nexen

Precision Motion Control

User Manual

RPG Rotary Drive System

FORM NO. L-21252-B-1209

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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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This document is the original, non-translated, version.

Conformity Declaration: In accordance with Appendix II B of CE Machinery Directive (2006/42/EC):

A Declaration of Incorporation of Partly Completed Machinery evaluation for the applicable EU directives was carried out for this product in accordance with the Machinery Directive. The declaration of incorporation is set out in writing in a separate document and can be requested if required.

This machinery is incomplete and must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the applicable provisions of the Directive.

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ISO 9001 Certified

FORM NO. L-21252-B-1209

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GENERAL SAFETY PRECAUTIONS

⚠ WARNING

Use appropriate guarding for rotating components. Failure to guard could result in serious bodily injury.

⚠ DANGER

This product has moving parts that can crush or cut appendages. Provide adequate spacing or guarding from any operating product.

⚠ WARNING

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

⚠ WARNING

Ensure proper guarding of the product is used. Nexen recommends the machine builder design guarding in compliance with OSHA 29 CFR 1910 “Occupational Safety and Health Hazards”.

⚠ CAUTION

Use lifting aids and proper lifting techniques when installing, removing, or placing this product in service.

⚠ CAUTION

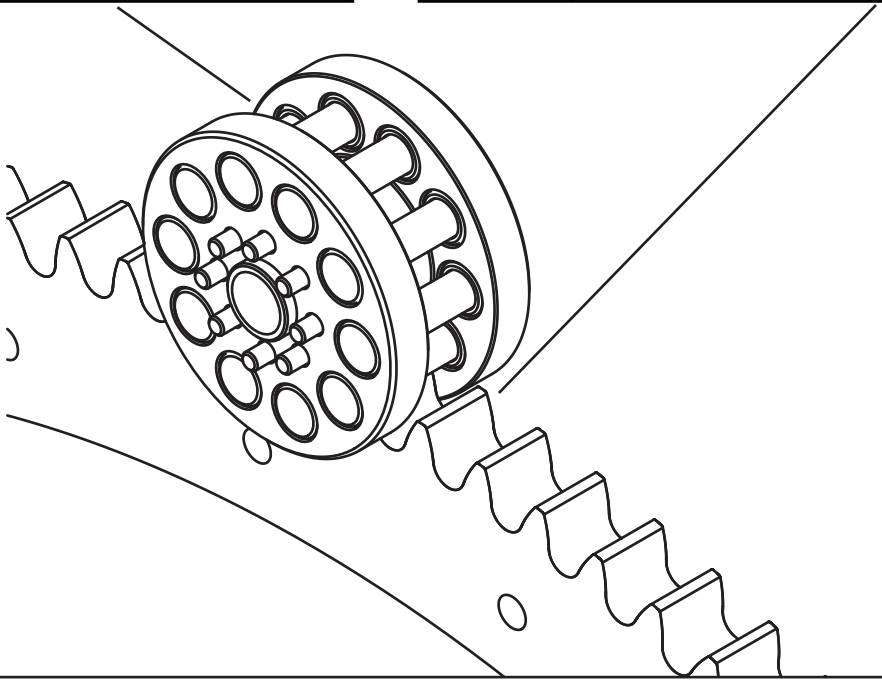
Watch for sharp features when interacting with this product. The parts have complex shapes and machined edges.

⚠ WARNING

Use appropriate guarding for rotating components. Failure to guard could result in serious bodily injury.

⚠ DANGER

This product has moving parts that can crush or cut appendages. Provide adequate spacing or guarding from any operating product.



SYSTEM DESIGN OVERVIEW

General System Requirements

- Unlike traditional gear systems, the Roller Pinion Gear (RPG) rotary drive system has zero mechanical clearance and requires a system preload for proper operation. This preload must remain relatively constant around the entire gear to obtain optimal system performance and life. To achieve this it is crucial that the bearing support system be as concentric as possible to the ring gear pitch circle diameter 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. See Figures 1 and 2 for more details.

- Make sure that the machine design is rigid enough to avoid deflection that could affect the RPG system preload.

- The allowed ring gear concentricity variance tolerances shown in Figure 2 are greater than the system preload. This is not an error. The RPG system has been designed to operate correctly under these conditions.

- The inner diameter and one side of the ring gear must be fully supported. This is best accomplished with a step in the mounting surface.

- For very large ring gears, a single piece mounting surface will become impractical requiring a segmented one. When installing the segmented ring gears, their joints should not be near the mounting surface joints but span them as much as possible.

- The RPG System generates a reaction force that tries to separate the pinion from the gear teeth. Make sure this is accounted for in the machine design. See product data for pressure angle specifications.

- The RPG System requires a mechanism to achieve proper pinion preload. It is recommended that the pinion be moved into the gear not vice versa. The recommended method is to mount the servo drive system on a sliding bracket that has an adjustment to push it into the gear. Another possible preloading method utilizes a bracket with an eccentric mounting slot pattern. Nexen offers a preloading mechanism that is easy to integrate into your application as shown in Figure 17. Spring loaded preloading mechanisms should not be used since the spring force required to counteract the separation forces are much higher than the allowed preloading force and would cause a reduction in pinion needle bearing life, and increase system noise. See Figure 18 for more details.

- The RPG System requires periodic lubrication and should use the grease offered on Nexen's website as an accessory to the RPG products or equivalent lubrication as described in the Lubrication section on page 16. For more information or applications with special lubrication needs consult Nexen.

