

# ES-curve Ophthalmic Lens Edger

## User Manual



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# Preface

## Cautionary Warning Symbols, Instructions and Messages

The following graphic symbols are used in this manual to alert users to situations that may impair optimum operation of the machine, damage the machine or work piece, or cause injury to the operator. Many of the symbols shown are also affixed to the edger itself.

	Important safety-related information or instructions related to optimum machine operation.
	Wear protective gloves.
	Wear protective goggles.
	Indicated operation is prohibited.
	Mechanical hazard or advisory.
	It is prohibited to remove or alter the safety devices.
	Assure safety devices are working correctly before starting work.
	Electrical shock warning.
	Dangerous or prohibited area.

	Hand-crush hazard.
	Maintenance alert or instruction.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, not to provide for every possible contingency in connection with installation, operation, or maintenance. The manufacturer assumes no obligation of notice to holders of this document with respect to changes subsequently made.

## Safety First

Observe the following precautions to minimize the risk of accidents or injury. Other important safety information appears elsewhere in this manual. Item #1 below is important.

1. Read and understand this manual before operating the equipment. If you do not understand the instructions, consult your supervisor or a service representative.
2. Assure that the installation instructions have been followed and that the electrical and pneumatic connections have been made as required.
3. Before turning on the equipment, visually verify that there are no foreign objects in the cutting area that may impede the machine motion.
4. Assure that all coolant and lubrication reservoirs are filled, and all filters are clear of obstruction.
5. Do not open any part of the cabinet unless you are certain that no cycle is in progress and all machine motion has completely stopped.
6. Do not attempt to bypass any of the safety interlocks for the door or case-top.
7. Do not attempt to operate the machine unless all cabinet access points are closed.
8. Never attempt to machine a glass lens. The edger is intended only for machining resin (plastic) ophthalmic lenses.
9. Perform maintenance as indicated in this manual. Clean the cutting area regularly.
10. When performing maintenance or repair operations, be sure to follow all safety instructions, such as removing electrical power, as described in this manual.
11. Assure that the lid lock is in the lock position during operation.
12. In some edging operations, the ES-curve may produce brief sound level peaks that reach 92 db. The use of hearing protection should be considered if the user experiences discomfort or abnormal hearing sensations during use.

# Safety Interlocks

The edger has been equipped with interlocks to block or stop machine operation if some anomalous or unsafe condition is detected. These interlocks must be checked as part of the periodic maintenance, and must never be defeated except by trained personnel during certain maintenance operations.



The manufacturer and seller hereby disclaim any liability in the following cases:

- Improper use of the machine.
- Use of the machine by unauthorized staff.
- Incorrect installation, unless such installation was performed by the manufacturer or seller.
- Unsuitable energy and fluid supplies.
- Lack of maintenance.
- Unauthorized modifications and installations.
- Use of non-original spare parts or parts that do not correspond to the manufacturer's specifications.

Refer to Chapter 4 for detailed maintenance instructions. Refer to Appendix B for descriptions of the standards to which ES-curve edgers comply applicable agency certifications and listings in effect. The user's attention is particularly directed towards the discussion of *residual risks* from operating the machine.





# Chapter 1: *The ES-curve Edger*

## **General Description**

The ES-curve edger is a device comprising mechanical, electrical, pneumatic and software elements whose function is the precise machining of resin ophthalmic lenses. This includes edging with a large variety of contours, drilling and milling. The edger is equipped with a tool-changing mechanism that permits all such operations to be performed without the user needing to manually change tools or remount the work piece. Additional flexibility is achieved via five primary axes of motions, including tilting the axis of rotation of the work piece. This allows, for example, very high-wrap lenses to be dynamically beveled or grooved, and complex shelf cuts to be made.

The ES-curve is contained within a single floor-standing cabinet, mounted on casters so that it may be easily repositioned for access to all points within the cabinet. The top-front of the cabinet swings up to open for maintenance access to the machining area. A smaller door in the center-front of the unit opens/closes vertically to allow insertion or retrieval of the lens, or access to the tool store. The touch screen display is above the door.

All doors and access panels must be closed in order for any motion in the machining area to occur.

## **Installation**

Installation of the ES-curve edger is normally included in the sales conditions and is therefore performed by personnel authorized by the machine supplier.

### **Transport and Handling**

The machine weighs about 700kg.

The machine may be moved in the following cases:

- Loading or unloading from the means of transport.
- Movement inside a lab or production facility.

In the loading and unloading operations, the machine must be lifted using a fork-lift truck. The fork must be adjusted in a way to be inserted into the designated lift points.

The machine is mounted on casters, allowing movement on flat, smooth surfaces. The rear wheels are fixed and the front ones swivel.

The manufacturer is not responsible for any damage due to incorrect handling.

## **Positioning**

The ES-curve must be installed so that a space is left behind the cabinet to allow the inspection of the parts located in the rear of the machine. These require periodic maintenance to guarantee optimal operation of the machine over time.

## **Unpacking**

The machine should be unpacked as close as possible to its final operating location. This reduces the likelihood of damage caused by vibration and jarring while moving the machine.


Do not use sharp tools to remove packaging materials to avoid marring or damaging the machine.

## **Connections to Sources of Energy**

Do not connect the ES-curve to external energy sources until it has been correctly positioned. The following connections are necessary:

- Electricity
- Compressed Air

## **Electrical Connections**

	<p style="text-align: center;"><b>ATTENTION !</b></p> <p>The customer's source of electric power must have the protections specified by the standards in force in the country of use. Moreover, the power source must be able to continuously supply the maximum power that the machine may draw.</p>
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The machine is supplied with a power supply cable with three poles, and ground. The user must connect this cable to the power source and supply it with a plug that is in compliance to those in use in that particular country. The connection to electricity or connection of the plug must be performed by specialized staff.

## **Pneumatic Connection**

The inlet is found in the left side of the machining unit and includes a FR unit for filtering and pressure adjustment (preset in the factory). Insert the connection pipe (Type 10/8 in polyurethane or Rilsan polyamide resin). Increase pneumatic pressure gradually to avoid whiplash of the supply line in the event that it is not solidly connected.

	<p style="text-align: center;"><b>WHIPLASH HAZARD</b></p> <p style="text-align: center;">Solidly connect the compressed air piping. Open the valve slowly.</p>
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# Major Subsystems Overview

- **Machining**  
The machining system consists of a high-speed spindle which rotates the selected cutting tool. The spindle traverses left and right, front-back, and up-down to engage the tool with the work piece. Also included is a lens probing system, a tool-length calibration pad, and the tool store holding up to seven tools. Pneumatic jets clear chips from the machining area. Cooling is provided both for the spindle and for the tool/work piece interface.
- **Lens Positioning**  
The lens positioning system secures the blocked lens for machining using a chuck below the lens that engages the block and a clamp arm above the lens which holds the lens in place. The positioning system rotates the lens so that the tool engages points around the lens perimeter, and tilts the axis of rotation to affect the angle at which the tool engages the work piece.
- **Motion Control**  
This subsystem consists of the servo motors that activate each of the axes via toothed belts, position detectors, and electronic elements which allow the position, velocity and acceleration of each axis to be precisely controlled. The motion control system is inside the cabinet and not generally accessed directly by the user.
- **Programmable Logic Control (PLC)**  
A specialized processor called the PLC sequences the various steps in the edging process. Like motion control, it is not generally accessed directly by the user.
- **Computer and Graphic User Interface (GUI)**  
The computer subsystem provides communication with an external host computer to download job information, and computes all of the parameters of the edging cycle (axis positions, speeds, feed rates). It directs the other subsystems accordingly to assure that the desired edging cycle is achieved. It interfaces with a touch screen display to provide a graphics user interface (GUI) with the user. This may be used to enter job data and cycle parameters, to report and display cycle status, and to perform maintenance and diagnostics. The computer has access to a large fixed disk storage device, as well as to a USB key which may be used to update the ES-curve software.
- **Miscellaneous**  
Included within this category are the safety devices, status sensors, pneumatics, filters, lubricant reservoirs and the like.

Many of the items discussed above, as well as other items of interest, are illustrated in the figures found at the end of this chapter.

## Axes of Motion

The edger implements five axes of motion as follows:

**X axis:** Transverse motion (left/right) of the cutting tool

**Y axis:** Orthogonal motion (front/back) of the cutting tool

**Z axis:** Vertical motion (up/down) of the cutting tool

**C axis:** Work-piece rotation

**B axis:** Inclination (tilt) of the C axis

# Electro-Spindle

The electro-spindle provides high-speed tool rotation. The speed of the electro-spindle is selected by the operator via the user interface. This can be adjusted electronically up to a maximum of 30,000 RPM; however, larger diameter tools should not be operated at more than 20,000 RPM. Optimum speed depends on many factors: Target cycle time, desired finish, type of tool, etc. The electro-spindle incorporates pneumatic cleaning systems for improved operation.

A constant flow of air at 1-1.5 bar prevents dust and shavings from entering the spindle and contaminating the high-speed bearings. The spindle is constantly cooled by circulating a solution of 85% water and 15% Ethylene Glycol. The fluid/air heat exchanger is found on the back of the machine and can be inspected by opening a rear hatch on which indicators are found that warn of any malfunctioning. Cooling requires only ambient air. If the ambient air temperature is too high, further machining is disabled to prevent overheating the spindle.

The coolant should be replaced at least yearly. The heat exchange coils should be cleaned at 1 to 3-month intervals. This operation can only be carried out with the machine at a standstill and after sources of energy have been disconnected. A vacuum should be used to clean the heat exchanger coils. Compressed air must not be used.


**Tool Taper Cleaning Jet:** In the automatic tool loading and unloading phases, a jet of compressed air cleans the area of contact between the spindle and tool. The jet is intense and has a duration of about one second.

**Tool Vise Sensor:** Tool changes are under software control. Software controls the selection and attachment of the desired tools from the tool store. The spindle can only rotate if a tool is properly attached. There is an electronic sensor that identifies the following cases:


- The spindle vise mechanism is open.
- The spindle vise mechanism is closed but the tool is not detected.
- The spindle vise mechanism is closed and the tool is properly detected.

# Tool Store

The tools are housed in a fixture called the tool store. It incorporates an access hatch which is always closed during machining to prevent dirt depositing inside. An automatic system opens the hatch only during the tool change phase. There are seven tool positions available inside the tool store. When tools are loaded into the tool store, or replaced, it is essential that the position of the tool in the tool store and the tool's dimensional properties be accurately recorded via the control software.

	<b>ATTENTION!</b>
	<p>The control software identifies tools by their position within the tool store housing. There is no additional sensing mechanism.</p> <p>When any tool is changed, it is essential to insert the new dimensional and performance features into the control software and to insert the tool into the correct housing position.</p>

## Tools

	<p style="text-align: center;"><b>ATTENTION!</b></p> <p>Only balanced tools with dimensions that are compatible to the machine should be used on the machine.</p> <p>When inserting new or re-sharpened tools, it is absolutely necessary to perform the following before any machining:</p> <ul style="list-style-type: none"><li>• Enter the new dimensional data.</li><li>• Check the length on the tool calibration system (presetting).</li></ul> <p>Always ensure that the position of the tool corresponds to that specified in the software program.</p>
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## Cooling the Tool and the Lens Being Machined

The tool cooling system consists of a coolant reservoir tray and a pneumatic pumping system. Coolant is dispensed through a small ejector nozzle. The software selects the cooling mode necessary in each individual phase of machining. Cooling of the tool, when necessary, uses air mixed with distilled water.

The edger will sense a low coolant level and notify the operator to refill the tank. The consumption of liquid is estimated at about one liter every 200 pieces.

## Vacuum

The edger has an integrated vacuum system mounted in the lower-front part of the machine. It can be easily accessed by opening the door under the machining area. The vacuum is controlled directly by software and failure causes the machine to stop.

The vacuum requires periodic maintenance to empty the bag and clean filters which, through time, tend to become blocked.

## Electric Control Board

The rear electrical cabinet is completely isolated from dirt, dust and moving parts. To work on the electrical cabinet, disconnect all electric power. Maintenance of the electrical cabinet is generally performed by trained service personnel.

## Pneumatic System

The air intake includes a pressure adjuster, air filter and oil filter. The pneumatic valve assembly is located in the rear of the unit.

# Programming Unit

The ES-curve is supplied with an integrated industrial PC, located in the upper-back of the machine in a position protected by fixed shields. Two external USB ports are made available for exchange of data or attachment of a barcode unit.

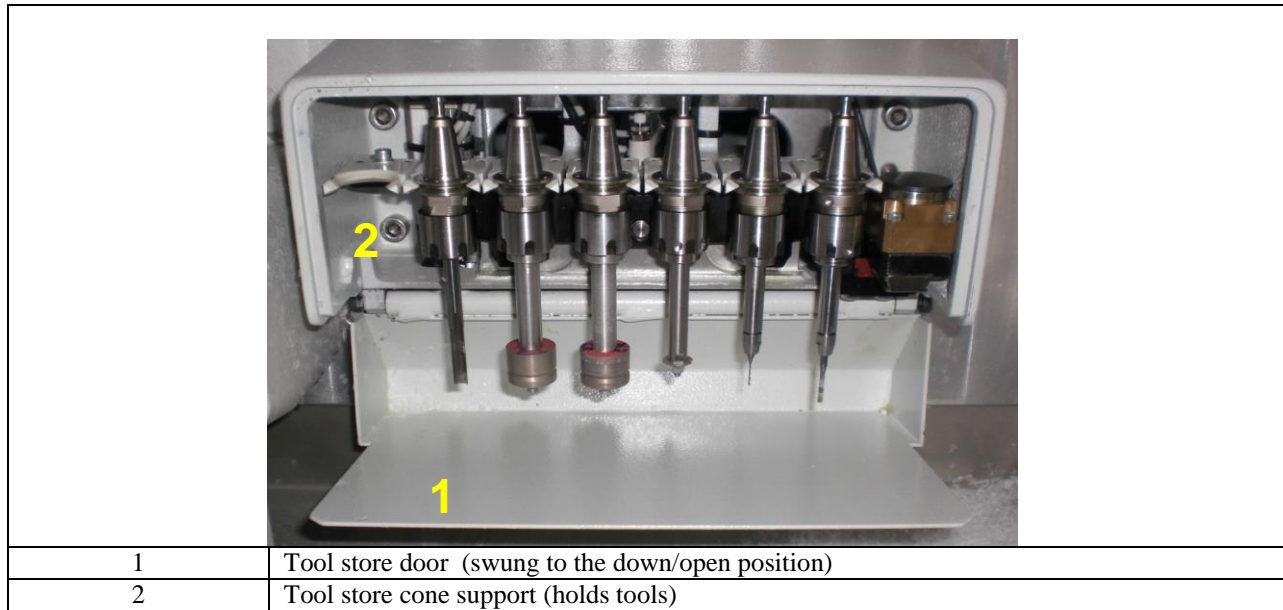
## Identification of Components and Subsystems

The following figures show the key ES-curve components and subsystems for ease of identification by the user.

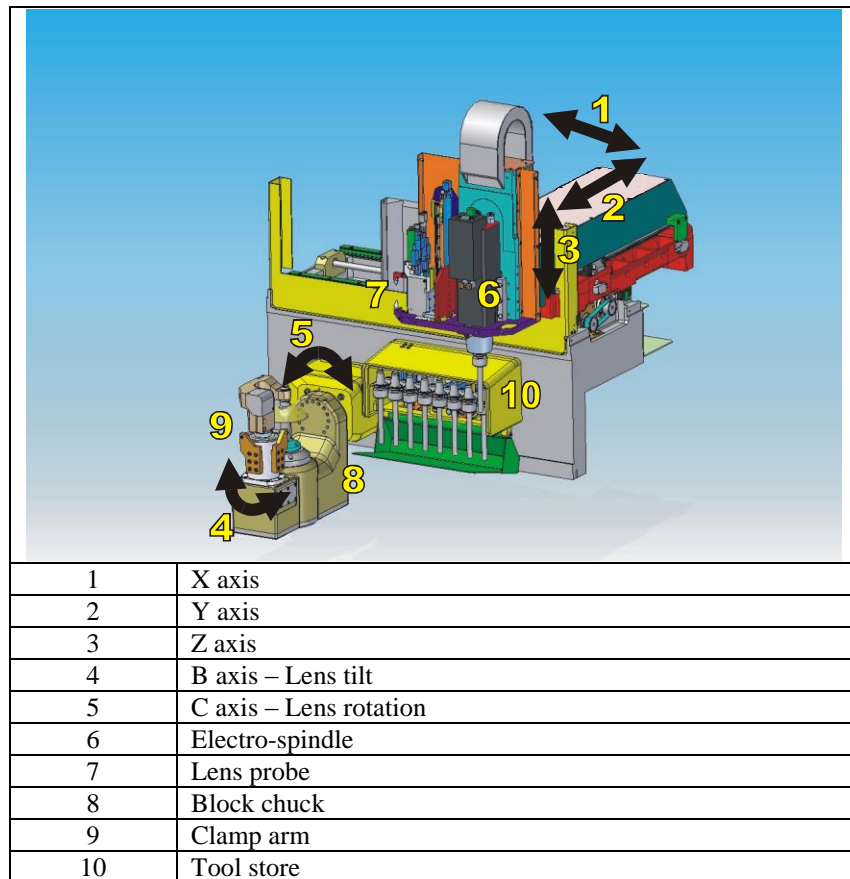


1	Touch screen
2	Machining chamber access door
3	Emergency stop (E-stop) button
4	Vacuum access door
5	Insertion/lift points for transport
6	Fixed guards (protective panels)
7	Conveyor & loader (automatic only)
8	Air filter inlet
9	Chiller exhaust
10	Serial and LAN connection
11	Hand controller
12	Leveling feet (x4)

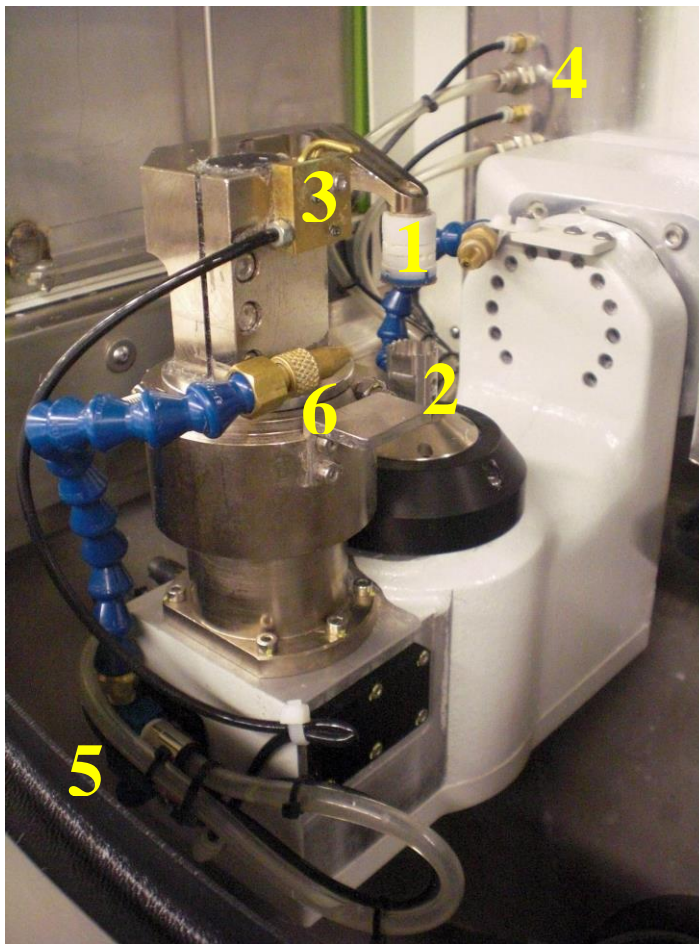
**Figure 1.1: Front view of ES-Curve**



**Figure 1.2: Tool Store**



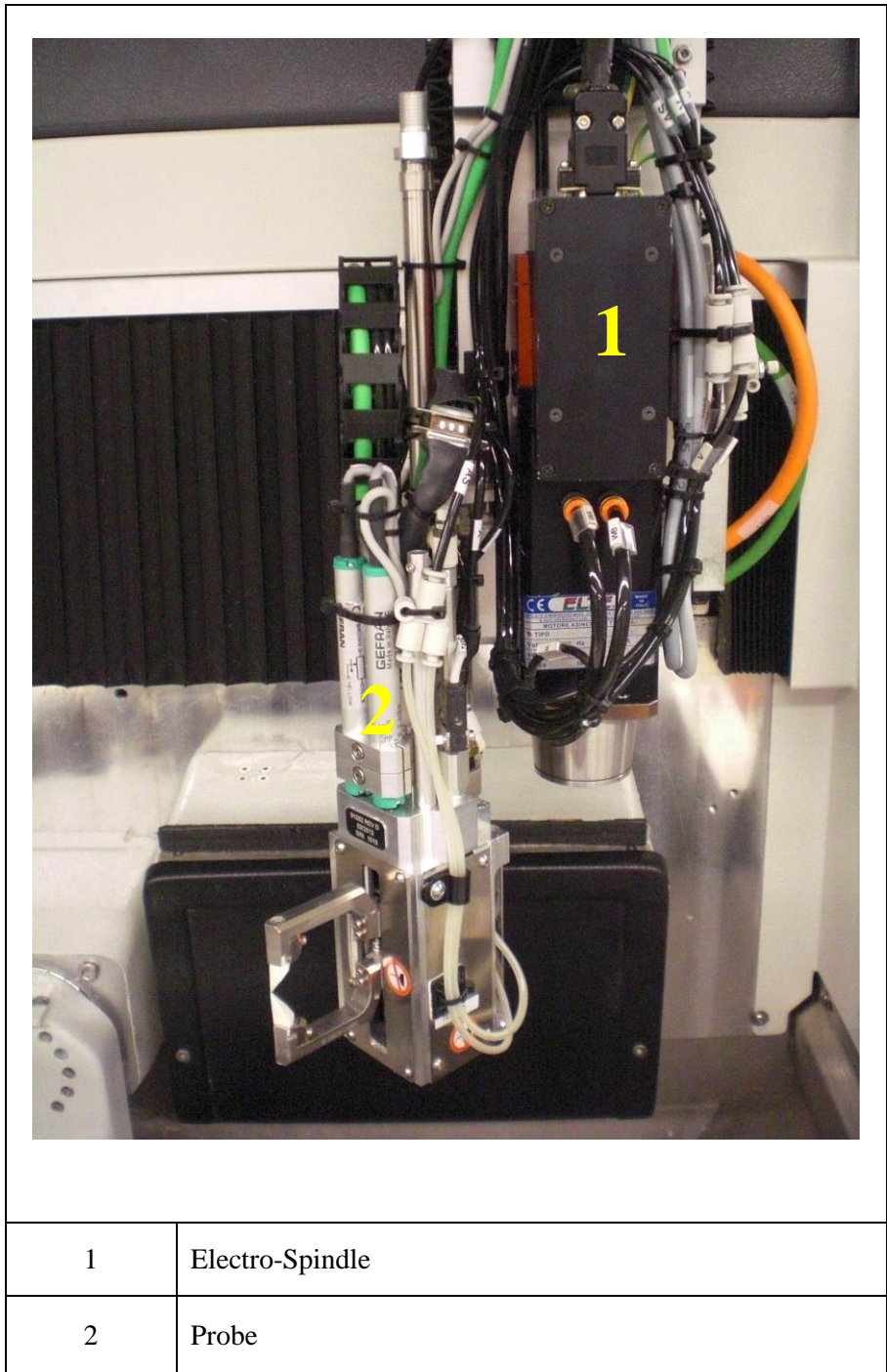
**Figure 1.3: Layout of machining elements.**



1	Lens clamp for securing blocked lens in chuck
2	Chuck for retaining blocked lens
3	Lens blow-off manifold
4	Compressed air and liquid supply lines for tool cooling
5	Compressed air adjustment for tool cooling
6	Air / liquid mixture adjustment nozzle for tool cooling

**Figure 1.4: Lens Blocking and Tool Cooling Area.**





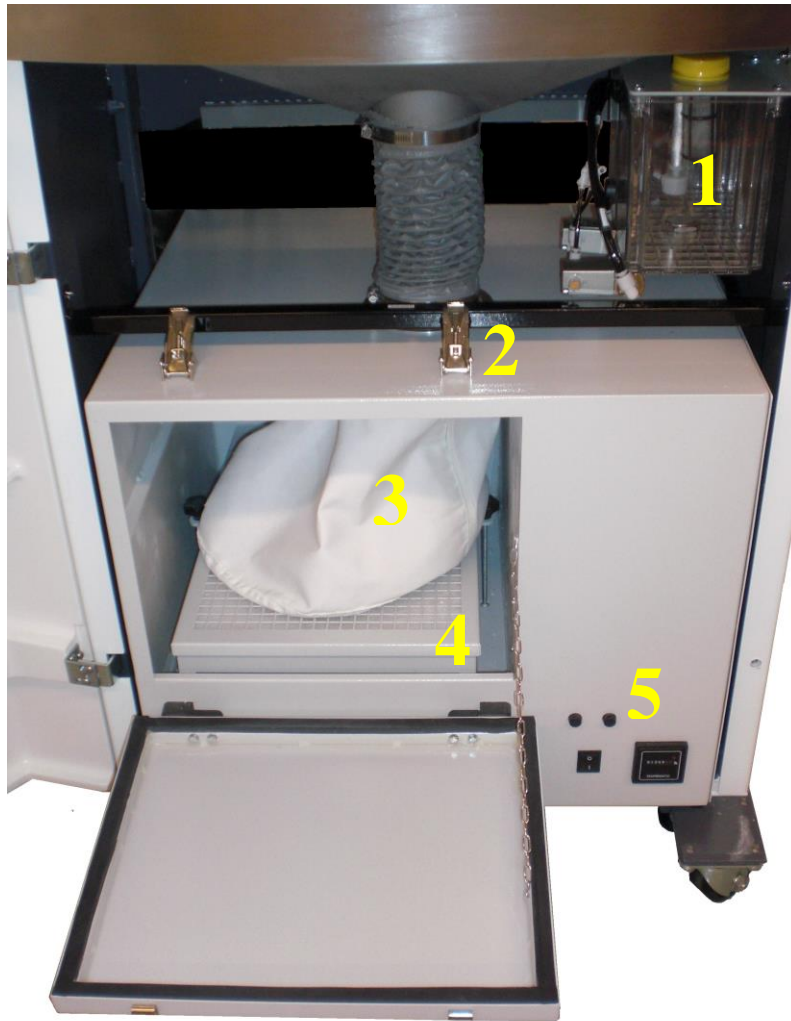
1	Electro-Spindle
2	Probe

**Figure 1.5: Electro-Spindle and Probe**



1	Spindle Cooling Unit
2	Compressed Air Filter Unit
3	Electrical Cabinet

**Figure 1.6: Rear of Machine**



1	Tool Coolant Reservoir
2	Vacuum Door Latches
3	Vacuum Bag
4	Vacuum Filters
5	Vacuum Switch and Fuses

**Figure 1.7: Vacuum and Polishing Coolant Reservoir**

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# Chapter 2: Operation

This chapter explains how to use the ES-curve edger in normal operations. Maintenance operations are described in a later chapter. The primary user interface to the edger is the touch screen, described in detail later in this chapter. For certain operations, however, a hand wheel controller is available for limited manual control.

