nexen

LINEAR MOTION CONTROL PRODUCTS

User Manual

Harmonic Gearhead with RPS Pinion (HGP)

CE

RoHS compliant

FORM NO. L-21277-C-0714

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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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, cause injury or death. Comply with all applicable codes.

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

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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 RPS system could cause serious harm to operators or equipment.

⚠ WARNING

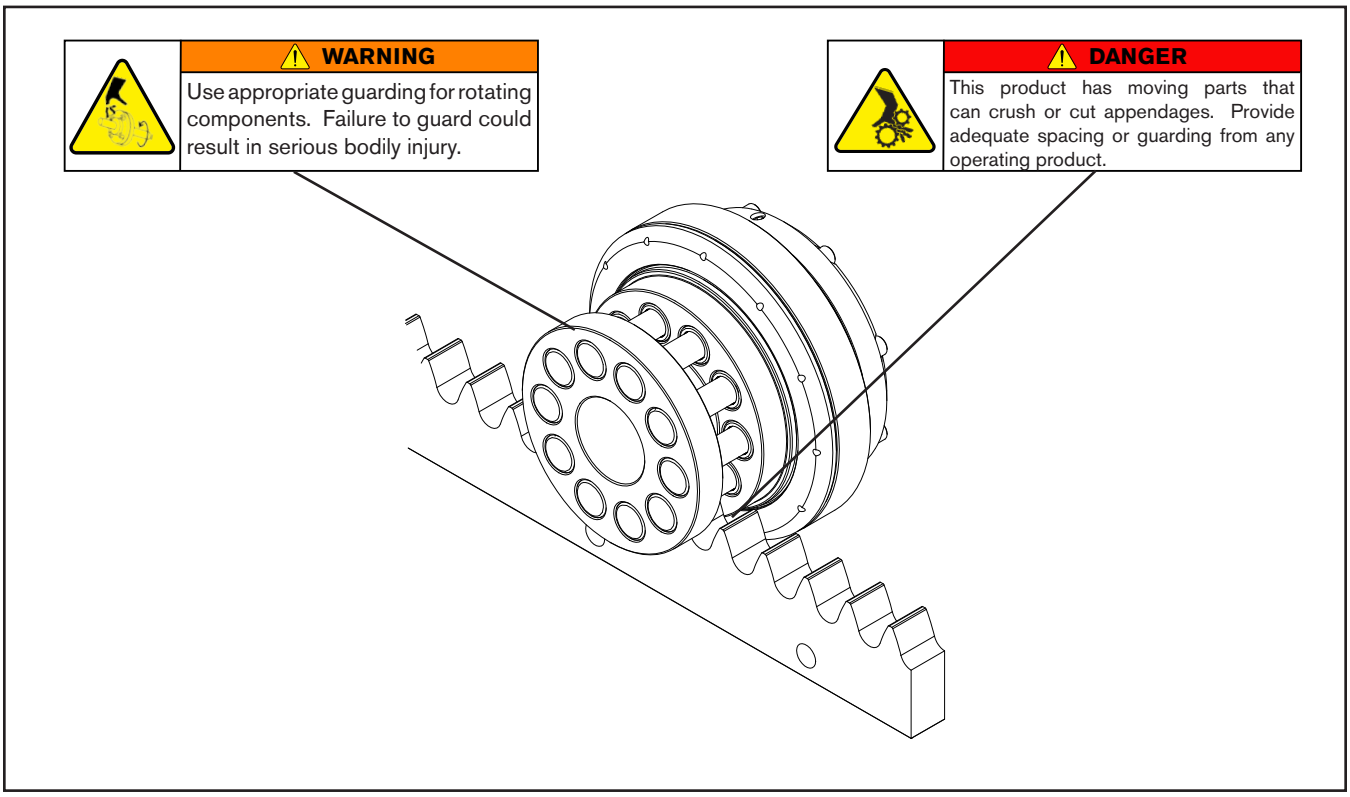
Ensure proper guarding of the product is used. Nexen recommends the machine builder design guarding in compliance with OSHA 29 CFR 1910 “Occupational Safety and Health Hazards”.

⚠ 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.



SYSTEM DESIGN OVERVIEW

The harmonic gearhead with integral pinion will hereafter be referred to within this manual as HGP. The pinion portion of the HGP is part of the Nexen Roller Pinion System (RPS), which is comprised of rack(s) and a pinion. Therefore this document will hereafter refer to those parts as RPS. For proper RPS operation, it is necessary for the user to adhere to the general system requirements outlined below.

General System Requirements

- Unlike traditional rack and pinion drives, the RPS has zero mechanical clearance and requires a system preload for proper operation. This preload must remain relatively consistent over the entire run to obtain optimal system performance and life. Therefore it is crucial that the linear guiding system's mounting surfaces are very parallel with those of the RPS system, eliminating the potential for convergence or divergence at any point. If the guiding system and RPS converge, preload will become excessive resulting in increased noise, reduction of life, and potential binding within the RPS. If the guiding system and RPS diverge, preload will be lost resulting in backlash, loss of positional accuracy, increased noise, and reduction of life. The main consideration when establishing guiding system and RPS mounting surfaces within a machine is that they rise and fall together, at the same rate and position within the run so that RPS preload remains within specifications. The best way to ensure minimal variation between the guiding system and the RPS is to machine their mounting surfaces within the same machining operation. See Figures 3 and 4 for more details.

- Ensure that the machine bed and guiding system have sufficient rigidity, to prevent deflections that would affect RPS preload and pinion alignment.

- The bottom and one side of the rack must be supported by a step in the machine bed. The height of this step should be at least half of the rack thickness. The rack should not be solely supported by fasteners or pins. See Figure 5 for specifications.

