Operator's Manual and Software Description

OptiCentric®100

Translation of the Original Operator’s Manual

Subsidiaries/Customer Service

Germany (Head office)

TRIOPTICS GmbH
Strandbaddamm 6
22880 Wedel
Germany

Phone: +49 4103 18006-0
Fax: +49 4103 18006-20
E-mail: sales@trioptics.com
www.trioptics.com

China

TRIOPTICS China
E.5/F., Bldg. M7
#1 JiuXianQiao East Road
100016, Beijing
Beijing
China

Phone: +86 10 8456 6186
Fax: +86 10 8456 9901
E-mail: info@trioptics-china.com
www.trioptics-china.com

France

TRIOPTICS France
76 rue d'Alsace
69100 Villeurbanne
France

Phone: +33 4 72 44 02 03
Fax: +33 4 72 44 05 06
E-mail: info@trioptics.fr
www.trioptics.fr

Japan

TRIOPTICS Japan Co., Ltd.
4-6-25, Nakada, Suruga-ku
422-8041 Shizuoka-city
Shizuoka
Japan

Phone: +81 54 203 4555
Fax: +81 54 203 4556
E-mail: info@trioptics.jp
www.trioptics.jp

USA

TRIOPTICS USA
9087 Arrow Route, Unit 180
Rancho Cucamonga
CA 91730
USA

Phone: +1 626 962 5181
Fax: +1 626 962 5188
E-mail: sales@trioptics-usa.com
www.trioptics-usa.com

Taiwan

TRIOPTICS Taiwan Ltd.
3F, No.5 Andong Rd
Zhongli Dist.
Taoyuan City 32063
Taiwan (R.O.C.)

Phone: +886 3 462 0405
Fax: +886 3 462 3909
E-mail: info@trioptics.tw
www.trioptics.com.tw

Korea

TRIOPTICS Korea Co., Ltd.
#701-101, Digital Empirell 486
Sin-Dong, Youngtong-Ku Suwon-City
Kyunggi-Do
440-050 Korea

Phone: +82 31 695 7450
Fax: + 82 31 695 7459
E-mail: info@trioptics.co.kr
www.trioptics.co.kr

Table of Contents

1. Introduction

1.1 Measurement system overview OptiCentric®100

OptiCentric®100 is a measuring system which allows the measurement of the following parameters in optical components:

- Centration errors in reflection
- Centration errors in transmission
- Centration errors of each individual surface within multi-lens optical systems (MultiLens®) *
- Wobble in plane optics
- Wedge angle
- Radii of curvature
- Center thicknesses *
- Distances between lenses *
- Effective focal lengths *
- Refractive indices *
- Back focal lengths *
- Flange focal length *
- Axial MTF measurement *

* with expansion module

OptiCentric®100 measures a wide range of samples with different dimensions and weights. The applications range from tiny endoscope and mobile phone optics (diameter less than 0.5 mm) to precise digital camera lenses.

Optics can also be aligned and assembled using OptiCentric®100.

The modular design allows for easy extension and adaptation to customer-specific measuring tasks.

OptiCentric®100 is computer-controlled and equipped with a stepper motor drive. The measurement head can move to any number of focus positions and centers of curvature that have previously been saved. The measurement procedure is largely automated, multi-lens objectives can thus easily be aligned and assembled.

The measurement head consists of an electronic autocollimator, which achieves an accuracy of 0.1 µm in the measurement of centration errors. In addition, all measurement systems can be fitted with an autocollimator with larger focal lengths or a higher resolution CCD camera.

The measurement system is equipped with a precise rotary air bearing. The built-in air bearings are specially designed for optical applications. They have excellent rigidity and precision (axial and lateral run-out errors less than 0.05 µm). They are fitted with a central hole, in order to measure optical surfaces from below in transmission or with the dual sensor. The precise rotary drive allows a smooth rotation, without any vibration, and if necessary a precise angular positioning. In order to ensure long service life, the air bearings are supplied with a full air conditioning unit including membrane dryer, filter and manometer.

The air bearing is also used with a stable tip-tilt table for the precise calibration of lenses.

The centering apparatus with vacuum unit is a rotary device used to measure centration errors of single lenses with the outer edge as a reference. It is characterized by high precision and reproducibility. If there are any errors in the outer cylinder, these are detected.

The OptiCentric® software supports operating, aligning, and measurement tasks and processes.

1.2 Documentation

This documentation contains all information necessary for the safe operation of the measurement system and the accompanying software.

Read the instructions carefully before you start working with the measurement system. Pay special attention to the safety instructions.

The documentation including all third party documents must be stored with the measurement system and must be readily available when needed.

Please contact the manufacturer or the respective local subsidiary (see page 3) for additional information.

1.2.1 Target group

This documentation is aimed at people who work with the measurement system:

Qualified person

A qualified person uses his or her technical training, expertise, and experience, as well as knowledge of the relevant rules and regulations to assess assigned work and identify potential hazards.

Trained person

A trained person has been

- informed,
- trained,
- and instructed about the required safety measures and safety equipment concerning the assigned work and possible hazards in case of improper conduct.

Persons working on or with the measurement system must be regularly trained about the associated dangers.

1.2.2 Safety notes layout

The operator's manual attaches different levels of importance to safety notes by using symbols and signal words.

Symbol	Signal word	Explanation
	DANGER!	Imminent danger. Will result in death or severe bodily injury.
	**WARNING!**	Possibly dangerous situation. May result in death or severe bodily injury.
	CAUTION!	Possibly dangerous situation. May result in slight or minor injuries.
	**CAUTION!**	Possibly dangerous situation. May result in damage to property.
	**NOTE**	Notes that must be considered in order to ensure optimal results and secure operation of the system.

The warnings are structured as follows.

Example:

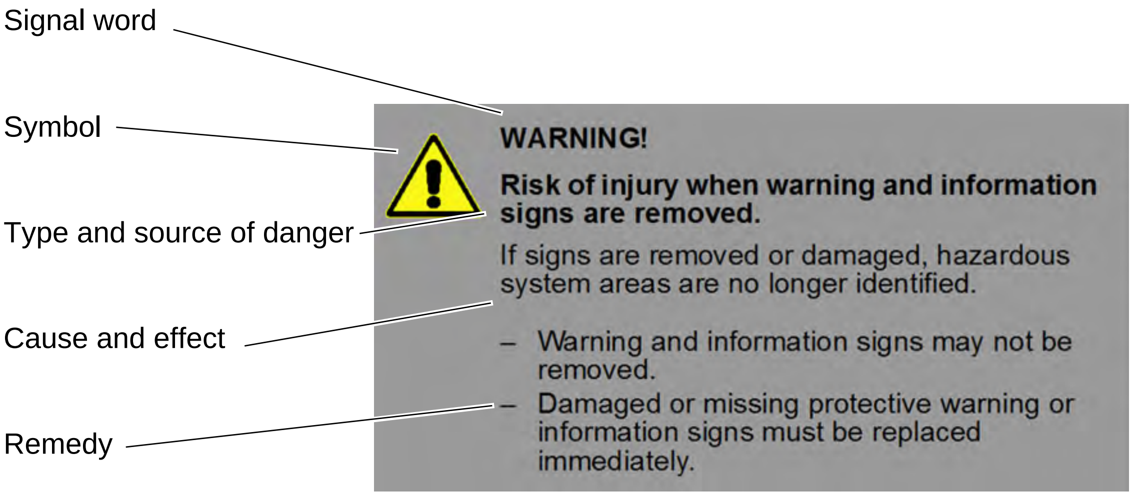


Fig. 1-1

Signal word

Specifies the severity of the danger (see table on page 9).

Type and source of danger

Specifies the type of danger associated with the warning and where this danger can occur.

Cause and effect

Describes the cause of the danger or damage and its effects.

Remedy

Describes how to prevent the danger.

1.2.3 Action instructions

Action instructions are numbered when the correct sequence of the individual steps is important. Results of the action instructions are directly underneath.

Example:

1. This is the first step.

   This is the result of the first step.

2. This is the second step.

   This is the result of the second step.

1.2.4 Operating and control elements

Operating and control elements such as buttons, keys and switches are depicted in bold.

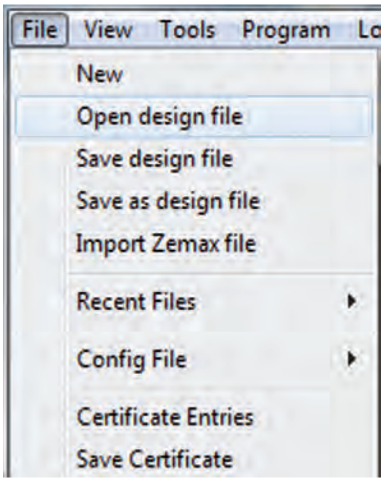
Example:

The **emergency stop** button is located on the left side of the measurement system.

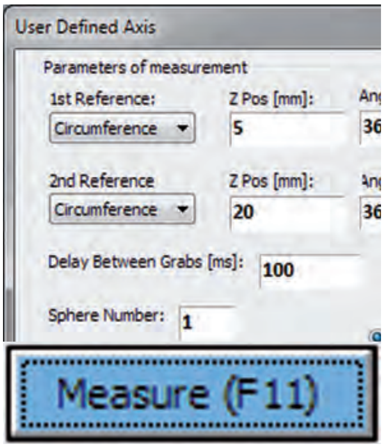
1.2.5 Operation via software

The menus and buttons in the software are depicted in a different font.

Example:



– Select `<File> <Open design file>`.



The `User Defined Axis` window opens.

1. Click the `Measure` button or press the **F11** key to start the measurement.

1.2.6 Designations

OptiCentric® and OptiCentric®100 are registered trademarks of TRIOPTICS GmbH.

If a trademark is not expressly mentioned here, this omission does not indicate a license for using this trademark.

2. Safety notes

The measurement system was designed and built in accordance with accepted technical and safety rules.

Nevertheless, risks to the operator, other people, for the system itself, and damage to property may still arise.

WARNING!

Personal injury or property damage

Installation, initial startup, operation and disposal of the system may cause or be associated with mechanical, electrical and thermal hazards.

– Observe all safety instructions in this operator's manual.

2.1 Intended use

WARNING!

Risk if not used as intended

Improper use of the measurement system may endanger people and cause property damage.

– Always use the measurement system as intended and as described below.

OptiCentric®100 may only be used for the measurement of optical components or optical systems. It is intended only for use in industrial and/or small or medium-sized companies. Any other utilization is considered unintended use.

Only the accessories described in this operator's manual may be used. Changes to the measurement system or the accessories may not be made.

The intended use includes the compliance with the prescribed cleaning and maintenance intervals.

2.2 Foreseeable misuse

Abuse is hereby included.

Any use that goes beyond the aforementioned intended use is regarded as improper. The manufacturer is not liable for any injury to persons or material damage resulting from such improper use.

- The use of attachments, spare parts or wearing parts other than those described in the operator's manual is prohibited. If necessary, TRIOPTICS must approve the use of other parts explicitly.
- It is prohibited to enter the position information ("Rel. pos") in the position table incorrectly.
- Measurements of too large or too heavy optics according to the limits may not be performed.
- It is prohibited to operate OptiCentric®100 beyond the specified service life.
- It is prohibited to remove the variable limit stop of the upper linear axis or to place it at an incorrect lower position.
- Only light sources that are approved for this measurement system may be used.
- It is prohibited to disregard the cleaning and maintenance cycles.

2.3 General notes

- Be sure to read the manual before working with the measurement system. Comply with all warnings in the operator's manual and on the measurement system. Keep the operator's manual for later reference.
- If the measurement system emits unusual smells or smoke, immediately turn off the main switch and remove the plug from the wall outlet. Continued use of the measurement system constitutes a hazard and may result in fire, electrical shock, or injury. Immediately notify the manufacturer or the responsible local subsidiary (see page 3).
- Do not use the measurement system if you suspect a malfunction or defect.
- The measurement system must be connected to a safety wall outlet with the specified voltage. Make sure the measurement system is grounded.
- Avoid damaging the connecting cables. Do not place any objects on cords or cables. Do not pull on cords or cables. Place cords and cables in such a way that they do not becomes a tripping hazard.
- Turn off the power and unplug the power plug from the measurement system and accessories, before cleaning or servicing the system.
- Never cover the ventilation slots.
- The lighting for any work on the machine must be in accordance with DIN EN 12464.

2.4 Employees

WARNING!

Risk of injury or property damage when operated by insufficiently qualified employees

Inadequately trained employees are not familiar with the dangers associated with handling of the measurement system.

– The system may only be operated and maintained by qualified and trained employees.

Installation and initial startup

Only employees of TRIOPTICS GmbH or correspondingly trained and authorized persons are permitted to install and operate the measurement system. This includes installing the software and the installation of accessories.

Operation

The measurement system may only be operated by trained employees (see chapter 1.2.1, page 10). In particular, they must have read and understood the operator's manual and the safety notes.

Maintenance and repairs

All maintenance and repair work must be carried out by qualified employees (see chapter 1.2.1, page 10).

NOTE

Inaccurate measurements

Failure to observe this point will result in decalibration and inaccurate measurements.

2.5 Hazards during transportation and installation

WARNING!

Risk of injury from heavy components

The transport and installation of the measurement system may be associated with hazards due to heavy and tipping parts.

Transport

- Only employees of TRIOPTICS GmbH or correspondingly trained and authorized persons are permitted to move the measurement system.
- Make sure the measurement system is transported without being subjected to impact or jolting.
- Remove transports locks only during installation.
- The measurement system has a weight of 80 kg. Only use suitable and checked lifting tools, for example a forklift with appropriate carrying capacity.
- Never step under suspended loads.

Installation and initial startup

Only employees of TRIOPTICS GmbH or correspondingly trained and authorized persons are permitted to install and operate the measurement system. Improper setup or incorrect installation may damage the measurement system or impair its function. This will result in inaccurate measurement results.

Ambient temperature

In order to prevent damage from condensation, all the components must be acclimatized to the ambient temperature prior to installation.

Different installation site

Please inform TRIOPTICS GmbH if you wish to transport the system to a different installation site. This requires a re-calibration after relocating the system.

Rotary air bearing

CAUTION!

Material damages

The air bearing is very sensitive.

– The air bearing should never be rotated by hand or without a compressed air supply.

2.6 Hazards during operation of the measurement system

2.6.1 Electrical hazards

DANGER!

Danger to life due to electric shock

Electrical currents may pose a hazard.

– Comply with the following safety notes and instructions when working on the measurement system.

Power supply

- Disconnect the main power supply before working on electrical equipment. Additional information on the main power supply is listed in chapter 3. "Technical Data", page 27.
- Do not touch live (energized) parts.
- Do not short-circuit or ground the power supply output.

Housing sections

- Do not remove any sections of the housing.
- Before you start work, make sure all sections of the housing are present and properly installed. Do not work on the measurement system if sections of the housing have been removed or are defective. Immediately reattach removed sections of the housing or notify the manufacturer or the responsible local subsidiary (see page 3).

Humidity

- Make sure that moisture cannot penetrate into the housing of the measurement system.
- Do not consume beverages at the workplace.
- Do not place the measurement system in a humid environment or outdoors.
- To avoid condensation, do not place the measurement system in environments with high temperature fluctuations. Additional information is listed in chapter 5.4 "Set-up location", page 47.

2.6.2 Mechanical hazards

WARNING!

Risk of injury from moving components

When working on the measurement system, injuries caused by crushing or shearing of moving parts may occur.

- Wear close fitting clothing.
- Tie back long hair.
- Keep a safe distance from rotating axes while measuring.
- Keep a safe distance from horizontally or vertically articulated axes while measuring.

NOTE

Information about the workspace and the dimensions of the measurement system can be found in chapter 5.5 "Required space", page 47.

