



WaferMaxZ Mechanical-Bearing Direct-Drive Lift Stage

HARDWARE MANUAL

Revision 2.00



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Table of Contents

WaferMaxZ Mechanical-Bearing Direct-Drive Lift Stage	1
Table of Contents	3
List of Figures	4
List of Tables	5
EU Declaration of Incorporation	6
UKCA Declaration of Incorporation	7
RoHS Conformity Declaration	8
Safety Procedures and Warnings	9
Installation and Operation	10
Electrical Warnings	11
Motor-Related Warnings	12
Pinch Points	13
Magnetic Hazards	14
Handling and Storage	15
Chapter 1: Overview	17
1.1. Environmental Specifications	18
1.2. Accuracy and Temperature Effects	18
1.3. Basic Specifications	19
1.4. Vacuum Operation	20
1.5. Air Requirements	20
Chapter 2: Installation	21
2.1. Dimensions	21
2.2. Securing the Stage to the Mounting Surface	22
2.3. Attaching the Payload or Fixturing to the Stage	24
2.4. Counterbalance Setup	26
Chapter 3: Electrical Installation	29
3.1. Motor and Feedback Connectors	30
3.2. Motor and Feedback Wiring	33
3.3. Motor and Feedback Specifications	34
3.4. Limits, Marker, and Machine Direction	36
3.5. Motor and Feedback Phasing	37
Chapter 4: Maintenance	39
4.1. Service and Inspection Schedule	39
4.2. Cleaning and Lubrication	40
4.3. Flexure Constraints	42
4.4. Troubleshooting	43
Appendix A: Warranty and Field Service	45
Appendix B: Revision History	47
Index	49

List of Figures

Figure 2-1: WaferMaxZ Dimensions	21
Figure 2-2: Stage Mounting Holes	23
Figure 2-3: Payload Mounting Hole Locations	25
Figure 2-4: Counterbalance Pressure vs External Payload	26
Figure 2-5: Counterbalance Air Flow vs Counterbalance Pressure	27
Figure 3-1: Motor and Feedback Wiring	33
Figure 3-2: Machine Direction	36
Figure 3-3: Hall Phasing Diagram	37
Figure 3-4: Encoder Phasing Reference Diagram (Analog/Sine Wave)	38
Figure 4-1: Cutaway View of an WaferMaxZ Flexure	42

List of Tables

Table 1-1: Model Numbers and Ordering Options	17
Table 1-2: Environmental Specifications	18
Table 1-3: WaferMaxZ Series Specifications	19
Table 2-1: Stage Mounting Surface Flatness Requirement	22
Table 2-2: Stage to Mounting Surface Hardware	22
Table 2-3: Payload Mounting Surface Flatness Requirement	24
Table 2-4: Customer Mounting Features	25
Table 3-1: High Power D-Style Motor Connector Pinout	31
Table 3-2: Mating Connector Part Numbers for the Motor Connector	31
Table 3-3: Feedback Connector Pinout	32
Table 3-4: Mating Connector Part Numbers for the Feedback Connector	32
Table 3-5: Hall-Effect Sensor Specifications	34
Table 3-6: Thermistor Specifications	34
Table 3-7: Encoder Specifications	34
Table 3-8: Motor Specifications	35
Table 4-1: Troubleshooting	43



EU Declaration of Incorporation

Manufacturer: Aerotech, Inc.
Address: 101 Zeta Drive
 Pittsburgh, PA 15238-2811
 USA
Product: WaferMaxZ - linear positioning stage
Models: All

This is to certify that the aforementioned product is in accordance with the applicable requirements of the following directive.

2006/42/EC

Machinery Directive (partially completed machinery)

1.1 General Remarks

- 1.1.2 Principles of safety integration
- 1.1.5 Design of machinery to facilitate handling

1.2 Control Systems

- 1.2.1 Safety and reliability of control systems

1.3 Protection against mechanical hazards

- 1.3.1 Risk of loss of stability
- 1.3.2 Risk of breakup during operation
- 1.3.3 Risks due to falling or ejected objects
- 1.3.4 Risks due to surfaces, edges, or angles

1.5 Risks due to other hazards

- 1.5.4 Error of fitting
- 1.5.9 Vibrations

1.6 Maintenance

- 1.6.5 Cleaning of internal parts

1.7 Instructions

- 1.7.4.1 Instructions

and that the following harmonized European standards have been applied:

EN ISO 12100

Safety of machinery – Basic concepts, general principles for design

EN 60204-1:2018

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

and furthermore declares that

the equipment shall not be put 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. Technical documentation showing compliance with this declaration in accordance with Annex VII part B will be provided in digital format upon request.

Authorized Representative:

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Engineer Verifying Compliance:

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

Alex Weibel

Date: 4/4/2025



AEROTECH UKCA Declaration of Incorporation

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

herewith declares that the following Aerotech stage series:

WaferMaxZ

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

 Restricted Substances Directive

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

 Safety of machinery – Basic concepts, general principles for design

EN 60204-1:2018

 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.

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Date: 4/4/2025

**Engineer Verifying
Compliance:**

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Alex Weibel



RoHS Conformity Declaration

Manufacturer: Aerotech, Inc.
Address: 101 Zeta Drive
Pittsburgh, PA 15238-2811
USA
Product: WaferMaxZ - linear positioning stage
Models: All

This is to certify that the aforementioned product is in accordance with the applicable requirements of the following directive:

(EU) 2015/863 restriction of the use of hazardous substances (RoHS3)

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.
- 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.

