TRIOPTICS

See the Difference.

OptiCentric® 100

Highly Precise Lens Centering Measurement, Alignment and Assembly Systems

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 see ourselves as 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

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OptiCentric®

The OptiCentric® product group sets the global standard for optical centering testing and manual and automated lens alignment.

With an extremely high degree of lens centering measurement accuracy and integrated operation, OptiCentric® systems are indispensable in modern optics productions. Regardless of whether the sample has a small or a very large diameter, works in the visual or infrared spectral range, or must be aligned, cemented, bonded or just measured: the OptiCentric® systems are modularly designed so that the appropriate system can be chosen for the desired applications and samples.

OptiCentric® 100

Definitions of Terms:

The terms cementing and bonding are not consistently used in optics production.
For TRIOPTICS, the following applies:

Cementing: Aligning and cementing of individual lenses to each other (doublets or triplets) or on an arbor.

Bonding: Aligning, assembly and bonding one or more lenses in a cell

TRIOPTICS

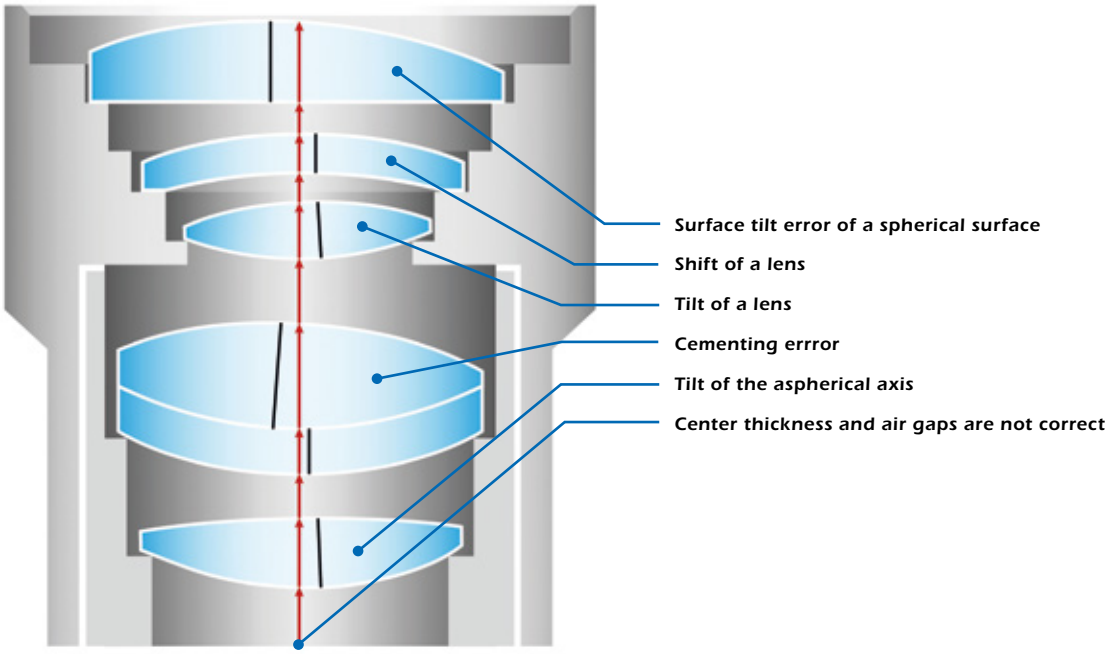
Advantages of OptiCentric® Systems

- Highest absolute accuracy of 0.1 µm and highest resolution of the measurement head
- Lens centering measurement of all types of optics, in UV, VIS and IR: spherical, aspherical and cylindrical lenses and lens assemblies
- Testing of complex lens assemblies with the MultiLens software module
- Fast and precise alignment processes, thanks to the OptiCentric® software module SmartAlign
- Exchangeable head lenses for virtually unlimited measurement range
- Measurement in reflection and transmission
- Modular and integrated OptiCentric® accessories
- Large diameter range from 0.5 mm to 800 mm: OptiCentric® systems are available in the sizes OptiCentric® 100, OptiCentric® 300 and OptiCentric® 300 & 600 UP

Centering Errors of Optics

Centering errors have a critical influence on the optical image quality of an imaging system.
There is a centering error when the optical axis of a lens does not correspond with a given reference axis.
The centering error is then the angle between the optical axis of the sample and the reference axis.

An overview of typical assembly and centering errors can be found in the adjacent drawing.

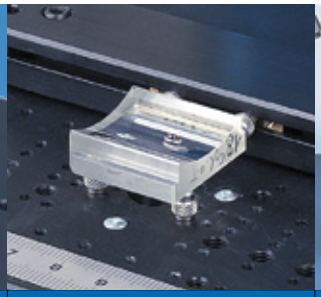


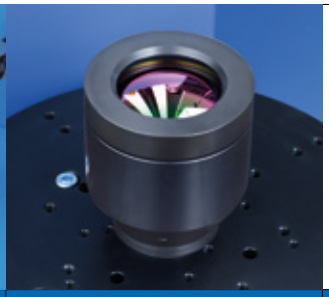
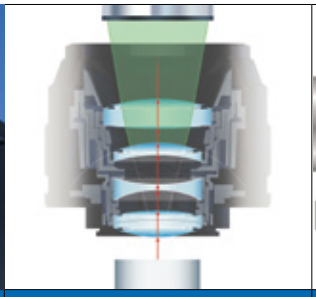
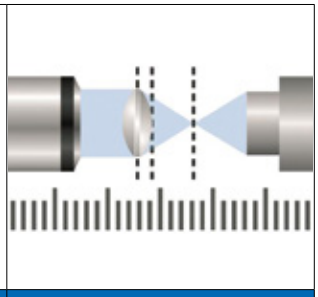
OptiCentric® Systems

- avoid these centering errors in the cementing and bonding process
- determine these centering errors precisely and in correspondence with the DIN / ISO standard 10110-6 DIN / ISO Norm 10110-6

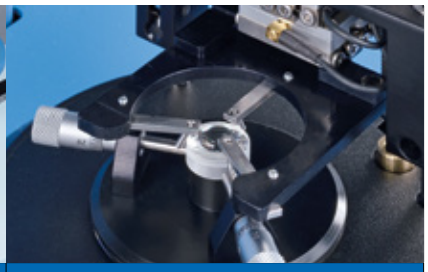
Applications

Application Overview – Measuring Single Lenses and Lens Assemblies

			
Centering Testing of Spherical Single Lenses	**Centering Testing of Single Lenses without Mechanical Reference**	**Testing of Cylinder Lenses**	**Testing of Aspheres**
All OptiCentric® 100 Systems are equipped with the Lens Rotation Device; no air bearing is required	OptiCentric® 100 Dual or OptiCentric® 3D 100 Dual, with one or two gauges depending on reference	An OptiCentric® 100 System with CylinderCheck Upgrade, depending on application	OptiCentric® 100 Dual or OptiCentric® 3D 100 Dual with AspheroCheck Upgrade

			
Centering Testing of Groups of Surfaces within Optical Systems	**Centering Testing of Groups of Surfaces within Infrared Lens Assemblies**	**Center Thickness and Air Gap Measurement, as well as Centering Testing of Single Lenses and Lens Assemblies**	**Measuring Centering Errors, Effective Focal Lengths, Flange Focal Length, Radius and on-axis MTF**
Up to 20 surfaces OptiCentric® 100, OptiCentric® 3D 100 Up to 40 surfaces: OptiCentric® 100 Dual, OptiCentric® 3D 100 Dual Always with the MultiLens software module and gauges	Up to 10 surfaces[1]: OptiCentric® 100 IR, OptiCentric® 3D 100 IR Up to 15 surfaces[1]: OptiCentric® 100 Dual IR, OptiCentric® 3D 100 Dual IR Always with the MultiLens software module and gauges [1]Depending on sample	OptiCentric® 3D 100 OptiCentric® 3D 100 Dual OptiCentric® 3D 100 IR OptiCentric® 3D 100 Dual IR	All OptiCentric® 100 Systems with VIS measurement head and with OptiSpheric® Upgrade

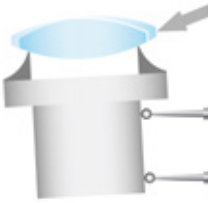
Application Overview – Aligment and Cementing of Doublets



	Alignment of Doublets with the Edge and the Bottom Surface of the Bottom Lens as Reference	Alignment of Doublets with the Optical Axis of the Bottom Lens as Reference
System for Automated Aligment and Cementing	Automated Version not available	- OptiCentric® Cementing and MultiCentric® Cementing for Lens Alignment and Cementing with respect to the optical axis
Manual Lens Alignment and Cementing Equipment	- All OptiCentric® 100 Systems, no air bearing required - Lens Rotation Device	- All OptiCentric® 100 Systems with air bearing - Seats for Lenses - SmartAlign software module
Finishing		Edge processing, fastening with Bell Clamping method in the lathe
Image Quality of the Cemented Element	Image quality depends on the quality of the edge processing and the production accuracy of the edge, Image quality may not be optimal	Maximum Image quality independent of edge properties

