



LensPro-HP™ Hardware Manual

Revision: 1.01.00



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EU Declaration of Conformity

Manufacturer Aerotech, Inc.
Address 101 Zeta Drive
 Pittsburgh, PA 15238-2811
 USA
Product LensPro-HP™
Model/Types All


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

2006/42/EC	Machinery Directive
2011/65/EU	RoHS 2 Directive

and has been designed to be in conformity with the applicable requirements of the following Standard(s) when installed and used in accordance with the manufacturer’s supplied installation instructions.

EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2010	Safety of machinery - electrical equipment of machines

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Date 11/2/2018



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Safety Procedures and Warnings

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

The following statements apply wherever the Warning or Danger symbol appears within this manual. Failure to observe these precautions could result in serious injury to those individuals performing the procedures and/or damage to the equipment.

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time.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

DANGER: This product contains potentially lethal voltages. To reduce the possibility of electrical shock, bodily injury, or death the following precautions must be followed.

1. Ensure that all electrical power switches are in the off position when servicing the equipment.
2. Disconnect electrical power before servicing equipment.
3. Disconnect electrical power before performing any wiring.
4. Access to the LensPro-HP and component parts must be restricted while connected to a power source.
5. Residual voltages greater than 60V may be present inside LensPro-HP chassis for longer than 10 seconds after power has been disconnected.
6. To minimize the possibility of electrical shock and bodily injury, extreme care must be exercised when any electrical circuits are in use. Suitable precautions and protection must be provided to warn and prevent persons from making contact with live circuits.
7. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
8. The user must restrict user access to motor coil / wires while energized. This is accomplished by providing an enclosure around the operating components which, when opened, removes power to the drive. The motor may also be contained in a grounded mechanical system (positioning stage) which restricts direct access to the high voltage motor components.
9. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
10. Disconnect electrical power before servicing equipment.
11. All components must be properly grounded in accordance with local electrical safety requirements.
12. Motor frame is safety grounded with a conductor equal in size to the phase conductors.
13. The drive must contain a properly-sized fuse, matched to the motor cable wire size.
14. Do not attempt to disassemble the U Channel magnet track. The magnet track contains powerful magnets that can suddenly and unexpectedly clamp together with any other object containing iron with extreme force.
15. These motors are not rated for use in explosive atmospheres. They are not to be operated in the presence of potentially explosive mixtures of air-borne dust or combustible vapors.
16. Motors and their associated drive, cabling, etc. are sources of electromagnetic fields. Persons with implanted medical devices need to evaluate the risks associated with these



devices before entering an area where they are in use.

17. All components must be properly grounded in accordance with local electrical safety requirements.
18. Operator safeguarding requirements must be addressed during final integration of the product.



DANGER: The motor temperature can pose a burn hazard. Do not touch the motor until it has cooled sufficiently.

WARNING: To minimize the possibility of electrical shock, bodily injury or death the following precautions must be followed.

1. Use of this equipment in ways other than described by this manual can cause personal injury or equipment damage.
2. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
3. Aerotech's motors are meant to be part of a drive package consisting of an amplifier and a controller. The motor relies on the drive package for fault protection. Aerotech, Inc. does not approve of their motors being used in any other way.
4. To prevent electrical shock hazards, allow only qualified persons to install and service this equipment.
5. Equipment grounds must be in place and maintained to reduce the risk of serious or potentially fatal injury from electric shock.
6. Moving parts can cause crushing or shearing injuries. Access to all stage and motor parts must be restricted while connected to a power source.
7. Never install or operate equipment that appears to be damaged.
8. Disconnect electrical power to the motor before performing maintenance procedures. In addition, uncouple or otherwise prevent motor-coupled machinery from moving the motor during service.
9. Motors are capable of very high speeds and acceleration rates. Always avoid being in the direct path of moving machinery.
10. The motor over temperature sensor must be monitored by the drive and used to shut down the drive in the event of excessive motor temperatures.
11. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
12. Compressed Air. Possible residual air pressure in LensPro-HP system after air pressure is turned off.
13. Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
14. Use care when moving the LensPro-HP . Lifting or transporting the LensPro-HP improperly can result in injury or damage to the LensPro-HP.
15. This product is intended for light industrial manufacturing or laboratory use. Use of this product for unintended applications can result in injury and damage to the equipment.
16. Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
17. All service and maintenance must be performed by qualified personnel.
18. Operators must be trained before operating this equipment.



19. If the product is used in a manner not specified by the manufacturer, the protection provided by the product can be impaired and result in damage, shock, injury, or death.

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Chapter 1: Overview

Aerotech’s LensPro-HP is a cost-effective, 2-axis, ultra-precision lathe capable of producing polish-free lenses on a variety of lens materials and geometries. Optimized for high-quality IOL production, the LensPro-HP provides the ultimate flexibility in lens fabrication without sacrificing lens quality and throughput.

Table 1-1: Model Options

Standard Features	
LensPro-HP	<p>High-performance, two-axis, air-bearing lathe. Standard features include:</p> <ul style="list-style-type: none"> • Air-bearing, linear-motor-driven XZ axes with sub-nm resolution glass encoder scales, 225 mm X travel, 120 mm Z-travel • Granite-base with pneumatic air-isolation system • 10,000 rpm air-bearing spindle with 0.5 inch dead-length collet system • Three tool posts with micro-height adjustment and integral dial indicator • A3200 CNC operator interface motion control software with LensPro lens design and recipe management software
Optional Machine Features	
	<ul style="list-style-type: none"> • Front surface probe (LVDT) for final lens thickness control • TLG-4000 fast-tool servo with 4 mm of total stroke • Additional tool posts; a total of seven tools can be used at any one time on the tooling platform • 15,000 rpm air-bearing spindle • Haptic milling spindle • Toric marking spindle • Automatic parts loader (customized for specific pallet and part sizes) • Uninterrupted power supply (UPS) • Jog pendant

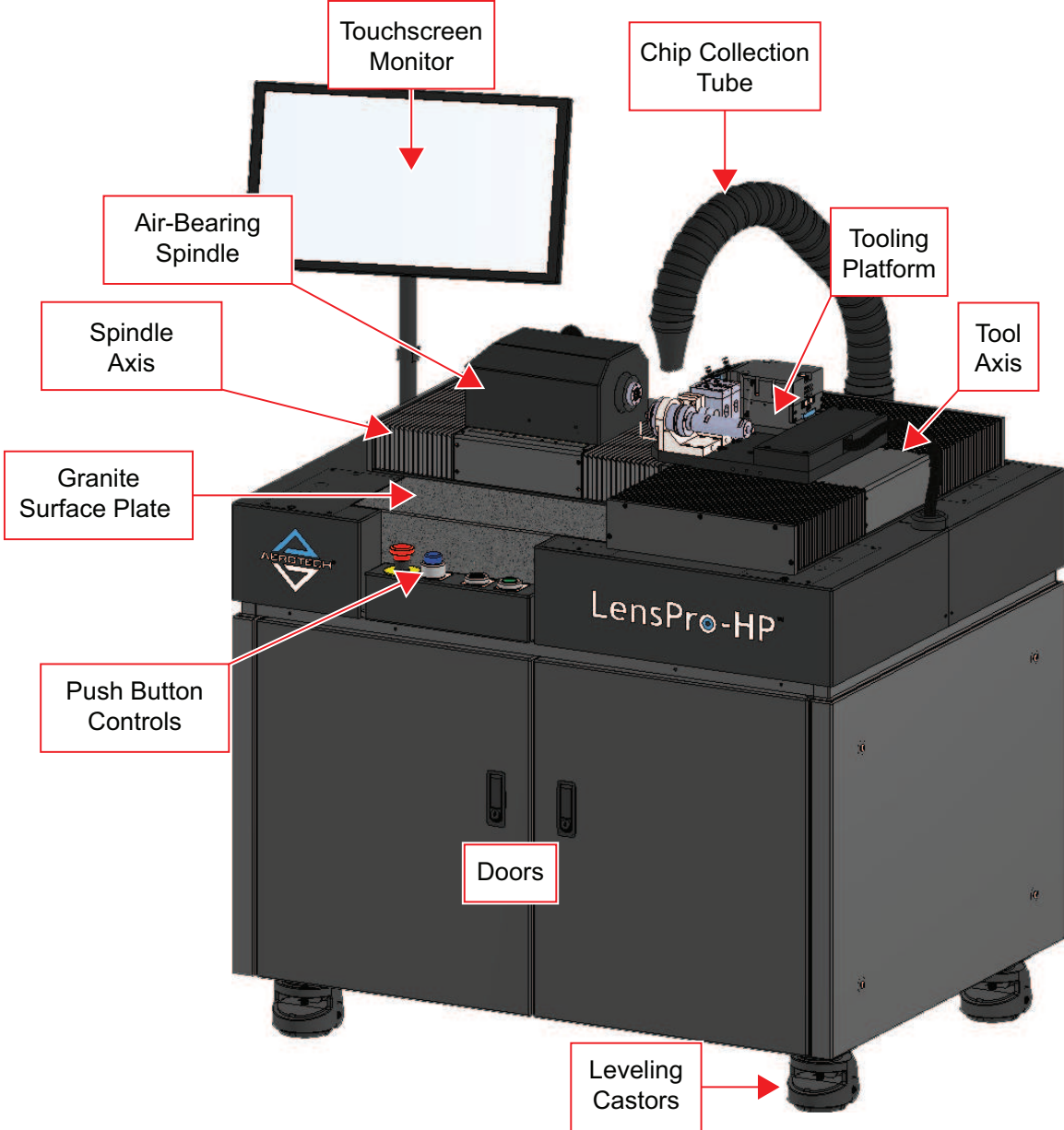


Figure 1-1: LensPro-HP Components

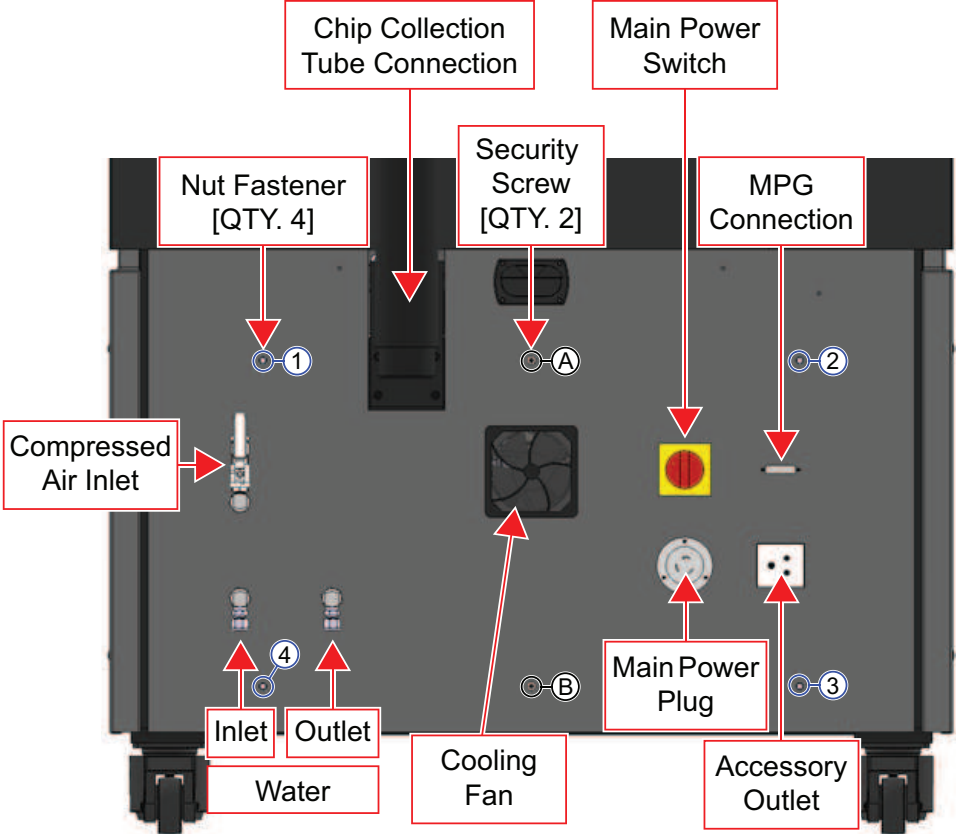


Figure 1-2: LensPro-HP Components

Table 1-2: Component List

Main Components	
Leveling Castors	These casters allow the machine to be moved by a single person without additional equipment. The integral leveling feet are used to level the machine and lock it in position for use.
Doors	The doors open to grant access to the internal contents of the machine base, and can be locked for security. See the internal contents section for more detail.
Touchscreen Monitor	The touchscreen monitor allows an operator to load and run parts without the use of a mouse and keyboard (refer to Figure 1-1). The mount allows the user to reposition the screen to a convenient location. The monitor is mounted directly to the machine base and does not disturb the air isolated granite surface plate.
Chip Collection Tube	This tube removes chips during the cutting process with the use of a vacuum (refer to Figure 1-1). The chip collection tube is mounted directly to the machine base and does not disturb the air isolated granite surface plate
Granite Surface Plate	The granite plate is isolated to reject vibration with self-leveling passive air isolators. The center of mass has been designed to be lower than the mounting point of the isolators for improved stability.
Machine Axes	Refer to Section 1.3 .
Tooling Platform	Refer to Section 1.4 .
Push Button Controls	Refer to Section 1.5 .
Back Panel	
Nut Fastener	Four 8 mm nuts fasten the back panel to the frame.
Chip Collection Tube Connection	The vacuum line is clamped to the tube on the back of the machine. Refer to Section 2.7. Vacuum Installation for more details.
Security Screw	Two security screws are used to restrict access to the back of the machine, and must be removed to detach the panel.
Main Power Switch	The main switch controls the power supply to the entire machine.
MPG Connection	The optional MPG pendant connects here through the back panel.
Accessory Outlet	The auxiliary power outlet can be turned on and off through the control software. An example of use is a chip collection vacuum.
Main Power Plug	The power supply for the machine is connected here. Refer to Section 2.6. Electrical Requirements for more details.
Cooling Fan	The fan provides air flow to the inside of the machine.
Water Outlet	If the high speed spindle option is installed on the machine, the water will exit here. Refer to Section 2.8. Optional Water Cooling Installation for more details.
Water Inlet	The connection to supply water for the high speed spindle option is located here. Refer to Section 2.8. Optional Water Cooling Installation for more details.
Compressed Air Inlet	The compressed air supply will connect to the fitting on the back of the machine. Refer to Section 2.5. Compressed Air Requirements for more details.

1.1. Environmental Specifications

Due to the small clearances in the air bearing design, extreme temperature environments could cause a decrease in performance or permanent damage to the machine. Standard Aerotech air-bearing stages are designed for and built in a 20°C (68°F) environment.



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

Table 1-3: Environmental Specifications

Ambient Temperature	Operation: 17 to 25°C (20 to 22°C is optimal) Deviation in temperature can result in performance degradation
	Storage: 5 to 35°C in original packaging
Humidity	Operation: 20% to 60% RH
	Storage: 10% to 70% RH in original packaging. The machine should be packaged with a desiccant for extended storage.
Altitude	Operation: 0 m to 2,000 m (0 ft to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
Vibration	Use the system in a low vibration environment. Excessive floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application.
Protection Rating	ABL1500-B stages have limited protection against particles and dust. This equates to an ingress protection rating of IP50.
Use	Indoor use only

1.2. Basic Specifications

The LensPro-HP is capable of achieving 1-3 nm Ra surface finish on rotationally symmetric parts and 3-5 nm Ra on toric lenses using the TLG-4000.

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

Table 1-4: LensPro-HP Series Specifications

Machine Configuration	T-style two-axis air-bearing lathe with linear motor drive, granite base with air-isolation
X/Z Travel	225 mm (X-axis), 120 mm (Z-axis)
Spindle	Air-bearing spindle: 10,000 rpm standard, 15,000 rpm optional
Workholding	1/2 inch diameter collet standard, 3/8 inch or other custom-sizes available; Internal or face-mounted dead-stop design
Tooling	Standard: Qty. 3 tool posts with micro-height adjustment and integral dial indicator. See Model Options section for details on options.
Machine Requirements	See the Compressed Air Requirements and Electrical Requirements sections for details.
Machine Footprint	910 mm (width) x 1100 mm (length)
	Note: Machine can fit through standard 34" (864 mm) office door by removal of vacuum extraction hose
Machine Mass	700 kg
Fast Tool Servo	See TLG-4000 Hardware Manual

1.3. A, X, Z and z Axes

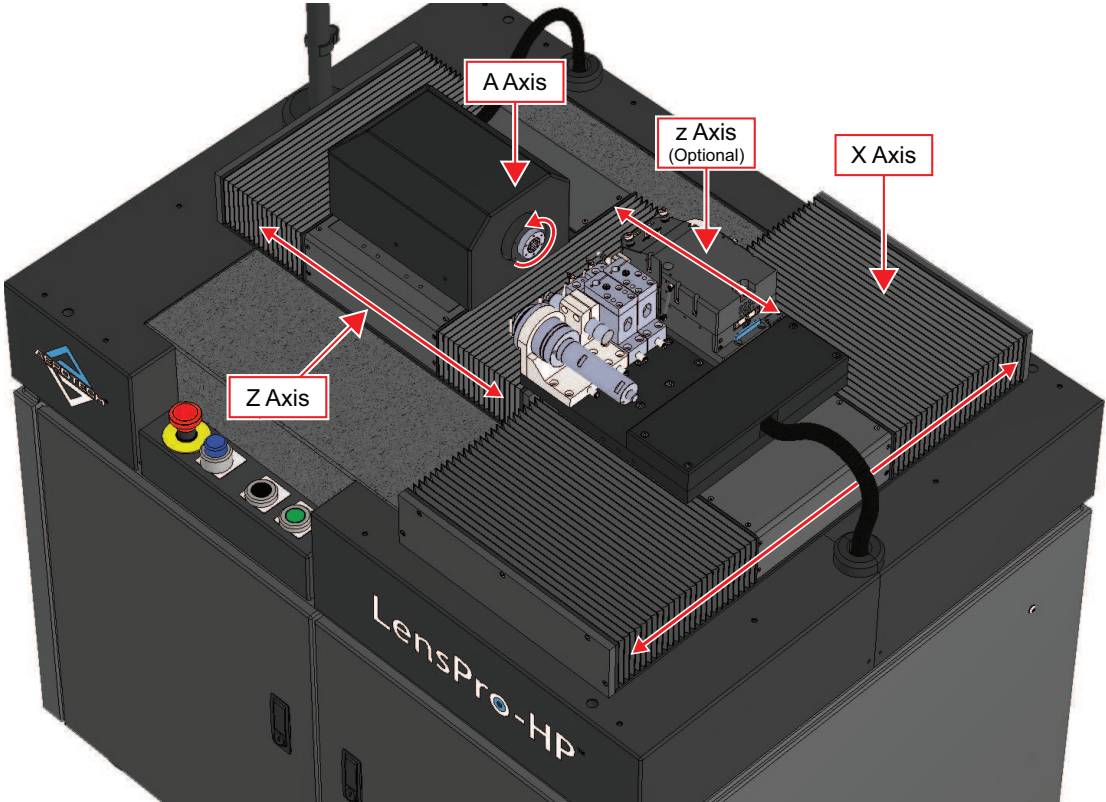


Figure 1-3: LensPro-HP Tool Axes

1.3.1. X Axis (Tool Axis)

The X axis is a motorized linear air bearing that controls the lateral motion of the cutting tools across the part. This axis is mounted to the granite perpendicular to the Z axis.

