

# PRECISION RING DRIVE SYSTEMS

*based on Nexen's innovative Roller Pinion Technology*

## This is an Interactive PDF

Hover your mouse over certain areas of this PDF to see the cursor change to a "hand". These areas can be selected to connect you directly to a specific website page. The interactive areas are primarily found in the headers of the selection charts.

### COMPACT RING DRIVE SYSTEMS (CRD)

The Compact Ring Drive System (CRD) comes complete with a precision grade, high capacity bearing and drive mechanism in a sealed housing. With options for high speed, high torque and zero backlash, the CRD can be optimized for every application.

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### PRECISION RING DRIVE SYSTEM (PRD)

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.

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# The CRD Advantage

Based on Nexen's innovative Roller Pinion technology, the Compact Ring Drive (CRD) system comes complete with a precision grade bearing and drive mechanism in a sealed housing.

Freely programmable, the three drive design configurations allow the CRD to be optimized for high speed, high torque or both depending on the application. With a 250 or 350 mm dial plate bolt circle diameter and a large open center, users can optimize performance in a small space.

## High Indexing Precision

With an indexing precision up to  $\pm 30$  ArcSec and repeatability up to  $\pm 5.1$  ArcSec, Nexen's CRD offers unmatched mechanical system capabilities.

## Zero Backlash

Unlike other mechanical drive systems, the CRD offers zero backlash options from the motor through the driven load.

## High Output Load Capacity

With the precision grade, high load capacity cross-roller bearing, the CRD can handle loads up to 108 kN.

## High Speed

The CRD can handle speeds up to 225 RPM.

## Smooth in Motion

Combining Nexen's RPS technology with an integrated bearing and motor/gearhead gives a rigid, smooth system.

**A DRIVE STATION  
FOR EVERY APPLICATION**

**High Precision Planetary (PL)**  
HIGH TORQUE • HIGH SPEED  
LOW BACKLASH  
FLEXIBLE GEARHEAD RATIO



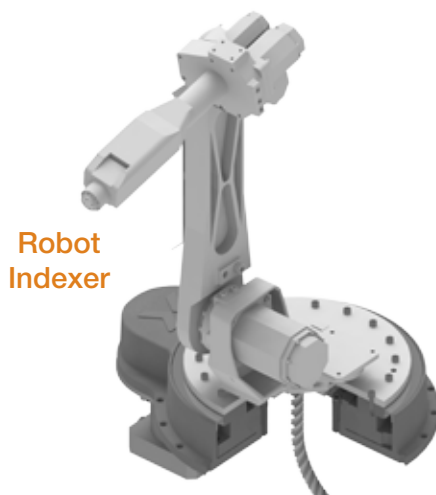
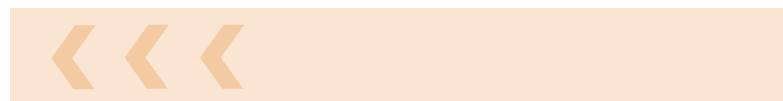


**Harmonic Gearhead (HG)**  
HIGH TORQUE • LOW SPEED  
ZERO BACKLASH  
HIGH RATIO GEARHEAD



**Direct Drive Pinion (DD)**  
HIGH SPEED • MID TORQUE  
ZERO BACKLASH  
INTEGRATED MOTOR  
NO GEARHEAD

**DEPENDABLE. VERSATILE.**  
OPTIONS THAT DELIVER.



**Robot Indexer**



**Indexer**

**Large Open Center**  
*The CRD and PRD have large open centers that allows users to easily mount equipment and cabling in the center of the rotating plate.*

# The PRD 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.

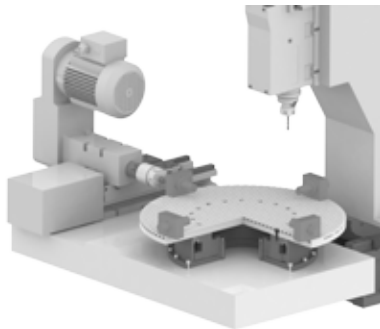
## Rigidity

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

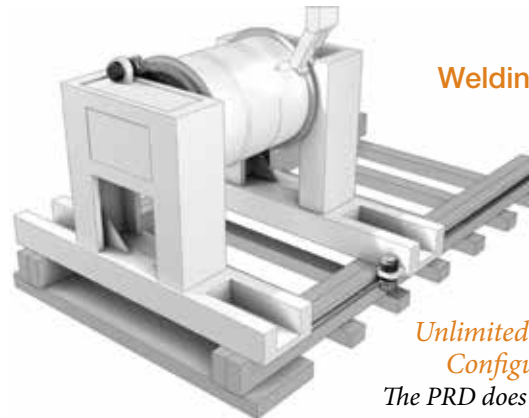
The PRD is capable of speeds of up to 94 RPM. Unlike traditional cam driven systems, the PRD can handle peak torque inputs at any time. This allows for indexing times up to 2x faster than the competition.

## Positioning Indexer



### Sealed Housing

*Rated for IP65, the Compact Ring Drive can be installed in more challenging environments.*



## Welding Trunnion

### Unlimited Mounting Configurations

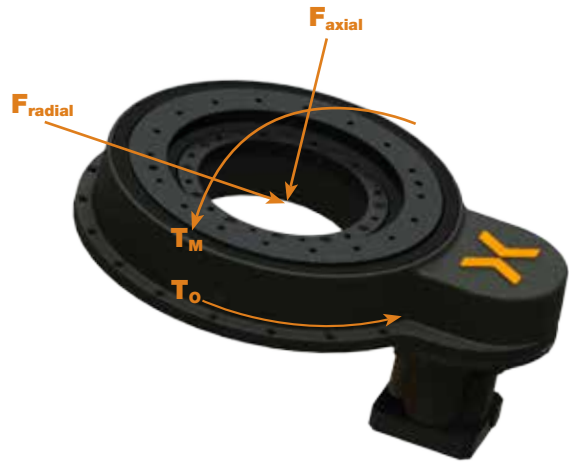
*The PRD does not require an oil bath as some other indexing technologies do, allowing it to be mounted in any orientation.*



DEPENDABLE. RELIABLE.  
**PERFORMANCE.**

# The Selection Process

Nexen will work with you to select the perfect 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 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 Selection	Customer Data (record your values below)	Sample Data
Load Inertia ( <b>I</b> )	kgm <sup>2</sup>	70 kgm <sup>2</sup>
Index Time ( <b>t<sub>i</sub></b> )	seconds	0.9 seconds
Move Distance ( <b>θ</b> )	°	45°
Maximum Axial Load ( <b>F<sub>axial</sub></b> )	kN	50 kN
Maximum Radial Load ( <b>F<sub>radial</sub></b> )	kN	0 kN
Maximum Moment Load ( <b>T<sub>M</sub></b> )	kNm	1 kNm
Other Applied Torque Loads ( <b>T<sub>o</sub></b> ) May include table support friction, cutting or clamping forces, etc.	Nm	10 Nm
Shock Factor ( <b>K</b> ) 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 REQUIREMENTS FOR SIMPLE INDEXING APPLICATIONS

Ring Drive 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.

