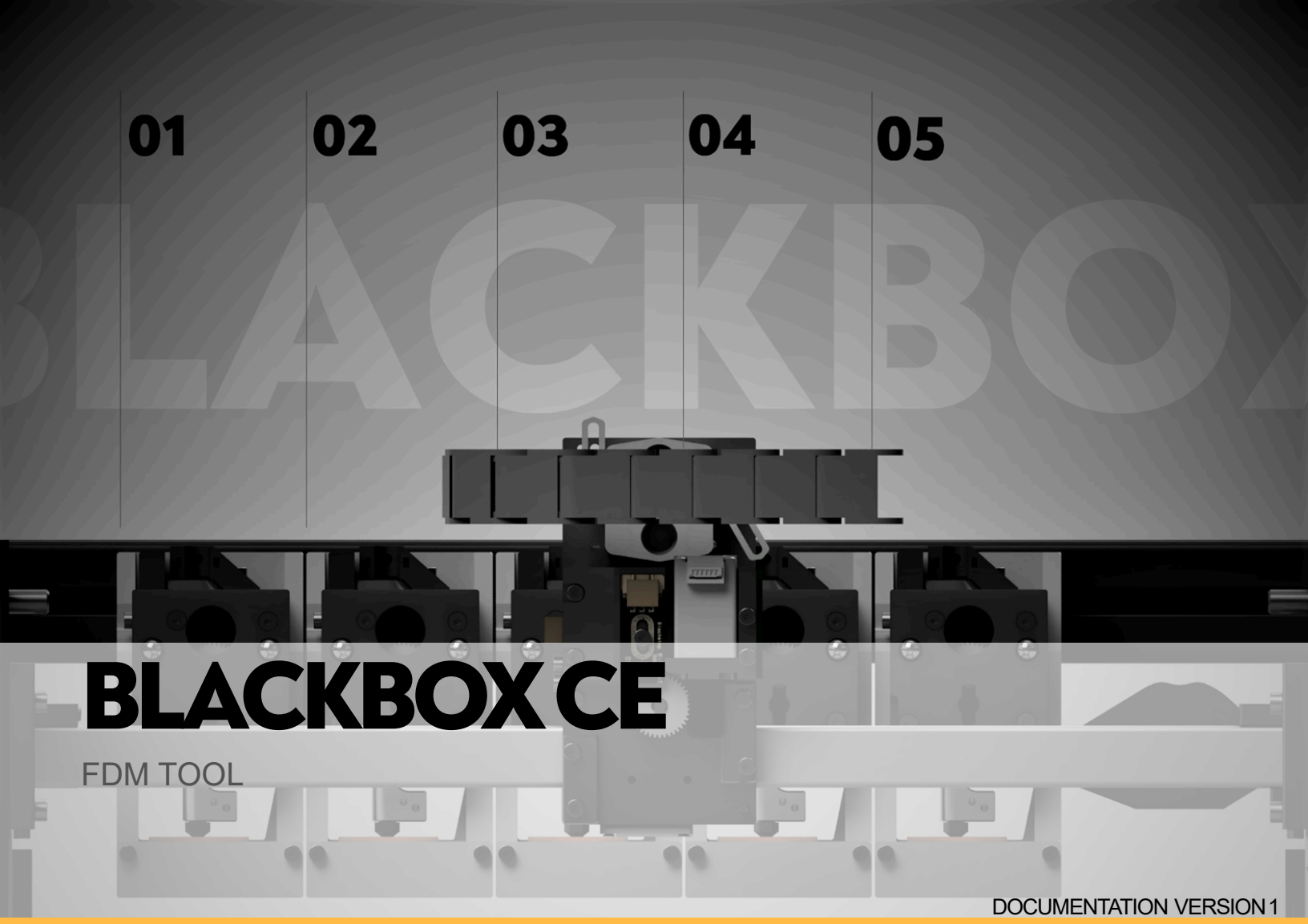


Blackbox CE Mechanical Assembly:

07. FDM Tool

Change Log

Version	Notes
1	Initial Release

Tools

Description
Heat Sinking Paste
Electric Drill
Hand Tap Wrench
Hex Wrenches
Open-End Wrench or small Pliers (For nozzle - V6 Style only)
Lightweight Oil (For geartrain)
Reamers
Threadlocker
Soldering Iron with Heatset insert tip

Parts

QTY	Description
2	Steel_Bearing_Ball_8mm_G10
1	Bondtech Shaft Assembly
1	IGUS Driven gear
2	Bearing_5x8x2.5mm_Bondtech
1	Bondtech Drive Gear Kit
1	Bondtech Thumbscrew Assembly
1	Linear_Shaft_2x6mm
1	Linear_Shaft_3x20mm
1	Linear_Shaft_3x22mm
3	Neodymium_Cylinder_Magnet_5x4mm
1	HeatInsert_Bowden
1	HeatInsert_Bowden
1	ColletClip_175
1	Molded_Wedge_Plate
1	CNC_ToolCooler_Kelvin_SmoothBore
1	Hotend_Heatbreak_E3D_Chimera
1	Hotend_Heatblock_E3DV6
1	Hotend_Nozzle
3	DIN7991_M3_6mm_FHHS
1	DIN7991_M3_8mm_FHHS
1	DIN7991_M3_10mm_FHHS
4	DIN7991_M3_16mm_FHHS
1	ISO7380_M3_10mm_BHHS
2	ISO7380_M3_18mm_BHHS
1	DIN912_M3_16mm_SHCS
10	M3_4.6x4mm_Heat_Set_Insert
3	DIN916_M3_4mm_Set_Screw
1	DIN916_M3_6mm_Set_Screw

Printed Parts

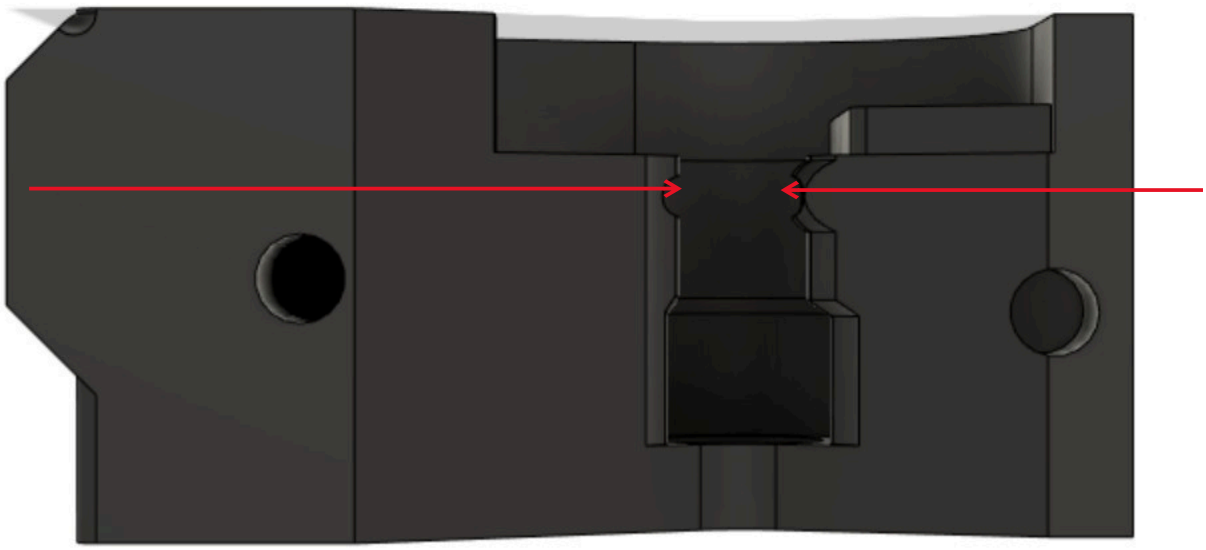
QTY	Description	Material	Ver	Link
1	Print_Jig_51T_Gear_Setter	PLA	1	
1	Print_Jig_SpringWire_Tool_Part_A	PLA	1	
1	Print_Jig_SpringWire_Tool_Part_B	PLA	1	
1	Print_ToolHead_part02	>=ABS	1	
1	Print_ToolHead_part03	>=ABS	1	
1	Print_Toolhead_Part06	>=ABS	1	
1	Print_ToolHinge	>=ABS	1	
1	Print_Toolhead_Part05	>=ABS	1	
1	Print_ToolHead_part04	>=ABS	1	

Step 1 – Preparation

Assembling your FDM tools with precision and care will lead to long-term reliable tool changes and operation. When compared to the rest of the machine inaccuracies in either geometry or assembly can result in significant effects to printed part quality and extrusion consistency. BE SURE TO PRINT AND PASS THE BLACKBOX READINESS TEST PRINT IF YOU HAVE NOT ALREADY. If at any point you lose confidence in assembly now is the time to rectify things!

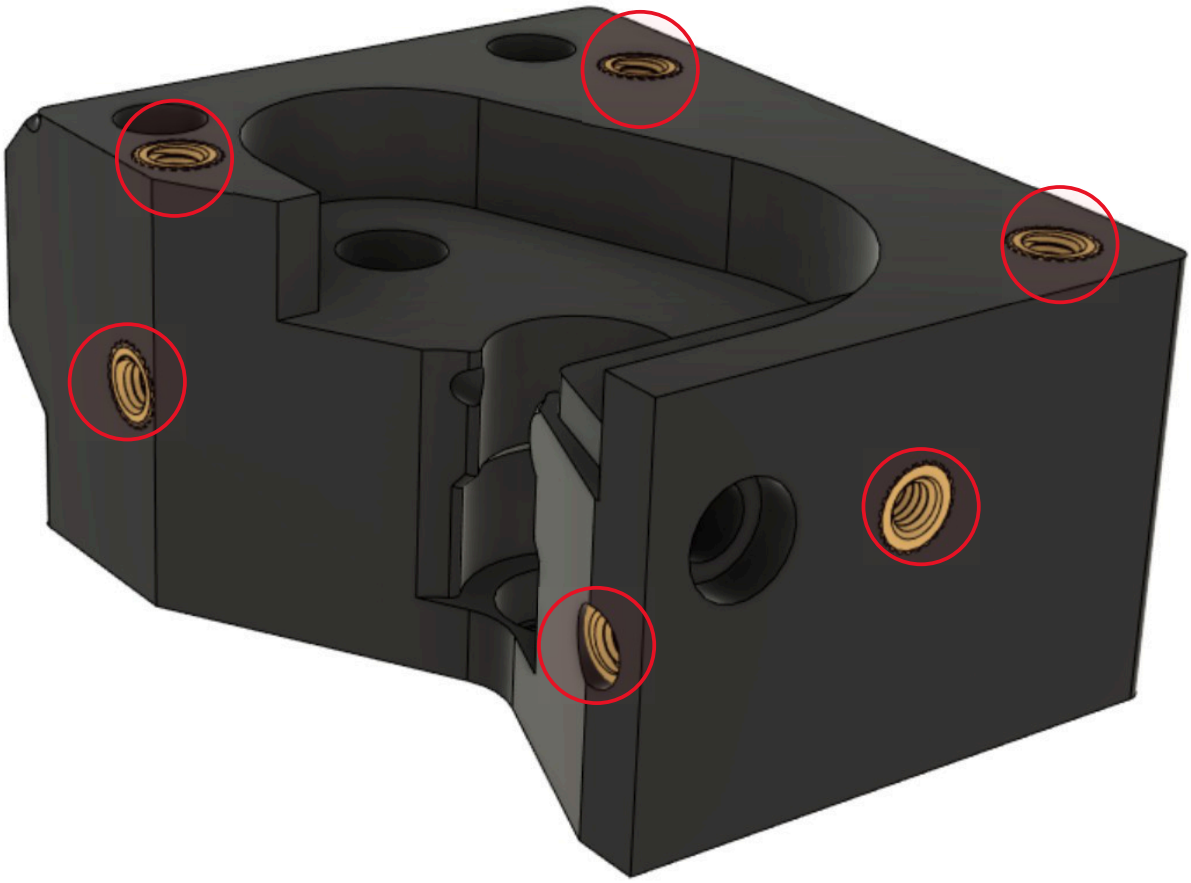
Step 2 – Main Body Preparation

Locate printed part 03. When printed in the correct orientation the filament path is a vertically printed hole. Run a 2mm reamer through the filament path shown below.



