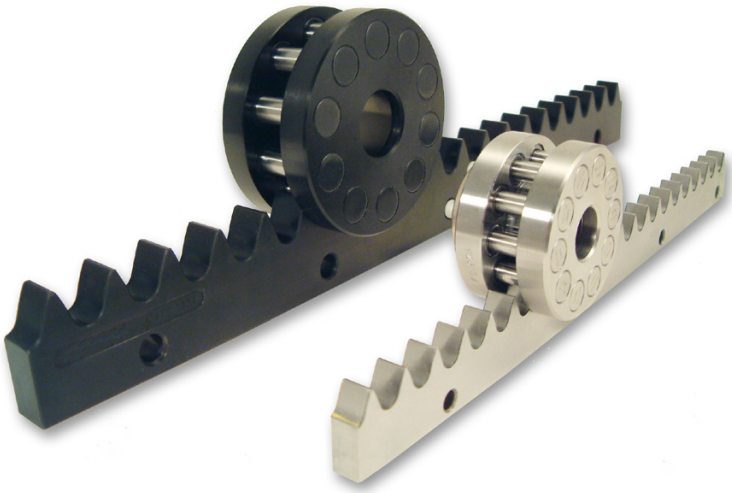
nexen®

LINEAR MOTION CONTROL PRODUCTS

User Manual



Precision Roller Pinion System

RPS 16 RPS20, RPS25, RPS32, RPS40

Premium and Standard Models

FORM NO. L-21235-A-0606

DANGER

Read this manual carefully before installation and operation.

Follow Nexen's instructions and integrate this unit into your system with care.

This unit should be installed, operated and maintained by qualified personnel ONLY.

Improper installation can damage your system or cause injury or death.

Comply with all applicable codes.

In accordance with Nexen's established policy of constant product improvement, the specifications contained in this manual are subject to change without notice. Technical data listed in this manual are based on the latest information available at the time of printing and are also subject to change without notice.

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ISO 9001 Certified

FORM NO. L-21235-A-0606

Table of Contents

General System Requirements

- Unlike traditional rack and pinion the RPS system has zero mechanical clearance and requires a system preload. This preload must remain relatively constant over the entire run to obtain optimal system performance and life. To achieve this it is crucial that the guiding system be as parallel as possible to the RPS system and not converge or diverge at any point. If the system converges, the pinion preload will become excessive and increase noise, reduce pinion roller bearing life, and potentially bind the system. If the system diverges pinion preload could be lost causing backlash, a loss of positional accuracy, an increase in noise, and a reduction in system life. A high degree of flatness is desirable but this may not be practical over long runs. The main consideration is that the guiding system and the RPS system are doing the same thing at the same place in the run so the pinion preload remains within specifications. One way to minimize the runout between the guiding system and the Roller Pinion system is to machine the mounting locations on the machine bed for both in a single machining setup. See figures 1 and 2 for more details.

- Make sure that the machine bed and guiding system are rigid enough to avoid deflection that could affect RPS system preload.

- The rack and guiding system installation parallelism tolerances are greater than the system preload. This is normal. Due to the RPS meshing geometry, published backlash and accuracy will still be obtained if the parallelism remains within specifications.

- The bottom of the rack and one side must be supported. This is best accomplished with a step in the machine bed.

- Over long runs a single machine bed will become impractical requiring a segmented bed. When installing the guiding system and the RPS rack, their joints should not be near the machine bed joints but span them as much as possible.

- The RPS system generates a reaction force that tries to lift the pinion off the rack. Make sure this is accounted for by the guiding system. See product data for pressure angle specifications.

- The RPS system will require a mechanism to apply the pinion preload. It is recommended that the pinion be moved into the rack not vice versa. The recommended method to do this is to mount the servo drive system and pinion on a sliding bracket that has an adjustment bolt to push it into the rack. Other possible preloading methods are shimming and eccentric cams. Spring loaded preloading mechanisms are not recommended. See figure 10 for more details.

