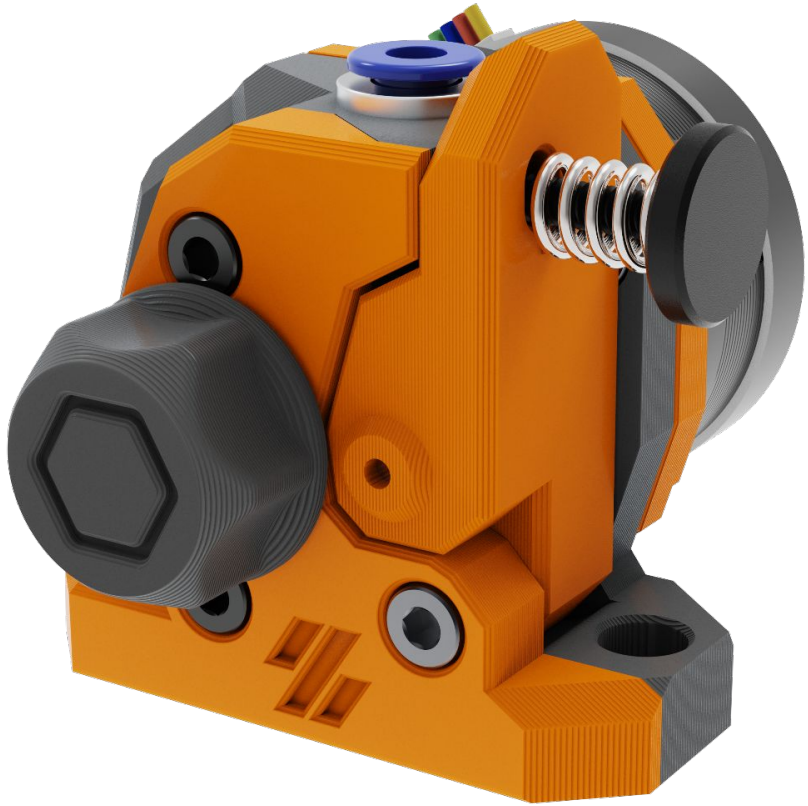
VORON



# GALILEO 2 STANDALONE

Planetary power for your gardening-tool-built space shuttle.

VERSION 22SEPT2023

## PART PRINTING GUIDELINES

Galileo 2 follows the Voron Team standards. The Voron Team has provided the following print guidelines for you to follow in order to have the best chance at success with your parts. There are often questions about substituting materials or changing printing standards, but we recommend you follow these.

### 3D PRINTING PROCESS

Fused Deposition Modeling (FDM)

### MATERIAL

ABS/ASA

### LAYER HEIGHT

Recommended: 0.2mm

### EXTRUSION WIDTH

Recommended: Forced 0.4mm

### INFILL TYPE

Grid, Gyroid, Honeycomb, Triangle or Cubic

### INFILL PERCENTAGE

Recommended: 40%

### WALL COUNT

Recommended: 4

### SOLID TOP/BOTTOM LAYERS

Recommended: 5

## FILE NAMING

By this time you should have already downloaded the STL files from the Galileo 2 GitHub repository. You might have noticed that we have used the Voron standard naming convention for the files. This is how to use them.

### PRIMARY COLOR

**front_body_ECAS_coupler.stl**
These files will have nothing at the start of the filename.

### ACCENT COLOR

**[a]_front_bearing_holder.stl**
We have added “[a]” to the front of any STL file that is intended to be printed with accent color.

## HOW TO GET HELP

If you need assembly assistance, we're here to help. Head on over to the Voron Discord group and post your questions. This is our primary medium to help Voron Users and we have a great community that can help you out if you get stuck.

Discord https://discord.gg/voron

VORON FORUM https://forum.vorondesign.com

### REPORTING AN ISSUE

Should you find an issue in the documentation or have a suggestion for an improvement please consider opening an issue on GitHub (https://github.com/JaredC01/Galileo2/issues). When raising an issue please include the relevant page numbers and a short description; annotated screenshots are also very welcome. We periodically update the manual based on the feedback we get.


https://github.com/JaredC01/Galileo2

## WHAT IS GALILEO?

Galileo is a series of planetary-geared projects designed for use in Voron printers designed by JaredC01. This document covers Galileo 2, or G2, which has an incredible 9:1 gear ratio in a custom-designed planetary gearbox. This manual covers the Galileo 2 Extruder, or G2E, specifically. There are also other G2-based projects, such a G2Z drives and a standalone extruder design, which will be covered in separate manuals.

## WHAT BIG GEARS YOU HAVE!

In addition to the planetary gear reduction, G2E also features a custom 16mm RNC-coated filament drive gear. This means more grip on the filament, helping to minimize filament slip and maximize extruder output.

## DROP IN REPLACEMENT FOR CW2

The G2E assembly is already “stealthed” so it aesthetically matches Clockwork 2, and with a few configuration tweaks, drops right in on a Stealthburner MGN12 Toolhead. This makes it compatible with Voron Tap as well as the standard inductive probe carriages.

### G2E CONFIGURATION

You must update both the gear_ratio and rotation_distance in your Klipper configuration and do a standard extruder calibration after installing the Galileo 2 Extruder. Additionally, your run_current will need to be updated.

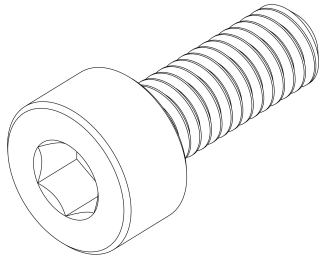
```
[extruder]
rotation_distance: 47.088
gear_ratio: 9:1
microsteps: 16

[tmc2209 extruder]
run_current: 0.6
```

Exploded Diagram Needed

FOR REFERENCE ONLY

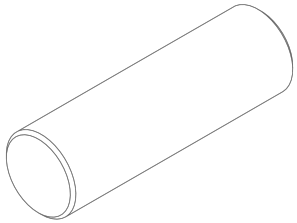
If yours explodes and ends up looking like this, you may have a problem. Please ask for help.



### SOCKET HEAD CAP SCREW (SHCS)

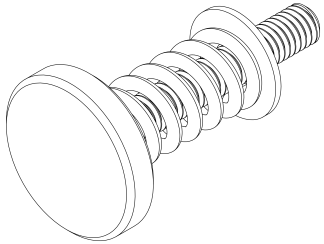
Metric fastener with a cylindrical head and hex drive. The most common fastener used on the Voron.

ISO 4762



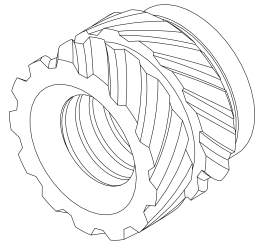
### PIN

16mm x 5mm OD



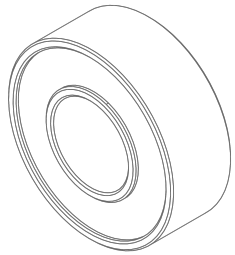
### EXTRUDER THUMBSCREW

Spring will be stiff



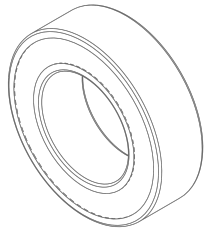
### HEAT SET INSERT

Heat inserts with a soldering tip so that they melt the plastic when installed. As the plastic cools, it solidifies around the knurls and ridges on the insert for excellent resistance to both torque and pull-out.