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

- The RPG systems are surface treated with Raydent®, Armaloy®, or Nickel Plating (with the exception of the pinion rollers that consist of bearing grade steel), and will have moderate corrosion resistance. Pinion roller corrosion will lead to pinion needle bearing damage and then system failure. Always protect the pinion from adverse conditions. If the RPG system comes with other coatings, consult the product specifications for performance. Review surface treatment product specifications for corrosion resistance performance, and determine whether the RPG system is suitable for your application based on your familiarity with the corrosion resistant surface treatment or thorough testing. Nexen makes no claims for RPG corrosion resistance in any application.

- Nexen can provide additional tapped, untapped or countersunk holes in the ring gear as needed.

SYSTEM DESIGN OVERVIEW

Ring Gear and Arc Segment Requirements

- RPG solid ring gears are available in diameters up to approximately 750 mm [29.5 in.], beyond this the ring gears will consist of segments that will be joined together to form a complete ring. Arcs of various radiuses and lengths can also be provided. Throughout this document “ring gear” will be used primarily but will also apply to arc segments unless otherwise noted.

- **CAUTION** Handle the ring gear or arc segments with care they are very high precision products. Do not drop, allow anything to fall on, or place them on non-flat surfaces.

- The ring gear ID, OD and the side without product numbers are reference surfaces. The side with the part number on it should be away from the machine bed mounting surface.

- Secure the ring gear using all of the available bolt holes. Refer to Table 1. This will ensure the highest degree of ring gear stability.

- Install the RPG system at the temperature at which it will be used.

- The ring gear teeth are hardened on the tooth faces only.

- If the gear is segmented, a special alignment tool is required to properly join the segments together and is available from Nexen. The alignment tool ensures proper pinion meshing and system accuracy when the pinion crosses gear joints. For full segmented rings an alignment tool for every joint is recommended, for arcs one aligment tool is required. To use the alignment tool a special mounting hole provision is required in the machine bed off to the side of where the gear segments meet to temporarily secure the alignment tool. When the adjacent gear segments are properly positioned, there will be a 0.1 - 0.2 mm gap between their ends. See Figures 1, 2, and 4 for details.

- If the ring gear rotates in the vertical plane, take precautions to prevent debris and contaminates from collecting on the ring gear since it could interfere with pinion meshing. In such environments, it is recommended that the ring gear be shielded and / or locate the pinion around the lower half of the ring gear to allow debris to fall out of the tooth pockets before reaching the pinion.

Pinion Requirements

- Verify the shaft variance and diameter tolerances meet Nexen specifications before mounting the pinion. See Figure 10.

- The shaft on which the pinion is mounted on must pass all of the way through the pinion and bushing for proper support.

- If using a flange mount pinion, verify that the dimensions and tolerances of the gearhead flange meet the specifications of the ISO 9409 Standard.

- Mount the pinion as close to a support bearing as possible to minimize shaft deflection.

- The pinion roller bearings are sealed. It is still recommended, however, that the pinion be shielded from liquids, dust, and debris.

- Multiple pinions can drive a gear without an additional service factor but the load sharing by each pinion must be equal. This is best accomplished with discrete drives linked electronically; mechanically linking pinions is not recommended. Contact Nexen for more information.

- The RPG system can be operated such that the pinion revolves around the ring gear as long as the pinion preload remains within specifications as it revolves.

PROPER SYSTEM ALIGNMENT

The RPG system is available as solid round gears, segmented gears, or arc segments with internal or external teeth. The instructions that follow will use the reference “ring gears” but applies universally to all cases.

Unlike traditional gear systems, the RPG System operates with no mechanical clearance and requires a preload. For optimal performance the preload must remain as constant as possible as the ring gear travels past the pinion, or conversely, the pinion orbits around the stationary ring gear. To achieve this the ring gear and pinion concentricity and axial variance and pinion axis concentricity and parallelism to the axis of rotation must be well maintained. To verify these conditions have been met it is recommended that the supporting structure and bearing systems are in place and the RPG system is installed last. This will allow a dial indicator to be positioned where the pinion will be located and the system rotated to verify variance before and during the ring gear installation. The following guidelines will ensure this is achieved.

a) The ring gear must be mounted on a step in the mounting surface that supports the inner diameter of the ring gear and the side of the ring gear opposite the product number and is rigid enough to prevent deflection that would affect pinion preload. The ring gear mounting surface concentric with the axis of rotation must have variance less than (- 0.02 mm [- 0.0008 in.]) and be within (± 0.02 mm [± 0.0008 in.]) of the gears inner diameter to provide a tight fit. The mounting surface perpendicular to the axis of rotation must have variance less than (± 0.02 mm [± 0.0008 in.]). This applies whether the ring gear is bearing supported and rotates or is fixed in place and the pinion orbits the ring gear. See figures 1 and 2.

b) The Pinion axis of rotation must be concentric (±0.02 mm [± 0.0008 in]) to the axis of rotation of the ring gear and the angle between the Pinion Shaft axis and the plane the ring gear is in 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 ring gear teeth.

d) Once the RPG system is properly installed and preloaded verify the meshing tooth pattern is correct as outlined in the System Alignment Verification section on Page 14.

