



# ABRX High-Performance Rotary Air-Bearing Stage

## HARDWARE MANUAL

Revision 2.00



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## EU Declaration of Incorporation

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



herewith declares that the product:

### ABRX 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  
1/29/2024

**Date**

## UKCA Declaration of Incorporation

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



herewith declares that the product:

### **ABRX 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:**

/ Simon Smith

Managing 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

**Date**

1/29/2024

## 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: Mechanical Hazard!** The air supply **MUST** be connected before you rotate the stage table.

You can cause permanent damage to the stage if you move stage table without the air supply installed.

- Do not move the stage table without air supplied.
- Do not remove or install the shipping brackets without air supplied.



**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: Exhaust Port Warning!** You could damage the stage or nearby equipment. Refer to [Figure 1-1](#) for Exhaust Port Locations.

- Do not obstruct the exhaust ports.
- Equipment installed near the exhaust ports could be affected by the exhaust flow.



**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.
- 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 use or operate a stage or 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.



### **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!**



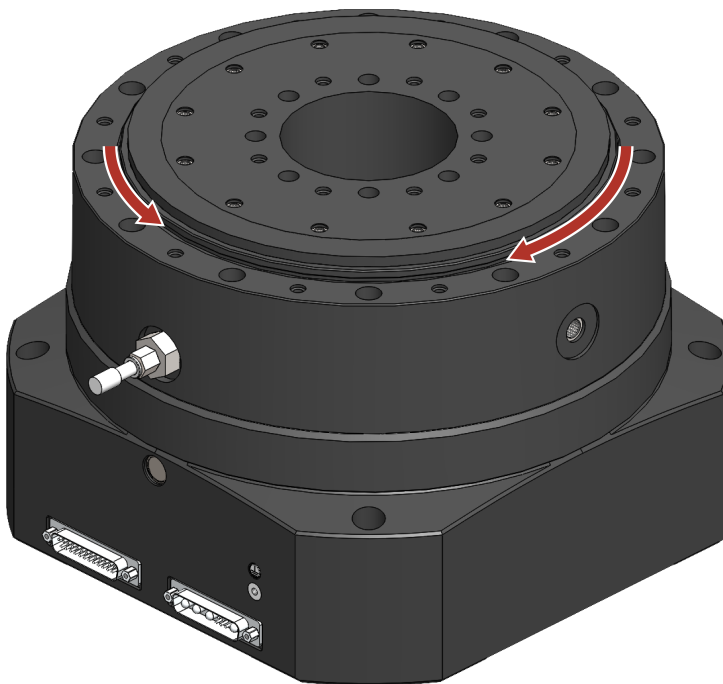
- System travel can cause crush, shear, or pinch injuries.
- Only trained operators should operate this equipment.
- Do not put yourself in the travel path of machinery.
- Restrict access to all motor and stage parts
  - when the system moves under power (during normal operation, for example).
  - when 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: Rotating Machinery Hazard!**

Keep hands and loose objects away from the stage while it is in motion.



## 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
  - 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 [Figure 2](#)).
- 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.

### Shipping Brackets

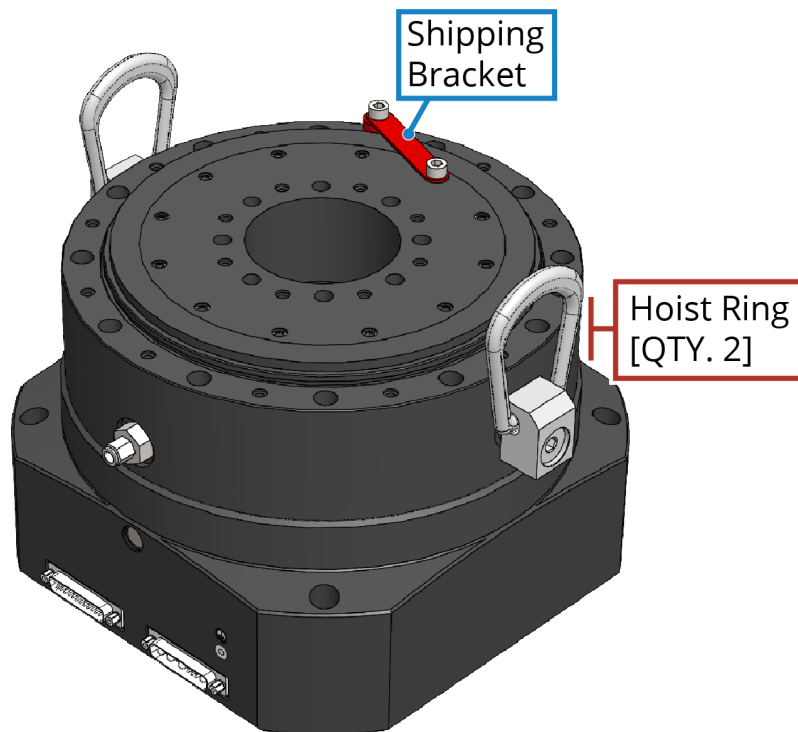


#### **DANGER: Mechanical Hazard!**

The air supply must be connected **BEFORE** you remove any shipping brackets. You can cause permanent damage to the stage if you move stage table without the air supply installed.

If the ABRX has shipped as part of a system, shipping brackets (typically red, anodized aluminum) have been installed to secure the system prior to shipment. The shipping brackets will need to be removed prior to machine start up.

**Figure 2: Shipping Brackets**



### 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](#)

# Chapter 1: Overview

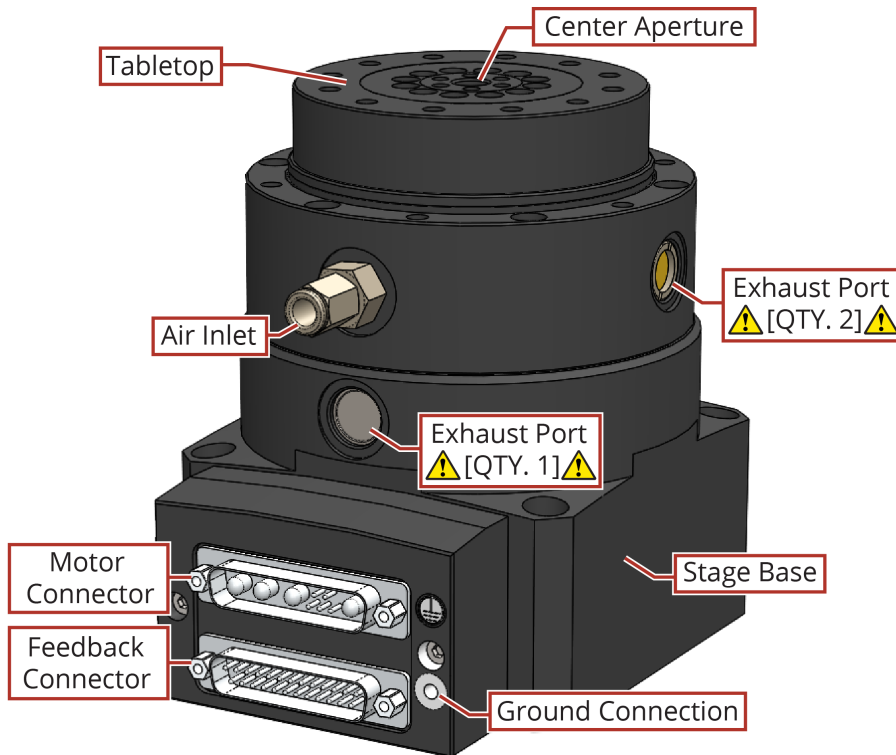
**Table 1-1: Model Numbers and Ordering Options**

