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

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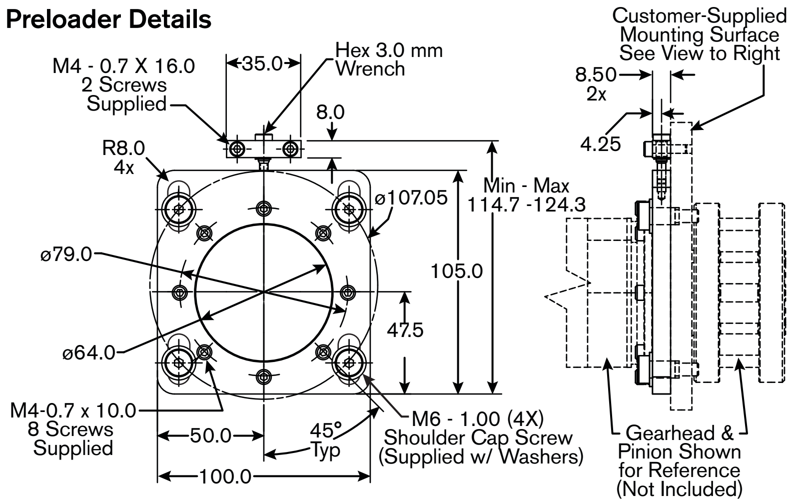
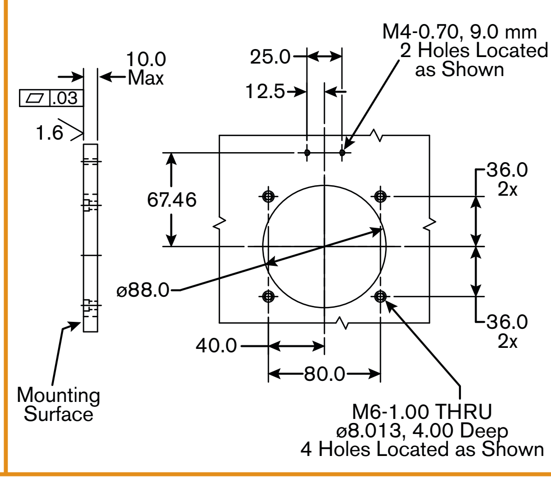


Customer Mounting Surface Details



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

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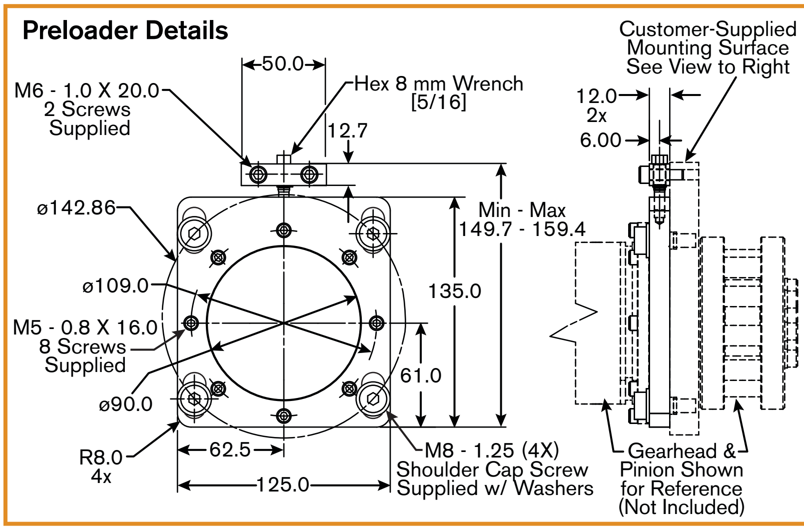

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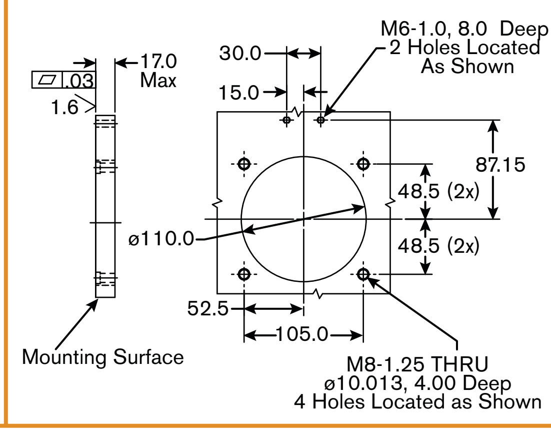

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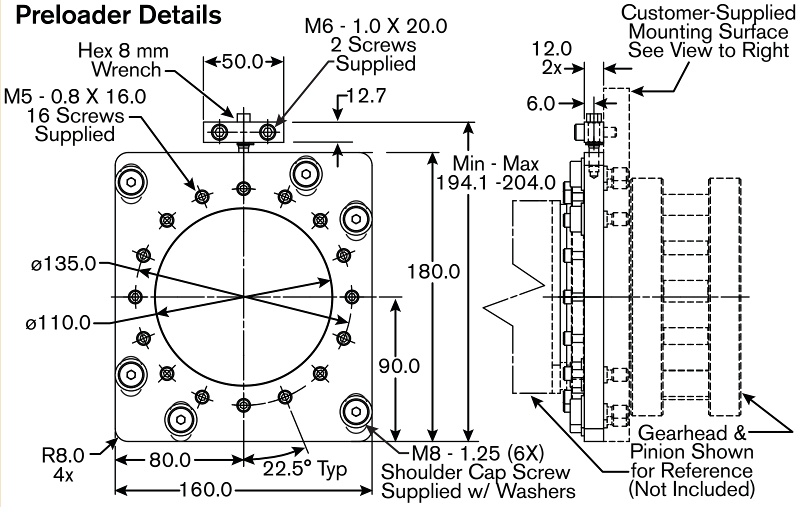
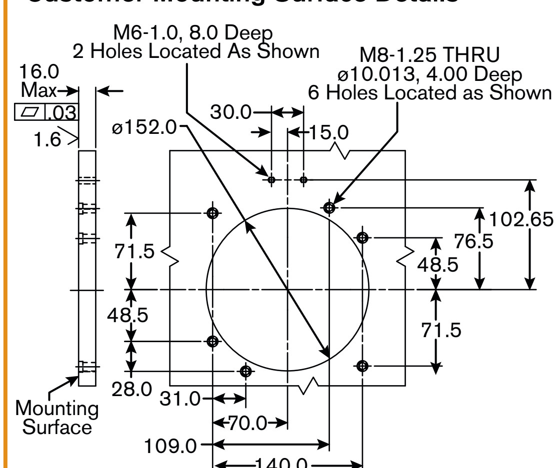


