Kollmorgen Linear Positioners Catalog

N2 and EC1 - EC5 Series

Electric Cylinders

KOLLMORGEN®

Because Motion Matters™

Kollmorgen.
Every solution comes from a real understanding of OEM challenges.

The ever-escalating demands of the marketplace mean increased pressure on OEMs at every turn. Time constraints. Demands for better performance. Having to think about the next-generation machine even before the current one is built. While expectations are enormous, budgets are not. Kollmorgen's innovative motion solutions and quality products help engineers not only overcome these challenges but also build truly differentiated machines.

Because motion matters, it's our focus. Motion can distinctly differentiate a machine and deliver a marketplace advantage by improving it's performance. This translates to overall increased efficiency on the factory floor. Perfectly deployed machine motion can make your customer's floor more reliable and efficient, enhance accuracy and improve operator safety. Motion also represents endless possibilities for innovation. We've always understood this potential, and have kept motion at our core, relentlessly developing products that offer precision control of speed, accuracy and position in machines that rely on complex motion.

KOLLMORGEN®

Because Motion Matters™

Table of Contents

N2 & EC Series Electric Cylinder Servo Systems

N2 with AKM23

EC2 with AKM23

Kollmorgen's
Electric Cylinder Servo Systems provide an unprecedented level of flexibility.

- The N2 and EC Series Electric Cylinders offer an unprecedented degree of flexibility. This flexibility enables solution to be optimized for the application requirements, reducing system cost and minimizing the electric cylinder size.
- The flexible design of the N2 and EC Series simplifies engineering design and system integration by providing an integrated gearing design of both timing belt and helical gearing.
- Integrated AKM brushless servomotor provides a system solution reducing application and engineering requirements as well as eliminates mechanical interface and interoperability issues. Stepper motors are also available.

Standard Configurable Electric Cylinder Designs:

	N2 Series	EC Series
Transport Screw	Precision ballscrew (2 and 5 [rev/in] pitch) Lead screw (5 and 8 [rev/in] pitch)	Precision ballscrew (3 to 32 [mm/rev] lead) Lead screw (4 [mm/rev] lead)
Integrated Gearing	Timing belt (1.0, 1.5, 2.0:1 ratios) Helical gear (2.5, 3.5, 12.0:1 ratios) Inline (direct coupled)	Timing belt (1.0, 1.5, 2.0:1 ratios) Helical gear (2.0, 2.5, 4.0, 5.0, 7.0, 10.0:1 ratios, model dependent) Inline (direct coupled)
Mounting Types	7 Parallel Mounts 5 Inline Mounts	8 Parallel Mounts 5 Inline Mounts
Rod-End Adapters	4 Types (English and Metric)	5 Types (English and Metric)
Stroke Lengths	Standard stroke (2 to 22.5 in) Custom stroke lengths available	Standard stroke lengths EC1 50 to 200 mm (7.87 in) EC2 50 to 750 mm (29.5 in) EC3 50 to 1000 mm (39.4 in) EC4 & EC5 50 to 1500 mm (59.1 in)

Options and Accessories

Electric Cylinder accessories and time-proven options have been designed for the industrial environment to simplify system integration. Options include limit switches, dual rod-end bearings, guide bearing, protective boot, and extended temperature ranges just to name a few. See the option and accessory section on pages 56 - 64 for more details.

N2 & EC Series Electric Cylinder Servo Systems

The Electric Cylinders Servo Systems are offered with three Kollmorgen brushless servo drive series to provide system flexibility. Let your application and system requirements determine what solution integrates the best.

- Single vendor solution for the complete electro-mechanical system ensures system interoperability and a single dedicated worldwide motion-control supplier for support.
- The Electric Cylinder Servo Systems are available in drive and control technologies ranging form simple and intuitive positioning drives to fully programmable IEC 61131 based control systems:
- The Electric Cylinder Servo Systems leverage multiple Kollmorgen Servo Drive/Controllers and the AKM brushless servomotors for complete system flexibility and industry leading servo response and precision.

Compact Drive High-Performance

S200 115 / 230 Vac

- Base Unit: Analog torque-and-velocity, step and direction, encoder following
- Network Option Cards (SynqNet, D-Link® Network for IEC 61131 Control)
- Indexer Option Card, Simple Positioning System
  - *180 motion tasks, incremental absolute positioning, Jog mode*
  - *Simple intuitive Graphical User Interface (GUI), no programming experience required*

Flexible Drive Universal Control Options & Power Range

S300 115 / 230 / 400 / 460 Vac

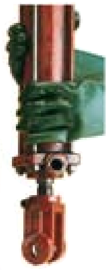
- Base Unit: Analog torque and velocity, CanOpen®, step and direction, encoder following
- Network Option Card solutions
- DeviceNet, Profibus DP, SynqNet, Ethercat®, SERCOS II, SERCOS III
- Simple Positioning System
  - *256 motion tasks, link motion tasks, ACCEL/DECEL control, S-curve*
  - *Incremental, absolute positioning, Jog mode and more*

Machine and motion Control IEC 61131 Integrated Controller/Drive

Smart Drive (SD) 115 / 230 / 400 / 460 Vac

- Fully Programmable IEC 61131 based Integrated Controller/Drive (1-16 axes)
- Ethernet network interface for motion that simplifies wiring, increases performance, reliability, and provides local and remote diagnostic capability
- Extensive library of motion control function blocks to reduce development time

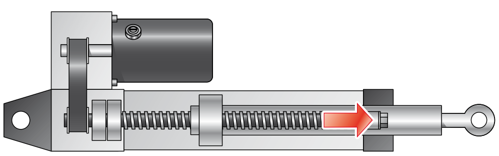
Electric Cylinder Features



Electric cylinders are direct descendents of hydraulic and pneumatic cylinders. Possessing many of the same unique design characteristics that made hydraulic and pneumatic cylinders popular, electric cylinders benefit from a cleaner and simpler power transmission. Decades of electric cylinder research and development has provided machine designers with a flexible, simple and unique approach to solving rigid or pivoting linear motion applications.

Electrically Powered, Maintenance Free

Today nearly all machines incorporate panel switches, sensors, lights, displays, PLCs or PCs. Electric power is nearly always available on the machine. Compressed air or hydraulic pumps are not always available or desirable. So why not simplify the machine by using the same control for all the axes of motion? A multi-axis programmable motor control can give you command of both rotary and linear motion. Lastly, the maintenance-free design provides another strong reason to consider electric cylinders in your next application.



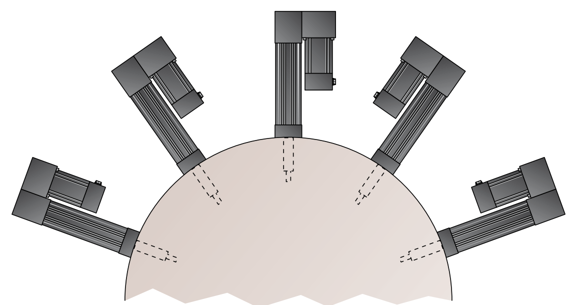
Straight Line Force Path

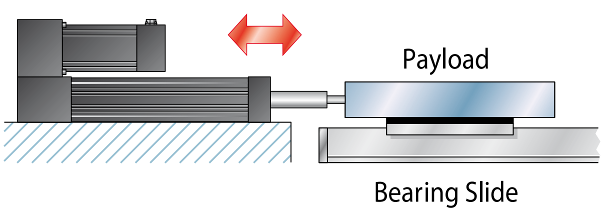
Straight-Line Thrust Transmission Use All Available Power

When high thrust is required, rod type cylinders have the advantage over other actuation means in that all the thrust transmitting components are in-line. This provides the simplest and most efficient means of transmitting thrust to the load.

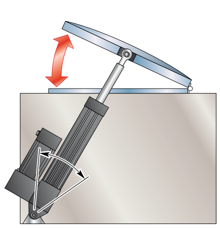
Non-Intrusive: Thrust Rod Can Clear Out of the Way.

A primary advantage of rod-type electric cylinders is the capability to extend into a work area during an operation and then retract to clear the area for subsequent operations. Another benefit of the rod-type design is that the motor and main body of the electric cylinder can be isolated from the work area. This is very useful when dealing with such hostile environments as vacuum, high temperature, or wash down applications.





Mounting examples…
Above: Rigid (side lug mounts)
Right: Pivot (clevis)



Mounting Flexibility

As in most aspects of design, a little creativity goes a long way when attaching a cylinder to a machine. Two general types of mounting styles are available, rigid and pivoting. Rigid mounting options include side-tapped holes, front and rear flanges, side lugs and side angle brackets. These typically restrict motion to straight-line travel paths. Pivoting mounts such as the clevis or trunnion allow the cylinder to move as a link in a dynamic assembly. There are many applications for this “arc-motion” – conveyor diverter gates, pivoting rollers, lid lifters for chemical chambers, “scissors clamps” and so on.

Electric Cylinders Are Preferred When:

- Positioning an externally guided and supported load.
- Moving a load that pivots.
- There is a high concentration of airborne contaminants (rodless positioners are inherently less well protected).
- Replacing a hydraulic or pneumatic cylinder with an electro-mechanical solution.

Kollmorgen offers electric cylinder drive mechanisms designed around either lead screws or ballscrews. Ballscrews, being the more efficient of the two, utilize ballnuts riding on recirculating ball bearings resulting in higher speeds, loads and cycle rates. However, the more efficient design of ballscrew technology lends it to being backdriven when power is removed if precautions are not taken (e.g., electric brakes or counter loading).

Lead screws are capable of holding the load in position when power is removed, but are less efficient in operation.

Kollmorgen's guide system prevents rotation of the ball / lead nut, thus eliminating any torque loading to machine linkage.

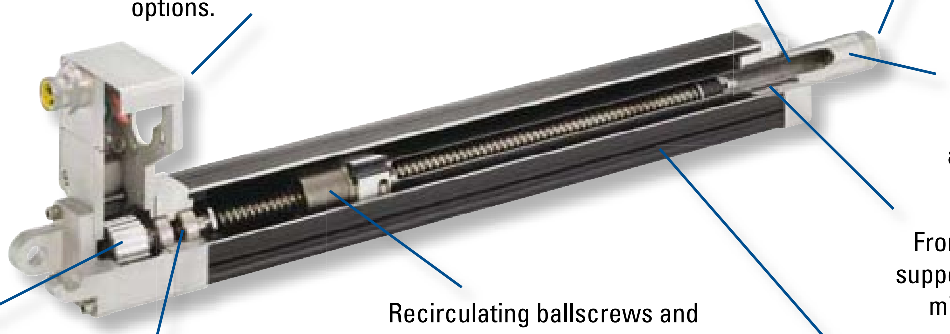
EC Servo Linear Positioners

- Designed for performance
- Highest quality precision rolled ballscrews and lead screws – for quiet, long-life operation
- Brushless Servo with encoder, resolver or SFD feedback
- Stepper motors are also available
- Sealed for IP54 protection and IP65 option available
- Thrust up to 25000 N [5620 lb]
- Speed up to 1.3 m/s [52.5 in/s]
- Metric design (ISO 6431)
- Available in 5 power ranges – EC1, 2, 3, 4 & 5

N2 Servo Linear Positioners

- Smallest Package Size
- Time-Proven Design
- Improved Durability Over Previous Designs
- Thrust up to 2670 N [600 lb]
- Speed up to 0.76 m/s [30 in/sec]
- English dimensions (to NFPA standards)
- Brushless Servo with encoder, resolver or SFD feedback

Typical Construction (EC2 cut-away shown)



Electric Cylinder Servo System: Specification Overview

Feature	N2		EC1	EC2		EC3		EC4	EC5
Std. Maximum Stroke Length [in (mm)]	* 22.5 (571.5)		7.87 (200)	29.53 (750)		39.37 (1000)		59.06 (1500)	59.06 (1500)
Type of Screw	Lead	Ball	Ball	Lead	Ball	Lead	Ball	Ball	Ball
Lead [displacement / rev]	0.2 in, 0.5 in	0.2 in, 0.5 in	0.125 in	4 mm	16, 5 mm	4 mm	16, 10, 5 mm	25, 10 mm	32, 10 mm
Nom. Lead Screw Diameter	0.625 in	0.625 in	0.375 in	16 mm	16 mm	20 mm	20 mm	25 mm	32 mm
Backlash [in (mm)]	0.016 (0.40)	0.015 (0.38)	0.015 (0.38)	0.016 (0.40)	0.010 (0.25)	0.016 (0.40)	0.010 (0.25)	0.12 (0.30)	0.12 (0.30)
Dimension Std.	English NFPA Std.		Metric ISO6431 Std.						
Bore size			30 mm	50 mm		63 mm		80 mm	100 mm
Brushless Servomotor	AKM23, NEMA 23		AKM1x, NEMA 17	AKM23, NEMA 23		AKM23, NEMA 23 AKM42, NEMA 34 AKM52, NEMA 42 **		AKM42, NEMA 34 AKM52, NEMA 42 **	AKM42, NEMA 34 AKM52, NEMA 42 **
Stepper Motor	Contact Factory		CTP12, NEMA 17	Contact Factory					
Max. Thrust [lb (N)]	600 (2670)		150 (667)	810 (3600)		1620 (7200)		2700 (12,000)	5620 (25,000)
Max. Velocity [in/sec (m/s)]	12 (0.3)	30 (0.76)	13 (0.33)	9.2 (0.23)	50 (1.27)	8.0 (0.20)	50 (1.28)	52.5 (1.33)	52.5 (1.33)
Max. Rated Duty Cycle (load, speed dependent) [%]	50	100	100	50	100	50	100	100	100
Limit Switches	Optional								
Std. Operating Temperature Range [C (F)]	0 to 60 (32 to 140)		-30 to 70 (-22 to 158)						
Moisture/ Contaminants	Humid, but Not Direct Contact		IP54 Std. IP65 Opt.						

Notes
* Requires dual rod-end bearing option for length over 12".
** NEMA 42 mount, shaft does not follow a NEMA std.

EC3

N2 Series Electric Cylinders: General Specifications

Travel Lengths

Cylinder	Stroke Designator/Effective Travel Lengths						
Stroke length designator [in]	2.0	4.0	6.0	8.0	12.0	*18.0	*24.0
Effective Travel Length [in]	2.0	4.0	6.0	8.0	12.0	16.5	22.5

* Dual rod-end bearing required for 18 inch and 24 inch stroke units.
* Effective travel reduced by 1.5 inches respectively with dual rod-end bearing. Custom travel lengths are available.

Construction Materials

Bearing Housings	Type 380 die cast aluminum, epoxy coated
Cylinder Housing	6063-T6 aluminum, hard-coated anodized and Teflon® coated
Thrust Tube	304 Series Stainless Steel, 1/4 hard, ground and polished
Wiper seal	Polyurethane

Speed Reducer Versions

Belt/Pulley	AT-5, polyurethane with steel tensile cords
Helical Gearing	Alloy steel, case hardened
Support Bearings	Ball bearings

Transport Screw Versions

Ballscrew	Carbon steel screw
Ballnut	Alloy steel, heat-treated ballnut
Lead screw	Carbon steel screw
Lead nut	Bronze lead nut (standard, recommended for servo system) (Lubricated polyacetal plastic drive nut also available but not recommended for use with servomotor based systems.)

System Specifications

Electric Cylinder	Screw-Nut Type	Pitch [revs/in]	Screw Diameter [in]	Efficiency [%]	Minimum Backdrive Load [lb]	Maximum Thrust [lb]	Maximum Speed [in/s]	Backlash [mm (in)]	Repeatability [mm/300mm (in/ft)]
N2-2B	Ballscrew	2.0	0.625	90	10	* 552	** 30	0.38 (0.015)	+/-0.15 (+/-0.006)
N2-5B	Ballscrew	5.0	0.625	90	20	600	12	0.38 (0.015)	+/-0.15 (+/-0.006)
N2-5A-BZ	Bronze	5.0	0.625	40	400	600	** 12	0.40 (0.016)	+/-0.75 (+/-0.003)

* Thrust limited by AKM23 motor/drive T peak limit.
** Maximum speed and Maximum Thrust specification define range of N2 series; not available on the same unit.
See Thrust Speed curves (pages 25, 26) for comprehensive details.

Weight (approximate, without options)

Cylinder- Motor	Weight [kg]	Weight [lbs]
N2-AKM23	= 2.28 + 0.11 x [in stroke]	= 5.0 + 0.25 x [in stroke]

Brushless Servomotor

Force Speed Cuves	See pages 25, 26
Servo System Specifications	See page 66
Dimensions	See page 118

N2 Series Electric Cylinders: Properties

Electric Cylinder	Screw Type	Pitch [revs/in]	Screw Efficiency [%]	Transmission			Overall Efficiency [%]
				Ratio	Type	Efficiency [%]	
N2-...-10L-2B	Ballscrew	2.0	90	Inline/direct coupled	N/A	N/A	90
N2-...-10-2B	Ballscrew	2.0	90	1:1	Timing belt	90	81
N2-...-15-2B	Ballscrew	2.0	90	1.5:1	Timing belt	90	81
N2-...-20-2B	Ballscrew	2.0	90	2.0:1	Timing belt	90	81
N2-...-25-2B	Ballscrew	2.0	90	2.5:1	Helical gear	70	63
N2-...-10L-5B	Ballscrew	5.0	90	Inline/direct coupled	N/A	90	90
N2-...-10-5B	Ballscrew	5.0	90	1:1	Timing belt	90	81
N2-...-15-5B	Ballscrew	5.0	90	1.5:1	Timing belt	90	81
N2-...-20-5B	Ballscrew	5.0	90	2.0:1	Timing belt	90	81
N2-...-25-5B	Ballscrew	5.0	90	2.5:1	Helical gear	70	63
N2-...-10L-5A	Lead	5.0	40	Inline/direct coupled	N/A	40	16
N2-...-10-5A	Lead	5.0	40	1:1	Timing belt	90	36
N2-...-15-5A	Lead	5.0	40	1.5:1	Timing belt	90	36
N2-...-20-5A	Lead	5.0	40	2.0:1	Timing belt	90	36
N2-...-25-5A	Lead	5.0	40	2.5:1	Helical gear	70	28

N2 Series Electric Cylinders - General Specifications

N2 Series Electric Cylinder Inertia						
Rotary Inertia (Reflected to Motor) = A + B* (Stroke, in) + C * (Load weight, lb)						
Model N2 Series	Ratio	Reduction type	Screw	A	B	C
				oz-in^2	oz-in^2 / in	oz-in^2 / lb
N2-…-10-5B	1:1	Belt/pulley	Pitch 5 revs/in Dia 0.625 in Ballscrew	0.5702	0.0685	0.0162
N2-…-15-5B	1.5:1			0.2756	0.03045	0.0072
N2-…-20-5B	2:1			0.1689	0.0171	0.0041
N2-…-10-2B	1:1	Belt/pulley	Pitch 2 revs/in Dia 0.625 in Ballscrew	0.6532	0.07555	0.1013
N2-…-15-2B	1.5:1			0.3126	0.03355	0.0450
N2-…-20-2B	2:1			0.1895	0.01899	0.0253
N2-…-10-5A	1:1	Belt/pulley	Pitch 5 revs/in Dia 0.625 in Lead Screw	0.06845	0.06845	0.0162
N2-…-15-5A	1.5:1			0.0304	0.0304	0.0072
N2-…-20-5A	2:1			0.0171	0.0171	0.0041

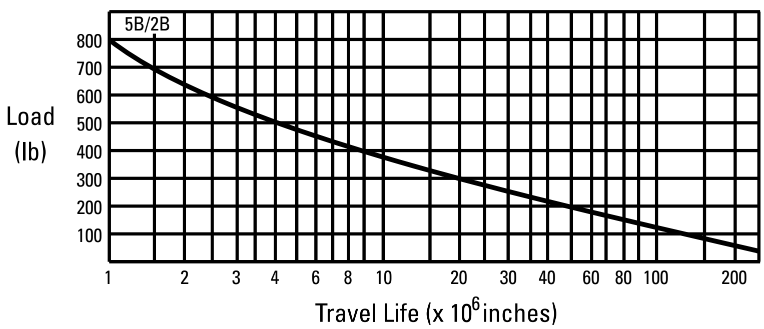
To convert inertia units from oz-in^2 to oz-in-sec^2 divide by 386.

N2 Series Electric Cylinders: General Specifications

Ballscrew Life

Ballscrew life is rated in inches of travel at a given load. The values in the chart below indicates the travel life where 90% of all units in a sample will continue to work, while 10% have failed. This is similar to the B10 rating of a roller bearing mechanism. Be sure to consider acceleration loads as well as thrust, gravity and friction loads.

Ballscrew Life: Load vs. Travel Life Chart



Environmental Operation (see Options and Accessories section, page 60-61)

Temperature
32° to 140°F, [0° to 60°C]
H High temperature option allows 32° to 160°F, [0° to 70°C]
F Sub-freezing temperature option allows -20° to 105°F, [-29° to 40°C]

Moisture
Humid, but not direct moisture contact
W Water resistant option allows some direct moisture contact

Contaminants
Non-corrosive, non-abrasive.
PB Protective Boot option prevents moisture and dry contaminants from entering the cylinder through the wiper ring on the rod

N2 with AKM23

EC Series Electric Cylinders: General Specifications

Travel Lengths

Cylinder	Travel Lengths [mm]										
EC1	50	100	150	200							
EC2	50	100	150	200	250	300	450	600	750		
EC3	50	100	150	200	250	300	450	600	750	1000		
EC4	50	100	150	200	250	300	450	600	750	1000	1250	1500
EC5	50	100	150	200	250	300	450	600	750	1000	1250	1500

Custom strokes available in increments of 1 mm.

Construction Materials

Bearing & Drive Housing	6063-T6 aluminum, anodized
Guide Cylinder	6063-T6 aluminum, hard anodized
Mounting Plates	6061-T6 aluminum and cast aluminum plate, anodized
Thrust Tube	300 Series Stainless Steel, 1/4 hard and ground
Thrust Bearings	Angular contact, high thrust ball bearings

Speed Reducer Versions

Belt/Pulley	AT-5, polyurethane with steel tensile cords
Helical Gearing	Alloy steel, case hardened

Transport Screw Versions

Ballscrew/Ballnut	Heat treated carbon steel alloy
Lead screw/Lead nut	Bronze; carbon steel alloy lead screw

Screw Properties					
Cylinder	Nominal Diameter [mm (in)]	Lead [mm (in)] / rev.			
		Lead Screw	Ballscrew		
EC1	(0.375)		3.175 (0.125)		
EC2	16	4 (0.157)	5 (0.197)	16 (0.630)	
EC3	20	4 (0.157)	5 (0.197)	10 (0.395)	16 (0.630)
EC4	25		10 (0.394)	25 (0.984)	
EC5	32		10 (0.394)	32 (1.259)	

Weight (approximate, without options)

Cylinder- Motor	Weight [kg]	Weight [lbs]
EC1-AKM11	= 0.864 + 0.162 x [mm stroke]	= 1.9 + 0.356 x [in stroke]
EC1-AKM13	= 1.136 + 0.162 x [mm stroke]	= 2.5 + 0.356 x [in stroke]
EC1-CTP12	= 0.764 + 0.162 x [mm stroke]	= 1.88 + 0.356 x [in stroke]
EC2-AKM23	= 4.18 + 0.006 x [mm stroke]	= 9.2 + 0.33 x [in stroke]
EC3-AKM23	= 5.75 + 0.008 x [mm stroke]	= 12.6 + 0.46 x [in stroke]
EC3-AKM42	= 6.70 + 0.008 x [mm stroke]	= 14.7 + 0.46 x [in stroke]
EC4-AKM42	= 14.7 + 0.0188 x [mm stroke]	= 32.2 + 1.05 x [in stroke]
EC4-AKM52	= 17.1 + 0.0188 x [mm stroke]	= 37.7 + 1.05 x [in stroke]
EC5-AKM42	= 14.7 + 0.0188 x [mm stroke]	= 32.2 + 1.05 x [in stroke]
EC5-AKM52	= 17.1 + 0.0188 x [mm stroke]	= 37.7 + 1.05 x [in stroke]

Brushless Servomotor

Force Speed Cuves

See pages EC1 (p.27),EC2 (p. 29, 30), EC3 (p. 31-33), EC4 (p. 34-36), EC5 (p. 37-39)

Servo System Specifications

See page 65-69

Dimensions

See page 117-120

Stepper Motor

Force Speed Cuves (p.28)

System Specifications and dimensions

See P7000 Selection Guide

See CT Series Selection Guide

EC Series Electric Cylinders: General Specifications

System Specifications - Backlash, Lead Accuracy

Cylinder	Lead [mm (in)]	Type	Backlash [mm (in)] /rev.	Lead Accuracy [mm/300mm (in/ft)]	Repeatability [mm (in)]
EC1	(0.125)	Ball	0.381 (0.015)	+/-0.10 (+/-0.004)	+/-0.013 (+/-0.0005)
EC2	16, 5	Ball	0.25 (0.010)	+/-0.05 (+/-0.002)	+/-0.013 (+/-0.0005)
	4	Lead	0.40 (0.016)	+/-0.10 (+/-0.004)	+/-0.013 (+/-0.0005)
EC3	16, 10, 5	Ball	0.25 (0.010)	+/-0.05 (+/-0.002)	+/-0.013 (+/-0.0005)
	4	Lead	0.40 (0.016)	+/-0.10 (+/-0.004)	+/-0.013 (+/-0.0005)
EC4	25, 10	Ball	0.30 (0.012)	+/-0.05 (+/-0.002)	+/-0.013 (+/-0.0005)
EC5	32, 10	Ball	0.30 (0.012)	+/-0.05 (+/-0.002)	+/-0.013 (+/-0.0005)

EC2 and EC3 with AKM23

EC Series Electric Cylinders: General Specifications

Environmental Operation

Temperature

-30° to 70°C [-22° to 158°F]
When operating below 2°C [35°F] vent tubing fitting must be installed.
Consult the factory for more information.

Moisture/Contaminants

IP 54 rated: Polyurethane thrust tube wiper seal.
Mating surfaces gasket sealed. Protected against dust and splashing water (non-corrosive, non-abrasive).
Limited ingress permitted.

Vent Tube Fitting: A vent tube fitting is included, which can be installed to permit the Linear Positioner to breathe from a non-contaminated area, or receive a positive pressure continuous purge (14-20 kPa [2-3 psi]).

PB Protective Boot (IP65) Option: An optional thrust tube boot prevents moisture and dry contaminants from bypassing the thrust tube wiper seal, providing IP65 protection when used with included vent tube fitting. The boot also prevents contaminant buildup on the thrust tube.

Clean Room & Vacuum Applications: Kollmorgen has designed special positioners for clean room and vacuum applications. Please consult the factory if your application requires special environmental compatibility.

Maintenance

The EC Series Linear Positioner design eliminates the need for most routine maintenance. Re-lubrication is required in high cycle applications. See the EC Series Operator’s Manual for replacement parts.

Lube Port

EC2 - EC5 models include a lube port and adapter for a standard grease gun.

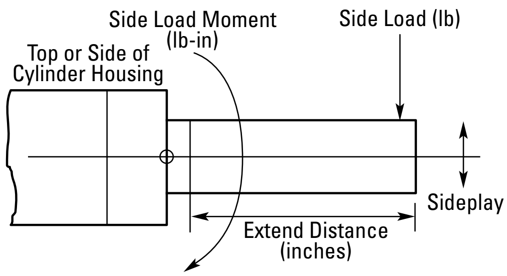
EC4 with AKM42

EC Series Electric Cylinders: General Specifications

Thrust Tube Torque Capacity

Thrust tube does not rotate during operation.
Maximum allowable torque during operation and installation is shown in the following table:

	Torque Capacity [lb-in (N-m)]
EC1	18 (2.0)
EC2	45 (5.0)
EC3	67 (7.5)
EC4	90 (10)
EC5	90 (10)

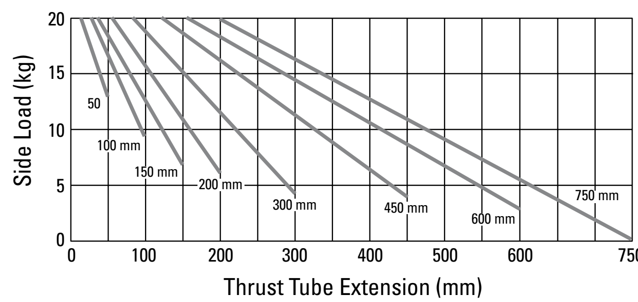


Thrust Tube Side Load Capacity vs. Extension

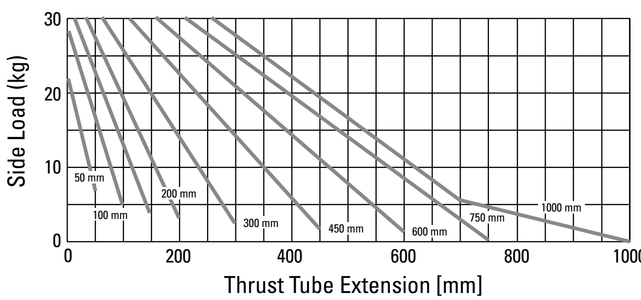
EC1

* Side loading is not recomended with the EC1.
Side loading will reduce the EC1 life.

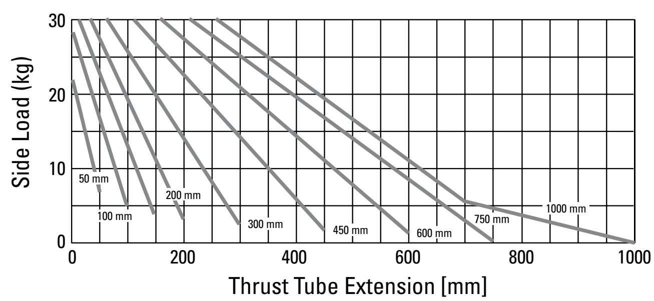
EC2



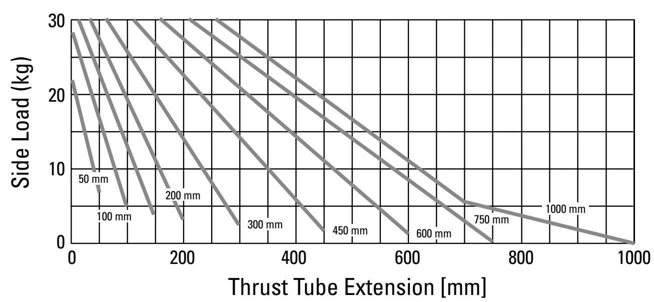
EC3



EC4



EC5



EC Series Electric Cylinders: General Specifications

Life

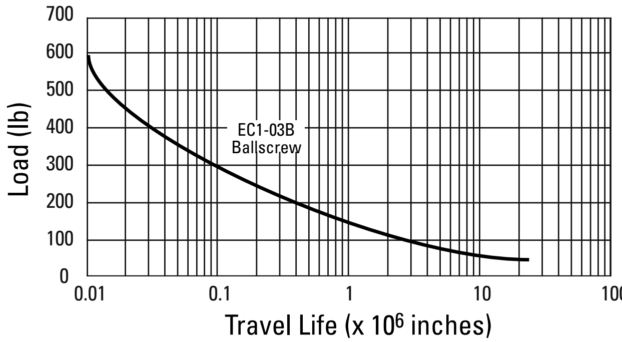
Ballscrew

Ballscrew life is rated in inches of travel at a given load. The values in the chart indicate the travel life where 90% of all units in a sample will continue to work, while 10% have failed. This is similar to the B10 rating of a roller bearing mechanism. Be sure to consider acceleration loads as well as thrust, gravity and friction loads.

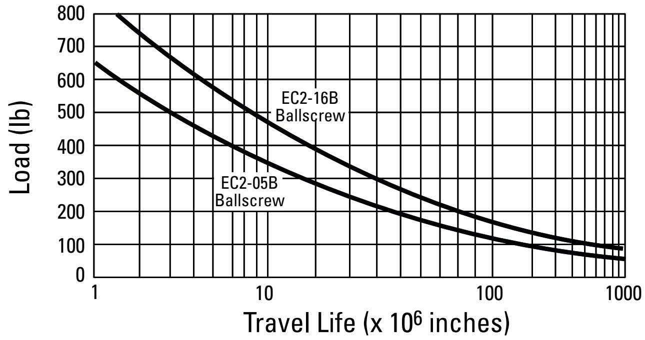
Lead Screw

Usable life for a lead screw is defined as the length of travel completed before backlash (of lead screw/nut) exceeds 0.020" [0.5 mm]. A travel life of 25 km [1 million inches] under the maximum rated load can be used as a general approximation. However, since directly dependent on application conditions (load, duty cycle, move profiles, and environment), it is difficult to predict a statistical travel life.

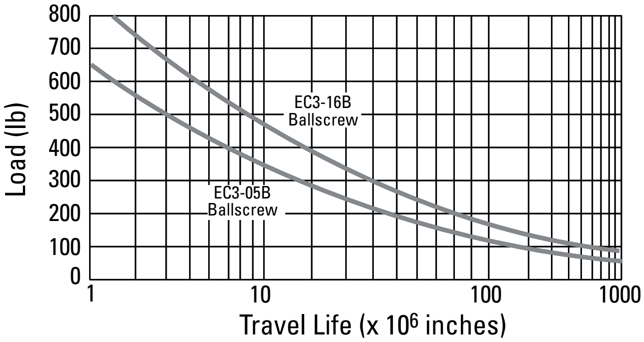
EC1-03B Ballscrew Life



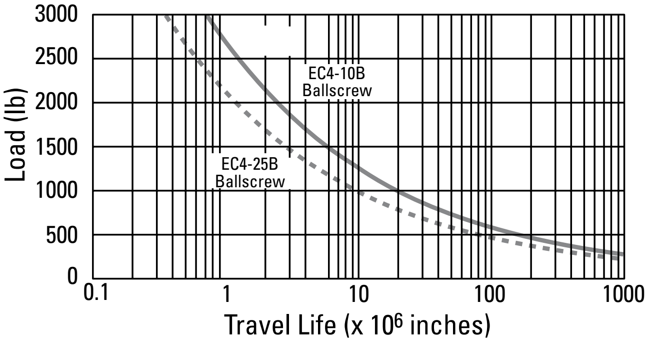
EC2 Ballscrew Life



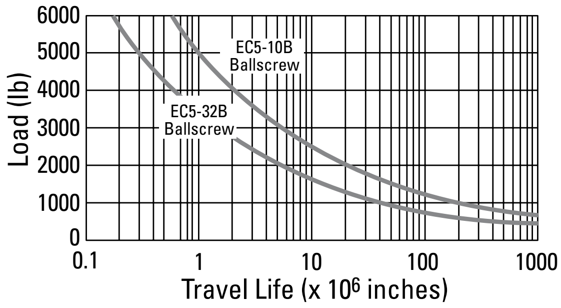
EC3 Ballscrew Life



EC4 Ballscrew Life



EC5 Ballscrew Life



EC Series Electric Cylinders: General Specifications

EC Series Linear Positioner Inertia						
Rotary Inertia (Reflected to Motor) = A + B* (Stroke, in) + C * (Load, lb)						
Model EC Series	Ratio	Reduction type	Screw	A	B	C
			Dia x Lead [mm (in)]	lb-in-s2	lb-in-s2 / in	lb-in-s2 / lb
EC1-...-10(L)-03B	1:1			1.74 E-04	4.98 E-06	1.53 E-06
EC1-...-20-03B	2:1	Helical gear	(0.375 x 0.125)	5.60 E-05	1.24 E-05	3.81 E-07
EC1-...-40-03B	4:1			3.15 E-05	1.97 E-06	6.05 E-08
EC2-…-10(L)-16B	1:1			3.18 E-04	1.07 E-05	2.60 E-05
EC2-…-15-16B	1.5:1	Belt/pulley		1.54 E-04	4.96 E-06	1.20 E-05
EC2-…-20-16B	2:1		16 x 16	1.01 E-04	2.68 E-06	6.51 E-06
EC2-…-50-16B	5:1	Helical gear		5.37 E-05	4.25 E-07	1.03 E-06
EC2-…-100-16B	10:1			4.60 E-05	1.07 E-07	2.60 E-07
EC2-…-10(L)-05B	1:1			2.90 E-04	8.30 E-06	2.54 E-06
EC2-…-15-05B	1.5:1	Belt/pulley		1.41 E-04	3.84 E-06	1.18 E-06
EC2-…-20-05B	2:1		16 x 5	9.33 E-05	2.07 E-06	6.36 E-07
EC2-…-50-05B	5:1	Helical gear		5.25 E-05	3.29 E-07	1.01 E-07
EC2-…-100-05B	10:1			4.57 E-05	8.29 E-08	2.54 E-08
EC2-…-10(L)-04A	1:1			2.89 E-04	8.20 E-06	1.63 E-06
EC2-…-15-04A	1.5:1	Belt/pulley		1.41 E-04	3.79 E-06	7.53 E-07
EC2-…-20-04A	2:1		16 x 4	9.33 E-05	2.05 E-06	4.07 E-07
EC2-…-50-04A	5:1	Helical gear		5.25 E-05	3.25 E-07	6.45 E-08
EC2-…-100-04A	10:1			4.57 E-05	8.19 E-08	1.626 E-08

EC1 with AKM13

EC2 with AKM23

EC Series Electric Cylinders: General Specifications

EC Series Linear Positioner Inertia						
Rotary Inertia (Reflected to Motor) = A + B* (Stroke, in) + C * (Load, lb)						
Model	Ratio	Reduction type	Screw	A	B	C
EC 3 Series			Dia x Lead [mm (in)]	lb-in-s2	lb-in-s2 / in	lb-in-s2 / lb
EC3-…-10(L)-16B	1:1	Belt/pulley	16 x 16	1.19 E-03	1.18 E-05	2.60 E-05
EC3-…-15-16B	1.5:1	Belt/pulley	16 x 16	7.44 E-04	5.23 E-06	1.16 E-05
EC3-…-20-16B	2:1	Belt/pulley	16 x 16	4.78 E-04	2.77 E-06	6.12 E-06
EC3-…-50-16B	5:1	Helical gear	16 x 16	2.28 E-04	4.64 E-07	1.03 E-06
EC3-…-70-16B	7:1	Helical gear	16 x 16	1.98 E-04	2.40 E-07	5.31 E-07
EC3-…-10(L)-10B	1:1	Belt/pulley	20 x 10	1.20 E-03	1.87 E-05	1.02 E-05
EC3-…-15-10B	1.5:1	Belt/pulley	20 x 10	7.43 E-04	8.33 E-06	4.52 E-06
EC3-…-20-10B	2:1	Belt/pulley	20 x 10	4.81 E-04	4.41 E-06	2.39 E-06
EC3-…-50-10B	5:1	Helical gear	20 x 10	2.29 E-04	7.38 E-07	4.01 E-07
EC3-…-70-10B	7:1	Helical gear	20 x 10	1.98 E-04	3.82 E-07	2.08 E-07
EC3-…-10(L)-05B	1:1	Belt/pulley	20 x 5	1.20 E-03	1.87 E-05	1.02 E-05
EC3-…-15-05B	1.5:1	Belt/pulley	20 x 5	7.49 E-04	8.33 E-06	4.52 E-06
EC3-…-20-05B	2:1	Belt/pulley	20 x 5	4.81 E-04	4.41 E-06	2.39 E-06
EC3-…-50-05B	5:1	Helical gear	20 x 5	2.28 E-04	6.95 E-07	1.00 E-07
EC3-…-70-05B	7:1	Helical gear	20 x 5	1.97 E-04	3.60 E-07	5.19 E-08
EC3-…-10(L)-04A	1:1	Belt/pulley	20 x 4	2.89 E-04	8.20 E-06	1.63 E-06
EC3-…-15-04A	1.5:1	Belt/pulley	20 x 4	1.41 E-04	3.79 E-06	7.53 E-07
EC3-…-20-04A	2:1	Belt/pulley	20 x 4	9.33 E-05	2.05 E-06	4.07 E-07
EC3-…-50-04A	5:1	Helical gear	20 x 4	5.25 E-05	3.25 E-07	6.45 E-08
EC3-…-70-04A	7:1	Helical gear	20 x 4	4.57 E-05	8.19 E-08	1.63 E-08

EC3 with AKM23

EC Series Electric Cylinders: General Specifications

EC Series Linear Positioner Inertia						
Rotary Inertia (Reflected to Motor) = A + B* (Stroke, in) + C * (Load, lb)						
Model	Ratio	Reduction type	Screw	A	B	C
EC 4 Series			Dia x Lead [mm (in)]	lb-in-s^2	lb-in-s^2 / in	lb-in-s^2 / lb
EC4-…-10(L)-25B	1:1	Belt/pulley	25 x 25	4.91 E-03	7.01 E-05	6.36 E-05
EC4-…-15-25B	1.5:1			2.80 E-03	3.18 E-05	2.83 E-05
EC4-…-20-25B	2:1			2.71 E-03	1.75 E-05	1.59 E-05
EC4-…-50-25B	5:1	Helical gear		6.27 E-04	2.69 E-06	2.43 E-06
EC4-…-100-25B	10:1			3.47 E-04	7.00 E-07	6.35 E-07
EC4-…-10(L)-10B	1:1	Belt/pulley	25 x 10	4.68 E-03	5.54 E-05	1.02 E-05
EC4-…-15-10B	1.5:1			2.70 E-03	2.46 E-05	4.52 E-06
EC4-…-20-10B	2:1			2.65 E-03	1.39 E-05	2.54 E-06
EC4-…-50-10B	5:1	Helical gear		6.18 E-04	2.12 E-06	3.90 E-07
EC4-…-100-10B	10:1			3.45 E-04	5.53 E-07	1.020 E-07

Model	Ratio	Reduction type	Screw	A	B	C
EC 5 Series			Dia x Lead [mm (in)]	lb-in-s^2	lb-in-s^2 / in	lb-in-s^2 / lb
EC5-...-10(L)-32B	1:1	Belt/pulley	32 x 32	5.63 E-03	1.67 E-04	1.04 E-04
EC5-...-15-32B	1.5:1			3.12 E-03	7.41 E-05	4.63 E-05
EC5-...-20-32B	2:1			2.89 E-03	4.17 E-05	2.60 E-05
EC5-...-50-32B	5:1	Helical gear		6.54 E-04	6.38 E-06	3.99 E-06
EC5-...-100-32B	10:1			3.55 E-04	1.66 E-06	1.04 E-06
EC5-...-10(L)-10B	1:1	Belt/pulley	32 x 10	5.16 E-03	1.41 E-04	1.02 E-05
EC5-...-15-10B	1.5:1			2.91 E-03	6.26 E-05	4.52 E-06
EC5-...-20-10B	2:1			2.78 E-03	3.52 E-05	2.54 E-06
EC5-...-50-10B	5:1	Helical gear		6.37 E-04	5.39 E-06	3.90 E-07
EC5-...-100-10B	10:1			3.50 E-04	1.41 E-06	1.02 E-07

Electric Cylinder - Servo System: Quick Selection Guide

Thrust (cont) lb	Speed (in/sec) - Low Speed: 1	2	4	6	8	10	12
50	EC1-10(L)-03B / 13C	EC1-10(L)-03B / 13C	EC1-10(L)-03B / 13C	EC1-10(L)-03B / 13C	EC1-10(L)-03B / 13C	EC1-10(L)-03B / 13C	EC1-10(L)-03B / 13C
100	EC1-20-03B / 13C	EC1-20-03B / 13C	EC1-20-03B / 13C	EC1-20-03B / 13C	N2-15-5B / 23D	N2-15-5B / 23D	N2-15-5B / 23D
150	EC1-40-03B / 11C	EC1-40-03B / 11C	N2-15-5B / 23D	N2-15-5B / 23D	N2-15-5B / 23D	N2-15-5B / 23D	N2-15-5B / 23D
200	N2-25-5B / 23D	N2-25-5B / 23D	N2-25-5B / 23D	N2-20-5B / 23D	N2-15-5B / 23D	EC2-15-05B / 23D	EC2-15-05B / 23D
300	N2-25-5B / 23D	N2-25-5B / 23D	N2-25-5B / 23D	N2-20-5B / 23D	EC2-20-05B / 23D	EC3-10-05B / 42G	EC2-15-05B / 23D
400	N2-20-5B / 23D	N2-20-5B / 23D	EC2-20-05B / 23D	N2-20-5B / 23D	EC3-15-05B / 42G	EC3-10-05B / 42G	EC2-15-05B / 23D
500	EC2-50-05B / 23D	EC2-50-05B / 23D	EC2-20-05B / 23D	EC2-20-05B / 23D	EC3-15-05B / 42G	EC3-10-05B / 42G	EC3-15-10B / 42G
600	EC2-50-05B / 23D	EC2-50-05B / 23D	EC2-20-05B / 23D	EC2-20-05B / 23D	EC3-15-05B / 42G	EC4-10-10B / 52G	EC4-20-10B / 52L
700	EC3-50-05B / 23D	EC2-50-05B / 23D	EC3-50-10B / 42G	EC3-15-05B / 42G	EC3-15-05B / 42G	EC4-10-10B / 52G	EC4-20-10B / 52L
800	EC3-50-05B / 23D	EC2-50-05B / 23D	EC3-50-10B / 42G	EC3-15-05B / 42G	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L
900	EC3-50-10B / 42G	EC3-50-10B / 42G	EC4-20-10B / 52G	EC3-15-05B / 42G	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L
1000	EC3-50-10B / 42G	EC3-50-10B / 42G	EC4-20-10B / 52G	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L
1100	EC3-50-10B / 42G	EC3-50-10B / 42G	EC4-20-10B / 52G	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L
1200	EC3-50-10B / 42G	EC3-50-10B / 42G	EC4-20-10B / 52G	EC4-20-10B / 52L	EC4-20-10B / 52L	EC4-20-10B / 52L	
1300	EC4-20-10B / 52G	EC4-20-10B / 52G	EC4-20-10B / 52G	EC4-20-10B / 52L			
1400	EC4-20-10B / 52G	EC4-20-10B / 52G	EC4-20-10B / 52G				
1500	EC4-50-10B / 42G	EC4-20-10B / 52L					

Thrust (cont) lb	Speed (in/sec) - High Speed: 16	20	24	30	36	42	50
50	N2-15-2B / 23D	N2-15-2B / 23D	N2-10-2B / 23D	N2-10-2B / 23D	EC2-15-16B / 23D	EC2-15-16B / 23D	EC2-10-16B / 23D
75	N2-15-2B / 23D	N2-15-2B / 23D	N2-10-2B / 23D	N2-10-2B / 23D	EC2-15-16B / 23D	EC3-10-16B / 42G	EC4-10-25B / 42G
100	N2-15-2B / 23D	N2-15-2B / 23D	EC2-20-16B / 23D	EC3-15-16B / 42G	EC3-10-16B / 42G	EC3-10-16B / 42G	EC4-10-25B / 42G
150	EC2-10-05B / 23D	EC3-10-10B / 42G	EC3-15-16B / 42G	EC3-10-16B / 42G	EC3-10-16B / 42G	EC4-15-25B / 42G	EC4-10-25B / 52L
200	EC3-15-10B / 42G	EC3-10-10B / 42G	EC3-15-16B / 42G	EC4-20-25B / 42G	EC4-15-25B / 52L	EC4-15-25B / 52L	EC4-10-25B / 52L
245	EC3-15-10B / 42G	EC3-10-10B / 42G	EC3-15-16B / 42G	EC4-20-25B / 52L	EC4-15-25B / 52L	EC4-15-25B / 52L	EC5-15-32B / 52L
290	EC3-15-10B / 42G	EC4-10-10B / 52L	EC4-20-25B / 52L	EC4-20-25B / 52L	EC4-15-25B / 52L	EC4-15-25B / 52L	
340	EC3-15-10B / 42G	EC4-10-10B / 52L	EC4-20-25B / 52L	EC4-20-25B / 52L	EC4-15-25B / 52L		
400	EC4-15-25B / 52G	EC4-10-10B / 52L	EC4-20-25B / 52L	EC4-20-25B / 52L			
460	EC4-15-10B / 52L	EC4-10-10B / 52L	EC4-20-25B / 52L				
600	EC4-15-10B / 52L	EC4-10-10B / 52L					
775	EC4-15-10B / 52L						

Quick Selection Guide Reference

Systems listed in charts represent the most economical package to meet the criterion.

1) Select chart for application speed range
   Top Chart - Low Speed - Speeds up to rated linear speed of 12 in/sec
   Bottom Chart - High Speed - Speeds greater than 12 in/sec
2) Select system by required continuous thrust (lbs) and required rated speed (in/sec).

Other applications considerations (system resolution, inertia ratio, desired safety margins, etc) may result in selection of a different system. For additional S200 system specifications see pages 71-73. For detailed force speed system curves for drives series, S200, S300 and Smart Drive , see pages 25-39.

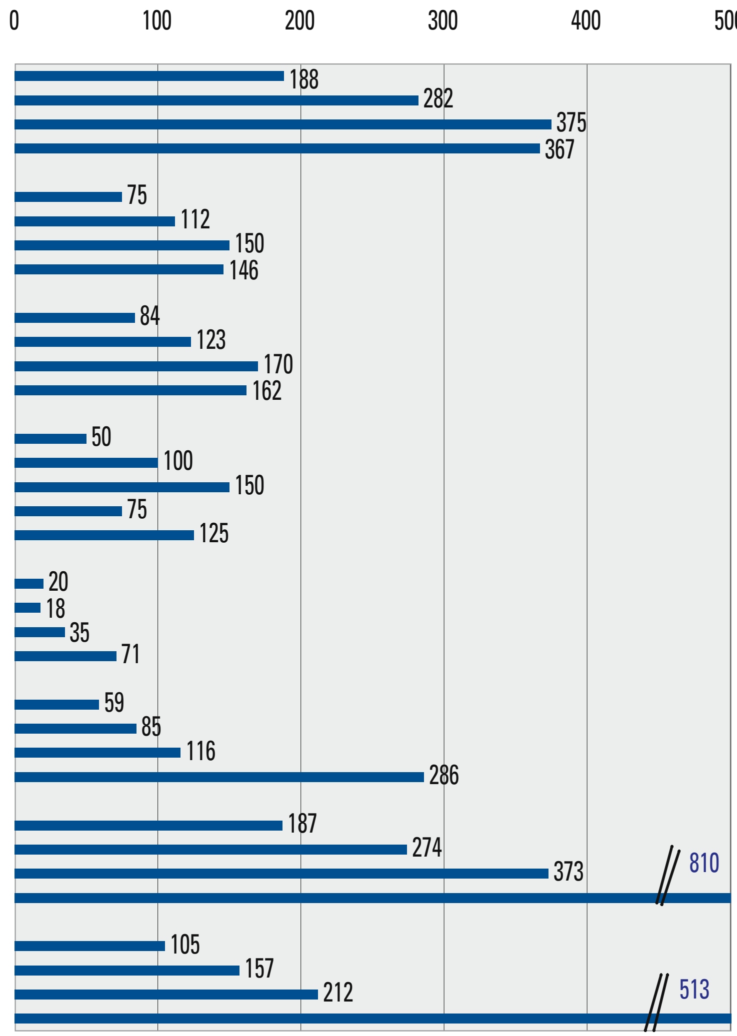
Performance data represents continuous thrust (lb) at rated speed (in/s).
Based on S200 amplifier with 230 Vac, 3 phase supply.