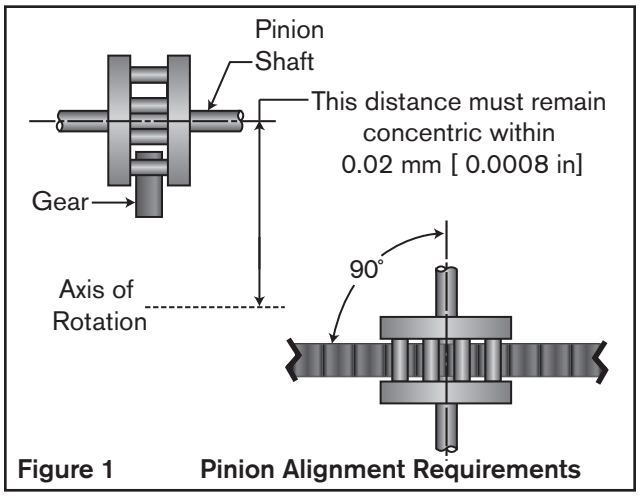
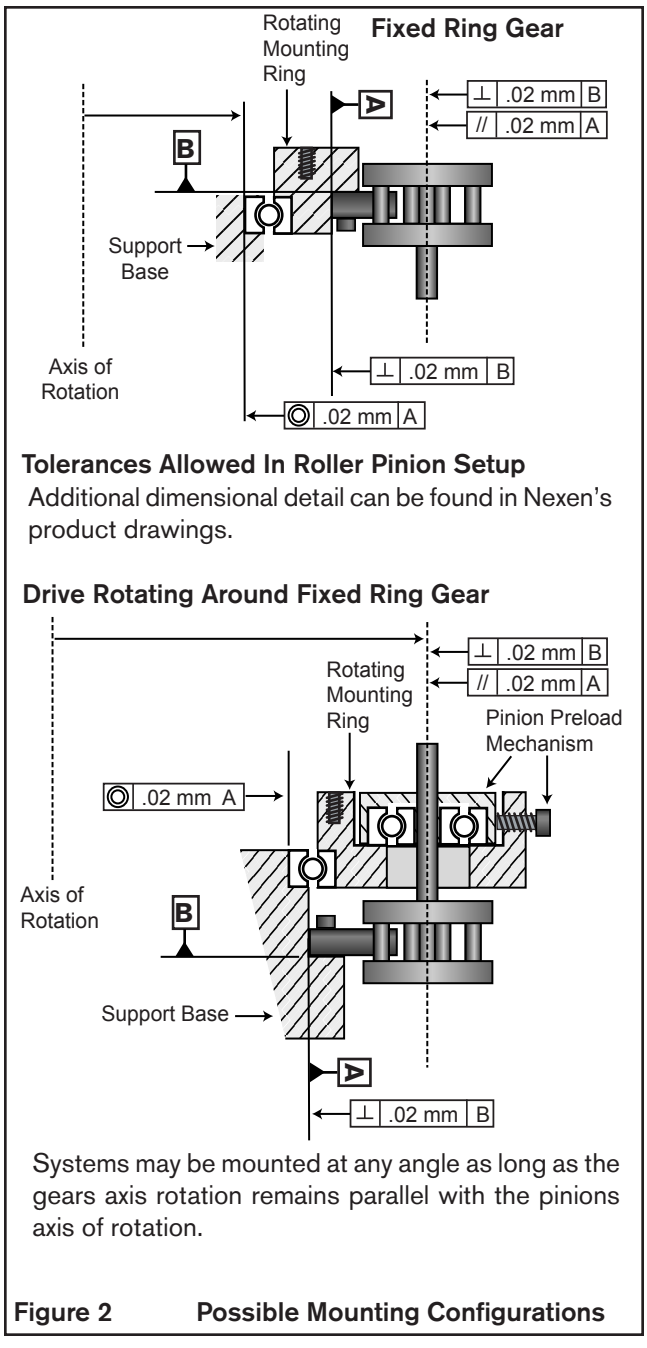


Figure 1 **Pinion Alignment Requirements**



Tolerances Allowed In Roller Pinion Setup
Additional dimensional detail can be found in Nexen’s product drawings.

Drive Rotating Around Fixed Ring Gear

Systems may be mounted at any angle as long as the gears axis rotation remains parallel with the pinions axis of rotation.

Figure 2 **Possible Mounting Configurations**

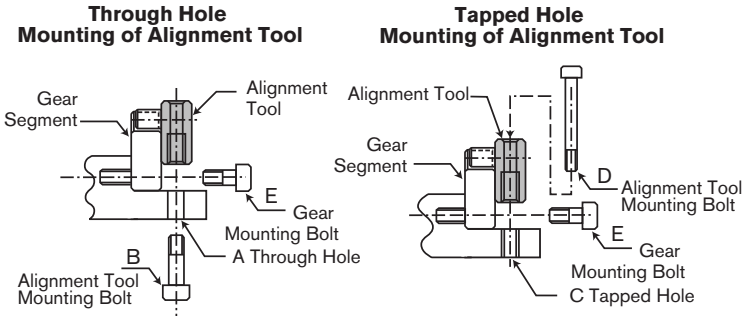


Figure 4

RPG Size	Through Hole Mounting		Tapped Hole Mounting		Gear Mounting Hole E	
	A	B	C & D	D	Through Hole	Bolt
16	9	M8 x 1.25	M6 x 1.00	M6-50	M6-50	M8
20	11	M10 x 1.50	M8 x 1.25	M6-60	M6-60	M10
25	14	M12 x 1.75	M10-20 x 1.50	M10-75	M10-75	M12
32	14	M12 x 1.75	M10-20 x 1.50	M10-95	M10-95	M12
40	14	M12 x 1.75	M10-20 x 1.50	M10-95	M10-95	M16
4014	14	M12 x 1.75	M10-20 x 1.50	M10-95	M10-95	M16

Refer to Nexen product drawings and CAD files for your product numbers for precise dimensions. Bolt lengths will vary based on machine design.