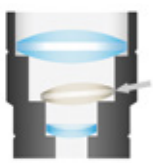
- The applications on the lens rotation device are performed in reflection or transmission; all others only in reflection.
- All applications can be performed with lenses from the entire spectral range

Application Overview – Alignment of Spherical and Aspherical Lenses on Arbor

		
	Alignment of Spherical and Aspherical Lenses on Arbor, Reference: Air Bearing Axis	**Alignment of Spherical and Aspherical Lenses on Arbor, Reference: Arbor Axis**
System for Automated Assembly	OptiCentric® Cementing for alignment on arbor	OptiCentric® Cementing for alignment on arbor
Manual Assembly Equipment	- All OptiCentric® 100 Systems with air bearing - Clamping device for arbor	- All OptiCentric® 100 Systems with air bearing - Clamping device for arbor - SmartAlign software module - 2 distance sensors
Image Quality of Lens After Finishing	Image quality depends on the alignment of the arbor with respect to the rotation axis, Image quality may not be optimal	High Image quality

- All applications are performed in reflection.
- All applications can be performed with lenses from the entire spectral range.
- In the case of aspherical lenses, only the spherical component (optical axis) is considered.

Application Overview – Bonding

				
	Bonding in 2 Degrees of Freedom, Reference: Air Bearing Axis	**Bonding in 2 Degrees of Freedom, Reference: Cell axis**	**Bonding in 5 Degrees of Freedom, Reference: Cell Axis**	**Alignment of a Lens within an Optical System**
System for automated bonding	OptiCentric® Bonding 2D	OptiCentric® Bonding 2D	OptiCentric® Bonding 5D	Upon request
Manual Bonding Equipment	All OptiCentric® 100 Systems with air bearing	All OptiCentric® 100 Systems with air bearing - SmartAlign software module - 2 distance sensors	Upon request	All OptiCentric® 100 Systems with air bearing - SmartAlign software module - 2 distance sensors
Image Quality of the Lens System	Image quality may not be optimal. - The air bearing axis and cell axis may not correspond. - Alignment can only be performed in two degrees of freedom - Dependent on production quality of the recess - Only the top lens surface is aligned	Image quality may not be optimal. - Alignment can only be performed in two degrees of freedom - Dependent on production quality of the recess - Only the top lens surface is aligned	Maximum image quality	- Improves the image quality of an existing system - Only the top lens surface is aligned

- All applications can be performed with lenses from the entire spectral range, only for the alignment of a lens within an IR optical system an IR measurement head is required
- All measurements are performed in reflection.
- All processes depend on the production accuracy of the cell and on the curing process and other properties of the adhesive.

Overview of OptiCentric® 100 Systems

OptiCentric® 100

The industry standard for centering testing and manual lens alignment and assembly

OptiCentric® 100 IR

Assemble and test IR lens systems

OptiCentric® 3D 100

Centering testing and center thickness/air gap measurement in one system

OptiCentric® 100 Dual

Centering testing of lenses and complex optical systems

OptiCentric® Cementing

Significant increase in efficiency and accuracy when cementing

- to the optical axis
- on an arbor

MultiCentric® Cementing

For the shortest cycle times and very high accuracy when cementing with the optical axis as reference

The following combinations of the systems presented above are also available:

OptiCentric® 3D 100 Dual

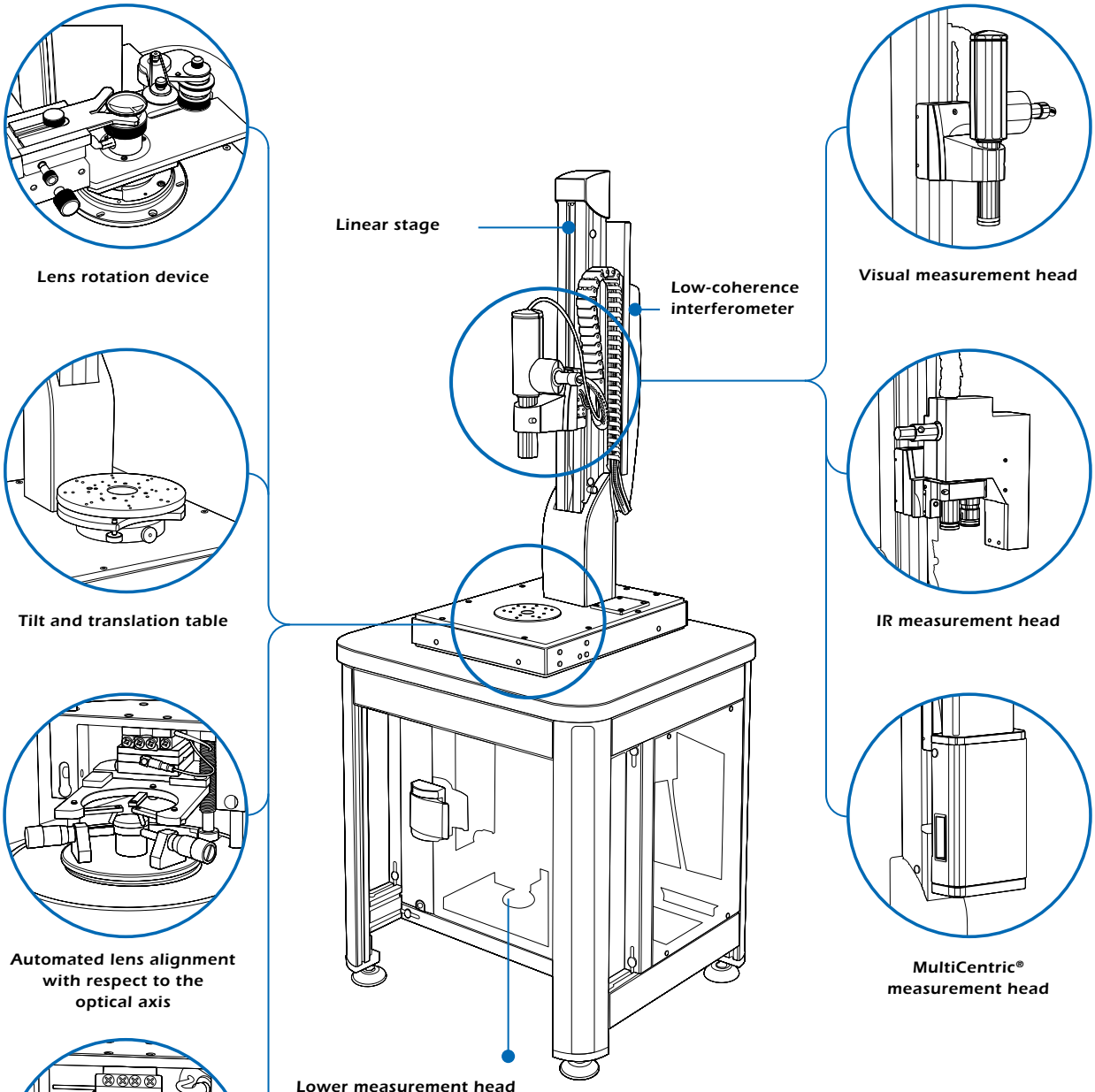
OptiCentric® 3D 100 IR

OptiCentric® 100 Dual IR

OptiCentric® 3D 100 Dual IR

System Overview

Modular Structure of the OptiCentric® Systems



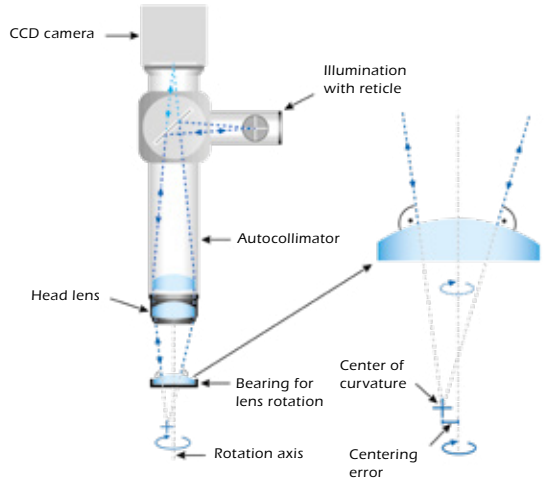
Configuration for Measurement in Reflection and Transmission

Centering errors can be measured in two different ways, in each of which the sample rotates around the reference axis. Differentiation is made between:

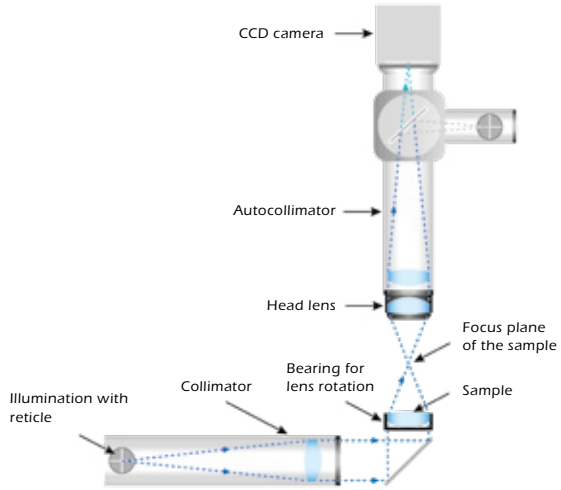
- Measurement in reflection: the center of curvature is the reference point for the centering error measurement
- Measurement in transmission: the focus point is the reference point for the centering error measurement

Every OptiCentric® system measures in reflection. The option to also be able to measure in transmission can additionally be ordered.