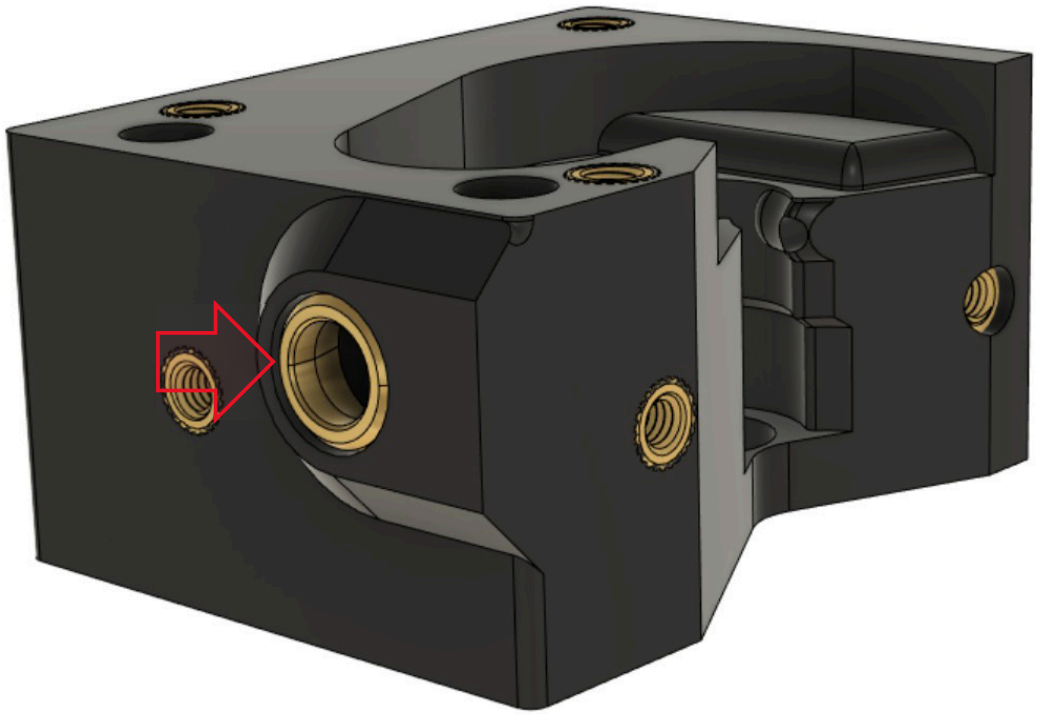
Install M3 heat set inserts (8) in the following locations:

Firstly, six here:

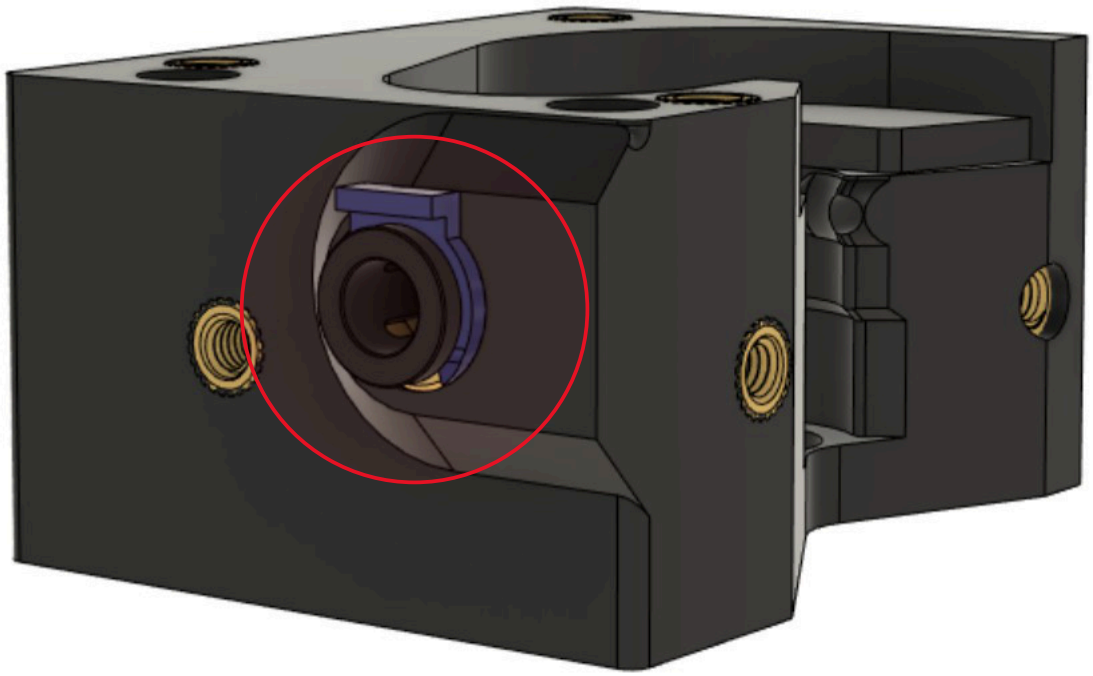


Flip and rotate and install the remaining heat set inserts here:

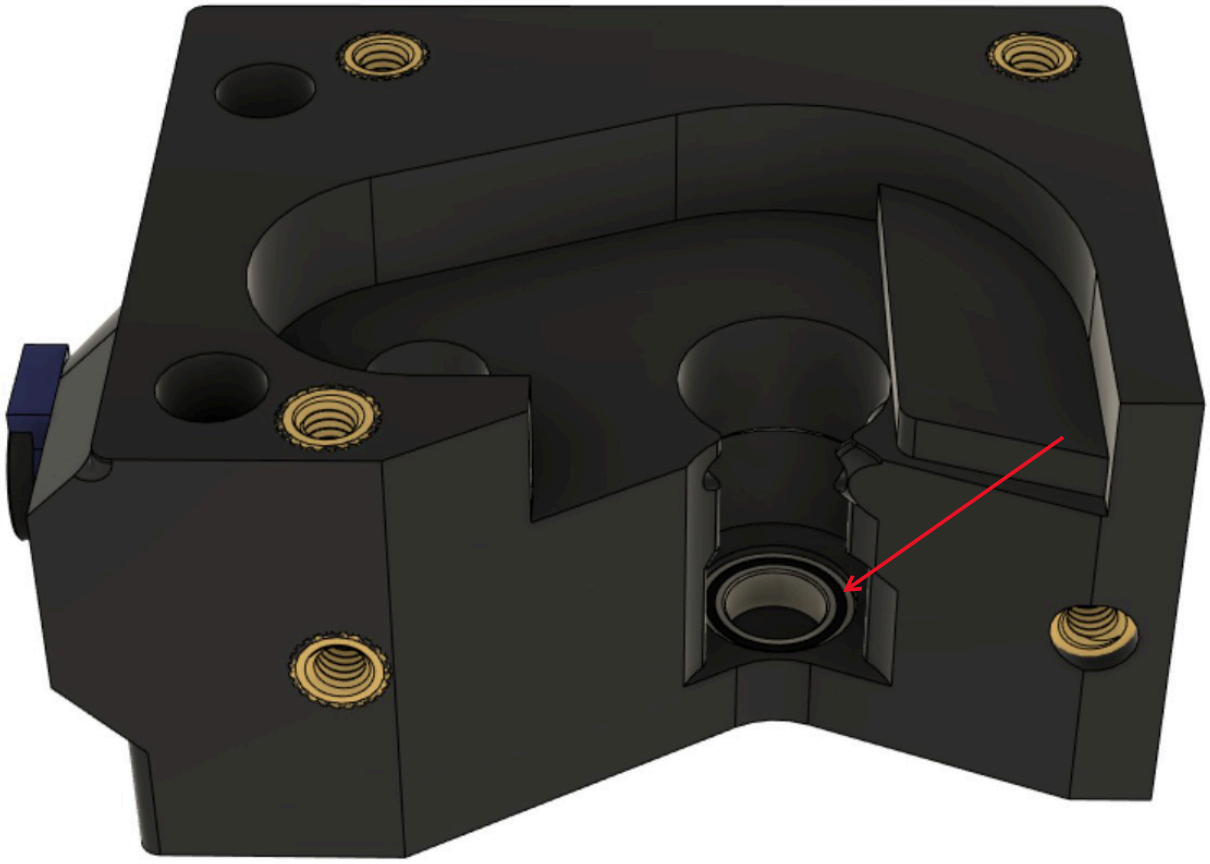
Install the embedded Bowden coupling. Be sure to take note of its direction in the image below. The “bottom” or inward facing portion of the insert has a chamfer feature. Reaming the bore in which it sits will aid in easy installation. If seating is difficult with the tools at your disposal, it can also be treated as a standard heat set insert and installed that way. When fully seated the insert will be flush with the printed part.



Install the Bowden collet and clip as shown.



Locate and Install (1) MR85ZZ bearing into the bottom pocket as shown. Be sure the bearing is fully seated. Note that the plastic behind the bearing is on the thinner side. For this reason, it is advised that the bearing be pushed into the printed part via its outer race with a suitable tool and the assembly resting against your work surface. Never push or pull a ball bearing from the inner race, as this can damage it.

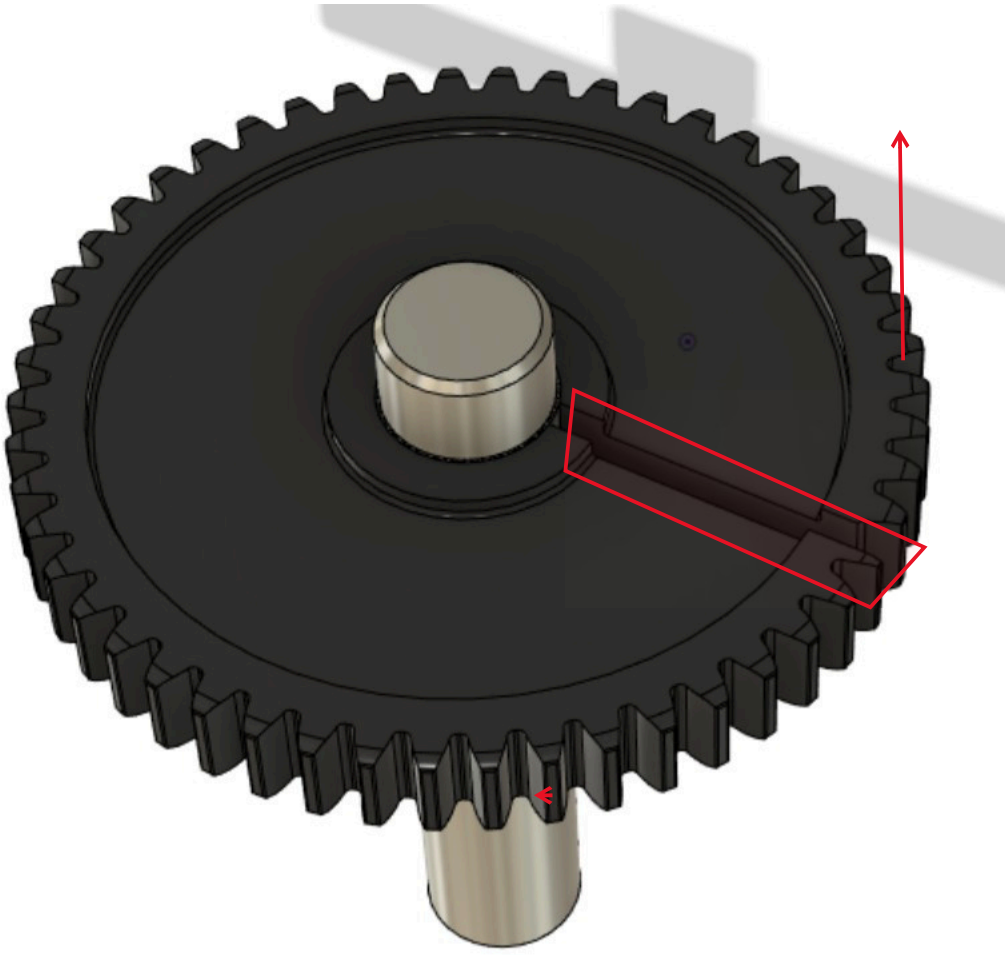


This step requires mechanically removing and replacing the standard 51 tooth gear from the main 5mm Bondtech drive shaft assembly. This is required to mesh reliably with our carriage mounted extruder motor/gear. Please exercise good safety practices as needed for your chosen method of removal.

