GALILEO 2 WRISTWATCH

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

VERSION 6JAN2024

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PART PRINTING GUIDELINES

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 WristWatch G2 GitHub repository.

PRIMARY COLOR

Rear_Plate.stl
Tension_Arm.stl

ACCENT COLOR

Front_Body_ECAS.stl

HOW TO GET HELP

Galileo is a series of planetary-geared projects 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 Wrist Watch Galileo 2 Extruder. Galileo 2 is a product supported by community at VORON Design. Help for Galileo and Wristwatch extruders can be found on VORON Discord or VORON forum.

WHAT BIG GEARS YOU HAVE!

In addition to the planetary gear reduction, WWG2 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.

WWG2 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.

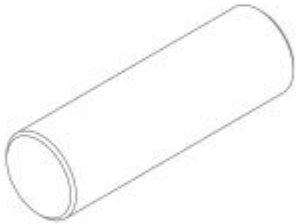
```
[extruder]
rotation_distance: 47.088
gear_ratio: 9:1
microsteps: 16

[tmc2209 extruder]
run_current: 0.6
```

HARDWARE - REFERENCES

SOCKET HEAD CAP SCREW (SHCS)
Metric fastener with a cylindrical head and hex drive.
ISO 4762

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.



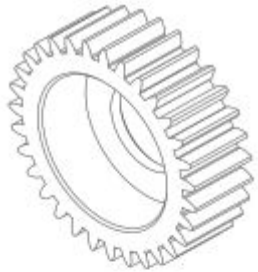
PIN
16mm x 5mm OD

MR148 BEARING
Main shaft support

EXTRUDER THUMBSCREW
Spring will be stiff

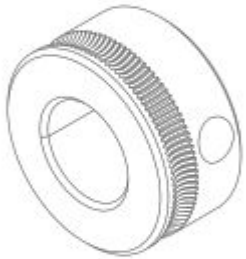
MR115 BEARING
Planetary and idlers

HARDWARE - REFERENCES



PLANETARY GEAR
31-Tooth MJF Gear

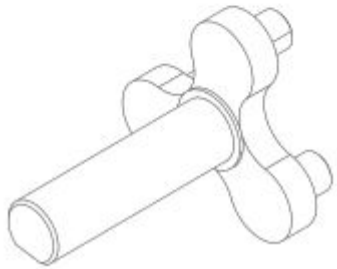
NEMA 14 PANCAKE STEPPER
9T, 20mm



GALILEO 2 EXTRUDER GEAR
RNC-Coated 16mm Drive Gear

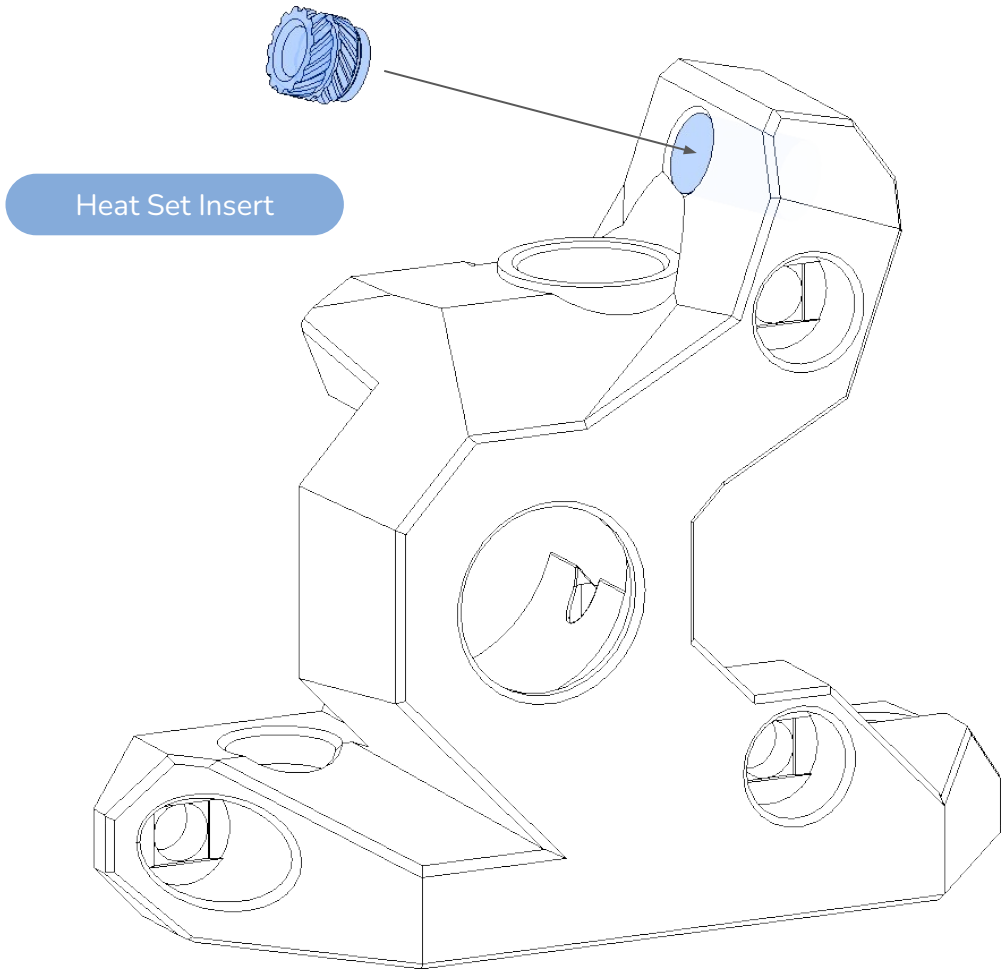
ECAS fitting
You won't need the black rubber part on the bottom

RING GEAR HOUSING
72-Tooth MJF Housing



PLANETARY CARRIER SHAFT
Aluminum Carrier

HEATSET PREP - MAIN BODY



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).

