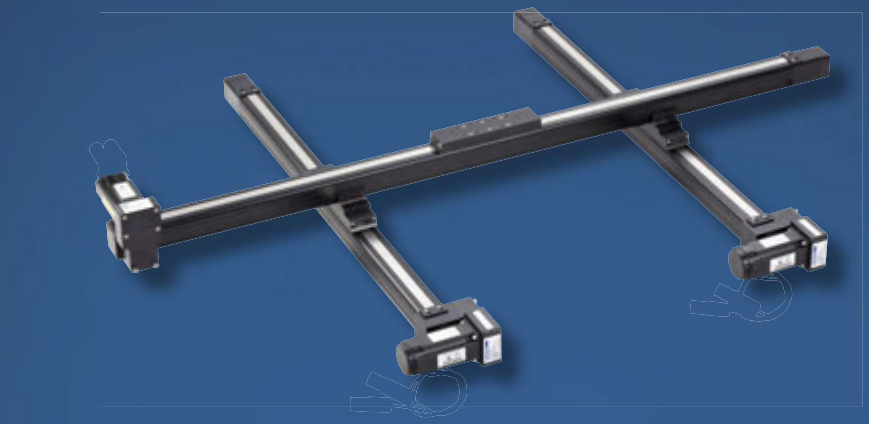
Linear Actuators Catalog

R2A - R4 Series Rodless Actuators



KOLLMORGEN®

Because Motion Matters™

Kollmorgen: Your partner. In Motion.

Every solution comes from a real understanding of the challenges facing machine designers and users.

Innovators consistently rate Kollmorgen as one of their best motion systems manufacturing partners. Whether you are looking for classic servo motors, direct-drive servo motors, stepper motors, drives & amplifiers, gearing, actuation, or CNC & multi-axis motion controllers, Kollmorgen is one of the few companies in the world who actually designs and manufactures all of these products.

Our customers are leaders in many industries such as Aerospace & Defense, Printing, Packaging & Converting, Food & Beverage Processing, Medical Imaging, In Vitro Diagnostics & Laboratory Automation, Pharmaceutical Manufacturing, Material Forming and Cutting, Oil & Gas, and Robotics. Kollmorgen is also a leader in Warehouse Automation, including complete AGV systems, software, awareness and autonomy.

Our Automation Solutions can be found on Mars and in space, ships and submarines, O&G drilling and metrology, surgical robots and laser eye surgery, even inside artificial hearts. These are just a few applications that demand high-performance and high-quality while satisfying their specific needs.

Because motion matters, it's our focus: Motion can distinctly differentiate a machine and deliver a marketplace advantage by increasing its performance and dramatically improving overall equipment effectiveness (OEE).

High-performance motion can make your customer's machine more reliable and energy-efficient, enhance accuracy and improve operator safety. Motion also represents endless possibilities for innovation.

We've always understood this potential, and thus have kept motion at our core and in our Vison, Mission & Values, relentlessly developing products that offer precise control of torque, velocity and position accuracy in machines that rely on complex motion.

KOLLMORGEN®

Because Motion Matters™

Table of Contents

Linear Actuation & Positioning Systems

Kollmorgen offers a comprehensive range of linear actuator products including electric cylinders, rodless actuators, and precision tables to meet a wide range of application requirements. For actuator products not included in this catalog go to www.kollmorgen.com for information about other Kollmorgen linear positioning products.
(Products highlighted are included in this catalog).

	Model	Product Family	General Information
	Electric Cylinders[1]	EC1 EC2 EC3 EC4 EC5 N2	• Highest Force (Thrust) • Clean, Hydraulic Replacement • Compact Cross Section • Extends into Work Area
	Rodless Actuators (screw drive)	R2A R3 R4	• High Force (Thrust) • High Repeatability • Long Travel • Load Carrying Capability
	Rodless Actuators (belt drive)	R2A R3 R4	• Very High Speed • Quiet Operation • Long Travel • Load Carrying Capability
	Precision Tables	DS4 DS6	• High Accuracy & Repeatability • Low Maintenance, Long Life • High Moment Loads

Electric Cylinders (EC)

Primarily designed to apply a force through an extendable rod, electric cylinders are a clean and efficient replacement for hydraulic actuators and pneumatic cylinders, and an alternative to many types of linear transmissions. A wide variety of mounting and coupling alternatives significantly increases their problem solving potential.

Rodless Actuators

Long travel, quiet operation, and high moment loading differentiates rodless actuators from other mechanical transmissions.

Precision Tables

Positioning tables are used when accurate and repeatable motion is critical (1 part per 10,000 or better). These tables offer a wide variety of single and multi-axis configurations, open and closed frame tables, ball or lead screw driven, and overhung and constant support for Kollmorgen geometry configurations.

Model	Max Speed [3] In/s (mm/s)	Max Thrust [2, 3] Lb (N)	Repeatability [4, 5] In (mm)	Max Payload Lb (kg)	Max Travel In (mm)
Electric Cylinders[1]	52.5 (1330)	5620 (25,000)	to 0.0005 (0.013)	Note 1	59.1 (1500)
Rodless Actuators (screw drive)	39 (1000)	700 (3110)	to 0.0005 (0.013)	300 (136)	108 (2743)
Rodless Actuators (belt drive)	118 (3000)	300 (1330)	to 0.004 (0.10)	300 (136)	108 (2743)
Precision Tables	32.5 (825)	440 (1960)	3 microns (commercial grade) / 1.3 microns (precision grade)	794 (360)	79 (2000)

Notes:
1. Electric cylinders are designed primarily for thrust application where loads are supported externally.
2. Thrust ratings are based on mechanical limits rather than motor limits unless indicated otherwise.
3. Max speed and max thrust ratings are not necessarily available simultaneously
4. Repeatability is dependent on feedback resolution, load, friction, and drive gain settings.
5. Repeatability is unidirectional unless otherwise specified

Rodless Actuator

The name "Rodless Actuator" comes from this technology's close relationship to Electric Cylinders, sharing many of the same components. Rather than having a rod, Kollmorgen Rodless Actuators incorporate a carriage supported by linear bearings. Where Electric Cylinders are designed to extend in and out of the work area delivering force or thrust, Rodless Actuators are designed to be load carrying mechanisms (up to 300 lb) incorporating ball screws, leadscrews, or belt drive transmissions with optional integrated gearheads.

Rodless Actuators also share many of the fundamental design characteristics of Precision Positioning Tables. Precision Tables are designed to carry larger payloads and deliver superior repeatability and accuracy. Rodless Actuators offer longer travels and higher speeds at a lower price. Screw driven Rodless Actuators are also thrust-producing devices that are best for axial force applications where the space is limited and a payload must also be supported or carried. They have less moment loading capabilities than Precision Tables, however, they can be effectively combined into complete Cartesian Systems for some multi-axis applications. For higher speed, lower thrust applications, Rodless Actuators are available with a timing belt drive instead of a screw.

Kollmorgen has combined the broad product offering of the R-Series Rodless Actuators with the industry leading AKM servo motors and AKD drives. Stepper motors are also available as an option.

The Benefits of R Series Rodless Actuators

• Rodless Actuators Provide Compact Low Cost Systems	• These system provide compact load positioning when moment loads are minimal • Eliminate need for external bearing guides compared to electric cylinders • Provide the shortest overall envelope • Multiple units can be combined into Cartesian Systems • Have a very compact cross-section
• Broad Range of Motor and Feedback Selections	• World class AKM® brushless servo motor with feedback options such as the Smart Feedback Device (SFD) provide plug-and-play commissioning with the Advanced Kollmorgen Drive (AKD®) • AKM offers an integrated fail-safe holding brake for vertical applications • High performance hybrid stepper motor options are available
• Highly Configurable Design Optimizes Solution and Speeds Development	• Three sizes (R2A, R3, R4 with choice of stroke lengths up to 108 inches, and speeds to 118 in/sec) • Screw or belt driven configurations to optimize performance for maximum thrust or speed • Wide range of geared and timing belt reduction ratios to optimize speed/thrust performance and to match motor/load inertia with drives • Multiple motor mounting orientations and frame mounting styles
• Standard and custom options	• Screw mounted brake (all models) • Water resistant seal, lube port, breather vent (model size dependent) • Custom motor mounts • Custom stroke lengths • Other custom options are available by request

Rodless Series Linear Actuators

Kollmorgen's

Rodless Series Linear Actuator Systems provide performance and versatility in a compact package.

- Travel lengths from 6 to 108 inches provide solutions to a wide range of applications.
- Precision ball screw drive, with 0.2, 0.25, 0.5 and 1.0 inch leads, offers high speed and efficiency, excellent repeatability and accuracy.
- Lead screws and bronze nuts with 0.125 and 0.2 inch leads offer quiet operation and self locking.
- Belt drive versions offer the highest speed when speed instead of thrust is of greatest importance.
- Easily configurable modular design and option set, including a variety of motor mounting orientations, motor sizes and type, drive options, reducer ratios, feedback options, limit/home sensor types and shaft brakes allow the R Series to be customized to meet your specific requirements.

Standard Configurable Rodless Linear Actuator Designs:

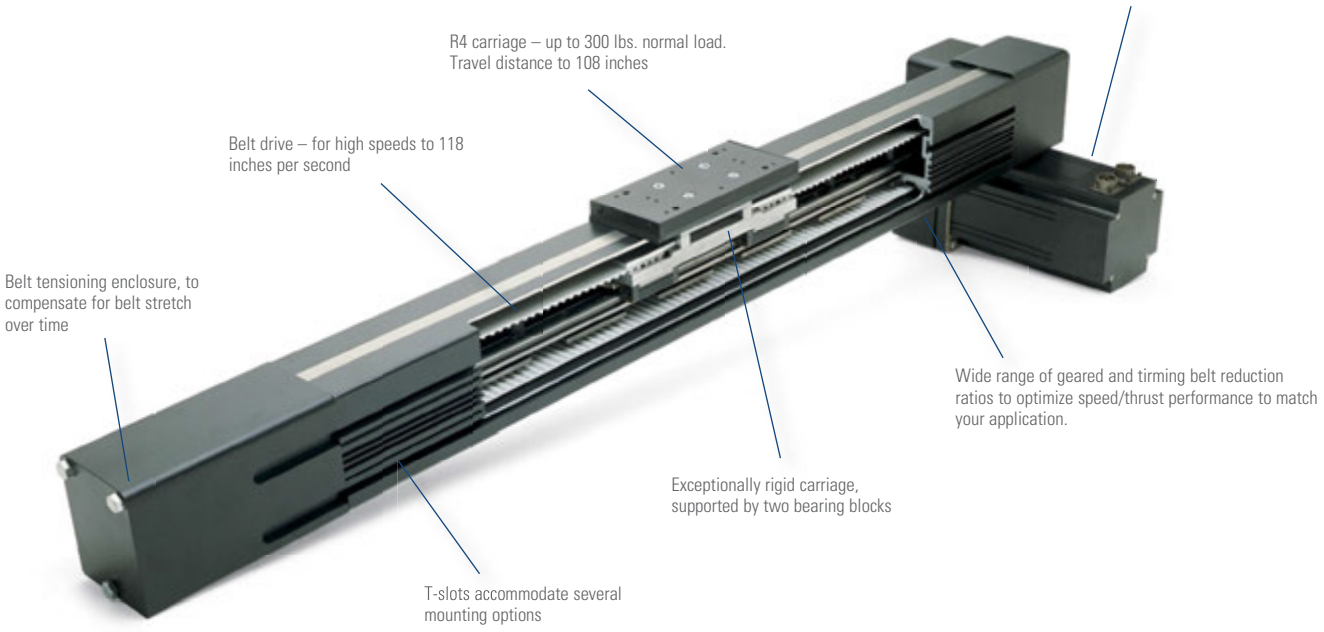
R Series	
Servo Motor options	AKM23, AKM42, AKM52
Stepper Motor options	T22, T31, T32, T41
Transport Method	Ball Screw (1, 2, 4, 5 [rev/in] pitch) Lead Screw (5 and 8 [rev/in] pitch) Transport Belt
Integrated Gearing	Timing Belt (1:1, 1.5:1, 2:1, 3:1 ratios) Helical Gear (3.1:1, 3.5:1, 5:1, 7:1, 10:1, 12:1 ratios) Inline (direct coupled)
Mounting Types	3 Parallel Mounts 1 Inline Mount
Stroke Lengths	Standard Stroke (6 to 108 in.) Custom Stroke Lengths Available

Use Rodless Linear Actuators When You Need:

- To position and guide a load for the lowest system cost.
- To save space by eliminating external guides and ways.
- The shortest overall work envelope (extended length equals retracted length).
- To combine multiple units into Cartesian systems.
- A complete, compact linear position system.

Typical Construction

(R4 belt-driven cutaway shown)



R Series Linear Actuators

- Designed for load carrying up to 300 lbs.
- Ball screw, lead screw or belt-driven transmission
- Integrated load carrying support bearing
- Integrated seal strip
- English and Metric carriage mounting
- Speeds up to 118 in/sec
- Motor options: AKM brushless servo motors or T series stepper motors
- Available in 3 power ranges: R2A, R3, R4

Rodless Series Linear Actuators

Mechanical Drive Comparison

The following chart will help pinpoint which linear drive mechanism is right for your application. Kollmorgen offers many positioner options, such as brakes, encoders, lubrication ports, preloaded nuts, and precision ground screws, that may help you meet your specification. If these standard options do not meet your requirements, please contact Kollmorgen for information regarding custom solutions.

Considerations	Lead Screw	Ball screw	Belt Drive
Noise	Quiet	Noisy	Quiet
Back Driving	Self locking	Easily backdrives	Easily backdrives
Backlash	Increases with wear	Constant throughout screw life	Can increase with wear or stretching of belt
Repeatability	+/- 0.001	+/- 0.001	+/- 0.010
Duty Cycle	Moderate max. 60%	High max. 100%	High max. 100%
Mechanical Efficiency	Low Bronze Nut - 40%	High 90%	High 90%
Life and Mechanical Wear	Shorter life due to high friction	Longer	Longer
Shock Loads	Higher	Lower	Low
Smoothness	Smooth operation at lower speeds	Smooth operation at all speeds	Smooth operation at all speeds
Speed	Low	High	Higher
Cost	$$$ Moderate	$$$ Moderate	$$$ Moderate

Comments
Lead Screw: Sliding nut design provides quiet operation. **Ball screw:** Transmits audible noise as balls recirculate through nut during motion. **Belt Drive:** The neoprene cover of the belt provides noise dampening. The support bearing will generate some noise.
Lead Screw: Good for vertical applications. **Ball screw:** May require brake or holding device when no holding torque is applied to the screw. **Belt Drive:** May require brake or holding device when no holding torque is applied to the drive pulley.
Lead Screw: Considered worn-out when backlash exceeds 0.020". Typically 0.006" when shipped from factory. **Ball screw:** Typically constant at 0.006" (screw/nut only). **Belt Drive:** Typically at 0.010" when shipped. Can be adjusted to compensate for wear or stretching.
Lead Screw: Low duty cycle due to high friction from sliding surface design. **Ball screw:** High screw efficiency and low friction allow high duty cycle. **Belt Drive:** High efficiency provides low heating and high duty cycle.
Lead Screw: Low efficiency sliding friction surfaces. **Ball screw:** High efficiency smooth rolling contact.
Lead Screw: Mechanical wear is function of duty cycle, load and speed. **Ball screw:** Virtually no mechanical wear when operated within rated load specifications. **Belt Drive:** High efficiency contributes to long life. Drive belts can be easily replaced to extend system life.
Lead Screw: Better suited because of larger surface area. **Ball screw:** Brinelling of steel balls limits shock load capability. **Belt Drive:** Shock loads can cause fatique and stretching of drive belts.
Lead Screw: At extreme low speeds, units have a tendency to stop/start stutter (due to friction). **Ball screw:** Generally smoother than lead screw types through the entire speed range. **Belt Drive:** 180° engagement of belt provides continuous smooth contact throughout the speed range.
Lead Screw: Extreme speeds and accelerations can generate excessive heat and deform the screw. **Ball screw:** Can achieve higher speeds than the lead screw due to the efficiency of the ballnut vs. the sliding contact of the solid nut. Speeds in excess of ratings can deform screw. **Belt Drive:** Each revolution of the drive pulley provides several inches of travel. Speeds up to 118 in/sec can be achieved.

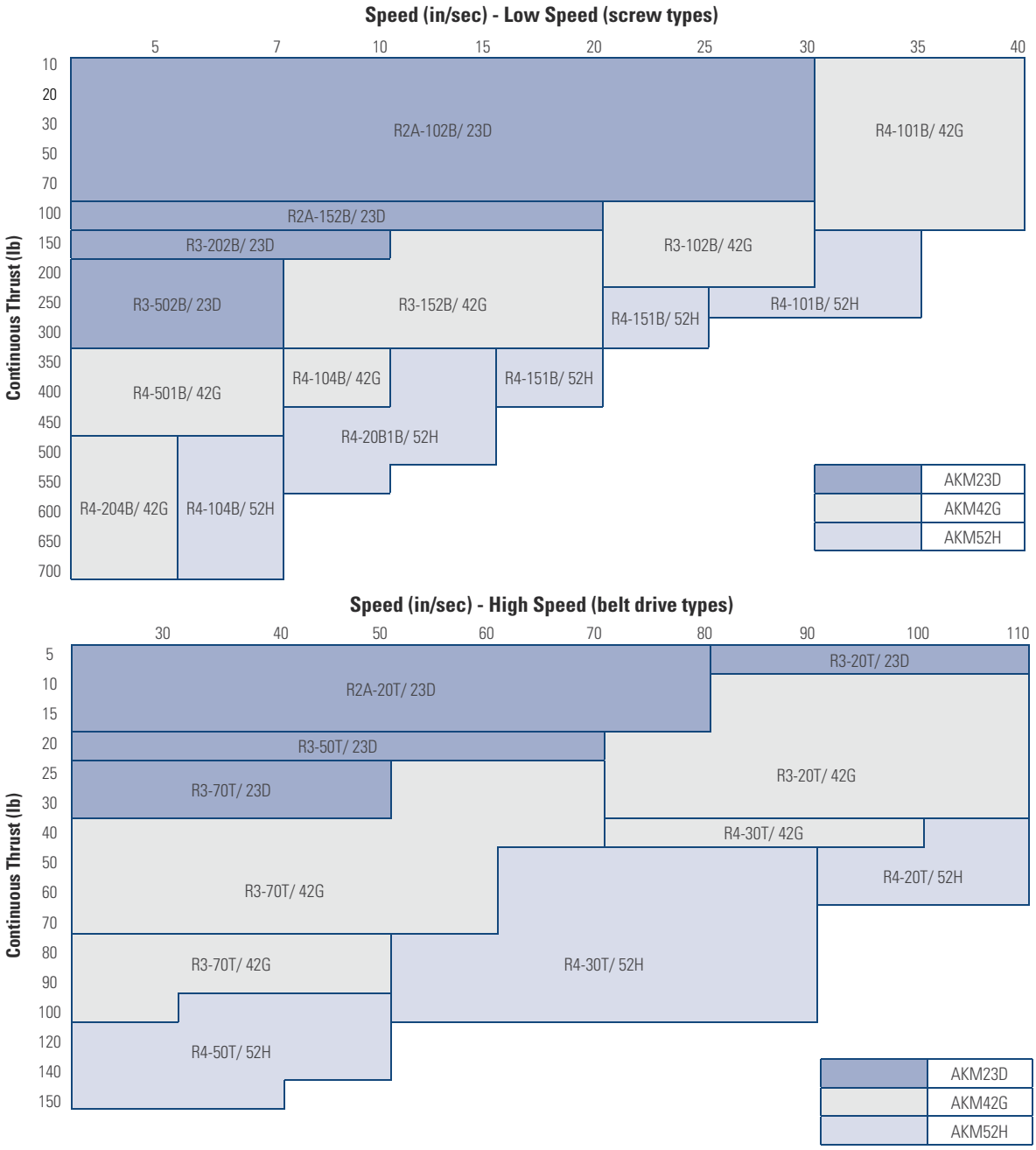
Rodless Actuator Servo Systems

The Rodless Linear Actuator Servo Systems are offered with the Advanced Kollmorgen Drive (AKD®) series to provide the optimum combination of performance and price. Let your application and system requirements determine what AKD option configuration integrates best.

- Single vendor solution for the complete electro-mechanical system ensures system interoperability and single dedicated worldwide motion-control supplier for support.
- The Rodless Linear Actuator Servo Systems are available in drive and control technologies ranging from simple and intuitive positioning drives to fully programable IEC 61131 based control systems.
- The Rodless Linear Actuator Servo Systems leverage Kollmorgen's AKD diverse option configurations and AKM brushless servo motors for complete system flexibility and to support positioning and guiding a load for the lowest system cost.
- The Precision Table Servo Systems have the flexibility for multi-axis configurations including XY, XZ, and XYZ and Gantry configurations.

Flexible Drive Universal Control Options & Power Range	**AKD 115 / 230 / 400 / 460 Vac**
	• Base Unit: Analog torque and velocity, CanOpen®, step and direction, encoder following
	• Network Option Cards
	• EtherCAT®, SynqNet®, Modbus®/TCP, and CANopen®
	• Simple Positioning System - Motion Task, Linked Motion Task, ACCEL/DECEL control, S-curve - Incremental, absolute positioning, Jog mode and more

Servo Motor System Quick Selection Guide



Quick Selection Guide Reference

1. Select Chart for application speed range
   Top chart - Low speeds, up to 40 in/sec
   Bottom Chart - High speeds, up to 118 in/sec
2. Select system by required continuous thrust (lb) and required rated speed (in/sec.)

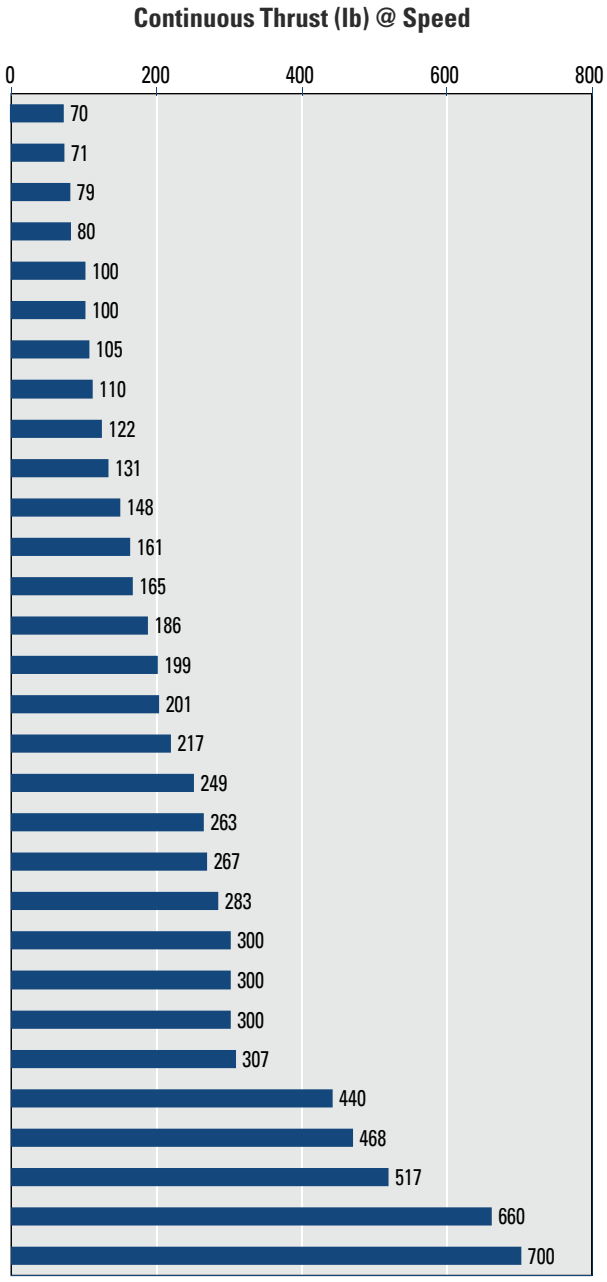
Other application considerations (stroke length, system resolution, inertia ratio, desired safety margins, note pages, etc) may result in selection of a different system. For additional AKD® system specifications see page 17.

Performance data represents continuous thrust (lb) at rated speed (in/s)
Based on AKD drive with 240 Vac, 3 phase supply.

Servo Motor System Performance Summary

Screw Based Systems

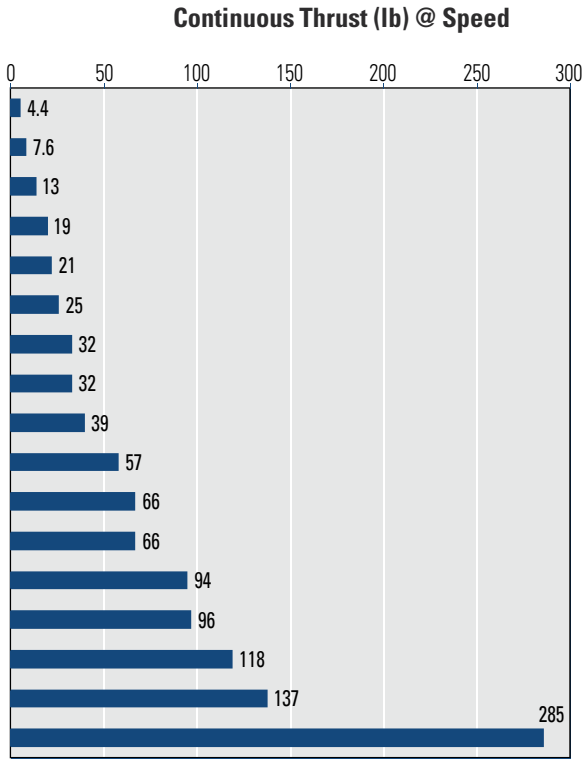
Screw Based System	AKD® Cont. Amps	Cont. Thrust @ speed		Peak Thrust @ speed		Max Thrust
		lb	in/s	lb	in/s	lb
R2A-AKM23D-xxx-102B-yy-P	3 A	70	30	100	30	100
R3-AKM23D-xxx-102B-yy-P	3 A	71	30	269	25	275
R2A-AKM23D-xxx-105A-yy-P	3 A	79	12	100	12	100
R3-AKM23D-xxx-105A-yy-P	3 A	80	12	255	12	300
R2A-AKM23D-xxx-152B-yy-P	3 A	100	20	100	20	100
R2A-AKM23D-xxx-155A-yy-P	3 A	100	8.0	100	8	100
R4-AKM42G-xxx-101B-yy-P	6 A	105	40	356	40	390
R3-AKM23D-xxx-152B-yy-P	3 A	110	20	300	20	300
R3-AKM23D-xxx-155A-yy-P	3 A	122	8.0	300	8.0	300
R3-AKM23D-xxx-108A-yy-P	3 A	131	7.5	300	7.5	300
R3-AKM23D-xxx-202B-yy-P	3 A	148	15	300	15	300
R4-AKM42G-xxx-151B-yy-P	6 A	161	27	540	27	588
R3-AKM23D-xxx-205A-yy-P	3 A	165	6.0	300	6.0	300
R3-AKM23D-xxx-105B-yy-P	3 A	186	12	300	12	300
R3-AKM23D-xxx-158A-yy-P	3 A	199	5.0	300	5.0	300
R3-AKM42G-xxx-102B-yy-P	6 A	201	30	300	30	300
R4-AKM42G-xxx-201B-yy-P	6 A	217	20	700	20	700
R3-AKM42G-xxx-105A-yy-P	6 A	249	12	300	12	300
R4-AKM52H-xxx-101B-yy-P	6 A	263	37	263	37	700
R3-AKM23D-xxx-208A-yy-P	3 A	267	3.8	300	3.8	300
R3-AKM23D-xxx-155B-yy-P	3 A	283	8.0	300	8.0	300
R3-AKM23D-xxx-505A-yy-P	3 A	300	2.4	300	2.4	300
R3-AKM42G-xxx-152B-yy-P	6 A	300	20	300	20	300
R3-AKM42G-xxx-155A-yy-P	6 A	300	8.0	300	8.0	300
R4-AKM52H-xxx-151B-yy-P	6 A	307	25	307	25	700
R4-AKM42G-xxx-104B-yy-P	6 A	440	10	700	10	700
R4-AKM42G-xxx-501B-yy-P	6 A	468	7.8	700	7.8	700
R4-AKM52H-xxx-201B-yy-P	6 A	517	18	600	18	700
R4-AKM42G-xxx-154B-yy-P	6 A	660	6.7	700	6.7	700
R4-AKM52H-xxx-104B-yy-P	6 A	700	9.4	700	9.4	700



Servo Motor System Performance Summary

Belt Based Systems

Belt Based System	AKD® Cont. Amps	Cont. Thrust @ speed		Peak Thrust @ speed		Max Thrust
		lb	in/s	lb	in/s	lb
R3-AKM23D-xxx-15T	3 A	4.4	118	29	118	29
R3-AKM23D-xxx-20T	3 A	7.6	118	41	118	41
R2A-AKM23D-xxx-15T	3 A	13	80	64	80	64
R2A-AKM23D-xxx-20T	3 A	19	80	78	80	87
R3-AKM23D-xxx-50T	3 A	21	71	76	71	92
R4-AKM42G-xxx-20T	6 A	25	118	100	118	100
R3-AKM23D-xxx-70T	3 A	32	51	108	51	131
R3-AKM42G-xxx-20T	6 A	32	118	117	118	126
R4-AKM42G-xxx-30T	6 A	39	100	139	100	153
R4-AKM42G-xxx-50T	6 A	57	59	200	59	219
R3-AKM42G-xxx-50T	6 A	66	72	138	72	200
R4-AKM52H-xxx-20T	6 A	66	118	200	90	202
R3-AKM42G-xxx-70T	6 A	94	51	197	51	200
R4-AKM52H-xxx-30T	6 A	96	92	300	60	300
R4-AKM42G-xxx-100T	6 A	118	30	300	30	300
R4-AKM52H-xxx-50T	6 A	137	54	300	44	300
R4-AKM52H-xxx-100T	6 A	285	27	300	27	300



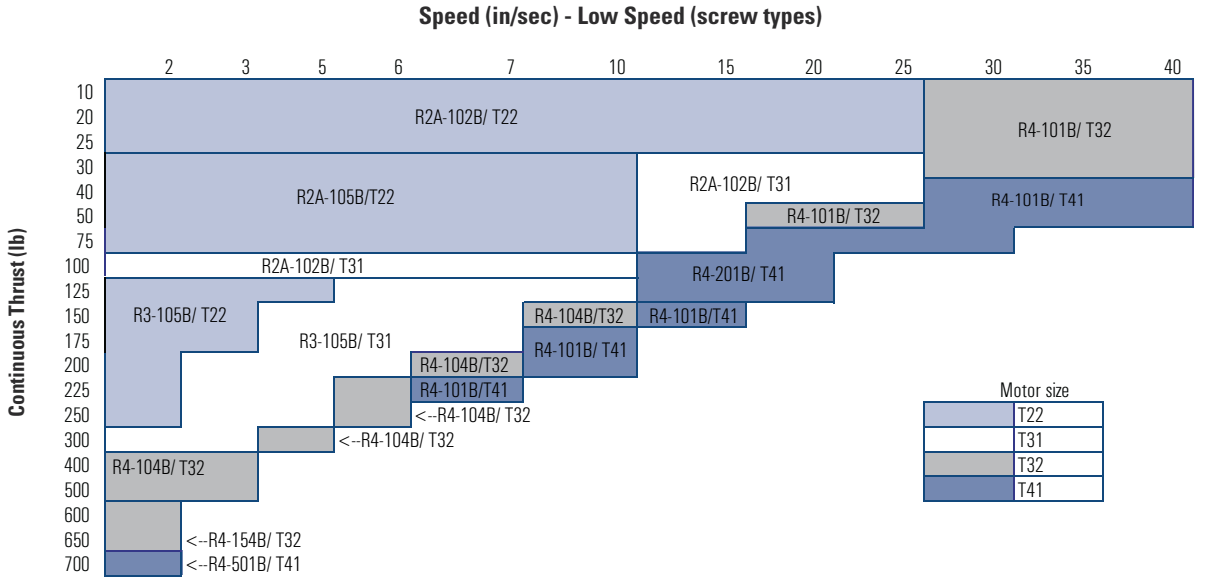
Rodless Actuator Stepper Systems

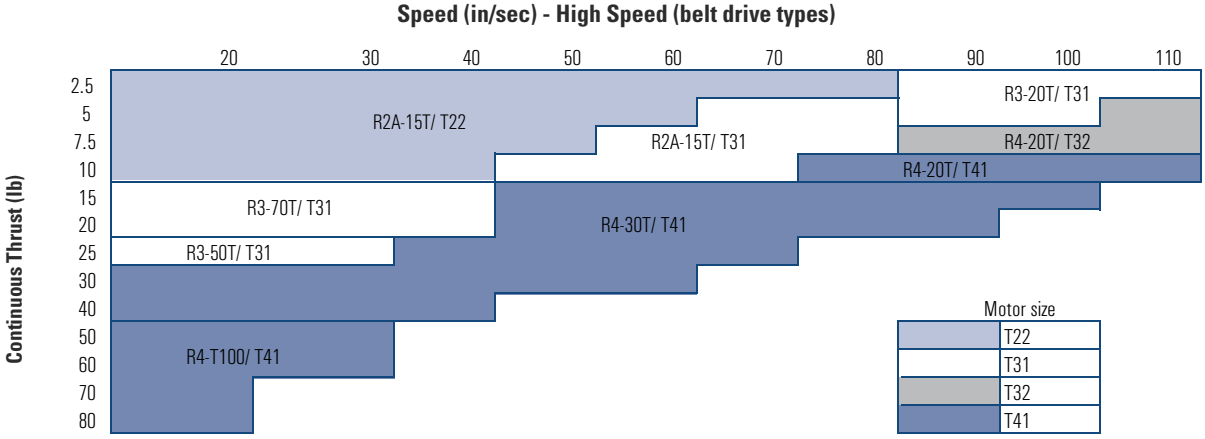
The Rodless Actuator Stepper Systems are offered with a versatile stepper drive and multiple hybrid stepper motor sizes to provide system flexibility. Let your application and system requirements determine what solution integrates best.

- Single vendor solution for the complete electro-mechanical system ensures system interoperability and single dedicated worldwide motion-control supplier for support.
- The Rodless Actuator Stepper Systems are available with standard step and direction drive functions, and enhanced drive technologies incorporating simple program control functionality (P7000 with -PL option).
- The Rodless Actuator Stepper Systems leverage multiple stepper motor sizes to provide the most cost effective solution to meet your machine's performance requirement.
- The Precision Table Stepper Systems have the flexibility for multi-axis configurations including XY, XZ, and XYZ and Gantry configurations.

	P70630 115/230 VAC
Advanced Stepper Motor Control Easy Commissioning Compatible with a Wide Range of Motors	• Base Unit: accepts step and direction inputs
	• An integrated position controller is available (-PN option) - Up to 68 absolute or incremental moves - Specify detailed move parameters or simply distance and time
	• Multistepping™ inserts fine micro-steps to smooth coarse low speed motion
	• Advanced auto-tuning provides outstanding low-speed performance

Stepper Motor System Quick Selection Guide





Quick Selection Guide Reference

1. Select Chart for application speed range
   Top chart - Low speeds, up to 40 in/sec
   Bottom Chart - High speeds, up to 118 in/sec
2. Select system by required continuous thrust (lb) and required rated speed (in/sec.)
3. Performance data respresents continuous output thrust and speed.

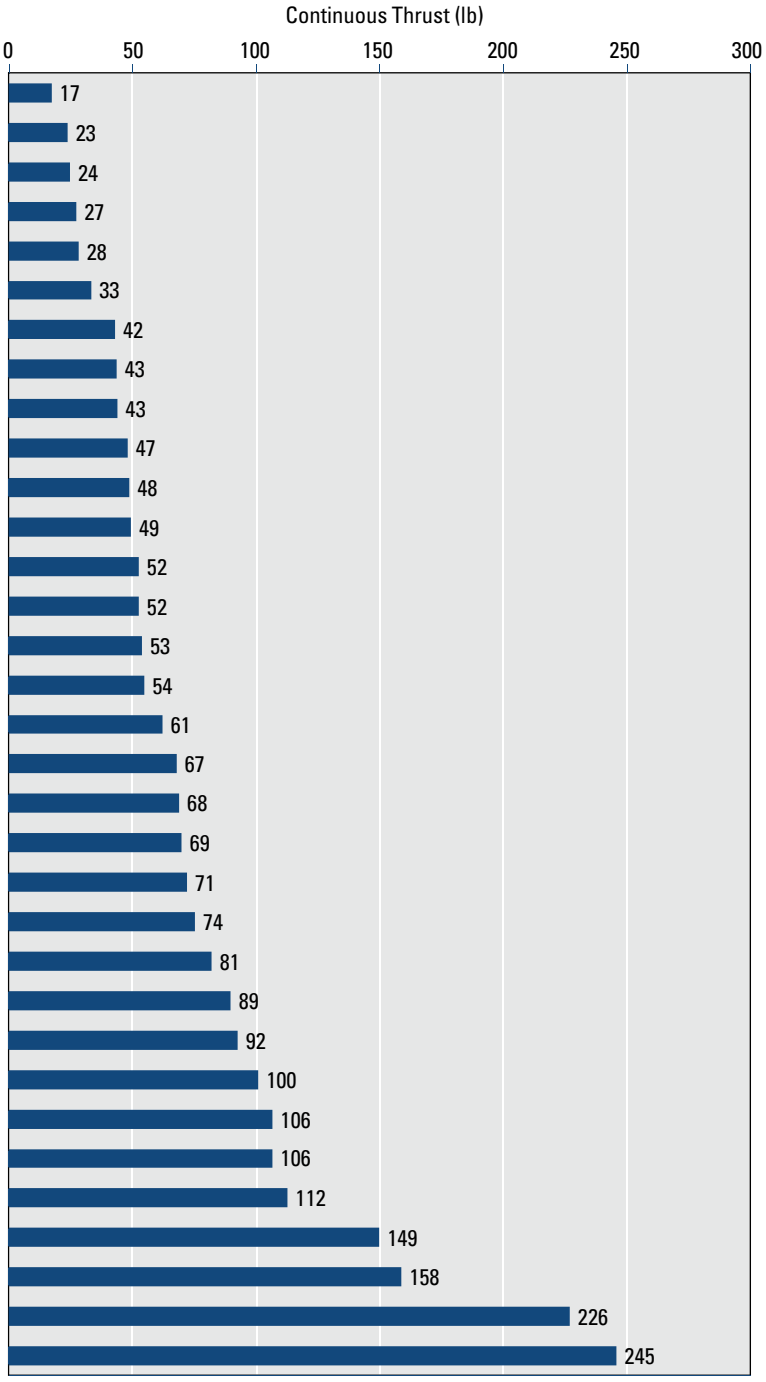
Other application considerations (stroke length, system resolution, inertia ratio, desired safety margins, etc) may result in selection of a different system.

Performance data represents continuous thrust (lb) at rated speed (in/s) based on P7000 drive with 240 Vac, single phase supply. For stepper motor systems it is good practice to size based on a 2x thrust margin and a 1.2x speed margin.

Stepper Motor System Performance Summary

Screw Based Systems

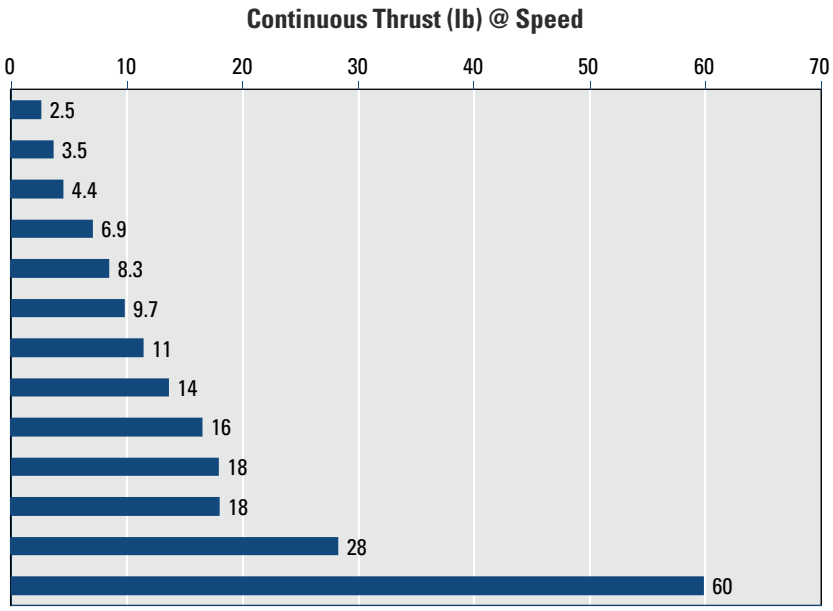
Screw Based System	Cont. Thrust @ speed		Max Thrust
	lb	in/s	lb
R2A-T22T-152B-yy-P	17	38	100
R2A-T22T-102B-yy-P	23	25	100
R3-T22T-102B-yy-P	24	25	96.2
R2A-T22T-105A-yy-P	27	10	100
R3-T22T-105A-yy-P	28	10	108
R4-T32T-101B-yy-P	33	40	218
R2A-T31T-102B-yy-P	42	25	100
R3-T31T-102B-yy-P	43	25	228
R2A-T22T-155A-yy-P	43	6.6	100
R3-T22T-108A-yy-P	47	6.2	175
R2A-T31T-105A-yy-P	48	10	100
R3-T31T-105A-yy-P	49	10	253
R4-T32T-151B-yy-P	52	26.6	330
R4-T41T-151B-yy-P	52	26.6	437
R4-T41T-101B-yy-P	53	40	290
R3-T22T-202B-yy-P	54	12.5	198
R3-T22T-205A-yy-P	61	5	221
R3-T31T-152B-yy-P	67	16.6	300
R2A-T22T-105B-yy-P	68	10	100
R3-T31T-105B-yy-P	69	10	249
R4-T32T-201B-yy-P	71	20	442
R3-T22T-158A-yy-P	74	4.1	266
R3-T31T-108A-yy-P	81	6.2	300
R3-T22T-105B-yy-P	89	10	249
R3-T31T-202B-yy-P	92	12.5	300
R3-T22T-208A-yy-P	100	3.1	300
R3-T22T-152B-yy-P	106	6.6	300
R3-T22T-155B-yy-P	106	6.6	300
R4-T41T-201B-yy-P	112	20	585
R4-T32T-104B-yy-P	149	10	700
R4-T32T-501B-yy-P	158	7.8	700
R4-T32T-154B-yy-P	226	6.6	700
R4-T41T-501B-yy-P	245	7.8	700



Performance data represents continuous thrust (lb) at rated speed (in/s) based on P7000 drive with 240 Vac, single phase supply.
For stepper motor systems it is good practice to size based on a 2x thrust margin and a 1.2x speed margin.

Belt Based Systems

Belt Based System	Cont. Thrust @ speed		Max Thrust
	lb	in/s	lb
R2A-T22T-15T	2.5	80	19.1
R2A-T22T-20T	3.5	75	27.5
R3-T31T-20T	4.4	118	33.3
R4-T32T-20T	6.9	118	54.1
R2A-T31T-15T	8.3	80	51.9
R2A-T31T-20T	9.7	75	71.3
R3-T31T-50T	11	59.5	75.9
R4-T41T-20T	14	118	73
R4-T32T-50T	16	58	122
R4-T41T-30T	18	100	113
R3-T31T-70T	18	42.8	108
R4-T41T-50T	28	58	162
R4-T41T-100T	60	30	300



Performance data represents continuous thrust (lb) at rated speed (in/s) based on P7000 drive with 240 Vac, single phase supply.
For stepper motor systems it is good practice to size based on a 2x thrust margin and a 1.2x speed margin.

Rodless Series General Specifications

R2A

R3

R4

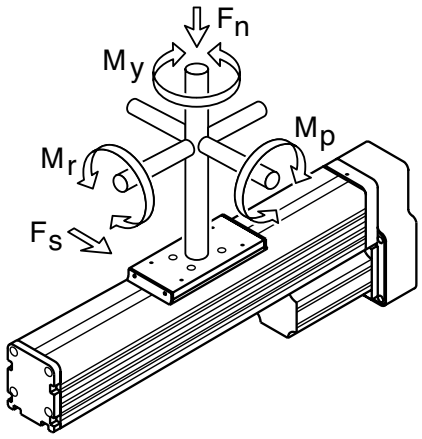
Specification Overview

Series	R2A			R3			R4	
Std. maximum stroke length (in)	72			108			108	
Cross Section (in)	2 x 2			2.5 x 2.8			3.6 x 4.25	
Guide Type	Roller Guides			Profile Rail			Profile Rail	
Drive Type	Ball screw	Lead Screw	Belt	Ball screw	Lead Screw	Belt	Ball screw	Belt
Screw Leads (in/rev)	0.5, 0.2	0.2, 0.125	n/a	0.5, 0.2	0.2, 0.125	n/a	1, 0.25	n/a
Nominal Screw Diameter (in)	0.625	0.625	n/a	0.625	0.625	n/a	1	n/a
Brushless Servo Motor (1)	AKM23			AKM23, AKM42			AKM42, AKM52	
Stepper Motor	T22, T31			T22, T31			T32, T41	
Max Thrust (lb)	100			300			700	300
Max Velocity (in/sec)	30		80	30		118	40	118
Max Carriage Load								
Normal (lb)	50			100			300	
Roll Moment (lb-in)	50			300			600	
Pitch Moment (lb-in)	100			500			1000	
Repeatability (in)	+/-0.001		+/-0.010	+/-0.001		+/-0.010	+/-0.001	+/-0.010
Max Duty Cycle (speed, load dependent)	100%	60%	100%	100%	60%	100%	100%	100%
Limit Sensors	Optional							
Std. Operating Temperature Range	-20 deg F to 140 deg F (-28 deg C to 60 deg C)							
Moisture/Contamination	IP 44 rated: Splash-proof, protected against ingress of solid particles greater than 0.040 [1mm] diameter.							

Carriage: Straigtness & Flatness ± 0.005 in/ft [0.125 mm/300 mm], not to exceed ± 0.035 in [0.9 mm] (all models)

Load Limits:
R2A, R3, R4

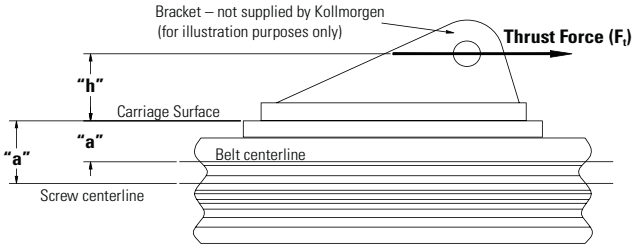
	R2A	R3	R4 Screw	R4 Belt
Normal (F_n): lb (N)	50 (222)	100 (445)	300 (1330)	300 (1330)
Side (F_s): lb (N)	50 (222)	100 (445)	150 (667)	150 (667)
Pitch (M_p): lb-in (N-m)	100 (11)	500 (56)	1700 (2305)	750 (1017)
Roll (M_r): lb-in (N-m)	50 (5.65)	300 (34)	600 (68)	600 (68)
Yaw (M_y): lb-in (N-m)	100 (11)	500 (56)	1000 (113)	1000 (113)



Pitch Moment Examples

Equation: Mp = (a + h) x Ft

Note that the distance from the carriage surface to the screw/belt center-line has been added to the moment arm.



R Series Positioner

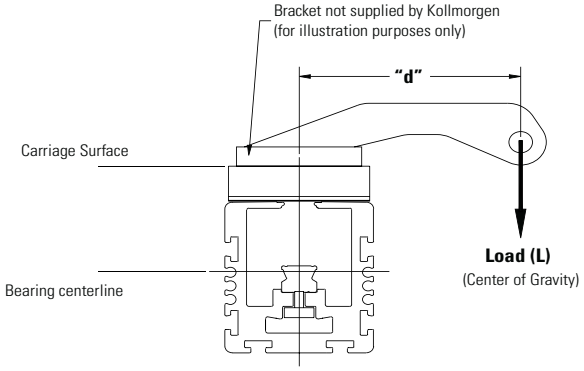
Pitch Moment offset values "a"

"a"	R2A	R3	R4
Screw Offset: in (mm)	1.82 (46.2)	1.68 (42.7)	3.94 (100)
Belt Offset: in (mm)	1.58 (40.1)	1.10 (27.9)	3.06 (77.7)

Roll Moment (overhung load) Example

Equation: Mr = d x L

Note that the distance from the carriage surface to the screw/belt center-line has been added to the moment arm.



R Series Positioner

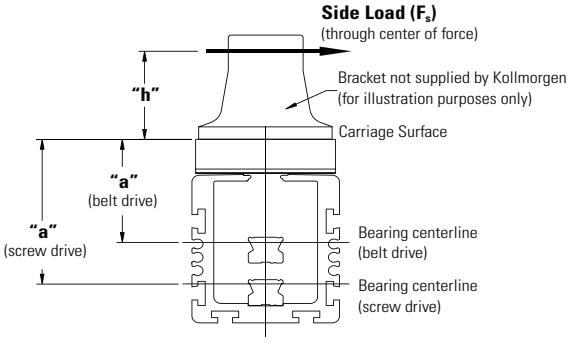
Roll Moment (side load) Example

Equation: Mr = (a + h) x Tf

Note that the distance from the carriage surface to the screw/belt center-line has been added to the moment arm.