| ABRX Air-Bearing Direct-Drive Rotary Stage          |   |
|---|---|
| ABRX100   | 100 mm wide air-bearing rotary stage  |
| ABRX150   | 150 mm wide air-bearing rotary stage  |
| ABRX250   | 250 mm wide air-bearing rotary stage  |
| Feedback (Required)                                 |   |
| -E1   | Incremental analog sinewave encoder, 1Vp-p  |
| -E2   | Incremental analog sinewave encoder, 1Vp-p, high performance  |
| -E3   | Incremental encoder, Digital RS422, electrical resolution 0.130 arc sec (ABRX100, ABRX150) or 0.116 arc sec (ABRX250)             |
|   | Maximum speed with -E3 option is limited to 170 rpm for ABRX100 and ABRX150, and 155 rpm for ABRX250.                             |
| Accessories (To be Ordered as a Separate Line Item) |   |
| -ABF  | Air bearing filtration kit  |
| Integration (Required)                              |   |
| -TAS  | Test as system: Testing, integration, and documentation of a group of components as a complete system that will be used together. |
| -TAC  | Test as components: Testing and integration of individual items as discrete components that ship together.                        |

**Figure 1-1: ABRX Series Rotary Air-Bearing Stage**

**WARNING: Exhaust Port Warning!** You could damage the stage or nearby equipment.

- Do not obstruct the exhaust ports.
- Equipment installed near the exhaust ports could be affected by the exhaust flow.



## 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**

|                            |   |
|----------------------------|---|
| <b>Ambient Temperature</b> | Operating: 10 °C to 35 °C (50 °F 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 °C to 40 °C (32 °F 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>   | Not suited for dusty or wet environments (IP00 equivalent ingress protection rating).   |
| <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.



### 1.3. Basic Specifications

**Table 1-3: Series Specifications**

|  |                  | ABRX100                           | ABRX150                           | ABRX250                          |
|--|------------------|-----------------------------------|-----------------------------------|----------------------------------|
| Travel   |                  | 360° Continuous                   |                                   |                                  |
| Accuracy <sup>(1)</sup>  | Standard         | ± 1 arc sec                       |                                   |                                  |
|  | High-Performance | ± 0.5 arc sec                     |                                   |                                  |
| Bidirectional Repeatability <sup>(1)</sup>   |                  | ± 0.2 arc sec                     |                                   |                                  |
| Resolution (Minimum Incremental Motion) <sup>(2)</sup>   |                  | 0.05 arc sec                      | 0.03 arc sec                      | 0.02 arc sec                     |
| Total Tilt Error Motion <sup>(1, 3)</sup>  |                  | 0.2 arc sec                       | 0.2 arc sec                       | 0.1 arc sec                      |
| Total Axial Error Motion <sup>(1, 3)</sup>   |                  | 25 nm                             | 25 nm                             | 30 nm                            |
| Total Radial Error Motion <sup>(1, 3)</sup>  |                  | 25 nm                             | 25 nm                             | 30 nm                            |
| Maximum Speed <sup>(4)</sup>   |                  | -E1/-E2: 1500 rpm<br>-E3: 170 rpm | -E1/-E2: 1200 rpm<br>-E3: 170 rpm | -E1/-E2: 800 rpm<br>-E3: 155 rpm |
| Maximum Torque   | Peak             | 1.16 N·m                          | 2.84 N·m                          | 9.35 N·m                         |
|  | Continuous       | 0.19 N·m                          | 0.44 N·m                          | 2.34 N·m                         |
| Load Capacity <sup>(5)</sup>   | Axial            | 17 kg                             | 40 kg                             | 110 kg                           |
|  | Radial           | 7 kg                              | 14 kg                             | 72 kg                            |
|  | Tilt             | 3.8 N·m                           | 10 N·m                            | 110 N·m                          |
| Operating Pressure <sup>(6, 7)</sup>   |                  | 80 psig                           |                                   |                                  |
| Air Consumption <sup>(7)</sup>   |                  | 18 SLPM                           | 25 SLPM                           | 30 SLPM                          |
| Rotor Inertia  |                  | 0.0005 kg·m <sup>2</sup>          | 0.0022 kg·m <sup>2</sup>          | 0.0308 kg·m <sup>2</sup>         |
| Stage Mass   |                  | 3.2 kg                            | 7.2 kg                            | 25.4 kg                          |
| Material   |                  | Anodized Aluminum                 |                                   |                                  |
| <p>(1) Certified with each stage. Requires an Aerotech controller.</p> <p>(2) With -E2 feedback</p> <p>(3) All error motion specifications are measured at 60 rpm. Certified with each stage.</p> <p>(4) Maximum speed based on stage capability assuming 340 VDC bus and balanced loading conditions. Maximum application speed could be limited by the system resolution and data rate. Consult the factory for more information.</p> <p>(5) Maximum loads are mutually exclusive.</p> <p>(6) To protect air bearing against under-pressure, an in-line pressure switch tied to the motion controller/amplifier E-Stop is recommended.</p> <p>(7) Air supply must be clean, dry to 0° F dew point and filtered to 0.25 μm or better. Recommend nitrogen at 99.9% purity.</p> |                  |                                   |                                   |                                  |

## 1.4. Air Requirements



### **DANGER: Compressed Air Hazard!**



Wear eye protection.

Check the condition of hoses and lines before use.



**WARNING: Mechanical Hazard!** Do not attempt to rotate the stage table until the air supply has been installed. Moving the stage table without air supplied can cause permanent damage to the stage.