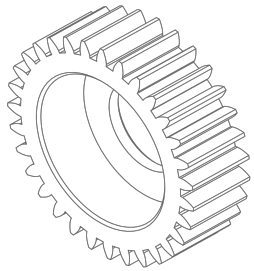
### MR148 BEARING

Main shaft support

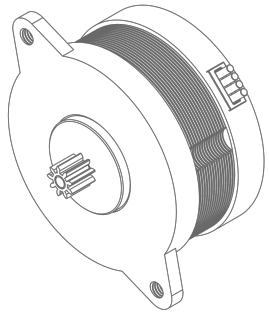


### MR115 BEARING

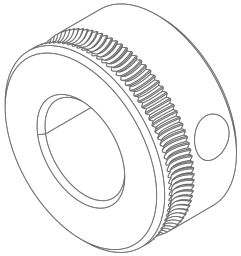
Planetary and idlers



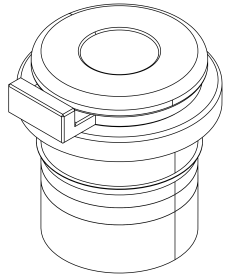
PLANETARY GEAR
31-Tooth MJF Gear



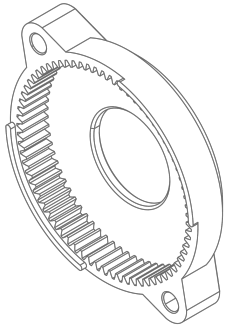
NEMA 14 PANCAKE STEPPER
9T, 20mm



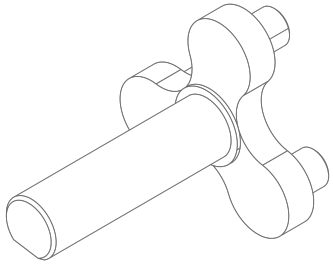
GALILEO 2 EXTRUDER GEAR
RNC-Coated 16mm Drive Gear



ECAS fitting
You won't need the black rubber part on the bottom



RING GEAR HOUSING
72-Tooth MJF Housing



PLANETARY CARRIER SHAFT
Aluminum Carrier

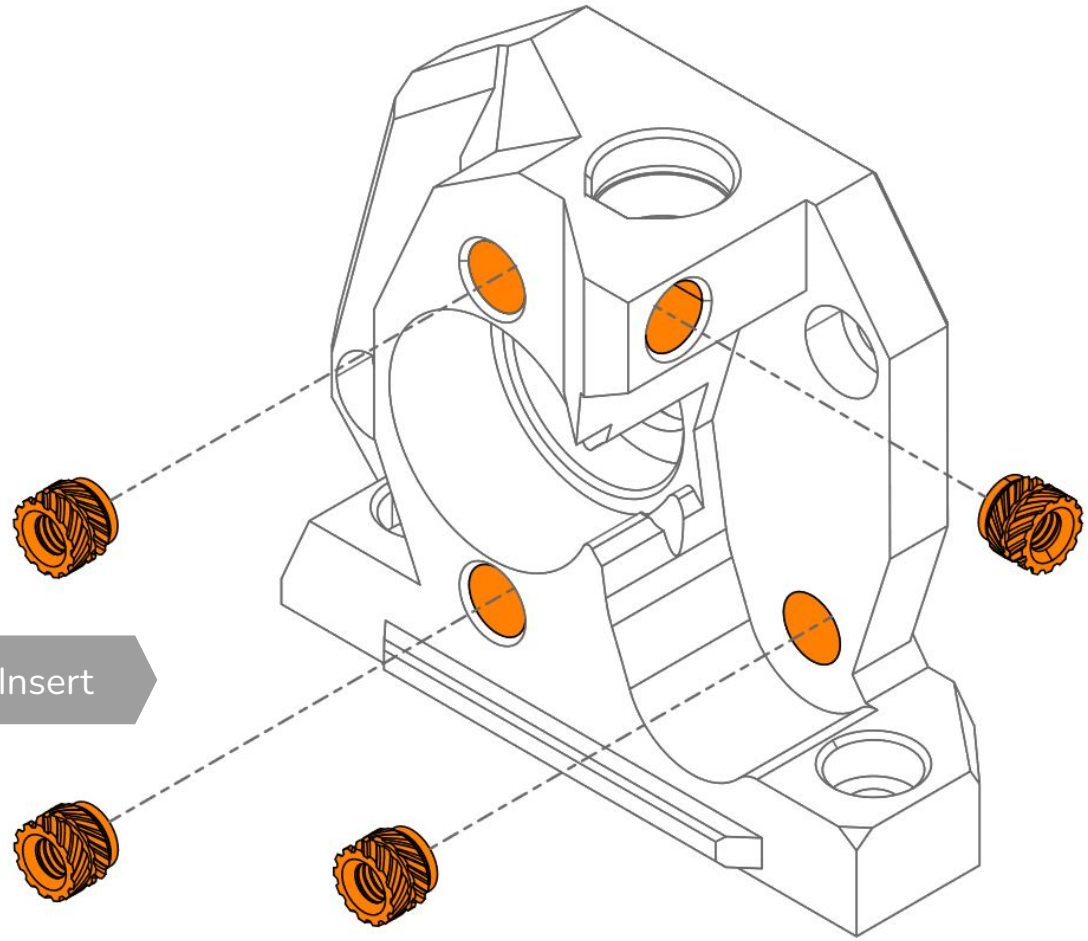

GALILEO 2

### HEAT SET INSERTS

This design relies on heat set inserts. Make sure you have the proper inserts (check the hardware reference for a close-up picture, and the BOM for dimensions).

If you've never worked with heat set inserts before, we recommend you watch the linked guide.

