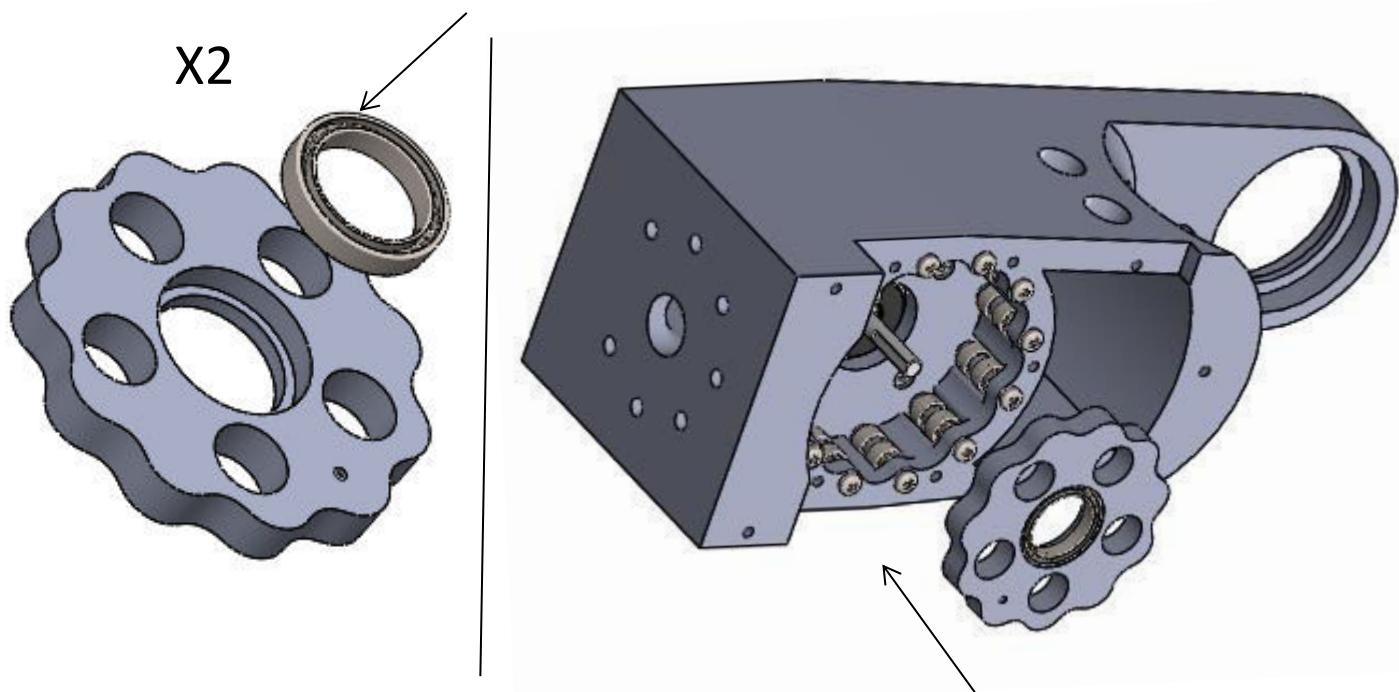
Part	Quantity	Position	Notes:
Ball bearing 3x8x4	24	1	
J5 Ring rollers	12	2	
M3 25mm screws	12	3	Place roller pin assembly in marked spot and secure it with M3 25 mm screw. Do this 12 times. It can take up to 1h to clean and assemble all 12 pins so take breaks if needed. ;)

Example how wiring should look like

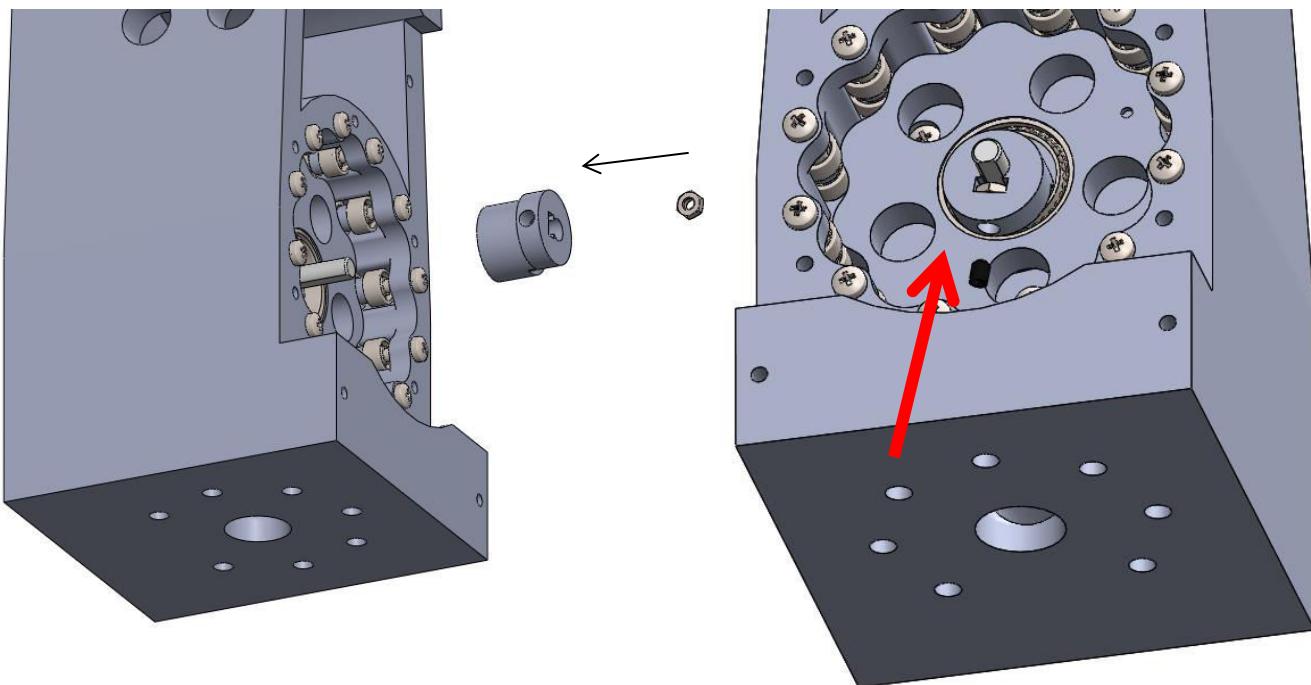


Forearm assembly

Step2



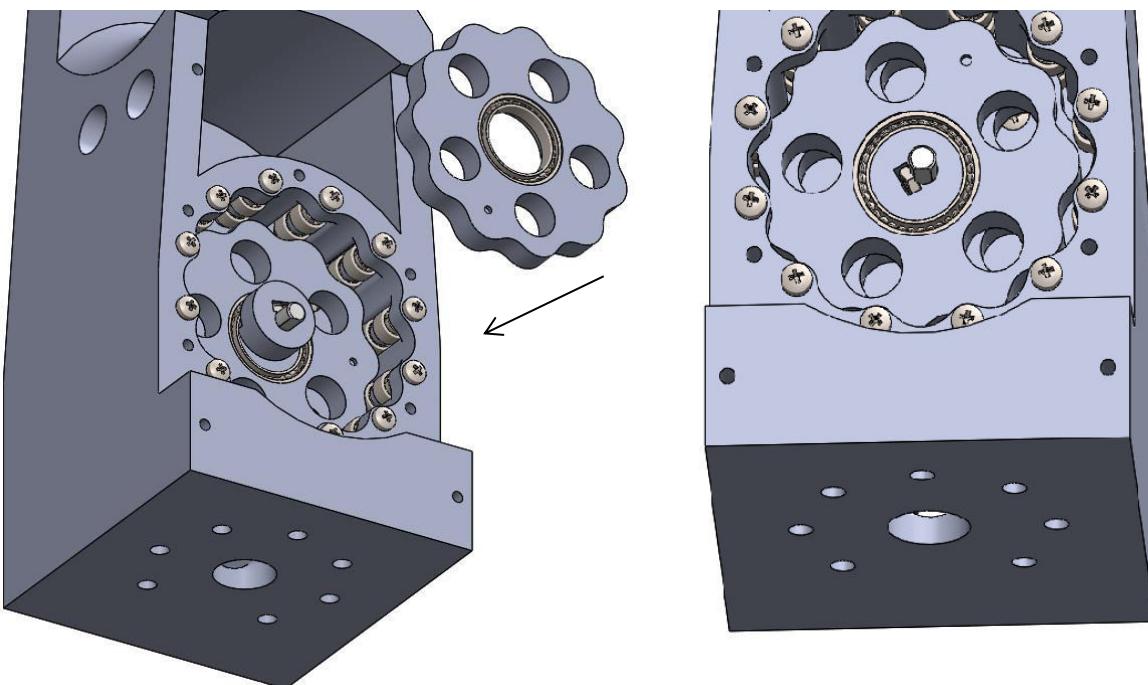
Part	Quantity	Position	Notes: Insert only one assembled cyclo disc
11:1 cyclo disc	2	1	
17x23x4 ball bearing	2	2	



Part	Quantity	Position	Notes: Dont overtighten set screw. When you start feeling some resistance make one extra half turn and that is it.
Eccentric shaft J5	1	1	
M3 nut	1	2	
M3 4mm set screw	1	3	

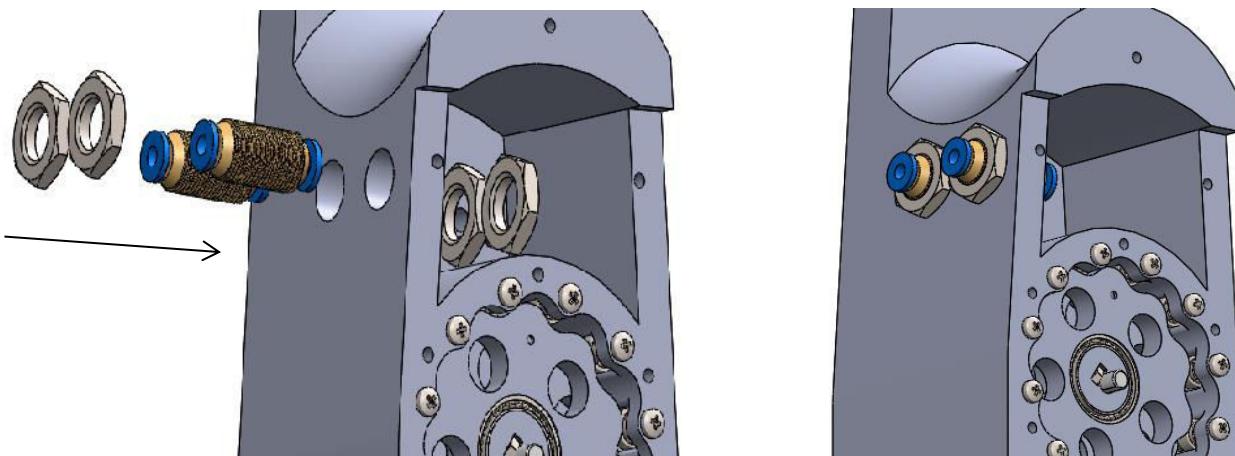
Forearm Assembly

Step3



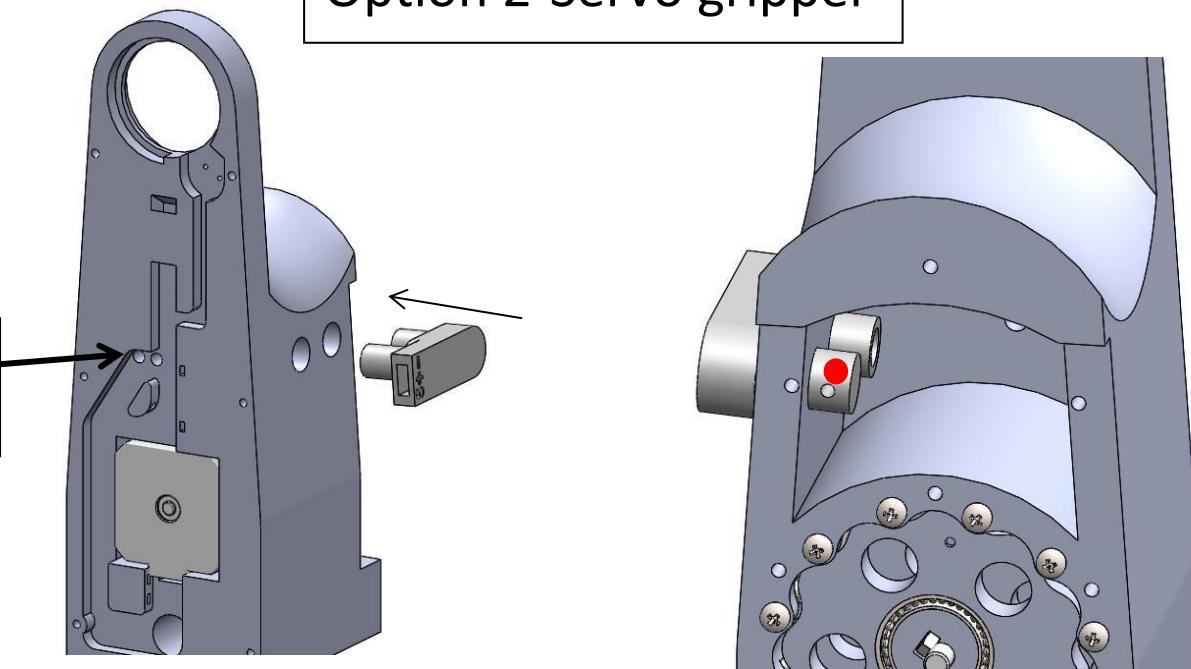
Part	Quantity	Position	Notes: When putting second cyclo disc try to align 2 holes on them. It will not be perfect but closest configuration should be correct.

Option 1 – pneumatic gripper

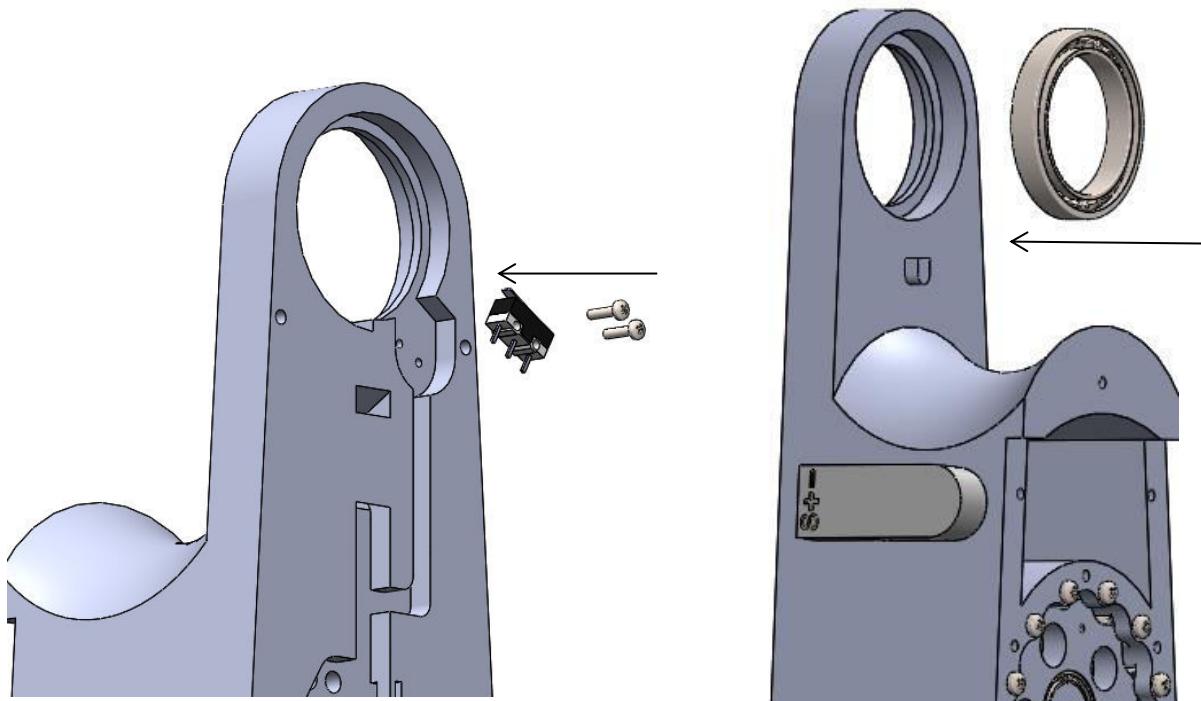


Part	Quantity	Position	Notes: there are 2 options for gripper. Pneumatic and servo gripper. Pneumatic one is not tested. After screwing 2 pneumatic connectors you should route pipes thru the 2 holes on side and then thru same hole that you pulled stepper wire.
Pneumatic Bulkhead connector 4mm xM12 thread	2	1	
M12 nuts	4	2	
4mm pneumatic tube	1	3	

Option 2-Servo gripper



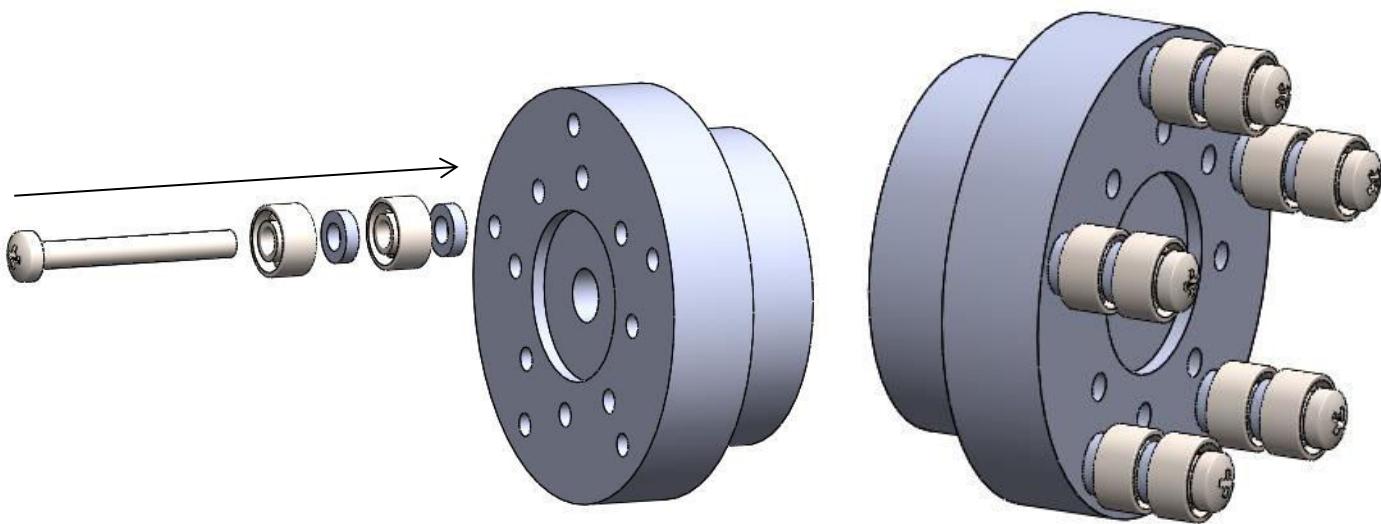
Part	Quantity	Position	Notes:
Servo gripper plug	1	1	This is option 2 that is tested and used. After you insert Servo plug take 2 zip ties and tie them around marked parts (RED).



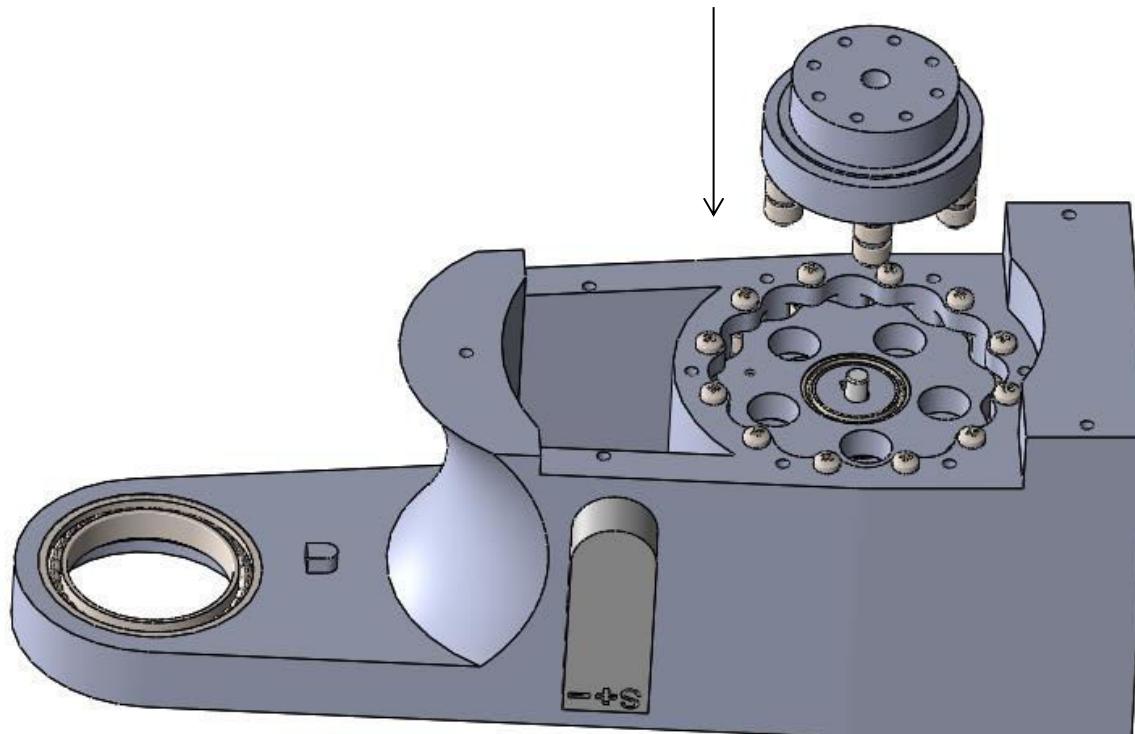
Part	Quantity	Position	Notes:
Micro limit switch	1	1	
Ball bearing 35x47x7	1	2	
M2 8mm screws	2	3	

Forearm Assembly

Step5



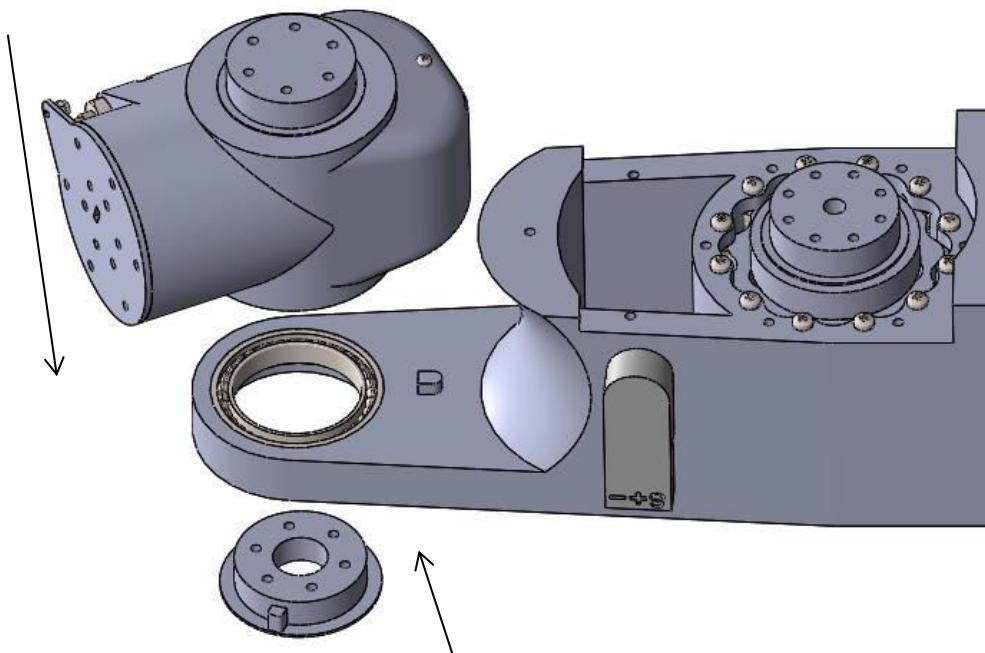
Part	Quantity	Position	Notes: bearing need to be able to turn freely so dont overtighten.
Joint 5 Output shaft	1	1	
Joint 5 Output spacers	10	2	
M3 20mm screw	5	3	
3x8x4 ball bearing	10	4	



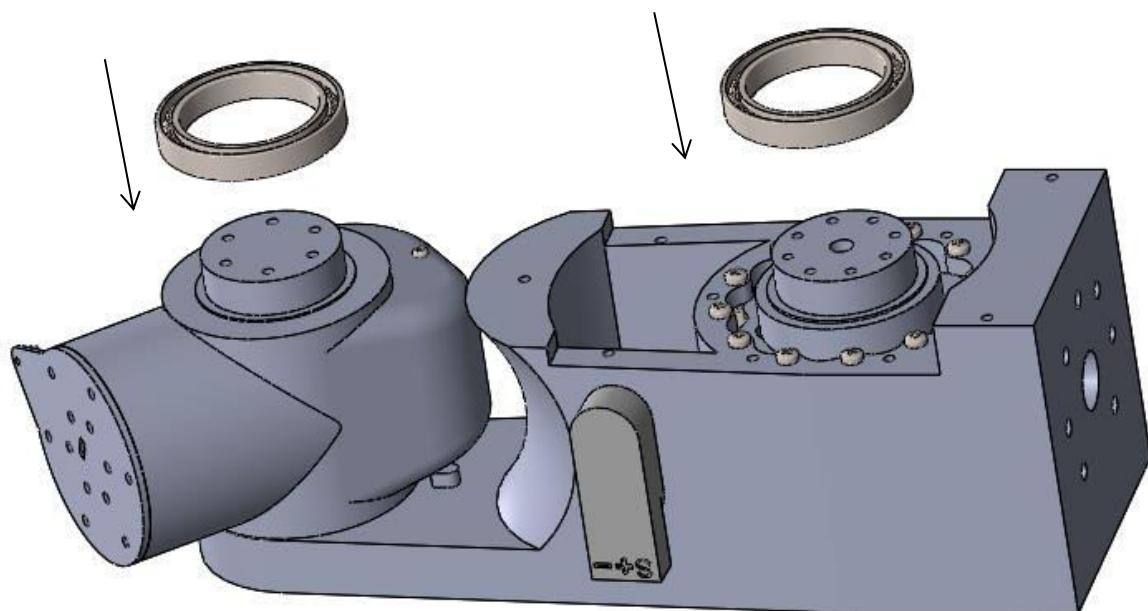
Part	Quantity	Position	Notes: If you have problems putting output shaft in, make sure you aligned the dots on cyclo discs.

Forearm Assembly

Step6



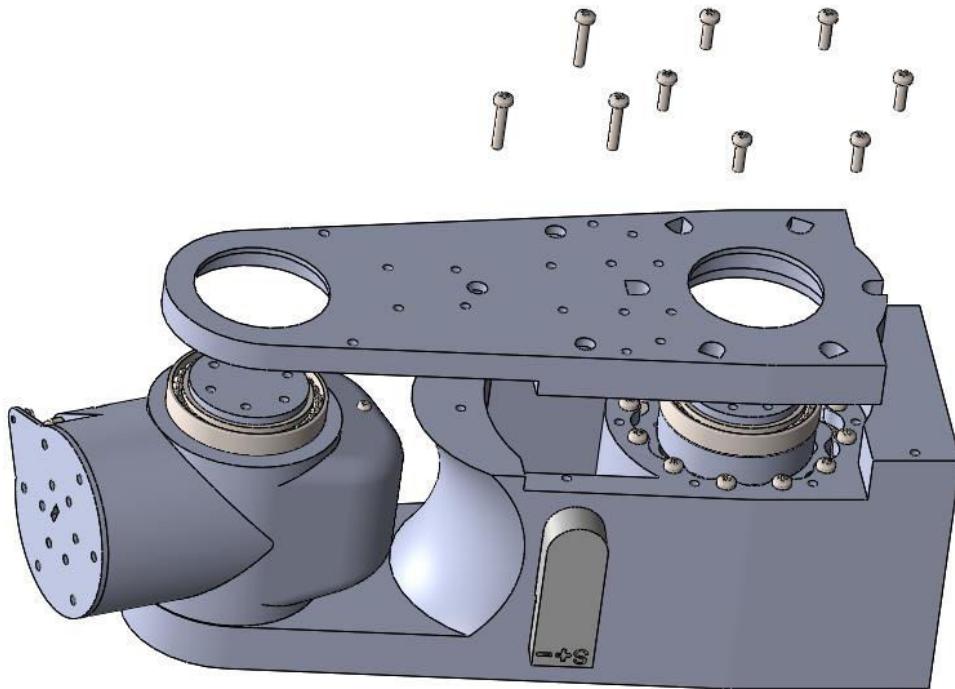
Part	Quantity	Position	Notes:
Joint 5 switch trigger	1	2	You will need to pull wires of Wrist part thru the bearing and J5 switch trigger part. We will secure them with screws later. Wires need to be routed like stated in step one of Forearm assembly.



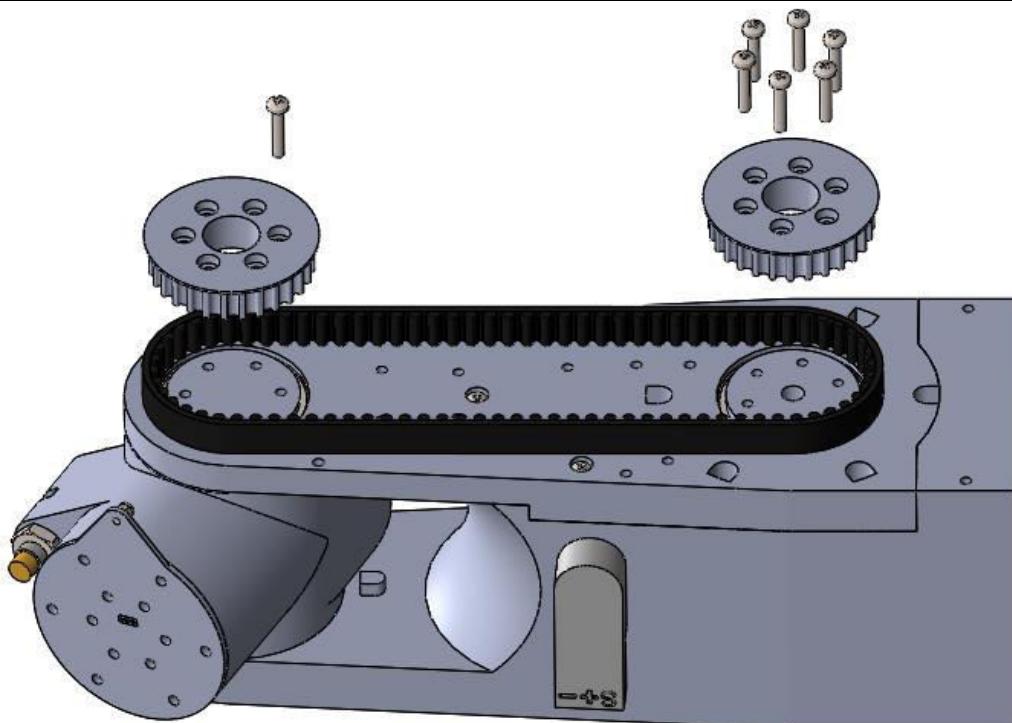
Part	Quantity	Position	Notes:
Ball bearing 35x47x7	2	1	

Forearm Assembly

Step7



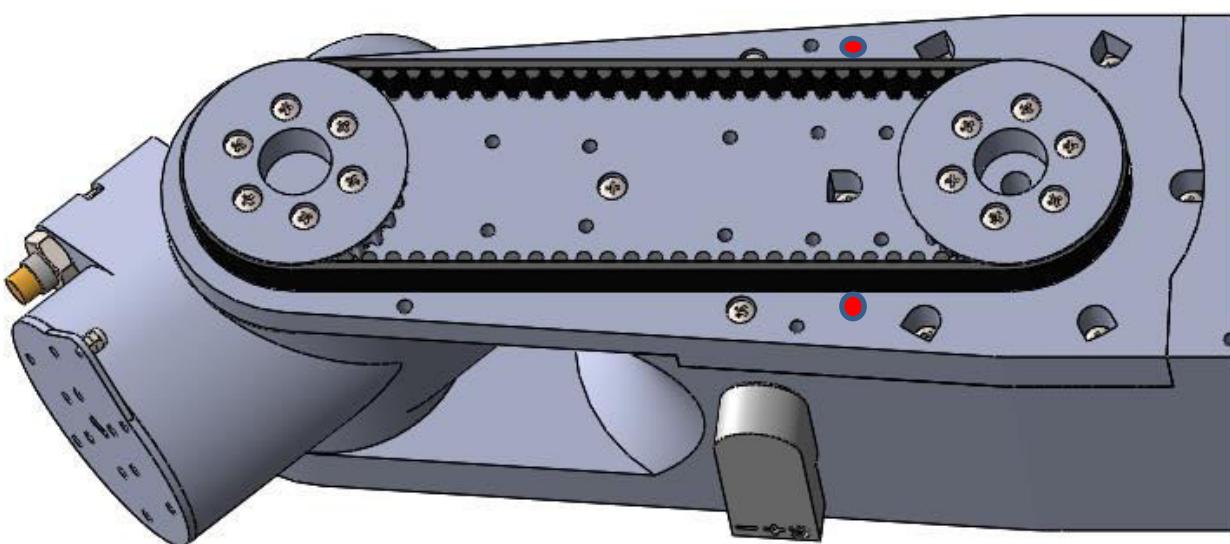
Part	Quantity	Position	Notes:
Forearm top cover	1	1	
M3 10 mm screws	6	2	
M3 15 mm screws	3	3	



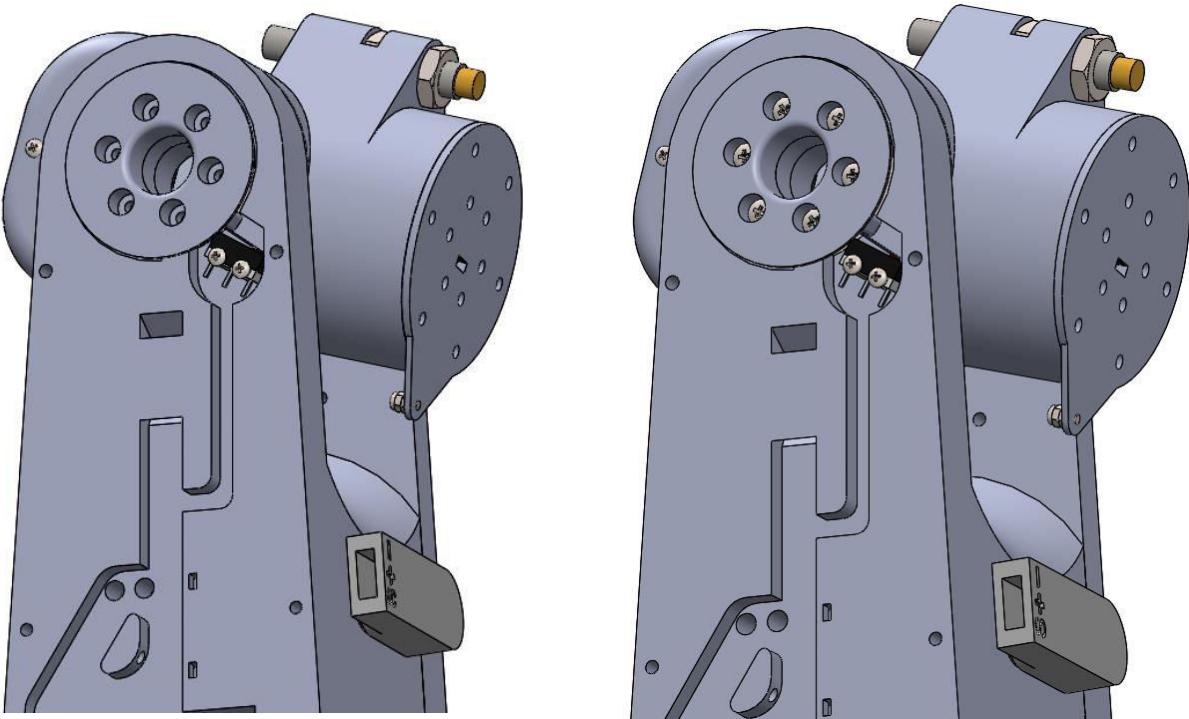
Part	Quantity	Position	Notes:On second pulley insert only one screw so you can tighten the belt.
M3 15mm screw	7	1	
J5 28 teeth pulley	2	2	
HTD 5M 430 mm timing belt 10 mm wide	1	1	

Forearm Assembly

Step8



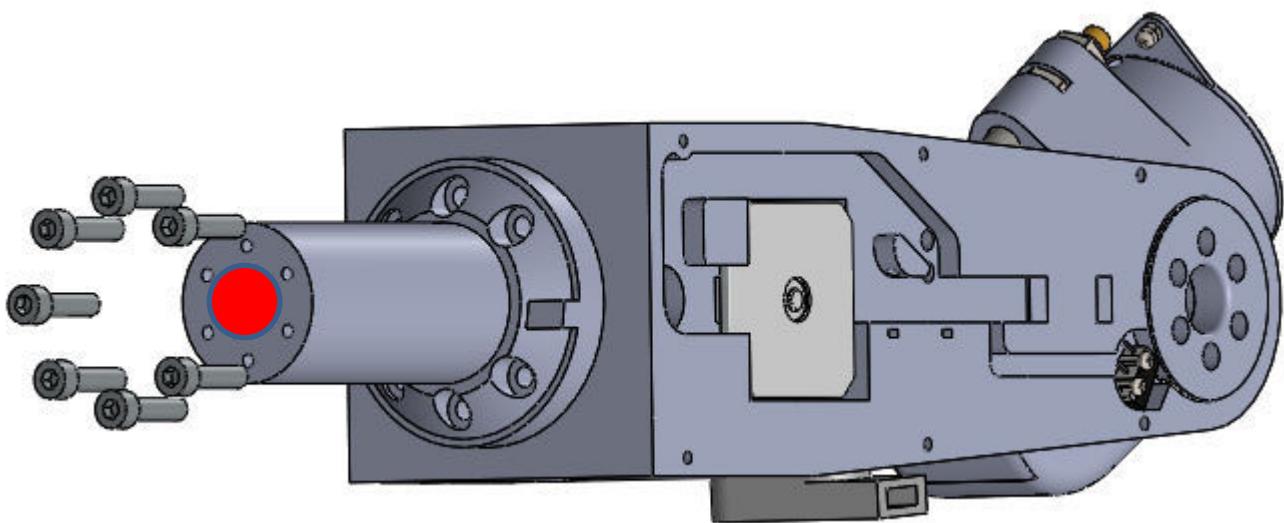
Part	Quantity	Position	Notes: Insert rest of the screws to the pulley. If the belt is not tight enough you can place additional ball bearings to holes marked with red to tighten it more	
M3 15mm screw	5	1		
Optional				
M3 15mm screw	2	2		
3x8x4 or 3x10x4 ball bearing	4	3		



