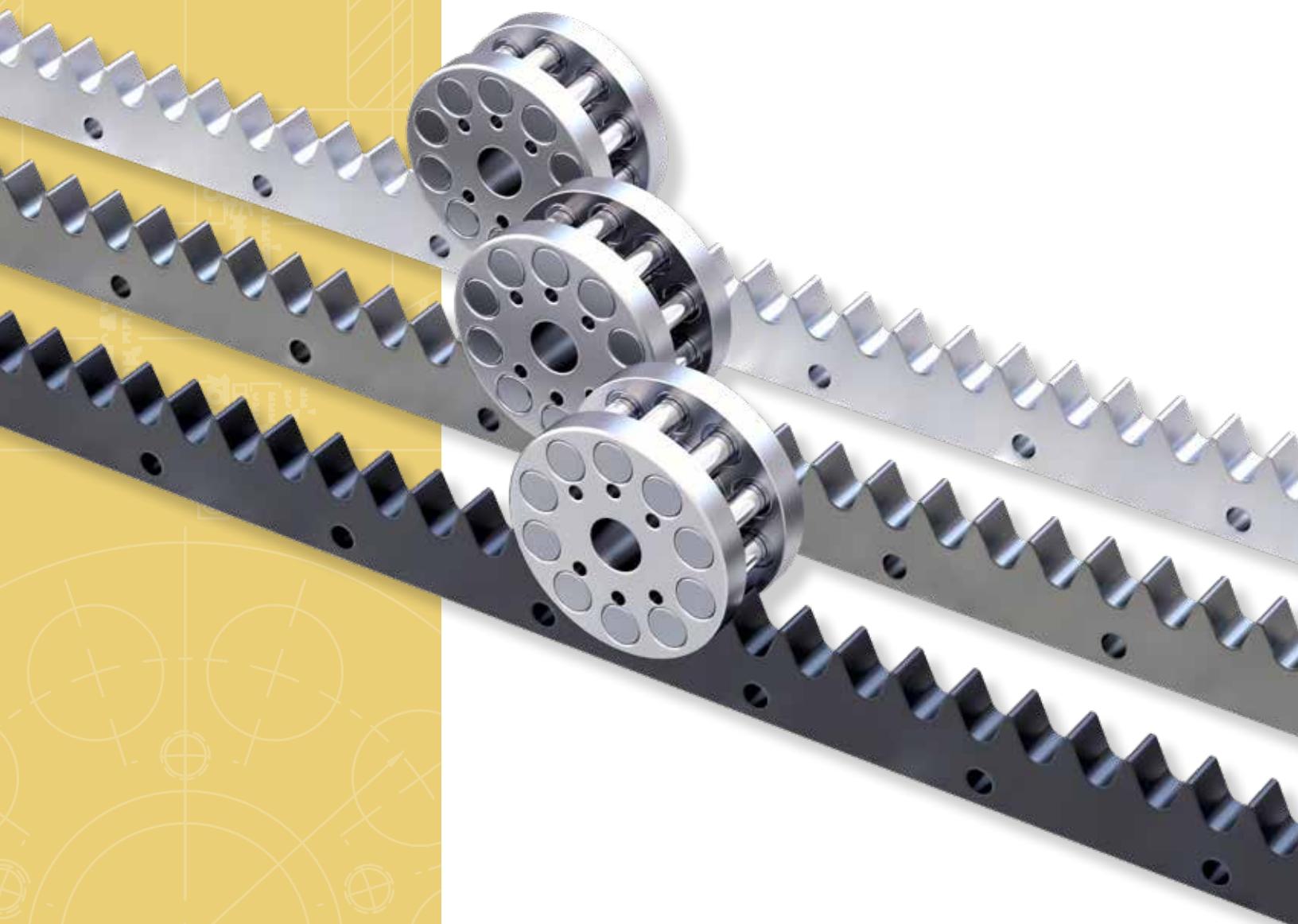


# nexen

## Precision Motion Control

Application and Selection Guide

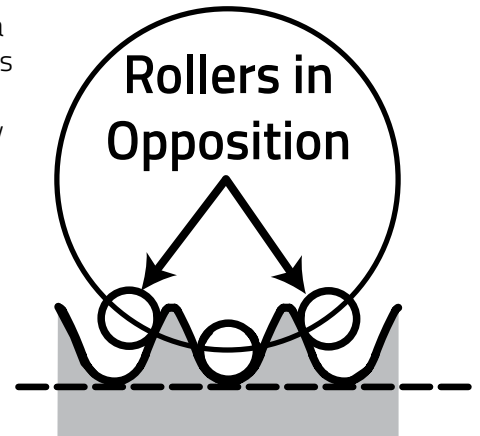


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# The Standard for Precision Linear and Rotary Motion Control

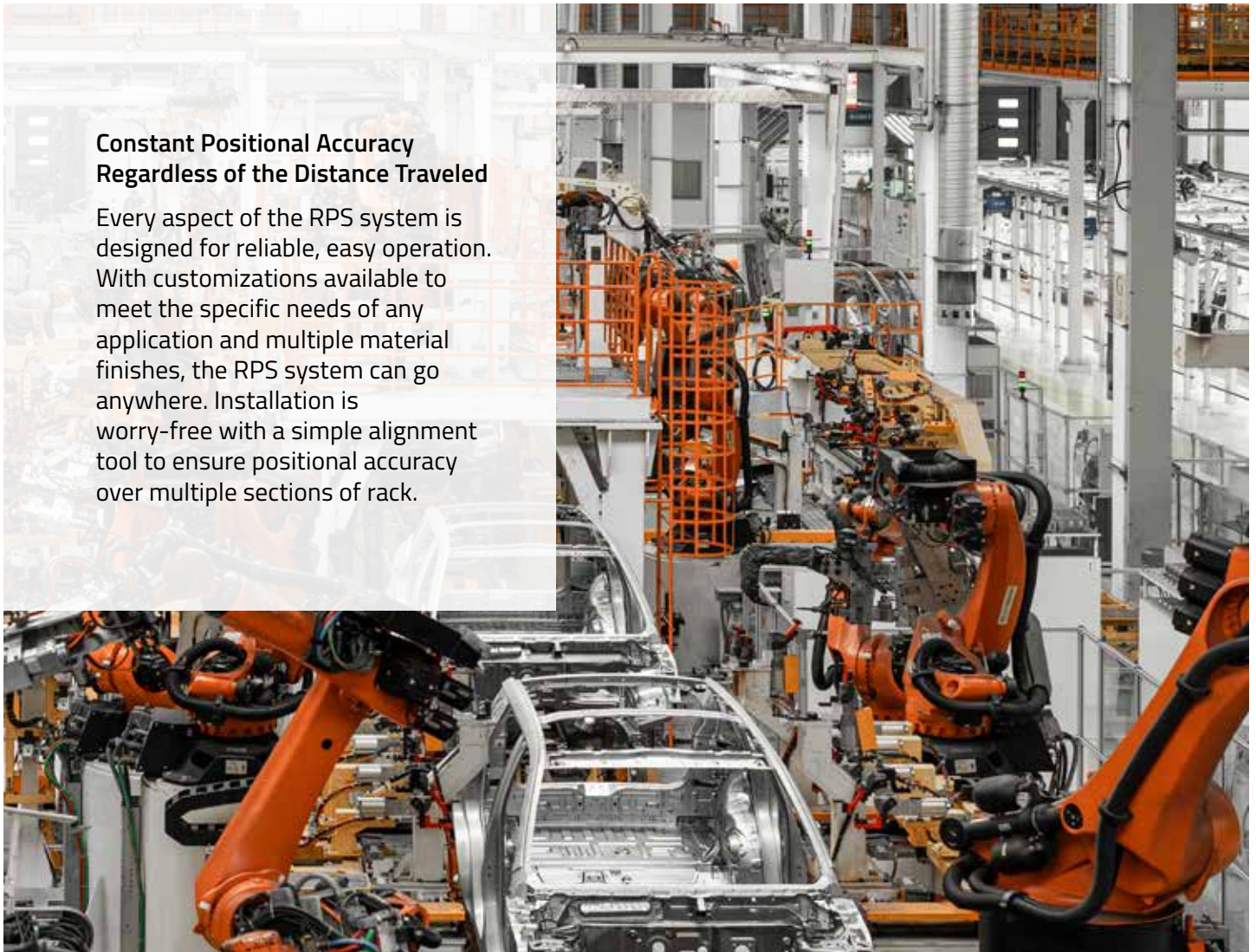
Nexen's Roller Pinion System (RPS) revolutionizes linear and rotary motion control possibilities. An upgrade to traditional rack-and-pinion systems, RPS overcomes the limitations of conventional drive systems and offers unmatched performance, extreme accuracy, and 99% efficiency by utilizing patented rollers and teeth geometry to provide a zero backlash solution..

Nexen's RPS pinion is engineered with bearing-supported rollers that engage a unique tooth profile designed to mesh together seamlessly. Two or more rollers engage the teeth in opposition at all times to eliminate backlash. The pinion rollers are designed to glide effortlessly along a tangent path and roll smoothly down the tooth face, ensuring a quiet, low-friction operation for the most demanding applications.

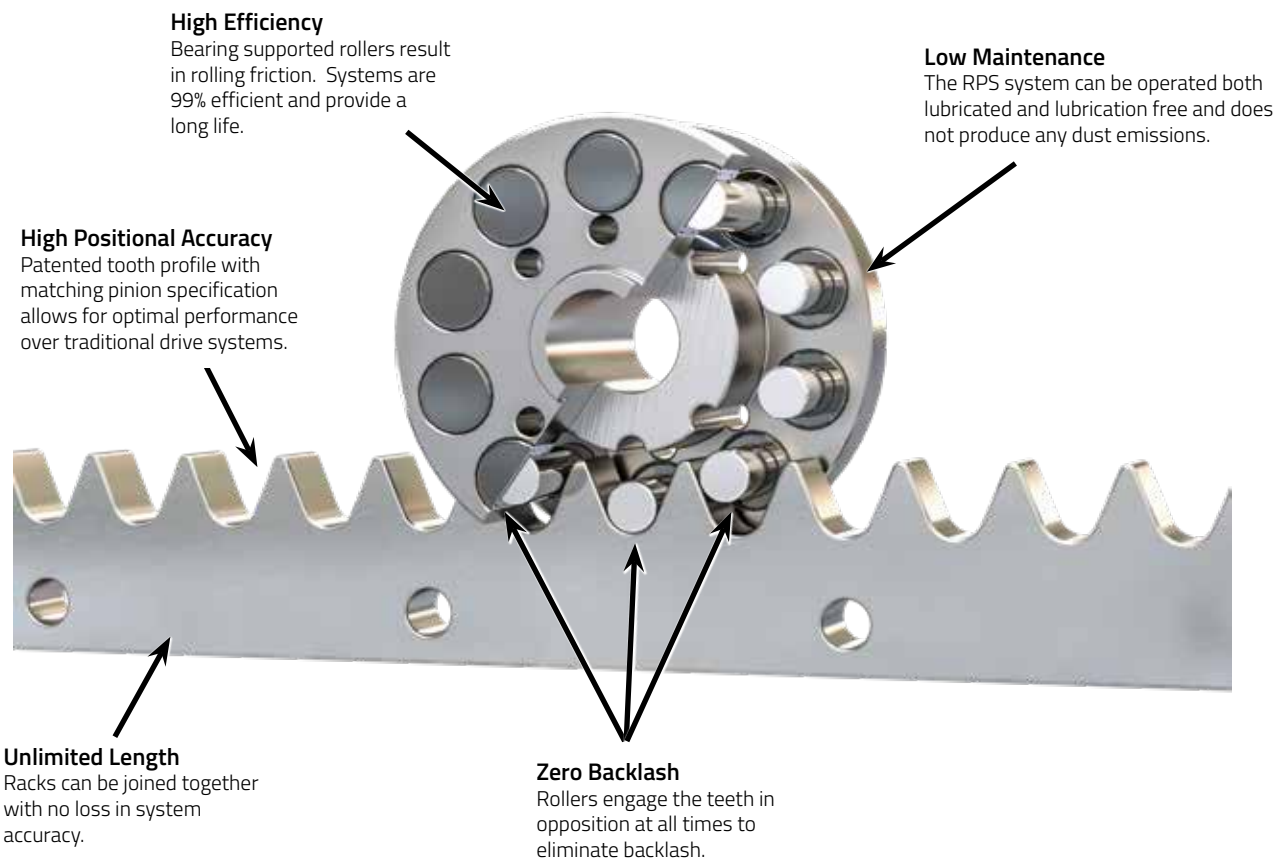


## Constant Positional Accuracy Regardless of the Distance Traveled

Every aspect of the RPS system is designed for reliable, easy operation. With customizations available to meet the specific needs of any application and multiple material finishes, the RPS system can go anywhere. Installation is worry-free with a simple alignment tool to ensure positional accuracy over multiple sections of rack.



# Nexen's RPS System provides precise and repeatable motion in various applications, offering machine builders the reliability and durability they expect from Nexen Group.



## Applications

Food Production	Robotics	Material Handling	Metal Processing	Gantry	Clean Room

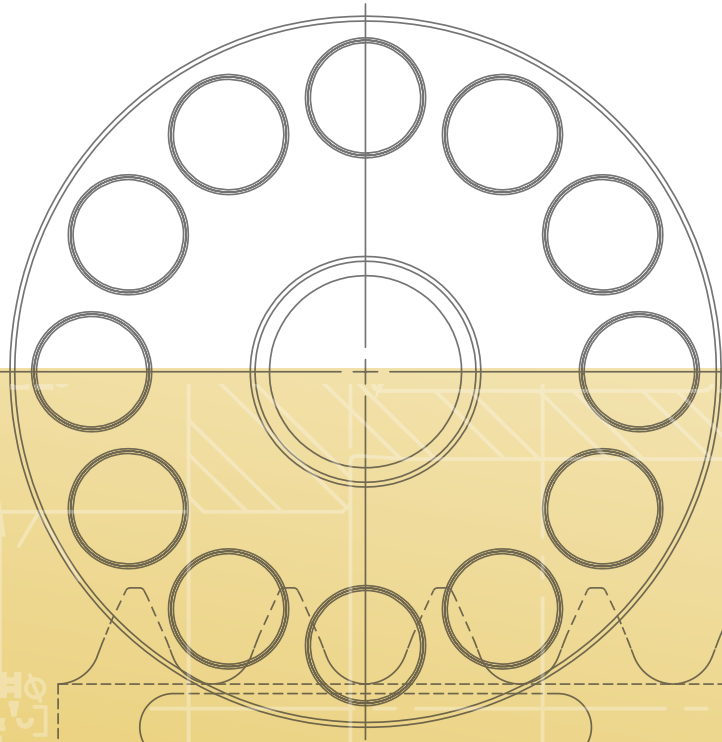




## Roller Pinion System

Nexen Group offers both premium and value roller pinions with rack options to fit any application. The following tables show specifications for the various rack and pinion configurations.





# Roller Pinion System

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# RPS System Configurations and Comparisons

Nexen offers many different rack models and pinion types, ensuring the perfect solution for any application. First compare the rack attributes to determine which rack model best meets your needs. Then compare the specifications of both the premium and value pinions to select the ideal RPS system configuration.

## Rack Models Available

<b>Premium Rack</b>	<p>As the name premium suggests, this is Nexen's top of the line model featuring market leading accuracy and a hard chrome coating for corrosion resistance. A perfect choice for any precision motion need.</p> <ul style="list-style-type: none"> <li>▪ Very High Precision/Accuracy</li> <li>▪ Suitable for Dirty Environments</li> <li>▪ Lubrication Free</li> <li>▪ High Load Capacity</li> <li>▪ High Corrosion Resistance</li> </ul> <p><b>Precision Assembly Equipment   Machine Tool/CNC Mills   High Precision Gantry   Robotics</b></p>
<b>Standard Rack</b>	<p>The Standard Rack offers similar performance to the Premium model without the corrosion resistant coating. With slightly lower accuracy, the standard model still delivers dependable performance in many the same types of applications. A great, cost-saving choice when corrosion resistance is not required.</p> <ul style="list-style-type: none"> <li>▪ High Precision/Accuracy</li> <li>▪ High Load Capacity</li> <li>▪ No Corrosion Resistance</li> <li>▪ Lower Cost than Premium Rack</li> </ul> <p><b>Precision Assembly Equipment   Machine Tool/CNC Mills   High Precision Gantry   Robotics</b></p>
<b>Endurance Rack</b>	<p>This is the work horse of the product line, combining both high load capacity and good corrosion resistance.</p> <ul style="list-style-type: none"> <li>▪ High Load Capacity</li> <li>▪ Medium Corrosion Resistance</li> <li>▪ Good Accuracy (not high precision)</li> </ul> <p><b>General Assembly Equipment   Machine Tool   Gantry Systems</b></p>
<b>Universal Rack</b>	<p>With better accuracy than Endurance Racks, the Universal Rack is a great option for lower load applications when corrosion resistance is not required.</p> <ul style="list-style-type: none"> <li>▪ High Accuracy</li> <li>▪ Medium Load Capacity</li> <li>▪ No Corrosion Resistance</li> </ul> <p><b>Material Handling Equipment   Gantry Systems   Packaging Equipment   General Motion Control</b></p>
<b>Universal Stainless Rack</b>	<p>Get all the features of the Universal Rack with the added benefits of corrosion resistant stainless steel.</p> <ul style="list-style-type: none"> <li>▪ High Accuracy</li> <li>▪ Medium Load Capacity</li> <li>▪ Wet or Dirty Environments</li> <li>▪ Very High Corrosion Resistance</li> </ul> <p><b>Material Handling Equipment   Gantry Systems   Packaging Equipment   General Motion Control</b></p>

## Pinion Models Available

<b>Premium Pinion</b>	<p>This long time standard at Nexen offers the best precision on the market. Use with any RPS rack for unbeatable performance.</p> <ul style="list-style-type: none"> <li>▪ Very High Precision/Accuracy</li> <li>▪ High Torque Capacity</li> <li>▪ Great Performance in Any Application</li> </ul>
<b>Value Pinion</b>	<p>A great fit for unique applications, Nexen offers the Value pinion to fit applications looking for the general features of Nexen's RPS in a conventional accuracy version.</p> <ul style="list-style-type: none"> <li>▪ Lighter Load, General Accuracy Applications</li> <li>▪ Harsh Environments</li> <li>▪ Available in Sizes 16, 20 &amp; 25</li> </ul>

## RPS System Specifications

Table 1 - Rack Thrust Capacity (N)

RPS Size	Premium Rack			Standard Rack			Endurance Rack			Universal & Universal Stainless Racks		
	Accel.	Avg.	Static	Accel.	Avg.	Static	Accel.	Avg.	Static	Accel.	Avg.	Static
Premium Pinion	10	250	250	380	NA	NA	NA	NA	NA	NA	NA	NA
	12	500	500	750	NA	NA	NA	NA	NA	NA	NA	NA
	16	2400	1000	2400	2400	1000	2400	1500	1000	2000	750	750
	20	2900	1500	3000	2900	1500	3000	2250	1500	3000	1125	1125
	25	4000	2200	4400	4000	2200	4400	3300	2200	4400	1650	1650
	32	10500	6000	18900	10500	6000	18900	5400	3600	7200	2700	2700
	40	18000	15000	26000	18000	15000	26000	6000	6000	12000	4500	4500
Value Pinion	16	500										
	20	750										
	25	1100										

Table 2 - Pinion Torque (Nm)

RPS Size	Premium Pinion			Value Pinion		
	Peak Torque	Max. Average Torque for Full Life	Static Torque	Peak Torque	Max. Average Torque for Full Life	Static Torque
10	4.0	4.0	6.0	NA	NA	NA
12	9.5	9.5	14.3	NA	NA	NA
16	61.1	33.7	61.1	12.8	12.8	12.8
20	92.3	52.5	95.5	23.9	23.9	23.9
25	159.2	89.5	176	43.8	43.8	43.8
32	641.5	366.6	1150	NA	NA	NA
40	1375.2	1146	1976.4	NA	NA	NA

Table 3 - Accuracy & Repeatability

		Rack Model			
Pinion Type		Premium Rack	Standard Rack	Endurance Rack	Universal Rack and Universal Stainless
Premium Pinion	Accuracy ( $\pm \mu\text{m}$ )	30	50	80	50
	Repeatability ( $\pm \mu\text{m}$ )	5	10	20	10
Value Pinion	Accuracy* ( $\pm \mu\text{m}$ )	110	130	160	130
	Repeatability* ( $\pm \mu\text{m}$ )	5	10	20	10

Table 4 - Rack Model Attributes  
(Not Affected By Pinion Choice)

Attributes	Rack Model				
	Premium Rack	Standard Rack	Endurance Rack	Universal Rack	Universal Stainless
Backlash*	0 $\mu\text{m}$				
Corrosion Resistant Surface Treatment	Hard Chrome	None	Nitrided	None	None
Corrosion Resistance Rating	High	None	Medium	None	Very High
Lubrication Free Operation	Yes up to 30 m/min	No	Yes up to 30 m/min	No	No
Noise Level	up to 75 dB (Speed Dependent)				
Temperature Range	-5 to 40 °C				

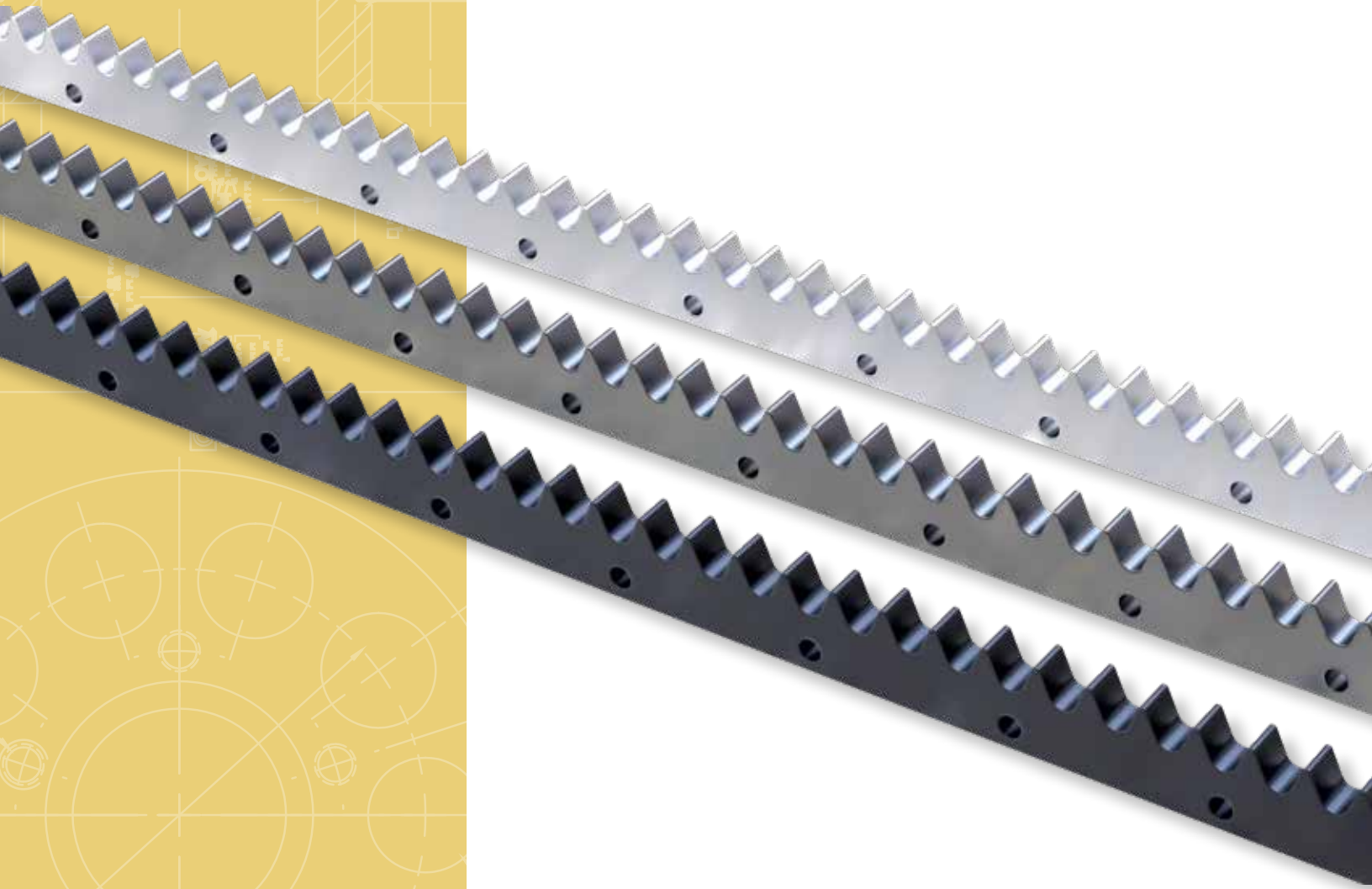
\* Specifications listed for the Value Pinion are "out-of-box" ratings. Over time, these specifications are affected by operating torque and speed.