https://voron.link/m5ybt4d



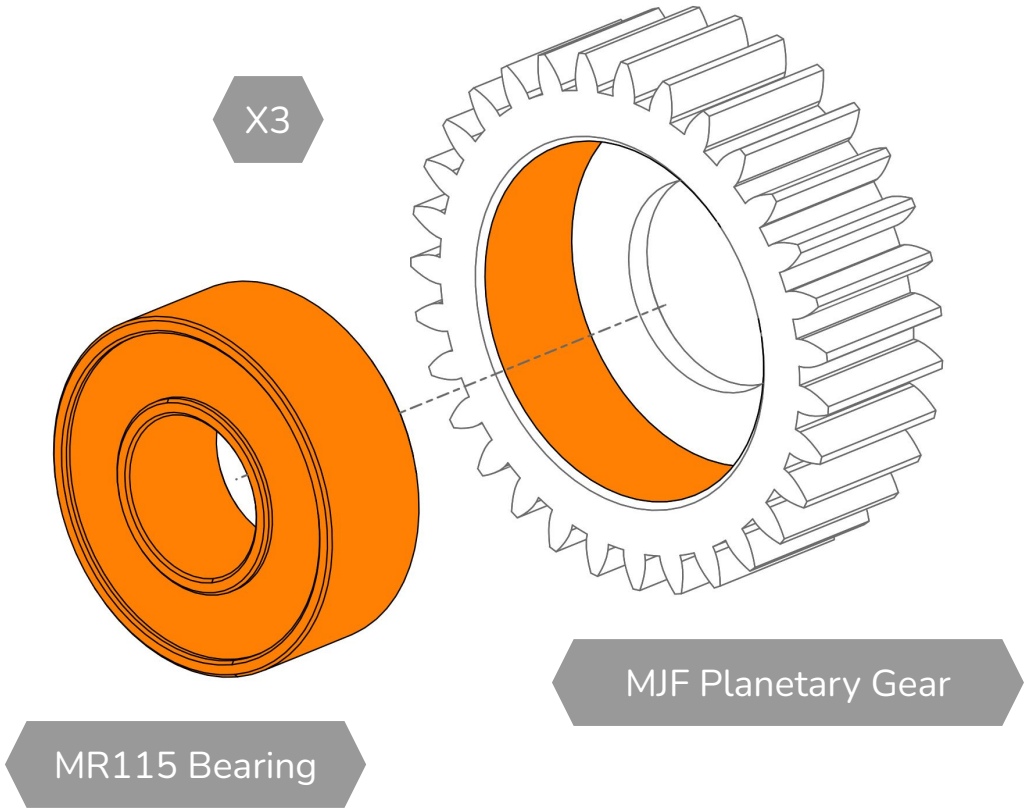

GALILEO 2

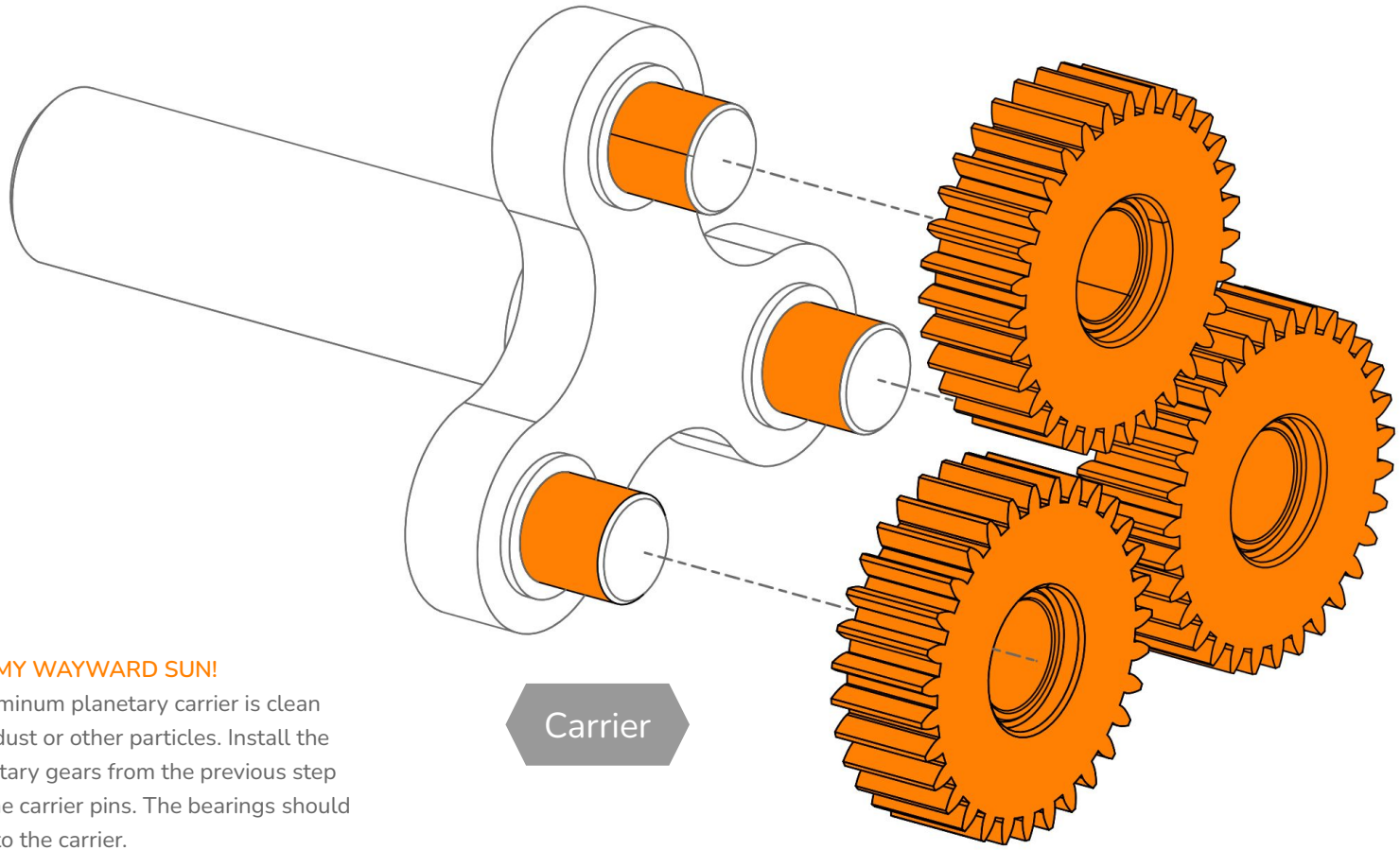
### HOW DO YOU THROW A PARTY ABOUT SPACE?.....YOU PLANET!

Planetary gearbox assembly can be a tedious process, but following these steps closely will ensure a smoothly running gearbox!

### INTERGALACTIC, PLANETARY!

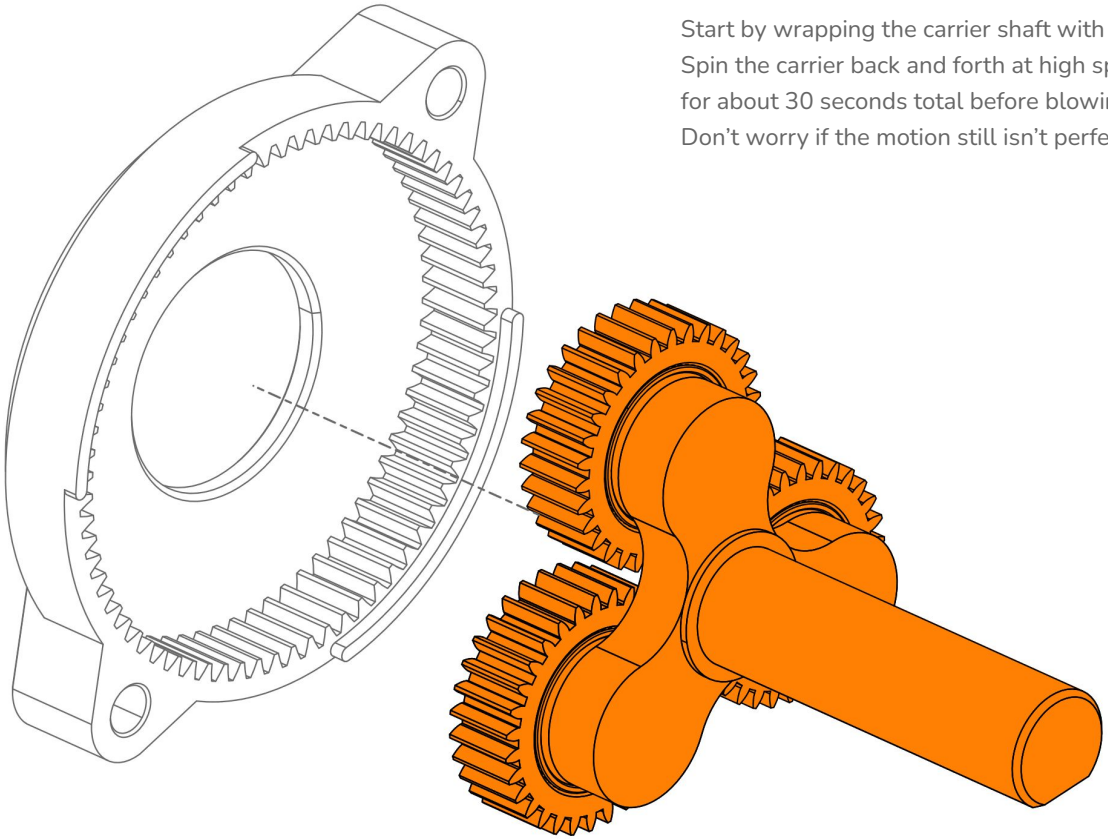
Start by inserting the bearings for each of the three (3) planetary gears. The bearings should press fit into place with little effort. It's okay if the bearings are loose enough to fall out on their own; they will be held captive when the gearbox is assembled.






### CARRIER ON MY WAYWARD SUN!

Ensure the aluminum planetary carrier is clean and free from dust or other particles. Install the three (3) planetary gears from the previous step onto each of the carrier pins. The bearings should slide easily onto the carrier.



## YOU KNOW WHAT REALLY GRINDS MY GEARS?

The G2 gearbox is made from MJF Nylon, and as such, is subject to printed part tolerances just like any other printed part. Unfortunately this means that some gearboxes will be tighter than others out of the box.

The best way to ensure a smooth-running gearbox is to manually run-in the gears using a drill!

Start by wrapping the carrier shaft with a strip of paper to protect it, then loosely chuck it into your drill. Spin the carrier back and forth at high speed in short bursts while you hold the ring gear in place. Do this for about 30 seconds total before blowing out any residual MJF dust and proceeding with assembly. Don't worry if the motion still isn't perfectly smooth after 30 seconds.

## PUT A RING ON IT AND DON'T FORGET THE LUBE

After running in the gearbox manually above, double check for and remove any residual MJF dust that may be in the gearbox before moving on to lubing the gearbox assembly.

