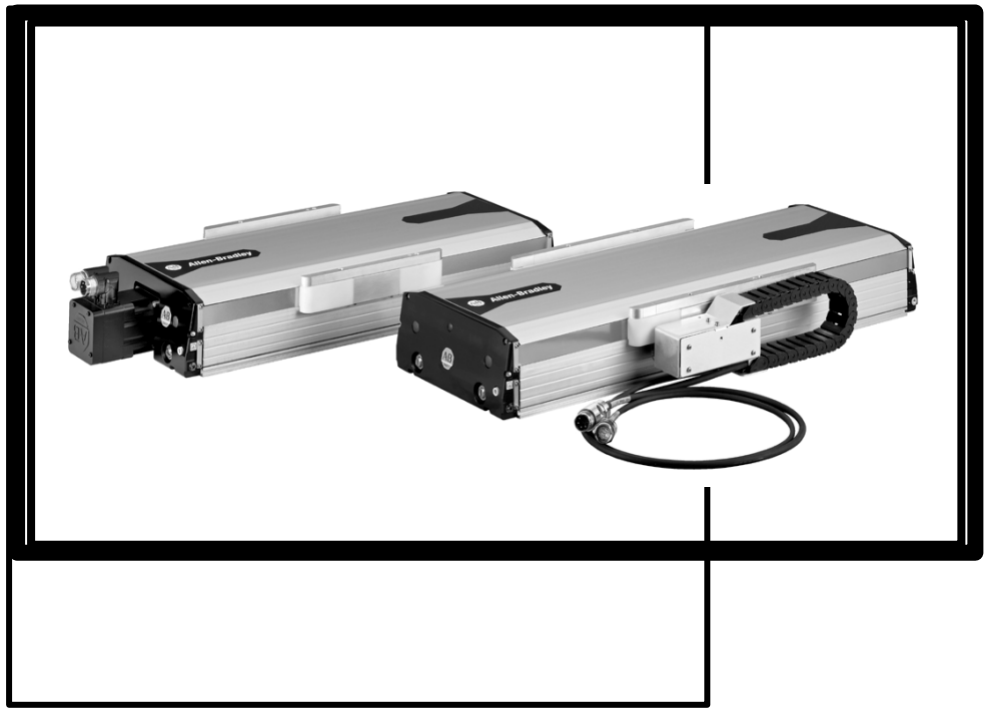


MP-Series Integrated Linear Stages Technical Information

Andy Kettle
Motion Solution Provider
SCS Automation and Control Ltd

ALLEN-BRADLEY • ROCKWELL SOFTWARE
Rockwell Automation

Topics

1. Product Line Overview

2. Application

3. Maintenance

Topics

1. Product Line Overview

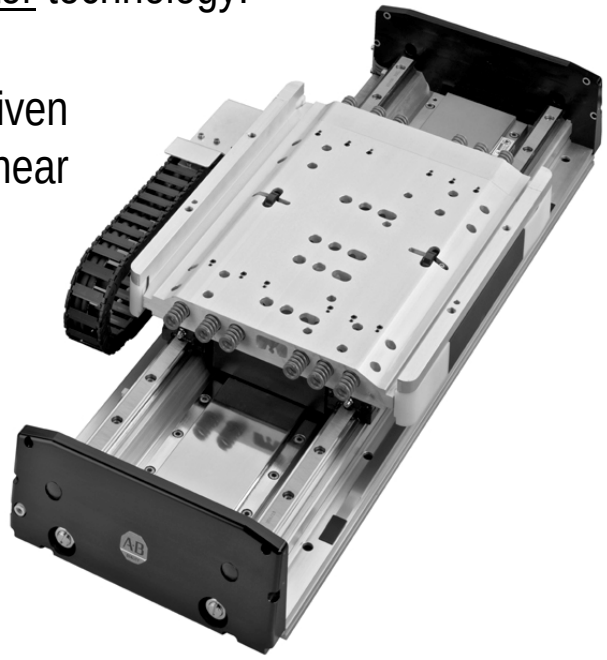
2. Application

3. Maintenance

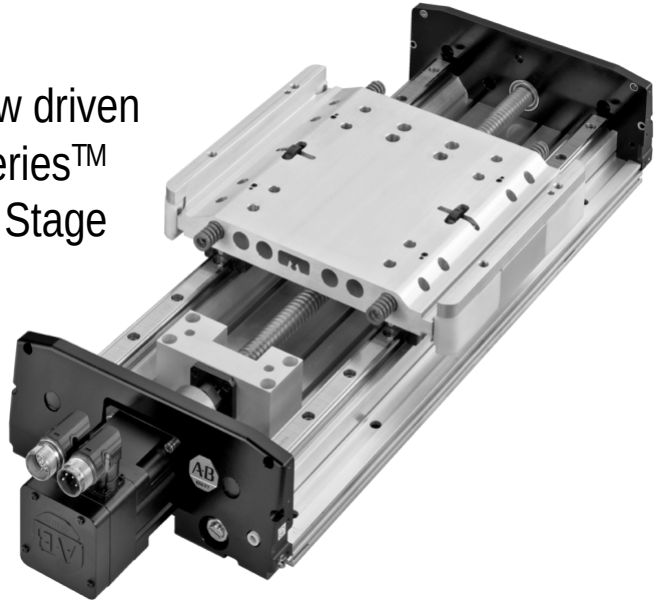
Product Line Overview

- Linear stages can be driven by ballscrews, synchronous timing belts, or linear motors.
- Synchronous timing belts and linear motors are typically used when applications require high speeds and relatively low force.
- Timing belt systems can achieve speeds up to 3 meters/sec. Linear motor system can achieve speeds up to 5 meters/sec.
- Because the cost of linear motor components continues to drop and they can achieve higher speeds than timing belts, MP-Series™ Integrated Linear Stages are designed with ballscrew and linear motor technology.