Roll Moment offset values "a"

"a"	R2A	R3	R4
Screw Offset: in (mm)	1.11 (28.2)	2.76 (70.1)	3.94 (100)
Belt Offset: in (mm)	1.11 (28.2)	1.97 (50)	3.06 (77.7)



R3 Series Positioner

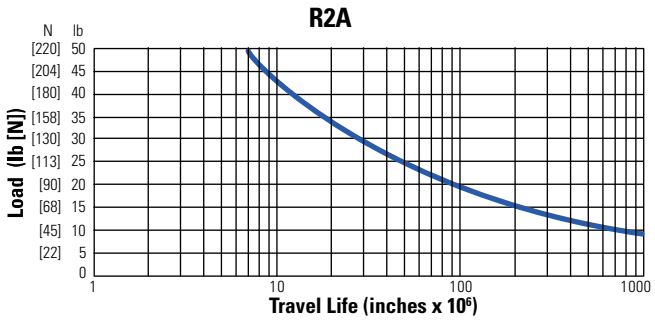
Rodless Series General Specifications

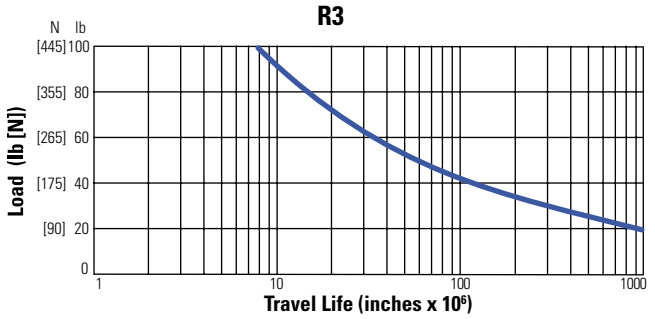
Life

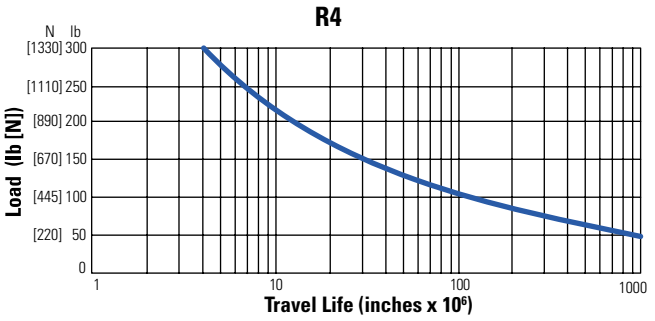
Belt Drive

As belt-driven actuators are generally used horizontally with light thrust loads, life is usually a function of the load weight. Actual life will be determined by carriage loading, speed, acceleration, and duty cycle and operating environment. The curves show predicted life of the actuator under ideal conditions. Derate as required by your application.

Carriage Load vs. Rail Life



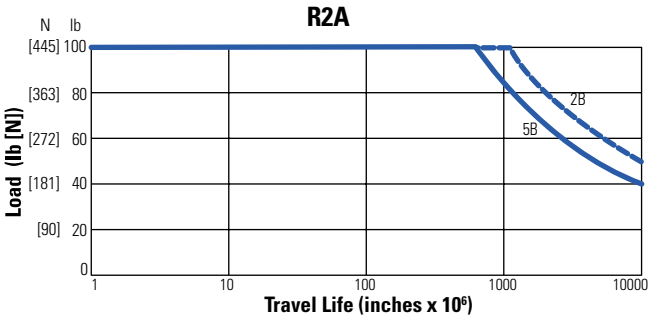


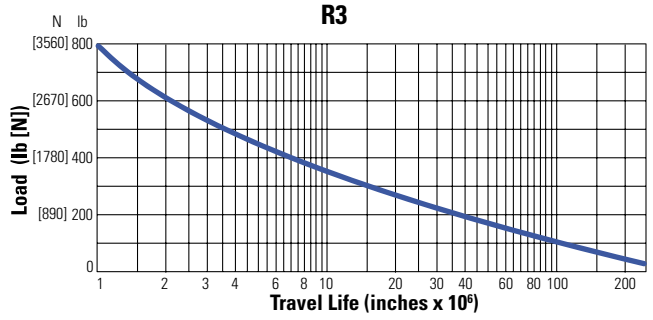


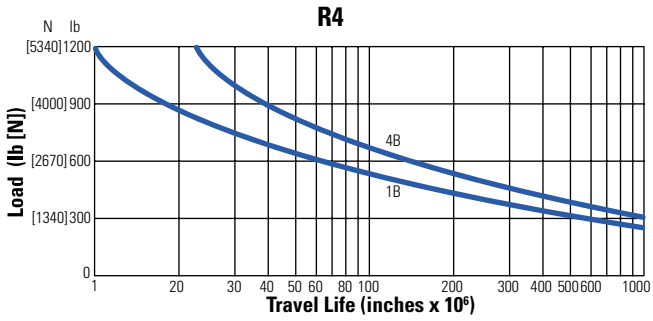
Ball screw

Ball screw life is rated in inches (meters) of travel for a given load. The values in the charts indicate the travel life where 90% of all units in the sample will continue to work, while 10% have failed. This is similar to the B10 rating where 90% of a roller bearing mechanism. Be sure to consider acceleration loads as well as thrust, gravitational and friction loads.

Ball screw Life vs. Travel Life







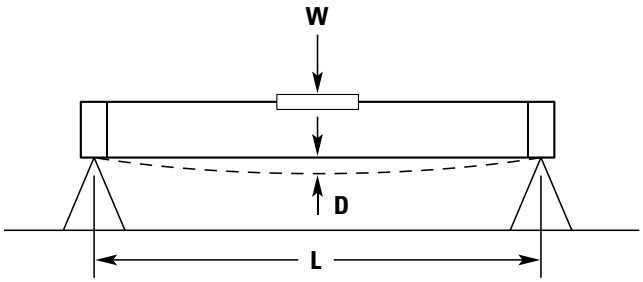
Lead Screw

Usable life for a lead screw is defined as the length of travel completed before linear backlash of the lead screw and nut exceeds 0.0200 in (0.051 mm). A travel life of 1 million inches under the maximum rated load can be used as a first approximation. Since wear is a function of several application parameters (load, duty cycle, speed, acceleration rates, environment, etc.) it is often difficult to exactly predict travel life of a lead screw.

Deflection

The equations shown provide deflection as a function of the various loads applied to the carriage.
Deflection should not exceed 0.015 in. (0.38 mm) for all models. Mounting spacing should not exceed 48 in. (1200 mm)

Deflection Equations



Where:

W = Load (lb)
D = Deflection (inches)
L = Mounting spacing (inches)

Positioner deflection will affect the flatness or straightness of the positioner when the system is supported at spaced mounting points.

Normal and Side: $D = WL^3/("c" \times 10^8 + "d")$

Orientation	R2A			R3			R4		
Value	"c"	"d"	"D" limit	"c"	"d"	"D" limit	"c"	"d"	"D" limit
Normal - Screw	3.3	3.0 E-5	0.015	7.20	0	0.015	28.0	0	0.015
Normal - Belt	3.3	1.2 E-4	0.015	7.20	0	0.015	28.0	0	0.015
Side	2.70	0	0.015	6.50	0	0.015	13.0	0	0.015

Pitch, Roll, Yaw: $D = "e" \times 10^{-6}$ radians/ lb-in

Orientation	R2A		R3		R4	
Value	"e"	limit (radians)	"e"	limit (radians)	"e"	limit (radians)
Pitch	4.0	0.004 @ 100 lb-in	3.3	0.002 @ 500 lb-in	3	0.003 @ 1000 lb-in
Roll	52	0.026 @ 50 lb-in	46	0.014 @ 300 lb-in	20	0.013 @ 600 lb-in
Yaw	10	0.010 @ 100 lb-in	5.1	0.003 @ 500 lb-in	4	0.004 @ 1000 lb-in

Maintenance

The carriage seal and internal bearing design prevents lubrication contamination and nearly eliminates the need for routine maintenance.

R2A Series Rodless Actuator

General Specifications

Travel Lengths	6, 12, 18, 24, 30, 36, 42, 48, 60, 72 inches
Construction Materials	
Bearing Housing	Type 380 die cast aluminum, epoxy coated
Guide Housing	6063 T-6 aluminum, hard anodized and Teflon® impregnated
Carriage Assembly	6061 T-6 aluminum, hard anodized
Internal Guide Bearings	Four angular contact bearings with ground Gothic arch raceway running on dual precision rails
Lead Screw or Belt	
Lead Choices	0.5, 0.2, Ball; 0.2, 0.125, Lead Screw (in/rev)
Support Bearings	Ball bearings
Lead Screw; drive nut	0.625" diameter alloy steel screw; lubricated bronze drive nut
Ball screw; ballnut	0.625" diameter hardened alloy steel screw; alloy steel, heat treated ballnut
Belt Drive	0.5" wide polyurethane with steel reinforcement cords
Flexible Seal	Stainless steel band with elastomeric seal
Motor	AKM® servo motor or T series stepper
Weight (approx, without options)	
R2A-AKM23	16 + 0.3 x (inches stroke) lb [7.3 + 0.14 x (inches stroke)] kg
R2A-T22	17 + 0.3 x (inches stroke) lb [7.7 + 0.14 x (inches stroke)] kg
R2A-T31	19 + 0.3 x (inches stroke) lb [8.6 + 0.14 x (inches stroke)] kg
Environmental Operation	
Temperature Range	-20° to 140°F [-28° to 60°C]
Moisture/Contaminants	IP 44 rated: Splash-proof, protected against ingress of solid particles greater than 0.040" [1 mm] diameter. Non-corrosive, non-abrasive.

R2A Series Actuator

R2A Series Inertia

Inertia Equations:

Rotary Inertia (lb-in-s^2, reflected to the motor) **= A + B x Stroke + C x Load + D**

Linear Inertia (lb, reflected to the carriage) **= [[A + B x Stroke + D]/C] + Load**

where:

A = Inertia of zero length slide (lb-in-s^2)

B = Inertia adder per inch of stroke length (lb-in-s^2/in)

C = Inertia adder per pound of payload (lb-in-s^2/lb)

D = Motor inertia (lb-in-s^2)

Stroke = Total stroke length in inches (in). Same as stroke length entered into part number

Load = Payload in pounds (lb)

Belt Driven Models	Motors	Ratio	Belt (in)	A (lb-in-s^2)	B (lb-in-s^2/in)	C (lb-in-s^2/lb)
R2A...-10T	AKM23	1:1	0.5 wide	5.85 E-04	2.41 E-06	5.74 E-04
R2A...-15T	AKM 23,T22, T31	1.5:1		2.63 E-04	1.07 E-06	2.56 E-04
R2A...-20T	AKM 23,T22, T31	2:1		1.51 E-04	5.98 E-07	1.46 E-04
Screw Driven Models	**Motors**	**Ratio**	**Screw dia. x lead (in)**	**A (lb-in-s^2)**	**B (lb-in-s^2/in)**	**C (lb-in-s^2/lb)**
R2A...-102B	AKM 23,T22, T31	1:1	0.625 x 0.5	1.99 E-04	7.12 E-05	1.64 E-05
R2A...-152B	AKM23, T22	1.5:1		9.14 E-05	3.17 E-05	7.29 E-06
R2A...-202B	AKM23	2:1		5.35 E-05	1.78 E-05	4.10 E-06
R2A...-105B	AKM23, T22	1:1	0.625 x 0.2	1.74 E-04	7.12 E-05	2.62 E-06
R2A...-155B	AKM23	1.5:1		8.04 E-05	3.17 E-05	1.17 E-06
R2A...-205B	AKM23	2:1		4.73 E-05	1.78 E-05	6.64 E-07
R2A...-105A	AKM 23,T22, T31	1:1	0.625 x 0.2	1.74 E-04	7.12 E-05	2.62 E-06
R2A...-155A	AKM23, T22	1.5:1		8.01 E-05	3.17 E-05	1.17 E-06
R2A...-205A	AKM23	2:1		4.71 E-05	1.78 E-05	6.64 E-07

Motor	D (lb-in-s^2)
AKM23	1.91 E-04
T22	3.50 E-04
T31	1.27 E-03

Metric Conversions:

1 mm = 0.03937 in

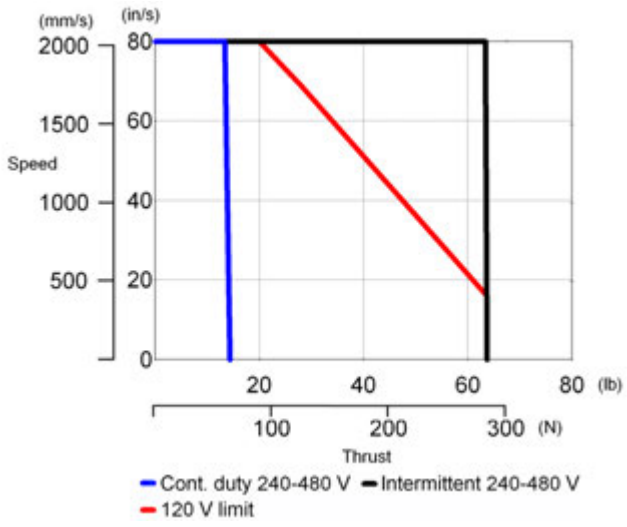
1 kg = 2.205 lb

1 lb-in-s^2 = 1129 kg-cm^2 = 1.152 kg-cm-s^2

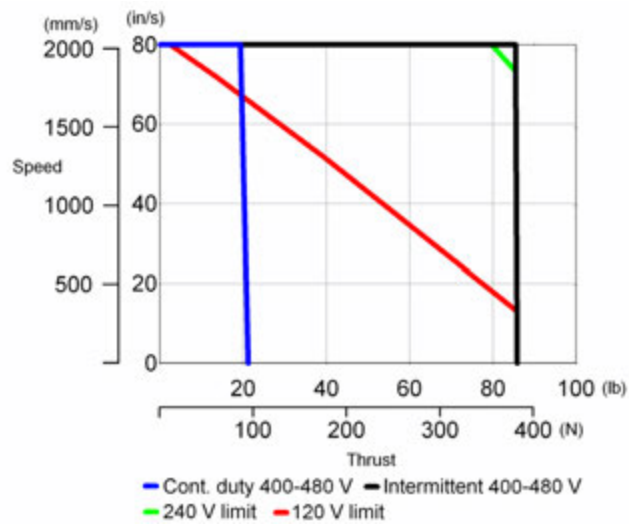
R2A Series Rodless Actuator

Servo Thrust Speed Curves

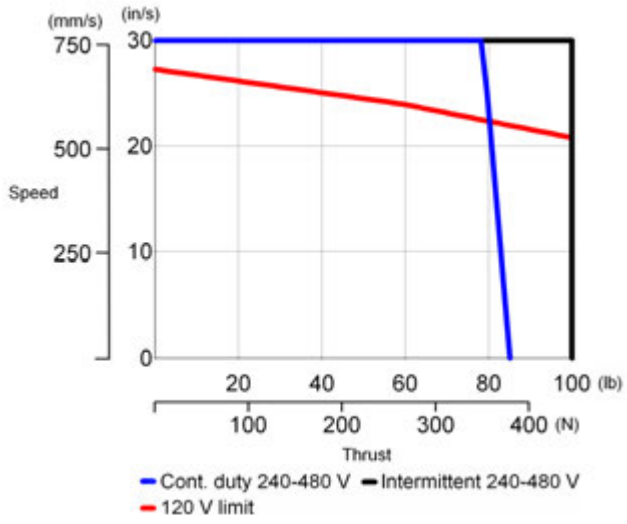
R2A-AKM23D-xxx-15T AKD (3 A)



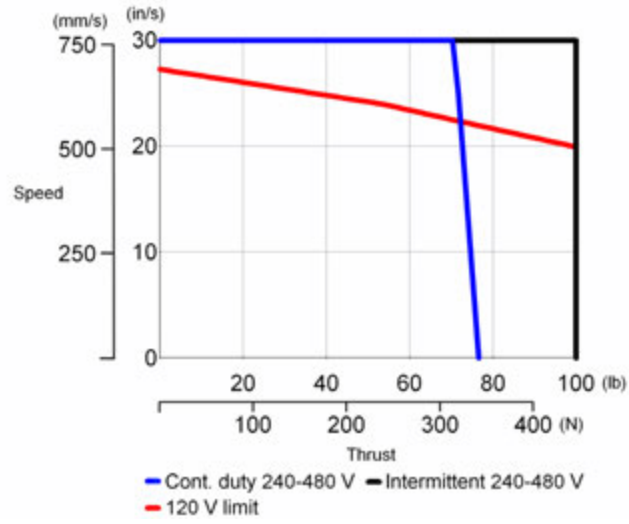
R2A-AKM23D-xxx-20T AKD (3 A)



R2A-AKM23D-xxx-102B-yy-I AKD (3 A)



R2A-AKM23D-xxx-102B-yy-P AKD (3 A)



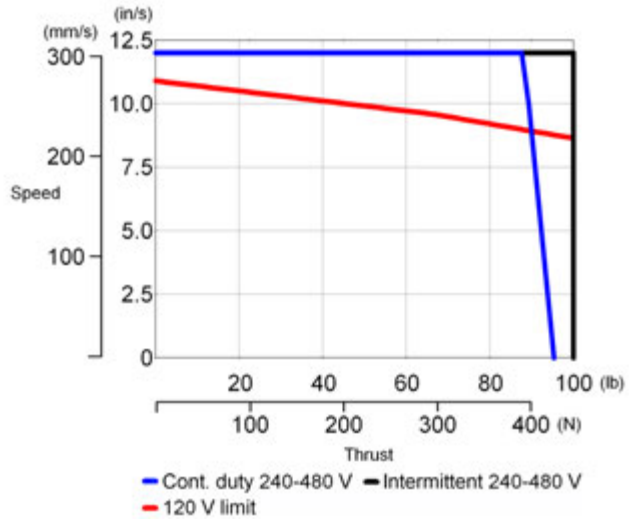
Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	25.5	17.3	12.5	9.4	7.4	5.9	4.1	3.0
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

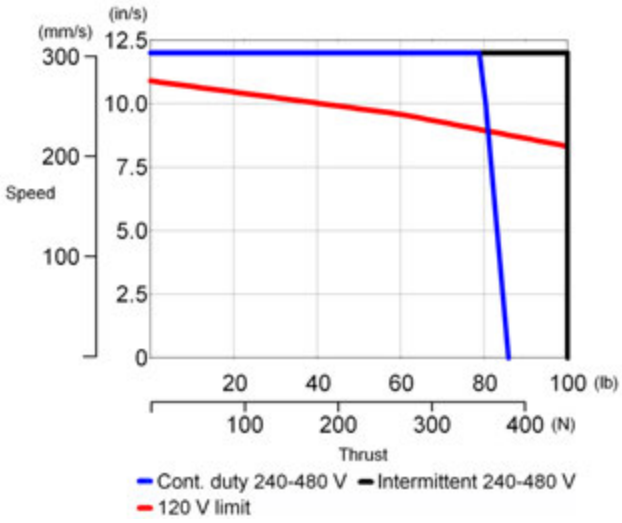
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Servo Thrust Speed Curves

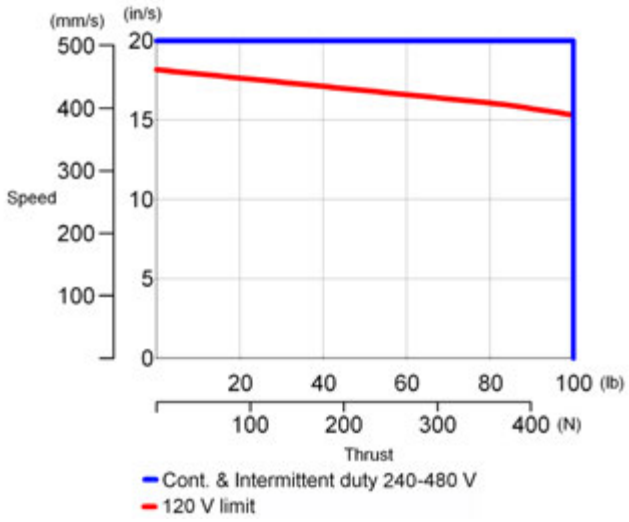
R2A-AKM23D-xxx-105A-yy-I AKD (3 A)



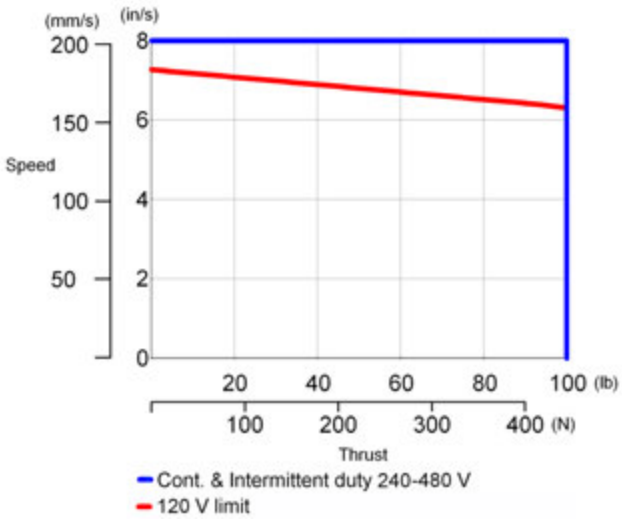
R2A-AKM23D-xxx-105A-yy-P AKD (3 A)



R2A-AKM23D-xxx-152B-yy-P AKD (3 A)



R2A-AKM23D-xxx-155A-yy-P AKD (3 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

5A	Critical Speed (in/sec)	15.0	12.5	7.7	5.2	3.8	2.8	2.2	1.8	1.2	0.9
	Stroke (in)	6 - 12	12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	98	63	44

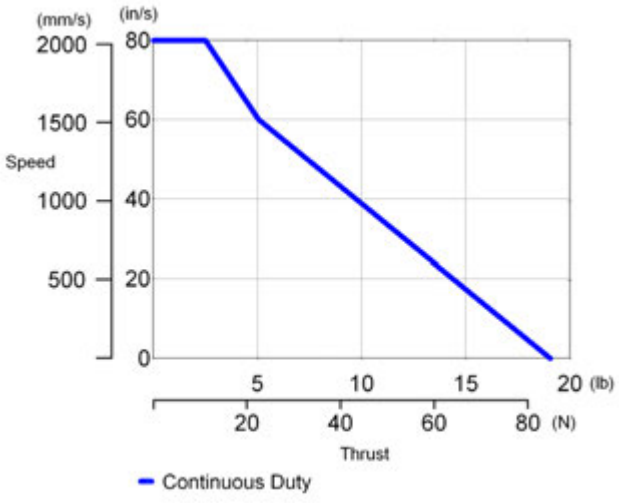
2B	Critical Speed (in/sec)	30.0	25.5	17.3	12.5	9.4	7.4	5.9	4.1	3.0
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

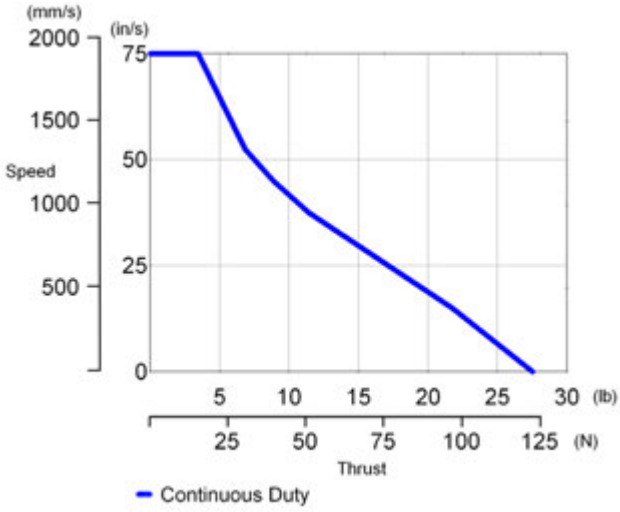
R2A Series Rodless Actuator

Stepper Thrust Speed Curves

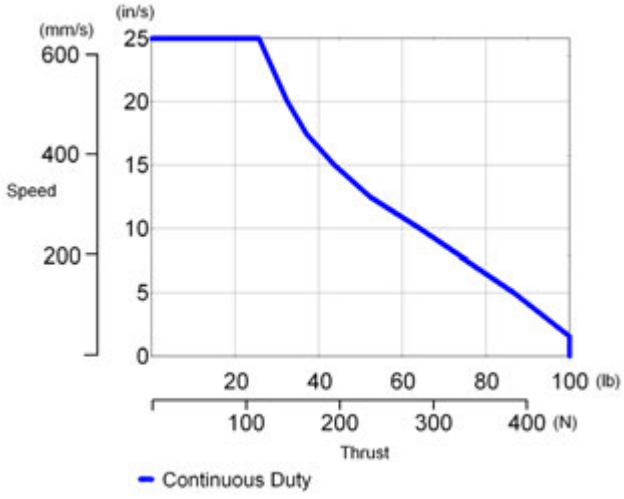
R2A-T22T-15T/P70360 (320 Vdc)



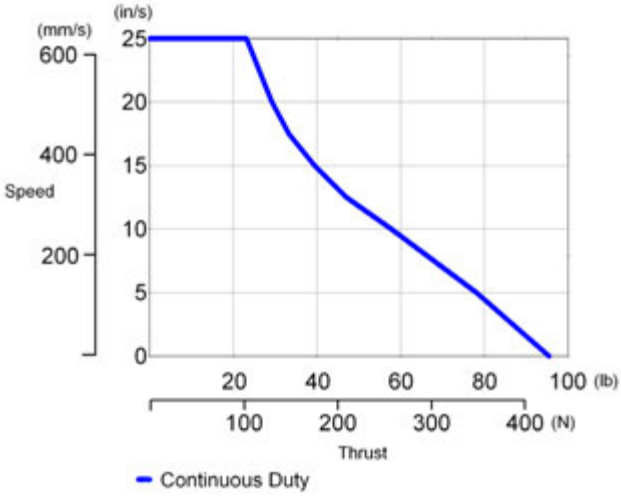
R2A-T22T-20T/P70360 (320 Vdc)



R2A-T22T-102B-yy-I/ P70360 (320 Vdc)



R2A-T22T-102B-yy-P/ P70360 (320 Vdc)



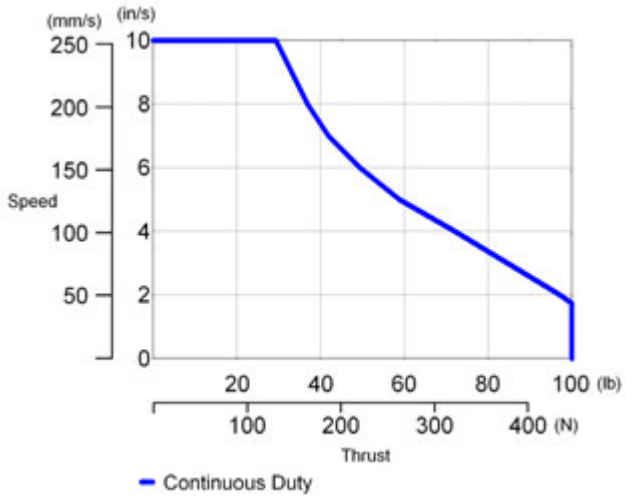
Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	25.5	17.3	12.5	9.4	7.4	5.9	4.1	3.0
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

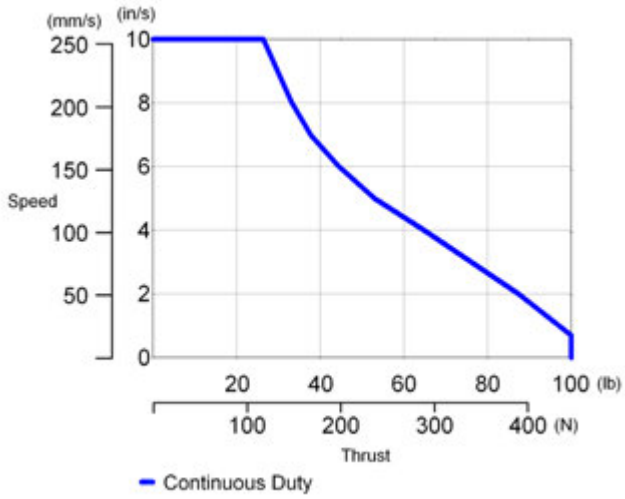
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

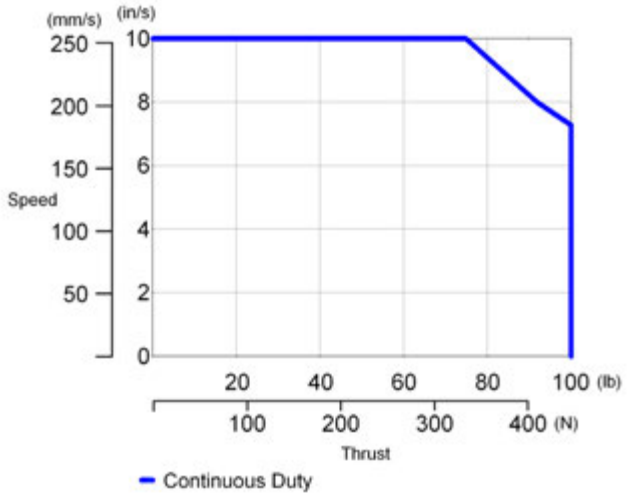
R2A-T22T-105A-yy-I/ P70360 (320 Vdc)



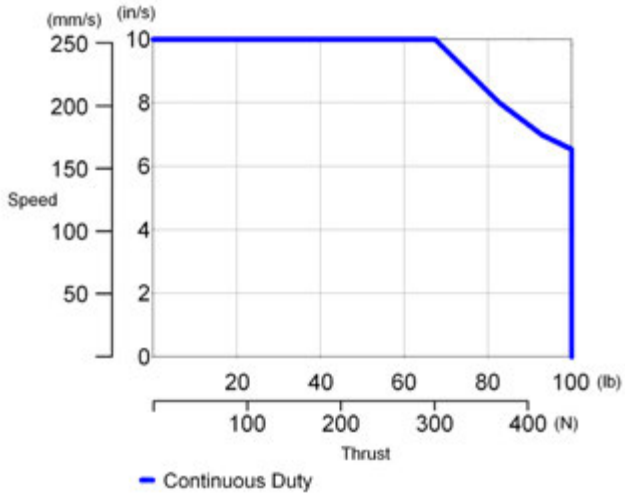
R2A-T22T-105A-yy-P/ P70360 (320 Vdc)



R2A-T22T-105B-yy-I/P70360 (320 Vdc)



R2A-T22T-105B-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

5A	Critical Speed (in/sec)	15.0	12.5	7.7	5.2	3.8	2.8	2.2	1.8	1.2	0.9
	Stroke (in)	6 - 12	12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	98	63	44

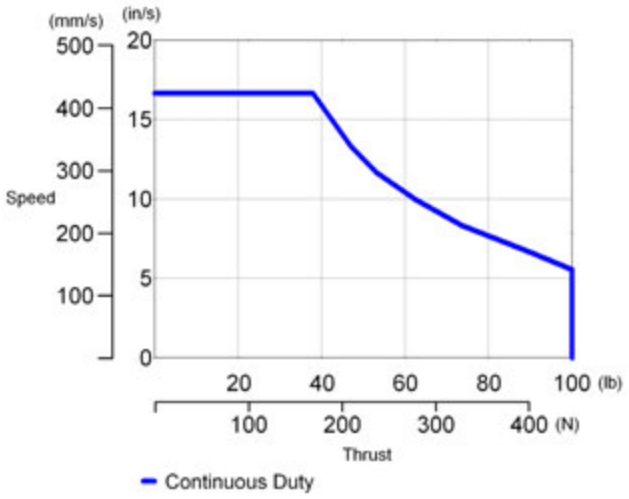
5B	Critical Speed (in/sec)	15.0	10.2	6.9	5.0	3.8	2.9	2.4	1.6	1.2
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

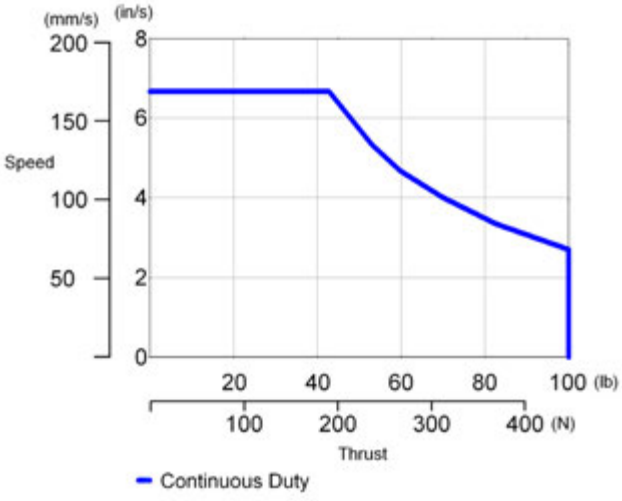
R2A Series Rodless Actuator

Stepper Thrust Speed Curves

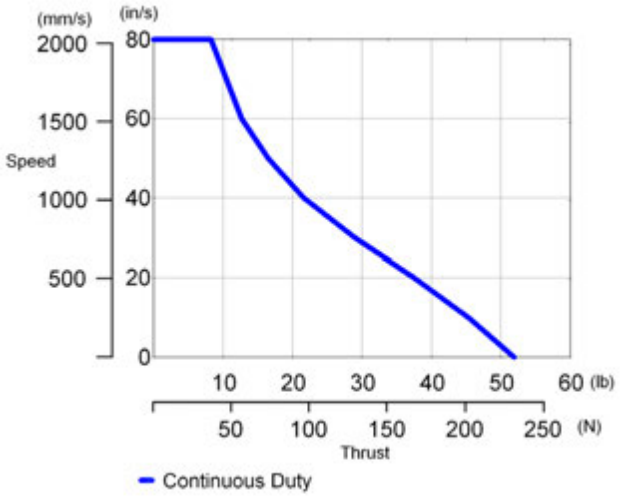
R2A-T22T-152B-yy-P/ P70360 (320 Vdc)



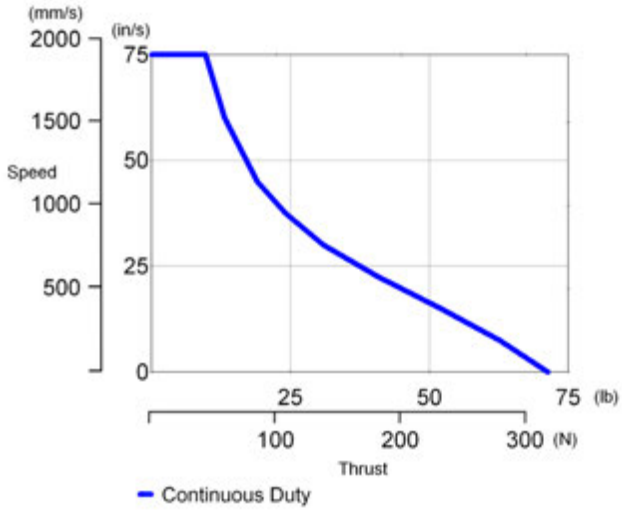
R2A-T22T-155A-yy-P/ P70360 (320 Vdc)



R2A-T31T-15T/ P70630 (320 Vdc)



R2A-T31T-20T/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

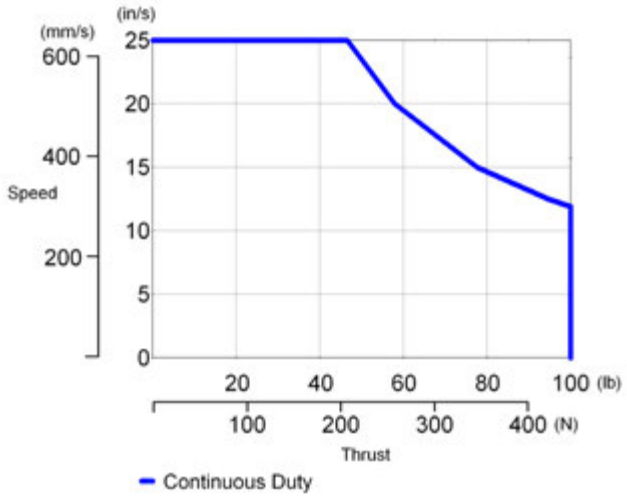
2B	Critical Speed (in/sec)	30.0	25.5	17.3	12.5	9.4	7.4	5.9	4.1	3.0
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

5A	Critical Speed (in/sec)	15.0	12.5	7.7	5.2	3.8	2.8	2.2	1.8	1.2	0.9
	Stroke (in)	6 - 12	12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	98	63	44

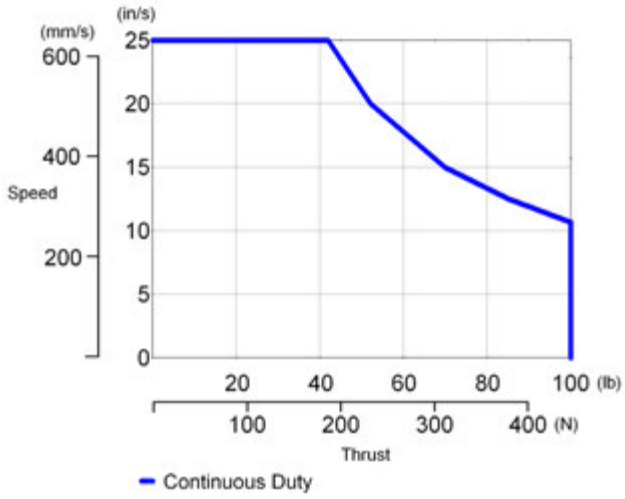
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

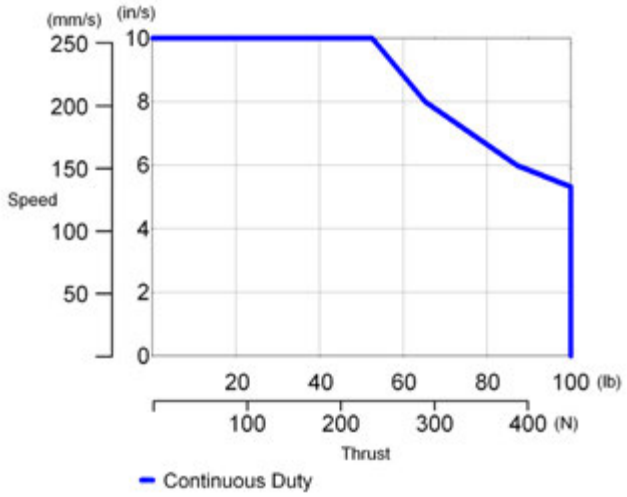
R2A-T31T-102B-yy-I/ P70630 (320 Vdc)



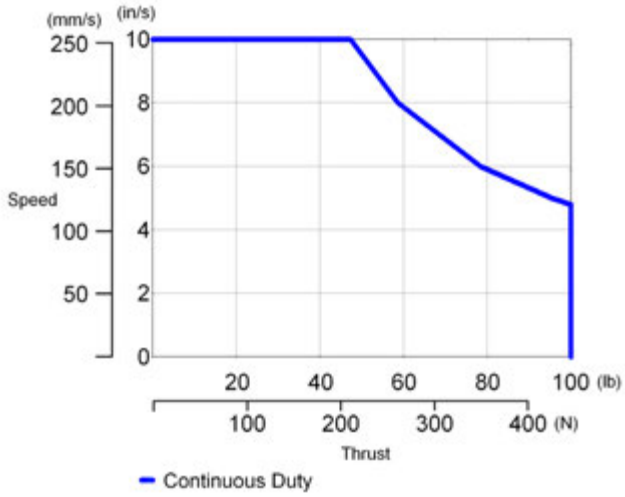
R2A-T22T-105A-yy-P/ P70360 (320 Vdc)



R2A-T31T-105A-yy-I/ P70630 (320 Vdc)



R2A-T31T-105A-yy-P/ P70630 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

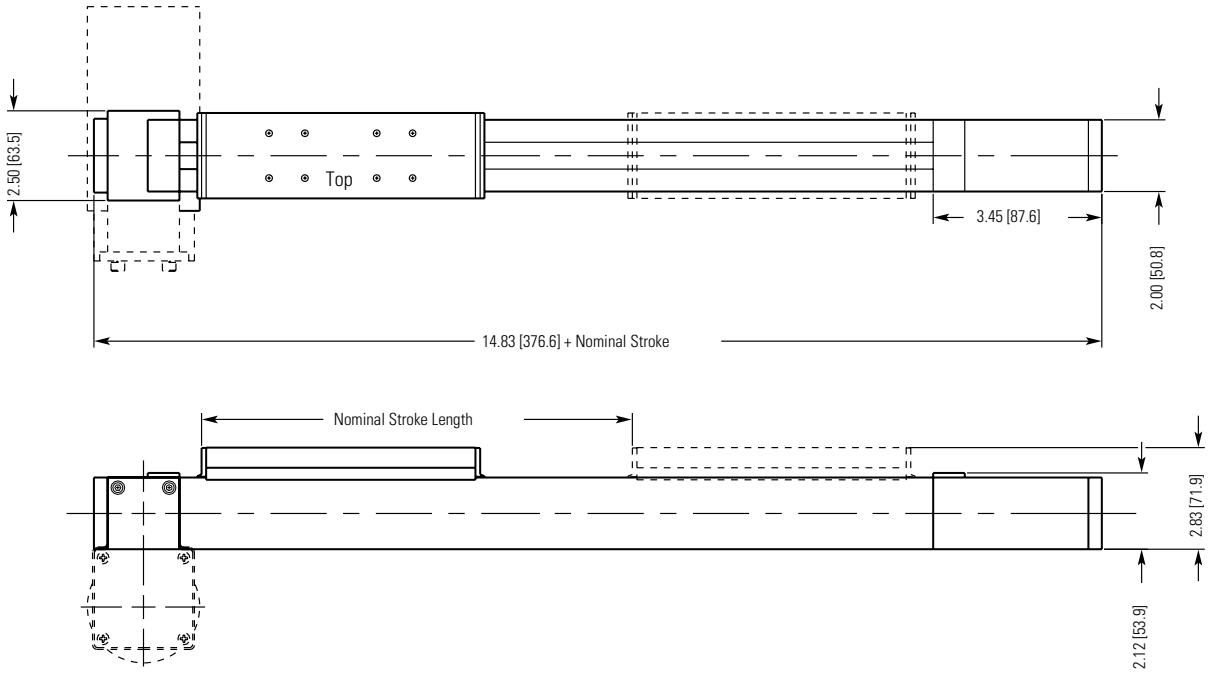
2B	Critical Speed (in/sec)	30.0	25.5	17.3	12.5	9.4	7.4	5.9	4.1	3.0
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

5A	Critical Speed (in/sec)	15.0	12.5	7.7	5.2	3.8	2.8	2.2	1.8	1.2	0.9
	Stroke (in)	6 - 12	12	18	24	30	36	42	48	60	72
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	98	63	44

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

R2A Series Rodless Actuator

Belt Drive Overall Dimensions



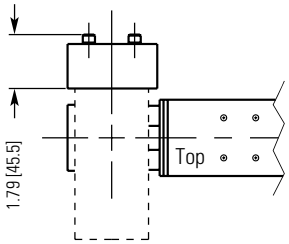
Belt Drive Orientation Options with Dimensions

-AL Over Left

Compatible Mountings

-MS1

-MS5

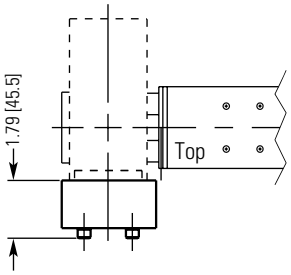


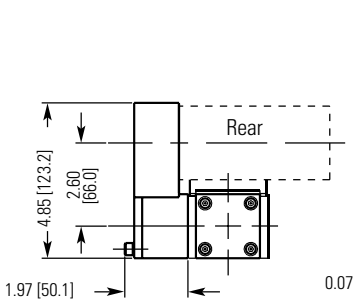
-AR Over Right

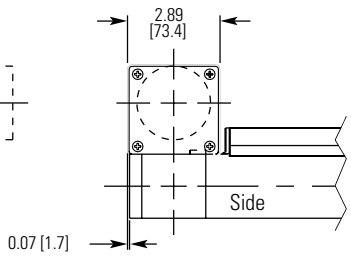
Compatible Mountings

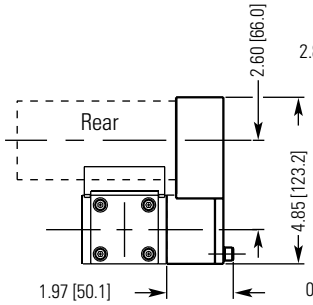
-MS1

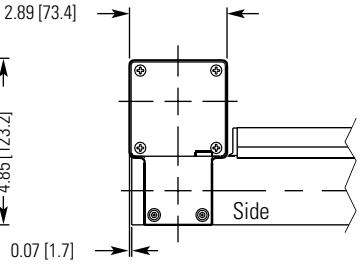
-MS5











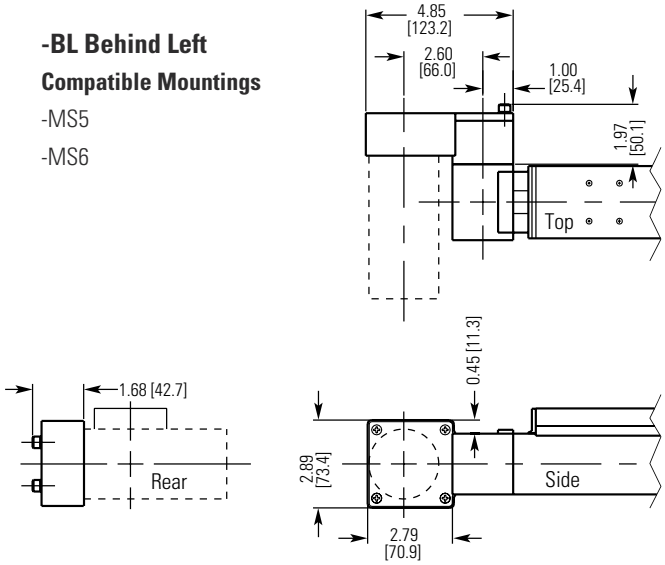
Belt Drive Orientation Options with Dimensions