- Under most circumstances, the RPS system will require periodic lubrication. In some special cases the system can be operated lubrication free if the maximum speed does not exceed 30 m/min. Typically this will involve dirty environments where contaminates will be attracted/stick to the lubricant on the rack creating mechanical interference or an abrasive paste that can accelerate wear. Other applications include food, and clean rooms. If run lube free there will be some reduction in life of the RPS system that will vary widely depending on the application. Contact Nexen for more information.

- Do not use the RPS system in environments with temperature outside of -5 to 40° C (23 to 104° F), or with wide temperature swings since this can effect the meshing of the system. If you have an application with any of these characteristics consult Nexen.

- If the RPS system is coated with Raydent, it performs similarly to stainless steel with the exception of the pinion rollers that consist of bearing grade steel and can corrode. Pinion roller corrosion will lead to system failure. Always protect the pinion from adverse conditions. If the RPS system comes with other coatings, consult the product specifications for performance.

- Nexen can provide additional tapped, untapped or countersunk holes in the side or bottom of the rack or cut the rack to length for an additional charge.

Rack Requirements

- **CAUTION** Handle the rack with care it is a very high precision product. Do not drop it, allow anything to fall on it, or place it on non-flat surfaces.
- Five sides of the RPS rack are reference surfaces. The side with the part number on it or ends that have been cut (not factory full or half sections) are not reference surfaces. The side with the part number on it should be away from the machine bed mounting surface.
- Secure the rack using all of the available bolt holes. This will ensure the highest degree of rack stability.
- Install the RPS system at the temperature it will be used at.
- The RPS rack is hardened on the tooth faces only.
- If joining multiple rack segments a special alignment tool is required and provided by Nexen. The alignment tool ensures proper pinion meshing when crossing rack joints. To use the alignment tool a special mounting hole provision is required in the machine bed off to the side of where the racks meet to temporarily secure the alignment tool. When the adjacent racks are properly positioned, there will be a 0.1 to 0.2 mm gap between them. See figure 3
- Avoid mounting the rack teeth up since debris could collect on the rack and interfere with the meshing of the RPS system. If the teeth must be mounted up shield the rack from debris.

Pinion Requirements

- The shaft the pinion is mounted on must pass all of the way through the pinion and bushing for proper support.
- Mount the pinion as close to a support bearing as possible to minimize shaft deflection.
- The pinion roller bearings are sealed but it is still recommended that the pinion be shielded from liquids, dust, and debris.
- Multi-pinion configurations are possible but must ensure equal load sharing by each pinion. Each of the pinions rollers should come into initial contact with a rack tooth at the same time. Decrease the load rating of the RPS system by 25% when using multiple pinions. Contact Nexen for more information.
- The system can be set up so that the pinion is stationary and the rack moves. A supporting structure and guiding system will still be required for the rack.

PROPER SYSTEM ALIGNMENT

In order to eliminate backlash and minimize wear on the rack, the RPS system must be installed on a rigid, straight, flat mounting surface with the shaft parallel (±0.03 mm [0.001in] to the mounting surface and perpendicular to the rack length.

The following requirements must be met to ensure proper RPS operation:

a) Mount a linear guide rail on a surface parallel to the RPS Rack mounting surface with the same flatness and grade as the rack mounting surface (Refer to Figure 2).

b) The Pinion Shaft must be parallel (±0.03 mm [0.001 in]) to the mounting surface and the angle between the Pinion Shaft and the rack must be exactly 90° (Refer to Figure 1).

c) The Pinion Shaft must be supported adequately to ensure full contact of roller pins along the face of rack teeth.

Alignment Verification*

Proper tooth engagement can be verified by applying machinists blueing to the pinion rollers and rolling the carriage assembly down the length of the rack. It should move smoothly with no binding and the contact pattern should be even across each tooth face when the pinion is properly aligned.

