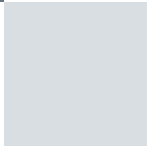


Precision Optics





Satisloh - the company

Satisloh - a company with over 120 years invaluable optical experience.

Satisloh supplies complete solutions for precision optics and ophthalmic manufacturing - equipment, consumables, tools, services and process knowledge from one source – for surfacing and coating.

Focus on customer solutions

Making our customers more successful is our goal. We want to shape the future of optical manufacturing and provide cutting edge technology solutions for factories and customers of all sizes.



Making our customers more successful is our goal.

Worldwide presence – local support

With our service technicians at 12 locations, Satisloh is close to you. Reach a Satisloh specialist by telephone or internet, supported by our logistic centres in Wetzlar (Germany), Germantown (WI; USA) and Hong Kong.

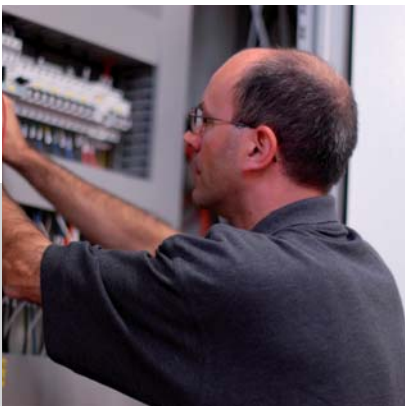


Innovation and integration

The driving force for our customers and Satisloh is innovation. No other company in the optical industry offers their customers the same number and quality of innovations. Satisloh derives its R&D projects from market intelligence, dialogue with customers and valuable business partners.

Team spirit

Employees are our most important asset. Our quality standards are reflected in continuous training and development. The leadership style encourages team building, decision making and always focuses on customers.





Precision Optics

Own identity within Satisloh

Satisloh designs and manufactures surfacing and coating solutions for precision optics and ophthalmic applications. It is obvious, that customer needs and technologies for precision optics differ from ophthalmics.

As a logical consequence, the precision optics activities were reorganized in 2007 to establish an independent market oriented business unit. This new structure gives the two main business units more autonomy and an even greater focus on specific customer demands.

The business unit structure includes independent technology, sales, application engineering, production and service personnel.

Market

Typical markets, where precision optics machinery is used, are optical components and systems, medical devices, camera manufacturing, aerospace, semiconductor lithography and defense industries.

The optical industry covers an enormous range of applications and uses many different materials and manufacturing processes. The solutions chosen for optical manufacturing range from dedicated high-throughput, single application machines, e.g. replication tools, for high volume production, to versatile, programmable machines for small/medium production volumes and varying applications. Satisloh's CNC-machines offer the desired flexibility and adaptability to varying specifications, as well as fast time-to-market even when changing production between different work geometries. Our products are tailored to meet the demand for both extraordinarily high production speed and excellent precision.



Shaping the future of optical manufacturing.

