Basic Assembly Instructions for the Power Truck Tower Drive

All Nation Power Truck Tower Drive, Diesel (40″ Wheels), KIT PN#9056ChainKit

This guide is to aid in the assembly of our Tower Drive mechanisms and is applicable for both chain drive configurations and the towers where helix gears are used on the driver and the driven shafts.

Included in this kit is our original reference drawing done in 1948. If you are knowledgeable about our history you will note that the top gear and the matching bottom have straight teeth and predates the implementation and use of the helix sets or chain drive configurations. However, little else has changed on the drawing.

So the first suggestion is to be come familiar with the parts list.

The breakdown of parts for this gear unit kit follows:

Parts List PN#9056Chainkit (aka 4056) Constant Torque Transmission Blueprint Section A

#4056 Blueprint Section A

1 Drive Shaft PN#4045 1-1/4″ Long and pin

4 Spacer Bushings For Drive Shafts PN#4040

1 Spur Gear i.e. Worm Gear for Axle PN#4052

2 Brass Axle Bushings PN#4073

1 Axle PN#1524

8 3-48 x 5/32″ Filister Head #C1301

8 Lock Washers #C2034 or C2031

12 Thrust Washers aka Shim Rings (note unit may only need a couple for fine tuning)

2 40″ wheels PN#2146 and PN#2147 (note may be substituted for 33″ or 36″ wheels)

2 Wheel Insulators (1 is a spare)

1 Worm #4051 (Worm may already be pressed onto shaft #4045)

2 Gear housing Side Panels PN#4038

1 Bottom Spur Gear Pan with 2 Retainers & 4 Screws 0-80 x 3/16 Screws 3D Print PN#253AN

1 Upper Drive Shaft with ball #4042

1 Lower Drive Shaft Coupler #4041

1 Delrin Sprocket 10 teeth Upper Drive Shaft #S123 to be mounted on #4042

1 Delrin Sprocket 16 teeth Lower Drive Shaft #S154 to be mounted on #4041

1 Chain 4” long

1 Upper Drive Shaft C Clip #C2036

Part #4038 is the main housing component that holds together the machined parts in this mechanism also sometimes called the gear box.

We decided to 3D Print stock in the Poly Carbonate (PC) filament instead of supplying this in the steel version. It is cut by the same die that does the steel version of the past. The PC is a tough material and it is easier for the modeler to work with. We also think it will reduce any gear noise as it does not act like a sound board.

The larger hole is host to the axle bushings #4073

For a single tower drive we supply 2 #4038 sides. If you put them back to back you might note that the holes only line up one way. Keep that in mind for later as the axle is slightly off center. Our axles are are 5/32”. The bushings should snap into #4038. In the past, with the steel sides, the bushings were pressed or even sometimes scored like a knurl before being pressed so they would not torque out of this frame. The axles must turn freely in these bushings. If the bushing is turning in the frame, it usually means the axles has a bur or knurl that locks onto the bushing. The axles must be absolutely smooth or slightly polished. If this mechanism is not put together as perfectly fine tuned as you can get it, when the device is initially set to a motor for a short break in period, the torque will try to push these bushings out away from the frame. This should not happen and can also happen with age as the mechanism wears.

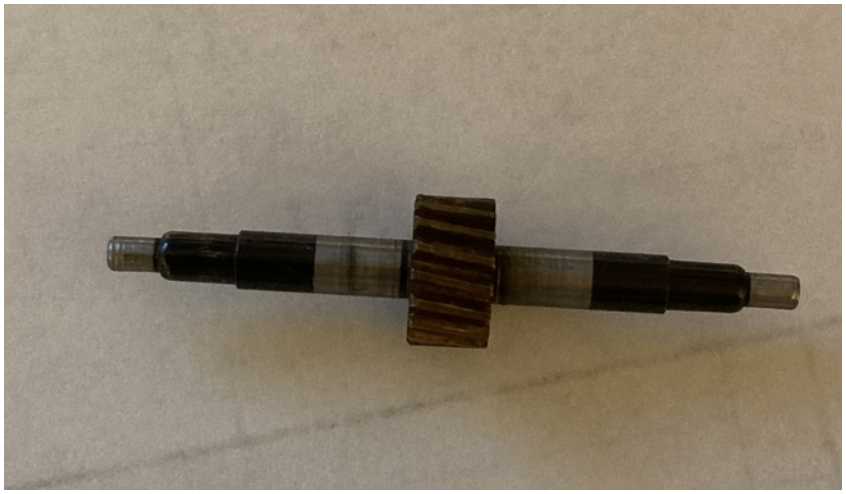
The smaller holes accommodate #4040 the spacer bushings.

We can supply these spacer bushings untapped. The original All Nation machine shop assembly used a ball type punch to spread the circular edge of the spacers on each side as though it was a rivet and rather permanently fixed the mechanism so it was not easily taken apart for service. We recommend to the modeler to go to the trouble of drilling and tapping these spacers for either a 2-56 x 1/8” or 3/16” machine screw or a 3-48. In the above kit we show a 3-48 x 3/16” screw with lock washers.

A hand built kit allows the modeler to feel how the mechanism is working before final assembly. With the screws used in the spacers, you can put it together or take it apart to fine tune its performance. If the spacer is tapped, make sure there is no bur on the inside of the spacer where the drive shaft can hang up on. If the shaft will not go into the spacers inside diameter, very likely there is a rough spot from drilling and tapping. Take a very fine rat tail file and gently touch up the sides where the drill holes came through.

The worm and worm gear set, sometimes is referred to by modelers as the spur gear on the axles. The gear on the axle is not cut with straight teeth. The worm gear on the axles is machined to work nice with the worm, thus the teeth are at a slight angle cut. The worm/spur gear pair are also parts for the All-Nation Line Tower Gear or Small Gear Unit, #9056(C) and #9027. The 4051 and 4052 part numbers are from our original blueprint and may also be recognized as PN# 9063 & 9064 if referred to by axle location. The spur gear has 17 teeth and measures 0.215″ in width, a diameter of 0.3625″, and an ID to press fit onto a 5/32″ AN axle. The worm gear 0.375” in length to match the spur gear and press fits onto our 5/32″ drive shafts, the outside diameter is 0.305″. With our drive shafts, a knurl should not be necessary for making sure the worm does not turn on the shaft. Typically the 5/32” steel drive shaft rod can be +/- a small fraction in size from exactly 5/32”. Our preference it to use rod that if slightly oversize. If a knurl is desired by the modeler or perhaps pinning the worm, that is the modelers prerogative.

The worm gear when pressed onto the axle #1524 must be centered.