Customer Mounting Surface Details



Preloader Dimensions

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

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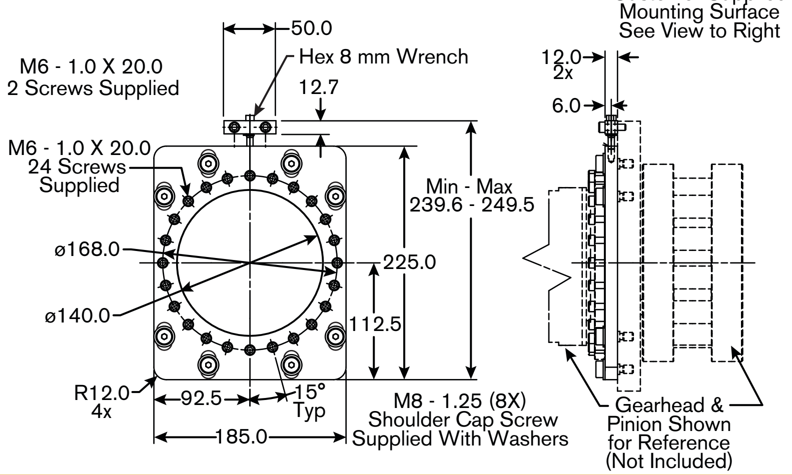
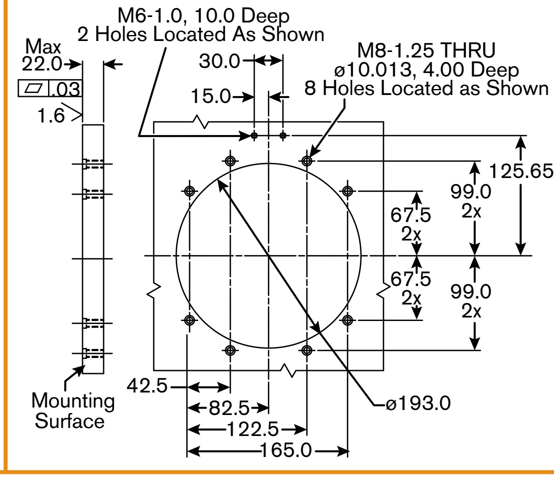


Customer Mounting Surface Details



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

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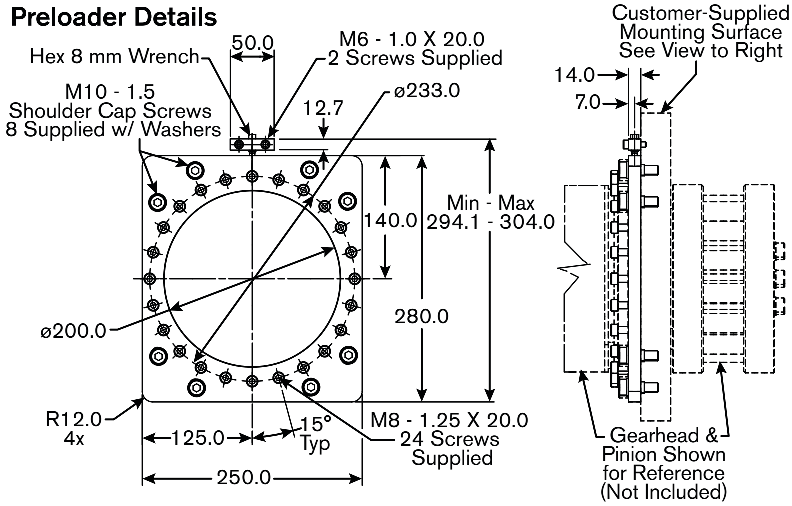
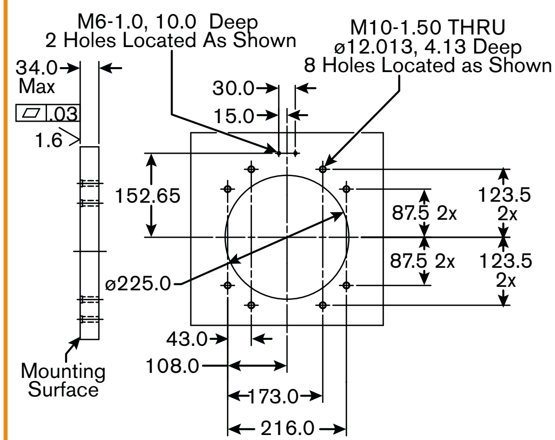


Customer Mounting Surface Details



Pinion Preloader

nexen

PRECISION RING DRIVE SYSTEM

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.

PATENTED

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 ± 11 ArcSec and repeatability up to ± 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.

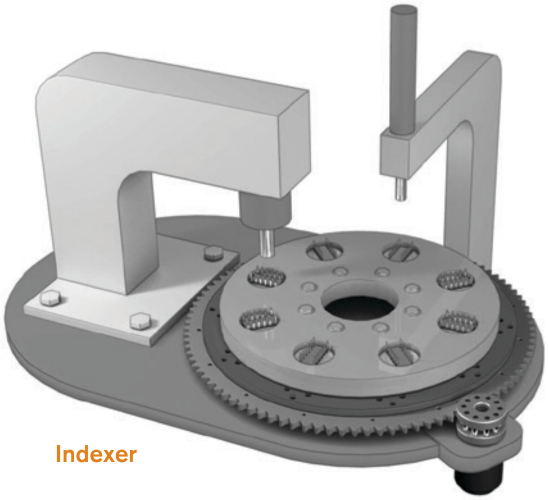
Rigidity

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



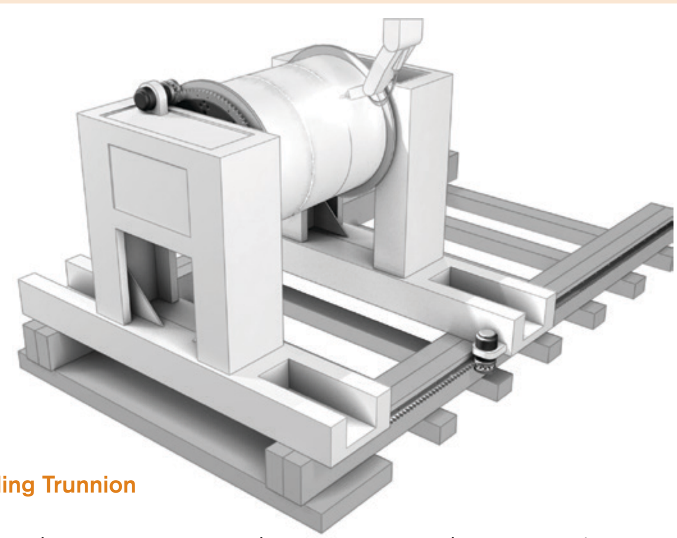
Indexer

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.

Overcoming Common Problems Found in Other Drive Systems

INDUSTRY PROBLEMS	Large, Open-Center Cam Indexers	Traditional Gearing	Belt Drives	Direct Drive Motors	nexen 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

Unlimited Mounting Configurations
The PRD does not require an oil bath as some other indexing technologies do, allowing it to be mounted in any orientation.

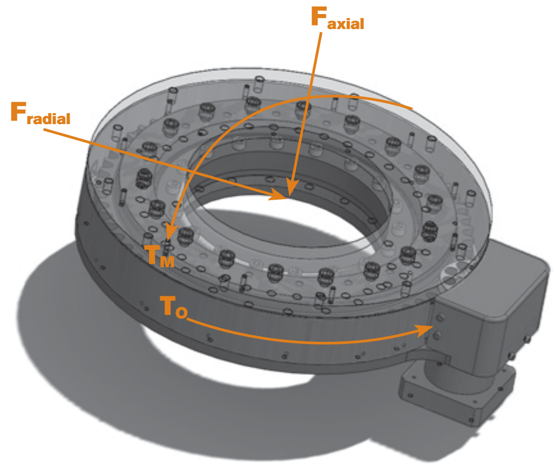


Welding Trunnion

DEPENDABLE. RELIABLE.
PERFORMANCE

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**)	kgm^2	*90 kgm^2*
Index Time (**t_I**)	seconds	*0.75 seconds*
Move Distance (**θ**)	°	*45°*
Maximum Axial Load (**F_{axial}**)	kN	*100 kN*
Maximum Radial Load (**F_{radial}**)	kN	*0 kN*
Maximum Moment Load (**T_M**)	kNm	*5 kNm*
Other Applied Torque Loads (**T_O**) 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 Temperature ☐ High Dust

Positional Accuracy Requirements:

Mounting Orientation: ☐ Vertical (Radial Load) ☐ Horizontal (Applied 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.