Table 1

Alignment Tool Mounting Bolt Specifications					
RPG Size	Through Hole		Tapped Hole		
	Bolt Size	Tightening Torque Initial/Final Nm [in-lb]	Thread	Depth mm [in]	Tightening Torque Initial/Final Nm [in-lb]
16	M6	1/5 [9/44]	M8	16 [0.63]	1/8 [7/71]
20	M8	1/8 [7/71]	M10	20 [0.79]	1/12 [9/106]
25	M10	2/28 [18/248]	M12	24 [0.94]	2/30 [18/266]
32	M10	2/28 [18/248]	M12	24 [0.94]	2/30 [18/266]
40	M10	3/32 [27/283]	M12	24 [0.94]	3/35 [27/310]
4014	M10	3/32 [27/283]	M12	24 [0.94]	3/35 [27/310]

Table 2

Bolt Type	Mounting Material		
	Steel	Cast Iron	Aluminum
Gear Mounting Tightening Torque for Socket Head Cap Screws (Class 10.9 or better)			
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]
Gear Mounting Tightening Torque for Stainless Steel Screws (Class 8.8 or better)			
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

RING GEAR INSTALLATION

In the following section “ring gear” will be used to describe solid ring gears, segmented ring gears, arcs, with internal or external teeth unless otherwise specified.

If the ring gear will be oriented in the vertical plane precautions should be taken to minimize the possibility that debris could be deposited in the tooth pockets and interfere with the pinion meshing. This can be accomplished with shielding and if the ring gear rotates placing the stationary pinion along the lower 120° of the ring gear to provide an opportunity for debris to fall out of the tooth pockets before arriving at the pinion.

RING GEAR MOUNTING SURFACE VERIFICATION

1. Ensure that the mounting surface and ring are completely clean, free of burrs, or anything that could interfere with full contact between the mounting surfaces.

2. Mount a dial indicator so that the ring gear can be rotated past it as shown in Figure 3. Verify that the radial variance in the ring gear mounting surface (ID or OD depending on internal or external teeth) meets the requirements of ±0.02 mm [±0.0008 in] as shown in Figures 1 & 2. Repeat the procedure with the dial indicator measuring the variance in the surface with the mounting holes tangent to the plane of rotation to verify it meets the requirements of ±0.02 mm [±0.0008 in] as shown in Figures 2. Mark the high point in the surfaces as they are rotated. If either of these variances is out of specification, attempt to correct it by adjusting the bearings or other ring gear support structures. If either variance cannot be brought into specifications but is close, it may be corrected by shimming between the ring gear and mounting surface, if the mounting surface variance is only slight out of specifications.

SOLID RING GEAR INSTALLATION

1. Carefully place the solid ring gear onto its mounting step, align the bolt holes, and insert the mounting bolts and hand tighten them.

2. Measure the ring gear tooth peak variance with a dial indicator at multiple points around the ring gear to ensure that is concentric to the axis of rotation with variance less than ±0.02 mm [0.0008 in] as shown in Figure 3.

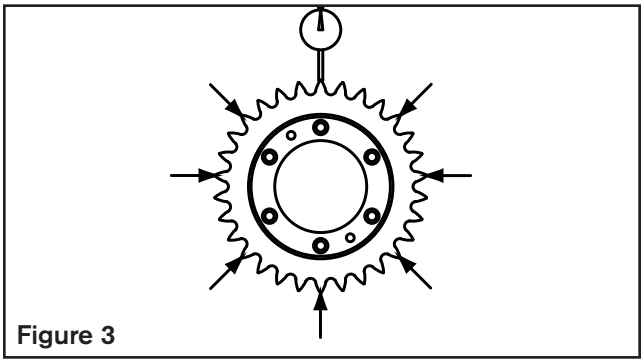


Figure 3

Mark the variance on the ring gear with a grease pencil or other easily removed marker at the high and low points that should be opposite each other. Rotate the ring gear so the dial indicator is resting on the tooth peak with the low reading and zero it. Place a wooden block on the high point tooth peak and gently drive it towards the center of rotation half the difference of the high and low variance readings. Remove any variance markings on the ring gear and repeat the tooth peak variance measurements again. Repeat this procedure until the tooth peak variance is within specifications all the way around the ring gear. If the tooth peak variance cannot be brought into specifications remove the ring gear mounting bolts and rotate the ring gear relative to the mounting surface and repeat the procedure starting with step one.

3. Once ring gear variance is within specifications drill through the dowel pin holes into the mounting surface and pin into place if desired and provisions are present.

ROLLER PINION INSTALLATION

Note: There are two pinion mounting styles, shaft or flange mount. Refer to the following section that applies to your situation. In either case it is critical to minimize radial variance. It will effect pinion preload and positional accuracy throughout the run.

Shaft Mounted Pinion Installation

NOTES:

- Refer to product drawings for shaft details.
- Refer to General Design Guidelines and Figures 1 and 2 for Roller Pinion mounting requirements.
- The pinion should be mounted as close to a shaft supporting bearing as possible to minimize shaft deflection and obtain optimal performance.
- The shaft the pinion is mounted on must extend all of the way through the pinion and bushing for proper pinion support and maximum torque transmission.

1. Clean the shaft the pinion will be mounted on and verify that variance is less than ±0.013 mm [±0.0005 in] as shown in Figure 10.

2. Inspect the shaft, pinion bore and the inner and outer bushing halves to ensure they are clean and have no defects.

3. Put oil that does not contain any pressure additives on the shaft, the tapered part of the bushing and the bushing bolts as shown in Figure 10. Do not lubricate the bore of the pinion bushing or shaft where the bushing contacts it or the torque transmission capacity of the bushing will be reduced.