The positive direction of the X axis is away from the operator, toward the back of the machine. The home position is fully away from the operator for safety.

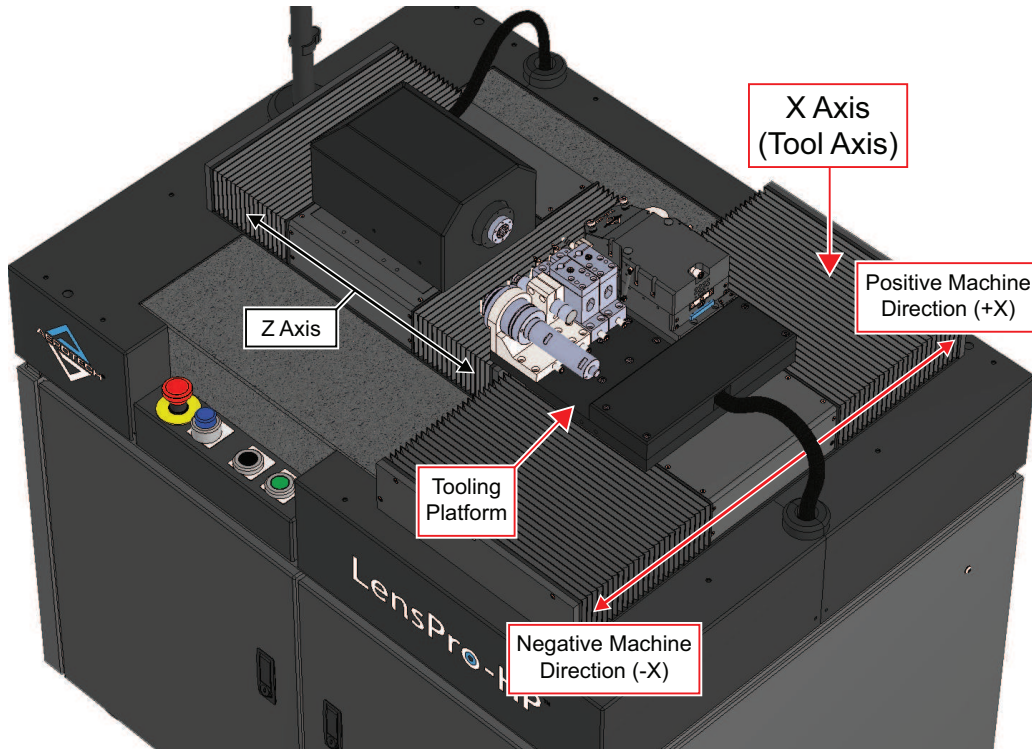


Figure 1-4: Positive and Negative Machine Direction of the X Axis

Table 1-5: X Axis Specifications

Stage	Custom Aerotech ABL1500-B
Bearing Type	Air Bearing
Travel	220 mm
Drive	Aerotech Ndrive ML Linear Amplifier
Controller	Aerotech A3200

1.3.2. Z Axis (Spindle Axis)

The Z axis is a motorized linear air bearing that controls the thickness of the lens by stepping the part into and away from the cutting tools. This axis is mounted to the granite perpendicular to the X axis.

The positive direction of the Z axis is away from the cutting tools. A move in the positive direction will result in more material left on the part, according to lathe convention. The home position is fully away from the cutting tools.

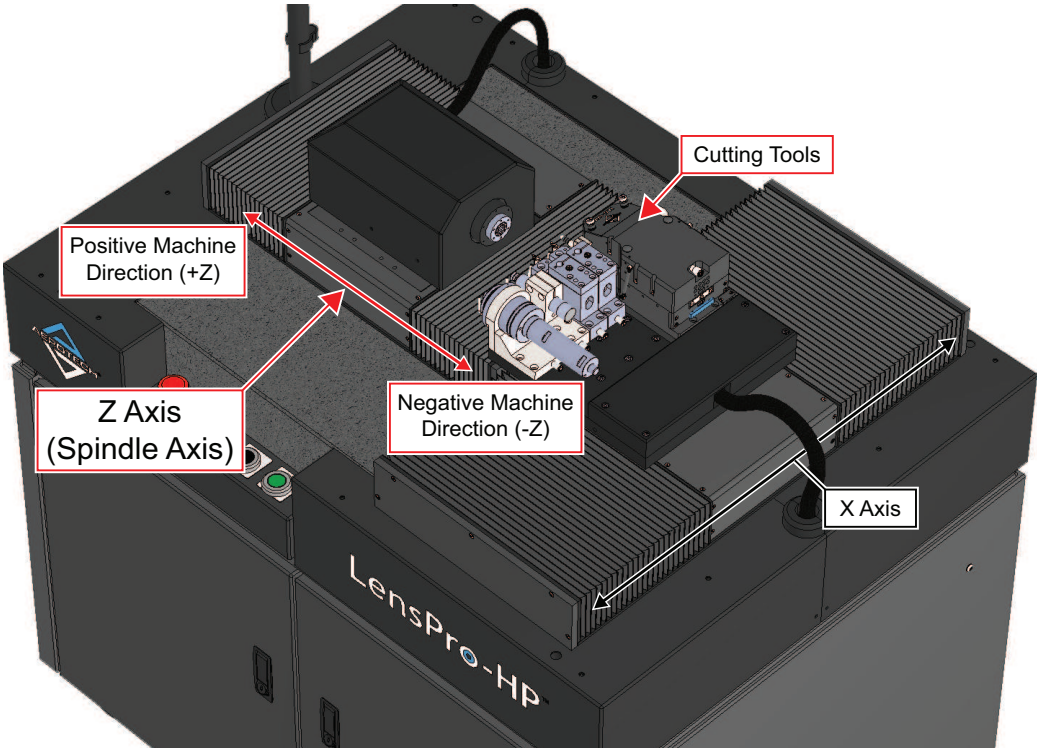


Figure 1-5: Positive and Negative Machine Direction of the Z Axis

Table 1-6: Z Axis Specifications

Stage	Custom Aerotech ABL1500-B
Bearing Type	Air Bearing
Travel	115 mm
Drive	AerotechNdriveML Linear Amplifier
Controller	AerotechA3200

1.3.3. A Axis (Air Bearing Spindle Axis)

The A axis is the main lathe spindle that holds the workpiece for the turning process. It is a rotary axis mounted on the Z axis tabletop, and is parallel to the Z axis. The spindle produces total radial and axial error motion of <25 nm to enable the production of very high quality lens surfaces

The positive direction of the A-axis is counter-clockwise when facing the spindle nose.

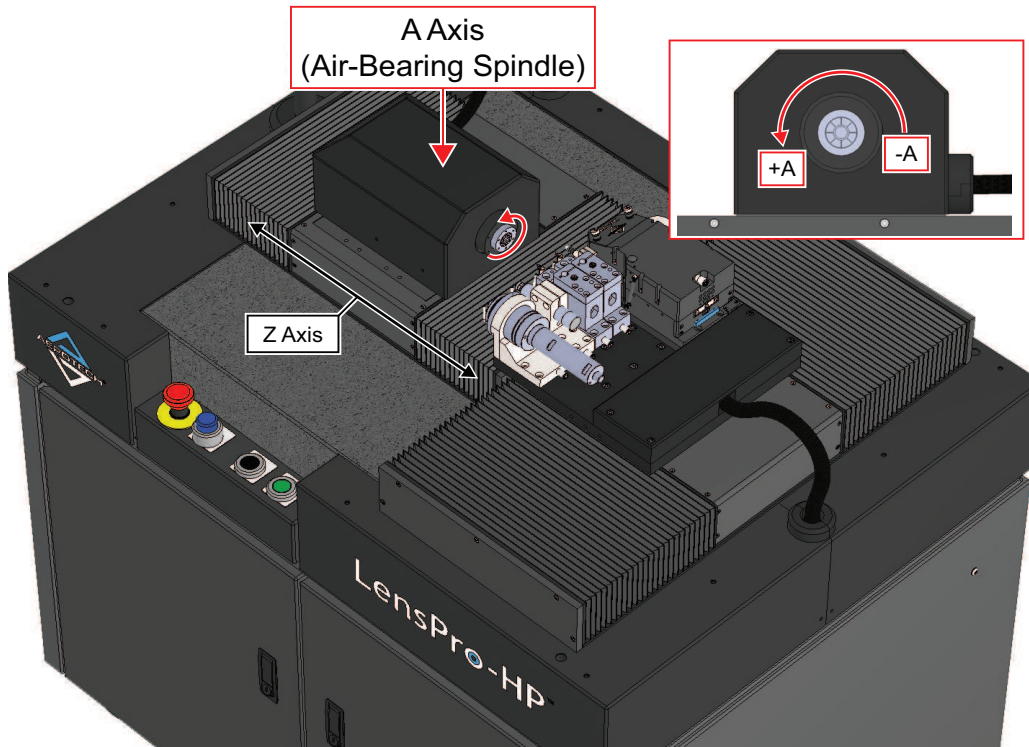


Figure 1-6: Positive and Negative Machine Direction of the A Axis

Table 1-7: A Axis Specifications

Stage	Custom Air-Bearing Spindle
Max Speed	10000 RPM standard, 15000 RPM with high speed spindle option
Drive	AerotechNdriveCP PWM Amplifier
Controller	AerotechA3200

1.3.4. z Axis (Optional Fast Servo Axis)

The z axis is an optional fast tool servo axis for cutting toric and free-form profiles. The z axis is mounted to the X axis tabletop and the motion is parallel to the Z axis.

The positive direction of the z axis is away from the workpiece. A move in the positive direction will result in more material left on the part, according to lathe convention.

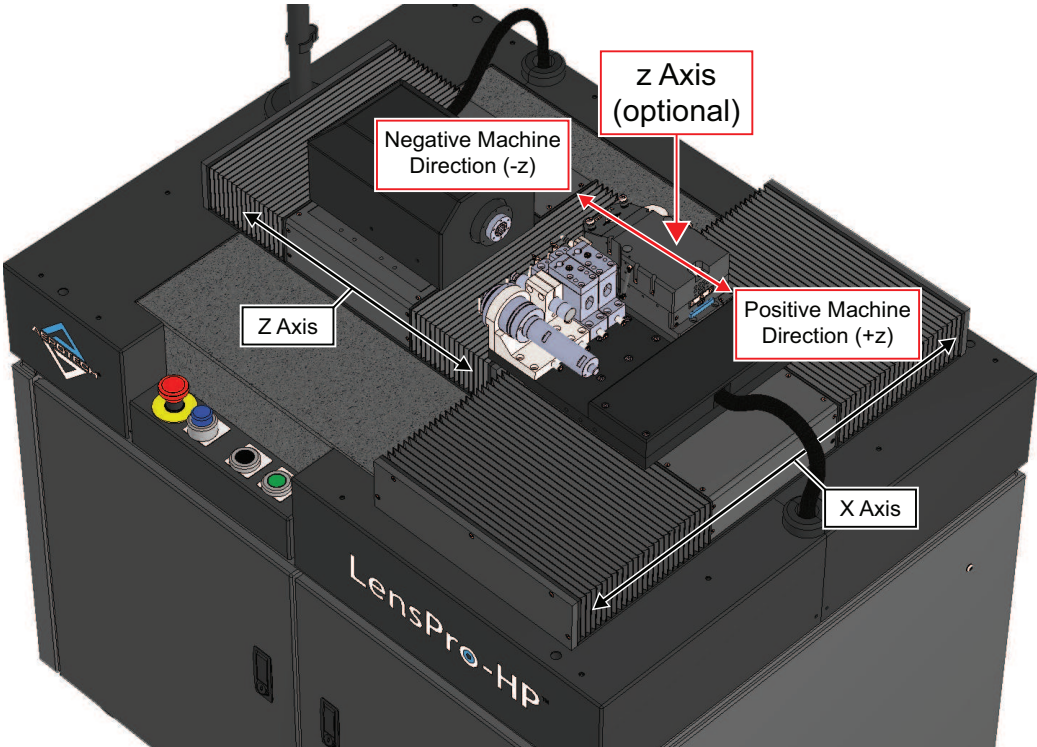


Figure 1-7: Positive and Negative Machine Direction of the Optional z Axis

Table 1-8: Optional z Axis Specifications

Stage	Aerotech TLG-4000
Travel	4.0 mm
Max Acceleration	20 g
Drive	AerotechNdrive FLS Linear Amplifier
Controller	AerotechA3200

1.4. Tooling Platform

The tooling platform has seven locations for standard tools such as tool holders for lathe inserts, small marking mills, LVDT probes, or other small tools (refer to [Figure 1-8](#)). See the model options section for more information.

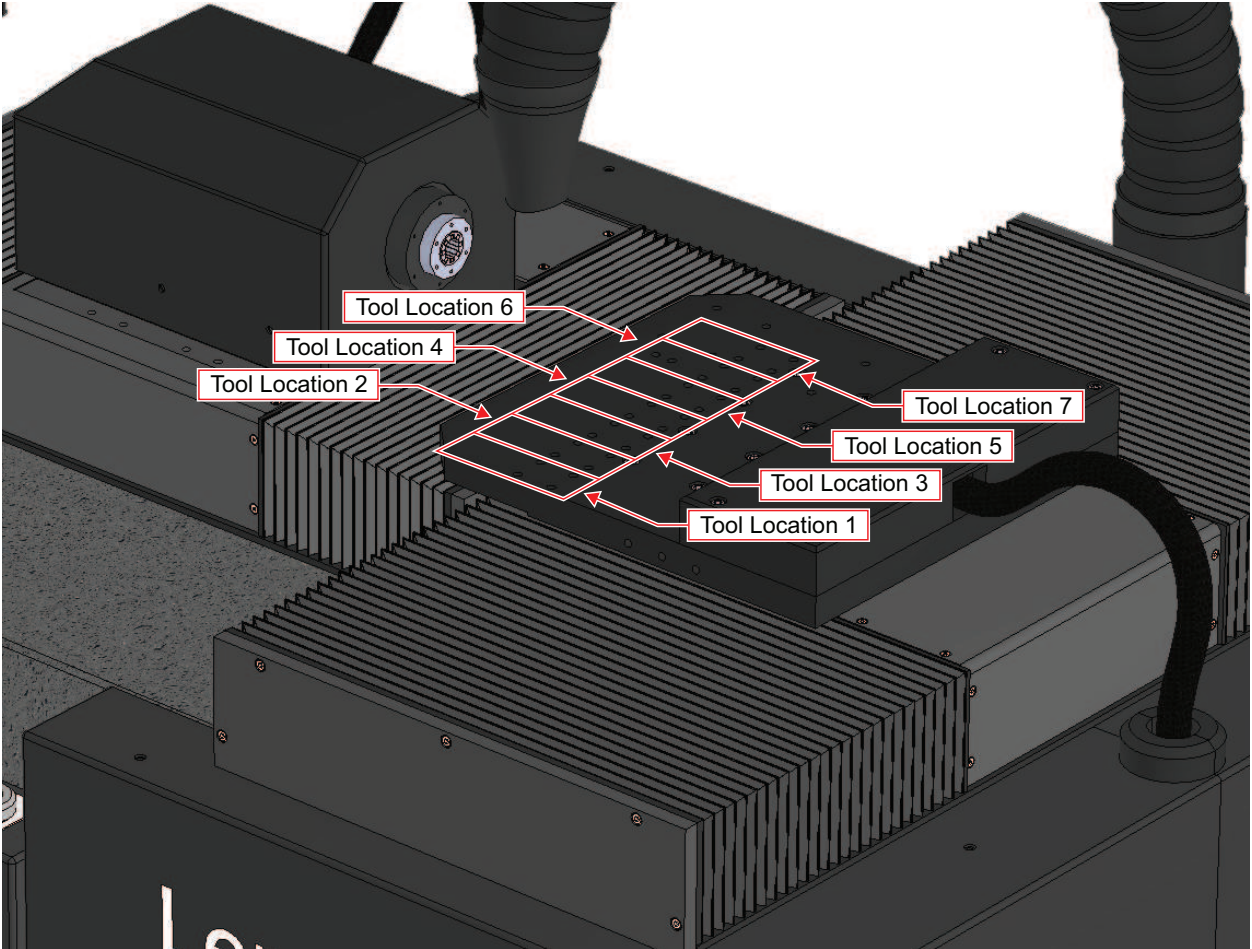


Figure 1-8: Tooling Locations on the Tooling Platform

When the TLG-4000 fast tool servo is used on the tooling platform, it occupies Tool Location 7 and some of Tool Location 6. The LVDT is small enough to still fit in Tool Location 6. The other five locations are not affected (refer to [Figure 1-9](#)).