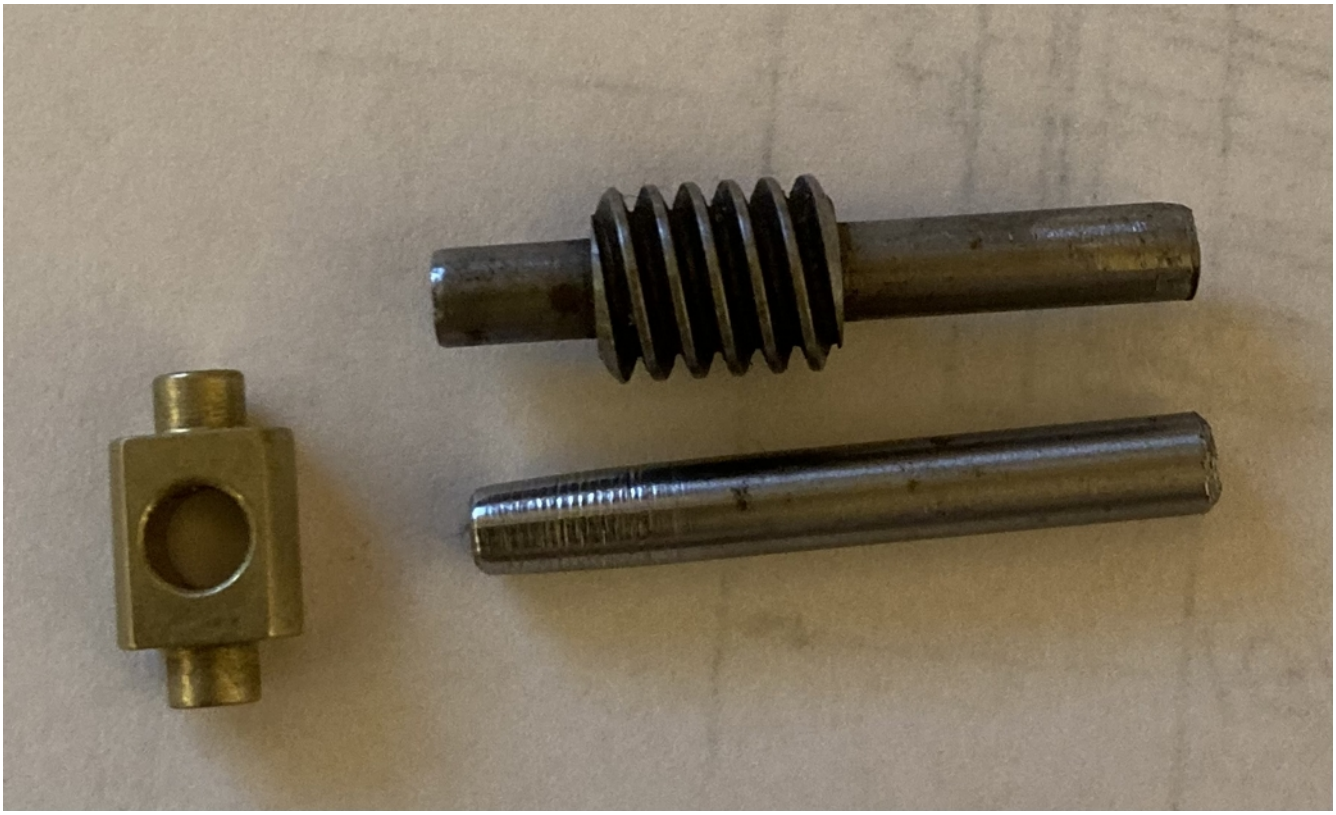
The drive shaft rod supplied for these transmission come in various lengths depending on the implementation. By that we mean a standard Blomberg truck the wheel spacing is known with respect to the distance between tower drive and its smaller gear unit on the opposing axle. Or, if these transmissions are used in other engine or power applications such as GP-7, GP-40 or ALCO engine examples, the lengths obviously will be longer for extension.

In regard to these assembly instructions the lower drive shaft rod as shown in the reference list above is #4045. For the small gear unit we may refer to the same type of 5/32” rod as #4047 in which case the length for a the small gear unit in Section B-B of the blueprint is longer. On drives where both trucks are powered via a universal jointed drive shaft through the fuel tank or underbody drive, the shaft rod will extend out the other side of the small gear unit and may appear something like the following.

The above photos shows a brass shaft coupler extender on the shaft. The left side of the shaft would connect to the tower drive shaft coupler #4041.

For a frame of reference, the upper shaft #4042 also known as the driving shaft because it takes its power from the motor, transfers power via the chain/sprockets or helix gears in that case, to the lower or driven drive shaft that has the worm press fitted onto the shaft. This 5/32” shaft is approximately 1.25” in length. It should be noted that #4040 will not slide onto the shaft due to the fact that it is slightly oversize, however it is the correct size for press fitting the worm.

The procedure to to successfully install this component involves several steps. First, take a caliber and measure the diameter of the rod. It should measure 0.1585” or 4.03mm. In order for the spacer bushings to slide onto the shaft, the shaft will need to be turned down ever so slightly to approximately to 0.154” or 3.92mm. We show an extreme close up photo to illustrated the above point.

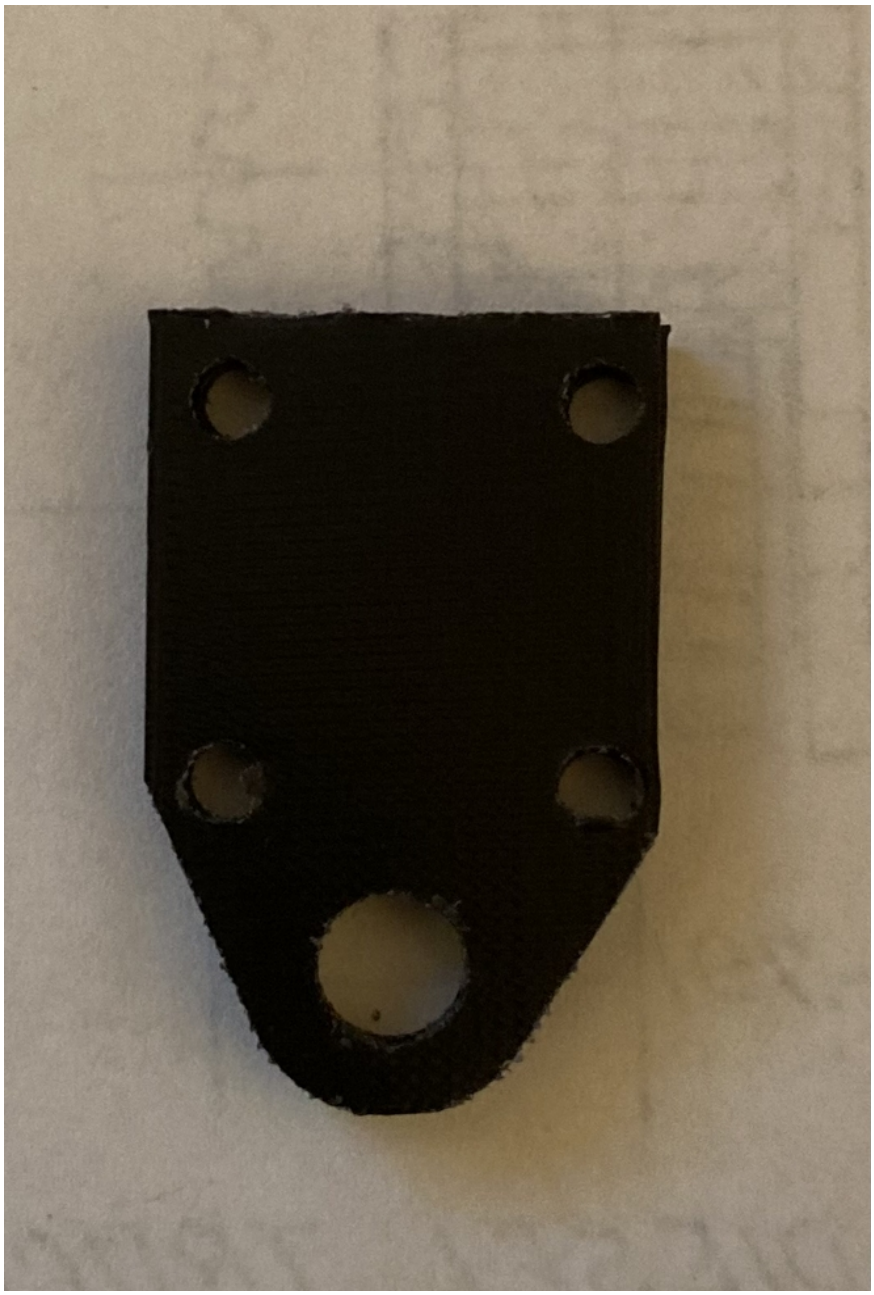


The width of the #4040 spacer i.e., the flat side facing the worm when installed is 0.1875” or 4.75mm aka 3/16”. Mark the shaft where the worm will finally rest once pressed on to the shaft and turn down the rod on both sides so that the #4040 spacers fit perfectly and can rotate in the bushing like a blade on ice. I typically will use a fine wet/dry sand paper to finish out the surface and then take to my high speed buffing wheel with a jeweler’s compound to give it that final finish.