Applications

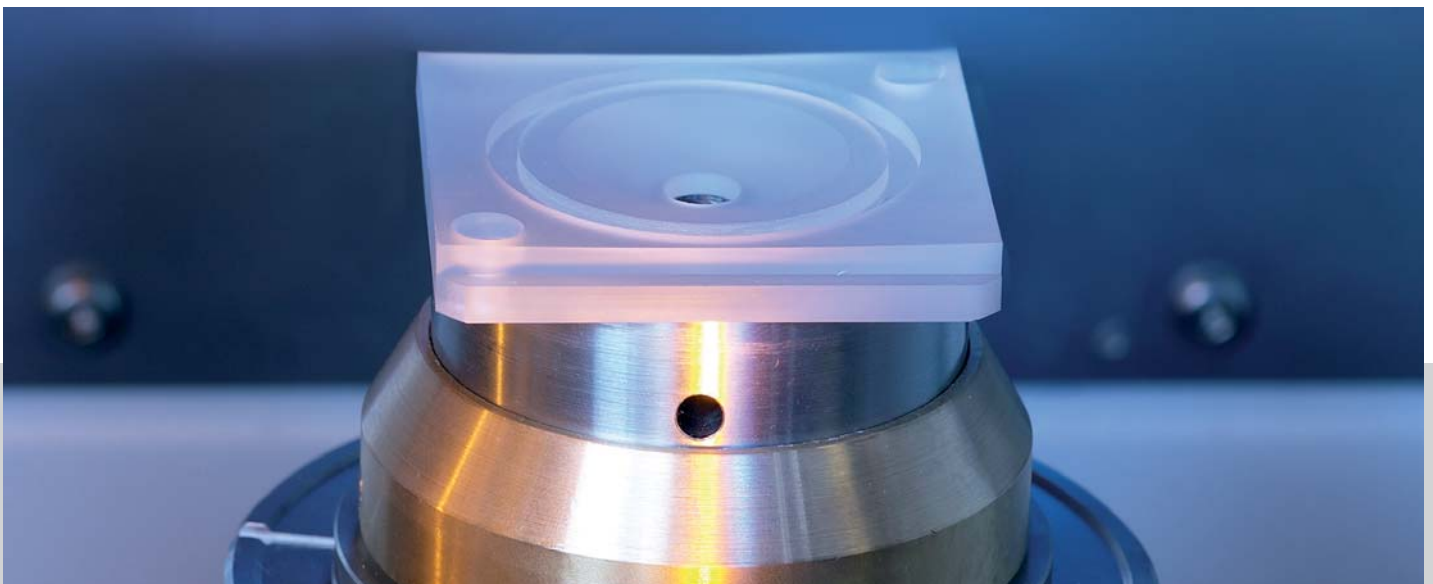
Our core competence is the processing of hard and brittle materials with a clear focus on optical applications. Satisloh's success is based on providing complete manufacturing solutions, including both equipment and processes.

Typical materials that our equipment processes are glass, crystals, ceramics, semiconductors (IR-materials), hard metal.

The main process steps consisting of grinding, polishing, centering and coating can easily be combined with additional production steps such as edging, chamfering, sawing and drilling, facilitating the manufacturing of very complex components.

Dimensions from below 1 mm to typically 500 mm diameter and a wide range of geometries are covered, for instance:

- Convex/concave spheres and aspheres
- Domes
- Cylindrical surfaces
- Prisms, plano
- Free-form, multi-focal and off-axis optics

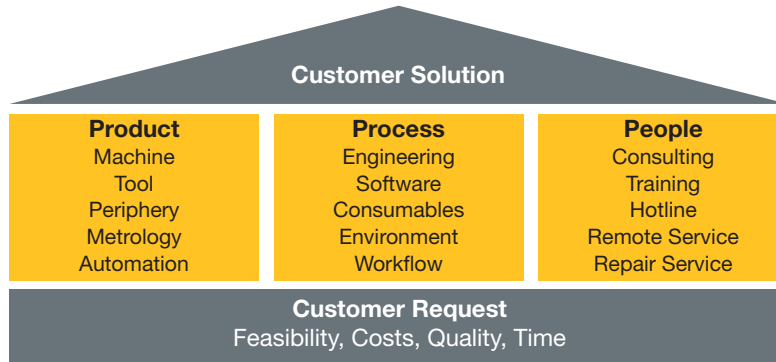


Precision Optics Processing Solutions

Optical manufacturing requires optimally balanced processing components: machinery for grinding, polishing, centering, measuring and coating equipment.

Experience in process engineering is a prerequisite to be able to specify appropriate tools, consumables, software and technical services.

Satisloh provides proven complete solutions for precision optics manufacturing, which perfectly fit together.



