



MPS50SL Hardware Manual

Revision: 1.01.00



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Safety Procedures and Warnings

Read this manual in its entirety before installing, operating, or servicing this product. If you do not understand the information contained herein, contact an Aerotech representative before proceeding. Strictly adhere to the statements given in this section and other handling, use, and operational information given throughout the manual to avoid injury to you and damage to the equipment.

This manual tells you how to carefully and correctly use and operate the MPS50SL. Read all parts of this manual before you install or operate the MPS50SL or before you do maintenance to your system. To prevent injury to you and damage to the equipment, obey the precautions in this manual. The precautions that follow apply when you see a Danger or Warning symbol in this manual. If you do not obey these precautions, injury to you or damage to the equipment can occur. If you do not understand the information in this manual, contact Aerotech Global Technical Support. This product has been designed for light industrial manufacturing or laboratory environments. The protection provided by the equipment could be impaired if the product is used in a manner not specified by the manufacturer.

WARNING: This product uses electrical supplies and signals. To minimize possible electrical damage to the stage or injury to the operator, obey the electrical precautions that follow.

1. Access to the MPS50SL and component parts must be restricted while connected to a power source.
2. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
3. Disconnect electrical power before servicing equipment.
4. All components must be properly grounded in accordance with local electrical safety requirements.
5. Operator safeguarding requirements must be addressed during final integration of the product.
6. Moving parts can cause crushing or shearing injuries. Access to all stage and motor parts must be restricted while connected to a power source.
7. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
8. Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
9. The MPS50SL stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.
10. Use care when moving the MPS50SL stage. Lifting or transporting the MPS50SL stage improperly can result in injury or damage to the MPS50SL.
11. This product is intended for light industrial manufacturing or laboratory use. Use of this product for unintended applications can result in injury and damage to the equipment.
12. If the product is used in a manner not specified by the manufacturer, the protection provided by the product can be impaired and result in damage, shock, injury, or death.
13. The motor case temperature may exceed 75°C.
14. Operators must be trained before operating this equipment.
15. All service and maintenance must be performed by qualified personnel.



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EU Declaration of Incorporation

Manufacturer: Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2811
USA

herewith declares that the product:

MPS50SL Stage

is intended to be incorporated into machinery to constitute machinery covered by the Directive 2006/42/EC as amended;

and that the following harmonized European standards have been applied:

EN ISO 12100:2010

Safety of machinery - Basic concepts, general principles for design

EN 60204-1:2010

Safety of machinery - Electrical equipment of machines - Part 1: General requirements

and further more declares that


it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, for example, as a whole, including the equipment referred to in this Declaration.

This is to certify that the aforementioned product is in accordance with the applicable requirements of the following Directive(s):

2011/65/EU

RoHS 2 Directive

Authorized Representative: Simon Smith, European Director
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Location Pittsburgh, PA
Date 1/14/2020



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Chapter 1: Overview

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to www.aerotech.com for the most up-to-date information.

Table 1-1: Model Numbers and Ordering Options

MPS50SL Miniature Mechanical-Bearing Screw-Driven Linear Stage	
Travel (Required)	
-025	25 mm travel
-050	50 mm travel
Drive Screw (Required)	
-BS	Precision-ground ball screw, 1 mm/rev
-LS	Precision-ground lead screw, 0.5 mm/rev
Vacuum Preparation (Optional)	
-HV	High-vacuum preparation to 10^{-6} torr
Motor (Required)	
-M1	DC servomotor
-M2	Stepper motor
Mounting Plate (Optional)	
-MP	Optical table mounting plate
Metrology (Required)	
-PL0	No metrology performance plots
-PL1	Metrology, Uncalibrated with performance plots
-PL2	Metrology, Calibrated (HALAR) with performance plots
Accessories (To be Ordered as a Separate Line Item)	
HDZ-MPS50SL	Right-angle bracket
HDZ-MPS50SL-HV	Right-angle bracket, high-vacuum preparation to 10^{-6} torr

1.1. Environmental Specifications



WARNING: Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.

Table 1-2: Environmental Specifications

Ambient Temperature	Operating: 10° to 35° C (50° to 95° F) The optimal operating temperature is 20° C ±2° C (68° F ±4° F). If at any time the operating temperature deviates from 20° C, degradation in performance could occur.
	Storage: 0° to 40° C (32° to 104° F) in original shipping packaging
Humidity	Operating: 20% to 60% RH
	Storage: 10% to 70% RH, non-condensing in original packaging. The stage should be packaged with desiccant if it is to be stored for an extended time.
Altitude	Operating: 0 m to 2,000 m (0 ft to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
Vibration	Use the system in a low vibration environment. Excessive floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application.
Protection Rating	The MPS50SL is not suited for dusty or wet environments. This equates to an ingress protection rating of IP00.
Use	Indoor use only

1.2. Accuracy and Temperature Effects

The accuracy specification of MPS50SL series stages is measured 25 mm above the table with the stage in an unloaded condition. The stage is assumed to be fully supported by a mounting surface meeting or exceeding the specification in [Section 2.3](#).

The accuracy of the screw is a key element in the overall positioning accuracy of the stage. A scale error can be expected if temperature of the screw differs from 20° C (68° F). The greater the temperature difference, the greater the error. The temperature of the screw depends on the speed and duty cycle of the stage. The faster the movement and higher the duty cycle, the more the stage accuracy will be affected by heat. The thermal expansion coefficient of the screw is 11.7 ppm/°C.

1.3. Basic Specifications

Table 1-3: MPS50SL Series Mechanical Specifications

Mechanical Specifications ⁽¹⁾			MPS50SL-025	MPS50SL-050
Travel			25 mm	50 mm
Accuracy ⁽²⁾	1.0 mm/rev Ball Screw	Uncalibrated (-PL1)	±3.0 µm	±4.0 µm
		Calibrated ⁽³⁾ (-PL2)	±1.5 µm	±1.5 µm
	0.5 mm/rev Lead Screw	Uncalibrated (-PL1)	±5.0 µm	±7.5 µm
		Calibrated ⁽³⁾ (-PL2)	±2.0 µm	±2.5 µm
Resolution (Minimum Incremental Motion)	1.0 mm/rev Ball Screw		0.1 µm	0.1 µm
	0.5 mm/rev Lead Screw		0.1 µm	0.1 µm
Bidirectional Repeatability (3)	1.0 mm/rev Ball Screw		±0.75 µm	±0.75 µm
	0.5 mm/rev Lead Screw		±1.5 µm	±1.5 µm
Straightness			±2.0 µm	±3.0 µm
Flatness			±2.0 µm	±3.0 µm
Maximum Speed	1.0 mm/rev Ball Screw	DC Motor (-M1)	5 mm/s	5 mm/s
		Stepper Motor (-M2)	1 mm/s	1 mm/s
	0.5 mm/rev Lead Screw	DC Motor (-M1)	2.5 mm/s	2.5 mm/s
		Stepper Motor (-M2)	0.5 mm/s	0.5 mm/s
Load Capacity ⁽⁴⁾	Horizontal		5 kg	5 kg
	Side		5 kg	5 kg
	Vertical		2.5 kg	2.5 kg
Stage Mass			0.85 kg	0.9 kg
Material			Anodized Aluminum Body	
<p>1. Specifications are for single-axis systems measured 25 mm above the tabletop; performance of multi-axis system is payload and workpoint dependent. Consult the Aerotech factory for multi-axis or non-standard applications.</p> <p>2. Excessive duty cycle may impact stage accuracy.</p> <p>3. With Aerotech controllers.</p> <p>4. Payload specifications are for a single-axis system.</p>				

1.4. Vacuum Operation

MPS50SL stages ordered with the -HV option (high vacuum preparation) are designed for operation in high vacuum environments. Special preparations include:

- Stage parts are lubricated with vacuum-compatible lubricants.
- Materials, fasteners, and coatings with vacuum outgas performance are ensured to be compatible with the specified level of vacuum.
- For high vacuum stages, situations that may allow gases to become temporarily trapped during pump down are removed.
- Prior to assembly, stage parts are thoroughly cleaned in a clean environment.
- Stages are packaged in a special polyethylene bag.

Vacuum Guidelines

To ensure that the MPS50SL will continue to perform well in the vacuum environment, follow the guidelines listed below (in addition to standard handling, installation, and lubrication guidelines outlined in this manual).

1. Do not remove the MPS50SL from its sealed bag until it is ready for use.
2. Always handle the MPS50SL in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the MPS50SL.
3. During installation, use cleaned, vented, stainless steel fasteners when securing the MPS50SL.
4. Reduced air pressure eliminates significant convective heat transfer. This, coupled with the viscous vacuum-compatible lubricants, could result in excessive motor operating temperatures. Because of this, consider all continuous torque ratings to be 40 to 60% lower than the value specified for operation in normal atmospheric environment. Reduce motor usage accordingly.
5. For vacuum applications, the recommended lubricant is a small quantity of **Braycote® 602EF** grease or a compatible substitute of equal quality.
6. Baking vacuum components at 60 °C for 24 to 48 hours significantly reduces outgassing at initial pump-down to vacuum pressure and evaporates water vapor that impregnates porous surfaces on the aluminum and Teflon cables. Aerotech recommends that customers bake out vacuum systems when first installing them in the vacuum chamber. Contact Aerotech to discuss your application and the recommended bakeout procedure.

Chapter 2: Installation



WARNING: MPS50SL installation must be in accordance to instructions provided by this manual and any accompanying documentation. Failure to follow these instructions could result in injury or damage to the equipment.

2.1. Unpacking and Handling the Stage

NOTE: If any damage has occurred during shipping, report it immediately.