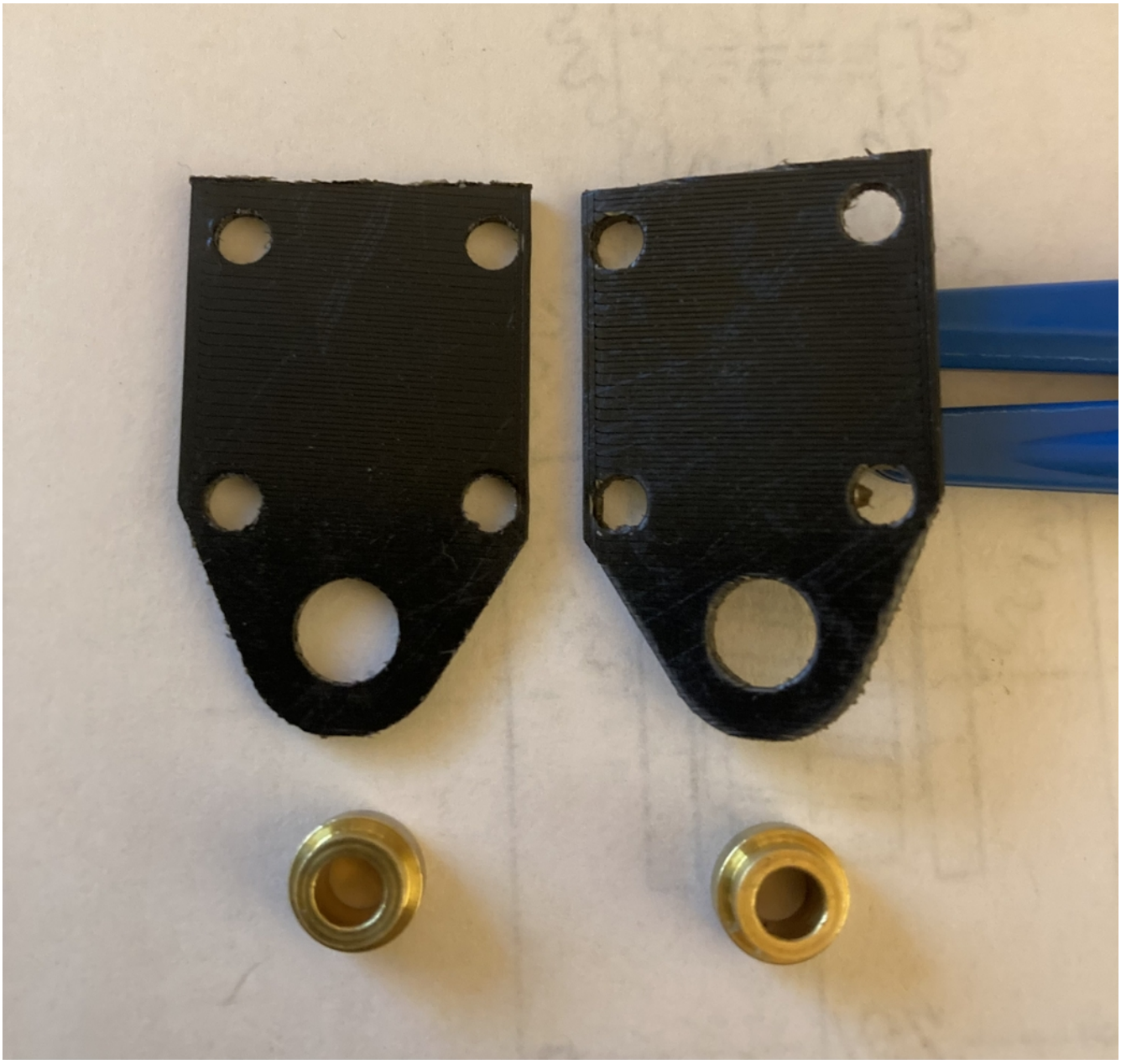
The best tip we can give is to take it slow when reducing the diameter of the shaft ends. This step is critical if you want the best performing mechanism and why hand crafting is so desirable. Do not turn down the area of the rod where the worm will be positioned or else you will end up having to knurl that dimension or drill and pin the worm so it does not rotate on the shaft. If the rod was slightly under 5/32” the #4040 spacer would slide on as would the worm in which case a knurl would need to be put on so the worm presses over the knurl. Turning can be done on a small drill press.

The upper shaft #4042 is already machined for the #4040 spacer bushing and there is usually no need to turn down the shaft.

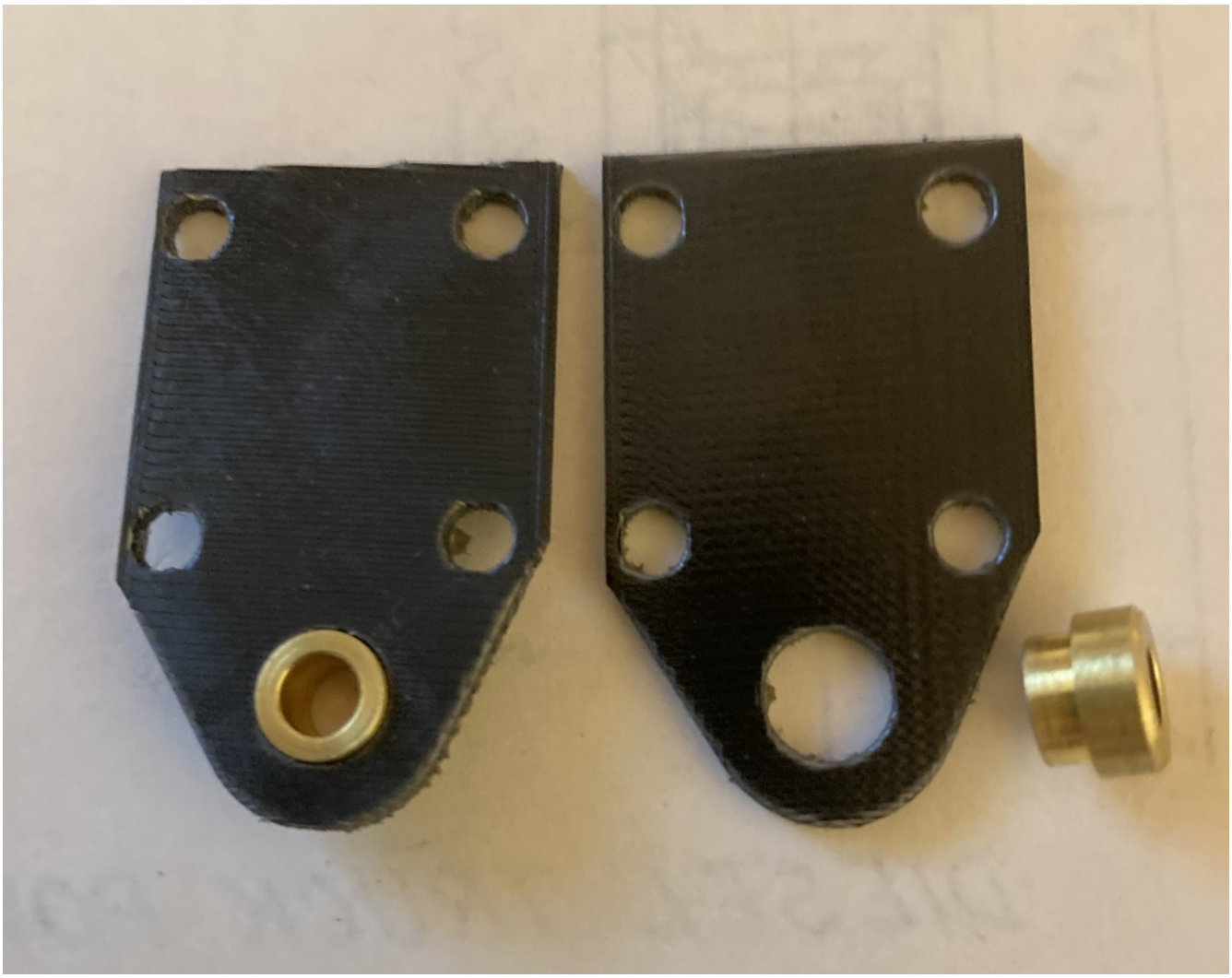
Now initial assembly can be done on the lower shaft. Take the 2 #4038 pieces and match them up back to back so the holes all lined up. Assembly is best commenced with a side view orientation and note the position of #4073 slightly off center. The right hand edge is the sprocket or helix gear side whereby the holes for the spacer bushings #4040 are closer to the right hand edge for clearance purposes. It is particularly important to pay attention to detail here.