Removal Options:

1. Press – If you have access to a press with pass-through functionality you can simply support the gear at the shown locations and press the shaft downward (with a suitable driver) and out of the gear itself.

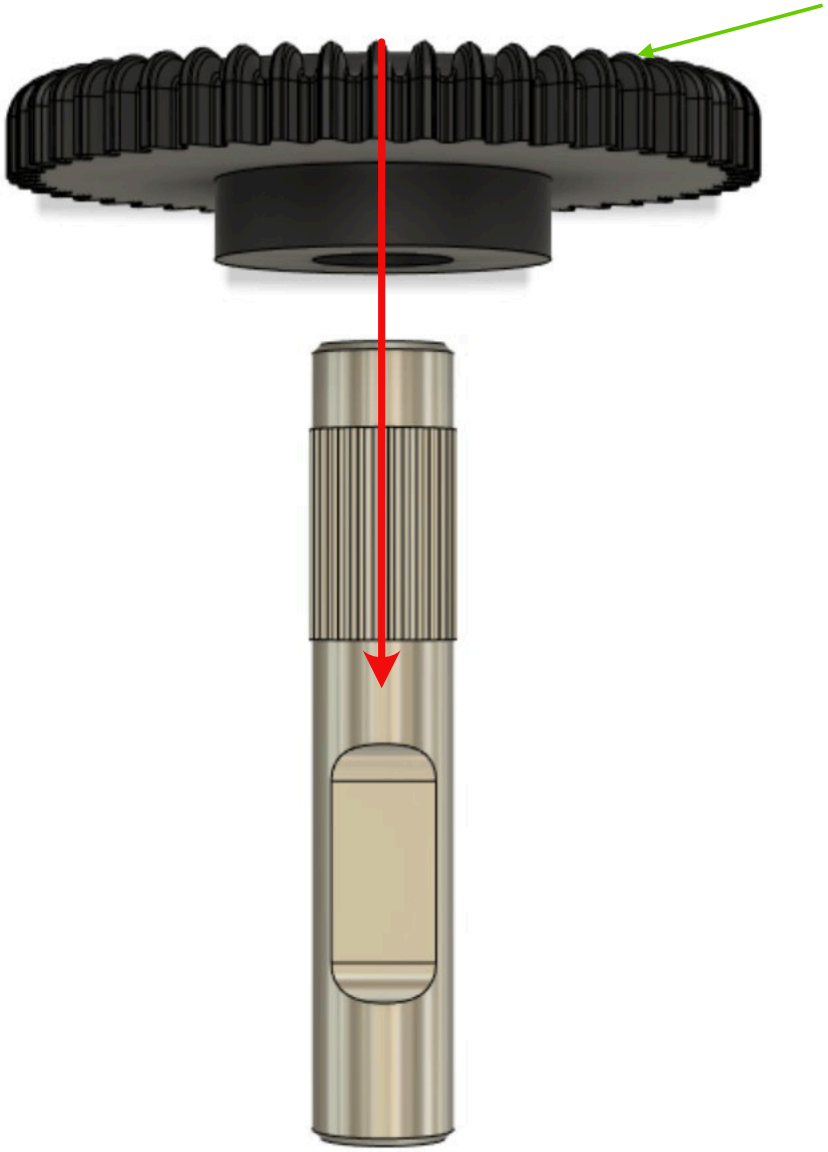
2. Cutting – The plastic gear can also be sliced down to the shaft and then spread apart for removal. A Dremel with a cutting wheel or even a small hacksaw makes quick work of the plastic. Use a pair of pliers to twist the gear and deform away from the shaft.



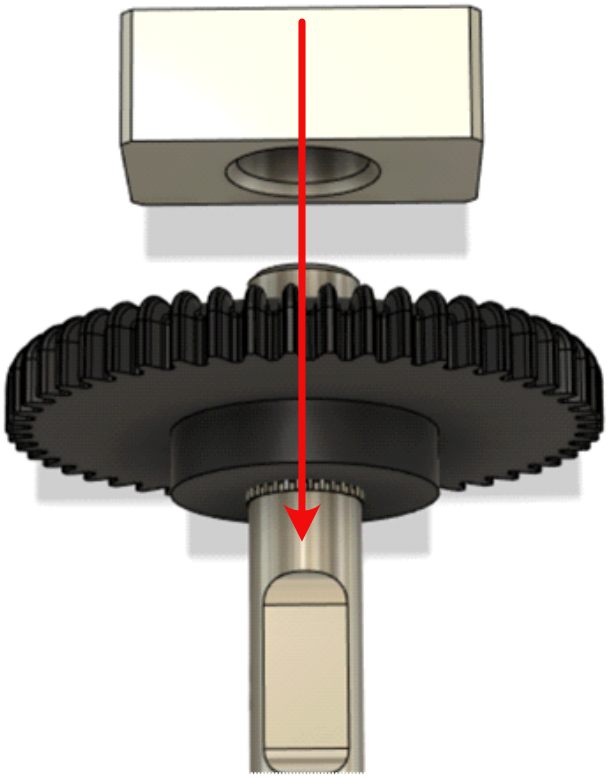
We will now be installing the new SLS printed 51 tooth gear onto the shaft. Note that SLS printed parts have a larger demanded tolerance allowance than FDM printed parts. For this reason, some driven gears may require reaming, whereas others may not. ALWAYS attempt installation before removing any material, as once reamed or modified we can't add it back!

Begin by starting the engagement of the driven gear onto the shaft in the following orientations.

NOTE: The crown of the driven gear has teeth that protrude past the surface of the face of the gear. Never drive the shaft into the gear with force whilst the driven gear is face-down on a work surface as this can damage the teeth. If the gear cannot be started by hand a chamfer can be added to aid in this. Alternatively, you can move onto the next step using the printed tool as the pressing surface.



Locate the printed gear pressing tool and note the orientation of parts below. We will cover a few different methods of assembly.

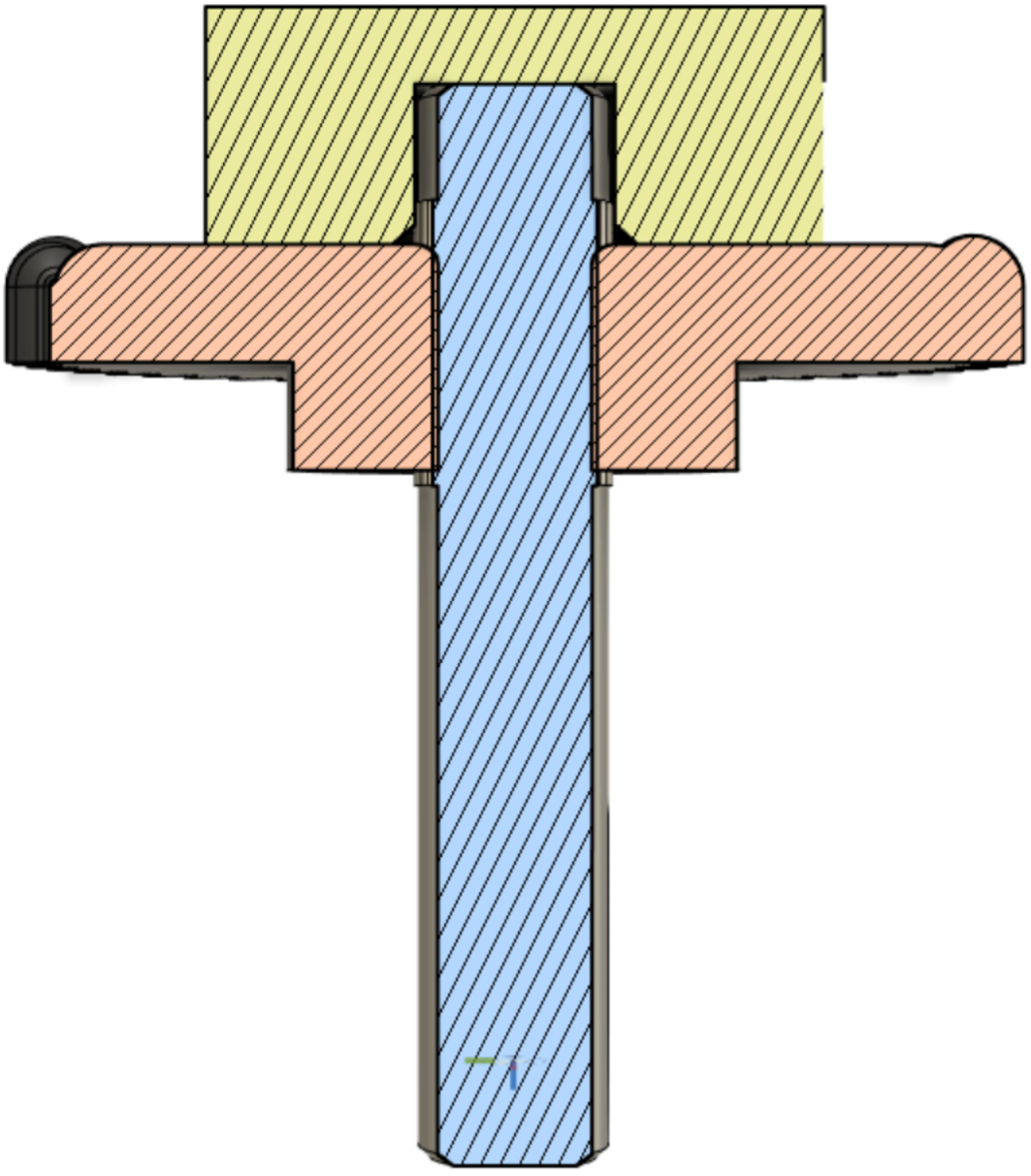


1. Press – If you have access to a press, this will be the simplest way forward. Simply drive the printed tool downward into the shaft until it stops.