Carefully remove the MPS50SL from the protective shipping container. Before operating the MPS50SL, it is important to let the MPS50SL stabilize at room temperature for at least 12 hours. Allowing the MPS50SL to stabilize to room temperature will ensure that all of the alignments, preloads, and tolerances are the same as they were when tested at Aerotech. Use compressed nitrogen or clean, dry, oil-less air to remove any dust or debris that has collected during shipping. Set the MPS50SL on a smooth, flat, and clean surface.

Each MPS50SL has a label listing the system part number and serial number. These numbers contain information necessary for maintaining or updating system hardware and software. Locate this label and record the information for later reference. If any damage has occurred during shipping, report it immediately.



WARNING: Make sure that all moving parts are secure before moving the MPS50SL. Unsecured moving parts may shift and cause bodily injury.



WARNING: Improper handling could adversely affect the performance of the MPS50SL. Use care when moving the MPS50SL.



WARNING: An unsecured MPS50SL could be dragged off of a mounting surface by its unsupported cable.



WARNING: Do not use the drive screw or motor as lifting points.

2.2. Dimensions

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. Refer to the most recent edition of the Aerotech Motion Control Product Guide for the most current product information at www.aerotech.com.

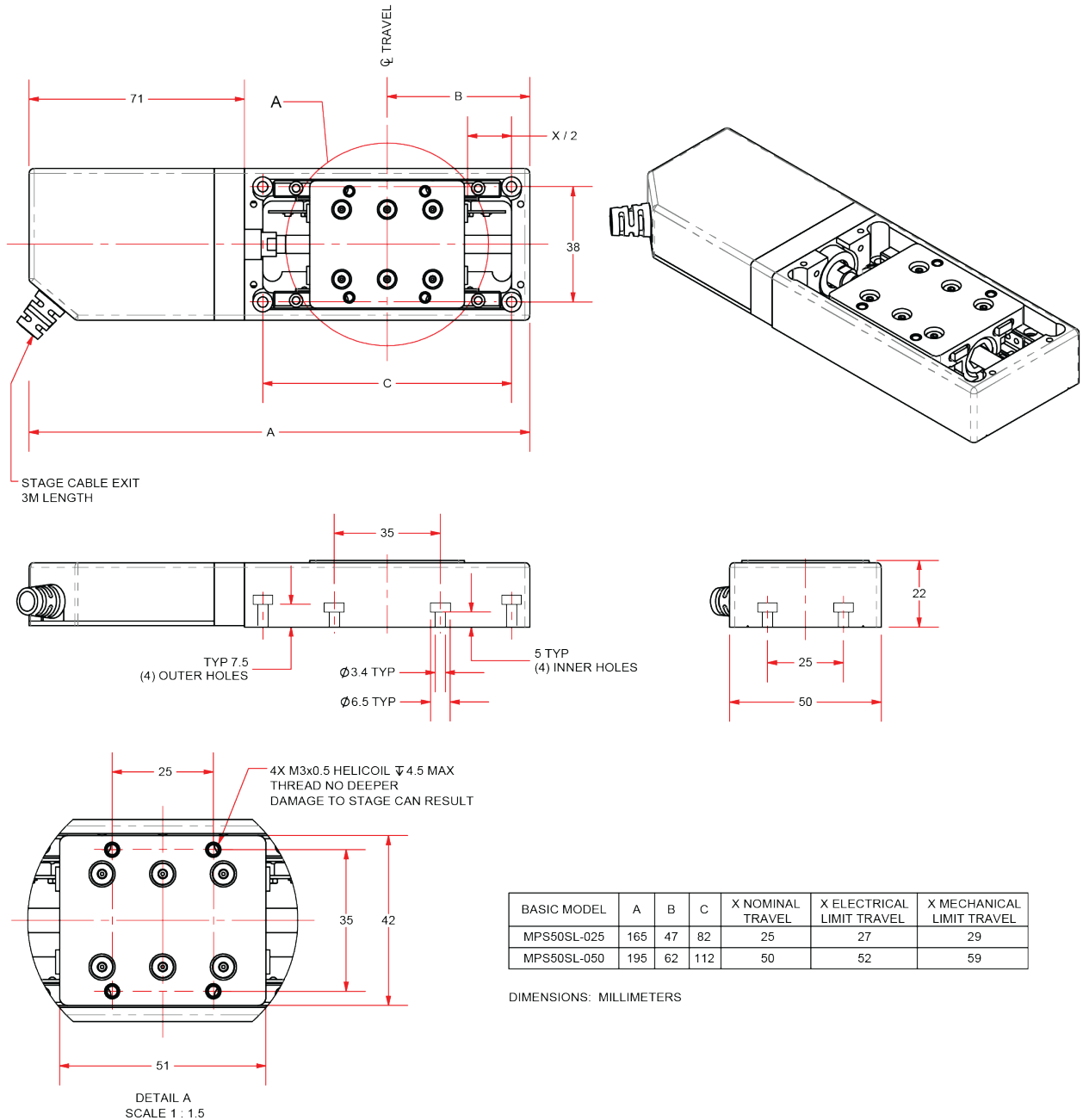


Figure 2-1: MPS50SL Dimensions

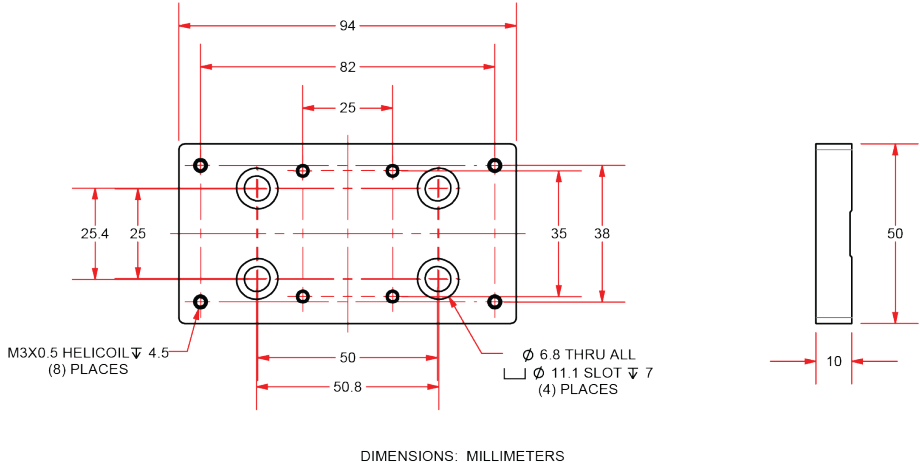


Figure 2-2: MPS50SL-025 Mounting Plate (-MP) Dimensions

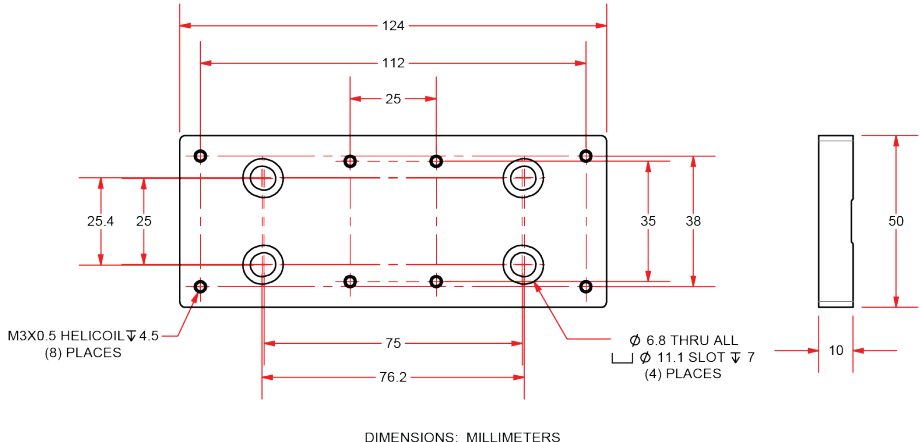


Figure 2-3: MPS50SL-050 Mounting Plate (-MP) Dimensions

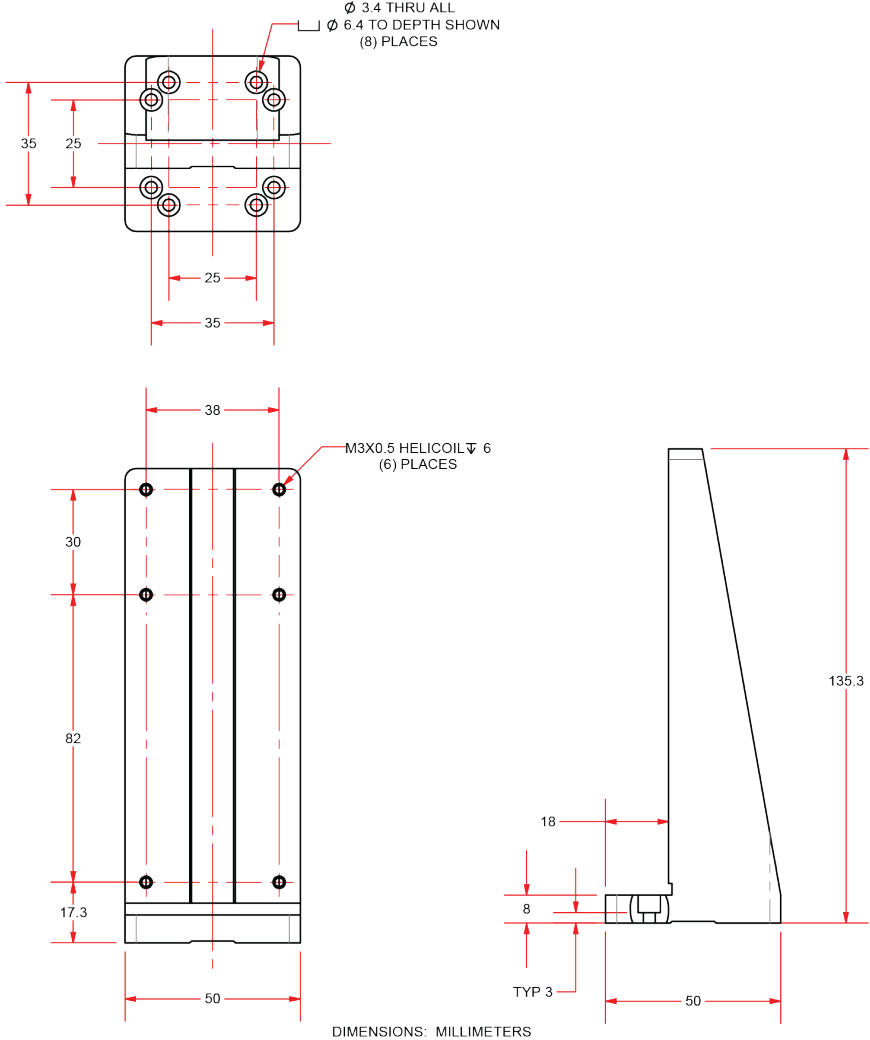


Figure 2-4: MPS50SL HDZ Angle Bracket Dimensions

2.3. Securing the Stage to the Mounting Surface



WARNING: The MPS50SL must be mounted securely. Improper mounting can result in injury and damage to the equipment.

The mounting surface must be flat and have adequate stiffness to achieve the maximum performance from the MPS50SL stage. When it is mounted to a non-flat surface, the stage can be distorted while the mounting screws are tightened. This distortion will decrease overall accuracy. Adjustments to the mounting surface must be done before the stage is secured.

Inspect the mounting surface for dirt or unwanted residue and clean if necessary. Use precision flatstones on the mounting surface to remove any burrs or high spots. Clean the mounting surface with a lint-free cloth and acetone or isopropyl alcohol and allow the cleaning solvent to completely dry. Gently place the stage on the mounting surface.

NOTE: To maintain accuracy, the mounting surface must be flat to within 5 μm .

NOTE: The MPS50SL is precision machined and verified for flatness prior to product assembly at the factory. If machining is required to achieve the desired flatness, it should be performed on the mounting surface rather than the MPS50SL. Shimming should be avoided if possible. If shimming is required, it should be minimized to retain maximum rigidity of the system.

Mount the stage to the mounting surface using M3 socket head cap screws (SHCS) in the [QTY 4] outer mounting holes. Additional mounting holes are hidden under the stage table and should only be used for mounting XY assemblies or, in special cases, when advised to by Aerotech. To mount the stage using the inner mounting holes, obey the special instructions in [Section 2.3.1](#).

The dimension drawings in [Section 2.2](#) include the mounting hole locations and screw lengths.



DANGER: To minimize the possibility of bodily injury or death, disconnect all electrical power prior to performing any maintenance or making adjustments to the equipment.



WARNING: An unsecured MPS50SL could be dragged off of a mounting surface by its unsupported cable.