Connect the air supply hose to the air inlet fitting. The location of the air inlet is shown in the dimensional drawings ([Section 2.1.](#)).

The air supply to the system should be clean and liquid water should not be present.

- If nitrogen is used, it must be 99.99% pure and filtered to 0.25 microns. [Recommended]
- If compressed air is used, it must be filtered to 0.25 microns, dry to 0° F dew point, and oil free.

Air pressure must be in the range of 551 kPa  $\pm$  34 kPa (80 psi  $\pm$  5 psi) with an airflow rate of 56 SLPM (standard liters per minute) at 551 kPa for a single axis.

Recommendations:

- You should connect the air supply with a polyurethane air hose.
- You should install a pressure switch (Aerotech P/N: MCA03094) tied to the emergency stop (ESTOP) of the motion controller that will remove power to the air bearing if pressure drops below 40 psi. A drop in pressure could result in contact between bearing surfaces which could cause damage to the surfaces. For reference, the ABF accessory kit from Aerotech incorporates air filtration plus a pressure monitoring switch.

## 1.5. Vacuum Operation

Air-bearing stages are not compatible with operation in a vacuum environment. Contact Aerotech for alternate solutions.

## Chapter 2: Installation



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: ABRX100 Dimensions

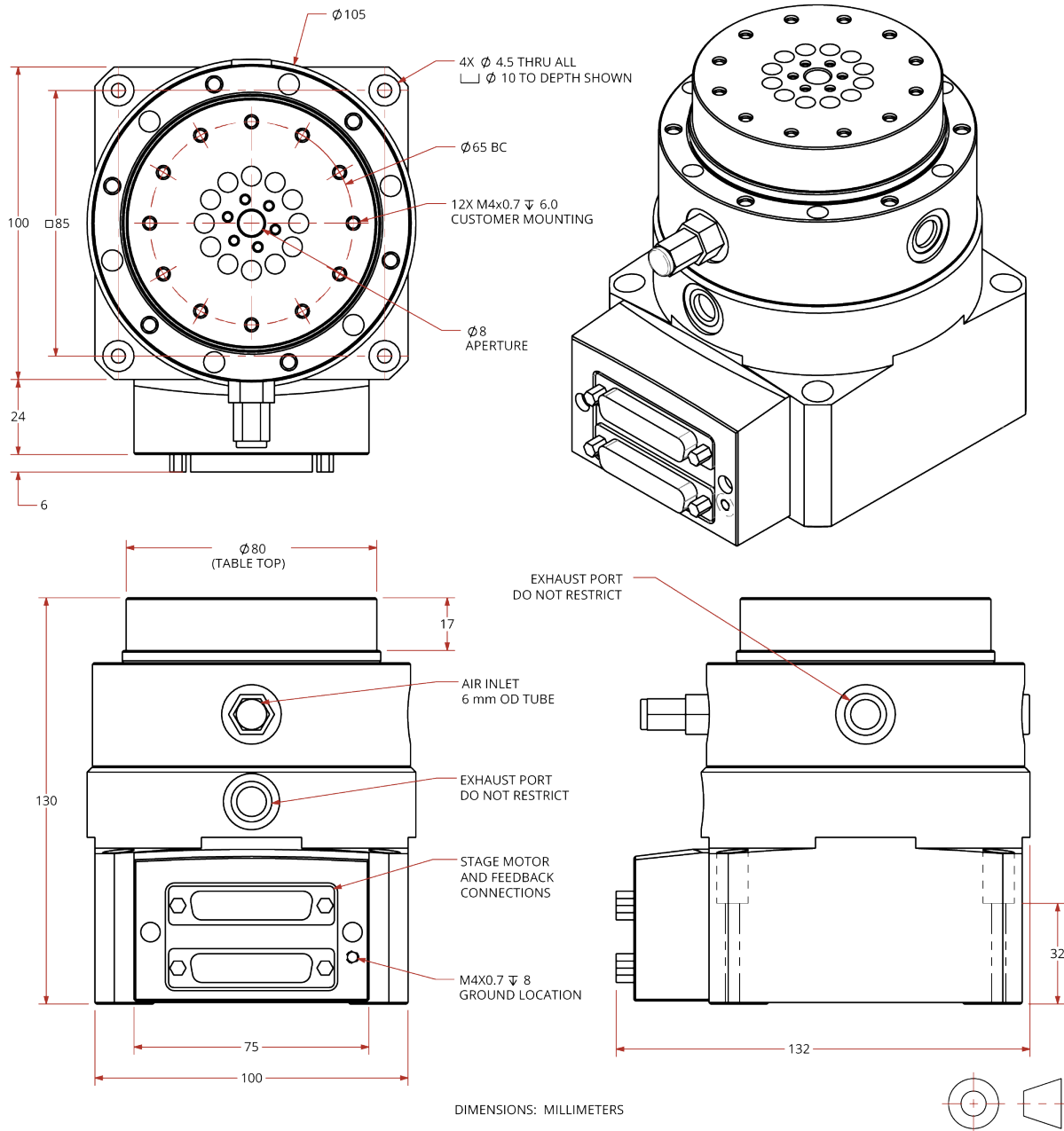


Figure 2-2: ABRX150 Dimensions

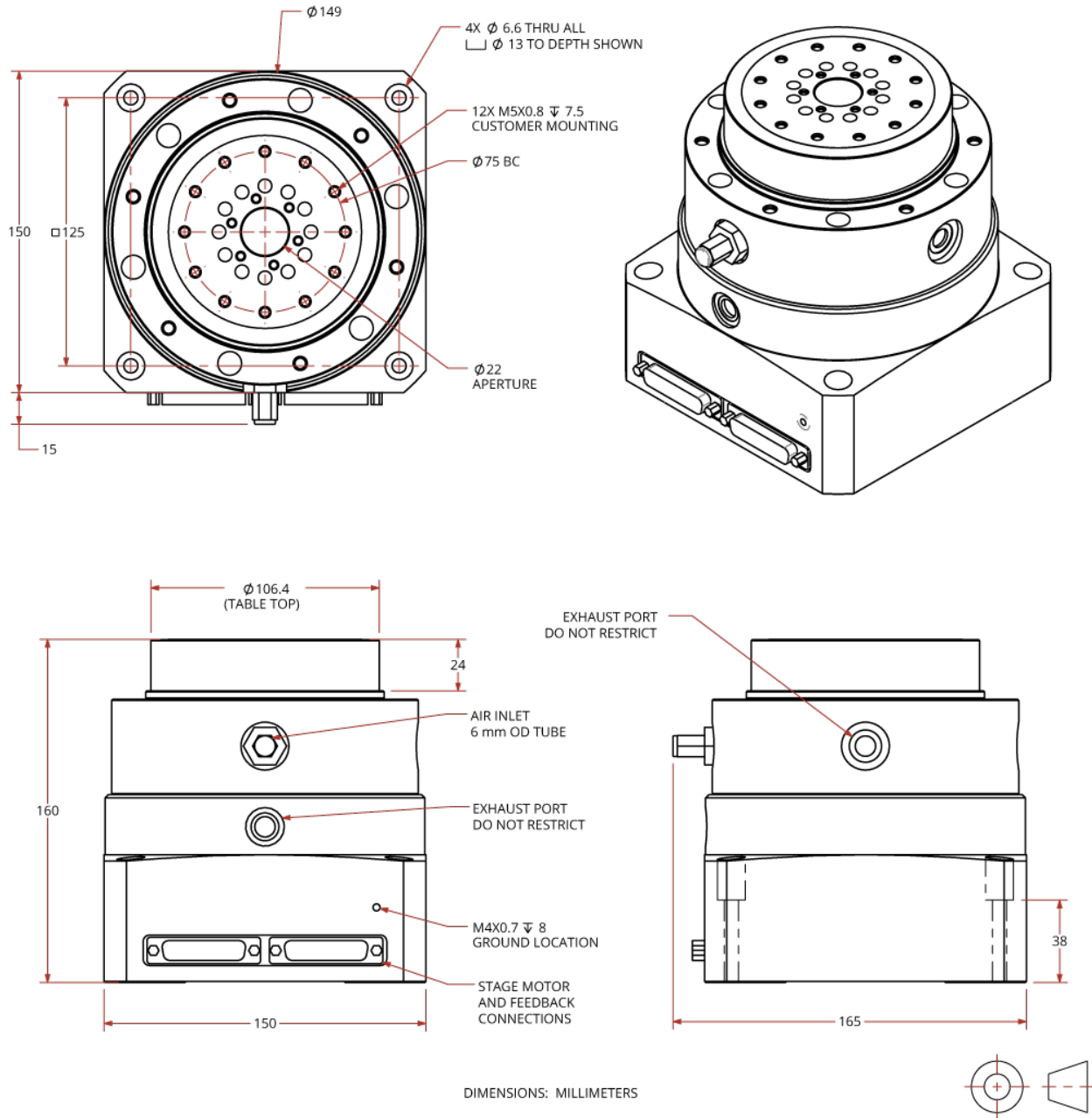
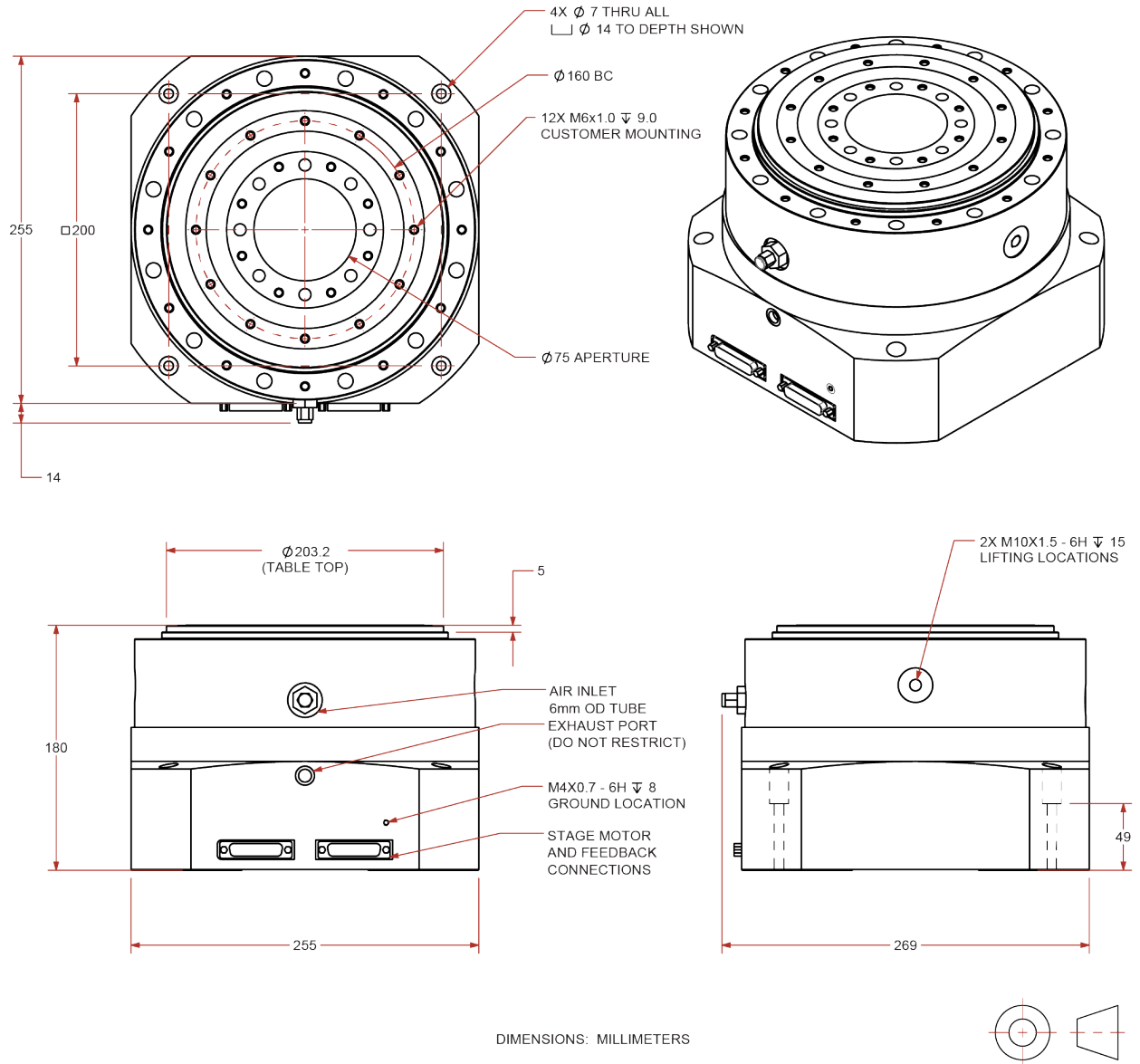


Figure 2-3: ABRX250 Dimensions



## 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 rotate the stage table if it is connected to a power source.
- Do not rotate the stage table without the air supply installed. Moving the stage table without air supplied can cause permanent damage to the stage.
- 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](#).