- For extremely long runs a single-piece machine bed will be impractical, requiring a segmented bed. When installing the guiding system and RPS rack, advance planning of mounting hole positions should be done to ensure that the machine bed's joints are not in close proximity to the joints in the guiding system or RPS. Instead, span the machine bed joints with the guiding system and RPS rack as much as possible.

- To achieve proper system preload, the recommended method is to mount the servo-driven components (motor and HGP pinion) onto a sliding plate or bracket whose position can be adjusted such that the pinion rollers can adequately slide into and out of engagement with the rack teeth.

    - It is recommended that when establishing preload, the pinion should be moved into the rack instead of vice versa.

    - If a sliding plate or bracket cannot be utilized, another possible preloading mechanism is to mount the servo-driven components to a plate or bracket which has an eccentric mounting slot pattern.

    As an accessory, Nexen offers a preloading system that can easily be integrated into an application, provided that a suitable mounting surface and the correct mounting hole pattern can be added to the customer machine frame as shown in Figure 14. Spring-loaded methods of achieving preload should not be used, as the spring force required to counteract rack and pinion separation forces would be much higher than the allowed preloading force and would therefore result in reduced product life and increased system noise.

- RPS should not be used in environments with temperatures outside of a -5° to 40° C (23° to 104° F) range or with wide temperature variations within this range, as thermal expansion or contraction can affect RPS preload and meshing. If you have an application with these temperature characteristics, consult Nexen.

- The HGP is available in a variety of corrosion resistant finishes. Consult Nexen for available options. Standard HGP product finish includes an anodized aluminum motor adapter, black oxided gear housing and pinion body, and unfinished bearing grade steel rollers. Pinion roller corrosion will lead to damage within the roller bearings, and eventual system failure. Always protect the pinion from adverse environmental conditions. RPS rack finish varies by performance grade, ranging from unfinished steel to stainless steel. Always review your requirements for corrosion resistance to determine whether the HGP or RPS rack(s) have suitable finishes for the application, based on your familiarity with the specified finishes and/or through relevant testing. Nexen makes no claims for HGP or RPS corrosion resistance in any application.

Rack Requirements

- **CAUTION** Handle the rack with care; it is a high precision product. Do not drop it, allow anything to fall on it, or place it on non-flat surfaces that could affect rack straightness. Doing so may negatively affect RPS performance.

- Five sides of the RPS rack are reference surfaces. The side displaying the part number, or ends that have been cut (not factory full or half sections) are non-reference surfaces. The side displaying the part number should **not** be mounted against the machine bed and cut rack ends must be positioned at the end of the run.

- Secure the rack using all of the available mounting holes to a precision step in the machine bed. Refer to Table 2 for proper fastener tightening torque. This will ensure the highest degree of rack stability and precision performance.

- Install the RPS at the temperature at which it will be used to minimize thermal expansion or contraction affecting the positional accuracy of the system.

- The RPS rack is hardened on the tooth faces only.

- Nexen offers rack sections in lengths of up to one meter long. When joining multiple rack sections, a special alignment tool is strongly recommended and available from Nexen. The alignment tool's primary purpose is to ensure proper pinion meshing and system accuracy over rack joints. The alignment tool is simply a spacing jig and can be manually seated to establish the spacing of a rack joint, see Figures 9 and 10 for details.

- Avoid mounting the rack with the teeth facing up, as debris could collect on the rack and interfere with the meshing of the RPS. If the rack must be mounted with the teeth facing up, shield the RPS from debris or install an air knife on the moving carriage just ahead of the pinion.

HGP Requirements

- The HGP can be mounted in any orientation, however must meet the recommended mounting specifications found later in this document.

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

- The HGP can be operated such that the pinion remains stationary while the rack moves as it travels along a linear guide system. In this scenario, the supporting structure and guide system are still required to be within the specifications found later in this document, to ensure that proper preload and system performance.

- There are two pilot options on the HGP product. If using the primary mounting pilot the product can be mounted directly to the machine frame or pre-loader. If the secondary mounting pilot is desired, it will require a transition plate as shown below.

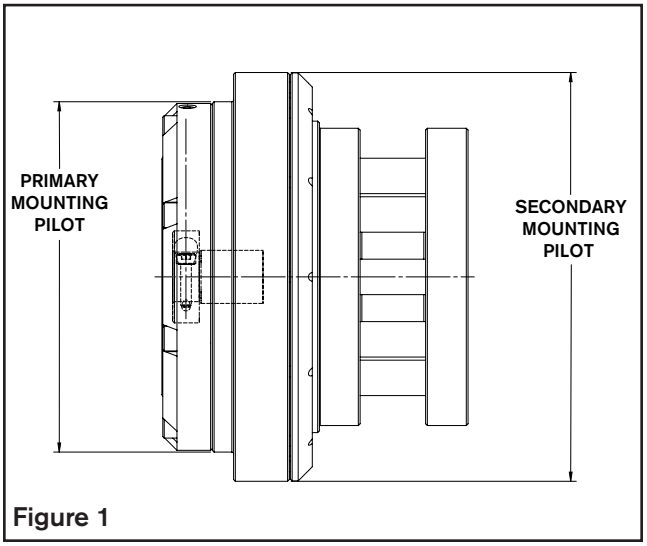


Figure 1

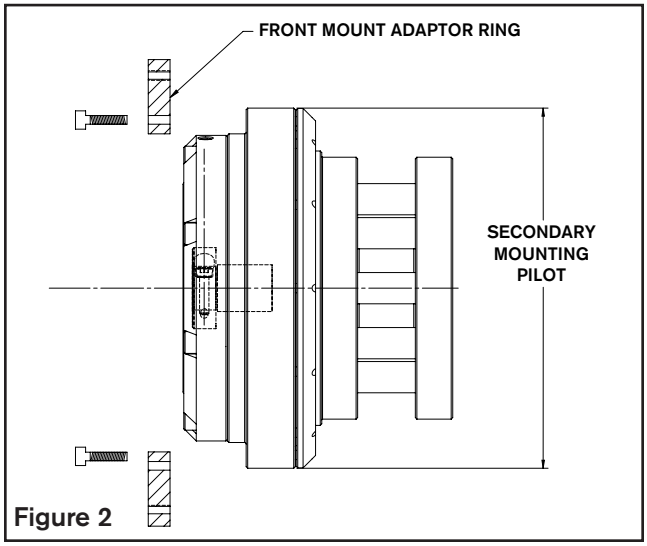


Figure 2

GENERAL RPS DESIGN GUIDELINES

In order to minimize backlash , obtain the highest positional accuracy, and minimize wear on the rack, the RPS must be installed on rigid, straight, flat mounting surfaces with the tolerances shown in Figures 3 and 4.