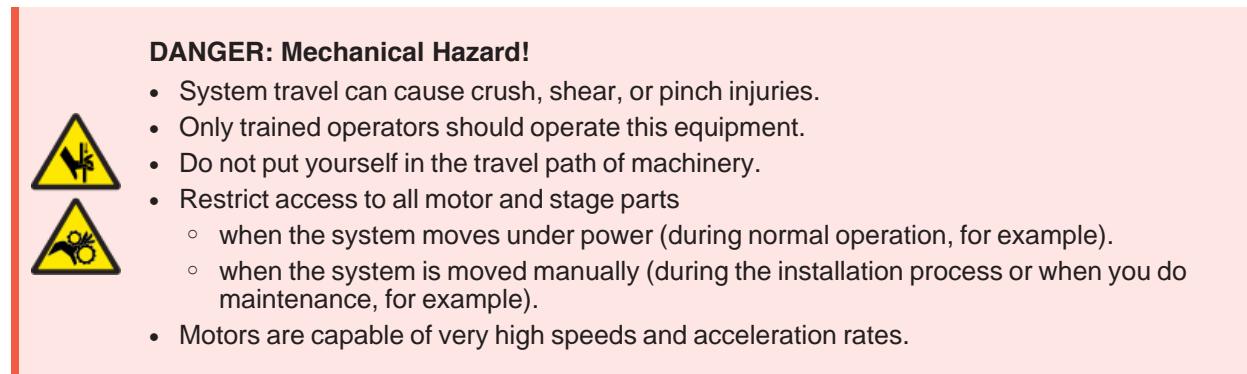
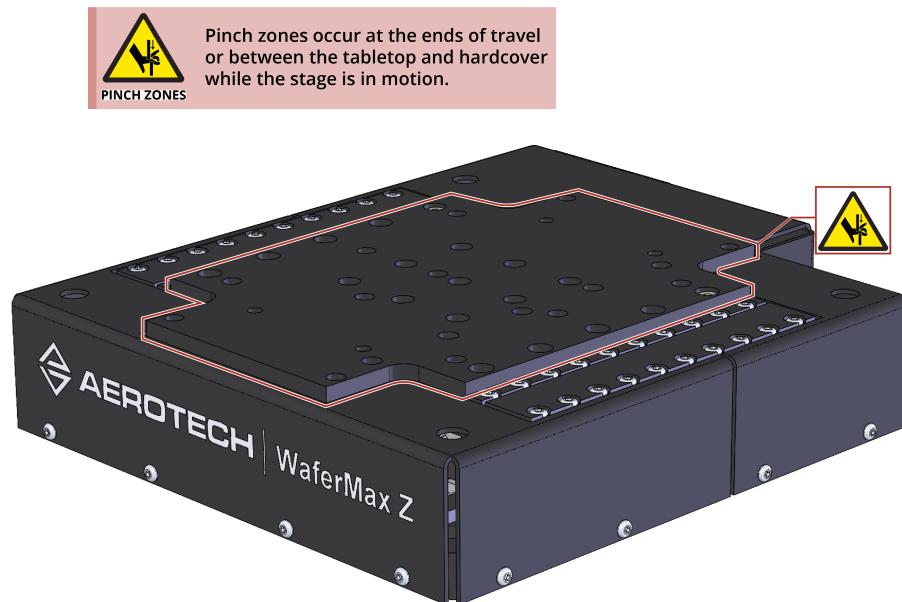


Figure 1: Typical Pinch Point Locations



Magnetic Hazards

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



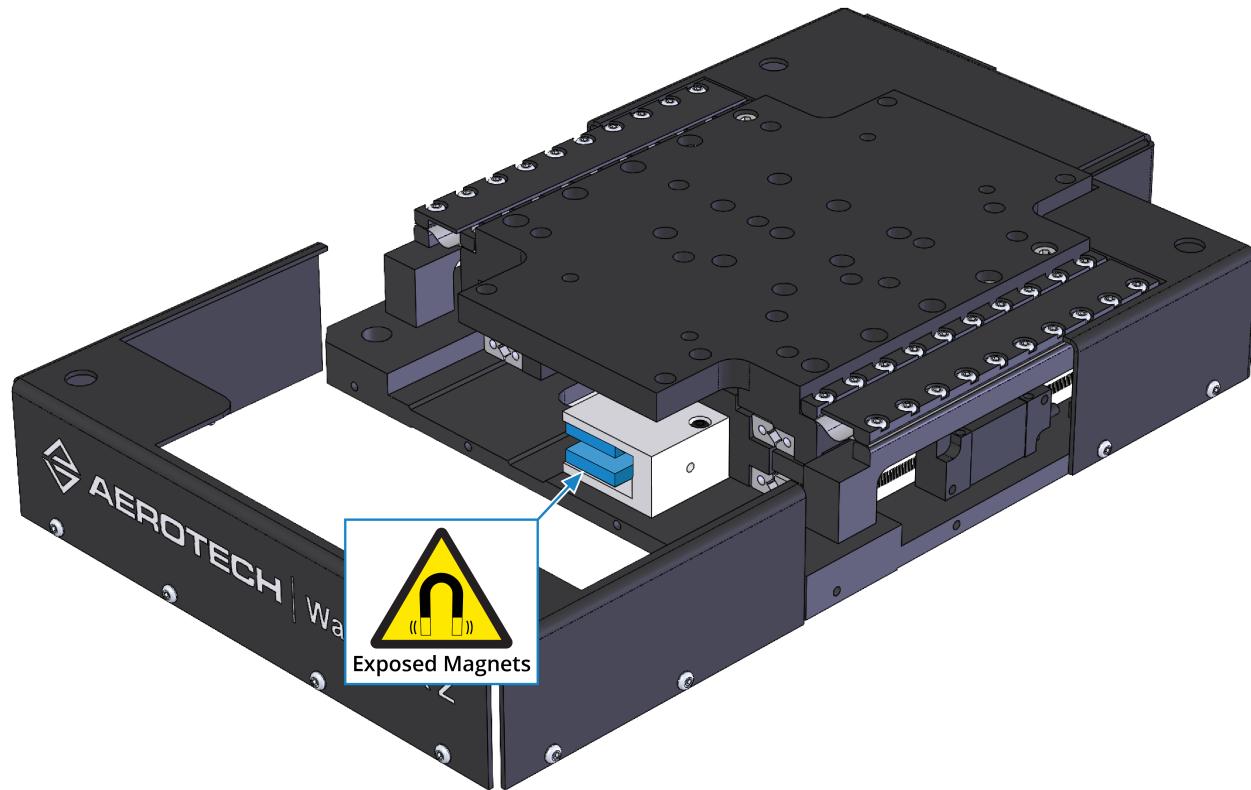
DANGER: Magnetic Field Hazard!

- 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 (pacemakers, 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.

Failure to observe the correct ESD practices could cause ESD damage to stage electronics, system drives, and/or power supplies.

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.
- 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.

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

Mechanical-Bearing Direct-Drive Lift Stage	
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.

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 °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
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 are not suited for dusty or wet environments. This equates to an ingress protection rating of IP00.
Use	Indoor use only

1.2. Accuracy and Temperature Effects

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 thermal expansion coefficient of the encoder scale is 10 ppm/°C. The encoder measures the linear wedge, not the tabletop. The wedge ratio of the stage is 12:1, so the effective thermal expansion of the encoder scale as seen at the tabletop is $10/12 = 0.833$ ppm/°C. Travel will increase or decrease at this rate as the encoder scale temperature deviates from 20°C (68°F).

1.3. Basic Specifications

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.

To ensure the achievement and repeatability of specifications over an extended period of time, environmental temperature must be controlled to within 0.25°C per 24 hours. Consult the Aerotech factory for more information.

Table 1-3: WaferMaxZ Series Specifications

		WaferMaxZ
Travel		5 mm
Motor Type		Direct-Drive Brushless Linear Motor
Bus Voltage		up to 160 VDC
Continuous Current	A_{pk}	2.9 A
	A_{rms}	2.1 A
Encoder		20 μ m fundamental; amplified sine output
Resolution (Minimum incremental motion.)		0.83 nm
Accuracy ^(1,3)		$\pm 1.5 \mu$ m
Bidirectional Repeatability ⁽³⁾		$\pm 0.3 \mu$ m
Straightness ⁽⁴⁾		$\pm 2 \mu$ m
Roll		20 arc sec
Pitch		20 arc sec
Yaw		20 arc sec
Maximum Speed		4 mm/s
Maximum Load ⁽⁵⁾		10 kg (requires use of integral pneumatic counterbalance)
Moving Mass		1.0 kg
Wedge Ratio		12:1
Stage Mass		4.2 kg
Material		Aluminum
Finish		Black anodize hard cover; Hard coat (62 Rockwell Hardness) tabletop

(1) Requires an Aerotech controller.
 (2) For inverted operation, consult factory.
 (3) Certified with each stage.
 (4) Measured perpendicular or parallel to wedge direction.
 (5) Higher maximum loads possible. Contact the factory for details.