-BL Behind Left

Compatible Mountings

-MS5

-MS6

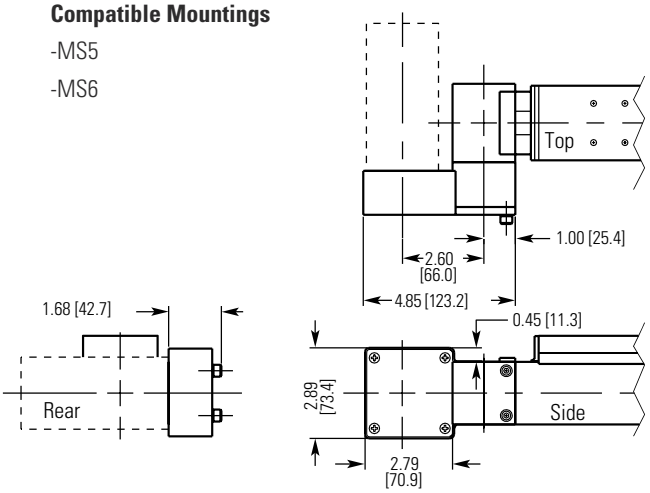


-BR Behind Right

Compatible Mountings

-MS5

-MS6

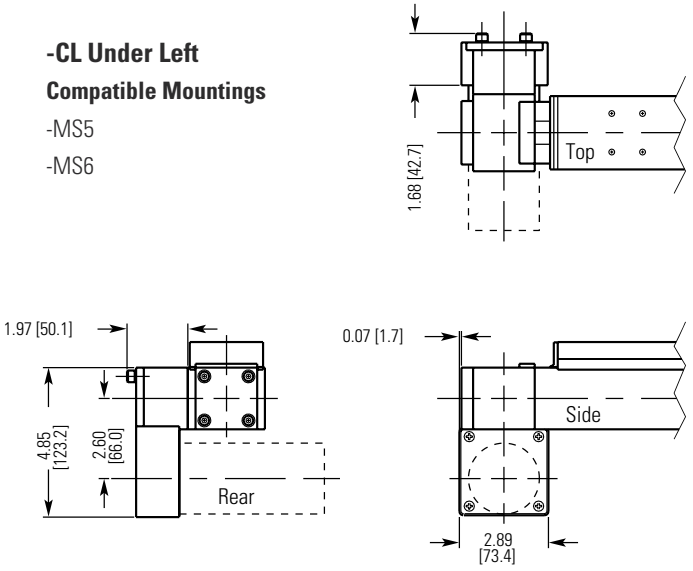


-CL Under Left

Compatible Mountings

-MS5

-MS6

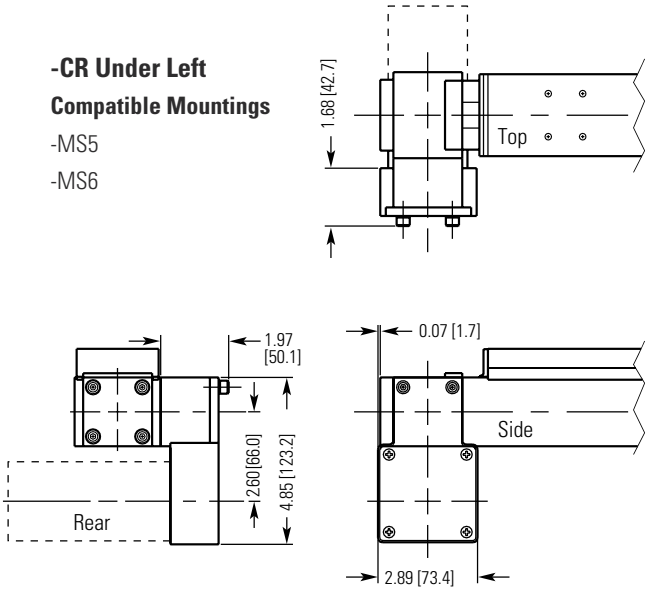


-CR Under Left

Compatible Mountings

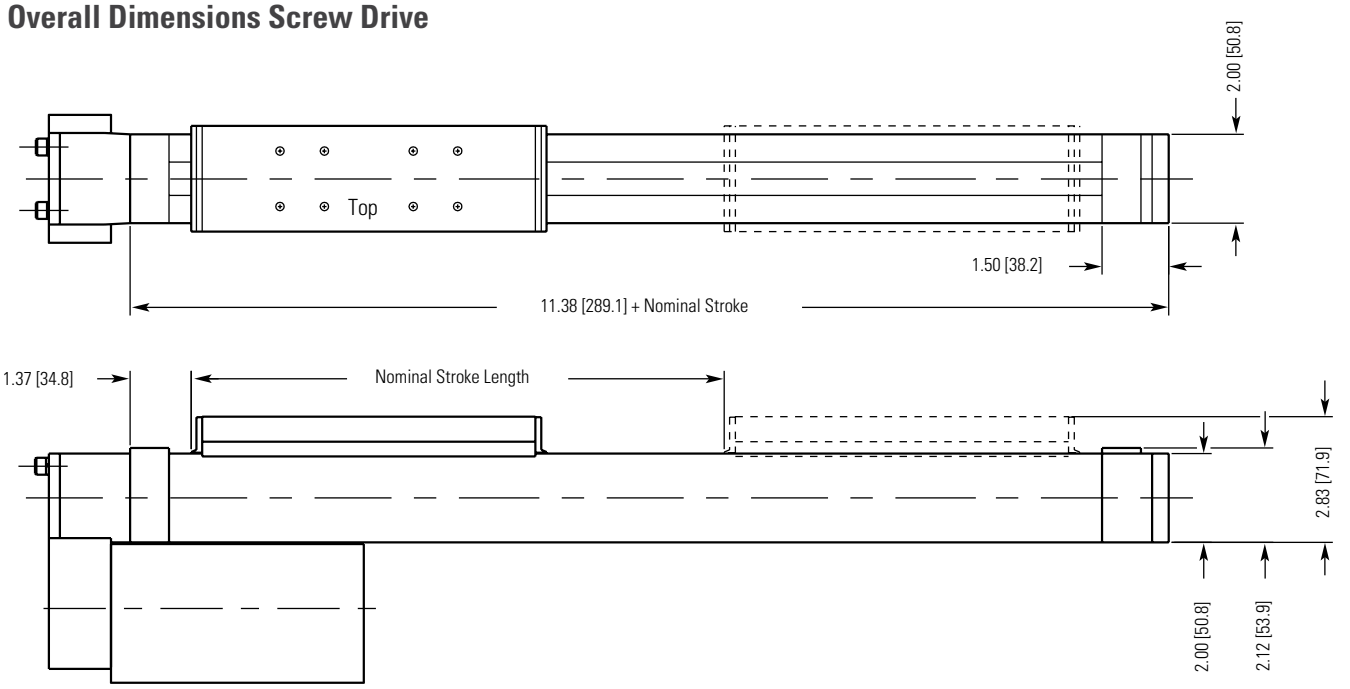
-MS5

-MS6



R2A Series Rodless Actuator

Overall Dimensions Screw Drive

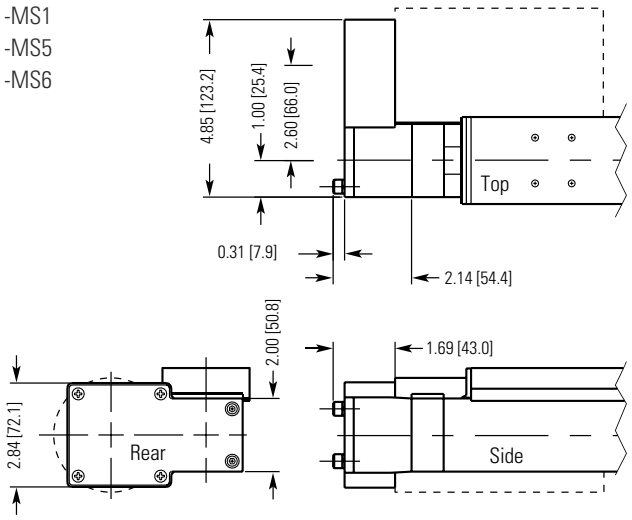


Screw Drive Orientation Options with Dimensions

-PL Parallel Left Side

Compatible Mountings

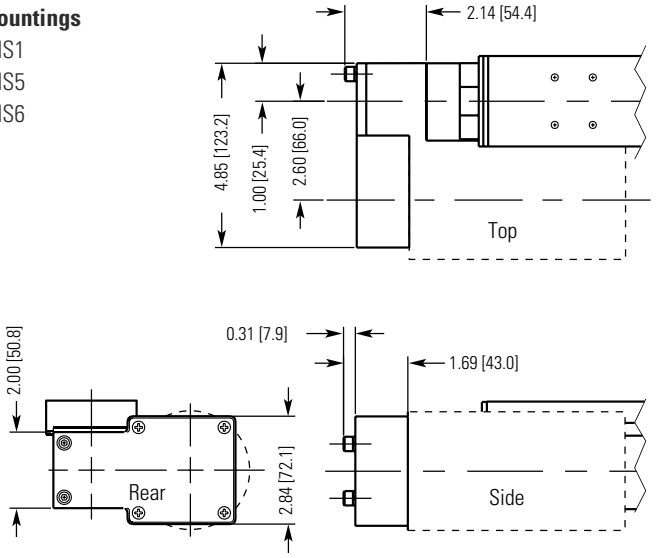
-MS1
-MS5
-MS6



-PR Parallel Right Side

Compatible Mountings

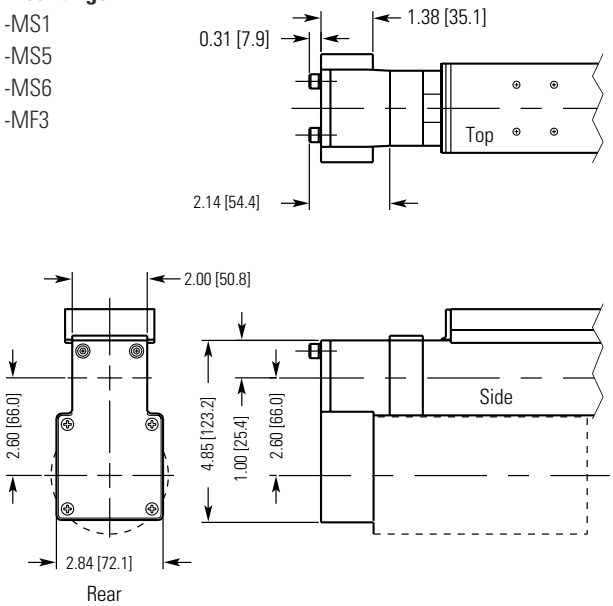
-MS1
-MS5
-MS6



-P Parallel Below

Compatible Mountings

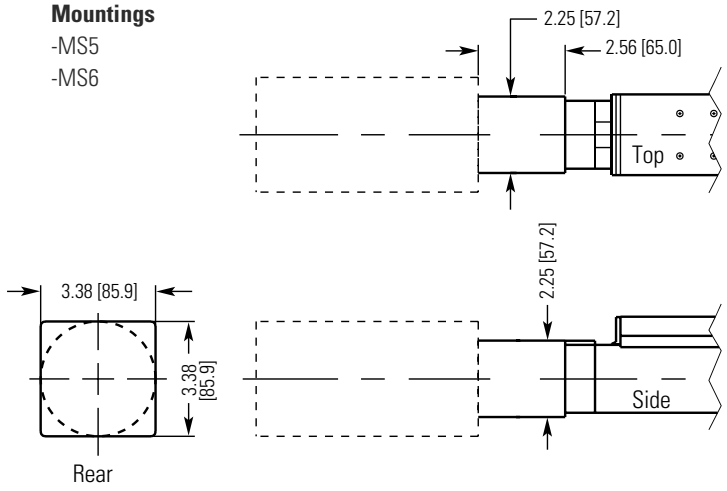
-MS1
-MS5
-MS6
-MF3



-I In-Line

Compatible Mountings

-MS5
-MS6



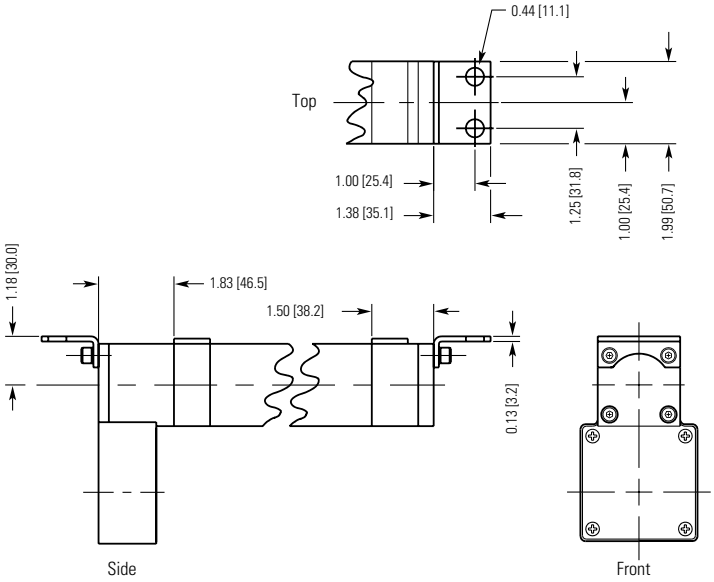
R2A Series Rodless Actuator

Mounting Option Dimensions

-MS1E Side End Angles

Compatible Motor Orientations

Belt	*Screw*
-AR	-P
-AL	-PR
	-PL

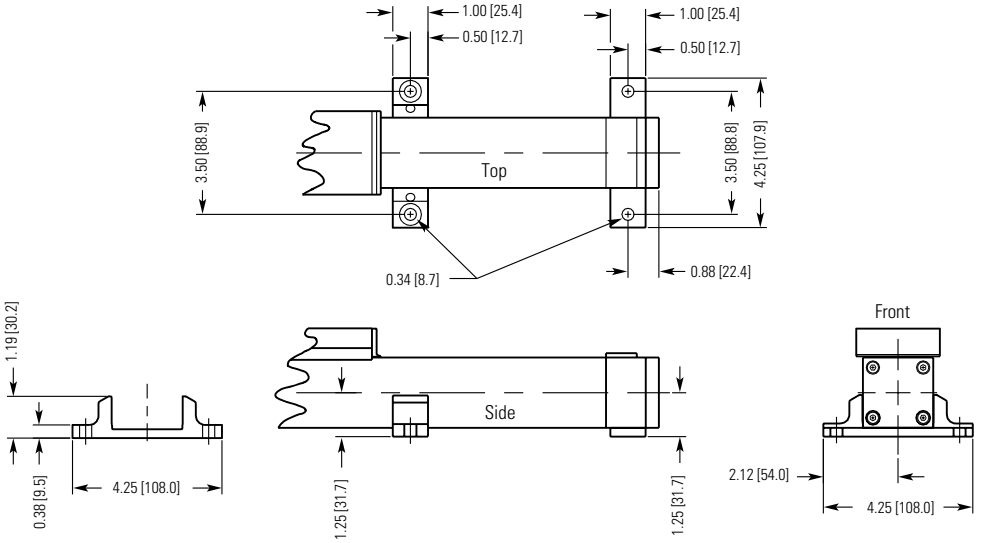


-MS5E Adjustable Feet

Compatible Motor Orientations

Belt	*Screw*
-AR	-P
-AL	-PR
-BR	-PL
-BL	-I
-CR	
-CL	

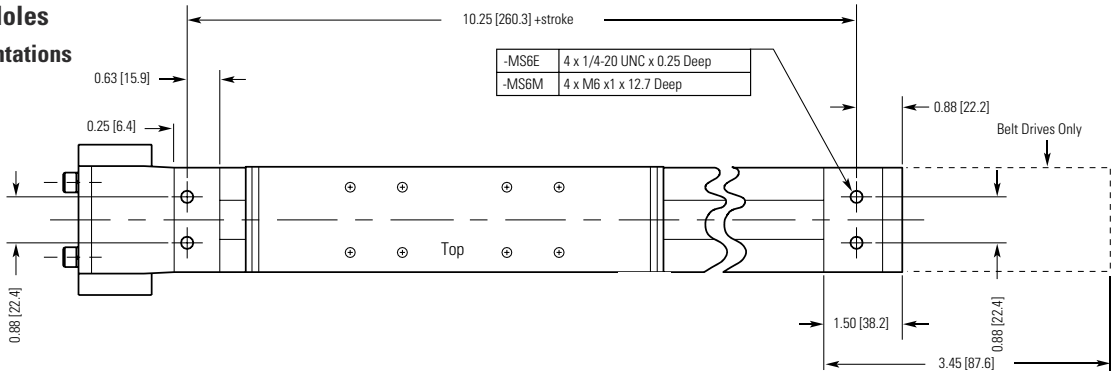
Stroke	Number of Feet
0-18	2
19-36	3
37-48	4
49-72	5



-MS5E Side Tapped Holes

Compatible Motor Orientations

Belt	*Screw*
-BR	-P
-BL	-PR
-CR	-PL
-CL	-I



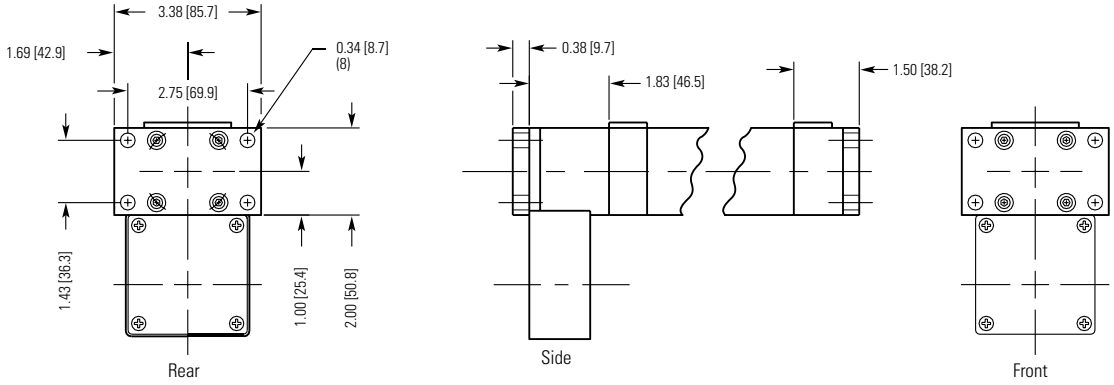
Mounting Option Dimensions

-MF3E Front & Rear Rectangular Flanges

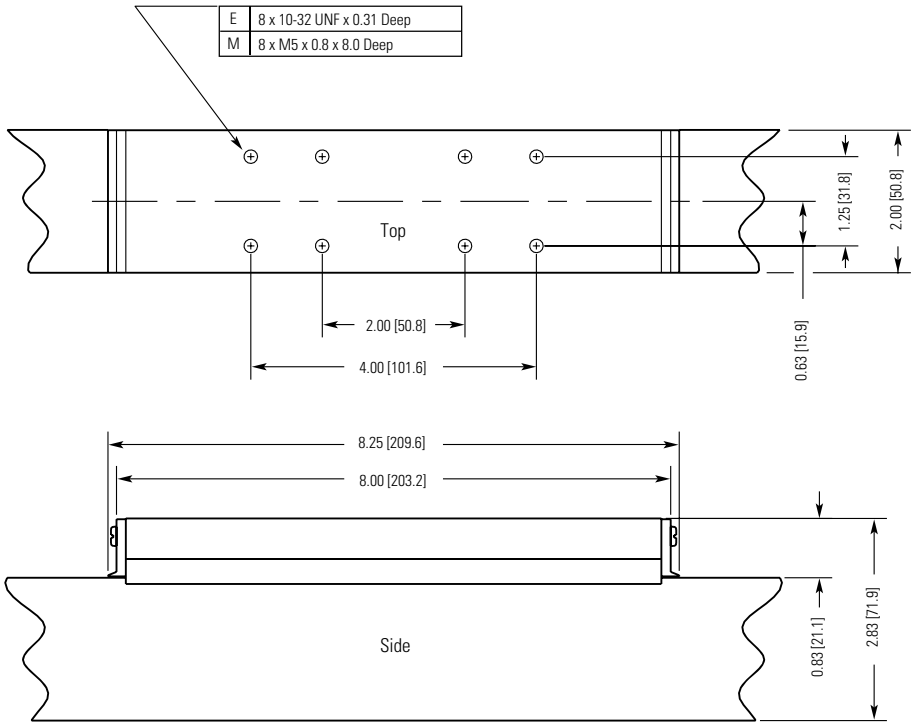
Screw Driven Models Only

Compatible Motor Orientations

Belt	*Screw*
N/A	-P



Carriage Dimensions



R3 Series Rodless Actuator

General Specifications

Travel Lengths	6, 12, 18, 24, 30, 36, 42, 48, 60, 72, 84, 96, 108 inches
Construction Materials	
Bearing Housing	6063 T-6 aluminum, hardcoat anodized
Guide Housing	6063 T-6 aluminum, hardcoat anodized
Carriage Assembly	6061 T-6 aluminum, hardcoat anodized
Internal Rail Bearings	Recirculating ball on precision ground rail
Lead Screw or Belt	
Support Bearing	Angular contact, high thrust ball bearings
Lead Screw; drive nut	Lubricated bronze drive nut
Ball screw; ballnut	0.625" diameter hardened alloy steel screw; alloy steel, heat treated ballnut
Belt Drive	1.0" wide XL pitch polyurethane with steel reinforcement cords
Flexible Seal	Stainless steel band with elastomeric seal
Motor	AKM® servo motor or T series stepper
Weight (approx, without options)	
R3-AKM23	17 + 0.4 x (inches stroke) lb [7.7 + 0.18 x (inches stroke)] kg
R3-AKM42	25 + 0.4 x (inches stroke) lb [11.3 + 0.18 x (inches stroke)] kg
R3-T22	17 + 0.4 x (inches stroke) lb [7.7 + 0.18 x (inches stroke)] kg
R3-T31	20 + 0.4 x (inches stroke) lb [9.1 + 0.18 x (inches stroke)] kg
Environmental Operation	
Temperature Range	-20° to 140°F [-28° to 60°C]
Moisture/Contaminants	IP 44 rated: Splash-proof, protected against ingress of solid particles greater than 0.040" [1 mm] diameter. Non-corrosive, non-abrasive.

R3 Series Actuator

R3 Series Inertia

Inertia Equations:

Rotary Inertia (lb-in-s^2, reflected to the motor) **= A + B x Stroke + C x Load + D**

Linear Inertia (lb, reflected to the carriage) **= [[A + B x Stroke + D]/C] + Load**

where:

A = Inertia of zero length slide (lb-in-s^2)

B = Inertia adder per inch of stroke length (lb-in-s^2/in)

C = Inertia adder per pound of payload (lb-in-s^2/lb)

D = Motor inertia (lb-in-s^2)

Stroke = Total stroke length in inches (in). Same as stroke length entered into part number

Load = Payload in pounds (lb)

Belt Driven Models	Motors	Ratio	Belt (in)	A (lb-in-s^2)	B (lb-in-s^2/in)	C (lb-in-s^2/lb)
R3...-10T	AKM23, 42	1:1	1.0 wide	6.18 E-03	1.92 E-05	2.30 E-03
R3...-15T	AKM23, 42	1.5:1		2.75 E-03	8.52 E-06	1.02 E-03
R3...-20T	AKM23, 42, T31	2:1		1.56 E-03	4.82 E-06	5.78 E-04
Screw Driven Models	**Motors**	**Ratio**	**Screw dia. x lead (in)**	**A (lb-in-s^2)**	**B (lb-in-s^2/in)**	**C (lb-in-s^2/lb)**
R3...-102B	AKM23, 42, T22, 31	1:1	0.625 x 0.5	2.15 E-04	7.12 E-05	1.64 E-05
R3...-152B	AKM23, 42, T22, 31	1.5:1		9.80 E-05	3.17 E-05	7.29 E-06
R3...-202B	AKM23, 42, T22, 31	2:1		5.70 E-05	1.78 E-05	4.10 E-06
R3...-502B	AKM23, 42	5:1		1.41 E-04	2.80 E-06	6.48 E-07
R3...-105B	AKM23, 42, T22, 31	1:1	0.625 x 0.2	1.80 E-04	7.12 E-05	2.62 E-06
R3...-155B	AKM23, 42, T22	1.5:1		8.22 E-05	3.17 E-05	1.17 E-06
R3...-205B	AKM23, 42	2:1		4.81 E-05	1.78 E-05	6.64 E-07
R3...-505B	AKM23, 42, T22, 31	5:1		1.40 E-04	2.80 E-06	9.71 E-08
R3...-102A		1:1	0.625 x 0.5	2.01 E-04	7.12 E-05	1.64 E-05
R3...-105A	AKM23, 42, T22, 31	1:1	0.625 x 0.2	1.79 E-04	7.12 E-05	2.62 E-06
R3...-155A	AKM23, 42	1.5:1		8.19 E-05	3.17 E-05	1.17 E-06
R3...-205A	AKM23, 42, T22	2:1		4.80 E-05	1.78 E-05	6.64 E-07
R3...-505A	AKM23, 42	5:1		1.40 E-04	2.80 E-06	9.71 E-08
R3...-108A	AKM23, 42, T22, 31	1:1	0.625 x 0.125	1.74 E-04	7.08 E-05	1.02 E-06
R3...-158A	AKM23, 42, T22	1.5:1		7.99 E-05	3.15 E-05	4.54 E-07
R3...-208A	AKM23, 42	2:1		4.68 E-05	1.77 E-05	2.55 E-07
R3...-508A	AKM23, 42	5:1		1.39 E-04	2.79 E-06	4.02E-08

Motor	D (lb-in-s^2)
AKM23	1.91 E-04
AKM42	1.28 E-3
T22	3.05 E-04
T31	1.27 E-03

Metric Conversions:

1 mm = 0.03937 in

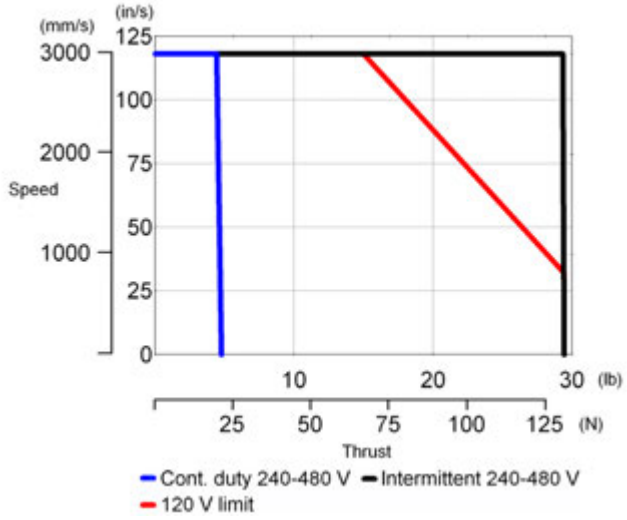
1 kg = 2.205 lb

1 lb-in-s^2 = 1129 kg-cm^2 = 1.152 kg-cm-s^2

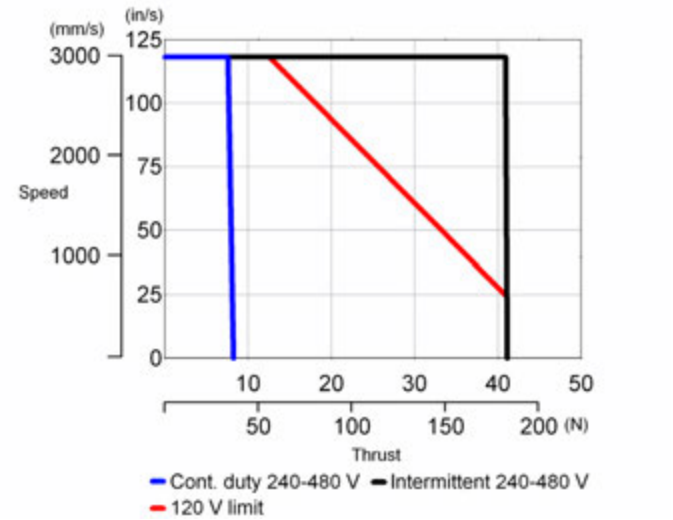
R3 Series Rodless Actuator

Servo Thrust Speed Curves

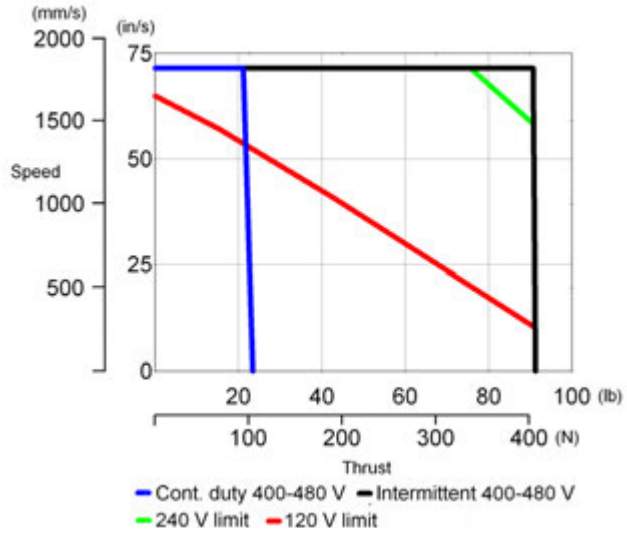
R3-AKM23D-xxx-15T AKD (3 A)



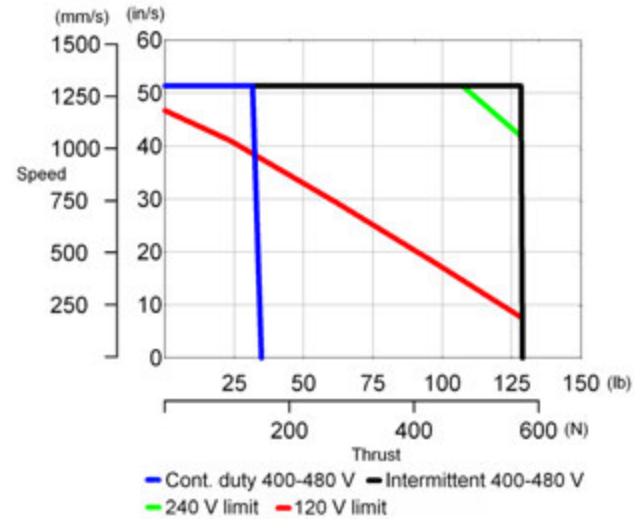
R3-AKM23D-xxx-20T AKD (3 A)



R3-AKM23D-xxx-50T AKD (3 A)

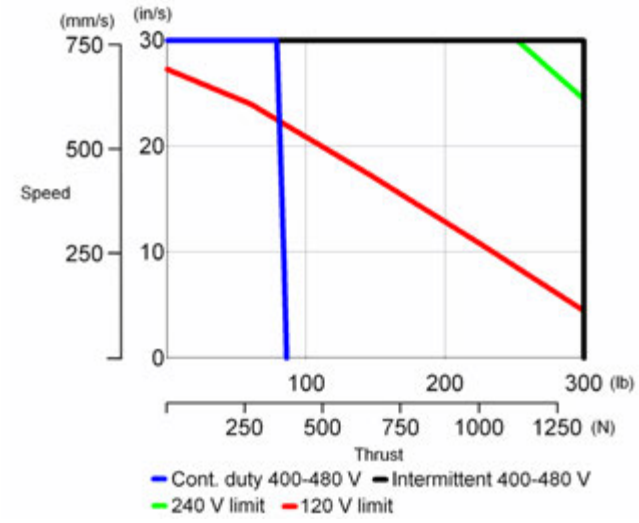


R3-AKM23D-xxx-70T AKD (3 A)

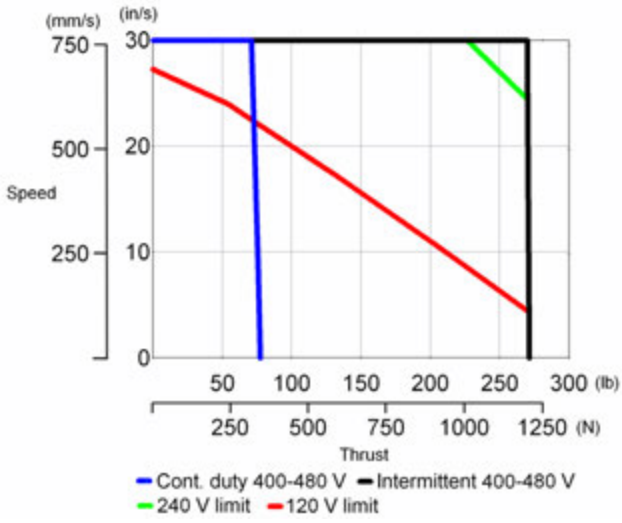


Servo Thrust Speed Curves

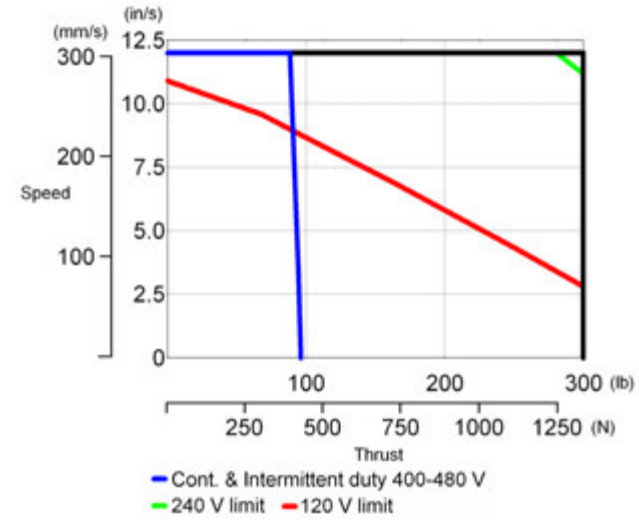
R3-AKM23D-xxx-102B-yy-I AKD (3 A)



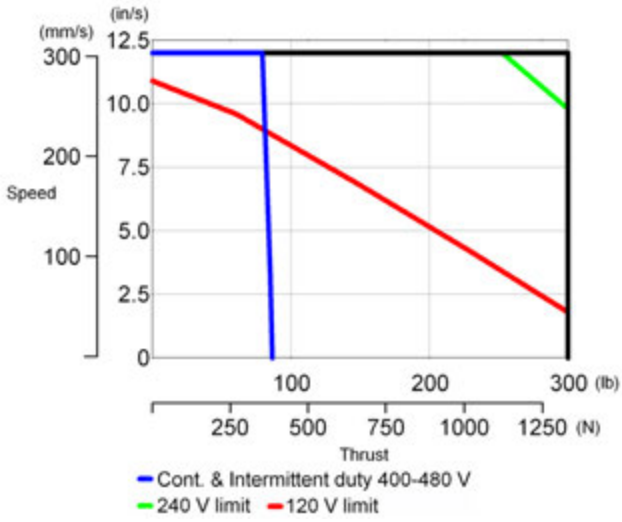
R3-AKM23D-xxx-102B-yy-P AKD (3 A)



R3-AKM23D-xxx-105A-yy-I AKD (3 A)



R3-AKM23D-xxx-105A-yy-P AKD (3 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

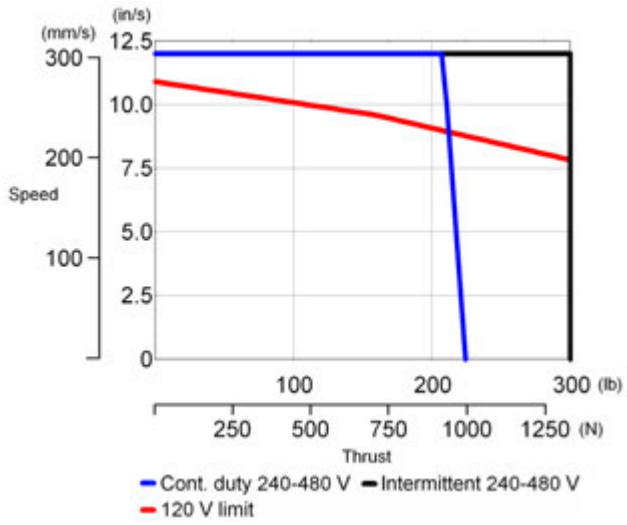
5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

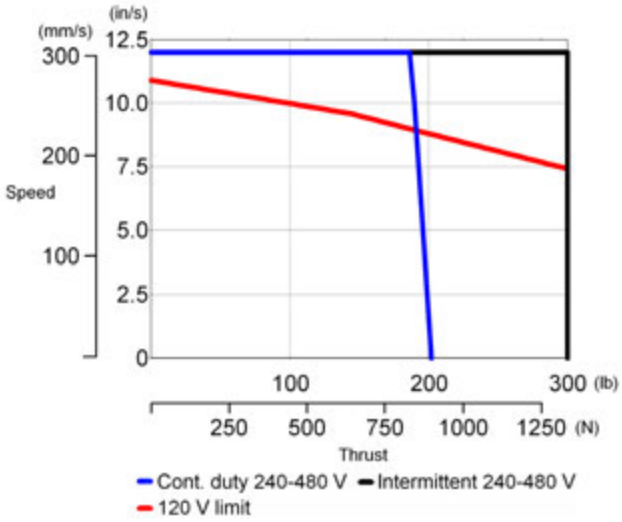
R3 Series Rodless Actuator

Servo Thrust Speed Curves

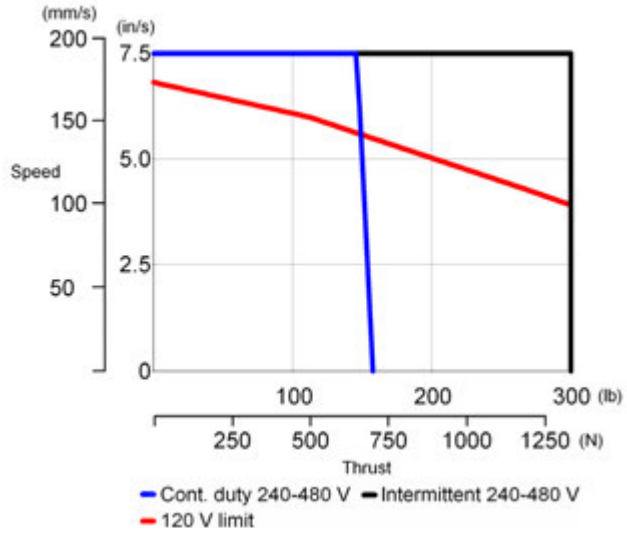
R3-AKM23D-xxx-105B-yy-I AKD (3 A)



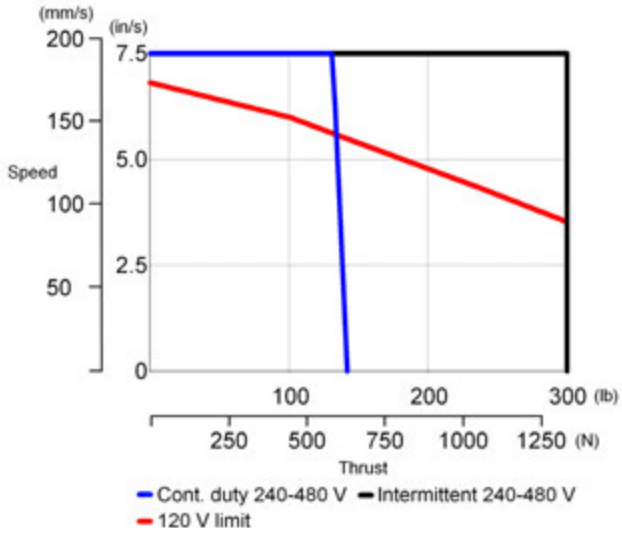
R3-AKM23D-xxx-105B-yy-P AKD (3 A)



R3-AKM23D-xxx-108A-yy-I AKD (3 A)



R3-AKM23D-xxx-108A-yy-P AKD (3 A)



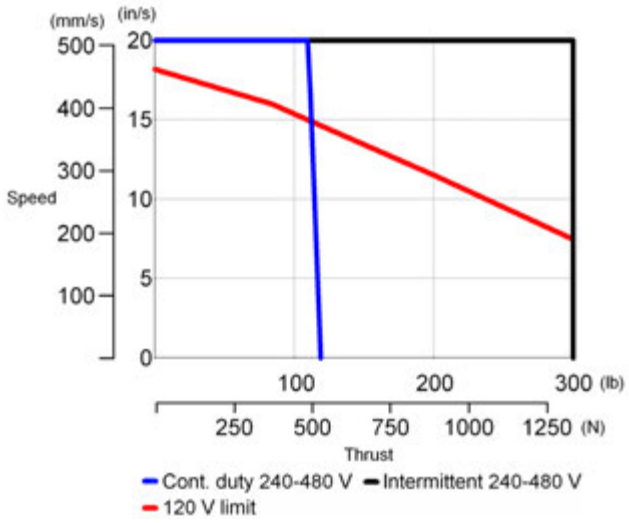
Column Loading and Critical Speed Limits for Screw-driven Configurations

5B	Critical Speed (in/sec)	15.0	9.4	6.5	4.7	3.6	2.8	1.9	1.3	1.0	0.8	0.6	
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108	
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56	
8A	Critical Speed (in/sec)	7.5	8.6	5.4	3.7	2.7	2.1	1.6	1.1	0.8	0.6	0.4	0.4
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	278	212	136	94	69	53	42

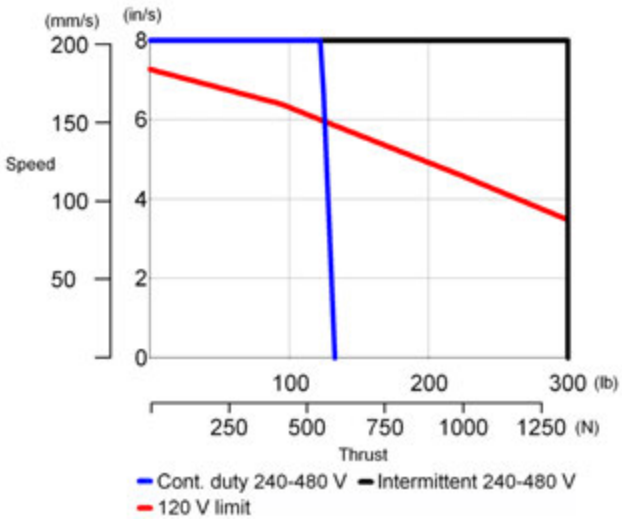
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Servo Thrust Speed Curves

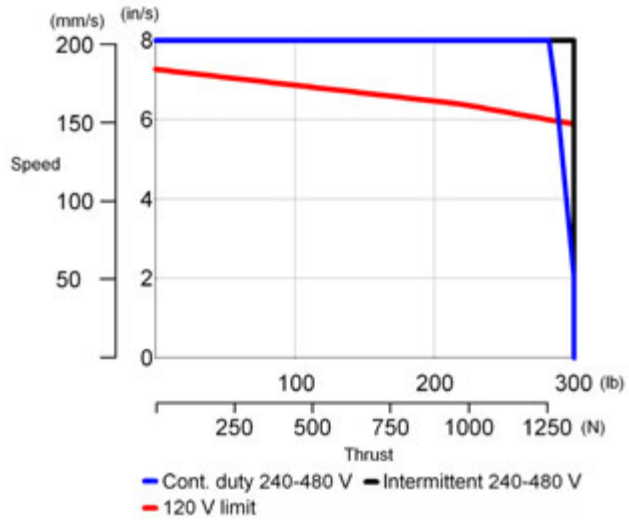
R3-AKM23D-xxx-152B-yy-P AKD (3 A)



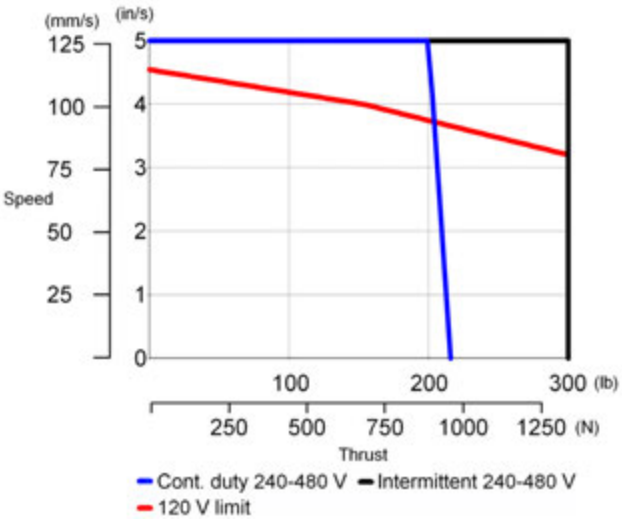
R3-AKM23D-xxx-155A-yy-P AKD (3 A)



R3-AKM23D-xxx-155B-yy-P AKD (3 A)



R3-AKM23D-xxx-158A-yy-P AKD (3 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

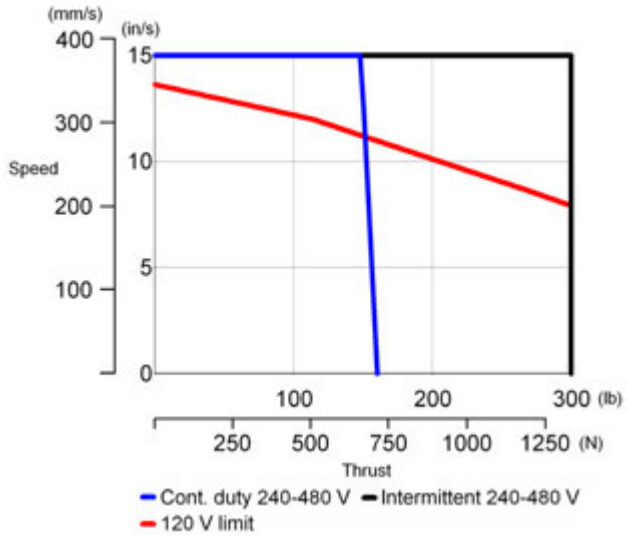
5B	8A	See Previous Page

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

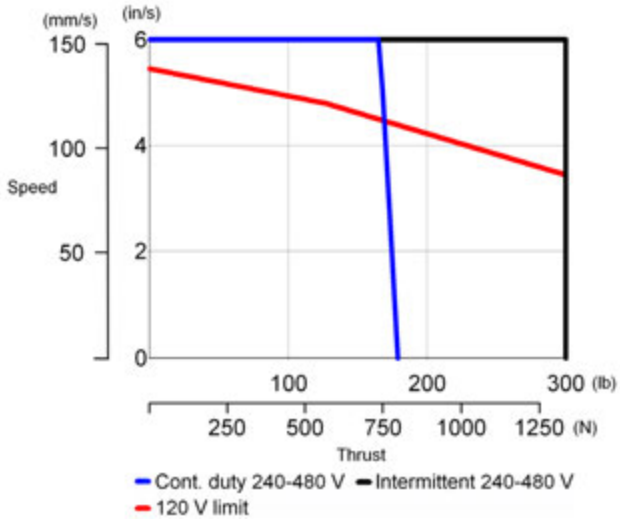
R3 Series Rodless Actuator

Servo Thrust Speed Curves

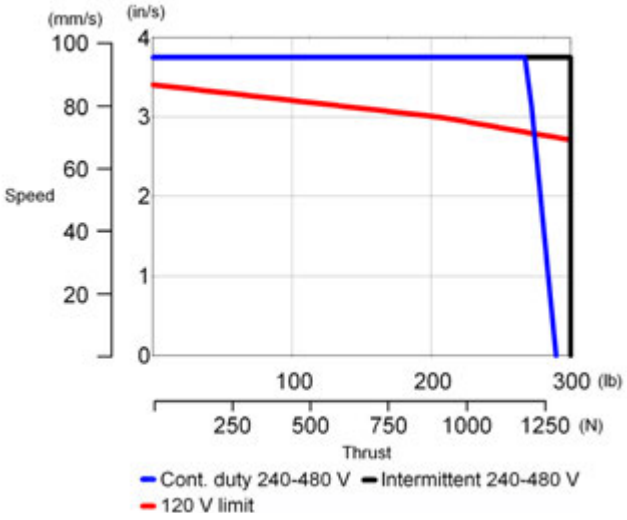
R3-AKM23D-xxx-202B-yy-P AKD (3 A)



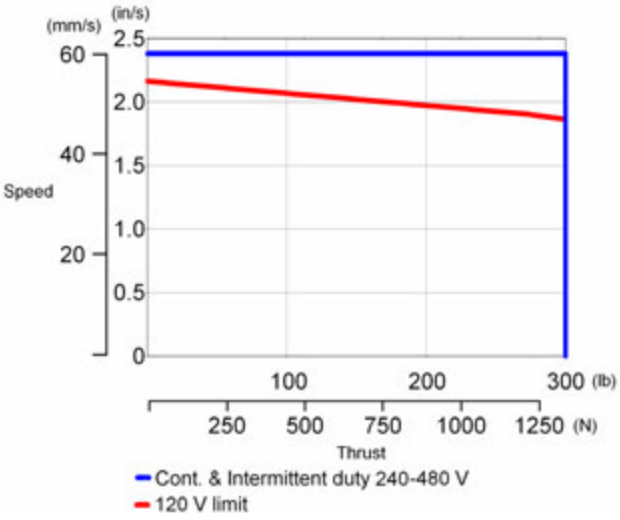
R3-AKM23D-xxx-205A-yy-P AKD (3 A)



R3-AKM23D-xxx-208A-yy-P AKD (3 A)



R3-AKM23D-xxx-505A-yy-P AKD (3 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

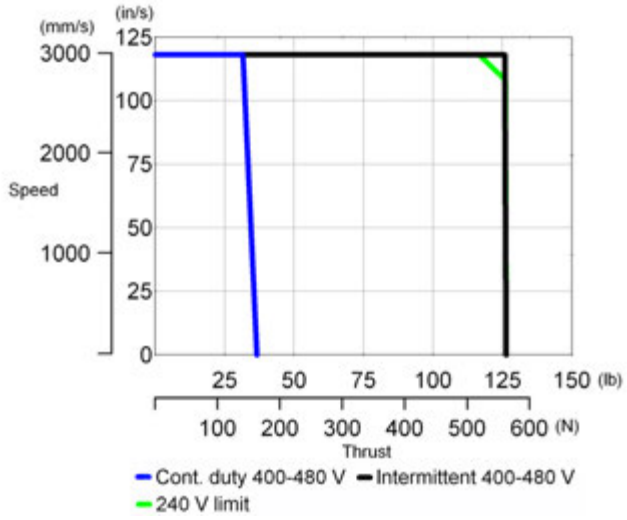
8A See Following Page

5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

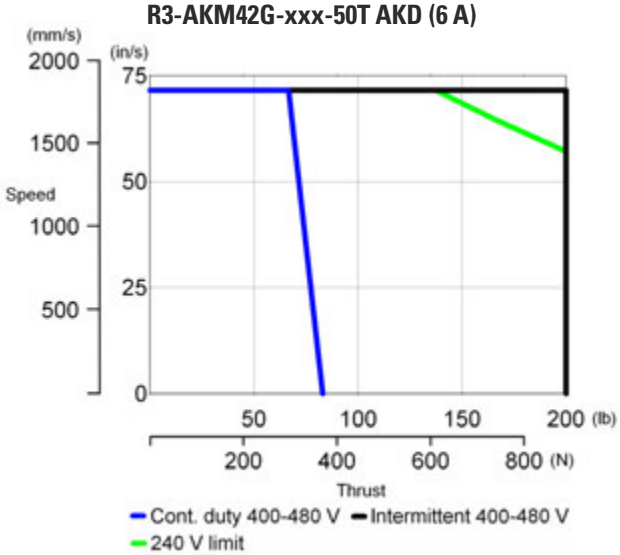
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Servo Thrust Speed Curves

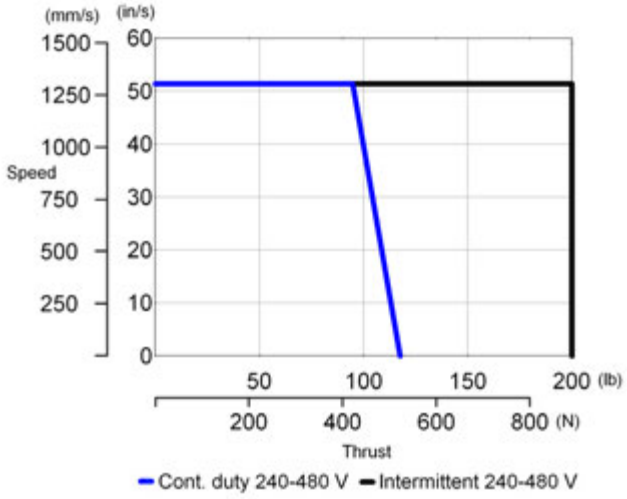
R3-AKM42G-xxx-20T AKD (6 A)



R3-AKM42G-xxx-50T AKD (6 A)



R3-AKM42G-xxx-70T AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

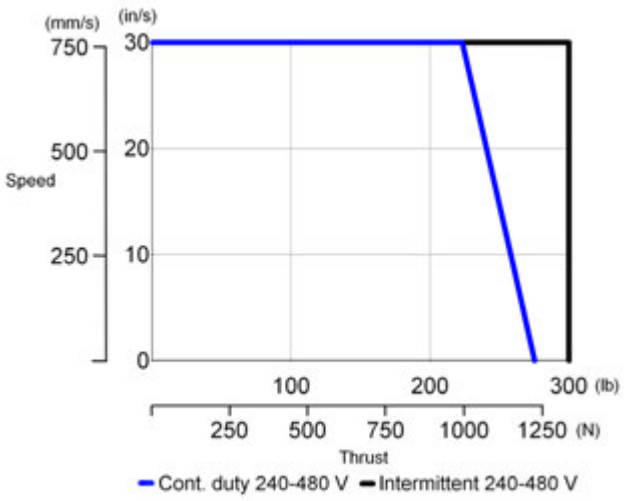
8A	Critical Speed (in/sec)	7.5	8.6	5.4	3.7	2.7	2.1	1.6	1.1	0.8	0.6	0.4	0.4
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	278	212	136	94	69	53	42