NOTE: Refer to the System Life section for Load Life Comparison. See the Definitions section at the end of this catalog for details on these attributes.



## Roller Pinion Racks

Nexen offers modular and custom rack sizes for unlimited system length. Choose from a wide range of rack models for a perfect fit in any application.







The image shows a technical drawing of a roller pinion rack. It features a horizontal rack profile with a series of teeth. Above the rack, a circular pinion is shown in mesh with the teeth. The pinion has eight teeth and is centered on a vertical axis. The drawing includes various geometric construction lines, such as center lines and tangents, and is set against a background of faint technical drawing symbols and grid lines.

# Roller Pinion Racks

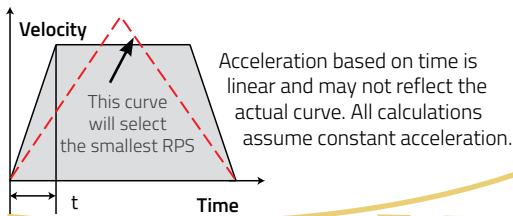
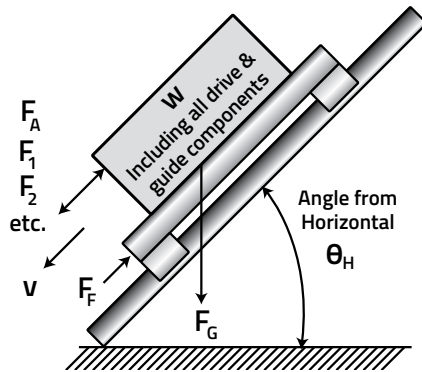
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# Linear Rack Selection Process

Nexen offers a large range of rack sizes and materials, so you can find the perfect components for your application. Take advantage of the following guide designed to make selecting the right components for your system simple. If you don't find what you need, contact Nexen Group.

**Figure 1**

Refer to this drawing when recording values for Force, Weight & Angle From Horizontal.



Weight to be driven should include all drive and guide components and structures being moved and should reflect the maximum weight each individual pinion must bear at any given time. Take into account any movable or asymmetric loads that may shift between multiple pinions during operation.

## Step 1: Gather Application Data

Before you begin calculations, there are nine key measurements that you will need from your application. Collect the data and record it in the chart below. With this data available you can proceed on to the calculations on the following page.

Measurements Required for RPS Selection	Customer Data (record your values below)		Sample Data
Angle from Horizontal ( $\theta_H$ ) Refer to Figure 1.	°		60°
Maximum Velocity ( $V_{max}$ )	m/s		0.5 m/s
Travel Distance (L) (single direction move)	m		5.4 m
Cycles Per Day ( $N_{day}$ ) (assumes single direction move)			1000
Acceleration Time ( $t_A$ ) or Known Acceleration	seconds m/s <sup>2</sup>		0.5 s
Weight to be Driven (W)	kgf		150.0 kgf
Other Forces ( $F_1$ , ( $F_2$ ) etc.	N		0 N
Shock Factor (K) Circle the value that best reflects the smoothness of your application.	Shockless Operation	1.0	1.2
	Normal Operation	1.2	
	Operation with Impact	1.5	
	Operation with High Impact	2.5	
Frictional Coefficient ( $\mu$ ) Circle the value that best reflects your application.	Profile Guide Rail	0.005	0.01
	Ball Bearing Guide Rail	0.02	
	Polymer Bushing Guide	0.1	
	Bronze Bushing Guide	0.2	

## Other Key Application Information

### Application Description:

Environmental Conditions: ☐ Typical Industrial ☐ High Humidity ☐ High Temperature ☐ High Dust

### Positional Accuracy Requirements:

## Step 2: Calculating RPS Requirements

Rack selection is based on the load capacity required by your application. Using the information gathered on the preceding page, perform the following calculations to determine the Total Force of the Load. Use the space provided to record your calculations. (The sample calculations assume a single pinion driving an axis. Use the Sample Data from the chart on the preceding page.)

### Load Mass: $M = W$

Use the total Weight to be Driven as your Load Mass value.

M=

Load Mass

kg

Sample:  $M = 150.0 \text{ kgf} = 150 \text{ kg}$

### Load Acceleration: $A = V_{\max} \div t_A$

A known acceleration from a servo drive provider is preferred if available.

A =

m/s

÷

s

A=

Load Acceleration

m/s<sup>2</sup>

Sample:  $A = 0.5 \text{ m/s} \div 0.5 \text{ s} = 1.0 \text{ m/s}^2$

### Force Due to Load Acceleration: $F_A = M \cdot A$

$F_A =$

kg

•

m/s<sup>2</sup>

$F_A =$

Force Due to Load Acceleration

N

Sample:  $F_A = 150 \text{ kg} \cdot 1.0 \text{ m/s}^2 = 150.0 \text{ N}$

### Force Due to Gravity: $F_G = M \cdot g \cdot \sin(\theta_H)$

$F_G =$

kg

•

9.81 m/s<sup>2</sup> • sin (

°)

$F_G =$

Force Due to Gravity

N

Sample:  $F_G = 150 \text{ kg} \cdot 9.81 \text{ m/s}^2 \cdot \sin(60^\circ) = 1274.4 \text{ N}$

### Force Due to Friction: $F_F = M \cdot \mu \cdot g \cdot \cos(\theta_H)$

$F_F =$

kg

•

•

9.81 m/s<sup>2</sup> • cos (

°)

$F_F =$

Force Due to Friction

m/s<sup>2</sup>

Sample:  $F_F = 150 \text{ kg} \cdot 0.01 \cdot 9.81 \text{ m/s}^2 \cdot \cos(60^\circ) = 7.4 \text{ N}$

### Sum of Forces:

$F_S = F_A + F_G + F_F + F_1 + F_2 + \dots \text{etc}$

$F_S =$

N

+

N

+

N

+

N

+

N

$F_S =$

Sum of Forces

N

Sample:  $F_S = 150.0 \text{ N} + 1274.4 \text{ N} + 7.4 \text{ N} = 1431.8 \text{ N}$

### Total Force with Shock Factor:

$F_T = F_S \cdot K$

$F_T =$

N

•

$F_T =$

Total Force with Shock Factor

N

Sample:  $F_T = 1431.8 \text{ N} \cdot 1.2 = 1718.2 \text{ N}$

## Step 3: Selecting a Rack Model

Use Table 4 in the RPS System section to review the five different rack models and determine the model best suited for your application.

Rack Model

## Step 4: Selecting Rack Size

Locate your chosen rack model in Table 1 in the RPS System section and determine the rack size with enough thrust capacity to handle the Total Force with Shock Factor calculated above for your application.

Rack Size

## Step 5: Evaluate Life and Verify Your System Specifications

With the rack model and size selections, evaluate expected life in the System Life section and review the Common Rack Specifications (Table 5 in the Rack Section) to be sure that the rack you have selected will meet all of your application requirements.

Rack Product Number

## Rack Specifications

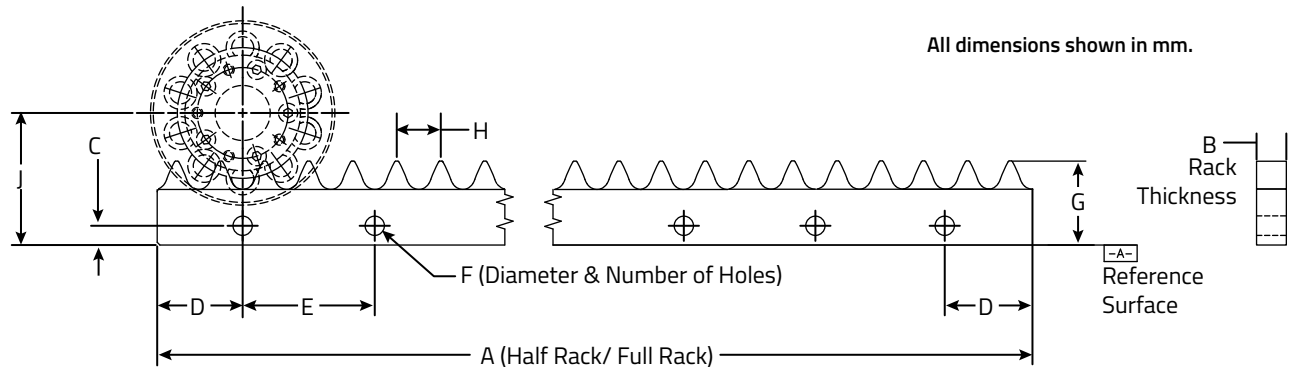
Table 5 - Common Rack Specifications

Attribute	Rack Size											
	RPS10	RPS12	RPS16		RPS20		RPS25		RPS32		RPS40	
Max Pressure Angle (°)	26.4	26.4	27.9		26.4		26.4		26.0		26.0	
Avg Pressure Angle (°)	21.9	21.9	23.4		21.9		21.9		22.7		21.3	
Module (mm)	3.0	3.6	4.8		6.0		7.5		9.5		12.0	
Max Speed (m/s)*	4	8	4		5		8		6		5	
Rack Tooth Pitch (mm)	10	12	16		20		25		32		40	
Rack Height (mm)	27	27	30.5		42.0		48.0		57.0		72.6	
Rack Width (mm)	5.7	5.7	11.5		15.5		18.5		24.5		31.5	
Rack Section Size	Half	Half	Half	Full	Half	Full	Half	Full	Half	Full	Half	Full
Rack Length (mm)	480	480	512	992	500	1000	500	1000	512	992	520	1000
Number of Rack Teeth	48	40	32	62	25	50	20	40	16	31	13	25
Rack Weight (kg)	0.5	0.6	1.1	2.1	2.1	4.1	2.7	5.4	4.2	8.2	6.9	13.2

\* The maximum rated speed of a RPS system is equal to the lowest rating of either the pinion or the rack.



## Rack Dimensions



RPS Size	A		B	C	D	E	F			G	H	J
	Rack Length		Rack Thickness	Hole Height	Hole From End	Hole Spacing	Mounting Holes			Rack Height	Tooth Pitch	Axis to Base
	Half	Full					Ø	# Half Rack	# Full Rack			
RPS10	480	NA	5.7	7	29.8	60	5.5	8	NA	27.0	10	37.5
RPS12	480	NA	5.7	7	29.8	60	5.5	8	NA	27.0	12	40
RPS16	512	992	11.5	7	16	96	7	6	11	30.5	16	48
RPS20	500	1000	15.5	10	50	100	9	5	10	42.0	20	64
RPS25	500	1000	18.5	12	50	100	11	5	10	48.0	25	75
RPS32	512	992	24.5	14	16	96	14	6	11	57.0	32	102
RPS40 <sup>1</sup>	520	1000	31.5	16	80	120	18	4	8	72.6	40	129
RPS40 <sup>2</sup>	520	1000	31.5	16	60	80	18	6	12	72.6	40	129

1. This applies to RPS40 Endurance and Universal Rack

2. This applies to RPS40 Premium and Standard Rack

See drawings or CAD models on Nexen's website for additional dimensions and tolerances.

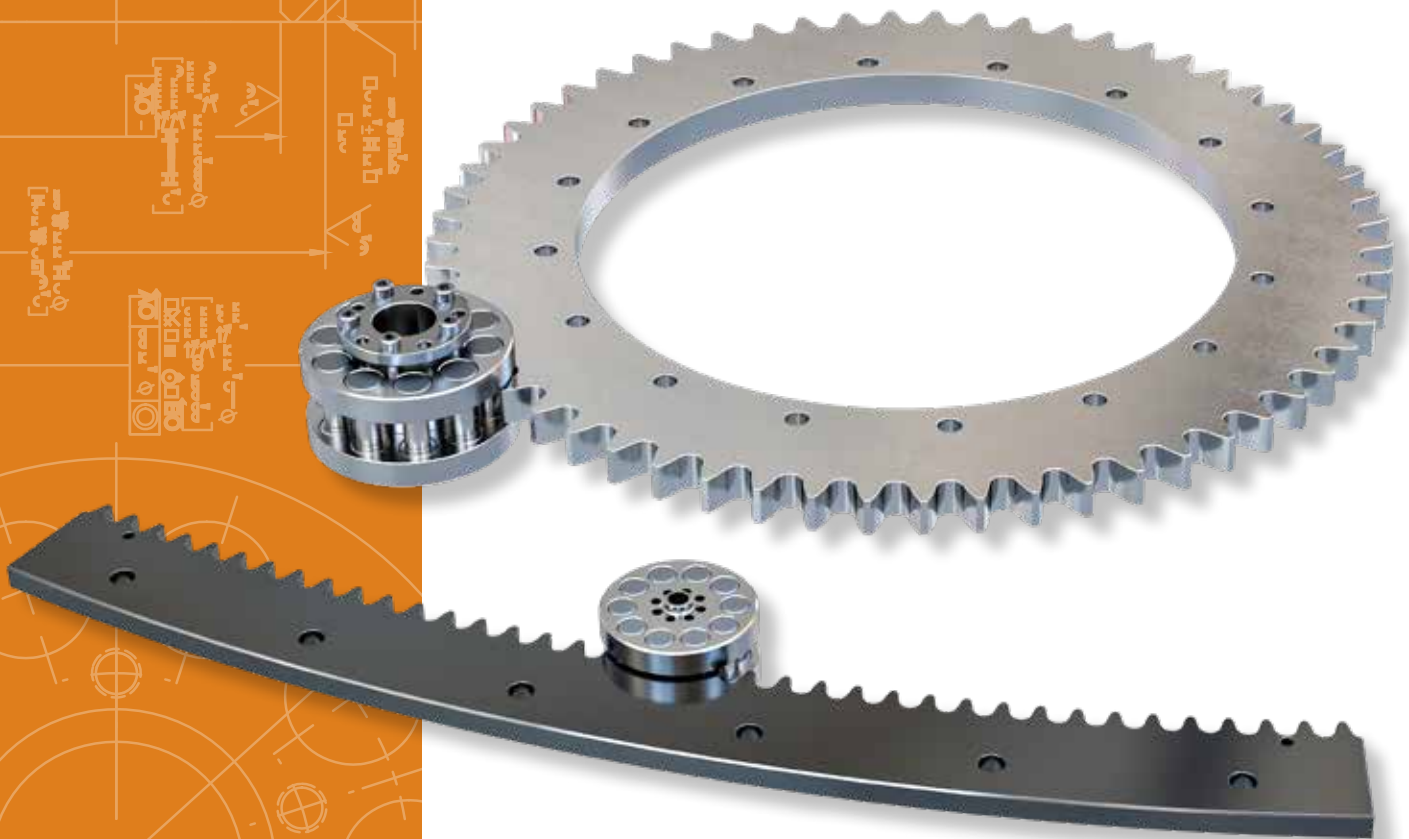
## Rack Product Numbers

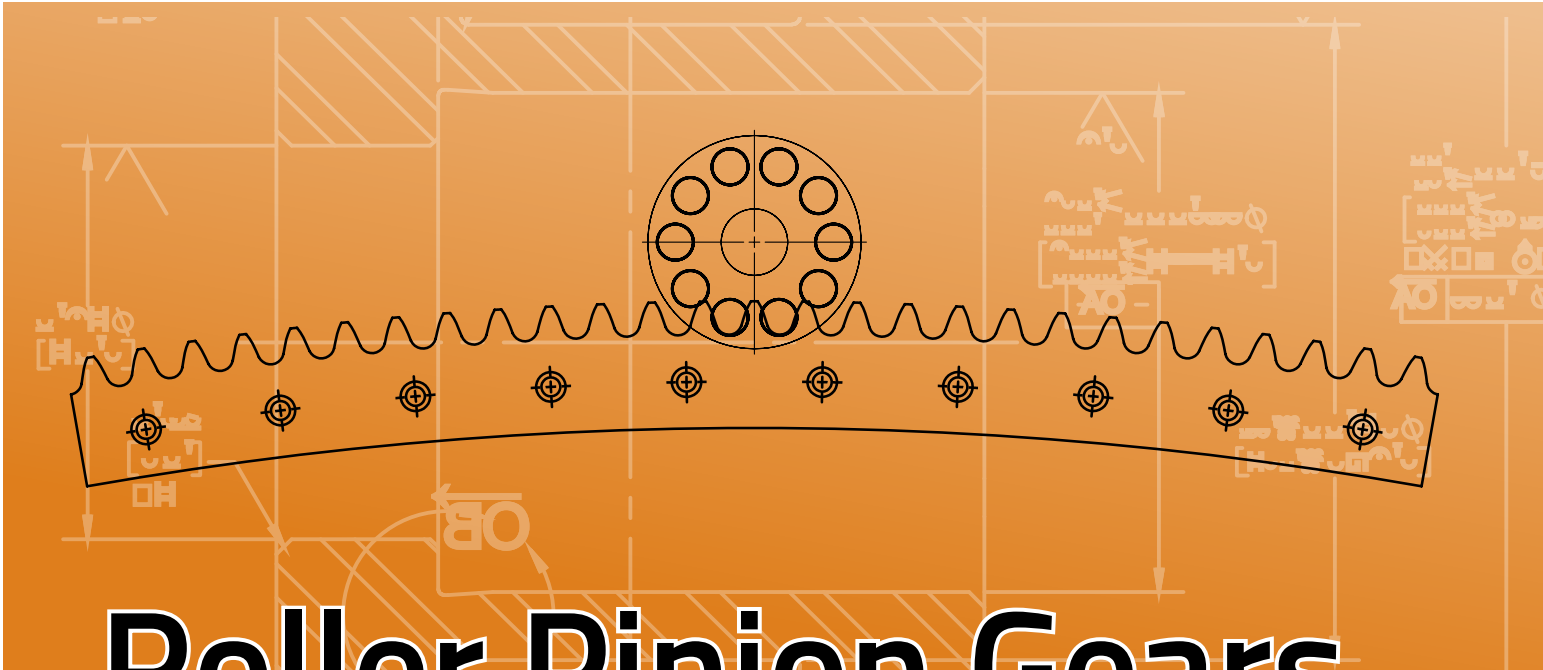
RPS Size	Rack Length		Premium	Standard	Endurance	Universal	Universal Uncoated Stainless	Universal Coated Stainless
10	Half	480 mm	966768	NA	NA	NA	Contact Nexen	Contact Nexen
	Alignment Tool		966507					
12	Half	480 mm	966769	NA	NA	NA	Contact Nexen	Contact Nexen
	Alignment Tool		966508					
16	Half	512 mm	966652	966602	Contact Nexen	966801	966760	966742
	Full	992 mm	966651	966601	966850	966800	966813	966741
	Alignment Tool		966503					
20	Half	500 mm	966662	966612	Contact Nexen	966803	Contact Nexen	Contact Nexen
	Full	1000 mm	966661	966611	966851	966802	966625	966619
	Alignment Tool		966513					
25	Half	500 mm	966672	966622	Contact Nexen	966805	Contact Nexen	Contact Nexen
	Full	1000 mm	966671	966621	966852	966804	966814	966755
	Alignment Tool		966523					
32	Half	512 mm	966682	966632	Contact Nexen	966807	Contact Nexen	Contact Nexen
	Full	992 mm	966681	966631	966853	966806	966812	Contact Nexen
	Alignment Tool		966533					
40	Half	520 mm	966978	967321	Contact Nexen	966809	Contact Nexen	Contact Nexen
	Full	1000 mm	966977	967320	966854	966808	966815	Contact Nexen
	Alignment Tool		966543					
Rack Grease			853901					



## Roller Pinion Gears

Nexen offers the RPG Gears as solid rings up to 1.7m in diameter. Segmented rings or arcs can also be combined to create a custom rotary drive system





# Roller Pinion Gears

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# Rotary Gear Selection Process

Nexen offers both gears and individual arc segments for unlimited possibilities in your machine design. Take advantage of the following guide designed to make selecting the right components for your system simple. Please contact Nexen for additional product configurations and options.

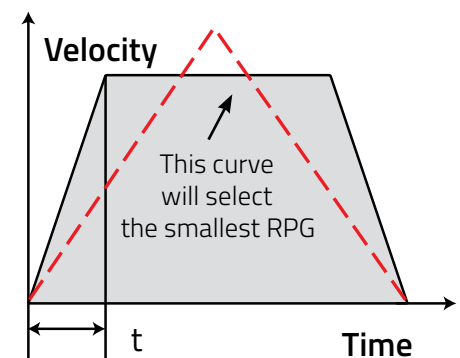
## Step 1: Gather Application Data

Before you begin calculations, there are key measurements that you will need from your application. Collect the data and record it in the chart below. With this data available you can proceed on to the calculations on the following page.

Measurements Required for RPG Selection	Customer Data (record your values below)	Sample Data
Angle Gear Rotates Relative to Horizontal Plane ( $\Theta_H$ )	°	0°
Rotational Moment of Inertia (I)	kgm <sup>2</sup>	10.0 kgm <sup>2</sup>
Indexes Per Revolution ( $N_i$ )	IPR	8 IPR
Indexes Per Day ( $N_{day}$ )		10800 RPD
Index Time ( $t_i$ ) or Known Angular Acceleration ( $\alpha$ )	seconds rad/s <sup>2</sup>	0.66 sec
Weight to be Driven (W) Should include everything in motion.	kg	20.0 kg
Dwell Time ( $t_o$ )	seconds	0.33 sec
Maximum Allowable Ring Gear OD ( $D_{max}$ )	mm	400 mm
Minimum Allowable Ring Gear ID ( $D_{min}$ )	mm	200 mm
Ring Gear Tooth Orientation (Select one)	external/internal	external
Other Forces ( $T_1$ ), ( $T_2$ ) etc. May include gravitational forces due to imbalanced load, springs, wind, counterbalance, fluid dampening systems, etc.	Nm	0 Nm
Shock Factor (K) Circle the value that best reflects the smoothness of your application.	Shockless Operation 1.0 Normal Operation 1.2 Operation with Impact 1.5 Operation with High Impact 3.0	1.2
Frictional Coefficient ( $\mu$ ) Circle the value that best reflects your application.	Rolling Bearing 0.005~0.02 Sliding Bearing 0.1~0.2	0.01
Diameter of Bearing Element ( $D_b$ )	mm	50 mm

## Sample Application Information

- Electronics Assembly Indexing Table
- 1 meter in diameter
- 8 stations equally spaced
- 60 indexes per minute desired
- Dwell time 0.33 sec



Acceleration based on time is linear and may not reflect the actual curve. All calculations assume constant acceleration.