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 as the rack mounting surface as shown in Figure 4.

b) The pinion shaft must be parallel (±0.03 mm [±0.001 in]) to the rack mounting surface opposite the rack teeth and the angle between the pinion shaft and the face of the rack must be 90° ±0.1° maximum as shown in Figure 3.

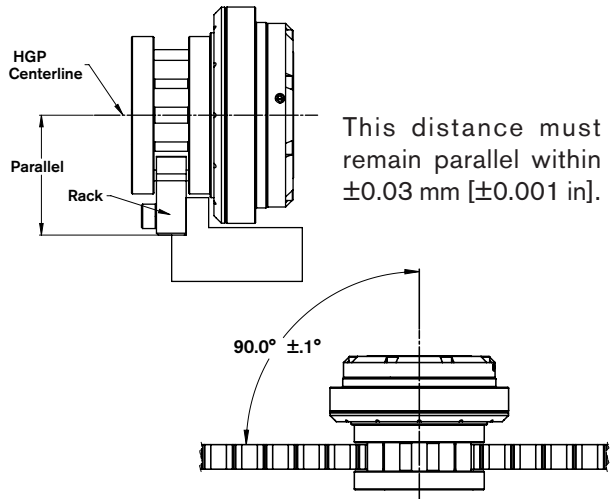
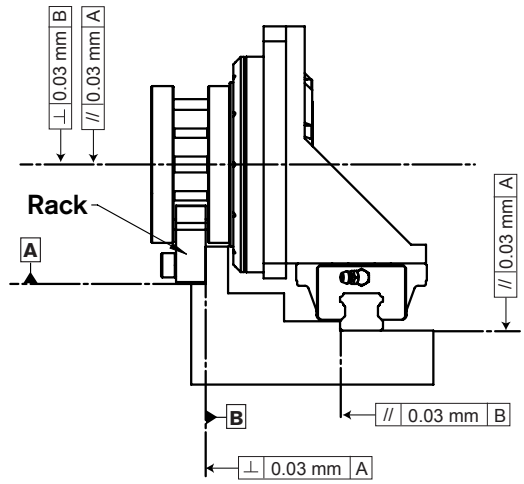


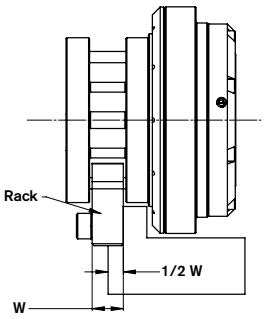
Figure 3 Pinion Alignment Requirements

The mounting surface for both the rack and the guiding system must be parallel within the specifications shown in Figure 4. 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 SYSTEM ALIGNMENT VERIFICATION section later in this manual.



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

Figure 4 Tolerances



The rack must sit on a step at least one half the width of the rack for proper support. The rack should not be supported by fasteners alone. Pinning the rack to its mounting surface is not recommended.

Figure 5 Rack Support Requirements

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 reference surfaces and includes all sides except the side with the product number. The non-reference face with the product number should not be placed against the machine bed surfaces. Any rack ends that have been cut must be located at the end of the run; the pinion must not cross cut rack ends.

RACK INSTALLATION

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

2. With the guiding system in place, mount a dial indicator on the carriage and measure the perpendicularity and parallelism variance on the two rack mounting surfaces by moving the carriage down the run and monitoring the dial indicator readings. Verify they meet or exceed specifications of ±0.03 mm [±0.001 in.] as shown in Figure 6. If variance is not within specifications, verify guiding system installation and correct if possible. Mark the location of the high point in the mounting surface the rack bottom sits on.

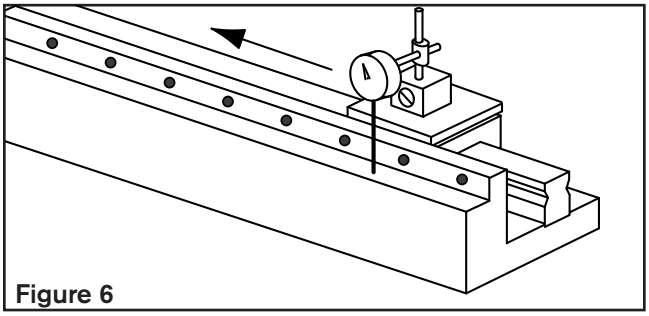


Figure 6

3. Start rack installation at the high point in the mounting surface the rack bottom sits on. This may not be at the end of the run.

   Additional sections of rack will be shimmed as required throughout the rest of the run to bring the rack tooth peak variance into specifications relative to the first rack section.

4. Apply a serviceable thread locking compound to the customer supplied mounting screws, lightly secure the first rack length to the mounting surface and clamp it in place while protecting the rack teeth by distributing the clamp load over several teeth. Make sure a clamp is close to each screw as it is tightened to ensure full rack to mounting surface contact. See Figure 7. Socket head cap screws are recommended for maximum pinion shoulder clearance. Make sure the side of the rack with the part number on it is not against the mounting surface and any cut rack ends are at the end of the run.