1.4. Vacuum Operation

Due to the pneumatic counterbalance design of this stage, it cannot be operated in a vacuum environment.

1.5. Air Requirements



IMPORTANT: Eye protection must be worn when in the proximity of compressed air components.

The stage has a pneumatic counterbalance ([Section 2.4.](#)) that counteracts the weight of the payload. It is important to the operation of the stage that the air supply to the counterbalance meets Aerotech specifications. Filtration is required to prevent particles from clogging internal components of the stage. If you need assistance with air filtration, contact Aerotech.

The pneumatic counterbalance supply pressure and flow rate is determined by the amount of payload carried by the stage (refer to [Figure 2-4](#) and [Figure 2-5](#)).

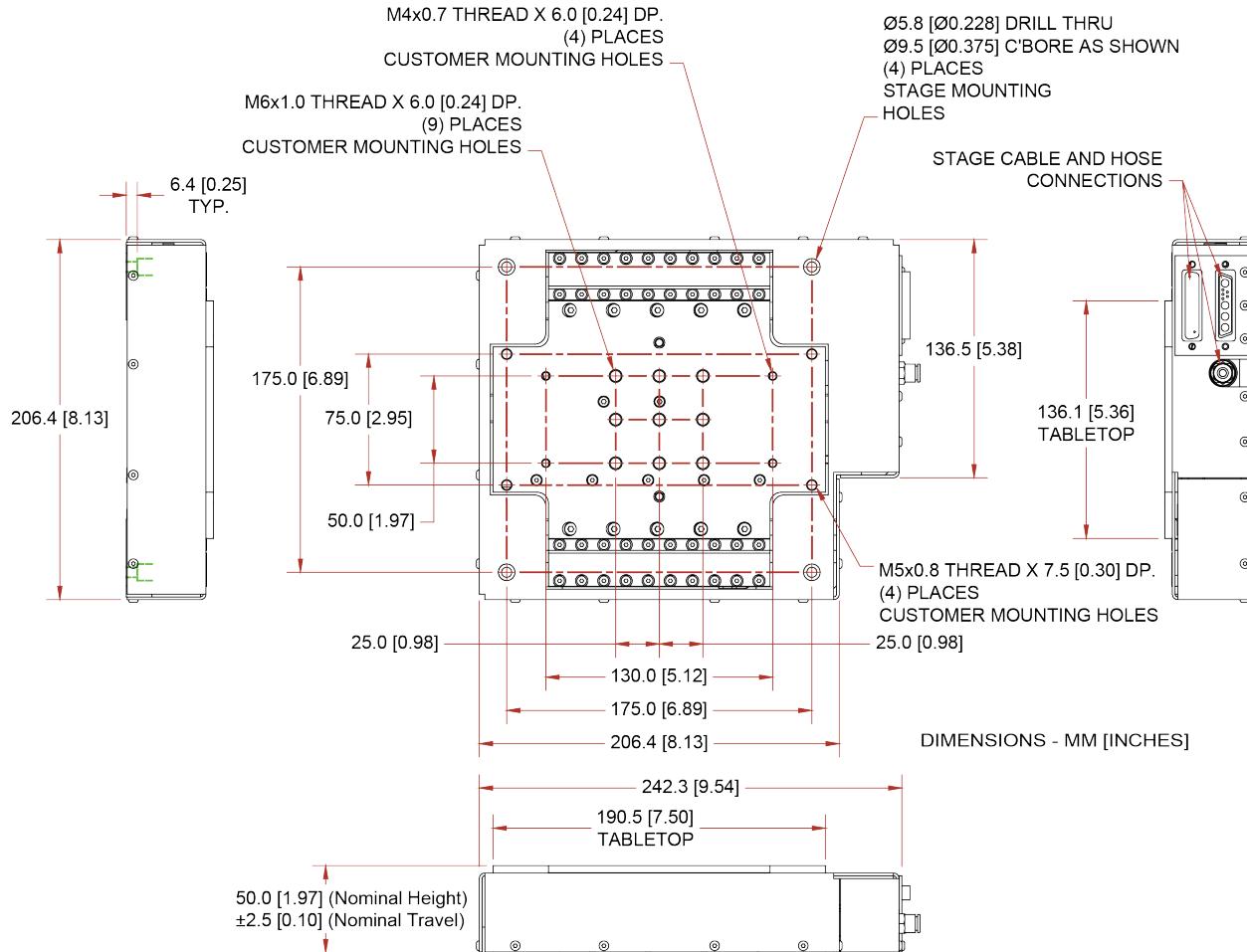
The air supply to the system should be clean and liquid water should not be present.

- 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.

Chapter 2: Installation

2.1. Dimensions

Figure 2-1: WaferMaxZ 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 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 13](#).



DANGER: Magnet Hazard! If you remove the cover of the stage, high magnetic fields at the ends of the magnet tracks will be exposed. Keep metal objects away from the ends of the magnet tracks.

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 at the factory.

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

Table 2-1: Stage Mounting Surface Flatness Requirement

Stage	Flatness Requirement
All Frame Sizes	7.5 μm

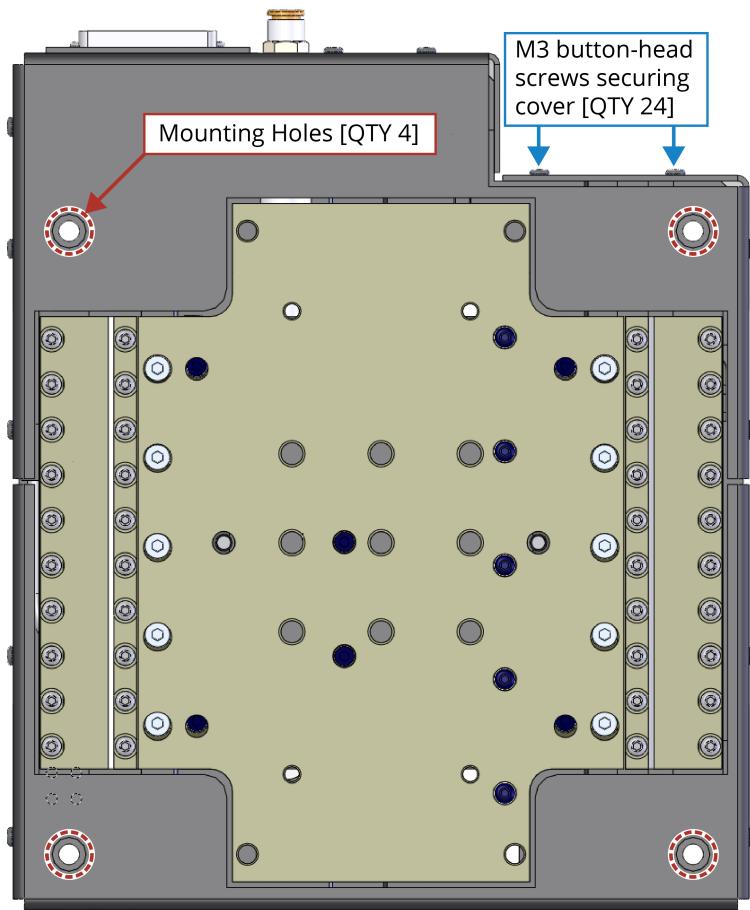
This stage is designed to use socket head cap screws (SHCS) to secure the base to the mounting surface (refer to [Figure 2-2](#)). There is a gap between the clearance holes in the cover and the counter-bores in the base for the mounting screws. It could be necessary to remove the cover of the WaferMaxZ to properly install or remove the mounting hardware. To remove the cover, remove all of the 24 M3 button head screws around the perimeter of the stage using a 2 mm hex wrench. The split-cover design is intended to make it easy to remove and replace the cover even if the payload of the stage is attached.