**IMPORTANT:** The mounting surface must be flat and have adequate stiffness to achieve the maximum performance from the stage. Contact Aerotech if you can not provide a mounting surface with the required flatness specification (refer to [Table 2-1](#)).



**IMPORTANT:** The stage is precision machined and verified for flatness at the factory.

- Do not machine the stage housing. If you must machine a surface to achieve a required flatness, machine the mounting surface.
- Do not use shims. The use of shims could reduce the rigidity of the system.

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.

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 and degrade error motions. Adjustments to the mounting surface must be done before the stage is secured.

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

| Stage           | Flatness Requirement |
|-----------------|----------------------|
| All Frame Sizes | 2 μm TIR             |

ABRX series stages have a fixed mounting pattern (as shown in [Figure 2-4](#)).

The stage should be mounted with the axis of rotation in the vertical direction using the counter-bored mounting holes shown in [Figure 2-4](#). Mounting the stage with the axis of rotation in a horizontal orientation is not recommended because this orientation can have a negative effect on performance. Consult Aerotech for more information if your application requires a horizontal axis of rotation configuration.

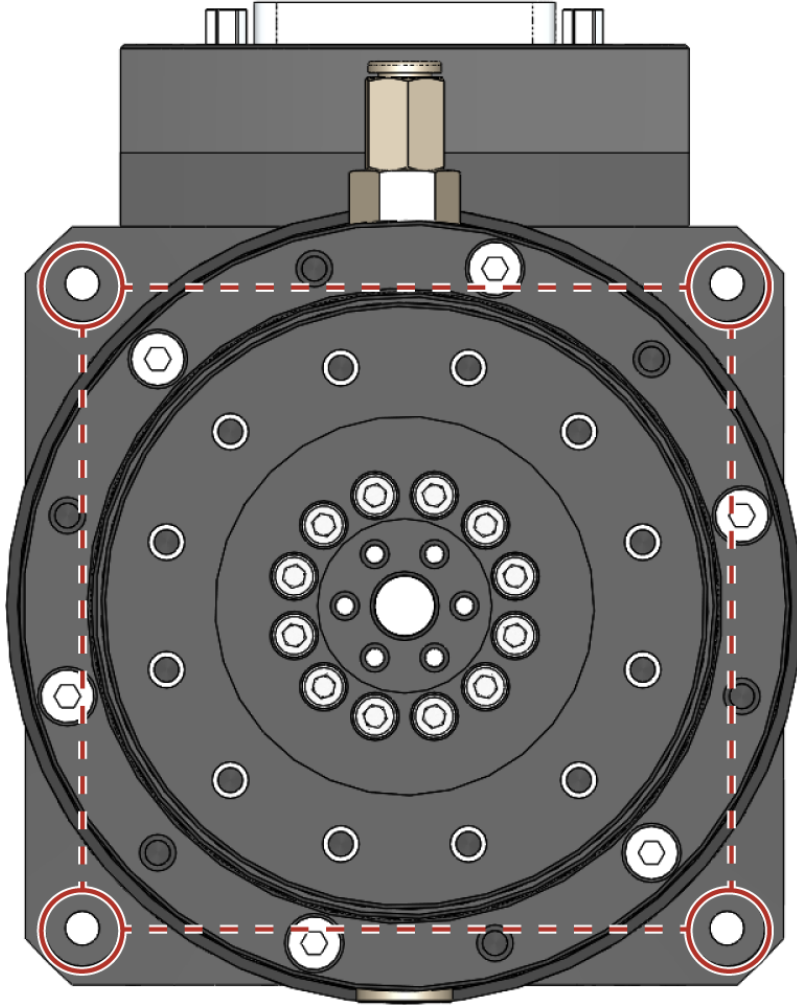
Tightening torque values for the mounting hardware are dependent on the properties of the surface to which the stage is being mounted. Values provided in [Table 2-2](#) are typical values and may not be accurate for your mounting surface. Refer to [Section 2.1](#) for specific model mounting locations and dimensions.

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

| Mounting Hardware | Typical Screw Torque <sup>(1)</sup>  |
|-------------------|--------------------------------------|
| ABRX100           | M4 SHCS with flat washers<br>2 N·m   |
| ABRX150, ABRX 250 | M6 SHCS with flat washers<br>6.9 N·m |

(1) The screw torque specification assumes an aluminum mounting surface.

Figure 2-4: Top View of an ABRX250 Stage Showing Mounting Holes



### 2.3. Attaching the Payload or Fixturing to the Tabletop

Inspect the mounting surfaces for dirt or unwanted residue and clean them if necessary (refer to [Section 4.2. Cleaning and Lubrication](#)). Gently place the payload on the tabletop.

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.



**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.



**IMPORTANT:** If your ABRX 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 ABRX 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.

Refer to [Section 1.3](#) for load capability specifications.

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

**Table 2-3: Mounting Interface Flatness Requirement**

| Stage Travel | Flatness Requirement |
|--------------|----------------------|
| All Travels  | 2 μm TIR             |

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.



**IMPORTANT:** Where possible, use 3-point mounting when you attach the payload to the stage.



## 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 ABRX 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 ABRX 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 ABRX 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.

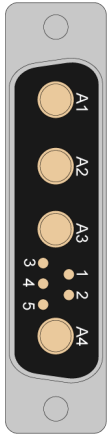
The protective ground connection of the ABRX provides motor frame ground protection only. Additional grounding and safety precautions are required for applications requiring access to the stage while it is energized. The System Integrator or qualified installer is responsible for determining and meeting 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.

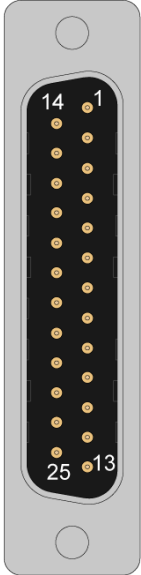
**Table 3-1: High Power D-Style Motor Connector Pinout**

| 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: 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 3-3: Feedback Connector Pinout**

| Pin  | Description                                    | Connector   |
|------|--|---|
| Case | Shield Connection                              |  |
| 1    | Reserved                                       |   |
| 2    | Over-Temperature Thermistor Sensor             |   |
| 3    | Encoder 5V 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                                       |   |
| 14   | COS+ (Encoder Cosine+)                         |   |
| 15   | COS- (Encoder Cosine-)                         |   |
| 16   | Encoder 5V Supply Input                        |   |
| 17   | SIN+ (Encoder Sine+)                           |   |
| 18   | SIN- (Encoder Sine-)                           |   |
| 19   | Reserved                                       |   |
| 20   | Common ground (internally connected to PIN-21) |   |
| 21   | Common ground (internally connected to PIN-20) |   |
| 22   | Reserved                                       |   |
| 23   | Reserved                                       |   |
| 24   | Reserved                                       |   |
| 25   | Reserved                                       |   |

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

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



### 3.3. Motor and Feedback Specifications

**Table 3-5: 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 3-6: Thermistor Specifications**

|                 | 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.