Schematic diagram, measurement in reflection



Schematic diagram, measurement in transmission



Comparison of Measurement in Reflection and Transmission

The values of centering error measurement in reflection and transmission differ and are only comparable with each other to a limited degree. A simple relationship between the two measurement methods for centering error measurement of single lenses without cell is given by:

$T = (n - 1) \times R$

Where: R = surface tilt error of the top surface as a result of the measurement in reflection
T = angle deviation for the measurement in transmission
n = refractive index of the glass

Rotation Devices for Samples

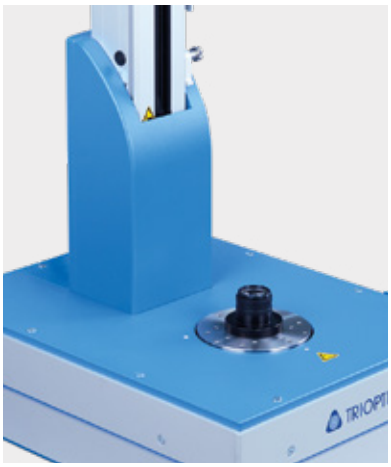
The precise rotation and holding device of the sample has a significant influence on measurement accuracy. For that reason, TRIOPTICS attaches great importance to the careful development and selection of rotation devices.

Air Bearing

A precise air bearing is a prerequisite for highly accurate lens centering testing and serves as a reference during the measurement. All modern OptiCentric® systems are equipped with an air bearing; it can optionally be left out in an OptiCentric® 100 system.

The OptiCentric® 100 systems are optionally equipped with a manual or motorized stable tilt and translation table (TRT 200) for the alignment and testing of optics.

Beside the tilt and translation table TRIOPTICS offers mechanical clamping devices and upgrades for the automated cementing of lenses.



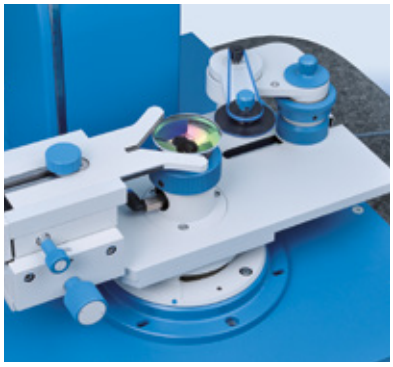
OptiCentric® 100 with air bearing

Motorized Lens Rotation Device

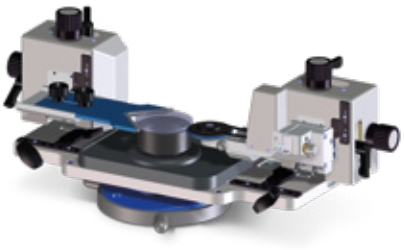
The motorized lens rotation device is a rotation device for measuring and aligning single lenses and doublets. The outer edge and the bottom surface serve as a reference.

No air bearing is required for the motorized rotation device. Equipped with a so-called „bridge“, the lens rotation device can be operated on the OptiCentric® 100 systems equipped with an air bearing.

TRIOPTICS now offers two lens rotation devices. In addition to the existing lens rotation device, TRIOPTICS has now developed a new lens rotation device which is better scalable using adjusting screws.



OptiCentric® 100
with lens rotation device



Lens rotation device with scalable adjusting screws.

Measurement Heads

OptiCentric® systems determine the centering errors of optics, with a high degree of accuracy and in real time, with their measurement head. It consists of an electronic autocollimator with a CCD camera, LED lighting and the reticle.

TRIOPTICS offers three different measurement heads for the OptiCentric® systems. Available for selection are:

- Standard measurement head with visual autocollimator
- IR measurement head for testing IR lens assemblies (VIS-MWIR or VIS-LWIR)
- MultiCentric® measurement head, which shortens the measurement time and is particularly well suited for lens alignment and cementing with respect to the optical axis

In order to be able to focus on the center of curvature (reflection measurement) or on the focus position (transmission measurement) of different lenses, the measurement heads are equipped with head lenses, resulting in unbeatable benefits:

- Optimized magnification for each individual lens surface
- Practically unlimited measurement range
- No long, time-consuming movements of the measurement head

In order to be able to change out the focusing head lenses quickly and without complications, TRIOPTICS optionally equips its systems with manual or motorized revolving turrets for the exchange of head lenses.

OptiCentric® 3D 100 with revolving turret for the exchange of head lenses

Stage for Measurement Head

The measurement head is mounted on a height-adjustable stage. This stage enables the user to set the measurement head to the desired height with the help of the software. As a result, the measurement process is extensively automated and multi-lens systems can be quickly aligned and assembled. OptiCentric® 100 is equipped with a motorized stage which has a travel of 450 mm. Travels of 250 mm, 550 mm or 900 mm are optionally available.

The OptiCentric® 100 Series

The OptiCentric® 100 systems are the most successful of the OptiCentric® product series. They measure and produce a wide range of samples with diameters from 0.5 mm to 225 mm and a weight of up to 20 kg. As a result, OptiCentric® 100 is the standard in a wide variety of fields of the optical industry. Applications range from tiny endoscopy and mobile telephone lenses to photography and film camera lenses.

OptiCentric® 100 with lens rotation device

OptiCentric® 100

The Industry Standard for Centering Testing and Manually Alignment, Cementing and Bonding of Lenses

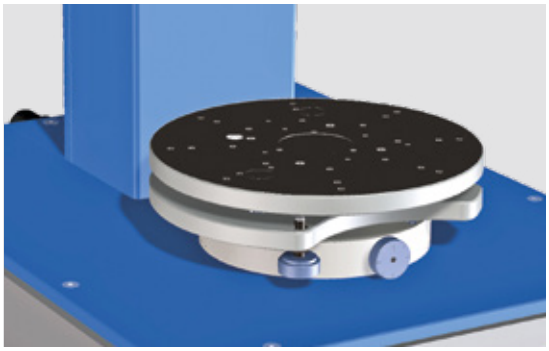
The OptiCentric® 100 system is the bestselling system of the OptiCentric® series. It is used around the world in optics production, quality assurance and development..

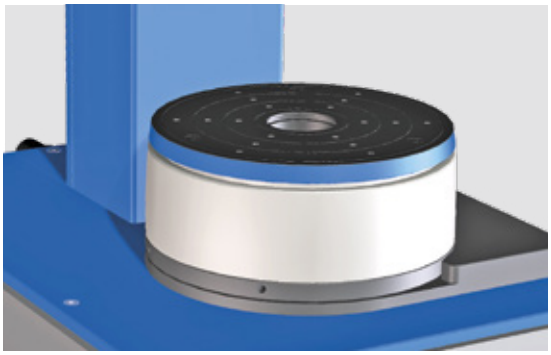
OptiCentric® 100 is equipped with a visual measurement head and available in two configurations in its basic version:

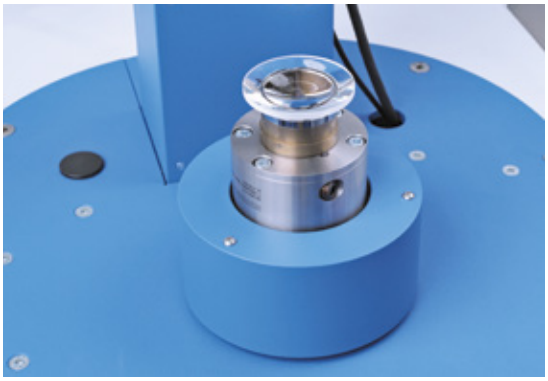
- OptiCentric® 100 without air bearing
- OptiCentric® 100 with air bearing

OptiCentric® 100 without air bearing is normally equipped with a lens rotation device which is used to measure the centering errors of single lenses and to cement doublets with the outer edge and the center of curvature of the bottom lens as a reference.