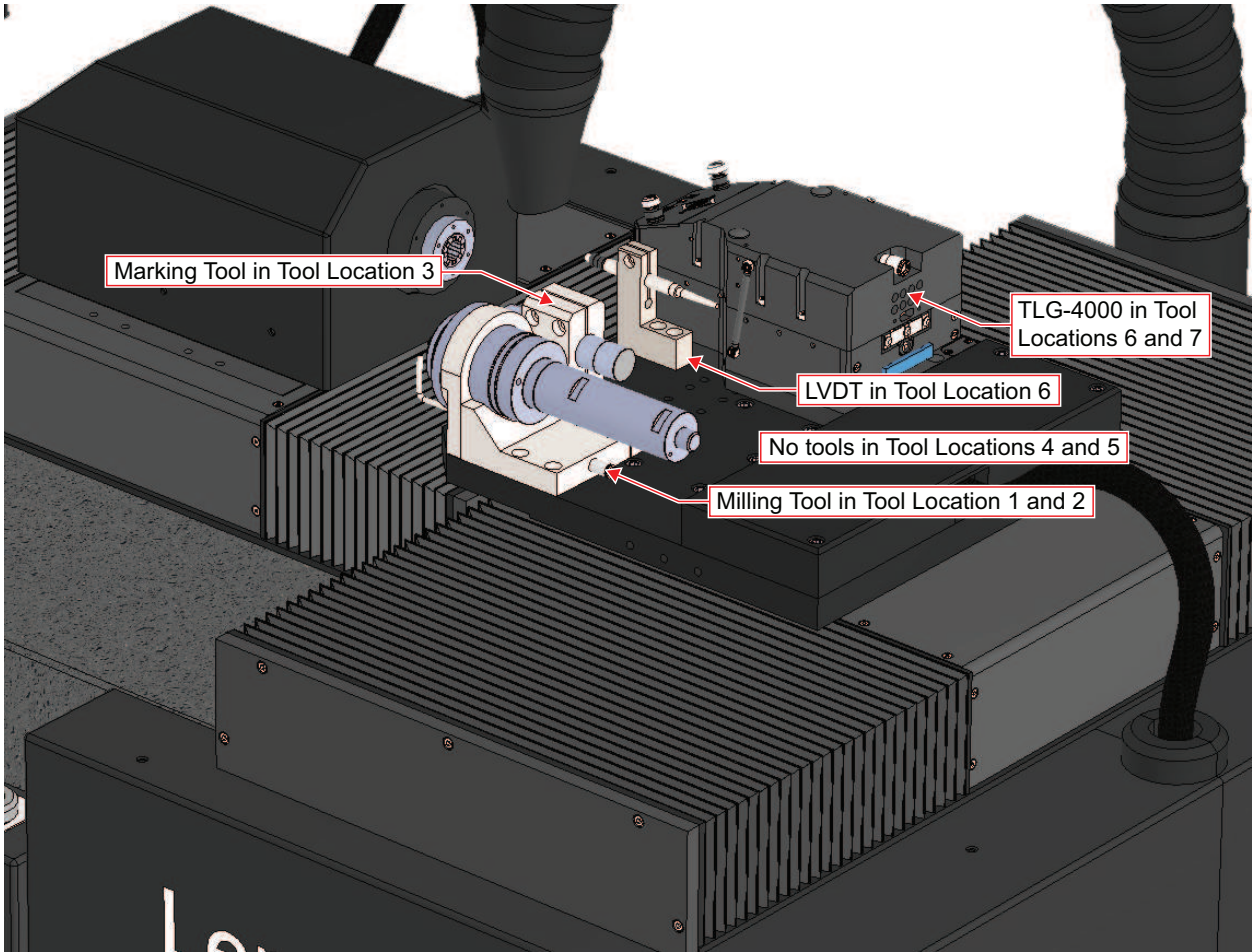


Figure 1-9: Tooling Locations with a TLG-4000

Custom tool holders can be fitted for the standard LensPro-HP. Each tool location has [QTY. 4] M5 threaded holes in a rectangle as dimensioned below. Multiple tool locations can be used to mount larger tools.

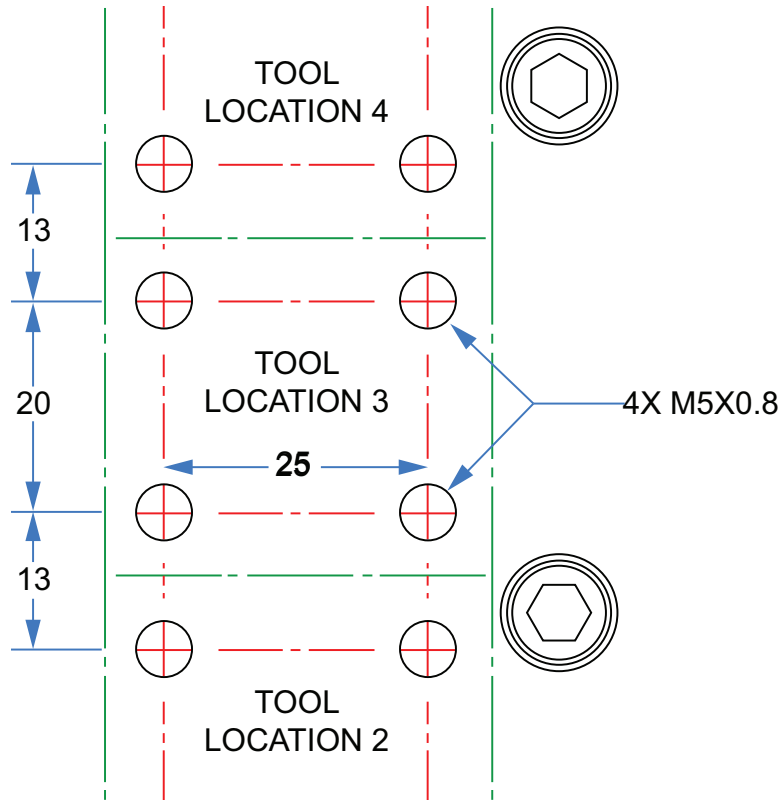


Figure 1-10: Tool Location Dimensions

The center height of the spindle above the tooling platform is 47.5 mm on a standard LensPro-HP.

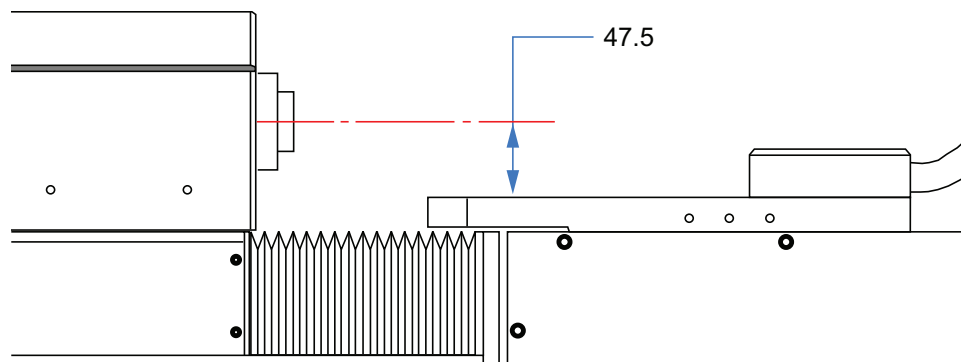


Figure 1-11: Center Height of the Spindle

1.5. Push Button Controls

The push button assembly is mounted directly to the machine base and does not disturb the air isolated granite surface plate.

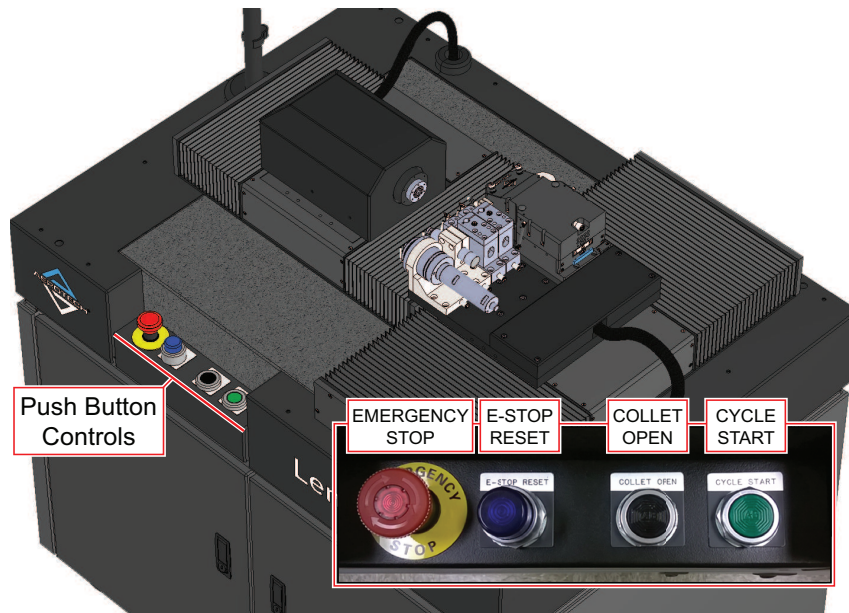


Figure 1-12: Push Button Assembly

Emergency Stop Button

Press this button to immediately cut power to all axes. Axes may still move after the button is pressed but will no longer be controlled.



WARNING: Pressing this button could cause damage to parts and/or tools and should only be used in emergency situations.

Return the LensPro-HP to a normal operating condition by rotating the Emergency Stop button clockwise to release it from the stopped position.

E-Stop Reset Button

Press the E-Stop Reset button to reset the safety circuit once the machine is in a safe condition to resume normal operation. If the Emergency Stop button has been pressed or if another safety device inside of the machine has been engaged, the E-Stop Reset button will illuminate.

Collet Open Button

Press and hold the Collet Open button to hold the collet open. The collet will return to its normally closed configuration once the Collet Open button is released.

Cycle Start Button

The Cycle Start button runs the program loaded in the Aerotech A3200 software. Either the Cycle Start push button or the software interface can be used to run the loaded program.

1.6. Internal Contents

Some internal contents are accessible through the front doors of the machine. During normal operation, the wireless keyboard and mouse can also be stored inside the doors, under the drives, and out of the way of the operator.

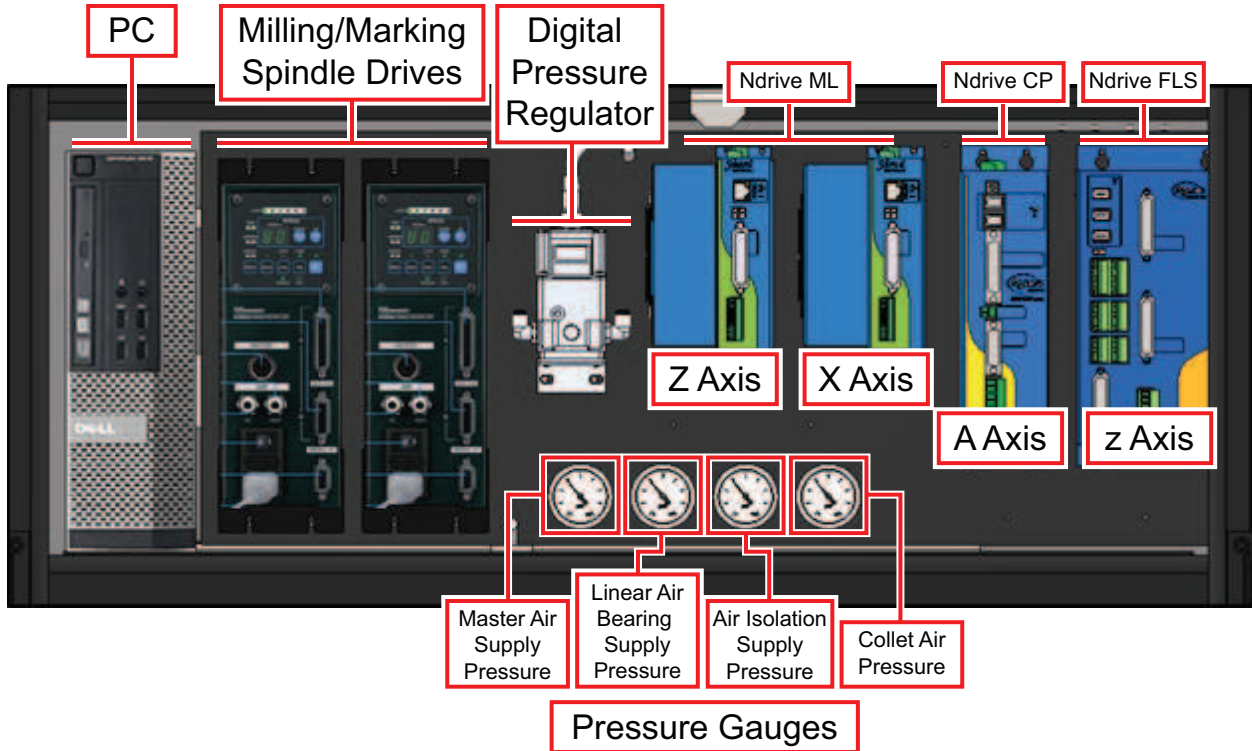


Figure 1-13: Internal Contents

Table 1-9: Internal Component List

PC	The PC runs the LensPro and A3200 motion control software packages.
Milling/Marking Spindle Drives	The optional milling and marking spindle drives are located here and are controlled by the A3200 software on the PC.
Digital Pressure Regulator	The digital regulator will set the tool blowoff pressure and is controlled by the A3200 software.
Axis Drives (from left to right)	1: An Aerotech Ndrive ML Linear Amplifier controls the Z axis. 2: An Aerotech Ndrive ML Linear Amplifier controls the X axis. 3: An Aerotech Ndrive CP PWM Amplifier controls the A axis. 4: An Aerotech Ndrive FLS Amplifier controls the optional z axis
Pressure Gauges (from left to right)	1: Master air supply pressure display 2: Linear air bearing supply pressure display 3: Air isolation supply pressure display 4: Collet air pressure display

1.7. LVDT Position Sensor Option

The LVDT option allows for high accuracy feedback in the Z-position of a tool, and better control for the depth of cut on a part or test piece. It also adds convenience to the tool replacement process by automating the depth feedback. The LVDT uses one tool location on the tooling platform.

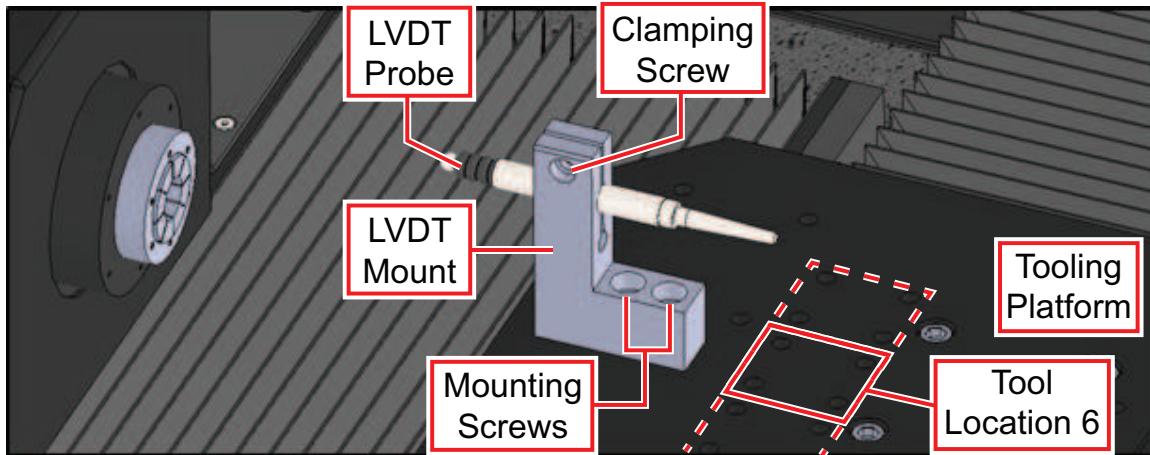


Figure 1-14: LVDT Position Sensor

The LVDT mount is mounted by [QTY. 2] M5 screws in the LVDT location shown. Tighten the M4 clamping screw to close the mount around the LVDT probe. Do not over-tighten the clamping screw, use only enough torque to firmly hold the LVDT. The LVDT can be attached in a regular tool location with a different style mount upon request.

1.8. Toric Lens Generator Fast Tool Servo Option (Axis z)

The Toric Lens Generator option adds a TLG-4000 to the LensPro-HP to make toric and freeform profiles. When the TLG-4000 fast tool servo is used on the tooling platform, it occupies Tool Location 7 and some of Tool Location 6. The LVDT is small enough to still fit in Tool Location 6. The other 5 locations are not affected. See the TLG-4000 Hardware Manual for mounting instructions.

