

Thrifty Swerve v2

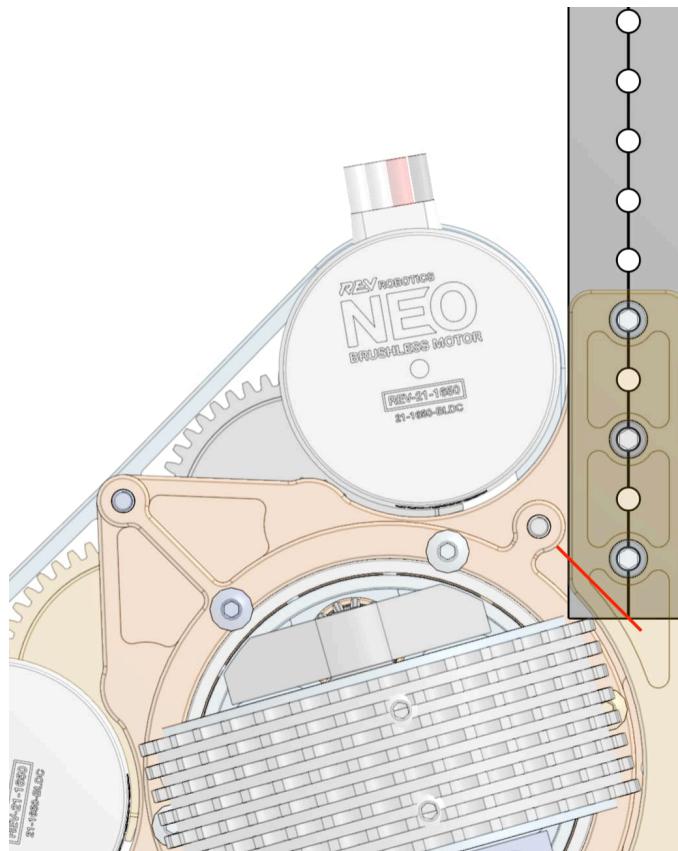
Assembly Guide

Version 1.2 Last Updated: 10/07/2024

Thank you for purchasing Thrifty Swerve v2. This module was designed and tested in collaboration with FRC teams [1706](#) Ratchet Rockers and [1684](#) The Chimeras during the 2024 Crescendo season. Their feedback helped us test & improve this module and we thank them for all their efforts.

Prior to your purchase, consider the following decisions that need to be made by your team -

- **Which motors will you use?**
 - Thrifty Swerve supports West Coast Products Kraken X60 motors, REV Robotics NEO motors & REV Robotics Vortex motors. You can use a combination of 8mm keyed and kraken motor output shafts if desired.
- **Which absolute encoder will you use?**
 - Thrifty swerve includes our absolute magnetic encoder, but also supports other commonly used encoders made by CTRE and Redux Robotics.
- **How large will your frame size be?**
 - Knowing how large to cut your 2" x 1" extrusion beforehand is good. Use our [OnShape CAD model](#) to insert the module into your design. Note that the 2" x 1" extrusion must be trimmed down on the ends in order to fit into the module if using standard ½" grid pattern tubing. See the image below & plan ahead!



- Which gear ratio option will you start with?
 - Thrifty swerve includes all the gear ratio options out of the box and is very easy to swap after modules are assembled and installed, but it's still good to consider which ratio you want to start with. Consult the speed table below.

Thrifty Swerve Free Speed (ft/s) - NEO			
Output Gear	Pinion Gear		
	12T	13T	14T
18T	15.0	16.3	17.6
16T	16.9	18.3	19.8

Thrifty Swerve Free Speed (ft/s) - Kraken without FOC			
Output Gear	Pinion Gear		
	12T	13T	14T
18T	15.5	16.8	18.1
16T	17.5	18.9	20.4

Azimuth Ratio: 25:1

- Module assembly video link here: [Thrifty Swerve v2 Assembly Video](#)
- **Bearing press & magnet press note:** Some of the bearings will be easier to press in using an arbor press or a c-clamp. We recommend a benchtop 1 ton press like the one sold at harbor freight or a small c-clamp. Some feedback teams have mentioned the magnet being harder to insert than expected as well - use a clamp and not a hammer on the magnets to ensure they do not crack.

<https://www.harborfreight.com/1-ton-arbor-press-59766.html>

Grease Your Gears

Prior to running your modules, apply grease to all gears.

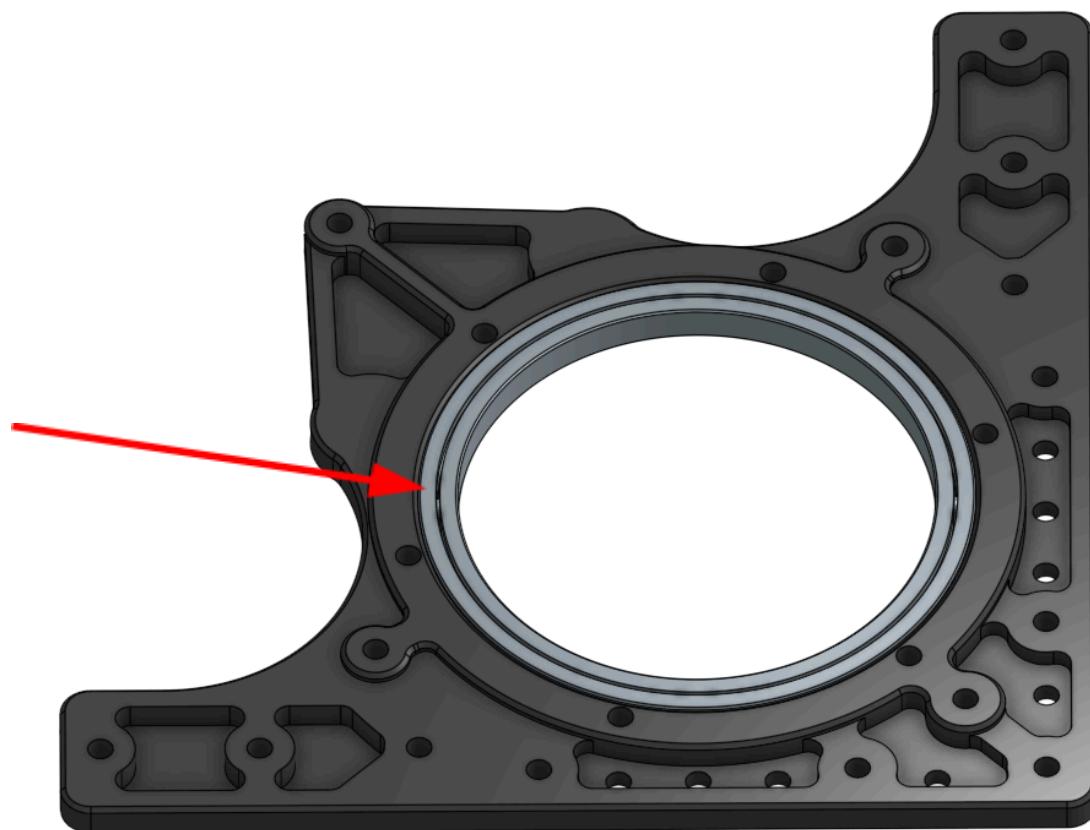
Do not skip this step.

We like [Lucas Oil Red N' Tacky](#) or [Mobil's Mobilux Ep 1](#)

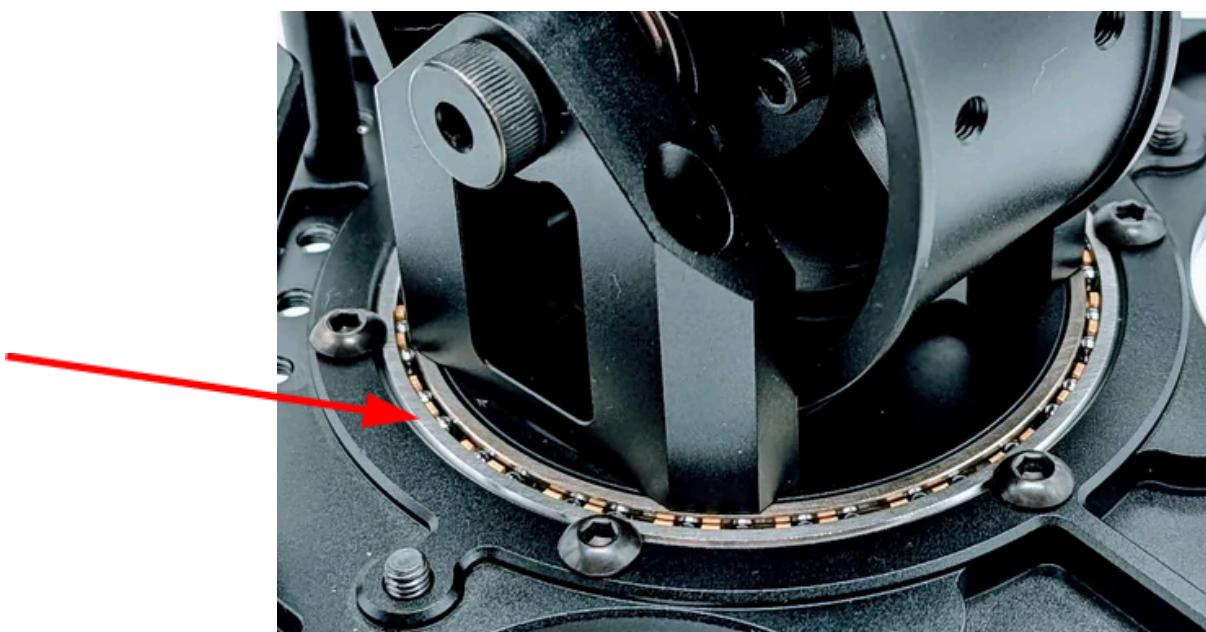


Step 1: Insert the X-Contact bearing into the main base plate

The 3.5" x 3" x .25" X-Contact bearing should sit flush with the bump out on the main base plate.

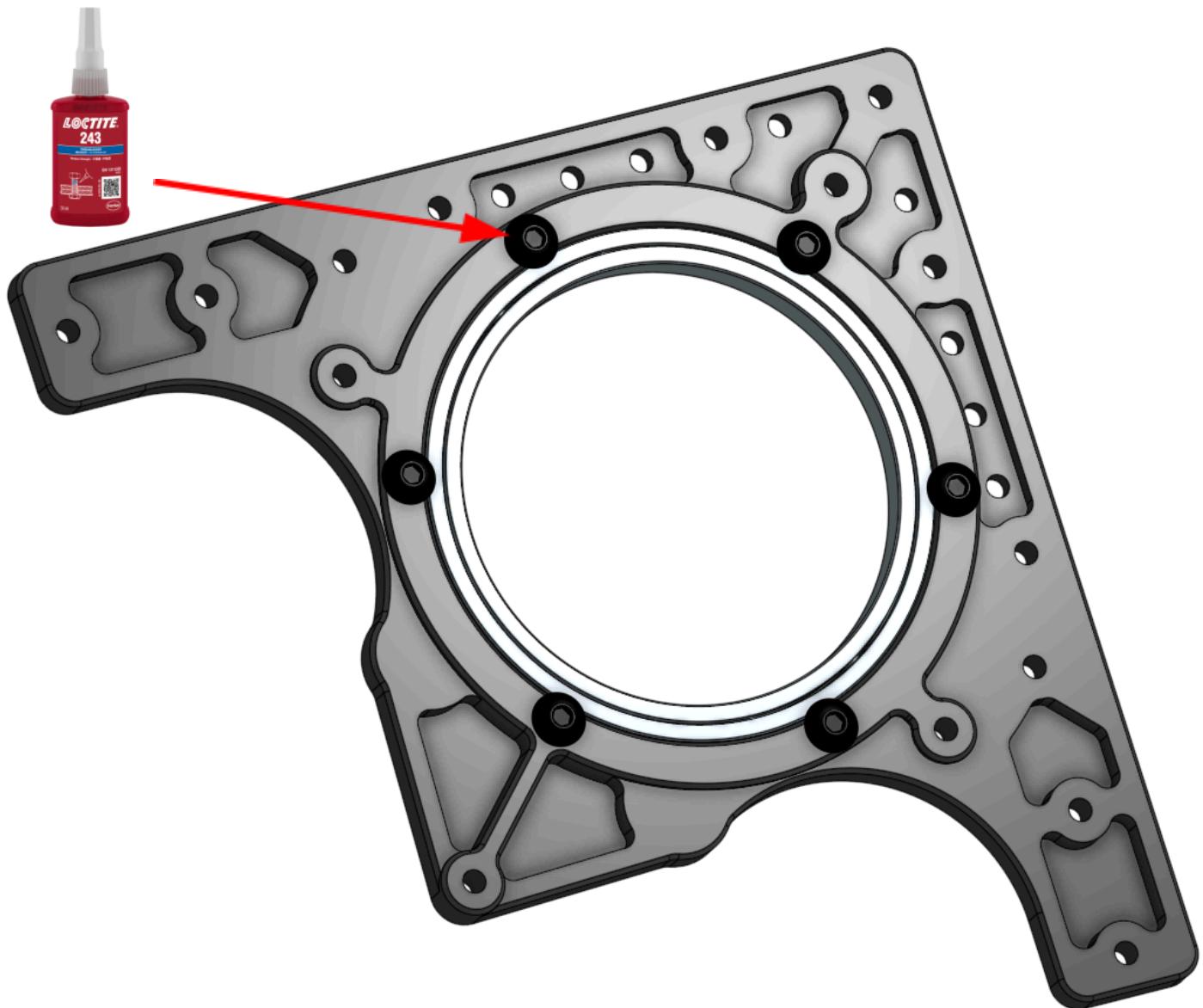


Note: We recommend installing the x-contact bearing with the open face exposed. This will allow you to more easily service and clean the bearing with lubricant over time. We also sell a [completely sealed upgraded](#) version of this bearing as well.