System Performance Summary - N2, EC1, EC2 Series

Pg	System	Cont Thrust @ Speed		Peak Thrust @ Speed		Max Thrust
		lb	in/s	lb	in/s	lb
25	N2-AKM23D-■■■-10-5B	188	12.0	600	11.0	600
25	N2-AKM23D-■■■-15-5B	282	8.0	600	8.0	600
25	N2-AKM23D-■■■-20-5B	375	6.0	600	6.0	600
25	N2-AKM23D-■■■-25-5B	367	4.8	600	4.8	600
25	N2-AKM23D-■■■-10-2B	75	30.0	275	25.0	275
25	N2-AKM23D-■■■-15-2B	112	20.0	415	16.7	415
25	N2-AKM23D-■■■-20-2B	150	15.0	552	12.5	552
25	N2-AKM23D-■■■-25-2B	146	12.0	536	10.0	536
26	N2-AKM23D-■■■-10-5A	84	12.0	306	10.0	306
26	N2-AKM23D-■■■-15-5A	123	8.0	460	6.6	460
26	N2-AKM23D-■■■-20-5A	170	6.0	600	5.4	600
26	N2-AKM23D-■■■-25-5A	162	5.0	596	4.0	600
27	EC1-AKM11B-■■■-10-03B	50	13.0	75	13.0	75
27	EC1-AKM11B-■■■-20-03B	100	6.0	125	6.0	125
27	EC1-AKM11B-■■■-40-03B	150	3.0	150	3.0	150
27	EC1-AKM13C-■■■-10-03B	75	11.5	75	13.0	75
27	EC1-AKM13C-■■■-20-03B	125	5.9	125	6.0	125
28	EC1-CTP12■LF10-10L-03B	20	5.0	75	1.4	75
28	EC1-CTP12■LF10-10-03B	18	5.0	75	1.2	75
28	EC1-CTP12■LF10-20-03B	35	2.5	125	0.74	125
28	EC1-CTP12■LF10-40-03B	71	1.25	150	0.61	150
29	EC2-AKM23D-■■■-10-16B	59	50.0	220	32.0	220
29	EC2-AKM23D-■■■-15-16B	85	35.0	293	23.2	320
29	EC2-AKM23D-■■■-20-16B	116	26.0	251	21.0	357
29	EC2-AKM23D-■■■-50-16B	286	7.2	810	7.2	810
30	EC2-AKM23D-■■■-10-05B	187	16.0	700	10.0	700
30	EC2-AKM23D-■■■-15-05B	274	11.0	810	8.0	810
30	EC2-AKM23D-■■■-20-05B	373	8.2	802	6.6	810
30	EC2-AKM23D-■■■-50-05B	810	2.3	810	2.3	810
30	EC2-AKM23D-■■■-10-04A	105	9.2	390	7.8	390
30	EC2-AKM23D-■■■-15-04A	157	6.2	521	5.8	572
30	EC2-AKM23D-■■■-20-04A	212	4.6	455	4.6	600
30	EC2-AKM23D-■■■-50-04A	513	1.8	810	1.8	810

Ratings are based on the AKM servomotor and the matching S200 Drive.
See pages 65,66 for details on Drive & Motor System combinations.
Specifications are based on 230 Vac, 3 phase voltage supply.
Force Speed Curves located on pages 25-30.

Continuous Thrust (lb) @ Speed



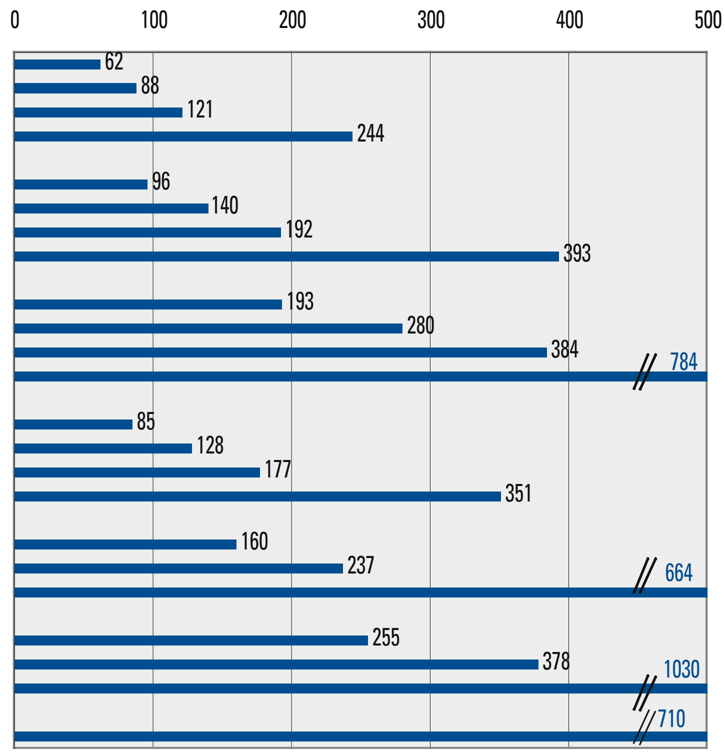
Plotted value is continuous thrust (lb), refer to chart for the associated rated speed value.

System Performance Summary - EC3 Series

Pg	System	Cont Thrust @ Speed		Peak Thrust @ Speed		Max Thrust
		lb	in/s	lb	in/s	lb
31	EC3-AKM23D-■■■-10-16B	62	50.0	219	31.5	219
31	EC3-AKM23D-■■■-15-16B	88	35.0	330	20.0	330
31	EC3-AKM23D-■■■-20-16B	121	25.0	452	12.8	452
31	EC3-AKM23D-■■■-50-16B	244	6.3	890	6.3	900
31	EC3-AKM23D-■■■-10-10B	96	21.0	350	19.7	350
31	EC3-AKM23D-■■■-15-10B	140	21.0	525	13.0	525
31	EC3-AKM23D-■■■-20-10B	192	16.0	723	10.0	723
31	EC3-AKM23D-■■■-50-10B	393	3.9	1430	3.9	1430
32	EC3-AKM23D-■■■-10-05B	193	10.3	700	10.3	700
32	EC3-AKM23D-■■■-15-05B	280	10.3	1050	6.0	1050
32	EC3-AKM23D-■■■-20-05B	384	8.0	1440	5.0	1440
32	EC3-AKM23D-■■■-50-05B	784	2.0	1610	2.0	1610
32	EC3-AKM23D-■■■-10-04A	85	7.9	311	7.8	311
32	EC3-AKM23D-■■■-15-04A	128	5.2	470	5.2	470
32	EC3-AKM23D-■■■-20-04A	177	3.8	640	3.8	640
32	EC3-AKM23D-■■■-50-04A	351	1.6	1270	1.6	1270
33	EC3-AKM42G-■■■-10-16B	160	42.2	601	24.0	627
33	EC3-AKM42G-■■■-15-16B	237	28.0	515	23.0	725
33	EC3-AKM42G-■■■-50-16B	664	6.2	1610	6.2	1610
33	EC3-AKM42G-■■■-10-10B	255	21.0	962	15.1	1000
33	EC3-AKM42G-■■■-15-10B	378	17.6	824	14.4	1059
33	EC3-AKM42G-■■■-50-10B	1030	3.9	1610	3.9	1610
33	EC3-AKM42G-■■■-15-05B	710	10.3	1620	7.74	1620

Ratings are based on the AKM servomotor and the matching S200 Drive.
See pages 66,67 for details on Drive & Motor System combinations.
Specifications are based on 230 Vac, 3 phase voltage supply.
Force Speed Curves located on pages 31-33.

Continuous Thrust (lb) @ Speed



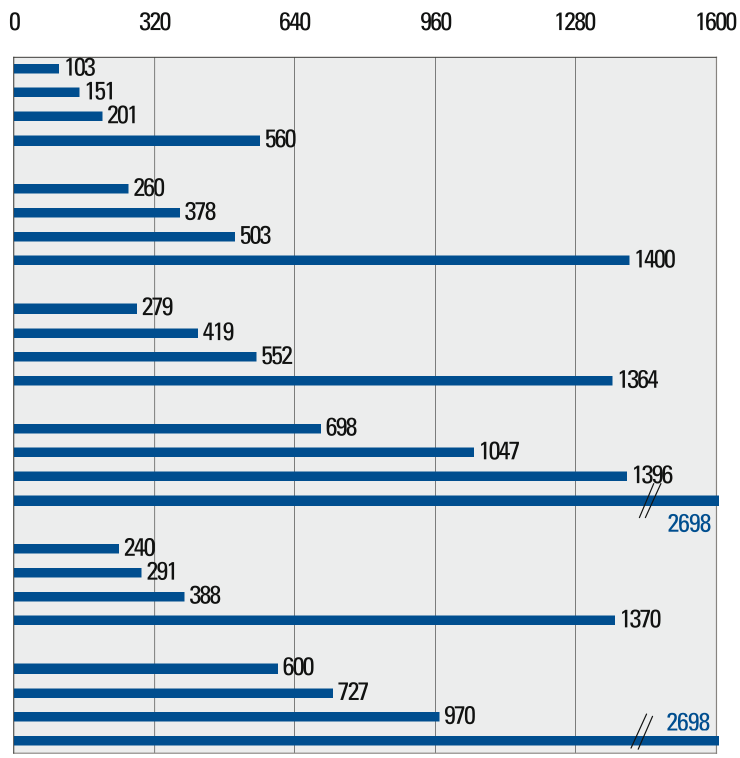
Plotted value is continuous thrust (lb), refer to chart for the associated rated speed value.

System Performance Summary - EC4 Series

Pg	System	Cont Thrust @ Speed		Peak Thrust @ Speed		Max Thrust
		lbs	in/s	lbs	in/s	lbs
34	EC4-AKM42G-■■■-10-25B	103	52.0	400	35.4	400
34	EC4-AKM42G-■■■-15-25B	151	44.0	600	23.6	600
34	EC4-AKM42G-■■■-20-25B	201	33.0	800	17.7	800
34	EC4-AKM42G-■■■-50-25B	560	5.1	1958	5.1	1958
34	EC4-AKM42G-■■■-10-10B	260	21.0	1000	14.2	1002
34	EC4-AKM42G-■■■-15-10B	378	17.5	1504	9.5	1504
34	EC4-AKM42G-■■■-20-10B	503	13.2	2005	7.1	2005
34	EC4-AKM42G-■■■-50-10B	1400	2.0	2700	2.0	2700
35	EC4-AKM52G-■■■-10-25B	279	26.6	481	22.6	692
35	EC4-AKM52G-■■■-15-25B	419	17.8	880	14.0	1041
35	EC4-AKM52G-■■■-20-25B	552	13.3	925	11.8	1199
35	EC4-AKM52G-■■■-50-25B	1364	5.2	2374	4.4	2374
35	EC4-AKM52G-■■■-10-10B	698	10.6	1204	9.4	1704
35	EC4-AKM52G-■■■-15-10B	1047	7.1	2200	5.6	2602
35	EC4-AKM52G-■■■-20-10B	1396	5.3	2320	4.6	2698
35	EC4-AKM52G-■■■-50-10B	2698	2.1	2698	2.1	2698
36	EC4-AKM52L-■■■-10-25B	240	52.5	420	52.5	725
36	EC4-AKM52L-■■■-15-25B	291	46.5	741	43.1	1087
36	EC4-AKM52L-■■■-20-25B	388	34.9	784	33.0	1180
36	EC4-AKM52L-■■■-50-25B	1370	5.1	2374	5.1	2374
36	EC4-AKM52L-■■■-10-10B	600	21.0	1055	21.0	1526
36	EC4-AKM52L-■■■-15-10B	727	18.6	1852	17.2	2698
36	EC4-AKM52L-■■■-20-10B	970	13.9	1960	13.2	2645
36	EC4-AKM52L-■■■-50-10B	2698	2.1	2698	2.1	2698

Ratings are based on the AKM servomotor and the matching S200 Drive.
See pages 67-69 for details on Drive & Motor System combinations.
Specifications are based on 230 Vac, 3 phase voltage supply.
Force Speed Curves located on pages 34-36.

Continuous Thrust (lb) @ Speed



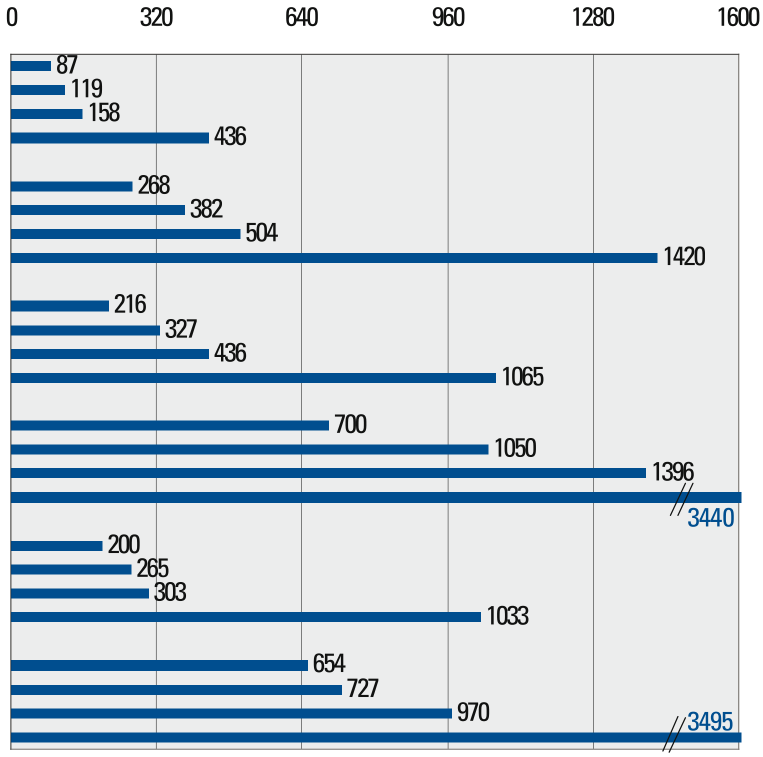
Plotted value is continuous thrust (lb), refer to chart for the associated rated speed value.

System Performance Summary - EC5 Series

Pg	System	Cont Thrust @ Speed		Peak Thrust @ Speed		Max Thrust
		lbs	in/s	lbs	in/s	lbs
37	EC5-AKM42G-■■■-10-32B	87	52.5	313	45.4	313
37	EC5-AKM42G-■■■-15-32B	119	52.5	470	30.2	470
37	EC5-AKM42G-■■■-20-32B	158	42.2	627	22.7	627
37	EC5-AKM42G-■■■-50-32B	436	6.6	1530	6.6	1530
37	EC5-AKM42G-■■■-10-10B	268	15.2	1002	14.2	1002
37	EC5-AKM42G-■■■-15-10B	382	15.2	1500	9.4	1500
37	EC5-AKM42G-■■■-20-10B	504	13.2	2000	7.1	2000
37	EC5-AKM42G-■■■-50-10B	1420	2.0	4895	2.0	4895
38	EC5-AKM52G-■■■-10-32B	216	34.2	376	28.7	541
38	EC5-AKM52G-■■■-15-32B	327	22.7	694	17.2	814
38	EC5-AKM52G-■■■-20-32B	436	17.0	723	15.0	1045
38	EC5-AKM52G-■■■-50-32B	1065	6.6	1854	5.7	1854
38	EC5-AKM52G-■■■-10-10B	700	10.6	1204	9.0	1730
38	EC5-AKM52G-■■■-15-10B	1050	7.0	2200	5.5	2602
38	EC5-AKM52G-■■■-20-10B	1396	5.3	2238	4.5	3343
38	EC5-AKM52G-■■■-50-10B	3440	2.1	5600	1.8	5600
39	EC5-AKM52L-■■■-10-32B	200	52.5	340	52.5	477
39	EC5-AKM52L-■■■-15-32B	265	52.5	580	52.5	850
39	EC5-AKM52L-■■■-20-32B	303	44.6	616	42.0	922
39	EC5-AKM52L-■■■-50-32B	1033	6.6	1854	6.6	1854
39	EC5-AKM52L-■■■-10-10B	654	15.3	1108	15.3	1526
39	EC5-AKM52L-■■■-15-10B	727	15.3	1852	15.3	2762
39	EC5-AKM52L-■■■-20-10B	970	13.9	1971	13.2	2950
39	EC5-AKM52L-■■■-50-10B	3495	2.1	5620	2.1	5620

Ratings are based on the AKM servomotor and the matching S200 Drive.
See pages 67-69 for details on Drive & Motor System combinations.
Specifications are based on 230 Vac, 3 phase voltage supply.
Force Speed Curves located on pages 37-39.

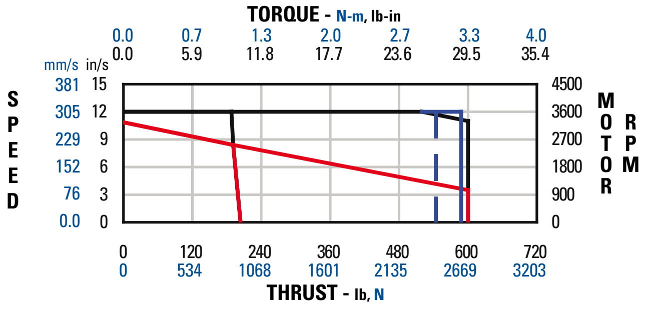
Continuous Thrust (lb) @ Speed



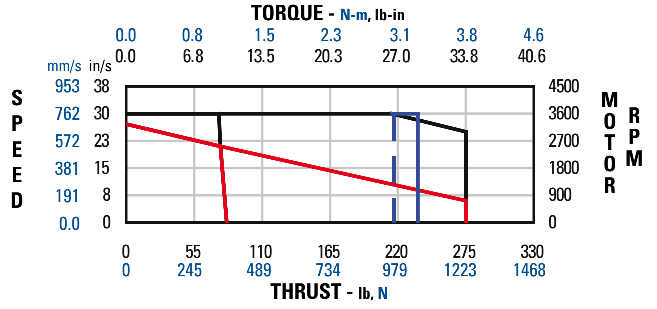
Plotted value is continuous thrust (lb), refer to chart for the associated rated speed value.

Thrust Speed Curves - N2 Series

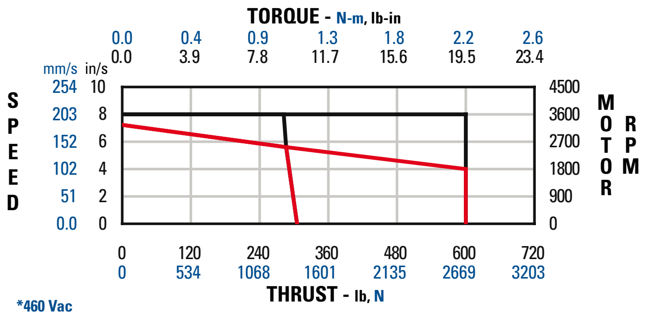
N2-AKM23■-■■■-10-5B



N2-AKM23■-■■■-10-2B

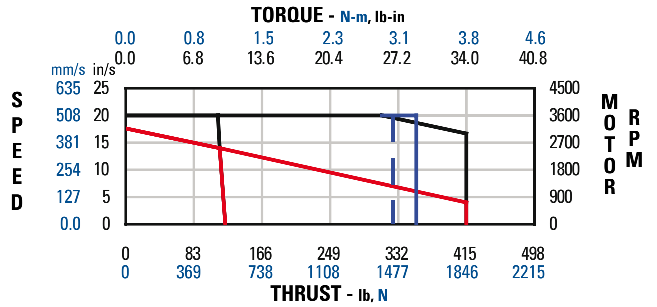


N2-AKM23■-■■■-15-5B

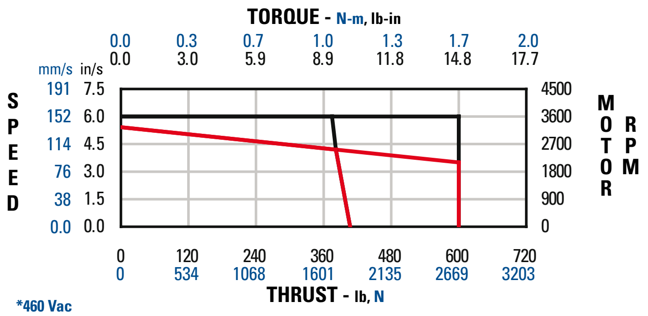


*460 Vac

N2-AKM23■-■■■-15-2B

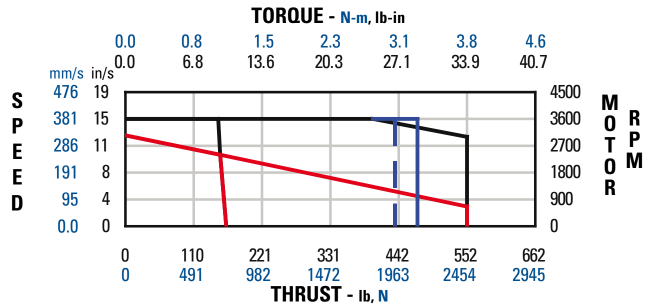


N2-AKM23■-■■■-20-5B

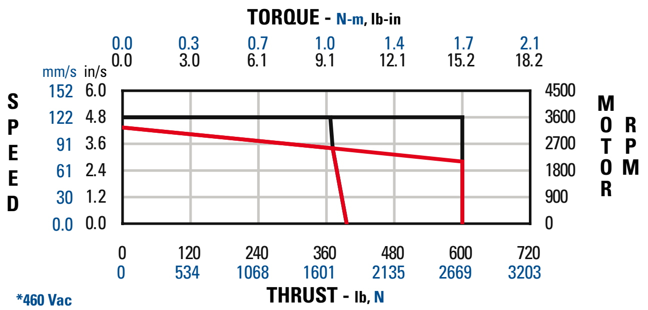


*460 Vac

N2-AKM23■-■■■-20-2B

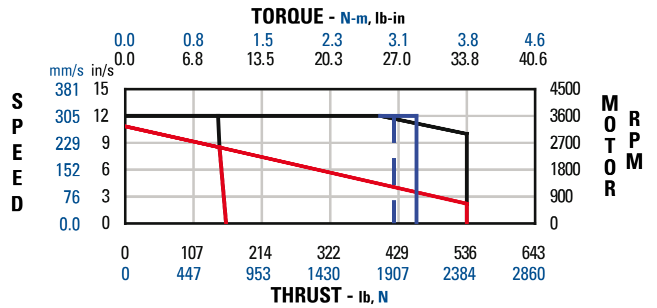


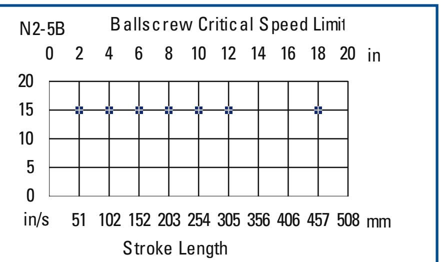
N2-AKM23■-■■■-25-5B



*460 Vac

N2-AKM23■-■■■-25-2B

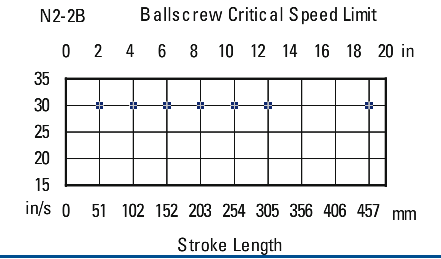




Legend

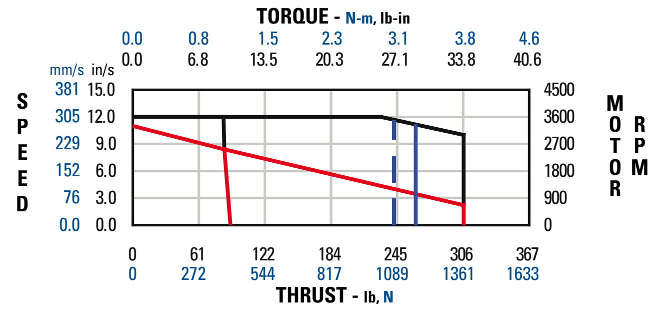
- 25 km/ 1 M" Life
- 460 Vac S300 1.5 /4.5 A
- 460 Vac SD 2.1 /4.2 A
- 230 Vac S200 3.0 /9.0 A
- 115 Vac S200 3.0 /9.0 A

* 460 Vac system limits are equivalent to 230 Vac system.

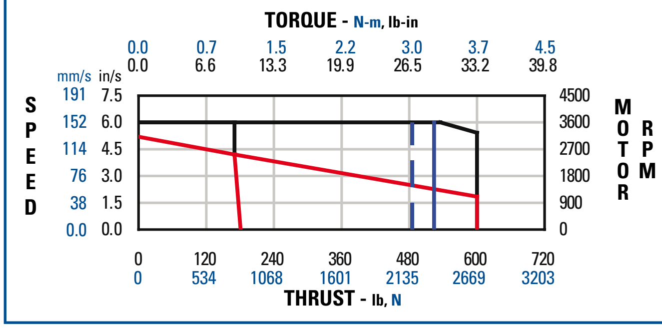


Thrust Speed Curves - N2 Series

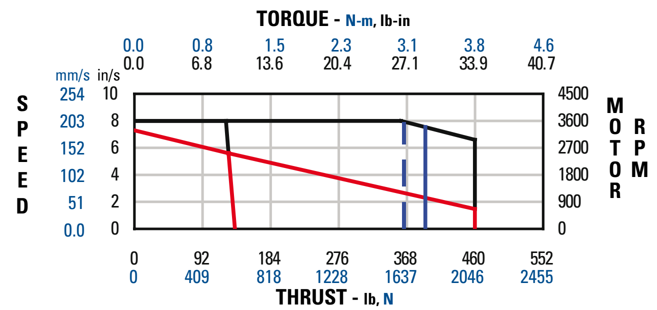
N2-AKM23■-■■■-10-5A



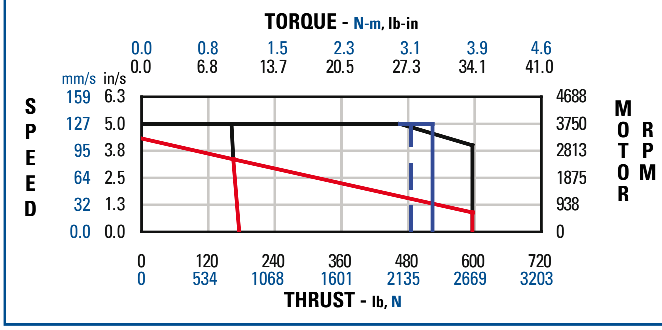
N2-AKM23■-■■■-20-5A

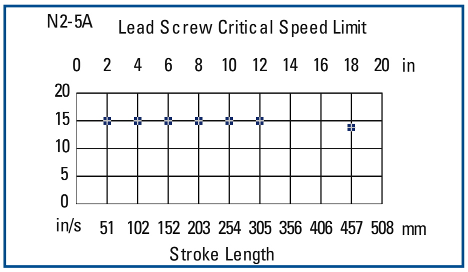


N2-AKM23■-■■■-15-5A



N2-AKM23■-■■■-25-5A



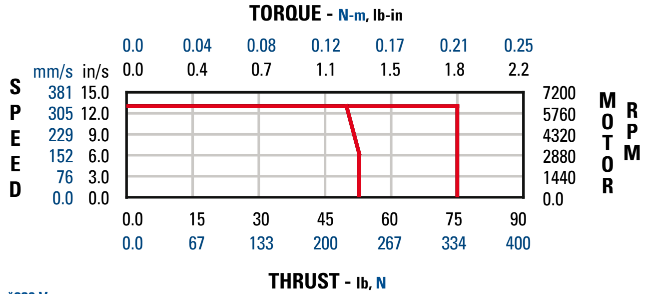


Legend

- 25 km/ 1 M" Life
- 460 Vac S300 1.5 /4.5 A
- 460 Vac SD 2.1 /4.2 A
- 230 Vac S200 3.0 /9.0 A
- 115 Vac S200 3.0 /9.0 A

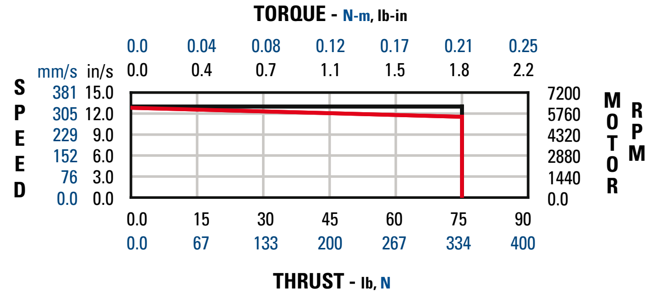
Thrust Speed Curves - EC1 Series

EC1-AKM11B-■■■-10-03B

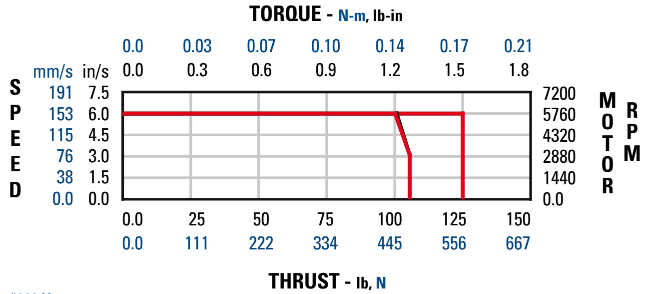


*230 Vac

EC1-AKM13C-■■■-10-03B

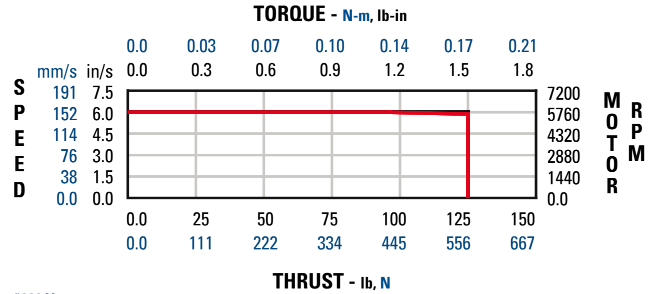


EC1-AKM11B-■■■-20-03B



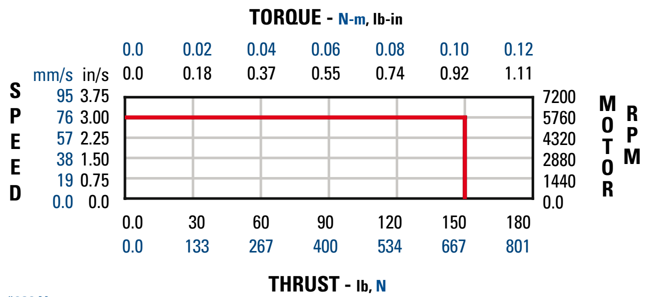
*230 Vac

EC1-AKM13C-■■■-20-03B

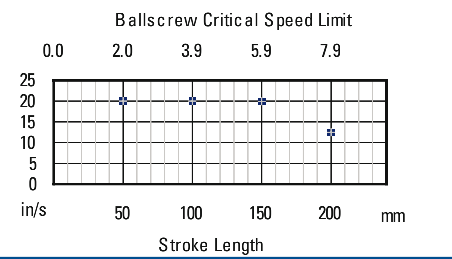


*230 Vac

EC1-AKM11B-■■■-40-03B



*230 Vac



Legend

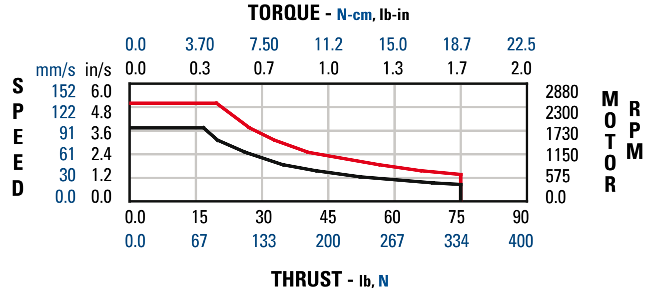
230 Vac S200 1.5 /4.5 A

115 Vac S200 1.5 /4.5 A

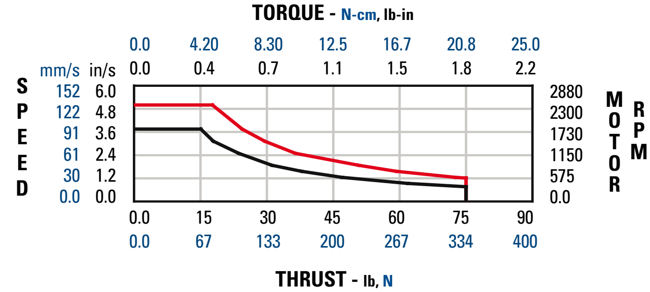
* 230 Vac system limits are equivalent to 115 Vac system.

Thrust Speed Curves - EC1 (w/CT Stepper) Series

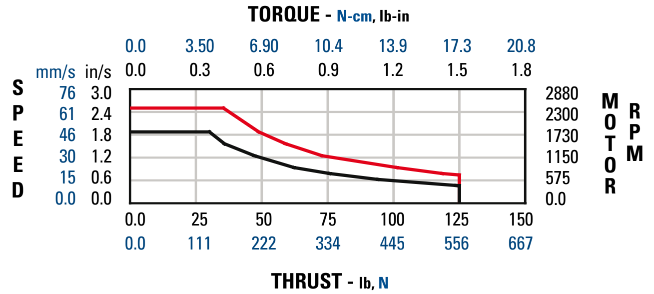
EC1-CTP12■LF10-10L-03B



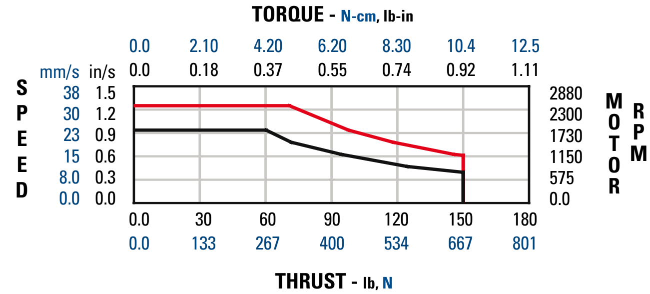
EC1-CTP12■LF10-10-03B

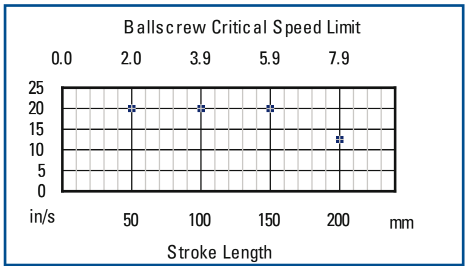


EC1-CTP12■LF10-20-03B



EC1-CTP12■LF10-40-03B



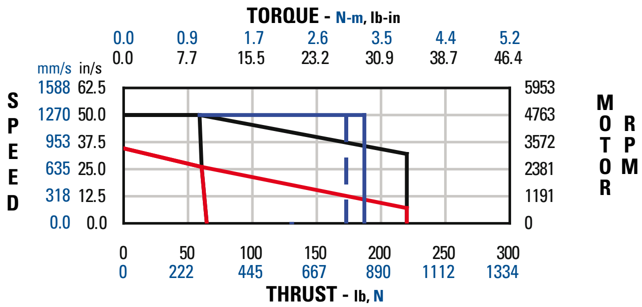


Legend

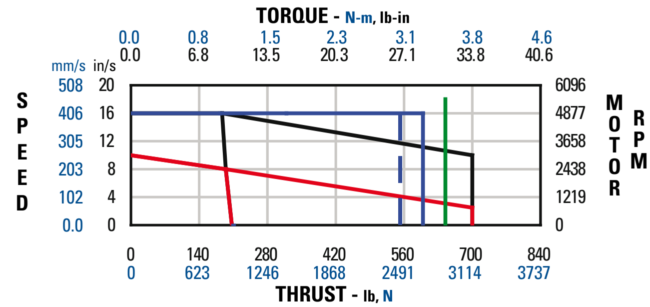
36 Vdc
24 Vdc

Thrust Speed Curves - EC2 Series

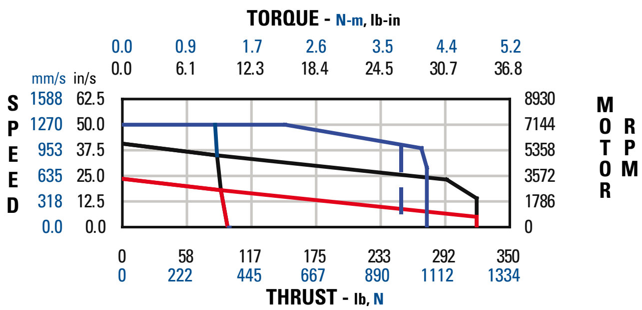
EC2-AKM23■-■■■-10-16B



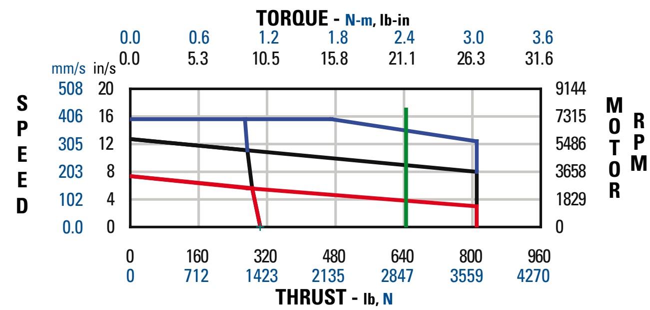
EC2-AKM23■-■■■-10-05B



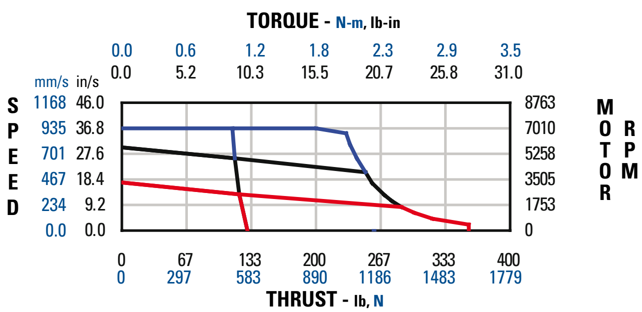
EC2-AKM23■-■■■-15-16B



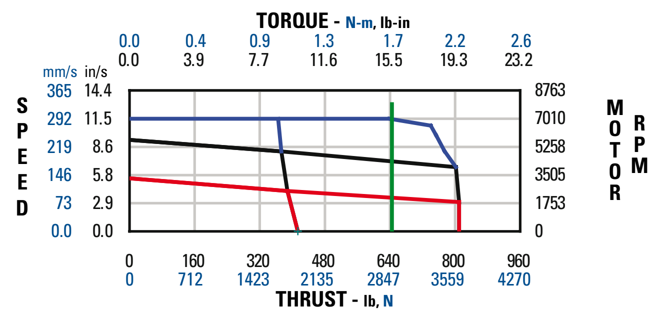
EC2-AKM23■-■■■-15-05B



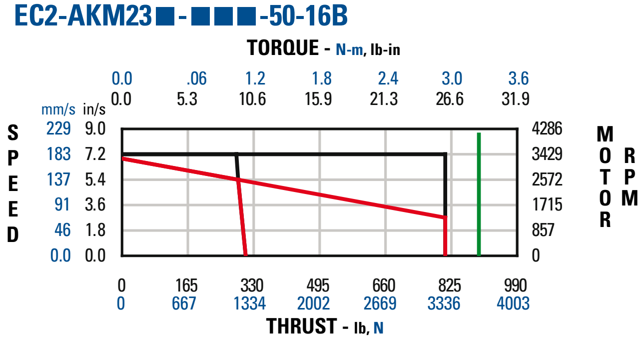
EC2-AKM23■-■■■-20-16B



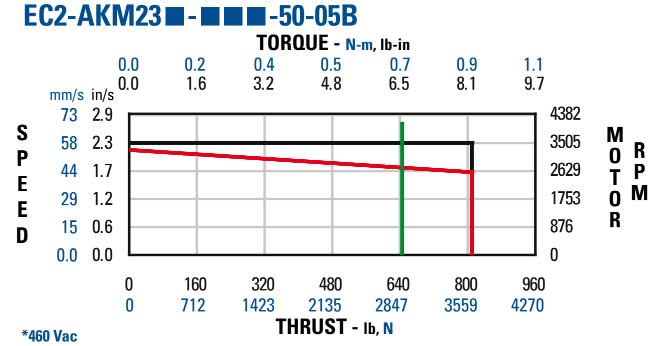
EC2-AKM23■-■■■-20-05B



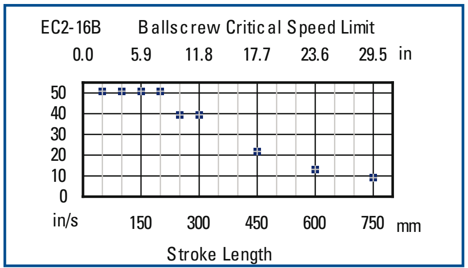
EC2-AKM23■-■■■-50-16B



EC2-AKM23■-■■■-50-05B



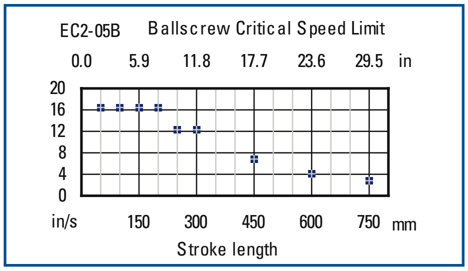
*460 Vac



Legend

- 25 km/ 1 M" Life
- 460 Vac S300 1.5 /4.5 A
- 460 Vac SD 2.1 /4.2 A
- 230 Vac S200 3.0 /9.0 A
- 115 Vac S200 3.0 /9.0 A

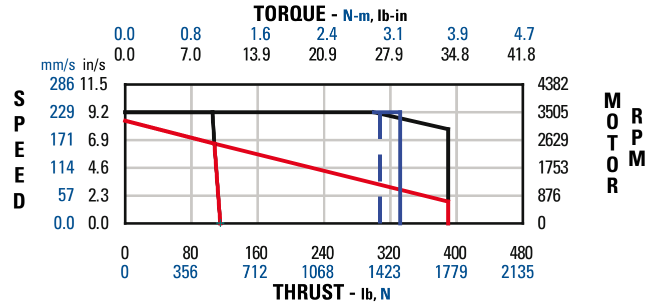
* 460 Vac system limits are equivalent to 230 Vac system.



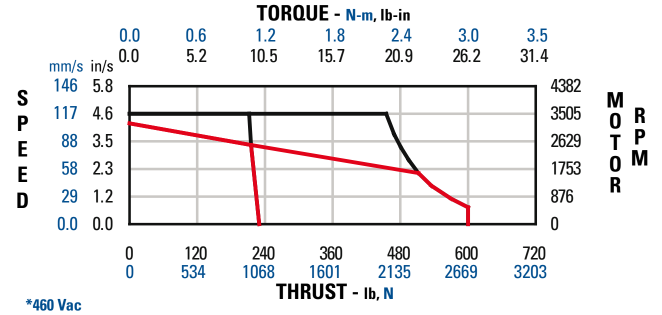
LINEAR POSITIONERS

Thrust Speed Curves - EC2 Series

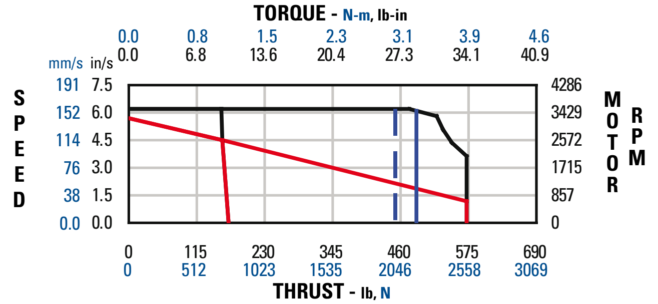
EC2-AKM23■-■■■-10-04A



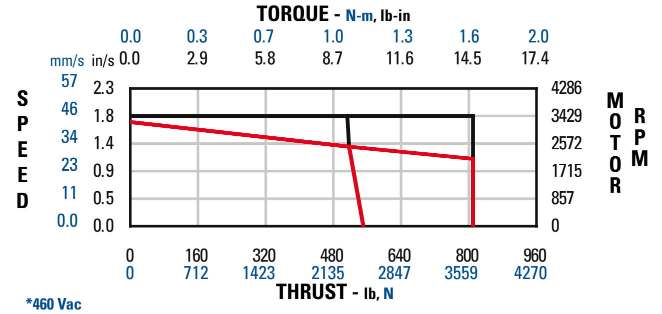
EC2-AKM23■-■■■-20-04A

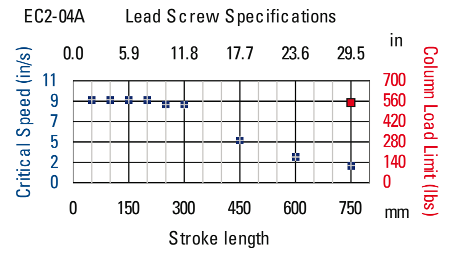


EC2-AKM23■-■■■-15-04A



EC2-AKM23■-■■■-50-04A





Legend

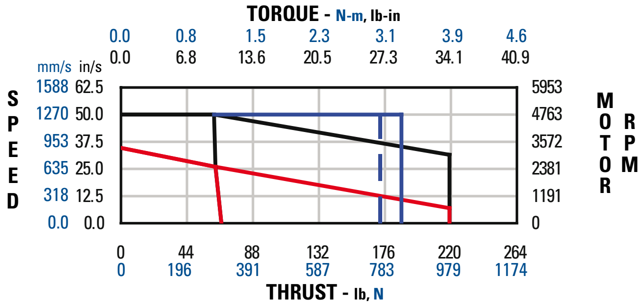
- 25 km/ 1 M" Life
- 460 Vac S300 1.5 /4.5 A
- 460 Vac SD 2.1 /4.2 A
- 230 Vac S200 3.0 /9.0 A
- 115 Vac S200 3.0 /9.0 A

* 460 Vac system limits are equivalent to 230 Vac system.