## Other Key Application Information

Application Description:

Environmental Conditions: ☐ Typical Industrial ☐ High Humidity ☐ High Temperature ☐ High Dust

Positional Accuracy Requirements:



## Step 2: Calculating RPG Requirements For Simple Indexing Applications

Gear selection is based on the load capacity required by your application. Using the information gathered on the preceding page, perform the following calculations. If acceleration or deceleration times vary, or there are other changes in velocity, calculate the acceleration torque for each interval and use the highest value for RPG selection purposes.

<b>Acceleration Time:</b> $t_A = t_i \div 2$ $t_A =$ <input type="text"/> <b>sec</b> $\div 2$	<b>Acceleration Time</b> $t_A =$ <input type="text"/> <b>sec</b>
---	---

Sample:  $t_A = 0.66 \text{ seconds} \div 2 = 0.33 \text{ seconds}$

<b>Rotation Angle Per Index:</b> $\theta = 2\pi \div N_i$ $\theta = 2\pi \div$ <input type="text"/> <b>IPR</b>	<b>Rotation Angle Per Index</b> $\theta =$ <input type="text"/> <b>rad</b>
--	---

Sample:  $\theta = 2\pi \div 8 \text{ IPR} = 0.785 \text{ rad}$

<b>Max Angular Speed:</b> $\omega = \theta \div t_i \cdot 2$ $\omega =$ <input type="text"/> <b>rad</b> $\div$ <input type="text"/> <b>sec</b> $\cdot 2$	<b>Max Angular Speed</b> $\omega =$ <input type="text"/> <b>rad/sec</b>
--	--

Sample:  $\omega = 0.785 \text{ rad} \div 0.66 \text{ seconds} \cdot 2 = 2.380 \text{ rad/sec}$

<b>Angular Acceleration:</b> $\alpha = \omega \div t_A$ $\alpha =$ <input type="text"/> <b>rad/sec</b> $\div$ <input type="text"/> <b>sec</b>	<b>Angular Acceleration</b> $\alpha =$ <input type="text"/> <b>rad/s<sup>2</sup></b>
---	---

Sample:  $\alpha = 2.380 \text{ rad/sec} \div 0.33 \text{ sec} = 7.212 \text{ rad/s}^2$

<b>Ring Gear Torque:</b> $T_{\text{gear}} = (I \cdot \alpha) + ((W \cdot g \cdot \mu \cdot D_B) \div 2000)$ $T_{\text{gear}} = ($ <input type="text"/> <b>kgm<sup>2</sup></b> $\cdot$ <input type="text"/> <b>rad/s<sup>2</sup></b> $) + (($ <input type="text"/> <b>kg</b> $\cdot$ <b>9.81 m/s<sup>2</sup></b> $\cdot$ <input type="text"/> <b>mm</b> $) \div 2000)$	<b>Ring Gear Torque</b> $T_{\text{gear}} =$ <input type="text"/> <b>Nm</b>
--	---

Sample:  $T_{\text{gear}} = (10 \text{ kgm}^2 \cdot 7.212 \text{ rad/s}^2) + ((20 \text{ kg} \cdot 9.81 \text{ m/s}^2 \cdot 0.01 \cdot 50 \text{ mm}) \div 2000) = 72.17 \text{ Nm}$

<b>Ring Gear Torque with Shock Factor:</b> $T_T = T_{\text{gear}} \cdot K$ $T_T =$ <input type="text"/> <b>Nm</b> $\cdot$ <input type="text"/>	<b>Ring Gear Torque w/ Shock Factor</b> $T_T =$ <input type="text"/> <b>Nm</b>
---	---

Sample:  $T_T = 72.17 \text{ Nm} \cdot 1.2 = 86.6 \text{ Nm}$

<b>Pinion Thrust Required at Max OD:</b> $F_1 = (T_T \div D_{\text{max}}) \cdot 2000$ $F_1 = ($ <input type="text"/> <b>Nm</b> $\div$ <input type="text"/> <b>mm</b> $) \cdot 2000$	<b>Pinion Thrust Required at Max OD</b> $F_1 =$ <input type="text"/> <b>N</b>
--	--

Sample:  $F_1 = (86.6 \text{ Nm} \div 400 \text{ mm}) \cdot 2000 = 433 \text{ N}$

<b>Pinion Thrust Required at Min ID:</b> $F_2 = (T_T \div D_{\text{min}}) \cdot 2000$ $F_2 = ($ <input type="text"/> <b>Nm</b> $\div$ <input type="text"/> <b>mm</b> $) \cdot 2000$	<b>Pinion Thrust Required at Min ID</b> $F_2 =$ <input type="text"/> <b>N</b>
--	--

Sample:  $F_2 = (86.6 \text{ Nm} \div 200 \text{ mm}) \cdot 2000 = 866 \text{ N}$

### Step 3: Selecting a Gear Size

Using the table to the right, circle the RPG size needed to meet the Pinion Thrust requirements of your application (as calculated above).

RPG SIZE		10	12	16	20	25	32	40
Premium Pinion Dynamic Thrust (N)	@ Min Life	250	500	2400	2900	4000	10500	18000
	@ Max Life	250	500	1000	1500	2200	6000	15000
Value Pinion Dynamic Thrust (N)		NA		500	750	1100	NA	

### Step 4: Verify your System Specifications

Using the selected RPG size and the Ring Gear Torque with Shock Factor requirement calculated above, use the tables on the next page to select a gear. Review Gear Specifications to ensure the selected gear meets all of your application requirements.

<b>Gear Product Number</b>

## Gear Specifications

RPG Size	Gear Product Number	Gear Ratio	Pinion Type	Maximum Dynamic Torque @		Max Static Torque	Max Speed	Accuracy	Repeatability
				Minimum Life	Maximum Life				
				Nm	Nm	Nm	RPM	ArcSec	ArcSec
16	966566	3:1	Premium	183.3	101.1	183.3	500	+/- 84.2	+/- 14
			Value	38.1	38.1	38.1	250	+/- 308.7	+/- 14.0
	966567	4:1	Premium	244.4	134.8	244.4	375	+/- 63.4	+/- 10.6
			Value	50.8	50.8	50.8	188	+/- 232.5	+/- 10.6
	966568	5:1	Premium	305.5	168.5	305.5	300	+/- 50.9	+/- 8.5
			Value	63.5	63.5	63.5	150	+/- 186.5	+/- 8.5
	966569	6:1	Premium	366.6	202.2	366.6	250	+/- 42.5	+/- 7.1
			Value	76.2	76.2	76.2	125	+/- 155.7	+/- 7.1
	966570	7:1	Premium	427.7	235.9	427.7	215	+/- 36.5	+/- 6.1
			Value	88.9	88.9	88.9	108	+/- 134.0	+/- 6.1
	966797	15:1	Premium	916.5	505.5	916.5	100	+/- 16.9	+/- 2.8
			Value	190.5	190.5	190.5	50	+/- 62.1	+/- 2.8
20	966571	40:1	Premium	2444.0	1348.0	2444.0	38	+/- 6.4	+/- 1.1
			Value	508.0	508.0	508.0	19	+/- 23.4	+/- 1.1
	966572	14:1	Premium	1292.2	735.0	1337.0	108	+/- 14.4	+/- 2.4
			Value	334.6	334.6	334.6	43	+/- 52.6	+/- 2.4
	966798	15:1	Premium	1384.5	787.5	1432.5	100	+/- 13.4	+/- 2.2
			Value	358.5	358.5	358.5	40	+/- 49.2	+/- 2.2
	966799	18:1	Premium	1661.4	945.0	1719.0	84	+/- 11.2	+/- 1.9
			Value	430.2	430.2	430.2	34	+/- 41.2	+/- 1.9
	966793	54:1	Premium	4984.2	2835.0	5157.0	28	+/- 3.7	+/- 0.6
			Value	1290.6	1290.6	1290.6	12	+/- 13.7	+/- 0.6
	966789	68.4:1	Premium	6313.3	3591.0	6532.2	22	+/- 2.9	+/- 0.5
			Value	1634.8	1634.8	1634.8	9	+/- 10.7	+/- 0.5
25	966573	3:1	Premium	477.6	268.5	528.0	607	+/- 53.6	+/- 8.9
			Value	138.0	138.0	138.0	160	+/- 196.4	+/- 8.9
	966574	4:1	Premium	636.8	358.0	704.0	455	+/- 40.1	+/- 6.7
			Value	184.0	184.0	184.0	120	+/- 147	+/- 6.7
	966575	5:1	Premium	796.0	447.5	880.0	364	+/- 32.3	+/- 5.4
			Value	230.0	230.0	230.0	96	+/- 118.4	+/- 5.4
	966576	6:1	Premium	955.2	537.0	1056.0	304	+/- 26.9	+/- 4.5
			Value	276.0	276.0	276.0	80	+/- 98.8	+/- 4.5
	966577	7.5:1	Premium	1194.0	671.3	1320.0	243	+/- 21.5	+/- 3.6
			Value	345.0	345.0	345.0	64	+/- 78.9	+/- 3.6
	966578	48.6:1	Premium	7737.1	4349.7	8553.6	38	+/- 3.3	+/- 0.6
			Value	2235.6	2235.6	2235.6	10	+/- 12.1	+/- 0.6
32	966638	4:1	Premium	2566.0	1466.4	4600.0	430	+/- 26.5	+/- 4.4
	966639	7.25:1	Premium	4650.9	2657.9	8338.0	238	+/- 14.6	+/- 2.4
	966763	37.5:1	Premium	24056.3	13747.5	43125.0	46	+/- 2.8	+/- 0.5
	966778	63.3:1	Premium	40607.0	23205.8	72795.0	28	+/- 1.7	+/- 0.3
40	966791	4:1	Premium	5500.8	4584.0	7906.0	188	+/- 21.0	+/- 3.5
	966549	16.7:1	Premium	22965.8	19138.2	33006.0	45	+/- 5.0	+/- 0.8

### Common Attributes for All Gears

Estimated Life	See System Life section.
Operating Temperature Range	-5 to 40 °C
Tooth Grease	Part Number 853901

## Gear Dimensions & Specifications by Product Number

Figure A

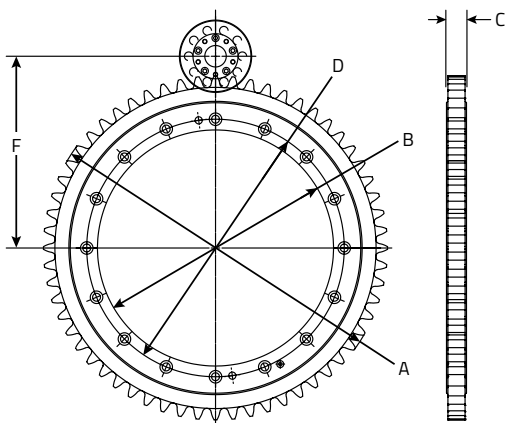


Figure B

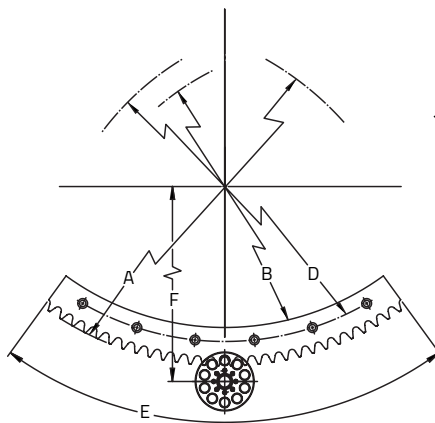
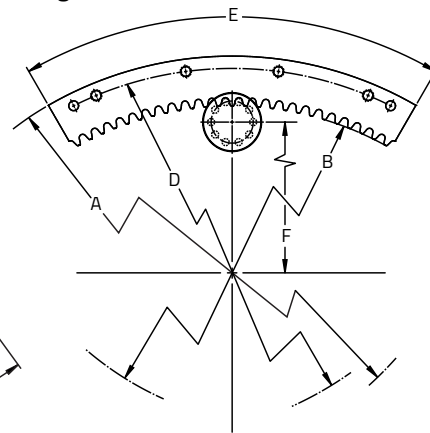


Figure C



Basic gear dimensions shown for selection purposes only and subject to change. Go to [www.nexengroup.com](http://www.nexengroup.com) for detailed drawings and CAD models. If none of the products below meet your needs, contact Nexen and one can be designed to your specifications. Due to the variety of gears and gear segments, these products are made to order. Please contact Nexen for lead times.

Dimensions shown in mm unless otherwise noted.

RPG Size	Gear Product Number	Alignment Tool Product Number	Teeth Orientation	Number of Teeth	Moment of Inertia	Weight	Figure	Coating	A		C	D	E	F
									Outer	Inner				
				Segment/ Ring	kgm <sup>2</sup>	kg			Diameter		Max Width	Bolt Circle Ø	Arc Length/ Full Ring	Distance from Center
16	966566	NA	External	NA/30	0.004	1.2	A	Hard Chrome	161	70	11.5	90	360°/yes	98
	966567	NA	External	NA/40	0.01	1.7	A	Hard Chrome	209	120	11.5	145	360°/yes	122
	966568	NA	External	NA/50	0.03	2.4	A	Hard Chrome	257	160	11.5	180	360°/yes	146
	966569	NA	External	NA/60	0.05	3.4	A	Hard Chrome	305	190	11.5	220	360°/yes	170
	966570	NA	External	NA/70	0.08	3.3	A	Hard Chrome	352	260	11.5	285	360°/yes	193.5
	966797	966557	External	30/150	0.19*	1.6*	B	Hard Chrome	745	652	11.5	670	72°/yes	390
20	966571	966656	External	25/400	1.64*	1.8*	B	Hard Chrome	1954	1830	11.5	1870	22.5°/yes	995
	966572	966706	External	28/140	0.48*	2.9*	B	Hard Chrome	880	770	15.5	810	72°/yes	462
	966798	966615	Internal	25/150	0.86*	3.6*	C	Hard Chrome	1038	906	15.5	1013	60°/yes	430
	966799	966734	External	30/180	0.76*	2.7*	B	Hard Chrome	1120	1020	15.5	1060	60°/yes	582
	966793	966794	External	30/540	9.57*	3.6*	B	Hard Chrome	3338	3220	15.5	3250	20°/yes	1692
	966789	966790	Internal	19/684	14.9*	3.2*	C	Hard Chrome	4400	4241	15.5	4354	10°/yes	2098
25	966787	966788	External	30/900	36.3*	4.9*	B	Hard Chrome	5554	5392	15.5	5438	12°/yes	2800
	966573	NA	External	NA/30	0.04	4.5	A	Hard Chrome	254	120	18.5	145	360°/yes	154
	966574	NA	External	NA/40	0.12	6.8	A	Hard Chrome	331	190	18.5	220	360°/yes	193
	966575	NA	External	NA/50	0.25	9.1	A	Hard Chrome	404	260	18.5	285	360°/yes	230
	966576	NA	External	NA/60	0.47	11.5	A	Hard Chrome	480	330	18.5	360	360°/yes	268
	966577	NA	External	NA/75	0.93	13.5	A	Hard Chrome	596	460	22.5	490	360°/yes	326
32	966578	966740	External	27/486	15.7*	4.6*	B	Hard Chrome	3760	3640	18.5	3684	20°/yes	1908
	966638	NA	External	NA/48	0.69	16.6	A	Hard Chrome	493	330	24.5	360	360°/yes	292
	966639	NA	External	NA/87	4.4	27.8	A	Black Oxide	874	730	24.5	770	360°/yes	482
	966763	966685	External	18/450	35.7*	7.7*	B	Hard Chrome	4400	4220	24.5	4280	14.4°/yes	2246
40	966778	966779	External	19/760	112.8*	8.4*	B	Hard Chrome	7428	7250	24.5	7310	9°/yes	3760
	966791	NA	External	NA/48	2.5	39.2	A	Hard Chrome	622	390	35.5	430	360°/yes	369
	966549	966546	External	11/200	9.1*	6.4*	B	Hard Chrome	2482	2320	31.5	2360	19.8°/no	1300

\*Per segment

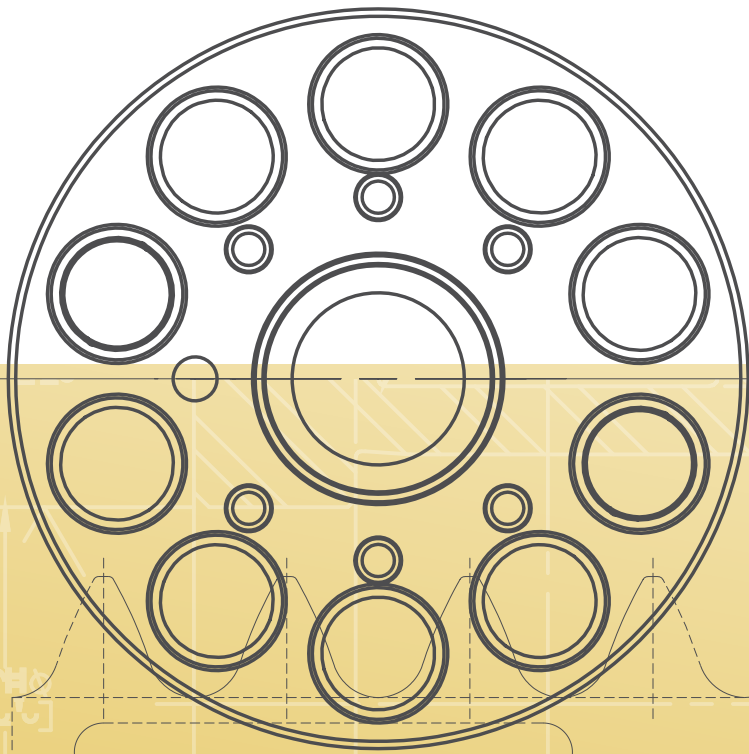


## Roller Pinion

Once you have selected your rack or gear, finding the right pinion is easy. The following pages offer step-by-step selection instructions as well as pinion specifications and details on accessories.







# Roller Pinion

Pinion Selection Process .....	22
Specifications .....	22
Dimensional Drawings .....	23-26
Pinion Accessories	
Adapters .....	27
Preloaders .....	27-29

# RPS Pinion Selection Process

**Step 1: Determine your rack/gear size and find the same RPS pinion size. Always use the same size rack/gear and pinion.**

**Step 2: Select the material best suited for your application. (Other materials available upon request.)**

Hard Chrome: alloy steel with a thin, dense chrome coating

Nickel: alloy steel with nickel plating

Stainless: stainless steel with or without a hard chrome coating

**Step 3: Select Mounting Style: For easy installation and maximum versatility, Nexen recommends using the flange-mounted version when practical.**

Shaft Mount	Flange Mount
<ul style="list-style-type: none"> <li>Shaft Coupling or Shaft &amp; Keyway mounting option</li> <li>Coupling option uses a keyless mechanical compression coupling to secure to shaft</li> <li>Available in multiple bore diameters. Contact Nexen.</li> </ul>	<ul style="list-style-type: none"> <li>Conforms to ISO 9409 specifications</li> <li>Nexen adapter preloader options available with this version</li> </ul>

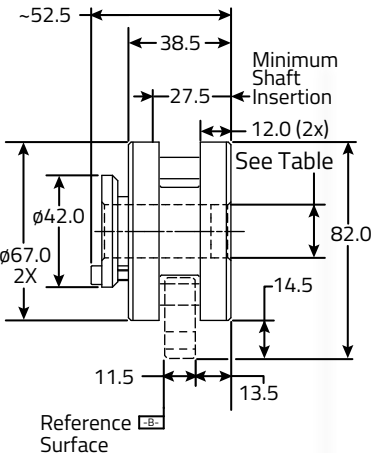
Pinion Type	RPS Size	Number of Rollers	Distance per Revolution (mm)	Pitch Circle Diameter (mm)	Max Speed (RPM)	Product Number	Base Material/ Coating	Mount Style	Bore Size (mm)	Mass (kg)	Moment of Inertia (kgm <sup>2</sup> x10 <sup>-4</sup> )
Premium Pinions	10	10	100	31.8	2400	966484	Hard Chrome	Shaft Coupling	12	0.2	0.4
	12	10	120	38.2	4000	966490	Hard Chrome	Shaft Coupling	16	0.3	1.0
	16	10	160	50.9	1500	966819	Nickel	Shaft Coupling	16	0.7	3.9
						966650	Nickel	Shaft Coupling	20	0.7	3.9
						966761	Stainless	Shaft Coupling	20	0.7	3.9
						966687	Nickel	Flange	N/A	0.8	4.0
						966759	Stainless	Flange	N/A	0.8	4.0
	20	10	200	63.7	1500	966820	Nickel	Shaft Coupling	22	1.4	10.6
						966660	Nickel	Shaft Coupling	25	1.3	10.5
						966771	Stainless	Shaft Coupling	25	1.3	10.5
						966675	Nickel	Flange	N/A	1.2	10.2
						Request	Stainless	Flange	N/A	1.2	10.2
	25	10	250	79.6	1820	966670	Nickel	Shaft Coupling	30	2.1	25.5
						966758	Stainless	Shaft Coupling	30	2.1	25.2
						966673	Nickel	Flange	N/A	2.1	25.2
						Request	Stainless	Flange	N/A	2.1	25.2
	32	12	384	122.2	938	966821	Nickel	Shaft Coupling	32	7.3	173.0
						966822	Nickel	Shaft Coupling	40	6.8	171.0
						966680	Nickel	Shaft Coupling	45	6.4	169.0
						Request	Stainless	Shaft Coupling	45	6.4	169.0
						966677	Nickel	Flange	N/A	6.6	168.0
						Request	Stainless	Flange	N/A	6.6	168.0
	40	12	480	152.8	625	966823	Nickel	Shaft Coupling	55	12.9	598.0
						966690	Nickel	Shaft Coupling	60	12.4	594.0
						Request	Stainless	Shaft Coupling	60	12.4	594.0
						966697	Nickel	Flange	N/A	15.5	665.0
						Request	Stainless	Flange	N/A	15.5	665.0
Value Pinions	16	10	160	50.9	750	966826	Aluminum	Shaft & Keyway	16	0.4	2.4
	20	10	200	63.7	600	966827	Aluminum	Shaft & Keyway	16	0.7	6.0
	25	10	250	79.6	480	966828	Aluminum	Shaft & Keyway	22	1.1	14.7

\* The maximum rated speed of a RPS system is equal to the lowest rating of either the pinion or the rack.