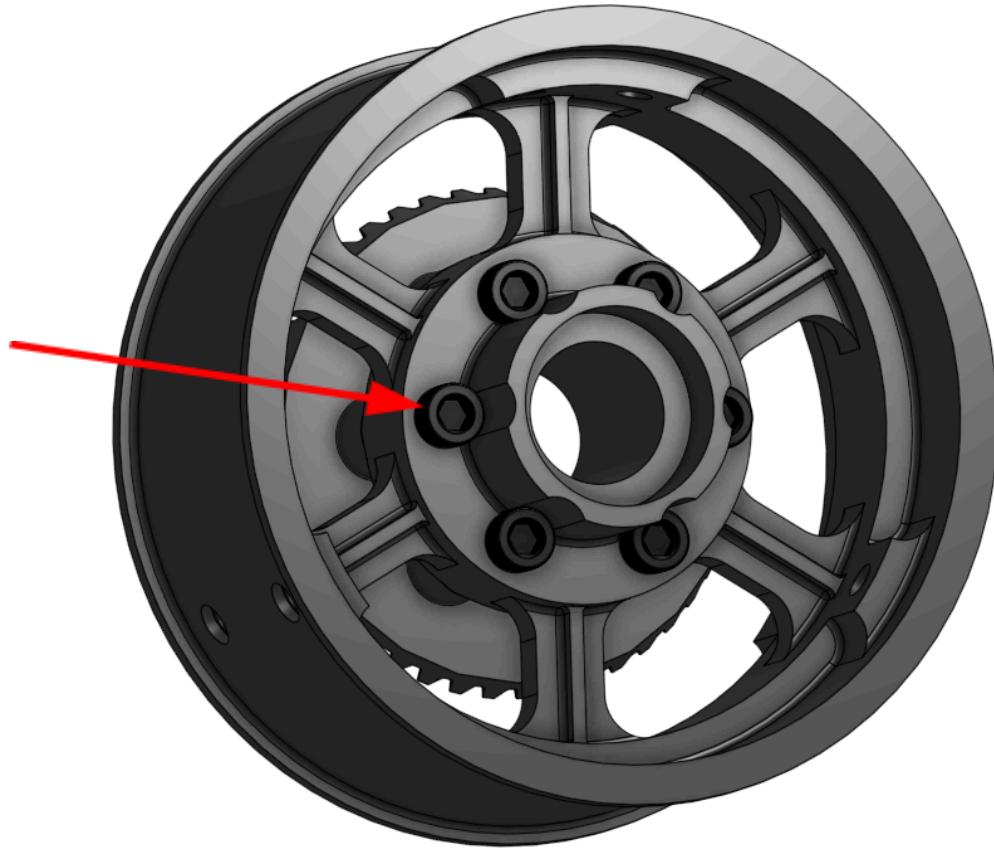
Step 2: Insert the six 10-32 ¼" long button head bolts

Insert the six ¼" long 10-32 button head bolts into the threaded holes to secure the x-contact bearing. We recommend a light application of blue threadlocker here.



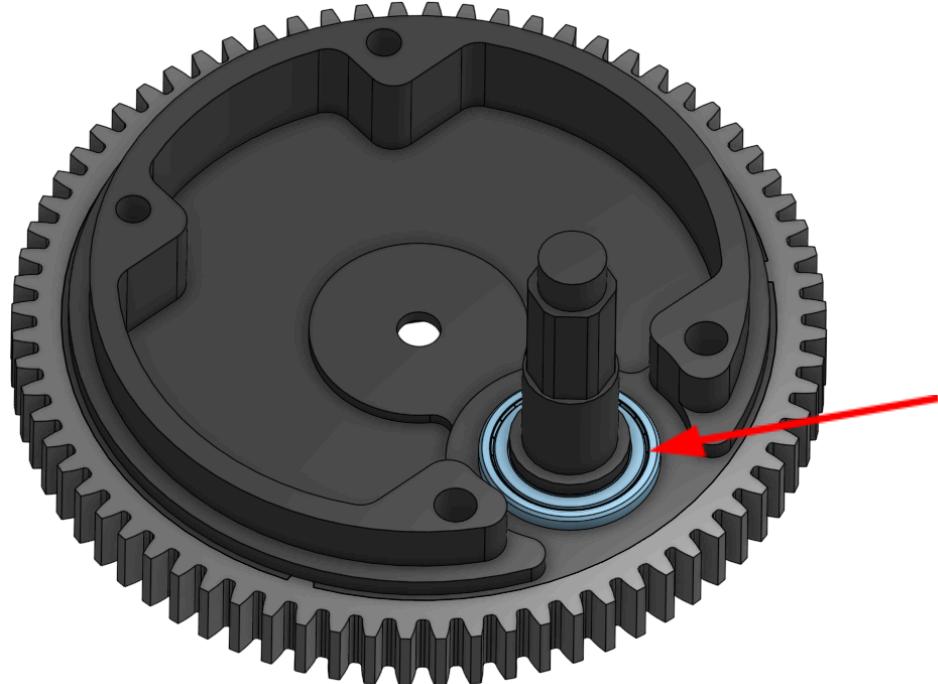
Step 3: Attach the bevel gear to the wheel

Use the six provided 8-32 x 1" socket head screws and attach the bevel gear. Note the orientation of the bolts and how they recess into pockets on the billet wheel. Use thread locker here as well.

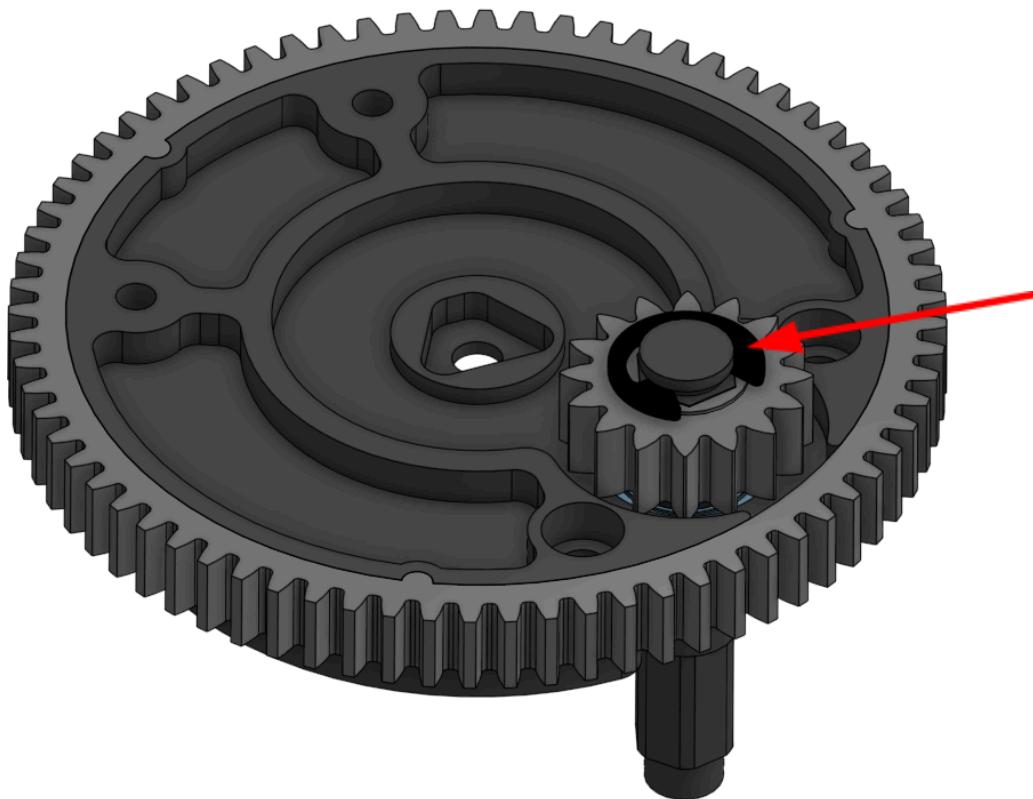


Step 4: Insert the small bevel gear shaft into the azimuth steering gear

Insert the 6801 bearing into the azimuth steering gear and then insert the small bevel gear shaft through it. **Ensure this bearing is 100% pressed in, an arbor press helps here.** If you have access to a dial caliper, the bearing should stick out around .0781".

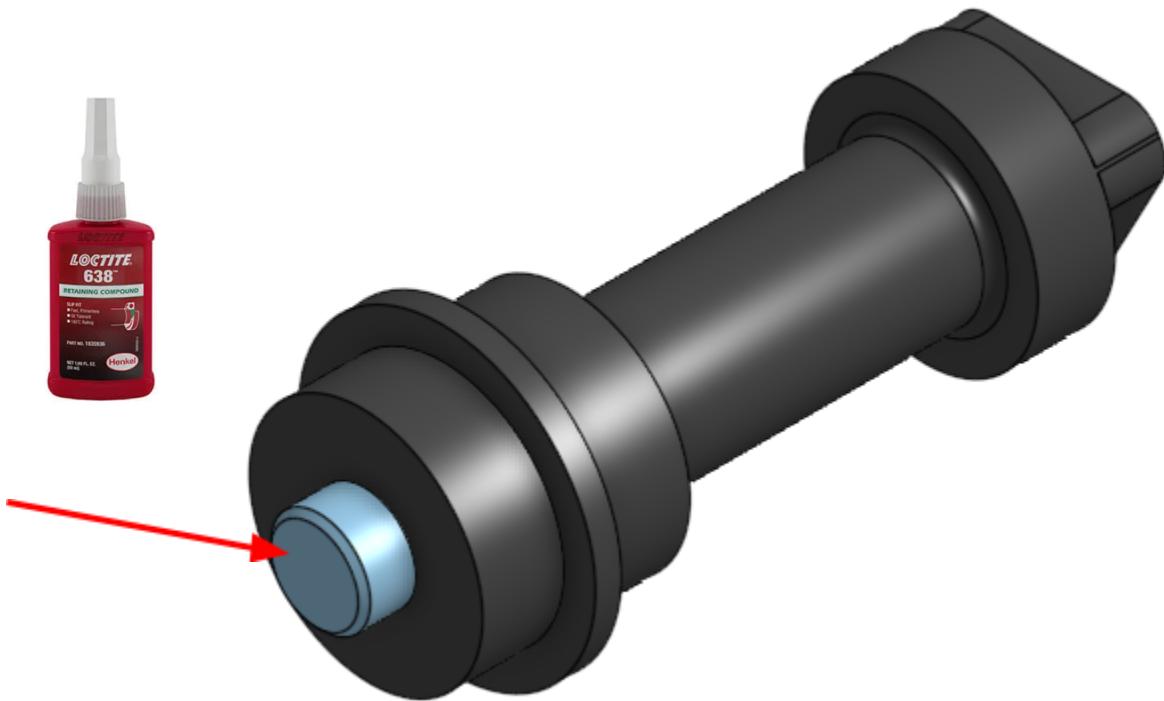


Then select which output gear you want to use - remember that the 16t gear will actually increase your speed if chosen. Place the e-clip snap ring onto the shaft to retain everything.



