

# **PRECISION MOTION CONTROL**

Application & Selection Guide

**RPS** System

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# A New Standard For Precision

The Nexen Roller Pinion System (RPS) revolutionizes linear and rotary motion control possibilities. Giving a fresh face to traditional rack and pinion systems, the RPS overcomes the troublesome limitations of conventional drive systems and offers unmatched performance. Across industries as varied as laser cutting and mining, users will benefit from the accuracy and 99% efficiency of this new technology.

The incredible performance of the RPS starts with a pinion consisting of bearing-supported rollers that engage a unique tooth profile. Two or more rollers engage the teeth in opposition at all times to eliminate backlash. The pinion rollers glide easily along a tangent path and roll smoothly down the tooth face for quiet, low-friction operation.



#### Premium ±30 µm *Universal* ±50 μm *Standard* ±50 μm .003 in 75 µm Endurance ±80 µm .004 in 100 µm .006 in 150 µm .01 in 250 µm Versa ±500 µm .02 in 500 µm .03 in 750 µm 1000 µm .04 in .06 in 1500 µm

## **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. Even installation is worry-free with a simple alignment tool to ensure positional accuracy over multiple sections of rack.

## Dependable Performance. Every Time.

The Nexen RPS System Always Delivers.





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## THE NEXEN ADVANTAGE

Overcoming Common Problems Found in Traditional Drive Systems

INDUSTRY PROBLEMS	Ball Screws	Traditional Rack/Gear & Pinion Systems	Belt Drives	Chain Drives	Linear Motors Direct Rotary Stages Direct Drive Motors	ROLLER PINION SYSTEMS
Low Accuracy						High Positional Accuracy
Backlash / Vibrations		۲				Near-Zero Backlash
High Cost		•			۰	Economical, Efficient Components
Dirty Operation						No Dust Emissions
High Maintenance		۲			۲	Little to No Maintenance
Low Load Capacity					۲	High Load Capacity
Noisy	•	۰				Quiet: pinion rollers glide smoothly along teeth
Low Speed	•	•				High Speeds (up to 11 m/sec)
Magnetic Field					۲	No magnetic field
High Wear/ Low Life		•				Long Life (up to 36 million meters)
Limited System Length/Size						Custom Rack Sizes & Modular Components



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# **RPS SYSTEM**

Nexen 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.

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## **RPS System Configurations & Comparisons**

Nexen features six different rack models and two 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**

	As the name <i>premium</i> 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.								
PREMIUM RACK	Very High Precision/Accuracy     Suitable for Dirty Environments     Lubrication Free      High Load Capacity     High Corrosion Resistance								
	Precision Assembly Equipment • Machine Tool/CNC Mills • High Precision Gantry • Robotics								
	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.								
STANDARD RACK	High Precision/Accuracy     High Load Capacity     No Corrosion Resistance     Lower Cost than Premium Rack								
	Precision Assembly Equipment • Machine Tool/CNC Mills • High Precision Gantry • Robotics								
	This is the work horse of the product line, combining both high load capacity and good corrosion resistance.								
ENDURANCE RACK	High Load Capacity     Good Accuracy (not high precision)     Medium Corrosion Resistance								
	General Assembly Equipment • Machine Tool • Gantry Systems								
	With better accuracy than Endurance Racks, the Universal Rack is a great option for lower load applications when corrosion resistance is not required.								
UNIVERSAL RACK	High Accuracy     No Corrosion Resistance     Medium Load Capacity								
	Material Handling Equipment • Gantry Systems • Packaging Equipment • General Motion Control								
	Get all the features of the Universal Rack with the added benefits of corrosion resistant stainless steel.								
UNIVERSAL STAINLESS RACK	High Accuracy     Wet or Dirty Environments     Medium Load Capacity     Very High Corrosion Resistance								
	Material Handling Equipment • Gantry Systems • Packaging Equipment • General Motion Control								
	Made from thermoplastic, this rack can go places no other racks can go. It's wide range of applications make it a great fit for general motion control applications looking for the advantages of the RPS in a conventional accuracy version.								
VERSA RACK	<ul> <li>Extremely High Corrosion Resistance</li> <li>Light Load Motion Control</li> <li>High Durability</li> <li>Basic Actuator (similar to cylinder/belt)</li> </ul>								

## **Pinion Models Available**

PREMIUM PINION	This long time standard at Nexen offers the best precision on the market. Use with any RPS rack for unbeatable performance.  • Very High Precision/Accuracy • High Torque Capacity • Great Performance in Any Application
VALUE PINION	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.  • Lighter Load, General Accuracy Applications • Harsh Environments • Available in Sizes 16, 20 & 25

## **RPS System Specifications**

RPS Size		Premium Rack			Standard Rack		Endurance Rack			Universal & Universal Stainless Racks			Versa Rack			
		Accel.	Avg.	Static	Accel.	Avg.	Static	Accel.	Avg.	Static	Accel.	Avg.	Static	Accel.	Avg.	Static
	10	250	250	380	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S	12	500	500	750	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
INIC	16	2400	1000	2400	2400	1000	2400	1500	1000	2000	750	750	750	500	500	500
N P	20	2900	1500	3000	2900	1500	3000	2250	1500	3000	1125	1125	1125	750	750	750
I'LI	25	4000	2200	4400	4000	2200	4400	3300	2200	4400	1650	1650	1650	1100	1100	1100
SEN	32	6300	3600	7200	6300	3600	7200	5400	3600	7200	2700	2700	2700	NA	NA	NA
PR	40	6000	6000	12000	6000	6000	12000	6000	6000	12000	4500	4500	4500	NA	NA	NA
	4014	14000	14000	21000	14000	14000	21000	14000	14000	21000	10500	10500	10500	NA	NA	NA
ШŞ	16								500							
ALU	20								750							
20	25								1100							

#### Table 1 Rack Thrust Canacity (N)

#### **Pinion Torque (Nm)** Table 2

RPS Size	Peak Pini	on Torque	Maximum Average Pinion Torque for Full Life			
	Premium Pinion	Value Pinion	Premium Pinion	Value Pinion		
10	4.0	NA	4.0	NA		
12	9.5	NA	9.5	NA		
16	61.1	12.8	33.7	12.8		
20	92.3	23.9	52.5	23.9		
25	159.2	43.8	89.5	43.8		
32	385.0	NA	218.7	NA		
40	458.4	NA	458.4	NA		
4014	1247.8	NA	1247.8	NA		

#### Table 3 Accuracy & Repeatability

PINION TYPE	RACK	MODEL	Premium Rack	Standard Rack	Endurance Rack	Universal Rack & Universal Stainless	Versa Rack
Premium Pinion	Accuracy	±μm	30	50	80	50	500
	Repeatability	±μm	5	10	20	10	20
Value Pinion	Accuracy *	±μm	110	130	160	130	580
	Repeatability *	±μm	5	10	20	10	20

#### Table 4 Rack Model Attributes (NOT AFFECTED BY PINION CHOICE)

RACK MODEL	Premium Rack	Standard Rack	Endurance Rack	Universal Rack	Universal Stainless	Versa Rack	
Backlash* µm			0				
Corrosion Resistant Surface Treatment	Hard Chrome	None	Nitrided	None	None	Plastic	
Corrosion Resistance Rating	High	None	Medium	None	Very High	Extremely High	
Lubrication Free Operation	Yes up to 30 m/min	No	Yes up to 30 m/min	No	No	Yes up to max speed	
Noise Level dB	up to 75 (Speed Dependent)						
Temperature Range °C		-5 to 40					

\* 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. 7



# **RPS RACKS**

Nexen offers modular & custom rack sizes for unlimited system length. Choose from six rack models for a perfect fit in any application.