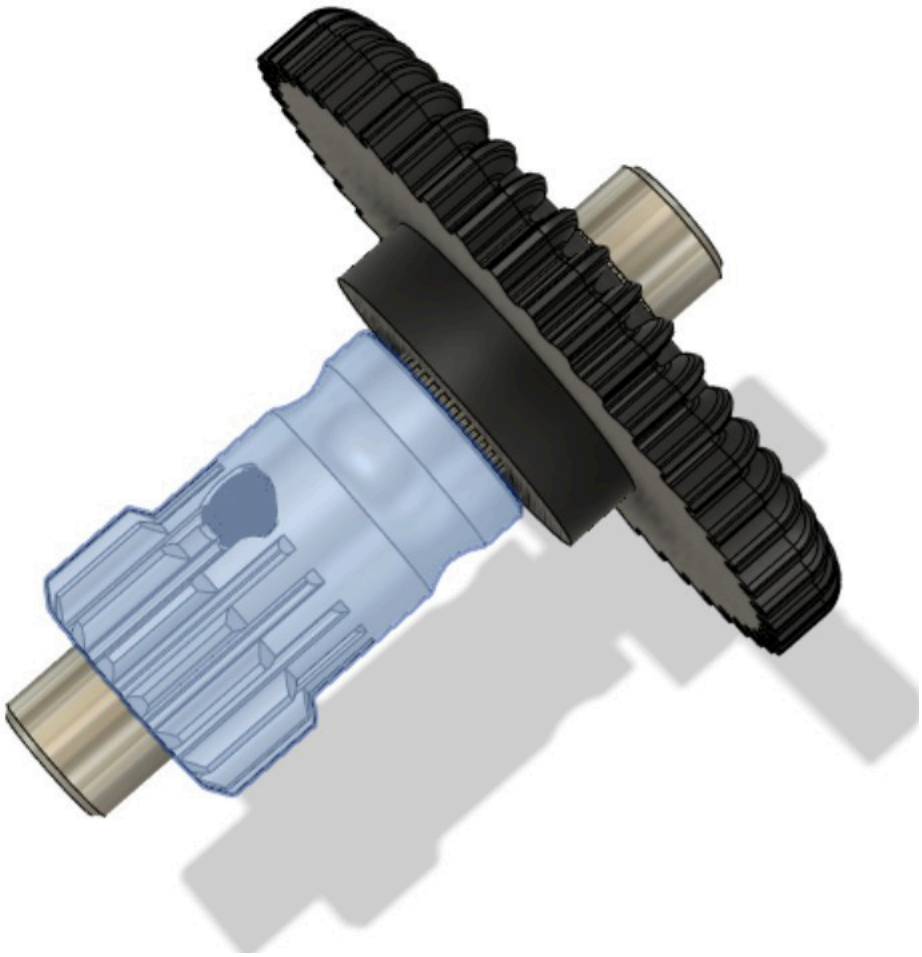
2. Squeeze – With a large pair of pliers or a bench vise you can also simply squeeze the parts together from both ends until movement stops.

3. HammerTime – With the printed tool on the work surface the shaft can be driven into 51 tooth gear with careful use of a dead blow or brass hammer. Please, no air hammers.

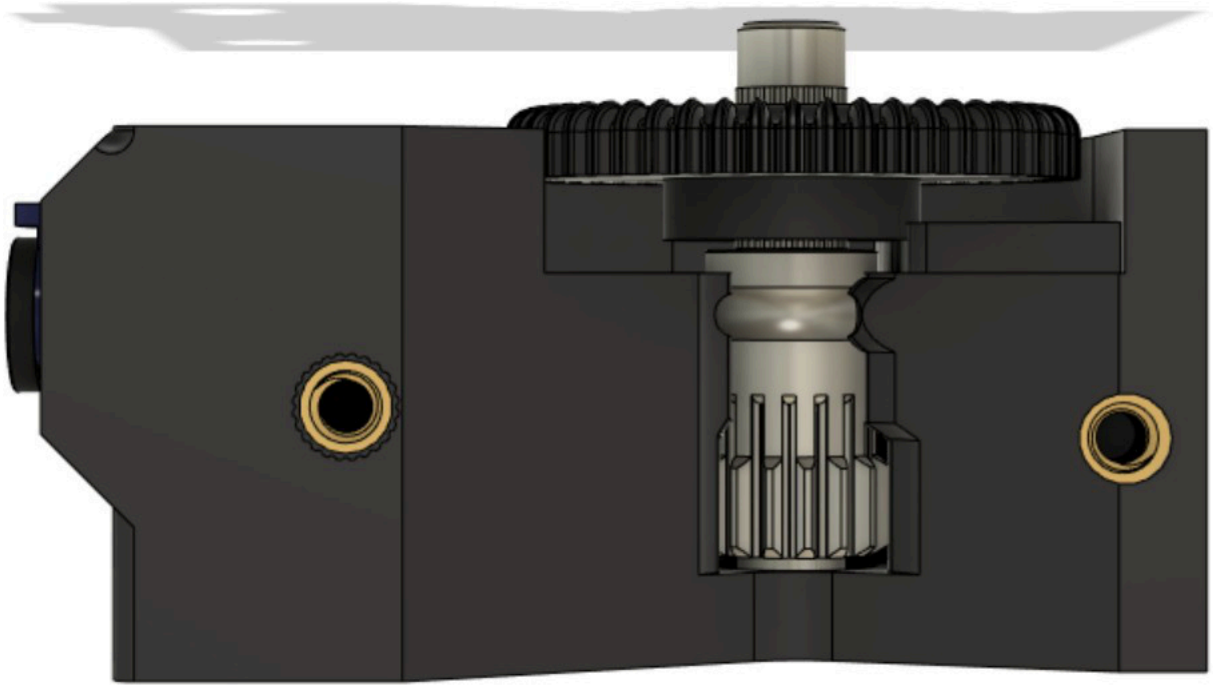
A view of a correctly installed/seated assembly.



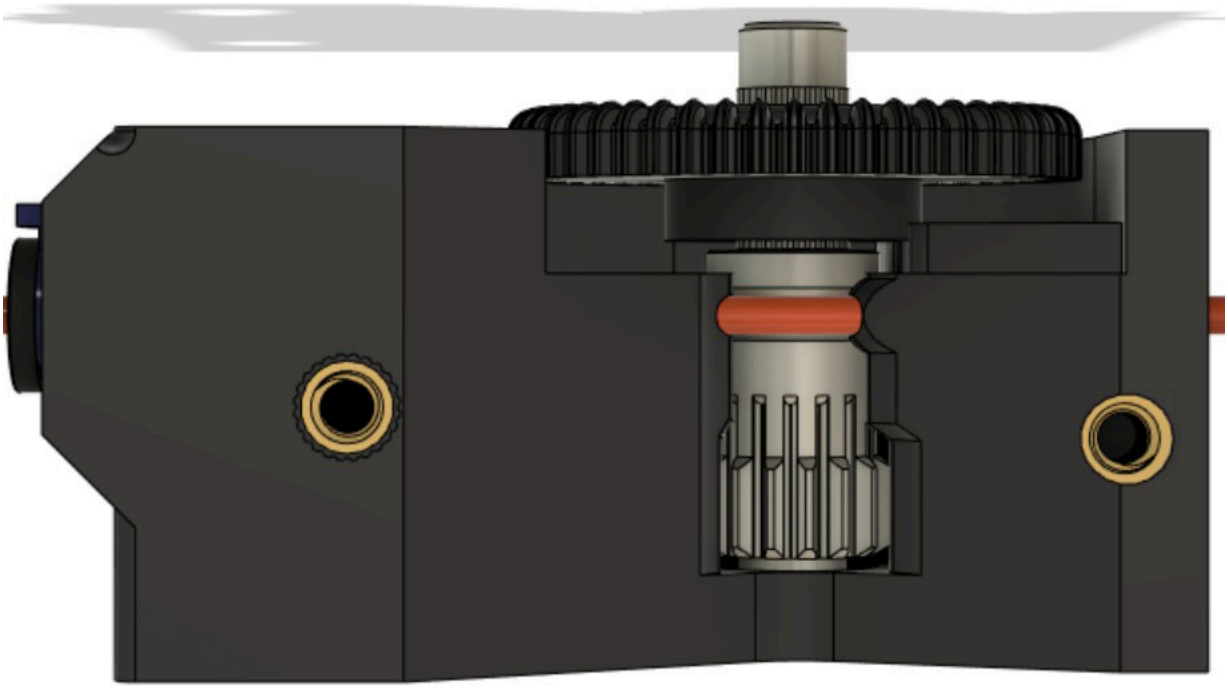
Install the Bondtech drive gear onto the shaft in the below orientation. Install an M3x2mm set screw into the drive gear being sure to catch the flat spot milled into the shaft. For now, we will be loosely tightening this set screw and omitting any Loctite. We'll finalize the gear's position a bit later.



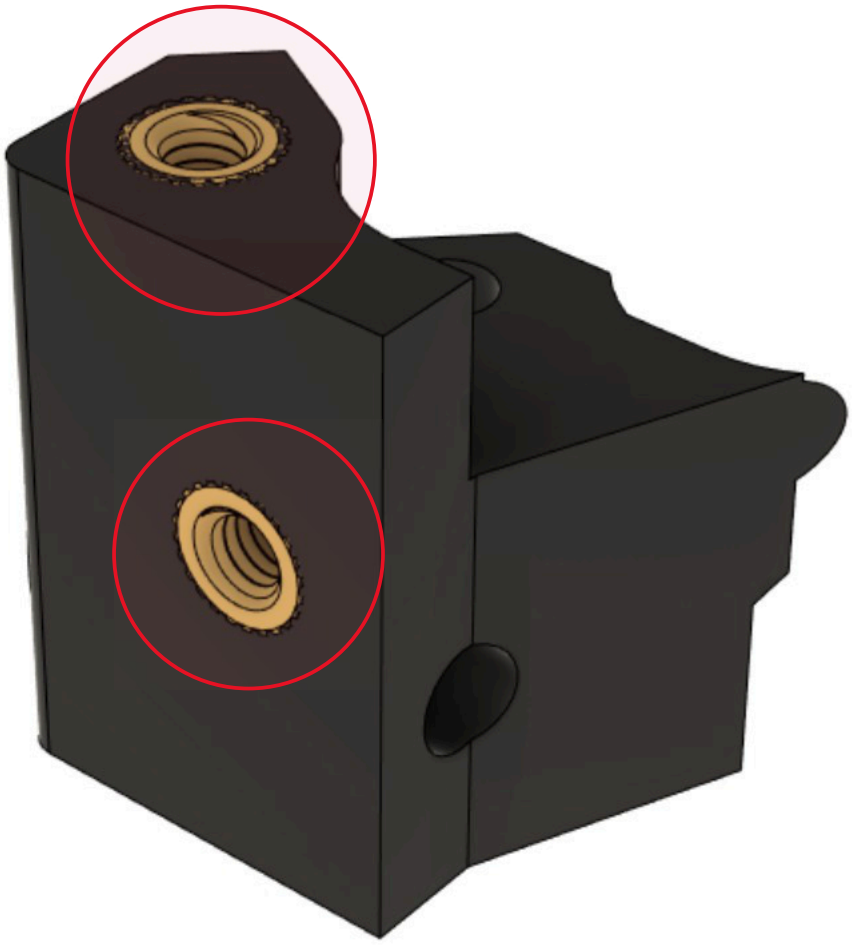
Place the entire assembly into the tool housing being sure that the shaft properly engages the bearing we installed previously.