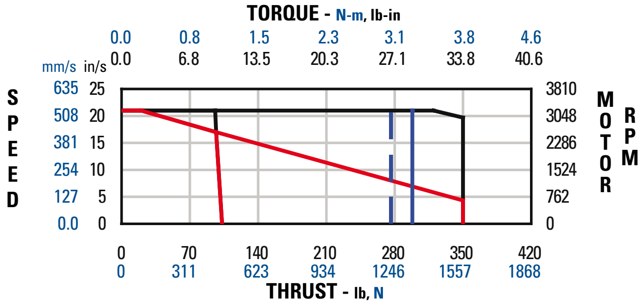
LINEAR POSITIONERS

Thrust Speed Curves - EC3 Series

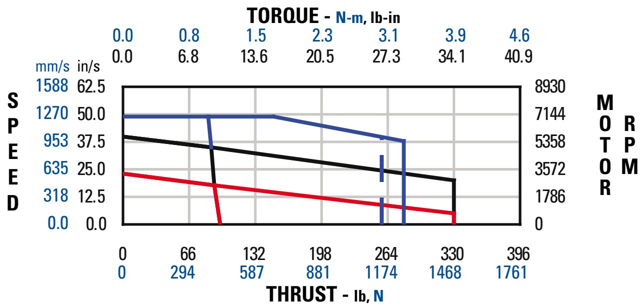
EC3-AKM23■-■■■-10-16B



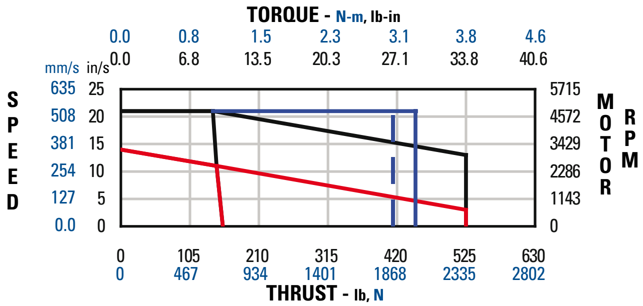
EC3-AKM23■-■■■-10-10B



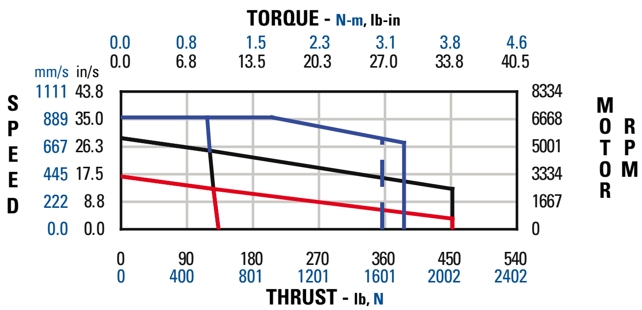
EC3-AKM23■-■■■-15-16B



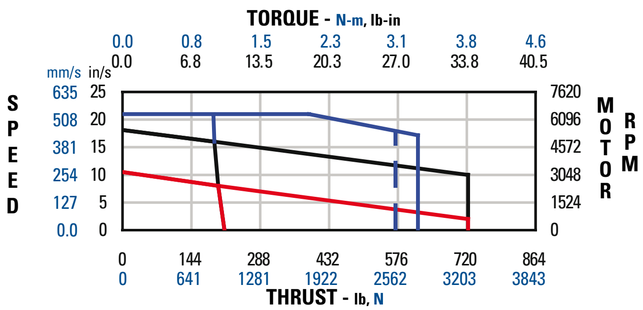
EC3-AKM23■-■■■-15-10B



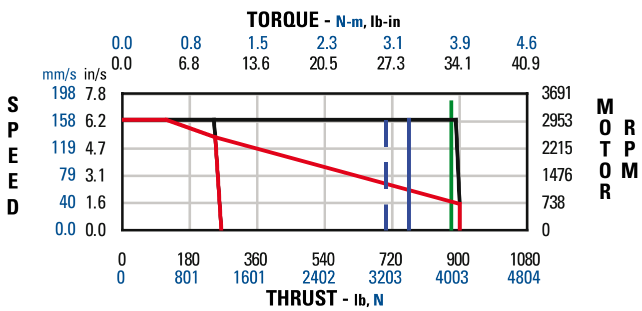
EC3-AKM23■-■■■-20-16B



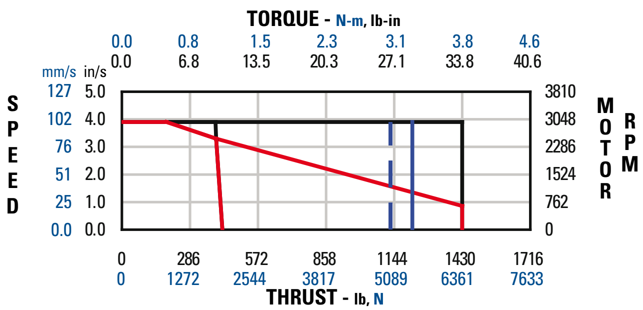
EC3-AKM23■-■■■-20-10B



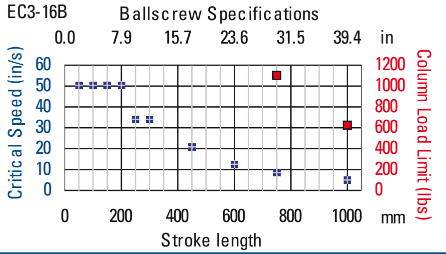
EC3-AKM23■-■■■-50-16B



EC3-AKM23■-■■■-50-10B



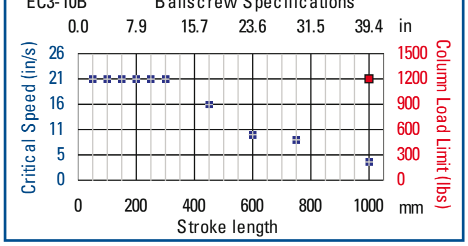
EC3-16B Ballscrew Specifications



Legend

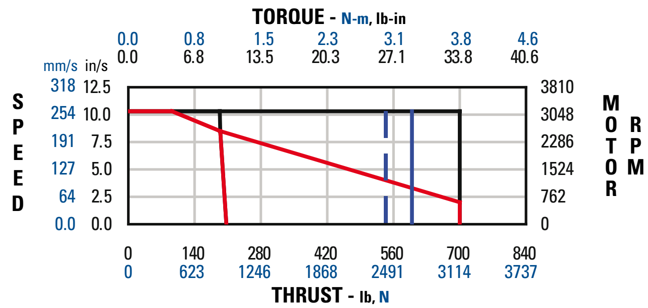
- 25 km/ 1 M" Life
- 460 Vac S300 1.5 /4.5 A
- 460 Vac SD 2.1 /4.2 A
- 230 Vac S200 3.0 /9.0 A
- 115 Vac S200 3.0 /9.0 A

EC3-10B Ballscrew Specifications

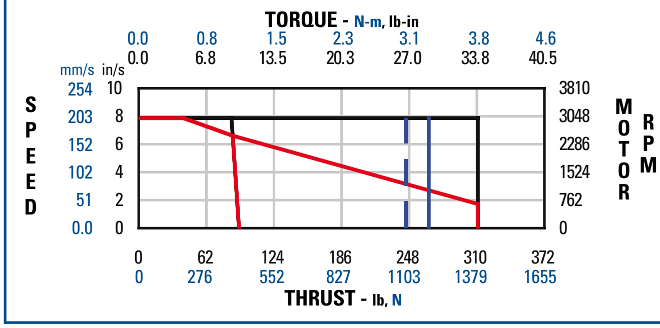


Thrust Speed Curves - EC3 Series

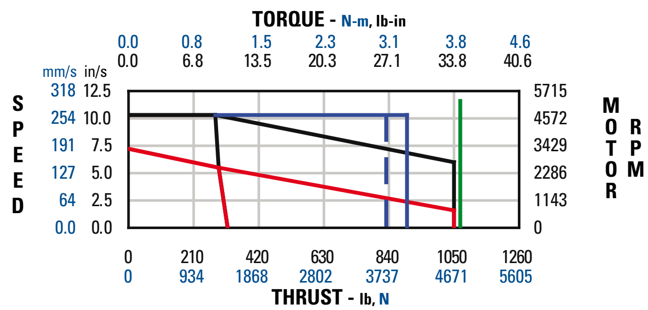
EC3-AKM23■-■■■-10-05B



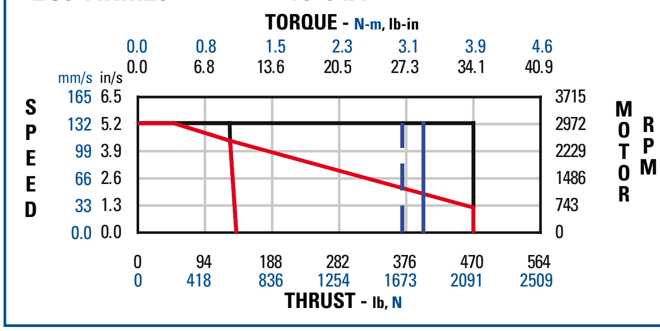
EC3-AKM23■-■■■-10-04A



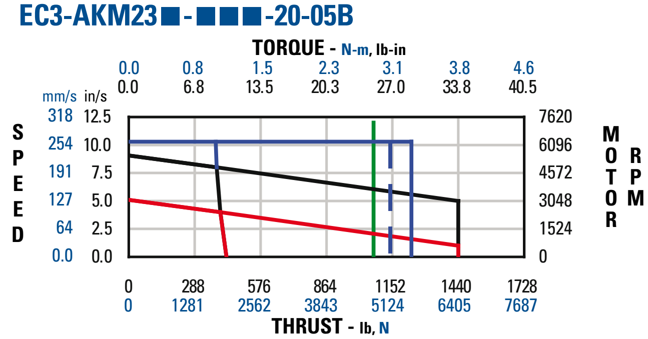
EC3-AKM23■-■■■-15-05B



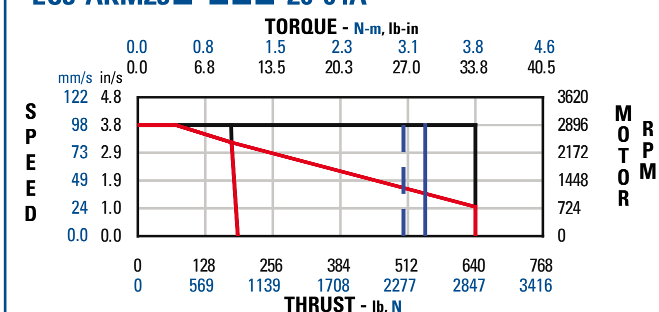
EC3-AKM23■-■■■-15-04A



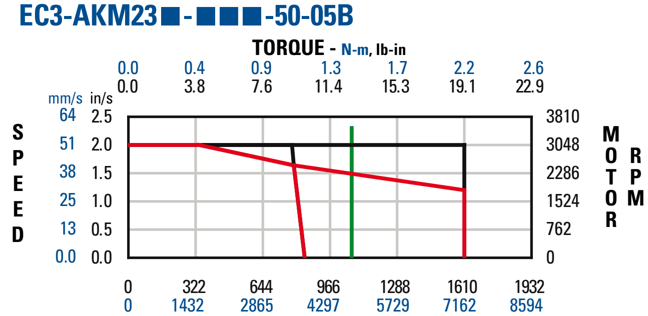
EC3-AKM23■-■■■-20-05B



EC3-AKM23■-■■■-20-04A

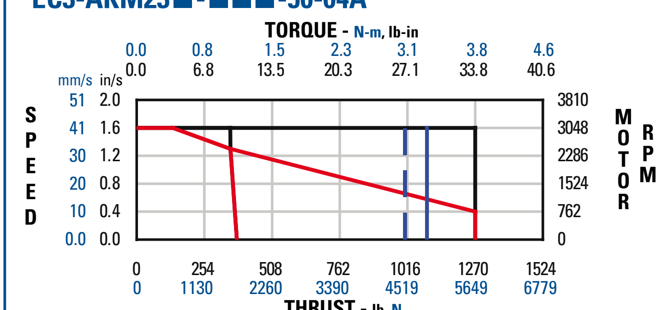


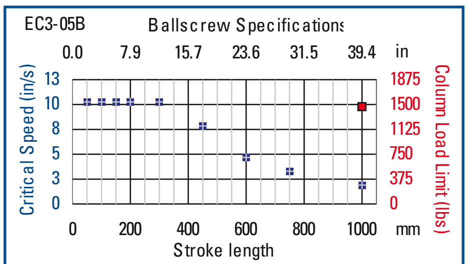
EC3-AKM23■-■■■-50-05B



*460 Vac

EC3-AKM23■-■■■-50-04A

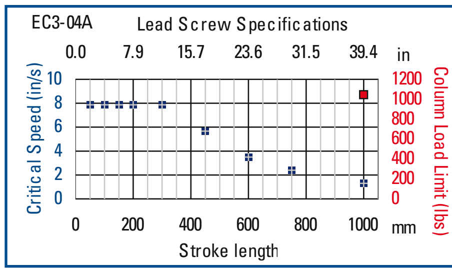




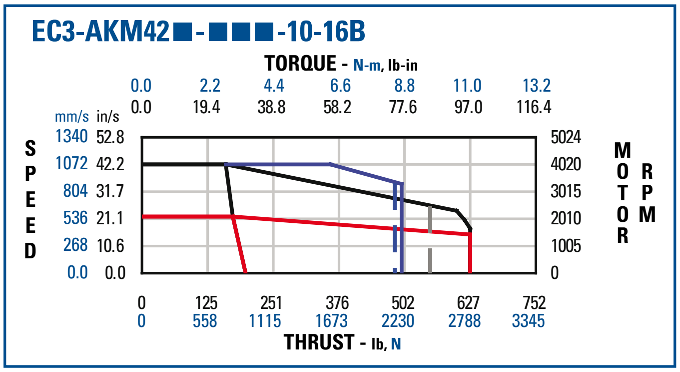
Legend

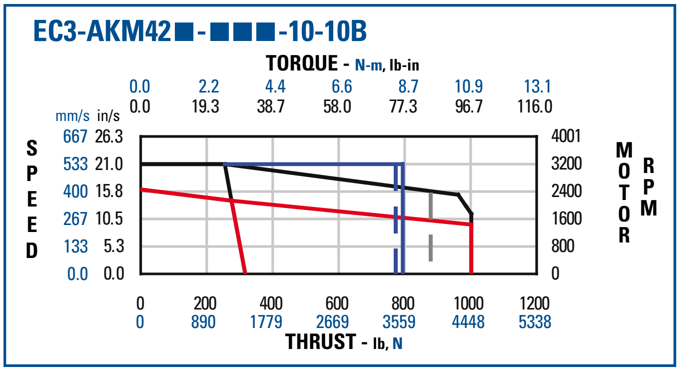
- 25 km/ 1 M" Life
- 460 Vac S300 1.5 /4.5 A
- 460 Vac SD 2.1 /4.2 A
- 230 Vac S200 3.0 /9.0 A
- 115 Vac S200 3.0 /9.0 A

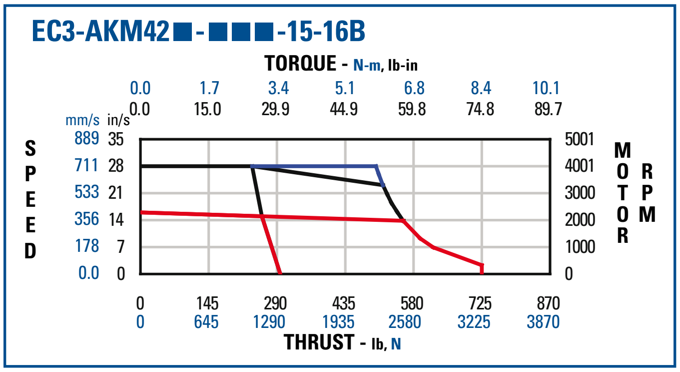
* 460 Vac system limits are equivalent to 230 Vac system.

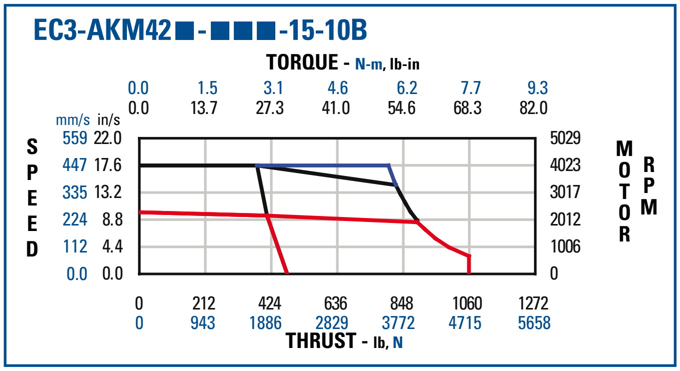


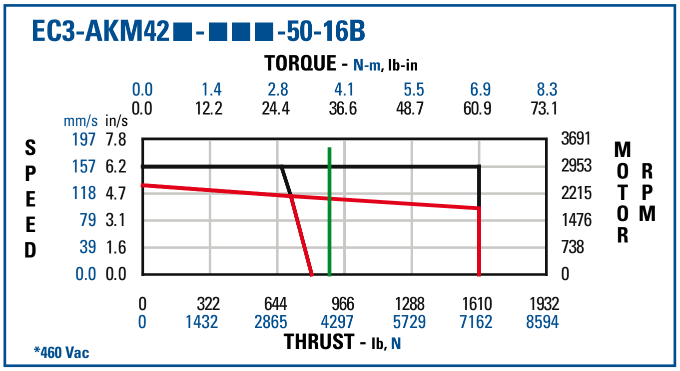
Thrust Speed Curves - EC3 Series

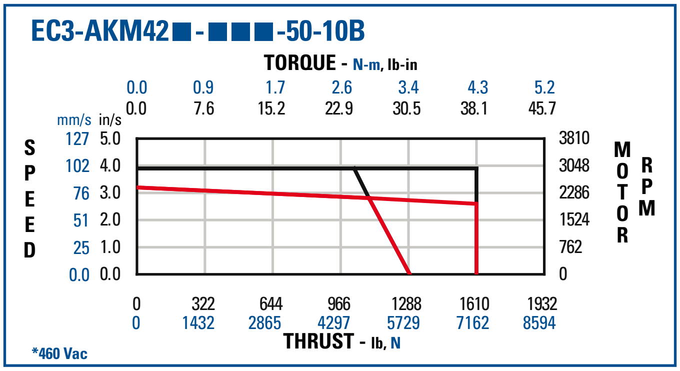


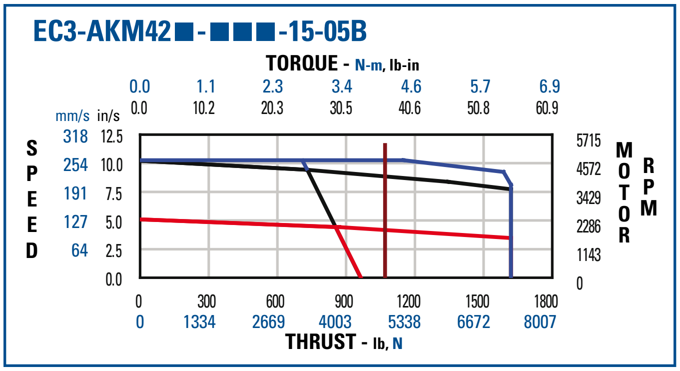


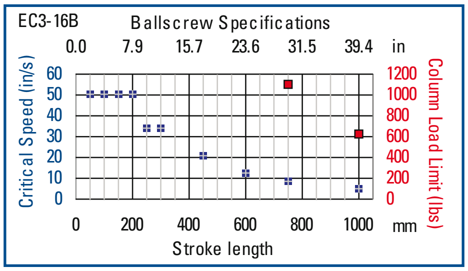








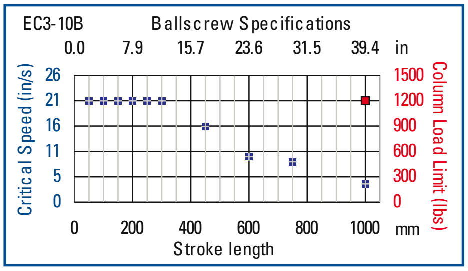




Legend

- 25 km / 1 M " Life
- 460 Vac SD 3.9 /7.8 A
- 460 Vac S300 3.0 /7.5 A (Ip limit)
- 230 Vac S200 6.0 /18.0 A
- 115 Vac S200 6.0 /18.0 A
- 115/230 Vac S300 6.0 /15.0 A (Ip limit)

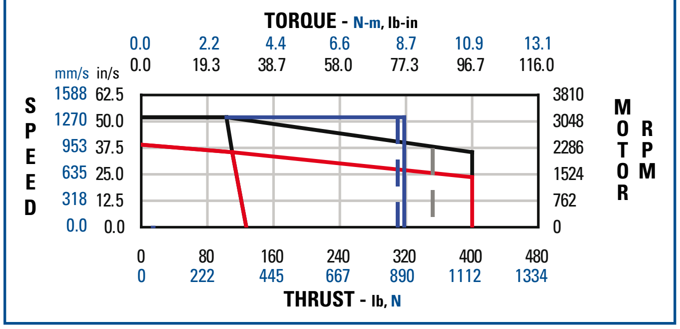
* 460 Vac system limits are equivalent to 230 Vac system.



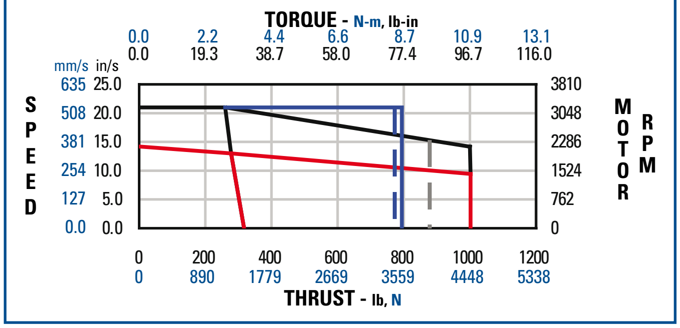
LINEAR POSITIONERS

Thrust Speed Curves - EC4 Series

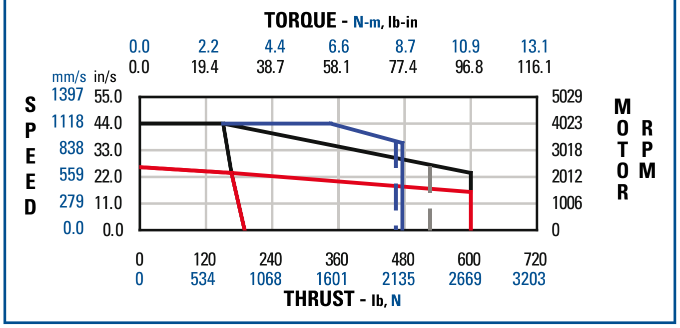
EC4-AKM42■-■■■-10-25B



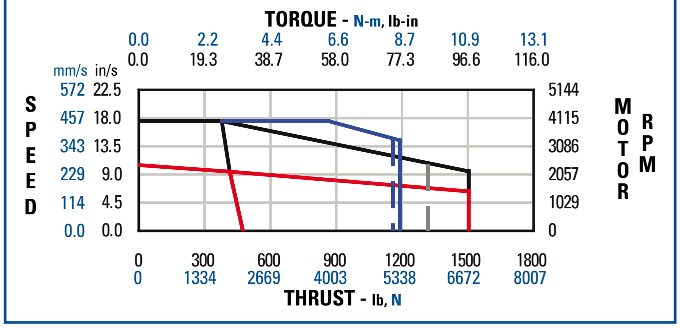
EC4-AKM42■-■■■-10-10B



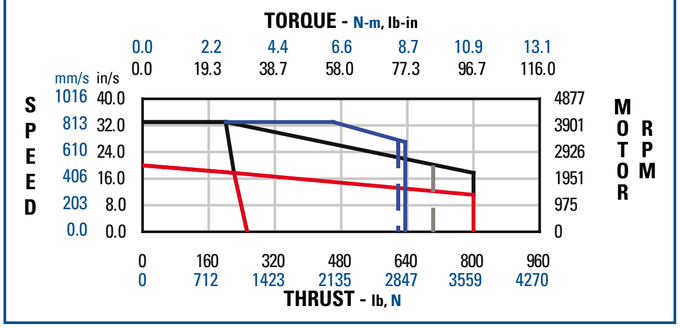
EC4-AKM42■-■■■-15-25B



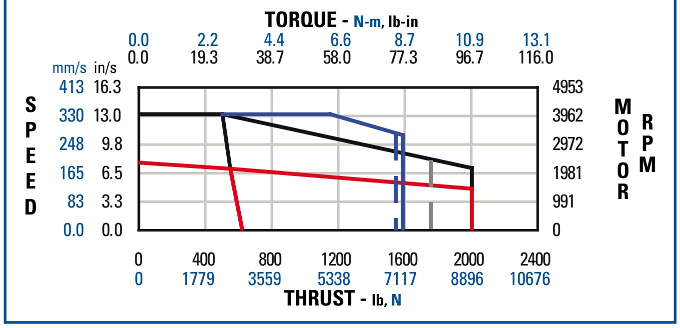
EC4-AKM42■-■■■-15-10B



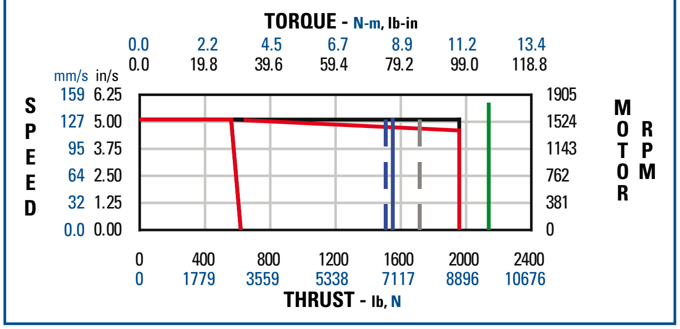
EC4-AKM42■-■■■-20-25B



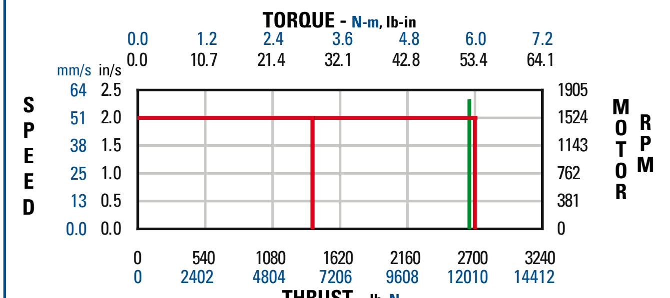
EC4-AKM42■-■■■-20-10B



EC4-AKM42■-■■■-50-25B

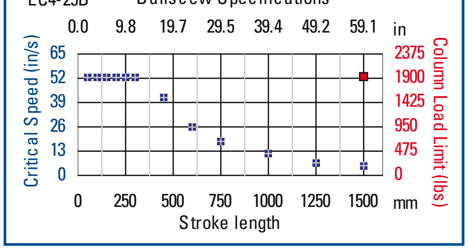


EC4-AKM42■-■■■-50-10B



*460 Vac

EC4-25B Ballscrew Specifications

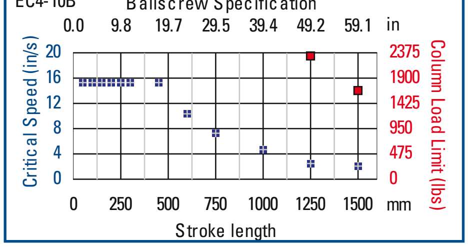


Legend

- 25 km / 1 M " Life
- 460 Vac SD 3.9/7.8 A
- 460 Vac S300 3.0/7.5 A (Ip limit)
- 230 Vac S200 6.0/18.0 A
- 115 Vac S200 6.0/18.0 A
- 115/230 Vac S300 6.0/15.0 A (Ip limit)

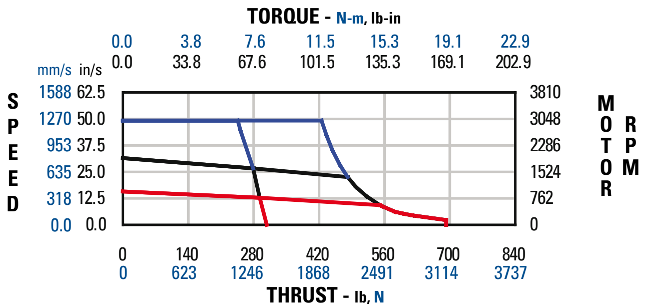
* 460 Vac system limits are equivalent to 230 Vac system.

EC4-10B Ballscrew Specification

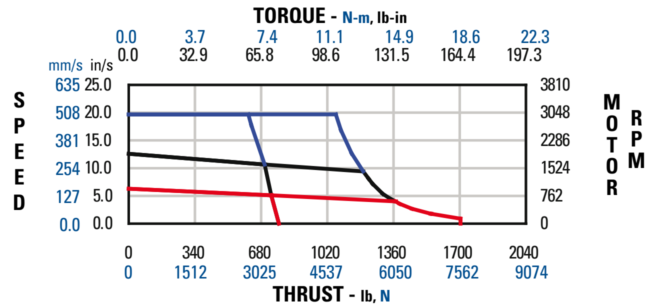


Thrust Speed Curves - EC4 Series

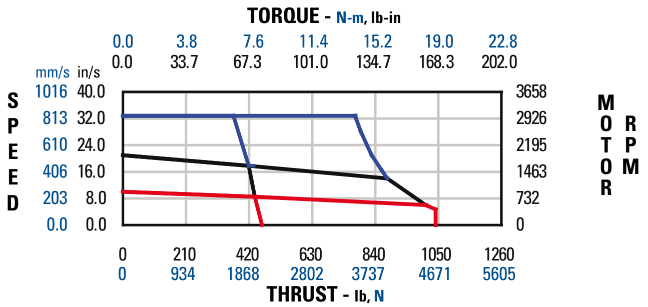
EC4-AKM52G■-■■■-10-25B



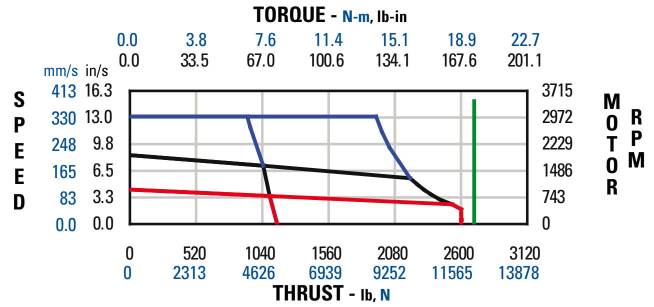
EC4-AKM52G■-■■■-10-10B



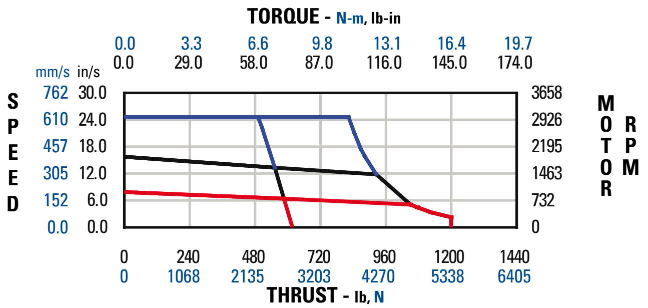
EC4-AKM52G■-■■■-15-25B



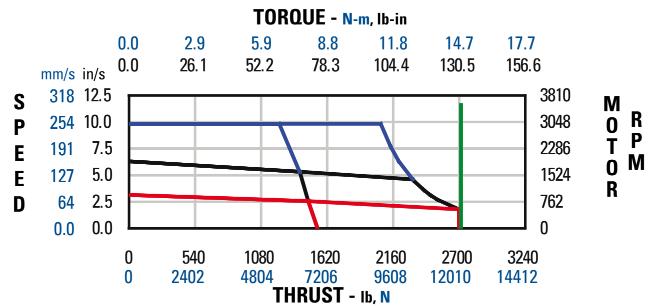
EC4-AKM52G■-■■■-15-10B



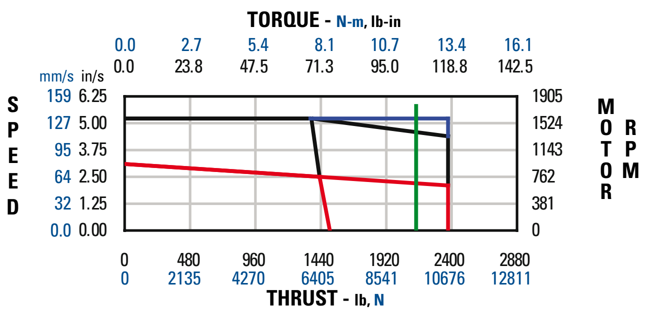
EC4-AKM52G■-■■■-20-25B



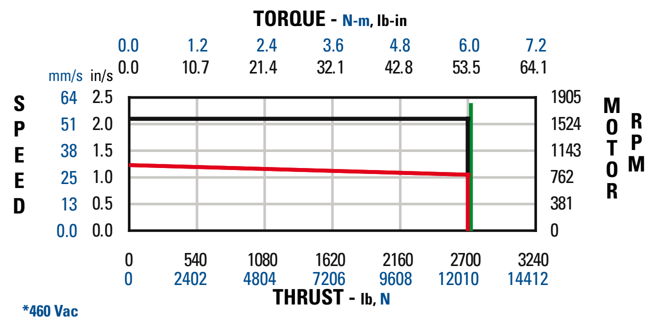
EC4-AKM52G■-■■■-20-10B



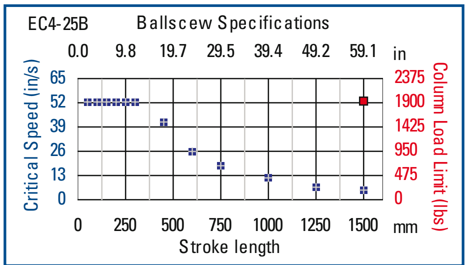
EC4-AKM52G■-■■■-50-25B



EC4-AKM52G■-■■■-50-10B



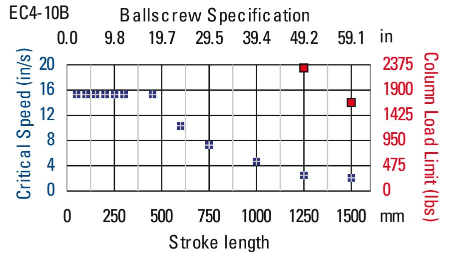
*460 Vac



Legend

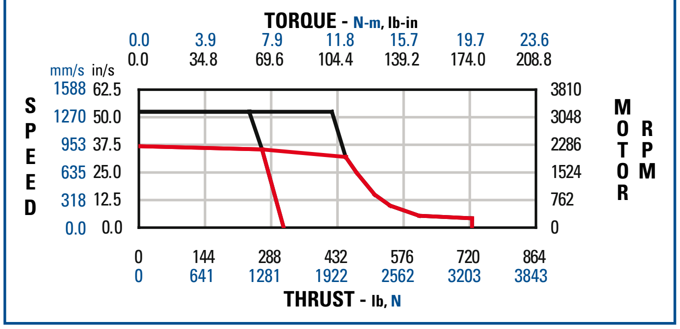
- 25 km / 1 M " Life
- 460 Vac SD 6.3 /12.7 A
- 460 Vac S300 6.0 /12.0 A (Ip limit)
- 230 Vac S200 6.0 /18.0 A
- 115 Vac S200 6.0 /18.0 A

* 460 Vac system limits are equivalent to 230 Vac system.

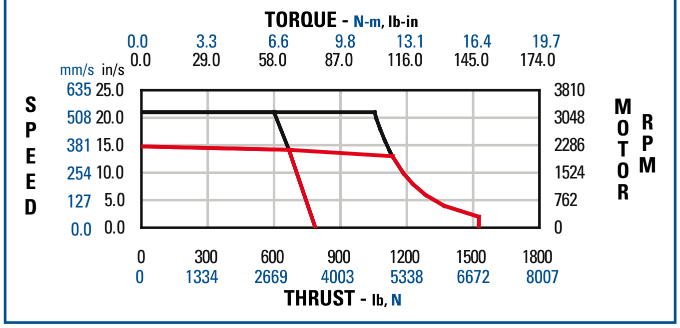


Thrust Speed Curves - EC4 Series

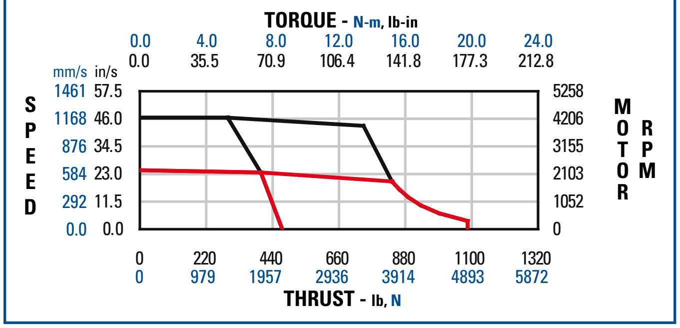
EC4-AKM52L-■■■-10-25B



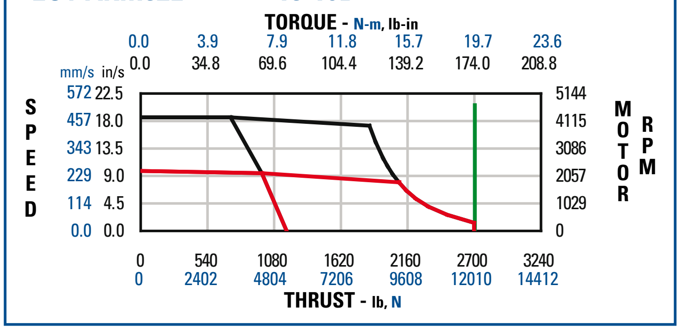
EC4-AKM52L-■■■-10-10B



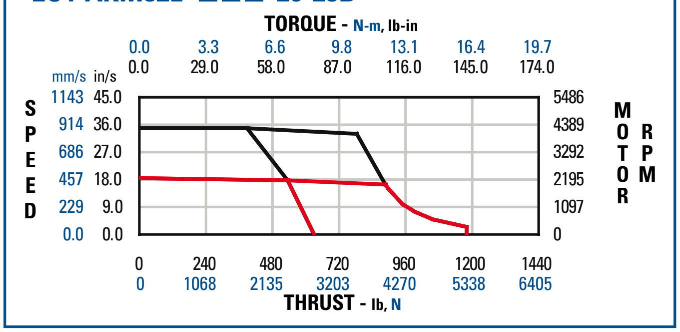
EC4-AKM52L-■■■-15-25B



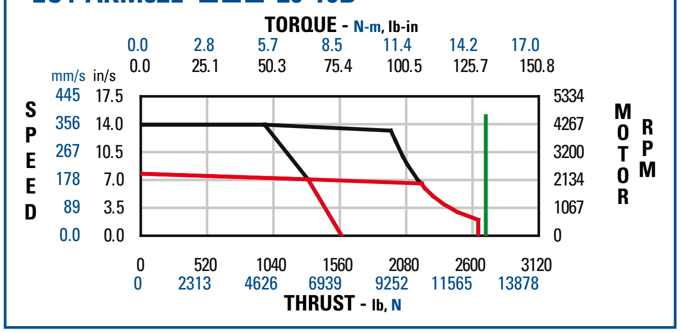
EC4-AKM52L-■■■-15-10B



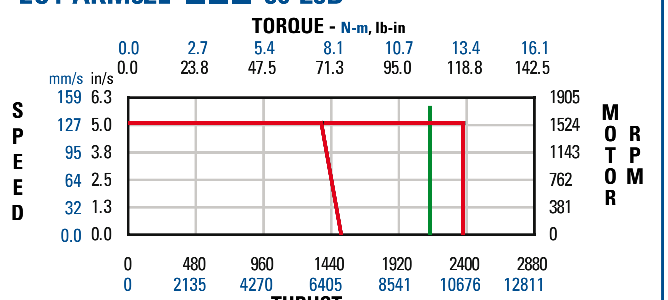
EC4-AKM52L-■■■-20-25B



EC4-AKM52L-■■■-20-10B

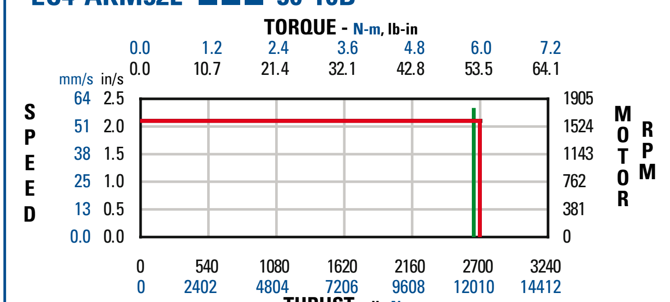


EC4-AKM52L-■■■-50-25B



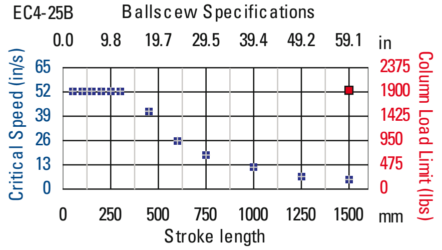
*230 Vac

EC4-AKM52L-■■■-50-10B



*230 Vac

EC4-25B Ballscew Specifications

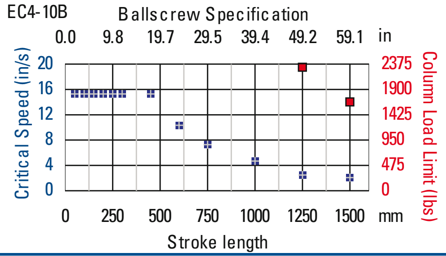


Legend

- 25 km / 1 M " Life
- 460 Vac SD 6.3 /12.7 A
- 460 Vac S300 6.0 /12.0 A (Ip limit)
- 230 Vac S200 6.0 /18.0 A
- 115 Vac S200 6.0 /18.0 A

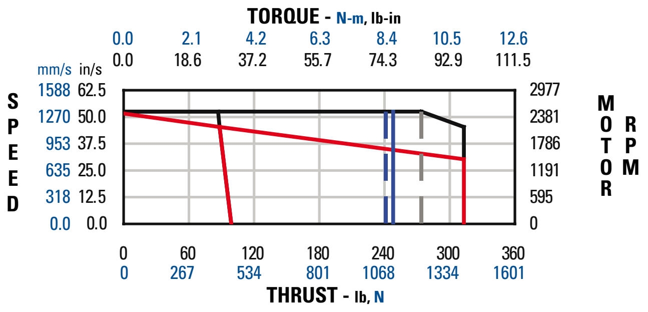
* 230 Vac system limits are equivalent to 115 Vac system.

EC4-10B Ballscrew Specification

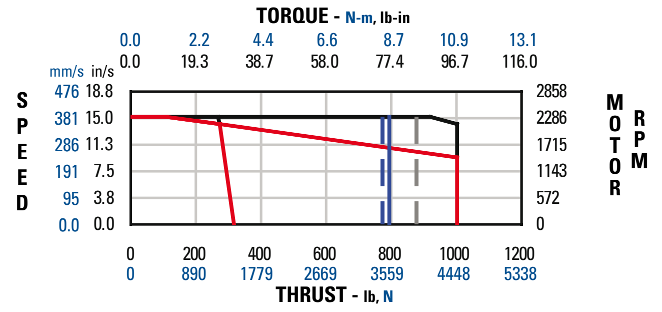


Thrust Speed Curves - EC5 Series

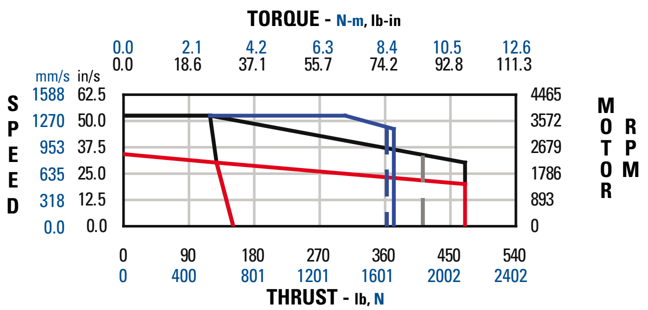
EC5-AKM42■-■■■-10-32B



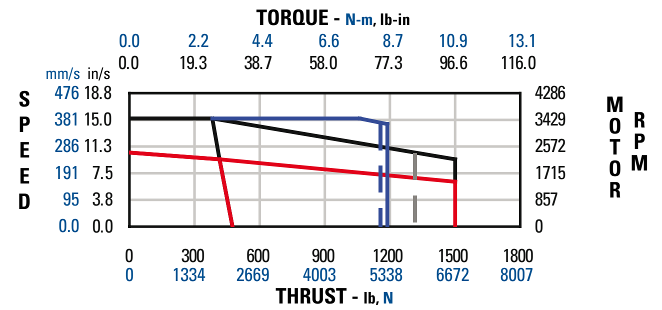
EC5-AKM42■-■■■-10-10B



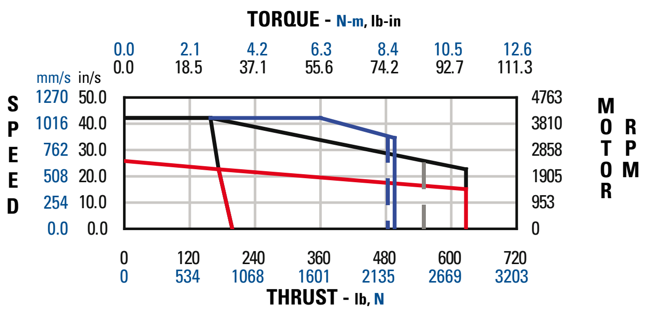
EC5-AKM42■-■■■-15-32B



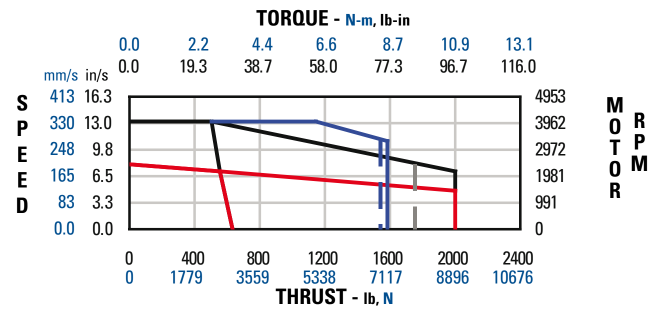
EC5-AKM42■-■■■-15-10B



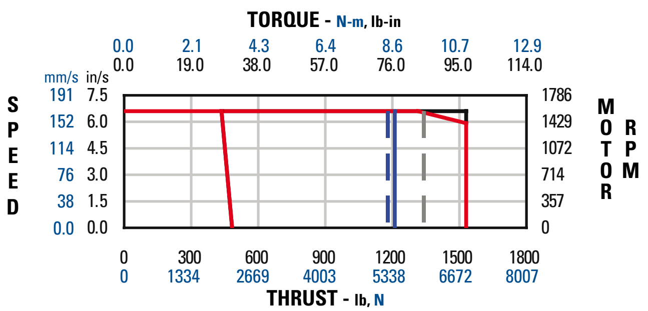
EC5-AKM42■-■■■-20-32B



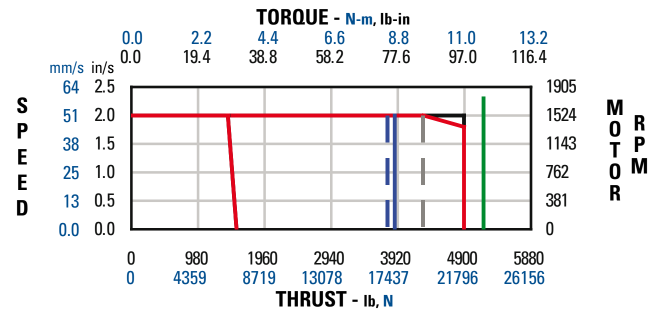
EC5-AKM42■-■■■-20-10B

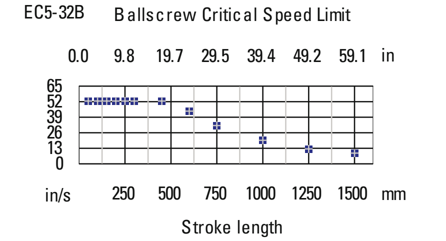


EC5-AKM42■-■■■-50-32B



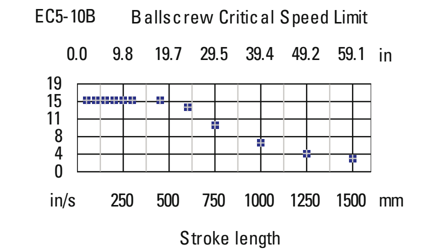
EC5-AKM42■-■■■-50-10B





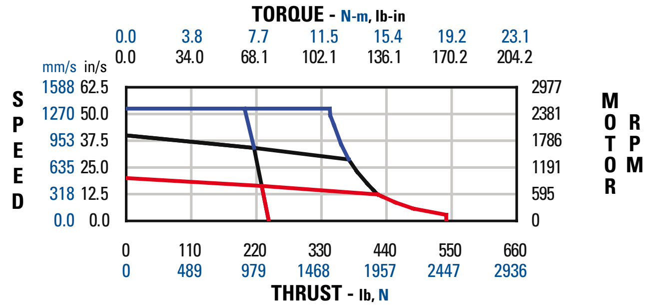
Legend

- 25 km / 1 M " Life
- 460 Vac SD 3.9 /7.8 A
- 460 Vac S300 3.0 /7.5 A (Ip limit)
- 230 Vac S200 6.0 /18.0 A
- 115 Vac S200 6.0 /18.0 A
- 115/230 Vac S300 6.0 /15.0 A (Ip limit)

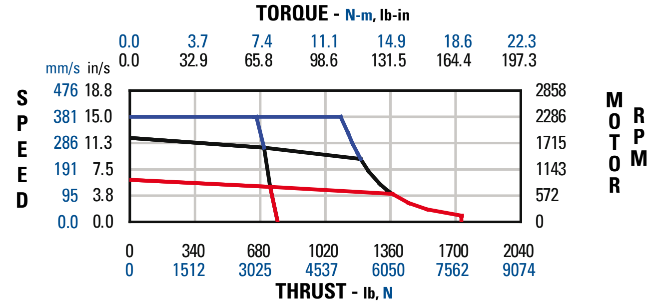


Thrust Speed Curves - EC5 Series

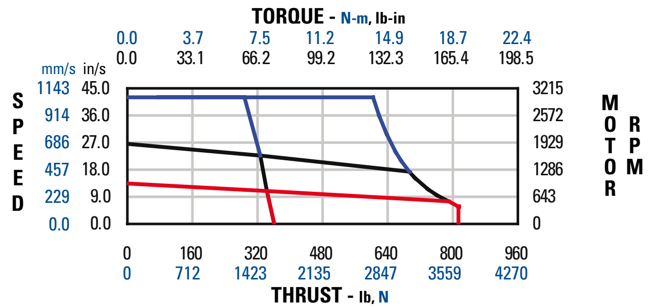
EC5-AKM52G-■■■-10-32B



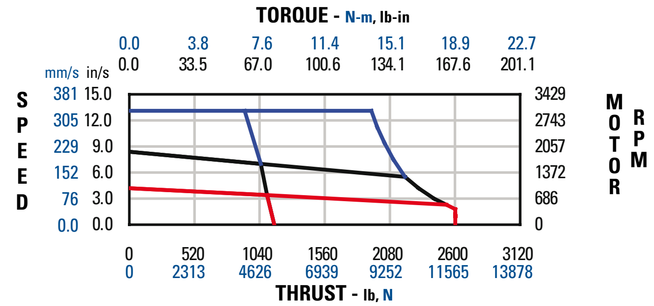
EC5-AKM52G-■■■-10-10B



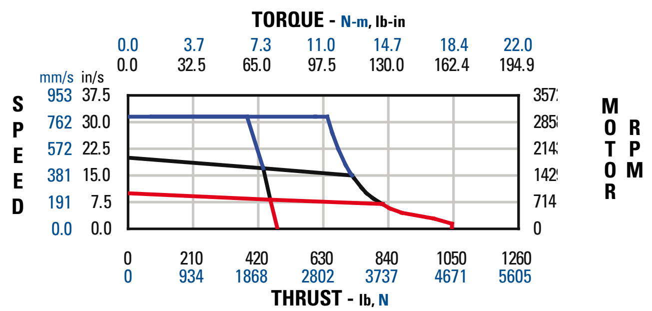
EC5-AKM52G-■■■-15-32B



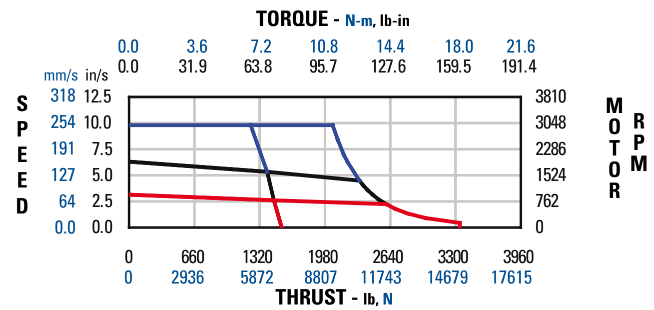
EC5-AKM52G-■■■-15-10B



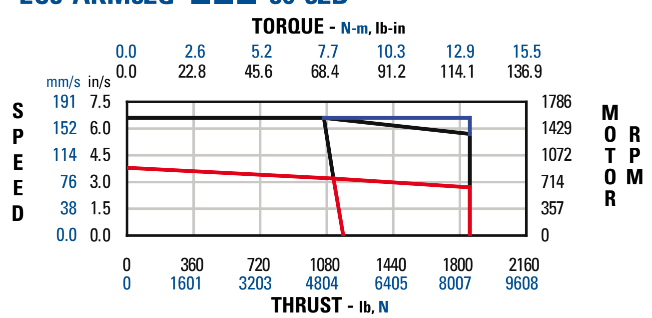
EC5-AKM52G-■■■-20-32B



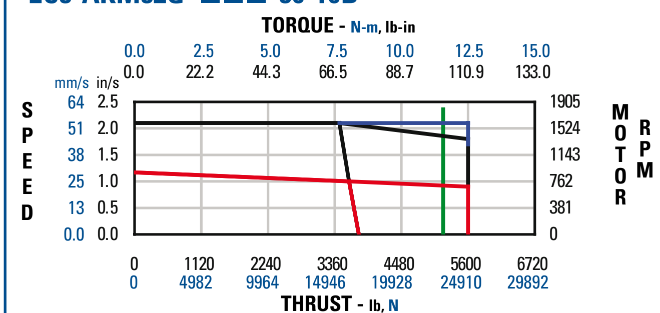
EC5-AKM52G-■■■-20-10B



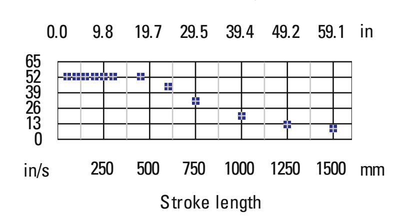
EC5-AKM52G-■■■-50-32B



EC5-AKM52G-■■■-50-10B



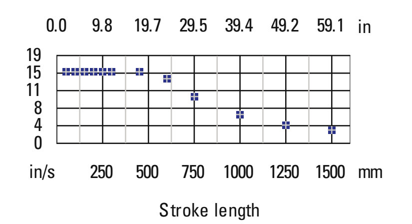
EC5-32B Ballscrew Critical Speed Limit



Legend

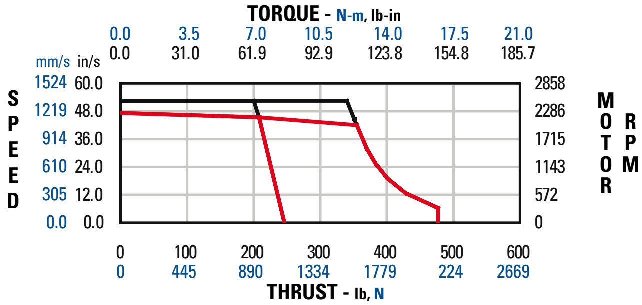
- 25 km / 1 M " Life
- 460 Vac SD 6.3 /12.7 A
- 460 Vac S300 6.0 /12.0 A (Ip limit)
- 230 Vac S200 6.0 /18.0 A
- 115 Vac S200 6.0 /18.0 A

EC5-10B Ballscrew Critical Speed Limit

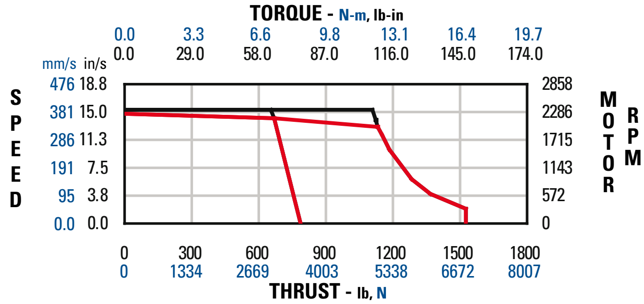


Thrust Speed Curves - EC5 Series

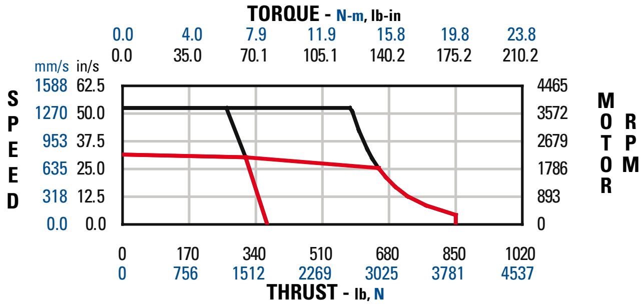
EC5-AKM52L-■■■-10-32B



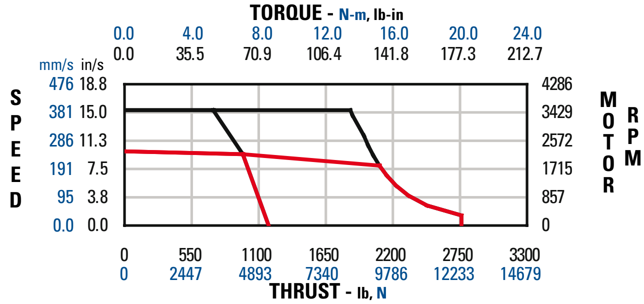
EC5-AKM52L-■■■-10-10B



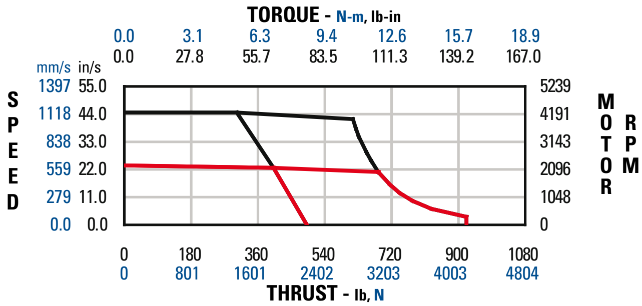
EC5-AKM52L-■■■-15-32B



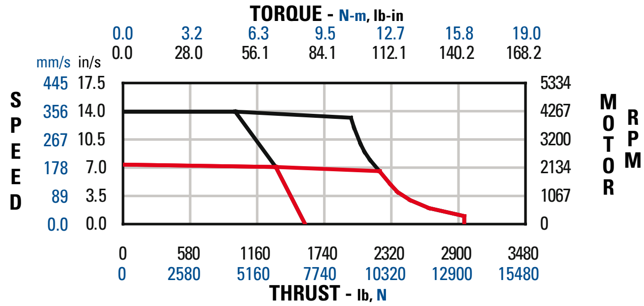
EC5-AKM52L-■■■-15-10B



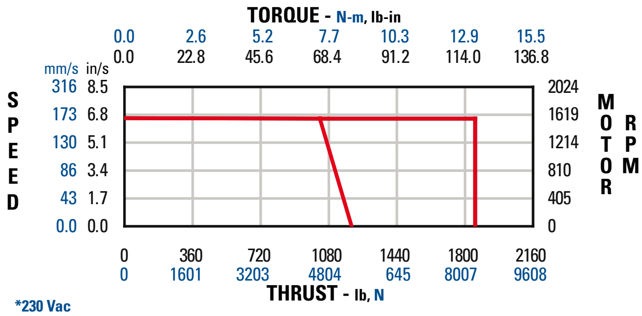
EC5-AKM52L-■■■-20-32B



EC5-AKM52L-■■■-20-10B

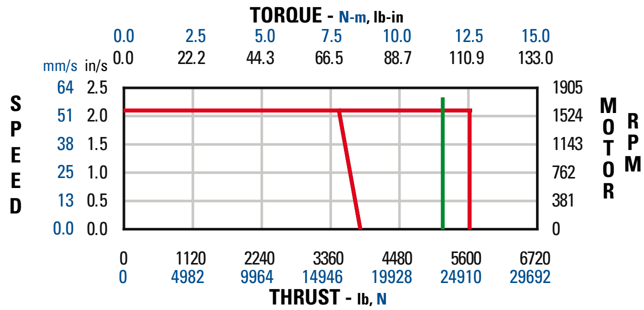


EC5-AKM52L-■■■-50-32B

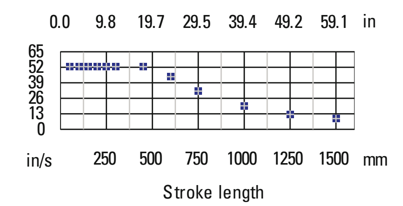


*230 Vac

EC5-AKM52L-■■■-50-10B



EC5-32B Ballscrew Critical Speed Limit



Legend

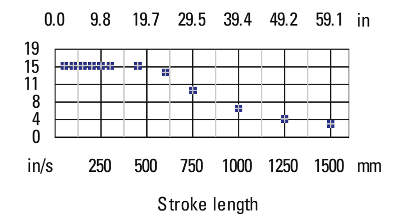
25 km / 1 M " Life

230 Vac S200 12.0 /30.0 A

115 Vac S200 12.0 /30.0 A

* 230 Vac system limits are equivalent to 115 Vac system.