OptiCentric® 100 with air bearing is equipped with a tilt and translation table (TRT) and is used for assembling and testing lens. Equipped with a mechanical clamping device, lenses can be cemented on a arbor, for example.







From top to bottom: manual tilt and translation table, automated tilt and translation table, mechanical clamping device

OptiCentric® 100 IR

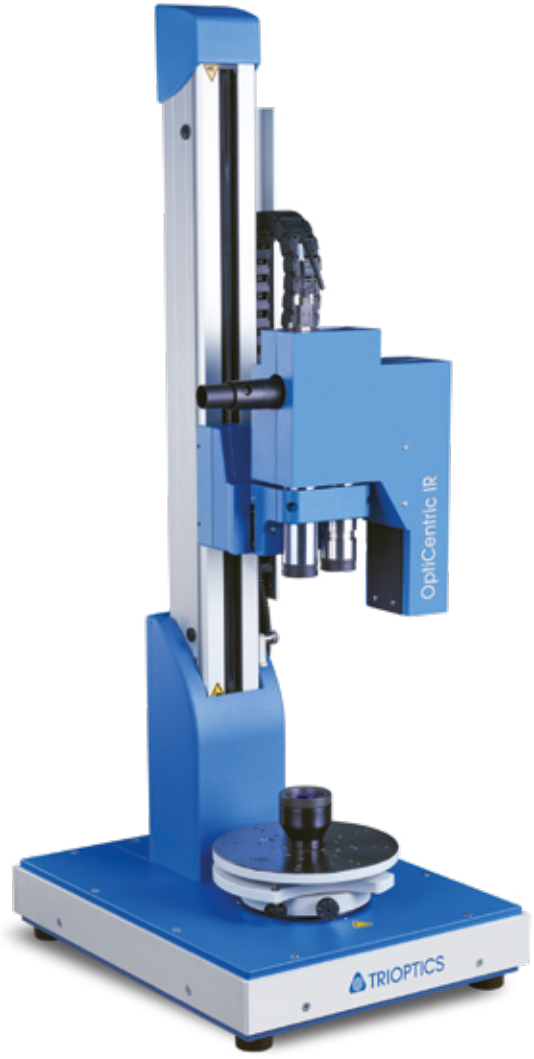
Precisely Test IR Lens Assemblies

OptiCentric® 100 IR is TRIOPTICS' solution for centering testing of infrared optics. The system is equipped with a flexible-changeover VIS-MWIR or VIS-LWIR measurement head and can test all types of infrared optics.

Best Accuracy for the Lens Centering Measurement and the Assembly of IR-Optics

In order to achieve the maximum possible accuracy when assembling and testing infrared optics, the selection of the appropriate wavelength (VIS or IR) is of crucial importance for centering testing:

- The measurement of single lenses and the assembling of lens assemblies in reflection can be performed in the visual. The highest degree of accuracy, at 0.1 µm, is also achieved here.
- By contrast, the testing of lens assemblies and lens groups within an optical system with the MultiLens software module, as well as measuring in transmission, are only possible in the infrared spectrum.



OptiCentric® 100 IR
with VIS-LWIR measurement head

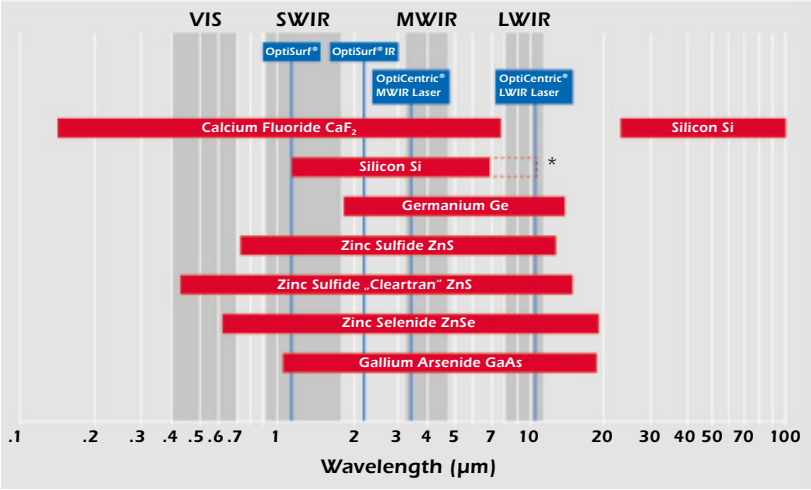
Advantages of the OptiCentric® 100 IR Systems

- Simple changeover between the visual and infrared wavelength
- The centering measurement accuracy of the MWIR and LWIR measurement heads is 1-2 µm due to the wavelength and the lower resolution in the IR camera, compared with visual cameras.
- Lens centering testing, as well as center thickness and air gap measurement (OptiCentric® 3D 100 IR)
- OptiCentric® 100 Dual IR for testing complex, multi-lensed optics
- Software is customized for measurement in the infrared
- Due to the laser light source, a pinhole is required as the reticle instead of a cross

OptiCentric® IR measurement head with VIS-MWIR light source

Systems with IR Measurement Head:

- OptiCentric® 3D 100 IR
- OptiCentric® 100 Dual IR
- OptiCentric® 3D 100 Dual IR



Comparison of light-permeable areas of typical infrared lens materials and the available OptiCentric® measurement heads.

*Dependent on the strength of the doping and the dopant

OptiCentric® 3D 100

Centering Testing and Center Thickness/ Air Gap Measurement in One System

For the complete opto-mechanical characterization of optical systems, which are already mounted, the OptiSurf® low-coherence interferometer is integrated into the OptiCentric® 100 system, which is then called the OptiCentric® 3D 100. This combination of both measurement systems results in a significant increase in measurement accuracy. The center thicknesses and lens distances can only be determined with maximum accuracy as a result of the highly accurate cetering testing and subsequent adjustment of the sample.

OptiSurf® is available in three configuration variants; each one can be integrated in an OptiCentric® system:

OptiCentric® 3D 100
with integrated OptiSurf®
low-coherence interferometer

Spezification for the Center Thickness and Air Gap Measurement with OptiCentric® 3D Systems

OptiSurf®	Measurement accuracy (optical thickness)	Light source	Scan ranges (optical thickness)
Standard	1 µm	1.3 µm	400 mm, 600 mm or 800 mm
Ultra Precision	0.15 µm	1.3 µm	200 mm, 400 mm, 600 mm or 800 mm
IR	upon request	2.2 µm	200 mm or 400 mm

Additional Systems with Integrated Center Thickness Measurement:

- OptiCentric® 3D 100 Dual
- OptiCentric® 3D 100 IR
- OptiCentric® 3D 100 Dual IR

OptiCentric® 100 Dual

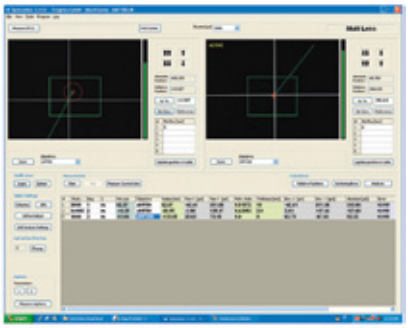
Advanced Lens Centering Testing of Lenses and Complex Optical Systems

TRIOPTICS developed the principle of the double measurement head for aligning, assembling and testing complex and multi-lens assemblies. In the copyright-protected OptiCentric® 100 Dual design, a second measurement head is additionally installed under the air bearing. Its travel equals 250 mm.