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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.



#### **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 ( <b>0<sub>H</sub>)</b> Refer to Figure 1.	o	60°
Maximum Velocity ( <b>V<sub>max)</sub></b>	m/s	0.5 m/s
Travel Distance (L) (single direction move)	m	5.4 m
Cycles Per Day( <b>N<sub>day</sub></b> ) (assumes single direction move)		1000
Acceleration Time ( <b>t</b> <sub>A</sub> ) or Known Acceleration	seconds m/s²	0.5 s
Weight to be Driven ( <b>W</b> )	kgf	150.0 kgf
Other Forces ( <b>F</b> <sub>1</sub> ), ( <b>F</b> <sub>2</sub> ) etc.	Ν	0 N
Shock Factor ( <b>K</b> ) Circle the value that best reflects the smoothness of your application.	Shockless Operation1.0Normal Operation1.2Operation with Impact1.5Operation with High Impact2.5	1.2
Frictional Coefficient (µ) Circle the value that best reflects your application.	Profile Guide Rail     0.005       Ball Bearing Guide Rail     0.02       Polymer Bushing Guide     0.1       Bronze Bushing Guide     0.2	0.01

#### **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
LOAD MASS: $\mathbf{M} = \mathbf{W}$ Use the total Weight to be Driven as your Load Mass value.			N	/ =	kg
<b>Sample:</b> <i>M</i> = 150.0 kgf = 150 kg			- 2		
<b>LOAD ACCELERATION:</b> $\mathbf{A} = \mathbf{V}_{max} \div \mathbf{t}_{\mathbf{A}}$ A known acceleration from a servo drive provider is preferred if ava	uilable. <b>A</b> =	m/s ÷	s	A =	m/s <sup>2</sup>
<b>Sample:</b> $A = 0.5 \text{ m/s} \div 0.5 \text{ s} = 1.0 \text{ m/s}^2$			F		
Force Due to Load Acceleration: $\mathbf{F}_{\mathbf{A}} = \mathbf{M} \cdot \mathbf{A}$	$\mathbf{F}_{\mathbf{A}} =$	kg •	m/s² F	_ =	N
<b>Sample: F</b> <sub>A</sub> = 150 kg • 1.0 m/s <sup>2</sup> = 150.0 N					
Force Due to Gravity: F <sub>g</sub> = M • g • sin(θ <sub>H</sub> )	<b>F</b> <sub><b>G</b></sub> = kg •	9.81 m/s² • sin(	) F	<sub>G</sub> =	N
<b>Sample: F</b> <sub>G</sub> = 150 kg • 9.81 m/s <sup>2</sup> • sin(60°) = 1274.4 N			- 6	Force Due	TO FRICTION
Force Due to Friction: $\mathbf{F}_{F} = \mathbf{M} \cdot \mathbf{\mu} \cdot \mathbf{g} \cdot \mathbf{cos}(\theta_{H})$ $\mathbf{F}_{F} =$	kg •	9.81 m/s² • cos(	) F	F =	N
<b>Sample:</b> $\mathbf{F}_{\mathbf{F}} = 150 \text{ kg} \cdot 0.01 \cdot 9.81 \text{ m/s}^2 \cdot \cos(60^\circ) = 7.4 \text{ N}$			- 2	Sum of	Forces
SUM OF FORCES: $F_s = F_A + F_G + F_F + F_1 + F_2 + \dots etc$ $F_s = N$	1 + N +	N + N +	N F	s =	N
<b>Sample: F</b> <sub>s</sub> = 150.0 N + 1274.4 N + 7.4 N = 1431.8 N			T	OTAL FORCE WITI	H SHOCK FACTOR
Total Force with Shock Factor: <b>F</b> <sub>T</sub> = <b>F</b> <sub>S</sub> • <b>K</b>	F,	- N •	F	÷ =	N
<b>Sample: F</b> <sub>T</sub> = 1431.8 N • 1.2 = 1718.2 N					
			_		

#### STEP 3: SELECTING A RACK MODEL

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

### 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.

#### 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 Size		e RPS10	RPS12	RP	S16	RP	S20	RP	S25	RP	S32	RP	S40	RPS	4014
Max Pres	sure Angle	° 26.4	26.4	2	7.9	2	26.4 2		6.4	26.0		26.0		26.0	
Avg Pres	vg Pressure Angle °		21.9	23.4		2	21.9		21.9		2.7	21.3		20.9	
Module	mr	mm 3.0 3.6 4.8 6.0		7.5 9.5		12.0		12.0							
Max	All Metal m/ Racks	s 4	8		4		5		8		1		6	6	
Speed *	Versa m/ Rack m/	s NA	NA		2		2		2		A	NA		NA	
Rack Too	ck Tooth Pitch mm 10 12 16 5		20	2	25	3	2	40		40					
Rack Hei	ight mr	n 27	27	3	0.5	4	2.0	4	B.O	57.0		7	2.6	6	9.0
Rack Wid	lth mr	n 5.7	5.7	1	1.5	1	5.5	1	8.5	24.5		3	1.5	4:	2.0
Rack Sec	ction Size	Half	Half	Half	Full	Half	Full	Half	Full	Half	Full	Half	Full	Half	Full
Rack Len	igth mr	n 480	480	512	992	500	1000	500	1000	512	992	520	1000	520	1000
Number	of Rack Teeth	Teeth         48         40         32         62         25         50		50	20	40	16	31	13	25	13	25			
Rack	All Metal k Racks k	g 0.5	0.6	1.1	2.1	2.1	4.1	2.7	5.4	4.2	8.2	6.9	13.2	8.8	17.0
Weight	Versa Rack k	g NA	NA	0.2	0.4	0.4	0.8	0.5	1.0	N	A	NA		NA	