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

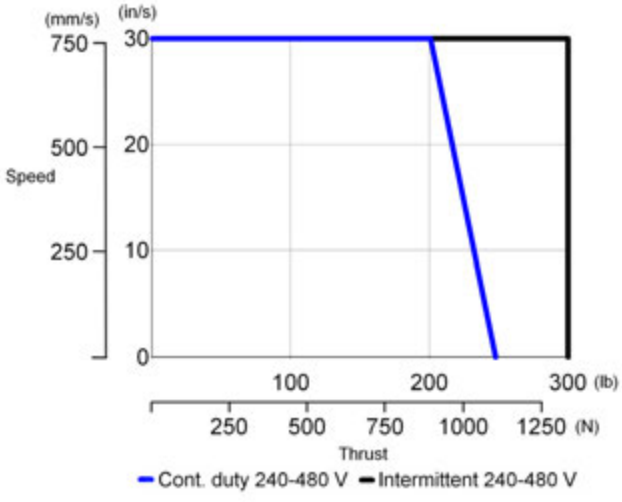
R3 Series Rodless Actuator

Servo Thrust Speed Curves

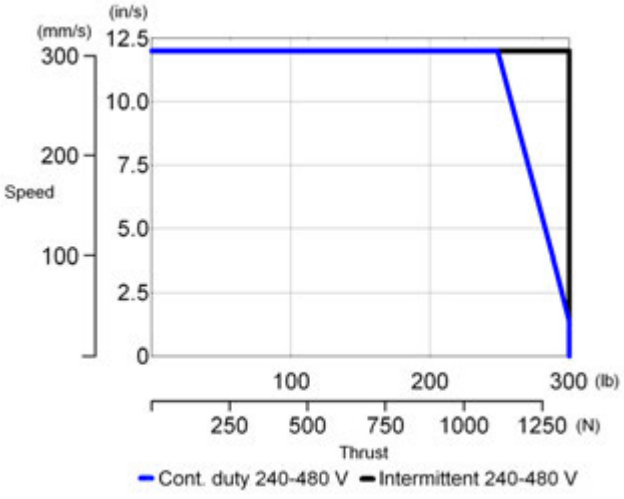
R3-AKM42G-xxx-102B-yy-I AKD (6 A)



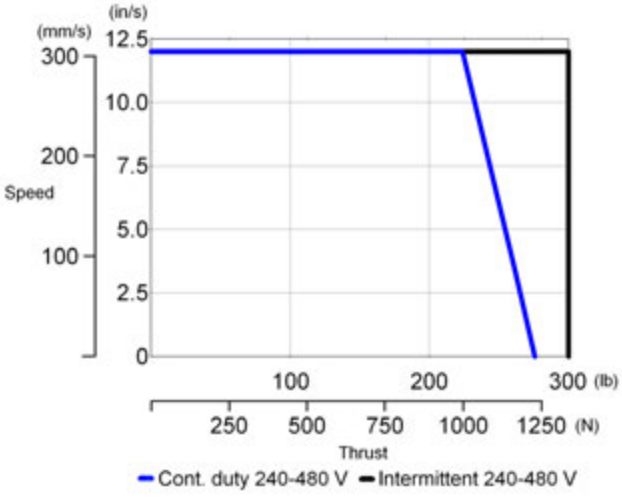
R3-AKM42G-xxx-102B-yy-P AKD (6 A)



R3-AKM42G-xxx-105A-yy-I AKD (6 A)



R3-AKM42G-xxx-105A-yy-P AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

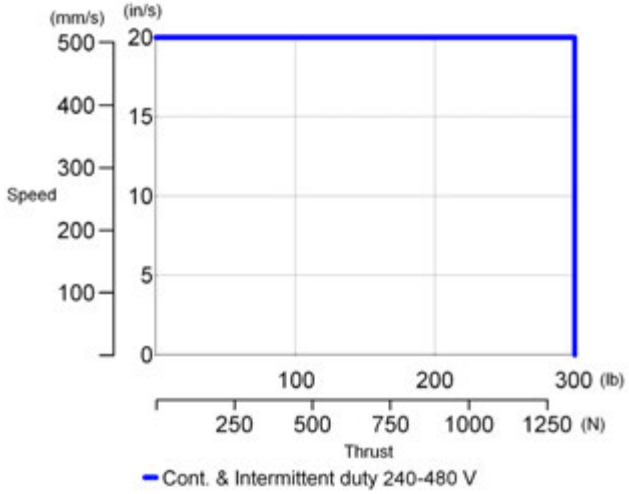
2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

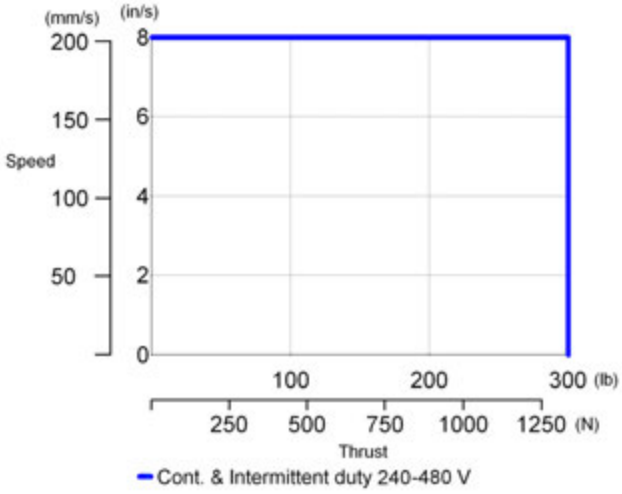
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Servo Thrust Speed Curves

R3-AKM42G-xxx-152B-yy-P AKD (6 A)



R3-AKM42G-xxx-155A-yy-P AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

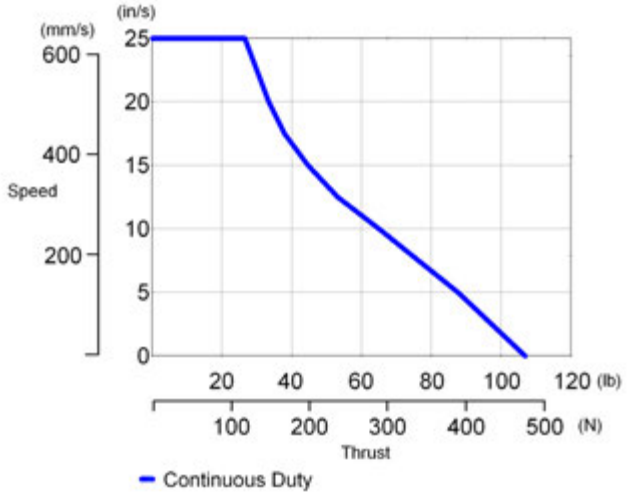
5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

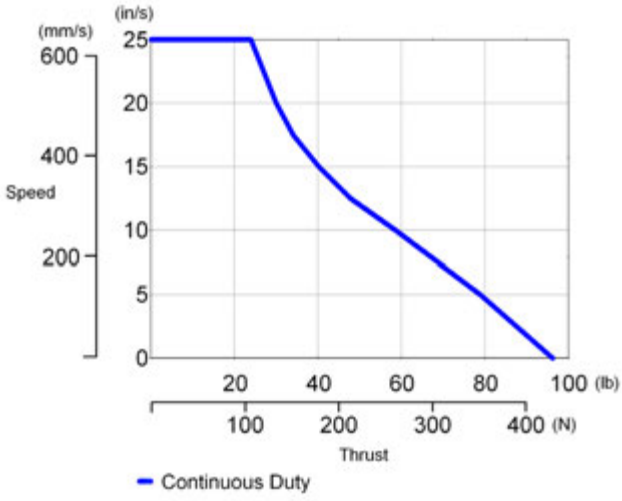
R3 Series Rodless Actuator

Stepper Thrust Speed Curves

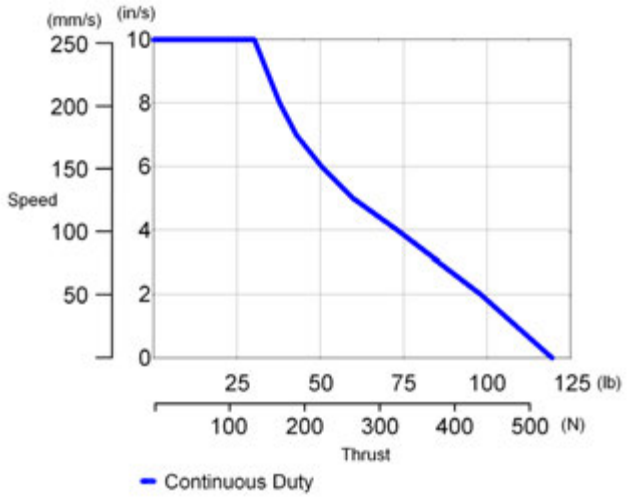
R3-T22T-102B-yy-I/ P70360 (320 Vdc)



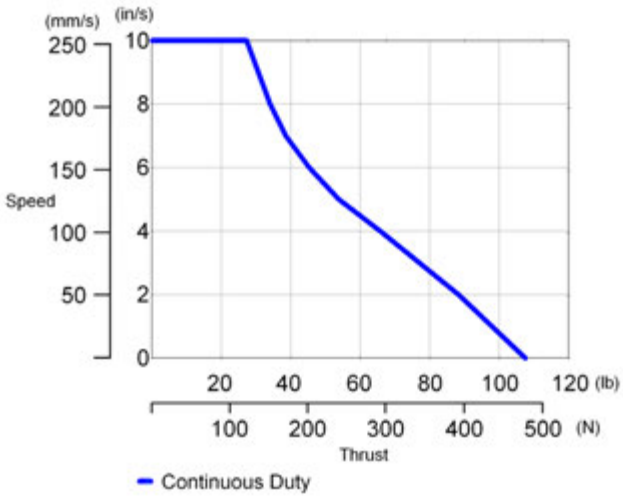
R3-T22T-102B-yy-P/ P70360 (320 Vdc)



R3-T22T-105A-yy-I/ P70360 (320 Vdc)



R3-T22T-105A-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

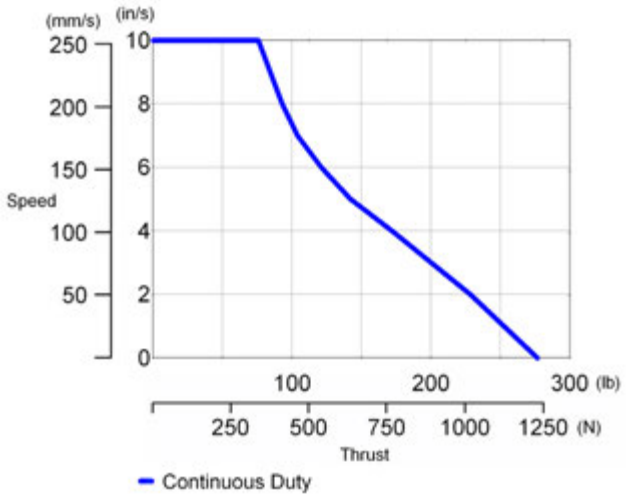
2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

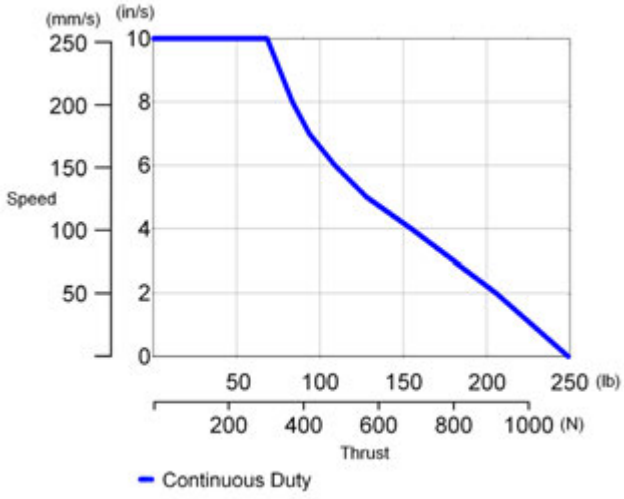
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

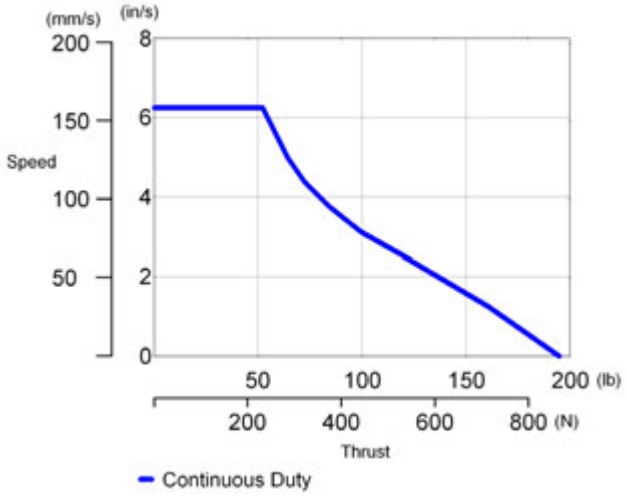
R3-T22T-105B-yy-I/ P70360 (320 Vdc)



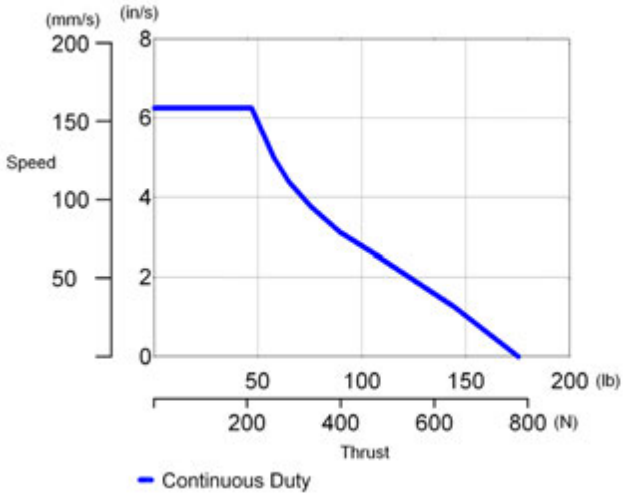
R3-T22T-105B-yy-P/ P70360 (320 Vdc)



R3-T22T-108A-yy-I/ P70360 (320 Vdc)



R3-T22T-108A-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

5B	Critical Speed (in/sec)	15.0	9.4	6.5	4.7	3.6	2.8	1.9	1.3	1.0	0.8	0.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

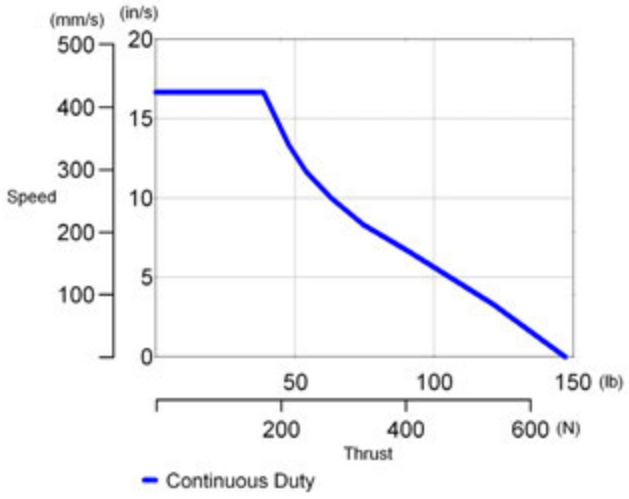
8A	Critical Speed (in/sec)	7.5	8.6	5.4	3.7	2.7	2.1	1.6	1.1	0.8	0.6	0.4	0.4
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	278	212	136	94	69	53	42

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

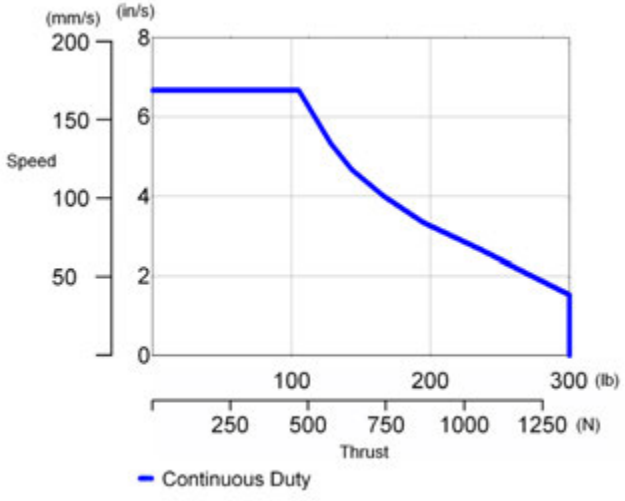
R3 Series Rodless Actuator

Stepper Thrust Speed Curves

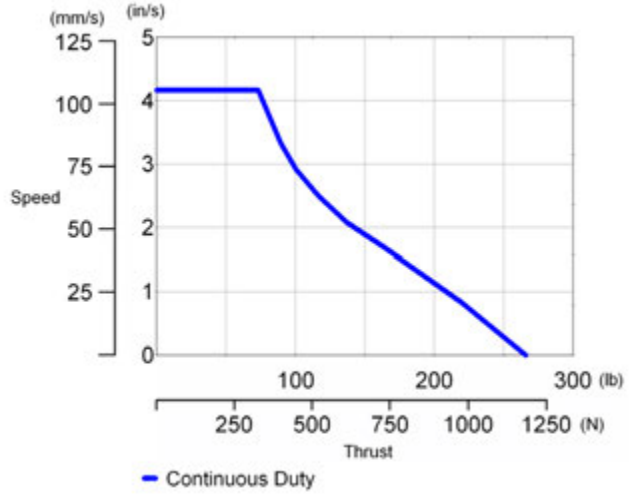
R3-T22T-152B-yy-I/ P70360 (320 Vdc)



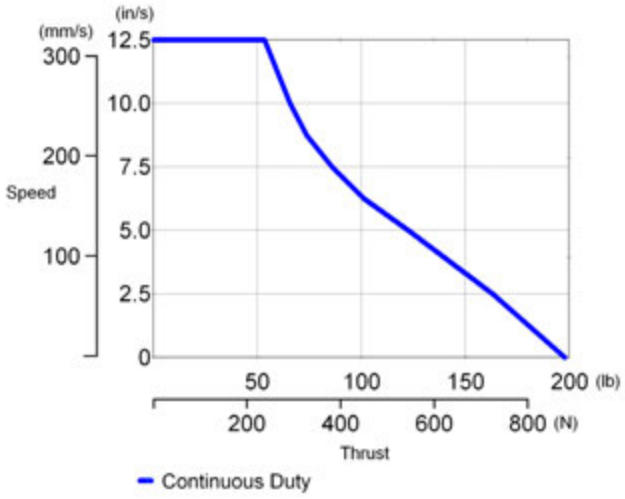
R3-T22T-155B-yy-P/ P70360 (320 Vdc)



R3-T22T-158A-yy-P/ P70360 (320 Vdc)



R3-T22T-202B-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

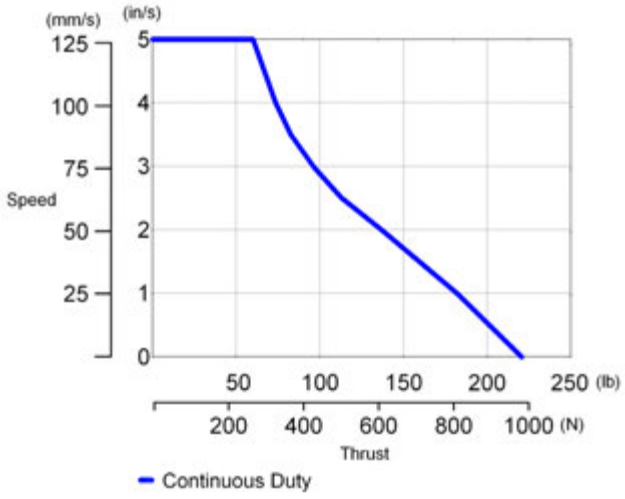
2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56
5B	Critical Speed (in/sec)	15.0	9.4	6.5	4.7	3.6	2.8	1.9	1.3	1.0	0.8	0.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

8A See Following Page

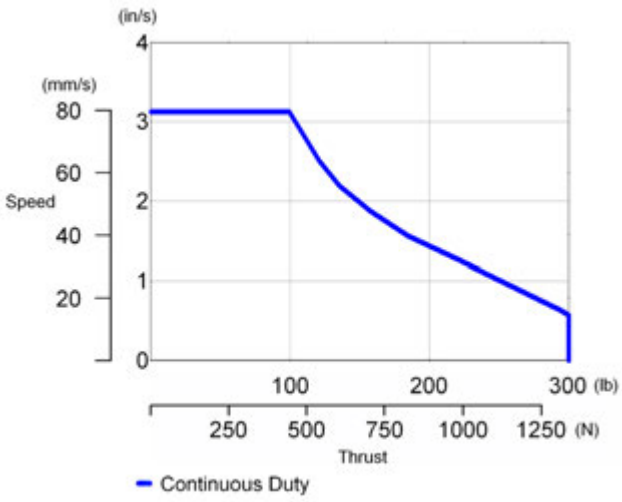
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

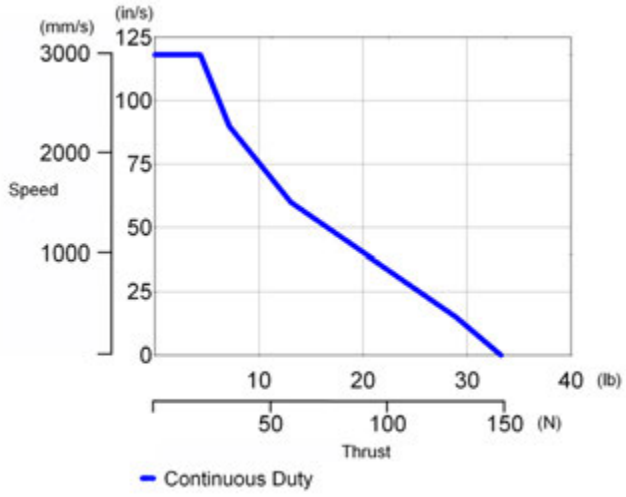
R3-T22T-205A-yy-P/ P70360 (320 Vdc)



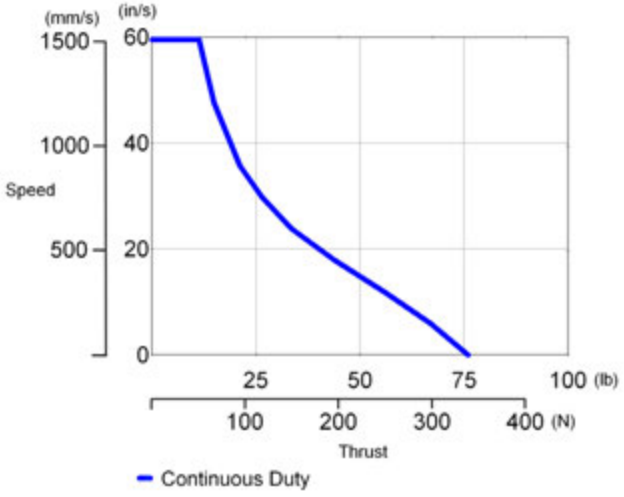
R3-T22T-208A-yy-P/ P70360 (320 Vdc)



R3-T31T-20T/ P70360 (320 Vdc)



R3-T31T-50T/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

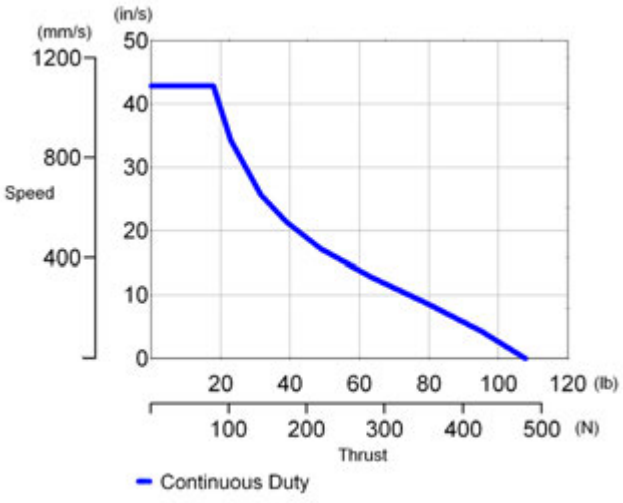
5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19
8A	Critical Speed (in/sec)	7.5	8.6	5.4	3.7	2.7	2.1	1.6	1.1	0.8	0.6	0.4	0.4
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	278	212	136	94	69	53	42

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

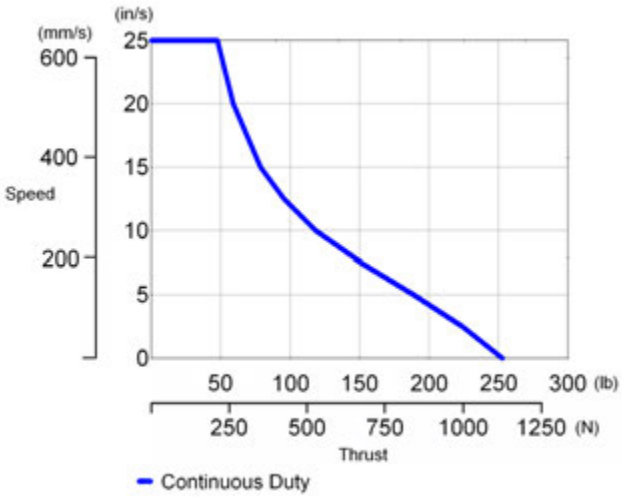
R3 Series Rodless Actuator

Stepper Thrust Speed Curves

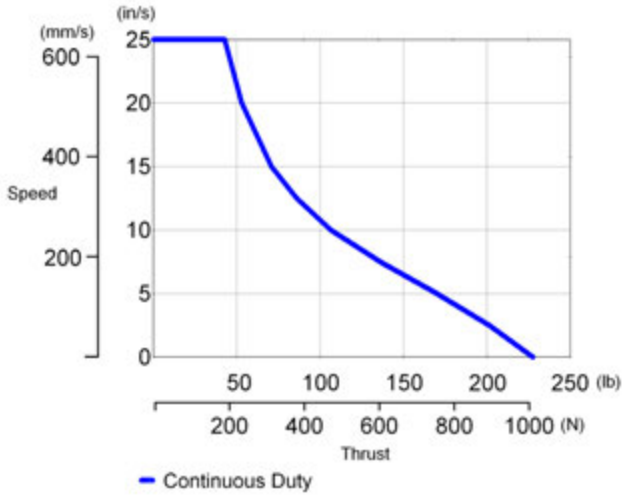
R3-T31T-70T/ P70360 (320 Vdc)



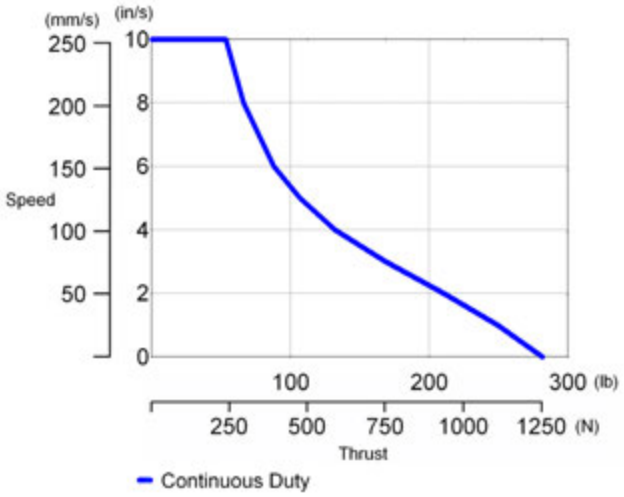
R3-T31T-102B-yy-I/ P70360 (320 Vdc)



R3-T31T-102B-yy-P/ P70360 (320 Vdc)



R3-T31T-105A-yy-I/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

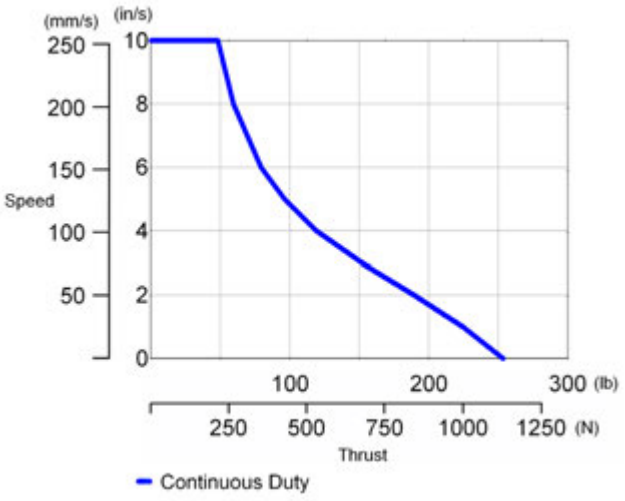
2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

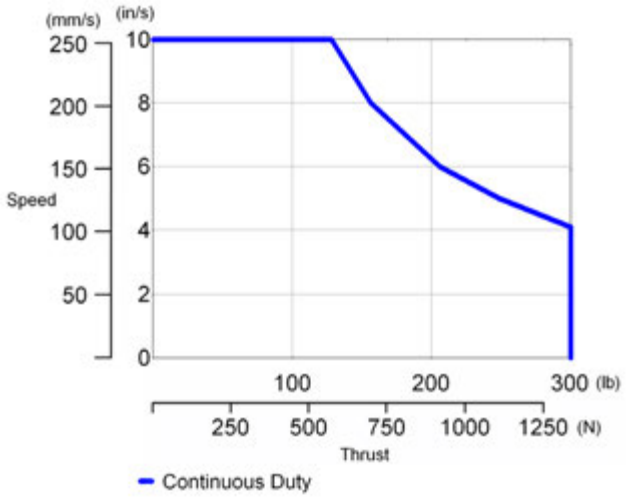
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

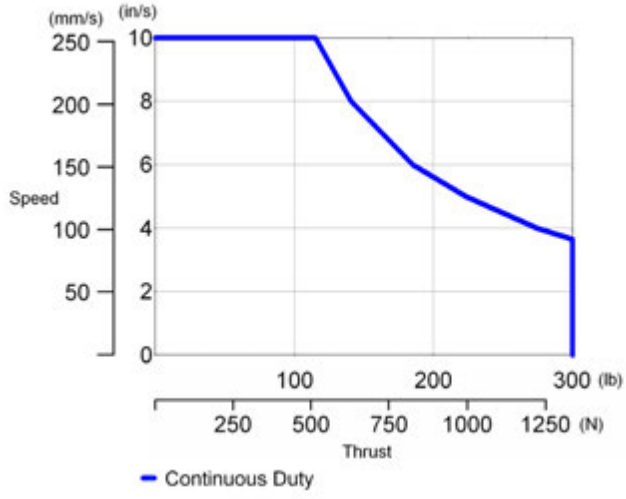
R3-T31T-105A-yy-P/ P70360 (320 Vdc)



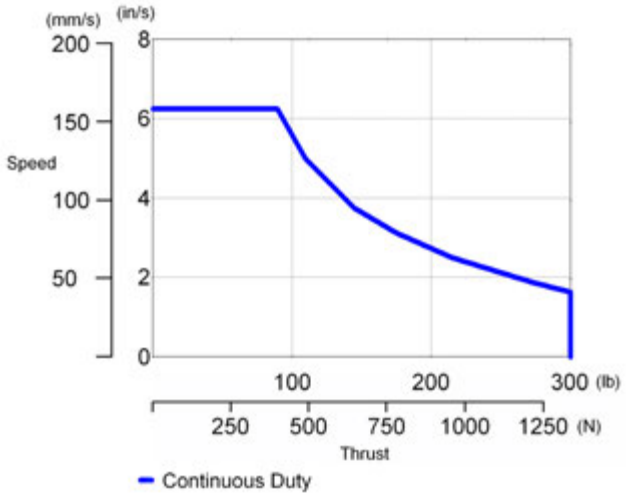
R3-T31T-105B-yy-I/ P70360 (320 Vdc)



R3-T31T-105B-yy-P/ P70360 (320 Vdc)



R3-T31T-108A-yy-I/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

5A	Critical Speed (in/sec)	15.0	11.3	7.1	4.9	3.6	2.7	2.1	1.4	1.0	0.8	0.6	0.5
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	250	175	125	95	60	40	30	25	19

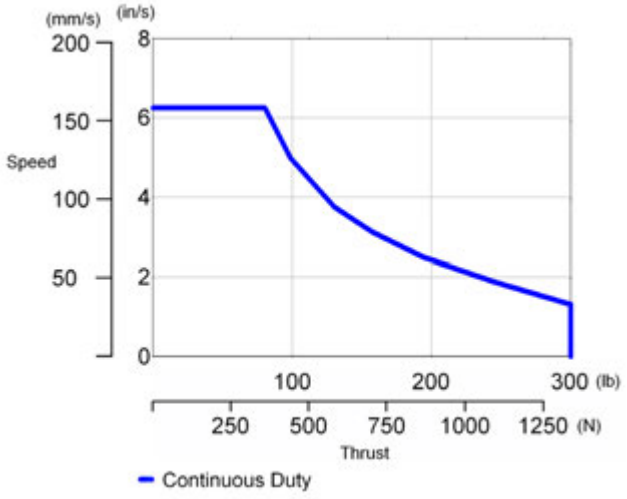
5B	Critical Speed (in/sec)	15.0	9.4	6.5	4.7	3.6	2.8	1.9	1.3	1.0	0.8	0.6	8A
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108	See Following Page
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56	

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

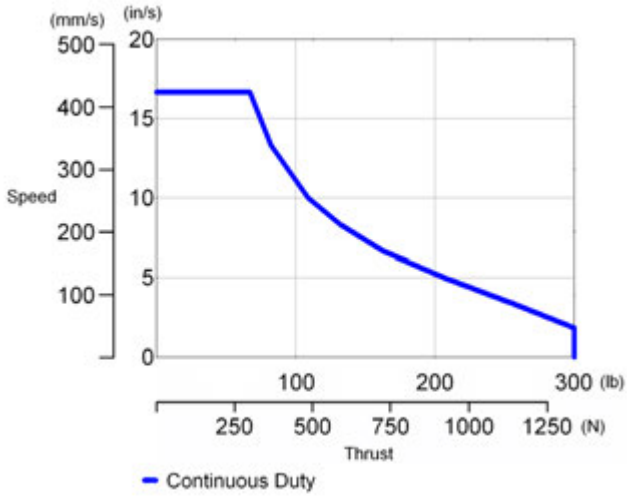
R3 Series Rodless Actuator

Stepper Thrust Speed Curves

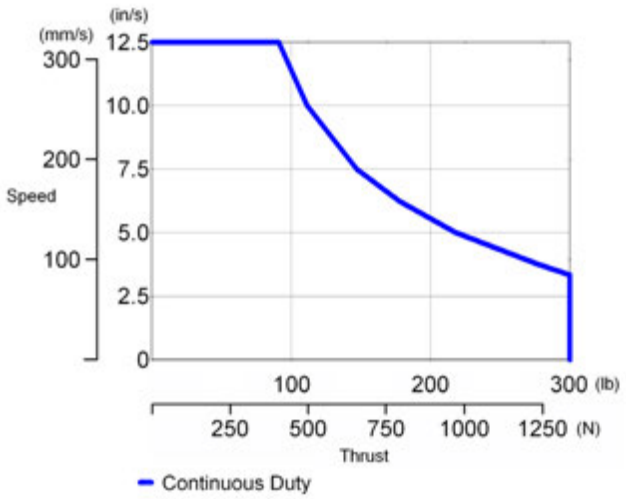
R3-T31T-108A-yy-P/ P70360 (320 Vdc)



R3-T31T-152B-yy-P/ P70360 (320 Vdc)



R3-T31T-202B-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

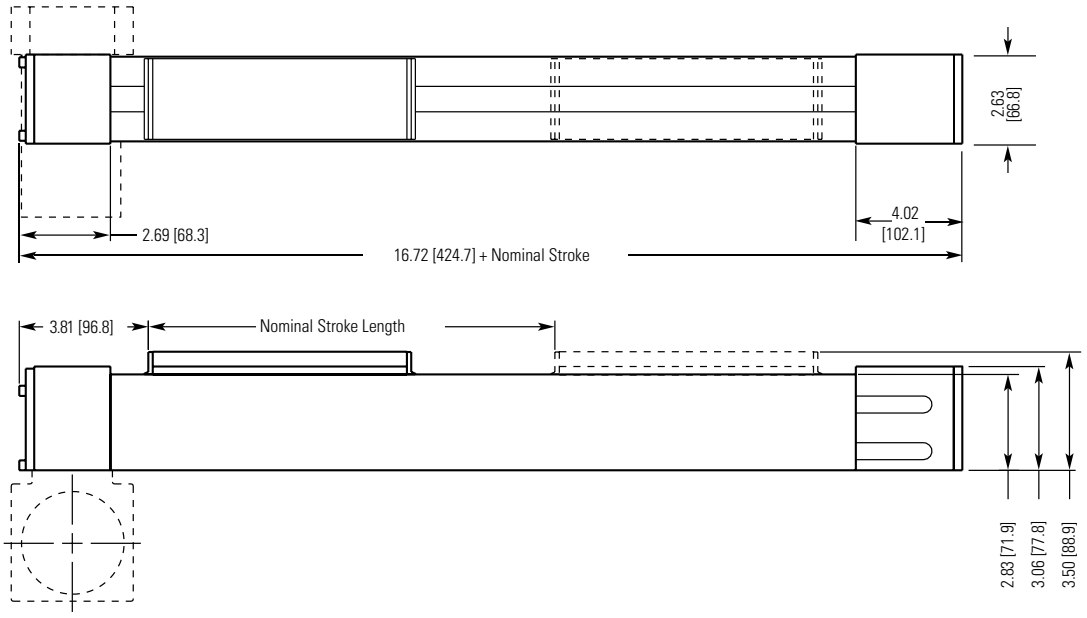
8A	Critical Speed (in/sec)	7.5	8.6	5.4	3.7	2.7	2.1	1.6	1.1	0.8	0.6	0.4	0.4
	Stroke (in)	6 - 12	18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	278	212	136	94	69	53	42

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Notes

R3 Series Rodless Actuator

Belt Drive Overall Dimensions



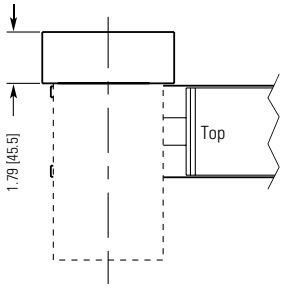
Belt Drive Orientation Options with Dimensions

-AL Over Left

Compatible Mountings

-A Angle Brackets

-B T-Nuts

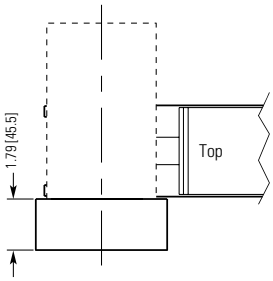


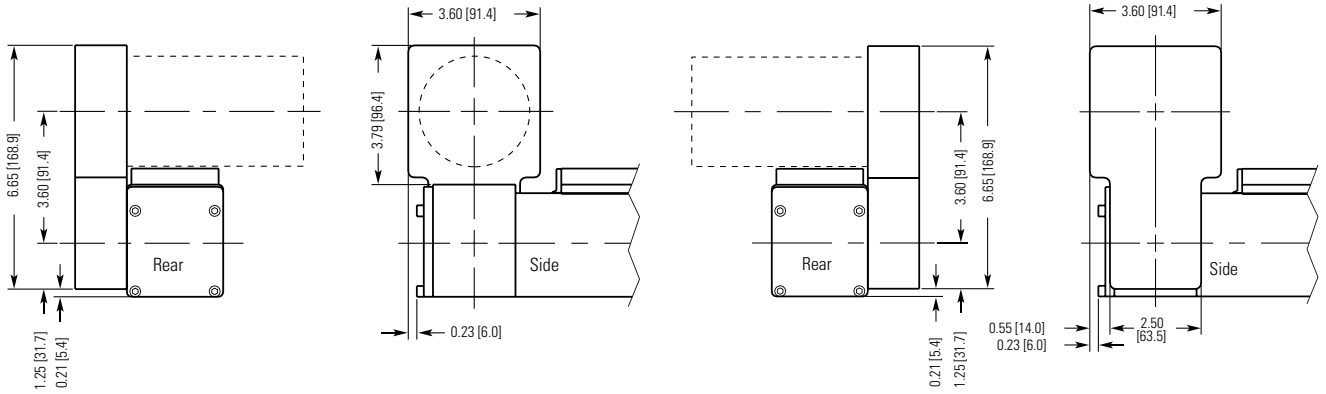
-AR Over Right

Compatible Mountings

-A Angle Brackets

-B T-Nuts





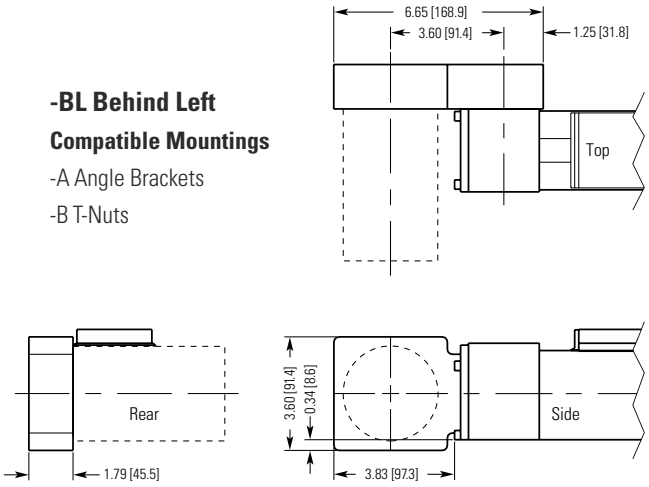
Belt Drive Orientation Options with Dimensions

