



# ECO115SL Series Mechanical Bearing, Ball-Screw Stage

## HARDWARE MANUAL

Revision 2.01



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## EU Declaration of Incorporation

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

*herewith declares that the product:*

ECO115SL Linear 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  
EU 2015/863

RoHS 2 Directive  
Amendment RoHS 3 Directive

**Authorized Representative**



/ Simon Smith, European Director

Aerotech Ltd  
The Old Brick Kiln, Ramsdell, Tadley  
Hampshire RG26 5PR  
UK

**Engineer Verifying Compliance**



/ Alex Weibel

Aerotech, Inc.  
101 Zeta Drive  
Pittsburgh, PA 15238-2811  
USA  
4/14/2022

**Date**



## Safety Procedures and Warnings



**IMPORTANT:** This manual tells you how to carefully and correctly use and operate the stage.

- Read all parts of this manual before you install or operate the stage or before you do maintenance to your system.
- To prevent injury to you and damage to the equipment, obey the precautions in this manual.
- All specifications and illustrations are for reference only and were complete and accurate as of the release of this manual. To find the newest information about this product, refer to [www.aerotech.com](http://www.aerotech.com).

If you do not understand the information in this manual, contact Aerotech Global Technical Support.



**IMPORTANT:** This product has been designed for light industrial manufacturing or laboratory environments. If the product is used in a manner not specified by the manufacturer:

- The protection provided by the equipment could be impaired.
- The life expectancy of the product could be decreased.

Safety notes and symbols are placed throughout this manual to warn you of the potential risks at the moment of the safety note or if you fail to obey the safety note.



Shock/Electrocution Hazard



Pinch, Shear, or Crush Hazard



General/Conditional Awareness



Rotational Machinery Hazard



Hot Surface Hazard



Pinch/Entanglement Hazard



Magnetic Field Hazard



Trip Hazard



Heavy, Bulky Lifting Hazard



Appropriate Equipment Required



Pressure/Explosive Atmosphere Hazard



Electrostatic Discharge Hazard

A blue circle symbol is an action or tip that you should obey. Some examples include:



General tip



Read the manual/section



Wear personal protective equipment (PPE): Safety Glasses



If applicable, do not lift unassisted



Wear personal protective equipment (PPE): Gloves



Wear personal protective equipment (PPE): Hearing Protection

## Installation and Operation

To decrease the risk of damage to the equipment, you must obey the precautions that follow.



### **DANGER: General Hazard Warning!**

This product can produce high forces and move at velocities that could cause injury. The user is responsible for its safe operation. The following general equation is provided to assist with risk assessments in regards to contact and pinch points:

$$Pressure_{Max} \left[ \frac{N}{mm^2} \right] = \frac{Force_{Peak} [N]}{Area_{Contact} [mm^2]}$$



### **WARNING: General Hazard Warning!**

- Only trained operators should operate this equipment.
- All service and maintenance must be done by approved personnel.
- Use this product only in environments and operating conditions that are approved in this manual.
- Never install or operate equipment that appears to be damaged.
- On stages with BMS motors: the motor over-temperature sensor must be monitored by the drive. Use it to shut down the drive if the motor overheats.
- Make sure that the product is securely mounted before you operate it.
- Make sure that all pneumatic lines are securely connected.
- Use care when you move the ECO115SL or you could negatively affect the performance of it.



### **WARNING: Trip Hazard!**

Route, house, and secure all cables, duct work, air, or water lines. Failure to do so could introduce trip hazards around the system that could result in physical injury or could damage the equipment.

## Electrical Warnings

To decrease the risk of electrical shock, injury, death, and damage to the equipment, obey the precautions that follow.



### **DANGER: Electrical Shock Hazard!**

- Stage motor phase voltage levels could be hazardous live.
- Personnel are protected from hazardous voltages unless electrical interconnections, protective bonding (safety ground), or motor/stage enclosures are compromised.
- Do not connect or disconnect stage/motor interconnections while connected to a live electrical power source.
- Before you set up or do maintenance, disconnect electrical power.
- It is the responsibility of the End User/System Integrator to make sure that stages are properly connected and grounded per Engineering Standards and applicable safety requirements.
- It is the responsibility of the End User/System Integrator to configure the system drive or controller within the Aerotech motor/stage electrical and mechanical specifications.

## Motor-Related Warnings

Aerotech motors are capable of producing high forces and velocities. Obey all warnings and all applicable codes and standards when you operate a system that incorporates Aerotech motors.

### DANGER: Mechanical Hazard!



Personnel must be made aware of the mechanical hazards during set up or when you do service to the stage.

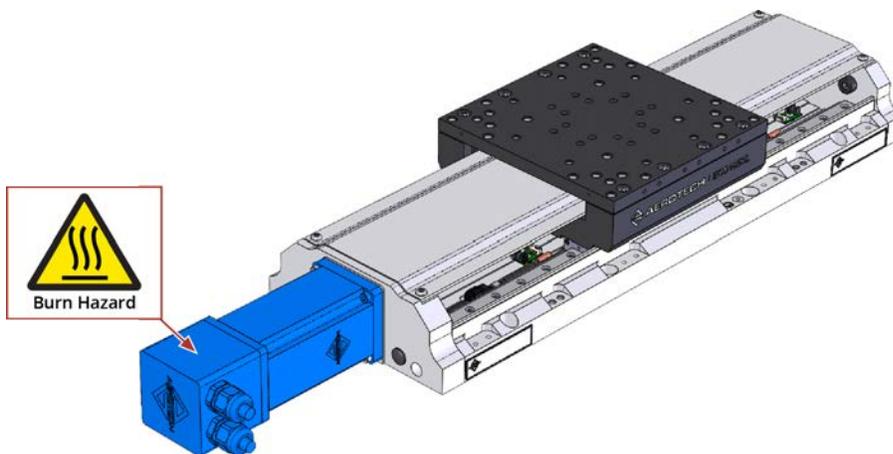
- Unintentional manual movement into the stage "end-of-travel" stops, could damage the stage or undo precision alignments.
- Stage movement could create pinch points, entanglement hazards, or rotational mechanical hazards.

### DANGER: Hot Surface Hazard!



- The stage/motor frame temperature could exceed 70°C in some applications.
- Do not touch the stage/motor frame while it is in operation.
- Wait until the stage/motor has cooled before you touch it.

Figure 1: Motor Location



### DANGER: Risk of Explosive Atmosphere!



- Standard Aerotech stage/motors are not rated for applications with explosive atmospheres such as air-borne dust or combustible vapors.
- Do not operate stage/motors outside of Aerotech environmental specifications.

### DANGER: Magnetic Field Hazard!



Aerotech stage/motors contain magnets which can present a Magnetic Field Hazard.

- Do not disassemble a stage motor under any circumstances.
- Strong magnetic fields could interfere with external/internal medical devices.
- Strong magnetic fields could present mechanical hazards such as pinch points.

## Pinch Points

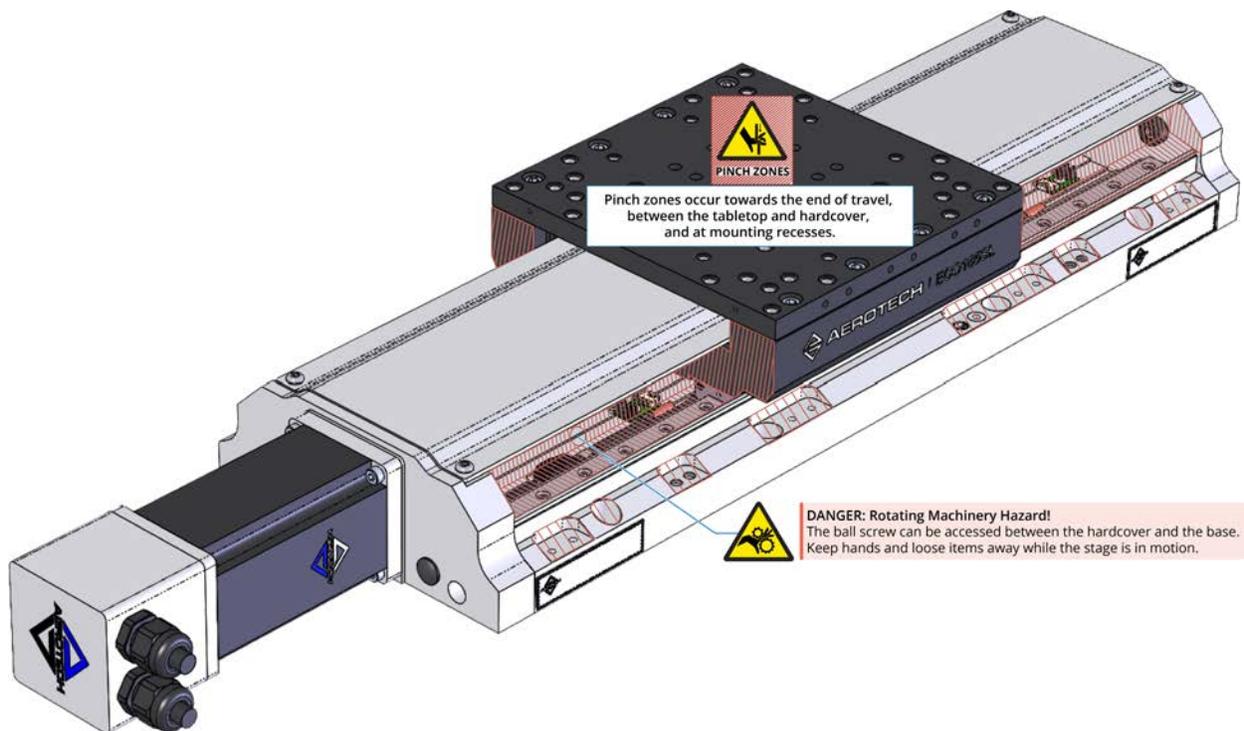
A pinch point is a mechanical hazard that can occur when there are exposed parts of the stage or system that can move. For example, the travel of a stage tabletop could expose the user to a pinch point between the tabletop and the stage housing. The images that follow will show you typical external and internal pinch point locations.

### **DANGER: Mechanical Hazard!**



- System travel can cause crush, shear, or pinch injuries.
- Only trained operators should operate this equipment.
- Do not put yourself in the travel path of machinery.
- Restrict access to all motor and stage parts
  - when the system moves under power (during normal operation, for example).
  - when the system is moved manually (during the installation process or when you do maintenance, for example).
- Motors are capable of very high speeds and acceleration rates.

**Figure 2: Typical Pinch Point Locations**



## Handling and Storage



**IMPORTANT:** It is the responsibility of the customer to safely and carefully lift and move the stage.

- Be careful when you move or transport the stage.
- Retain the shipping materials for future use.
- Transport or store the stage in its protective packaging.



### **WARNING: Electrostatic Discharge (ESD) Sensitive Components!**

Wear an ESD wrist strap when you handle, install, or do service to the system assembly. You could damage the power supply or drives if you fail to observe the correct ESD practices.

Inspect the shipping container for any evidence of shipping damage. If any damage exists, notify the shipping carrier immediately.

Remove the packing list from the shipping container. Make sure that all the items specified on the packing list are contained within the package.

The documentation for the stage is on the included installation device. The documents include manuals, interconnection drawings, and other documentation pertaining to the system. Save this information for future reference.

Each stage has a label listing the system part number and serial number. These numbers contain information necessary for maintenance or system hardware and software updates. Locate this label and record the information for later reference.

## Unpacking and Handling

It is the responsibility of the customer to safely and carefully lift and move the stage.



**IMPORTANT:** All electronic equipment and instrumentation is wrapped in antistatic material and packaged with desiccant. Ensure that the antistatic material is not damaged during unpacking.



**DANGER: Lifting Hazard!** Use care when you move the ECO115SL or you could negatively affect the performance of it.

- Use the correct lifting techniques, mechanical assistance, or additional help to lift or move this product.
- Do not use the cables or the connectors to lift or move this product.
- Make sure that all moving parts are secure before you move the stage. Unsecured moving parts could shift and cause injury or damage to the equipment.
- If the stage is heavy, a single person lift could cause injury. Use assistance when you lift or move it.
  - Refer to [Section 2.1. Dimensions](#) for dimensions
  - Refer to [Section 1.3. Basic Specifications](#) for weight specifications.

Carefully remove the stage from its protective shipping container.

- Lift this product only by the base.
- Use lifting hardware if it has been provided (refer to ).
- For multi-axis assemblies, always lift the system by the lower axis.
- Use a cart, dolly, or similar device to move the stage to a new location.

Gently set the stage on a smooth, flat, and clean surface. Use compressed nitrogen or clean, dry, oil-free air to remove any dust or debris that has collected during shipping.

Before you operate the stage, let it stabilize at room temperature for at least 12 hours. This will ensure that all of the alignments, preloads, and tolerances are the same as they were when they were tested at Aerotech.

Each stage has a label listing the system part number and serial number. These numbers contain information necessary for maintenance or system hardware and software updates. Locate this label and record the information for later reference.

### **Storage**

Store the stage in the original shipping container. If the original packaging included ESD protective packaging, make sure to store the stage in it. The storage location must be dry, free of dust, free of vibrations, and flat.