**IMPORTANT:** The encoders used on all ABRX series stages come standard with a MHz clock rate. Aerotech can provide slower or faster clock rates to match the controller being used. Consult Aerotech for more information.

**Table 3-7: Encoder Specifications**

|                           | Specification  |
|---------------------------|--|
| Supply Voltage            | 5 V $\pm$ 5%   |
| Supply Current            | 250 mA (typical)   |
| Output Signals (-E1, -E2) | <b>Sinusoidal Type (Incremental Encoder):</b> Analog: SIN+, SIN-, COS+, COS-, 1V <sub>pk-pk</sub> ; Digital (RS422): MRK+, MRK- signals. |
| Output Signals (-E3)      | <b>Digital Output (Incremental Encoder):</b> TTL Encoder line-driver signals; RS422/485 compatible                                       |

**Table 3-8: Encoder Resolution Specifications**

|                                      |     | ABRX100          | ABRX150          | ABRX250          |
|--------------------------------------|-----|------------------|------------------|------------------|
| Fundamental Resolution               | -E1 | 5,000 lines/rev  | 10,052 lines/rev | 22,304 lines/rev |
|                                      | -E2 | 23,000 lines/rev | 30,000 lines/rev | 63,000 lines/rev |
|                                      | -E3 | 5,000 lines/rev  | 10,052 lines/rev | 22,304 lines/rev |
| Electrical Resolution <sup>(1)</sup> | -E1 | 0.016 arc sec    | 0.008 arc sec    | 0.004 arc sec    |
|                                      | -E2 | 0.004 arc sec    | 0.003 arc sec    | 0.001 arc sec    |
|                                      | -E3 | 0.130 arc sec    | 0.130 arc sec    | 0.116 arc sec    |

(1) -E1, -E2 shown 16,000x total multiplication (including quadrature). Higher multiplication factors are available. Contact Aerotech for details..

**Table 3-9: Maximum Speed (rpm) Per Encoder Option**

| Resolution Speed | ABRX100       | ABRX150       | ABRX250       |
|------------------|---------------|---------------|---------------|
| -E1              | Motor Limited | Motor Limited | Motor Limited |
| -E2              | Motor Limited | Motor Limited | Motor Limited |
| -E3              | 170 rpm       | 170 rpm       | 155 rpm       |

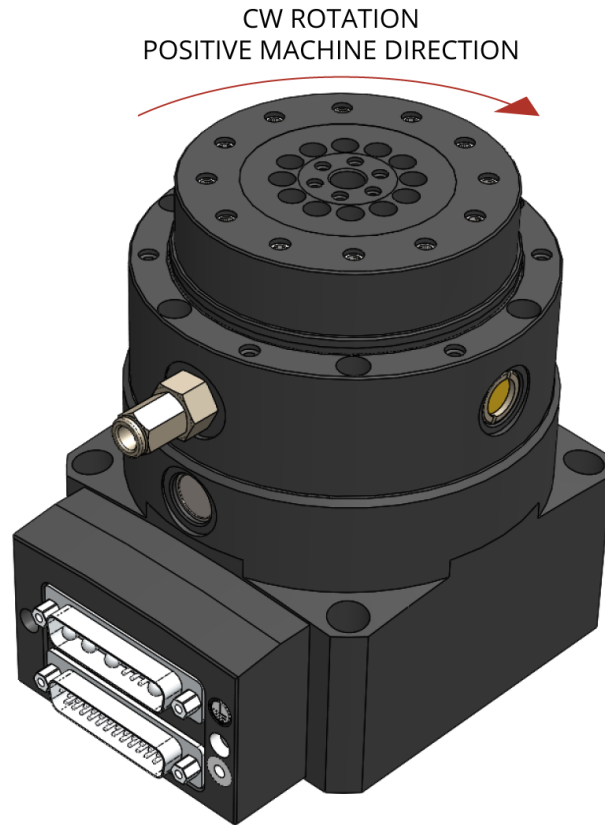
**Table 3-10: ABRX Series Motor Specifications**

|  |  | ABRX100      | ABRX150       | ABRX250        |
|--|--|--------------|---------------|----------------|
| <b>Performance Specifications</b>  |  |              |               |                |
| Stall Torque, Continuous <sup>(2)</sup>  | N·m (oz·in)                                    | 0.19 (26)    | 0.44 (62)     | 2.85 (404.0)   |
| Peak Torque <sup>(3)</sup>   | N·m (oz·in)                                    | 1.2 (170)    | 2.9 (411)     | 16.3 (2308.5)  |
| Rated Speed  | rpm  | 1000         | 1000          | 500            |
| Rated Power Output, Continuous   | W  | 17.6         | 41.0          | 149.3          |
| <b>Electrical Specifications</b>   |  |              |               |                |
| BEMF Constant (line to line, maximum)  | $V_{pk}/Krpm$                                  | 18.14        | 43.45         | 164.2          |
| Continuous Current, Stall <sup>(2)</sup>   | $A_{pk}$                                       | 1.3          | 1.22          | 2.1            |
|  | $A_{rms}$                                      | 0.9          | 0.86          | 1.5            |
| Peak Current, Stall <sup>(3)</sup>   | $A_{pk}$                                       | 7.7          | 8             | 12.0           |
|  | $A_{rms}$                                      | 3.5          | 5.66          | 8.5            |
| Torque Constant <sup>(4, 8)</sup>  | $N\cdot m / A_{pk}$<br>(oz·in / $A_{pk}$ )     | 0.149 (21.1) | 0.357 (50.55) | 1.358 (192.37) |
|  | $N\cdot m / A_{rms}$<br>(oz·in / $A_{rms}$ )   | 0.211 (29.8) | 0.505 (71.5)  | 1.921 (272.06) |
| Motor Constant <sup>(2, 4)</sup>   | $N\cdot m / \sqrt{W}$<br>(oz·in / $\sqrt{W}$ ) | 0.043 (6.04) | 0.088 (12.54) | 0.400 (56.65)  |
| Resistance, 25°C (line-line)   | $\Omega$                                       | 12.54        | 16.69         | 13.63          |
| Inductance (line-line)   | mH   | 1.42         | 3.15          | 3.40           |
| Maximum Bus Voltage  | VDC  | 340          | 340           | 340            |
| Thermal Resistance   | °C/W   | 3.93         | 3.1           | 0.63           |
| Number of Poles  | P  | 12           | 16            | 18             |
| Maximum Coil Temperature   | °C   | 100          | 100           | 100            |
| (1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.<br>(2) Values shown at 31 °C rise above a 25 °C ambient temperature, with a thermally isolated stage.<br>(3) Peak torque assumes correct rms current; consult Aerotech.<br>(4) Torque constant and motor constant specified at stall.<br>(5) All performance and electrical specifications have a tolerance of ±10%.<br>(6) Maximum winding temperature is 100 °C (thermistor trips at 100 °C).<br>(7) Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures.<br>(8) All Aerotech amplifiers are rated $A_{pk}$ ; use torque constant in $N\cdot m/A_{pk}$ when sizing. |  |              |               |                |

