

ATS

Alignment Turning Stations for the High-Precision Centering, Alignment and Machining of Mounted Lenses and Lens Groups



LEADING TO THE FUTURE OF OPTICS

Optical systems have changed the world.
And they will continue to do so. TRIOPTICS
is significantly involved in this process.

We are a solution provider for optical
measurement and manufacturing
systems and offer our customers the
right system for their current and
future applications.

www.trioptics.com



ATS – Innovation for Production

The ATS Alignment Turning Station with integrated precision measurement technology is excellent proof of TRIOPTICS' innovative capacity. It is a family of high-efficiency alignment turning stations for use in production that are easy to operate thanks to their user-friendly software and in spite of their versatility. Controlling all operating steps in one process enables the safe production of high-performance lens systems. Not only does this make manufacturing more accurate and significantly faster, it 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:

Precise manufacturing of high-performance lens systems, which is offered by hardly any other process

Speed:

Higher profitability with consistent accuracies by streamlining your production processes



ATS 200 alignment turning station

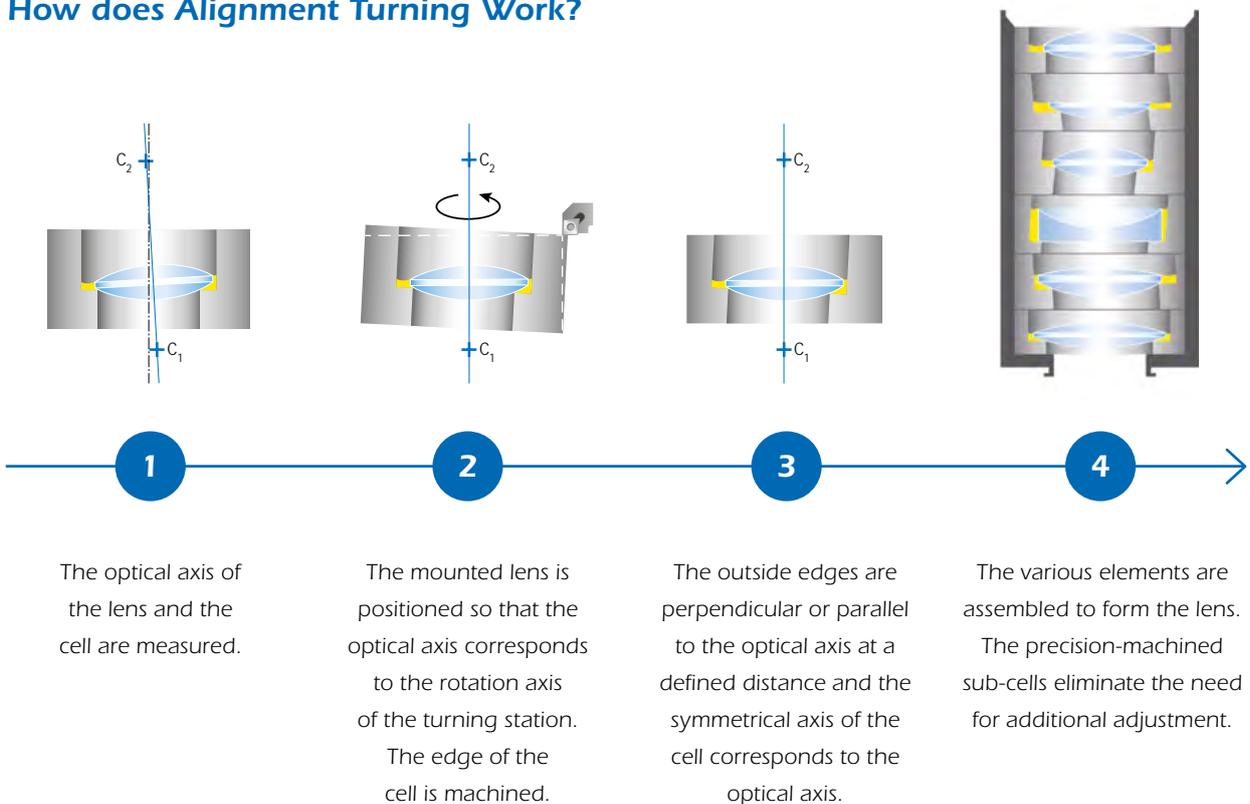
Current Challenges: Increase Precision and Efficiency