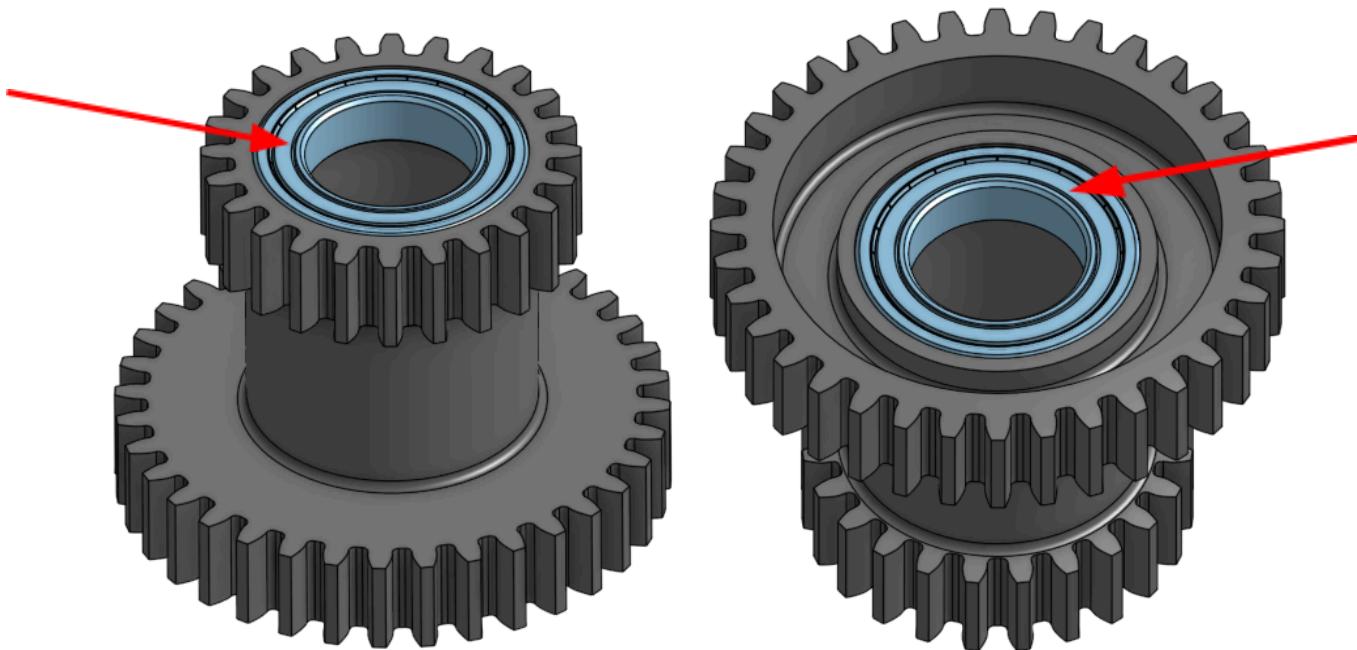
Step 5: Insert the diametrically polarized encoder magnet into the center steering shaft

Press the magnet into the steering column, one is included in the Thrifty Absolute Encoder box. We recommend gluing this magnet in or use green thread locker to ensure it never comes loose. Do this for all of your modules. **Note: Some teams have mentioned this being a press fit - use a c-clamp or an arbor press if having difficulty pressing in by hand - do not hammer these in as they will crack**



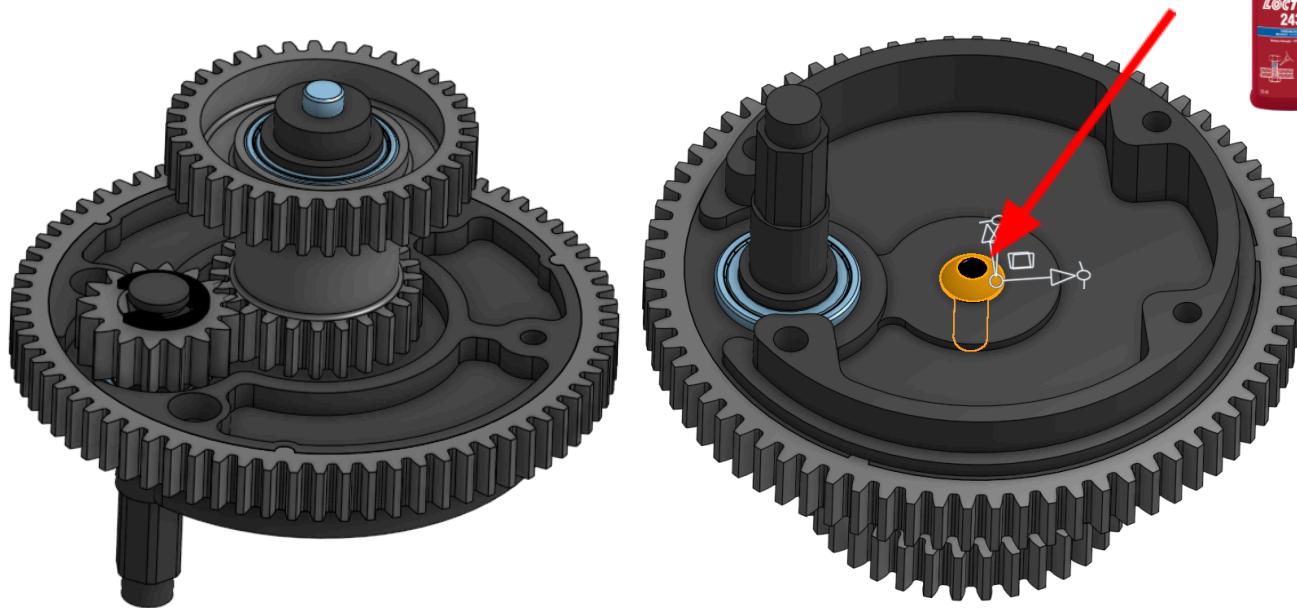
Step 6: Press bearings into the double gear

Press two 6802 bearings into the top and bottom of the double gear.



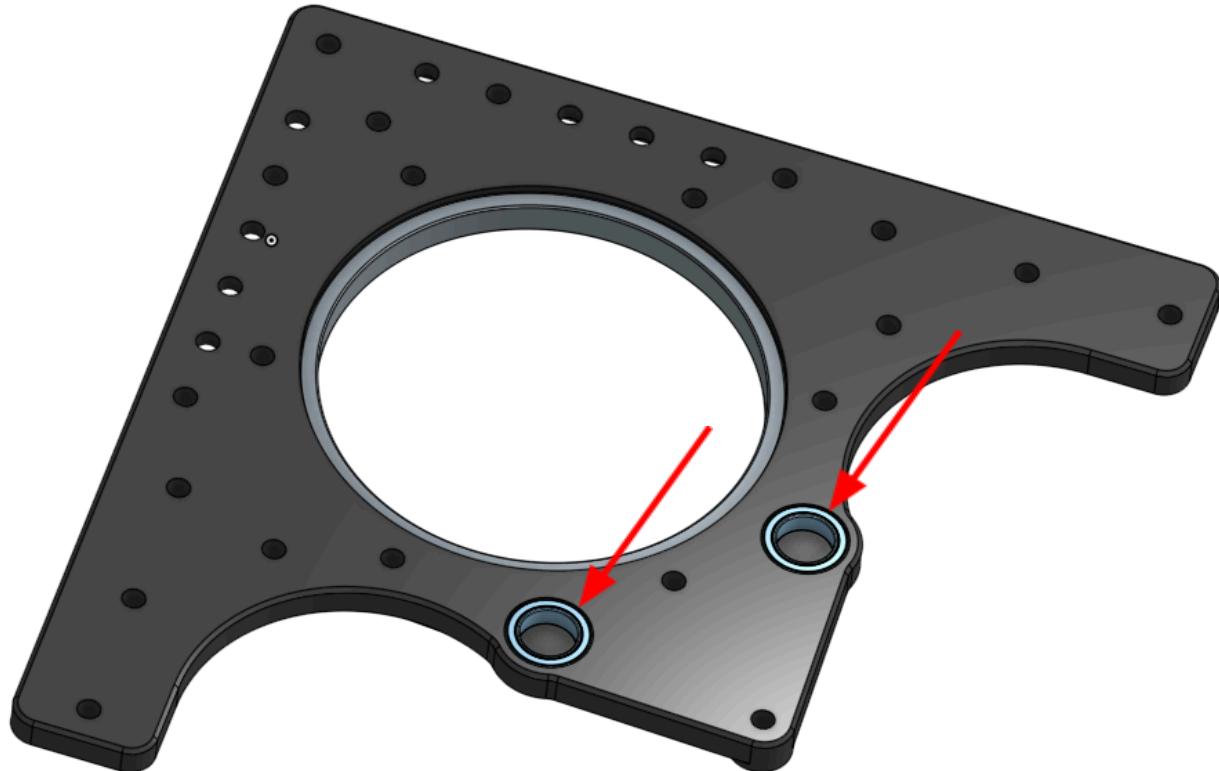
Step 7: Attach the double gear

Place the double gear so it meshes with the output gear and secure it with a half inch long 10-32 button head bolt. Use loctite to ensure it does not back out.



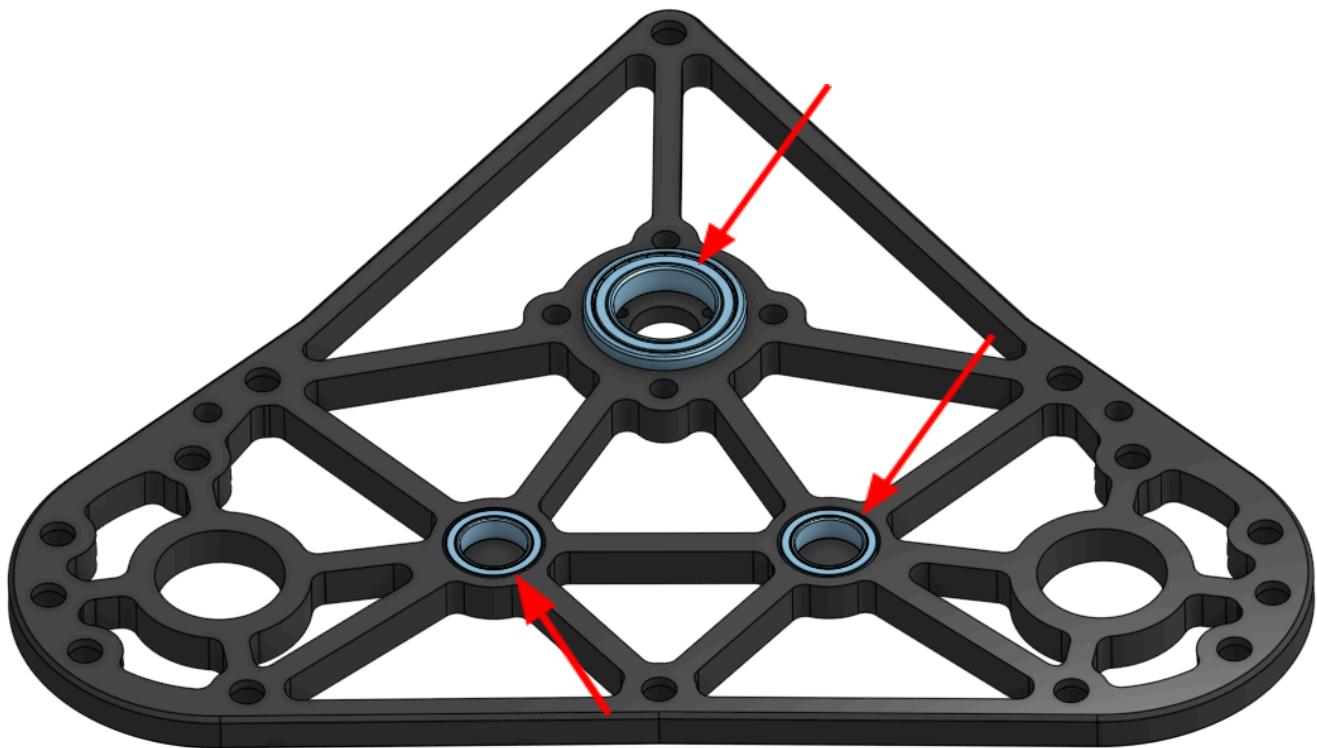
Step 8: Press in base plate bearings

Press in the two 6700 series bearings on the base plate.

