

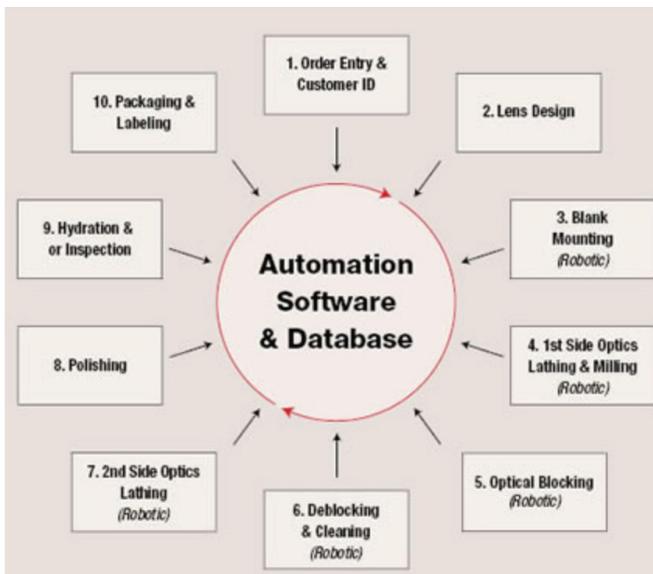
Integrated Lens Manufacturing

Overview

Integrated Lens Manufacturing (ILM-3) is a lens manufacturing process developed and refined over the past 12 years. In ILM, each lens manufactured has a discrete identity. This identity is defined by order number and the bar code numbers associated with each portion of the manufacturing process:

- base curve manufacturing and blocking
- front curve manufacturing and hydration
- inspection, packaging, labeling and shipping

These three separate bar codes are associated with each lens from the first machining step through labeled vial. All data associated with each lens, including the order, the practitioner, the patient and all manufacturing data from each step is saved in the Oracle 10 database of ILM-3. ILM is designed for robotic handling of parts. Manual part handling can be substituted for robots, but with a substantial loss in productivity. A 2-cell ILM-3 operated at full capacity and using ILM's validated statistical parameter verification will require approximately 1/5 of the manpower of a traditional manufacturing process. All lathe calibrations for radius and sphere are automatically performed using ILM.



Technology

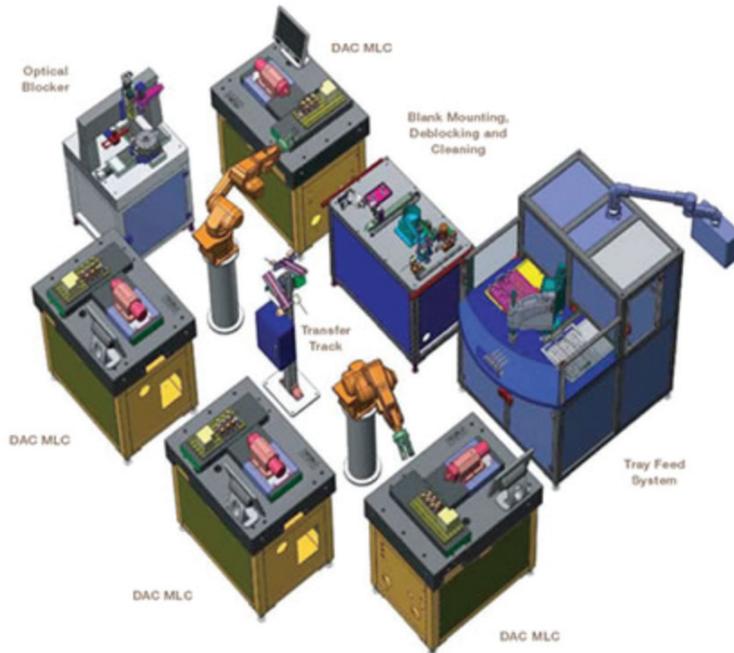
ILM utilizes the following manufacturing technology components in a fully integrated system:

- The Benz precision collect/spindle assembly with Benz mandrels
- The Benz Optical Blocker
- The Benz ILM automation program utilizing an Oracle 10 database
- Custom ILM part handling robot effectors
- Re-calculation of the front curve radius for every part based on the actual measured base curve radius
- Real-time re-calibration of all lathes for radius and sphere
- Design front end program for spherical and toric lens designs that is accessible for further customization by each manufacturer
- Windows-based operator interface for all manufacturing operations including Order/Entry, Maintenance, Quality Control, Inspection, Packaging, Labeling, Shipping and interface to QuickBooks accounting software for automatic billing options.