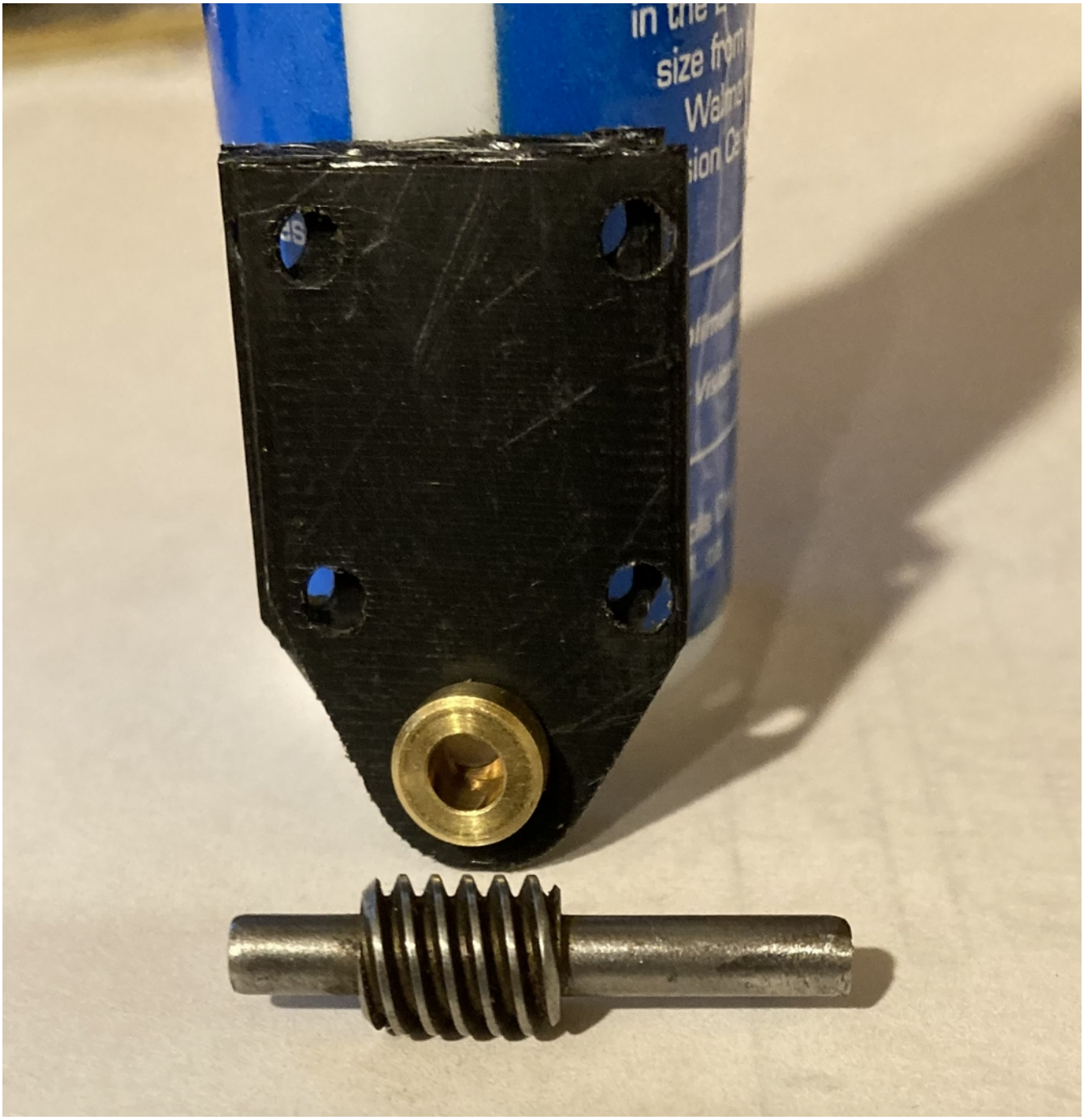
The next photo shows the #4038 open from right to left like a butterfly because now we want to be clear as to how to insert #4073 into the axle holes.



In the next photo you can see the gear or sprocket facing edge is turned over to the left hand side to illustrate how the inside of the #4038 is flush when the bushing is inserted.

