

ATS

Alignment Turning Stations
for the high precision centering,
alignment, and machining of
mounted lenses and lens groups





Passion for optics

TRIOPTICS develops and produces the world's largest range of optical measurement and manufacturing technology for the development, quality control and production of lenses, lens systems, and camera modules.



ATS – Innovation for production

The ATS Alignment Turning Station with integrated precision measurement technology is an excellent example of TRIOPTICS' innovative power. It is a family of highly efficient alignment turning machines for use in production that are easy to operate thanks to their user-friendly software, despite their versatility. The control of all work steps in one

process enables the safe production of high performance lens systems. This not only makes production more accurate and significantly faster, but also results in more robust finished products that are better equipped to withstand conditions such as temperature fluctuations and shocks.

Using the ATS has two important benefits:

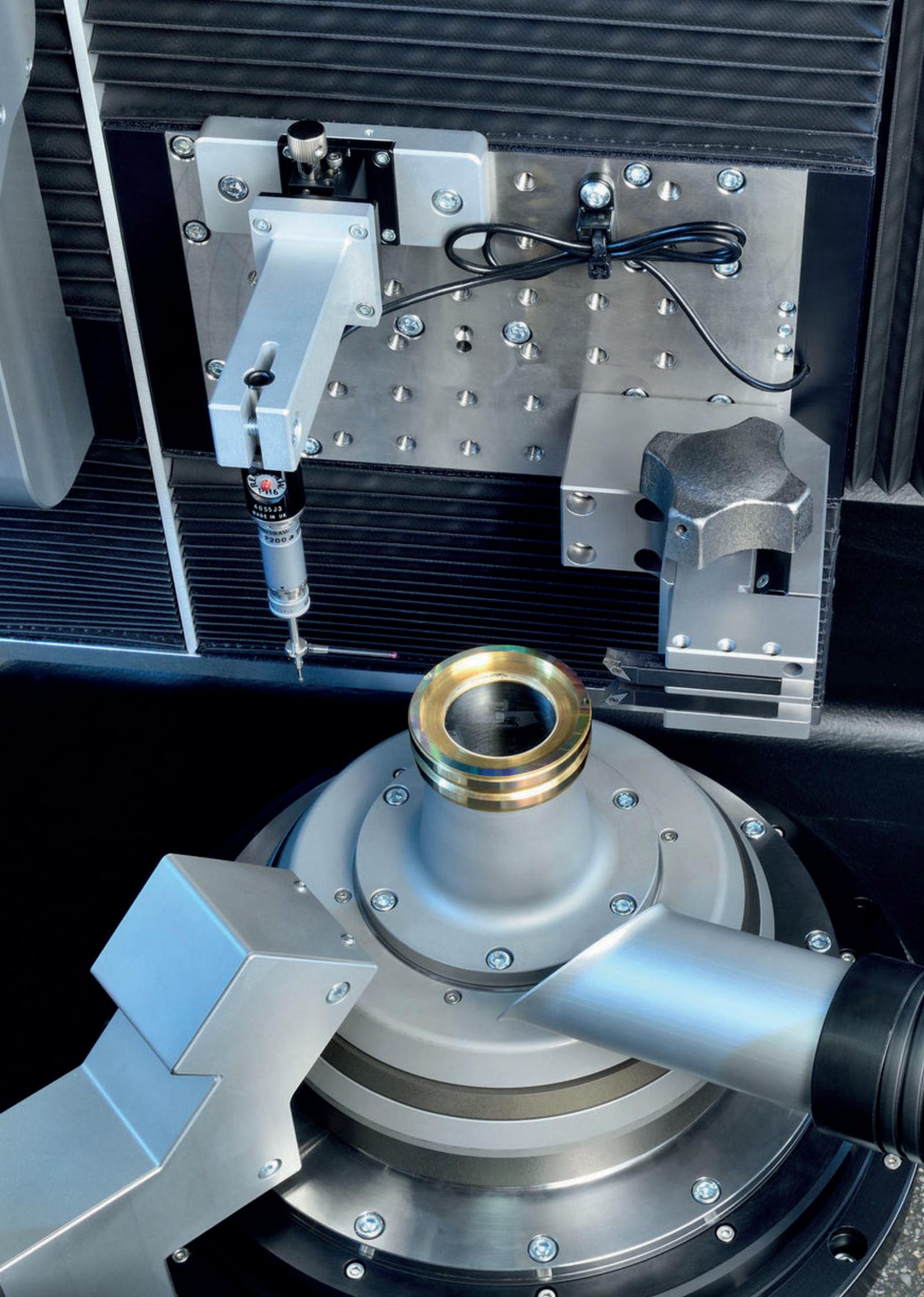
Accuracy:

Precision manufacturing of high-performance lens systems unmatched by any other process