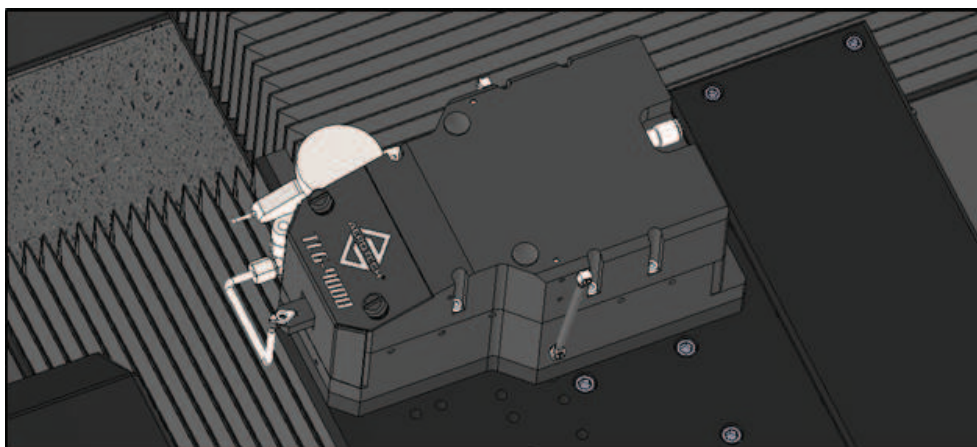


Figure 1-15: TLG-4000 in Tool Location 7

1.9. High Speed Lathe Spindle

The High Speed Spindle option allows for operation up to 15000 RPM on the main spindle by water-cooling the spindle motor. Water cooling requires features to be added in the machine and an external source of water. This option can be ordered with or without a chiller. See the Optional Water Cooling Installation section for more details.

1.10. Toric Axis Marking Spindle

The toric axis marking spindle is a 20 mm micro-machining spindle for drilling marks on the lens surface. The marking spindle occupies one tool location.

This option includes the following components:

- Motorized spindle
- Motor cable
- Control unit and drive connected to LensPro-HP PC
- Collet chuck
- Spindle mount for LensPro-HP
- Blowoff tube and fittings
- Mounting hardware

Table 1-10: Toric Axis Marking Spindle Specifications

Spindle outer diameter	20 mm
Maximum speed	60000 RPM
Collet size	1/8" (3.175 mm); other sizes available

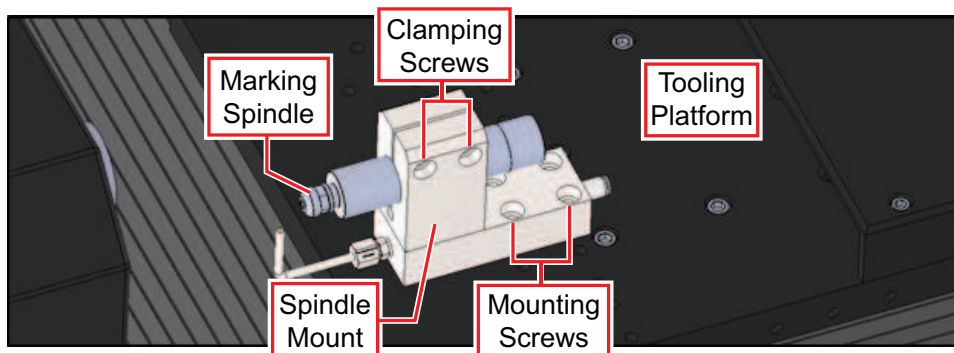


Figure 1-16: Toric Axis Marking Spindle

The marking spindle mount can be mounted by [QTY. 4] M5 screws in any free tool location. Loosen the M5 clamping screws to adjust the position of the spindle. Tighten the M5 clamping screws to close the mount around the spindle. Do not over tighten the clamping screws, use only enough torque to firmly hold the spindle. Attach the 4 mm diameter blowoff tubing from the machine into the blowoff fitting on the mount.

1.11. Haptic Milling Tool Spindle

The haptic milling spindle is a 50 mm air bearing micro-machining spindle used for milling haptics on an IOL. The milling spindle occupies two tool locations.

This option includes the following components:

- Motorized spindle
- Motor cable
- Control unit and drive connected to LensPro-HP PC
- Collet chuck
- Spindle mount for LensPro-HP
- Air bearing tubing and fittings
- Blowoff tube and fittings
- Mounting hardware

Table 1-11: Toric Axis Marking Spindle Specifications

Spindle outer diameter	50 mm
Maximum speed	80000 RPM
Collet size	1/8" (3.175 mm); other sizes available

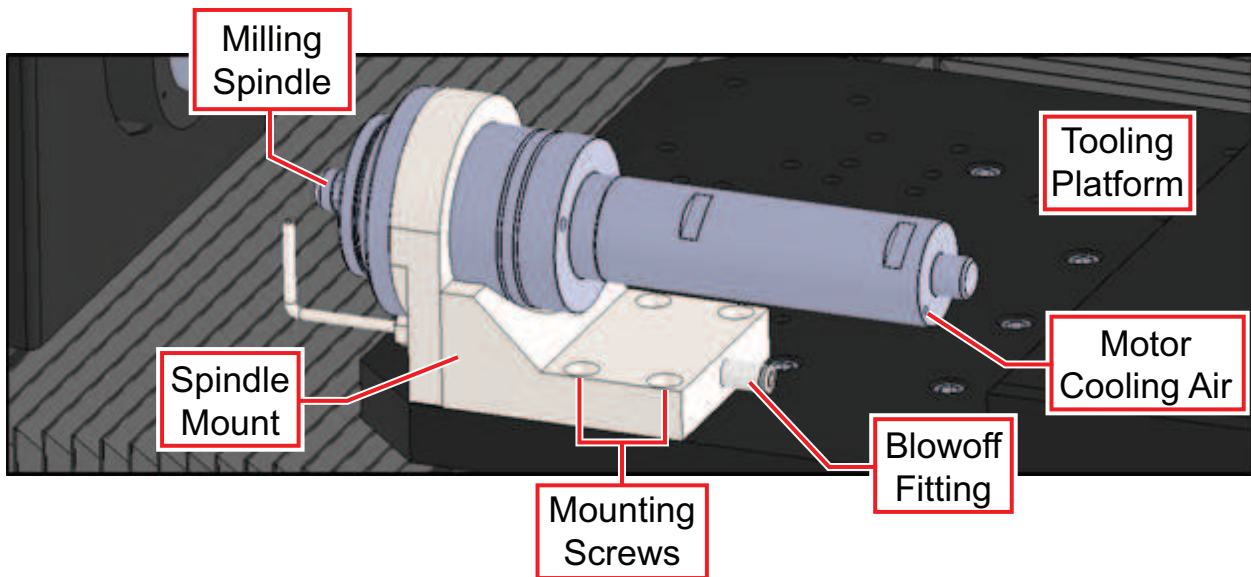


Figure 1-17: Haptic Milling Tool Spindle

The milling spindle mount can be mounted by [QTY. 4] M5 screws in any two consecutive tool locations. The appropriate 4 mm tubing should be attached to the air bearing supply, motor cooling air, and blowoff fittings.

1.12. Additional Toolholder

Three toolholders are supplied standard with the LensPro-HP. The Additional Toolholder option will supply one more of the same assembly, and is therefore mounted the same way as the standard supplied toolholders. See the Installing or Moving a Toolholder section for more details.

1.13. Handwheel Pendant

The optional CNC handwheel pendant can add convenience to alignment procedures. The plug connects on the back panel of the machine. See the Back Panel section for connection. The handwheel is an Aerotech MPGA32 Pendant. See the MPGA32 Pendant manual for more details on this part.

To operate the pendant, turn the axis selection knob to either “Z” or “X” depending on the desired motion. Turn the speed multiplier knob to the desired speed setting. Start with the lowest setting to get familiar with the speeds. Press and hold the yellow enable button on the left side of the pendant. While holding this button, rotate the handwheel to move the stage. Refer to the axes section for positive travel directions.

In case of a crash condition, press the red Emergency Stop button on the right side of the pendant. This will cut power to all motors and stop any programs from running. To reset, turn the red knob counter-clockwise.

1.14. Custom Modifications

Consult the factory for additional modifications or accessories for the LensPro-HP.

- Automated parts loader
- Cryogenic machining for hydrophobic materials
- Uninterrupted power supply (UPS)
- Other additions

Chapter 2: Assembly and Installation

2.1. Unpacking and Handling



DANGER/HEAVY: Do not attempt to manually lift the LensPro-HP.

- If the machine is on uneven ground or a surface that is not smooth, it should be pushed by multiple workers.



WARNING: It is the customer's responsibility to safely and carefully move the LensPro-HP.

- Improper handling could adversely affect the LensPro-HP's performance. Use care when moving the LensPro-HP.
- When moving the machine on the casters, only push the machine from the base.
- Be careful not to apply too much pressure on any one area when moving the machine on its casters.
- Make sure that all moving parts are secure before moving the LensPro-HP. Unsecured moving parts may shift and cause bodily injury.
- Do not attempt to move the carriages or rotors on any air bearings on the LensPro-HP without the air supply connected. All workers near the machine should be aware that this will cause damage to the air bearings.

Carefully remove the LensPro-HP from the protective shipping container and position the machine in the working environment. Use compressed nitrogen or clean, dry, oil-less air to remove any dust or debris that has collected during shipping. If any damage has occurred during shipping, report it immediately.

When the LensPro-HP is in the desired position, lower the leveling feet by turning the hex nut inside the leveling casters. Use the exposed granite surface as a reference to level the machine. Make sure all four feet support some of the load and the machine is steady. After the LensPro-HP is leveled, all four caster wheels should spin without contacting the ground.

Before operating the machine, it is important to let the LensPro-HP stabilize at room temperature for at least 18 hours. Allowing it to stabilize to room temperature will ensure that all of the alignments, preloads, and tolerances are the same as they were when tested at Aerotech.

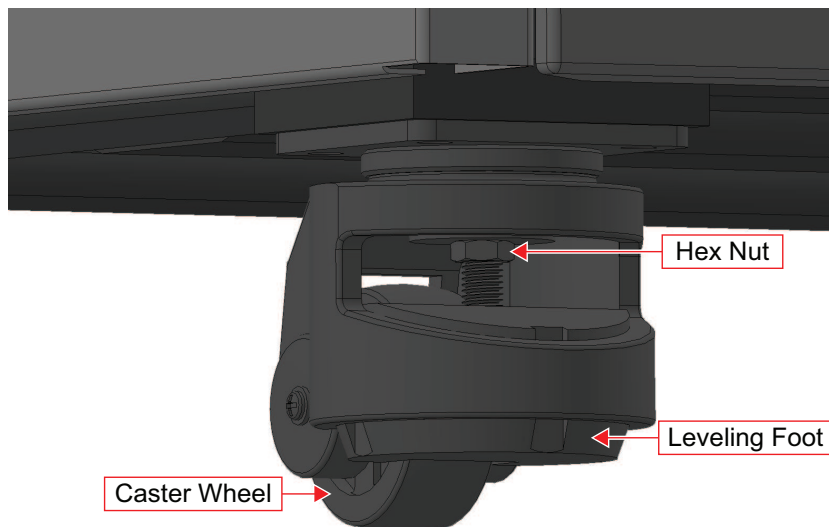


Figure 2-1: Leveling Caster

2.2. Mounting the Monitor

The LensPro-HP is shipped with the touchscreen monitor removed to prevent damage during shipping. Attach the monitor once the machine is in the production area. The mounting arm should be placed onto the mounting post by sliding the bore on the end of the arm over the mounting post. The mounting arm will rest on the mounting post collar.

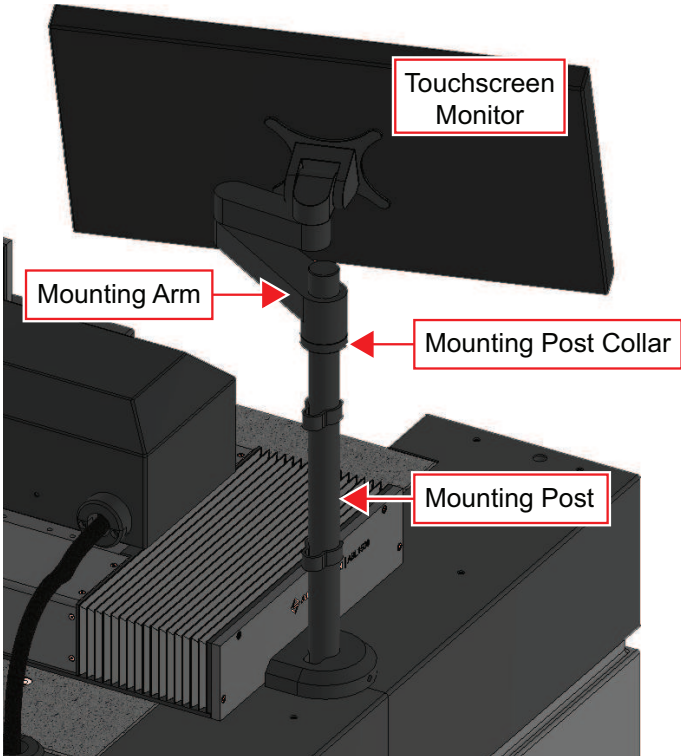


Figure 2-2: Mounting the Monitor

2.3. Removing the Shipping Clamps

The LensPro-HP is packaged with shipping brackets installed to prevent unwanted stage motion and potential damage from occurring during shipment. The shipping brackets are red anodized aluminum, and must be removed before the machine can be operated. The Z-, X-, and A-axis shipping clamps shouldn't be removed until after the air supply has been connected. Keep all shipping clamps and mounting hardware for future use.

NOTE: Do not loosen any screws that are not specified in these instructions, as important alignments may be affected. Only the red anodized parts are shipping clamps. Consult the factory regarding concerns with other screws.

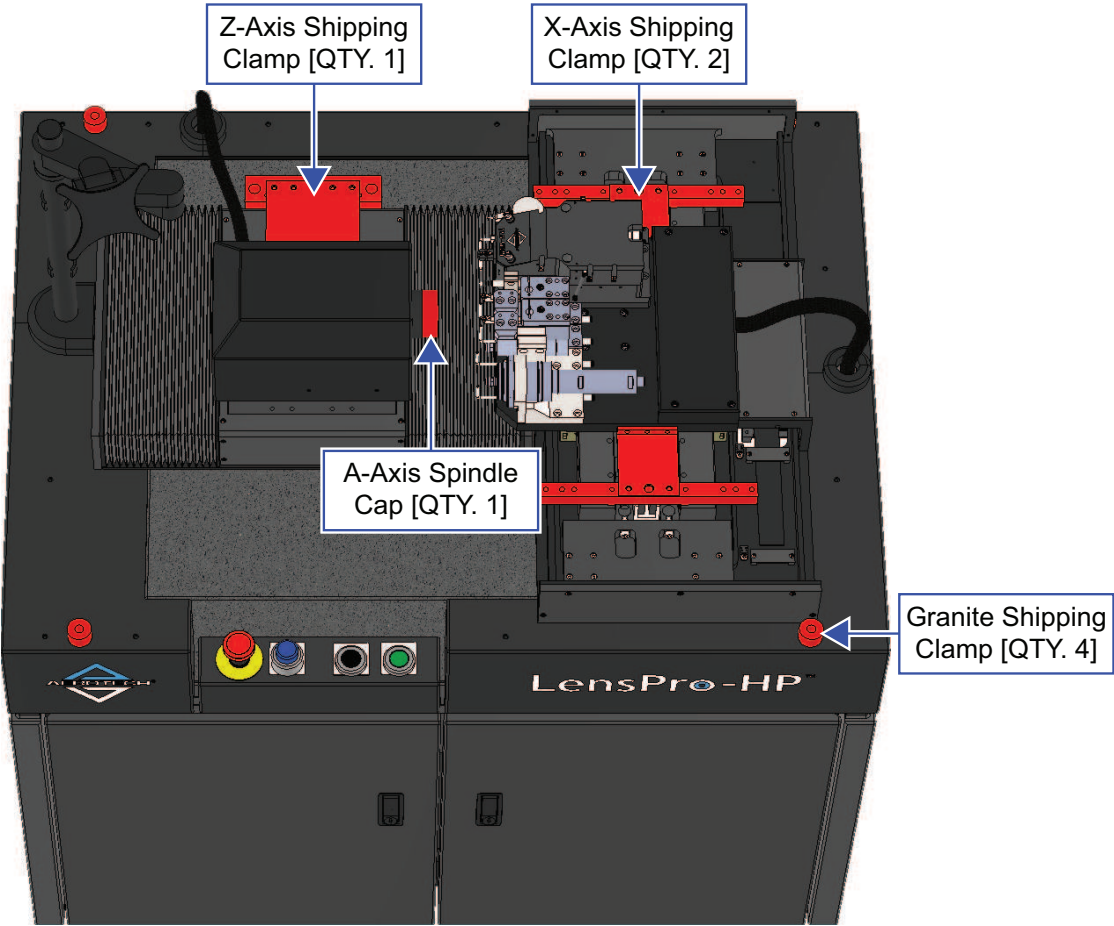


Figure 2-3: Shipping Clamp Overview

The granite shipping clamps [QTY. 4] hold the granite firmly to the machine base using M10 screws. Remove the screws with an 8 mm hex key. After these screws are removed, connect the air supply to the machine according to the [Section 2.5](#). After a few minutes, the isolators will fill with air and should lift the granite off the machine base. Verify that the granite has between 3 mm and 7 mm of lift on each corner by pressing on the corner by hand. Contact Aerotech if the lift is not in this range.