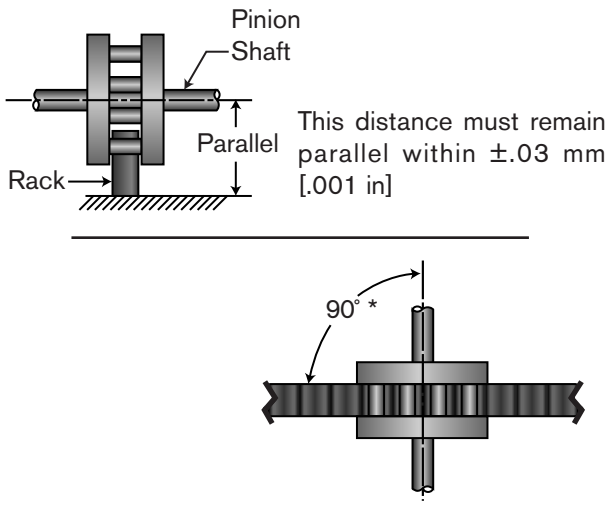
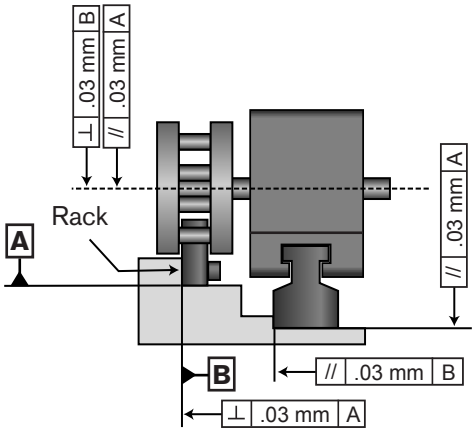
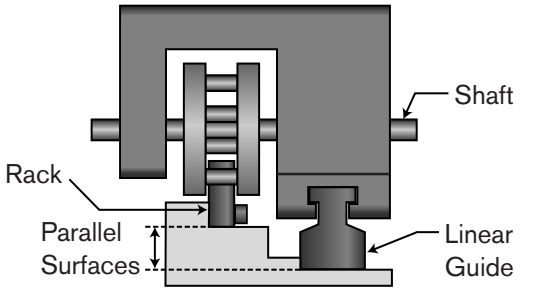


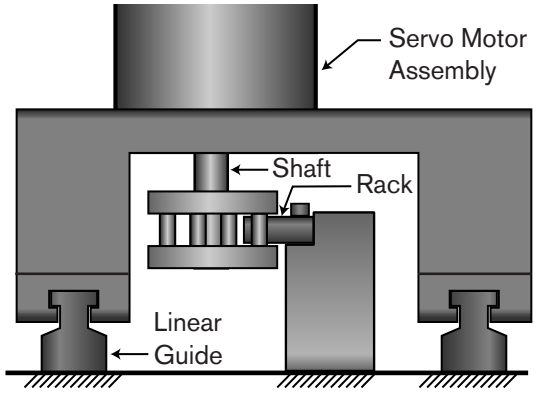
Figure 1 Alignment Requirements



Tolerances Allowed In Roller Pinion Setup

Additional dimensional detail can be found in Nexen's product drawings.





Systems may be mounted at any angle as long as the rack, guiding system and mounting surface remain parallel with the shaft at a 90° angle from the rack.