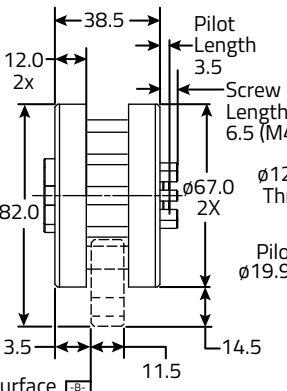
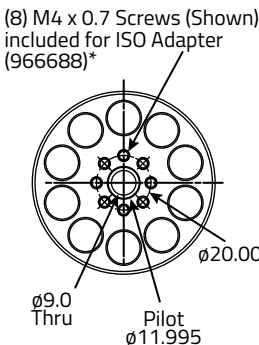
See the Definitions section for more information on these attributes.



## RPS16 Premium Pinion

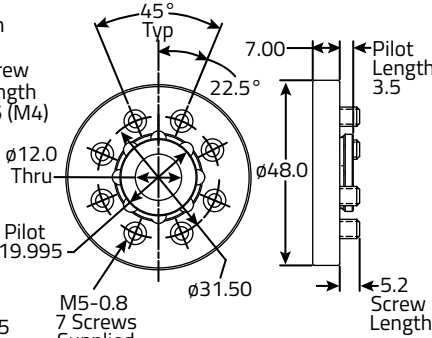


## ISO 9409 Flange Mount Pinion Pinion



## Adapter

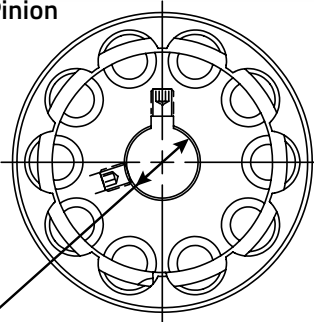
### Required For Some Gearhead Sizes



\* (4) M3 x 0.5 x 45 mm screws (Not Shown) included for use with APEX AD047

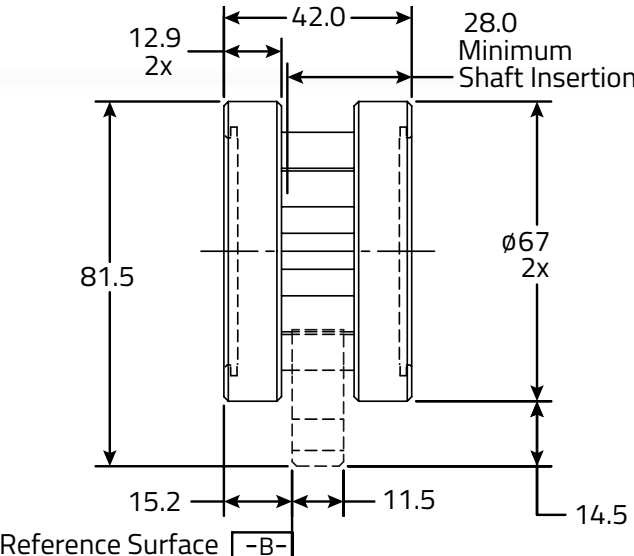
### RPS16 Value Pinion

### Shaft & Keyway Mounted Pinion



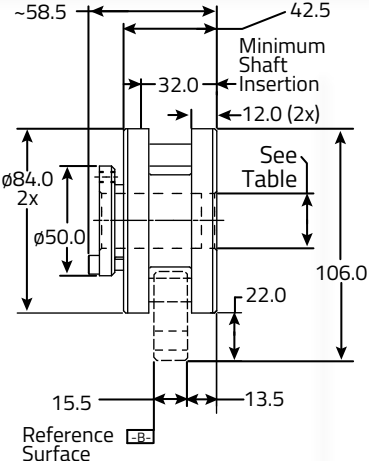
See Table

Note: See product drawing for keyway specifications.

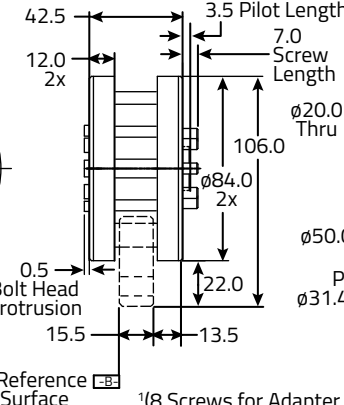
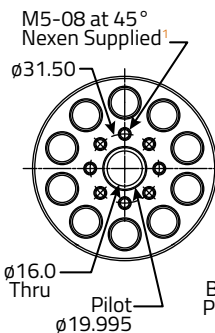


## RPS20 Premium Pinion

## Shaft Mounted Pinion

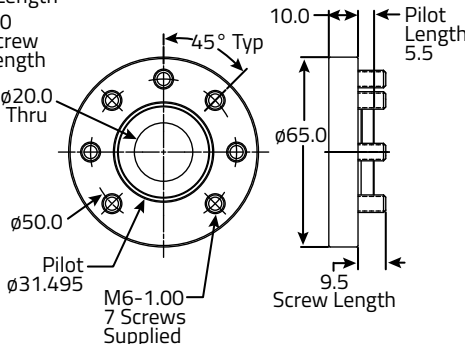


## ISO 9409 Flange Mount Pinion Pinion



## Adapter

**Required For Some Gearhead Sizes:**

<sup>1</sup>(8 Screws for Adapter Mount)(7 Screws for Direct Mount)



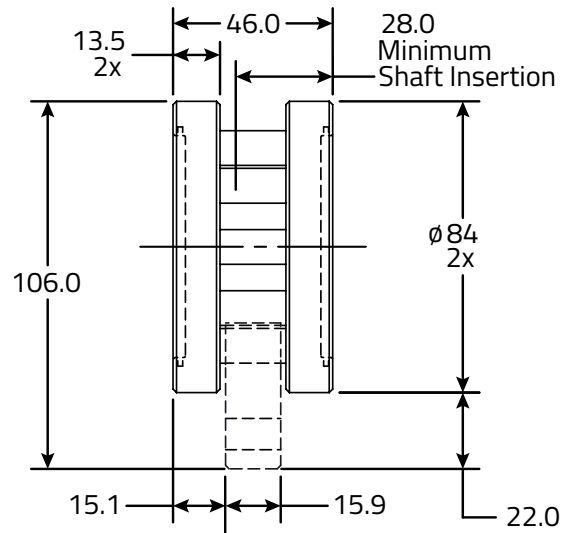
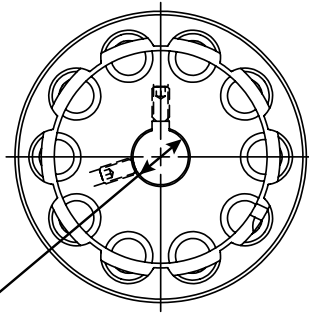
## Pinion Dimensions

### RPS20 Value Pinion

#### Shaft & Keyway Mounted Pinion

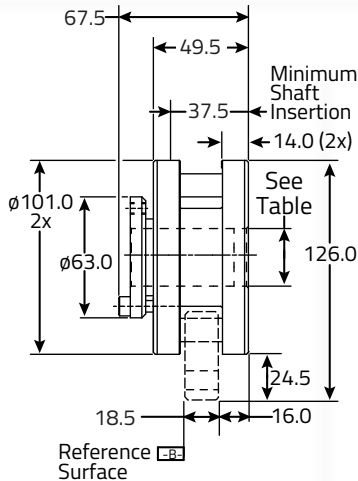
Note: See product drawing for keyway specifications.

See Table



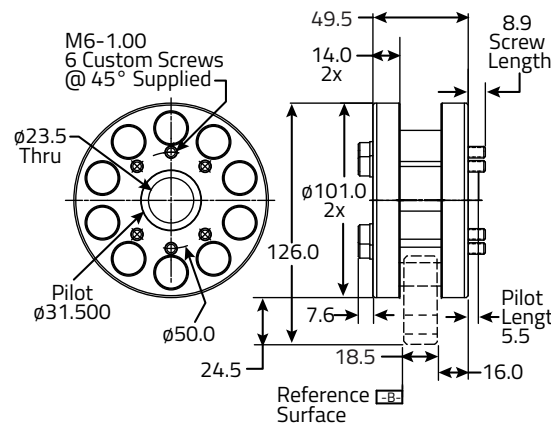
### RPS25 Premium Pinion

#### Shaft Mounted Pinion



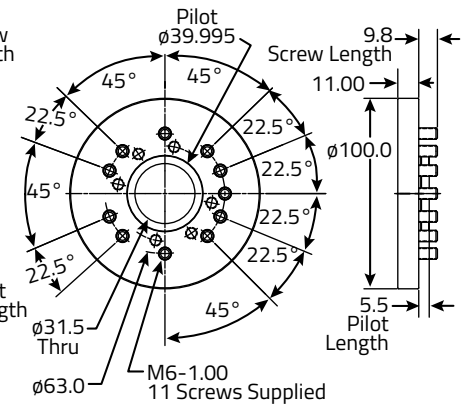
#### ISO 9409 Flange Mount Pinion

##### Pinion



##### Adapter

Required For Some Gearhead Sizes

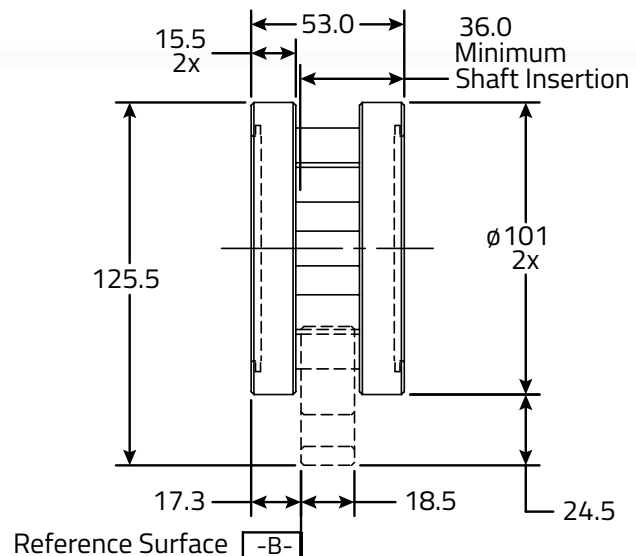
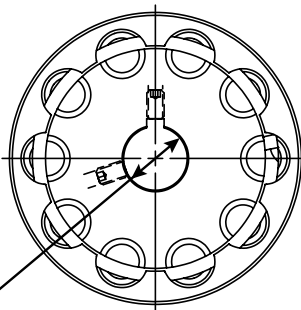


### RPS25 Value Pinion

#### Shaft & Keyway Mounted Pinion

Note: See product drawing for keyway specifications.

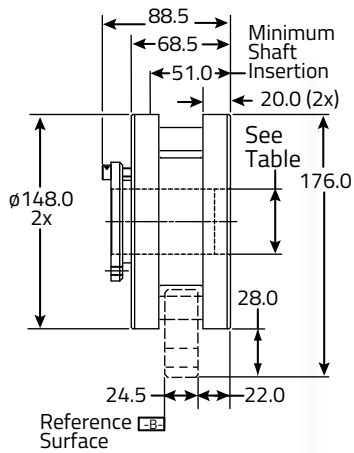
See Table



## Pinion Dimensions

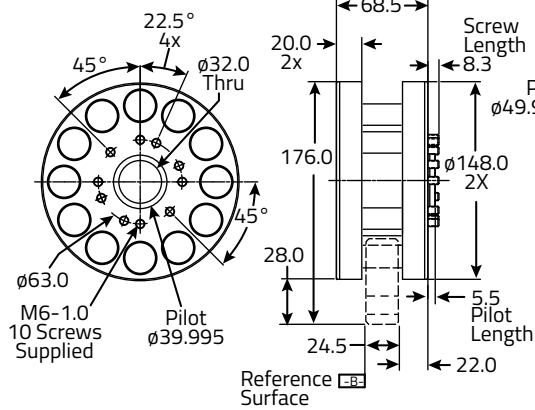
### RPS32 Premium Pinion

#### Shaft Mounted Pinion



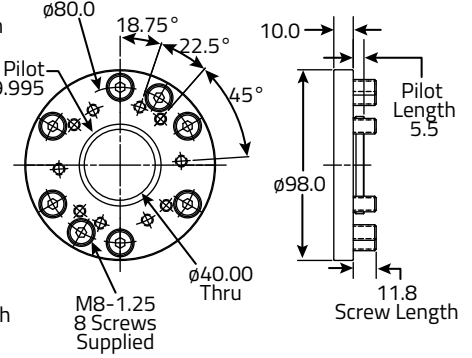
#### ISO 9409 Flange Mount Pinion

##### Pinion



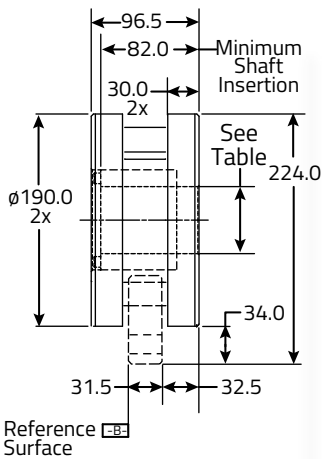
##### Adapter

Required For Some Gearhead Sizes



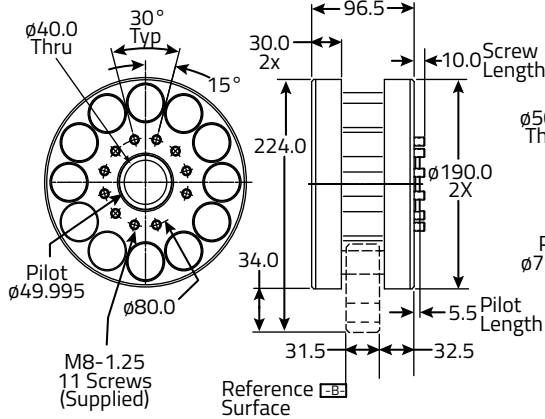
### RPS40 Premium Pinion

#### Shaft Mounted Pinion



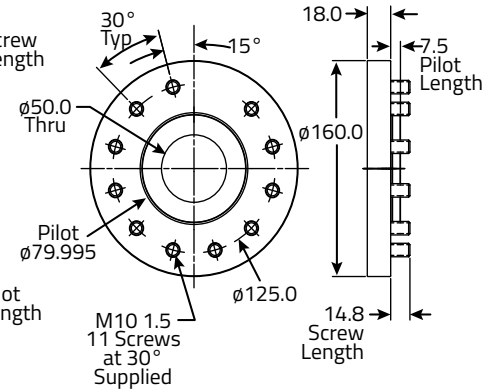
#### ISO 9409 Flange Mount Pinion

##### Pinion



##### Adapter

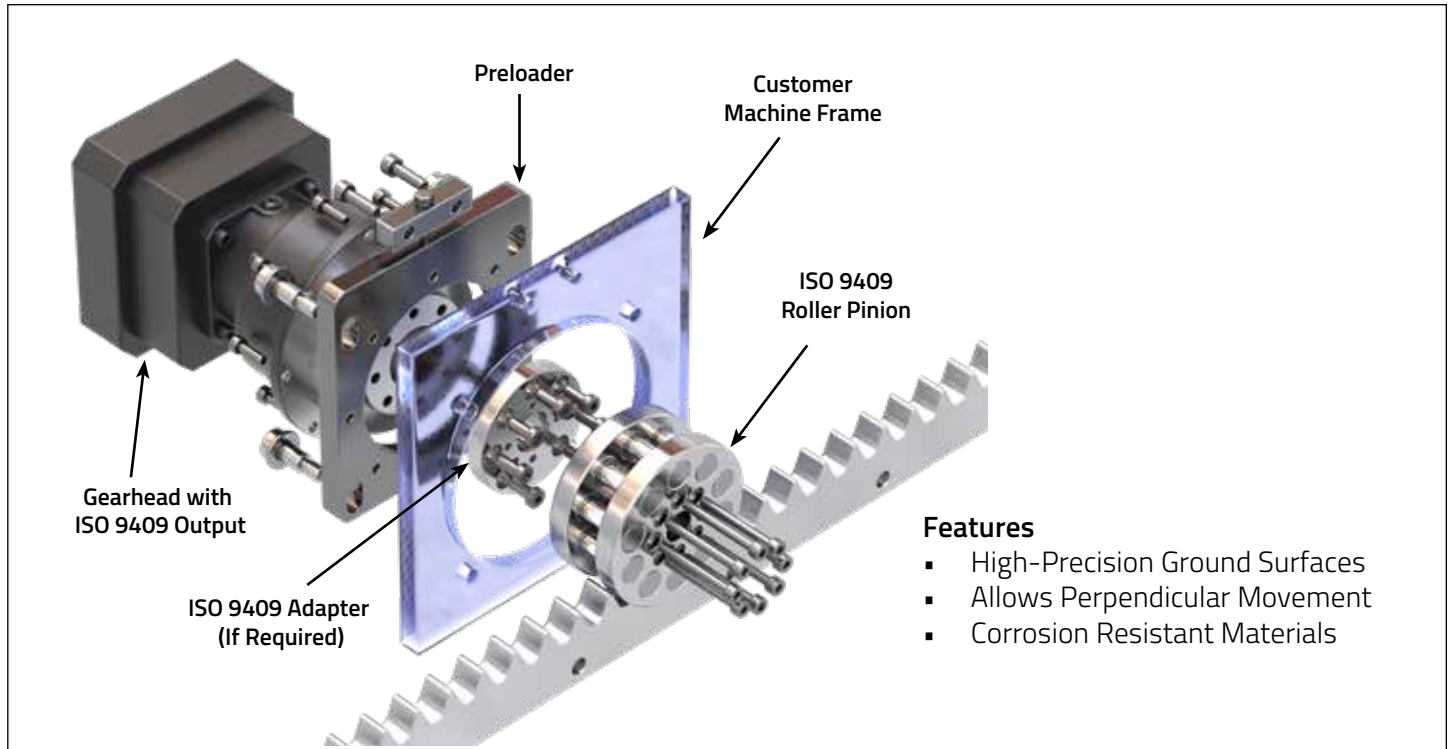
Required For Some Gearhead Sizes



## Pinion Preloader

Pair Nexen's Flange-Mount Pinion with our RPS Pinion Preloader for easy integration into your machine design. Preloaders feature an adjuster that allows the pinion to be moved up or down into the rack while keeping the pinion properly oriented to the rack. The pilot in the adjuster plate accommodates common servo gearhead sizes from many servo gearhead manufacturer.

Preloader and Adapter components are either made from corrosion-resistant stainless steel, nickel, or zinc plating.



### Selecting Pinion Adapters and Preloaders

If directly mounting the pinion to the reducer:	If going up a reducer frame size
Disregard the Pinion w/ Adapter column and select the preloader and gearhead for your RPS Pinion size.	Start in the Pinion w/ Adapter column and select the compatible pinion, adapter, preloader and gearhead.

**Table 6 - Gearhead Compatibility Table**

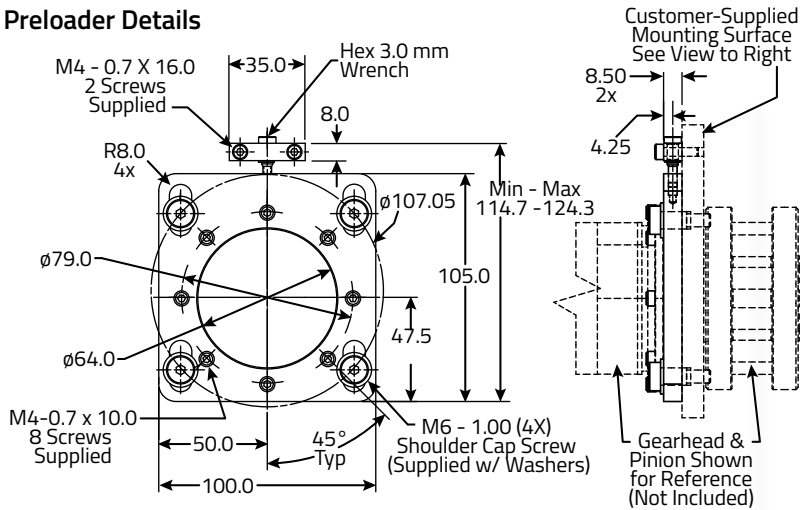
Pinion Size	Pinion w/ Adapter (not required in some applications)	Pinion Preloader	Customer Provided Gearhead								
			Alpha/Wittenstein	APEX	GAM	Mijno	Neugart	Nidec-Shimpo	SEW-Euro	Stöber	Sumitomo
RPS16	N/A	N/A	N/A	AD047	N/A	N/A	N/A	VRT047	N/A	N/A	N/A
RPS20	RPS16 & 966688	960851	TP004	AD064	N/A	BDB 085	PLFE/N 64	VRT064	PSBF221/2	PH/A/KX 321/2	N/A
RPS25	RPS16 & 966865 RPS20 & 966676	960850	TP010	AD090	SPH-F75	BDB 120	PLFE/N 90	VRT090	PSBF321/2	PH/A/KX 421/2	PNFX080
RPS32	RPS16 & 966834 RPS25 & 966674	960852	TP025	AD110	SPH-F100	BDB 145	PLFE/N 110	VRT110	PSBF521/2	PH/A/KX 521/2	PNFX250
RPS40	RPS32 & 966668	960853	TP050	AD140	SPH-F140	BDB 180	PLFN 140	VRT140	PSBF621/2	PH/A/KX 721/2	PNFX450
N/A	RPS40 & 966698 RPS40 & 967004*	960854	TP110	AD200	N/A	BDB 250	PLFN 200	VRT200	PSBF721/2	PH/A/KX 821/2	N/A
N/A	RPS40 & 967313*	967314	N/A	AD255	N/A	N/A	N/A	VRT255	N/A	N/A	N/A

\* Adaptors for highest capacity RPS40 Pinion  
This is a partial list. Other gearheads may apply.