Tightening torque values for the mounting hardware are dependent on the properties of the surface to which the stage is being mounted. Values provided in [Table 2-1](#) are typical values and may not be accurate for your mounting surface. Refer to [Section 2.2](#) for specific model mounting locations and dimensions.

Table 2-1: Stage to Mounting Surface Hardware

Mounting Hardware		Typical Screw Torque
Outer Mounting Holes (typical assembly)	M3 Socket Head Cap Screws, 12 mm long, stainless steel	0.9 N·m

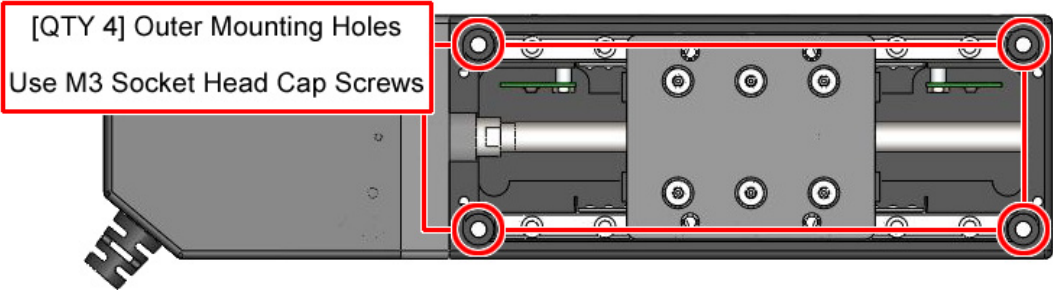


Figure 2-5: Mounting Hole Locations

2.3.1. For XY Assemblies and Special Cases

To access the inner mounting holes, the stage tabletop must be moved. The following is the procedure for moving the table and mounting the stage (see [Figure 2-6](#)).



WARNING: Do not attempt to manually back drive a MPS50SL. Doing so will damage the MPS50SL.

1. Drive the stage to one end of travel to access two of the hidden mounting holes for the stage.
2. Disconnect all electrical power.
3. Mount the stage with M3 low-head socket cap screws (LHSCS). See [Table 2-2](#) for hardware details.
4. Reconnect the stage to the power supply and drive the tabletop to the other end of travel to access the other two hidden mounting holes.
5. Disconnect all electrical power.
6. Mount the stage to the base using the remaining mounting holes with M3 LHSCS.

Table 2-2: Table Mounting for XY Assemblies and Special Cases

Mounting Hardware		Typical Screw Torque
Inner Mounting Holes (XY assemblies and special cases)	M3 Low-head Socket Cap Screws, 10 mm long, stainless steel	0.9 N·m

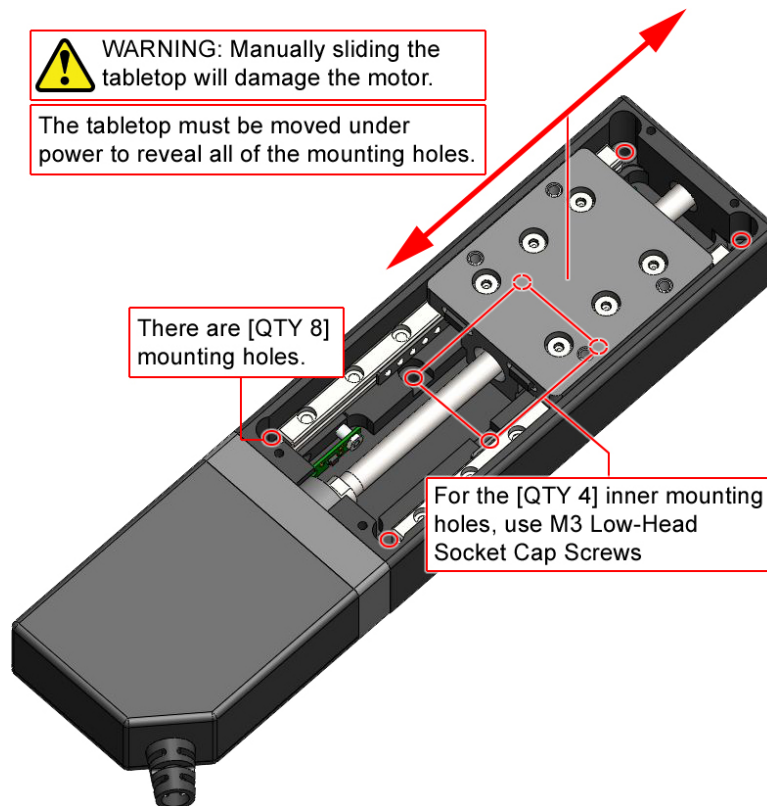


Figure 2-6: Access To All Mounting Holes

2.4. Attaching the Payload to the Stage

Aerotech recommends that customers use a representative payload during start-up to prevent accidental damage to the stage and the payload. Proceed with the electrical installation and test the motion control system in accordance with the system documentation. Document all results for future reference. For information on electrical installation refer to [Electrical Specifications and Installation](#) and the documentation delivered with the stage.

NOTE: If your MPS50SL was purchased with Aerotech controls, it might have been tuned with a representative payload based on the information provided at the time of order. If the MPS50SL is started up without a payload, the servo gains provided by Aerotech with the shipment may not be appropriate and servo instability can occur. Refer to the controller help file for tuning assistance.

The payload must be flat, rigid, and comparable to the stage in quality to maintain optimum performance.

NOTE: For valid system performance, the mounting interface should be flat within 5 μm .



WARNING: Refer to the dimensions in [Section 2.2](#) for maximum allowable thread engagement. A screw extending through the stage table can affect travel and damage the stage.

Refer to the dimension drawing in [Section 2.2](#) for mounting hole locations and screw lengths.

Application loads should be symmetrically distributed whenever possible (i.e., the payload should be centered on the stage table and the entire stage should be centered on the support structure). If cantilevered loads are applied, refer to [Figure 2-7](#) to find the maximum allowable load.

In [Figure 2-7](#), three curves are shown for different loading conditions. The vertical curve, L_v , is for situations where the stage is mounted in a vertical orientation and the payload is mounted to the table top with its center of gravity extended outward. If a cantilevered load situation is used, first determine if it is a pitch cantilever or roll cantilever system based on [Figure 2-8](#). Measure the cantilever length, then find the corresponding load value from [Figure 2-7](#).

