

Integrated Lens Manufacturing

Overview

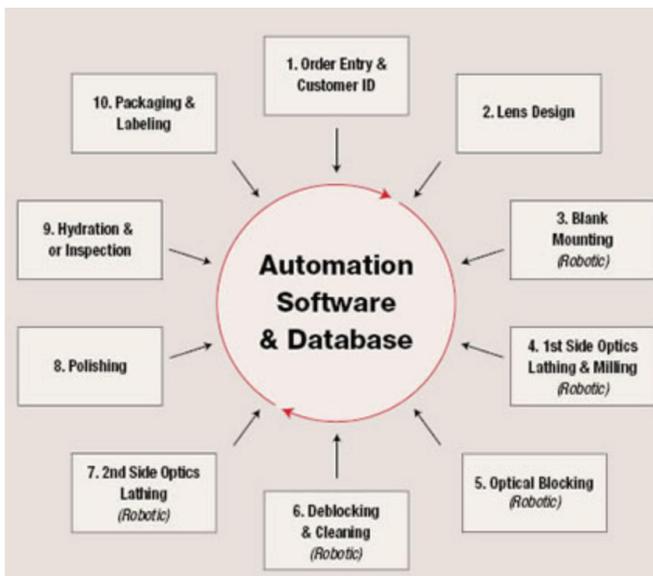
Benz Research & Development's proven Integrated Lens Manufacturing (ILM-3), is a lens manufacturing process developed and refined over the past 13 years. In ILM, each lens manufactured has a discrete identity. This identity is defined by order number and the bar code numbers associated with each portion of the manufacturing process:

- First side manufacturing and blocking
- Second side manufacturing, polishing and hydration
- Inspection, packaging, labeling.

All data associated with each lens, including the order, and all manufacturing data from each step is saved and stored in the Oracle 10 database of ILM-3.

ILM-3 consists of an automation program that coordinates all automation steps and storage of all data associated with each order including machining parameters created by the front end Design Program for use in each manufacturing step. The automation program also coordinates the activities and movements of the tray feed system, blank mounting, lathes, optical blocker, drill, deblocker and robots. ILM is designed for robotic handling of parts. Manual part handling can be substituted for robots, but with a substantial loss in productivity. ILM operated with robots will require approximately 1/8 of the manpower of a traditional manufacturing process. Also, all lathe calibration for radius and sphere are automatically performed using ILM.

The illustration below shows the flow of information and instructions including all robot moves and bar code reads coordinated by the automation program.



Technology

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

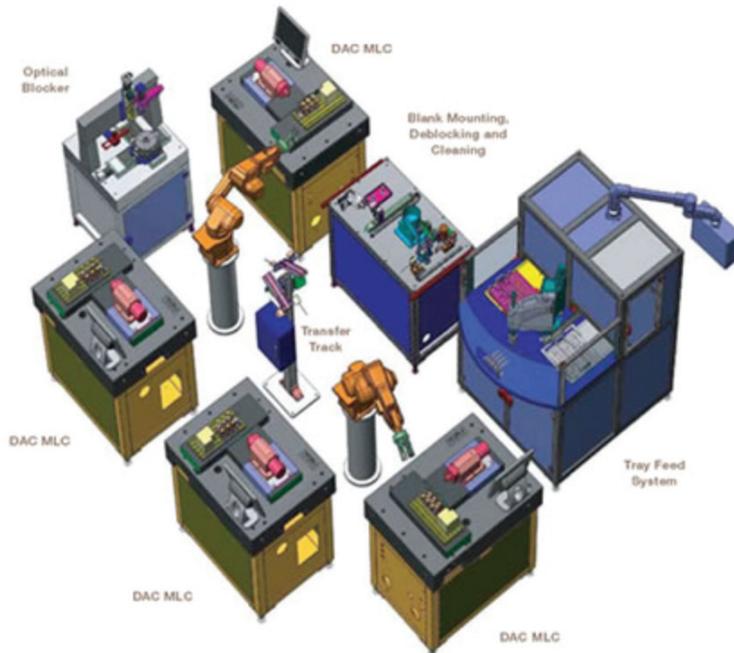
- The Benz precision collet/spindle assembly with Benz mandrel
- The Benz Optical Blocker
- The Benz IOL Drill
- The Benz Tray Feed System
- The Benz Automatic Blank Mounting System
- The Benz Automatic Blank Deblocking System
- The Benz Solvent Cleaning System
- The Benz ILM automation program utilizing an Oracle 10 database
- Custom ILM part handling robot effectors Re-calculation of the second side radius for every part based on the actual measured first side radius
- Real-time re-calibration of all lathes for radius and sphere
- ILM in-feed and out-feed tracks with bar code readers and sensors

Technology continued

- 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, and Auto Calibration.
- Automatic laser profiling of aspheric surfaces
- Automatic video inspection of haptic milling

Operation

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. Adding cells and rearranging equipment within cells is easy through the secure operator interface. There is no limit to the size of an ILM system imposed by the Benz Automation Program.



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 first side lathes are 100% monitored because all base curves are optically inspected before being blocked.