Linear motor driven MP-Series™ Linear Stage



Ballscrew driven MP-Series™ Linear Stage

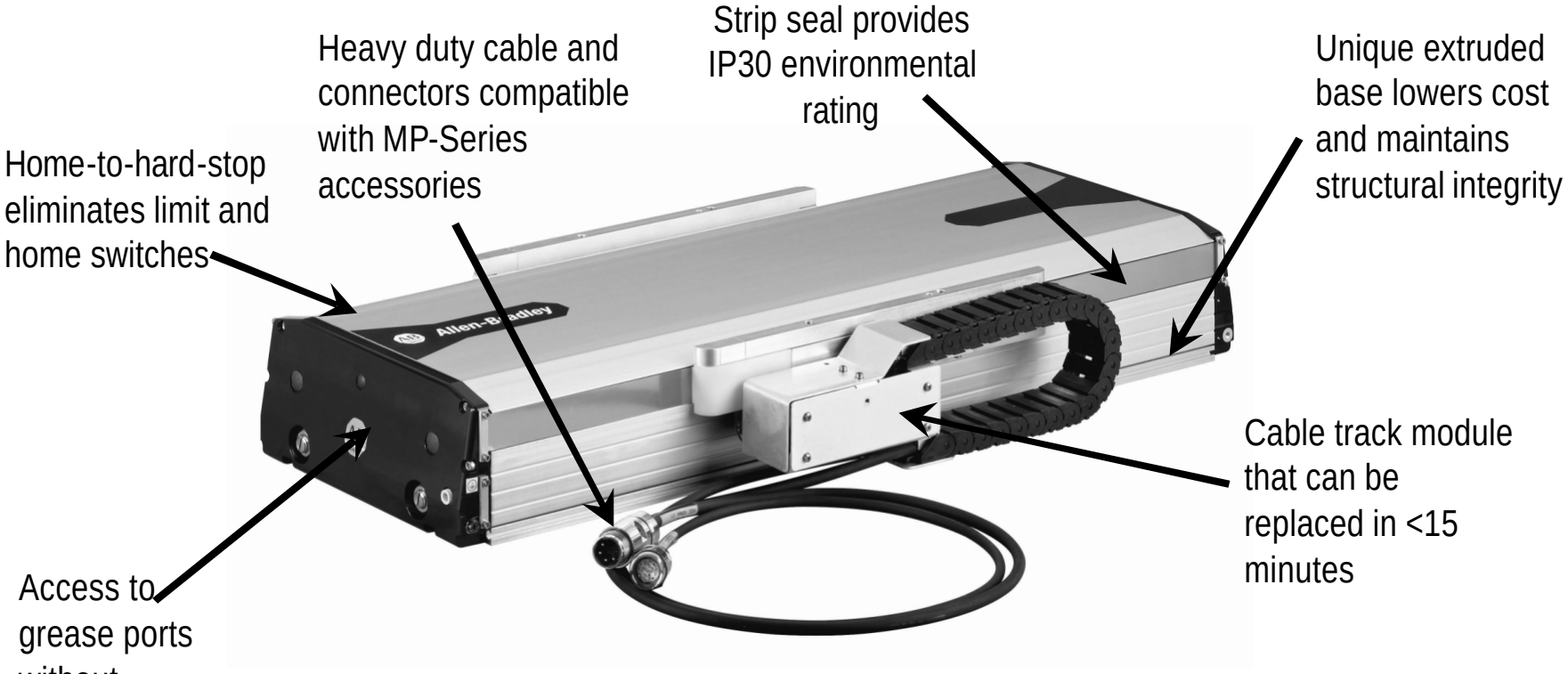


Product Line Overview

- Frequently, machine designers do not know if they need a linear motor or ballscrew driven linear stage; they only know the application requirements.
- MP-Series™ Integrated Linear Stages allow the designer to select a linear actuator based on the desired performance and not worry about the internal drive mechanism.

Product Line Overview

- Even though they can carry very heavy loads, most linear stages are designed for high precision applications in clean environments.
- MP-Series™ Integrated Linear Stages are design for industrial environments and industrial applications



MP-Series Direct Drive (linear motor driven) Linear Stage

Product Line Overview

- MP-Series™ Integrated Linear Stages are designed for easy integration
- Mounting can be accomplish using “toe-clips”, T-nuts, and thru-holes in the base of the stage.
- XY configurations can be created using existing mounting holes and adapter plates will be available in the future for additional configurations.

XY “Stacked” System using existing mounting holes in carriage and base of stages

Adapter plates (future) will allow “cantilever” configurations

Product Line Overview

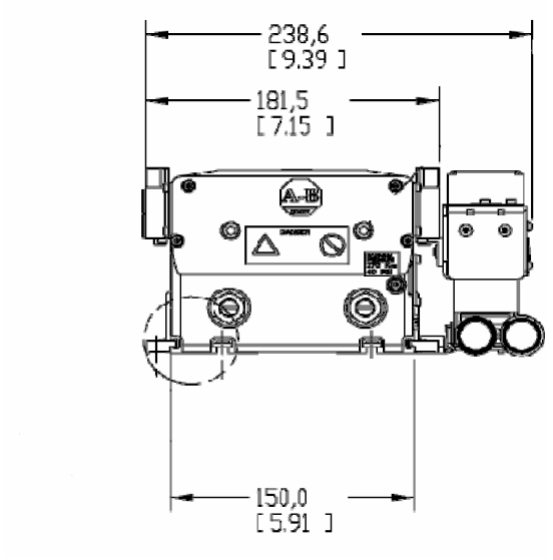
MP-Series Integrated Linear Stages simplify...

- **Design Phase Cost Savings**
  - ✓ Eliminates mechanical design, selection, and integration of multiple components from different suppliers
  - ✓ Reliable, tested performance from single integrated actuator
  - ✓ Comprehensive support from Rockwell Automation's sizing and selection tools – Integrated Architecture Builder and Motion Analyzer
- **Assembly Phase Cost Savings**
  - ✓ Eliminate assembly of motor, coupler, adapter, and ballscrew
  - ✓ Eliminate installation, wiring, and alignment of home and over-travel sensors
- **Commissioning Phase Cost Savings**
  - ✓ Complete integration with RSLogix 5000 software
- **Support Phase Cost Savings**
  - ✓ Integrated device eliminates reliability problems that occur when products from separate manufacturers are bolted together.
  - ✓ Pre-calculation of lubrication intervals based on number of cycles, speed, and acceleration alerts user to periodic maintenance (future)

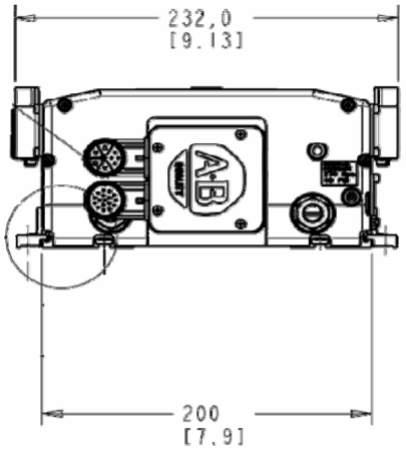
Product Line Overview

- MP-Series™ Integrated Linear Stages are available in 3 frame sizes (base widths): 150 mm, 200 mm, and 250 mm.
- Stroke lengths up to 2 meters are available