### Table 5 Common Rack Specifications

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



	ŀ	4	В	С	D	E		F			н	J
	Rack Length		Rack	Hole	Hole From	Hole		Mounting Ho	oles	Rack	Tooth	Axis to
RPS Size	Half	Full	Thickness	Height	End	Spacing	Ø	# Half Rack	# Full Rack	Height	Pitch	Base
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	520	1000	31.5	16	80	120	18	4	8	72.6	40	129
RPS4014	520	1000	42.0	16	60	80	18	6	12	69.0	40	140

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

## **Rack Product Numbers**

RPS Size	e Rack Length Prem		Premium	Standard	Endurance	Universal	Universal Uncoated Stainless	Universal Coated Stainless	Versa				
10	Half	480 mm	966768	NA	NA	NA	Contact Nexen	Contact Nexen	NA				
10	Align	ment Tool		966507									
10	Half	480 mm	966769	NA	NA	NA	Contact Nexen	Contact Nexen	NA				
Alignment Tool			966508										
Half 512 m			966652	966602	Contact Nexen	966801	966760	966760 966742					
16	Full	992 mm	966651	966601	966850	966800	966813	966741	966860				
	Alignm	nent Tool				966503							
	Half	500 mm	966662	966612	Contact Nexen	966803	Contact Nexen	Contact Nexen	Contact Nexen				
<b>20</b> Full 1000 mm 966661 966611 966851 966802 966625 9666 <sup>1</sup>						966619	966861						
	Alignm	nent Tool		966513									
	Half 500 mm		966672	966622	Contact Nexen	966805	966805 Contact Nexen Contact Nex		Contact Nexen				
25	Full	1000 mm	966671	966621	966852	966804	966814	966755	966862				
	Alignm	nent Tool		966523									
	Half	512 mm	966682	82 966632 Contact Nexen 966807 Contact Nexen Contact Nexe		Contact Nexen	NA						
32	Full	992 mm	966681	966631	966853	966806	966812	Contact Nexen	NA				
	Alignm	nent Tool				966533							
	Half	520 mm	966692	966642	Contact Nexen	966809	Contact Nexen	Contact Nexen	NA				
40	Full	1000 mm	966691	966641	966854	966808	966815	Contact Nexen	NA				
	Alignm	nent Tool				966543							
	Half	520 mm	966695	966647	Contact Nexen	966811	Contact Nexen	Contact Nexen	NA				
4014	Full	1000 mm	966694	966646	966855	966810	966816	Contact Nexen	NA				
	Alignm	nent Tool				966543							
Ra	ck Grea	ase				853901							

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## **RPG GEARS**

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

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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. **If you don't find what you need, contact Nexen Group about a custom design.** 

#### **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 ( <b>θ<sub>н</sub></b> )	o	0°	:
Rotational Moment of Inertia (I)	kgm²	10.0 kgm²	
Indexes Per Revolution ( <b>N</b> <sub>I</sub> )	IPR	8 IPR	
Indexes Per Day ( <b>N<sub>day</sub></b> )		10800 RPD	
Index Time ( <b>t</b> <sub>ι</sub> ) or Known Angular Acceleration ( <b>α</b> )	seconds rad/s²	0.66 sec	
Weight to be Driven ( <b>W</b> ) Should include everything in motion.	kg	20.0 kg	
Dwell Time ( <b>t<sub>p</sub></b> )	seconds	0.33 sec	
Maximum Allowable Ring Gear OD ( <b>D<sub>max</sub>)</b>	mm	400 mm	
Minimum Allowable Ring Gear ID ( <b>D<sub>min</sub>)</b>	mm	200 mm	
Ring Gear Tooth Orientation (Select one)	external/internal	external	
Other Forces ( <b>T</b> <sub>1</sub> ), ( <b>T</b> <sub>2</sub> ) 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 Operation1.0Normal Operation1.2Operation with Impact1.5Operation with High Impact3.0	1.2	
Frictional Coefficient (µ) Circle the value that best reflects your application.	Rolling Bearing0.005~0.02Sliding Bearing0.1~0.2	0.01	
Diameter of Bearing Element ( <b>D</b> <sub>B</sub> )	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.

High Dust

#### **Other Key Application Information**

Application Description:

**Environmental Conditions:** 

nditions: Typical Industrial

Positional Accuracy Requirements:

High Humidity

High Temperature

#### 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.



#### **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	4014
PREMIUM PINION	@ Min Life	250	500	2400	2900	4000	6300	6000	14000
Dynamic Thrust (N)	@ Max Life	250	500	1000	1500	2200	3600	6000	14000
VALUE PINION Dynamic Thrust (N)		N	A	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.



## **Gear Specifications**

PDC	GGGear		Dinion	Maximum Dyn	amic Torque @	Max Static		Δοομερογ	Popostability
Size	Product	Ratio	Туре	Minimum Life	Maximum Life	Torque	Max RPM	Accuracy	Repeatability
	Number			Nm	Nm	Nm		ArcSec	ArcSec
	OCCECC	0.1	PREMIUM	183.3	101.1	183.3	500	+/- 84.2	+/- 14
	900000	3:1	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
		7.1	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
16	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
	966571	40:1	PREMIUM	508.0	508.0	508.0	38	+/- 0.4	+/- 1.1
			VALUE	508.0	508.0	508.0	19	T/- 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
20			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
	966789		VALUE	1290.6	1290.6	1290.6	12	+/- 13.7	+/- 0.6
	966789	68.4:1	PREMIUM	1694.9	1624.9	1624.9	22	+/- 2.9	+/- 0.5
			DDEMUIN	83070	4725.0	8595.0	17	+/- 10.7	+/- 0.3
	966787	90:1	VALUE	2151.0	2151.0	2151.0	7	+/- 8.2	+/- 0.4
			VALUE	2101.0	2101.0	2101.0	,	17 0.2	17 0.4
	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	706.0	184.0	184.0	120	+/- 14/	+/- 0.7
	966575	5:1	PREMIUM	790.0	447.5	220.0	06	+/- 32.3	+/- 5.4
25			DDEMUIN	250.0	537.0	1056.0	304	+/- 110.4	+/- 1.4
	966576	6:1	VALUE	276.0	276.0	276.0	80	+/- 98.8	+/- 4.5
			PREMILIM	1194.0	671.3	1320.0	243	+/- 21.5	+/-36
	966577	7.5:1	VALUE	345.0	345.0	345.0	64	+/- 78.9	+/- 3.6
			PREMIUM	7737.1	4349.7	8553.6	38	+/- 3.3	+/- 0.6
	966578	48.6:1	VALUE	2235.6	2235.6	2235.6	10	+/- 12.1	+/- 0.6
	966638	4.1	PREMILIM	1540.0	874 8	1760.0	430	+/- 26.5	+/- 4 4
	966639	725.1	PREMIUM	2791.3	1585.6	3190.0	238	+/- 14.6	+/- 2.4
32	066762	275.1	PREMIUM	144275	8001.2	16500.0	46	+/- 0.8	+/- 0.5
	900703	37.3.1	PREMIUM	14437.5	8201.3	16300.0	40	+/- 2.8	+/- 0.3
	900778	63.3:1	PREMIUM	24383.3	13851.0	27866.7	28	+/- 1.7	+/- 0.3
40	966791	4:1	PREMIUM	1833.6	1833.6	3667.2	188	+/- 21.0	+/- 3.5
40	966549	16.7:1	PREMIUM	7640.0	7640.0	15280.0	45	+/- 5.0	+/- 0.8
	966818	3:1	PREMIUM	3743.4	3743.4	5614.8	215	+/- 23.8	+/- 4.0
4014	966696	5.14:1	PREMIUM	6417.3	6417.3	9625.4	126	+/- 14.0	+/- 2.3
	966725	13.7.1	DEMILIM	17110 7	171127	256677	47	+/- 5.2	+/- 0.9
	000/20	1 10.7.1		17112.7	11112.1	20001.1		17 0.2	1, 0.0

