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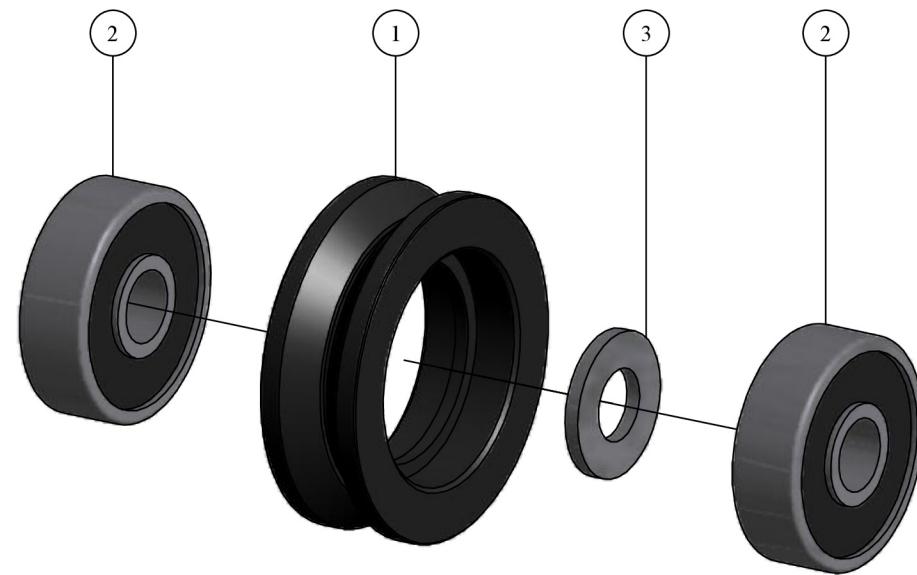
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# STEP 1

## V-Wheel Assembly:

- Insert a bearing into one side. These are force fit tolerances so you might have to push hard.
- Press the bearing until it's seated against the inside lip of the v-wheel.
- Slide an M5 bolt through the bearing (outside in) - you'll use this to align the precision washer and the other bearing.
- Slide the precision washer over the bolt and let it slide all the way down until it is touching the bearing you just inserted
- Slide the other bearing over the bolt and let it slide down until it hits the rim of the v-wheel.
- Press the second bearing into the v-wheel just as you did the first
- When the assembly is complete, you can remove the M5 bolt

**Note: do not forget the precision washer!**



| ITEM | QTY | PART NUMBER | TITLE                        |
|------|-----|-------------|------------------------------|
| 1    | 1   | MSK01-05    | V Wheel                      |
| 2    | 2   | MSK01-07    | 5mm x 16mm x 5mm bearing     |
| 3    | 1   | MSK01-08    | Precision Washer (1mm thick) |

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**shapeoko**

DESIGNED BY: ERF DETAILED BY: ERF DATE: 6/5/2012

TOLERANCES (EXCEPT AS NOTED)

BETWEEN FINISHED SURFACES

FRACTIONAL:  $\pm 1/64"$

DECIMAL:  $\pm .010"$

DETAIL DIMENSIONS:  $\pm 1/16"$

SIZE B DRAWING NUMBER

MSK01-05A

SCALE

SHEET 1 OF 1

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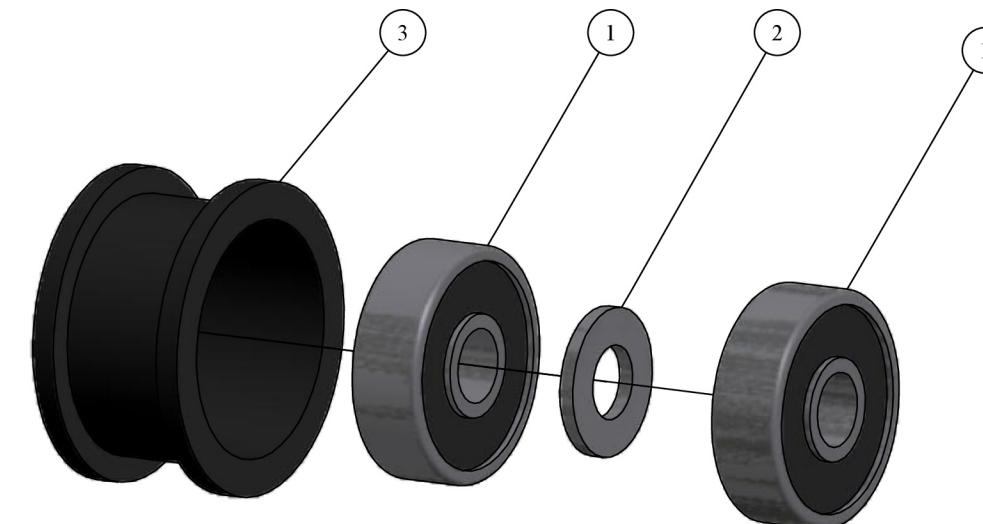
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## STEP 2

### Smooth Idler Assembly:

- Insert a bearing into the open side side. These are force fit tolerances so you might have to push hard.
- Press the bearing until it's seated against the inside lip of the idler drum.
- Slide an M5 bolt through the bearing (outside in) - you'll use this to align the precision washer and the other bearing.
- Slide the precision washer over the bolt and let it slide all the way down until it is touching the bearing you just inserted
- Slide the other bearing over the bolt and let it slide down until it hits the rim of the drum.
- Press the second bearing into the drum just as you did the first until it is tight against the precision washer
- When the assembly is complete, you can remove the M5 bolt

**Note: do not forget the precision washer!**



| ITEM | QTY | PART NUMBER | TITLE                        |
|------|-----|-------------|------------------------------|
| 1    | 2   | MSK01-07    | 5mm x 16mm x 5mm bearing     |
| 2    | 1   | MSK01-08    | Precision Washer (1mm thick) |
| 3    | 1   | MSK01-06    | Smooth Idler Drum            |

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|                                   |                                    |                     |
|-----------------------------------|------------------------------------|---------------------|
| DESIGNED BY:<br>ERF               | DETAILED BY:<br>ERF                | DATE:<br>6/5/2012   |
| <b>TITLE</b>                      |                                    |                     |
|                                   | Smooth Idler Assembly              |                     |
| <b>SIZE</b><br>B                  | <b>DRAWING NUMBER</b><br>MSK01-06A | <b>SCALE</b>        |
| <b>DETAIL DIMENSIONS:</b> ± 1/16" |                                    | <b>SHEET 1 OF 1</b> |