HEATSET PREP - REAR PLATE

HEAT SET INSERTS

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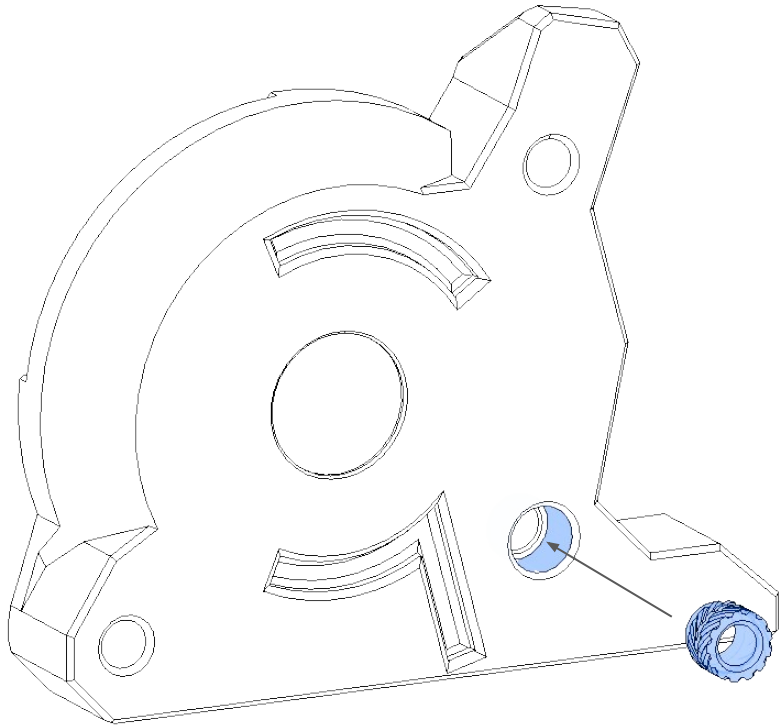


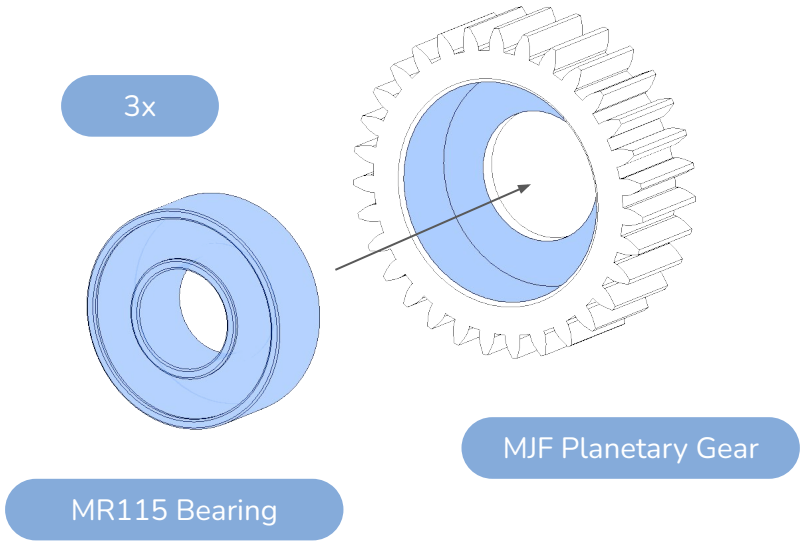
Heat Set Insert

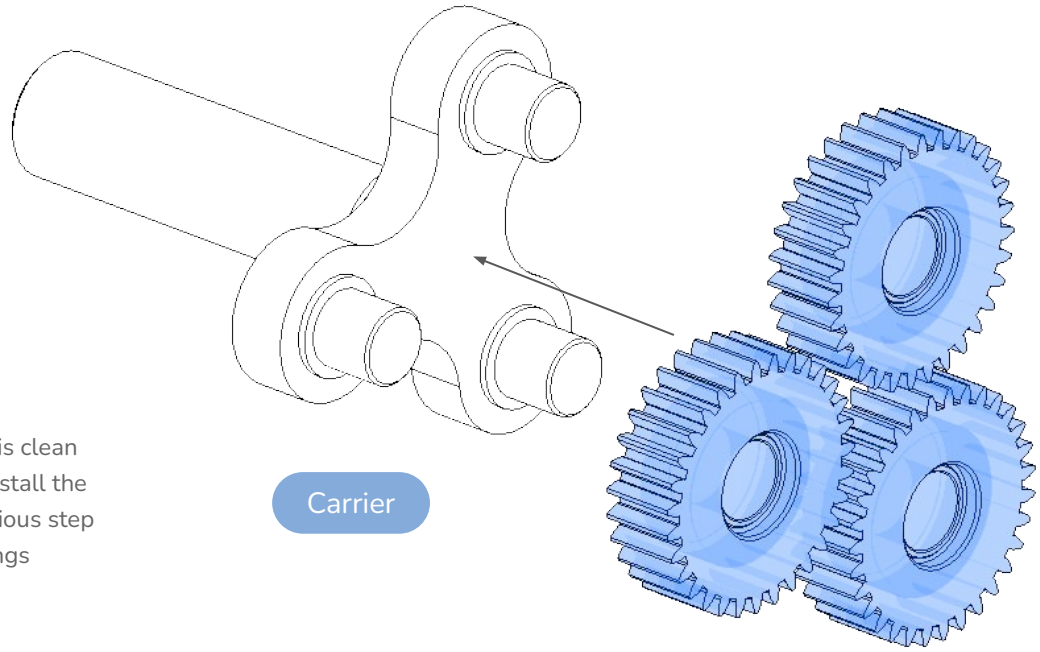
HOW DO YOU THROW A PARTY ABOUT SPACE?.....YOU PLANET!

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

INTERGALACTIC, PLANETARY!