Figure 2 Possible Mounting Configurations

RACK MOUNTING DIMENSIONS

***B**
Through Hole Mounting of Connecting Tool

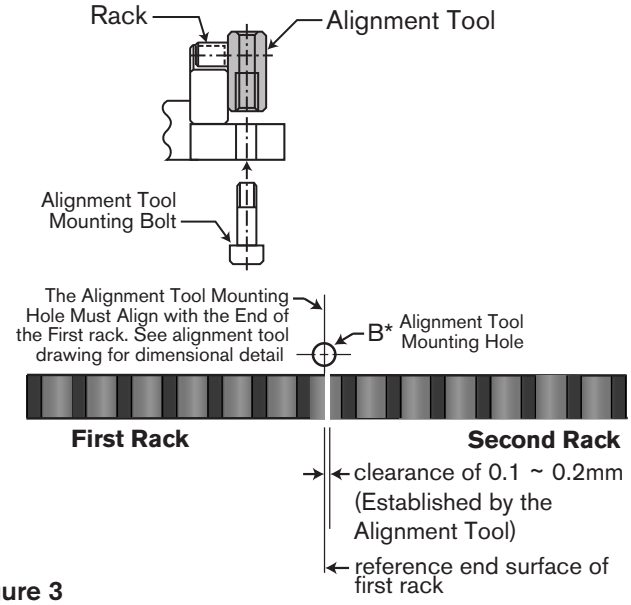


Figure 3

***B**
Tapped Hole Mounting of Connecting Tool

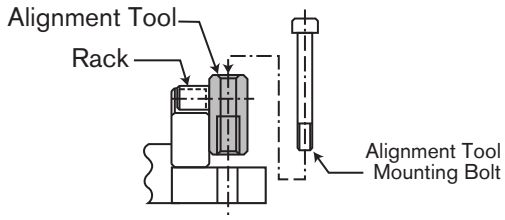


Table 1

B			
Through Hole	Tapped Hole		Tightening Torque
	Thread	Depth	
9 [.035]	M6	12 [0.47]	5 Nm [44 in-lb]
11 [0.43]	M8	16 [0.63]	8 Nm [71 in-lb]
14 [0.55]	M10	20 [0.79]	12 Nm [106 in-lb]
14 [0.55]	M10	20 [0.79]	12 Nm [106 in-lb]
14 [0.55]	M10	20 [0.79]	12 Nm [106 in-lb]

Table 2

Rack Mounting Tightening Torque for Socket Head Cap Screws (Class 10.9 or better)			
Bolt Type	Mounting Material		
	Steel	Cast Iron	Aluminum
M6	16 Nm [140 in-lb]	10 Nm [89 in-lb]	8 Nm [71 in-lb]
M8	31 Nm [275 in-lb]	20 Nm [177 in-lb]	15 Nm [128 in-lb]
M10	68 Nm [602 in-lb]	45 Nm [398 in-lb]	33 Nm [292 in-lb]
M12	120 Nm [1062 in-lb]	78 Nm [690 in-lb]	58 Nm [513 in-lb]
M16	196 Nm [1735 in-lb]	131 Nm [1160 in-lb]	98 Nm [867 in-lb]

Table 3

Rack Mounting Tightening Torque for Stainless Steel Screws (Class 8.8 or better)			
Bolt Type	Mounting Material		
	Steel	Cast Iron	Aluminum
M6	10 Nm [89 in-lb]	10 Nm [89 in-lb]	8 Nm [71 in-lb]
M8	19 Nm [168 in-lb]	19 Nm [168 in-lb]	15 Nm [128 in-lb]
M10	41 Nm [363 in-lb]	41 Nm [363 in-lb]	33 Nm [292 in-lb]
M12	70 Nm [620 in-lb]	70 Nm [620 in-lb]	58 Nm [513 in-lb]
M16	137 Nm [1213 in-lb]	131 Nm [1160 in-lb]	98 Nm [867 in-lb]

INSTALLATION

The mounting surface for both the rack and the guiding system must be parallel within the specifications shown in the PROPER SYSTEM ALIGNMENT section. This parallelism requirement is best achieved by machining the mounting locations for both the guiding system and rack in the same machining operation. (Refer to PROPER SYSTEM ALIGNMENT and Figures 1 & 2 for Possible Mounting Configurations.)

Nexen recommends orienting the rack teeth downward or to the side so it minimizes the possibility of debris collecting on the teeth and causing meshing interference. The rack has 5 ground faces / ends. The face with the product number should not be placed against the machine bed surfaces.