OptiCentric® 100 Dual

Advantages of the OptiCentric® Dual System:

- Doubling of measurable surfaces during centering error testing within lens assemblies with the MultiLens software module.
  - VIS lens assembly: up to 40 surfaces
  - IR lens assembly up to 15 surfaces, depending on sample and with corresponding IR measurement head (OptiCentric®100 Dual IR)
- Ideal in combination with the MultiLens software module: centering measurement of complex lens assemblies, as well as lens groups within an optical system.
- The upper and lower measurement head determine the lens centering of the sample within one measurement
- Correction of the centering error of two optical surfaces in the x and y direction in real time
- Optional: Measurement of aspheres in combination with the AspheroCheck module



Screenshot with live images of the upper and lower measurement heads

Additional Systems with Second Measurement Head:

- OptiCentric® 3D 100 Dual
- OptiCentric® 100 Dual IR
- OptiCentric® 3D 100 Dual IR

Combinations of the Previously Presented Systems

OptiCentric® 3D 100 IR

- Lens centering testing
- Center thickness and air gaps measurement
- IR-measurement head (VIS-MWIR or VIS-LWIR)

OptiCentric® 100 Dual IR

- Lens centering testing
- IR-measurement head (VIS-MWIR or VIS-LWIR)
- Second measurement head setup underneath the air bearing

OptiCentric® 3D 100 Dual

- Lens centering testing and assembly of lenses
- Center thickness and air gaps measurement
- Second measurement head setup underneath the air bearing

OptiCentric® 3D 100 Dual IR

- Lens centering testing
- IR-measurement head (VIS-MWIR or VIS-LWIR)
- Center thickness and air gaps measurement
- Second measurement head setup underneath the air bearing

Technical Data OptiCentric® 100

Legend: ☑ Standard configuration ○ Optional configuration

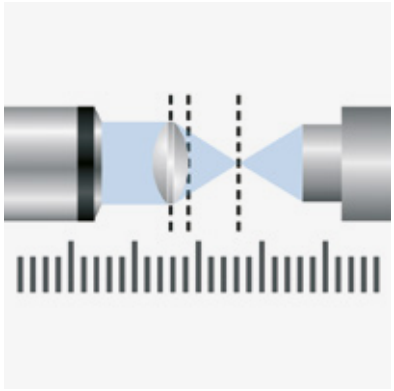
	OptiCentric® 100	OptiCentric® 100 IR	OptiCentric® 3D 100	OptiCentric® 100 Dual	OptiCentric® MultiCentric® Cementing
Measurement accuracy[1]	0.1 µm	1 – 2 µm	0.1 µm	0.1 µm	0.1 µm
Maximum sample weight	Air bearing 20 kg | Lens Rotation Device 2 kg				
Maximum sample diameter	Air bearing 0.5 – 225 mm | Lens Rotation Device 0.5 – 200 mm				
Optimal sample diameter	0.5 – 120 mm				
Lens rotation					
Air bearing	○	☑	☑	☑	☑
Lens Rotation Device	○	○	○	○	○
Motorized stages[2]					
450 mm	☑	☑	☑	☑	☑
250 mm, 550 mm oder 990 mm	○	○	○	○	
Reflection | Transmission					
Measurement in reflection	☑	☑	☑	☑	☑
Measurement in transmission	☑	○	○	☑	○
Measurement head					
Visual measurement head	☑		☑	☑	☑
IR measurement head (VIS-MWIR or VIS-LWIR)	○	☑	○	○	○
MultiCentric® measurement head					○
Additional upgrades					
Center thickness and Air Gap Measurement	○	○	☑	○	
Dual upgrade (2nd measurement head)	○	○	○	☑	
Effective Focal Length, Flange Focal Length, Radius, on-axis MTF (OptiSpheric® Upgrade)	○		○	○	
Asphere axis measurement, AspheroCheck	○			○	
Cylinder Lens measurement, CylinderCheck	○	○	○	○	
Angle measurement, OptiAngle	○		○	○	
Workstation	○	○	○		○
Upgrade for Lens Alignment and Cementing - on arbor or with respect to the optical axis	○	○	○	○	☑

[1] Under stable environmental conditions at 100 mm height above the surface of the air bearing

[2] Manual stages upon request

Upgrades for Special Measurement Tasks

OptiSpheric® Upgrade



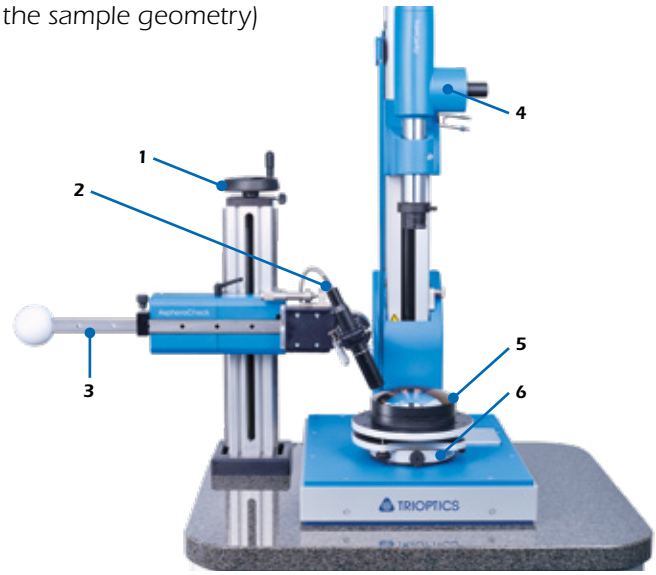
With an OptiSpheric® Upgrade, an OptiCentric® system also measures the following parameters

- Effective Focal Length (EFL)
- Back Focal Length (BFL)
- Flange Focal Length (FFL)
- Radius of curvature
- Modulation Transfer Function (MTF) on-axis

AspheroCheck: Measurement of Aspheres

AspheroCheck, patent application 10 2006 052.047.5-5, is a hardware and software module that measures the inclination and position of an asphere axis to a given reference axis. The upgrade is characterized by:

- Measurement in reference to the optical axis of the asphere or to a reference axis
- Specified reference axis according to DIN ISO 10110-6
- Measurement of lenses with one or two aspherical surfaces
- Sample diameters from 2 mm
- Accuracy up to 5 arcsec (depending on the sample geometry)
- Contact-free measurement



OptiCentric® 100 with AspheroCheck

1. Height adjustment
2. AspheroCheck-Sensor
3. Adjustment of lateral position (x)
4. Focusable autocollimator
5. Sample
6. Tilt and translation table with air bearing

CylinderCheck: Measurement of Cylinder Lenses

CylinderCheck is a hardware and software module for measuring the centering error of cylindrical surfaces without contact. Depending on application and OptiCentric® configuration, the following parameters can be detected with the CylinderCheck module:

- Measurement of wedge errors on cylindrical single lenses
- Measurement of the distance between the vertex line and a reference edge on rectangular cylindrical single lenses
- Measurement of the angle between the vertex line and a reference edge on a rectangular cylindrical single lens
- Measurement of double cylindrical single lenses („clocking angle" measurement)
- Lens alignment and bonding of cylindrical single lenses in a cell
- Measurement of lens assemblies with cylinder lenses

OptiCentric® 100 with CylinderCheck module

Upgrade for the Measurement of Flat Optics

The OptiAngle® software module expands the OptiCentric® system into a tool for angle measurement. The following parameters can be measured

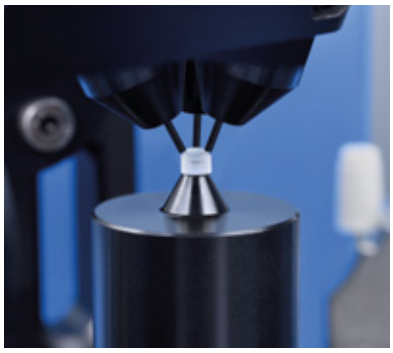
- Wedge angles
- 90°-prisms
- Parallelism of flat plates
- Deflection angle through wedges and prisms
- Tilt angle of mirrors
- Wobble error of rotating glass plates

An operator measures a cylinder lens

Manual and Automatic Alignment, Cementing and Bonding with OptiCentric® 100 Systems

All OptiCentric® 100 systems are used for alignment, cementing and bonding. TRIOPTICS continually develops in this field in order to optimize this complex and error-prone process for the user.

The SmartAlign software module provides a significant contribution to the manual as well as automated alignment processes. With the SmartAlign software module the lens is aligned fast and directly to the desired axis.



Advantages of the Automated Alignment, Cementing and Bonding Process

Manual alignment processes have long since been established in optics and are mastered by experienced workers with a high degree of accuracy and speed; however, automated processes offer significant advantages:

- Continually uniform quality,
- Alignment accuracy of better than 1 µm, regardless of the operator
- Faster and more direct process thanks to SmartAlign software module
- Cementing and bonding from micro-optics to microlithography optics (depending on configuration of the OptiCentric® system)

OptiCentric® Cementing cements two hemispherical lenses of different diameters

Employee performing automated lens alignment and cementing

OptiCentric® Cementing

Efficient and Highly Accurate, Automated Cementing

With the OptiCentric® Cementing system, TRIOPTICS has developed an automated production device for lens alignment and cementing that significantly increases throughput, greatly reduces waste and simultaneously achieves higher alignment accuracy.