Refer to [Section 1.1. Environmental Specifications](#)

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## Chapter 1: Overview

**Table 1-1: Model Numbers and Ordering Options**

<b>ECO115SL Mechanical-Bearing Screw-Driven Linear Stage</b>	
<b>Travel</b>	
-050	50 mm travel stage
-100	100 mm travel stage
-150	150 mm travel stage
-200	200 mm travel stage
-250	250 mm travel stage
-300	300 mm travel stage
-400	400 mm travel stage
-500	500 mm travel stage
-600	600 mm travel stage
<b>Tabletop (Optional)</b>	
-TT1	Tabletop with metric dimension mounting
-TT2	Tabletop with English dimension mounting
-TT3	Accessory tabletop with mounting for select rotary stages
<b>Motor (Optional)</b>	
-M1	BMS60 Brushless Servomotor and 2500-Line TTL Encoder
-M2	BMS60 Brushless Servomotor, 2500-Line TTL Encoder, and Brake
-M3	BMS60 Brushless Servomotor and 1000-Line 1 Vpp Encoder
-M4	BMS60 Brushless Servomotor, 1000-Line 1 Vpp Encoder, and Brake
-M5	BM75 Brushless Servomotor and 2500-Line TTL Encoder
-M6	BM75 Brushless Servomotor, 2500-Line TTL Encoder, and Brake
-M7	BM75 Brushless Servomotor and 1000-Line 1 Vpp Encoder
-M8	BM75 Brushless Servomotor, 1000-Line 1 Vpp Encoder, and Brake
-M9	SM60 High Voltage Stepper Motor
-M10	SM60 High Voltage Stepper Motor and Brake
<b>Foldback (Optional)</b>	
-FB1	Foldback Kit for .250 Inch Diameter Shaft NEMA 23 Motor
-FB2	Foldback Kit with Brake for .250 Inch Diameter Shaft NEMA 23 Motor
-FB3	Foldback Kit for .375 Inch Diameter Shaft NEMA 23 Motor
-FB4	Foldback Kit with Brake for .375 Inch Diameter Shaft NEMA 23 Motor
<b>Motor Orientation (Optional)</b>	
-2	Bottom cable exit (optional orientation)
-3	Left side cable exit (standard orientation)
-4	Top cable exit (optional orientation)
-5	Right side cable exit (optional orientation)
-8	Right side foldback (standard orientation)
-12	Left side foldback (optional orientation)

<b>ECO115SL Mechanical-Bearing Screw-Driven Linear Stage (continued)</b>	
<b>Limits (Required)</b>	
-LI1	Normally-closed limit switches, 5 VDC with 9-pin D connector
-LI2	Normally-open limit switches, 5 VDC with 9-pin D connector
<b>Coupling (Optional)</b>	
-CP1	Coupling for 0.250 in diameter shaft
-CP2	Coupling for 0.375 in diameter shaft
<b>Metrology (Required)</b>	
-PL0	No Metrology Performance Plots
-PL1	Uncalibrated with Performance Plots
-PL2	Calibrated with Performance Plots
<b>Accessories (ordered as a separate line item)</b>	
ALIGN-NPA	Non-precision XY assembly
ALIGN-NPAZ	Non-precision XZ or YZ assembly
ALIGN-PA10	XY assembly; 10 arc sec orthogonality; alignment to within 7 $\mu\text{m}$ orthogonality for short travel stages
ALIGN-PA10Z	XZ or YZ assembly with L-bracket; 10 arc second orthogonality; alignment to within 10 $\mu\text{m}$ orthogonality for short travel stages
ALIGN-PA5	XY assembly; 5 arc sec orthogonality; alignment to within 3 $\mu\text{m}$ orthogonality for short travel stages
ALIGN-PA5Z	XZ or YZ assembly with L-bracket; 5 arc second orthogonality; alignment to within 5 $\mu\text{m}$ orthogonality for short travel stages
HDZ115	Right angle L-bracket for 50 mm, 100 mm, and 150 mm travels only; <b>NOTE:</b> Requires a tabletop when mounting to an ECO series stage

## 1.1. Environmental Specifications



**WARNING: General Hazard Warning!** Do not expose this product to environments or conditions outside of the listed specifications. You could damage the equipment if you exceed the environmental or operating specifications.



**DANGER: Risk of Explosive Atmosphere!**

- Standard Aerotech stage/motors are not rated for applications with explosive atmospheres such as air-born dust or combustible vapors.
- Do not operate stage/motors outside of Aerotech environmental specifications.

**Table 1-2: Environmental Specifications**

<b>Ambient Temperature</b>	Operating: 10° to 35° C (50° to 95° F) The optimal operating temperature is 20° C $\pm$ 2° C (68° F $\pm$ 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
<b>Humidity</b>	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.
<b>Altitude</b>	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.
<b>Vibration</b>	Use the system in a low vibration environment. Floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application.
<b>Protection Rating</b>	These stages have an ingress protection rating of IP10.
<b>Use</b>	Indoor use only

## 1.2. Accuracy and Temperature Effects

Aerotech products are designed for and built in a 20°C (68°F) environment. Temperature changes could cause a decrease in performance or permanent damage to the stage. At a minimum, the environmental temperature must be controlled to within 0.25°C per 24 hours to ensure the stage specifications are repeatable over an extended period of time. The severity of temperature effects on all specifications depends on many different environmental conditions, which include how the stage is mounted. Contact the factory for more details.

The accuracy specification of stage 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 2.2](#).

The accuracy of the screw is a key element in the overall positioning accuracy of the SL 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

Resolution is dependent on screw pitch, encoder resolution, and controller interpolation.

**Table 1-3: ECO115SL Series Specifications (-050 to -250)**

		-050	-100	-150	-200	-250
Travel		50 mm	100 mm	150 mm	200 mm	250 mm
Accuracy <sup>(1)</sup>	Standard	±18 µm	±23 µm	±27 µm	±30 µm	±34 µm
	Calibrated	±5 µm	±5 µm	±5 µm	±5.5 µm	±5.5 µm
Resolution (Minimum Incremental Motion)		0.2 µm <sup>(2)</sup> , 0.75 µm <sup>(3)</sup>				
Bidirectional Repeatability <sup>(1)</sup>		±4 µm	±4 µm	±4 µm	±4.5 µm	±4.5 µm
Straightness <sup>(1)</sup>		±2 µm	±3 µm	±4 µm	±5 µm	±6 µm
Flatness <sup>(1)</sup>		±2 µm	±3 µm	±4 µm	±5 µm	±6 µm
Pitch		35 µrad (7.2 arc sec)	40 µrad (8.3 arc sec)	40 µrad (8.3 arc sec)	50 µrad (10.3 arc sec)	60 µrad (12.4 arc sec)
Roll		35 µrad (7.2 arc sec)	40 µrad (8.3 arc sec)	40 µrad (8.3 arc sec)	50 µrad (10.3 arc sec)	60 µrad (12.4 arc sec)
Yaw		35 µrad (7.2 arc sec)	40 µrad (8.3 arc sec)	40 µrad (8.3 arc sec)	50 µrad (10.3 arc sec)	60 µrad (12.4 arc sec)
Maximum Speed <sup>(4)</sup>		300 m/s				
Maximum Acceleration <sup>(4)</sup>		Function of motor, amplifier, payload, and maximum axial load				
Load Capacity <sup>(5)</sup>	Horizontal	40 kg				
	Vertical (Axial)	18 kg				
	Side	40 kg				
Moving Mass with tabletop		1.7 kg				
Stage Mass with no motor		3.8 kg	4.1 kg	4.5 kg	4.9 kg	5.3 kg
Material		Anodized Aluminum				
Mean Time Before Failure		20,000 Hours				
1. Certified with -PL1 and -PL2 option. 2. Achieved with Aerotech rotary motor with amplified sine encoder. 3. Achieved with Aerotech rotary motor with 2500 counts/rev digital encoder. 4. Requires the selection of an applicable amplifier with sufficient voltage and current. 5. Axis orientation for on-axis loading is listed. 6. Specifications are for single-axis systems measured 25 mm above the tabletop; performance of multi-axis system depend upon the payload and workpoint. Consult the Aerotech factory for multi-axis or non-standard applications. 7. Specifications listed are non-foldback kit options. Contact the factory for specifications when a foldback kit (-FBx) is used.						

**Table 1-4: ECO115SL Series Specifications (-300 to -600)**

		-300	-400	-500	-600
Travel		300 mm	400 mm	500 mm	600 mm
Accuracy <sup>(1)</sup>	Standard	±38 µm	±43 µm	±45 µm	±48 µm
	Calibrated	±5.5 µm	±6 µm	±6 µm	±7 µm
Resolution (Minimum Incremental Motion)		0.2 µm <sup>(2)</sup> , 0.75 µm <sup>(3)</sup>			
Bidirectional Repeatability <sup>(1)</sup>		±4.5 µm	±5 µm	±5 µm	±5 µm
Straightness <sup>(1)</sup>		±7 µm	±9 µm	±11 µm	±13 µm
Flatness <sup>(1)</sup>		±7 µm	±9 µm	±11 µm	±13 µm
Pitch		70 µrad (14.4 arc sec)	90 µrad (18.6 arc sec)	110 µrad (22.7 arc sec)	130 µrad (26.8 arc sec)
Roll		70 µrad (14.4 arc sec)	90 µrad (18.6 arc sec)	110 µrad (22.7 arc sec)	130 µrad (26.8 arc sec)
Yaw		70 µrad (14.4 arc sec)	90 µrad (18.6 arc sec)	110 µrad (22.7 arc sec)	130 µrad (26.8 arc sec)
Maximum Speed <sup>(4)</sup>		300 m/s			
Maximum Acceleration <sup>(4)</sup>		Function of motor, amplifier, payload, and maximum axial load			
Load Capacity <sup>(5)</sup>	Horizontal	40 kg			
	Vertical (Axial)	18 kg			
	Side	40 kg			
Moving Mass (with tabletop)		1.7 kg			
Stage Mass (no motor)		5.7 kg	6.4 kg	7.2 kg	8.0 kg
Material		Anodized Aluminum			
Mean Time Before Failure		20,000 Hours			
<p>1. Certified with -PL1 and -PL2 option.</p> <p>2. Achieved with Aerotech rotary motor with amplified sine encoder.</p> <p>3. Achieved with Aerotech rotary motor with 2500 counts/rev digital encoder.</p> <p>4. Requires the selection of an applicable amplifier with sufficient voltage and current.</p> <p>5. Axis orientation for on-axis loading is listed.</p> <p>6. Specifications are for single-axis systems measured 25 mm above the tabletop; performance of multi-axis system depend upon the payload and workpoint. Consult the Aerotech factory for multi-axis or non-standard applications.</p> <p>7. Specifications listed are non-foldback kit options. Contact the factory for specifications when a foldback kit (-FBx) is used.</p>					

## 1.4. Vacuum Operation

There are two vacuum preparation options:

- Low Vacuum (for use in atmospheric pressures to  $10^{-3}$  Torr)
- High Vacuum (preparation for environments from  $10^{-3}$  to  $10^{-6}$  Torr).

Special preparations include:

- Parts are lubricated with vacuum-compatible lubricants.
- Materials, fasteners, and coatings are selected to be compatible with the specified level of vacuum.
- High-vacuum systems are designed to eliminate trapped volumes.
- Prior to assembly, stage parts are thoroughly cleaned in a clean environment.
- The stage is packaged in a special polyethylene bag.

### Vacuum Guidelines

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

1. Do not remove the stage from its sealed bag until it is ready to use.
2. Always handle the stage in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the stage.
3. During installation, use cleaned, vented, stainless steel fasteners to secure the stage.
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. We recommend that you use a small quantity of **Braycote® 602EF** grease or a compatible substitute of equal quality lubricant in vacuum applications.
6. To reduce outgassing during the initial pump-down to vacuum pressure, Aerotech recommends that you bake out vacuum systems when you first install them into the vacuum chamber. Bake the vacuum components at 60 °C for 24 to 48 hours to desorb water vapor from surfaces and degas polymers (such as cable insulation).

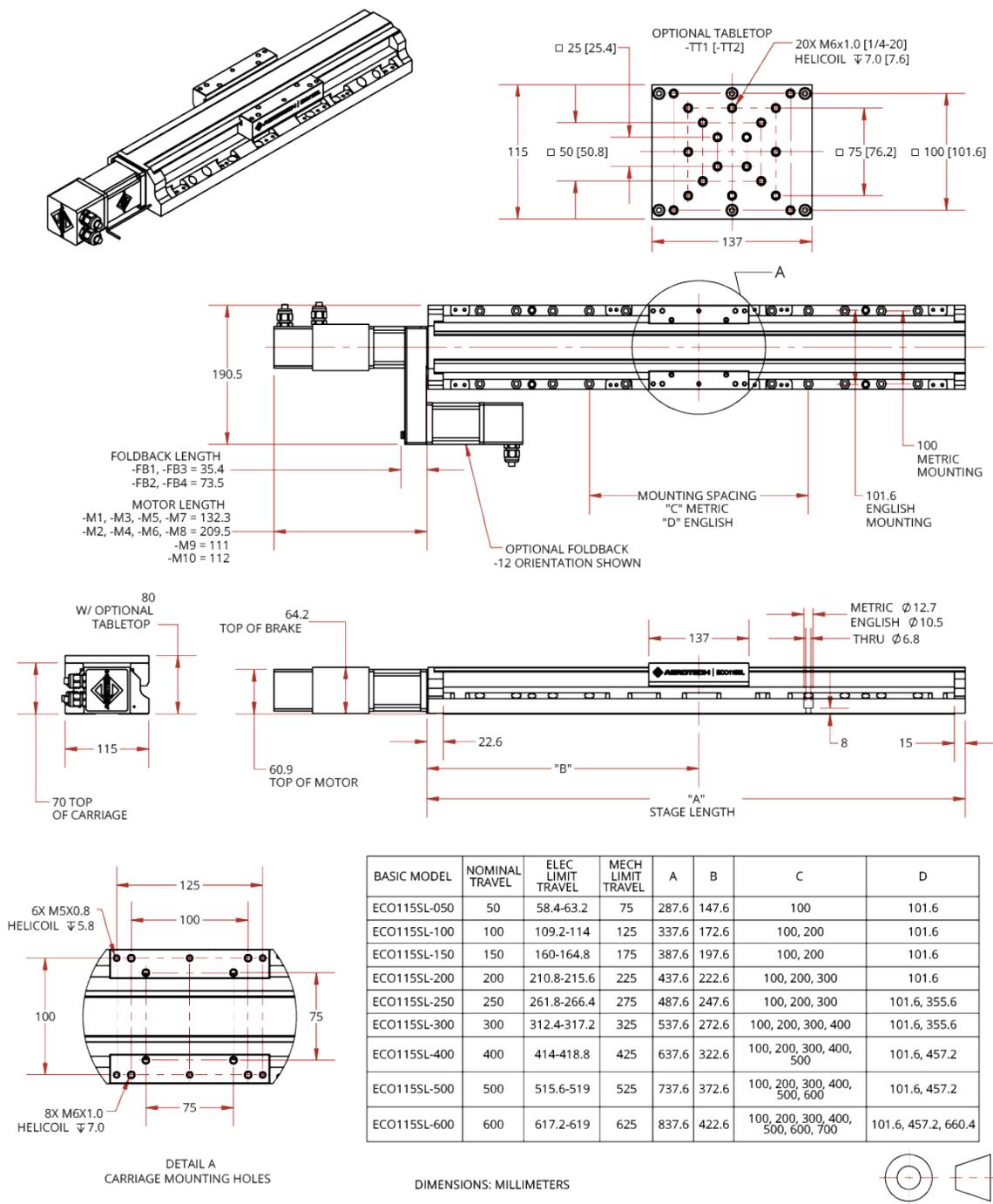
# Chapter 2: Installation



**IMPORTANT:** The stage installation must be in accordance with the 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. Dimensions