RACK INSTALLATION

1. Ensure that the mounting surface and rack are completely clean.

2. Using customer supplied mounting bolts, loosely secure the first rack length to the mounting surface and carefully fix in place while protecting the rack teeth by distributing the clamp load over as many teeth as possible. Socket head cap screws are recommended for maximum pinion shoulder clearance. (Figure 4)

3. Tighten the mounting bolts on the first rack alternately and incrementally 25%, 50%, then fully torque, from the center of the rack to the ends. Refer to Table 2 and 3 for recommended tightening torques.

4. Align the second rack segment with the first segment along the base of each rack.

5. Lightly tighten the rack mounting bolts on the second rack so it is slightly movable.

6. Carefully mount the Alignment Tool between the two racks while being careful not to damage the rack. (Refer to Figure 5).

NOTE: Alignment Tools for each rack size are required and available for purchase from Nexen. This tool is required for proper installation of multiple rack segment runs.

7. Temporarily fasten the Alignment Tool to the mounting surface using customer supplied mounting bolts and lightly tighten.

8. Adjust the second rack so that the alignment tool pins rest evenly in both racks and are in full contact with the side of both racks. (Refer to Figure 5) Torque the alignment tool bolt to the the specified torque in Table 1.

9. Fix the rack in place and tighten the bolts following the procedure in step 3.

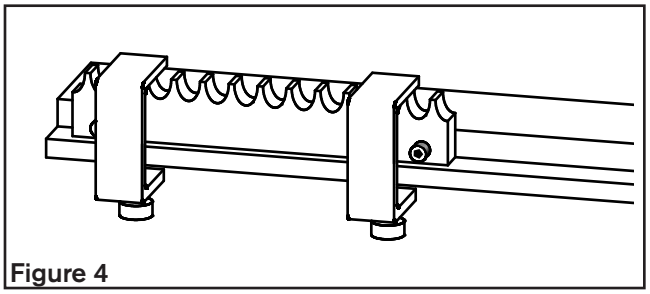


Figure 4

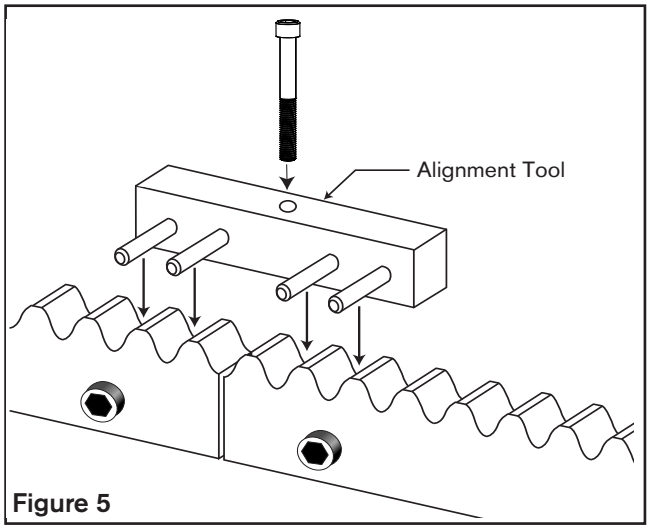


Figure 5

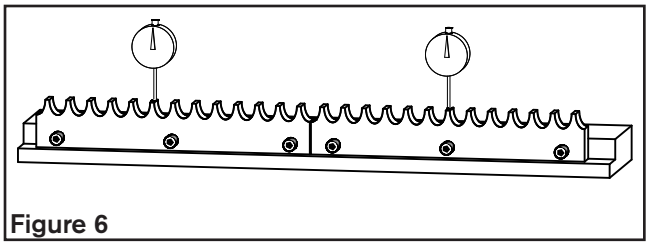


Figure 6

10. Measure the distance from tooth peak to mounting surface at multiple points along each section of the rack to ensure they are parallel within ±0.02 mm [0.0008 in]. (Figure 6)

11. Carefully remove the alignment tool, while avoiding any damage to the rack.

12. Follow steps 3 through 11 for any additional rack lengths.

ROLLER PINION SETUP

NOTE: Refer to product drawings for shaft details.