Machine Overview

Satisloh solutions at a glance

| Machine model | Standard work piece dia. mm | Geometries | | | | Surfacing | | | | | | | | | | Coating | | | | | | |
|-------------------|-----------------------------|----------------|-----------|------------|-----------|----------------------|----------|--------|----------|------------------|-----------------------|-----------------------------|----------------|-----------|-----------------|----------------------|---------------------------|--------------|---------------|------------------------------------|----------------|---|
| | | prisms (plano) | spherical | aspherical | free-form | generating, grinding | drilling | sawing | scooping | free-form edging | polishing, pre & fine | aspherical shape correction | metrology link | centering | laser venturing | beveling, chamfering | automated handling system | BBAR coating | super-hard AR | high durability AR (autoclav-safe) | filter-coating | |
| Generating | | | | | | | | | | | | | | | | | | | | | | |
| GI | 500 | s | s | s | s | s | o | o | o | o | o | o | o | o | o | s | | | | | | |
| SPM-140 | 140 | | s | s | s | s | o | o | o | o | o | o | o | o | o | s | o | | | | | |
| SPM-60 | 80 | | s | s | s | s | o | o | o | o | o | o | o | o | o | s | o | | | | | |
| SPM-55 | 60 | | s | | | s | | | | | | | | | | s | | | | | | |
| SPM-30 | 30 | | s | o | | s | | | | | | | | | | s | o | | | | | |
| PR-150 | 150 | s | | | | s | o | | | | | | | | | s | | | | | | |
| Polishing | | | | | | | | | | | | | | | | | | | | | | |
| SPS-140 | 140 | | s | s | s | | | | | | | s | o | o | | | | | | | | |
| SPS-60 | 60 | | s | s | s | | | | | | | s | o | o | | | | | | | | |
| SPS-55 | 60 | | s | | | | | | | | | s | | | | | | | | | | |
| SPS-30 | 30 | | s | o | | | | | | | | s | | | | | | | | | | |
| Centering | | | | | | | | | | | | | | | | | | | | | | |
| C-2 | 300 | | s | s | o | | | | | o | | | | | s | o | s | | | | | |
| CM-2 | 50 | | s | s | o | | | | | o | | | | | s | o | s | o | | | | |
| Coating | | | | | | | | | | | | | | | | | | | | | | |
| SP-100 | 100 | s | s | s | s | | | | | | | | | | | | | | s | s | s | s |

standard = s optional = o

For further options or customization, please contact your local sales.

Generating

Satisloh offers a comprehensive range of CNC grinding machines covering working ranges from < 1 mm to 500 mm. These machines are dedicated to high precision and extremely reliable performance under the high work load imposed by the processing of very hard and

brittle materials such as glass, ceramic, crystals, sapphire, hard metal, etc. The virtually unlimited variety of optical manufacturing solutions ranges from multifunctional 5/6-axis production of complex prisms to sawing, drilling, scooping of domes and

a/spherical as well as free-form grinding. An operator-oriented user interface, integrated quality control system (IQS) compensating tool wear, and process simulation guarantee easy-to-use operation and high production output.



GI

The G-System is a 5/6-axis processing center for complex high performance components manufacturing. The GI processes work piece diameters up to 500 mm (prisms 310 mm envelope circle).

The G-System offers unmatched process flexibility, including steps like drilling and sawing. Highest surface quality, consistent accuracy and long time stability of processes are superior features of this machine series.



SPM-140

The SPM-140 is part of the same modular system family as the SPM-60, but for larger work pieces. Innovative 2-tool spindle technology enables the production of highly sophisticated aspheres in both disk and cup wheel modes in the same machine.

Flexibility and performance elevate both SPM-140 and SPM-60 into compact processing centers.



SPM-60

The 60-series is designed for the fast and economic production of lenses up to 80 mm in diameter, or even higher depending on the lens design. SPM-60 stands for a modular system platform enabling application specific grinder and polisher variants.

The fully loaded system configuration with two 2-tool spindles enables in total four different tools and optionally complete 2-side processing of lenses with automated loading system and flip-over function.



SPM-55

The SPM-55 is a fast and cost-effective CNC grinding solution for spherical work. Pre- and fine-grinding from diameter 10 up to 60 mm. The machine also features a motorized Y-axis for cross-cut adjustment. The integrated Bosch Rexroth MTX controller

and our Satisloh user guided interface make operation easy.