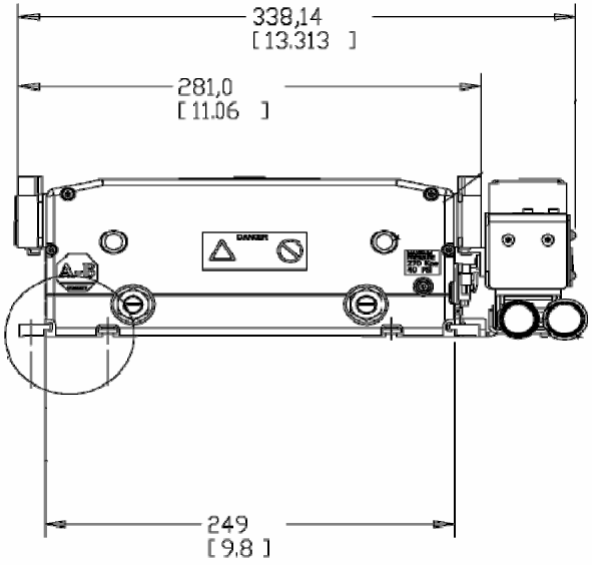
150 mm frame size
MPAS-x6xxxx



200 mm frame size
MPAS-x8xxxx



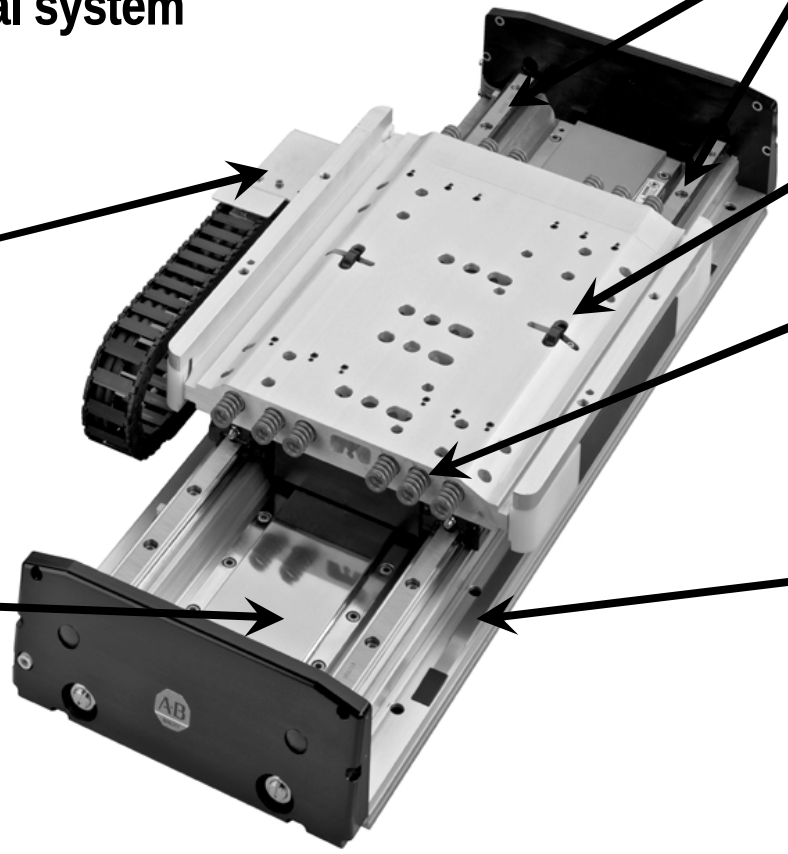
250 mm frame size
MPAS-x9xxxx



Technical – Internal Construction

Direct Drive Linear Stages

Only direct drive linear stages are available with and without cover/seal system



- Replaceable cable track module
- Includes cable leads with MPF/MPS style connectors

Linear motor magnet track (not considered field replaceable)

Precision linear guide bearings (not field replaceable)

Rollers in carriage support top cover

Heavy duty bumper springs (see manual for energy absorption rating)

- 5 micron resolution magnetic linear encoder (not considered field replaceable)
- Allows speeds up to 5 meters/sec with Kinetix 2000, Kinetix 6000, and Ultra 3000

Technical – Internal Construction

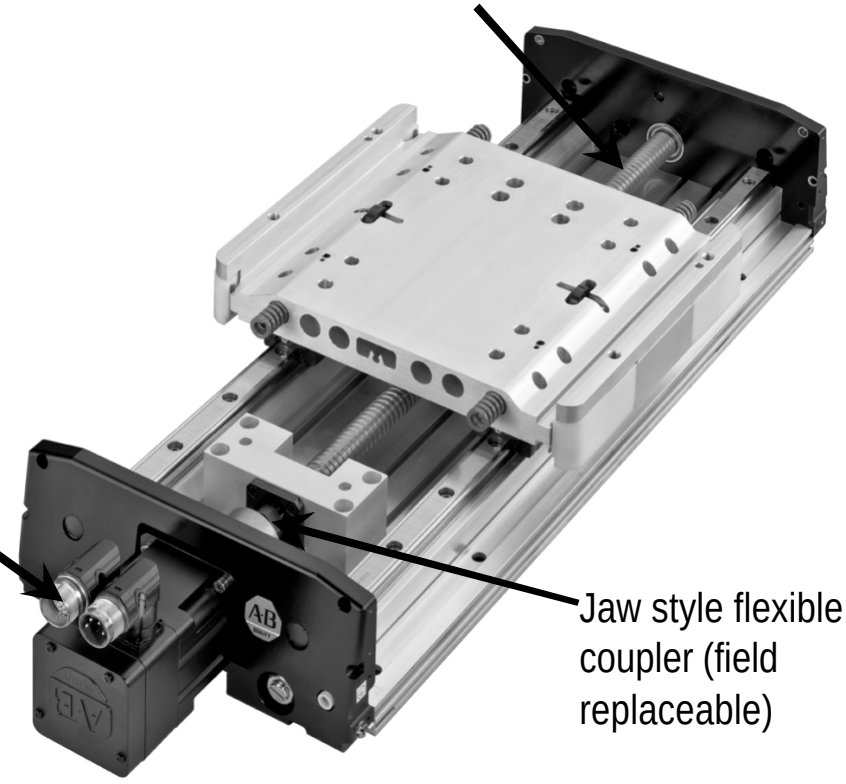
Ballscrew Linear Stages

Not available uncovered due to potential for grease to be thrown from ballscrew

Motor Catalog Number	Screw Lead	MPAS Ballscrew Linear Stage
MPLS-A220H-VJ42AA	20 mm	230V w/o brake
MPLS-A220H-VJ44AA	20 mm	230V w/brake
MPLS-B220H-VJ42AA	20 mm	460V w/o brake
MPLS-B220H-VJ44AA	20 mm	460V w/brake
MPLS-A210E-VJ42AA	5 mm	230V w/o brake
MPLS-A210E-VJ44AA	5 mm	230V w/brake
MPLS-B210E-VJ42AA	5 mm	460V w/o brake
MPLS-B210E-VJ44AA	5 mm	460V w/brake

Ballscrew in 5 mm/rev and 20 mm/rev lead

MP-Series servo motor with **absolute multi-turn encoder** programmed to limit speed and torque to prevent ballscrew damage (field replaceable)



Jaw style flexible coupler (field replaceable)

150mm Frame Size Performance

Catalog Number MPAS-	**Screw Lead** mm	**Max. Velocity**[2] mm/sec (in./s)	**Cont. Stall Force** N (lbs)	**Peak Stall Force** N (lbs)	**Drive Mechanism and Feedback Type**	**Stroke Length**[1] mm	**Bi-directional Repeatability**	**Accuracy**
A6xxx1-V05SxA	5	200 (7.9)	521 (117)	1212 (272)	Ballscrew with absolute multi-turn rotary encoder	120-660	± 60µm	50um + 50um/300mm
A6xxx2-V20SxA	20	1124 (44.3)	462 (104)	968 (218)				
B6xxx1-V05SxA	5	200 (7.9)	521 (117)	1212 (273)				
B6xxx2-V20SxA	20	1124 (44.3)	462 (104)	968 (218)				
A6xxxB-ALMO2C (No Cover)	N/A	5000 (196.9)	105 (24)	359 (81)	Linear Motor with incremental linear encoder	120-1140	±15µm	100µm + 20µm/m
A6xxxB-ALMS2C (Covered)			83 (19)	312 (70)				

200mm Frame Size Performance

Catalog Number MPAS-	**Screw Lead** mm	**Max. Velocity**[2] mm/sec (in./s)	**Cont. Stall Force** N (lbs)	**Peak Stall Force** N (lbs)	**Drive Mechanism and Feedback Type**	**Stroke Length**[1] mm	**Bi-directional Repeatability**	**Accuracy**
A8xxx1-V05SxA	5	200 (7.9)	521 (117)	1212 (273)	Ballscrew with absolute multi-turn rotary encoder	120-1020	± 60µm	50um + 50um/300mm
A8xxx2-V20SxA	20	1124 (44.3)	462 (104)	968 (218)				
B8xxx1-V05SxA	5	200 (7.9)	521 (117)	1212 (273)				
B8xxx2-V20SxA	20	1124 (44.3)	462 (104)	968 (218)				
A8xxxE-ALMO2C (No Cover)	N/A	5000 (196.9)	189 (43)	456 (103)	Linear Motor with incremental linear encoder	140-1940	±15µm	100µm + 20µm/m
A8xxxE-ALMS2C (Covered)			159 (36)	399 (90)				
B8xxxF-ALMO2C (No Cover)			189 (43)	456 (103)				
B8xxxF-ALMS2C (Covered)			159 (36)	399 (90)				