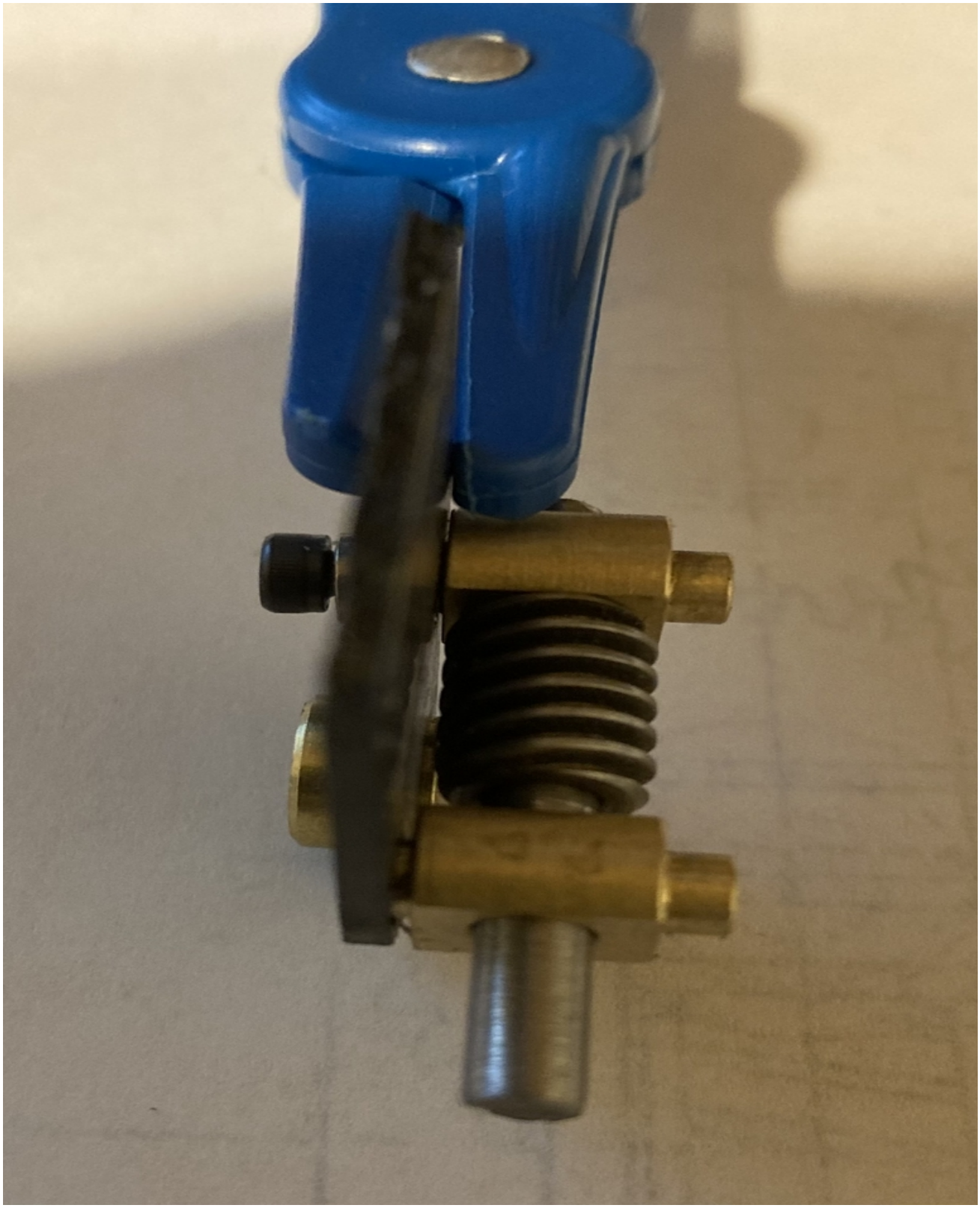


Assembly is best managed by keeping the orientation as shown below where the sprockets will be installed on the #4041 and ultimately the coupler with the sprocket installed will be press fit onto the end of the shaft protruding out of the right hand side #4040 bushing.

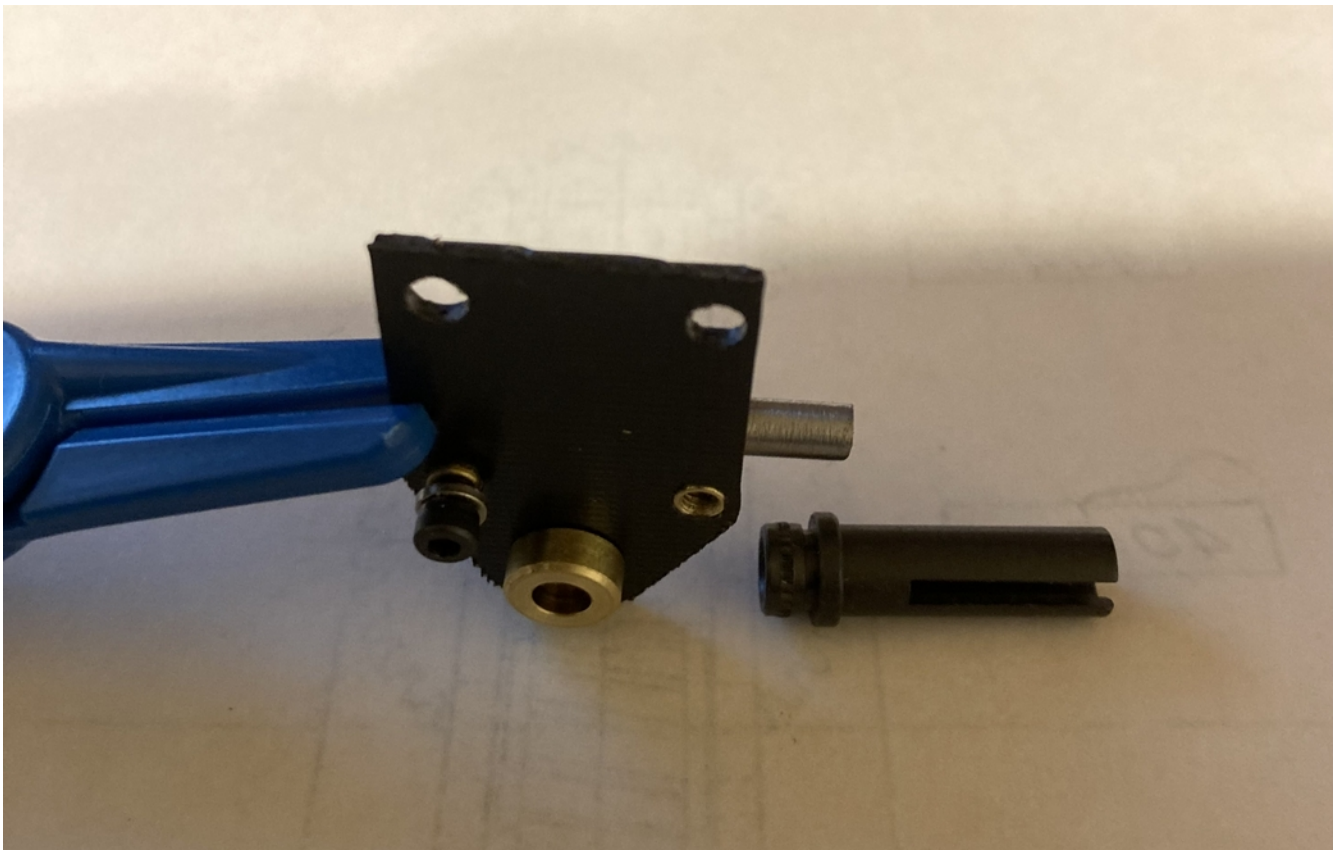


Next, take and place the first #4040 into the left lower hole and temporarily put the 3-48 screw with the lock washer on finger tight.

Next, we put the #4040 bushing on the drive shaft with the worm and install it for observation. Note, we have not put in any thrust washer aka shim rings, and we want to feel how the shaft turns freely in the bushings.



Once again, viewing orientation makes it easier to assemble. The next side view gives the modeler an idea about the interface between the drive shaft and the #4041 shaft coupler.

