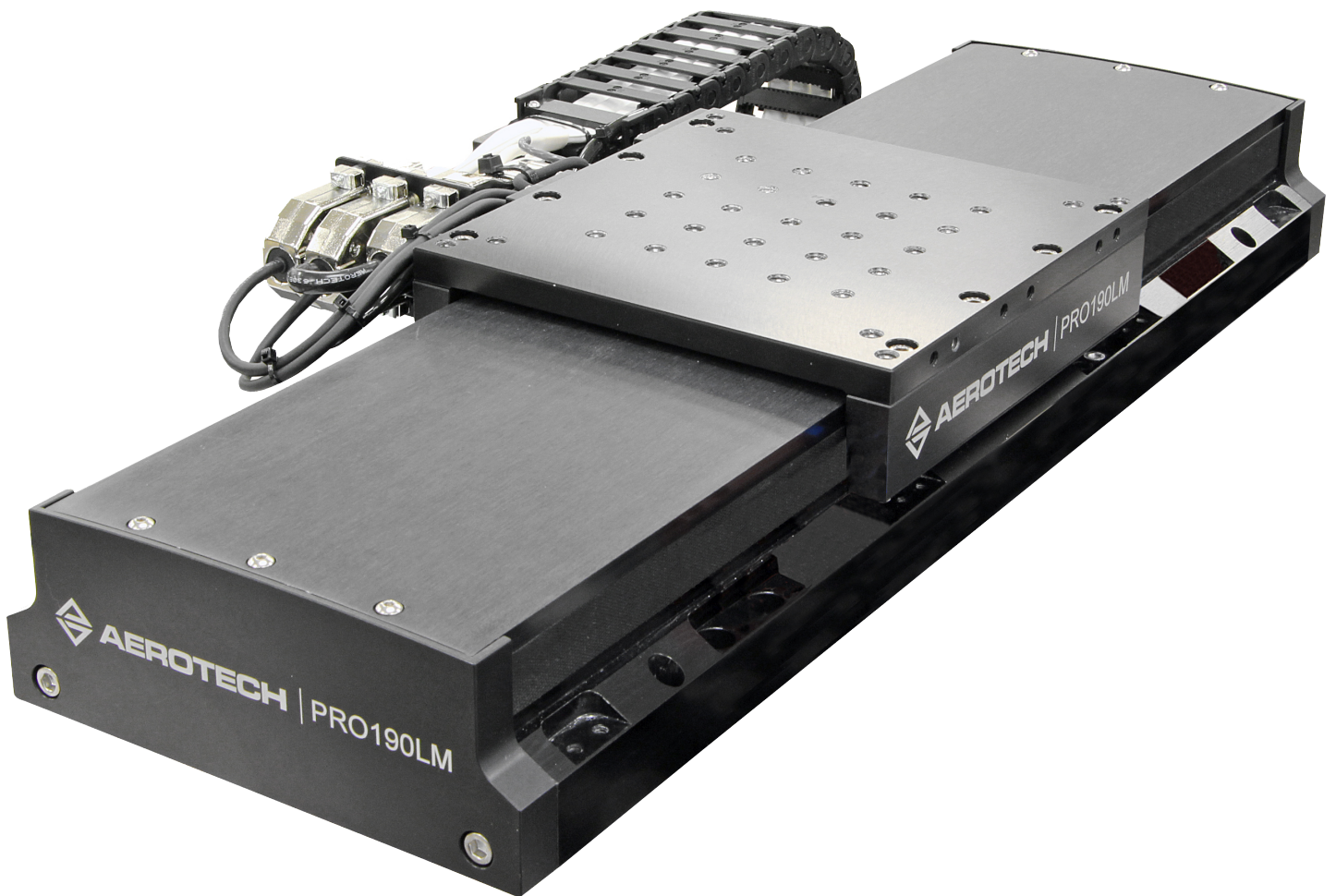




PRO190LM Mechanical Bearing, Direct-Drive Linear Stage

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:

PRO190LM 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):

EU 2015/863

Directive, Restricted Substances (RoHS 3)

Authorized Representative:

/ Norbert Ludwig

Managing Director
Aerotech GmbH
Gustav-Weißkopf-Str. 18
90768 Fürth
Germany

Engineer Verifying Compliance

/ Alex Weibel

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2811
USA
7/19/2023

Date

UKCA Declaration of Incorporation

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



herewith declares that the product:

PRO190LM stage

To which this declaration relates, meets the essential health and safety requirements and is in conformity with the relevant UK Legislation listed below:

Supply of Machinery (Safety) Regulations 2008

Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Using the relevant section of the following UK Designated Standards and other normative documents when installed in accordance with the installation instructions supplied by the manufacturer.

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 furthermore declares that it is not allowed to put the product 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 Supply of Machinery (Safety) Regulations 2008 UK Legislation and with national implementing legislation, for example, as a whole, including the equipment referred to in this Declaration.

**Authorized
Representative:**

A handwritten signature in black ink, appearing to read 'Simon Smith'.

/ Simon Smith

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

**Engineer Verifying
Compliance**

A handwritten signature in black ink, appearing to read 'Alex Weibel'.

/ Alex Weibel

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

Date

7/19/2023

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.

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.
- 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 stage 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.



- When the system is not electrically energized (disabled), linear stage/motors can still allow a stage carriage to move freely. This can create mechanical hazards such as pinch or crush points.
- 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.

DANGER: Risk in Explosive Atmosphere!



- Standard Aerotech stage/motors are not rated for applications with explosive atmospheres such as airborne 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.

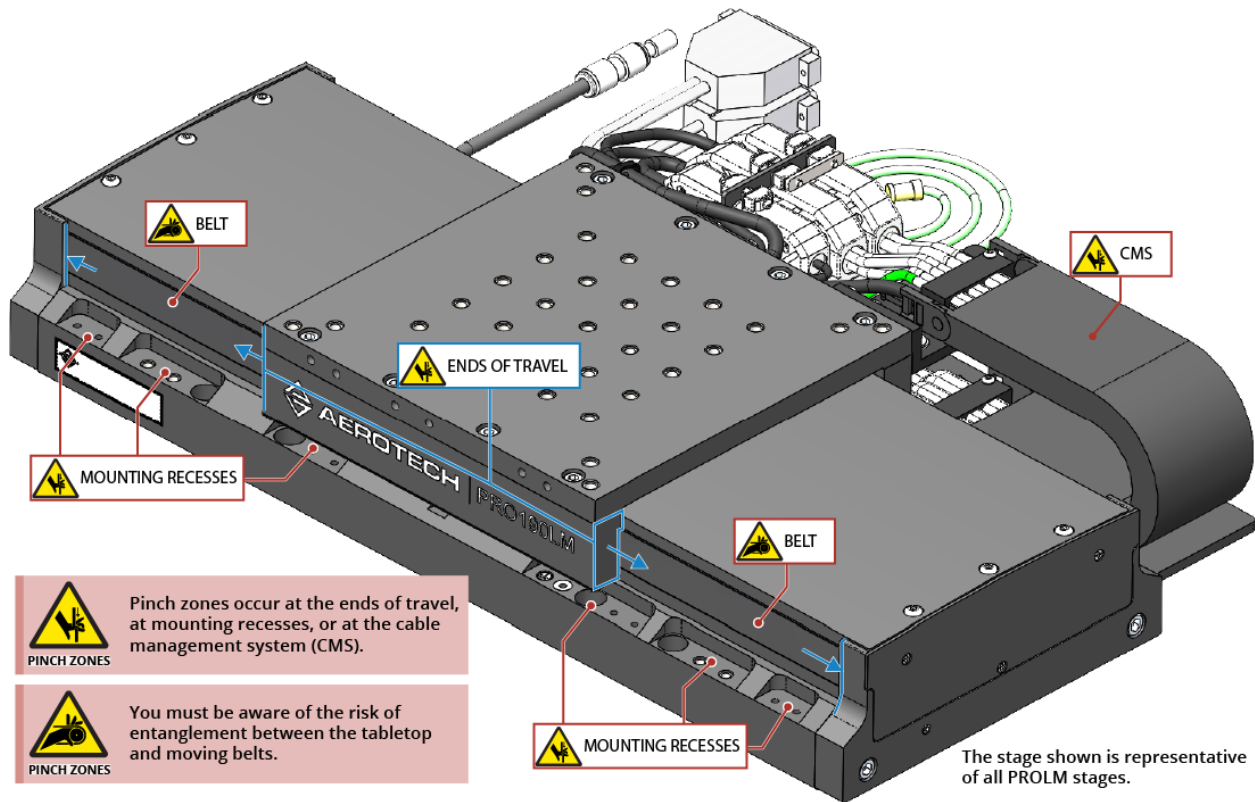
DANGER: Mechanical Hazard!

- 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 1: Typical Pinch Point Locations

DANGER: Mechanical Hazards!

- **Pinch Point!** The stage tabletop is a potential pinch hazard.
- **Entanglement Hazard!** The side belts are a potential entanglement hazard.



Magnetic Hazards

The magnet track will be exposed when you do maintenance to the system.



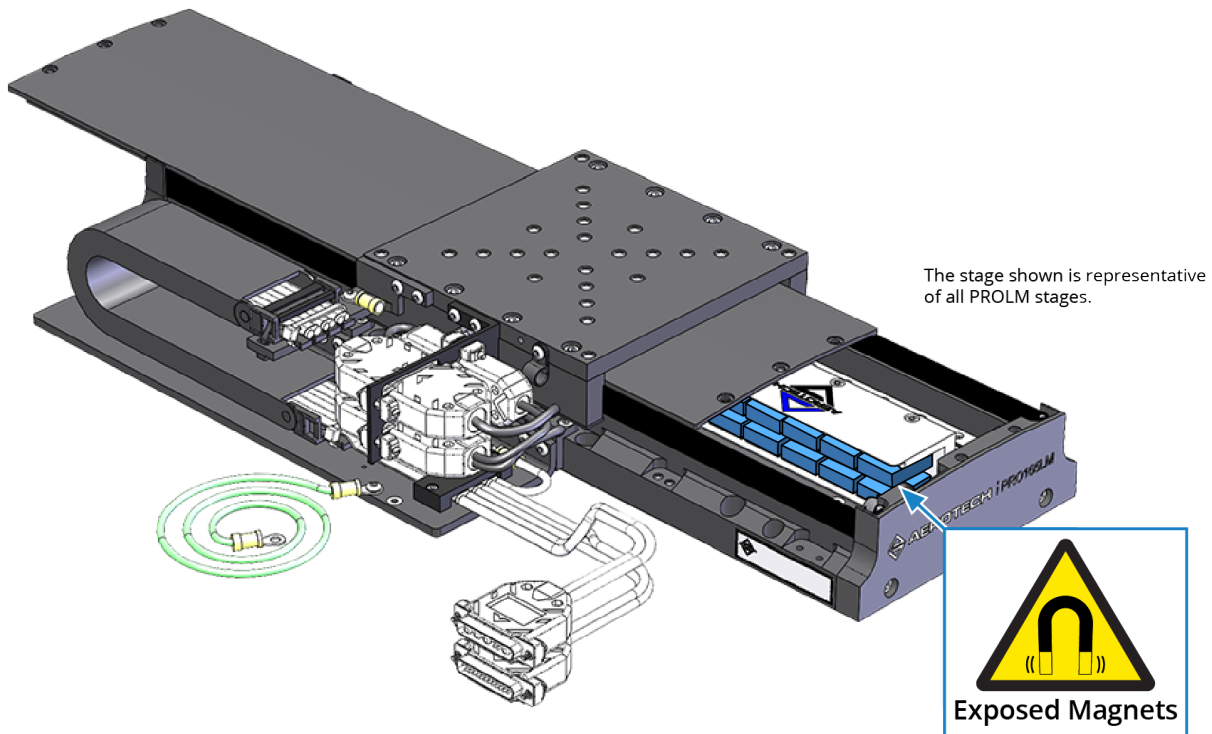
DANGER: Magnetic Field Hazard!

- Only qualified, trained personnel should be allowed to have access to exposed magnet tracks during setup or when you do maintenance.
- Strong magnetic fields are present near and inside the magnet track assembly.
- Do not disassemble the magnet track components. If you do so, you will expose yourself to mechanical crush, pinch, or impact hazards.
- Magnetic fields could interfere with external or internal medical devices (pace-makers, for example).
- Magnetic fields can create mechanical hazards (crush, impact, or pinch points, for example).
- Loose items such as metallic tools, watches, or keys could get drawn into and damage the magnet track assembly.



IMPORTANT: Use non-magnetic tools when you install or do service to the stage.

Figure 2: Exposed Magnet 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 stage 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

Carefully remove the stage from its protective shipping container.

