



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade





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Thank you for purchasing MDG upgrades for your 3D printer!

MDG products are designed by us, in the USA. Our designs focus on improving print reliability, repeatability and speed for some of the most common consumer grade 3D printers on the market. At MAKERS DEVELOPMENT GROUP we were tired of the never ending “game of clones” and going on in consumer 3D printer market so we decided to design a few of our own products that brought something different to the community. We hope you enjoy them, and we thank you for your patronage.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

## COMPATABILITY

	CR-10 V3	CR-10 V2	CR-10 PRO	CR-10S PRO	CR-10S PRO V2	CR-X PRO	CR-10 Mini	CR-10 MAX
DUAL-X LR KIT, 400MM, CR-10	✓	✓	✓	✓	✓	✓	✓	✗
DUAL-Y LR KIT, CR-10	✓	✓	✓	✗	✗	✗	✗	✗
DUAL-Z LR KIT, 500MM, CR-10	✓	✓	✓	✓	✓	✓	✗	✗
DUAL-Z LR KIT, 400MM, CR-10	✗	✗	✗	✗	✗	✗	✓	✗
Solid Bed Spacers	✓	✓	✓	✓	✓	✓	✓	✓
DUAL-Y LR MOUNT SET L&R, CR-10	✓	✓	✓	✗	✗	✗	✗	✗
Tool Base, CR-10 V2 / V3	✓	✓	✗	✗	✗	✗	✗	✗
Tool Base Ender 3 / CR-10	✗	✗	✓	UNK	UNK	UNK	✓	✗

✓ Compatible

✗ Not Compatible

UNK To be determined



**INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade**

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## **PREPERATION**



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### PREPERATION



If you are installing the DUAL-Y linear rails go to [makersdevelopmentgroup.com](http://makersdevelopmentgroup.com) to download STL files for MGN12 - 2040 installation tool shown below. Print two (2) MGN12-2040 installation tools in advance of any printer disassembly. This tool is helpful to properly align the Y-axis linear rails.





## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### PREPERATION



Remove filament from extruder as per typical routine.

Once filament from extruder is removed allow the printer hotend to reach room temperature before beginning disassembly.

Power off the control box and disconnect all three (3) control box electrical connectors.

Disconnect the heated bed connector at the control box.

Disconnect the wire connector at the base of the CR-10 printer.

Disconnect the connector at the X axis gantry.



INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

# MDG DUAL-Y LINEAR RAIL KIT, CR-10 INSTALL

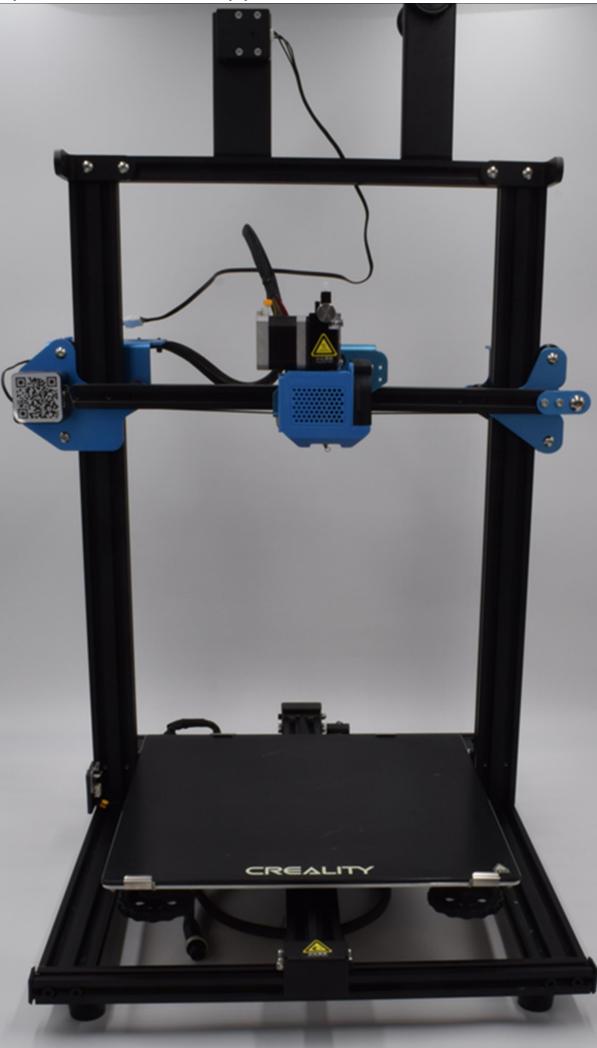




## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation

#### Step 1 – Remove Z support rods



Remove the Z support rods and place them aside.