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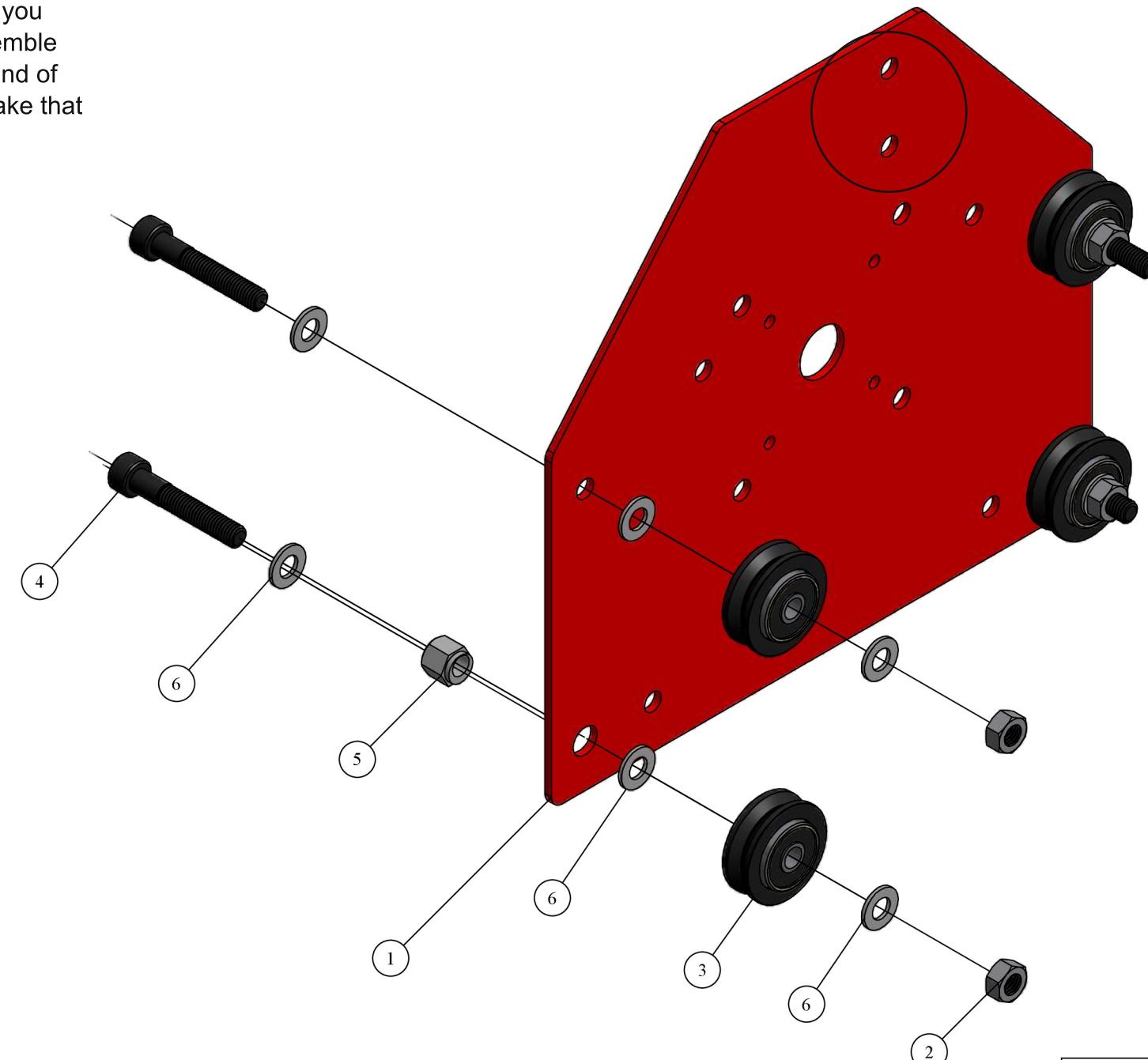
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## STEP 3

### Y-Axis Idle Plate Assembly:

Take note of the top hole orientation. Looking from the inside of the plate (view shown) the cross mount holes (circled) need to be in the top right of the plate. If you assemble these backwards you'll have to disassemble the plate and flip the wheels around. It's not the end of the world, but it's tedious and frustrating if you make that mistake.



| ITEM | QTY | PART NUMBER | TITLE            |
|------|-----|-------------|------------------|
| 1    | 1   | SM-S01      | Mounting Plate   |
| 2    | 4   | SM-H04      | M5 Hex Nut       |
| 3    | 4   | MSK01-05A   | V-Wheel Assembly |
| 4    | 4   | SM-H08      | M5 x 30mm SHCS   |
| 5    | 2   | MSK01-04    | Eccentric Nut    |
| 6    | 12  | SM-H03      | M5 Flat Washer   |

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DESIGNED BY: ERF DETAILED BY: ERF DATE: 6/5/2012

TITLE: Y Axis Idle Mount Assembly

SIZE: B DRAWING NUMBER: SM\_YA02

SCALE: SHEET 1 OF 1

DETAIL DIMENSIONS:  $\pm 1/16"$

FRACTIONAL:  $\pm 1/64"$

DECIMAL:  $\pm .010"$

BETWEEN FINISHED SURFACES

(EXCEPT AS NOTED)

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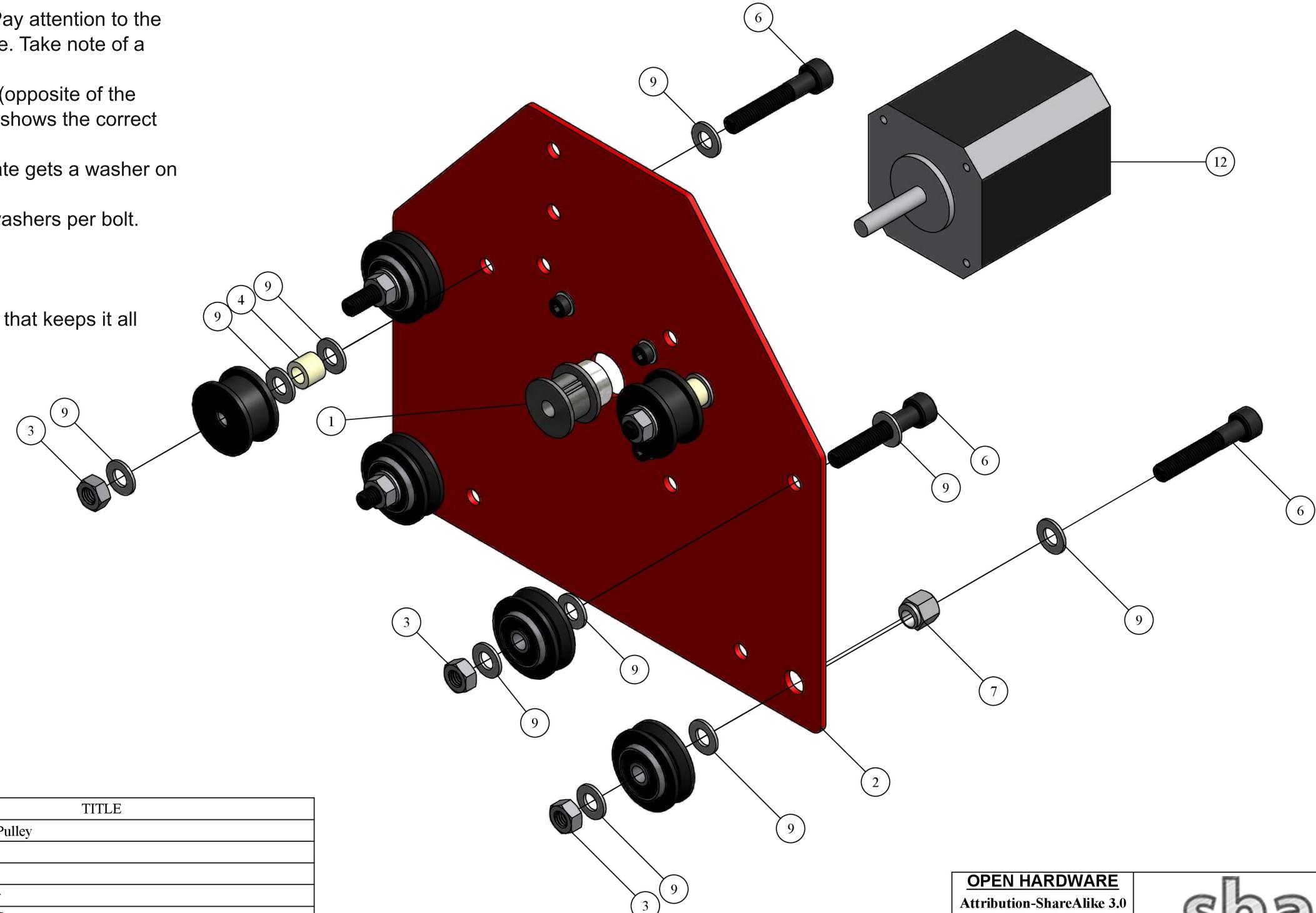
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## Y-Axis Motor Mount Plate

This is the other side of the gantry. Pay attention to the hole orientation at the top of the plate. Take note of a couple of things:

- These holes need to be on the left (opposite of the previous sub-assembly). The image shows the correct orientation.
- Each Bolt that goes through the plate gets a washer on BOTH sides.
- The smooth idlers get a total of 4 washers per bolt.
  - One on the backside of the plate
  - One on the front side of the plate
  - One on the end of the 1/4" spacer
  - One between the idler and the nut that keeps it all together.