SPM-30

The Micro Series is the world-wide leading CNC manufacturing solution for micro-optics, featuring air bearing spindle technology for up to 80000 rpm. The SPM-30 covers the diameter range of lenses from <1 to 30 mm. The variety of functions of the Micro machines

include pre- and fine-grinding in one cycle, edging, chamfering, steps, radial grooves and tool dressing. In addition an upgrade for aspherical processing and an automated loading system is available.



PR-150

The PR-150 is a dedicated prism grinding tool, capable of processing numerous different prism surfaces as well as different facets and radii in only one cycle. It grinds extremely accurate angles of the plano surfaces, also enabled by the high accuracy of 30" of the rotational

axis. Variable programming of the feed rate allows the machine to adapt the process to the geometry of the work piece.

Machine Types

Polishing

CNC polishing is the ideal tool for fast and precise results. Satisloh polishers are precision machines, which can be equipped with in-machine dressing of the polishing tools - a prerequisite for achieving ultimate form accuracy.

Besides the working range, our polishers are characterised by the number of CNC-axes and the range of processes. Processes range from fast spherical polishing in Synchrospeed mode, to Variospeed processing and aspherical polishing methods.

Basic corrective polishing as well as deterministic polishing (ADAPT) are available on all Satisloh polishing machines.



SPS-140

The SPS-140 is part of the same modular system family as the SPS-60, but for larger work pieces. Innovative 2-tool spindle technology enables a fast and efficient spherical polishing process.

Advanced corrective polishing technology for aspheres enables customers to prepare lenses "ready for super finish". Removable dressing spindle for using max. work space.



SPS-60

The modular system design of the 60-series can be configured for spherical and aspherical polishing. Multiple step polishing enables both time savings as well as exceptionally low form error. The high shape accuracy and long-term

process stability can be achieved by separating the polishing in a fast pre-polishing step, followed by a fine-polishing step with very low tool wear. An integrated tool dressing function is available.



SPS-55

The SPS-55 is a fast and cost-effective CNC polishing solution for spherical work. The machine also features integrated tool dressing using a motorized Y-axis for the cross-cut adjustment.

The integrated Bosch Rexroth MTX controller and our Satisloh user guided interface make operation easy. The SPS-55 is ideally suited for the diameter range 10-60 mm, and 10-∞ mm radius.



SPS-30

The SPS-30 is the perfect match to the SPM-30 grinder. Suitable for polishing of spheres in Synchrospeed mode as well as aspherical shapes. The machine is equipped with an additional dressing tool spindle.

The full Micro-Line, consisting of SPM-30, SPS-30 and CM-2 machines, offers unsurpassed performance in small optics for spheres and aspheres.



Centering

The Centromatic series sets the state-of-the-art for the edging and centering of lenses and other work pieces that find applications in precision optics. It is also used for the free-form edging of windows, watch glasses and integrated optoelectronics devices. The centering chucks are manufactured under

highest quality standards; in addition the machines can be equipped with a laser system. Economy, flexibility and quality of the work pieces are the most notable characteristics of Satisloh's well-proven centering technology. The impressive range of functions is continuously expanded.

Latest examples include the precision edging of steps and facets on aspheres using center thickness calculation for aspherical (front side) surfaces. Processing lenses cemented on exchangeable high precision holder complete the functions on this machine.



Centromatic C-2

The C-2 offers an extensive working range from 10 to 300 mm diameter. The rotational axis of the centering spindle is designed as CNC axis. This permits machining of non-circular outer contours of the work pieces.

The user-friendly software automatically calculates the processing program according to the geo-metry data entered, and checks the plausibility of the process.

Centromatic Micro CM-2

Precise centering and edging of small lenses is a very delicate process, therefore the machine's clamping and processing must be extremely sensitive and accurate. The CM-2 perfectly meets this demand. The CM-2 can process lenses from approx.

1 to 50 mm in diameter very accurately. The clamping pressure can be finely adjusted to a very low force. The CM-2 also supports front lens processing on a clamping chuck. Automated loading is an available option.

Coating

Dependent on the application, Satisloh offers multiple coating technologies, ensuring top notch results. For precision optics applications, sputtering has become our main focus.

