Honeywell Enraf

CALIBRON® Small Volume Prover Service Manual

CALIBRON®

SMALL VOLUME PROVER (SVP) SERVICE MANUAL

FOR

MODELS 35, 85, 120

U.S. PATENT #5,052,211

1st Edition
Released June 2012

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SERVICE OF FLOW PROVERS

NOTE: ALL FIGURES CAN BE FOUND IN THE APPENDIX

Safety instructions for installation, commissioning, operation and maintenance

Preface

The Calibron® SVP (Small Volume Prover) is a high precision instrument for verification of calibration of flow metering equipment.

Warning

Only use the instrument for its intended purpose.

EC declaration of conformity

Refer to the EC declaration of conformity and ATEX certificate(s), shipped with the instrument.

Installation

Refer to Honeywell Enraf installation manual 44103445M for additional information.

The mechanical and electrical installation shall only be carried out by trained personnel with knowledge of the requirements for installation of explosion proof equipment in (potentially) explosive atmospheres.

The entire installation procedure shall be carried out in accordance with national, local and company regulations. The entire electrical installation

shall be carried out in accordance with the International Standard EN 60079-14 for electrical equipment to be installed in (potentially) explosive atmospheres.

Warning – Risk of Explosion

Do not open any of the electronics enclosures when an explosive atmosphere may be present.

Warning – Risk of Explosion

Explosion proof (Ex d) compound cable glands or conduit sealed directly at all cable entries must be used.

Which type depends on local & national requirements and legislation.

Warning – Risk of Explosion

Unused cable entries must be sealed with an approved metric or NPT threaded stopping (“Stopper”) plugs. Take care to select whichever is appropriate and contact Honeywell Enraf in case of doubt. Improper installation of cable glands, conduit or stopping plugs will invalidate the Ex approval.

Warning – Risk of Explosion

Intrinsically safe connections are factory wired. No unauthorized changes are allowed as these would invalidate the approval.

There are no intrinsically safe connections that need wiring and thus no verification of Intrinsic Safety (entity parameter compatibility) applies.

Warning – Risk of injury

Honeywell Enraf recommends mains power to be shut off, including lockout-tagout at that mains switch to ensure safety during maintenance and related work being performed on the inside of the drive end cover.

Warning – Risk of injury

Ensure that the motor drive end cover is always in place before operating the device, to guard against human injury.

Warning – Risk of injury

Pressurize system slowly to avoid a hydraulic shock which could result in damage to prover, personnel, and/or lines.

Warning – Risk of injury

Ensure that the unit is fully depressurized and drained prior to disassembly or service.

Commissioning

The commissioning of the instrument shall be conducted by qualified engineers, trained by Honeywell Enraf and with knowledge of the (local and national) requirements for electrical equipment in (potentially) explosive atmospheres.

Operation

After commissioning the Calibron® SVP can be used for its intended purpose.

Maintenance and troubleshooting

In the unlikely event of malfunction, only a qualified service engineer, trained by Honeywell Enraf and with knowledge of safety regulations for working in (potentially) explosive atmospheres is allowed to repair the instrument.

Additional information

If you require additional information, contact Honeywell Enraf or its representative.

Approvals :
Refer to the EC declaration of conformity and ATEX certificate(s), shipped with the instrument (as it may vary per configuration)

Certificates and standards :

CE Directive	Certificate number	Standards applied
94/9/EC ATEX electrical	LCIE 05 ATEX 6068X	EN 60079-0:2006, EN 60079-1:2004, EN 60079-11:2007
94/9/EC ATEX mechanical	Honeywell Enraf declared	EN 13463-1:2009, EN 13463-5:2003
2006/42/EC Machinery Directive	Honeywell Enraf declared	EN 60204-1:2006, EN 953: 1998 + A1: 2009
97/23/EC Pressure Equipment Directive	60330-2009-CE-HOU-DNV	

Environmental conditions:

Ambient pressure	:	atmospheric
Relative humidity	:	5 – 95 %
Ambient temperature	:	ATEX Approval -29˚C to +40˚C (-20˚ F to +104˚F) and CSA Approval -29˚C to +50˚C (-20˚ F to +122˚F)

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CHAPTER 1 PRE-SERVICING CONDITIONS

Servicing the prover should be done in a de-engergized state but may require reactivating power for the motor or flow through the prover to position the piston. Use extreme caution and keep clear of all moving components including the downstream shaft. All covers should remain in place while the prover is energized if at all possible. Metal tools should not be used inside the flow tube so as not to damage the surface finish.

1.1. Portable Prover

- Lock out AC or DC power to motor with padlock
- Install Condat System and computer
- Install fake flow meter / signal generator (if checking optical switches)
- Turn on the 24VDC to the Condat

1.2. Stationary prover

- Lock out AC power to prover with padlock.

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CHAPTER 2 CHECKING THE OPTICAL SWITCHES AND 401D BOARD

a. If you check the 401D board and the LED light is not on, check the input power (24 VDC). If you have power to the board and no LED light, replace 401D and run through the following sequence.

b. Check that the piston is completely downstream, if not check for reasons why and correct the problem.

c. If flow computer is not receiving a flow meter signal, install signal generator to produce a signal in place of the flow meter.

d. Tell the Flow Computer to take a proving cycle then take a business card or anything similar and swipe it through the downstream optic switch, the one closet to the flow tube. Next, swipe the card through the upstream optic switch, trip the motor stop switch, and then swipe the card through the upstream optic switch. After performing this sequence check to see if the computer is receiving flow meter pulses. Lastly, swipe the card through the downstream optic switch and the pulses should stop.

If you do not receive pulses when you trip the upstream optic switch check the 401D board and see if the light is on and flashing, if so replace the optic switch and run test again. If the pulses now start at the upstream switch, you can trip the downstream switch and the pulses should stop.

If the pulse did not stop when you swiped the downstream switch and the light is flashing on the 401D board, replace the optic switch.

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CHAPTER 3 INSTALLING DOWNSTREAM SHAFT SEALS

Do not remove upstream seal retainer at this time.

a. Move the piston to the upstream position.
b. Disconnect power from prover.
c. Disconnect prover from line, or block off from line, and drain completely.
d. Remove downstream shaft cover by removing outer support, carefully sliding tube cover from the shaft, and unscrew the threaded rod from the downstream stop.
e. Remove downstream stop and remove seal retainer, Figure 1.
f. Remove the retaining rings, seals and washers from the downstream seal retainer.
g. Clean and inspect seal retainer.
h. Check seal surfaces for scratches and a surface finish of 12rms. If necessary, polish the seal surfaces.
i. Install new seals and washers in proper orientation, Figure 2.

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CHAPTER 4 INSTALLING NEW PISTON SEALS

a. Ensure that the piston is in the upstream position.

b. Disconnect power from prover.

c. Remove downstream flange, Figure 1. This involves removing transmitters and the flange support plate.

d. Push piston downstream. Place puller on the front side of the guide block and use a wrench on the drive sprocket to push piston downstream.

e. Remove piston by first removing upstream shaft from the guide block and the mechanical stop and then pull piston from the tube. Lift piston with a nylon strap wrapped through support to prevent damage or injury. NEVER lift piston with the end of shaft that is away from the piston body.

f. Remove downstream shaft from piston assembly, protect the shaft surface from any damage and place it aside.

g. Set remaining piston assembly down flat onto two 2x4s with upstream shaft pointing up.

h. Clean and inspect flow tube. Check for gouges, excessive wear, deplating, pitting, etc.

i. Remove piston support. Use caution on larger units (S85 and S120) as it takes three people to remove the piston support, two to stand on the support and the other one to remove the bolts. If the support should be stuck in the piston body, the two people standing on the support should remain until the third person can tap it loose using a dead blow hammer.

j. Remove old seals.

k. Clean and inspect all parts.

l. Check seal grove width for proper seal fit, use gauge if available. If the grove is too small check with factory to get the proper dimensions to have the piston body machined.

m. Install new riders. If piston appears tight when installing new seal kits into the tube a grove could be cut on the rider surface. This will consist of two 45-degree groves cut in the rider spaced 90 or 180 degrees apart. Use a sharp utility knife to create groove. Depth of groove is to be 80% of the rider thickness and 1/8” wide. Cut grooves after rider is installed on piston body. All riders should have chamfered inside edges to allow for proper seating in the piston, Figure 4.

n. Install new piston seals so that the open end points outward, away from the rider.

o. Install new poppet seal and reassemble piston.

p. Check the operation of the poppet if possible.

   a. Keep all body parts clear of the piston support when performing this test to avoid serious injury.
   b. Pick up the piston body / poppet / shaft assembly and place onto a fixture so that the assembly is only supported at the poppet and the piston body if free to move. A 4” or larger pipe fitting is a good support fixture, as it will clear the shaft mounting point and allow for movement of the piston body.
   c. Support the upstream shaft so that the assembly will not tip or fall. To prevent tipping, attach one end of a chain to the piston shaft using a bolt and attach the other end of the chain to a fixed point.
   d. With the assembly supported and resting on the poppet only, push down on the piston body. The body should move independently from the poppet and return to its original location when the pushing force is removed. Be careful not to damage the piston seals when pushing on the piston body as they can be damaged easily.

q. Lift piston with nylon strap using a crane and install downstream shaft.

r. Install piston into flow tube using caution not damage the shafts or piston itself. After piston is inserted, pull upstream.

s. Install downstream flange then push piston downstream until the shaft extends past the flange approximately 2" to 6".

t. Install the downstream stop and seal retainer.

CHAPTER 5 INSTALLING UPSTREAM SHAFT SEALS

a. Move the piston to the downstream position.

b. Disconnect power from prover.

c. Remove the upstream seal retainer assembly, Figure 5, from the upstream flange by first removing the shock absorbers and then removing the hex socket cap screws holding the seal retainer to the end flange. Then remove the seal retainer assembly.

d. Remove the retaining rings, seals and washers from the upstream seal retainer.

e. Clean and inspect seal retainer.

f. Check seal surfaces for scratches and a surface finish of 12rms. If necessary, polish the seal surfaces.

g. Install new seals and washers in proper orientation, Figure 5.

h. Install seal retainer on prover.

i. Install mechanical stop, guide block, washer, and nut onto the stud in the upstream piston shaft; be sure to clean the threads on the stud and be careful not to damage the optic switches. If prover has only a bolt in the piston shaft, it is recommended that it be replaced with a B7 stud and 2H nut. Any prover found using a standard nut in place of the 2H needs to have it replaced with a 2H nut. For Loctite location on the above items, see Figure 9.

g. Lock washers are not used at the location described in “5.i”. If the prover does have a lock washer remove it and replace with a flat washer.

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CHAPTER 6 SERVICING DRIVE SYSTEM

6.1. Before working on the Drive System

a. Ensure that the power to the motor is removed and locked and tagged.

b. Check that the piston is in the downstream position (the distance between the mechanical stop and the upstream seal retainer should be approximately 2-3 inches).

c. Close and lock the block and bleed valves at inlet and outlet to prover.

d. Bleed and drain prover.

e. Remove the motor (main drive) chain (the chain between the output sprocket on the gear reducer and the main drive sprocket.