OptiCentric® Cementing is available in two versions:

OptiCentric® Cementing for lens alignment and cementing with respect to the optical axis

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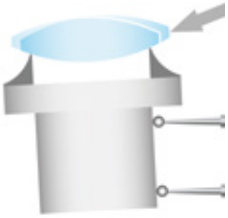
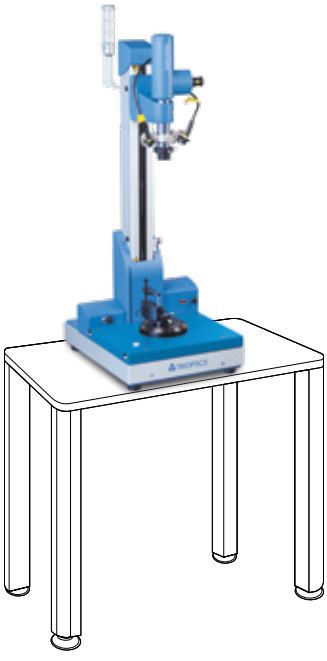


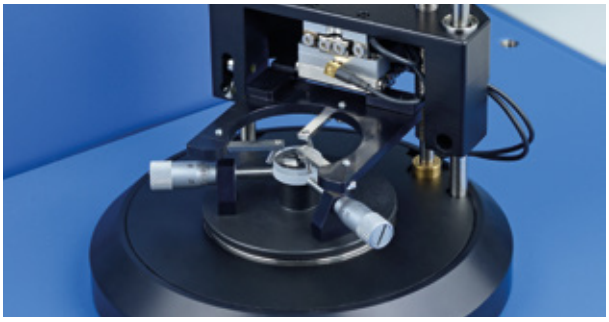
OptiCentric® Cementing for alignment on an arbor with the arbor axis as reference

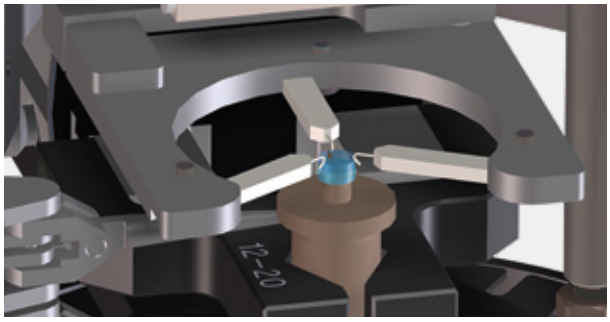


At left, OptiCentric® Cementing as stand-alone system; at right, integrated in the workstation

Depending on Lens geometry, the OptiCentric® Cementing system is equipped with an alignment unit for the alignment process:

Alignment Unit Standard





left: alignment with respect to the optical axis, right: alignment with respect to the arbor axis, both with alignment unit standard

An OptiCentric® Cementing system equipped with the Alignment Unit Standard cements lenses with a geometry of R/D ≥ 0.7[1]. The unit can be easily customized to different sample geometries and is recommended when lenses must be aligned and cemented with respect to the optical axis or with respect to the arbor axis and the lens design is frequently changed.

[1] D = Lens diameter, R = curvature radius of the inside surface in doublets

Alignment Unit Advanced

For optimal cementing results, the radial positions of the actuators can be adjusted.

The Alignment Unit Advanced was developed in order to overcome the limitations of the Alignment Unit Standard. An OptiCentric® Cementing system equipped with the Alignment Unit Advanced aligns all lens geometries, including:

- Hemispherical lenses
- Lenses with R/D < 0.7
- Doublets in which the edge of the upper lens is not accessible
- Lenses with close alignment tolerances
- Lenses in which the cement wedge is especially critical

MultiCentric® Cementing

The Guarantee for Increasing Lens Alignment and Cementing Productivity

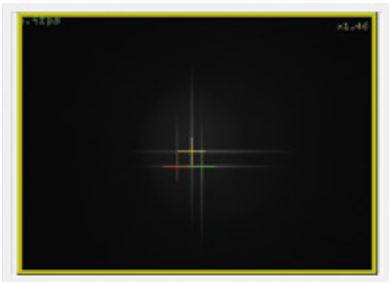
The MultiCentric® Cementing system is an OptiCentric® Cementing system with an integrated MultiCentric® measurement head. It provides the highest degree of productivity in optics production.

The MultiCentric® measurement head simultaneously measures three centers of curvature, reducing the duration for measurement and alignment to less than 10 sec. The measurement head is therefore particularly well suited for:

- Lens alignment and cementing of doublets in series production
- Series testing of identical doublets

Every OptiCentric® Cementing system can be upgraded with this measurement head as an upgrade.

A MultiCentric® Cementing system is integrated in the ergonomic workstation.



Live image of a MultiCentric® measurement with three centers of curvature

Workstation

As a general rule, all devices of the OptiCentric® 100 series can be integrated in the workstation. Accessories, PC and various controllers in particular can be efficiently attached and stored in the specially developed table design. This makes daily work with the OptiCentric® systems easier and adds both efficiency and ergonomics to the workflow.

Cementing Upgrade

Every OptiCentric® 100 system equipped with an air bearing can be upgraded for highly precise, automated alignment and cementing of lenses without having to invest in a new system.

OptiCentric® Cementing Upgrade

Technical Data OptiCentric® & MultiCentric® Cementing

	OptiCentric® Cementing Lens Alignment with respect to the optical axis	OptiCentric® Cementing Lens Alignment on arbor	MultiCentric® Cementing Lens Alignment with respect to the optical axis[3]
Base unit	OptiCentric® 100 with air bearing and setup for aligning with respect to optical axis	OptiCentric® 100 with air bearing and setup for Lens Alignment and cementing on arbor	OptiCentric® 100 with air bearing and setup for aligning with respect to optical axis, MultiCentric® measurement head
Alignment Unit Standard			
Sample geometry[1]	R/D ≥ 0.7	R/D ≥ 0.7	R/D ≥ 0.7
Alignment accuracy	better than 2 µm	better than 2 µm	better than 2 µm
Lens diameter[2]	4 – 90 mm	4 – 90 mm	4 – 90 mm
Time required to change the sample type (predefined sample)	10 sec	10 sec	10 sec
Cycle time, OptiCentric® 100 measurement head	1 min (three surfaces)	10 sec (1 surface)	10 sec (three surfaces)
Alignment Unit Advanced			
Sample geometry	All geometries	Upon request	All geometries
Alignment accuracy	better than 1 µm		better than 1 µm
Lens diameter[2]	5 – 100 mm		5 – 100 mm
Time required to change the sample type (predefined setup)	5 min		5 min
Cycle time	1 min		10 sec (three surfaces)

[1] D = lens diameter, R = curvature radius of inside surface with doublets
[2] Other diameters upon request
[3] Optimized for the measurement of three centers of curvature, lens alignment and cementing on arbor is possible

OptiCentric® Bonding 2D

Fully Automatic Centering Testing, Automated Alignment and Bonding in Two Degrees of Freedom

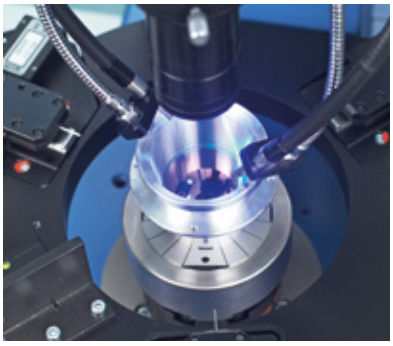
Modern lens assemblies increasingly consist of bonded components, which not only reduces costs but also saves on space and weight.

The OptiCentric® Bonding 2D tilts or shifts a lens in the cell so that the optical axis corresponds with the cell axis as much as possible

Advantages of OptiCentric® Bonding 2D

- Alignment accuracy of better than 2 µm (tilting or shifting)
- Highly accurate alignment of a single lens in the cell or assembly of a lens system in two degrees of freedom
- Fully automatic, PC-controlled bonding process: measuring, aligning, controlling of bonding dispenser and UV curing
- Alignment and bonding based on the SmartAlign software module
- Equipped with three actuators on z stepper motor stage for precise alignment of the lens
- Process time 2 min. (alignment and bonding process)

OptiCentric® Bonding 2D



OptiCentric® Bonding with three actuators for alignment of the lens in the cell

OptiCentric® Bonding 5D

Assembly, Bonding and Test of Precision Optics Highly Accurately in Five Degrees of Freedom

The OptiCentric® Bonding 5D station was developed to achieve the maximum degree of accuracy when aligning and bonding lens systems.

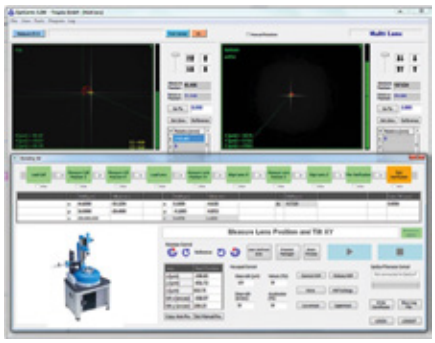
The system aligns a lens within a cell automatically so that the optical axis of the lens and the symmetry axis of the cell correspond with respect to tilt and shift. The lens does not sit within the cell, but can instead be adjusted to any desired axis on a lens holder with ring chuck.