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

## **Gear Dimensions & Specifications by Product Number**



Basic gear dimensions shown for selection purposes only and subject to change. Go to <u>www.nexengroup.com</u> 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.

D	imension	is shown ir	n <i>mm</i> unless	s otherwise		Α	В	С	D	E	F			
RPG Size	Gear Product	Alignment Tool Product	Teeth Orientation	Number of Teeth	Moment of Inertia	Weight	Figure	Coating	Outer	Inner	Max Width	Bolt Circle Ø	Arc Length/	Distance from
	Number	Number		segment/ring	kgm <sup>2</sup>	kg			Dian	neter			T un King	Center
	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
16	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*	В	Hard Chrome	745	652	11.5	670	72°/yes	390
	966571	966656	external	25/400	1.64*	1.8*	В	Hard Chrome	1954	1830	11.5	1870	22.5°/yes	995
	966572	966706	external	28/140	0.48*	2.9*	В	Hard Chrome	880	770	15.5	810	72°/yes	462
	966798	966615	internal	25/150	0.86*	3.6*	С	Hard Chrome	1038	906	15.5	1013	60°/yes	430
20	966799	966734	external	30/180	0.76*	2.7*	В	Hard Chrome	1120	1020	15.5	1060	60°/yes	582
20	966793	966794	external	30/540	9.57*	3.6*	В	Hard Chrome	3338	3220	15.5	3250	20°/yes	1692
	966789	966790	internal	19/684	14.9*	3.2*	С	Hard Chrome	4400	4241	15.5	4354	10°/yes	2098
	966787	966788	external	30/900	36.3*	4.9*	В	Hard Chrome	5554	5392	15.5	5438	12°/yes	2800
	966573	NA	external	NA/30	0.04	4.5	А	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
25	966575	NA	external	NA/50	0.25	9.1	А	Hard Chrome	404	260	18.5	285	360°/yes	230
25	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
	966578	966740	external	27/486	15.7*	4.6*	В	Hard Chrome	3760	3640	18.5	3684	20°/yes	1908
	966638	NA	external	NA/48	0.69	16.6	Α	Hard Chrome	493	330	24.5	360	360°/yes	292
20	966639	NA	external	NA/87	4.4	27.8	A	Black Oxide	874	730	24.5	770	360°/yes	482
32	966763	966685	external	18/450	35.7*	7.7*	В	Hard Chrome	4400	4220	24.5	4280	14.4°/yes	2246
	966778	966779	external	19/760	112.8*	8.4*	В	Hard Chrome	7428	7250	24.5	7310	9°/yes	3760
10	966791	NA	external	NA/48	2.5	39.2	А	Hard Chrome	622	390	35.5	430	360°/yes	369
40	966549	966546	external	11/200	9.1*	6.4*	В	Hard Chrome	2482	2320	31.5	2360	19.8°/no	1300
	966818	NA	external	NA/42	1.69	31.5	Α	Hard Chrome	551	390	46	430	360°/yes	346
4014	966696	966547	external	18/72	2.82*	17.3*	В	Hard Chrome	916	711.2	42	785	90°/yes	529
	966725	966548	external	12/192	12.5*	9.4*	В	Hard Chrome	2392	2230	42	2270	22.5°/yes	1268

\* Per Segment



# **RPS ROLLER PINION**

Once you have selected your rack/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.

Pinion Selection Process 2	2
Specifications 2	2
Dimensional Drawings 23-2	6
Pinion Accessories	
Adapters 2	7
Preloaders	9



## **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 flangemounted version when practical.

Product

#### Shaft Mount

RPS Number

Pinion

- Shaft Coupling or Shaft & Keyway mounting option

**Pitch Circle** 

Available in multiple bore diameters. Contact Nexen.

#### Flange Mount

Base Material/

Conforms to ISO 9409 specifications

Bore

Mass

Moment of

· Coupling option uses a keyless mechanical compression coupling to secure to shaft · Nexen adapter preloader options available with this version

Max

Distance per

Tuno	Cino	or	of Revolution Diameter RPM * Number Coating		wount Style	Size	( I	merua			
туре	Size	Rollers	mm	mm	RPM	Number	Coating		mm	kg	kgm²x10 <sup>-4</sup>
	10	10	100	31.8	2400	966480	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
						966819	Nickel	Shaft Coupling	16	0.7	3.9
			160			966650	Nickel	Shaft Coupling	20	0.7	3.9
	16	10		50.9	1500	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
						966820	Nickel	Shaft Coupling	22	1.4	10.6
						966660	Nickel	Shaft Coupling	25	1.3	10.5
	20	10	200	63.7	1500	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
SN						966670	Nickel	Shaft Coupling	30	2.1	25.5
ō	25	10	250	79.6	1820	966758	Stainless	Shaft Coupling	30	2.1	25.2
Z	25	10	200	79.0	1620	966673	Nickel	Flange	N/A	2.1	25.2
ЧЬ						Request	Stainless	Flange	N/A	2.1	25.2
2					1719	966821	Nickel	Shaft Coupling	32	7.3	173.0
Ξ <u></u>						966822	Nickel	Shaft Coupling	40	6.8	171.0
Ш	32	12	384	122.2		966680	Nickel	Shaft Coupling	45	6.4	169.0
Ъ	32					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
						966823	Nickel	Shaft Coupling	55	12.9	598.0
						966690	Nickel	Shaft Coupling	60	12.4	594.0
	40	12	480	152.8	750	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
						966824	Nickel	Shaft Coupling	55	21.4	1184.0
						966693	Nickel	Shaft Coupling	60	20.9	1180.0
	<b>4014</b> 14		560	178.3	643	Request	Stainless	Shaft Coupling	60	20.9	1180.0
						966700	Nickel	Flange	N/A	23.5	1306.0
						Request	Stainless	Flange	N/A	23.5	1306.0
ЧS	16	10	160	50.9	750	966826	Aluminum	Shaft & Keyway	16	0.4	2.4
ALU	20	10	200	63.7	600	966827	Aluminum	Shaft & Keyway	16	0.7	6.0
> II	<b>25</b> 10 250		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.