- Never block the linear stages.
- Do not insert anything into the housing of the linear stages.
- The limit switch must be set up before moving the measurement head towards the sample.

2.6.3 Danger from light sources

Read the enclosed documentation on the light source and follow the safety instructions.

WARNING!

Fire hazard and risk of burns

Light-absorbing materials convert light into heat. High intensity visible light can cause damage to the eyes, skin or other materials in the environment.

- Avoid directly looking into the open clamping sleeve or the optical fiber output while the light source is switched on.
- Never uncover the open clamping sleeve or the optical fiber output.
- Never cover the open clamping sleeve or the optical fiber output with your hand or other parts of the body.
- All optical fiber outputs not used in the operation must always be located a safe distance of at least 10 cm away from heat sensitive or flammable light-absorbing materials when the light source is switched on.

- Do not cover the ventilation slots of the light source and never insert anything into these slots.
- Reduce the brightness and duration of illumination to the absolutely minimum extent necessary. Turn the light source off when not in use.

2.6.4 Danger to the rotary air bearing

CAUTION!

Damage to the air bearing

Rotating the air bearing without compressed air will result in damage to the air bearing. Precise measurements will then no longer be possible.

– Always turn on the compressed air supply first before using the measurement system.

Make sure that the requirements for the compressed air supply defined in chapter 5.7 "Required external connections", page 48 are met.

2.6.5 Danger to the linear air bearing

CAUTION!

Damage to the air bearing

Moving the air bearing without compressed air will result in damage to the air bearing. Precise measurements will then no longer be possible.

– Always turn on the compressed air supply first before using the measurement system.

- Make sure that the requirements for the compressed air supply defined in chapter 5.7 "Required external connections", page 48 are met.
- Protect the contact surface against mechanical influences.

2.6.6 Risk due to defective or missing parts or components

CAUTION!

Risk due to defective or missing parts or components

Defective or missing components, parts, or assemblies may pose mechanical, electrical or thermal hazards.

– Defective or missing parts or components must be replaced or repaired immediately.

NOTE

Addresses and telephone numbers for the service hotline and spare parts orders can be found in chapter "Subsidiaries/Customer Service", page 3.

2.6.7 PC

Read the documentation enclosed with the PC and follow the safety instructions.

2.6.8 Software

CAUTION!

Inaccurate measurement results due to incorrect software operation

– Familiarize yourself with the software and the correct settings before starting work.
– Information about the software and how to select the correct settings is listed in chapter 17. "Software", page 147.

Default settings

Changes to the default settings must only be made by authorized employees of the manufacturer.

2.7 Safety equipment

Do not operate the measurement system if the safety devices are not functioning correctly.

Emergency stop button

The function of the emergency stop button must be checked once a year.

After activating the emergency stop, the measurement system may only be re-started once the fault has been eliminated and there is no danger to persons or property.

Measurement head

An emergency stop is triggered if the travel path of the measurement head is blocked. This function must be checked once a year.

2.8 Warning and information signs

Warning and information signs mark sites and locations where certain conditions may result in hazards.

WARNING!

Risk of injury when warning and information signs are removed

If signs are removed or damaged, hazardous system areas are no longer identified.

– Warning and information signs may not be removed.
– Damaged or missing protective warning or information signs must be replaced immediately.

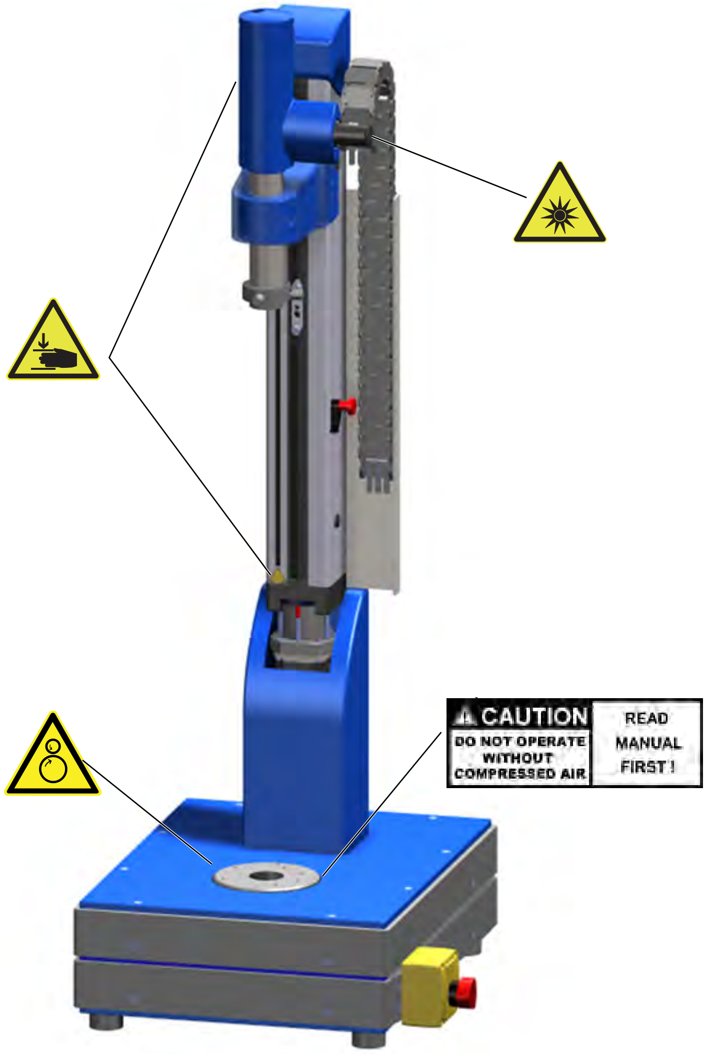


Fig. 2-1

	Linear stage movements may cause hand injuries.
	Entanglement hazard at the rotary air bearing
	Risk of damage to the air bearing when it is moved without compressed air
	Optical radiation warning

Rating plate

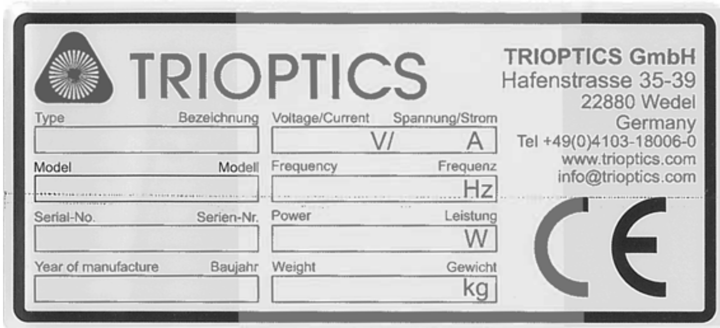


Fig. 2-2

Certified sticker

Fig. 2-3

2.9 Operator obligations

- The operator must ensure a general prohibition of alcohol and drugs for employees.
- The operator must ensure that only suitably qualified employees work on and with the measurement system. A briefing must be given when using for the first time, when personnel change and additionally at regular intervals.
- The operator must ensure that all necessary protective equipment is worn correctly.
- The operator must ensure that persons working on and with the measurement system have read and understood the Operator's manual and safety instructions.

3. Technical Data

3.1 Dimensions of the measurement system

Length	approx. 2000 mm
Width	approx. 800 mm
Height	approx. 1000 mm
Weight	approx. 80 kg

3.2 Specifications

Test parameter	Centration error
Possible measurement method	In reflection In transmission
Measurement accuracy for a single surface	0.1 µm
Maximum measuring range	± 450 mm
Reproducibility	0.05 µm
Repeatability	0.02 µm
Free aperture	30 mm
Maximum number of surfaces in MultiLens measurement	Approx. 20 Approx. 40 (with dual measurement head)
Diameter of the sample	225 mm
Load capacity of the air bearing	20 kg

3.3 Power supply

Voltage	90 - 240 VAC
Maximum electrical power consumption	1500 W

3.4 Rotary air bearing

Run-out error	Axial and radial < 0.05 µm
Compressed air required	4.5 - 5.0 bar
Air requirement	50 L/min

3.5 Tip-tilt-table TRT 200

Accuracy	± 2 arcsec ± 1 µm
Load capacity	30 kg
Weight	22 kg

3.6 Light source

Type	Halogen lamp
Stability	≤0.3% typical @8h
Voltage	100 - 240 VAC

4. Design and Function

This chapter describes the design of the measurement system and its basic functions.

NOTE

The configuration of your measurement system may differ from the one described here. Detailed information is listed in chapter 3. "Technical Data", page 27.

4.1 OptiCentric®100 and accessories

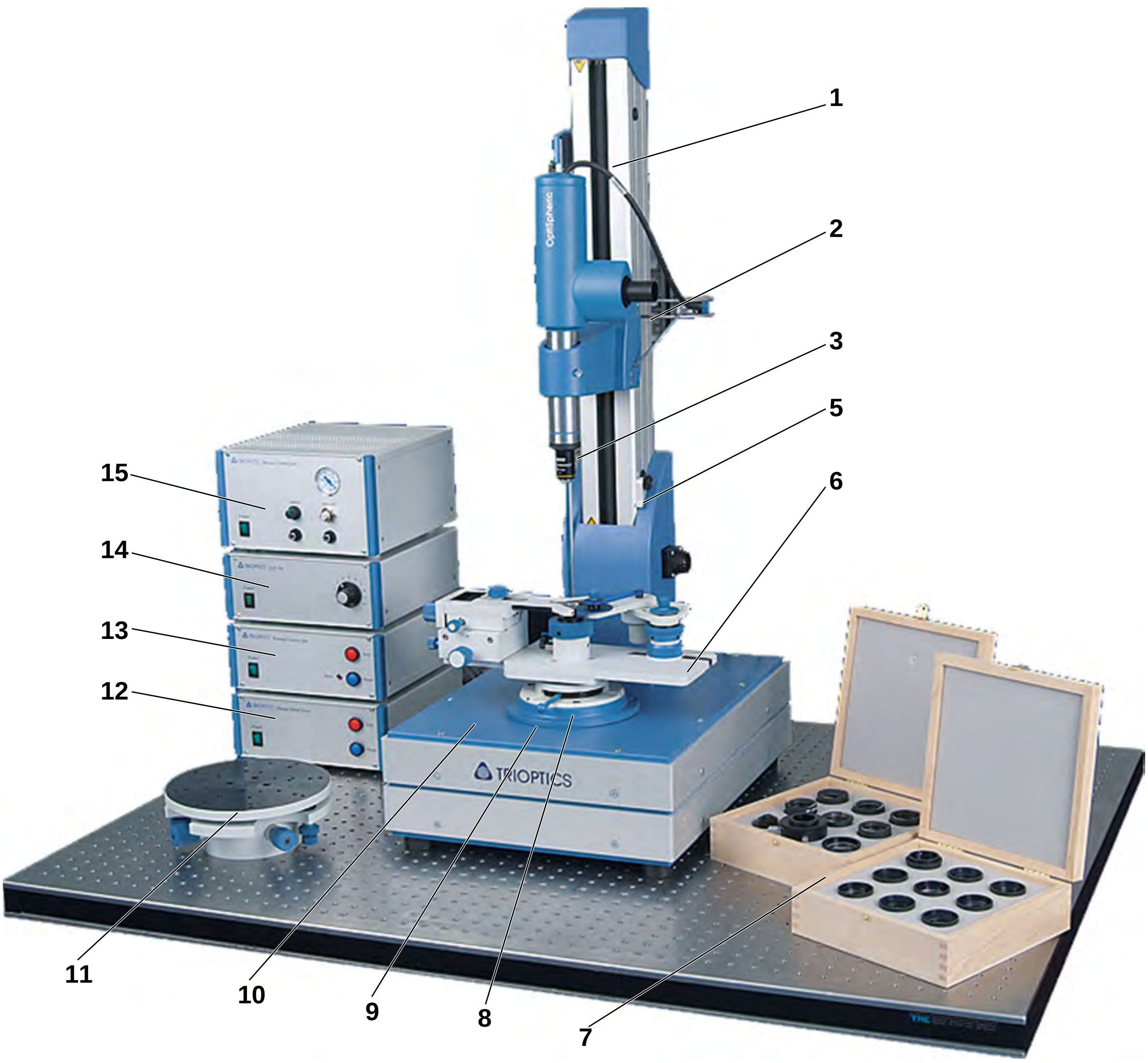


Fig. 4-1

1	**Air-bearing linear stage with stepper motor** The linear stage is used to adjust the height of the measurement head. The motor is controlled by the control unit (stepper motor driver) **13**. This achieves a positioning accuracy of 1 µm.
2	**Connection for fiber optic cable** Connection to the cold light source
3	**Optical measurement head** The optical measurement head consists of an electronic autocollimator with a CCD camera and a reticle. The images produced both in reflection and in transmission can be seen on the monitor. The measurement head can also be used for aligning individual elements before these elements are cemented or glued to their mount.
4	**Objective changer (optional), not shown** A revolver is recommended to change head lenses quickly and easily. OptiCentric®100 offers a manual four-way changer and a motorized six-way changer, both of which are equipped with head lenses from the range supplied.
5	**Safety limit switch** The safety limit switches restrict the downwards travel of the measurement head. This avoids collisions with the sample.
6	**Motorized lens rotation device with vacuum** The lens rotation device provides highest accuracy for measuring centration errors of single lenses (spherical or plane).
7	**Replacement head lens objectives**
8	**Bridge** The bridge is required for mounting a motorized lens rotation device with vacuum **6** above the air bearing.
9	**Rotary air bearing** The air bearing is used as a mount and rotation device for the sample. The axis of the air bearing is the reference axis for centration error measurements of lenses. The very low eccentricity guarantees high accuracy when measuring the centration error.
10	**Drive cover** The blue cover shields the rotary air bearing and its drive.
11	**Tip-tilt-table** The air bearing is also used with a stable tip-tilt table for the precise calibration of lenses.
12	**Control unit for rotation (Rotation Control Unit, RCU)** The control unit rotates the sample on the air bearing **9** or the tip-tilt-table **11** during the measurement.

13	**Control unit for the Stepper Motor Driver (SMD)** The motors drive the sample very precisely upward and downward, and rotate the sample on the air bearing and tip-tilt-table during the measurement. **Note:** The control unit may also be integrated; in this case it is not present as a separate device.
14	**Cold light source** (example, may look different) The light source is connected to the measurement head via a fiber optic cable. The light projects the test pattern (reticle) on the sample.
15	**Control unit for vacuum (Vacuum Control Unit, VCU)** Is required when using the motorized lens rotation device with vacuum **6**. The control unit is used to set the vacuum and the rotational speed.

4.2 Control elements

Emergency stop

– To immediately interrupt the power supply in a dangerous situation, press the emergency stop button. The power supply is interrupted and all movements of the measurement system are stopped immediately.

  The emergency stop button locks into place.

– If the reason for the danger has been removed, turn the emergency stop button clockwise to unlock it.

CAUTION!

Only use the emergency stop button in emergencies.

NOTE!

The power supply for the PC is not connected to the emergency stop. All data entered and measurement results are retained.