NOTE: Refer PROPER SYSTEM ALIGNMENT and Figures 1 & 2 for Roller Pinion mounting requirements.

NOTE: Pinion should be mounted as close to a shaft supporting bearing as possible to minimize shaft deflection and obtain optimal performance.

NOTE: The shaft the pinion is mounted on must extend all of the way through the pinion and bushing for proper pinion support.

1. Inspect the shaft, pinion bore and the inner and outer bushing halves to ensure they are clean and smooth.

2. Put oil that does not contain any pressure additives on the shaft, the tapered part of the bushing and the bushing bolts as indicated by figure 8. Do not lubricate the bore of the pinion bushing or shaft where the bushing contacts it or the torque capacity of the bushing will be reduced.

3. Insert the outer bushing half into the roller pinion bore until it bottoms in the roller pinon.

4. Insert the inner bushing half into the outer bushing half previously inserted into the pinion with one non-threaded bolt hole in the 12 o-clock position. The threaded holes are for bushing removal. (See Figure 9).

NOTE: Ensure that the slots in the two components that make up the bushing are not aligned. See figure 9

5. Insert the shaft into the pinion and bushing bore.

6. Insert the bushing bolts into the through holes. Only use the provided bushing bolts.

7. Hand tighten the bushing bolts.

8. Equally tighten the bushing bolts with 25% of the recommended tightening torque. Start tightening at the top bolt and alternate back and forth across the face in a star pattern. Repeat this procedure with 50% and then full torque. (Refer to Figure 9 and Table 4).

   Progressive tightening of the bushing bolts is important to prevent any misalignment of components while installing the bushing.

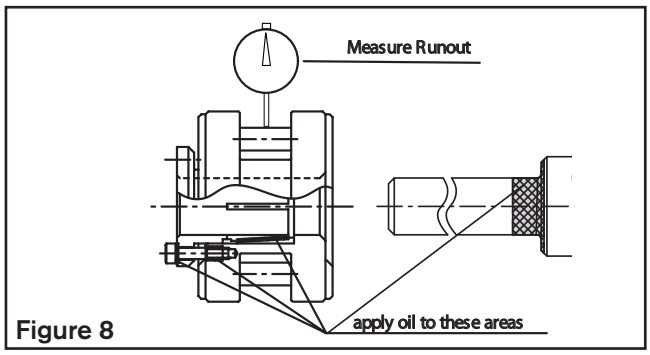


Figure 8

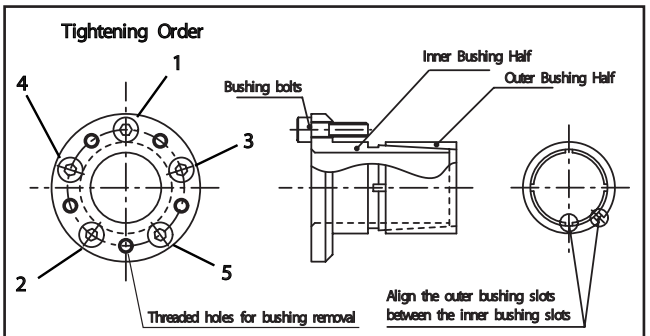


Figure 9 Bushing Installation Details

Table 4

Model	Bolt Type	Tightening Torque
RPS16	M4	3.5 Nm [30.98 in-lb]
RPS20	M5	7.0 Nm [61.96 in-lb]
RPS25	M6	12.0 Nm [106.21 in-lb]
RSP32	M6	12.0 Nm [106.21 in-lb]
RPS40	M6	12.0 Nm [106.21 in-lb]

NOTE: When the bushing is fully torqued measure the runout at the center of the pinion rollers. (See Figure 8). Runout on this surface must be ± 0.13 mm [±0.005 in] TIR when lock bolts are fully tightened.