Speed:

Increase profitability with consistent accuracy by streamlining your production processes





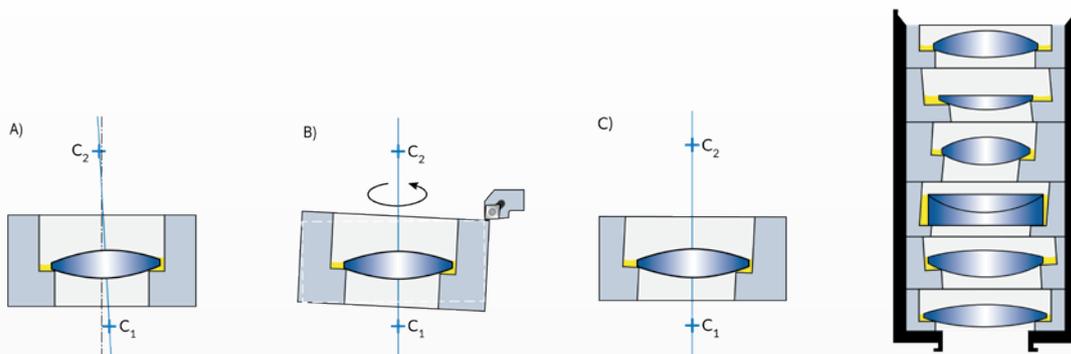
Current challenges: Increase precision and efficiency

In the traditional production of a lens, there are generally two factors that limit the precision of the final product, depending on the efficiency of the manufacturing process: The first is the achievable mechanical tolerances of the mount, and the second is the centering and positioning accuracy with which the lens is fixed in the mount.

Product precision can be improved by using individually mounted lenses, which are then inserted into a tube and aligned. To ensure the required precision is reproducible and to increase efficiency, new technologies are needed to accurately align the elements.

The solution: Alignment turning

Alignment turning is the only method of machining the sub-cell of a mounted spherical, aspherical, and cylindrical lens to meet the opto-geometric requirements (in particular centration and air gaps).



Measure

The optical axis of the lens and the cell are measured. The lens does not need to be precisely pre-aligned in the cell.

Align and machine

The mounted lens is positioned so that the optical axis corresponds to the rotation axis of the turning machine. The edge of the cell is machined.

Finished sub-cell

The outer edges are perpendicular or parallel to the optical axis at a defined distance, and the symmetry axis of the cell corresponds to the optical axis.

Assemble

The various elements are assembled to form the lens. The precision-machined sub-cells eliminate the need for additional alignment.

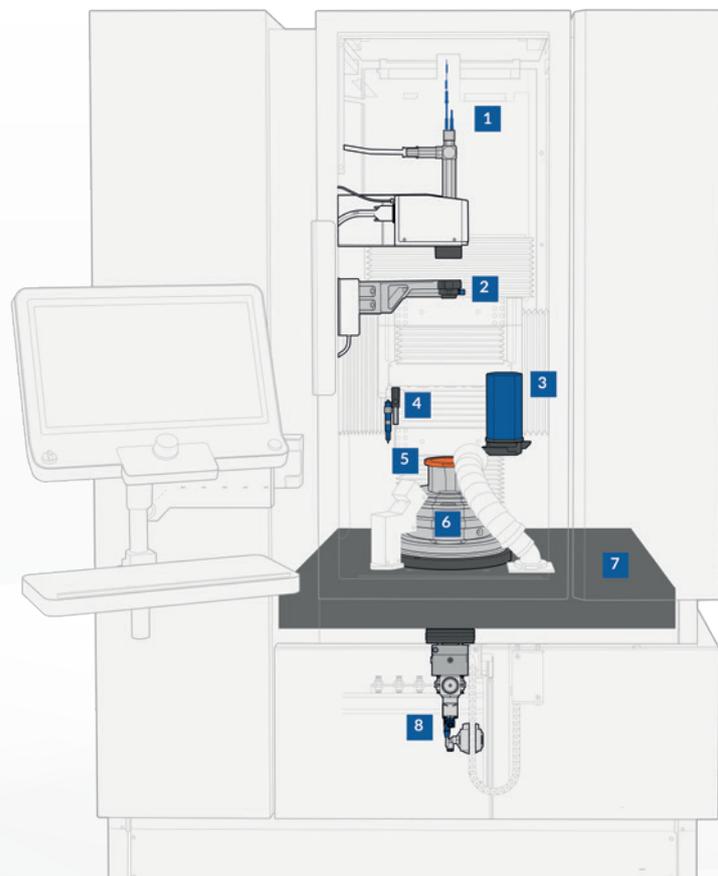
Additional benefits of alignment turning

A benefit of alignment turning is that it makes the finished lens system more robust against shock and vibration, since the entire contact surface of the mounted lens sits firmly in the lens tube. Experience has also shown that alignment turning allows optical designs with smaller air gaps. The lens systems produced in this way are characterized by their optical stability, which is particularly advantageous in applications with large temperature fluctuations.