Typically, high-precision lens systems consist of several individual lenses that are glued directly into the lens tube. To increase accuracy, it is advisable to mount lenses individually and aligning them when they are inserted into the lens tube. This requires meeting even the smallest centering tolerances and – with increasing importance – is also subject to tight air gap tolerances. Depending on the required accuracy, the final alignment can take a great deal of time and effort – especially because gluing the individual lenses into their sub-cells not always meets the tolerance requirements. To ensure that the necessary precision is reproducible and to increase efficiency, new technologies are needed for the exact alignment of the elements.

The Solution: Alignment Turning

Alignment turning is the only method for machining the sub-cell of a mounted spherical, aspheric and cylindrical lens in a way that all relevant parameters are achieved with high precision. While the air gaps are corrected by cutting the flange surfaces of the cell, the external cell contour can be machined so that its symmetrical axis aligns with the optical axis of the lens. The precision thus achieved in cell machining eliminates the time-consuming alignment process, increasing efficiency throughout the lens manufacturing process.

How does Alignment Turning Work?



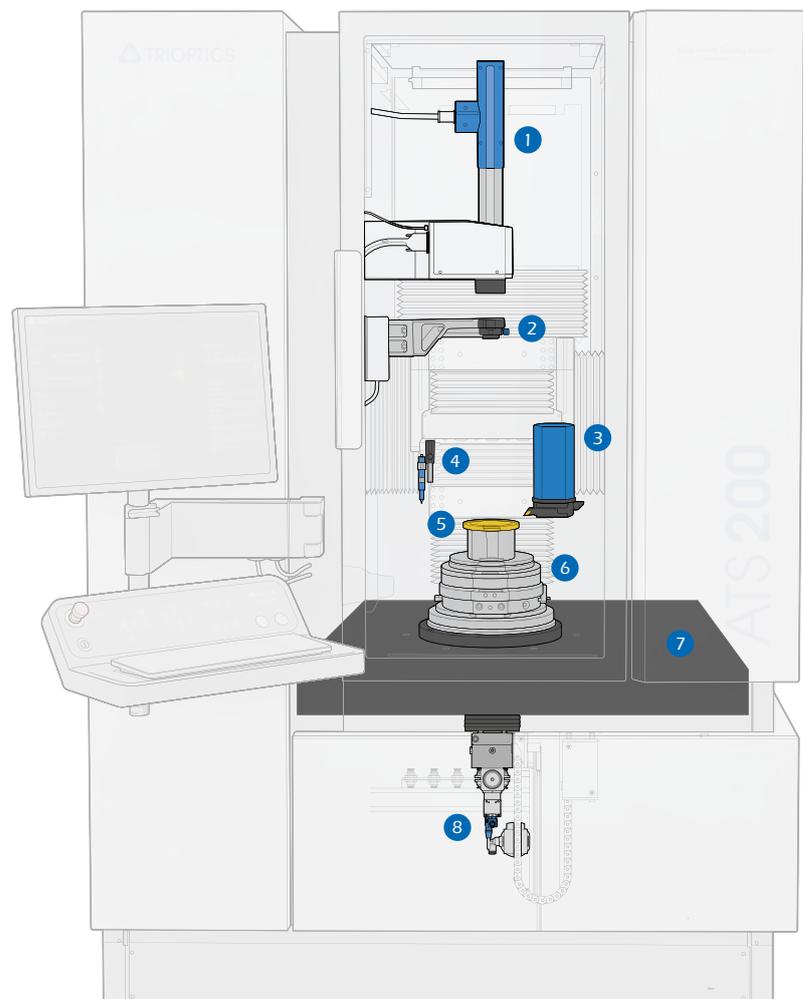
Additional Benefits of Alignment Turning

A benefit of alignment turning is that it makes the finished lens system more robust against shocks and vibrations, for instance, since the entire contact surface of the mounted lenses sits firmly in the lens tube. Experience has also shown that manufacturing by means of alignment turning permits optical designs with smaller air gaps. The lens systems produced in this way are characterized by their optical stability which offers advantages in particular for applications with large temperature fluctuations.