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Common Attributes for All Pinions									
Estimated Life	See System Life section.								
Operating Temperature Range °C	-5 to 40								
Lubrication/Tooth Grease	Part Number 853901								

### **Pinion Dimensions**

#### Additional **D**IMENSIONS

The Pinion dimensions listed here are for selection purposes only. For detailed drawings and CAD models, please visit www.nexengroup.com.

#### **PINION ADAPTERS**

Pinion adapters allow the pinion to mount to one frame-size larger of a reducer. Moving up a reducer size is sometimes needed due to reducer availability or motor sizing reasons. All Nexen pinion adapters are made from corrosion resistant materials or coatings. For your convenience, we have included pinion adapter dimensions next to each ISO9409 flange mounted pinion. See Table 6 for pinion adapter part numbers.

#### **RPS10** Premium Pinion



## **RPS12** Premium Pinion



### **RPS16** Premium Pinion



## **RPS16 Value Pinion**



### **RPS20** Premium Pinion



## **RPS20 Value Pinion**



#### **RPS25** Premium Pinion



### **RPS25 Value Pinion**



### **RPS32** Premium Pinion



### **RPS40** Premium Pinion



## **RPS4014** Premium Pinion



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### **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 your favorite servo gearhead manufacturer.

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

#### FEATURES:

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



### SELECTING PINION ADAPTERS AND PRELOADERS

If directly mounting the pinion to the reducer: Disregard the Adapter column and select the preloader and gearhead for your RPS Pinion size.

#### If going up a reducer frame size:

Start in the Adapter column and select the compatible pinion, adapter, preloader and gearhead.

## Table 6 Gearhead Compatibility Table

	Adapter w/ Pinion	Pinion			Cust	omer Provideo	d Gearhead		
Pinion Size	(not required in some applications)	Preloader	Alpha/ Wittenstein	APEX	Mijno	Neugart	SEW-Euro	Sumitomo	Stöber
RPS16	N/A	N/A	N/A	AD047	N/A	N/A	N/A	N/A	N/A
RPS20	RPS16 & 966688	960851	TP004	AD064	BDB 085	PLFE/N 64	PSBF221/2	N/A	PH/A/KX 321/2
RPS25	RPS20 & 966676	960850	TP010	AD090	BDB 120	PLFE/N 90	PSBF321/2	PNFX080	PH/A/KX 421/2
RPS32	RPS25 & 966674	960852	TP025	AD110	BDB 145	PLFE/N 110	PSBF521/2	PNFX250	PH/A/KX 521/2
RPS40	RPS32 & 966668	960853	TP050	AD140	BDB 180	PLFN 40	PSBF621/2	PNFX450	PH/A/KX 721/2
RPS4014	RPS40 & 966698	960854	TP110	AD200	BDB 250	PLFN 200	PSBF721/2	N/A	PH/A/KX 821/2
N/A	RPS4014 & 966701	N/A	TP300	AD255	BDB 300	N/A	N/A	N/A	PH/A/KX 912/23

This is a partial list. Other gearheads may apply.

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



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



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





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

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





## **PRECISION RING DRIVE SYSTEM**

CE

PATENTED

RoHS

Based on Nexen's innovative Roller Pinion technology, the Precision Ring Drive System (PRD) comes complete with a precision-grade bearing and gearhead for a system with unmatched performance and efficiency. With accelerations up to twice as high as other indexing technologies, the PRD system provides more productivity while boasting low maintenance and long life.

Features & Benefits	33
PRD Selection Process	34
Calculations	35
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Load Diagrams	39
Dimensional Drawing 4	10
Specifications	11

## The Nexen Precision Ring Drive Advantage

The Precision Ring Drive System (PRD) simplifies the selection process and includes all components needed for your rotary drive system. The PRD system offers all the great features of our other advanced RPS technology and opens up new design possibilities to next generation machines.

#### **High Indexing Precision**

With an indexing precision up to  $\pm$  11 ArcSec and repeatability up to  $\pm$  1.2 ArcSec, Nexen's PRD offers unmatched mechanical system capabilities.

#### **Unlimited Performance At Any Position**

Unlike some cam driven systems, the PRD can start and stop at any incremental position. Users can change the motion profile by simply loading a new servo drive program. The PRD also allows maximum acceleration or deceleration at any point without the risk of damage.

#### **High Load Capacity**

The PRD table is supported by a high capacity cross-roller bearing rated for loads up to 1575 kN.

#### Rigidity

The PRD provides very high system rigidity. An innovative design combination of a preloaded cross-roller bearing, RPS, and a precision gearbox create the high rigidity customers demand.

#### **High Speed & Acceleration**

The PRD is capable of speeds of up to 94 RPM. Unlike traditional cam driven systems, the PRD can handle peak torque inputs at any time. This allows for indexing times up to 2x faster than the competition.

## EASY SYSTEM INTEGRATION MINIMAL ONGOING MAINTENANCE



#### Large Open Center

The Ring Drive has a large open center that allows users to easily mount equipment and cabling in the center of the rotating plate.

Positioning Semiconductors Medical Products Robotics Courtesy of Steven Engineering, Inc. - (800) 258-9200 - sales@steveneng.com - www.stevenengineering.com

INDUSTRY PROBLEMS	Large, Open-Center Cam Indexers	Traditional Gearing	Belt Drives	Direct Drive Motors	<b>Nexen</b> . PRECISION RING DRIVE
Low Accuracy					High Positional Accuracy
Backlash /Vibrations					Near-Zero Backlash
High Cost					Economical & Efficient
Dirty Operation					No Dust or Oil Emissions
High Maintenance					Little to No Maintenance
Low Load Capacity					High Load Capacity
Noisy					Quiet
Low Speed	•				Speeds up to 94 RPM
Magnetic Field					No magnetic field
High Wear/Low Life					Long Life
Low Acceleration					Rapid Accelerations
Inefficient					99% Efficient
Poor Rigidity					High Rigidity
Mounting Restrictions					Mounting In Any Position

## Overcoming Common Problems Found in Other Drive Systems



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## **Precision Ring Drive Selection Process**

Nexen will work with you to select the perfect Precision Ring Drive for your application needs. Please fill in the application data below and perform the calculations on the following page. With this information, Nexen will select a PRD system to meet all your application requirements.



#### **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. (Refer to the diagram to the right when completing the table below.)