Each rod is secured by two button head cap screws (BHCS).

Remove (4) BHCS to remove both rods.

Take care not to misplace the fasteners by placing them in a small bin.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

## MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation

## Step 2 – Remove the Print Bed



Remove the glass print surface.

Remove the bed leveling thumb wheels and lift the aluminum heat bed up and set aside. Take care to not damage the heat bed cable.

Leaving the timing belt connected, Remove all roller wheels and fasteners from the bed plate.

With the wheels removed, slide the bed plate to the rear.

**TIP:** You should be able to install the Y-axis linear rails without removing tension from the timing belt. Doing so will save you the time and effort of re-applying belt tension later.

If you are having trouble completing the install you can disconnect the timing belt from the bed plate to gain better access. If you do, be sure to remove tension from the belt prior to disconnecting from the bed plate or you may damage the belt.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation



Caution should be taken during this step to ensure the linear carriages do not slide off the end of the rail. If this occurs, the ball bearings will fall out of the carriage and need to be repacked.

#### Step 3 – Prepare the linear rails for the Y-axis.



Prepare the (2) two 450 mm MGN12 linear rails by inserting M3 X 8 mm socket head cap screws (SHCS) into each linear rail counter-bore hole. Thread an M3 T-nut on to the M3 BHCS with only a couple of turns. DO NOT TIGHTEN.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation



**Linear Rail Fasteners & Torque** – Linear rails are designed to have equal bearing pressure applied to the length of the rail. As such, it is CRITICAL to use all fasteners on the rail. ALL MOUNTING HOLES MUST BE USED. In addition, all linear rail fasteners should have equal torque applied. USE a torque wrench and set to 1.0 Nm for mounting rails to aluminum.

#### Step 4 – Mount the Y-Axis Linear rails



Align the T-nuts with the t-slot and place one (1) linear rails on each side of the 2040 Y-axis aluminum extrusion.

LIGHTLY tighten a couple M3 SHCS to keep the rail in place. At this point, the rail should be able to move in all directions with a little force but not fall off the extrusion once you let go. Tighten or loosen to get this affect.

Slide the linear rails as far towards the front of the printer as possible until they come into contact with the pulley cover.

Using two (2) MDG MGN12 – 2040 3D printed alignment tools printed in the preparation section. Clamp both rails in place. The MGN12 tool will center the linear to the extrusion and ensure they are near parallel to each other.

Using a torque wrench set to 1.0 Nm, tighten the M3 SHCS at the front of the printer and work your way to the back. Reposition the MGN12 alignment tools and carriages as necessary until all M3 SHCS are torqued. Be sure at least one (1) alignment tool is clamped in place at all times to ensure the rails do not move.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation



**Linear Rail Alignment** - For proper operation it is critical the linear rails are parallel to each other within a very tight tolerance (~ 0.001"). Linear rails that are not parallel will bind and cause excessive friction during motion, reduced print speeds, and excessive linear rail wear. DO NOT RUSH THIS STEP!

#### Step 5 – Align (Tram) the Y-axis linear rails



This is by far the trickiest part of installing linear rail. Take your time, have some patience and don't be too hard on yourself if your first measurements are not perfect. Just take a deep breath, loosen up the rail and try again.

Using a dial indicator and magnetic base ensure the linear rails are parallel to each with a deviation no more than 0.001"

Below is a short video on the process.

