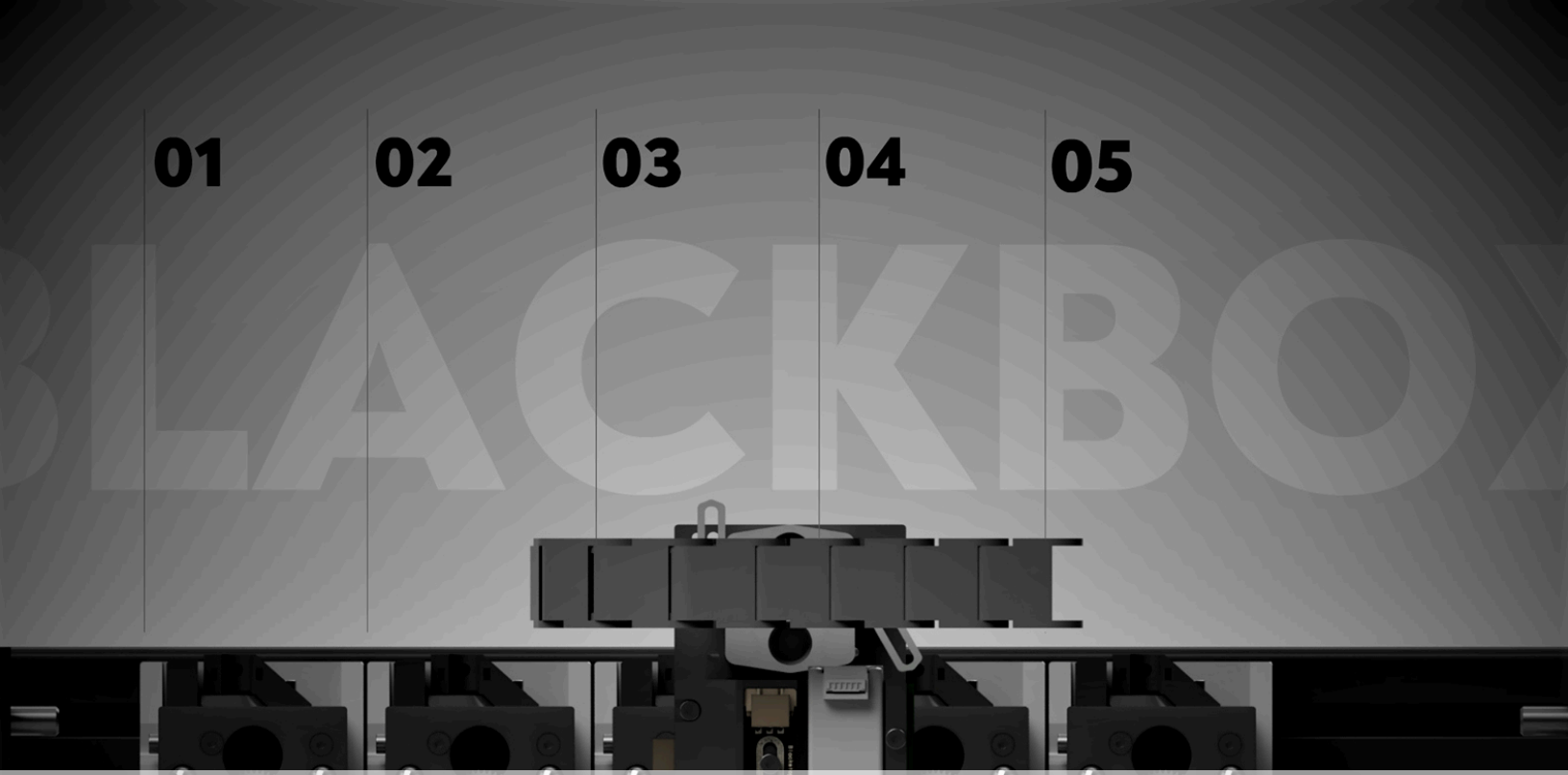


BLACKBOX CE

Counterweight

DOCUMENTATION VERSION 1

Blackbox CE Mechanical Assembly:

09. Counterweight

Change Log

Version	Notes
1	Initial Release

Tools

Description
Metric Tape Measure or Meter Stick
Electric Drill
Hand Tap Wrench
Hex Wrenches
Reamers
Soldering Iron with Heatset insert tip
Sharp Scissors or Razor Blade
PTFE Tube cutter or Razor Blade

Parts

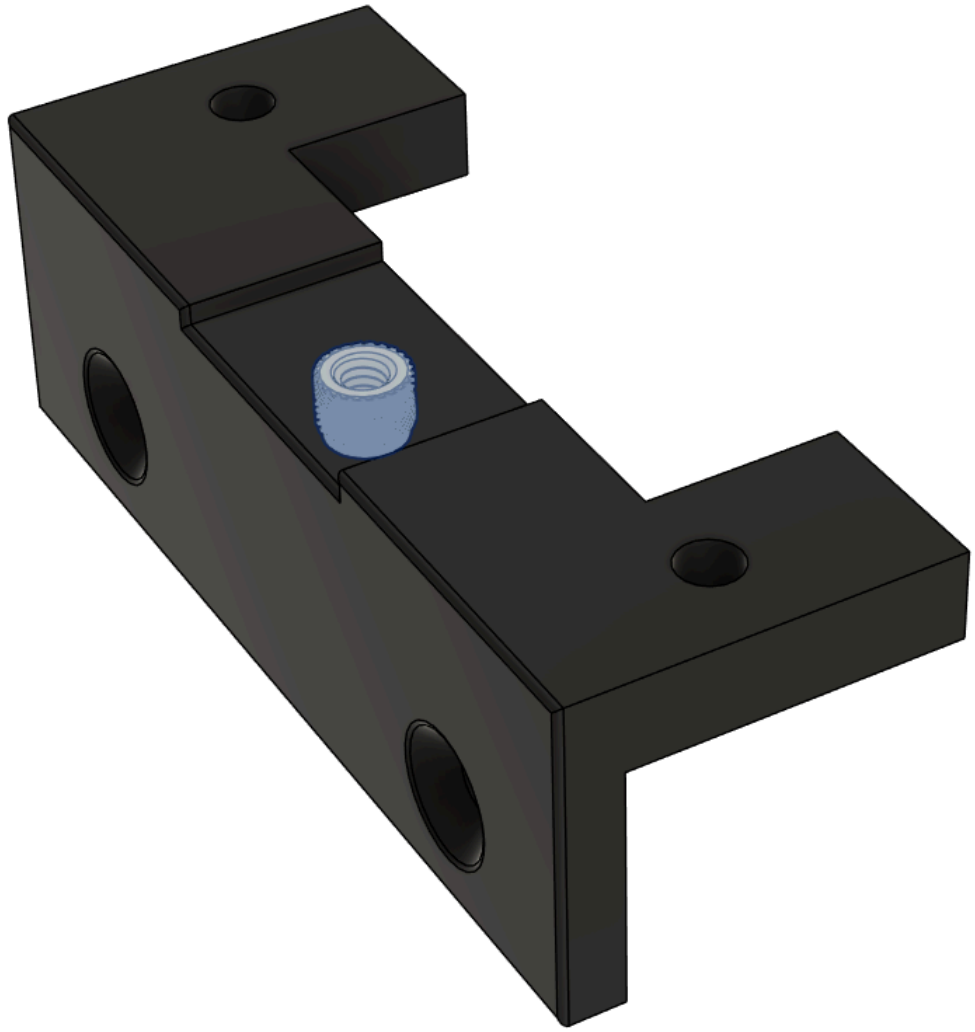
QTY	Description
4	PTFE_Bowden_Tube_5x3_74mm
4	M4_6x5mm_Heat_Set_Insert
4	DIN7991_M4_10mm_FHHS
6	DIN912_M4_12mm_SHCS
2	DIN912_M4_16mm_SHCS
4	DIN912_M4_30mm_SHCS
6	Bearing_4x9x4mm
2	Linear_Shaft_4x15mm
2	Linear_Shaft_4x30mm
8	M4 20 Series T-Nut
4	Tnut_40Series_M4

Printed Parts

QTY	Description	Material	Ver
1	Print_Counterweight_Alignment_Jig_Upper	PLA	1
1	Print_Counterweight_Container_Left_Small_Part01_R2	>=ABS	3
1	Print_Counter_Weight_Container_Left_Small_Part_02_R2	>=ABS	2
1	Print_Counterweight_Container_Right_Small_Part01_R2	>=ABS	3
1	Print_Counter_Weight_Container_Right_Small_Part_02_R2	>=ABS	2
2	Print_Counter_Weight_Lower_Mount_Part_01	>=ABS	1
1	Print_CounterWeight_LowerRight_Part02_R2	>=ABS	1
2	Print_Counter_Weight_Lower_Mount_Part_03	>=ABS	1
2	Print_CounterWeight_Pulley_Lower	>=ABS	1
1	Print_CounterWeight_LowerLeft_Part02_R2	>=ABS	1
1	Print_Counter_Weight_Upper_Mount_Right_Part_01	>=ABS	1
2	Print_Counter_Weight_Upper_Mount_Part_02_CE	>=ABS	1
4	Print_Counter_Weight_Pulley_Upper	>=ABS	1
1	Print_Counter_Weight_Upper_Mount_Left	>=ABS	1

Step 1 – Lower Pulley Assemblies:

Locate (2) Print_Counter_Weight_Lower_Mount_Part01 and install an M4 heat set insert into the location shown on both pieces.