<b>ACCELERATION TIME: <math>t_A = t_i \div 2</math></b>		$t_A =$ <input type="text"/> sec $\div 2$	<b>ACCELERATION TIME</b> $t_A =$ <input type="text"/> sec
<i>Sample: <math>t_A = 0.9 \text{ seconds} \div 2 = 0.45 \text{ seconds}</math></i>			
<b>MAX ANGULAR SPEED:</b> $\omega = (\theta \div t_i) \cdot (\pi \div 90)$		$\omega =$ ( <input type="text"/> ° $\cdot$ <input type="text"/> sec ) $\cdot$ ( $\pi \div 90$ )	<b>MAX ANGULAR SPEED</b> $\omega =$ <input type="text"/> rad/sec
<i>Sample: <math>\omega = (45^\circ \div 0.9 \text{ seconds}) \cdot (\pi \div 90) = 1.75 \text{ rad/sec}</math></i>			
<b>ANGULAR ACCELERATION: <math>\alpha = \omega \div t_A</math></b>		$\alpha =$ <input type="text"/> rad/sec $\div$ <input type="text"/> sec	<b>ANGULAR ACCELERATION</b> $\alpha =$ <input type="text"/> rad/s <sup>2</sup>
<i>Sample: <math>\alpha = 1.75 \text{ rad/sec} \div 0.45 \text{ sec} = 3.89 \text{ rad/s}^2</math></i>			
<b>APPLICATION TORQUE:</b> $T_{\text{gear}} = (I \cdot \alpha) + T_O$		$T_{\text{gear}} =$ ( <input type="text"/> kgm <sup>2</sup> $\cdot$ <input type="text"/> rad/s <sup>2</sup> ) + <input type="text"/> Nm	<b>RING GEAR TORQUE</b> $T_{\text{gear}} =$ <input type="text"/> Nm
<i>Sample: <math>T_{\text{gear}} = (70 \text{ kgm}^2 \cdot 3.89 \text{ rad/s}^2) + 10 \text{ Nm} = 282.3 \text{ Nm}</math></i>			
<b>APPLICATION TORQUE WITH SHOCK FACTOR:</b> $T_T = T_{\text{gear}} \cdot K$		$T_T =$ <input type="text"/> Nm $\cdot$ <input type="text"/>	<b>RING GEAR TORQUE W/ SHOCK FACTOR</b> $T_T =$ <input type="text"/> Nm
<i>Sample: <math>T_T = 282.3 \text{ Nm} \cdot 1.2 = 339 \text{ Nm}</math></i>			

## 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 chart(s) to ensure that your requirements fall into the shaded area representing load capacity available in that CRD or PRD size and orientation.

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

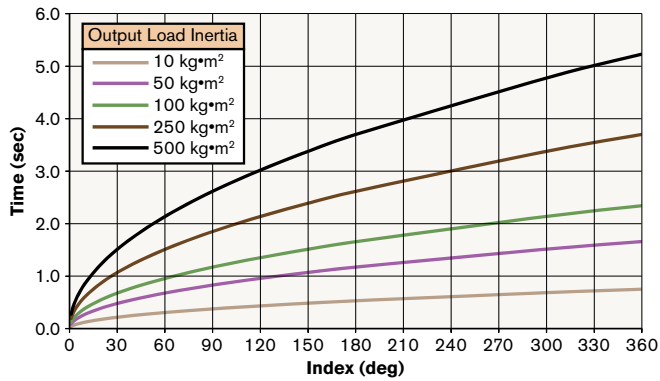
## STEP 4: CHOOSE YOUR SIZE

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

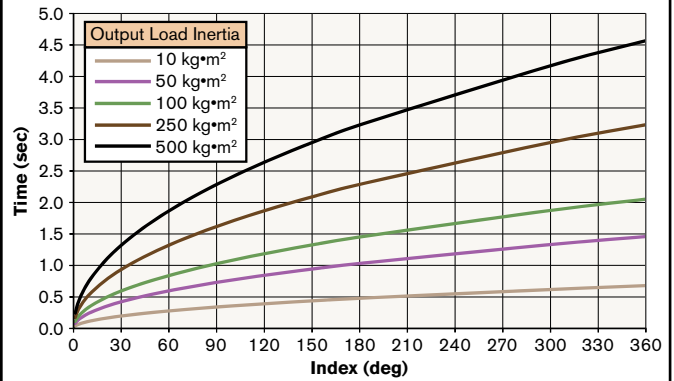
SELECTED CRD OR PRD SIZE
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# CRD Timing Diagrams