## STEP 4



| ITEM | QTY | PART NUMBER | TITLE  |
|------|-----|-------------|--|
| 1    | 1   | MSK01-09    | 18 Tooth Timing Pulley                         |
| 2    | 1   | SM-S01      | Mounting Plate                                 |
| 3    | 6   | SM-H04      | M5 Hex Nut                                     |
| 4    | 2   | SM-H01      | 1/4" Nylon Spacer                              |
| 6    | 6   | SM-H08      | M5 x 30mm SHCS                                 |
| 7    | 2   | MSK01-04    | Eccentric Nut                                  |
| 9    | 20  | SM-H03      | M5 Flat Washer                                 |
| 10   | 4   | SM-H14      | M3 x 8mm SHCS                                  |
| 11   | 4   | SM-H15      | M3 Flat Washer                                 |
| 12   | 1   | SM-E01      | Nema 17 Stepper Motor (60oz/in holding torque) |
| 13   | 4   | MSK01-05    | V Wheel  |
| 14   | 12  | MSK01-07    | 5mm x 16mm x 5mm bearing                       |
| 15   | 6   | MSK01-08    | Precision Washer (1mm thick)                   |
| 16   | 2   | MSK01-06    | Smooth Idler Drum                              |

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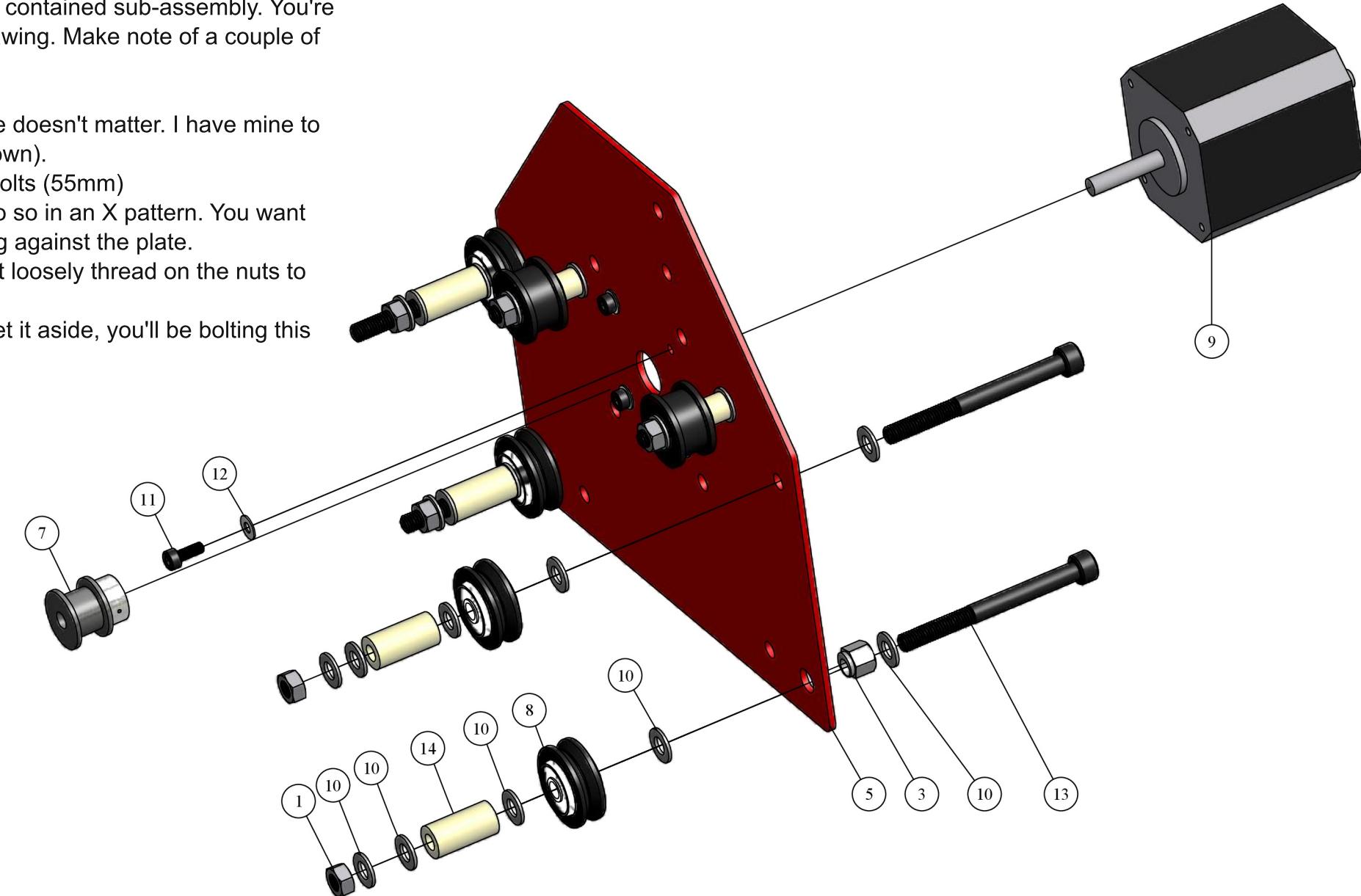
|                         |   |                   |
|-------------------------|---|-------------------|
| DESIGNED BY:<br>ERF     | DETAILED BY:<br>ERF                     | DATE:<br>6/5/2012 |
| <b>TITLE</b>            |   |                   |
|                         | Y Axis Motor Mount Assembly             |                   |
| <b>SIZE</b><br><b>B</b> | <b>DRAWING NUMBER</b><br><b>SM_YA01</b> | <b>SCALE</b>      |

SHEET 1 OF 1

**X-Axis Motor Mount Plate****STEP 5**

This is more of a pre-assembly than a fully contained sub-assembly. You're going to assemble this as shown in the drawing. Make note of a couple of things:

- The hole orientation at the top of the plate doesn't matter. I have mine to the left, but they can be to the right (as shown).
- The bottom set of bolts are the long M5 bolts (55mm)
- When you tighten the motor into place, do so in an X pattern. You want the face of the motor to be equally pressing against the plate.
- Don't tighten down the v-wheel bolts. Just loosely thread on the nuts to keep everything together.
- When you are done with the assembly, set it aside, you'll be bolting this to the next assembly build.



| ITEM | QTY | PART NUMBER | TITLE  |
|------|-----|-------------|--|
| 1    | 6   | SM-H04      | M5 Hex Nut                                     |
| 2    | 2   | SM-H01      | 1/4" Nylon Spacer                              |
| 3    | 2   | MSK01-04    | Eccentric Nut                                  |
| 4    | 2   | SM-H08      | M5 x 30mm SHCS                                 |
| 5    | 1   | SM-S01      | Mounting Plate                                 |
| 6    | 2   | MSK01-06A   | Smooth Idler Assembly                          |
| 7    | 1   | MSK01-09    | 18 Tooth Timing Pulley                         |
| 8    | 4   | MSK01-05A   | V-Wheel Assembly                               |
| 9    | 1   | SM-E01      | Nema 17 Stepper Motor (60oz/in holding torque) |
| 10   | 28  | SM-H03      | M5 Flat Washer                                 |
| 11   | 4   | SM-H14      | M3 x 8mm SHCS                                  |
| 12   | 4   | SM-H15      | M3 Flat Washer                                 |
| 13   | 4   | SM-H09      | M5 x 55mm SHCS                                 |
| 14   | 4   | SM-H02      | 3/4" Nylon Spacer                              |

|   |   |                     |                     |
|---|---|---------------------|---------------------|
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|   | DESIGNED BY:<br>ERF                                   | DETAILED BY:<br>ERF | DATE:<br>6/5/2012   |
| <b>TOLERANCES</b><br>(EXCEPT AS NOTED)<br><br>BETWEEN<br>FINISHED SURFACES<br><br>FRACTIONAL: $\pm 1/64"$<br>DECIMAL: $\pm .010"$<br><br>DETAIL DIMENSIONS: $\pm 1/16"$ | <b>TITLE</b><br><br>X Axis Motor Mount Plate Assembly |                     |                     |
| <b>SIZE</b><br>B  | <b>DRAWING NUMBER</b><br>SM_XA01                      |                     |                     |
| <b>SCALE</b>  |   |                     | <b>SHEET 1 OF 1</b> |