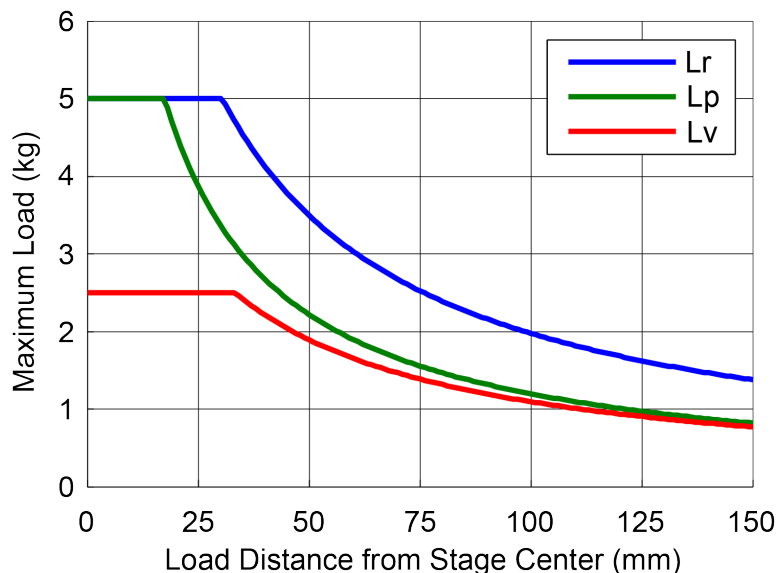


Figure 2-7: Load Capability of MPS50SL Series Stages

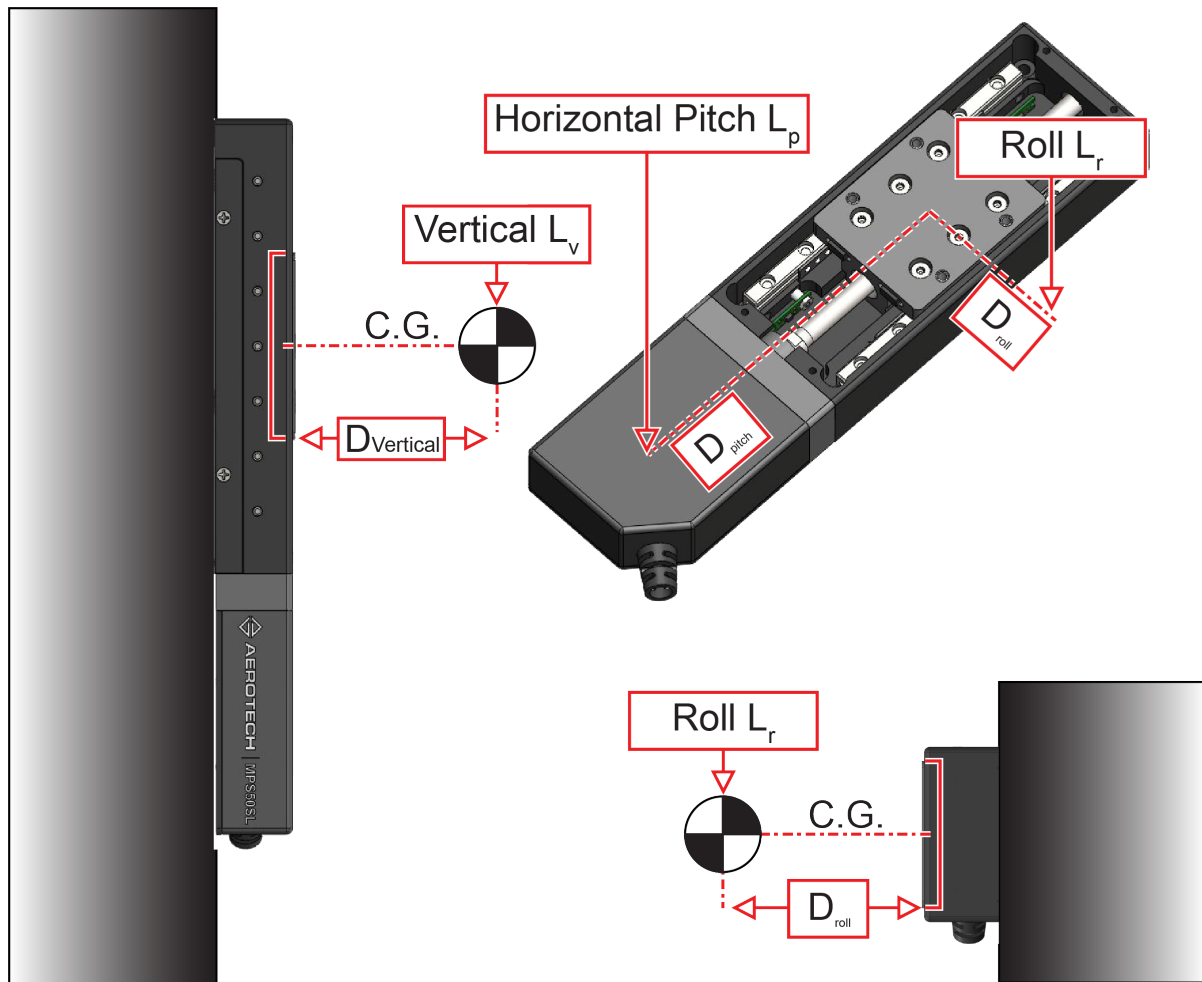


Figure 2-8: Stage Orientations

The approximate amount of torque required to turn the drive screw of an MPS50SL series stage can be found from [Figure 2-9](#) or the following equation:

$$\text{Torque}_{\text{REQ}} = \frac{(\text{Axial Load}) \times (\text{Lead of Screw}) \times (\text{Reduction Ratio})}{2 \times \pi \times (\text{Efficiency})} + (\text{Preload Torque}) \times (\text{Reduction Ratio})$$

Where:

Lead of Screw = see [Table 1-3](#)

Efficiency = .90 for ball screws, .50 for MPS50 lead screws

Reduction Ratio = 49/676 for MPS50SL-DC; 63/2704 for MPS50SL-SM

Moving Mass = 0.2 kg

Preload Torque = 5 Nmm for ball screws, 15 Nmm for lead screws

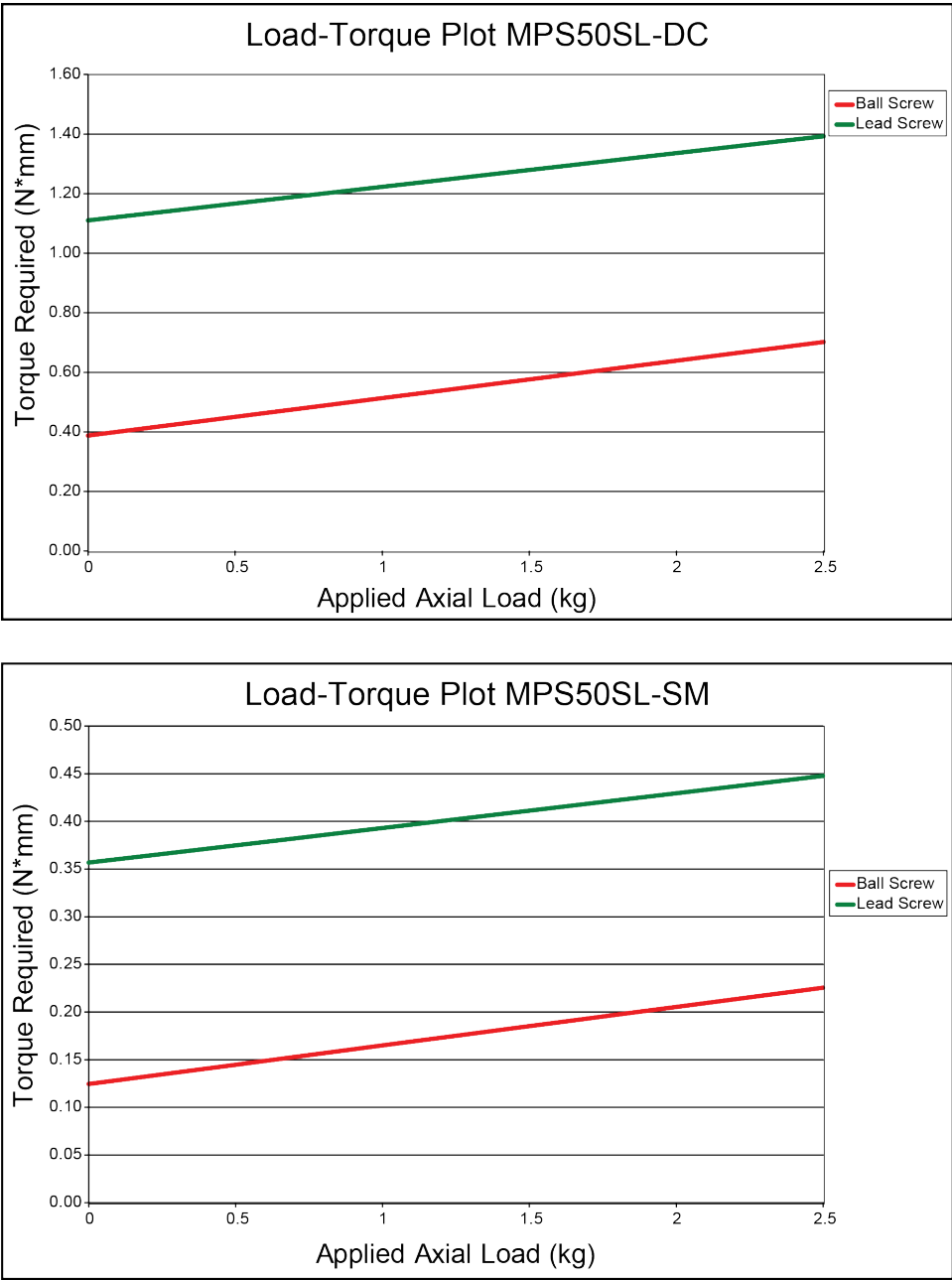


Figure 2-9: Torque Required to Turn Drive Screw in Vertical Orientation

Chapter 3: Electrical Specifications and Installation



WARNING: Electrical installation must be performed by properly qualified personnel.