Figure 2-1: ECO115SL Dimensions



**Figure 2-2: Tabletop Accessory Dimensions (-TT3 Option)**

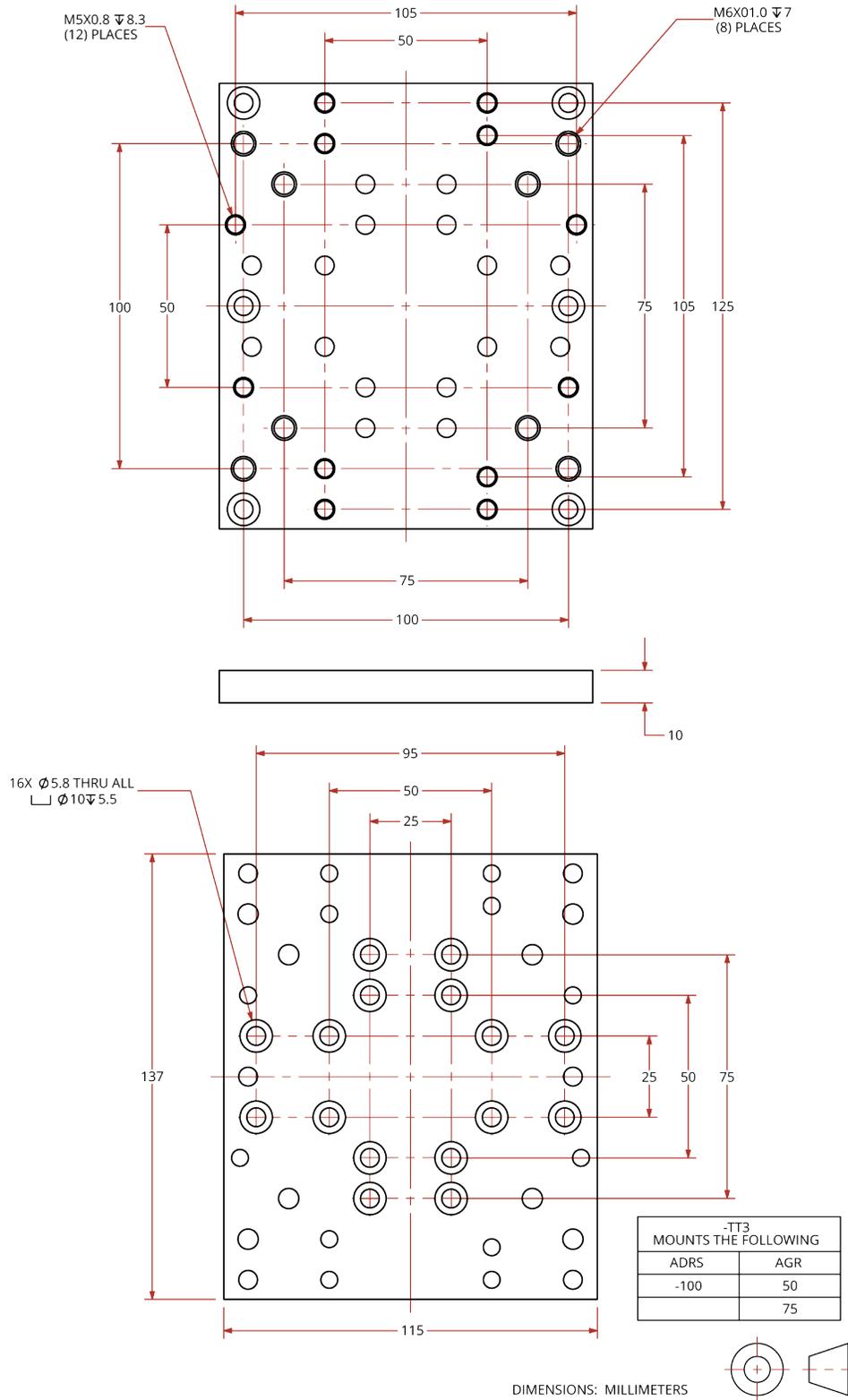
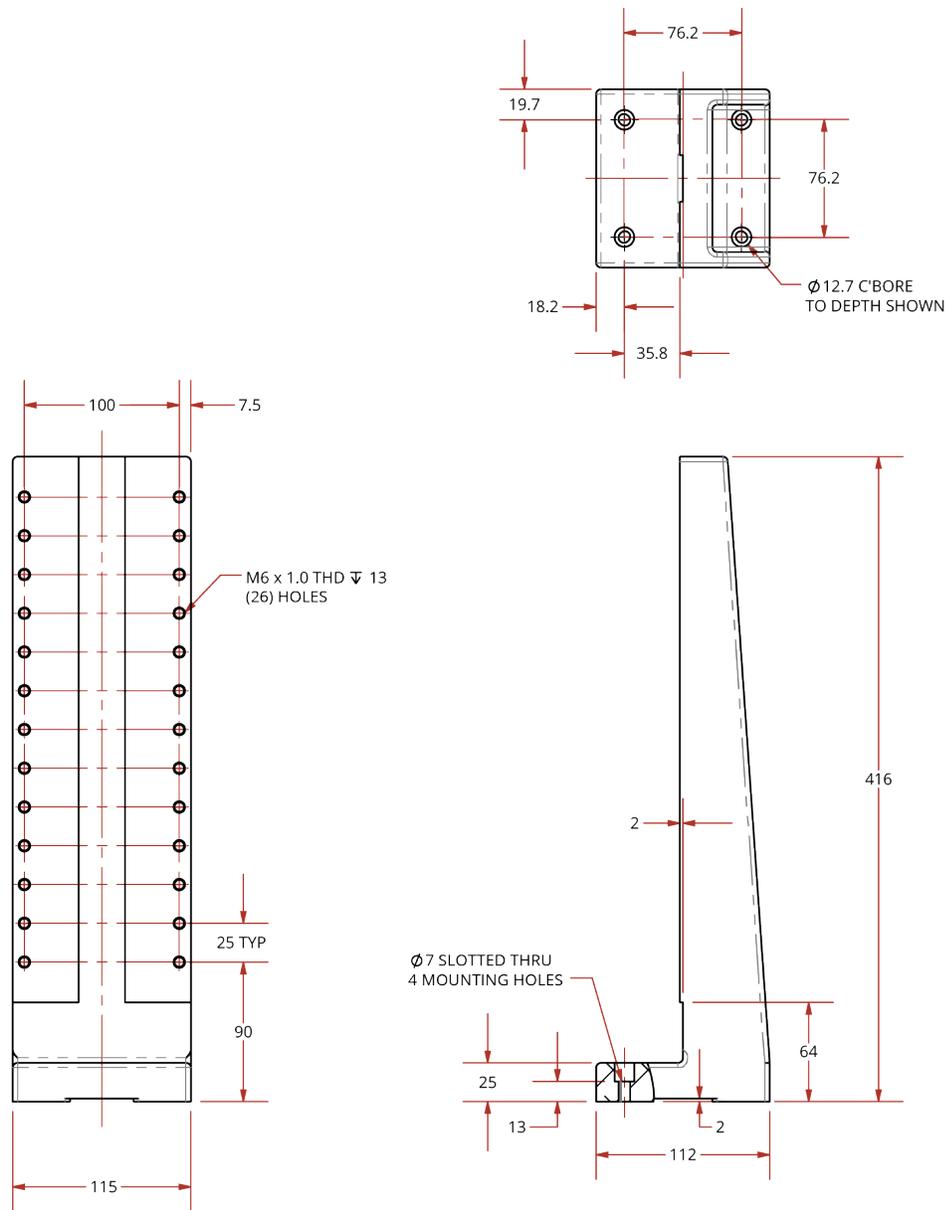
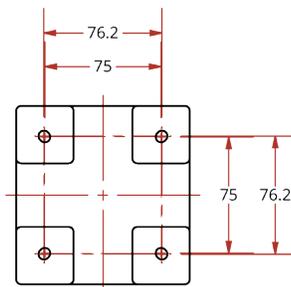
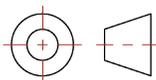


Figure 2-3: Z-Axis Bracket Dimensions



BASIC MODEL	RECOMMENDED FOR	MASS [kg]
HDZ115	PRO115SL-050, PRO115SL-100, PRO115SL-150, ECO115SL-050, ECO115SL-100, ECO115SL-150	3.7

DIMENSIONS: MILLIMETERS



## 2.2. Securing the Stage to the Mounting Surface

### **DANGER: Mechanical Hazard!**



Personnel must be made aware of the mechanical hazards during set up or when you do service to the stage.

- Do not manually move the stage if it is connected to a power source.
- The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.
- When you move the tabletop manually to do maintenance, this could expose the operator to pinch points. Refer to [Pinch Points](#) on [Page 11](#).

The mounting surface must be flat and have adequate stiffness to achieve the maximum performance from the 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.



**IMPORTANT:** The stage 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 stage. Shimming should be avoided if possible. If shimming is required, it should be minimized to retain maximum rigidity of the system.

**Table 2-1: Stage Mounting Surface Flatness Requirement**

Stage Travel	Flatness Requirement
All Travels	7.5 $\mu\text{m}$

If necessary, manually move the stage table to access the mounting holes along the edges of the stage. This stage is designed to use socket head cap screws (SHCS) to secure the base to the mounting surface.



**IMPORTANT:** The stage table may offer a considerable amount of resistance when it is moved manually.

- Do not attempt to manually move the stage if it is connected to a power source or includes an integrated brake.

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 2-2](#) are typical values and may not be accurate for your mounting surface. Refer to [Section 2.1](#) for mounting locations and dimensions.

**Table 2-2: Stage to Mounting Surface Hardware**

Mounting Hardware	Typical Screw Torque
M6 x 18 mm (or 1/4" x 3/4") SHCS with flat washers	7 N·m [5 ft·lb]

## 2.3. Attaching the Payload to the Stage

Inspect the mounting surface for dirt or unwanted residue and clean if necessary. 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.

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 [Chapter 3: Electrical Installation](#) and the documentation delivered with the stage.



**IMPORTANT:** If your ECO115SL was purchased with Aerotech controls, it could have been tuned with a representative payload based on the information provided at the time of order. If you start the ECO115SL 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.



**IMPORTANT:** For valid system performance, the mounting interface should be flat within 12  $\mu\text{m}$ .



**WARNING: General Hazard Warning!**

Be careful when you attach the payload to the stage table.

- If a screw extends through the stage table, it can affect travel and damage the stage.
- Refer to the dimensions in [Section 2.1](#), for maximum allowable thread engagement.

Applied loads should be symmetrically distributed whenever possible. The payload should be centered on the stage table and the entire stage should be centered on the support structure.

For a cantilevered load, first determine if it is a **Vertical**, **Horizontal**, or a **Side** cantilever system (refer to [Figure 2-4](#)).

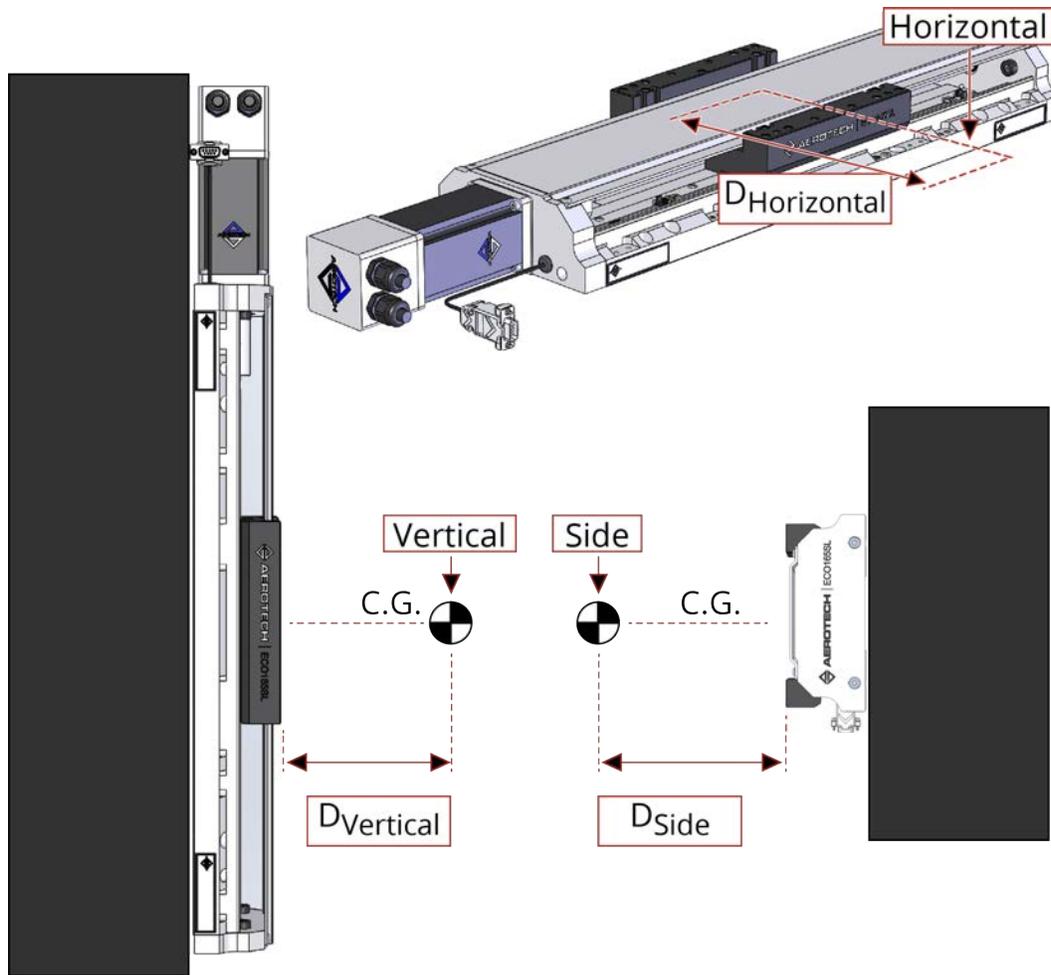
The **Vertical** curve is for situations where the stage is mounted in a vertical orientation and the payload is mounted to the table top with its center of gravity extended outward in a direction normal to the tabletop surface. Refer to [Figure 2-6](#) or [Figure 2-7](#) for torque requirements on a vertical orientation.

The **Horizontal** curve assumes a horizontal stage orientation with the payload offset extending outwards along the surface of the tabletop.