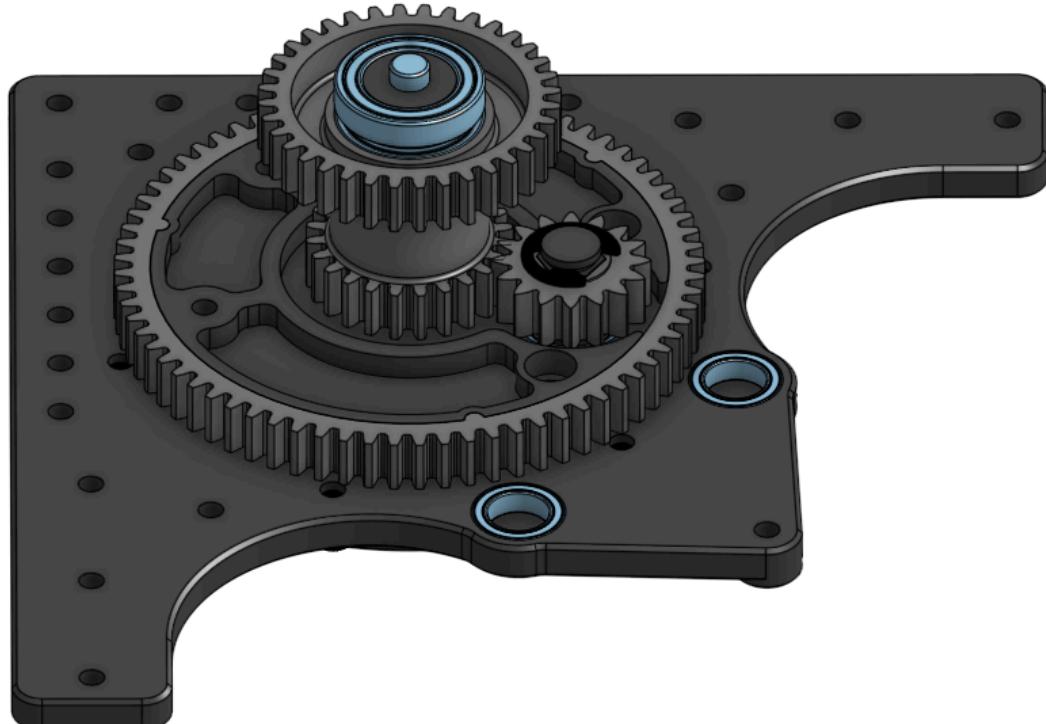


Step 9: Press in top plate bearings

Press in the one 6802 bearing and two 6700 bearings into the top plate.

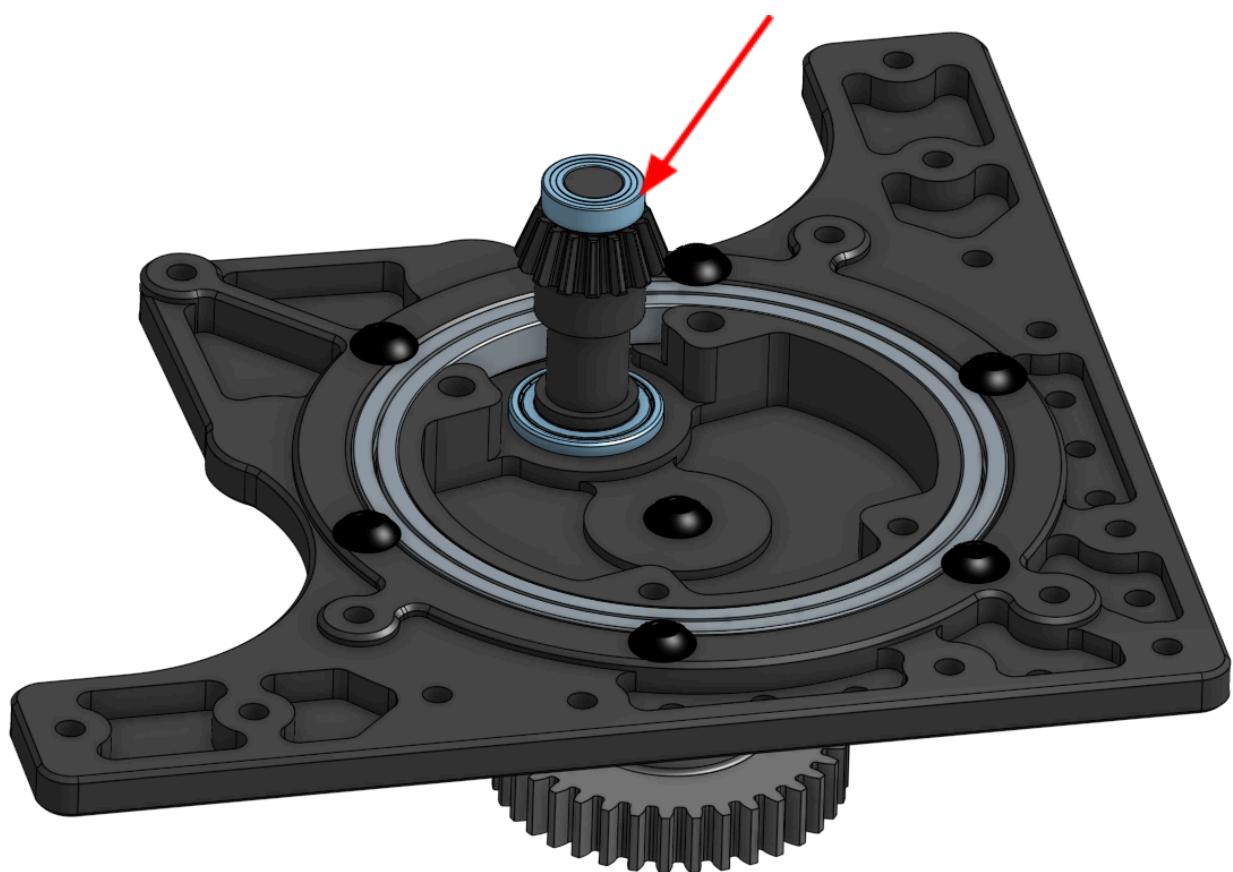
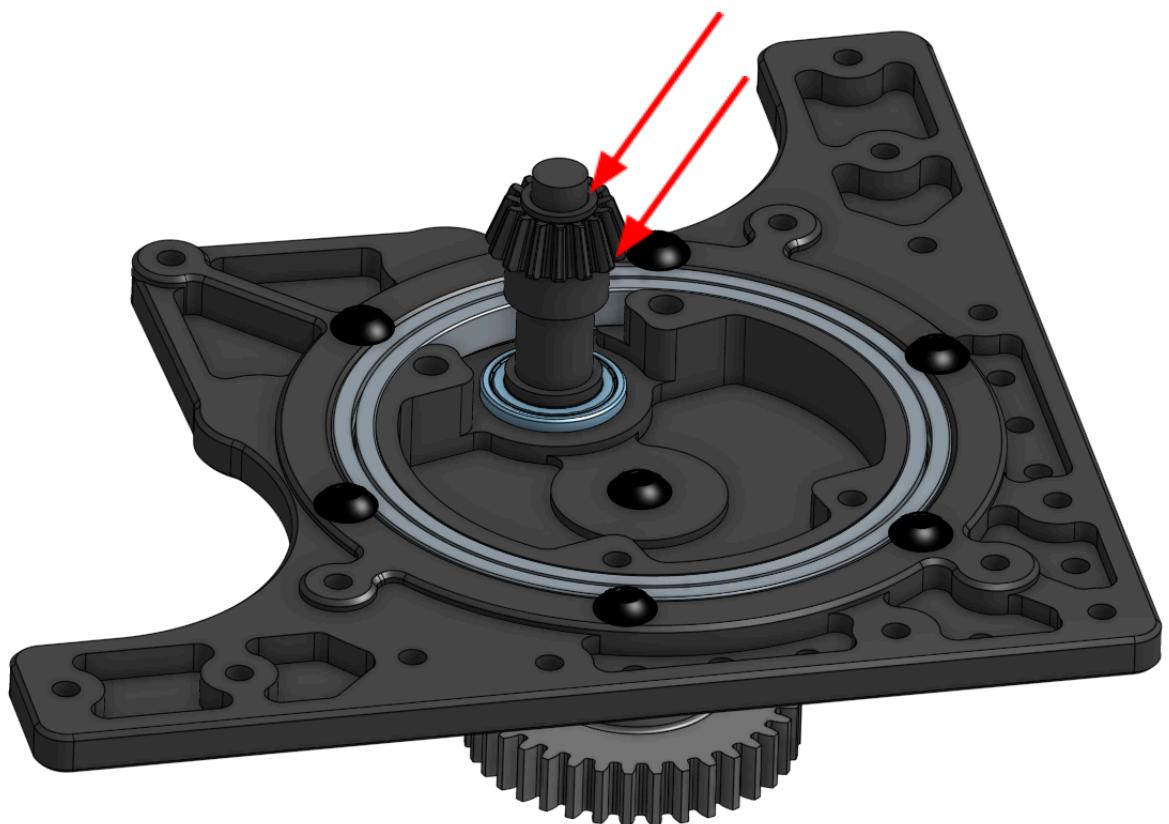


Step 10: Place gear stackup into the main plate x-contact bearing



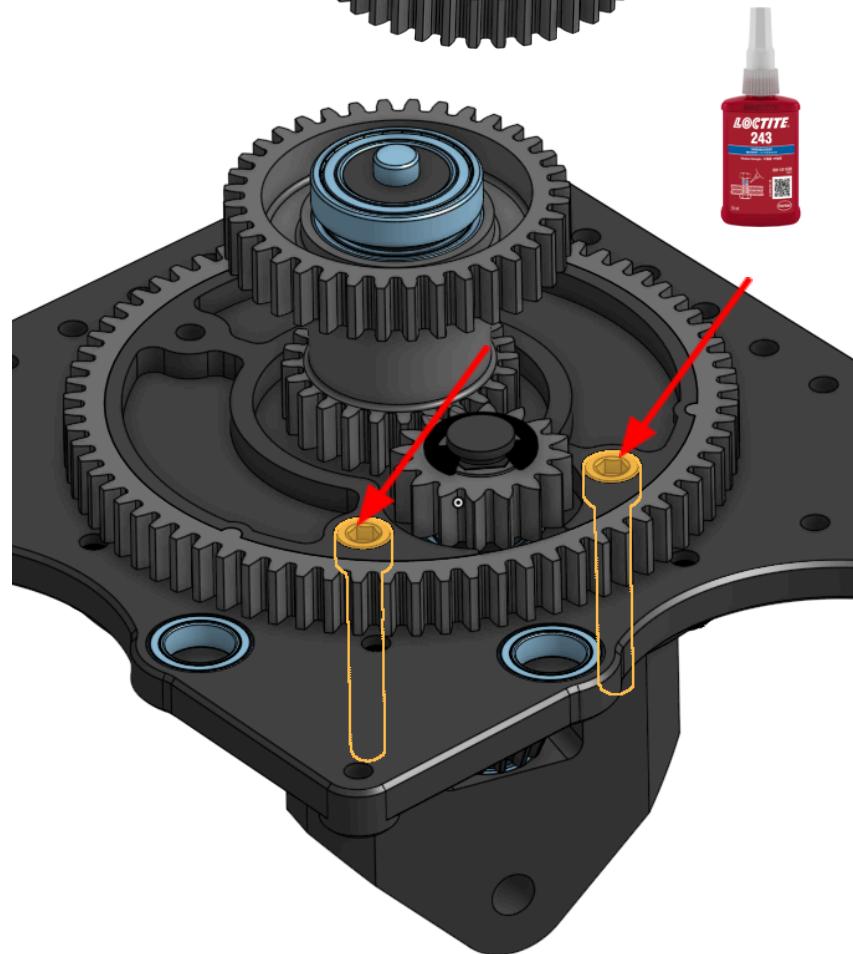
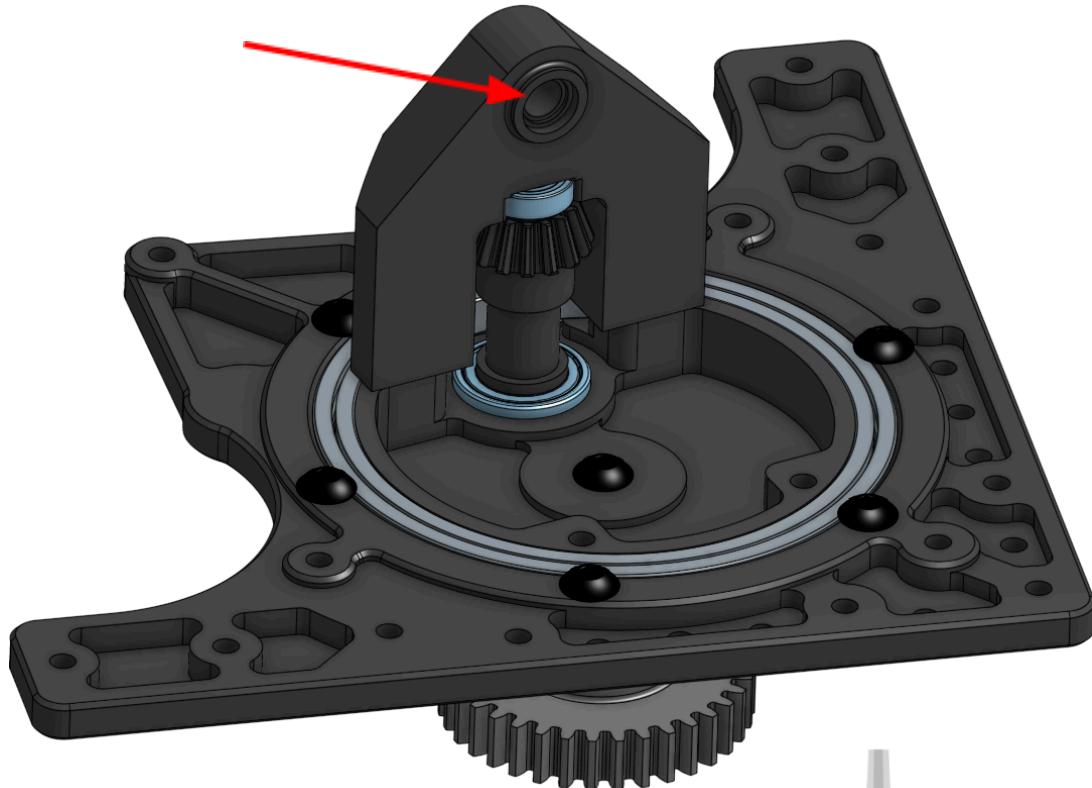
Step 11: Add the small bevel gear, bevel shim and MS148 bearing