6.2. Checking Alignment of Drive System (general checking)

a. Check the drive system to see if there are any lose bolts or parts.

b. Be certain to check the washers on the end of the guide bars. If these washers are not thick stainless steel washers replace them, even if they appear to be tight (standard bolt washers do not work correctly).

c. Check to see if all six pins have been installed Figure 6.

d. When checking alignment, loosen bolt on end of guide bar and use a wrench to check that the guide bar is tight to the flange Figure 7. The guidebar is pocketed in the two plates in the drive end on 85 and 120 models. Tightening the upstream bolt is all that is necessary.

e. Check the ground spring to ensure it is in contact with the ground bar. In the case of larger provers, check that the ground cable is connected to both the ground strap and frame **Figure 8**

6.3. Checking Alignment of Guide Block

a. With the piston close to the downstream position, remove the piston shaft nut. Being careful not to break the optic switch, slide the guide block off the stud.

b. Check side play of guide block, clearance should be .003/.005. If play is excessive, remove and shim Ryton bushing see Figure 10.

c. Check that the B7 Stud is straight and square in all direction to the end of the piston.

Care should be taken to ensure that the hole in the guide block aligns with the B7 stud in the piston shaft. If the hole does not align with the stud, adjust shims accordingly. Slide the guide block upstream and check the side play. If side play is too tight upstream, you will have to readjust shims, remembering that the guide block MUST always align with the B7 stud in the downstream position see ***Figure 11***

d. Reinstall the guide block to the piston shaft.

e. Pull the piston upstream being careful not to break the optic switches.

f. Use a wrench on the hub of the large drive sprocket and move the piston to the position that you want. Remove nut, slide guide block off the B7 stud, and check alignment with the guide block.

g. The hole in the guide block should be aligned side to side with the B7 stud and the shaft should have 1/32" to 1/16' sag when upstream see **Figure 11.**

h. If the B7 stud is not aligned properly, adjust the upstream plate by loosening the respective bolts and removing the 1/4" spring pins used to maintain alignment. Once you remove the alignment pins you must drill and tap new holes, after all adjustments have been made see Section **6.9.** Adjust the upstream drive end plate so that the side of the plate is perpendicular to the frame. Tighten all the bolts, and check the alignment again.

i. To avoid a twist on the drive system, squareness between the two plates in the drive end must be maintained.

6.4. Check the Alignment of the Flag

a. Inspect the upstream and downstream optical switches to verify they are correctly seated, see Figure 12. If not, reposition and replace springs and seals as needed.

b. Position the flag with the guide block in the opening of the downstream optical switch and check the alignment. The flag should be centered as showed in the Figure 13. This can be observed through the hole in the upstream drive end plate or using a mirror positioned close to the optical switch.

c. If necessary, gently shift the flag until it is centered.

d. Repeat first two steps at the upstream optical switch.

e. If adjusting the flag does not provide centering of the flag on both switches, the switch bar may not be aligned with the piston assembly.

   a. First confirm that the guide block is aligned with the piston shaft see Section 6.3.

b. Use a pipe clamp and pull the switch bar, if possible, in the direction needed being careful not to affect other adjustments. You may have to move both ends see Figure 14.

f. If the pocket in the plate is bigger than the switch bar, the gap will need to be shimed. The shim must be installed between the 5/8" rod and the switch bar itself. This shim must be bolted to the plate. These adjustments will most likely need to be performed at both ends of the switch bar on opposite sides see Figure 13.

g. Recheck the flag alignment.

6.5. Shimming the Puller

a. Inspect the puller, verify that the chain pins are straight and not showing any signs of bending or wear. If any damage is noted replace the pins. The cam followers should move freely without play and not exhibit excessive corrosion. Some cosmetic discoloration is expected.

b. Inspect the cam follower contact surface on the guide block or puller depending on prover model. It should have some smoothing and discoloration. Excessive and uneven wear is indicative of puller alignment problems.

c. With the piston close to the downstream position, rotate by hand the main drive sprocket to position puller in contact and behind guide block (in pull position).

d. Check that both cam followers are in contact with the guide block. If there is a gap on one record the gap downstream using a feeler gauge see Figure 15.

e. Move the piston to the midstream position, position the puller in the pull position.

f. Check that both cam followers are in contact with the guide block. If there is a gap on one side, record the gap at midstream using a feeler gauge.

g. Move the piston to the upstream position, position the puller in the pull position.

h. Check that both cam followers are in contact with the guide block. If there is a gap on one side, record the gap at the upstream using a feeler gauge.

i. Compare your measurements of the gap. They should be consistent between all three measurements and not exceed 0.03" see Figure 15. If not, further diagnosis is required (see 6.5 i-a and 6.5 i-b below).

a. Check if the sprockets are matched to each other by removing them from the driving shaft. Place two sprockets back-to-back and align the keyways. A piece keystock placed in the keyway between

them can be used to assist. Observe the teeth. They should be well aligned.
If not, replace the sprockets with a matched set. After the sprockets are replaced with the new ones, repeat the procedures mentioned in 6.5 c through 6.5 i.

b. If both sprockets located on the driving are matched than the chains have stretched and should be replaced with a matched set.

j. If the gap is still the same at all three locations and exceeds 0.03” then the sideplates need to be shimmed. Shimming is only necessary when machining tolerances stack-up unfavorably. This requires that the guide block and flag be realigned.

Shimming the 120 models requires the drive end to be removed to access the sideplate bolts on downstream drive endplate.

k. If the gap is on the LEFT SIDE OF THE PULLER, loosen but do not remove the bolts that connect the sideplate located on the left side to the downstream end plate see Figure 16.

a. Loosen but do not remove the bolts connecting the drive end support bracket to the frame.

b. Loosen but do not remove the bolts connecting the upstream drive end plate to the sideplate located on the right side (motor side).

c. Remove the top bolt from the sideplate flange (left side) only and place enough shims equal to the gap measured see Figure 18. Make sure the shims drop below the top bolt hole. Use a spare shim to help push them down if necessary.

d. Tighten all the bolts and check the squareness of the drive end in order to avoid twist on the drive system. If necessary, install shims between the side plate on the right side and the upstream drive end plate.

l. If the gap is on the RIGHT SIDE OF THE PULLER, loosen but do not remove the bolts that connect the sideplate located on the right side to the downstream plate see Figure 16.

a. Loosen but do not remove the bolts connecting the drive end support bracket to the frame.

b. Loosen but do not remove the bolts connecting the upstream drive end plate to the sideplate on the left side (opposite motor side).

c. Remove the top bolt from the sideplate flange (right side) only and place enough shims equal to the gap measured see Figure 18. Make sure the shims drop below the top bolt hole. Use a spare shim to help push them down if necessary.

d. Tighten all the bolts and check the squareness of the drive end in order to avoid twist on the drive system. If necessary, install shims between the side plate on the left side and the upstream drive end plate.

6.6. Check the Alignment of the Shafts and Puller

The spacing of the sprockets and guide rail bearings is a fixed distance determined by the shaft and based on the size of the puller. To center the puller, the shafts also must be centered.

a. Do the following on the downstream shaft (driven shaft).

b. With the piston close to the downstream position, rotate by hand the main drive sprocket to position puller behind guide block (in pull position).

c. Check the side to side position of the puller relative to the guide block see Figure 19. The puller should have equal spacing on either side of the guide block.

d. If the puller is not centered it will need to be repositioned.

e. Remove the shaft collars holding the shaft against the bearings and sprockets, and loosen the set screws on all the bearings.

f. On 85 models only, loosen the set screws holding the bearings in the guide bearing rails.

g. On 35 models only, the proper sprocket spacing is determined by set screws seated in grooves see Figure 20.

   a. Verify that the sprocket set screws are seated in the shaft retaining groove on each sprocket. This can be done by removing one of the two set screws in each sprocket and looking down the hole. The groove should be centered.

   b. If not centered, loosen the second set screw a half turn.

   c. Adjust the position of the sprocket.

   d. Tighten the second set screw. It will now seat several turns lower.

   e. Apply Loctite and reinstall the first set screw.

   f. Reapply Loctite to the second set screw.

h. On 85 and 120 models only, the proper sprockets spacing is determined by a shoulder on the shaft or spacer. Reference Figure 21 for 85 models and Figure 22 for 120 models.

   a. Loosen the set screws holding the sprockets in place. The shaft and sprockets should now all be able to move freely.

   b. Squeeze the sprockets together inward. This should force the sprockets against a shaft shoulder or bearings spacer.

On 85 models the guide bearings on the guide bearing rail must be loose. The bearing spacer must be tight without any side to side movement.

   c. Loctite and tighten the set screws in the sprockets only.

i. Center the shaft so that the puller has equal spacing on either side of the guide block. This can be done by lightly tapping the shaft with a

soft mallet and can be observed through the hole in the upstream drive end plate or using a mirror positioned close to the front of the guide see Figure 19.

j. Verify the shaft projects equally according to Figure 20, Figure 21, or Figure 22 depending on model.

k. Loctite and tighten the sets screws in all the shaft's bearings, Do not forget both the shaft set screws and set screws holding the bearing in place on the 85 and 120 guide bearing rails.

l. Move the piston close to the upstream shaft and position the puller behind the guide block (in the pull position) and repeat the previous steps for the upstream shaft.

m. Rotate by hand the main drive sprocket and make sure that the chain moves freely and easily.

n. Reinstall shaft collars with and Loctite according to the Section 7.

6.7. UHMW Chain Rail Adjustment

a. Adjust plastic rail so it holds chain flat and even with the top of the sprockets and is centered in the chain see Figure 23.

b. Verify by observing a flat smooth transition from the sprockets to the chain support while moving the chain back and forth.

6.8. Check the Chain Tension

1. Checking the motor chain tension:
   a. There must be ¾" of play in the motor chain. Any adjustments can be made using the adjustment bolts in the adjustment blocks.
   b. Check everything twice to avoid any missed items. DO NOT OVER TIGHTEN.
   c. Loctite the adjustment bolts with #242 Blue Loctite. If the adjustment blocks are missing install new ones as needed.
2. Checking the tension on two drive chains (chains with puller in between):
   a. The chain droop verification should be completed as showed in the Figure 24.
   b. On model S35 the chain drop should not exceed 1". On models S85 & S120 the chain drop should not exceed 2.5".

6.9. Securing the Drive End

a. All provers must be pinned to maintain drive end alignment see Figure 6. Check everything twice to avoid any missed items.

b. Using a ¼" drill, drill two holes through the mount bracket and the upstream drive end plate, next to the mounting bolts. Drill two holes through the mount plate and the frame, next to the mounting bolts. Drill two holes through the downstream drive end plate and the frame.

c. Insert ¼" x 1.25 Spring Pins into all six of the drilled holes.

6.10. Check Shocks

a. Push down on the shock very fast and it should stop, then continue moving some more.

b. If you push down on the shock and it bottoms out check the adjustment. Almost all of the shocks are adjustable. All shocks must be on the same setting.

c. If after adjusting and retesting the shock it still does not perform correctly, the shock needs replacement.

d. The shocks depth must also be adjusted on the prover itself see Figure 25. This insertion depth must be correct and the same on all four shocks.

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CHAPTER 7 THREAD LOCKER FLUID LOCATION LIST

Back out the bolt and apply Loctite to threads. After application of the Loctite readjust bolt back to a tight position. This procedure must be completed at all the following locations.

a. All bolts on the inside of the prover use # 242 Blue Loctite.
b. B7 stud assembled in to the piston shaft uses #272 Red Loctite.
c. 2H nut for the B7 stud uses # 242 Blue Loctite.
d. Tension bolts used to hold the adjustment of the pillow blocks and gear box use #242 Blue Loctite.
e. Sprockets and Bearings to shafts use # 290 Green Loctite see Figure 26.