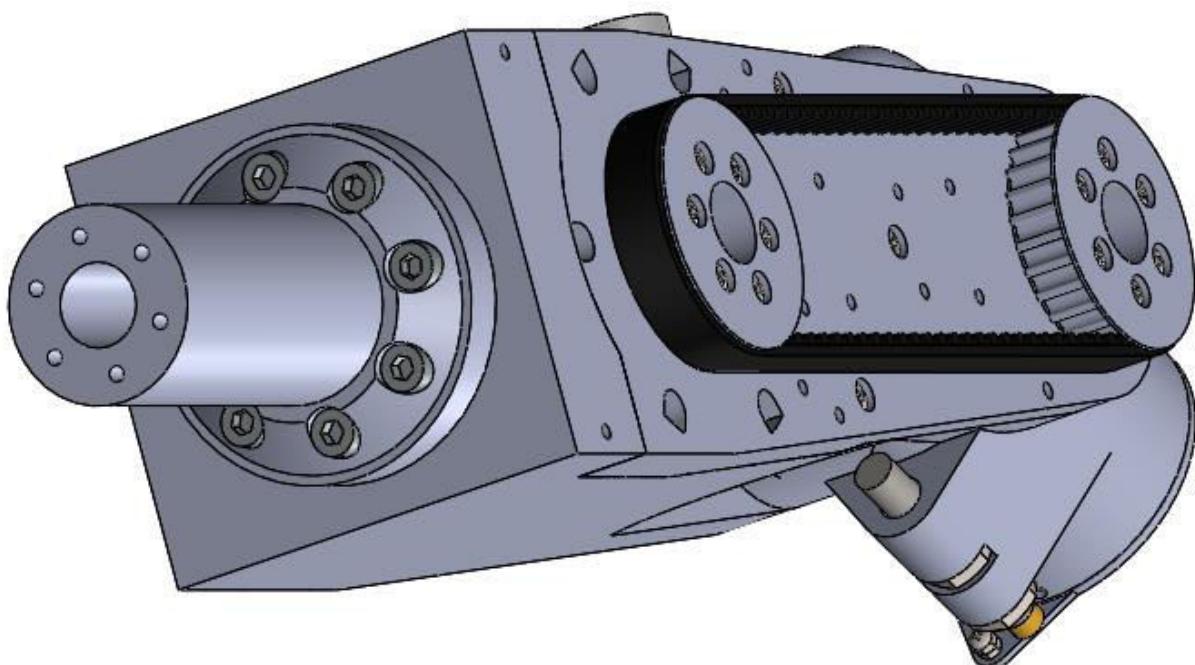
Part	Quantity	Position	Notes: wires from wrist need to go thru the channels marked by green and thru the hole marked in red in step 1 of forearm assembly.
M3 15mm screw	6	1	

Forearm Assembly

Step9



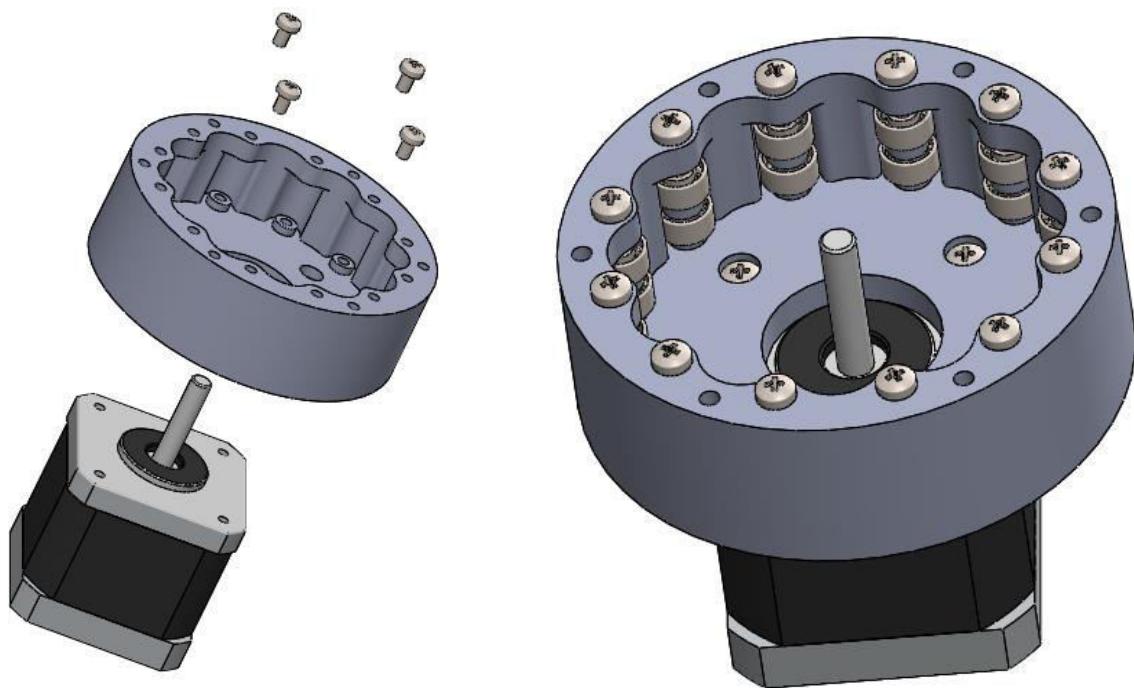
Part	Quantity	Position	Notes: ALL wires (and pipes if you are using them) need to go thru the hole marked with red.
Joint4 shaft	1	1	
M5 20mm IMBUS screw	7	2	



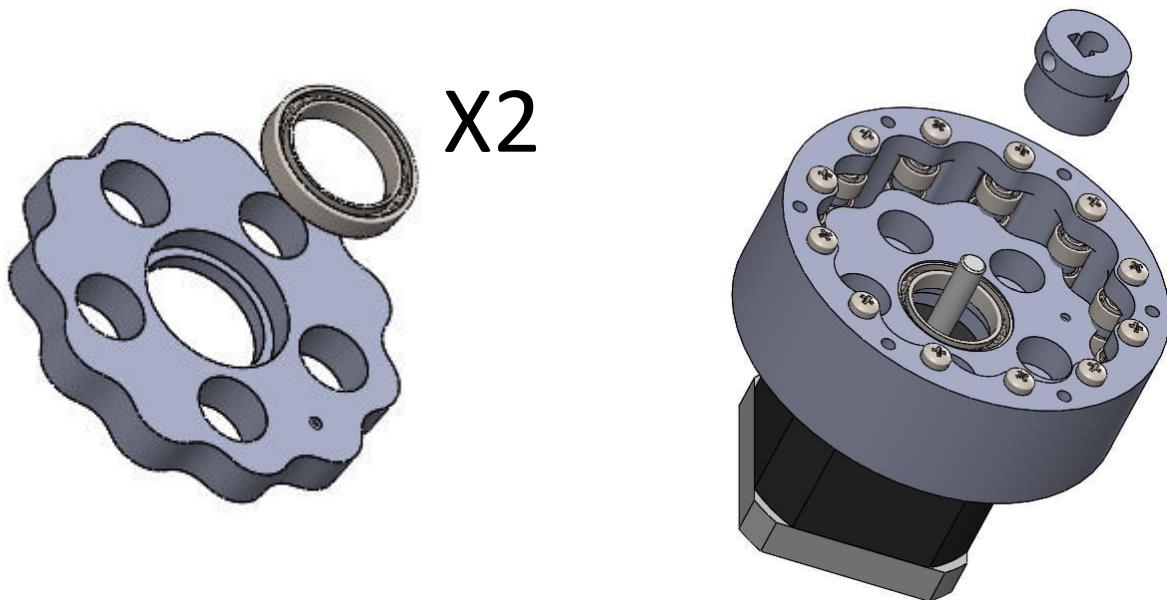
Part	Quantity	Position	Notes:

Elbow Assembly

Step1



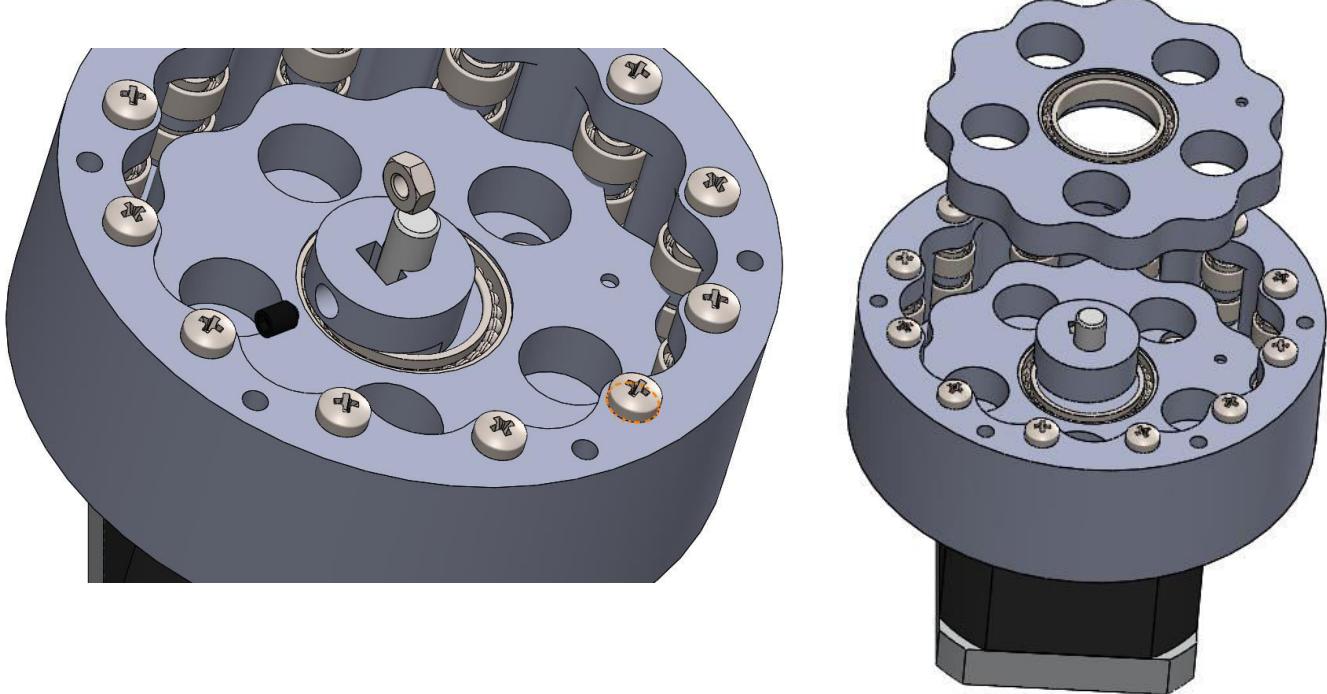
Part	Quantity	Position	Notes: This assembly is same as one for Joint 5 cyclo .
Joint 4 motor case	1	1	
J4 ring spacers	12	2	
Nema 17 motor	12	3	
M3 5mm screw	4	4	
M3 25mm screw	12	5	
3x8x4 ball bearing	24	6	



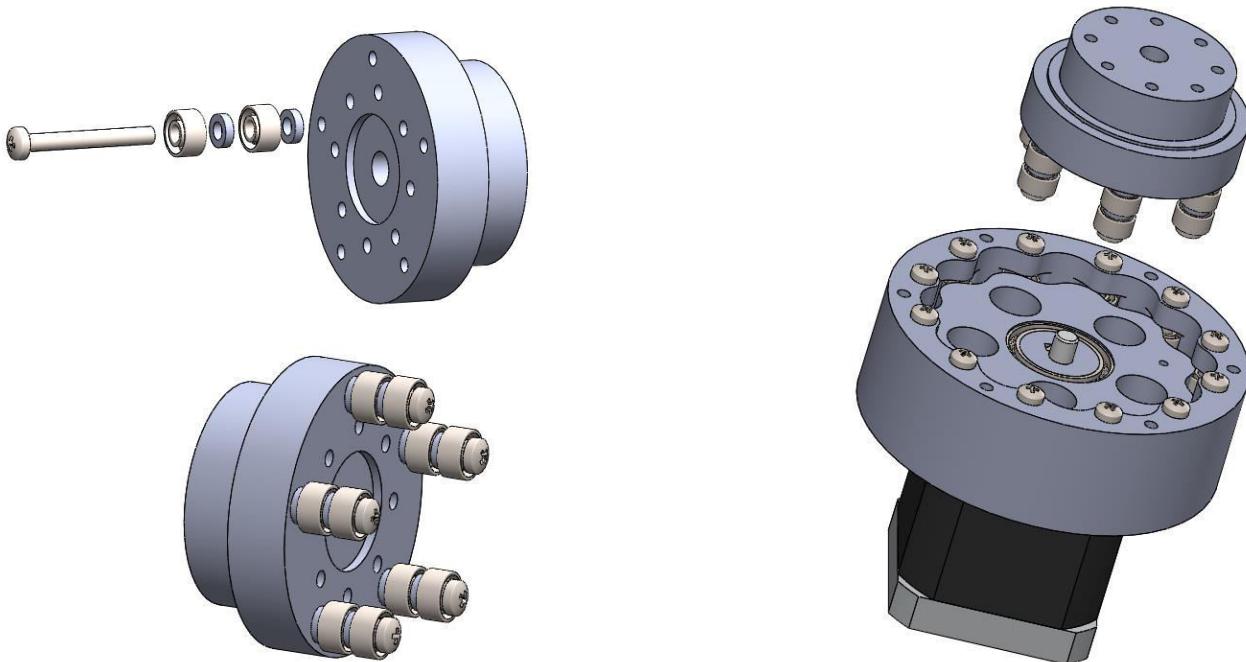
Part	Quantity	Position	Notes:
11:1 cyclo disc	2	1	
Ball bearing 17x23x4	2	2	
Eccentric shaft J4	1	3	

Elbow Assembly

Step2



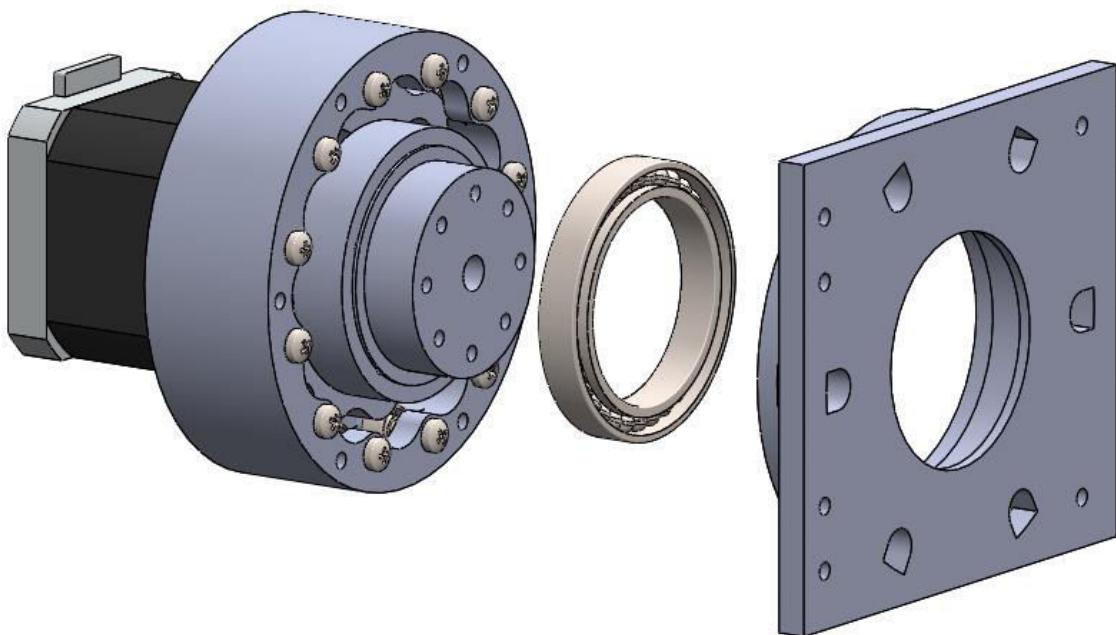
Part	Quantity	Position	Notes: Make shure holes on discs are alligned.
M3 nut	1	1	
M3 4mm set screw	1	2	



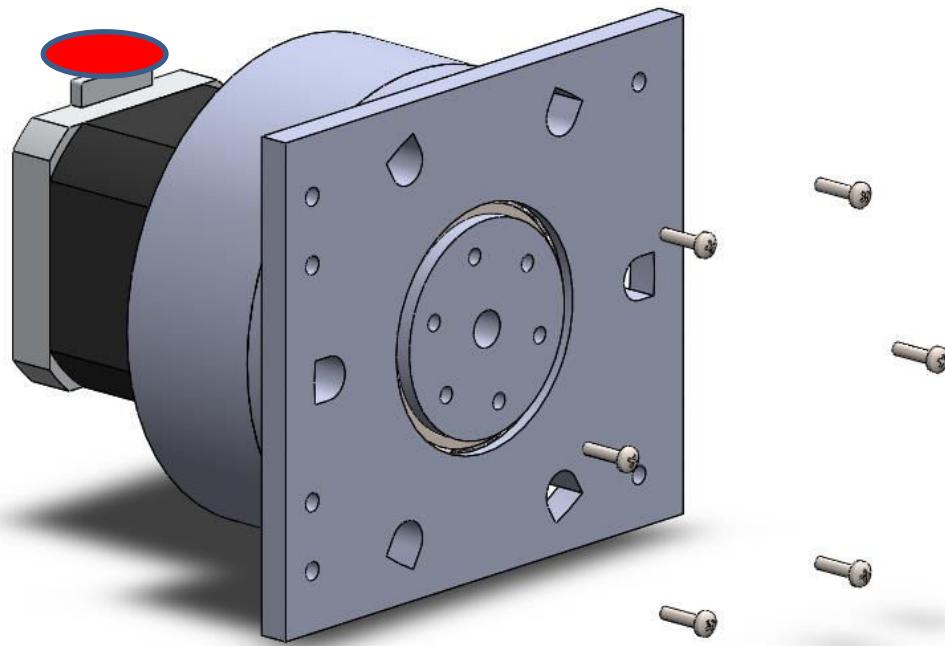
Part	Quantity	Position	Notes:
J4 cyclo output shaft	1	1	
M3 20mm screw	1	2	
3x8x4 ball bearing	10	3	
joint 4 output spacers	10	4	

Elbow Assembly

Step3



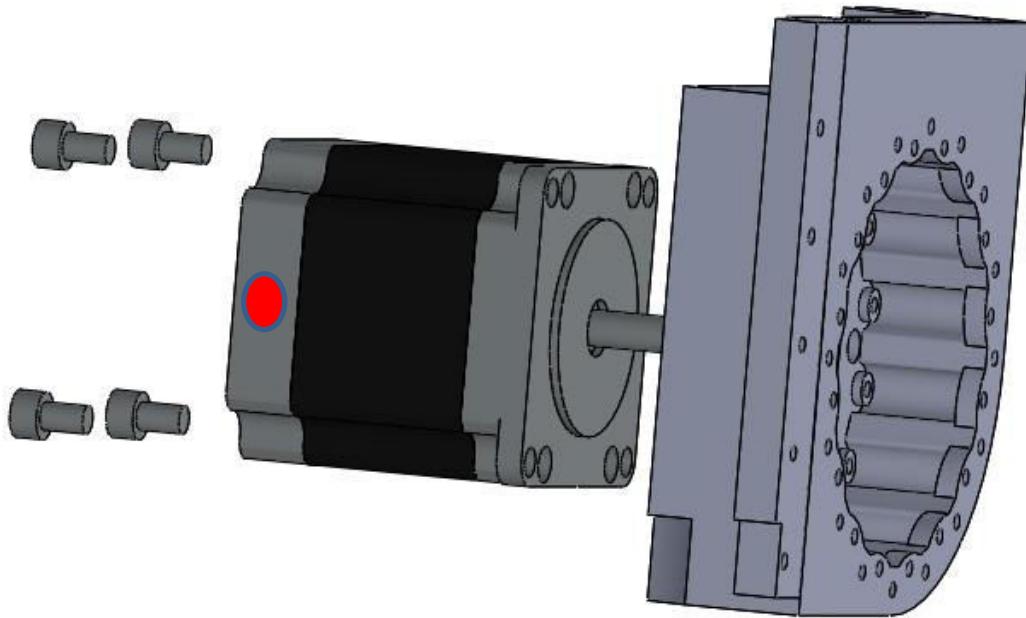
Part	Quantity	Position	Notes:
Ball bearing 35x47x7	1	1	
Joint 4 top cover	1	2	



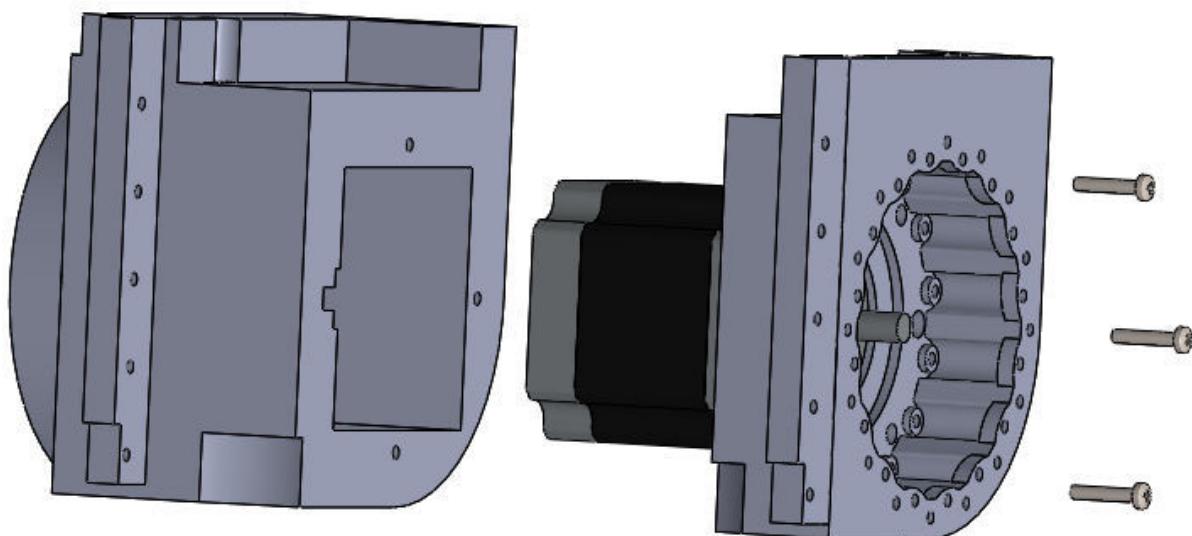
Part	Quantity	Position	Notes: make shure that side of stepper where wires go is one marked with red here.(Watch out on orientation of holes Joint 4 top cover.)
M3 10 mm screw	5	1	

Elbow Assembly

Step4



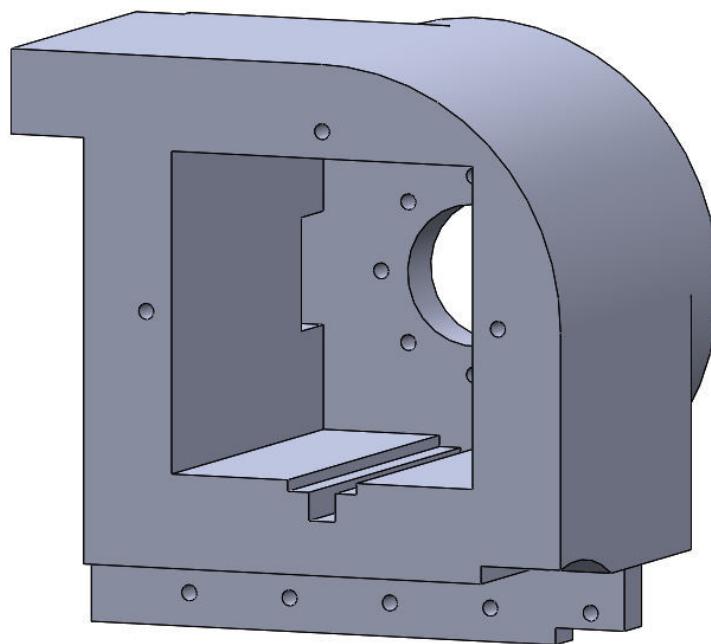
Part	Quantity	Position	Notes: Red dot is side of stepper where wires need to be.
Nema 23 Bipolar 0.9deg 2.8A 2.5V 57x57x56mm	1	1	
M5 8mm HEX screws	4	2	
Joint 3 main case	1	3	



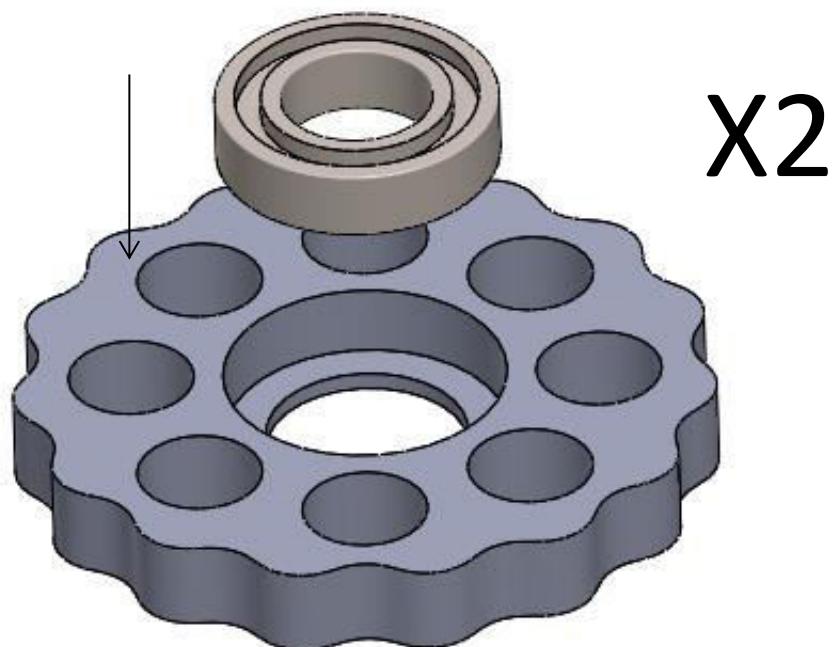
Part	Quantity	Position	Notes:
Joint 3 cover	1	1	
M3 10mm screws	3	2	

Elbow Assembly

Step5



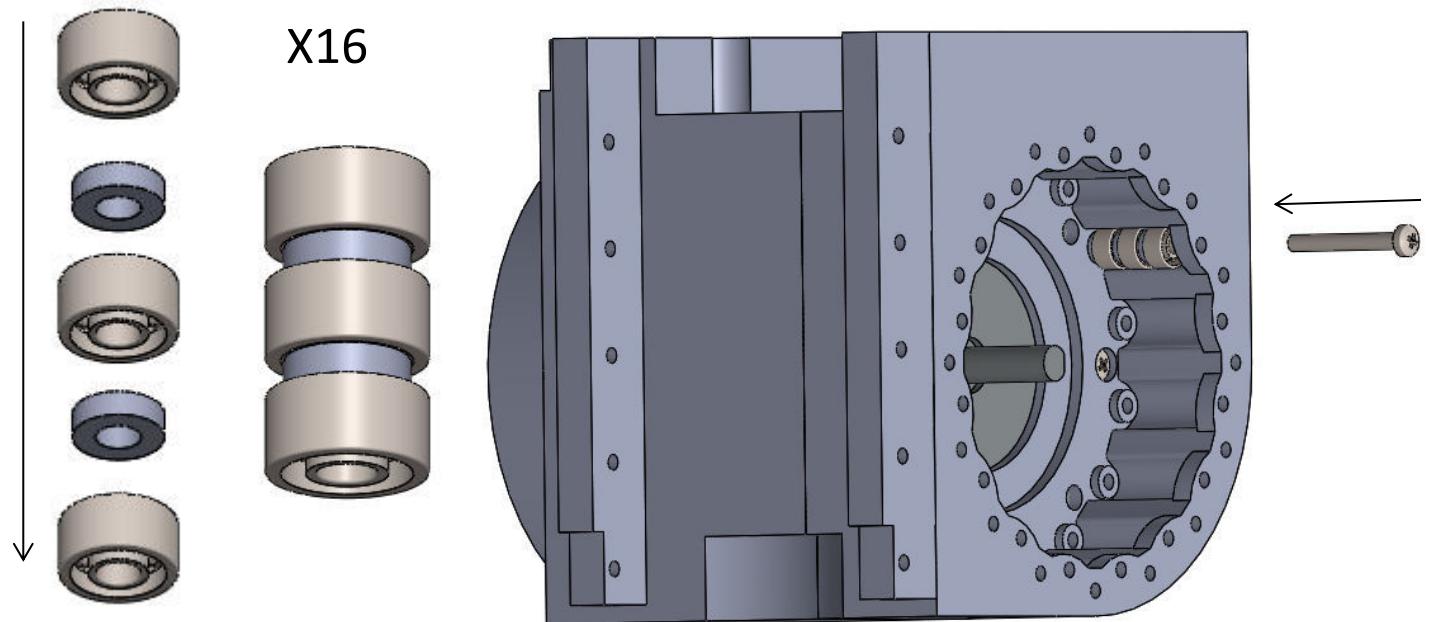
Part	Quantity	Position	Notes: Wires of the stepper need to go thru the channel on the bottom and then thru the large hole on the side



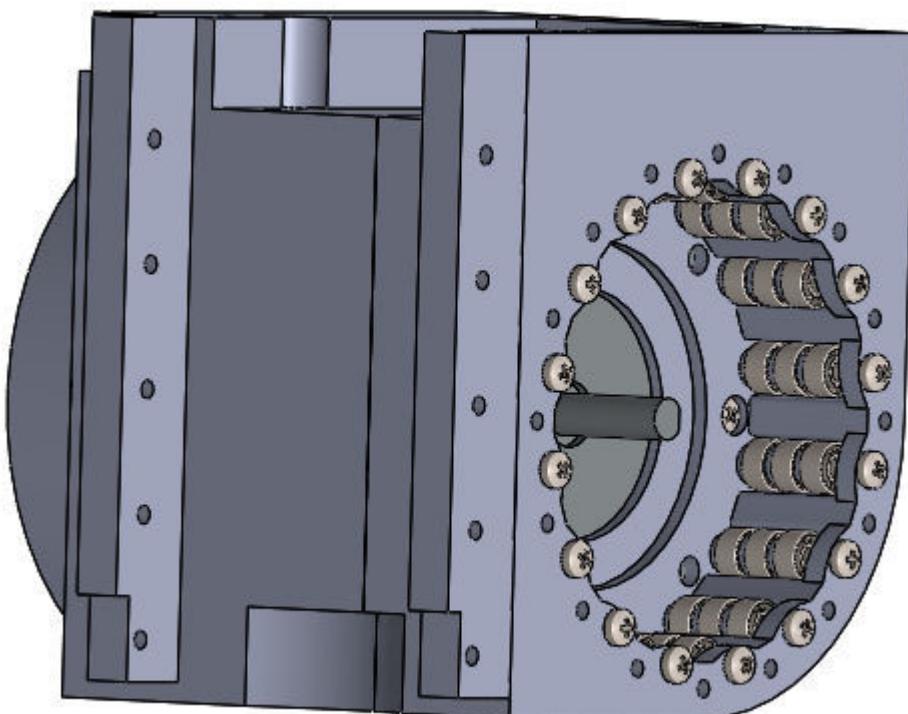
Part	Quantity	Position	Notes:
Ball bearing 15x28x7	2	1	
15:1 cyclo disc	2	2	

Elbow Assembly

Step6



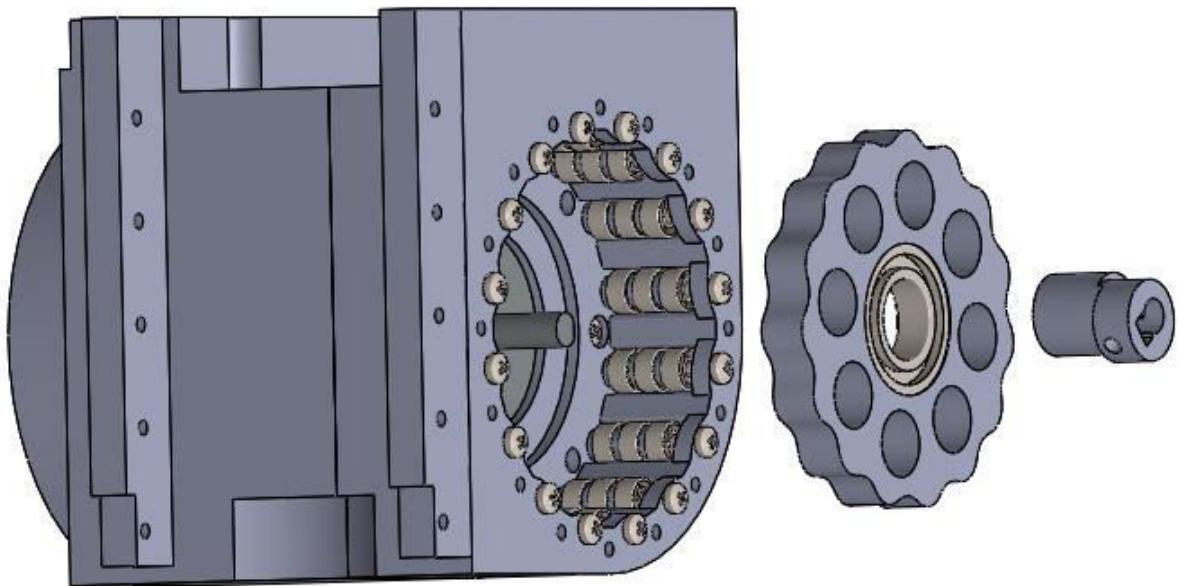
Part	Quantity	Position	Notes:
3x8x4 ball bearing	48	1	
Joint 3 ring spacers	32	2	
M3 25mm screws	16	3	



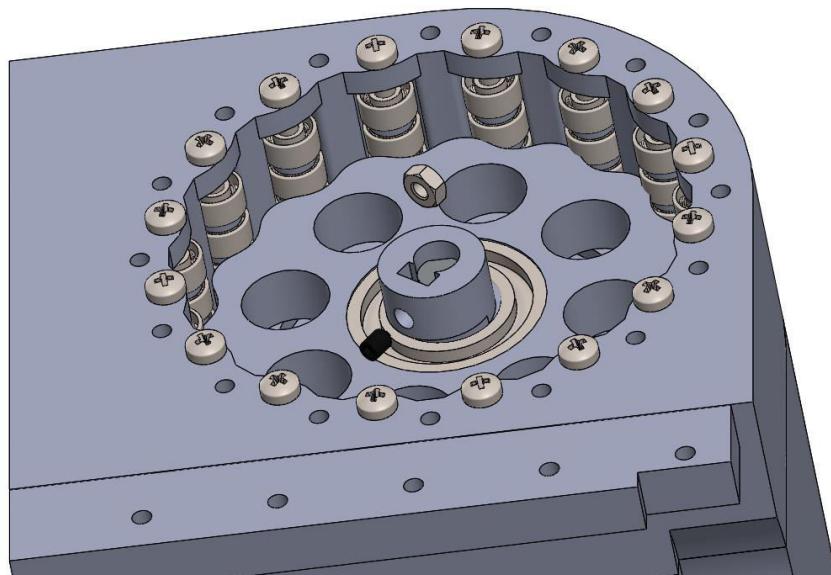
Part	Quantity	Position	Notes:
			Repeat the process on top 16 times.