Aerotech motion control systems are adjusted at the factory for optimum performance. When the MPS50SL is part of a complete Aerotech motion control system, setup usually involves connecting the MPS50SL to the appropriate drive chassis with the cables provided. Labels on the system components usually indicate the appropriate connections.

If system level integration was purchased, an electrical drawing showing system interconnects has been supplied with the system (separate from this documentation).

The electrical wiring from the motor and encoder are integrated at the factory. Refer to the sections that follow for standard motor wiring and connector pinouts.



WARNING: Applications requiring access to the stage while it is energized will require additional grounding and safeguards. The System Integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements necessary for the integration of this stage into the final application.



DANGER: Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock or damage to the equipment.



WARNING: The DC Power supplies for controllers must be double insulated. All Aerotech-provided power supplies are double insulated.

3.1. Motor and Feedback Connectors

The MPS50SL comes from the factory completely wired and assembled. Each MPS50SL is shipped with documentation regarding the wiring, controller interface connectors, and specifications.

NOTE: Refer to the other documentation accompanying your Aerotech equipment. Call your Aerotech representative if there are any questions on system configuration.

The System Integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements necessary for the integration of this stage into the final application.



DANGER: Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock or damage to the equipment.



CAUTION: The stage controller must provide over-current and over-speed protection. Failure to do so may result in permanent damage to the motor and stage components.

Table 3-1: 25-Pin D Motor and Feedback Connector Pinouts (-M1)

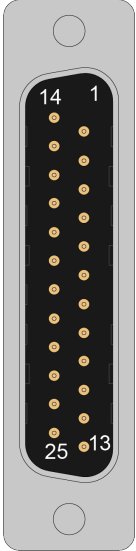
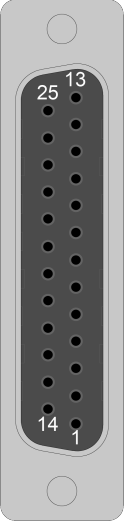
Pin	Description	Connector
1	Connector key (to prevent improper connection)	
2	Cosine-N	
3	Sine-N	
4	Marker-N	
5	Encoder Common	
6	Limit Common	
7	Negative (CCW) hardware limit	
8	Reserved	
9	Reserved	
10	Motor -	
11	Motor +	
12	Reserved	
13	Reserved	
14	Cosine	
15	Sine	
16	Marker	
17	+5 V power supply	
18	Stage ID	
19	Positive (CW) hardware limit	
20	Common ground	
21	Common ground	
22	Motor -	
23	Motor +	
24	Reserved	
25	Reserved	
Case	Signal shield connection (to case)	

Table 3-2: 25-Pin D Motor Mating Connector (-M1)

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK01057	TE #5745173-4
Connector	ECK00300	Amphenol #DB25S064 TLF

Table 3-3: 25-Pin D Motor and Feedback Connector Pinouts (-M1 with -HV Option)

Pin	Description	Connector
1	Reserved	
2	Reserved	
3	Motor +	
4	Motor -	
5	Reserved	
6	Reserved	
7	Negative (CCW) hardware limit	
8	Common ground	
9	Common ground	
10	Marker-N	
11	Sine-N	
12	Cosine-N	
13	Reserved	
14	Reserved	
15	Reserved	
16	Motor +	
17	Motor -	
18	Reserved	
19	Reserved	
20	Positive (CW) hardware limit	
21	Reserved	
22	+5 V power supply	
23	Marker	
24	Sine	
25	Cosine	
Case	Signal shield connection (to case)	

1. Vacuum stages require a double-male bulkhead adapter (through the vacuum chamber wall) to mate to our standard cables.

Table 3-4: 25-Pin D Motor and Feedback Connector Pinouts (-M2)

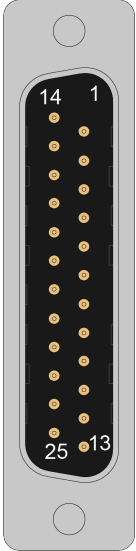
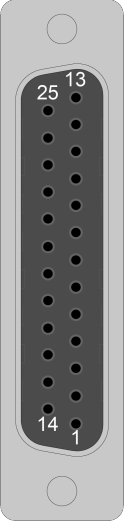
Pin	Description	Connector
1	Connector key (to prevent improper connection)	
2	Reserved	
3	Reserved	
4	Reserved	
5	Encoder Common	
6	Limit Common	
7	Negative (CCW) hardware limit	
8	Reserved	
9	Reserved	
10	Motor Return	
11	Motor Phase A	
12	Motor Phase B	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	
17	+5 V power supply	
18	Stage ID	
19	Positive (CW) hardware limit	
20	Common ground	
21	Common ground	
22	Motor Return	
23	Motor Phase A	
24	Motor Phase B	
25	Reserved	
Case	Signal shield connection (to case)	

Table 3-5: 25-Pin D Motor Mating Connector (-M2)

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK01057	TE #5745173-4
Connector	ECK00300	Amphenol #DB25S064 TLF

Table 3-6: 25-Pin D Motor and Feedback Connector Pinouts (-M2 with -HV Option)

Pin	Description	Connector
1	Reserved	
2	Motor Phase B	
3	Motor Phase A	
4	Motor Return	
5	Reserved	
6	Reserved	
7	Negative (CCW) hardware limit	
8	Common ground	
9	Common ground	
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	
14	Reserved	
15	Motor Phase B	
16	Motor Phase A	
17	Motor Return	
18	Reserved	
19	Reserved	
20	Positive (CW) hardware limit	
21	Reserved	
22	+5 V power supply	
23	Reserved	
24	Reserved	
25	Reserved	
Case	Signal shield connection (to case)	

1. Vacuum stages require a double-male bulkhead adapter (through the vacuum chamber wall) to mate to our standard cables.

3.2. Motor and Feedback Wiring

Shielded cables are required for the motor and feedback connections.

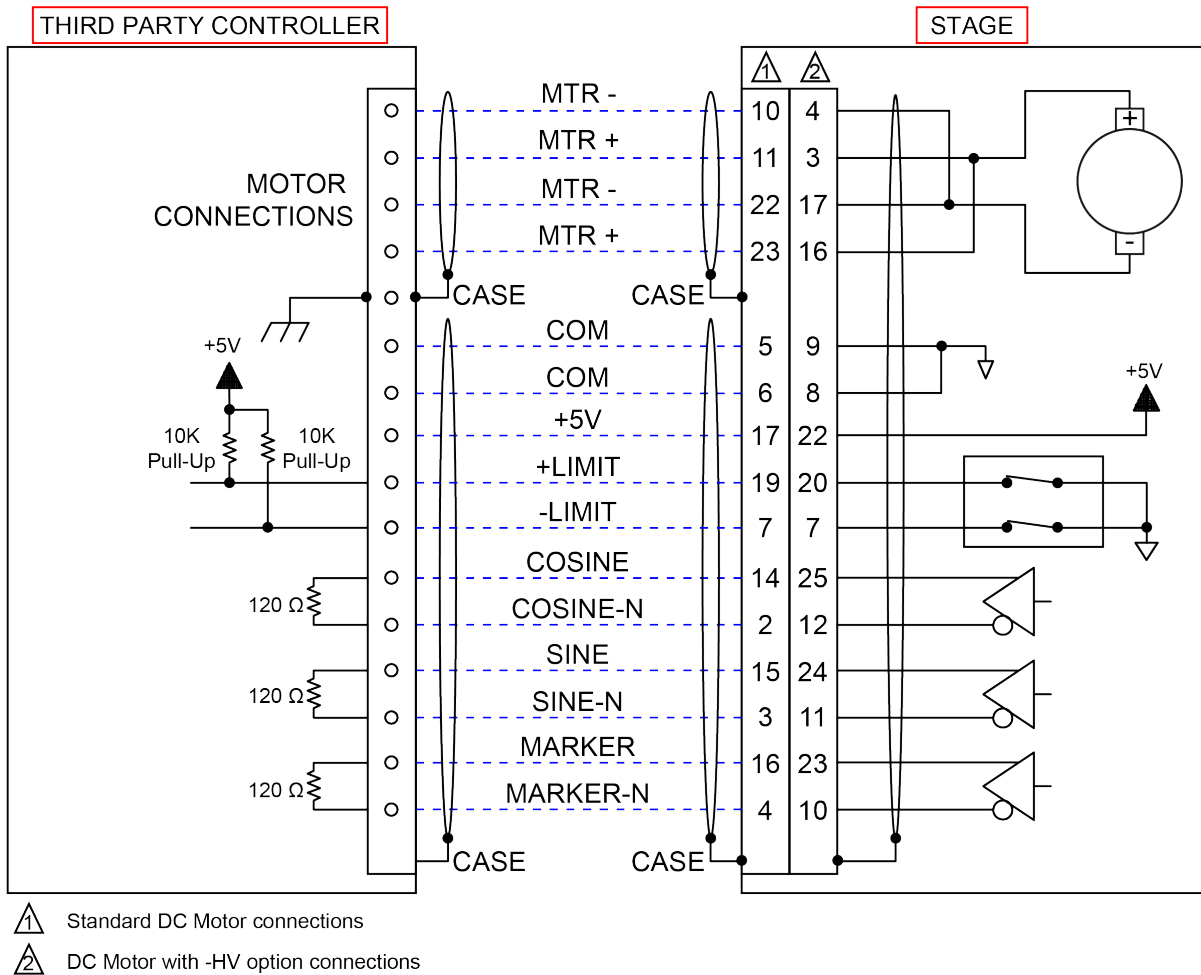


Figure 3-1: Motor and Feedback Wiring (-M1 Option)