-BL Behind Left

Compatible Mountings

-A Angle Brackets

-B T-Nuts

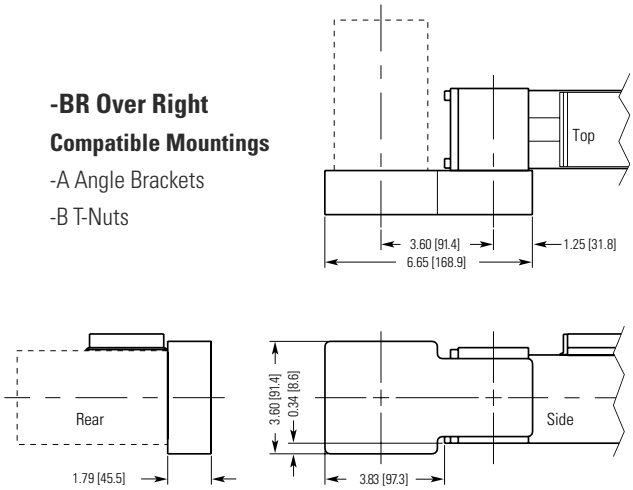


-BR Over Right

Compatible Mountings

-A Angle Brackets

-B T-Nuts

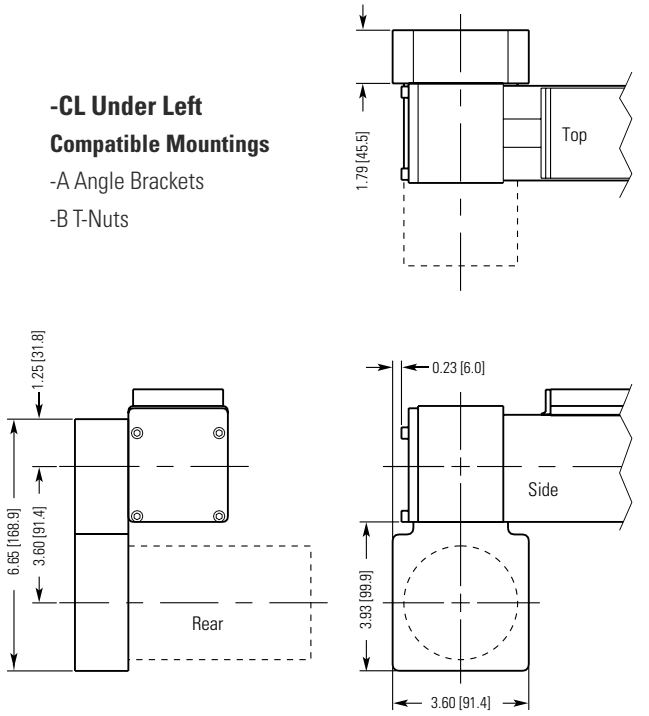


-CL Under Left

Compatible Mountings

-A Angle Brackets

-B T-Nuts

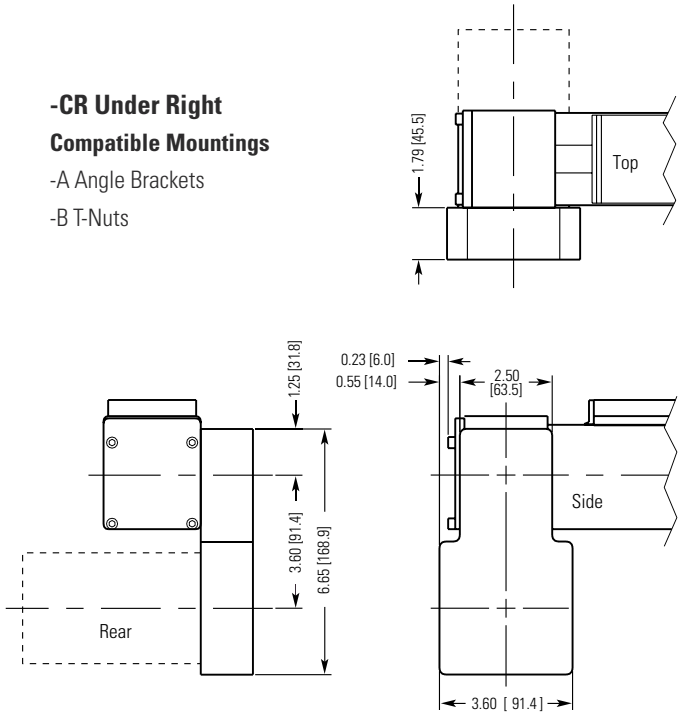


-CR Under Right

Compatible Mountings

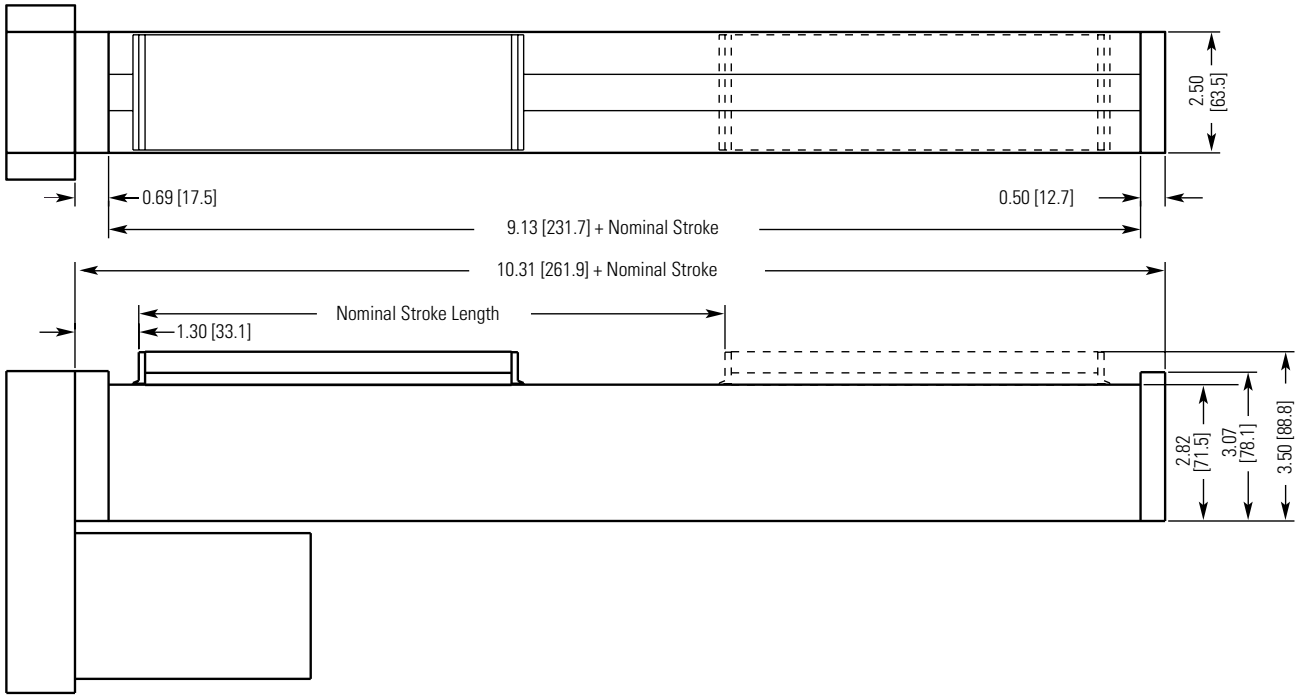
-A Angle Brackets

-B T-Nuts



R3 Series Rodless Actuator

Overall Dimensions Screw Drive

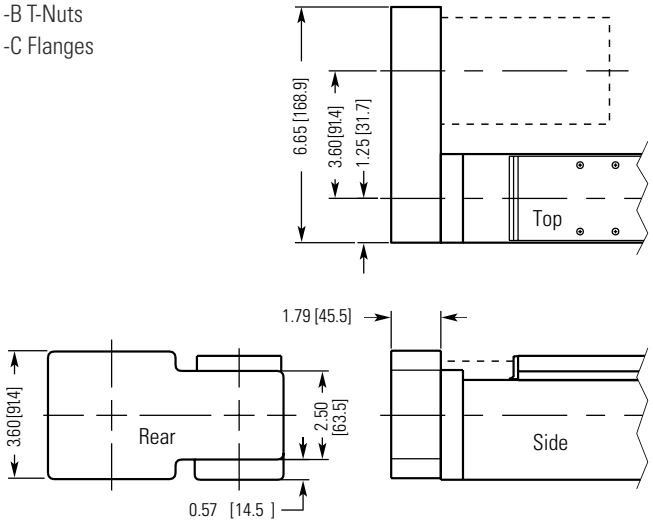


Screw Drive Orientation Options with Dimensions

-PL Parallel Left Side

Compatible Mountings

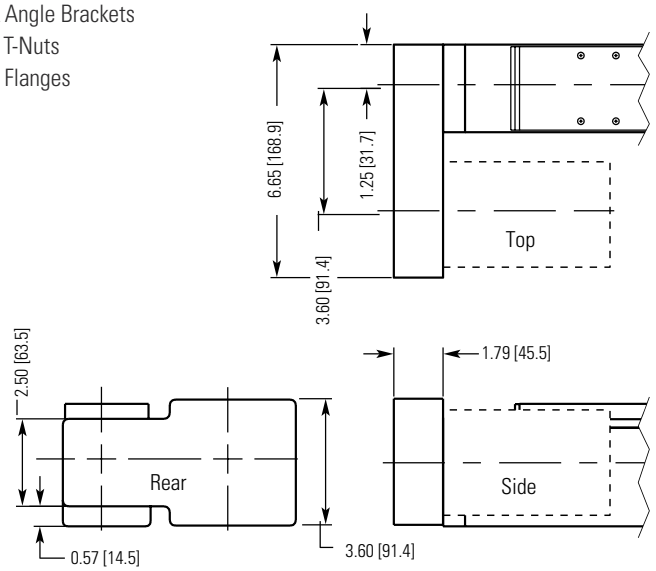
-A Angle Brackets
-B T-Nuts
-C Flanges



-PR Parallel Right Side

Compatible Mountings

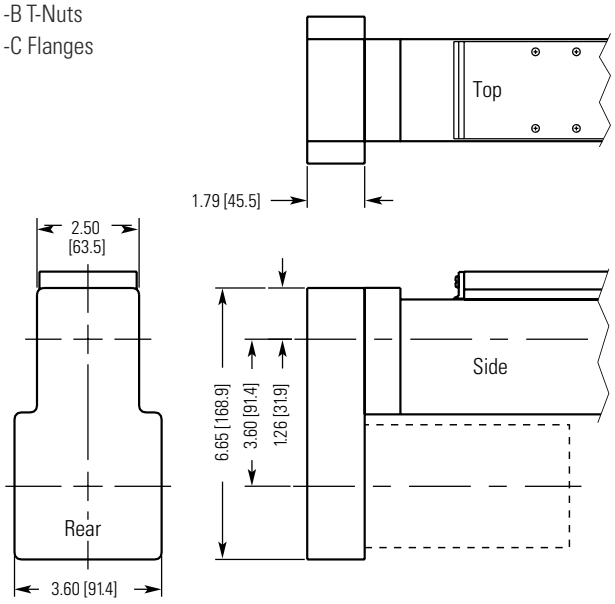
-A Angle Brackets
-B T-Nuts
-C Flanges



-P Parallel Below

Compatible Mountings

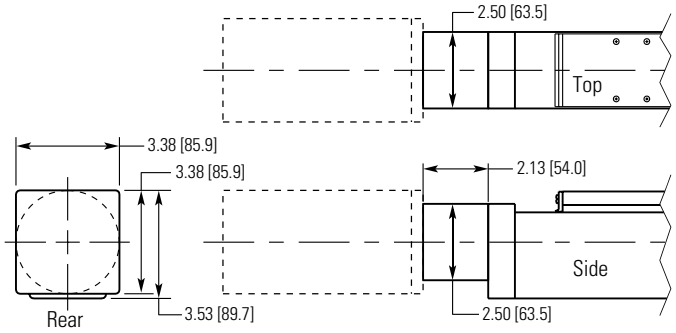
-A Angle Brackets
-B T-Nuts
-C Flanges



-I In-Line

Compatible Mountings

-A Angle Brackets
-B T-Nuts



R3 Series Rodless Actuator

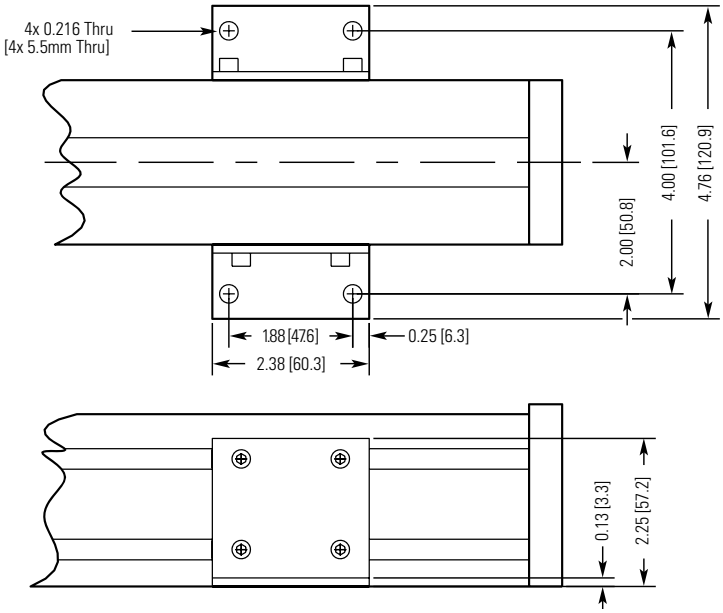
Mounting Option Dimensions

-A Adjustable Angle Brackets

Compatible Motor Orientations

Belt	*Screw*
-AR	-P
-AL	-PR
-BR	-PL
-BL	-I
-CR	
-CL	

Stroke	No. of Angle Brackets
0-18	4
19-36	6
37-48	8
49-72	10

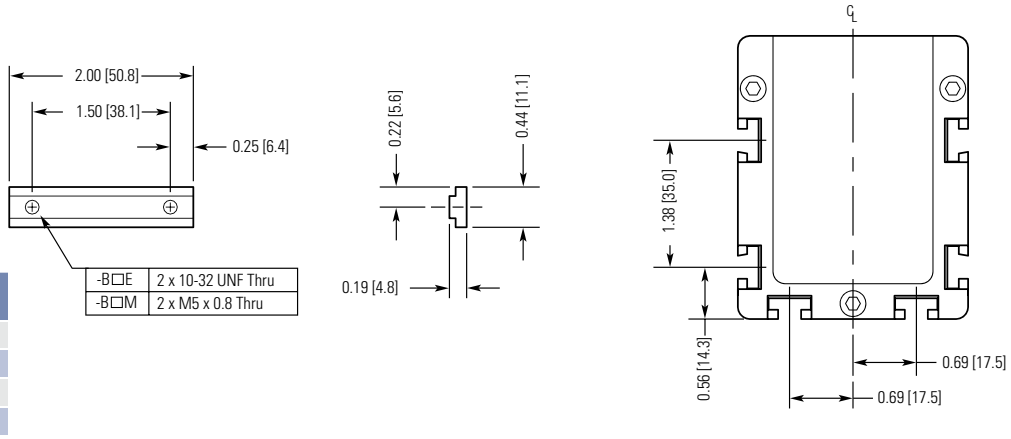


-B Adjustable T-Nuts

Compatible Motor Orientations

Belt	*Screw*
-AR	-P
-AL	-PR
-BR	-PL
-BL	-I
-CR	
-CL	

Stroke	Pairs of T-Nuts
0-18	4
19-36	6
37-48	8
49-72	10

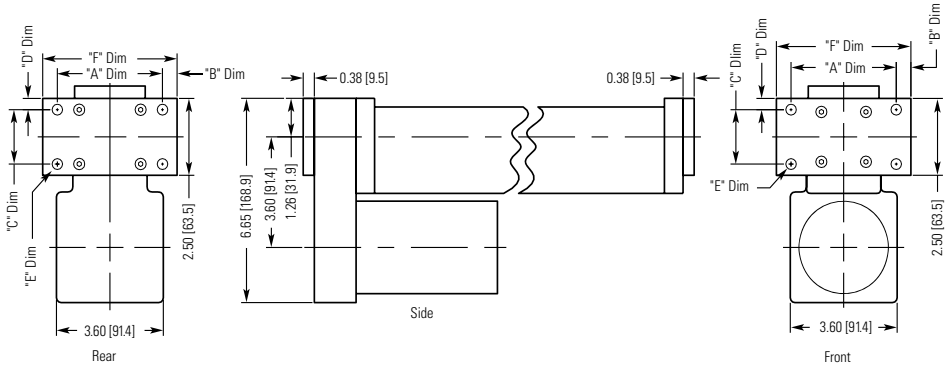


-C Front & Rear Rectangular Flanges

Compatible Motor Orientations

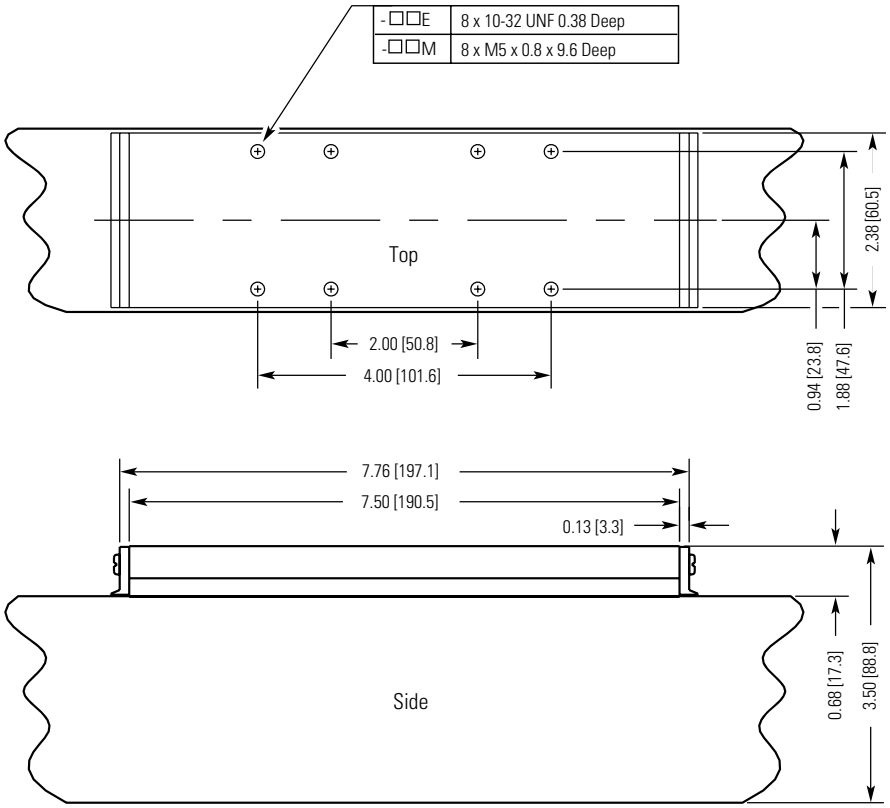
Belt	*Screw*
N/A	-P

Dimensions	-C □ E Enlish (in)	-C □ M Enlish (in)
A	3.44	90.0
B	0.34	12.5
C	1.63	45.0
D	0.44	9.2
E	0.38	9.0
F	4.13	115.0



Carriage Dimensions

- ❑ S ❑ Single Carriage Option



- ❑ D*nn* ❑ Dual Carriage Option

(nn is the distance between carriage centers.
Omit for screw-driven actuators.)
Increase carriage capacity by supporting the load at two separate locations.
For screw-driven actuators, the second carriage is attached to the internal rail bearings, but is not driven by the lead screw. For belt-driven actuators, the second carriage is attached to the internal rail bearings and is also rigidly fixed to the driven carriage. In this case, the distance between carriage centers needs to be specified in the part number.

- Available actuators travel will be reduced by the distance between carriage centers. The minumum distance between carriage centers is 10 in [250 mm].

R4 Series Rodless Actuator

General Specifications

Travel Lengths	6, 12, 18, 24, 30, 36, 42, 48, 60, 72, 84, 96, 108 inches			
Construction Materials				
Bearing Housing	6063 T-6 aluminum, hardcoat anodized			
Guide Housing	6063 T-6 aluminum, hardcoat anodized			
Carriage Assembly	6061 T-6 aluminum, hardcoat anodized			
Internal Rail Bearings	Recirculating ball on precision ground rail			
Lead Screw or Belt				
Support Bearing	Angular contact, high thrust ball bearings			
Ball screw; ballnut	1.0" diameter hardened alloy steel screw; alloy steel, heat treated ballnut			
Belt Drive	1.5" wide L pitch urethane with steel reinforcement cords			
Flexible Seal	Stainless steel band with elastomeric seal			
Motor	AKM® servo motor or T series stepper			
Weight (approx, without options)	**Screw-driven Positioners**		**Belt-driven**	
R4-T32	32 + 0.85 x (inches stroke) lb	14.5 + 0.39 x (inches stroke) kg	32 + 0.64 x (inches stroke) lb	14.5 + 0.29 x (inches stroke) kg
R4-T41	40 + 0.85 x (inches stroke) lb	18.2 + 0.39 x (inches stroke) kg	40 + 0.64 x (inches stroke) lb	18.2 + 0.29 x (inches stroke) kg
R4-AKM42	30 + 0.85 x (inches stroke) lb	13.6 + 0.39 x (inches stroke) kg	30 + 0.64 x (inches stroke) lb	13.6 + 0.29 x (inches stroke) kg
R4-AKM52	36 + 0.85 x (inches stroke) lb	16.4 + 0.39 x (inches stroke) kg	36 + 0.64 x (inches stroke) lb	16.4 + 0.29 x (inches stroke) kg
Environmental Operation				
Temperature Range	-20° to 140°F [-28° to 60°C]			
Moisture/Contaminants	IP 44 rated: Splash-proof, protected against ingress of solid particles greater than 0.040" [1 mm] diameter.			

R4 Series Actuator

R4 Series Inertia

Inertia Equations:

Rotary Inertia (lb-in-s^2, reflected to the motor) **= A + B x Stroke + C x Load + D**

Linear Inertia (lb, reflected to the carriage) **= [[A + B x Stroke + D]/C] + Load**

where:

A = Inertia of zero length slide (lb-in-s^2)

B = Inertia adder per inch of stroke length (lb-in-s^2/in)

C = Inertia adder per pound of payload (lb-in-s^2/lb)

D = Motor inertia (lb-in-s^2)

Stroke = Total stroke length in inches (in).
Same as stroke length entered into part number

Load = Payload in pounds (lb)

Belt Driven Models	Motors	Ratio	Belt (in)	A (lb-in-s^2)	B (lb-in-s^2/in)	C (lb-in-s^2/lb)
R4...-10T	AKM42, 52	1:1	1.5 wide	1.88 E-02	4.32 E-05	3.67 E-03
R4...-15T	AKM42, 52	1.5:1		8.50 E-03	1.92 E-05	1.63 E-03
R4...-20T	AKM42, 52, T32, 41	2:1		6.06 E-03	1.06 E-05	9.02 E-04
R4...-30T	AKM42, 52, T41	3:1		2.32 E-03	4.71 E-06	4.01 E-04
R4...-50T	AKM42, 52, T32, 41	5:1		1.07 E-03	1.62 E-06	1.38 E-04
R4...-100T	AKM42, 52, T41	10:1		4.40 E-04	4.21 E-07	3.60 E-05
Screw Driven Models	**Motors**	**Ratio**	**Screw dia. x lead (in)**	**A (lb-in-s^2)**	**B (lb-in-s^2/in)**	**C (lb-in-s^2/lb)**
R4...-101B	AKM42, 52, T32, 41	1:1	1 x 1	2.17 E-03	7.12 E-05	6.56 E-05
R4...-151B	AKM42, 52, T32, 41	1.5:1		1.04 E-03	3.17 E-05	2.92 E-05
R4...-201B	AKM42, 52, T32, 41	2:1		6.63 E-04	1.78 E-05	1.64 E-05
R4...-501B	AKM42, 52, T32, 41	5:1		4.32 E-04	2.72 E-06	2.51 E-06
R4...-1001B	AKM42, T32, 41	10:1		2.75 E-04	7.12 E-07	6.48 E-07
R4...-104B	AKM42, 52, T32	1:1	1 x 0.25	1.80 E-03	7.12 E-05	4.10 E-06
R4...-154B	AKM42, 52, T41	1.5:1		8.99 E-04	3.17 E-05	1.83 E-06
R4...-204B	AKM42, 52	2:1		5.84 E-04	1.78 E-05	1.02 E-06
R4...-504B	AKM42, 52	5:1		4.20 E-04	2.72 E-06	1.62 E-07

Motor	D (lb-in-s^2)
AKM42	1.28 E-03
AKM52	5.51 E-03
T32	2.37 E-03
T41	4.89 E-03

Metric Conversions:

1 mm = 0.03937 in

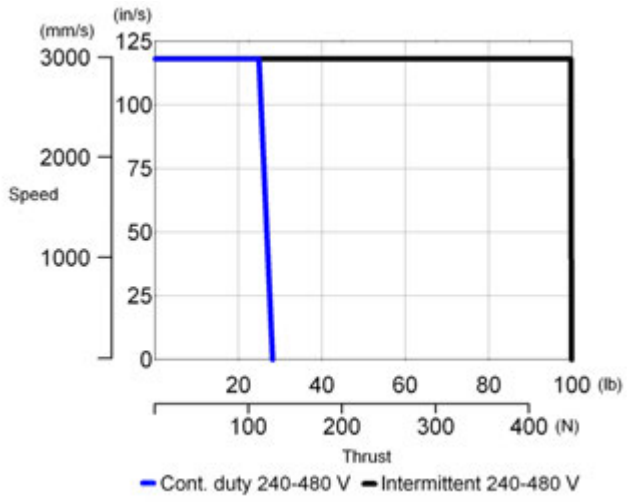
1 kg = 2.205 lb

1 lb-in-s^2 = 1129 kg-cm^2 = 1.152 kg-cm-s^2

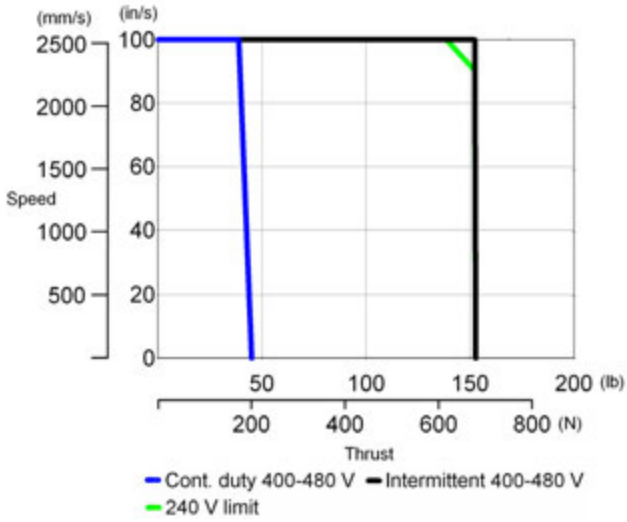
R4 Series Rodless Actuator

Servo Thrust Speed Curves

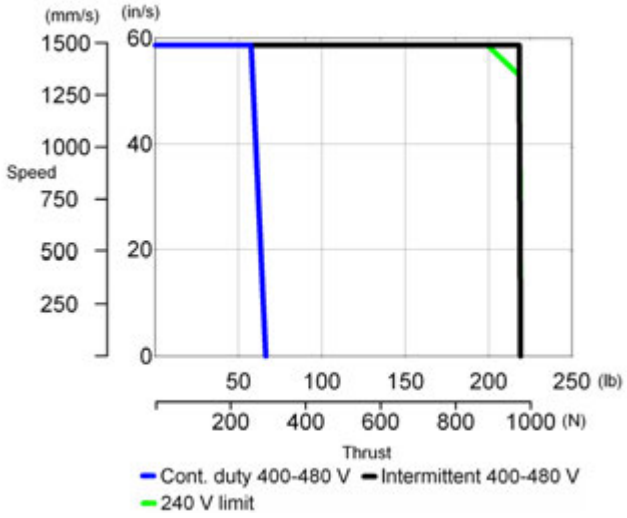
R4-AKM42G-xxx-20T AKD (6 A)



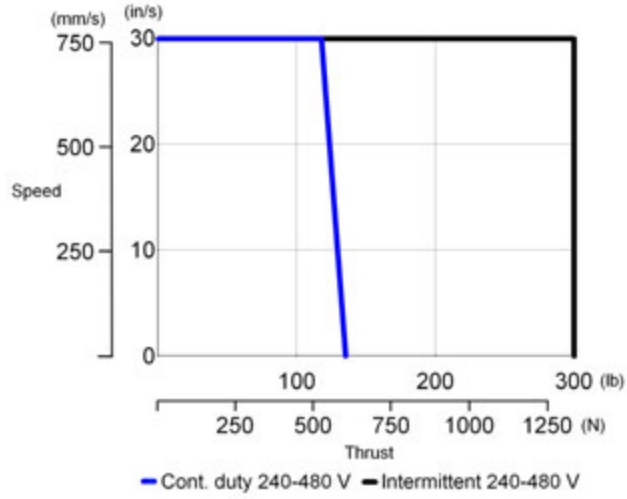
R4-AKM42G-xxx-30T AKD (6 A)



R4-AKM42G-xxx-50T AKD (6 A)

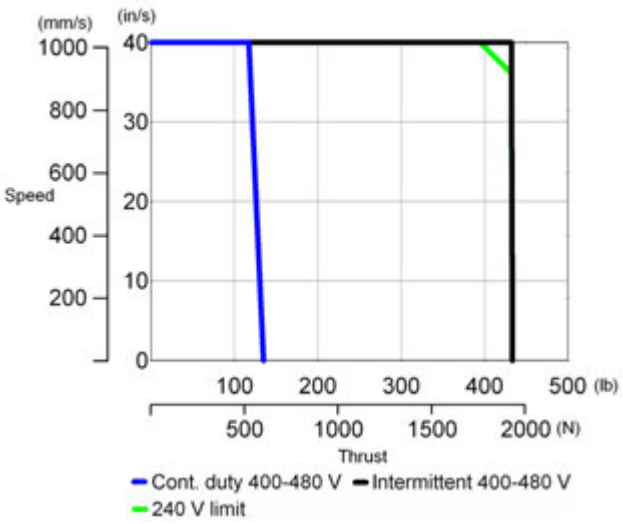


R4-AKM42G-xxx-100T AKD (6 A)

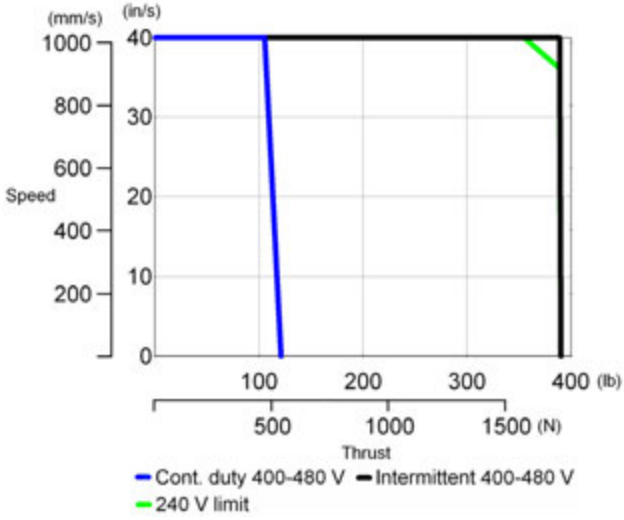


Servo Thrust Speed Curves

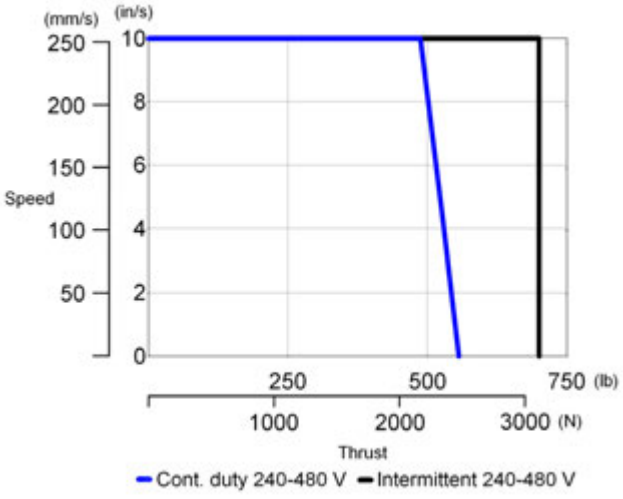
R4-AKM42G-xxx-101B-yy-I AKD (6 A)



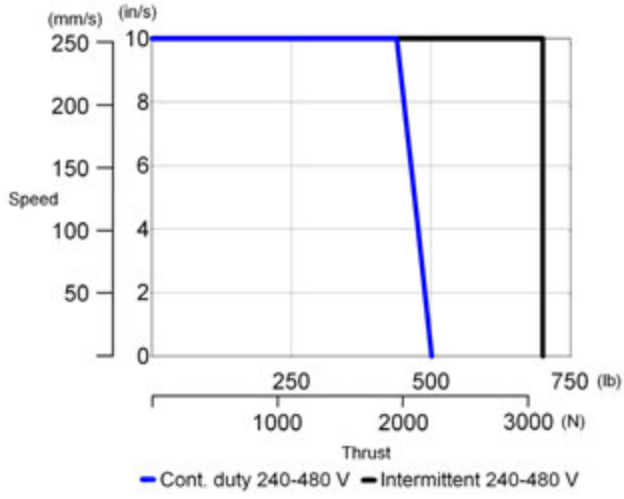
R4-AKM42G-xxx-101B-yy-P AKD (6 A)



R4-AKM42G-xxx-104B-yy-I AKD (6 A)



R4-AKM42G-xxx-104B-yy-P AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

1B	Critical Speed (in/sec)	40.0	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

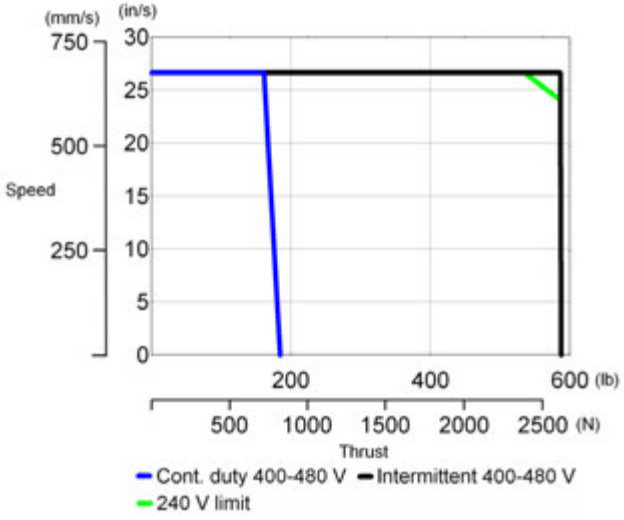
4B	Critical Speed (in/sec)	10.0	8.8	7.1	4.9	3.6	2.7	2.1	1.7
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

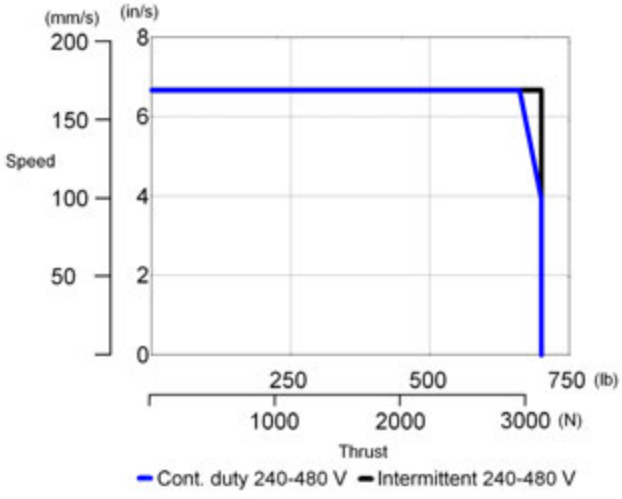
R4 Series Rodless Actuator

Servo Thrust Speed Curves

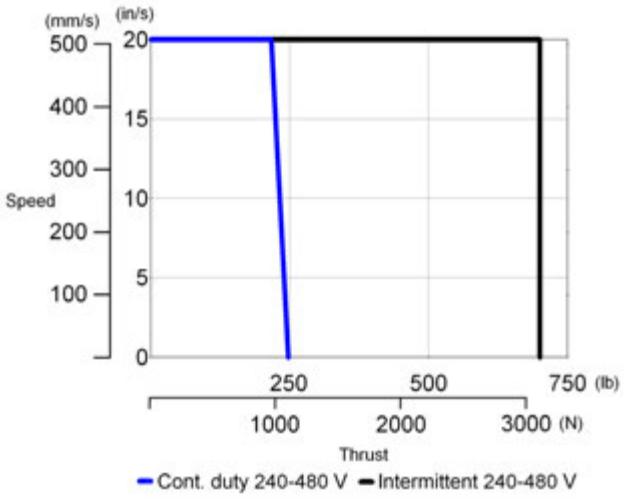
R4-AKM42G-xxx-151B-yy-P AKD (6 A)



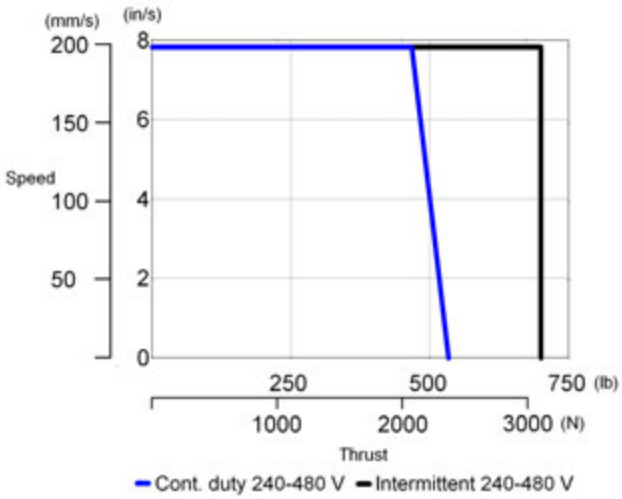
R4-AKM42G-xxx-154B-yy-P AKD (6 A)



R4-AKM42G-xxx-201B-yy-P AKD (6 A)



R4-AKM42G-xxx-501B-yy-P AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

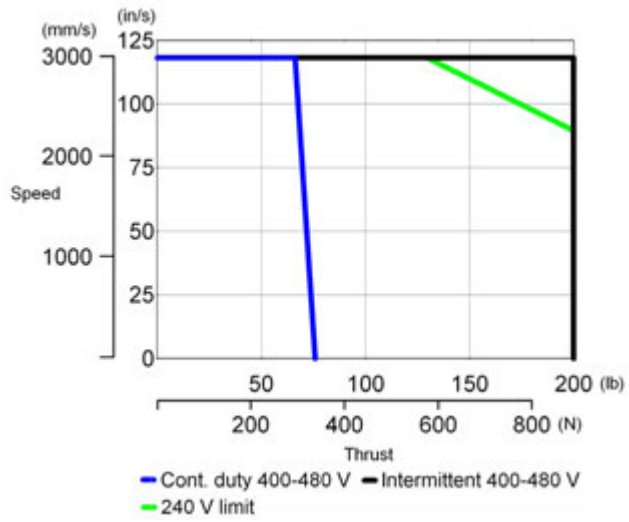
1B	Critical Speed (in/sec)	40.0	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

4B	Critical Speed (in/sec)	10.0	8.8	7.1	4.9	3.6	2.7	2.1	1.7
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

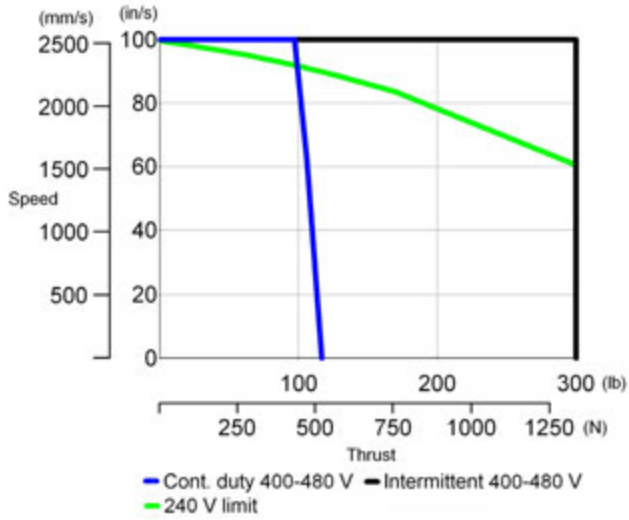
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Servo Thrust Speed Curves

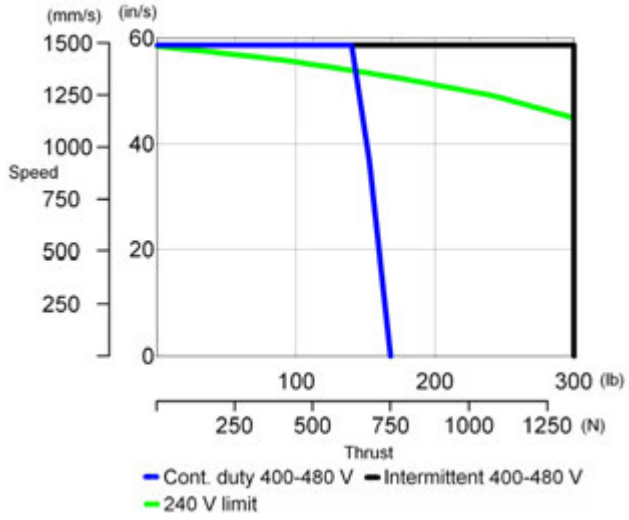
R4-AKM52H-xxx-20T AKD (6 A)



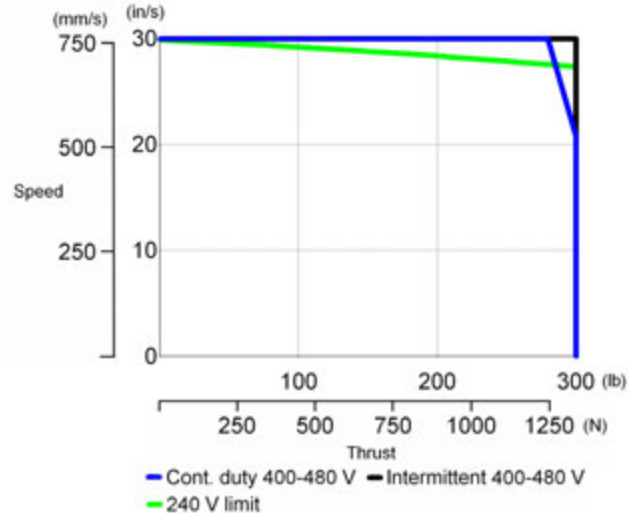
R4-AKM52H-xxx-30T AKD (6 A)



R4-AKM52H-xxx-50T AKD (6 A)



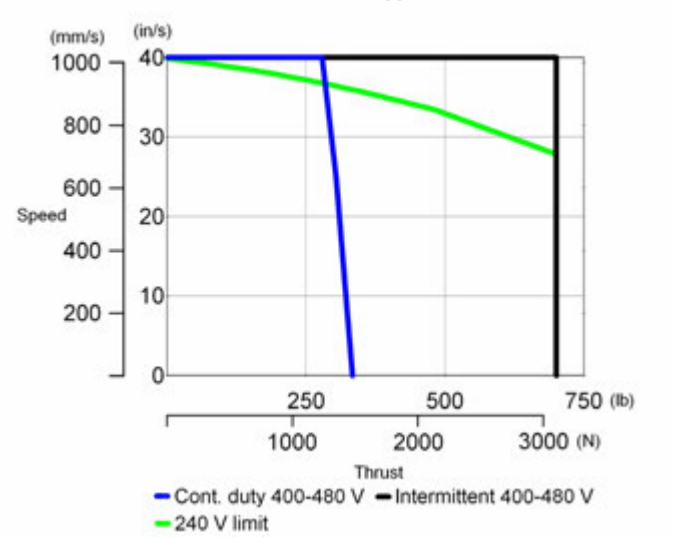
R4-AKM52H-xxx-100T AKD (6 A)



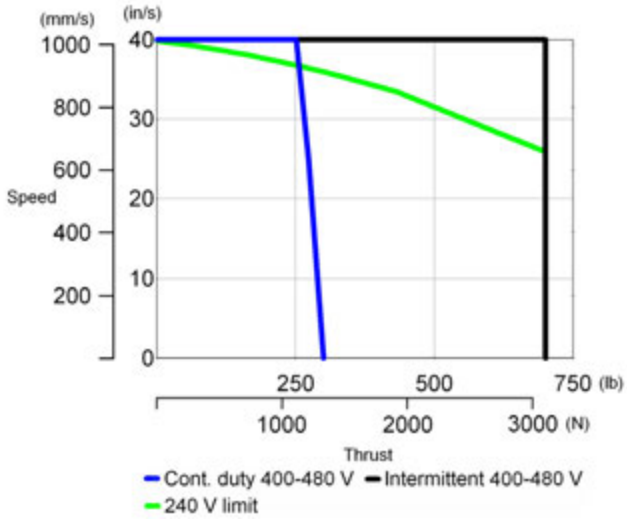
R4 Series Rodless Actuator

Servo Thrust Speed Curves

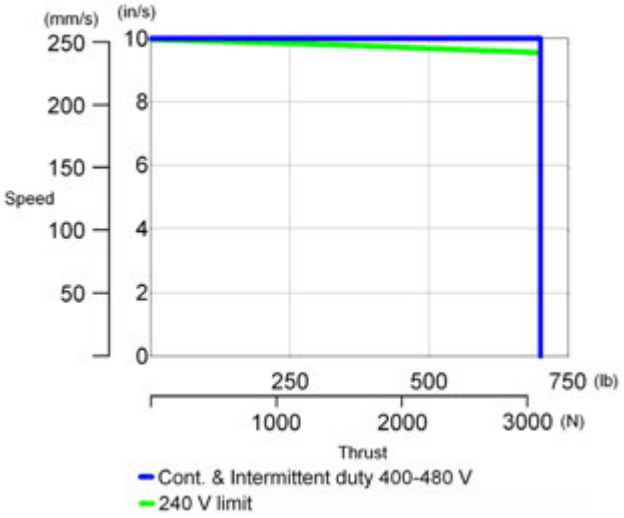
R4-AKM52H-xxx-101B-yy-I AKD (6 A)



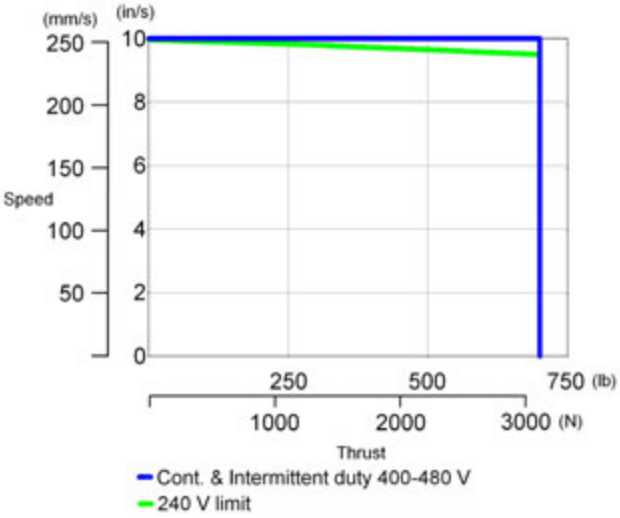
R4-AKM52H-xxx-101B-yy-P AKD (6 A)



R4-AKM52H-xxx-104B-yy-I AKD (6 A)



R4-AKM52H-xxx-104B-yy-P AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

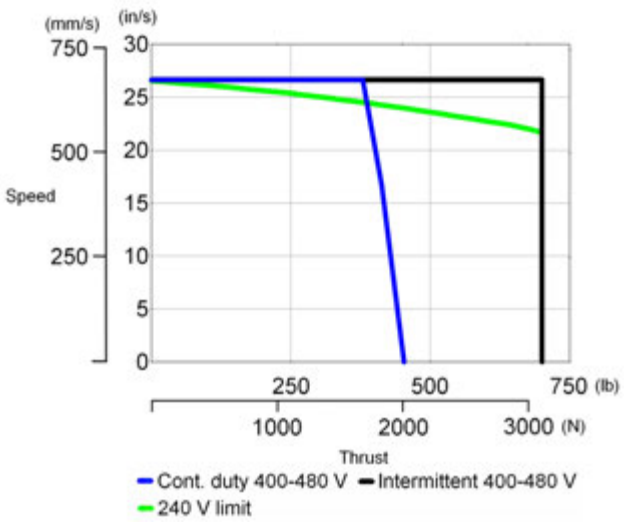
1B	Critical Speed (in/sec)	40.0	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

4B	Critical Speed (in/sec)	10.0	8.8	7.1	4.9	3.6	2.7	2.1	1.7
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

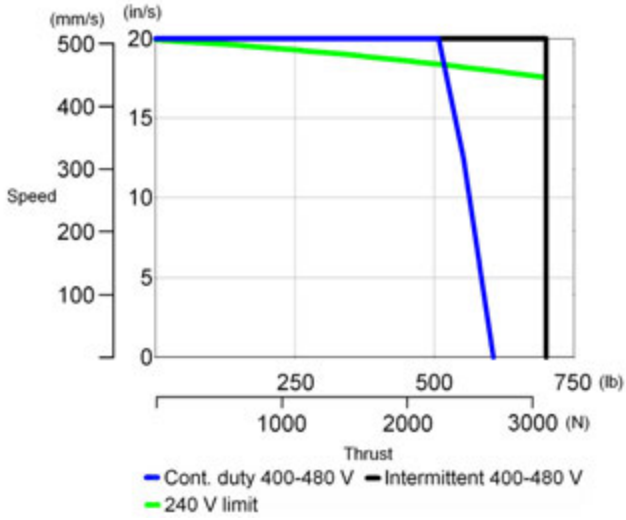
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Servo Thrust Speed Curves

R4-AKM52H-xxx-151B-yy-P AKD (6 A)



R4-AKM52H-xxx-201B-yy-P AKD (6 A)



Column Loading and Critical Speed Limits for Screw-driven Configurations

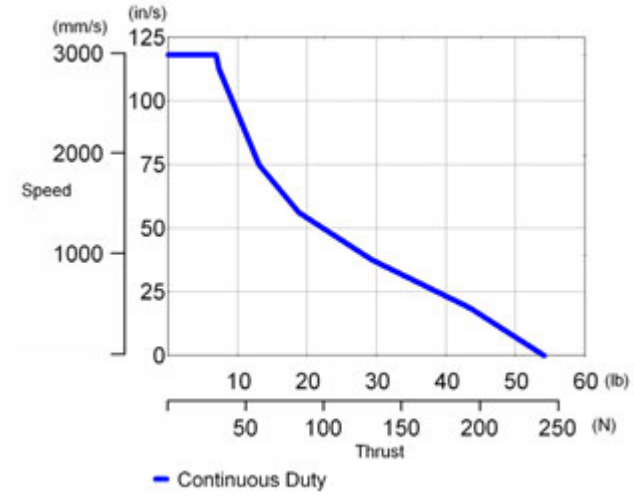
1B	Critical Speed (in/sec)	40.0	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

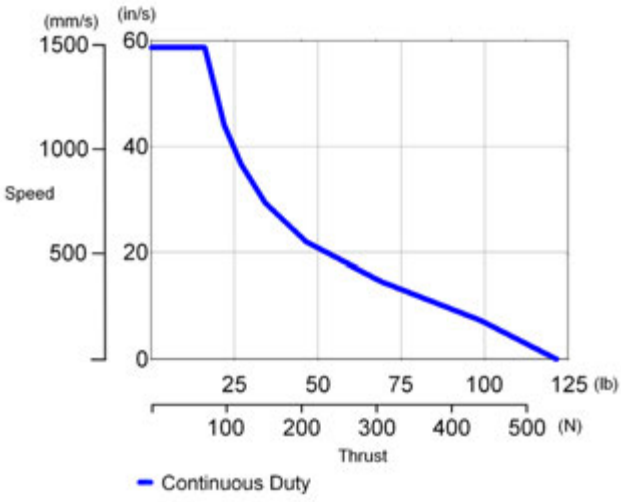
R4 Series Rodless Actuator

Stepper Thrust Speed Curves

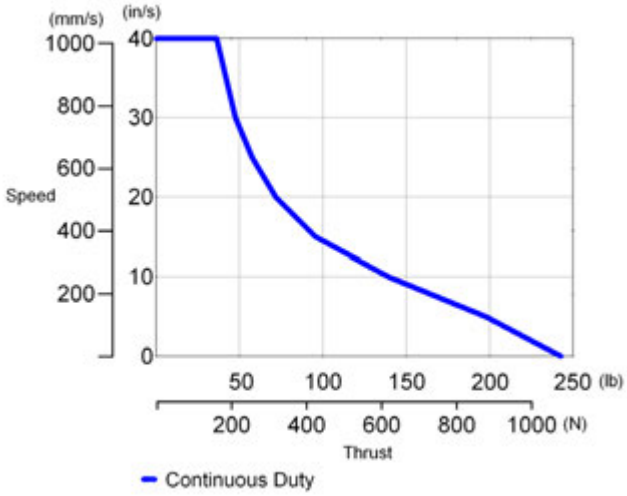
R4-T32T-20T/ P70360 (320 Vdc)



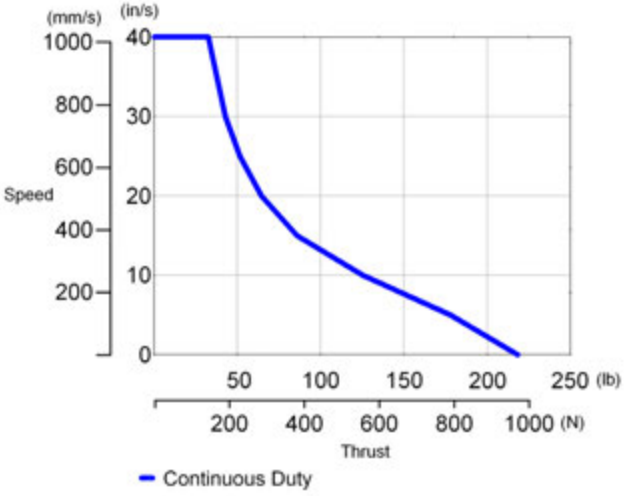
R4-T32T-50T/ P70360 (320 Vdc)



R4-T32T-101B-yy-I/ P70360 (320 Vdc)



R4-T32T-101B-yy-P/ P70360 (320 Vdc)



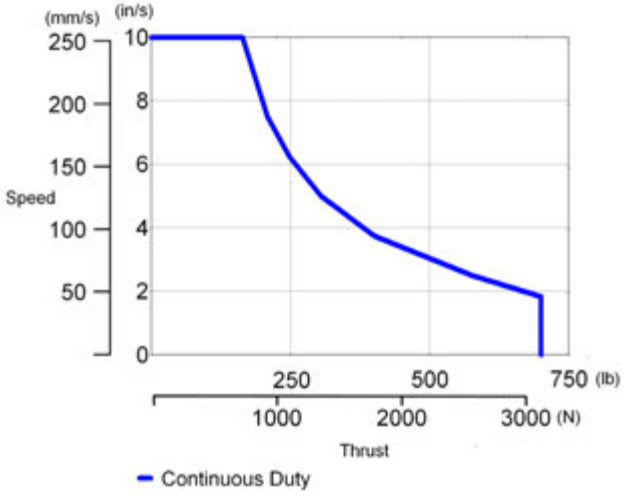
Column Loading and Critical Speed Limits for Screw-driven Configurations

1B	Critical Speed (in/sec)	40	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

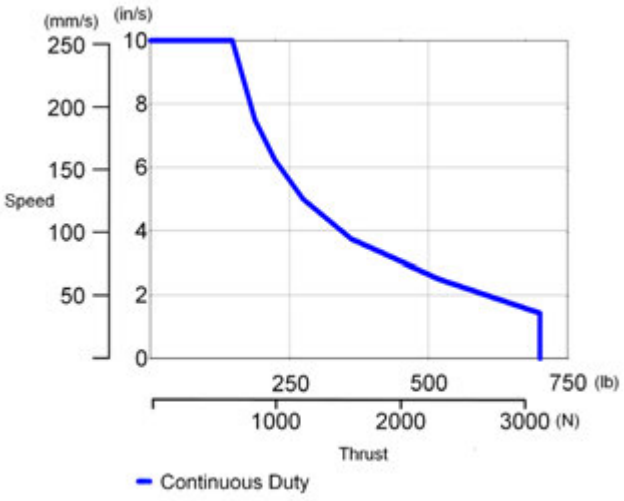
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

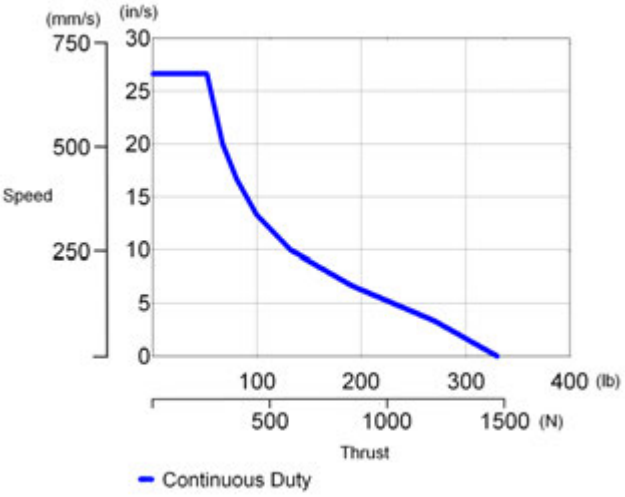
R4-T32T-104B-yy-I/ P70360 (320 Vdc)



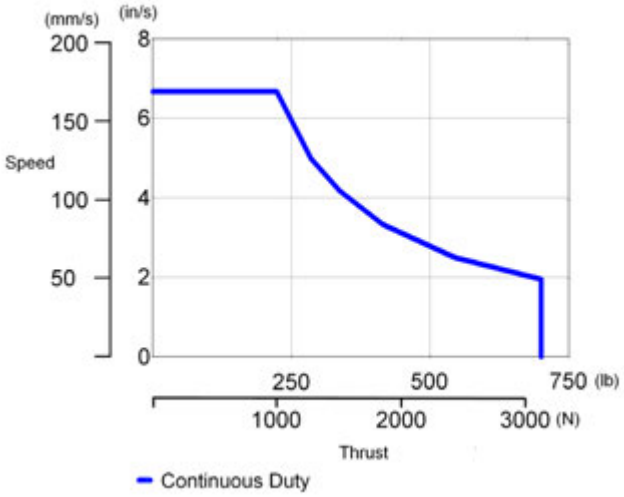
R4-T32T-104B-yy-P/ P70360 (320 Vdc)