NOTE: As the bushing bolts are tightened, the pinion will be pulled slightly towards it. When fully torqued down, make sure there is adequate clearance between the pinion inner sides and the rack all the way down the run.

CAUTION

Preload must be applied before putting your system into operation. Refer to APPLYING PRELOAD to properly set preload for your RPS system.

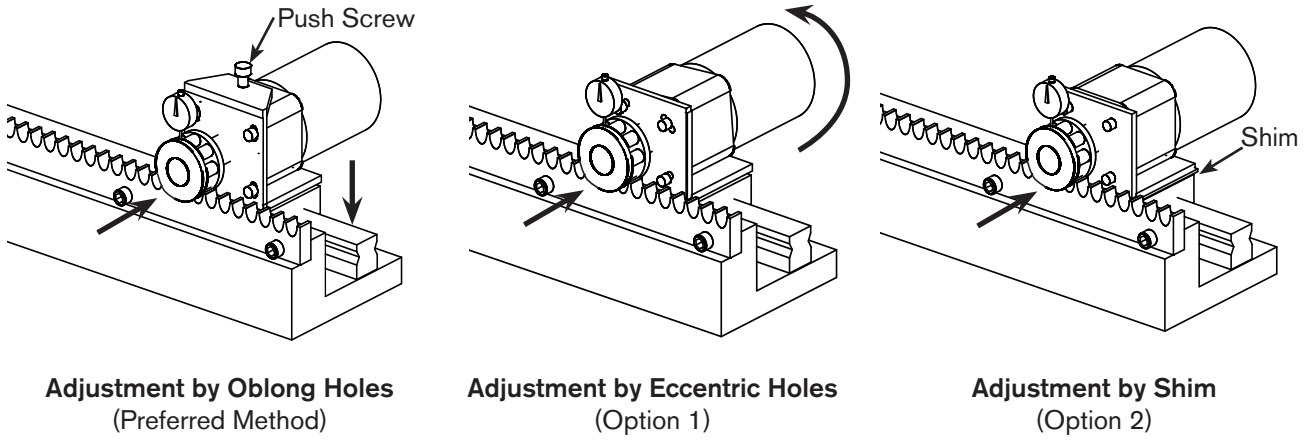
APPLYING PRELOAD

To ensure optimal meshing of the roller pins with the rack teeth, the shaft must be preloaded to 0.01 mm [0.0004 in] beyond full engagement.

NOTE: Do not apply excessive preload. Preloading beyond 0.01 mm will decrease product life and increase noise and vibration.

Refer to Figure 10 for suggested preload methods.

NOTE: When the RPS system is properly preloaded, there will be no tangential play between the rack and the pinion if the pinion is not allowed to turn.



Adjustment by Oblong Holes
(Preferred Method)

Adjustment by Eccentric Holes
(Option 1)

Adjustment by Shim
(Option 2)

Figure 10

DISENGAGING THE ROLLER PINION

1. Remove the load from the RPS system
2. Cut the power source, ensuring that no torque is applied to the roller pinion.
3. Remove preload (Refer to APPLYING PRELOAD section).
4. Gradually loosen the mechanical lock bolts in the same order they were tightened (Refer to Figure 9)
5. Insert the bushing bolts into the threaded bushing bolt holes and alternately tighten them as illustrated in figure 9 to release the bushing.
6 Lift the servo/reducer from the rack or slide them out of the pinion bore.

NOTE: Inspect all lock bolts and replace any that show excessive wear. Contact Nexen for replacements.

⚠ DANGER

Failure to properly support the load before disengaging the RPS system could cause serious harm to operators or equipment.