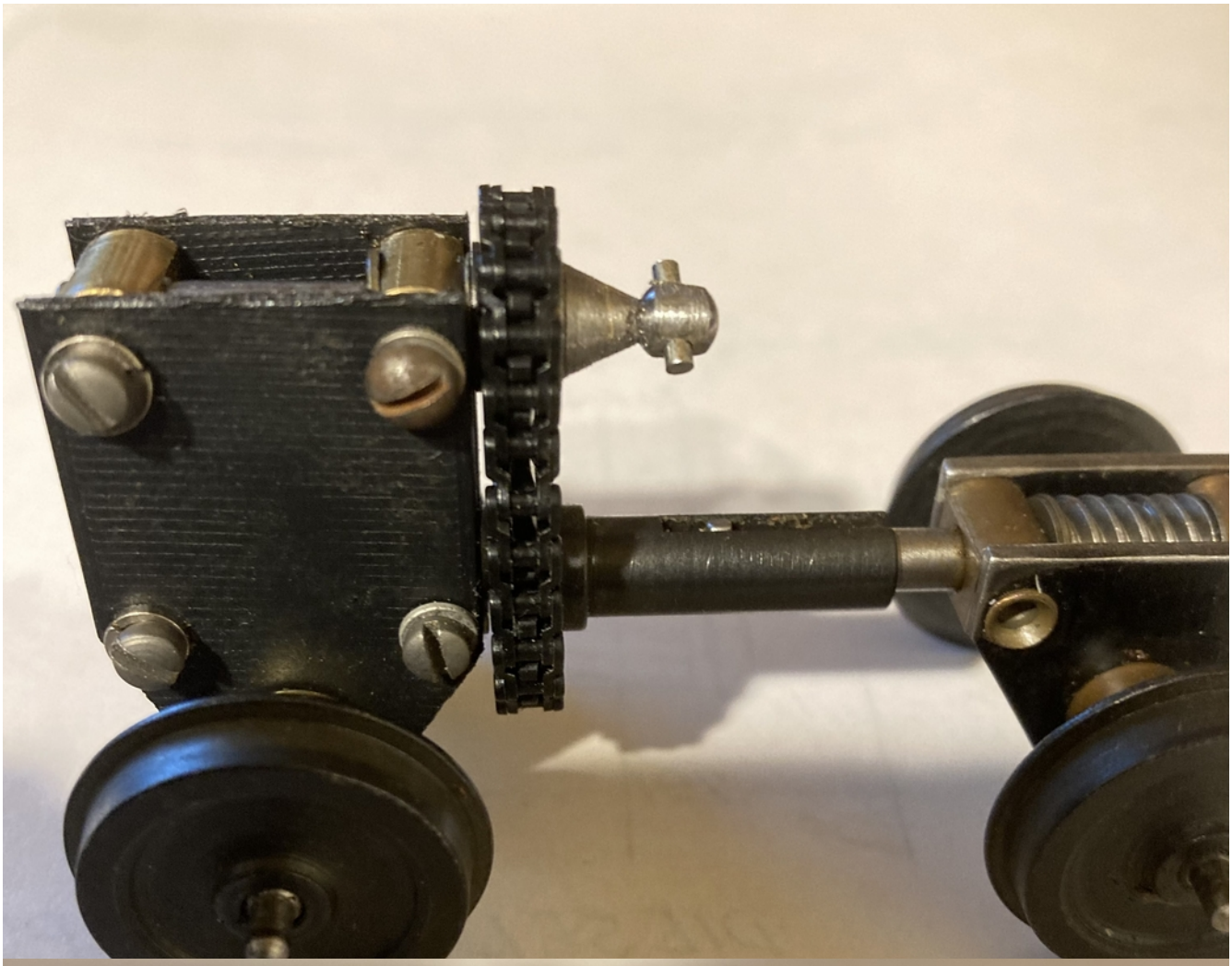


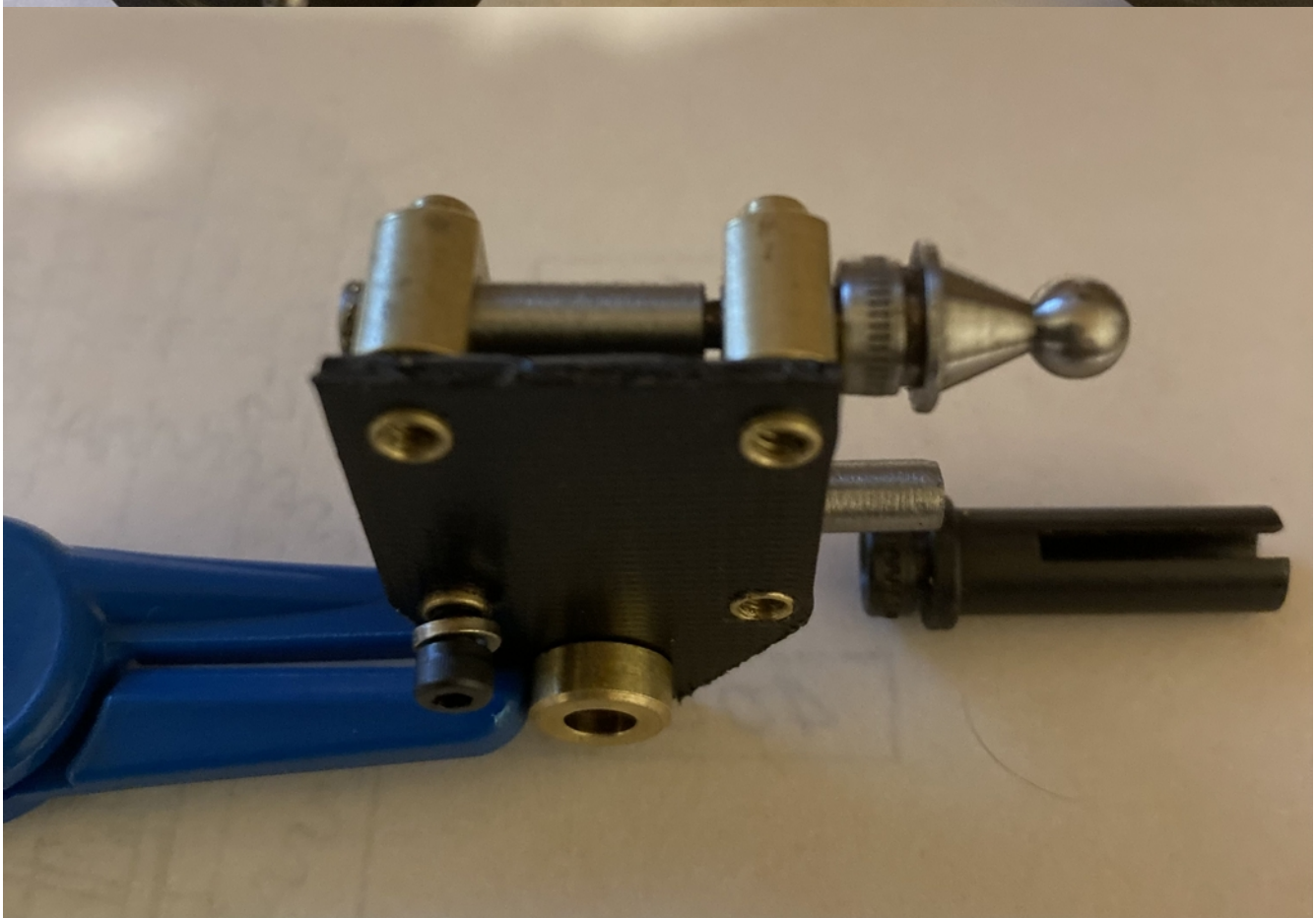
By reading these instructions, it will help the modeler think through the process and the kinds of things to look out for during the procedures. In the above photo, it appears the drive shaft is a little to long. If it is to long and long is better than short, the modeler will have to take the Dremel with a cutting disk and trim it ever so slightly to the correct length. Determining the correct length involves several factors to be discuss now.

First, a good description of part # 4041 is in order. The left hand side press fits onto to the drive shaft. The outside diameter is ¼” knurled and the larger sprocket or the larger brass helix gear press fits onto this outside diameter pressing against the face of the larger 5/16” diameter circular face plate. This prevents the sprocket from moving forward. The opposite end of the coupler has an inside diameter to accommodate the drive shaft from the smaller gear unit and is slotted for the pin that is press on the drive shaft. The slot is elongated to the shaft can telescope or slide inside the coupler as a self adjusting distance function at the time of assembling the 2 units into the truck.