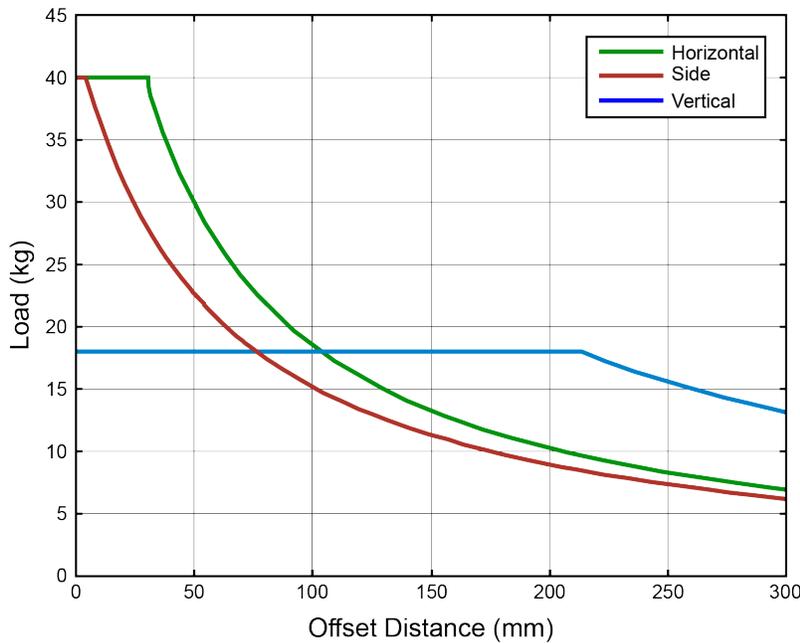
The **Side** curve is for situations where the stage is mounted on its side and the offset load extends outwards in a direction normal to the tabletop surface.

Measure the cantilever length, then find the corresponding load value from [Figure 2-5](#).

Figure 2-4: Stage Orientations



**Figure 2-5: Cantilevered Load Capability**



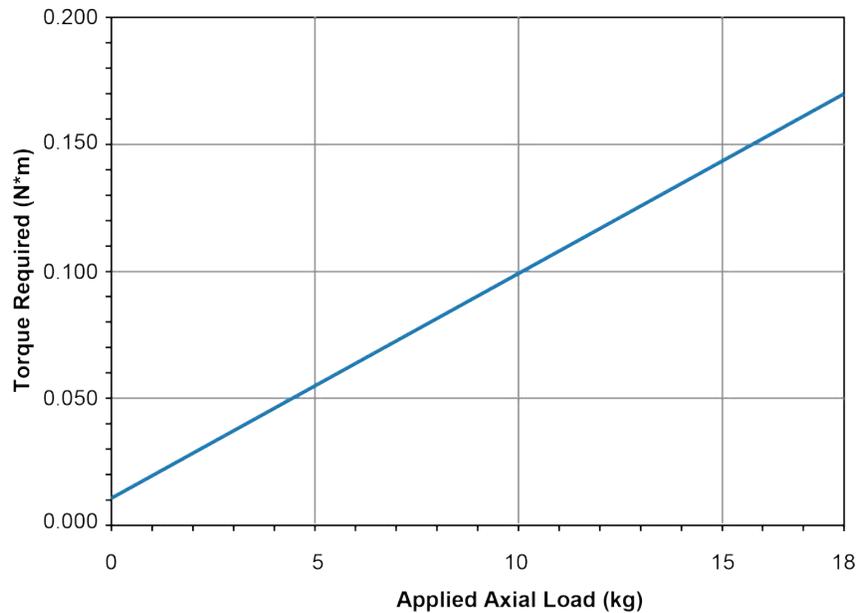
The approximate amount of torque required to turn the ball screw of ECO115SL series stages can be found from [Figure 2-7](#) or the following equation:

**Figure 2-6: Load Torque Equation**

$$Torque_{REQ} = \frac{(AxialLoad) \times (LeadofScrew)}{2 \times \pi \times (Efficiency)}$$

For ECO115SL series stages, the ball screw efficiency is rated at 90% (0.90). Refer to [Section 1.3](#) for Load Capacity specifications.

**Figure 2-7: Torque Required to Turn Ball Screw in Vertical Orientation**



## Chapter 3: Electrical Installation

### **DANGER: Electrical Shock Hazard!**



- Stage motor phase voltage levels could be hazardous live.
- Personnel are protected from hazardous voltages unless electrical interconnections, protective bonding (safety ground), or motor/stage enclosures are compromised.
- Do not connect or disconnect stage/motor interconnections while connected to a live electrical power source.
- Before you set up or do maintenance, disconnect electrical power.
- It is the responsibility of the End User/System Integrator to make sure that stages are properly connected and grounded per Engineering Standards and applicable safety requirements.
- It is the responsibility of the End User/System Integrator to configure the system drive or controller within the Aerotech motor/stage electrical and mechanical specifications.

### **WARNING: General Hazard Warning!**



Applications that require access to the ECO115SL must be restricted to qualified and trained personnel. The system integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements when they integrate the ECO115SL into a completed system.

Electrical installation requirements will depend on the ordered product options. Installation instructions in this section are for Aerotech products equipped with standard Aerotech motors intended for use with an Aerotech motion control system. Contact Aerotech for further information on products that are otherwise configured.

Aerotech motion control systems are adjusted at the factory for optimum performance. When the ECO115SL is part of a complete Aerotech motion control system, setup should only require that you connect the stage to the appropriate drive chassis with the cables provided. Labels on the system components should indicate the appropriate connections.

If system level integration was purchased, an electrical drawing that shows the 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.



**IMPORTANT:** Refer to the controller documentation to adjust servo gains for optimum velocity and position stability.

### 3.1. Motor and Feedback Connectors

Stages equipped with standard motors and encoders come from the factory completely wired and assembled.



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



**IMPORTANT:** If you are using standard Aerotech motors and cables, motor and encoder connection adjustments are not required.

The protective ground connection of the ECO115SL provides motor frame ground protection only. Additional grounding and safety precautions are required for applications requiring access to the stage while it is energized. 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: Electrical Shock Hazard!**

- The protective ground connection must be properly installed to minimize the possibility of electric shock.
- The stage controller must provide over-current and over-speed protection. Failure to do so could cause electric shock or damage to the equipment.

**Table 3-1: Brushless Motor Connector Pinout [-M1 to -M8]**

Pin	Description	Connector
Case	Shield Connection	
A1	Motor Phase A	
A2	Motor Phase B	
A3	Motor Phase C	
1	Reserved	
2	Reserved	
3	Reserved	
4	Reserved	
5	Reserved	
A4	Frame Ground (motor protective ground)	

**Table 3-2: Mating Connector Part Numbers for the Brushless Motor Connector**

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK00656	Amphenol #17E-1726-2
Sockets [QTY. 4]	ECK00659	ITT Cannon #DM53744-6
Connector	ECK00657	ITT Cannon #DBM9W4SA197

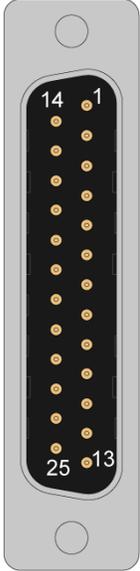
**Table 3-3: Stepper Motor Connector Pinout [-M9 and -M10]**

Pin	Description	Connector
A1	Motor Phase A	
A2	Motor Phase B	
A3	Motor Phase A Return	
1	Brake - (with Brake Option)	
2	Brake + (with Brake Option)	
3	Reserved	
4	Frame Ground (motor protective ground)	
5	Frame Ground (motor protective ground)	
A4	Motor Phase B Return	

**Table 3-4: Mating Connector Part Numbers for the Stepper Motor Connector**

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK00656	Amphenol #17E-1726-2
Sockets [QTY. 4]	ECK00659	ITT Cannon #DM53744-6
Connector	ECK00657	ITT Cannon #DBM9W4SA197

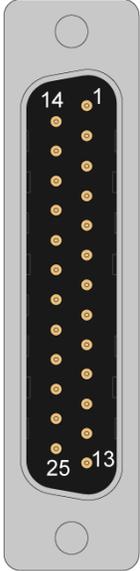
**Table 3-5: Brushless Motor Feedback Connector Pinout [-M1 to -M8]**

Pin	Description	Connector
Case	Shield Connection	
1	Reserved	
2	BMS Motors: Over-Temperature Thermistor Sensor BM Motors: Reserved	
3	5V Power Supply Input	
4	Reserved	
5	Hall Effect Sensor (Phase B)	
6	MRK- (Encoder Marker-)	
7	MRK+ (Encoder Marker+)	
8	Reserved	
9	Reserved	
10	Hall Effect Sensor (Phase A)	
11	Hall Effect Sensor (Phase C)	
12	Reserved	
13	Reserved Brake - (with Brake Option)	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	Reserved	
17	SIN+ (Encoder Sine+)	
18	SIN- (Encoder Sine-)	
19	Reserved	
20	Common ground	
21	Common ground	
22	Reserved	
23	Reserved	
24	Reserved	
25	Reserved Brake + (with Brake Option)	

**Table 3-6: Mating Connector Part Numbers for the Brushless Motor Feedback Connector**

Mating Connector	Aerotech P/N	Third Party P/N
25-Socket D-Connector	ECK00300	FCI DB25S064TLF
Backshell	ECK00656	Amphenol 17E-1726-2

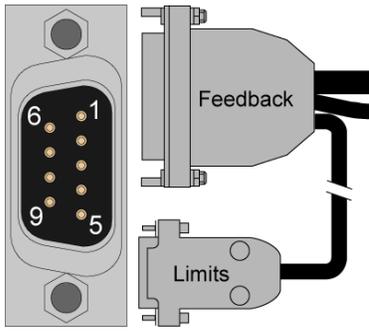
**Table 3-7: Stepper Motor Feedback Connector Pinout [-M9 and -M10]**

Pin	Description	Connector
Case	Shield Connection	
1	Reserved	
2	Reserved	
3	5V Power Supply Input	
4	Reserved	
5	Reserved	
6	MRK- (Encoder Marker-)	
7	MRK+ (Encoder Marker+)	
8	Reserved	
9	Reserved	
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	5V Power Supply Input	
17	SIN+ (Encoder Sine+)	
18	SIN- (Encoder Sine-)	
19	Reserved	
20	Common	
21	Common	
22	Reserved	
23	Reserved	
24	Reserved	
25	Reserved	

**Table 3-8: Mating Connector Part Numbers for the Stepper Motor Feedback Connector**

Mating Connector	Aerotech P/N	Third Party P/N
25-Socket D-Connector	ECK00300	FCI DB25S064TLF
Backshell	ECK00656	Amphenol 17E-1726-2

**Table 3-9: Limit Connector Wiring**

Pin	Description	Limits Connector
Case	Shield Connection	
1	5V Power Supply Limit Input	
2	Limit Common	
3	+Limit/CW (Positive/Clockwise Travel Limit)	
4	Home Limit	
5	-Limit/CCW (Negative/Counterclockwise Limit)	
6	Reserved	
7	Common ground	
9	Reserved	

**Table 3-10: Mating Connector Part Numbers for the Limit Connector**

Mating Connector	Aerotech P/N	Third Party P/N
9-Pin D-Connector	ECK00340	FCI DE09S064TLF
Backshell	ECK01021	Amphenol 17E-1724-2

### 3.2. Motor and Feedback Wiring

Shielded cables are required for the motor and feedback connections.