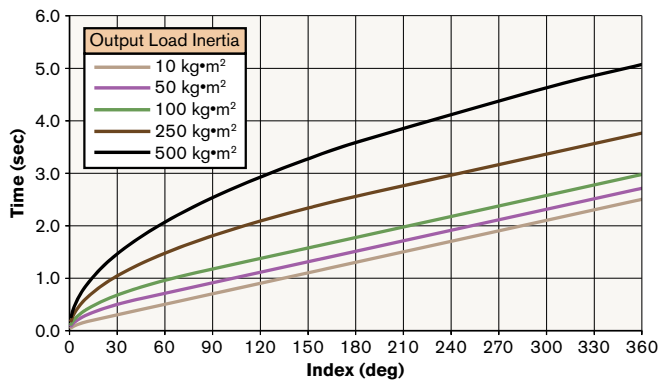
### CRD250-PL Timing Diagram



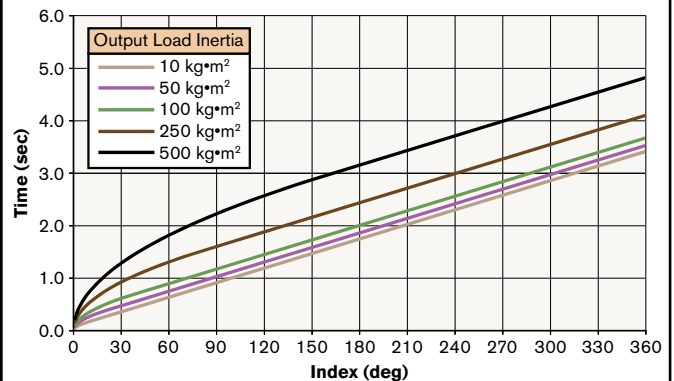
### CRD350-PL Timing Diagram



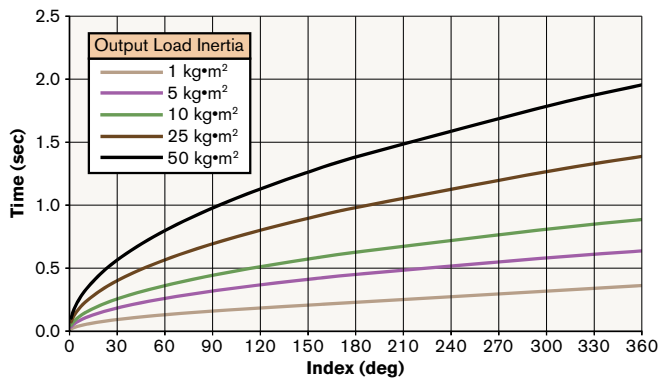
### CRD250-HG Timing Diagram



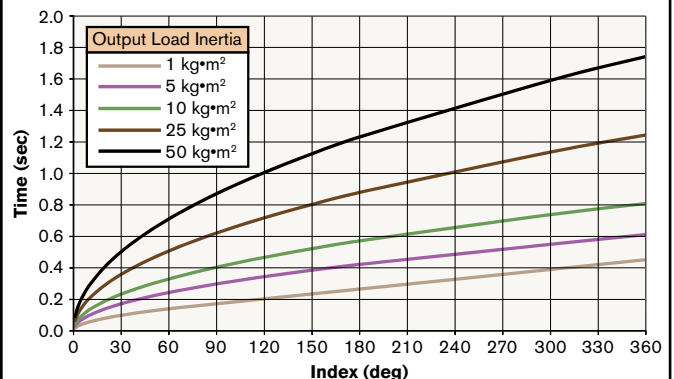
### CRD350-HG Timing Diagram



### CRD250-DD Timing Diagram



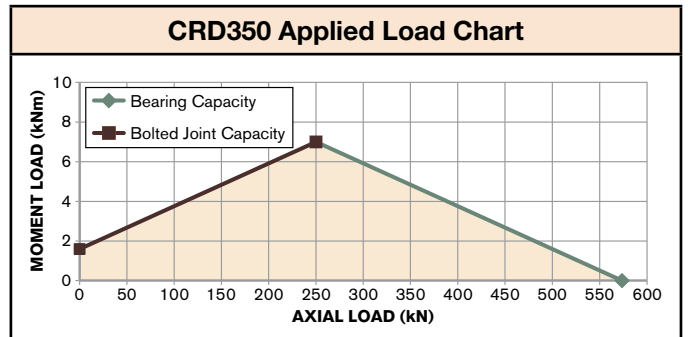
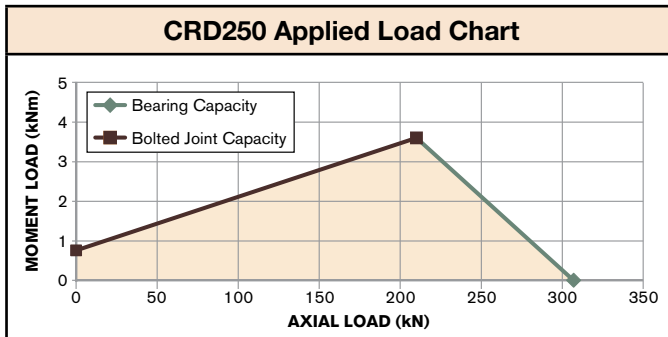
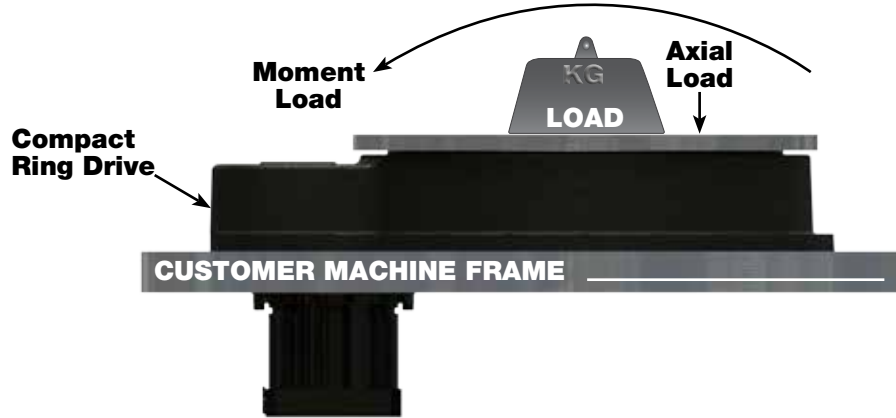
### CRD350-DD Timing Diagram



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

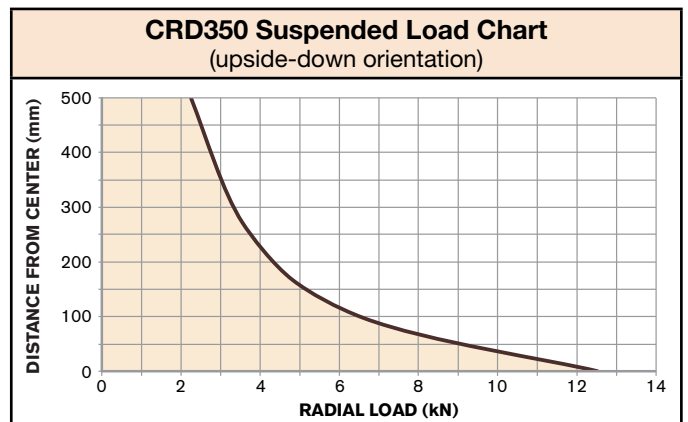
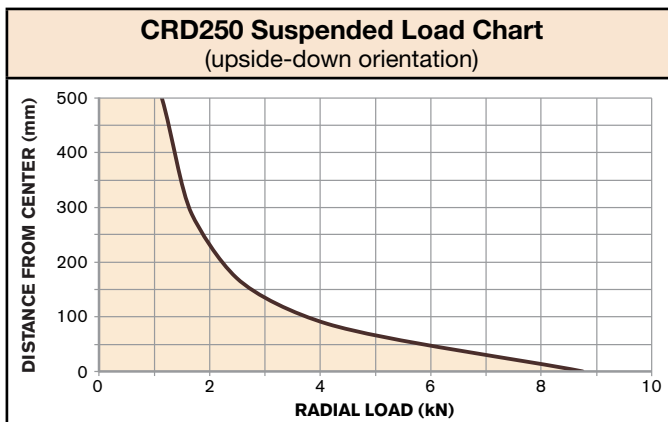
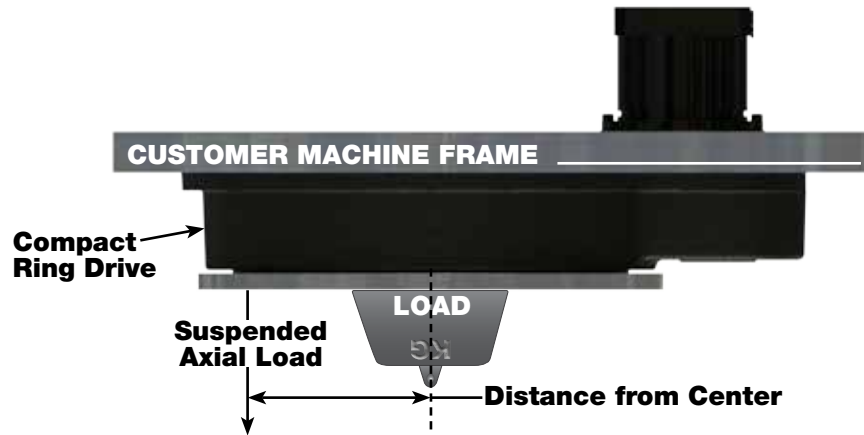


## CRD Load Diagrams (Applied Load)

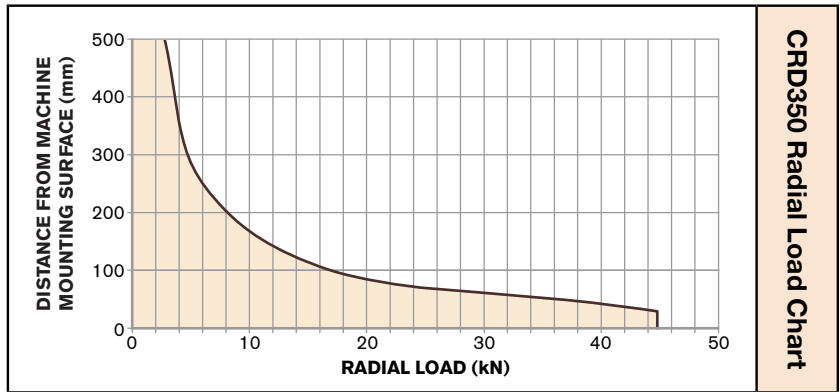
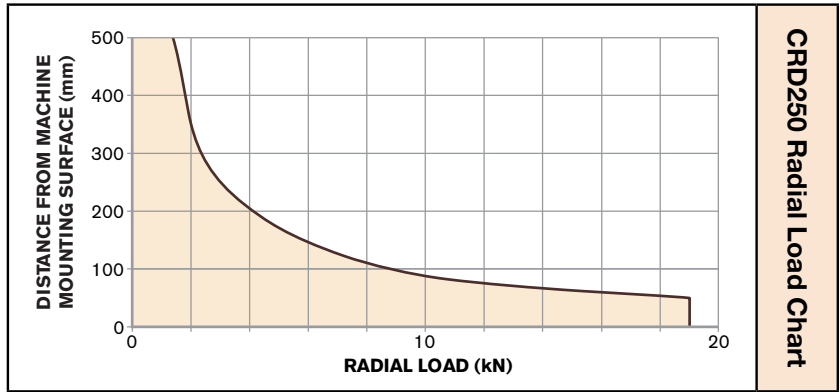
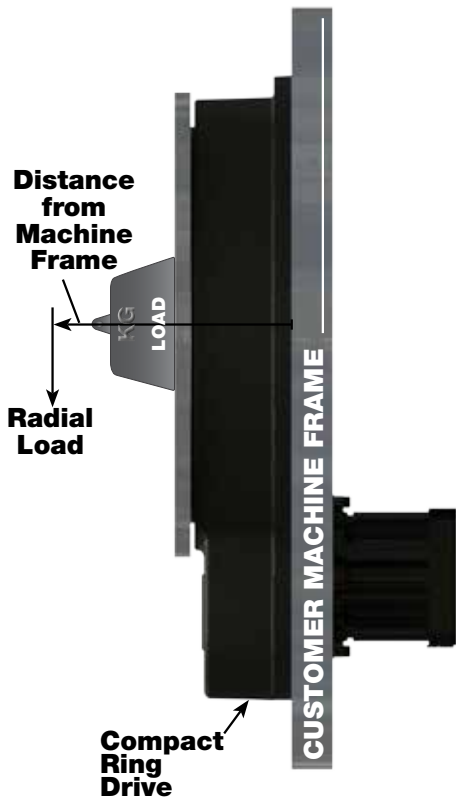