<https://www.youtube.com/watch?v=8Yfl17AEkdc>

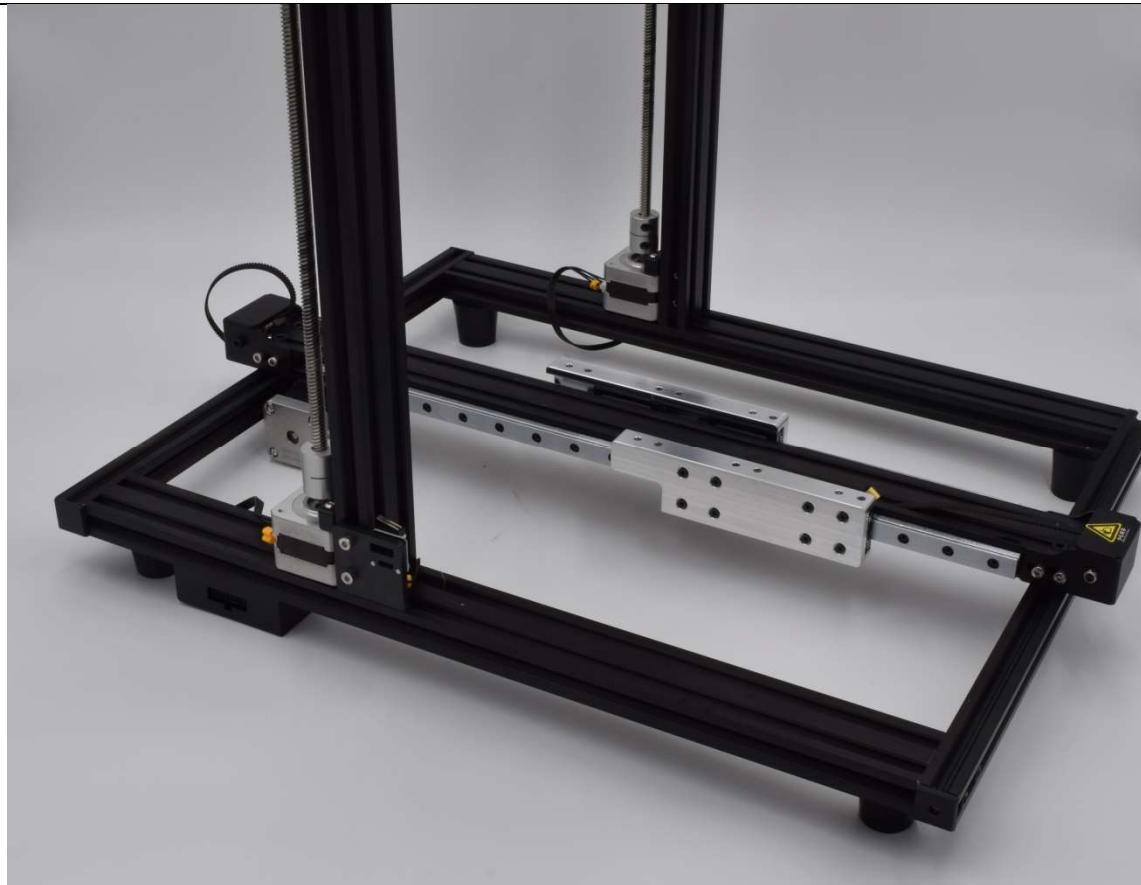
If you used the MGN12 – 2040 alignment clamp they should be close, but may still require adjustment.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation

#### Step 6 – Attach the MDG DUAL-Y LINEAR RAIL MOUNTS, L&R



Using eight (8) M3 X 6 mm SHCS per rail, attach the linear rails mounts as shown. Place light pressure on the top to ensure the mounts are resting on the top edge of the linear rail carriages.

Torque each M3 SHCS to 1.0 Nm. Slide each carriage back and forth to ensure there is no bind. If there is bind, loose the M3 carriage screws and place less downward pressure on the mount and re-tighten.

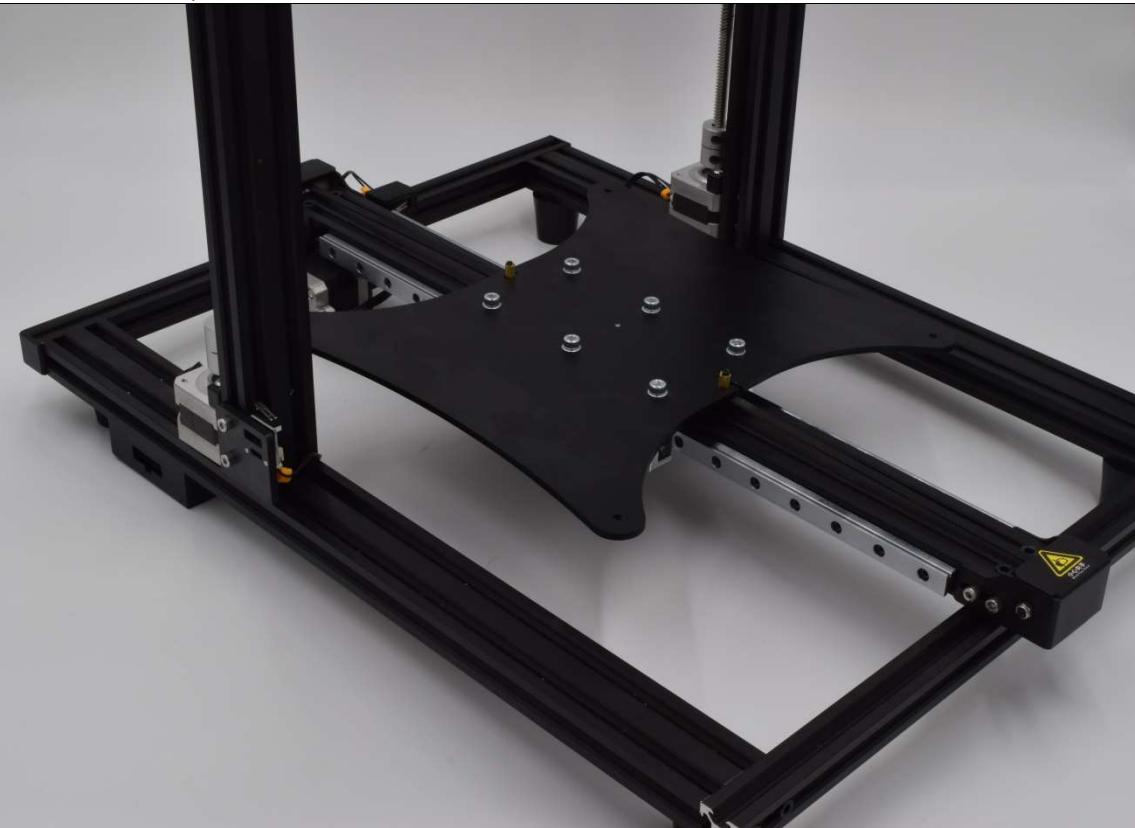
Slide the right side mount to the rear until the limit switch engaged. Make adjustment to the limit switch position if required.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Y LINEAR RAIL KIT, CR-10 Installation