ACCELERATION TIME: $t_A = t_I \div 2$ $t_A =$ ____ sec $\div 2$ | ACCELERATION TIME: $t_A =$ ____ sec

Sample: t_A = 0.75 seconds ÷ 2 = 0.37 seconds

MAX ANGULAR SPEED: $\omega = (\theta \div t_I) \cdot (\pi \div 90)$ $\omega =$ (____ ° • ____ sec) • ($\pi \div 90$) | MAX ANGULAR SPEED: $\omega =$ ____ rad/sec

Sample: ω = (45° ÷ 0.75 seconds) • (π ÷ 90) = 2.09 rad/sec

ANGULAR ACCELERATION: $\alpha = \omega \div t_A$ $\alpha =$ ____ rad/sec ÷ ____ sec | ANGULAR ACCELERATION: $\alpha =$ ____ rad/s²

Sample: α = 2.09 rad/sec ÷ 0.37 sec = 5.65 rad/s²

APPLICATION TORQUE: $T_{gear} = (I \cdot \alpha) + T_O$ $T_{gear} =$ (____ kgm² • ____ rad/s²) + ____ Nm | RING GEAR TORQUE: $T_{gear} =$ ____ Nm

Sample: T_{gear} = (90 kgm² • 5.65 rad/s²) + 50 Nm = 558.5 Nm

APPLICATION TORQUE WITH SHOCK FACTOR: $T_T = T_{gear} \cdot K$ $T_T =$ ____ Nm • ____ | RING GEAR TORQUE W/ SHOCK FACTOR: $T_T =$ ____ Nm

Sample: T_T = 558.5 Nm • 1.2 = 670 Nm

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.)

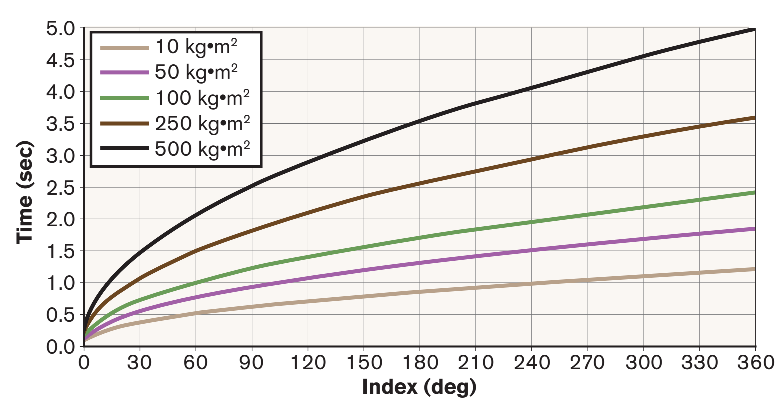
STEP 4: CHOOSE YOUR PRD SIZE

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.