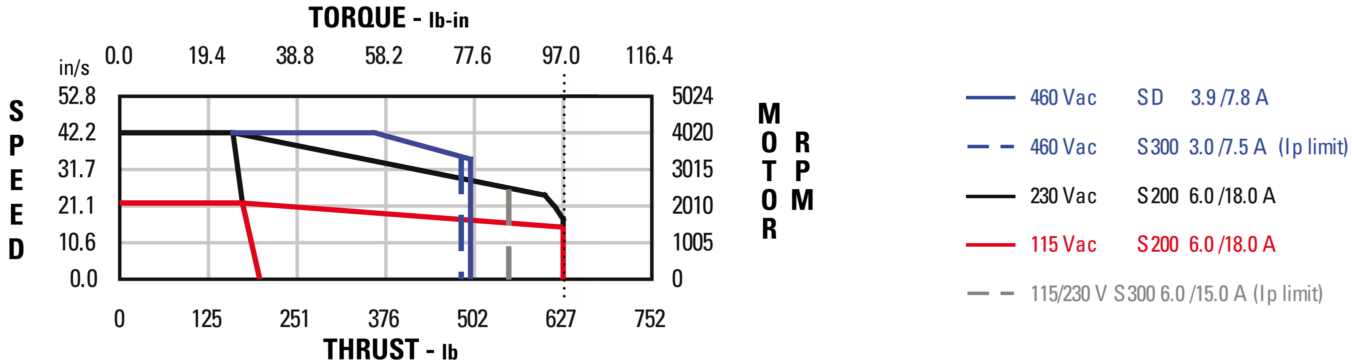
EC5-10B Ballscrew Critical Speed Limit



NOTES:

Servo System Current Calculation

EC3-AKM42■-■■■-10-16B



To determine the current required for a given force, calculate as follows:

Example of AKM42G (115/230 Vac System)

For Force, F = 627 lb (lower X axis) corresponds to Torque, T = 97.0 lb-in (upper X Axis)

1) Determine effective K_t to use. (see chart below)
   K_t is motor constant. K_t becomes non-linear ($K_{t\ eff}$) in the upper peak current range of the motor capacity.
   Due to this non-linearity the current calculation in this peak range is less accurate than for current values at or less than the continuous current rating of the motor.

   For Torque of 97.0 lb-in for AKM42G, use $K_{t\ eff}$ = 5.39 lb-in/Arms

2) Calculate I required.
   Motor torque is represented by $T = I * K_t$, the motor current multiplied by the motor constant (K_t or $K_{t\ eff}$).

   Thus, I required = Torque/ $K_{t\ eff}$
   I required = 97.0 lb-in / 5.39 lb-in/Arms
   I required = 18.0 Arms

		AKM11B		AKM13C	
AKM1x		115/230 Vac		115/230 Vac	
Torque [lb-in (N-m)]		lb-in/Arms	N-m/Arms	lb-in/Arms	N-m/Arms
<= 2.4 (0.27) AKM11 <= 5.4 (0.60) AKM13	K_t	1.40	0.158	2.46	0.278
> 2.4 (0.27) AKM11 > 5.4 (0.60) AKM13	$K_{t\ eff}$	1.16	0.131	2.18	0.246

		AKM23D		AKM23C	
AKM23		115/230 Vac		460 Vac	
Torque [lb-in (N-m)]		lb-in/Arms	N-m/Arms	lb-in/Arms	N-m/Arms
<= 15 (1.69)	K_t	4.60	0.52	7.10	0.80
> 15 (1.69)	$K_{t\ eff}$	3.86	0.44	6.44	0.73

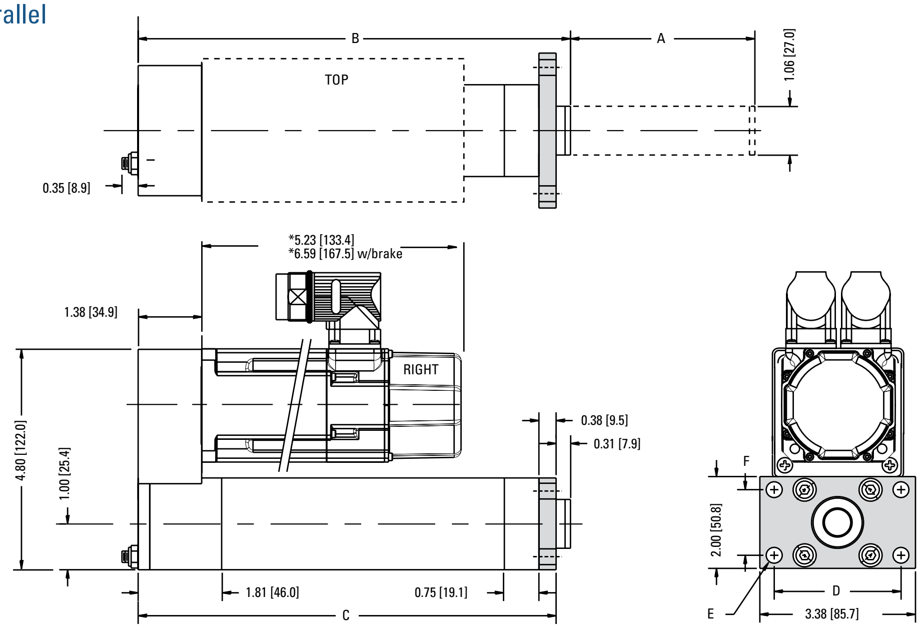
		AKM42G		AKM42E	
AKM42		115/230 Vac		460 Vac	
Torque [lb-in (N-m)]		lb-in/Arms	N-m/Arms	lb-in/Arms	N-m/Arms
<= 45 (5.08)	K_t	6.50	0.73	11.20	1.27
> 45 (5.08)	$K_{t\ eff}$	5.39	0.61	9.85	1.11

		AKM52L		AKM52G	
AKM52		115/230 Vac		115/230/460 Vac	
Torque [lb-in (N-m)]		lb-in/Arms	N-m/Arms	lb-in/Arms	N-m/Arms
<= 112 (12.65)	K_t	6.56	0.74	15.80	1.79
> 112 (12.65)	$K_{t\ eff}$	5.83	0.66	13.38	1.51

N2 Dimensions

MF1 Front Rectangular Flange Mount

Parallel



	English Option MF1 (inches)	Metric Option MF1M (mm)
D	2.75	72*
E	0.34	9*
F	1.43	36*

* Meets ISO 40mm bore standard

A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

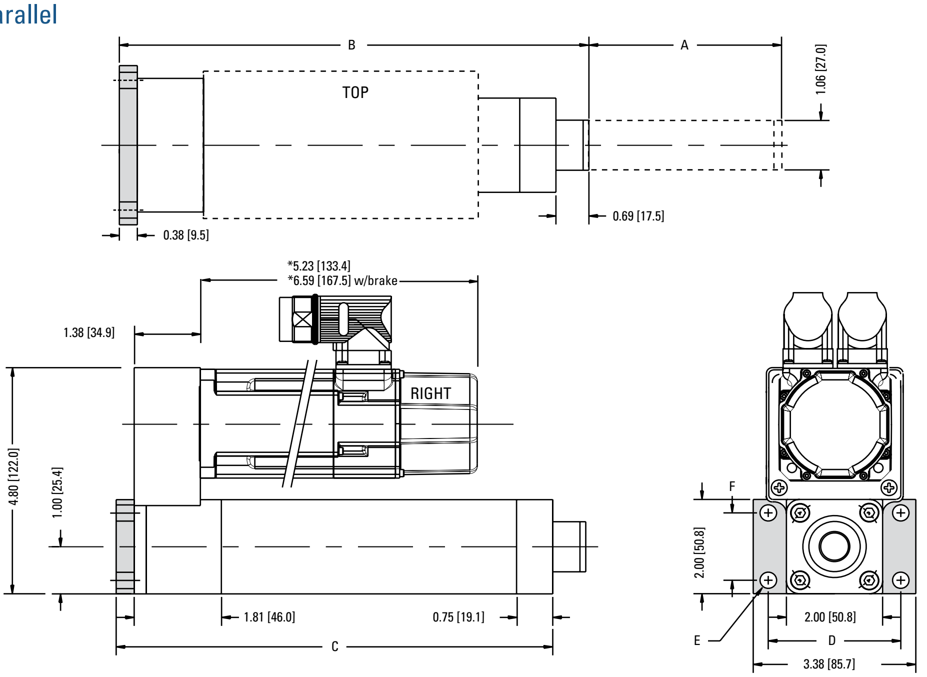
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length
inch	5.37 + S	inch	5.06 + S
mm	136.4 + S	mm	128.5 + S

S = stroke

MF2 Rear Rectangular Flange Mount

Parallel



	English Option MF2 (inches)	Metric Option MF2M (mm)
D	2.75	72*
E	0.34	9*
F	1.43	36*

* Meets ISO 40mm bore standard

A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

* AKM23 with motor mounted connectors.

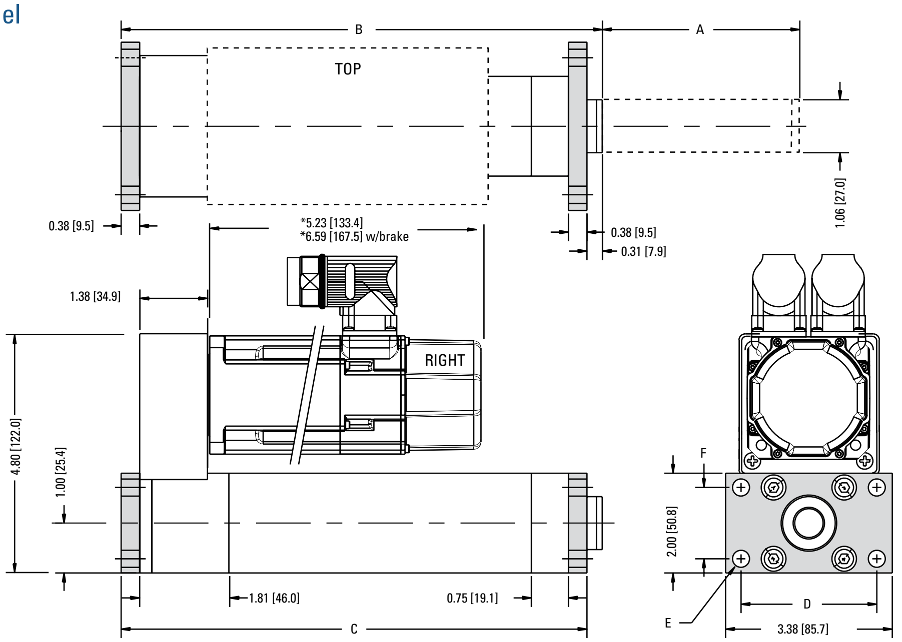
B	Retract Length	C	Mounting length
inch	5.75 + S	inch	5.06 + S
mm	146.1 + S	mm	128.5 + S

S = stroke

N2 Dimensions

MF3 Front and Rear Rectangular Flange Mount

Parallel



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

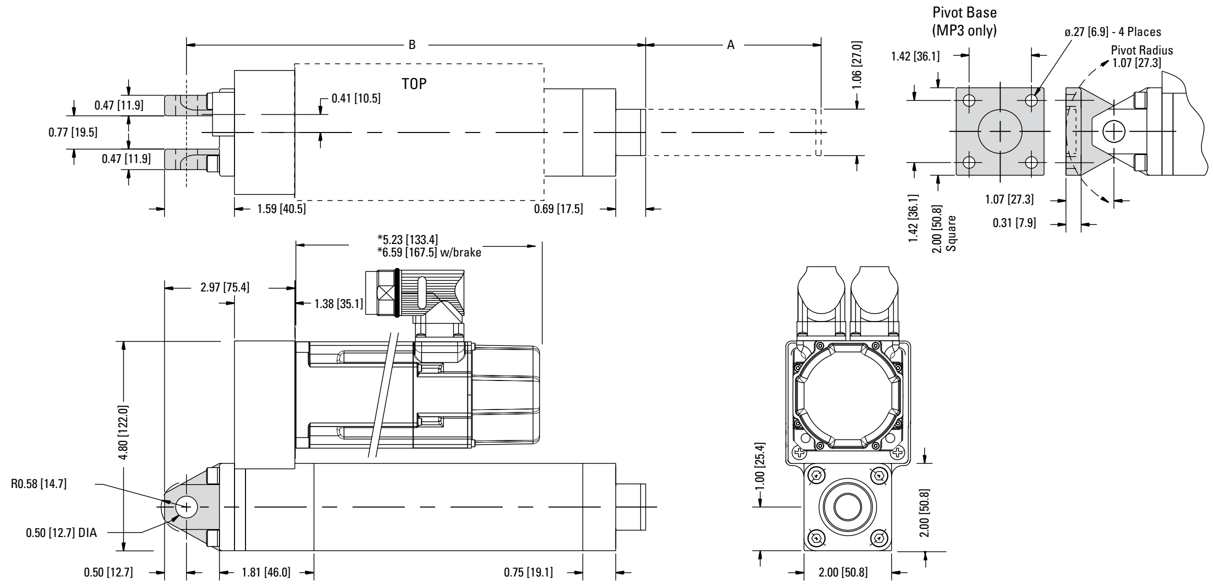
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length
inch	5.75 + S	inch	5.44 + S
mm	146.1 + S	mm	138.2 + S

S = stroke

MP2 Clevis Mount / MP3 Clevis Mount with Pivot Base

Parallel



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

* AKM23 with motor mounted connectors.

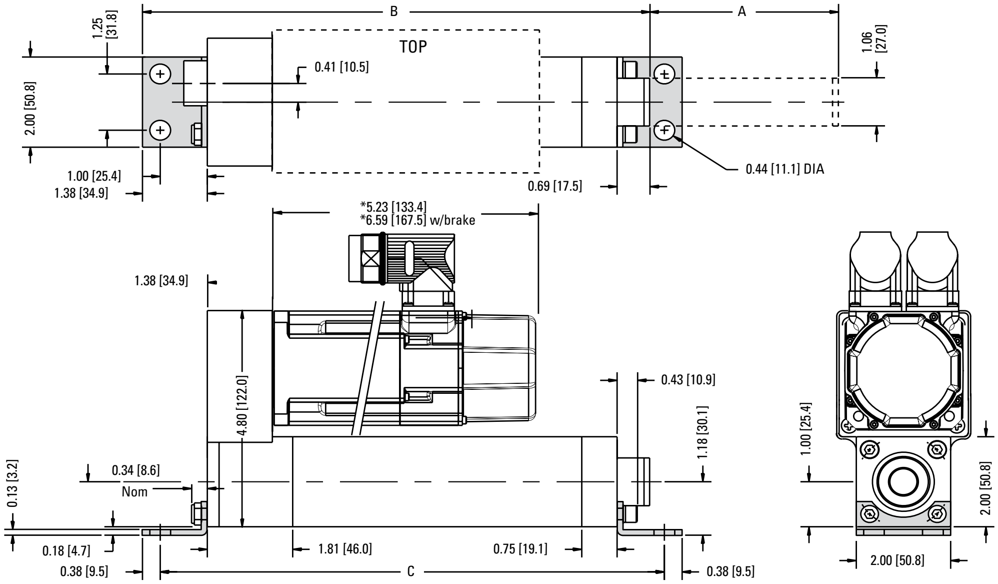
B	Retract Length
inch	6.47 + S
mm	164.4 + S

S = stroke

N2 Dimensions

MS1 Side End Angles Mount

Parallel



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

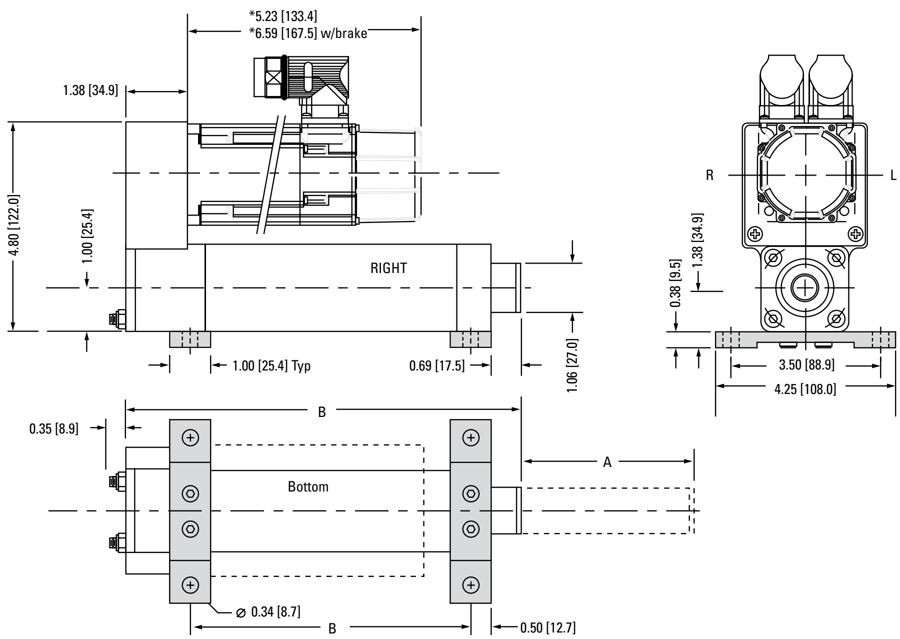
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length
inch	6.75 + S	inch	6.69 + S
mm	171.5 + S	mm	169.9 + S

S = stroke

MS2 Side Foot Mount

Parallel



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

* AKM23 with motor mounted connectors.

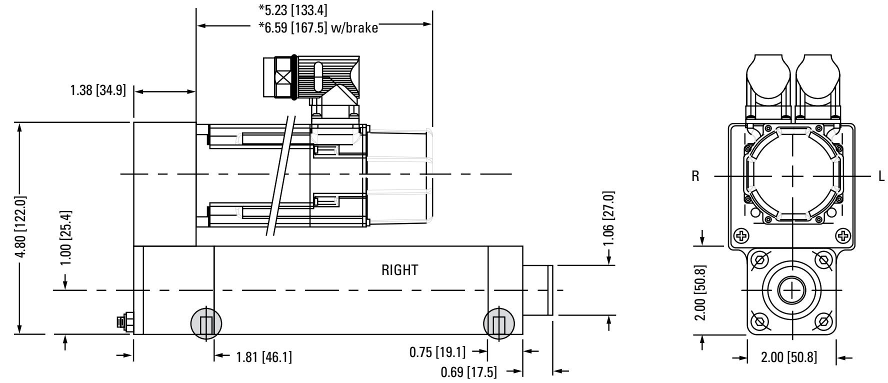
B	Retract Length	C	Mounting length
inch	5.37 + S	inch	2.56 + S
mm	136.4 + S	mm	65.0 + S

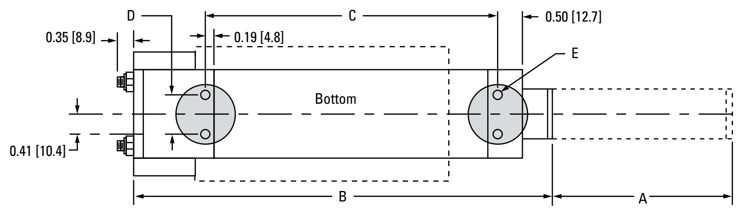
S = stroke

N2 Dimensions

MS6 Side Tapped Holes

Parallel





	English Option	Metric Option
	MS6 (inches)	MS6M (mm)
D	0.88	16
E	1/4-20 UNC x 0.38 deep	M6 x 1 x 8 deep

A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

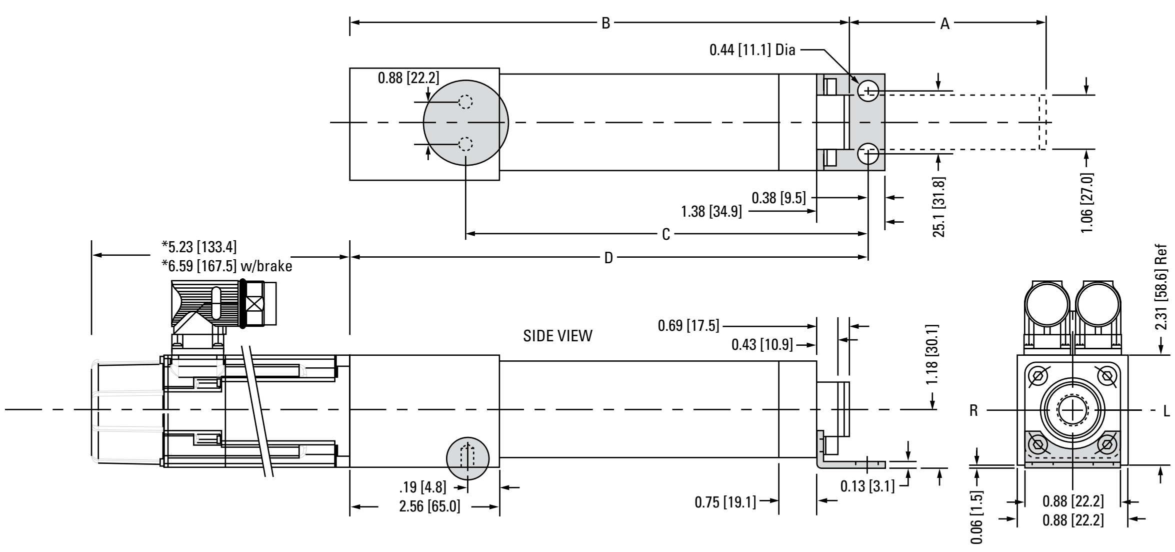
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length
inch	5.37 + S	inch	2.56 + S
mm	136.4 + S	mm	65.0 + S

S = stroke

MS1 Side End Angles

Inline



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

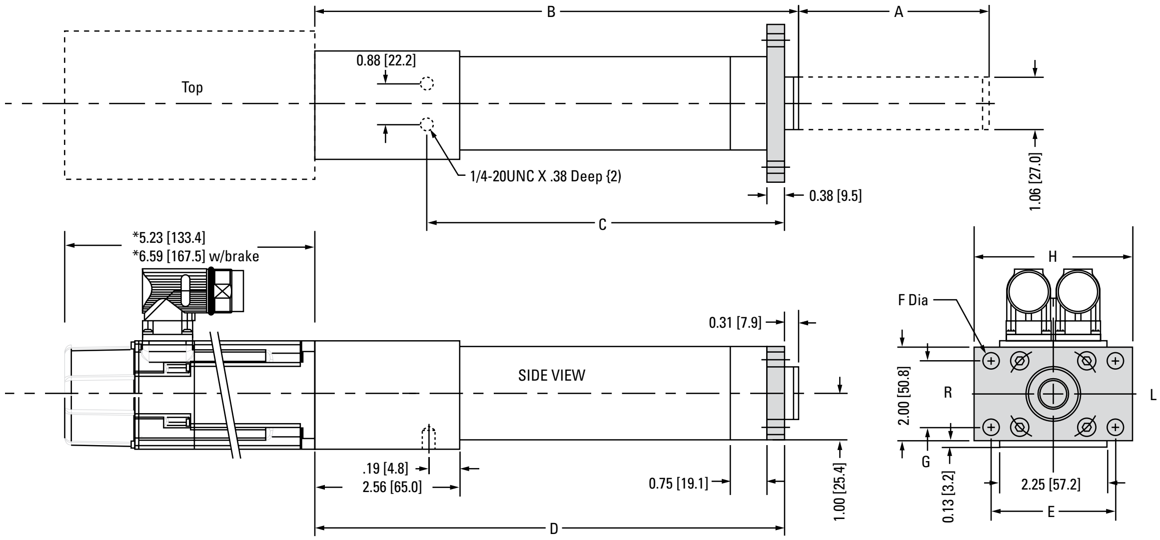
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length
inch	6.12 + S	inch	4.06 + S
mm	155.4+ S	mm	103.1+ S

S = stroke

N2 Dimensions

MF1 Front Flange
Inline



	English Option MS1 (inches)	Metric Option MF1M (mm)
E	2.75	72*
F	0.34	9*
G	1.43	36*
	3.38	85.7*

*Meets ISO 40mm bore standard

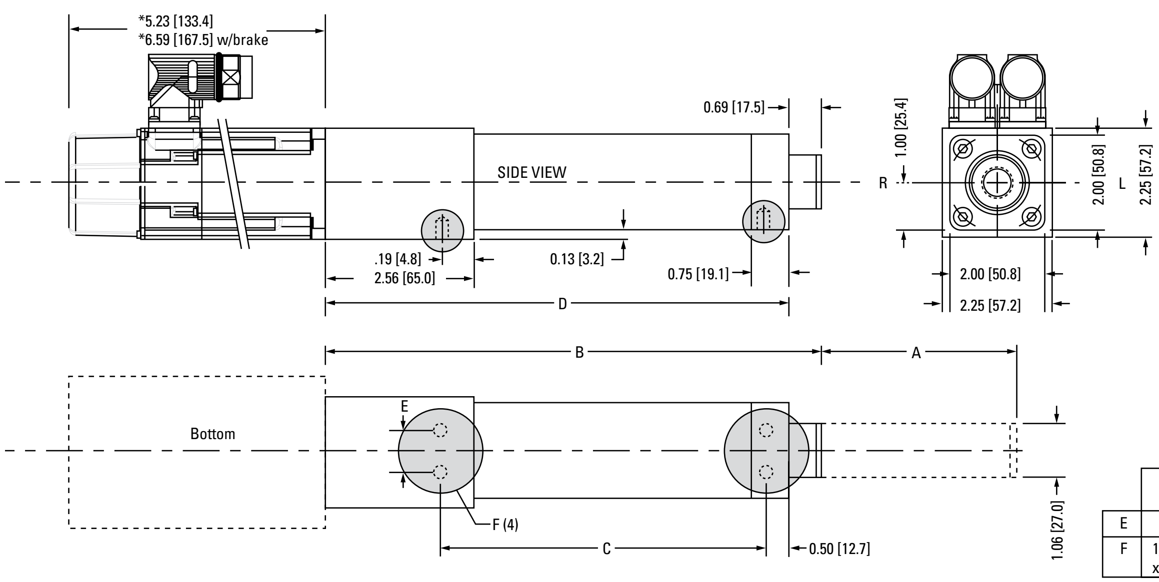
A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length	D	Mounting length
inch	6.12 + S	inch	3.44 + S	inch	5.81 + S
mm	155.4+ S	mm	87.4+ S	mm	147.5 + S

S = stroke

MS6 Side Tapped Holes
Inline



	English Option MS6 (inches)	Metric Option MS6M (mm)
E	0.88	16
F	1/4-20 UNC x 0.38 deep	M6 x 1 x 8 deep

A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

* AKM23 with motor mounted connectors.

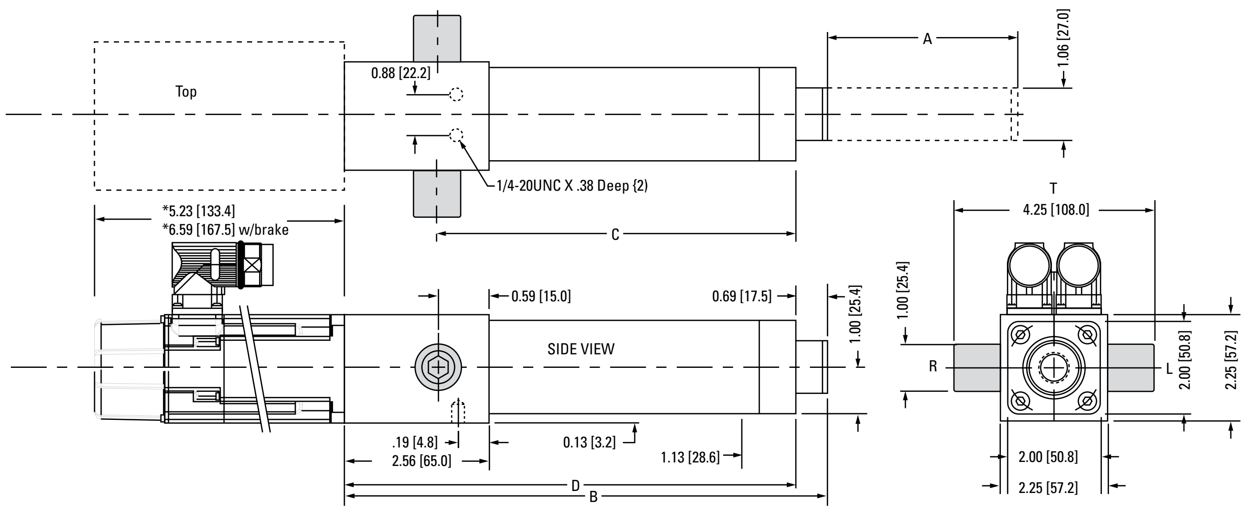
B	Retract Length	C	Mounting length	D	Mounting length
inch	6.12 + S	inch	2.56 + S	inch	5.43 + S
mm	155.4+ S	mm	65.0 + S	mm	137.8 + S

S = stroke

N2 Dimensions

MT4 Trunnion Mounting

Inline



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

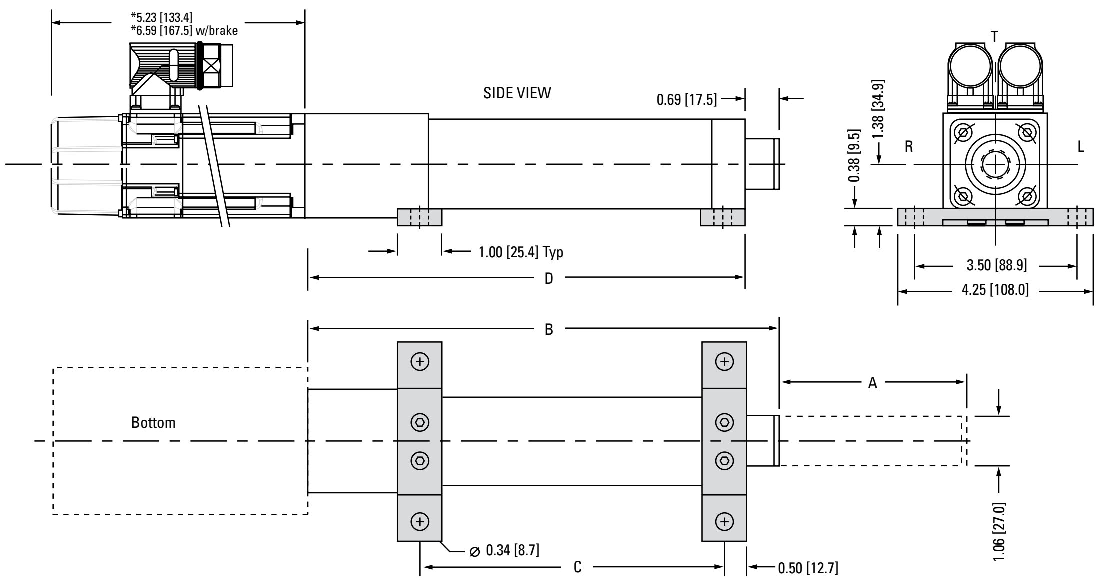
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length	D	Mounting length
inch	6.12 + S	inch	3.47 + S	inch	5.43 + S
mm	155.4+ S	mm	88.1 + S	mm	137.8 + S

S = stroke

MS2 Side Foot

Inline



A	Standard Stroke Lengths Available						
inch	2.0	4.0	6.0	8.0	12.0	18.0	24.0
mm	50.8	101.6	152.4	203.2	304.8	457.2	609.6

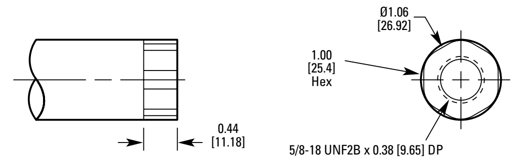
* AKM23 with motor mounted connectors.

B	Retract Length	C	Mounting length	D	Mounting length
inch	6.12 + S	inch	2.56 + S	inch	5.43 + S
mm	155.4+ S	mm	65.0 + S	mm	137.8 + S

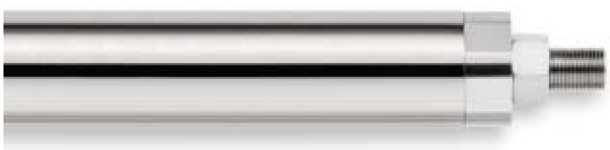
S = stroke

N2 Rod End Dimensions

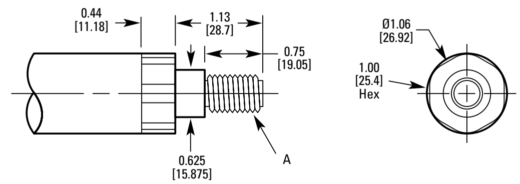
FT1 Female Threads Dimensions in [mm]



	FT1E	FT1M	FT2M
A	5/8 - 18 UNF	M12 x 1.25	M12 x 1.75
B	0.38 (9.65) deep	0.44 (11.18) deep (thru)	.32 (8.13) deep

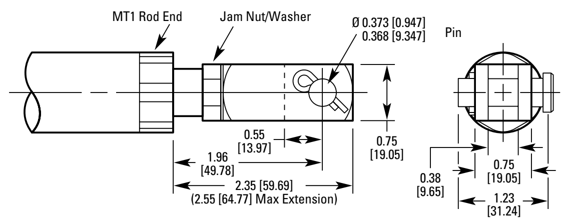


MT1 Male Threads Dimensions in [mm]

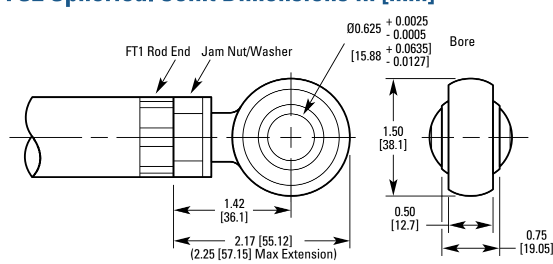


	MT1E	MT1M
A	7/16 - 20 UNF	M12 x 1.25

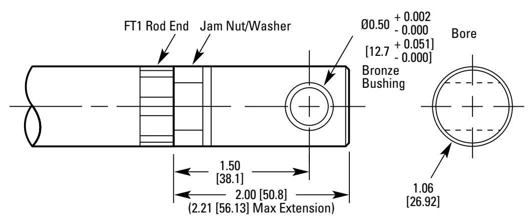
FC2 Clevis with Pin Dimensions in [mm]



FS2 Spherical Joint Dimensions in [mm]

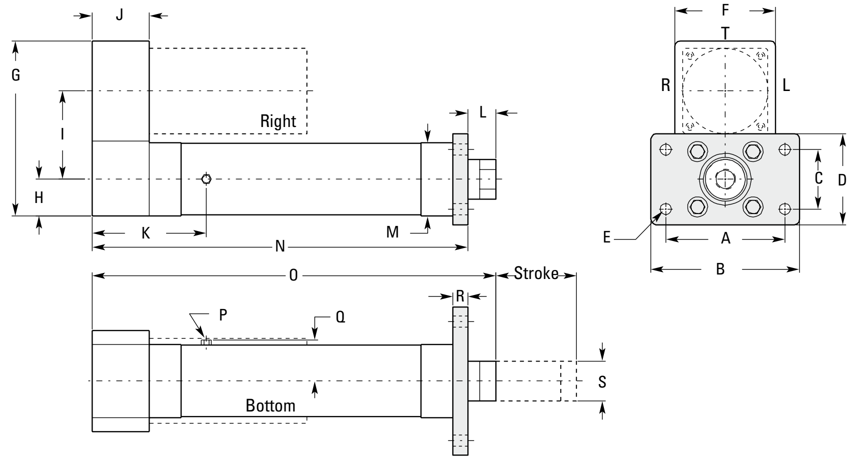


FE2 Female Eye Dimensions in [mm]



EC Series Dimensions

MF1 Front Flange
Parallel



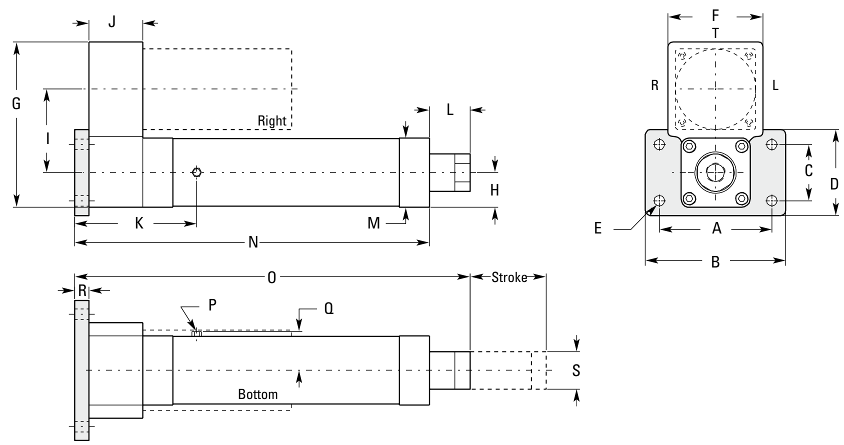
Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J mm (in)	K mm (in)
EC1	60.0 (2.36)	74.0 (2.91)	28.0 (1.10)	40.0 (1.57)	6.60 (0.26)	48.0 (1.89)	82.6 (3.25)	19.0 (0.75)	41.8 (1.65)	31.3 (1.23)	-
EC2	90.0 (3.54)	114.3 (4.50)	45.0 (1.77)	63.5 (2.50)	9.0 (0.35)	79.8 (3.14)	144.0 (5.7)	28.4 (1.12)	74.7 (2.94)	41.7 (1.64)	88.6 (3.49)
EC3	100.0 (3.94)	127.0 (5.00)	50.0 (1.97)	69.1 (2.72)	9.0 (0.35)	95.5 (3.76)	169.7 (6.7)	34.8 (1.37)	*87.6/89.7 (*3.45/3.53)	49.3 (1.94)	94.2 (3.71)
EC4	127.0 (5.00)	152.4 (6.00)	69.9 (2.75)	96.3 (3.79)	13.5 (0.53)	127.0 (5.00)	221.0 (8.7)	46.1 (1.81)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)
EC5	150.0 (5.91)	186.9 (7.36)	75.0 (2.95)	114.3 (4.50)	14.2 (0.56)	127.0 (5.00)	221.0 (8.7)	46.1 (1.81)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)

	L mm (in)	M mm (in)	N Cyl Length mm (in)	O Retract length mm (in)	P Breather port Hex		Q mm (in)	R mm (in)	S mm (in)
					type	mm (in)			
EC1	10.2 (0.40)	38.1 (1.50)	106.8 + S (4.2 + S)	117.0 + S (4.60 + S)	-	-	-	10.0 (0.39)	22.2 (0.88)
EC2	25.0 (0.98)	56.9 (2.24)	218.5 + S (8.6 + S)	243.4 + S (9.58 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	9.5 (0.37)	28.0 (1.10)
EC3	25.0 (0.98)	69.6 (2.74)	246.3 + S (9.7 + S)	271.1 + S (10.67 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	12.7 (0.50)	35.0 (1.38)
EC4	41.4 (1.63)	92.2 (3.63)	365.8 + S (14.4 + S)	406.9 + S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	12.7 (0.50)	50.0 (1.97)
EC5	35.0 (1.38)	92.2 (3.63)	365.8 + S (14.4 + S)	406.9 + S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	19.1 (0.75)	50.0 (1.97)

* AKM23 / AKM42 dimension

MF2 Rear Flange
Parallel



Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J mm (in)	K mm (in)
EC2	90.0 (3.54)	114.3 (4.50)	45.0 (1.77)	63.5 (2.50)	9.0 (0.35)	79.8 (3.14)	147.3 (5.80)	28.45 (1.12)	74.7 (2.94)	41.7 (1.64)	98.3 (3.87)
EC3	100.0 (3.94)	127.0 (5.00)	50.0 (1.97)	69.1 (2.72)	9.0 (0.35)	95.5 (3.76)	169.7 (6.68)	34.8 (1.37)	*87.6/89.7 (*3.45/3.53)	49.3 (1.94)	106.9 (4.21)
EC4	127.0 (5.00)	152.4 (6.00)	69.9 (2.75)	96.3 (3.79)	13.5 (0.53)	127.0 (5.00)	221.0 (8.70)	46.1 (1.81)	111.1 (4.37)	71.9 (2.83)	163.5 (6.44)
EC5	150.0 (5.91)	186.9 (7.36)	75.0 (2.95)	114.3 (4.50)	14.2 (0.56)	127.0 (5.00)	221.0 (8.70)	46.1 (1.81)	111.1 (4.37)	71.9 (2.83)	169.9 (6.69)

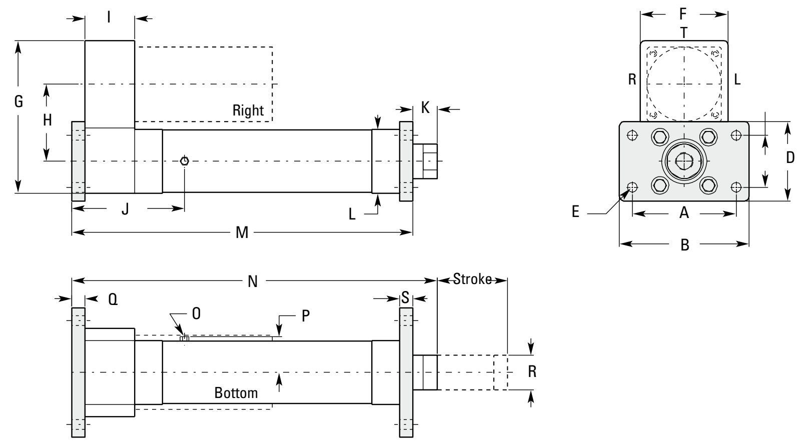
	L mm (in)	M mm (in)	N Cyl Length mm (in)	O Retract length mm (in)	P Breather port Hex		Q mm (in)	R mm (in)	S mm (in)
					type	mm (in)			
EC2	34.5 (1.36)	56.9 (2.24)	218.5 + S (8.6 + S)	253.0 + S (9.96 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	9.5 (0.37)	28.0 (1.10)
EC3	37.7 (1.48)	69.6 (2.74)	246.3 + S (9.7 + S)	284.3 + S (11.19 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	12.7 (0.50)	35.0 (1.38)
EC4	54.1 (2.13)	92.2 (3.63)	365.8 + S (14.4 + S)	419.6 + S (16.52 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	12.7 (0.50)	50.0 (1.97)
EC5	54.1 (2.13)	92.2 (3.63)	365.8 + S (14.4 + S)	419.6 + S (16.52 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	19.1 (0.75)	50.0 (1.97)

* AKM23 / AKM42 dimension

EC Series Dimensions

MF3 Front and Rear Flanges
Parallel

Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm



	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J mm (in)	K mm (in)
EC2	90.0 (3.54)	114.3 (4.50)	45.0 (1.77)	63.5 (2.50)	9.0 (0.35)	79.8 (3.14)	147.3 (5.80)	74.7 (2.94)	41.7 (1.64)	98.3 (3.87)	25.0 (0.98)
EC3	100.0 (3.94)	127.0 (5.00)	50.0 (1.97)	69.1 (2.72)	9.0 (0.35)	95.5 (3.76)	169.7 (6.68)	*87.6/89.7 (*3.45/3.53)	49.3 (1.94)	106.9 (4.21)	25.0 (0.98)
EC4	127.0 (5.00)	152.4 (6.00)	69.9 (2.75)	96.3 (3.79)	13.5 (0.53)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	163.5 (6.44)	41.4 (1.63)
EC5	150.0 (5.91)	186.9 (7.36)	75.0 (2.95)	114.3 (4.50)	14.2 (0.56)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	169.9 (6.69)	35.1 (1.38)

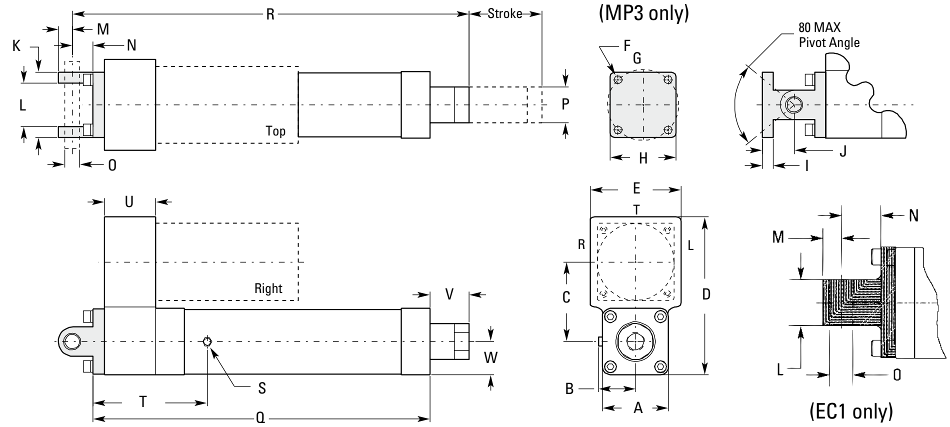
	L mm (in)	M Cyl Length mm (in)	N Retract length mm (in)	O Breather port Hex		P mm (in)	Q mm (in)	R mm (in)	S mm (in)
				type	mm (in)				
EC2	56.9 (2.24)	228.1+ S (8.98 + S)	253.0 + S (9.96 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	9.5 (0.37)	28.0 (1.10)	9.5 (0.37)
EC3	69.6 (2.74)	259.3 + S (10.21+ S)	284.3 + S (11.19 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	12.7 (0.50)	35.0 (1.38)	12.7 (0.50)
EC4	92.2 (3.63)	387.5 + S (14.9 + S)	419.6 + S (16.52 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	12.7 (0.50)	50.0 (1.97)	12.7 (0.50)
EC5	92.2 (3.63)	378.5 + S (14.9 + S)	419.6 + S (16.52 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	19.1 (0.75)	50.0 (1.97)	19.1 (0.75)