#### Step 7 – Mount bed plate and tension belt



Using six (6) M5 X 8 mm SHCS and six (6) M5 washers secure the bed plate to the MDG Linear rail mounts.

Torque each M5 SHCS to 1.0 Nm.

Slide each bed plate back and forth to ensure there is no bind.

If there is bind, it is likely the linear rails are misaligned or the M3 / M5 SHCS are too tight. Go back and repeat step 5 until any bind is eliminated.

Attach the GT2 timing belt to the bed plate and apply proper belt tension using the pulley guard.



INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

# MDG DUAL-Z LINEAR RAIL KIT, CR-10 INSTALL

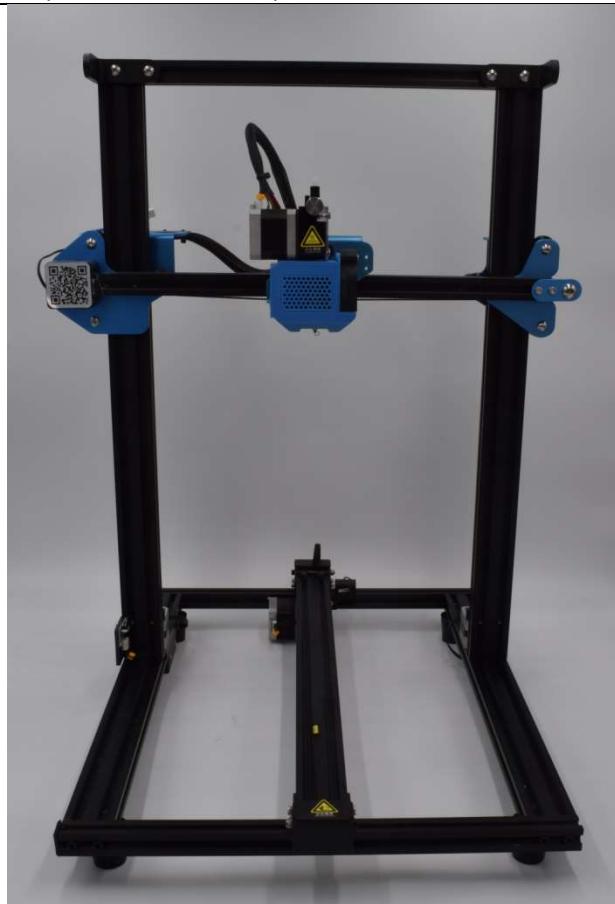




## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

## MDG DUAL-Z LINEAR RAIL KIT, CR-10 Installation

## Step 8 – Remove the spool holder and filament sensor.



If you have not already done so, remove the Z support rods as detailed in step 1.

Unplug the filament sensor from the X-axis gantry and loosen the two (2) BHCS from the top rail. Place filament sensor and bracket to the side.

Loosen the two (2) BHCS securing the spool holder to the top rail. Remove spool holder and place to the side.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Z LINEAR RAIL KIT, CR-10 Installation

#### Step 9 – Remove the top aluminum extrusion bar



Remove the four (4) M5 SHCS from the top aluminum extrusion. Place the top bar to the side.