Emergency stop box

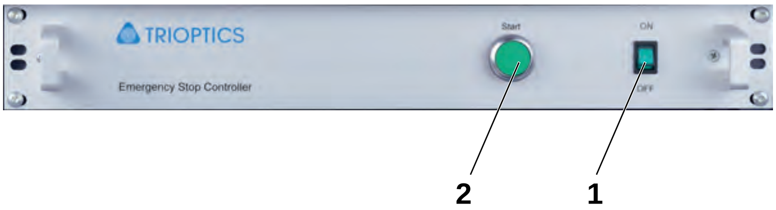


Fig. 4-2

1	Switch on/off
2	Enable

Light source KL 1500 *compact*

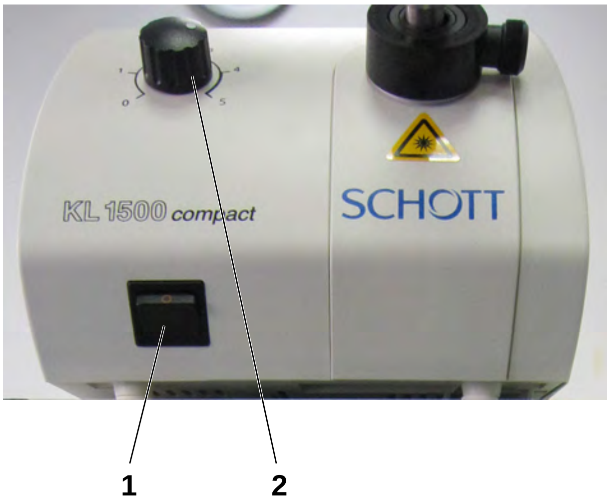


Fig. 4-3

1	**I/0** Turn light source on/off
2	Control intensity of illumination

Control unit for the Stepper Motor Driver (SMD)

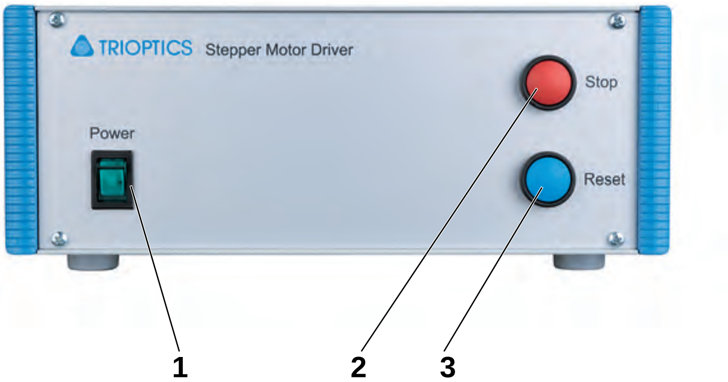


Fig. 4-4

1	**Power** Turn the control unit for the stepper motor drive on/off
2	**Stop** Immediately stops all movement.
3	**Reset** The reset button resets the internal micro-controller (in case of malfunction or if the control unit is overloaded).

Control unit for rotation (Rotation Control Unit, RCU)

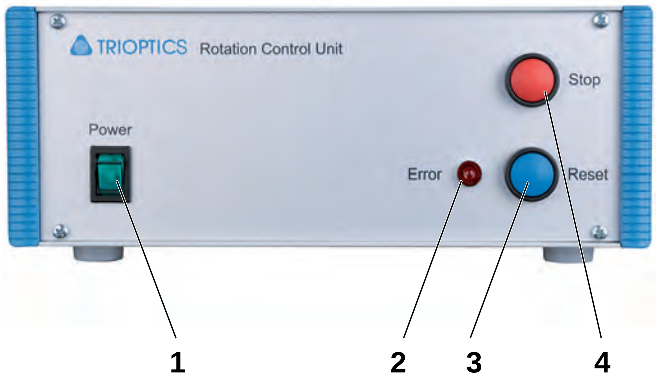


Fig. 4-5

1	**Power** Turn the control unit for rotation regulation on/ off
2	**Error** The red LED flashes when communication between the system and RCU is disturbed or when the pressure required for the air bearing (4.5 to 5 bar) is not achieved.
3	**Reset** The reset button resets the internal micro-controller (in case of malfunction or inadequate supply of compressed air).
4	**Stop** Immediately stops all movement.

Control unit for vacuum (Vacuum Control Unit, VCU)

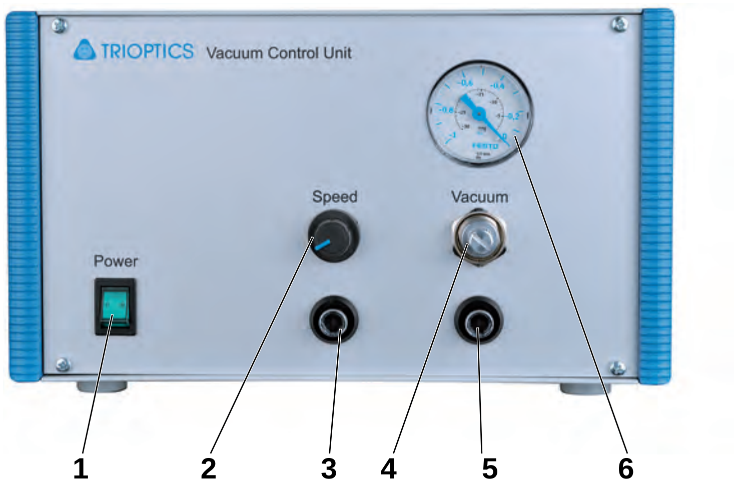


Fig. 4-6

1	**Power** Turn the control unit for vacuum control on/off
2	**Speed** Adjust rotational speed of the vacuum unit
3	Turn on and off the vacuum unit motor When turned on, the switch is illuminated in green.
4	**Vacuum** Regulate the vacuum on the vacuum unit
5	Turn on and off the vacuum at the vacuum unit When turned on, the switch is illuminated in green.
6	Vacuum display

4.3 Principle of centration error measurement in reflection with an electronic autocollimator

The basis for the measurement is an electronic autocollimator. The following graphic shows the functional method and the tried and tested principle of centration error measurement in reflection.

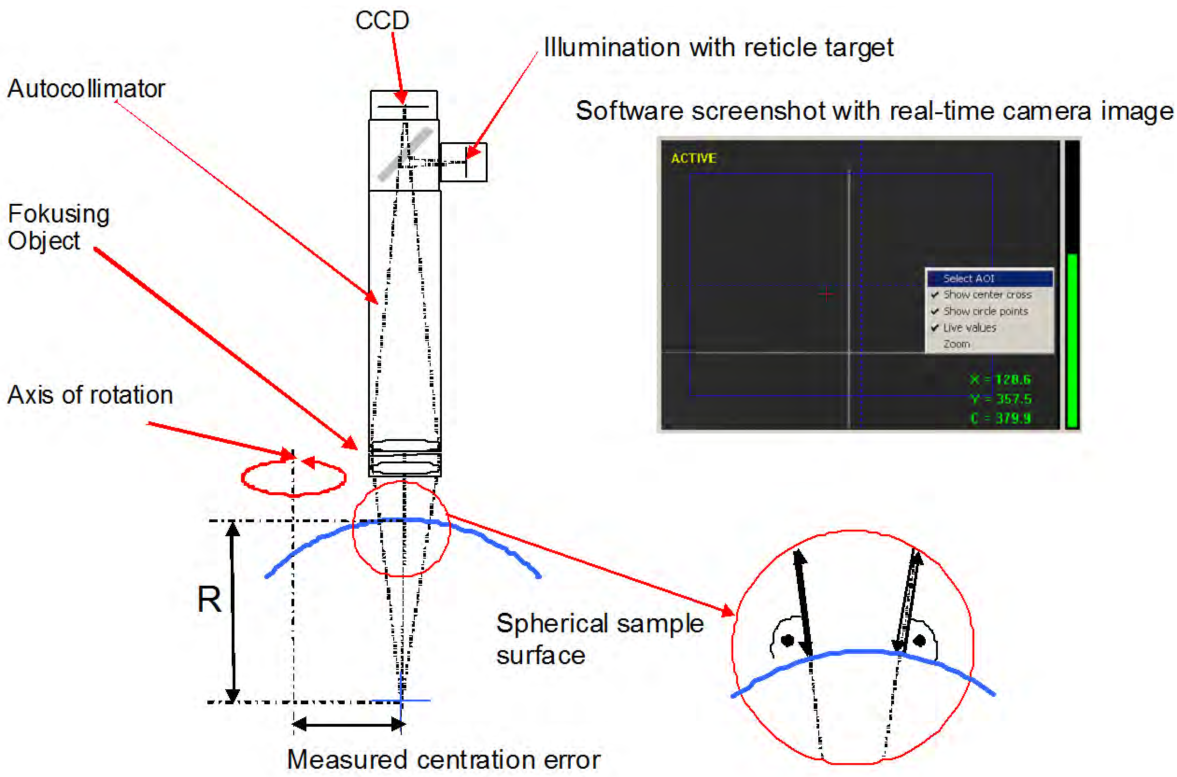


Fig. 4-7

An illuminated target (bright crosshair on a dark background) is projected through a beam splitter and a focusing lens projected in the plane of the center of curvature of the sphere being studied. In this case, the light beams strike the surface nearly perpendicular.

A portion of the reflected light returns on precisely the same path on which it arrived (autocollimation condition) and is focused on a CCD chip. The image of the target appears on this chip.

A displacement of the center of curvature is represented directly in the image in a lateral displacement of the crosshair image.

If the sphere being examined is rotated about a reference axis, then circular movement of the center of curvature about the reference axis is transmitted to the CCD chip. The diameter or radius of this circle is directly proportional to the shift of the center of curvature to the reference axis.

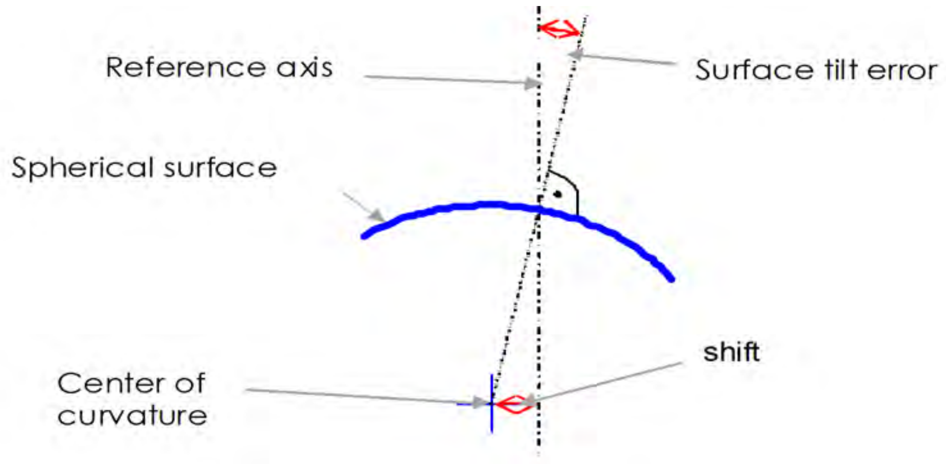


Fig. 4-8

The current crosshair image represents the exact position of the center of curvature in the XY plane.

Alternatively, the centration error of a spherical surface can also be represented as a surface tilt error.

$$\text{Surface tilt error} = \arcsin \frac{\text{Shift}}{\text{Radius of curvature}}$$

Powerful light sources and light-sensitive CCD sensors ensure that anti-reflective samples also provide an autocollimation image that is sufficiently strong.

4.4 MultiLens®measurement

This comprehensive software module is used to measure, align and assemble lens systems. The centration error of each surface of complex and already assembled optical systems is determined.

The MultiLens® software provides complete information about the individual centration errors of every surface, without destroying the optics. The centration errors are measured in the reflection mode, starting with the surface that is located closest to the measurement head, followed by the surface below, and so on.

When focusing in the respective centers of curvature, it is necessary to take into account the MultiLens® principle:

- The focus point of the first surface is coincident with the center of curvature **C1**.

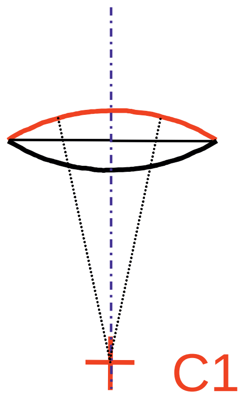


Fig. 4-9

- Because the light beam is refracted at the first surface, in the second surface the focus point **C2 image** is shifted with respect to the geometrical center of curvature **C2**. This calculation requires the design data (radius, center thickness, refractive index) of the sample.

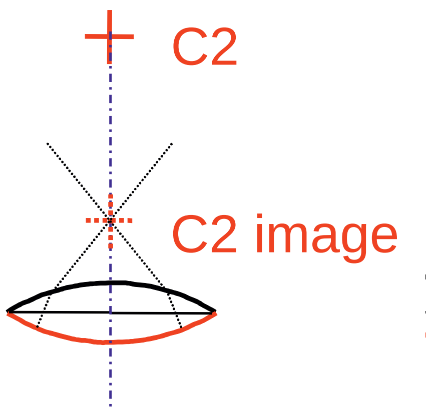


Fig. 4-10

- The same applies to all of the following surfaces.

- When assessing the measurement, it is also necessary to take into account both the image-forming properties and the centration error of the first surface. If the exact centration error of the first surface is determined, it is possible to determine the centration error of the second surface, and so on.

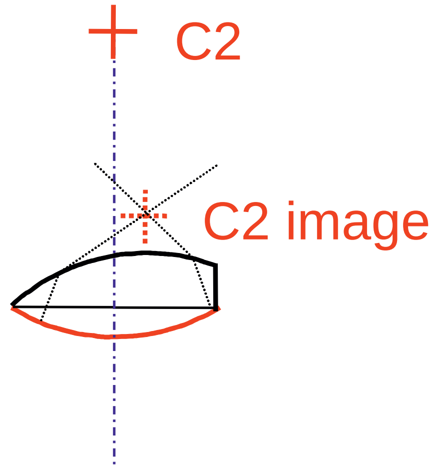


Fig. 4-11

OptiCentric®100 can therefore easily measure 20 surfaces and more with a single autocollimator, with accuracies in the range of 1 µm and better.

The measurement system uses the rotary axis of an air bearing as the reference axis. The air bearing has a radial runout in the range of 0.05 µm.

5. Installation and Initial Startup

NOTE

Only employees of TRIOPTICS GmbH or correspondingly trained and authorized persons are permitted to unpack, install, and commission the measurement system. Improper setup or incorrect installation may damage the measurement system or impair its function. This will result in inaccurate measurement results.

5.1 Transport

The measurement system is delivered to its destination packed in a wooden crate or aluminum case. The wooden crate is firmly bolted to a pallet. The accessories are packed in boxes.

WARNING!

Risk of injury by cutting, stabbing or crushing

Personal protective equipment required.

– Wear protective gloves to DIN EN 388.
– Wear a safety vest.
– Wear safety shoes of grade S2 to DIN EN ISO 20345.

WARNING!

Risk of injury from heavy components

There may be dangers due to heavy and tipping parts.

– Never step under suspended loads.
– Make sure the measurement system is transported without being subjected to impact or jolting.
– Only remove transport locks during installation.
– Always use suitable and tested lifting equipment.

NOTE

Dimensions and weights

Information about dimensions and weights is listed in "Technical Data", Page 27.

Damage to the packaging

1. Check the packaging for damage upon delivery.
2. Document any damage to the packaging and report this immediately to the manufacturer or the responsible local subsidiary (see page 3).

Impact indicators

NOTE

Check impact indicators

Impact indicators are affixed to the packaging. These indicate whether there were any impacts during transport. Read the notes on the indicators and check their status.

Fig. 5-1: "SHOCKWATCH" impact indicator

Tilt indicator

NOTE

Check tilt indicator

A tilt indicator is glued to the packaging for equipment that must be transported upright. It indicates whether the package was tilted during transportation. Read the notes on the indicator and check its status.