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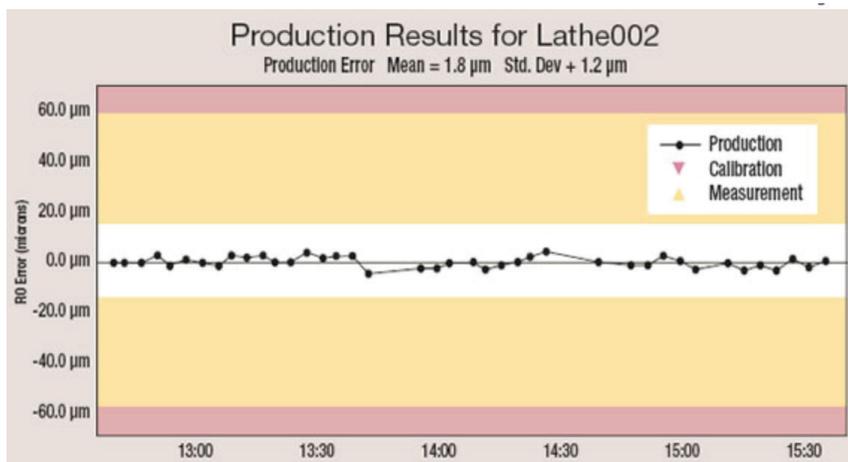
Operations

The system can be used in three modes: semi-auto and fully auto, or any combination at the same time. The system allows the process manager to select each machine mode, thereby optimizing operation time and allowing for other functions like calibration, maintenance, diamond change, that take a single machine off line while the remaining equipment remains in automation.



Auto-Lathe Calibration

Auto-lathe calibration feature allows for automatic adjustments to be made to all the lathes in the system for radius and sphere. During start-up, two calibration parts are machined on each lathe, one to calibrate and a second to verify both the radius and the sphere adjustments. During production, calibration parts can be automatically run on the lathes in the system at an interval chosen by the operator. Lathes can be maintained to tighter operational tolerances using the precision of the Optical Blocker inspection and the auto-calibration feature. All base curve lathes are 100% monitored because all base curves are optically inspected before being blocked.



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Productivity

The productivity of ILM-3 has been extensively studied at BRD. We have tested a 2-lathe, 1-blocker, 1-robot cell for more than three years. In the ILM-3 approach, prismatic, stabilized custom toric lenses are manufactured by first machining the base curve, toric cylinder, complete edge, front bevel and diagnostic marks all on a DAC ALM OTT lathe during the base curve operation. After the base curve step, the part is taken directly to the optical blocker, where the part is optically inspected for major and minor radius and blocked off set from the center to create the prism stabilization. The toric cylinder angle is also set via the blocker rotary table at this time. After blocking the robot takes the part to the automated deblocking and cleaning station.

The robot then picks up the blocked part with cleaned mandrel and places it into the front surface lathe. Finished lenses are placed in the finished lens output track. The base curve manufacturing cycle time for toric lenses made from Benz-G materials averages 3.5 minutes. This determines the production rate of a single cell ILM-3 system at approximately 17 toric lenses per hour.

By adding 1 ALM OTT lathe, transfer track and robot to the above single cell ILM-3 system, creating a second 1 lathe cell for front surface, twice as many base curve operations can be performed in the same time or approximately 34 toric lenses per hour. The number of operators remains the same, only the productivity doubles.