## Operators

The edger should not be operated except by personnel familiar with the machine's operation. However, a high level of professional knowledge of opticianry is not required.

Any routine and periodic maintenance should be performed by specialized staff that fully understand the problems of safety highlighted in this manual.

The staff engaged for extraordinary maintenance (e.g., refurbishment or repair) must be highly professional and have sufficient experience regarding the management of machines with significant content of electronics.



### **ATTENTION !**

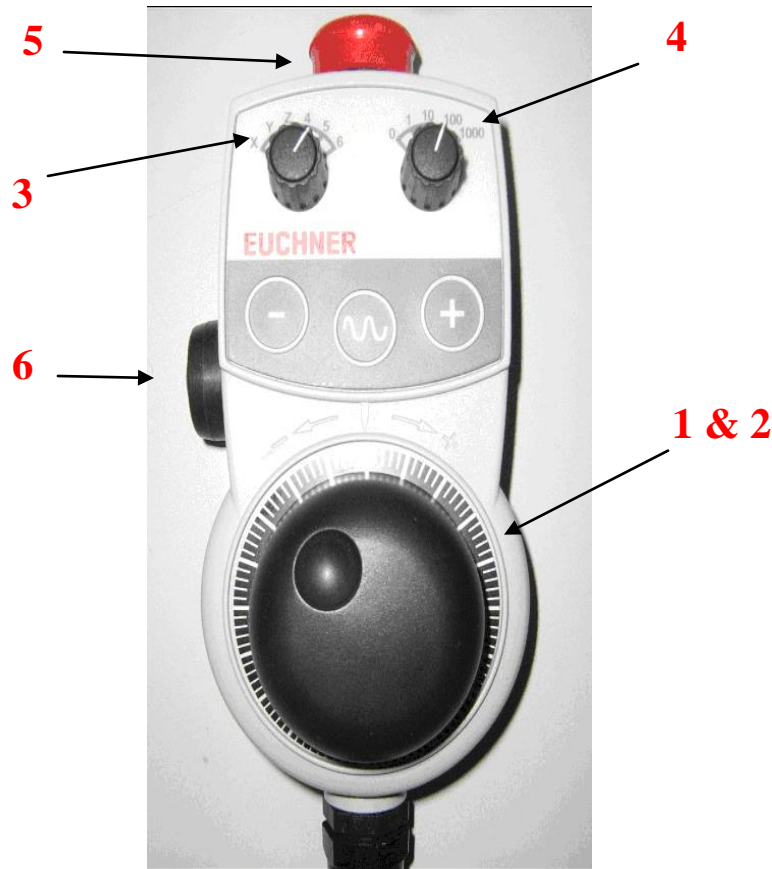
It is recommended that the After-Sales Service be contacted before performing extraordinary maintenance in the case of breakdown.

## Manual Hand Wheel Functioning Mode

The edger can be controlled manually using the hand wheel, decoupling the axes from the embedded processor. This must first be enabled through the Diagnostic Screen. Some typical operations used with this instrument are:

- Diagnostics
- Calibration of the edger
- Emergency stop
- Controlling feed rates

Figure 2.1 below describes the functions available on the hand wheel controller:



**Figure 2.1: Hand Wheel**

<b>1</b>	<b>Feed Rate, Adjustment of Working Speed</b> During a cycle, rotate clockwise to increase the speed of the axes up to 100%. Rotate counter-clockwise to decrease the machining speed to 0% (axes stopped).
<b>2</b>	<b>Hand Wheel Positioner</b> In manual mode, rotate clockwise to move the selected axis in a positive direction. Rotate counter-clockwise to move the selected axis in a negative direction. The selected axis is determined by the Axis Selection (3). The amount of movement is determined by the Pitch Selection (4).
<b>3</b>	<b>Axis Selection</b> Rotate the knob to select the axis on which to act manually. Select 4 for the B-axis and 5 for the C-axis.
<b>4</b>	<b>Pitch Selection</b> Rotate the knob to select the pitch which can be small, medium or large. If "0" is selected, the "+" and "-" buttons can be used to jog the selected axis.
<b>5</b>	<b>Emergency Stop (E-Stop) Button</b> Press this button to stop all motion immediately.
<b>6</b>	<b>Enable Button</b> Push this button half way to activate other buttons. Push in fully for E-stop function.

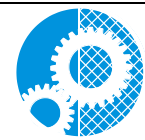
## Edging Scenario

The term “edging” is used in a general sense to refer to any or all of the machining operations provided by the ES-curve, except in cases where a specific operation needs to be identified (i.e., drilling, shelving, etc.).

The edging process may consist of the following steps. Specific actions mentioned here are described in detail later in this chapter.

- **Enter job information.** Job data includes, for example, data describing the shape of the edged lens, the specific operations to be performed, properties of the lens blank, shape and location of special features (holes, slots, shelves, etc.) and machining parameters (tools, feeds and speeds). In most laboratories, this data is downloaded electronically from a lab host computer. The user should check the data to assure that all needed data is present and accurate. Manual data entry is available to supply missing values or to override downloaded values. Downloading requires only that the user enter a job or tray number; the job data and a drawing of the edged lens appear on the display. Alternatively, the ES-curve allows frequently-run jobs to be stored internally and retrieved from memory when desired.
- **Mount workpiece.** When the access door opens, check the cutting chamber to be sure that there are no obstructions to machine movement. The blocked lens is placed (block down) on the chuck and the clamp is engaged to secure the lens with pressure from above. Some ES-curve edgers are equipped with robotic (automated) lens mounting. The operation of the automated subsystem is described elsewhere.
- **Edge.** The access door closes, the required tool is fetched from the tool store and the machining begins. The actual edging process may occur in multiple phases, depending on the specific job: Rough cutting, beveling, safety beveling, drilling, shelving, polishing, etc. The ES-curve selects the appropriate tool(s) for each phase; tools are automatically fetched and mounted as required.
- **Remove workpiece:** When the edging cycle is complete, the door opens and the workpiece may be removed. A recut cycle is available which allows small changes to be made to the shape to improve sizing, finish or fit. If the removed lens is the first of two for a job, the data for the second eye may be accessed.

## System Startup Checks



The ES-curve can only function with the cabinet closed. It is essential that the door and cabinet interlocks be checked periodically as described in the chapter on maintenance. The manufacturer disclaims any responsibility for any injury to persons caused by a lack of maintenance or disabling/removal of the protective interlocks.

Optimum operation of the edger requires that fluid reservoirs be maintained at appropriate levels and filters be cleaned periodically. Emergency stop buttons should be released prior to startup.

Requirements for fluid levels and filters are discussed in detail in the chapter on maintenance, but summarized here.

## Spindle Cooling System

The spindle operates at high speed and it must be cooled. A pump is used to circulate coolant to the spindle. The coolant storage tank must be replenished with de-ionized (or distilled) water mixed with a Propylene Glycol or Ethylene Glycol based antifreeze. Use an automotive type antifreeze that contains corrosion inhibitors. Do not use tap water because it may cause scaling. The final coolant liquid should be 85% de-ionized water, 15% concentrated antifreeze by volume. Mix 30% antifreeze and 70% de-ionized water if a 50/50 pre-diluted mix antifreeze is used. See the **ES-curve Maintenance Schedule** in this manual.

Before startup, check that the level of cooling liquid is within the established limits. As the system is a closed circuit, the level should not change appreciably in the short term. A continuing decrease in fluid level indicates there is a leak in the circuit. Call maintenance staff in order to troubleshoot the leak. Before restarting the machine, top-off the coolant until it reaches the desired level. The coolant must also be changed periodically.

## Cooling System for the Tool and Lens Being Machined

A reduction of the level of tool cooling liquid prevents the processing of some jobs. The tool/lens cooling liquid is not recycled, thus its level should be checked and topped-off before each startup or shift.

## Vacuum

Cleanliness of the operational area is provided by a vacuum located under the operational area. The bag and filters in the vacuum must be checked and changed periodically for optimum cleaning action.

## Compressed Air Supply

The compressed air filter can clog due to the accumulation of dirt in the operating environment. Before startup, always check and flush the compressed air filter. The filter must be replaced periodically depending on the operating environment.

# Graphic User Interface (GUI)

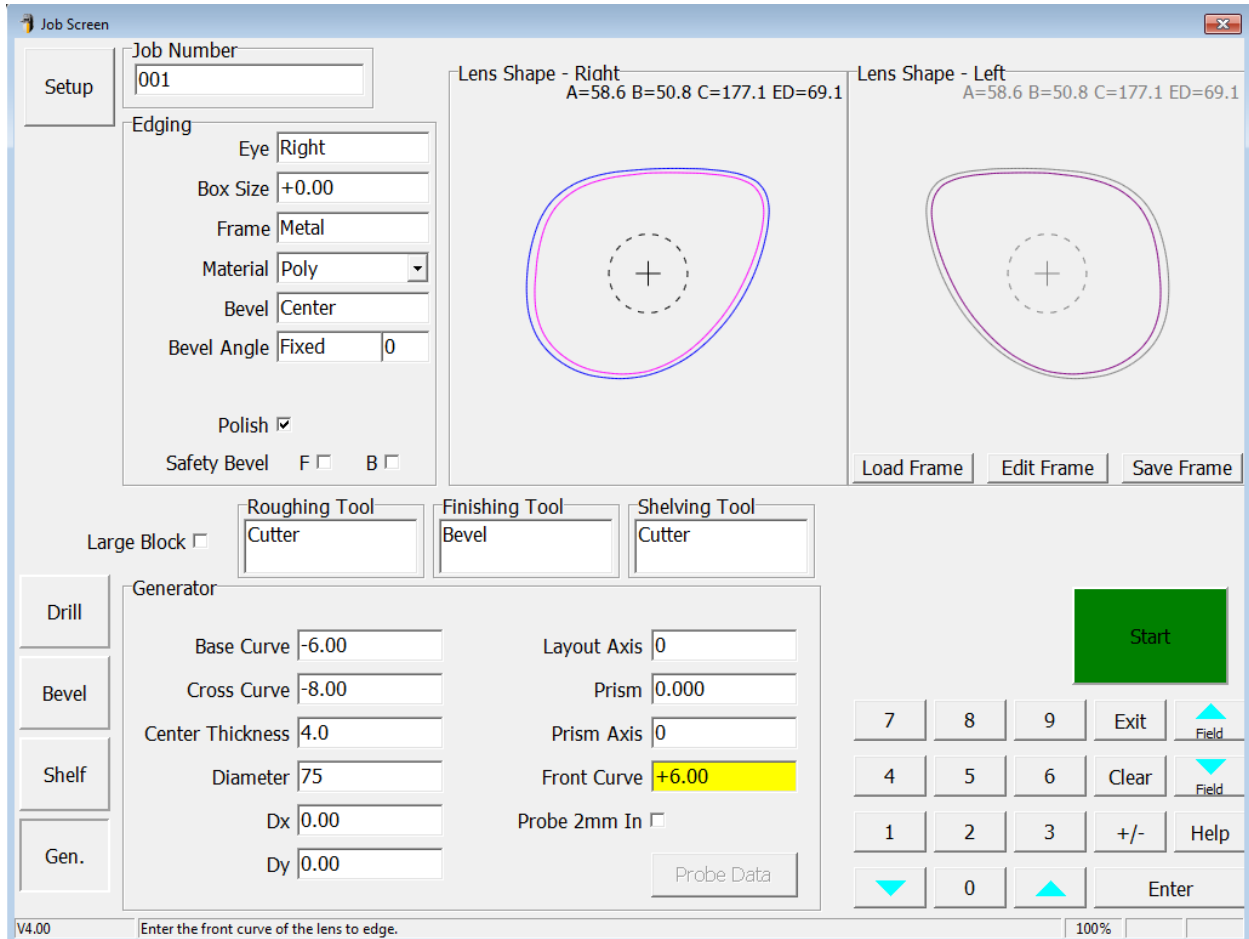
This section describes the screens used to configure and operate the edger. Each screen is shown in a figure and the use and significance of fields on the screen are described thereafter.

Many screens include a keypad that is used to enter commands and numeric values. Tap the keys lightly with the fingertip or a stylus designed for touch screen use. Do not use sharp objects such as pencil/pen points, paper clips, etc. on the touch screen. To enter a number, first tap the field that is to receive the input value; it will be shown in yellow. Press the **Clear** control to erase any existing entry. A newly-entered value may be made effective by tapping **Enter**, or by selecting a different field, or by tapping **Start**. Some screen controls act as toggles; repeatedly tapping a toggle control causes it to cycle through its allowed values. Tapping a check box enables or disables the associated option. Navigation between screens is accomplished via control buttons on the left side of the screen, or across the top.



## Job Screen

The **Job Screen** is the main screen used by the operator to make the machine work. From this screen the operator carries out all routine operations such as loading the program, modifying the program, starting the program, etc.



**Figure 2.2: Job Screen**

**Job Number:** Enter the number for the job data to be retrieved from the host computer. To recall a previously edged job from internal memory, press **Clear** and **Enter** to switch to internal memory mode. This will allow re-edging a job in recut mode to avoid probing. Press **Clear** and **Enter** again to switch to Host mode. This will override any Frame file data and only use information received from the Host. Press **Clear** and **Enter** again to return to normal job number entry.

### **Edging:**

- **Eye:** Specifies the current eye to be edged.
- **Box Size / Circ. Size:** Specifies a sizing offset for this eye (in mm). If the value is less than 65, the entry will be treated as an offset. If the value is greater than 65, the entry will be treated as the desired C-size. An offset will be applied to the Box Size or Circ. Size depending on the Size Dimension field on the **Setup Preference Screen**.
- **Frame:** Specifies the frame type for this job.
- **Material:** Specifies the lens material for this eye (Selected from **Material Screen**).

- **Bevel / Groove:** Specifies the location of the bevel or groove.
  - *Fixed:* Specifies the location of the bevel or groove from the lens front as a fixed distance. The adjacent modifier specifies the distance in millimeters.
  - *Percent:* Specifies the location of the bevel or groove from the lens front as a percentage of the finished edge thickness. The adjacent modifier specifies the percentage.
  - *Automatic:* Specifies the location of the bevel or groove from the lens front as a percentage of the finished edge thickness. The **Default Percent** on the *Setup Preference Screen* specifies the percentage. If the **Center Automatic** checkbox on the *Setup Preference Screen* is checked, automatic bevels will be centered in areas of the lens that are less than the width of the bevel. Automatic grooves will be centered in areas of the lens that are less than 2.0mm. The **Default Percent** will be applied everywhere else.
  - *Back:* Specifies the location of the bevel or groove from the lens back as a fixed distance. The adjacent modifier specifies the distance in millimeters.
  - *Center:* Specifies the location of the bevel or groove to be equidistant from the lens front and back.
  - *Base:* Specifies the bevel or groove to follow a curve that is placed a fixed distance from the lens front. The adjacent modifier specifies the curve to follow in diopters based on an index of 1.53. The second modifier specifies the minimum distance from the lens front in millimeters.
  - *Base%:* Specifies the bevel or groove to follow a curve that is placed as a percentage of the finished edge thickness. The adjacent modifier specifies the curve to follow in diopters based on an index of 1.53. The second modifier specifies the minimum distance from the lens front as a percentage.
- **Bevel Angle / Rimless Angle:** Specifies the finished edge angle.
  - *Dynamic:* Specifies the finished edge of the lens to be normal to the lens front at each point.
  - *Fixed:* Specifies the finished edge to be a constant angle from the lens front. The adjacent modifier specifies the angle in degrees.
- **Groove Angle:** Specifies the groove angle.
  - *Dynamic:* Specifies the groove angle to be normal to the lens front at each point.
  - *Fixed:* Specifies the groove to be a constant angle from the lens front. The adjacent modifier specifies the angle in degrees.
- **Polish:** If checked, then lens will be polished.
- **Safety Bevel:** If checked, then (F) front, or (B) back of lens will be safety beveled.
- **Large Block:** If checked, this will cause the probing cycle to adjust, to avoid interfering with the block.
- **Roughing Tool:** Specifies the tool to use for the roughing cycle.
- **Finishing Tool:** Specifies the tool or bevel style for the finishing cycle.
- **Shelving Tool:** Specifies the tool to use for the shelving cycle.
- **Load Frame:** Retrieve a stored frame from the frame database.
- **Edit Frame:** Edit the current frame on the *Job Screen*.
- **Save Frame:** Save the current frame to the frame database.

#### Keypad:

- **0-9:** Numeric entry
- **Exit:** Abort current data entry operation
- **Clear:** Clear entry of a highlighted field
- **Help:** Display help for current field
- **Enter:** Accept current value of field
- **+/-:** Change sign of current numeric field, or toggle value of non-numeric fields
- **Field ▲** Highlight field above existing field
- **Field ▼** Highlight field below existing field

- ▲: Increment value of existing field
- ▼: Decrement value of existing field
- **Start:** This will start cycle. Once cycle has started, this button will turn red and become a stop button.

*Note: In the lower left of the Job Screen are four navigation buttons: Drill, Bevel, Shelf and Gen. Tapping any of these will change the lower half of the Job Screen to allow parameters for the selected machining to be entered, as described below.*

**Generator:** These are standard lens parameters that describe the lens blank to be edged.

The screenshot shows a software window titled "Generator" with a sidebar on the left containing four buttons: "Drill", "Bevel", "Shelf", and "Gen.". The "Gen." button is selected. The main area contains the following parameters:

Base Curve	-6.00	Layout Axis	0
Cross Curve	-8.00	Prism	0.000
Center Thickness	4.0	Prism Axis	0
Diameter	75	Front Curve	+6.00
Dx	0.00	Probe 2mm In	<input type="checkbox"/>
Dy	0.00		

At the bottom right of the window is a button labeled "Probe Data".

**Figure 2.3: Lens Blank Specification Parameters**

- **Probe Data:** This will display the front and back probe data, along with the calculated bevel placement of the previous job. This may be useful for diagnostic purposes.
- **Probe 2mm In:** If checked, the probe tips will follow a path 2 millimeters inside of the normal location. Use this feature if you know the lens is marginally too small for cutout and want to avoid the probe tips falling off the lens.

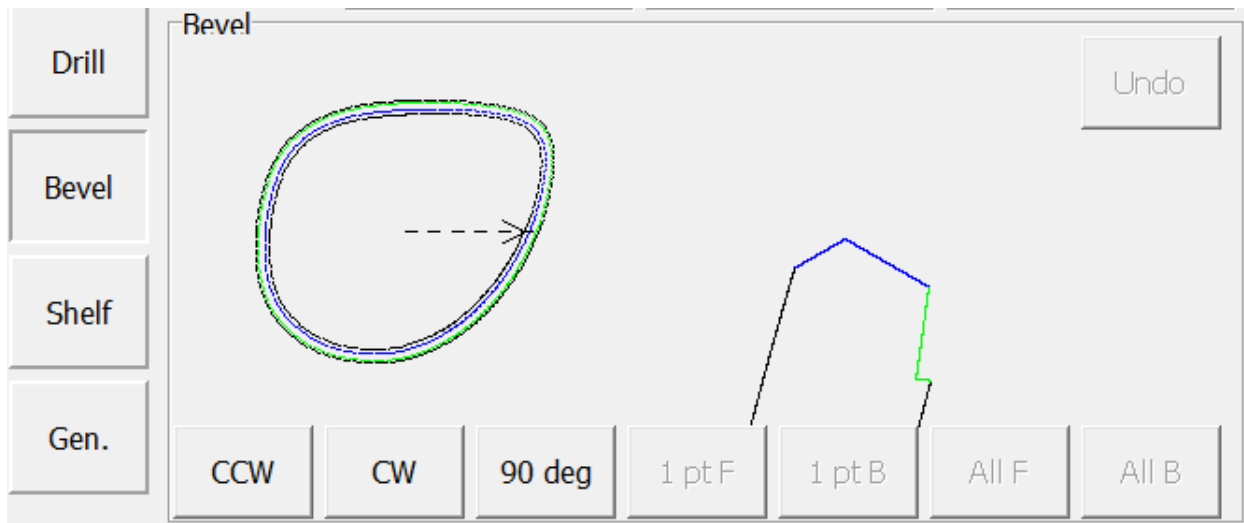
**Drill:** These are standard DCS parameters that describe drill features. An **Angle Mode** of *Normal to Front* will follow the curvature of the lens. *Specify Angle* allows the operator to enter the Angle.

Drill	Drill		Click on a feature on the screen to edit drill data.	
Bevel	Type	Hole	Angle Mode	Specify Angle
Shelf	Reference	Center	Angle	+13.0
Gen.	Start X	+21.00	Both Eyes <input checked="" type="checkbox"/>	
	Start Y	+15.00	Next Feature	
	Diameter	1.60	Add Feature	
	End X	+21.00	Remove Feature	
	End Y	+15.00	Prev. Feature	
	Depth	+0.00		

**Figure 2.4: Drill Specification Parameters**

**Drill** features can be created manually by entering the parameters, and then pressing **Add Feature**. An existing feature can be edited by touching the drill feature on the drawing, thus highlighting it. After highlighting the feature, it can be edited by entering new data, or removed by pressing **Remove Feature**. Subsequent features can be selected by pressing **Next Feature** or **Prev. Feature**.

**Bevel:** A picture of the lens is drawn to illustrate the position of bevel. The picture on the left shows the thickness of the lens and position of bevel around the lens. The picture on the right shows the cross-section of the lens that coincides with the arrow on the left. The pictures are based on generator data acquired before the cycle and are for general reference only; final lens profile may vary.

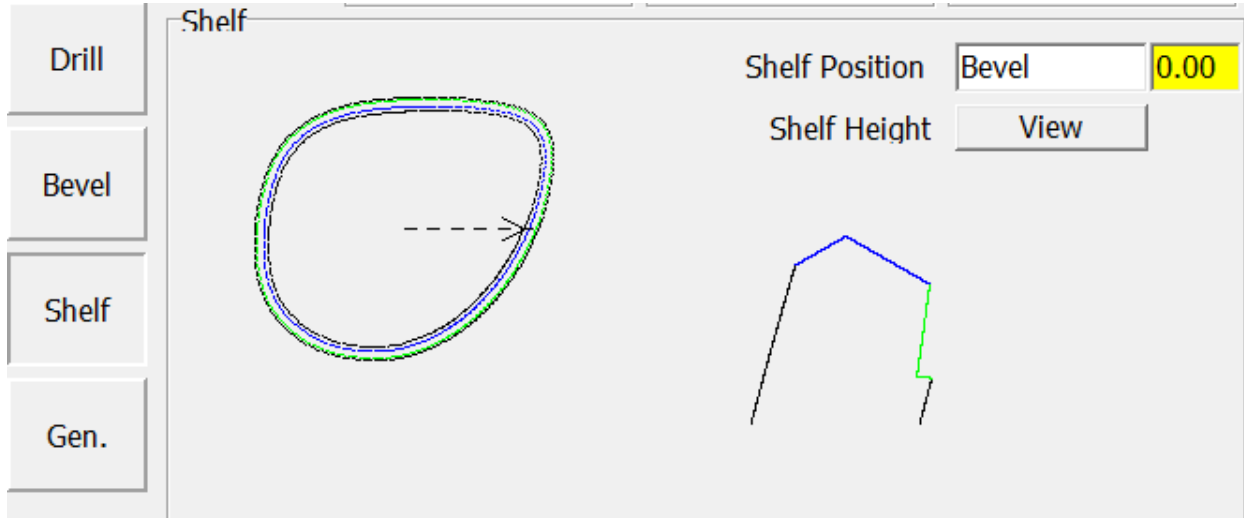


**Figure 2.5: Bevel Parameters**

- **CCW:** Rotates arrow counter-clockwise
- **CW:** Rotates arrow clockwise
- **90 deg:** Rotates arrow 90 degrees CCW
- **1ptF:** No function
- **1ptB:** No function
- **All F:** No function
- **All B:** No function
- **Undo:** No function

**Shelf:** A picture of the lens is drawn to illustrate the position of the shelf. The picture on the left shows the thickness of the lens and position of the shelf around the lens. The picture on the right shows the cross-section of the lens that coincides with the arrow on the left. The pictures are based on generator data acquired before the cycle and are for general reference only; final lens profile may vary.

*Note: Items displayed on the screen may vary based on shelving parameters selected.*



**Figure 2.6 Shelving Parameters**

- **Shelf Position:** Specifies the location of the shelf.
  - *Bevel / Groove:* Specifies the shelf to follow the bevel or groove. The adjacent modifier specifies the distance in millimeters from the back of the bevel or groove to the shelf.
  - *Fixed:* Specifies the shelf to follow the lens front. The adjacent modifier specifies the distance in millimeters from the lens front to the shelf.
  - *Base:* Specifies the shelf to follow a curve that is placed a fixed distance from the lens front. The adjacent modifier specifies the curve to follow in diopters based on an index of 1.53. The second modifier specifies the minimum distance from the lens front in millimeters.
- **Shelf Height:** Specifies the height of the shelf, or how far the shelf extends from the rimless edge of the lens in millimeters. This value may be specified for each quadrant.

## Setup Screen

The **Setup Screen** is accessed from the **Job Screen**, and allows the operator to modify preferences and cycle parameters, depending on the lens to be machined. Properties of tools and materials may be entered or edited. The **Setup Screen** is often the starting point to perform calibrations, change default material or frame settings, or clean the machine.