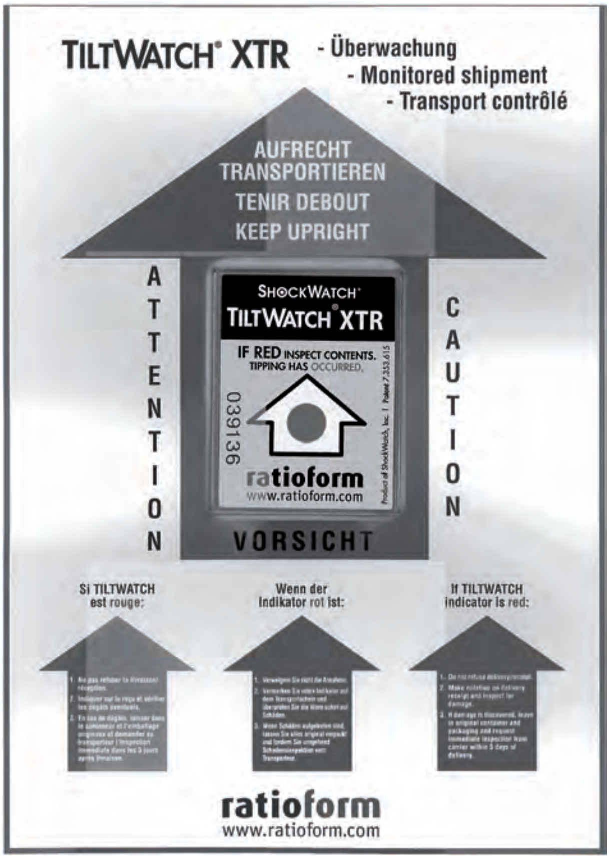


Fig. 5-2

Means of transport

– If possible, transport the measurement system to its final location in the wooden crate or in the aluminum case.

> **CAUTION!**
>
> **Material damages**
>
> The measurement system may only be transported using appropriate means, such as a forklift or pallet truck.

5.2 Storage

- If the measurement system is to be stored prior to installation, store it in a dry and dust-free environment at 15 °C to 32 °C.
- If the measurement system is stored without packaging, cover it with the supplied dust protection sheet.

WARNING!

Risk of injury from sharp components

Hands/arms can be injured on rough, sharp surfaces of crates, pallets or nails.

- Wear protective gloves to DIN EN 388.

5.3 Unpacking

WARNING!

Risk of injury from sharp components

Hands/arms can be injured on rough, sharp surfaces of crates, pallets or nails.

- Wear protective gloves to DIN EN 388.

WARNING!

Risk of injury from heavy components!

A minimum of two persons is required to lift the measurement system out of the packaging.

CAUTION!

Material damages

The measurement system consists of sensitive optical components.

- Open the package in a dust free environment only.
- Handle all components with care, especially the main unit, the optical measurement head and the wooden crate with head lenses.

Measurement system in wooden crate

– Open the lid of the wooden crate using a suitable screwdriver or cordless screwdriver.

Measurement system in aluminum case

– Open the aluminum case.
– Reach under the base of the measurement system as shown in Fig. 5-3 and pull it out of the packaging.

CAUTION!

Material damages

Do **not** lift the measurement system by the stepper motor or the linear stage.

Fig. 5-3

Accessories

– A service engineer from the manufacturer should be allowed to unpack the accessories.

NOTE!

Keep the original packaging in order to return the measurement system in the event of a repair.

Delivery scope

– Check that the delivery is complete by referring to the delivery note or packing list.

Damage to the components

1. Check the components for damage.
2. Document any damage to the packaging and report this immediately to the manufacturer or the responsible local subsidiary (see page 3).

Dust protection

– Always cover the measurement system with the supplied dust film when it is not in use.

Clean room operation

Comply with the following instructions if the measurement system is to be installed in a clean room:

– Unpack the main device outside the clean room.
– Do not bring any packing material into the clean room.
– If necessary: Clean the main device with suitable cleaning agents outside the clean room.

5.4 Set-up location

The set-up location for the measurement system must meet the following conditions:

- In closed heated rooms
- Level and sturdy surface
- Free of vibrations
- Constant ambient temperature (ideally 20 to 22 °C, max. 25 °C)
- Relative humidity 0 to 80 %
- Altitude: -50 to +2000 m above sea level
- Free of smoke and dust
- No direct sunlight
- Well ventilated

NOTE!

If the measurement system is placed on a sturdy table, the vibration isolation through the rubber feet is sufficient for the proper operation of the OptiCentric®100 unit.

An optical measuring table is recommended for the highest accuracy.

5.5 Required space

NOTE!

The operator must have at least 1 m of space in front of the device.

Ventilation requires a clearance of at least 0.1 m to the rear and sides.

5.6 PC requirements

If your own PC is being used, it is necessary to clarify with TRIOPTICS or the local representative which conditions must be met.

5.7 Required external connections

Power supply

DANGER!

Danger to life due to electric shock

Electrical currents may pose a hazard.

– Connect the measurement system and the equipment only to properly grounded electrical outlets.

The measurement system and its accessories are available for 100 - 120 VAC or 220 - 240 VAC, 50 Hz or 60 Hz.

Two sockets (with at least C16 fuses) are required.

Compressed air

NOTE!

Ask the provider what kind of compressor is best suited to ensure the following requirements.

- 5 bar
- Consumption approx. 30 L/min (Airbearing 100)
- Supply volume of at least 90 L/min in order to ensure the necessary gap in the air bearing
- Conditioning of compressed air according to ISO/DIS 8573-1, Class 3, Filter Level 1
- Oil residue ≤ 0.01 mg/m^2
- Free of particles ≥ 0.01 mm
- Residual moisture dew point -20 °C 0.88 g/m^3

Network connection

Optional

Internet access

Not mandatory, but desirable for remote support.

5.8 Installing measurement system and accessories

1. Place the measurement system on a suitable table.
2. Place the light sources and control units on a suitable table in the vicinity of the measurement system.

NOTE!

To avoid vibrations during the measurement, do not place the Vacuum Control Unit (VCU) on the same table as the measurement system.

3. Set up the PC with monitor, keyboard, and mouse.

WARNING!

Risk of injury due to crushing

There is a risk of crushing hands and/or torso when the measurement system moves unexpectedly.

- Place PC, monitor, keyboard and mouse in such a way that the operator can see the entire measurement system.
- The direct sight on the system must not be obstructed by movements on transport routes, material containers or other obstacles.

5.9 Mounting the measurement head

Required tools

- Allen key (hex) size 5 mm

1. Loosen the clamping screw **1**.
2. Pass the cable through the opening and attach the optical measurement head **2** on top of the holder from above.

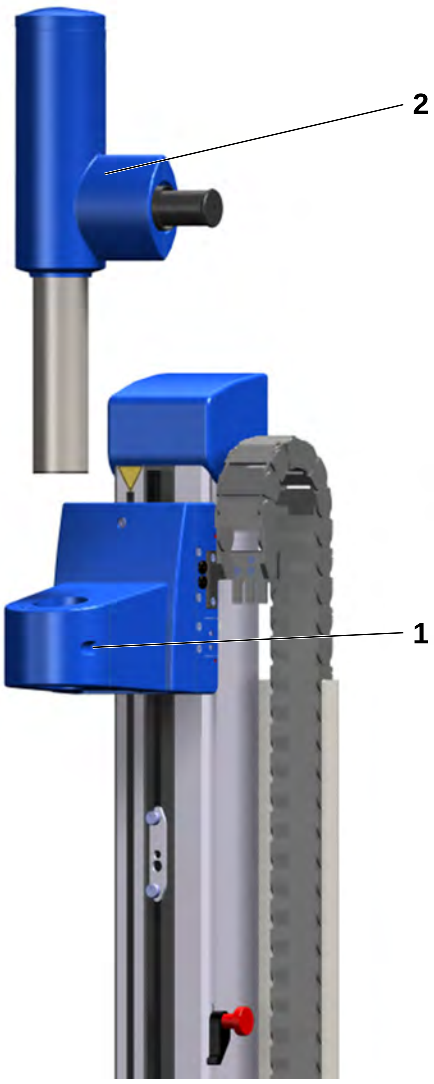


Fig.5-4

3. Tighten the clamping screw.

5.10 Assembling the XY adapter

When used without objective changer

– Screw the XY adapter onto the measurement head.

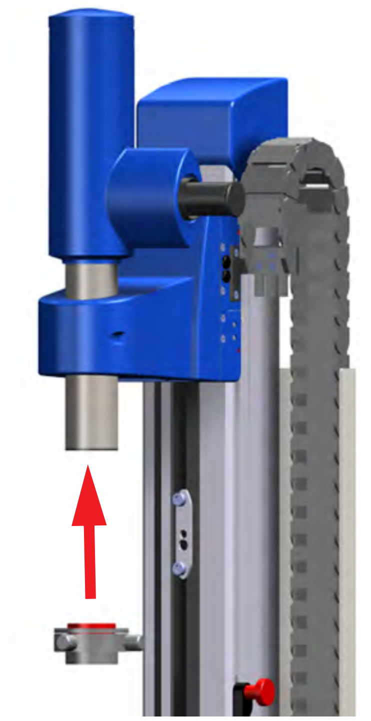


Fig. 5-5

When used with objective changer

– Screw the XY adapter onto the objective changer.

5.11 Screwing in the head lenses

– Screw the desired head lens onto the XY adapter.
  Or:
– Screw the desired head lenses into the objective changer.

5.12 Installing the emergency stop

Required tools

- Allen key (hex)

– Install the emergency stop using the screws provided on the right-hand side of the measurement system.

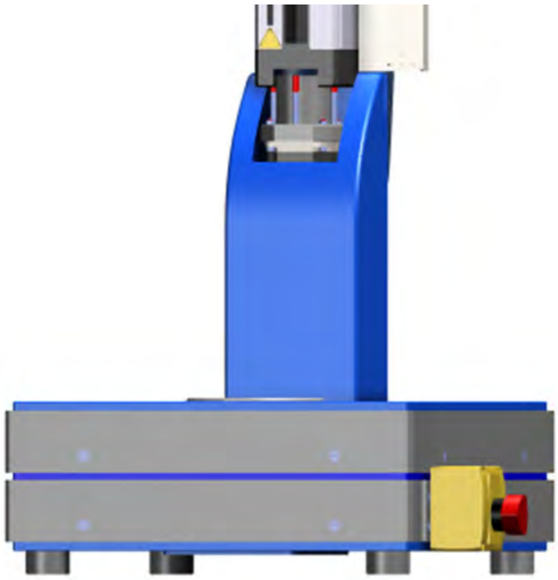


Fig.5-6

WARNING!

Personal injury or property damage

– The emergency stop switch must be readily visible and easily accessible for the operator.

5.13 Compressed air connection

1. Mount the compressed air supply.

NOTE!

The filter unit must be placed upright.

2. In order to avoid contamination in the measurement system, flush the tube with clean air before connecting the existing compressed air supply to the device.
3. Ensure a supply pressure of 5 bar.
4. Remove any water and oil accumulations in the cylinder.

5.14 Cabling

WARNING!

Risk of electric shock

Parts that are under tension due to faulty connections pose a risk of electric shock.

– Any work on the electrical system must be performed by appropriately qualified persons.
– Lock the switch cabinets.
– Check the electrical system on a regular basis.

– Connect all cables, optical fibers, connecting lines and compressed air hoses according to the labeling. Check each one individually for damage that may have occurred during unpacking.

NOTE

Details are listed in the connection diagram (see chapter 23. "Appendix", page 229).

5.15 Mounting the tip-tilt-table

Required tools

- Allen key (hex) size 3 mm

1. Carefully place the tip-tilt-table on the air bearing.

   The adjusting screws should be located at the front and on the right side.

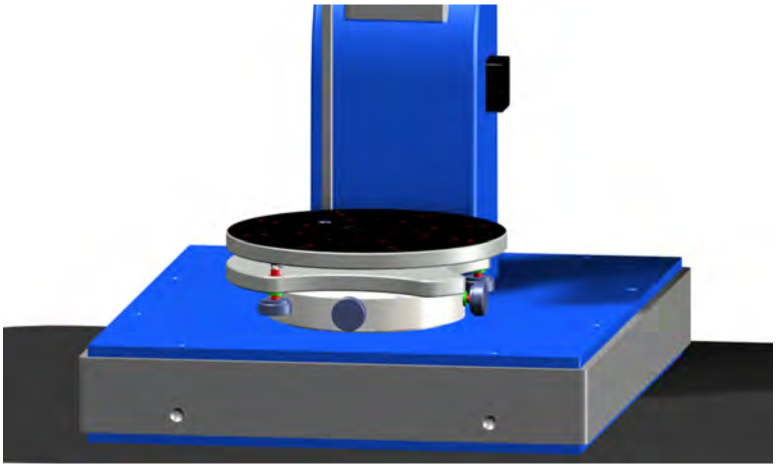


Fig.5-7

2. Tighten the four fastening screws.

5.16 Mounting and connecting the bridge and lens rotation device

> **NOTE!**
>
> The tip-tilt-table must be removed.

Required tools

- Allen key (hex)

Material

- Screws
- Vacuum hose
- Cable

1. If bridge **1** and lens rotating device **2** are connected, swing the lever **3** counter-clockwise and lift the lens rotating device upward to remove it.

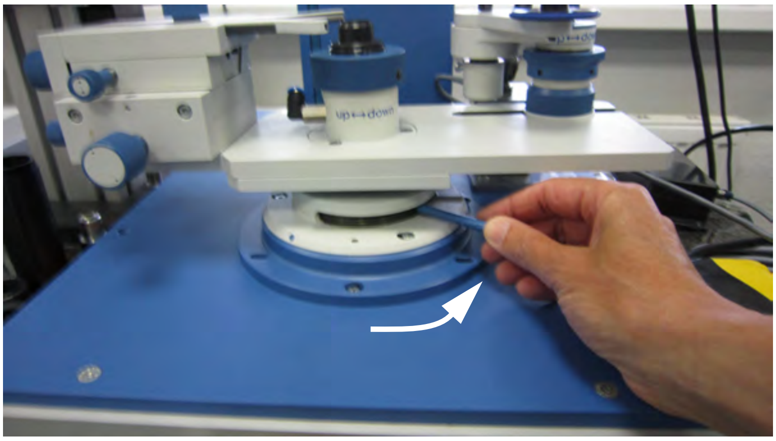


Fig.5-8

2. Place the bridge on the table of the OptiCentric®100.

   The lever should be on the right side.
3. Tighten the three fastening screws.

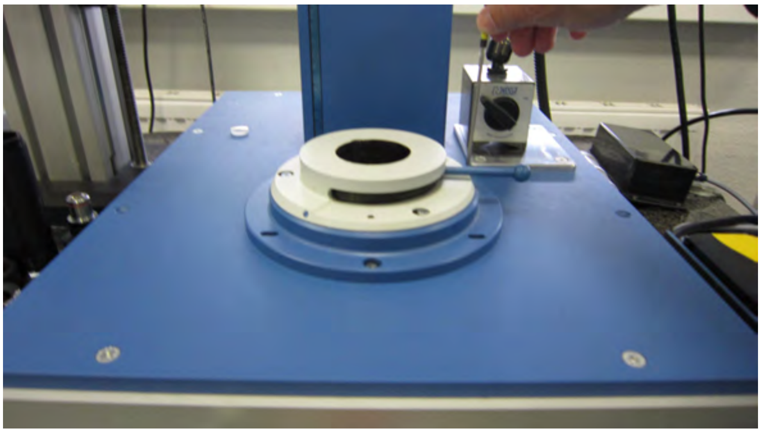


Fig.5-9

4. Place the cone of the lens rotating device into the receptacle of the bridge.
5. To lock the lens rotating device, swing the lever forward clockwise.