**Figure 3-1: Brushless Motor and Feedback Wiring [-M1 through -M8 Options]**

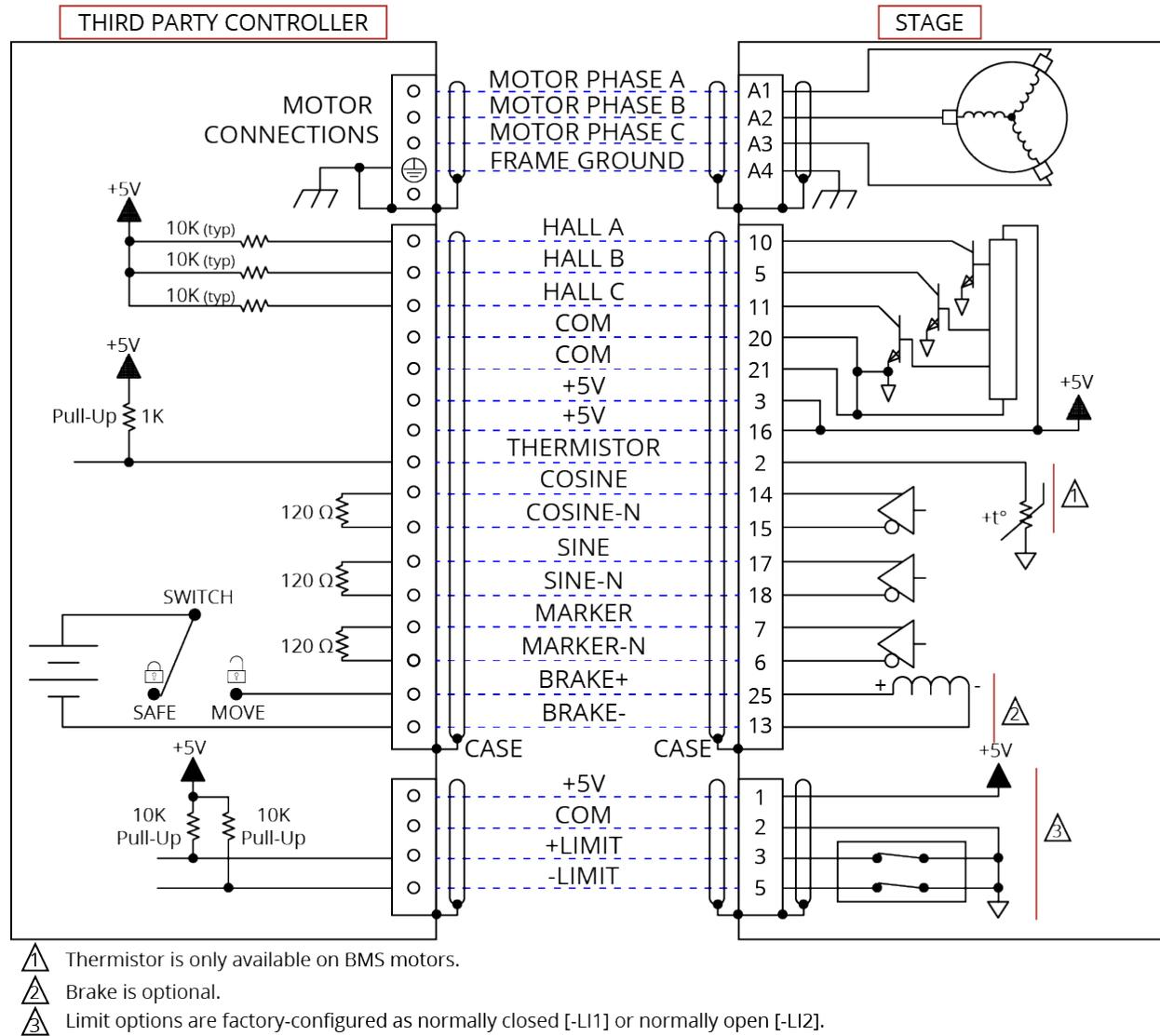
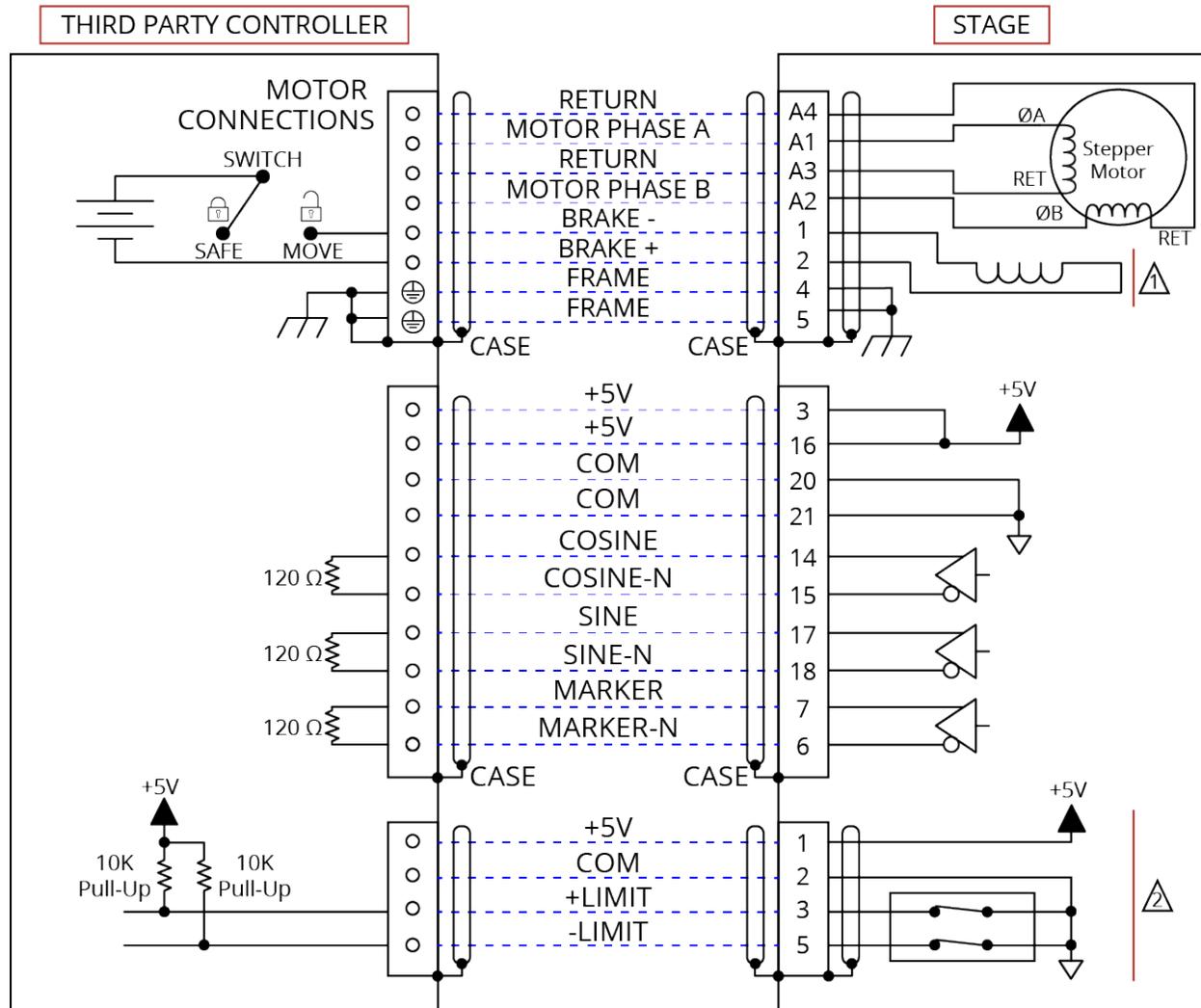


Figure 3-2: Stepper Motor and Feedback Wiring [-M9 and -M10 Options]



### 3.3. Motor and Feedback Specifications



**IMPORTANT:** All 5 V supplies share one common connection within the stage.

**Table 3-11: Hall-Effect Sensor Specifications**

	Specification
Supply Voltage	5 V $\pm$ 5%
Supply Current	50 mA
Output Type	Open Collector
Output Voltage	24 V max (pull up)
Output Current	5 mA (sinking)

**Table 3-12: Thermistor Specifications (BMS Motor Options)**

	Specification
Polarity	Logic "0" (no fault)
	Logic "1" (over-temperature fault)
Cold Resistance	$\sim$ 100 $\Omega$
Hot Resistance	$\sim$ 10 K

**Note:** 1K pull-up to +5V recommended.

**Table 3-13: Encoder Specifications**

	Specification
Supply Voltage	5 V $\pm$ 5%
Supply Current	250 mA (typical)
Output Signals (Differential)	<p><b>Sinusoidal Type (Incremental Encoder):</b> Analog: SIN+, SIN-, COS+, COS-, 1V<sub>pk-pk</sub>; Digital (RS422): MRK+, MRK- signals.</p> <p><b>Digital Output (Incremental Encoder):</b> TTL Encoder line-driver signals; RS422/485 compatible</p>

**Table 3-14: Limit Switch Specifications**

	-LI1 Option	-LI2 Option
Supply Voltage	5 V	5 V
Supply Current	25 mA	
Output Type	Open Collector	
Output Voltage	5 V	5 V
Output Current	10 mA (sinking)	10 mA (sinking)
Output Polarity <sup>(2)</sup> (Factory Configured)	<p><b>Normally Closed (NC)</b></p> <ul style="list-style-type: none"> <li>Not In Limit: Sinks current to ground (Logic "0")</li> <li>In Limit: High impedance (Logic "1")</li> </ul>	<p><b>Normally Open (NO)</b></p> <ul style="list-style-type: none"> <li>Not In Limit: High impedance (Logic "1")</li> <li>In Limit: Sinks current to ground (Logic "0")</li> </ul>

**Notes:**

- If you drive the ECO115SL beyond the electrical limit, it will encounter a mechanical stop. An impact against the mechanical stop could cause damage to the stage.
- LI1 and -LI2 must have an external pull-up to +5 V (10 k $\Omega$  recommended).

**Table 3-15: Brake Specifications**

	Specification
Supply Voltage	24 VDC
Supply Current (typical)	250 mA (current required to release the brake and allow motion)

**Table 3-16: ECO115SL Motor Specifications (BMS60)**

		BMS60
<b>Performance Specifications</b> <sup>(1, 5)</sup>		
Stall Torque, Continuous <sup>(2)</sup>	N·m (oz·in)	0.33 (46.2)
Peak Torque <sup>(3)</sup>	N·m (oz·in)	1.31 (184.9)
Rated Power Output, Continuous	W	116
<b>Electrical Specifications</b> <sup>(5)</sup>		
Winding Designation		-A
BEMF Constant (Line-Line, Max)	$V_{pk}/k_{rpm}$	19.0
Continuous Current, Stall <sup>(2)</sup>	$A_{pk} (A_{rms})$	2.3 (1.6)
Peak Current, Stall <sup>(3)</sup>	$A_{pk} (A_{rms})$	9.2 (6.5)
Torque Constant <sup>(4, 8)</sup>	$N\cdot m/A_{pk}$ (oz·in/ $A_{pk}$ )	0.140 (20.10)
	$N\cdot m/A_{rms}$ (oz·in/ $A_{rms}$ )	0.200 (28.40)
Motor Constant <sup>(2, 4)</sup>	$N\cdot m/\sqrt{W}$ (oz·in/ $\sqrt{W}$ )	0.050 (7.02)
Resistance, 25°C (Line-Line)	$\Omega$	8.40
Inductance (Line-Line)	mH	1.30
Maximum Bus Voltage	$V_{DC}$	340
Thermal Resistance	$^{\circ}C/W$	1.73
Number of Poles	--	8
<p>1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.</p> <p>2. Values shown @ 75°C rise above a 25 °C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink</p> <p>3. Peak torque assumes correct rms current; consult Aerotech</p> <p>4. Force constant and motor constant specified at stall</p> <p>5. All performance and electrical specifications <math>\pm 10\%</math>.</p> <p>6. Maximum winding temperature is 100 °C (thermistor trips at 100 °C).</p> <p>7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures.</p> <p>8. All Aerotech amplifiers are rated <math>A_{pk}</math>; use torque constant in <math>N\cdot m/A_{pk}</math> when sizing.</p>		

**Table 3-17: ECO115SL Motor Specifications (BM75)**

		BM75
<b>Performance Specifications</b> <sup>(1,2)</sup>		
Stall Torque, Continuous <sup>(3)</sup>	N·m (oz·in)	0.51 (72.0)
Peak Torque <sup>(4)</sup>	N·m (oz·in)	1.30 (181.0)
Rated Power Output, Continuous	W	192
<b>Electrical Specifications</b> <sup>(2)</sup>		
BEMF Constant (Line-Line, Max)	$V_{pk}/k_{rpm}$	9.0
Continuous Current, Stall <sup>(3)</sup>	$A_{pk} (A_{rms})$	9.0 (6.4)
Peak Current, Stall <sup>(4)</sup>	$A_{pk} (A_{rms})$	22.5 (15.9)
Torque Constant <sup>(5)</sup>	$N\cdot m/A_{pk}$ (oz·in/ $A_{pk}$ )	0.06 (8.0)
	$N\cdot m/A_{rms}$ (oz·in/ $A_{rms}$ )	0.08 (11.4)
Motor Constant <sup>(3,5)</sup>	$N\cdot m/\sqrt{W}$ (oz·in/ $\sqrt{W}$ )	0.055 (7.84)
Resistance, 25°C (Line-Line)	$\Omega$	1.00
Inductance (Line-Line)	mH	1.42
Maximum Bus Voltage	$V_{DC}$	340
Thermal Resistance	$^{\circ}C/W$	1.18
Number of Poles	--	8
<p>1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.</p> <p>2. All performance and electrical specifications <math>\pm 10\%</math>.</p> <p>3. Values shown @ 105°C rise above a 25 °C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink</p> <p>4. Peak torque assumes correct rms current; consult Aerotech</p> <p>5. Torque constant and motor constant specified at stall.</p> <p>6. Maximum winding temperature is 130 °C.</p> <p>7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures.</p> <p>8. All Aerotech amplifiers are rated <math>A_{pk}</math>; use torque constant in <math>N\cdot m/A_{pk}</math> when sizing.</p>		

**Table 3-18: ECO115SL Motor Specifications (SM60-VT2)**

	<b>SM60-VT2</b>
NEMA Motor Frame Size	NEMA 23
Stall Torque	1.41 N·m (200 oz·in)
Rated Phase Current	0.84 A
Maximum Voltage Across the Motor	160 V
Rotor Inertia	3.00E-05 kg·m <sup>2</sup> (0.0042 oz·in·s <sup>2</sup> )
Full Step Angle	1.8°
Accuracy	±0.09°
Maximum Radial Load	7.7 kg (17 lb)
Maximum Thrust Load	1.5 kg (3.4 lb)
Weight	0.70 kg (1.54 lb)

**Table 3-19: Rotary Encoder Specifications for ECO115SL Stages**

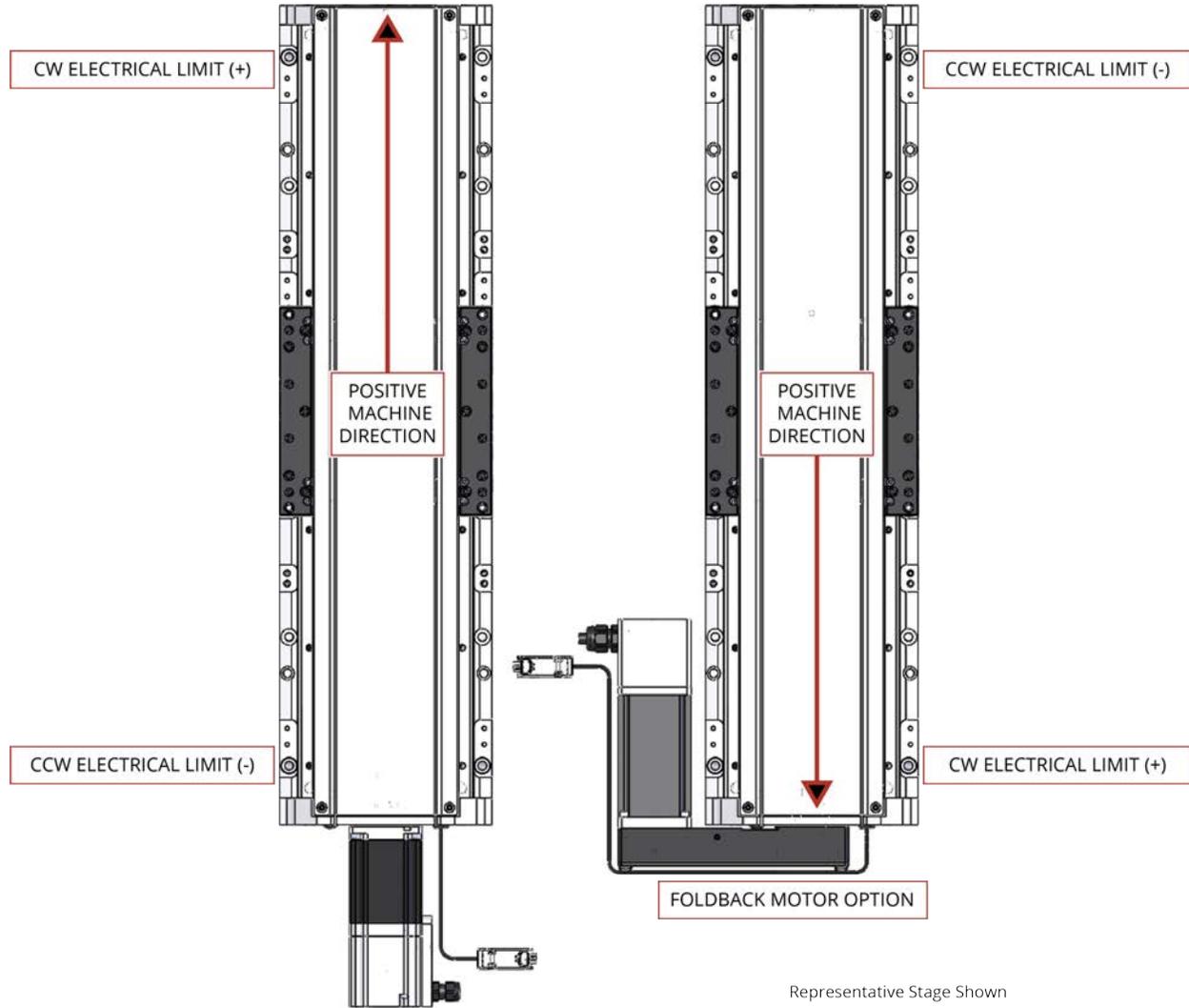
<b>Encoder Option</b>	<b>Fundamental Signal Period</b>	<b>Digital Resolution</b>
-M1, -M2, -M5, -M6 (2500 line TTL signal)	2 μm	0.5 μm
-M3, -M4, -M7, -M8 (1000 line 1Vpp Amplified Sine signal)	5 μm	--
-M3, -M4, -M7, -M8 with 1000x Interpolation <sup>(1)</sup> (1000 line 1Vpp Amplified Sine signal)	5 μm	5 nm
-M3, -M4, -M7, -M8 with 4000x Interpolation <sup>(1)</sup> (1000 line 1Vpp Amplified Sine signal)	5 μm	1.25 nm

1. Quadrature decoding included in interpolated resolution calculations

### 3.4. Limits, Marker, 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 3.2.). 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 ECO115SL stages.