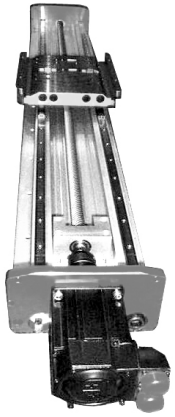
250mm Frame Size Performance

Catalog Number MPAS-	**Screw Lead** mm	**Max. Velocity**[2] mm/sec (in./s)	**Cont. Stall Force** N (lbs)	**Peak Stall Force** N (lbs)	**Drive Mechanism and Feedback Type**	**Stroke Length**[1] mm	**Bi-directional Repeatability**	**Accuracy**
A9xxx1-V05SxA	5	200 (7.9)	521 (117)	1212 (273)	Ballscrew with absolute multi-turn rotary encoder	120-1020	± 60µm	50um + 50um/300mm
A9xxx2-V20SxA	20	1124 (44.3)	462 (104)	968 (218)				
B9xxx1-V05SxA	5	200 (7.9)	521 (117)	1212 (273)				
B9xxx2-V20SxA	20	1124 (44.3)	462 (104)	968 (218)				
A9xxxK-ALMO2C (No Cover)	N/A	5000 (196.9)	285 (64)	680 (153)	Linear Motor with incremental linear encoder	140-1940	±15µm	100µm + 20µm/m
A9xxxK-ALMS2C (Covered)			245 (55)	601 (135)				
B9xxxL-ALMO2C (No Cover)			285 (64)	680 (153)				
B9xxxL-ALMS2C (Covered)			245 (55)	601 (135)				

Product Line Overview

Force and speed available from Allen-Bradley linear actuators

MPAI Screw



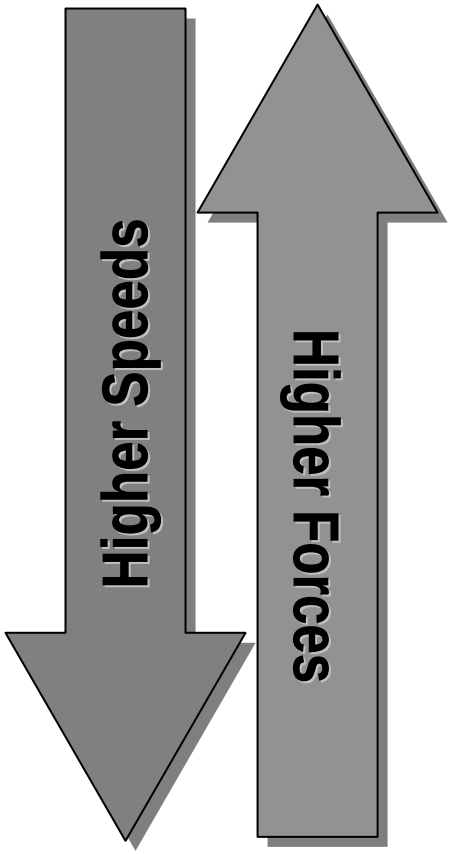
MPAS Screw Driven

MPAS Direct Drive

MPAI	Max. Speed	Max. Cont. Force
	23 in/sec (580 mm/sec)	2000 lbs-force (8900 N)

MPAS Ball-screw	Max. Speed	Max. Cont. Force
	44 in/sec (1124 mm/sec)	117 lbs-force (521 N)

MPAS Direct Drive	Max. Speed	Max. Cont. Force
	197 in/sec (5000 mm/sec)	65 lbs-force (285 N)



MP-Series™ Integrated Linear Stages Summary

- **Wide range of features**
  - 230V and 460V versions
  - Direct drive (linear motor) and ballscrew versions
  - Brake motors available on ballscrew versions
  - Stroke lengths up to 2 meters
  - IP30 Environmental rating
  - High resolution multi-turn absolute encoders on ballscrew versions
  - Incremental linear encoders on direct drive linear stages
  - Field replaceable cable track system on direct drive linear stages
- **Approvals**
  - UL and CSA listed
  - CE marked for applicable directives
  - Complies with European RoHS (Restriction of Hazardous Substances) requirements
- **Allen-Bradley quality and support**
  - Globally supported and built to order in USA (no more than 15 business day lead-time)
  - Fully supported by Rockwell Automation Logix controllers and Kinetix servo systems
  - Uses standard Allen-Bradley bulletin 2090 motor power and feedback cables

Topics

1. Product Line Overview

2. Application

3. Maintenance

Application – Selection and Sizing

- From a sizing perspective, MP-Series™ Integrated Linear Stages are virtually identical to MP-Series™ rotary servo motors except the performance parameters are expressed in linear units:
  - Peak Force
  - Continuous Force
  - Linear Speed

Application – Selection and Sizing

- The steps in applying MP-Series™ Integrated Linear Stages include:
  - Using Motion Analyzer to size the linear stage based on load and motion requirements
  - Configuring the MPAS/Kinetix/Logix system with the correct accessories
  - Mechanical integration with the machine system
  - Software setup (configuration, tuning, and programming)

Application – Selection and Sizing

How do you know if the application requires a linear motor or ballscrew driven linear stage?

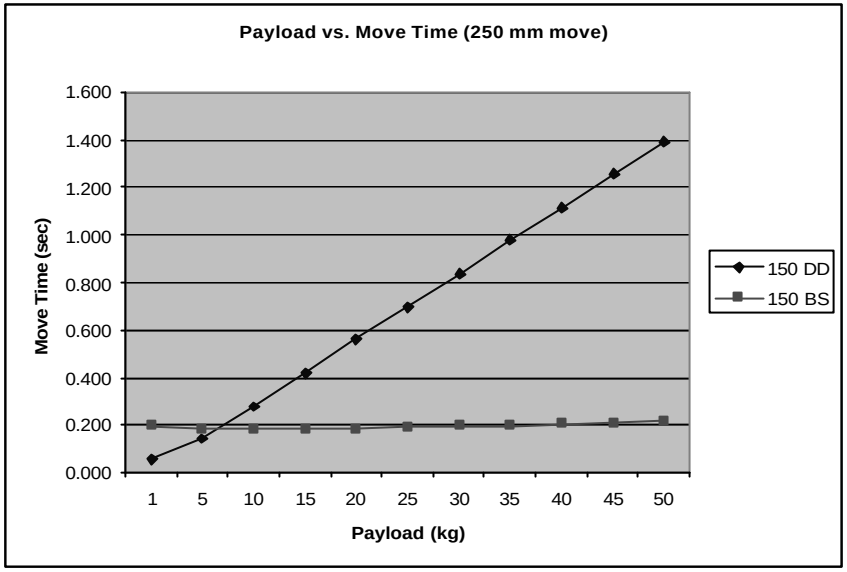
The choice is primarily determined by load mass, move distance, move time, and desired life of the linear stage.

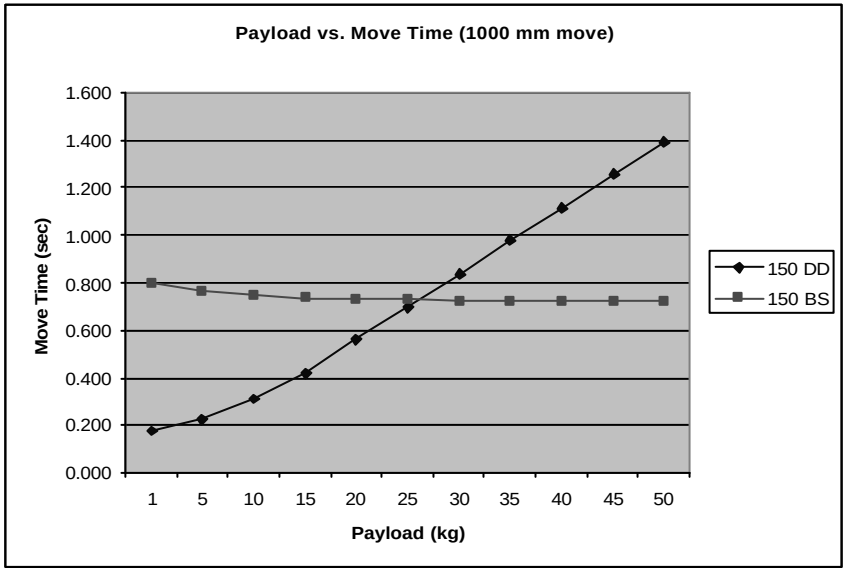
Note how the move time changes based on payload and total move distance.