Contact Nexen for bearing life in this orientation

## CRD Load Diagrams (Suspended Load)

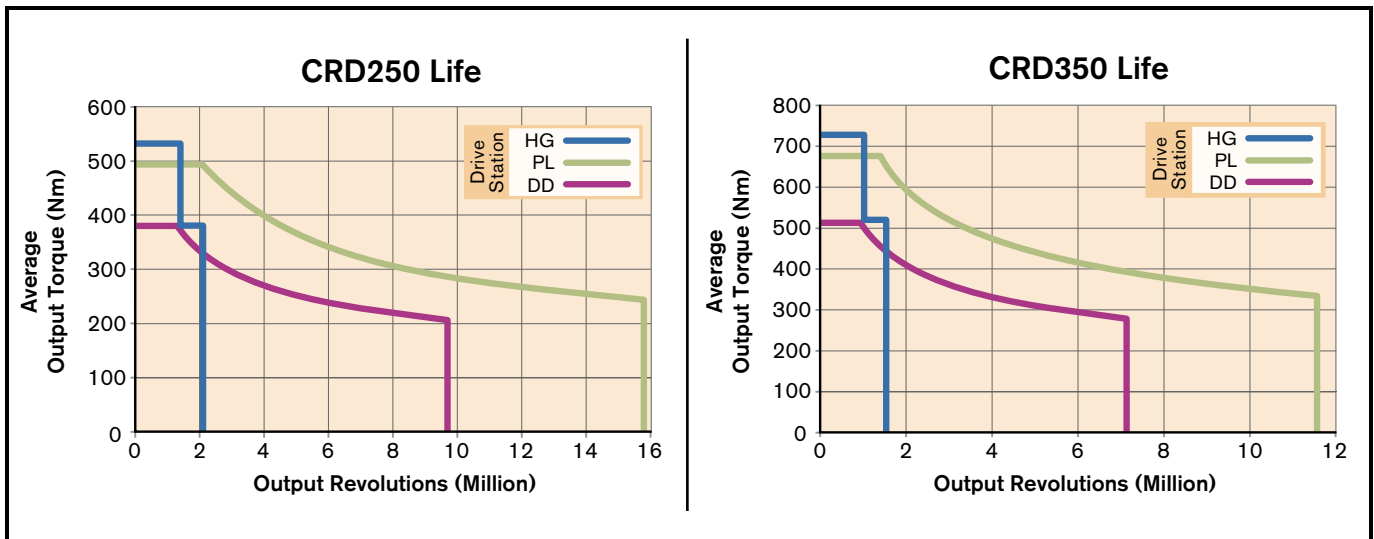


## CRD Load Diagrams (Radial Load)



## CRD System Life

CRD life is based on average output torque and drive station options.

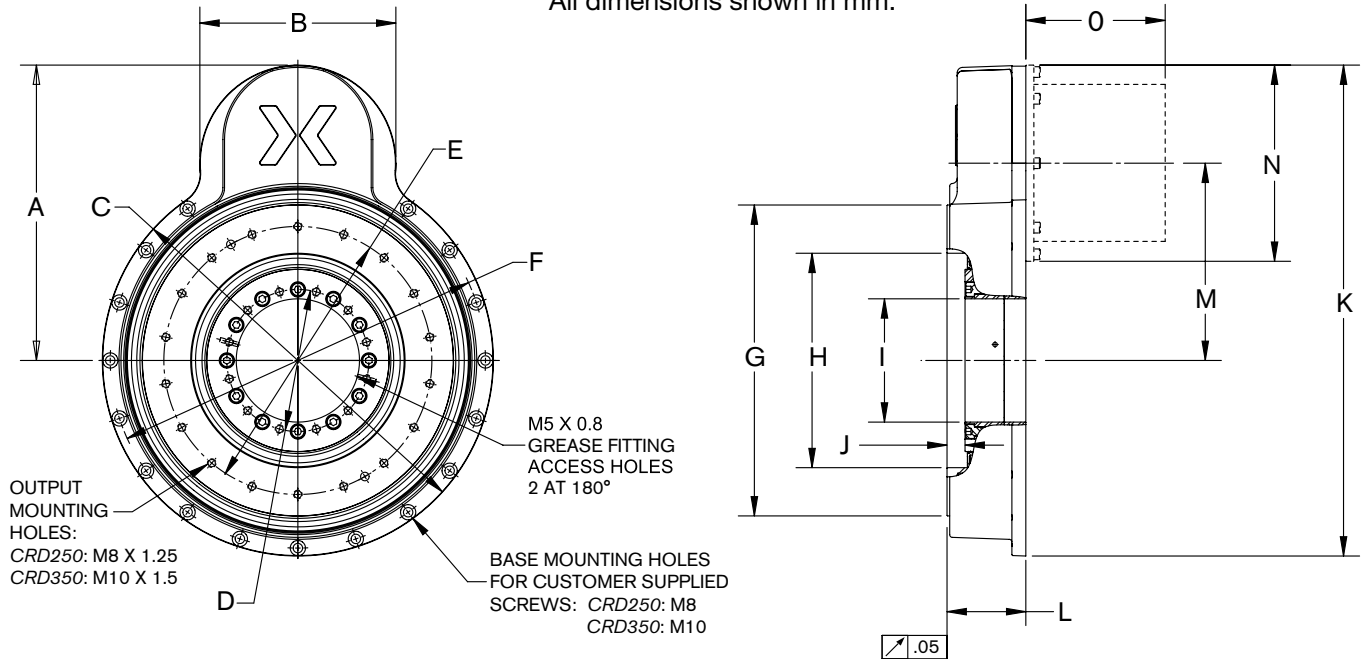


Assumes Planetary Gearbox Ratio of 4:1 and Harmonic Gearhead Ratio of 50:1 (other ratio options available)



## CRD Dimensions

All dimensions shown in mm.



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

		CRD250	CRD350	
A	Drive Station Envelope to Center Distance	275.5	329.5	
B	Drive Station Envelope Width	182.8	184.3	
C	Outer Diameter	363.3	487.8	
D	Stationary Bolt Circle Diameter	132.5	180	
E	Output Bolt Circle Diameter	250	350	
F	Base Mounting Hole Circle Diameter	350	465	
G	Output Outer Diameter	290	385	
H	Output Inner Diameter (H7)	200	280	
I	Inner Diameter (H7)	115	155	
J	Depth to Stationary Ring	16.8	10	
K	Overall Length	457.2	573.4	
L	Unit Height	73.5	73.5	
M	Drive Station Center to CRD Center	PL, HG	184	238
		DD	174	228
N	Drive Station & Adapter Width	PL, HG	183	183
		DD	193	193
O	Drive Station Depth	PL	130	130
		HG	58.5	58.5
		DD	191	191

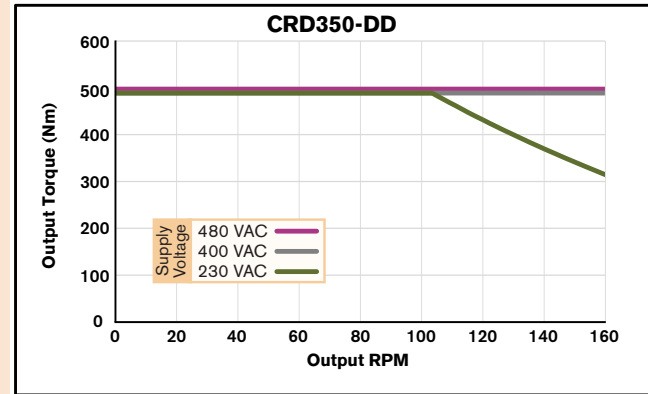
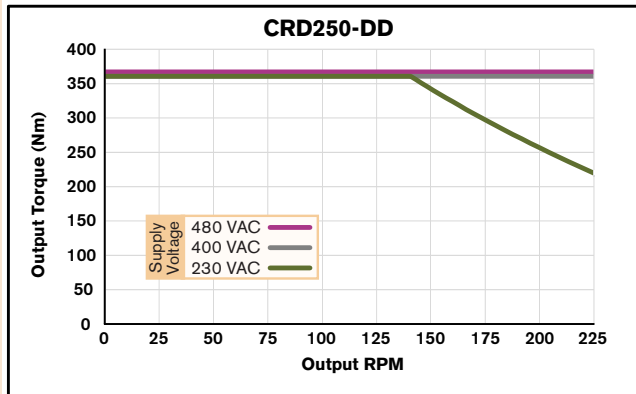
## CRD Specifications