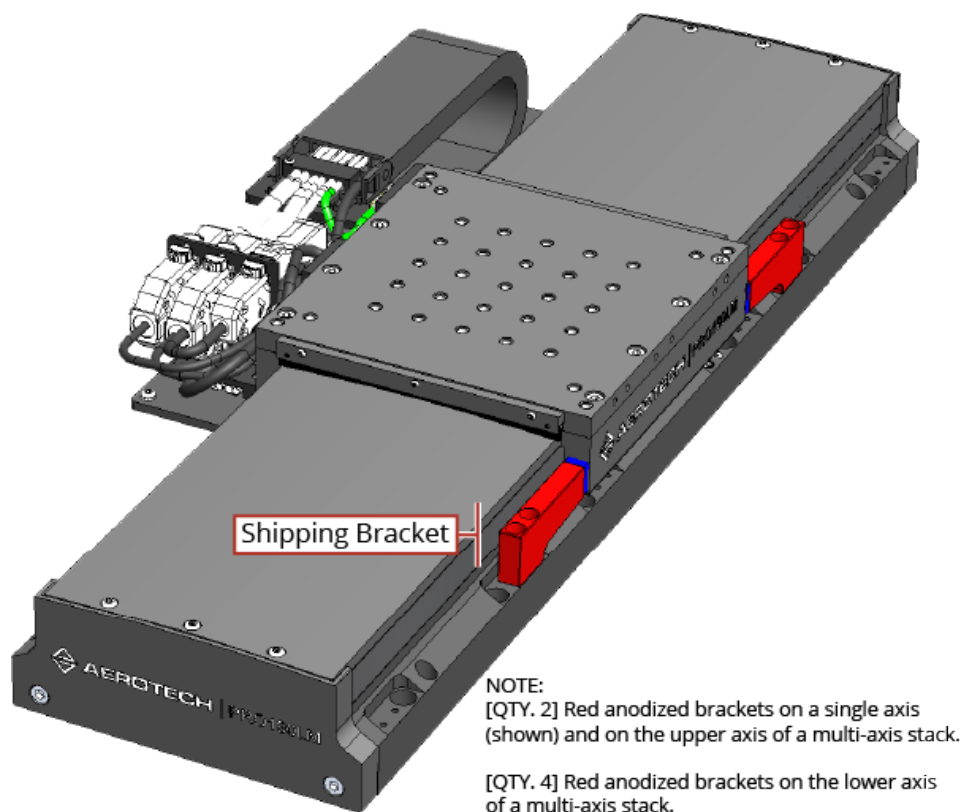
- Lift this product only by the base.
- Use lifting hardware if it has been provided (refer to).
- For multi-axis assemblies, always lift the system by the lower axis.
- Use a cart, dolly, or similar device to move the stage to a new location.

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.

Figure 3: Shipping Brackets



Lifting Features

The lifting kit includes four eyebolts and four standoffs. Thread the eyebolts onto the standoffs and thread the standoffs into the stage base. Remove the lifting hardware by turning a wrench on the flats of the standoffs (see). If the stage is part of a multi-axis system, the lifting hardware should be attached to the lower axis. The lifting hardware must be removed before the stage can be operated.

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

| PRO190LM Linear Motor Stage | |
|--|--|
| Travel (Required) | |
| -0100 | 100 mm travel stage |
| -0150 | 150 mm travel stage |
| -0200 | 200 mm travel stage |
| -0250 | 250 mm travel stage |
| -0300 | 300 mm travel stage |
| -0400 | 400 mm travel stage |
| -0500 | 500 mm travel stage |
| -0600 | 600 mm travel stage |
| -0800 | 800 mm travel stage |
| -1000 | 1000 mm travel stage |
| Mounting Orientation (Required) | |
| | Normal mounting orientation |
| -MT1 | Side-mounted or vertical orientation |
| -MT2 | Inverted mounting orientation |
| Tabletop (Required) | |
| -TT1 | Tabletop with metric dimension mounting |
| -TT2 | Tabletop with English dimension mounting |
| -TT3 | Accessory tabletop with mounting for select rotary stages |
| -TT4 | Tabletop with metric dimension mounting and wiper brushes |
| -TT5 | Tabletop with English dimension mounting and wiper brushes |
| -TT6 | Accessory tabletop with mounting for select rotary stages and wipers |
| NOTE: -TT1 option required for lower axis of XY | |
| Feedback (Required) | |
| -E1 | Incremental linear encoder; 1 Vpp |
| -E2 | Incremental linear encoder; 0.1 μ m digital TTL output |
| -E3 | Absolute linear encoder; EnDat 2.2 |

| PRO190LM Linear Motor Stage (continued) | |
|---|--|
| Cable Management (Required) | |
| -CMS0 | No external CMS, motor/feedback connector bracket on carriage |
| -CMS1 | External CMS for single axis |
| -CMS2 | External CMS for lower-axis of two-axis PRO XY assembly |
| -CMS3 | External CMS for lower-axis of two-axis (XZ or XT) assembly |
| -CMS4 | External CMS for upper-axis of two-axis PRO XY assembly |
| -CMS5 | External CMS for upper-axis of two-axis (YZ or YT) assembly |
| -CMS6 | External CMS for lower-axis of three-axis (XYZ or XYT) assembly |
| -CMS7 | External CMS for lower-axis of three-axis (XZT) assembly |
| -CMS10 | External CMS for upper-axis of two-axis PRO225LM XY assembly |
| -CMS11 | External CMS for upper-axis of three-axis PRO 225LM XYZ/T assembly |
| -CMS12 | External CMS for upper-axis of four-axis PRO 225LM/ XYZT assembly |
| Lifting Hardware (Optional) | |
| -LF | Lifting hardware |
| NOTE: Lifting option only available on travels 400 mm and greater. Lifting should never be ordered on the upper-axis of an XY set (only order on lower-axis) | |
| ThermoComp™ (Optional) | |
| -TCMP | ThermoComp™ integrated temperature compensation unit |
| NOTE: An A3200 controller must be used with the -TCMP option | |
| Metrology (Required) | |
| -PL0 | No metrology performance plots |
| -PL1 | Uncalibrated with performance plots |
| -PL2 | Calibrated with performance plots |
| Accessories (To be Ordered as a Separate Line Item) | |
| 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 μm orthogonality for short travel stages. |
| ALIGN-PA10Z | XZ or YZ assembly with L-bracket; 10 arc sec orthogonality. Alignment to within 10 μm orthogonality for short travel stages. |
| ALIGN-PA5 | XY assembly; 5 arc sec orthogonality. Alignment to within 3 μm orthogonality for short travel stages. |
| ALIGN-PA5Z | XZ or YZ assembly with L-bracket; 5 arc sec orthogonality. Alignment to within 5 μm orthogonality for short travel stages. |

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 in Explosive Atmosphere!

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

Table 1-2: Environmental Specifications

| | |
|----------------------------|--|
| Ambient Temperature | 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 |
| 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. Floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application. |
| Protection Rating | These stages have limited protection against dust, but not water. This equates to an ingress protection rating of IP50. |
| Use | 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 specifications listed in [Section 1.3](#), assume a 20°C operating environment. If the temperature of the stage differs from 20°C, the encoder scale in the stage will expand or contract at the rate of 3.25 ppm per °C for -E1 and -E2 options, or 10 ppm per °C for the -E3 option.

The ThermoComp™ option is a hardware and software solution that uses the functionality of the Automation1 or A3200 controller to mitigate the effects of changing temperature by detecting and compensating for thermal changes. ThermoComp™ is effective at compensating for both self-heating and environmental temperature changes.

1.3. Basic Specifications

Table 1-3: PRO190LM Series Specifications (-0100 to -0300)

| PRO190LM | | -0100 | -0150 | -0200 | -0250 | -0300 |
|--|------------|--|------------------------|--------------------------|--------------------------|---------------------------|
| Travel | | 100 mm | 150 mm | 200 mm | 250 mm | 300 mm |
| Accuracy ⁽¹⁾ | Standard | ±4 μm | ±6 μm | ±8 μm | ±9 μm | ±10 μm |
| | Calibrated | ±1 μm | ±1 μm | ±1 μm | ±1 μm | ±1 μm |
| Resolution (Minimum Incremental Motion) | | 5 nm (-E1 Encoder), 10 nm (-E3 Encoder) | | | | |
| Bidirectional Repeatability ⁽¹⁾ | | ±0.3 μm | ±0.4 μm | ±0.4 μm | ±0.4 μm | ±0.4 μm |
| Horizontal Straightness ⁽¹⁾ | | ±1.5 μm | ±2 μm | ±2.5 μm | ±3 μm | ±3.5 μm |
| Vertical Straightness ⁽¹⁾ | | ±1.5 μm | ±2 μm | ±2.5 μm | ±3 μm | ±3.5 μm |
| Pitch | | 27 μrad (5.6 arc sec) | 29 μrad (6 arc sec) | 40 μrad (8.2 arc sec) | 45 μrad (9.3 arc sec) | 50 μrad (10.3 arc sec) |
| Roll | | 27 μrad (5.6 arc sec) | 29 μrad (6 arc sec) | 40 μrad (8.2 arc sec) | 45 μrad (9.3 arc sec) | 50 μrad (10.3 arc sec) |
| Yaw | | 27 μrad (5.6 arc sec) | 29 μrad (6 arc sec) | 40 μrad (8.2 arc sec) | 45 μrad (9.3 arc sec) | 50 μrad (10.3 arc sec) |
| Maximum Speed ⁽²⁾ | | 2 m/s | | | | |
| Maximum Acceleration ⁽²⁾ | | 3 g | | | | |
| Maximum Force, Continuous | | 106.7 N – Standard 154.7 – With Air Cooling (20 psig) | | | | |
| Load Capacity ⁽³⁾ | Horizontal | 60 kg | | | | |
| | Side | 60 kg | | | | |
| Moving Mass | | 4.5 kg | | | | |
| Stage Mass | | 14.4 kg | 15.6 kg | 16.8 kg | 18.1 kg | 19.3 kg |
| Material | | Anodized Aluminum | | | | |
| Mean Time Between Failure | | 20,000 Hours | | | | |
| <p>(1) Certified with -PL1 option.</p> <p>(2) Requires the selection of an applicable amplifier with sufficient voltage and current.</p> <p>(3) Axis orientation for on-axis loading is listed.</p> <p>(4) 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> | | | | | | |

Table 1-4: PRO190LM Series Specifications (-0400 to -1000)

| PRO190LM | | -0400 | -0500 | -0600 | -0800 | -1000 |
|--|------------|--|---------------------------|---------------------------|---------------------------|----------------------------|
| Travel | | 400 mm | 500 mm | 600 mm | 800 mm | 1000 mm |
| Accuracy ⁽¹⁾ | Standard | ±12 µm | ±14 µm | ±15.5 µm | ±17 µm | ±18 µm |
| | Calibrated | ±1 µm | ±1 µm | ±1 µm | ±1.5 µm | ±1.5 µm |
| Resolution (Minimum Incremental Motion) | | 5 nm (-E1 Encoder), 10 nm (-E3 Encoder) | | | | |
| Bidirectional Repeatability ⁽¹⁾ | | ±0.4 µm | ±0.4 µm | ±0.4 µm | ±0.5 µm | ±0.5 µm |
| Horizontal Straightness ⁽¹⁾ | | ±4.5 µm | ±5.5 µm | ±6.5 µm | ±8 µm | ±9.5 µm |
| Vertical Straightness ⁽¹⁾ | | ±4.5 µm | ±5.5 µm | ±6.5 µm | ±8 µm | ±9.5 µm |
| Pitch | | 60 µrad (12.4 arc sec) | 70 µrad (14.4 arc sec) | 80 µrad (16.5 arc sec) | 90 µrad (18.6 arc sec) | 110 µrad (22.7 arc sec) |
| Roll | | 60 µrad (12.4 arc sec) | 70 µrad (14.4 arc sec) | 80 µrad (16.5 arc sec) | 90 µrad (18.6 arc sec) | 110 µrad (22.7 arc sec) |
| Yaw | | 60 µrad (12.4 arc sec) | 70 µrad (14.4 arc sec) | 80 µrad (16.5 arc sec) | 90 µrad (18.6 arc sec) | 110 µrad (22.7 arc sec) |
| Maximum Speed ⁽²⁾ | | 2 m/s | | | | |
| Maximum Acceleration ⁽²⁾ | | 3 g | | | | |
| Maximum Force, Continuous | | 106.7 N – Standard 154.7 – With Air Cooling (20 psig) | | | | |
| Load Capacity ⁽³⁾ | Horizontal | 60 kg | | | | |
| | Side | 60 kg | | | | |
| Moving Mass | | 4.5 kg | | | | |
| Stage Mass | | 21.7 kg | 24.2 kg | 26.6 kg | 31.5 kg | 36.4 kg |
| Material | | Anodized Aluminum | | | | |
| Mean Time Between Failure | | 20,000 Hours | | | | |
| <p>(1) Certified with -PL1 option.</p> <p>(2) Requires the selection of an applicable amplifier with sufficient voltage and current.</p> <p>(3) Axis orientation for on-axis loading is listed.</p> <p>(4) 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> | | | | | | |

1.4. Vacuum Operation

There are two vacuum preparation options:

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

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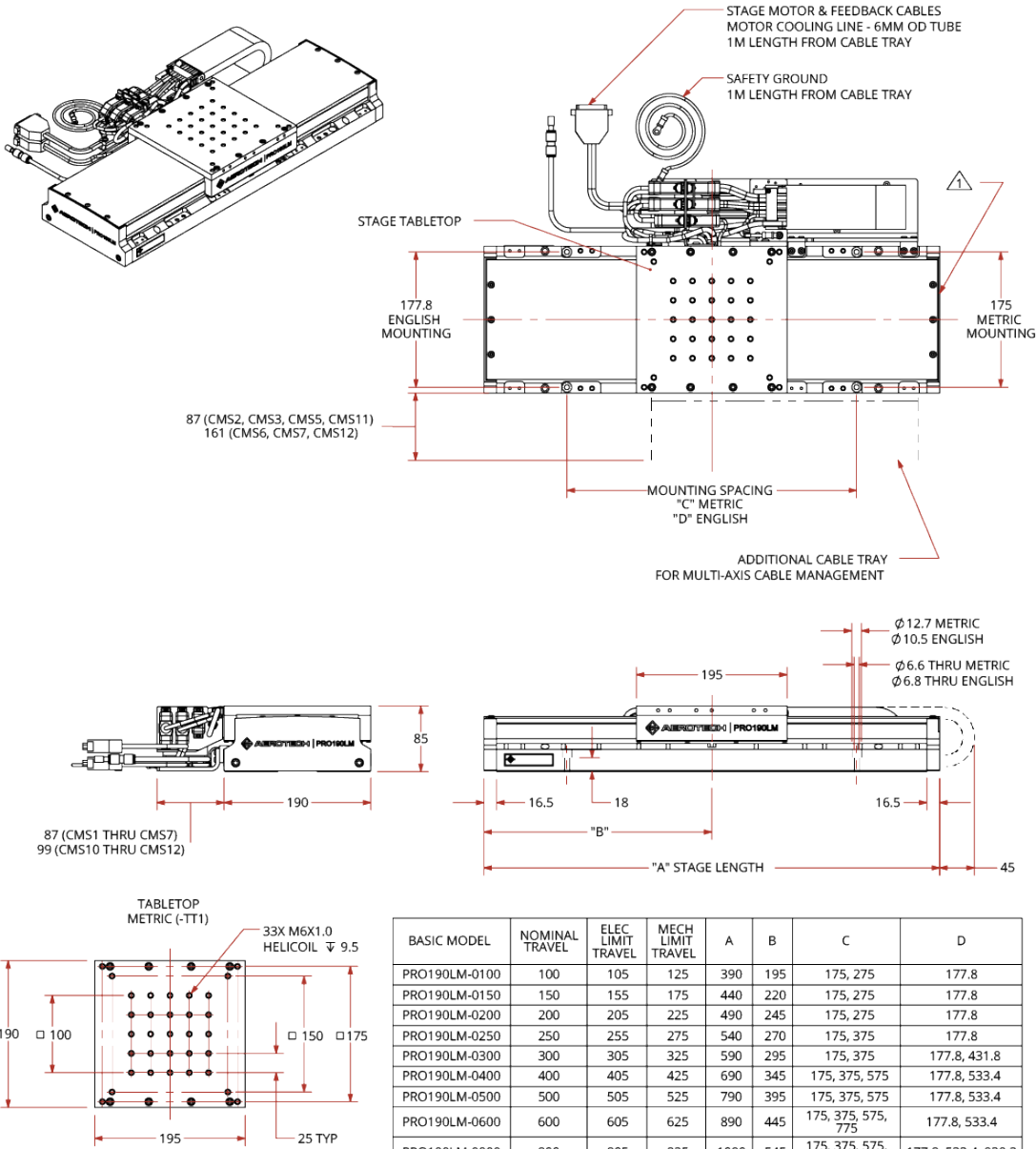
Chapter 2: Installation



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: PRO190LM Dimensions



NOTES:

1. MSX0.8 FOR CUSTOMER-INSTALLED AIR PURGE FITTING.

2. DIMENSIONS: MILLIMETERS.

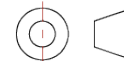
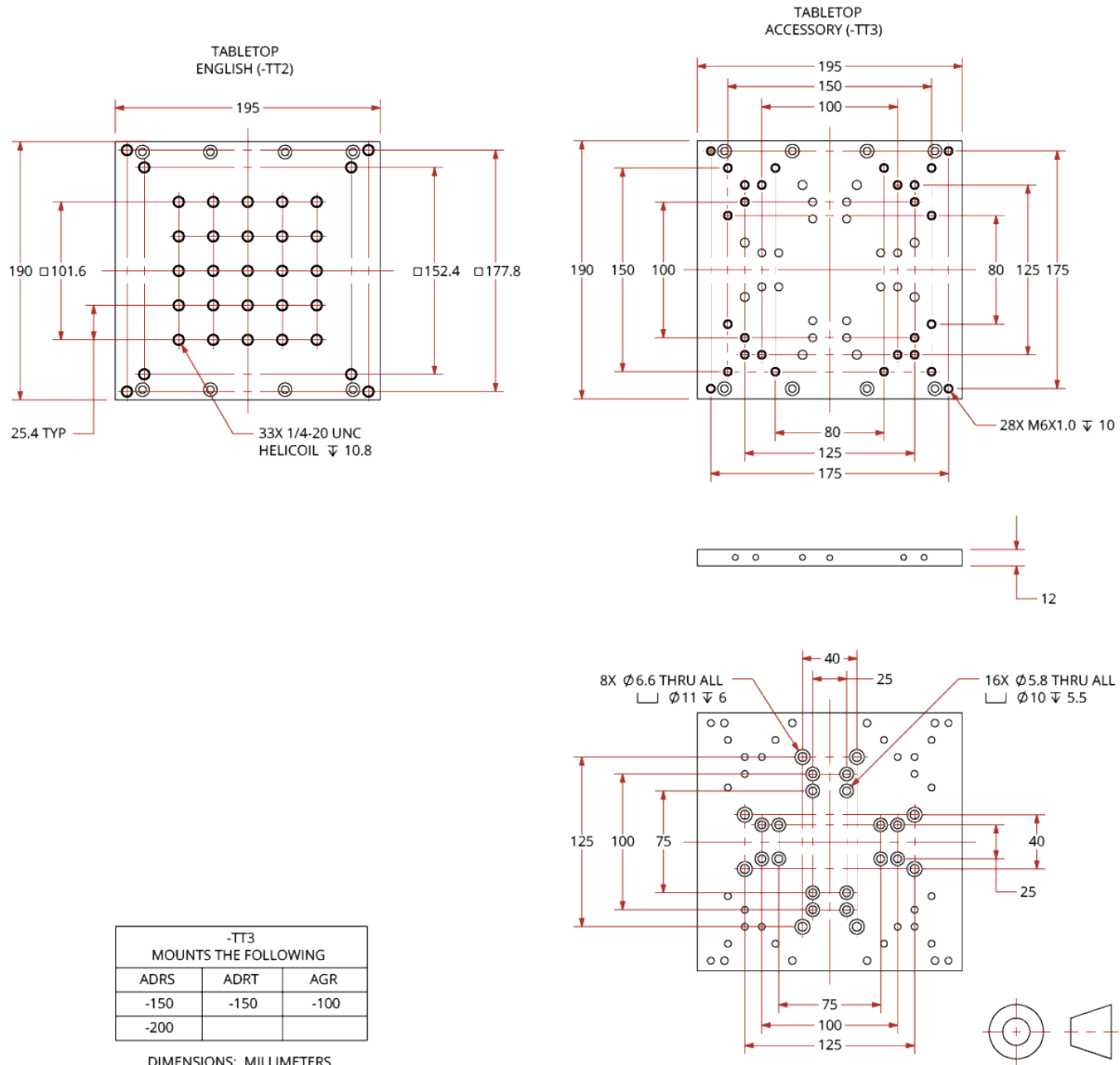


Figure 2-2: PRO190SL Tabletop Dimensions (-TT2/-TT3 Option)



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 12](#).

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 μ 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.

- If the stage is not connected to a power source, the stage should move freely by hand.
- Do not attempt to manually move the stage if it is connected to a power source.

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 30 mm (or 1/4" x 1-1/8") 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 PRO190LM 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 PRO190LM 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.

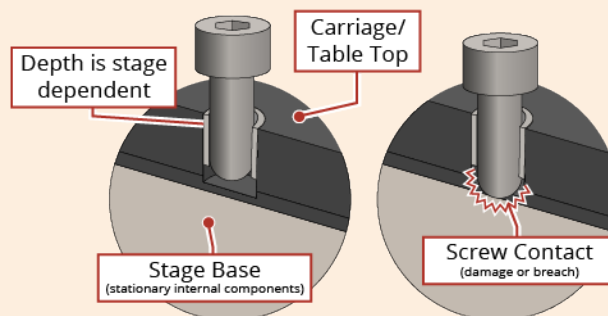
Table 2-3: Payload Mounting Surface Flatness Requirement

| Stage Travel | Flatness Requirement |
|--------------|----------------------|
| All Travels | 12 μm |

WARNING: General Hazard Warning!

Be careful when you attach the payload to the stage mounting surface.

- If a mounting screw extends through the carriage/table top, it can affect travel and damage the stage.
- Refer to the dimensions in [Section 2.1](#) for maximum allowable thread engagement.
- **Mounting Hole Cutaway:**



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

For a cantilevered load, first determine if it is a **Horizontal** or a **Side** cantilever system (refer to Figure 2-3).

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 2-4.

Figure 2-3: Stage Orientations

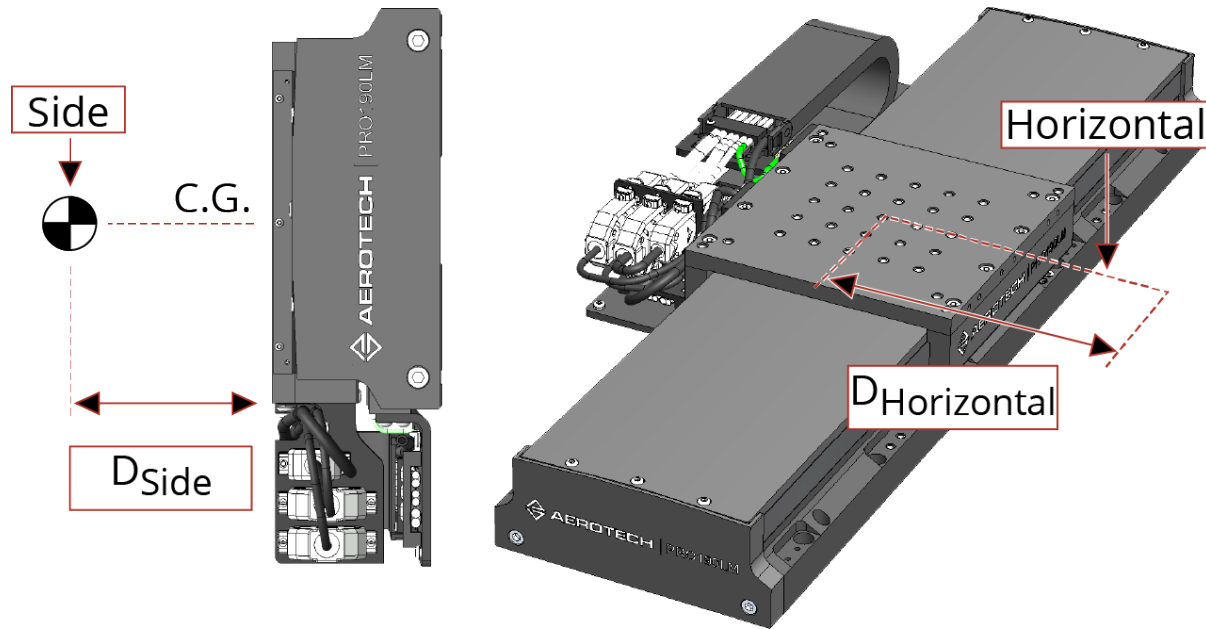
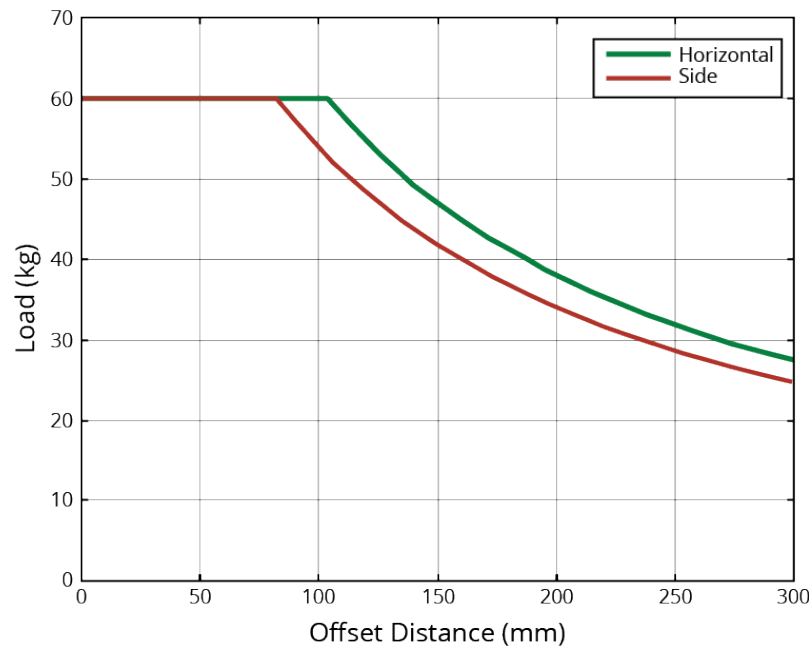


Figure 2-4: Cantilevered Load Capability



2.3.1. Speed Capability

To help ensure safety and prevent damage to the system, speed limitations are required for the PRO190LM. Achievable speeds are application-dependent and determined by factors such as travel length, payload, amplifier sizing and duty cycle. The Motor Sizer application supplied by Aerotech at <https://www.aerotech.com/resources/motor-sizer.aspx> can be used to estimate allowable speeds and accelerations based on these parameters. Consult with an Aerotech Applications Engineer to specify the system configuration for optimum performance.

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 PRO190LM 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 PRO190LM into a completed system. Failure to do so could expose the operator to electrical or mechanical hazards.

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 PRO190LM 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 PRO190LM 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.