Implementing alignment turning

With the ATS, we offer an alignment turning machine that optimally supports the alignment, turning process and takes into account the highly complex interaction of all components and motion sequences:

1. Autocollimator: VIS or IR
2. Head lens, optionally with changer
3. Turning tool or tool changer
4. Tactile sensor, optionally with optical sensor
5. Spindle: aerostatic or hydrostatic
6. Automatic alignment chuck
7. Stable granite or mineral composite base
8. Optional motorized autocollimator



Important components for the implementation of alignment turning using the ATS 200 as an example

The ATS family

The ATS family consists of several product variants. They differ both in the maximum work piece size that can be machined, in their accuracy, and in their upgradability. All variants can be set up efficiently and allow machining of medium and small batch sizes. In addition, individual customizations are possible as well.



ATS 100

Cycle time-optimized processing for life science optics such as microscope and endoscope objectives as well as camera systems

- Work piece diameter: up to 100 mm
- Manufacturing accuracy: 2.5 μm
- Optional laser diode turning and center thickness measurement

ATS 200 und 200 UP

Flexible use for numerous applications

- Work piece diameter: up to 200 mm
- Manufacturing accuracy: up to 0.5 μm
- Optional asphere measurement and center thickness measurement



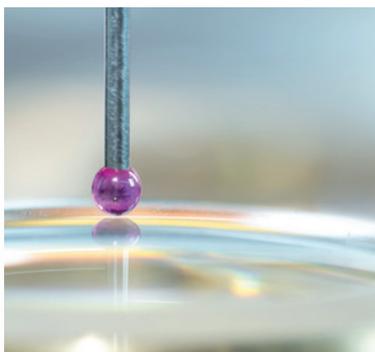
ATS 300 UP

High-precision alignment turning station for the semiconductor industry

- Work piece diameter: up to 300 mm
- Manufacturing accuracy: 0.5 μm
- Optional asphere measurement and center thickness measurement

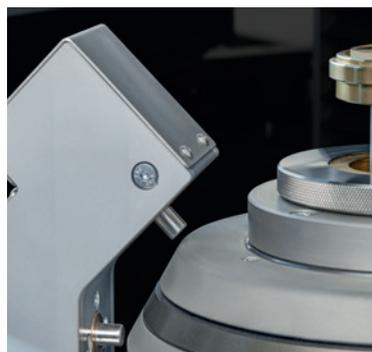


All ATS Alignment Turning Stations combine the proven OptiCentric® centration measurement system with a high-precision turning machine. These always carry out the steps of measuring, aligning and machining. The standard equipment with two autocollimators above and below the sample allows simultaneous measurement of both lens surfaces. This reflection measurement can be used in the visual spectral range as well as for UV and IR lenses. This means that all lenses, regardless of their transmission range, can be processed with the highest possible precision. The patented¹ MultiLens® method, which calculates the centering of each individual surface in relation to the axis of rotation of the alignment turning machine, can be used to center not only single lenses, but also doublets and apochromats.



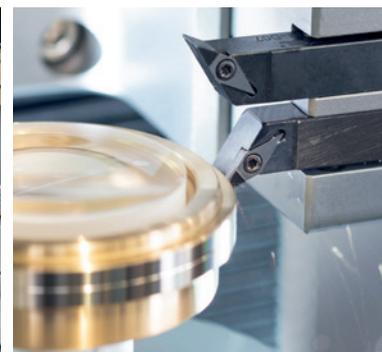
Measure

Measurement of the cell with a tactile probe and of the optics with the OptiCentric® centration measurement system as well as the OptiSurf® center thickness measurement system



Align

Alignment of the optical axis with the rotation axis of the turning machine using the automatic alignment chuck



Machine

Machining the cell so that the center of the cell is in the rotation axis or the optical axis

¹ Patent DE102004029735C5

Benefits of the ATS family

Despite their differences, all ATS variants meet the essential requirements for daily use:

High precision

Two autocollimators are installed for precise measurement of the optical system. Based on the results of these measurements, the work piece is automatically aligned with high repeatability by means of an automatic alignment chuck – independent of the operator. Subsequent machining is performed by two high-precision linear axes mounted on a stable and vibration-damping base. This allows the ATS to center mounted lenses for highly accurate results. Brass, for example, is machined with an accuracy of < 1 micron in terms of centering error, flange distance, and roundness.

Stable and durable

The stable granite or mineral composite base as well as vibration-damped axes and spindle provide resistance to external influences such as temperature fluctuations, as well as very quiet operation of all moving parts. This durable design ensures consistent performance for many years.