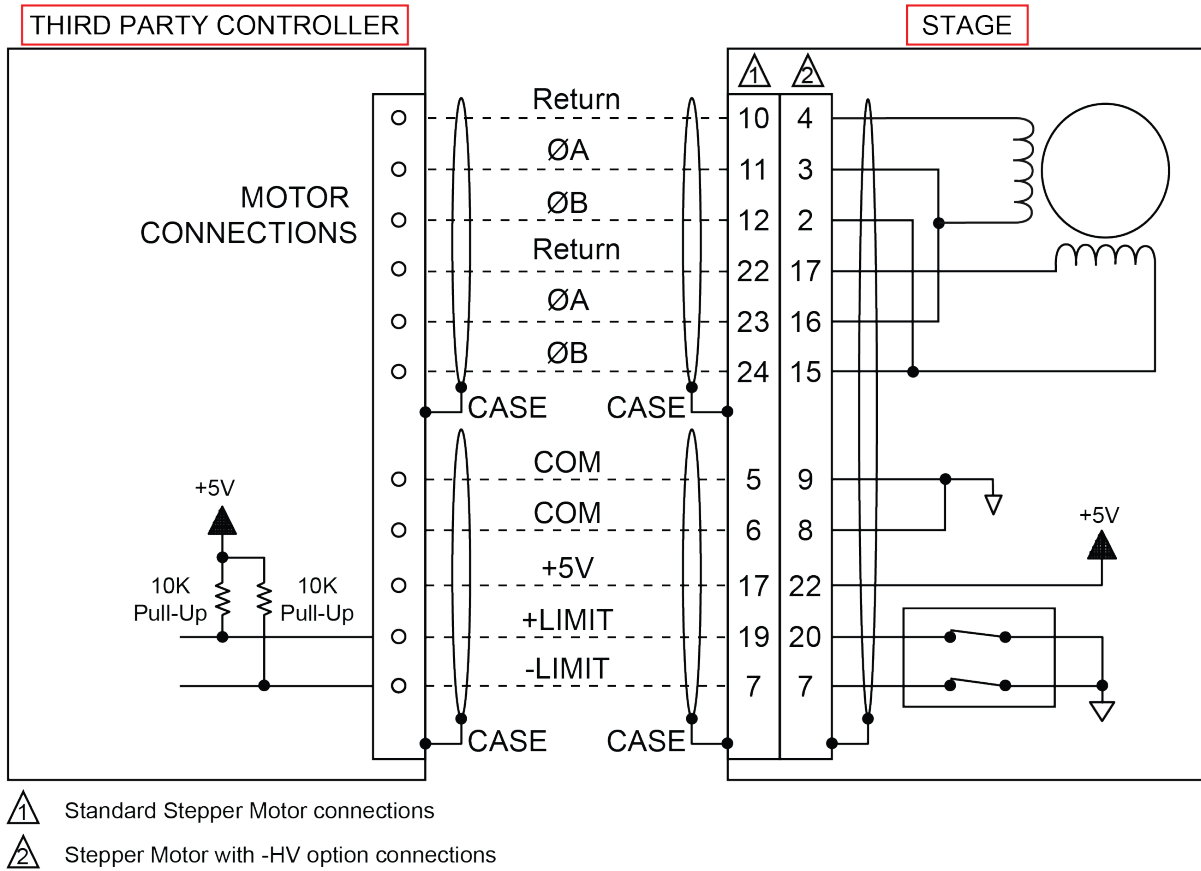


Figure 3-2: Motor and Feedback Wiring (-M2 Option)

3.3. Motor and Feedback Specifications

Table 3-7: Feedback Specifications

Encoder Specifications	
Supply Voltage	5 V \pm 5%
Supply Current	100 mA Typical
Output Signals	Digital Output (Incremental Encoder): RS422/485 compatible
Limit Switch Specifications	
Supply Voltage	5 V \pm 5%
Supply Current	25 mA
Output Type	Open Collector
Output Voltage	5 V
Output Current	10 mA (sinking)
Output Polarity	Normally Closed (NC) <ul style="list-style-type: none"> • Sinks current to ground (Logic "0") when not in limit • High impedance (Logic "1") when in limit • Requires external pull-up to +5 V (10 kΩ recommended)
Notes: <ul style="list-style-type: none"> • If the MPS50SL is driven beyond the electrical limit, it will encounter a mechanical stop. Impacting the mechanical stop could cause damage to the stage even at low speeds. • Encoder and Limit 5 V supplies are connected to each other internally. 	

Table 3-8: DC Motor Specifications

	DC Motor (-M1)
Stall Torque, Continuous	0.0045 N·m
Peak Torque	0.0095 N·m
Maximum Speed	300 rpm
Peak Current, Stall	0.40 A
Continuous Stall Current	0.19 A
Torque Constant	0.0263 N·m/A
Terminal Resistance	54.6 Ohm
BEMF Constant	2.76 V/krpm
Inductance	0.0012 H
Rotor Moment of Inertia	1.00E-07 kg·m ²
Recommended Bus Voltage	24 V
Maximum Terminal Voltage	48 V
Motor Constant	0.0036 N·m/ \sqrt{w}
Gear Ratio	676:49

Table 3-9: Stepper Motor Specifications

	Stepper Motor (-M2)
Stall Torque	0.0036 N·m
Rated Phase Current	0.15 A
Recommended Bus Voltage	24 V
Rotor Inertia	4.50E-08 kg·m ²
Full Step Angle	15°
Phase Resistance	35 Ohm
Phase Inductance	0.0165 H
Maximum Speed	60 rpm
Gear Ratio	2704:63



WARNING: The motor case temperature may exceed 75°C.

Table 3-10: Encoder Specifications

		DC Motor (-M1)	Stepper Motor (-M2)
Feedback		512 lines/rev Rotary Encoder	N/A
Electronic Resolution	1.0 mm/rev Ball Screw	0.0348 μ m	0.0484 μ m @ 480 steps/rev Motor Resolution
	0.5 mm/rev Lead Screw	0.0174 μ m	0.0242 μ m @ 480 steps/rev Motor Resolution

3.4. Limits and Machine Direction

Aerotech stages are configured to have positive and negative "machine" directions. The machine direction defines the phasing of the feedback and motor signals and is dictated by the stage wiring (refer to [Section 3.5](#) for Motor and Feedback phasing information). Programming direction of a stage is set by the controller that is used to move the stage. Programming direction is typically selectable in the controller, while machine direction is hardwired in the stage. [Figure 3-3](#) shows the machine direction of MPS50SL stages.