Elbow Assembly

Step7



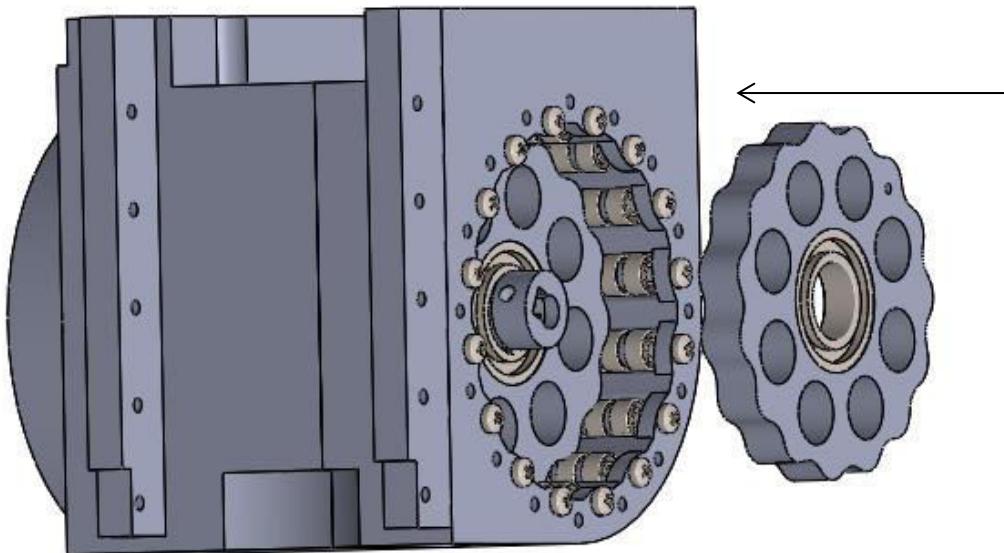
Part	Quantity	Position	Notes:
Joint 3 eccentric shaft	1	1	



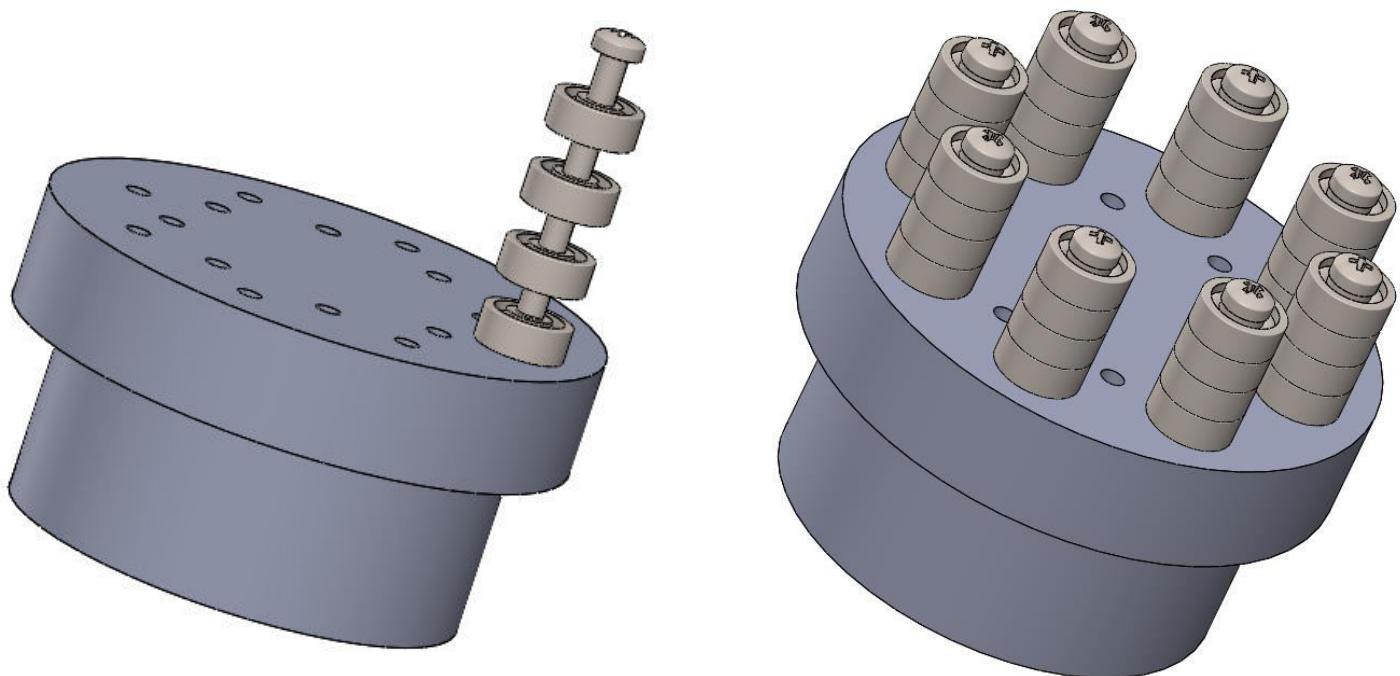
Part	Quantity	Position	Notes:
M3 4mm set screw	1	1	
M3 nut	1	2	

Elbow Assembly

Step8



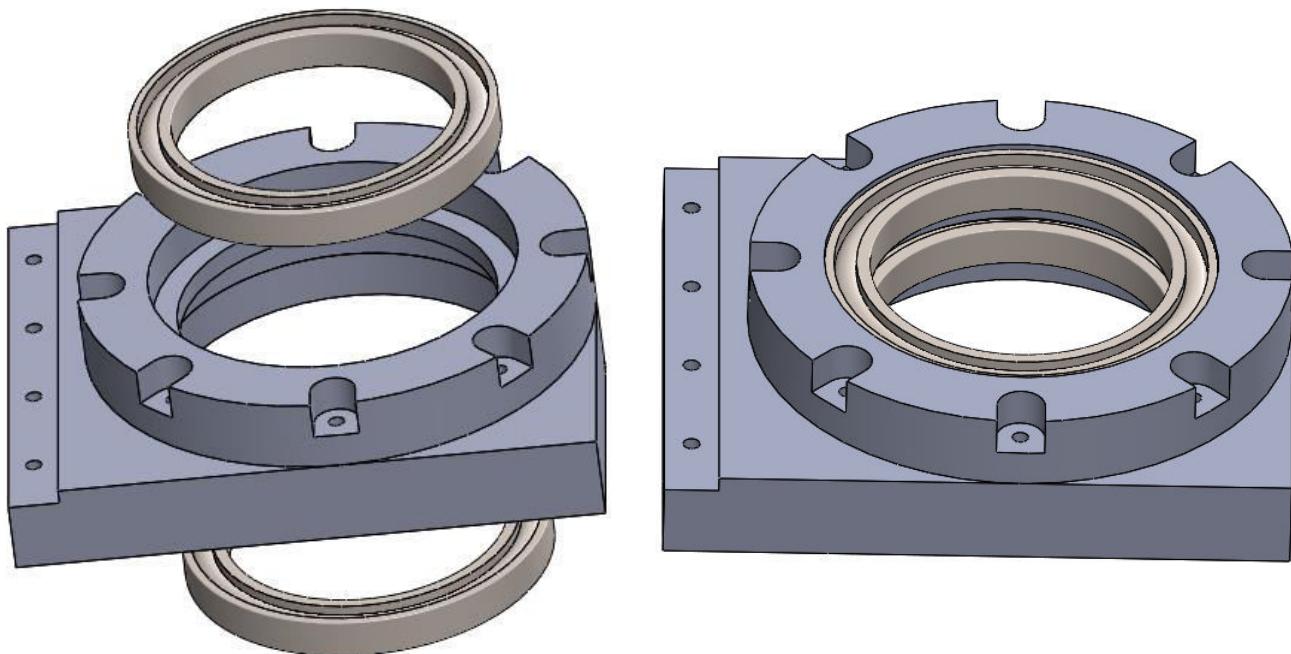
Part	Quantity	Position	Notes: Make shure that holes on discs are alligned.



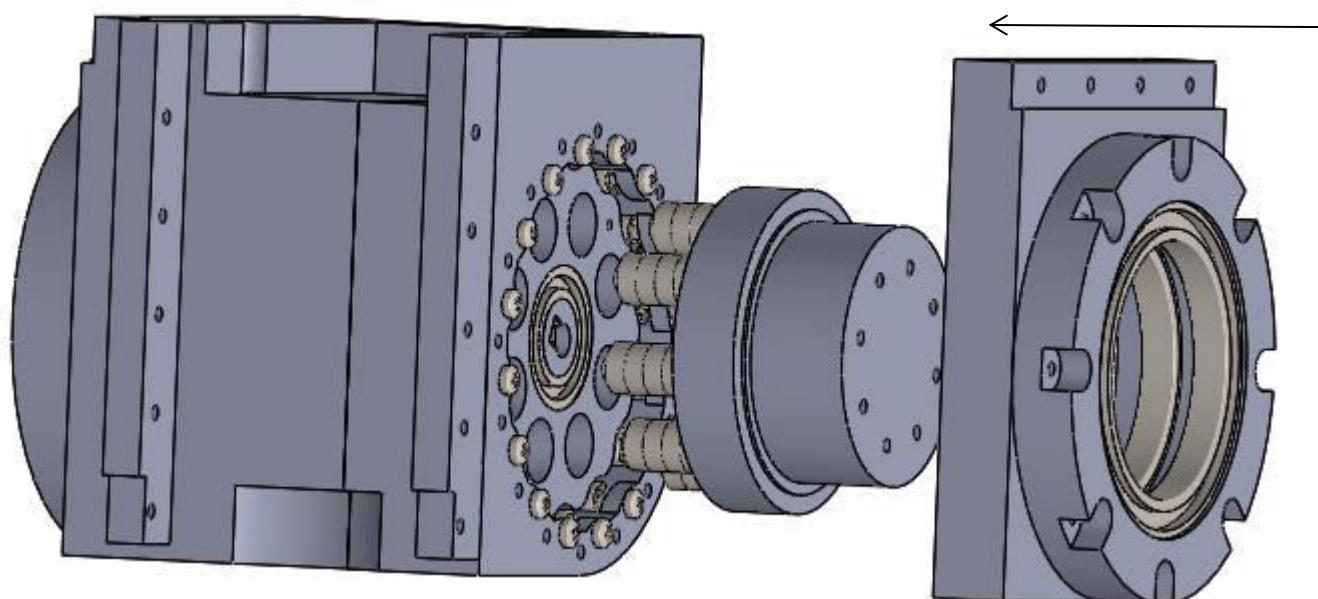
Part	Quantity	Position	Notes:Dont overtighten the bearings , they must be able to rotate freely.
Ball bearing 3x10x4	32	1	
M3 30mm screw	8	2	
J3 output shaft	1	3	

Elbow Assembly

Step9



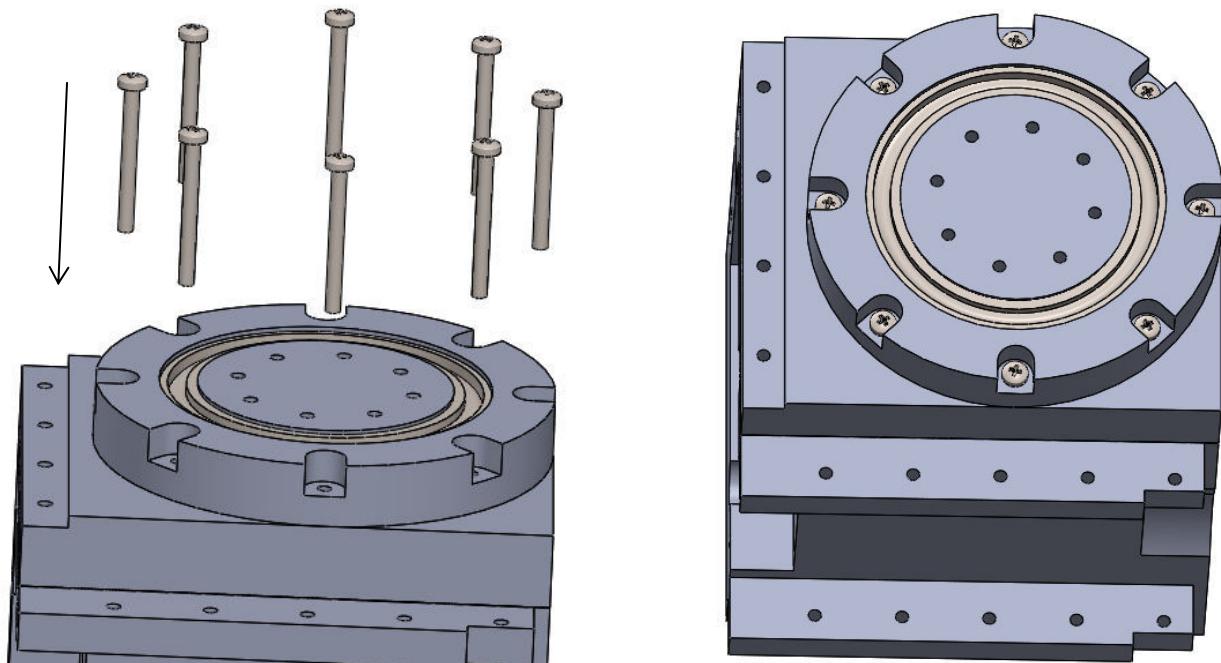
Part	Quantity	Position	Notes
Ball bearing 50x65x7	2	1	
Joint 3 top cover	1	2	



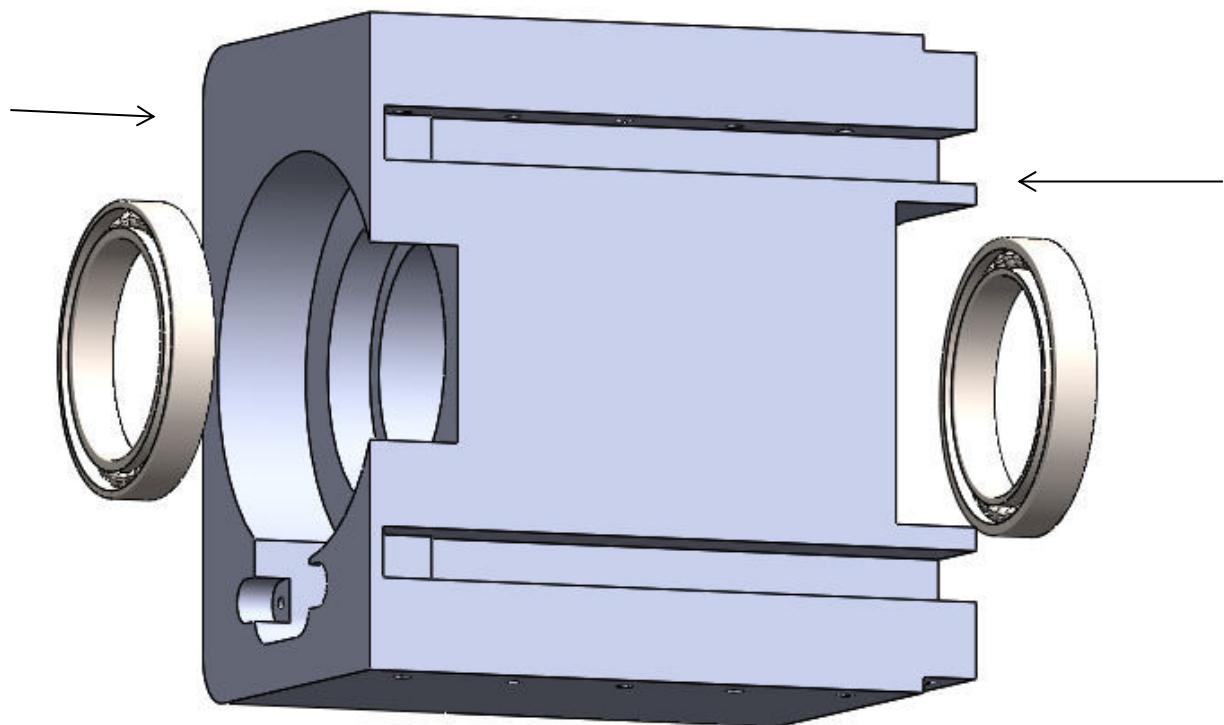
Part	Quantity	Position	Notes:

Elbow Assembly

Step 10



Part	Quantity	Position	Notes:
M3 30mm screws	8	1	



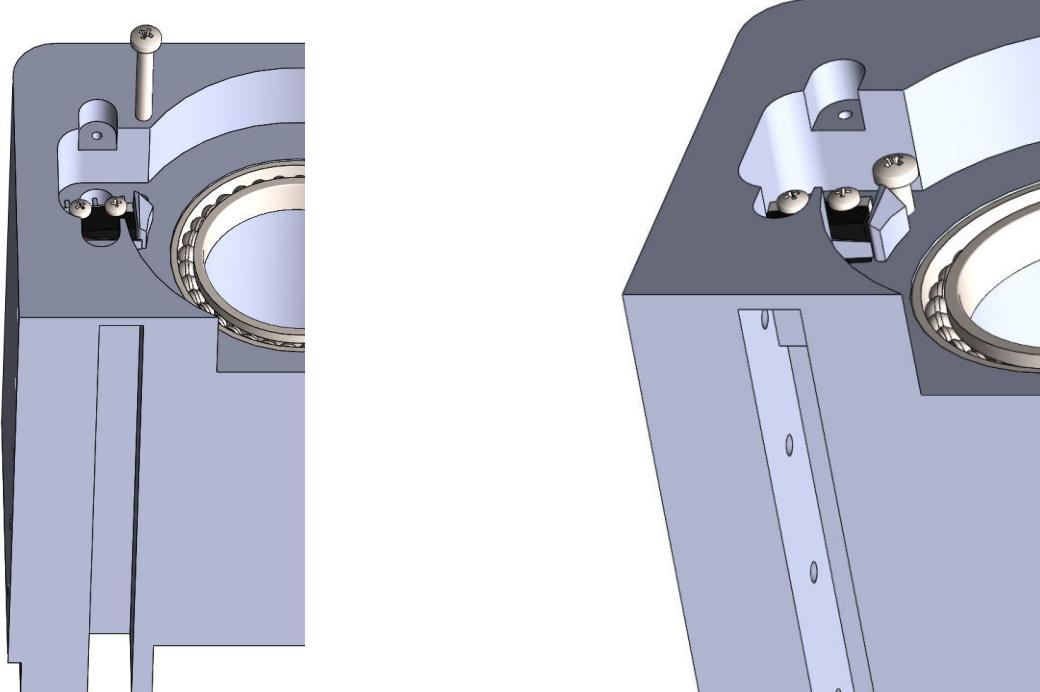
Part	Quantity	Position	Notes:
J4 Offset	1	1	
Ball bearing 35x47x7	2	2	

Elbow Assembly

Step11



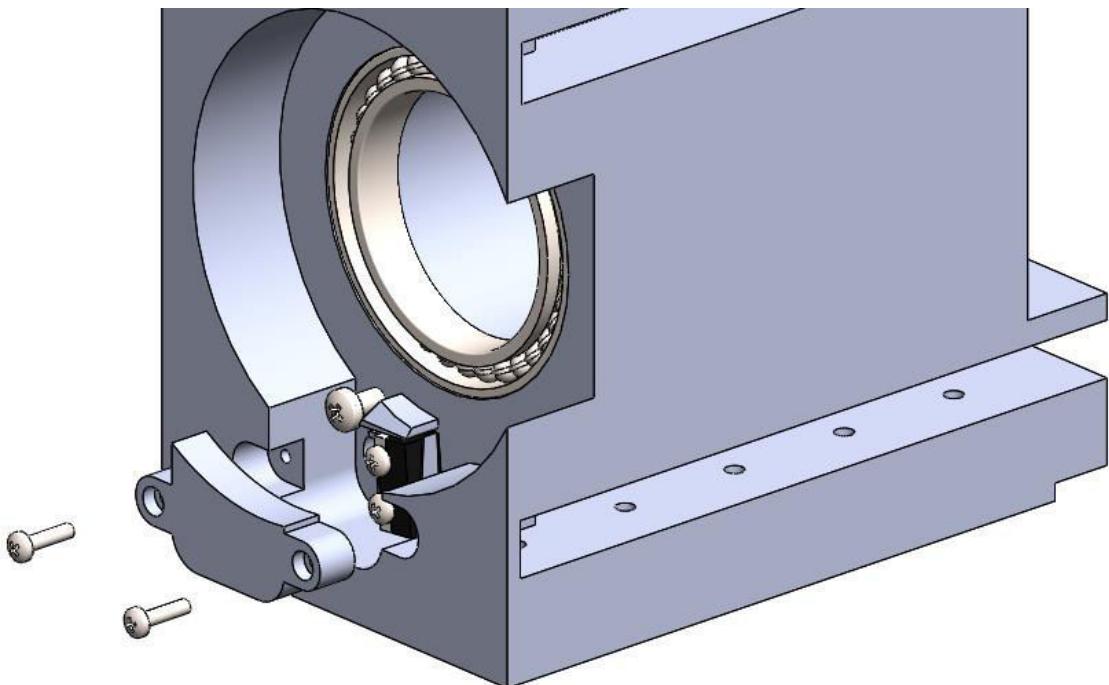
Part	Quantity	Position	Notes: Wires of micro limit switch need to go thru the hole marked with red.
Micro limit switch	1	1	
M2 8mm screws	2	2	



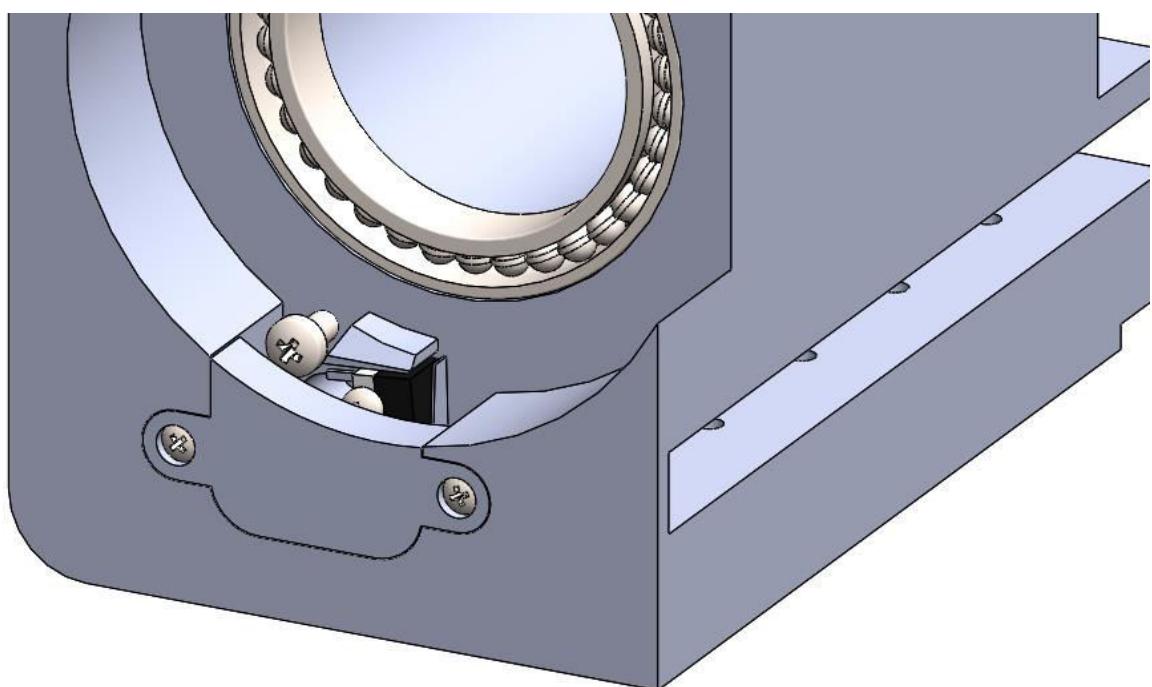
Part	Quantity	Position	Notes:screw the M3 15 mm screw so that its head is on same level with screws of micro limit switch.
M3 15mm screw	1	1	

Elbow Assembly

Step 12



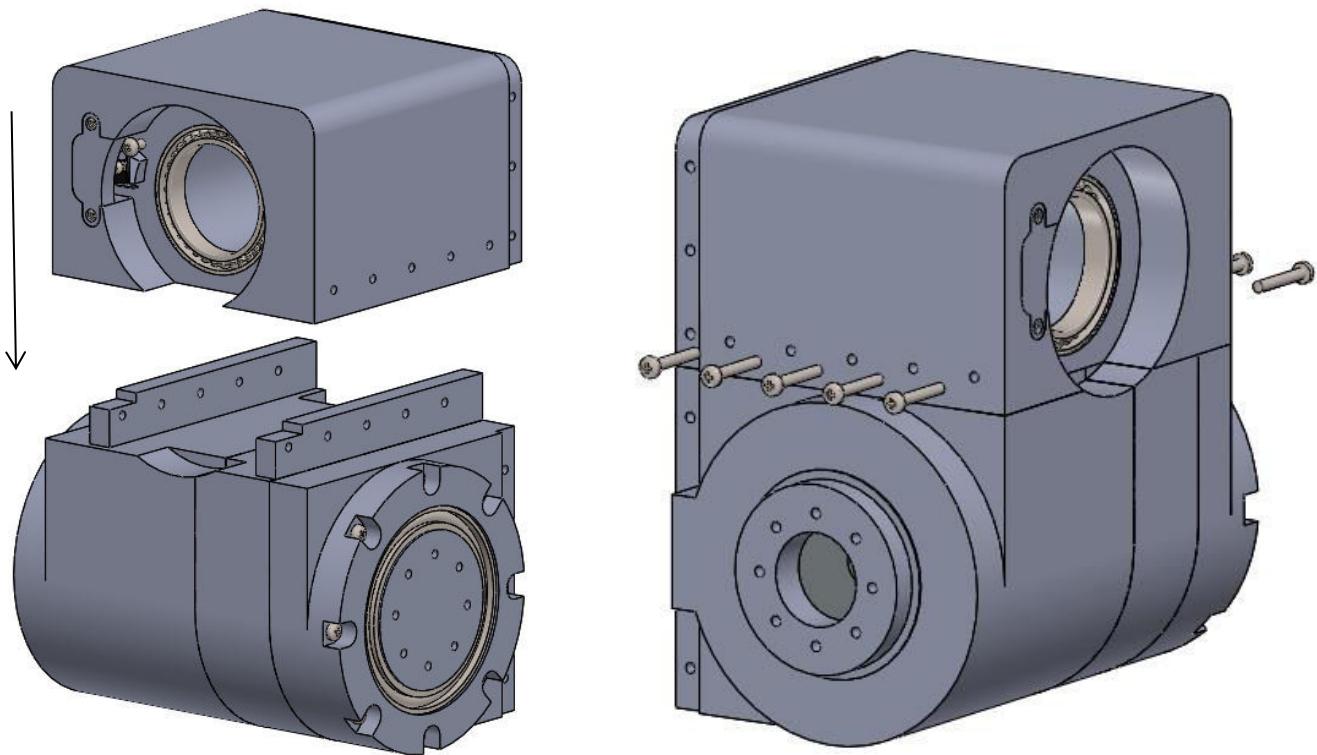
Part	Quantity	Position	Notes:
M2 8mm screw	2	3	
J4 limit switch cover	1	4	



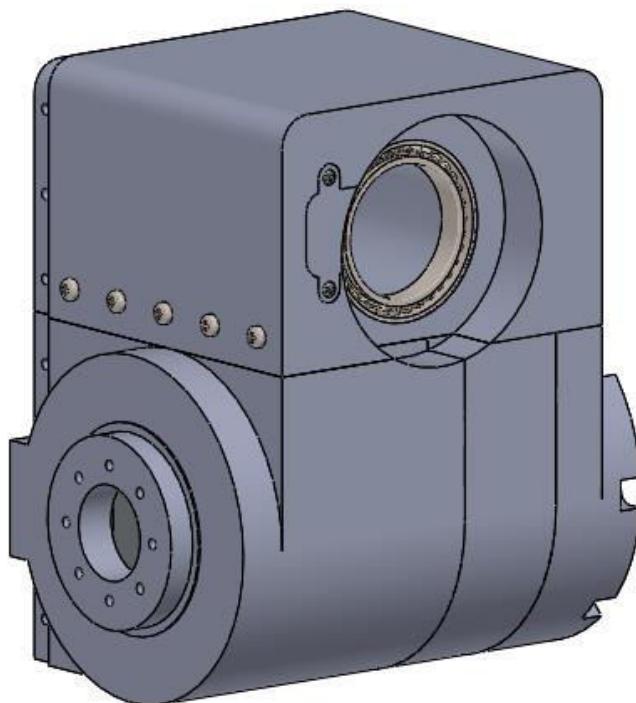
Part	Quantity	Position	Notes:

Elbow Assembly

Step13



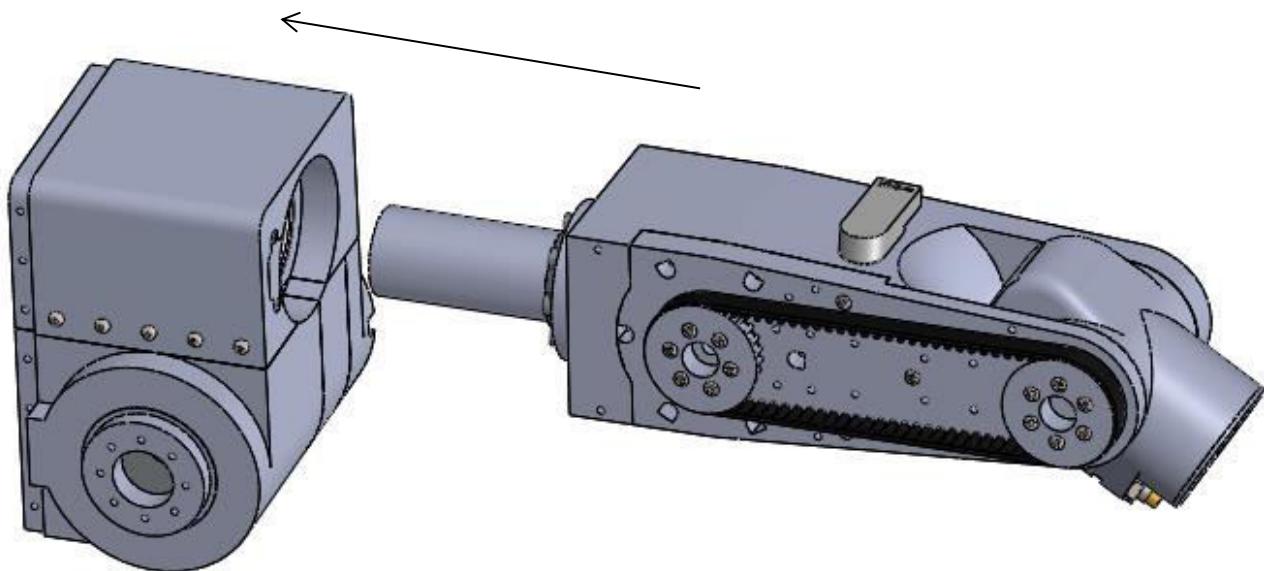
Part	Quantity	Position	Notes:
M3 20mm screw	10	3	



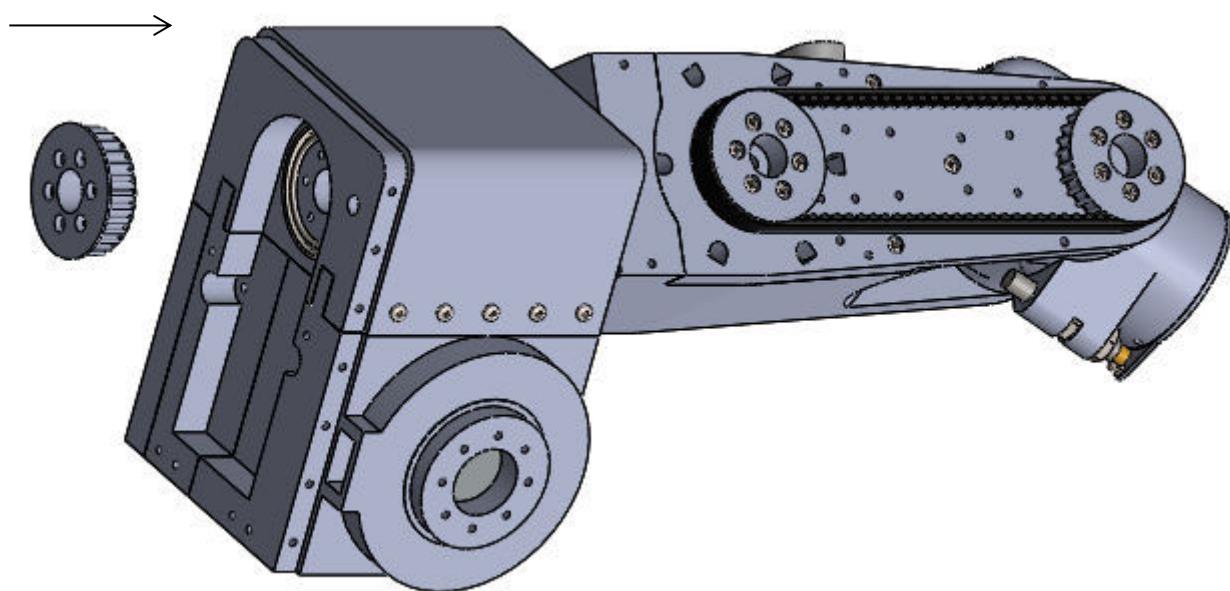
Part	Quantity	Position	Notes:

Lower arm Assembly

Step1



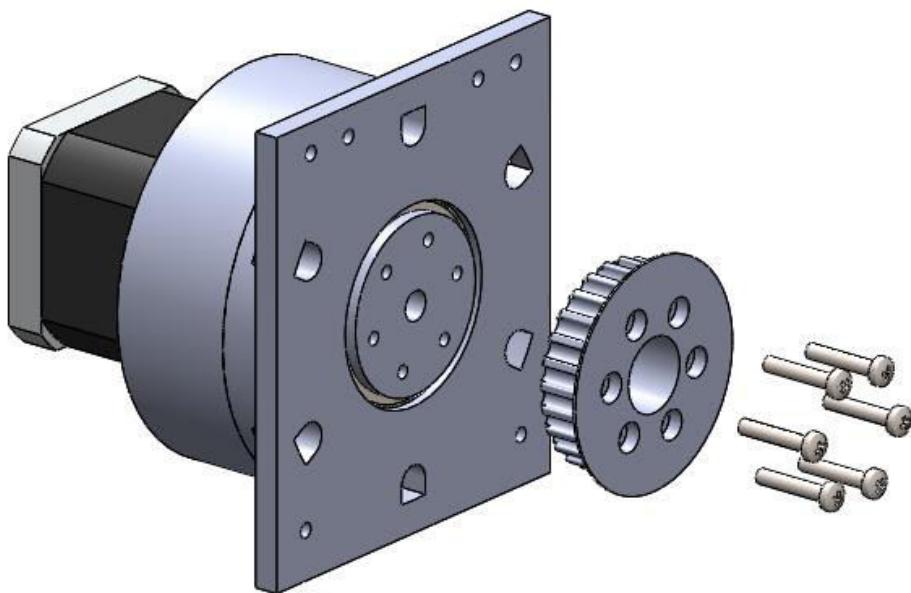
Part	Quantity	Position	Notes:
			.



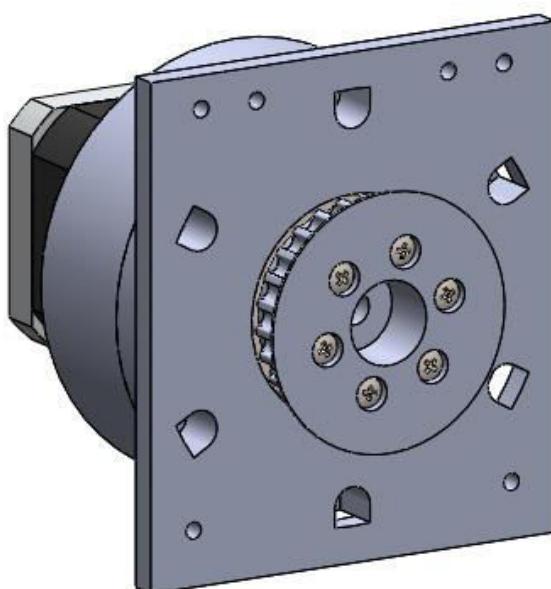
Part	Quantity	Position	Notes:
Joint 4 pulley 28 teeth	1	1	Notes: pull all wires thru pulley (only those that come from forearm and wrist assembly). we will attach it with screw later.

Lower arm Assembly

Step2



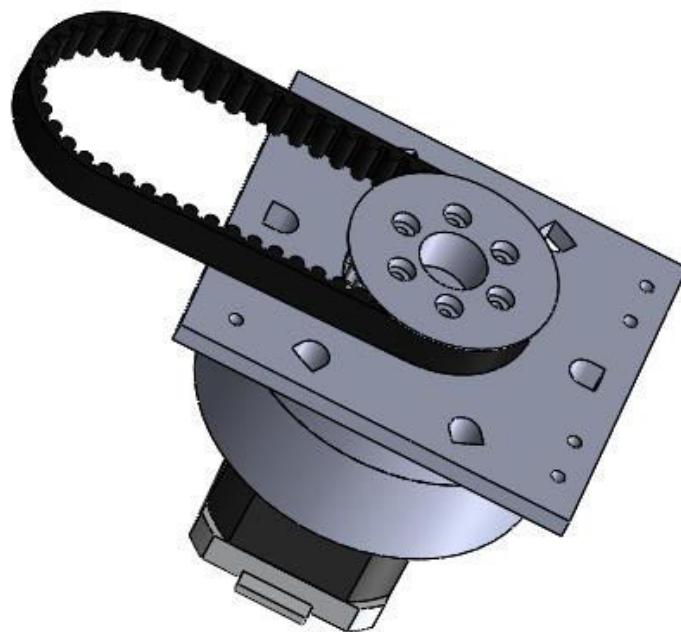
Part	Quantity	Position	Notes:
26 teeth J4 pulley	1	1	
M3 15 mm screw	6	2	



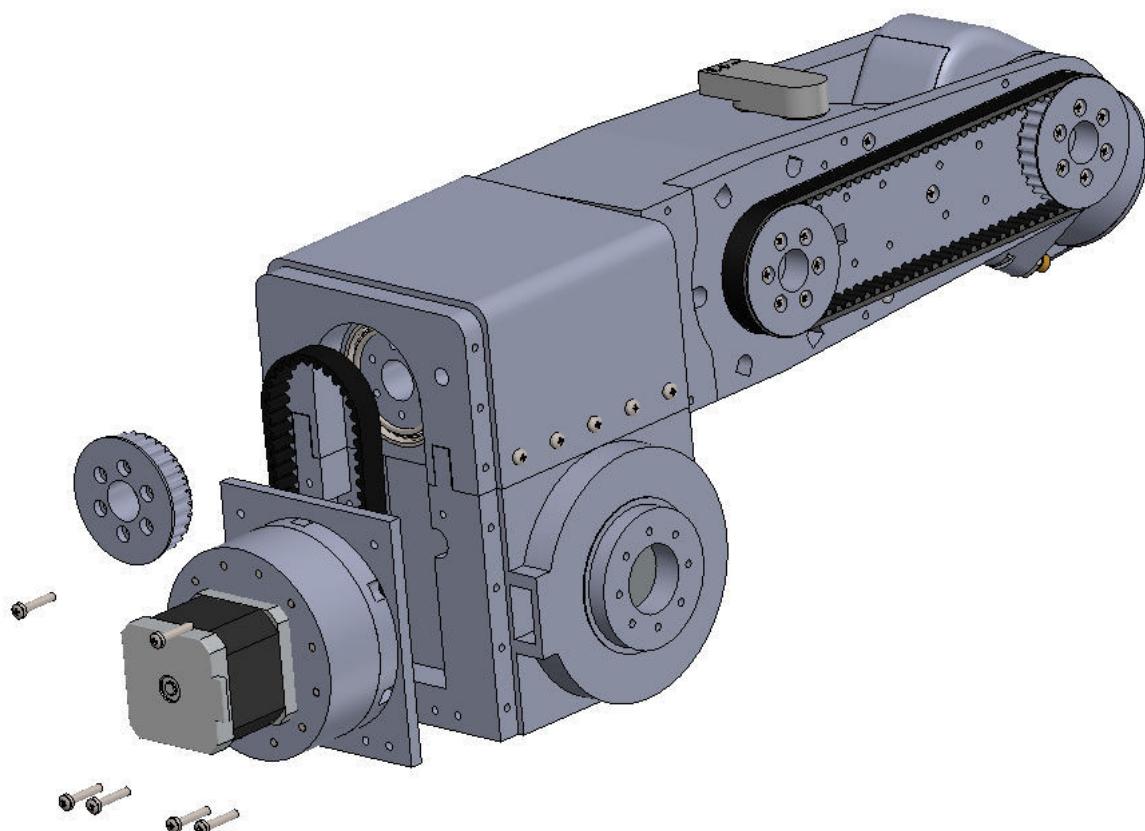
Part	Quantity	Position	Notes:

Lower arm Assembly

Step3



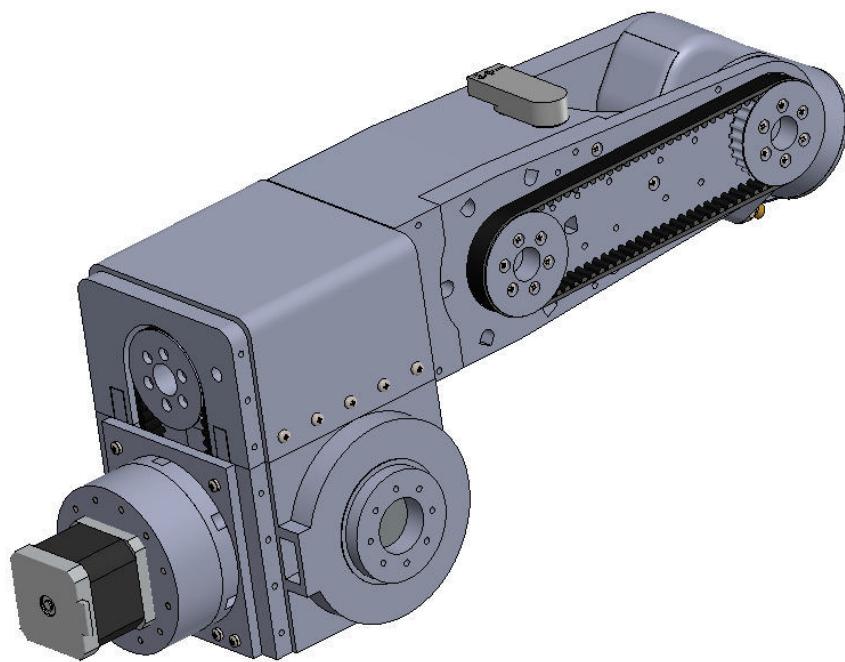
Part	Quantity	Position	Notes:
J4 Belt	1	1	