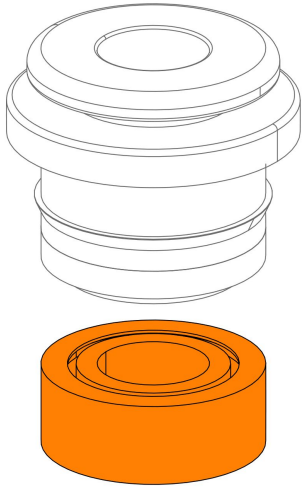
To lube the gearbox, put a pea-sized blob of grease on the bottom flat surface of the ring gear housing, then insert the carrier with planets into the ring gear housing, rotating while installing. Give the carrier 10-20 full rotations to allow the grease to move around and fill all of the nooks in the gear faces. You can use the drill for this step as well, but do take care not to sling grease everywhere!

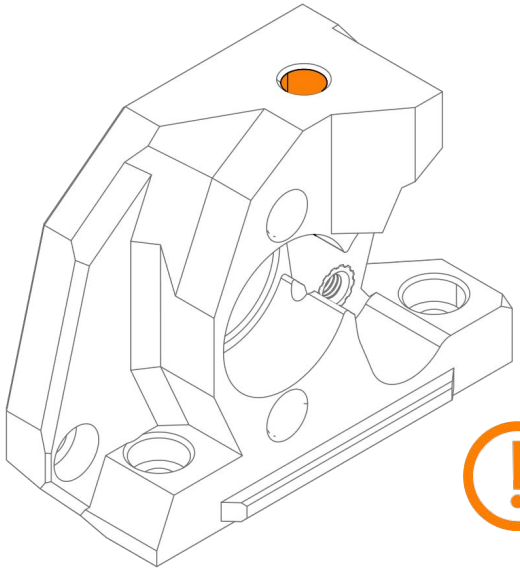

GALILEO 2

### ECAS PREP

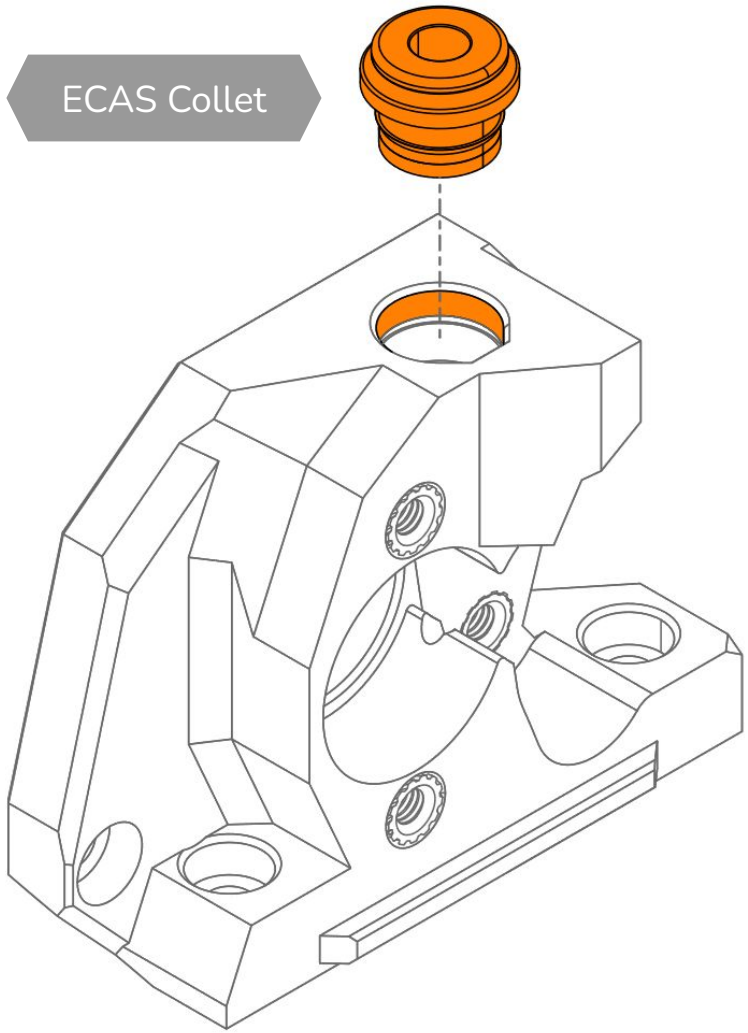
The rubber donut on the bottom highlighted here is not used in this build. Pry the rubber donut off and set it aside where pets won't find a way to use it to increase your vet bill.

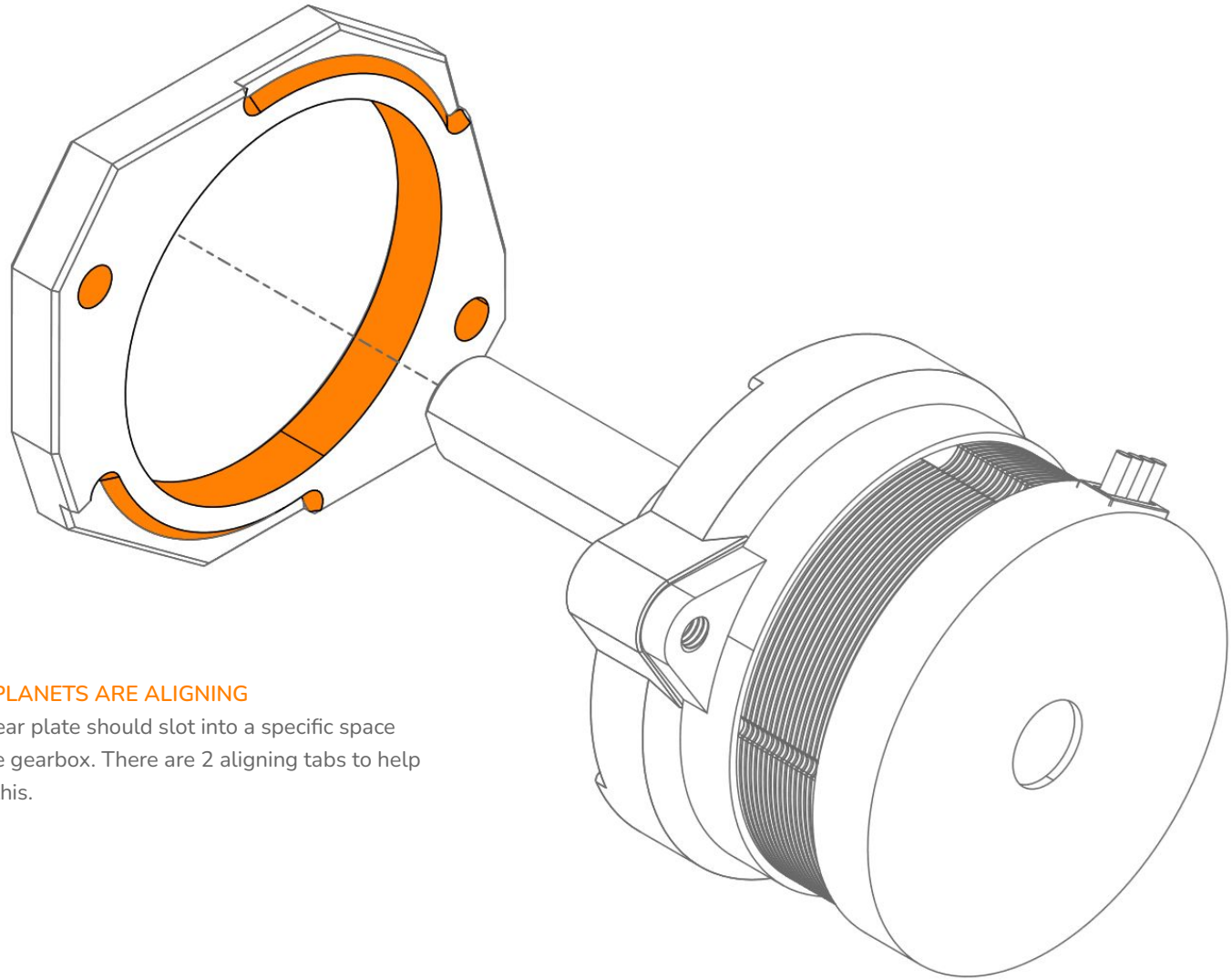
Press the collet straight down into the extruder body. This may be a tight fit—you can start it by hand, then push against it using a doorway, the floor, etc. Just try not to ding the pointy top of the printed part.





NOTE: If you're using the press-fit front body, you can skip this step!