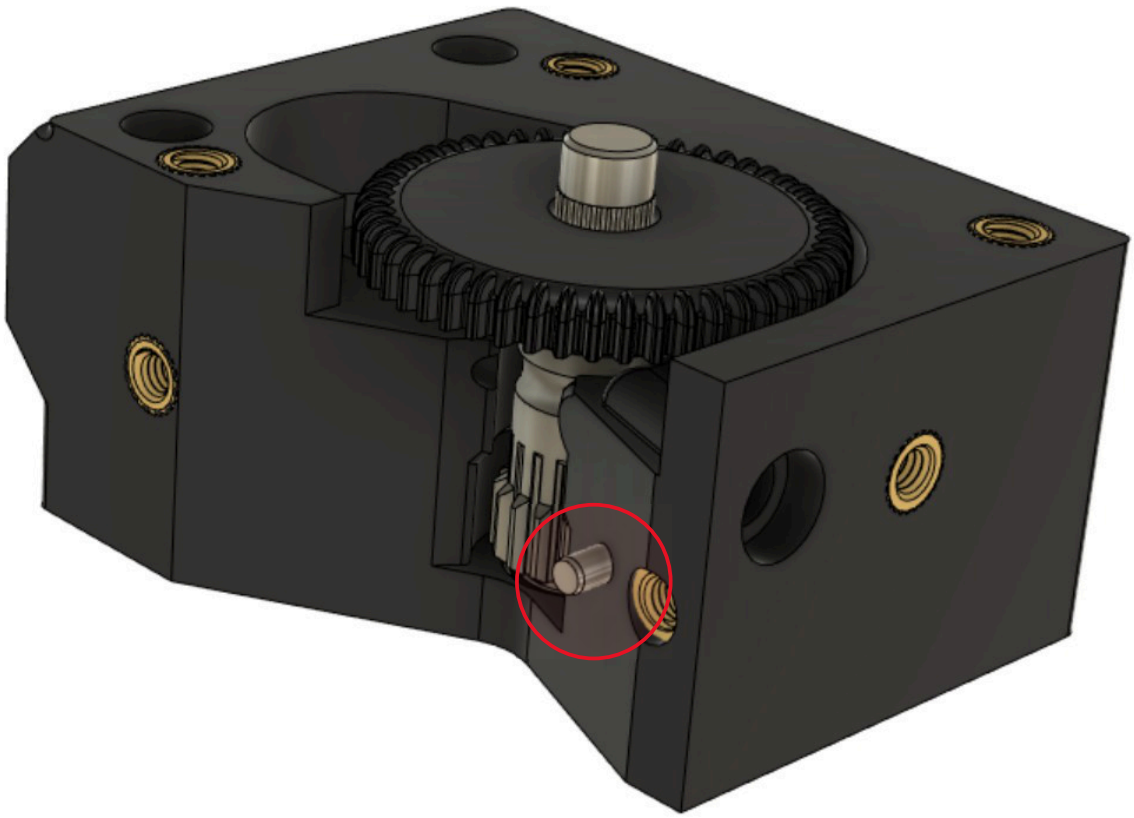
Slide a (ideally straight) length of 1.75mm filament through the entirety of the tool housing. Use the exposed length of filament at the drive gear interface to position the height of the drive gear. Rotate the drive gear so that the set screw is exposed, and tighten the set screw.



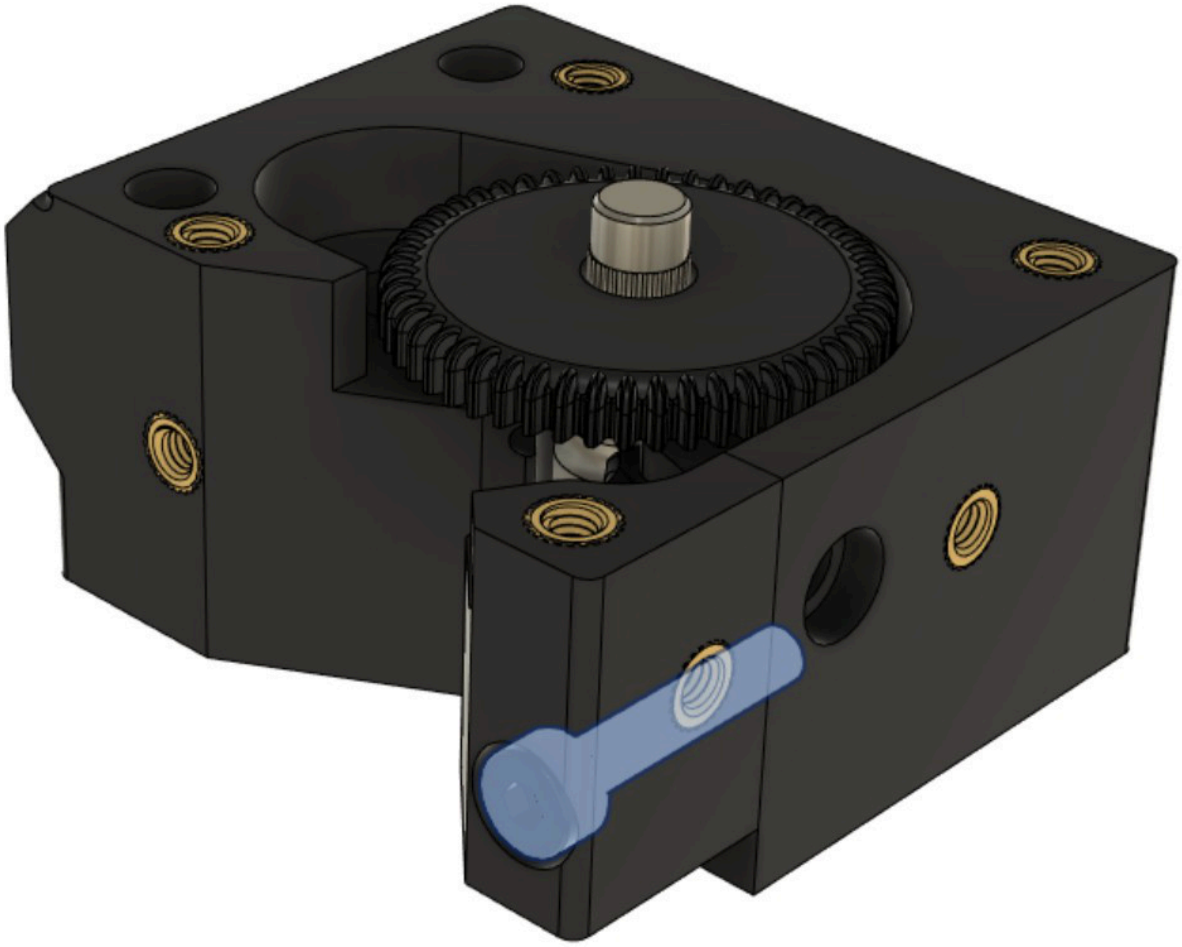
Locate Printed Part 06 and install 2 heat set inserts at these locations:



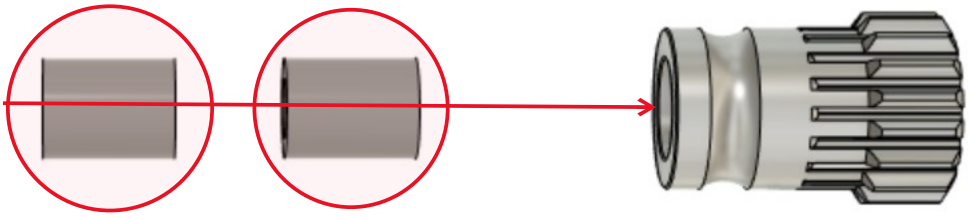
Insert a 2mm (6mm length) dowel pin into the locating bore on Print_Toolhead_Part03 as shown.



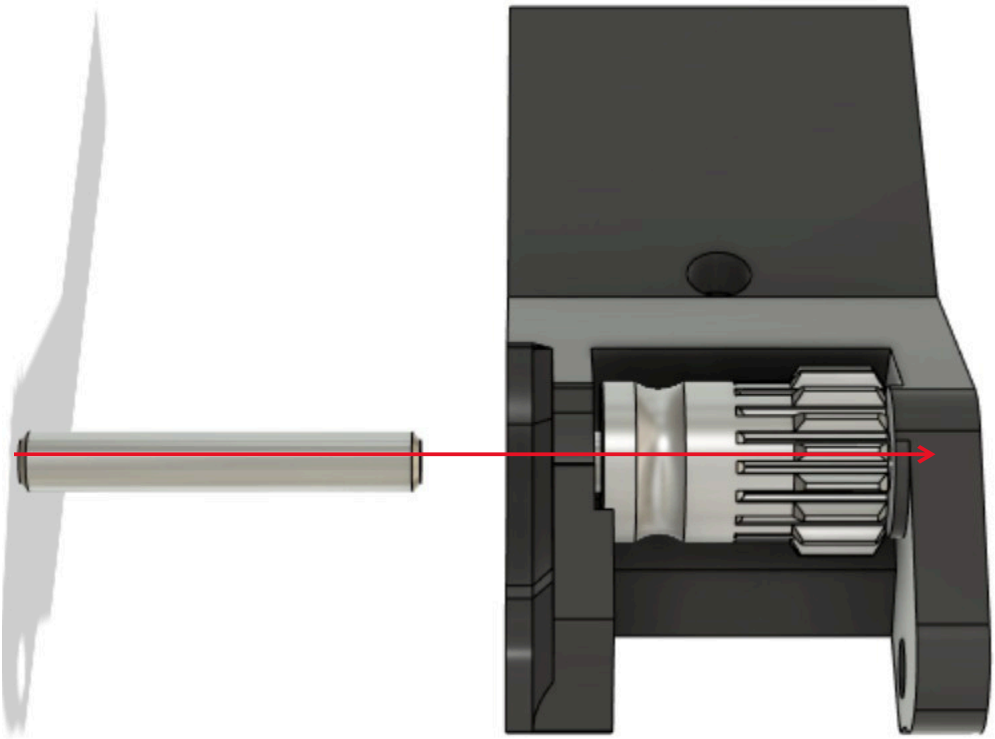
Secure Part 06 to Part 03 using an M3x16 SHCS



Install (2) needle bearings into the Bondtech idler gear with a light oiling.

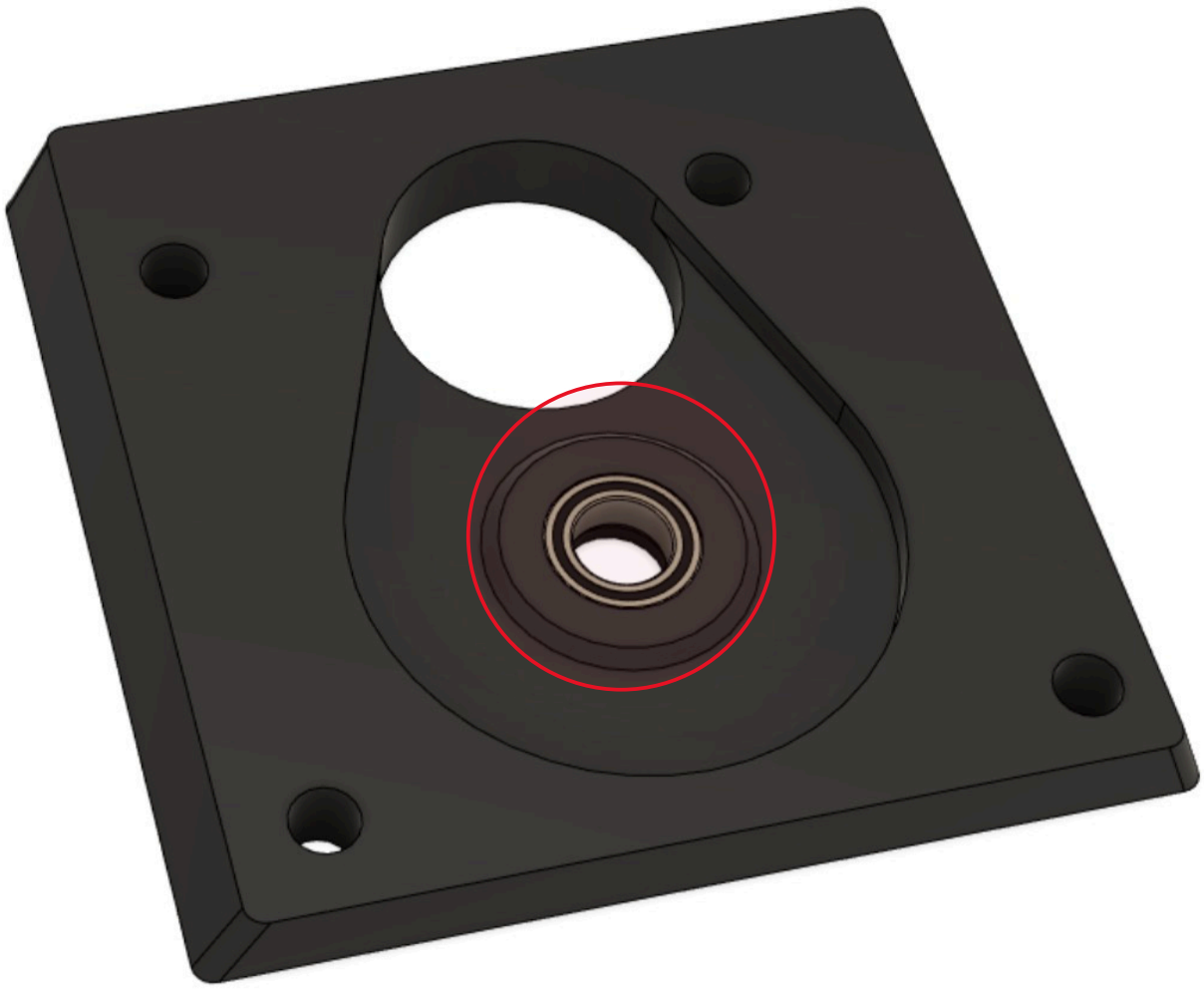


Place idler gear into the printed hinge noting the below orientation. Capture the idler with a 3x20mm shaft.