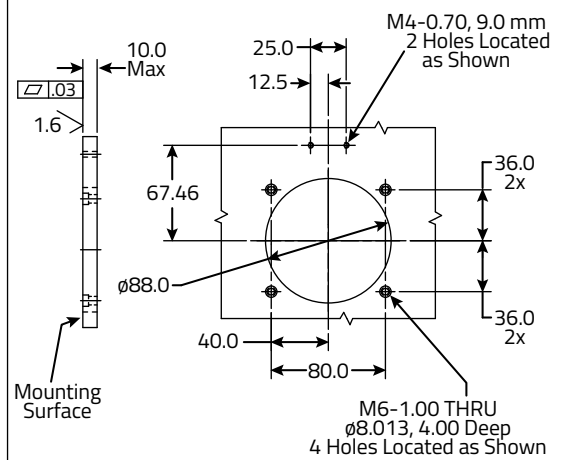
## Preloader Dimensions

### RPS-PRE-ISO-064-3 Product Number 960851

#### Preloader Details

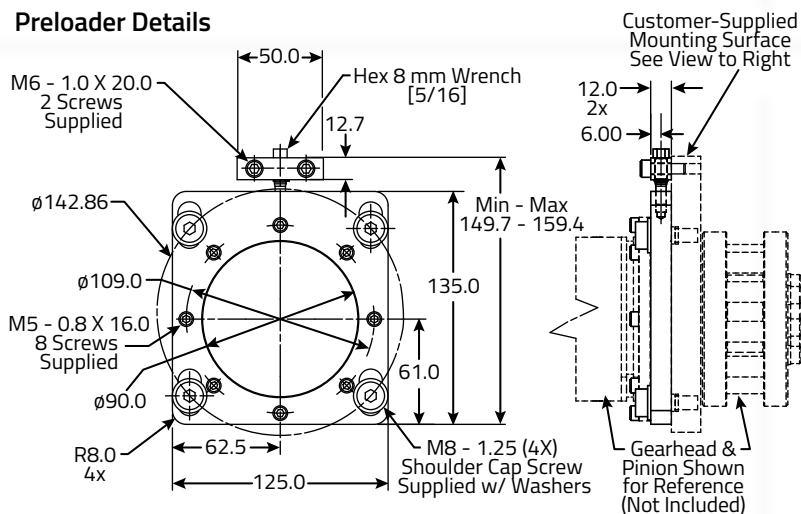


#### Customer Mounting Surface Details

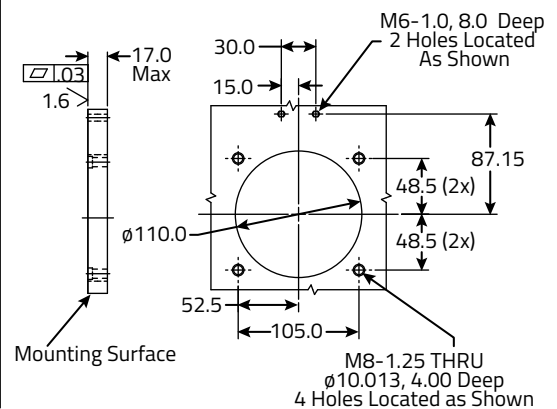


### RPS-PRE-ISO-090-3 Product Number 960850

#### Preloader Details

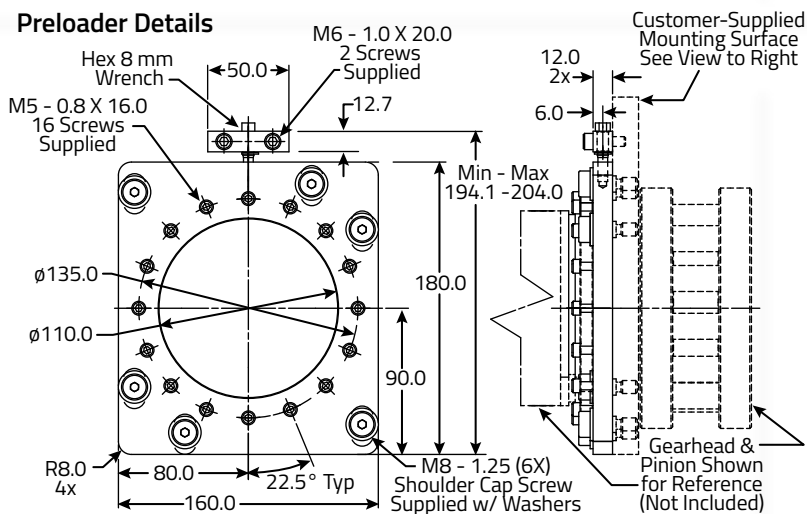


#### Customer Mounting Surface Details

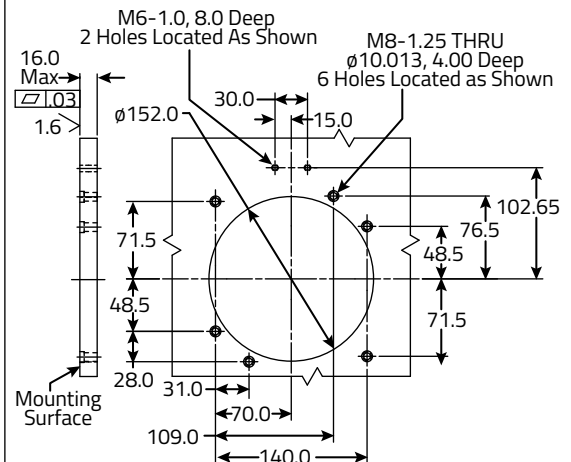


### RPS-PRE-ISO-110-3 Product Number 960852

#### Preloader Details



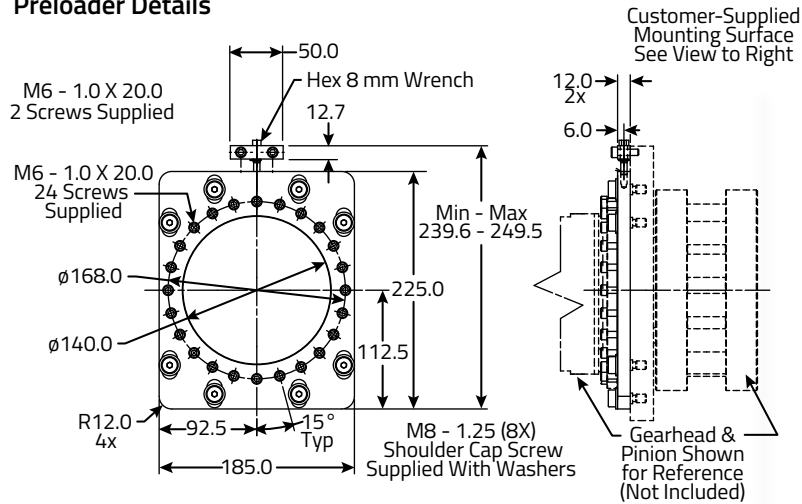
#### Customer Mounting Surface Details



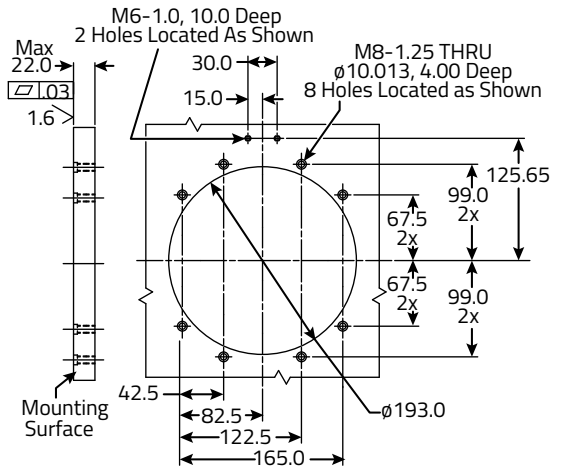
## Preloader Dimensions

### RPS-PRE-ISO-140-3 Product Number 960853

#### Preloader Details

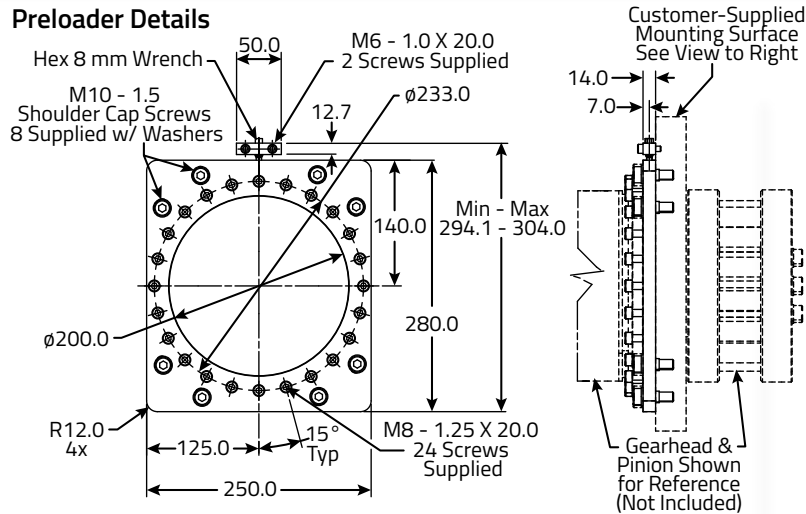


#### Customer Mounting Surface Details

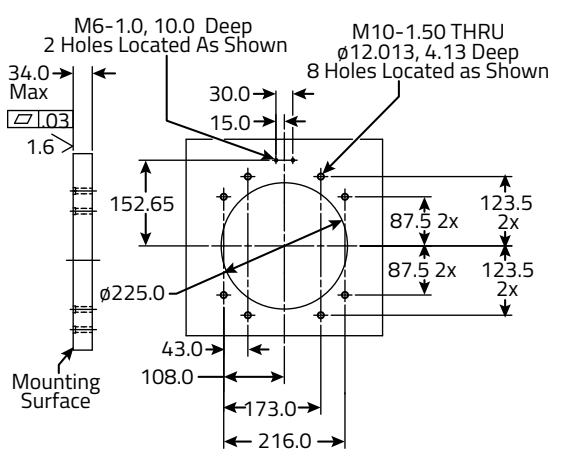


### RPS-PRE-ISO-200-3 Product Number 960854

#### Preloader Details



#### Customer Mounting Surface Details

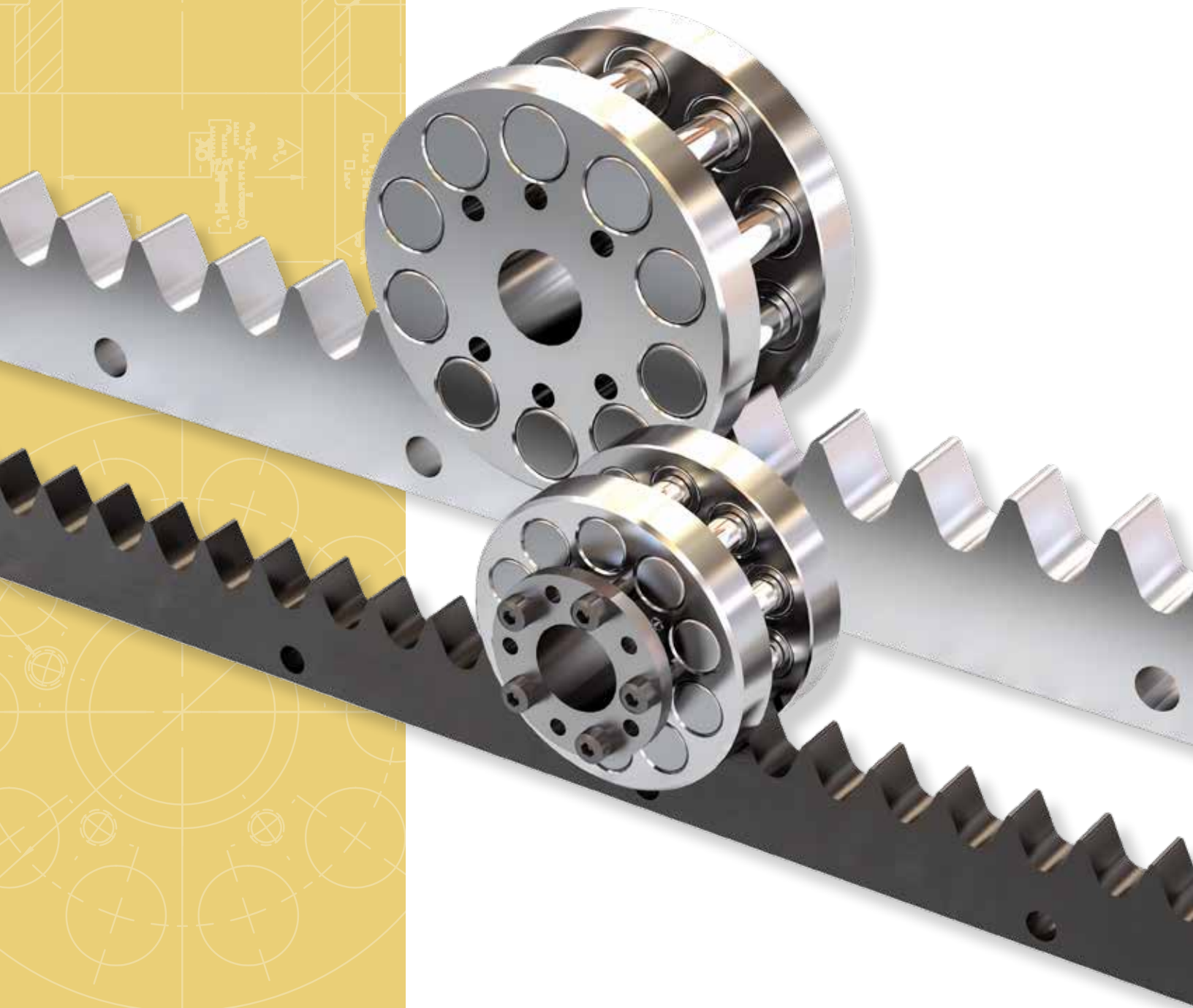




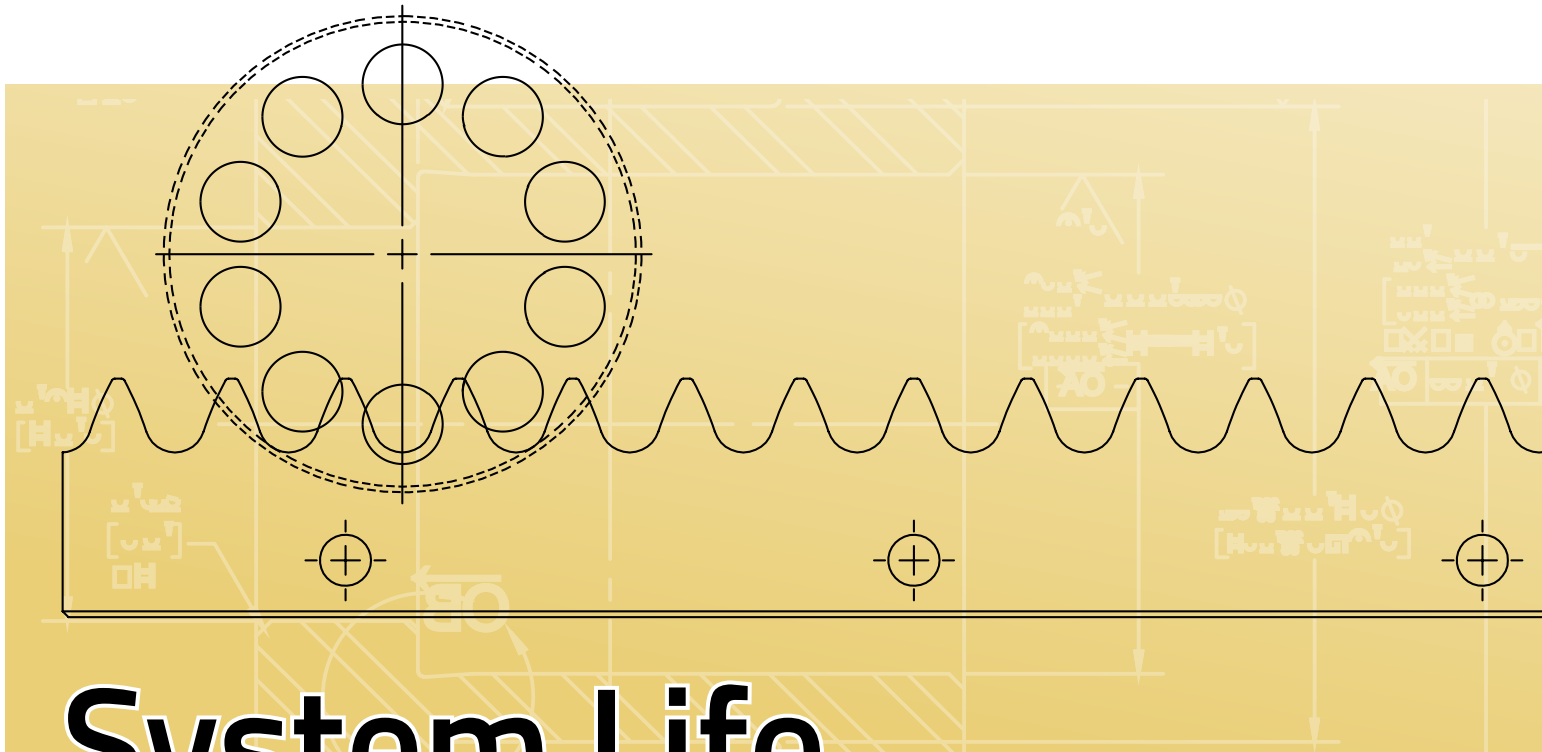


## Roller Pinion System Life

The RPS system offers an efficiency greater than 99% with a long life of up to 60,000,000 pinion revolutions (up to 36 million meters of travel). Typically the rack/gear lasts through several pinion changes.







# System Life

Pinion Life Data & Calculations .....	32–33
Rack Life Data & Calculations .....	34–35
System Life Graphs .....	36–38

# Calculating RPS System Life

The calculations in the following section will allow you to calculate the expected rack and pinion life. These calculations will result in the same values as the charts on the following pages.

## RPS Pinion Life Data & Calculations

Table 7 - RPS Pinion Life Values

		RPS10	RPS12	RPS16		RPS20		RPS25		RPS32	RPS40
				Premium	Value	Premium	Value	Premium	Value		
Max Torque ( $T_{max}$ )	Nm	4.0	9.5	61.1	12.8	92.3	23.9	159.2	43.8	641.5	1375.2
Torque at Max Life ( $T_{final}$ )	Nm	4.0	9.5	33.7	12.8	52.5	23.9	89.5	43.8	366.6	1146
Distance Per Revolution ( $L_{rev}$ )	m	0.1	0.12	0.16	0.16	0.2	0.2	0.25	0.25	0.384	0.48
Transition Point ( $E_T$ )	million contacts	60	60	8	2	8.2	2	8.5	2	9.4	32
Max Life ( $N_{max\ contacts}$ )	million contacts	60	60	60	2	60	2	60	2	60	60
Constant (C)		NA	NA	115.30	NA	179.43	NA	305.91	NA	1255.14	3916.09

### Step 1: Gather Application Data

Before you begin calculations, there are three key measurements that you will need from your application. Collect the data and record it in space provided to the right.

Measurements Required for Pinion Calculations	Customer Data (record your values below)	Sample Data
Average Torque ( $T_{avg}$ )	Nm	85 Nm
Distance Per Cycle (L) (single direction move)	m	1.3 m
Average Speed ( $V_{avg}$ )	m/s	2 m/s

### Step 2: Calculate The Total Number of Pinion Contacts ( $N_{contacts}$ )

Perform the following calculations using the data collected from your application data in Step 1.

#### Pinion Roller Contacts ( $N_{contacts}$ )

The total number of roller contacts ( $N_{contacts}$ ) that an RPS Pinion can sustain before needing replacement is based on the average torque of your application. Determine which equivalency or inequality statement below is true for the average torque ( $T_{avg}$ ) of your application. Then complete the corresponding pinion roller contact equation and record your value below.

If $T_{avg}$ is:	Then $N_{contacts}$ :
$\leq T_{final}$	$= N_{max\ contacts}$
$> T_{final}$ and $< T_{max}$	$= (C \div T_{avg})^{3.333} = \left( \div \text{Nm} \right)^{3.333}$
$= T_{max}$	$= E_T$

Pinion Life in Roller Contacts	
$N_{contacts} =$	<input type="text"/> million contacts

Sample: (Evaluating RPS20 size)  $N_{contacts} = (179.43 \div 85 \text{ Nm})^{3.333} = 12$  million contacts

## RPS Pinion Life Calculations

### Step 3: Convert Roller Contacts To Hours, Meters Or Revolutions

There are two options for converting contacts to other units: exact and estimated. Exact should be used whenever possible. The estimation is available for customers who do not have a well-defined distance per cycle.

#### Exact option: Pinion Life in Hours ( $N_{\text{hours}}$ )

Use Table 7 along with the data you collected above to calculate the total number of service hours your pinion can provide before needing replacement. First calculate  $E_1$  to use in the  $N_{\text{hours}}$  equation.

$$E_1 = L \div L_{\text{rev}}$$

$$E_1 = \text{round up } \left( \frac{\text{m}}{\text{m}} \right) =$$

Must round  $E_1$  up to the nearest whole integer

Sample:  $E_1 = 1.3 \text{ m} \div 0.2 \text{ m} = 6.5 \text{ m} \rightarrow$  Round up to 7.

$$N_{\text{hours}} = (N_{\text{contacts}} \cdot 10^6 \cdot L) \div (3600 \cdot E_1 \cdot V_{\text{avg}})$$

$$N_{\text{hours}} = \left( \frac{\text{million contacts}}{\cdot 10^6 \cdot \text{m}} \right) \div \left( 3600 \cdot \cdot \text{m/s} \right) \quad N_{\text{hours}} = \text{hrs}$$

Sample:  $N_{\text{hours}} = (12 \cdot 10^6 \cdot 1.3 \text{ m}) \div (3600 \cdot 7 \cdot 2 \text{ m/s}) = 309.5 \text{ hrs}$

#### Estimation Options: Pinion Life in Meters and Life in Revolutions

These calculations assume the pinion travels nonstop in one direction throughout its whole life.

##### Pinion Life in Meters ( $N_{\text{meters}}$ )

$$N_{\text{meters}} = N_{\text{contacts}} \cdot L_{\text{rev}} \cdot 10^6$$

$$N_{\text{meters}} = \cdot \text{m} \cdot 10^6$$

$$N_{\text{meters}} = \text{m}$$

Sample:  $N_{\text{meters}} = 12 \cdot 0.2 \text{ m} \cdot 10^6 = 2,400,000 \text{ m}$

##### Pinion Life in Revolutions ( $N_{\text{rev}}$ )

$$N_{\text{rev}} = N_{\text{contacts}}$$

$$N_{\text{rev}} = \text{million revolutions}$$

Sample:  $N_{\text{rev}} = 12 \text{ million revolutions}$

Table 8 - RPS Rack Life Values

RPS Rack Size		RPS10	RPS12	RPS16	RPS20	RPS25	RPS32	RPS40
Pitch (P) meters		0.01	0.012	0.016	0.02	0.025	0.032	0.04
Distance Per Revolution ( $L_{rev}$ ) meters		0.1	0.12	0.16	0.2	0.25	0.384	0.48
Premium & Standard	Max Dynamic Thrust ( $F_{max}$ ) N	250	500	2400	2900	4000	10500	18000
	Thrust at Max Life ( $F_{final}$ ) N	250	500	1000	1500	2200	6000	15000
	Transition Point ( $E_r$ ) million contacts	30	30	5	5	5	5	5
	Max Life ( $N_{max\ contacts}$ )	30 Million Contacts						
	Slope (m)	NA	NA	-56	-56	-72	-180	-120
	Intercept (b) N	NA	NA	2680	3180	4360	11400	18600
Endurance	Max Dynamic Thrust ( $F_{max}$ ) N	NA	NA	1500	2250	3300	5 400	6000
	Thrust at Max Life ( $T_{final}$ ) N	NA	NA	1000	1500	2200	3600	6000
	Transition Point ( $E_r$ ) million contacts	NA	NA	5	5	5	5	30
	Max Life ( $N_{max\ contacts}$ )	NA	NA	30 Million Contacts				
	Slope (m)	NA	NA	-20	-30	-44	-72	NA
	Intercept (b) N	NA	NA	1600	2400	3520	5760	NA
Universal & Universal Stainless	Max Dynamic Thrust ( $F_{max}$ ) N	NA	NA	750	1125	1650	2700	4500
	Thrust at Max Life ( $F_{final}$ ) N	NA	NA	750	1125	1650	2700	4500
	Max Life ( $N_{max\ contacts}$ )	NA	NA	5 Million Contacts				2 Million Contacts

## RPS Rack Life Calculations

### Step 1: Gather Application Data

Before you begin calculations, there are three key measurements that you will need from your application. Collect the data and record it in space provided below.