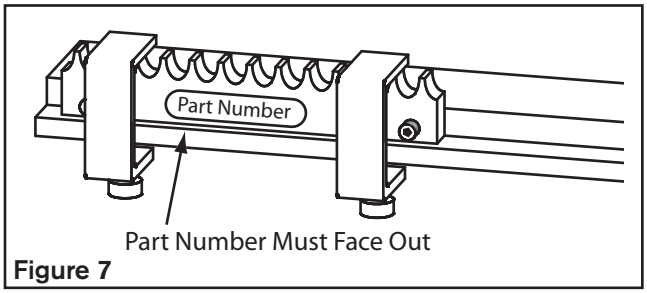


Figure 7

5. Tighten the mounting screws on the first rack alternately and incrementally 10%, 50%, 100% then working from the center of the rack towards the ends.

6. Once the rack mounting screws are fully tightened, verify tooth peak variance is less than ±0.03 mm [±0.001 in] by placing a dial indicator on the movable carriage with the indicator tip on the tooth peaks. Measure the tooth peak variance at points throughout the rack section as shown in Figure 8.

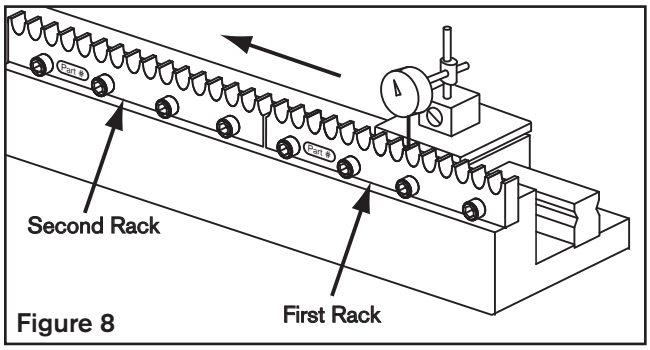


Figure 8

   If the tooth peak variance is out of specifications and the mounting surface was in specifications dismount the rack and inspect for dirt, burs, or anything that would prevent proper rack to mounting surface seating.

   If the mounting surface is out of recommended specifications then shimming between the rack bottom and the mounting surface will be required. Locate the high point within the rack section and shim all other points to meet it.

   When shimming, it is recommended to support the rack as much as possible, not just short pieces near mounting screws.

Adding Additional Racks

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

7. Position the end of the additional rack segment against the end of the first fully secured rack on the mounting surface and lightly secure with screws with serviceable thread locking compound applied. The additional rack should be in full contact with the mounting surface but still moveable within the rack mounting hole tolerances.

8. Place the Alignment Tool between the two racks utilizing the adjacent tooth roots of each rack while being careful not to damage the rack or alignment tool. There are two types of alignment tools, Gen B and Gen A, they are pictured below in Figures 9 and 10 respectively. The tools have different appearances but provide the same function.

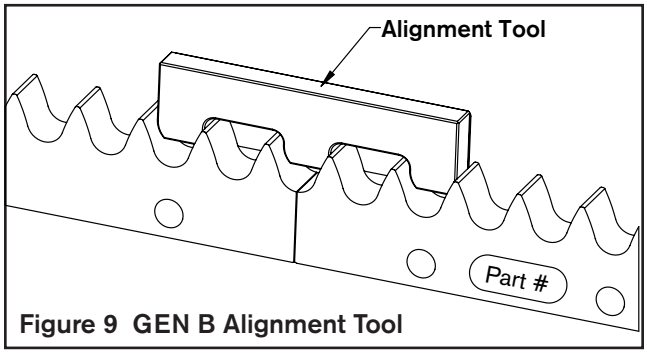


Figure 9 GEN B Alignment Tool

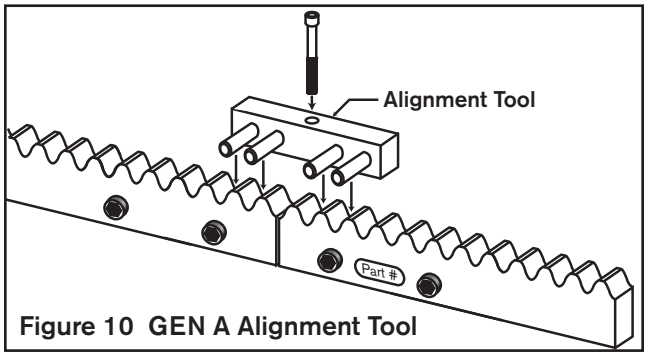


Figure 10 GEN A Alignment Tool

9. It is recommend that both tools are clamped into place as shown in Figure 11. If clamping is not possible, both tools can be set by hand by forcefully pressing it into the rack while securing the rack fasteners. When the rack joint has been properly set, the alignment tool should feel solidly seated against its datums, the same as if it were engaged with teeth in the middle of an individual rack section. The tool should not be able to move when a tilting or rocking motion is induced manually. This should be true whether the motion is being induced at the joint over the rack teeth or across the rack faces.

10. Tighten both rack's screws to 10% of the torque values in Table 2.

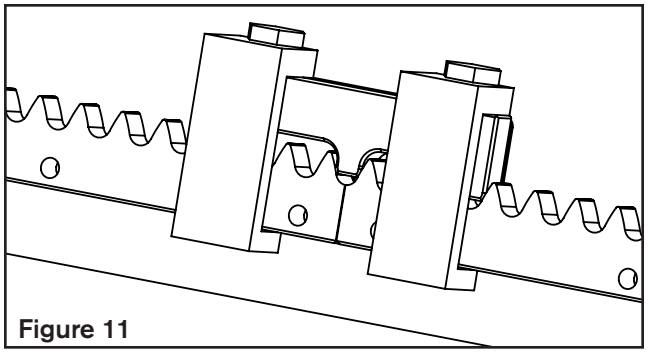


Figure 11

11. If a GEN A alignment tool and it's fastener provisions are being used, tighten the alignment tool fastener screws to the final torque specified in Table 1.