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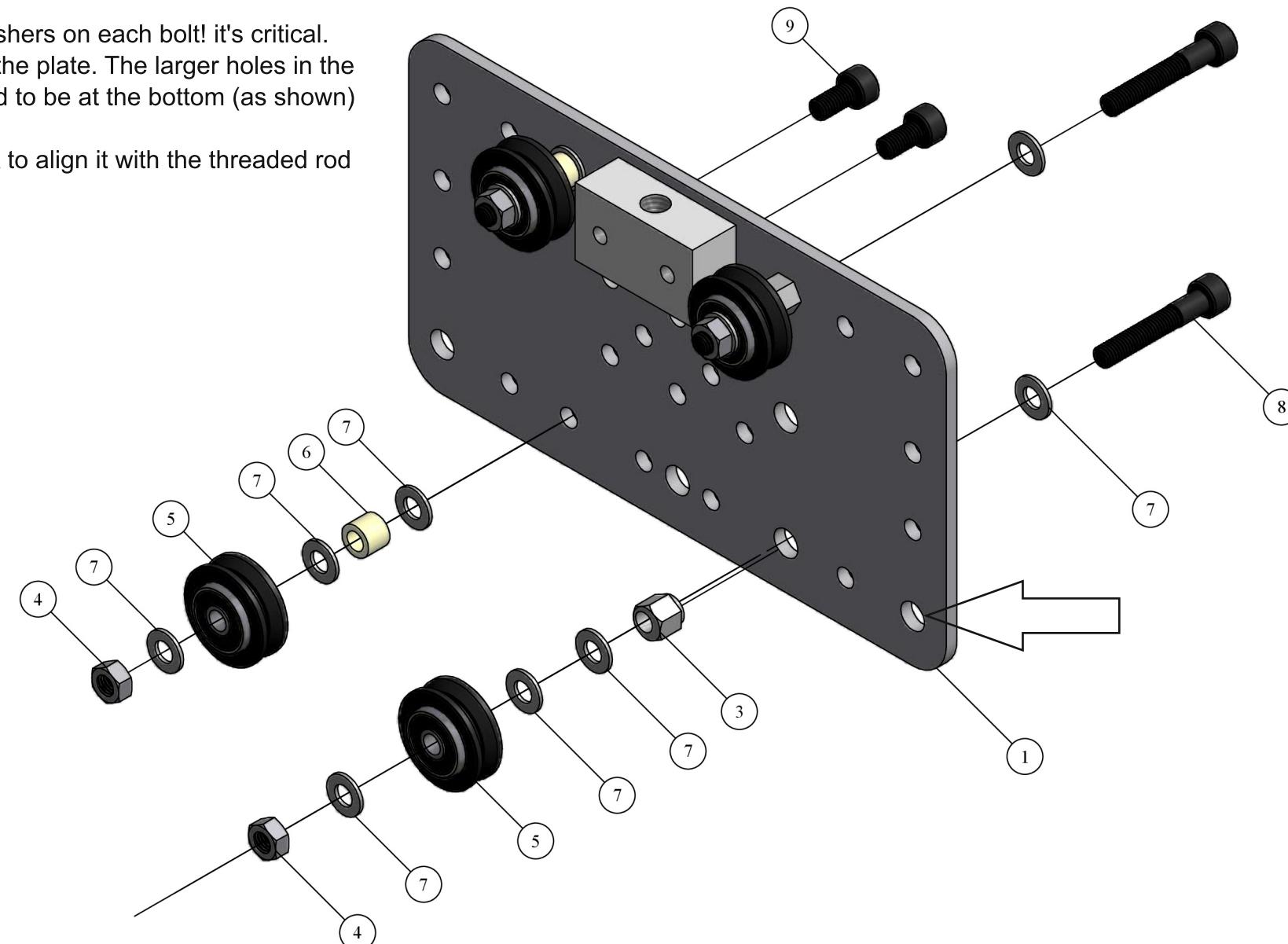
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**Z-Axis Mount Plate****STEP 6**

This is the second part of your pre-assembly.

Assemble this as shown in the drawing. Make note of a couple of things:

- Pay attention to the number of washers on each bolt! it's critical.
- Pay attention to the orientation of the plate. The larger holes in the corner (denoted with an arrow) need to be at the bottom (as shown)
- Tighten the non-eccentric vwheels
- Just snug the delrin nut, we'll want to align it with the threaded rod later, then tighten it down.



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| ITEM | QTY | PART NUMBER | TITLE                   |
|------|-----|-------------|-------------------------|
| 1    | 1   | MSK01-01    | Standard Carriage Plate |
| 2    | 1   | SM-M08      | Delrin lead nut.        |
| 3    | 2   | MSK01-04    | Eccentric Nut           |
| 4    | 4   | SM-H04      | M5 Hex Nut              |
| 5    | 4   | MSK01-05A   | V-Wheel Assembly        |
| 6    | 2   | SM-H01      | 1/4" Nylon Spacer       |
| 7    | 16  | SM-H03      | M5 Flat Washer          |
| 8    | 4   | SM-H08      | M5 x 30mm SHCS          |
| 9    | 2   | SM-H07      | M5 x 10mm SHCS          |

|   |                                    |                           |                       |
|---|------------------------------------|---------------------------|-----------------------|
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| DESIGNED BY:<br>ERF   | DETAILED BY:<br>ERF                | DATE:<br>6/5/2012         |                       |
| <b>TOLERANCES</b><br>(EXCEPT AS NOTED)<br><br>BETWEEN<br>FINISHED SURFACES                | <b>Z Axis Mount Plate Assembly</b> |                           |                       |
| FRACTIONAL: $\pm 1/64"$<br><br>DECIMAL: $\pm .010"$<br><br>DETAIL DIMENSIONS: $\pm 1/16"$ | SIZE<br>B                          | DRAWING NUMBER<br>SM_ZA01 | SCALE<br>SHEET 1 OF 1 |

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## X / Z Plate Assembly

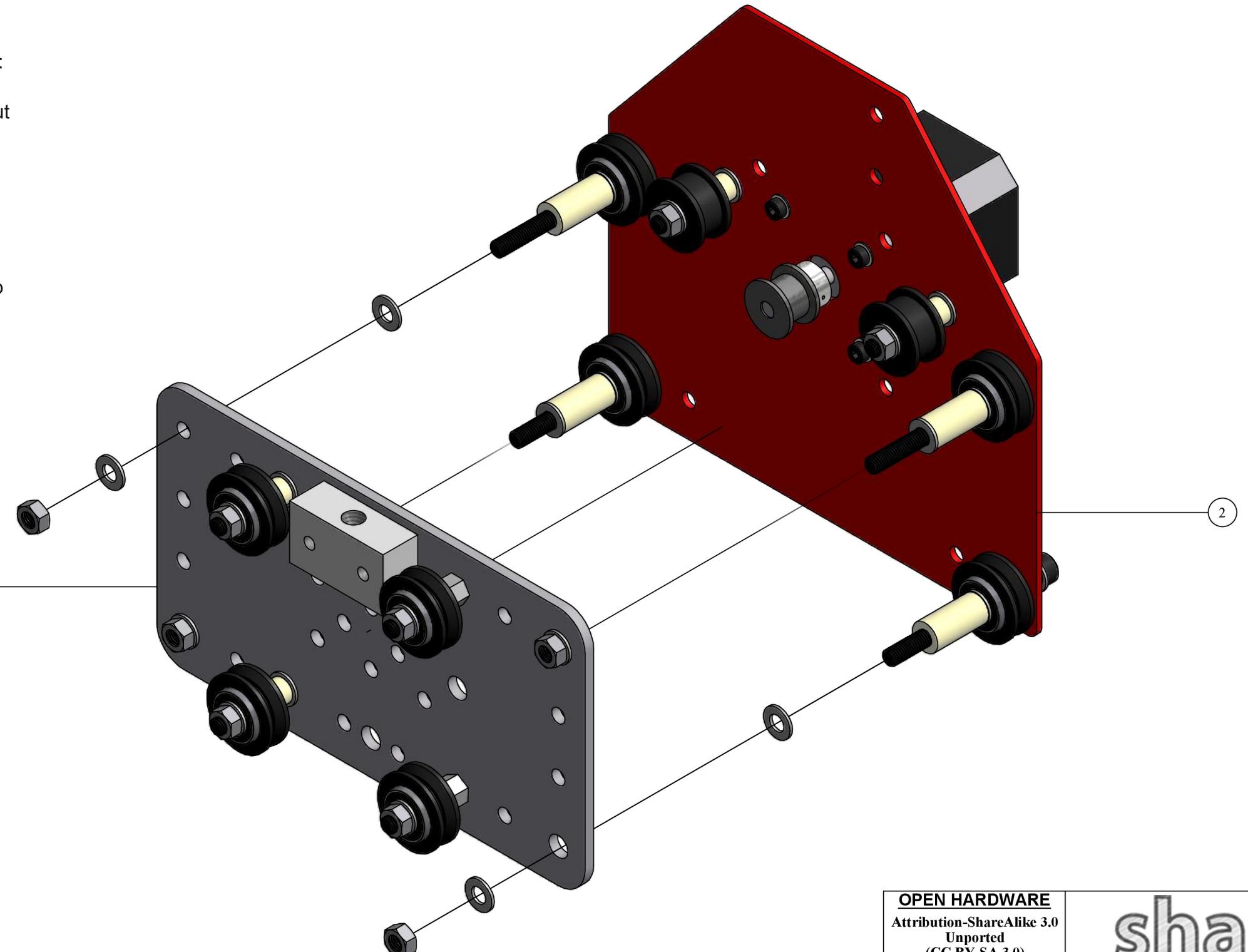
# STEP 7

This is the assembly of the previous 2 pre-assemblies. Make note of a couple of things:

- This can get tricky if the bolts start to fall out of the X plate. If possible, use a small piece of tape across the bolt head to keep them in place
- B - Remove the nut and one (only 1!) washer from the ends of each M5 x 55mm bolt.
- Slide the Z-axis plate onto the M5 x 55mm bolts. Replace the washer and hex nuts onto each one.