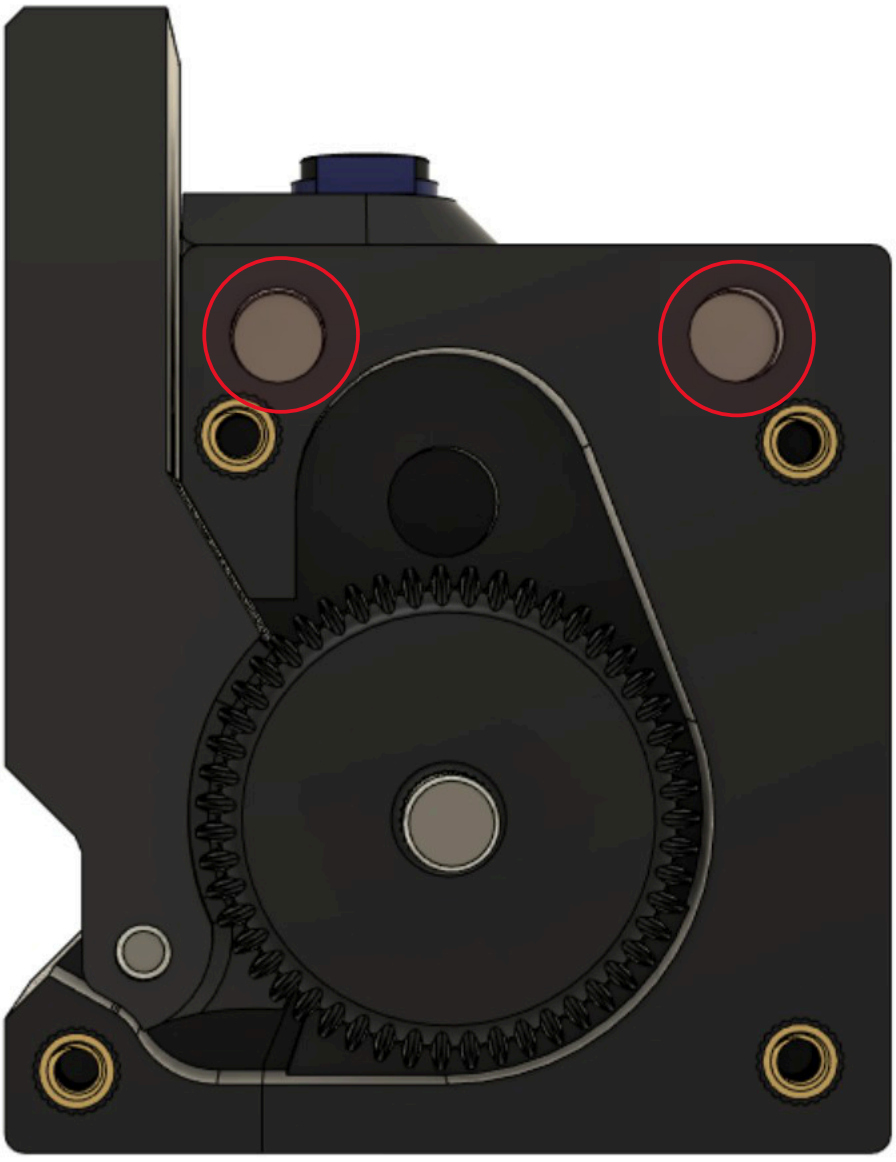


Align the hinge with the main tool body and capture with a 3x22mm shaft at the shown location.

Locate Printed Part 02 and insert the remaining MR85ZZ bearing into the pocket shown. Ensure the bearing is fully seated.

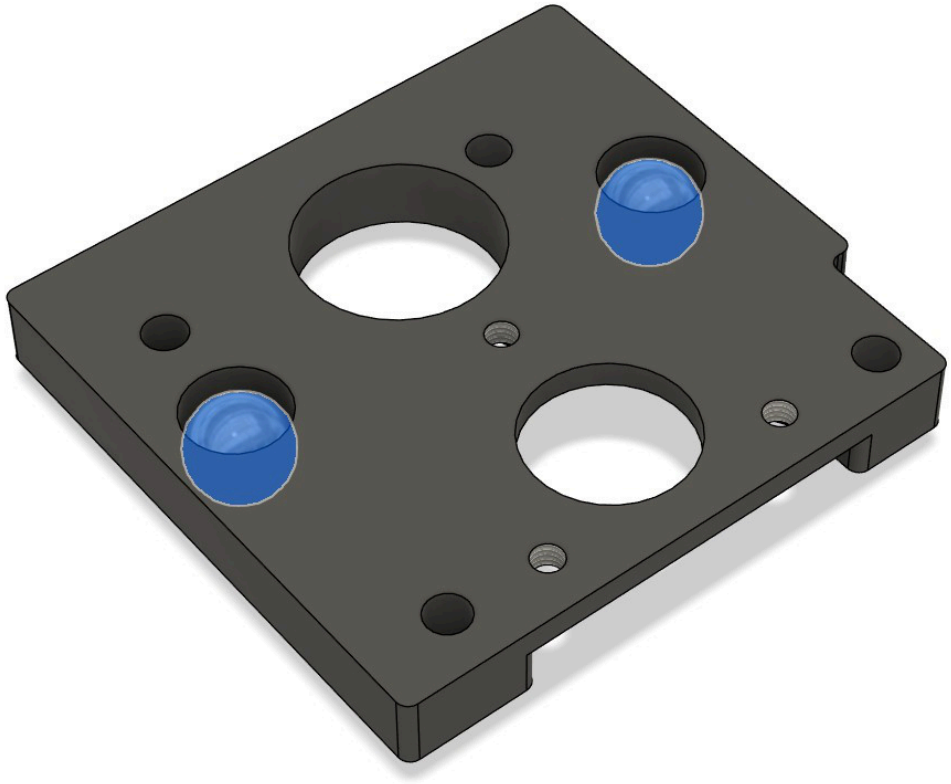


Place (2) 5x4mm magnets into the shown locations. The magnets should rest against the printed stop ring resulting in a below-flush position.



Align and seat Printed Part 02 being sure to squarely engage the bearing with the main 5mm shaft.

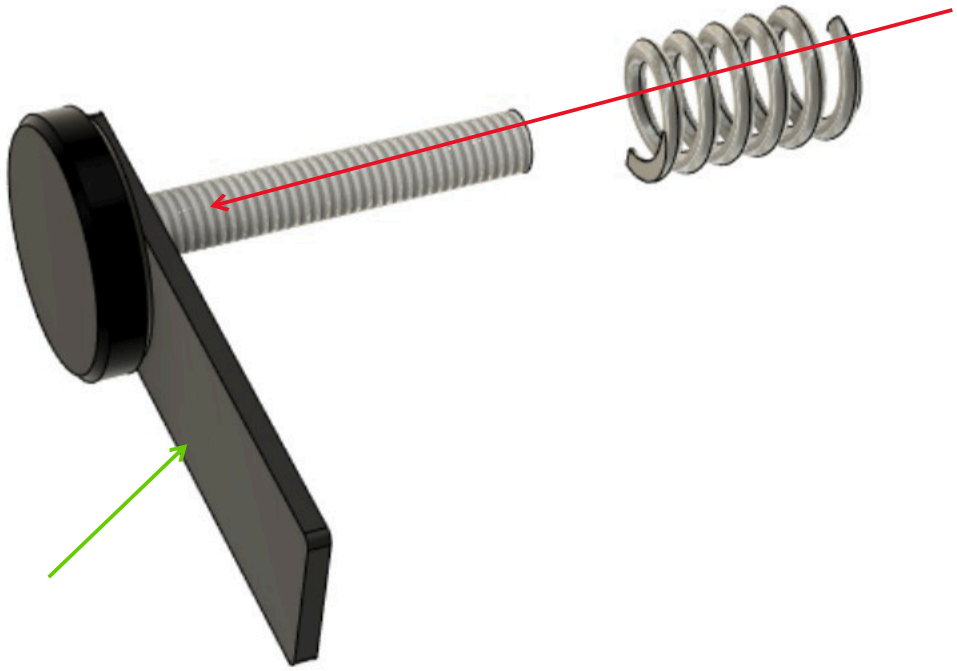
Locate CNC Tool Plate and install (2) 8mm balls in the shown locations.



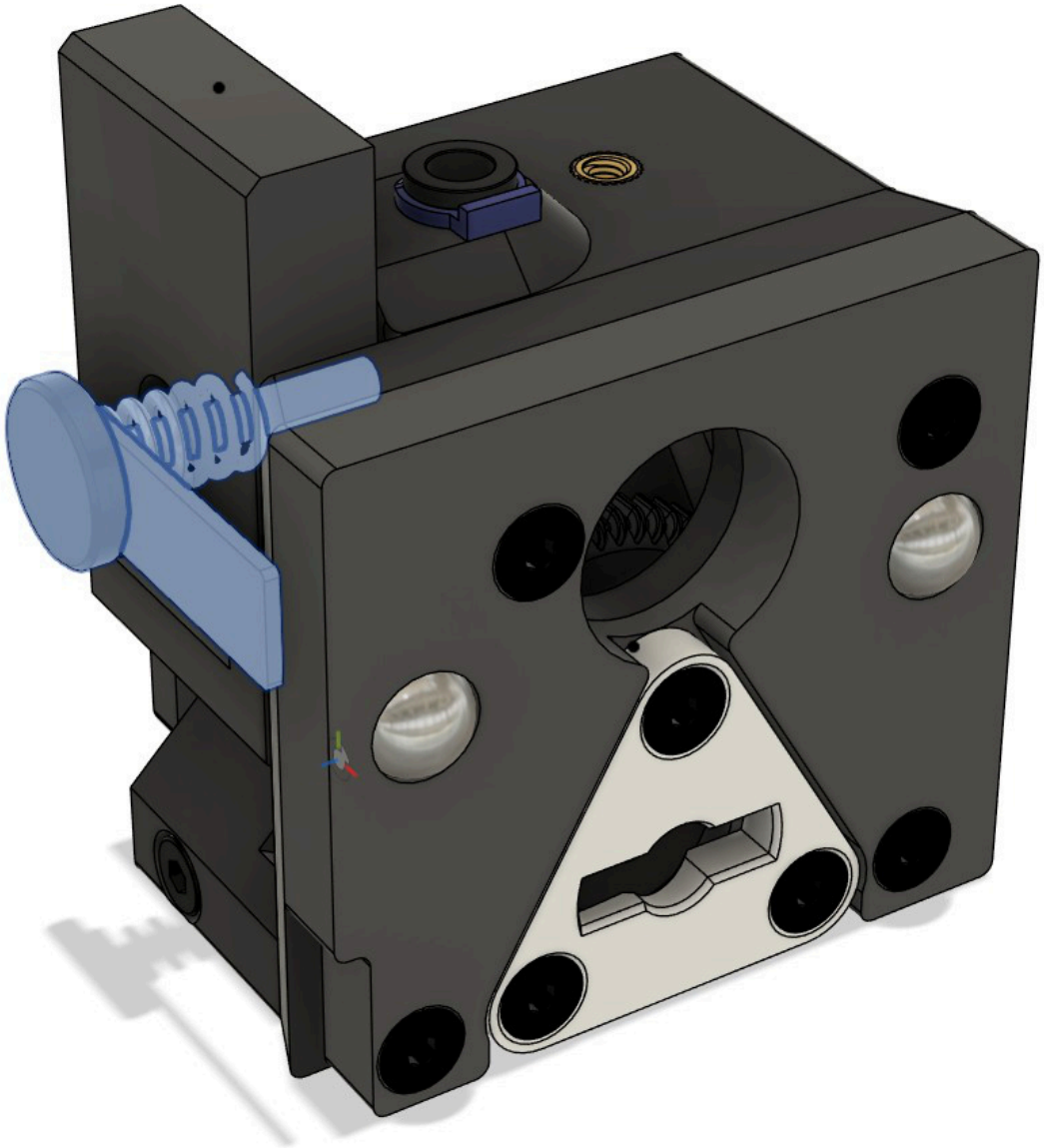
Loosely secure the tool plate with the main body using (4) M3x16 FHHS

Locate the wedge plate and secure to the tool plate using (3) M3x6 FHHS.