Implementing Alignment Turning

The high-precision implementation of alignment turning requires the highly complex interaction of all components used and their motions. This was given special consideration during the development of the ATS:

1. Autocollimator: VIS or IR
2. Head lens, optionally with changer
3. Turning tool or tool changer
4. Tactile sensor, with the addition of an optical sensor if applicable
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 features two product variants. They can be distinguished by the maximum size of the work piece that can be machined as well as by the repeatability that can be achieved.

ATS 100

- Compact design requiring little space, optimized for volume production
- Designed for machining small work pieces with a diameter of up to 100 mm and a weight of up to 3 kg
- Reproducible manufacturing with a repeatability of better than 2.5 microns
- Easy to clean via integrated chip extraction
- Software controlled consideration of temperature during machining

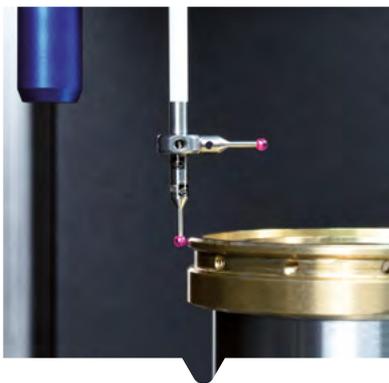


ATS 200

- Small and medium-sized lens systems with a diameter of up to 150 mm and a weight of up to 5 kg
- Quick and easy set-up of the work piece is ideal for machining medium batch sizes
- Reproducible manufacturing with a repeatability of better than 1.0 micron or even better than 0.5 micron in the ATS 200 UP variant
- Its modular design allows the ATS 200 set-up to be customized, e.g. optional measuring technology with tactile and optical sensor for measuring the cell geometry



The tried-and-tested OptiCentric® centering measurement system is combined with a high precision turning machine in all ATS alignment turning stations. This combination is always used to carry out the following steps: measuring, aligning and machining. The machining of UV or IR lenses is just as precise as that of components for the visible light spectrum. The patented MultiLens® method can be used not only to machine the centering of individual lenses but also that of the achromats and apochromats used in sub-cells.



1

Measuring

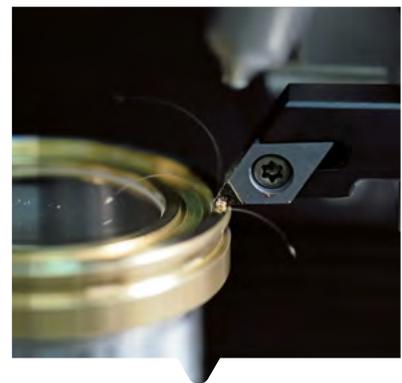
the cell with a tactile probe as well as the optics using the OptiCentric® centering measurement system



2

Aligning

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



3

Machining

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

Benefits of the ATS Family

In spite of their differences, all ATS variants meet the essential requirements for daily use:

High Precision

With their use of high-quality components and exact machining, alignment turning stations made by TRIOPTICS allow the production of quality optics that achieve very high accuracy and require only little time for additional processing. Brass, for instance is machined with an accuracy of < 1 micron with regard to centering errors, flange distance and roundness.

Up to two autocollimators are installed in order to enable the precise measurement of the optical system. Based on these measurement results, the work piece is aligned automatically – and thus irrespectively of the operator – as well as with high repeatability with the help of the automatic alignment chuck. The subsequent machining is carried out via two high-precision linear axes that are mounted on a stable and vibration-damping base. The perfect design of the ATS thus permits the centering of mounted lenses for high-precision results.

Stability and Durability

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

Versatility

The ATS can be used for a wide range of manufacturing products and applications without spending much time on setting up a new work piece. Work piece data are imported quickly. Tools for brass, aluminum and steel as cell materials are readily available. This flexibility allows numerous manufacturing possibilities.

Independent

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

Simple

User-friendly software that represents the measurement and machining process in its entirety permits a fast work process with extremely high repeatability.

Important Characteristics at a Glance

- Operation irrespective of operator and high repeatability due to the automatic alignment chuck
- Easy to use in the production process due to manageable and progressive software
- Manufacture of complex lens systems with the help of MultiLens® measurement
- High absolute repeatability of up to 0.5 microns due to stable and vibration-damping machine design
- Vertical design for convenient work piece loading and unloading



ATS 100

With its ATS 100, TRIOPTICS offers a compact and stable alignment turning station optimized for lens systems with a diameter of up to 100 mm and a weight of up to 3 kg. Very easy operation and automated processes permit its use in volume production.