If it is necessary to remove the cover to mount the stage, make sure that the stage is not connected to its power source. Be careful not to damage any of the sensitive internal components of the stage while the cover is removed. Replace the cover as soon as the mounting screws are secured to protect the stage during additional setup and operation.

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
M5 by 16 mm [#10-32 x 5/8 in] SHCS	4 N·m

Figure 2-2: Stage Mounting Holes

2.3. Attaching the Payload or Fixturing 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 WaferMaxZ 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 WaferMaxZ 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.

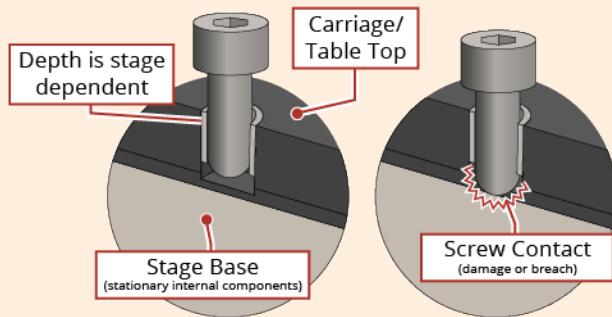
Table 2-3: Payload Mounting Surface Flatness Requirement

Stage Travel	Flatness Requirement
All Travels	10 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:**

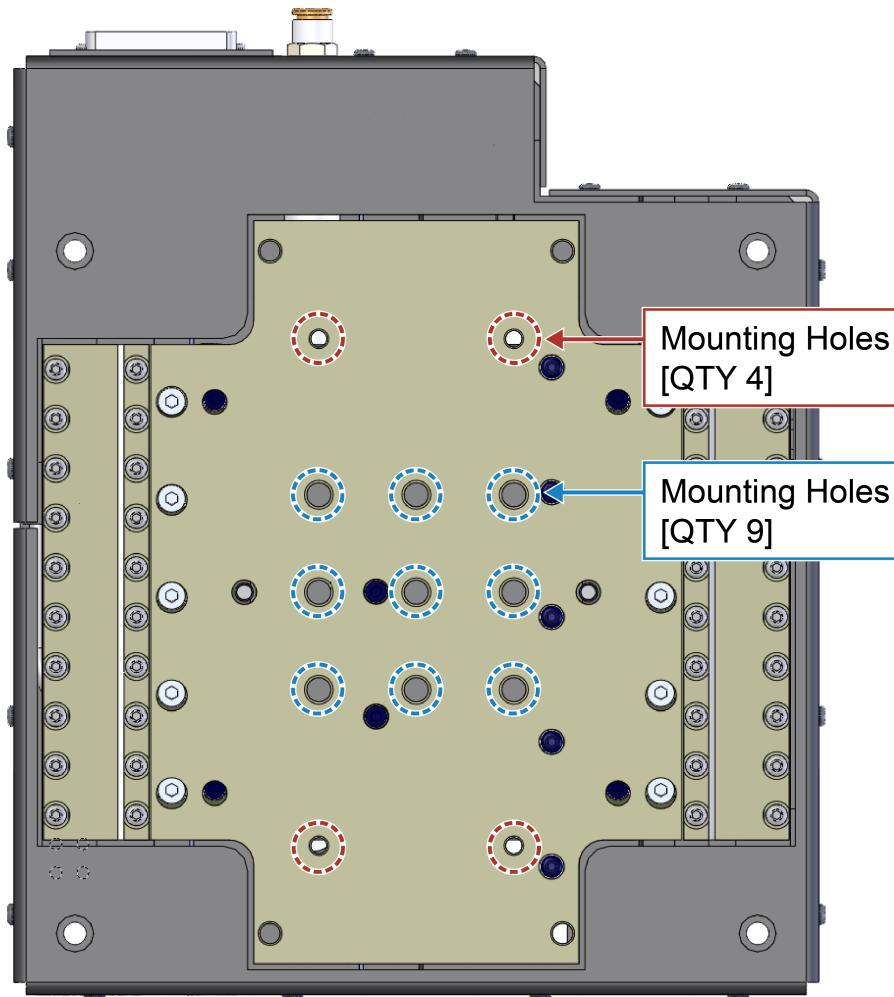


Applied loads should be symmetrically distributed whenever possible. The payload should be centered on the stage mounting surface and the entire stage should be centered on the support structure.

Table 2-4: Customer Mounting Features

Mounting Hardware	Quantity
M6X1.0, 6 mm deep	9 places
M4X0.7, 6 mm deep	4 places

Figure 2-3: Payload Mounting Hole Locations



2.4. Counterbalance Setup



WARNING: Failure to adjust the counterbalance per the following instructions could result in bodily injury as well as stage and payload damage.



IMPORTANT: Eye protection must be worn when in the proximity of compressed air components.

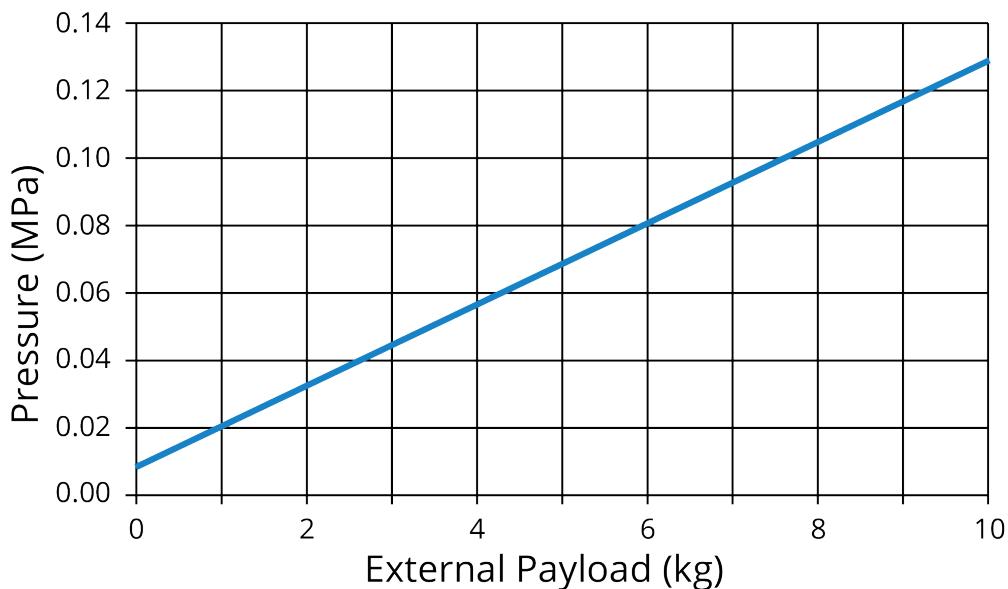
By default, the pneumatic counterbalance is factory set to operate in the as-shipped condition. For stages that are shipped unloaded, the counterbalance is set for the mass of the carriage only. For stages that ship with payloads or other axes attached, the counterbalance is set for the mass of the carriage plus the additional mass. Any adjustment to the mass that is carried by the counterbalance cylinder, either adding or subtracting payload, necessitates an adjustment to the counterbalance pressure supplied to the pneumatic cylinder.