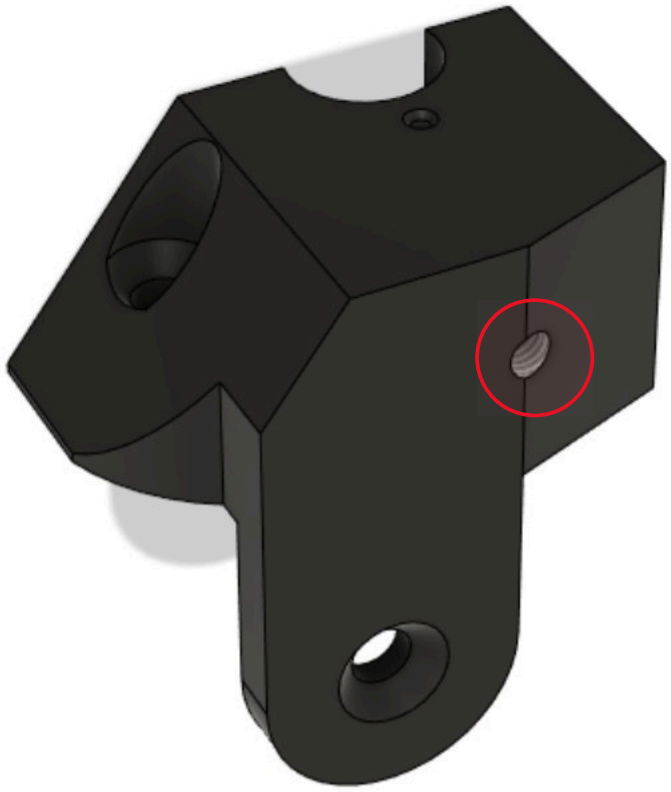
Locate the Bondtech thumb screw and temporarily remove the spring (and small spring retention washer. Install Printed part 05 against the inside face of the thumbscrew and reinstall the spring and retention washer.



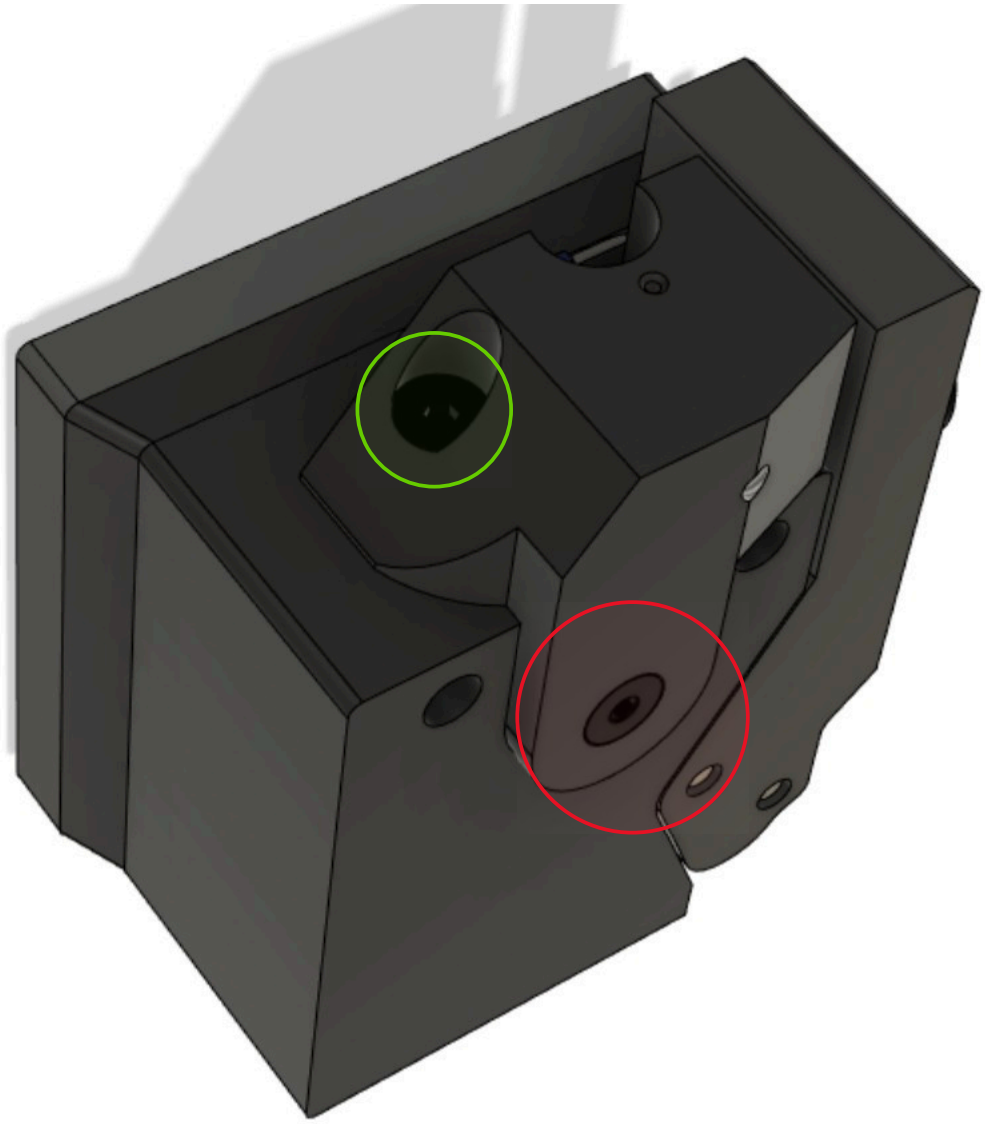
Loosely install thumb screw through the latch and into the heat set insert of the main tool body.



Locate Printed Part 04 and use an M3x-.5mm tap to create threads at the shown location. Temporarily install an M3x6mm set screw in this location for use later in assembly.



Fit part 04 to the main tool body as shown. Secure using an M3x8mm FHHS at the location in red, and an M3x10n FHHS at the location in green.



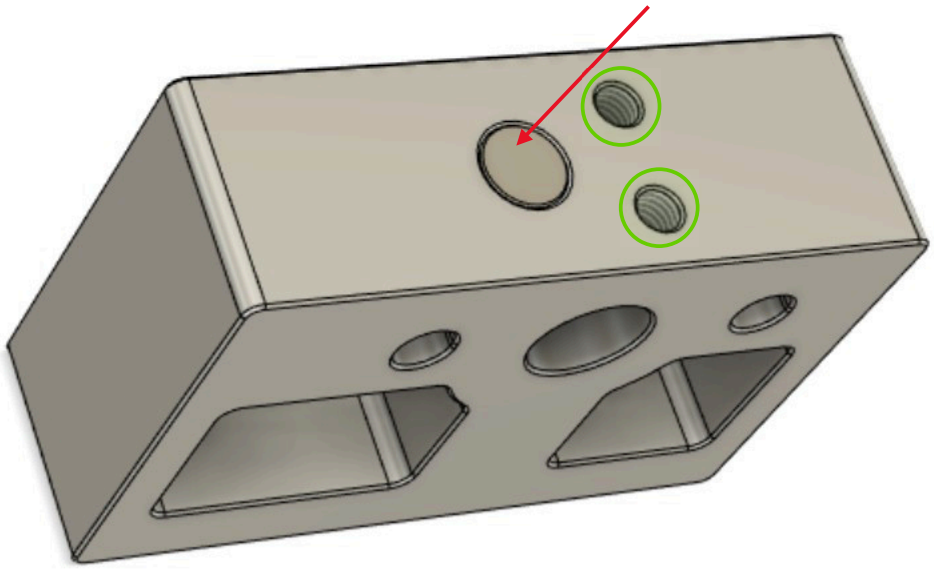
Locate CNC Tool Cooler Block and orient as shown.

IMPORTANT: Magnet polarity matters! Once installed it is very difficult to remove this magnet without permanent damage to the tool cooler block. The shown face below at which we will be installing the magnet will ultimately face and interact with the tool dock. The magnet must be installed so that it attracts the previously installed 5x10 magnets along the idle tool cooler bar.

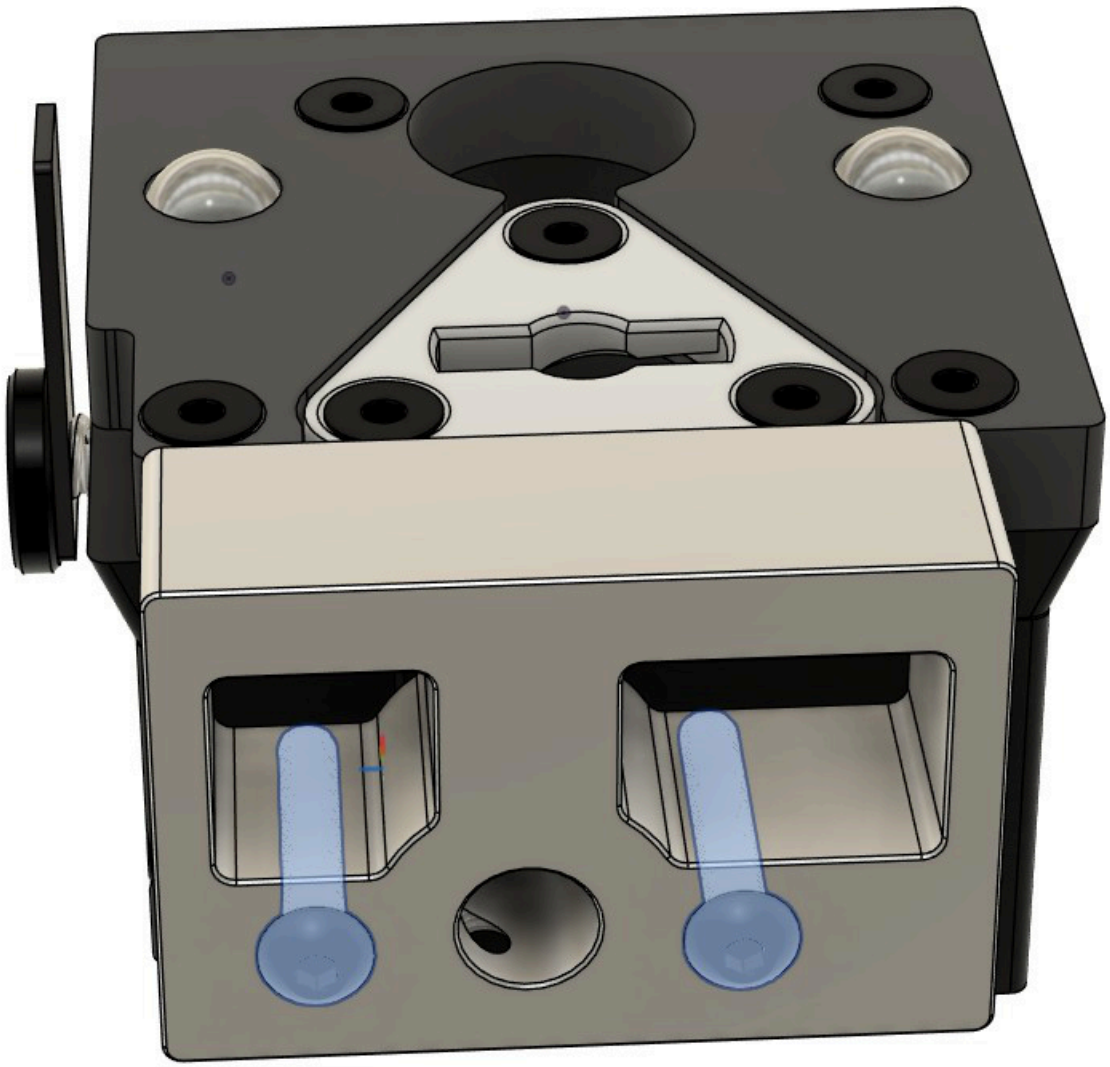
NOTE: Shown below is a standard tool cooler for use with slide-in heat breaks such as the Chimera/Kraken from E3D. If you are using instead a threaded tool cooler the two threaded set screw locations in green will not exist.