12. Tighten the second rack's screws to 50% of the torque listed in Table 2 working from the middle of the rack to the ends. Then repeat with 100% torque, as specified in Table 2.

13. Carefully remove the alignment tool, avoiding any damage to the rack or alignment tool.

14. Starting on the first rack perform the tooth peak variance check and extend it to the second rack as covered in step 6. If the tooth peak variance on the second rack is out of specifications shim it to match the first rack. Always reference the runout of additional rack sections against the first rack installed at the high point in the run as shown in Figure 12.

15. Repeat Steps 7 through 14 for any additional rack sections.

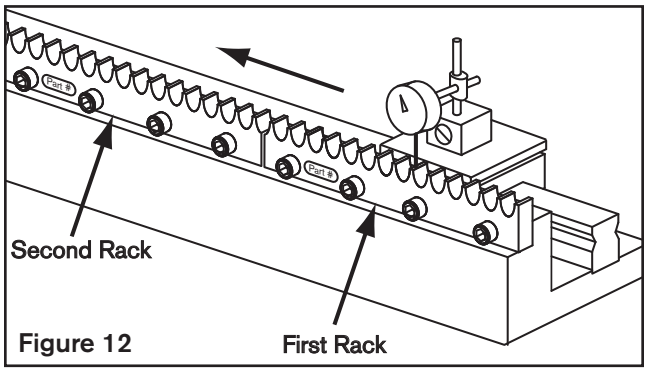


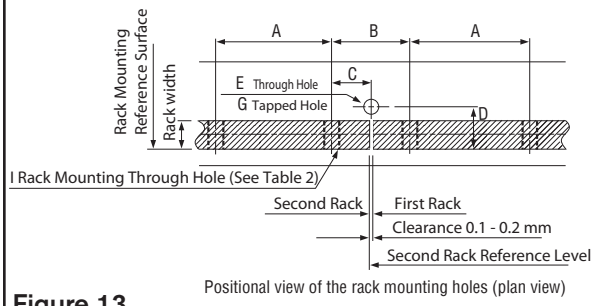
Figure 12

GEN A ALIGNMENT TOOL PROVISIONS

When joining multiple sections of rack with a GEN A alignment tool, provisions for an alignment tool mounting bolts shown in Figure 13 be made if desired.

The bolt can either pass through the alignment tool from the top and thread into the machine bed or pass through the machine bed and thread into the alignment tool.

See Table 1 for bolt sizes depending on method chosen. If clamping is not possible, the alignment tool can be manually seated across the rack joint while pressing the pins forcefully into the rack teeth. When the adjoining rack section is properly spaced, no movement should be felt when alternately pushing down on opposite ends of the alignment tool.



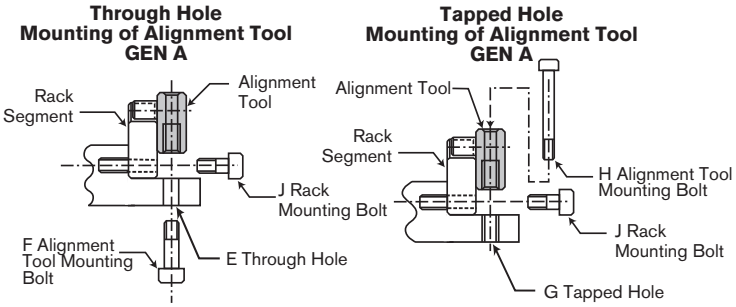


Figure 13

The dimensions below are nominal in mm and applicable only to standard catalog offerings. Refer to Nexen product drawings and CAD files for your product numbers for precise dimensions. Special and cut sections of rack may not conform to these dimensions. The RPS 10 & 12 alignment tools do not require fasteners so no data is listed for them below.

RPS Size	A	B	C	D	Through Hole Mounting		Tapped Hole Mounting		I	J
					E	F	G & H	H		
16	96	32	16	19.5	9	M8 x 1.25	M6 x 1.00	M6-50	7	M6
20	100	100	50	25.5	11	M10 x 1.50	M8 x 1.25	M6-60	9	M8
25	100	100	50	30.5	14	M12 x 1.75	M10 x 1.50	M10-75	11	M10
32	96	32	16	36.5	14	M12 x 1.75	M10 x 1.50	M10-95	14	M12
40	120	160	80	43.5	14	M12 x 1.75	M10 x 1.50	M10-95	18	M16
4014	80	120	60	54.0	14	M12 x 1.75	M10 x 1.50	M10-95	18	M16

Dimensions apply to standard length rack sections. Cut lengths and customs could vary. Refer to drawings for your specific product numbers. * Bolt length will vary based on machine design.

Table 1

Alignment Tool Mounting Bolt Specifications					
RPS 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 & 32	M10	2/28 [18/248]	M12	24 [0.94]	2/30 [18/266]
40 & 4014	M10	3/32 [27/283]	M12	24 [0.94]	3/35 [27/310]

Table 2

Bolt Type	Mounting Material		
	Steel	Cast Iron	Aluminum
Rack Mounting Tightening Torque for Socket Head Cap Screws (Class 10.9 or better)			
M5	8.2 Nm [73 in-lb]	5.4 Nm [48 in-lb]	4.0 Nm [35 in-lb]
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]
Rack Mounting Tightening Torque for Stainless Steel Screws (Class 8.8 or better)			
M5	5 Nm [44 in-lb]	5 Nm [44 in-lb]	4.0 Nm [35 in-lb]
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]

HGP INSTALLATION

The order in which the HGP is assembled to the motor, preload adjustment system, machine, or initial engagement with the RPS rack is not critical, and should be done in whichever order provides for the least amount of difficulty to the machine assembler.