Note: The bevel shim is placed between the bevel gear and the bearing



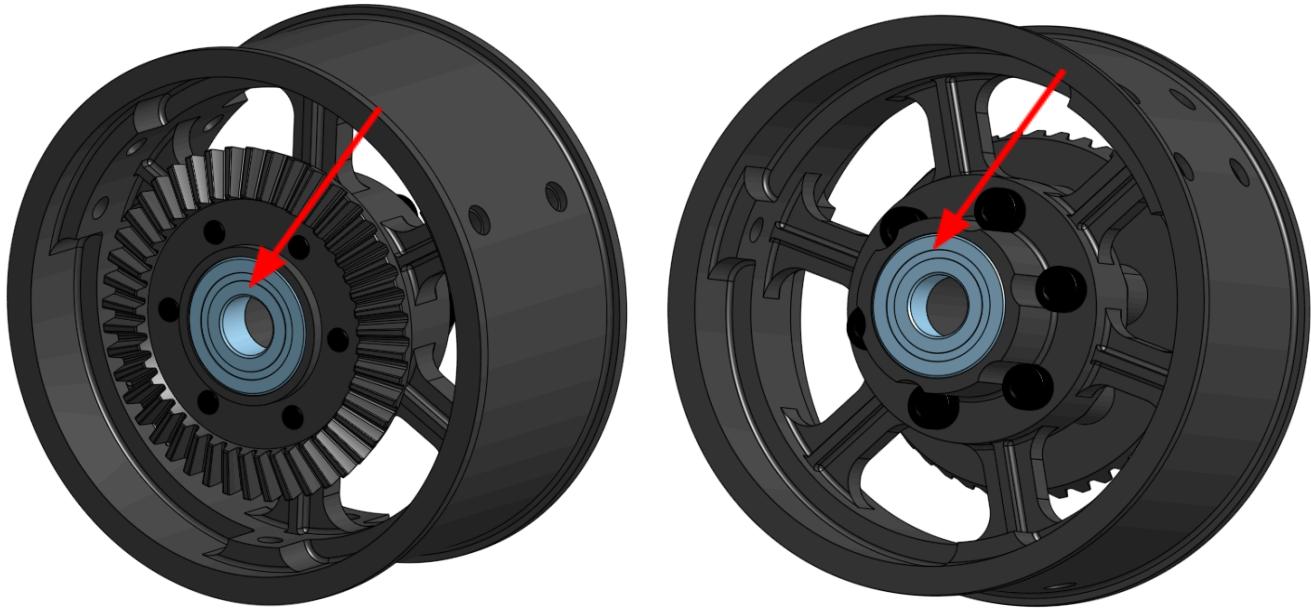
Step 12: Add the fork to the bevel shaft

Add TTB-S-04 and ensure the built in spacer boss is facing inward. Add two of the 1.25" long 10-32 bolts with loctite into the fork, but **don't tighten it all the way just yet.**



Step 13: Add 3/8 Bearings to Billet Wheel

Add the two R6Z $\frac{3}{8}$ " ID x $\frac{7}{8}$ " OD bearings to your billet wheel



Step 14: Add tread to the billet wheel

Thrifty Swerve v2 uses the same hole pattern as SDS MK4 tread templates. There are several good examples available linked below. Use the 8x included $\frac{1}{2}$ " long 10-32 button heads.

Basic 3D Printed Thrifty Swerve v2 Tread Template:

<https://cad.onshape.com/documents/b9dc47e49da277d721a90f47/w/e9e3662f7c80a824c14370ee/e/3803d5655440c49743b0b501>

FRC2363 Triple Helix Tread Jigs:

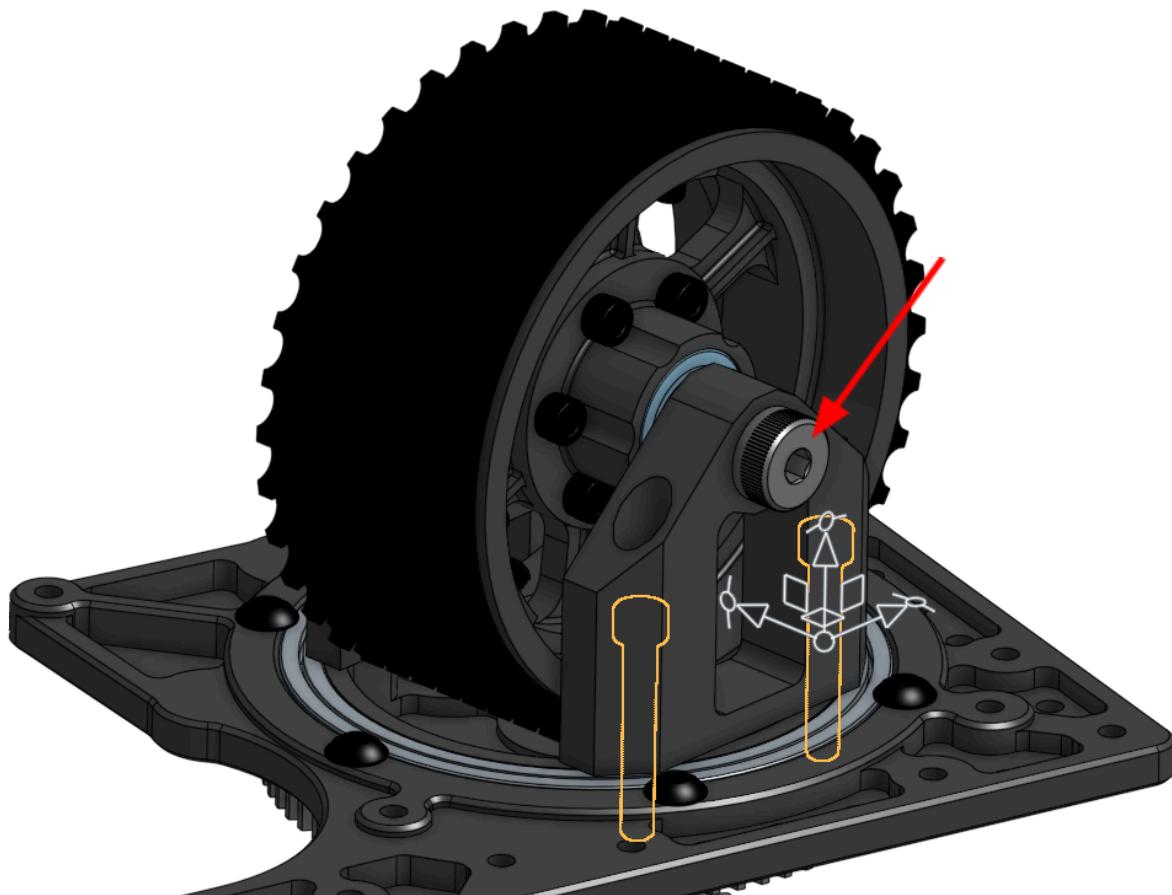
<https://team2363.org/2022/05/sds-mk4-swerve-wheel-tread-jigs/>

Note that we recommend using hand tools for this operation - it is possible to strip out the threaded 10-32 holes if you go in cross threaded or at an odd angle.



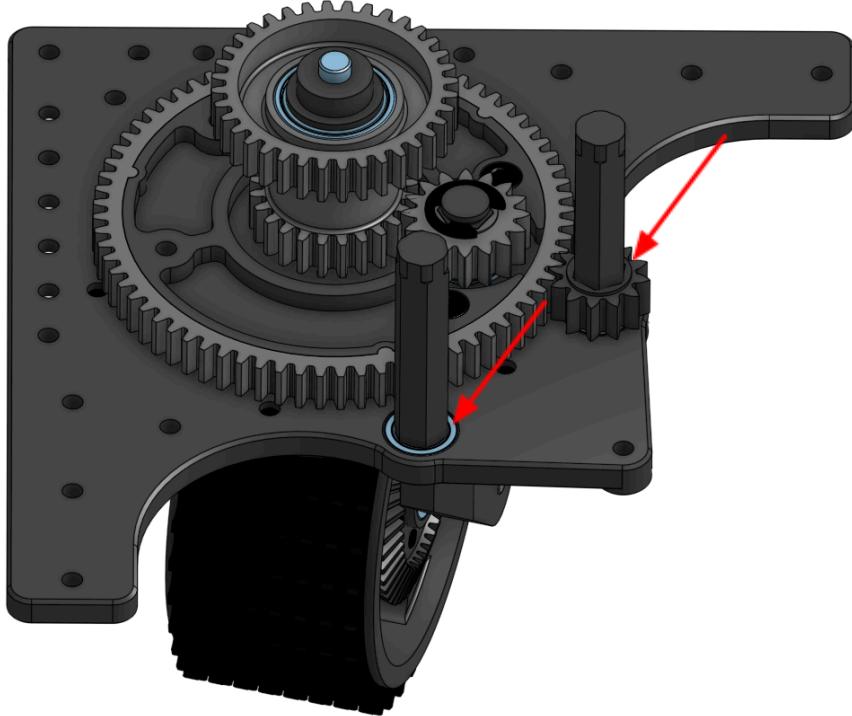
Step 15: Add opposite fork and wheel shoulder bolt

Insert two more of the 1.25" long 10-32 bolts into the holes in the opposite fork. Once again ensure the built in spacer on the fork faces towards the wheel. Insert the shoulder bolt and start to tighten them up loosely. Once all bolts have started to thread, go around the assembly and snug up all the 10-32 bolts and the shoulder bolt. Use blue loctite on these bolts. Refer to the [assembly video](#) as needed. After assembled, the wheel should spin freely.