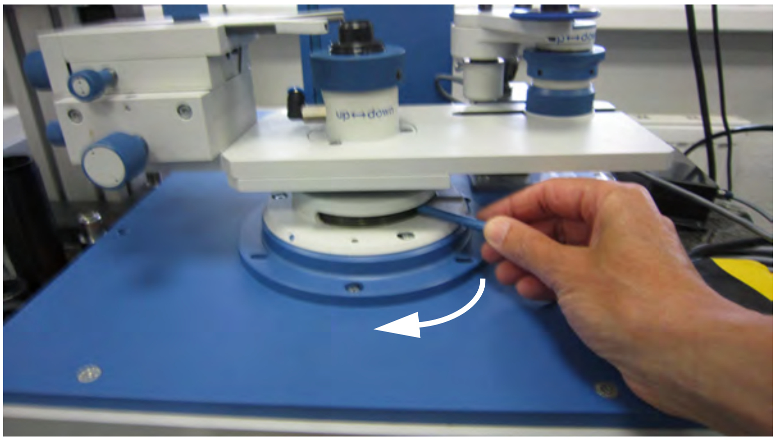


Fig.5-10

6. Connect the vacuum hose of the vacuum control unit to the connection of the lens rotating device.

Fig. 5-11: Connections on the rear of the vacuum control unit

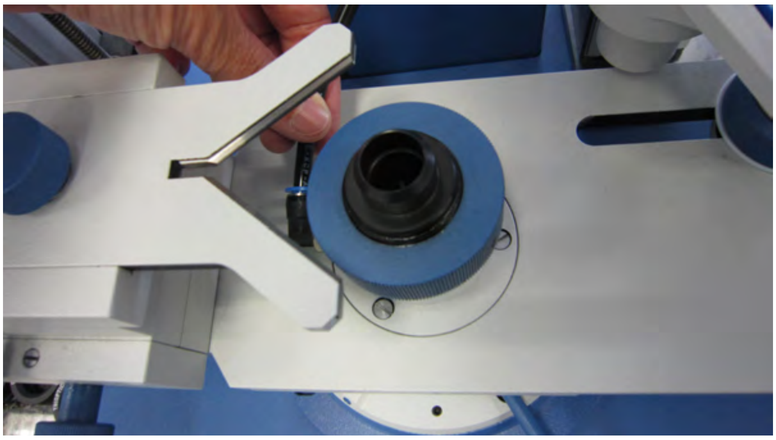


Fig. 5-12: Vacuum connection on the lens rotating device

7. Connect the monitor cable to the lens rotating device.
8. Connect the foot switch, if you wish to use one.
9. Connect the supply line of the lens rotating device to the power supply.

5.17 Unmounting bridge and lens rotating device

Required tools

- Allen key (hex)

1. Loosen the vacuum and motor connections of the lens rotating device.
2. Swing the lever **3** counter-clockwise and lift the lens rotating device upward to remove it.

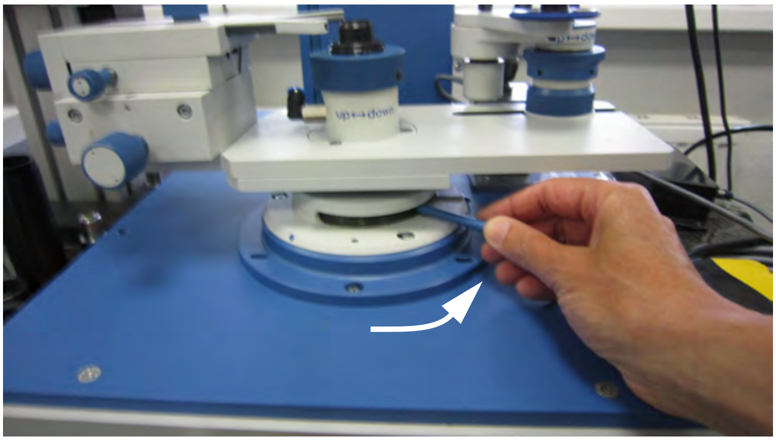


Fig.5-13

3. Loosen the three fastening screws.

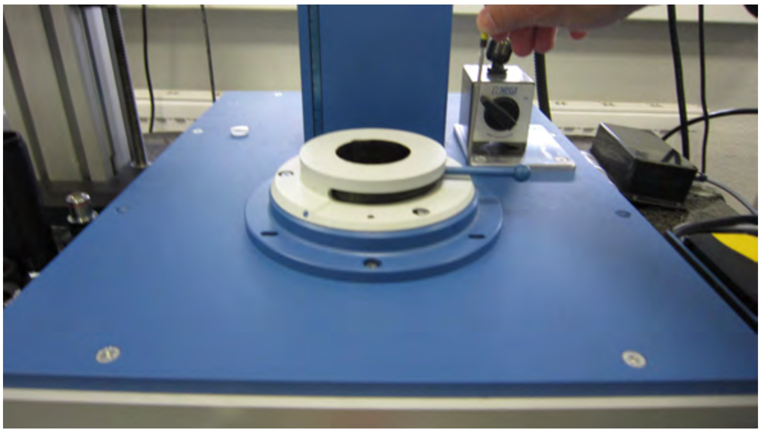


Fig.5-14

4. Remove the bridge.

5.18 Software

The OptiCentric program is pre-installed when the measurement system is delivered.

NOTE!

If an already available in-house PC is used, the software must be installed on site or as a remote maintenance process by a TRIOPTICS employee.

5.19 Copy protection plug (hardware dongle)

– Insert the copy protection plug (hardware dongle) into a USB port on your PC.

Fig.5-15

6. General Information on the Measurement System Operation

This chapter describes general topics related to operating the measurement system.

The following chapters provide detailed descriptions on how to perform certain measuring tasks:

- chapter 7. "Centration error Measurement in Reflection", page 77
- chapter 8. "Centration error Measurement in Transmission", page 83
- chapter 9. "Measurement of Radii", page 87
- chapter 10. "Preparation for a MultiLens® Measurement", page 89
- chapter 11. "Conducting a MultiLens® Measurement", page 103

6.1 Pre-operation checks

> **CAUTION!**
>
> Do not operate the measurement system if parts are damaged.

1. Make sure the housing of the measurement system and the connecting cables are not damaged.
2. Make sure that there are no loose parts on the linear stages.
3. Make sure the compressed air supply is properly connected and the connecting hoses are not damaged.
4. Ensure that the sample holder and the optical components are clean.

6.2 Switching the measurement system on

1. Remove the dust protector hood from the measurement system.
2. Switch on the compressed air supply.

> **CAUTION!**
>
> **Damage to the air bearing**
>
> Rotating the air bearing without compressed air will result in damage to the air bearing. Precise measurements will then no longer be possible.
>
> – Always turn on the compressed air supply first before using the measurement system.

3. Turn on the emergency stop box with switch **1**.

   The switch lights up green.

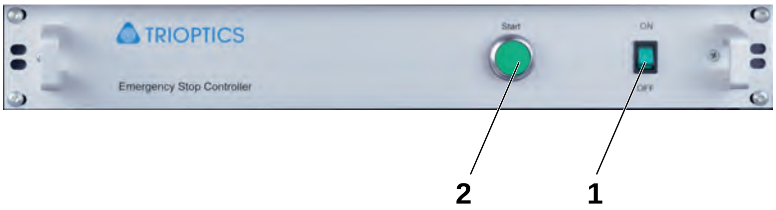


Fig. 6-1

4. Activate the emergency stop box via switch **2**.

   The following devices are activated via the emergency stop box:

   - Light source KL 1500 compact
   - Control unit for the stepper motor drive
   - Control unit for the rotation regulation
   - Control unit for the vacuum control

5. Switch the PC and the monitor on.

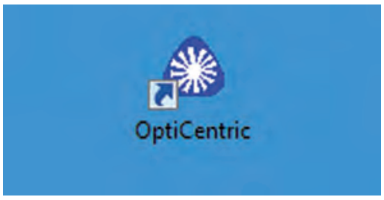
6.3 Starting the program

The OptiCentric program can be started as soon as the computer has booted completely and the measurement system is turned on.

NOTE

Copy protection plug (hardware dongle) required!

The program can be started only if the copy protection plug (hardware dongle) is plugged into a USB port on your PC.



– Start the software by double-clicking the desktop icon labeled `OptiCentric`.

NOTE

You can also find the shortcut to the program in the "Trioptics GmbH" program group in the Start menu.

You will see the following splash screen with vendor and version information:

Fig. 6-2

All axes of the measurement system are being initialized. The upper axis moves upward, the lower axis moves downward and the table makes one full revolution. The device displays the message "Please wait...".

DANGER!

Risk of injury from moving components!

Make sure that there are no body parts or objects in the axes' path of travel during the reference cycle.

Program and measurement system are operational after the reference run.

The device displays the program window of the measurement program that was last selected.

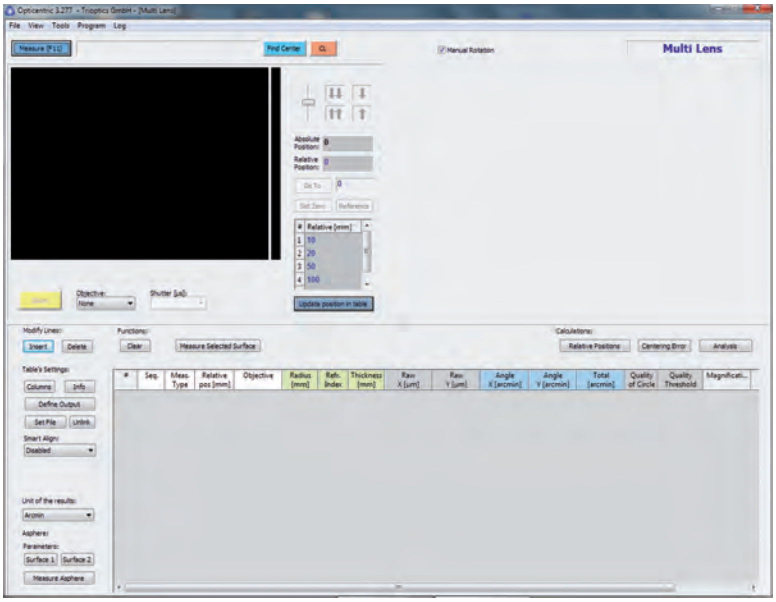


Fig. 6-3: Example, the program window "Multi Lens"

NOTE

For detailed information on all features of the software, please refer to chapter 17. "Software", page 147.

6.4 User rights

After starting the program, you are logged in with the rights of an operator by default. This means you are allowed to make limited changes in only some dialogs.

User	Rights
Operator	Restricted rights as operator, for example: – Import lens design – Carry out pre-configured measurements – Output certificates
Supervisor	Full access rights, e.g.: – Configure measurements – Open, edit, save lens designs – Select measurement program – Enter new materials
Administrator	Full access and configuration rights

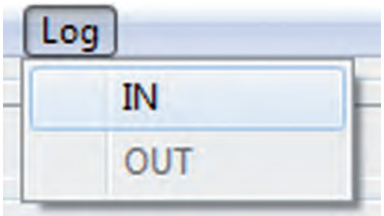
NOTE

The "Administrator" user level is usually reserved for the manufacturer's service technicians.

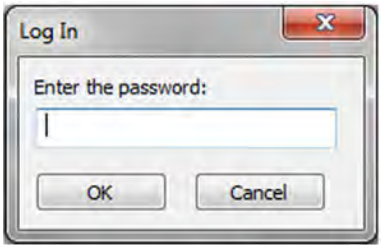
The passwords are listed on a separate sheet and provided during the initial startup.

6.5 Login

Follow these login steps:



1. Select `<Log> <In>`.



2. Enter the password and click `OK`.

6.6 Moving limit switch

To avoid collisions with the sample, it is necessary to set lower limits to the travel path of the measuring head. To adjust the safety limit switch, follow these steps:

1. Loosen the screw **1**.

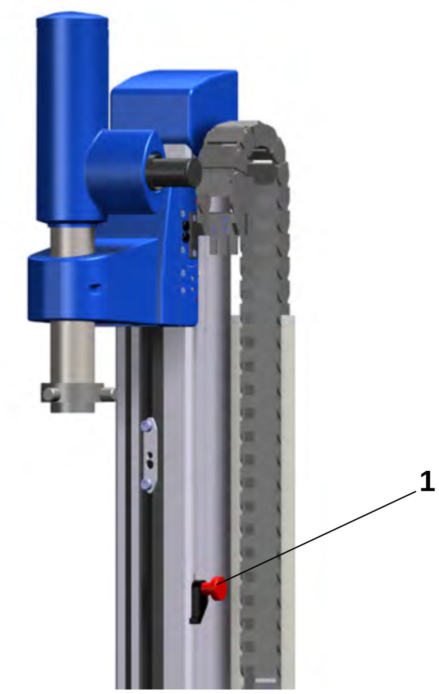


Fig. 6-4

2. Move the safety limit switch and re-tighten the screw.

6.7 Placing and securing the sample

OptiCentric®100 measures a wide range of samples with different dimensions and weights.

Preparation

Threaded holes are provided on air bearing and tip-tilt-table to mount the sample. For the dimensioned drawings please refer to Chapter 23. "Appendix".

In some cases, the sample can be screwed on directly.

If this is not the case, a suitable retainer must be built for each individual sample.

Placing the sample

WARNING!

Risk of injury from heavy samples

The sample can weigh up to 80 kg. A maximum weight of 20 kg is permissible when using the tip-tilt-table.

– Use suitable hoisting equipment to lift the sample.

1. Lift the sample onto the measurement system.
2. Fix the sample.

6.8 Focusing or moving a position / a center of curvature

This section describes the different ways to focus and to move to a specific position or a center of curvature.

CAUTION!

Material damages

– The safety limit switch must be set before moving the measurement head (see chapter 6.6, page 65).
– Press the **ESC** key to cancel the measurement head cycle.

Moving by means of the arrow keys

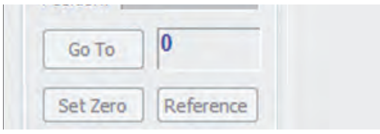
The measurement head is moved with the arrow keys.

- Use the double arrow key to quickly move the measurement head up or down.
- Use the single arrow key to slowly move the measurement head up or down.

NOTE

Use the slider to the left of the arrow buttons to change the velocities.
Slider to the top = maximum velocity

Moving by means of the GoTo button



1. Enter the desired position (relative to the set zero position) using the keypad.
2. Click the **GoTo** button.

   The linear stage is moved to the specified position.

Moving to relative positions

#	Rel Pos [mm]
1	10
2	20
3	50
4	100
5	200

Five positions (relative to the defined zero position) can be entered in the table.

- Double-click the column # to move the measurement head to the corresponding position.

Design table

#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]
1	8000	1	m	62.37
2	64000	2	m	-16.26
3	8000	3	m	-53.90

- Double-click the column # in the design table to move the measurement head to the corresponding position.

NOTE

For details on design tables please refer to chapter 10. "Preparation for a MultiLens® Measurement", page 89.

Manual focusing of a surface

1. Select a head lens with positive focal length in the range of 50 to 500 mm.
2. Place a sheet of paper on the surface.
3. Use the arrow keys to move the guide until the crosshair can clearly be seen on the paper.