Pro-tip. Do the top left bolt first. Then snug the nut back on so the bolt doesn't fall out. Now do the same thing to the bottom right bolt. Once you have those two in place, do the top right bolt, then finally the bottom left bolt.

Once all of the bolts are through, and their respective washers and nuts are replaced, tighten everything down.



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DESIGNED BY: ERF   DETAILED BY: ERF   DATE: 6/5/2012

TITLE: X/Z Carriage Assembly

SIZE: B DRAWING NUMBER: SM-XZA1

SCALE: SHEET 1 OF 1

| ITEM | QTY | PART NUMBER | TITLE                             |
|------|-----|-------------|-----------------------------------|
| 1    | 1   | SM_ZA01     | Z Axis Mount Plate Assembly       |
| 2    | 1   | SM_XA01     | X Axis Motor Mount Plate Assembly |

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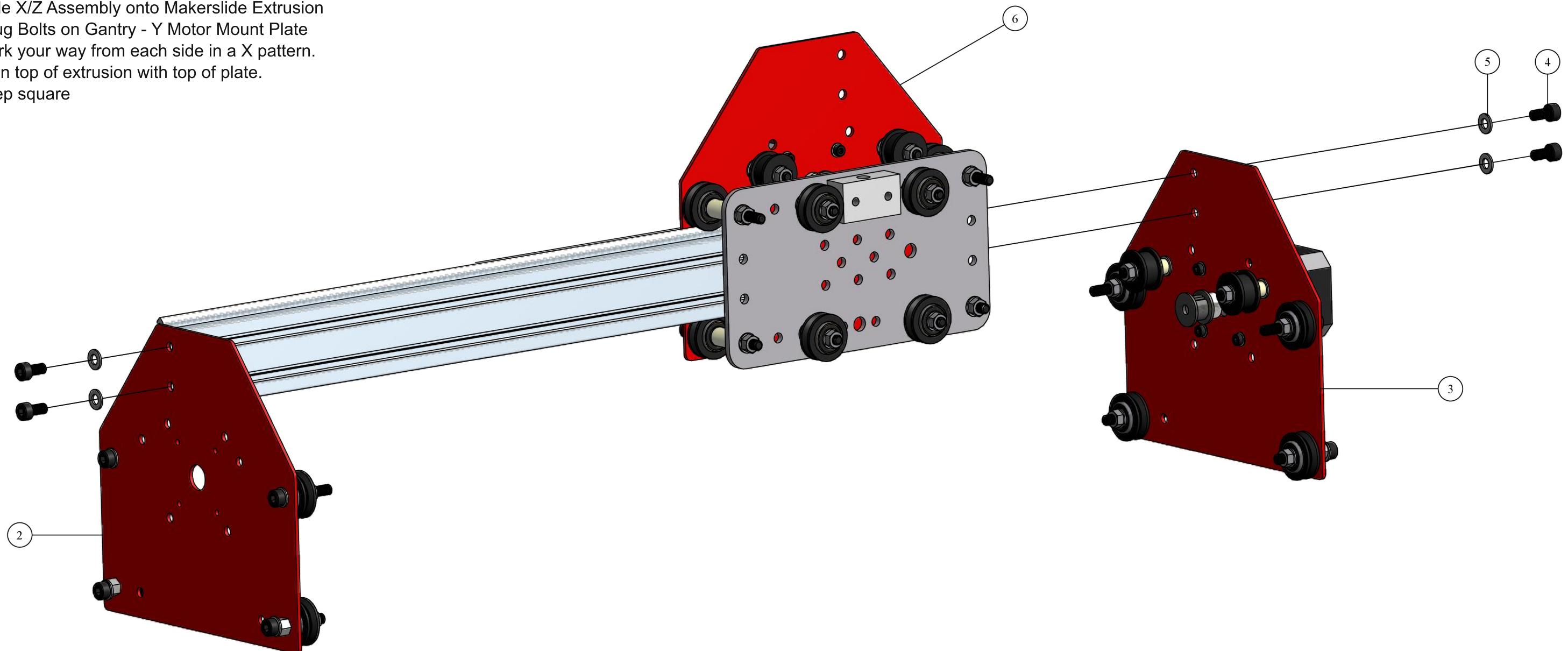
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## STEP 8

### Full Gantry Assembly

- Clean ends of extrusion of any debris.
- Snug bolts on Gantry - Y Idle Mount Plate.
- PRO TIP! - Set eccentric wheels on SM-XZA1 to their widest position before attempting to slide onto makerslide.
- Slide X/Z Assembly onto Makerslide Extrusion
- Snug Bolts on Gantry - Y Motor Mount Plate
- Work your way from each side in a X pattern.
- Align top of extrusion with top of plate.
- Keep square



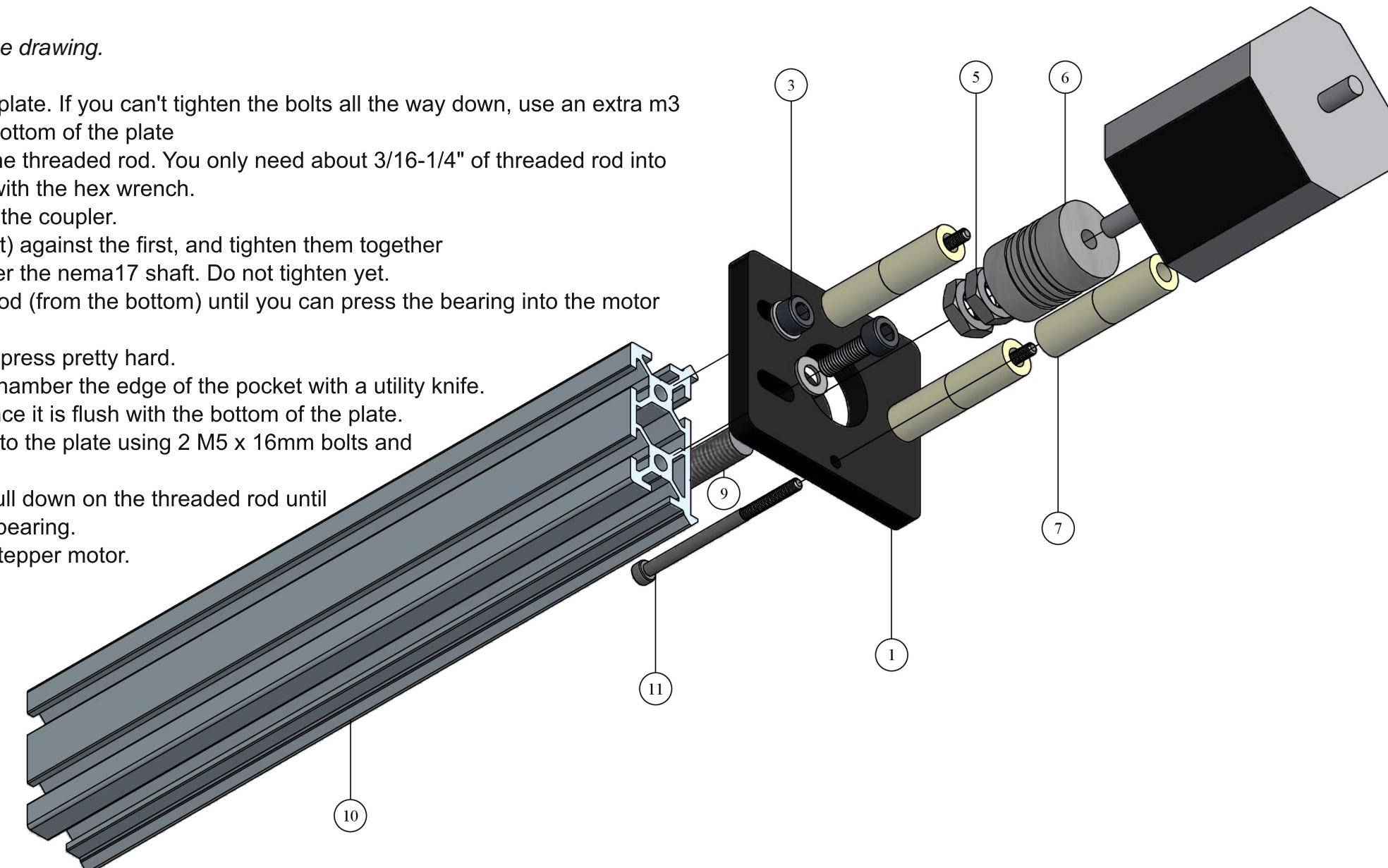
| ITEM | QTY | PART NUMBER | TITLE                        |
|------|-----|-------------|------------------------------|
| 1    | 1   | MKS01-02    | Makerslide Extrusion - 375mm |
| 2    | 1   | SM_YA02     | Y Axis Idle Mount Assembly   |
| 3    | 1   | SM_YA01     | Y Axis Motor Mount Assembly  |
| 4    | 4   | SM-H07      | M5 x 10mm SHCS               |
| 5    | 4   | SM-H03      | M5 Flat Washer               |
| 6    | 1   | SM-XZA1     | X/Z Carriage Assembly        |