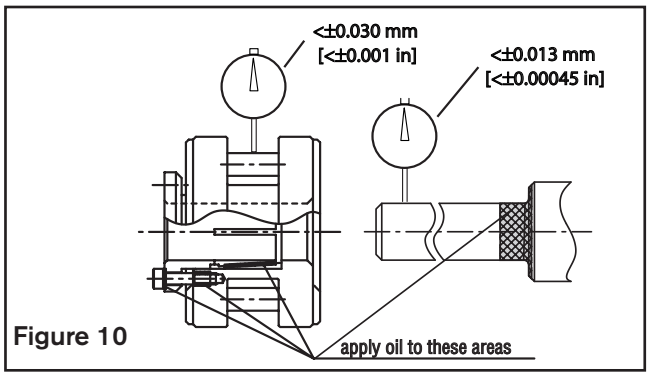


Figure 10

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

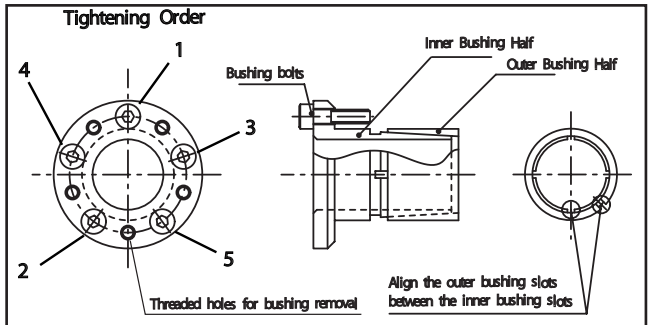


Figure 11 Bushing Installation Details

5. Insert the inner bushing half into the outer bushing half (previously inserted into the pinion) while ensuring that the inner and outer bushing half slots are not aligned as shown in Figure 11. For RPG32 and below you will also have to simultaneously ensure the bushing bolt through holes align with the pinion bolt holes. On RPG40 and larger the bushing bolts thread into the other half of the bushing, not the pinion body, so misalignment is not possible. The threaded holes are for bushing removal.

NOTE: Ensure that the slots in the two components that make up the bushing are not aligned as shown in Figure 11.

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

7. Insert the bushing fasteners into the through holes. Only use the provided bushing fasteners.

8. Locate the pinion on the shaft and lightly tighten the fasteners to take clearance out of all of the bushing parts but still allow the pinion to be moved axially on the shaft. Position the pinion and bushing assembly on the shaft so that the gap between the gear face and pinion roller bearing shoulders is even on both sides. As the bushing fasteners are tightened the pinion will be drawn slightly in the bushing direction so it is recommended that the pinion and bushing assembly be offset axially away from the bushing side 3 - 5 mm [0.1 - 0.2 in] initially so when the bushing fasteners are fully torqued the pinion ends up centered on the gear.

9. Equally tighten the bushing fasteners with 25% of the recommended tightening torque listed in Table 3. Start tightening at the top fastener and alternate back and forth across the face in a star pattern as shown in Figure 11. Repeat this procedure with 50% and then full torque. An additional 1 or 2 repetitions at full torque are recommended to ensure all fasteners have reached their target torque values. Progressive tightening of non-adjacent bushing fasteners is important to prevent any misalignment of components while installing the bushing.

10. Once the fasteners are fully torqued verify the pinion is centered on the gear. If not, measure the positional error and then remove the pinion as described in the Disengaging The Roller Pinion section on page 16. Repeat the pinion installation procedure and offset the pinion by the recorded error plus the previous off set value. When the pinion is fully torqued and properly centered then verify pinion concentric variation at the center of the pinion rollers as shown in Figure 15. Variation on this surface must be less than ± 0.030 mm [±0.0010 in].

Table 3 Pinion Bushing Bolt Information

Model	Bolt Type	Tightening Torque
RPG16	M4	3.5 Nm [30.98 in-lb]
RPG20	M5	7.0 Nm [61.96 in-lb]
RPG25	M6	12.0 Nm [106.21 in-lb]
RPG32	M6	12.0 Nm [106.21 in-lb]
RPG40	M6	12.0 Nm [106.21 in-lb]
RPG4014	M8	38.0 Nm [336.26 in-lb]

⚠ CAUTION

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

Flange Mount Pinion Installation (ISO 9409)

1. Clean the gearhead mounting face and pilot bore, inspecting for contaminates, burs, or surface defects that would interfere with full contact between the pinion and flange.

2. Using a test indicator, check the rotational flatness of the face as shown in Figure 12. Position the contact point of the indicator where the pinion will contact it. Rotate slowly for a minimum of one complete revolution and note the total amount of variance.

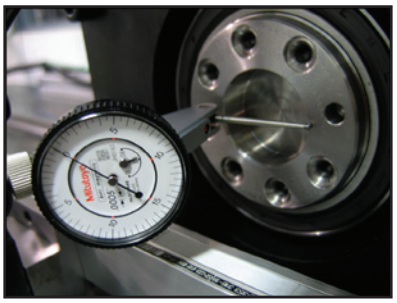


Figure 12

3. Position the contact point of the indicator at bottom dead center of the pilot bore as shown in Figure 13. Rotate slowly for a minimum of one complete turn and note the amount of total variance in one rotation.

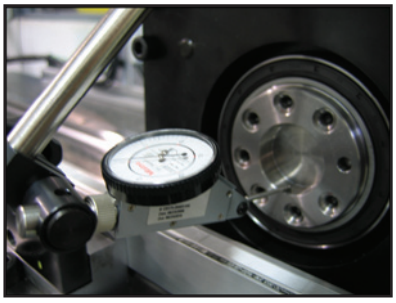


Figure 13

4. If either of the following conditions are true, the gearhead itself may contribute to excessive pinion preload variation, a reduction in pinion life and/or accuracy. The user should consider having the gearhead re-worked or replaced.

a. The measured total variance of the mounting face is greater than 0.013 mm [0.0005 in].
b. The measured total variance of the pilot bore wall is greater than 0.005 mm [0.0002 in].