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CHAPTER 8 APPENDIX

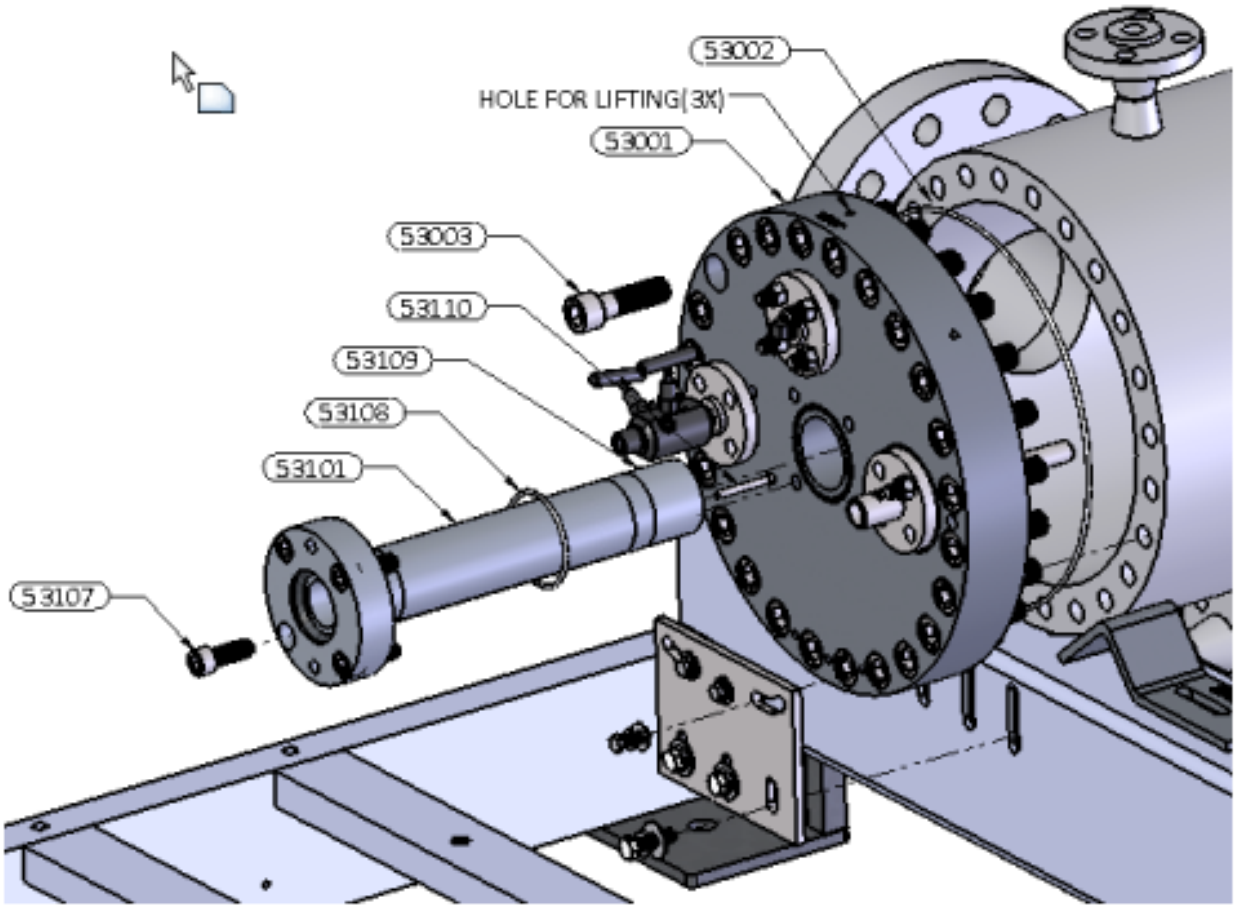

Figure 1: Downstream Flange Assembly

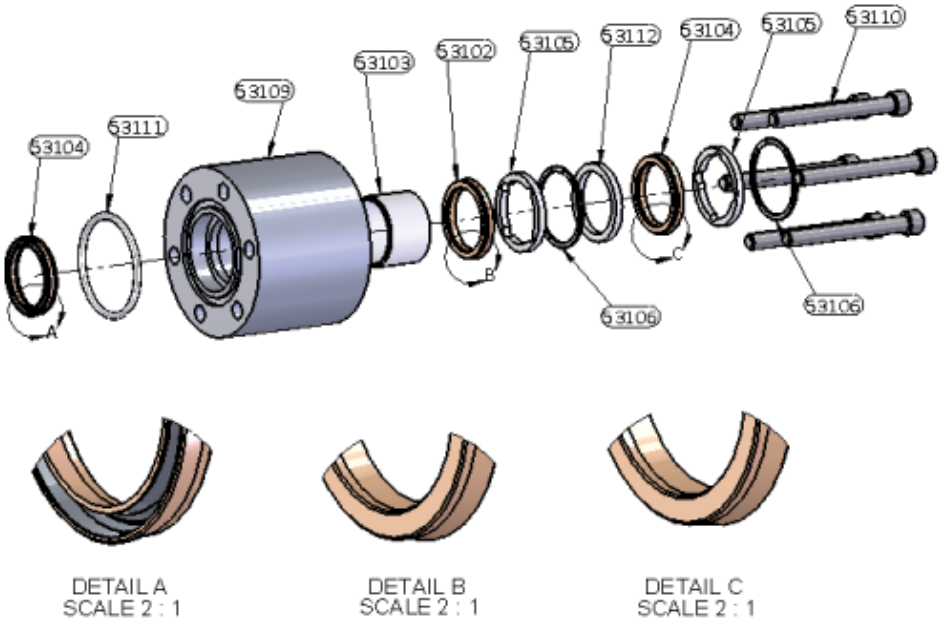

Figure 2: Downstream Seal Retainer

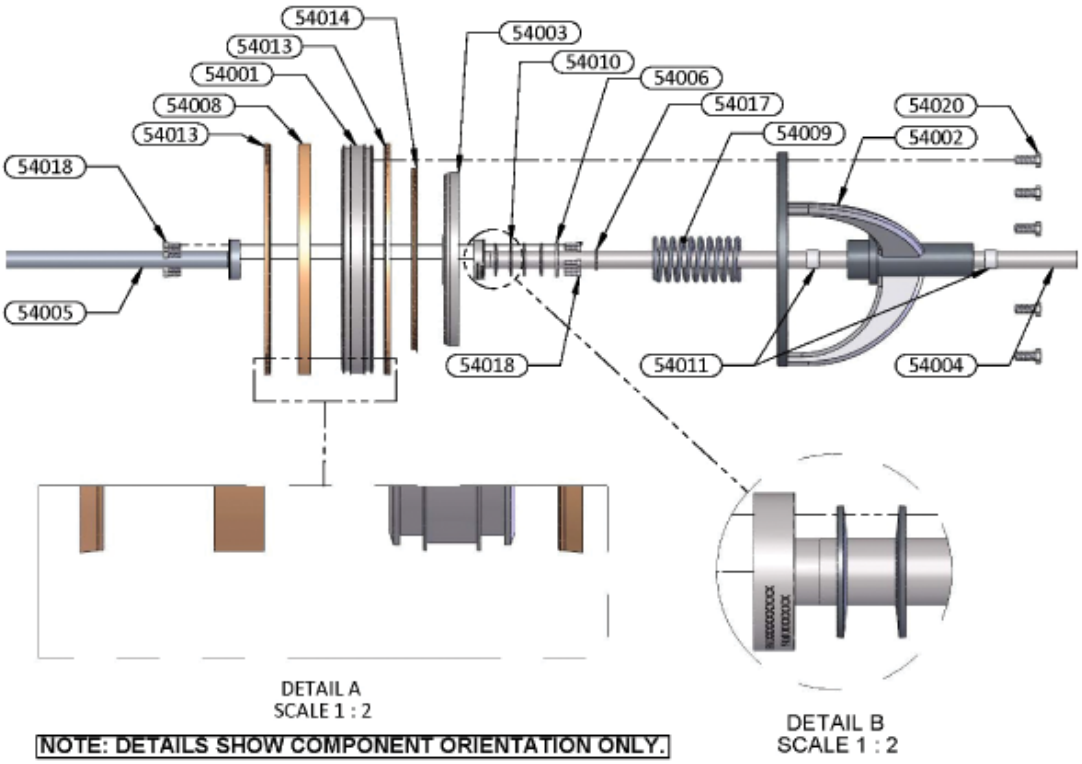

Figure 3: Piston Assembly

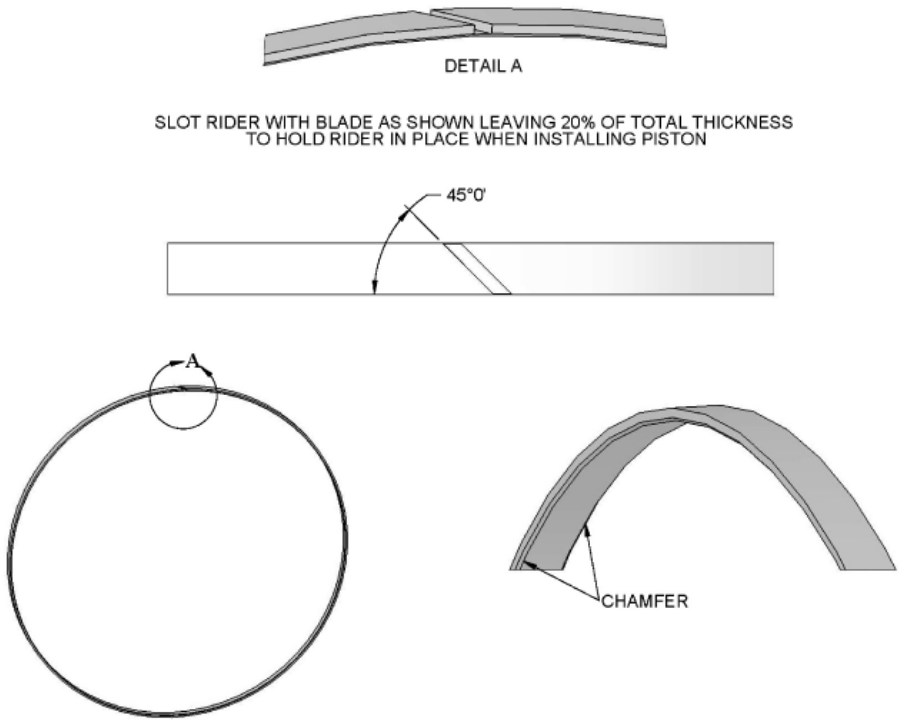

Figure 4: Piston Rider

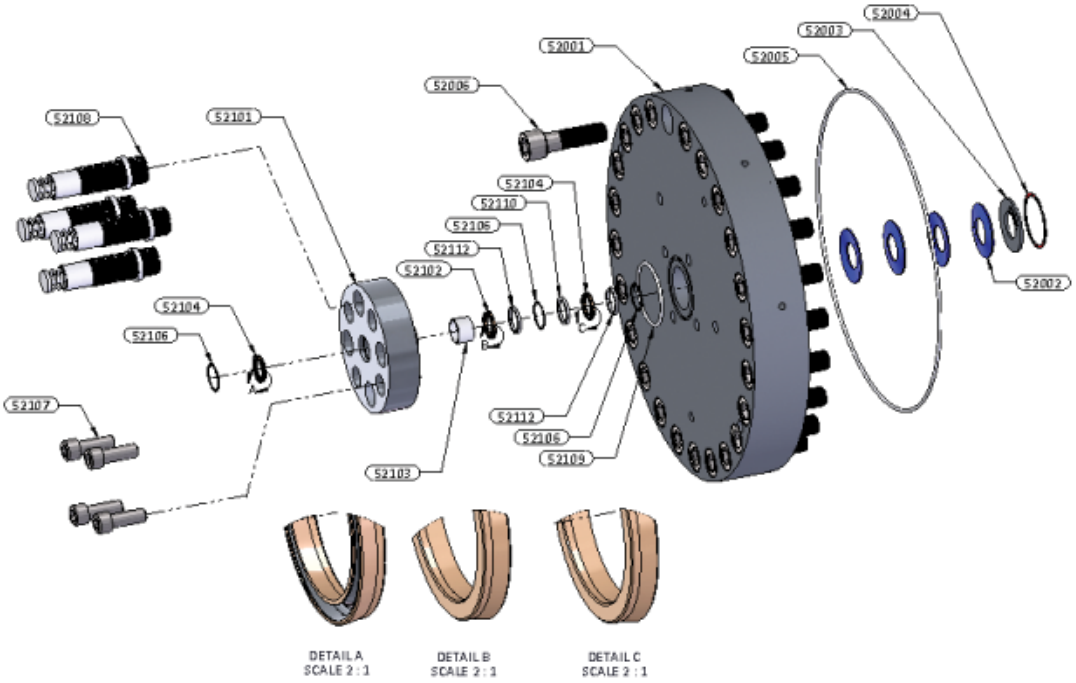