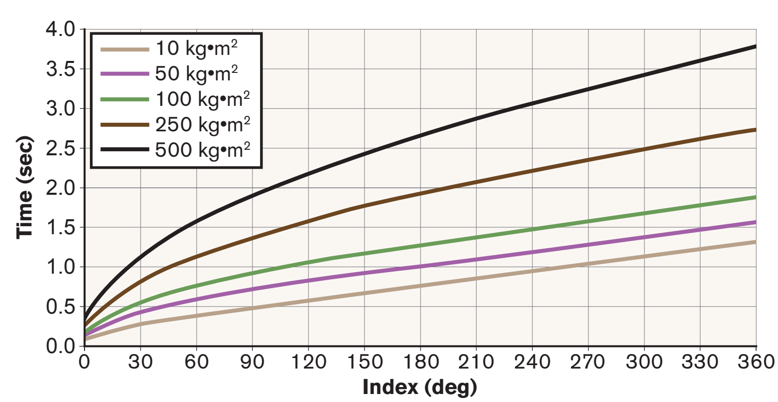
SELECTED PRD SIZE: ____

Precision Ring Drive Timing Diagrams

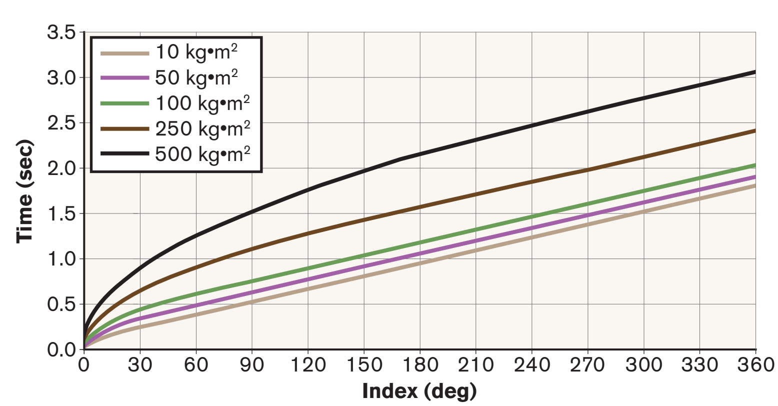
PRD400 Timing Diagram



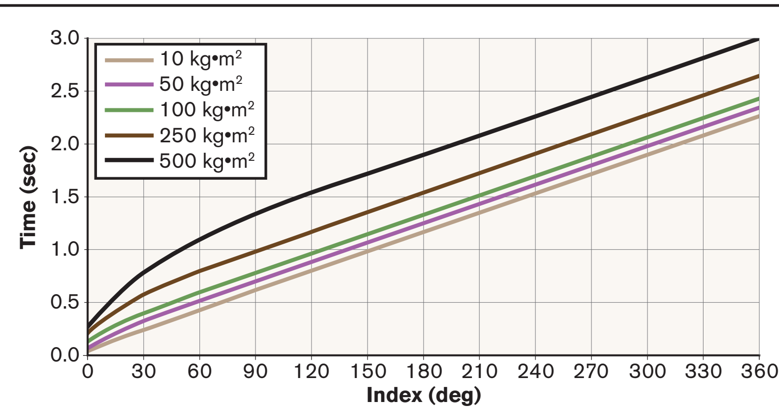
PRD750 Timing Diagram



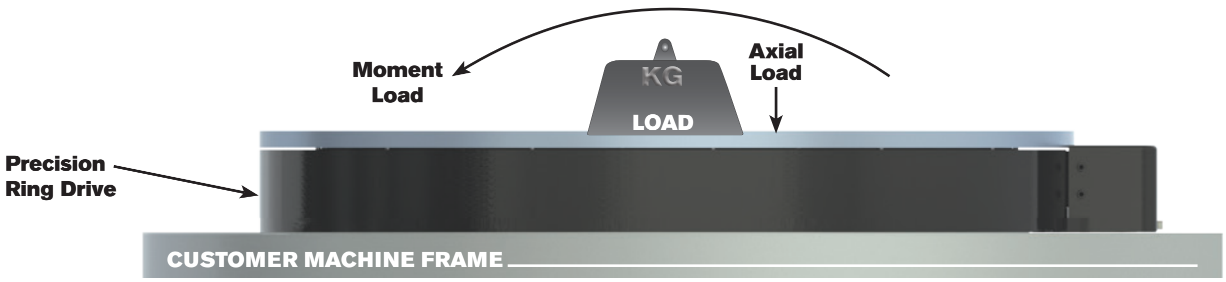
PRD1100 Timing Diagram



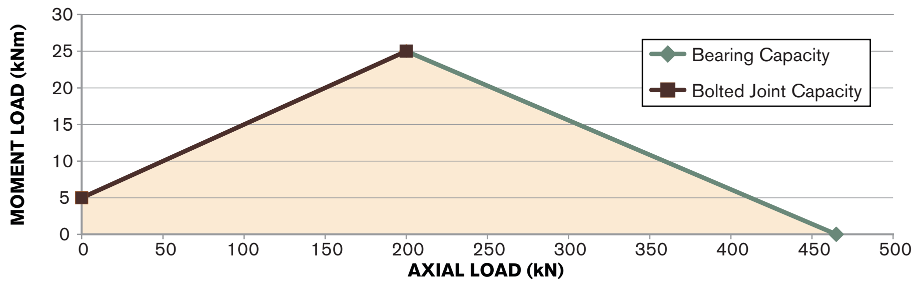
PRD1500 Timing Diagram



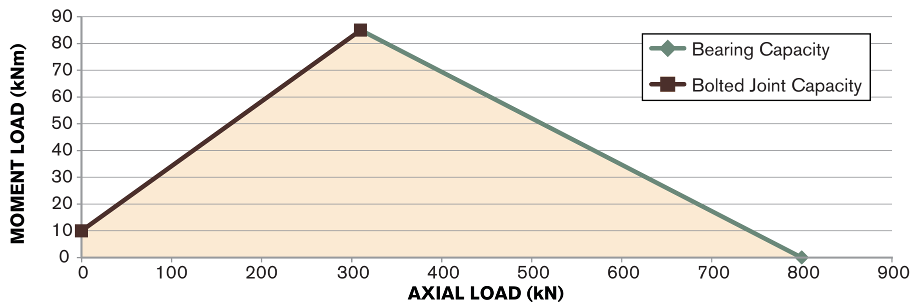
NOTE: Curves assume no external forces such as additional table support friction, cutting forces, etc.



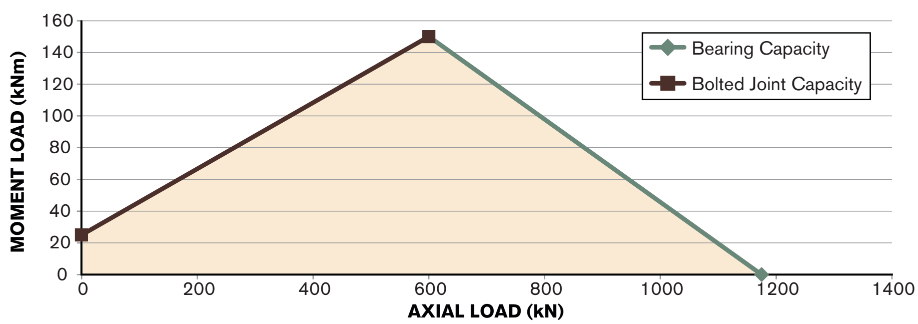
PRD400 Applied Load Chart



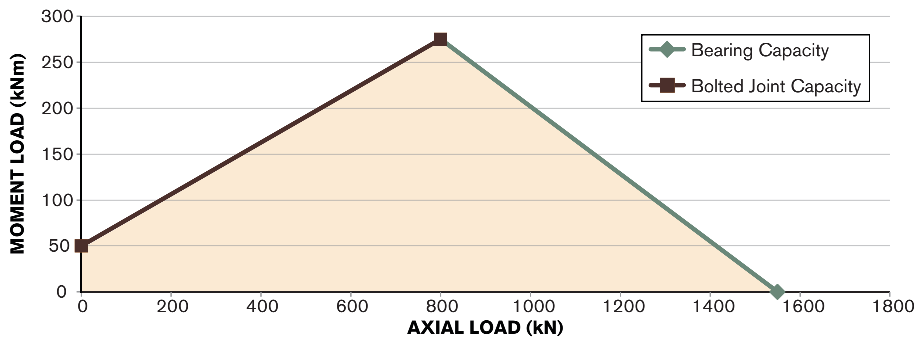
PRD750 Applied Load Chart



PRD1100 Applied Load Chart



PRD1500 Applied Load Chart



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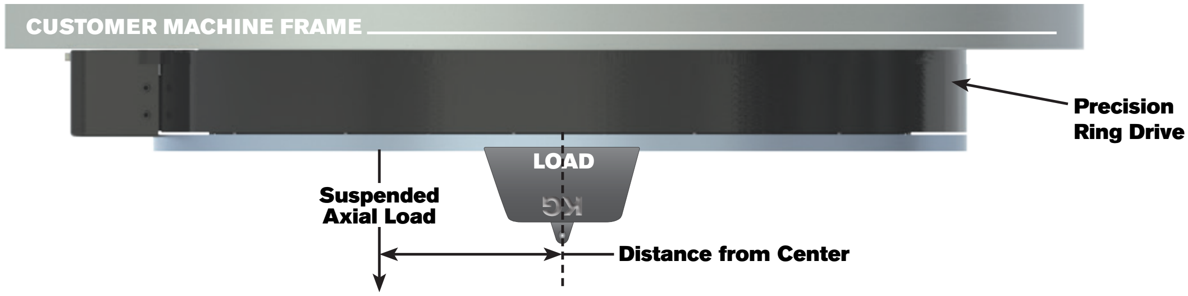
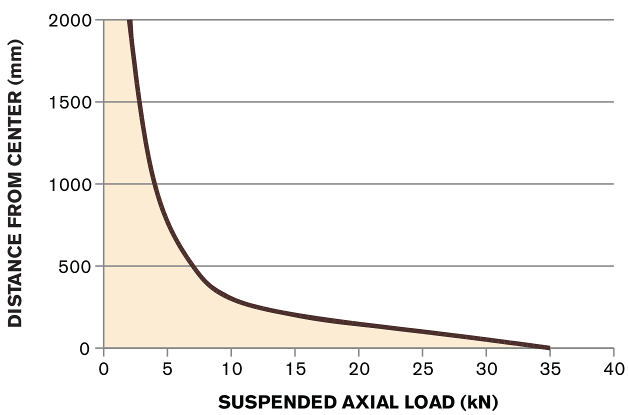
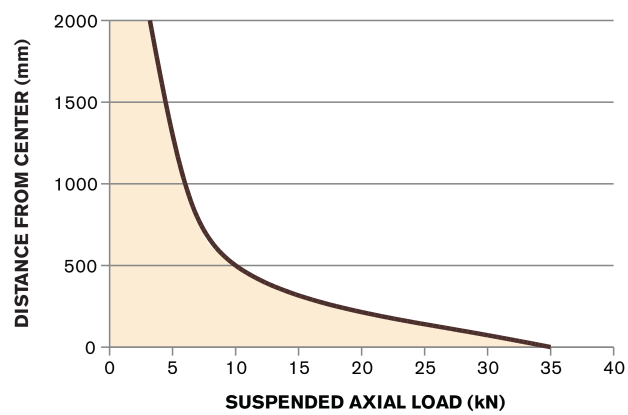
PRD Load Diagrams (Suspended Load)



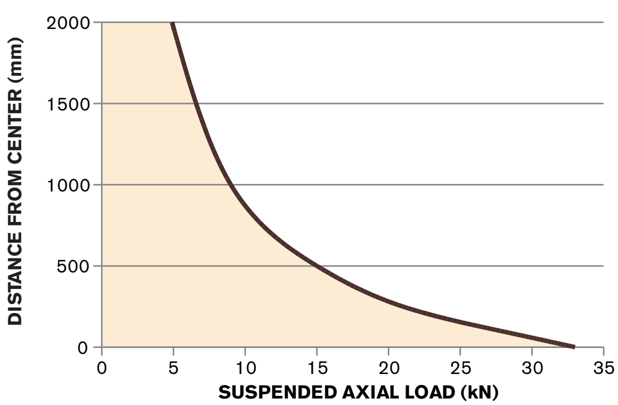
PRD400 Suspended Load Chart
(upside-down orientation)