Performance Specifications		High Torque & High Speed		High Torque & Low Speed		High Speed & Mid Torque	
		CRD250-PL	CRD350-PL	CRD250-HG	CRD350-HG	CRD250-DD	CRD350-DD
Maximum Velocity	RPM	225	161	25 <sup>(2)</sup>	18 <sup>(2)</sup>	See Charts	See Charts
Max Continuous Velocity	RPM	151 <sup>(2)</sup>	111 <sup>(2)</sup>	18 <sup>(2)</sup>	13 <sup>(2)</sup>	See Charts	See Charts
Positional Accuracy <sup>(3)</sup>	±ArcSec	59 <sup>(1)</sup>	43 <sup>(1)</sup>	43	31	41	30
One Way Repeatability <sup>(3)</sup>	±ArcSec	7.1	5.2	7.1	5.2	6.9	5.1
Max Backlash	ArcSec	20.3 <sup>(1)</sup>	14.8 <sup>(1)</sup>	0	0	0	0
Max Acceleration Torque	Nm	494	676	532	728	367	497
Continuous Stall Torque	Nm	N/A	N/A	N/A	N/A	100	136
Nominal Torque	Nm	323	442	380	520	N/A	N/A
Gear/Pinion Ratio		3.8:1	5.2:1	3.8:1	5.2:1	6.2:1	8.4:1
Input to Output Ratio		15.2:1 <sup>(2)</sup>	20.8:1 <sup>(2)</sup>	190:1 <sup>(2)</sup>	260:1 <sup>(2)</sup>	6.2:1	8.4:1
Min/Max Initial Drag Torque <sup>(4)</sup>	Nm	30 / 121	80 / 187	30 / 121	80 / 187	30 / 121	80 / 187
Max Load Inertia	kgm <sup>2</sup>	N/A	N/A	N/A	N/A	50	50
Output Inertia	kgm <sup>2</sup>	0.227	0.782	0.227	0.782	0.219	0.761
Total Reflected Inertia to Gearbox Output	kgm <sup>2</sup>	0.0182	0.0314	0.0157	0.0289	N/A	N/A

(1) Includes Gearbox Backlash (2) Assumes Planetary Gearbox Ratio of 4:1 and Harmonic Gearhead Ratio of 50:1 (other ratio options available)  
 (3) Contact Nexen for higher precision options (4) Min/Max drag torque based on initial output drag in zero and maximum bearing load scenarios

## CRD Direct Drive Motor Specifications

### Peak Speed Torque Curves at Output



\*For non-cyclic continuous operation, contact Nexen.

Direct Drive Motor Specifications		CRD250-DD			CRD350-DD		
Voltage Req'd at Rated Output (Vac Input)	Vac	230	400	480	230	400	480
Peak Current (Ip) <sup>(1)</sup>	Amps	49.5	49.5	39.2	49.5	49.5	39.2
Continuous Stall Current (Ic) <sup>(2)</sup>	Amps	9.8	9.8	7.9	9.8	9.8	7.9
Torque Sensitivity (Kt) <sup>(3)</sup>	Nm/Arms	10.2	10.2	12.7	13.7	13.7	17.2
Back EMF Constant (Kb) <sup>(3)</sup>	Vpk/kRPM	613	613	769	830	830	1040
Resistance (Line to Line) (Rm)	Ohms	1.14	1.14	1.80	1.14	1.14	1.80
Inductance (Lm)	mH	9.3	9.3	15	9.3	9.3	15
Motor Poles		10	10	10	10	10	10

(1) @ 25°C winding temperature (2) Winding temperature = 145°C @ continuous stall, 25°C ambient  
 (3) System Equivalent Values

## CRD Direct Drive Motor

### Drive Selection

Nexen has partnered with Kollmorgen on the Direct Drive servomotor and, for best results, recommend Kollmorgen for the drive. Use the following table to select a Kollmorgen AKD drive based on the application's voltage and current requirements. Refer to [www.kollmorgen.com](http://www.kollmorgen.com) for complete product offering, specifications and to locate sales and distribution offices in your area.

### Kollmorgen AKD Servodrives

120/240 VAC 1 & 3 Phase (85-265 V)	Continuous Current (A RMS)	Peak Current (A RMS)	Drive Continuous Output Power (Watts)
AKD-x00306	3	9	1100
AKD-x00606	6	18	2000
AKD-x01206	12	30	4000
AKD-x02406	24	48	8000
240/480 VAC 3 Phase (187-528 V)	Continuous Current (A RMS)	Peak Current (A RMS)	Drive Continuous Output Power (Watts)
AKD-x00307	3	9	2000
AKD-x00607	6	18	4000
AKD-x01207	12	30	8000
AKD-x02407	24	48	16000



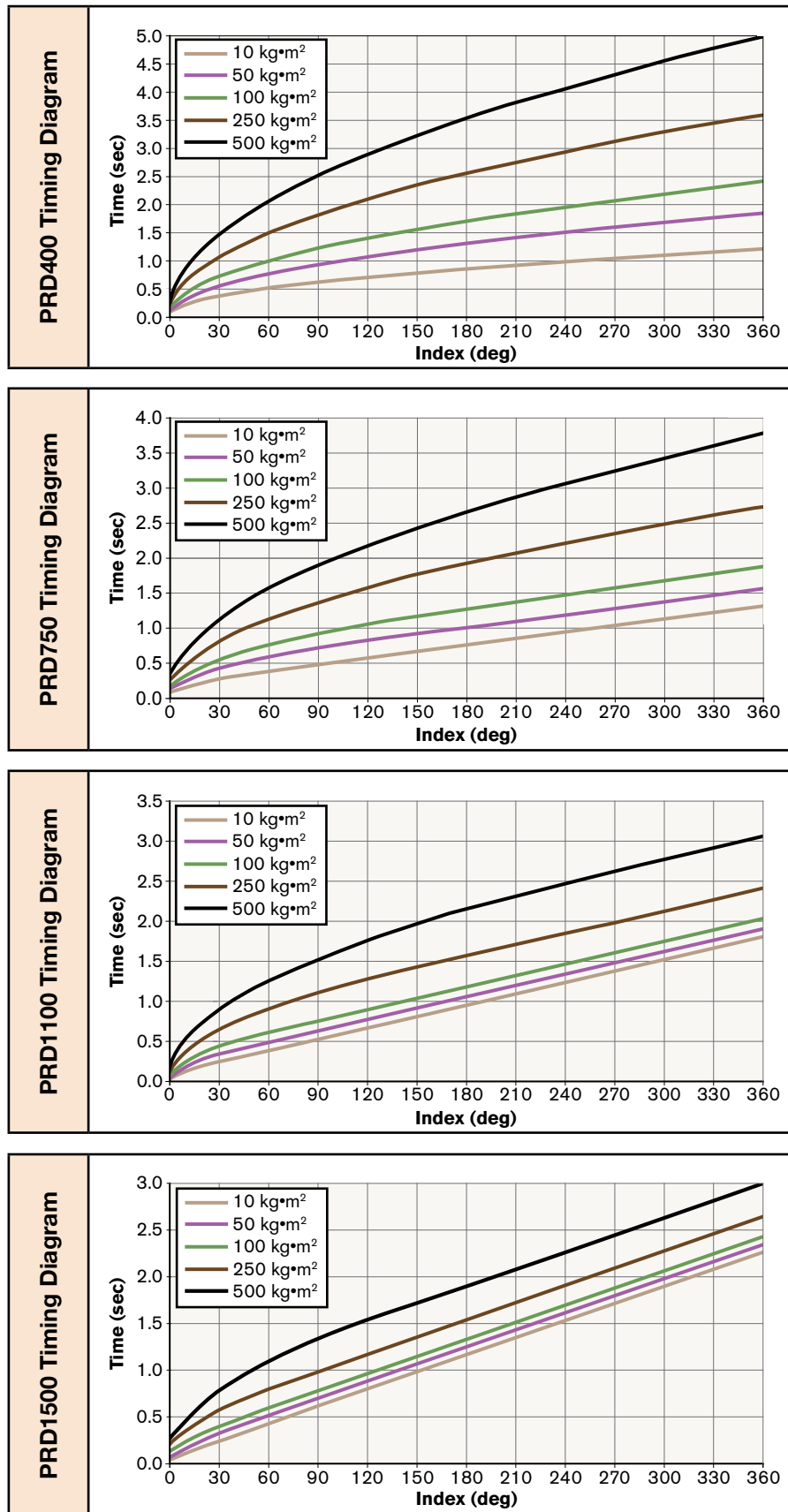
### Motor Feedback

CRD Feedback Specifications		ENDAT01
Output Interface		Endat 2.1 Multi-turn
Device Resolution	Cycles or Lines/Rev	2048
Resolution after AKD Interpolation	Counts	134, 217, 728
Input Voltage	VDC ±5%	5
Current Consumption	mA Max	250
Plug and Play Motor ID *		Yes

\*These feedback devices include electronic motor nameplate data allowing plug-and-play commissioning, eliminating the need for drive parameter set-up and servo loop tuning in most applications.