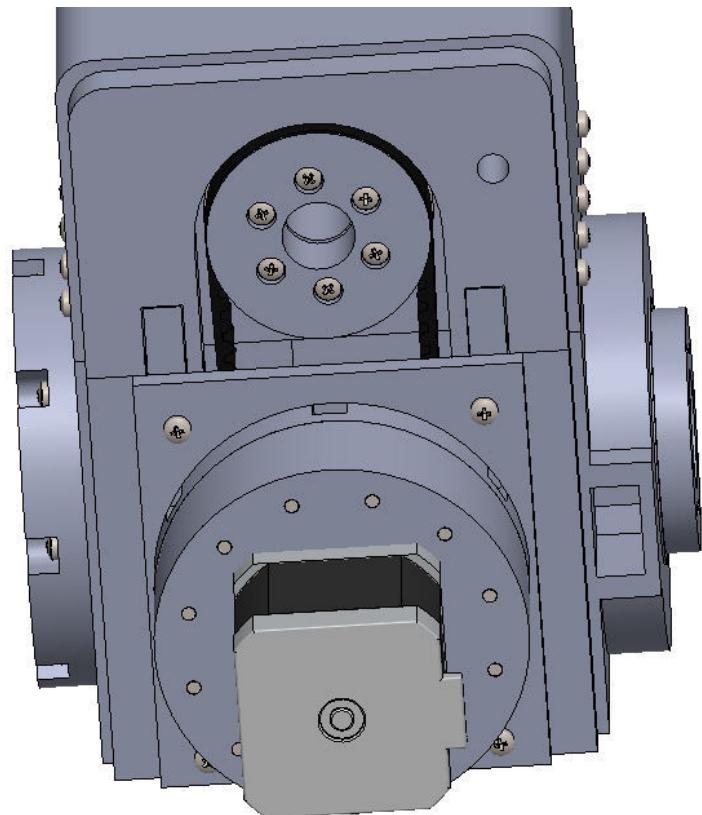
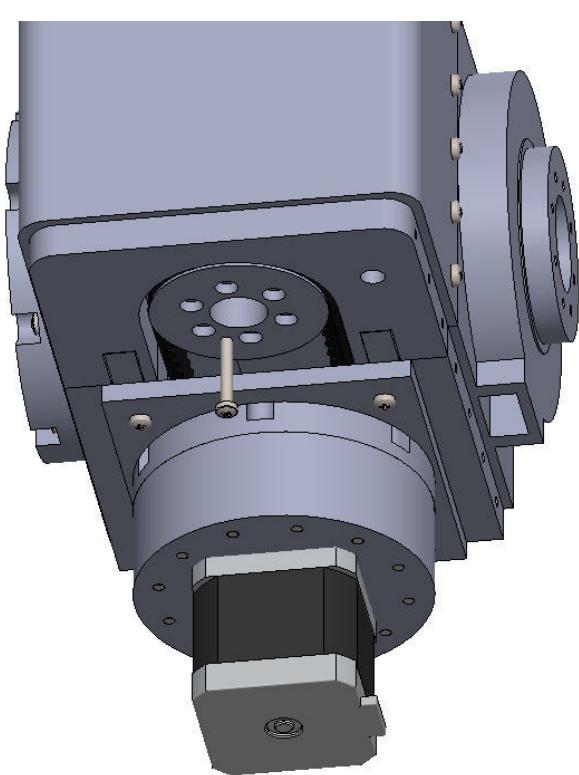
Part	Quantity	Position	Notes:
M3 15 mm screw	6	1	

Lower arm Assembly

Step4

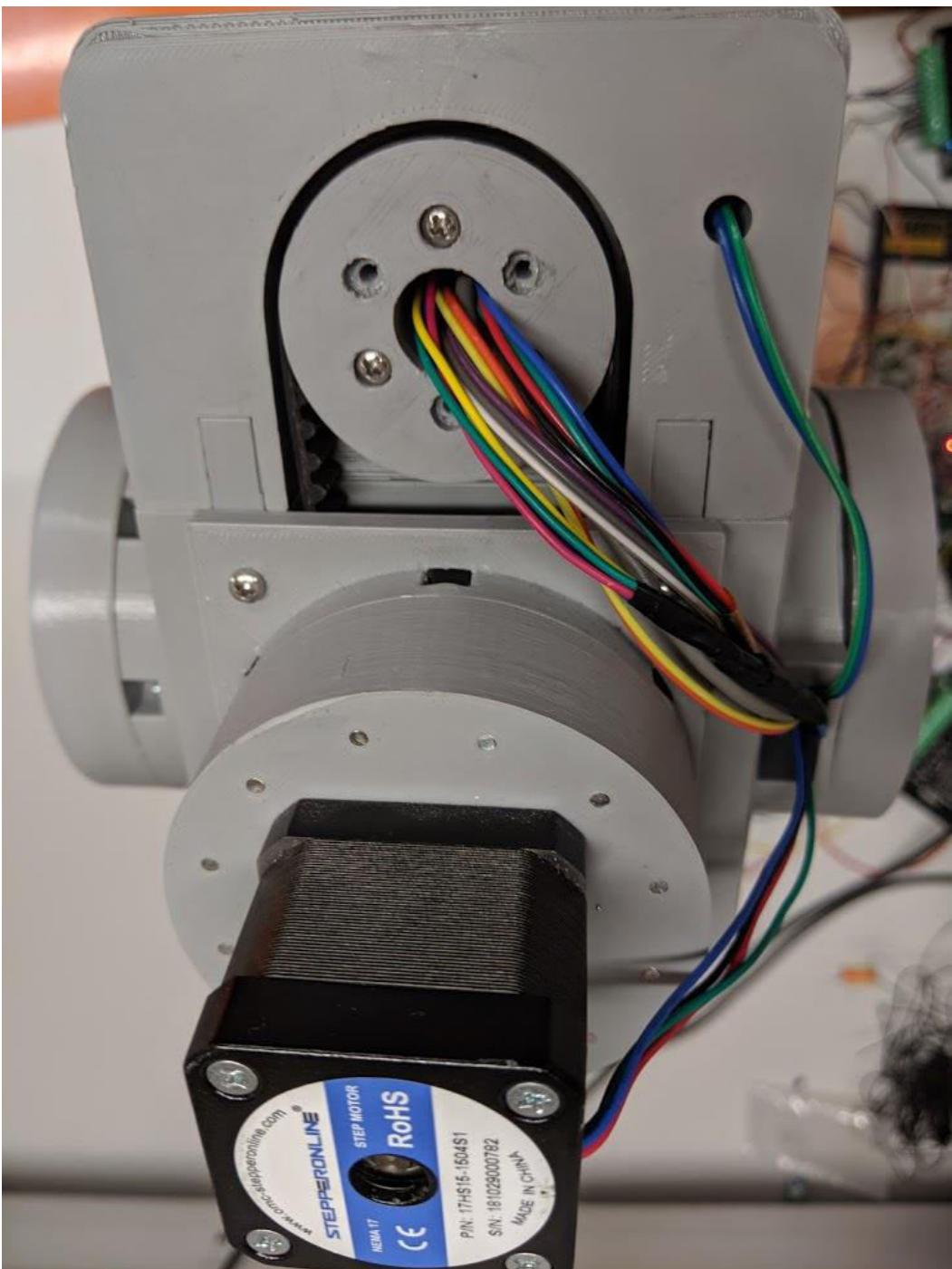


Part	Quantity	Position	Notes:

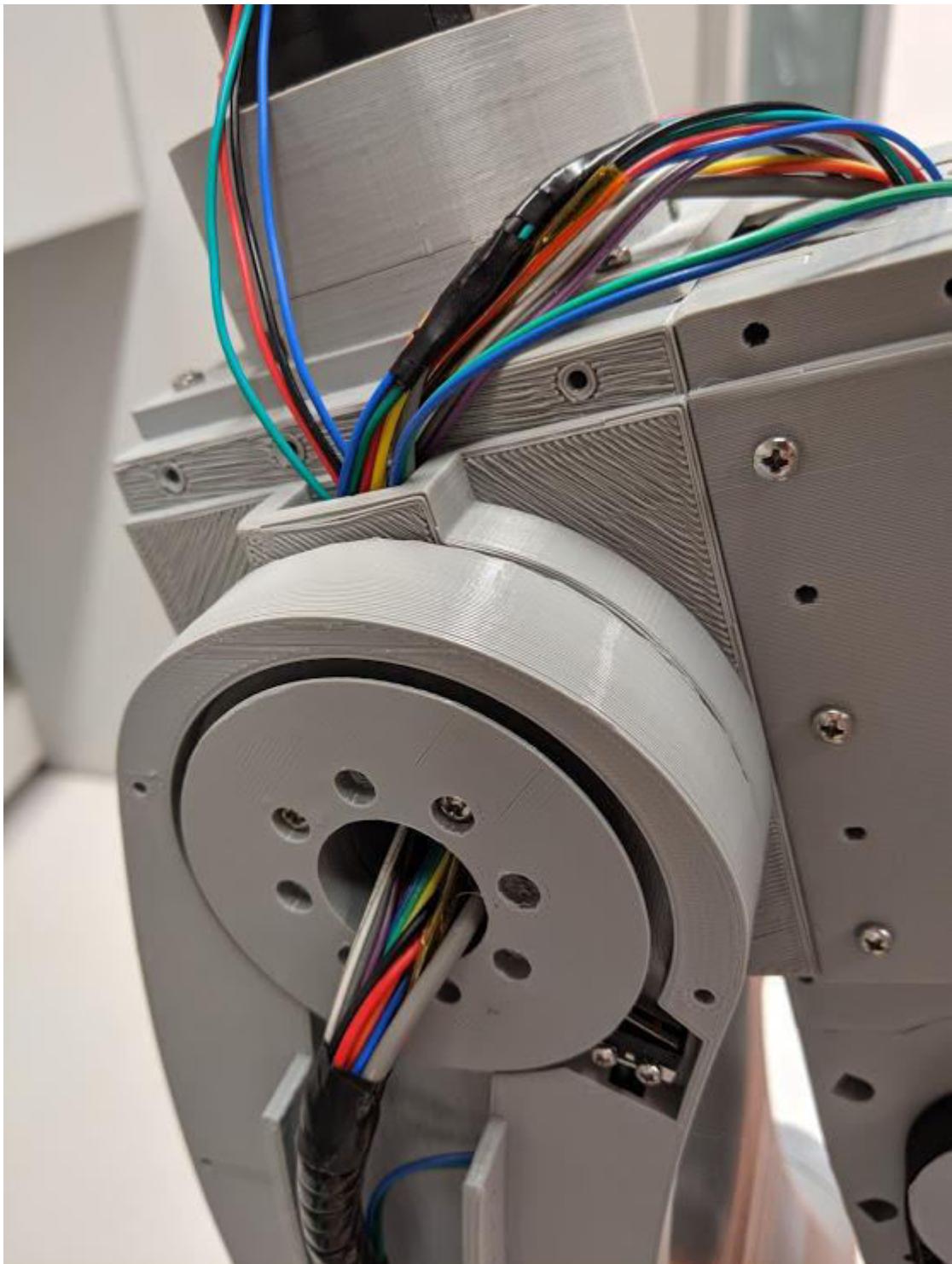


Part	Quantity	Position	Notes:
M3 20 -25 mm screw	6	1	Notes:First insert one screw and then tighten the belt and insert other screws.

Example how wiring should look like

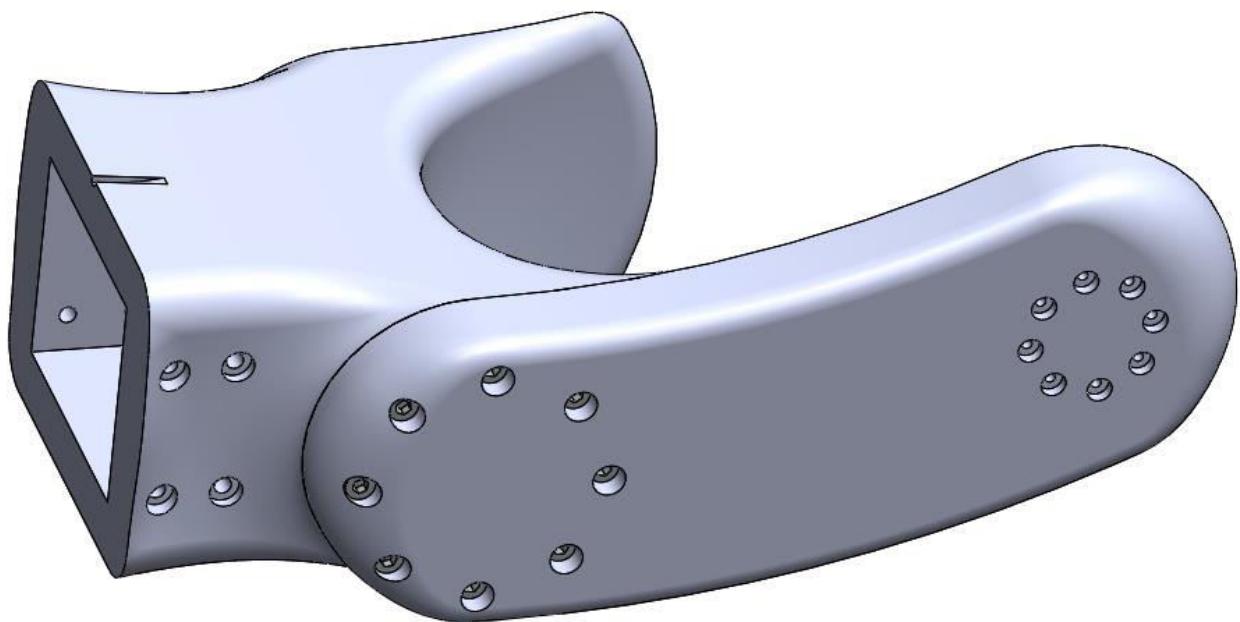


Example how wiring should look like

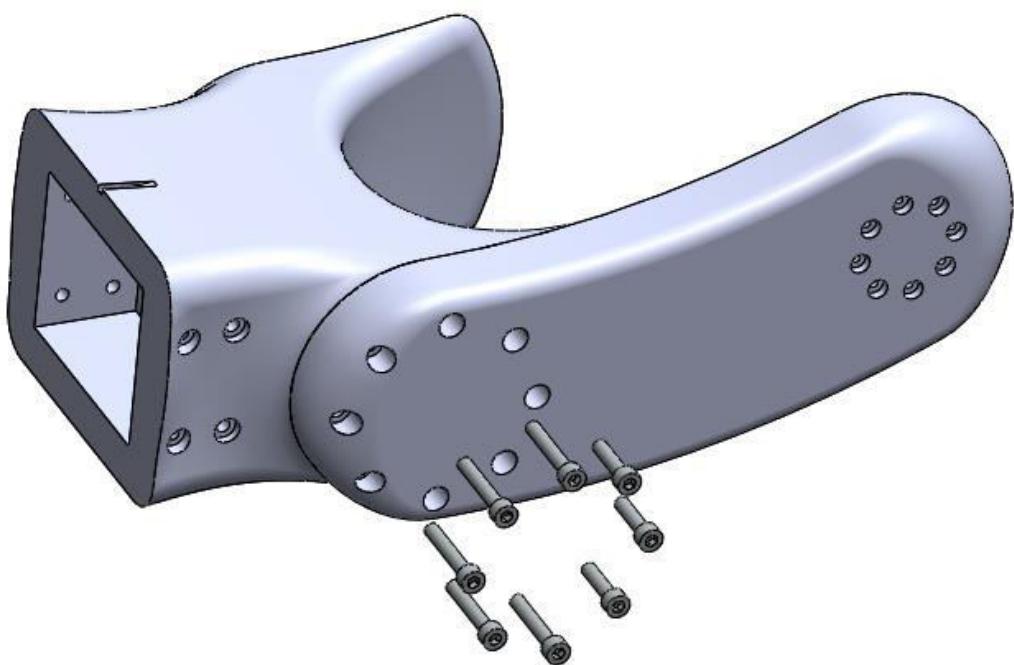


Arm Assembly

Step1



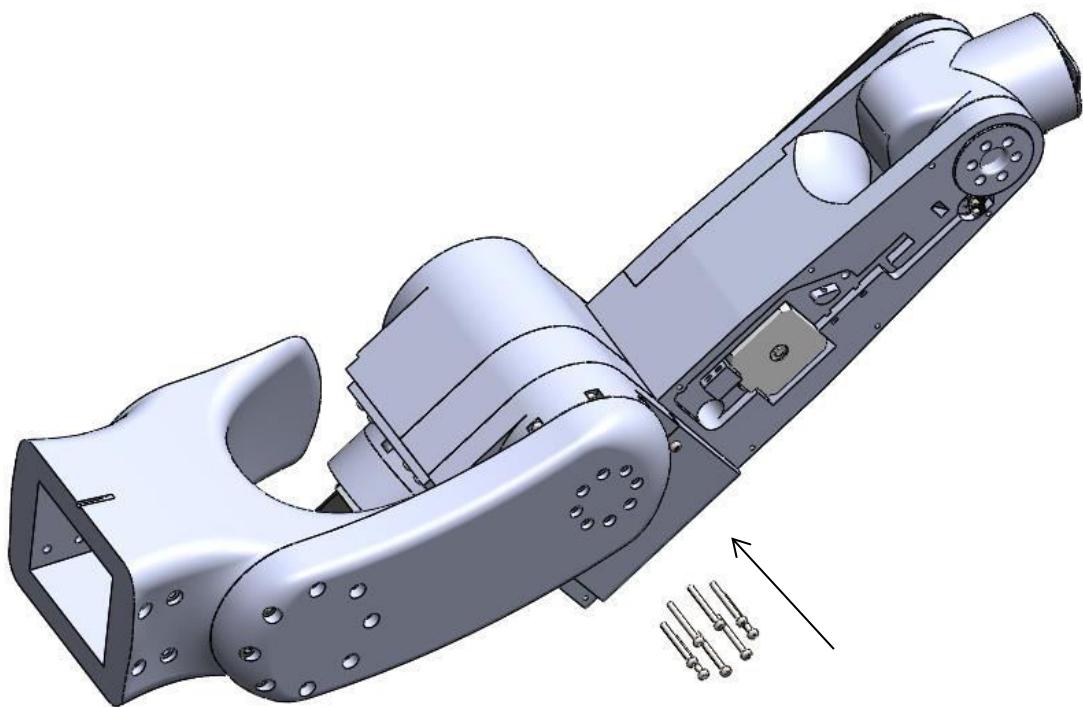
Part	Quantity	Position	Notes:
Fork	1	1	
Fork motor	1	2	



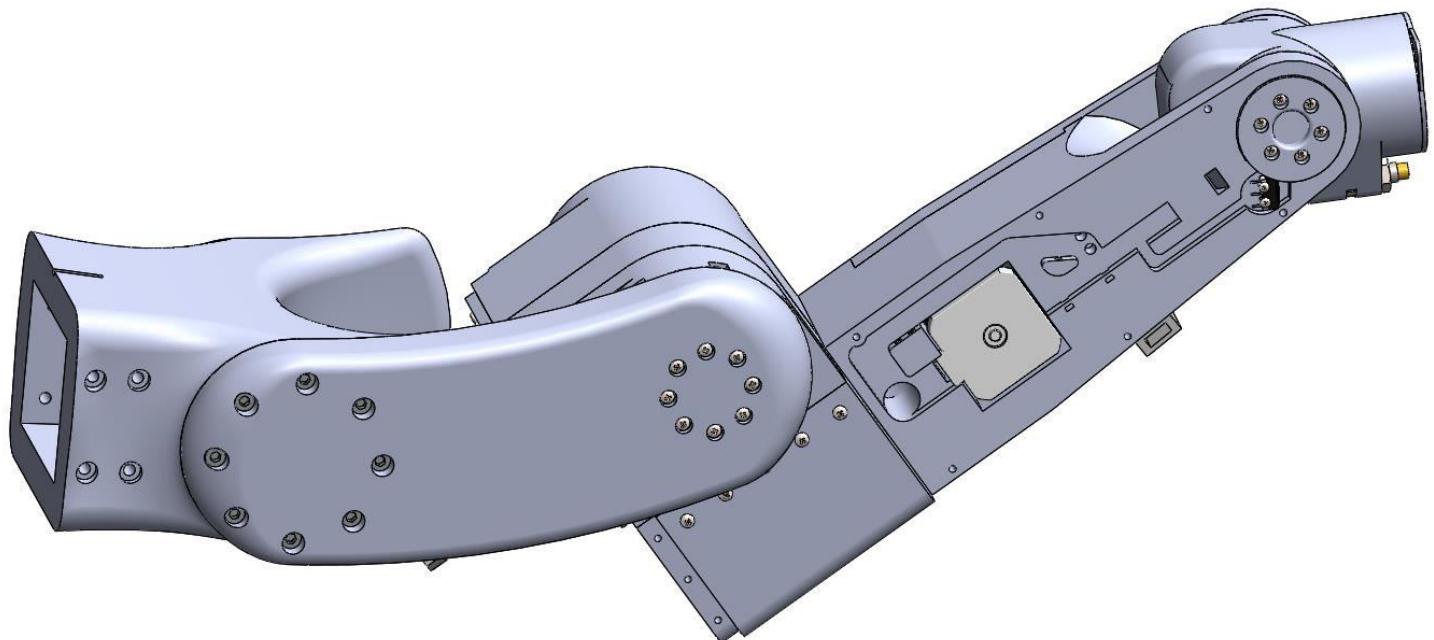
Part	Quantity	Position	Notes:Top 3 screws are 20mm , bottm five are 30 mm.
M5 HEX 20 mm screw	3	1	
M5 HEX 30 mm screw	5	2	

Arm Assembly

Step2



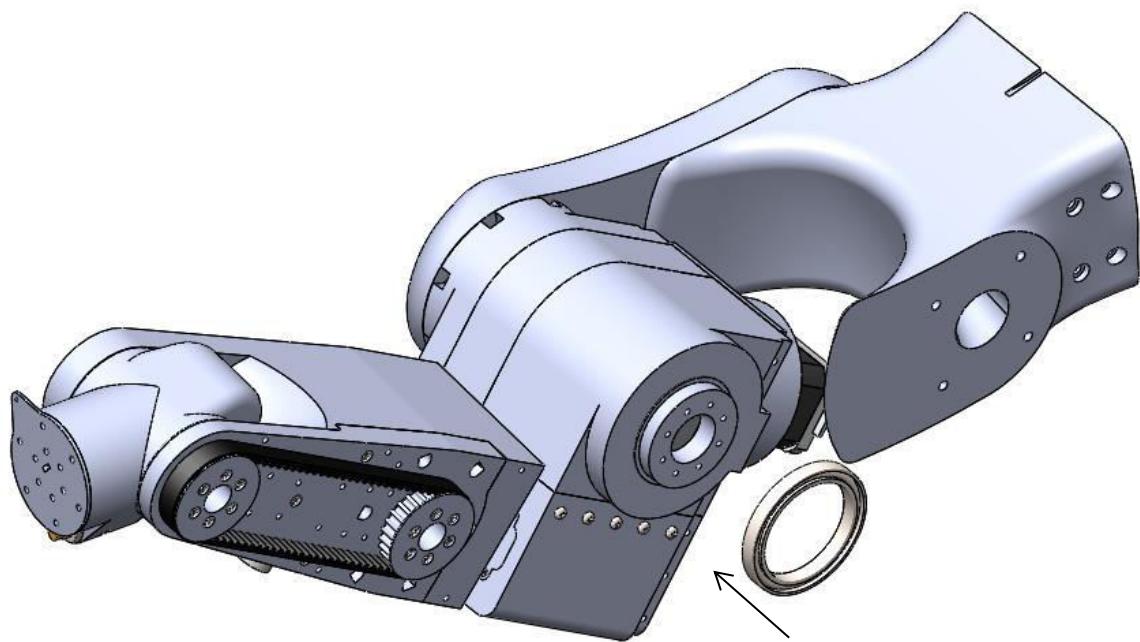
Part	Quantity	Position	Notes:
M3 30 mm screws	8	1	



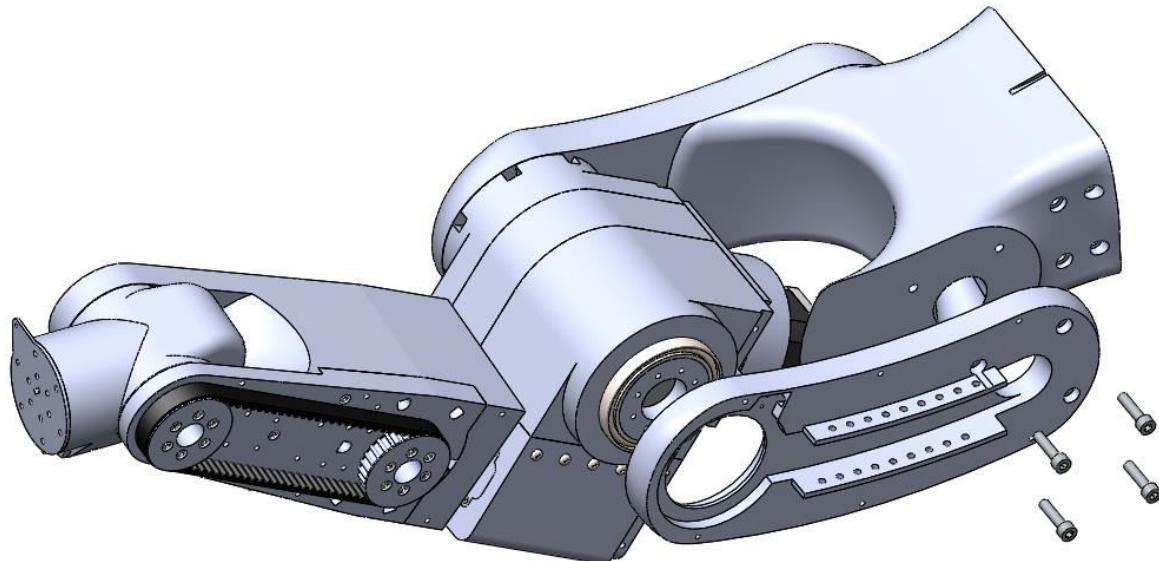
Part	Quantity	Position	Notes:

Arm Assembly

Step3



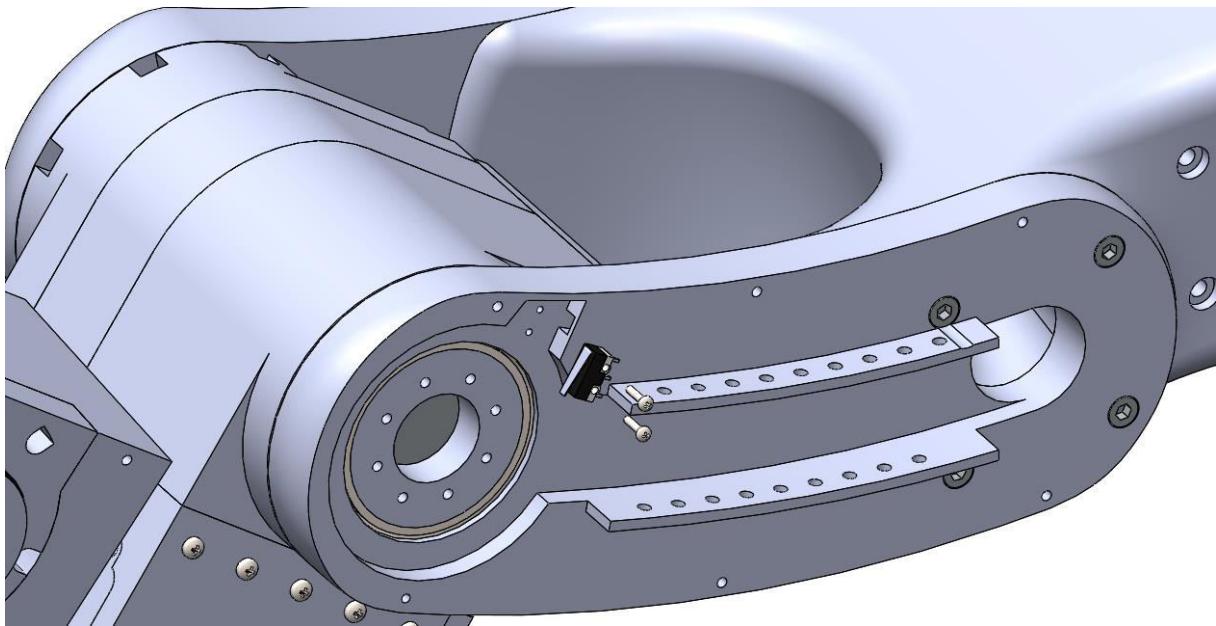
Part	Quantity	Position	Notes:
Ball bearing 35x47x7	1	1	



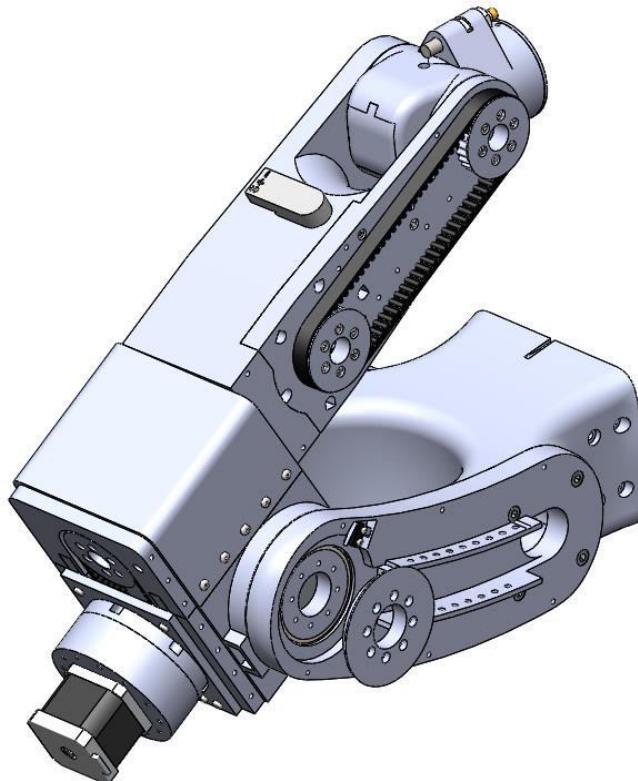
Part	Quantity	Position	Notes:
Fork wires	1	1	
M5 HEX 20 mm screw	4	2	

Arm Assembly

Step4



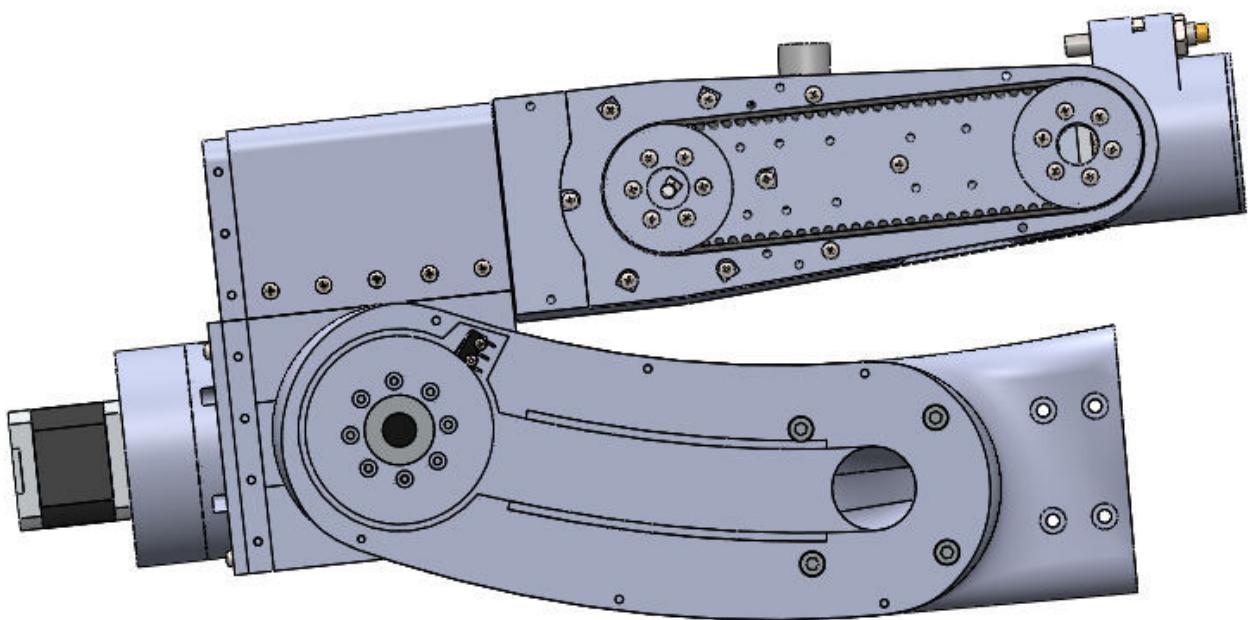
Part	Quantity	Position	Notes: route the wires thru the tunnel .
Micro limit switch	1	1	
M2 8mm screws	2	2	



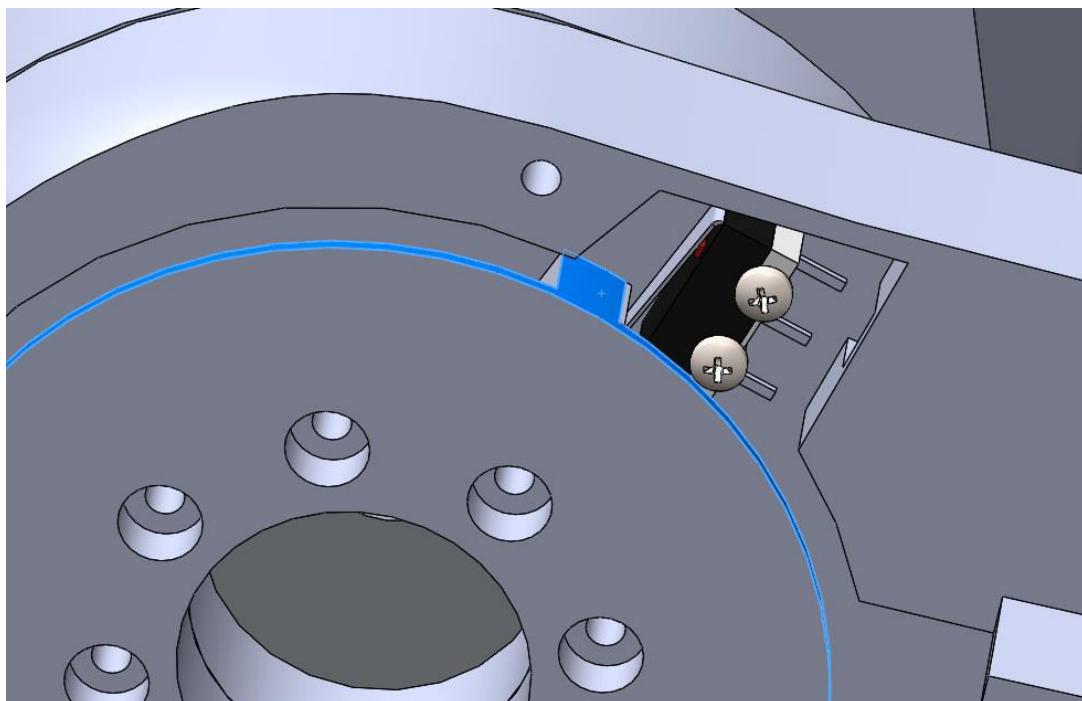
Part	Quantity	Position	Notes: Pull all wires thru joint 3 limit trigger. We will adjust it later.
Joint 3 limit trigger	1	1	

Arm Assembly

Step6



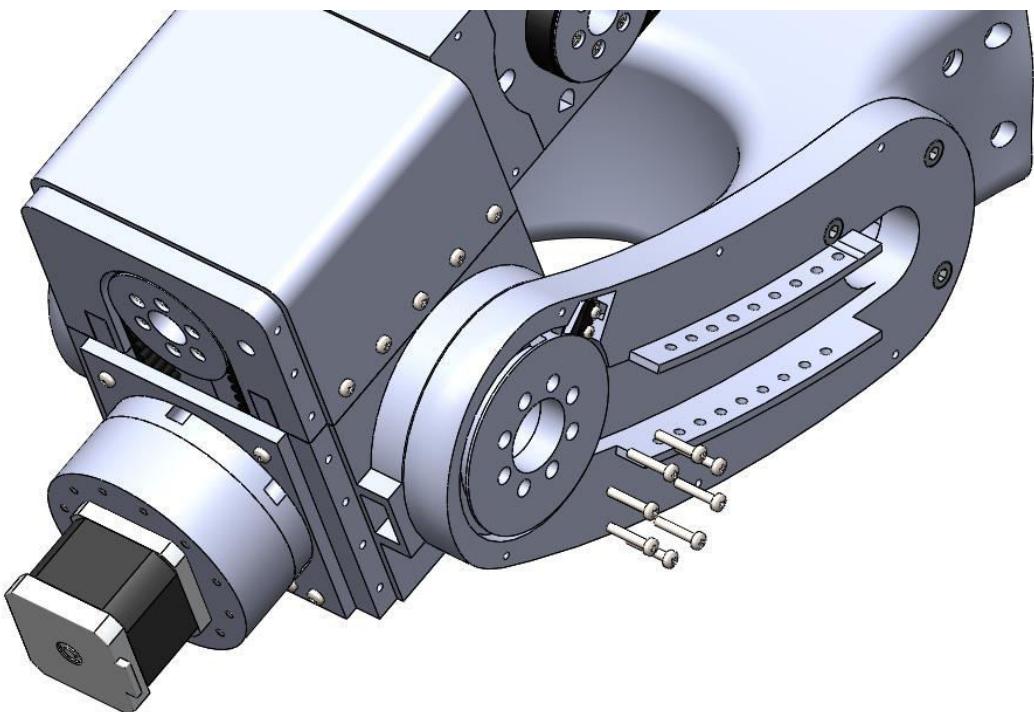
Part	Quantity	Position	Notes: adjust the holes on limit trigger so that they match ones on Elbow assembly . They must be matched to look like bottom and top picture . If they are not matched your arm will not look like top picture so move the trigger for one hole up or down.