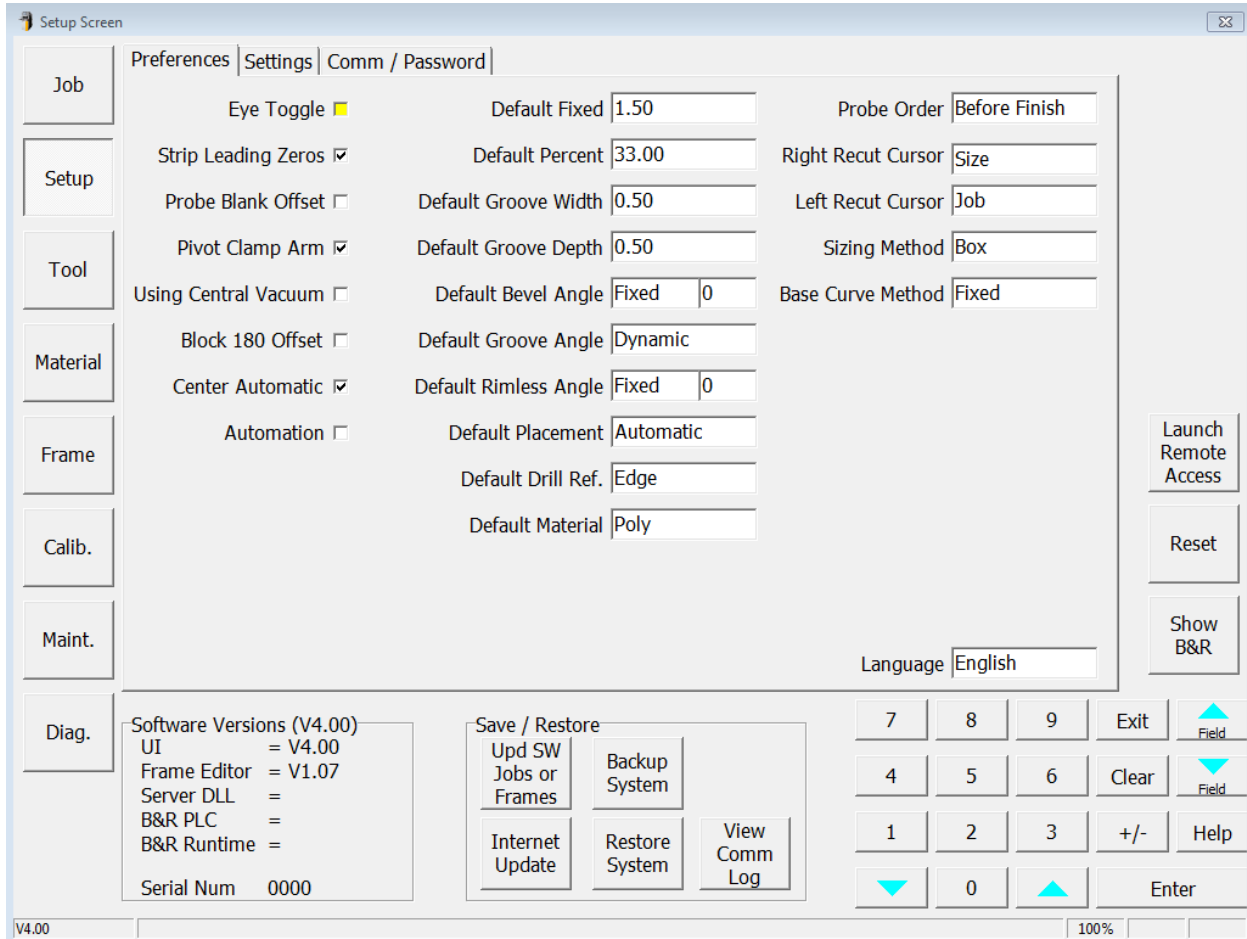


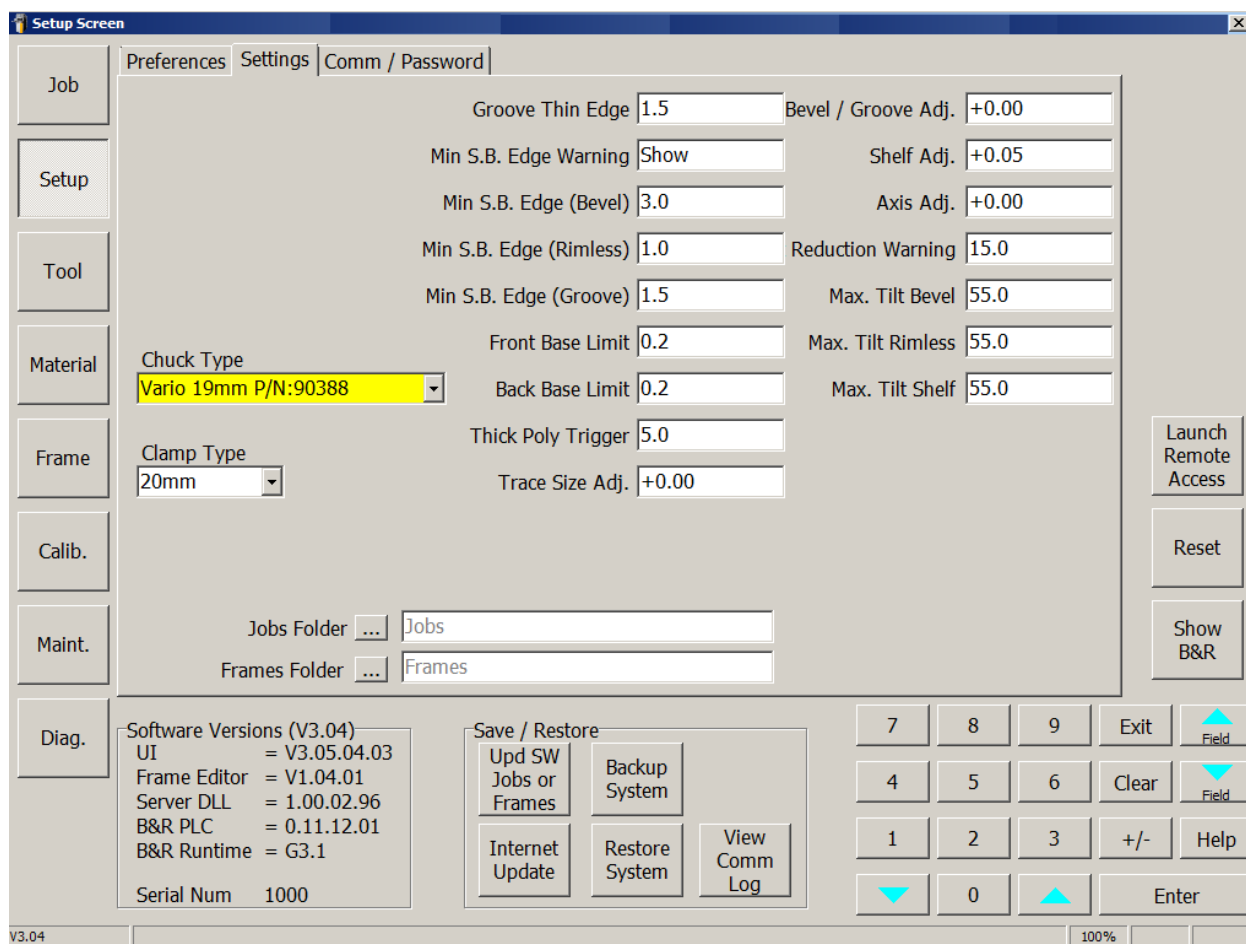
Figure 2.7: Setup Screen (Preferences)

### Preferences:

- **Eye Toggle:** If checked, then it will automatically toggle to the left eye after the right has been cut. The operator may still manually toggle back to the right eye for recut.
- **Strip Leading Zeros:** If checked, leading zeros will be stripped from job numbers requested from the host.
- **Probe Blank Offset:** If checked, this will invoke a special probing method to estimate the lens center. This will optimize the roughing cycle to prevent axis slippage due to blank decentration. Use this when blocking information is not available from the host.
- **Pivot Clamp Arm:** If checked, the clamp arm will pivot for each cycle in manual mode. If unchecked, the clamp arm will remain over the chuck to allow manual loading of steeper back curves.
- **Using Central Vacuum:** This should be checked if a central vacuum is connected to the edger.
- **Block 180 Offset:** If checked, this will offset the edging axis by 180 degrees.

- **Center Automatic:** If checked, automatic bevels will be centered in areas of the lens that are less than the width of the bevel. Automatic grooves will be centered in areas of the lens that are less than 2.0mm. The requested percentage will be applied everywhere else.
- **Automation:** If checked, unit will operate in automation mode. This field is not available if automation option is not installed.
- **Default Fixed:** Specifies the distance used for fixed placement if not provided by the host. This is the location of the bevel or groove from the lens front in millimeters.
- **Default Percent:** Specifies the percentage used for percent placement if not provided by the host. This is the location of the bevel or groove from the lens front as a percentage of the finished edge thickness.
- **Default Groove Width:** Specifies the groove width in millimeters if not provided by the host. If the requested width is less than the tool width, the groove will be equal to the tool width.
- **Default Groove Depth:** Specifies the groove depth in millimeters if not provided by the host. If the requested depth is exceeding the tool capabilities, the maximum possible depth will be processed.
- **Default Bevel Angle:** Specifies the bevel angle if not provided by the host.
  - *Dynamic:* Variable angle in degrees so that the tool stays normal to the lens front.
  - *Fixed:* Constant angle in degrees. The angle value in the adjacent modifier box will be used.
- **Default Groove Angle:** Specifies the groove angle if not provided by the host.
  - *Dynamic:* Variable angle in degrees so that the tool stays normal to the lens front.
  - *Fixed:* Constant angle in degrees. The angle value in the adjacent modifier box will be used.
- **Default Rimless Angle:** Specifies the rimless angle if not provided by the host.
  - *Dynamic:* Variable angle in degrees so that the tool stays normal to the lens front.
  - *Fixed:* Constant angle in degrees. The angle value in the adjacent modifier box will be used.
- **Default Placement:** Specifies method for bevel or groove placement if not provided by the host.
- **Default Drill Ref:** Specifies the default drill coordinates reference for newly created features on the Job Screen.
- **Default Material:** Specifies the default lens material to be used on the Job Screen for internal frames and jobs.
- **Probe Order:** Specifies the preferred method of probing. Before Rough: Probe before roughing. Before Finish: Probe before finishing. Both: Probe before roughing and again before finishing.
- **Right Recut Cursor:** Specifies the field where the cursor will appear after cutting a right eye. Toggle between job and size.
- **Left Recut Cursor:** Specifies the field where the cursor will appear after cutting a left eye. Toggle between job and size.
- **Sizing Method:** Specifies how the size field is used on the Job and Frame Screen.
  - *Box:* Size adjustment is applied to the box size.
  - *Circumference:* Size adjustment is applied to the circumference size.
- **Base Curve Method:** Specifies how the base bevel or groove modifier is interpreted when downloaded from the host.
  - *Fixed:* Will interpret the modifier to be a specified distance in millimeters from the front of the lens.
  - *Percent:* Will interpret the modifier to be a specified percentage from the front of the lens.
- **Language:** Specifies the language to use when displaying screen text.






**Figure 2.8: Setup Screen (Settings)**

### Settings:

- **Chuck Type:** Specifies the lens chuck currently installed in the machine. The software uses this parameter to avoid collision between the tool and clamping system.
- **Clamp Type:** Specifies the lens clamp currently installed in the machine. The software uses this parameter to avoid collision between the tool and clamping system.

	<p><b>Collision Danger</b></p> <p>To avoid a collision during edging, it is critical that the chuck type and clamp type values always reflect the actual parts installed in the machine.</p>
---	--

- **Groove Thin Edge:** Specifies the lens thickness in millimeters at which a warning is displayed when a lens is too thin to be grooved. The warning can be disabled in automation mode. A value of zero (0) will disable this feature.
- **Min S.B. Edge Warning:** Specifies whether to display warnings associated with safety bevel.
  - *Show:* Displays a warning if the lens is detected to be thinner than the **Min. S.B. Edge** for Bevel, Rimless, or Groove. The operator will have a choice to skip safety beveling, only safety bevel portions of the lens thicker than **Min. S.B. Edge**, or safety bevel everywhere.
  - *Don't Show:* No warning is displayed and the lens will only be safety beveled where the lens is thicker than **Min. S.B. Edge**. The warning can be disabled in automation mode.
- **Min S.B. Edge (Bevel):** Specifies the minimum beveled lens thickness at which a warning is displayed for safety beveling. A value of zero (0) will turn off the warning message.

- **Min S.B. Edge (Rimless):** Specifies the minimum rimless lens thickness at which a warning is displayed for safety beveling. A value of zero (0) will turn off the warning message.
- **Min S.B. Edge (Groove):** Specifies the minimum grooved lens thickness at which a warning is displayed for safety beveling. A value of zero (0) will turn off the warning message.
- **Front Base Limit:** Specifies minimum allowed distance in millimeters between the bevel or groove and the front of the lens for a base curve if the **Base Curve Method** is *Fixed*. This may override the Job Screen entry to fit the requested curve. A value of zero (0) will allow the bevel apex to touch the front of the lens.
- **Back Base Limit:** Specifies the minimum allowed distance in millimeters between the bevel or groove and the back of the lens for a base curve if the **Base Curve Method** is *Fixed*. This may override the Job Screen entry to fit the requested curve. A value of zero (0) will allow the bevel apex to touch the back of the lens.
- **Thick Poly Trigger:** Specifies the minimum unfinished edge thickness in millimeters to activate the *Thick Poly* material settings. If the host generator data shows any part of the lens edge to be greater than the value entered, it will change the material setting from *Poly* to *Thick Poly*. A value of zero (0) will disable this feature.
- **Trace Size Adj.:** Specifies the amount in millimeters to adjust the box size of downloaded shapes for frame fit. The size change is not visible on the **Job Screen**. This is set after the internal sizing of the edger is verified.
- **Bevel/Groove Adj.:** Specifies the amount in millimeters to shift the bevel (cutter and polish) and groove positions after calibration is complete. Increase this number to move the bevel and groove forward. Decrease this number to move the bevel and groove backward.
- **Shelf Adj.:** Specifies the amount in millimeters to adjust the shelf thickness after calibration is complete. Increase this number to increase the shelf thickness. Decrease this number to decrease the shelf thickness.
- **Axis Adj.:** Specifies the amount in degrees to adjust the shape axis after calibration is complete. Increase this number to rotate the shape clockwise. Decrease this number to rotate the shape counterclockwise.
- **Reduction Warning:** Specifies the amount by which the tilt angle may be reduced without prompting the user. The edger computes the maximum tilt angle for every job and tool set. If this angle results in a potential collision, it is automatically reduced to a safe value. If the reduction is greater than **Tilt Reduction**, the user is prompted to accept the change; else, the reduced tilt angle is accepted without prompting the user.
- **Max. Tilt Bevel:** Specifies the maximum tilt angle in degrees for a beveled lens. If a tilt value is requested beyond this limit, the tilt will be capped at this value.
- **Max. Tilt Rimless:** Specifies the maximum tilt angle in degrees for a rimless lens. If a tilt value is requested beyond this limit, the tilt will be capped at this value.
- **Max. Tilt Shelf:** Specifies the maximum tilt angle in degrees for a shelved lens. If a tilt value is requested beyond this limit, the tilt will be capped at this value.
- **Jobs Folder:** Identifies the location of stored job files.
- **Frames Folder:** Identifies the location of stored frame files.

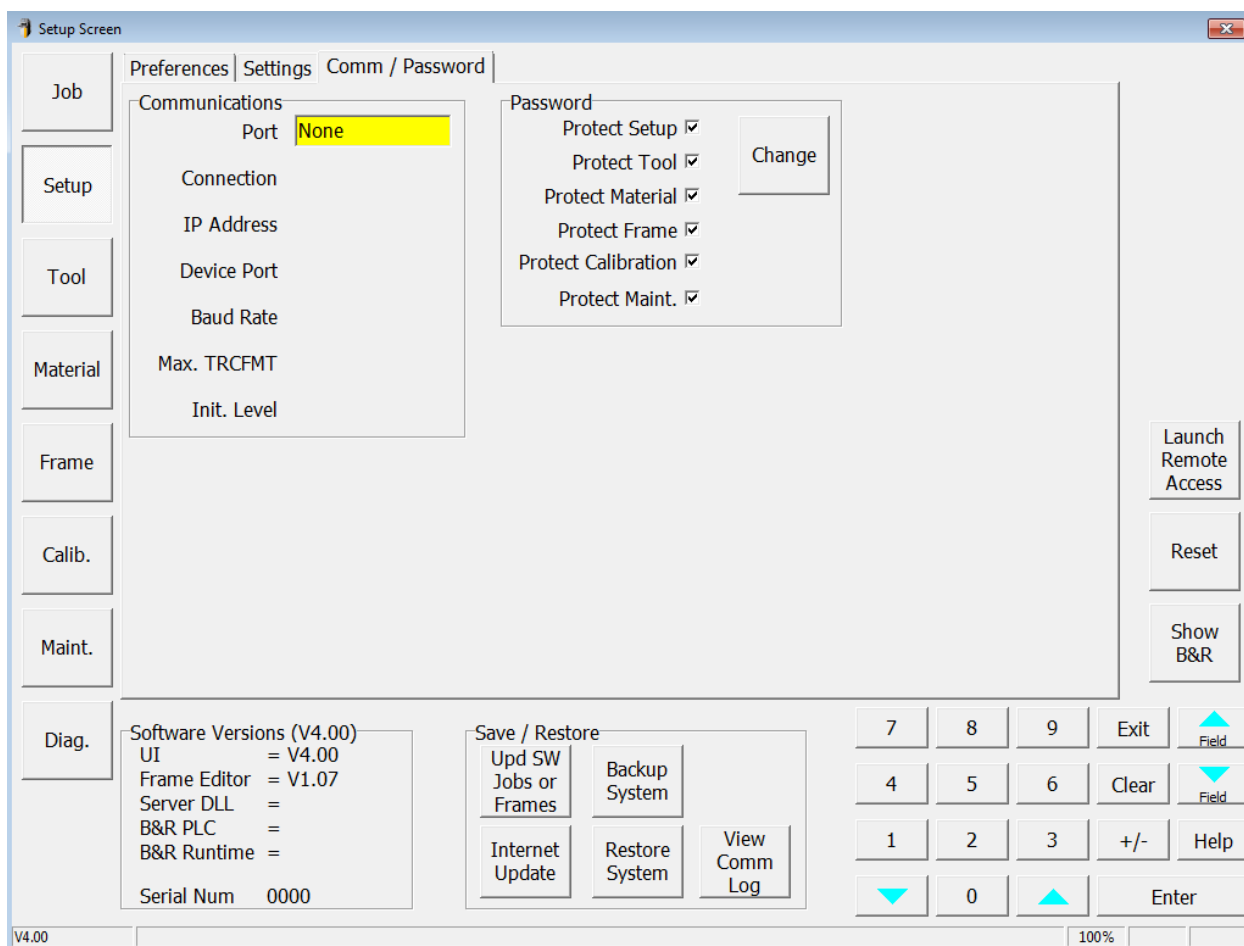


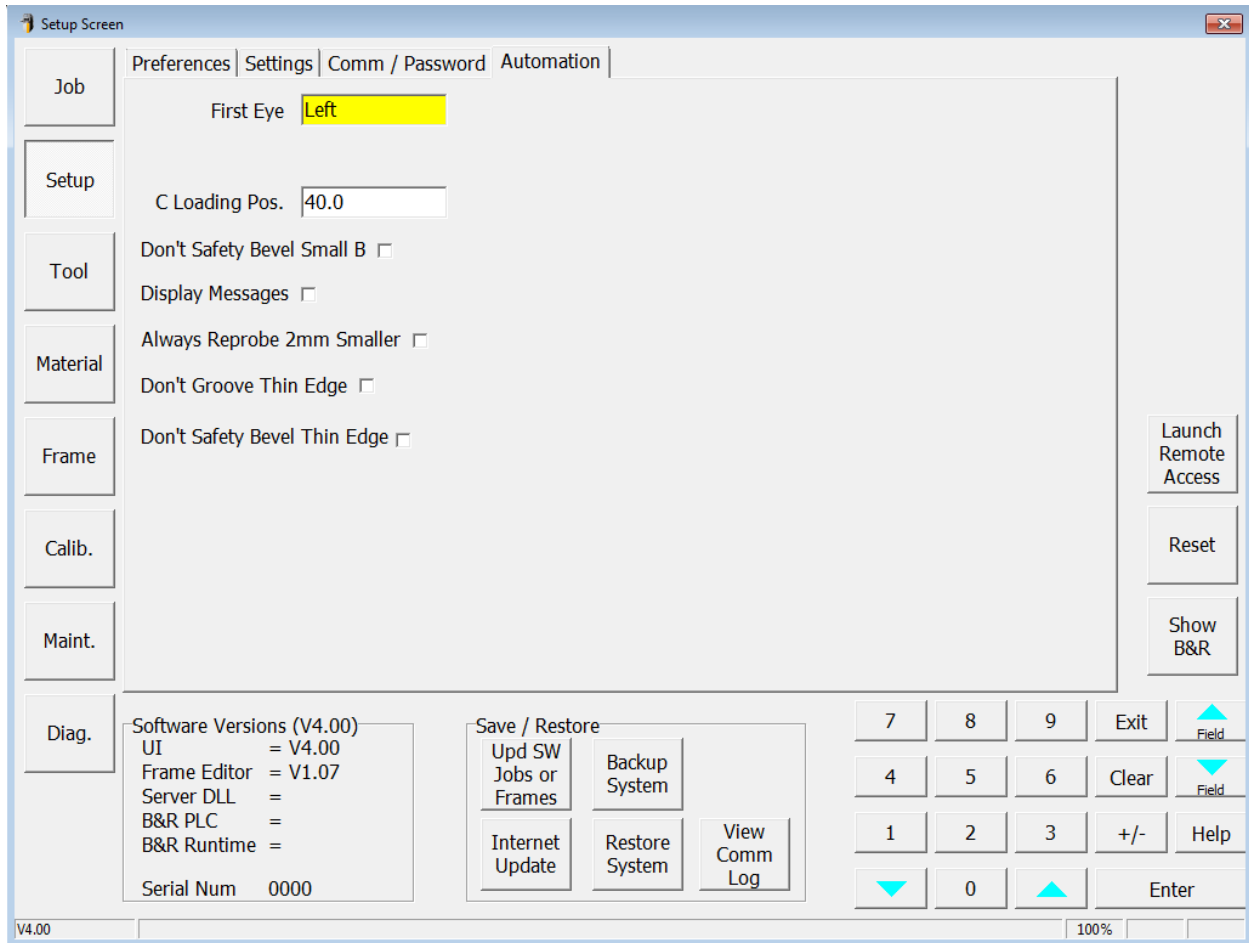
Figure 2.9: Setup Screen (Communications/Password)

### Communications:

- **Port:** Specifies if connection to host computer is *TCP/IP* (Ethernet) or *Com 2* (serial).
- **Connection:** If **Port** is set to *TCP/IP*, this specifies if connection method is *Autoconnect*, *Local*, or *Remote*.
- **IP Address:** Specifies the IP address for *Local* and *Remote* connection.
- **Device Port:** Specifies the device port for *Local* and *Remote* connection.
- **Baud Rate:** Specifies the baud rate for *Com 2* port. **Baud Rate** should match host computer.
- **Max TRCFMT:** Specifies the highest trace format requested by the ES-curve. A value of *1* is used to represent an ASCII packet. Values of *2* through *4* are used for increasingly compact binary encodings, with a value of *4* being the most efficient packed binary.
- **Init Level:** Set this value to *Auto* to automatically initialize with the host computer. Set to *None* to suppress initialization.

**Password:** If checked, the selected screen will require password entry to modify. Follow on-screen instructions to create a custom password.

- **Protect Setup:** If checked, a password will be required to modify the *Setup Screen*.
- **Protect Tool:** If checked, a password will be required to modify the *Tool Screen*.
- **Protect Material:** If checked, a password will be required to modify the *Material Screen*.
- **Protect Frame:** If checked, a password will be required to modify the *Frame Screen*.
- **Protect Calibration:** If checked, a password will be required to modify the *Calibration Screen*.
- **Protect Maint:** If checked, a password will be required to modify the *Maintenance Screen*.
- **Change:** Press this to change the password, and follow on-screen directions.



**Figure 2.10: Setup Screen (Automation)**

**Automation:**

- **First Eye:** Specifies if the first lens in the tray is a left or right eye.
- **C Loading Pos:** Specifies the position of the C-axis during automation lens loading (in degrees).
- **Display Messages:** If checked, all messages below will be displayed and the user will have to press **OK** or **Yes/No** to proceed. If unchecked, all messages will be suppressed and the default action will be executed.

**Warning Message**

Tilt reduction required to avoid collision  
 Requested base curve bevel does not fit  
 Lens is too thick to be drilled  
 Lens too small to be edged or safety beveled

**Default Action**

Reduce tilt to recommendation  
 Adjust base curve bevel to recommendation  
 Skip drilling phase  
 Skip edging of lens

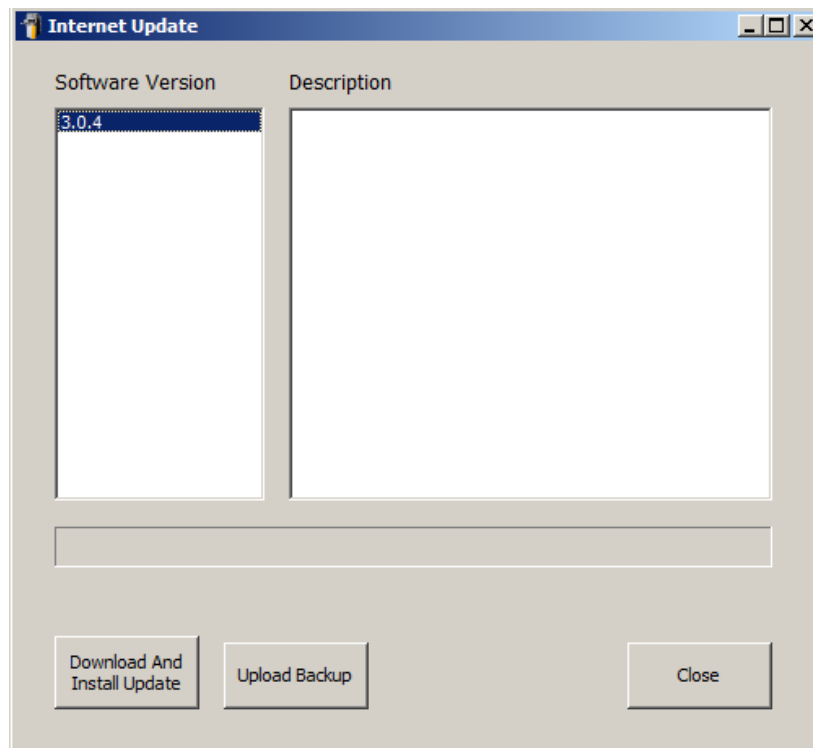
- **Always Reprobe 2mm Smaller:** Select this checkbox to always reprobe 2mm smaller if probe falls off.
- **Don't Groove Thin Edge:** Select this checkbox to skip grooving phase if edge is thinner than specified thickness.
- **Don't Safety Bevel Thin Edge:** Select this checkbox to skip safety beveling phase if edge is thinner than specified thickness.

(Miscellaneous - Appears on all Setup Screens.)

- **Software Versions:** These items are for display only.
- **Launch Remote Access:** Causes a program to execute which allows the ES-curve to communicate with a remote computer over the internet. This feature is primarily used by service personnel.
- **Reset:** This causes a hardware reset of the machine. This feature is primarily used by service personnel.
- **Show B & R:** Displays other screens not normally used by the operator. This feature is primarily used by service personnel.

**Save/Restore:**

- **Upd SW Jobs or Frames:** Update ES-curve operational software and internally stored jobs and frames data by placing appropriate USB key in USB port.
  - *Software:* Should be located in the root directory of USB (\ESCurveSetup-xxx.exe)
  - *Jobs:* Should be located in the “Jobs” directory of USB (\Jobs\xxx.job)
  - *Frames:* Should be located in the “Frames” directory of USB: (\Frames\xxx.frame)
- **Backup System:** Back up your system by placing USB key in USB port. The setup and log files are backed up to both the USB key and to the ES-curve's internal hard disk drive.
- **Internet Update:** Check for software versions available through the internet. An backup can also be uploaded to an FTP site for technical service support. When pressed, the following pop-up will appear.