Standard WaferMaxZ stages have one counterbalance cylinder with a piston area of $6.77 \times 10^{-5} \text{ m}^2$. The required counterbalance pressure for a given payload can be estimated using the following formula where Payload Weight is specified in Newtons:

$$\text{Pressure (MPa)} = [(\text{Payload Weight}) / 812.4 \text{ N/MPa}] + 0.008 \text{ MPa}$$

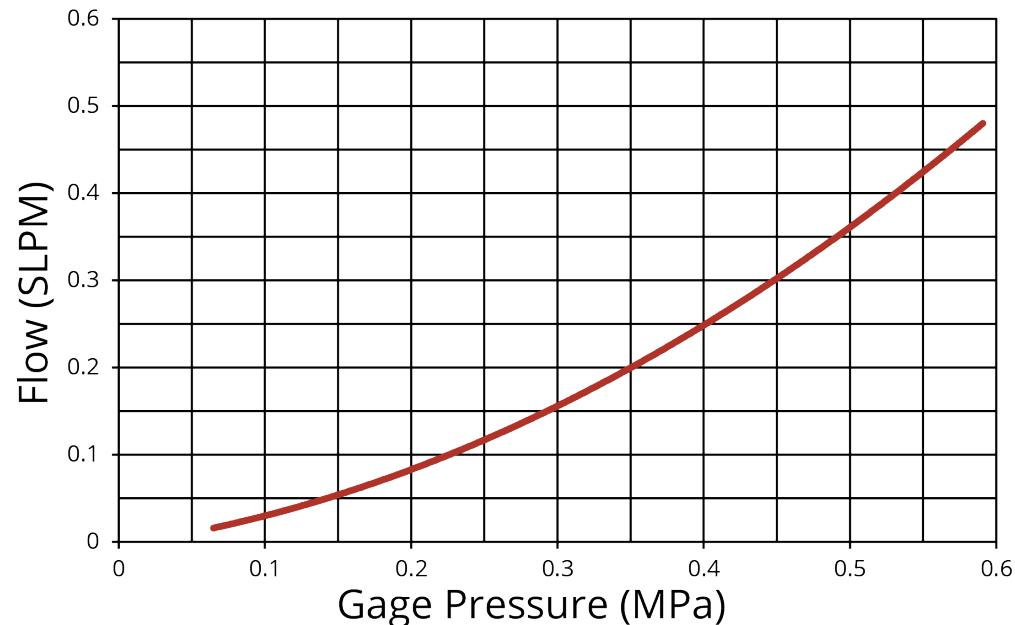
This relationship is shown graphically in [Figure 2-4](#).

Figure 2-4: Counterbalance Pressure vs External Payload



The flow required from the air supply is based on counterbalance pressure and can be estimated with [Figure 2-5](#).

Figure 2-5: Counterbalance Air Flow vs Counterbalance Pressure



Procedure for initial pneumatic counterbalance setup:

1. Connect the air supply and counterbalance regulator to the stage. Refer to [Section 2.1.](#) for regulator details.
 - a. Remove the shipping plug from the counterbalance fitting on the back of the stage.
 - b. Attach the regulator outlet to the stage with a 0.25 inch OD, polyurethane air tube.
 - c. With the air supply turned off, connect the supply to the regulator inlet. The inlet accepts a 0.25 inch OD, polyurethane air tube.
2. Turn the regulator knob counterclockwise to close off the air supply to the stage.



IMPORTANT: Refer to [Section 1.5.](#) for air requirements. Be sure that the air supply meets the listed specifications before you continue with these steps.

3. Turn on the air supply to the regulator.
4. Estimate pressure required using the formula provided or by referencing [Figure 2-4.](#)
5. Slowly increase regulator pressure by turning the regulator knob clockwise until the carriage begins to move. Adjust the pressure so that the carriage does not rise or drop when it is at the approximate center of travel.

To turn off the air supply to the stage:

1. Make sure the stage is not under servo control.
2. Gently push the carriage down to the bottom of travel until the mechanical stop engages.
3. Turn off the counterbalance pressure. Once the counterbalance pressure has completely bled out, release the hand pressure on the carriage.

To change the payload on the stage (add or remove mass):

1. Follow the steps above for turning off the air to the stage
2. Turn the regulator knob on the back of the angle bracket counterclockwise until it bottoms out (prevents any pressure from reaching the cylinders).
3. Change the payload as required. Refer to [Section 2.3.](#) for payload flatness requirements.
4. Estimate the pressure required to lift the payload using the formula provided or by referencing [Figure 2-4.](#)
5. Turn on the air supply to the counterbalance input
6. Gradually increase the pressure to the cylinder with the precision regulator. Make fine adjustments when approaching the estimated pressure required for counterbalance. Adjust until the payload does not rise or drop when it is at the approximate center of travel.

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 WaferMaxZ 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 WaferMaxZ 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 WaferMaxZ 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 WaferMaxZ 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 (internally connected 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.) [with the Limited Travel option]	
13	Reserved	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	Encoder 5V Supply Input (internally connected to PIN-3)	
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	-/CCW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the “machine negative” or “machine counter-clockwise” direction.) [with the Limited Travel option]	
25	Reserved	