* AKM23 / AKM42 dimension

MP2 Clevis Mount
MP3 Clevis Mount
with Pivot Base and Pin
Parallel

Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

PIVOT BASE (MP3 only)



(EC1 only)

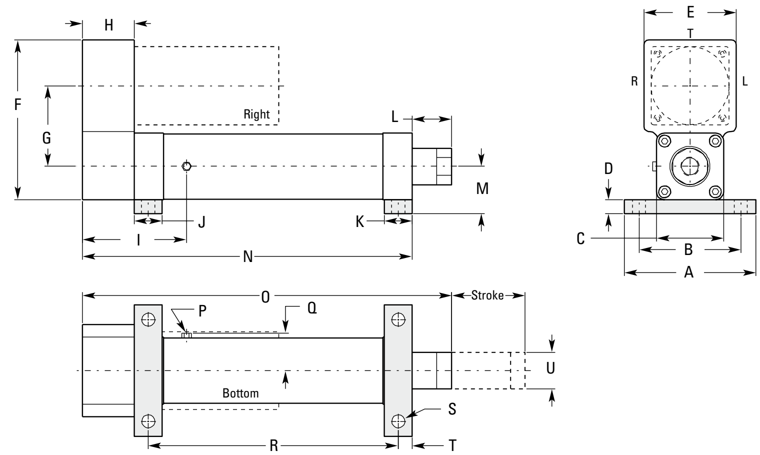
	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J mm (in)	K mm (in)	L mm (in)	M mm (in)
EC1	43.7 (1.72)	-	41.8 (1.65)	82.6 (3.25)	48.0 (1.89)	5.5 (0.22)	48.0 (1.89)	46.0 (1.81)	8.0 (0.31)	30.0 (1.18)	-	19.9/20.1 (0.782/0.792)	8.0 (0.31)
EC2	56.9 (2.24)	34.8 (1.37)	74.7 (2.94)	144.0 (5.67)	79.8 (3.14)	5.4 (0.21)	61.7 (2.43)	56.9 (2.24)	9.5 (0.37)	25.4 (1.00)	57.0 (2.24)	32.0/32.6 (1.26/1.28)	12.7 (0.50)
EC3	69.6 (2.74)	41.1 (1.62)	87.6/89.7* (3.45/3.53*)	169.7 (6.68)	95.5 (3.76)	6.5 (0.26)	76.0 (2.99)	69.3 (2.73)	9.5 (0.37)	31.5 (1.24)	69.3 (2.73)	40.0/40.6 (1.58/1.60)	15.2 (0.60)
EC4	92.2 (3.63)	52.8 (2.08)	111.1 (4.37)	221.0 (8.70)	127.0 (5.00)	11.1 (0.44)	98.8 (3.89)	91.4 (3.60)	15.7 (0.62)	44.4 (1.75)	91.4 (3.60)	60.0/60.5 (2.36/2.38)	19.6 (0.77)
EC5	92.2 (3.63)	52.8 (2.08)	111.1 (4.37)	221.0 (8.70)	127.0 (5.00)	11.1 (0.44)	98.8 (3.89)	91.4 (3.60)	15.7 (0.62)	44.4 (1.75)	91.4 (3.60)	60.0/60.5 (2.36/2.38)	19.6 (0.77)

	N mm (in)	O mm (in)	P mm (in)	Q Cyl Length mm (in)	R Retract length mm (in)	S Breather port Hex		T mm (in)	U mm (in)	V mm (in)	W mm (in)
						type	mm (in)				
EC1	17.2 (0.68)	9.86/10.1 (0.388/0.398)	22.2 (0.88)	102.9 + S (4.05 + S)	140.5 + S (5.53 + S)	-	-	-	31.3 (1.23)	20.2 (0.80)	19.1 (0.75)
EC2	15.7 (0.62)	11.9/12.0 (0.470/0.472)	28.0 (1.10)	218.5+ S (8.6 + S)	267.5 + S (10.5)	1/8 NPT	11.1 (0.44)	98.3 (3.87)	41.7 (1.64)	34.5 (1.36)	28.5 (1.12)
EC3	21.8 (0.86)	15.9/16.0 (0.628/0.630)	35.0 (1.38)	242.7+ S (9.55+ S)	302.6+ S (11.91 + S)	1/8 NPT	11.1 (0.44)	103.9 (4.09)	49.3 (1.94)	37.7 (1.48)	34.8 (1.37)
EC4	28.7 (1.13)	19.9/20.0 (0.785/0.787)	50.0 (1.97)	368.3 + S (14.5 + S)	451.4+ S (17.77 + S)	1/4 NPT	14.0 (0.55)	166.6 (6.56)	71.9 (2.83)	54 (2.13)	46.1 (1.81)
EC5	28.7 (1.13)	19.9/20.0 (0.785/0.787)	50.0 (1.97)	368.3 + S (14.5 + S)	451.4+ S (17.77 + S)	1/4 NPT	14.0 (0.55)	166.6 (6.56)	71.9 (2.83)	54 (2.13)	46.1 (1.81)

* AKM23 / AKM42 dimension

EC Series Dimensions

MS2 Side Lugs
Parallel



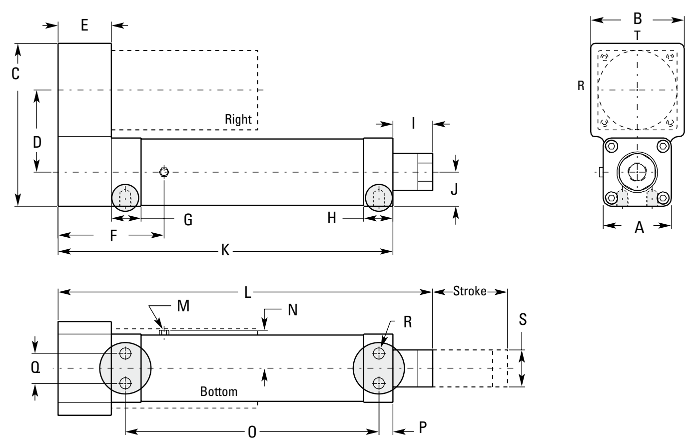
Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J mm (in)	K mm (in)
EC1	78.0 (3.07)	62.0 (2.44)	43.7 (1.72)	8.0 (0.31)	48.0 (1.89)	82.6 (3.25)	41.8 (1.65)	31.3 (1.23)	-	20.0 (0.79)	20.0 (0.79)
EC2	114.3 (4.50)	85.0 (3.35)	56.9 (2.24)	9.5 (0.37)	79.8 (3.14)	144.0 (5.67)	74.7 (2.94)	41.7 (1.64)	88.6 (3.49)	22.1 (0.87)	22.1 (0.87)
EC3	127.0 (5.00)	100.0 (3.94)	69.6 (2.74)	12.7 (0.50)	95.5 (3.76)	169.7 (6.68)	87.6/89.7 * (3.45/3.53 *)	49.3 (1.94)	94.2 (3.71)	25.0 (0.98)	25.0 (0.98)
EC4	181.1 (7.13)	140.0 (5.51)	92.2 (3.63)	19.1 (0.75)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)	38.1 (1.50)	38.1 (1.50)
EC5	181.1 (7.13)	140.0 (5.51)	92.2 (3.63)	19.1 (0.75)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)	38.1 (1.50)	38.1 (1.50)

	L mm (in)	M mm (in)	N Cyl Length mm (in)	O Retract length mm (in)	P Breather port Hex		Q mm (in)	R mm (in)	S mm (in)	T mm (in)	U mm (in)
					type	mm (in)					
EC1	20.5 (0.81)	27.1 (1.06)	96.5 + S (3.79 + S)	117.0 + S (4.60 + S)	-	-	-	58.6 + S (2.30 + S)	6.6 (0.26)	10.0 (0.39)	22.2 (0.88)
EC2	34.5 (1.36)	38.1 (1.50)	208.8 + S (8.22 + S)	243.4 + S (9.58 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	144.8 + S (5.7 + S)	9.0 (0.35)	11.0 (0.43)	28.0 (1.10)
EC3	37.7 (1.48)	47.5 (1.87)	233.4 + S (9.19 + S)	271.1+ S (10.67 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	158.8 + S (6.25 + S)	11.0 (0.43)	12.5 (0.49)	35.0 (1.38)
EC4	54.0 (2.13)	65.3 (2.57)	353.1 + S (13.9 + S)	406.9+ S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	242.6 + S (9.55 + S)	18.0 (0.71)	19.1 (0.75)	50.0 (1.97)
EC5	54.0 (2.13)	65.3 (2.57)	353.1 + S (13.9 + S)	406.9+ S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	242.6 + S (9.55 + S)	18.0 (0.71)	19.1 (0.75)	50.0 (1.97)

* AKM23 / AKM42 dimension

MS6 Side Tapped Holes
Parallel



Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J mm (in)	K Cyl Length mm (in)
EC1	43.7 (1.72)	48.0 (1.89)	82.6 (3.25)	41.8 (1.65)	31.3 (1.23)	-	10.5 (0.41)	19.2 (0.76)	20.2 (0.80)	19.1 (0.75)	96.5 (3.80)
EC2	56.9 (2.24)	79.8 (3.14)	144.0 (5.67)	74.7 (2.94)	41.7 (1.64)	88.6 (3.49)	22.1 (0.87)	22.1 (0.87)	34.5 (1.36)	28.5 (1.12)	208.8 + S (8.22 + S)
EC3	69.6 (2.74)	95.5 (3.76)	169.7 (6.68)	87.6/89.7 * (3.45/3.53 *)	49.3 (1.94)	94.2 (3.71)	25.1 (0.99)	25.1 (0.99)	37.7 (1.48)	34.8 (1.37)	233.4 + S (9.19 + S)
EC4	92.2 (3.63)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)	40.0 (1.57)	40.0 (1.57)	54.0 (2.13)	46.1 (1.81)	353.1 + S (13.9 + S)
EC5	92.2 (3.63)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)	40.0 (1.57)	40.0 (1.57)	54.0 (2.13)	46.1 (1.81)	353.1 + S (13.9 + S)

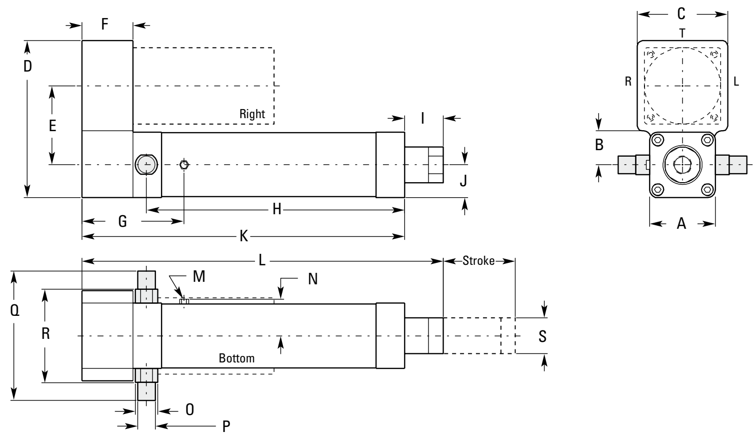
	L Retract length mm (in)	M Breather port Hex		N mm (in)	O Mounting Length mm (in)	P mm (in)	Q mm (in)	R (MS6E) Thread	R (MS6M) Thread	S mm (in)
		type	mm (in)							
EC1	117.0 + S (4.60 + S)	-	-	-	58.66 + S (2.31 + S)	9.94 (0.39)	16.0 (0.63)	-	M6 x 1-6H x 6.8 mm Dp	22.2 (0.88)
EC2	243.4 + S (9.58 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	144.8 + S (5.7 + S)	11.0 (0.43)	25.0 (0.98)	5/16-18 UNC-2B x 0.33 Dp	M8 x 1.25-6H x 8.4 mm Dp	28.0 (1.10)
EC3	271.1 + S (10.67 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	158.8 + S (6.25 + S)	12.5 (0.49)	30.0 (1.18)	3/8-16 UNC-2B x 0.40 Dp	M10 x 1.50-6H x 10.2 mm Dp	35.0 (1.38)
EC4	406.9 + S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	242.6 + S (9.55 + S)	19.1 (0.75)	40.6 (1.60)	5/8-18 UNF-2B x 0.55 Dp	M16 x 2-6H x 14 mm Dp	50.0 (1.97)
EC5	406.9 + S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	242.6 + S (9.55 + S)	19.1 (0.75)	40.6 (1.60)	5/8-18 UNF-2B x 0.55 Dp	M16 x 2-6H x 14 mm Dp	50.0 (1.97)

* AKM23 / AKM42 dimension

EC Series Dimensions

MT4 Trunnion
Parallel

Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm



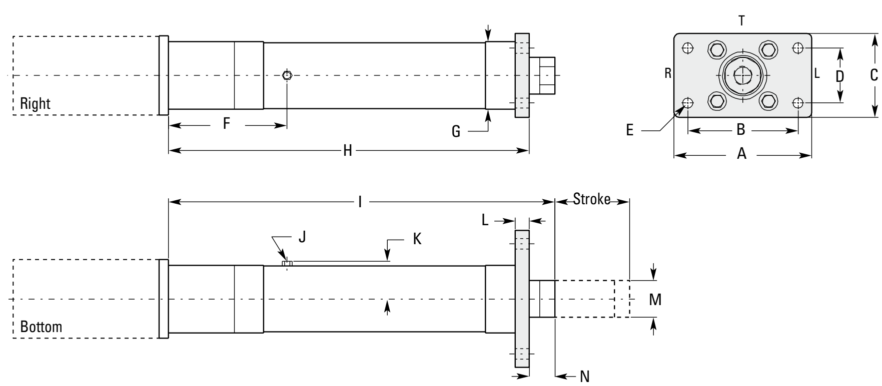
	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H Mounting Length mm (in)	I mm (in)	J mm (in)
EC2	56.9 (2.24)	28.5 (1.12)	79.8 (3.14)	144.0 (5.67)	74.7 (2.94)	41.7 (1.64)	88.6 (3.49)	155.8 + S (6.13 + S)	34.5 (1.36)	28.5 (1.12)
EC3	69.6 (2.74)	38.6 (1.52)	95.5 (3.76)	169.7 (6.68)	87.6/89.7 * (3.45/3.53 *)	49.3 (1.94)	94.2 (3.71)	171.2 + S (6.74 + S)	37.7 (1.48)	34.8 (1.37)
EC4	92.2 (3.63)	48.0 (5.94)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)	261.6 + S (10.30 + S)	54.0 (2.13)	46.1 (1.81)
EC5	92.2 (3.63)	48.0 (1.89)	127.0 (5.00)	221.0 (8.70)	111.1 (4.37)	71.9 (2.83)	150.9 (5.94)	261.6 + S (10.30 + S)	54.0 (2.13)	46.1 (1.81)

	K Cyl Length mm (in)	L Retract length mm (in)	M Breather port Hex		N mm (in)	O mm (in)	P mm (in)	Q mm (in)	R mm (in)	S mm (in)
			type	mm (in)						
EC2	208.8+ S (8.22 + S)	243.4 + S (9.58 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	19.1 (0.75)	15.9/16.0 (0.627/0.629)	106.9 (4.21)	75.0 (2.95)	28.0 (1.10)
EC3	233.4+ S (9.19 + S)	271.1 + S (10.67 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	25.0 (0.98)	19.9/20.0 (0.784/0.786)	129.6 (5.10)	90.0 (3.54)	35.0 (1.38)
EC4	353.1 + S (13.9 + S)	406.9 + S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	31.8 (1.60)	24.9/25.0 (0.981/0.983)	181.6 (1.60)	131.8 (5.19)	50.0 (1.97)
EC5	353.1 + S (13.9 + S)	406.9 + S (16.02 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	31.8 (1.25)	24.9/25.0 (0.981/0.983)	181.6 (7.15)	131.8 (5.19)	50.0 (1.97)

* AKM23 / AKM42 dimension

MT1 Front Flange
Inline

Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

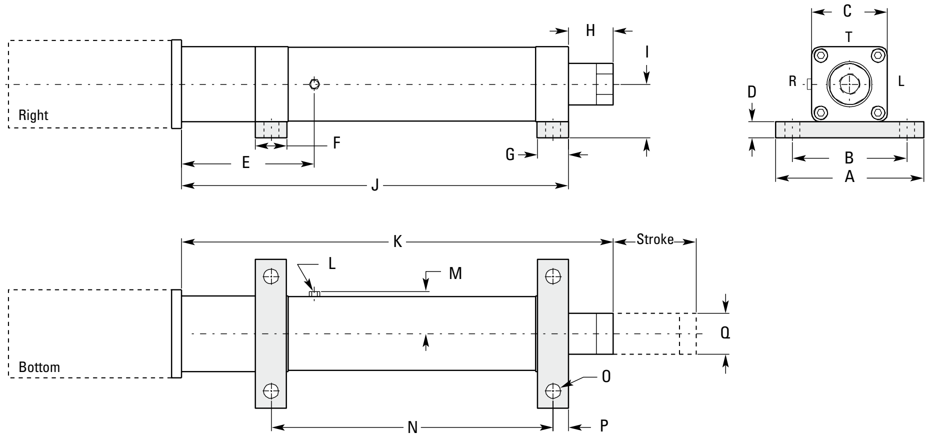


	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H Cyl Length mm (in)
EC1	74.0 (2.91)	60.0 (2.36)	40.0 (1.57)	28.0 (1.10)	6.6 (0.26)	-	38.1 (1.50)	104.73 + S (4.12 + S)
EC2	114.3 (4.50)	90.0 (3.54)	63.5 (2.50)	45.0 (1.77)	9.0 (0.35)	100.7 (3.96)	56.9 (2.24)	230.5 + S (9.08 + S)
EC3	127.0 (5.00)	100.0 (3.94)	69.1 (2.72)	50.0 (1.97)	9.0 (0.35)	121.3 (4.78)	69.6 (2.74)	273.4 + S (10.76 + S)
EC4	152.4 (6.00)	127.0 (5.00)	96.3 (3.79)	69.85 (2.75)	13.5 (0.53)	169.2 (6.66)	92.2 (3.63)	390.3 + S (15.37 + S)
EC5	186.9 (7.36)	155.0 (6.10)	114.3 (4.50)	75.0 (2.95)	14.2 (0.56)	169.2 (6.66)	92.2 (3.63)	390.3 + S (15.37 + S)

	I Retract length mm (in)	J Breather port Hex		K mm (in)	L mm (in)	M mm (in)	N mm (in)
		type	mm (in)				
EC1	115.1 + S (4.53 + S)	-	-	-	10.0 (0.39)	22.2 (0.88)	10.2 (0.40)
EC2	255.5 + S (10.06 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	9.5 (0.37)	28.0 (1.10)	25.0 (0.98)
EC3	298.3 + S (11.74 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	12.7 (0.50)	35.0 (1.38)	25.0 (0.98)
EC4	425.3 + S (16.74 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	12.7 (1.60)	50.0 (1.97)	41.1 (1.60)
EC5	425.3 + S (16.74 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	19.1 (0.75)	50.0 (1.97)	35.0 (1.38)

EC Series Dimensions

MS2 SideLugs
Inline

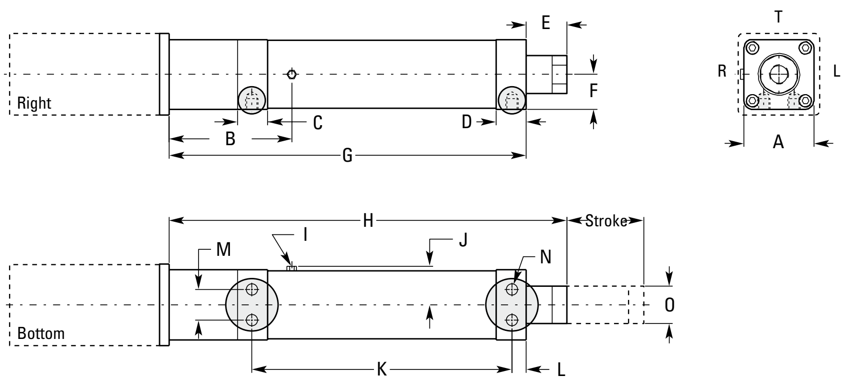


Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I mm (in)	J Cyl Length mm (in)
EC1	78.0 (3.07)	62.0 (2.44)	43.7 (1.72)	8.0 (0.31)	-	20.0 (0.79)	20.0 (0.79)	20.5 (0.81)	27.1 (1.06)	94.7 + S (3.72 + S)
EC2	114.3 (4.50)	85.0 (3.35)	56.9 (2.24)	9.5 (0.37)	100.7 (3.96)	22.1 (0.87)	22.1 (0.87)	34.5 (1.36)	38.1 (1.50)	220.9 + S (8.70 + S)
EC3	127.0 (5.00)	100.0 (3.94)	69.6 (2.74)	12.7 (0.50)	121.3 (4.78)	25.0 (0.98)	25.0 (0.98)	37.7 (1.48)	47.5 (1.87)	260.5 + S (10.25 + S)
EC4	181.1 (7.13)	140.0 (5.51)	92.2 (3.63)	19.1 (0.75)	169.2 (6.66)	38.1 (1.50)	38.1 (1.50)	54.0 (2.13)	65.3 (2.57)	371.3 + S (14.62 + S)
EC5	181.1 (7.13)	140.0 (5.51)	92.2 (3.63)	19.1 (0.75)	169.2 (6.66)	38.1 (1.50)	38.1 (1.50)	54.0 (2.13)	65.3 (2.57)	371.3 + S (14.62 + S)

	K Retract length mm (in)	L Breather port Hex		M mm (in)	N mm (in)	O mm (in)	P mm (in)	Q mm (in)
		type	mm (in)					
EC1	115.1 + S (4.53)	-	-	-	58.76 + S (2.31 + S)	6.6 (0.26)	10.0 (0.39)	22.2 (0.88)
EC2	255.5 + S (10.06 + S)	1/8 NPT	11.1 (0.44)	34.8 (1.37)	144.8 + S (5.7 + S)	9.0 (0.35)	11.0 (0.43)	28.0 (1.10)
EC3	298.1 + S (11.74 + S)	1/8 NPT	11.1 (0.44)	41.1 (1.62)	158.8 + S (6.25 + S)	11.0 (0.43)	12.5 (0.49)	35.0 (1.38)
EC4	425.3 + S (16.74 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	242.6 + S (9.55 + S)	18.0 (0.71)	19.1 (0.75)	50.0 (1.97)
EC5	425.3 + S (16.74 + S)	1/4 NPT	14.0 (0.55)	52.8 (2.08)	242.6 + S (9.55 + S)	18.0 (0.71)	19.1 (0.75)	50.0 (1.97)

MS6 Side Tapped Holes
Inline



Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC1	30 mm
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

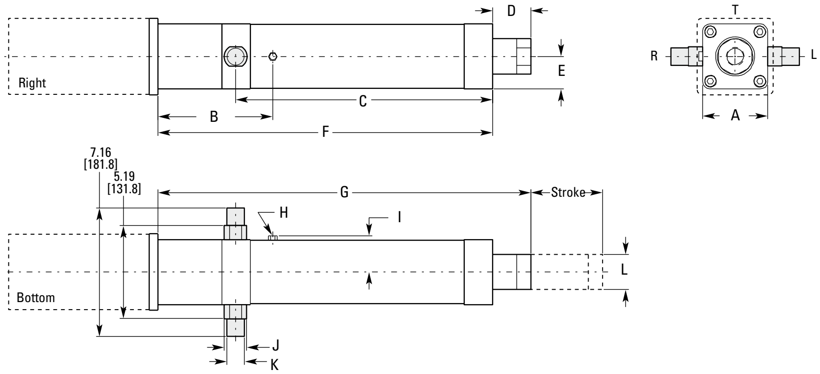
	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G Cyl Length mm (in)	H Retract length mm (in)	I Breather port Hex	
									type	mm (in)
EC1	43.7 (1.72)	-	-	19.2 (0.76)	20.5 (0.81)	27.1 (1.06)	94.7 + S (3.72 + S)	115.1 + S (4.53 + S)	-	-
EC2	56.9 (2.24)	100.7 (3.96)	22.1 (0.87)	22.1 (0.87)	34.5 (1.36)	28.5 (1.12)	220.9 + S (8.70 + S)	255.5 + S (10.06 + S)	1/8 NPT	11.1 (0.44)
EC3	69.6 (2.74)	121.3 (4.78)	25.1 (0.99)	25.1 (0.99)	37.7 (1.48)	34.8 (1.37)	260.5 + S (10.25 + S)	298.1 + S (11.74 + S)	1/8 NPT	11.1 (0.44)
EC4	92.2 (3.63)	169.2 (5.94)	40.0 (1.57)	40.0 (1.57)	54.0 (2.13)	46.1 (1.81)	371.3 + S (14.62 + S)	425.3 + S (16.74 + S)	1/4 NPT	14.0 (0.55)
EC5	92.2 (3.63)	169.2 (6.66)	40.0 (1.57)	40.0 (1.57)	54.0 (2.13)	46.1 (1.81)	371.3 + S (14.62 + S)	425.3 + S (16.74 + S)	1/4 NPT	14.0 (0.55)

	J mm (in)	K mm (in)	L mm (in)	M mm (in)	N (MS6E) mm (in)	N (MS6M mm (in)	O mm (in)
EC1	-	58.8 + S (2.31 + S)	9.9 (0.39)	16.0 (0.63)	-	M6 x 1-6H x 6.8 mm Dp	22.2 (0.88)
EC2	34.8 (1.37)	144.8 + S (5.7 + S)	11.0 (0.43)	25.0 (0.98)	5/16-18 UNC-2B x 0.33 Dp	M8 x 1.25-6H x 8.4 mm Dp	28.0 (1.10)
EC3	41.1 (1.62)	158.8 + S (6.25 + S)	12.5 (0.49)	30.0 (1.18)	3/8-16 UNC-2B x 0.40 Dp	M10 x 1.50-6H x 10.2 mm Dp	35.0 (1.38)
EC4	52.8 (2.08)	242.6 + S (9.55 + S)	19.1 (0.75)	40.6 (1.60)	5/8-18 UNF-2B x 0.55 Dp	M16 x 2-6H x 14 mm Dp	50.0 (1.97)
EC5	52.8 (2.08)	242.6 + S (9.55 + S)	19.1 (0.75)	40.6 (1.60)	5/8-18 UNF-2B x 0.55 Dp	M16 x 2-6H x 14 mm Dp	50.0 (1.97)

EC Series Dimensions

MT4 Trunnion Mounting
Inline

Flange dimensions in accordance with ISO 6431 for:	
Type	Bore Size
EC2	50 mm
EC3	63 mm
EC4	80 mm
EC5	100 mm

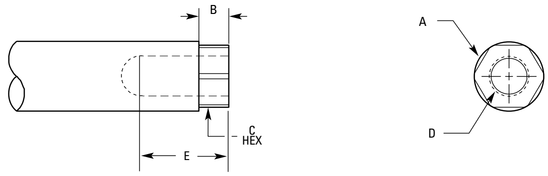


	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F Cyl Length mm (in)	G Retract length mm (in)
EC2	56.9 (2.24)	100.7 (3.96)	155.8 + S (6.13 + S)	34.5 (1.36)	28.5 (1.12)	220.9 + S (8.70 + S)	255.5 + S (10.06 + S)
EC3	69.6 (2.74)	121.3 (4.78)	171.2 + S (6.74 + S)	37.7 (1.48)	34.8 (1.37)	260.5 + S (10.25 + S)	298.1 + S (11.74 + S)
EC4	92.2 (3.63)	169.2 (5.94)	261.6 + S (10.30 + S)	54.0 (2.13)	46.1 (1.81)	371.3 + S (14.62 + S)	425.3 + S (16.74 + S)
EC5	92.2 (3.63)	169.2 (6.66)	261.6 + S (10.30 + S)	54.0 (2.13)	46.1 (1.81)	371.3 + S (14.62 + S)	425.3 + S (16.74 + S)

	H Breather port Hex		I	J	K	L
	type	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)
EC2	1/8 NPT	11.1 (0.44)	34.8 (1.37)	19.1 (0.75)	15.9/16.0 (0.627/0.629)	28.0 (1.10)
EC3	1/8 NPT	11.1 (0.44)	41.1 (1.62)	25.0 (0.98)	19.9/20.0 (0.784/0.786)	35.0 (1.38)
EC4	1/4 NPT	14.0 (0.55)	52.8 (2.08)	31.8 (1.60)	24.9/25.0 (0.981/0.983)	50.0 (1.97)
EC5	1/4 NPT	14.0 (0.55)	52.8 (2.08)	31.8 (1.25)	24.9/25.0 (0.981/0.983)	50.0 (1.97)

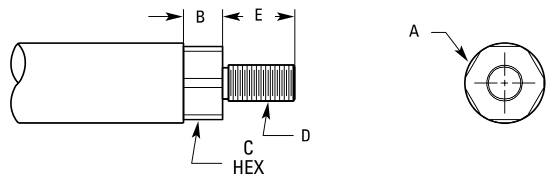
EC Series Rod End Dimensions

FT1 Female Threads Dimensions in [mm]



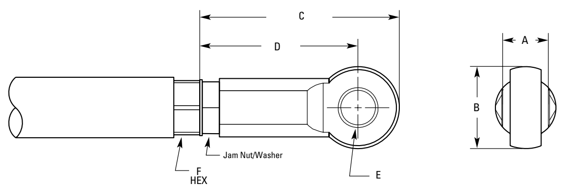
	A mm (in)	B mm (in)	C mm (in)	D		E mm (in)
				FT1M	FT1 [FT1E]	
EC1	20.8 (0.80)	7.6 (0.30)	19.0 (0.70)	M10 x 1.25 mm	-	17.0 (0.70)
EC2	27.8 (1.09)	12.0 (0.47)	25.4 (1.0)	M16 × 2.0 mm	5/8-18 UNF	19.0 (0.75)
EC3	34.9 (1.375)	17.2 (0.68)	31.8 (1.25)	M16 × 2.0 mm	5/8-18 UNF	25.4 (1.00)
EC4	50.0 (1.97)	20.0 (0.79)	47.6 (1.875)	M20 × 1.5 mm	1-14 UNS	31.0 (1.22)
EC5	50.0 (1.97)	20.0 (0.79)	47.6 (1.875)	M24 × 2.0 mm	1-12 UNF	31.0 (1.22)

MT1 Male Threads Dimensions in [mm]



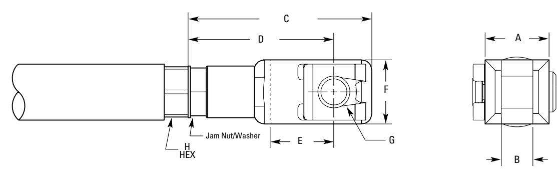
	A mm (in)	B mm (in)	C mm (in)	D		E mm (in)
				MT1M	MT1 [MT1E]	
EC1	20.8 (0.80)	7.6 (0.30)	19 (0.70)	M10 x 1.25 mm	-	27.0 (1.06)
EC2	27.8 (1.09)	12.0 (0.47)	25.4 (1.00)	M16 × 2.0 mm	5/8-18 UNF	32.0 (1.26)
EC3	34.9 (1.375)	17.2 (0.68)	31.8 (1.25)	M16 × 2.0 mm	5/8-18 UNF	32.0 (1.26)
EC4	50.0 (1.97)	20.0 (0.79)	47.6 (1.875)	M20 × 1.5 mm	3/4-16 UNF	40.0 (1.57)
EC5	50.0 (1.97)	20.0 (0.79)	47.6 (1.875)	M24 × 2.0 mm	1-12 UNF	40.0 (1.57)

FS2 Spherical Joint Dimensions in [mm]



	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F HEX mm (in)
EC1	14.0 (0.55)	26.0 (1.02)	67.5 (2.66)	54.4 (2.14)	9.98/10.1 (0.393/0.396)	17.0 (0.70)
EC2	21.0 (0.83)	38.0 (1.50)	92.2 (3.63)	73.2 (2.88)	16.0/16.1 (0.629/0.633)	25.4 (1.00)
EC3	21.0 (0.83)	38.0 (1.50)	92.2 (3.63)	73.2 (2.88)	16.0/16.1 (0.629/0.633)	31.8 (1.25)
EC4	25.0 (0.98)	46.0 (1.81)	111.0 (4.37)	88.0 (3.46)	20.0/20.1 (0.787/0.790)	47.6 (1.875)
EC5	31.0 (1.22)	60.0 (2.36)	138.5 (5.45)	108.5 (4.27)	24.9/25.0 (0.979/0.984)	47.6 (1.875)

FC2 Clevis with Pin Dimensions in [mm]



	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H HEX mm (in)
EC1	20.0 (0.78)	10 (0.39)	62.9 (2.48)	50.9 (2.00)	32 (1.26)	20 (0.79)	9.88/10.0 (0.389/0.393)	17.0 (0.67)
EC2	32.0 (1.26)	16.0 (0.63)	92.2 (3.63)	73.2 (2.88)	32.0 (1.26)	32.0 (1.26)	15.9/16.0 (0.625/0.630	25.4 (1.00)
EC3	32.0 (1.26)	16.0 (0.63)	92.2 (3.63)	73.2 (2.88)	32.0 (1.26)	32.0 (1.26)	15.9/16.0 (0.625/0.630	31.8 (1.25)
EC4	40.0 (1.57)	20.0 (0.79)	116.0 (4.57)	91.0 (3.58)	40.0 (1.57)	40.0 (1.57)	19.9/20.0 (0.782/0.787	47.6 (1.875)
EC5	50.0 (1.97)	25.0 (0.98)	145.5 (5.73)	113.5 (4.47)	50.0 (1.97)	50.0 (1.97)	24.9/25.0 (0.979/0.984	47.6 (1.875)

Brake Option

The BS and motor brake options are typically used with electric cylinders employing ball screw drive assemblies. The electrically released, spring set brake prevents backdriving when the unit is at rest, or in case of a power failure.

When power is applied, the brake releases and the cylinder is free to move. When power is off, springs engage the brake to hold the load in position.

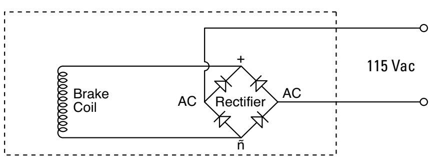
The BS brake is mounted directly to the ballscrew to provide holding torque, without relying on the rest of the drive train.

When using a motor mounted brake the brake torque is multiplied by the belt or gear reduction, and does not interfere with certain rear mounting options. But, if the belt fails, the brake will be inoperative.

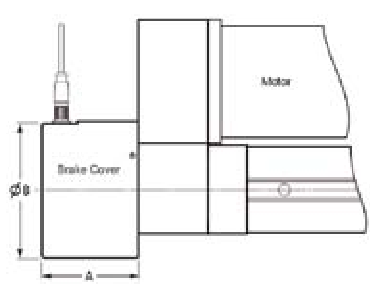
BS is not available with:

- Inline motor orientation
- Rear mounting options: -MP2, -MP3, -MS1, -MF2, -MF3
- EC1

BS115 Wiring Connections



BS Option



Series	Dim "A" in [mm]	Dim "B" in [mm]
EC2	2.73 (69.3)	3.09 (78.5)
EC3	3.32 (84.3)	3.83 (97.3)
EC4	3.94 (100.0)	5.58 (141.7)
EC5	3.94 (100.0)	5.58 (141.7)

Specifications

BS Ballscrew Brake Option

Mounting Location	Ballscrew (see dimensions)
Voltage Options	115 Vac (-BS115), 24 Vdc (-BS24), 24 Vac (-BA24)
Cable Type/Length	EC2/3/4/5 – 3.7 m [12 ft] with quick disconnect N2 – 3.7 m [12 ft] flying leads (no quick disconnect)
Holding Torque	EC2 – 3.9 N-m [35 lb-in], 12.5 W electrical power EC3 – 6.7 N-m [60 lb-in], 17 W electrical power EC4/5 – 39.2 N-m [350 lb-in], 15 W electrical power N2 – 3.4 N-m [30 lb-in], 13 W electrical power

Screw		With BS Option N [lb]	Without BS Option N [lb]
EC2	-16B Ball	1550 [350]	—
	-05B Ball	3600 [810]	—
	-04A Lead	3600 [810]	3600 [810]
EC3	-16B Ball	2660 [600]	—
	-10B Ball	4260 [960]	—
	-05B Ball	7200 [1620]	—
	-04A Lead	7200 [1620]	7200 [1620]
EC4	-25B Ball	9940 [2230]	—
	-10B Ball	12000 [2700]	—
EC5	-32B Ball	7770 [1750]	—
	-10B Ball	24800 [5590]	—
N2	-2B Ball	1100 [240]	—
	-5B Ball	2670 [600]	—
	-5A Lead (N2-D/P)	2670 [600]	445 [100]
	-5A Lead (N2-other)	2670 [600]	1780 [400]
	-8A Lead	-	2670 [600]

Notes:

- High vibration in a machine may cause an lead screw to backdrive at lower values than indicated above. In such applications, a brake may be necessary.
- The BS and motor brakes should only be used to hold static (already stopped) leads. They are not designed for repeated use as dynamic brakes.
- Quick-disconnect cable provided only on EC models. N2 includes flying leads cable from grommet on brake can.

Motor Brake and EC1 (BA24) Option

Mounting Location	Rear motor shaft, opposite motor (BA24)
Voltage Options	24 Vdc
Cable Type/Length	Part of motor cable set, flying leads (BA24)

	Holding Torque N-m (lb-in)
EC1 w/BA24	0.56 (5.0)
AKM23	1.42 (12.6)
AKM42	5.30 (46.9)
AKM52	14.50 (128)

$$\text{Holding Force (N)} = \frac{\text{Brake (N-m)} \times 2\pi \times 1000 \times \text{gear ratio}}{\text{Lead (mm/rev)}}$$

Example: EC3-AKM42G- ■■■-15-16B

$$\text{Holding Force} = \frac{5.3 \times 2\pi \times 1000 \times 1.5}{16} = 3120\ \text{N}$$

N2 Dual Rod-End Bearing Option

DB Dual Rod-End Bearing

Our standard N2 Series electric cylinder contains a single rod-end bearing. The dual rod-end bearing (DB) option increases thrust tube side load capacity and reduces undesirable thrust tube runout, while reducing the stroke by 1.5 inches. (All EC Series cylinders are equipped with a dual rod-end bearing automatically, so this option does not apply to them.)

DB available with:

- N2 Series 12 inch stroke and below

DB required with:

- N2 Series above 12 inch stroke

Notes:

- The DB option reduces stroke by 1.5 inches (e.g. 18” with DB yields only 16.5” actual stroke.)

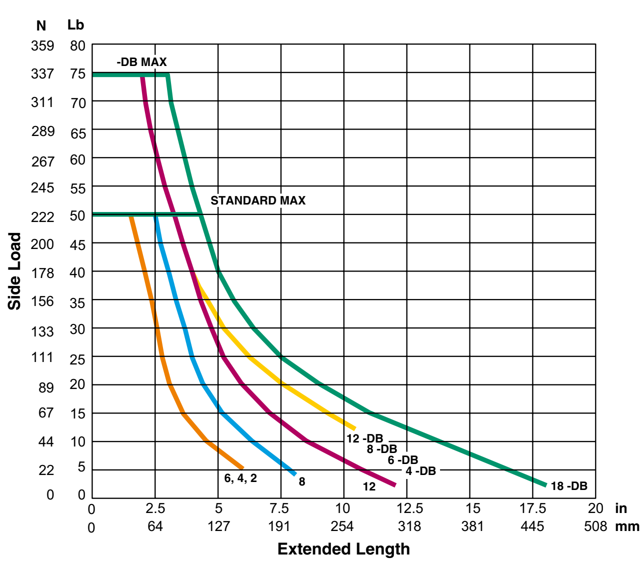
Side Load

All Kollmorgen electric cylinders are designed to withstand a limited amount of side load on the thrust tube. The thrust tube in a standard N2 Series cylinder is supported by a single rod-end bearing and by a patented internal guide assembly. This bearing system has a limited capacity to handle side loads, shown in the curve below.

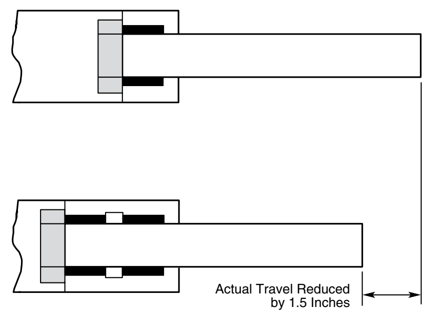
When increased side load capacity or stiffness is required, or when moving a load that is not externally supported, the dual rod-end bearing (DB) option is recommended. This option adds a second thrust tube rod-end bearing for additional support, while subtracting 1.5 inches from the available stroke. N2 models above 12 inches stroke require the DB option.

Another means of increasing side load capacity is to use the higher capacity EC series, which includes the dual rod-end bearing in its standard configuration.

N2 Series — Side Load Capacity vs. Extended Length



Standard N2 Cylinder (Single Bearing)



DB Option (Dual Bearings)

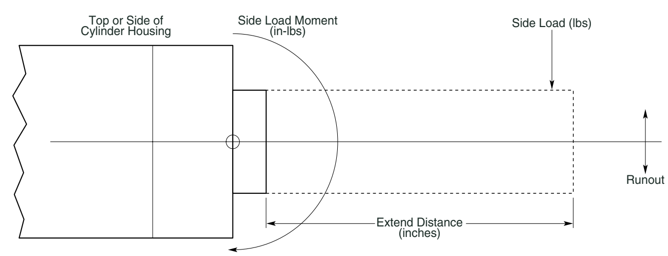
Runout

The -DB option reduces thrust tube runout by lengthening the thrust tube support bearing in the rod-end housing.

Kollmorgen recommends the DB option to reduce runout whenever the thrust tube is the only means of guiding the load. Performance improvement is most observable for cylinders with stroke length above 12 inches, or whenever runout is critical as the thrust tube approaches full extension.

For the least amount of runout possible for a standard product, specify the DB option and also increase the stroke of the cylinder while “short-stroking” the unit.

If the load is guided externally by linear bearings, the standard bearing is preferred since it allows greater mounting misalignment and minimal friction.



Selection Criteria

DB Option	Standard
When using clevis or trunnion mount	When rigidly mounted
>12 in	<12 in
Unguided thrust tube	Guided thrust tube (externally)
High side load	
Low runout critical	

Linear Potentiometer Option

L Linear Potentiometer Option

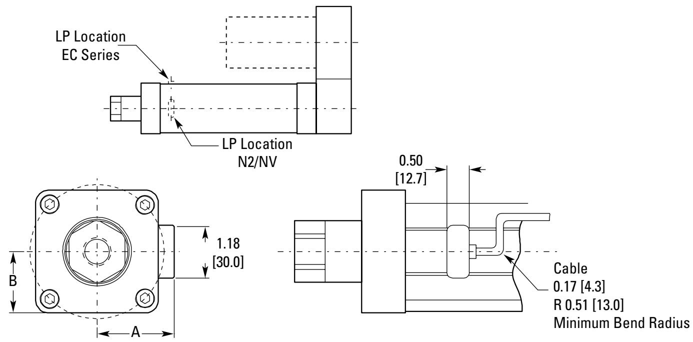
The L linear potentiometer option is required for operation with our Analog Position Controls, and is used in applications where analog position feedback Voltage signal is needed.

The linear potentiometer resides within the cylinder housing and is energized by an external DC voltage source. The potentiometer wiper arm is attached to the drive nut/guide flange assembly, and moves the same distance as the thrust tube. The signal from the linear potentiometer is an absolute voltage, proportional to linear displacement of the cylinder.

L available with:

- EC and NC cylinders

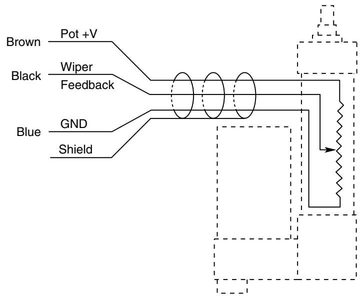
Dimensions in [mm]



Cylinder Model	Dim. B [in (mm)]	Dim. A [in (mm)]
N2	1.38 (35.1)	1.01 (25.7)
EC2	1.47 (37.3)	1.12 (28.5)
EC3	1.72 (43.7)	1.37 (34.8)
EC4	2.15 (54.5)	1.82 (46.1)
EC5	2.15 (54.5)	1.82 (46.1)

* EC1 linear pot option - consult factory

Connections



Specifications

Operating Temperature	-28° to +70°C [-20° to +160°F]
Power Rating	1.0 Watt max. (11 mA at 24 V; 6 mA at 12 V; 3 mA at 5 V)
Resistance	see table below
Linearity	see table below
Stroke	Available in the lengths shown below. Consult factory for lengths.

Cylinder Model	Stroke [in (mm)]	Resistance (± 30%)	Linearity
N2	2.00 (50.8)	3000	±1% of full stroke
	4.00 (102)	6000	
	6.00 (152)	9000	
	8.00 (203)	9000	
	10.0 (254)	9000	
	12.0 (305)	7000	
	16.5 (419)	7000	
EC2, EC3, EC4, EC5	1.97 (50)	3000	±1% of full stroke
	3.94 (100)	6000	
	5.91 (150)	9000	
	7.87 (200)	9000	
	9.84 (250)	9000	
	11.8 (300)	7000	
	17.7 (450)	7000	
	23.6 (600)	7000	

Linear Rod Bearing Option

LR Linear Rod Bearing Option

The LR linear rod bearing option is used in applications where side loads are present, or when the load is not externally supported.

Reasons for using the LR Linear Rod Bearing are:

- Increased side load capacity
- Anti-rotation–reduces any rotational motion of the moving load
- Higher positioning efficiency when side loads are present
- Lower thrust tube runout

LR available with:

- EC2

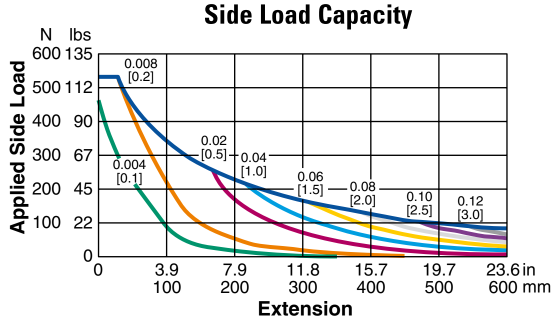
LR not available with:

- MF1, MF3, MS1, MS2 mounting options

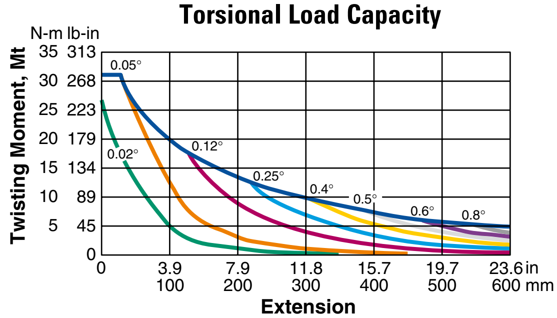
Weight calculation:

Weight (lb_f) = 0.0147 stroke (mm) + 7.6 lb_f

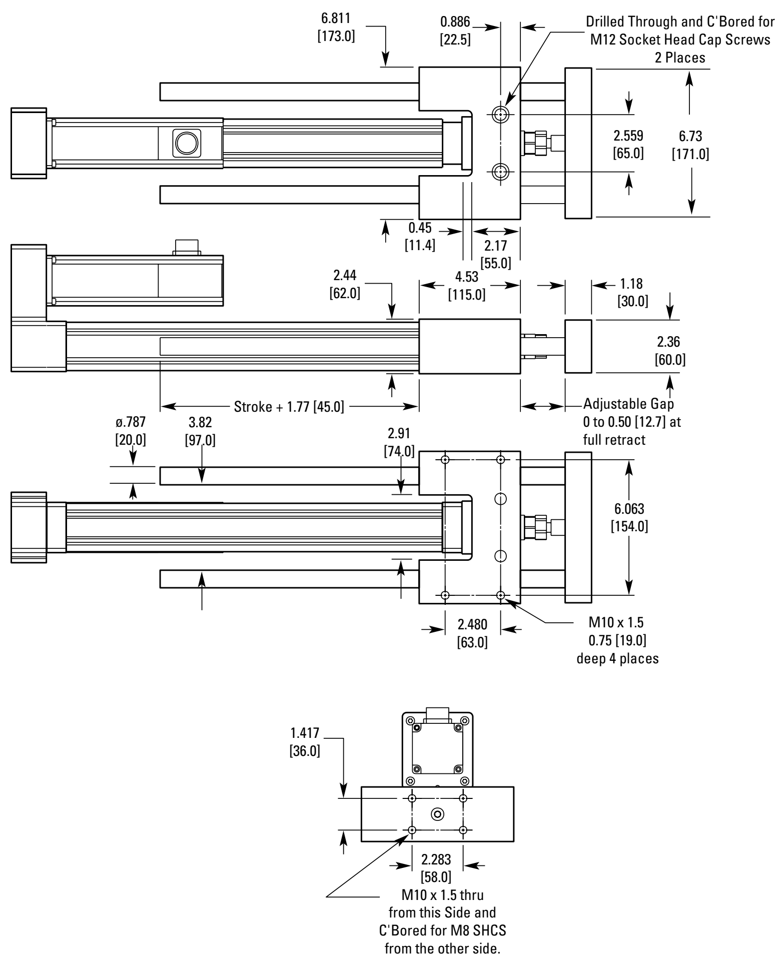
Side Load Capacity



Torsional Load Capacity



Dimensions in [mm]



To order the Linear Rod Bearing as a separate component:
Linear Rod Bearing Part Number

Example: LR-EC2-0200-A

LR	—	EC2	—	0200	—	A
LR		EC2		Stroke in mm		Revision

Protective Boot Option

PB Protective Boot Option

With the PB option, a durable polyurethane boot protects the thrust tube area from solid contaminants (dust, wood and metal shavings), and splashed liquids, etc.

EC Series cylinders equipped with the PB are protected to the IP65 standard. Note that some Kollmorgen motor options are not protected to this level.

Contact Kollmorgen for assistance when special environmental protection is required.

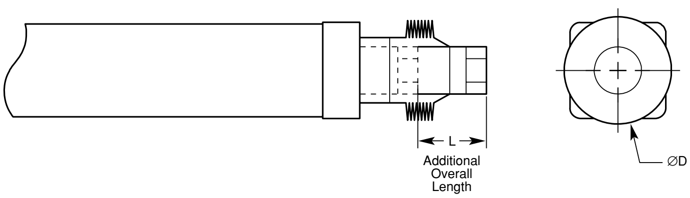
We also have special options for clean room applications, where outgassing and contamination by the cylinder are a concern.

PB available with:

- All EC and N2 Electric Cylinders
  (Consult factory for EC1)

Dimensions in [mm]

When fully retracted, the boot gathers on an extra length of thrust tube. The extra thrust tube length is tabulated here.