Figure 3-1: Ground Connection Points for the -CMS0 Option

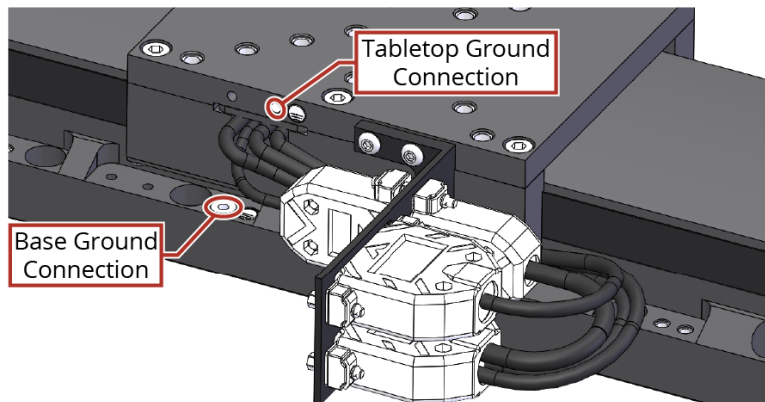


Table 3-1: Motor Connector Pinout

| 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: General Motor Connector Pinout (for Z or T Axes)

| Pin | Description | Wire Gauge AWG [mm ²] | Connector |
|------|--|--------------------------------------|-----------|
| Case | Shield Connection | 16 [1.31] | |
| A1 | Motor Phase A | 16 [1.31] | |
| A2 | Motor Phase B | 16 [1.31] | |
| A3 | Motor Phase C | 16 [1.31] | |
| 1 | Reserved | -- | |
| 2 | Reserved | -- | |
| 3 | Reserved | -- | |
| 4 | Reserved | -- | |
| 5 | Reserved | -- | |
| A4 | Frame Ground (motor protective ground) | 16 [1.31] | |

Table 3-3: Mating Connector Part Numbers for the 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 3-4: Feedback Connector Pinout

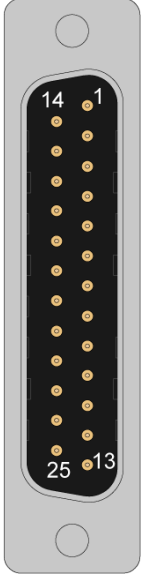
| Pin | Description | Connector |
|------|---|---|
| Case | Shield Connection |  |
| 1 | Reserved | |
| 2 | Over-Temperature Thermistor Sensor | |
| 3 | 5V Power Supply Input (connected internally to Pin-16) | |
| 4 | Reserved | |
| 5 | Hall Effect Sensor (Phase B) | |
| 6 | MRK- (Encoder Marker-) | |
| 7 | MRK+ (Encoder Marker+) | |
| 8 | Reserved | |
| 9 | Reserved | |
| 10 | Hall Effect Sensor (Phase A) | |
| 11 | Hall Effect Sensor (Phase C) | |
| 12 | + /CW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the "machine positive" or "machine clockwise" direction.) | |
| 13 | Reserved | |
| 14 | COS+ (Encoder Cosine+) | |
| 15 | COS- (Encoder Cosine-) | |
| 16 | 5V Power Supply Input (connected internally to Pin-3) | |
| 17 | SIN+ (Encoder Sine+) | |
| 18 | SIN- (Encoder Sine-) | |
| 19 | Reserved | |
| 20 | Common ground (connected internally to Pin-21) | |
| 21 | Common ground (connected internally to Pin-20) | |
| 22 | Reserved | |
| 23 | Reserved | |
| 24 | - /CCW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the "machine negative" or "machine counter-clockwise" direction.) | |
| 25 | Reserved | |

Table 3-5: 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 3-6: Feedback Connector Pinout (-E3 Option)

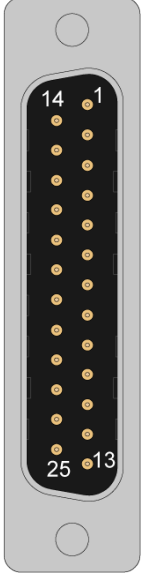
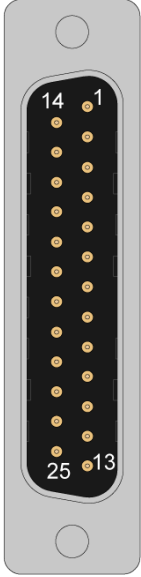
| Pin | Description | Connector |
|------|--|---|
| Case | Shield Connection |  |
| 1 | Reserved | |
| 2 | Over-Temperature Thermistor Sensor | |
| 3 | 5V Power Supply Input (connected internally to Pin-16) | |
| 4 | Reserved | |
| 5 | Hall Effect Sensor (Phase B) | |
| 6 | CLK- (Absolute Encoder Clock-) | |
| 7 | CLK+ (Absolute Encoder Clock+) | |
| 8 | DATA- (Absolute Encoder Data-) | |
| 9 | Reserved | |
| 10 | Hall Effect Sensor (Phase A) | |
| 11 | Hall Effect Sensor (Phase C) | |
| 12 | Reserved | |
| 13 | Reserved | |
| 14 | Reserved | |
| 15 | Reserved | |
| 16 | 5V Power Supply Input (connected internally to Pin-3) | |
| 17 | Reserved | |
| 18 | Reserved | |
| 19 | DATA+ (Absolute Encoder Data+) | |
| 20 | Common ground (connected internally to Pin-21) | |
| 21 | Common ground (connected internally to Pin-20) | |
| 22 | Reserved | |
| 23 | Reserved | |
| 24 | Reserved | |
| 25 | Reserved | |

Table 3-7: Mating Connector Part Numbers for the Encoder Connector

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

Table 3-8: General Feedback Connector Pinout (for Z or T Axes)

| Pin | Description | Wire Gauge AWG [mm ²] | Connector |
|-------------------|---|--------------------------------------|--|
| Case | Shield Connection | 26 [0.129] |  |
| 1 | Reserved | -- | |
| 2 | Over-Temperature Thermistor Sensor | 26 [0.129] | |
| 3 | 5V Power Supply Input (connected internally to Pin-16) | 26 [0.129] | |
| 4 | Reserved | -- | |
| 5 | Hall Effect Sensor (Phase B) | 26 [0.129] | |
| 6 | MRK- (Encoder Marker-) | 26 [0.129] | |
| 7 | MRK+ (Encoder Marker+) | 26 [0.129] | |
| 8 | Reserved | -- | |
| 9 | Reserved | -- | |
| 10 | Hall Effect Sensor (Phase A) | 26 [0.129] | |
| 11 | Hall Effect Sensor (Phase C) | 26 [0.129] | |
| 12 | + /CW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the "machine positive" or "machine clockwise" direction.) | 26 [0.129] | |
| 13 ⁽¹⁾ | Brake - | 26 [0.129] | |
| | Reserved | -- | |
| 14 | COS+ (Encoder Cosine+) | 26 [0.129] | |
| 15 | COS- (Encoder Cosine-) | 26 [0.129] | |
| 16 | 5V Power Supply Input (connected internally to Pin-3) | 26 [0.129] | |
| 17 | SIN+ (Encoder Sine+) | 26 [0.129] | |
| 18 | SIN- (Encoder Sine-) | 26 [0.129] | |
| 19 | Reserved | -- | |
| 20 | Common ground (connected internally to Pin-21) | 26 [0.129] | |
| 21 | Common ground (connected internally to Pin-20) | 26 [0.129] | |
| 22 | Reserved | -- | |
| 23 | Reserved | -- | |
| 24 | - /CCW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the "machine negative" or "machine counter-clockwise" direction.) | 26 [0.129] | |
| 25 ⁽¹⁾ | Brake + | 26 [0.129] | |
| | Reserved | -- | |

(1) Brake pins on the Z or T Axes, otherwise Reserved.

Table 3-9: Mating Connector Part Numbers for the Encoder Connector

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

3.2. Motor and Feedback Wiring

Shielded cables are required for the motor and feedback connections.

Figure 3-2: Motor and Feedback Wiring

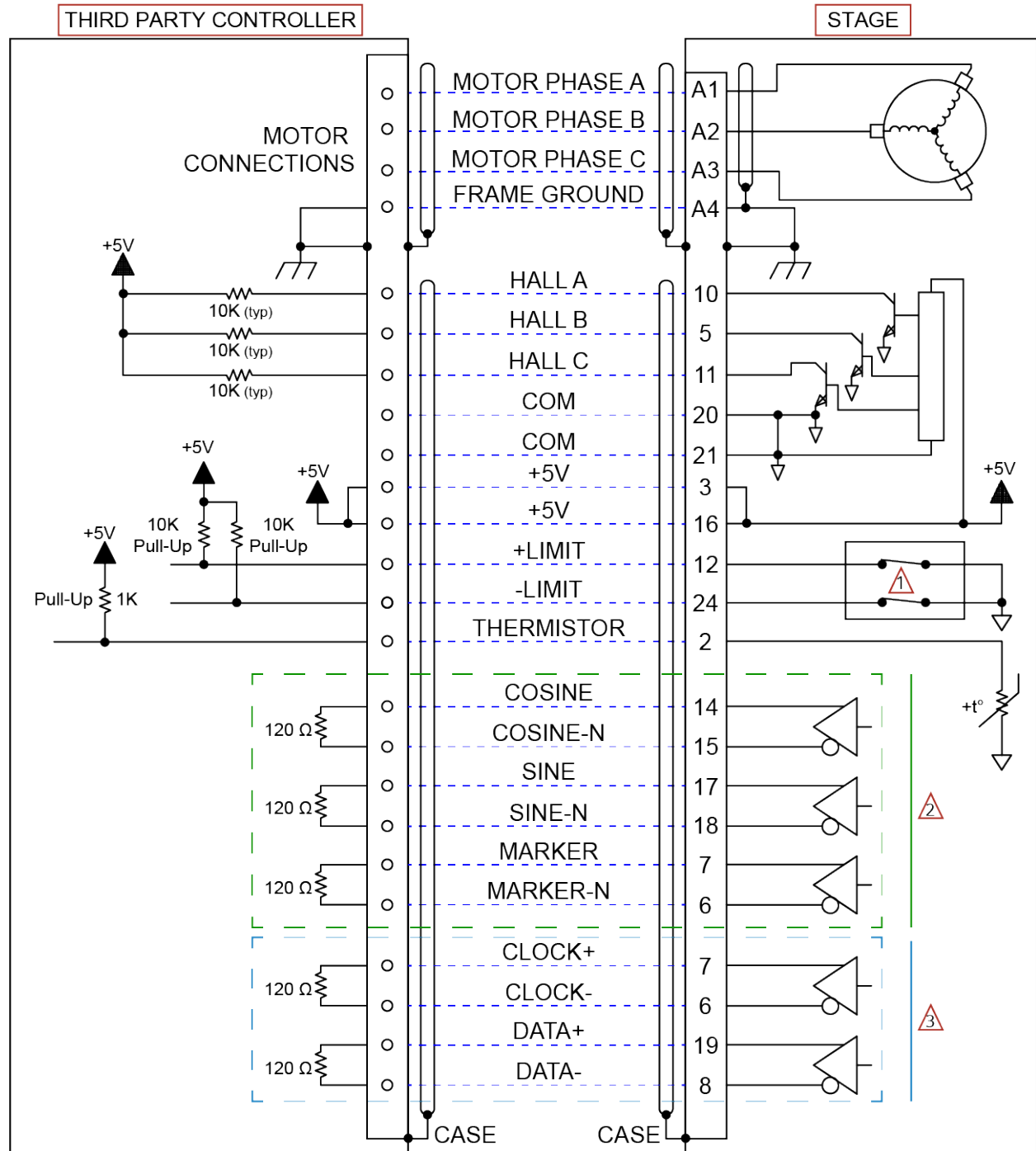
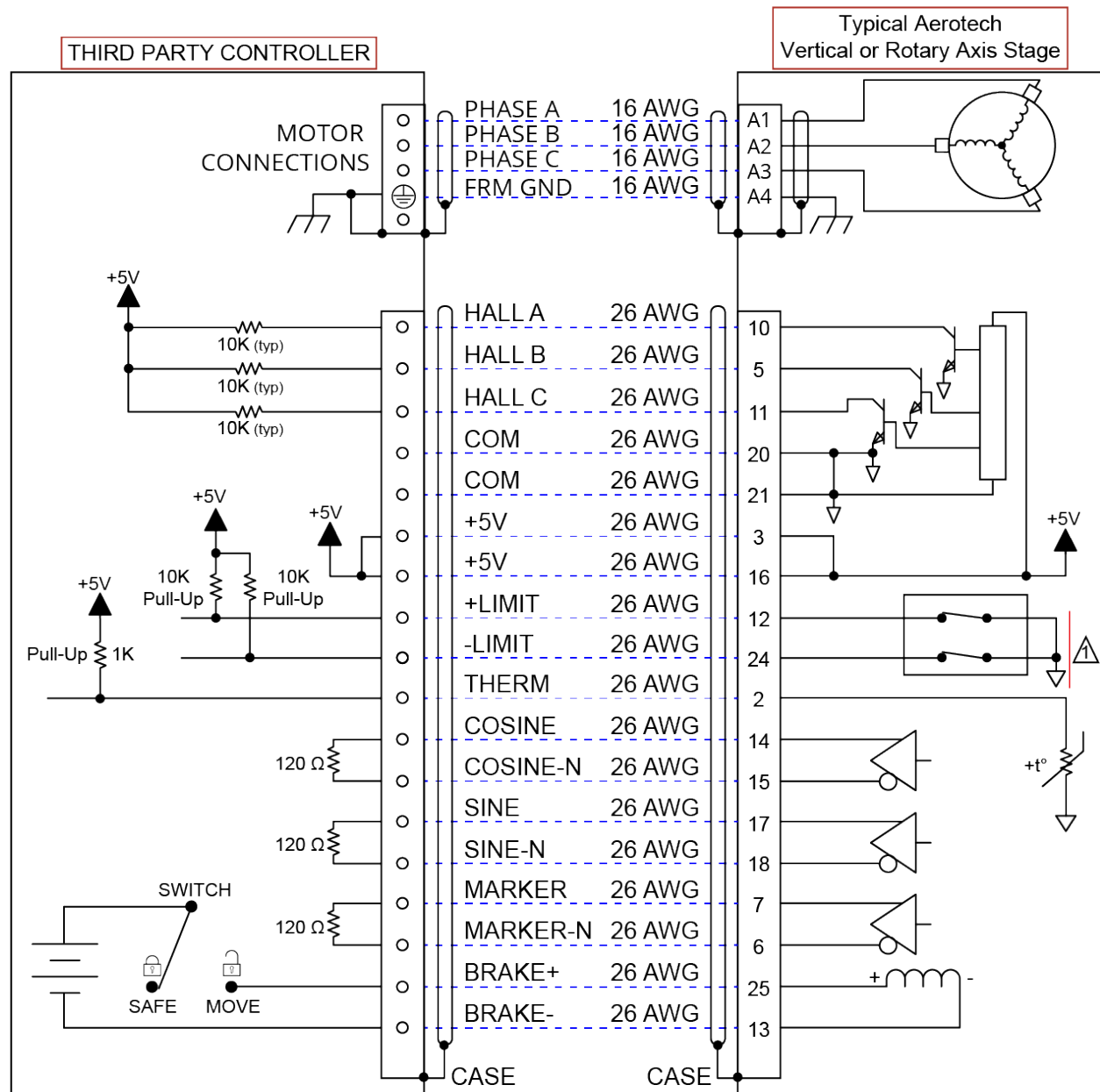