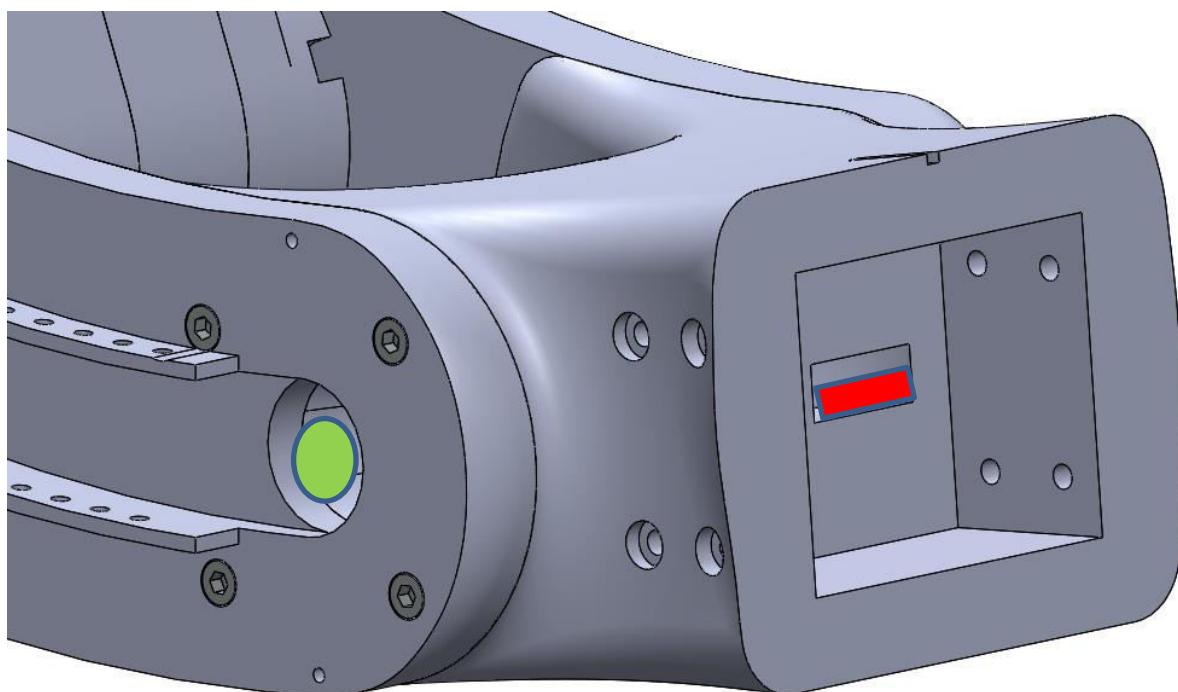
Part	Quantity	Position	Notes:

Arm Assembly

Step7

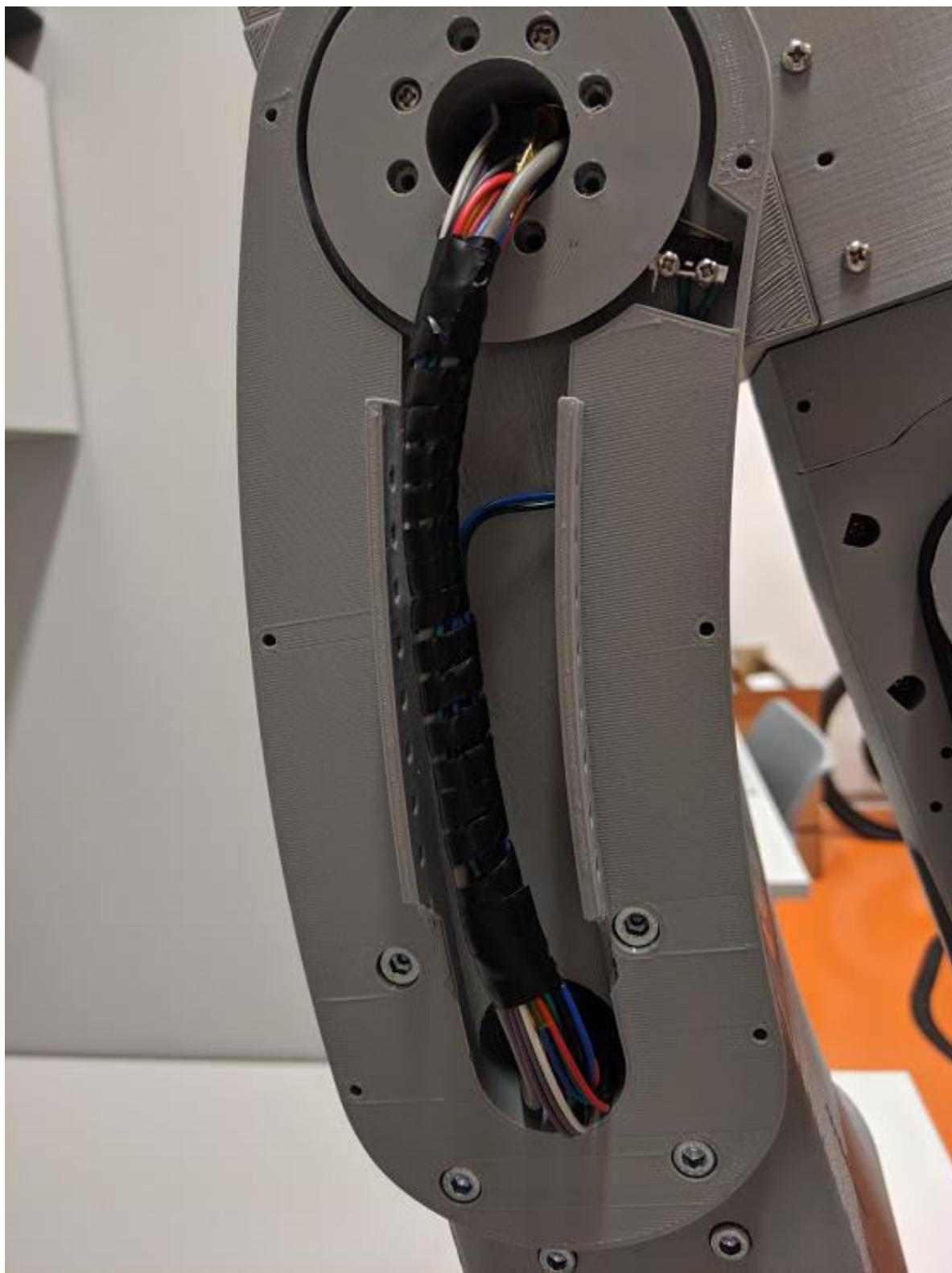


Part	Quantity	Position	Notes:
M3 20 mm screws	8	1	



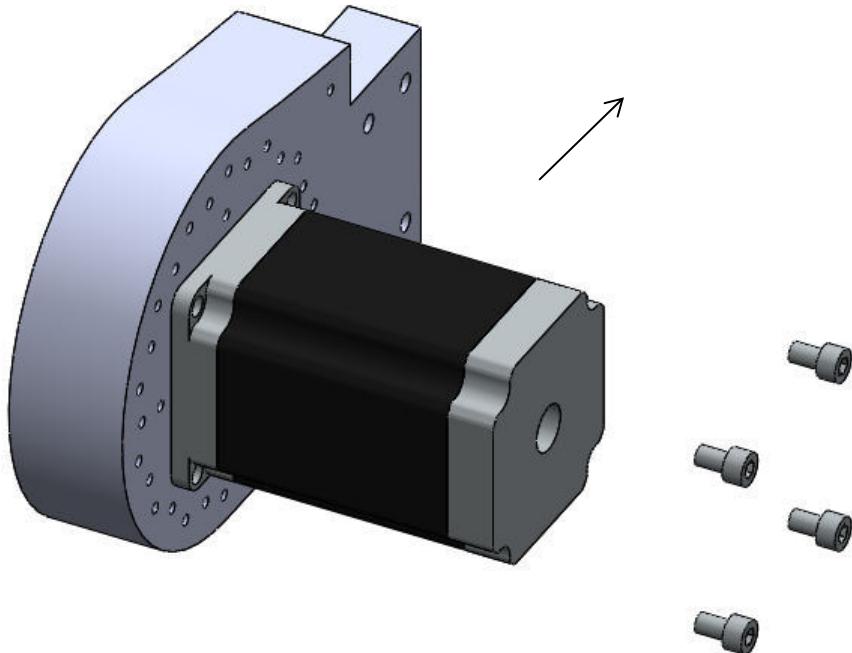
Part	Quantity	Position	Notes:Now all wires must be pulled thru hole marked with green to the rectangle marked with red.

Example how wiring should look like

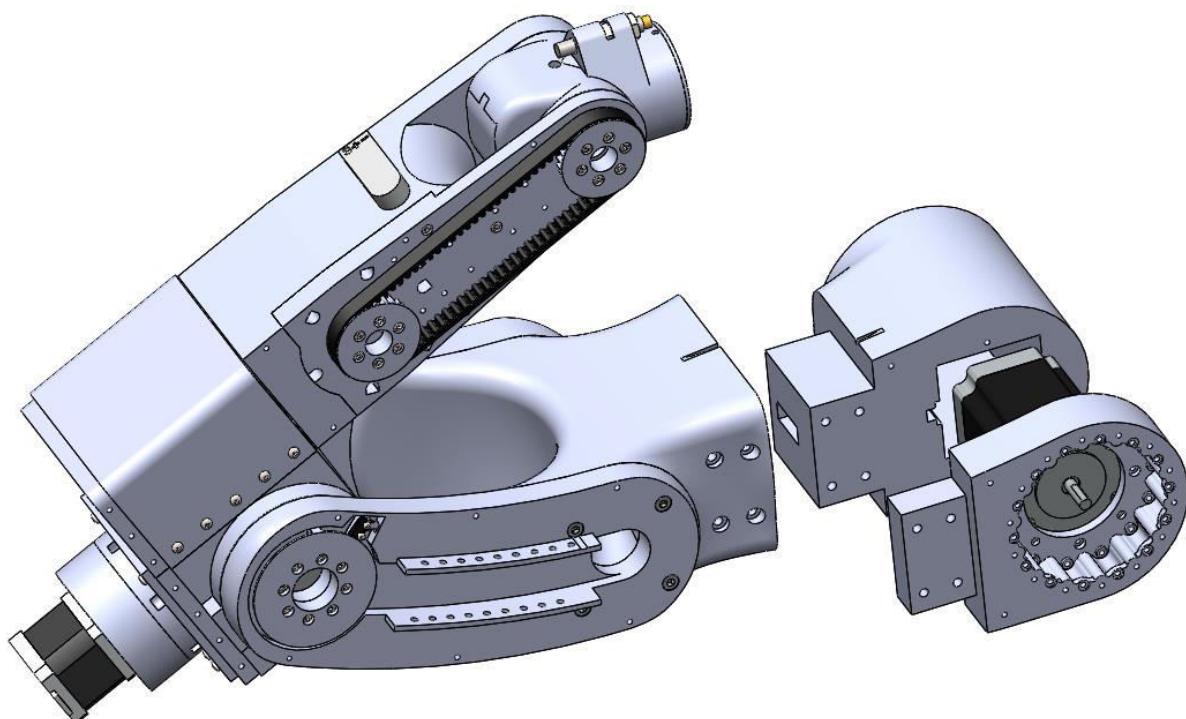


Joint 2 cyclo Assembly

Step1



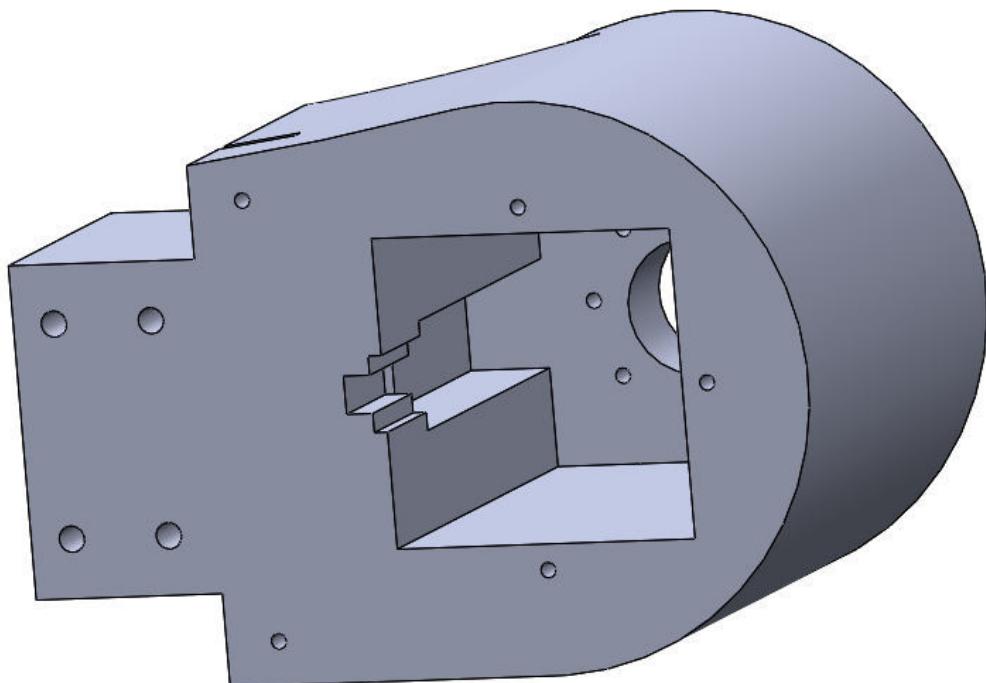
Part	Quantity	Position	Notes: make shure that side of stepper is pointing To the side where arrow is pointing
J2 main case	1	1	
M5 HEX 8 mm screws	4	2	
Nema 23 Bipolar 4A 2.26V 57x57x84mm	1	3	



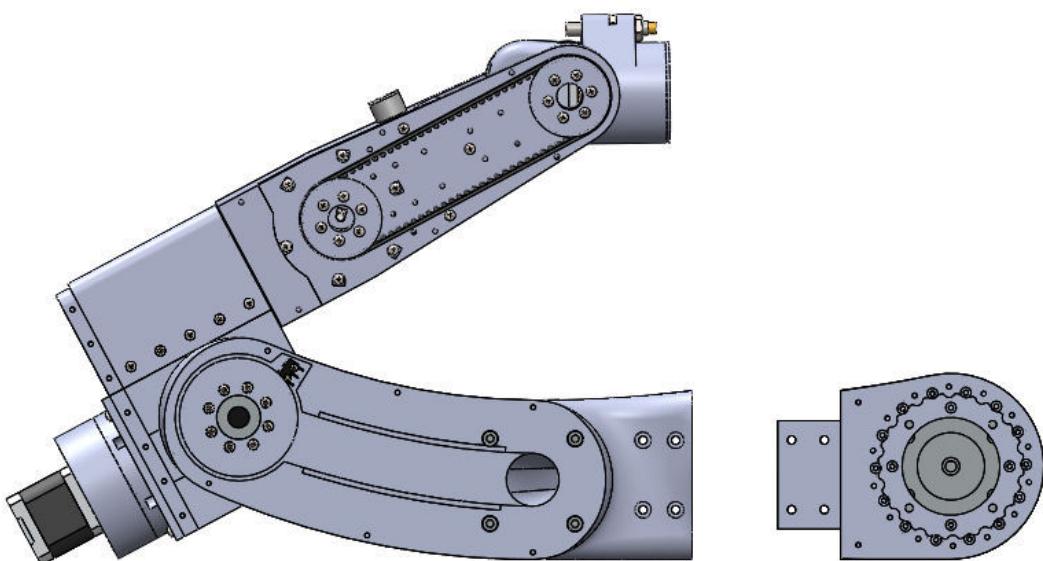
Part	Quantity	Position	Notes:Now all wires from previous step should be routed thru Joint2 cover part.
J2 cover	1	1	

Joint2 cyclo Assembly

Step2



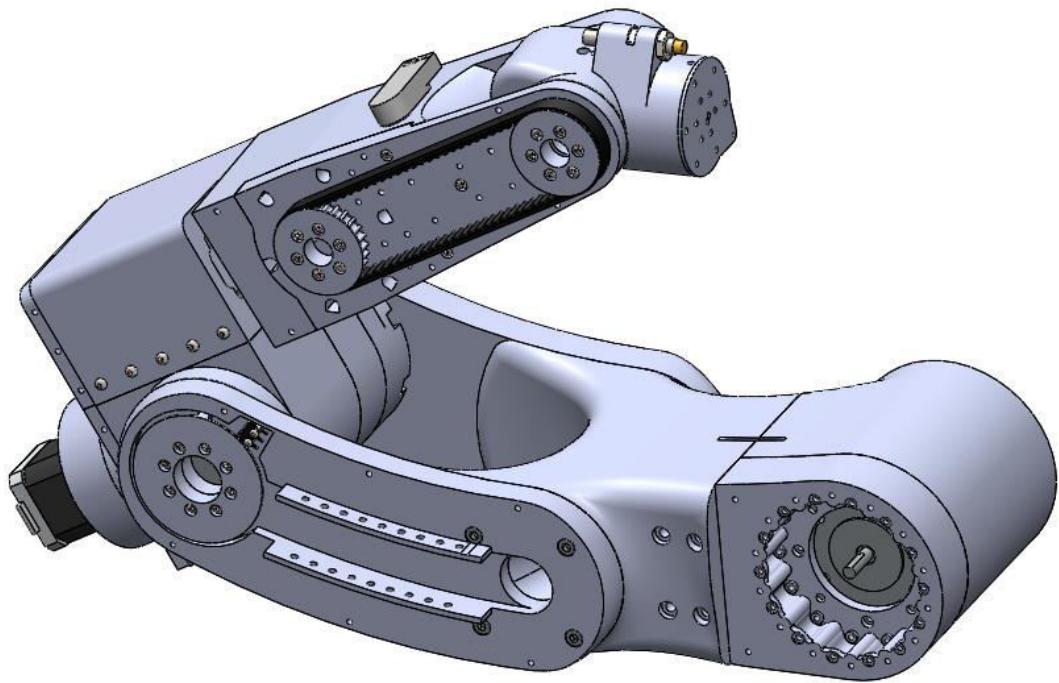
Part	Quantity	Position	Notes: Wires must go thru the square hole on top to the hole on side.



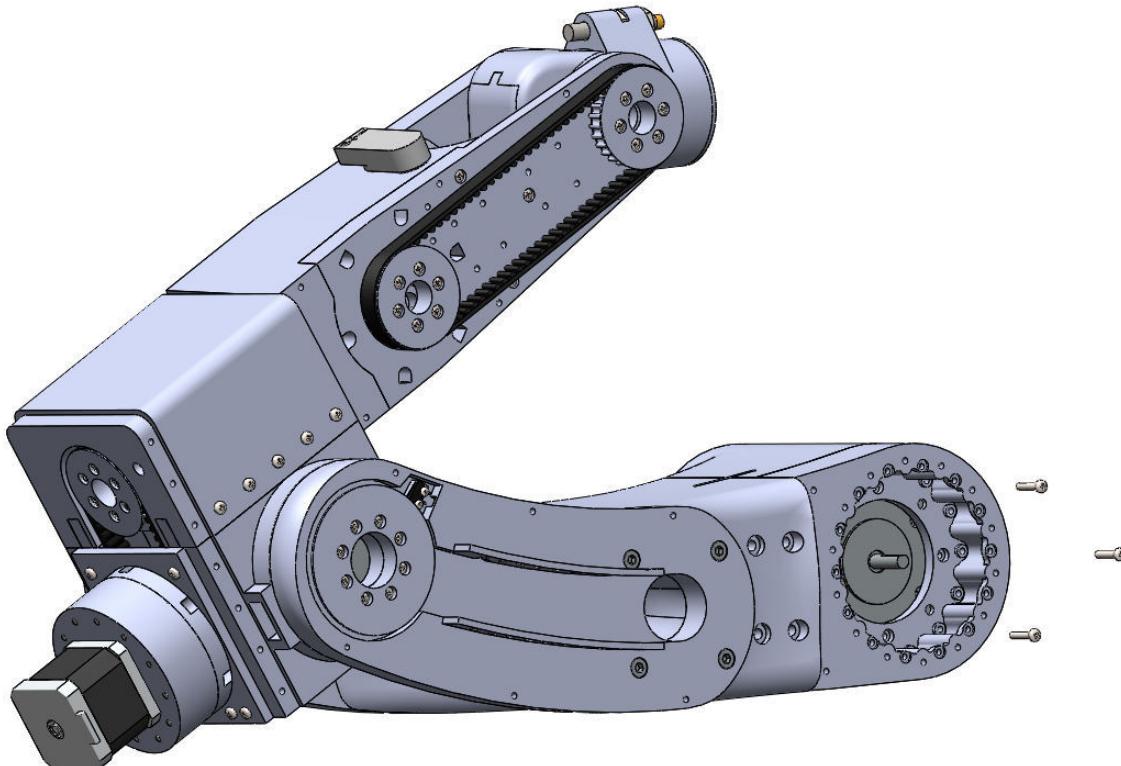
Part	Quantity	Position	Notes: After you adjusted wires press J2 cover to main case and press them in the arm.

Joint2 cyclo Assembly

Step3



Part	Quantity	Position	Notes: It must look like this . If you accidentally pressed wires while pressing parts together ,there will be gaps so try again.

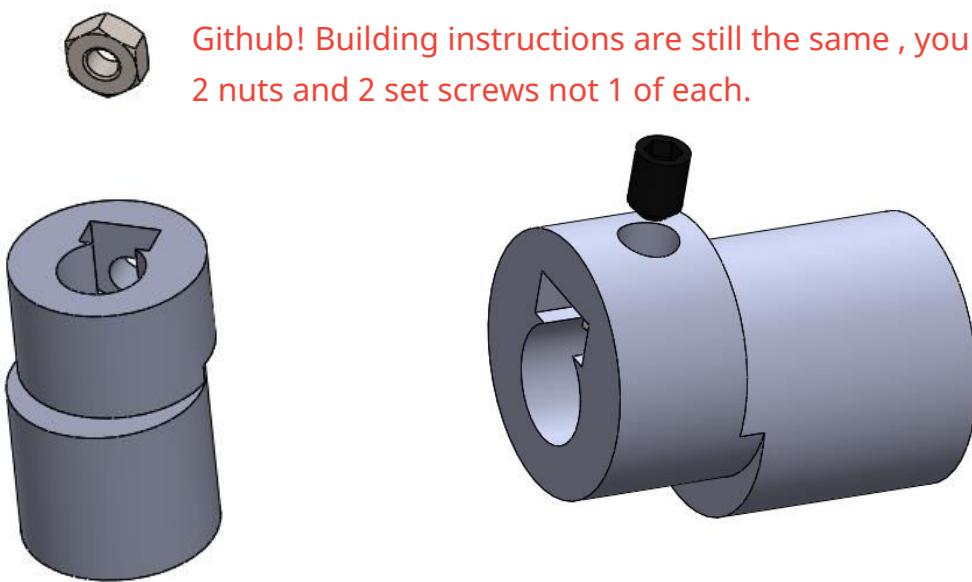


Part	Quantity	Position	Notes:
M3 20 mm screws	3	1	

Joint 2 cyclo Assembly

Step4

This part is changed, it is now called 27to1 esc_shaft_rework_2 and can be found in rework folder in STL folder. All files are on Github! Building instructions are still the same , you will only need 2 nuts and 2 set screws not 1 of each.



Part	Quantity	Position	Notes: dont screw set screw all the way.
Joint 2 eccentric shaft	1	1	
M3 nut	1	2	
M3 4mm set screw	1	3	

This part is also changed it is named 27to1 disc_rework and it is in same folder as part changed in previous step. You will also need to use TWO 20x27x4 ball bearings.

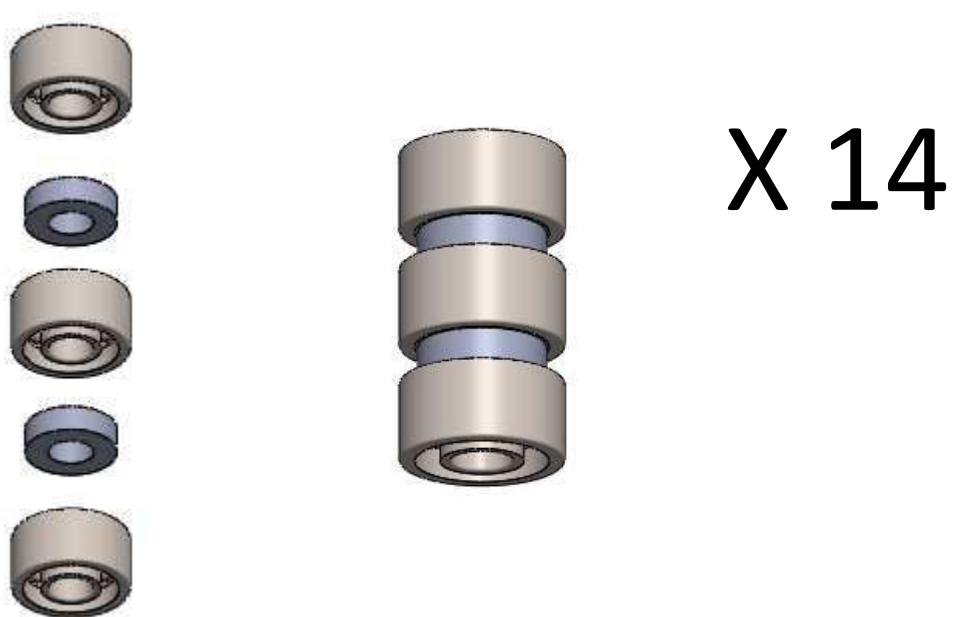
X2



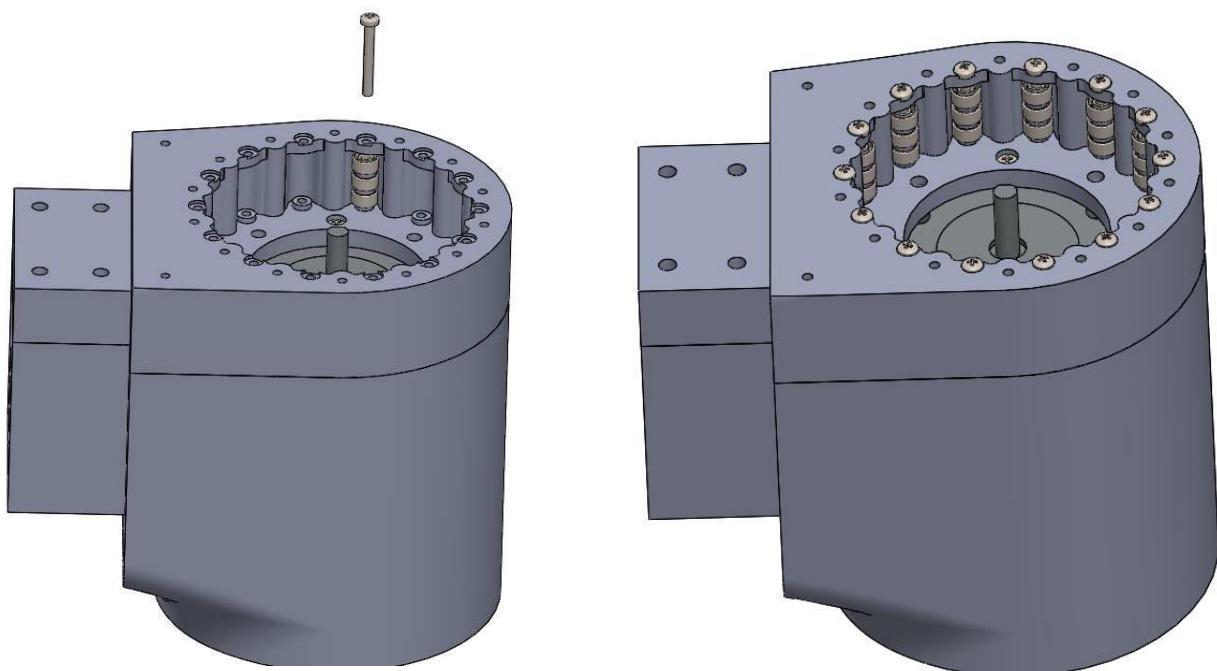
Part	Quantity	Position	Notes:
Ball bearing 15x28x7	2	1	
Joint2 cyclo disc	2	2	

Joint 2 cyclo Assembly

Step5



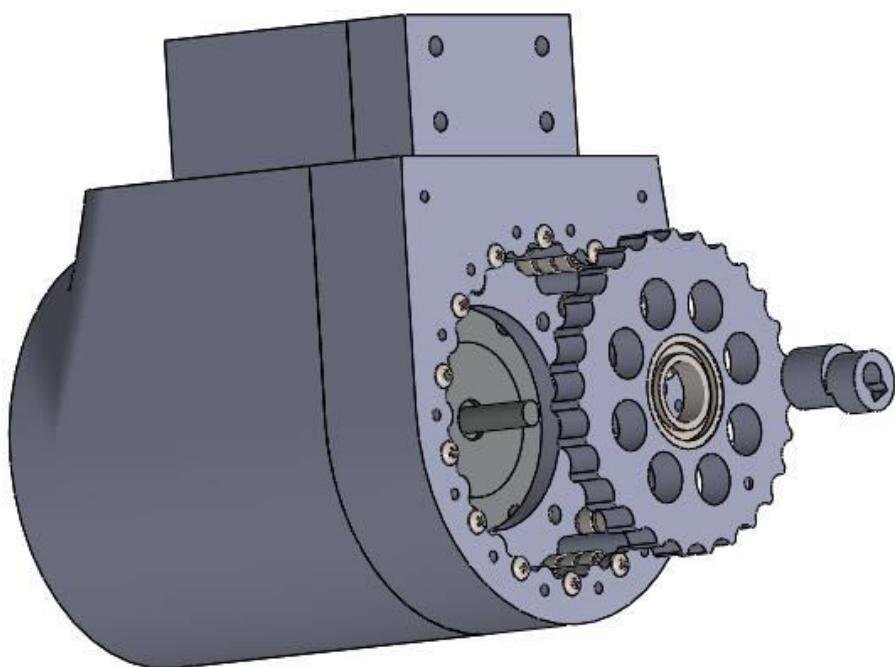
Part	Quantity	Position	Notes:
Ball bearing 3x8x4	42	1	
J2 ring spacer	28	2	



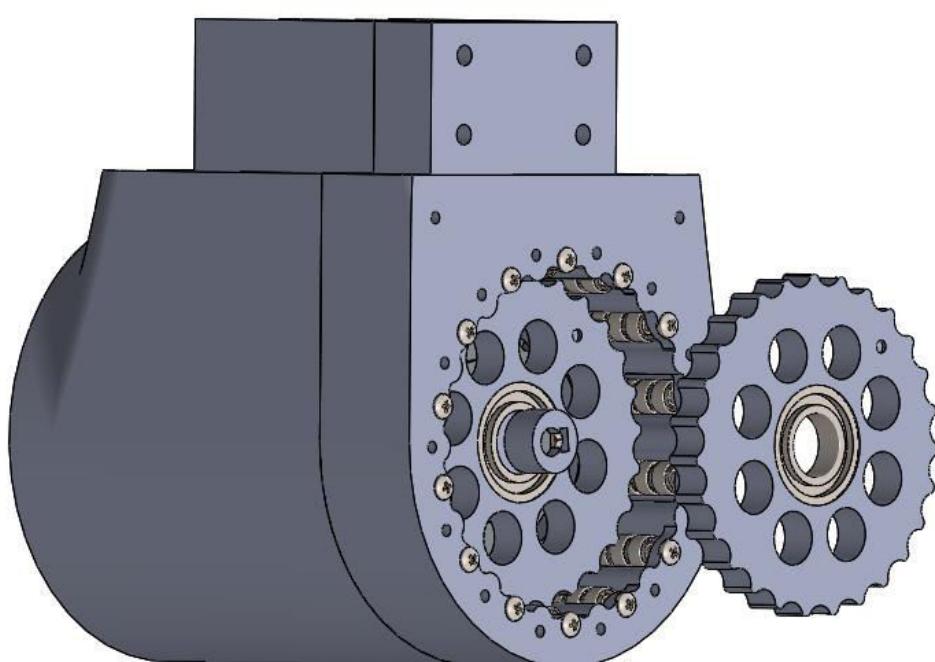
Part	Quantity	Position	Notes: This part is still attached to rest of the arm. Rest of the arm is hidden so that instructions are more clear.
M3 30 mm screw	14	1	

Joint 2 cyclo Assembly

Step6



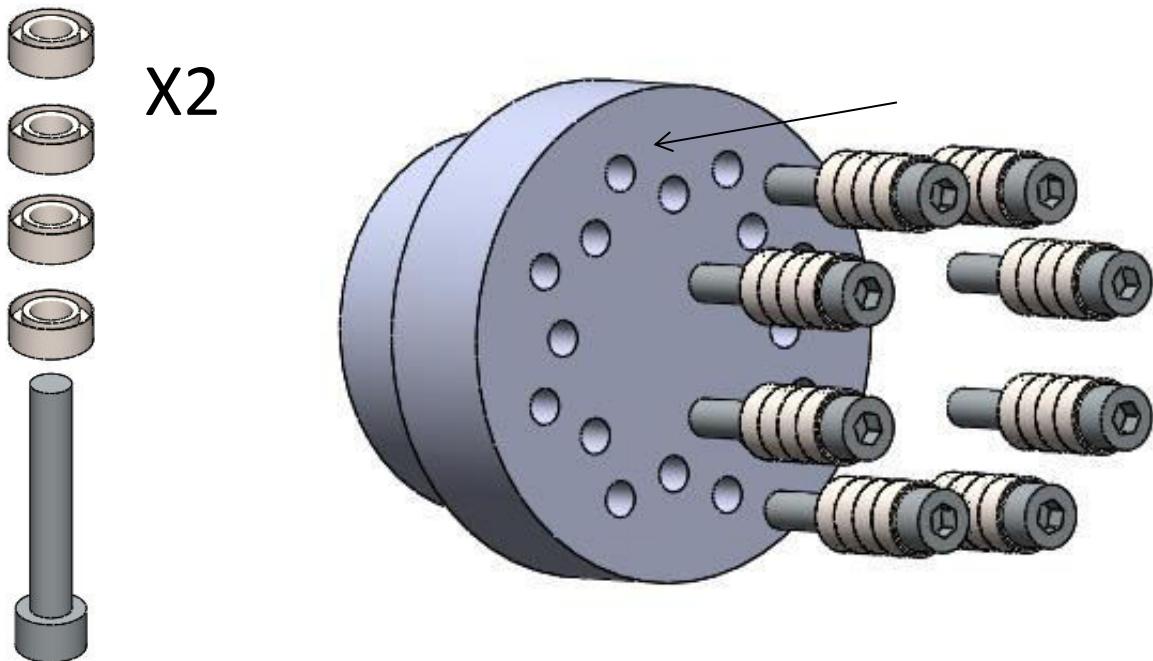
Part	Quantity	Position	Notes: crew 4mm set screw .



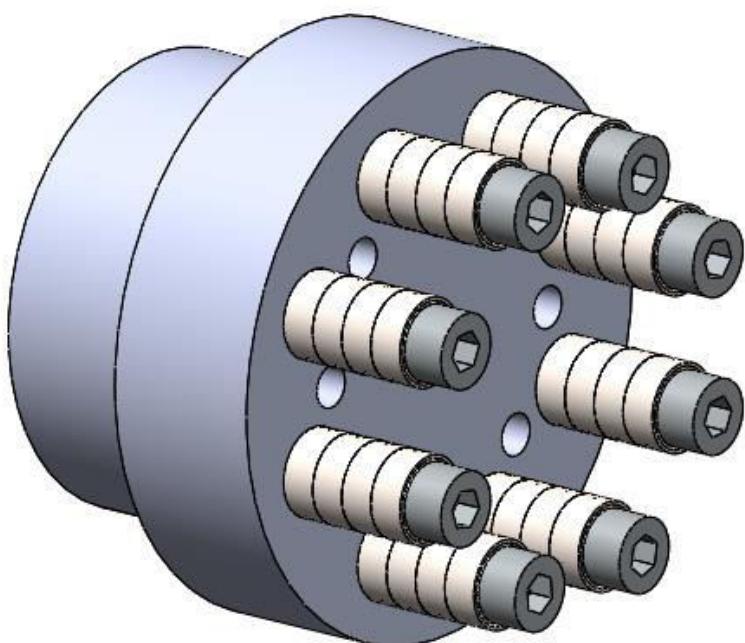
Part	Quantity	Position	Notes:Make shure you align holes on cyclo discs.