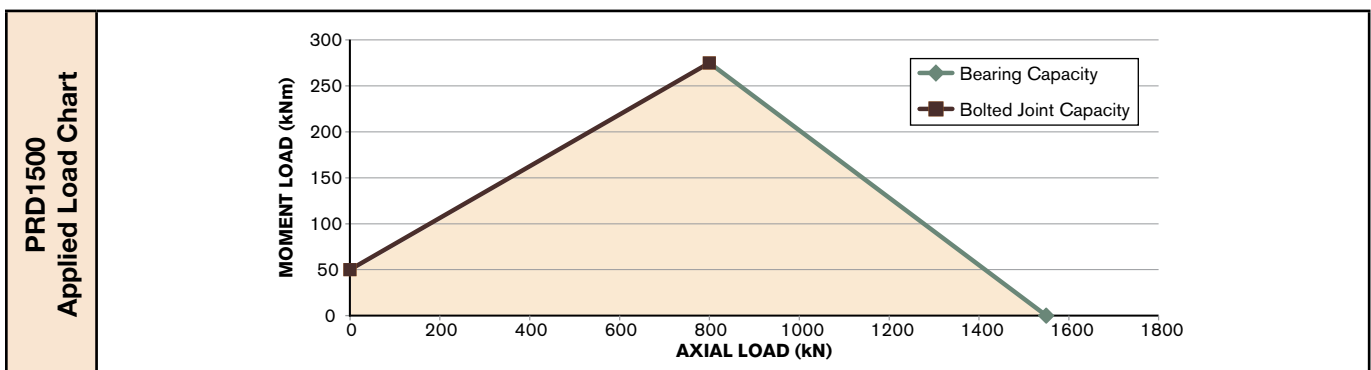
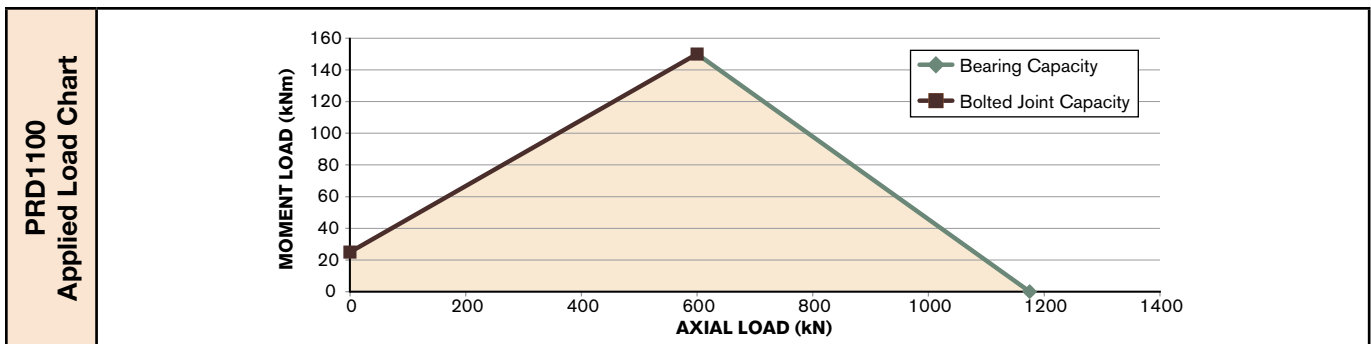
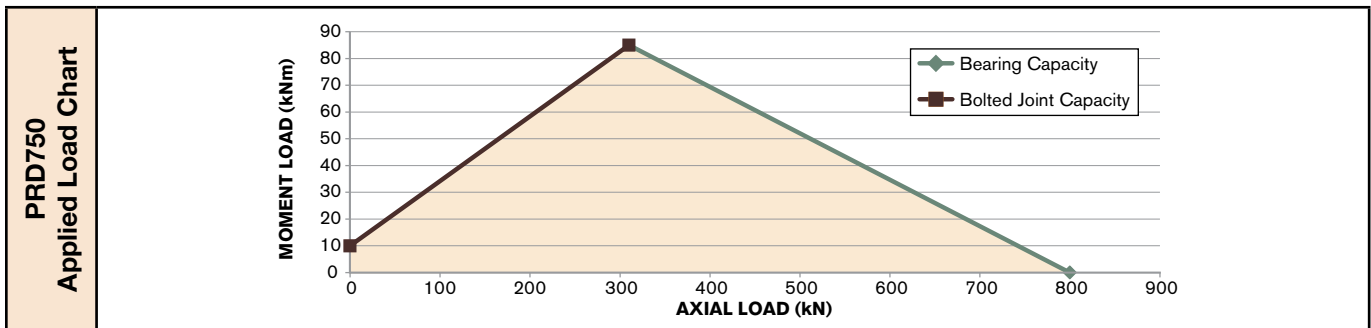
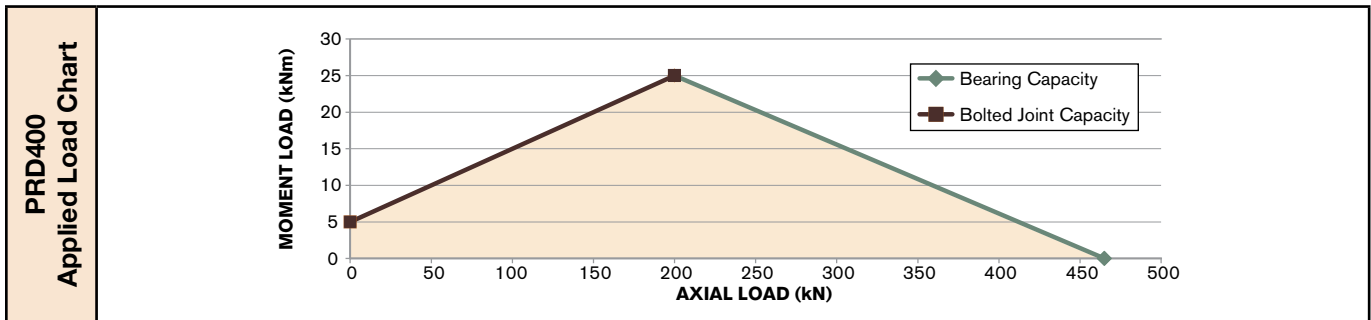
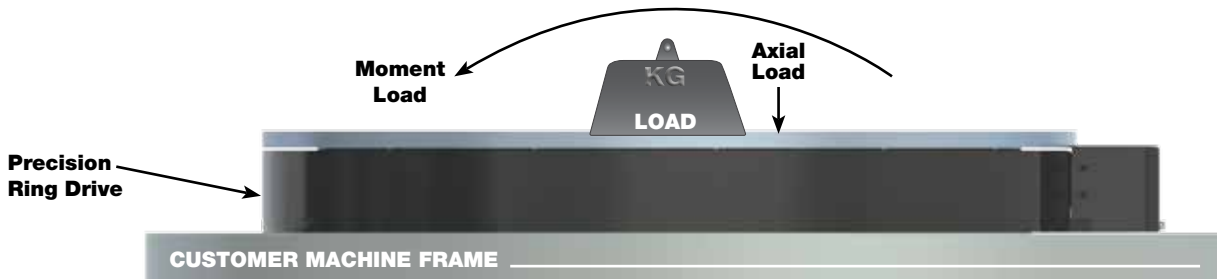