R4-T32T-151B-yy-P/ P70360 (320 Vdc)



R4-T32T-154B-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

1B	Critical Speed (in/sec)	40	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

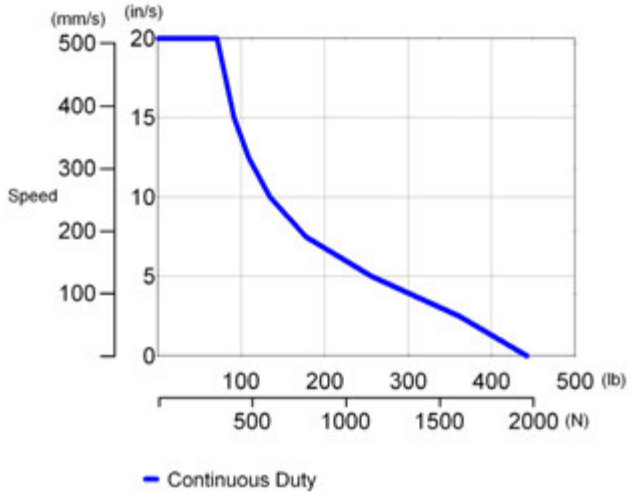
4B	Critical Speed (in/sec)	10.0	8.8	7.1	4.9	3.6	2.7	2.1	1.7
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

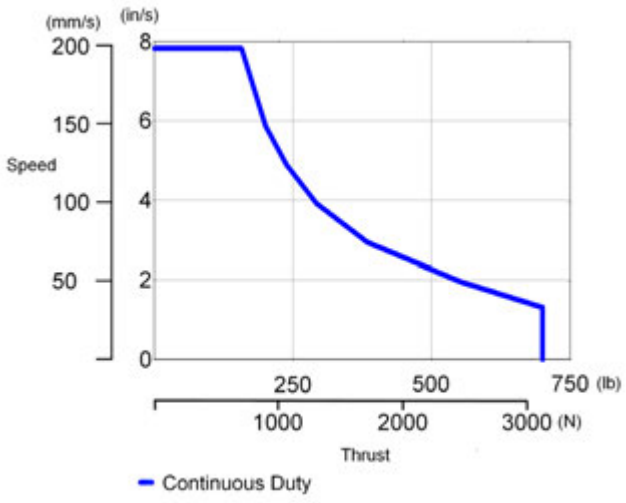
R4 Series Rodless Actuator

Stepper Thrust Speed Curves

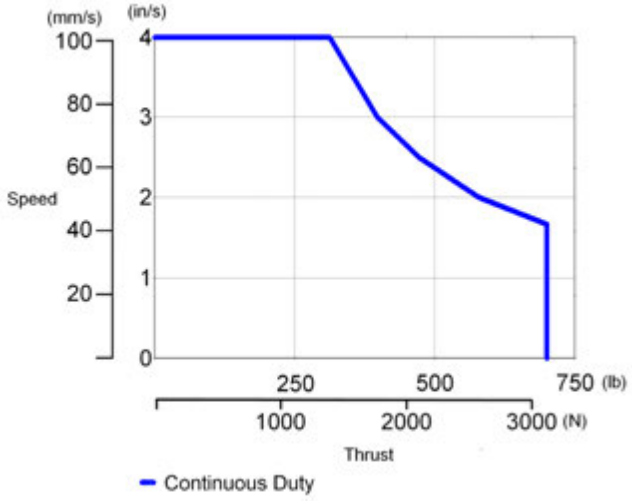
R4-T32T-201B-yy-P/ P70360 (320 Vdc)



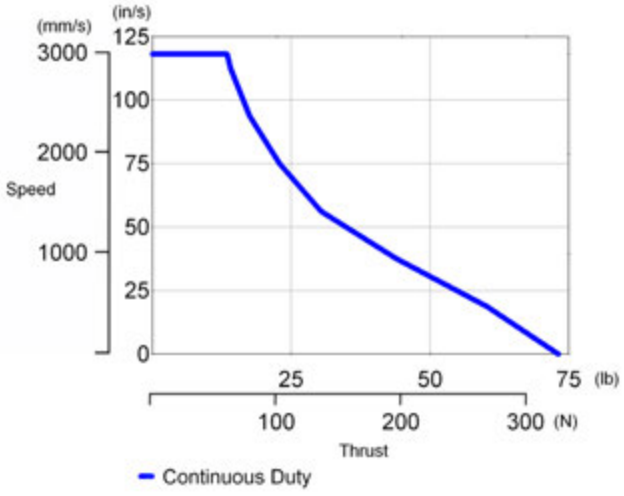
R4-T32T-501B-yy-P/ P70360 (320 Vdc)



R4-T32T-1001B-yy-I/ P70360 (320 Vdc)



R4-T41T-20T/ P70360 (320 Vdc)



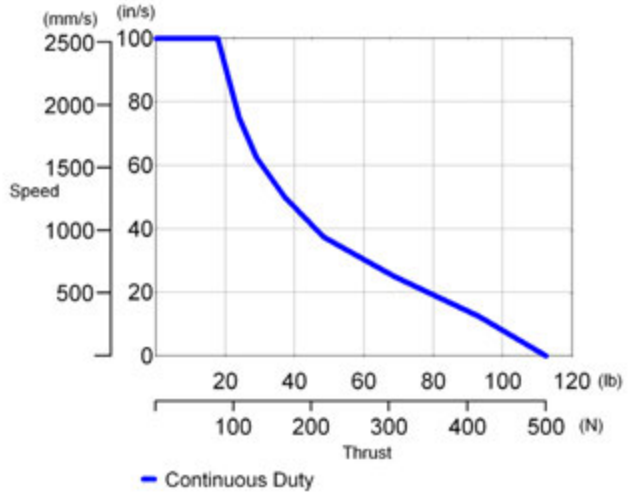
Column Loading and Critical Speed Limits for Screw-driven Configurations

1B	Critical Speed (in/sec)	40	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

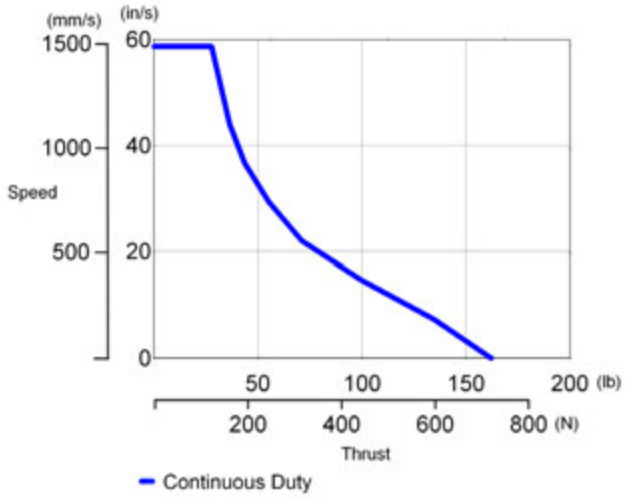
Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Stepper Thrust Speed Curves

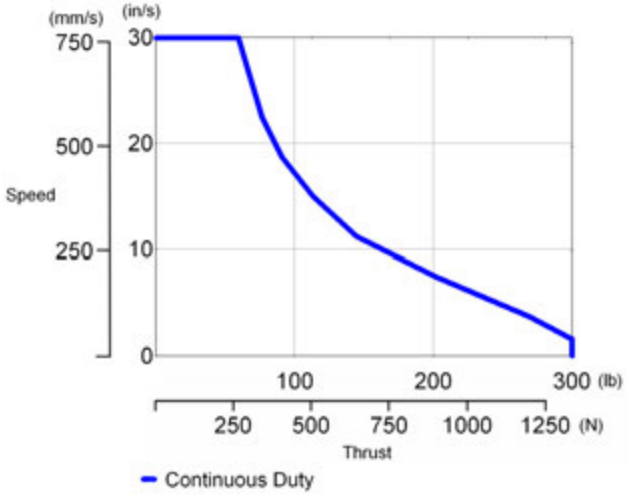
R4-T41T-30T/ P70360 (320 Vdc)



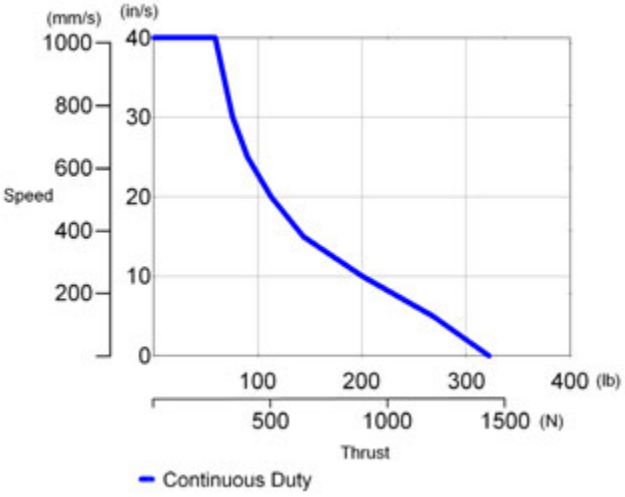
R4-T41T-50T/ P70360 (320 Vdc)



R4-T41T-100T/ P70360 (320 Vdc)



R4-T41T-101B-yy-I/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

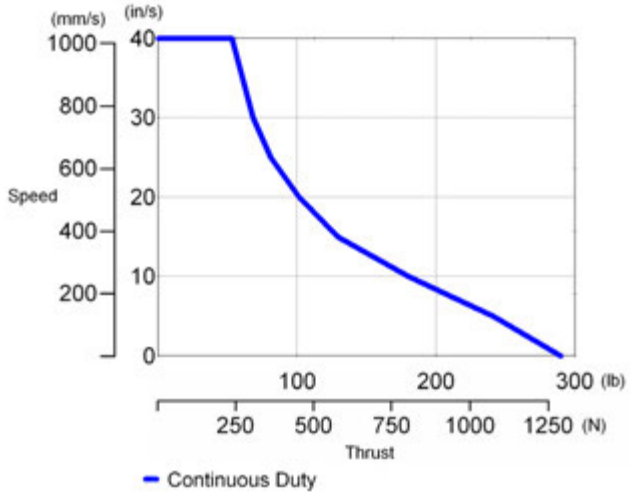
1B	Critical Speed (in/sec)	40	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

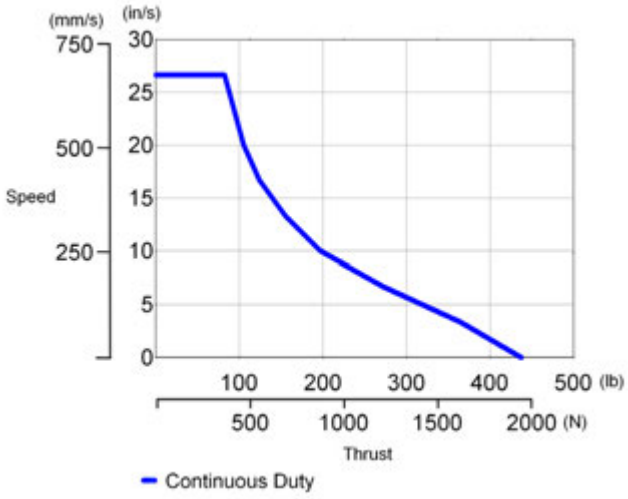
R4 Series Rodless Actuator

Stepper Thrust Speed Curves

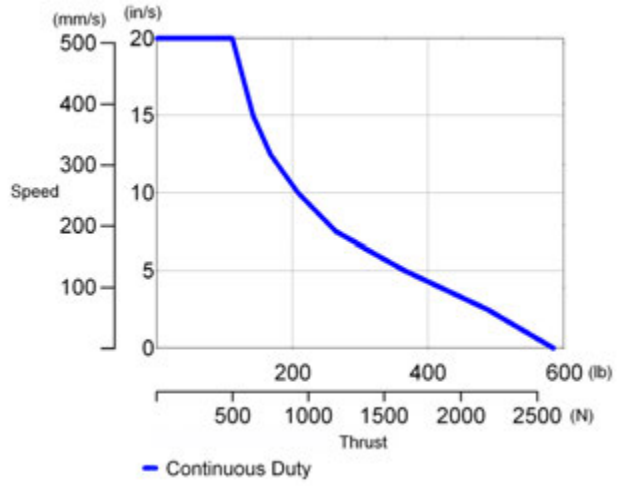
R4-T41T-101B-yy-P/ P70360 (320 Vdc)



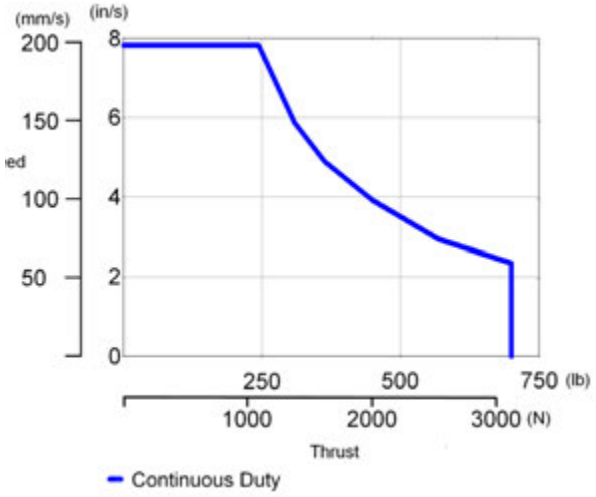
R4-T41T-151B-yy-P/ P70360 (320 Vdc)



R4-T41T-201B-yy-P/ P70360 (320 Vdc)



R4-T41T-501B-yy-P/ P70360 (320 Vdc)



Column Loading and Critical Speed Limits for Screw-driven Configurations

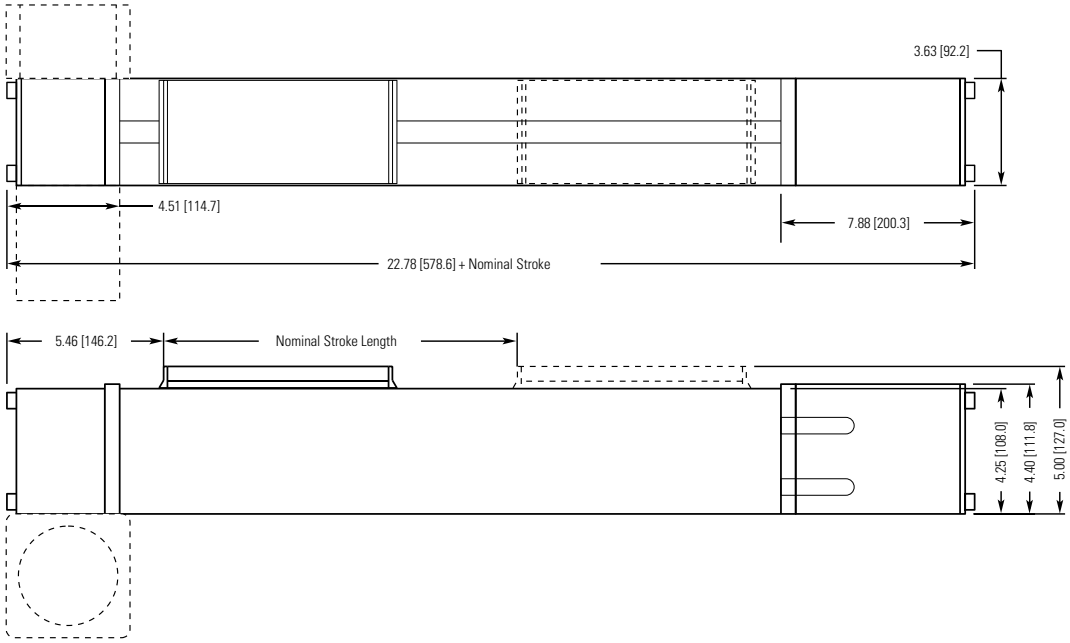
1B	Critical Speed (in/sec)	40	35	28	20	14	11	8.5	6.9
	Stroke (in)	6 - 36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
Column loads listed as "n/a" exceed the maximum force the positioner is rated for.

Notes

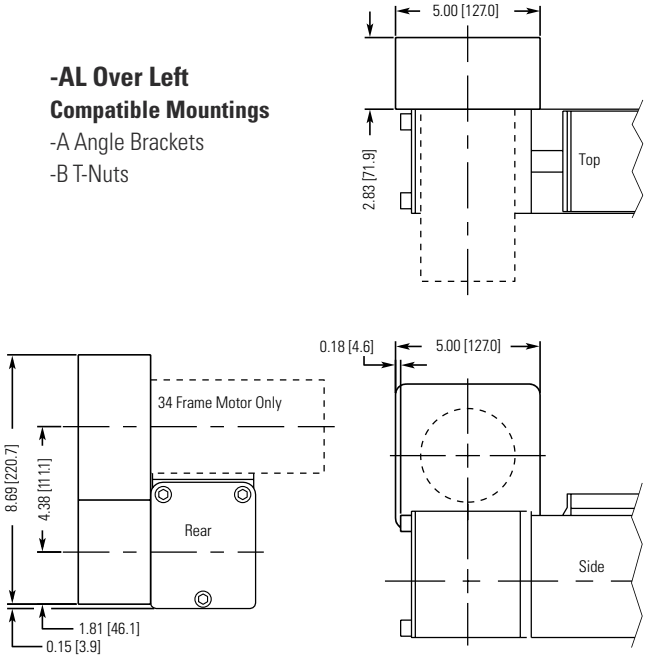
R4 Series Rodless Actuator

Belt Drive Overall Dimensions

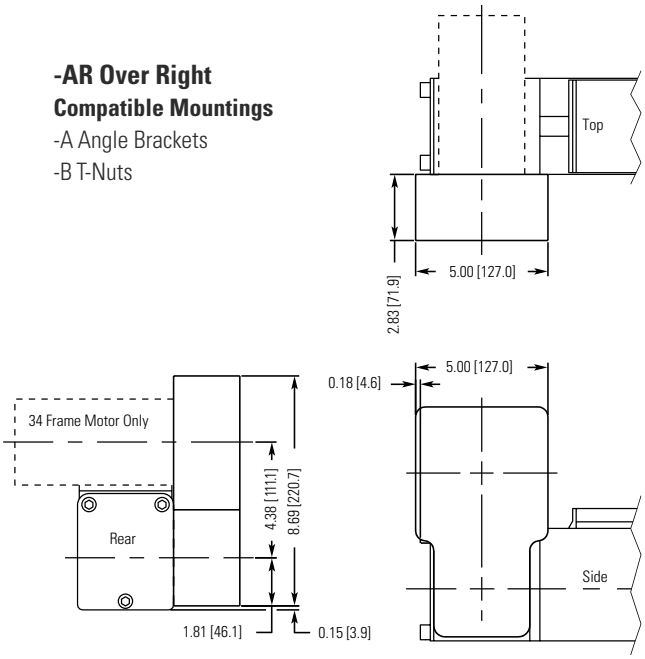


Belt Drive Orientation Options with Dimensions

-AL Over Left
Compatible Mountings
-A Angle Brackets
-B T-Nuts



-AR Over Right
Compatible Mountings
-A Angle Brackets
-B T-Nuts



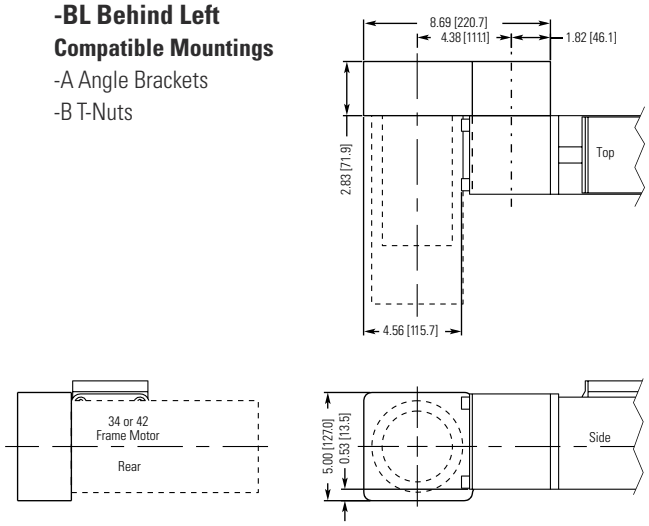
Belt Drive Orientation Options with Dimensions

-BL Behind Left

Compatible Mountings

-A Angle Brackets

-B T-Nuts

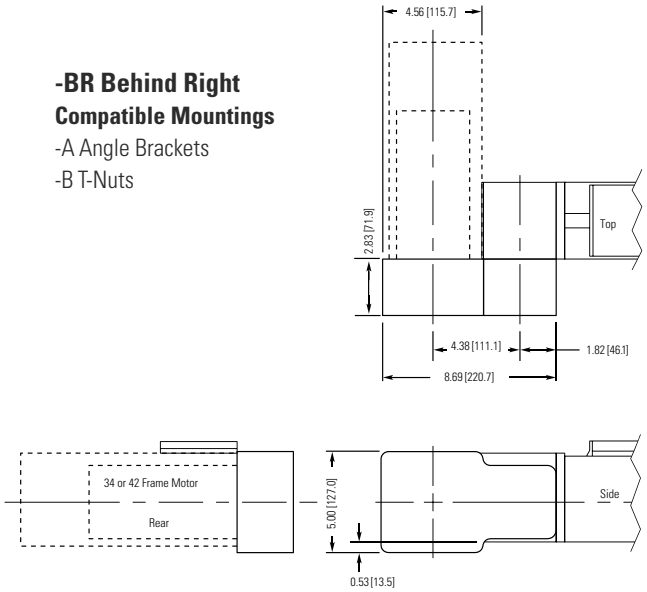


-BR Behind Right

Compatible Mountings

-A Angle Brackets

-B T-Nuts

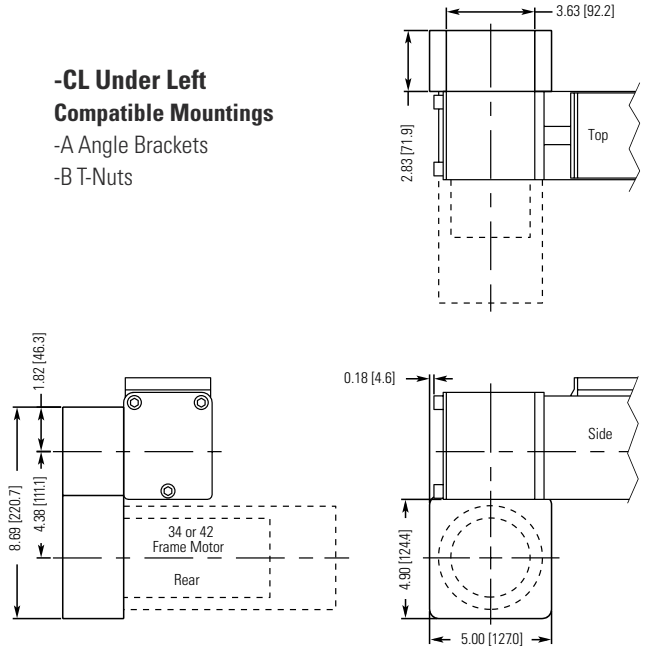


-CL Under Left

Compatible Mountings

-A Angle Brackets

-B T-Nuts

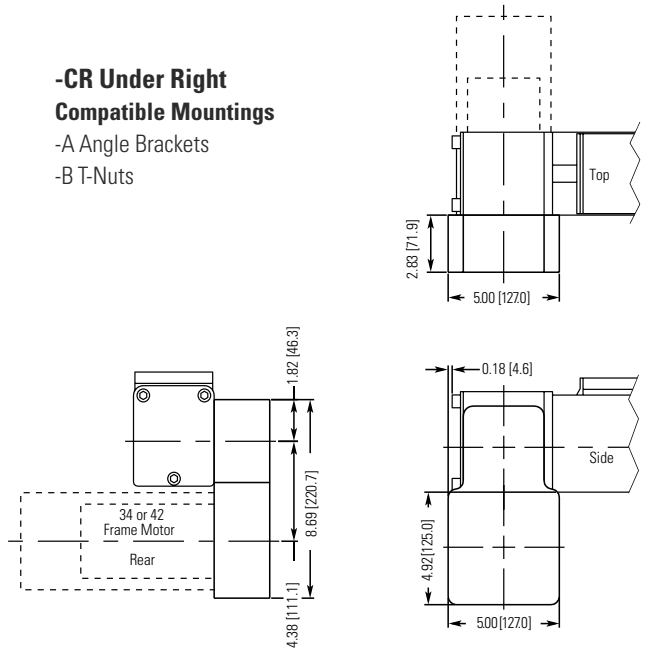


-CR Under Right

Compatible Mountings

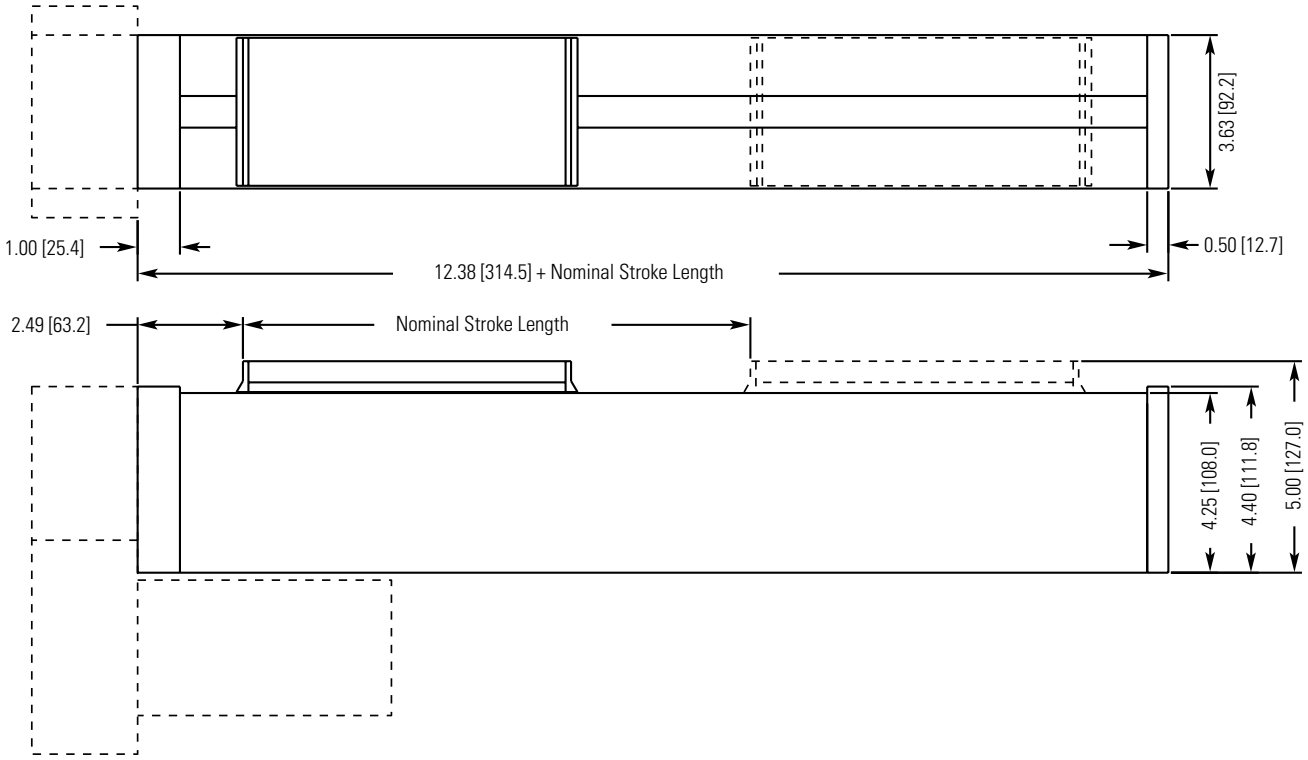
-A Angle Brackets

-B T-Nuts



R4 Series Rodless Actuator

Overall Dimensions Screw Drive

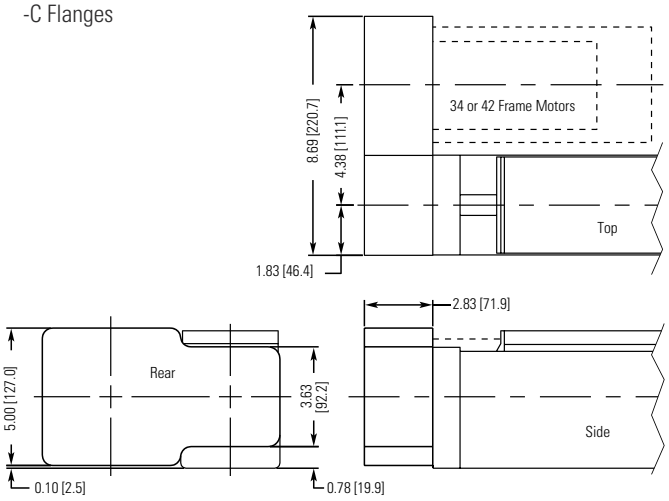


Screw Drive Orientation Options with Dimensions

-PL Parallel Left Side

Compatible Mountings

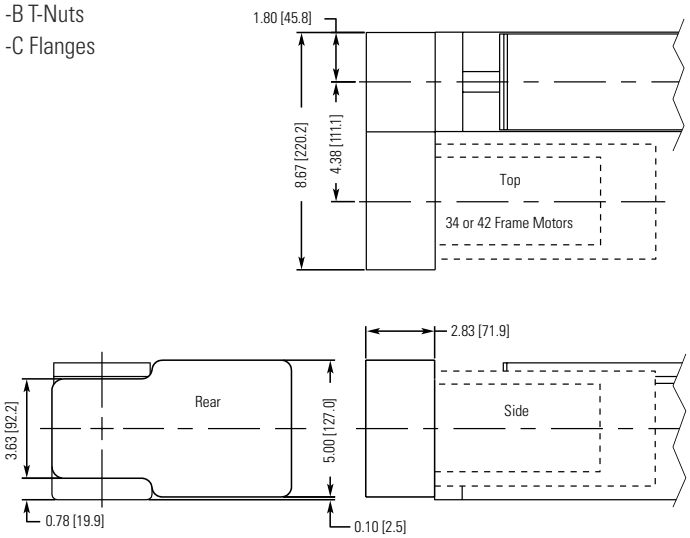
-A Angle Brackets
-B T-Nuts
-C Flanges



-PR Parallel Right Side

Compatible Mountings

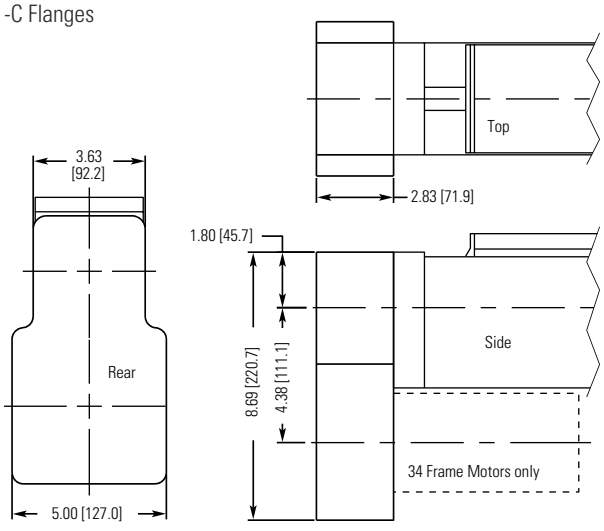
-A Angle Brackets
-B T-Nuts
-C Flanges



-P Parallel Below

Compatible Mountings

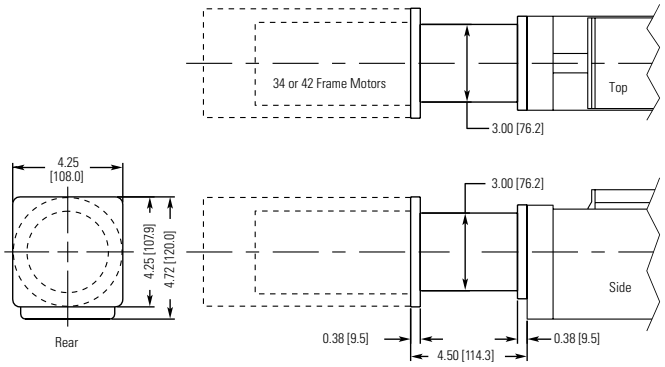
-A Angle Brackets
-B T-Nuts
-C Flanges



-I In-Line

Compatible Mountings

-A Angle Brackets
-B T-Nuts



R4 Series Rodless Actuator

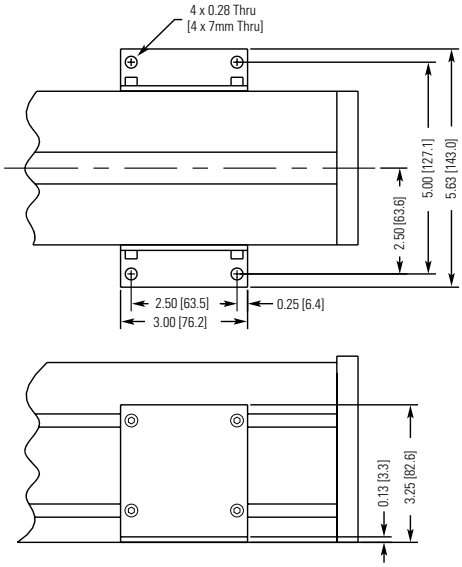
Mounting Option Dimensions

-A Adjustable Angle Brackets

Compatible Motor Orientations

Belt	*Screw*
-AR	-P
-AL	-PR
-BR	-PL
-BL	-I
-CR	
-CL	

Stroke	No. of Angle Brackets
0-18	4
19-36	6
37-48	8
49-72	10
73-108	12

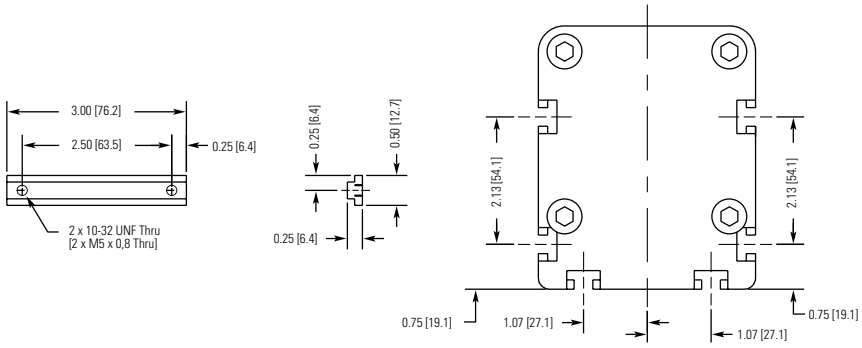


-B Adjustable T-Nuts

Compatible Motor Orientations

Belt	*Screw*
-AR	-P
-AL	-PR
-BR	-PL
-BL	-I
-CR	
-CL	

Stroke	Pairs of T-Nuts
0-18	4
19-36	6
37-48	8
49-72	10
73-108	12

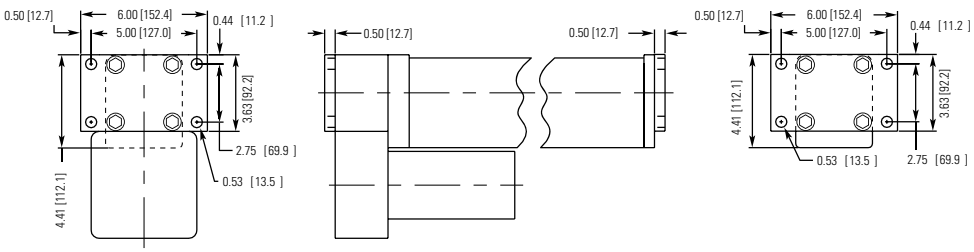


-C Front & Rear Rectangular Flanges

Screw Driven Models Only

Compatible Motor Orientations

Belt	*Screw*
N/A	-P



Carriage Dimensions

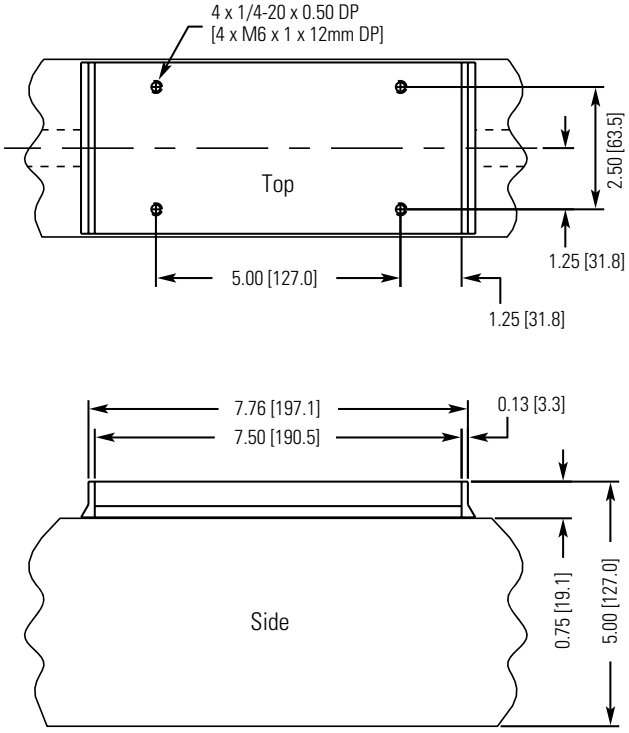
- ❑ S ❑ Single Carriage Option

- ❑ D*nn* ❑ Duel Carriage Option

(nn is the distance between carriage centers.
Omit for screw-driven actuator.)

Increase carriage capacity by supporting the load at two separate locations. For screw-driven actuators, the second carriage is attached to the internal rail bearings, but is not driven by the leadscrew. For belt-driven actuators, the second carriage is attached to the internal rail bearings and is also rigidly fixed to the driven carriage. In this case, the distance between carriage centers needs to be specified in the part number.

- Available actuator travel will be reduced by the distance between carriage centers. The minimum distance between carriage centers is 10 in [250 mm]



R Series Options & Accessories

R Series Options

In addition to mounting styles and motor orientation options as detailed in the outline drawing sections, a number of other options are available.

Screw Mounted Holding Brake (BS24 standard, others are special options)

(When requiring a brake, the motor mounted holding brake is recommended when using an AKM servo motor)

Option	Voltage	Torque (lb-in)		
		R2A	R3	R4
BS24	24 Vdc	20	20	75
BS115	115 Vac	20	20	75
BS230	230 Vac	20	20	75

AKM mounted brake for reference	AKM2x	AKM4x	AKM5x
Torque (lb-in)	12.6	46.9	128

Note: For screw based systems multiply motor brake torque by reducer ratio to determine torque at screw.

Water Resistant Option (R2A special option)

This option provides custom sealing at joints, along with the breather option and accessories as outlined by the VR or VL options.

WR Water resistant seal option right
WL Water resistant seal option left

Lube Port (R3 and R4 special option)

Lubrication ports allow easy re-lubrication of moving parts

GR Lube port, right side
GL Lube port, left side

Breather Vent (R4 special option)

VR Breather vent, fitting, tubing, left side
VL Breather vent, fitting, tubing, right side

Dual Carriage (R3 and R4 standard option)

Dxx Dual carriage (screw driven models only)
xx = center distance between carriages in inches

R Series Accessories

Position Sensors (order separately)

Position sensors are available for indication of stopping position, for changing direction or speed, end-of-travel sensing, etc. End-of-travel limit switches are recommended for all positioners to prevent accidental hard stops. Assume the loss of one inch of travel on each end of the positioner that a sensor is placed.

RPS-1 Mechanical reed switch, open
RPS-2 Mechanical reed switch, closed
RP1 Hall Effect switch (open), 12 ft. cable
RP1-25 Hall Effect switch (open), 25 ft. cable
RP2 Hall Effect switch (closed), 12 ft. cable
RP2-25 Hall Effect switch (closed), 25 ft. cable

Notes

AKD® Servo Drive

Our AKD series is a complete range of Ethernet-based servo drives that are fast, feature-rich, flexible and integrate quickly and easily into any application. AKD ensures plug-and-play commissioning for instant, seamless access to everything in your machine. And, no matter what your application demands, AKD offers industry-leading servo performance, communication options, and power levels, all in a smaller footprint.

This robust, technologically advanced family of drives delivers optimized performance when paired with our best-in-class components, producing higher quality results at greater speeds and more uptime. With Kollmorgen servo components, we can help you increase your machine's overall equipment effectiveness (OEE) by 50%.

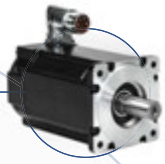
The Benefits of AKD Servo Drive

• Optimized Performance in Seconds	• Auto-tuning is one of the best and fastest in the industry • Automatically adjusts all gains, including observers • Immediate and adaptive response to dynamic loads • Precise control of all motor types • Compensation for stiff and compliant transmission and couplings
• Greater Throughput and Accuracy	• Up to 27-bit-resolution feedback yields unmatched precision and excellent repeatability • Very fast settling times result from a powerful dual processor system that executes industry-leading and patent pending servo algorithms with high resolution • Advanced servo techniques such as high-order observer and bi-quad filters yield industry-leading machine performance • Highest bandwidth torque-and-velocity loops. Fastest digital current loop in the market
• Easy-to-use Graphical User Interface (GUI) for Faster Commissioning and Troubleshooting	• Six-channel real-time software oscilloscope commissions and diagnoses quickly • Multi-function Bode Plot allows users to quickly evaluate performance • Auto-complete of programmable commands saves looking up parameter names • One-click capture and sharing of program plots and parameter settings allow you to send machine performance data instantly • Widest range of programming options in the industry
• Flexible and Scalable to Meet any Application	• 3 to 48 Arms continuous current; 9 to 96 Arms peak • Very high power density enables an extremely small package • True plug-and-play with all standard Kollmorgen servo motors and actuators • Supports a variety of single and multi-turn feedback devices—Smart Feedback Device (SFD), EnDat2.2, 01, BiSS, analog Sine/Cos encoder, incremental encoder, HIPERFACE®, and resolver • Tightly integrated Ethernet motion buses without the need to add large hardware: EtherCAT®, SynqNet®, Modbus® TCP, EtherNet/IP™, PROFINET® RT, SERCOS® III, and CANopen® • Scalable programmability from base torque-and-velocity through multi-axis master

AKD® Servo Drive

The AKD servo drive delivers cutting-edge technology and performance with one of the most compact footprints in the industry. These feature-rich drives provide a solution for nearly any application, from basic torque-and-velocity applications, to indexing, to multi-axis programmable motion with embedded Kollmorgen Automation Suite™. The versatile AKD sets the standard for power density and performance.

AKMH™ Hygienic Stainless Steel Motors



AKM® 2G Servo Motors

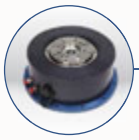
Frameless Brushless Direct Drive Motors

AKD®-N Decentralized Servo Drive

Control of motors with AKD® PDMM programmable multi-axis master

Cartridge DDR® Motors

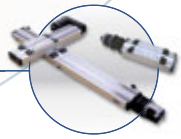
AKD® Servo Drive



Housed DDR® Motors

Direct Drive Linear Motors

Linear Actuators



Multi-Axis Precision Tables

Best-in-Class Components

AKD works seamlessly with Kollmorgen motors and actuators–well-known for quality, reliability, and performance.

Industry-leading power density

General Specifications

120 / 240 Vac 1 & 3 Phase (85 -265 V)	Continuous Current (Arms)	Peak Current (Arms)	Drive Continuous Output Power Capacity (Watts)	Internal Regen (Watts) (Ohms)		Height mm (in)	Width mm (in)	Depth mm (in)	Depth with Cable Bend Radius mm (in)
AKD-x00306	3	9	1100	0	0	168 (6.61)	59 (2.32)	156 (6.14)	184 (7.24)
AKD-x00606	6	18	2000	0	0	168 (6.61)	59 (2.32)	156 (6.14)	184 (7.24)
AKD-x01206	12	30	4000	100	15	196 (7.72)	78 (3.07)	187 (7.36)	215 (8.46)
AKD-x02406	24	48	8000	200	8	247 (9.72)	100 (3.94)	228 (8.98)	265 (10.43)

240/480 Vac 3 Phase (187-528 V)	Continuous Current (Arms)	Peak Current (Arms)	Drive Continuous Output Power Capacity (Watts)	Internal Regen (Watts) (Ohms)		Height mm (in)	Width mm (in)	Depth mm (in)	Depth with Cable Bend Radius mm (in)
AKD-x00307	3	9	2000	100	33	256 (10.08)	70 (2.76)	185 (7.28)	221 (8.70)
AKD-x00607	6	18	4000	100	33	256 (10.08)	70 (2.76)	185 (7.28)	221 (8.70)
AKD-x01207	12	30	8000	100	33	256 (10.08)	70 (2.76)	185 (7.28)	221 (8.70)
AKD-x02407	24	48	16,000	200	23	306 (12.01)	105 (4.13)	228 (8.98)	264 (10.39)
AKD-x04807	48	96	35,000	–	–	385 (15.16)	185 (7.28)	225 (8.86)	260 (10.23)

Note: For complete AKD model nomenclature, refer to page 122.

AKM® Servo Motor

Kollmorgen's AKM family of servo motors gives you unprecedented choice and flexibility from a wide range of standard products so you can select the best servo motor for your application. By pairing AKM servo motors with our family of plug-and-play AKD® servo drives, selecting the right motion control products has never been easier. Pick from thousands of servo motor/servo drive combinations outlined in this selection guide or go to our website to find the best solution for your application.

Standard AKM servo motors and AKD servo drives offer the best of both worlds – the exact specifications of a custom solution with the faster delivery times and lower cost of a standard catalog product. For your truly unique motion control applications, work with our engineering team to customize a solution for your machine design. Either way, standard product or customized, we can help you choose the motion control solution that meets your exact requirements.

The Benefits of AKM® Servo Motor

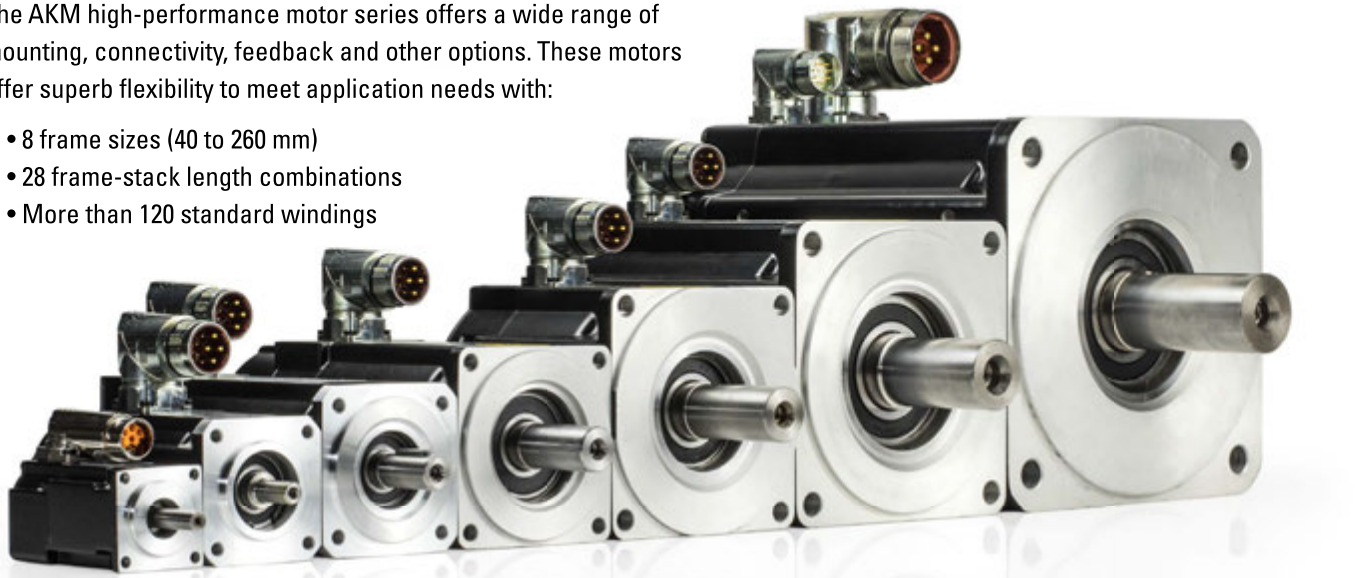
• Best-in-Class Performance	• Industry-leading motor power density • Same size AKM/AKD system delivers up to 47% more shaft power • Compensation for stiff and compliant transmissions and couplings • Exceptionally low cogging
• Flexibility to Find an Exact-fit Solution in a Standard Product	• AKM offers 28 frame-stack combinations and 120 standard windings in a single motor line • 4.8 million possible AKM part number combinations and growing • Simplifies or eliminates mechanical modifications and engineering adaptation • Available with single cable technology with digital feedback (Digital Resolver SFD3 or HIPERFACE® DSL) • Washdown and Food Grade options for AKM • Higher torque models up to 180 Nm of continuous torque
• Ease-of-Use and Faster Commissioning	• Plug-and-play motor recognition drive commissioning • Reduce cycle time and sensor-and-wiring costs by eliminating traditional homing methods • Reduction in set-up time for each servo system

AKM® Servo Motor Series

AKM Motors Offer Extremely High Torque Density and High Acceleration

The AKM high-performance motor series offers a wide range of mounting, connectivity, feedback and other options. These motors offer superb flexibility to meet application needs with:

- 8 frame sizes (40 to 260 mm)
- 28 frame-stack length combinations
- More than 120 standard windings



Features

Torque
0.16 to 180 Nm continuous stall torque (1.4 to 1590 lb-in) in 28 frame/stack combinations. Specific torques are often available from multiple frame sizes to optimize mounting and inertia matching capabilities.

Speed
Speeds up to 8000 rpm meet high speed application requirements. Windings tailored to lower speeds are also available.