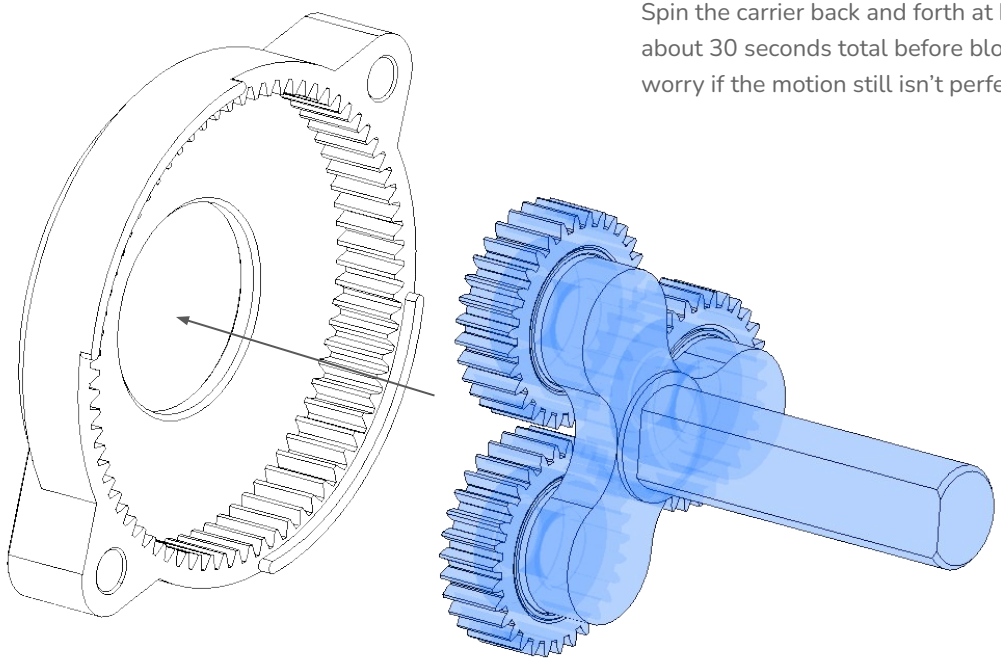
Start by inserting the bearings for each of the three (3) planetary gears. The bearings should press fit into place with little effort. It's okay if the bearings are loose enough to fall out on their own; they will be held captive when the gearbox is assembled.





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

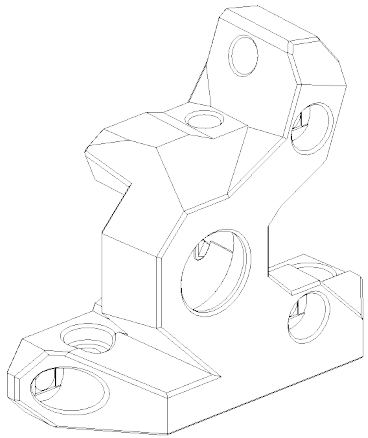
After running in the gearbox manually above, double check for and remove any residual MJF dust that may be in the gearbox before moving on to lubing the gearbox assembly.

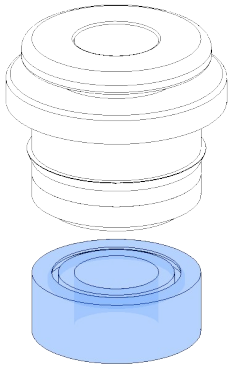
To lube the gearbox, put a pea-sized blob of grease on the bottom flat surface of the ring gear housing, then insert the carrier with planets into the ring gear housing, rotating while installing. Give the carrier 10-20 full rotations to allow the grease to move around and fill all of the nooks in the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