Figure 5: Upstream Flange Assembly

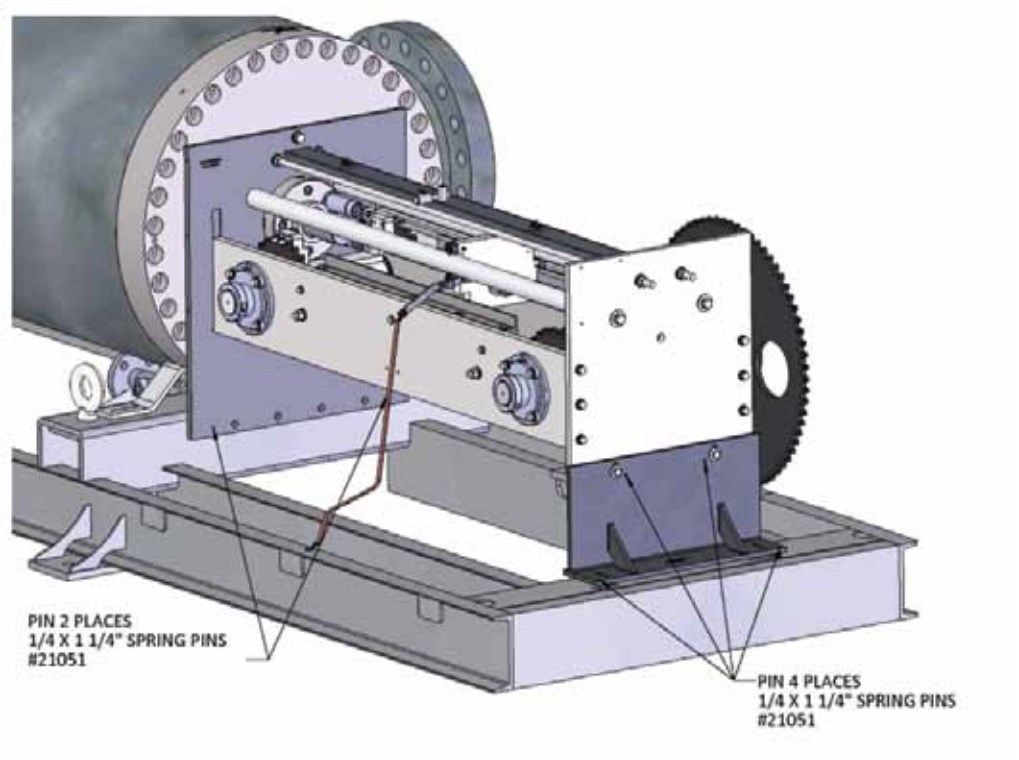

Figure 6: Pinning Locations

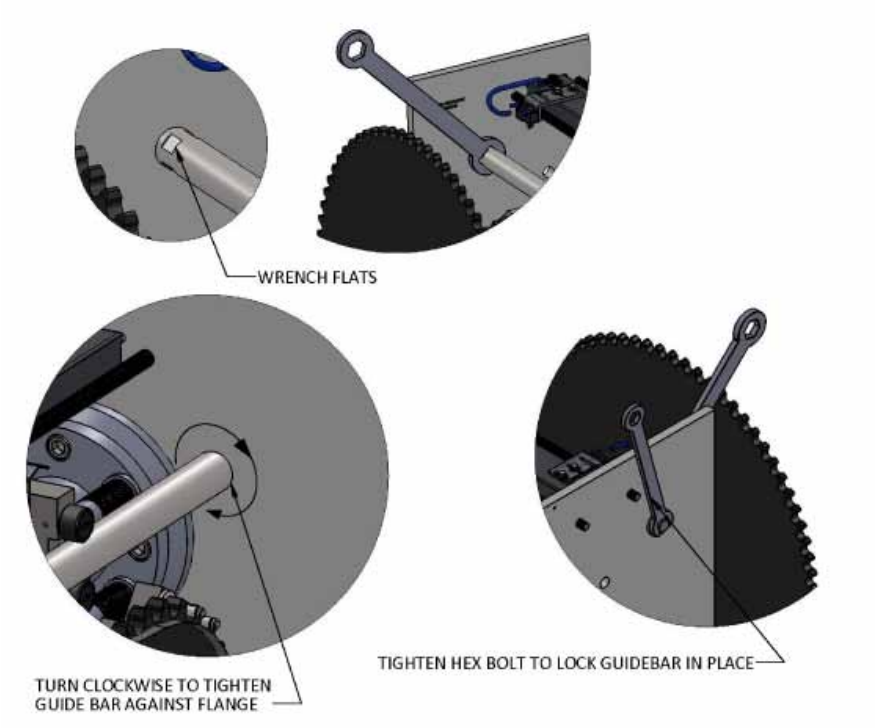

Figure 7: Tighten Guidebar

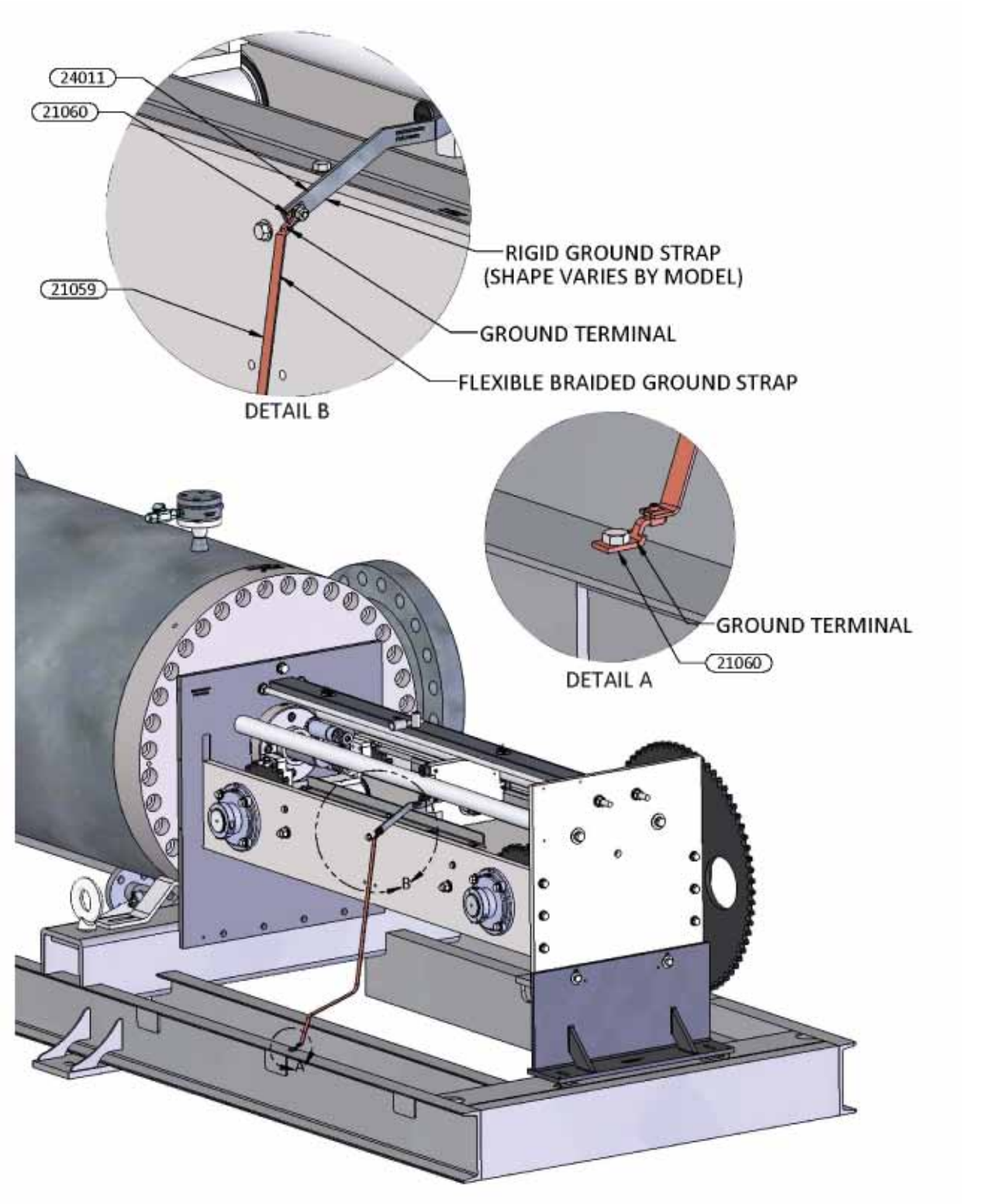

Figure 8: Grounding the Prover

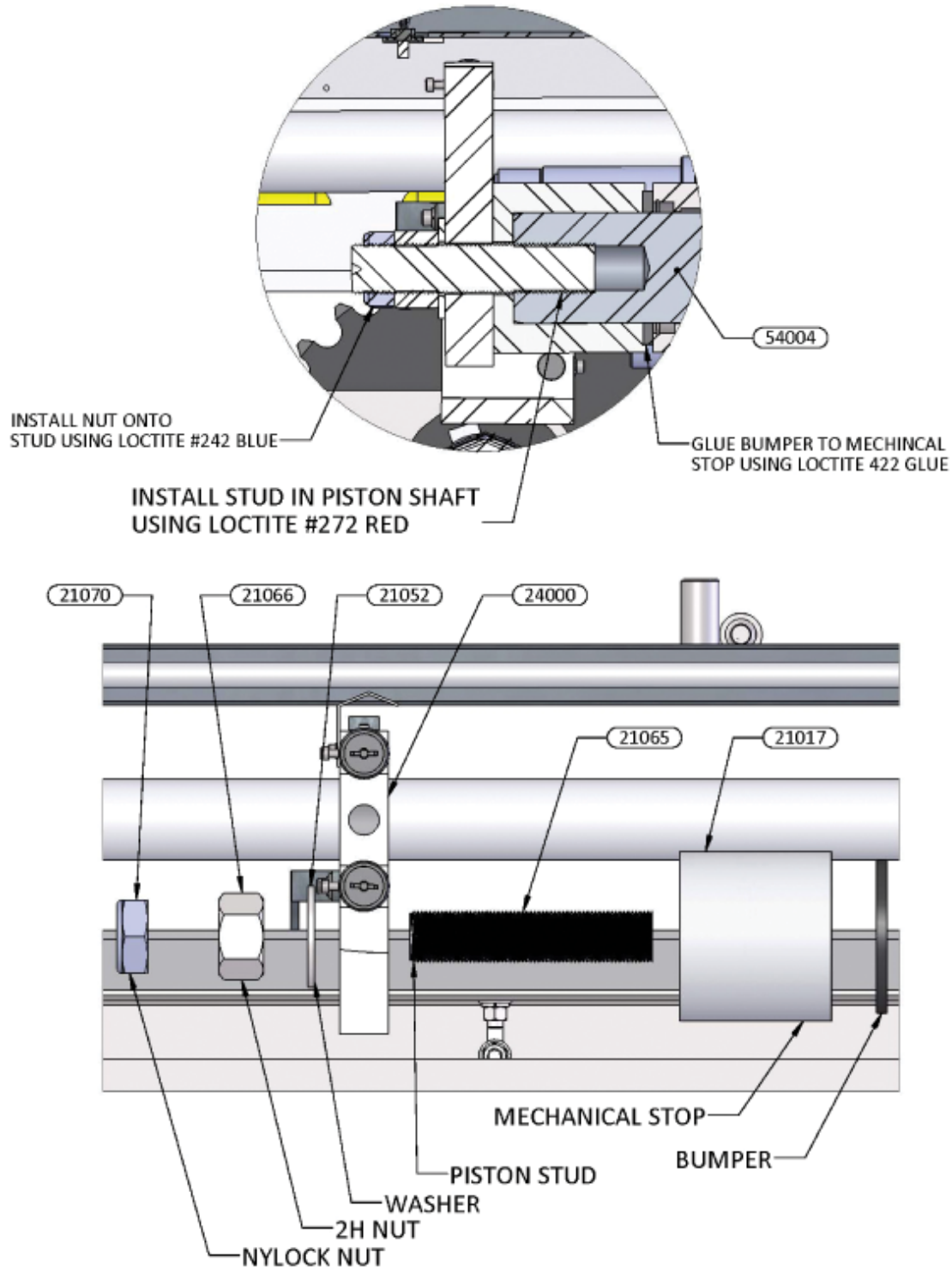

Figure 9: Guide Block to Piston Shaft Connection

Please Note: *Figure 9 shows S85 and S120 guideblocks. The guide block for S35 prover has additional two cam followers.*