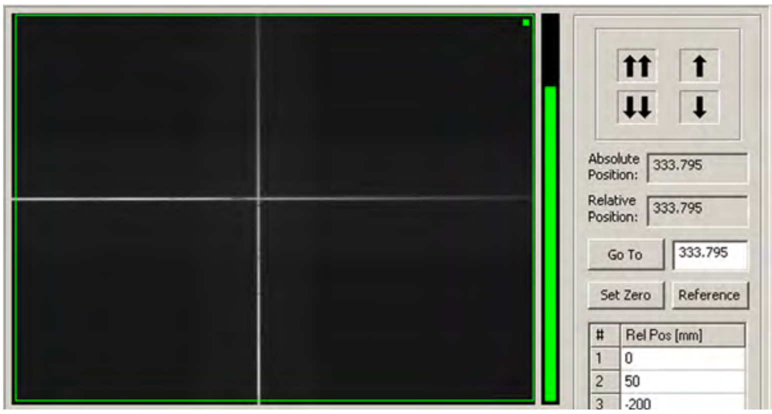
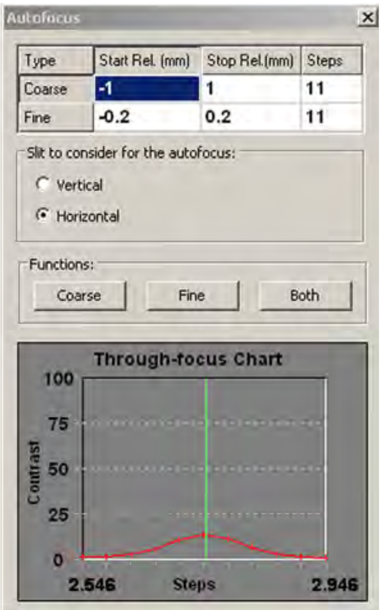


Fig. 6-5

4. Remove the paper and make any fine adjustments via the camera image.

> **NOTE**
>
> To ensure that the focus is on the surface, gently tap on the autocollimator. The cross in the camera view should not move.

Autofocus



1. Select `<Tools> <Autofocus>`.
2. Enter the range for searching the focus:

`Range(mm)`	The range
`Steps`	Number of measurement points

> **NOTE**
>
> For special applications (e.g. cylindric lenses) you may switch between using the horizontal or vertical slit of the reticle for the adjustment under `Slit to consider for the autofocus`.

3. Click on **Coarse** for a coarse adjustment.

> **NOTE**
>
> The determined position is used as the current position for the fine adjustment.

4. Click on `Fine` for the fine adjustment.
5. Click on `Both` for performing both the coarse and fine adjustment sequentially.

   The `Through-focus Chart` is a graphical display of the measurement points and the contrast.

6.9 Selecting the head lens

This section describes the criteria and the different options for selecting a head lens.

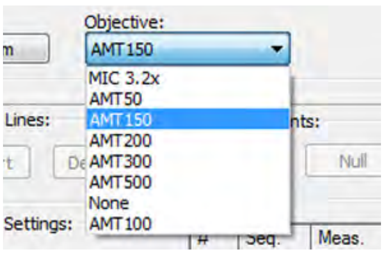
Please note the following criteria:

- In general, the focal length of the head lens should be selected as small as possible.
  The smaller the focal length, the higher the measurement accuracy. However, this will also decrease the size of the image field.
  A greater focal length and thus a larger image field may be required if the sample is not fully pre-centered or if the tolerance is high.
- For a convex sample surface, the back focal length of the head lens must be greater than the radius of curvature to prevent the optics mechanically colliding with the sample.

> **NOTE**
>
> The following applies for the achromatic lenses provided with the device:
> Back focal length ≤ effective focal length of the achromatic lens

- When measuring objectives, it may be necessary to use different head lenses.
- Head lenses with an effective focal length between 100 and 300 mm are very versatile.

With motorized changer



– Select the objective from the list.
  The objective changer will proceed accordingly.

> **NOTE**
>
> The different back focal lengths of the objectives are compensated, so that a predetermined reference position is maintained.

> **NOTE**
>
> The position of the individual lenses can be entered in the `Objectives` tab under `<Tools>` `<Settings>` (see chapter 17.7, page 174).

With manual changer

1. Screw the required objectives into the desired position.
2. Turn the objective changer to the desired position.
3. Select the objective from the list.

> **NOTE**
>
> If the objective selected in the software does not correspond to the objective that is actually mounted, the results of the measurement will be wrong.

Without objective changer

1. Unscrew the current head lens.
2. Screw the desired head lens in and select the corresponding objective from the list.

6.10 Intensity setting

The intensity of the camera image **2** depends on various factors, including:

- Brightness of the light source
- Exposure time
- Number of surfaces
- Reflectivity of the lens surface
- Objective used

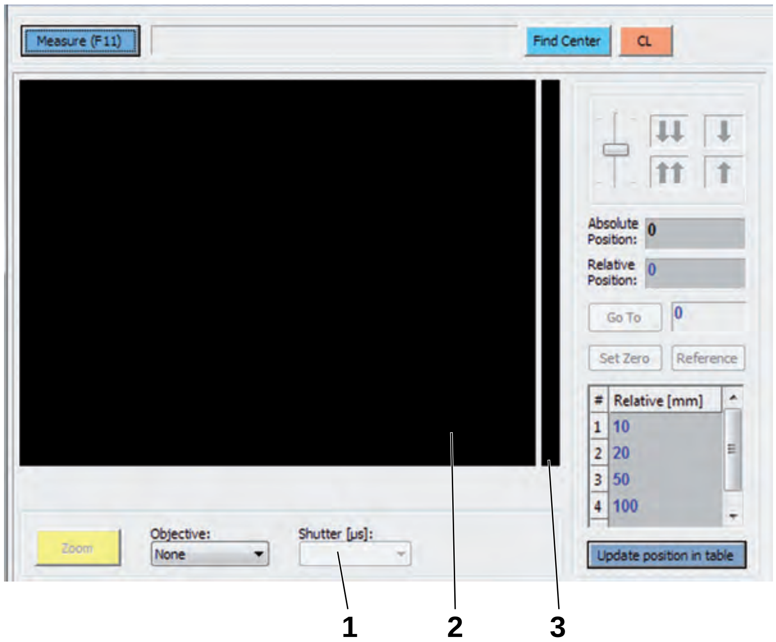


Fig. 6-6

The bar graph **3** shows the light intensity in the measuring window (AOI):

- Green readout when saturated within a certain range
- Red readout if saturation level exceeded or not reached

> **NOTE**
>
> Low exposure times mean the effect of ambient light is minor. Motion artifacts do not occur.
>
> The signal-to-noise ratio is better when using longer exposure times.
>
> The required exposure time is shorter if brightness increases.
>
> Please note that cemented surfaces always require a slightly higher illumination.

1. If necessary, please modify the exposure time in the drop down menu **1 Shutter [µs]** until the bar graph for the light intensity is approximately at the center.
2. To change the brightness of the light source, rotate the dial **1**.

6.11 The coordinate system

NOTE

The measurement system is delivered with a left-handed coordinate system. This can be changed upon request.

Fig. 6-7

X-axis	• is parallel to the front of the measurement system • points right from the operator's point of view
Y-axis	• points back from the operator's point of view
Z-axis	• points downwards in the table • is parallel to the optical axis of the measurement head • corresponds to the rotational axis of the air bearing

6.12 Output measured values as a certificate

The measured values can be issued in a certificate after completion of the measurement.

General texts

First, enter the information for the header of the certificate. Follow these steps:

1. Select `<File> <Certificate Entries>`.
2. Enter the texts and confirm with `OK`.

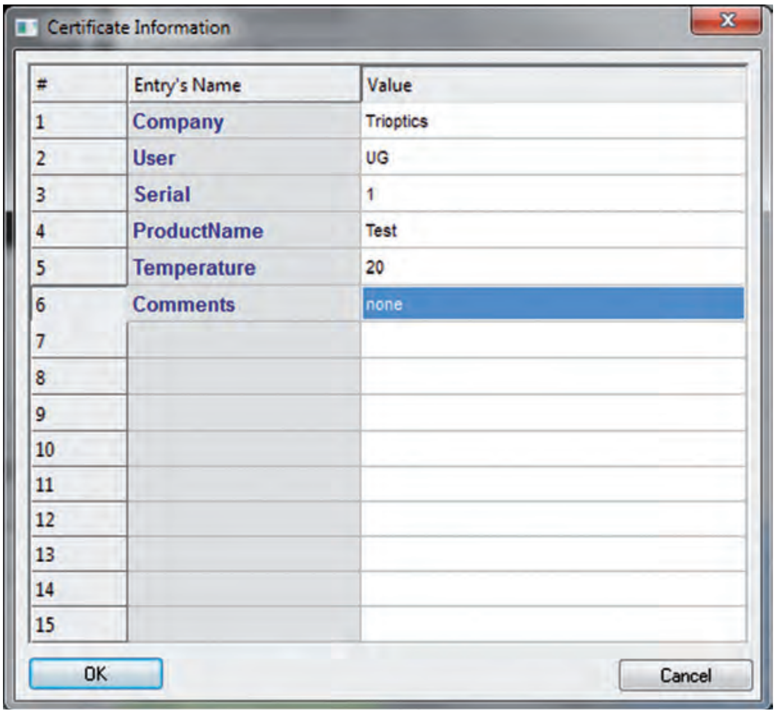


Fig. 6-8: Example

NOTE

The columns "Entry name" and "Value" are free text fields. The maximum number of rows is 15.

Viewing the certificate

– Select <View> <Certificate>.
  The certificate is displayed.

Fig. 6-9: Example

Saving the certificate as an HTML file

1. Select <File> <Generate HTML Certificate>.
2. Enter the file name and click Save.

   You can now open the certificate with the browser and print it.

Export certificate data, e.g., for import to Excel

1. Select <File> <Export to CSV>.
2. Enter the file name and click Save.

   You can now import the certificate to Excel and edit or print it.

6.13 Switching the measurement system off

Follow these steps to disable the measurement system:

1. Shut down the PC and switch off the monitor.
2. Turn off the emergency stop box with switch **1**.

1

Fig. 6-10

3. Switch off the compressed air supply.

   The measurement system is completely switched off.

4. Cover the measurement system with the dust protector hood.

7. Centration Error Measurement in Reflection

This chapter describes the measurement procedure for the wobble of a flat surface and the centration error of a spherical (lens) surface.

> **NOTE**
>
> The measuring principle is described under Chapter 4.3, page 36.

7.1 Preparation

1. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
2. Power up the measurement system as described in Chapter 6.2, page 61.

If necessary:

3. Log in as Supervisor (see chapter 6.4, page 64).
4. Select `<Program> <Centering in Reflection>` (Measurement mode "Centration error in Reflection").

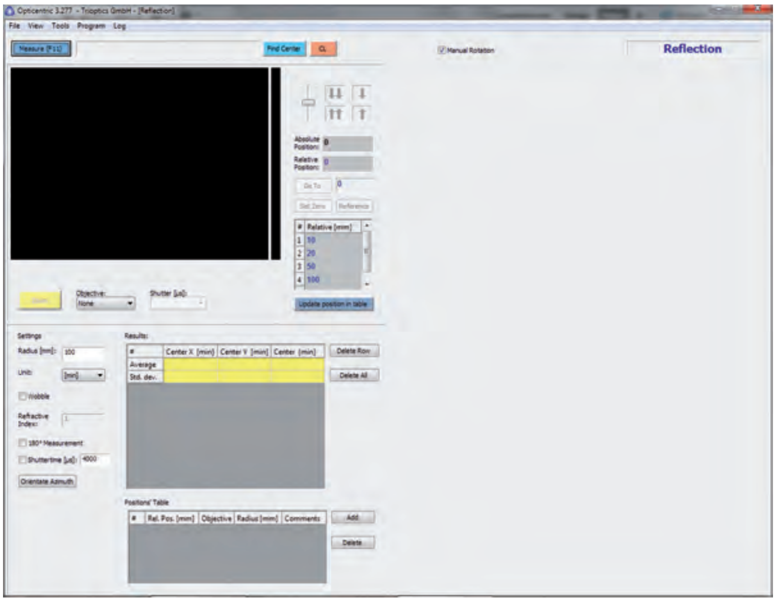
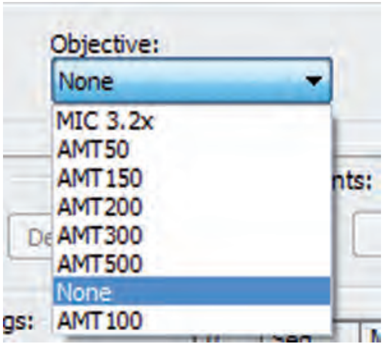


Fig. 7-1

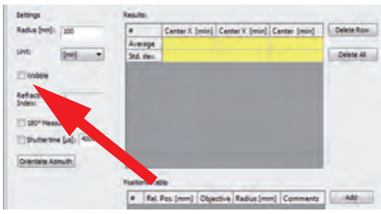
> **NOTE**
>
> For detailed information on all features of the software, please refer to chapter 17. "Software", page 147.

7.2 Measuring the wobble

The wobble of a flat surface is measured using collimated light in reflexion.



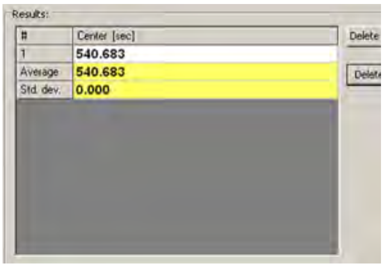
1. Select the setting `None` under `Objective` to deselect the head lens of the autocollimator.
   - A motorized objective changer will move into position accordingly.
   - A manual objective changer must be set to an empty position.
   - If no objective changer is used, the head lens must be unscrewed and removed.
2. Control the intensity on the camera by adjusting the exposure time ("Shutter") or by adjusting the light intensity of the light source (see chapter 6.10, page 70).



3. Tick the checkmark for `Wobble` to measure the wobble.
4. Under `Unit` select `min` (minutes) or `sec` (seconds) to set an angular size for the unit of measurement.
5. To perform a measurement, click on the `Measure` button or use the **F11** function key.

   The rotary bearing is rotated by 360°.

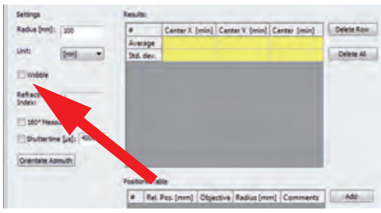
   The results of this measurement are then listed in the table `Results`.



7.3 Measuring centration errors of a spherical (lens) surface

1. Use a suitable mount to place the sample into the measurement system.
2. Loosen the thumb screw and move the safety limit switch **1** within the guidance.

   The safety limit switch has to limit the travel of the measurement head so that collisions with the sample are avoided.
2. Re-tighten the knurled nut.



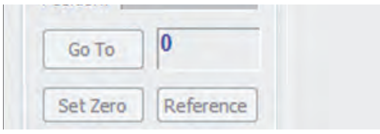
3. Remove the checkmark for `Wobble`.
4. Enter the radius of curvature for the topmost sample surface into the field `Radius`.

> **NOTE**
>
> The design value is sufficient.
> The radius is important if the results is provided as an angle (arc min, arc sec).

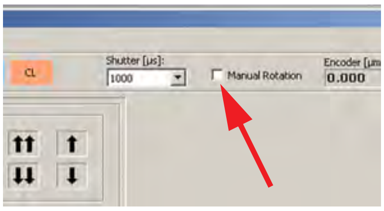
5. Select the desired unit of measurement for the output under `Unit`.
6. Select an appropriate head lens for the centration error measurement (see chapter 6.9, page 69).

> **CAUTION!**
>
> **Material damages**
>
> For a convex sample surface, the back focal length of the head lens must be greater than the radius of curvature to prevent the optics mechanically colliding with the sample.

7. Focus on the vertex of the topmost sample surface (see chapter 6.8, page 66).

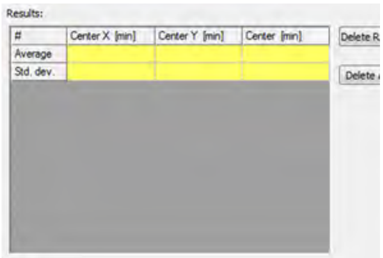


8. To set this position as a reference position, click `Set Zero`.
9. Enter the nominal radius into the position field and click on the button `Go To` to move to the center of curvature.
10. Now, check the focus of the autocollimation image and the intensity of the camera and amend it, if required.