Sputtering optical thin films offers a variety of advantages: high quality of films, very durable hard coatings, and absence of particle contaminations.

Furthermore the sputtering process is very stable and easy to control.



SP-100

The SP-100 represents an extremely fast and flexible sputter coater with multiple process possibilities. The machine allows highly uniform coatings ($\pm 0,25\%$). The easily adaptable layer deposition process is suitable for organic and mineral substrates.

The SP-100 produces excellent broadband AR coatings with low residual reflections across the entire visible wavelength range. It is also ideally suited for ultra-hard AR coatings on substrates such as Sapphire, low tolerance NIR filters and Rugate type layer systems with variable indices from $n = 3.3$ down to 1.46.

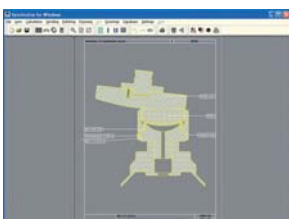
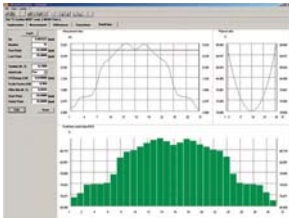
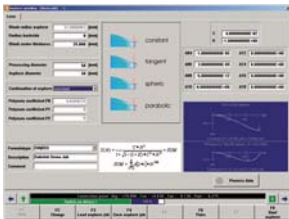
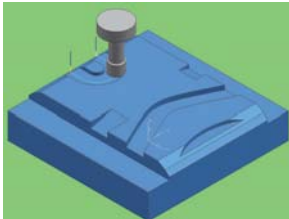
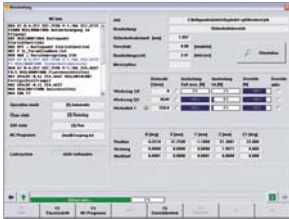


Software Solutions

Besides high precision CNC machines Satisloh offers a wide spectrum of software solutions. Today's programs are designed to lead the user to the desired results, directly and in a timely manner. The standardized graphical user interface Satisloh BaSyS provides a tool for all grinding and polishing machines that allows the operator to easily create programs for all the various applications.

It is possible to add application specific modules like drilling, dicing, scooping or G-code scripts in order to fulfill all requirements of modern lens production. Programming complex geometries via CAM systems is possible with the postprocessor CAMPos. The Synline software helps to create the drawings for the required tools and receptions.

Satisloh's DataCorrect software is the link between the metrology tool and the grinding or polishing machine and allows to apply corrections of the process parameters in order to establish a stable and reliable result. The deterministic polishing correction via the ADAPT software finally eliminates the residual symmetric and non-symmetric errors for best form accuracy.



Satisloh BaSyS

Satisloh BaSyS – the standard software platform for all Satisloh grinding and polishing machines. The graphical user interface offers the user an easy access to complex functions of the CNC-machines: All process parameters can be entered in self-explaining menus supported by context sensitive images. Corrections or changes of parameters can be directly entered and saved. The modular architecture of the job deck allows additional applications

(like drilling, dicing, scooping and G-code) at any time. As the software is used in all Satisloh grinding and polishing machines (SPM/SPS-30, SPM/SPS-55, SPM/SPS-60, SPM/SPS-140 and GI) the operators can adapt very quickly to any new machine. An emulation software version of Satisloh BaSyS is available for offline programming and process simulation.

CAMPos

CAMPos is a postprocessor interface between CAM system and machine which is transferring CAM-data into machine specific NC programs. Its open architecture allows data exchange with all common CAM systems to generate 2-, 2.5-, 3- and 5-axis motion for producing rotational symmetric parts, prisms and free form surfaces precisely: As CAMPos is integrated into the machine soft-

ware, the calibrated reference values of the specific machine are available for the postprocessor. To machine edges of larger parts, the CAM tool path can be converted into a roller curve tool path. CAMPos supports independent CLS- and APT-data formats. It is available for all Satisloh machines with MTX controller GI, SPM/SPS-140 and SPM/SPS-60.