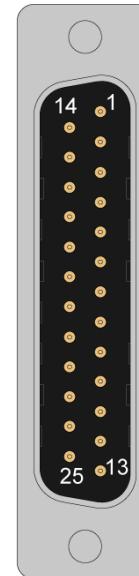


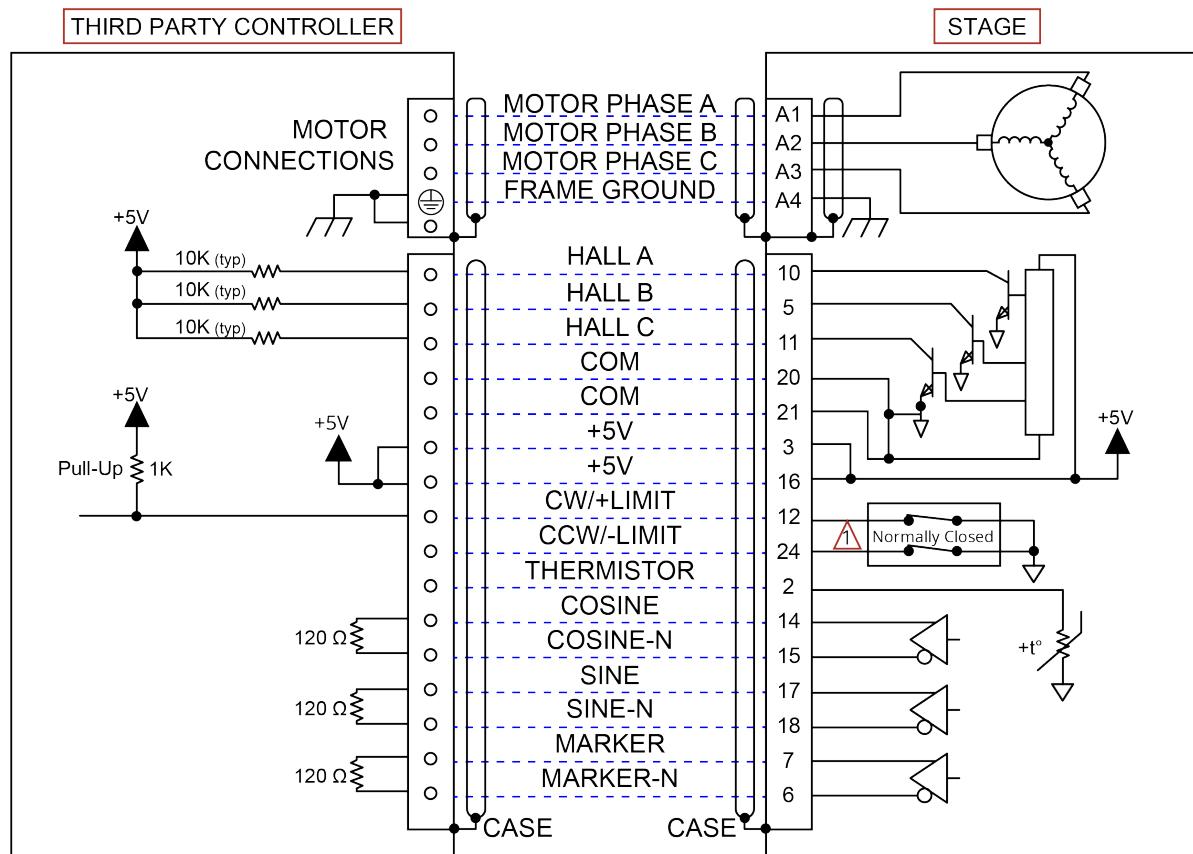
Table 3-4: Mating Connector Part Numbers for the Feedback Connector

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

3.2. Motor and Feedback Wiring

Shielded cables are required for the motor and feedback connections.

Figure 3-1: Motor and Feedback Wiring



⚠ Over-travel limit switches are normally-closed.

3.3. Motor and Feedback Specifications

Table 3-5: Hall-Effect Sensor Specifications

Specification	
Supply Voltage	5 V $\pm 5\%$ NOTE: Hall and Encoder supplies share a common 5 V supply connection.
Supply Current	50 mA
Output Type	Open Collector
Output Voltage	5 V (TTL Levels)
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.	

Table 3-7: Encoder Specifications

Specification	
Supply Voltage	5 V $\pm 5\%$ NOTE: Hall and Encoder supplies share a common 5 V supply connection.
Supply Current	150 mA (typical)
Output Signals	Sinusoidal Type (Incremental Encoder) with Marker <ul style="list-style-type: none"> Signal-A (COS/COS-): 0.6 - 1.2 V_{ss} Signal-B (SIN/SIN-): 0.6 - 1.2 V_{ss} Signal-R (MKR/MKR-): 0.2 - 0.85 V Signal Period: 20 μm <p>NOTES:</p> <ul style="list-style-type: none"> Sinusoidal encoder signals are optimized at the factory for 1.0 V_{ss}. Marker encoder signals are optimized at the factory for optimum amplitude and phasing. <p>Over-Travel Limits</p> <p>L1 (-Limit), Digital Output L2 (+Limit), Digital Output</p> <p>NOTES:</p> <ul style="list-style-type: none"> Limit "Not Active" output state = "Active Low" Limit "Active" output state = "Active High" If the stage is driven beyond the electrical limit, it will encounter a mechanical stop. Impacting the mechanical stop could cause damage to the stage, even at low speeds.

Table 3-8: Motor Specifications

		BLMUC-95
Performance Specifications		
Continuous Force, 1.4 bar (20 psi)	N	40.5
Continuous Force, No Forced Cooling	N	23.0
Electrical Specifications		
BEMF Constant (line-line, max)	V/(m/s)	9.00
Continuous Current, No Forced Cooling	A	2.94
Peak Current, Stall	A	20.68
Force Constant, Sine Drive	N/A	7.83
Motor Constant	N/ \sqrt{W}	3.35
Resistance, 25 °C (line-line)	Ω	5.2
Inductance (line-line)	mH	0.70
Thermal Resistance, 1.4 bar (20 psi)	°C/W	0.69
Thermal Resistance, No Forced Cooling	°C/W	2.12
Maximum Bus Voltage	VDC	160
(1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature. (2) All performance and electrical specifications have a tolerance of $\pm 10\%$. (3) Values shown @ 100 °C rise above a 25 °C ambient temperature, with motor mounted to the specified aluminum heat sink. (4) Peak force assumes correct rms current; consult Aerotech. (5) Force constant and motor constant specified at stall (6) All Aerotech amplifiers are rated A_{pk} ; use force constant in N/ A_{pk} when sizing. (7) All Aerotech motors and amplifiers are rated using vector amplitude values. For sinusoidal signals, use sine wave peak value.		

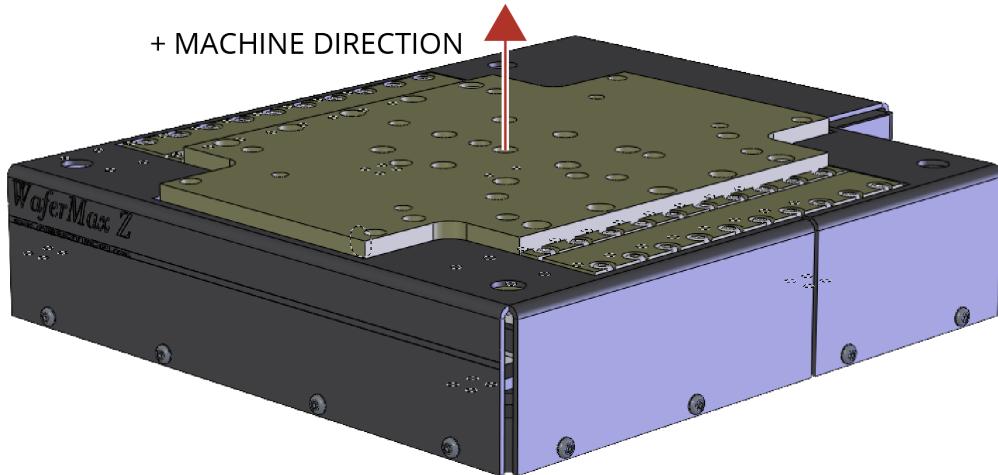
3.4. Limits, Marker, and Machine Direction

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 WaferMaxZ stages.