Measurements Required for Rack Calculations	Customer Data (Record your values below)	Sample Data
Average Thrust Force ( $F_{avg}$ )	N	2500 N
Distance Per Cycle (L) (single direction move)	m	1.3 m
Average Speed ( $V_{avg}$ )	m/s	2 m/s

### Step 2: Calculate The Total Number of Tooth Contacts

Perform the following calculations using the data collected from your application and the values from Table 8.

#### Rack Tooth Contacts ( $N_{contacts}$ )

The total number of tooth contacts ( $N_{contacts}$ ) that an RPS Rack can sustain before needing replacement is based on the average thrust force of your application. Use Table 5 to determine which equivalency or inequality statement below is true for the average thrust force ( $F_{avg}$ ) of your application. Then complete the corresponding rack tooth contact formula and record your value below.

If $F_{avg}$ is:	Then $N_{contacts}$ :
$\leq F_{final}$	$= N_{max\ contacts}$
$> F_{final} \ \& \ < F_{max}$	$= (F_{avg} - b) \div m = \left( \quad N \quad - \quad N \quad \right) \div \quad$
$= F_{max}$	$= E_T$

Rack Life in Tooth Contacts	
$N_{contacts} =$	million contacts

Sample: (Evaluating RPS20 size)  $N_{contacts} = (2500\text{ N} - 3180) \div -56 = 12$  million contacts

### Step 3: Convert Rack Tooth Contacts to Hours of Life

Perform the following calculations using the data collected from your application and the values from Table 5.

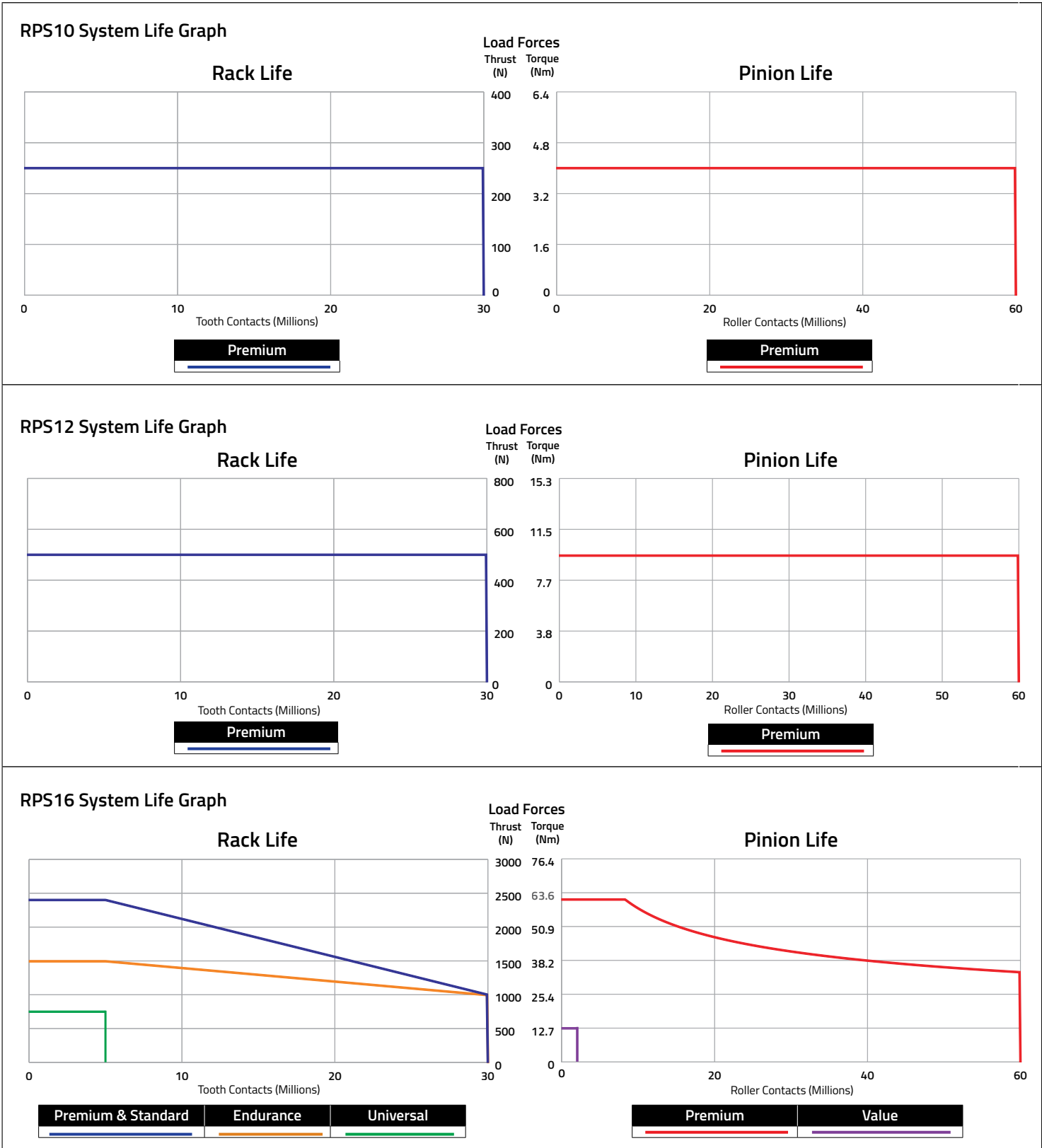
#### Rack Life in Hours ( $N_{hours}$ )

$N_{hours} = (N_{contacts} \div 3600) \cdot (L \div V_{avg}) \cdot 10^6$ $N_{hours} = \left( \quad \div 3600 \right) \cdot \left( \quad m \div \quad m/s \right) \cdot 10^6$	<table border="1"> <thead> <tr> <th colspan="2">Rack Life in Hours</th> </tr> </thead> <tbody> <tr> <td><math>N_{hours} =</math></td> <td>hours</td> </tr> </tbody> </table>	Rack Life in Hours		$N_{hours} =$	hours
Rack Life in Hours					
$N_{hours} =$	hours				

Sample:  $N_{hours} = (12 \div 3600) \cdot (1.3\text{ m} \div 2\text{ m/s}) \cdot 10^6 = 2166$  hours

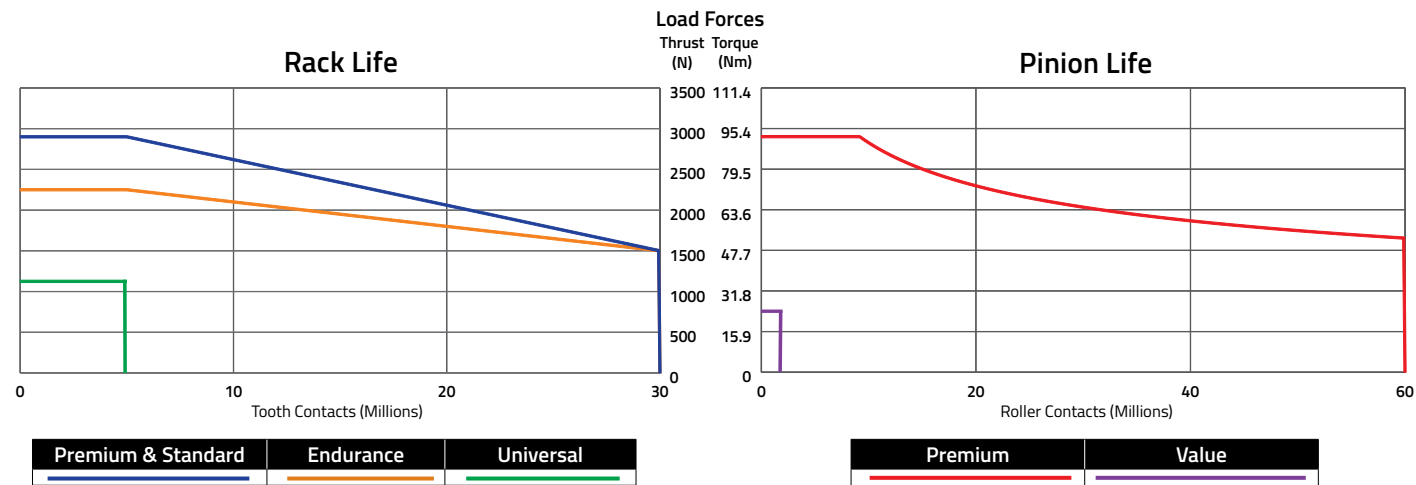
RPS System Life Graphs (RPS10, 12 and 16)

The RPS system life ratings are based on the force of the load. Refer to the following graphs to determine the pinion and rack life based on your application load forces. Graphs show the thrust along side the corresponding torque to more easily calculate your complete system life. Typically the pinion can be replaced numerous times before replacing the rack.

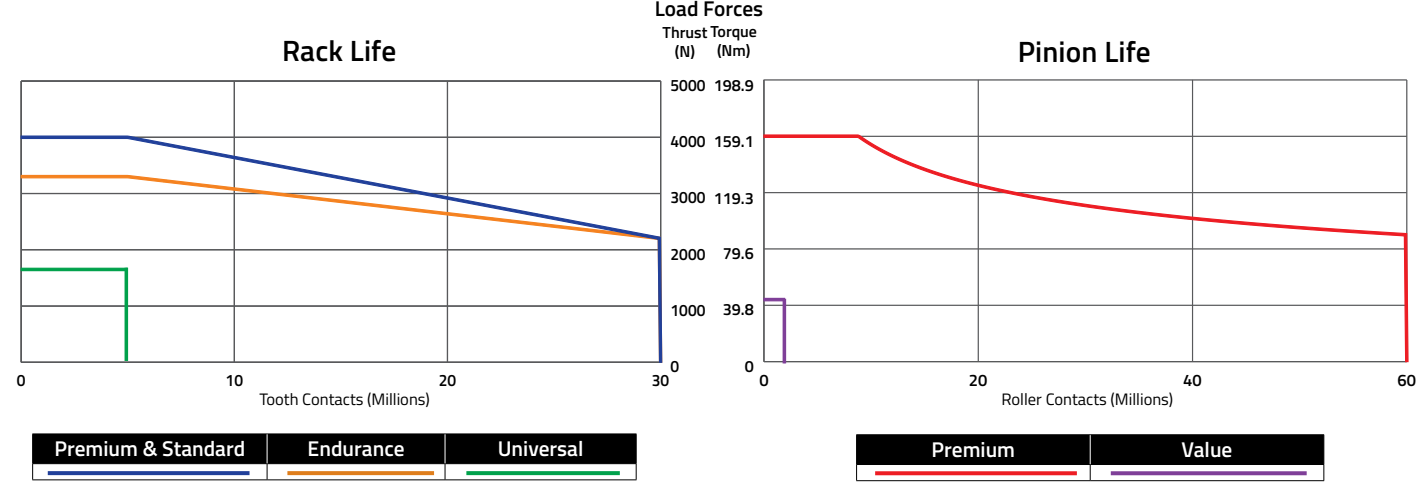




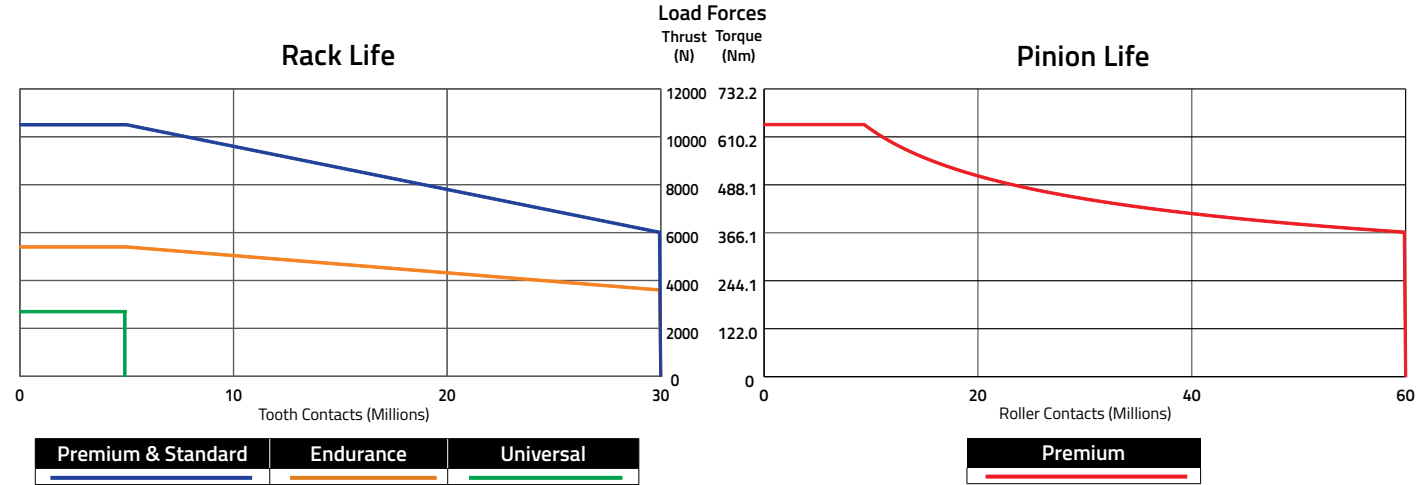
RPS20 System Life Graph

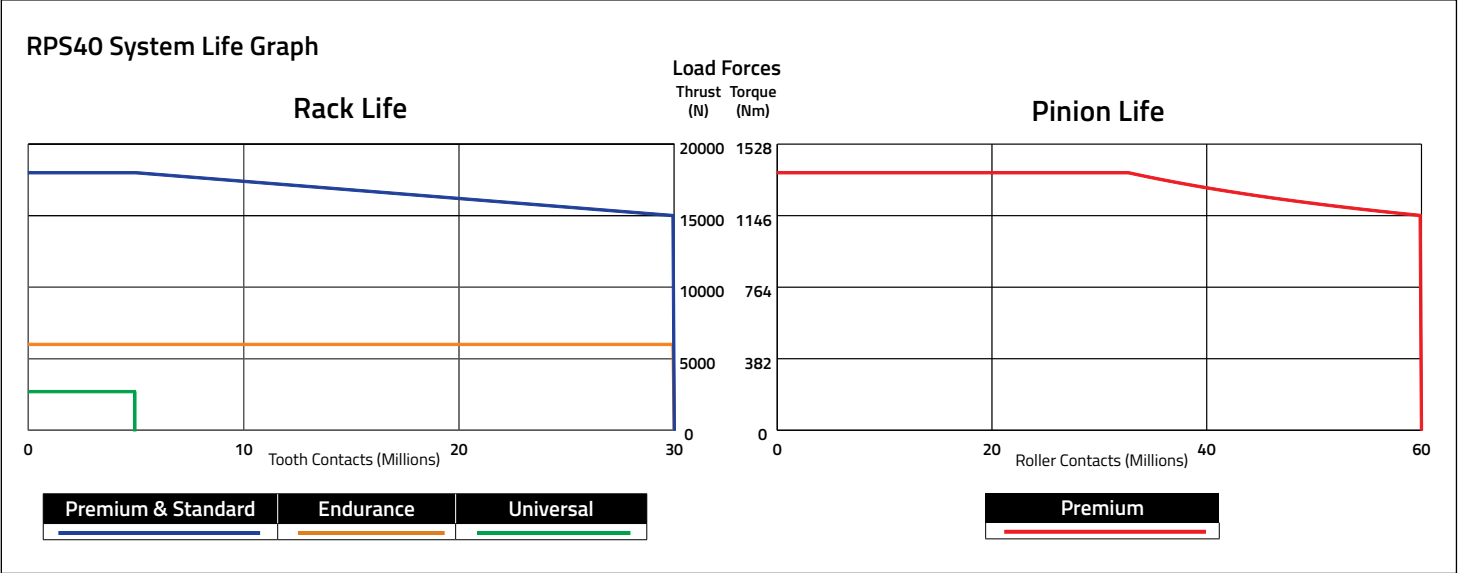


RPS25 System Life Graph



RPS32 System Life Graph





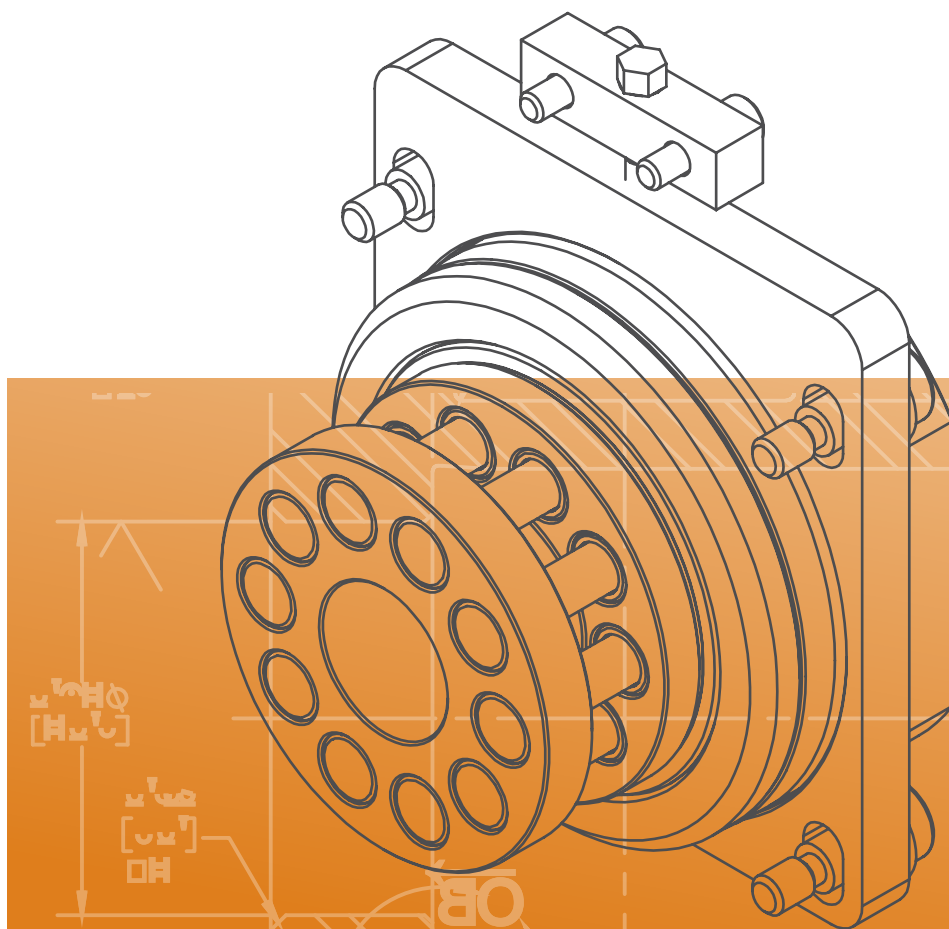
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## Harmonic Gearhead

Nexen's revolutionary Harmonic Gearhead (HG) is the perfect combination of size and precision. Use the Harmonic Gearhead integrated with Nexen's RPS Pinion (HGP) to create a true backlash-free solution from the motor to the driven load. With up to a 70% reduction in length over standard gearheads, machine designers will appreciate the opportunities available with this space saving product.





# Harmonic Gearhead

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# The Nexen Harmonic Gearhead Advantage

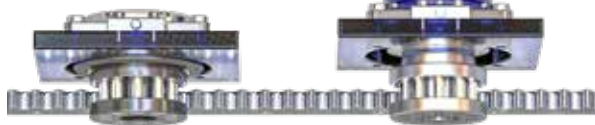
Nexen's Harmonic Gearhead (HG) offers a precision drive solution that overcomes the challenges of existing gearing methods. This new technology eliminates problems with backlash that have plagued the motion control industry, offering reliable precision even when intricate movements are required.

In the tradition of Nexen's entire line of precision motion control products, the Harmonic Gearhead sets new standards with these great features:

- Zero Backlash
- High Positional Accuracy and Repeatability
- Quiet Operation
- Large, Rugged Cross-Roller Output Bearing
- Compact



**Save 70% or more in  
gearhead length**



HGP

Standard  
Two-Stage Planetary

## Harmonic Gearhead with Pinion

Save space by taking advantage of Nexen's Harmonic Gearhead with Pinion (HGP).

In this model, the RPS pinion comes fully integrated into the gearhead, creating a drive solution that maintains zero backlash from the driving motor shaft through to the driven load for both linear and rotary motion.

## Driving Technology in Advancing Markets

Nexen's HG(P) utilizes Harmonic Strain-Wave Technology made up of a circular spline, flex-spline and wave generator. As these components rotate, their unique shape and tooth profile allow 30% of the teeth to be engaged simultaneously for Smooth Rotation, High Torque and Zero Backlash.

The effortless, low-stress meshing of the circular spline and flex-spline teeth results in a long gearhead life with reliable, quiet operation. Some operators call this peace of mind.



## Harmonic Gearhead Specifications

### Harmonic Gearhead (HG)

Specifications	HG17				HG25				HG32				HG50		
Gear Ratio	50:1	80:1	100:1	120:1	50:1	80:1	100:1	120:1	50:1	80:1	100:1	120:1	80:1	100:1	120:1
Max Acceleration Torque¹ (Nm) Nm	35	35	51	51	72	113	140	140	140	217	281	281	675	866	1057
Max Average Torque¹ (Nm) Nm	25	30	35	35	51	85	90	90	100	153	178	178	484	611	688
Inertia at Input kgcm²	0.1959	0.1954	0.1952	0.1952	0.7522	0.7503	0.7498	0.7496	2.6294	2.6236	2.6222	2.6215	20.485	20.467	20.457
Backlash ArcSec	0				0				0				0		
One Way Accuracy ±ArcSec	45				45				45				45		
One Way Repeatability ±ArcSec	10				10				10				10		
Weight kg	1.4				2.6				5.2				20.0		
Product Number	969000	969001	969002	969003	969040	969041	969042	969043	969060	969061	969062	969063	969100	969101	969102

### Harmonic Gearhead with Pinion (HGP)

Specifications		HGP17				HGP25				HGP32				HGP50		
Integrated Pinion Size		RPS16				RPS20				RPS25				RPS40		
Gear Ratio		50:1	80:1	100:1	120:1	50:1	80:1	100:1	120:1	50:1	80:1	100:1	120:1	80:1	100:1	120:1
Max Acceleration <sup>1</sup>	Torque (Nm)	35	35	51	51	72	92	92	92	140	159	159	159	675	866	1057
	Thrust (N)	1374	1374	2003	2003	2262	2900	2900	2900	3519	4000	4000	4000	8836	11336	13836
Max Average <sup>1</sup>	Torque (Nm)	25	30	35	35	51	85	90	90	100	153	159	159	484	611	688
	Thrust (N)	982	1178	1374	1374	1602	2670	2827	2827	2513	3845	4000	4000	6335	7998	9006
Inertia at Input kgcm <sup>2</sup>		0.1971	0.1958	0.1955	0.1954	0.7538	0.7509	0.7502	0.7499	2.6326	2.6248	2.6230	2.6221	20.518	20.488	20.471
Backlash μm		0				0				0				0		
One Way Accuracy ± μm		25				25				25				25		
One Way Repeatability ± μm		7.5				7.5				7.5				7.5		
Weight kg		1.7				3.0				5.8				24.8		
Product Number		969010	969011	969012	969013	969050	969051	969052	969053	969070	969071	969072	969073	969110	969111	969112

### General Specifications for both HG and HGP Units

Specifications		Size 17	Size 25	Size 32	Size 50
Max Input Speed <sup>1</sup>	cyclic RPM	7300	5600	4800	3500
	continuous RPM	3650	3500	3500	2500
Max Average Input Speed <sup>1</sup>	RPM	3650	3500	3500	2500
Max Input Acceleration Rate	rad/sec <sup>2</sup>	5100	3900	3350	2450
Efficiency @ Max Average Torque (E <sub>T_max</sub> )		80% ±5%			
Stiffness, Hysteresis		See Stiffness Section			
Output Loading		See Output Loading Section			
Temperature Limits		Ambient Temperature: 0°C to +40°C Maximum Unit Temperature: 90°C			
Mounting Position		No Restriction			
Direction of Rotation		Motor Opposite Gearhead			
Lubrication		Lubricated for Life			
Life		See HG and HGP Life Section			

<sup>1</sup> Refer to the Harmonic Gearhead Selection Process section for product sizing procedures.