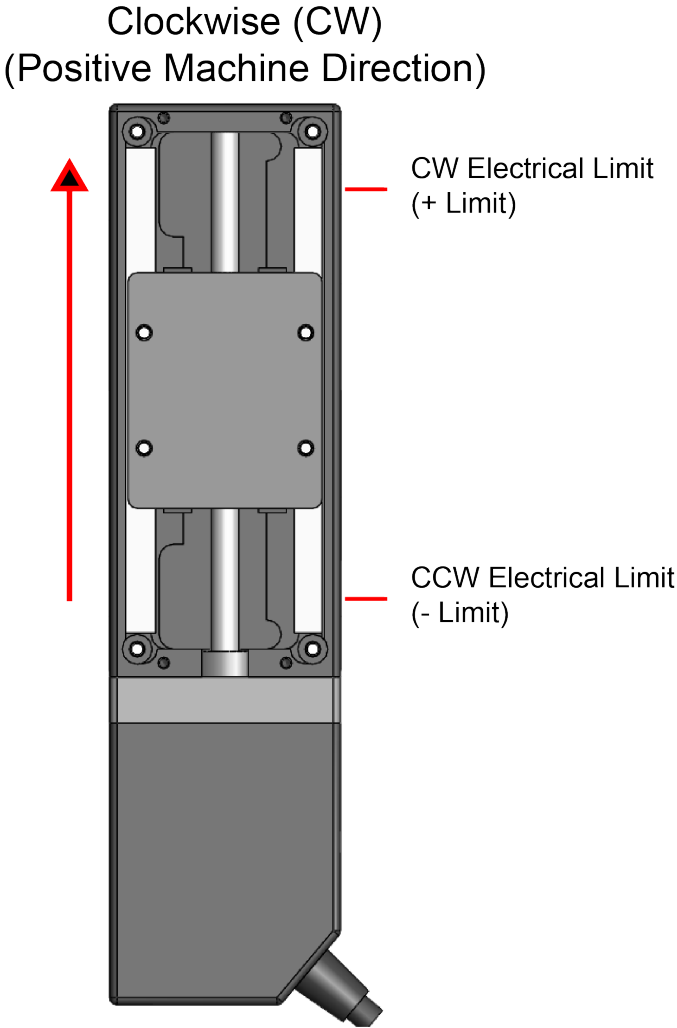


Figure 3-3: Machine Direction

3.5. Motor and Feedback Phasing

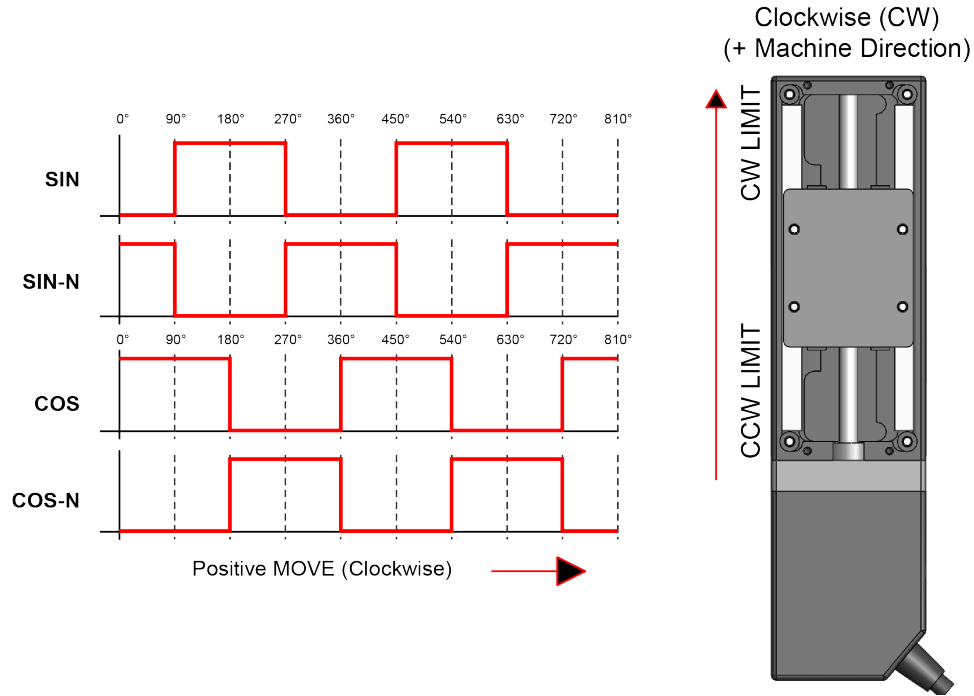


Figure 3-4: Encoder Phasing Reference Diagram (-M1 Motor Option)

Chapter 4: Maintenance

This chapter provides information about intervals between lubrications, details of the lubrication and inspection process, and recommendations of lubricants for use.

NOTE: If the bearing area is not kept free of foreign matter and moisture, the performance and life expectancy of the stage will be reduced.



DANGER: Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock or damage to the equipment.

4.1. Service and Inspection Schedule

Lubricant inspection and replenishment in MPS50SL series stages depends on conditions such as duty cycle, speed, and the environment. An inspection interval of once per month is recommended until a trend develops for the application. Longer or shorter intervals may be required to maintain the film of lubricant on the bearing surfaces.

If the application process uses only a small portion of travel for most of the duty cycle, periodically drive the stage through full travel to redistribute the lubrication in the bearings and drive screw. The drive screw end bearings and motor bearings are sealed, and should not need to be relubricated under normal use.

Monthly inspections should include but not be limited to:

- Visually inspect the stage and cables.
- Re-tighten loose connectors.
- Replace or repair damaged cables.
- Clean the MPS50SL and any components and cables as needed.
- Repair any damage before operating the MPS50SL.
- Inspect and perform an operational check on all safeguards and protective devices.

4.2. Cleaning and Lubrication



DANGER: Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock or damage to the equipment.



WARNING: In applications that have multiple stages bolted together to form multi-axis systems, the orthogonality may be lost if the stage tables of the support stages are loosened. Precision aligned stages should not be loosened or disassembled.



WARNING: Further disassembly of the stage is not recommended because proper assembly and calibration can only be done at the factory. In addition, a laser interferometer is required for post assembly verification to maintain warranties. Contact Aerotech for more information.

Cleaning

Before using a cleaning solvent on any part of the MPS50SL, blow away small particles and dust with nitrogen or, less preferably, clean, dry, compressed air.

Any external metal surface of the MPS50SL can be cleaned with isopropyl alcohol on a lint-free cloth. Harsher solvents, such as acetone, may damage the plastic and rubber seals on the drive screw or damage the precision rail guides. If acetone is required, avoid the screw and bearing seals. Acetone can also damage the black paint on the motor and encoder covers



WARNING: Make sure that all solvent has completely evaporated before attempting to move the stage.

Lubrication

Take the opportunity during the lubrication procedure to inspect the precision rail guides for any damage or signs of wear.

For standard applications, use NSK LG2 grease on the precision rail guides and ball screw. For vacuum applications, refer to the vacuum guidelines in [Section 1.4](#) for the appropriate grease. Only use the specified grease as other greases may be incompatible.

If the application process uses only a small portion of travel for most of the duty cycle, periodically drive the stage through full travel to redistribute the lubrication in the bearings.

For high-speed applications (i.e., near maximum speed at a duty cycle of 50%), frequent maintenance with standard lubricants is required.

NOTE: Removing the upper axis on an XY, XZ, or YZ system will alter a precision alignment. Do not remove the upper axis for lubrication and cleaning if possible.



WARNING: Do not attempt to manually back drive a MPS50SL. Doing so will damage the MPS50SL.

1. Drive the carriage to one end of travel, and remove power from the stage.
2. Blow off the interior of the stage with clean, dry compressed air or nitrogen.
3. Remove all dirty or dried lubricant from the drive screw and the precision rail guides. Use a small application of isopropyl alcohol with a clean, lint-free cloth or cotton swab.
4. Using a grease syringe, apply an approximate 2 mm diameter bead of lubricant to the drive screw threads and precision rail guides.
5. Restore power to the stage and move the carriage to the opposite end of travel. Then repeat steps 2 through 4 for the opposite sides of the bearing rails.
6. Restore power to the stage and move the carriage through full travel three or more times to distribute the lubricant.
7. Repeat the grease application process three more times to reach the total replacement grease quantity.
8. Restore power to the stage.

4.2.1. Bearing Centering Procedure

The MPS50SL bearing cage assembly may creep in one direction over time. This is normal, but may require correction if the cage creeps far enough to risk contact with the corners of the stage base. Scribed lines are provided on the stage base as a visual indicator of bearing cage centering. [Figure 4-1](#) below shows an off-centered bearing cage on an MPS50SL-050 stage.

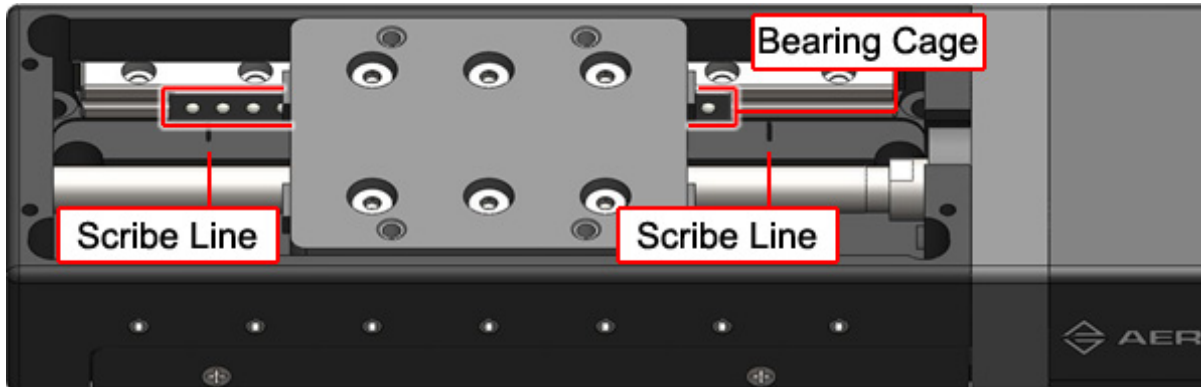


Figure 4-1: MPS50SL-050 Bearing Cage Creep

To correct this problem, the cage can be pushed back into position using a bearing centering fixture, which is available for purchase from Aerotech. Two fixtures are available depending on travel length, the part numbers are BCF-MPS50SL-025 and BCF-MPS50SL-050. A drawing of each fixture is shown below for customers with the ability to manufacture it themselves. The fixture must be soft enough to prevent damage to the steel balls and rails. 6061 aluminum is the recommended material. The step cut in the fixture captures the balls to prevent the cage from buckling as it is pushed from the end.

MPS50SL-025 Bearing Centering

Drive the stage to one end of nominal travel and disconnect power to the system. Insert the MPS50SL-025 bearing centering fixture next to the bearing that requires adjustment. Manually push the bearing cage toward the stage carriage until the fixture bottoms out against the carriage-side bearing rail to ensure proper cage centering. A tapped hole in the fixture (M3 thread) is provided to aid in removal of the fixture. To verify cage centering, restore power to the system, drive the stage to the center of travel, and verify the cage position against scribe marks in the base.