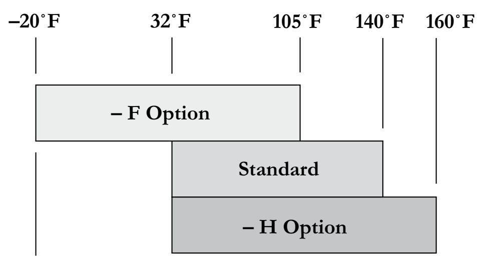
Cylinder Model		Dimensions	
Series	Stroke Length	Dim. L Add'l Length in [mm]	Boot Diameter in [mm]
EC2	0-149 mm	1.16 [29.5]	2.50 [63.5]
	150-299	1.83 [46.5]	
	300-449	2.54 [64.5]	
	450-600	3.21 [81.5]	
	601-750	3.75 [95.3]	
EC3	0-199 mm	1.46 [37.1]	3.00 [76.2]
	200-399	2.13 [54.0]	
	400-599	2.83 [71.9]	
	600-800	3.54 [89.9]	
	801-1000	4.06 [103.1]	
EC4	0-249 mm	1.60 [40.6]	3.75 [95.3]
	250-499	2.47 [62.7]	
	500-749	3.35 [85.1]	
	750-999	4.17 [105.9]	
	1000-1249	5.05 [128.3]	
	1250-1500	5.93 [150.6]	
EC5	0-249 mm	1.60 [40.6]	3.75 [95.3]
	250-499	2.47 [62.7]	
	500-749	3.35 [85.1]	
	750-999	4.17 [105.9]	
	1000-1249	5.05 [128.3]	
	1250-1500	5.93 [150.6]	
N2	0-2.57 in	0.75 [19.1]	2.50 [63.5]
	2.58-5.08	1.00 [25.4]	
	5.09-7.59	1.30 [33.0]	
	7.60-10.11	1.40 [35.6]	
	10.12-15.19	1.90 [48.3]	
	15.20-16.50	2.80 [71.1]	

Protective Boot

N2 Environmental Options

Temperature Ranges (N2 Series)

	Operating	Storage
Standard N2	32° to 140°	-40° to 185°
[F (C)]	(0° to 60°)	(-40° to 85°)
F Freezing	-20° to 105°	-40° to 185°
[F (C)]	(-29° to 41°)	(-40° to 85°)
H High Temp	32° to 160°	-40° to 185°
[F (C)]	(0° to 70°)	(-40° to 85°)



Note: F and H can not be ordered on the same cylinder.

H High Temperature

The H high temperature option allows operation in high temperature environments (to 160°F [70°C]) by changing certain plastic parts within the cylinder to bronze.

H available with:

- All N2 Series

Notes:

- Consideration must be given to the operating temperature ranges of the motor, encoder, and limit switches.

F Sub-Freezing Environment Option

In extremely cold conditions the lubricating grease in the positioner thickens, rubber parts (belts and stops) stiffen, and mechanical clearances tighten. This option includes two alterations:

1. Bearing grease is replaced with a less viscous lubricant.
2. Lead nut tolerances are increased. Both thread clearance and pitch length are increased to allow for the varying coefficients of expansion between the steel lead screw and polyacetal or bronze drive nut.

The result is a device which can operate at these low temperatures, but with reduced life (due to the pre-worn lead nut surfaces).

Contact Kollmorgen for more details. No change is necessary in ball nut models since there is steel to steel contact (same coefficient of thermal expansion).

F Sub-Freezing Environment Option available with:

- All N2 Series

Notes:

- This option increases system backlash to 0.025 inches (0.64 mm) max. for lead screw units.
- Should a -F sub-freezing option lead screw unit be operated at room temperature or above, noisy operation and increased backlash are normal.

W Water Resistant Option

The water resistant option (W) is recommended in applications where the cylinder is exposed to light mist or occasional splashing with water or non-corrosive liquids. In addition to a sealant on all mating surfaces, a 10 foot (3 m) breather tube and fitting is provided to allow the unit to breathe from a non-contaminated dry area. Or, the customer may choose to apply positive, low pressure (2-3 psi [14-20 kPa]) dry air to the cylinder through this fitting.

W available with:

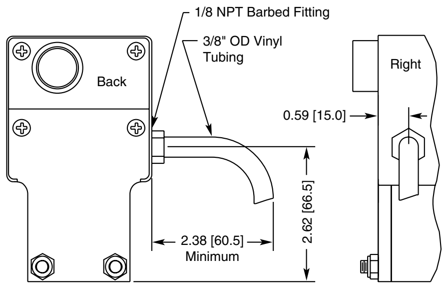
- All N2 Series

Notes:

- The -W option does not provide a waterproof cylinder. The cylinder cannot be submerged or immersed repeatedly in water.

W Breather Dimensions

N2 Series Cylinders



Accessories

Magnetic Position Sensors

Kollmorgen Electric Cylinders are equipped with position indicating magnets installed internally on both sides of the guide cylinder. Non-contacting position sensors are available to sense the magnet as it passes by.

Position sensors mount directly to standard EC and N2 Series cylinders. PSP-1 are normally open switches. PSP-2 are normally closed switches. PSP sensors use a Hall-effect sensing element and a simple solid state electrical circuit.

End-of-Travel Limits

To maximize cylinder life, Kollmorgen recommends the use of end-of-travel “limit switches” (position sensors) with all cylinders.

The purpose of an end-of-travel sensor is to signal the controller that the cylinder is about to travel beyond its normal safe operating region, and is nearing its physical end of stroke. The controller brings the cylinder to a stop to prevent physical contact, and to avoid damage to the cylinder, the load, or the machine. The sensors must be located such that an adequate stopping distance is provided between the sensing position and the physical end of stroke. Normally closed switches are generally used for end-of-travel sensing. Normally closed switches are considered “fail safe” because when a cable becomes accidentally severed or disconnected, motion is prevented.

Position Sensing

Programmable position controls use position sensors for two purposes. A normally open switch is generally used to establish a home, or zero reference position. Normally closed switches are used for extend and retract end-of-travel limits.

Position Sensors

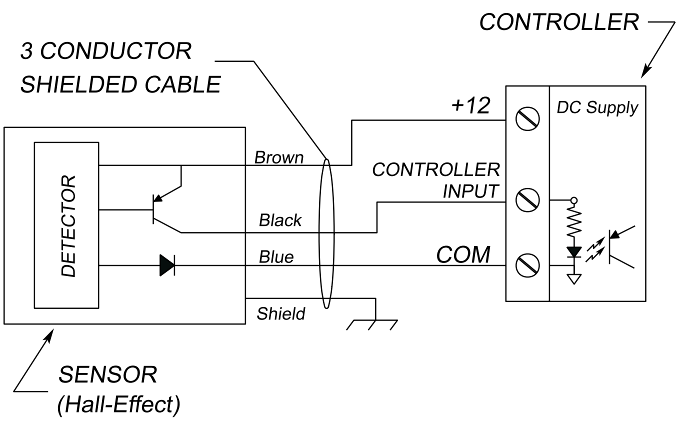
Position Sensor Specifications

	PSP-1	PSP-2
Connection	Norm. open	Norm. closed
Led Color	Yellow	Red
Switch Type	Hall-effect	
Output Type	Sourcing (PNP)	
Number of Leads	3 + Shield	
Supply		
Voltage	10–24 Vdc	
Current	7 mA @ 12 Vdc; 13 mA @ 24 Vdc	
Power	0.24 W	
Output		
DC Voltage max	24 Vdc	
AC Voltage max	AC not allowed	
Current max	100 mA	
Power max	3 W	
Operating Temperature	-4° to 158°F [-20° to 70°C]	
Storage Temperature	-4° to 176°F [-20° to 80°C]	
Protection Rating	IP67	
CE Approved	Yes	

Hall-Effect Switches

- Higher tolerance to vibration
- Greater durability and reliability (no moving parts)
- Requires external DC power. Available on Kollmorgen controls.

Wiring for PSP-1 and PSP-2



Position Sensors

Position Sensor Mounting

The diagrams below show sensor mounting location when cylinder magnet and sensor are physically aligned.

This location is recommended as a starting point when setting up a cylinder for the first time. Depending on the speed and payload of the application, switches may need to be moved inward to prevent hard-stop crash when the load travels at full speed past a limit switch.

Notes:

- Position sensors can be mounted along either side of a cylinder.
- Recommended minimum distance between switches is 0.65 inches.
- Using position sensors for end-of-travel protection reduces effective travel distance. Contact Kollmogen for assistance.

Ordering Information

Position Sensors

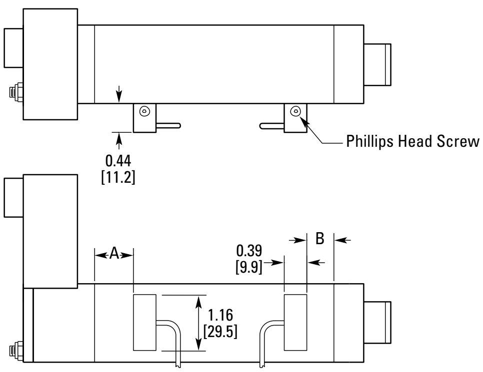
Model Number	Description	LED
Wire Leads 10 ft [3 m]	Quick Disconnect 13 ft [4 m[1]]	
PSP-1[2]	PSP-1Q[2] N.O. PNP Hall Effect	Yellow
PSP-2[2]	PSP-2Q[2] N.C. PNP Hall Effect	Red

Notes:

1. Long length 30 ft [9 m] quick-disconnect cables are available, specify by adding –C9M to part number (example: PSP-1Q-C9M).
2. PNP Hall Effect Switches are not compatible with Kollmorgen controls. These versions are offered for compatibility with devices which require PNP style sensors.

Dimensions in [mm]

N2 Cylinder Position Sensor Mounting



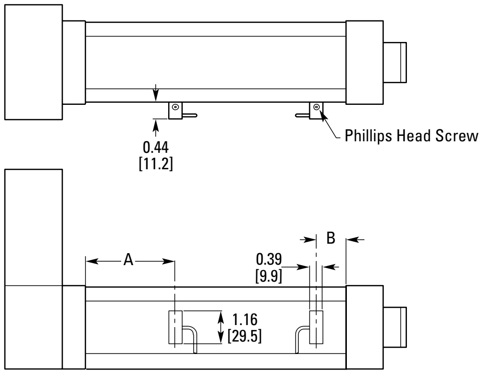
NOTE: Dimensions "A" and "B" are Approximate End of Stroke Locations for the Position Sensors.

Model	Dim "A" in [mm]	Dim "B" in [mm]
N2 Lead	1.00 (25.4)	0.70 (17.8)
N2 Ball	1.40 (35.6)	0.30 (7.6)

Spare Quick Disconnect Cables

Model Number	Description
QPS-4M	13 ft [4 m] extension cable
QPS-9M	30 ft [9 m] extension cable

EC Cylinder Position Sensor Mounting



NOTE: Dimensions "A" and "B" are Approximate End of Stroke Locations for the Position Sensors.

Model	Dim "A" in [mm]	Dim "B" in [mm]
EC1	0.748 (19.0)	0.551 (14.0)
EC2	2.90 (73.7)	1.90 (48.3)
EC3	3.03 (77.0)	2.23 (56.6)
EC4	5.39 (137.0)	2.48 (63.0)
EC5	5.39 (137.0)	2.48 (63.0)

AKM1x Brushless Servo Systems

AKM11B 115/230 Vac

		S200	S300	Smart Drive
System	Drive [Ic / Ip] Arms	1.5 / 4.5	3.0 / 9.0	1.77 / 5.3
	Feedback type	SFD	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	1.62 (0.183)	1.62 (0.183)	1.62 (0.183)
	T peak stall [lb-in (N-m)]	5.22 (0.59)	5.39 (0.609)	5.39 (0.609)
	RPM max 230 Vac	8000	8000	8000
	Drive	S20260	S30361	MMC-SD-0.5-230-D
	Motor	AKM11B-BNC	AKM11B-BNR	AKM11B-BN2
Cables	Power	VP-102BEAN-XX	CP-SS-R1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Feedback	VF-DA0411N-XX	CF-SS-RHGE-XX	

AKM13C 115/230 Vac

		S200	S300	Smart Drive
System	Drive [Ic / Ip] Arms	1.5 / 4.5	3.0 / 9.0	1.77 / 5.3
	Feedback type	SFD	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	3.62 (0.409)	3.62 (0.409)	3.62 (0.409)
	T peak stall [lb-in (N-m)]	9.82 (1.11)	12.9 (1.46)	11.5 (1.30)
	RPM max 230 Vac	8000	8000	8000
	Drive	S20260	S30361	MMC-SD-0.5-230-D
	Motor	AKM13C-BNC	AKM13C-BNR	AKM13C-BN2
Cables	Power	VP-102BEAN-XX	CP-SS-R1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Feedback	VF-DA0411N-XX	CF-SS-RHGE-XX	

AKM1x Mechanical Specifications

	AKM11B	AKM13C
Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on resolver)	0.000015 (0.017)	0.000040 (0.045)
Motor weight [lb (kg)]	0.80 (0.35)	1.4 (0.63)

AKM23 Brushless Servo Systems

AKM23D 115/230 Vac

		S200	S300	Smart Drive
System	Drive [Ic / Ip] Arms	3.0 / 9.0	3.0 / 9.0	3.5 / 10.6
	Feedback type	SFD	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	10.3 (1.16)	10.3 (1.16)	10.3 (1.16)
	T peak stall [lb-in (N-m)]	34.0 (3.84)	34.0 (3.84)	34.0 (3.84)
	RPM max 230 Vac	5700	5700	5700
	Drive	S20360	S30361	MMC-SD-1.0-230-D
	Motor	AKM23D-BNC	AKM23D-BNR	AKM23D-BN2
	Motor/Brake	AKM23D-B2C	AKM23D-B2R	AKM23D-B22
Cables	Power	VP-102BEAN-XX	CP-SS-R1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Power/Brake	CP-102ABAN-XX-X	CP-SS-RAHBE-XX	
	Feedback	VF-DA0411N-XX	CF-SS-RHGE-XX	

AKM23C 400/460 Vac

		S300	Smart Drive
System	Drive [Ic / Ip] Arms	1.5 / 4.5	2.1 / 4.2
	Feedback type	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	10.0 (1.13)	10.0 (1.13)
	T peak stall [lb-in (N-m)]	29.0 (3.27)	26.8 (3.03)
	RPM max 460 Vac	7000	7000
	Drive	S30101	MMC-SD-1.3-460-D
	Motor	AKM23C-BNR	AKM23C-BN2
	Motor/Brake	AKM23C-B2R	AKM23C-B22
Cables	Power	CP-SS-G1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Power/Brake	CP-SS-GAHBE-XX	
	Feedback	CF-SS-RHGE-XX	

AKM23 Mechanical Specifications

Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on resolver)	0.00019 (0.22)
Brake Inertia [lb-in-s^2 (kg-cm^2)] (additional)	0.000011 (0.012)
Motor weight [lb (kg)]	3.0 (1.38)

AKM42 Brushless Servo Systems

AKM42G 115/230 Vac

		S200	S300	Smart Drive
System	Drive [Ic / Ip] Arms	6.0 / 18.0	6.0 / 15.0	7.0 / 21.2
	Feedback type	SFD	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	31.2 (3.53)	31.2 (3.53)	31.2 (3.53)
	T peak stall [lb-in (N-m)]	97.0 (11.0)	85.0 (9.60)	97.0 (11.0)
	RPM max 230 Vac	4020	4020	4020
	Drive	S20660	S30661	MMC-SD-2.0-230-D
	Motor	AKM42G-BNC	AKM42G-BNR	AKM42G-BN2
	Motor/Brake	AKM42G-B2C	AKM42G-B2R	AKM42G-B22
Cables	Power	VP-102BEAN-XX	CP-SS-R1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Power/Brake	CP-102ABAN-XX-X	CP-SS-RAHBE-XX	
	Feedback	VF-DA0411N-XX	CF-SS-RHGE-XX	

AKM42E 400/460 Vac

		S300	Smart Drive
System	Drive Ic / Ip Arms	3.0 / 7.5	3.9 / 7.8
	Feedback type	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	30.3 (3.42)	30.3 (3.42)
	T peak stall [lb-in (N-m)]	74.8 (8.45)	76.8 (8.68)
	RPM max 460 Vac	4020	4020
	Drive	S30301	MMC-SD-2.4-460-D
	Motor	AKM42E-BNR	AKM42E-BN2
	Motor/Brake	AKM42E-B2R	AKM42E-B22
Cables	Power	CP-SS-G1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Power/Brake	CP-SS-GAHBE-XX	
	Feedback	CF-SS-RHGE-XX	

AKM42 Mechanical Specifications

Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on resolver)	0.0013 (1.5)
Brake Inertia [lb-in-s^2 (kg-cm^2)] (additional)	0.00006 (0.068)
Motor weight [lb (kg)]	7.5 (3.39)

AKM52G Brushless Servo Systems

AKM52G 115/230 Vac

		S200	S300	Smart Drive
System	Drive [Ic / Ip] Arms	6.0 / 18.0	6.0 / 15.0	7.0 / 21.2
	Feedback type	SFD	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	74.6 (8.43)	74.6 (8.43)	74.6 (8.43)
	T peak stall [lb-in (N-m)]	190 (21.5)	190 (21.5)	190 (21.5)
	RPM max 230 Vac	1920	1920	1920
	Drive	S20660	S30661	MMC-SD-2.0-230-D
	Motor	AKM52G-BNC	AKM52G-BNR	AKM52G-BN2
	Motor/Brake	AKM52G-B2C	AKM52G-B2R	AKM52G-B22
Cables	Power	VP-102BEAN-XX	CP-SS-R1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Power/Brake	CP-102ABAN-XX-X	CP-SS-RAHBE-XX	
	Feedback	VF-DA0411N-XX	CF-SS-RHGE-XX	

AKM52G 400/460 Vac

		S300	Smart Drive
System	Drive Ic / Ip Arms	6.0 / 12.0	6.3 / 12.7
	Feedback type	resolver	incremental comm encoder
	T cont stall [lb-in (N-m)]	74.6 (8.43)	74.6 (8.43)
	T peak stall [lb-in (N-m)]	167 (18.9)	174 (19.7)
	RPM max 460 Vac	3000	3000
	Drive	S30601	MMC-SD-4.0-460-D
	Motor	AKM52G-BNR	AKM52G-BN2
	Motor/Brake	AKM52G-B2R	AKM52G-B22
Cables	Power	CP-SS-G1HE-XX	Unique part number per length Contact Kollmogen for assistance
	Power/Brake	CP-SS-GAHBE-XX	
	Feedback	CF-SS-RHGE-XX	

AKM52 Mechanical Specifications

Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on resolver)	0.0055 (6.2)
Brake Inertia [lb-in-s^2 (kg-cm^2)] (additional)	0.00015 (0.17)
Motor weight [lb (kg)]	12.8 (5.8)

AKM52L Brushless Servo System

AKM52L 115/230 Vac

		S200
System	Drive [Ic / Ip] Arms	12.0 / 30.0
	Feedback type	SFD
	T cont stall [lb-in (N-m)]	76.2 (8.61)
	T peak stall [lb-in (N-m)]	175 (19.8)
	V max 230 Vac	4250 RPM
	Drive	S21260
	Motor	AKM52L-BNC
	Motor/Brake	AKM52L-B2C
Cables	Power	VP-105CEAN-XX
	Power/Brake	CP-105CDAN-XX-X
	Feedback	VF-DA0411N-XX

AKM52 Mechanical Specifications

Motor Inertia [lb-in-s^2 (kg-cm^2)] (based on resolver)	0.0055 (6.2)
Brake Inertia [lb-in-s^2 (kg-cm^2)] (additional)	0.00015 (0.17)
Motor weight [lb (kg)]	12.8 (5.8)

S200 Indexer with EC2 and AKM23

Kollmorgen Servo Drive Overview

S200 Series Drive
Compact Drives both AC and DC type

S300 Series Drive
Flexible Drive both 230 & 460 Vac systems

Voltage & Current Specifications	S200		S300		Smart Drive	
	Voltage	Cont Current	Voltage	Cont Current	Voltage	Cont Current
	20 to 90 Vdc	3.0 to 6.0 Arms	115/230 Vac	3.0 to 10.0 Arms	115/230 Vac	1.77 to 7.0 Arms
	115/230 Vac	1.5 to 24 Arms	230/400/460 Vac	1.5 to 6.0 Arms	230/400/460 Vac	2.1 A to 39 Arms
Control Modes	Positioner - Configurable Simple Registration Pulse Follower - Step/Direction Electronic Gearing Velocity - analog Torque - analog		Positioner - Configurable Simple Registration Pulse Follower - Step/Direction Electronic Gearing Velocity - analog Torque - analog		IEC 61131 - Fully Programmable Position, Velocity, Torque modes all suppoted - switch modes on the fly Advanced Motion, CAMMING Complex Registration, Master/Slave, etc	
Key Attributes	Most Compact Highest-Performance Most Cost-effective		Integrated design for CE Internal regen Flexibility to requirements		Fully Programmable Machine & Motion Controller Scalable Control (1 to 16 axes)	
Network/Fieldbus	D-Link® CANopen SynqNet		CANopen DeviceNet SynqNet EtherCAT® SERCOS II Profibus DP		D-Link- Dedicated motion bus - "100baseT physical layer" (IEEE802.3) Modbus RTU, Modbus TCP Ethernet IP messaging TCP/IP	
Feedback	Smart Feedback Device (SFD) Comcoder (w/ option card) SynQNet - Sine-encoder or SFD DLS - SFD DLS (Future Comcoder, BiSS, EnDat 2.2, 01)		Resolver Comcoder Sine-encoder		Resolver (option) Comcoder Sine-encoder Dual-feedback support	

Smart Drive Series
Full Range from 0.5 kW watt to 65 kW
230 and 460 Vac systems

S200 Servo Drive

Compact, High-Performance Drive

The S200 digital brushless servo drives are compact and high-performance drives. High-performance is achieved though a specialized design that uses high-resolution feedback and rapid servo loop updates that result in an industry leading bandwidth capability for the base drive.

The S200 drive is available in 115/230 Vac systems with continuous current ranges from 1.5 Arms to 24 Arms.

The 24 Arms AC type unit and also DC supply versions are also available, but not shown in this brochure.

Control Modes

Base Drive Functionality
Velocity or Torque Mode Position Follower

Motion or Fieldbus Option
SynqNet
Indexer
Indexer/CANOpen
D-Link® IEC 61131 Control

Specifications

S200 Drive Systems

S200 Systems		115/230 Vac Systems		Drive
Drive	I cont / I peak Arms	Motor Type	Frame size	Dimensions H x W x D inch (mm)
S20260 -	1.5 / 4.5	AKM11B,13C	NEMA 17	6.90 (175) x 2.16 (54.8) x 5.18 (131.6)
S20360 -	3.0 / 9.0	AKM23D	NEMA 23	6.90 (175) x 2.16 (54.8) x 5.18 (131.6)
S20660 -	6.0 / 18.0	AKM42G	NEMA 34	6.90 (175) x 2.52 (64.0) x 5.18 (131.6)
		AKM52G	NEMA 42	
S21260 -	12.0 / 30.0	AKM52L	NEMA 42	6.97 (177) x 3.00 (76.0) x 5.98 (152.0)

Drive depth dimension does not include drive front connectors

S200 SynqNet Drives

S200 Indexer (S20360, S20660)

S200 Servo Drive

Compact, High-Performance Drive

Product Features

Control Functionality

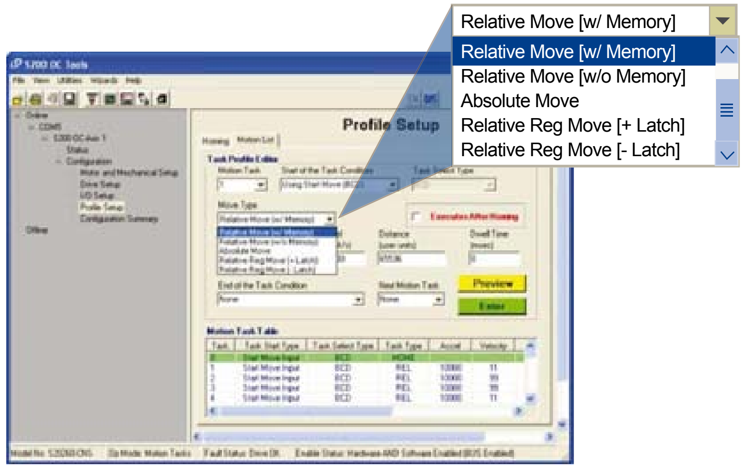
Base Unit
Velocity or Torque mode, +/- 10 V analog
Pulse Follower – Step/Direction
Master/Slave – Electronic gearing

Indexer Option Card
Position mode
Absolute or Incremental Positioning
180 Motion Tasks – Link or blend tasks
Electronic gearing, Simple Registration
Velocity mode (jog)
Communication: - CNS type, CANopen

Power

Main AC Supply and control logic are separate

Main Power	115/230 Vac	1 or 3 phase
Control logic	115/230 Vac	1 phase



Motion Task Configuration

- Configuring motions tasks is a simple process with the S200 Indexer
- Intuitive software requires no programming experience
- Independent accel, decel with s-curve capability

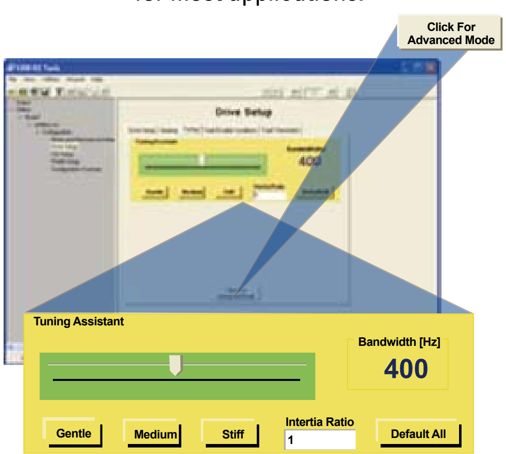
Plug & Play Features

- Motor recognition for auto drive setup from SFD
- New Valueline cables for AKM series motors
- Optimized IO through din-rail mounted breakout board (CK-S200-CNDN-B01)
- Simplified setup and tuning with OC Tools software

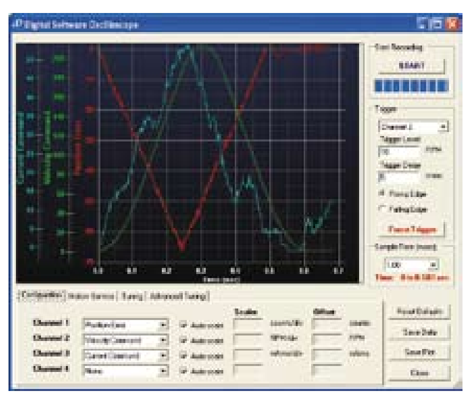
Optimized Performance

- High-resolution feedback system (24 bit)
- Indexer Programmable Position Resolution of 65,536 counts/rev
- High-bandwidth (400 Hz) Velocity loop enables rapid response, high-stiffness and quick settling

Tuning is as easy as moving a slider bar for most applications.



An advanced tuning option is also available as needed for complex system requirements

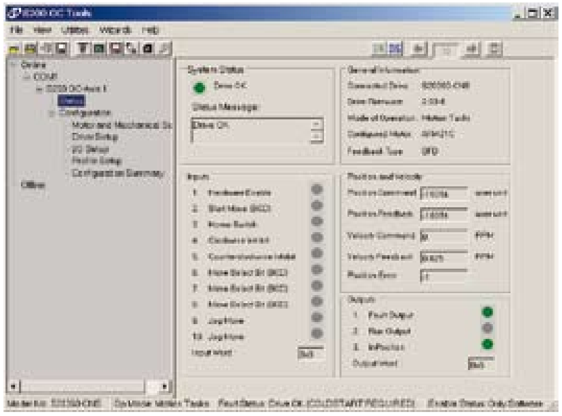


The S200 Indexer has a digital oscilloscope which facilitates system tuning, allowing for settling times down to or below 1 msec

S200 Indexer and Linear System Digital IO

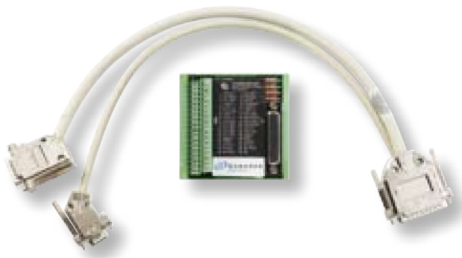
The S200 Indexer is powerful and flexible, yet easy to configure with the OC Tools software package.

Quick Start-up with S200 OC Tools Software



S200 Breakout board

Enhances the onboard S200 IO and designed for linear application support.



S200 OC Tools

- Easy to configure with no programming experience necessary
- Integrated scope function for performance optimization
- Dynamic performance can be optimized during operation
- Configuration file allows for complete system documentation and easy system duplication
- Smart Feedback Device (SFD) provides motor ID that automatically configures motor parameters

S200 Breakout board (CK-S200-CNDN-B01) Enhancements to S200 standard IO

- Converts of DINP5 & DINP10 inputs (5 V) to 12-24 V sink/source
- One uncommitted 24 Vdc, 1.0 amp Solid State Relay to boost drive output capability (applicable for brake control)
- Convenient power supply connections for electric cylinder hall-effect limit switches (PSN & PSP type) for simplified wiring
- Pre-defined function labels for linear applications.
- Includes 14 inch Y-cable for plug-n-play cabling.
- 12-24 Vdc supply required

S200 Indexer Digital IO

Digital Inputs	(10), (9) Configurable, (1) Enable (Reserved)
Digital Outputs	(3), (1) Configurable, (1) Fault (Reserved), (1) Not Run (Reserved)

Digital Input Configurable Functions (Partial List)

Travel Limit	Two limit inputs for end-of-travel hardware limits for limiting motion
Home Limit	Home signal input
BCD Motion Select	Used for BCD Selection of Motion Task Number
Start Motion Task	Start Input for Motion Task
Start Gearing	Enable/Disable Gearing or Master Slave operation mode
Start Jog	Start Jog Function, Jog includes programmable Accel/Dec Control

Digital Output Configurable Functions

In Position	Motion Task complete & within user defined position window
Following Error	Following error exceeded user defined value
Speed Compare	Motor Speed compared (> or <) to a user defined value
Position Compare	Absolute Motor Position greater than a user defined value

S300 Servo Drive

Flexible Drive with Broad Connectivity

S300 Series digital brushless servo amplifiers are compact and easy-to-use amplifiers that offer a maximum range of flexibility to your project design. The broad connectivity allows for application of the drive in a wide-range of control architectures.

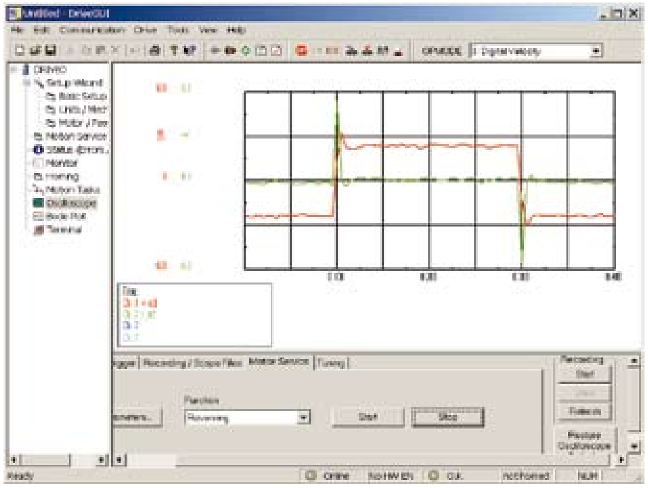
Flexibility is offered through wide-voltage range including 115/230/400/460 Vac systems and multiple feedback types of incremental encoder, sine-encoder, and resolver.

Control Modes

Standard Drive Functionality
Positioner
300 Motion Tasks – Linked or blended
Absolute or Incremental Positioning
Master-Slave/Electronic Gearing
Pulse/Direction Input
Simple Registration
Velocity or Torque Mode

Drive Networks
SynqNet
DeviceNet
CANOpen
Profibus DP
SERCOS II
EtherCAT®

PC Setup Software



Intuitive - Setup Software via RS232
Windows® compatible with NT/2000/XP systems

- Quick start wizard enables setup to motion in eight clicks
- Software access to all drive parameters
- Dynamic performance can be optimized during operation
- Integrated 4-channel scope for performance evaluation and optimization
- Integrated Bode plot tool for system analysis

S300 Servo Drive

Features

- CE, UL, cUL, includes all necessary filters for CE for cables less than 25 meters
- Operation directly from grounded 115 to 480 V, 3-phase, 50-60 Hz AC lines
- With integral AC line filter, all shield connections terminate directly to the amplifier
- Configurable Analog IO: 2 inputs (12,14 bit), IO via screw-terminal X3
- Configurable 24 Vdc digital IO: 4 inputs (PLC compatible), 2 outputs (open collector)
- Internal regen Cont 20 watt (S30361, S30101), 40 watt (S30661,S30301)
- External regen Cont 300 watt (S30361, S30661, S30101) , 1000 watt (S30301, S30301)
- DC bus can be connected in parallel for regenerative benefits
- CANOpen standard – CAN standard ISO 11898, 1MBaud transmission rate
- Option Cards
  - SynqNet – Industry standard "100baseT physical layer" (IEEE802.3)
    Redundant "self-healing network"
    Up to 48 kHz setpoint update rate
    32 Coordinated axes, 100 meter network lengths
  - DeviceNet – CAN-standard ISO 11898, transmission rates up to 500 kBaud
  - Profibus DP – EN 50170, Profidrive support, transmission rates up to 12 MBaud
  - SERCOS II – IEC 61491, Fiber-optic transmission
    1 to 65 ms setpoint, Baud rates of 2, 4, 8, 16 MBaud
    Adjustable fiber optic transmission power level
  - EtherCAT® – Plug & play, automatic baud rate setting
  - CANOpen Master – Provides 2 CAN interfaces including CAN Master, RS232 port
  - I/O Expansion – 14 Digital Inputs/8 Outputs, 24 V, screw-terminal connections

Specifications: S300 Drive Systems

S300 Systems		115/230 Vac Systems		Drive
Drive	**I cont / I peak Arms**	**Motor Type**	**Frame size**	**Dimensions H x W x D inch (mm)**
S30361-	3.0 / 9.0	AKM 11B, 13C	NEMA 17	10.6 (270) x 2.8 (70) x 7.9 (200)
		AKM23D	NEMA 23	
S30661-	6.0 / 15.0	AKM42G	NEMA 34	11.0 (279) x 2.8 (70) x 7.9 (200)
		AKM52G	NEMA 42	

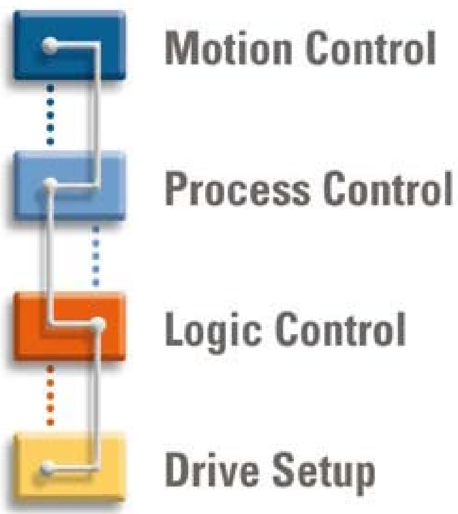
S300 Systems		400/460 Vac Systems		Drive
Drive	**I cont / I peak Arms**	**Motor Type**	**Frame size**	**Dimensions H x W x D inch (mm)**
S30101-	1.5 / 4.5	AKM23C	NEMA 23	10.6 (270) x 2.8 (70) x 9.2 (235)
S30301-	3.0 / 7.5	AKM42E	NEMA 34	11.0 (279) x 2.8 (70) x 9.2 (235)
S30601-	6.0 / 12.0	AKM52G	NEMA 42	

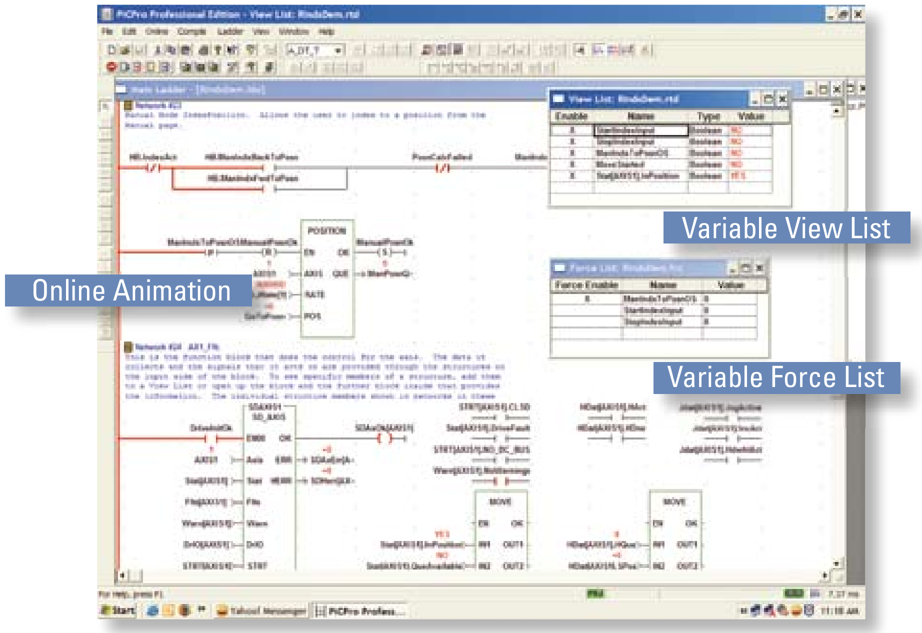
Dimensions reflects maximum dimensions including panel mounting hardware.
Depth dimensions includes drive front mating connectors.

Smart Drive

IEC 61131 Machine and Motion Control

The Smart Drive utilizes PiCPro®'s IEC 61131 programming language.





PiCPro® IEC 61131 Software

Kollmorgen's PiCPro software

Enables you to leverage decades of industry control and application experience to allow you to build a better machine, faster.

PiCPro Offers:

- Position, Velocity and Torque Mode operation, switch "on the fly" with "bumpless transfer"
- A large library of Motion Control application function blocks
- Single-point programming for logic, motion, process and drive setup & diagnostics
- Ladder logic for easy machine control implementation
- Function block programming for motion, data manipulation and more
- Structured text for higher level operations
- User-defined function blocks (UDFB) for simplifying program generation and to protect IP
- Integrated drive setup and tuning with scope
- Drive parameter read/write access from application program
- Powerful motion application function blocks including positioning, camming, master/slave
- Close coupled integration of IO to motion enables rapid response (0.25 msec interrupt) to event based triggers
- Real-time pre-emptive multi-tasking to solve high-performance applications
- Ethernet TCP/IP support for plant integration and remote diagnostic capability

Smart Drive

IEC 61131 Machine and Motion Control

Kollmorgen's Smart Drive servo amplifiers provide 500 W to 65 kW continuous output power in a compact, easy-to-apply package. Available in both 230 Vac and 460 Vac systems, Smart Drives operate over wide line voltage range.

Application of the Smart Drives is simple. The integral power supply and plug-and-play cable sets simplify installation. Configuration, tuning and maintenance are intuitive using PiCPro software with features including basic and expert parameter views, a software storage oscilloscope and auto-tuning.

Product Features

D-Link® Digital Network – High Speed & Deterministic

Industry standard “100baseT physical layer” (IEEE802.3)
Axis Update Rate from 0.25 msec to 8.0 msec
Axis Update Rate is Independently Selected by Servo Axis

Advanced Control Algorithms

Observer Provides outstanding servo system “stiffness”, critical for direct drive systems
Bi-Quad filter allows flexibility in addressing machine resonance conditions

Drive IO & Interfaces

Configurable Digital Inputs:	(8) 24 Vdc optically isolated, (2) sink/source, (6) source only
Configurable Digital Outputs:	(4) 24 Vdc optically isolated, source only
Configurable Analog Input:	(1) +/- 10 Vdc, 12 bit, read access in application code
Relay output	(1) Motor brake control, BR+, BR- screw terminals
Feedback One (F1)	Incremental commutating encoder, Sine-encoder (BiSS, Endat 2.1) Resolver (requires internally installed option card)
Feedback Two (F2)	Incremental commutating encoder
Logic Power	24 Vdc Input required

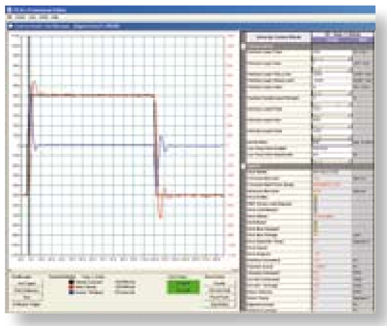
Smart Drive (SD) Systems		115/230 Vac Systems		Drive
Drive	**I cont / I peak Arms**	**Motor Type**	**Frame size**	**Dimensions H x W x D in (mm)**
MMC-SD-0.5-230-D	1.77 / 5.3	AKM11B, 13C	NEMA 17	10.1 (257) x 3.69 (93.7) x 6.12 (156)
MMC-SD-0.5-230-DN				10.0 (257) x 2.96 (75.2) x 6.12 (156)
MMC-SD-1.0-230-D	3.5 / 10.6	AKM23D	NEMA 23	10.1 (257) x 4.69 (119) x 6.12 (156)
MMC-SD-1.0-230-DN				10.1 (257) x 3.96 (100) x 6.12 (156)
MMC-SD-2.0-230-D	7.0 / 21.2	AKM42G	NEMA 34	10.1 (257) x 4.69 (119) x 6.12 (156)
MMC-SD-2.0-230-DN		AKM52G	NEMA 42	10.1 (257) x 3.96 (100) x 6.12 (156)

Smart Drive (SD) Systems		400/460 Vac Systems		Drive
Drive	**I cont / I peak Arms**	**Motor Type**	**Frame size**	**Dimensions H x W x D in (mm)**
MMC-SD-1.3-460-D	2.1 / 4.2	AKM23C	NEMA 23	13.66 (347) x 4.14 (105) x 8.35 (212)
MMC-SD-2.4-460-D	3.9 / 7.8	AKM42E	NEMA 34	13.66 (347) x 4.14 (105) x 8.35 (212)
MMC-SD-4.0-460-D	6.3 / 12.7	AKM52G	NEMA 42	16.85 (428) x 4.15 (106) x 11.35 (288)

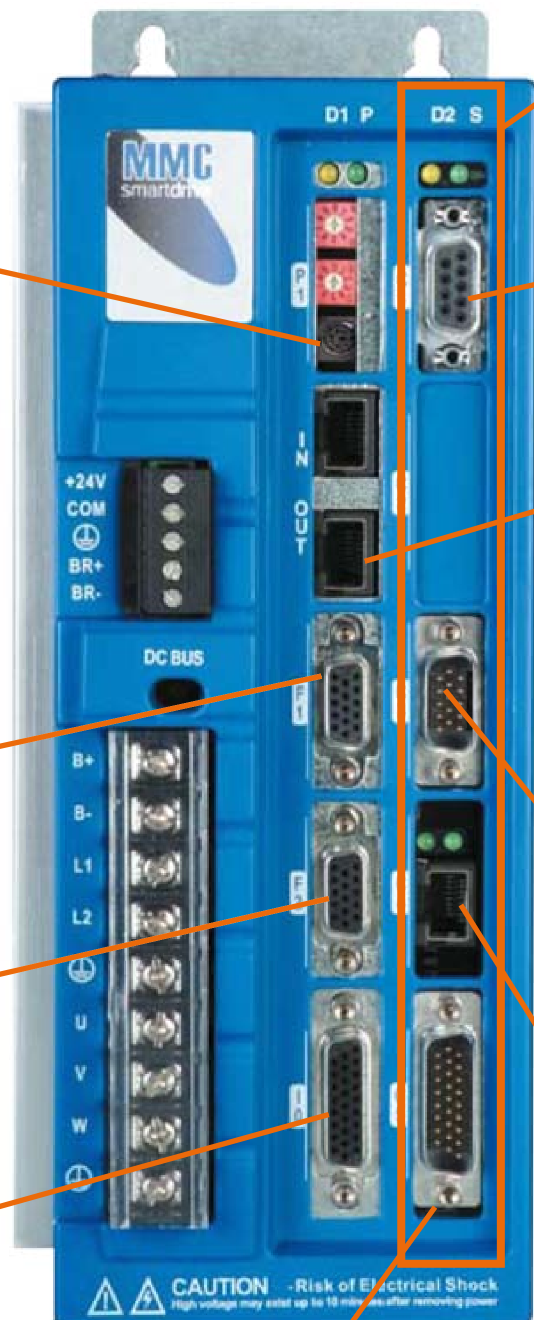
Note: -DN is narrow version, Digital drive network slave only, space for control card removed.

Smart Drive (SD) - IEC 61131 Machine and Motion Drive/Control

PiCPro® Drive Setup and Motion Programming
PiCPro provides single point programming for logic, motion, drive commissioning, tuning, process, data management and communications. A virtual connection is established through this single point to allow you to access all of the drives on the network.



Motor Feedback
Standard feedback support for incremental encoder and sine-encoder, optional resolver feedback.



Auxiliary Feedback
Master encoder input for use in 1 1/2 axis master/slave motion applications or use the dual-loop feedback capability to improve control.

Drive I/O
Each MMC Smart Drive has 8 DC inputs, 4 DC outputs and 1 analog input that can be used in the application program. Two of the inputs are high speed for position capture and registration. The states of the drive I/O are available to the application program over the Digital Network.

Machine Control I/O
Drive-Resident MMC controller has 8 DC Inputs and 8 DC Outputs for use in your application program. The outputs may be used as PLS outputs.

MMC Control System

The D16, Drive Resident Control can control up to 16 sevo axes. It controls the drive it is installed in and up to 15 additional axes through a deterministic RJ45 CAT5 interface. Drive Resident controllers are also available in 1, 2, 4 and 8 axes versions.

Block I/O Options

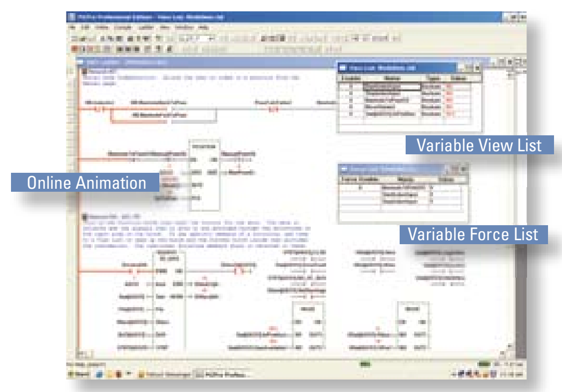
Applications that require I/O beyond what is available on the control and the drives are easily expanded using Block I/O. A simple four-wire connection provides access to up to 77 I/O blocks that can be mounted locally or up to 200 feet apart. Select from our family of Block I/O modules including discrete I/O, analog I/O and motion I/O.

IEC 61131 Machine & Motion Control

Utilize PicPro decades of experience to leverage a rich library of application function blocks, PicPro's close coupling of machine IO and motion provides industry-leading IEC 61131 performance control.

MMC Multi-Smart Drive Control Scheme

A total of 16 MMC Smart Drives with 16 axes of control can be configured via a simple RJ45 cable connection.



HMI Serial Port Connection

The serial port allows you to connect to our operator interfaces, or a third-party serial device.

10/100 Ethernet for Device Connectivity

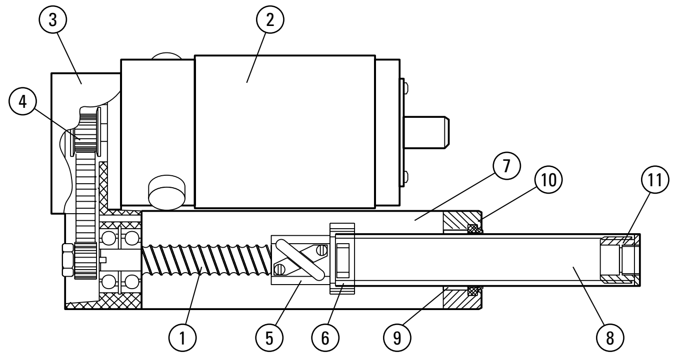
The built-in 10/100 Ethernet port provides a wide variety of connectivity options. Connect to third-party devices using our OPC Server, Modbus TCP or other control protocols, transfer recipe or data files to and from the RAMDISK using TFTP file transfer, share data between controls using UDP packets, and access your plant network. You can also simultaneously run PiCPro over Ethernet either directly or remotely.

Linear Positioning: Rod Type or Rodless

Rod Type electric cylinders are similar in configuration to a hydraulic or pneumatic actuator and are preferred when you need to position an externally supported load, move a load that pivots, retrofit a hydraulic or pneumatic actuator, or have "reach in requirements".

EC and N2 electric cylinders (see the N2 series figure, right) use *ballscrews* (1) to convert rotary motion into linear motion. The *motor* (2) is mounted to the *bearing housing* (3), and the motor's power is transmitted to the screw through a *gear*, or *timing-belt reduction* (4). The screw turns and moves the *ball nut* (5), which is connected to a *guide flange* (6). The guide flange keeps the nut from rotating, by sliding through the *guide cylinder* (7). The *thrust tube* (8) is threaded on to the nut, and is supported by the *sleeve bearing* (9) in the *rod-end housing* (10). The load is attached to the *rod end* (11).

N2 Series

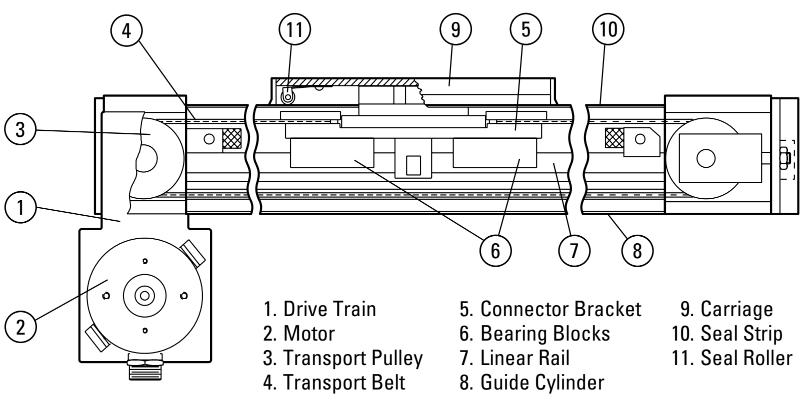


1. Ballscrew
2. Motor
3. Bearing Housing
4. Drive Train
5. Ball Nut
6. Guide Flange
7. Guide Cylinder
8. Thrust Tube
9. Sleeve Bearing
10. Rod End Housing
11. Rod End

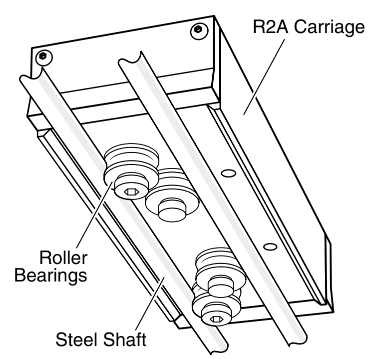
Rodless positioners have a bearing support system and a carriage that runs the length of the body. This type of positioner is preferred when you need to save space by eliminating external guides and ways, when high speed and long stroke lengths are needed, when the shortest overall work envelope is needed, or when a multi axis Cartesian System is required.