Figure 3-3: Motor and Feedback Wiring for a Typical Vertical or Rotary Axis Stage



⚠ Stage over-travel limits are configured N.C. at the factory

3.3. Motor and Feedback Specifications



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

Table 3-10: 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 3-11: Thermistor Specifications

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

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

Table 3-12: Encoder Specifications

| | Specification |
|----------------------------------|--|
| Supply Voltage | 5 V \pm 5% |
| Supply Current | 250 mA (typical) |
| Output Signals (Differential) | Sinusoidal Type (Incremental): Analog: SIN+, SIN-, COS+, COS-, 1V _{pk-pk} ; Digital (RS422): MRK+, MRK- signals. |
| | Digital Output (Incremental): TTL Encoder line-driver signals; RS422/485 compatible |
| | Serial Output (Absolute): EnDat 2.2 with 36 bit word |

Table 3-13: Linear Encoder Resolution Specifications

| Encoder Option | Fundamental Signal Period | Digital Resolution |
|--|---------------------------|--------------------|
| -E1 | 20 μ m | -- |
| -E1 with x4000 Interpolation ⁽¹⁾ | | 5 nm |
| -E1 with x16000 Interpolation ⁽¹⁾ | | 1.25 nm |
| -E2 ⁽¹⁾ | | 100 nm |
| -E3 | | 1 nm |

1. Quadrature decoding included in interpolated resolution calculations

Table 3-14: Limit Switch Specifications

| | Specification |
|---|---|
| Supply Voltage | 5 V \pm 5% |
| Supply Current | 25 mA |
| Output Type | Open Collector, Current Sinking, 24 VDC Max., 25 mA max. |
| Output Polarity (Factory Configured) | Normally Closed (NC) <ul style="list-style-type: none"> Sinks current to ground (Logic "0") when not in limit (limit not active). High impedance (Logic "1") when in limit (limit active). Third party controller LIMIT inputs typically require 10 kΩ pull-up to logic VDC supply. |
| | <ul style="list-style-type: none"> If the PRO190LM is driven beyond the electrical limit, it will encounter a mechanical stop. This could damage the stage, even at low speeds. |

Table 3-15: PRO190LM Motor Specifications (BLMC-192-A)

| | | BLMC-192 |
|--|--------------------------------|---------------|
| Performance Specifications | | |
| Continuous Force, 1.4 bar (20 psi) | N (lb) | 154.7 (34.8) |
| Continuous Force, No Forced Cooling | N (lb) | 106.7 (24.0) |
| BEMF Constant (line-line, max) | V/(m/s) (V/(in/s)) | 30.66 (0.78) |
| Continuous Current 1.4 bar (20 psi) | A_{pk} (A_{rms}) | 5.80 (4.10) |
| Continuous Current, No Forced Cooling | A_{pk} (A_{rms}) | 4.00 (2.83) |
| Peak Current, Stall | A_{pk} (A_{rms}) | 23.20 (16.40) |
| Force Constant, Sine Drive | N/A_{pk} (lb/ A_{pk}) | 26.67 (6.00) |
| | N/A_{rms} (lb/ A_{rms}) | 37.72 (8.48) |
| Motor Constant | N/\sqrt{W} (lb/ \sqrt{W}) | 10.29 (2.31) |
| Resistance, 25°C (line-line) | Ω | 6.4 |
| Inductance (line-line) | mH | 1.90 |
| Thermal Resistance, 1.4 bar (20 psi) | °C/W | 0.44 |
| Thermal Resistance, No Forced Cooling | °C/W | 0.93 |
| Maximum Bus Voltage | V_{DC} | 340 |
| <p>(1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.</p> <p>(2) All performance and electrical specifications have a tolerance of $\pm 10\%$.</p> <p>(3) Values shown @ 100 °C rise above a 25 °C ambient temperature, with motor mounted to the specified aluminum heat sink.</p> <p>(4) Peak force assumes correct rms current; consult Aerotech.</p> <p>(5) Force constant and motor constant specified at stall</p> <p>(6) All Aerotech amplifiers are rated A_{pk}; use force constant in N·m/A_{pk} when sizing.</p> | | |

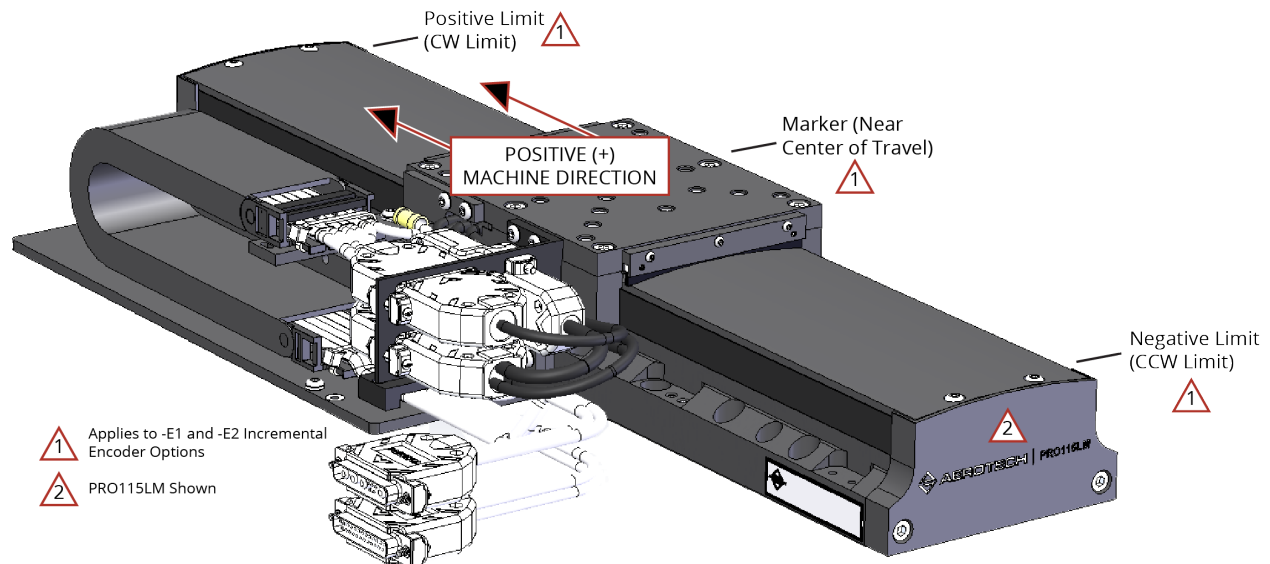
3.4. Limits, Marker, and Machine Direction

Aerotech stages have both a positive and negative **Machine Direction** and a positive and negative **Programming Direction**.

Machine Direction: The machine direction is defined by how the encoder and motor are mounted and the electrical wiring connections in the stage.

Programming Direction: Your system controller defines the programming direction of the stage and is application specific. A positive programmed move may or may not agree with the machine positive direction. Refer to your programming help documentation for more information.

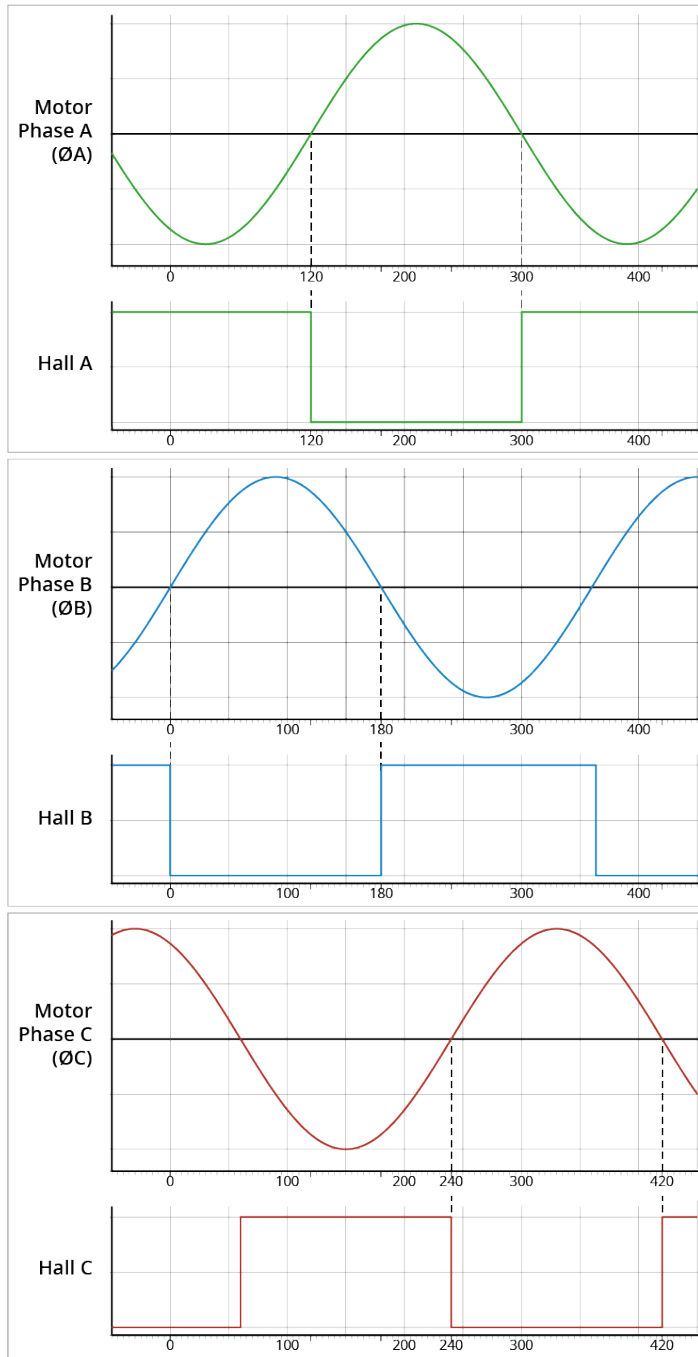
Figure 3-4: Machine Direction



3.5. Motor and Feedback Phasing

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

Figure 3-5: Hall Phasing Diagram



Positive MOVE (Clockwise) →

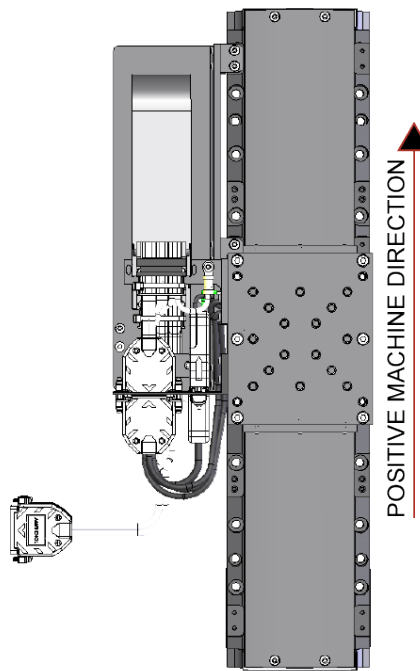


Figure 3-6: Encoder Phasing Reference Diagram (Standard/Square Wave)