Versatile

The ATS can be used for a wide variety of cell geometries. This versatility is further enhanced by the ease with which a new work piece can be set up in just a few steps. The software accesses previously created design data so that stored positions can be approached.

Independent

The production of high performance optics on an ATS is independent of adhesive properties or shrinkage, since machining is based on real radii and air gaps. It is even possible to machine lenses that are not glued, but clamped, for example for high power UV applications.

Simple

The machine is operated by software designed for production use. No manual input is required from the operator and no program code needs to be written. The software identifies potential problems before processing begins and makes suggestions for improvement.

Unique

The vertical design of the ATS Alignment Turning Station is particularly advantageous for large and heavy samples, as there is no tilting moment on the rotary axis. This arrangement also creates a smaller footprint and makes it easier to load and unload work pieces.



ATS 100

With its ATS 100, TRIOPTICS offers a compact and stable alignment turning machine optimized for lens systems with a diameter of up to 100 mm and a weight of up to 3 kg.

Compact design

Space is valuable in efficient production. The size of a machine is often determined by the ducts required for supply lines, which are hidden under large covers outside the support frame. The mineral composite base of the ATS 100 allows these ducts to be fully integrated – without compromising stability. This means less space is required and floor space can be used in the best way possible.

Efficient – Even in daily cleaning

For TRIOPTICS, a machine designed for mass production must not only provide excellent machining performance, but must also be easy and thorough to clean on a daily basis. To ensure this, the lower part of the ATS 100 is equipped with a connection for an industrial vacuum cleaner, which extracts all chips through an opening in the measurement and machining chamber.

Active adaptation to environmental conditions

Its extremely robust design makes the ATS 100 largely resistant to external influences. Environmental conditions, such as temperature, can be taken into account in the machining process to achieve continuous corrections in the production process. This active control ensures high repeatability under fluctuating external conditions.

ATS 200

Ideal conditions for precise manufacturing

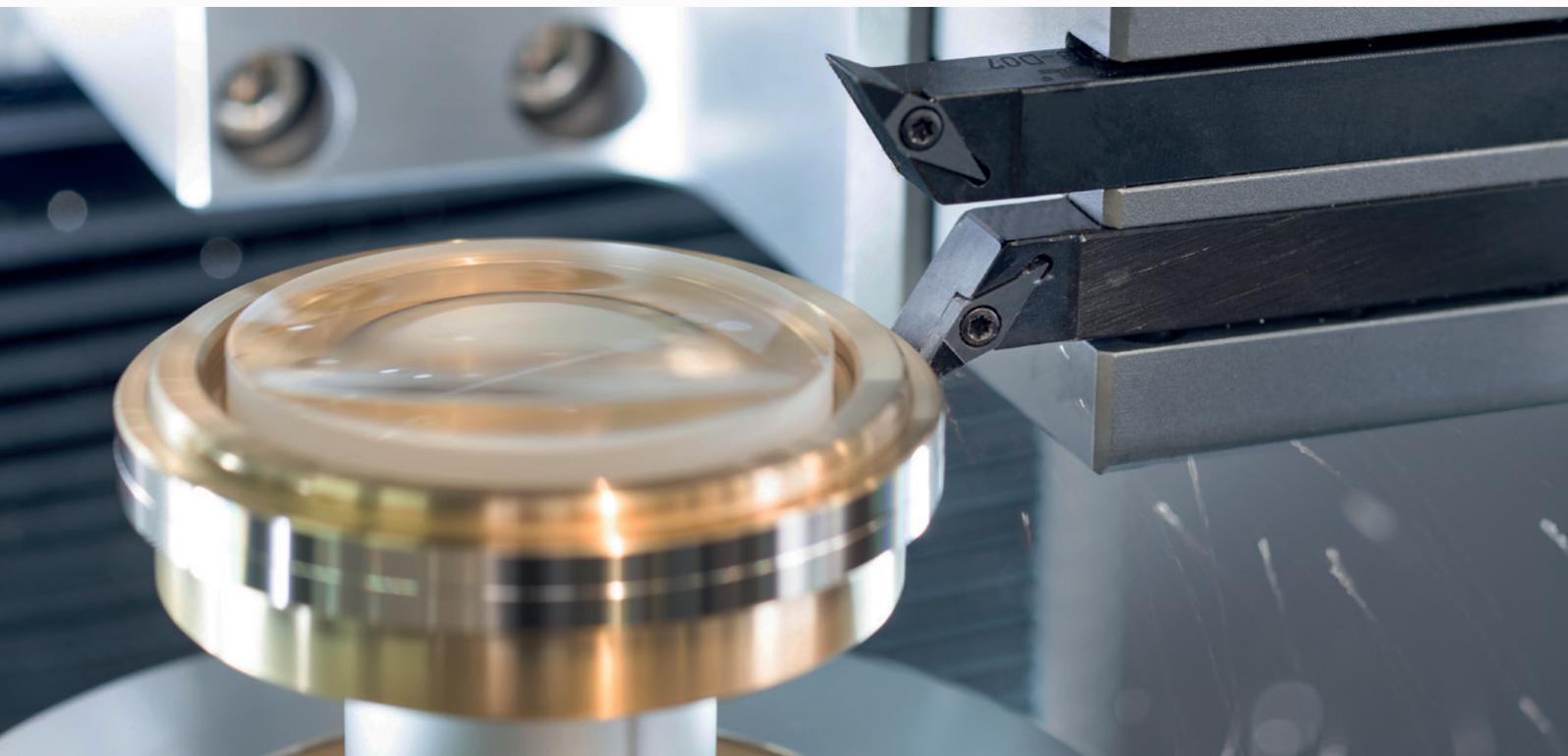
The ATS 200 was specially developed for the production of high-precision lenses. Its modular design permits it to be adapted to a wide range of applications or to increasing requirements.