|   |                              |  |                                     |
|---|------------------------------|--|-------------------------------------|
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| DESIGNED BY:<br>ERF   | DETAILED BY:<br>ERF          | DATE:<br>6/5/2012                                    |                                     |
| TITLE   |                              | Shapeoko Gantry Assembly<br>Shapeoko Gantry Assembly |                                     |
| TOLERANCES<br>(EXCEPT AS NOTED)   | BETWEEN<br>FINISHED SURFACES | FRACTIONAL: $\pm 1/64"$                              | SIZE<br>B DRAWING NUMBER<br>SM-GA01 |
|   |                              | DECIMAL: $\pm .010"$                                 | SCALE                               |
|   |                              | DETAIL DIMENSIONS: $\pm 1/16"$                       | SHEET 1 OF 1                        |

**Z-Axis Slide****STEP 9**

*Take your time, be patient and look at the drawing.*

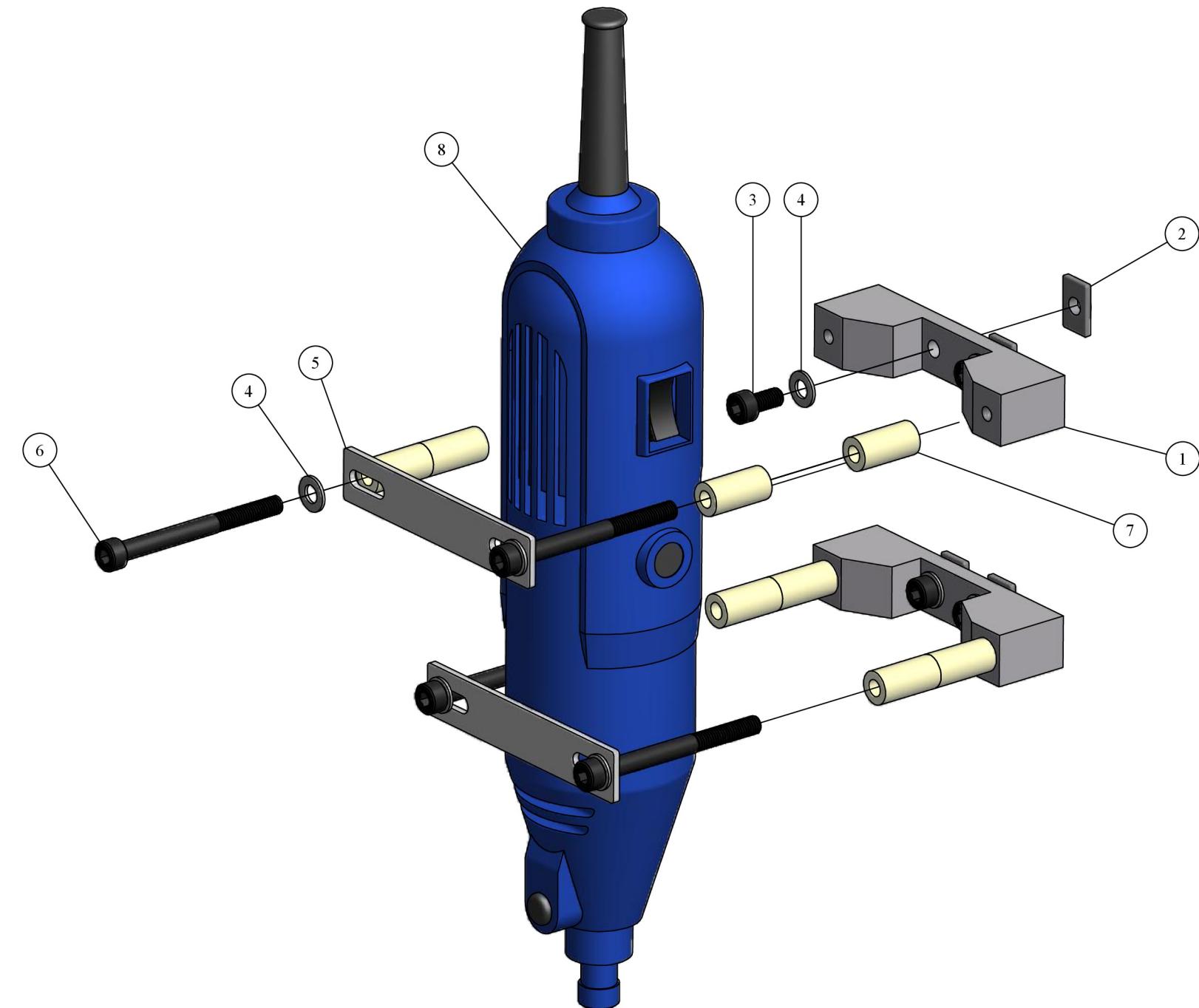
- 1.) Mount the Motor to the motor mount plate. If you can't tighten the bolts all the way down, use an extra m3 washer between the bolt head and the bottom of the plate
- 2.) Assemble the coupler to the end of the threaded rod. You only need about 3/16-1/4" of threaded rod into the coupler for it to grab. Tighten firmly with the hex wrench.
- 3.) Snug 1 M8 hex nut (jam nut) against the coupler.
- 4.) Tighten the other M8 hex nut (jam nut) against the first, and tighten them together
- 5.) Slide the other end of the coupler over the nema17 shaft. Do not tighten yet.
- 5.) Slide the bearing over the threaded rod (from the bottom) until you can press the bearing into the motor mount plate.  
- This is a friction fit so you may have to press pretty hard.  
- Some people have found it helpful to chamber the edge of the pocket with a utility knife.
- 6.) The bearing is in the correct place once it is flush with the bottom of the plate.
- 7.) Attach 200mm section of makerslide to the plate using 2 M5 x 16mm bolts and washers (as shown)
- 8.) Once your makerslide is attached. Pull down on the threaded rod until the M8 jam nuts are seated against the bearing.
- 9.) Tighten the coupler on the nema17 stepper motor.



| ITEM | QTY | PART NUMBER | TITLE  |
|------|-----|-------------|--|
| 1    | 1   | SM-S06      | Z-Axis Mount Plate                             |
| 2    | 2   | SM-H03      | M5 Flat Washer                                 |
| 3    | 2   | SM-H13      | M5 x 16mm SHCS                                 |
| 4    | 1   | SM-M07      | Z-Axis Bearing                                 |
| 5    | 2   | SM-H10      | M8 Jam Nut                                     |
| 6    | 1   | SM-H12      | Coupler  |
| 7    | 6   | SM-H02      | 3/4" Nylon Spacer                              |
| 8    | 1   | SM-E01      | Nema 17 Stepper Motor (60oz/in holding torque) |
| 9    | 1   | SM-H05      | Threaded Rod                                   |
| 10   | 1   | MSK01-03    | Makerslide Extrusion - 200mm                   |
| 11   | 3   | SM-H06      | M3 x 50mm SHCS                                 |

|   |  |                                  |                     |
|---|--|----------------------------------|---------------------|
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| <b>TOLERANCES</b><br>(EXCEPT AS NOTED)<br><br>BETWEEN<br>FINISHED SURFACES                | <b>TITLE</b><br><br>Z Axis Spindle Mount |                                  |                     |
| FRACTIONAL: $\pm 1/64"$<br><br>DECIMAL: $\pm .010"$<br><br>DETAIL DIMENSIONS: $\pm 1/16"$ | <b>SIZE</b><br>B                         | <b>DRAWING NUMBER</b><br>SM-ZA02 | <b>SCALE</b>        |
|   |  |                                  | <b>SHEET 1 OF 1</b> |