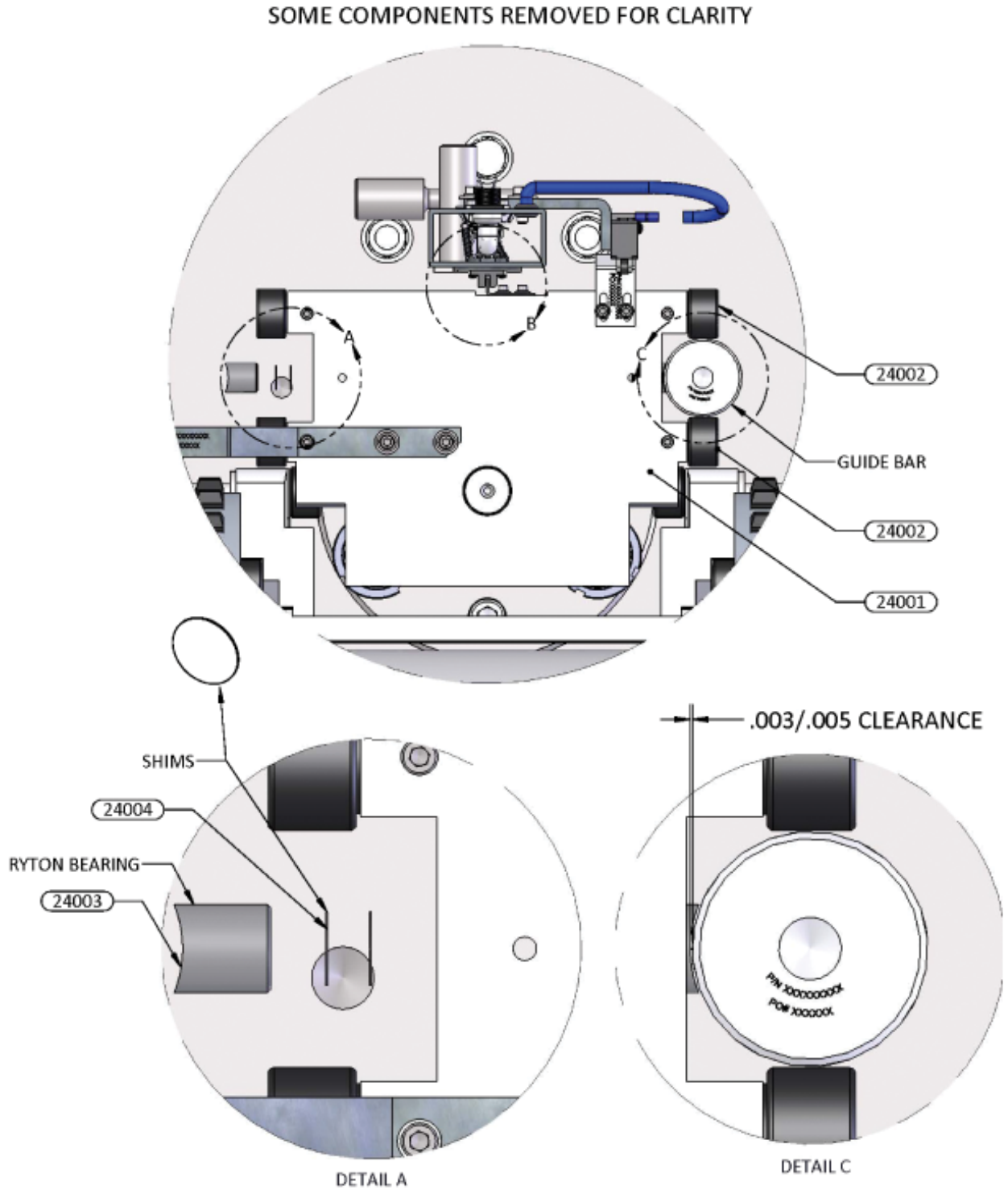

Figure 10: Guide Block Shims

Please Note: *Figure 10 shows S85 and S120 guideblocks. The guide block for S35 prover has additional two cam followers.*

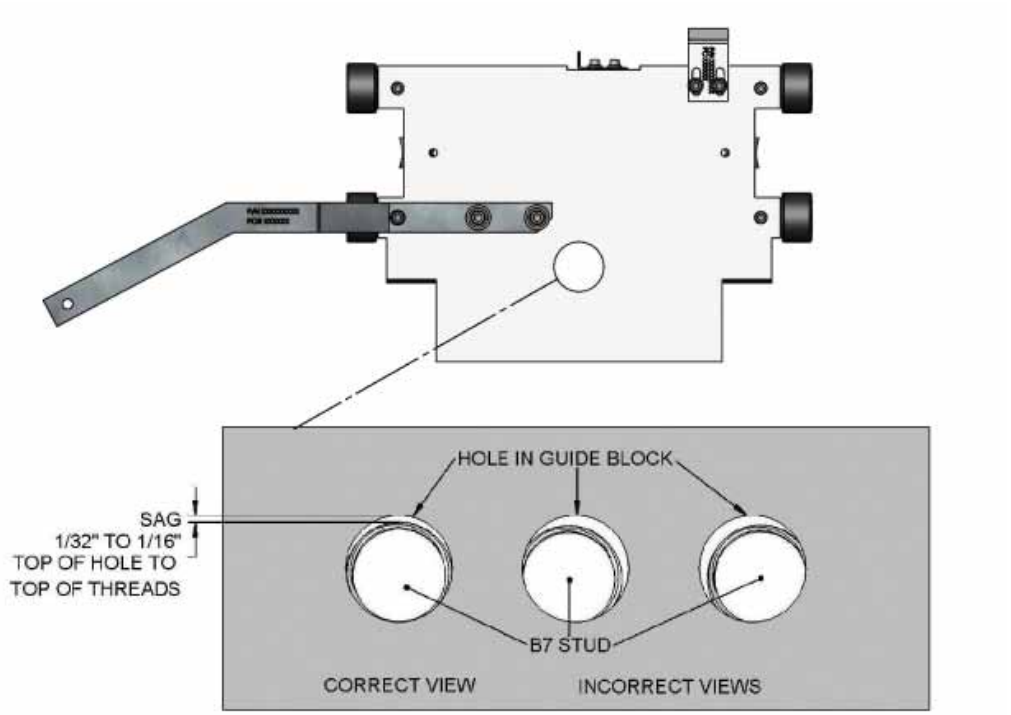

Figure 11: Stud Alignment

Please Note: *Figure 11 shows S85 and S120 guideblocks. The guide block for S35 prover has additional two cam followers.*