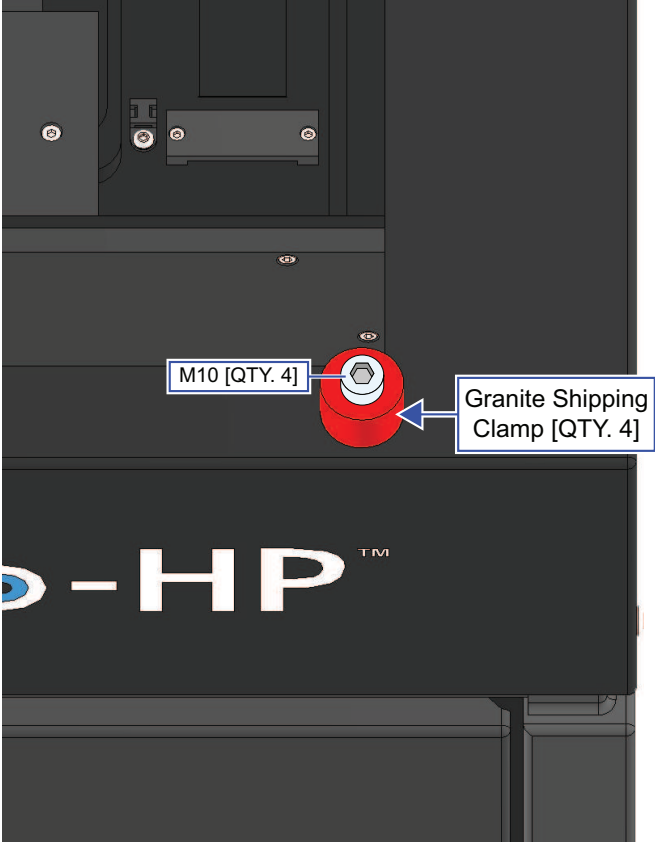


Figure 2-4: Granite Shipping Clamps



WARNING: Do not remove the axis shipping clamps until after the air supply has been connected and that the granite has between 3 mm and 7 mm of lift on each corner (refer to [Section 2.5.](#)).

The Z-axis shipping clamp is comprised of a clamp plate attached to a clamp block. The plate is held by M6 screws [QTY. 8] that can be removed with a 5 mm hex key. The shipping clamp block is held by M8 screws [QTY. 3] that can be removed with a 6 mm hex key. Verify the air supply by very lightly and carefully pushing on the carriage. The carriage should move with almost no resistance and feel smooth during travel. Do not crash the spindle into the tooling on the X axis.

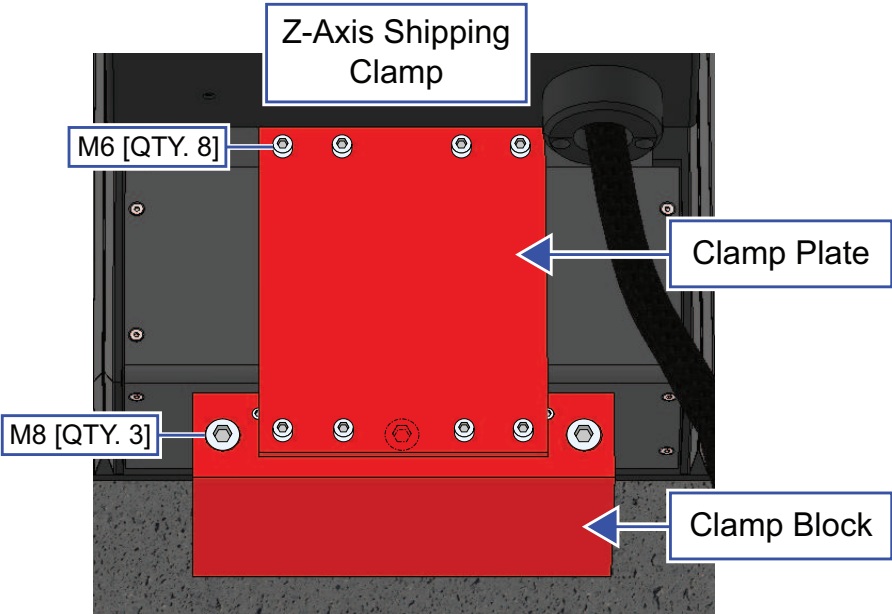


Figure 2-5: Z-Axis Shipping Clamp



WARNING: Do not remove the axis shipping clamps until after the air supply has been connected and that the granite has between 3 mm and 7 mm of lift on each corner (refer to [Section 2.5.](#)).

The X-axis shipping clamps [QTY. 2] are comprised of a clamp plate attached to a clamp block. The X-axis shipping clamp plates are held by M5 [QTY. 3] and M6 [QTY. 2] screws that can be removed with 4 mm and 5 mm hex keys. The shipping clamp bars are held by M5 [QTY. 2] screws that can be removed with a 4 mm hex key. Verify the air supply by very lightly and carefully pushing on the carriage. The carriage should move with almost no resistance and feel smooth during travel.

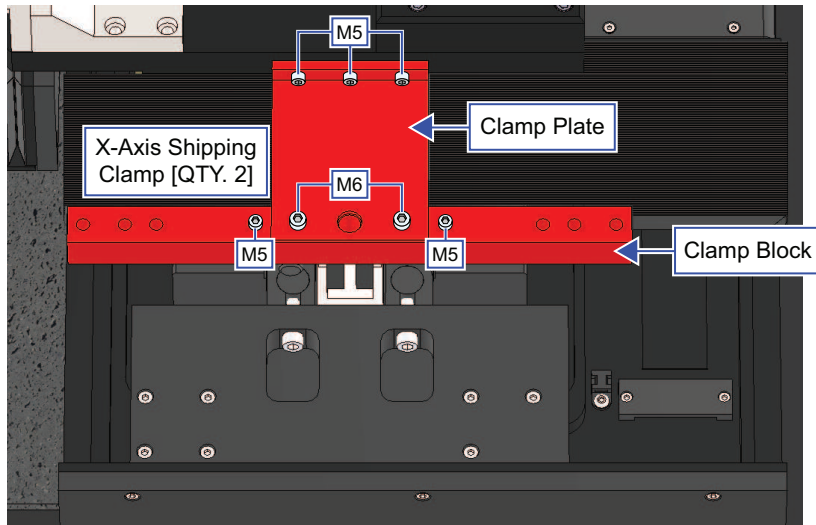


Figure 2-6: X-Axis Shipping Clamp

The bellows have been retracted to mount the shipping clamps. Once the clamps have been removed, reattach the bellows to the endplates using the captive screws in the endplates. The captive screws require a 3 mm hex key to tighten. See the ABL1500-B Hardware Manual for more information.

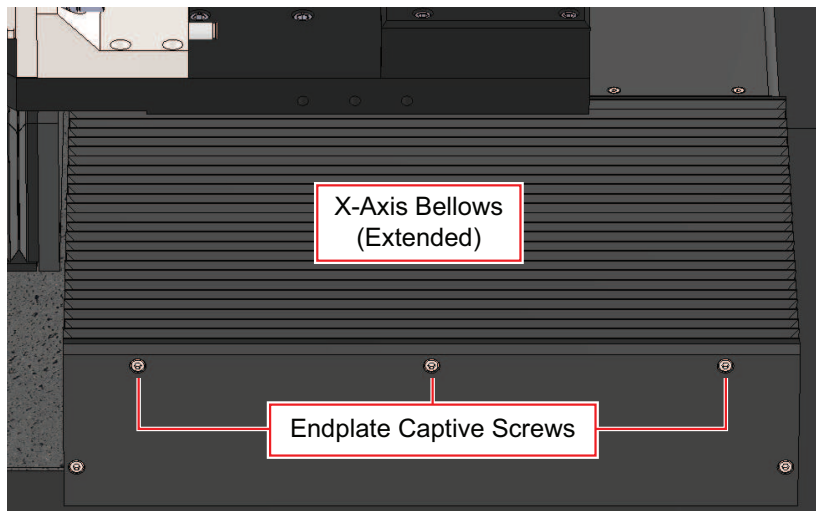


Figure 2-7: X-Axis Bellows Reattachment



WARNING: Do not remove the axis shipping clamps until after the air supply has been connected and that the granite has between 3 mm and 7 mm of lift on each corner (refer to [Section 2.5.](#)).

The spindle cap is held by #2-56 [QTY. 2] screws that can be removed with a 2 mm hex key.

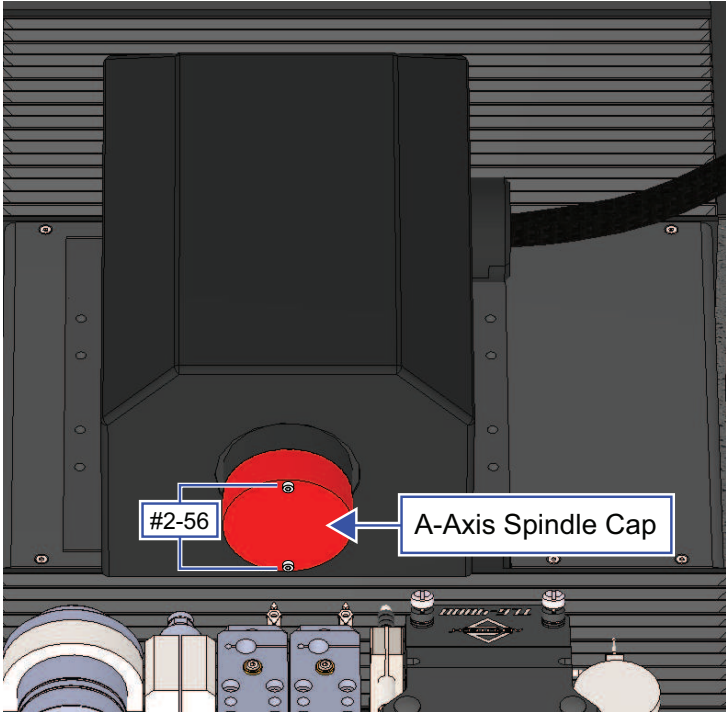


Figure 2-8: A-Axis Spindle Cap

The Toric Lens Generator (TLG-4000) has two sets of shipping brackets that must be removed before the TLG-4000 can be operated. Remove the red anodized bracket that locks the reaction mass in the back (Figure 2-9) and remove the second red anodized bracket to free the carriage. The front cover will have to be removed to access the bracket locking the carriage (refer to Figure 2-10). Save the shipping brackets to be used for long-term storage of the stage or return shipping for service.

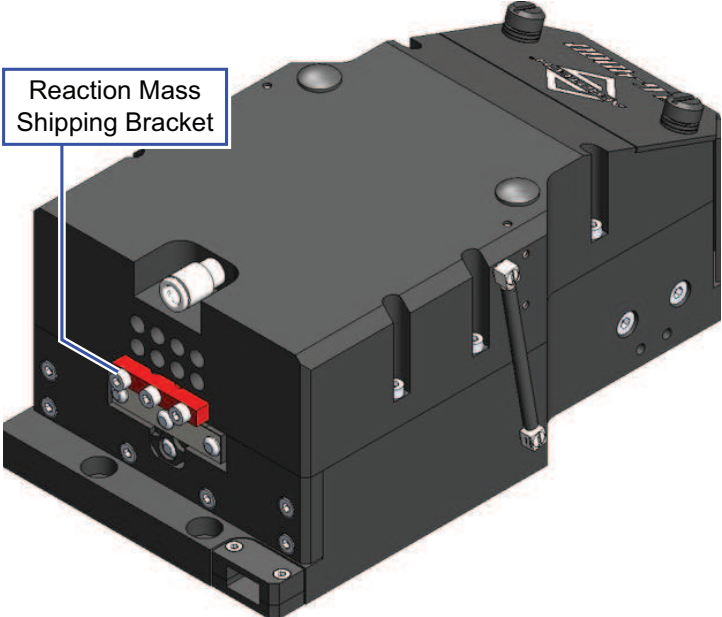


Figure 2-9: Reaction Mass Shipping Clamp Location

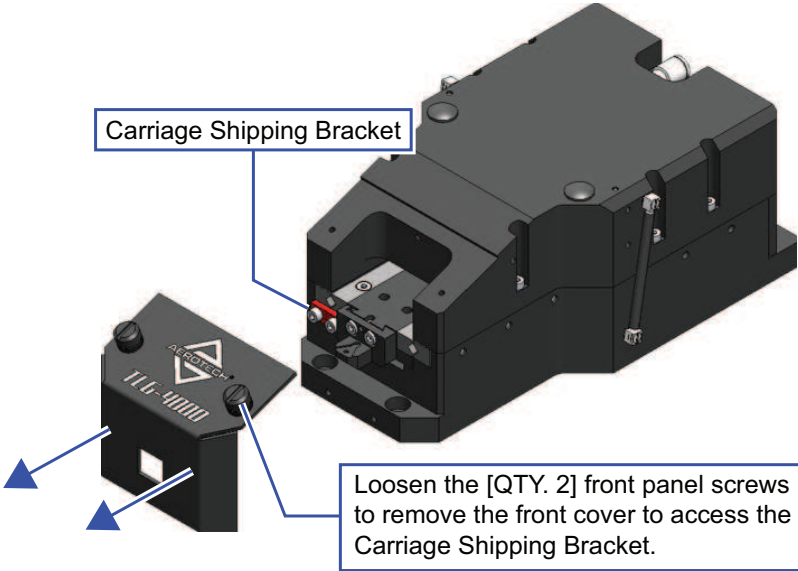


Figure 2-10: Carriage Shipping Clamp Location

2.4. Dimensions

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

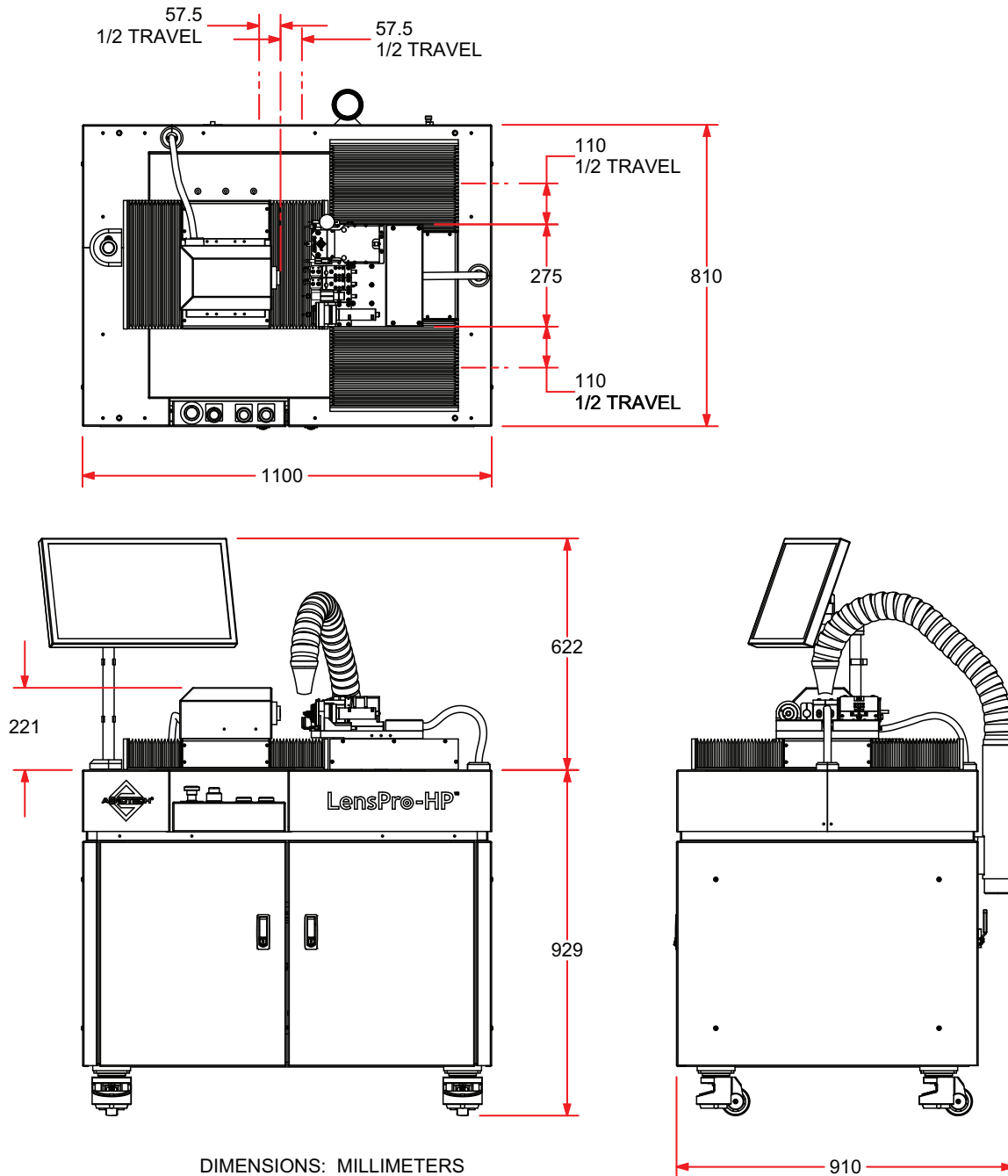


Figure 2-11: LensPro-HP Dimensions

2.5. Compressed Air Requirements

The LensPro-HP requires compressed air for air bearings, air isolation, and blowoffs for cutting tools. One connection supplies air for all functions.

Attach the air supply to the fitting on the back panel. To open the ball valve and allow air flow, turn the handle up as shown below.

Table 2-1: Air Supply Specifications

Gas Type	Nitrogen (99% purity) or Clean, Dry Air
Supply Pressure	100 to 250 psig (6.9 to 17.2 bar) (Lower end recommended)
Air Consumption	Up to 5 scfm (140 slpm)
Filter	Filtered to 0.25 µm
Dew Point	Dry to 0°F dew point
Fitting Size	3/8" quick-disconnect hose fitting (standard). The connection type is customer-specified at the time of order.

Contact Aerotech regarding solutions for filtering and drying air for the LensPro-HP.