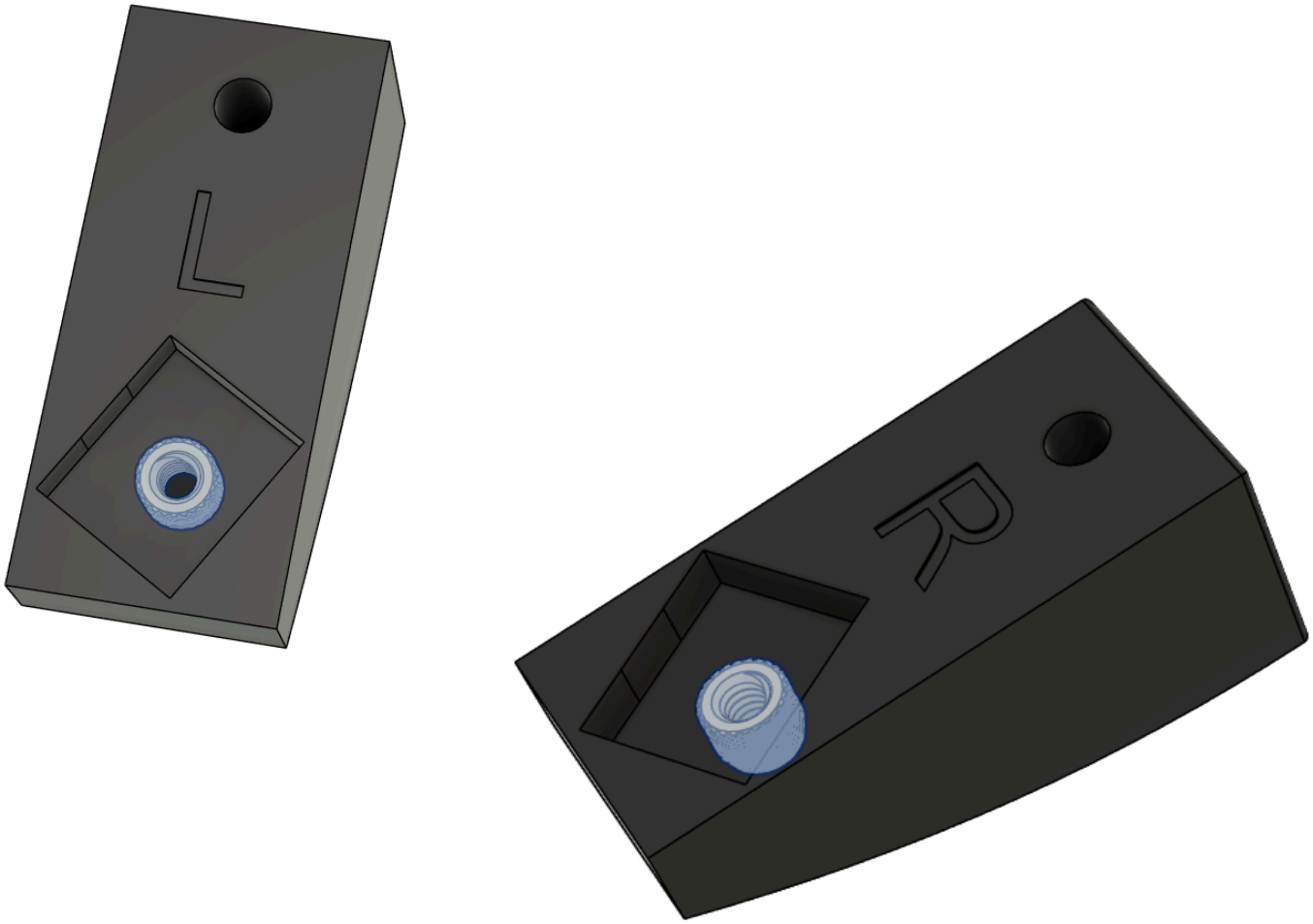


Locate (1) Print_Counter_Weight_LowerLeft_Mount_Part02

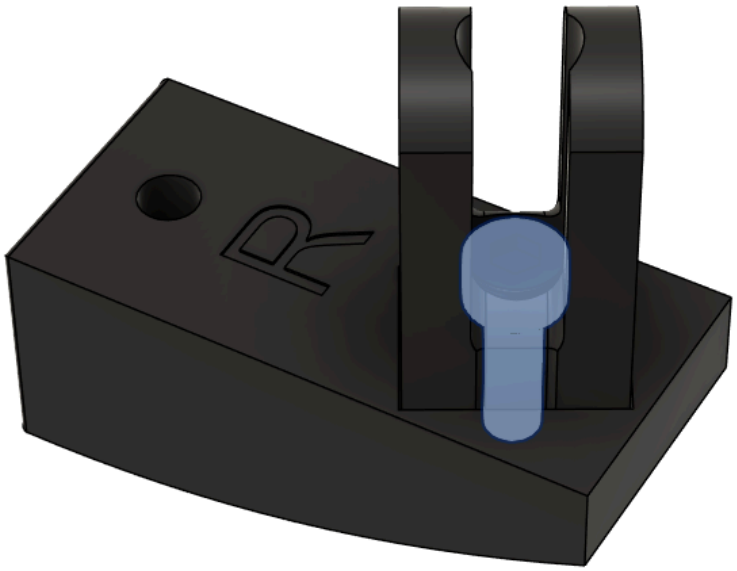
Locate (1) Print_Counter_Weight_LowerRight_Mount_Part02

Install and M4 heat set insert into the pocket of each printed part as shown below.

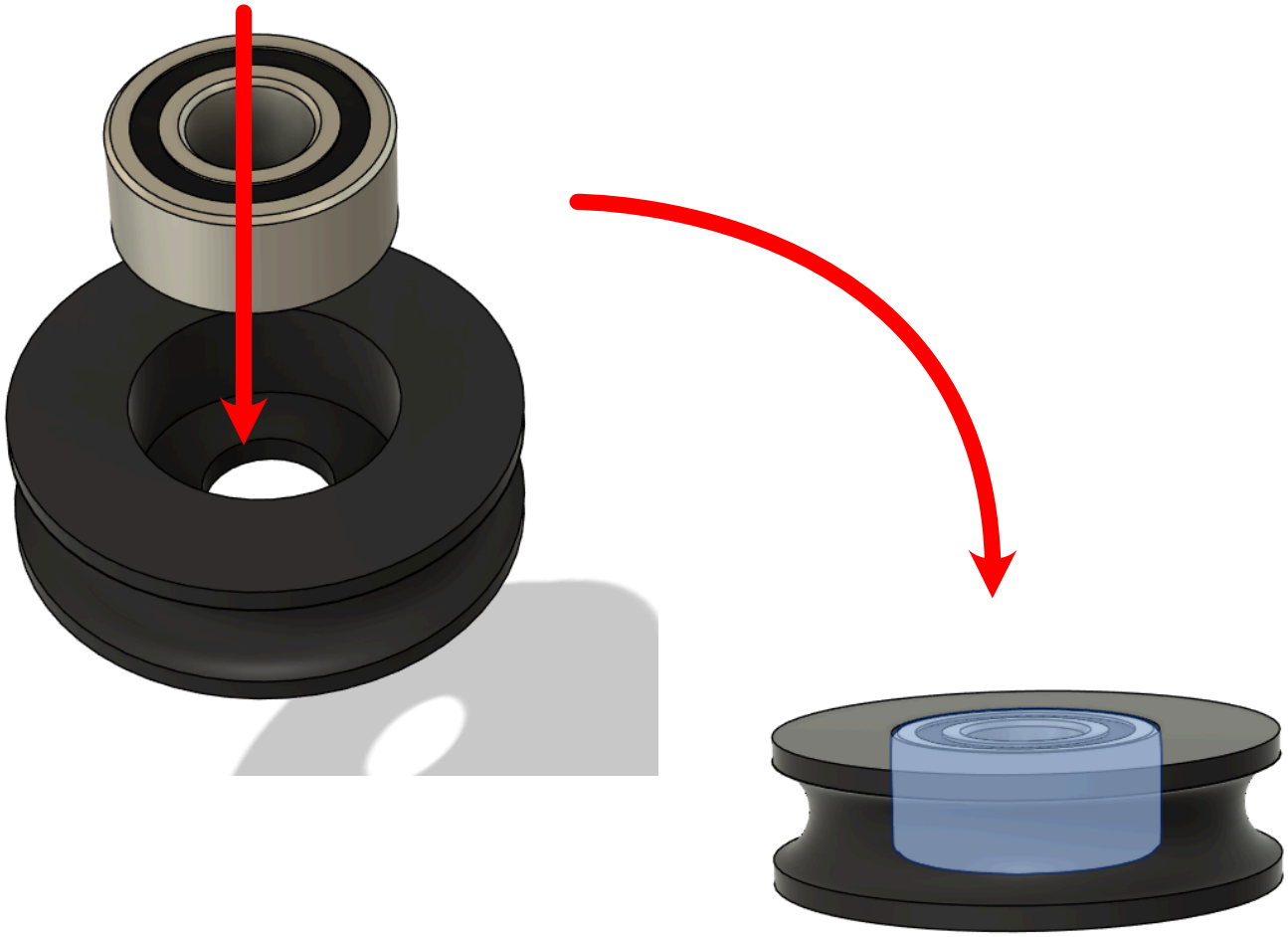
NOTE: Each of these printed parts are embossed with the side of the machine they will be installed on. They cannot be reversed!



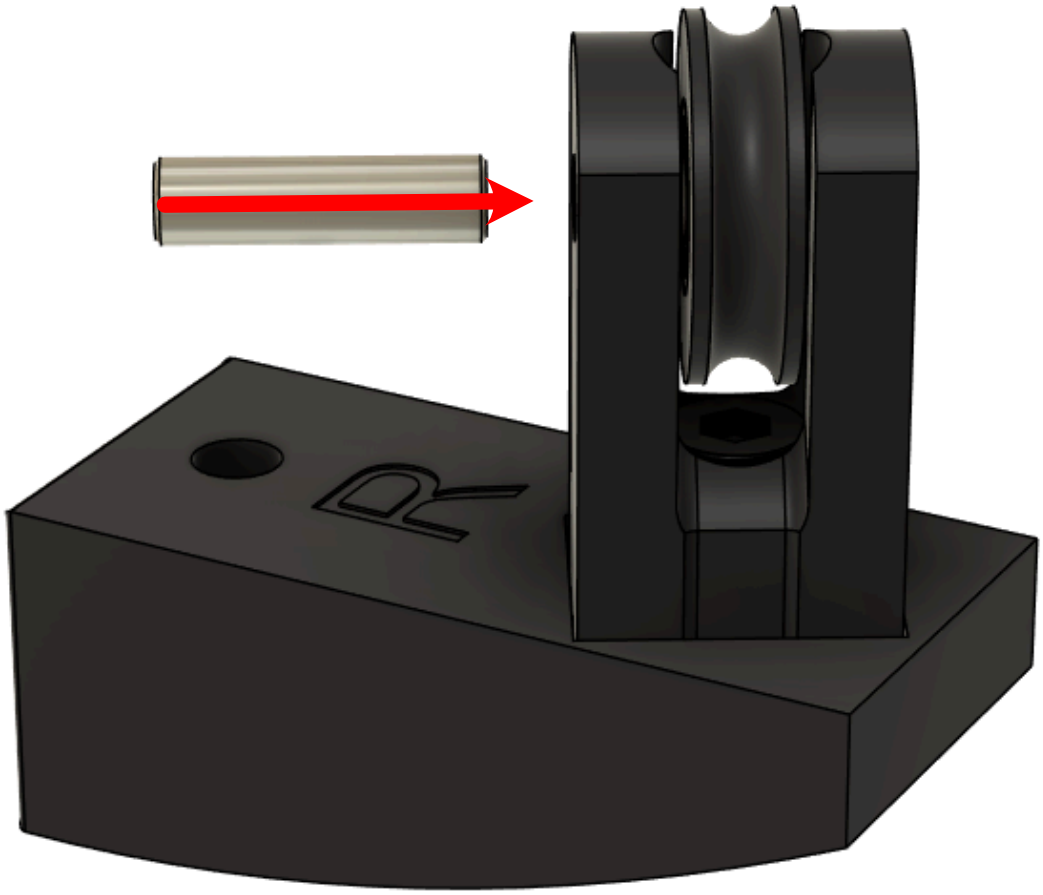
Locate (2) Print_Counter_Weight_Lower_Part03 and secure to each of the Part02s using an M4x12mm SHCS.



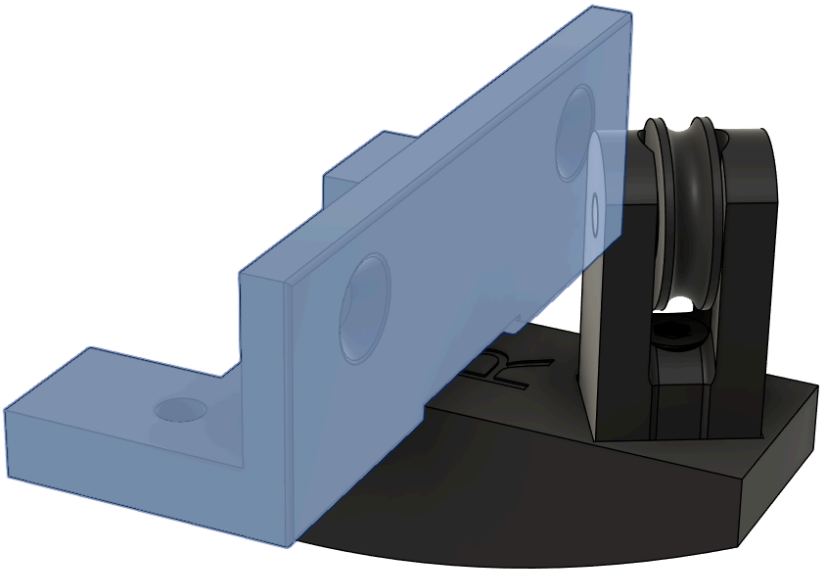
Locate (2) Print_Counterweight_Pulley_Lower and fully seat/install a 4x9x4 ball bearing into each pocket. When fully seated the bearing should be flush with the top face of the printed part.