In addition, the Bonding 5D station determines the axial distance in the z direction between a reference surface, such as the top flange surface of the cell, and the lens vertex by means of the integrated OptiSurf® low-coherence interferometer and then shifts the lens to the target position.

OptiCentric® Bonding 5D

Advantages of OptiCentric® Bonding 5D

- Alignment of a lens in a cell in 5 degrees of freedom
- Positioning accuracy of the system:
  - x/y/z <1 µm
  - θx,θy < 2 arcsec
  (Alignment accuracy of the lens depends on the sample)
- Short cycle time: < 5 min
  (without appyling adhesive and UV curing)
- Fully automatic, PC-controlled alignment and bonding process
- Stable process which is independent of the user's qualifications
- Simple and fast changeover to other sample geometries

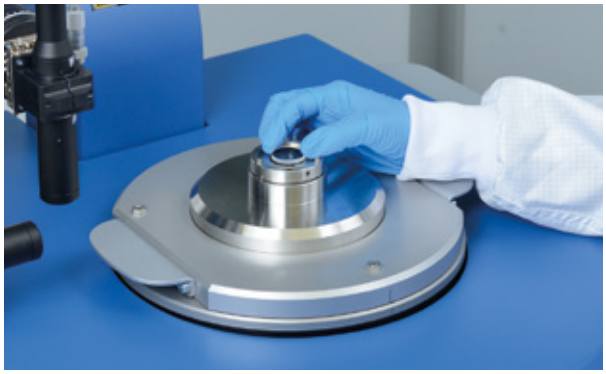


The software of the OptiCentric® Bonding 5D system leads the operator in a simple and intuitive way through the assembly and bonding process

Technical Data OptiCentric® Bonding 2D & Bonding 5D

		OptiCentric® Bonding 2D	OptiCentric® Bonding 5D
Application		Bonding in 2 degrees of freedom Alignment with three actuators	Bonding in 5 degrees of freedom
Max. diameter of the Lens		200 mm	10 – 150 mm[1]
Max. diameter of the cell		10 – 200 mm	20 – 260 mm[1]
Lens weight		< 10 kg	1 kg[1]
Cell weight		< 10 kg	20 kg[1]
Measuring accuracy	x/y (Lens)	0.1 µm	< 0.1µm[2]
	z (Lens)	no (optional)	< ±1 µm
	x/y (cell)	< 0.2 µm	< 0.2 µm
Positioning accuracy		x or y: 2 µm	x, y, z: < 1 µm[2]
			0x, 0y < 2 arcsec
Process time		2 min [2,3]	< 5 min [2,3]
Air bearing		☑	☑
Motorized stage		☑	☑
Measurement in reflection		☑	☑
Visual measurement head		☑	☑
OptiSurf		○	☑

[1] others upon request, [2] depending on lens geometry, [3] without UV curing

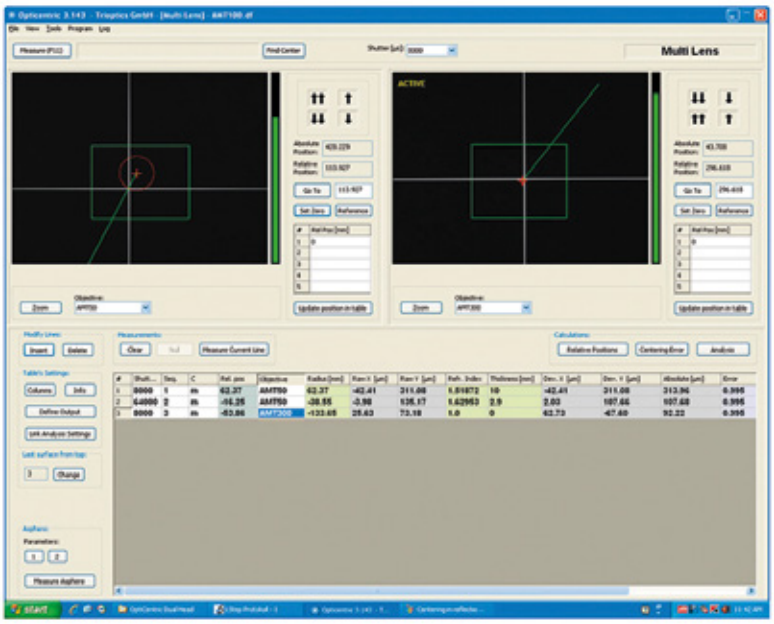


Software

The user of an OptiCentric® system controls the entire measurement, alignment and cementing process via OptiCentric® software. All components, upgrades, measurement and analysis programs are integrated in the software so that the user can perform their measurements easily, quickly and with a high degree of accuracy.

Main Advantages

- Real-time display of measured value/live measurement of centering error
- Coordinated control and evaluation of all axes
- Data capture and evaluation of all integrated sensors
- Auto-focus
- Options for the measurement of lens assemblies, aspheres and cylinder lenses
- Patented MultiLens software module for the measurement of lens assemblies
- Centering error calculation and alignment with respect to a freely definable mechanical or optical reference axis (SmartAlign)
- Data import and export
- Pass/Fail display
- The OptiCentric® Cementing and Bonding systems are delivered with an own software
- Customized software on request



Screenshot of a OptiCentric® Dual measurement

Software-Modules

MultiLens and SmartAlign are the two powerful software modules which make the OptiCentric®
a highly precise system for testing complex lens assemblies and for manual or automated cementing
and bonding.

MultiLens

MultiLens is the software module for measuring and aligning lens assemblies.
The centering errors of each individual surface of a lens assembly and the centering of
the system are determined non-destructively.

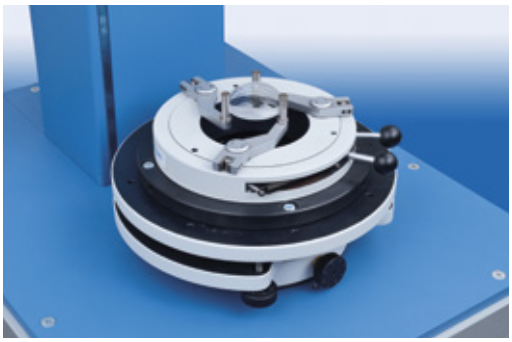
SmartAlign

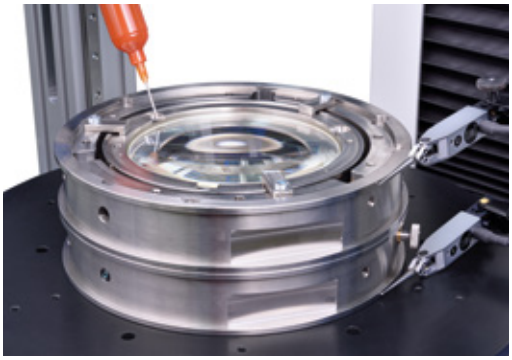
With the SmartAlign module, the position of the measured centering error is analyzed in
reference to a user-defined optical or mechanical axis. This unique tool is used particularly successfully
for cementing & bonding applications.

Screenshot of the OptiCentric® Cementing process

Accessories

- Measuring probe
- Revolving turret for exchange of head lenses
- Lens rotation device, tilt and translation table (TRT)
- Lens holders
- Expansion of measurement range to effective focal lengths of up to ±2000 mm
- Encoder for the motorized stage
- Alignment set, calibration wedge
- Ring chucks
- Manual air pusher for easy and non-contact alignment of lenses
- Foot-pedal control for the compressed air
- Tool-stage with kinematic seat for holding the alignment tools
- UV light source, manual bonding unit with foot pedal, automated bonding unit, needles and tubes for the bonding unit