Remove the Z axis limit switch plate and set aside.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Z LINEAR RAIL KIT, CR-10 Installation

#### Step 10 – Remove the X-axis gantry

	<p>Slide the X-axis gantry towards the top of the machine until the lead screw nuts and roller wheels are free of the Z axis uprights.</p>
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## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Z LINEAR RAIL KIT, CR-10 Installation

Step 11 – Prepare the upper and lower alignment blocks	
	<p>For the lower alignment blocks use (16) M5 X 8mm BHCS and (16) M5 T-Nuts. Insert the BHCS in the designated counter-bores and thread on the M5 T-nuts with only a couple of turns. DO NOT TIGHTEN.</p> <p>For the upper alignment blocks use (4) M5 X 8mm SHCS and (4) M5 T-nuts. Insert the SHCS in the designated counter-bores and thread on the M5 T-nuts with only a couple of turns. DO NOT TIGHTEN.</p>



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-Z LINEAR RAIL KIT, CR-10 Installation



Caution should be taken during this step to ensure the linear carriages do not slide off the end of the rail. If this occurs, the ball bearings will fall out of the carriage and need to be repacked.

#### Step 12 – Prepare the linear rails for the Z-axis.



Prepare the (2) two 500 mm MGN12 linear rails by inserting M3 X 8 mm SHCS into each linear rail mounting hole. Thread an M3 T-nut on to the M3 BHCS with only a couple of turns. DO NOT TIGHTEN.

NOTE: The photo above shows the Y-axis linear rails. The Z-axis rails will only have one carriage.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

## MDG DUAL-Z LINEAR RAIL KIT, CR-10 Installation



**Linear Rail Fasteners & Torque** – Linear rails are designed to have equal bearing pressure applied to the length of the rail. As such, it is CRITICAL to use all fasteners on the rail. ALL MOUNTING HOLES MUST BE USED. In addition, all linear rail fasteners should have equal torque applied. USE a torque wrench and set to 1.0 Nm for mounting rails to aluminum.

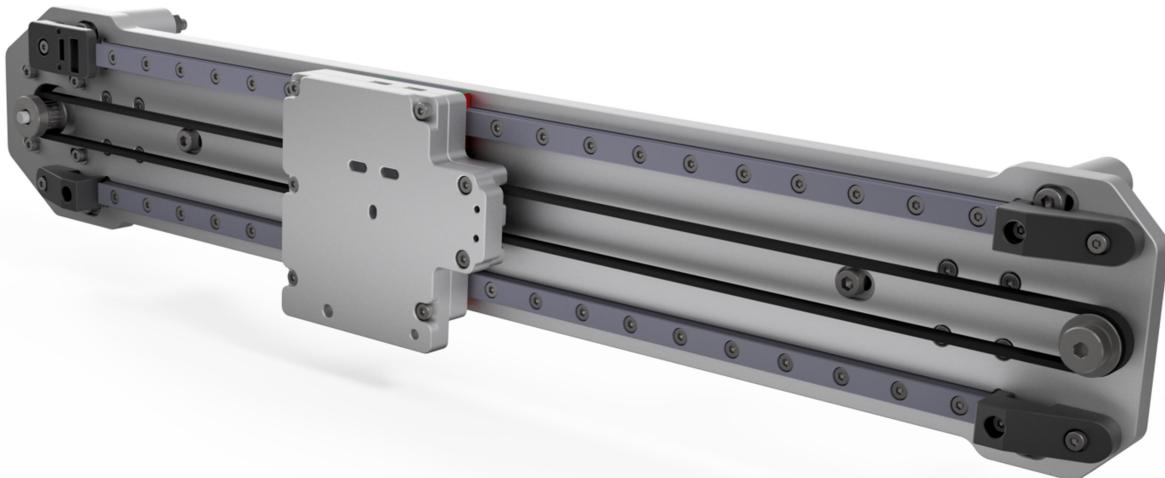
## Step 13 – Prepare the upper and lower alignment blocks

	<p>Align the T-nuts with the t-slot and place one (1) linear rail on each side of the 2040 Z-axis aluminum extrusion.</p> <p>LIGHTLY tighten a couple M3 SHCS to keep the rail in place. At this point, the rail should be able to move in all directions with a little force but not fall off the extrusion once you let go. Tighten or loosen to get this affect.</p> <p>Slide the linear rails as far towards the bottom of the printer as possible until they come into contact with the lower alignment block.</p> <p>Using two (2) MDG MGN12 – 2040 3D printed alignment tools printed in the preparation section. Clamp both rails in place. The MGN12 tool will center the linear to the extrusion and ensure they are near parallel to each other.</p> <p>We will fully torque the Z-axis linear rails once the X-Axis linear rail plate is in place. For now, leave them un-torqued.</p>
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INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

# MDG X-AXIS DUAL LINEAR RAIL KIT, CR-10 INSTALL





## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

## MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation



Caution should be taken during this step to ensure the linear carriages do not slide off the end of the rail. If this occurs, the ball bearings will fall out of the carriage and need to be repacked.