# PRD Timing Diagrams

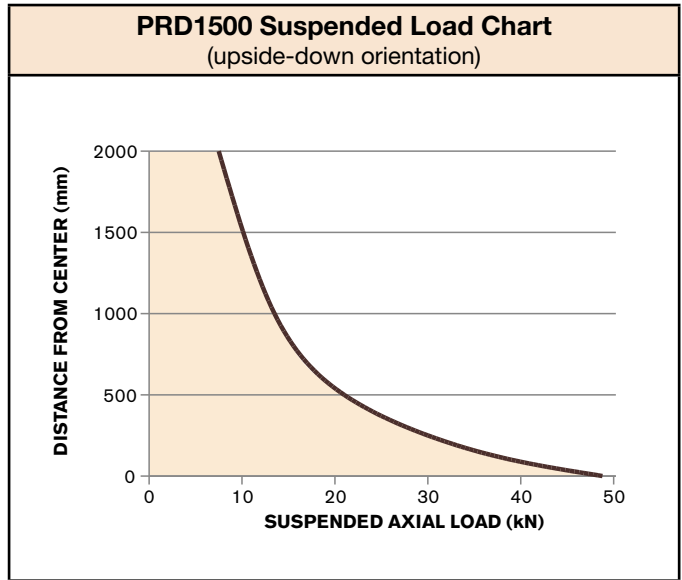
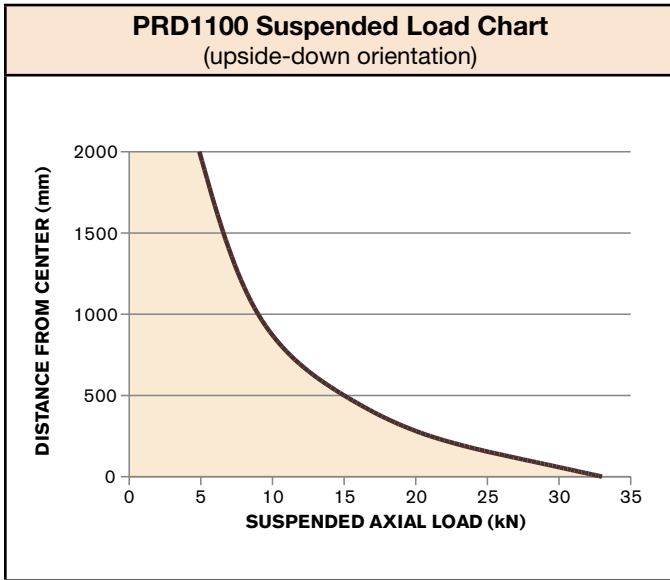
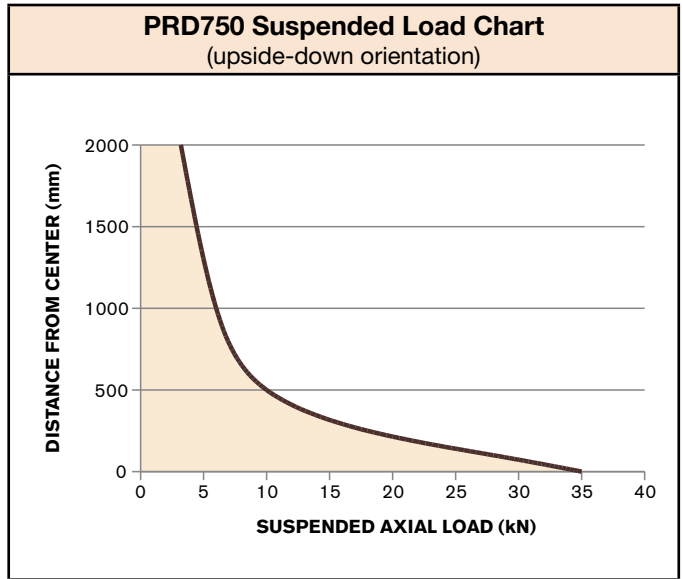
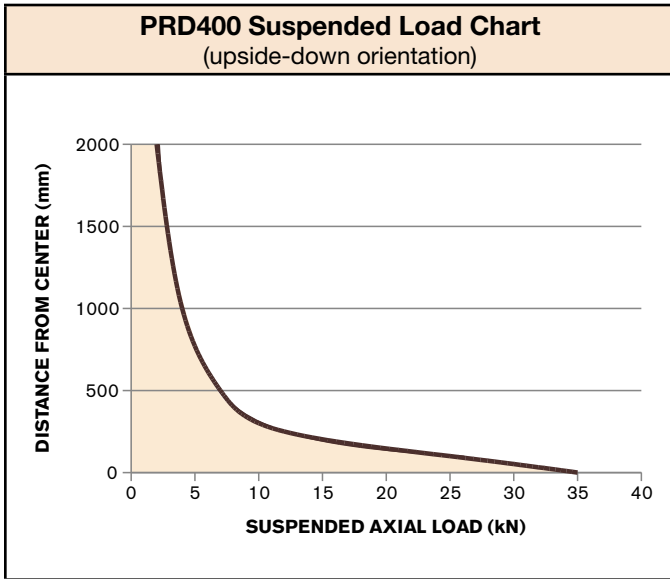
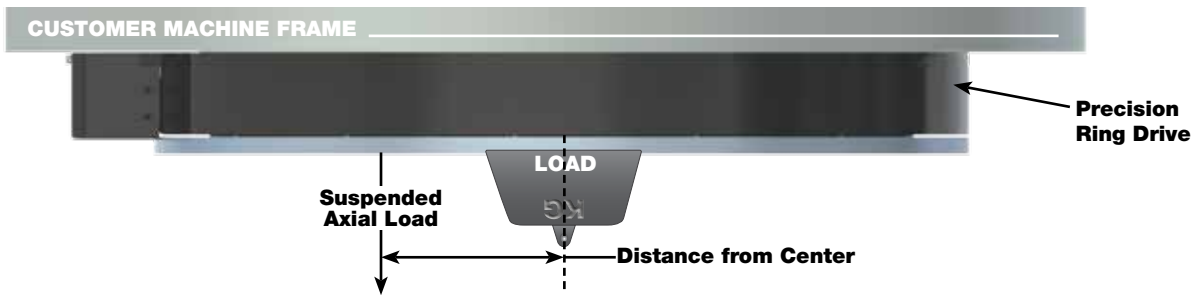