R2A, R3 and R4 rodless positioners use a ballscrew or a transport belt to convert the motor's power to linear thrust. Pictured below is a belt-drive positioner. As in the EC and N2 electric cylinders, there is a *timing belt*, or *gear reduction* (1) between the *motor* (2) and the *driven pulley* (3). The *transport belt* (4) runs over two pulleys and each end is connected to the *connector bracket* (5). The connector bracket is connected to two *bearing blocks* (6) that ride on the recirculating ball-bearing *rail* (7) that is mounted in *the guide cylinder* (8). The *carriage* (9) is mounted to the connector bracket and the *seal strip* (10) runs between them. The connector bracket lifts the seal as the carriage moves, while *roller wheels* (11) in the carriage push the seal back in place.

R2A positioners have no bearing blocks, but instead have *roller wheels* for bearing support (as seen in the figure below). Four track-roller bearings run on two hardened and ground steel shafts, pressed into the extrusion.



1. Drive Train
2. Motor
3. Transport Pulley
4. Transport Belt
5. Connector Bracket
6. Bearing Blocks
7. Linear Rail
8. Guide Cylinder
9. Carriage
10. Seal Strip
11. Seal Roller



Linear Actuation Operation: Rotary to Linear Conversion

Linear motion systems driven by rotating electric motors commonly employ one of three rotary-to-linear conversion systems: **ballscrew, belt drive, or lead screw.**

Ball / Lead Screw

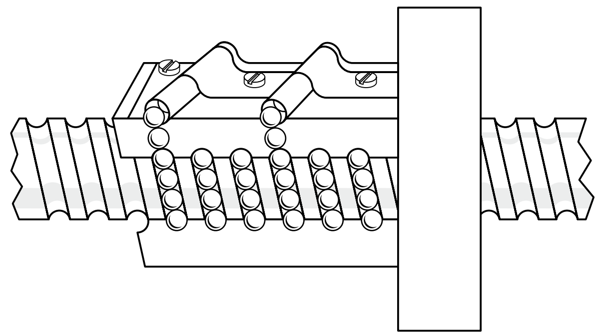
Screw-drive mechanisms, whether lead screw or ballscrew provide high thrust (to thousands of pounds), but are often limited by critical speed, maximum recirculation speed of ball nut circuits, or sliding friction of lead nut systems.

Ballscrew

The majority of linear motion applications convert motor torque to linear thrust using ballscrews due to their ability to convert more than 90% of the motor's torque to thrust. As seen below the ballnut uses one or more circuits of recirculating steel balls which roll between the nut and ballscrew threads. Ballscrews provide an effective solution when the application requires:

- High efficiency - low friction
- High duty cycle (> 50%)
- Long life - low wear

Ballscrew

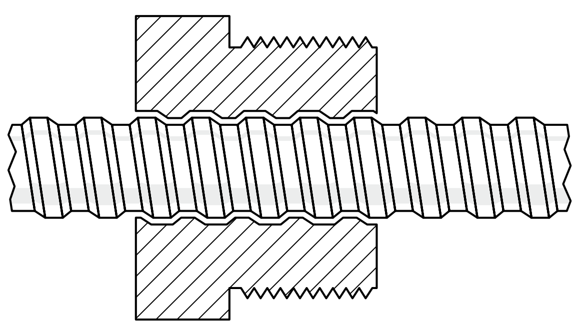


Lead Screw

The lead screw uses a plastic or bronze solid nut that slides along the threads of the screw, much like an ordinary nut and bolt. Since there are no rolling elements between the nut and the lead screw, lead screws yield only 30-50% of the motor's energy to driving the load. The remaining energy is lost to friction and dissipated as heat. This heat generation limits the duty cycle to less than 50%. A great benefit of the lead screw is its ability to hold a vertical load in a power-off situation (refer to the Backdrive specifications for lead screw positioners). The lead screw is a good choice for applications requiring:

- Low speeds
- Low duty cycles (50%)
- The ability to hold position while motor power is off

Lead Screw



Linear Positioning: 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	Ballscrew	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	+/-0.005" to 0.0005"	+/-0.005" to 0.0005"	+/-0.004"
Duty Cycle	Moderate max. 50%	High max. 100%	High max. 100%
Mechanical Efficiency	Low Plastic Nut - 50% 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
Speeds	Low	High	Higher
Cost	$$ Lowest	$$$ Moderate	$$$ Moderate

Linear Positioning: Mechanical Drive Comparison

	Comments
	Lead: Sliding nut design provides quiet operation. **Ball:** Transmits audible noise as balls recirculate through nut during motion. **Belt:** the neoprene cover of the belt provides damping of noise. The support bearings will generate some noise.
	Lead: Good for vertical applications; vibration may cause position loss. **Ball:** May require brake or holding device when no holding torque is applied to the screw. **Belt:** May require brake or holding device when no holding torque is applied to the drive pulley.
	Lead: Considered worn-out when backlash exceeds 0.020”. Typically 0.006” when shipped from the factory. **Ball:** Typically constant at 0.006” (lead screw/nut only). **Belt:** Typically at 0.010” when shipped. Can be adjusted to compensate for wear or stretching.
	Lead: Low duty cycle due to high friction from sliding surface design. **Ball:** High screw efficiency and low friction allow high duty cycle. **Belt:** High efficiency provides low heating and high duty cycle.
	Lead: Low efficiency sliding friction surfaces. **Ball**: High efficiency smooth rolling contact.
	Lead: Mechanical wear is a function of duty cycle, load and speed. **Ball:** Virtually no mechanical wear when operated within rated load specifications. **Belt:** High efficiency contributes to long life. Drive belts can be easily replaced to extend system life.
	Lead: Better suited because of larger surface area. **Ball:** Brunelling of steel balls limits shock load capability. **Belt:** Shock loads can cause fatigue and stretching of drive belts.
	Lead: At extreme low speeds, units have a tendency to stop/start stutter (due to friction). **Ball:** Generally smoother than lead through the entire speed range. **Belt:** 180° engagement of belt provides continuous smooth contact throughout the speed range.
	Lead: Extreme speeds and accelerations can generate excessive heat and deform the screw. **Belt:** Each revolution of the drive pulley provides several inches of travel. Speeds up to 120 in/sec can be achieved.

Electric Cylinders vs. Hydraulics & Pneumatics Linear Technology Comparison

For many applications, hydraulic or pneumatic linear cylinders are a better choice than their electromechanical alternatives. For example, when extremely heavy loads (>25,000 N [5,620 lb]) must be moved, hydraulic cylinders are usually the best solution.

Or, when very light loads must be moved rapidly and repeatedly from one fixed location to another fixed location, pneumatic cylinders may be the most economical solution.

	Kollmorgen Electric Cylinders	Hydraulic Cylinders	Pneumatic Cylinders
Installation	All electric operation requires simple wiring; directly compatible with other electronic controls.	Requires expensive plumbing, filtering, pumps, etc. Must pay close attention to compatibility of components.	Requires expensive plumbing, filtering, pumps, etc.
Precise Positioning	Cost-effective, repeatable (to ±0.013 mm [±0.0005 in]), rigid multi-stop capabilities.	Requires expensive position sensing and precise electro-hydraulic valving to implement; has tendency to creep.	Most difficult to achieve. Requires expensive position sensing and precise valving to implement; has tendency to creep.
Control	Solid-state microprocessor-based controls allow automatic operation of complex motion sequences.	Requires electronic/fluid interfaces and sometimes exotic valve designs. Hysteresis, dead zone, supply pressure and temperature changes complicate control.	Inherently non-linear, compressible power source severely complicates servo control. Compressibility can be an advantage in open loop operation.
Speed	Smooth, variable speed capabilities from 0.5 to 1330 mm/sec [0.02 to 52.5 in/sec].	Difficult to control accurately. Varies with temperature and wear. Stick slip can be a problem.	More susceptible to stick slip and varying load. Well-suited for high speed applications to 5 m/sec [200 in/sec].
Reliability	Repeatable, reproducible performance throughout useful life of product; little maintenance required.	Very contamination sensitive. Fluid sources require maintenance. Seals are prone to leak. Good reliability with diligent maintenance.	Very contamination sensitive. Air sources require proper filtration. Good reliability, but usually many system components are involved.
Power	Up to 25,000 N [5620 lb], 3 kW [4 hp].	Virtually unlimited force. Most powerful.	Up to 5,000 lbs. Typically used below 0.75 kw [1 hp].
Cycle Life	Up to millions of cycles at rated load. Easy to predict.	Dependent on design and seal wear; usually good.	Dependent on seal wear, usually good.
Environment	Standard models rated for -20° to 160° F. Inherently clean and energy efficient.	Temperature extremes can be a major problem. Seals are prone to leak. Waste disposal is increasingly problematic.	Temperature extremes can be a major problem. Seals prone to leak. Air-borne oil can be a problem.
Safe Load Holding	Lead screw units are self-locking if power fails. Fail-safe brakes available for ballscrew models.	Complex back-up safety devices must be used.	Complex back-up safety devices must be used.
Cost	Moderate initial cost; very low operating cost.	Components often cost less, but installation and maintenance are increased. Hydraulic power unit cost is high if not pre-existing. Most economical above 7.5 kw [10 hp].	Components often cost less, but installation and maintenance are increased. Most cost-effective for low power, simple point-to-point applications.

Electric Cylinders vs. Hydraulics & Pneumatics Linear Technology Comparison

But when simplicity, flexibility, programmability, accuracy and reliability are important and loads are within the capacity of the technology, electromechanical solutions often are the most desirable.

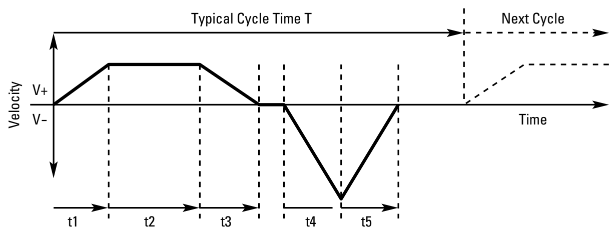
Further, electromechanical systems are inherently more compatible with today's automation controls.

	ELECTRIC CYLINDER	PNEUMATIC ACTUATORS	HYDRAULIC ACTUATORS
OPERATES WITHOUT COMPRESSED AIR	YES	NO	YES
OPERATES WITHOUT COMPRESSED FLUID	YES	YES	NO
OPERATES WITHOUT VALVES, PIPES OR HOSES	YES	NO	NO
SMOOTH, CONTROLLABLE SPEED	YES	NO	PARTIAL
HOLDS POSITION WITHOUT POWER	YES	NO	PARTIAL
OPERATES IN TEMPERATURE EXTREMES	YES	NO	NO
ACCURATE MID-STROKE POSITIONING	YES	NO	NO
GUIDED AGAINST ROTATION	YES	NO	NO
HIGH CYCLE CAPABILITY	YES	YES	LIMITED
CAN BE OPERATED WITHOUT LIMIT SWITCHES	YES	YES	YES

Linear Sizing Calculations: Move Profile

Rotary and linear positioner 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:

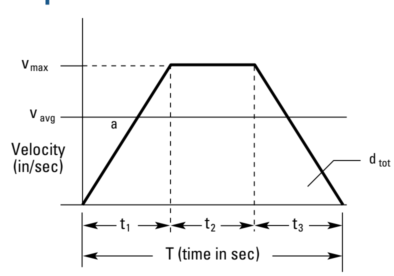
- **Peak acceleration** is the steepest slope on the curve, in this case during t_4 or t_5.
- **Maximum velocity** is at the highest or lowest point over the entire curve, here at the peak between t_4 and t_5.
- **Distance** is equal to the area under the curve. Area above the time axis represents distance 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



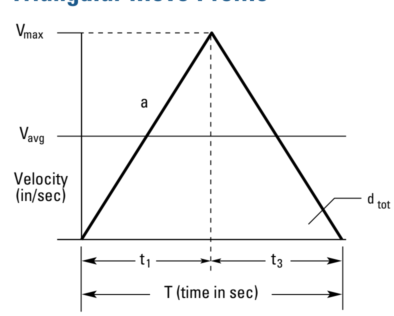
$$v_{AVE} = \frac{d_{tot}}{t_{tot}}$$

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

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

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

Triangular Move Profile



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

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

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

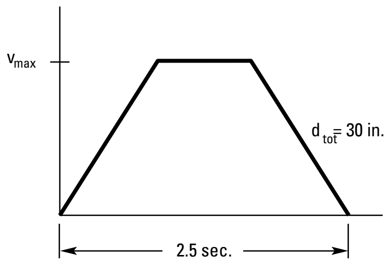
$$a = \frac{4d_{tot}}{(t_{tot})^2} = \frac{2v_{MAX}}{t_{tot}}$$

Linear Sizing Calculations: 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



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

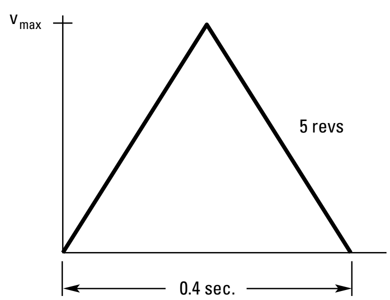
$$v_{MAX} = 1.5\frac{d_{tot}}{t_{tot}} = 18\text{ in/sec}$$

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

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



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

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

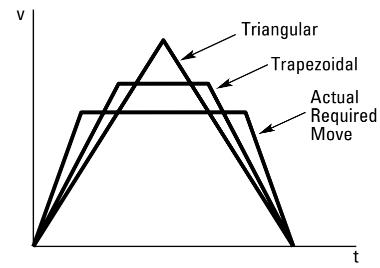
$$v_{MAX} = 2\,v_{AVE} = 157.1\frac{\text{rad}}{\text{sec}}$$

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

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,

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

$t_2 = 1.33$ sec

Now assume $t_1 = t_3$, so

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

Finally, calculate acceleration

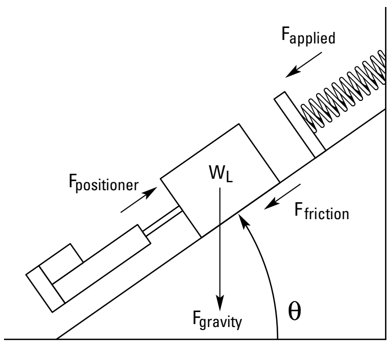
$$a = \frac{v_{MAX}}{t_1} = \frac{6\text{ in/sec}}{0.33\text{ sec}} = 18\frac{\text{in}}{\text{sec}^2}$$

Linear Sizing Calculations: Thrust Calculation

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 positioners, magnets, etc., and are the forces that act on the mass other than friction, gravity, and the positioner's thrust. The spring shown in the figure below is an example of an Applied force.
- **Positioner thrust** is the required force, and is what we need to determine.



The figure above shows a general case where the force required by positioner 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 positioner. All of these forces added up (Σ) must be equal to mass × acceleration, or:

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

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

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

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

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

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

$W_{positioner}$ 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 a positioner, 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 <u>200 lb.</u> And the worst case velocity is <u>7.5 in/sec.</u>

Linear Sizing Calculations: Thrust Calculation

Positioner Mass

In applications where the **acceleration force**, $(W_t/g)a$, is a significant part of the required thrust, the positioner mass must be considered in the thrust calculation. After a positioner is chosen, the positioner weight (linear inertia), $W_{positioner}$, is added to the weight of the load. $W_{positioner}$ can be determined using the tables and equation in the positioner data section. To illustrate, we will use the previous example.

1. The first step is to pick a linear positioner with the above thrust and speed capability. One such positioner is an EC3-AKM42-20-16B-300. This is an EC3 Electric Cylinder with a AKM42 motor, a 2:1 gear reduction, a 16 mm lead ballscrew, and a 300 mm stroke.
2. The next step is to look up the effective **Positioner Linear Inertia** in the tables located in the particular positioner 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 0.0013 in-lb-sec^2. The effective positioner weight, calculated from the table is 297 lb.
3. The final step is to add this weight to the weight of the load, 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:

Ma = 447 lb/386 in/sec^2 × 11.25 in/sec^2

= 13.03 lb

F_{total} = 169 lb

Slew Section:

Ma = 0 lb (since a=0)

Deceleration Section:

Ma = 447 lb/386 in/sec^2 × -11.25 in/sec^2)

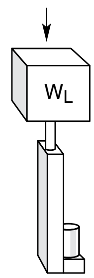
= -13.03 lb

F_{total} = 193 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 EC3-AKM42-20-16B-300 will work in the application.

Vertical and Horizontal Cases

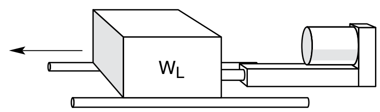
In a vertical system, θ is 90°, sin90 = 1, and $F_{gravity}$ is equal to W_L. Since cos90 = 0, $F_{friction}$ = 0.



$$F_{positioner} = (W_t/g)a + F_{applied} + F_{gravity}$$

$$\boxed{F_{positioner} = (W_t/g)a + F_{applied} + W_L}$$

In a horizontal system, sinθ = 0, so gravity would play no part ($F_{gravity}$ = 0), and cosθ =1, so $F_{friction}$ would be equal to μW_L, or 50 lb.

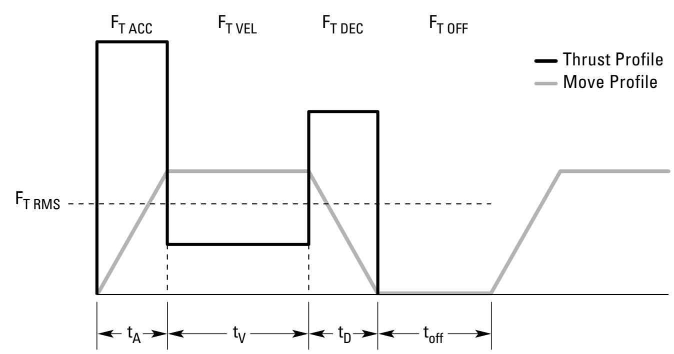


$$F_{positioner} = (W_t/g)a + F_{applied} + F_{friction}$$

$$\boxed{F_{positioner} = (W_t/g)a + F_{applied} + \mu W_L}$$

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 positioner. Use the following equation when calculating RMS Thrust:



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

EC Series Linear Positioner Inertia						
Rotary Inertia (Reflected to Motor) = A + B* (Stroke, in) + C * (Load, lb)						
Model	Ratio	Reduction type	Screw	A	B	C
EC 3 Series			Dia x Lead (mm)	lb-in sec^2	lb-in sec^2 / in	lb-in sec^2 / lb
EC3-…-10-16B	1:1	Belt/pulley	16 x 16	1.188 E-03	1.176 E-05	2.604 E-05
EC3-…-15-16B	1.5:1			7.435 E-04	5.228 E-06	1.157 E-05
EC3-…-20-16B	2:1			4.779 E-04	2.765 E-06	6.121 E-06
EC3-…-50-16B	5:1	Helical gear		2.280 E-04	4.635 E-07	1.026 E-06
EC3-…-70-16B	7:1			1.975 E-04	2.401 E-07	5.314 E-07

AKM42 Mechanical Specifications

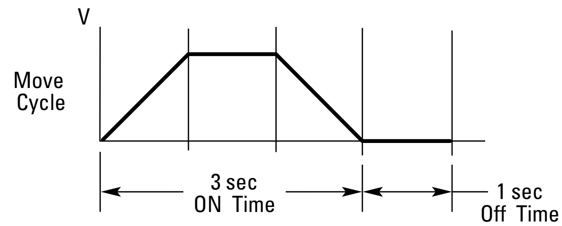
Motor Inertia (based on resolver)	0.0013 lb-in-sec^2

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 positioner 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:

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

Example:



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

$$\boxed{= 75\%}$$

Lead screw 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 positioner with **ballscrews** the motor is the only duty-cycle limitation when used within the listed speed vs. thrust curves in the catalog.

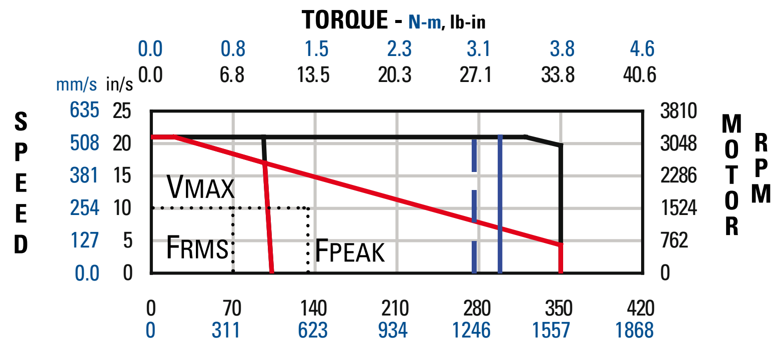
Motor Type

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.

Servomotors

Linear Positioners 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 positioner Speed vs. Thrust curve indicates the allowable Duty Cycle. For ballscrew positioners, 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 below is an example of proper servo electric cylinder sizing.

EC3-AKM23-xxx-10-10B



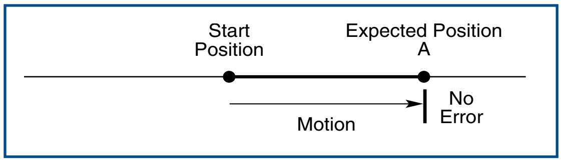
Linear Motion Terminology: Linear Positioner Precision

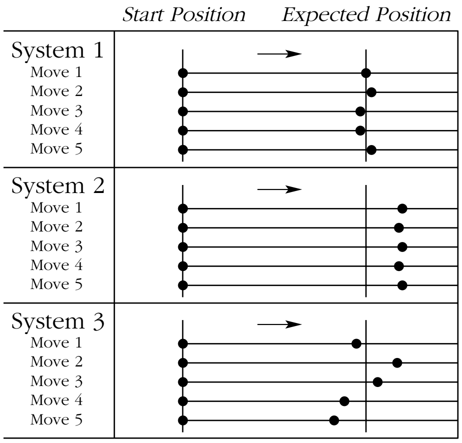
Parameter	Definition	Dominating Factors
Absolute Accuracy	The maximum error between expected and actual position.	• Accuracy of the motor/drive system • Screw pitch error (lead accuracy) • System backlash (drive train, screw and nut assembly)
Repeatability	The ability of a positioning system to return 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 Motion Terminology: Linear Positioner 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.

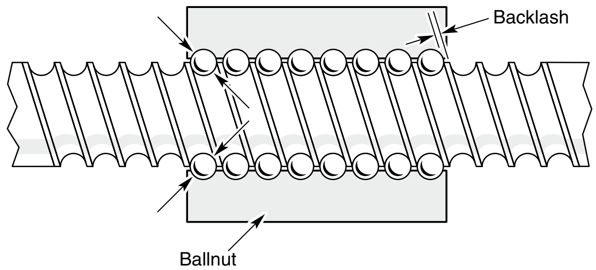
In most mechanical systems, some degree of backlash is necessary to reduce friction and wear. In a Kollmorgen Linear Positioner System, system backlash will typically be 0.010 – 0.015 inches. Usually 0.006 – 0.008" is attributed to the ball-screw / lead screw assembly. For ballscrews this will remain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

Reducing the Effects of Backlash

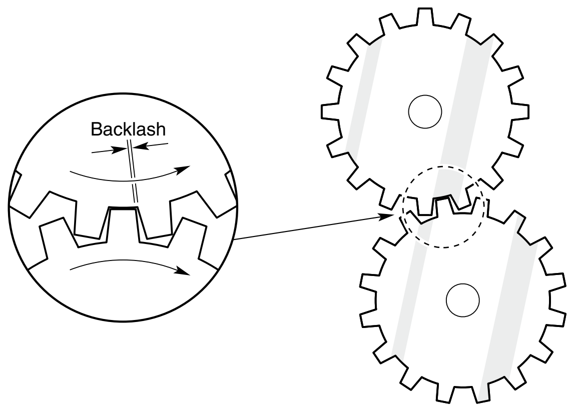
1. Approach a stop position from the same direction.
2. Apply a constant linear force on the cylinder thrust tube or carriage. This is done automatically for cylinders used in vertical orientations with a backdriving load.
3. For programmable positioning devices it is possible to program out backlash 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 ballscrew 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 ballscrew has less backlash than parallel or reverse parallel units which utilize a gear train or drive belt/pulley.

Primary Sources of Backlash

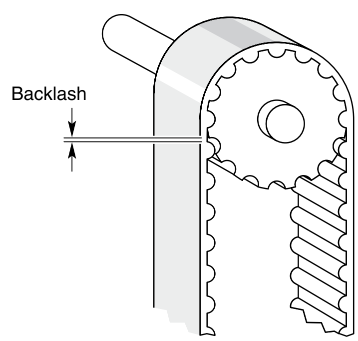
1. Ballscrew/Lead screw Assembly



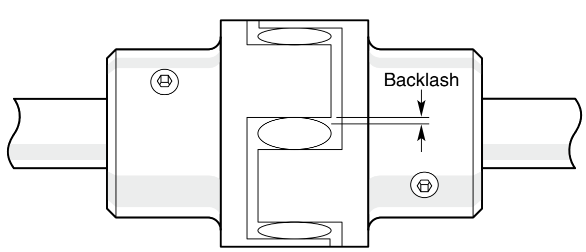
2. Drive Train (Gears, Timing Belt/Pulley)



3. Timing Belt/Pulley



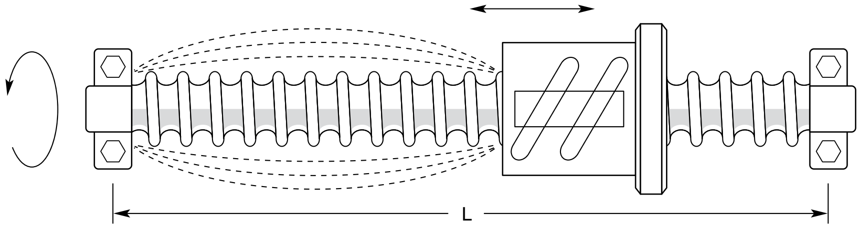
4. Coupling



Linear Motion Terminology: Critical Speed and Column Loading

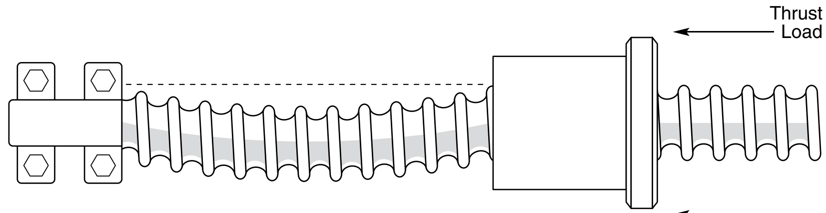
Critical Speed

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



Column Strength

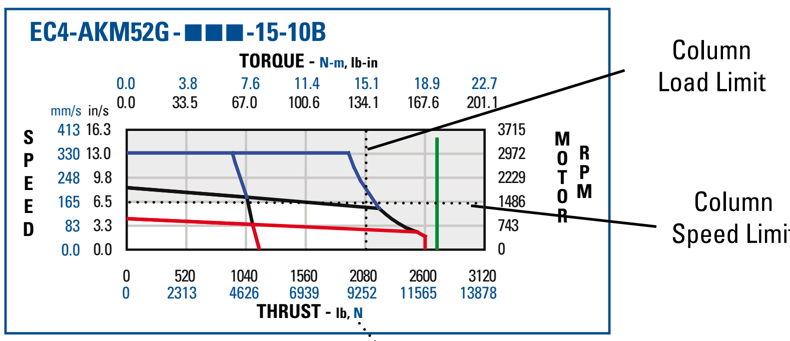
All ballscrews have a maximum column loading limit which causes the screw to compress as load increases. In Kollmorgen cylinders this limit is a function of unsupported lead screw length. Exceeding this limit will cause the ballscrew to buckle and become permanently damaged.



Compression (column) Load

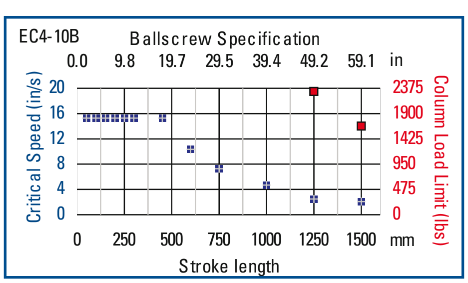
Determining the Limits

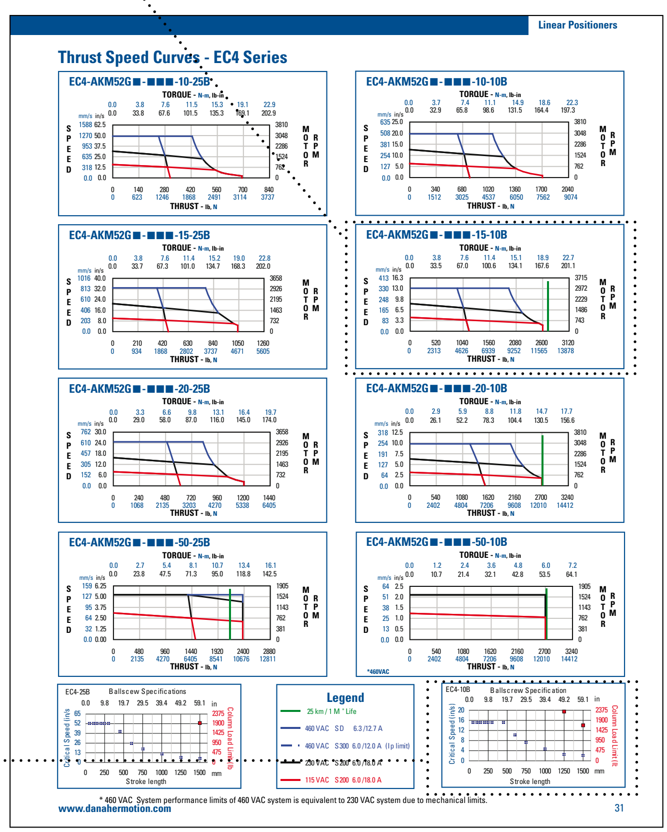
Critical Speed and Column Loading information for each screw type (i.e. 2B, 5A, 8A, 5B …) can be found at the bottom of each "Performance" page in the particular linear positioner's section.



Example

Find the Column Load and Critical Speed limits for an EC4-10B, 42 inch stroke electric cylinder. The positioner data can be found in the R3B Section. Reading off the chart at the bottom of page, the limits are 400 lb and 3.6 in/sec. The usable speed/thrust is restricted to less than these values as seen in the modified speed vs. thrust curve.





Linear Positioner Environmental Considerations

Environmental conditions are an important design consideration when selecting a Kollmorgen Linear Positioner. Kollmorgen units are self-contained systems which are protected from "direct contact" with harsh environments by an aluminum housing with a durable anodized and epoxy coated surface finish. However, extreme conditions can have an adverse effect on cylinder operation and life. Factors such as extreme temperature, liquids or abrasive contaminants (gaining internal access) can impede performance and cause premature wear of mechanical parts. Review the information below when sizing your application to choose appropriate options or protective measures.

Primary Environmental Factors

- Temperature
- Liquid contaminants
- Particle contaminants

Rod Type

Temperature

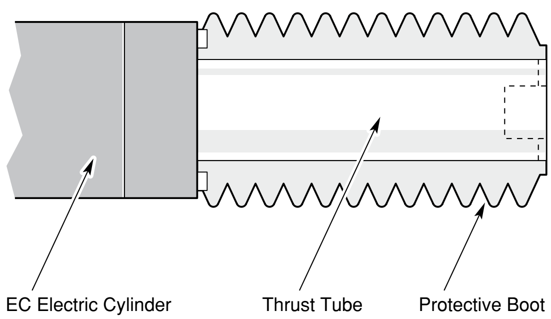
- N2 electric cylinders are rated for use between 0 and 60°C (32 to 140°F).
- EC electric cylinders are rated for use between -30 and 70°C (-22 to 158°F)

Particle and Liquid Contaminants

- N2 series electric cylinders are protected against dust but are not protected against direct water (or any liquid) contact. Liquid or moisture can gain access into the housing, eventually corroding internal components.
- EC electric cylinders are sealed and gasketed and are rated to IP54. They are protected against dust and light water sprays and splashing.

Protective Boot Option

The PB option is available for EC electric cylinders and increases the positioner's resistance to liquids. The diagram to the right shows a typical installation of an EC with the PB option. This option protects the positioner to IP65. Note that some motor options are not protected to this level. The PB option is not available with R-series Rodless positioners.

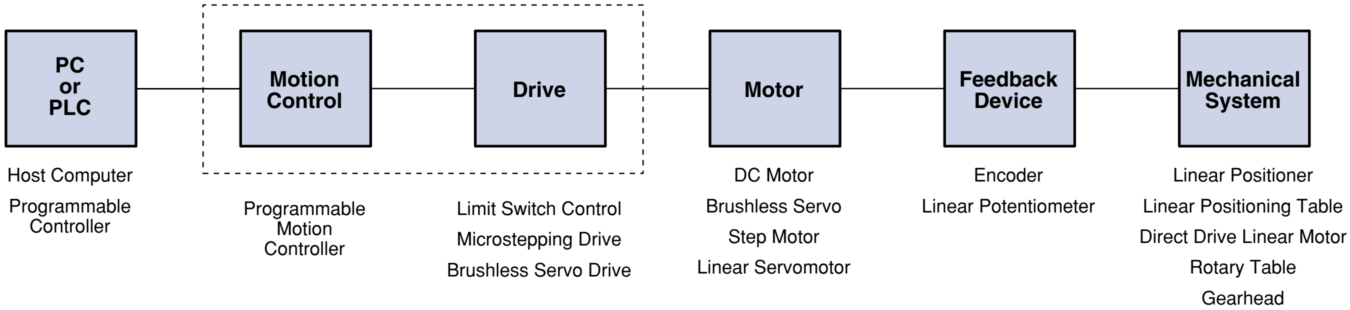


Custom Environmental Options

Kollmorgen has over 30 years experience designing custom linear positioners. We have designed fully encapsulated linear positioners for Corrosive, Food Processing, and Washdown environments, and have experience designing for Cleanroom compatible environments. Call Kollmorgen for more information regarding custom environmental options.

Introduction to Motion Control Technology

Many different components are used in a variety of combinations to create a complete motion control or positioning system. Kollmorgen offers the broadest range of products spanning the complete spectrum from mechanical linear positioners to microstepping and brushless servo drives to programmable motion controllers. A successful application depends on choosing the right combination of positioner, motor, drive, and control technology. More than one technology may meet the requirements of your application. In this case, factors such as performance, cost, flexibility, and simplicity may determine your selection.



Rotary System Selection: Sizing and Calculations

This section provides useful information for calculating your application's mechanical requirements, and selecting the proper motor and drive to meet your needs. To insure the proper motor/drive system is selected, follow these steps:

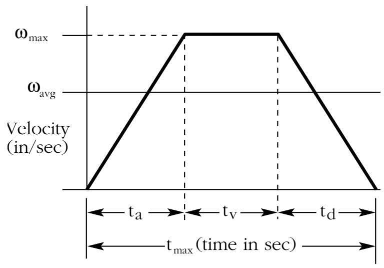
1. Sketch the **move profile** and calculate acceleration, deceleration and maximum velocity required to make the desired move.
2. Select **mechanical drive mechanism** to be used and calculate inertia, friction and load torque using formulas for the mechanical drive mechanism.
3. Determine **peak and continuous (RMS) torque** requirements for the application.
4. **Select a system** – choose the appropriate motor and drive combination that meets all of the application requirements.

1. Move Profile

Refer to the Move Profile section on page 84 to determine your peak velocity and acceleration. Rotary distance units should be radians. Time units are seconds.

NOTE: 1 rev = 2π radians.

Example: We need to move a total distance of 10 revolutions in 1 second using a 1/3, 1/3, 1/3 trapezoidal move profile. What is the distance (d_{tot}), peak velocity (ω_{max}) and acceleration (α) required to make the move.



Total distance, $d_{tot} = 10 \text{ rev} \bullet 2\pi \frac{\text{rad}}{\text{rev}} = 63 \text{ rad}$

Max velocity, $\omega_{max} = \frac{1.5\, d_{tot}}{t_{tot}} = \frac{1.5 \bullet 63}{1} = 95 \frac{\text{rad}}{\text{sec}}$

Acceleration, $\alpha = \frac{4.5\, d_{tot}}{(t_{tot})^2} = \frac{4.5 \bullet 63}{1^2} = 284 \frac{\text{rad}}{\text{sec}}$

2. Mechanical Drive Mechanisms

The system equations on the following page will help you calculate the reflected inertia (J), reflected applied loads (T), motor speed (ω), and acceleration (α), based on the move requirements that were determined in step one.

3. Peak Torque and RMS Torque Requirements

To find the peak and RMS torque required by the motor to make the move successfully, the Reflected Torque, T_{RL}, is added to the Torque required to accelerate (or decelerate) the load. T_{RL} includes all external forces, such as gravity, friction, and applied forces. The equations for peak torque and RMS torque required are:

$$T_{PEAK} = T_{RL} + \left[\frac{J_T\,\alpha}{e}\right]$$

$$T_{RMS} = \sqrt{\frac{T_A{}^2 t_A + T_{RL}{}^2 t_R + T_D{}^2 t_D}{t_c}}$$

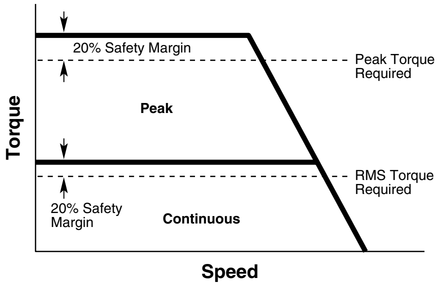
4. Selecting a System

Once the above torques have been calculated, a safety factor needs to be added. The safety margin varies with the motor type desired.

$$\text{Safety Margin} = \left(\frac{(\text{Torque Avail}) - (\text{Torque Req.})}{(\text{Torque Req.})}\right) \times 100$$

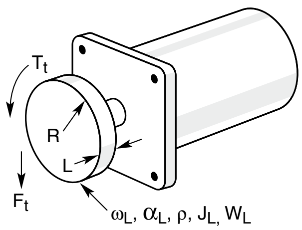
Servo Systems

For servo systems, a torque safety margin of at least 20% is recommended. The peak torque required by the application must fall within the peak torque rating of the motor at the peak speed. You must also calculate the RMS torque based on your application's duty cycle. The RMS torque must fall within the continuous area of the speed torque curve at the peak speed of the application.

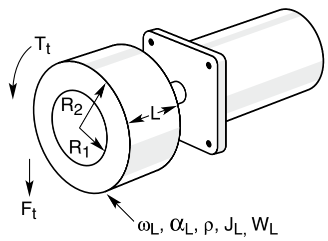


Rotary System Selection: Calculations

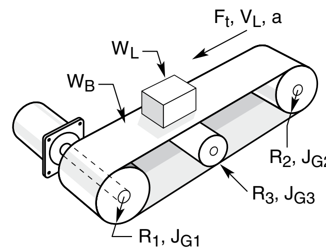
Inertia Solid Cylinder



Inertia Hollow Cylinder

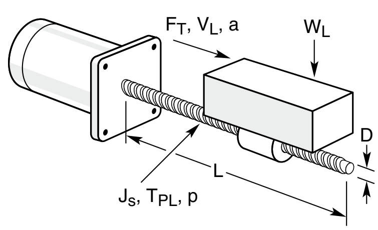


Tangential
(Conveyor, Rack and Pinion, etc.)

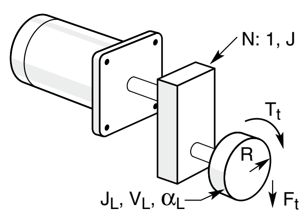


	Inertia Solid Cylinder	Inertia Hollow Cylinder	Tangential
ω	$\omega = \omega_L$	$\omega = \omega_L$	$\omega = \frac{V_L}{R_1}$
α	$\alpha = \alpha_L$	$\alpha = \alpha_L$	$\alpha = \frac{a}{R_1}$
J_T	$W_L = \pi L \rho R^2$ $J_T = J_L + J_{Motor}$ $J_L = \frac{1}{2}\frac{W_L}{g} \bullet R^2$	$W_L = \pi L \rho [R_2^2 - R_1^2]$ $J_T = J_L + J_{Motor}$ $J_L = \frac{1}{2}\frac{W_L}{g}[R_2^2 + R_1^2]$	$J_{RL} = \frac{W_L + W_B}{g} \bullet R_1^2$ $J_T = J_{Motor} + J_{RL} + J_{G1} + J_{G2}\left(\frac{R_1}{R_2}\right)^2 + J_{G3}\left(\frac{R_1}{R_3}\right)^2$
T_{RL}	$F_t = F_{Friction} + F_{Applied} + F_{Gravity}$ $T_{RL} = F_t \bullet R + T_t$	$F_t = F_{Friction} + F_{Applied} + F_{Gravity}$ $T_{RL} = F_t \bullet R_2 + T_t$	$F_t = F_{Friction} + F_{Applied} + F_{Gravity}$ $T_{RL} = \frac{F_t \bullet R_1}{e}$

Leadscrew



Gear Box



	Leadscrew	Gear Box
ω	$\omega = 2\pi p V_L$	$\omega = \frac{V_L}{N}$
α	$\alpha = 2\pi p a$	$\alpha = \frac{\alpha_L}{N}$
J	$J_S \approx 0.0012\ LD^4$ (for steel) $J_{RL} = \frac{W_L}{g}\left[\frac{1}{2\pi p}\right]^2$ $J_T = J_{RL} + J_S + J_{Motor}$	$J_{RL} = \frac{J_L}{N^2}$ $J_T = J_{RL} + J_{Reducer} + J_{Motor}$
T	$F_t = F_{Friction} + F_{Applied} + F_{Gravity}$ $T_{RL} = \frac{F_t}{2\pi \bullet p \bullet e} + T_{PL}$	$F_t = F_{Friction} + F_{Applied} + F_{Gravity}$ $T_{RL} = \frac{(F_t \bullet R) + T_t}{N \bullet e}$

Gear Reducers

Follow these guidelines when selecting an IDC precision gearhead:

1. Be sure your application's peak torque is less than the maximum momentary torque rating of the gearhead. Be sure to multiply the motor's torque by the gearhead efficiency and gear ratio when determining output torque from the reducer.

2. Be sure your application's RMS torque is less than the rated continuous torque of the gearhead.

Units

- a = acceleration rate (rad/sec^2)
- α = rotary acceleration (rad/sec^2)
- D = diameter
- e = efficiency of mechanism
- F_t = total load force including friction, gravity, or other external forces (oz)
- g = gravity = 386 in/sec^2
- J = rotary inertia (oz-in-sec^2)
- J_T = total inertia seen by motor (oz-in-sec^2)
- J_{RL} = reflected load inertia (oz-in-sec^2)
- L = length (in)
- ρ = material density (oz/in^3)
- p = pitch of screw (rev/in)
- R = radius (in)
- t_A = acceleration time (sec)
- T_A = acceleration torque (oz-in)
- t_D = deceleration time (sec)
- T_D = deceleration torque (oz-in)
- T_{PL} = preload torque of lead screw (oz-in)
- t_R = running time (sec)
- T_R = running torque (oz-in)
- T_{RL} = reflected load torque due to friction, gravity, or other external forces (oz-in)
- V_L = linear velocity of load (in/sec)
- ω = rotary velocity (rad/sec)
- W = weight (oz)

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.

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

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

ASCII (American Standard Code for Information Interchange)
A code which assigns a number to each numeral and letter of the alphabet. This allows information to be transmitted between machines as a series of binary numbers.

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.

Ballscrew
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.

Baud Rate
The number of binary bits transmitted per second on a serial communication link such as RS232C.

BCD (Binary Coded Decimal)
A binary numbering system in which the decimal digits 0 to 9 are represented by a 4 bit binary number.

Binary
Numbering system in which the base is two, each number being expressed in the powers of two, by 0 or 1.

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 cylinder.

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.

Dwell Time
Time within a move cycle where no motion occurs

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

EEPROM (Electrically Erasable Programmable Read Only Memory)
Non-volatile data storage chip.

Efficiency
Ratio of output power vs. input power.

EMI (Electromagnetic Interference)
Electrical disturbances which interfere with proper transmission of electrical signals, also known as "Electrical noise".

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.

Glossary of Motion Control Terminology

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 Collector (NPN)
An output signal which is provided by a transistor where the "open collector output" acts like a switch closure to ground when activated.

Open Loop
A positioning system which does not employ feedback information.

Optically Coupled
An interface circuit that transmits a signal with no direct electrical connection except for the logic ground.

Optical Isolation
An interface circuit that transmits a signal with no direct electrical connection.

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

PID (Proportional, Integral, and Derivative)
Refers to a group of gain parameters used for tuning or optimizing the response of a closed loop positioning system.

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.

PWM (Pulse Width Modulation)
A type of adjustable frequency drive output where the drive's output voltage is always a constant amplitude and by "chopping" (pulse width modulating) the average output power is controlled.

RAM (Random Access Memory)
A memory chip that can be read from and written to. Used as a medium for temporary information storage. Data is lost after power loss.

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.

ROM (Read Only Memory)
A memory chip that can be read but not altered.

RS232C
A method of Serial Communication where data is encoded and transmitted on a single line in a sequential time format.

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

Spur Gear
Gears with teeth straight and parallel to the axis of rotation.

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.

TTL (Transistor-Transistor-Logic)
Refers to a family of integrated circuit devices used for control. Typically use voltage levels from 5-12 Vdc.

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	.8679	$9.806x10^{-2}$	$7.233x10^{-2}$	10^{-2}
lb-in	$1.129x10^{6}$	$1.152x10^{3}$	16	1.152	1	.112	$8.333x10^{-2}$	$1.152x10^{-2}$
N-m	10^{7}	$1.019x10^{4}$	141.612	10.197	8.850	1	.737	.102
lb-ft	$1.355x10^{7}$	$1.382x10^{4}$	192	13.825	12	1.355	1	.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	.186	.182	.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	.9806	.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	.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	.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	.4297	.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	.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

Conversion Tables

Angular Velocity

A \ B	deg/s	**rad/s**	rpm	**rps**
deg/s	1	**1.75×10^{-2}**	.167	**2.78×10^{-3}**
rad/s	57.3	**1**	9.55	**.159**
rpm	6	**.105**	1	**1.67×10^{-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	**.0833**	.0167	**1.39×10^{-3}**	0.42	**4.2×10^{-4}**
ft/min	12	**1**	.2	**.0167**	5.08	**5.08×10^{-3}**
in/sec	60	**5**	1	**.083**	25.4	**.0254**
ft/sec	720	**60**	12	**1**	304.8	**.3048**
cm/sec	23.62	**1.97**	.3937	**.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**	2.54×10^4	**25.4**	2.54	**0.0254**
ft	12	**1**	3.048×10^5	**304.8**	30.48	**0.3048**
micron(µm)	3.937×10^{-7}	**3.281×10^{-6}**	1	**0.001**	1.0×10^{-4}	**1.0×10^{-6}**
mm	0.03937	**0.00328**	1000	**1**	0.1	**0.001**
cm	0.3937	**0.03281**	1.0×10^4	**10**	1	**0.01**
m	39.37	**3.281**	1.0×10^6	**1000**	100	**1**

Mass

A \ B	gm	**kg**	slug	**lb(m)**	oz(m)
gm	1	**0.001**	6.852×10^{-5}	**2.205×10^{-3}**	0.03527
kg	1000	**1**	6.852×10^{-2}	**2.205**	35.274
slug	14590	**14.59**	1	**32.2**	514.72
lb(m)	453.6	**0.45359**	.0311	**1**	16
oz(m)	28.35	**0.02835**	1.94×10^{-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	**3.59×10^{-5}**	——	**980.6**
oz(f)	0.0625	**0.27801**	2.78×10^4	**1**	0.02835	**28.35**
kg(f)	2.205	**9.80665**	——	**35.274**	1	**1000**
gm(f)	2.205×10^{-3}	——	1.02×10^{-3}	**.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/in^3	lb/in^3	gm/cm^3
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

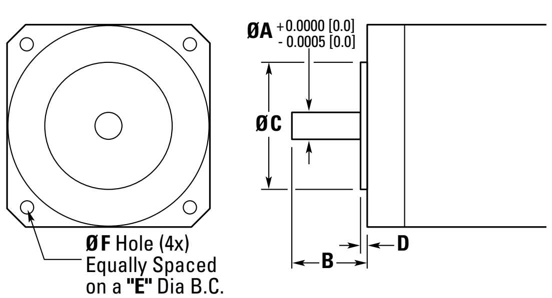
(Acceleration Constant)

g = 386 in/s^2 = 32.2 ft/s^2 = 9.8 m/s^2

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, fill out this form below and email to Kollmorgen at contactus@kollmorgen.com or send a fax at 1-540-639-4162.