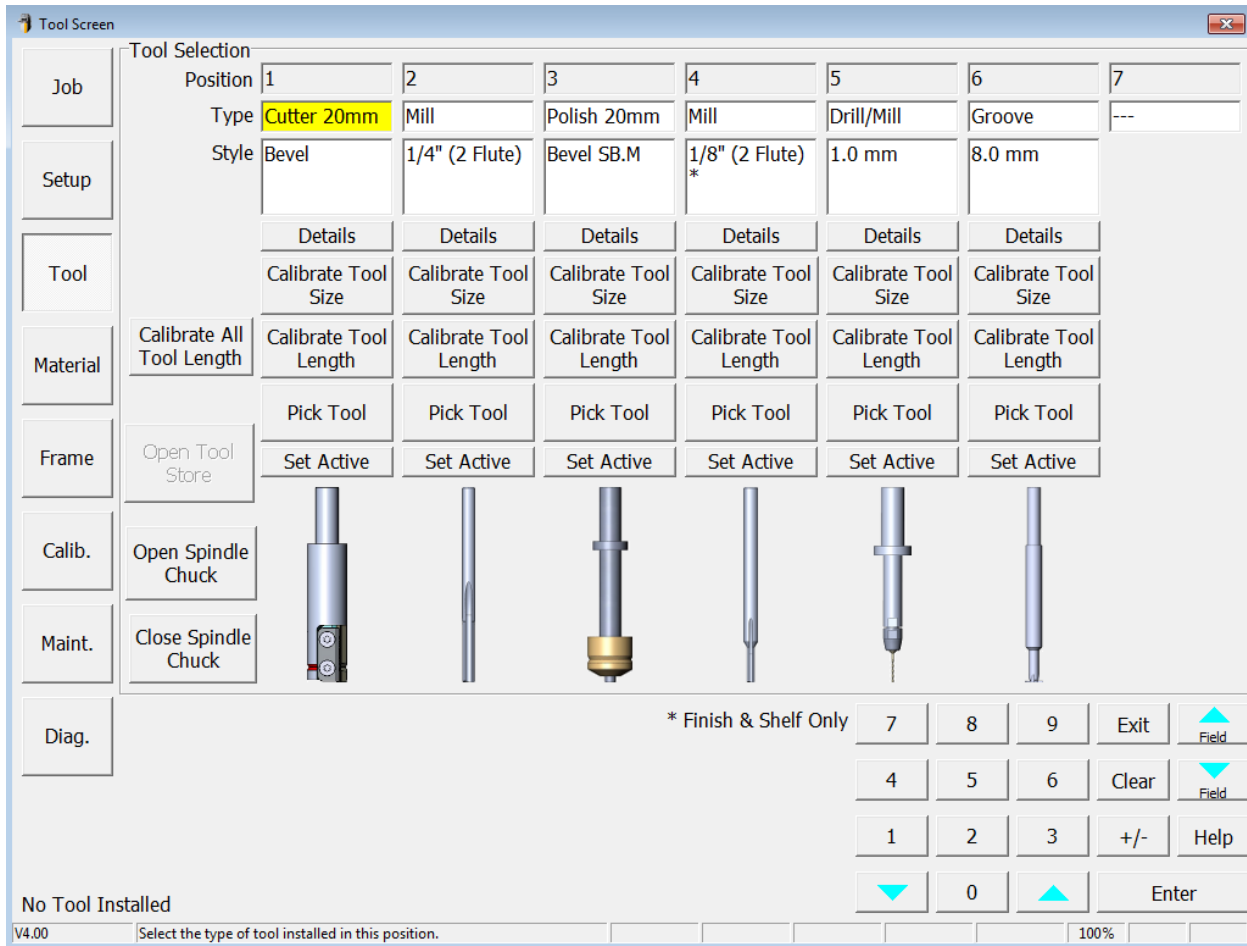
**Figure 2.11: Internet Update**

- **Download And Install Update:** Download and install the selected software version.
- **Upload Backup:** Upload a backup of the machine to the manufacturer FTP site. This backup contains information about machine settings and the last processed job. This can be analyzed by service personnel.
- **Restore System:** Restore setup values from the ES-curve's hard disk drive.
- **View Comm Log:** View the previous communication session with the host computer.

## Tool Screen

*Note: The position and type of tools may vary compared to what is described in this manual. The position of tools may be changed by the user.*

The **Tool Screen** is used every time a tool is introduced into the tool store. It is essential that the operator specify the features of the new tool, such as type, dimensions, not defined on Tool Screen, in order to prevent problems in the machining phase.



**Figure 2.12: Tool Screen**

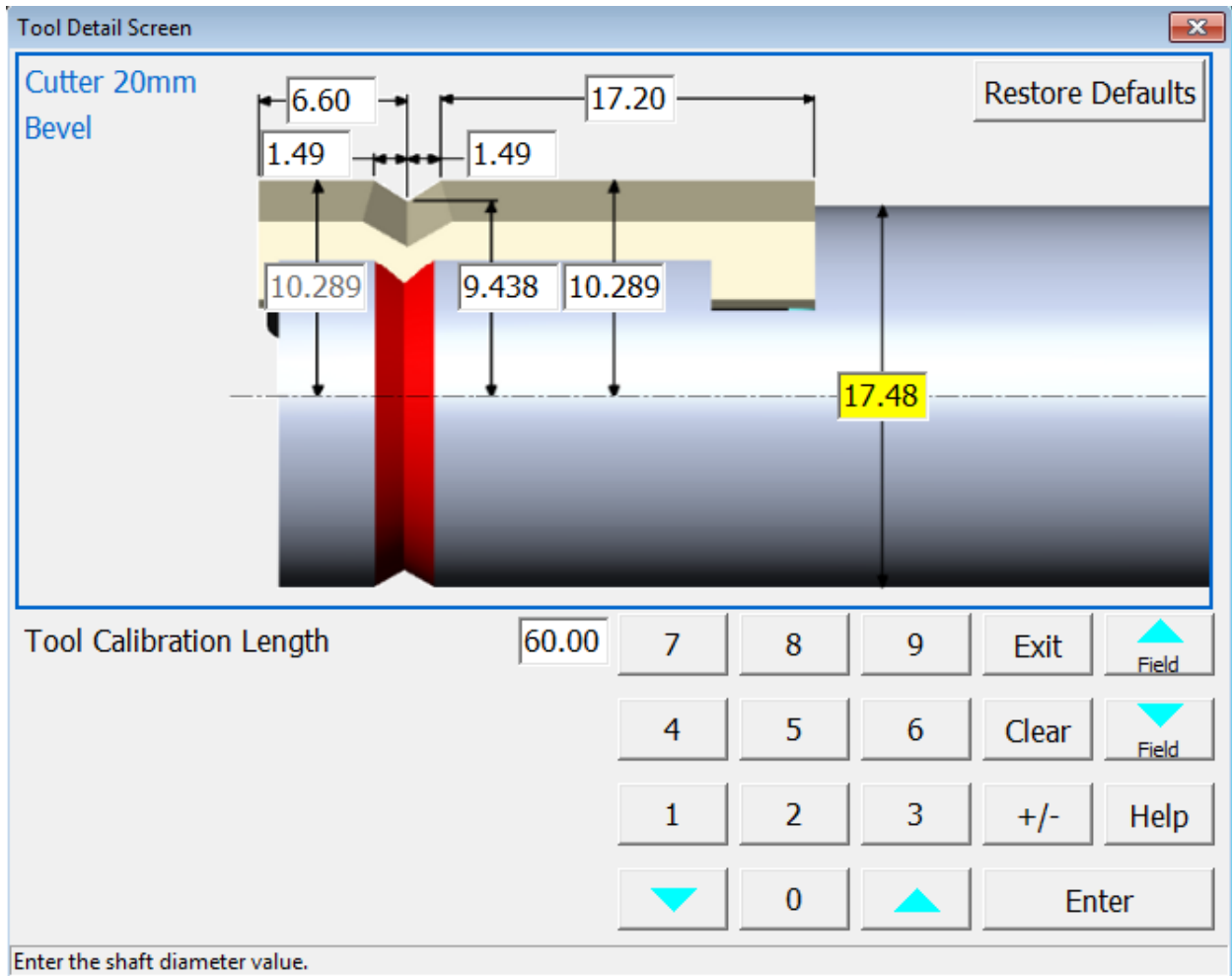
### **Tool Selection:**

*Note: Repeatedly tapping the Type or Style fields will cause them to cycle through their allowed values.*

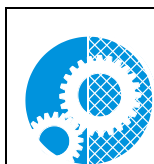
- **Position:** Tool Positions 1-7 as they are positioned in tool store. These values are not changeable.
- **Type:** Specifies the type of tool.
- **Style:** Specifies the style of tool of the selected type.
- **Details:** Opens a dialog box to allow entry of tool dimensions as defined by the distributor. See Figure 2.13.
- **Calibrate Tool Size:** Initiates routine to calibrate tool size. See Chapter 3 for more details.
- **Calibrate Tool Length:** Initiates auto-calibration routine to calibrate tool length of specified tool.

- **Calibrate All Tool Length:** Initiates auto-calibration routine to calibrate tool length of all tools.
- **Pick Tool:** Loads the requested tool into the spindle.
- **Set Active:** Specifies that this tool is currently mounted in the motor spindle.
- **Open Tool Store:** Opens the tool store to allow access to tools.
- **Open Spindle Chuck:** Opens the spindle chuck to manually change tools.
- **Close Spindle Chuck:** Closes the spindle chuck to manually change tools.
- **\*Finish & Shelf Only:** Identified mill tool is not appropriate for roughing.

The following figure is an example of a dialog box used to enter tool data. Tap a field whose value is to be entered or changed and use the numeric keypad to enter the new value. When done, press **Enter**, or change to a new field. (Dimensions shown are for illustration only.)








**Figure 2.13: Dialog Box for Entering Tool Data**



It is essential that the tool information entered into the *Tool Screen* (position, type, style, and the detailed dimensional data) match exactly the actual tools in the tools store. Any change of tools should prompt a rechecking of the entered data, plus a calibration of the new or changed tool.






Calibration of tool length and tool size is required whenever a tool is replaced.

A variety of tools are available to accomplish various tasks. The following table lists these tools and their use.



Tool Type	Tool Style	Available Functions	Primary Use	Secondary Use	When to Use	
Cutter 20mm		Bevel*	Rough Finish Shelf	Roughing and Finishing of standard bevels	Shelving of beveled lenses	All standard work; Shelving with large shape radii and shelf depth < 4mm. Shelf thinning may occur when shelf depth is > 4mm.  Max outside Radius = 10mm
		Hi-Wrap 1, Hi-Wrap 2, Shallow, Fendall, NBA, NBA Flat, Hilco RX, Hilco A2, Liberty, T-bevel	Rough Finish Shelf	Roughing and Finishing of specialty bevel profiles	Shelving of specialty profile lenses	All specialty profile work; Shelving with large shape radii and shelf depth < 4mm. Shelf thinning may occur when shelf depth is > 4mm.  Max outside Radius = 10mm
Mill		1/4" 2-flute*	Rough Carving Finish Shelf	Shelving of all types of lenses	Rough carving	Carving; Finishing and Shelving of medium shape and shelf radii and for shelf depths > 4mm to avoid thinning of shelf edge.  Max outside Radius = 3.2mm
		1/4" Premium XL 2-flute	Rough Carving Finish Shelf	Shelving of all types of lenses	Rough carving	Same as 1/4" 2-flute, but longer life.
		1/8"*	Finish Shelf	Finishing of specialty lenses	Shelving of small radii (hooks)	Finishing and Shelving of small radii. Increased cycle time if Shelf depth > 4mm  Max outside Radius = 1.6mm

\*Indicates standard with machine



Tool Type	Tool Style	Available Functions	Primary Use	Secondary Use	When to Use	
Polish 20mm		Bevel SB. F*	Polish Safety Bevel	Fine grit polishing for best finish		Primarily for CR-39, Hi-Index polishing
		Bevel SB. M*	Polish Safety Bevel	Medium grit polishing for good finish		Primarily for Poly, Trivex polishing
		High Wrap 2	Polish Safety Bevel	Medium grit, High Wrap 2 bevel profile		All materials
		Shallow	Polish Safety Bevel	Medium grit, Shallow bevel profile		All materials
Groove		Premium XL	Groove	Standard carbide groove cutter		All groove work.

\*Indicates standard with machine

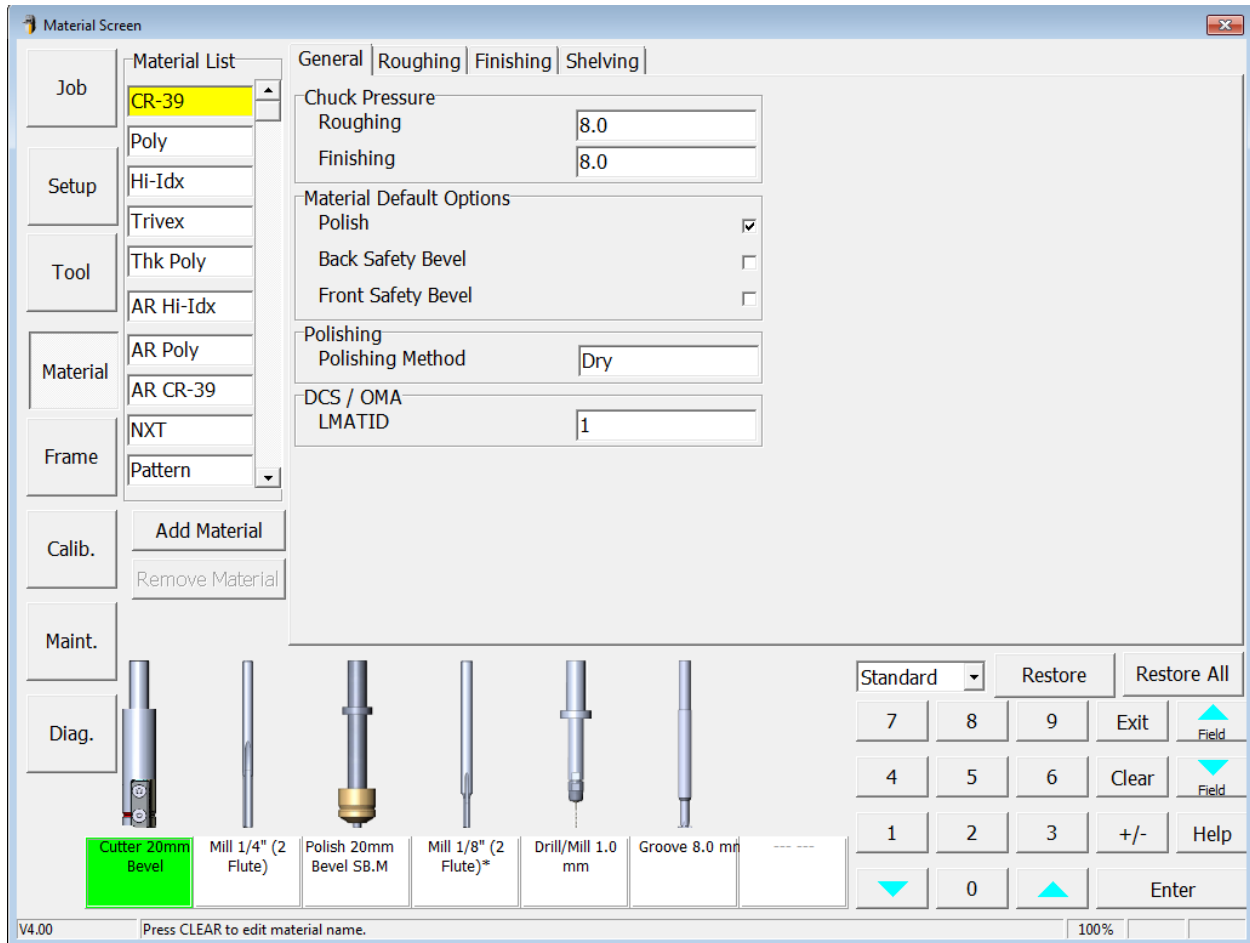
Tool Type	Tool Style	Available Functions	Primary Use	Secondary Use	When to Use	
Drill / Mill		1.0mm*	Drill	Standard drill tool to create holes 1-5mm		Drilling all holes and slots
Helix		Bevel	Rough Finish Safety Bevel	Roughing, Finishing and Safety Beveling with the same tool		High production environment with no (very little) polish work. Increases machine throughput.

\*Indicates standard with machine

## Material Screen

The ES-curve can machine all resin materials used for ophthalmic lenses. However, each combination of tool and material may require different operating parameters for optimum performance. The **Material Screen** permits operating parameters for each combination of tool and material to be entered and edited. When you specify the material on the **Job Screen**, the ES-curve edges according to the speeds and other data listed on the **Material Screen**. There is a General tab, plus additional tabs for each cycle phase. To edit a field, first select the desired tool and material. The General tab provides data which is only material dependent not associated with any specific tool.

### General:



**Figure 2.14: Material Screen, General Tab For All Tool**

**Material List:** The list of material as displayed on the **Job Screen**.

**Add Material:** Add additional material types. A pop-up will appear to select the default feeds and speeds based on an existing material type. The new material will have the name “New” which can then be edited by selecting the name. Use the scroll bar at right to access more than 10 materials.

**Remove Material:** Delete the selected material.

**Restore:** Restore the selected value to the default settings of *Standard* or *Premium*.

**Restore All:** Restore all values on the selected tab to the default settings of *Standard* or *Premium*.

### Chuck Pressure:

- **Roughing:** The force the machine exerts in clamping the lens during roughing. For lenses with Anti-reflective Coatings (AR), the pressure can be reduced to prevent cracking or crazing of the lens. Multiply entered value times 10 to get approximate force in pounds. (e.g. 6 x 10 = 60lbs.).

- **Finishing:** The force the machine exerts in clamping the lens during finishing. For lenses with Anti-reflective Coatings (AR), the pressure can be reduced to prevent cracking or crazing of the lens. Multiply entered value times 10 to get approximate force in pounds. (e.g. 6 x 10 = 60lbs.).

**Material Default Options:**

- **Polish:** This option indicates whether the polishing cycle is indicated as a default for a specific material.
- **Back Safety Bevel:** This option indicates whether the safety bevel cycle is indicated as a default for a specific material.
- **Front Safety Bevel:** This option indicates whether the front safety bevel cycle is indicated as a default for a specific material.

**Polishing:**

- **Polish Method:** This value toggles between *Wet*, *Dry* or *Dry/Wet*, depending on what is selected on the polish wheel material screens. Tells the edger which polishing method to use for a specific material.

**DCS/OMA:**

- **LMATID:** Enter the LMATID value for this material. This value needs to match the LMATID value sent by the host software for this material.

**20mm Cutter (Roughing):**

General	Roughing	Finishing	Shelving
<b>General</b>			
Cooling	Air		
Tool RPM x1000	20		
<b>Spiral</b>			
Feed (mm/rot)	12.000		
Speed (m/min)	6.00		
Method	2 Phase		
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)	1.500000		
First Cut Feed (mm/rot)	0.0010		
First Cut Speed (m/min)	0.00		
Skim Cut Feed (mm/rot)	0.001		
Skim Cut Speed (m/min)	0.00		
<b>Spiral-In</b>			
Distance (mm)	5.00		
Speed (m/min)	0.00		
Angle (deg)	5.0		
Contact Angle (deg)	95.0		
<b>Spiral-Out</b>			
Distance (mm)	0.50		
Speed (m/min)	0.00		
Angle (deg)	0.0		

**Figure 2.15: Material Screen, 20mm Cutter-Bevel (Roughing Tab)**

**General:**

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool.

**Spiral:**

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.
  - Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.
  - 2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

**2 Phases Spiral Options** (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

**Spiral-In:**

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

**Spiral-Out:**

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

## 20mm Cutter (Finishing):

General	Roughing	Finishing	Shelving
<b>General</b>			
Cooling	Air		
Tool RPM x1000	20		
Take Off (mm)	0.50		
<b>Spiral</b>			
Feed (mm/rot)	5.000		
Speed (m/min)	3.50		
Method	2 Phase		
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)	1.500000		
First Cut Feed (mm/rot)	0.0010		
First Cut Speed (m/min)	0.00		
Skim Cut Feed (mm/rot)	0.001		
Skim Cut Speed (m/min)	0.00		
<b>Spiral-In</b>			
Distance (mm)	0.50		
Speed (m/min)	0.00		
Angle (deg)	0.0		
Contact Angle (deg)	90.0		
<b>Spiral-Out</b>			
Distance (mm)	0.10		
Speed (m/min)	0.00		
Angle (deg)	20.0		

Figure 2.16: Material Screen, 20mm Cutter-Bevel (Finishing Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool.
- **Take Off (mm):** Specifies the amount of Material that will be removed during the complete phase. Number is radial.

### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.
  - Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.
  - 2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

### 2 Phases Spiral Options (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

### Spiral-In:

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

### Spiral-Out:

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

### 20mm Cutter (Shelving):

General	Roughing	Finishing	Shelving
<b>General</b>			
Cooling			Air
Tool RPM x1000			20
<b>Spiral</b>			
Feed (mm/rot)			1.500
Speed (m/min)			0.60
Method			2 Phase
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)			0.200000
Skim Cut Take-Off Z(mm)			0.100000
First Cut Feed (mm/rot)			0.7500
First Cut Speed (m/min)			0.60
Skim Cut Feed (mm/rot)			5.000
Skim Cut Speed (m/min)			0.20
<b>Spiral-In</b>			
Distance (mm)			0.50
Speed (m/min)			0.00
Angle (deg)			0.0
Contact Angle (deg)			95.0
<b>Spiral-Out</b>			
Distance (mm)			0.50
Speed (m/min)			15.00
Angle (deg)			0.0
Lift Off (mm)			0.50
<b>Segmented Shelf Options</b>			
CW Feed (mm/rot)			1.500
CW Speed (m/min)			0.60
Feed Z Offset (mm/rot)			-0.50
CCW Feed (mm/rot)			-0.500
CCW Speed (m/min)			15.00
Path Extension (mm)			3.00

Figure 2.17: Material Screen, 20mm Cutter-Bevel (Shelving Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool.

### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.

- **Method:**  
**Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.  
**Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.  
**2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

**2 Phases Spiral Options** (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **Skim Cut Take-Off Z (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in Z-Axis direction).
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

**Spiral-In:**

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

**Spiral-Out:**

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.
- **Lift Off (mm):** Specifies an Offset to the tool's Z-Axis-Position after reaching the Exit Point.

**Segmented Shelf Options:**

- **CW Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the clockwise cut. Number is radial.
- **CW Speed (m/min):** Specifies the Linear Speed of the tool on the lens for the clockwise cut.
- **Feed Z Offset (mm/rot):** Specifies an Offset to the tool's Z-Axis-Position above the desired shelf. A positive value will offset the tool position only in the clockwise direction. A negative value will offset the tool position only in the counter clockwise direction.
- **CCW Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the counter clockwise cut. Number is radial. A negative number will move the tool away by that radial amount from the previous clockwise tool path.
- **CCW Speed (m/min):** Specifies the Linear Speed of the tool on the lens for the counter clockwise cut.
- **Path Extension (mm):** Specifies the distance to extend the Shelf toolpath beyond the shape.

## Mill (Carving) – Only If Applicable:

General	Carving	Finishing	Shelving
General			
Cooling		Air	
Tool RPM x1000		30	
Spiral			
Feed Z (mm/rot)		23.000	
Speed (m/min)		0.20	
Method		Carving	

Figure 2.18: Material Screen, Mill – 1/4" 2 Flute (Carving Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool.

### Spiral:

- **Feed Z (mm/rot):** Specifies the depth of the cut per carving revolution. If the lens thickness exceeds the specified depth, additional revolution(s) may be necessary.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - **Carving:** The Tool cuts out the shape in several large pieces.



## Mill (Finishing):

General	Carving	Finishing	Shelving
<b>General</b>			
Cooling	Air		
Tool RPM x1000	20		
Take Off (mm)	0.50		
<b>Spiral</b>			
Feed (mm/rot)	0.250		
Speed (m/min)	6.00		
Method	2 Phase		
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)	0.000001		
First Cut Feed (mm/rot)	0.2500		
First Cut Speed (m/min)	3.00		
Skim Cut Feed (mm/rot)	5.000		
Skim Cut Speed (m/min)	8.00		
<b>Spiral-In</b>			
Distance (mm)	0.50		
Speed (m/min)	0.00		
Angle (deg)	0.0		
Contact Angle (deg)	90.0		
<b>Spiral-Out</b>			
Distance (mm)	0.10		
Speed (m/min)	0.00		
Angle (deg)	20.0		

Figure 2.19: Material Screen, Mill – ¼” 2 Flute (Finishing Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool.
- **Take Off (mm):** Specifies the amount of Material that will be removed during the complete phase. Number is radial.

### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**  
**Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.  
**Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.  
**2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

### 2 Phases Spiral Options (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

### Spiral-In:

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

### Spiral-Out:

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

### Mill (Shelving):

General	Carving	Finishing	Shelving
<b>General</b>			
Cooling	Air		
Tool RPM x1000	30		
<b>Spiral</b>			
Feed (mm/rot)	2.500		
Speed (m/min)	1.25		
Method	2 Phase		
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)	1.500000		
Skim Cut Take-Off Z(mm)	0.000000		
First Cut Feed (mm/rot)	0.0010		
First Cut Speed (m/min)	0.00		
Skim Cut Feed (mm/rot)	0.001		
Skim Cut Speed (m/min)	0.00		
<b>Spiral-In</b>			
Distance (mm)	0.50		
Speed (m/min)	0.00		
Angle (deg)	0.0		
Contact Angle (deg)	95.0		
<b>Spiral-Out</b>			
Distance (mm)	0.50		
Speed (m/min)	15.00		
Angle (deg)	0.0		
Lift Off (mm)	0.50		
<b>Segmented Shelf Options</b>			
CW Feed (mm/rot)	2.500		
CW Speed (m/min)	1.25		
Feed Z Offset (mm/rot)	-0.50		
CCW Feed (mm/rot)	-0.500		
CCW Speed (m/min)	15.00		
Path Extension (mm)	3.00		

Figure 2.20: Material Screen, Mill – ¼” 2 Flute (Shelving Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool. For Cutter & Polisher the valid range is: 5-20 RPM, for all other tools the valid range is 5-30 RPM).

### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.

- **Method:**  
**Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.  
**Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.  
**2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

**2 Phases Spiral Options** (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **Skim Cut Take-Off Z (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in Z-Axis direction).
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

**Spiral-In:**

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

**Spiral-Out:**

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.
- **Lift Off (mm):** Specifies an Offset to the tool's Z-Axis-Position after reaching the Exit Point.