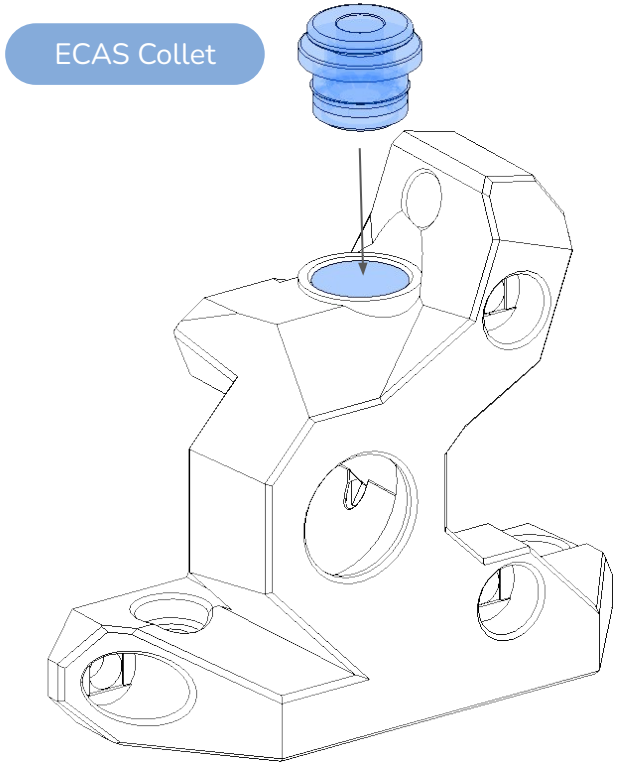
ECAS PREP

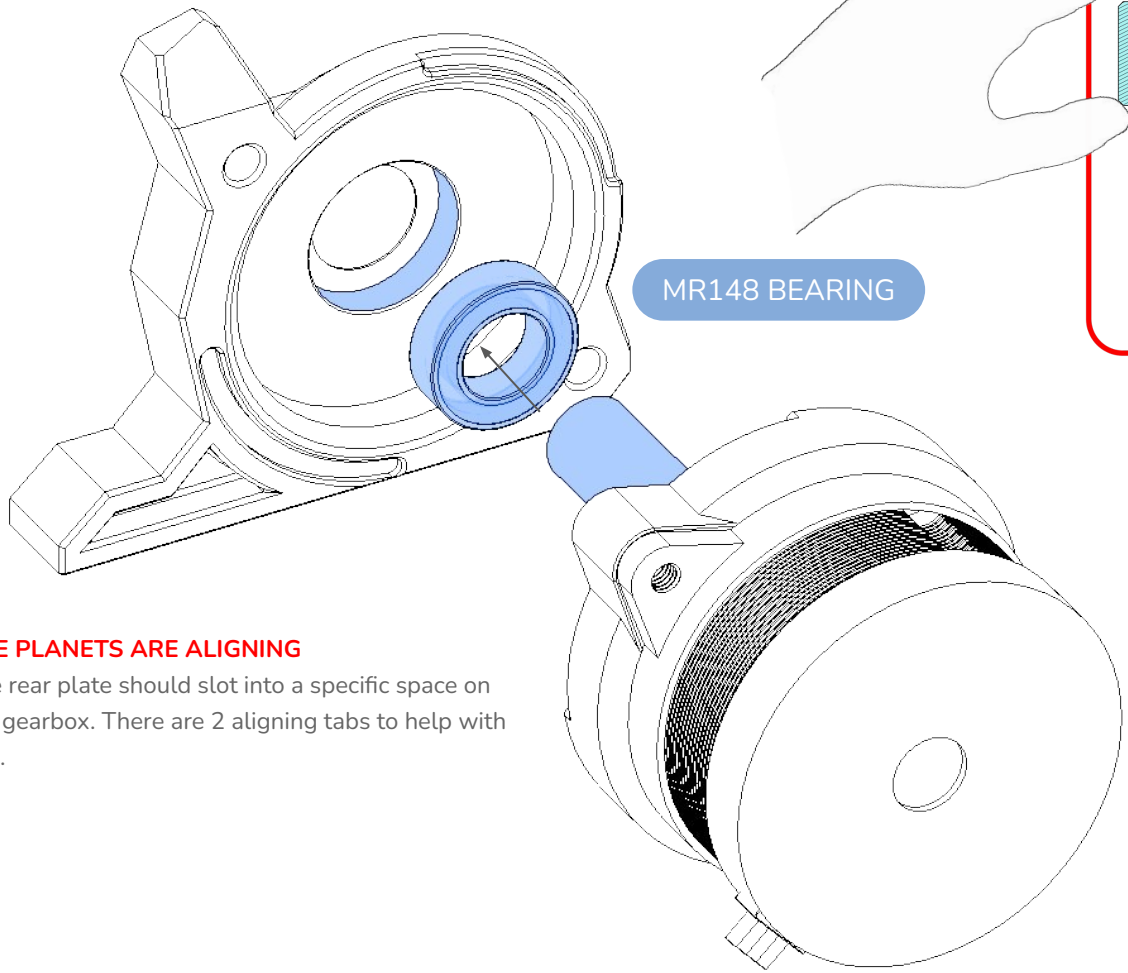
The rubber donut on the bottom highlighted here is not used in this build. Pry the rubber donut off and set it aside where pets won't find a way to use it to increase your vet bill.

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.