Compact Design

Space is highly valuable in efficient production. The size of a machine is often determined by the ducts required for supply lines that are hidden under large covers outside of the support frame. In the mineral composite base of the ATS 100 these lines can be fully integrated – without affecting stability. This means little space is required and floor areas can be utilized in the best way possible.

Efficient – Even in Daily Cleaning

For TRIOPTICS, a machine developed for volume production not only has to supply excellent machining performance but daily cleaning also has to be easy and thorough. To ensure this, the bottom section of the ATS 100 features a connection for an industrial vacuum cleaner that 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 temperatures can be integrated into the machining process to achieve continuous corrections in the production process. This active regulation ensures high repeatability under fluctuating external conditions.



ATS 200

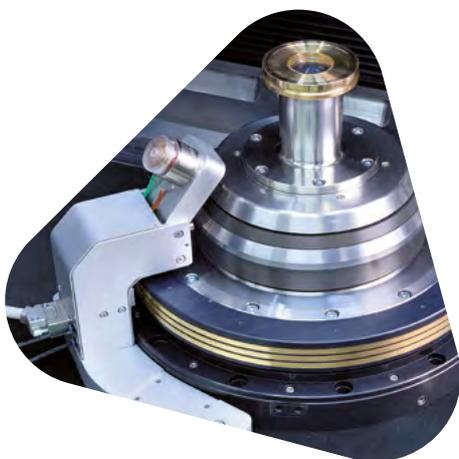
The ATS 200 was developed especially for machining small and medium-sized lenses. As the ATS 200 allows the easy set-up of new cell types and cell sizes, it is particularly suitable for use in production with medium batch sizes. Its modular design permits it to be adapted to a large number of applications or to increasing requirements.

Ideal Conditions for Precise Manufacturing

A structure that is in line with 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 bearing supports and are equipped with linear motors with high-precision motion. The ATS 200 thus supplies precise and highly reproducible results when used in production.

For Very High Accuracy: ATS 200 UP

The ATS 200 UP is a variant of the ATS 200 with an identical basic structure. What sets it apart is the use of an extremely stable spindle with hydrostatic bearing supports. This increases its rigidity even more and offers excellent damping, ensuring that very high accuracy requirements of better than 0.5 microns can be achieved.



Customized Solutions

Achieving the best possible manufacturing process often requires individual circumstances to be taken into consideration with regard to the work piece, the test room, the periphery and the requirements. This is just another example of TRIOPTICS' expertise.

ATS 400

The ATS 400 is currently the largest alignment turning station in the ATS family. It was developed especially for the requirements in the semiconductor industry, and its design is very well suited for machining large and heavy lenses with very high accuracy.

- Very high absolute manufacturing accuracy of 0.5 microns due to ultra-precision axes with hydrostatic bearing
- Intuitive, manual alignment of the lens because the moving and tilting functions of the chuck are separate
- Machining of large and heavy lens cell systems with a weight of up to 30 kg



ATS 400 for the semiconductor industry

Connection to Existing Air Conditioning Systems

In its standard configuration, the ATS is a closed system. However, certain conditions may require the system to be connected to the existing air conditioning system of a building. For this purpose, the ATS can be equipped with a customized Laminar Air Flow ceiling.

Integration into the ERP System

The software of all ATS systems permits access to external programs and databases. These can be automated and create the basis for the individual programming of specific company connections. This allows the integration into the ERP system and related complete data interchange.

Accessories

TRIOPTICS offers various upgrades for an optimal adjustment of the ATS to manufacturing requirements and even greater efficiency.

Additional Autocollimator

The additional autocollimator allows two lens surfaces to be measured simultaneously, enabling faster processing and higher flexibility. It provides additional information on the tilting of the work piece. It also allows the lower lens surface to be measured for infrared lenses.

Optical Distance Sensor

All standard ATS are equipped with a tactile probe for determining the exact cell geometry before and after machining. Additional options are provided by an optical distance sensor that can be used to perform non-contact measurements on highly sensitive parts.