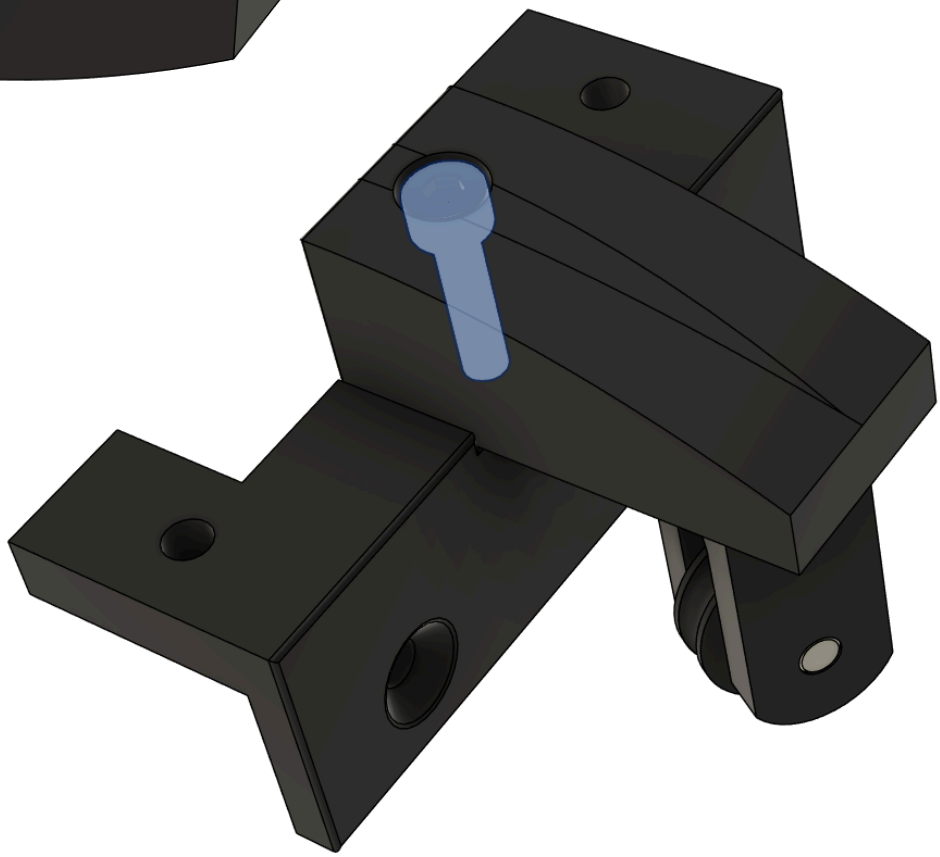


Locate (2) 4x15mm shafts and capture a pulley into each (L + R) lower pulley assemblies.



Fit one of each previously assembled Print_Counterweight_Lower_Part 01 to both the left and right dedicated sub assemblies as shown and secure using (2) M4x16mm SHCS.

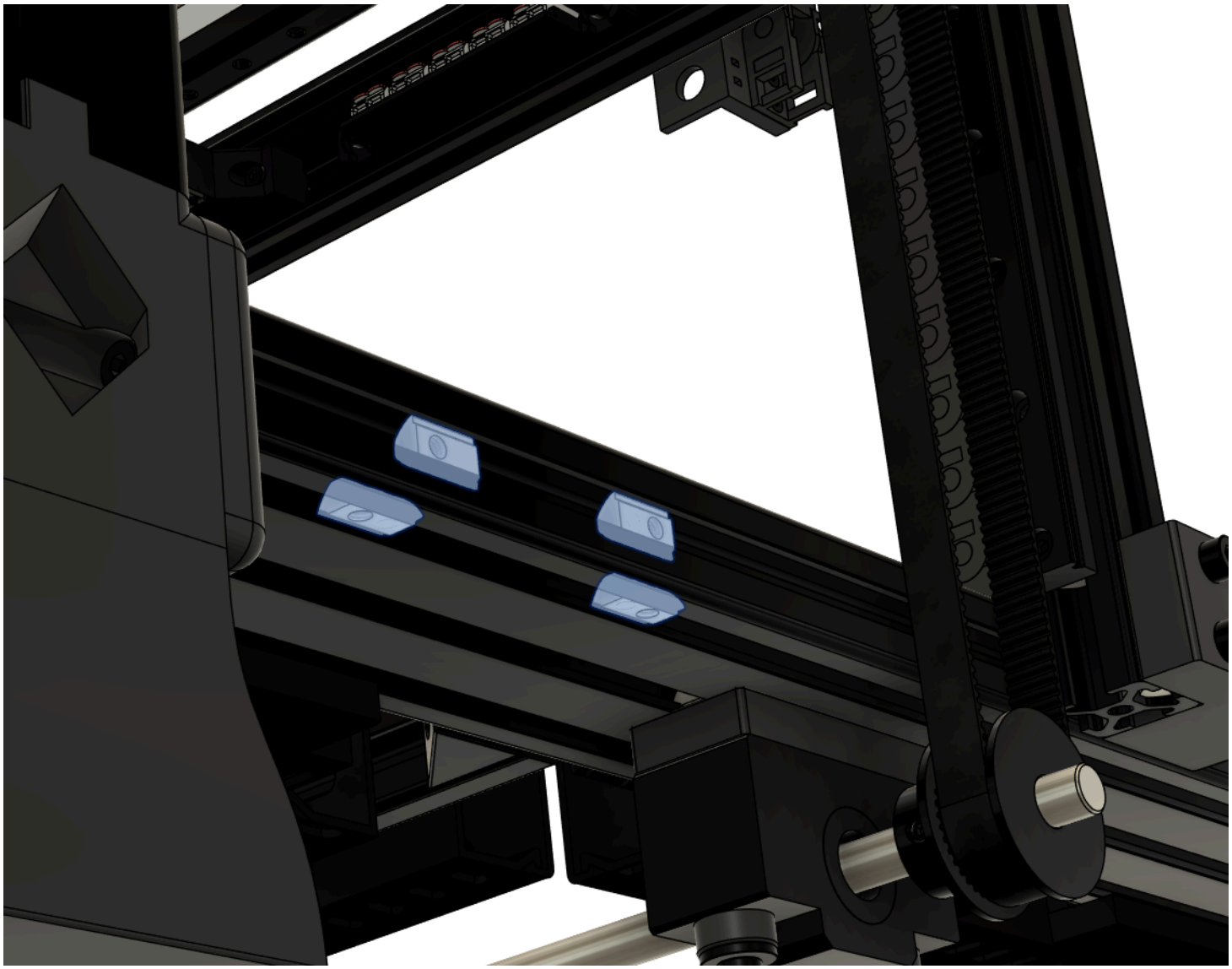




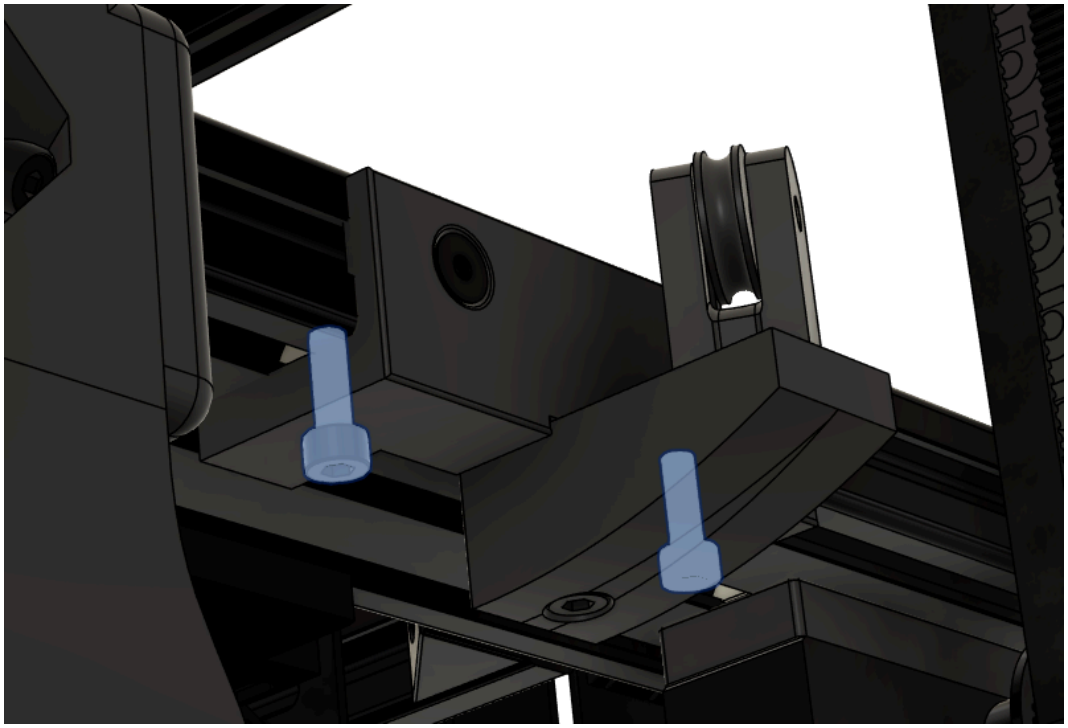
Insert (4) 20 series M4 T-nuts into the right side 2060 Extrusion:

(2) into the outside facing slot

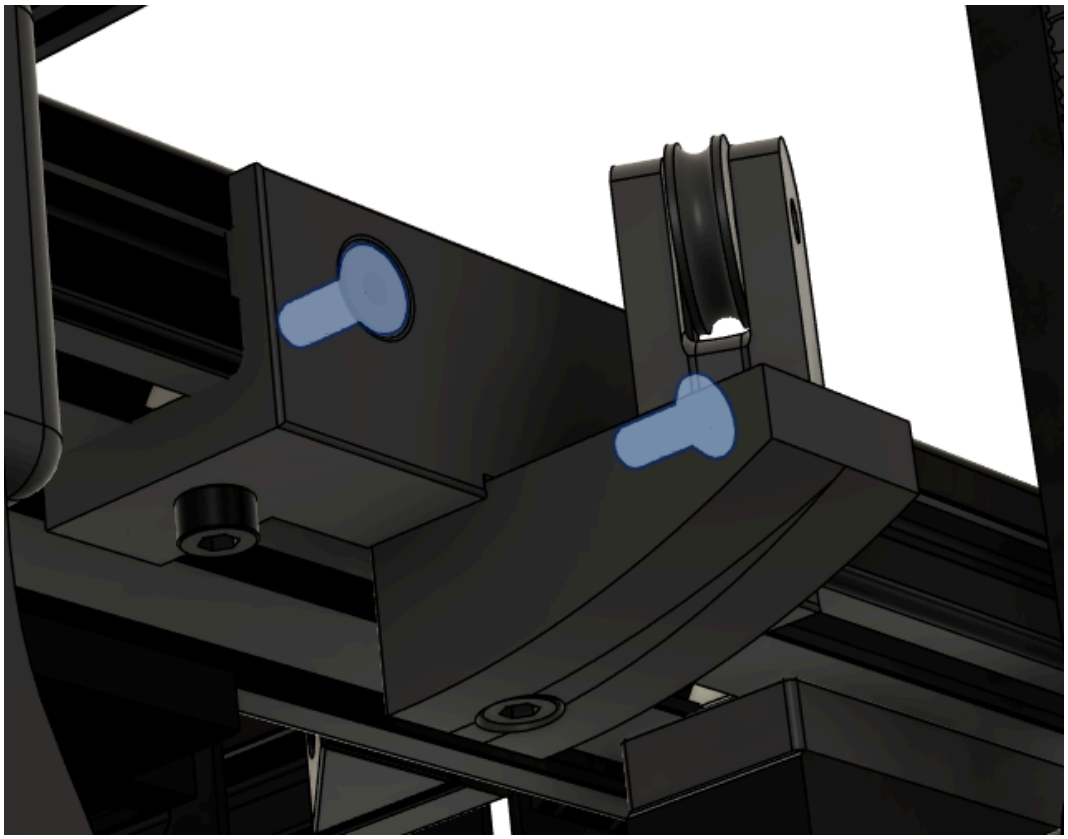
(2) into the outer most underside slot



Secure the lower right pulley sub assembly to the extrusion using (2) M4x12mm SHCS in the underside holes.



Finish securing with (2) M4x10mm FHHS through the outside facing slot.