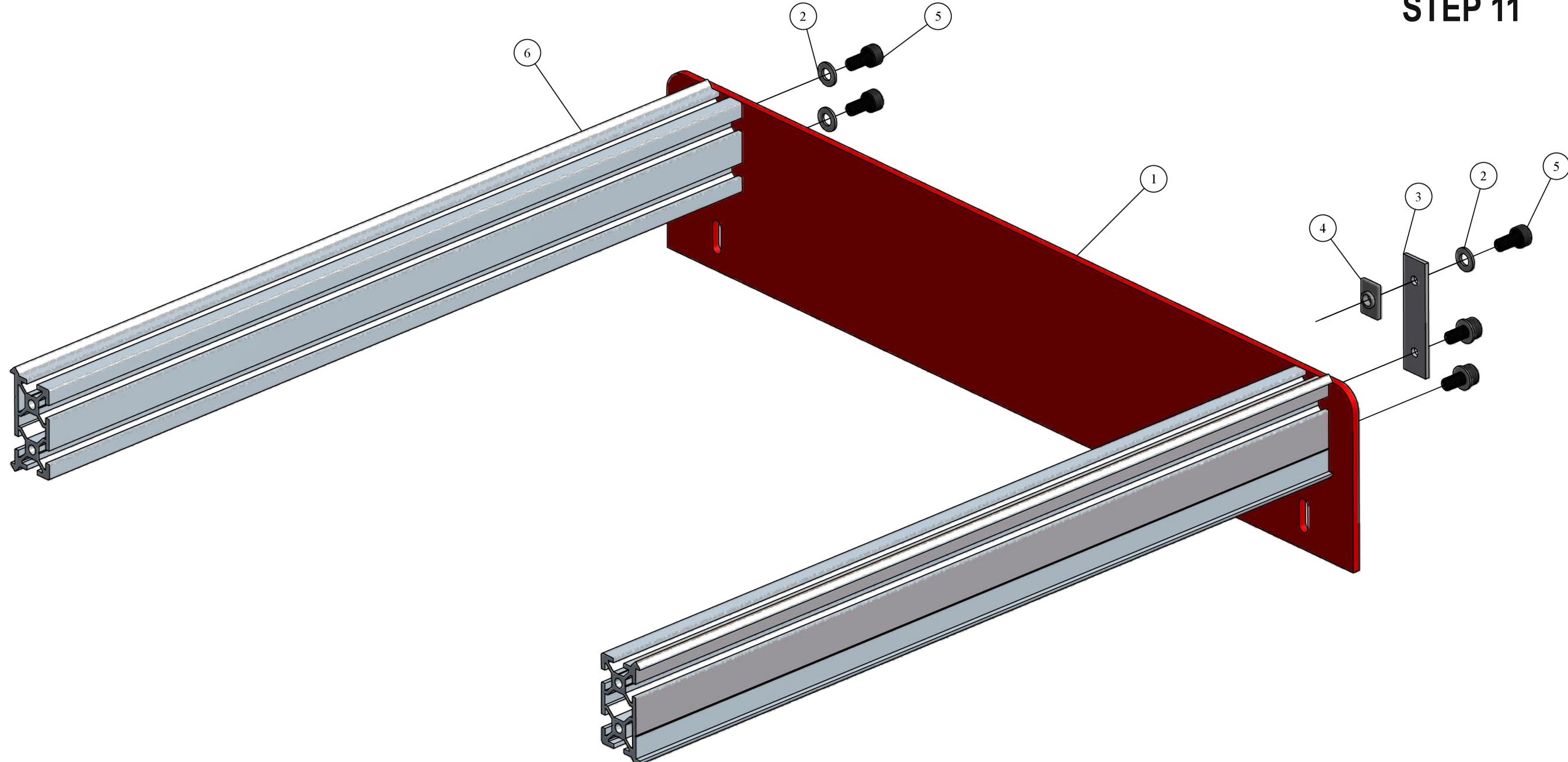
## Spindle Mount assembly

**STEP 10**

| ITEM | QTY | PART NUMBER | TITLE             |
|------|-----|-------------|-------------------|
| 1    | 2   | SM-TM1      | Spindle Mount     |
| 2    | 4   | SM-H11      | Insertion Nut     |
| 3    | 4   | SM-H07      | M5 x 10mm SHCS    |
| 4    | 8   | SM-H03      | M5 Flat Washer    |
| 5    | 2   | SM-TM2      | Spindle Strap     |
| 6    | 4   | SM-H09      | M5 x 55mm SHCS    |
| 7    | 8   | SM-H02      | 3/4" Nylon Spacer |
| 8    | 1   | SM-TM3      | Rotary Tool       |

|  |                      |   |                           |              |
|--|----------------------|---|---------------------------|--------------|
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| DESIGNED BY:<br>ERF  | DETAILED BY:<br>ERF  | DATE:<br>6/5/2012                           |                           |              |
| <b>TOLERANCES</b><br>(EXCEPT AS NOTED)<br><br>BETWEEN<br>FINISHED SURFACES       |                      | <b>TITLE</b><br><br>Z Axis Spindle Assembly |                           |              |
| FRACTIONAL: $\pm 1/64"$  | DECIMAL: $\pm .010"$ | SIZE<br>B                                   | DRAWING NUMBER<br>SM-ZA03 | SCALE        |
| DETAIL DIMENSIONS: $\pm 1/16"$   |                      |   |                           | SHEET 1 OF 1 |

## Frame Assembly 1

**STEP 11**

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DESIGNED BY: ERF DETAILED BY: ERF DATE: 6/5/2012

TITLE Shapeoko - Frame Assembly

SIZE B DRAWING NUMBER

SCALE SHEET 1 OF 1

DETAIL DIMENSIONS: ± 1/16"

FRACTIONAL: ± 1/64" DECIMAL: ± .010"

BETWEEN FINISHED SURFACES

TOLERANCES (EXCEPT AS NOTED)

| ITEM | QTY | PART NUMBER | TITLE                        |
|------|-----|-------------|------------------------------|
| 1    | 2   | SM-S02      | Front/Back Plate             |
| 2    | 10  | SM-H03      | M5 Flat Washer               |
| 3    | 2   | SM-M05      | Belt Anchor                  |
| 4    | 2   | SM-H11      | Insertion Nut                |
| 5    | 10  | SM-H07      | M5 x 10mm SHCS               |
| 6    | 2   | MKS01-02    | Makerslide Extrusion - 375mm |