Four-Fold Tool Changer

A tool holder for up to four tools can be integrated to save time and work for tool changes. The inserts are placed in holders included in the delivery. Before machining, the exact cutting positions of the tools are measured. The high-precision clamping block integrated in the tool changer ensures that the tool position remains exactly the same to 1 micron even after many tool changes.



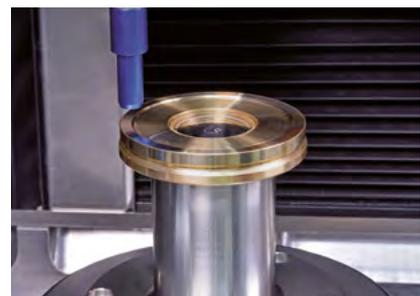
Automatic head lens changer

Automatic Change of Head Lenses

The top autocollimator is equipped with an automatic revolver to save time when changing head lenses.

Manufacture of Aspheric Lenses

The ATS can be equipped with an additional sensor to align the optical axis of an aspheric lens with the rotation axis of the spindle.



Sensor for aspheres

ATS Control – One Software for All Measurement and Production Processes

The ATS Control software makes the ATS easy to operate. Its graphic user interface combines the routines for measuring the centering error with the control of all machine functions for turning the lens cell. The special advantage of the software is its support of the volume production process. ATS Control supports the configuration of the manufacturing process with intelligent suggestions for tools and rotational paths. The necessary travel during machining is calculated automatically and the result is monitored. Here, ATS Control actively guides the user through all steps to be completed. At the end of a completed process, the software issues an inspection report with the tolerances achieved. This allows individual mounted lenses to be traced later.

- User-friendly thanks to one software for all measurement and machining processes
- Automatic evaluation of the centering error
- Optimized travel reduces machining time
- In-process control through verification measurements
- Process-controlled mode for use in volume production
- Assignment of user rights in three stages
- Operation via touch screen
- Generation of inspection reports via the machining result
- Optional integration into ERP systems

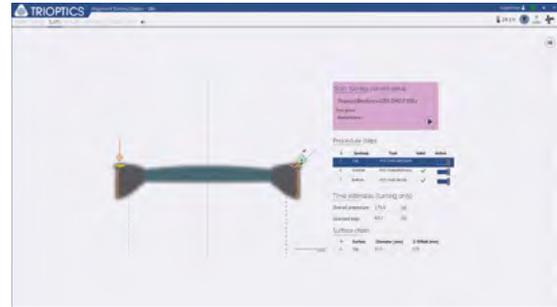
Optimized Machining in Accordance with Lens Design

The user can enter information on the lens and the cell in an easy-to-use mask. Saved set-ups for the work pieces can be selected at any time during the production process. Machining is carried out automatically at the push of a button without requiring any extensive input of data. Based on this design and the actual measured values, the alignment turning station calculates the optimum travel. This saves a great deal of time during the production process.



Continuous Monitoring

The ATS Control software monitors both the alignment of the lens and the turning result after manufacturing. Upon request, this monitoring can also be automated to be performed after the relevant process step through verification measurement. This takes into consideration influencing factors from external conditions such as temperature in order to achieve an optimum result.



Monitoring the machining process

Customized Configuration

Software management involves three authorization stages. The supervisor status offers the greatest levels of freedom because it is usually awarded to individual employees. This makes it possible to define company-specific settings for all other users. The operator in volume production thus only has to set very few values, which allows him to focus on the essentials.

Technical Data at a Glance

	ATS 100	ATS 200	ATS 200 UP
Machine type	Mineral composite base	Granite base	Granite base
Spindle	Aerostatic	Aerostatic	Hydrostatic
Work piece diameter	Up to 100 mm	Up to 200 mm	Up to 200 mm
Maximum weight of work piece	3 kg	5 kg	5 kg
Work piece material	Brass, aluminum, NiP-coated steel	Brass, aluminum, NiP-coated steel	Brass, aluminum, NiP-coated steel, Invar, titanium
Manufacturing accuracy	Up to < 2.5 µm	Up to < 1.0 µm	Up to < 0.5 µm
Dimensions	WxD: 1.0 m x 1.0 m H: 2.0 m	BxT: ca. 1.55 m x 1.10 m H: 2.20 m	BxT: ca. 1.55 m x 1.10 m H: 2.20 m

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