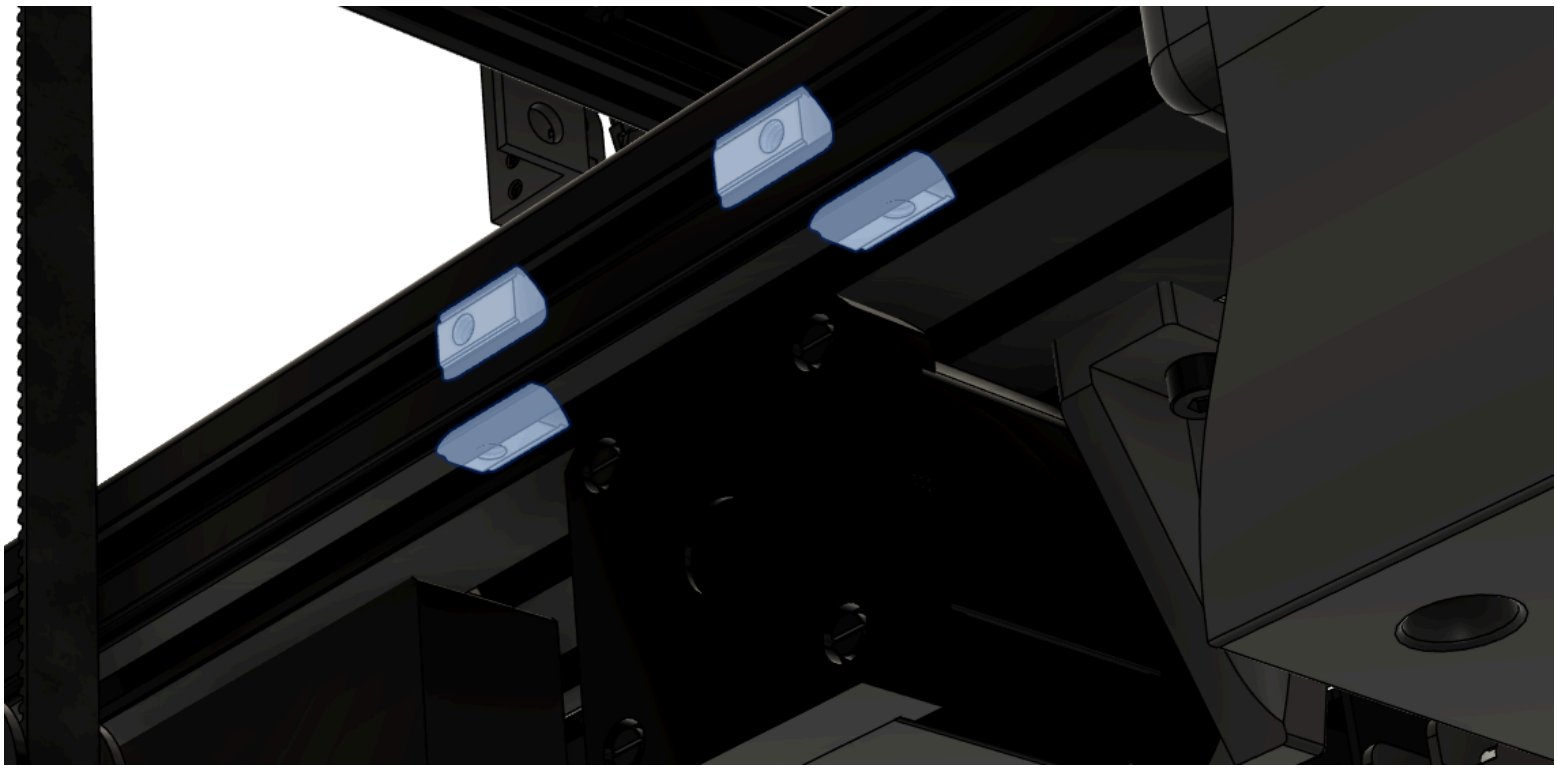


NOTE: The exact position of this assembly will be tuned later in this guide

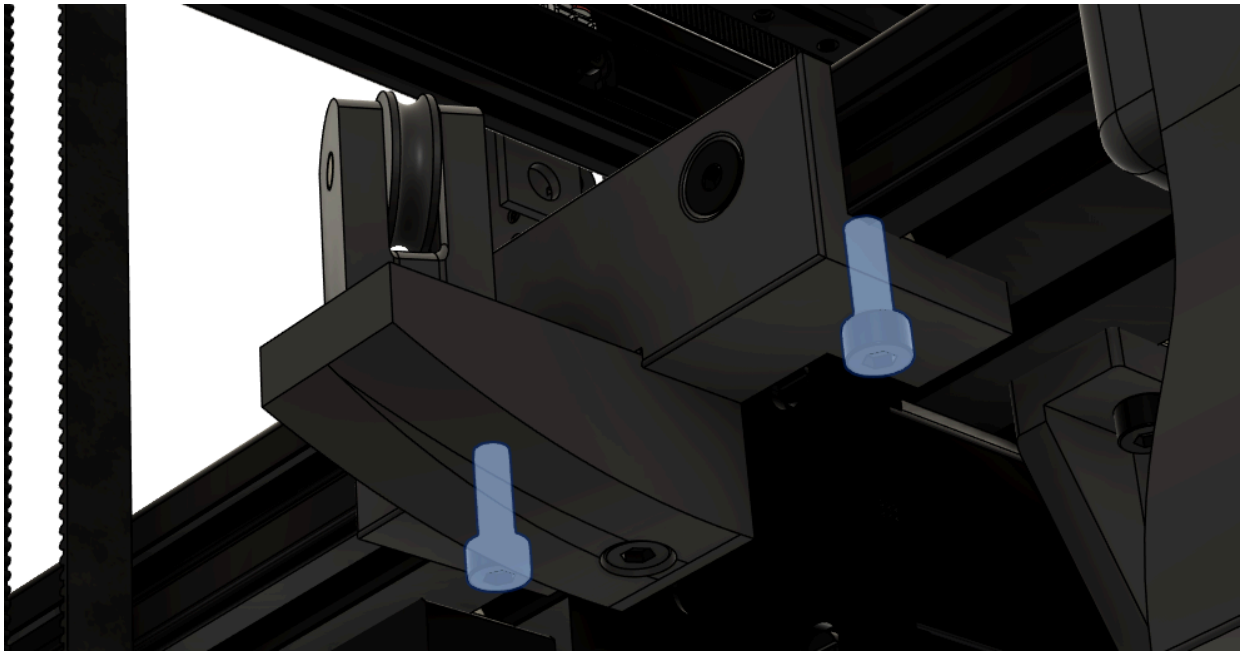
Insert (4) 20 series M4 T-nuts into the left side 2060 Extrusion:

(2) into the outside facing slot

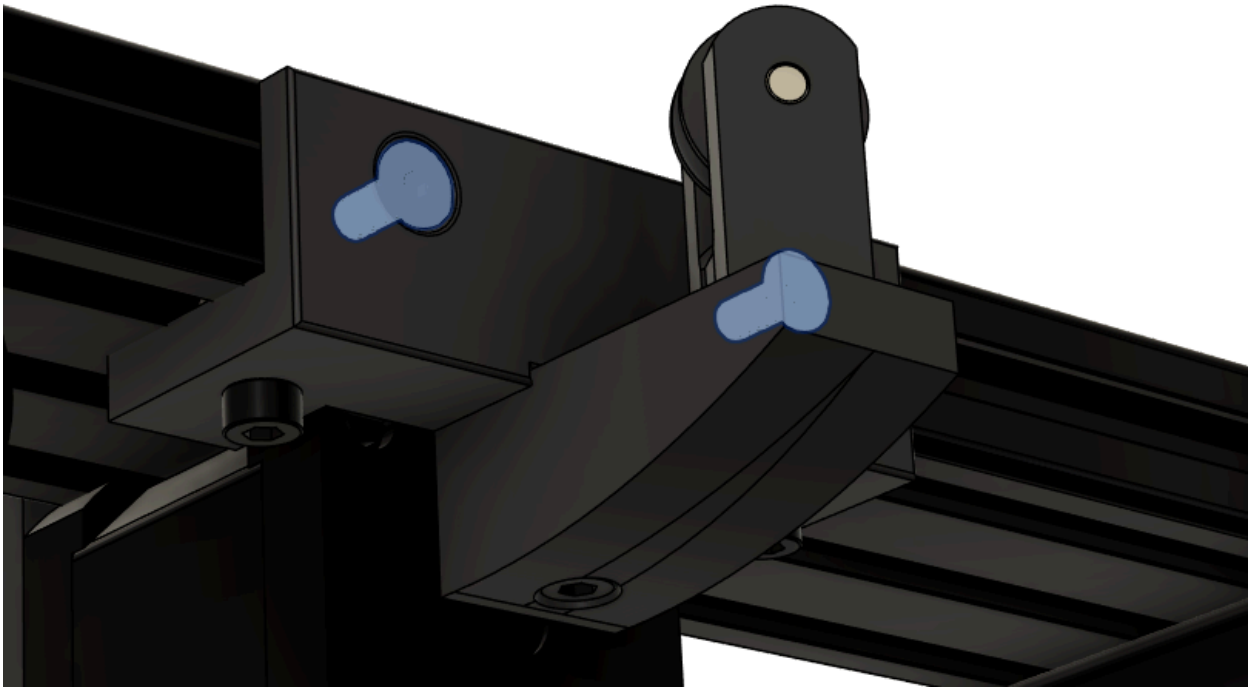
(2) into the outer most underside slot



Secure the lower left pulley sub assembly to the extrusion using (2) M4x12mm SHCS in the underside holes.

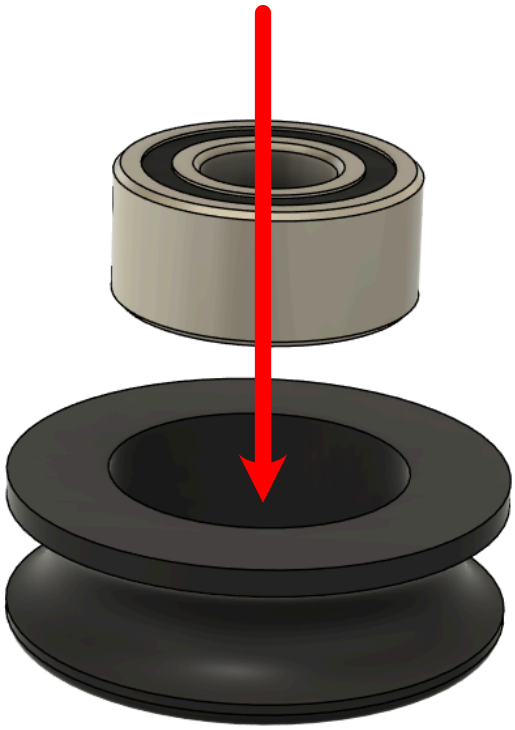


Finish securing with (2) M4x10mm FHHS through the outside facing slot.



NOTE: The exact position of this assembly will be tuned later in this guide

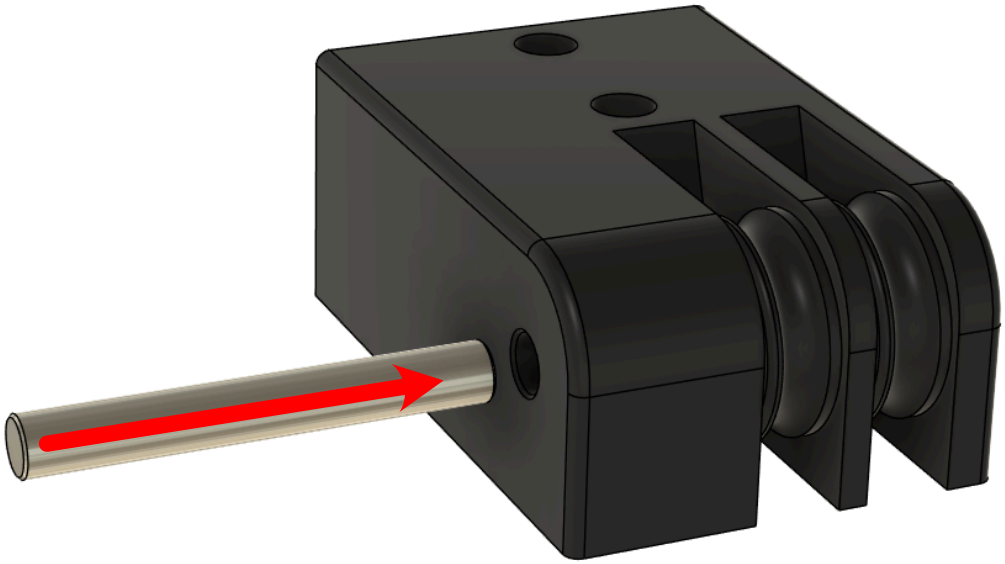
Locate (4) Print_Counter_Weight_Pulley_Upper and press in a 4x9x4mm ball bearing into each.