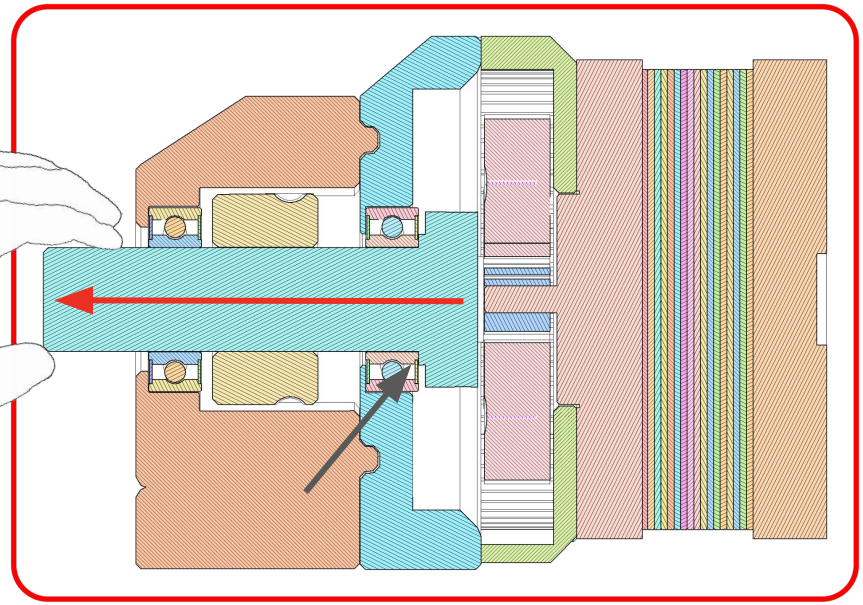








MR148 BEARING

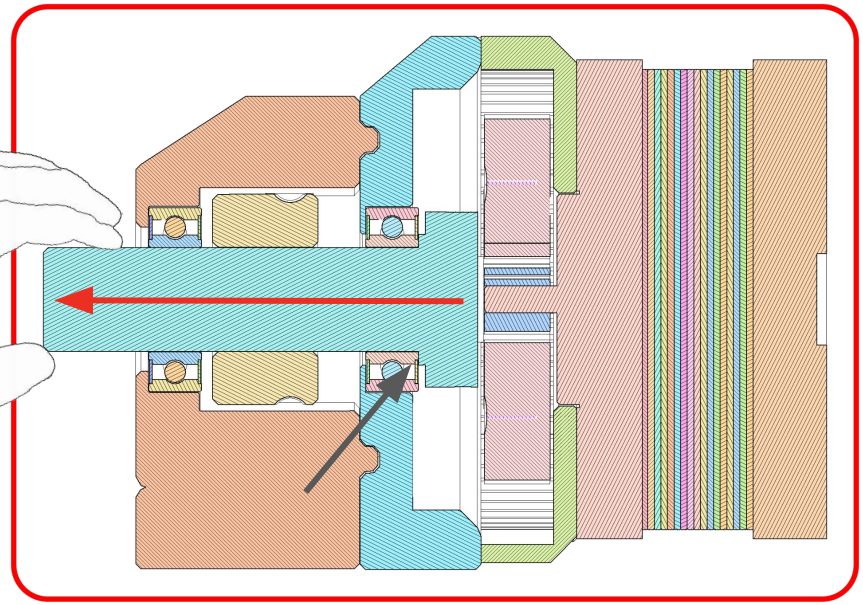


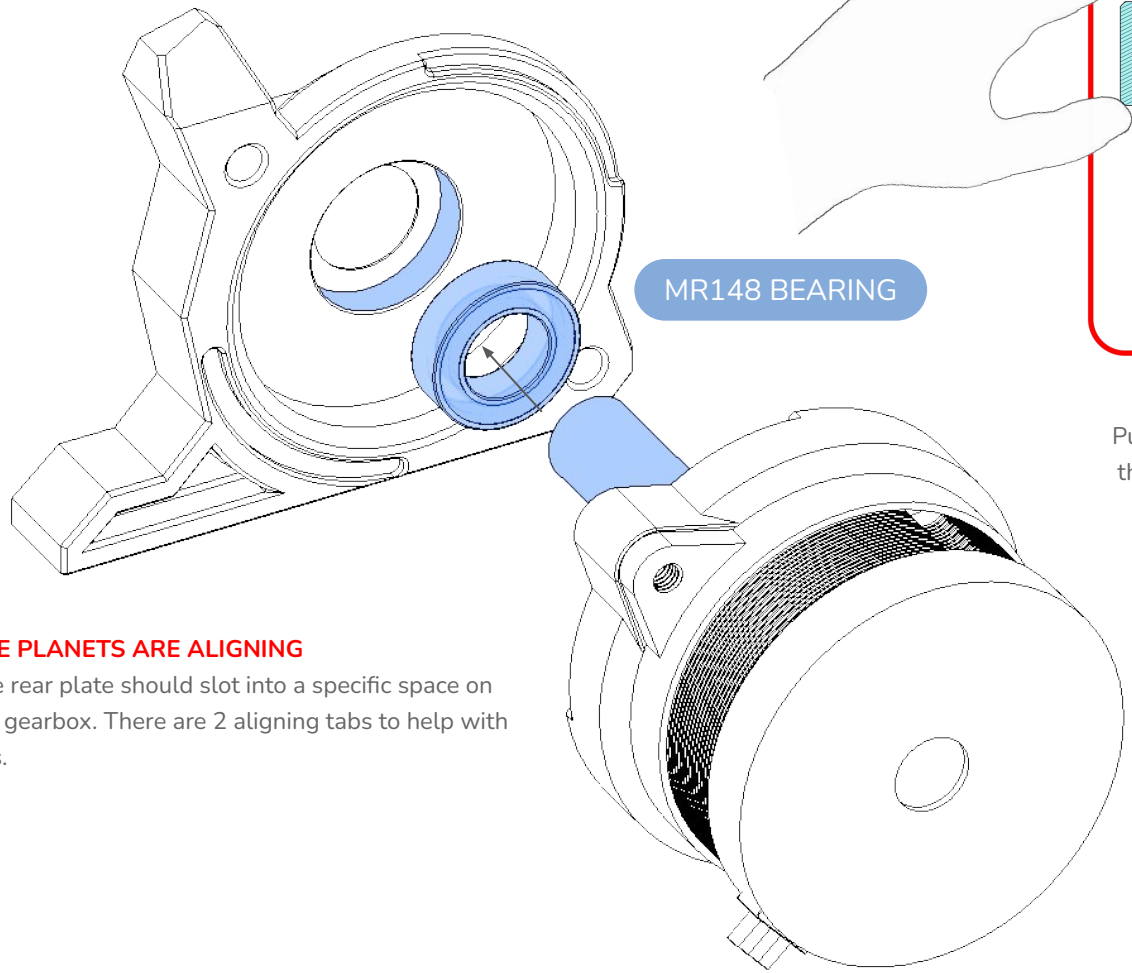
THE PLANETS ARE ALIGNING

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

WARNING!

The shoulder of the carrier here is supposed to be resting on the inner race of the rear bearing when the filament path is aligned.





WARNING!

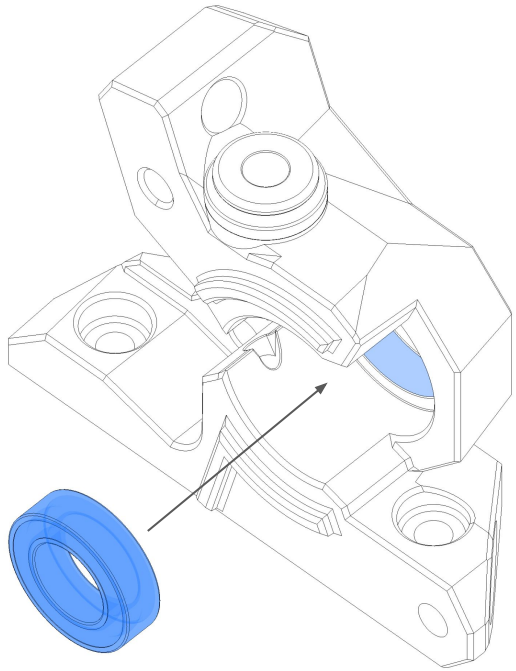
Pull the planetary carrier forward while aligning the filament path. This lets the planetary carrier rest on the inner ring of the rear bearing, and align the tolerances correctly.