**NOTE:** Curves assume no external forces such as additional table support friction, cutting forces, etc.

# PRD Load Diagrams (Applied Load)

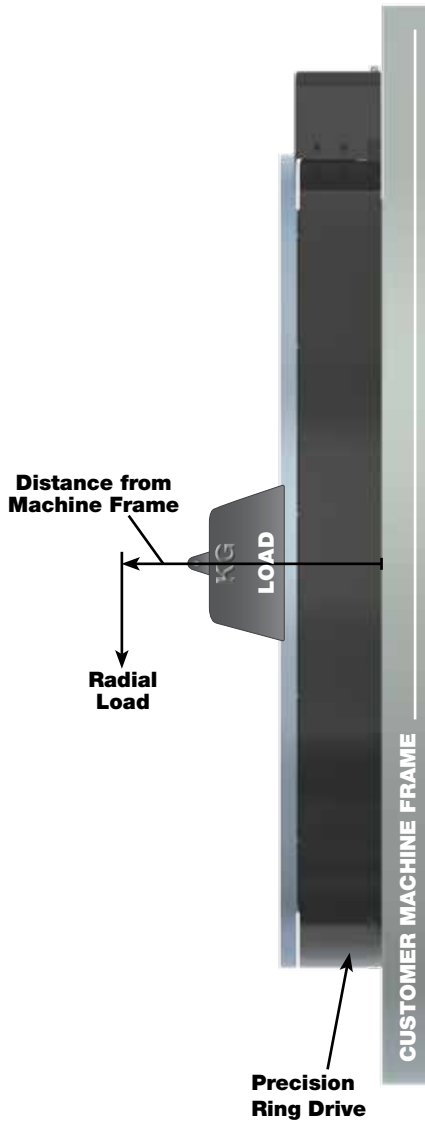


# PRD Load Diagrams (Suspended Load)

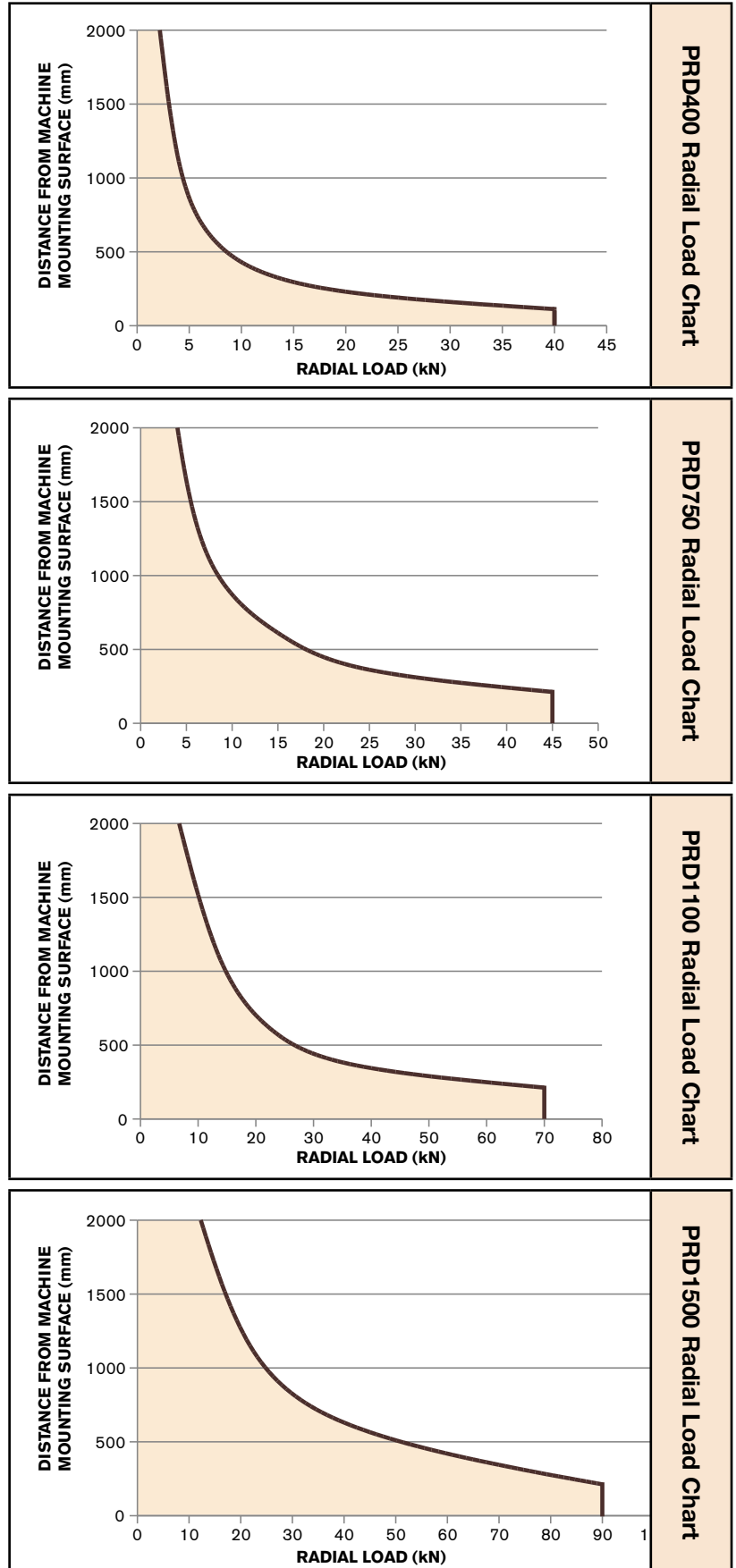


NOTE: The weight of the PRD is already factored into these charts.

# PRD Load Diagrams (Radial Load)

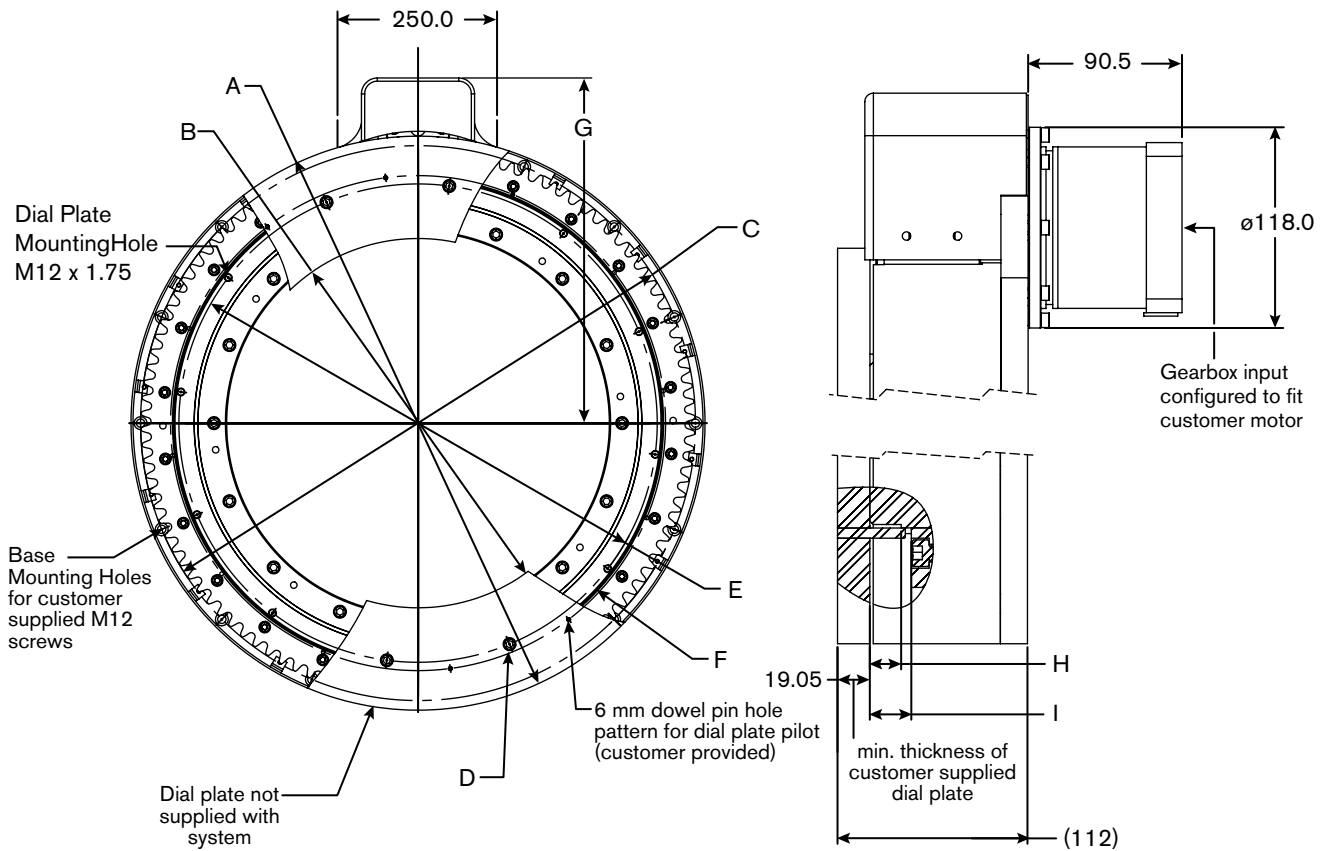


NOTE: The weight of the PRD is already factored into charts.





## Precision Ring Drive Dimensions



**NOTE:** Basic dimensions shown for selection purposes only and subject to change. Visit [www.nexengroup.com](http://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 <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	kgm <sup>2</sup>	1.39	8.83	48.97	112.95
Pinion Inertia	kgm <sup>2</sup>	0.0025			
Total reflected inertia to gearbox output	kgm <sup>2</sup>	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.





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