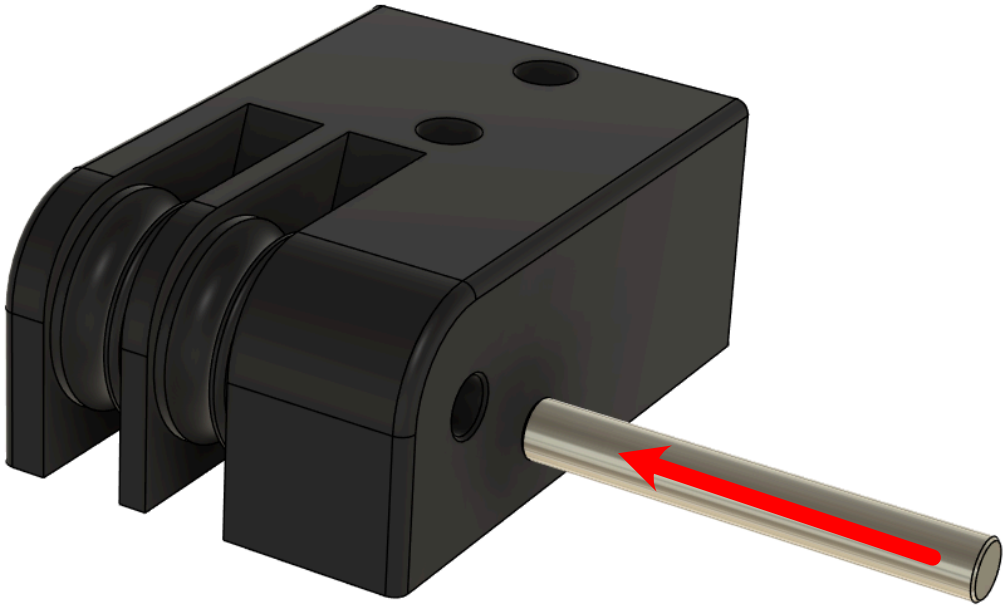


A fully seated bearing will be flush with the top surface of the printed part

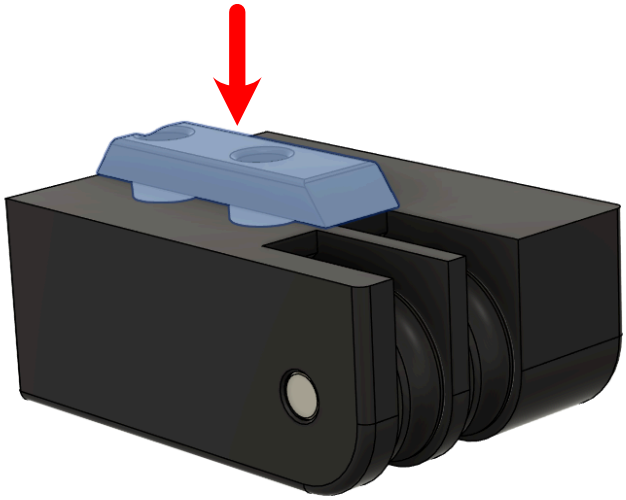
Locate (1) Print_Counter_Weight_Upper_Right_Part01 and (1) Print_Counter_Weight_Upper_Left_Part01.

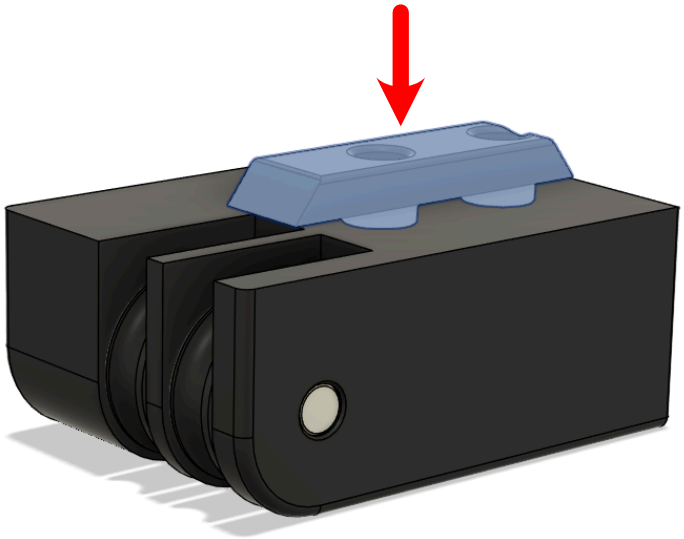
Locate and insert a 4x30mm shaft into and through each of the printed parts while capturing (2) of the pulley assemblies.





Locate (2) Print_Counter_Weight_Upper_Part02 and seat one into each of the upper pulley assemblies as shown.

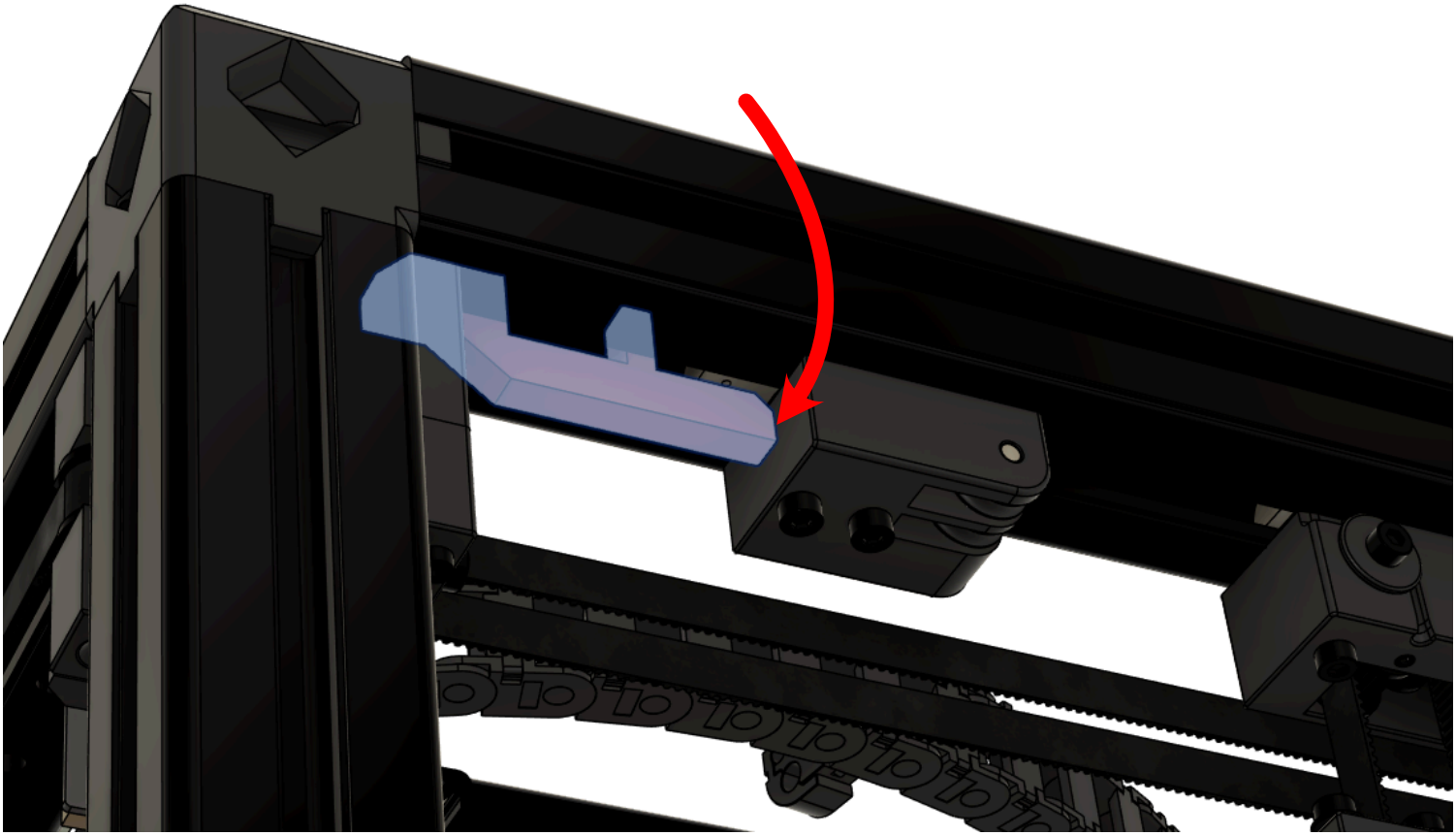




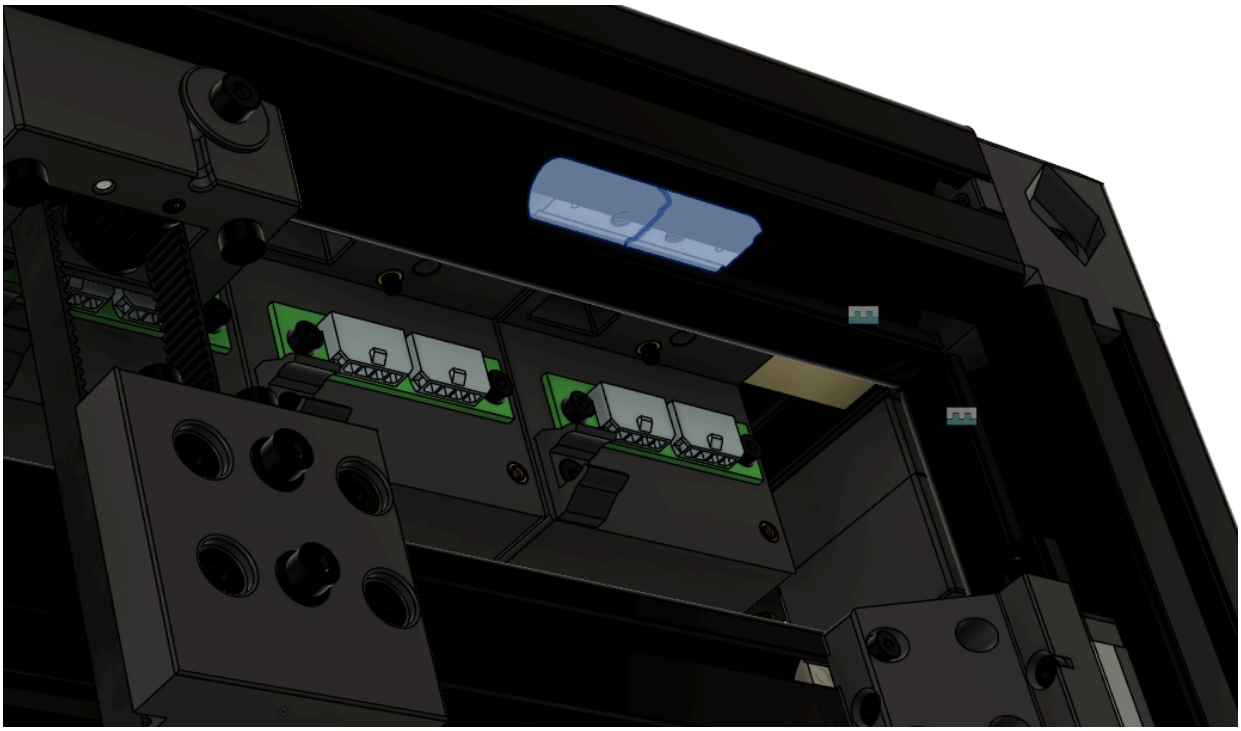
Locate and install (2) 40 series M4 T-nuts and insert both into the forward underside of the top right extrusion as shown.

Mount the right side upper counter weight pulley assembly and loosely secure using (2) M4x30mm SHCS.