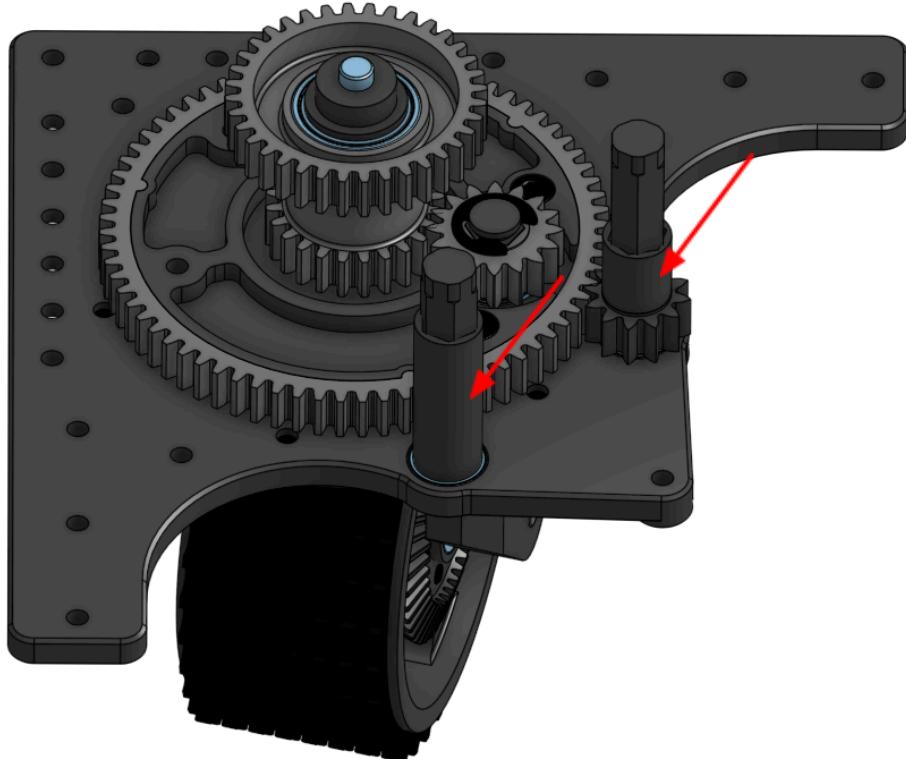


Step 16: Add azimuth gear, hex shafts, hex spacers and spur gears

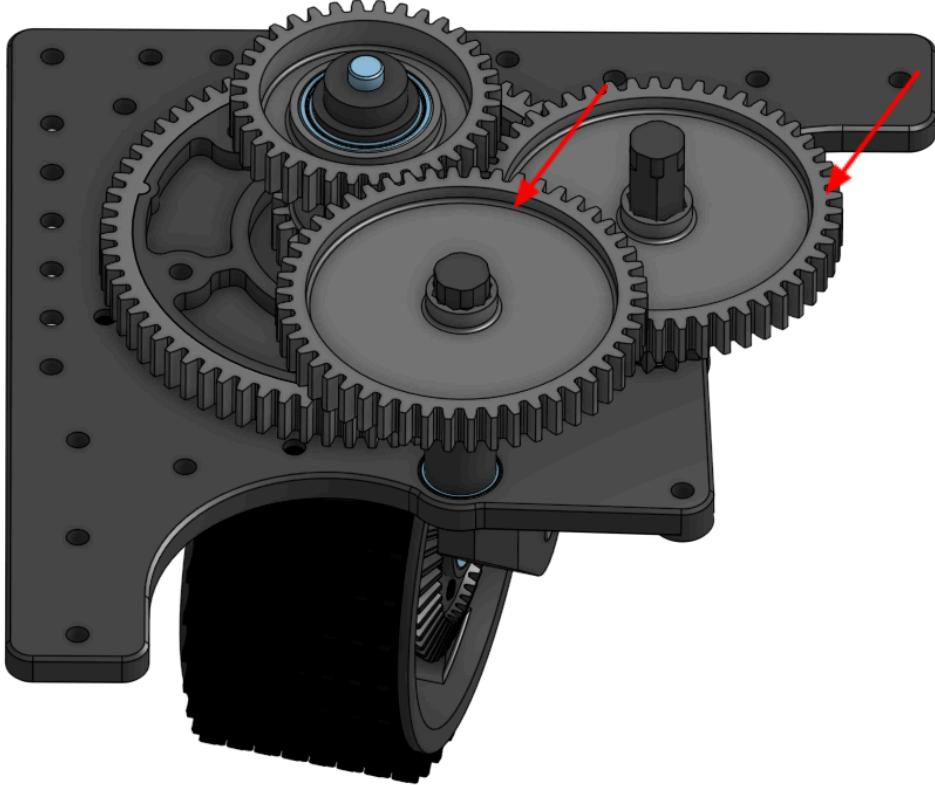
Install both hex shafts into the base plate. It should be noted that the 12 tooth azimuth gear (wheel directional rotation) can be installed on either hex shaft depending on which motor you want to drive the azimuth. Teams will need to decide for themselves which side they prefer and should make note of this.



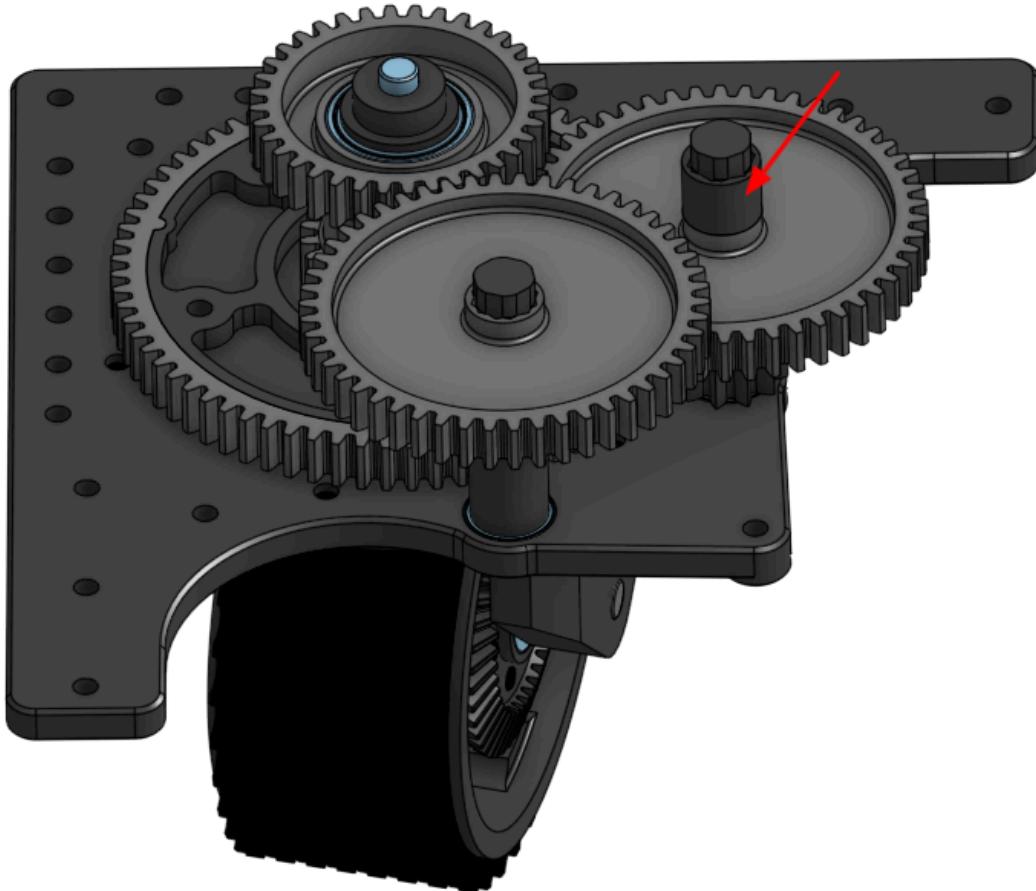
On the shaft opposite of the 12 tooth azimuth gear, place the long 1 & 23/64" spacer on it. Place the second longest hex spacer (17/32") on top of the 12 tooth azimuth gear.



Add the two 50 tooth spur gears onto each of the hex shafts.

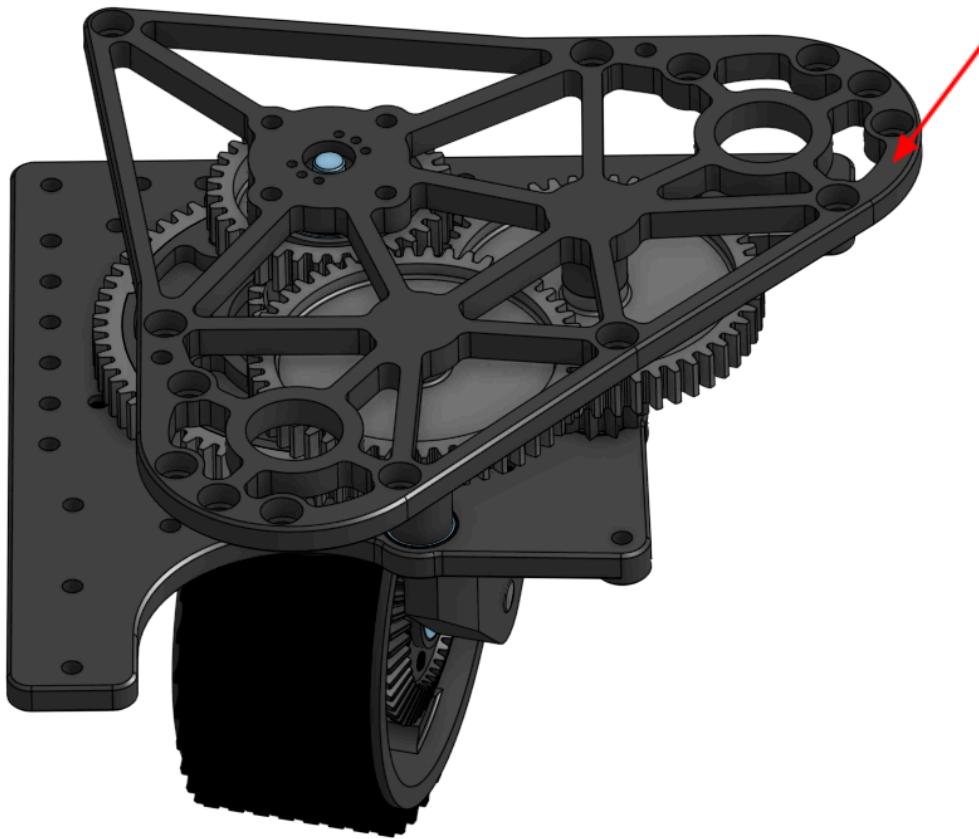


Add the smallest hex spacer on top of the 50 tooth gear with the 12 tooth azimuth gear on it to fill the remaining space.