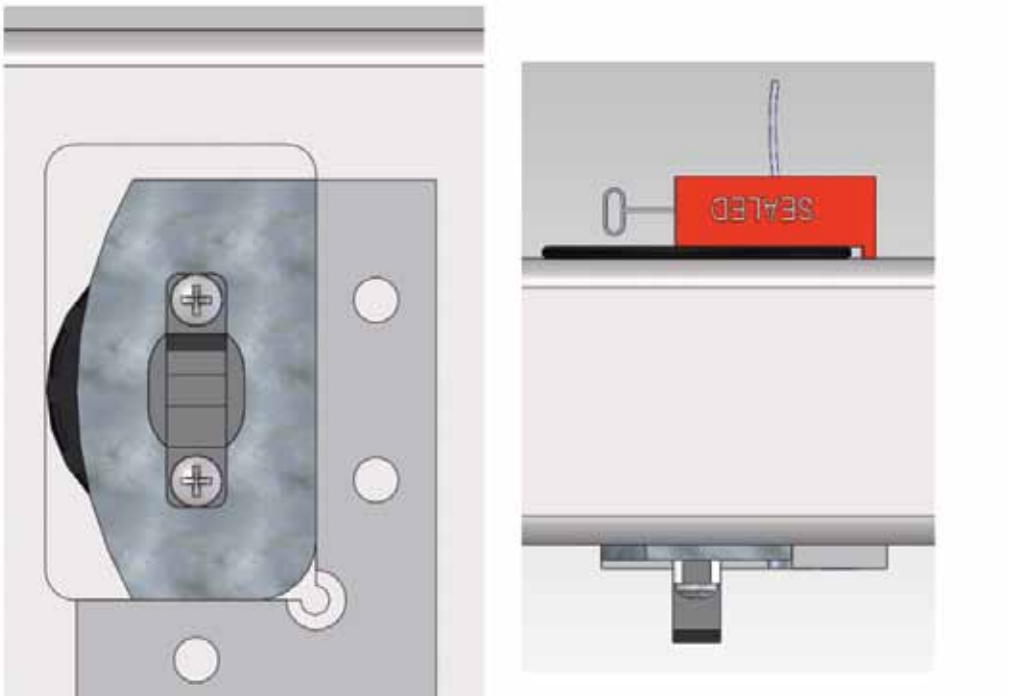

Figure 12: Correctly Seated Optical Switch Bottom and Side View

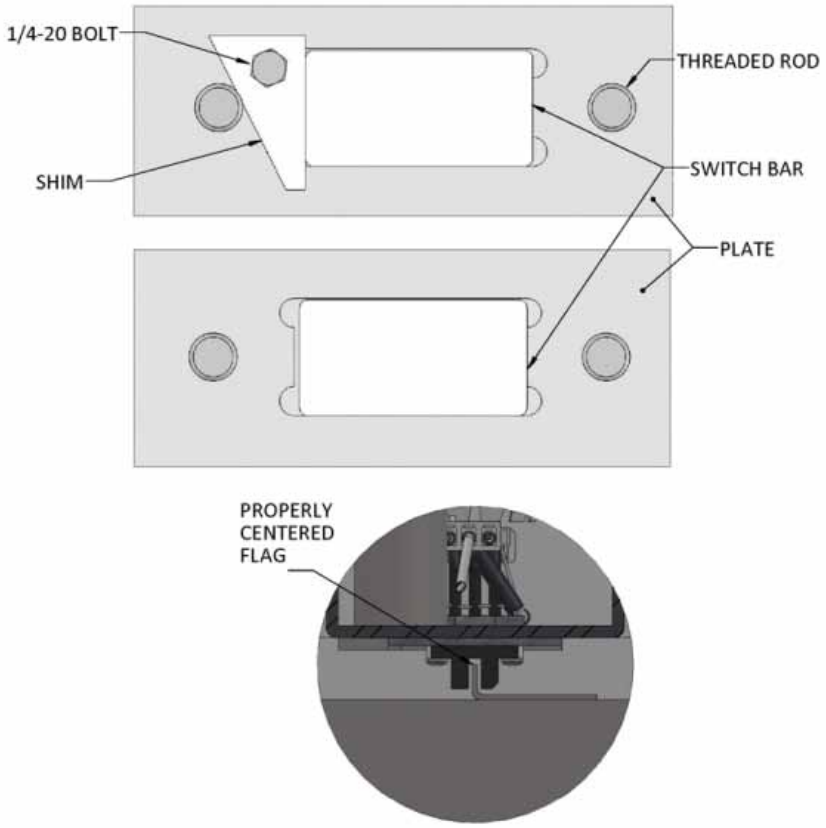

Figure 13: Switchbar Position

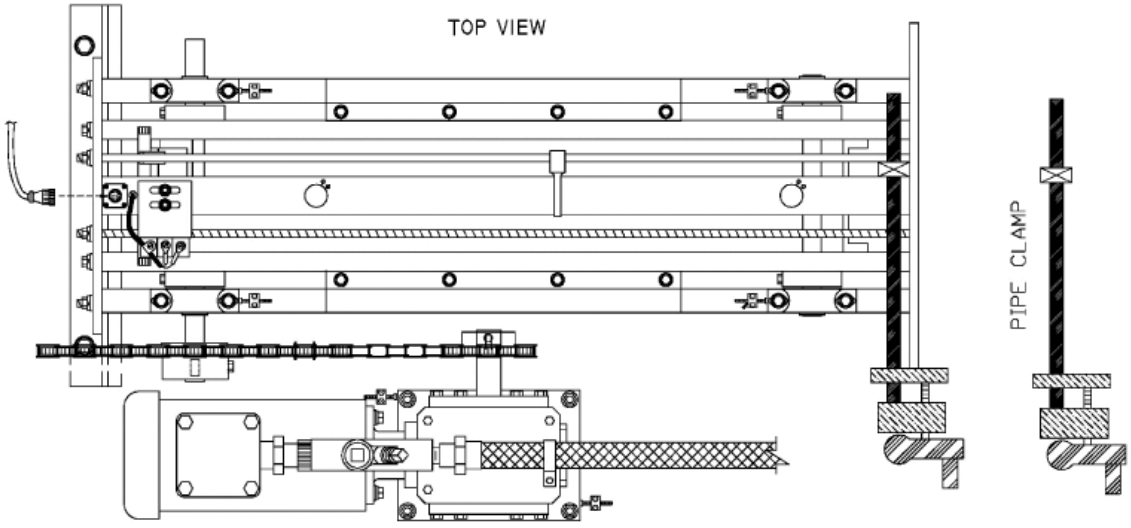

Figure 14: Pipe Clamp Position

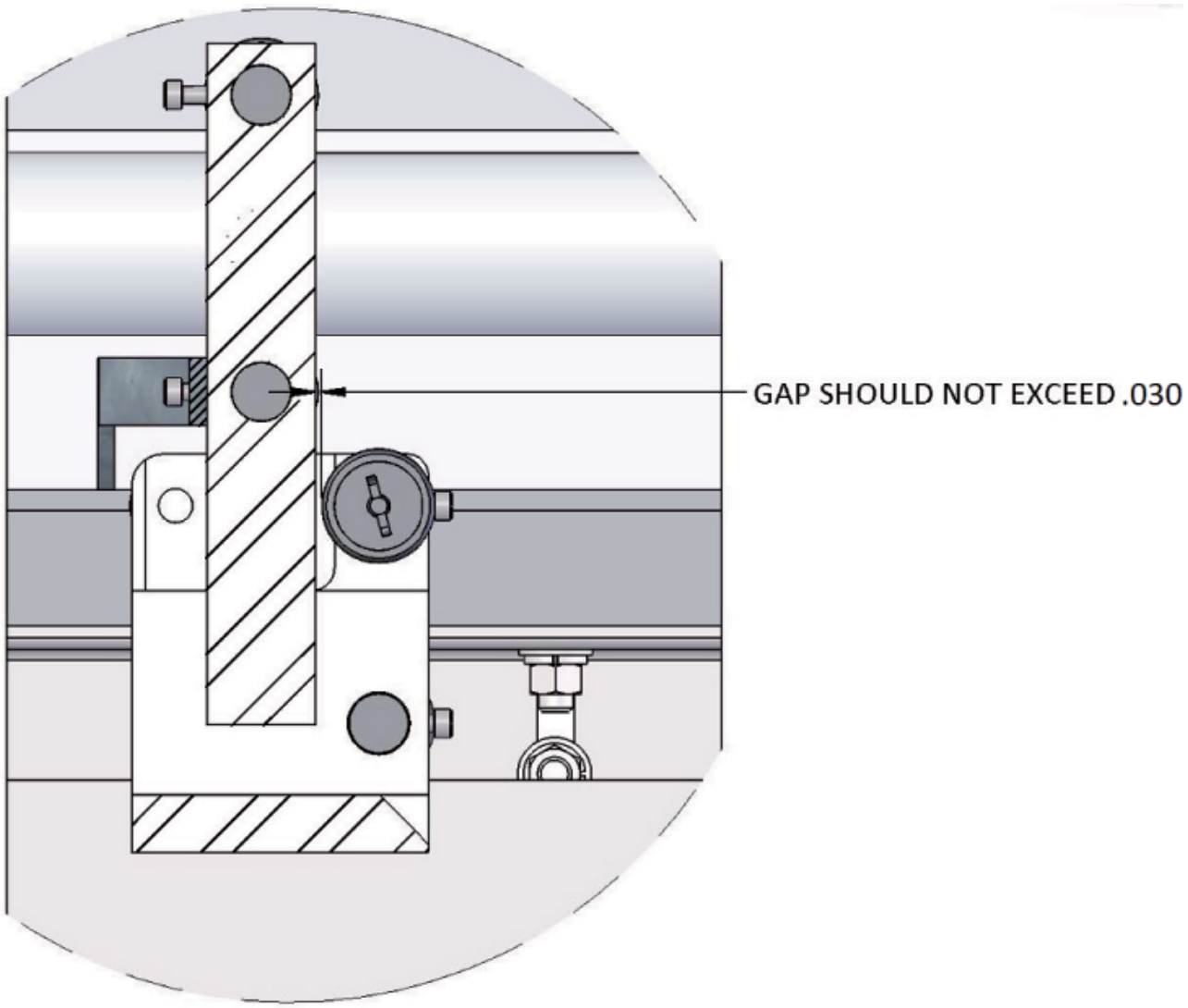

Figure 15: Maximum Allowable Gap

Please Note: *Figure 15 shows guideblock and puller used on S85 and S120 provers. The puller for the S35 prover does not have cam followers on it.*