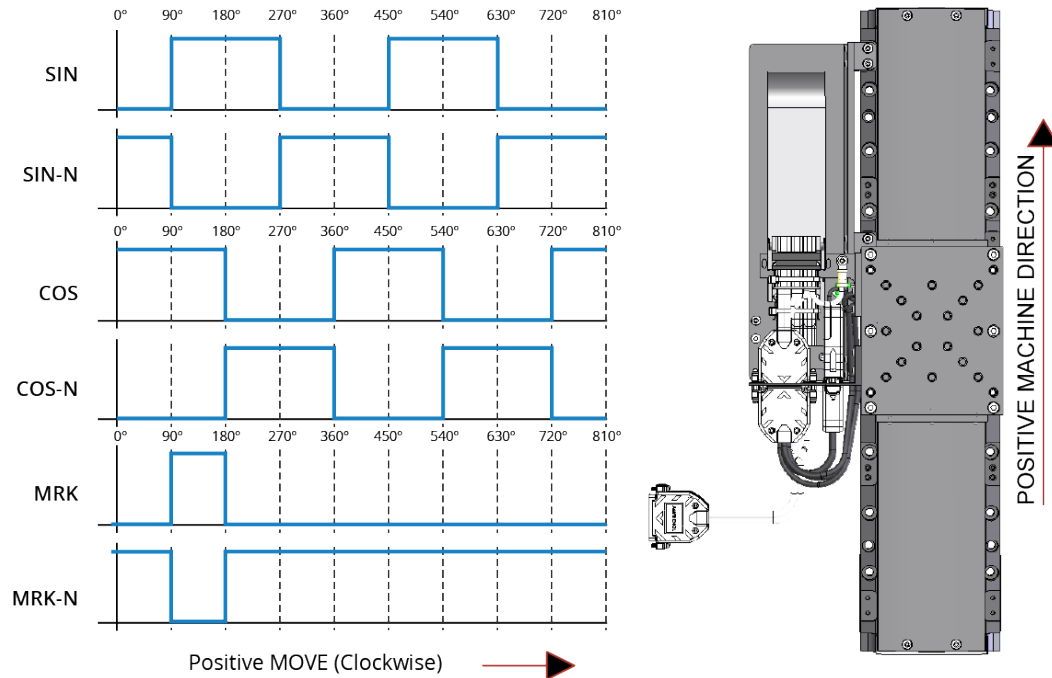
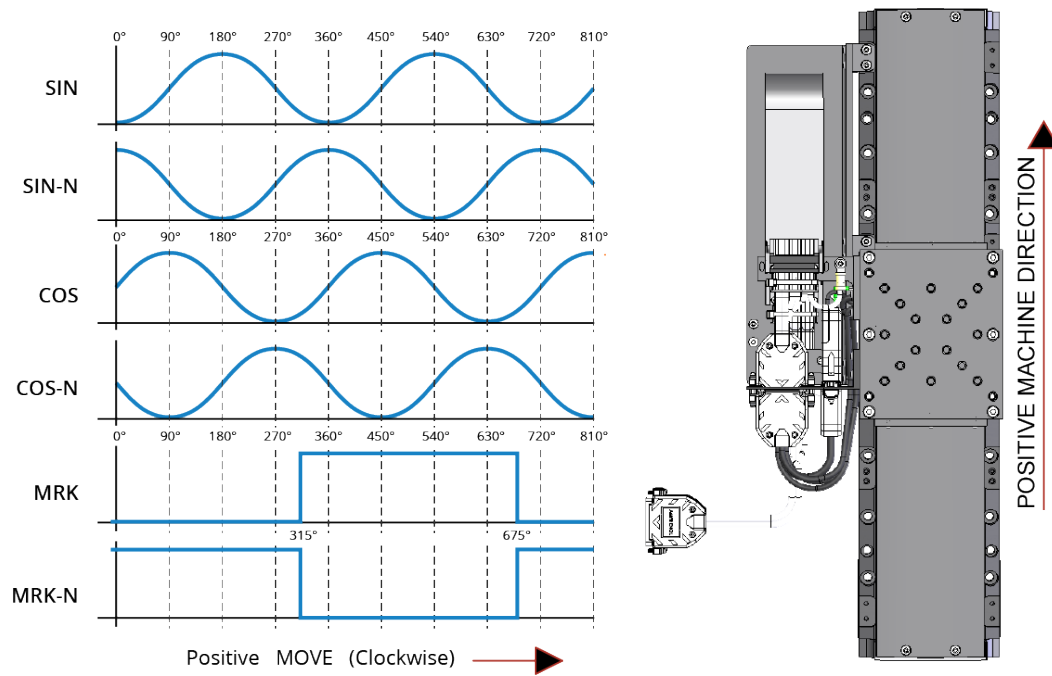


Figure 3-7: Digital Encoder Phasing Reference Diagram (Sine Wave)



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Chapter 4: Maintenance



IMPORTANT: Read the [Safety Procedures and Warnings](#) (on [Page 8](#)) 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 PRO190LM 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 PRO190LM and any components and cables as needed.
- Repair any damage before operating the PRO190LM.
- 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.



DANGER: Mechanical Hazards! When you move the tabletop manually to do maintenance, this could expose the operator to pinch points. Refer to [Pinch Points](#) on [Page 12](#).



- **Pinch Point!** The stage tabletop can present a pinch hazard.
- **Entanglement Hazard!** The side belts can present an entanglement hazard.



DANGER: Magnetic Field Hazard! When you move the tabletop manually to do maintenance, this could expose the operator to the magnet track. Refer to [Magnetic Hazards](#) on [Page 13](#).



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 PRO190LM series stage:

1. 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 can 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.

Cleaning

Use isopropyl alcohol if you must use a solvent to clean the stage. Harsher solvents, such as acetone, could damage the plastic and end caps on the 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 PRO190LM 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 linear motion guides for damage or signs of wear.

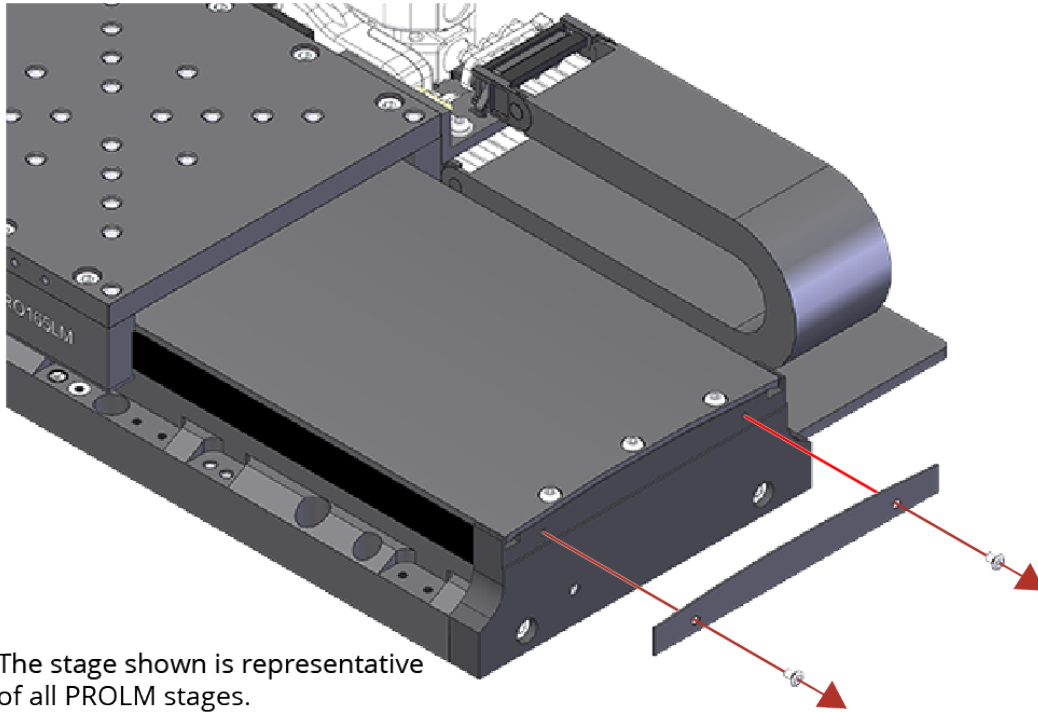
1. Remove power to the stage.
2. Remove the cover attached to the rear endplate (Figure 4-1).
3. Remove the screws on the edges of the hardcover (Figure 4-2) and slide it out from under the stage (Figure 4-3). This can be done without removing the table.
4. Remove any accumulated dust or debris from the inside of the assembly.
5. Remove any dirty or dried lubricant from the linear bearing rails.
 - Use a clean, lint-free cloth with a side-to-side motion.
 - Use a swab soaked in Isopropyl Alcohol to remove stubborn debris.
6. Apply a thin, continuous film of lubricant to the linear bearing guides. Aerotech recommends that you use a good quality, natural bristle artist's brush as an applicator.
7. Manually move the stage to the opposite end of travel. This will work the grease into the linear bearing guides.
8. Repeat steps 4 through 6 for any areas covered by the original table position.
9. Refasten the hardcover.
10. Restore power to the stage; drive the stage table back to its original position to redistribute lubricants.



IMPORTANT: For **GEN II PRO series stages with travel lengths greater than or equal to 800 mm**. The hardcover mounting surfaces in the stage end plates are designed to compensate for the sag of the long hardcover that is caused by gravity. As the mounting screws are tightened, the cover gently conforms to the shape of the end plates. Ensure that the cover is fully seated on the end plate mounting surfaces before you operate the stage. Check each mounting screw for full engagement by tightening the screw while holding the long side of a standard hex wrench.

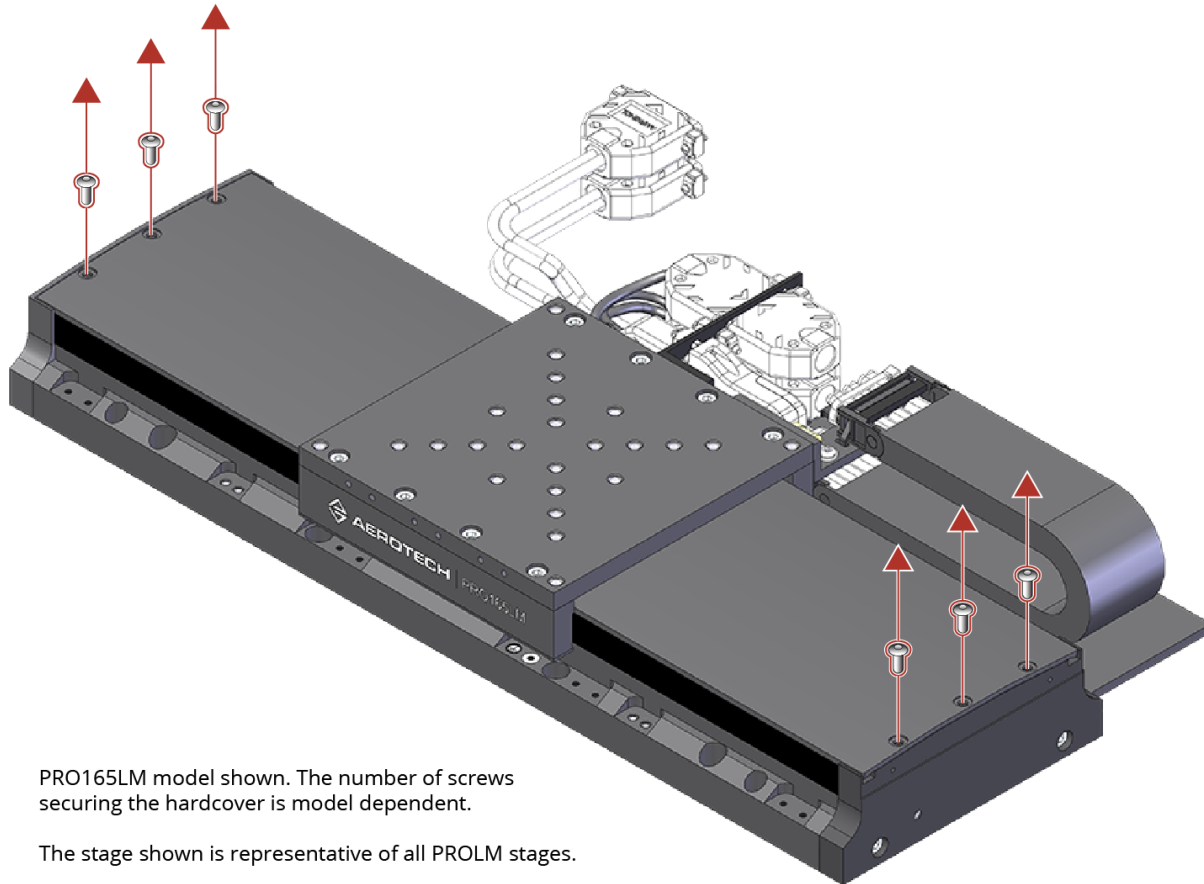
11. Restore power to the stage and drive the stage table back to its original position to redistribute lubricants.

Figure 4-1: Hardcover Rear End Plate Removal



The stage shown is representative of all PROLM stages.

Figure 4-2: Hardcover Screw Removal



PRO165LM model shown. The number of screws securing the hardcover is model dependent.

The stage shown is representative of all PROLM stages.

Figure 4-3: Hardcover Removal

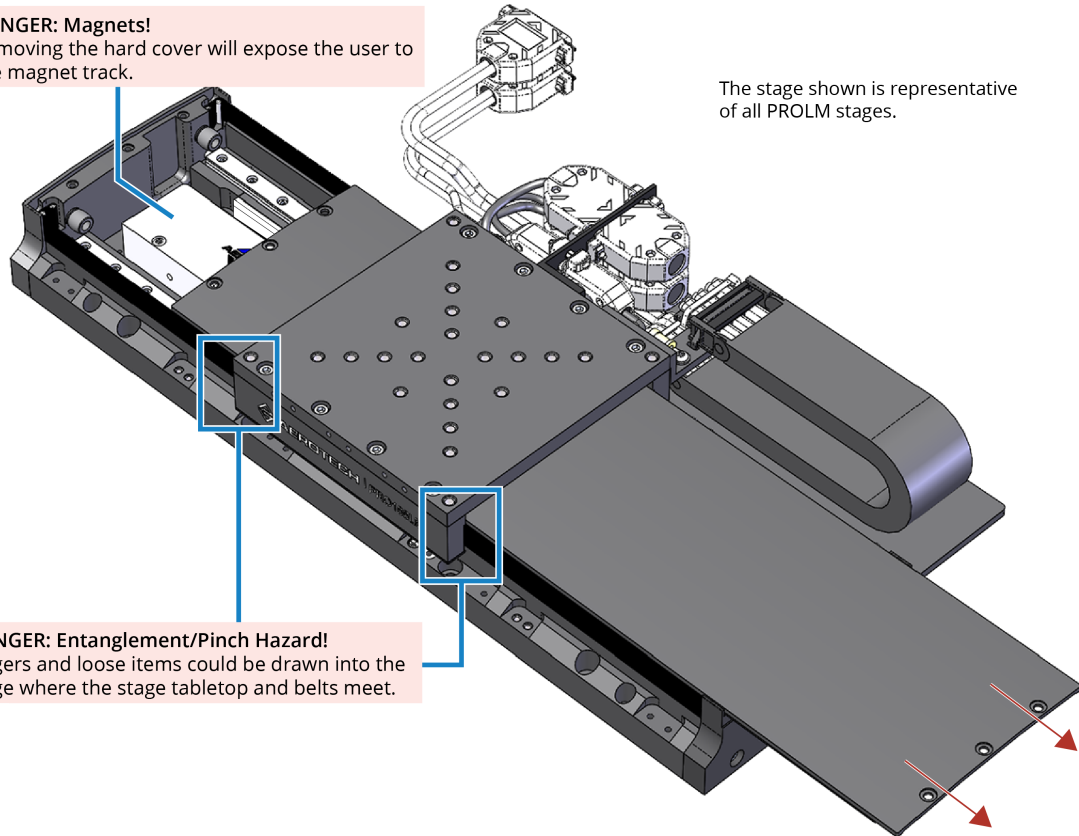


DANGER: Magnets!
Removing the hard cover will expose the user to the magnet track.