## Step 14 – Prepare the X-axis dual linear rail plate



Prepare two (2) 400 mm MGN9 linear rails by placing them in the precision machined pockets on the MDG X-axis linear rail plate.

Using the M5 X 50mm SHCS, insert them through the M5 slots as shown. These SHCS remain captured.

Using (12) M3 X 12mm SHCS mount three (3) MDG X-AXIS END STOPS and one (1) MDG X LIMIT SWITCH MOUNT in the positions as shown. Installing them now will help prevent the linear rail carriage from sliding off the end of the rail during the assembly process.

Using (40) M3 X 10mm SHCS and (40) M3 Hex locknuts. Lightly thread (DO NOT TIGHTEN) the SHCS to the hex locknut for all (40) pairs. There is a machined pocket on the back side MDG X-axis linear rail plate to prevent the nut from rotating. Move the linear rail carriage left and right to gain access to all SHCS.

The top rail is the reference rail and should be tightened first. Using light pressure push the top linear rail to the bottom ensuring good contact on the side of the rail. Starting at the SHCS furthest to the left, torque each SHCS to 1.0 Nm. Work your way to the right on SHCS at a time until all (20) SHCS on the top rail are torqued.

Leave the bottom with the (20) SHCS lightly threaded to the hex locknuts. We will torque later.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

#### Step 15 – Prepare the tool base



Press the MDG X-AXIS TIMING BELT CLAMP into the machined pocket on the back side of the MDG tool base.

Using two (2) M2.5 X 10mm SHCS secure the timing belt clamp to the tool base.

Loop the timing belt as shown above and press the timing belt in the appropriate slot on the timing belt clamp.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

#### Step 16 – Install M8 Shoulder Bolt and shoulder bolt shims



The shoulder bolt assembly consists of an M8 X 12mm Shoulder bolt, (1) thin shim, (1) thick shim and (2) flanged ball bearings with an 8mm bore.

Place the thin shoulder bolt shim over the shoulder bolt first

Next place both flanged ball bearing on the shoulder bolt with the flanges oriented as shown

Lastly, place the thicker shoulder bolt shim

Thread the assembly in the M6 tapped hole on the MDG linear rail plate as shown.

Check free rotation of flanged bearings and there is no axial movement or thrust clearance.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

Step 17 – Install NEMA 17 Motor
<p>Using four (4) M3 X 8mm SHCS and four (4) M3 washers. Mount the NEMA 17 motor to the X-axis linear rail plate. Keep the fasteners loose enough to slide the motor along the slots to allow for belt tensioning.</p>



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation



**Linear Rail Alignment** - For proper operation it is critical the linear rails are parallel to each other within a very tight tolerance. Linear rails that are not parallel will bind and cause excessive friction during motion, reduced print speeds, and excessive linear rail wear. DO NOT RUSH THIS STEP!

#### Step 18 – Mount tool base and align lower linear rail



The lower liner rail should still have the M3 X 10mm SHCS loose. DO NOT tighten them yet. If they are already tightened, then loosen all (20) now.

Using eight (8) M3 X 8mm SHCS secure the MDG Tool Base to the MGN9 linear rail carriages. DO NOT loop the belt around the motor or idle pulley yet.

Slide the tool base right and left a couple times to ensure align the lower rail to the upper rail. Now move the tool base to the left end stop. Torque each SHCS to 1.0 Nm (from left to right) until complete. After all SHCS are torqued, slide the carriage back and forth to ensure there is no bind. If bind is present, repeat this step.

Once the tool base is mounted successfully, loop the synchronous belt around the idle pulley and then the motor pulley.

Tension the by sliding the stepper motor to the left and tightening the screws the four (4) M3 X 8mm SHCS.