Even though linear motors do not produce as much force as a ballscrew, they may outperform ballscrews when longer stroke lengths and lighter loads are required.

DD = Direct Drive

BS = Ball Screw





Application – Selection and Sizing

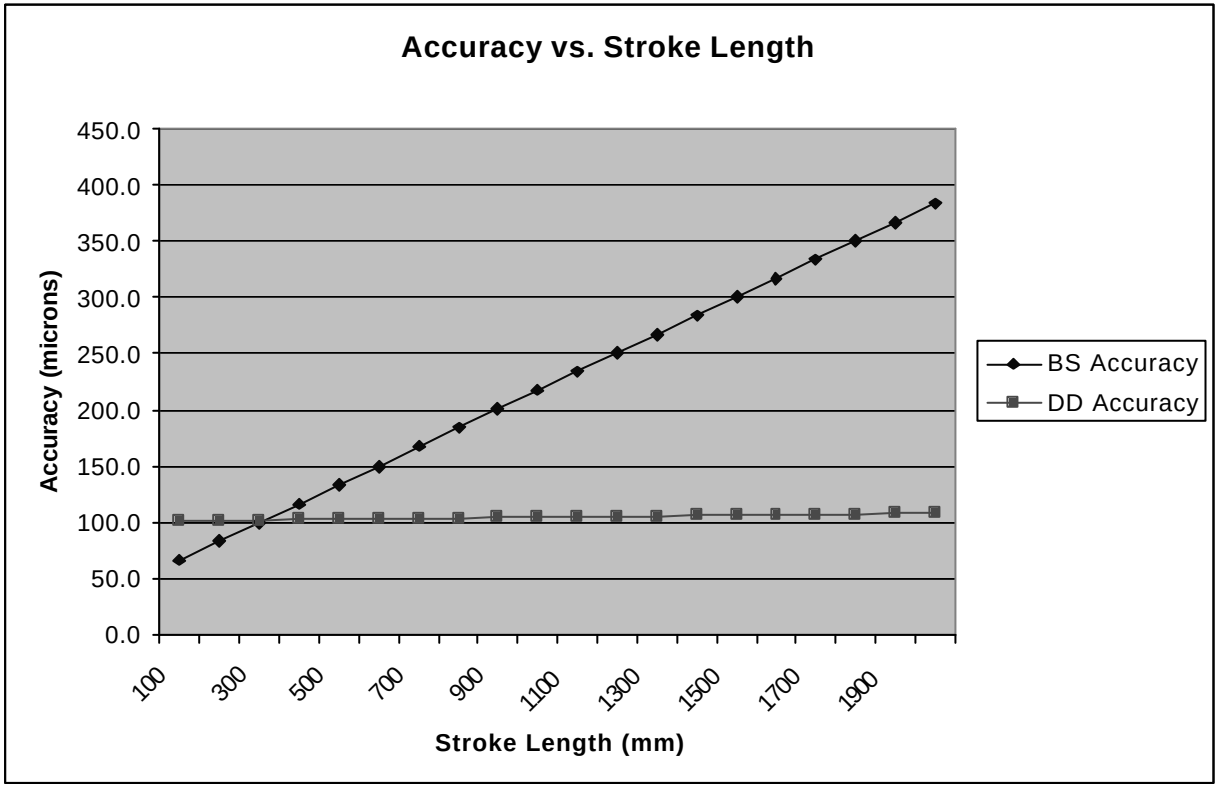
Positioning accuracy can be another criteria for the selection of a ballscrew or direct drive linear stage

Bi-directional repeatability of linear motor driven stages is better than ballscrew stages:

- Ballscrew = +/- 60 micron

- Direct Drive = +/- 15 micron

Accuracy of the stage is dependant on stroke length as shown below



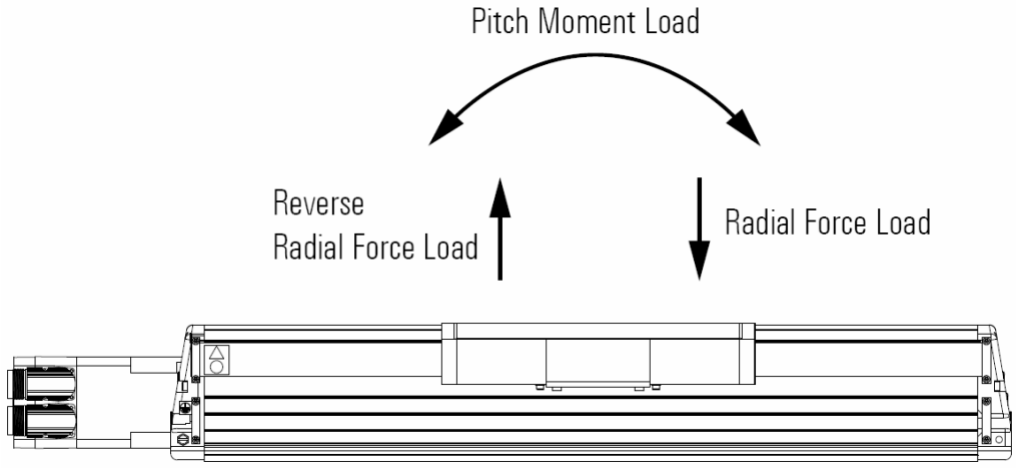
Application – Selection and Sizing

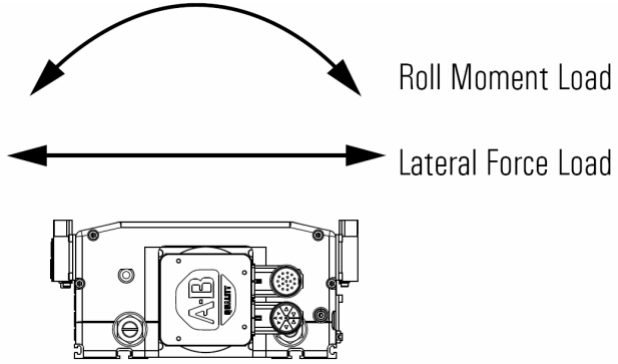
Load orientation can influence the choice between ballscrew and direct drive linear stages

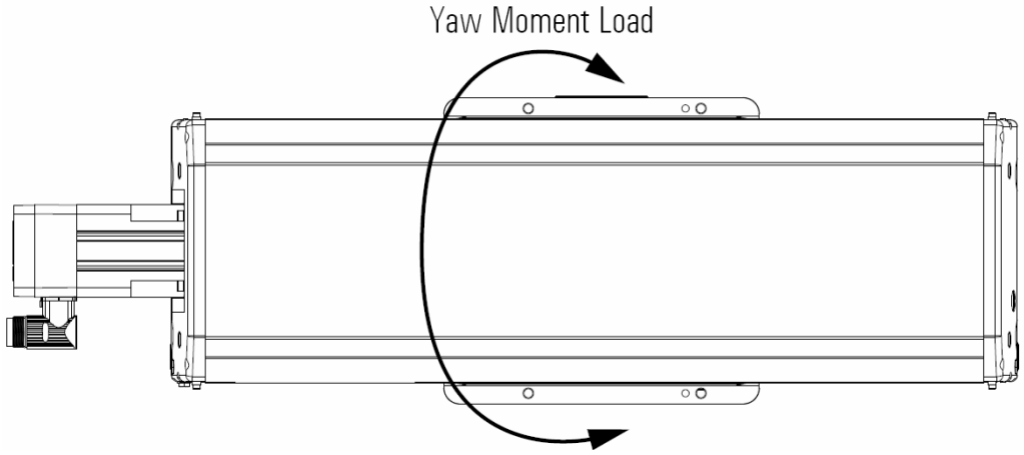
Orientation	Direct Drive	Ballscrew
Horizontal Table Mount	No limitations	No limitiations if within available stroke lengths
Horizontal Wall Mount	< 1 meter stroke due to cable track support	No limitiations if within available stroke lengths
Horizontal Ceiling Mount	Not possible due to cable track support	No limitiations if within available stroke lengths
Vertical Wall Mount	Must consider carriage motion due to gravity if power is removed. RBM (resistive brake module), counter balance, or external holding brake should be considered	Use brake motor option. No limitiations if within available stroke lengths