Measurements Required for PRD Selection	Customer Data (record your values below)	Sample Data	
Load Inertia (I)	kgm²	90 kgm²	
Index Time ( <b>t</b> <sub>I</sub> )	seconds	0.75 seconds	
Move Distance (0)	0	45°	
Maximum Axial Load ( <b>F<sub>axial</sub></b> )	kN	100 kN	
Maximum Radial Load ( <b>F<sub>radial</sub></b> )	kN	0 kN	
Maximum Moment Load ( <b>T</b> <sub>M</sub> )	kNm	5 kNm	
Other Applied Torque Loads ( <b>T</b> <sub>0</sub> ) May include table support friction, cutting or clamping forces, etc.	Nm	50 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	

#### **Other Key Application Information**

Application Description:						
Environmental Conditions:	Typical Industrial	High Humidity	🔲 High Tem	oerature	High Dust	
Positional Accuracy Requirements:						
Mounting Orientation:	Vertical (Radial Load	l) 🔲 Horizontal (A	pplied Load)	Horizontal (Suspended Load)		

#### STEP 2: CALCULATING PRD REQUIREMENTS FOR SIMPLE INDEXING APPLICATIONS

PRD selection is based on the torque requirements of your application. Using the information gathered on the preceding page, perform the following calculations. If your application movement is more complex than basic indexing, evaluate each stage of movement independently and perform separate calculations for each stage.



#### STEP 3: EVALUATE LOAD CARRYING CAPACITY

*Use the data for Maximum Axial Load, Maximum Radial Load, Maximum Moment Load, and Mounting Orientation to evaluate your load carrying needs against the load diagrams on the following pages.* 

To do this, find the set of charts that represents your mounting orientation, then graph your data in the appropriate charts(s) to ensure that your requirements fall into the shaded area representing load capacity available in that PRD size and orientation.

(NOTE: The weight of the PRD is already factored into the load charts.)

#### STEP 4: CHOOSE YOUR PRD SIZE

Use the Application Torque with Shock Factor requirement calculated in Step 2 and the load evaluation from Step 3 to select the PRD size that best fits your application. Review PRD Specifications to ensure the selected size meets all of your application requirements.

SELECTED PRD SIZE



NOTE: Curves assume no external forces such as additional table support friction, cutting forces, etc.





## PRD Load Diagrams (Suspended Load)





NOTE: The weight of the PRD is already factored into these charts.

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Precision Ring Drive Load Diagrams

## PRD Load Diagrams (Radial Load)



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Precision Ring Drive Load Diagrams

## **Precision Ring Drive Dimensions**



**NOTE**: Basic dimensions shown for selection purposes only and subject to change. Visit www.nexengroup.com for detailed drawings and CAD models before designing into your system. (All dimensions shown in mm.)

		PRD400	PRD750	PRD1100	PRD1500
Α	Minimum Outer Diameter	550	900	1350	1750
В	Maximum Inner Diameter	280	579	966	1330
С	Base Mounting Hole Circle Diameter	500	870	1325	1715
D	Dial Plate Bolt Pattern Circle Diameter	396	750	1100	1500
Е	Ring Drive Pilot Diameter	460	770	1150	1525
F	Dowel Pin Hole Circle For 6mm Pins	466	776	1156	1531
G	Drive Enclosure Envelope to Center Distance	363	543	770	970
н	Minimum Depth to Dial Plate Pilot	0	18.5	18.5	18.5
I	Maximum Depth to Dial Plate Pilot	7	24.5	24.5	24.5

## **Precision Ring Drive Specifications**

Performance Specifications		PRD400	PRD750	PRD1100	PRD1500	
Positional Accuracy*	±ArcSec	35	21	13	11	
One Way Repeatability*	±ArcSec	4.2	2.4	1.6	1.2	
Maximum Backlash*	±ArcSec	12	7	4	3	
Peak Torque at Output	Nm	563	968	1496	1936	
Maximum Velocity Output	RPM	94	54	35	27	
Maximum Acceleration	rad/sec <sup>2</sup>	414	110	30	17	
Input to Output Ratio (assuming 10:1 gearhead)		64:1	110:1	170:1	220:1	
Gear/Pinion Ratio		6.4:1	11:1	17:1	22:1	
Estimated Pinion & Ring Gear Life**		60 Million Contacts per Pinion Roller or 30 Million per Gear Tooth				
Output Inertia	kgm²	1.39	8.83	48.97	112.95	
Pinion Inertia	0.0025					
Total reflected inertia to gearbox output	kgm²	0.036	0.075	0.172	0.236	
Maximum Bearing Drag Torque	Nm	40	100	150	200	

\* All performance specifications assume using Nexen's standard 10:1 high precision reducer. Other customer specified reducers can be requested but will have an impact on the above specifications.

\*\* Life rating is an estimate based on maintaining published accuracy specifications while operating with allowable dynamic loading. Nexen does not guarantee life since it can be impacted by environmental conditions, and lubrication intervals.



## **RPS 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.

Pinion Life Data & Calculations	44–45
Rack Life Data & Calculations	46-47
System Life Graphs	48–50

## 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	RPS	16	RPS	20	RPS	25	DDC20	DDC40	DDC4014
			premium	value	premium	value	premium	value	RP332	KF 340	KF 34014
Max Torque (T <sub>max</sub> ) Nm	4.0	9.5	61.1	12.8	92.3	23.9	159.2	43.8	385.0	458.4	1247.8
Torque at Max Life (T <sub>final</sub> ) Nm	4.0	9.5	33.7	12.8	52.5	23.9	89.5	43.8	218.7	458.4	1247.8
Distance Per Revolution (Lrev) meters	0.1	0.12	0.16	0.16	0.2	0.2	0.25	0.25	0.384	0.48	0.56
Transition Point (E <sub>T</sub> ) million contacts	60	60	8	2	8.2	2	8.5	2	9.2	60	60
Max Life (N <sub>max contacts</sub> ) million contacts	60	60	60	2	60	2	60	2	60	60	60
Constant (C)	NA	NA	115.30	NA	179.43	NA	305.91	NA	747.91	NA	NA

#### **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 ( <b>T</b> <sub>avg</sub> )	Nm	85 Nm
Distance Per Cycle (L) (single direction move)	m	1.3 m
Average Speed ( <b>V</b> avg)	m/s	2 m/s

## STEP 2: CALCULATE THE TOTAL NUMBER OF PINION CONTACTS (N<sub>contacts</sub>)

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

#### PINION ROLLER CONTACTS (Ncontacts)

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.



Sample: (Evaluating RPS20 size) N<sub>contacts</sub> = (179.43 ÷ 85 Nm)<sup>3.333</sup> = 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 (Nhours)

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  $N_{hours}$  equation.