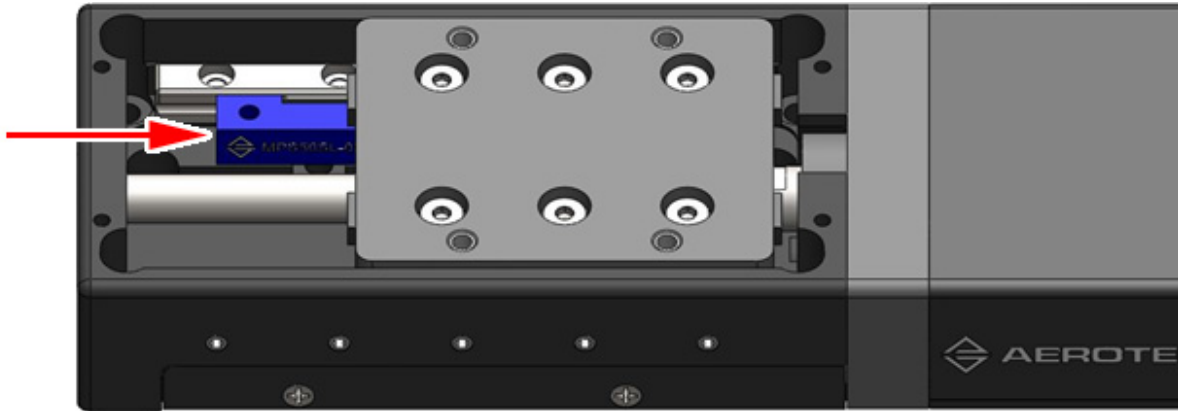


Figure 4-2: MPS50SL-025 Bearing Cage Centering

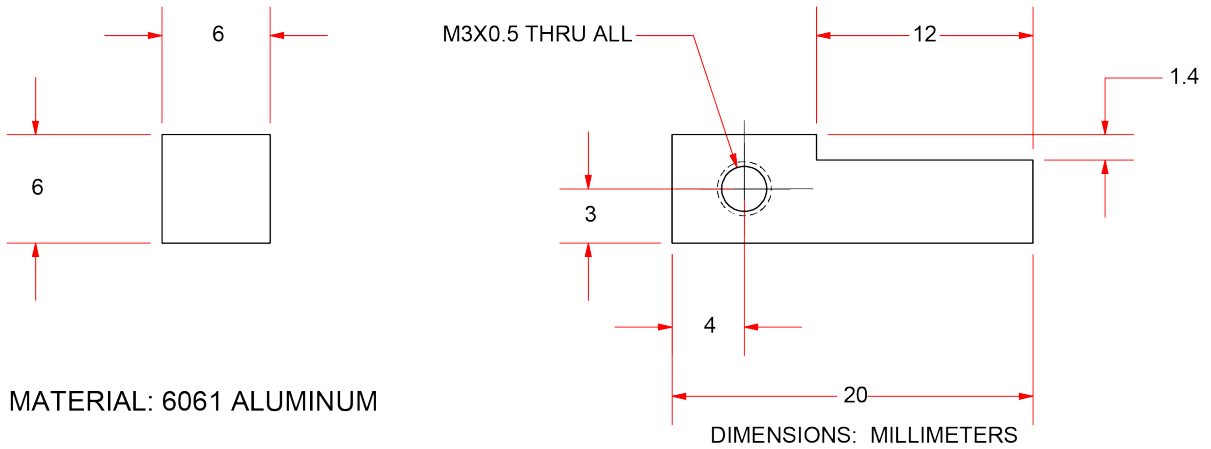


Figure 4-3: BCF-MPS50SL-025 Bearing Centering Fixture

MPS50SL-050 Bearing Centering

Drive the stage to the center of travel and disconnect power to the system. Insert the MPS50SL-050 bearing centering fixture next to the bearing that requires adjustment. Manually push the bearing cage toward the stage carriage until the fixture bottoms out against the carriage-side bearing rail to ensure proper cage centering. Verify cage position against scribe marks in the base. A tapped hole (M3 thread) is provided to aid in removal of the fixture.

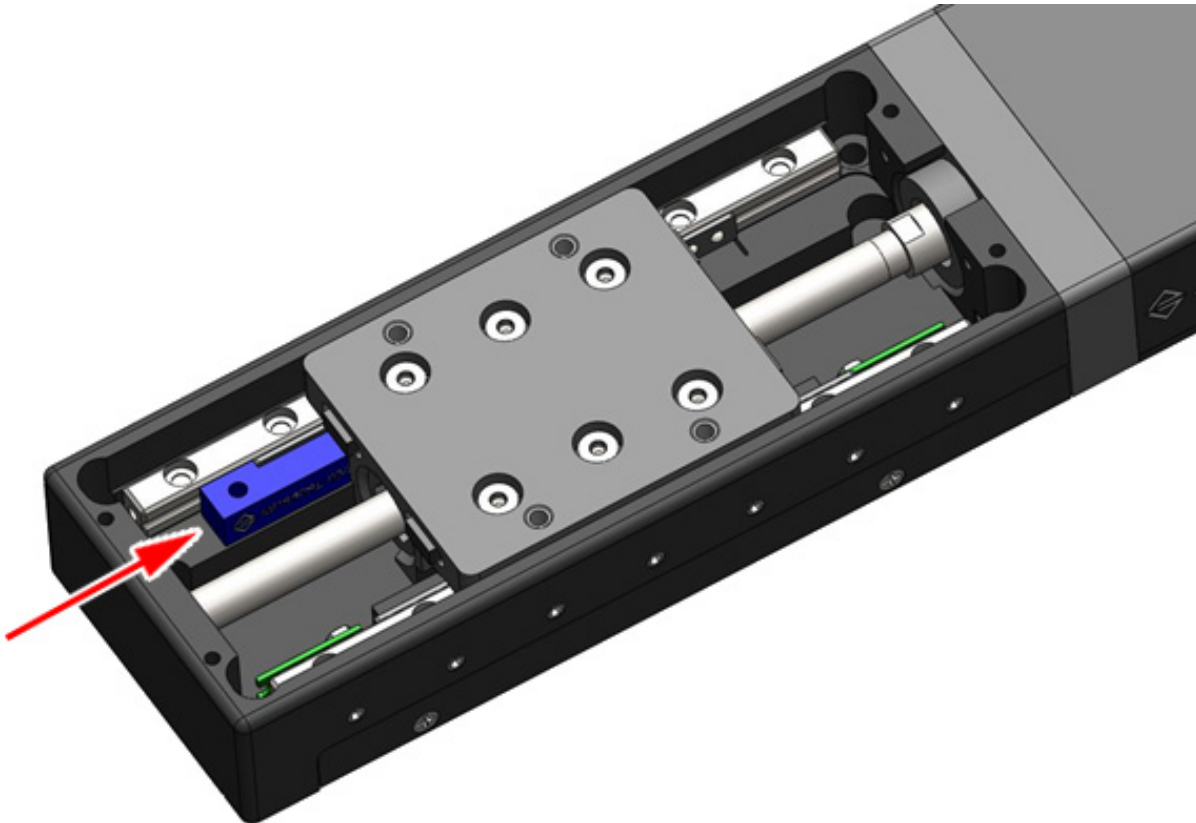


Figure 4-4: MPS50SL-050 Bearing Cage Centering

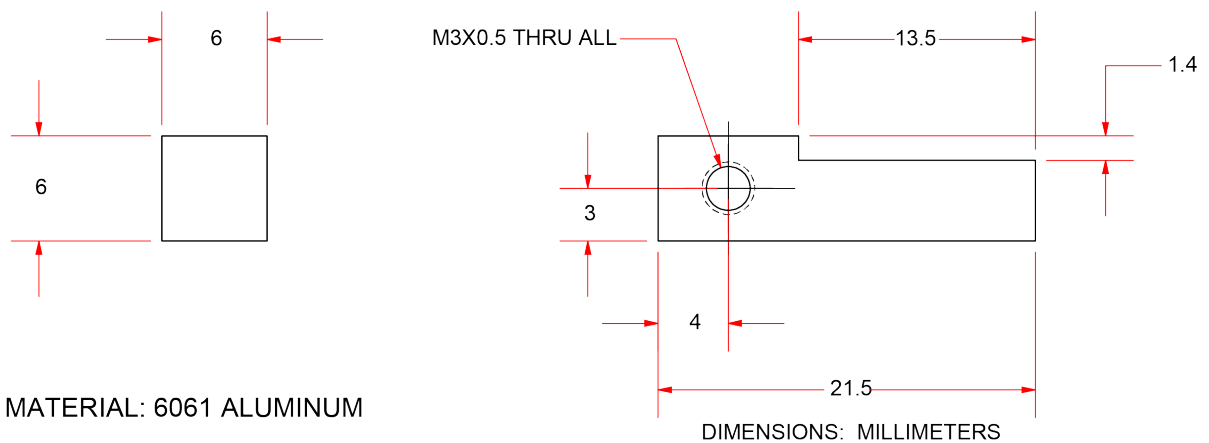


Figure 4-5: BCF-MPS50SL-050 Bearing Centering Fixture

4.3. Troubleshooting

Table 4-1: Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move	Brake not released (if equipped with brake; refer to stage documentation). In Limit condition. Check limits (refer to Chapter 3) and refer to the Controller documentation for polarity and compatibility requirements (Example: voltage requirements). Controller trap or fault (refer to the Controller documentation).
Stage moves uncontrollably	Encoder (sine and cosine) signal connections (refer to Chapter 3 and Controller documentation). Motor Connections (refer to Chapter 3 and the Controller documentation).
Stage oscillates or squeals	Gains misadjusted (refer to the Controller documentation). Encoder signals (refer to the Controller documentation).

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Appendix A: Warranty and Field Service

Aerotech, Inc. warrants its products to be free from harmful defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products that are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale, or use of any of its products shall in no event exceed the selling price of the unit.

THE EXPRESS WARRANTY SET FORTH HEREIN IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE. IN NO EVENT SHALL AEROTECH BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within thirty (30) days of shipment of incorrect material. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. A "Return Materials Authorization (RMA)" number must accompany any returned product(s). The RMA number may be obtained by calling an Aerotech service center or by submitting the appropriate request available on our website (www.aerotech.com). Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than thirty (30) days after the issuance of a return authorization number will be subject to review.

Visit <https://www.aerotech.com/global-technical-support.aspx> for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an expedited method of return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Fixed Fee Repairs - Products having fixed-fee pricing will require a valid purchase order or credit card particulars before any service work can begin.

All Other Repairs - After Aerotech's evaluation, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within thirty (30) days of notification will result in the product(s) being returned as is, at the buyer's expense.

Repair work is warranted for ninety (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-site Non-Warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

Service Locations

<http://www.aerotech.com/contact-sales.aspx?mapState=showMap>

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 5508 6731	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720
TAIWAN	UNITED KINGDOM	
Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649	

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	General Information
1.01.00	Full revision
1.00.00	New Manual

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