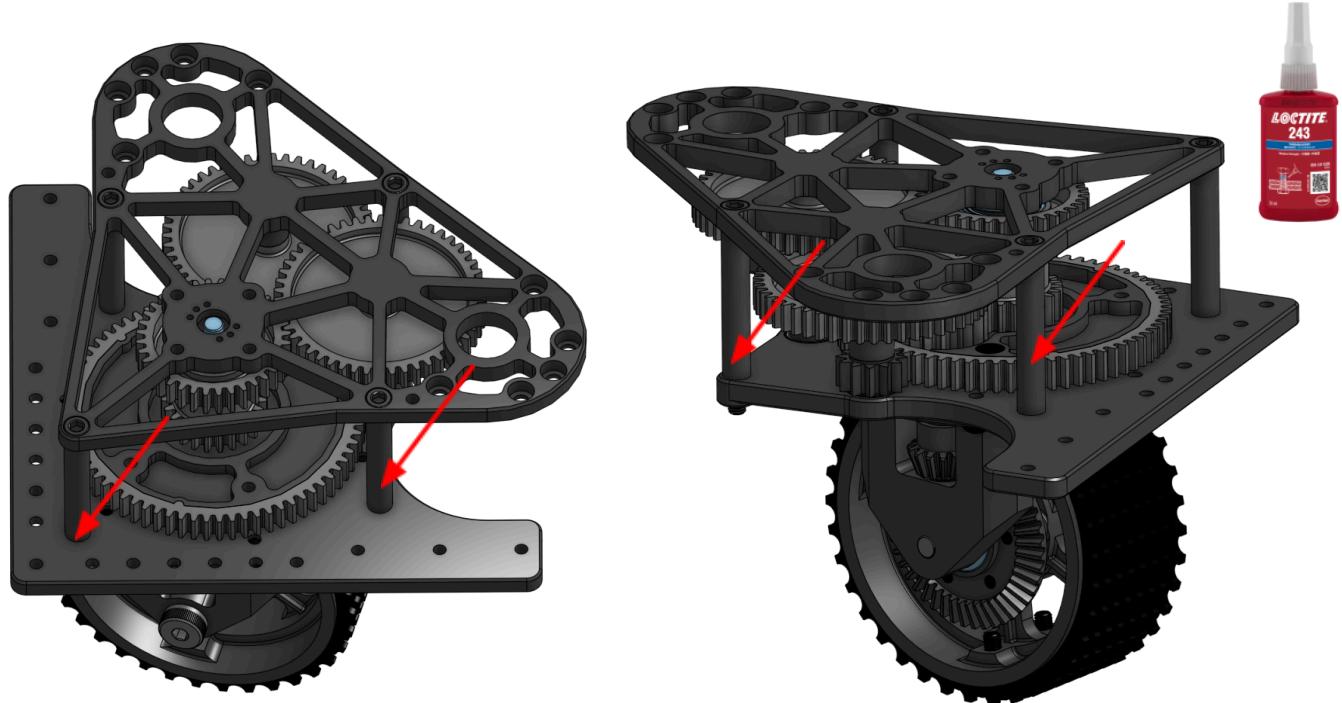


Step 17: Add the top plate

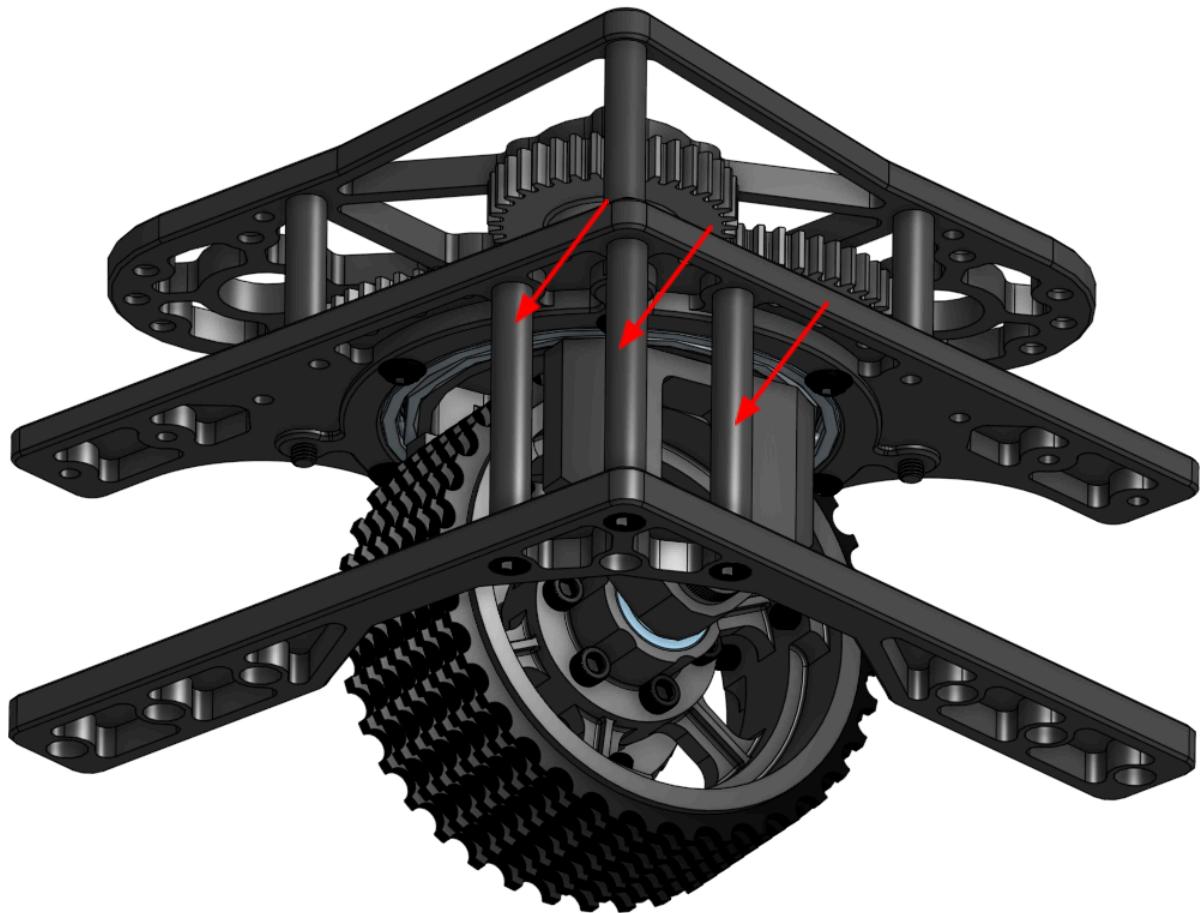
Add the top plate and interface it with the two hex shafts and the central steering shaft



Step 18: Add the 1.75" long spacers and 2.25" long 10-32 bolts - use blue threadlocker

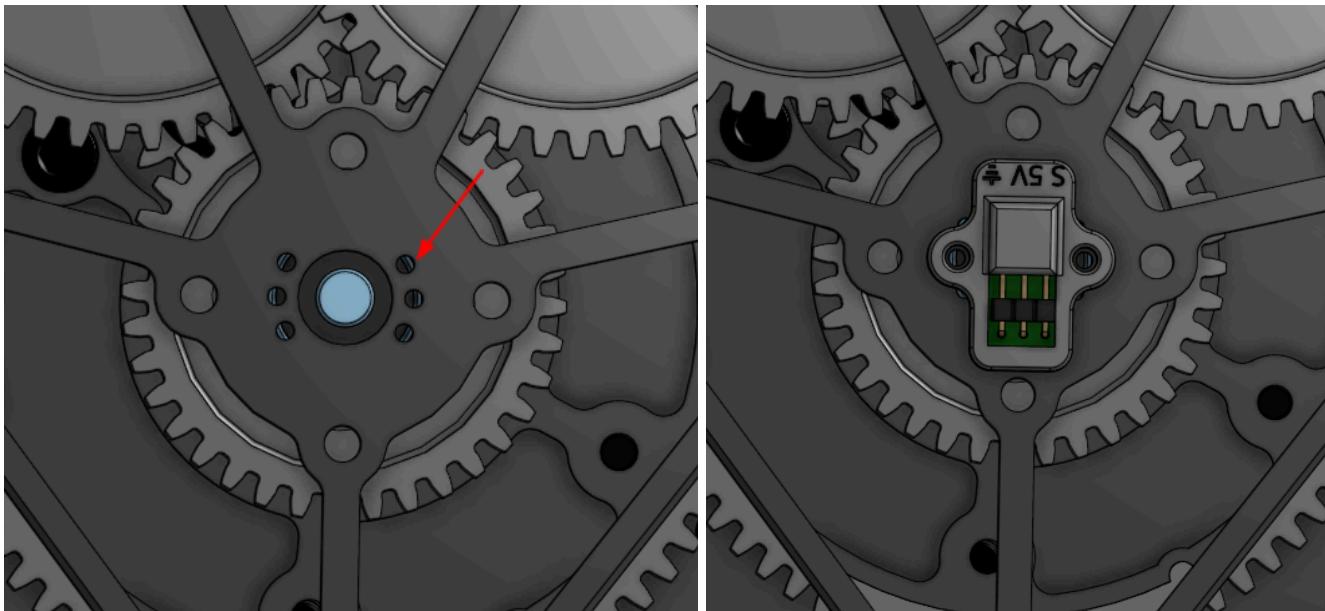


Step 19: Add the bottom plate using the 2" long spacers and 2.5" long 10-32 bolts



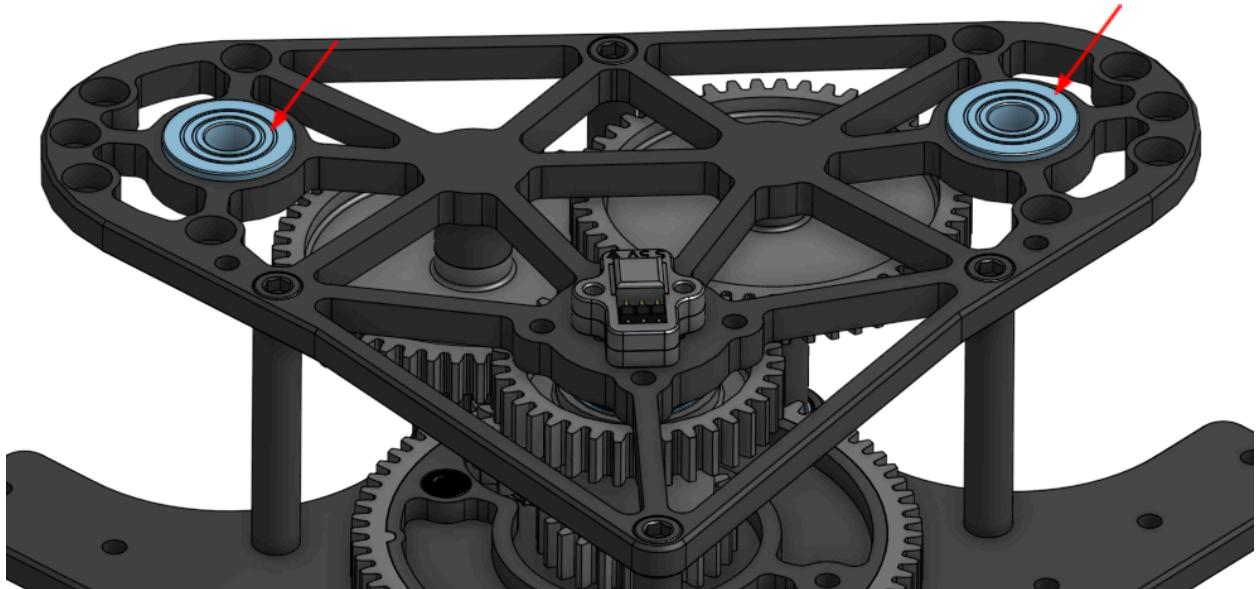
Step 20: Attach the absolute magnetic encoder to the top plate

There are multiple hole patterns to angle the encoder depending on which direction you want the cables to be routed.



Step 21: Install the 8mm motor shaft support bearings

These bearings will help support the shaft and work with either Kraken motors or 8mm keyed output motors (REV Neo, Vortex)