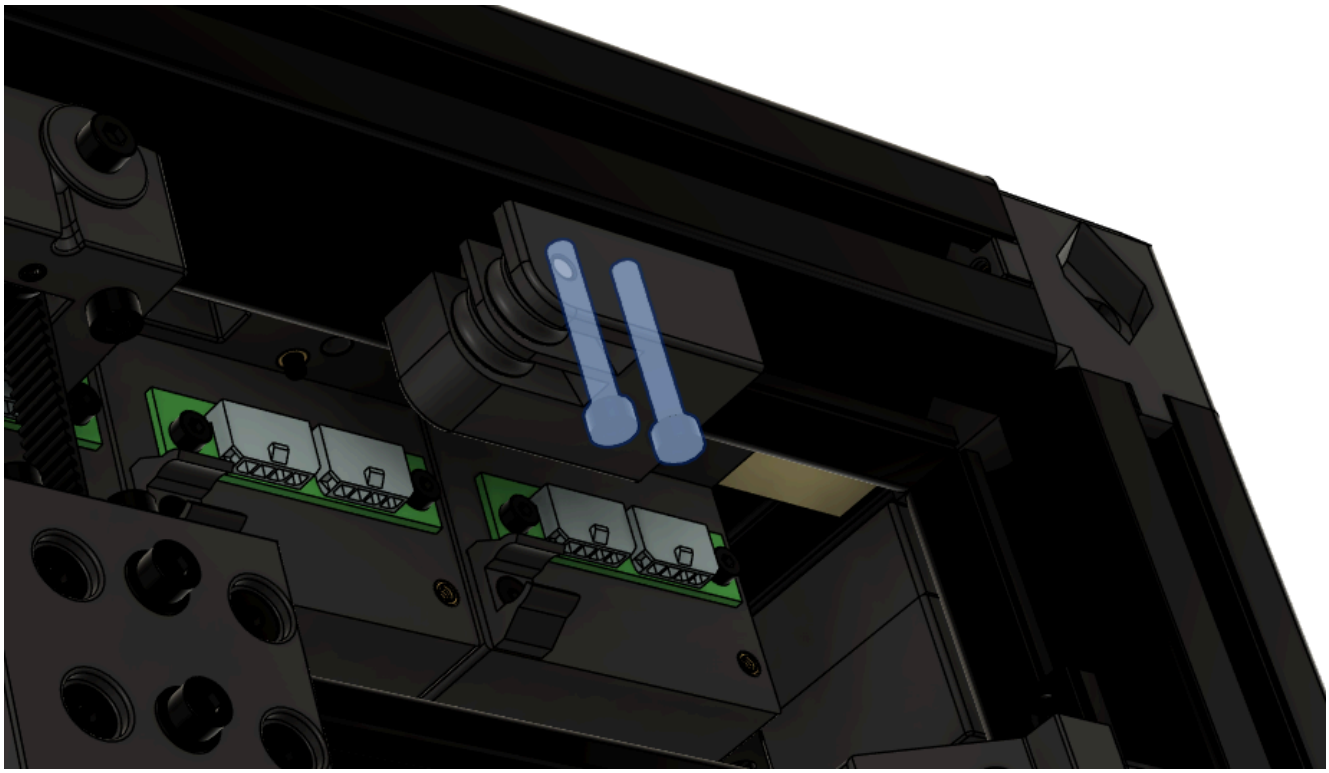
Locate Print_Counterweight_Alignment_Jig_Upper and fit into the machine as shown below. Slide the upper pulley assembly against the tool face and fully tighten the fasteners.



Locate and install (2) 40 series M4 T-nuts and insert both into the forward underside of the top left extrusion as shown.



Mount the left side upper counter weight pulley assembly and loosely secure using (2) M4x30mm SHCS.



Use the same alignment jig tool from the right side installation and repeat for this side!

Locate the following printed parts:

Print_Counterweight_Container_Left_Small_Part01

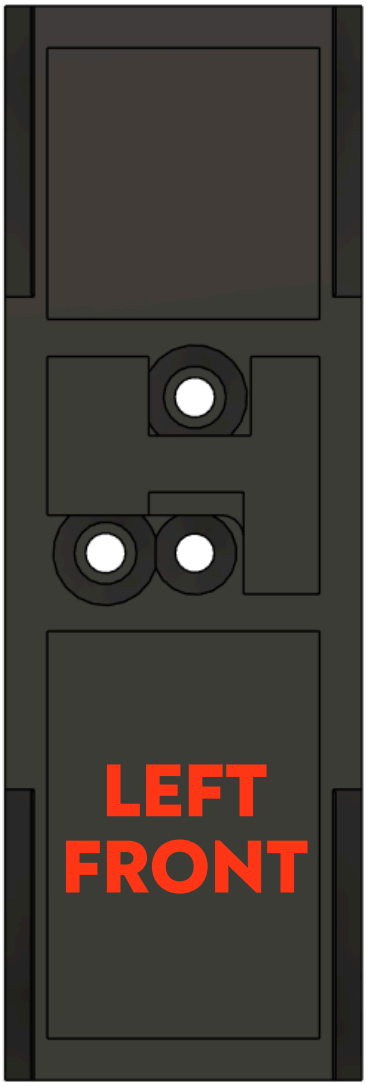
Print_Counterweight_Container_Left_Small_Part02

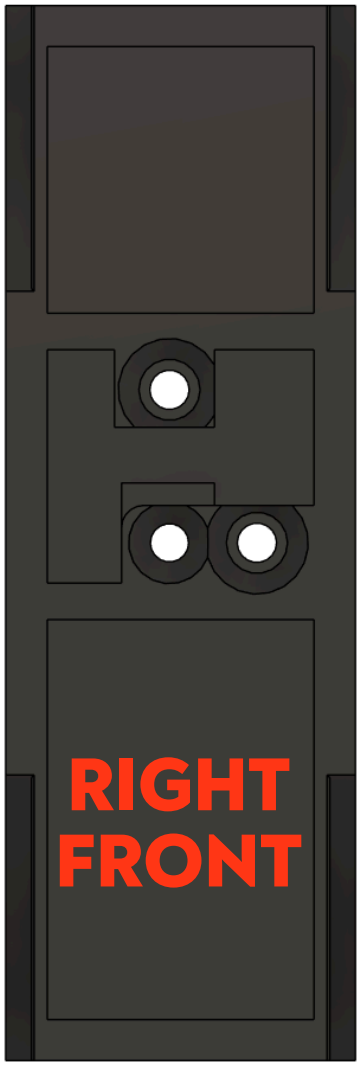
Print_Counterweight_Container_Right_Small_Part01

Print_Counterweight_Container_Right_Small_Part02

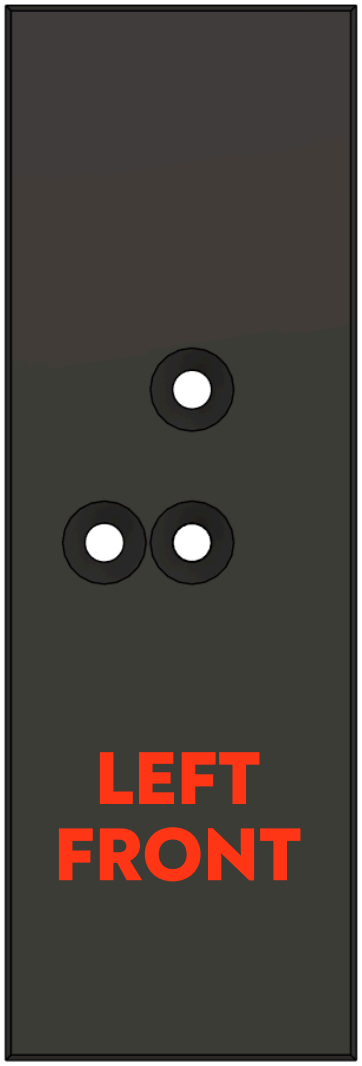
These parts can be easy to swap with each other during assembly. Take the opportunity now to familiarize yourself with the left vs right parts and label them temporarily appropriately.