Installation of Motor to HGP

1. Before installing the motor into the HGP:

    a. Wipe the motor shaft, pilot, and mounting face clean. Wipe the internal pilot and motor mounting face of the HGP clean.

    b. Ensure that the HGP's clamp collar is positioned over the slotted portion of the motor shaft bore such that the slots do not line up (HG17 only).

    c. Remove clamp collar access set screw.

    d. Insert the long blade of a hex bit (included) through the clamp collar screw access hole in the motor adapter and engage with the clamp collar screw head.

2. Apply a serviceable thread locking compound to the threads of the motor face mounting screws and a thin film of anti-sieze compound to the motor shaft.

3. Slowly and gently guide the motor into the input of the HGP. During this part of the procedure, the weight of the motor should be adequately supported. **Never** allow the motor to be suspended from HGP until the motor mounting screws are installed.

    Note: Ensure black input gasket seal is seated uniformly into radial groove of motor adaptor.

4. Once the motor shaft and pilot are fully seated within the HGP input, tighten the motor face mounting screws according to Table 3. After the motor face screws are tightened the clamp collar screw can be tightened, also according to Table 3.

    NOTE: Once motor has been fully assembled to HGP, remove the hex bit from the clamp collar access hole and save for future disassembly needs.

5. Reinstall clamp collar access set screw.

Installation of HGP to Preloader System or Machine

1. Before installing the HGP into the preloader system:

    a. Wipe the HGP pilot and mounting face clean. Wipe the internal pilot and HGP mounting face of the adjusting member of the preloader system clean.

    b. Wipe clean and apply a light coating of oil to any faces of the preloader system which will slide against one another during adjustment.

Table 3

HG Installation Fasteners			
Size	**HGP Mounting Screw Torque**	**Motor Mounting Screw Torque**	**Clamp Collar Screw Torque**
17	32 in-lbs	28 in-lbs	18 in-lbs
25	32 in-lbs	28 in-lbs	18 in-lbs
32	84 in-lbs	71 in-lbs	37 in-lbs
50	275 in-lbs	292 in-lbs	84 in-lbs

    c. Apply a serviceable thread locking compound to the threads of the HGP mounting screws. If using the Nexen Preloader System, these screws are provided.

    d. Gently guide the HGP into the adjusting member of the preloader system. Install HGP mounting screws, using a star pattern while tightening to the torque values shown in Table 3. These screws should be tightened to 25% of this value in the first iteration of the star pattern, 50% in the second iteration, and 100% in the final iteration.

2. If the HGP will be installed directly to the machine frame, clean all the piloting faces and install using the torques described in Step 1.d above.

HGP Engagement with RPS Rack

Initial engagement with the rack may be accomplished using one or more of the following methods, as the machine's design allows:

- The HGP can be initially assembled to the machine. Set the position of the preload system's sliding member for a small amount of clearance (backlash) between the pinion rollers and rack teeth. The pinion can then be rolled onto the end of a section of rack which has been secured. Backdriving of the HGP is permissible.

- A section of rack within a run can be removed to allow the pinion to roll onto an adjacent rack as described above, and then reinstalled.

- If sufficient travel within the preload system exists, the HGP can be initially assembled to the machine. Adjust the position of the preload system's sliding member until the pinion rollers clear the rack tooth tips. From it's end face, the rack can then be slid beneath the pinion rollers and between the pinion's bearing flanges into position. The preloader's position can then shift to attain initial engagement of the pinion rollers and rack teeth.

- If sufficient travel within the preload system exists, the HGP can be initially assembled to the machine. Adjust the position of the preload system's sliding member until the pinion OD clears the rack tooth tips.

From it's side face, the rack can then be slid beneath the pinion flanges and into position. The preload adjuster's position can then shift to attain initial engagement of the pinion rollers and rack teeth.

APPLYING PRELOAD

If the machine design does not already have provisions for a preloading mechanism, Nexen offers a high precision lifting and jacking screw style preloading system onto which the HGP is fastened. It can simplify machine design and help achieve the best possible system performance. A suitable mounting surface and the correct mounting hole pattern is required to add the Nexen preloading system to the customer machine frame. See Figure 14.

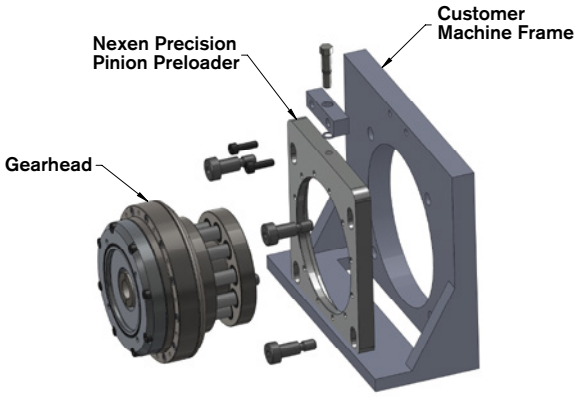


Figure 14

Nexen precision preloader system product numbers and dimensional information, and customer machine frame mounting hole requirements can be found at www.nexengroup.com on any of the HGP pages under "Accessories".

To ensure optimal meshing of the pinion's roller pins with the rack teeth, the HGP must be preloaded to 0.010 – 0.015 mm [.0004 - .0006 in] beyond full roller/tooth 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 RPS is properly preloaded, there will be no tangential play between the rack and pinion when pinion rotation is restrained and the carriage assembly is manually forced back and forth in the direction of travel.

Refer to Figure 15 for other suggested preload methods.

Preloading Procedure

Note: Exercise care when engaging the HGP with the rack to avoid damaging the rack teeth or pinion rollers.