THE PLANETS ARE ALIGNING

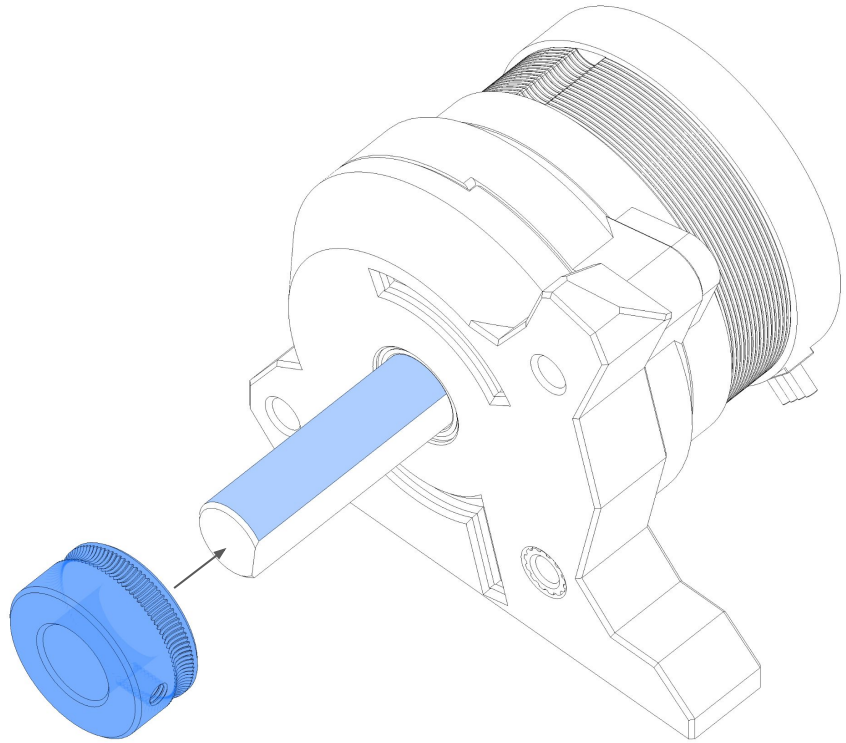
The rear plate should slot into a specific space on the gearbox. There are 2 aligning tabs to help with this.

PLANETARY EXTRUSION? IT'S OUT OF THIS WORLD!

Install the custom 16mm drive gear onto the carrier shaft. Insert the MR148 Bearing into the front body.