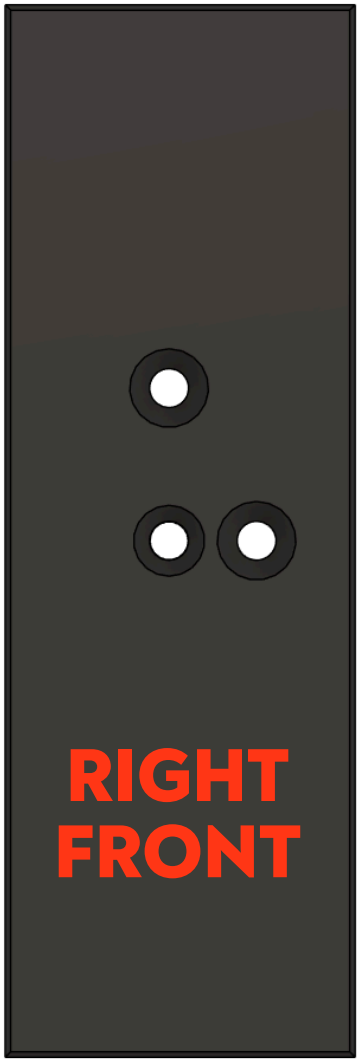
TOP VIEWS
PART 01



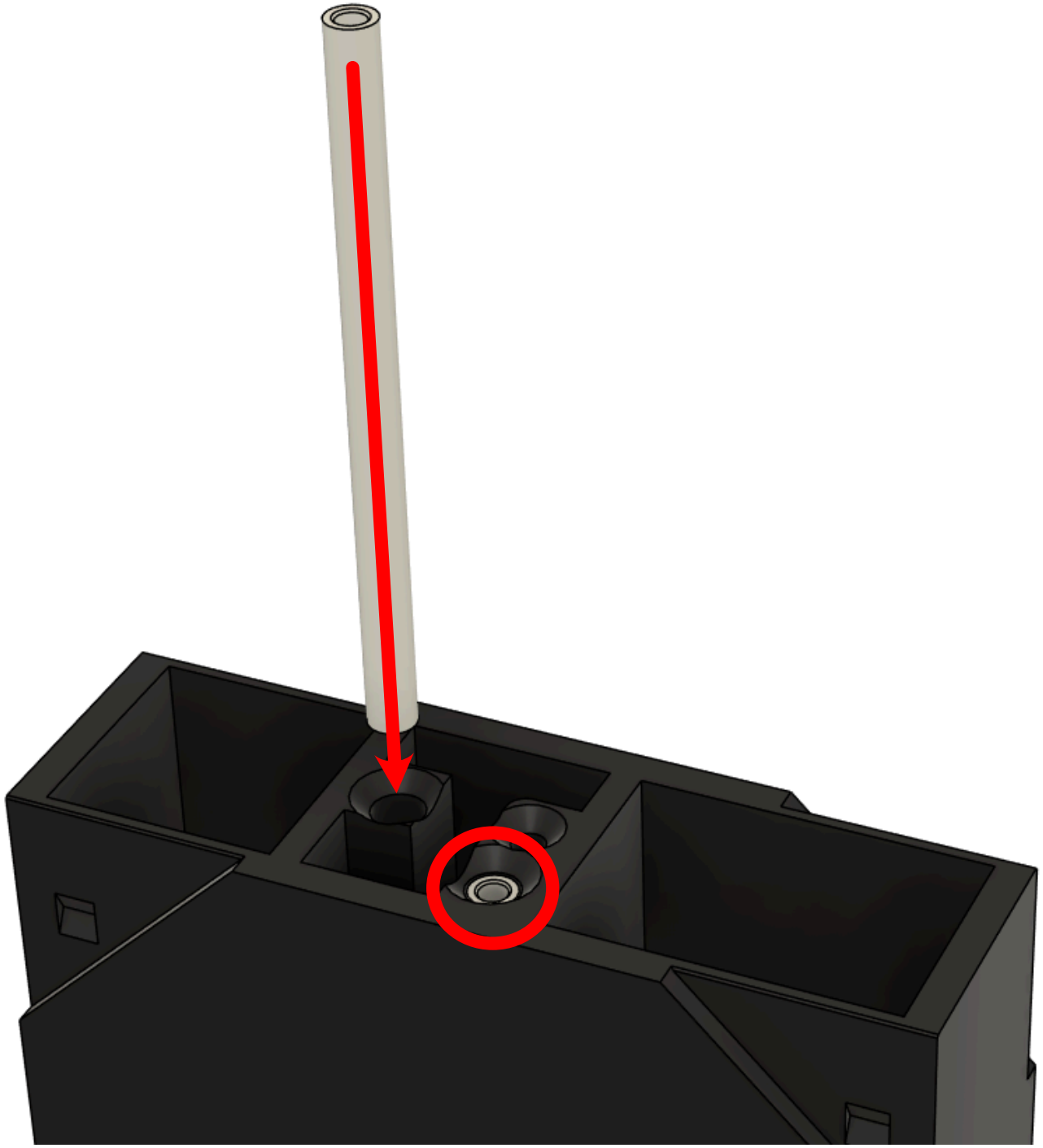


TOP VIEWS
PART 02

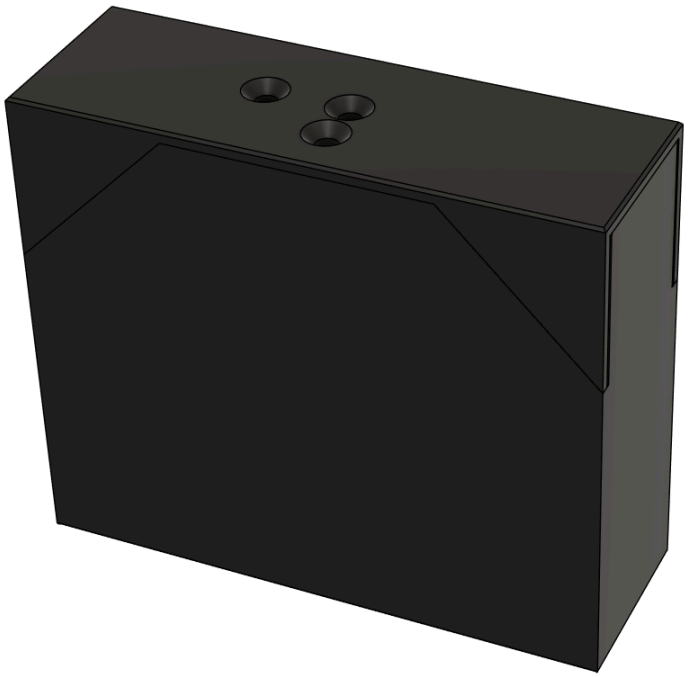




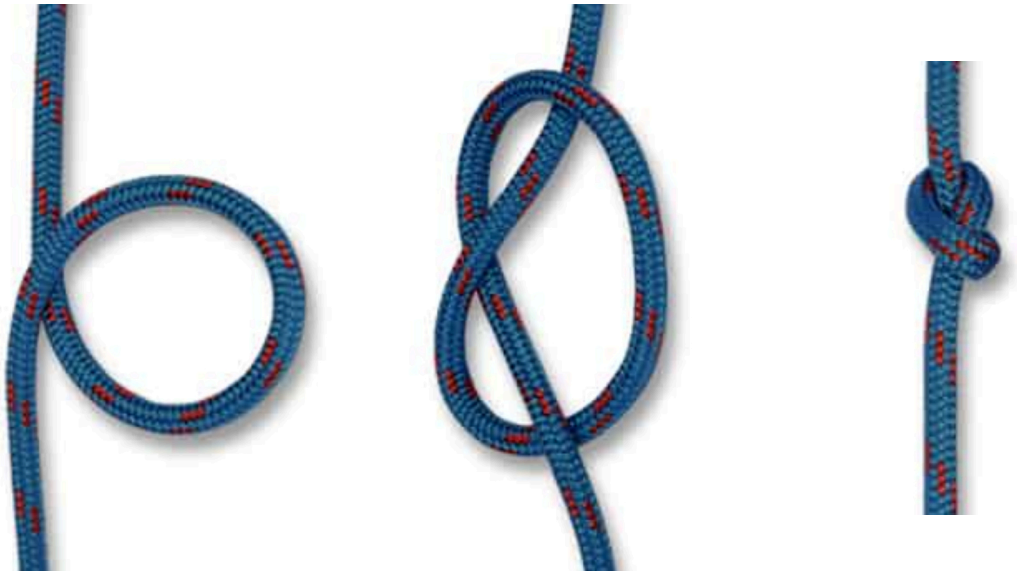
Locate (4) 74mm length 3x5mm PTFE tubes and insert into each of the shown locations (2) on BOTH counter weight containers.



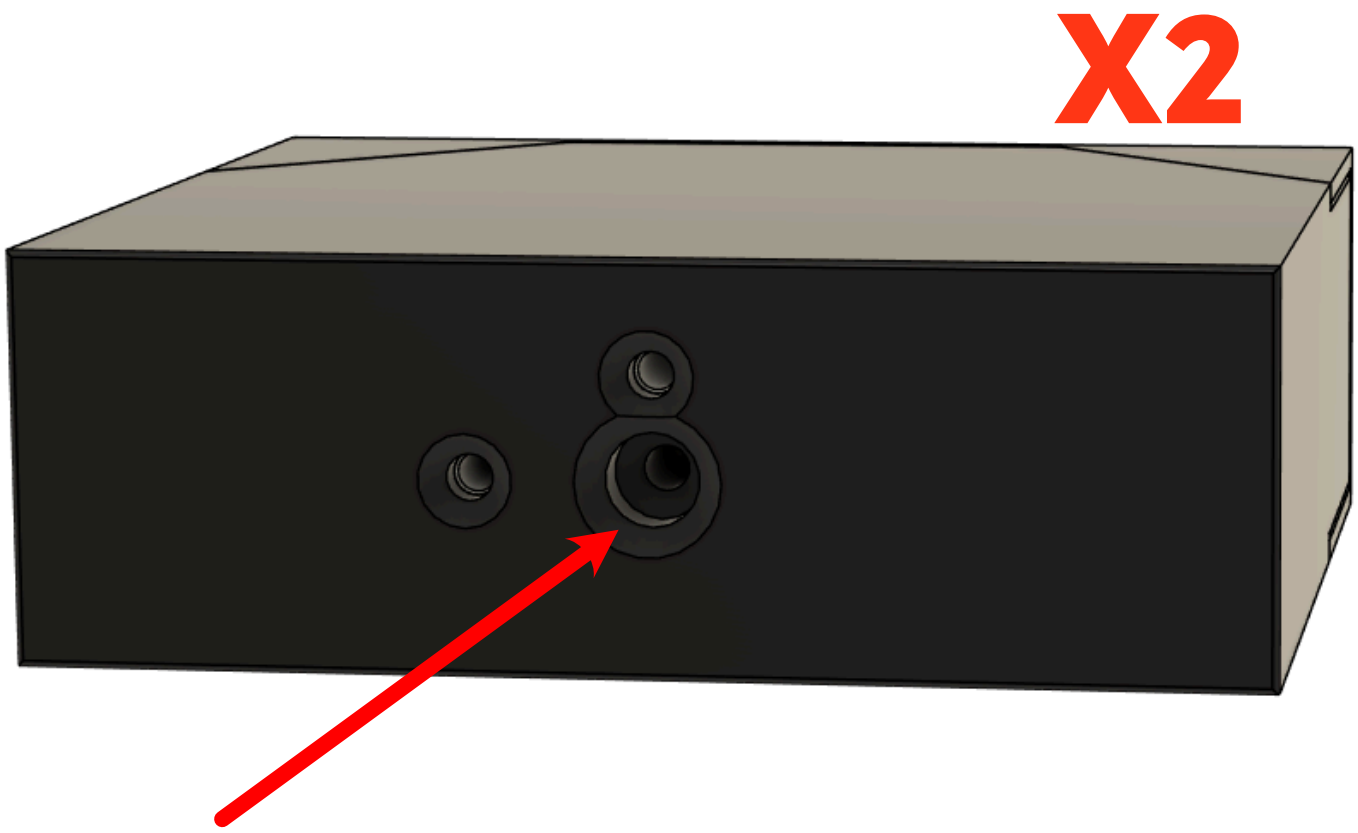
Install the appropriate caps onto each counterweight container.



Locate (2) 1.6M lengths of paracord and tie a standard knot into one end of each length.



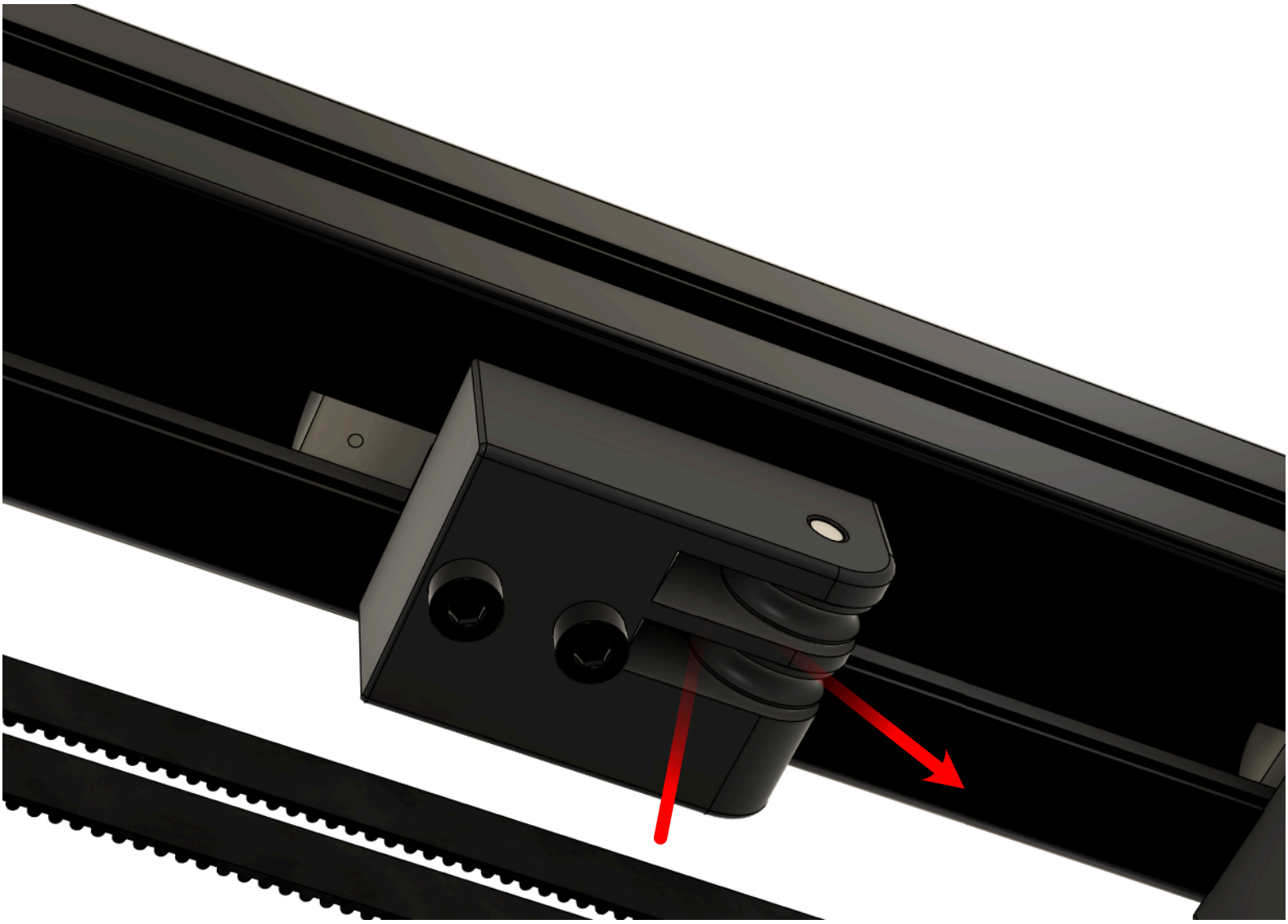
Insert the open end of each length of paracord into and through the larger hole at the bottom side of each container. When pulled through completely the previously made knots should sit INSIDE the pocket. Trim away any protruding paracord so that the bottom of the container remains a flat surface.



Note once more the orientation of the left and right counter weight container assemblies below. We will now cover the routing of the paracord.