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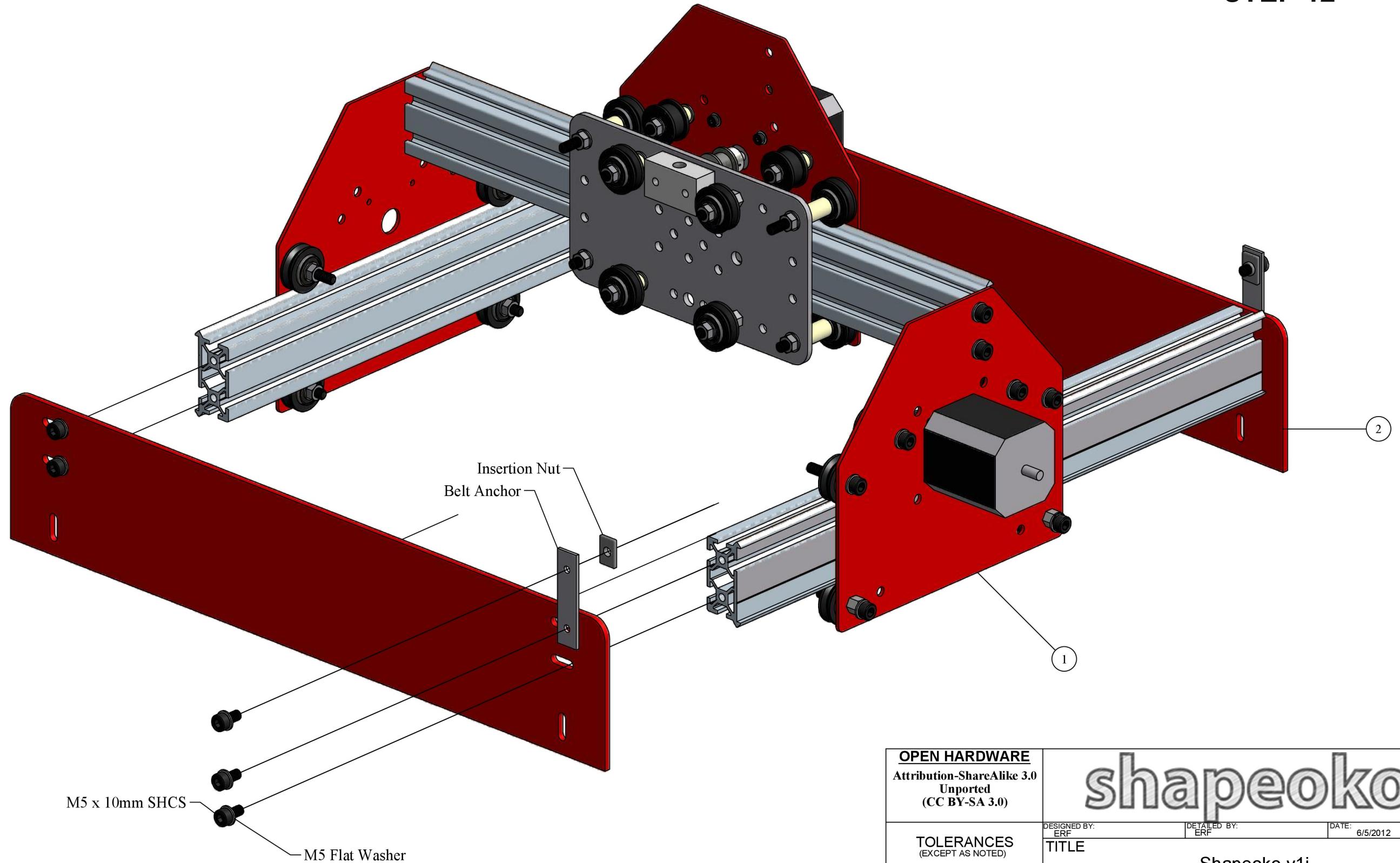
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## Frame Assembly 2

STEP 12

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# shapeoko

**TOLERANCES**  
(EXCEPT AS NOTED)  
BETWEEN  
FINISHED SURFACES

FRACTIONAL:  $\pm 1/64"$   
DECIMAL:  $\pm .010"$   
DETAIL DIMENSIONS:  $\pm 1/16"$

DESIGNED BY:  
ERF

DETAILED BY:  
ERF

DATE:  
6/5/2012

**TITLE**

Shapeoko v1i

**SIZE**   **DRAWING NUMBER**

B   Shapeoko\_v1i

**SCALE**

1

| ITEM | QTY | PART NUMBER | TITLE                     |
|------|-----|-------------|---------------------------|
| 1    | 1   | SM-GA01     | Shapeoko Gantry Assembly  |
| 2    | 1   | SM-FA01     | Shapeoko - Frame Assembly |

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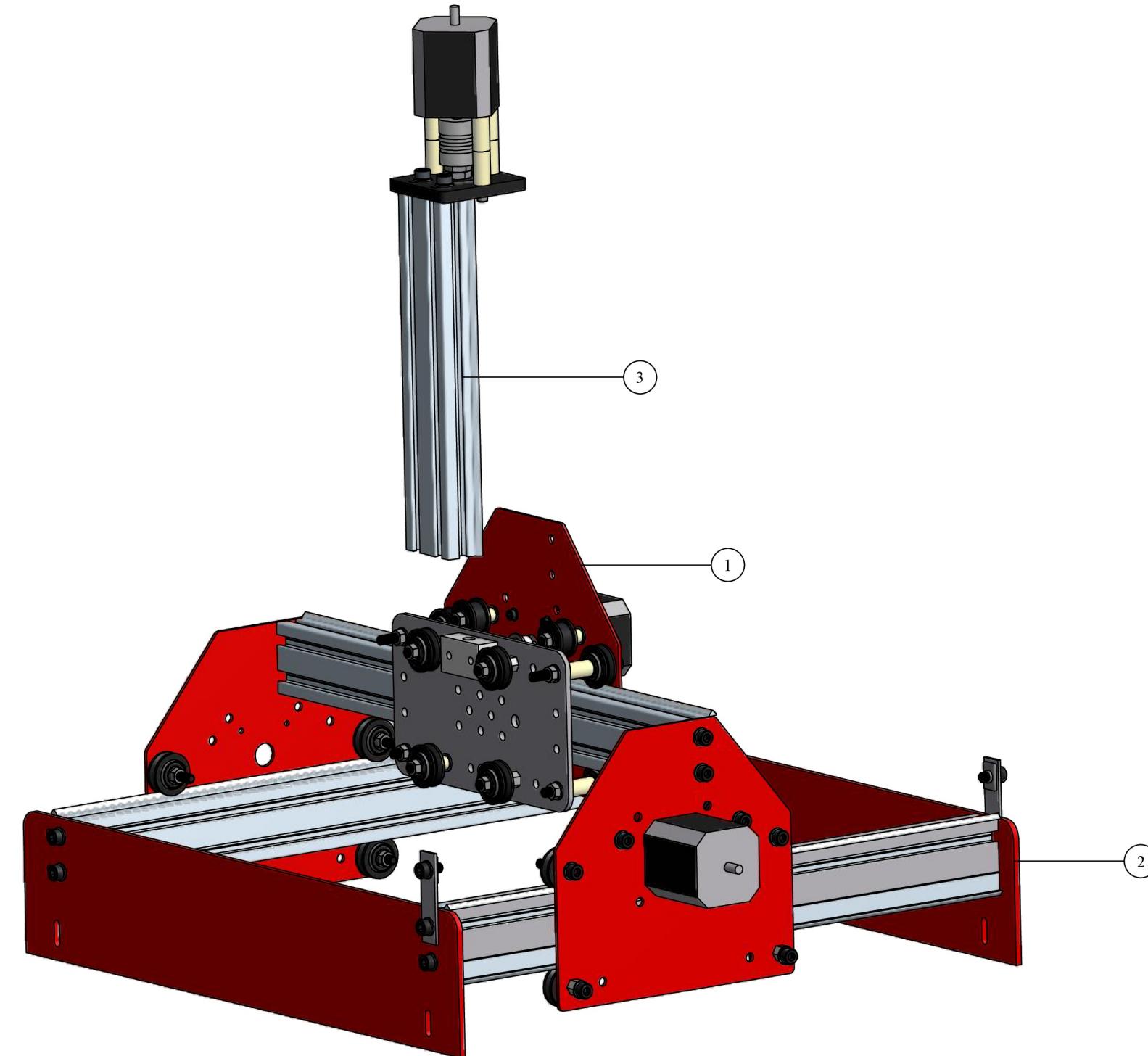
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## Final Assembly

STEP 13



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| ITEM | QTY | PART NUMBER | TITLE                     |
|------|-----|-------------|---------------------------|
| 1    | 1   | SM-GA01     | Shapeoko Gantry Assembly  |
| 2    | 1   | SM-FA01     | Shapeoko - Frame Assembly |
| 3    | 1   | SM-ZA02     | Z Axis Spindle Mount      |

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**TOLERANCES**  
 (EXCEPT AS NOTED)  
 BETWEEN  
 FINISHED SURFACES  
 FRACTIONAL:  $\pm 1/64"$   
 DECIMAL:  $\pm .010"$   
 DETAIL DIMENSIONS:  $\pm 1/16"$

DESIGNED BY:  
 ERF      DETAILED BY:  
 ERF      DATE:  
 6/5/2012

TITLE  
 Shapeoko v1i

SIZE      DRAWING NUMBER  
 B      Shapeoko\_v1i  
 SCALE      SHEET 1 OF 1