Note: All accuracy data taken at 2% of maximum load.

# Harmonic Gearhead Selection Process

When selecting the proper Harmonic Gearhead, use the Specifications table to determine the HG/HGP size that best fits the application's torque, speed and physical size requirements. Then, use the following calculation sections to evaluate whether the cycle type, stiffness, efficiency and bearing load capacity of the selected HG/HGP size meets all the application requirements.

## HG/HGP Cycle Determination

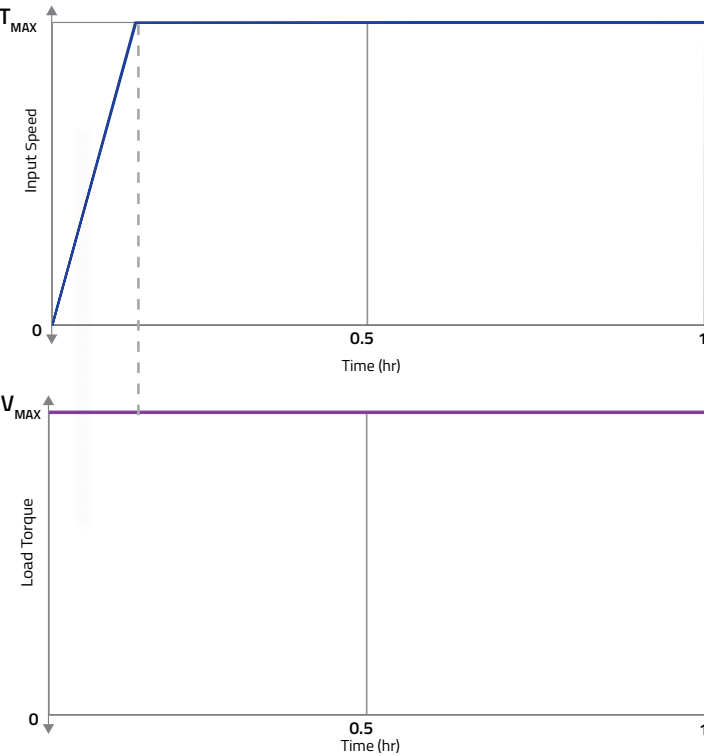
Correct sizing of the Harmonic Gearhead is critical to the proper function and life expectancy of your unit. The following section provides information regarding cycle type to be used in the gearhead sizing process. The two Cycle Types are Continuous Motion and Cyclic Motion.

- Step 1: Determine which Cycle Type applies to your application.
- Step 2: Use the Cycle Limitations information to correctly size the gearhead.

**Continuous Motion:** Single direction motion lasting longer than one hour

Cycle Limitations	
Input Speed	Max average input speed
Output Torque	Max average torque

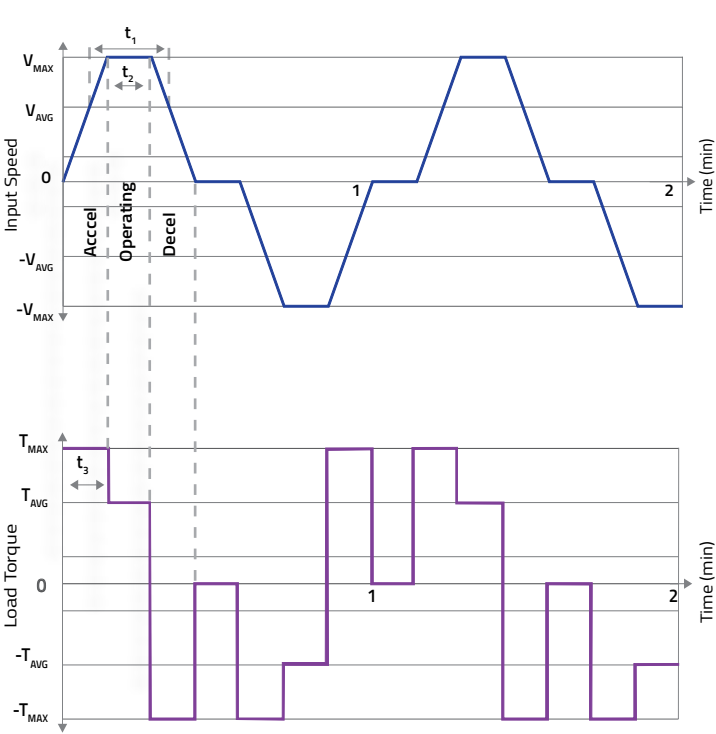
Example Cycle



**Cyclic Motion:** Reversing direction motion

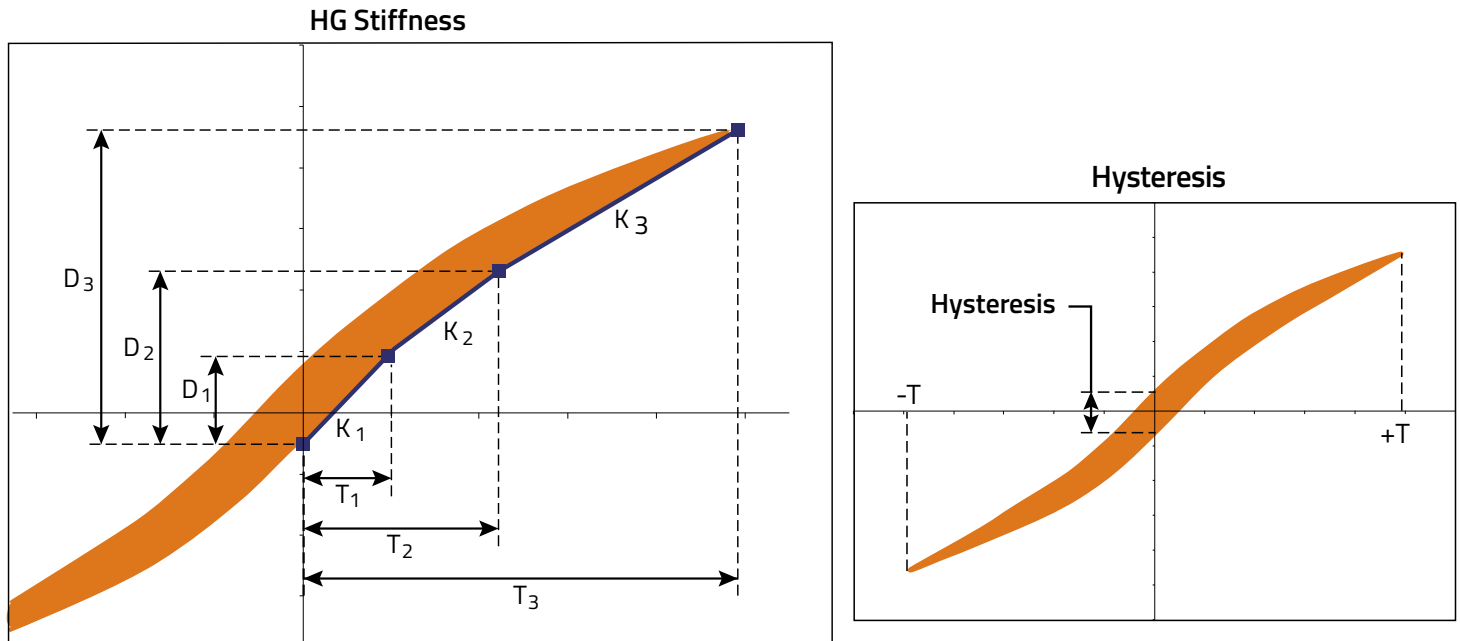
Cycle Limitations	
Input Speed	Time at Max Input Speed $\leq 10$ seconds ( $t_2$ )
	Time above Max Average Input Speed $\leq 30$ seconds ( $t_1$ )
	Average over any 2 minutes $\leq$ Max Average Input Speed
Output Torque	Time at Max Acceleration Torque $\leq 10$ seconds ( $t_3$ )
	Time above Max Average Torque $\leq 10$ seconds
	Average over any 2 minutes $\leq$ Max Average Torque

Example Cycle



## HG/HGP Torsional Stiffness

Unlike many other gearing types, Harmonic Gearhead stiffness is non-linear. As torque increases, stiffness also increases, as shown in the graph below. NOTE: If you wish to calculate "windup" at torque greater than  $T_1$ , remember to include the displacement caused by lower stiffness regions.



### HG and HGP Stiffness Data

Torsional stiffness is determined by applying a torque to the output of the gearhead while the input is held from rotation. For ease of calculation, the slope of the curve is approximated using three straight lines representing stiffness values  $K_1$ ,  $K_2$ , and  $K_3$ .

Refer to the tables below for the typical stiffness values for each size HG and HGP.

	Reference Torque (Nm)		Ref. Disp. (ArcMin)			Stiffness (Nm/ArcMin)		
				50:1	80:1 +		50:1	80:1 +
Size 17	$T_1$	3.9	$D_1$	1.66	1.44	$K_1$	2.36	2.70
	$T_2$	8.0	$D_2$	2.94	2.81	$K_2$	3.20	3.00
	$T_3$	35.0	$D_3$	10.08	10.99	$K_3$	3.78	3.30
Size 25	$T_1$	14.0	$D_1$	2.00	2.12	$K_1$	7.00	6.60
	$T_2$	48.0	$D_2$	6.53	6.98	$K_2$	7.50	7.00
	$T_3$	90	$D_3$	11.20	11.98	$K_3$	9.00	8.40

	Reference Torque (Nm)		Ref. Disp. (ArcMin)			Stiffness (Nm/ArcMin)		
				50:1	80:1 +		50:1	80:1 +
Size 32	$T_1$	52.0	$D_1$	3.11	2.81	$K_1$	16.70	18.50
	$T_2$	108.0	$D_2$	6.06	4.81	$K_2$	19.00	28.00
	$T_3$	178.0	$D_3$	8.52	6.93	$K_3$	28.50	33.00
Size 50	$T_1$	108.0	$D_1$	NA	1.66	$K_1$	NA	65.00
	$T_2$	382.0	$D_2$		5.81	$K_2$		66.00
	$T_3$	688.0	$D_3$		10.38	$K_3$		67.00

### Hysteresis

Hysteresis is measured by applying maximum average torque in both directions on the output with the input locked. Typical values are provided in the table to the below.

Hysteresis (ArcSec)			
Size 17	Size 25	Size 32	Size 50
90	90	60	60

## HG Output Loading

Harmonic Gearheads come equipped with a cross roller bearing on the output, offering high precision and large, load-carrying capabilities. Use the following information to verify that the selected gearhead meets all application load requirements.

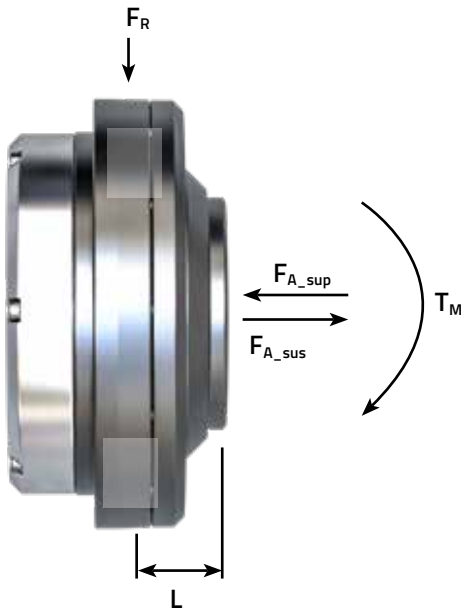


Table 9

Harmonic Gearhead Output Load Ratings		HG(P) 17	HG(P) 25	HG(P) 32	HG(P) 50
Bearing Constant ( $C_b$ )	$m^{-1}$	31.25	23.81	18.52	11.90
Bearing Center Distance to Flange (L)	m	0.0185	0.0255	0.029	0.0425
Max Axial Suspended Load ( $F_{A\_sus\_max}$ )	N	450	1100	1550	4500
Max Axial Supported Load ( $F_{A\_sup\_max}$ )	N	10100	11700	19000	45400
Max Radial Load ( $F_{R\_max}$ )	N	2220	3180	4220	12200
Max Moment Load ( $T_{M\_max}$ )	Nm	170	270	450	1590
Max Combined Load ( $P_{c\_max}$ )	N	6800	7900	12800	30450

## Single vs. Multiple Load Direction

### Single Loading Direction

If only one loading direction applies to your application, simply compare the maximum application load with the HG ratings above to ensure that the gearhead is capable of withstanding the application load.

### Multiple Loading Directions

When two or more loading directions apply, calculate the combined load using radial, axial and moment load values. Record your application data and perform the calculations on the following page to determine the Combined Load ( $P_c$ ) of your application. Then compare this value with the Max Combined Load in Table 9 above.

NOTE: Although Combined Load is calculated using average loads, no load should exceed the maximum rated load for that loading direction.

## HG Output Loading (continued)

### Calculating Combined Load Requirements

Refer to the explanations and data on the preceding page to complete the following calculations to determine the combined load requirements of your application.

#### Step 1: Gather Application Data

Axial ( $F_A$ ), Radial ( $F_R$ ), and Moment ( $T_M$ ) Loads are application specific. Use the table below to record the average loads that the gearhead will be subjected to during operation.

Application Loads Required for Gearhead Selection	Customer Application Data (record your values below)	Sample Data (HG25)	Sample Application
<b>Average Axial Load (<math>F_A</math>)</b> [Either suspended ( $F_{A\_sus}$ ) or supported ( $F_{A\_sup}$ ), whichever is present in your application]	N	1000 N ( $F_{A\_sup}$ )	
<b>Average Radial Load (<math>F_R</math>)</b>	N	500 N	
<b>Average Moment Load (<math>T_M</math>)</b>	Nm	250 Nm	

#### Step 2: Calculate Combined Load on Bearing

Calculating a Combined Load simplifies a complex load scenario into a single value that characterizes the application and can be compared to the Maximum Combined Load ( $P_{C\_max}$ ) in the ratings table. Follow the steps below to find the Combined Load that characterizes your application.

<b>Radial/Moment Load (<math>F_{RM}</math>):</b> $F_{RM} = F_R + (C_B \cdot T_M)$	$F_{RM} = $ <input type="text" value="500"/> N + ( <input type="text" value="23.81"/> m <sup>-1</sup> • <input type="text" value="250"/> Nm )	<b>Radial/Moment Load (<math>F_{RM}</math>)</b> $F_{RM} = $ <input type="text" value="6452.5"/> N
--	---	--

Sample:  $F_{RM} = 500 \text{ N} + (23.81 \text{ m}^{-1} \cdot 250 \text{ Nm}) = 6452.5 \text{ N}$

Use this table to determine the correct value for X & Y to be used in the Combined Load equation below			
$\frac{F_A}{F_{RM}} = \frac{\text{N}}{\text{N}} = $ <input type="text" value="0.155"/>	If:	Then:	
		X	Y
	$\frac{F_A}{F_{RM}} \leq 1.5$	1	0.45
$\frac{F_A}{F_{RM}} > 1.5$		0.67	0.67

Sample:  $1000 \text{ N} \div 6452.5 \text{ N} = 0.155$  So, X = 1 & Y = 0.45

<b>Combined Load (<math>P_C</math>):</b> $P_C = (X \cdot F_{RM}) + (Y \cdot F_A)$	$P_C = ( $ <input type="text" value="1"/> $ \cdot $ <input type="text" value="6452.5"/> N $ ) + ( $ <input type="text" value="0.45"/> $ \cdot $ <input type="text" value="1000"/> N $ )$	<b>Combined Load (<math>P_C</math>)</b> $P_C = $ <input type="text" value="6902.5"/> N
--	--	---

Sample:  $P_C = (1 \cdot 6452.5 \text{ N}) + (0.45 \cdot 1000 \text{ N}) = 6902.5 \text{ N}$

#### Step 3: Verify Appropriate HG Size

Compare the calculated Combined Load ( $P_C$ ) value with the Max Combined Load ( $P_{C\_max}$ ) found in Table 9 to verify whether the selected HG size meets your application load requirements.

NOTE: Consult Nexen if application subjects the HG output to significant vibrations or impact loading.

## HG /HGP Efficiency

Gearhead efficiency is dependent on many factors, including temperature, speed, torque, and lubrication type. However, the biggest contributor to efficiency loss is running torque, therefore the following calculations focus on your application torque. As is true with any system, efficiency calculations are merely estimations and should be treated as such.

### Step 1: Calculate the Torque Ratio

To find the Torque Ratio, divide your application torque by the maximum average torque.

- Refer to the HG Specifications Table to find max average torque values.
- Determine the torque on which you want to base your efficiency ratings.

Application Torque ( $T_{AP}$ )	Max Torque ( $T_{MAX}$ )
Sample: 12 Nm	Sample: 25 Nm

Torque Ratio: $R = \frac{T_{AP}}{T_{MAX}}$	$R =$	Torque Ratio $R =$
--	-------	-----------------------

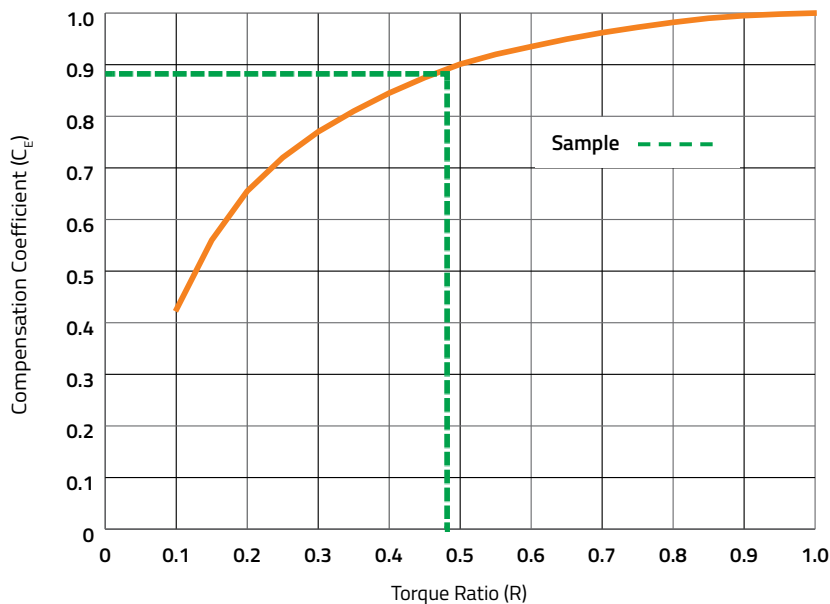
Sample:  $R = 12 \div 25 = 0.48$

### Step 2: Find the Efficiency Compensation Coefficient ( $C_E$ )

Use the graph below to determine the Compensation Coefficient ( $C_E$ ).

- Mark on the x-axis the Torque Ratio ( $R$ ) value calculated in Step One.
- Draw a vertical line from this point until it intersects the curve.
- From the intersection point marked on the curve, draw a horizontal line to the y-axis.
- Record the value at this y-axis intersection point as the Compensation Coefficient ( $C_E$ ).

Efficiency Compensation Coefficient Graph



Compensation Coefficient
$C_E =$

Sample:  $C_E = 0.88$

### Step 3: Calculate Expected Application Efficiency

To find the expected efficiency at your application torque, simply multiply the Efficiency Compensation Coefficient ( $C_E$ ) by the Efficiency at Max Torque ( $E_{T_{max}}$ ).

- Refer to the HG Specifications table to find the  $E_{T_{max}}$  value and record it in the equation below.

Expected Application Efficiency: $E_A = C_E \cdot E_{T_{MAX}}$	$E_A =$	$\cdot$	%	Expected Application Efficiency %
--	---------	---------	---	--------------------------------------

Sample:  $E_A = 0.88 \cdot 80\% = 70.4\%$

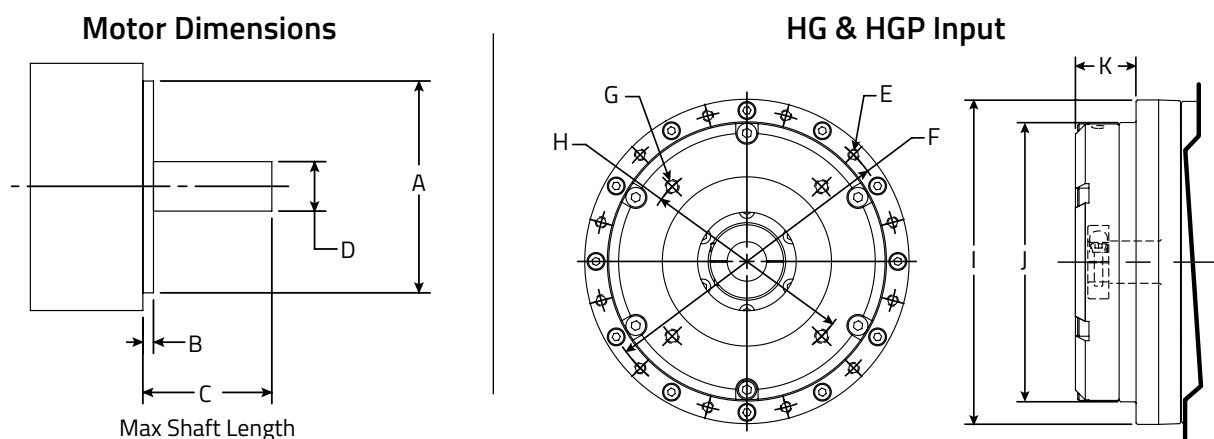


## Harmonic Gearhead Dimensional Drawings

### Sample Input Configuration

Input can be configured for user servomotor. Contact Nexen.

All dimensions shown in mm.