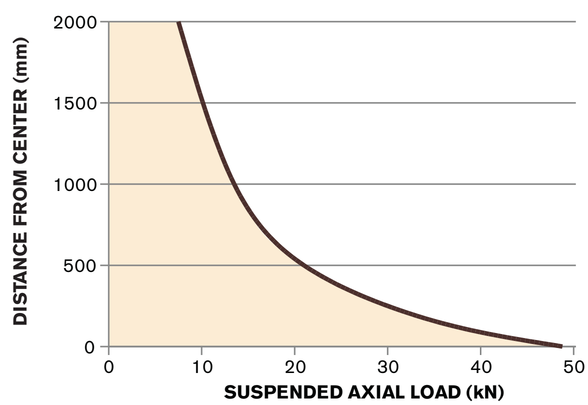
PRD750 Suspended Load Chart
(upside-down orientation)



PRD1100 Suspended Load Chart
(upside-down orientation)

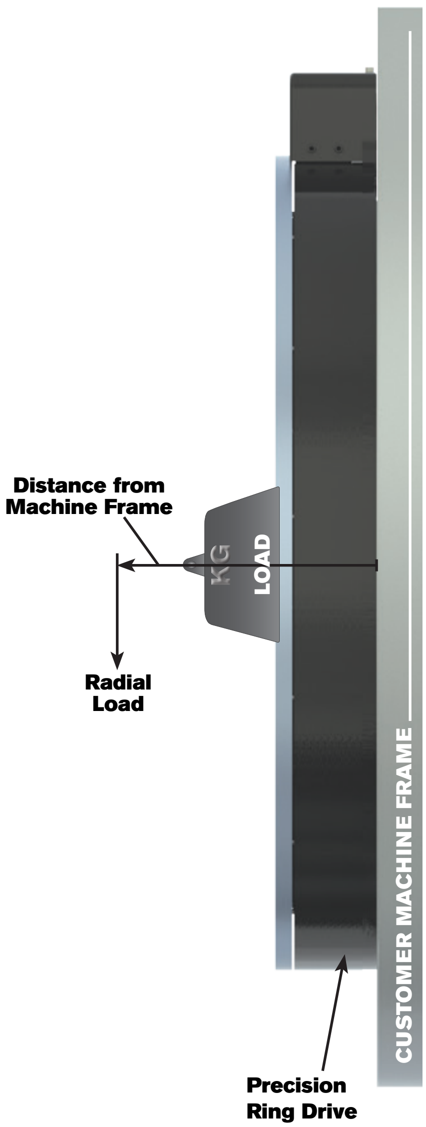


PRD1500 Suspended Load Chart
(upside-down orientation)



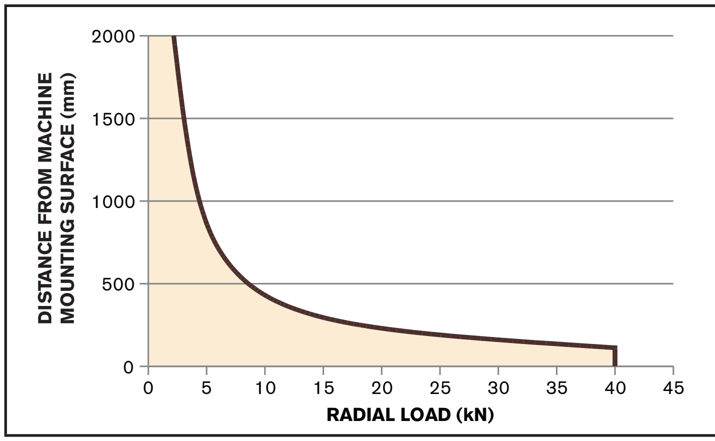
NOTE: The weight of the PRD is already factored into these charts.

PRD Load Diagrams (Radial Load)

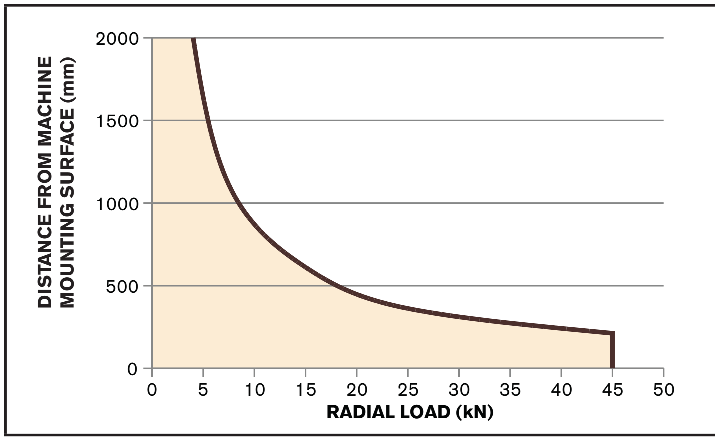


NOTE: The weight of the PRD
is already factored into charts.