1. With a dial indicator mounted on the movable carriage, measure the height of 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.

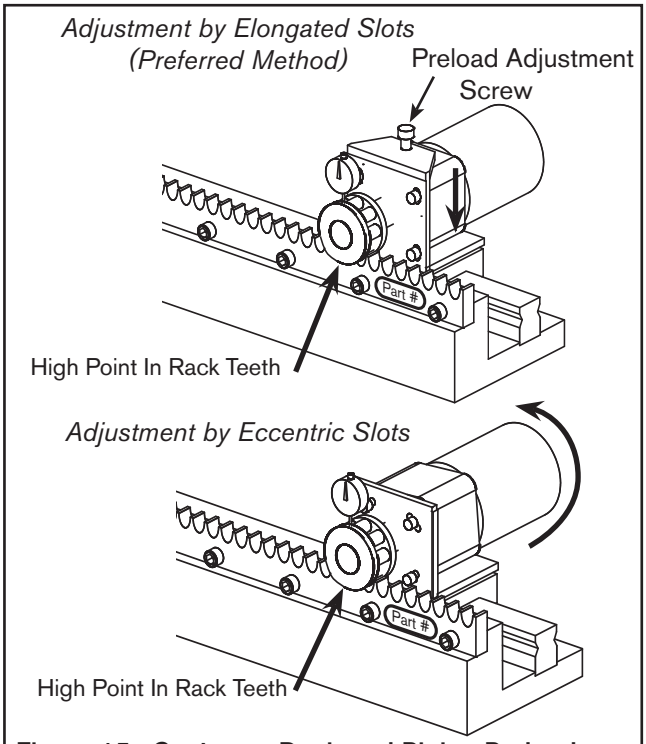


Figure 15 Customer Designed Pinion Preloaders

2. Install the HGP onto the preload system's sliding member. Apply a serviceable threadlocking compound to all fasteners which perform the function of locking down the position of this sliding member. Assemble the HGP assembly onto the machine, ensuring that the preloader lockdown fasteners are left just loose enough to allow the pinion rollers to be pulled in and out of mesh with the rack teeth. For the Nexen Preloader System, this is approximately 0.2 – 0.3 Nm [2-3 in-lbs]. If sufficient travel within the preload system exists, the pinion can be initially engaged with the rack by adjusting the pinion until the OD clears the rack tooth tips.

Preloading Procedure *(continued)*

3. Verify that pinion alignment requirements are being met, and the rack is centered between the pinion bearing flanges as shown in Figure 3.

4. If your preload system utilizes lifting/jacking screws to vary the amount of preload, rotate the adjustment screws to separate the pinion from the rack, verifying that clearance is initially present. Clearance can be observed in the form of system backlash. Then rotate the adjustment screws in the opposite direction to begin seating the pinion into contact with the rack. When a larger amount of resistance is felt, back the adjustment screw(s) off approximately 1/8 of a turn. This step is critical to prepare for the setting of actual preload.

   If your preload system utilizes eccentric slots or other methods of adjustment, rotate or shift the adjusting member as necessary to separate the pinion from the rack, verifying that clearance is initially present. Clearance can be observed in the form of system backlash. Then rotate or shift the adjusting member in the opposite direction to begin seating the pinion into contact with the rack. When the pinion contacts the rack, stop. This step is critical to prepare for the setting of actual preload.

5. Place a magnetic base dial indicator on the movable carriage, 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) (or either preload application device specific to your preloading system) and then tighten the preload lockdown fasteners to their recommended torques. See Table 4 for Nexen Preloader System torque values. Typically the preload will change slightly when the preloader lockdown fasteners are tightened. If tightening the preload fasteners causes the amount of preload to fall outside of specifications, record how much it changed when tightening the preloader lock down fasteners, 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 fasteners are tightened the amount of preload will remain within specifications.

7. With the pinion preloaded to specifications manually traverse the carriage down the run (if possible), checking for smoothness and uniformity of resistance. If manually applied motion is not possible, use the servo motor to traverse the carriage along the run slowly while looking and listening for resistance to motion.

Table 4

	Screw	Tightening Torque Nm [in-lb]
Preloader Screw		
All Models	--	1.7 [15] Max
Shoulder Screws (Mtg. Plate)		
Preloader, HG17	M6 x 1.0	17.5 [155]
Preloader, HG25	M8 x 1.25	40 [354]
Preloader, HG32	M8 x 1.25	40 [354]
Preloader, HG50	M10 x 1.5	68 [602]

SYSTEM ALIGNMENT VERIFICATION

Proper roller to tooth meshing is critical and 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 slowly move the RPS back and forth over a short distance (about 1/2 meter). It is important the dye remain wet so it transfers to the rack 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 RPS alignment over the entire length of travel. See Figure 16.

Option 2: Apply a small amount of grease (see **Lubrication** section) to each rack tooth face over 1/2 meter of rack. Slowly move the RPS 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 RPS alignment over the entire length of travel as shown in Figure 16.

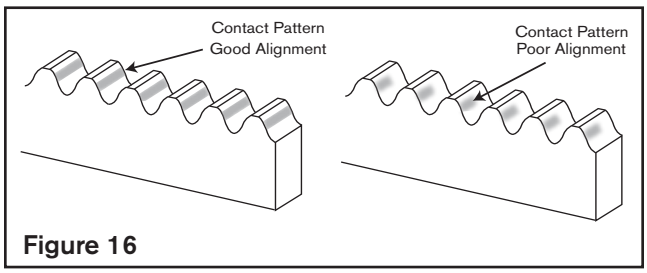


Figure 16

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

HGP OPERATION

⚠ DANGER

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

⚠ 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.

⚠ WARNING

Never exceed maximum operating speeds listed for your product. (See Table 5).