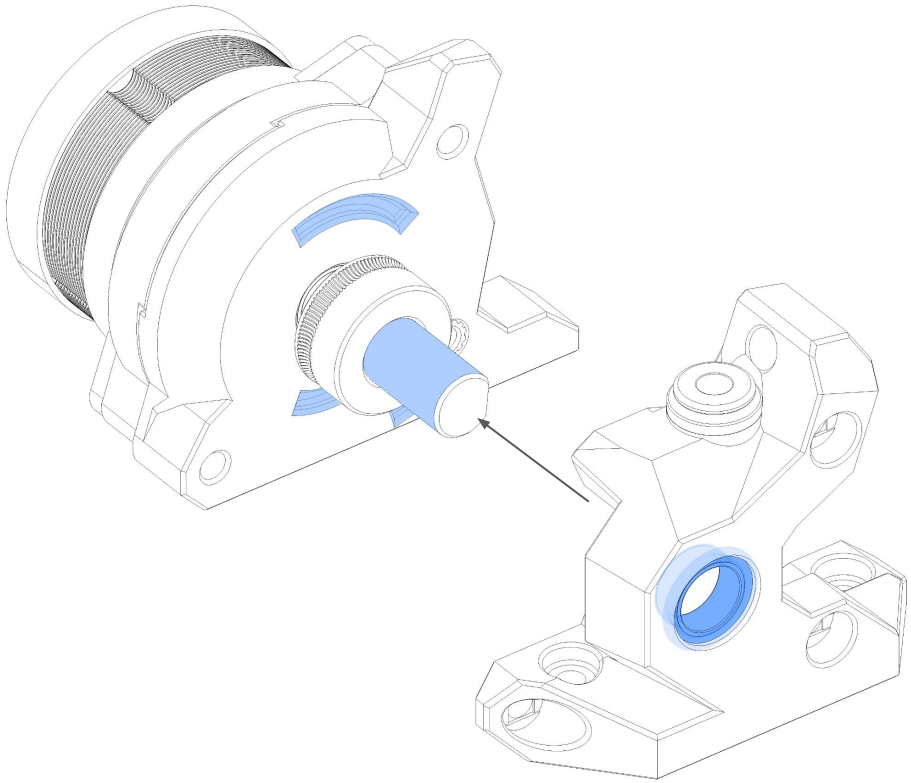
MR 148 BEARING

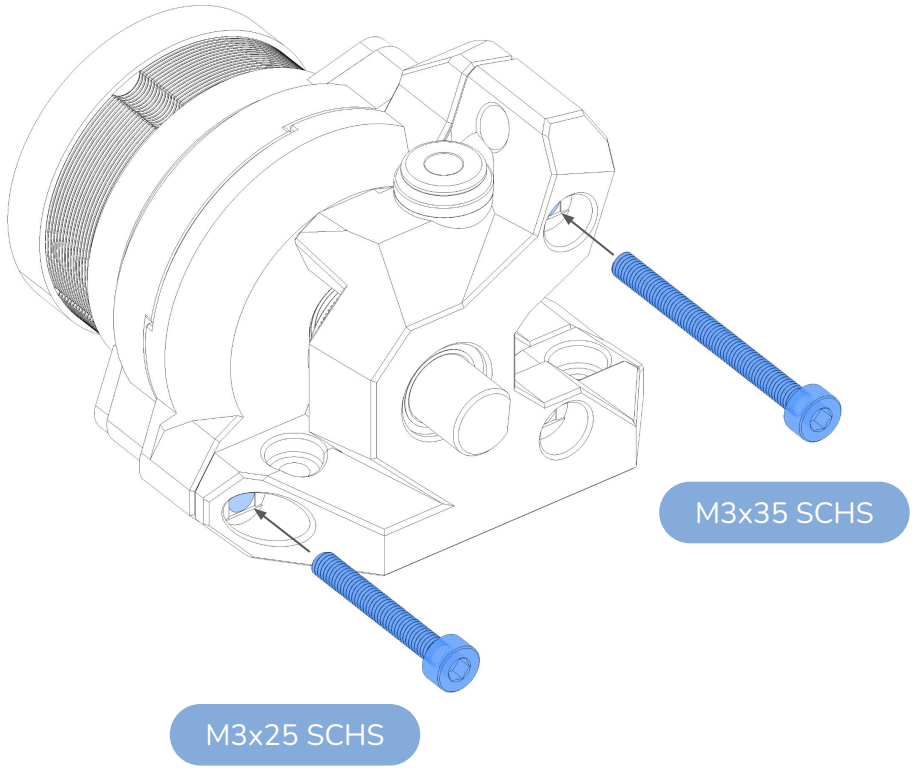


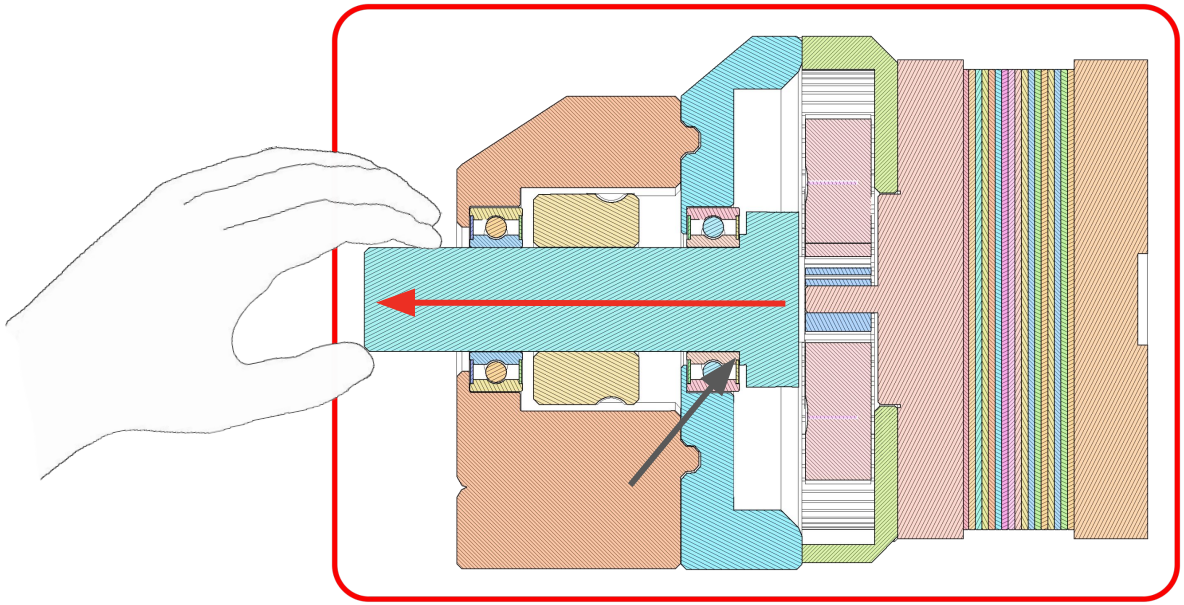
Drive Gear

SHAFT SUPPORT

The drive gear should be left loose until this step and only after the front body is connected to the rear plate should the user fine tune by moving the drive gear to the correct location.







WARNING!

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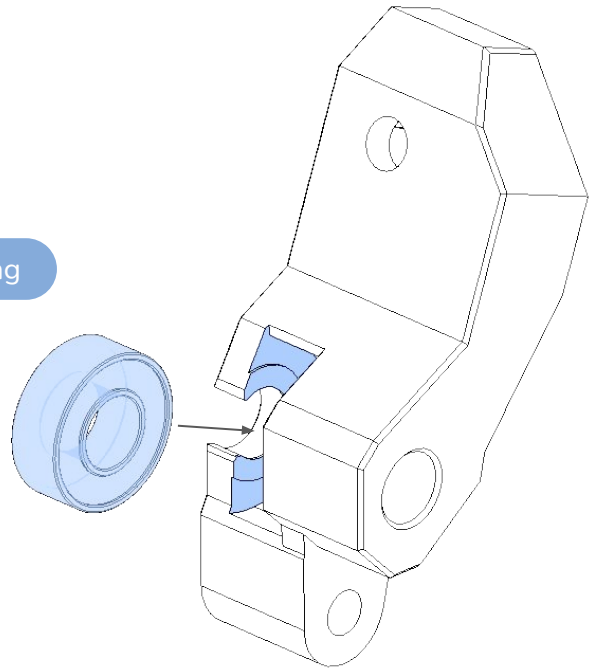
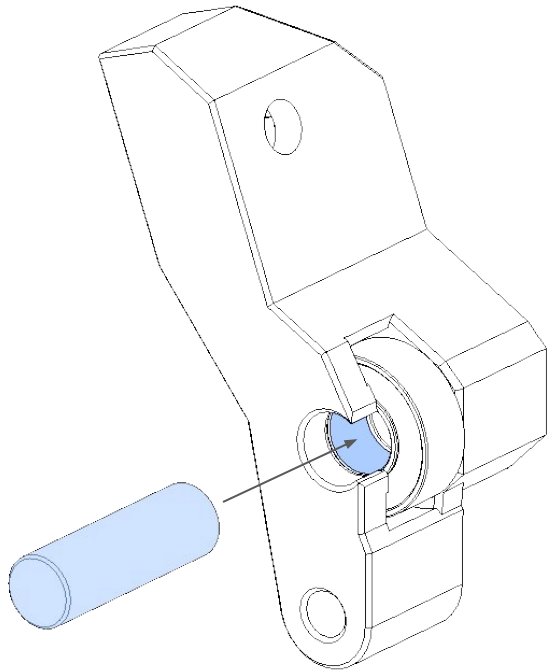
I WANTED TO MAKE ANOTHER JOKE, BUT THE TENSION WAS TOO HIGH...

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.