### 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 3-2](#) shows the machine direction of ABRX stages.

**Figure 3-2: Machine Direction**

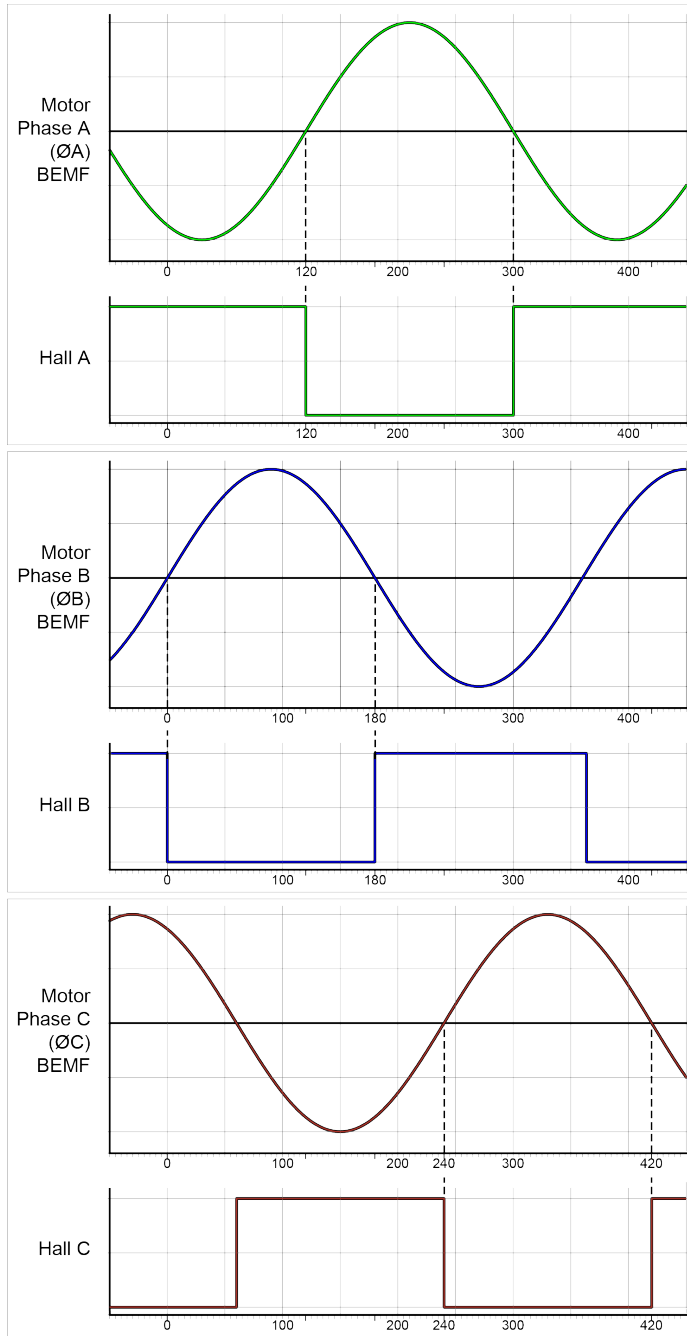




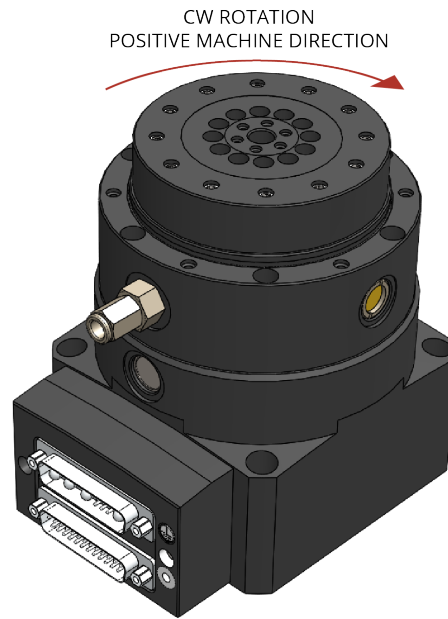
### 3.5. Motor and Feedback Phasing

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

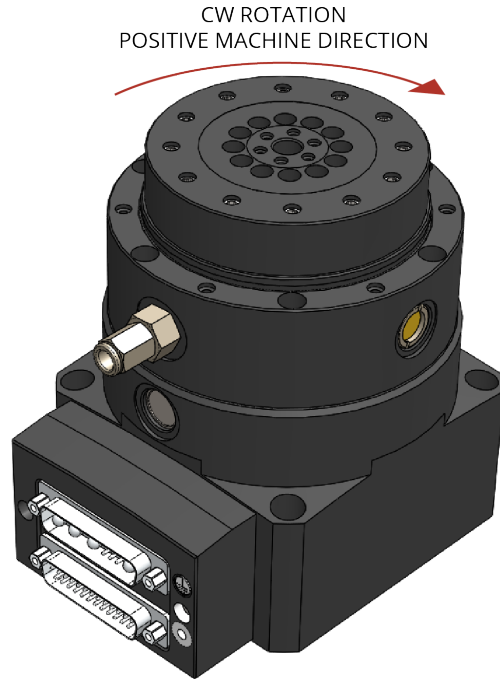
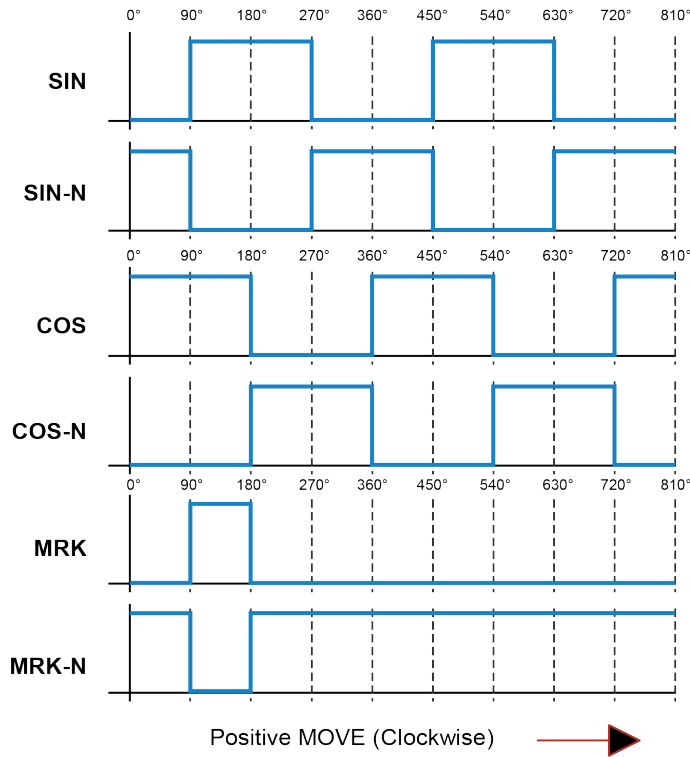
**Figure 3-3: Hall Phasing Diagram**