Note: In some cases an adapter will be required to mount the pinion on the reducer. If so, proceed with Step 5, if not, skip to Step 13.

5. Clean the adapter flange and pilot where it will contact the gearhead flange inspecting for contaminates, burs, or surface defects that would interfere with full contact between the adapter and gearhead flange. See Figure 14.

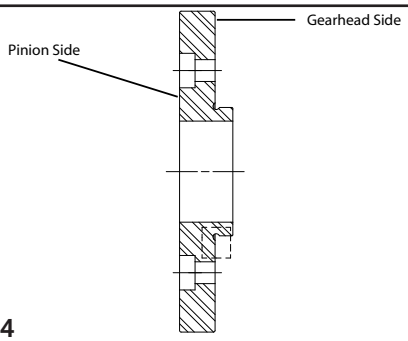


Figure 14

6. Apply a serviceable thread locking compound to the adapter mounting screws then assemble the adapter to the gearhead, leaving the mounting screws snug but do not tighten at this time as shown in Figure 15.

7. Position a test indicator at bottom dead center of the pilot bore wall as shown in Figure 15 and zero the indicator. Rotate the assembly slowly by using the gearhead input shaft a minimum of one complete revolution while noting the amount of total indicator variance and mark the angular location in which the lowest reading occurs throughout the rotation.

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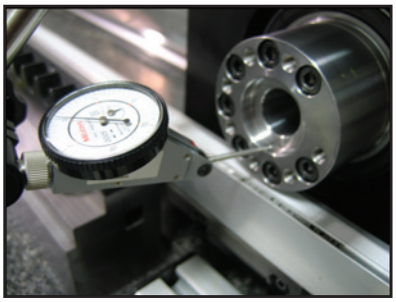


Figure 15

8. If the measured total indicator variance of the adapter pilot bore is greater than 0.008 mm [0.0003 in], tap gently on the O.D. of the adapter using a soft hammer at the angular location in which the lowest reading occurred. Doing this will shift the center of the adapter closer to the center of rotation.

9. Repeat steps 7 and 8 until the total measured amount of indicator variance is 0.008 mm [0.0003 in] or less.

10. Tighten the mounting screws to 50% of the specified torque specified in Table 4 in a star pattern that allows for an even distribution of axial clamping force. Then repeat the tightening pattern with 100% of the recommended torque.

Table 4

Adapter Fasteners	Tightening Torque Nm [in-lb]
ISO 16/20 (M5x0.8)	6.5 [58.08]
ISO 16/25 (M6x1.0)	11.5 [78]
ISO 20/25 (M6x1.0)	11.5 [78]
ISO 20/32 (M6x1.0)	11.5 [78]
ISO 32/40 (M8x1.25)	26 [156]
ISO 40/4014 (M10x1.5)	46 [273]

11. Re-torque the mounting screws once more to the full-specified torque value in Table 4 to ensure full torque has been reached on all fasteners. Tighten in the same order as above.

12. Repeat inspection Step 7 and verify the variance listed in Step 8 is achieved after fully torquing the adapter. If variance is out of specifications the adapter should be removed inspecting for contaminates, burs, or surface defects that would interfere with full contact between the adapter and gearhead flange. In some cases indexing the adapter relative to the gearhead flange can be helpful. Then repeat the adapter installation procedure starting with Step 6.

13. Clean the pinion flange and pilot where it will contact the adapter (if used) or gearhead flange inspecting for contaminates, burs, or surface defects that would interfere with full contact between the pinion and adapter (if used) or gearhead flange.

14. Apply a serviceable thread locking compound to the pinion mounting screws and assemble the pinion to the adapter (if used) or gearhead, leaving the mounting screws snug but do not tighten at this time.

15. Position a test indicator on the center of the pinion rollers as shown in Figure16 and zero the indicator. Rotate pinion a minimum of one complete revolution by turning the gearhead input shaft while noting the amount of total indicator variance and mark the angular location on the pinion shoulder in which the highest reading occurs throughout the rotation. When the pinion is properly centered the concentric variation at the center of the pinion rollers must be less than ± 0.030 mm [± 0.0010 in].

Figure 16

If the measured total indicator variance of the pinion rollers is greater than ± 0.030 mm [± 0.0010 in], tap gently on the O.D. of the pinion using a soft hammer at the angular location in which the highest reading occurred. Doing this will shift the pinion center closer to the center of rotation.

16. Tighten the mounting screws to 50% of the specified torque specified in Table 5 below in a star pattern that allows for an even distribution of axial clamping force. Then repeat the tightening pattern with 100% of the recommended torque in Table 5.

Table 5

Pinion Fasteners	Tightening Torque Nm [in-lb]
RPG 16 (M3x0.5-APEX)	1.5 [13]
RPG 16 (M4x0.7)	5.3 [47]
RPG 20 (M5x0.8)	10 [88]
RPG 25 (M6x1.0)	17.5 [155]
RPG 32 (M6x1.0)	17.5 [155]
RPG 40 (M8x1.25)	40 [354]
RPG 4014 (M10x1.5)	70 [620]

17. Re-torque the mounting screws once more to the full-specified torque value in Table 4 to ensure full torque has been reached on all fasteners. Tighten in the same order as above.

18. Repeat variance inspection Step 15 and verify the variance listed is achieved after fully torquing the pinion. If variance is out of specifications the pinion should be removed inspecting for contaminates, burs, or surface defects that would interfere with full contact between the adapter (if used) and gearhead flange. Indexing the pinion relative to the adapter (if used) or gearhead may help in some cases. Repeat the pinion installation procedure starting with Step 13.

APPLYING PRELOAD

If you would prefer to not design your own pinion preloading mechanism, Nexen offers a high precision push bolt preloading system that bolts between the machine frame and servo reducer to simplify machine design and achieve optimal results. See figure 17.