Voltage
AKM motors can be applied to all standard global voltages. Windings are specifically tailored to work with drives powered by 75 Vdc, 120, 240, 400 or 480 Vac.

Mounting
Multiple mounting standards are available to meet common European, North American, and Japanese standards.

Feedback
AKM motors include resolver, encoder (commutating), Sine-Absolute encoder or SFD (Smart Feedback Device) feedback options to meet specific application requirements.

Smoothness
Smooth performance results from low-cog, low-harmonic distortion magnetic designs.

Connectivity
Rotatable IP65 connectors, straight IP67 connectors or low cost IP20 Molex plugs are both available to provide flexibility. Single connectors/plugs (combined power and feedback) are also available to minimize motor and cable cost (SFD and DSL only).

Thermal
Windings are rated conservatively at 100°C rise over a 40°C ambient while using 155°C (class F) insulation materials. Motors meet applicable UL, CSA, and CE requirements and include thermistors.

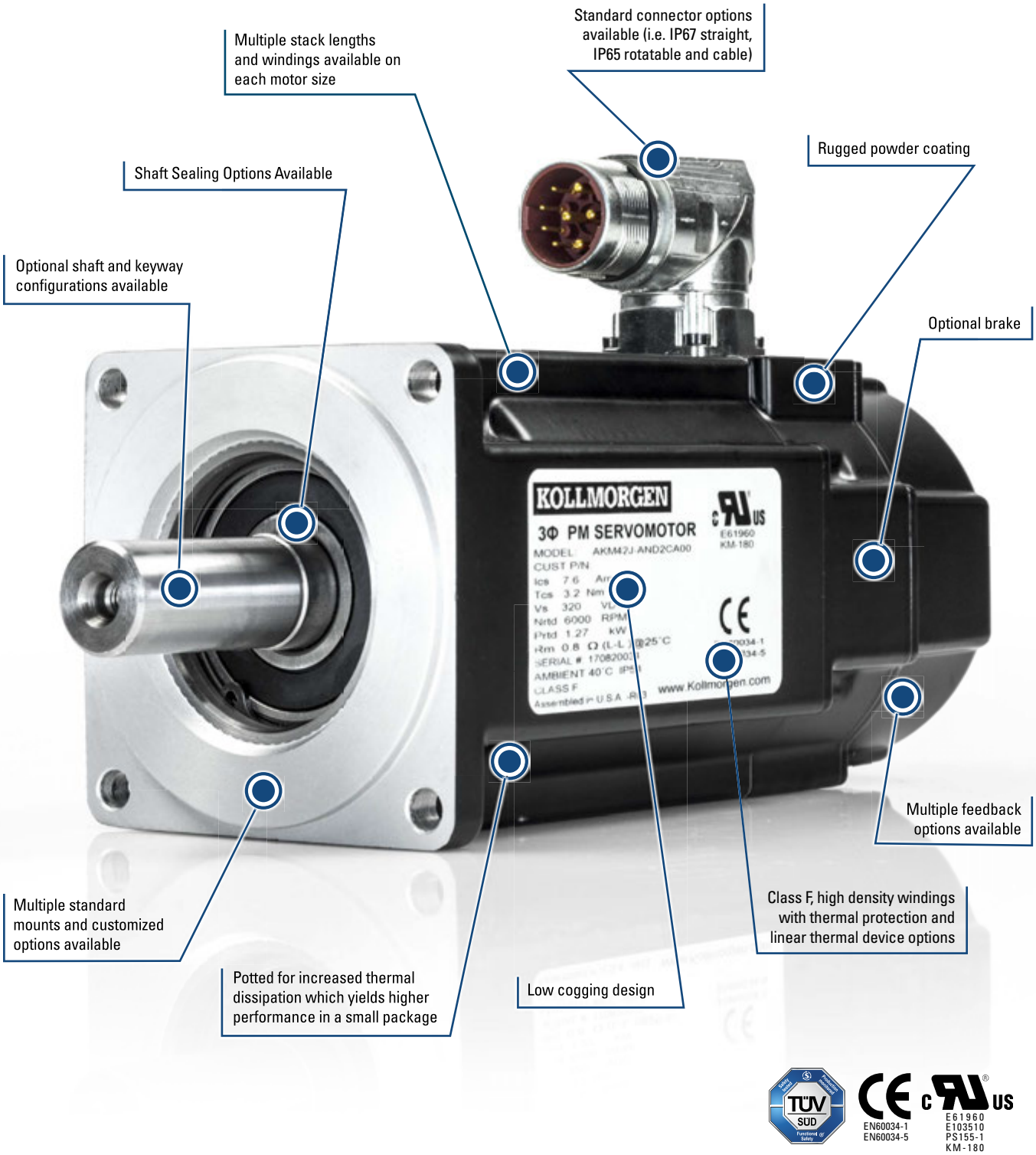
Additional Options:

- Holding Brakes
- Shaft sealing options available
- Feedback devices
- Shaft and mounting variations
- Custom windings
- Connectivity

Kollmorgen Cables Offer the Complete Solution

Kollmorgen offers complete cable solutions for connecting drives and motors. This includes static, low cost cable sets for simple applications to high bend, high flex, hybrid cables that combine feedback and power in one cable. Not sure which cable offering would best suit your needs? No problem. Kollmorgen Customer Support is available to discuss cable options and what makes the most sense for your machine.

Kollmorgen AKM Configurable Servo Motor Features



EN60034-1
EN60034-5
E61960
E103510
PS155-1
KM-180

AKM® Brushless Servo System Specifications

AKM11, 13, and 23 Servo Motor Performance with AKD Servo Drive

AKM Servo Motor	AKM11B 120/240 Vac	AKM13C 120/240 Vac	AKM23D 120/240 Vac
Servo Drive	**AKD**	**AKD**	**AKD**
Drive [Ic/Ip] Arms	3.0 / 9.0	3.0 / 9.0	3.0 / 9.0
Feedback Type	SFD	SFD	SFD
T Cont Stall [lb-in (Nm)]	1.62 (0.183)	3.62 (0.409)	10.3 (1.16)
T Peak Stall [lb-in (Nm)]	6.26 (0.707)	15.3 (1.73)	34.0 (3.84)
RPM Max 240 Vac	8000	8000	6540
Drive	AKD-x00306	AKD-x00306	AKD-00306
Motor	AKM11B-CNC	AKM13C-CNC	AKM23D-BNC
Motor/Brake	–	–	AKM23D-B2C
Value Line Cables*			
Power	VP-507BEAN-xx-x	VP-507BEAN-xx-x	VP-507BEAN-xx-x
Power/Brake	VF-DA0474N-xx-x	VF-DA0474N-xx-x	VP-508CFAN-xx-x
SFD Feedback	VF-RA2474N-xx-x	VF-RA2474N-xx-x	VF-DA0474N-xx-x
Resolver Feedback	–	–	VF-RA2474N-xx-x
Sine Encoder Feedback	–	–	VF-SB4474N-xx-x

*Value Line Cables are not suitable for flexing applications. For flexing applications request information about Performance Line Cables. Cable part number suffix xx-x indicates cable length in meters. Example: suffix 03-0 equals 3.0 meters. Available lengths include 1.0, 3.0, 6.0, 9.0, or 12.0 meters.

AKM11, 13, and 23 Mechanical Specifications

	AKM11	AKM13	AKM23
Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on SFD)	1.5E-5 (0.0169)	4.0E-5 (0.045)	0.00019 (0.22)
Brake Inertia [lb-in-s^2 (kg-cm^2)] (additional)	–	–	0.000011 (0.012)
Motor Weight [lb (kg)]	0.77 (0.35)	1.4 (0.63)	3.0 (1.38)

AKM1X

AKM23

AKM42 and 52 Servo Motor Performance with AKD Servo Drive

AKM Servo Motor	AKM42G 120/240 Vac	AKM52H 120/240 Vac	AKM52H 400/800 Vac
Servo Drive	**AKD**	**AKD**	**AKD**
Drive [Ic/Ip] Arms	6.0 / 18.0	6.0 / 18.0	6.0 / 18.0
Feedback Type	SFD	SFD	SFD
T Cont Stall [lb-in (Nm)]	31.2 (3.53)	75.0 (8.48)	75.0 (8.48)
T Peak Stall [lb-in (Nm)]	97.0 (11.0)	191 (21.6)	191 (21.6)
RPM Max 240 Vac	4460	2390	4780
Drive	AKD-x00606	AKD-x00606	AKD-x00607
Motor	AKM42G-BNC	AKM52H-BNC	AKM52H-BNC
Motor/Brake	AKM42G-B2C	AKM52H-B2C	AKM52H-B2C
Value Line Cables*			
Power	VP-507BEAN-xx-x	VP-507BEAN-xx-x	VP-507BEAN-XX-X
Power/Brake	VP-508CFAN-xx-x	VP-508CFAN-xx-x	VP-508CFAN-XX-X
SFD Feedback	VF-DA0474N-xx-x	VF-DA0474N-xx-x	VF-DA0474N-XX-X
Resolver Feedback	VF-RA2474N-xx-x	VF-RA2474N-xx-x	VF-RA2474N-XX-X
Sine Encoder Feedback	VF-SB4474N-xx-x	VF-SB4474N-xx-x	VF-SB4474N-XX-X

*Value Line Cables are not suitable for flexing applications. For flexing applications request information about Performance Line Cables. Cable part number suffix xx-x indicates cable length in meters. Example: suffix 03-0 equals 3.0 meters. Available lengths include 1.0, 3.0, 6.0, 9.0, or 12.0 meters.

AKM42 and 52 Mechanical Specifications

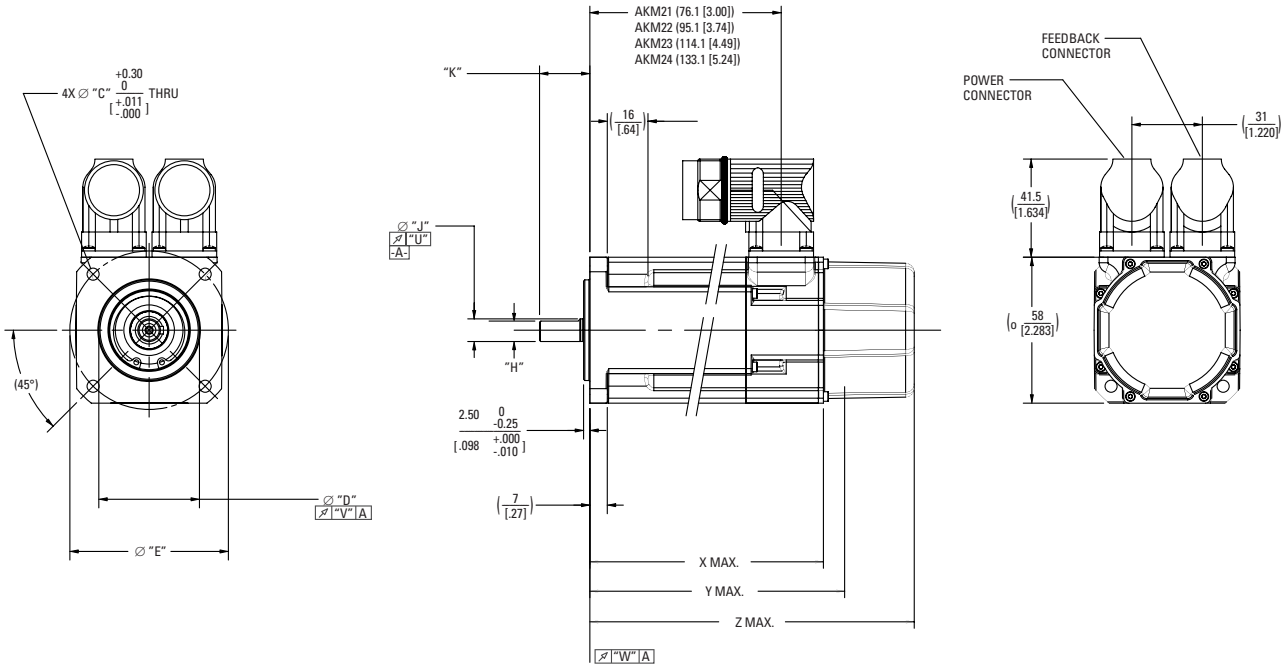
	AKM42	AKM52
Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on SFD)	0.0013 (1.5)	0.0055 (6.2)
Brake Inertia [lb-in-s^2 (kg-cm^2)] (additional)	0.00006 (0.068)	0.00015 (0.17)
Motor Weight [lb (kg)]	7.5 (3.39)	12.8 (5.8)

AKM42

AKM52

AKM Brushless Servo System Specifications

AKM2x Frame Outline Drawings



AKM2x Frame Dimensions

Mounting Flange-Shaft	"C"	"D"	"E"	"H"	"J"	"K"	"U"	"V"	"W"
EF	5.10 [0.201]	38.10 [1.500]	66.68 [2.625]	8.64 [0.340]	9.525 [0.3750]	20.57 [0.810]	0.051 [0.0020]	0.10 [0.004]	0.10 [0.004]

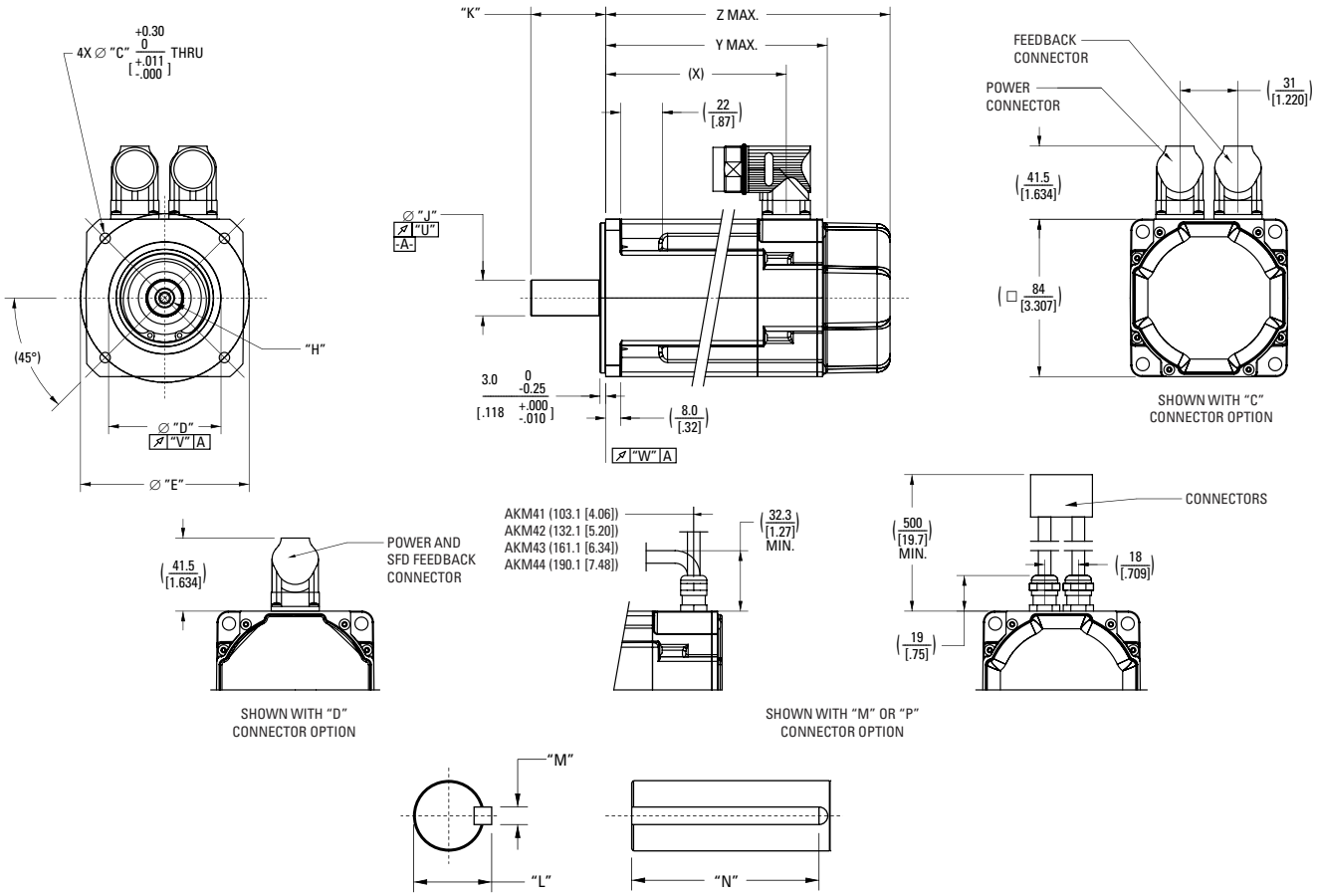
(X MAX) ("C" Connector Option W/ Resolver)	Y MAX	Z MAX (W/ BRAKE)	MODEL
86.2 [3.39]	95.4 [3.76]	129.5 [5.10]	AKM21
105.2 [4.14]	114.4 [4.50]	148.5 [5.85]	AKM22
124.2 [4.89]	133.4 [5.25]	167.5 [6.59]	AKM23
143.2 [5.64]	152.4 [6.00]	186.5 [7.34]	AKM24

Dimensions are in mm [inches].

*Complete AKM series model nomenclature can be found on page 123.

AKM® Brushless Servo System Specifications

AKM4x Frame Outline Drawings



AKM4x Frame Dimensions

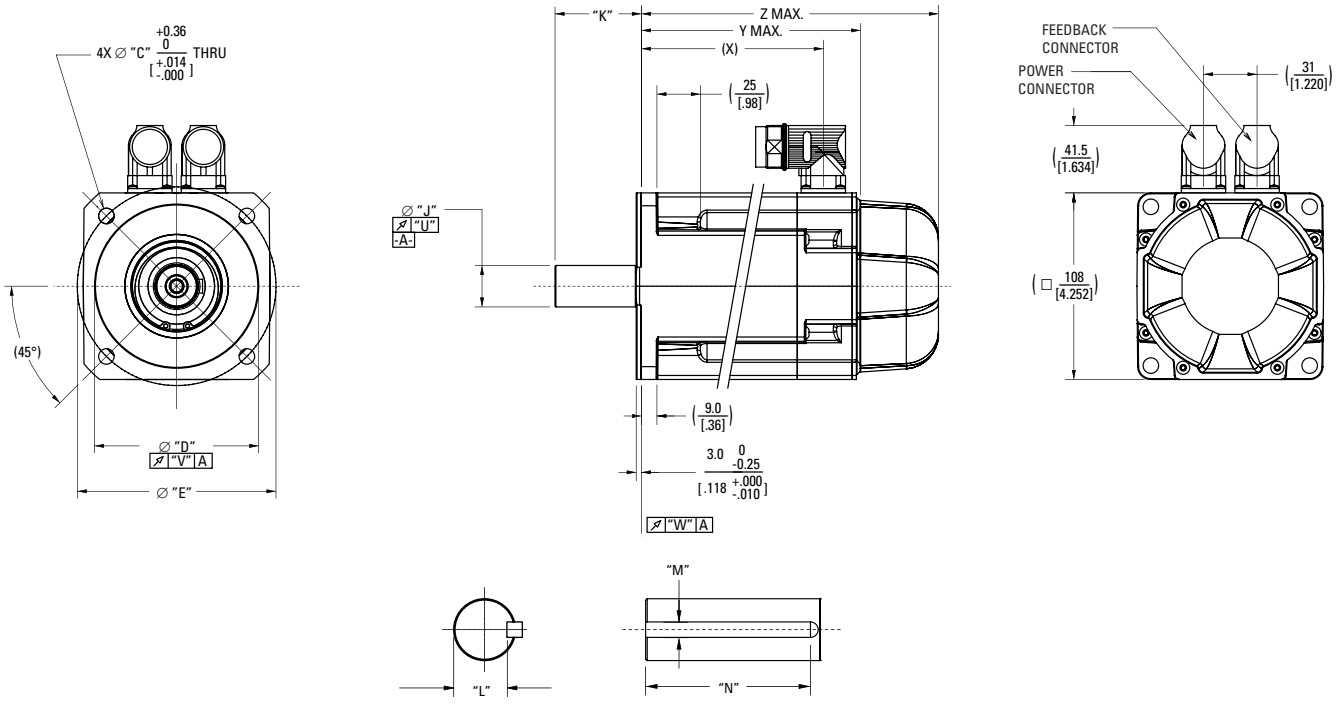
Mounting Flange-Shaft	"C"	"D"	"E"	"H"	"J"	"K"	"L"	"M"	"N"	"U"	"V"	"W"
EK	5.54 [0.218]	73.025 [2.8750]	98.43 [3.875]	–	12.700 [0.5000]	31.75 [1.250]	14.09 [0.555]	3.175 [0.1250]	19.05 [0.750]	0.051 [0.0020]	0.10 [0.004]	0.10 [0.004]

(X)	Y MAX	Z MAX (W/ BRAKE)	MODEL
96.4 [3.80]	118.8 [4.68]	152.3 [6.00]	AKM41
125.4 [4.94]	147.8 [5.82]	181.3 [7.14]	AKM42
154.4 [6.08]	176.8 [6.96]	210.3 [8.28]	AKM43
183.4 [7.22]	205.8 [8.10]	239.3 [9.42]	AKM44

Dimensions are in mm [inches].
Product designed in metric.
English conversions provided for reference only.

AKM Brushless Servo System Specifications

AKM5x Frame Outline Drawings



AKM5x Frame Dimensions

Mounting Flange-Shaft	"C"	"D"	"E"	"J"	"K"	"L"	"M"	"N"	"U"	"V"	"W"
EK	8.33 [0.328]	55.563 [2.1874]	125.73 [4.950]	15.875 [0.625]	44.45 [1.75]	13.16 [0.518]	4.737 [0.1865]	34.9 [1.375]	0.051 [0.0020]	0.10 [0.004]	0.10 [0.004]

Z MAX SINE ENCODER (NO BRAKE)	Z MAX SINE ENCODER (W/ BRAKE)	(X)	Y MAX	Z MAX (W/ BRAKE)	MODEL
146.0 [5.75]	189.0 [7.44]	105.3 [4.15]	127.5 [5.02]	172.5 [6.79]	AKM51
177.0 [6.97]	220.0 [8.66]	136.3 [5.37]	158.5 [6.24]	203.5 [8.01]	AKM52

Dimensions are in mm [inches].
Product designed in metric.
English conversions provided for reference only.

*Complete AKM series model nomenclature can be found on page 123.

Notes

P7000 Stepper Drive-Controller

P7000 stepper drives offer a unique level of system functionality, smoothness, high-speed performance and innovation unmatched in the industry.

The compact P7000 is designed to power Kollmorgen step motors ranging from NEMA size 17 up to NEMA size 42. Two power configurations are available for operation directly from AC power, or from a DC power supply.

There are two levels of control offered. The basic drive accepts step and direction inputs. P7000 drives are also available with an integrated position controller (-PN option). The drives are configured by either on-board dip switches, or with the P7000 tools software.

Advanced P7000 Features Make it the Best Choice to Meet Your Application Requirements

Multistepping™

Also known as auto-smoothing. The P7000 drive accepts full step pulse commands from the indexer and inserts fine micro-steps to smooth coarse low speed motion. This allows you to significantly upgrade machine performance without having to redesign machine control architecture.

Auto-Tuning

Advanced current auto-tuning techniques provide outstanding low-speed smoothness. The P7000 senses the motor's characteristics and automatically fine tunes itself to meet your high-performance needs. This reduces installation and set-up time.

Mid-Band Anti-Resonance Control

Reduces negative effects of mechanical resonance, allowing you to get more out of a smaller motor and virtually eliminating nuisance stalls and machine downtime.

Idle Current Reduction

If you do not require the motor's full torque to hold a load at rest, you can select the right amount of current (torque) to reduce motor heating and power consumption. This increases the life of the system.

Dynamic Smoothing

Quasi-S-curve algorithm reduces jerk, especially upon acceleration. Increases mechanical life of the machine and reduces energy consumption.

Intelligent Indexing Option (-PN)

Wizard-like P7000 helps you to develop and link motion tasks such as homing and conditional and unconditional indexing. You can be up-and-running quickly.

Modbus RTU Compatible

The intelligent indexing option (-PN) supports Modbus RTU to control motion with an external interface device. External interfaces make controlling motion simple for machine operators.

P7000 Tools

The position node option allows you to configure up to 63 absolute or relative moves. You can specify the moves' distance, acceleration, velocity, and deceleration rates, or simply specify the distance and total time for the move – P7000 will perform the calculations automatically.

Specifications	Units	P70530	P70360
Input voltage range	Volts	20 - 75 Vdc	120 or 240 Vac
Continuous current	Amps rms	5	2.5
Microstep peak current	Amps peak	7.1	3.5

Note: For complete P7000 Series model nomenclature, refer to page 124.

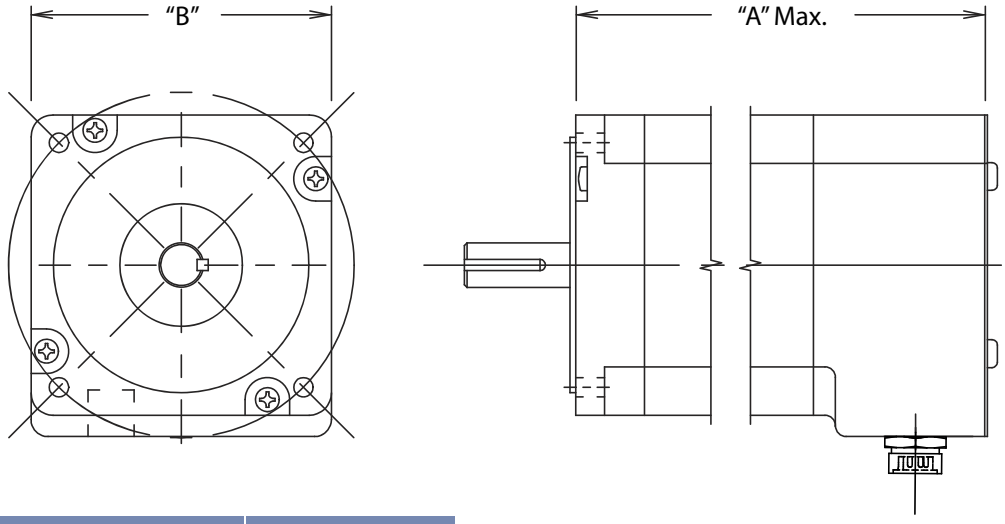
Stepper Motor System Specifications

T22, T31, T32, T41 Stepper System Performance with P70360

Motor	System Voltage [Vdc]	Continuous Current [Arms]	Continuous Torque [lb-in (Nm)]	Nmax. [rpm]	Motor Inertia [lb-in-s^2 (kg-cm^2)]	Motor Weight [lb (kg)]
CTP12	24	1.0	3.73 (0.422)	1800	6.2E-5 (0.070)	0.75 (0.34)
	36		4.02 (0.454)	2400		
T22V	160	1.5	17.5 (1.98)	3000	0.000350 (0.395)	2.2 (1.0)
T22T	320	0.77				
T31V	160	2.8	40.2 (4.54)	3000	0.00127 (1.43)	5.0 (2.27)
T31T	320	1.4				
T32V	160	3.2	74.7 (8.44)	3000	0.00237 (2.68)	8.42 (3.82)
T32T	320	1.6				
T41T	320	2.8	101 (11.4)	3000	0.00489 (5.52)	11.0 (5.0)

Cables options:
See R series nomenclature page 121 for details about cable availability defined within positioner part number.

Typical Stepper Motor Frame Dimensions



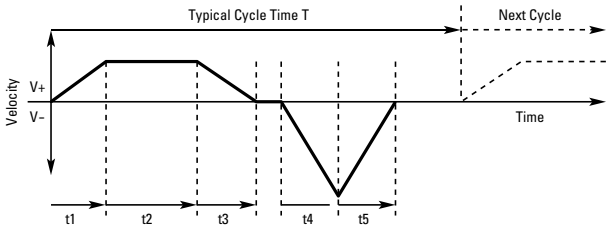
Model	Square dimension "B" [in (mm)]	"A" [in (mm)]
CTP12	1.68 (42.67)	1.90 (48.3)
T22	2.240 (56.90)	3.60 (77.72)
T31	3.38 (85.85)	4.44 (112.8)
T32	3.38 (85.85)	5.96 (151.4)
T41	4.325 (109.9)	5.20 (132.1)

Linear Sizing Calculations

Move Profile

Rotary and linear actuator selection begins with the calculation of speed, thrust and torque requirements. In order to determine the torque required, the acceleration of the mass being moved must be calculated. A **"move profile"**, or a **plot of load velocity vs. time,** is sketched in order to simplify the **peak acceleration** and **peak velocity** calculations.

Typical Machine Cycle



(1) Total distance, $$d_{tot} = v_{MAX}\left[\frac{t_1}{2} + t_2 + \frac{t_3}{2}\right]$$

(2) Max velocity, $$v_{MAX} = \frac{d_{tot}}{\left(\frac{t_1 + t_3}{2}\right) + t_2}$$

(3) Acceleration, $$a = \frac{v_{MAX}}{t_{ACCEL}}$$

The figure above is an example of a typical machine cycle, and is made up of two Move Profiles; the first is an example of a **trapezoidal profile,** while the second is a **triangular profile.** The horizontal axis represents time and the vertical axis represents velocity (linear or rotary). The load accelerates for a time (t_1), has a constant velocity or slew section (t_2), and decelerates to a stop (t_3). There it dwells for a time, accelerates in the negative direction (t_4), and decelerates back to a stop (t_5) without a slew region. The equations needed to calculate Peak Velocity and Acceleration for a general trapezoidal profile are shown in the figure. A triangular profile can be thought of as a trapezoidal profile where $t_2 = 0$.

The Move Profile sketch contains some important information:

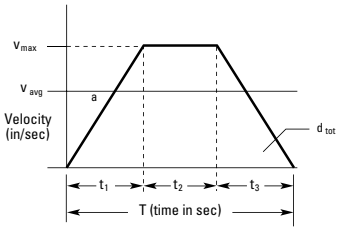
- **Peak acceleration** is the steepest slope on the curve, in this case during t_4 or t_5.
- **Maximum velocity** is at the highest or lowest point over the entire curve, here at the peak between t_4 and t_5.
- **Distance** is equal to the area under the curve. Area above the time axis represents distance covered in the positive direction, while negative distance falls below this axis. The distance equation (1) is just a sum of the areas of two triangles and a rectangle.

Trapezoidal and Triangular Profiles

A couple of assumptions can greatly simplify the general equations. For the Trapezoidal profile we assume $t_1=t_2=t_3$, and for the Triangular we assume $t_3=t_4$. Substituting these assumptions into equations (2) and (3) yields the equations shown in the figure below.

For a given distance (or area), a triangular profile requires lower acceleration than the trapezoidal profile. This results in a lower thrust requirement, and in turn, a smaller motor. On the other hand, the triangular profile's peak speed is greater than the trapezoidal, so for applications where the motor speed is a limiting factor, a trapezoidal profile is usually a better choice.

Trapezoidal Move Profile



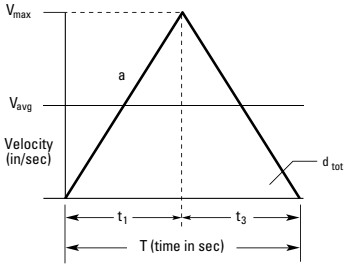
$$v_{AVE} = \frac{d_{tot}}{t_{tot}}$$

$$t_1 = t_2 = t_3 = \frac{t_{tot}}{3}$$

$$v_{MAX} = 1.5\,\frac{d_{tot}}{t_{tot}} = 1.5\,v_{AVE}$$

$$a = 4.5\,\frac{d_{tot}}{(t_{tot})^2}$$

Triangular Move Profile



$$v_{AVE} = \frac{d_{tot}}{t_{tot}}$$

$$t_1 = t_3 = \frac{t_{tot}}{2} \qquad t_2 = 0$$

$$v_{MAX} = \frac{2d_{tot}}{t_{tot}} = 2\,v_{AVE}$$

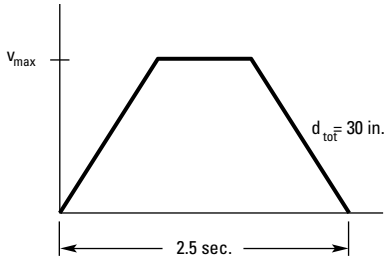
$$a = \frac{4d_{tot}}{(t_{tot})^2} = \frac{2v_{MAX}}{t_{tot}}$$

Move Profile

Example 1

Calculate the peak acceleration and velocity for an object that needs to move 30 inches in 2.5 seconds. Assume a Trapezoidal Profile.

Solution



$$v_{AVE} = \frac{30\text{ in}}{2.5\text{ sec}} = 12\text{ in/sec}$$

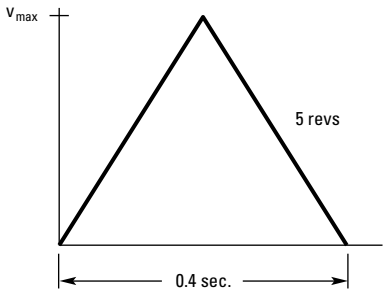
$$v_{MAX} = 1.5\ \frac{d_{tot}}{t_{tot}} = 18\text{ in/sec}$$

$$a = 4.5\ \frac{d_{tot}}{(t_{tot})^2} = 21.6\text{ in/sec}^2$$

Example 2

Calculate, in radians/sec, the peak acceleration and velocity for an cylinder that needs to move 5 revolutions in 0.4 seconds. Assume a Triangular Profile.

Solution



$$d_{tot} = \frac{5\text{ revs} \times 2\pi\text{ rad}}{\text{rev}} = 31.42\text{ rad}$$

$$v_{AVE} = \frac{31.42\text{ rad in}}{0.4\text{ sec}} = 78.55\ \frac{\text{rad}}{\text{sec}}$$

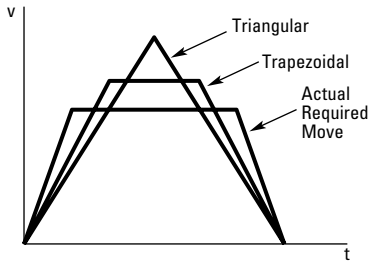
$$v_{MAX} = 2\ v_{AVE} = 157.1\ \frac{\text{rad}}{\text{sec}}$$

$$a = 4\ \frac{d_{tot}}{T^2} = 785.5\ \frac{\text{rad}}{\text{sec}^2}$$

Example 3

This is an example of a case when triangular and trapezoidal move profiles are not adequate approximations. Assume a maximum positioner speed is 6 inches/sec. Sketch a move profile that will complete a 10 inch move in 2 seconds. What is the minimum allowable acceleration rate in inches/sec^2?

Solution



Triangular

$$v_{AVE} = \frac{10\text{ in}}{2\text{ sec}} = 5\text{ in/sec}$$

$v_{MAX} = 2 \times v_{AVE} = 10$ in/sec ($v_{MAX} > 6$ in/sec – too fast)

Trapezoidal

$v_{MAX} = 1.5 \times v_{AVE} = 7.5$ in/sec ($v_{MAX} > 6$ in/sec – too fast)

These are too fast, so we need to find t_1 as follows:

Required Profile

$$d_{tot} = v_{MAX}\ \left(\frac{(t_1 + t_3)}{2} + t_2 \right)$$

$$\frac{d}{v_{MAX}} = \left(\frac{(t_{tot} - t_2)}{2} \right) + t_2 = \frac{t_{tot}}{2} + \frac{t_2}{2}$$

solving for t_2,

$$t_2 = \left(\frac{d_{tot}}{v_{MAX}} - \frac{t_{tot}}{2} \right) \times 2 = \left(\frac{10\text{ in}}{6\text{ in/sec}} - \frac{2\text{ sec}}{2} \right) \times 2$$

$$t_2 = 1.33\text{ sec}$$

Now assume $t_1 = t_3$, so

$$t_1 = (t_{tot} - t_2)/2 = 0.33\text{ sec.}$$

Finally, calculate acceleration

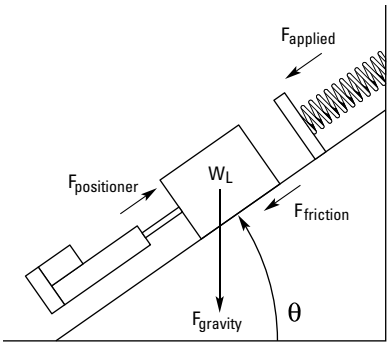
$$a = \frac{v_{MAX}}{t_1} = \frac{6\text{ in/sec}}{0.33\text{ sec}} = 18\ \frac{\text{in}}{\text{sec}^2}$$

Linear Sizing Calculations

Thrust Calculation

The thrust required to move a mass a given distance within a given time may be calculated by summing all of the forces that act on the mass. These forces generally fall within the following four categories:

- **Gravity** is important when something is being raised or lowered in a system. Lifting a mass vertically is one example, as is sliding something on an incline.
- **Friction forces** exist in almost all systems and must be considered.
- **Applied forces** come from springs, other actuators, magnets, etc., and are the forces that act on the mass other than friction, gravity, and the actuator's thrust. The spring shown in the figure below is an example of an Applied force.
- **Actuator thrust** is the required force, and is what we need to determine.



The figure above shows a general case where the force required by the actuator must be determined. All of the above forces are included, and it is important to note that all of these forces can change over time, so the thrust must be calculated for each section of the move profile. The worst case thrust and speed required should be used to pick the appropriate actuator. All of these forces added up (Σ) must be equal to mass × acceleration, or:

$$\Sigma F = m \times a, \text{ or,} \quad (1)$$

$$F_{actuator} - F_{applied} - F_{friction} - F_{gravity} = ma = \left(\frac{W_t}{g}\right)a \quad (2)$$

$$F_{actuator} = \left(\frac{W_t}{g}\right)a + F_{applied} + F_{friction} + F_{gravity} \quad (3)$$

where $W_t = W_{load} + W_{actuator}$ (4)

$F_{friction} = \mu W_L \cos\theta$, and

$F_{gravity} = W_L \sin\theta$

$W_{actuator}$ becomes important when the acceleration force, $(W_t/g)a$, is a significant part of the thrust calculation. For simplicity, start by neglecting this weight, and calculate the required thrust without it. After selecting an actuator, add its mass to the mass of the load and recalculate. To make these equations clear, lets begin with an example.

Example 1

We would like to move a 200 lb weight a distance of 10 inches in 2 seconds. The mass slides up and incline with a friction coefficient of 0.1 at an angle of 45°. There is a spring that will be in contact with the mass during the last 0.5 inch of travel and has a spring rate of 100 lb/in. What is the maximum thrust and velocity?

Solution

We need to look at the thrust requirement during each part of the move, and find the points of maximum thrust and maximum speed. Choosing a trapezoidal profile we calculate that v_{max} is 7.5 in/sec and the peak acceleration is 11.25 in/sec^2 (see Move Profile Section).

Acceleration Section:

Ma = 200 lb/386 in/sec^2 × 11.25 in/sec^2
= 5.83 lb

$F_{applied}$ = 0 lb
$F_{friction}$ = [200 lb × cos (45)] × 0.1 = 14.14 lb
$F_{gravity}$ = 200 lb × sin (45) = 141.4 lb
F_{total} = 161 lb

Slew Section:

Ma = 0 lb (since a=0)
$F_{applied}$ = 0 lb
$F_{friction}$ = [200 lb × cos (45)] × 0.1 = 14.14 lb
$F_{gravity}$ = 200 lb × sin (45) = 141.4 lb
F_{total} = 156 lb

Deceleration Section:

Ma = 200 lb/386 in/sec^2 × -11.25 in/sec^2
= -5.83 lb

$F_{applied}$ = K × x = 0.5 in × 100 lb/in =50 lb
(worst case)

$F_{friction}$ = [200 lb × cos (45)] × 0.1 = 14.14 lb
$F_{gravity}$ = 200 lb × sin (45) = 141.4 lb
F_{total} = 200 lb

So the worst case required thrust is 200 lb. And the worst case velocity is 7.5 in/sec.

Thrust Calculation

Actuator Mass

In applications where the acceleration force, $(\mathbf{W}_t/g)\mathbf{a}$, is a significant part of the required thrust, the actuator mass ($\mathbf{M}$) must be considered in the thrust calculation. After an actuator is chosen, the actuator weight (linear inertia), $\mathbf{W}_{actuator}$, is added to the weight of the load. $\mathbf{W}_{actuator}$ can be determined using the tables and equation in the actuator data section.

To illustrate, we will use the previous example.

1. The first step is to pick a linear actuator with the previously calculated thrust and speed capability. One such actuator is an R3-AKM23D-xxx-152B-12-P. This is an R3 Rodless Actuator with an AKM23 motor, a 1.5:1 gear reduction, 0.5 in. lead ball screw and a 12 inch stroke.
2. The next step is to look up the effective Actuator Linear Inertia in the tables located in the particular actuator section (do not include the "load" term in the equation). An entry from this table can be seen in the table below. The AKM42 motor inertia is 0.00128 lb-in-sec^2. The effective actuator weight, calculated from the table is 241lb. See page 49 for the linear inertia equation.
3. The final step is to add this weight to the weight of the load, $\mathbf{W}_L$, and recalculate the peak thrust required for each section of the move profile (do not add this weight to the gravity or friction terms):

Acceleration Section:

$\mathbf{Ma}$ = (241 lb + 200 lb)/386 in/sec^2 × 11.25 in/sec^2

= 12.9 lb

$\mathbf{F}_{total}$ = 12.9 + 14.14 + 141.4 = 168.4 lb

Slew Section:

$\mathbf{Ma}$ = 0 lb (since a=0)

$\mathbf{F}_{total}$ = 156 lb

Deceleration Section:

$\mathbf{Ma}$ = 414 lb/386 in/sec^2 × -11.25 in/sec^2)

= -12.9 lb

$\mathbf{F}_{total}$ = -12.9 + 50 + 14.14 + 141.4 = 192.6 lb

We can see from this calculation that the addition of this extra "acceleration weight" increases the thrust required during acceleration, but reduces the peak thrust required during deceleration. The R3-AKM42G-xxx-152B-12P/ AKD (6A) will work in the application.

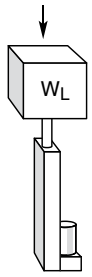
Screw Driven Models	Motors	Ratio	A (lb-in-s^2)	B (lb-in-s^2/in)	C (lb-in-s^2/lb)
R3...-152B	All*	1.5:1	9.80 E-05	3.17 E-05	7.29 E-06

Motor	Motor Inertia (lb-in-s^2)
AKM42	1.28 E-03

Inertia data extracted from the R3 series interia tables found on page 39.

Vertical and Horizontal Cases

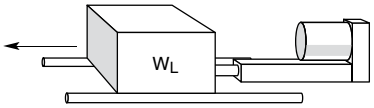
In a vertical system, θ is 90°, sin90 = 1, and $\mathbf{F}_{gravity}$ is equal to $\mathbf{W}_L$. Since cos90 = 0, $\mathbf{F}_{friction}$ = 0.



$$\mathbf{F}_{actuator} = (\mathbf{W}_t/g)\mathbf{a} + \mathbf{F}_{applied} + \mathbf{F}_{gravity}$$

$$\mathbf{F}_{actuator} = (\mathbf{W}_t/g)\mathbf{a} + \mathbf{F}_{applied} + \mathbf{W}_L$$

In a horizontal system, sinθ = 0, so gravity would play no part ($\mathbf{F}_{gravity}$ = 0), and cosθ =1, so $\mathbf{F}_{friction}$ would be equal to $\mu\mathbf{W}_L$, or 50 lb.

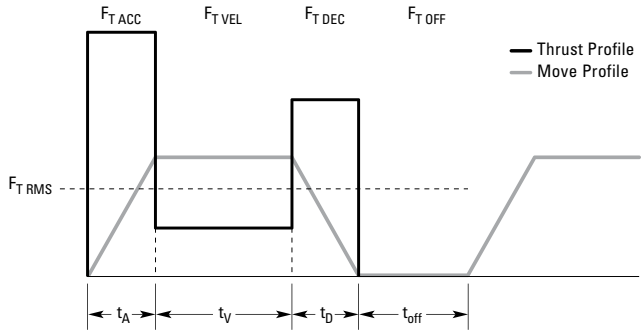


$$\mathbf{F}_{actuator} = (\mathbf{W}_t/g)\mathbf{a} + \mathbf{F}_{applied} + \mathbf{F}_{friction}$$

$$\mathbf{F}_{actuator} = (\mathbf{W}_t/g)\mathbf{a} + \mathbf{F}_{applied} + \mu\mathbf{W}_L$$

RMS Thrust

For all Servomotor applications, the RMS Thrust needs to be calculated. This thrust must fall within the continuous duty region of the linear actuator. Use the following equation when calculating RMS Thrust:



$$F_{T\,RMS} = \sqrt{\frac{(F_{T\,ACC})^2 t_a + (F_{T\,VEL})^2 t_v + (F_{T\,DEC})^2 t_d + (F_{T\,OFF})^2 t_{off}}{t_a + t_v + t_d + t_{off}}}$$

Linear Sizing Calculations

Duty Cycle

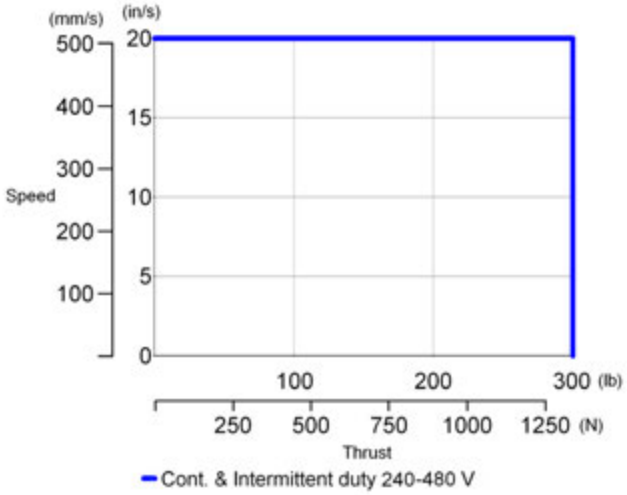
Duty Cycle is the ratio of motor-on time to total cycle time and is used to determine the acceptable level of running time so that the thermal limits of the motor or actuator components are not exceeded. Inefficiencies cause a temperature rise in a system, and when the temperature reaches a critical point, components fail. Letting the system to rest idle during the cycle allows these system components to cool. Duty Cycle is limited by lead screw and motor thermal limits. Use the following equation and example to determine Duty Cycle:

$$\text{Duty Cycle } \% = \frac{\text{ON TIME}}{\text{ON TIME + OFF TIME}} \times 100$$

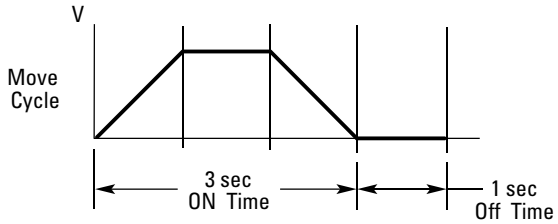
Leadscrew Limitations

Cylinders with **lead screws** have sliding friction surfaces and are limited to a maximum 50% duty cycle regardless of motor capability. The friction in the lead screw causes rapid heating, and continuous operation is likely to end in a ruined nut or screw. For an actuator with **ball screws** the motor is the only duty-cycle limitation when used within the listed speed vs. thrust curves in the catalog.

R3-AKM42G-xxx-152B-yy-P AKD (6 A)



Example:



$$\text{Duty Cycle} = \frac{3 \text{ sec} \times 100}{3 + 1 \text{ sec}} = 75\%$$

Motor Type

Electric motors incur heat losses via a number of paths, namely, friction, ohmic (I^2R) losses in copper windings, hysteresis and eddy current induction in magnetic core materials, and proximity and/or skin effect in windings. As a result duty cycle can be limited by the motor winding temperature limitations.

Servo Motors

Linear Actuators using AKM series motors must have their peak (F_{peak}) and continuous (F_{RMS}) thrust requirements determined to establish their safe operation within an application. F_{RMS} can be determined using the RMS Thrust equation in the Thrust Calculation section. Plotting F_{RMS} on the actuator Speed vs. Thrust curve indicates the allowable Duty Cycle. For ball screw actuators, F_{RMS} must fall within the continuous duty region, while for lead screws it must fall in the 50% duty region. F_{peak} must fall within remaining operating envelope. The speed vs. thrust curve left is an example of proper servo motor and actuator sizing for the previous example.

Notes

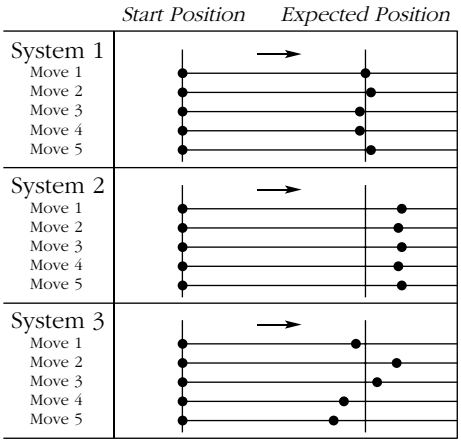
Linear Motion Terminology

Linear Actuator Precision

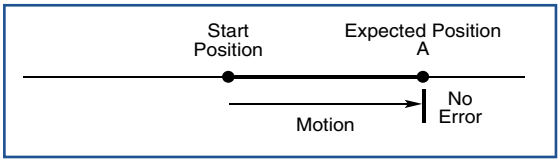
Parameter	Definition	Dominating Factors
Absolute Accuracy	The maximum error between expected and actual position.	• Accuracy of the motor/drive system • Screw pitch error (lead accuracy) • System backlash (drive train, screw and nut assembly)
Repeatability	The ability of a positioning system to return to a location during operation when approaching from the same direction, at the same speed and deceleration rate.	• Angular repeatability of the motor/drive system • System friction • Changes in load, speed, and deceleration • Angular resolution of the motor/drive system
Resolution	The smallest positioning increment achievable. In digital control systems, resolution is the smallest specifiable position increment.	• Drive Train Reduction • Screw Pitch • Lead screw Assembly wear
Backlash	The amount of play (lost motion) between a set of moveable parts.	• Drive train wear • Spaces between moving parts

Accuracy and Repeatability

Assume three linear positioning systems each attempt five moves from an absolute zero position to absolute position "A". The individual end positions of each move are charted on a linear scale below to demonstrate their accuracy and repeatability by displaying their proximities to the expected position.