NOTE

When using a vacuum rotary device, tick the checkmark in front of `Manual Rotation` (external rotation possible) before starting the measurement.



11. To perform a measurement, click on the button `Measure` or use the function key **F11**.

    The rotary bearing is rotated by 360°.

    The results of this measurement are then listed in the table "Results".

7.4 Saving positions

The measurement settings can be saved for performing measurements for several individual surfaces in succession.

1. Click the button Add to add a row.
2. Enter values for the relative position, the head lens, the radius of curvature and a comment, if required.

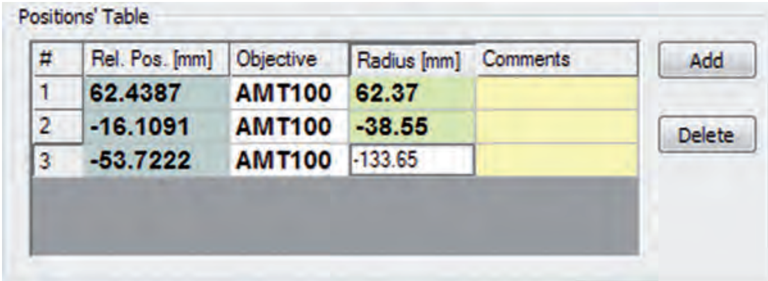
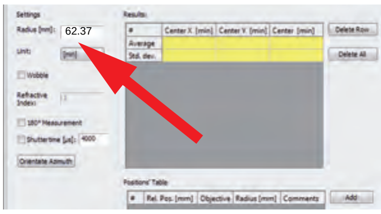


Fig. 7-2

3. Double-click the number # to move to a specific position.

   The radius is added to the settings.



Storing values

– Select `<View>` `<Config File>` `<Save>` to store the values in the configuration file.

Loading values

– Select `<View>` `<Config File>` `<Open>` to load the values from the configuration file.

8. Centration Error Measurement in Transmission

This chapter describes centration error measurement in transmission. Compared to measurement in reflection and the MultiLens® measurement, this measurement is fast and simple.

Generally, the measurement in transmission provides information on the offset of the optical axis to the reference axis. However, it is advisable to use caution when interpreting the measured data.

8.1 Preparation

1. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
2. Power up the measurement system as described in Chapter 6.2, page 61.

If necessary:

3. Log in as Supervisor (see chapter 6.4, page 64).
4. Select `<Program> <Centering in Transmission>` (Measurement mode "Centration error in Transmission").

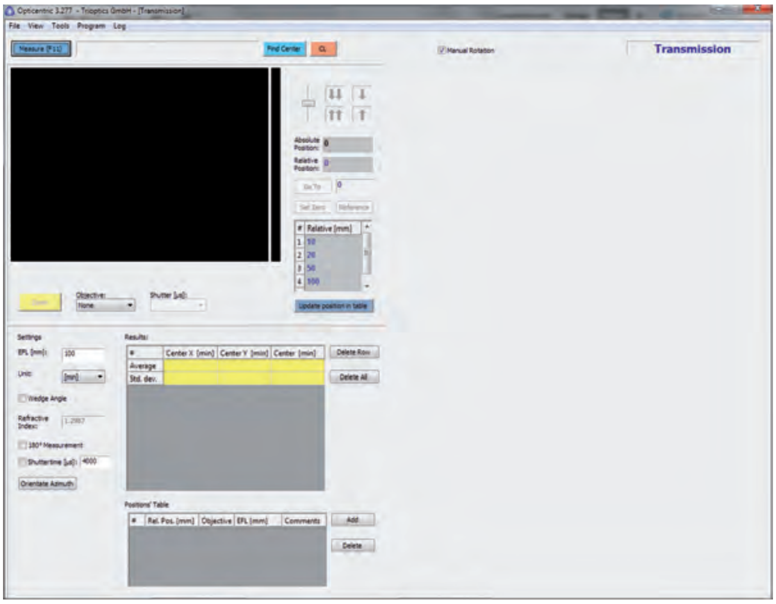


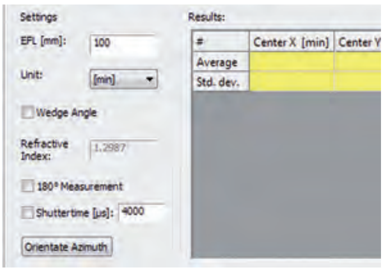
Fig. 8-1

> **NOTE**
>
> For detailed information on all features of the software, please refer to chapter 17. "Software", page 147.

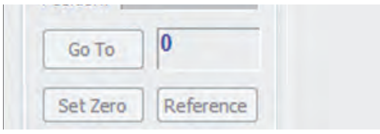
8.2 Measuring the centration error of a multi-lens optical system

1. Use a suitable mount to place the sample into the measurement system.
2. Select an appropriate head lens for the centration error measurement.

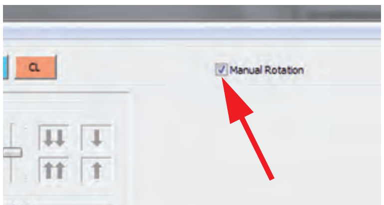
> **CAUTION!**
>
> **Material damages**
>
> For a convex sample surface, the back focal length of the head lens must be greater than the radius of curvature to prevent the optics mechanically colliding with the sample.



3. Use the input field **EFL [mm]** to enter the focal length of the sample.
4. Select the desired unit of measurement for the output under `Unit`.
5. Remove the checkmark from `Wedge Angle`.
6. Focus on the vertex of the topmost sample surface (see chapter 6.8, page 66)

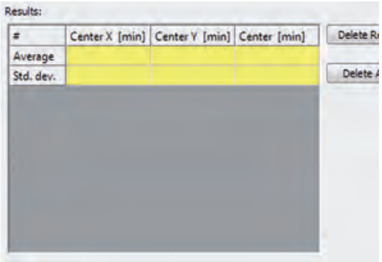


7. To set this position as a reference position, click `Set Zero`.
8. In order to move to the focal plane, enter the back focal length and click on the button `Go To`. **Note the preceding positive or negative sign!**
9. Now, check the focus of the autocollimation image and the intensity of the camera and amend it, if required.



> **NOTE**
>
> When using a vacuum rotary device, tick the checkmark in front of `Manual Rotation` (enable motor rotation) before starting the measurement.

10. To perform a measurement, click on the button `Measure` or use the function key **F11**.



The rotary bearing is rotated by 360°.

The results of this measurement are then listed in the table `Results`.

8.3 Saving positions

The measurement settings can be saved for performing several measurements of multiple samples in succession.

1. Click the button Add to add a row.
2. Enter values for the relative position, the head lens, the effective focal length (EFL), and a comment, if required.

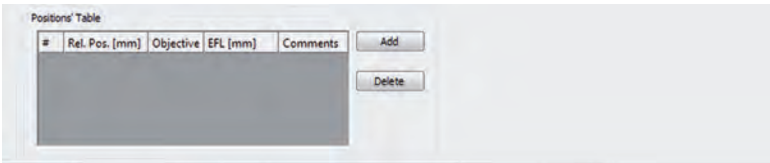
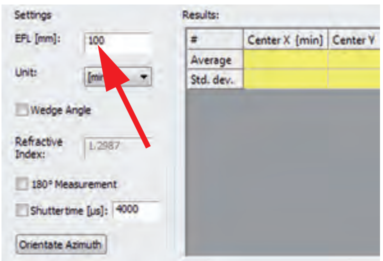


Fig. 8-2

3. Double-click the number # to move to a specific position.

   The effective focal length (EFL) is added to the settings.



Storing values

– Select `<View> <Config File> <Save>` to store the values in the configuration file.

Loading values

– Select `<View> <Config File> <Open>` to load the values from the configuration file.

9. Measurement of Radii

This chapter describes how to measure the radius of a sample.

9.1 Preparation

1. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
2. Power up the measurement system as described in Chapter 6.2, page 61.

If necessary:

3. Log in as Supervisor (see chapter 6.4, page 64).
4. Select <Program> <Distance> (measuring mode "Radii").

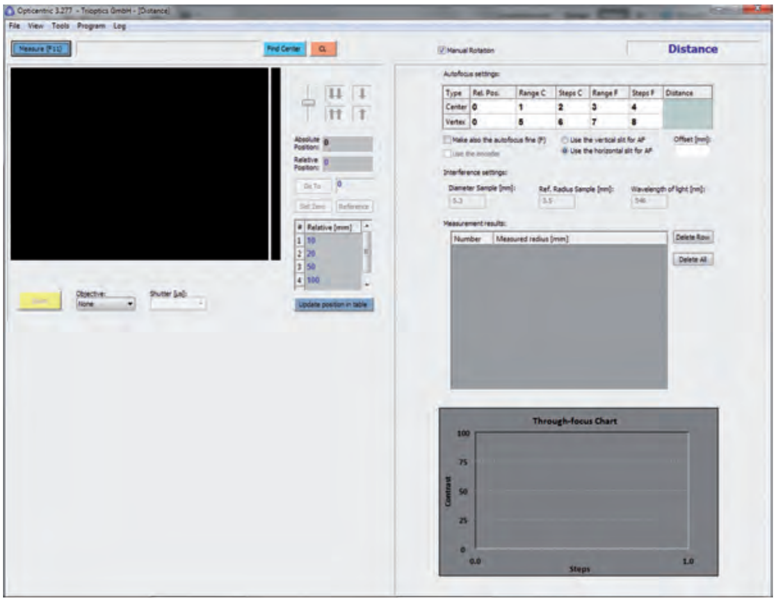
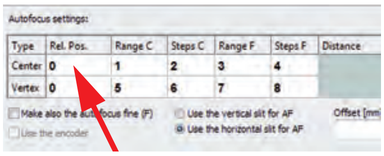


Fig. 9-1

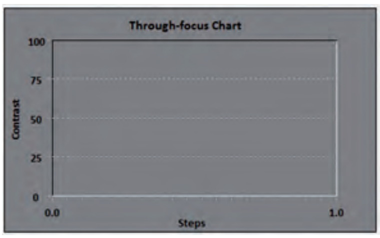
9.2 Measuring radii

1. Use a suitable mount to place the sample into the measurement system.
2. Select an appropriate head lens for the measurement.
3. Focus on the vertex of the topmost sample surface (see chapter 6.8, page 66).

4. To set this position as a reference position, click `Set Zero`.

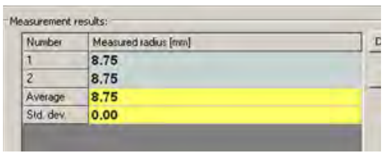


5. Enter the nominal radius as the relative position for the center of curvature (`Center`).
6. Enter the `Autofocus settings`. Refer to Chapter 17. "Software", Page 147 for further details.
7. To conduct a measurement, click on the button `Measure` or use the function key **F11**.



The specified range around the first relative position is scanned for the position with the highest contrast (Best Focus Position). This is displayed in the `Through-focus chart`.

Subsequently, the best focus position is determined for the second relative position.



The difference between the two positions is the radius of the measured surface. The result is then displayed in the `Measurement results` table.

10. Preparation for a MultiLens® Measurement

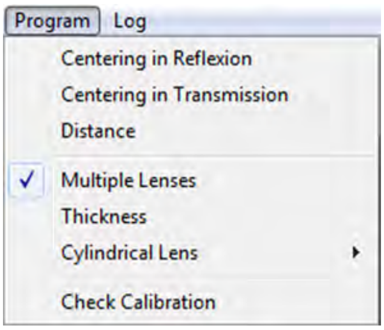
This chapter describes what preparations are required for a MultiLens® measurement (see chapter 11., page 103).

NOTE

Making the necessary changes requires the user rights of a supervisor (see chapter 6.4, page 64).

The measuring principle is described under Chapter 4.4, page 38.

10.1 Preparation



1. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
2. Power up the measurement system as described in Chapter 6.2, page 61.
3. Log in as Supervisor (see chapter 6.4, page 64).
4. Select `<Program> <Multiple Lenses>` (Measurement mode "Centration error measurement of multi-lens systems").

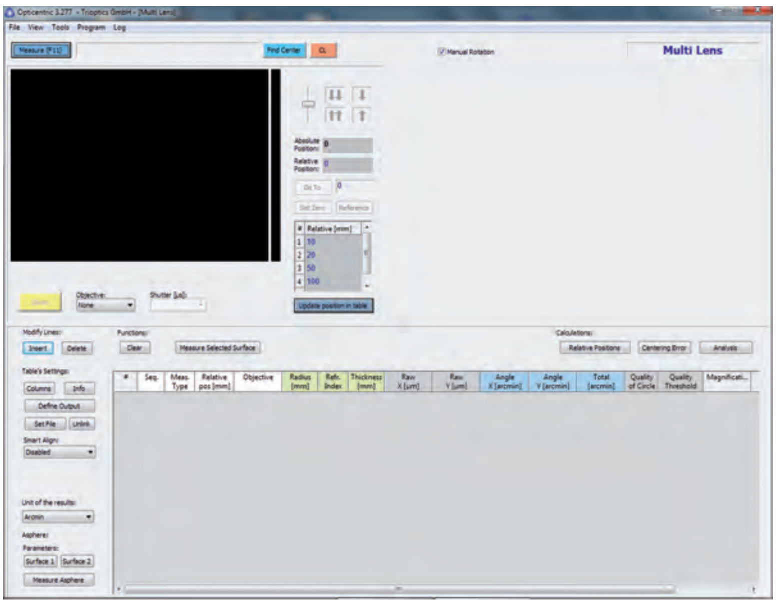


Fig. 10-1

10.2 Creating the design table

The imaging effect of the surfaces in front must be taken into consideration when measuring centration errors of multi-lens systems, as described in chapter 4.4 "MultiLens®measurement", page 38.

The imaging effect is essentially described by the lens design:

- Radius of curvature of the surfaces
- Refractive index of the medium behind the surface (for λ=546 nm)
- Distance to next surface

NOTE

The design table can be prepared for a sample type and saved. Then, the saved parameters can be loaded and the measurements carried out.

Import design data from design file

If the design data for the sample were saved in a design file, they can be loaded.

1. Select `<File> <Open Design File>`.

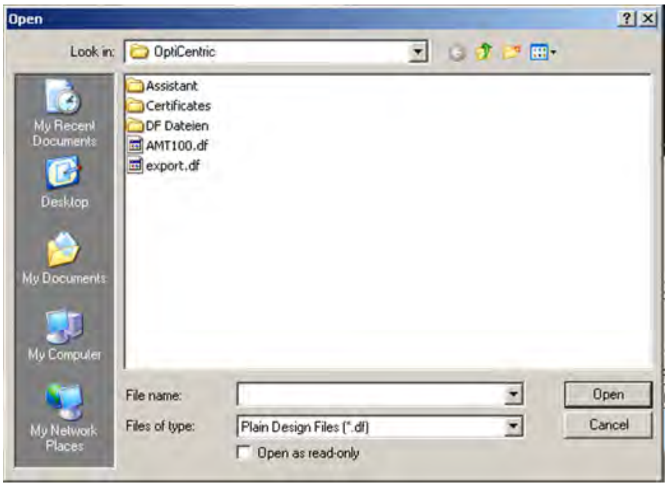


Fig. 10-2

2. Select the file (*.df) and click `<Open>`.

NOTE

*.df is a TRIOPTICS format.

This reads in and displays the data.