Step 22: Install the motors

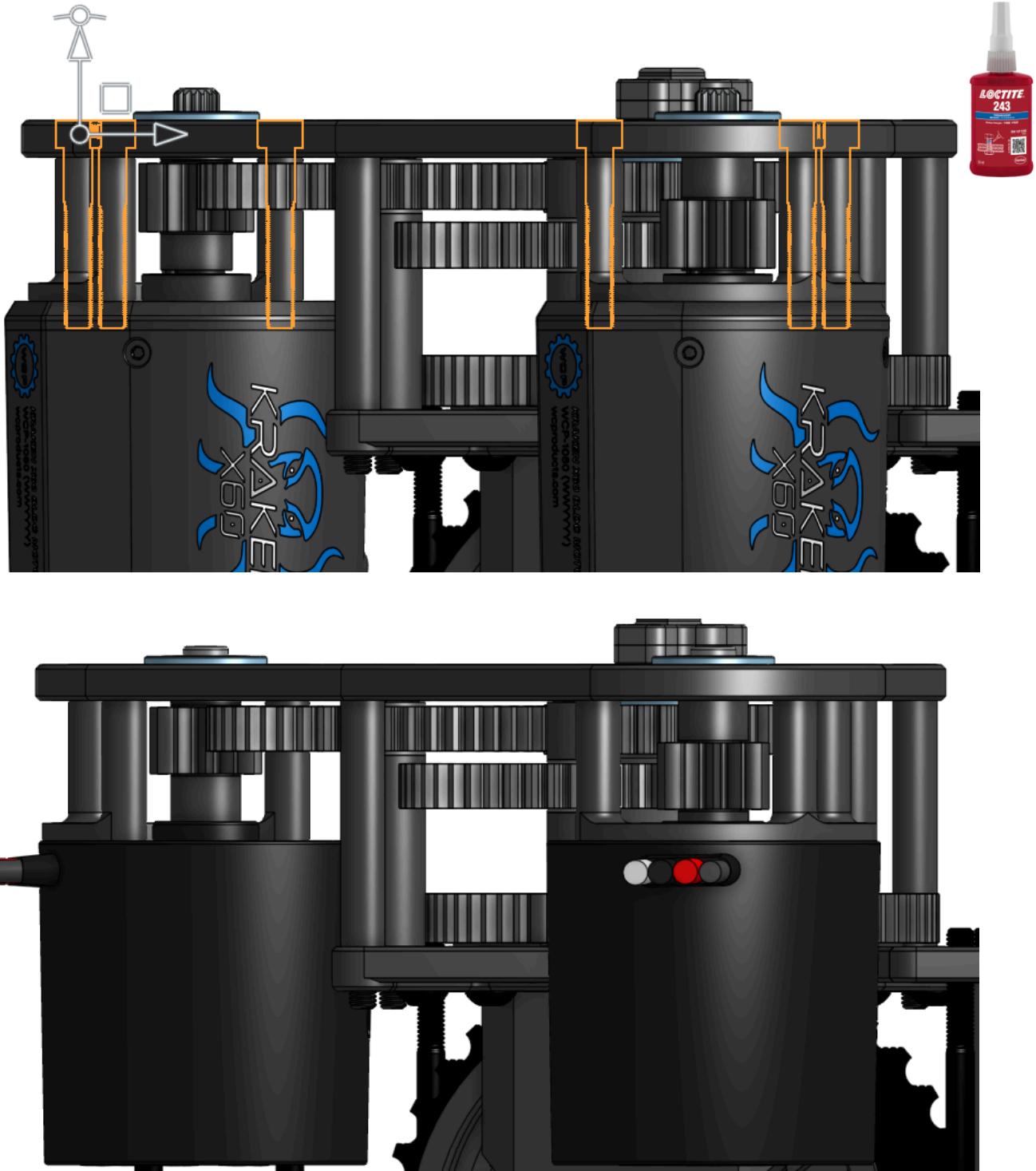
Thrifty Swerve v2 has specific gear kits for both Kraken X60 and 8mm Keyed output shaft motors that includes spacers to space the pinion gears - for both the azimuth rotation and driving gear. Pay attention to which side is which when opening up these hardware bags.

It also includes a billet motor spacer that has holes for mounting the spacer to the motor - we recommend installing the motor for the first time and then securing the spacer secondly to ensure everything is aligned properly.



Use three of the provided 1.25" long 10-32 socket head bolts and insert them through the billet motor spacer into the motor - do this for the azimuth side and the driving motor side. We recommend blue threadlocker on the ends of these bolts.

Pay attention to the spacing of the pinion gears on the motor shaft - they should align as shown below where one face of the gear is nearly flush with the 50 tooth spur gears.

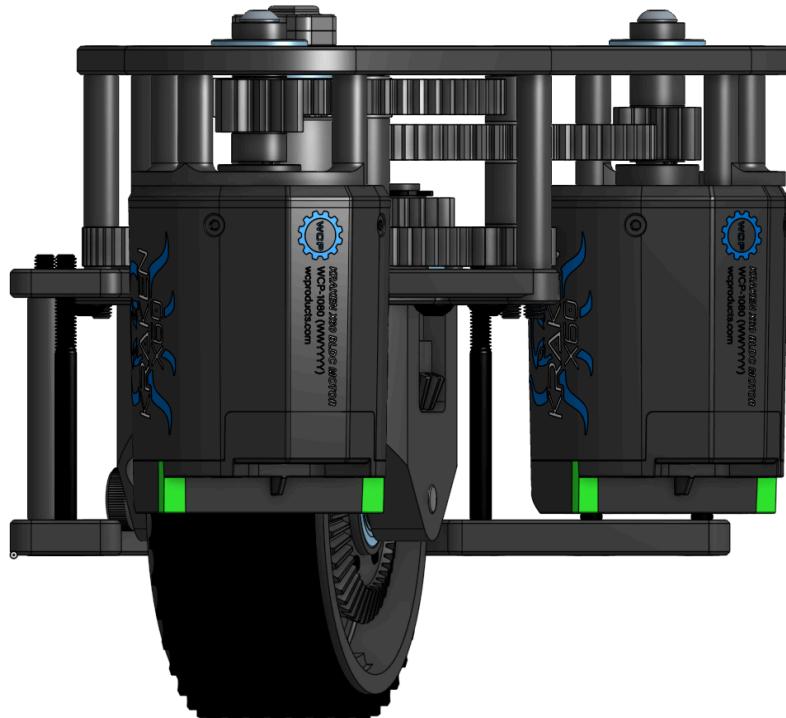


Kraken Drive Motor Spacing:

.25" spacer under gear, .094" spacer on top of gear, .15" spacer on top of bearing

Kraken Azimuth Motor Spacing:

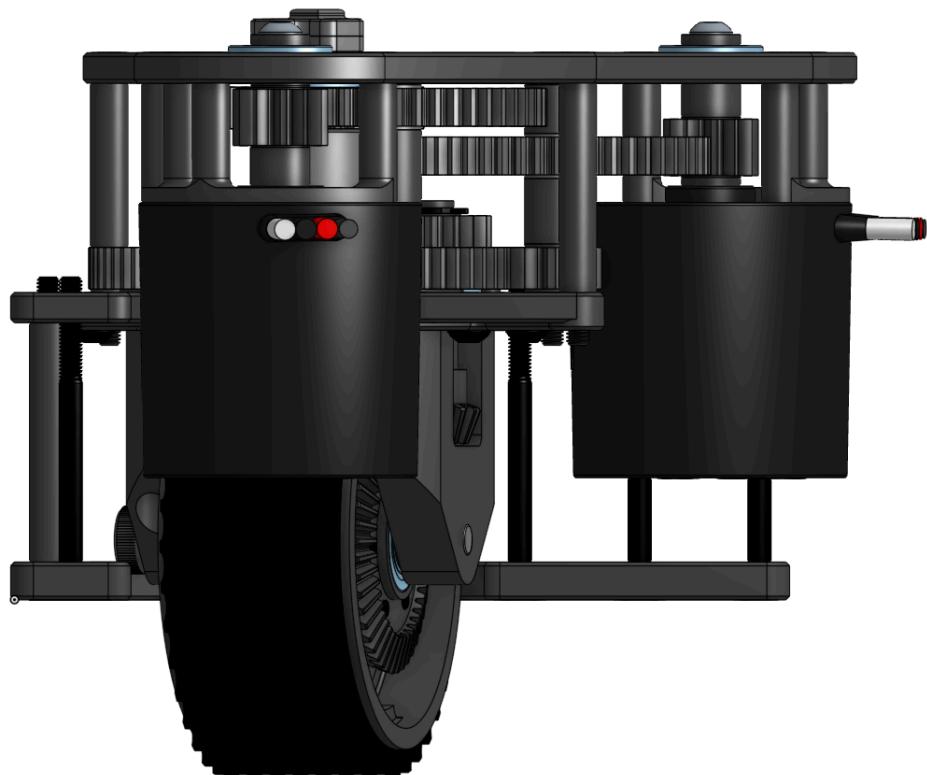
No spacer under gear, .345" spacer on top of gear, .15" spacer on top of bearing

**NEO Drive Motor Spacing:**

.345" spacer under gear, .094" spacer on top of gear, .094" spacer on top of bearing

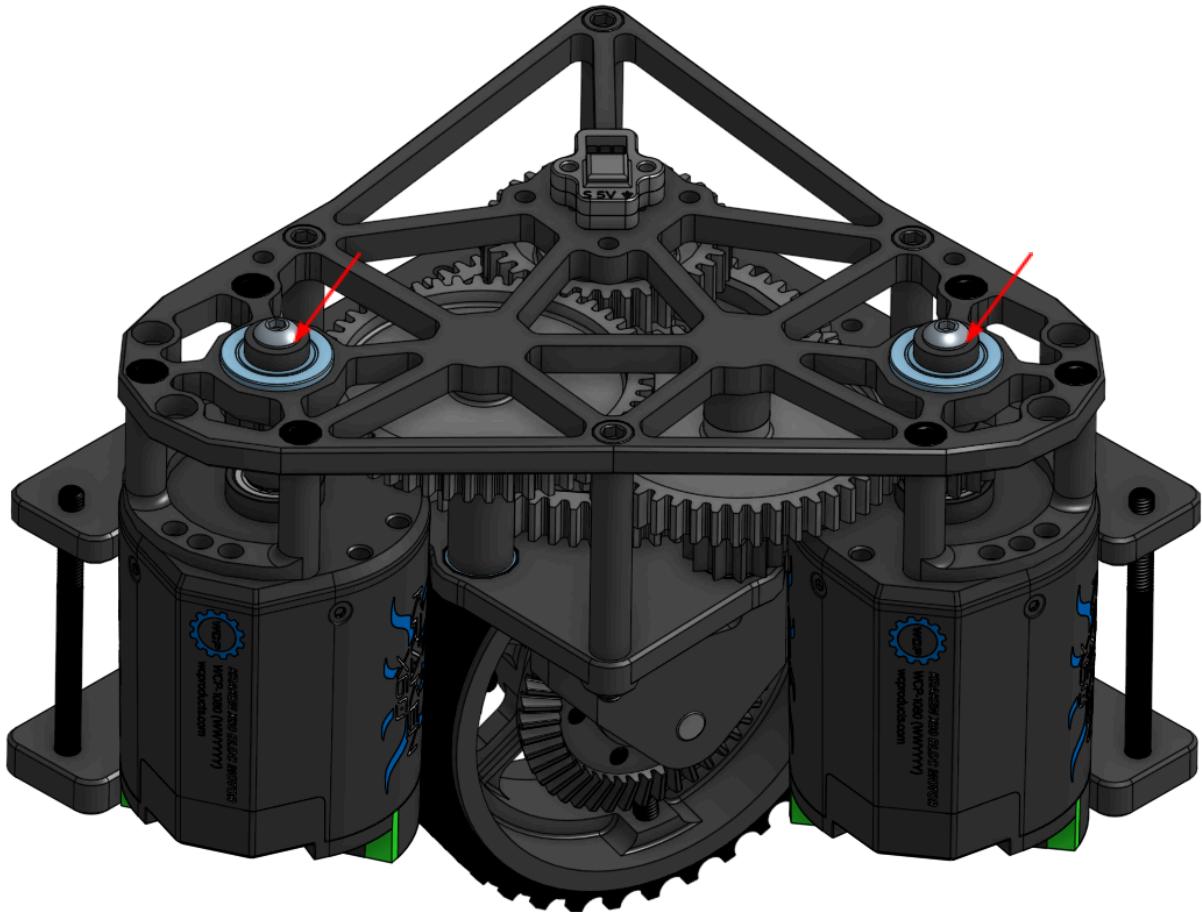
NEO Azimuth Motor Spacing:

.094" spacer under gear, .345" spacer on top of gear, .094" spacer on top of bearing



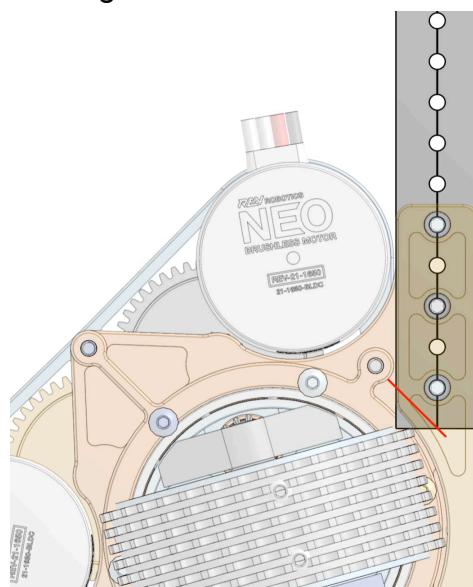
Step 23: Add fasteners to the motor output shafts

We've included spacers and $\frac{3}{8}$ " long 10-32 button head bolts to secure the bearing / motor stackup.



Step 24: Attach to frame

Remember to check your 2" x 1" extrusion and shorten the length from the edge of the tube to the last hole or add a beveled edge as needed.



Step 25: Did you grease your gears?

Grease Your Gears

Prior to running your modules, apply grease to all gears.

Do not skip this step.

We like [Lucas Oil Red N' Tacky](#) or [Mobil's Mobilux Ep 1](#)