Application – Selection and Sizing

Force and Moment Load Definitions







- Maximum force and moment loads are shown in user manual and selection guide
- Force and moment loads are calculated and checked by Motion Analyzer
- Resulting bearing life is calculated by Motion Analyzer

Application – Comparison

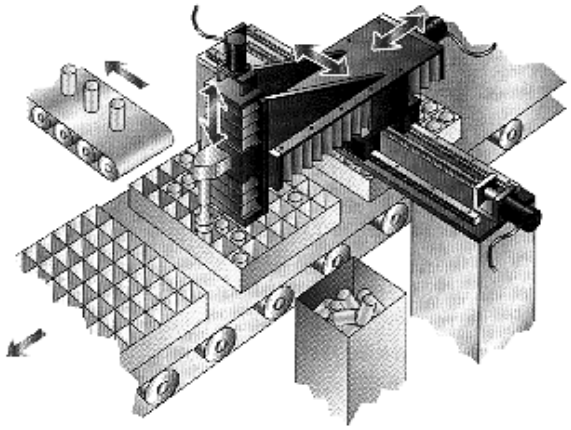
Direct Drive MP-Series Linear Stage

- High speeds
- Moderate force
- Long stroke lengths
- Some restrictions to mounting orientation
- Fast settling time
- Large changes in payload may present tuning challenges
- Less audible noise
- Incremental magnetic linear encoder
- Suited for some vertical applications
- Higher initial cost
- Higher accuracy that ballscrew for long stroke lengths

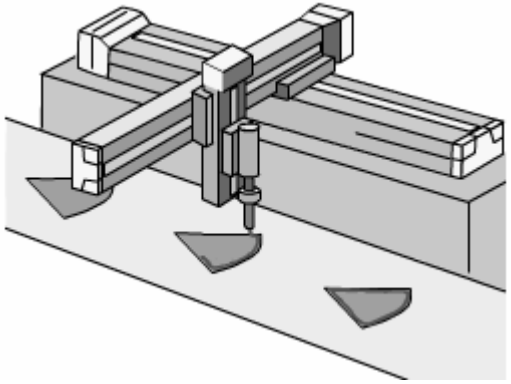
Ballscrew Drive MP-Series Linear Stage

- Moderate speed
- High force
- Limited stroke lengths
- No restrictions to mounting orientation
- Less affected by large changes to payload
- Ballscrew life may be a factor
- High resolution absolute multi-turn encoder
- May be used in vertical applications when brake is used
- Lower initial cost