Joint 2 cyclo Assembly

Step7



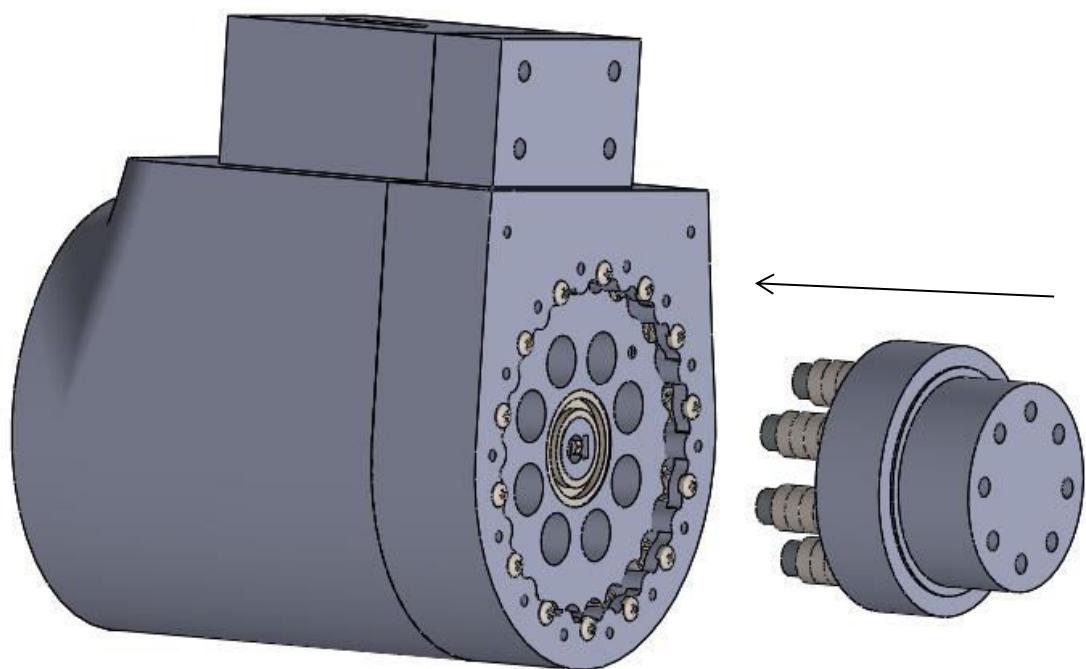
Part	Quantity	Position	Notes: screws go to the outer holes.
Joint 2 Output shaft	1	1	
M5 HEX 30 mm screw	8	2	
Ball bearing 5x10x4	32	3	



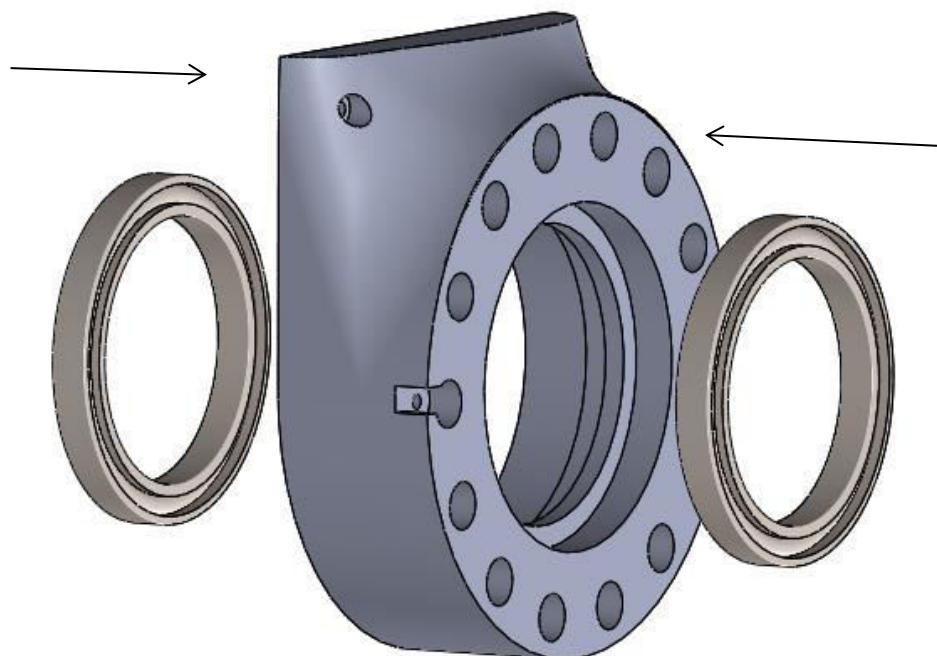
Part	Quantity	Position	Notes:

Joint 2 cyclo Assembly

Step8



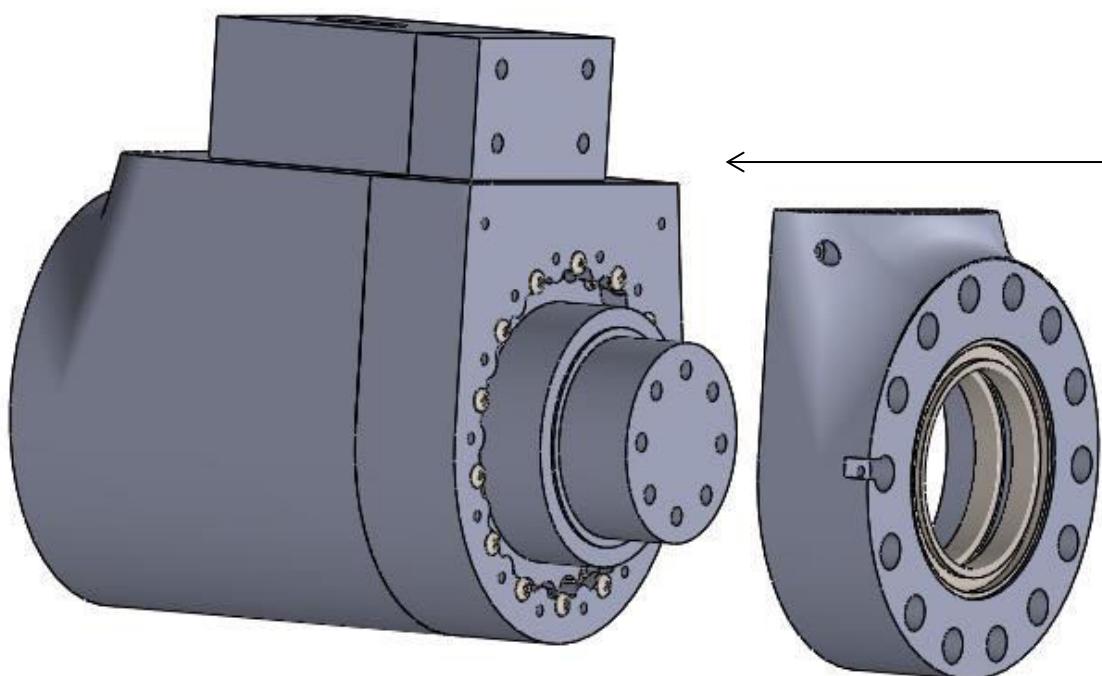
Part	Quantity	Position	Notes:



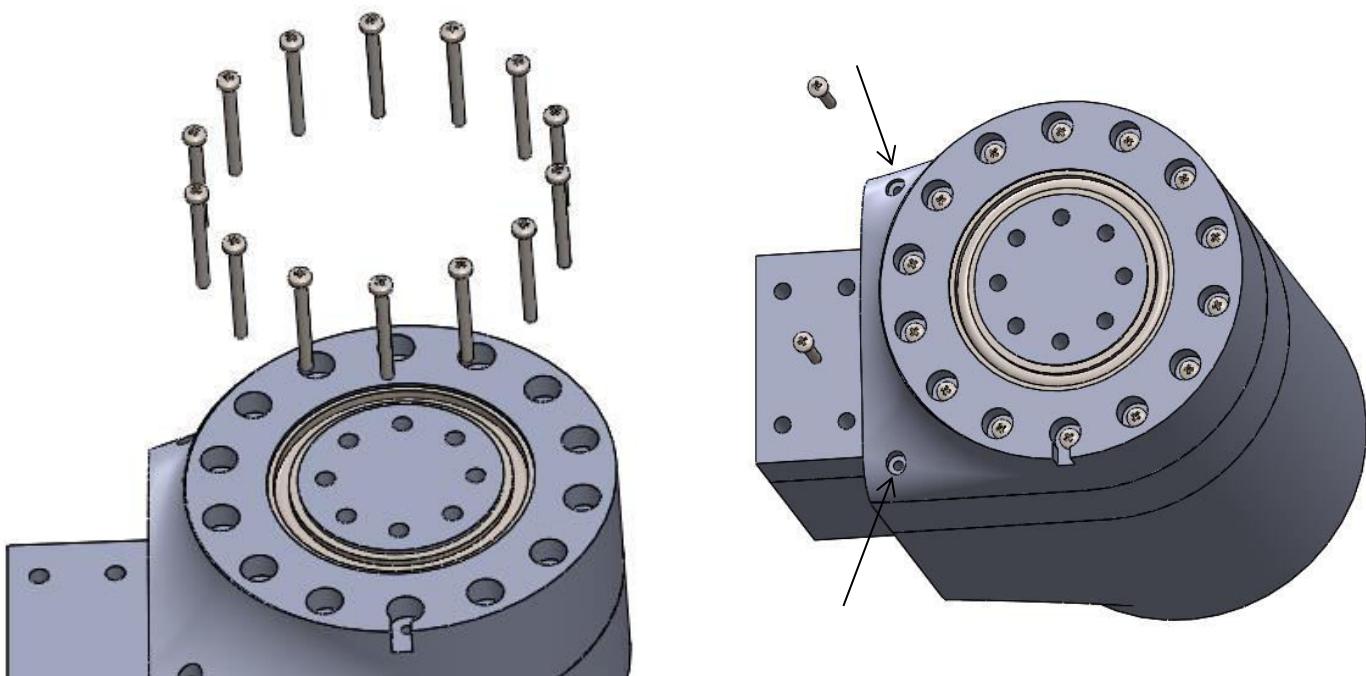
Part	Quantity	Position	Notes:	
Ball bearing 50x65x7	2	1		
Joint 2 top cover	1	2		

Joint 2 cyclo Assembly

Step9



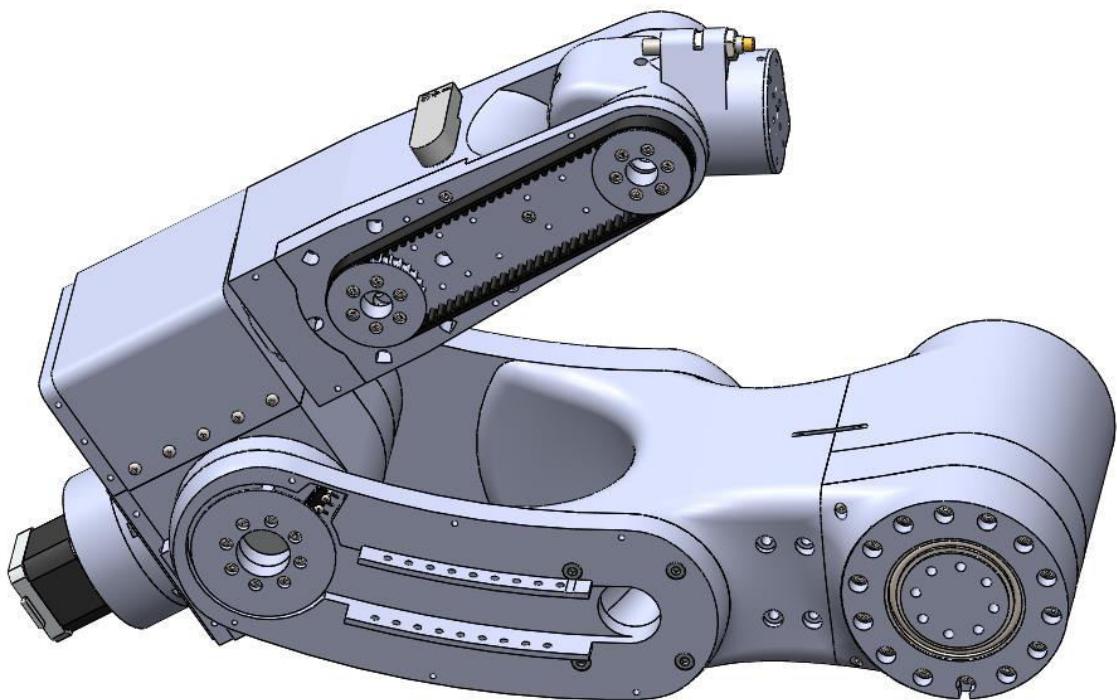
Part	Quantity	Position	Notes:



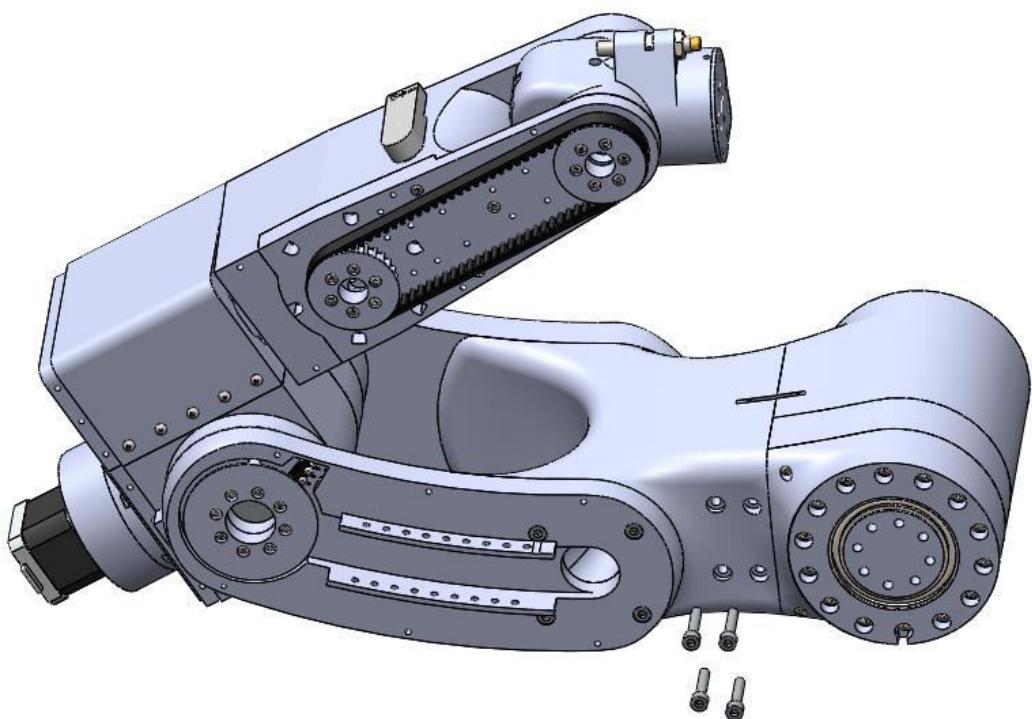
Part	Quantity	Position	Notes:
M3 10 mm screws	2	1	
M3 30 mm screws	14	2	

Arm Assembly

Step8



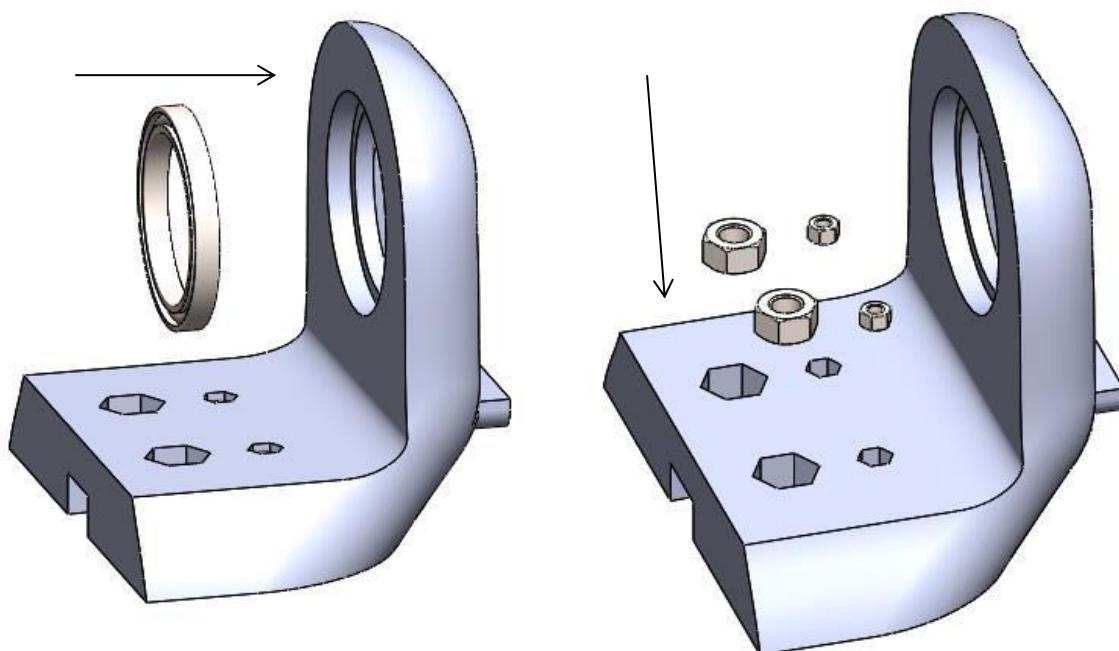
Part	Quantity	Position	Notes:



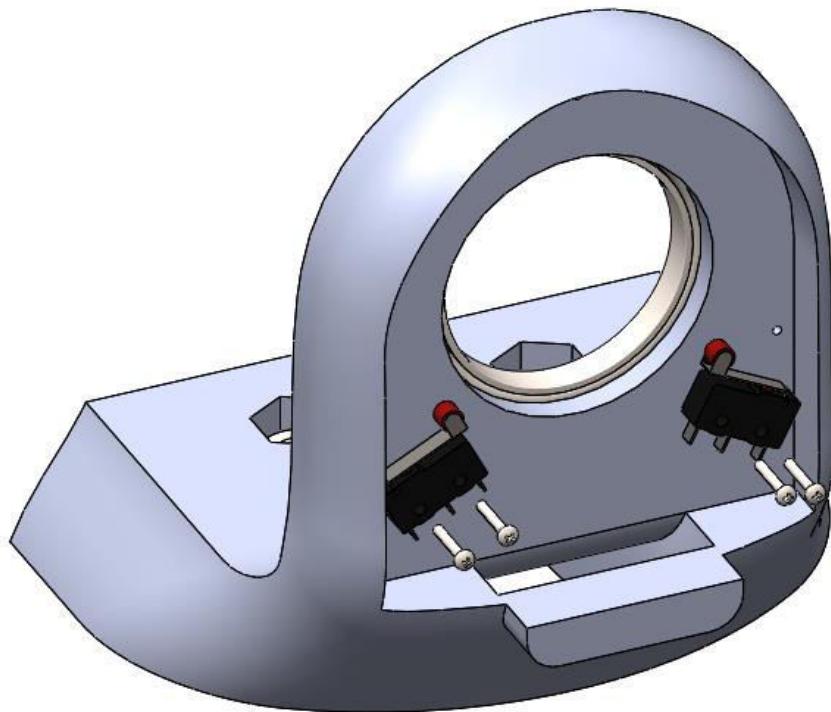
Part	Quantity	Position	Notes: 4 of these screws go to the holes on this picture and 4 go to the oposite side
M5 25 mm HEX screws	8	1	

Rotating base Assembly

Step1



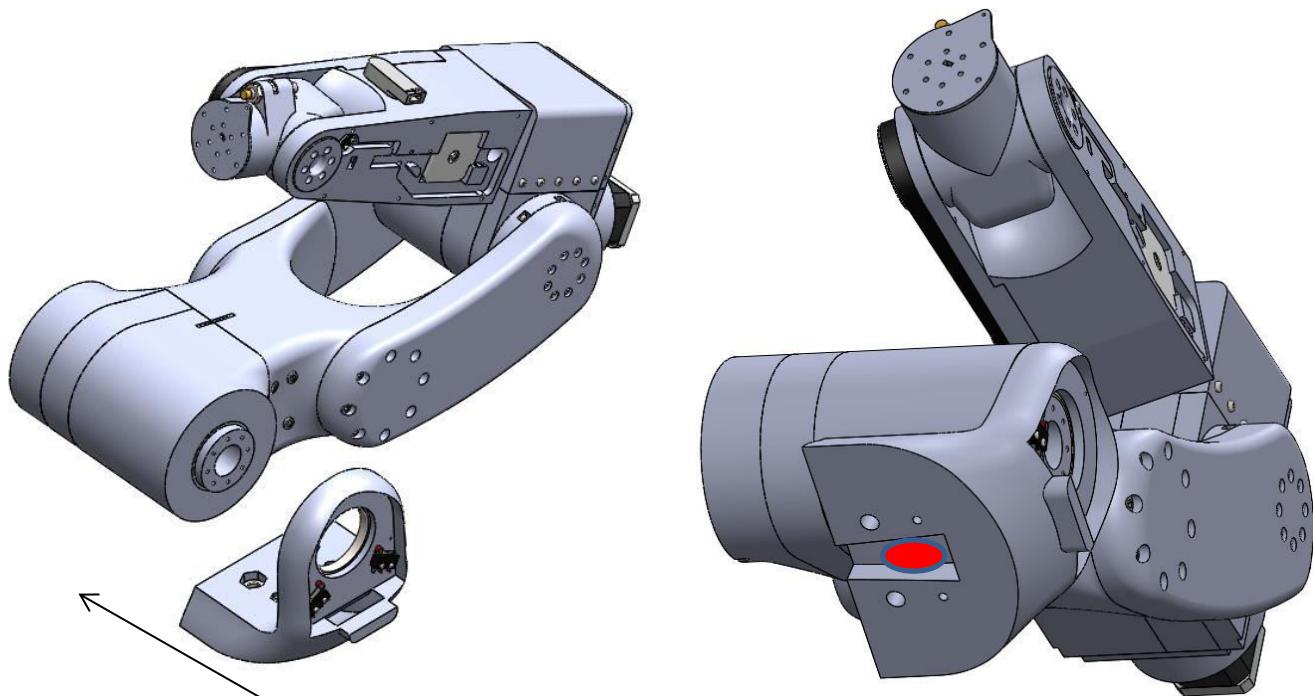
Part	Quantity	Position	Notes: The wires from the roller switches must be connected in parallel and their wires must go through the hole under them.
Rotating base_wires	1	1	
M10 nuts	2	2	
M5 nuts	2	3	
Ball bearing 50x65x7	1	4	



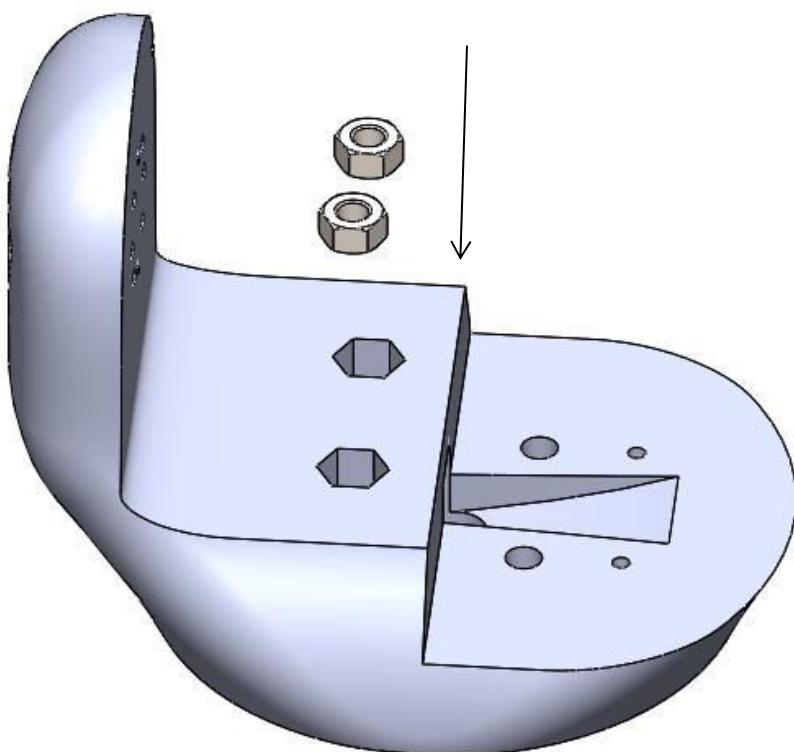
Part	Quantity	Position	Notes: These 2 switches must be connected in parallel and their wires must go through the hole under them.
Roller switches	2	1	
M2 10 mm screws	4	2	

Rotating base Assembly

Step2



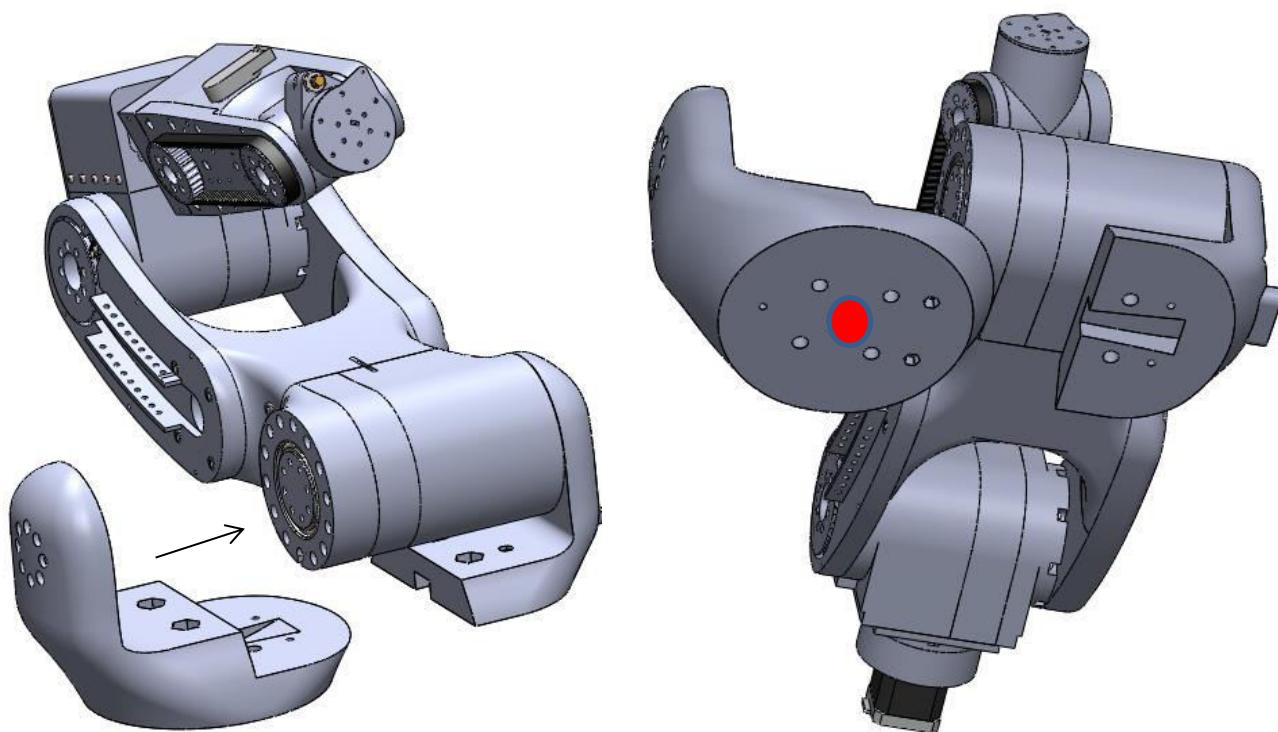
Part	Quantity	Position	Notes: ALL wires from arm now must come out of the hole marked with red



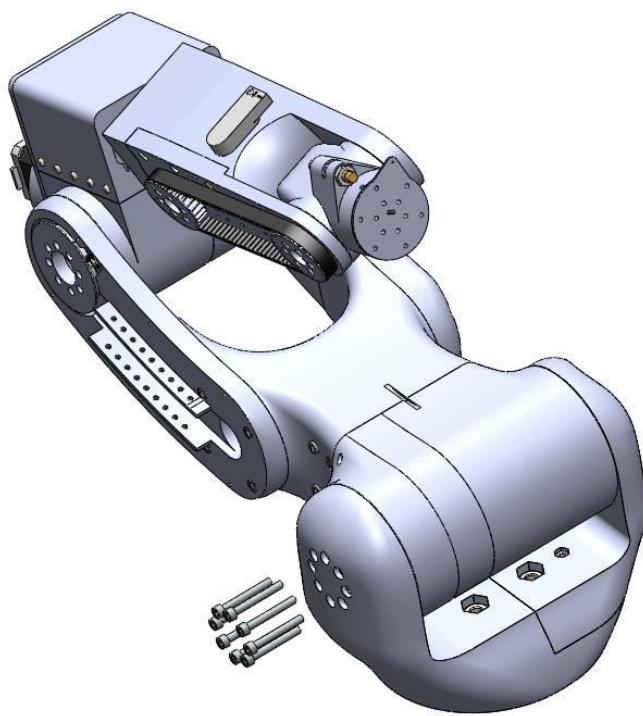
Part	Quantity	Position	Notes:
Rotating base_motor	1	1	
M10 nuts	2	2	

Rotating base Assembly

Step3



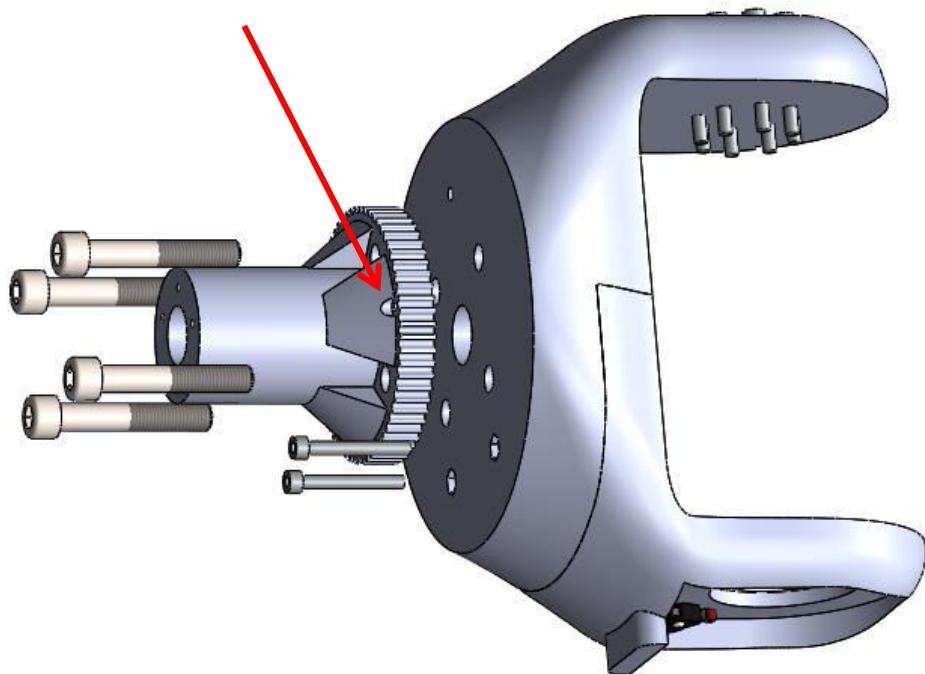
Part	Quantity	Position	Notes: Pull all wires thru hole marked with red.



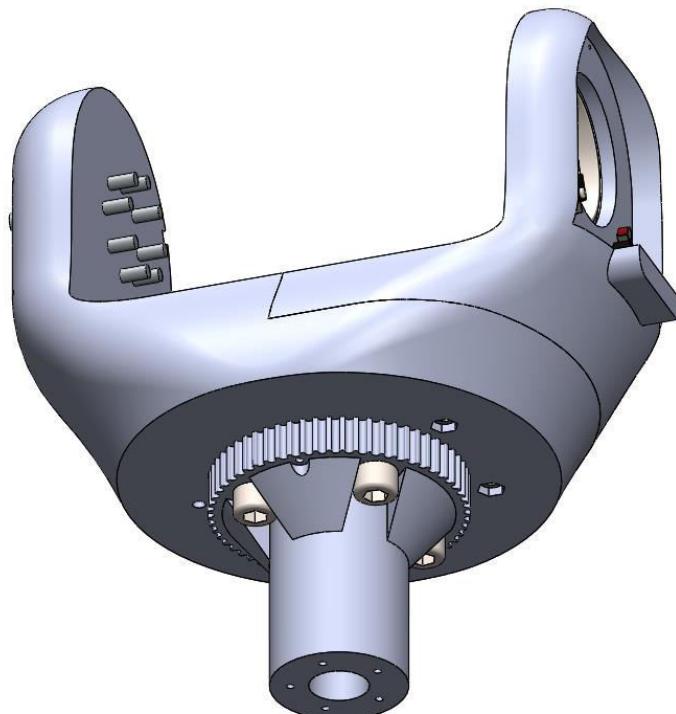
Part	Quantity	Position	Notes:
M5 HEX 40 mm screws	8	1	

Rotating base Assembly

Step4



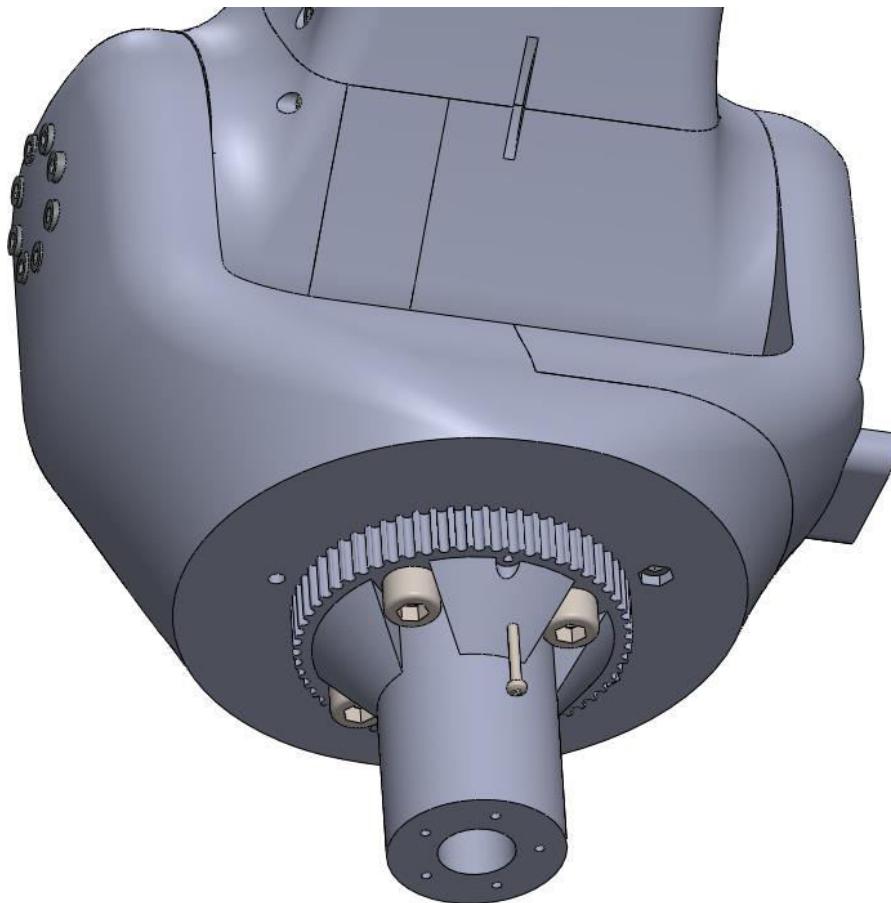
Part	Quantity	Position	Notes: Make shure that hole pointed by arrow is oriented like this. ALL wires must go thru Joint 1 output shaft
M10 HEX 60 mm screw	4	1	
M5 HEX 40mm screws	2	2	
Joint 1 output shaft	1	3	



Part	Quantity	Position	Notes:

Rotating base Assembly

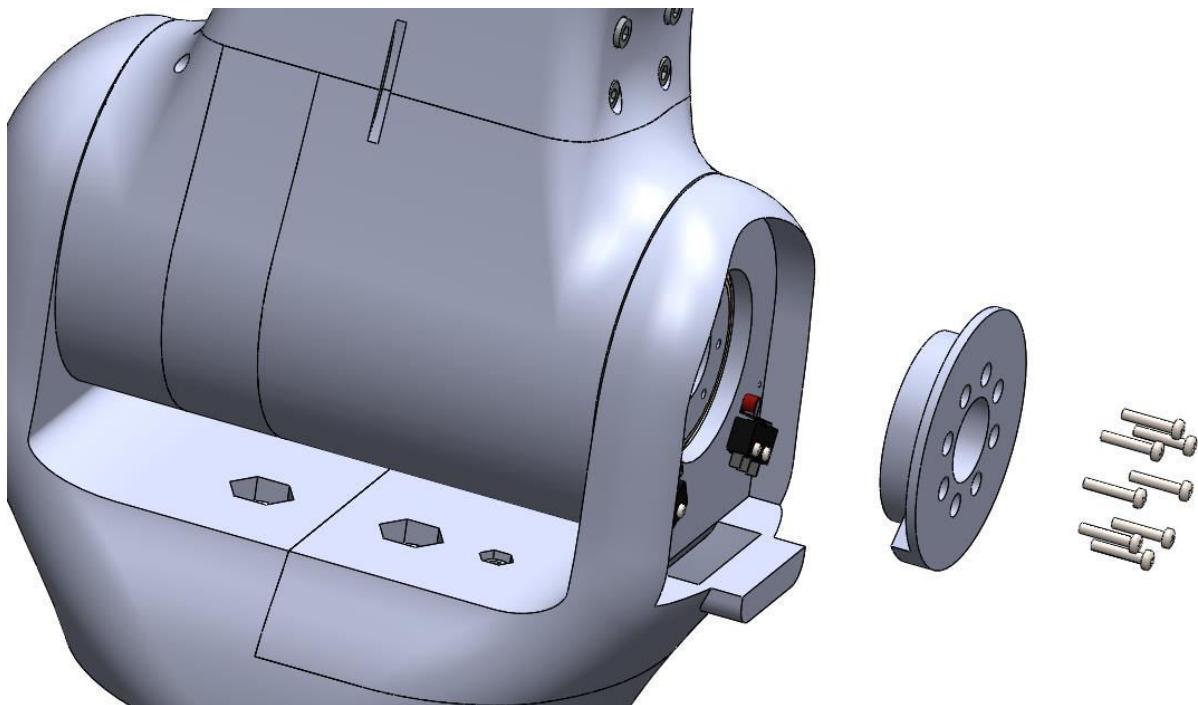
Step5



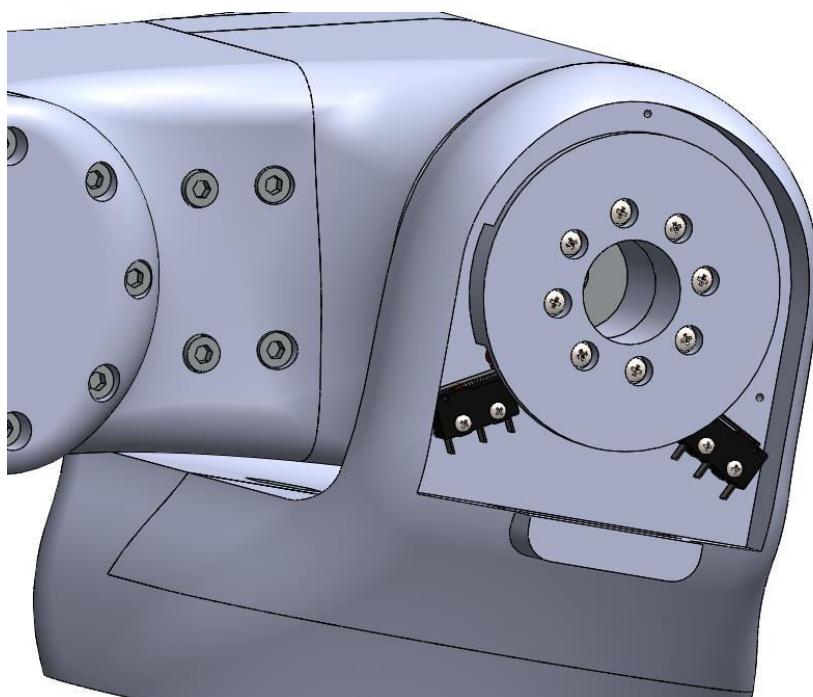
Part	Quantity	Position	Notes: We will adjust this screw later.
M3 15 mm screws	1	1	

Rotating base Assembly Assembly

Step6



Part	Quantity	Position	Notes:
Joint 2 limit trigger	1	1	
M3 20 mm screws	8	2	



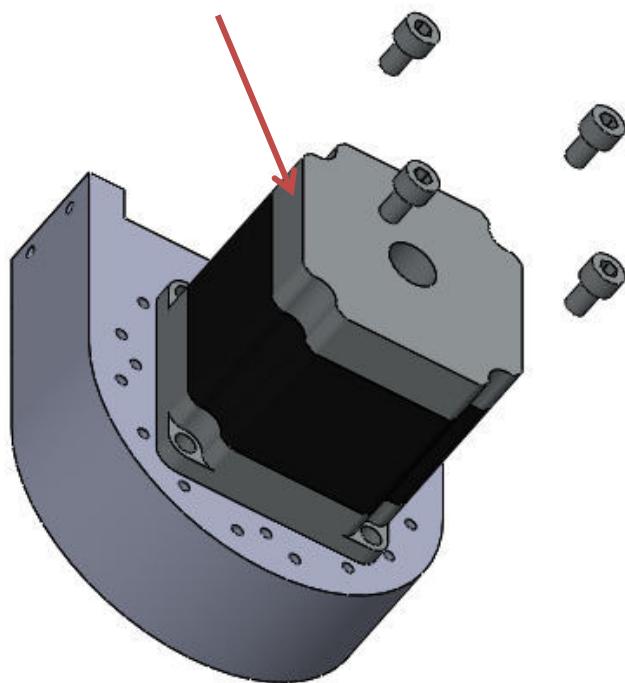
Part	Quantity	Position	Notes:Limit trigger needs to be in this position. If it is not looking like this unscrew it and reposition it.