**Segmented Shelf Options:**

- **CW Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the clockwise cut. Number is radial.
- **CW Speed (m/min):** Specifies the Linear Speed of the tool on the lens for the clockwise cut.
- **Feed Z Offset (mm/rot):** Specifies an Offset to the tool's Z-Axis-Position above the desired shelf. A positive value will offset the tool position only in the clockwise direction. A negative value will offset the tool position only in the counter clockwise direction.
- **CCW Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the counter clockwise cut. Number is radial. A negative number will move the tool away by that radial amount from the previous clockwise tool path.
- **CCW Speed (m/min):** Specifies the Linear Speed of the tool on the lens for the counter clockwise cut.
- **Path Extension (mm):** Specifies the distance to extend the Shelf toolpath beyond the shape.

## 20mm Polish (Dry Polishing-Only if Applicable):

General		Dry polishing		Wet polishing		Safety bevelling	
General				Spiral-In			
Cooling		Air		Distance (mm)		0.50	
Tool RPM x1000		8		Speed (m/min)		0.00	
Take Off (mm)		0.05		Angle (deg)		0.0	
Spiral				Spiral-Out			
Feed (mm/rot)		0.015		Distance (mm)		0.10	
Speed (m/min)		1.50		Speed (m/min)		0.00	
Method		2 Phase		Angle (deg)		20.0	
2-Phases Spiral Options							
Skim Cut Take-Off X(mm)		1.500000					
First Cut Feed (mm/rot)		0.0010					
First Cut Speed (m/min)		0.00					
Skim Cut Feed (mm/rot)		0.001					
Skim Cut Speed (m/min)		0.00					

Figure 2.21: Material Screen, Polish 20mm-Bevel SB.M (Dry Polishing Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool. For Cutter & Polisher the valid range is: 5-20 RPM, for all other tools the valid range is 5-30 RPM).
- **Take Off (mm):** Specifies the amount of Material that will be removed during the complete phase. Number is radial.

### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.
  - Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.
  - 2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

### 2 Phases Spiral Options (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.

- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

**Spiral-In:**

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

**Spiral-Out:**

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

**20mm Polish (Wet Polishing):**

General	Dry polishing	Wet polishing	Safety bevelling
<b>General</b>			
Cooling	Mister		
Tool RPM x1000	20		
Take Off (mm)	0.02		
<b>Spiral</b>			
Feed (mm/rot)	0.005		
Speed (m/min)	3.00		
Method	2 Phase		
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)	1.500000		
First Cut Feed (mm/rot)	0.0010		
First Cut Speed (m/min)	0.00		
Skim Cut Feed (mm/rot)	0.001		
Skim Cut Speed (m/min)	0.00		
<b>Spiral-In</b>			
Distance (mm)	0.50		
Speed (m/min)	0.00		
Angle (deg)	0.0		
Contact Angle (deg)	90.0		
<b>Spiral-Out</b>			
Distance (mm)	0.10		
Speed (m/min)	0.00		
Angle (deg)	10.0		

**Figure 2.22: Material Screen, Polish 20mm-Bevel SB.M (Wet Polishing Tab)**

**General:**

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool. For Cutter & Polisher the valid range is: 5-20 RPM, for all other tools the valid range is 5-30 RPM).
- **Take Off (mm):** Specifies the amount of Material that will be removed during the complete phase. Number is radial.

**Spiral:**

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.
  - Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.
  - 2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

**2 Phases Spiral Options** (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

**Spiral-In:**

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

**Spiral-Out:**

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

## 20mm Polish (Safety Beveling):

General	Dry polishing	Wet polishing	Safety bevelling
<b>General</b>			
Cooling	Mister		
Tool RPM x1000	20		
<b>Spiral</b>			
Feed (mm/rot)	0.020		
Speed (m/min)	2.00		
Method	2 Phase		
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)	1.500000		
First Cut Feed (mm/rot)	0.0010		
First Cut Speed (m/min)	0.00		
Skim Cut Feed (mm/rot)	0.001		
Skim Cut Speed (m/min)	0.00		
<b>Spiral-In</b>			
Distance (mm)	0.50		
Speed (m/min)	0.00		
Angle (deg)	0.0		
Contact Angle (deg)	90.0		
<b>Spiral-Out</b>			
Distance (mm)	0.10		
Speed (m/min)	0.00		
Angle (deg)	20.0		

Figure 2.23: Material Screen, Polish 20mm-Bevel SB.M (Safety Beveling Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool. For Cutter & Polisher the valid range is: 5-20 RPM, for all other tools the valid range is 5-30 RPM).

### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.
  - Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.
  - 2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

### 2 Phases Spiral Options (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.
- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

### Spiral-In:

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

### Spiral-Out:

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

### Drill/Mill (Drilling):

The screenshot shows a software interface with two tabs: 'General' and 'Drilling'. The 'Drilling' tab is active. It contains two sections: 'General' and 'Drilling/Milling'. The 'General' section has 'Cooling' set to 'Air' (highlighted in yellow) and 'Tool RPM x1000' set to '30'. The 'Drilling/Milling' section has 'Bite Depth (mm)' set to '2.00', 'Plunge Feed (mm/sec)' set to '2.00', and 'Endmill Feed (mm/sec)' set to '2.00'.

Section	Parameter	Value
General	Cooling	Air
	Tool RPM x1000	30
Drilling/Milling	Bite Depth (mm)	2.00
	Plunge Feed (mm/sec)	2.00
	Endmill Feed (mm/sec)	2.00

Figure 2.24: Material Screen, Drill/Mill - 1.0mm (Drilling Tab)

### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool. For Cutter & Polisher the valid range is: 5-20 RPM, for all other tools the valid range is 5-30 RPM).

### Drilling/Milling:

- **Bite Depth (mm):** Depth to bite into lens before reversing direction.
- **Plunge Feed (mm/sec):** Feed rate of the bit when plunging into the lens.



- **Endmill Feed (mm/sec):** Feed rate of the bit when milling drill feature.

### 8.0mm Groove (Grooving):

General		Grooving	
<b>General</b>			
Cooling		Air	
Tool RPM x1000		10	
<b>Spiral</b>			
Feed (mm/rot)		0.100	
Speed (m/min)		15.00	
Method		2 Phase	
<b>2-Phases Spiral Options</b>			
Skim Cut Take-Off X(mm)		1.500000	
First Cut Feed (mm/rot)		0.0010	
First Cut Speed (m/min)		0.00	
Skim Cut Feed (mm/rot)		0.001	
Skim Cut Speed (m/min)		0.00	
<b>Widening</b>			
Widening Feed (mm/rot)		0.20	
<b>Spiral-In</b>			
Distance (mm)		0.50	
Speed (m/min)		0.00	
Angle (deg)		0.0	
Contact Angle (deg)		90.0	
<b>Spiral-Out</b>			
Distance (mm)		0.50	
Speed (m/min)		15.00	
Angle (deg)		0.0	

Figure 2.25: Material Screen, Groove - 8.0mm (Grooving Tab)

#### General:

- **Cooling:** Cooling method for cycle. Possible values are Air, Mister or None.
- **Tool RPM x1000:** Specifies the Rotational Speed of the Tool. For Cutter & Polisher the valid range is: 5-20 RPM, for all other tools the valid range is 5-30 RPM).

#### Spiral:

- **Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens. Number is radial.
- **Speed (m/min):** Specifies the Linear Speed of the Tool on the lens.
- **Method:**
  - Step:** The tool is incremented toward the lens a specified amount per revolution of the lens.
  - Spiral:** The tool is continually moved toward the lens a specific amount per revolution of the lens.
  - 2 Phase:** The tool is continually moved toward the lens a specified amount per revolution of the lens but is divided in two independently controlled phases of a First Cut and Skim Cut.

#### 2 Phases Spiral Options (only visible if Method is set to 2 Phase):

- **Skim Cut Take-Off X (mm):** Specifies the amount of Material that will be removed during the Skim Cut (in X-Axis direction). Number is radial and cannot exceed the total Take-Off.
- **First Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the First Cut. Number is radial.
- **First Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the First Cut.

- **Skim Cut Feed (mm/rot):** Specifies the maximum amount of material to be removed per revolution of the lens during the Skim Cut. Number is radial.
- **Skim Cut Speed (m/min):** Specifies the Linear Speed of the Tool on the lens for the Skim Cut.

**Widening:**

**Widening Feed (mm/rot):** Specifies the maximum amount of Z-Axis movement per revolution of the lens. This is only applied if the requested Groove Width exceeds the Tool's flute width.

**Spiral-In:**

- **Distance (mm):** Specifies the radial offset between the Start Point of the cutting phase and the first Contact Point between tool and lens.
- **Speed (m/min):** Specifies the linear speed between the Start Point of the cutting phase and the first Contact Point between tool and lens. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Start Point and the Contact Point.
- **Contact Angle (deg):** Specifies the shape angle where the first and last Contact Point is made between tool and lens.

**Spiral-Out:**

- **Distance (mm):** Specifies the radial offset between the Exit Point of the cutting phase and the End Point of this cutting phase.
- **Speed (m/min):** Specifies the linear speed between the Exit Point and the End Point. If Zero, the Spiral Speed will be applied.
- **Angle (deg):** Specifies the angular offset between the Exit Point and the End Point.

## Frame Screen

Use the *Frame Screen* to set defaults for size adjustment for each of the frame types listed.

Name	Size Adjustment	Polish	Front Safety Bevel	Back Safety Bevel
Plastic	+0.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metal	+0.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rimless	+0.00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Groove	+0.00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Figure 2.26: Frame Screen**

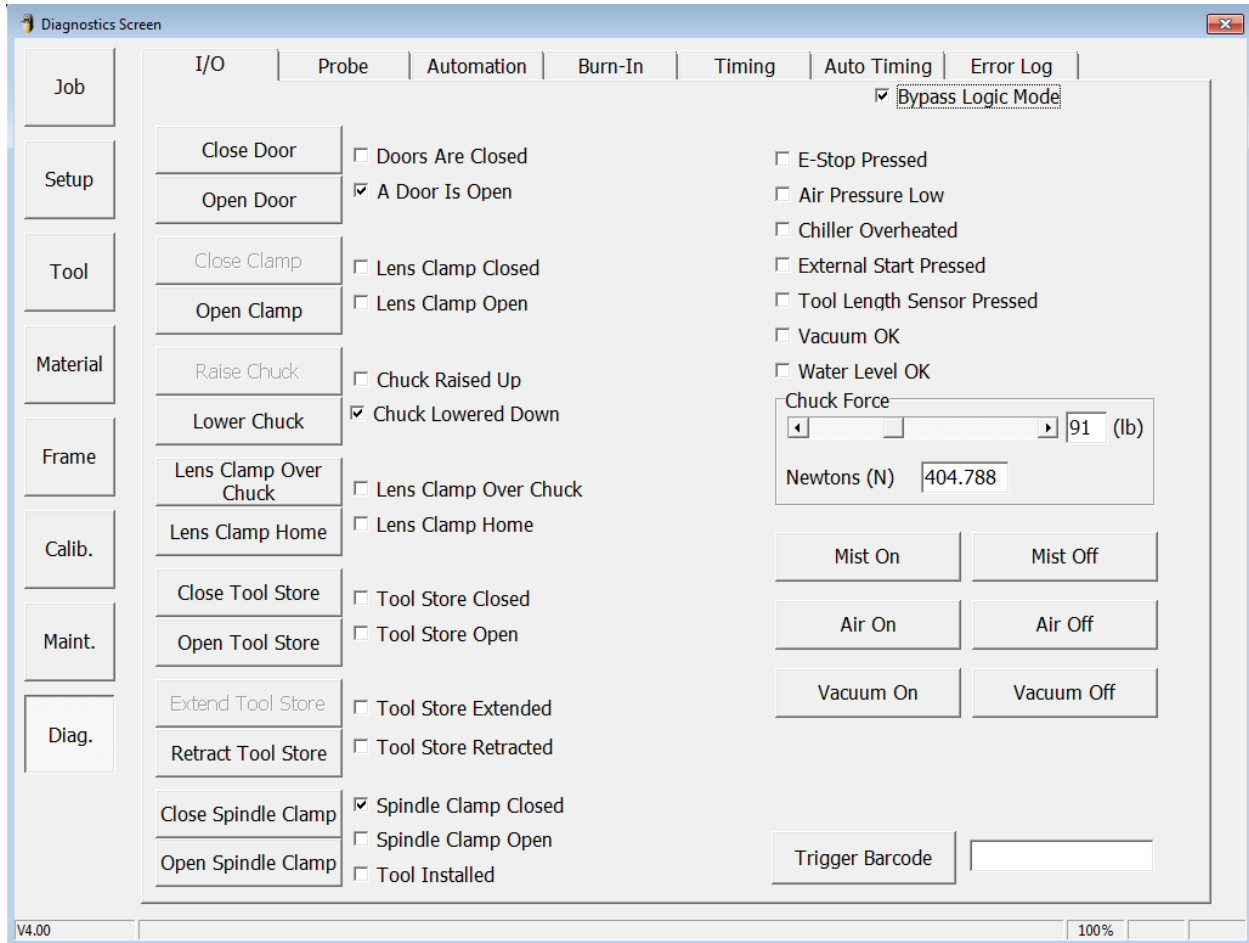
**Name:** The material name as displayed on the *Job Screen*.

### **Frame Settings:**

- **Size Adjustment:** Amount in millimeters to increase or decrease the size field on the *Job Screen*. This could be a Box adjustment or a C-size adjustment depending on the Size Dimension setting on the Setup Preference screen. For example, in operations that use Zyl frames, set this value for slightly larger. For operations that use “cold-snap frames,” the tolerance is much tighter; therefore, this value should be set to zero or a very small value.
- **Polish:** Selecting this checkbox will enable polishing for this frame type, by default.
- **Front Safety Bevel:** Selecting this checkbox will enable front safety beveling for this frame type, by default.
- **Back Safety Bevel:** Selecting this checkbox will enable back safety beveling for this frame type, by default.

## Diagnostics Screen

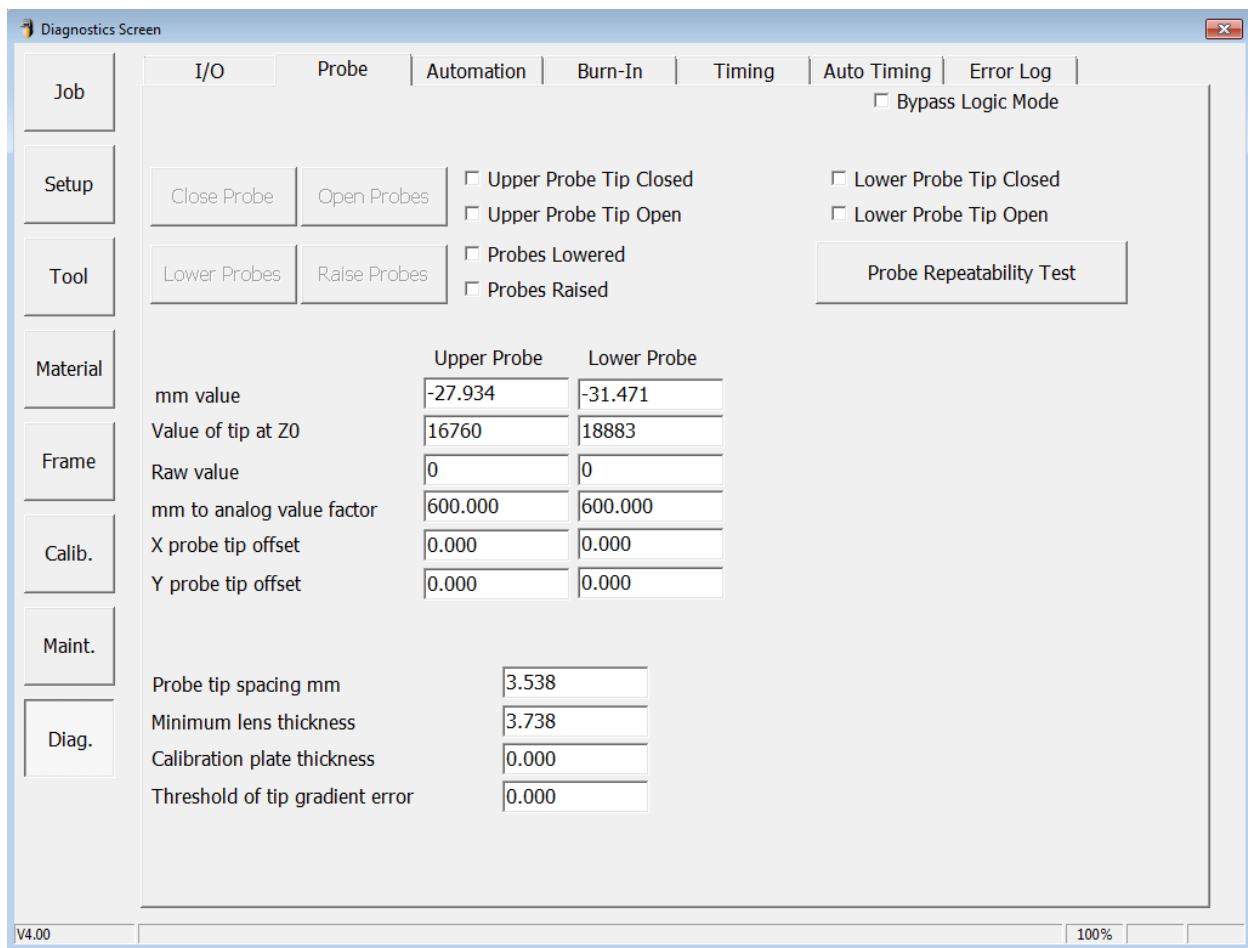
Use the *Diagnostics Screens* to test all machine systems. These screens are primarily used by service personnel.



**Figure 2.27: Diagnostics Screen (I/O)**

**I/O:** Used to check the various inputs and outputs of the machine.

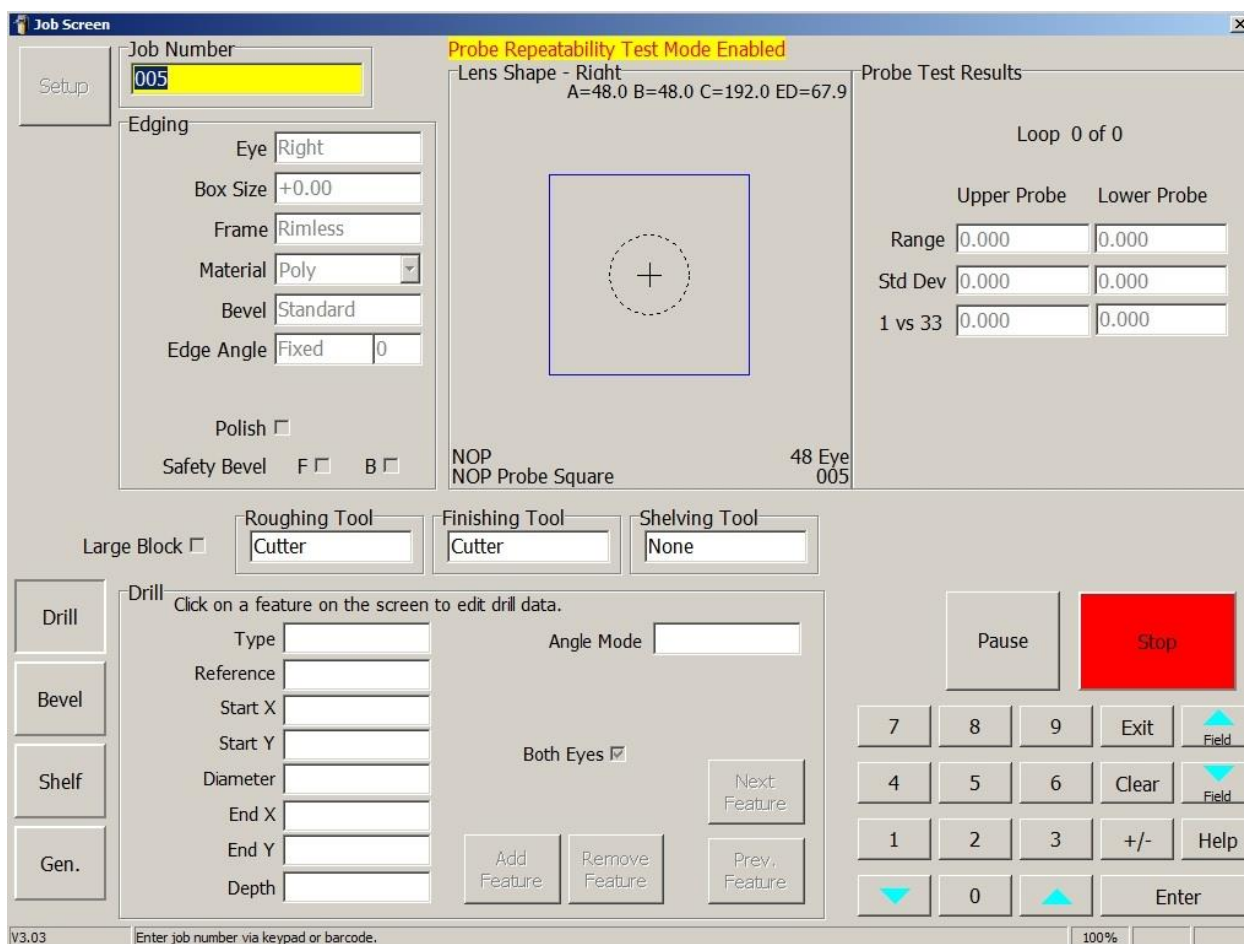
- **Bypass Logic Mode:** If checked, this will allow activation of outputs without checking the input status of related items.
- **E-Stop Pressed:** Checked if safety circuit is closed.
- **Air Pressure Low:** Checked if pressure is below setting on input air regulator.
- **Chiller Overheated:** Checked if spindle chiller has over-heated or if flow is restricted.
- **External Start Pressed:** Checked if the green start button is pressed on the front of the machine.
- **Tool Length Sensor Pressed:** Checked if the tool length sensor in the tool store is pressed.
- **Vacuum OK:** Checked if the vacuum system is on.
- **Water Level OK:** Checked if the water level for polishing is not low.



**Figure 2.28: Diagnostics Screen (Probe)**

**Probe:** Used to check the operation of the probe.

- **Close Probes:** Closes the probe arms.
- **Open Probes:** Opens the probe arms.
- **Lower Probes:** Lowers the probe assembly.
- **Raise Probes:** Raises the probe assembly.
- **mm value:** The current probe positions in millimeters.
- **Value of tip at Z0:** The analog value of the probe at center of travel.
- **Raw value:** The current analog probe position.
- **mm to analog value factor:** Factor used to convert the probe signal from analog to millimeter units.
- **X probe tip offset:** The relative offset between the upper and lower probe tips in the X direction.
- **Y probe tip offset:** The relative offset between the upper and lower probe tips in the Y direction.
- **Probe tip spacing mm:** The current distance between the probe tips.
- **Minimum lens thickness:** The minimum thickness of a lens that can be measured. This should always be more than the **Probe tip spacing mm**. Replace tips and recalibrate probe if this value is above 1mm.
- **Calibration plate thickness:** The thickness of the probe calibration plate.
- **Threshold of tip gradient error:** The trigger value to detect that the probe has fallen off the lens.
- **Probe Repeatability Test:** This will initiate a test to help analyze the probe performance. The user will be prompted to insert a plano 8 base 75mm blank into the machine, and will then be taken to a special Job Screen while the probe measures the lens multiple times.



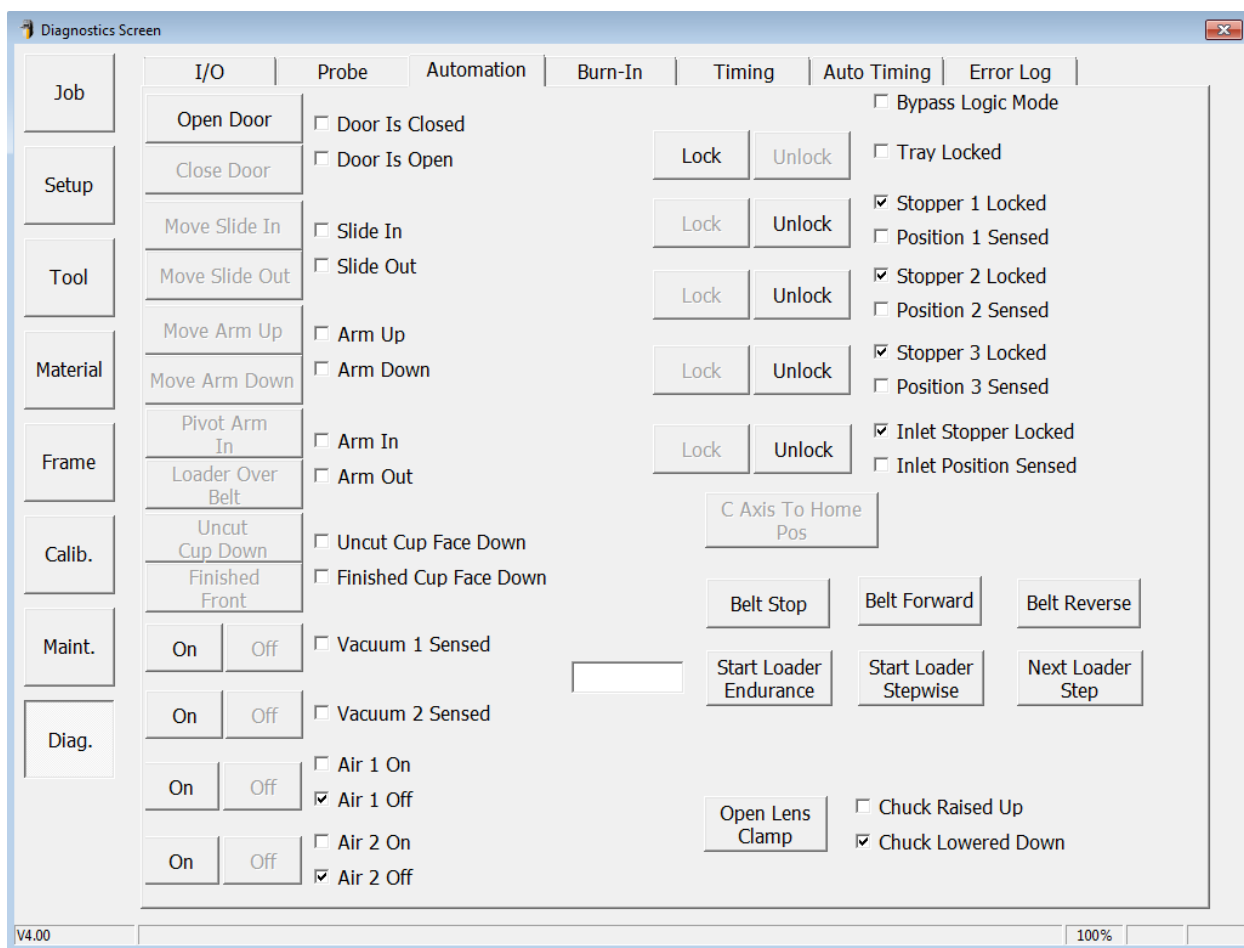
**Figure 2.29: Diagnostics Screen (Probe Repeatability Test Mode)**

The Probe Repeatability Test Mode is a special Job Screen, and is launched from the *Diagnostic Probe Screen*. This test will probe the previously loaded lens 105 times, and compare the probe data of consecutive loops. The results of the test are displayed in the upper right hand corner of the screen for both the Upper and Lower Probe arms. These values are updated after each probe loop.