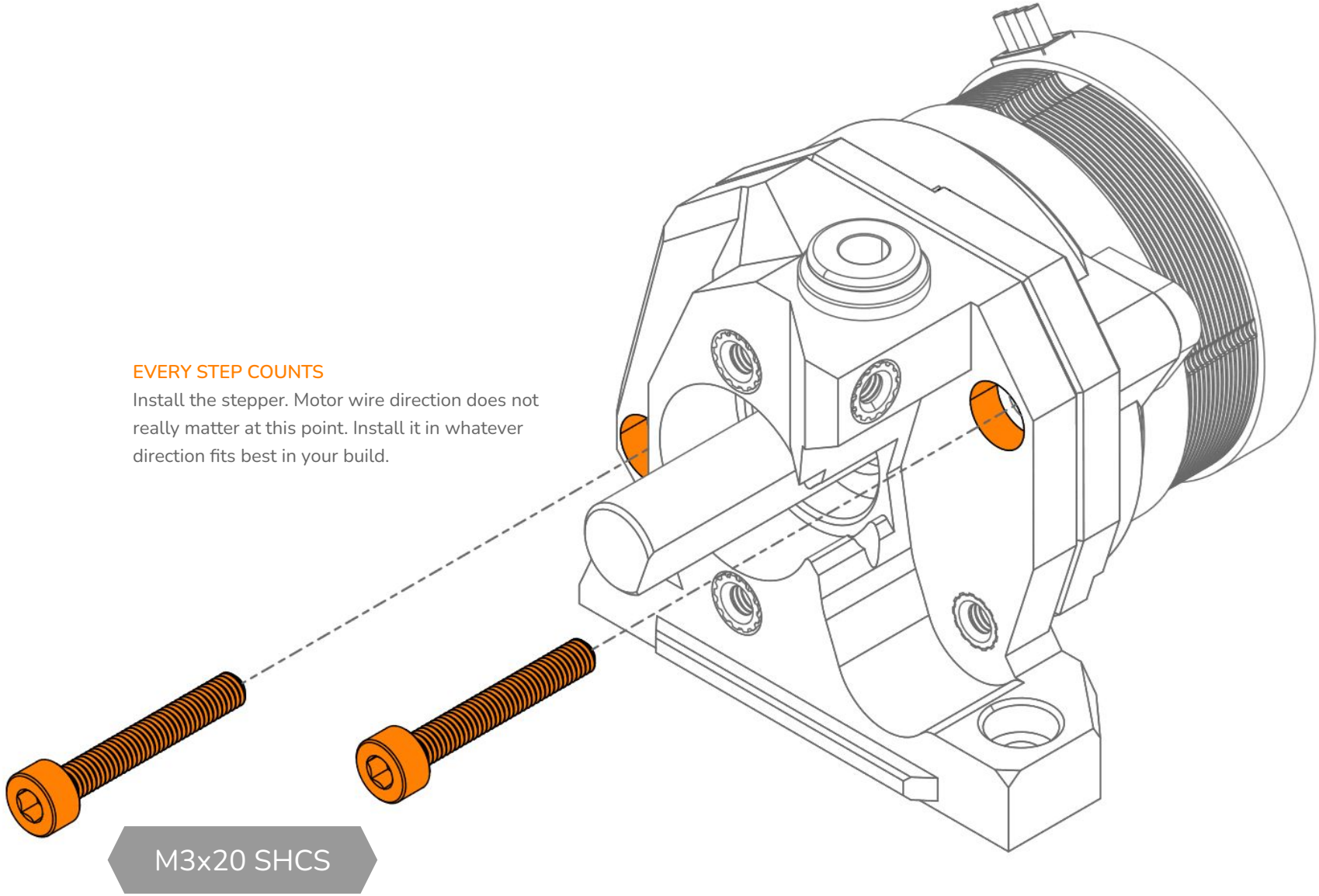


### THE PLANETS ARE ALIGNING

The rear plate should slot into a specific space on the gearbox. There are 2 aligning tabs to help with this.

EVERY STEP COUNTS

Install the stepper. Motor wire direction does not really matter at this point. Install it in whatever direction fits best in your build.



M3x20 SHCS

### PLANETARY EXTRUSION? IT'S OUT OF THIS WORLD!

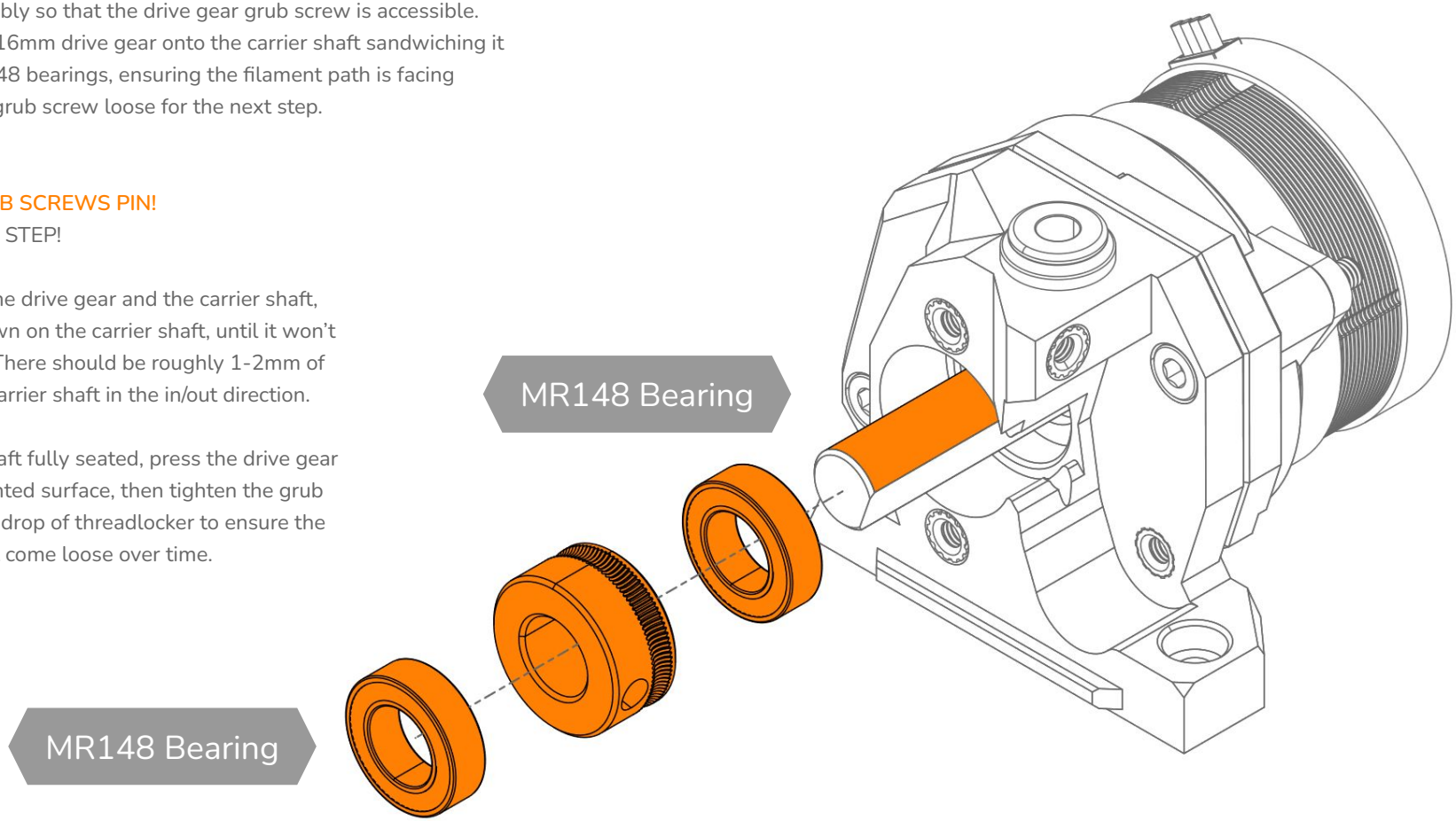
Ensure the flat face of the carrier shaft is facing out towards the opening in the G2SA assembly so that the drive gear grub screw is accessible. Install the custom 16mm drive gear onto the carrier shaft sandwiching it between two MR148 bearings, ensuring the filament path is facing inward. Leave the grub screw loose for the next step.