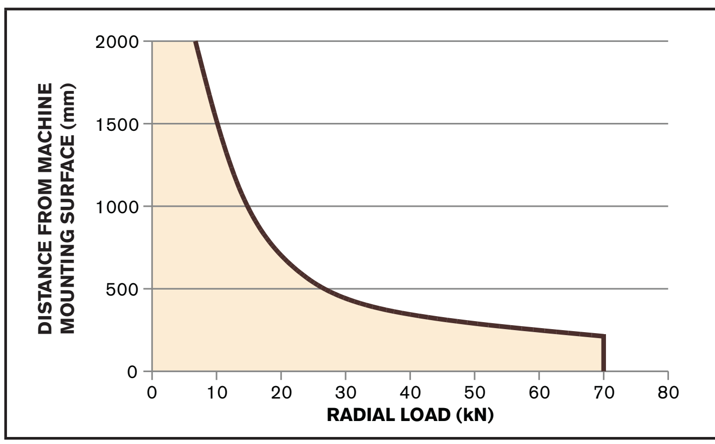
PRD400 Radial Load Chart



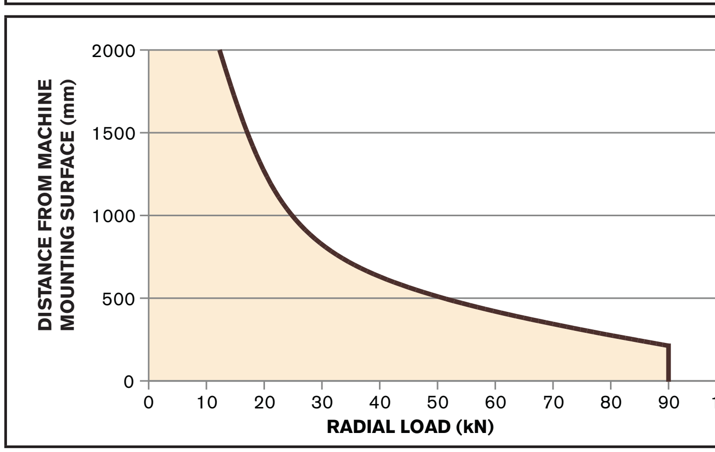
PRD750 Radial Load Chart



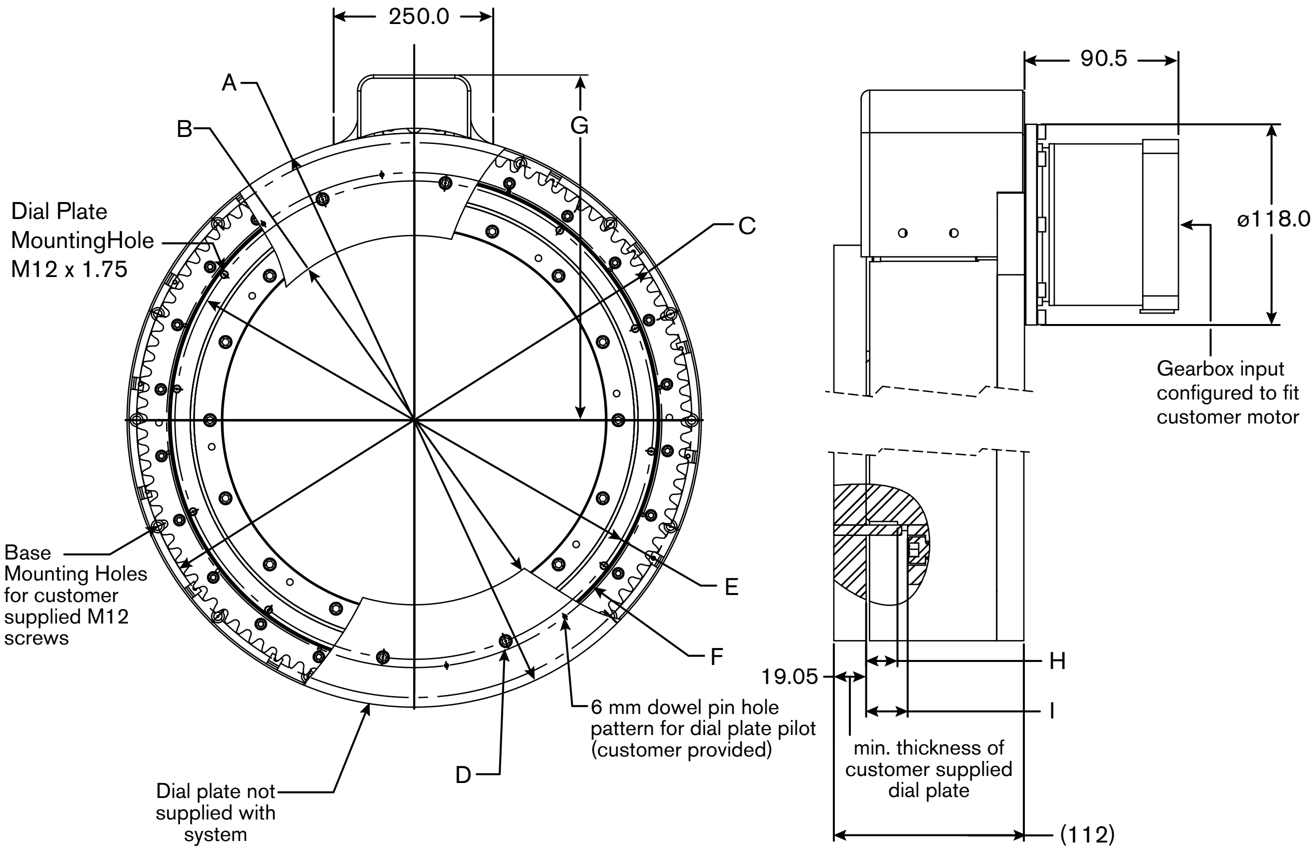
PRD1100 Radial Load Chart



PRD1500 Radial Load Chart



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
A	Minimum Outer Diameter	550	900	1350	1750
B	Maximum Inner Diameter	280	579	966	1330
C	Base Mounting Hole Circle Diameter	500	870	1325	1715
D	Dial Plate Bolt Pattern Circle Diameter	396	750	1100	1500
E	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
H	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^2	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	kgm^2	1.39	8.83	48.97	112.95
Pinion Inertia	kgm^2	0.0025			
Total reflected inertia to gearbox output	kgm^2	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.

nexen

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.

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	RPS4014
				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	385.0	458.4	1247.8
Torque at Max Life (T_{final})	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 (L_{rev})	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_T)	million contacts	60	60	8	2	8.2	2	8.5	2	9.2	60	60
Max Life ($N_{max\ contacts}$)	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 (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*

RPS Pinion Life

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 $< T_{max}$	$= (C \div T_{avg})^{3.333} = (\quad \div \quad Nm)^{3.333}$
$= T_{max}$	$= E_T$

PINION LIFE IN ROLLER CONTACTS

$N_{contacts} =$ million contacts

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

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_{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_{hours} equation.

$E_1 = L \div L_{rev}$

Must round E_1 up to the nearest whole integer.

$E_1 = \text{round up}(\_\_\_\_ \text{ m} \div \_\_\_\_ \text{ m}) = \_\_\_\_$

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

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

$N_{hours} = (\_\_\_\_ \text{ million contacts} \cdot 10^6 \cdot \_\_\_\_ \text{ m}) \div (3600 \cdot \_\_\_\_ \cdot \_\_\_\_ \text{ m/s})$

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

Pinion Life in Hours

$N_{hours} = \_\_\_\_ \text{ hrs}$

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 METERS (N_{meters})

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

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

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

Pinion Life in Meters

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

PINION LIFE IN REVOLUTIONS (N_{rev})

$N_{rev} = N_{contacts}$

Sample: $N_{rev} = 12$ *million revolutions*

Pinion Life in Revolutions

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

RPS Pinion Life

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
	Distance Per Revolution (L_{rev})	meters	0.1	0.12	0.16	0.2	0.25	0.384	0.48	0.56
Premium & Standard	Max Dynamic Thrust (F_{max})	N	250	500	2400	2900	4000	6300	6000	14000
Premium & Standard	Thrust at Max Life (F_{final})	N	250	500	1000	1500	2200	3600	6000	14000
Premium & Standard	Transition Point (E_T)	million contacts	30	30	5	5	5	5	30	30
Premium & Standard	Max Life ($N_{max\ contacts}$)		30 Million Contacts							
Premium & Standard	Slope (**m**)		NA	NA	-56	-56	-72	-108	NA	NA
Premium & Standard	Intercept (**b**)	N	NA	NA	2680	3180	4360	6840	NA	NA
Endurance	Max Dynamic Thrust (F_{max})	N	NA	NA	1500	2250	3300	5 400	6000	14000
Endurance	Thrust at Max Life (T_{final})	N	NA	NA	1000	1500	2200	3600	6000	14000
Endurance	Transition Point (E_T)	million contacts	NA	NA	5	5	5	5	30	30
Endurance	Max Life ($N_{max\ contacts}$)		NA	NA	30 Million Contacts					
Endurance	Slope (**m**)		NA	NA	-20	-30	-44	-72	NA	NA
Endurance	Intercept (**b**)	N	NA	NA	1600	2400	3520	5760	NA	NA
Universal & Universal Stainless	Max Dynamic Thrust (F_{max})	N	NA	NA	750	1125	1650	2700	4500	10500
Universal & Universal Stainless	Thrust at Max Life (F_{final})	N	NA	NA	750	1125	1650	2700	4500	10500
Universal & Universal Stainless	Max Life ($N_{max\ contacts}$)		NA	NA	5 Million Contacts				2 Million Contacts	
Versa	Max Dynamic Thrust (F_{max})	N	NA	NA	500	750	1100	NA	NA	NA
Versa	Thrust at Max Life (F_{final})	N	NA	NA	500	750	1100	NA	NA	NA
Versa	Max Life ($N_{max\ contacts}$)		NA	NA	2 Million Contacts				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 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 $N_{contacts}$:
$\leq F_{final}$	$= N_{max\ contacts}$
$> F_{final}$ AND $< F_{max}$	$= (F_{avg} - b) \div m = ($ N $-$ N $) \div$
$= F_{max}$	$= E_T$

RACK LIFE IN TOOTH CONTACTS

$N_{contacts} =$ million contacts

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

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.