- **Range:** Compares the measurement at each probe position and displays the largest difference recorded during the whole test. This can help expose a single bad probe data point.
- **Std Dev:** Standard Deviation indicates the overall deviation from the expected average value. This can help determine the frequency of bad probe data.
- **1 vs 33:** Compares the measurement at a probe position that is checked twice on each loop, and displays the maximum difference recorded during the whole test. This can help expose a single bad probe loop.

A typical value for all fields is less than 0.100. Consult Technical Services for assistance in interpreting the results.

Press **Stop** to abort the test. Enter a job number and press **Enter** to return to the normal *Job Screen*.

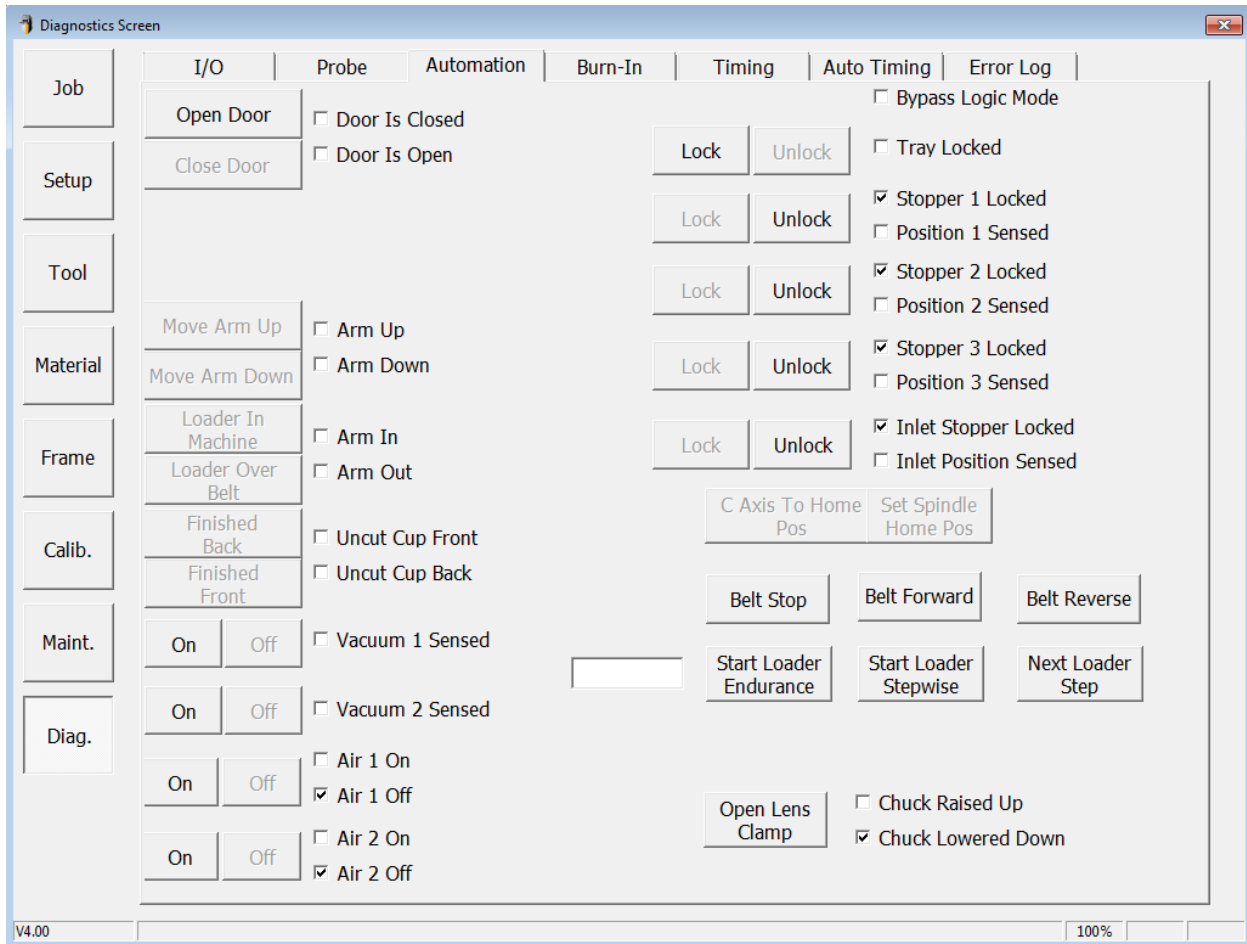


**Figure 2.30: Diagnostics Screen (Automation – Version 1 Loader)**

**Automation:** Used to check the various inputs and outputs of the machine associated with automation (if applicable).

- **Open/Close Door:** Open and close the automation door.
- **Move Slide In/Out:** Extend or retract the loader arm.
- **Move Arm Up/Down:** Move the loader arm up and down.
- **Pivot Arm In/Out:** Pivot the loader arm between the tray and chuck.
- **Finished/Uncut Cup Down:** Pivot the suction cup arm.
- **Vacuum 1 On/Off:** Turn Vacuum 1 on and off.
- **Vacuum 2 On/Off:** Turn Vacuum 2 on and off.
- **Air 1 On/Off:** Turn Air 1 on and off.
- **Air 2 On/Off:** Turn Air 2 on and off.
- **Lock/Unlock Tray:** Turn the tray lock on and off.
- **Lock/Unlock Stopper 1:** Raise and lower tray stopper 1.
- **Lock/Unlock Stopper 2:** Raise and lower tray stopper 2.
- **Lock/Unlock Stopper 3:** Raise and lower tray stopper 3.
- **Lock/Unlock Inlet Stopper:** Raise and lower the inlet tray stopper.
- **C Axis To Home Position:** Rotate the chuck to the automation loading position.
- **Belt Forward:** Start the belt moving forward.
- **Belt Reverse:** Start the belt moving backward.
- **Start Loader Endurance:** Start the loader endurance test which requires 1 tray with R/L lenses on the belt. The number of cycles is recorded in the box to the left.
- **Start Loader Stepwise:** Step through the automation sequence. Used to verify alignment.

- **Next Loader Setup:** Advance to the next automation step.
- **Open Lens Clamp:** Open and close the lens clamp.



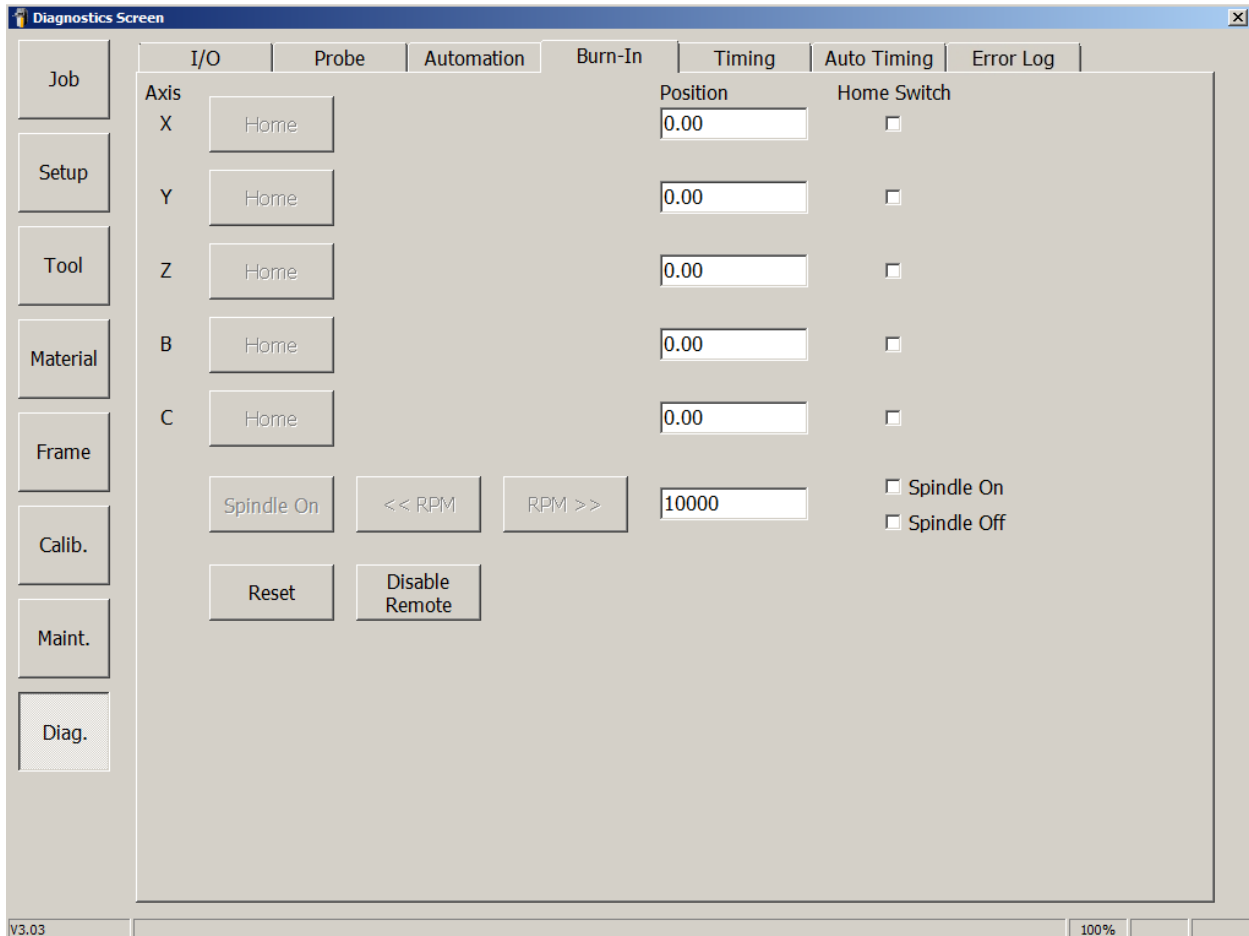
**Figure 2.31: Diagnostics Screen (Automation – Version 2 Loader)**

**Automation:** Used to check the various inputs and outputs of the machine associated with automation (if applicable).

- **Open/Close Door:** Open and close the automation door.
- **Move Arm Up/Down:** Move the loader arm up and down.
- **Loader In Machine/Over Belt:** Move the loader arm between the tray and chuck.
- **Finished Front/Back:** Rotate the suction cup arm.
- **Vacuum 1 On/Off:** Turn Vacuum 1 on and off.
- **Vacuum 2 On/Off:** Turn Vacuum 2 on and off.
- **Air 1 On/Off:** Turn Air 1 on and off.
- **Air 2 On/Off:** Turn Air 2 on and off.
- **Lock/Unlock Tray:** Turn the tray lock on and off.
- **Lock/Unlock Stopper 1:** Raise and lower tray stopper 1.
- **Lock/Unlock Stopper 2:** Raise and lower tray stopper 2.
- **Lock/Unlock Stopper 3:** Raise and lower tray stopper 3.
- **Lock/Unlock Inlet Stopper:** Raise and lower the inlet tray stopper.
- **C Axis To Home Position:** Rotate the chuck to the automation loading position.
- **Belt Stop:** Stop the belt from moving.
- **Belt Forward:** Start the belt moving forward.
- **Belt Reverse:** Start the belt moving backward.



- **Start Loader Endurance:** Start the loader endurance test which requires 1 tray with R/L lenses on the belt. The number of cycles is recorded in the box to the left.
- **Start Loader Stepwise:** Step through the automation sequence. Used to verify alignment.
- **Next Loader Setup:** Advance to the next automation step.
- **Open Lens Clamp:** Open and close the lens clamp.

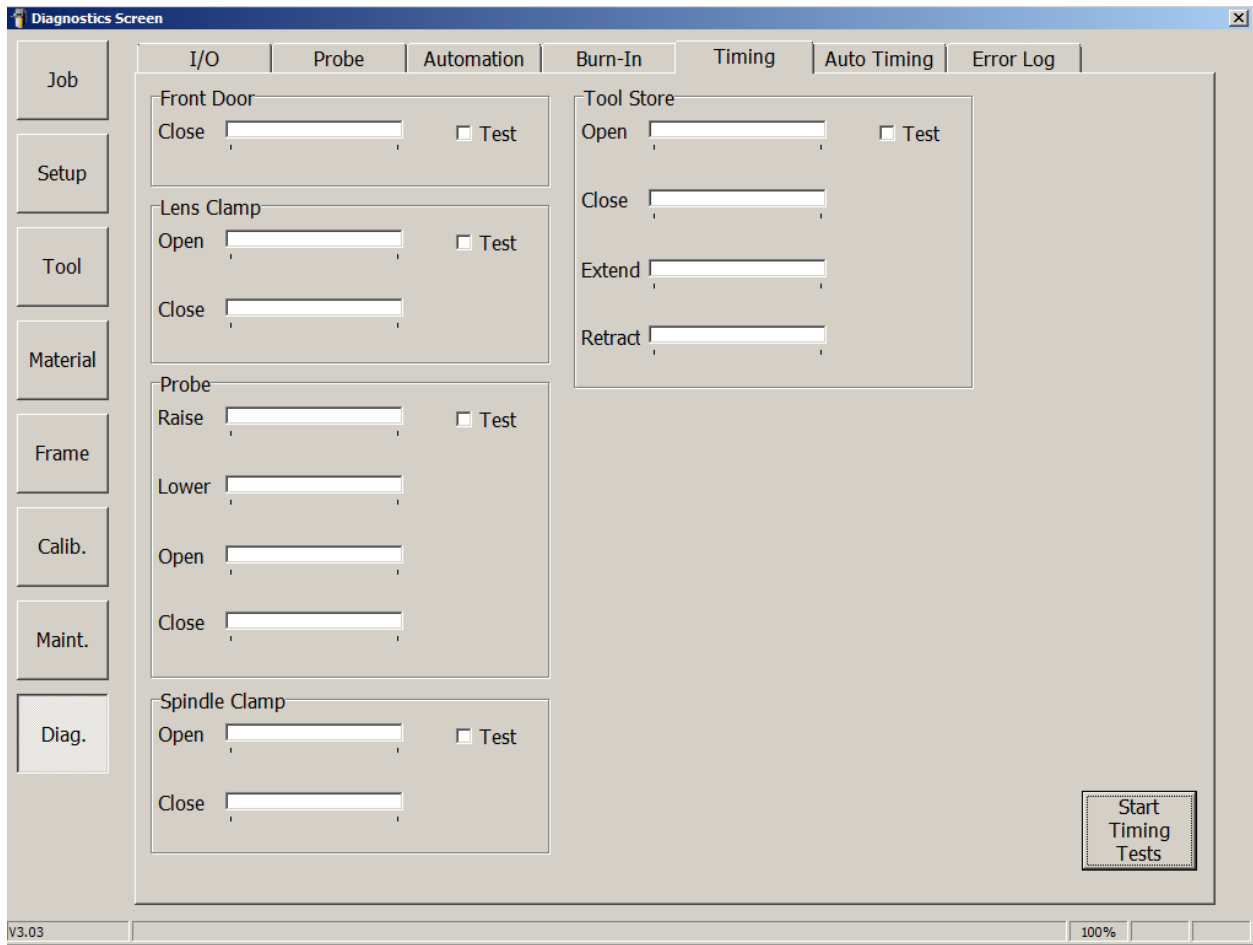


**Figure 2.32: Diagnostics Screen (Burn-In)**

**Burn-In:** Used to check the operation of the five axes.

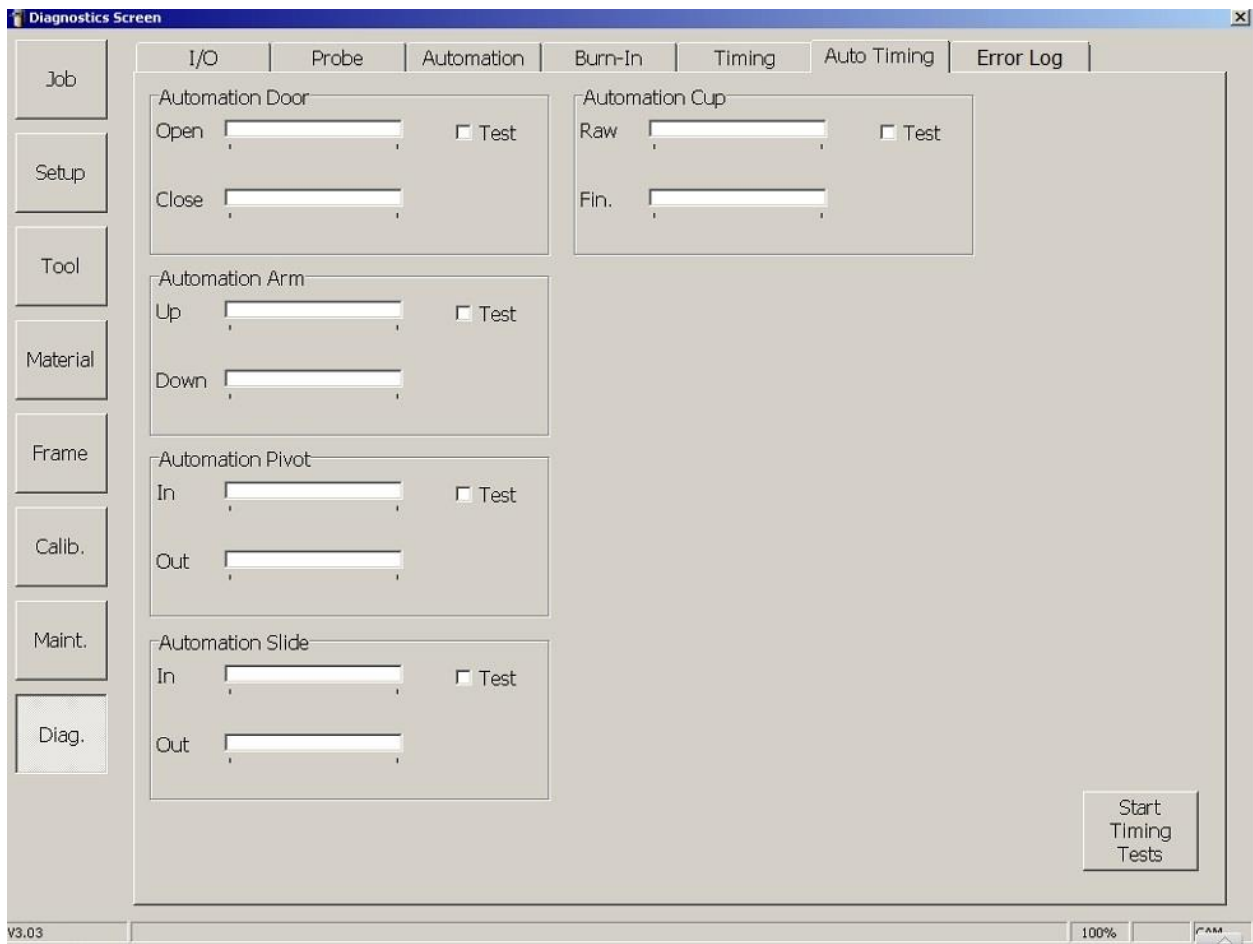
- **Axis X Home:** Discovers the home position of the X-axis.
- **Axis Y Home:** Discovers the home position of the Y-axis.
- **Axis Z Home:** Discovers the home position of the Z-axis.
- **Axis B Home:** Discovers the home position of the B-axis.
- **Axis C Home:** Discovers the home position of the C-axis.
- **Spindle On:** Turns on the spindle at the designed RPM.
- **<<RPM>>:** Speed up or slow down the spindle.
- **Reset:** Moves all axes to the home position.
- **Enable/Disable Remote:** Enables and disables the hand controller in order to move the axes.
- **Position:** Displays the current position of each axis.
- **Home Switch:** Checked if home switch is activated for each axis.
- **Spindle On/Off**

**Note:** Front door must be closed for buttons to be active.



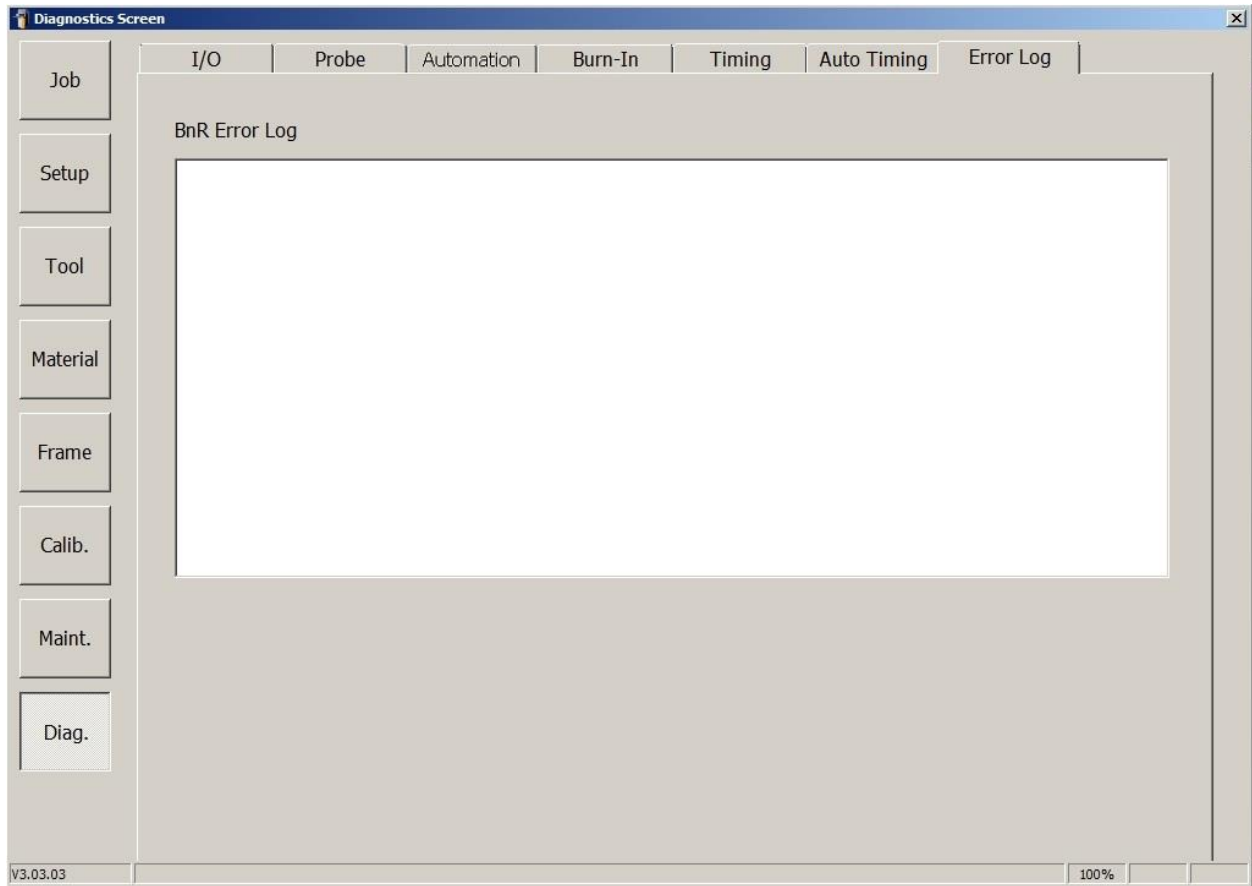
**Figure 2.33: Diagnostics Screen (Timing)**

**Timing:** Used to check the timing of the various systems. For factory and Service use.



**Figure 2.34: Diagnostics Screen (Auto Timing)**

**Auto Timing:** Used to check the timing of the various automation systems (if applicable). For factory and Service use.



**Figure 2.35: Diagnostics Screen (Error Log)**

**Error Log:** Displays the most recent errors encountered by the PLC system. For Service use.

# Chapter 3: Calibration

## Overview

The ES-curve edger and its tools are manufactured to strict tolerances; however, there are minute dimension variations among machines, and over time. The process of calibration measures these variations so that the software can compensate for them, resulting in accurate size of the edged lens.

In general, the calibration process is to edge a lens, measure the edged lens, compare the measured value to the desired value, and use the difference to compute a calibration offset. The ES-curve performs many required computations. In some calibrations, the tool tip is brought into contact with a fixed location within the machining area. This allows the tool length to be automatically computed. Calibrating safety bevels does not involve computation; rather, the user inspects a safety-beveled lens and adjusts the depth of the bevel as required. Calibrations which require that a lens be edged use internal job number 002. This is a 58 mm diameter circle. Use a caliper to measure the diameter of the edged lens.

### First Time Calibration

1. Access the **Tool Screen** as shown below and define the tools that are installed in the machine and verify the details of each tool.

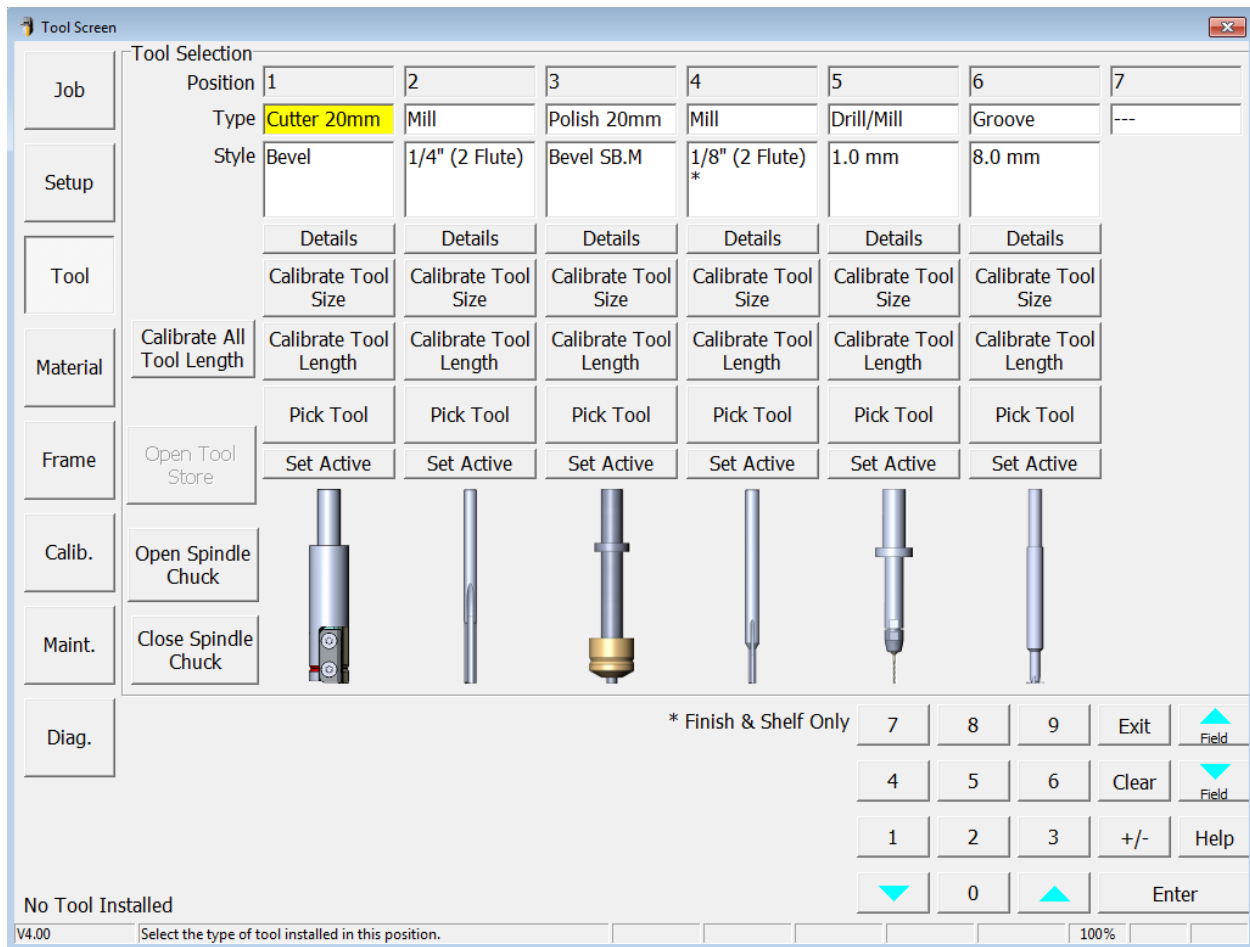


Figure 3.1

2. Access the *Material Screen* and click the **Restore All** button for each tool to ensure *Standard* settings.

## Normal Calibration

Access the *Calibration Screen* as shown below and place a check mark next to each calibration step you wish to perform. If you select individual steps rather than selecting all steps at once, they should always be done in the same order they appear on the screen. After selecting the calibration steps to be done, press **Start** to begin with the calibration steps.