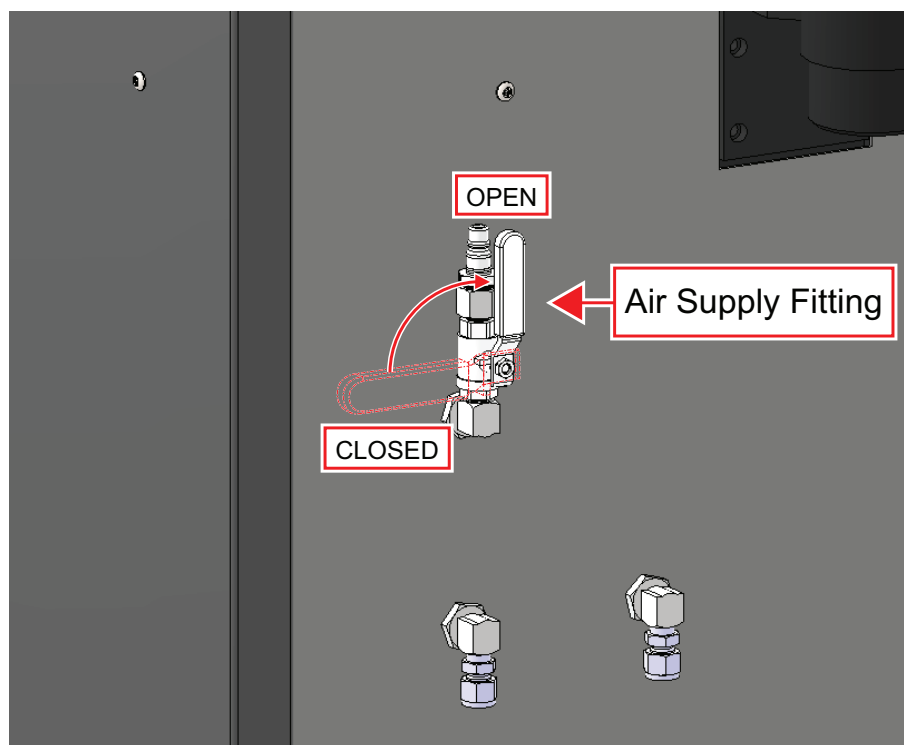


Figure 2-12: Air Supply Fitting (Open)

2.6. Electrical Requirements

Other power requirements and connections are available upon request. Power configuration should be specified with the machine order, and may not be the same on every machine. Check the documentation to the specific LensPro-HP for clarification.

Table 2-2: Electrical Specifications

Voltage	230 VAC
Phase	Single Phase
Frequency	50/60 Hz
Connection	NEMA L6-20P (three-blade twist lock, 20 A male plug)

Before plugging in the machine, turn the main power switch to the OFF position. Connect the power plug into the machine and twist to lock. Verify that all panels and doors to the machine are closed and the plug is secure. Turn the main power switch to the ON position.

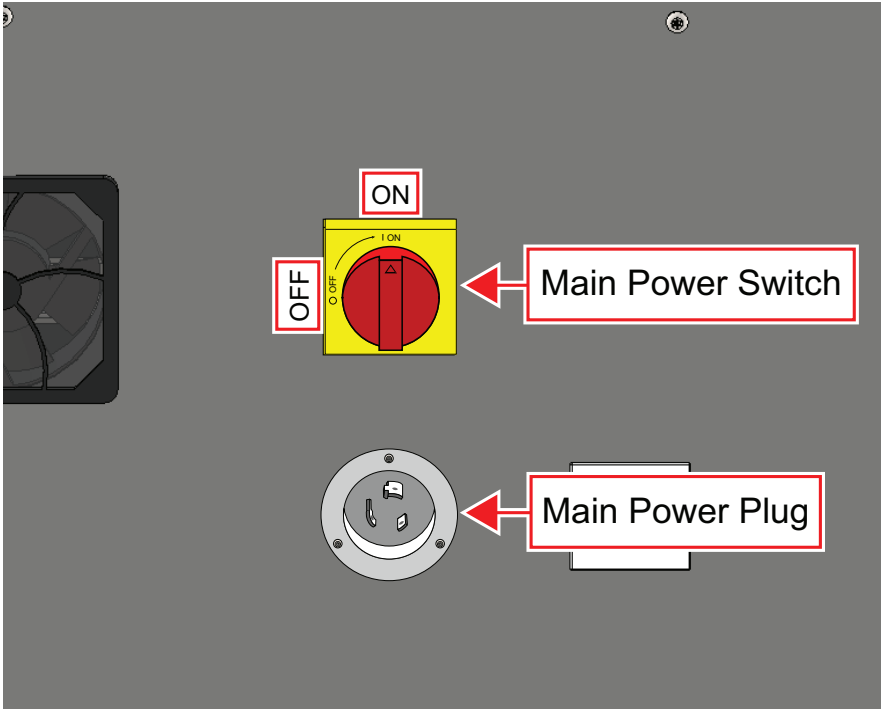


Figure 2-13: Power Plug and Power Switch Locations

2.7. Vacuum Installation

The LensPro-HP requires an external vacuum for chip collection. The tube is sized for flexible duct with an internal diameter of 75 mm (3 in) and can be adapted to other sizes upon request. Fit your vacuum duct over the tube, and secure it with a hose clamp.

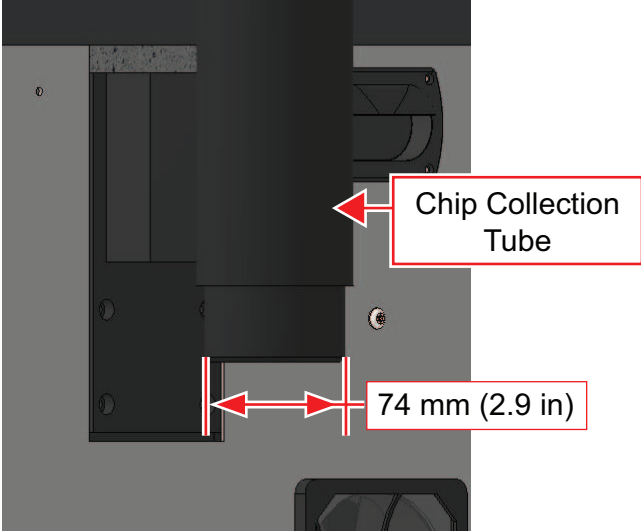


Figure 2-14: Chip Collection Tube Fitting

To turn the vacuum on and off through the control software, plug your vacuum into the accessory outlet on the back of the machine. The type of power and connection should be specified with the machine order. Check the documentation to the specific LensPro-HP for details on this plug.

The LensPro-HP will turn the power on for this outlet when vacuum is needed for the process. Leave the power switch on your vacuum in the ON position.

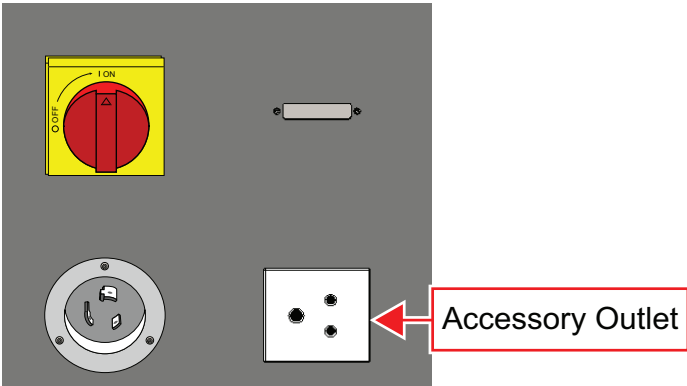


Figure 2-15: Accessory Outlet Location

2.8. Optional Water Cooling Installation

Water cooling is required to operate the main spindle at speeds over 10000 RPM. If the High Speed Lathe Spindle has been ordered, the LensPro-HP will have two flexible tubes with outer diameters of 10 mm.

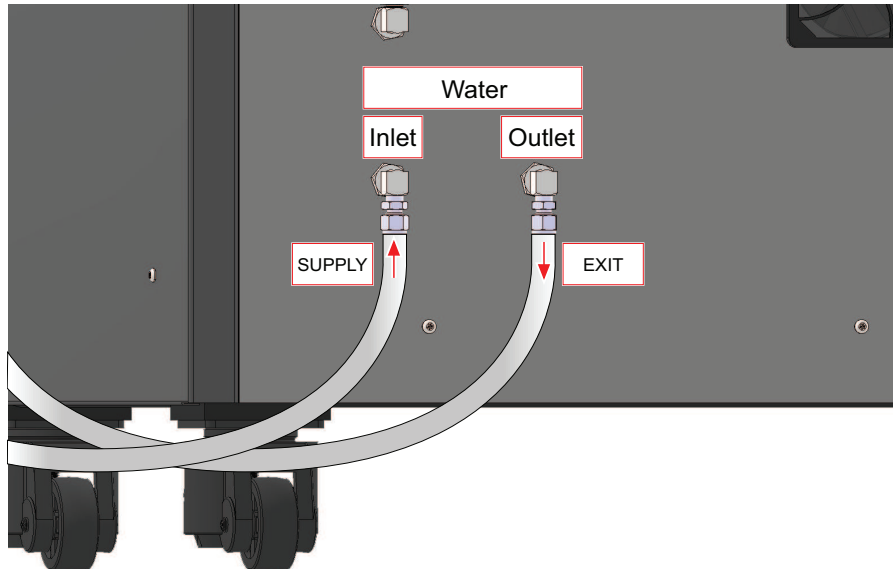


Figure 2-16: Water Cooling Fittings

If the chiller was purchased from Aerotech, there will be quick-connect fittings on the chiller. See the chiller manual for details. Use clean, distilled water to fill the reservoir and follow the conditions specified in [Table 2-3](#).

If the water source is customer-supplied, use only clean distilled water. The pump must create smooth flow to not cause vibration in the spindle. Positive displacement pumps are not recommended for this reason. Turbine pumps produce smooth flow. The pump must be able to supply water under the conditions specified in [Table 2-3](#).

Table 2-3: Water Cooling Specifications

Water	Clean, Distilled Water
Pressure Difference	35 to 45 PSI (2.4 to 3.1 bar)
Max Pressure	50 PSI (3.5 bar)
Water Temperature	15 to 25°C
Flow	At least 1LPM

To install a water source:

1. Prime the pump by turning on the pump and let water flow directly back to the reservoir
2. Connect the supply tube on the LensPro-HP
3. Pump water through the machine until water fills the exit tube
4. Connect the exit tube to the chiller inlet or water reservoir
5. Verify the pressure and flow conditions are met

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Chapter 3: Operation

3.1. Operator Interface

The CNC Operator Interface is a standard product with Aerotech’s A3200 software package. The LensPro-HP comes with customized buttons and routines specific for the lens cutting setup and process. The CNC Operator Interface is an application that will be set to run on system start up. For additional information about the CNC Operator Interface or A3200 software, refer to A3200 Help.

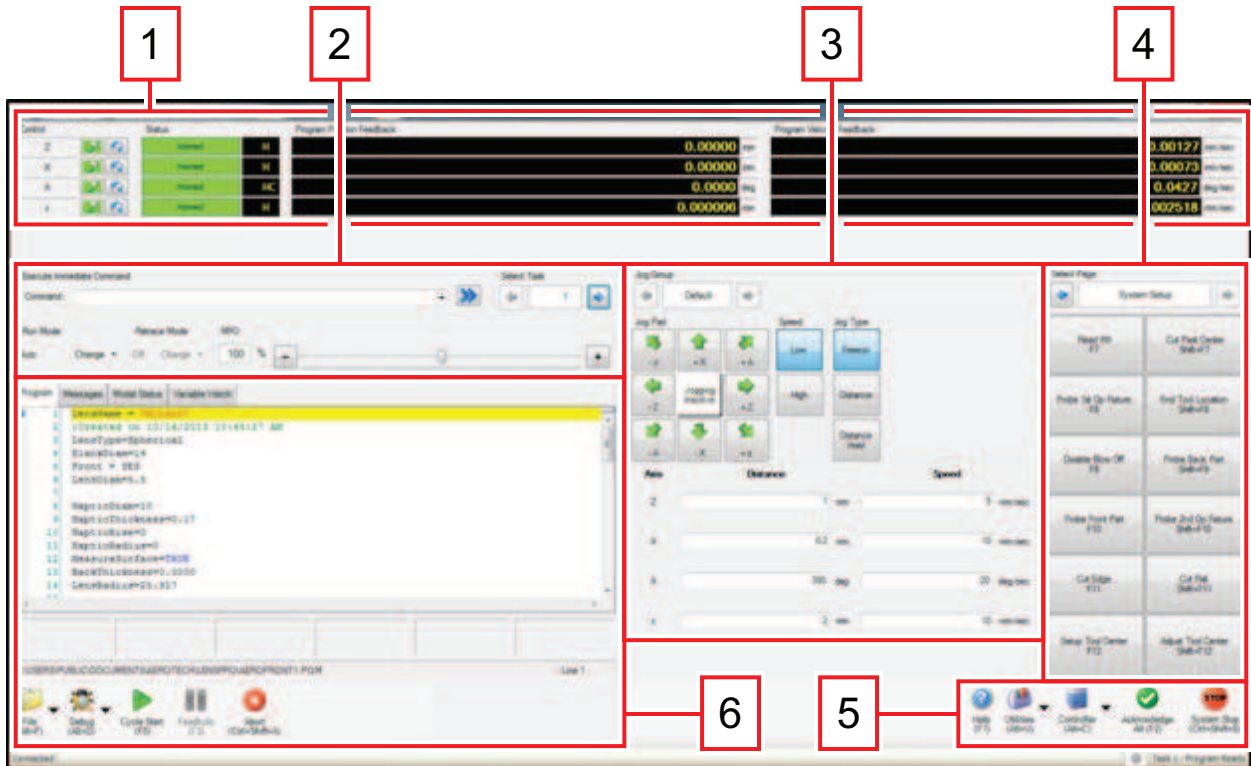


Figure 3-1: CNC Operator Interface

1. Axis Controls and Status

The axes on the LensPro-HP can be monitored and controlled at the top of the interface. The first button on the left enables and disables each axis. The next button commands the home routine. The status bar tells the operator if the axis is enabled and homed. To the right of the status bars are feedback outputs of the axes.

2. Immediate Command Input

The command line can execute single A3200 commands, but is generally not used on the LensPro-HP.

3. Jog Controls

The jog buttons will move the axes incrementally according to the distance or speed specified in the distance and speed boxes. Use caution with the jog buttons to not crash a tool into a part or the spindle. See the Axes section for axis directions. It is recommended to use the “Distance” jog type, especially when using the touchscreen control.

4. Function Buttons

The buttons on the right side of the interface command subroutines that have been written for machine setup. These buttons are called “Customizable Buttons” in the A3200 Help. Routines and buttons can be added to perform tasks specific to your process. Up to twelve buttons can be used on each page. The page is selected above the buttons.

5. Miscellaneous Controls

Help: Opens the A3200 Help

Utilities: To change settings or open a different A3200 program

Controller: Resets or connects to the A3200 controller

Acknowledge: Clears errors and faults on all axes

System Stop: Causes an Emergency Stop

6. Program Controls

The buttons in the bottom left corner control the A3200 programs.

File: Open, close, or edit a program

Debug: Advanced commands to debug Aerobasic programs

Cycle Start: Runs the currently opened program

Feedhold: Pauses a running program

Abort: Stops and ends a running program

The window above the buttons shows the program that is open or running, and messages from the program. It can also be used to monitor the modes of the controller and the variables of the programs.

3.2. Workpiece Holding

The pneumatic collet holds mandrels for the lathing process. The mandrel or part can be referenced to either the front face of the collet or the dead stop inside the collet (Figure 3-2). If the part has a mounting flange, it can mount on the front face. If the part has no flange, it will reference the dead stop. Both cases are accurate ways to control lens thickness.

To insert a part in the collet, press and hold the **Collet Open** push button on the front of the machine. Insert the part into the collet until it is resting on either the front face or the dead stop (refer to Figure 3-2). Firmly hold the part against the collet and release the **Collet Open** button (refer to Figure 1-12). To remove a part from the collet, hold down the **Collet Open** button and remove the part.

NOTE: Keep the collet clear of debris to assure accurate workpiece holding.

Table 3-1: Standard Collet Specifications

Collet Diameter	12.7 mm (0.5 in)
Collet Depth	12.7 mm (0.5 in)

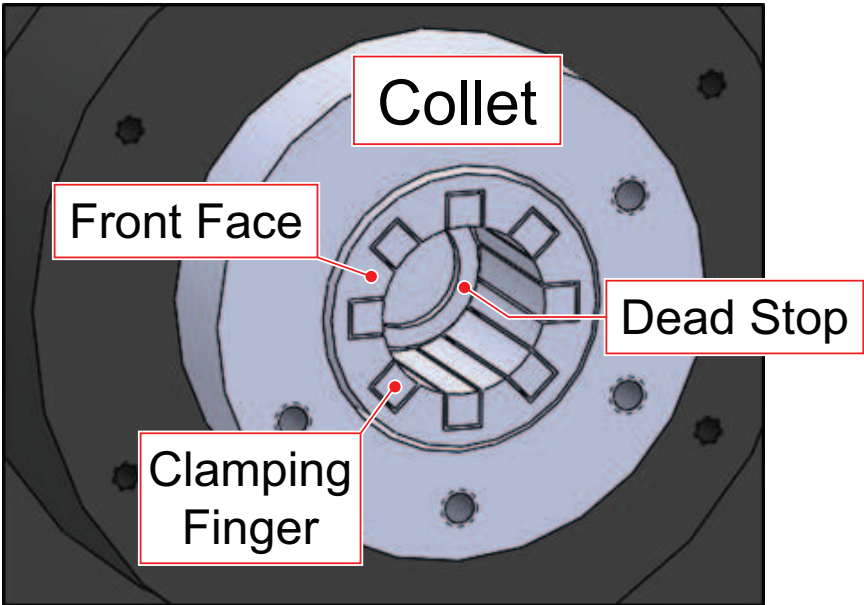


Figure 3-2: Collet Reference

3.3. Installing or Moving a Toolholder

Mount a standard toolholder to the tooling platform with [QTY. 4] M5 screws (refer to [Figure 3-3](#)). Two of the mounting screws are captured inside the standard toolholder and can only be tightened through a clearance hole. Use a 4 mm hex key to tighten or remove the captured mounting screws.

Cables and hoses are tied down and bundled together under the cable cover. Remove the cable cover by using a 4 mm hex key and find the 4 mm blowoff tubing that corresponds to the tool location of the toolholder. The toolholder shown in [Figure 3-3](#) is in Tool Location 5. Press the appropriate blowoff tubing into the blowoff fitting on the back of the toolholder and reattach the cable cover.