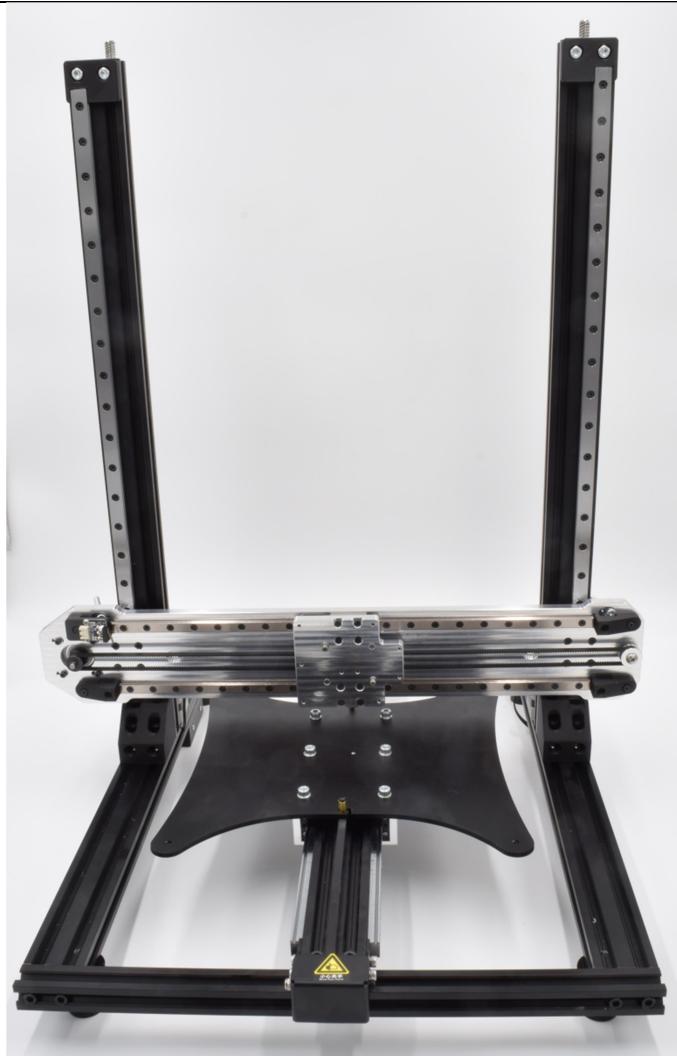
## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

## MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation



**Linear Rail Alignment** - For proper operation it is critical the linear rails are parallel to each other within a very tight tolerance. Linear rails that are not parallel will bind and cause excessive friction during motion, reduced print speeds, and excessive linear rail wear. DO NOT RUSH THIS STEP!

## Step 19A – Mount the DUAL-X linear rail plate to the Z-axis

*Linear rail Z-axis Install*

The photo shows the top bar removed but it is best to complete this step with the top bar secured and the four (4) SHCS tight.

Using eight (8) M3 X 6mm SHCS, secure the Dual-X plate to the Z-axis linear rail carriages.

Do not fully tighten.

Slide the Dual-X axis plate up and down to allow the linear rails to move into alignment.

Starting on the right side rail at the top SHCS torque to 1.0 Nm. With the right rail secure it is now the reference rail.

The left side rail must be made parallel with the right side. Slide the Dual-X axis plate up and down to allow the left side linear rail to move into alignment with the reference rail. Starting at the top SHCS torque to 1.0 Nm.

Using a bubble level on the top of the Dual-X plate, make level and torque the eight (8) M3 SHCS for the Z rail carriages. It is important the bed is level at the same time the Dual-X plate is level.

Move the Dual-X plate up and down to ensure there is no bind. If bind is present repeat this step until the bind is eliminated.



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

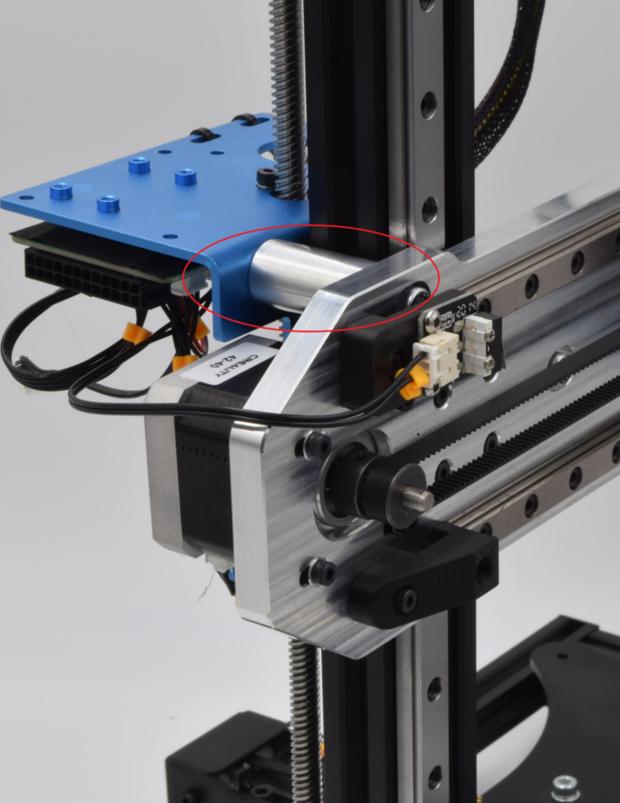
## MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