$\mathbf{E}_1 = \mathbf{L} \div \mathbf{L}_{rev}$ Must round $\mathbf{E}_1$ up to t	the nearest whole integer.	$r = round \left( up \right)$	m÷ m	) =		
<b>Sample: E</b> <sub>1</sub> = 1.3 m	$n \div 0.2 m = 6.5 m \longrightarrow F$	Round up to 7.				
$N_{hours} = (N_{contact})$	<sub>ts</sub> • 10 <sup>6</sup> • L) ÷ (3600 • E₁	• V <sub>avg</sub> )			Ρινιον	LIFE IN HOURS
$N_{hours} = ($	million contacts • 10 <sup>6</sup> •	m ) ÷ ( 3600 ·	• •	m/s )	N <sub>hours</sub> =	hrs
Sample: $N_{hours} = (1)$	$2 \cdot 10^6 \cdot 1.3 m$ ÷ (3600	• 7 • 2 $m/s$ = 309.5	hrs			

#### **ESTIMATION OPTIONS: PINION LIFE IN METERS & LIFE IN REVOLUTIONS**

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



PINION LIFE IN REVOLUTIONS (N <sub>rev</sub> ) N <sub>rev</sub> = N <sub>contacts</sub>	N <sub>rev</sub> =	million

Sample: N<sub>rev</sub> = 12 million revolutions

## **RPS Rack Life Data**

## Table 8 RPS Rack Life Values

	RPS Rack Size	RPS10	RPS12	RPS16	RPS20	RPS25	RPS32	RPS40	RPS4014
	Pitch (P) meters	0.01	0.012	0.016	0.02	0.025	0.032	0.04	0.04
Dista	nce Per Revolution (L <sub>rev</sub> ) meters	0.1	0.12	0.16	0.2	0.25	0.384	0.48	0.56
	Max Dynamic Thrust ( <b>F</b> <sub>max</sub> )	250	500	2400	2900	4000	6300	6000	14000
aium & Standard	Thrust at Max Life N ( <b>F</b> <sub>final</sub> )	250	500	1000	1500	2200	3600	6000	14000
	Transition Point million contacts	30	30	5	5	5	5	30	30
REMI	Max Life (N <sub>max contacts</sub> )				30 Millio	n Contacts			
"	Slope ( <b>m</b> )	NA	NA	-56	-56	-72	-108	NA	NA
	Intercept ( <b>b</b> ) N	NA	NA	2680	3180	4360	6840	NA	NA
	Max Dynamic Thrust N ( <b>F</b> <sub>max</sub> )	NA	NA	1500	2250	3300	5 400	6000	14000
UC E	Thrust at Max Life N ( <b>T</b> <sub>final</sub> )	NA	NA	1000	1500	2200	3600	6000	14000
ENDURAN	Transition Point million contacts	NA	NA	5	5	5	5	30	30
	Max Life ( <b>N</b> <sub>max contacts</sub> )	NA	NA			30 Millio	n Contacts		
	Slope ( <b>m</b> )	NA	NA	-20	-30	-44	-72	NA	NA
	Intercept (b) N	NA	NA	1600	2400	3520	5760	NA	NA
LL &	Max Dynamic Thrust ( <b>F</b> <sub>max</sub> )	NA	NA	750	1125	1650	2700	4500	10500
Univers⊿ ersal S1	Thrust at Max Life N ( <b>F</b> <sub>final</sub> )	NA	NA	750	1125	1650	2700	4500	10500
	Max Life (N <sub>max contacts</sub> )	NA	NA		5 Million	Contacts		2 Million	Contacts
	Max Dynamic Thrust (F <sub>max</sub> )	NA	NA	500	750	1100	NA	NA	NA
Vers/	Thrust at Max Life N	NA	NA	500	750	1100	NA	NA	NA
	Max Life (N <sub>max contacts</sub> )	NA	NA		2 Million	Contacts		1	A

### **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( <b>F</b> avg)	Ν	2500 N
Distance Per Cycle (L) (single direction move)	m	1.3 m
Average Speed ( <b>V</b> 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<sub>contacts</sub>)

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.



Sample: (Evaluating RPS20 size) N<sub>contacts</sub> = (2500 N - 3180) ÷ -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 (Nhours)

Use Table 5 along with the data you collected above to calculate the total number of service hours your rack can sustain before needing replacement.

$N_{hours} = (I$	$N_{\text{contacts}} \div 3600) \cdot (L \div V_{\text{avg}}) \cdot 10^6$			Rac	k Life in Hours
$\mathbf{N}_{\text{hours}} = ($	÷ 3600)•(	m÷	m/s)•10 <sup>6</sup>	$N_{hours} =$	hours
Samplar N	$-(10 \div 2600) \cdot (12 m \div 2 m(a))$	• 106 —	0166 hours		

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

## **RPS System Life Graphs** (RPS10, 12 & 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**







## RPS System Life Graphs (RPS40, 4014 & 50)

#### **RPS40 System Life Graph** LOAD FORCES Thrust Torque (N) (Nm) **RACK LIFE PINION LIFE** 12000 916.7 Premium, Standard & Endurance -10000 764.0 Premium Universal 8000 611.2 6000 458.4 4000 305.6 2000 152.8 0.0 0 10 20 0 20 40 ΰ 30 60 Tooth Contacts (Millions) **Roller Contacts (Millions)**

#### **RPS4014 System Life Graph**

#### LOAD FORCES





## 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.

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## The Nexen Harmonic Gearhead Advantage

Nexen's patent pending 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 & Repeatability
- Quiet Operation
- Large, Rugged Cross-Roller Output Bearing
- Compact









#### **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 the only 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 • 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.

Aerospace Robotics Semiconductor Factory Automation Medical / Surgical

#### HARMONIC GEARHEAD (HG)

Specificati	ons		HG	à17		HG25				HG	i32		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 Torque <sup>1</sup>	Nm	35	35	51	51	72	113	140	140	140	217	281	281	675	866	1057
Max Average Torque <sup>1</sup>	Nm	25	30	35	35	51	85	90	90	100	153	178	178	484	611	688
Inertia at Input	kg-cm <sup>2</sup>	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		(	C		0				(	C			0		
One Way Accuracy	±ArcSec		4	5		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)

Specifica	ations		HGP17			HGP25				HGP32				HGP50		
Integrated Pinio	on 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	Torque (Nm)	35	35	51	51	72	92	92	92	140	159	159	159		458	
Acceleration <sup>1</sup>	Thrust (N)	1374	1374	2003	2003	2262	2900	2900	2900	3519	4000	4000	4000		6000	
May Average1	Torque (Nm)	25	30	35	35	51	85	90	90	100	153	159	159		458	
Max Average	Thrust (N)	982	1178	1374	1374	1602	2670	2827	2827	2513	3845	4000	4000		6000	
Inertia at Input	kg-cm <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		(	)			(	C			(	0			0	
One Way Accuracy	± µm		2	5			2	5			2	!5			25	
One Way Repeatability	± µm		7.	5			7	.5		7.5		7.5		7.5		
Weight	/eight 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 & HGP UNITS**

Specifica	tions	Size 17	Size 25	Size 32	Size 50				
May la gut Ca a a di	cyclic RPM	7300	5600	4800	3500				
Max input Speed	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 Aver (E <sub>T_max</sub> )	age Torque	80% ±5%							
Stiffness, Hysteresis		See <b>Stiffness</b> 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 & HG	P 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**

Harmonic Gearhead

Cycle Types

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 <u>Cycle Types</u> are: **Continuous Motion &** Cyclic Motion

STEP 1: Determine which Cycle Type applies to your application.