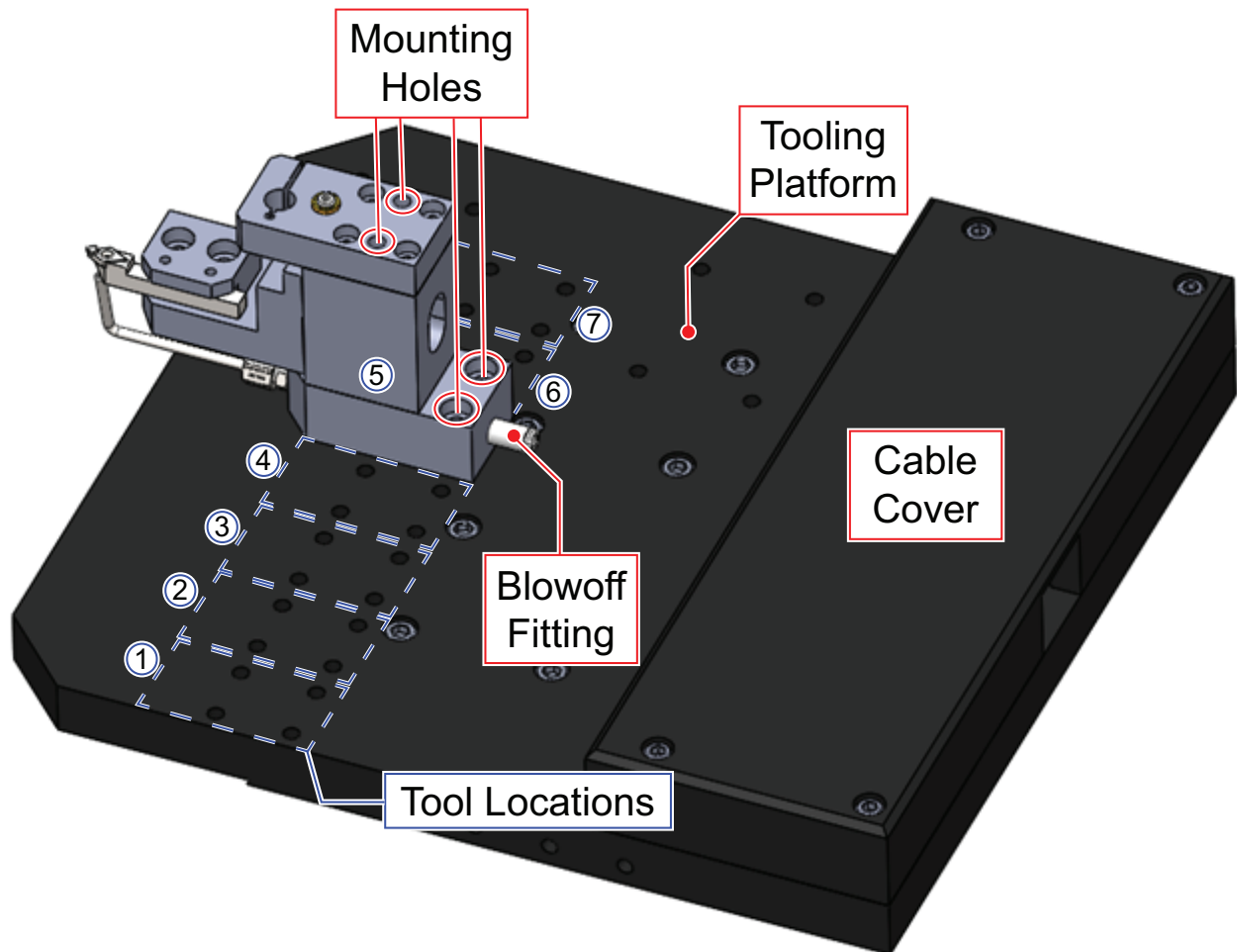


Figure 3-3: Toolholder Installation

3.4. Installing or Replacing a Tool

The tool clamp on a standard toolholder can be positioned so that the tool shank is on either side of the toolholder (Figure 3-4). The tool clamp is secured by [QTY. 2] M5 screws.

Insert the new tool shank into the tool clamp so that the tip of the tool shank is positioned above the blowoff tube. Tighten the [QTY. 2] clamping screws with a 3 mm hex key to a torque of 1.5 N·m. The blowoff tube can be adjusted by loosening the compression fitting nut. Custom blowoff tubes available upon request.

To replace a tool on the TLG-4000, refer to the TLG-4000 Hardware Manual (Aerotech P/N: EDS174).

For replacing a milling tool or marking drill bit, see your manual for the milling or marking spindle.

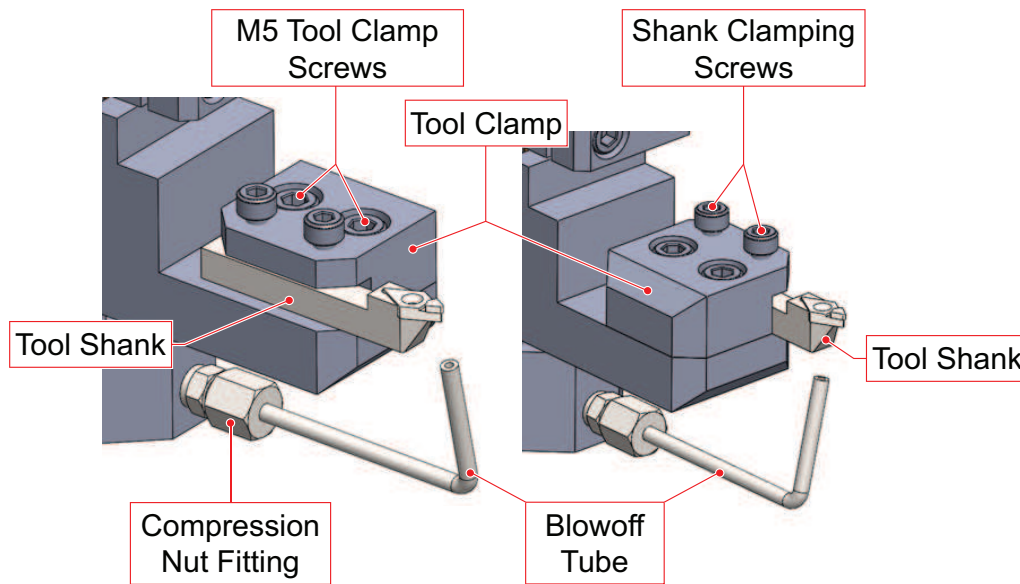


Figure 3-4: Installing a Tool Shank

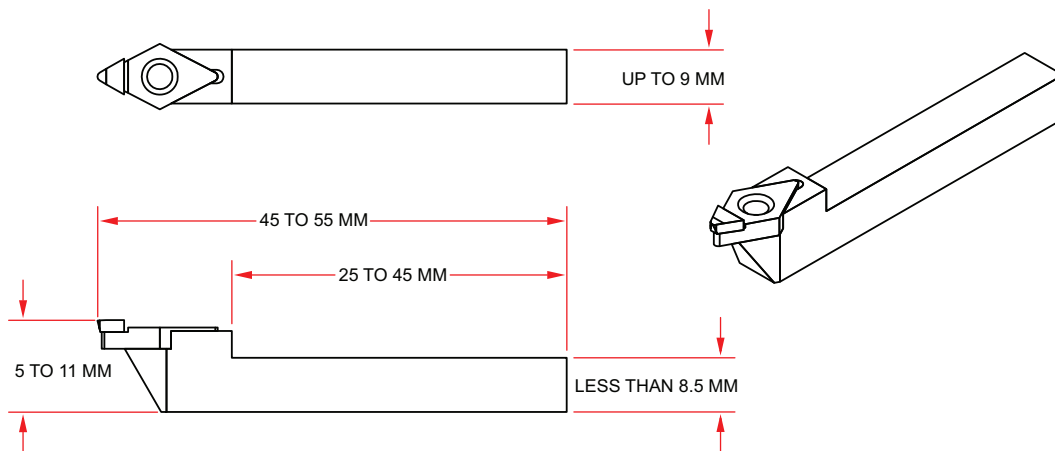


Figure 3-5: Shank Dimensions for a Standard Toolholder

3.5. Adjusting Tool Height

The standard toolholder has a dove tail slide built in for precision adjustment of the tool height. One height indicator is supplied with the standard LensPro-HP.

To adjust the height:

1. Insert the height indicator into the top of the toolholder and carefully tighten the indicator clamping screw until the indicator is secure.



WARNING: Over tightening the indicator clamping screw could damage the indicator. Never tighten the indicator clamping screw without a properly sized indicator in the toolholder.

2. Record the indicator reading.
3. Loosen the M6 locking screw with a 5 mm hex key.
4. Turn the adjustment screw with a 2 mm hex key. One full revolution will move the tool 0.254 mm.
 - Turning the screw counter-clockwise to raise the tool
 - Turning the screw clockwise to lower the tool
5. Slowly tighten the locking screw while watching the indicator for movement.
6. If the height shifts while locking, slightly loosen the locking screw and turn the adjustment screw to compensate for the shift.
7. Slowly tighten the locking screw again.
8. Record the new indicator reading to verify that the difference from the initial reading is the desired change in height.

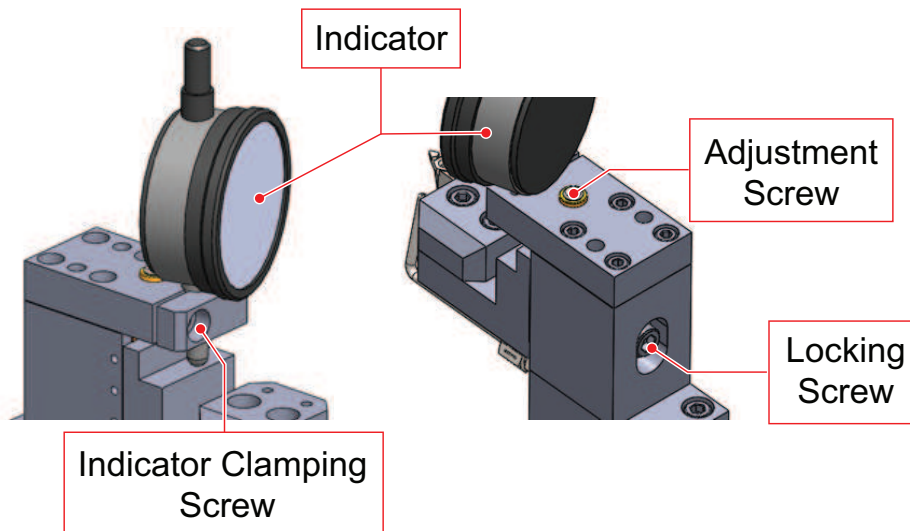


Figure 3-6: Height Indicator

To adjust the tool height on the TLG-4000, refer to the TLG-4000 Hardware Manual (Aerotech P/N: EDS174).

3.6. New and Replacement Tool Setup



DANGER: Several steps in the Tool Setup operation initiate a cutting process to find the position of the tool. Keep all hands and objects away from the machine when starting a cutting process.



WARNING: To preserve the quality of the diamond, keep the diamond tool tip below or at the center of the spindle axis for all cuts (refer to [Section 3.5. Adjusting Tool Height](#)).

New tools must be found by the controller before they can be used. To make accurate parts, several physical aspects of the new or replacement part must also be found by the controller.

The order in which the physical aspects of a new or replacement tool are captured by the controller is important and should be found in the order listed below:

1. Setup New Tool Function (refer to [Section 3.6.1.](#))
2. Edit the Tool Radius (refer to [Section 3.6.2.](#))
3. Find the Z Position (refer to [Section 3.6.3.](#))
4. Center the Tool Height (refer to [Section 3.6.4.](#))
5. Find the X Position (refer to [Section 3.6.5.](#))

3.6.1. Setup a New Tool Function

NOTE: If you are replacing a tool and the replacement tool is within 0.5 mm in all directions of the tip of a previous tool in the same tool location, skip to the Editing Tool Radius section (refer to [Section 3.6.2.](#)).

In the CNC Operator Interface, click the function button labeled “Setup New Tool” and follow the instructions in the dialog boxes (refer to [Figure 3-1](#) for the location of the Function buttons).

When prompted to move the tool to the center of the spindle, use the jog buttons from the CNC Operator Interface or the handwheel pendant, if equipped, to align the tool ([Figure 3-7](#)). Position the tool in the open area of the collet, but be careful not to crash the tool into the spindle during movement.

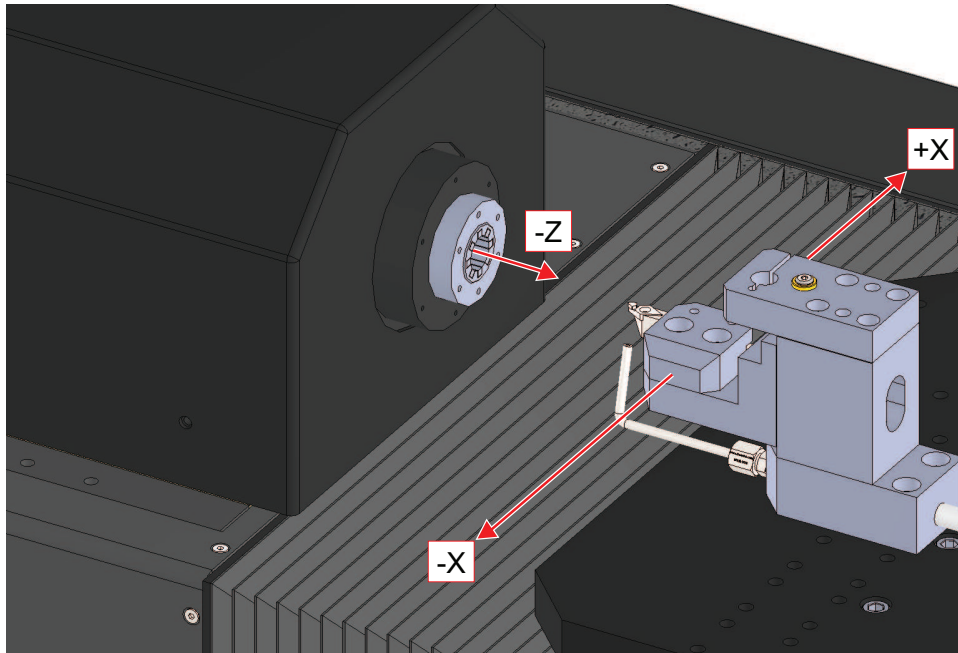


Figure 3-7: Tool Alignment 1

The tool should be close to the front face of the spindle with enough gap to slide a slip of paper through without resistance (Figure 3-8). The tool should be close to the X-axis center, but does not need to be precise at this time.

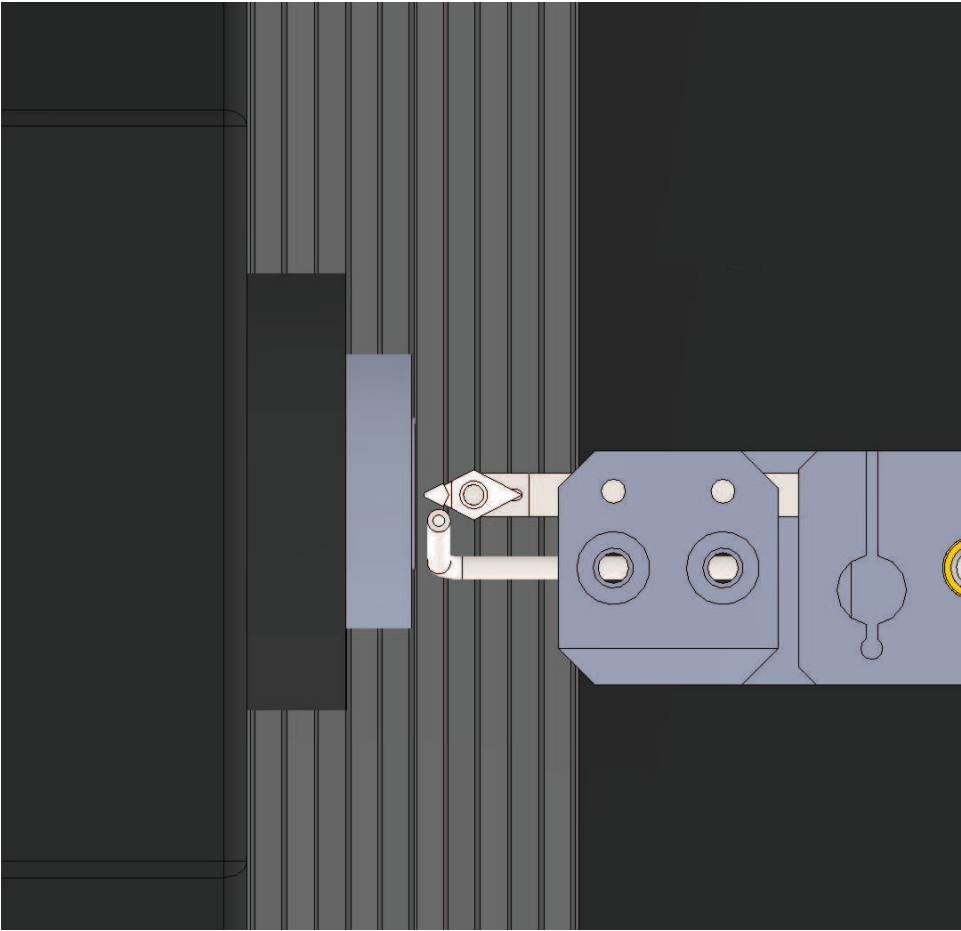


Figure 3-8: Tool Alignment 2

Click the Cycle Start button in the Program Controls of the CNC Operator Interface when you have the new tool roughly aligned (Figure 3-8) and follow the rest of the instructions for tool setup.