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

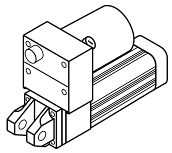
☐ Recommend product

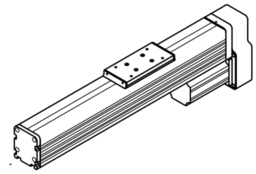
☐ Call me to discuss

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

Application Worksheet

☐ Electric Cylinder or ☐ Rodless Positioner





Loads

Payload

Weight ________ lbs

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

Hold Position:
☐ After move ☐ Power off

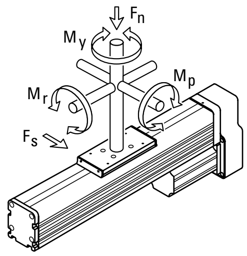
Carriage Loads (Rodless only)

M_p ________ in-lb

M_r ________ in-lb

M_y ________ in-lb

Side Load ______ lbs



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 page 100)

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

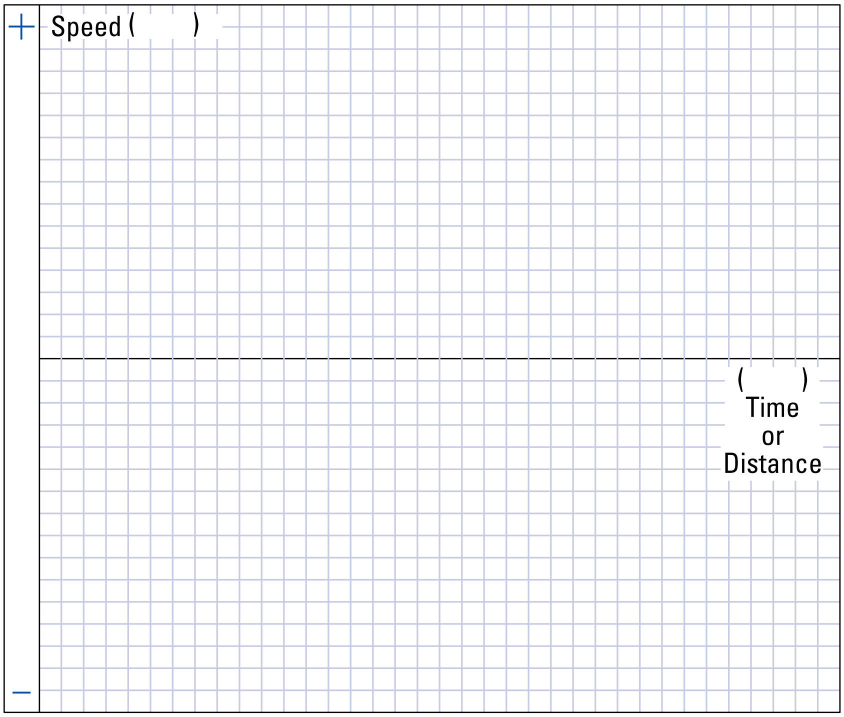
Conditions

☐ 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 ☐ Digital (Step & Direction) ☐ Analog Velocity

☐ Limit Switches ☐ Analog Torque ☐ Analog Position

☐ Programmable (Basic) ☐ 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 :

Ordering Information N2 Series

1		2		3		4		5		6		7		8		9		10
Base Unit		Motor		Motor Options		Drive Ratio		Screw Pitch		Stroke Length		Cylinder Mounting		Rod End		Options		Cable Option
N2	-	AKM23D	-	BNR	-	15	-	5B	-	8	-	MP2	-	FT1M	-		-	C0

1. N2 SERIES
N2

2. MOTOR TYPE

AKM23D	AKM23D-EFxxx-00 Brushless Servo
AKM23C	AKM23C-EFxxx-00 Brushless Servo
X	Customer-Supplied Motor (motor described in Options element of part number)

3. MOTOR OPTIONS

B ■■	Rotatable IP65 connectors
C ■■	0.5 m shielded cables w/ IP65 connectors
■N■	No Brake
■2■	24 Vdc Power-Off Holding Brake
■■ R	Resolver
■■ 2	2048 LPR Incremental Comm Encoder
■■ C	SFD (Smart Feedback Device)

4. DRIVE RATIO

10	1.0:1 Drive Belt/Pulley
15	1.5:1 Drive Belt/Pulley
20	2.0:1 Drive Belt/Pulley
25	2.5:1 Helical Gears
35	3.5:1 Helical Gears
120	12.0:1 Helical Gears
10L	1.0:1 Inline Coupling (Direct 1:1 coupling is the only ratio available for Inline Models)

5. SCREW PITCH, TYPE

2B	2 rev/inch ballscrew
5B	5 rev/inch ballscrew
5A	5 rev/inch lead screw
8A	8 rev/inch lead screw

6. STROKE LENGTH

2	2 inch total stroke
4	4 inch total stroke
6	6 inch total stroke
8	8 inch total stroke
12	12 inch total stroke
18	18 inch total stroke (requires -DB option, effective stroke is 16.5")
24	24 inch total stroke (requires -DB option, effective stroke is 22.5")
nn.n	Custom stroke lengths available in 0.1 inch increments

7. CYLINDER MOUNTING

MF1	Front Rectangular Flange
MF2	Rear Rectangular Flange
MF3	Front & Rear Rectangular Flange
MP2	Rear Double Clevis (without Pivot Base)
MP3	Rear Double Clevis with Pivot Base
MS1	Side End Angle
MS2	Side Lugs
MS6M	Side Tapped Holes (metric)
MS6E	Side Tapped Holes (English)
MT4	Trunion

8. ROD ENDS

FC2	Clevis (includes MT1M)
FS2	Spherical Joint (includes FT1M)
FT1M	Female Thread (metric)
FT1E	Female Thread (English))
MT1M	Male Thread (metric)
MT1E	Male Thread (English))

9. OPTIONS (add multiple in the following sequence)

DB	Dual Front Bearing
BS24	24 Vdc Brake on lead screw (not available with 10L ratio, or with MF2, MF3, MS1, MP2, MP3 mounting options)
BS115	115 Vac Brake on lead screw (not available with 10L ratio, or with MF2, MF3, MS1, MP2, MP3 mounting options)
PB	Protective Boot
W	Water Resistent
F	Sub-Freezing Temperature
H	High Temperature Prep
L	Linear Potentiometer (only valid for std lengths)

Motor Mod Codes for X (customer supplied) Motors also found in "Option" portion of Part Number.
Consult Kollmorgen.

Motor Mod codes (customer supplied and customer installed)
IDR60X N2 for AKM23X-EFXXX

10. CABLE

C0	No cable supplied, motor includes connectors. Default for all AKM motor; Select cable as an accessory.

1-5 Base Model Number

Choose the model with sufficient speed and thrust with a comfortable safety margin. Refer to the Speed vs. Thrust curves.

EC cylinders with gear or timing belt drive reductions have the motor mounted parallel to the screw. Inline models have the motor coupled directly to the screw with no reduction.

6. Stroke Length

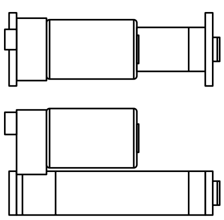
Standard lengths are listed, and custom lengths are also available. To maximize cylinder life, the thrust tube should not impact the physical end-of-travel on either end. Extra travel length is necessary to decelerate the load to a stop when an end-of-travel limit switch is encountered. This extra travel distance depends on load and speed.

7. Cylinder Mounting

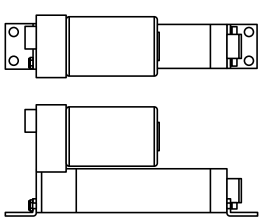
Specify any one of these cylinder mounting options. Dimensional drawings are on pages 42-47.

Cylinder base mount options -MS1,-MP2, -MP3, -MF2, -MF3 cannot be ordered with inline models.

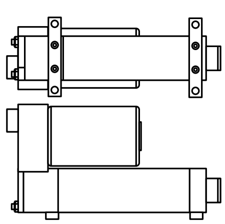
MF1 Front Flange
MF2 Rear Flange
MF3 Both Flanges



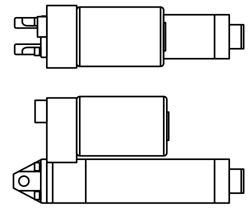
MS1 Side End Angles



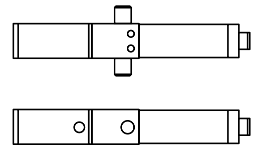
MS2 Side Lugs



MP3 Rear Clevis
(MP2 omits pivot base)



MT4 Trunnion



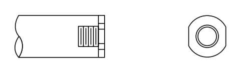
Pivot Mount Caution:

When utilizing a pivot mounting option (MP2, MP3 or MT4) in conjunction with a pivot rod end (FS2 or FC2), it is recommended that the electric cylinder be extended only to 90–95% of its full stroke. This increases the system's rigidity and extends the life of the guide bearings and rod seal.

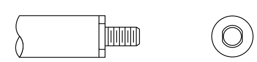
8. Rod Ends

Four rod end types are available:

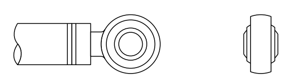
FT1M or FT1E
Female Thread



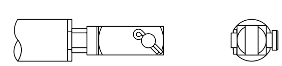
MT1M or MT1E
Male Thread



FS2 Spherical Joint



FC2 Clevis



9. Other Options

See Options and Accessories Section for complete specifications.

* Limit sensors are sold as accessories

Ordering Information EC Series

1 Base Unit		2 Motor		3 Motor Options		4 Drive Ratio		5 Screw Lead		6 Stroke Length		7 Cylinder Mounting		8 Rod End		9 Options		10 Cable Option
EC2	-	AKM23D	-	BNR	-	10	-	05B	-	300	-	MP2	-	FT1M	-		-	C0

1. EC SERIES

EC1
EC2
EC3
EC4
EC5

2. MOTOR TYPE

		Available
CTP12	CTP12xLF10MMA00 Stepper Motor	EC1
AKM11B	AKM11B-ANCxx-00 Brushless Servo	EC1
AKM13C	AKM13C-ANCxx-00 Brushless Servo	EC1
AKM23D	AKM23D-EFxxx-00 Brushless Servo	EC2, EC3
AKM23C	AKM23C-EFxxx-00 Brushless Servo	EC2, EC3
AKM42G	AKM42G-EKxxx-00 Brushless Servo	EC3, EC4, EC5
AKM42E	AKM42E-EKxxx-00 Brushless Servo	EC3, EC4, EC5
AKM52G	AKM52G-EKxxx-00 Brushless Servo	EC4, EC5
AKM52L	AKM52L-EKxxx-00 Brushless Servo	EC4, EC5
X	Customer-Supplied Motor (motor described in Options element of part number)	EC2, EC3, EC4, EC5

3. MOTOR OPTIONS

		Available
B■■	Rotatable IP65 connectors	AKM2
C■■	0.5 m shielded cables w/ IP65 connectors	AKM1, AKM2
C■■	Rotatable IP65 connectors	AKM4, AKM5
■N■	No Brake	AKM1, AKM2, AKM4, AKM5
■2■	24 Vdc Power-Off Holding Brake	AKM2, AKM4, AKM5
■■ R	Resolver	AKM1, AKM2, AKM4, AKM5
■■ 2	2048 LPR Incremental Comm Encoder	AKM1, AKM2, AKM4, AKM5
■■ C	SFD (Smart Feedback Device)	AKM1, AKM2, AKM4, AKM5
■■■	Omit field for CTP12	CTP12

4. DRIVE RATIO

		Available
10	1.0:1 Drive Belt/Pulley (EC1 - Helical)	All
15	1.5:1 Drive Belt/Pulley	EC2, EC3, EC4, EC5
20	2.0:1 Drive Belt/Pulley (EC1 - Helical)	Not valid for EC3-AKM42
40	4.0:1 Helical Gears	EC1 only
50	5.0:1 Helical Gears	EC2, EC3, EC4, EC5
70	7.0:1 Helical Gears	EC3 only
100	10.0:1 Helical Gears	EC2, EC4, EC5
10L	1.0:1 Inline Coupling (Direct 1:1 coupling is the only ratio available for Inline Models)	All

5. SCREW LEAD, TYPE

		Available
03B	0.125 in/rev ballscrew	EC1
05B	5 mm/rev ballscrew	EC2,.EC3
10B	10 mm/rev ballscrew	EC3, EC4, EC5
16B	16 mm/rev ballscrew	EC2, EC3
25B	25 mm/rev ballscrew	EC4
32B	32 mm/rev ballscrew	EC5
04A	4 mm/rev lead screw	EC2, EC3

6. STROKE LENGTH

		Available
50	50 mm total stroke	All
100	100 mm total stroke	All
150	150 mm total stroke	All
200	200 mm total stroke	All
250	250 mm total stroke	EC2, EC3, EC4, EC5
300	300 mm total stroke	EC2, EC3, EC4, EC5
450	450 mm total stroke	EC2, EC3, EC4, EC5
600	600 mm total stroke	EC2, EC3, EC4, EC5
750	750 mm total stroke	EC2, EC3, EC4, EC5
1000	1000 mm total stroke	EC3, EC4, EC5
1250	1250 mm total stroke	EC4, EC5
1500	1500 mm total stroke	EC4, EC5
nnn	Custom stroke lengths available in 10 mm increments	

7. CYLINDER MOUNTING

		Available
MF1	Front Rectangular Flange	EC1, EC2, EC3, EC5
MF1E	Front Rectangular Flange (English)	EC4 only
MF1M	Front Rectangular Flange (Metric)	EC4 only
MF2	Rear Rectangular Flange	EC2, EC3, EC5
MF2E	Rear Rectangular Flange (English)	EC4 only
MF2M	Rear Rectangular Flange (Metric)	EC4 only
MF3	Front & Rear Rectangular Flange	EC2, EC3, EC5
MF3E	Front & Rear Rectangular Flange	EC4 only
MF3M	Front & Rear Rectangular Flange	EC4 only
MP2	Rear Double Clevis (without Pivot Base)	All
MP3	Rear Double Clevis with Pivot Base	All
MS1	Side End Angle	All
MS2	Side Lugs	All
MS6M	Side Tapped Holes (metric)	All
MS6E	Side Tapped Holes (English)	EC2, EC3, EC4, EC5
MT4	Trunnion	EC2, EC3, EC4, EC5

8. ROD ENDS

		Available
FC2	Clevis (includes MT1M)	All
FS2	Spherical Joint (includes FT1M)	All
FT1M	Female Thread (metric)	All
FT1E	Female Thread (English)	EC2, EC3, EC4, EC5
MT1M	Male Thread (metric)	All
MT1E	Male Thread (English)	EC2, EC3, EC4, EC5
LR	Linear Rod Bearing (EC2 only)	

9. OPTIONS (add multiple in the following sequence, omit if no options)

BA24	24 Vdc Brake on actuator (EC1 only, not available with 10L ratio, or MS1 mounting options)
BS24	24 Vdc Brake on ballscrew (not available with EC1 or 10L ratio, or with MF2(x), MF3(x), MS1, MP2(x), MP3(x) mounting options)
BS115	115 Vac Brake on ballscrew (not available with EC1 or 10L ratio, or with MF2(x), MF3(x), MS1, MP2(x), MP3(x) mounting options)
PB	Protective Boot*
L	Linear Potentiometer (only valid thru 600 mm stroke, std lengths)*
17X	NEMA 17 mount less motor (EC1 only)

10. CABLE

C0 — No cable supplied, motor includes connectors.
Default for all AKM motor; select cable as an accessory.

* Consult factory for EC1

Motor Mod Codes for X (customer supplied) motors also found in "Option" portion of Part Number.
Contact Kollmorgen.

Motor Mod codes (customer supplied and customer installed)

IDR67X EC1	for AKM1XX-ANXXX
IDR60X EC2, EC3	for AKM23X-EFXXX
IDR61X EC3, EC4, EC5	for AKM42X-EKXXX
IDR62X EC4, EC5	for AKM51X-EKXXX or AKM52X-EKXXX

1-5 Base Model Number

Choose the model with sufficient speed and thrust with a comfortable safety margin. Refer to the Speed vs. Thrust curves.

EC cylinders with gear or timing belt drive reductions have the motor mounted parallel to the screw. Inline models have the motor coupled directly to the screw with no reduction.

6. Stroke Length

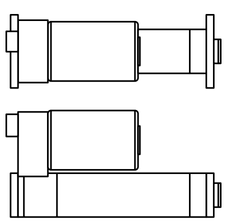
Standard lengths are listed, and custom lengths are also available. To maximize cylinder life, the thrust tube should not impact the physical end-of-travel on either end. Extra travel length is necessary to decelerate the load to a stop when an end-of-travel limit switch is encountered. This extra travel distance depends on load and speed.

7. Cylinder Mounting

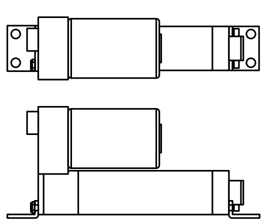
Specify any one of these cylinder mounting options. Dimensional drawings are on pages 49-54.

Cylinder base mount options -MS1,-MP2, -MP3, -MF2, -MF3 cannot be ordered with inline models.

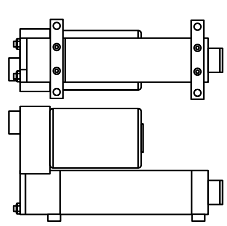
MF1 Front Flange
MF2 Rear Flange
MF3 Both Flanges



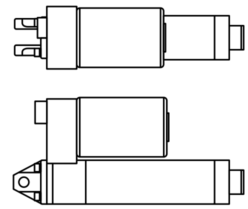
MS1 Side End Angles



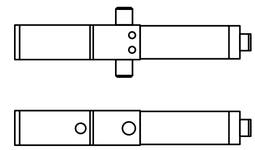
MS2 Side Lugs



MP3 Rear Clevis
(MP2 omits pivot base)



MT4 Trunnion



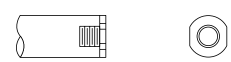
Pivot Mount Caution:

When utilizing a pivot mounting option (MP2, MP3 or MT4) in conjunction with a pivot rod end (FS2 or FC2), it is recommended that the electric cylinder be extended only to 90–95% of its full stroke. This increases the system's rigidity and extends the life of the guide bearings and rod seal.

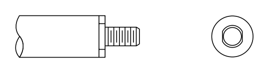
8. Rod Ends

Four rod end types are available:

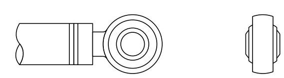
FT1M or FT1E
Female Thread



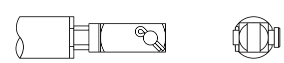
MT1M or MT1E
Male Thread



FS2 Spherical Joint



FC2 Clevis



9. Other Options

See Options and Accessories Section on pages 56-64.

* Limit sensors are sold as accessories

Electric Cylinder Servo Systems - S200

S200 Systems		115/230 Vac	
Drive	I cont / I peak Arms	Motor Type	Frame size
S20160 -	1.5 / 4.5	AKM1xx	NEMA 17
S20360 -	3.0 / 9.0	AKM23D	NEMA 23
S20360 -	3.0 / 9.0	AKM42E	NEMA 34
S20660 -	6.0 / 18.0	AKM42G	NEMA 34
S20669	6.0 / 18.0	AKM52G, H	NEMA 42
S21260 -	12.0 / 30.0	AKM52L	NEMA 42

S200 Indexer (S20360, S20660)

Control Options	
- VTS	Base Unit: Analog Velocity & Torque, Pulse Input Follower (Step/Dir & Master Encoder)
- CNS	Indexer / CANOpen Option Card
-SRS	SynqNet Network Option Card, std RJ45 connectors
- SDS	SynqNet Network Option Card, Micro-D connectors
-DLS	D-Link®, IEC 61131 Control
Example	S20360-CNS S200 115/230 Vac, 3 A, Indexer Option Card

Connector Kits (Base Unit)	
CK-S200-P-AC	Mating connector for input power (J1) for base unit S20260, S20360 and S20660 drives
CK-S200-P-ACL	Mating connector for input control power (J1) for base unit S21260 drive
CK-S200-IP-AC	Mating connectors for I/O (J4) and input power (J1) for base unit S20260, S20360 and S20660 drives
CK-S200-IP-ACL	Mating connectors for I/O (J4) and input control power (J1) for base unit S21260 drive
CK-S200-IP-AC-TB	Terminal block adapter for I/O (J4) connector and input power (J1) mating connector for base unit S20260, S20360 and S20660 drives
CK-S200-IP-ACL-TB	Terminal block adapter for I/O (J4) connector and input control power (J1) mating connector for base unit S21260 drive
768-026902-01	Terminal block adapter for base unit I/O connector (J4) HD26

Connector Kits (Option Cards)	
CK-S200-CNDN-B01	System Breakout Board for Indexer, Din Rail mount, screw-terminals. 14-in Y-cable for S200 IO connectors J13 HD15 and J4 HD26.
CK-S200-CNDN	Indexer option card mating connectors: CanOpen or DevicNet(J11), I/O(J12), Feedback(J13)
CK-S200-CNDN-TB	Indexer option card mating connectors: CanOpen or DevicNet(J11), Terminal block adapter for I/O(J12), Feedback(J13)
CK-S200-SQ	SynqNet option card mating connectors for I/O(J13) and Feedback(J14) HD15
CK-S200-SQ-TB	SynqNet option card mating connectors, terminal block adapters for I/O(J13) and Feedback(J14) both HD15
768-016902-01	Terminal block adapter for single HD15 connector for option cards (Indexer, SynqNet)

Accessories	
P7S2-232-9D	RS232 serial communication cable DB9 to ModJack - 6 feet

Feedback cables	
VF-DA0411N-XX	Feedback cable (Value Line) : Euro IP65 connector to IEEE1394 connector at S200 Drive for SFD
CF-DA0111N-XX-X	Feedback cable (Performance Line) : Euro IP65 connector to IEEE1394 connector at S200 Drive for SFD
Power only cables	
VP-102BEAN-XX	Power cable (Value Line) : Euro IP65 connector to S200 drive crimp-pin pluggable connector for S202, S203, S206 Drive
VP-105CEAN-XX	Power cable (Value Line) : Euro IP65 connector to S200 drive crimp-pin pluggable connector for S212 Drive
CP-102AAAN-XX-X	Power cable (Performance Line) : Euro IP65 connector to S200 drive crimp-pin pluggable connector for S202, S203, S206 Drive
CP-105CCAN-XX-X	Power cable (Performance Line) : Euro IP65 connector to S21260 drive
Power/Brake cables	
CP-102ABAN-XX-X	Power/brake cable (Performance Line) : Euro IP65 connector to S200 Drive (S202, S203, S206 Drive)
CP-105CDAN-XX-X	Power/brake cable (Performance Line) : Euro IP65 connector to S21260 drive
Note:	Use XX to designate cable length in whole meters and -X to order half meter increments.
Example	CF-DC0111N-03-5 Represents a 3.5 meter cable

Note: Value Line Cables available only in 1, 3, 6, 9 and 12 meter lengths

Electric Cylinder Servo Systems - S300

S300 Systems		115/230 Vac Systems	
Drive	I cont / I peak Arms	Motor Type	Frame size
S30361-	3.0 / 9.0	AKM1xx	NEMA 17
S30361-	3.0 / 9.0	AKM23D	NEMA 23
S30361-	3.0 / 9.0	AKM42E	NEMA 34
S30661-	6.0 / 15.0	AKM42G	NEMA 34
		AKM52G	NEMA 42

S300 Systems		400/460 Vac Systems	
Drive	I cont / I peak Arms	Motor Type	Frame size
S30101-	1.5 / 4.5	AKM23C	NEMA 23
S30301-	3.0 / 7.5	AKM42E	NEMA 34
S30601-	6.0 / 12.0	AKM52G	NEMA 42

Control Options	
- CB	CANOpen Master
- DN	DeviceNet
- EC	Ethercat
- EI	Extended I/O
- PB	Probibus DP
- SE	SERCOS II
- NA	No option card
Example	S30101-PB
	S300, 1.5 A, 230-460 Vac, Profibus option card

Feedback Cables	
CF-SS-RHGE-XX	Resolver feedback cable, Euro IP65 connectors to 9 pin sub D connector at S300 Drive (X2)
CF-SS-CHGE-XX	Commutating Encoder feedback cable, Euro IP65 connectors to 15 pin sub D connector at S300 Drive (X1)
CF-SS-S3HGE-XX	Sine-Encoder feedback cable, Euro IP65 connectors to 15 pin sub D connector at S300 Drive (X1)
Power only Cables	
CP-SS-R1HE-XX	Power cable, 115/230 Vac system, Euro IP65 to Drive screw-terminal connector (X9)
CP-SS-G1HE-XX	Power cable, 380/400/460 Vac system, Euro IP65 to Drive screw-terminal connector (X9)
Power/Brake Cables	
CP-SS-RAHBE-XX	Power/brake cable, 115/230 Vac system, Euro IP65 to Drive screw-terminal connector (X9)
CP-SS-GAHBE-XX	Power/brake cable, 380/400/460 Vac system, Euro IP65 to Drive screw-terminal connector (X9)
Notes:	Filters and chokes are not needed for motor cable lengths less than 25 meters. Includes provisions for CE
	Use XX to designate cable length in meters. 1 meter length, 03 meter, 06 meter, etc in 3 meter increments up to 75 meters
Example	CP-SS-RAHBE-09 represents a 9.0 meter cable

Electric Cylinder Servo Systems - Smart Drive (SD)

Smart Drive (SD) Systems		115/230 Vac		
Drive	Part Number	I cont / I peak Arms	Motor Type	Frame size
MMC-SD-0.5-230-D	M.3000.0461	1.77 / 5.3	AKM11B	NEMA 17
MMC-SD-0.5-230-DN	M.1302.8908		AKM13C	
MMC-SD-1.0-230-D	M.3000.0462	3.5 / 10.6	AKM23D	NEMA 23
MMC-SD-1.0-230-DN	M.3000.0459			
MMC-SD-2.0-230-D	M.3000.0463	7.0 / 21.2	AKM42G	NEMA 34
MMC-SD-2.0-230-DN	M.3000.0460		AKM52G	NEMA 42

Note: -DN is narrow version, Digital drive network slave only, space for control card removed.

Smart Drive (SD) Systems			400/460 Vac Systems	
Drive	Part Number	I cont / I peak Arms	Motor Type	Frame size
MMC-SD-1.3-460-D	M.3000.0464	2.1 / 4.2	AKM23C	NEMA 23
MMC-SD-2.4-460-D	M.3000.0465	3.9 / 7.8	AKM42E	NEMA 34
MMC-SD-4.0-460-D	M.3000.0466	6.3 / 12.7	AKM52G	NEMA 42

Control Options		
Control Card	Part Number	Description
MMC-D1	M.3000.0164	1 Axis Controller, Digital I/O (8 / 8), Serial port (RS232/422/485)
MMC-D2	M.3000.0165	2 Axis Controller, Digital I/O (8 / 8), Serial port (RS232/422/485), Ethernet, Block I/O interface
MMC-D4	M.3000.0166	4 Axis Controller, Digital I/O (8 / 8), Serial port (RS232/422/485), Ethernet, Block I/O interface
MMC-D8	M.3000.0518	8 Axis Controller, Digital I/O (8 / 8), Serial port (RS232/422/485), Ethernet, Block I/O interface
MMC-D16	M.3000.0167	16 Axis Controller, Digital I/O (8 / 8), Serial port (RS232/422/485), Ethernet, Block I/O interface

Note: Control card installs into -D type SD Drive.

Feedback cables - Flex Rated		Euro IP65 connector type
Length [m}	Part Number	Type
3	M.1302.8435	Incremental commutating encoder
6	M.1302.8601	
9	M.1302.8602	
3	M.1302.8438	Sine-Encoder BiSS or EnDat 2.2, 01
6	M.1302.8614	
9	M.1302.8615	
3	M.1302.8450	Resolver
6	M.1302.8631	
9	M.1302.8632	

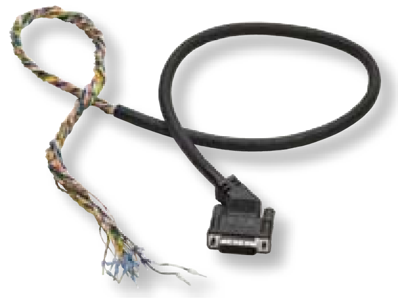
Power/Brake cables - Flex Rated		Euro IP65 connector type
Length [m]	Part Number	Type
3	M.1302.8545	16 AWG for AKM23, AKM42, AKM52G
6	M.1302.8581	
9	M.1302.8553	

For additional cable length options, Operator Interfaces, Block IO and other accessories, see PicPro Integrated Solution Brochure online.

Electric Cylinder Servo Systems - Smart Drive (SD)

Smart Drive (SD) Systems **Accessories**

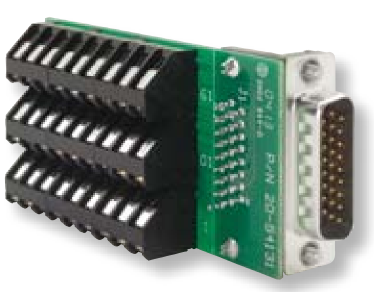
Control Card I/O (C5) - Connection Options		
Length	Part Number	Description
1 meter	M.1302.8257	Interface Cable, Digital I/O connector (C5) HD26 to flying leads (Figure 1)
3 meters	M.1302.8258	
9 meters	M.1302.8259	
1 meter	M.1302.8254	Interface Cable, Digital I/O connector (C5) to Breakout box, (2) HD26 connectors (Figure 2)
3 meters	M.1302.8255	
9 meters	M.1302.8256	
Use with cable above	M.1302.8253	Breakout box (Din-rail mount) for I/O connector (C5)



(Figure 1)
I/O Connector (C5) to Flying Lead Cable

(Figure 2)
Interface Cable to Break-Out Box

Drive I/O - Connection Options		
Length	Part Number	Description
1 meter	M.1302.7032	Interface Cable, Drive I/O connector (IO) HD26 to flying leads
3 meters	M.1302.7034	
9 meters	M.1302.7035	
1 meter	M.1302.6982	Interface Cable, Drive I/O connector (IO) to Breakout box, (2) HD26 connectors
3 meters	M.1302.6984	
9 meters	M.1302.6985	
Use with cable above	M.1302.6973	Breakout box (Din-rail mount) for Drive I/O connector (IO)
(Figure 3 , 4)	M.1302.6971	Screw terminal adapter , Drive I/O, Drive mounted



(Figure 3)
Screw terminal adapter
HD 26 pin Drive I/O

(Figure 4)
Connector shown on drive

Alternate AKM Servomotor and Electric Cylinder Systems

For use when AKM motor is not included as part of Electric Cylinder model number.					
Electric Cylinder	AKM Frame	AKM Motor Model #	* Allowable AKM stack lengths	Kollmorgen Motor Mount Code	Example Motor
N2	AKM2	AKM2XX-EFXXX	AKM 21, 22, 23	IDR60	AKM23D-EFCNC-00
EC1	AKM1	AKM1XX-ANXXX	AKM 11, 13	IDR67	AKM11B-ANCNC-00
EC2	AKM2	AKM2XX-EFXXX	AKM 21, 22, 23	IDR60	AKM23D-EFCNC-00
EC3	AKM2	AKM2XX-EFXXX	AKM 21, 22, 23	IDR60	AKM23D-EFCNC-00
EC3	AKM4	AKM4XX-EKXXX	AKM 41, 42	IDR61	AKM42G-EKCNR-00
EC4	AKM4	AKM4XX-EKXXX	AKM 41, 42, 43, 44	IDR61	AKM42G-EKCNR-00
EC4	AKM5	AKM5XX-EKXXX	AKM 51, 52	IDR62	AKM52G-EKCN2-00
EC5	AKM4	AKM4XX-EKXXX	AKM 41, 42, 43, 44	IDR61	AKM44G-EKCNR-00
EC5	AKM5	AKM5XX-EKXXX	AKM 51, 52	IDR62	AKM52G-EKCN2-00

* Based on maximum torque capacity, consult factory for other combinations
Review application for inertia mismatch when considering motor options

Alternate AKM Model Number for use with Electric Cylinders

AKM 4 2 E - EK C N R- 00

AKM Series

Motor Frame Size
1, 2, 3, 4, 5

Rotor Stack Length
1, 2, 3, 4

Winding Type
A, B, C, D, etc.

Mount Code
AN = AKM1 with EC1
EF = AKM2 with N2, EC2, EC3
EK = AKM4 with EC3, EC4, EC5
EK = AKM52 with EC4, EC5

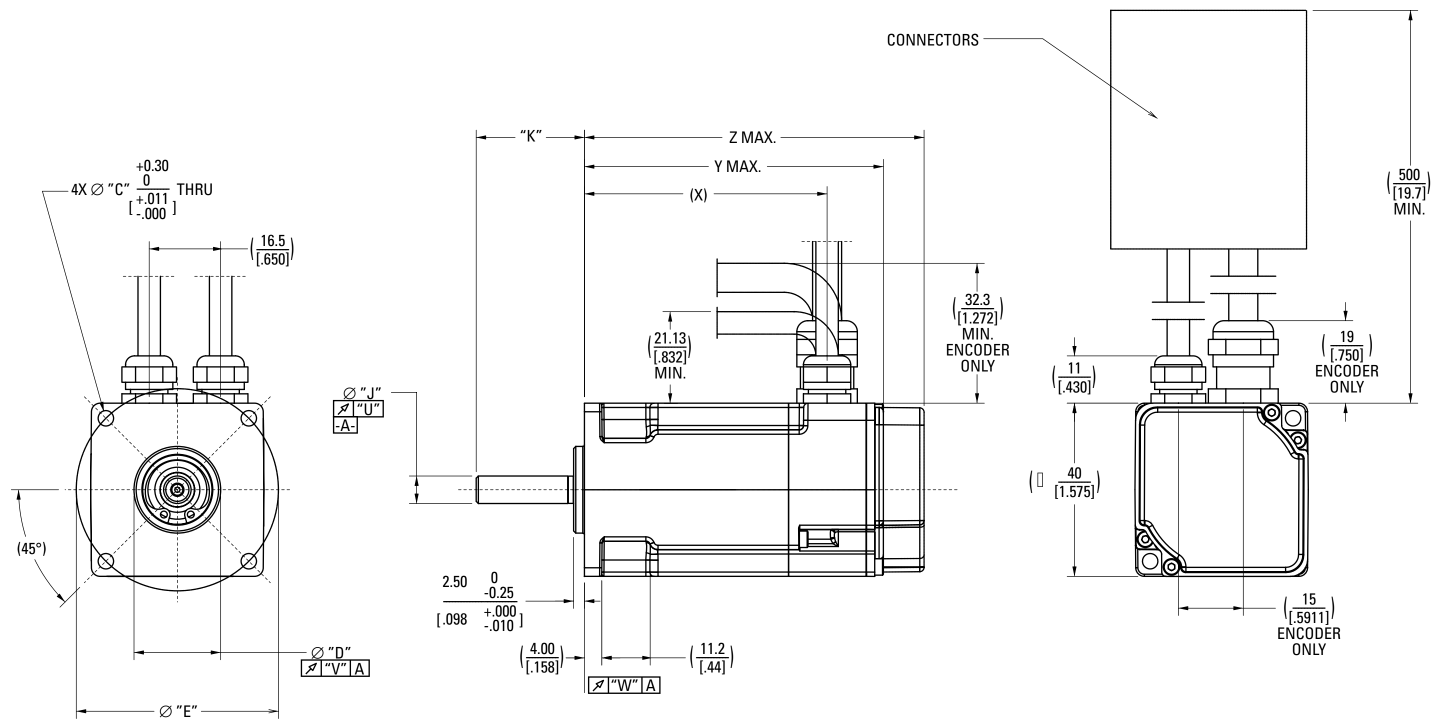
Connectors
C = 0.5 meter shielded cables with (Euro) IP65 connectors (AKM1, 2)
C = Motor-mounted rotatable (Euro) IP65 connectors (AKM3, 4, 5)
B = Dual Motor-mounted rotatable (Euro) IP65 connectors (AKM 2 only)
M = 0.5 meter shielded cables with IP20 molex connectors
(AKM1, 2, 3, 4 models less than 6.0 amps rms)

Brake
2 = 24 Vdc brake (AKM2, 3, 4, 5 models)
N = No brake

Feedback Device
2 - = 2048 PPR digital encoder w/ commutation
R - = Resolver
C - = S200 SFD Smart Feedback
DA = Single-turn Absolute Sine Encoder
DB = Multi-turn Absolute Sine Encoder

Customization / Seal
00 = Standard motor w/o shaft seal
01 = Standard motor w/ shaft seal

Dimensional Data - AKM1x Frame



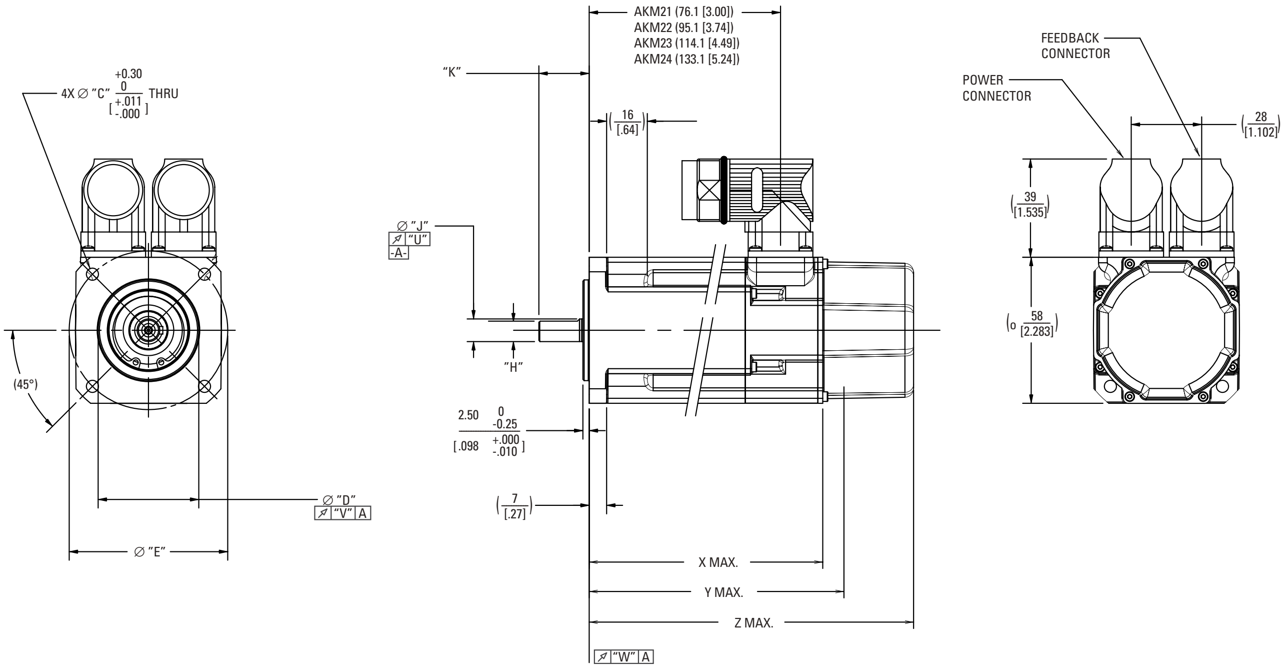
AKM1x Frame Dimensions

Mounting Code	"C"	"D"	"E"	"F"	"H"	"J"	"K"	"L"	"M"	"N"
AN	4.30 [.169]	30 $^{0}_{-0.021}$ [1.811 $^{+.0000}_{-.0008}$]	46.0 [1.811]	–	–	8.0 $^{0}_{-0.015}$ [.3150 $^{+.0000}_{-.0006}$]	25.0 [.984]	–	–	–

(X)	Y MAX	Z MAX (W/ BRAKE)	MODEL
56.1 [2.21]	69.6 [2.74]	79.0 [3.11]	AKM11
94.1 [3.70]	107.6 [4.24]	117.0 [4.61]	AKM13

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

Dimensional Data - AKM2x Frame



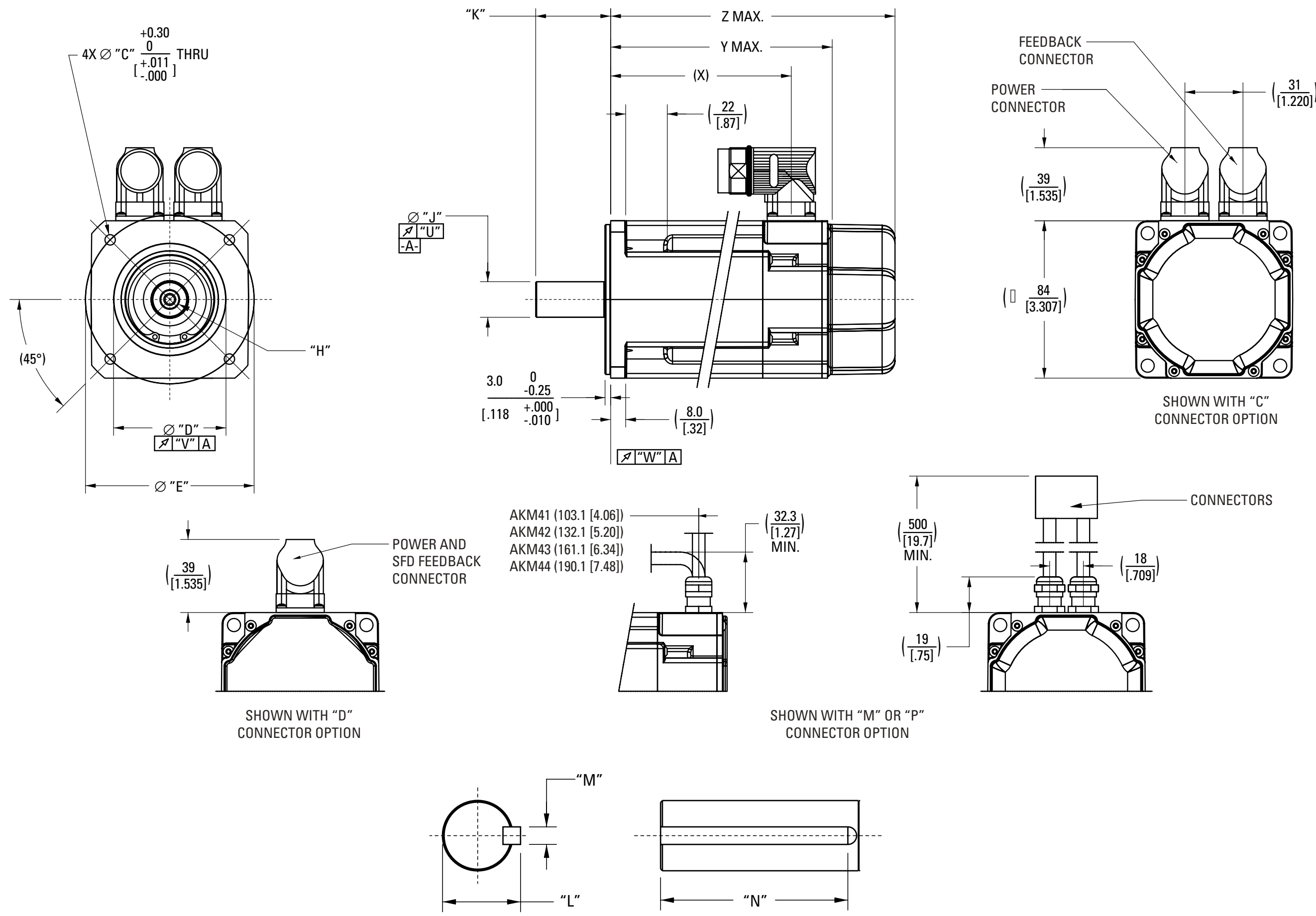
AKM2x Frame Dimensions

Mounting Code	"C"	"D"	"E"	"H"	"J"	"K"	"U"	"V"	"W"
EF	5.10 [.201]	38.10 $^{0}_{-0.05}$ [1.500 $^{+.000}_{-.002}$]	66.68 [2.625]	8.64 [.340]	9.525 $^{+0}_{-0.013}$ [.3750 $^{+.0000}_{-.0005}$]	20.57 ± 0.25 [0.810 ± 0.010]	0.051 [.0020]	0.10 [.004]	0.10 [.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].
Product designed in metric.
English conversions provided for reference only.

Dimensional Data - AKM4x Frame



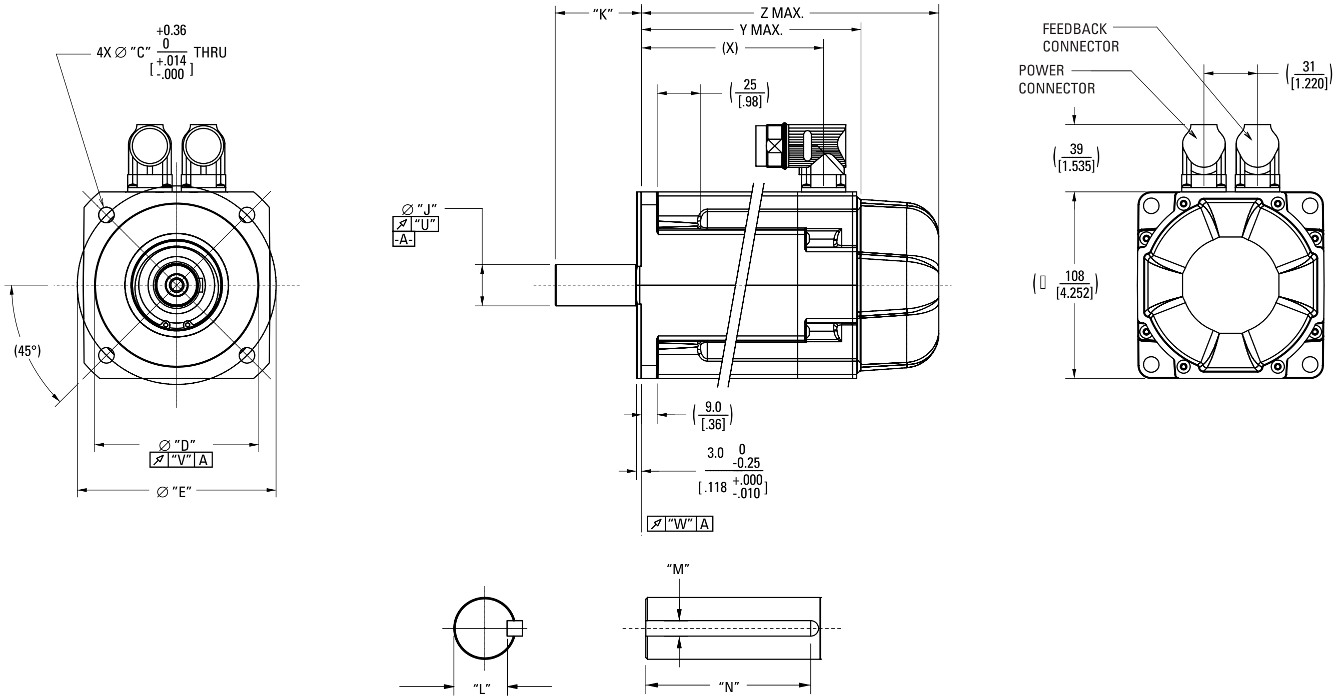
AKM4x Frame Dimensions

Mounting Code	"C"	"D"	"E"	"H"	"J"	"K"	"L"	"M"	"N"	"U"	"V"	"W"
EK	5.54 [.218]	73.025 $^{0}_{-0.051}$ [2.8750 $^{+.0000}_{-.0020}$]	98.43 [3.875]	–	12.700 $^{0}_{-0.013}$ [.5000 $^{+.0000}_{-.0005}$]	31.75 ± 0.25 [1.250 ± .010]	14.09 $^{0}_{-0.43}$ [.555 $^{+.000}_{-.017}$]	3.175 $^{0}_{-0.050}$ [.1250 $^{+.0000}_{-.0020}$]	19.05 ± 0.25 [.750 ± .010]	0.051 [.0020	0.10 [.004]	0.10 [.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.

Dimensional Data - AKM5x Frame



AKM5x Frame Dimensions

Mounting Code	"C"	"D"	"E"	"J"	"K"	"L"	"M"	"N"	"U"	"V"	"W"
EK	8.33 [.328]	55.563 +0 -0.051 [2.1874 +.0000 -.0020]	125.73 [4.950]	15.875 +.0000 -0.013 [.625 +.0000 -.0005]	44.45 [1.75]	13.16 +0.00 -0.10 [.518 +.000 -.004]	4.737 +0.051 -0.000 [.1865 +.0020 -.0000]	34.9 +0.25 -0.25 [1.375 +.0100 -.0100]	0.051 [.0020]	0.10 [.004]	0.10 [.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.

NOTES:

Global Service & Support

Americas

50+ Direct Sales & Application Engineers
1,800 Distribution Branches

Europe

40 Direct Sales & Application Engineers
300+ Distribution Branches

Asia

36 Direct Sales & Application Engineers
45 Distribution Branches

Application Centers

Global Design & Manufacturing

Global Manufacturing

Removing the Barriers of Design, Sourcing andTime

At Kollmorgen we know that OEM engineers can achieve a lot more when obstacles aren't in the way. So, we knock them down in three important ways:

Integrating Standard and Custom Products

The optimal solution is often not clear-cut. Our application expertise allows us to modify standard products or develop totally custom solutions across our whole product portfolio so that designs can take flight.

Providing Solutions, Not Just Components

As companies reduce their supplier base and have less engineering manpower, they need single-source vendors with a wide range of integrated solutions. Kollmorgen is in full response mode with complete solutions that combine programming software, engineering services and best-in-class motion components.

Global Footprint

With direct sales, engineering support, manufacturing facilities and distributors across the U.S., Europe, Middle East and Asia, we're close to OEMs worldwide. Our proximity helps speed delivery and lend support where and when they're needed.

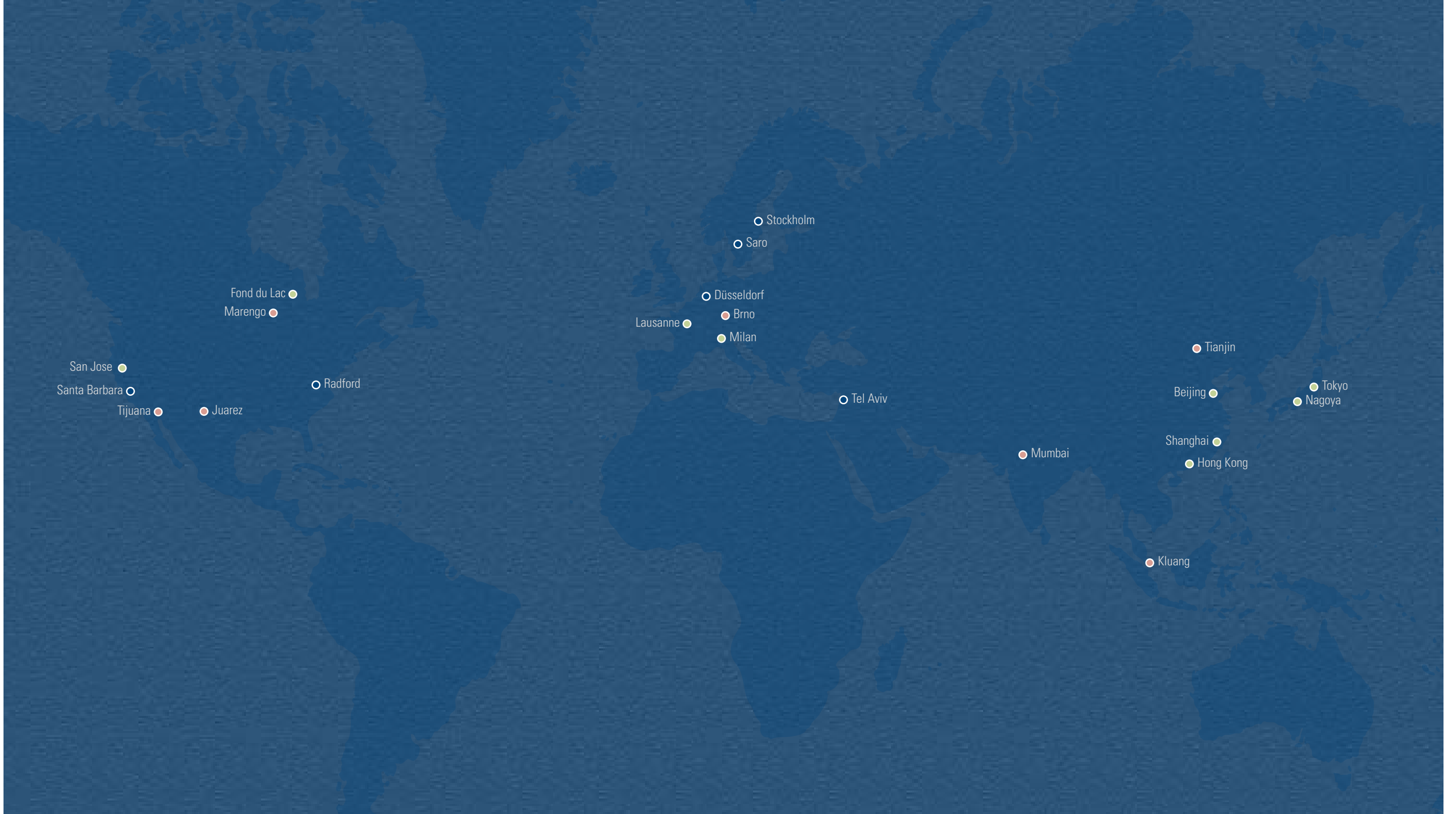
Financial and Operational Stability

Kollmorgen is part of Danaher Motion, a $1B+ global platform of Danaher Corporation, its $13B parent company. A key driver in the growth of all Danaher divisions is the Danaher Business System, which relies on the principle of kaizen—or continuous improvement. Using world-class tools, cross-disciplinary teams of exceptional people evaluate process and develop plans that result in superior performance.

About Kollmorgen

Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

For assistance with your application needs, contact us at: 540-633-3545, contactus@kollmorgen.com or visit www.kollmorgen.com



KOLLMORGEN®

Because Motion Matters™

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