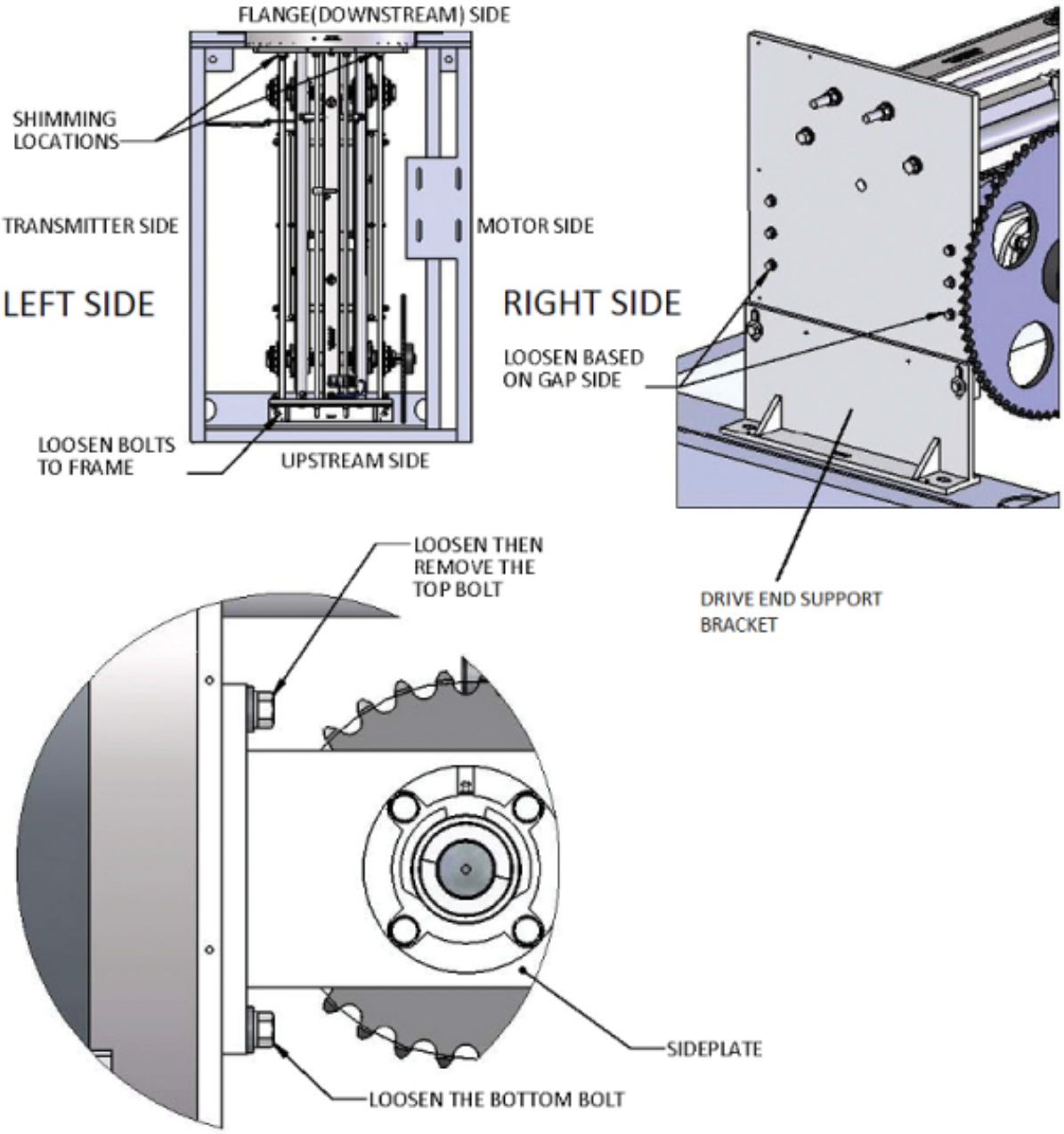

Figure 16: Shim Location

Figure 17: Side Plate with Stop in Place

Figure 18: Inserting Shim behind Side Plate

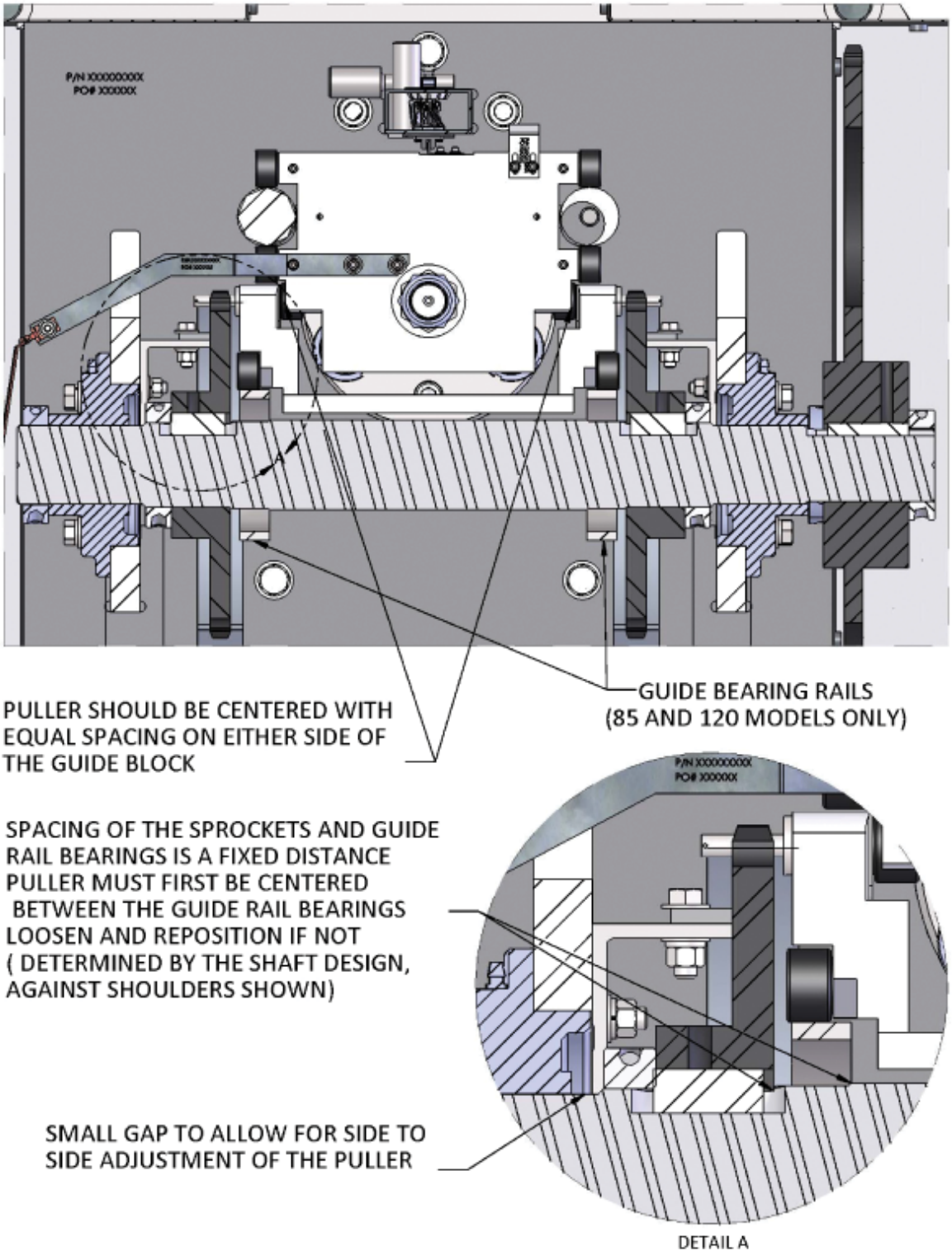

Figure 19: Puller Alignment

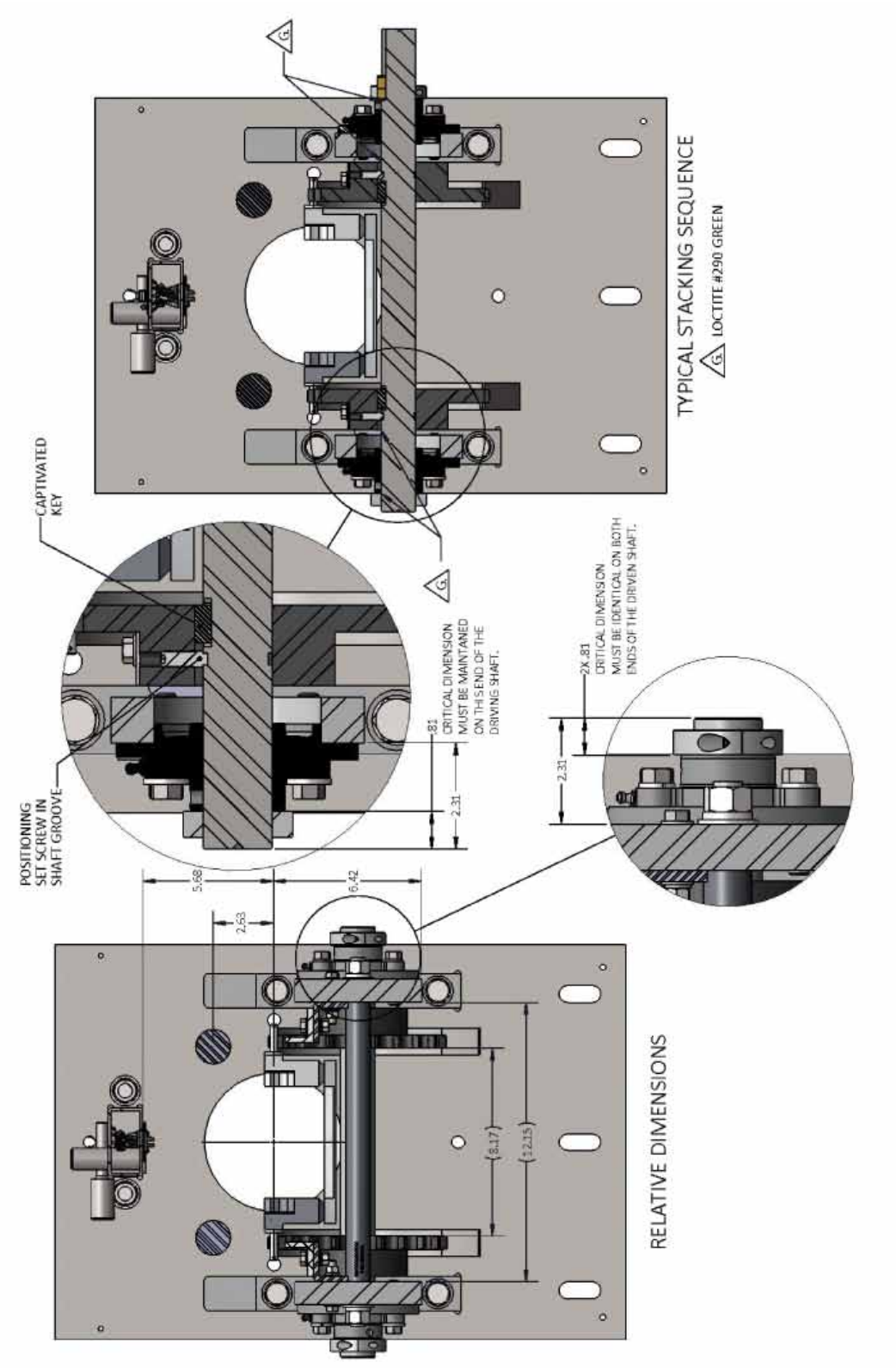

Figure 20: S35 Shaft Spacing

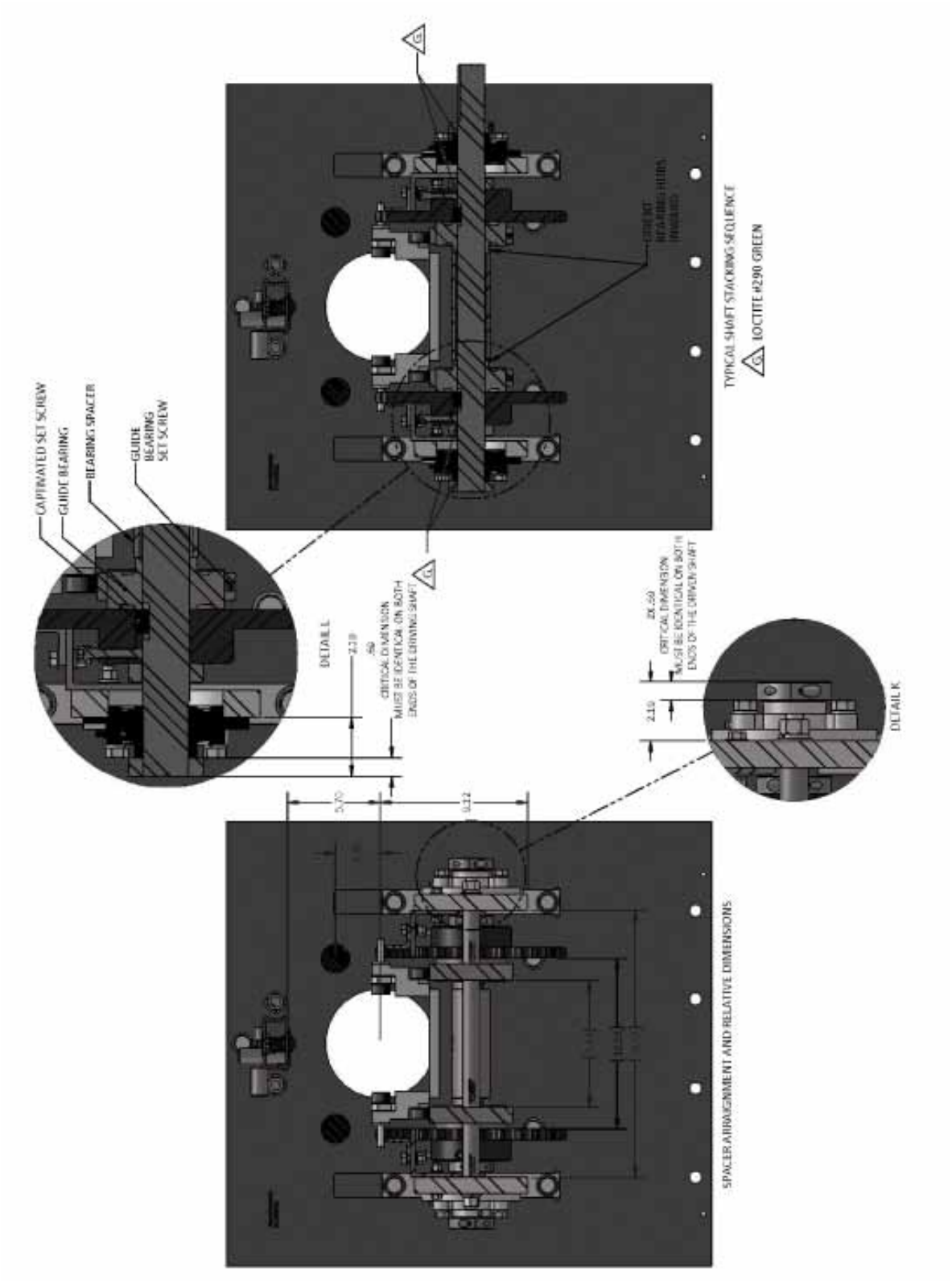

Figure 21: S85 Shaft Spacing

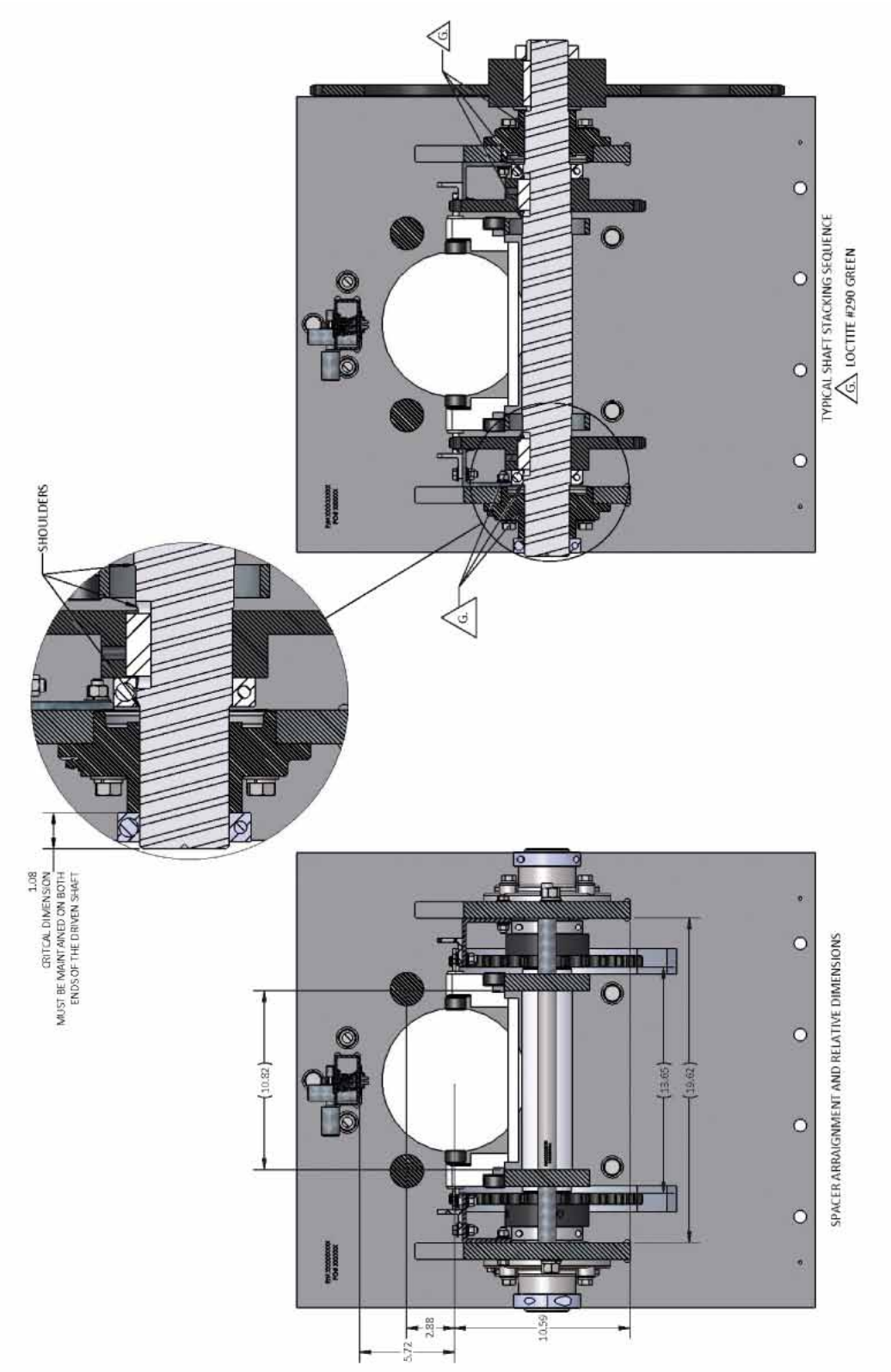