### GEARS SPIN, GRUB SCREWS PIN!

VERY IMPORTANT STEP!

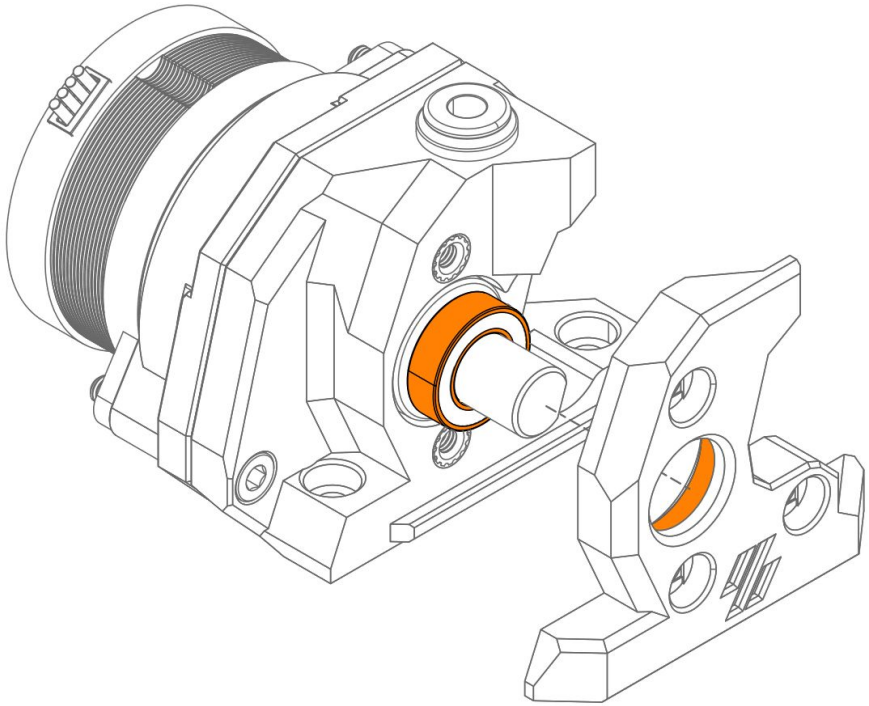
To properly align the drive gear and the carrier shaft, PRESS FIRMLY down on the carrier shaft, until it won't move any further. There should be roughly 1-2mm of total travel in the carrier shaft in the in/out direction.

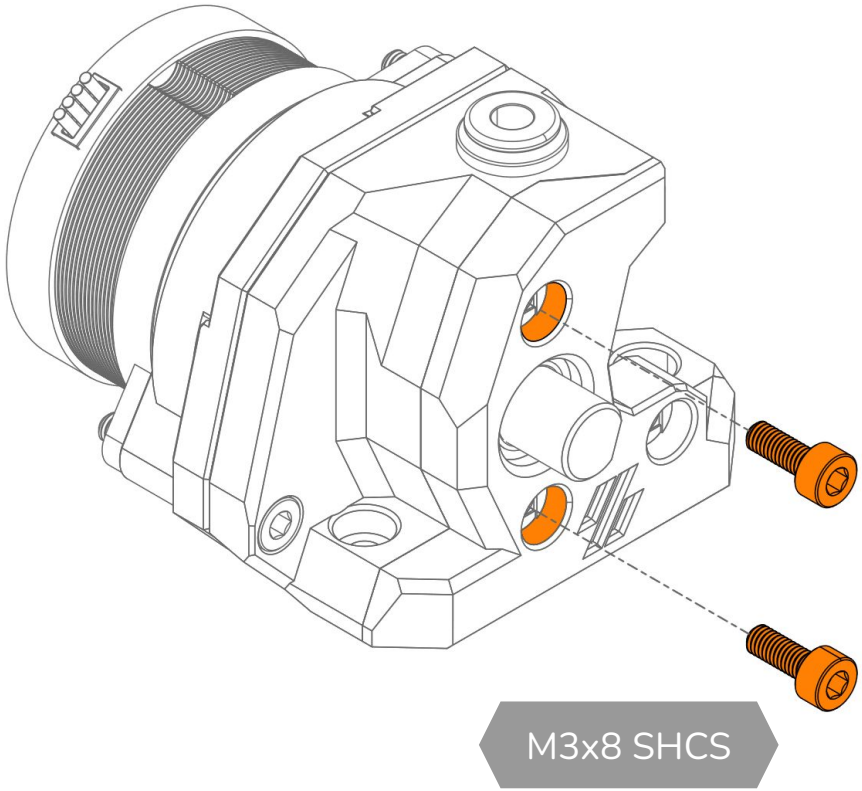
With the carrier shaft fully seated, press the drive gear flat against the printed surface, then tighten the grub screw. Use a small drop of threadlocker to ensure the grub screw doesn't come loose over time.

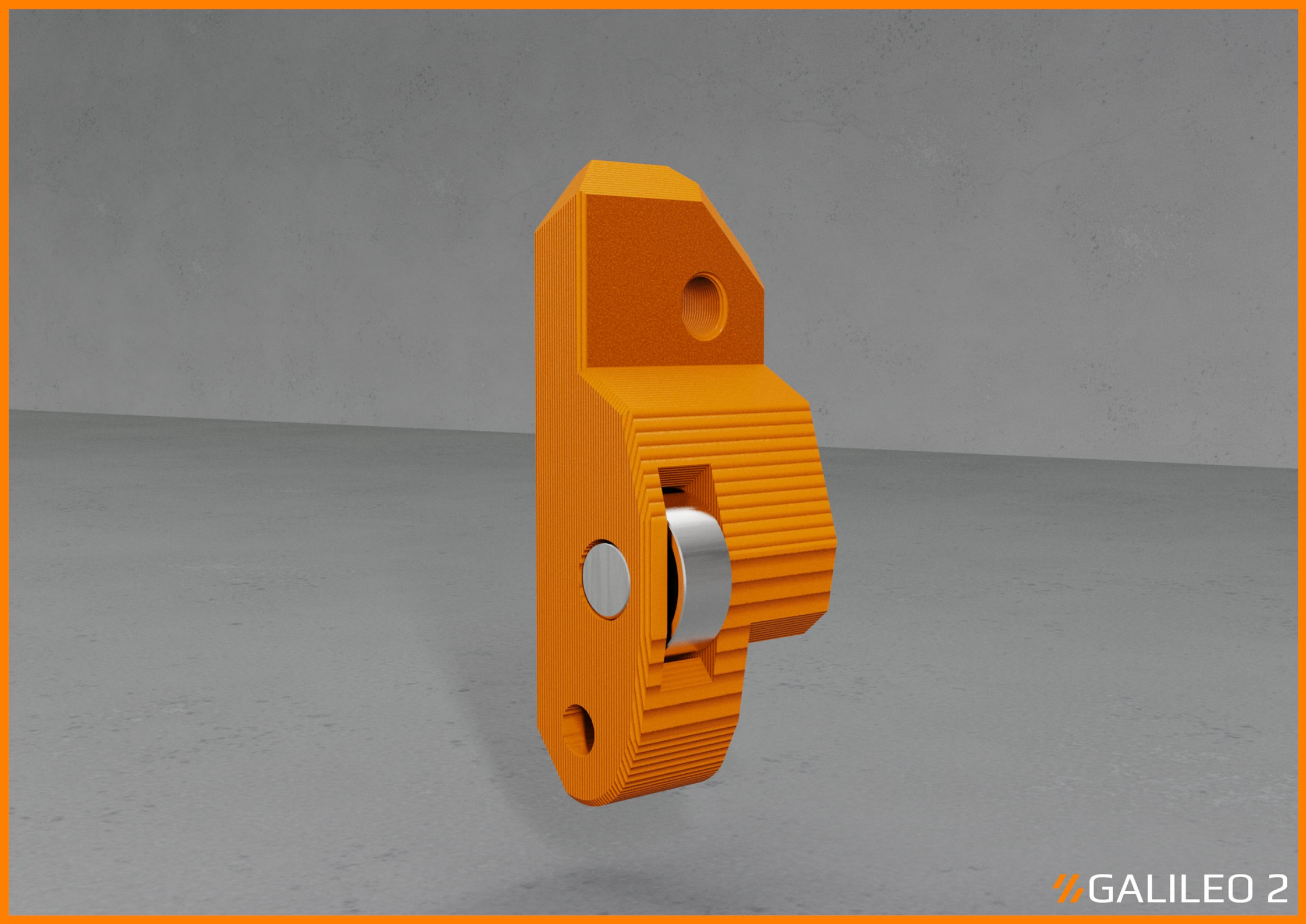


### SHAFT SUPPORT

The front shaft support piece needs to slot over the front bearing. There are also some keying features on the bottom that will snap into place.