IMPORTANT: Machine direction terminology is per Aerotech standards for linear motor systems and does not necessarily correspond to program direction.

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

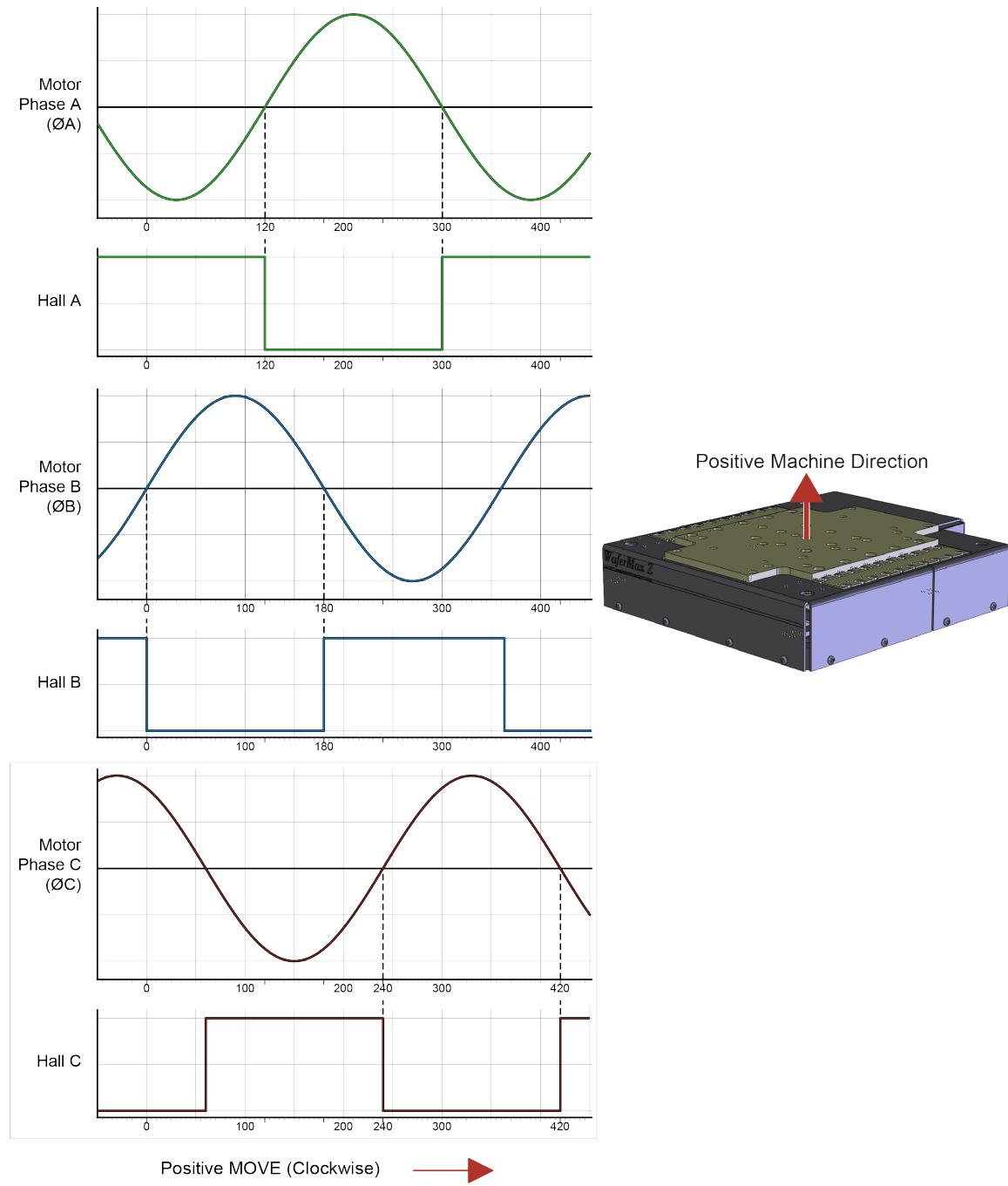
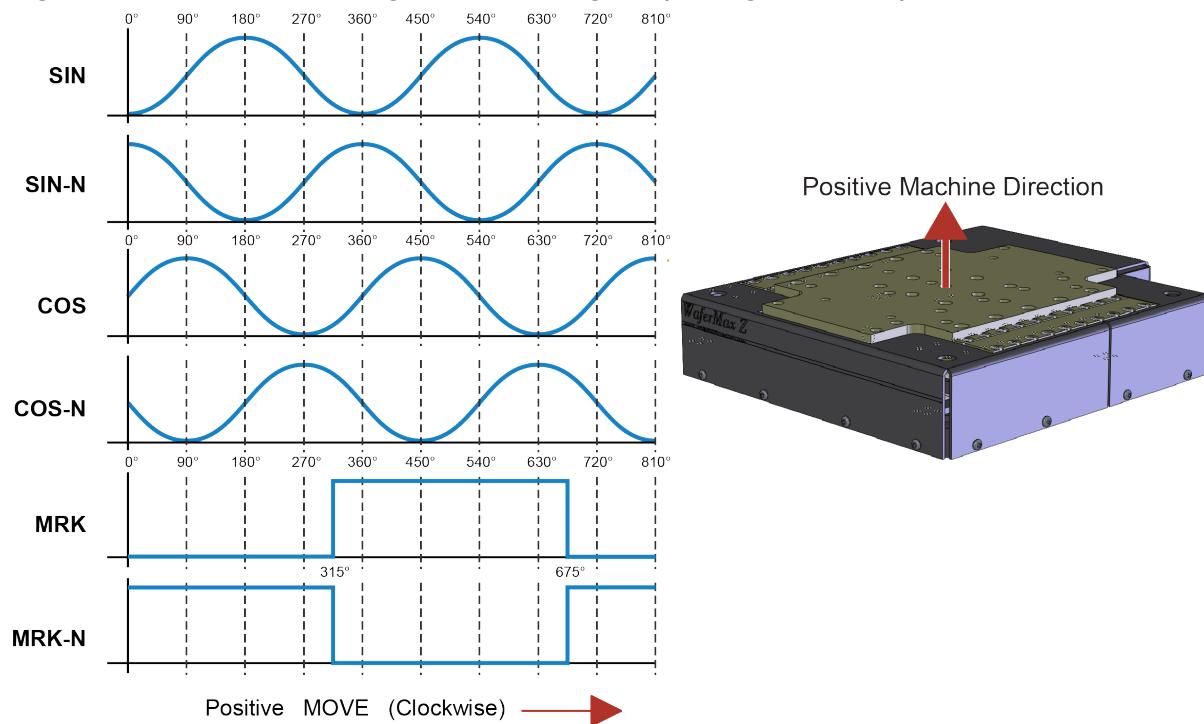


Figure 3-4: Encoder Phasing Reference Diagram (Analog/Sine Wave)

Chapter 4: Maintenance



IMPORTANT: Read the [Safety Procedures and Warnings](#) (on [Page 9](#)) 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 WaferMaxZ 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.