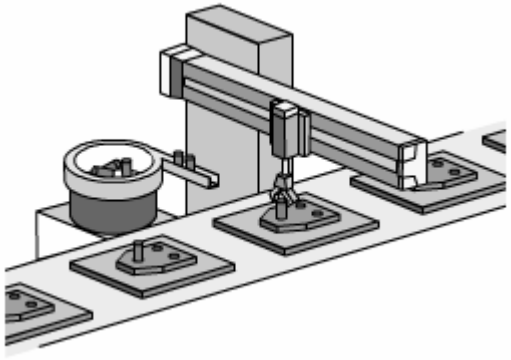
Potential Applications



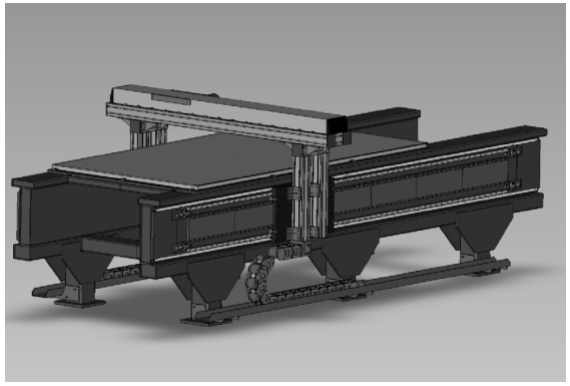
Cartoning



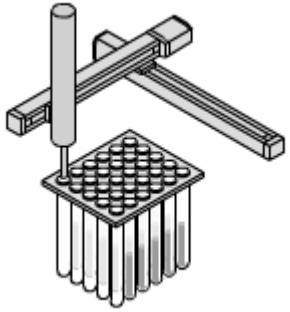
Dispensing



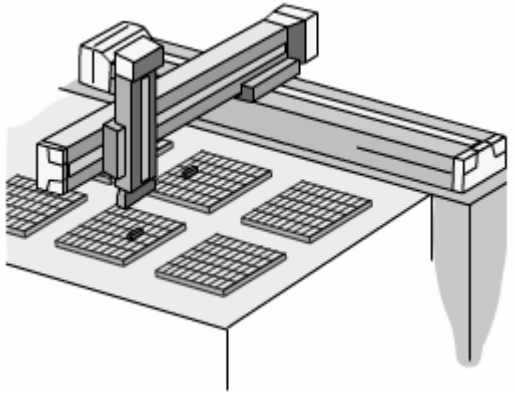
Small Assembly



Large Assembly



Life Science

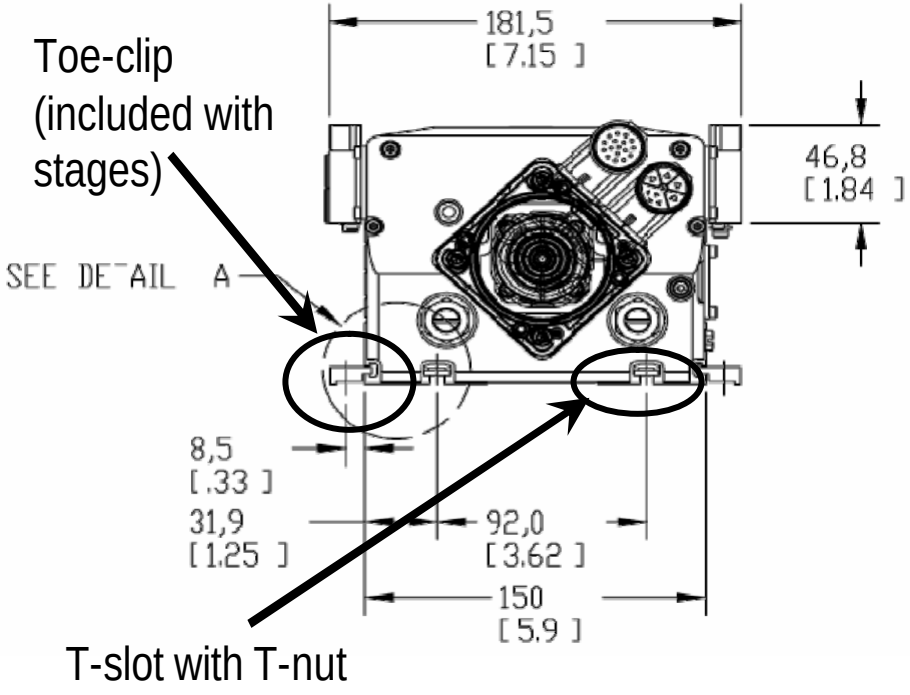


Electronic Inspection & Assembly

Application – Mechanical Integration

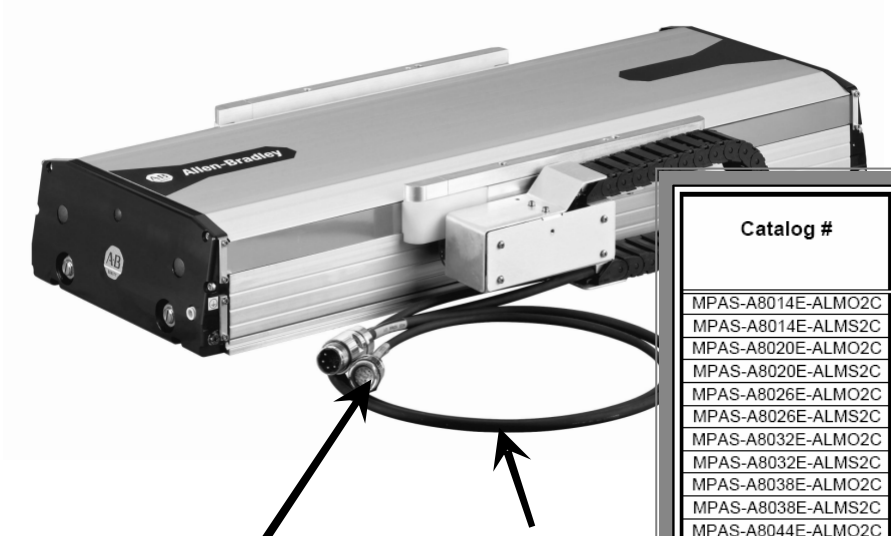
Mounting MP-Series Integrated Linear Stages to the Machine System

- Mounting surface requirements
  - Flatness of 0.025 mm / 300 x 300 mm
  - Must be supported under full length of linear stage
  - Lack of sufficient support can cause deflection in linear stage and reduce life
- Mounting methods
  - Toe-clips (included with stage)
  - T-slots (using T-nuts)
  - Through holes in base (easiest with uncovered direct drive stages)



Application – Mechanical Integration

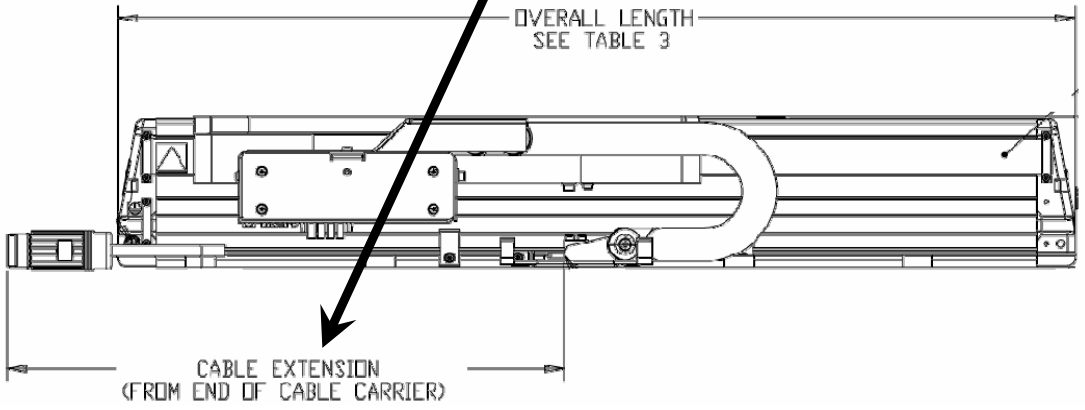
Cables on Direct Drive MP-Series Integrated Linear Stages



Catalog #	Material Master #	Overall Length		Cable Extensions		No. of Mounting Locations	Stage Weight		Shipping Weight	
		(Meters)	(Inches)	(Meters)	(Inches)		(kgs)	(lbs.)	(kgs)	(lbs.)
MPAS-A8014E-ALMO2C	PN-12791	0.581	22.87	1.2	49	10	20.96	46.11	26.30	57.86
MPAS-A8014E-ALMS2C	PN-12759	0.581	22.87	1.2	49	10	22.63	49.79	27.98	61.56
MPAS-A8020E-ALMO2C	PN-12792	0.641	25.24	1.2	48	10	21.89	48.16	27.23	59.91
MPAS-A8020E-ALMS2C	PN-12760	0.641	25.24	1.2	48	10	23.73	52.21	29.08	63.98
MPAS-A8026E-ALMO2C	PN-12793	0.701	27.60	1.2	46	12	22.83	50.23	28.17	61.97
MPAS-A8026E-ALMS2C	PN-12761	0.701	27.60	1.2	46	12	24.85	54.67	30.20	66.44
MPAS-A8032E-ALMO2C	PN-12794	0.761	29.96	1.1	45	12	24.09	53.00	29.50	64.90
MPAS-A8032E-ALMS2C	PN-12762	0.761	29.96	1.1	45	12	26.28	57.82	31.70	69.74
MPAS-A8038E-ALMO2C	PN-12795	0.821	32.32	1.1	44	14	24.69	54.32	30.11	66.24
MPAS-A8038E-ALMS2C	PN-12763	0.821	32.32	1.1	44	14	27.06	59.53	32.48	71.46
MPAS-A8044E-ALMO2C	PN-12796	0.881	34.68	1.1	43	14	25.95	57.09	31.36	68.99
MPAS-A8044E-ALMS2C	PN-12764	0.881	34.68	1.1	43	14	28.49	62.68	33.91	74.60

MPF/MPS/Small
MPL Connectors
(Intercontec)

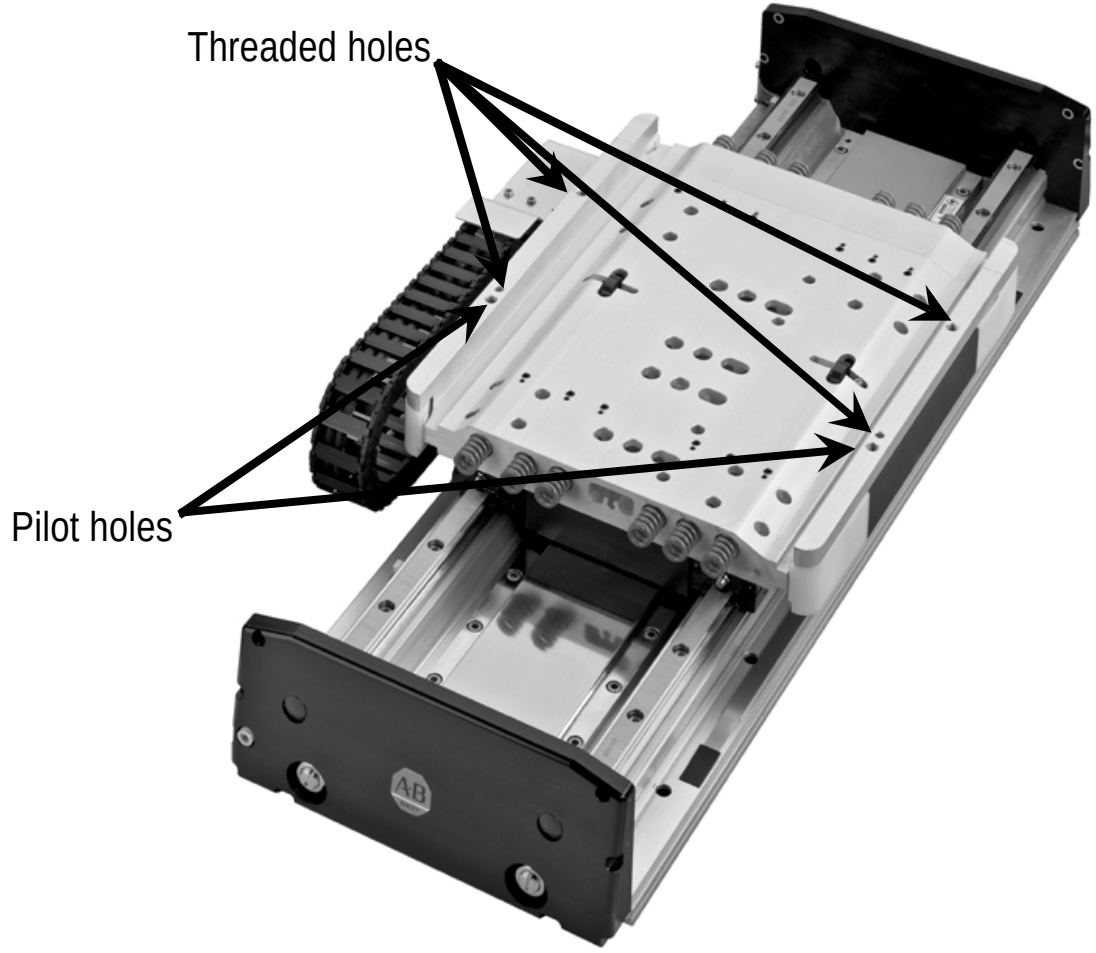
Cable extension
(flex rated)