3.6.2. Editing the Tool Radius

The LensPro-HP controller stores the radius for each tool on the machine for cutter compensation. When a new tool is installed or when a tool is replaced, the radius of the new tool must be stored in order to make accurate parts.

To input the value of a tool radius, click the “Input Tool Radius” function button in the CNC Operator Interface and follow the instructions in the dialog boxes.

NOTE: To use this procedure, the Z and X positions must already be initialized to approximate values, either from a previous tool in the same location or by using the Setup New Tool function (refer to [Section 3.6.1.](#)).

3.6.3. Finding Z Position

To control the depth of each cut and the final thickness of parts, each tool must have an accurate Z position stored in the controller. Occasionally, the Z position will need to be reestablished due to tool wear or environmental changes.

To start the Find Tool operation, click the “Find Tool” function button in the CNC Operator Interface and follow the instructions in the dialog boxes.



DANGER: The Find Tool operation is a cutting process. Keep all hands and objects away from the machine after starting the operation.

The machine will automatically probe the part, attempt a cut with the current parameters, and probe the part again. It will repeat this process until a different measurement occurs during the probe.



WARNING: To preserve the quality of the diamond, keep the diamond tool tip below or at the center of the spindle axis for all cuts (refer to [Section 3.5. Adjusting Tool Height](#)).

NOTE: To use this procedure, the Z and X positions must already be initialized to approximate values, either from a previous tool in the same location or by using the Setup New Tool function (refer to [Section 3.6.1.](#)). The controller must also have the correct tool radius stored (refer to [Section 3.6.2.](#)).

3.6.4. Tool Height Centering

The height of the cutting tip must be centered to the spindle axis of rotation to cut high quality surfaces.



WARNING: To preserve the quality of the diamond, keep the diamond tool tip below or at the center of the spindle axis for all cuts (refer to [Section 3.5. Adjusting Tool Height](#)).

NOTE: Tool height centering should only be performed after the Z position of the tool has been found (refer to [Section 3.6.3.](#)).

To center the height of a tool:

1. Lower the tool below the spindle axis according to the Adjusting Tool Height section (refer to [Section 3.5.](#)).
2. Insert a test piece such as 12.7 mm diameter PMMA stock into the collet.
3. Make a test cut using the “Cut Past Center” button and follow the instructions in the dialog boxes. Enter a distance past center of 1 mm. This operation will make a slightly tapered cut past the center of the part using the input parameters. Watch the cut to ensure the tool passes center and stops cutting before it pulls away.



DANGER: The Cut Past Center operation is a cutting process. Keep all hands and objects away from the machine after starting the operation.

4. Measure the “nub” diameter that remains uncut on the part using your choice of equipment.
5. Raise the tool height by 40% of the nub diameter.
6. Repeat steps 2 through 4 until the nub is not detectable. If the nub diameter ever increases in size, start again from step 1.

NOTE: If the tool shifts horizontally during the vertical adjustment, the Z position will need to be found again (refer to [Section 3.6.3.](#)).

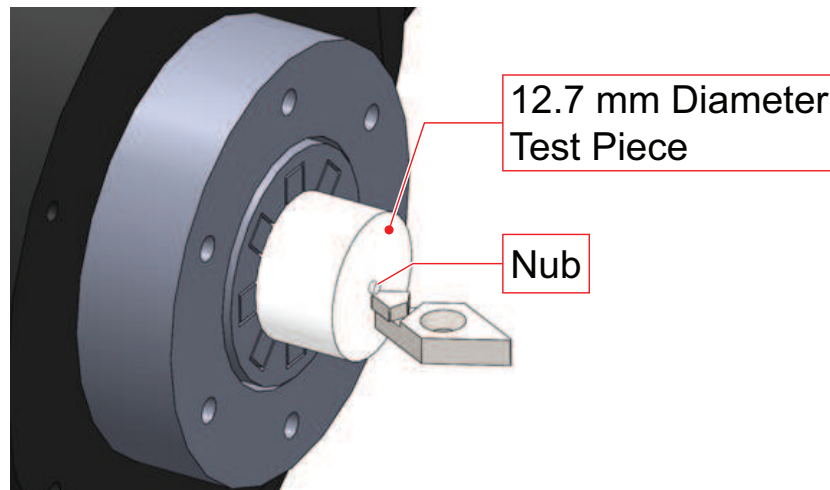


Figure 3-9: Tool Height Centering

3.6.5. Finding X Position

NOTE: This step should be completed only after the Z position has been found (refer to [Section 3.6.3.](#)) and the Tooling Height has been centered to the spindle axis (refer to [Section 3.6.4.](#))

To find the X position:

1. Insert a test piece such as 12.7 mm diameter PMMA stock into the collet.
2. Make a test cut using the “Cut Past Center” button with a distance of (-1) negative one. This will cause the tool to stop cutting 1mm from the stored center value.



DANGER: The Cut Past Center operation is a cutting process. Keep all hands and objects away from the machine after starting the operation.

3. Measure the “nub” diameter that remains uncut on the part using your choice of equipment. Divide that number by 2 to get the radius.

The nub diameter should measure 2 mm, but in this example, it measures 1.8 mm. The nub radius is therefore 0.9 mm.

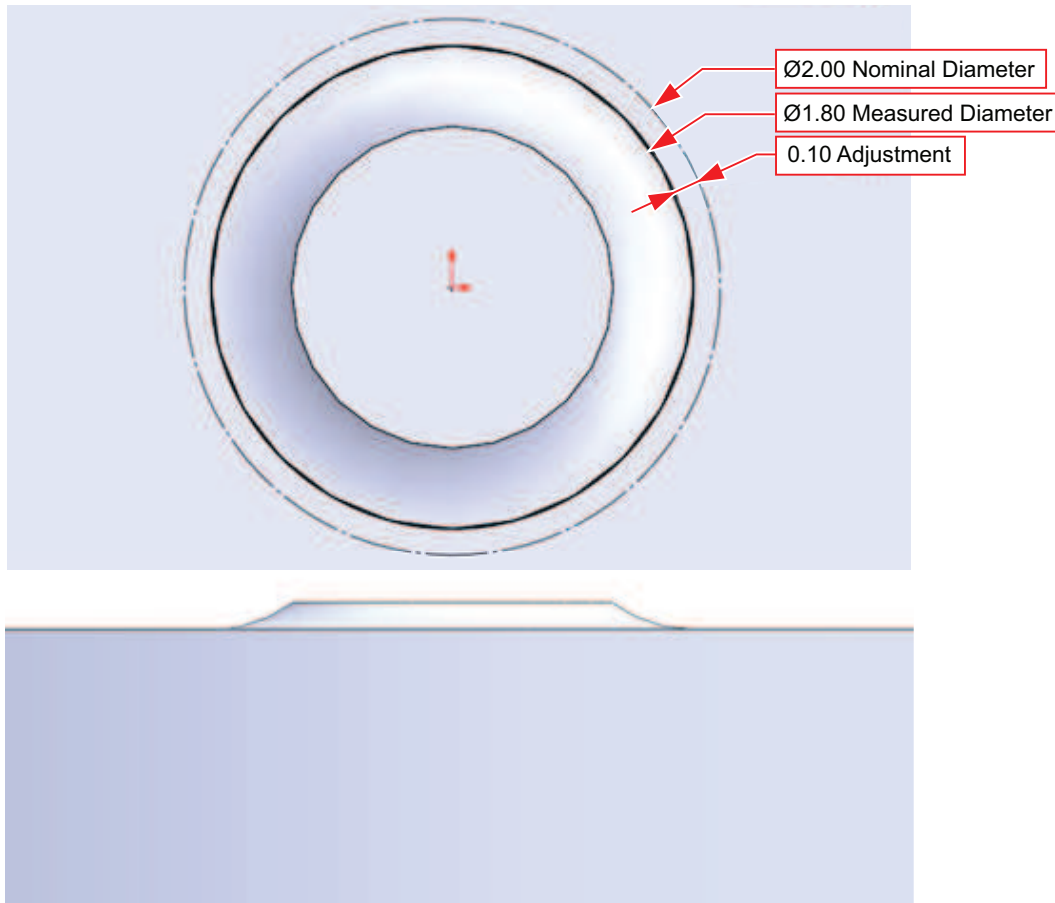


Figure 3-10: Nub Diameter Adjustment

4. Determine the adjustment by subtracting 1 from the nub radius. In the previous example, the nub radius is 0.9 mm. This would mean the adjustment is $0.9 - 1 = -0.1$ mm.

5. Adjust the tool center using the “Adjust Tool Center” function button and entering the adjustment that was calculated in the previous step, which was calculated to be -0.1 in the example. This is an incremental adjustment and will change the center value automatically.
6. Cut a convex spherical profile to verify the X position of the tool. Use the included programs that are named “FindXPosTool” followed by the desired tool number, or create a custom profile. These programs are intended for using a 12.7 mm diameter test piece as shown in the Tool Height Centering section ([Section 3.6.4.](#)). Refer to the Cutting a Part section ([Section 3.7.](#)). The tool should be moving toward the back of the machine during the test cut.
7. Measure the spherical surface for radius and form error.
8. If the averaged radius and form are inaccurate, the center should be adjusted. Determine the direction and distance to adjust the tool center. Enter a positive number in “Adjust Tool Center” to command the tool to cut further towards the back of the machine, or a negative number for the opposite.

If the spherical cut produces an ogive shape, the best fit sphere will have a smaller radius than the desired cutting radius. In this case, the adjustment should be negative.



Figure 3-11: Ogive Shape

If the spherical cut produces a peak in the middle, the best fit sphere will have a smaller radius than the desired cutting radius. In this case, the adjustment should be positive.



Figure 3-12: Peak Shape

3.7. Cutting a Part

The LensPro-HP is used to cut lenses of various types. It can also be used to cut faces on other turned parts such as mandrels or arbors to hold lens blanks. The process for making lenses varies widely by manufacturer. This is the general process for making lenses on the LensPro-HP, though it can be customized by Aerotech or the user.



DANGER: Keep all hands and objects away from the machine after starting a cutting operation.

1. Design a lens using the LensPro Designer application. Create A3200 programs for the front and back profiles of the lens. See the help file in the LensPro Designer for more details.
2. Open the A3200 CNC Operator Interface. Verify the tools are aligned and the centers are found.
3. Prepare one or more lens blanks for first cutting operation.
4. Open the program for the back cut by selecting “File” from the Program Controls in the CNC Operator Interface (refer to [Figure 3-1](#)), then “Open”, and selecting the desired program.
5. Insert one first operation mandrel into the collet as described in the workpiece holding section (refer to [Section 3.2](#)).
6. Press Cycle Start and wait for the cutting process to finish. Cycle start can be commanded from the CNC Operator Interface or the push button on the front of the machine.
7. Remove the part from the collet.
8. Repeat the previous 3 steps for each part in the batch.
9. The second operation mandrel must be referenced to cut the lens to an accurate thickness. If the mandrel that will be used for the second operation has not been referenced, insert an empty mandrel into the collet, and click the “Probe 2nd Op Fixture” function button.
10. Transfer the batch of lens blanks to second operation mandrels.
11. Open the program for the front cut in the CNC Operator Interface.
12. Insert a second operation mandrel into the collet as described in the workpiece holding section (refer to [Section 3.2](#)).

13. Press Cycle Start and wait for the cutting process to finish.
14. Remove the part from the collet.
15. Repeat the previous 3 steps for each part in the batch.
16. Remove and clean lenses. Verify the quality of each lens.
17. The estimated wax thickness is stored in the controller. If the actual wax thickness varies from this value, the final lens thickness will not be correct. If the measured lens thickness is not correct, click the "Adjust Final Lens Thickness" function button and enter the amount the lens thickness should be increased by. Enter a negative to make the next lens thinner.

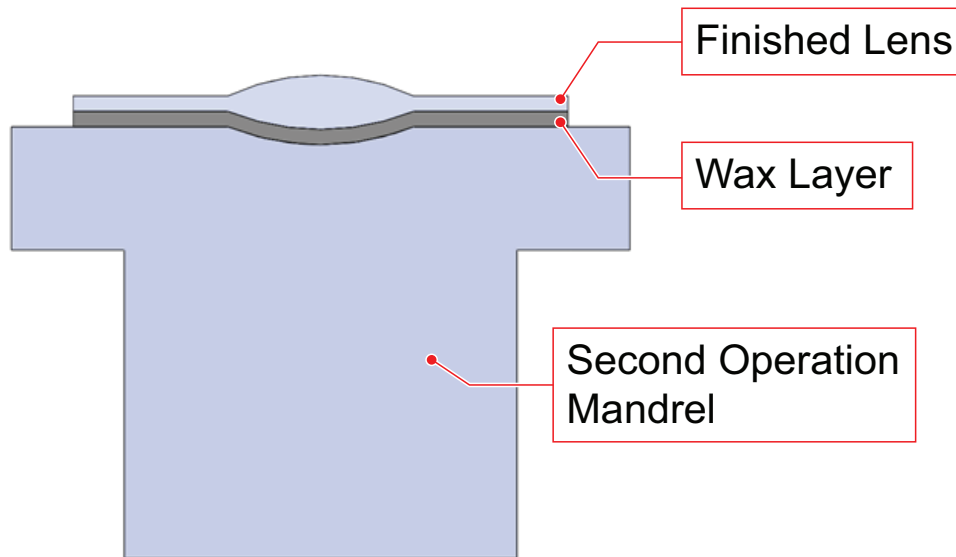


Figure 3-13: Example Lens Mandrel

Chapter 4: Maintenance

The LensPro-HP is designed to require minimum maintenance. However, occasional inspection and cleaning must be done to maintain accuracy and prevent damage to the machine.

NOTE: The bearing areas must be kept free of foreign matter and moisture; otherwise, the performance and life expectancy of the stage will be reduced. Always operate the axes with the bellows and covers in place to help keep dirt out.



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

4.1. Regular Maintenance Requirements

Perform the following services once per month until a trend develops for the specific application and environment. Longer or shorter intervals may be required to maintain the cleanliness of the machine. The cleaning interval depends on conditions such as duty cycle and environment. Isopropyl alcohol is recommended for cleaning most surfaces of the LensPro-HP.

- Shut down the PC and turn the main power switch OFF
- Move each axis through full travel by hand to verify the travel is smooth
- Check for loose connectors and tighten if necessary
- Check for damaged cables and replace or repair them
- Clean or replace the foam fan filter on the back panel
 1. Remove the fan cover held on by four clips

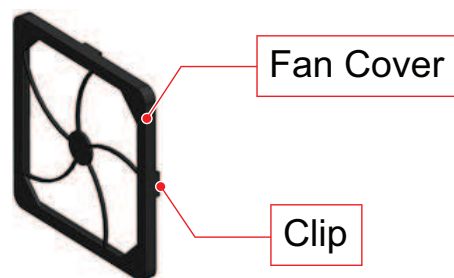


Figure 3-14: Fan Cover

2. Clean the filter with soapy water or replace the filter
 3. Thoroughly dry the filter
 4. Attach the filter and fan cover
- Vacuum all surfaces accessible inside the front doors of the machine base
 - Clean the Z-axis and X-axis air bearings. Refer to the ABL1500-B Hardware Manual for more details.
 1. Retract the bellows by unscrewing from each endplate
 2. Gently blow clean, dry air under the bellows to remove dust
 3. Wipe the air bearing surfaces with isopropyl alcohol and a lint-free cloth
 4. Lubricate the bellows tracks if the bellows begin to bind when moving
 5. Screw the bellows into the endplates
 - Verify that the air isolation lifts the granite between 3 mm and 7 mm in each corner.
 - If the TLG-4000 is installed on the machine, check the running currents according to the TLG-4000 Hardware Manual
 - Contact Aerotech before operating the machine if any damage has occurred.

Since the LensPro-HP is designed to be used in a cutting application, steps have been taken to protect the bearings from debris. However, the system is not fully sealed, and it is up to the user to control cutting debris and remove it from the work point. It is highly recommended that both blowoff air and vacuum are used while cutting. Do not allow chips to build up and enter through the bellows and covers of the axes.

4.2. Troubleshooting

Symptom	Possible Cause	Possible Solution
Monitor has no display	Power to the machine is off	Plug in machine and turn the main power switch to ON
	PC or monitor is off	Plug in PC and monitor and press the power buttons
	Monitor not connected	Connect cables to the monitor
Axes will not move	Controller fault	Refer to controller documentation
Axes are unstable or squeal	Gains not optimized	See controller documentation for tuning instructions
	Encoder signals not optimized	See controller documentation for encoder tuning instructions
Machine is cutting inaccurate parts	Gains not optimized	See controller documentation for tuning instructions
	Encoder signals not optimized	See controller documentation for encoder tuning instructions
	Cutting tool radius is incorrect in controller	Follow the procedure for a new tool (refer to Chapter 3)
	Cutting tool not aligned to spindle	Follow the tool centering procedure (refer to Section 3.6.4.)
	Axes are not aligned correctly	Contact Aerotech service
Parts have poor surface finish	Damaged cutting tool	Replace cutting tool
	Loose cutting tool	Tighten mounting screws for the tool and toolholder
	Gains not optimized	See controller documentation for tuning instructions
	Air isolation not working properly	Contact Aerotech service
	Excessive environmental vibration	Reduce environmental disturbances

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Appendix A: Warranty and Field Service

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

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

Return Products Procedure

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

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

Returned Product Warranty Determination

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

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

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

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

Rush Service

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

On-site Warranty Repair

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

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

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

On-site Non-Warranty Repair

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

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

Service Locations

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

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 5508 6731	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720
JAPAN	TAIWAN	UNITED KINGDOM
Aerotech Japan Full-Service Subsidiary Phone: +81 (0)50 5830 6814 Fax: +81 (0)43 306 3773	Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	Description
1.01.00	Section 2.3. Removing the Shipping Clamps updated
1.00.00	New manual

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