ADAPT

Aspheric Deterministic Adaptive Polishing Technology available on MTX-controlled polishing-machines SPS-60 and SPS-140. This technology allows deterministic pre- and local corrective-polishing on aspherical shapes. The calculation of the removal function follows finite element methods considering the lens and tool shapes. Using the local removal functions, the feed rates

of the tool are optimized to achieve the user defined material removal. ADAPT offers three polishing-modes: Spiral tool-path (edge-to-center), double-spiral tool-path (edge-to-edge) and raster tool-path. Exchangeable, pre-configured maintenance-free polishing-pads as well as high removal rates and less iterative steps in production help to decrease non-productive-times.

DataCorrect

This software solution efficiently corrects rotationally symmetric shape errors for grinding and polishing of spheres and aspheres. DataCorrect uses direct input of metrology data, and offers extensive data manipulation capabilities.

Providing complex algorithms, it leads to significant processing time savings. DataCorrect is ideally suited for all Satisloh CNC generating and polishing machines.

Synline

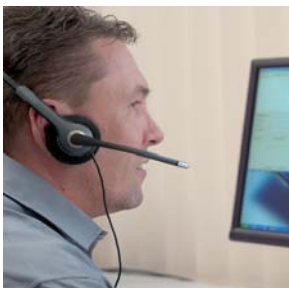
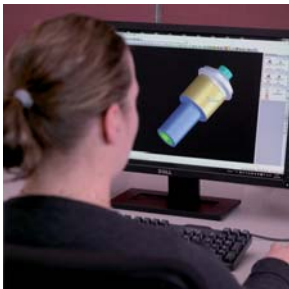
Suitable tools are a key factor for quality production results. Synline software program automatically calculates and designs tools for Synchrospeed & Variospeed polishing processes,

including polishing pad shapes, as well as work piece receptions. It can be used in combination with all Satisloh CNC generating and polishing machines.

Manufacturing high precision optical components is a complex process consisting of many steps. Therefore, Satisloh does not only offer high end optical machinery but complete manufacturing solutions. We offer intensive customer support, from the initial concept to the final process and beyond.

With our service technicians at 12 locations, Satisloh is close to you.

Reach a Satisloh specialist by telephone or internet, supported by our logistic centres in Wetzlar (Germany), Germantown (WI; USA) and Hong Kong.



Tool Service

Customer service extensive tool supply and support

Tools

- Analyzing, consulting and conception of customer specific tool variants and alternatives
- Design, production and assembly of custom-built lens specific tools
- Offering wide range of standard tools like centering chucks, diamond tools and receptions

Process optimization

- Performing long term tests and field trials
- Prototyping with special tools at Satisloh

Consumables

Satisloh offers a large variety of consumables for machines and processes. The consistent quality, ensured by continuous in-house process qualification guarantees stable production processes.

Main consumable groups for precision optics are:

- Cooling
- Emeries
- Polishing compounds
- Polishing supports
- Cements, adhesives
- Protective agents
- Working aids
- Cleaning agents
- Equipment
- Diamond tools

Consulting Service

Service center for training, support and information

Customer requirements & Concept Development

- Information and consulting before any machine, software or consumables sale.
- Development of technical concepts and processes
- Explanation of price- and cost-structures

Process know how transfer

- Machine and software demonstrations
- Performing prototyping tests in our demo center using process specific equipment
- Process development

Training on-the-job

- Operator training after the purchase of machines or software
- Maintenance- and refresher training

Mentoring

- Individual or regular trainings at Satisloh or on-site
- Application support for new machines, tools and technologies
- Support and consulting for machine-consumables concepts

Technical Service

Satisloh provides a worldwide extensive service performance and an efficient spare part support. The customer support and satisfaction is our passion and a manifested issue in our company philosophy. By constantly training we are keeping our own technicians in Wetzlar and at our subsidiaries at a high performance level, which is important to guaranty

fast and efficient solutions for technical matters. Satisloh offers dedicated contact person for service and spare part hotline and individual annual STEP service contracts



Cover picture and picture on page 4 (middle) from Leica Microsystems, Wetzlar.
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Subject to technical changes

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