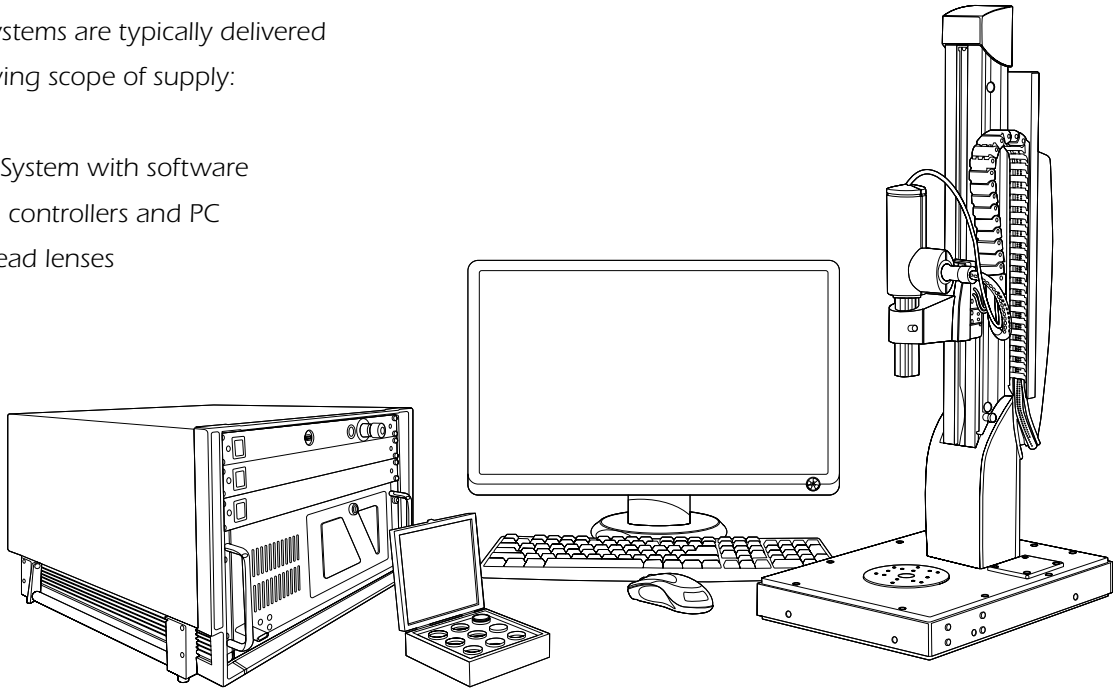




Scope of Supply

OptiCentric® systems are typically delivered with the following scope of supply:

- OptiCentric® System with software
- 19" rack with controllers and PC
- One set of head lenses
- Accessories
- Monitor



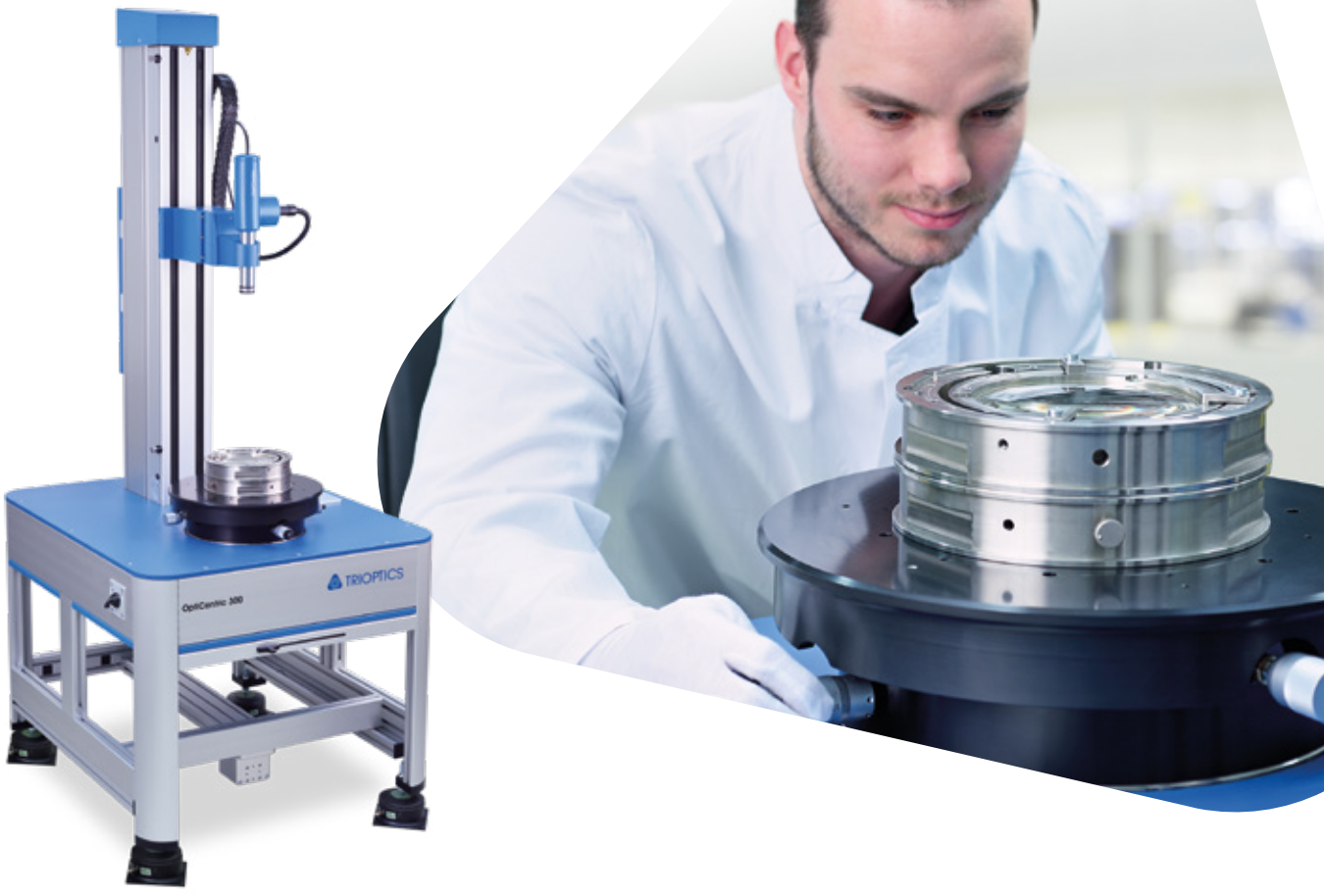
Other OptiCentric® Systems

OptiCentric® 300

The OptiCentric® 300 series measures samples up to a diameter of 400 mm and an axial load of 300 kg. As a result, it is ideally suited for centering testing, cementing or bonding applications for which the OptiCentric® 100 is too small and for which the high degree of rigidity and thermal stability of the OptiCentric® UP series is not required.

The systems consist of a stable frame, anti-vibration dampers, a highly resistant air bearing and an optional, stable tilt and translation table (TRT 400)

A second measurement head, the low-coherence interferometer for center thickness measurement or IR measurement heads can optionally be integrated in the system.



OptiCentric® 300 UP & 600 UP

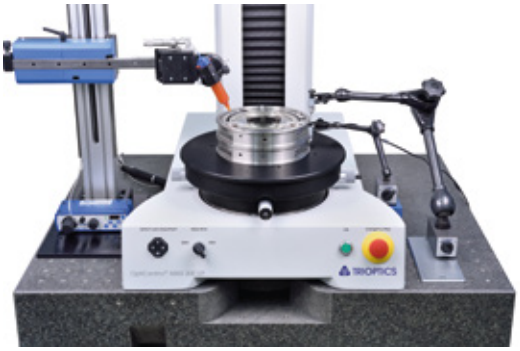
Die OptiCentric® UP devices transfer the advantages of the OptiCentric® 100 series to the measurement of large, heavy lens assemblies with a weight of up to 1200 kg and a diameter of 800 mm.

OptiCentric® 300 UP

OptiCentric® 600 UP with bonding frame

Like an OptiCentric® 100 system, an OptiCentric® UP system can also be equipped

- with a second measurement head underneath the air bearing
- with the OptiSurf® low-coherence interferometer for center thickness measurement
- with IR measurement heads for testing IR lens assemblies

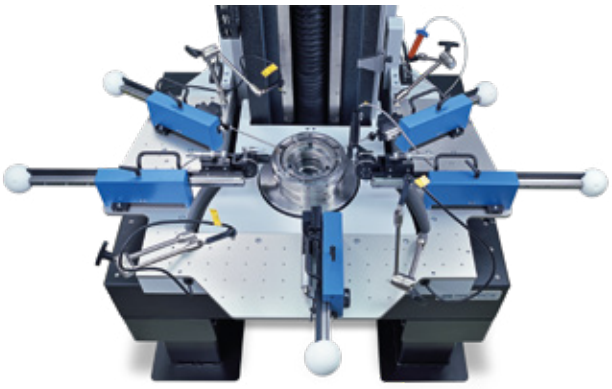


OptiCentric® UP with tool stage
for manual lens alignment and bonding

The system's design on a granite base provides you with extraordinary rigidity and thermal stability, so that the greatest accuracy is achieved even with slowly curing adhesives.

TRIOPTICS offers one bonding system for manual bonding and one system for semi-automatic bonding for OptiCentric® UP systems. For simple bonding processes in a small production, TRIOPTICS recommends the bonding system for manual bonding. It is equipped with an x-z linear stage with kinematic mount so that all tools required for the alignment and bonding process can be easily and quickly changed out.

The bonding system for semi-automatic lens alignment and bonding is ideal for recurring bonding processes or large quantities. All tools required for the bonding process are positioned on a frame so that aligning and bonding can be performed more quickly and precisely than with the manual process.



OptiCentric® UP
with bonding frame for semi-automatic lens alignment and bonding

93-004-101-EN Version 002

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