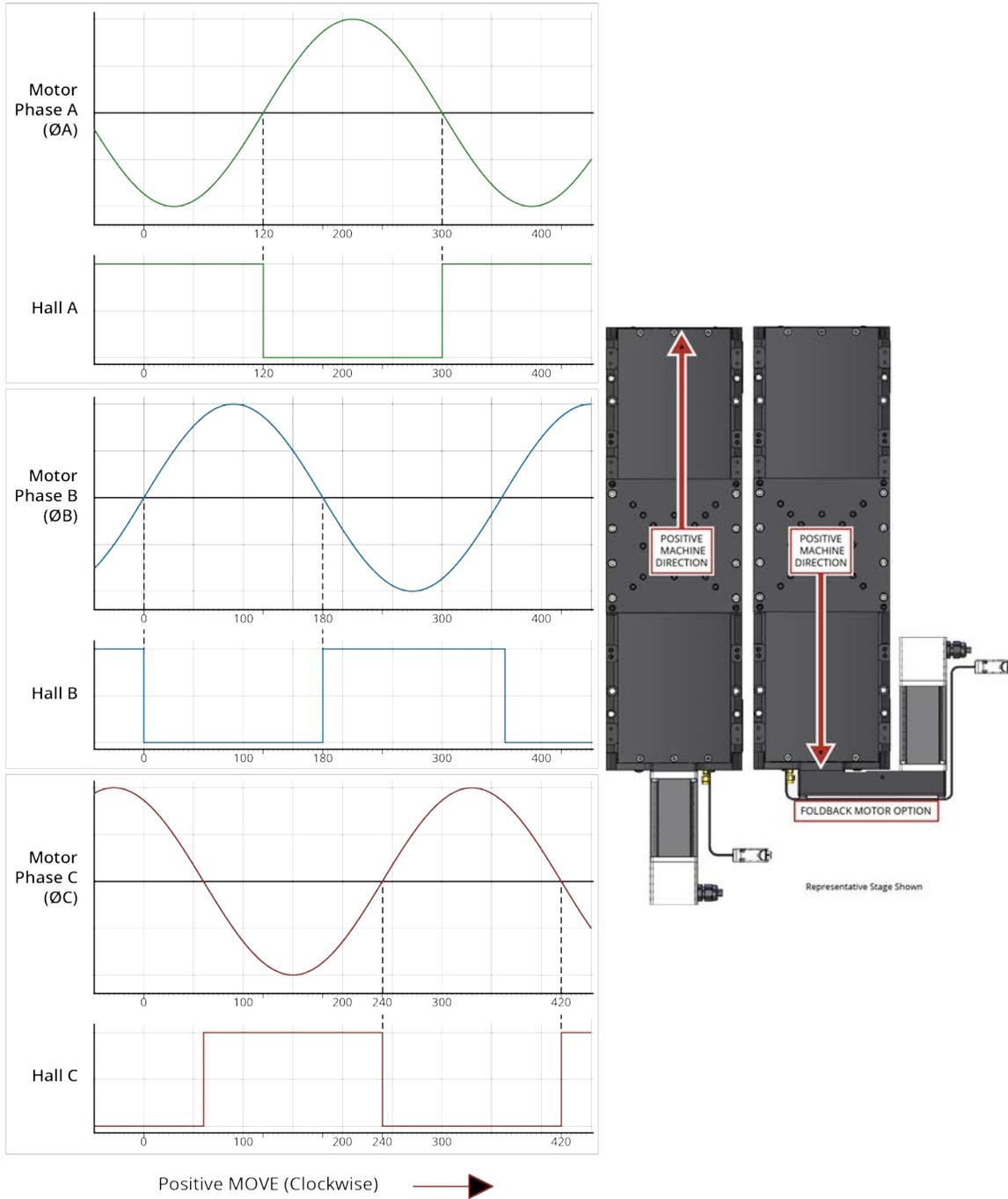
**Figure 3-3: Machine Direction**



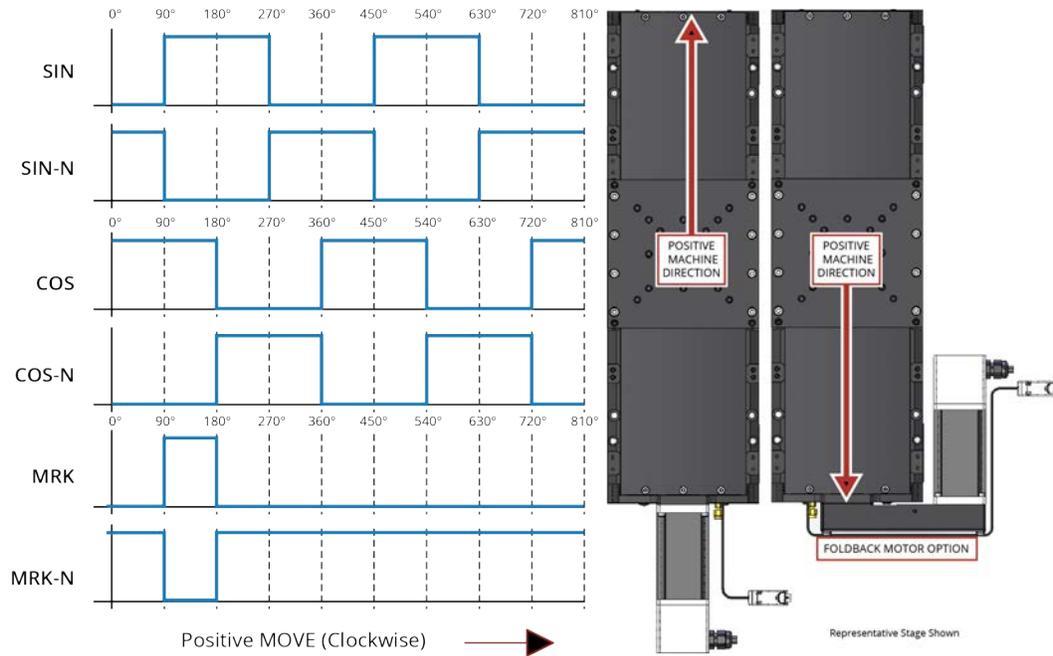
### 3.5. Motor and Feedback Phasing

Motor phase voltage is measured relative to the virtual wye common point.

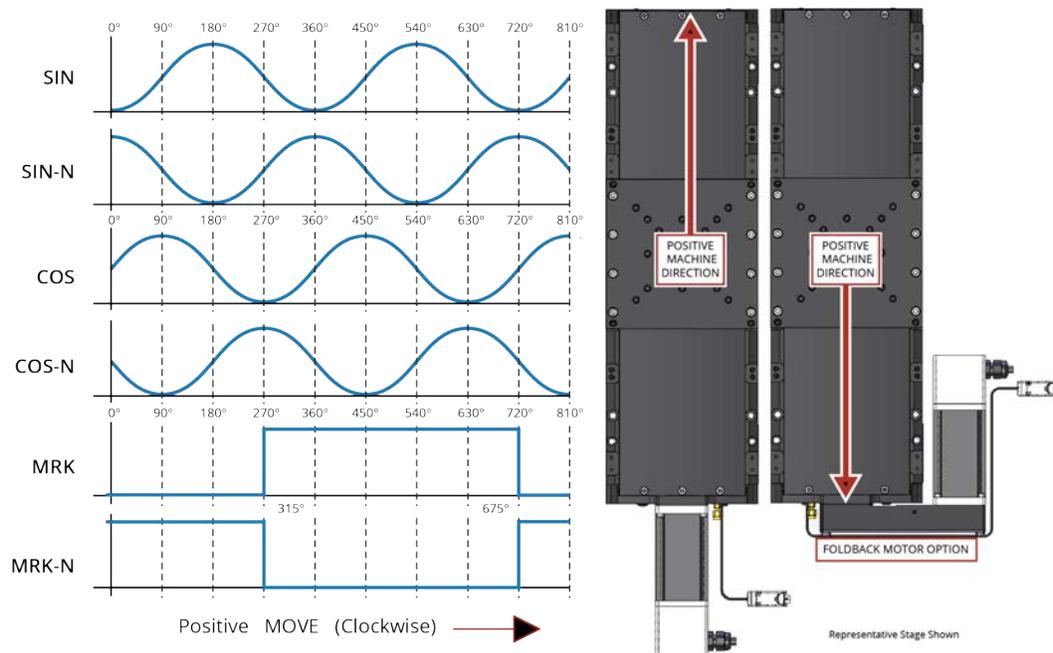
**Figure 3-4: Hall Phasing Diagram**



**Figure 3-5: Encoder Phasing Reference Diagram (Standard/Square Wave)**



**Figure 3-6: Encoder Phasing Reference Diagram (Analog/Sine Wave)**



## Chapter 4: Maintenance



**IMPORTANT:** Read the [Safety Procedures and Warnings](#) (on [Page 7](#)) before you do maintenance to the stage.



**IMPORTANT:** Keep the bearing area free of foreign matter and moisture or the performance and life expectancy of the stage will be reduced.

### 4.1. Service and Inspection Schedule

Inspect the ECO115SL at least once per month. The need for a longer or shorter inspection interval will depend on the application and conditions, such as the duty cycle, speed, and environment.

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 ECO115SL and any components and cables as needed.
- Repair any damage before operating the ECO115SL.
- Inspect and perform an operational check on all safeguards and protective devices.

## 4.2. Cleaning and Lubrication



**DANGER: Electrical Shock Hazard!** Before you do maintenance to the equipment, disconnect the electrical power.



**IMPORTANT:** Wear appropriate personal protective equipment (PPE) when you use cleaning solvents or lubricants.

In general, if the stage operates in a clean environment, it should be cleaned and lubricated annually or every 500 km (whichever comes first). For stages that are operated under conditions with excessive debris, the stage should be cleaned every six months. For high-speed applications (those near max speed at a duty cycle of 50%), more frequent maintenance with standard lubricants will be required.

When you clean and/or lubricate components of the ECO115SL series stage:

1. Be sure to use a clean, dry, soft, lint-free cloth for cleaning.
2. Before you use a cleaning solvent on any part of the stage, blow away small particles and dust with clean, dry, compressed air.
3. Take the opportunity during the lubrication procedure to inspect the motion guides or bearings for any damage or signs of wear.
4. 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.
5. We recommend that you do not disassemble the stage beyond the instructions given in this manual. Proper assembly and calibration can only be done at the factory. Contact Aerotech for more information.

For stages equipped with foldback motors, you should check the belt tension when you clean or lubricate the stage. Refer to [Section 4.4](#).

### Cleaning

Use isopropyl alcohol if you must use a solvent to clean the stage. Harsher solvents, such as acetone, could damage the plastic and rubber seals on the ball screw and bearing trucks.



**WARNING: General Hazard Warning!** Make sure that all solvent has completely evaporated before you move the stage.

### Lubrication

You should only use Kluberplex BEM 34-132 as the standard lubricant for ECO115SL stages.

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.



**IMPORTANT:** During the lubrication procedure, inspect the bearings and ball screw for any damage or signs of wear.



**DANGER: Mechanical Hazards!**

Use extreme caution when you operate the stage without the hardcover.



- **Rotating Machinery!** The ball screw can present a rotating machinery hazard.
- **Pinch Point!** The stage tabletop can present a pinch hazard.

1. Drive the stage table to one end of travel and remove power to the stage.
2. Remove the screws on the edges of the hardcover (Figure 4-1) and slide it out from under the stage (Figure 4-2). This can be done without removing the table.
3. Remove any accumulated dust or debris from the inside of the assembly.
4. Remove any dirty or dried lubricant from the ball screw.
  - Use a clean, lint-free cloth with a side-to-side motion.
  - Use a swab soaked in Isopropyl Alcohol to remove stubborn debris.
5. Move the stage to the opposite end of travel. If the stage has an optional brake, the stage cannot be moved by hand.
  - If the stage has a brake: restore power to the stage, drive it to the desired position, then remove power
  - Redo Steps 3 and 4 for any areas covered by the previous table position.
6. Clean the end of the ball-screw nut and wiper with a clean, lint-free cloth or swab.
7. Clean the linear bearing guides with a clean, lint-free cloth or swab.
8. Apply a thin, continuous film of lubricant to the ball-screw threads and linear bearing guides. Aerotech recommends that you use a good quality, natural bristle artist's brush.
9. Move the stage to the opposite end of travel. If the stage has an optional brake, the stage cannot be moved by hand.
  - If the stage has a brake: restore power to the stage, drive it to the desired position, then remove power.
  - Redo Steps 6 through 8 for any areas covered by the previous table position.
10. Refasten the hardcover.
11. Restore power to the stage and drive the stage table back to its original position to redistribute lubricants.