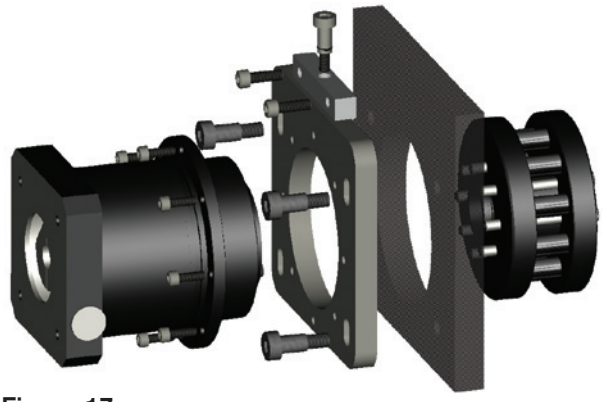


Figure 17

Nexen Precision Pinion Preloader product numbers and more information can be found at www.nexengroup.com on any of the RPG pinion pages under accessories in the left hand column.

To ensure optimal meshing of the roller pins with the gear teeth, the shaft must be preloaded to 0.010 - 0.015 mm [0.0004 - 0.0006 in] beyond full roller/tooth root engagement.

NOTE: Do not apply excessive preload. Preloading beyond 0.015 mm [0.0006 in] will decrease product life, increase noise, and cause vibration. When the RPG system is properly preloaded, there will be no tangential play between the gear teeth and the pinion rollers if the pinion is not allowed to turn and the rotating assembly forced back and forth in the direction of rotation.

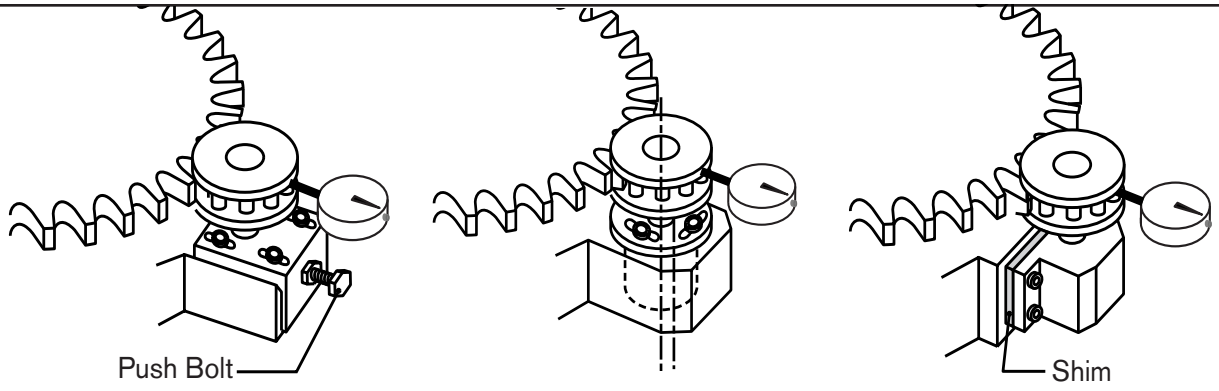
Refer to Figure 18 for suggested preload methods.

Preloading Procedure

Note: Be careful engaging the pinion and servo assembly to the gear to avoid damaging the gear teeth or pinion rollers.

1. With a dial indicator mounted on the movable carriage, measure off the tooth peaks. Move the carriage down the run taking frequent measurements to locate the high spot in the run. This is where the pinion preloading should be done to prevent excessive preload from occurring elsewhere in the run.

2. Apply serviceable thread locking compound to the pinion preloader slider bolts and install the servo and preload mechanism. Ensure the preload related bolts are just loose enough to allow the pinion to be pulled away from the gear teeth. For the Nexen Preloader System, this is approximately 0.2 - 0.3 Nm [2 - 3 in-lbs].



Adjustment by Oblong Holes (Preferred Method)

Adjustment by Eccentric Holes (Option 1)

Adjustment by Shim (Option 2)

Figure 18

3. Verify that the pinion rotational axis is as parallel as possible to the gears rotational axis, and the gear is centered between the pinion bearing flanges as shown in Figure 1.

4. Rotate the preload adjustment screw clockwise to separate the pinion from the gear. This will ensure that clearance is initially present. Then seat the pinion into contact by turning the preload adjustment screw counterclockwise until a slight resistance is felt and then back the screw off 1/8 of a turn. This step is critical to prepare for preload settings.

5. Place a magnetic base dial indicator on the same part of the machine as the motor and reducer, and locate its probe on the OD of the pinion flange such that it measures in the direction of preload travel.

6. Apply the preload of 0.010 - 0.015 mm [0.0004 - 0.0006 in] with the preload application screw(s) and then tighten the preload lockdown bolts to their recommended torques. See Table 6 for Nexen Preloader System torque values. Typically the preload will change slightly when the preloader lockdown bolts are tightened. If tightening the preload bolts causes the amount of preload to fall outside of specifications, record how much it changed when tightening the preloader lock down bolts then loosen the preloading system and repeat the preloading procedure but adjust the initial preload (more or less) by the recorded preload deviation. This procedure will ensure that when the preloader lockdown bolts are tightened the amount of preload should fall within specifications.

7. With the pinion preloaded to specifications manually rotate the gear by hand (if possible) checking for smoothness and uniformity of resistance. If manually applied motion is not possible, use the servo motor to rotate the gear, with just enough torque output to move it while looking and listening for resistance to motion.