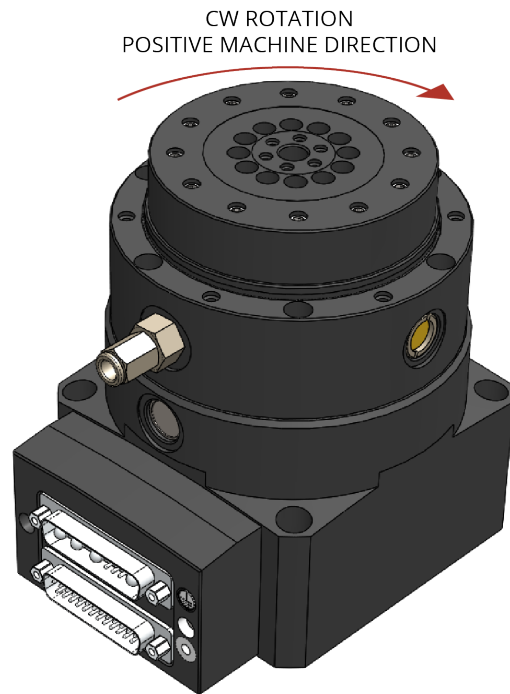
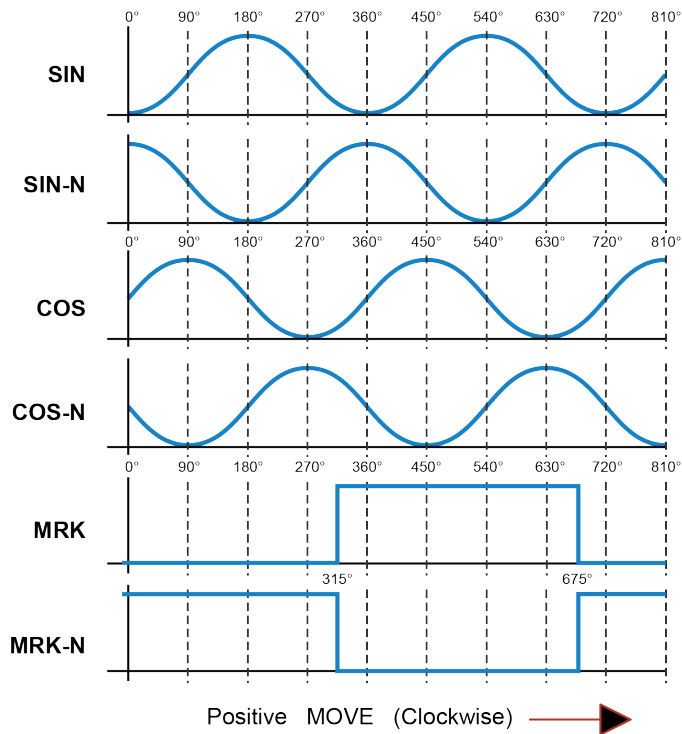
Positive MOVE (Clockwise) →



**Figure 3-4: Encoder Phasing Reference Diagram (Standard/Square Wave)**



**Figure 3-5: Encoder Phasing Reference Diagram (Analog/Sine Wave)**



## 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.

The ABRX series stages are designed to require minimum maintenance. Due to the non-contact air bearing design, there are no friction surfaces or dynamic seals to wear or require lubrication. This chapter will detail the cleaning process and specify recommended cleaning solvents.

In general, it is not possible for Aerotech field service personnel to repair or replace damaged or components that have malfunctioned. Repairs will typically require you to return the unit to the factory. Contact Aerotech Global Technical Support for more information.

### 4.1. Service and Inspection Schedule

Inspect the ABRX 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 ABRX and any components and cables as needed.
- Repair any damage before operating the ABRX.
- 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.

### Cleaning

Use isopropyl alcohol on a lint-free cloth to clean any external metal surface of the ABRX.

When you clean components of the ABRX series stage:

1. Use a clean, dry, soft, lint-free cloth.
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. 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.
4. 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.



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

### Lubrication

There are no elements on ABRX stages that require lubrication.

## 4.3. Troubleshooting

**Table 4-1: Troubleshooting**

| Symptom                     | Possible Cause and Solution   |
|-----------------------------|---|
| Stage will not move         | <ul style="list-style-type: none"> <li>• The air supply is not connected (<a href="#">Section 1.4</a>).</li> <li>• Shipping restraints still installed. Remove the red anodized shipping brackets.</li> <li>• Controller trap or fault (refer to the Controller documentation).</li> </ul>                                |
| Stage moves uncontrollably  | <ul style="list-style-type: none"> <li>• Encoder (sine and cosine) signal connections (refer to <a href="#">Chapter 3: Electrical Installation</a> and Controller documentation).</li> <li>• Motor Connections (refer to <a href="#">Chapter 3: Electrical Installation</a> and the Controller documentation).</li> </ul> |
| Stage oscillates or squeals | <ul style="list-style-type: none"> <li>• Gains misadjusted (refer to the Controller documentation).</li> <li>• Encoder signals (refer to the Controller documentation).</li> </ul>  |

## 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

<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 | General Information   |
|----------|---|
| 2.00     | <ul style="list-style-type: none"><li>• Product update</li><li>• General revision</li><li>• Updated safety information and warnings</li></ul> |
| 1.00     | New Manual  |

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**T**

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