Example how wiring should look like

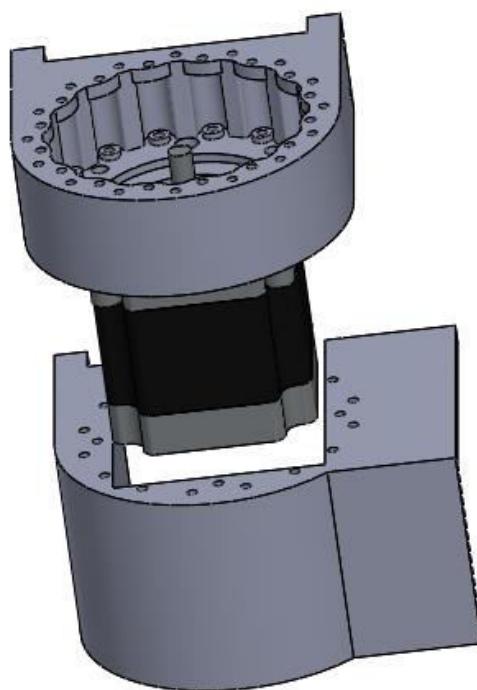


Base Assembly

Step1



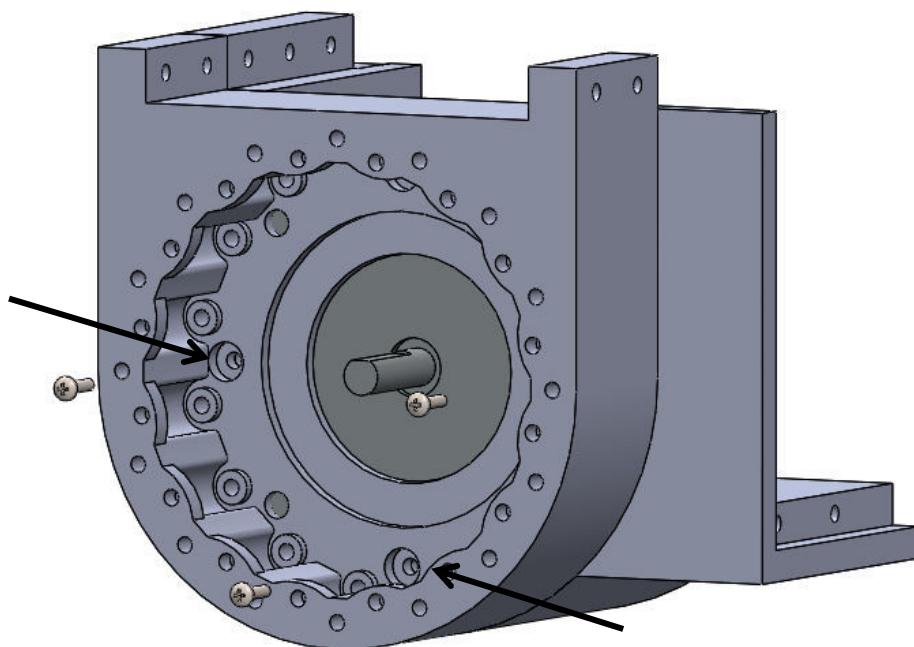
Part	Quantity	Position	Notes: Wires should be on side where arrow points.
M5 HEX 8 mm screws	4	1	
Nema 23 Bipolar 1.5A 5.4V 57x57x56mm	1	2	
Joint 1 main case	1	3	



Part	Quantity	Position	Notes:
Joint 1 cover	1	1	

Base Assembly

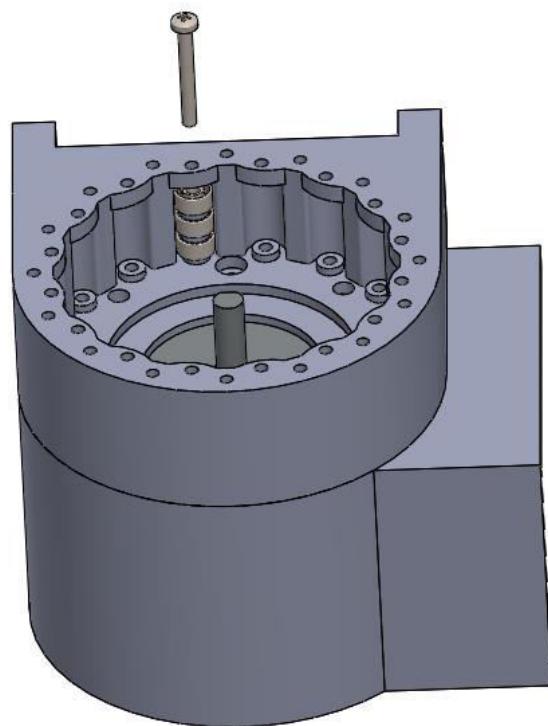
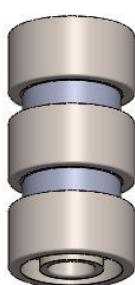
Step2



Part	Quantity	Position	Notes:
M3 10 mm screws	3	1	



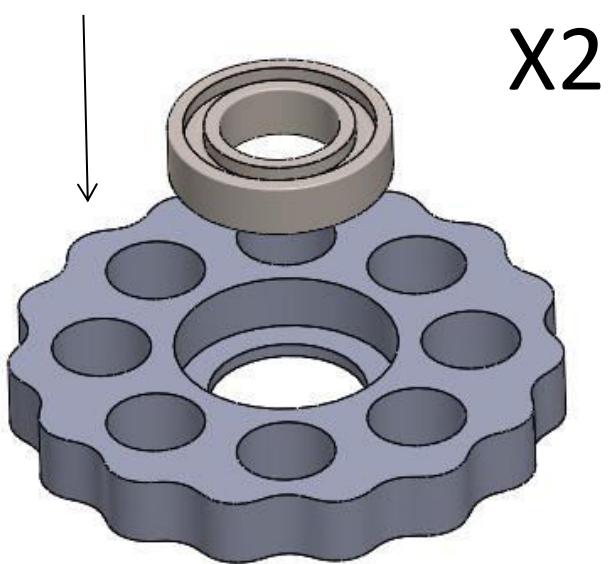
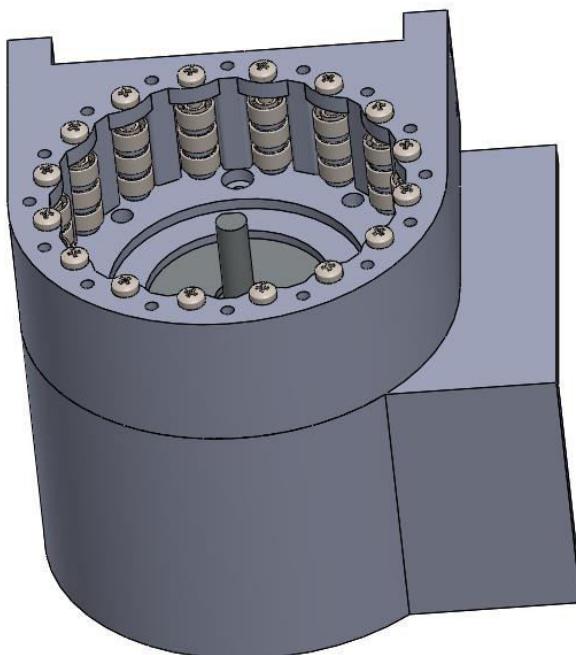
X16



Part	Quantity	Position	Notes:
Ball bearing 3x8x4	48	1	
Joint 1 ring spacers	32	2	
M3 25mm screws	16	3	

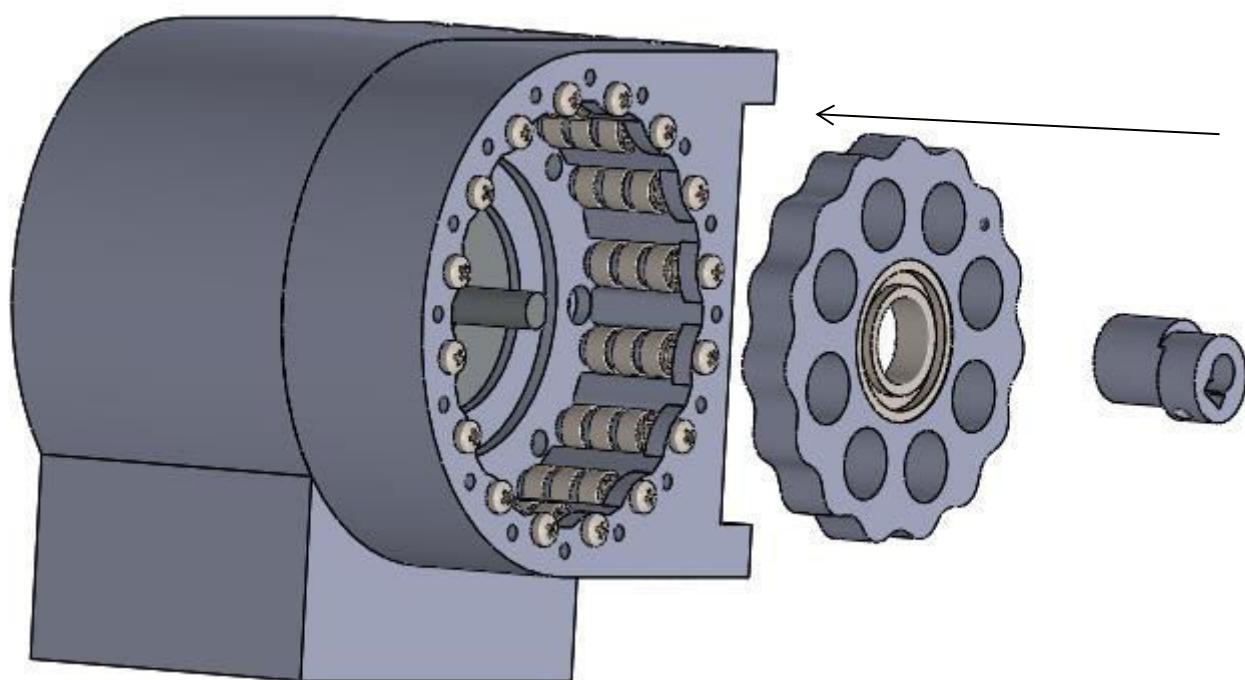
Base Assembly

Step3



X2

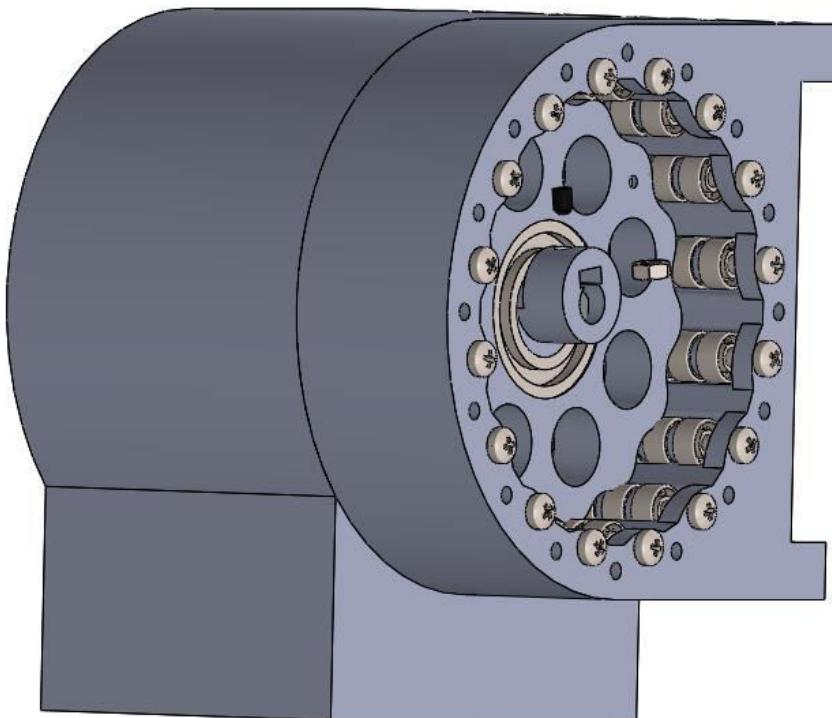
Part	Quantity	Position	Notes:	
Ball bearing 15x28x7	2	1		
15:1 cyclo disc	2	2		



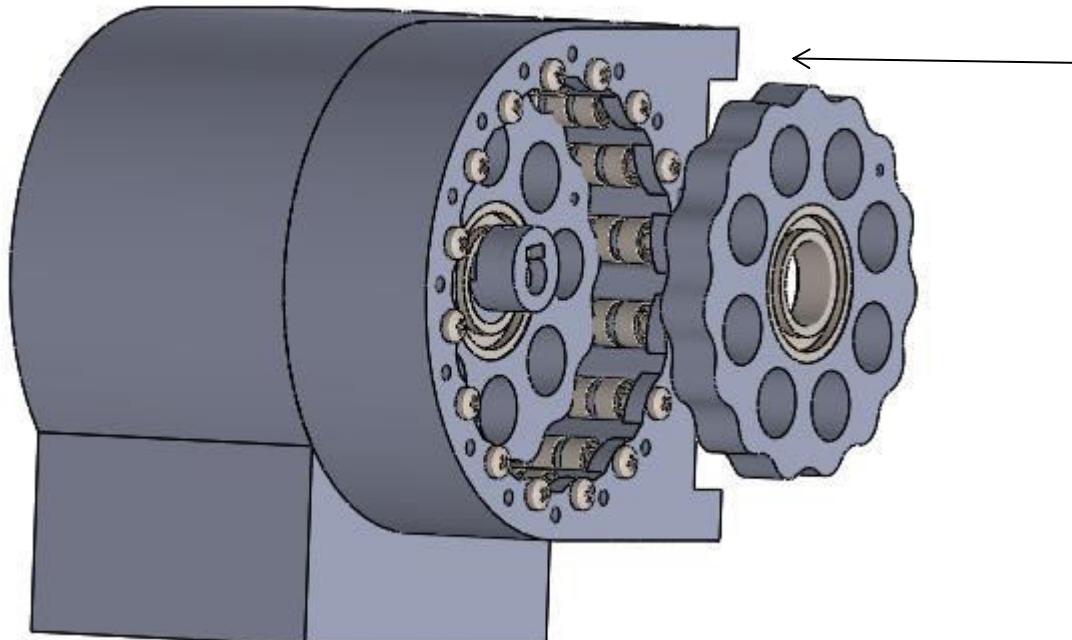
Part	Quantity	Position	Notes:
Joint 1 eccentric shaft	1	1	

Base Assembly

Step1



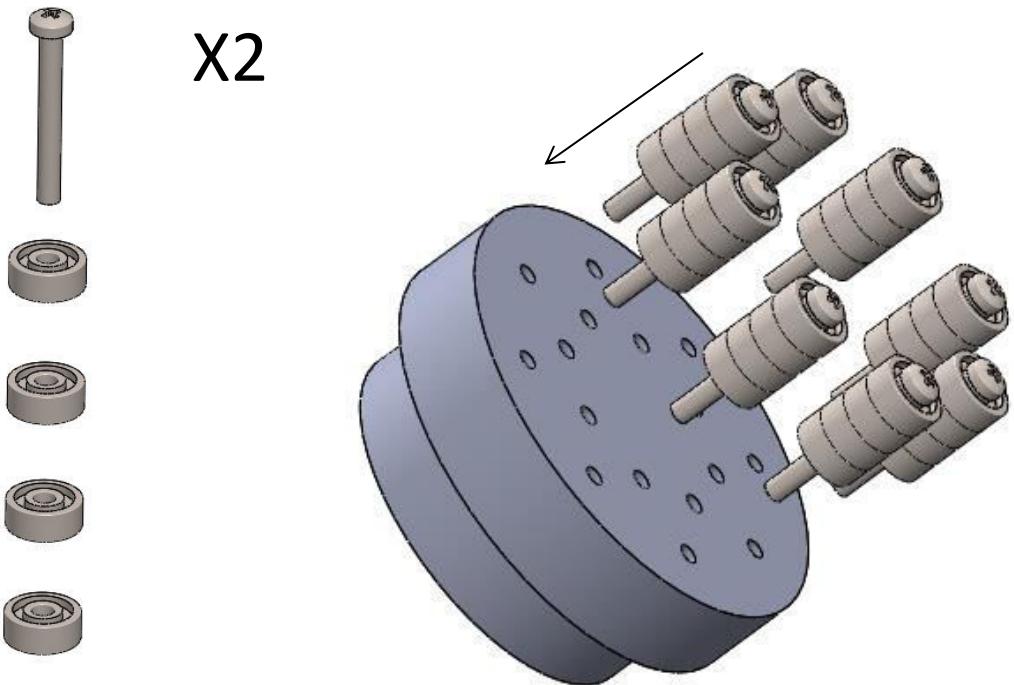
Part	Quantity	Position	Notes:
M3 nut	1	1	
M3 4mm set screw	1	2	



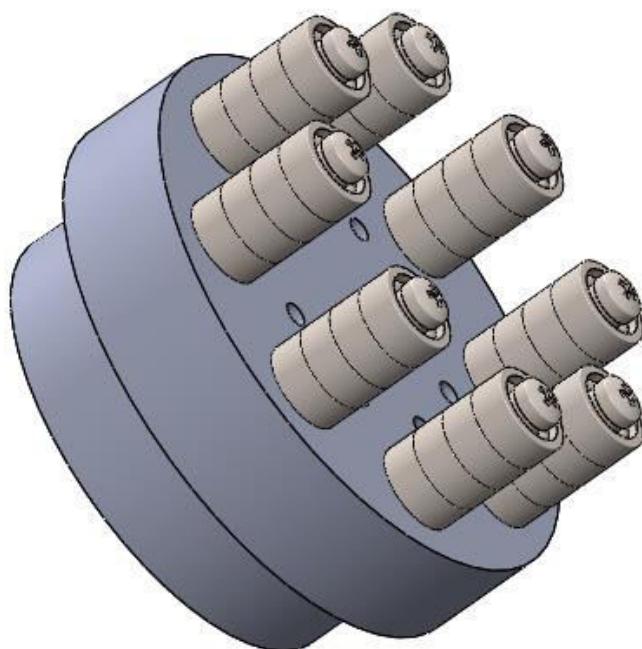
Part	Quantity	Position	Notes:Make shure you align the dots.

Base Assembly

Step5



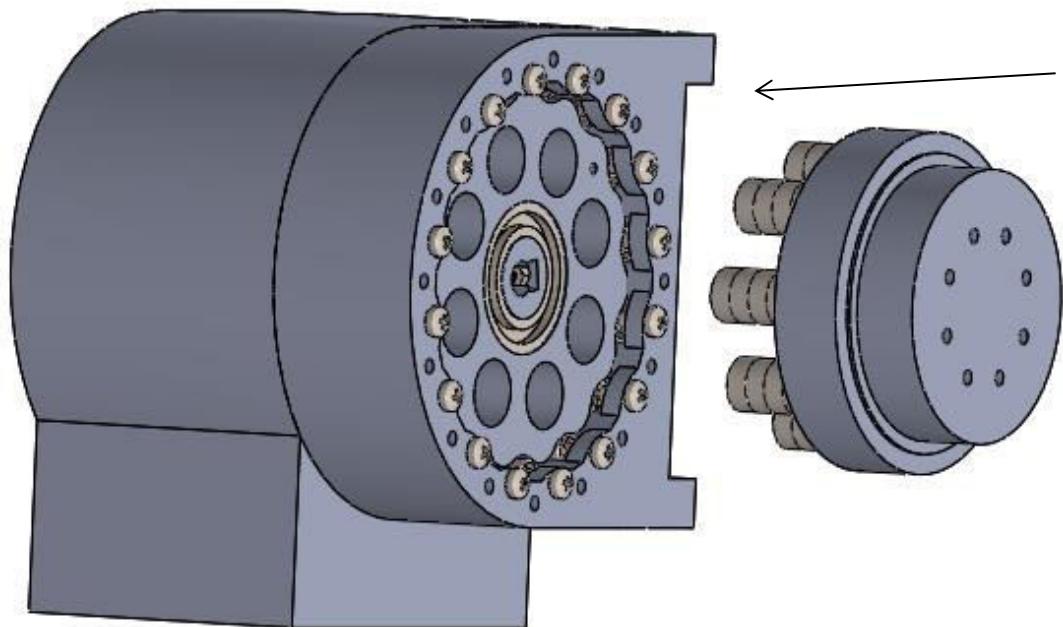
Part	Quantity	Position	Notes:
Ball bearing 3x10x4	32	1	
M3 25 mm screws	8	2	
Joint 1 cyclo output shaft	1	1	



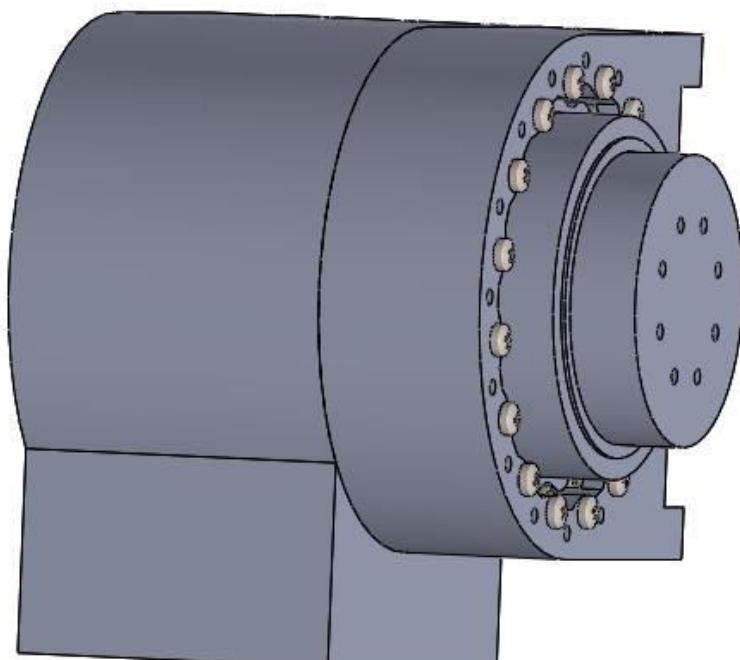
Part	Quantity	Position	Notes:

Base Assembly

Step6



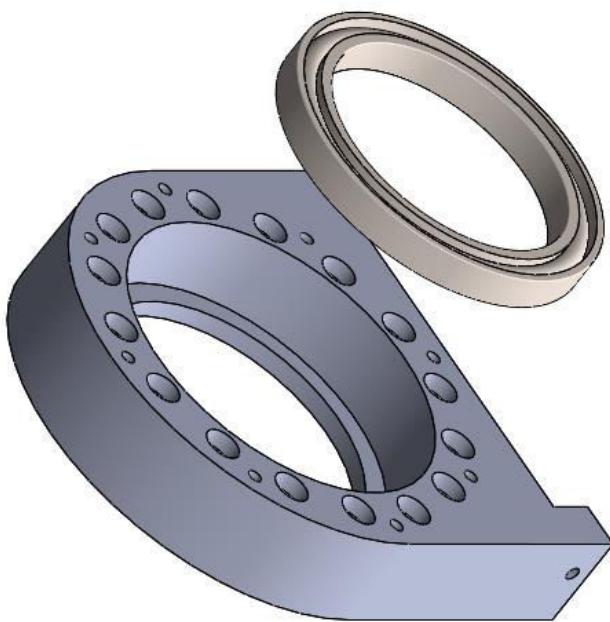
Part	Quantity	Position	Notes:
			.



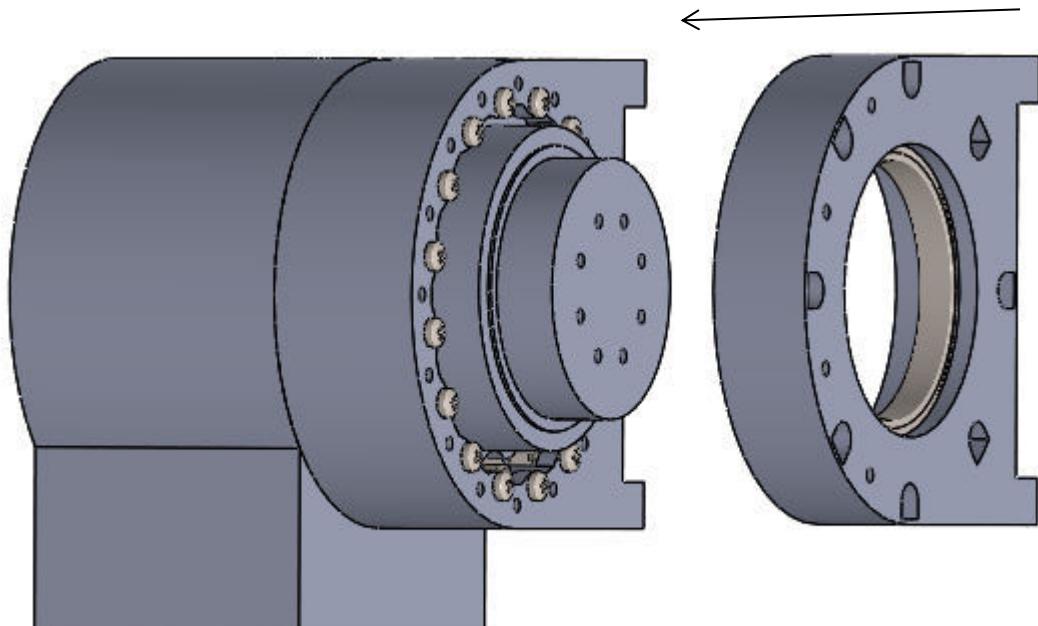
Part	Quantity	Position	Notes:

Base Assembly

Step7



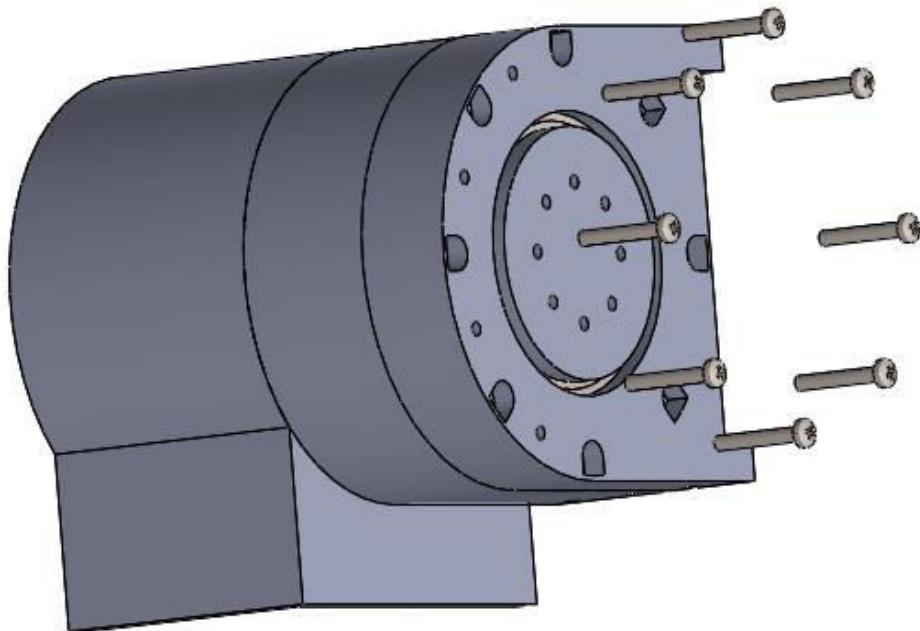
Part	Quantity	Position	Notes
Joint 1 top cover	1	1	
Ball bearing 50x65x7	1	2	



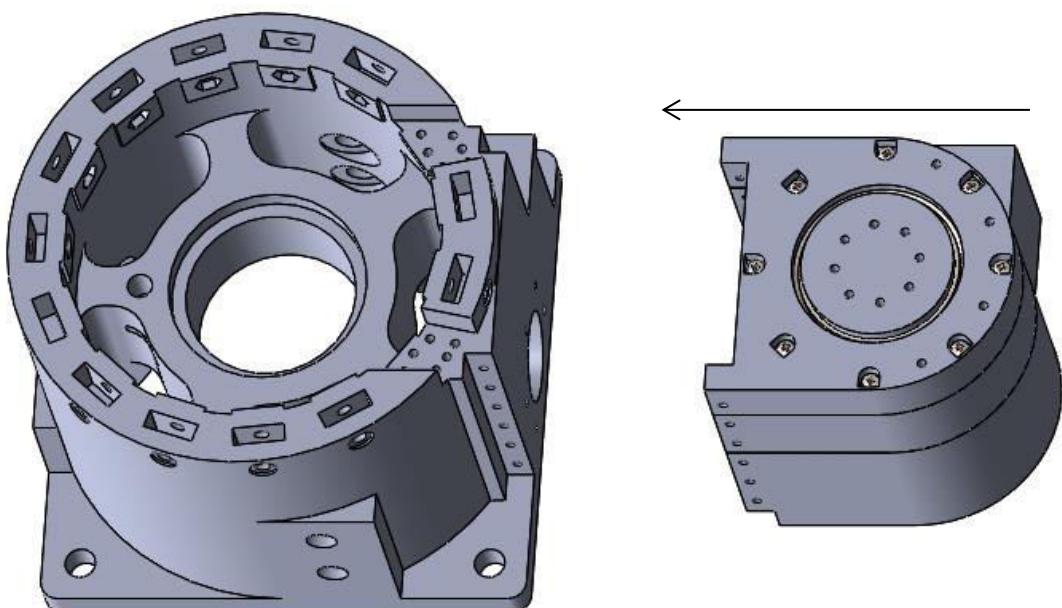
Part	Quantity	Position	Notes:

Base Assembly

Step8



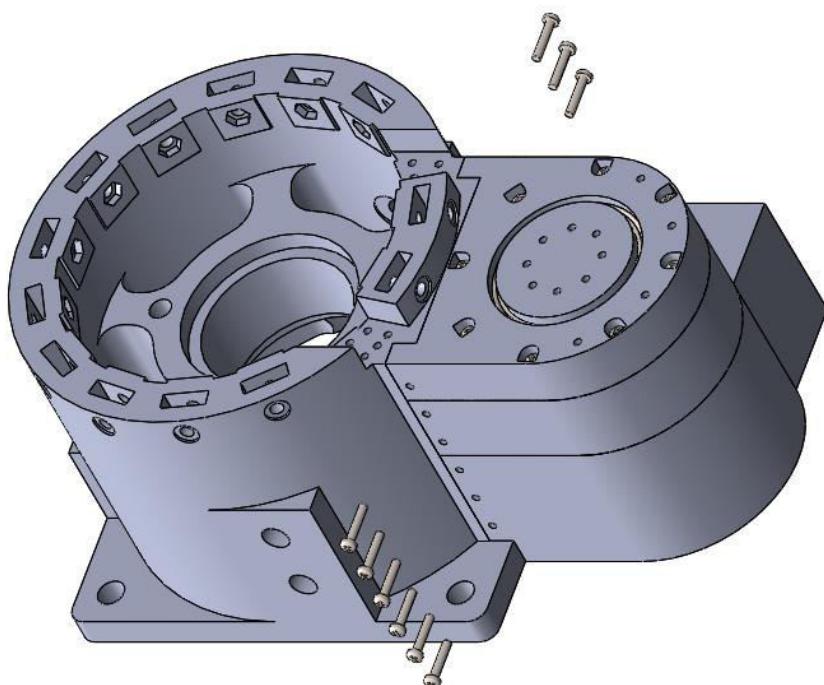
Part	Quantity	Position	Notes:
M3 20 mm screws	8	1	



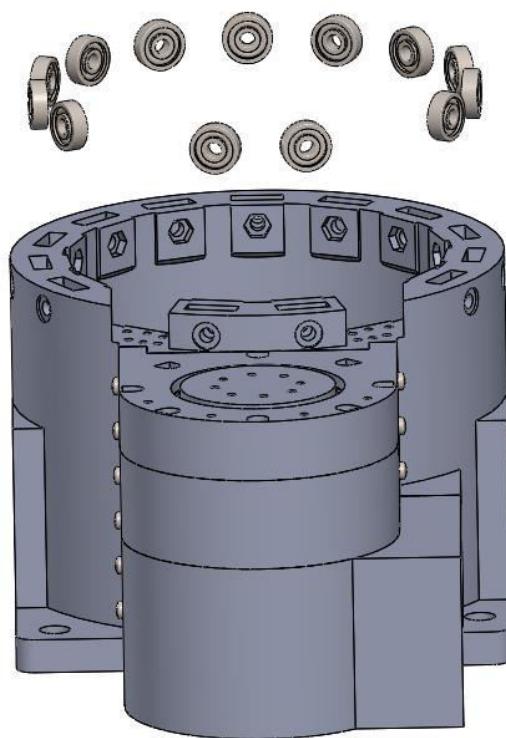
Part	Quantity	Position	Notes:
Main base	1	1	

Base Assembly

Step9



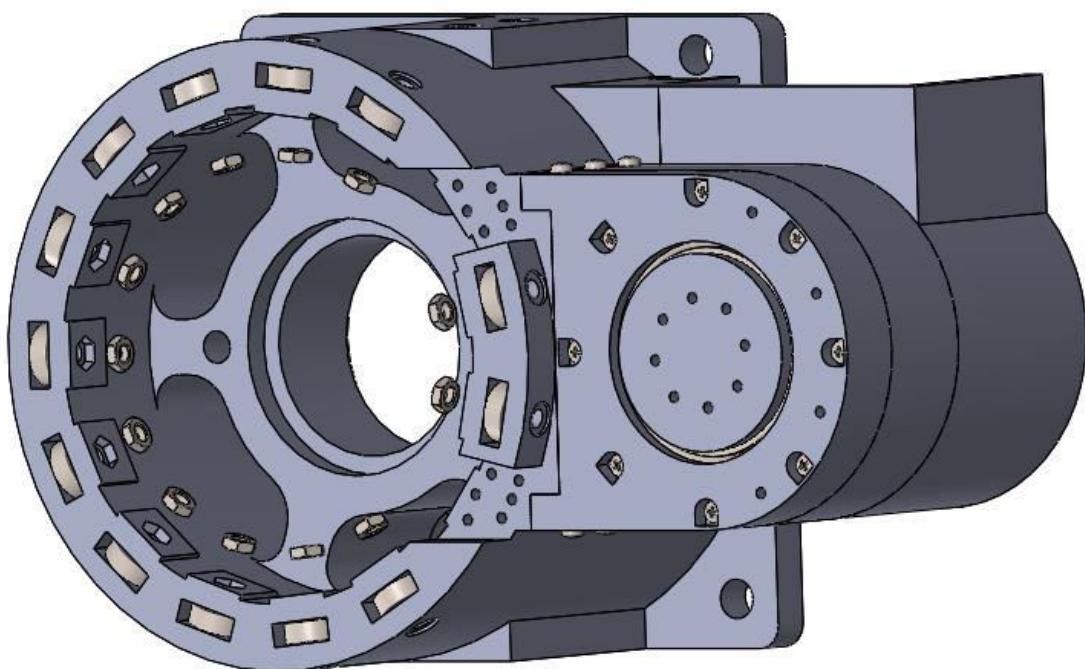
Part	Quantity	Position	Notes:
M3 15 mm screws	9	1	



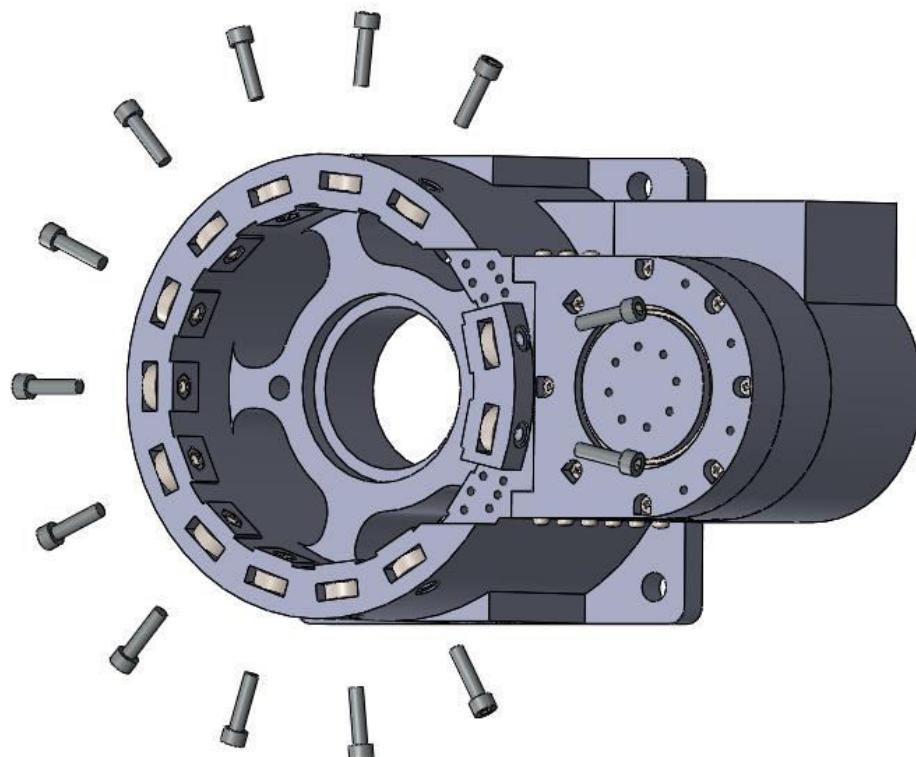
Part	Quantity	Position	Notes:
Ball bearing 5x16x5	13	1	

Base Assembly

Step 10



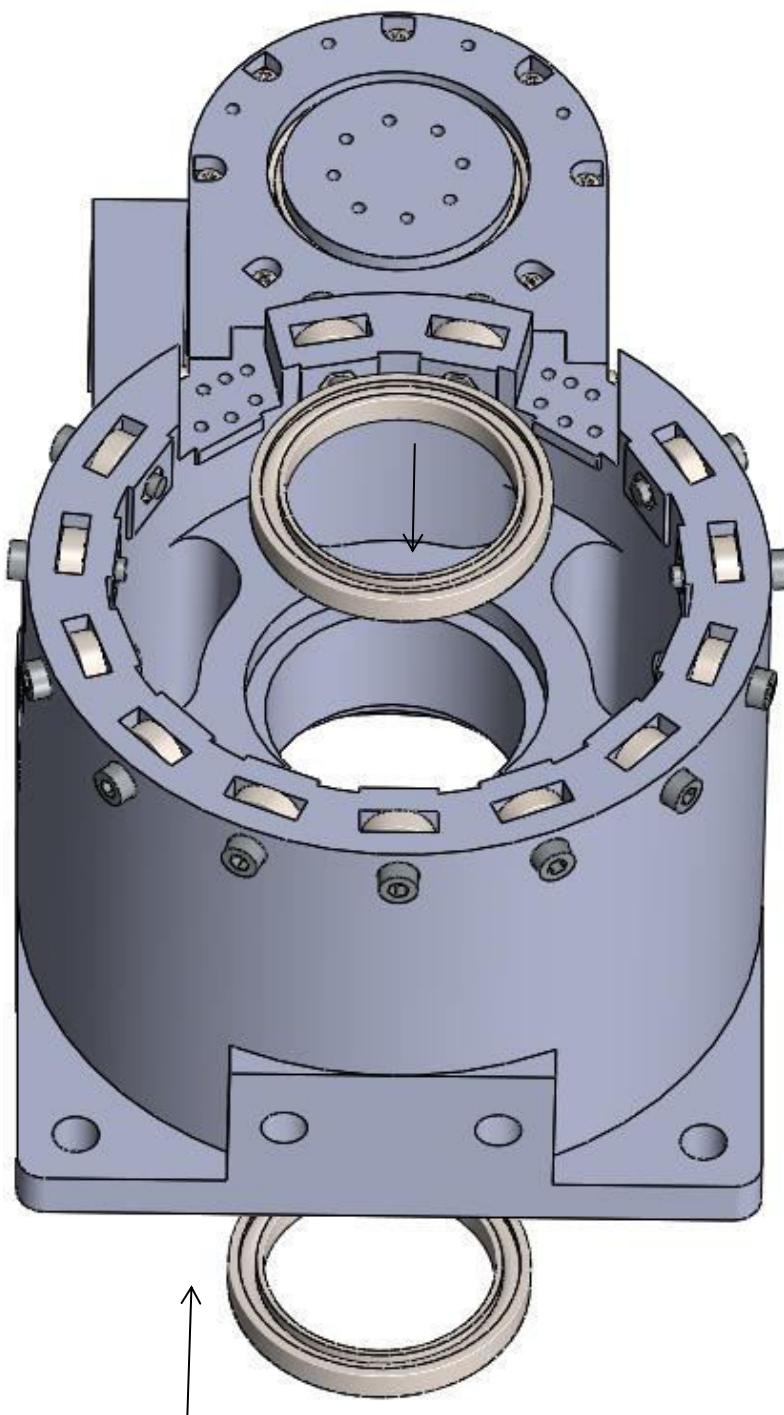
Part	Quantity	Position	Notes:
M5 nuts	13	1	