A structure that meets the guidelines for ultra-precision machinery provides the required accuracy for measuring the optics and the cell as well as a high level of rigidity during processing. This means that the axes have friction-free bearings and are equipped with linear motors with high-precision motion. As a result, the ATS 200 delivers precise and highly reproducible results in production.

ATS 200 UP und 300 UP

For very high stability

The ATS 200 UP and ATS 300 UP have the same basic design as the ATS 200. What distinguishes both from the ATS 200 is the use of an extremely stable, hydrostatically mounted spindle. With even greater rigidity, this spindle provides excellent damping. This ensures that very high accuracy requirements of better than 0.5 microns are achieved.



Customized solutions

In order to achieve the best possible manufacturing process, it is often necessary to consider individual circumstances with regard to the work piece, the test room, the periphery, and the requirements. This is just another example of TRIOPTICS' expertise.

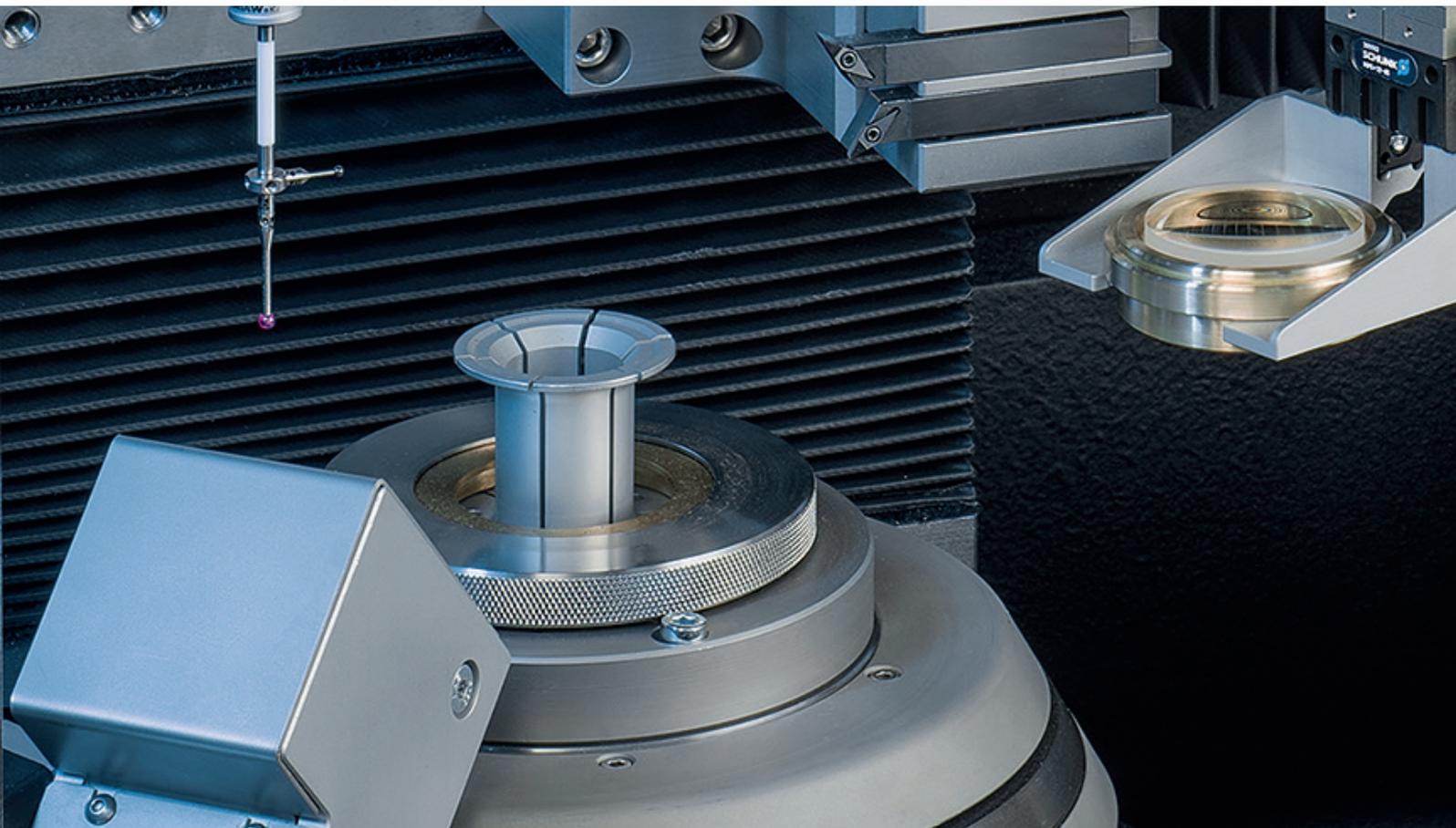
Automation

Adding a robot to the ATS for automatic loading and unloading further increases efficiency. The robot is directly integrated into the process so that the ATS-specific production process begins seamlessly after the optics are inserted.

Integration into the ERP system

The software of all ATS systems permits access to external programs and databases. These can be automated and form the basis for individual programming of specific company connections. This enables integration with the ERP system and full data exchange.