#### STEP 2: Use the Cycle Limitations information to correctly size the Gearhead.





## **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 T1, 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  $K_1$ ,  $K_2$ , &  $K_3$ .

	Re	Reference		f. Disp. (/	ArcMin)	Stiffness (Nm/ArcMin)				
	Torc	<b>ue (</b> Nm <b>)</b>		50:1	80:1 +		50:1	80:1 +		
17	T <sub>1</sub>	3.9	D <sub>1</sub>	1.66	1.44	K <sub>1</sub>	2.36	2.70		
Se	T <sub>2</sub>	8.0	$D_2$	2.94	2.81	$K_2$	3.20	3.00		
Si	Тз	35.0	D <sub>3</sub>	10.08	10.99	K <sub>3</sub>	3.78	3.30		
25	T <sub>1</sub>	14.0	D <sub>1</sub>	2.00	2.12	K <sub>1</sub>	7.00	6.60		
ze	$T_2$	48.0	$D_2$	6.53	6.98	$K_2$	7.50	7.00		
Si	Тз	90	D <sub>3</sub>	11.20	11.98	K₃	9.00	8.40		

Refer t	to the	tables	below	for the	typical	stiffness	values	for ea	ich si	ze HG	and	HGP.

	Re	ference	Re	f. Disp. (/	ArcMin)	Stiff	<b>ness</b> (Nrr	n/ArcMin)
	Torque (Nm)			50:1			50:1	80:1 +
32	T <sub>1</sub>	52.0	D <sub>1</sub>	3.11	2.81	K <sub>1</sub>	16.70	18.50
A C	$T_2$	108.0	$D_2$	6.06	4.81	$K_2$	19.00	28.00
Si	Тз	178.0	D <sub>3</sub>	8.52	6.93	K <sub>3</sub>	28.50	33.00
20	<b>T</b> <sub>1</sub>	108.0	D <sub>1</sub>		1.66	K <sub>1</sub>		65.00
ze	$T_2$	382.0	$D_2$	NA	5.81	$K_2$	NA	66.00
Si	T <sub>3</sub>	688.0	D <sub>3</sub>		10.38	K₃		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 right.

Hysteresis (ArcSec)											
Size 17	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 Gea	rhead	Output Lo	ad Ratings	Table	
		HG(P)17	HG(P)25	HG(P)32	HG(P)50
Bearing Constant ( <b>C</b> <sub>B</sub> )	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 ( <b>F<sub>A_sus_max)</sub></b>	N	450	1100	1550	4500
Max Axial Supported Load ( <b>F<sub>A_sup_max</sub>)</b>	N	10100	11700	19000	45400
Max Radial Load ( <b>F<sub>R_max</sub>)</b>	Ν	2220	3180	4220	12200
Max Moment Load ( <b>T<sub>M_max</sub>)</b>	Nm	215	335	690	2550
Max Combined Load ( <b>P<sub>c_max</sub></b> )	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.

#### CALCULATING COMBINED LOAD REQUIREMENTS

Refer to the explainations 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
Average Axial Load ( <b>F</b> <sub>A</sub> ) [Either suspended ( <b>F</b> <sub>A_sus</sub> ) or supported ( <b>F</b> <sub>A_sup</sub> ), whichever is present in your application]	Ν	1000 N ( <b>F<sub>A_sup</sub></b> )	<b>F</b> <sub>A</sub> =1000 N
Average Radial Load ( <b>F</b> <sub>R</sub> )	Ν	500 N	0.5 m
Average Moment Load ( <b>T<sub>M</sub></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.



#### **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.

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



#### STEP 2: FIND THE EFFICIENCY COMPENSATION COEFFICIENT (C<sub>E</sub>)

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

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

#### EFFICIENCY COMPENSATION COEFFICIENT GRAPH



#### 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 ( $E_{T_max}$ ).

a. Refer to the HG Specifications table to find the  $E_{T_max}$  value and record it in the equation below.

				EXPECTED APPLICA	TION EFFICIENCY
Expected Application Efficiency: $\mathbf{E}_{\mathbf{A}} = \mathbf{C}_{\mathbf{E}} \cdot \mathbf{E}_{\mathbf{T}_{\text{max}}}$	$\mathbf{E}_{\mathbf{A}} =$	•	%	E <sub>A</sub> =	%
Sample: $E_A = 0.88 \cdot 80\% = 70.4\%$					

#### SAMPLE INPUT CONFIGURATION

Input will be configured for user servomotor.



HG/HGP	Α	В	C (max)	D	E	F	G	Н	l (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**





Harmonic Gearhead Dimensions

## HG & 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 servo motor 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	(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



Preloader

#### HGP17 Product Number 960870



HGP

Customer Machine Frame



Harmonic Gearhead Preloader

## HGP Preloader Dimensional Drawings (continued)

#### HGP25 Product Number 960872

All dimensions shown in mm.



### HGP32 Product Number 960873



#### HGP50 Product Number 960875

Harmonic Gearhead

Preloader



## **APPENDIX: UNDERSTANDING THE TECHNOLOGY**

The revolutionary technology of Nexen's line of precision motion control products is changing the industry. New standards for precision, efficiency and ease of use are being set. The following section goes even deeper into the performance characteristics of these products. You'll find details about:

ArcSecond Backlash Corrosion Resistance Efficiency Life Rating Lubrication Free Operation Mass vs. Weight Noise Rating Operating Temperature Range Positional Accuracy Series Differentiation Shock Factor

### Appendix: Definitions & Notes

#### ARCSECOND

ArcSecond is a unit of angular measurement equal to 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 & 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 contaminates 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  $\pm 10 \mu m$ . Other rack positional accuracy specifications have been rounded up to the next  $\pm 5 \mu m$ . 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.

CUTTING SYSTEMS GANTRY SYSTEMS MEDICAL PRODUCTS ROBOTICS AEROSPACE MACHINE TOOL SEMICONDUCTOR MATERIAL HANDLING

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FORM NO. L-21282-E-1014