The stage shown is representative of all PROLM stages.



DANGER: Entanglement/Pinch Hazard!
Fingers and loose items could be drawn into the stage where the stage tabletop and belts meet.



4.3. Side Seal Belt Replacement

The side seal belts on this stage protect it from the ingress of dust and debris. Over time, the side seal belts could fray and deteriorate due to normal use. To order replacement side seal belt kits (referred to as “belt replacement kits”), refer to [Table 4-1](#) and contact Aerotech Global Technical Support.



IMPORTANT: Side seal belt replacement should only be attempted on stages that are in working order without any damages other than the worn side seal belts. If there are other issues or inconsistencies in performance, contact Aerotech Global Technical Support.



DANGER: Electrical Shock Hazard!

- Do not connect or disconnect stage/motor interconnections while connected to a live electrical power source.



DANGER: Mechanical Hazard!

- System travel can cause crush, shear, or pinch injuries.
- 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).



IMPORTANT: Do not disassemble the stage more than we recommended in these instructions. Further dis-assembly will result in loss of calibration and alignment.

Table 4-1: Side Seal Belt Replacement Kit Ordering Guide

| Stage Travel Length | Description | Part Number |
|---------------------|-------------------------------------|-------------|
| ≤400 mm | Regular Length Belt Replacement Kit | MFB32959 |
| ≥500 mm | Long Length Belt Replacement Kit | MFB32960 |

Side Seal Belt Replacement

Required Materials:

- Belt Replacement Kit (refer to [Table 4-1](#))
- Needle Nose Pliers
- Instant adhesive super glue (cyanoacrylate glue)
- Sharp scissors (to cut the belt to length)

Replacement Procedure:

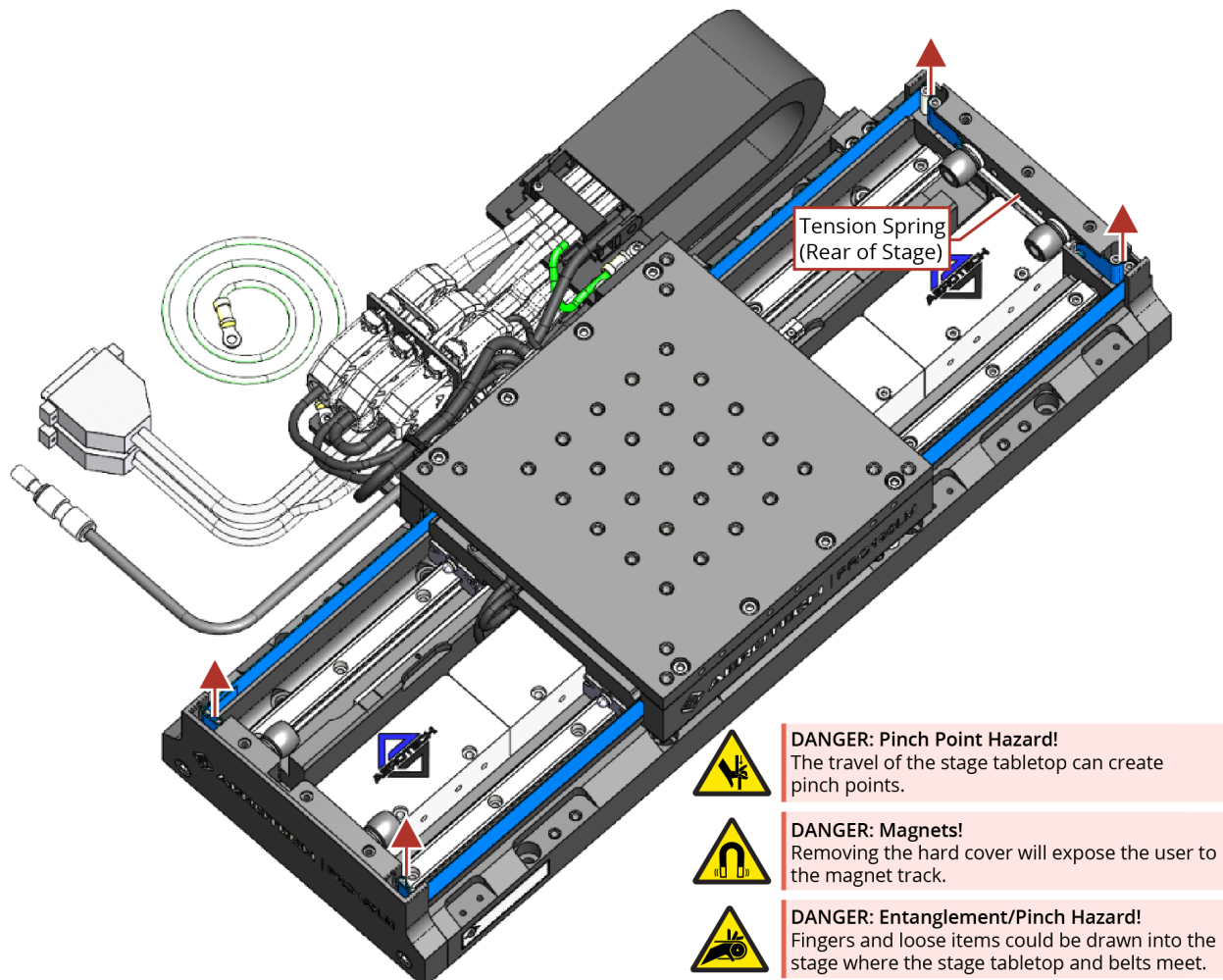
1. Remove the hardcover. Clean and lubricate the stage (optional but recommended).
 - a. Refer to [Section 4.2](#).
 - b. DO NOT replace hardcover or rear end plate after you clean and lubricate the stage.



IMPORTANT: Inspect the stage for any damage that could have caused the old side seal belts to need replacement. Do not continue with this procedure if there are signs of damage. Contact Aerotech Global Technical Support for assistance.

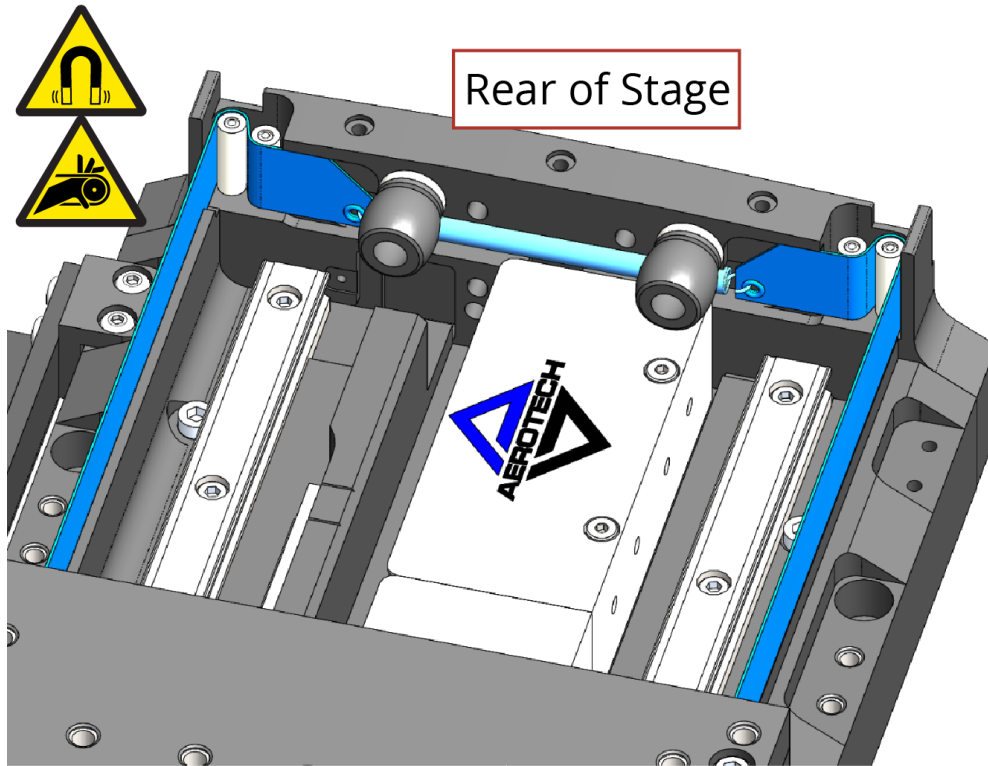
2. Remove the old side seal belt.
 - a. DO NOT pull the belt out of the stage table if the belt is intact.
 - b. Note which side of the stage holds the tension spring, this will be referred to as the rear of the stage.
 - c. Pull the belt up at the attachment pins ([Figure 4-4](#)).
 - d. Use pliers to open the spring loop that connects the spring to the side seal belt.

Figure 4-4: Belt Removal at the Attachment Pins



3. Install the new side seal belt at the rear of the stage.
 - a. If the belt is connected by the spring, use pliers to open one of the spring loops that connects the spring to the side seal belt.
 - b. Slide the spring into the stage channel before you reconnect it to the side seal belt.
 - c. Use pliers to close the spring loop around the side seal belt connection.
 - d. Slide the belt into the attachment pins at the rear of the stage.
 - e. Refer to [Figure 4-5](#) for the correct belt/pin orientation. The belt and spring will not sit correctly until tension is applied in later steps.

Figure 4-5: Spring Location Detail



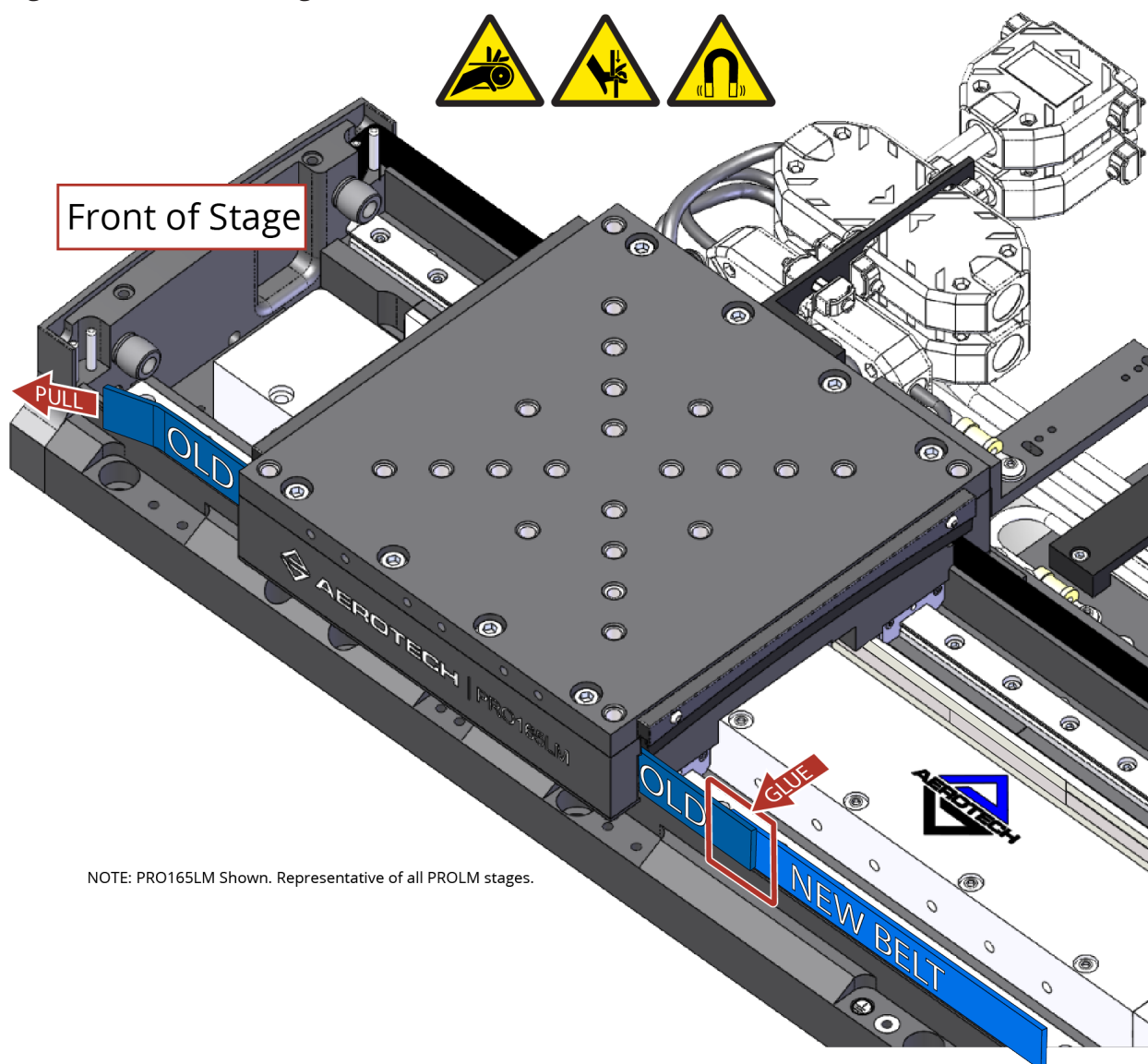
There are two methods that you can use to install the new belt through the stage table:

Pull Through Method: Use this method if the old belt is intact and fed through the stage table.

Manual Feed Method: Use this method if the old belt is not fed through the stage table.