Figure 22: S120 Shaft Spacing

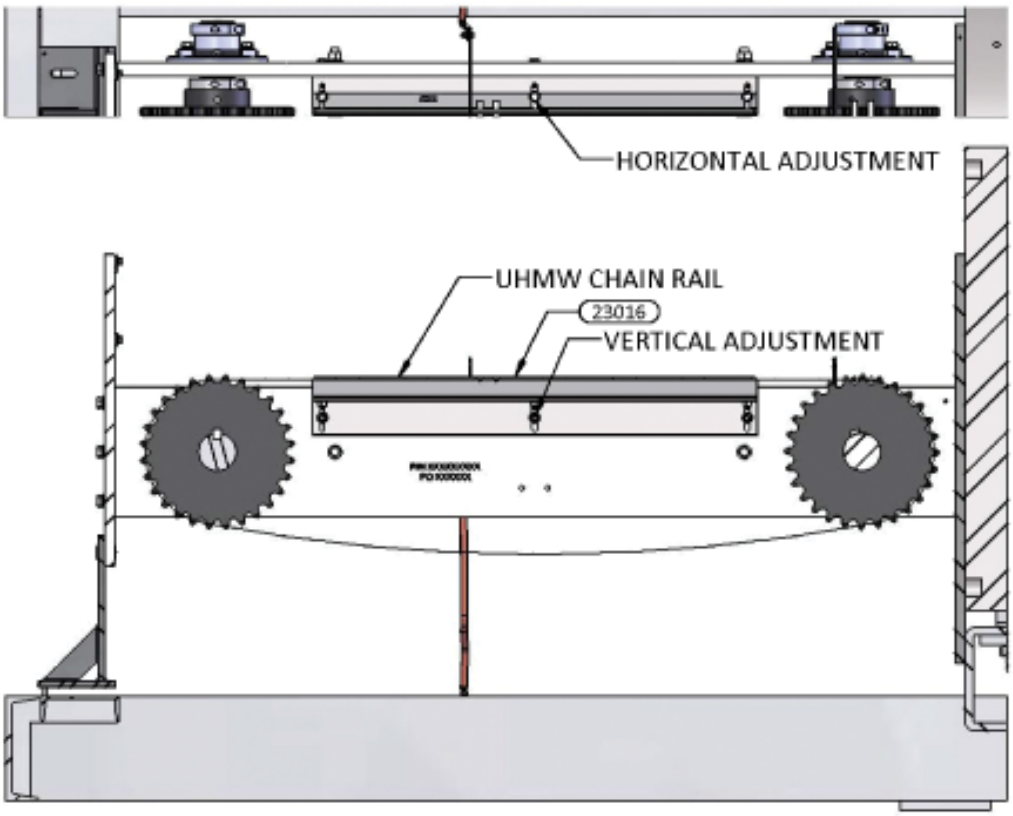

Figure 23: Chain Support Adjustment

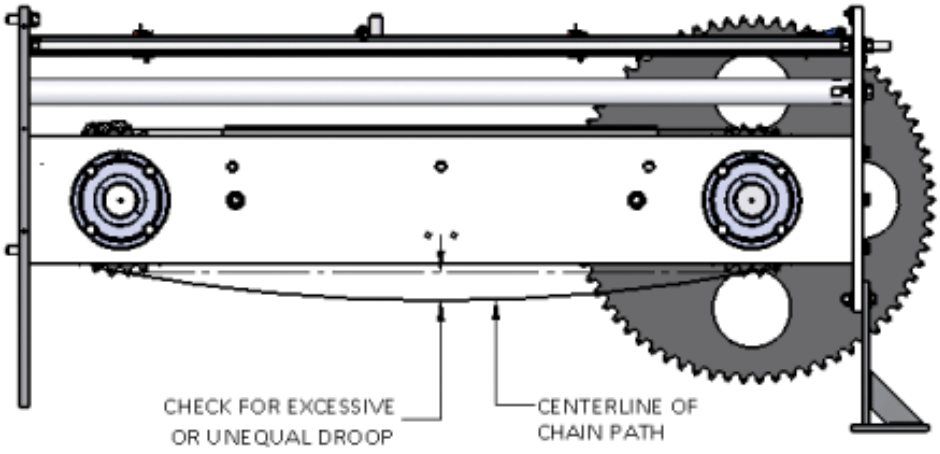

Figure 24: Chain Sag

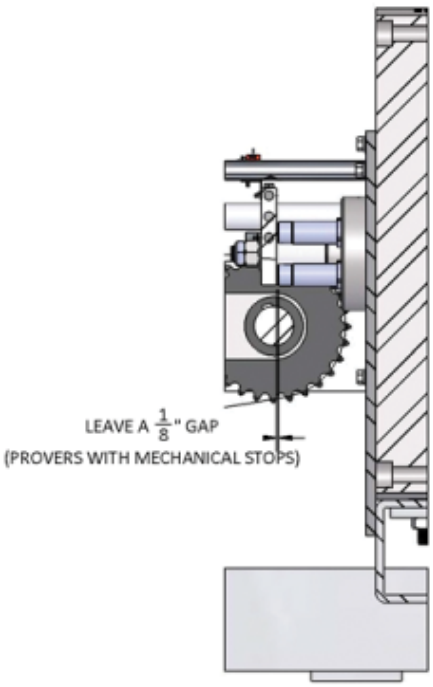

Figure 25: Shock Installation Depth

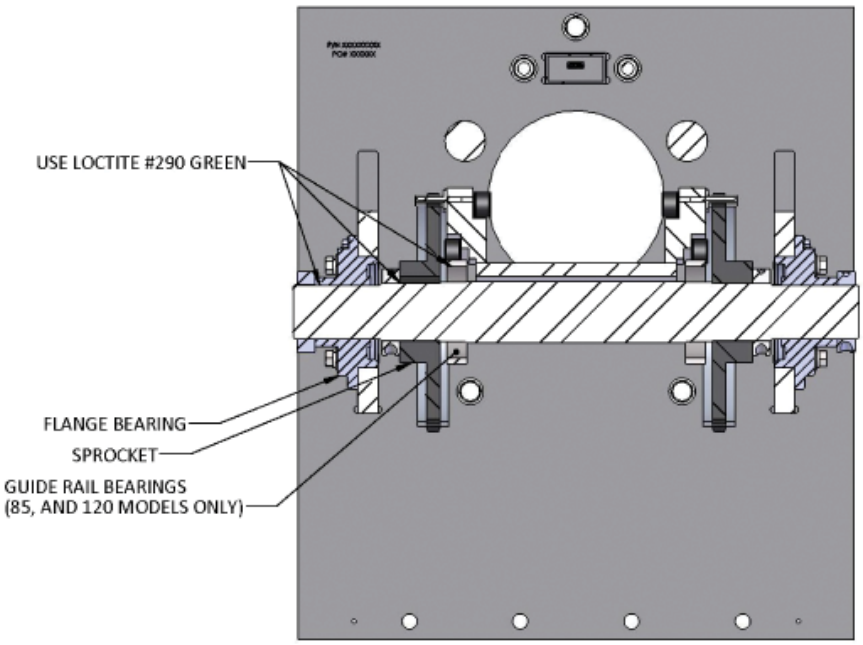

Figure 26: Shaft Loctite Locations

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