**Figure 4-1: Hardcover Screw Removal**

The stage shown is representative of all ECOSL stages.

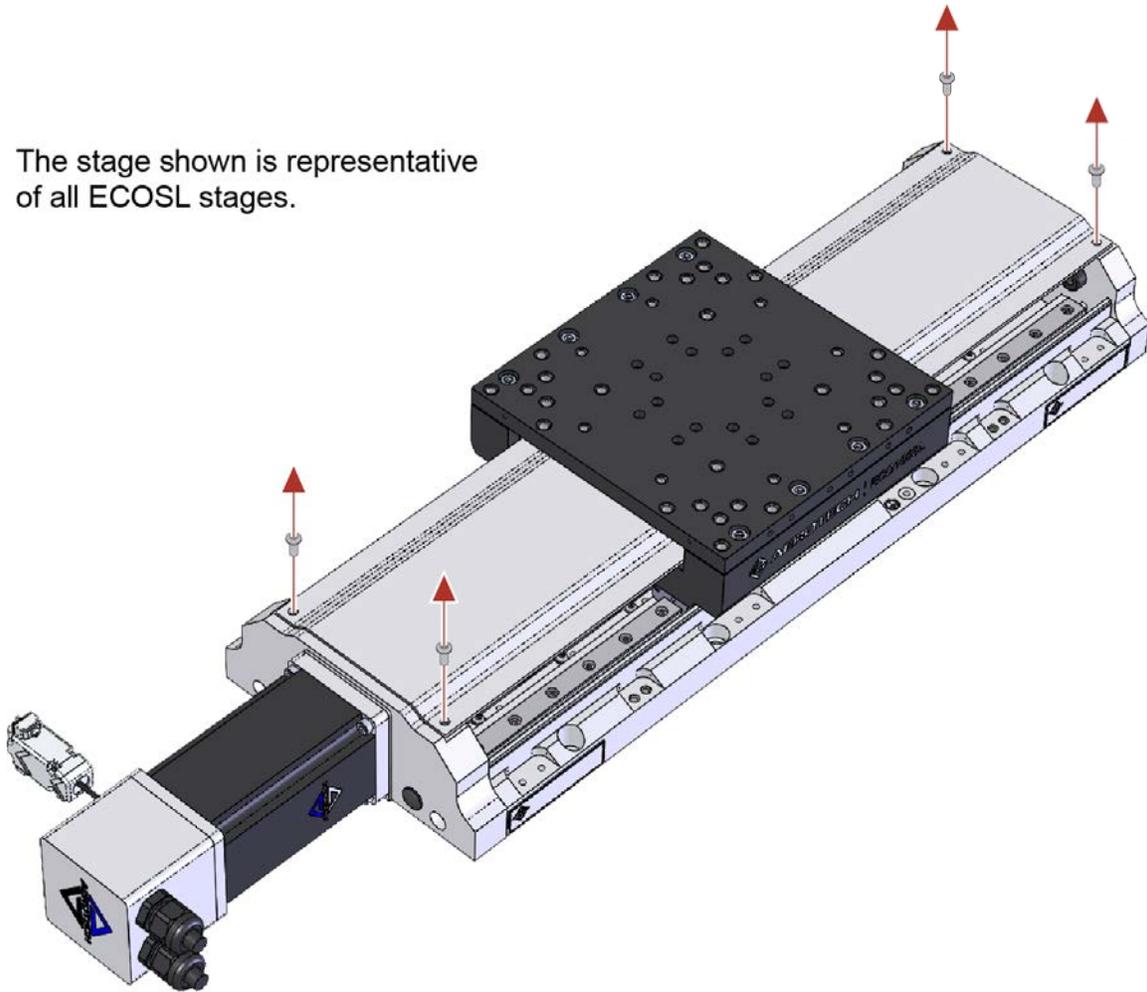
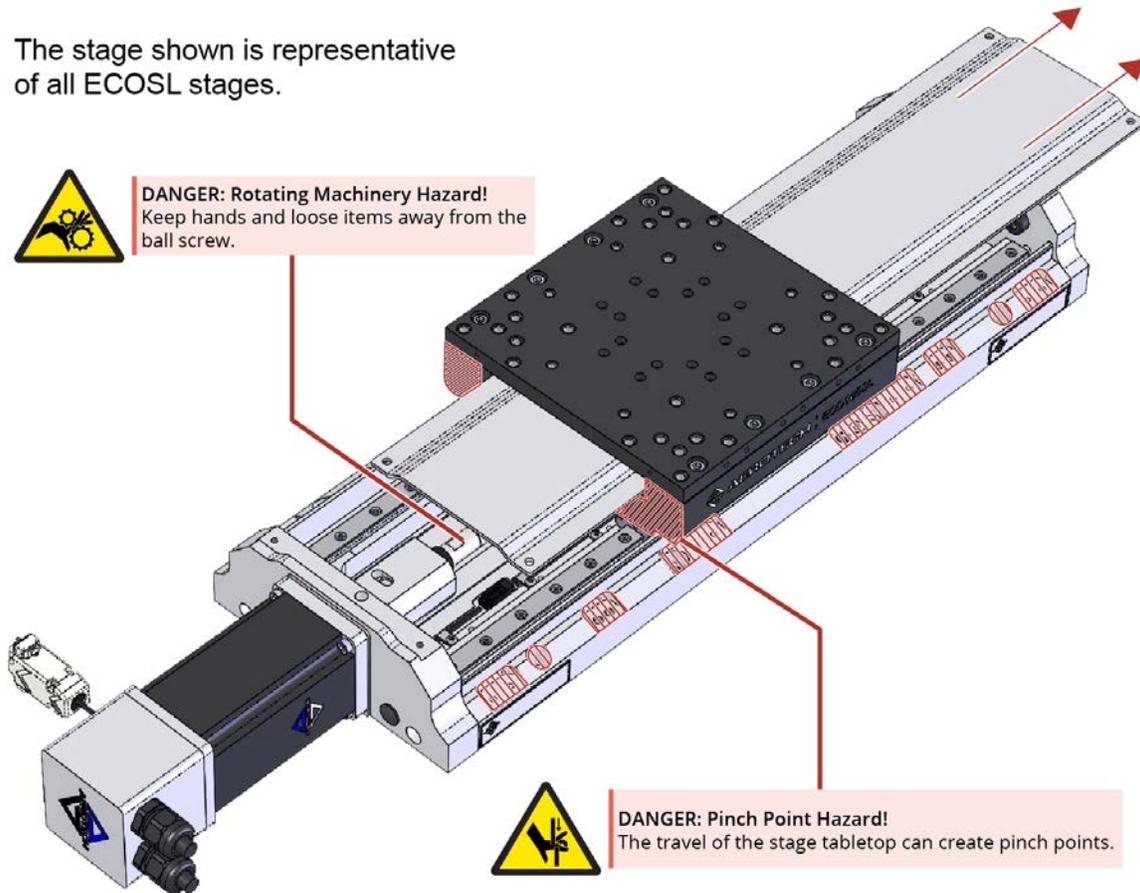


Figure 4-2: Hardcover Removal

The stage shown is representative of all ECOSL stages.



### 4.3. Motor Mounting



**DANGER: Electrical Shock Hazard!**

- Do not connect or disconnect electrical components, wires, and cables while this product is connected to a power source.
- Before you do maintenance to the equipment, disconnect the electrical power.
- Uncouple or otherwise prevent motion of motor-coupled machinery when you do service to the equipment.

**Table 4-1: Hardware Requirements**

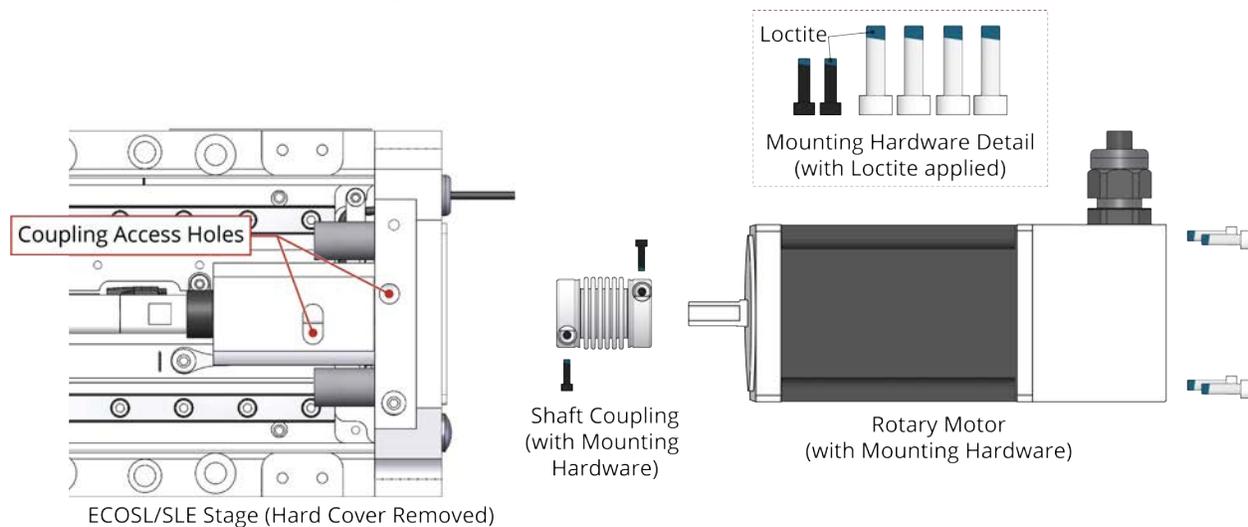
Motor Screw Size	Shaft Coupling Screw Size	Coupling Screw Bit Size	Coupling Screw Torque
M4	M2.5	2 mm Hex	7 in·lbs



**IMPORTANT:** Use Loctite 242 or Loctite 248 on the motor and coupling adapter hardware (Figure 4-3). Loctite products are printed with an expiration date. Before use, be sure that the expiration date is legible and the product has not expired.

If your stage is used in a vacuum or cleanroom environment, contact Aerotech.

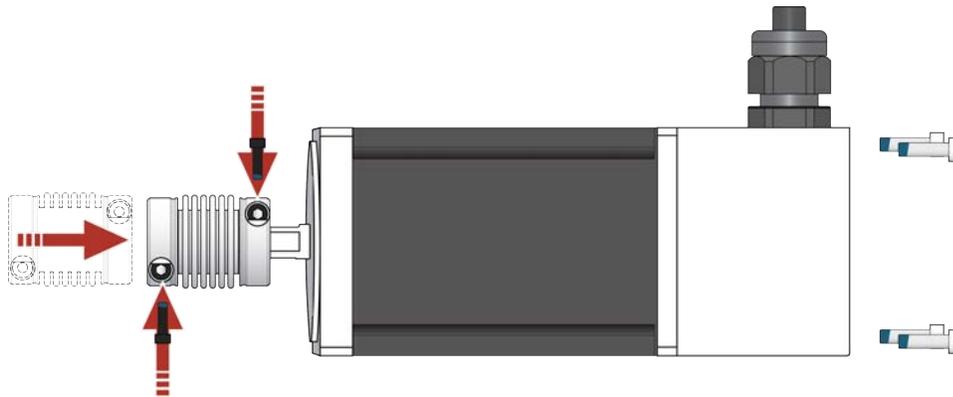
**Figure 4-3: Motor Mounting Overview**



### How to Mount a Motor

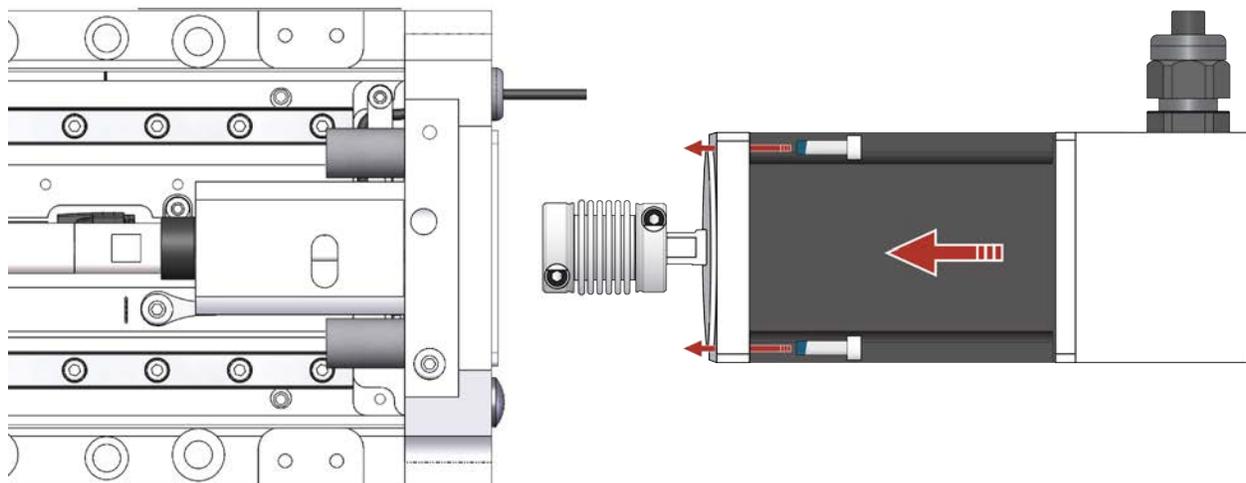
1. Remove the hard cover from the stage.
2. Locate the Shaft Coupling access holes (refer to [Figure 4-3](#)).
3. Test fit the Motor and Shaft Coupling to the Stage to ensure that you have access to the Shaft Coupling clamp screws.
4. Apply a small quantity of either Loctite 242 or Loctite 248 to motor and coupling hardware.
5. Attach the Shaft Coupling to the Motor shaft (refer to [Figure 4-4](#)). Refer to [Table 4-1](#) for the correct hardware and torque requirements.