Table 6

	Screw	Tightening Torque Nm [in-lb]
Preloader Screw		
All Models	-	1.7 [15] Max
Shoulder Screws (Mtg. Plate)		
RPG-PRE-064	M8x1.25	40 [350]
RPG-PRE-090	M8x1.25	40 [350]
RPG-PRE-110	M8x1.25	40 [350]
RPG-PRE-140	M8x1.25	40 [350]
RPG-PRE-200	M12x1.75	120 [1060]
Gearhead Screws (Mtg. Plate)		
RPG-PRE-064	M4x0.7	5.3 [47]
RPG-PRE-090	M5x0.8	10 [88]
RPG-PRE-110	M5x0.8	10 [88]
RPG-PRE-140	M6x1.0	17.5 [155]
RPG-PRE-200	M8x1.25	40 [354]
Preloader Mtg. Screws (2x)		
All Models	M6x1.0	17.5 [155]

SYSTEM ALIGNMENT VERIFICATION

Proper roller to tooth meshing can be verified by two methods depending on which you find easier to interpret:

Option 1: Apply a slow drying machinists dye to the pinion rollers and move the RPG system back and forth over a short distance (about 1/2 meter). It is important the dye remain wet so it transfers to the gear teeth and is not depleted. Analyze the dye pattern transferred to the teeth. If the meshing geometry is good the dye will be spread evenly all the way across the tooth face over the middle 2/3 - 3/4 of the teeth with none at the top and bottom. If this section is properly aligned clean off dye residue and repeat as necessary to verify the RPG alignment over the entire rotation as shown in Figure 19.

Option 2: Apply a small amount of high contrast grease to each gear tooth face over 1/2 meter of circumference. Operate the RPG system back and forth over this 1/2 meter of travel. If the meshing geometry is good the grease will be completely wiped away all the way across the tooth face over the middle 2/3 - 3/4 of the teeth with some remaining at the top and bottom. If this section is properly aligned clean off grease with a solvent and repeat as necessary to verify the RPG alignment over the entire rotation as shown in Figure 19.

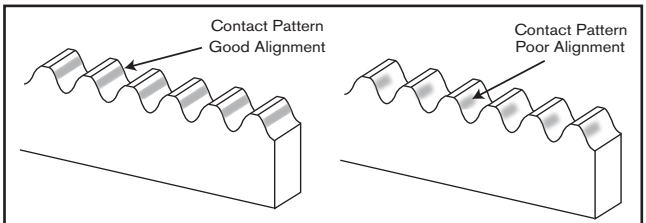


Figure 19

If the dye or grease contact pattern indicates a meshing problem, diagnose the problem, correct it, and then repeat the preload and Alignment Verification procedures.

DISENGAGING THE ROLLER PINION

1. De-couple the load from the RPG system.

⚠ WARNING

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

2. Disconnect the power source, ensuring that no torque is applied to the roller pinion.

3. Remove pinion preload by loosening the preload mechanism sliding bolts slightly and then turning the preload application screw(s) to remove the pinion preload. You should be able to slightly separate the pinion from the gear teeth now.

4. Progressively loosen non-adjacent bushing fasteners in the same order they were tightened until all are removed from the bushing (Refer to Figure 11).

5. Insert the bushing fasteners into the threaded holes in the bushing flange and alternately tighten them as illustrated in Figure 11 to release the locking action of the bushing.

6 Lift the servo/reducer/preload mechanism assembly from the gear or slide the servomotor/reducer out of the pinion bore.

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

OPERATION

⚠ DANGER

This product has moving parts that can crush or cut appendages. Provide adequate spacing or guarding from any operating product.

⚠ WARNING

Never exceed maximum operating speeds listed for your product. (See Table 7).

⚠ WARNING

Ensure proper guarding of the product is used. Nexen recommends the machine builder design guarding in compliance with OSHA 29 CFR 1910 “Occupational Safety and Health Hazards”.

⚠ WARNING

Use appropriate guarding for rotating components. Failure to guard could result in serious bodily injury.

Table 7

RPG Maximum Speeds*		
Product	Tangential Speed	Pinion RPM
RPG16	4 m/s [13.1 ft/s]	1500
RPG20	5 m/s [16.4 ft/s]	1500
RPG25	8 m/s [26.2 ft/s]	1920
RPG32	11 m/s [36.1 ft/s]	1719
RPG40	6 m/s [19.7 ft/s]	750
RPG4014	6 m/s [19.7 ft/s]	643

*Standard RPG speed ratings, specials can vary. Review Nexen specifications for your specific product number.

LUBRICATION

The pinion needle bearings are sealed and lubricated for life and cannot be serviced.

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

When lubricating the RPG system inspect the pinion rollers and gear teeth for any abnormal wear patterns and ensure the pinion rollers are not seized or have excessive play. Wear on the edges of the gear teeth (not uniform across the tooth face) or rings on the rollers indicate an alignment problem which should be corrected to obtain maximum system performance and life.

The rollers in new pinions, especially larger sizes, can seem difficult to turn due to seal drag. This improves as the pinion breaks in.

THK AFA grease is recommended for gear tooth lubrication. Nexen offers this grease under product number 853901. Greases for special applications such as food grade, vacuum, or others are allowed if they use a synthetic base, a polyurea thickener, and meet the following Kinematic Viscosity Levels: CST@40C = 25; CST@100C = 5. Contact Nexen for recommendations on alternative greases.

The RPG system can be lubricated in two ways:

1. Apply grease to the pinion rollers and roll the pinion back and forth 5 times over one meter circumference of gear teeth, repeating the process until the entire gear is lubricated.

2. Using a swab apply a very small dab of grease on the middle of each tooth face and rotate the ring gear 5 times.

Wipe excess grease from the sides of the gear and pinion body to prevent grease being thrown off during operation and for general cleanliness.

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.

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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.

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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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