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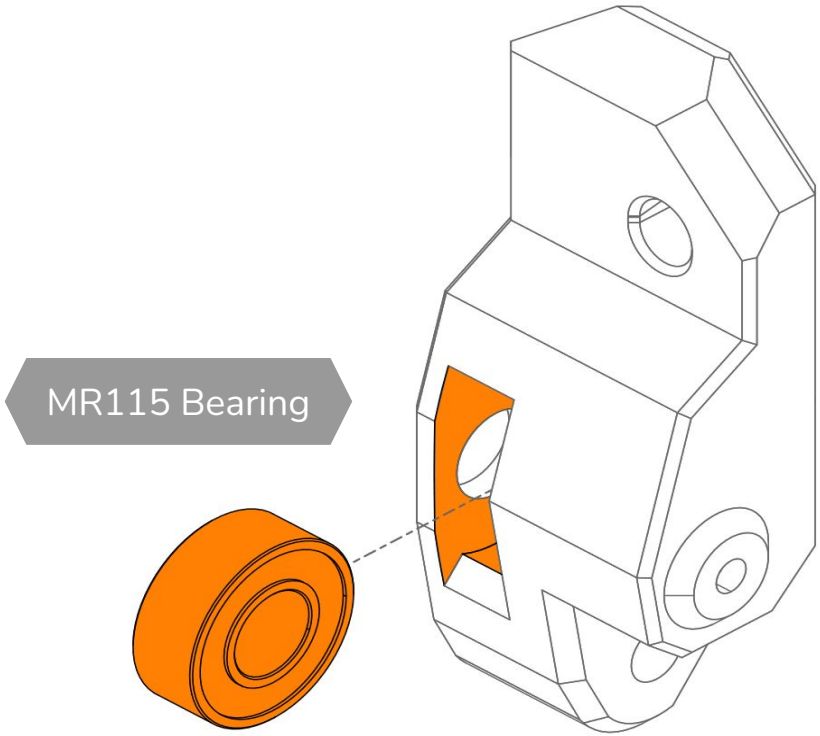
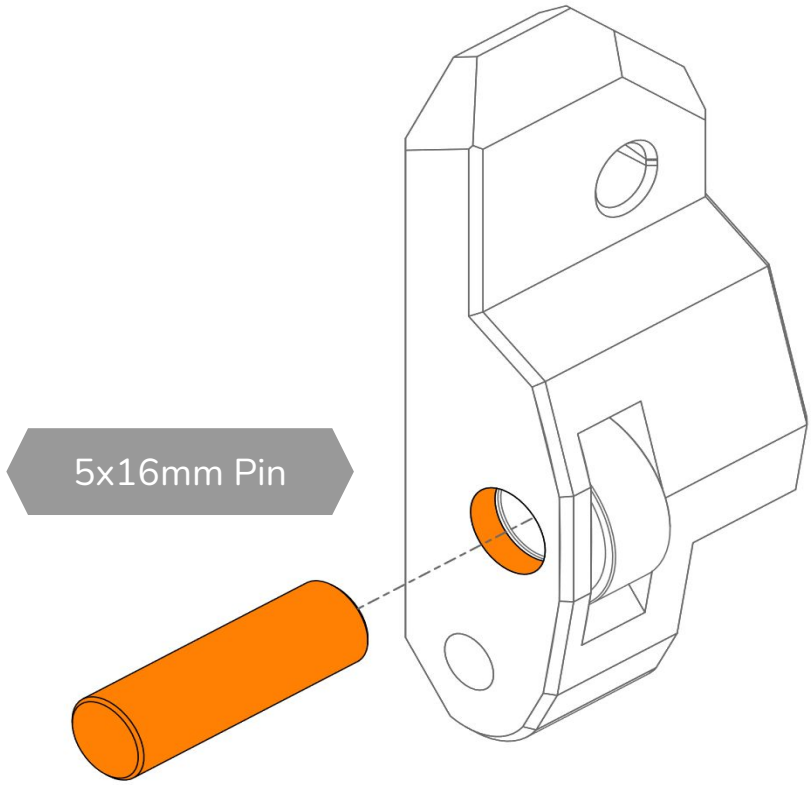
### I WANTED TO MAKE ANOTHER JOKE, BUT THE TENSION WAS TOO HIGH...

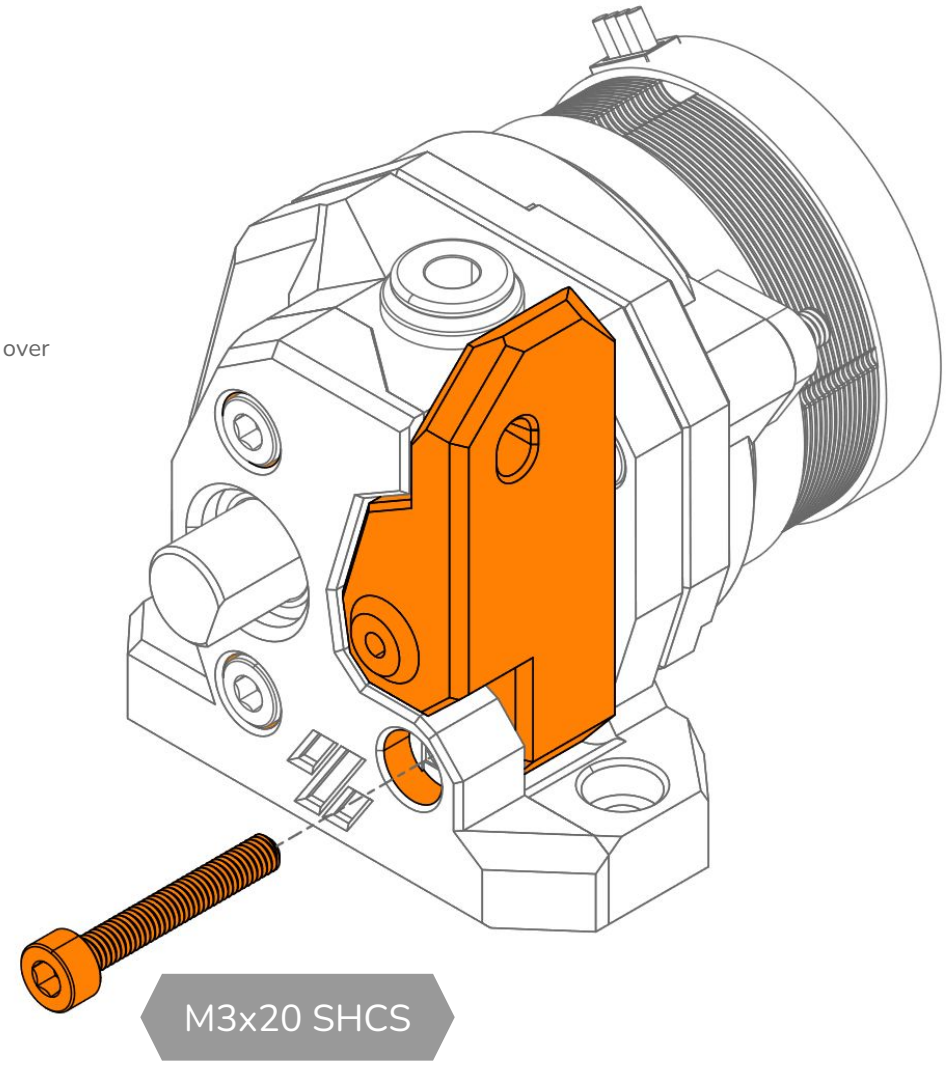
Bearing and pin will be installed in the tensioner arm next. Make sure the bearing spins freely on the pin once installed. If if it doesn't you may need to remove it and check and see if there are any print remnants in the pocket that the bearing slots into.