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

$$N_{hours} = (\quad \div 3600) \bullet (\quad m \div \quad m/s) \bullet 10^6$$

RACK LIFE IN HOURS

$N_{hours} =$ hours

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

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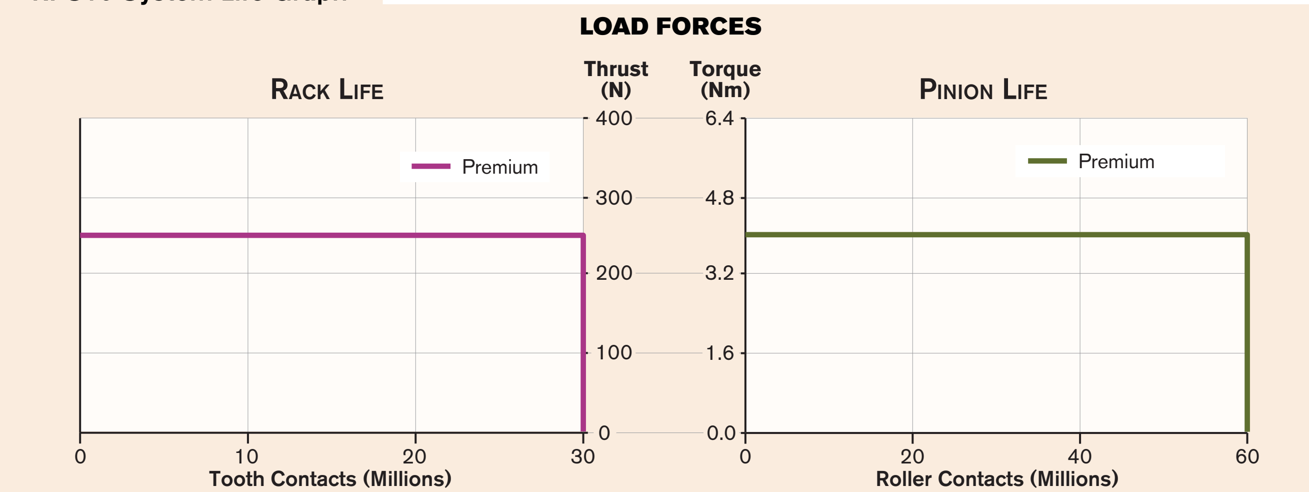
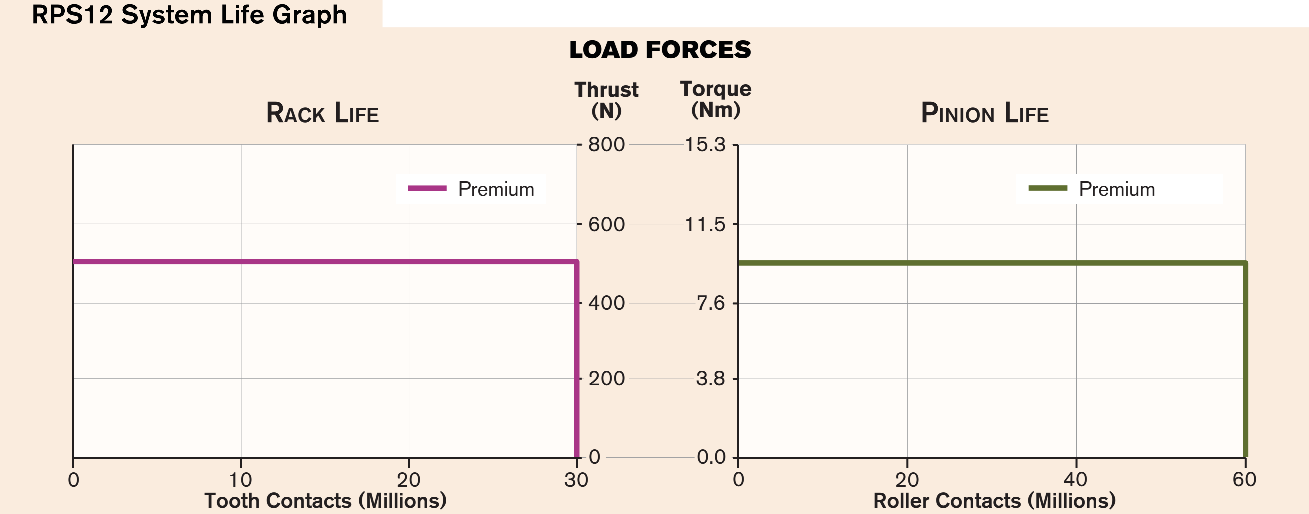
RPS System Life Graphs (RPS10, 12 & 16)

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.