Part	Quantity	Position	Notes:
M5 20mm HEX screws	13	1	

Base Assembly

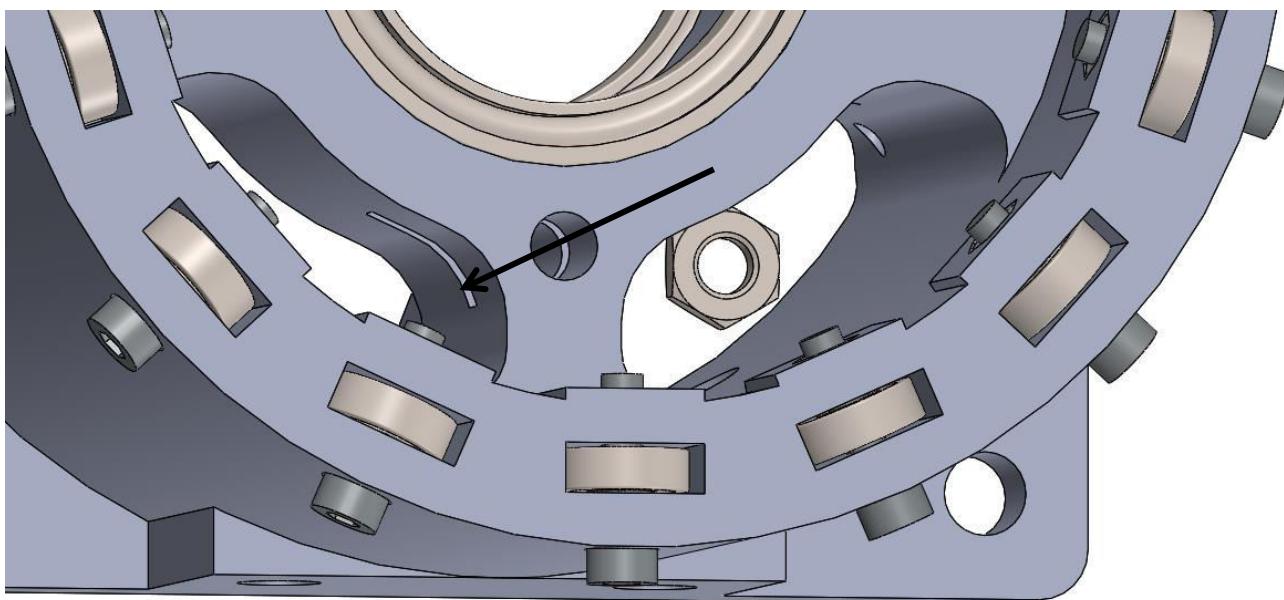
Step 11



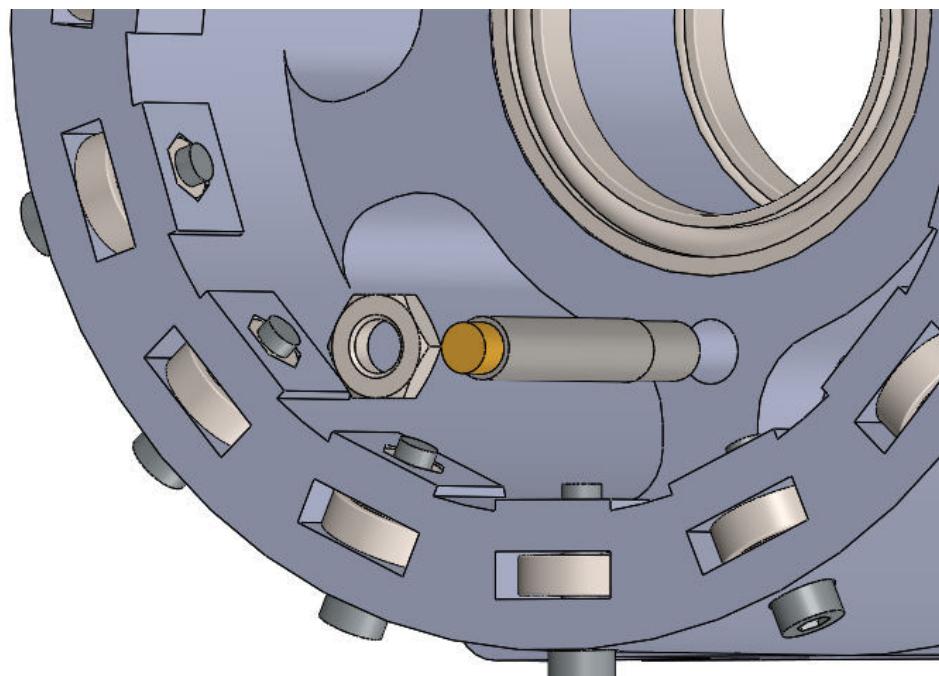
Part	Quantity	Position	Notes:
Ball bearing 50x65x7	2	1	

Base Assembly

Step12



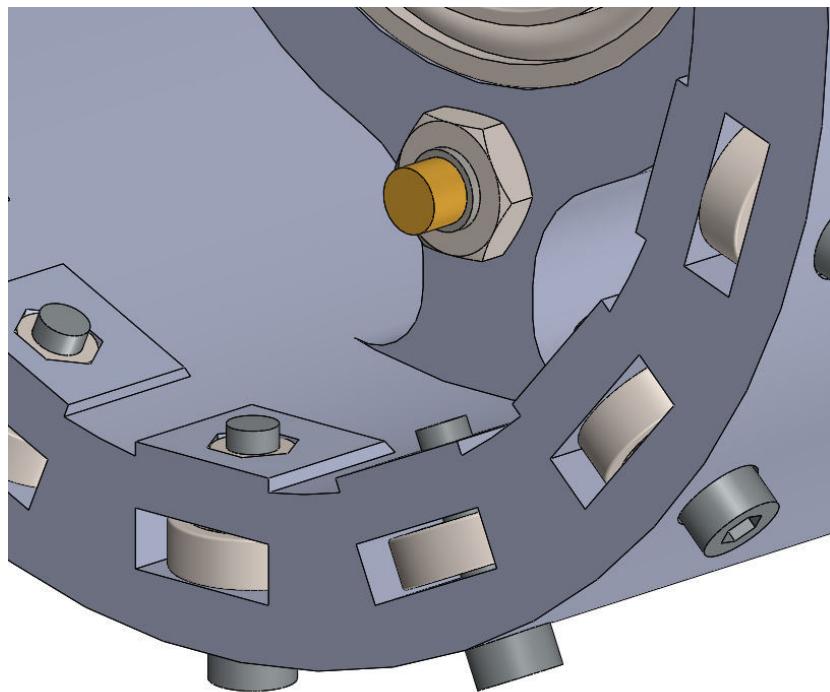
Part	Quantity	Position	Notes: Slide this nut in the hole marked with arrow
M8 nuts (usually included with sensor)	1	1	



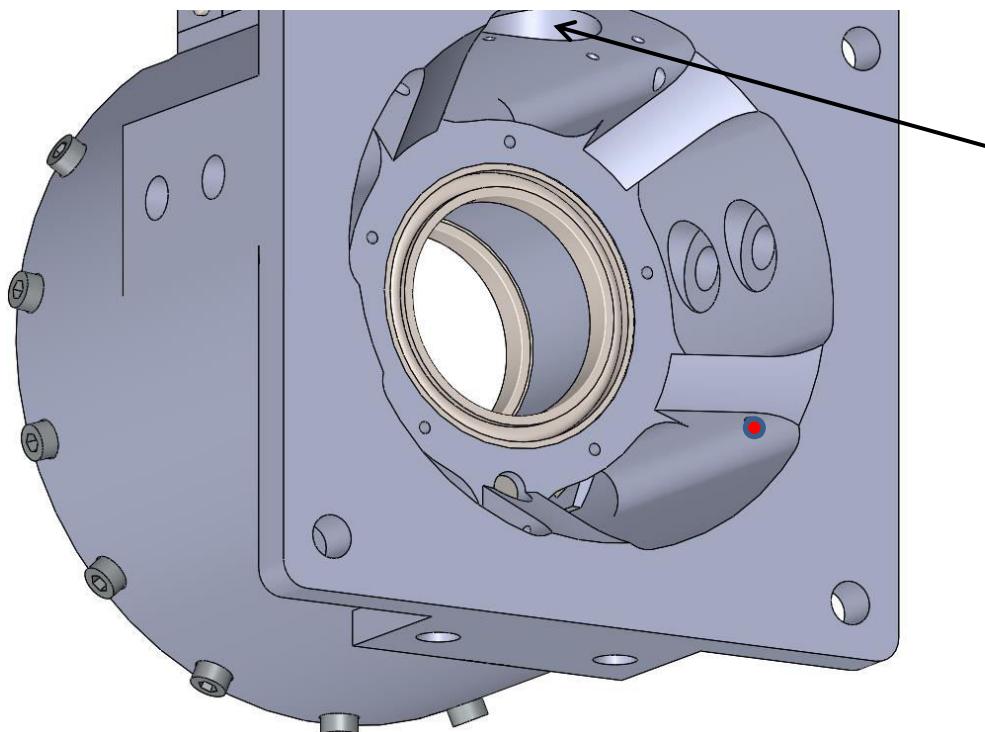
Part	Quantity	Position	Notes:First pull sensor wires thru the hole.After that screw the sensor in the nut we inserted in previous step.Now screw second nut .Sensor should be inserted so very little of its thread can be seen.
Inductive sensor	1	1	
M8 nuts (usually included with sensor)	1	2	

Base Assembly

Step13



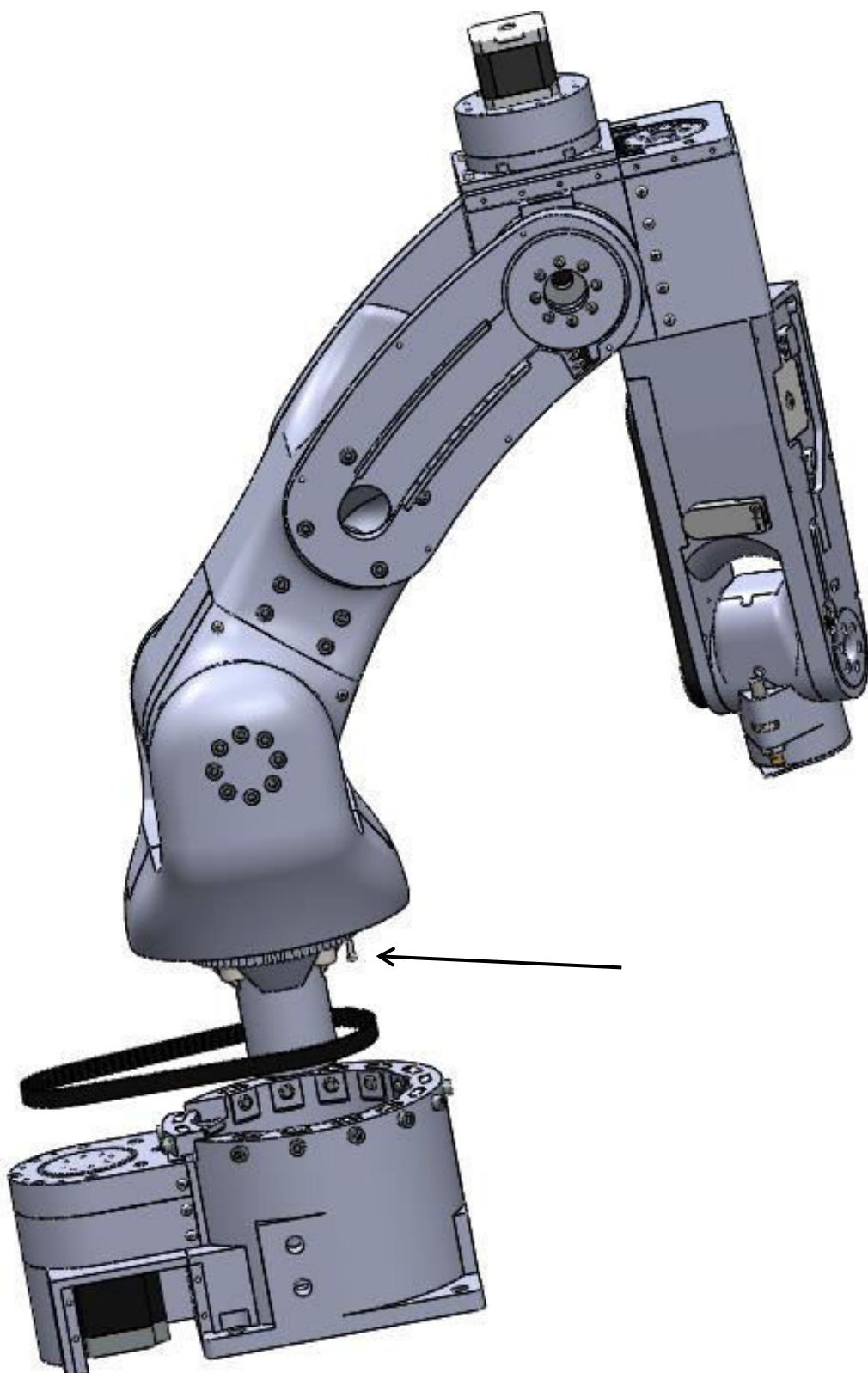
Part	Quantity	Position	Notes:sensor should peek like this.



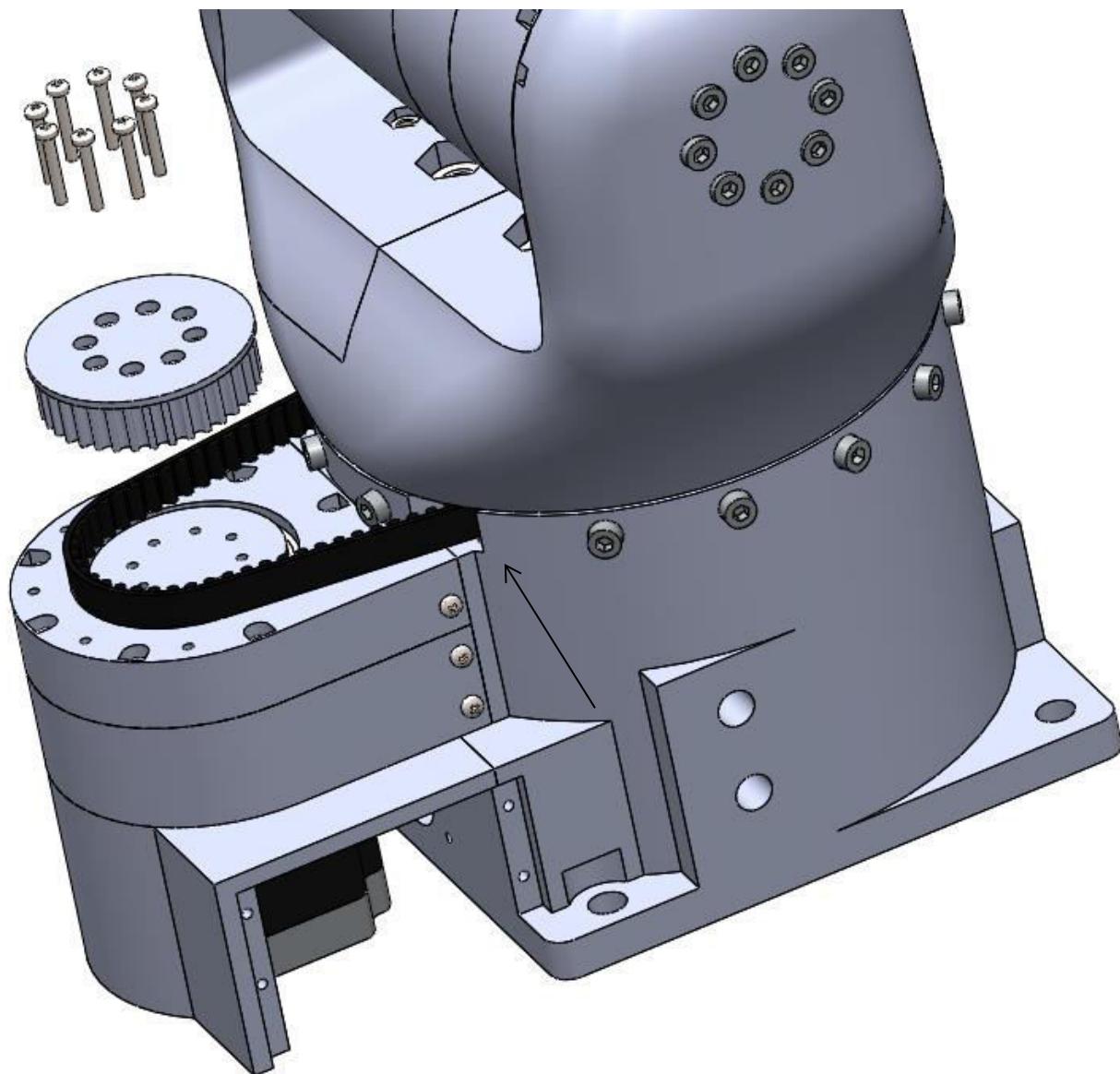
Part	Quantity	Position	Notes:Pull sensor wires thru hole marked with red and other same holes . Wires should go thru the big hole marked with arrow.

Base Assembly

Step14



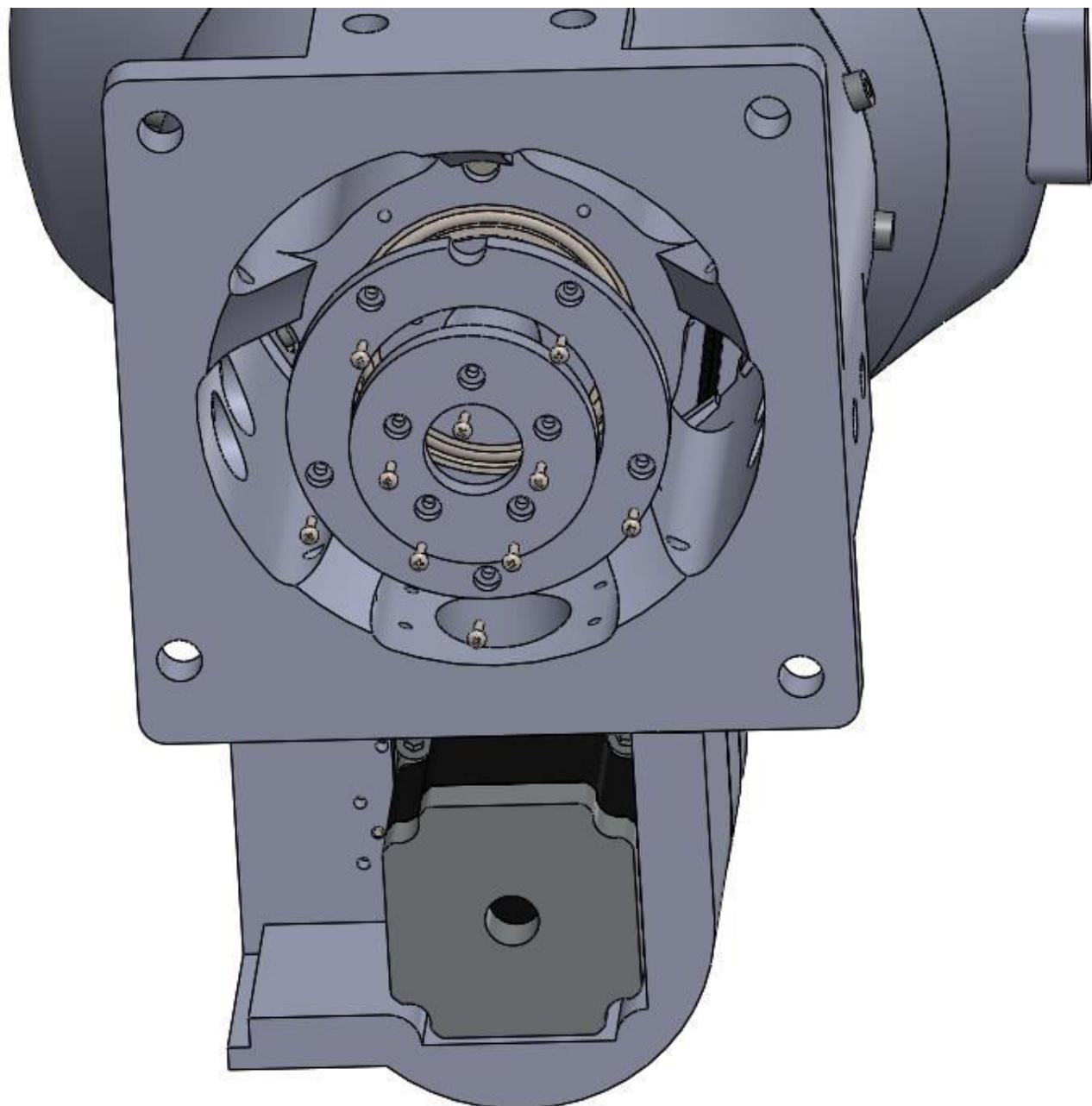
Part	Quantity	Position	Notes
HTD 5M 490 mm timing belt 10 mm wide			After inserting arm to the base make shure there is around 0.5-1mm space between inductive sensor in base and screw marked with arrow. Test the sensor to see if it triggers properly. If it does not adjust the screw or sensor and try again.



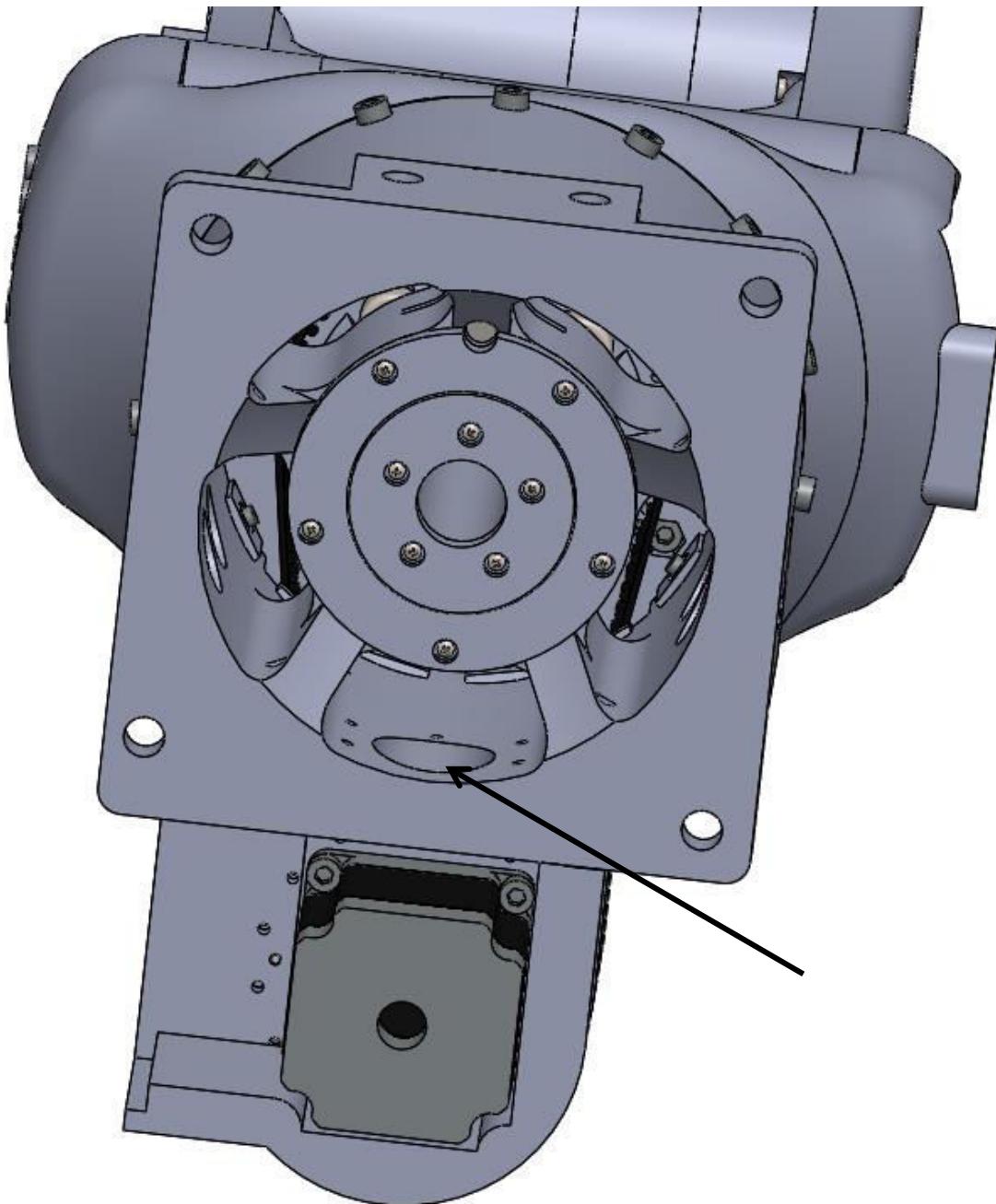
Part	Quantity	Position	Notes:
36 teeth pulley	1	1	If belt is not tight enough you can insert ball bearings to tighten it up .You can insert them where arrow points.
M3 15mm screws	8	2	

Base Assembly

Step 16



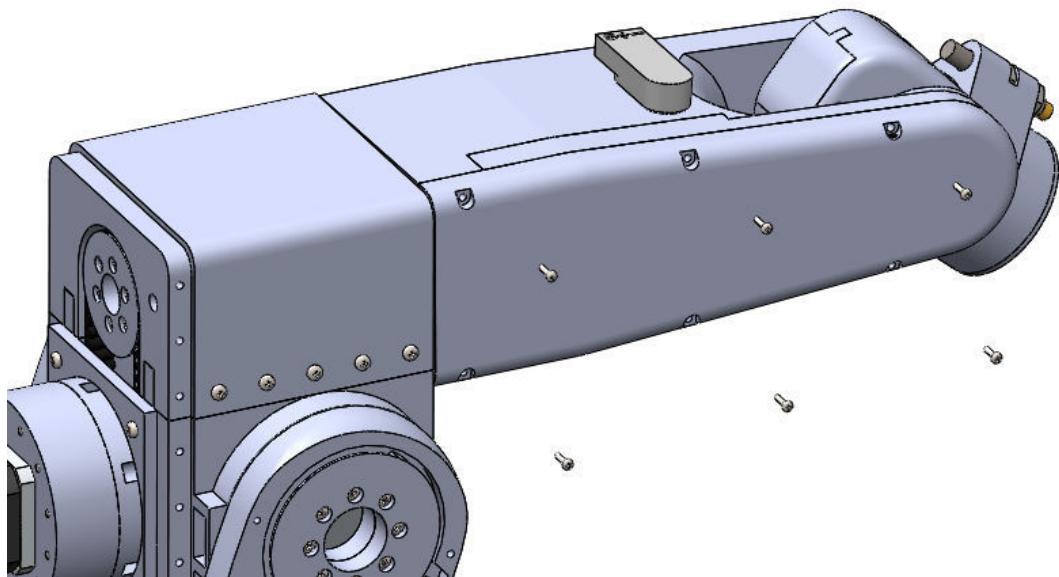
Part	Quantity	Position	Notes:
Ball bearing retainer	1	1	
Shaft blocker	1	2	
M3 10 mm screws	10	3	



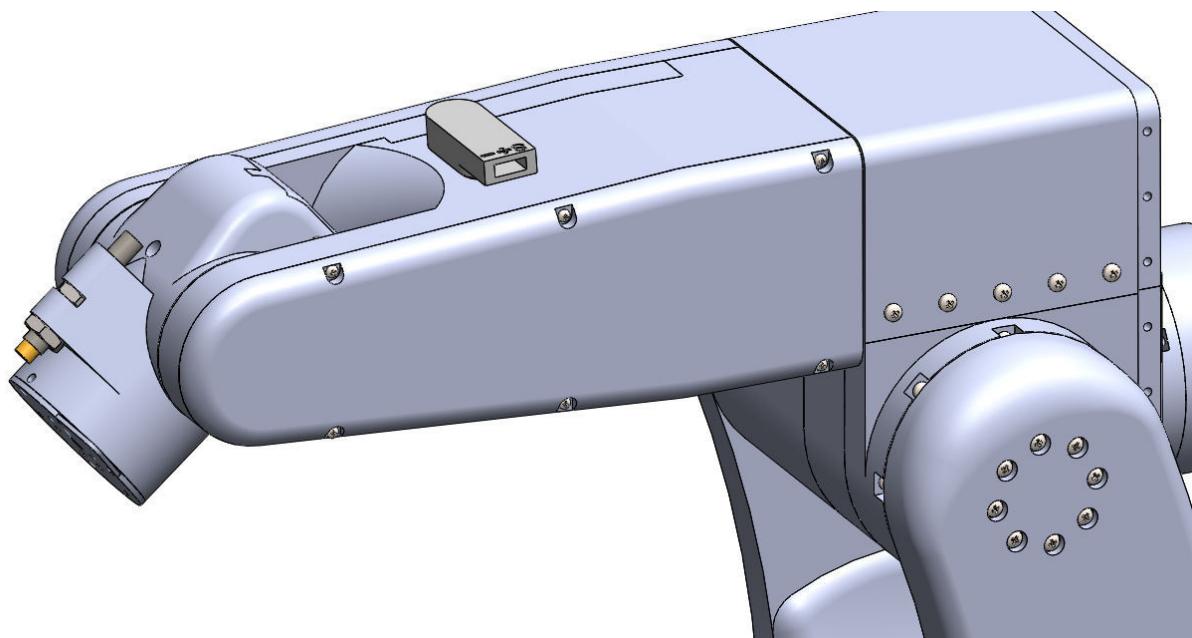
Part	Quantity	Position	Notes:ALL wires go thru hole marked with arrow. We are done with main assembly , good job.

Covers

Step1



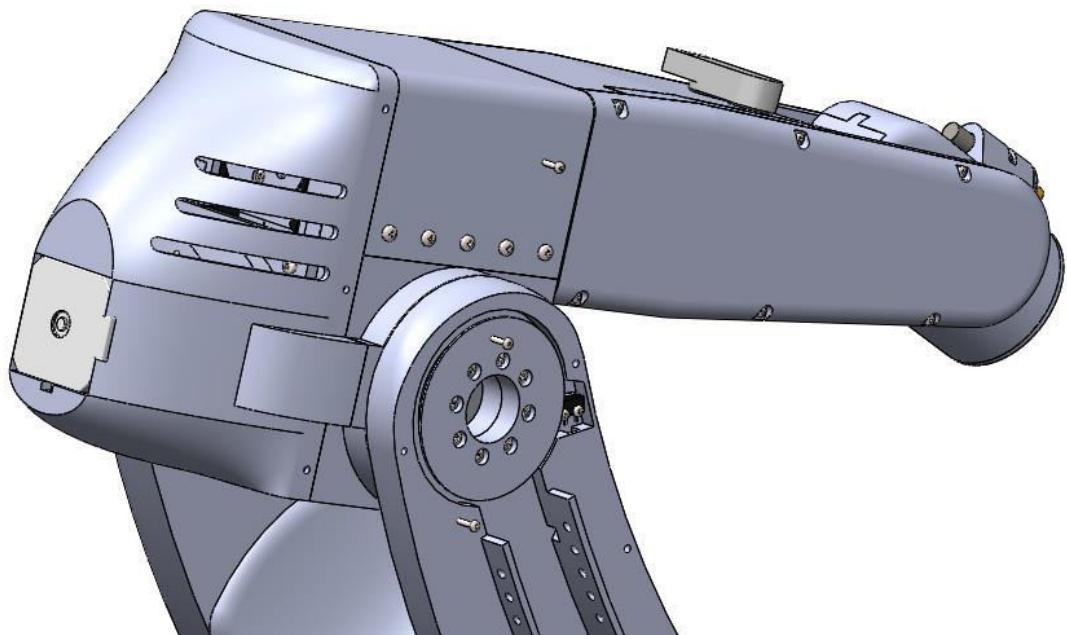
Part	Quantity	Position	Notes:	
Forearm motor lid	1	1		
M3 10 mm screws	6	2		



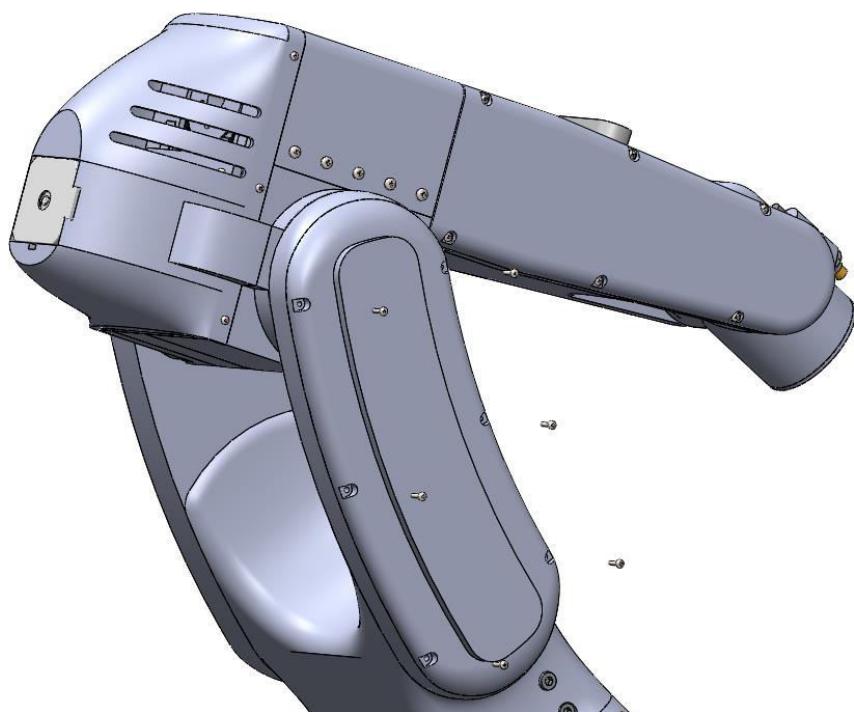
Part	Quantity	Position	Notes:	
Forearm wires lid	1	1		
M3 10 mm screws	6	2		

Covers

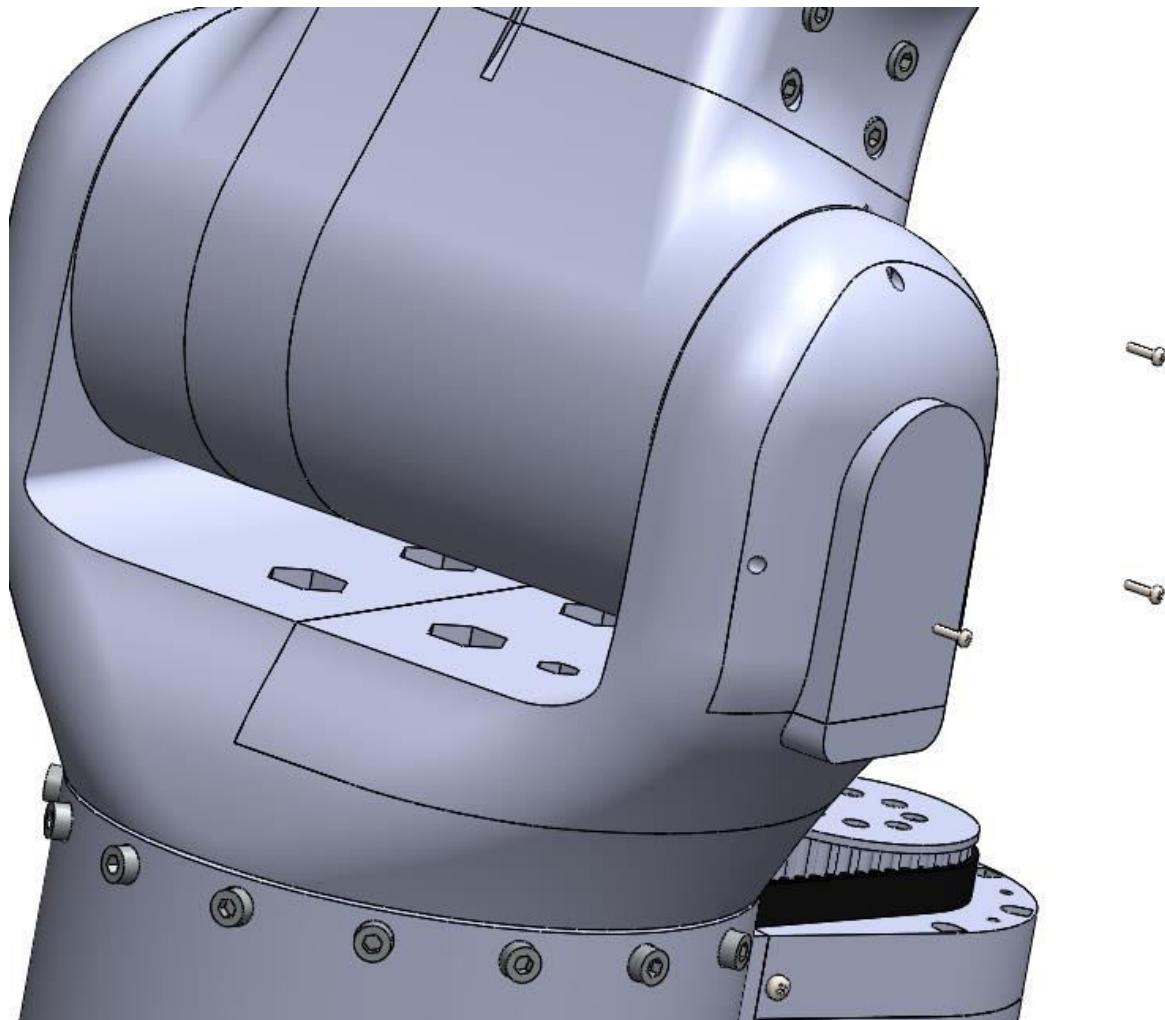
Step2



Part	Quantity	Position	Notes:	
Elbow lid	1	1		
M3 10 mm screws	6	2		



Part	Quantity	Position	Notes:	
Upper arm lid	1	1		
M3 10 mm screws	6	2		



Part	Quantity	Position	Notes:
Rotating base lid	1	1	
M2 10 mm screws	3	2	