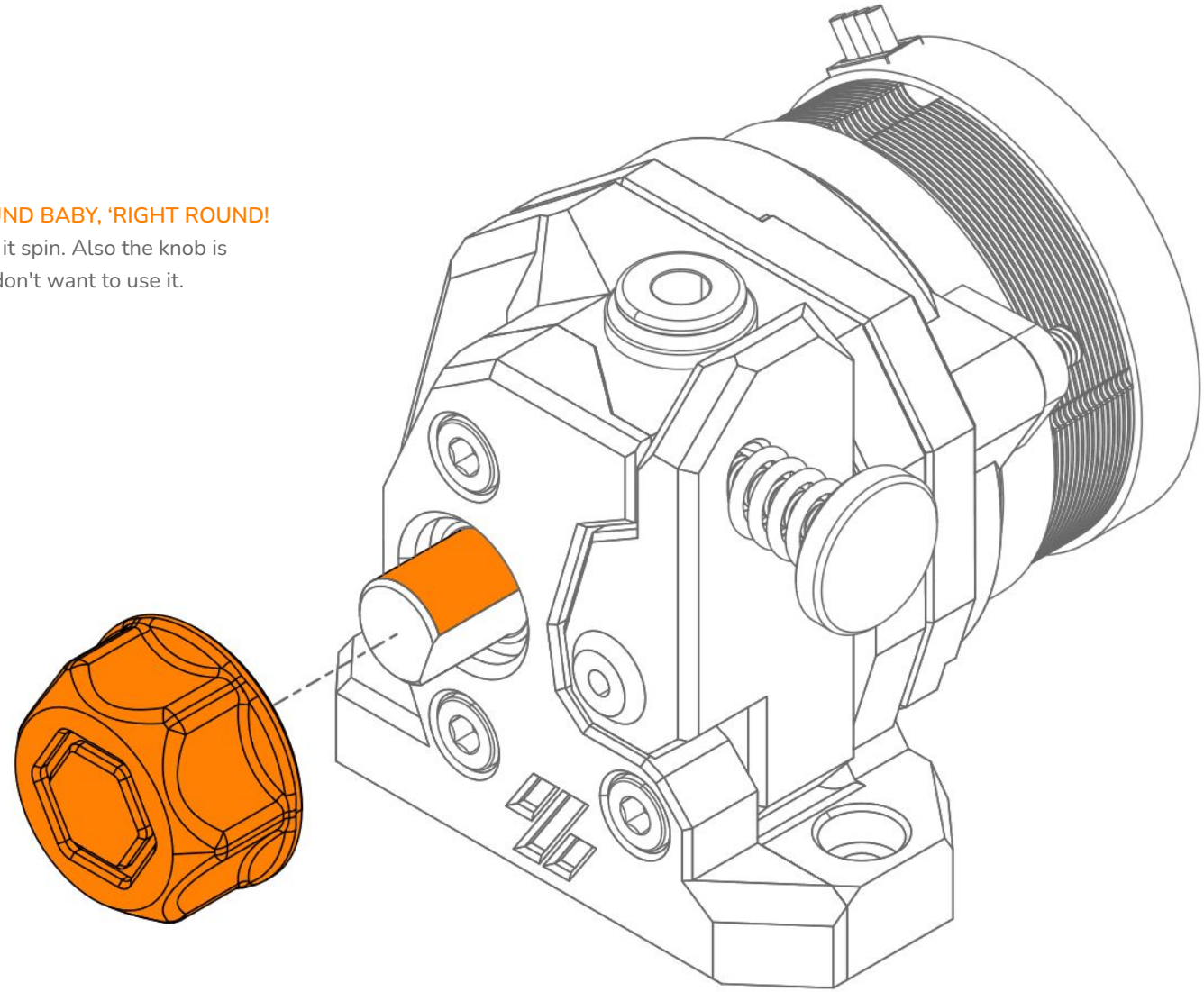
### LET US EASE SOME OF THAT TENSION

One of the last steps is to install the tensioner arm. Don't over tighten this as it is supposed to be able to move freely.



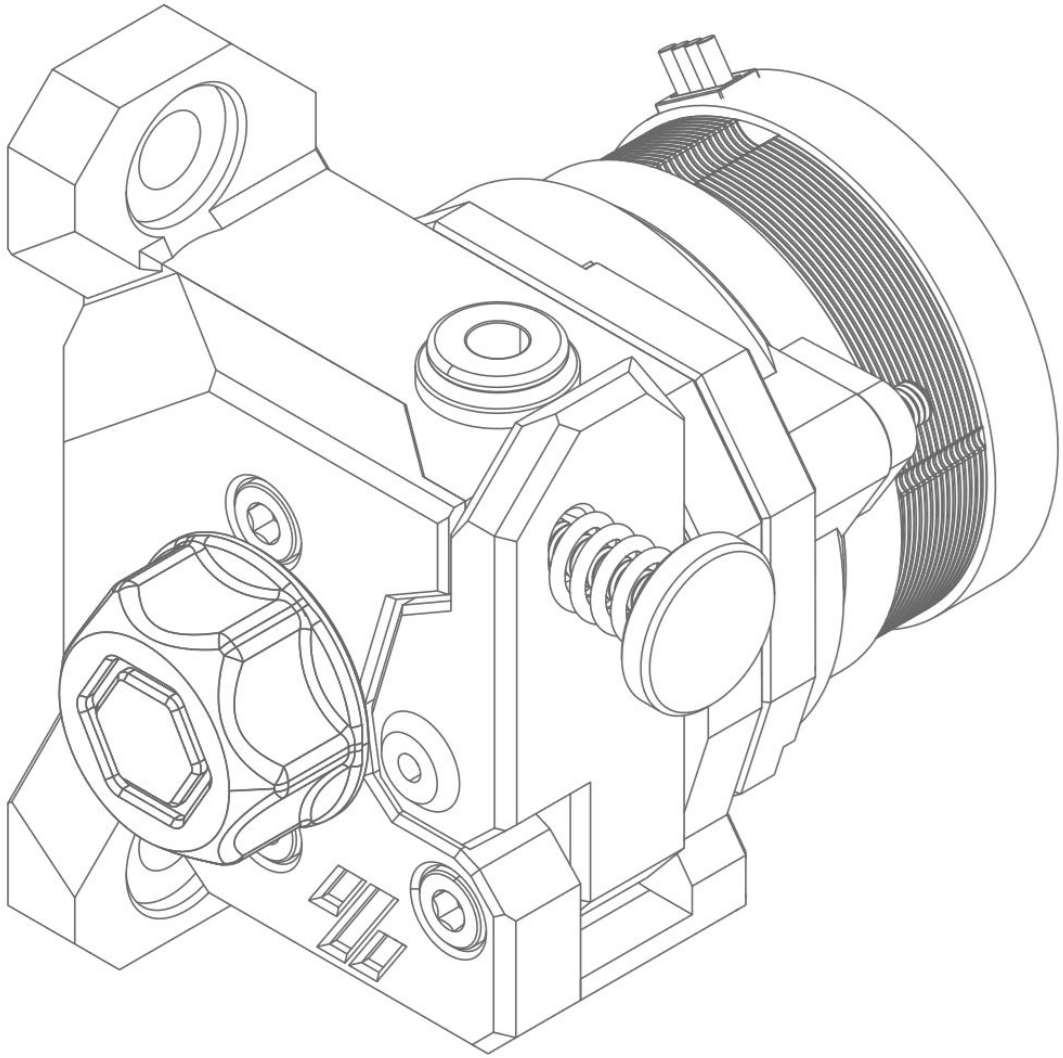
YOU SPIN ME RIGHT ‘ROUND BABY, ‘RIGHT ROUND!

Press the knob on and give it spin. Also the knob is completely optional if you don't want to use it.



SOMEONE SAY BOWDEN??!!

A Bowden extruder variant will be available soon

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**WEBSITE**
vorondesign.com

**GITHUB**
github.com/VoronDesign

**DISCORD**
discord.gg/voron