Step 19 B – Mount the DUAL-X linear rail plate to the Z-axis with Roller wheels	
No photo available	<p><b><i>Roller wheel Z-axis Install</i></b></p> <p>The MDG Dual-X plate can be used with roller wheels on the Z-axis.</p> <p>For this installation re-purpose the Z-axis roller wheels, and z leadscrew brackets from the donor CR-10 X-axis gantry.</p> <p>Install the roller wheels and Z-axis lead screw plates on the appropriate slots and slide the DUAL-X assembly over the Z-axis 2040 extrusions ensuring the Z-axis lead screw plate are threaded onto both lead screws.</p> <p>Level and set tension the Z-axis roller wheels roller wheels.</p>



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

Step 20 – Mount the Z-spacers, Z lead screw brackets	
	<p>Remove the Z-axis lead screw brackets and extruder assembly from the donor CR-10.</p> <p>Thread the Z lead screw brackets onto the lead screw.</p> <p>Insert the Z-spacer, M5 X 50mm SHCS, M5 washer, and M5 locknut into position and tighten. Be sure not to over tighten or place any bind on the z-lead screw.</p> <p>It may be necessary to removing the X limit switch plate and end stop for this step.</p>



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

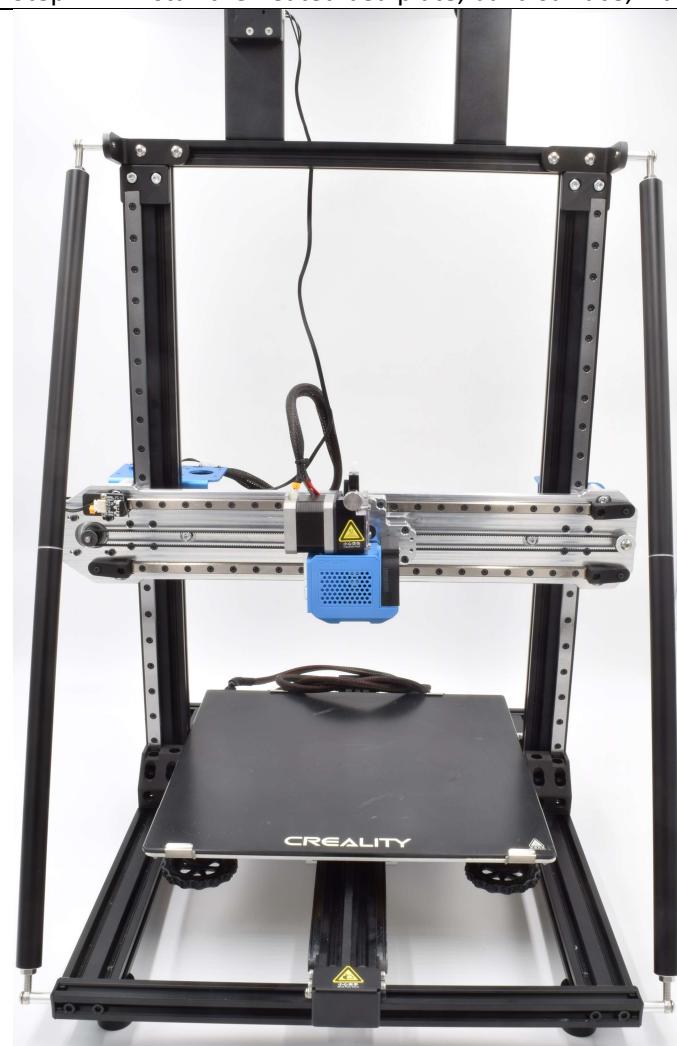
### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

Step 21 – Mount the extruder and hotend assembly to the tool base	
	<p>Mount the CR-10 V2 / V3 hotend / extruder assembly to the MDG mount. For this part all OEM screws are reused.</p> <p>Using six (6) M3 X 12mm SHCS, secure the MDG extruder mount to the MDG Tool base.</p> <p>For the lower right SHCS the blower should be removed to gain access.</p> <p>For the upper left SHCS this is only used for the V2 with the extruder mounted on the Z-bracket or if a thinner direct drive extruder motor is in use.</p>



## INSTALLATION INSTRUCTIONS – MDG CR-10 Upgrade

### MDG DUAL-X LINEAR RAIL KIT, CR-10 Installation

Step 22 – Install the heated bed plate, build surface, filament sensor, spool holder and Z support rods	
	<p>Install the heated bed plate, level springs or spacers, thumb wheels and glass build surface.</p> <p>Install filament sensor and spool holder.</p> <p>Install Z-support rods</p>

Congratulations! You've just completed the installation.