The cleaning and lubrication interval depends on the conditions (duty cycle, speed, and the environment) in which the stage operates. In general, stages operating in a clean environment should be cleaned/lubricated annually. For stages operating under conditions involving excessive debris, stages should be cleaned/lubricated every six months. Use the inspection interval and operating conditions to determine if a shorter cleaning and lubrication interval is required.

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.

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 WaferMaxZ and any components and cables as needed.
- Repair any damage before operating the WaferMaxZ.
- 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 13](#).



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



IMPORTANT: 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.

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

When you clean components of the WaferMaxZ series stage:

1. Blow away small particles and dust with clean, dry, compressed air before you use a cleaning solvent on any part of the stage.
2. Use isopropyl alcohol on a lint-free cloth to clean any external metal surface of the WaferMaxZ. Harsher solvents, such as acetone, could damage the plastic, rubber, or precision components.



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

Lubrication

For the cross-roller bearings, only use Kluberplex BEM 34-132 grease. Other greases may be incompatible. If the application process uses only a small portion of travel for most of the duty cycle, periodically drive the stage through full travel to redistribute the lubrication in the bearings.



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 14](#).

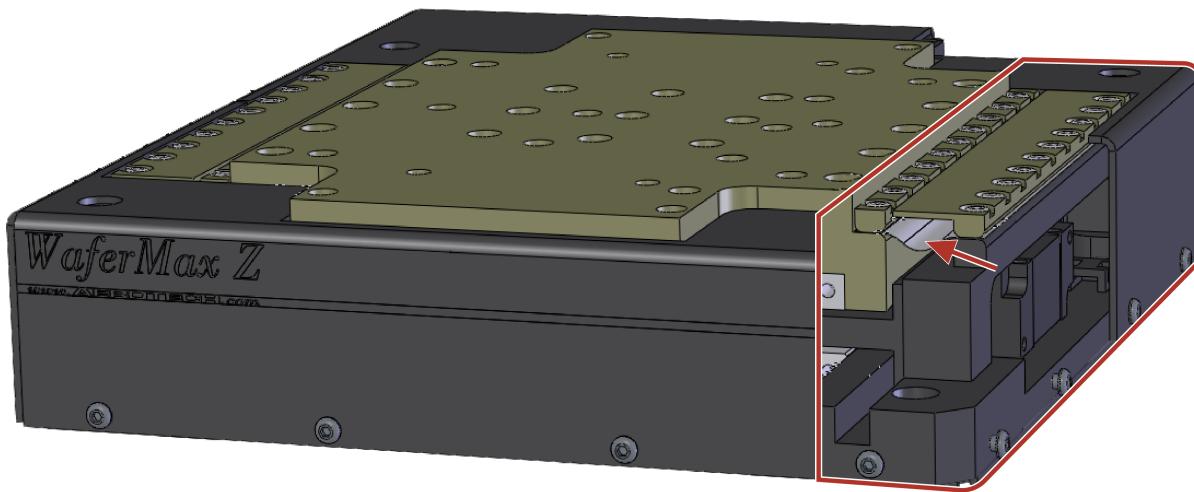
Lubrication Procedure

1. Disable and then remove power to the stage.
2. Make sure that the pressure to the pneumatic counterbalance is still supplied to the stage.
3. Remove the button head screws that attach the outer covers to the stage base and then remove the covers.
4. Remove any accumulated dust or debris from the inside of the assembly.
5. Remove any dirty or dried lubricant from the crossed roller bearing ways.
 - 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 ways. Aerotech recommends that you use a good quality, natural bristle artist's brush.
7. Manually move the wedge to the opposite end of travel. This will work the grease into the linear bearings. The stage table should move freely with little resistance.
8. Repeat steps 3 through 5 for any areas covered by the original table position.
9. Refasten the covers
10. Restore power to the stage and drive the stage table back to its original position to redistribute lubricants.

4.3. Flexure Constraints

The WaferMaxZ uses flexures to fix the table top in the X and Y directions. These flexures are vital to the fundamental operation of the stage (refer to [Figure 4-1](#)).

Figure 4-1: Cutaway View of an WaferMaxZ Flexure



The flexures are delicate and must not be tampered with, scratched, or dented. Covers protect the flexures from damage and should be kept in place during normal stage operation.

When the covers are removed during maintenance and servicing, be sure not to damage these flexures. This may cause premature fatigue failure of the flexures due to stress concentration.

4.4. Troubleshooting

Table 4-1: Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move	<ul style="list-style-type: none">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	<ul style="list-style-type: none">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	<ul style="list-style-type: none">Gains misadjusted (refer to the Controller documentation).Encoder signals (refer to the Controller documentation).

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Appendix A: Warranty and Field Service

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

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

Return Products Procedure

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

Visit [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">Updated safety informationUpdated EU Declaration of IncorporationAdded UKCA Declaration of Incorporation
1.01	<ul style="list-style-type: none">Product UpdateUpdated Section 1.3. Basic SpecificationsUpdated Section 2.1. DimensionsUpdated Section 2.4. Counterbalance Setup
1.00	New manual

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Index

	Handling	15	
	Humidity	18	
A			
Accuracy	19		
Accuracy and Temperature Effects	18	Inspection Schedule	39
Accuracy of the Ballscrew	18	isopropyl alcohol	40
air			
nitrogen	20		
Altitude	18	Kluberplex BEM 34-132 grease	41
Ambient Temperature	18		
Attaching the Payload	24		
B			
Bidirectional	19	label	15
Bus Voltage	19	Load	19
		Lubrication	41
C			
cleaning		Material	19
mounting surface	22,24	Maximum Load	19
Cleaning	40	Motor Type	19
cleaning solvent	40	Motor-Related Warnings	12
compressed air	20	mounting surface	
Continuous Current	19	cleaning	22,24
		securing stage	22
		Moving Mass	19
		multiaxis combinations	40
D			
Dimensions	21		
E			
Electrical Installation	29	nitrogen	20
Electrical Warnings	11		
Encoder	19		
Encoder Specifications	34	P	
		packing list	15
		part number	15
		Pitch	19
		Possible Cause	43
		Protection Rating	18
Finish	19	protective ground connection	30
F			
grease	41		
G			
Hall-Effect Sensors Specifications	34	R	
		Repeatability	19
		Resolution	19
		Roll	19
I			
K			
L			
M			
N			
P			
R			

S

serial number	15
shims	22
Solution	43
solvents	40
Specifications	19
Encoder	34
Hall-Effect Sensors	34
Thermistor Specifications	34
Speed	19
stabilizing stage	16
stage	
distortion	22
stabilizing	16
Stage Mass	19
Storage	15
Straightness	19
Symptom	43

T

Table of Contents	3
Temperature Effects	18
Thermistor Specifications	34
Travel	19
Troubleshooting	43

V

Vacuum Operation	20
Vibration	18

W

Warnings	9
Warranty and Field Service	45
Wedge Ratio	19

Y

Yaw	19
-----	----