MR115 Bearing

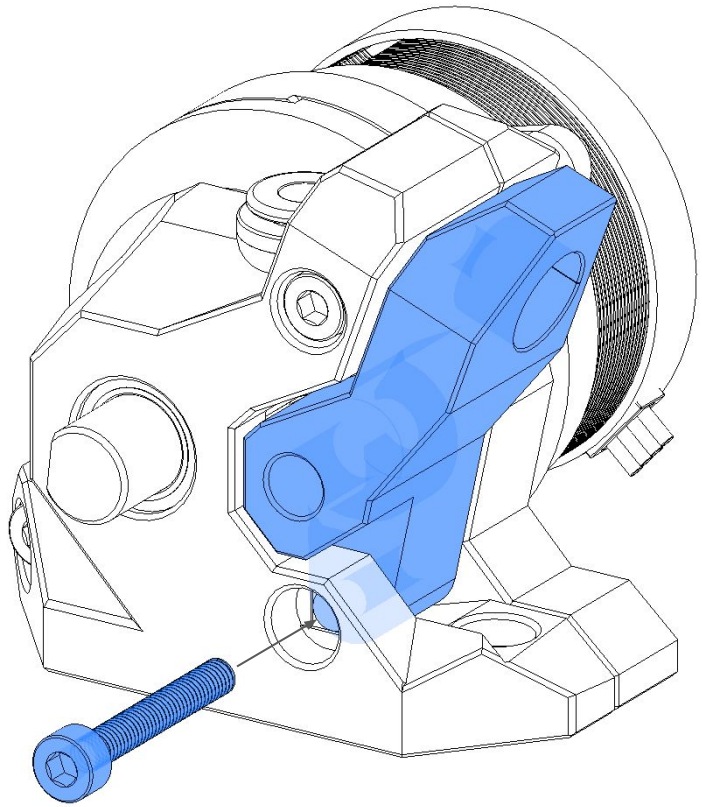




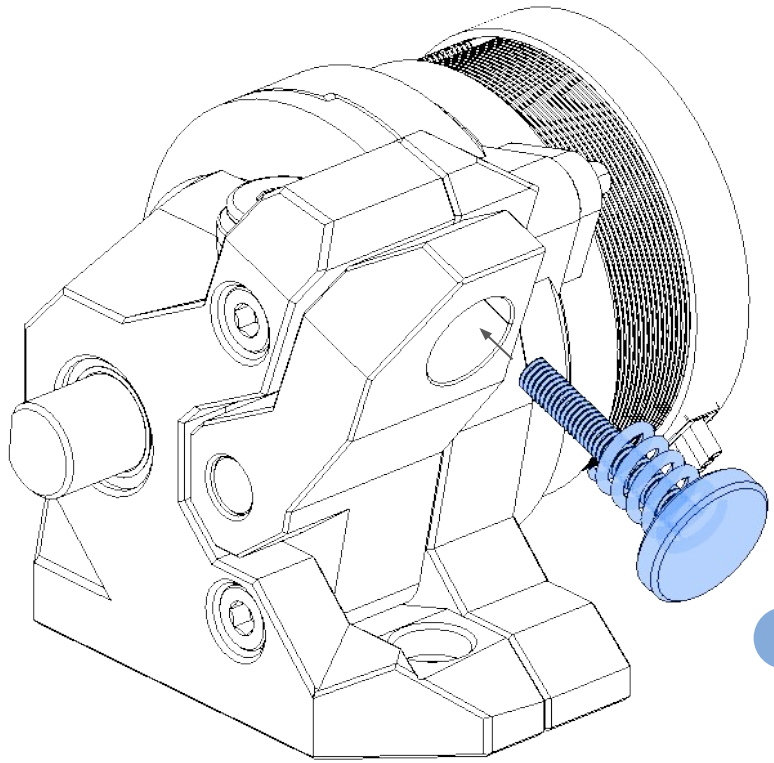
5x16mm Pin

LET US EASE SOME OF THAT TENSION

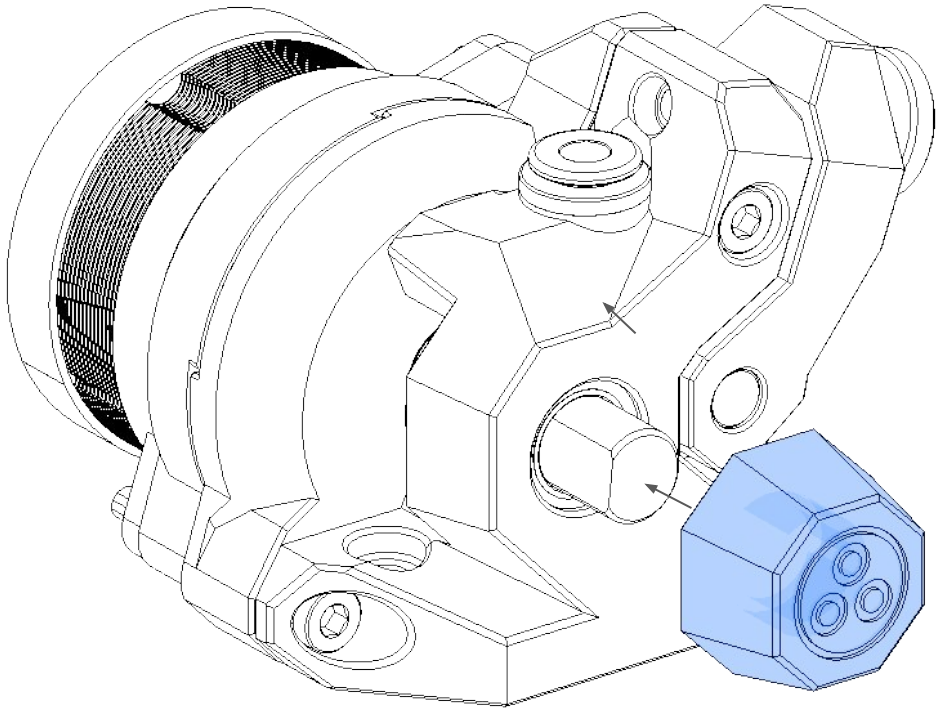
One of the last steps is to install the tensioner arm. Don't over tighten this as it is supposed to be able to move freely



M3x20 SHCS



EXTRUDER THUMBSCREW



EXTRUDER KNOB