Robot loading on the ATS 100

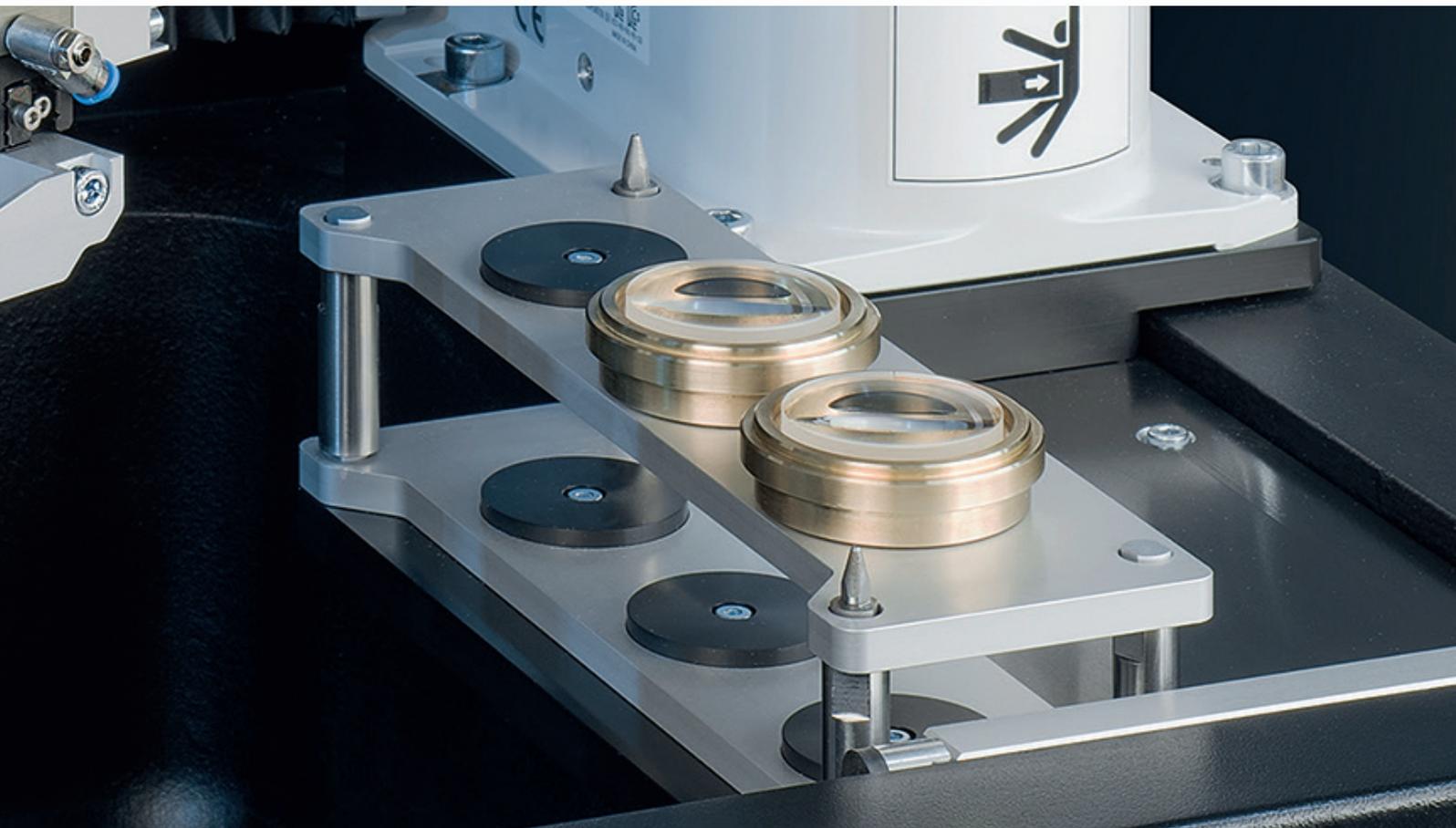


Alignment of lasers

Just as the ATS can be used to align mounted lenses as passive elements, it can also be used to align lasers. For these active samples, the laser beam generated by the laser serves as the centering axis. While tilt correction is possible in the standard configuration, a second optical measuring arm must be installed for additional shift correction. Processing is the same as for passive elements.

Cutting threads and grooves

The ATS Alignment Turning Stations also allow for extended cell edge machining with threads and grooves. The thread or groove is cut directly onto the lens mount. This saves time and is done in one operation with the rest of the cell machining.



ATS Control

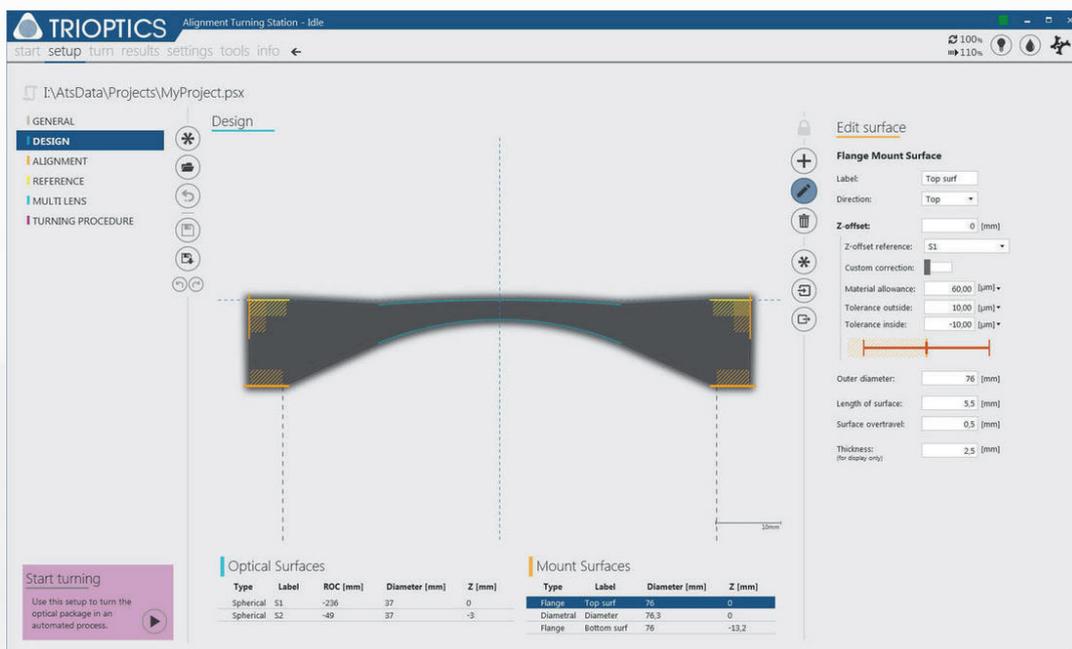
One software for all measurement and production processes

The ATS Control software makes the ATS easy to use. Its graphical user interface combines the centering error measurement routines with the control of all machine functions for turning the lens cell. A particular advantage of the software is its support of the mass production process: ATS Control supports the configuration of the manufacturing process with intelligent suggestions for tools and rotation paths.

The travel required during machining is automatically calculated and the result is monitored. ATS Control actively guides the user through all the steps to be performed. At the end of the process, the software generates a test report with the tolerances achieved. This makes it possible to trace the individual mounted lenses.

Key features

- Easy-to-use software for all measuring and machining processes
- Automatic centering error evaluation
- Optimized travel reduces machining time
- In-process control through verification measurements
- Process-controlled mode for use in mass production
- Adjustable in several steps
- Touch screen operation
- Generation of inspection reports on the machining result
- Optional integration with ERP systems
- Simulation of cutting process



Continuous monitoring

The user can enter lens and cell information in an easy-to-use mask. The alignment turning machine calculates the optimal trajectories from this design and the actual measured values. This saves a lot of time in the production process. Work piece setups can be saved and recalled at any time during the production process.