HG/HGP	A	B	C (max)	D	E	F	G	H	I (h7)	J (h7)	K
Size 17	Ø40	1.5 – 2.5	31.0	Ø9.0	M4 x 0.7 (12 holes)	Ø86.0	M4 x 0.7 (4 holes)	Ø63.0	Ø92.0	Ø75.0	24.0
Size 25	Ø60	2.0 – 3.0	36.5	Ø14.0	M4 x 0.7 (12 holes)	Ø107.0	M5 x 0.8 (4 holes)	Ø75.0	Ø115.0	Ø99.0	21.5
Size 32	Ø80	2.5 – 3.5	48.0	Ø19.0	M5 x 0.8 (12 holes)	Ø138.0	M6 x 1.0 (4 holes)	Ø100.0	Ø148.0	Ø125.0	29.0
Size 50	Ø130	2.5 – 4.2	64.0	Ø32.0	M8 x 1.25 (12 holes)	Ø212.0	M10 x 1.5 (4 holes)	Ø165.0	Ø225.0	Ø195.0	41.25

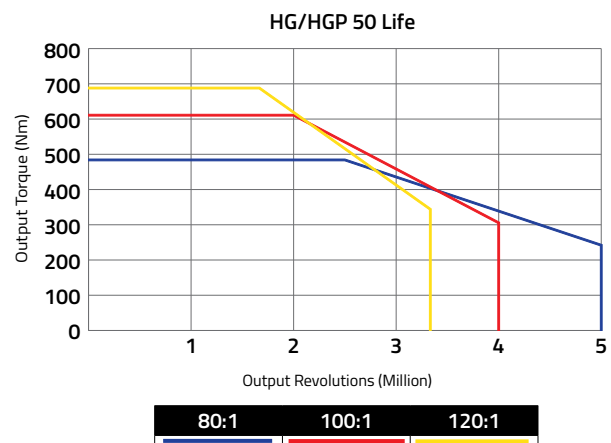
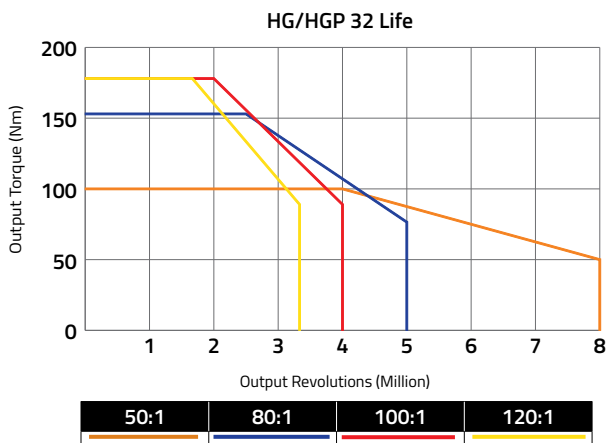
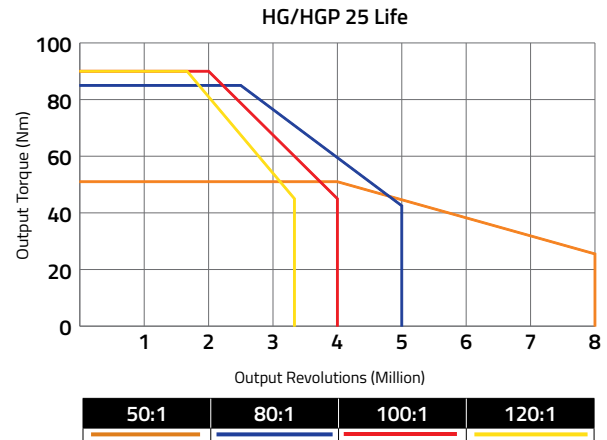
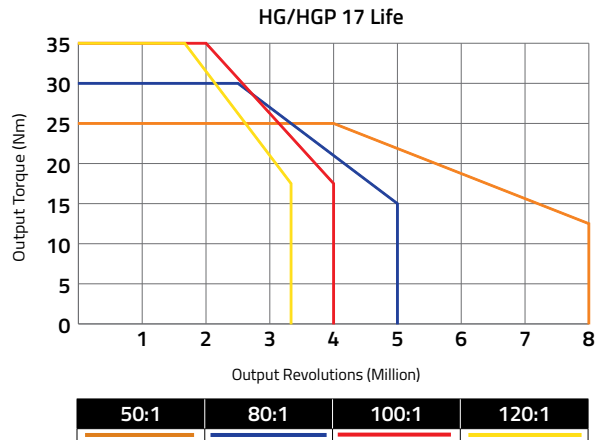
### Output Configuration

All dimensions shown in mm.

HGP Output				HG Output									
Size	L	M	N	Size	O (H7)	P	Q	R	S	T	U	V (H7)	W (h8)
HGP17	79.8	34.8	Ø67.0	HG17	Ø5.0 ↓5.0	M5 x .08 7 Holes	Ø31.5	52.0	7.0	6.13	4.0	Ø20.0	Ø40.0
HGP25	87.8	40.5	Ø84.0	HG25	Ø6.0 ↓6.0	M6 x 1.0 7 Holes	Ø50.0	60.3	13.0	6.5	6.0	Ø31.5	Ø63.0
HGP32	107.0	47.5	Ø101.0	HG32	Ø6.0 ↓6.0	M6 x 1.0 11 Holes	Ø63.0	74.0	14.5	6.5	6.0	Ø40.0	Ø80.0
HGP50	179.5	86.5	Ø190.0	HG50	Ø10.0 ↓10.0	M10 x 1.5 11 Holes	Ø125.0	108.3	15.3	8.5	8.0	Ø80.0	Ø160.0

## HG and HGP Life

Harmonic Gearhead life is based on average output torque and ratio.



## Input Motor Recommendations

### Allowable Motor Tilting Torque

Allowable motor tilting torque is defined as the combination of static and dynamic force acting through the motor's center of gravity, multiplied by the distance ( $d_{CG}$ ) to the HG motor adaptor mounting face.

**Note:** Do not subject the input coupling to an overhung load (example: pulley, sheave, etc.).

### Input Sealing

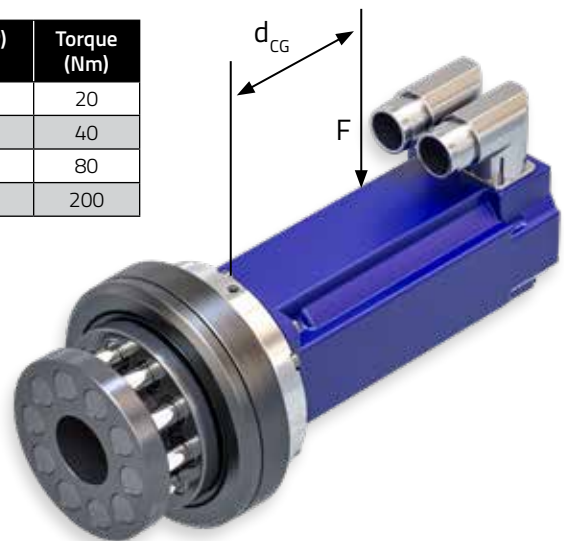
A gasket seal is positioned between the motor adaptor and the motor pilot to help seal the HG product from external dust and debris. Be sure to use a properly sized servo motor input flange. A servomotor with an oil seal on the output shaft is recommended.

**Note:** Consult Nexen in the following situations: a) before using a motor with an interrupted pilot; b) applications in which liquids or excessive dust are present and may ingress into the product.

### Heat Dissipation

To dissipate heat generated by the motor, Nexen recommends mounting the gearhead to a machine frame or heat sink. Refer to the table at the right for aluminum heat sink plate sizes used in testing by Nexen.

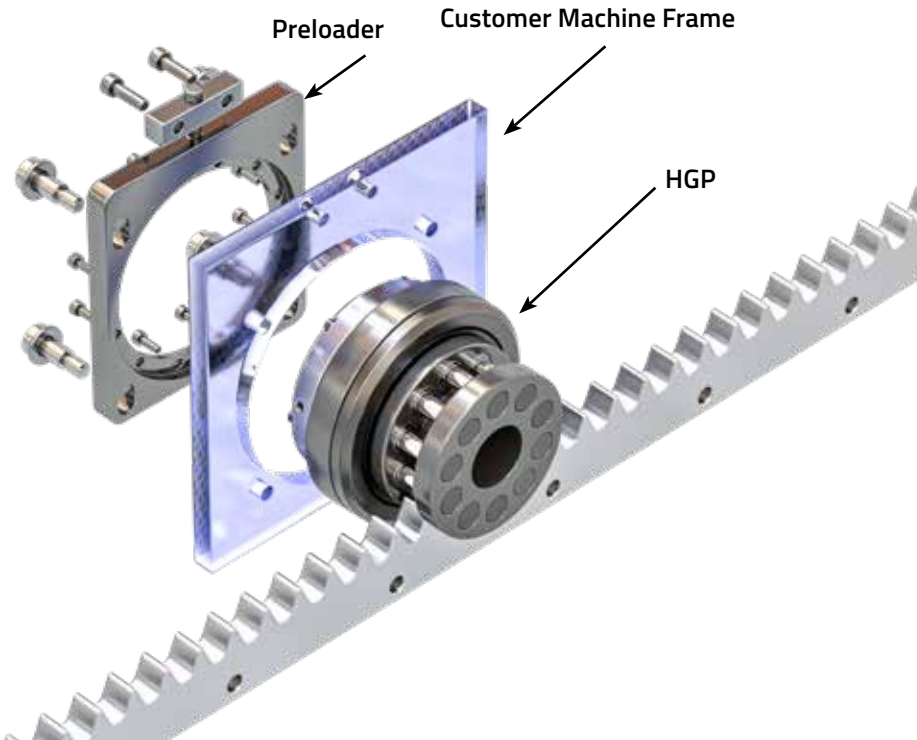
HG(P) Size	Torque (Nm)
17	20
25	40
32	80
50	200



Heat Sink Surface Area (m²)			
HG(P)17	HG(P)25	HG(P)32	HG(P)50
0.11	0.14	0.14	0.27

## HGP Preloader

Pair Nexen's Harmonic Gearhead with our HG Preloader for easy integration into your machine design. Preloaders feature an adjuster that allows the HGP to be moved up or down into the rack while keeping the pinion properly oriented to the rack.



Preloader components are made of an alloy steel with a corrosion-resistant nickel finish.

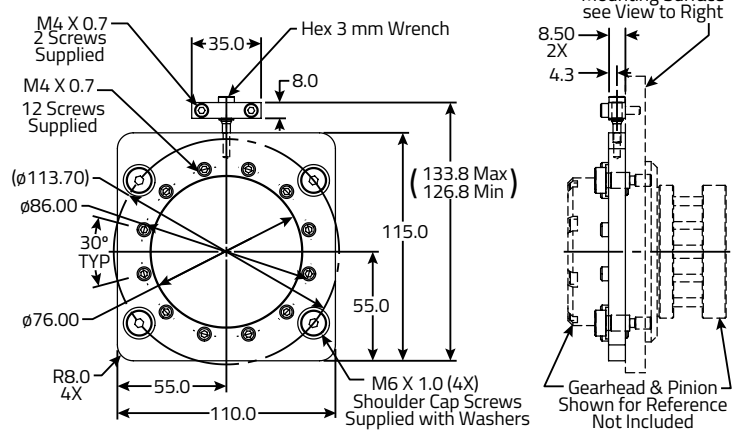
- High-Precision Ground Surfaces
- Allows Perpendicular Movement
- Corrosion Resistant Materials

## HGP Preloader Dimensional Drawings

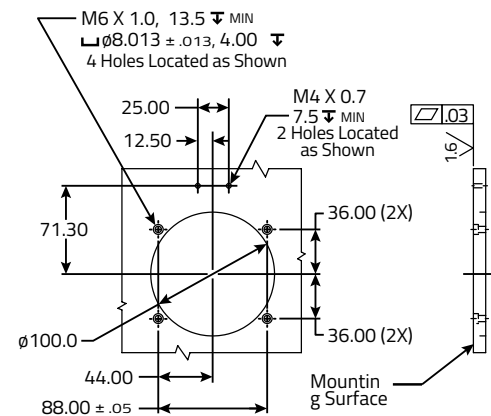
### HGP17 Product Number 960870

All dimensions shown in mm.

#### Preloader Details



#### Customer Mounting Surface Details

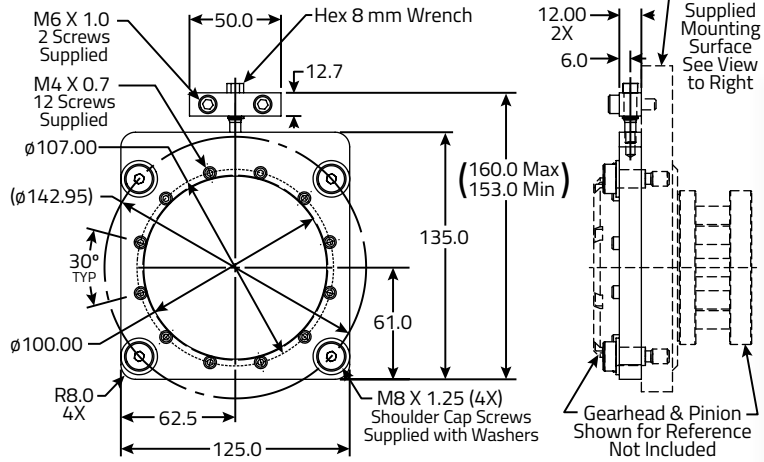


## HGP Preloader Dimensional Drawings (continued)

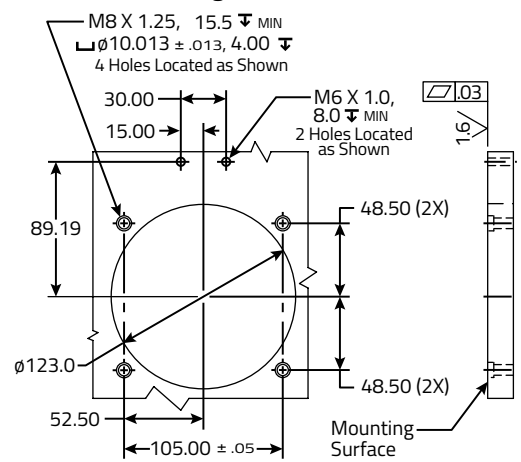
### HGP25 Product Number 960872

All dimensions shown in mm.

#### Preloader Details

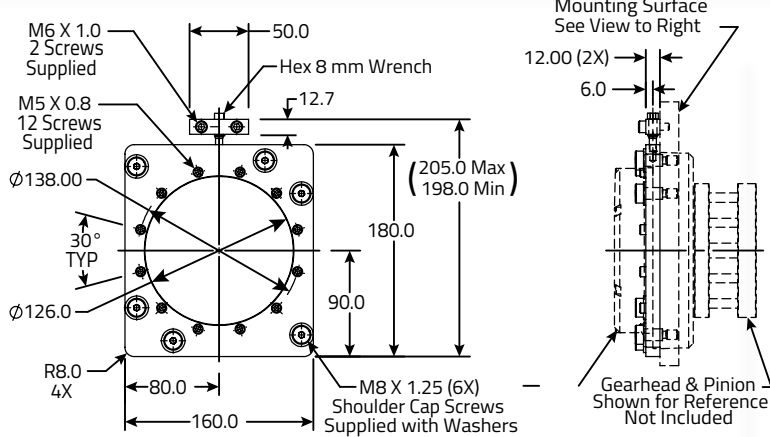


#### Customer Mounting Surface Details

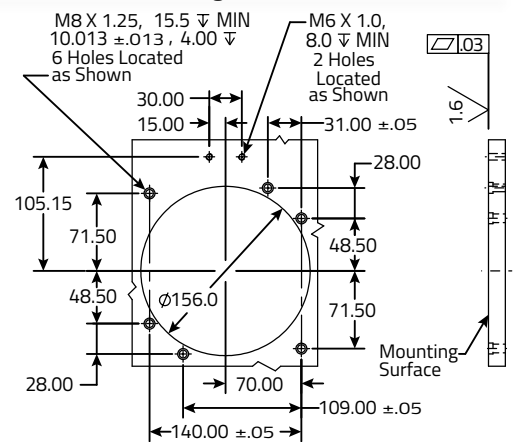


### HGP32 Product Number 960873

#### Preloader Details

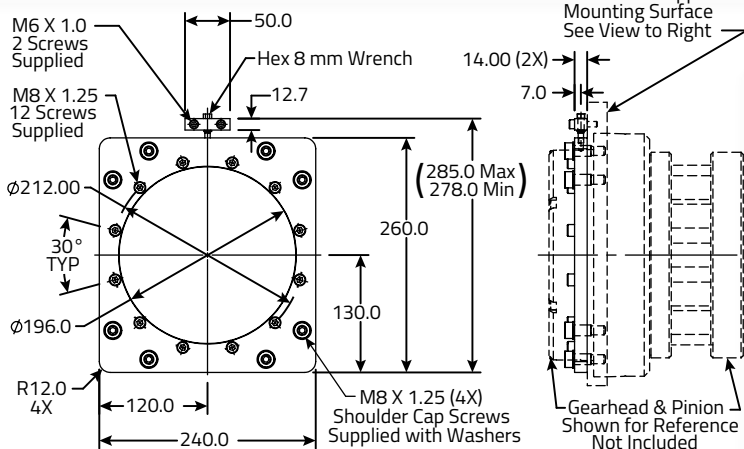


#### Customer Mounting Surface Details

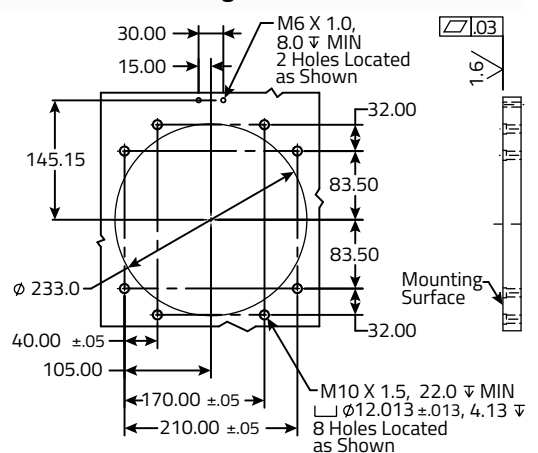


### HGP50 Product Number 960875

#### Preloader Details



#### Customer Mounting Surface Details



[illegible]

# Appendix: Understanding the Technology

## ArcSecond

ArcSecond is a unit of angular measurement equal to  $\frac{1}{3600}$  of a degree.

## Backlash

The innovative design of the RPS tooth allows for a zero-backlash drive system. Because zero backlash is impossible to measure, industry standard maintains that anything under 3.2 microns is considered zero.

## Corrosion Resistance

Nexen makes no corrosion resistance claims for specific applications but does offer various corrosion countermeasures that include stainless steel and various surface treatments or coatings. Nexen will convey all material and coating specifications, but it is up to the customer to determine application suitability based on this information and/or thorough sample testing.

## Efficiency

The RPS system uses needle bearings to support the rollers that engage the teeth. This eliminates the sliding friction found in many other motion control systems and gives it an efficiency greater than 99%. This high efficiency means little is lost to friction, heat, and wear, providing a long life of 60,000,000 pinion revolutions (up to 36 million meters of travel).

## Life Rating

Pinions: Pinion life is based on L10 of the bearing components. Just like any bearing, environmental conditions will affect life. The product rating is assuming a clean environment with normal manufacturing facility temperatures.

Pinion performance tends to be constant over its life with a rapid deterioration at the end of life as the needle bearings supporting the rollers fail.

Racks and Gears: The rack and gears have their own specific life ratings depending on model, and in some cases RPS size, and is based on tooth contacts at allowed loads and speeds. The combined pinion and rack or gear that makes up a given RPS or RPG system will have the combined life of the lower-rated component and will be greatly effected by machine design, RPS or RPG installation, operating patterns, and receiving recommended lubrication intervals while operated in a clean, dry, 20° C environment.

Rack wear is relatively linear over its life. Application and environmental conditions and lubrication intervals will impact expected product life. Depending on the length of the rack or diameter of the gear and usage patterns, it is often possible to replace the pinion several times, restoring full system performance before the rack or gear would need replacement if the pinion is replaced before reaching the point where its failure starts damaging rack or gear teeth.

## Lubrication Free Operation

In some cases the RPS rack can be operated without lubrication on the rack teeth or pinion rollers. This is dependent on the specific rack model and the maximum speed being less than 30 m/min. The no-lubrication option generally applies to rack that has received a surface treatment and does not apply to bare steel models of rack or any gearing. See specifications for the specific rack model you are considering to know if this is possible.

Operating without tooth/roller lubrication will reduce tooth life but can be beneficial in food, pharmaceutical, clean room, and other applications where the grease could contaminate the environment, or applications with high levels environmental contaminants that would be attracted to the grease and accelerate the wear rate. Nexen can not calculate a life rating when running without lubrication due to the number of variables that impact life, but based on past experience, the reduction has been modest and far exceeds other mechanical drive alternatives.

## Mass vs. Weight

Mass is the quantity of matter contained in an object, while weight is the force by which the object is pulled to the earth due to gravity. Therefore, in this literature, mass is shown in kilograms (kg) and weight is shown in kilograms force (kgf).

## Noise Rating

The RPS system is nearly silent at low speeds and typically less than 75 dB at full speed. This is dependent on machine design, proper RPS installation, whether lubrication is used or not, and is difficult to isolate from other drive train and guiding system noise, so your results may vary.

### **Operating Temperature Range**

This is the range that the RPS system will function in. Accuracy specifications are based on 20° C and thermal expansion/contraction will effect the accuracy of the RPS system. It is recommended the RPS system be installed at the highest temperature the system will be operated at and avoid wide temperature swings for maximum accuracy and performance. For applications outside of this temperature range, or with wide temperature swings, contact Nexen for more information.

### **Positional Accuracy**

This is dependent on proper machine design and RPS product installation. Positional accuracy is measured at 20° C and subject to variations due to mounting surface irregularities, rigidity, installation accuracy, proper maintenance, and ambient temperature. To be conservative, the RPS rack transmitting accuracy has been rounded up to the next  $\pm 10 \mu\text{m}$ . Other rack positional accuracy specifications have been rounded up to the next  $\pm 5 \mu\text{m}$ . For RPG gearsets, the angular accuracy rating is increased (less accurate) by 5% and then rounded to the next whole number, except in the case of very large gears where rounding may be fractional. This allows customers to achieve Nexen accuracy ratings with reasonable effort. Higher performance can be obtained if machine design and tolerances are optimized.

### **Series Differentiation**

The RPS and RPG pinions, racks and gears have been made in different series (thicknesses) depending on the specific product and should not be mixed when matching a pinion to a given rack or gear. All current pinions, racks and gears are B-series. Series A pinions (discontinued) are interchangeable with C-series pinions (discontinued) and have a wider body with longer rollers than the B-series pinions. The current rack and gear products only use B-series pinions, and the previous gears could use either depending on the RPG size. B-series pinions will not physically fit on a C-series gear, and a C-series pinion would be compromised if used on a B-series rack or gear due to a higher bending moment on the rollers, which would reduce their lives.

### **Shock Factor**

Shock Factor is a value given to represent the smoothness of operation. Accommodating for Shock Factor when calculating system requirements ensures more accurate product selection.



# Engineering Support

Nexen Group engineers and manufactures precision motion control for OEM machine designers, system integrators, and maintenance personnel, keeping equipment running trouble-free in the harshest environments.

Contact Nexen Group to see how our engineers can help design the must-have motion control products for your next project.



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