The tower drive shaft can only press into the coupler for an approximate total of ¼”. Thus, at this point before taking the the liberty to shorten the shaft if necessary, stop. It is now time to have a look at the upper shaft because the vertical alignment of the top and bottom sprocket is very important to get right. If you look into the end of the coupler, it is machined out so that it will only allow ¼” in length to be pressed into it.

Now is as good as anytime to look at a photo of the final assembly with regard to alignments.

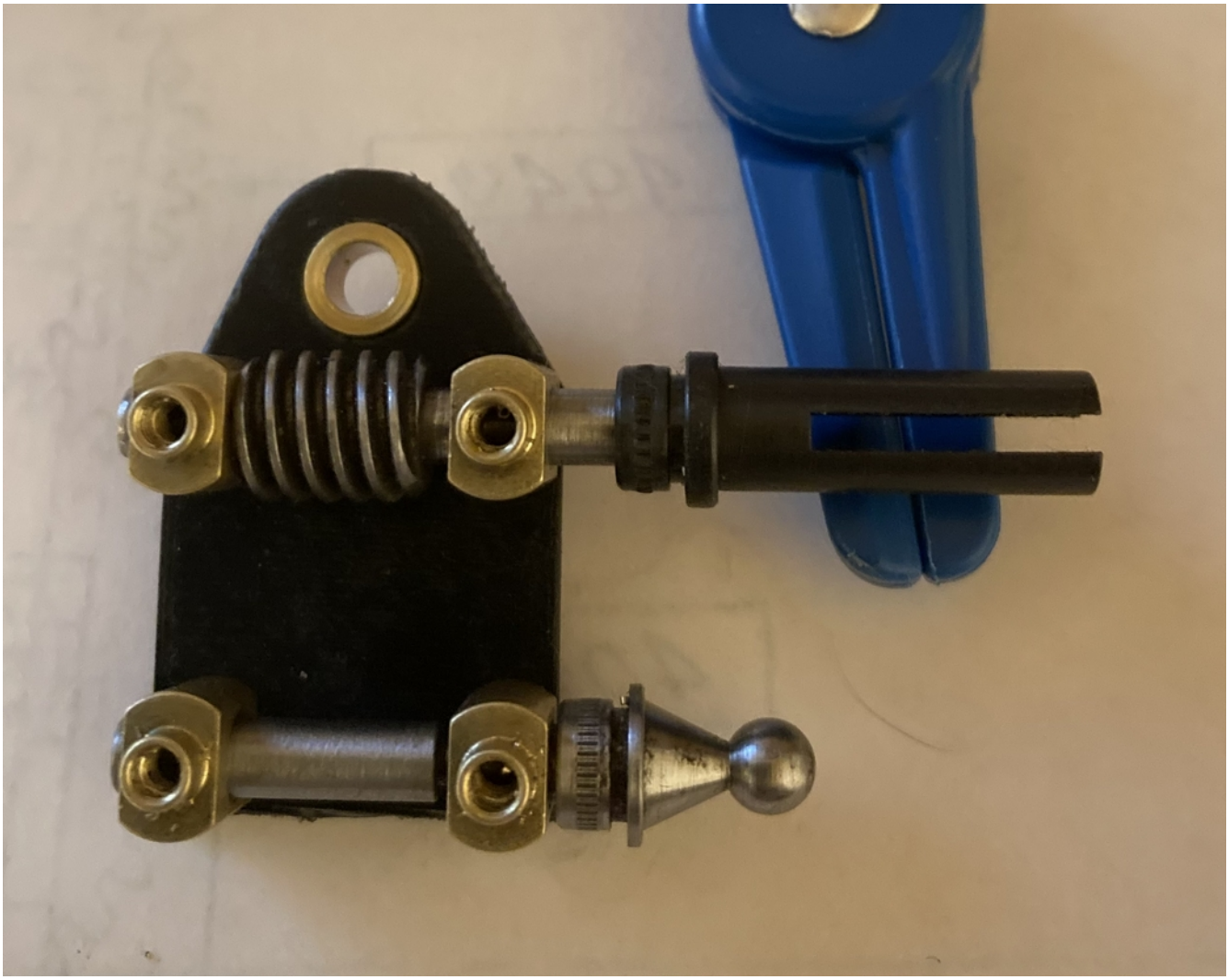




You can now see the right hand edge of #4038 where the spacer bushings are closer to the edge compared to the right hand side. Both #4041 and #4042 have the thrust washer that buffer against the #4040 spacers. Consequently, this is why one needs to be thinking about the extra factors involved before shortening the lower drive shaft.

The upper drive shaft #4042 also has a knurl to press fit the upper sprocket as well. It appears in this case the lower shaft is a little long. So as a point of reference, the modeler can install the upper sprocket with the thrust washer and the c/e clip onto the shaft on the slot machined into the shaft immediately to the left of the right hand spacer. This will give a more exact positioning visual for the lower drive shaft.

But wait, there is one more variable to consider.