Application – Mechanical Integration

Mounting the payload to MP-Series Integrated Linear Stages

- Threaded holes provided in carriage
- Pilot holes to aid in locating
- Be sure to consider potential for payload to shear fasteners in a runaway condition
- Be sure that payload does not interfere with cover



Topics

1. Product Line Overview

2. Application

3. Maintenance

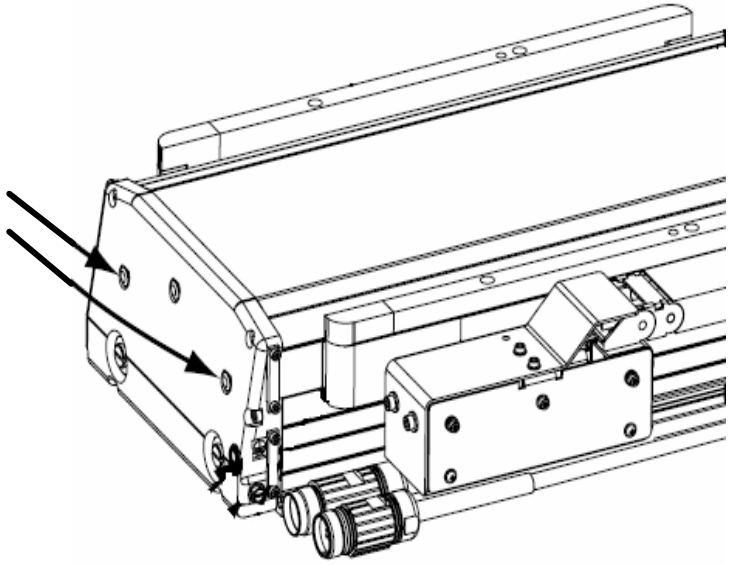
Maintenance

- Replaceable components include
  - Strip seals
  - Cable track module
  - Top and side covers
  - Rotary motors

Maintenance

- Lubrication must be performed on linear bearings
  - Additional lubrication required on ballscrew style MP-Series Linear Actuators
  - Requires grease gun kit
  - Greasing intervals and quantity of grease are specified in users manual

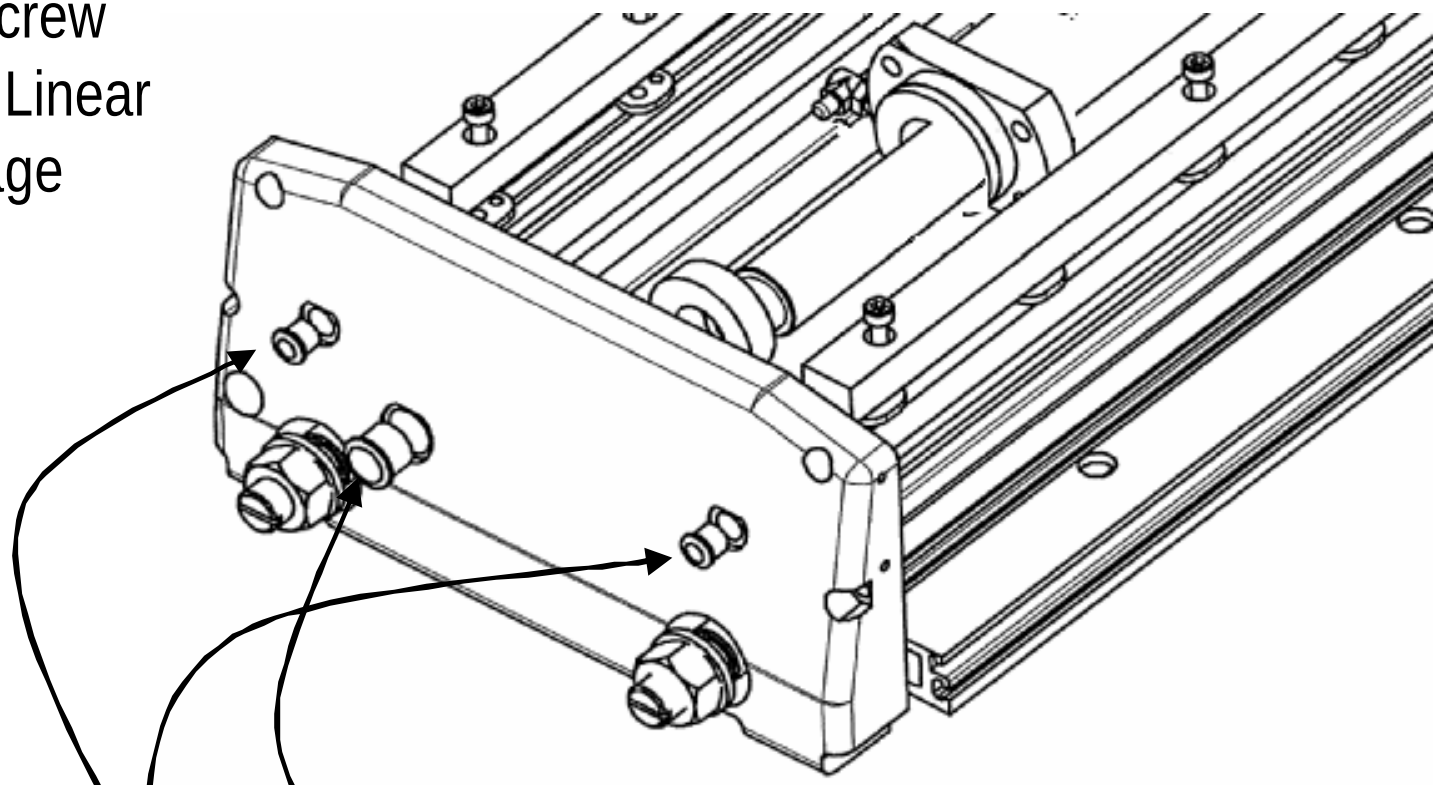
Bearing lubrication ports (x4)



Direct Drive
Linear Stage

Maintenance

Ballscrew Driven Linear Stage



Linear Bearing Lubrication Ports (x4)

Ballscrew Nut Block Lubrication Port (x1)

MP-Series Integrated Linear Stages

Thank You!