Ideal System



Degree of Accuracy	Degree of Repeatability	Comment
High	High	System 1 is both accurate and repeatable, the end positions are tightly grouped together and are close to the expected position.
Low	High	System 2 is inaccurate but repeatable, the end positions are tightly grouped around a point but are not close to the expected position.
Low	Low	System 3 is neither accurate nor repeatable, the end positions are not tightly grouped and are not close to the expected position.

Linear Actuator Precision

Backlash

The clearance between elements in a drive train or lead screw assembly which produces a mechanical "dead band" or "dead space" when changing directions, is known as the **backlash** in a system.

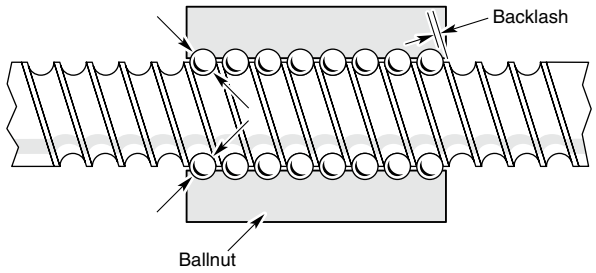
In most mechanical systems, some degree of backlash is necessary to reduce friction and wear. In a Kollmorgen Linear Actuator System, system backlash will typically be 0.010 – 0.015 inches. Usually 0.006 – 0.008" is attributed to the ball screw / lead screw assembly. For ball screws this will remain constant throughout the life of a cylinder, while for lead screws it will increase with wear.

Reducing the Effects of Backlash

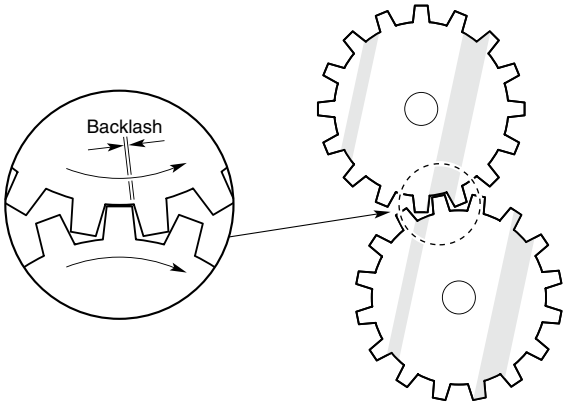
1. Approach a stop position from the same direction.
2. Apply a constant linear force on the cylinder thrust tube or carriage. This is done automatically for cylinders used in vertical orientations with a backdriving load.
3. For programmable positioning devices it is possible to program out backlash by specifying a small incremental move (enough to take out the backlash) prior to making your normal moves in a particular direction.
4. Use a preloaded nut on a ball screw to counteract the backlash. Contact Kollmorgen about the precision ground screw option which reduces backlash in the drive nut.
5. An inline positioner with the motor directly coupled to the ball screw has less backlash than parallel or reverse parallel units which utilize a gear train or drive belt/pulley.

Primary Sources of Backlash

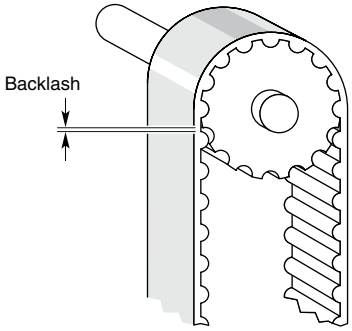
1. Ball screw/Lead screw Assembly



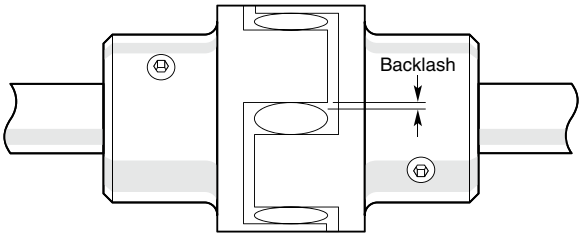
2. Drive Train (Gears, Timing Belt/Pulley)



3. Timing Belt/Pulley



4. Coupling

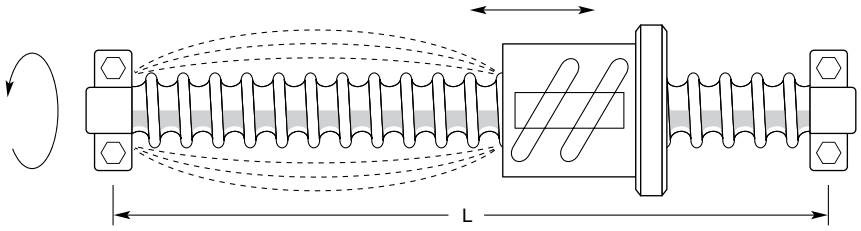


Linear Motion Terminology

Critical Speed and Column Loading

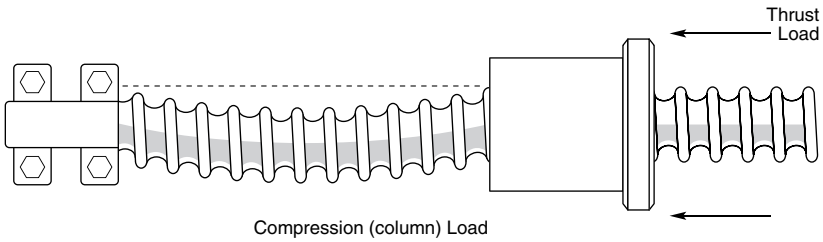
Critical Speed

All ball screw systems have a rotational speed limit where harmonic vibrations occur. With Kollmorgen, this limit is a function of unsupported ball screw length. Operation beyond this critical speed will cause the ball screw to vibrate (whip violently) eventually bending or warping the screw.



Column Strength

All ball screws have a maximum column loading limit which causes the screw to compress as load increases. In Kollmorgen this limit is a function of unsupported leadscrew length. Exceeding this limit will cause the ball screw to buckle and become permanently damaged.

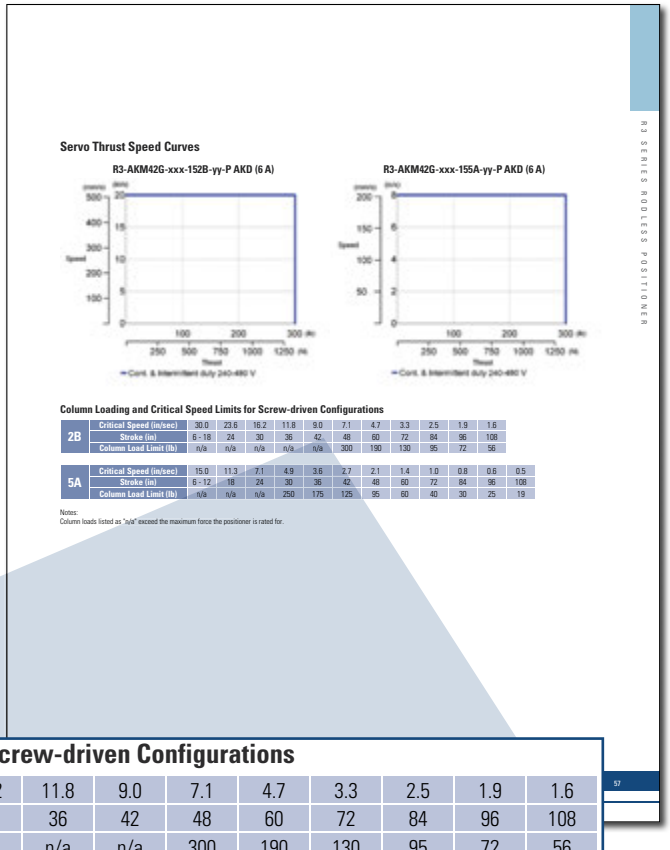


Determining the Limits

Critical Speed and Column Loading information for each screw type (i.e. 2B, 5A, 8A, 5B …) can be found at the bottom of each "Performance" page in the particular linear positioner's section.

Example

Find the Column Load and Critical Speed limits for a R3-AKM42G-xxx-152B-yy-P, 60 inch stroke rodless positioner. The positioner data can be found on the page with the force speed curve. Reading off the chart at the bottom of page, the limits are 190 lb and 4.7 in/sec. The usable speed/thrust is restricted to less than these values as seen in the thrust vs. speed curve.



Column Loading and Critical Speed Limits for Screw-driven Configurations

2B	Critical Speed (in/sec)	30.0	23.6	16.2	11.8	9.0	7.1	4.7	3.3	2.5	1.9	1.6
	Stroke (in)	6 - 18	24	30	36	42	48	60	72	84	96	108
	Column Load Limit (lb)	n/a	n/a	n/a	n/a	n/a	300	190	130	95	72	56

Notes

Glossary of Motion Control Terminology

Absolute Move
A move referenced from a fixed absolute zero position.

Acceleration
The change in velocity as a function of time, going from a lower speed to a higher speed.

Accuracy
An absolute measurement defining the difference between expected and actual position.

Lead Screw
A screw which uses a threaded screw design with sliding surfaces between the screw and nut.

Backdrive
Tendency of a cylinder to creep out of its set position due to an applied load or force.

Backlash
The amount of play (lost motion) between a set of moveable parts when changing the direction of travel. Typically seen in drive trains, ball/lead screws, & bearings.

Ball screw
A screw assembly which uses a ball nut which houses one or more circuits of recirculating steel balls which roll between the nut and screw.

Bearing
A support device which allows a smooth, low friction motion between two surfaces loaded against each other.

Bushing
A cylindrical metal sleeve inserted into a machine part to reduce friction between moving parts.

Closed Loop
A positioning system which employs feedback information to regulate the output response.

Cogging
Motor torque variations which occur at low speeds due to a weak magnetic field.

Critical Speed
Rotational speed of a ball screw at which vibrations (whipping) will occur.

Current
The flow of charge through a conductor.

Cycle
One complete extension and retraction of a positioner.

Deceleration
The change in velocity as a function of time, going from a higher speed to a lower speed.

Drive Ratio
The ratio of motor revolutions per ball/lead screws revolution.

Drive Train
The arrangement by which the motor is coupled to the ball/lead screws. Typically provided by gears, timing belt/pulley or direct coupling.

Duty Cycle
The ratio of motor on time and total cycle time within a given cycle of operation.

$$\text{Duty Cycle}\ (\%) = \frac{\text{Motor ON Time}}{\text{Total Cycle Time}} \times 100$$

Dwell Time
Time within a move cycle where no motion occurs.

Efficiency
Ratio of output power vs. input power.

Electric Cylinder
A self contained system which converts rotary motion (from a motor) to linear motion.

Encoder
An electromechanical device which produces discrete electrical pulses directly related to the angular position of the input shaft, providing high resolution feedback data on position, velocity, and direction.

Force
The action of one body on another which tends to change the state of motion of that body. Typically described in terms of magnitude, direction, and point of application.

Friction
The resistance to motion of two surfaces that touch.

Helical Gear
Gears with teeth that spiral around the gear.

Incremental Move
A move referenced from the current set position.

Inertia
Property of an object that resists a change in motion. It is dependent on the mass and shape of the object. The greater an object's mass, the greater its inertia, and the more force is necessary to accelerate and decelerate.

Lead
The linear distance a nut will travel with one revolution of the Ball / Lead Screw.

Screw Assembly
Device which converts rotary motion to linear motion.

Mass
The quantity of matter that an object contains.

Microprocessor
A device that incorporates many or all functions of a computer in a single integrated circuit. Used to perform calculations and logic required to do motion or process control.

Moment (Load)
Rotational forces applied to a linear axis, typically expressed as yaw, pitch, and roll.

Motion Profile
A method of describing a move operation in terms of time, position, and velocity. Typically velocity is characterized as a function of time or distance which results in a triangular or trapezoidal profile.

Motor
A device which converts electrical energy into mechanical energy.

Non-Volatile Memory
Memory that does not lose information on loss of power.

Open Loop

A positioning system which does not employ feedback information.

Overshoot

The amount by which a parameter being controlled exceeds the desired value. Typically referring to velocity or position in servo systems.

Pitch

The number of revolutions a Ball / Lead Screw must turn for the nut to travel one inch (single start only).

PLC (Programmable Logic Controller)

A programmable device which utilizes "ladder" logic to control a bank of inputs and outputs which are interfaced to external devices.

Power

How much work is done in a specific amount of time.

Repeatability

The ability of a positioning system to return to an exact location during operation (from the same direction with the same load and speed).

Resistance

The opposition to the flow of charge through a conductor.

Resolution

The smallest positioning increment achievable. In digitally programmed systems it is the smallest specifiable positioning increment.

Resonance

Oscillatory behavior in a mechanical body when operated or subjected to a periodic force occurring at its natural frequency.

RS232C

A method of Serial Communication where data is encoded and transmitted on a single line in a sequential time format.

Servo Motor

A motor which is used in closed loop systems where feedback is used to control motor velocity, position, or torque.

Stepper Motor

Motor which translates electrical pulses into precise mechanical movements. Through appropriate drive circuitry, controlling the rate and quantity of pulses will control the motor's velocity and position.

Thrust

The measurement of linear force.

Torque

A measure of angular force which produces rotational motion.

Velocity (Speed)

The change in position as a function of time.

Voltage

Difference in electrical potential between two points.

Weight

Force of gravity acting on a body. Determined by multiplying the mass of the object by the acceleration due to gravity.

Conversion Tables

Torque

A \ B	dyne-cm	**gm-cm**	oz-in	**kg-cm**	lb-in	**N-m**	lb-ft	**kg-m**
dyne-cm	1	**$1.019x10^{-2}$**	$1.416x10^{-5}$	**$1.0197x10^{-6}$**	$8.850x10^{-7}$	**10^{-7}**	$7.375x10^{-6}$	**$1.019x10^{-6}$**
gm-cm	980.665	**1**	$1.388x10^{-2}$	**10^{-3}**	$8.679x10^{-4}$	**$9.806x10^{-5}$**	$7.233x10^{-5}$	**10^{-5}**
oz-in	$7.061x10^{4}$	**72.007**	1	**$7.200x10^{-2}$**	$6.25x10^{-2}$	**$7.061x10^{-3}$**	$5.208x10^{-3}$	**$7.200x10^{-4}$**
kg-cm	$9.806x10^{5}$	**1000**	13.877	**1**	0.8679	**$9.806x10^{-2}$**	$7.233x10^{-2}$	**10^{-2}**
lb-in	$1.129x10^{6}$	**$1.152x10^{3}$**	16	**1.152**	1	**0.112**	$8.333x10^{-2}$	**$1.152x10^{-2}$**
N-m	10^{7}	**$1.019x10^{4}$**	141.612	**10.197**	8.850	**1**	0.737	**0.102**
lb-ft	$1.355x10^{7}$	**$1.382x10^{4}$**	192	**13.825**	12	**1.355**	1	**0.138**
kg-m	$9.806x10^{7}$	**10^{5}**	$1.388x10^{3}$	**100**	86.796	**9.806**	7.233	**1**

Inertia (Rotary)

A \ B	$gm\text{-}cm^2$	**$oz\text{-}in^2$**	$gm\text{-}cm\text{-}s^2$	**$kg\text{-}cm^2$**	$lb\text{-}in^2$	**$oz\text{-}in\text{-}s^2$**	$lb\text{-}ft^2$	**$kg\text{-}cm\text{-}s^2$**	$lb\text{-}in\text{-}s^2$	**$lb\text{-}ft\text{-}s^2$ or $slug\text{-}ft\text{-}s^2$**
$gm\text{-}cm^2$	1	**$5.46x10^{-2}$**	$1.01x10^{-3}$	**10^{-3}**	$3.417x10^{-4}$	**$1.41x10^{-5}$**	$2.37x10^{-6}$	**$1.01x10^{-4}$**	$8.85x10^{-7}$	**$7.37x10^{-4}$**
$oz\text{-}in^2$	182.9	**1**	0.186	**0.182**	0.0625	**$2.59x10^{-3}$**	$4.34x10^{-4}$	**$1.86x10^{-4}$**	$1.61x10^{-4}$	**$1.34x10^{-5}$**
$gm\text{-}cm\text{-}s^2$	980.6	**5.36**	1	**0.9806**	0.335	**$1.38x10^{-2}$**	$2.32x10^{-3}$	**10^{-3}**	$8.67x10^{-4}$	**$7.23x10^{-5}$**
$kg\text{-}cm^2$	1000	**5.46**	1.019	**1**	0.3417	**$1.41x10^{-2}$**	$2.37x10^{-3}$	**$1.019x10^{-3}$**	$8.85x10^{-4}$	**$7.37x10^{-5}$**
$lb\text{-}in^2$	$2.92x10^{3}$	**16**	2.984	**2.925**	1	**$4.14x10^{-2}$**	$6.94x10^{-3}$	**$2.96x10^{-3}$**	$2.59x10^{-3}$	**$2.15x10^{-4}$**
$oz\text{-}in\text{-}s^2$	$7.06x10^{4}$	**386.08**	72.0	**70.615**	24.13	**1**	0.1675	**$7.20x10^{-2}$**	$6.25x10^{-2}$	**$5.20x10^{-3}$**
$lb\text{-}ft^2$	$4.21x10^{5}$	**2304**	429.71	**421.40**	144	**5.967**	1	**0.4297**	0.3729	**$3.10x10^{-2}$**
$kg\text{-}cm\text{-}s^2$	$9.8x10^{5}$	**$5.36x10^{3}$**	1000	**980.66**	335.1	**13.887**	2.327	**1**	0.8679	**$7.23x10^{-2}$**
$lb\text{-}in\text{-}s^2$	$1.129x10^{4}$	**$6.177x10^{3}$**	$1.152x10^{3}$	**$1.129x10^{3}$**	386.08	**16**	2.681	**1.152**	1	**$8.33x10^{-2}$**
$lb\text{-}ft\text{-}s^2$ or **$slug\text{-}ft^2$**	$1.355x10^{7}$	**$7.41x10^{4}$**	$1.38x10^{4}$	**$1.35x10^{4}$**	$4.63x10^{3}$	**192**	32.17	**13.825**	12	**1**

Angular Velocity

A \ B	deg/s	**rad/s**	rpm	**rps**
deg/s	1	**1.75 x 10^{-2}**	0.167	**2.78 x 10^{-3}**
rad/s	57.3	**1**	9.55	**0.159**
rpm	6	**0.105**	1	**1.67 x 10^{-2}**
rps	360	**6.28**	60	**1**

Linear Velocity

A \ B	in/min	**ft/min**	in/sec	**ft/sec**	mm/sec	**m/sec**
in/min	1	**0.0833**	0.0167	**1.39 x10^{-3}**	0.42	**4.2 x10^{-4}**
ft/min	12	**1**	0.2	**0.0167**	5.08	**5.08 x10^{-3}**
in/sec	60	**5**	1	**0.083**	25.4	**0.0254**
ft/sec	720	**60**	12	**1**	304.8	**0.3048**
cm/sec	23.62	**1.97**	0.3937	**0.0328**	10	**0.01**
m	2362.2	**196.9**	39.37	**3.281**	1000	**1**

Abbreviated Terms

C	=	Celsius	lb(f)	=	pound force
cm	=	centimeter	lb(m)	=	pound mass
F	=	Fahrenheit	min	=	minute
ft	=	foot	mm	=	millimeter
g	=	gravity	m	=	meter
gm	=	gram	N	=	Newton
gm(f)	=	gram force	oz(f)	=	ounce force
hp	=	horse power	oz(m)	=	ounce mass
in	=	inch	rad	=	radians
kg	=	kilogram	rpm	=	revs per minute
kg(f)	=	kilogram force	rps	=	revs per second
kw	=	kilowatt	s	=	seconds

Metric Prefixes

Name	Abbreviation		Multiple
Giga	G	10^{9}	1,000,000,000
Mega	M	10^{6}	1,000,000
Kilo	k	10^{3}	1,000
Hecto	h	10^{2}	100
deka	da	10^{1}	10
—	—	10^{0}	1
deci	d	10^{-1}	.1
centi	c	10^{-2}	.01
milli	m	10^{-3}	.001
micro	µ	10^{-6}	.000001
nano	n	10^{-9}	.000000001

Conversion Tables

(To convert from A to B, multiply by entry in table)

Length

A \ B	in	ft	micron (μm)	mm	cm	m
in	1	**0.0833**	$2.54x10^{4}$	**25.4**	2.54	**0.0254**
ft	12	**1**	$3.048x10^{5}$	**304.8**	30.48	**0.3048**
micron(μm)	$3.937x10^{-7}$	**$3.281x10^{-6}$**	1	**0.001**	$1.0x10^{-4}$	**$1.0x10^{-6}$**
mm	0.03937	**0.00328**	1000	**1**	0.1	**0.001**
cm	0.3937	**0.03281**	$1.0x10^{4}$	**10**	1	**0.01**
m	39.37	**3.281**	$1.0x10^{6}$	**1000**	100	**1**

Mass

A \ B	gm	kg	slug	lb(m)	oz(m)
gm	1	**0.001**	$6.852x10^{-5}$	**$2.205x10^{-3}$**	0.03527
kg	1000	**1**	$6.852x10^{-2}$	**2.205**	35.274
slug	14590	**14.59**	1	**32.2**	514.72
lb(m)	453.6	**0.45359**	0.0311	**1**	16
oz(m)	28.35	**0.02835**	$1.94x10^{-3}$	**0.0625**	1

Force

A \ B	lb(f)	N	dyne	oz(f)	kg(f)	gm(f)
lb(f)	1	**4.4482**	4.448×10^{5}	**16**	0.45359	**453.6**
N	0.22481	**1**	100.000	**3.5967**	0.10197	——
dyne	2.248×10^{-6}	**0.00001**	1	**$3.59x10^{-5}$**	——	**980.6**
oz(f)	0.0625	**0.27801**	$2.78x10^{4}$	**1**	0.02835	**28.35**
kg(f)	2.205	**9.80665**	—	**35.274**	1	**1000**
gm(f)	$2.205x10^{-3}$	——	$1.02x10^{-3}$	**0.03527**	0.001	**1**

Note: lb(f) = 1slug x 1 ft/s^2 N = 1kg x 1 m/s^2 dyne = 1gm x 1 cm/s^2

Power

A \ B	Watts	kw	hp(english)	hp(metric)	ft-lb/s	in-lb/s
Watts	1	**1×10^{-3}**	1.34×10^{-3}	**1.36×10^{-3}**	0.74	**8.88**
kw	1000	**1**	1.34	**1.36**	738	**8880**
hp(english)	746	**0.746**	1	**1.01**	550	**6600**
hp(metric)	736	**0.736**	0.986	**1**	543	**6516**
ft-lb/s	1.35	**1.36×10^{-3}**	1.82×10^{-3}	**1.84×10^{-3}**	1	**12**
in-lb/s	0.113	**1.13×10^{-4}**	1.52×10^{-4}	**1.53×10^{-4}**	8.3×10^{-2}	**1**

NEMA and Material Specifications

Material Densities

	oz/in³	lb/in³	gm/cm³
Aluminum	1.57	0.098	2.72
Brass	4.96	0.31	8.6
Bronze	4.72	0.295	8.17
Copper	5.15	0.322	8.91
Plastic	0.64	0.04	1.11
Steel	4.48	0.28	7.75
Hard Wood	0.46	0.029	0.8
Soft Wood	0.28	0.018	0.48

Friction Coefficients

(Sliding)	μ_s
Steel on Steel	0.58
Steel on Steel (Greased)	0.15
Aluminum on Steel	0.45
Copper on Steel	0.36
Brass on Steel	0.40
Plastic on Steel	0.2
Linear Bearings	0.001

Mechanism Efficiencies

Lead Screw (Bronze Nut)	0.4
Lead Screw (Plastic Nut)	0.5
Ball Screw	0.9
Helical Gear	0.7
Spur Gear	0.6
Timing Belt/Pulley	0.9

Temperature

°F = (1.8 x °C) + 32

°C = 0.555 (°F - 32)

Gravity

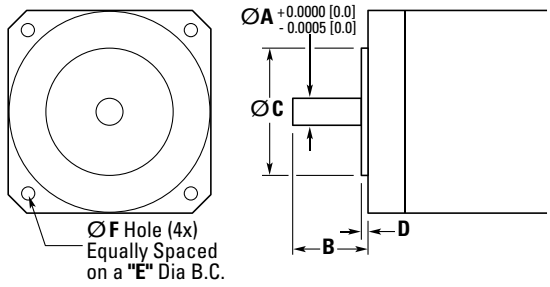
(Acceleration Constant)

g = 386 in/s² = 32.2 ft/s² = 9.8 m/s²

NEMA Standard Motor Dimensions

Dimension (in)	NEMA 17	NEMA 23	NEMA 34	NEMA 42
"A" Motor Shaft Diameter	0.197	0.250	0.375	0.625
"B" Motor Shaft Length*	0.945	0.810	1.250	1.380
"C" Pilot Diameter	0.866	1.500	2.875	2.186
"D" Pilot Length*	0.080	0.062	0.062	0.062
"E" Mounting Bolt Circle	1.725	2.625	3.875	4.950
"F" Bolt Hole Size	0.127	0.195	0.218	0.218

* These dimensions can be less than value indicated.



Application Worksheet

For selection assistance, fax, to your local Kollmorgen Distributor or directly to Kollmorgen

Prepared By

Name _____

Company _____

Phone _____

Fax _____

Email _____

Address _____

Prepared For

Name _____

Company _____

Phone _____

Fax _____

E-mail _____

Address _____

User's primary business _____

_____

Type of machine Kollmorgen product to be used on _____

_____

Current Kollmorgen user? Yes ☐ No ☐

Project Time Frame

Proposal ____/____/____

Build prototype ____/____/____

In production ____/____/____

Volume Requirements

Next 12 months: _____

Year 2: _____

Year 3: _____

Action Required

☐ Demo

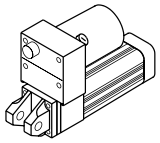
☐ Price quotation

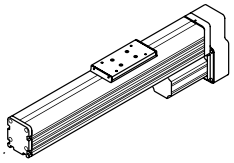
☐ Recommend product

☐ Call me to discuss

Please include drawings, comments or additional information on separate pages.

☐ Electric Cylinder or ☐ Rodless Actuator





Loads

Payload

Weight _____ lb

☐ Payload Externally Supported, by _____ (rails, etc.)

Hold Position:
☐ After move ☐ Power off

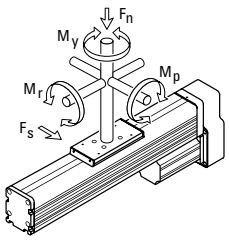
Carriage Loads (Rodless only)

M_p _____ lb-in

M_r _____ lb-in

M_y _____ lb-in

Side Load _____ lb



Orientation

☐ Vertical

☐ Horizontal

☐ Inclined _____ (angle from horizontal plane)

Motion

Travel

Stroke Length Required _____ in
(= usable travel distance + min. 2 inches for limit switches)

Shortest Move _____ in

Speed (WCM=Worst-Case Move)

WCM Distance _____ in

Time for WCM _____ sec

or

Max. Speed _____ in/sec

Min. Speed _____ in/sec

Complete Move Profile Chart (see p. 100)

Precision

Repeatability _____ in

Accuracy _____ in

Max. Backlash _____ in

Resolution _____ in

Straightness/Flatness _____ in

Thrust Calculation (See Engineering Section in this catalog for assistance)

Thrust

Thrust = Force ACCELERATED MASS + Force FRICTION + Force GRAVITY + Force EXTERNAL

_____ lb = _____ lb + _____ lb + _____ lb + _____ lb

Duty Cycle/Life

Duty Cycle

Total Cycle Time _____ sec. Extend/Retract Cycles per day _____

Sum of Move Times _____ sec. Move Distance per cycle _____

Complete Move Profile Chart (see next page)

Required Life

Units: ☐ Inches ☐ Meters ☐ Cycles ☐ Months ☐ Years

Minimum Life _____

Maintenance/Lube Interval _____

Environment

Operating Temperature

☐ Normal 32-140°F [0-60°C]

☐ High Temp. _____ °F / °C

☐ Low Temp. _____ °F / °C

Contaminants (Check all that apply)

Solid: _____

☐ non-abrasive ☐ coarse chips

☐ abrasive ☐ fine dust

Liquid: _____

☐ Dripping ☐ Non-corrosive

☐ Mist / Spray ☐ Corrosive

☐ Splashing

☐ High Pressure

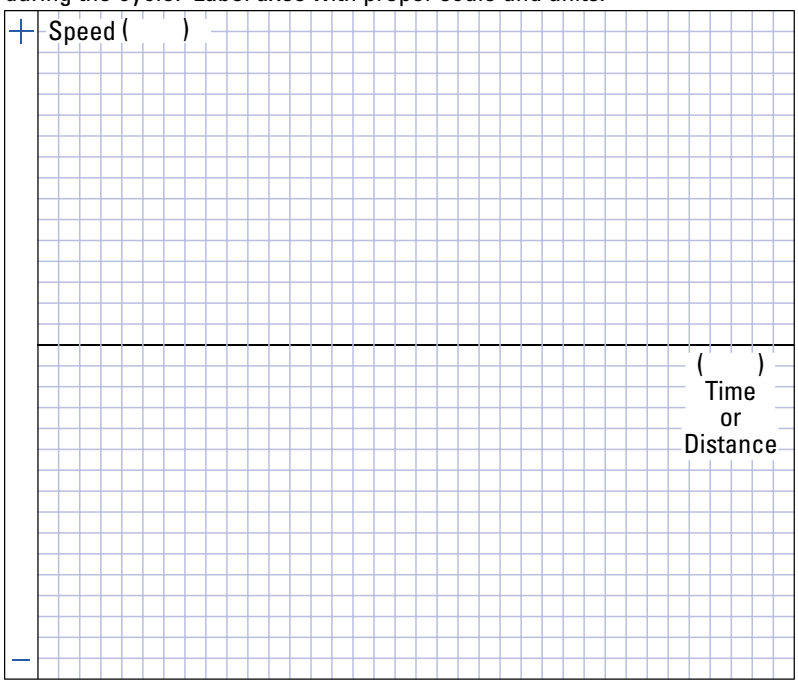
Conditions

☐ Washdown ☐ Outdoor ☐ Vacuum ☐ Cleanroom

Application Worksheet

Move Profile

Graph your most demanding cycle, include accel/decel, velocity and dwell times. You may also want to indicate load variations and I/O changes during the cycle. Label axes with proper scale and units.



Control Method

☐ Motion or Fieldbus Network _____

☐ Manual Jog

☐ Limit Switches

☐ Digital (Step & Direction)
☐ Analog Torque
☐ Programmable (Basic)

☐ Analog Velocity
☐ Analog Position
☐ IEC61131 Control

Description of Application

Motor Type Preferred

☐ Servo ☐ Stepper

☐ Other _____

Axes of Motion

☐ Single ☐ Multiple # _____

☐ Synchronized

Interface

☐ Fieldbus _____

☐ PLC ☐ Computer

☐ Analog I/O ☐ RS232

☐ Digital I/O Control

☐ Other _____

Operator

☐ Keypad/LCD Display

☐ Pushbuttons

☐ HMI Size (H x W): _____

Supply Voltage

☐ 110 Vac ☐ 220 Vac

☐ 400 Vac ☐ 480 Vac

☐ Other _____

Feedback Required

☐ Encoder ☐ Linear Potentiometer

☐ Other _____

Resolution Required _____

Input Functions

Output Functions

Notes

Model Nomenclature

Rodless Actuators R-Series with AKM Servo Motors

R Series	Motor Type*	Motor Options	Drive Ratio	Linear Drive Type	Stroke Length	Motor Orientation	Mounting Style	Carriage	English/ Metric	Cable Option
R3	**AKM42G**	**CNC**	**10**	**5B**	**12**	**P**	**A**	**S**	**E**	**CO**

R Series

R2A, R3, R4

Motor Type*

	Available
AKM23C = AKM23C-EFxxx-00 brushless servo	R2A, R3
AKM23D = AKM23D-EFxxx-00 brushless servo	R2A, R3
AKM42E = AKM42E-EKxxx-00 brushless servo	R3, R4
AKM42G = AKM42G-EKxxx-00 brushless servo	R3, R4
AKM52G = AKM52G-EKxxx-00 brushless servo	R4
AKM52H = AKM52H-EKxxx-00 brushless servo	R4

Motor Options

	Available
B■■ = Rotatable IP65 connectors	AKM2
C■■ = 0.5 m shielded cables w/ IP65 connectors	AKM2
C■■ = Rotatable IP65 connectors	AKM4, AKM5
■N■ = No brake	AKM2, AKM4, AKM5
■2■ = 24 Vdc power-off holding brake	AKM2, AKM4, AKM5
■■R = Resolver	AKM2, AKM4, AKM5
■■2 = 2048 LPR incremental comm. encoder	AKM2, AKM4, AKM5
■■C = Smart Feedback Device (SFD)	AKM2, AKM4, AKM5

Drive Ratio

	Available
10 = 1.0:1 drive belt/pulley	R2A, R3, R4
15 = 1.5:1 drive belt/pulley	R2A, R3, R4
20 = 2.0:1 drive belt/pulley	R2A, R3, R4
30 = 3.0:1 drive belt/pulley	R4
50 = 5:1 helical gear	R3, R4
70 = 7:1 helical gear	R3
100 = 10:1 helical gear	R3

Linear Drive Type

	Available
5A = 5 pitch (0.2" lead) lead screw	R2A, R3
8A = 8 pitch (0.125" lead) lead screw	R2A, R3
1B = 1 pitch (1" lead) ball screw	R4
2B = 2 pitch (0.5" lead) ball screw	R2A, R3
4B = 4 pitch (0.25" lead) ball screw	R4
5B = 5 pitch (0.2" lead) ball screw	R2A, R3
T = Tangential drive belt	R2A, R3, R4

Stroke Length**

	Available
6 = 6" of total stroke	R2A, R3, R4
12 = 12" of total stroke	R2A, R3, R4
18 = 18" of total stroke	R2A, R3, R4
24 = 24" of total stroke	R2A, R3, R4
30 = 30" of total stroke	R2A, R3, R4
36 = 36" of total stroke	R2A, R3, R4
42 = 42" of total stroke	R2A, R3, R4
48 = 48" of total stroke	R2A, R3, R4
54 = 54" of total stroke	R2A, R3, R4
60 = 60" of total stroke	R2A, R3, R4
66 = 66" of total stroke	R2A, R3, R4
72 = 72" of total stroke	R2A, R3, R4
84 = 84" of total stroke	R3, R4
96 = 96" of total stroke	R3, R4
108 = 108" of total stroke	R3, R4
Custom lengths available in the increment of 1"	

Options***

	Available
BS24 = 24 Vdc brake on lead screw (Screw option only, n/a with inline models, MF3 or "C" options)	R2A, R3, R4
BS115 = 115 Vdc brake on lead screw (Screw option only, n/a with inline models, MF3 or "C" options)	R2A, R3, R4
BS230 = 230 Vdc brake on lead screw (Screw option only, n/a with inline models, MF3 or "C" options)	R2A, R3, R4
WR = Water resistant seal option right	R2A
WL = Water resistant seal option left	R2A
GR = Lube port, right side	R3, R4
GL = Lube port, left side	R3, R4
DC1 = Idler carriage between driven carriage and non-motor end	R2A
DC2 = Idler carriage between driven carriage and motor end	R2A
VR = Breather vent, fitting, tubing, right side	R4
VL = Breather vent, fitting, tubing, left side	R4
C0 = No motor cable	R2A, R3, R4
S = Stub shaft	R2A

English/Metric (carriage/mounting)

	Available
E = English carriage & mounting dimensions	R2A, R3, R4
M = Metric carriage & mounting dimensions	R2A, R3, R4

Carriage (omit this field for R2A models)

	Available
S = Single carriage	R3, R4
Dxx = Dual carriage (xx = center distance between dual carriages in inches – contact customer support for lengths)	R3, R4

Mounting Style

	Available
MF3 = Front & rear rectangular flanges	R2A
MS1 = Side end angles	R2A
MS5 = Adjustable feet	R2A
MS6 = Side tapped mounting holes	R2A
A = Side angle brackets	R3, R4
B = Adjustable T-nuts	R3, R4
C = Front & rear rectangular flanges	R3, R4

Motor Orientation

	Available
Belt options	
AR = Motor housing rotated above/right	R2A, R3, R4
BR = Motor housing rotated behind/right	R2A, R3, R4
CR = Motor housing rotated under/right	R2A, R3, R4
AL = Motor housing rotated above/left	R2A, R3, R4
BL = Motor housing rotated behind/left	R2A, R3, R4
CL = Motor housing rotated under/left	R2A, R3, R4
Screw options	
I = Motor mounted inline	R2A, R3, R4
P = Motor mounted parallel	R2A, R3, R4
PR = Motor mounted parallel/right	R2A, R3, R4
PL = Motor mounted parallel/left	R2A, R3, R4

* Contact customer support for AKM combinations outside of those listed.
** For custom lengths round up to next standard incremental plus add standard cut fee.
*** Contact customer support if C0 is not selected.

Note: Options shown in blue text are considered standard.

Rodless Actuators R Series with Stepper Motors

R Series	Stepper Type*	Drive Ratio	Linear Drive Type	Stroke Length	Motor Orientation	Mounting Style	Carriage	English/ Metric	Cable Option
R3	– T22V	– 10	5B	– 12	– P	– A	S	E	– C0

R Series
R2A, R3, R4

Motor Type*

	Available
T22V = T22NSLE-LDN-SS-02 stepper	R2A, R3
T22T = T22NSLS-LDN-SS-02-stepper	R2A, R3
T31x = N31HSFH-LSS-SS-02 stepper	R2A, R3
T32x = N32HSFS-LEK-SS-02 stepper	R4
T41T = N41HSFS-LSS-SS-03 stepper	R4

where: X = V (for 160 Vdc) or T (for 320 Vdc)

Drive Ratio

	Available
10 = 1.0:1 drive belt/pulley	R2A, R3, R4
15 = 1.5:1 drive belt/pulley	R2A, R3, R4
20 = 2.0:1 drive belt/pulley	R2A, R3, R4
30 = 3.0:1 drive belt/pulley	R4
50 = 5:1 helical gear	R3, R4
70 = 7:1 helical gear	R3
100 = 10:1 helical gear	R3

Linear Drive Type

	Available
5A = 5 pitch (0.2" lead) lead screw	R2A, R3
8A = 8 pitch (0.125" lead) lead screw	R2A, R3
1B = 1 pitch (1" lead) ball screw	R4
2B = 2 pitch (0.5" lead) ball screw	R2A, R3
4B = 4 pitch (0.25" lead) ball screw	R4
5B = 5 pitch (0.2" lead) ball screw	R2A, R3
T = Tangential drive belt	R2A, R3, R4

Stroke Length**

	Available
6 = 6" of total stroke	R2A, R3, R4
12 = 12" of total stroke	R2A, R3, R4
18 = 18" of total stroke	R2A, R3, R4
24 = 24" of total stroke	R2A, R3, R4
30 = 30" of total stroke	R2A, R3, R4
36 = 36" of total stroke	R2A, R3, R4
42 = 42" of total stroke	R2A, R3, R4
48 = 48" of total stroke	R2A, R3, R4
54 = 54" of total stroke	R2A, R3, R4
60 = 60" of total stroke	R2A, R3, R4
66 = 66" of total stroke	R2A, R3, R4
72 = 72" of total stroke	R2A, R3, R4
84 = 84" of total stroke	R3, R4
96 = 96" of total stroke	R3, R4
108 = 108" of total stroke	R3, R4

Custom lengths available in the increment of 1"

Motor Orientation

	Available
Belt options	
AR = Motor housing rotated above/right	R2A, R3, R4
BR = Motor housing rotated behind/right	R2A, R3, R4
CR = Motor housing rotated under/right	R2A, R3, R4
AL = Motor housing rotated above/left	R2A, R3, R4
BL = Motor housing rotated behind/left	R2A, R3, R4
CL = Motor housing rotated under/left	R2A, R3, R4
Screw options	
I = Motor mounted inline	R2A, R3, R4
P = Motor mounted parallel	R2A, R3, R4
PR = Motor mounted parallel/right	R2A, R3, R4
PL = Motor mounted parallel/left	R2A, R3, R4

Options***

	Available
BS24 = 24 Vdc brake on lead screw (Screw option only, n/a with inline models, MF3 or "C" options)	R2A, R3, R4
BS115 = 115 Vdc brake on lead screw (Screw option only, n/a with inline models, MF3 or "C" options)	R2A, R3, R4
BS230 = 230 Vdc brake on lead screw (Screw option only, n/a with inline models, MF3 or "C" options)	R2A, R3, R4
WR = Water resistant seal option right	R2A
WL = Water resistant seal option left	R2A
GR = Lube port, right side	R3, R4
GL = Lube port, left side	R3, R4
DC1 = Idler carriage between driven carriage and non-motor end	R2A
DC2 = Idler carriage between driven carriage and motor end	R2A
VR = Breather vent, fitting, tubing, right side	R4
VL = Breather vent, fitting, tubing, left side	R4
Q = 12' quick disconnect stepper cable	R2A, R3, R4
C0 = No motor cable	R2A, R3, R4
C25 = 25' quick disconnect stepper cable	R2A, R3, R4
C50 = 50' quick disconnect stepper cable	R2A, R3, R4
S = Stub shaft	R2A

English/Metric (carriage/mounting)

	Available
E = English carriage & mounting dimensions	R2A, R3, R4
M = Metric carriage & mounting dimensions	R2A, R3, R4

Carriage
(omit this field for R2A models)

	Available
S = Single carriage	R3, R4
Dxx = Dual carriage (xx = center distance between dual carriages in inches – contact customer support for lengths)	R3, R4

Mounting Style

	Available
MF3 = Front & rear rectangular flanges	R2A
MS1 = Side end angles	R2A
MS5 = Adjustable feet	R2A
MS6 = Side tapped mounting holes	R2A
A = Side angle brackets	R3, R4
B = Adjustable T-nuts	R3, R4
C = Front & rear rectangular flanges	R3, R4

* Contact customer support for AKM combinations outside of those listed.
** For custom lengths round up to next standard incremental plus add standard cut fee.
*** Contact customer support if C0 is not selected.
Note: Options shown in blue text are considered standard.

Model Nomenclature

AKD® Servo Drive

AKD – B 003 06 – NB AN – 0000

AKD Series

Version

B = Base drive
C = Central power supply for AKD-N (Requires CB Extention)
N = Decentralized drive (Requires DB, DF, or DS Extention)
P = Position indexer (motion tasking)
T = AKD BASIC Language Programmable drive (Requires IC or NB Extention)
M = Multi-axis Master Drive (Requires MC Extension option, and EC Connectivity option)

Current Rating

003 = 3 Amp
006 = 6 Amp
010 = 10kW (for AKD-C, this field refers to power.)
012 = 12 Amp
024 = 24 Amp
048 = 48 Amp

Voltage

06 = 120/240 Vac 1Ø/3Ø (24 Amp Drive: 240 Vac 3Ø only)
07 = 240/480 Vac 3Ø (Version C: 07 = 400/480 Vac 3Ø I Version N: 07 = 560/680 Vdc)

Extension

CB = without extention (AKD-C version only)
DB = hybrid motor cable (AKD-N version only)
DF = additional EtherCAT® port + feedback connector (AKD-N version only)
DS = local STO + feedback connector (AKD-N version only)
IC = Expanded I/O version and SD card slot (AKD-T version only)
NB = Without extensions

Connectivity*

	Drive Version Availability
AN = Analog command	B, P, T
CN = CANopen®	P
EC = EtherCAT®	C, M, N, P
EI = EtherNet/IP™	P
PN - PROFINET®	P
SQ = SynqNet®	B

*Motion Tasking is included as a free upgrade with CN, EC, EI and PN

Variants

0000 = Standard

Note: Options shown in blue text are considered standard.

AKM® Brushless Servo Motor

AKM 6 2 P – A N C N DA 00

AKM Series

Flange Size

1	40 mm
2	58 mm
3	70 mm
4	84 mm
5	108 mm
6	138 mm
7	188 mm
8	260 mm

Rotor Length

1
2
3
4
5

Winding Type

A to Z

S	Special

Flange

A	IEC with tolerance N
B	NEMA
C	Alternative IEC standard
D	Other standard
G	Alternative IEC standard
H	Alternative IEC standard
R	IEC with tolerance R
M, T	Reinforced bearing AKM8
W	Flange coating for Washdown, IEC
S	Special

Version

00	Standard motor without shaft seal
01	With shaft seal
0W	Washdown
0F	Washdown Food
FAN	Fan Option for AKM7 only
xx	Special

Feedback Device

For all options see following page

S	Special

Brake

2	24 V holding brake
N	Without brake
S	Special

Connections

For all options see following page

S	Special

Shaft

C	Keyway
K	Open keyway
N	Smooth shaft
S	Special

Model Nomenclature

P-Series Stepper Drive

P7 03 6 0 – SD N __

P-Series
P5 = P5000 Series
P6 = P6000 Series
P7 = P7000 Series

Current Rating
03 = 2.5 Arms continuous, 3.5 Arms peak (AC models only)
05 = 5 Arms continuous, 7.2 Arms peak (DC models only)
06 = 5.7 Arms Continuous, 8.0 Amps peak*

Voltage Range
3 = 20 - 75 Vdc
6 = 120/240 Vac (160/320 Vdc)

Electrical Options
0 = None

Customization
Omit field for standard configurations
000 = Optimized for Standard POWERPAC
001 = Optimized for Enhanced POWERPAC
PMX = Optimized Powermax Settings

Feedback Device
N = No feedback, with mating connectors (P6000)
O = No feedback, no connectors

Fuctionality
PN = Motion node indexing
SD = Step/direction base drive, Internal VCO (P5000)
R4 = RS485 (P70360 only)

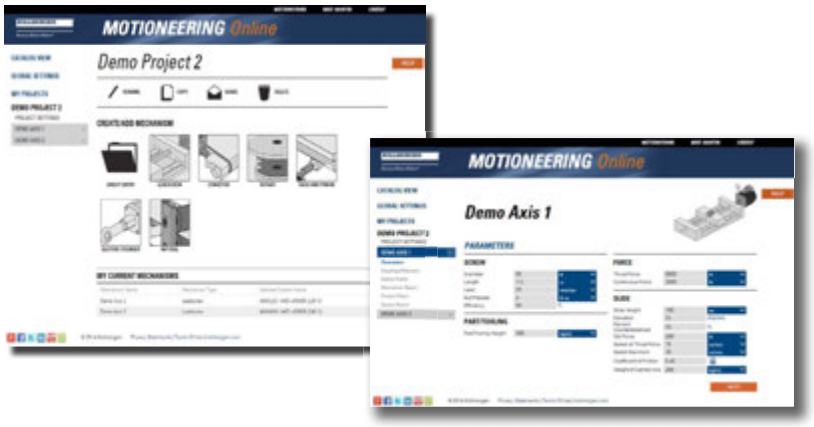
MOTIONEERING® Online

MOTIONEERING® Online – Kollmorgen has revamped, modernized and put online one of the most respected applications sizing programs of the last 20 years. You now can access this application sizing and selection tool wherever you have access to the internet. MOTIONEERING Online is just a start of a series of releases that will empower you to optimize solutions for your toughest applications. Sizing frameless motors and drive systems has never been easier. Using a mechanism project concept for collecting and saving multiple axes of load information, MOTIONEERING® Online can automatically calculate application results and compare against a catalog of systems - recommending the most optimized set of Kollmorgen system solutions available.

Versatile units-of-measure selection options for mechanism and motion profile data-entry, with the ability to convert data into other available units, makes this a convenient international tool. A user-friendly Help file teaches program functions and algorithms used to provide results.

Mechanism Projects

- Direct drive entry, lead screw, conveyor
- Rack and pinion, nip rolls
- Direct Drive Rotary
- Electric Cylinder
- Direct data entry



Solution Set Search Screen

- Color-coded indication of system's ability to meet application requirements
- Review system components specifications
- Save, print, or create a pdf application report
- Evaluate system performance curve with application points

MOTIONEERING® Online Features:

- Inertia Calculator - lets you build up inertia based on odd shapes by additive or subtractive methods
- Custom Motion Profile - easy to add entire segments or copy segments to repeat
- Environmental Factor - takes into account your ambient temperature
- Project by Project Units - You can tailor your units on a project by project basis, or use the global units settings

MOTIONEERING Online Supported Browsers

- IE, Chrome, Firefox, Safari

www.kollmorgen.com/motioneering

About Kollmorgen

Since its founding in 1916, Kollmorgen's innovative solutions have brought big ideas to life, kept the world safer, and improved peoples' lives. Today, its world-class knowledge of motion systems and components, industry-leading quality, and deep expertise in linking and integrating standard and custom products continually delivers breakthrough motion solutions that are unmatched in performance, reliability, and ease-of-use. This gives machine builders around the world an irrefutable marketplace advantage and provides their customers with ultimate peace-of-mind.

For assistance with your application needs in North America, contact us at: 540-633-3545, support@kollmorgen.com or visit www.kollmorgen.com for a global contact list.

KOLLMORGEN®

Because Motion Matters™

Kollmorgen
203A West Rock Road
Radford, VA 24141 USA
Phone: 1-540-633-3545
Fax: 1-540-639-4162

Kollmorgen Europe GmbH
Pempelfurtstraße 1
40880 Ratingen
Germany
Phone: +49 (0) 2102 9394 0
Fax: +49 (0) 2102 9394 3155

Kollmorgen Asia
Floor 4, Building 9, No. 518,
North Fuquan Road, Changning District,
Shanghai 200335, China
Phone: + 86 400 661 2802

Kollmorgen Aerospace and Defense
501 West Main Street
Radford, VA 24141 USA
Phone: 1-540-731-5668
Fax: 1-540-731-5679