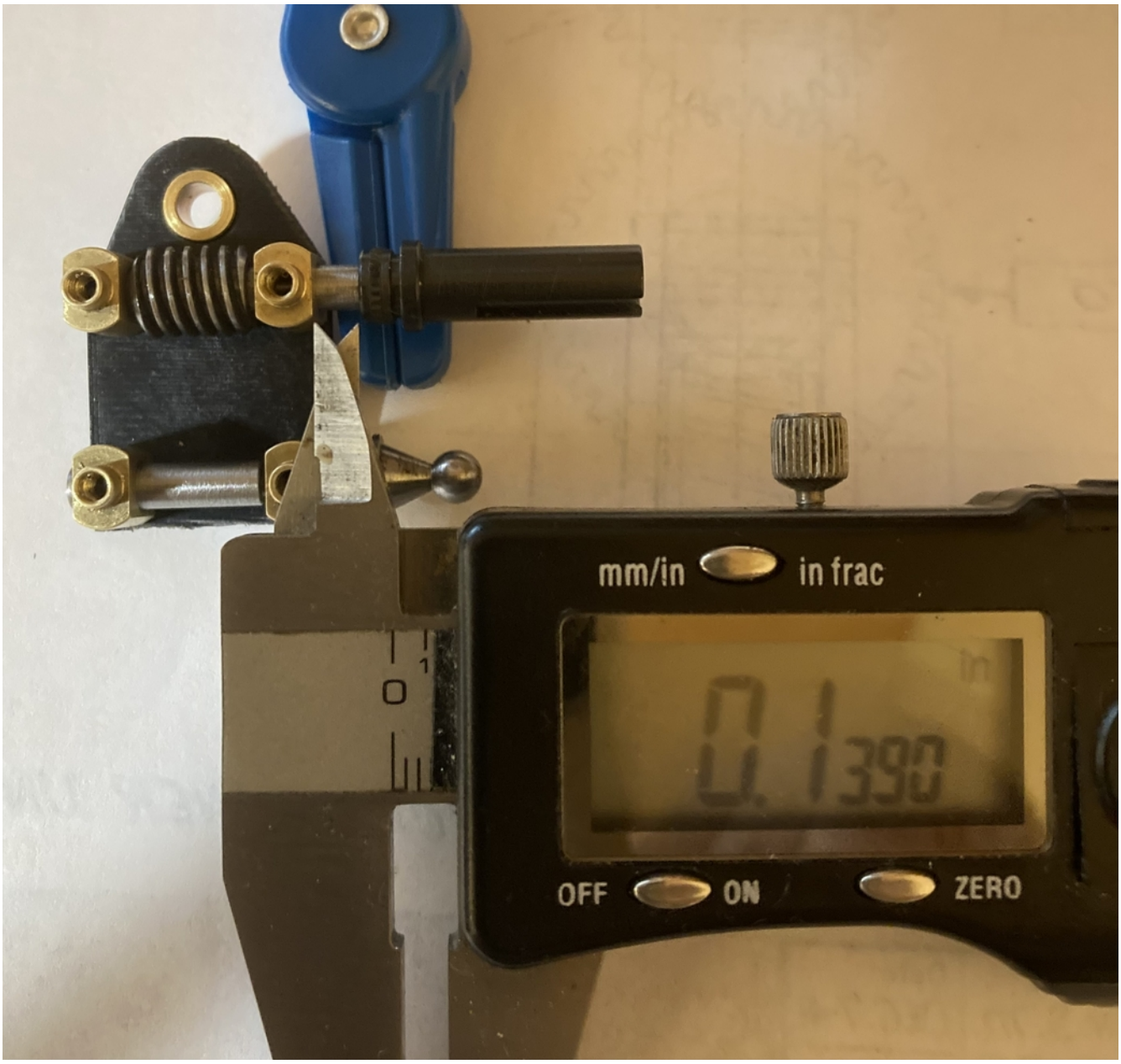


Note in the photo above the lower drive shaft can be shifted left and right. Before taking a measurement as to how much the shaft needs to be shortened, center the worm. In fact it might not be a bad idea to insert the axle with the worm gear. Thrust washers will need to go on both sides of the worm so as you can see in this photo the shaft will likely move slight to the right. The gap between the ends of the worm and the spacer bushings is desirable because there should be a little play when the engine goes either forward or reverse and yet you do not want to tight a mechanism after installing the

thrust washers. If the drive shaft is trimmed to short, the sprocket will be out of alignment with the top sprocket and might rub against the edge of #4038 so any friction points should be avoided.

It appears the shaft in this photo will need to be shortened.

Distance of 7/64” before centering the worm by moving the shaft slightly to the right.



Distance between the spacer without a thrust washer to the coupler with the shaft already inserted increased slightly measuring 0.1390”. The shim rings or thrust washers come in various thicknesses. The ones in the parts photo above are 0.25 mm or 0.1” approximately. So depending if you were to use thicker or thinner rings it is something to keep in mind. Because, the rings at the end of the day assist in fine tuning the mechanism where they are used not only behind the sprockets but also on the worm drive shaft and the worm gear on the axles. They help overcome torque but also serve to keep the horizontal and vertical axis aligned and centered between the worm shaft and axle worm gear for smoothly meshed operation in both directions.

The final step before making any cuts to shorten the lower drive shaft, the modeler should measure the thickness of either the lower helix gear or in the case of this kit the sprocket. The thickness of the helix

gear is 3.25 mm or 0.1275” as a secondary frame of reference to at least eye ball where the ideal gear position should be in relation to the upper gear or sprocket for alignment.

The sprockets come from Serv-O-Link (aka Pilot Bore Sprockets). Pilot bore sprockets feature a cylindrical projection that can be drilled to the bore size required to provide a contact surface around the shaft. They can then be fixed with a grub screw, pin, locking bushes, knurl, etc. The bore size used in this kit is ¼”. The projected cylinder must be decreased in length such that the overall thickness when pressed onto #4041 is approximately 3.5 mm or 0.14”.

When pressing the lower drive shaft into #4041, because the shaft was reduced slightly to allow #4040 to slide on, the drive shaft rod will not be a tight fit when fitted into #4041. Therefore, the end of the shaft must be knurled. Short of a knurl,it is easier to set the end of the shaft on a small anvil and flare

the edge with a light tap of the hammer to get a snug press fit to join them. Before doing so, make sure the sprocket is not turning on the ¼" knurled #4041 part.

Now that this part of the craftsmanship is done, the fun part starts. Finally assembly begins with installing the axle and then attaching the 2nd #4038 to the #4040 spacer bushings. Using the 3-48 screws, tighten the screws finger tight. Start turning the upper and the lower shafts by hand to get a feel for the type of resistance if any that may exist. Stiffness is okay at this point since it has no lubrication. Observe the action from differing angles of the worm turning the worm gear on the axle. Look for any shifting. The upper shaft on the tower will not require in most cases a shim ring between the c/e clip C2036 and the #4040 spacer. Install the clip into the slot on the shaft and turn the shaft once again to check for performance and final alignment. Note, installing the chain is not suggested at this juncture just yet.

Upon observation and notes taken, the modeler can take apart the mechanism and start adding the thrust washers. At a minimum, 1 washer in either side of the worm gear on the axle and 1 on each side of the worm. Put the mechanism back together again and test its performance by turning the shafts. If there is any binding or the worm gear on the axle is walking left or right from being centered under the worm, then add another shim. If the shafts will not turn at all or feel like they are binding in one or more turning directions, then thinner thrust washers might be needed. What you are trying to achieve is smoothness but not any slop in one direction or the other.

If you are testing with the helix gears already mounted on the shafts they will be mated up and the thing to watch for is to make sure neither shaft is shifting horizontally which would cause a slight unalignment of the sprockets, a risk that the chain could come off. The bottom brass helix gear should stay perfectly aligned under the top steel helix gear for the most smooth and quiet operation.

For the chain drive kit, it is time to install the chain onto the sprockets. After, test and feel the performance by turning the upper shaft by hand. It is okay to note some stiffness because the last mechanical test is to take the drive and connect it to a motor such as a Pittman 12 vdc to run the transmission under real circumstances but not under load. Lubricate the mechanism thoroughly and start running it at several different speeds for 2 to 3 minutes in both forward and reverse. A stiff transmission should immediately free up. If something is causing friction in the transmission, one way to tell is if it tends to torque in a rotation manner in your fingers, then something is not perfectly right. A 2nd way to tell if the drive is not perfectly tuned is to run it at full speed and see if it heats up. A friction point will cause it to warm up.

Remove the transmission and at this point it should turn perfectly freely by hand. If there is a problem, disassemble the transmission ascertain what the root cause of the problem is and fix it. Usually it may be the combination of shim rings. If the worm gear and worm are totally seized, do not force it because the steel worm will chew up the brass worm gear on the axle and become unusable.

Once your transmission is operating correctly, it is time to install the 40" scale wheels onto the axles. If you do not have an arbor press to press the wheels, you could use our tool the All Nation O Scale 2 Rail Wheel Press Tool 40 Inch wheels PN#3816T40 in a vise. Take note which side you choose for the insulated wheel using the plastic spacer in the wheel with the larger hole.

Last but not least, the kit comes with All Nation Bottom Spur Gear Pan with Retainers & Screws 3D Print PN#253AN. This clips onto the bottom of the gear box housing and has adequate clearances on the rail heads. Use the 0-80 screws to secure the pan. The pan serves several purposes. First it keeps the

gears clean and holds the #4073 in place should they try to come out of the #4038. Second, it can keep the worm gear lubricated during operation. Third, electric wiper pickups on the wheels can be installed if so desired.

This concludes the assembly instructions for the Power Truck Transmission Tower Drive. The small gear kit is considerably easier to assemble and may be a good starting point. If shafts need to be turned down slightly for fitting the #4040 spacer bushings, a small drill press is adequate to do the job. We reiterate to take it slow so as to not take off to much material on the shafts which would give a sloppy bearing fit At this point the transmission can be installed in to the Blomberg truck side frames and you are ready to operate and run trains.