Press a 5x4mm magnet into the bore shown in red and be sure the magnet is fully seated. It must be confirmed that the magnet sits either flush with or below the surface of the CNC tool cooler.

Tip: Avoid the use of sharp objects or harsh blows to the magnet itself. Neodymium magnets are extremely brittle. A 5mm reamer may be used if needed, but generally this is not the case. For best success consider warming the cooler block before inserting the magnet. This can be done with safe use of a small butane/propane torch or even setting the block on the build plate of another 3D printer at 60-70C.



Secure the tool cooler assembly LOOSELY to the main tool body as shown using (2) M3x18 BHHS



Prepare a short length of Bowden tubing for use between the heat break and tool body.

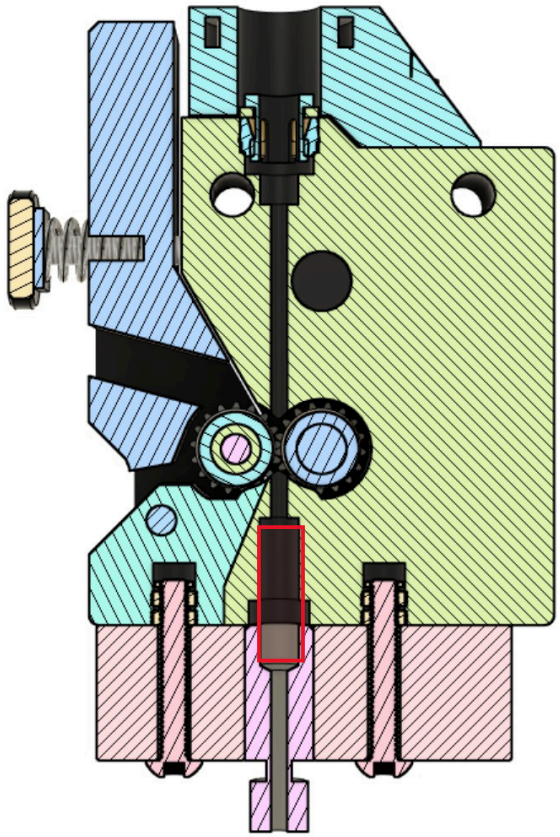
NOTE: This is not applicable to E3D Revo equipped tools!

Target Length (nominal)

Standard Smooth Bore Cooler Block with Kraken/Chimera Heat Break = 12.8mm

Threaded Tool Cooler Block with E3D Titanium Heat Break = 13.2mm

Insert the previously cut length of Bowden tube into the main tool body and make sure it is fully seated. The below cutaway shows the correct location for the tube when fully assembled. Our goal here is too completely fill this void in the filament path with a length of Bowden tube WITHOUT causing the tube to collapse or deform due to too much length/material.



Apply a light coating of thermal paste to the heat break. This step is relevant to all styles of heat break.

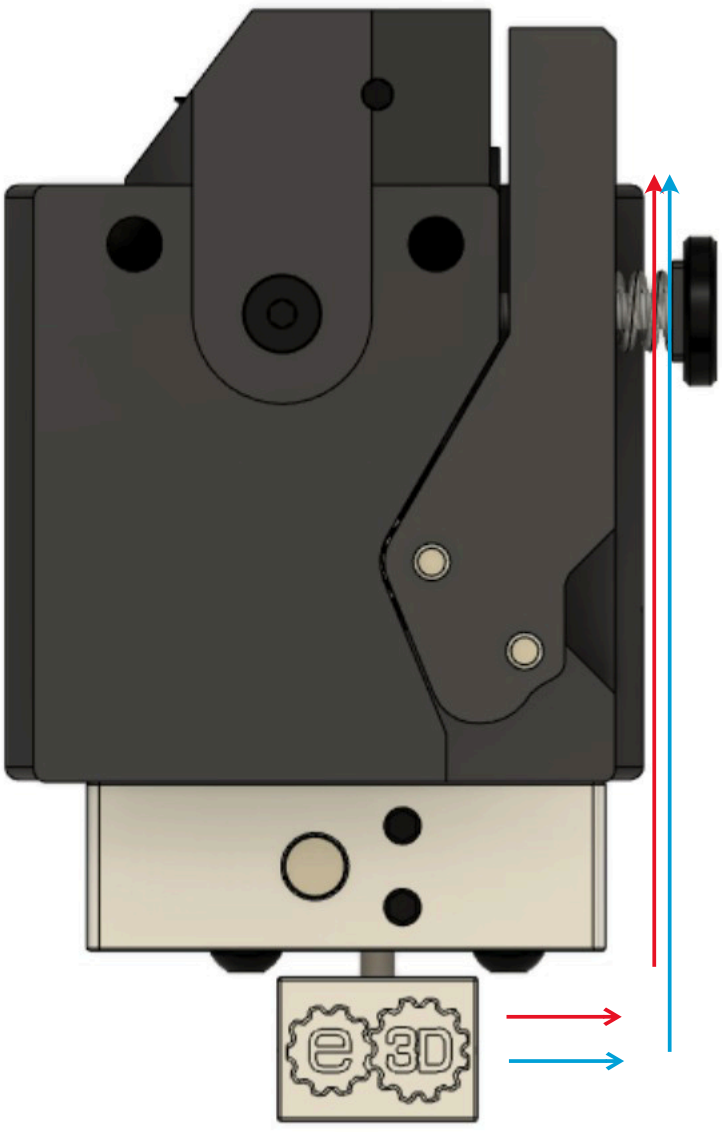
Push upward on the heat break and tighten the two M3x18 BHHS shown in red. Secure the heat break with (2) M3x4 set screws shown in green.

Thread on the heat block using the image below for a height reference showing the ideal final location of the hot block.

Not shown here:

We will also now install the heater cartridge using an M3x10 BHHS to pinch the heater block around the cartridge itself. Finally, install and secure the thermistor using an M3x4 set screw. showing wires exiting the correct side. Reference the V6 assembly guide from E3D for further information.

The wires themselves should exit the right side as reference from the image below.

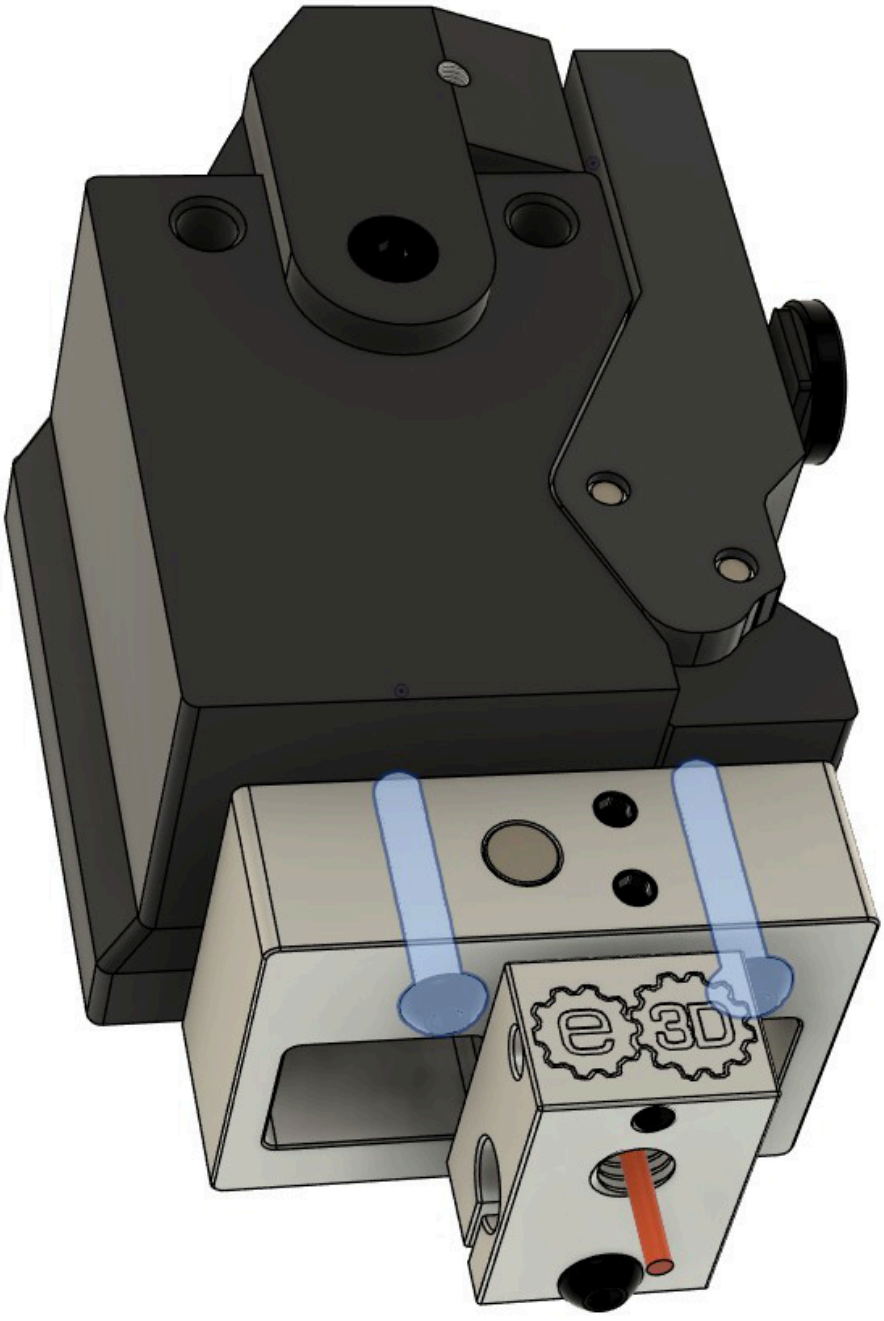


Before proceeding take the time now to ensure that filament enters and exits the drive gears smoothly with no hang ups. A properly assembled tool with a clean filament path will allow you to push a length of filament through the entire tool without snags or high resistance.

Things to consider:

1. The amount of tension on the latch arm may need to be adjusted for this dry run test.
2. You can rotate instead the 51 Tooth gear through the SLS drive gear hole with a finger to gain some mechanical advantage.
3. Take the tool apart if you need to! Now is the time for these adjustments.

Loosen again the M3x18 BHHS.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Install a nozzle and torque against the heat break.

This process is identical to the buildup of a standard V6 hot end and many other hot ends on the market. See E3D's V6 Build Guide for help if you're not familiar.

Things to consider:

1. Maintain a gap between the hot block and the cold block.
2. Maintain a gap between the hot block and nozzle face.
3. When fully tightened be sure the heater block is nicely square.
4. Do not install any silicone boots at this time.