4. **(Pull Through Method)** Install the new belt through the stage table. Refer to [Figure 4-6](#).
 - a. Make a clean, perpendicular cut on the rear portion of one side of the old side seal belt.
 - b. Attach the loose end of the new side seal belt to the old belt with super glue.
 - i. Overlap the old belt and new belt by 10 mm.
 - ii. The new belt should be on the inside of the old belt.
 - iii. Make sure there are no twists in the glued side seal belts and that the glue connection is secure.
 - c. Carefully pull on the old side seal belt to thread the new side seal belt through the stage table.
 - d. After the new belt is pulled through the stage table, cut off the old side seal belt from the new belt with a perpendicular cut.
 - e. Repeat steps "a" through "d" on the opposite side of the stage.

Figure 4-6: Pull Through Method



NOTE: PRO165LM Shown. Representative of all PROLM stages.



DANGER: You will invalidate the alignment and could invalidate the calibration if you unmount a stage from its mounting surface.



IMPORTANT: A minimum of two (2) people are required to tilt the stage on its side to avoid injury to the user.

5. **(Manual Feed Method)** Install the new belt through the stage table.
 - a. Carefully tilt the stage onto its side. Do not pinch any wires or damage any machined surfaces.
 - b. Manually position the stage table to provide access to the cover plate mounting screws. Refer to [Figure 4-7](#).
 - c. Remove the cover plate.
 - d. Push the new side seal belt around the rollers. Refer to [Figure 4-8](#).
 - e. Reinstall the cover plate and screws.
 - f. Repeat steps "a" through "e" on the opposite side of the stage.

Figure 4-7: Stage Table Cover Plate Removal

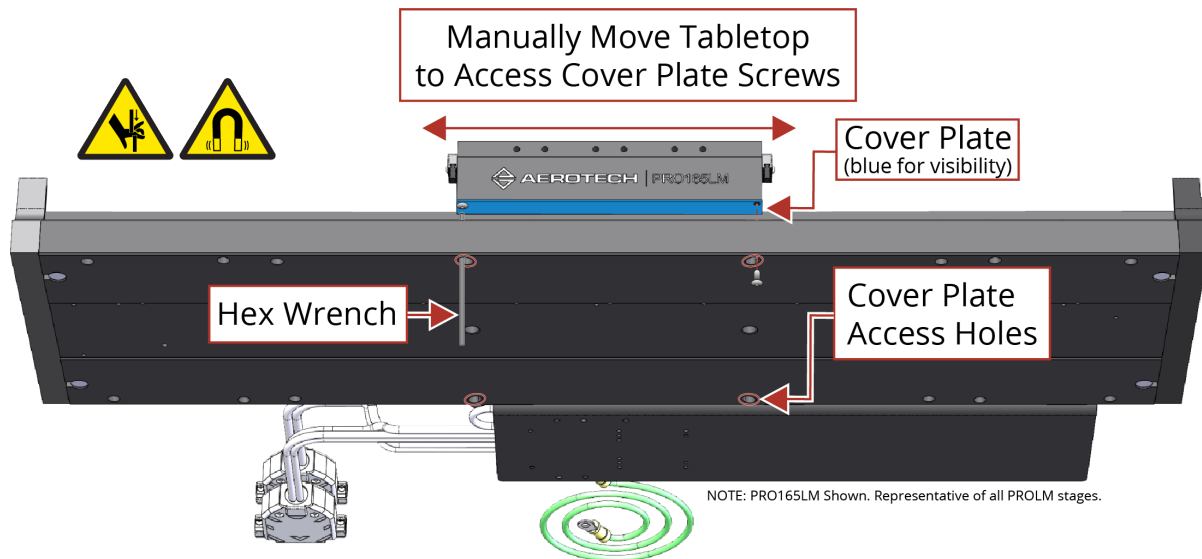
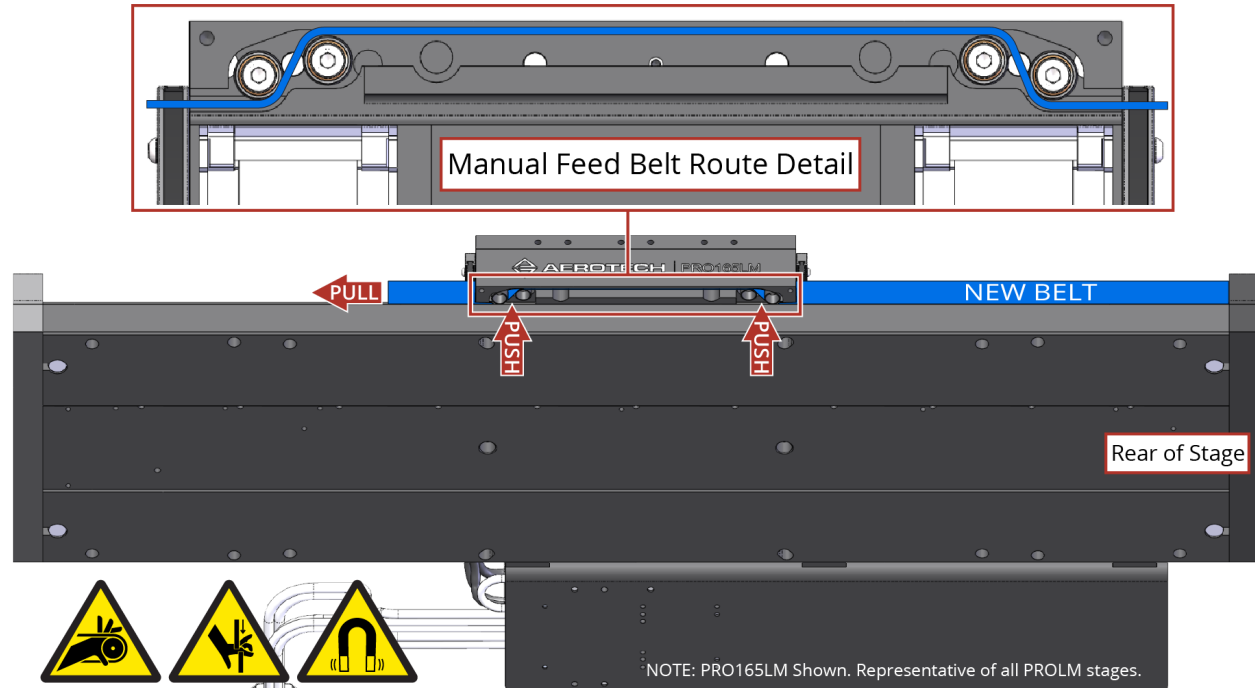
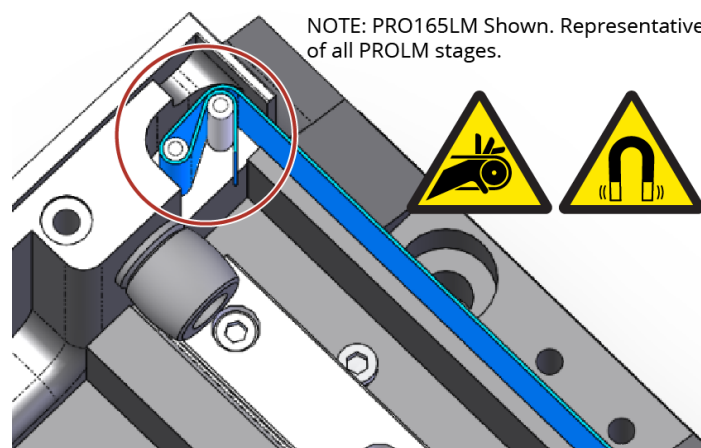


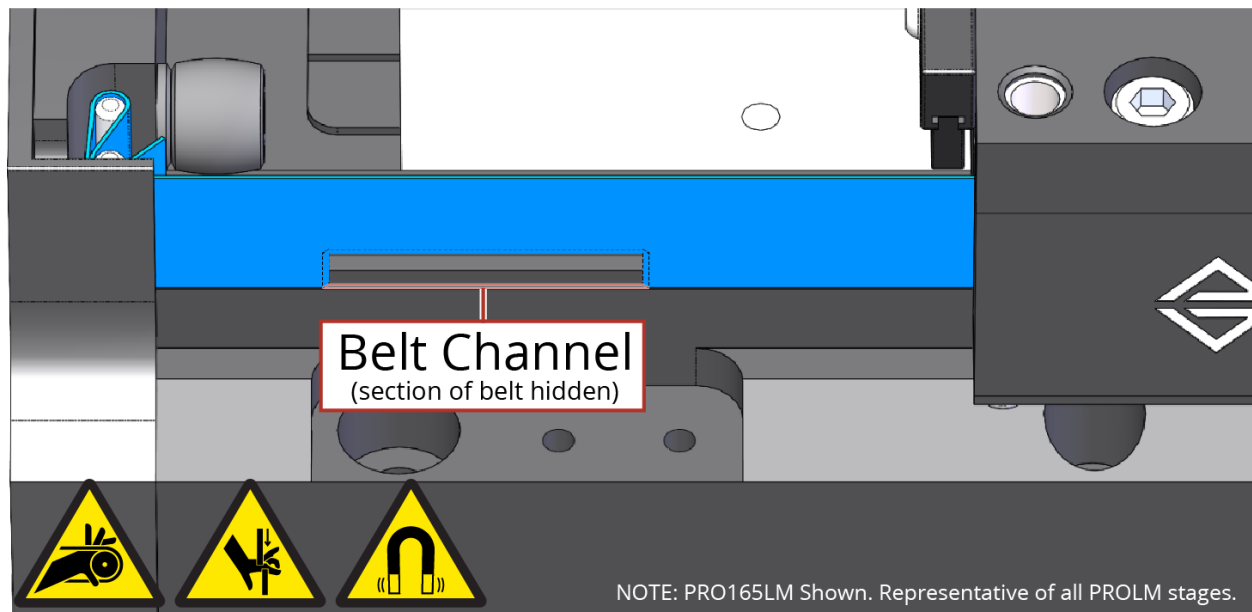
Figure 4-8: Manual Feed Method

6. Manually pull the new belt back and forth through the table. Confirm that the side seal belt feeds through smoothly without friction or snagging. If there appears to be damages preventing successful installation, contact Aerotech Global Technical Support .
7. Apply equal tension to both loose ends of the new side seal belt to stretch the spring. With the spring stretched, the spring and belt assembly should look like [Figure 4-5](#) at the rear of the stage.
8. While you are still holding tension in the belt, wrap the ends of the side seal belt around the front pins as shown in [Figure 4-9](#). The side seal belt should hold the tension without glue if it is properly wrapped around the pins and there is enough spring tension.

Figure 4-9: Belt Wrap

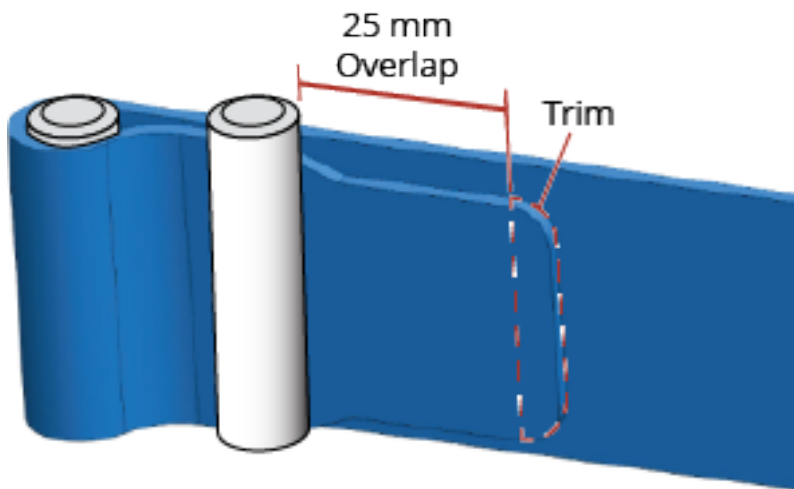
9. Adjust the tension on the left and right sides. Make sure that the spring is centered and stretched. Make sure that there is enough tension in the spring to satisfy all alignment requirements.
10. Trim the side seal belts. Leave approximately 50 mm of overlap for adjustments and glue.
11. With the belts secured in place and holding tension without glue, manually move the stage table through its full travel to confirm belt alignment.
 - a. The side seal belt must run parallel to the direction of travel and the belt must ride within its channel to avoid damaging the belt. Refer to [Figure 4-10](#).
 - b. Adjust the tension and placement of the new side seal belt until it is correctly aligned.

Figure 4-10: Belt Alignment



- Once the belt is fully adjusted, trim the ends of the belt as shown in [Figure 4-11](#).

Figure 4-11: Belt Trim



- Create a permanent loop on both ends of the side seal belt by applying a small amount of super glue (cyanoacrylate glue) to the overlapping end tabs. The belt can be removed from the pins to avoid getting excess glue on stage components.
- Reinstall the hardcover and rear end plate. Refer to [Section 4.2](#).
- With the stage fully reassembled, do a final test of the belt alignment. Move the stage through full travel to observe if there is interference with the hardcover. Repeat installation steps as needed to improve belt alignment.

4.4. Troubleshooting

| Symptom | Possible Cause and Solution |
|-----------------------------|--|
| Stage will not move | Shipping brackets still installed. Remove the red anodized shipping brackets. In Limit condition. Check limits (refer to Chapter 3: Electrical Installation) 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: Electrical Installation and Controller documentation). Motor Connections (refer to Chapter 3: Electrical Installation 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). 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

<https://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 | <ul style="list-style-type: none">• Added Section 4.3. |
| 2.00 | <ul style="list-style-type: none">• EU Declaration of Incorporation updated• UKCA Declaration of Incorporation added• Safety information updated• Dimensions updated• General product update |
| 1.01 | Revision changes have been archived. If you need a copy of this revision, contact |
| 1.00 | Aerotech Global Technical Support. |

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