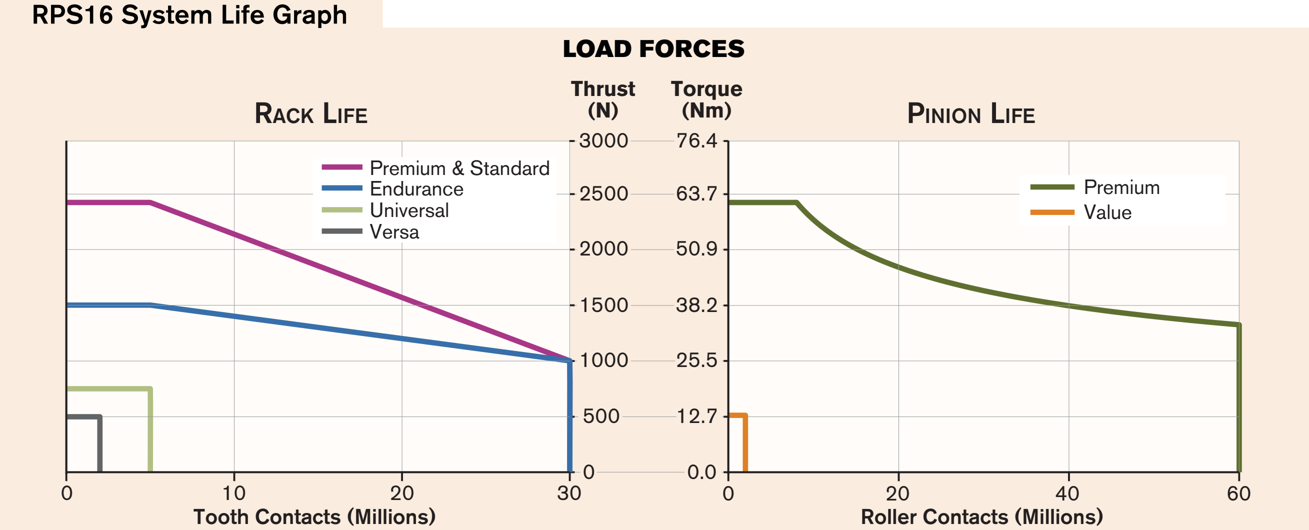
RPS10 System Life Graph



RPS12 System Life Graph

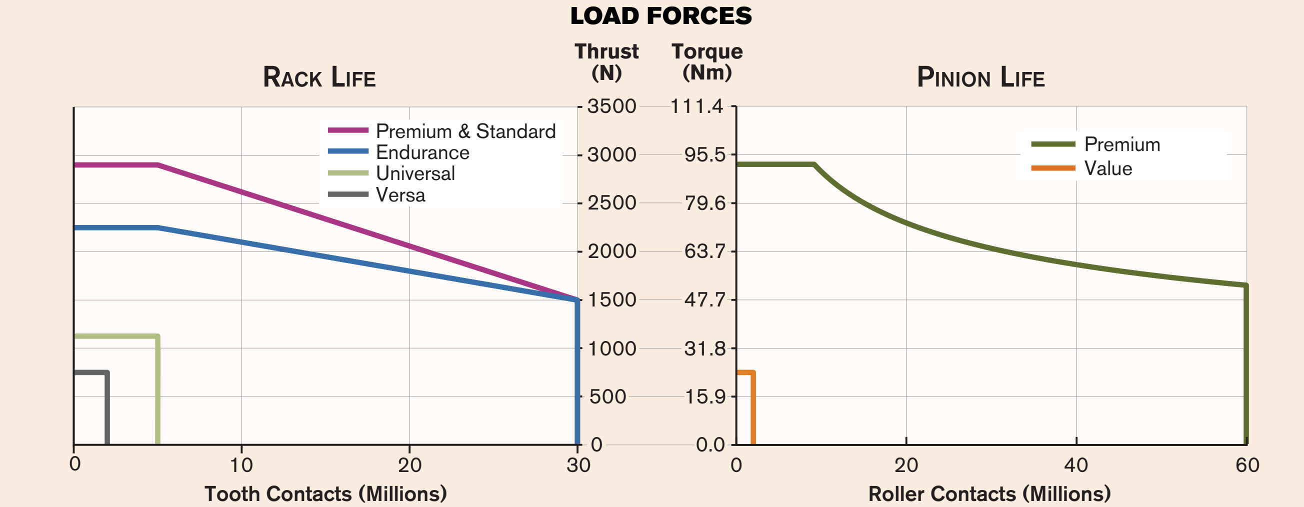


RPS16 System Life Graph

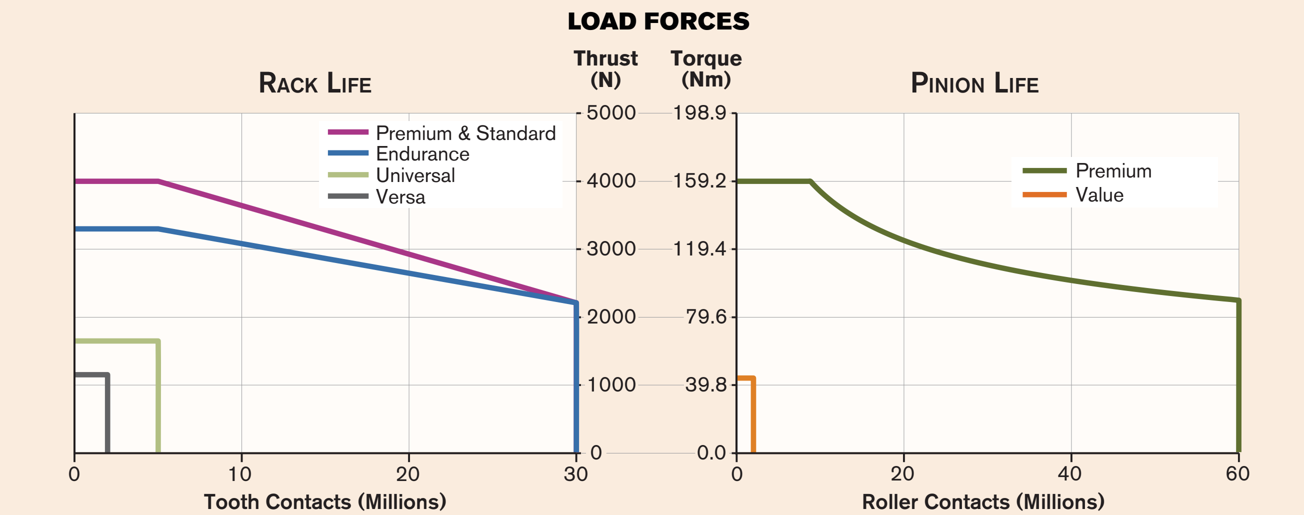


RPS System Life Graphs (RPS20, 25 & 32)

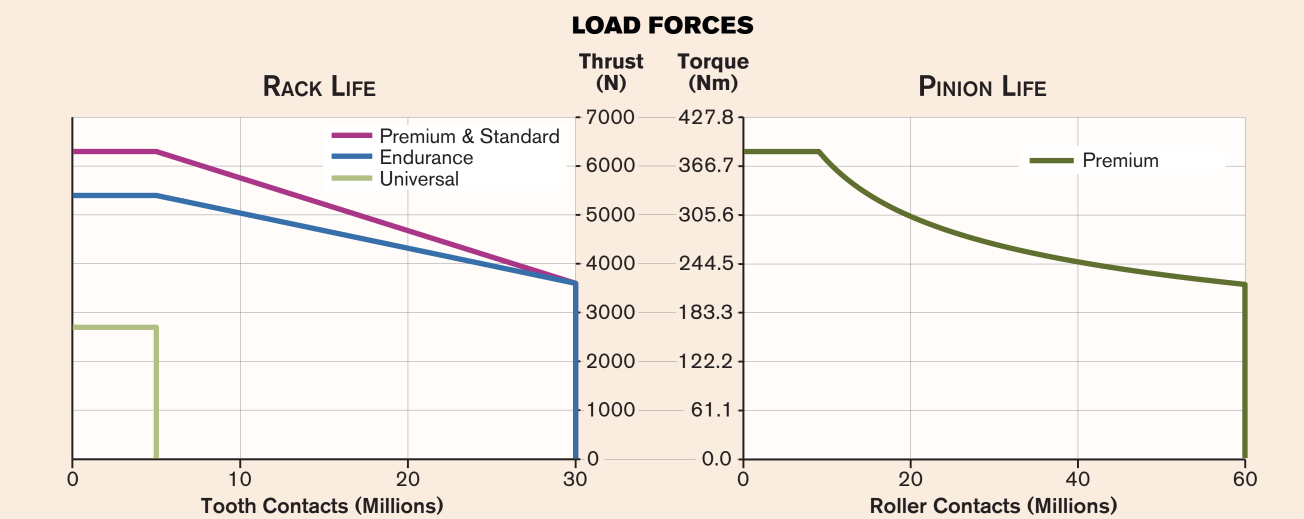
RPS20 System Life Graph



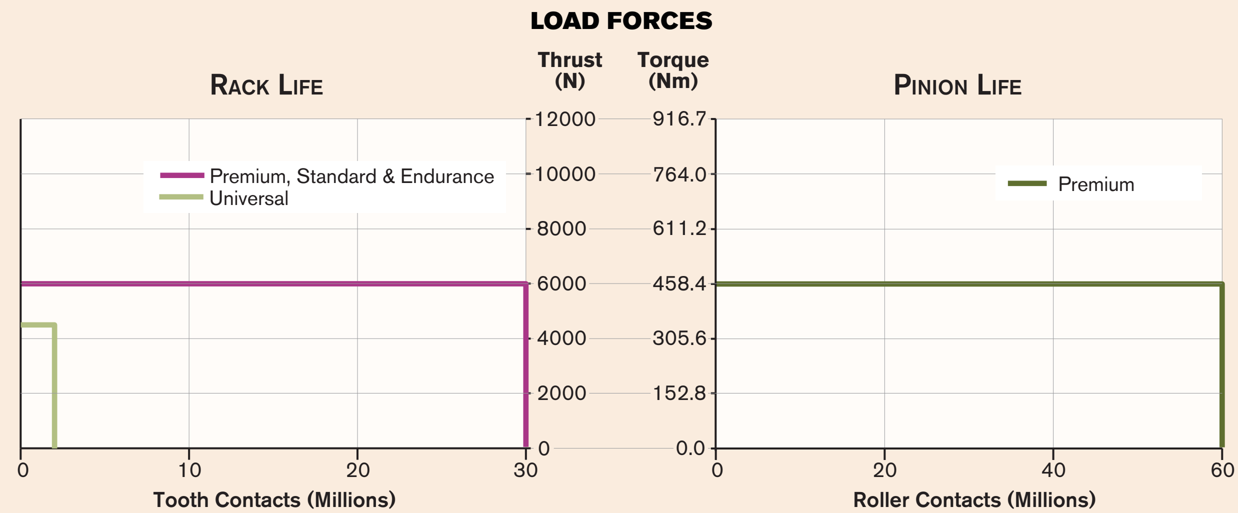
RPS25 System Life Graph



RPS32 System Life Graph



RPS40 System Life Graph



RPS4014 System Life Graph