TABLE 5

Geared Pinion Maximum Speeds		
Product / Ratio	**Motor RPM**	**Pinion RPM**
HGP17 / 50:1	7300	146
HGP17 / 80:1	7300	91
HGP17 / 100:1	7300	73
HGP17 / 120:1	7300	61
HGP25 / 50:1	5600	112
HGP25 / 80:1	5600	70
HGP25 / 100:1	5600	56
HGP25 / 120:1	5600	47
HGP32 / 50:1	4800	96
HGP32 / 80:1	4800	60
HGP32 / 100:1	4800	48
HGP32 / 120:1	4800	40
HGP50 / 80:1	3500	44
HGP50 / 100:1	3500	35
HGP50 / 120:1	3500	29

DISENGAGING AND REMOVAL OF THE HGP

1. De-couple the load from the RPS carriage.

⚠ WARNING

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

2. Disconnect the power source, ensuring that no torque can be applied to the HGP.

3. Remove pinion preload by loosening the preload mechanism lockdown fasteners slightly and then turning the preload application screw(s) (or other preload device specific to your preloading system) to remove the pinion preload. At this time the pinion should separate slightly from the rack teeth.

4. The HGP can then be completely disengaged from the rack, following the reverse order of steps taken to attain initial engagement as described in the GEARED PINION INSTALLATION section.

5. The motor/HGP/preload mechanism assembly can then be disassembled from the machine, following the reverse order of assembly steps.

6. If the motor is to be disassembled from the HGP, it will be necessary to direct a flashlight beam into the clamp collar access hole in order to align the clamp collar screw so that the hex key can easily be re-engaged to loosen it. The HGP will need to be slowly backdriven so that the input rotates to achieve this alignment.

LUBRICATION

General RPS

The pinion needle bearings are sealed and lubricated for life and do not require servicing.

Nexen recommends lubricating the rack or individual roller contacts every two million pinion revolutions or six months, which ever comes first. However, lubrication may need to be applied more frequently based on the application conditions, and observable tooth or roller wear.

When lubricating the RPS, inspect the pinion rollers and rack teeth for any abnormal wear patterns and ensure the pinion rollers are not seized or have excessive play. Wear on the edges of the rack 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. Seal drag is reduced after an initial break-in period.

THK AFC or AFA are recommended for rack tooth lubrication. Both can be found on the RPS product pages of Nexen's website under accessories. 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 RPS can be lubricated in two ways:

1. Apply grease to the pinion rollers and roll the pinion back and forth five times over one meter of rack, repeating the process for each meter of rack.

2. Using a swab apply a very small dab of grease on the middle of each tooth face and roll the pinion back and forth over the entire length of the run at least five times.

After initial application, wipe excess grease from the sides of the rack and pinion body to prevent grease being ejected off during operation and for general cleanliness.

Maximum RPS life will be obtained by following the recommended lubrication intervals as stated above. In some special applications, Premium and Endurance grade of RPS rack can be operated without lubrication if the maximum speed does not exceed 0.5 m/s [1.64 ft/s].

Typical lubrication free applications 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.

- Food processing

- Clean rooms or applications where very low particle emissions are desired

- Vacuum environments

- Applications where periodic servicing is problematic

If the RPS is operated without lubrication, there will be some reduction in life of the RPS which will vary widely depending on the application. Standard and Universal grade RPS rack **should not** be run without lubrication. Contact Nexen for more information.

HGP

The gearcase of the HGP geared pinion has been filled with a high quality synthetic extreme pressure grease and is considered to be "lubed for life". It is not recommended, therefore, that the geared pinion be field-serviced. Contact Nexen in the event that the HGP requires maintenance.

The HGP can be mounted in any orientation and requires no special provisions for sealing or venting when operating within the recommended ambient temperature range of -5 to 40° C (23 to 104° F) and max product housing temperature of 90° C (194° F). Contact Nexen for applications requiring the HGP to operate outside of this temperature range.

WARRANTY

Warranties
Nexen warrants that the Products will (a) be free from any defects in material or workmanship for a period of 12 months from the date of shipment, and (b) will meet and perform in accordance with the specifications in any engineering drawing specifically for the Product that is in Nexen's current product catalogue, or that is accessible at the Nexen website, or that is attached to this Quotation and that specifically refers to this Quotation by its number, subject in all cases to any limitations and exclusions set out in the drawing. 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 for the Buyer for any breach of any warranties provided in connection with this agreement will be, at the election of Nexen: (a) repair or replacement with new, serviceably used, or reconditioned parts or products; or (b) issuance of credit in the amount of the purchase price paid to Nexen by the Buyer for the Products.

Agent's Authority
Buyer agrees that no agent, employee or representative of Nexen has authority to bind Nexen to any affirmation, representation, or warranty concerning the Products other than those warranties expressly set forth herein.

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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 damages, 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.

Inspection
Buyer shall inspect all shipments of Products upon arrival and shall notify Nexen in writing, of any shortages or other failures to conform to these terms and conditions which are reasonably discoverable upon arrival without opening any carton or box in which the Products are contained. Such notice shall be sent within 14 days following arrival. All notifications shall be accompanied by packing slips, inspection reports and other documents necessary to support Buyer's claims. In addition to the foregoing obligations, in the event that Buyer receives Products that Buyer did not order, Buyer shall return the erroneously shipped Products to Nexen within thirty (30) days of the date of the invoice for such Products; Nexen will pay reasonable freight charges for the timely return of the erroneously shipped Products, and issue a credit to Buyer for the returned Products at the price Buyer paid for them, including any shipping expenses that Nexen charged Buyer. All shortages, overages and nonconformities not reported to Nexen as required by this section will be deemed waived.

Limitation on Actions
No action, regardless of form, arising out of any transaction to which these terms and conditions are applicable may be brought by the Buyer more than one year after the cause of action has accrued.

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