**Figure 4-4: Attach the Coupling Adapter to the Motor Shaft**



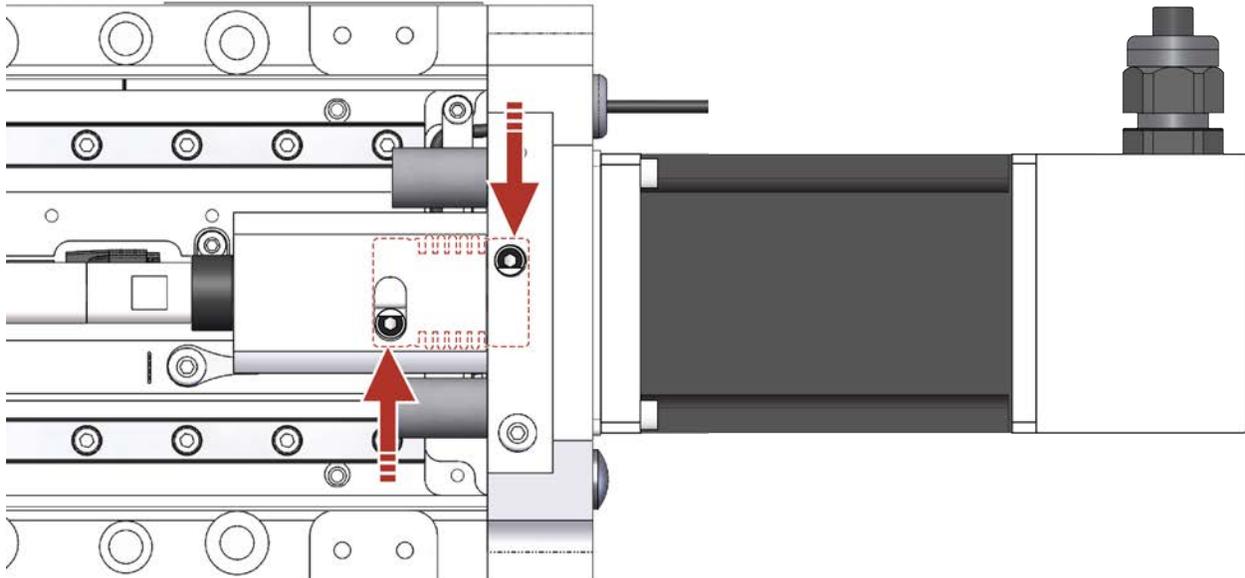
6. Attach the Motor to the Stage in the correct orientation ([Figure 4-5](#)). Use a hex wrench to ensure that the motor flange is fully seated and the hardware is tight. The motor housing prevents the use of a torque wrench.

**Figure 4-5: Attach the Motor the Stage**



7. Tighten the Shaft Coupling to the drive screw (Figure 4-6). Refer to Table 4-1 for the correct hardware and torque requirements.

**Figure 4-6: Tighten the Shaft Coupling to the Drive Screw**



8. Rotate the drive screw by hand to ensure that the drive screw rotates freely.



**IMPORTANT:** You must reapply Loctite to the mounting hardware if the Motor or Shaft Coupling screws are removed, adjusted, loosened, or replaced.

## 4.4. Belt Adjustment

This section applies to stages equipped with foldback motor options. On foldback stages, the motor torque is transferred to the ball screw via a timing belt. Belt tension is critical to stage performance and accuracy.

Check the belt tension when you clean or lubricate the stage. Deflection in the belt should be within  $\pm 10\%$  of 2.5 mm when applying a 5 N downward force directly between the pulleys. If the deflection exceeds this value, you will need to adjust the belt tension.

You will also need to apply lubricant to the inside flanges of the pulleys if the flanges are dry. The flanges should have a thin film of lubricant to reduce belt wear as the belt contacts the flanges. Use Parker Super O-Lube (silicone-based) for standard polyurethane belts.

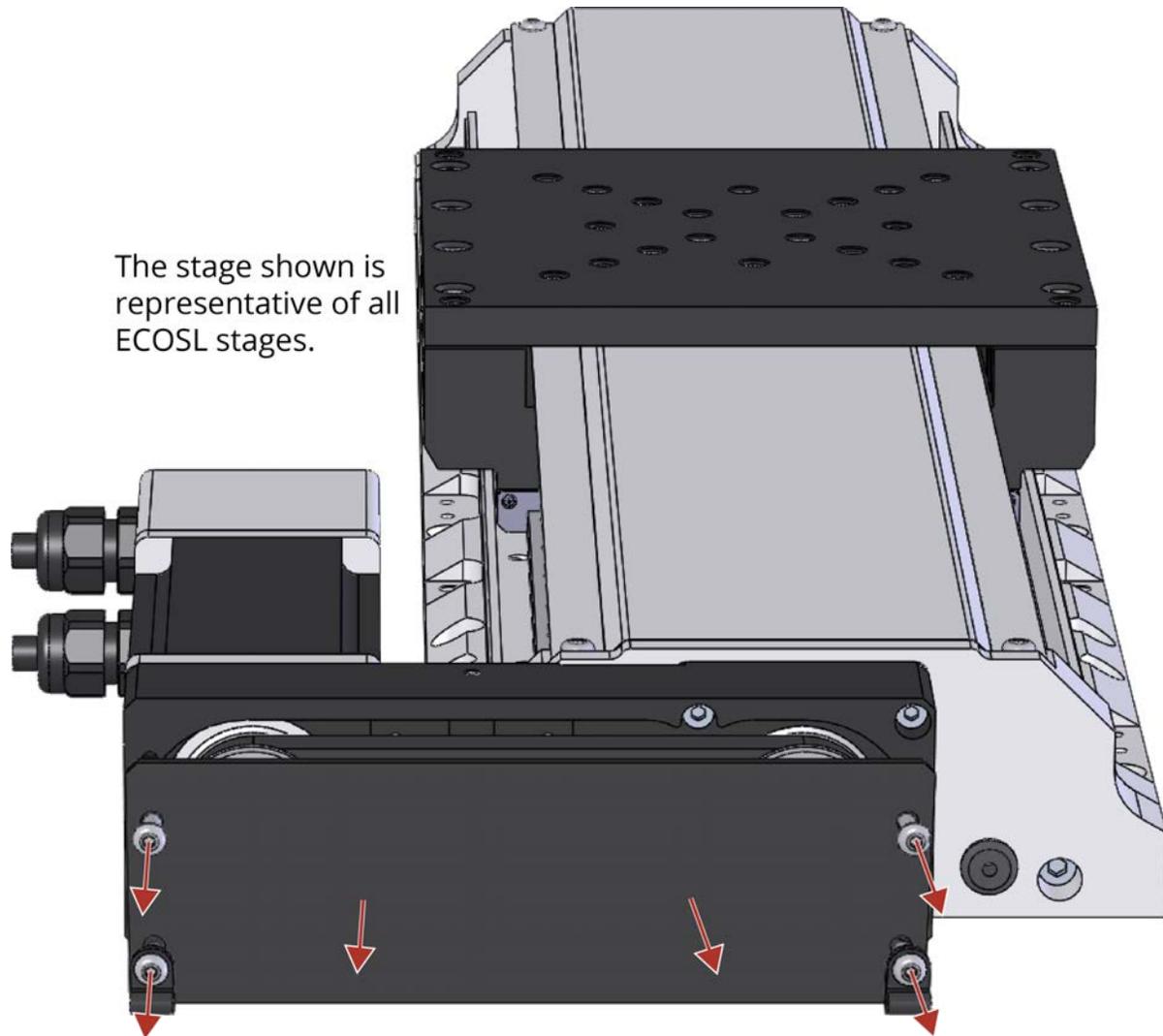


### **DANGER: Rotating Machinery Hazard!**

Fingers and loose articles can get caught in the foldback belt or pulleys.

### **Belt Tension Adjustment Procedure**

1. Remove power to the stage.
2. Remove the four mounting screws for the foldback cover ([Figure 4-7](#)).
3. Check that the pulleys are tight on their respective shafts ([Figure 4-8](#)).
  - a. Each pulley is held in position with two set screws.
  - b. Ensure that the set screws are tight and centered over the shaft flats.
4. Check the tension in the belt to determine if adjustment is necessary.
5. If adjustment is required, loosen (but do not remove) the mounting screws for the idler pulley mounting bracket.
6. Remove the M4 set screw to gain access to the tapped hole above the idler pulley mounting bracket.
7. Insert an M4 screw or threaded stud long enough to contact the idler pulley mounting bracket.
8. Use the threaded stud to drive the idler pulley mounting bracket downward and increase belt tension.
9. Tighten the mounting screws for the idler pulley mounting bracket.
10. Measure the belt deflection again and repeat the previous steps until the belt tension adjustment is complete.
11. Check the pulley flanges for lubrication.
12. Add small amounts of Parker Super O-Lube lubricant around the circumference of both pulley flanges ([Figure 4-9](#)).
13. Replace the foldback cover and mounting screws.
14. Restore power to the stage and resume normal use.

**Figure 4-7: Foldback Motor Cover Removal**

**IMPORTANT:** If the stage has been calibrated (-PL2 option), note the orientation of the two pulleys with regard to each other or recalibration might be required.

Figure 4-8: Foldback Motor Part Callouts

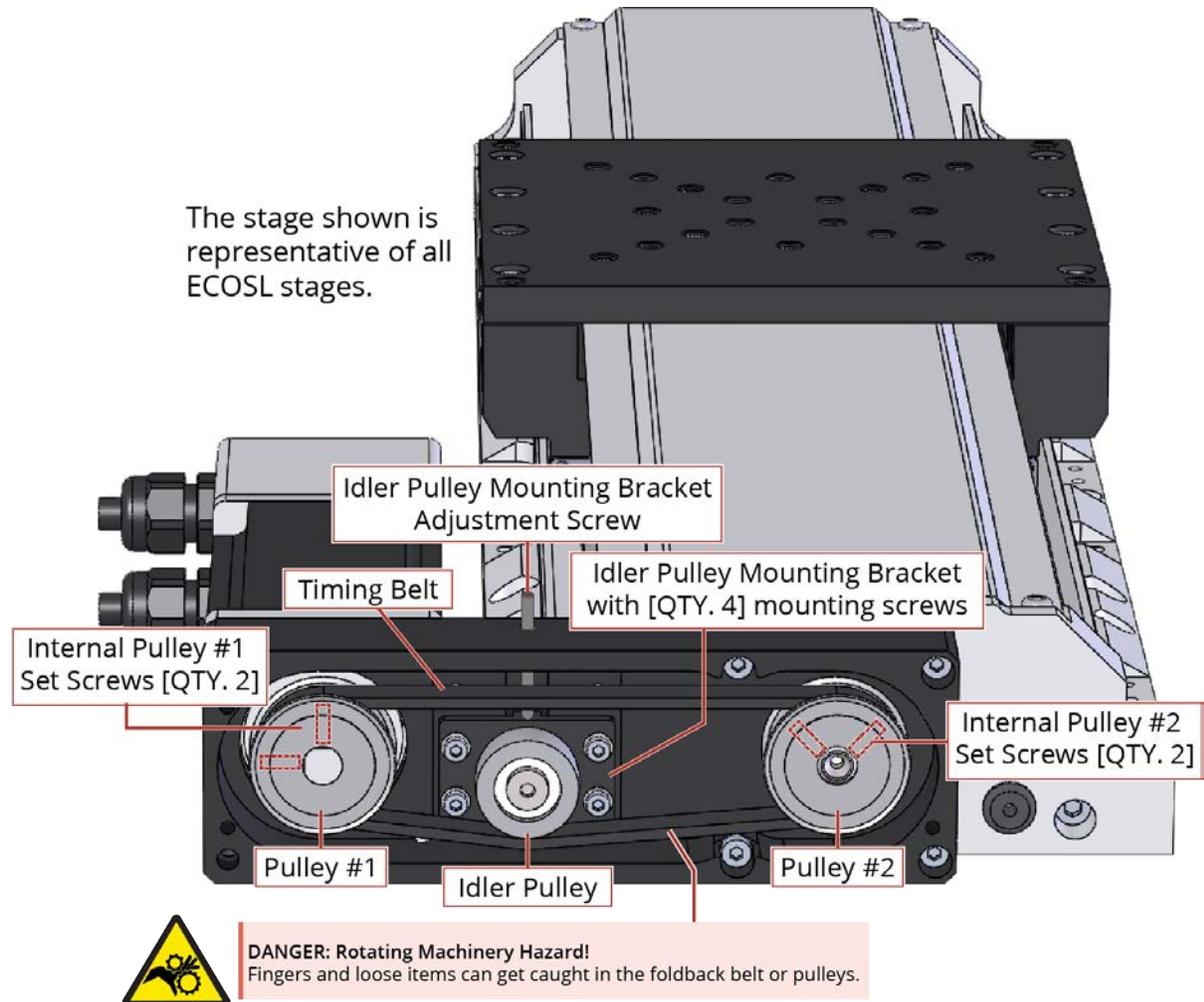
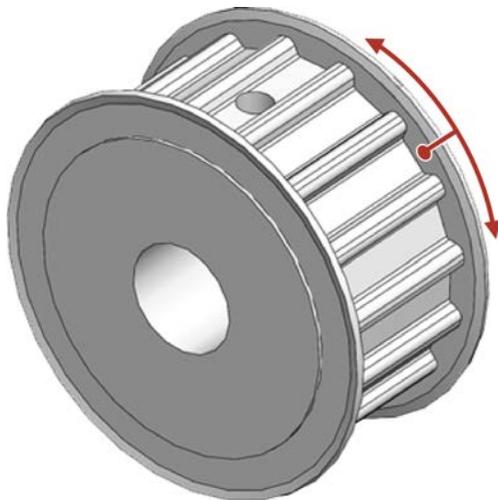


Figure 4-9: Lubricate the Pulley Flanges



## 4.5. Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move	Shipping brackets still installed. Remove the red anodized shipping brackets. Brake not released (if equipped with brake; refer to stage documentation). In Limit condition. Check limits (refer to <a href="#">Chapter 3: Electrical Installation</a> ) 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 <a href="#">Chapter 3: Electrical Installation</a> and Controller documentation). Motor Connections (refer to <a href="#">Chapter 3: Electrical Installation</a> and the Controller documentation).
Stage oscillates or squeals	Gains misadjusted (refer to the Controller documentation). Encoder signals (refer to the Controller documentation).

## 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](http://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 [Global Technical Support Portal](#) 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

Aerotech, Inc.  
Global Headquarters

#### CHINA

Aerotech China  
Full-Service Subsidiary

#### GERMANY

Aerotech Germany  
Full-Service Subsidiary

#### TAIWAN

Aerotech Taiwan  
Full-Service Subsidiary

#### UNITED KINGDOM

Aerotech United Kingdom  
Full-Service Subsidiary

## Appendix B: Revision History

Revision	Description
2.01	Safety section updated
2.00	New Section: <a href="#">Section 4.3. Motor Mounting</a>
1.02	Dimensions updated: <a href="#">Section 2.1.</a>
1.01	Product updates
1.00	New Manual

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