LUBRICATION

Nexen recommends lubricating the RPS rack to ensure smooth operation and long service life.

1. Lubricate the rack by applying a synthetic oil based grease to the pins of the roller pinion. Then glide the roller pinion back and forth over the meter segment of rack five times to distribute the grease. Verify smooth operation with no binding.

NOTE: Use THK AFA or equivalent grease. Grease must meet the following Kinematic Viscosity Levels: CST@40C - 25; CST@100C - 5.

2. Repeat step one for each meter of rack

This will distribute lubrication along the rack teeth in all contact areas.

NOTE: Nexen recommends lubricating the rack every 2 million pinion revolutions or 6 months but may need to be lubricated more frequently based on the application conditions, and observable tooth or roller wear.

Under most circumstances, the RPS system life will be extended by periodic cleaning and lubrication. In some special cases the system can be operated lubrication free if the maximum speed does not exceed 30 m/min. Typically this will involve dirty environments where contaminates will be attracted/stick to the lubricant on the rack creating mechanical interference or an abrasive paste that can accelerate wear. Other applications include food processing, clean rooms or applications where very low particle emissions are desired or periodic servicing is problematic. If run lube free there will be some reduction in life of the RPS system that will vary widely depending on the application. Contact Nexen for more information.

WARRANTY

Warranties

Nexen warrants that the Products will be free from any defects in material or workmanship for a period of 12 months from the date of shipment. NEXEN MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. This warranty applies only if (a) the Product has been installed, used and maintained in accordance with any applicable Nexen installation or maintenance manual for the Product; (b) the alleged defect is not attributable to normal wear and tear; (c) the Product has not been altered, misused or used for purposes other than those for which it was intended; and (d) Buyer has given written notice of the alleged defect to Nexen, and delivered the allegedly defective Product to Nexen, within one year of the date of shipment.

Exclusive Remedy

The exclusive remedy of the Buyer for any breach of the warranties set out above will be, at the sole discretion of Nexen, a repair or replacement with new, serviceably used or reconditioned Product, or issuance of credit in the amount of the purchase price paid to Nexen by the Buyer for the Products.

Limitation of Nexen's Liability

TO THE EXTENT PERMITTED BY LAW NEXEN SHALL HAVE NO LIABILITY TO BUYER OR ANY OTHER PERSON FOR INCIDENTAL DAMAGES, SPECIAL DAMAGES, CONSEQUENTIAL DAMAGES OR OTHER DAMAGES OF ANY KIND OR NATURE WHATSOEVER, WHETHER ARISING OUT OF BREACH OF WARRANTY OR OTHER BREACH OF CONTRACT, NEGLIGENCE OR OTHER TORT, OR OTHERWISE, EVEN IF NEXEN SHALL HAVE BEEN ADVISED OF THE POSSIBILITY OR LIKELIHOOD OF SUCH POTENTIAL LOSS OR DAMAGE. For all of the purposes hereof, the term "consequential damages" shall include lost profits, penalties, delay images, liquidated damages or other damages and liabilities which Buyer shall be obligated to pay or which Buyer may incur based upon, related to or arising out of its contracts with its customers or other third parties. In no event shall Nexen be liable for any amount of damages in excess of amounts paid by Buyer for Products or services as to which a breach of contract has been determined to exist. The parties expressly agree that the price for the Products and the services was determined in consideration of the limitation on damages set forth herein and such limitation has been specifically bargained for and constitutes an agreed allocation of risk which shall survive the determination of any court of competent jurisdiction that any remedy herein fails of its essential purpose.

Limitation of Damages

In no event shall Nexen be liable for any consequential, indirect, incidental, or special damages of any nature whatsoever, including without limitation, lost profits arising from the sale or use of the Products.

Warranty Claim Procedures

To make a claim under this warranty, the claimant must give written notice of the alleged defect to whom the Product was purchased from and deliver the Product to same within one year of the date on which the alleged defect first became apparent.

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