Begin with the right side of the machine:

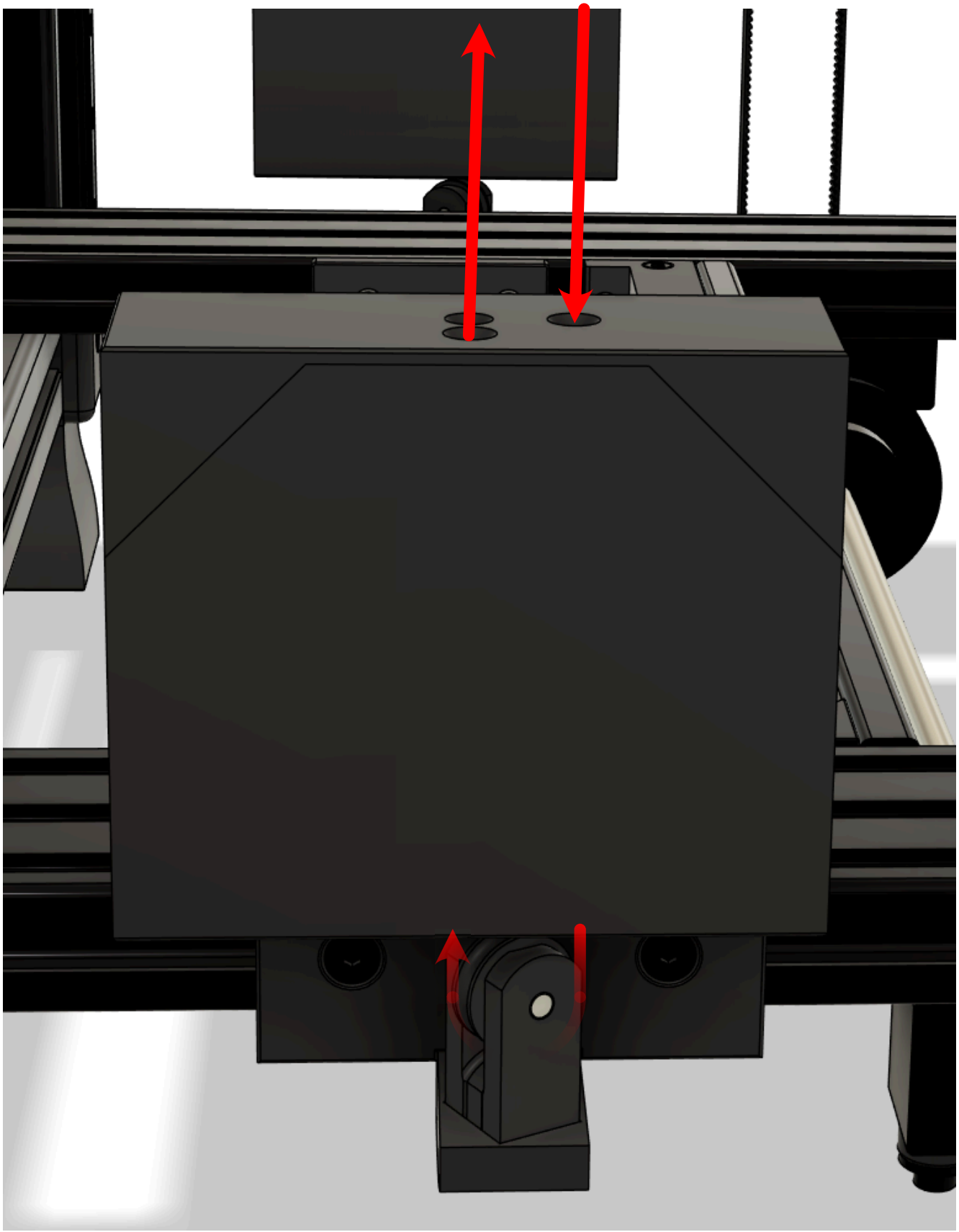
Route the cord up through the forward-inside pulley and out of the other side:



Route the cord downward and through the rearward inside hole of the counterweight container.

Follow by routing the cord into and around the lower counterweight pulley from the rear

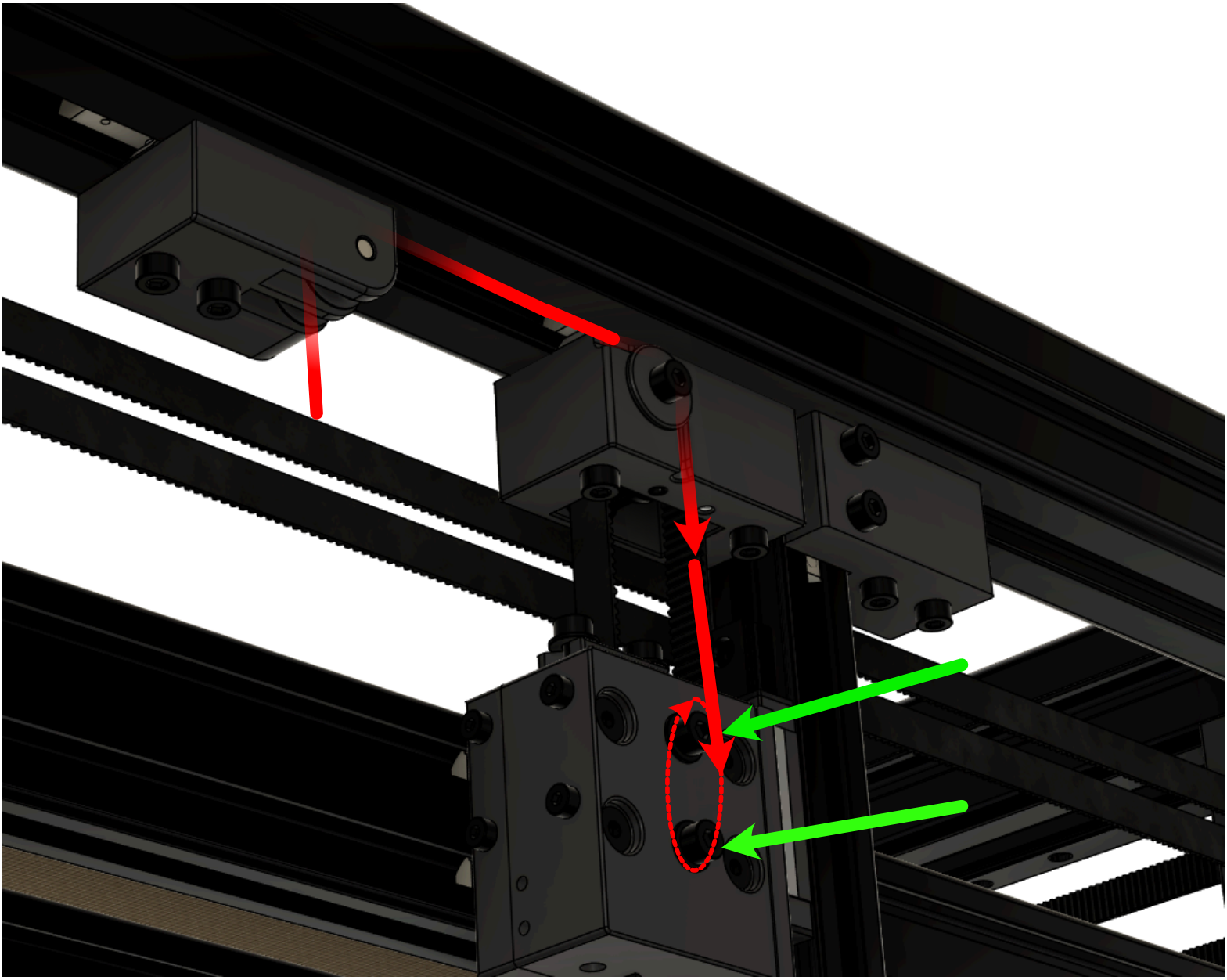
Finish by routing the cord back upward through the outer most hole in the container



Route the cord upward through the front outer pulley and out toward the rear of the machine

Continue by routing the cord rearward through into and through the Z belt idler assembly

Finish by loosening the M4 fasteners marked in GREEN and wrap the cord around each fastener as shown. These fasteners will secure the cord in it's final position.



Final Adjustment:

1. Be sure the bed is resting at it's lowest point.

2. Pull the free end of the cord until the container is around 2mm from the face of the SHCS securing the upper idler pulleys.

3. Secure the cord in this position by tightening the M4 SHCS on the heated bed frame.

4. Adjust the lower pulley mount position along the 2060 extrusion to achieve a vertical counterweight cord angle and fully tighten all (4) fasteners on the lower pulley assembly.

Now repeat these steps for the left side of the machine! Everything is mirrored.

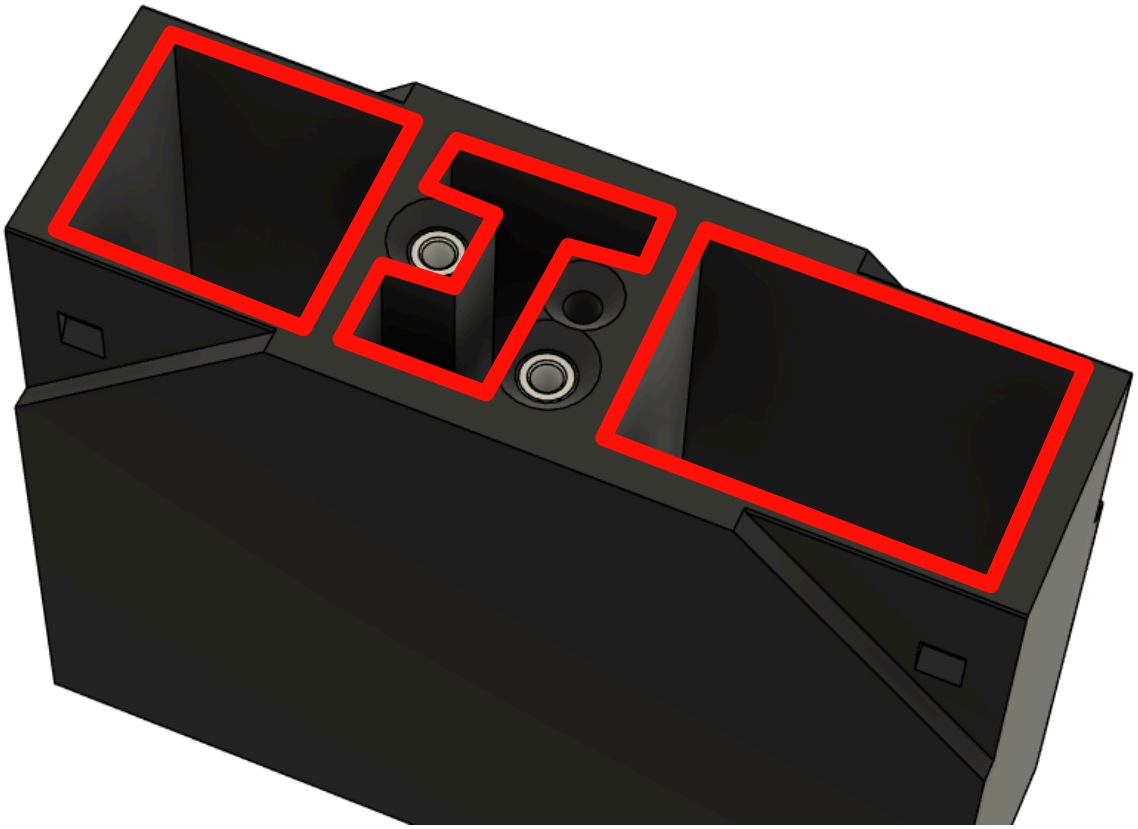
Once mechanically mounted, the bed can be raised manually by hand and held up with something sturdy (a couple rolls of filament, perhaps.)

NOTE: Always manually lift the bed slowly with even upward pressure applied to BOTH sides of the bed frame. Excessive load on only one side can cause your Z tram to deviate and require an adjustment.

This will allow easier access with a paper funnel or similar tool to begin filling the chambers with counterweight media. All 3 chambers of both containers should be filled with media. This ensures the center of gravity remains in the correct position allowing the container to move up and down without tilting!

Tapping the sides of the container can help the media to settle allowing maximum media quantity.

The lid can now be re-secured to protect from spilling.



Note: The cord is expected to stretch when new by around 2-3mm of effective container drop over the first few days. Due to the difficulty in accessing the adjustment point for this step it is recommended you wait until the following day to install the enclosure panel on the left side of the machine!