Figure 3.2

## WARNING

*Note: If you perform any calibrations in the “Basic Calibration” section, every calibration step in the “Calibration with Disk” section and the “Calibration with Edging Cycle” section must be completed.*

- **Origins:** Specifies the origin of the spindle relative to the chuck.
- **Probe:** Specifies the origin of the probe relative to the chuck.
- **Tool Store:** Specifies the origin of the spindle relative to the left-most position of the tool store (Tool 1).
- **Install New Probe:** Will automatically guide the calibration process after changing a probe assembly.

### **Basic Calibration:**

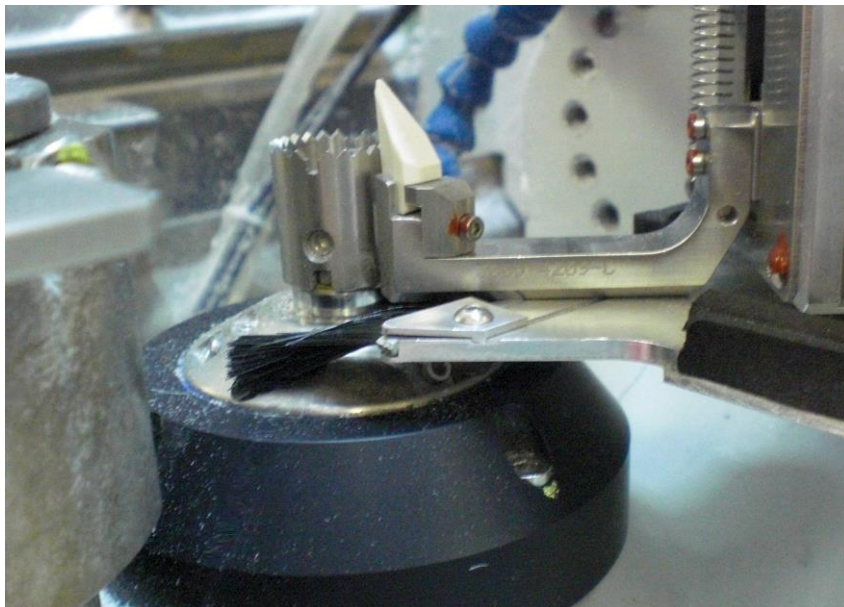
This section is used to define the approximate mechanical relationships of the spindle, chuck, and tool store. These steps should be followed for first time calibration, and require use of the hand controller as described in Figure 2.1.

1. **Spindle to Chuck** – Use the hand controller to move the spindle with the 20mm cutter above the lens chuck to set the approximate X, Y, and Z position as shown in the photo below. Press **OK** after adjusting the cutter tool into position.



**Figure 3.3**

2. **Probe to Chuck** – Use the hand controller to move the Z axis so that the bottom of the probe is approximately 3mm above the chuck collar, the X axis is positioned at the right side of the clamp, and the Y axis is set to the center of the clamp as shown in the photo below. Press **OK** after adjusting the probe into position.



**Figure 3.4**

3. **Probe to Calibration Pad** – Use the hand controller to move the Z axis so that the probe tips are centered on the probe pad, the X axis so the probe tips are on the right side of the probe pad, and the Y axis of the probe tips are in the center of the probe pad as shown below. Press **OK** after adjusting the probe into position.



**Figure 3.5**

4. **Tool Storage** – Use one hand to hold onto the 20mm cutter tool firmly and then press **OK** to release the tool from the spindle. Place the 20mm cutter tool into the tool store in the first location. Make sure the tool is flush with the back of the fork and press **OK**. Use the hand controller to move the spindle into position directly on top of the 20mm cutter tool as if inserting the tool directly into the spindle. Press **OK** when spindle is in position as shown below.



**Figure 3.6**



### Calibration With Disk:

This section is used to calibrate the probe and B, C axes. These steps require the use of the special calibration disk and appropriate PDA (Vario shown below).



**Figure 3.7**

1. **Probe Range** – Insert the calibration disk in the lens chuck and press **OK**. The remainder of this calibration step is automatic and requires no user input.
2. **B Axis** – Insert the calibration disk in the lens chuck and press **OK**. The remainder of this calibration step is automatic and requires no user input.
3. **C Axis** – Insert the calibration disk in the lens chuck and press **OK**. The remainder of this calibration step is automatic and requires no user input.
4. **Probe X & Y** – Insert the calibration disk in the lens chuck and press **OK**. The remainder of this calibration step is automatic and requires no user input. Remove the calibration disk from the lens chuck.

### Calibration With Edging Cycle:

This section is used to calibrate the X, Y, Z axes as well as the B axis radius. Several of these steps require the use of a pattern blank and block as shown below:



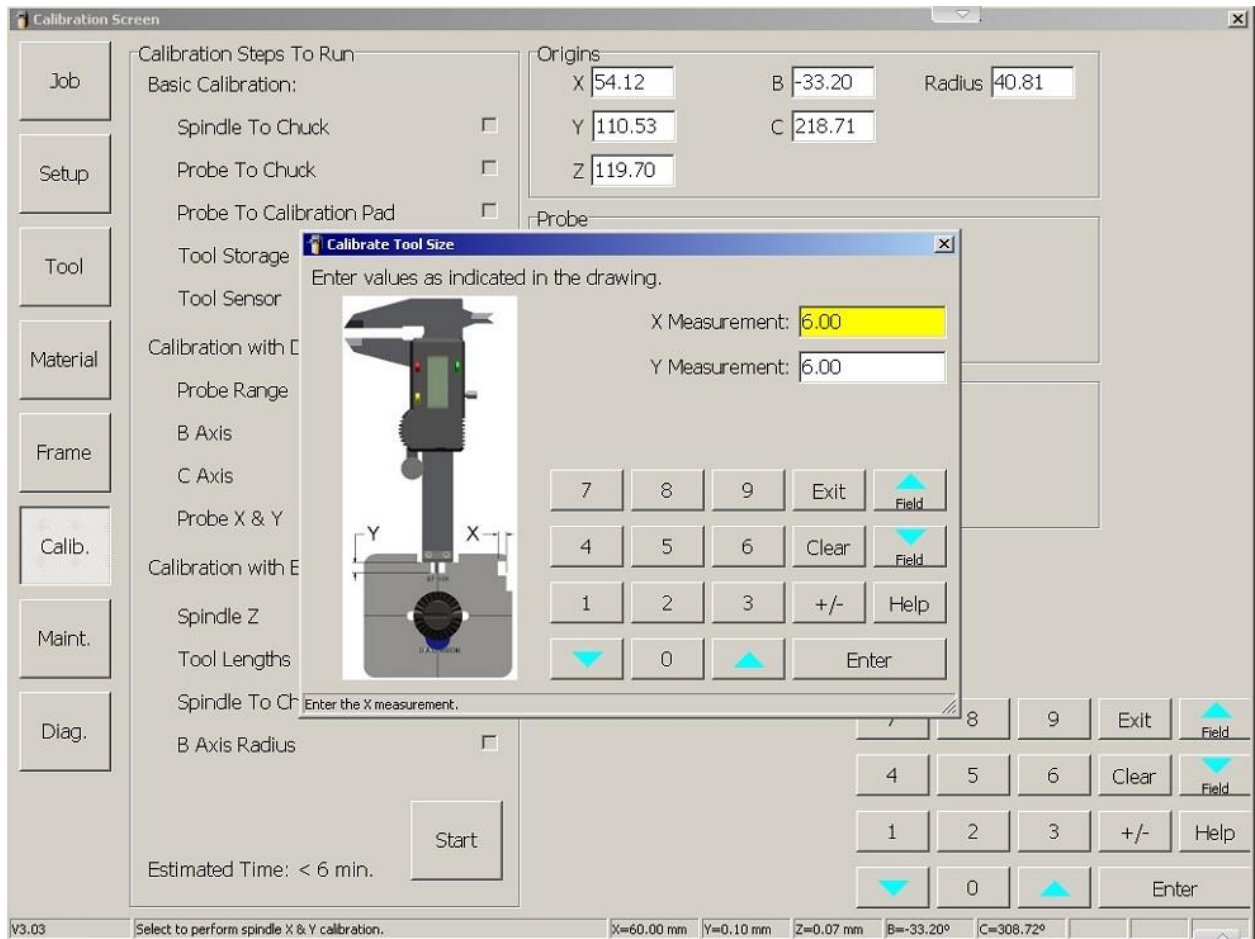
**Figure 3.8**

1. **Spindle Z** – Insert a pattern blank and block into the lens chuck and press **OK**. Use the hand controller to move the spindle so the tip of the milling tool is lightly touching the top of the pattern as shown below. Once the tool is in position, put away the hand controller and press **OK** to start calibration. The remainder of this calibration step is automatic and requires no user input.



**Figure 3.9**

2. **Tool Lengths** - This calibration step measures the tool lengths and is automatic and requires no user input.
3. **Spindle to Chuck X & Y** –Insert a pattern blank and block into the lens chuck and press **OK**. Two notches will be cut in the edge of the pattern. Measure the depth of the X and Y notches and enter the values in the form as shown below and then press the **Enter** button. This process will be repeated with a new pattern blank until the depth of the notches is within tolerance.

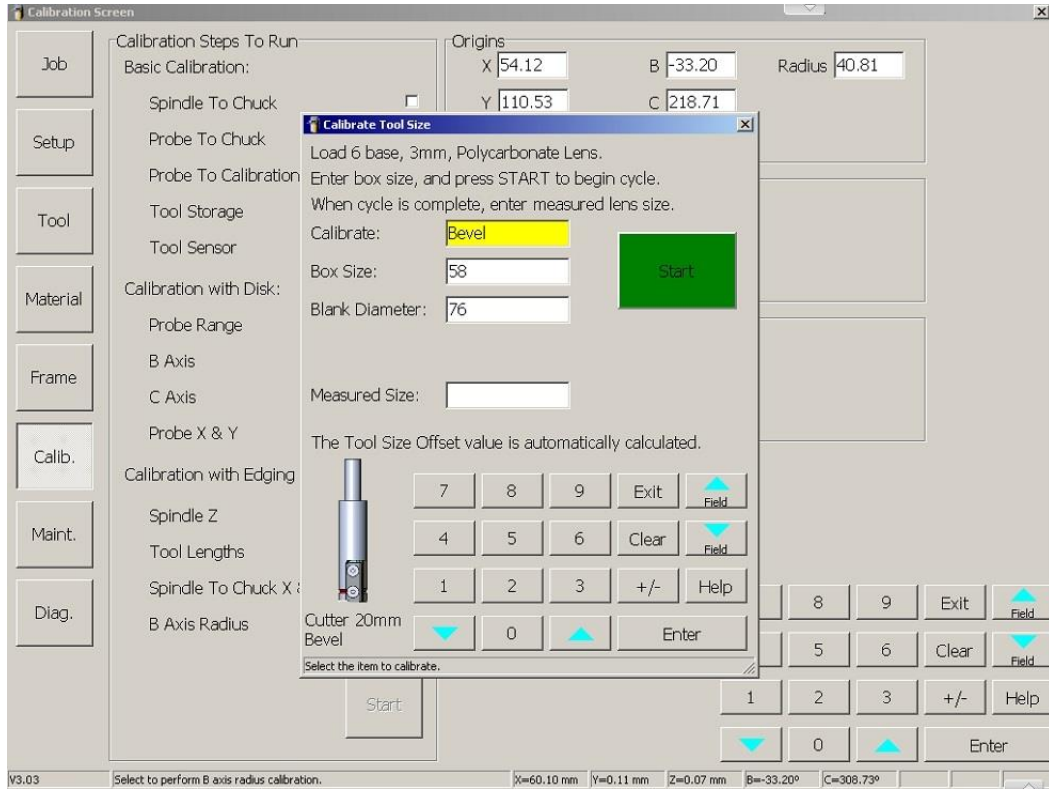


**Figure 3.10**

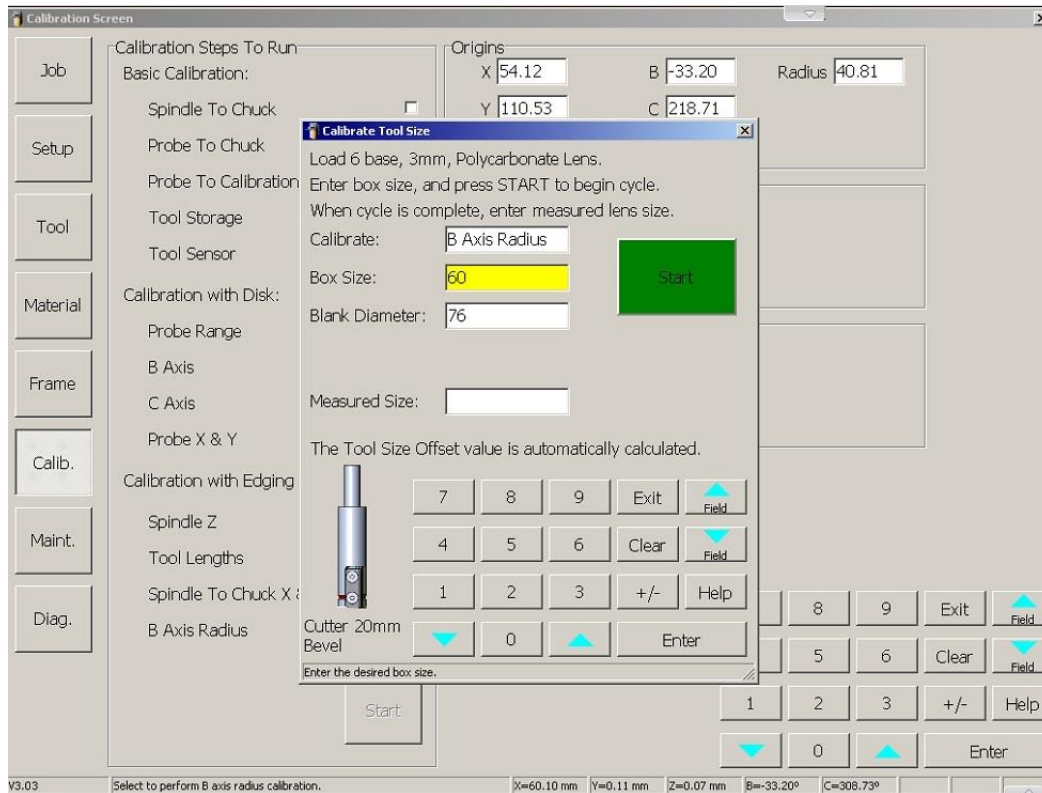
#### 4. **B Axis Radius:**

**Step 1 --** Insert a blocked 6-base, 3mm poly lens into the lens chuck. Select *Rimless* in the **Calibrate** box field. Enter the appropriate diameter (in mm) in the **Box Size** field and press **Start** to cut a lens. Measure the diameter of the rimless lens and enter the value and then press the **Enter** button. Select *Bevel* in the **Calibrate** field and repeat the same cutting process with a new lens. Press **Exit** when complete.

**Step 2 –** Insert a blocked 6-base, 3mm poly lens into the lens chuck. Select *B Axis Radius* in the **Calibrate** field. Enter *60.00* in the **Box Size** field and press **Start** to cut a lens. Measure the diameter of the dynamically edged beveled lens and enter the value and then press the **Enter** button. Press **Exit** when complete.



**Figure 3.11 – B-Axis Radius Calibration – Step 1**



**Figure 3.12 – B-Axis Radius Calibration – Step 2**

# Tool Calibration

Two aspects of the tool are calibrated:

- **Tool Size:** Affects diameter of the edged lens, groove depth, and the diameter of drilled holes.
- **Tool Length:** Affects depth of drilled holes and bevel placement.

The tool size and length calibrations are initiated from the **Tool Screen**.

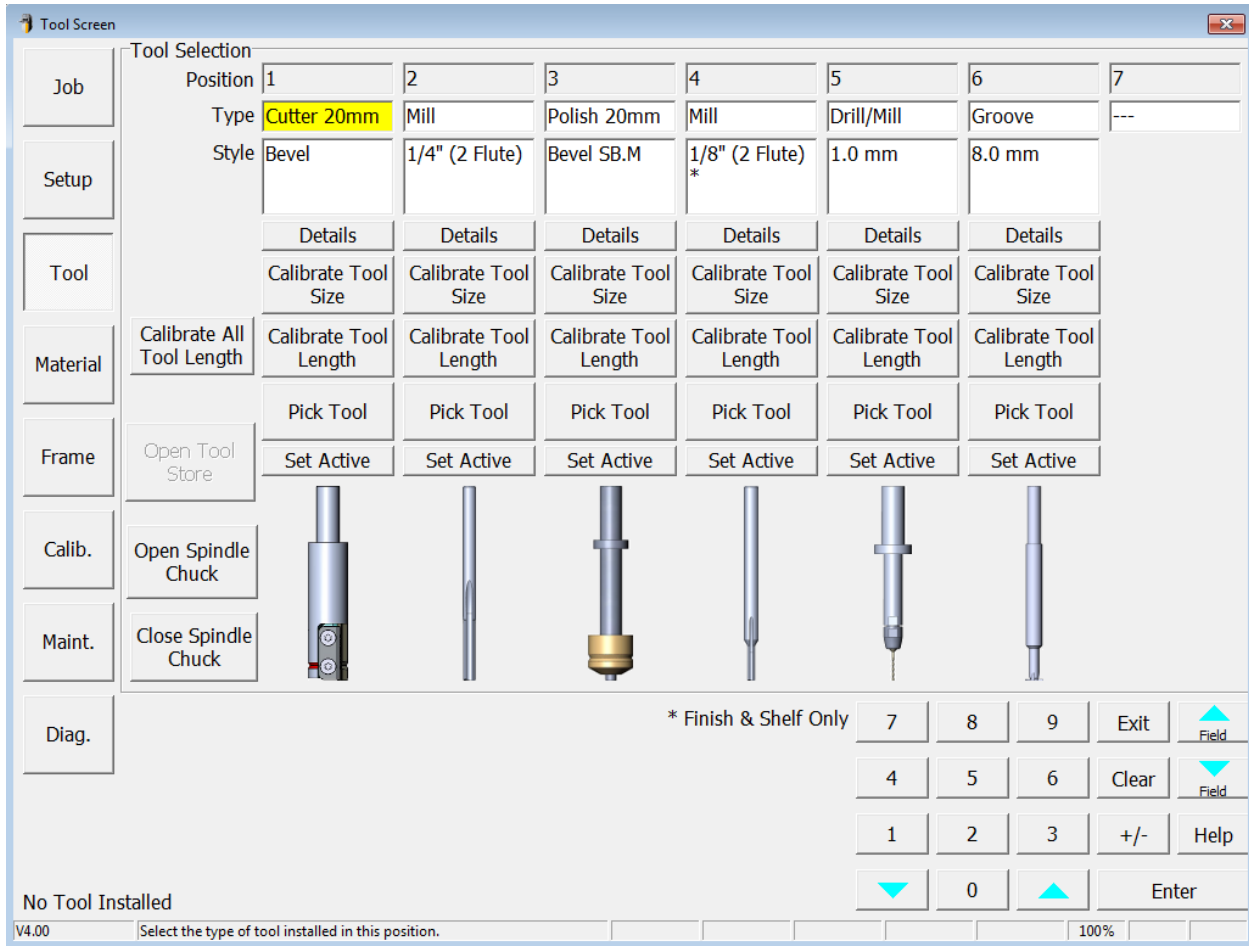
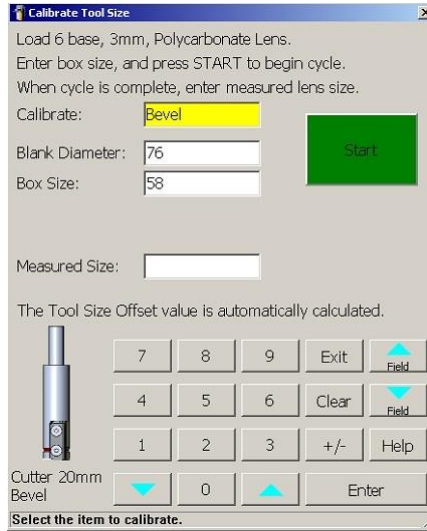


Figure 3.13: Tool Screen

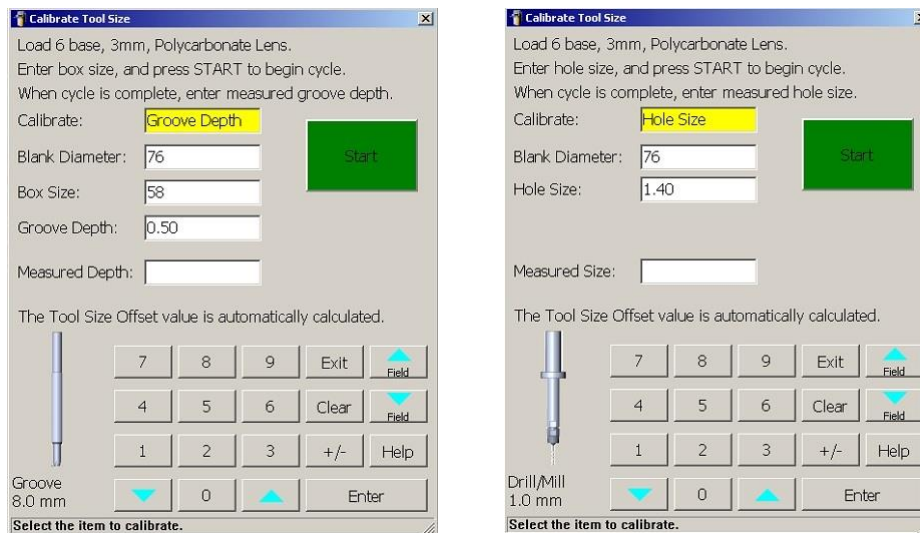
## **Tool Size:**

The tool size for each tool is calibrated by tapping the **Calibrate Tool Size** button. For cutters, mills and polishing tools, this calibration affects the diameter of the edged lens. The following screen instructions appear:



**Figure 3.14: Instructions for Tool Size Calibration - Lens Diameter**

For grooving tools the calibration affects the groove depth, and for drill tools the calibration affects the drilled hole diameter. The following screen instructions appear:



**Figure 3.15: Instructions for Tool Size Calibration – Groove Depth (left) and Hole Size (right)**

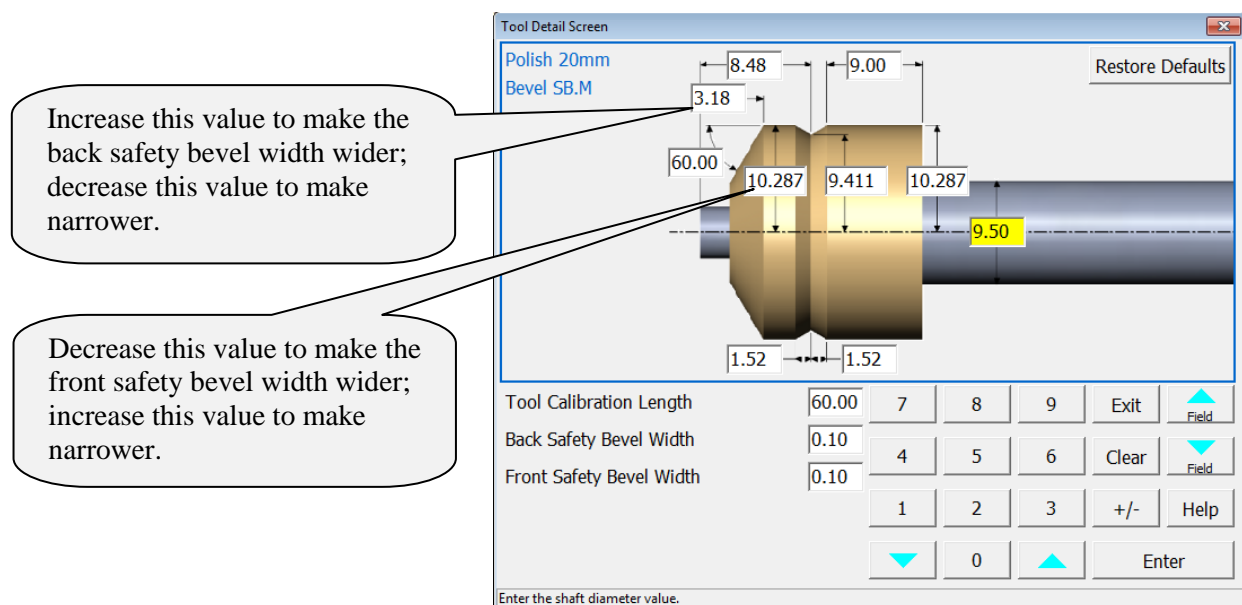
**Note:** When downsizing a previously edged lens, the Box Size should be at least 3mm smaller than the Blank Diameter.

**Tool Length:** Calibrating tool length requires only tapping the **Calibrate Tool Length** button. The tool is fetched from the tool store and brought into contact with a precisely located stage at the far right of the tool store which senses contact with the tool tip. To calibrate the length of all tools, tap the **Calibrate All Tool Length** button.