Optimized machining according to lens design

The user can enter details of the lens and mount in a clearly laid out screen. The alignment turning machine calculates the optimum trajectories from this design and the actual measured values. This saves a lot of time in the production process. Workpiece setups can be saved and recalled at any time during the production process.

Technical data

	ATS 100	ATS 200	ATS 200 UP	ATS 300 UP
Machine type	Mineral composite base	Granite base	Granite base	Granite base
Spindle	Aerostatic	Aerostatic	Hydrostatic	Hydrostatic
Work piece diameter	Up to 100 mm	Up to 200 mm	Up to 200 mm	Up to 300 mm
Maximum weight of work piece	3 kg	5 kg	5 kg	15 kg
Work piece material	Brass, aluminum, NiP-coated steel	Brass, aluminum, NiP-coated steel	Brass, aluminum, NiP-coated steel, invar, titanium	Brass, aluminum, NiP-coated steel, invar, titanium
Manufacturing accuracy	Up to < 2.5 μ m	Up to < 1 μ m	Up to < 0.5 μ m	Up to < 0.5 μ m
Dimensions (W x D x H)	1.0 m x 1.0 m x 2.0 m	ca. 2.20 m 1.55 m x 1.10 m + 1.65 m x 0.87 m x 0.65 m	ca. 2.20 m 1.55 m x 1.10 m + 1.65 m x 0.87 m x 0.65 m	ca. 2.20 m 1.85 m x 1.10 m + 1.65 m x 0.87 m x 0.65 m

Accessories

TRIOPTICS offers various upgrades to tailor the ATS to your production needs and to increase efficiency.

	ATS 100	ATS 200/200 UP/300 UP
Coolant and lubricant system	■	■
Chip extraction	■	■
2nd tool holder	■	
Automatic tool changer		■
AspheroCheck®		■
OptiSurf®	■	■
QR code scanner		■

Coolant and lubricant system

The spray system moistens the work piece with a residue-free oil. This smooths and cools the surface at the same time.

Chip extraction

A flexible extraction system can be integrated into the device to keep the alignment turning machine clean during operation and prevent the negative effects of chips.

2nd tool holder

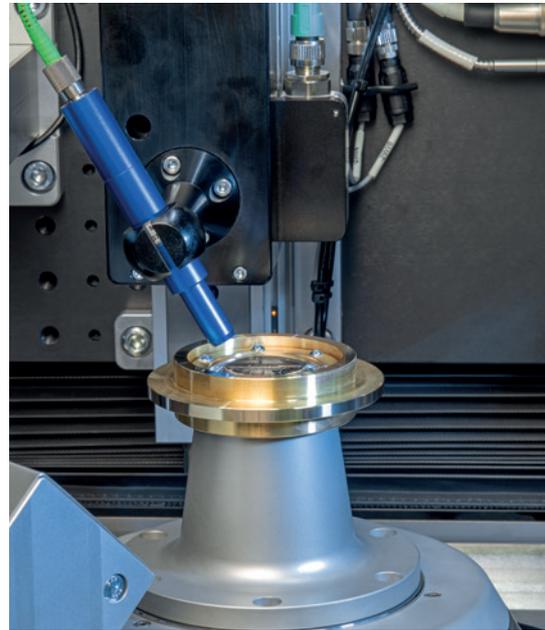
While the standard tool changer is located to the right of the work piece, it is possible to add a second tool changer to the left to double the number of available tool positions.

Integrated temperature sensor

The integrated temperature sensor measures the temperature directly on the work piece. This allows thermal effects to be taken into account during machining.

Measurement technology for aspherical lenses

For aspheric lenses, alignment can be performed on the aspheric surface axis or on the paraxial optical axis. The AspheroCheck® chromatic sensor is used in the ATS to check the aspheric axis: While an autocollimator measures the centration of the paraxial optical axis during a sample rotation, the distance sensor, which points to an off-axis zone of the aspheric surface, provides precise information about the alignment of the aspheric surface. Both axes are thus taken into account during processing in the ATS.



Automated tool changer

An automatic tool changer with four tool positions is available to reduce the time and effort required for tool changes. The high-precision clamping block installed in the tool changer ensures that the tool position remains accurate to 1 μm even after many changes.

Center thickness measurement

The integrated OptiSurf® short coherence interferometer measures the center thickness of the lens in a non-contact manner. Knowing the actual values helps to adjust processing so that the air gaps between the elements at the optically critical positions are achieved with a precise fit.

QR code scanner

The stored design data can be accessed quickly and securely using the QR code scanner.



TRIOPTICS GmbH

Strandbaddamm 6
22880 Wedel
Germany

+49 4103 18006-0
sales@trioptics.com
www.trioptics.com