### Safety Bevel Calibration (Select *Detail* for Polish Tool):

**Safety Bevel Width:** Specifies the width of the safety bevel, measured in millimeters.

1. Set the **Back Safety Bevel Width** and **Front Safety Bevel Width** to *0.20* on the **Polish Detail Screen**.
2. Enter **Job Number 002** on the **Job Screen** and set **Frame** to *Rimless*, **Rimless Angle** to *Fixed @ 0*, and use the checkboxes to turn on **Back Safety Bevel** and **Front Safety Bevel**.
3. Edge a 6-base plano lens with at least 3-4mm thickness, and inspect the back and front safety bevel.
4. To increase the back safety bevel width, increase the indicated tool geometry below; decrease value to make narrower. Repeat until the observed back safety bevel width is 0.2mm.
5. To increase the front safety bevel width, decrease the front rimless tool geometry indicated below; increase value to make narrower. Repeat until the observed front safety bevel width is 0.2mm.
6. Set the final **Back Safety Bevel Width** and **Front Safety Bevel Width** according to lab preference.

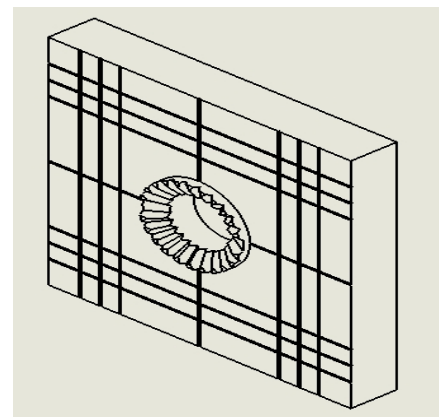


**Figure 3.16**

### Check Axis:

**Note:** This check requires the **Axis Gauge** shown below on the right, and requires that the user estimate an angle.

1. Enter **Job Number 004** on the **Job Screen** and set **Material** to *Pattern*.
2. Block a pattern and load this into the chuck and press **Start**.
3. The pattern will be edged to a 40mm square.
4. Remove the blocked pattern and insert the block into the axis gauge.
5. Estimate the angle between the edge of the pattern and the lines scribed on the gauge.
6. Add the estimated angle of error to the **Axis Adj.** on the **Setup Settings Screen**. Increase this number to rotate the pattern CW.



**Figure 3.17**

### Check Bevel Placement:

1. Enter **Job Number 002** on the **Job Screen** and set **Frame** to *Metal*, **Bevel** to *Center*, and **Bevel Angle** to *Fixed @ 0*.
2. Block a 6-base plano lens with a 3-4mm edge thickness.
3. Load this into the chuck and press **Start**.
4. Remove the edged lens and inspect the bevel position.
5. If the bevel is not centered, add the estimated offset to the **Bevel/Groove Adj.** on the **Setup Settings Screen**. Increase this number to move the bevel forward.

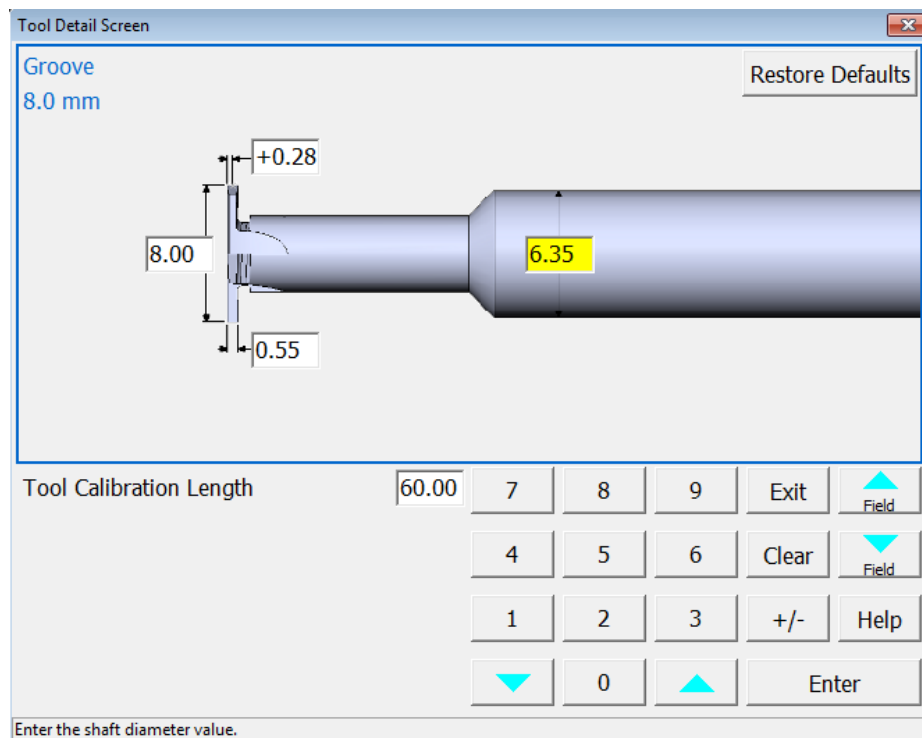
*Note: The Bevel/Groove Adj. parameter offsets both the bevel and groove placement. Check the groove placement after making this adjustment.*

### Check Shelf Thickness:

1. Enter **Job Number 002** on the **Job Screen** and set **Frame** to *Rimless* and **Shelf Position** to *Fixed* at +2.00.
2. Block a 6-base plano lens with 3-4mm edge thickness.
3. Load this into the chuck and press **Start**.
4. Remove the shelved lens and measure the shelf thickness with calipers.
5. If the shelf is not 2mm thick, add the estimated offset to the **Shelf Adj.** on the **Setup Settings Screen**. Increase this number to increase the thickness of the shelf.

### Check Groove Placement:

1. Enter **Job Number 002** on the **Job Screen** and set **Frame** to *Groove*, **Groove** to *Center*, **Rimless Angle** to *Fixed @ 0*, and **Grove Angle** to *Fixed @ 0*.
2. Block a 6-base plano lens with a 3-4mm edge thickness.
3. Load this into the chuck and press **Start**.
4. Remove the edged lens and inspect the groove position.
5. If the groove is not centered, add the estimated offset to the highlighted field in **Groove Detail Screen** shown below. Increase this number to move the groove forward.



**Figure 3.18**



# Chapter 4: Maintenance

Periodic maintenance as described in this chapter is essential for optimizing productivity and quality. All maintenance operations must be performed with the machine disconnected from sources of energy.



## GENERAL WARNING

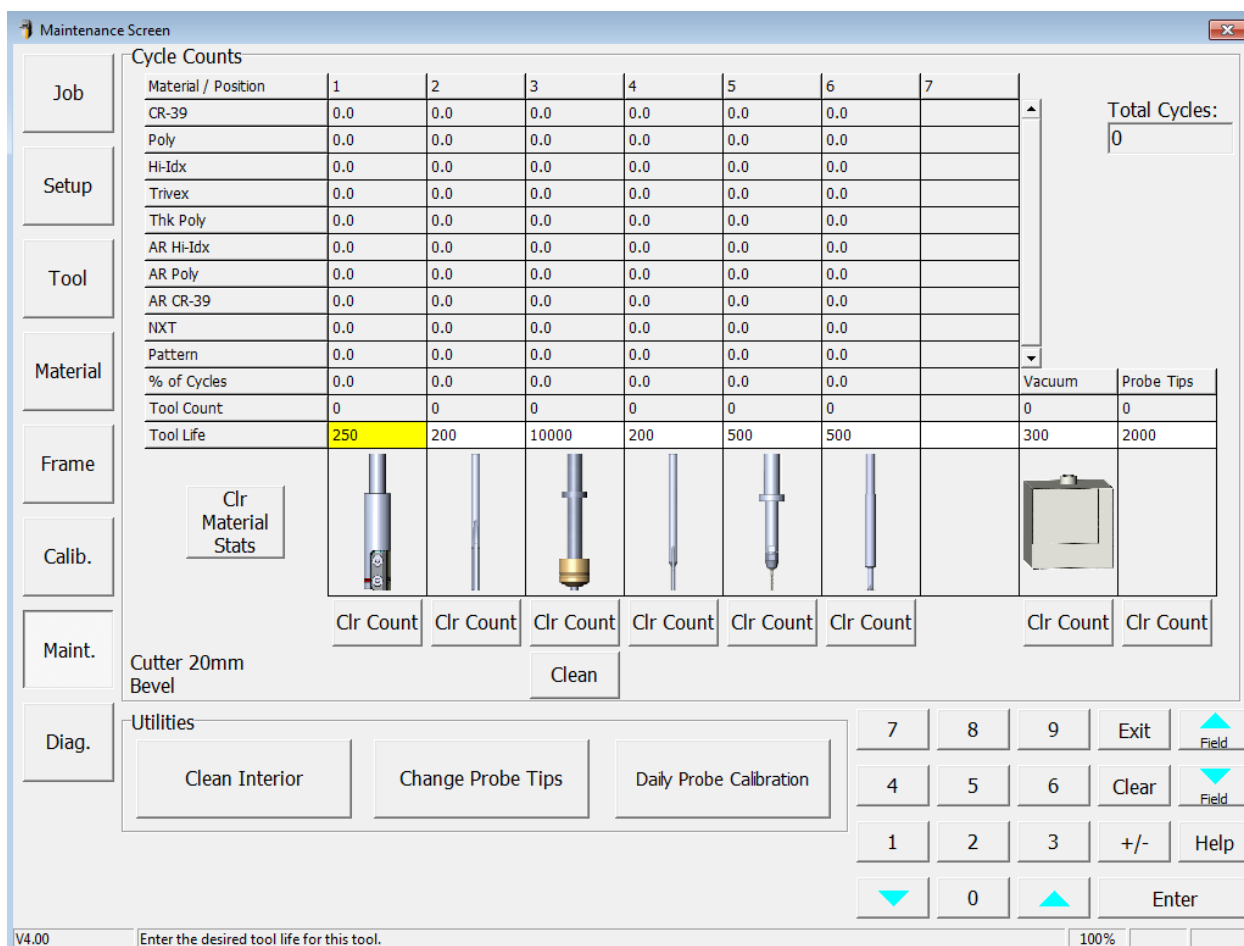
The manufacturer and seller disclaim all responsibility for damage caused by tampering with safety interlocks or from maintenance operations performed by unauthorized staff, or for malfunctioning due to the use of non-original spare parts.

Maintenance of the ES-curve is of three categories:

- **Cleaning**: Can be performed directly by the operator; it requires no special expertise beyond familiarity with the machine's operation.
- **Routine Maintenance**: Is scheduled according to a maintenance plan and can be carried out by the end user provided they have been properly trained.
- **Extraordinary Maintenance**: May be scheduled or performed as-needed (i.e., in the case of machine failure). In either case, extraordinary maintenance should only be performed by the manufacturer's technical staff.

## **Maintenance Screen**

Most expendable maintenance items used by the ES-curve require cleaning or replacement based on the number of edging cycles since the last maintenance. This information is visible on the *Maintenance Screen*.



**Figure 4.1: Maintenance Screen**

**Maintenance Cycles:** The statistics in this area show how many types of cuts have been performed and the material used. These cycles are usually used to record statistics for the life cycle of the ES-curve; however, a lab manager may use them for other accounting analyses.

- **Tool Count:** Current number of cycles with that tool.
- **Tool Life:** Maximum number of cycles for that tool. (Adjustable by the user.)
- **Clear Material Stats:** Clear all the maintenance cycle statistics.
- **Clr Count:** Clears the tool count for that tool.
- **Clean:** Initiates an automatic routine to clean the specified polish wheel. Follow on-screen instructions.
- **Utilities:**
  - **Clean Interior:** Initiates a routine to store sharp tools and move carriages for cleaning.
  - **Change Probe Tips:** Used to place the probe tips in accessible position for changing and initiates the appropriate calibration routine.
  - **Daily Probe Calibration:** Initiates a probe tip calibration for optimum bevel placement. After this step, check the bevel and groove placement by referring to the “Check Bevel Placement” and “Check Groove Placement” sections of the manual.

## Routine Maintenance

Routine maintenance comprises periodic operations that can be performed by the operator or by a specialized technician of the user's company.

**Cleaning:** Basic cleaning should be performed every day or more often if the machine becomes clogged with debris.


	Wear a respirator mask when cleaning chips and debris.
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To access the machining area for cleaning:

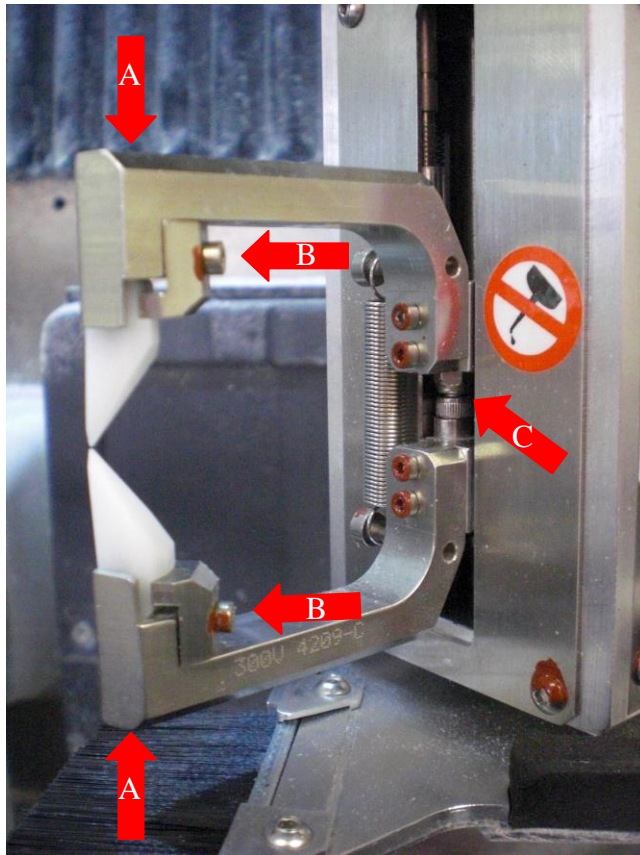
1. Initiate the cleaning routine by pressing "Clean Interior" from the *Maintenance Screen*.
2. Grasp the upper front cover on each side of the door opening and lift the cover.
3. Using a soft brush as provided in the accessory kit, sweep chip debris to the collection basin.
4. Follow on-screen instructions to move carriages for cleaning.

To access and clean the built-in vacuum system:

1. Grasp the recess on the right side of the lower panel and pull to swing open.
2. Unlatch the two clasps on top of the vacuum unit to access the vacuum chamber. Detach the cloth bag from the throat of the tube at the top of the vacuum chamber and dispose of chips and debris in the bag.
3. Use an industrial vacuum cleaner to remove chips and debris in the vacuum chamber.
4. Re-attach the cloth bag to the tube. Latch the vacuum chamber shut. Close the panel.

	Compressed air must not be used for cleaning as there is the risk of distributing the debris instead of removing it. Use cloths soaked in a mild detergent to remove stubborn dirt. Use protective gloves.
---	--

**Probe Tip Replacement:** The upper and lower probe tips should touch without any gap between them as shown below. To initiate the tip replacement, press **Change Probe Tips** from the *Maintenance Screen*. This will move the probe tips into position for easy access. Each tip is secured by a screw inserted from the back of the probe tip (“A”), and clamped with a screw from the side (“B”). If the probe tip spacing needs to be adjusted, use the screw and jam nut between the probe arms (“C”). Follow the on-line instructions to calibrate the probe after tip replacement.



### **Extraordinary Maintenance**

Extraordinary maintenance refers to those cases in which parts must be replaced due to breakage or wear, or the electronic/computer subsystems are not working properly. Such maintenance requires specialized training not normally available at the end user's site. Consult the factory when extraordinary maintenance appears to be required.

## Maintenance Frequency

Maintenance operations and suggested frequencies are stated in the following table.

ES-curve Maintenance Schedule							
Maintenance Item	Every 250 Cycles	Every 750 Cycles	Every 5,000 Cycles	Every 10,000 Cycles	Every 30,000 Cycles	Every 60,000 Cycles	Description
Tool Life	X						Check Tool Life on Maintenance Screen. Change and calibrate as necessary.
Probe Tip Spacing	X						Ensure probe tips are touching. Replace and calibrate as necessary.
Vacuum Bag	X						Empty vacuum bag. Vacuum inside of bag chamber as necessary.
Polish Fluid	X						Check reservoir fluid level. Refill as necessary with distilled water.
Mister Flow	X						Check for proper air / fluid mixture. Adjust as necessary.
Mister Direction	X						Check for proper direction of mister spray. Adjust as necessary.
Clamp Pad	X						Check clamp pad for wear and / or debris. Replace as necessary.
Lens Clamp	X						Check for free movement of lens clamp. Replace as necessary.
Clean Interior		X					Turn on internal vacuum. Raise hood and wipe interior with soft brush.
Clean Accordion Shield		X					Use external vacuum crevice tool to clean top of accordion dust shield.
Clean Probe Assembly		X					Use external vacuum crevice tool and air gun to clean probe assembly.
Clean Vacuum Interior		X					Open vacuum bag chamber and clean with external vacuum crevice tool.
Clean Vacuum Filter			X				Remove vacuum filter grid and filters. Clean filters and filter chamber.
Clean Rear Air Filters			X				Remove air filters and blow out dust. Clean in warm soapy water.
Clean Compressed Air Filter			X				Check incoming air filter / regulator. Flush and clean filter.
Replace Clamp Pad			X				Replace lens clamp pad.
Replace Probe Tips			X				Replace probe tips. Calibrate probe.
Clean Under Probe Cover			X				Remove probe cover and use vacuum crevice tool and air gun to clean around probe and spindle.
Replace Vacuum Bag				X			Replace vacuum filter bag to ensure good dust collection and filtration.
Replace Rear Filters				X			Replace rear filters to ensure good air flow.
Clean Rear Cabinet					X		Remove rear covers and clean any debris.
Clean Chiller Coils					X		Remove chiller and clean bottom coils. Coils are fragile; do not damage.
Chiller Fluid Levels					X		Check chiller liquid level. Top off as necessary.
Replace Lens Clamp					X		Replace lens clamp.
Clean Ball Screws					X		Clean using a cloth dampened with solvent.
Replace Vacuum Filters						X	Replace vacuum filters under vacuum grid.
Replace Chiller Fluids						X	Bleed and replace with proper mixture of water and Ethylene Glycol.
Check Belt Tensions						X	Check ball screw belt tensions. Tighten as necessary.



# Appendix A: General Specifications

## Machine Identification

ES-curve Ophthalmic Lens Edger

## Name and Address of Manufacturer

National Optronics  
100 Avon Street  
Charlottesville, VA 22902  
Tel: 434-295-9126

## Name and Address of Manufacturer's Representative for Service:

USA	Europe	Asia
National Optronics 100 Avon Street Charlottesville, VA 22902 Tel: 434-295-9126	Satisloh GmbH Wilhelm-Loh-Straße 2-4 35578 Wetzlar Tel: +49 6441 912 222	Satisloh Asia Ltd. Sino Industrial Plaza 9 Kai Cheung Road Kowloon Bay Hong Kong Tel: +852 2756 7654

## External Connections

Electric power supply  
Pneumatic air supply  
USB data connectors (3)  
Hand Wheel controller connector  
25-pin subminiature D-connector (DCS serial communications)  
15-pin subminiature D-connector (Automation barcode reader)  
RJ-45 Ethernet connector (DCS Ethernet communications)

## General Specifications

*Note: In the following table, if no value is shown for an item in the Automatic column, the item assumes the same value as in the Manual case.*

GENERAL DATA			
		Manual	Automatic
Clearance dimensions (W x D x H)		710x1484x1832 mm 28x58x72 inches	1321x1585x1832 mm 52x62x72 inches
Minimum ceiling height		2290 mm 91 in.	
Total weight		665 kg 1465 lbs.	725 kg 1600 lbs.
Electrical	Voltage	3 Phase 200-480 VAC	
	Frequency	50/60 Hz	
	Power	6 KVA	
	Connection	3 Poles, Ground	
Maximum diameter of the piece being machined		90 mm	
Minimum diameter of the finished piece	Smooth edge	21 mm	
	Mitered edge	23 mm	
Airborne noise emissions			
Movements			
Lateral run	X axis	350 mm	
Longitudinal run	Y axis	200 mm	
Vertical run	Z axis	100 mm	
Oscillation (tilting)	B axis	90° anti-clockwise 55° clockwise	
Rotation	C axis	360°	
Spindle			
Spindle power		460 W	
Spindle speed		0-30,000 RPM	
Type of tool-holder taper		ISO 10	
Tool Store			
Tool storage capacity		7	
Pneumatic Supply			
Air pressure		85 PSI 6 BAR	
Air consumption		11 CFM 300 ltr/min	14 CFM 400 ltr/min
Central Vacuum System (if applicable)			
Air flow		100 CFM 2800 l/min	
Lift		80 inches water 200 cm water	
PC Connection			
Type of connection with remote PC		File transfer: USB 1.0/2.0 DCS communications: Ethernet DCS communications: RS-232	



# Appendix B: Certifications & Standards

## Laws and Directives

The ES-curve is in conformity with the following requirements and provisions of Directives:

- 2004/108/EG:** Relating EMC Directive
- 2006/95/EG:** Relating to Low Voltage Directive
- 2006/42/EG:** Relating to Machinery Safety

The standards listed have been used as references in order to gain the CE marking:

<b>EN ISO 12100-1:2003 + A1:2009</b>	Safety of machinery – Basic elements, general design guidelines, Part 1: Basic terminology, methodology
<b>EN ISO 12100-1:2003 + A1:2009</b>	Safety of machinery – Basic elements, general design guidelines, Part 2: Technical guidelines and specifications
<b>EN ISO 14121:2007</b>	Safety of machinery – Risk assessment, Part 1: Guidelines
<b>EN ISO 13849-1:2006</b>	Safety of machinery – Safety-related parts of control systems – Part 1: General design guidelines
<b>EN 60204-1:2006</b>	Safety of machinery – Electrical equipment of machinery – Part 1: General requirements
<b>EN 61000-6-2:2005</b>	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Interference immunity for industrial areas
<b>EN 61000-6-4:2007</b>	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Electromagnetic interference for industrial areas

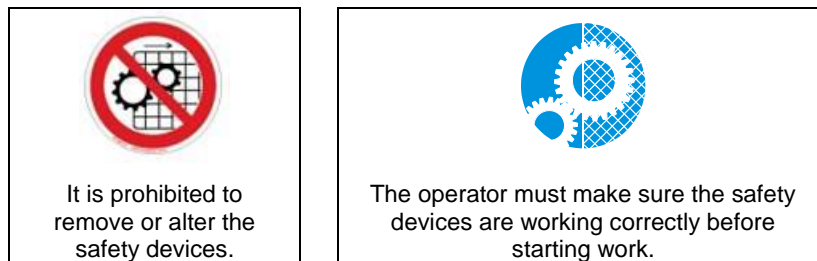
## FCC Class A Device Compliance

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

# Safety Devices

- **Mechanical end runs** have been mounted to prevent damage caused by excess movement along the X-Y-Z axes.
- In order to prevent **accidental contact with moving parts**, interlocked mobile protection has been designed and implemented in transparent, shock-proof material that also acts as **protection against the risk of projection of materials**.
- An **emergency stop button** and lid lock have been installed on the right of the operator position.
- Another **emergency stop button** is present on the control hand wheel.

The emergency stop buttons intervene by isolating all energy sources with immediate shutdown of movement.



The removal of safety devices can only be allowed for maintenance operations by staff trained especially regarding maintenance and who have explicit authorization and training. Any maintenance or repair which involves removing or disabling safety devices should only be performed after this instruction manual has been read thoroughly.

# Signs

The edger has the following signs for the operators:



# Residual Risks

The ES-curve edger has been designed and constructed to provide safe and dependable service, thanks to the constant study and application of the applicable standards. However, some residual risks must be highlighted that depend upon the installation environment, training of the staff in charge, and the materials to be machined.

Use of the machine will produce dust and residue. The user must keep the machine suitably clean in order to prevent the accumulation of chips and debris causing, for example, a greater effort in machining or difficult mechanical movement. Excessive effort of the tool due to the particular hardness of the material or incorrect programming of the work parameters (axes speed, rotation speed of the milling cutter, etc.) can cause the tool to break, possibly causing fragments of the tool or work piece to be ejected at high speed. The case surrounding the machining area is designed to resist the projection of chips. Any fluid spills or leaks should be cleaned promptly to prevent slippery conditions around the machine.

The machine has been designed to work resin materials only. Other material could cause excessive effort, quick wear of the tool, or tool breakage with expulsion of tool and work piece fragments.

	<p><b>Do not remove protections!</b></p> <p>It is prohibited to test tools with the cabinet open. For any other tests that can be performed with the guard open, e.g. in the case of maintenance by specialized staff, the person in charge must wear protective gloves and goggles.</p>	
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# Appendix C: Certificate of Compliance

Manufacturer:



**National Optronics**

100 Avon Street  
P.O. Box 1547  
Charlottesville, VA 22902

Authorized Representative:

The logo for Satisloh GmbH, with the word "satisloh" in a bold, blue, lowercase sans-serif font and a registered trademark symbol (®) to the upper right.

**Satisloh GmbH**

Wilhelm-Loh-Str.2-4  
35578 Wetzlar

## DECLARATION OF CONFORMITY

National Optronics, a manufacturer of precision lens processing equipment used in the ophthalmic industry, declares that the product(s) described hereafter:

**ES-curve** : **Multi Axis Lens Edger**  
**Serial No.** : \_\_\_\_\_

is in conformity with the following requirements and provisions of Directives:

**2004/108/EG:** relating EMC Directive  
**2006/95/EG:** relating to Low Voltage Directive  
**2006/42/EG:** relating to Machinery Safety  
**2011/65/EC:** relating to Restriction of Hazardous Substances

The standards listed have been used as references in order to gain the CE marking:

<b>EN ISO 12100-1:2003 + A1:2009</b>	Safety of machinery – Basic elements, general design guidelines, Part 1: Basic terminology, methodology
<b>EN ISO 12100-1:2003 + A1:2009</b>	Safety of machinery – Basic elements, general design guidelines, Part 2: Technical guidelines and specifications
<b>EN ISO 14121:2007</b>	Safety of machinery – Risk assessment, Part 1: Guidelines
<b>EN ISO 13849-1:2006</b>	Safety of machinery – Safety-related parts of control systems – Part 1: General design guidelines
<b>EN 60204-1:2006</b>	Safety of machinery – Electrical equipment of machinery – Part 1: General requirements
<b>EN 61000-6-2:2005</b>	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Interference immunity for industrial areas
<b>EN 61000-6-4:2007</b>	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Electromagnetic interference for industrial areas
<b>768/2008/EC</b>	Common framework for marketing of products, Annex II, Module A

This declaration is issued under the sole responsibility of National Optronics.

SIGNED: \_\_\_\_\_

**Andreas Huthoefer**  
CEO, National Optronics

DATE: 12-May-11