#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Error	Threshold
1						62.37	1.51...	10							
2						-38.55	1.62...	2.9							
3						-133.65	1.0	0							

Fig. 10-3: Example: Design data from AMT-100

Import design data from Zemax

If the design data for the sample are saved in a Zemax file, they can be imported.

1. Select <File> <Import Zemax file>.
2. Select the file (*.zmx) and click <Open>.

   This reads in and displays the data.

> **NOTE**
>
> The Zemax files only specify the types of glass, not the refractive index.
>
> The refractive index for the individual surfaces must be entered manually in Zemax' "Lens Data Editor".

Manually input or edit design data

> **NOTE**
>
> These manually input design data can be stored in a design file and imported again for measurements at a later date.

1. Select <File> <New>.

   A new design table is created. It contains one row.

#	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Quality of Circle	Threshold	Comments
1	1	M	-290.687	AMT200	100	1.0	0								

Fig. 10-4

2. Now enter the values:

Radius [mm]		Positive radius
		Negative radius
		Plan surface: enter "p"
Refr. index	Refractive index for λ = 546 nm	
Thickness [mm]	Distance to next surface; enter "0" for final surface	

– Double-click in the box to enter or edit a value.

– To add additional rows, click <Modify Lines> <Insert>

  Or:

  Right click in the design table and select Insert New Surface.

  One row for each optical surface!

– To delete the selected row, click <Modify Lines> <Delete>

  Or:

  Right click in the design table and select Delete Selected Surface(s).

Example:

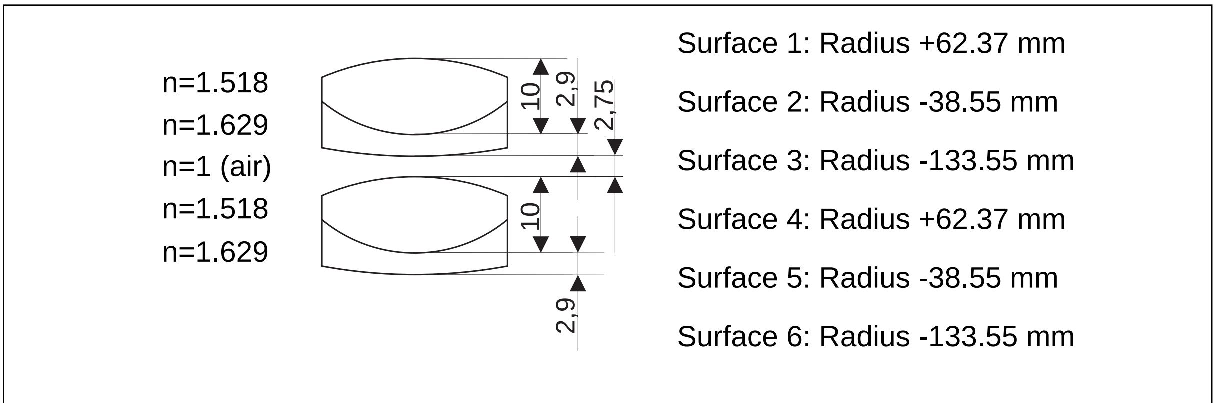
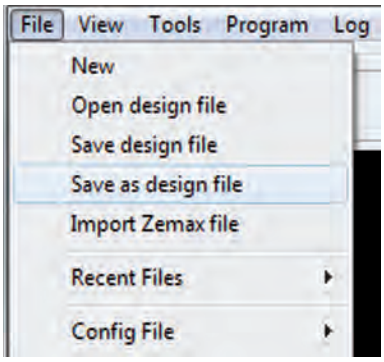


Fig. 10-5: Dimensions of a sample

#	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Error	Threshold	Magnification	Com
1	1				62.37	1.518	10									
2	2				-38.55	1.629	2.9									
3	3				-133.55	1	2.75									
4	4				62.37	1.518	10									
5	5				-38.55	1.629	2.9									
6	6				133.55	1	0									

Fig. 10-6: Design data for a sample

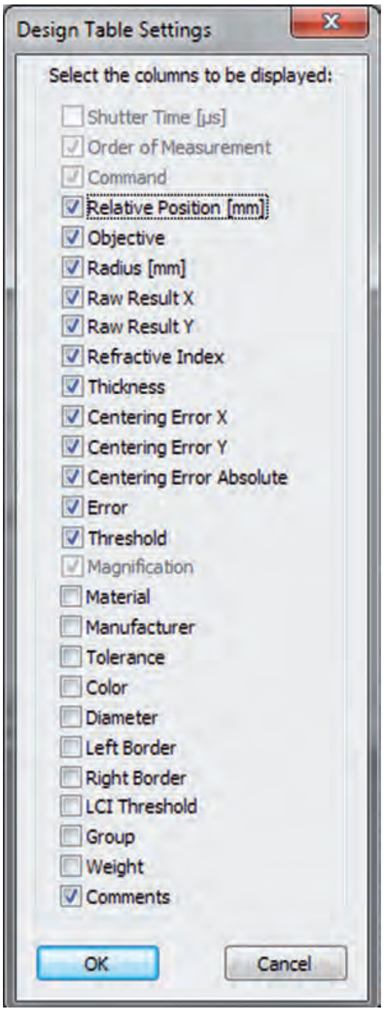
10.3 Saving the design table



1. Select <File> <Save as design file>.
2. Select the directory and enter the file name (.df).
3. Click <Save>.

10.4 Changing the appearance of the design table

You can choose which columns are displayed in the design table.



– Click the Columns button.
  This opens a window where you can select the columns.

> **NOTE**
>
> Refer to chapter 17. "Software", page 147 for further details.

10.5 Calculate relative positions

The relative positions in the design table indicate the distance of the image of a center of curvature relative to the top lens vertex.

NOTE

For the upper surface, the relative position is equal to the radius of curvature.

1. Click <Calculate> <Relative Positions>.

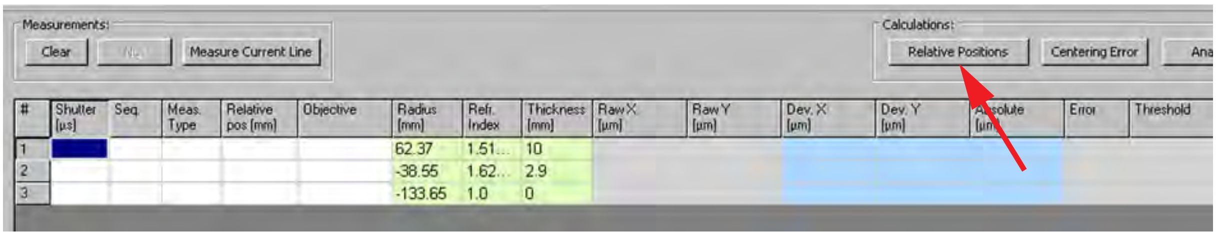
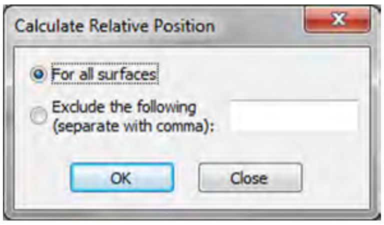


Fig. 10-7



2. Select <For all surfaces> and click OK.

   The relative positions of the individual surfaces are calculated and displayed in the Rel. pos. column.

Fig. 10-8

10.6 Selecting the head lens

A suitable head lens has to be selected for each individual surface.

Please note the criteria listed in chapter 6.9 "Selecting the head lens", page 69.

1. Enter the head lens description in the `Objective` column in the design data.

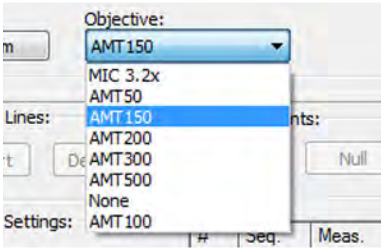


Fig. 10-9

NOTE

Pay close attention to the correct spelling (lowercase/uppercase, use of space).

You can check the correct spelling in the `Objective` drop down menu or under `<Settings> <Objectives>`.

2. To save the changes, select `<File> <Save design file>`.

10.7 Checking relative positions and adjusting exposure time

The vertex is determined and set as the zero position. With this information, the measurement system can automatically find the focuses on all other surfaces.

This chapter describes how the relative positions calculated in Chapter 10.5, page 94 are checked.

The same operation determines the necessary exposure time for each surface.

To find the vertex, focus must be on the top of the uppermost surface.

1. Place the sample on the tip-tilt-table
2. Place a sheet of paper on the sample and use the arrow keys to move the stage until the crosshair can be clearly seen on the paper.
3. Remove the paper.
4. Now look at the camera image and use the arrow keys to move the stage until the crosshair can be clearly seen.

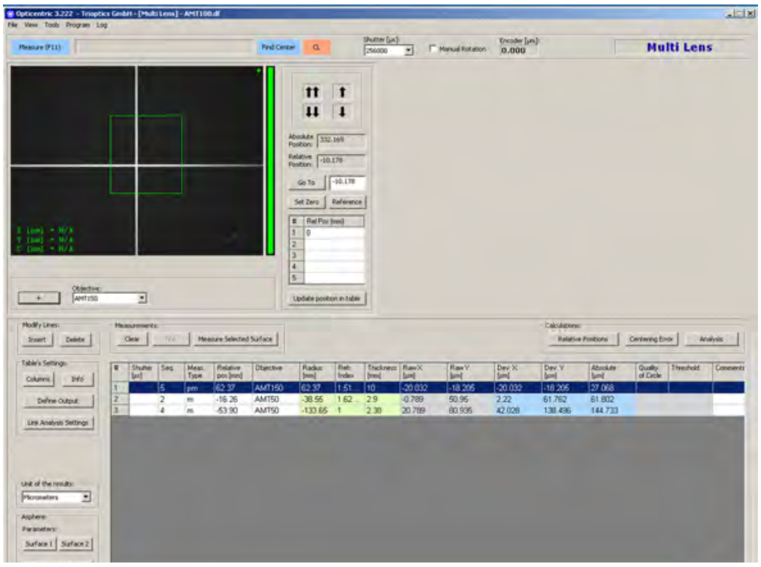
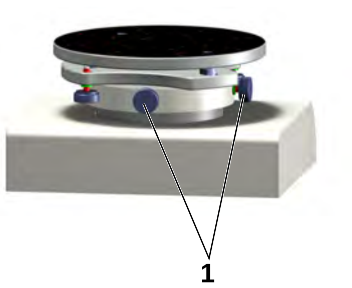


Fig. 10-10

> **NOTE**
>
> To ensure that the focus is on the surface, gently tap on the autocollimator. The cross in the camera view should not move.

The camera image should be **evenly** illuminated as shown in Fig. 10-10.



Should this not be the case (as shown in the example in Fig. 10-11), proceed as follows:

– Center the sample approximately by hand.
– Use the X/Y adjusting screws **1** to center the tip-tilt-table.

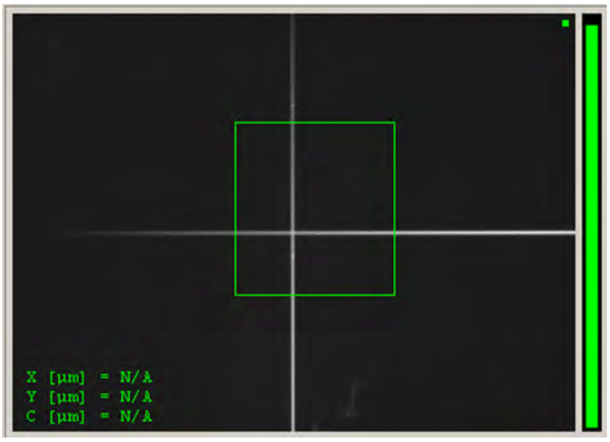
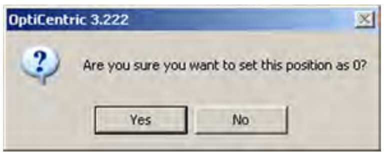


Fig. 10-11: Camera image is unevenly illuminated because the sample is not centered

2. Click `Set Zero`.



3. Confirm the prompt with `Yes`.

   The current position is set as the zero position.

4. Double-click the `1` to focus on the center of curvature of the first surface.

#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	RawX [µm]	RawY [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Error	Threshold
1	16000			62.37	AMT300	62.37	1.51...	10							
2	64000			-16.26	AMT300	-38.55	1.62...	2.9							
3	32000			-53.90	AMT300	-133,65	1,0	0							

Fig. 10-12

The crosshair should now be clearly seen in the camera image. If not, follow these steps:

– If necessary, change the exposure time and/or the brightness of the light source (see chapter 6.10, page 70).

– Use the arrow keys to move the stage until the crosshair can be clearly seen.

– Click the `Update Position in table` button.

The values for the relative position and the exposure time are overwritten.

#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Error	Threshold
1	16000			62.37	AMT300	62.37	1.51...	10							
2	64000			-16.26	AMT300	-38.55	1.62...	2.9							
3	32000			-53.90	AMT300	-133.65	1.0	0							

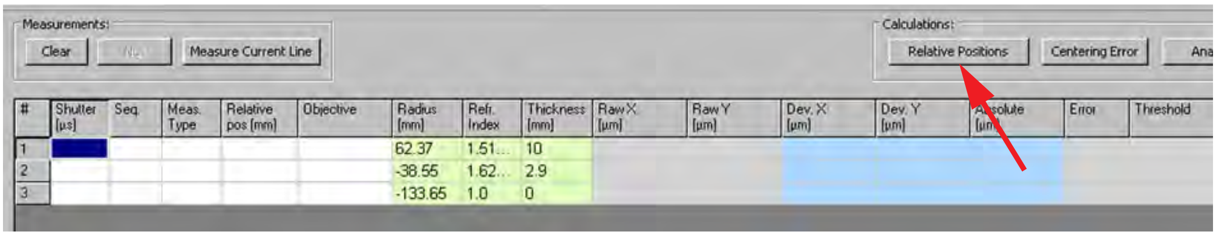
Fig. 10-13

5. Repeat step 4. for all other surfaces.
6. To save the changes, select `<File> <Save design file>`.

Calculate relative position for individual surfaces

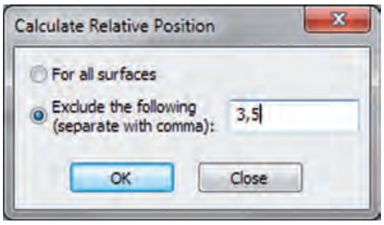
It is possible to recalculate the relative position for individual surfaces. This may be necessary if a relative position has been repeatedly corrected and you are unsure whether it still matches the original. Follow these steps:

1. Click `<Calculate> <Relative Positions>`.



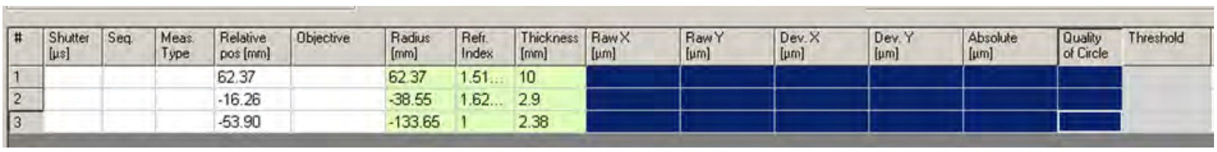
#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Error	Threshold
1						62.37	1.51...	10							
2						-38.55	1.62...	2.9							
3						-133.65	1.0	0							

Fig. 10-14



2. Select `<Exclude the following (separate with comma)>`.
3. Enter the numbers of the surfaces **not** to be recalculated separated by commas.
4. Click `OK`.

   The relative positions of the surfaces are calculated and displayed in the `Rel. pos.` column.



#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Quality of Circle	Threshold
1				62.37		62.37	1.51...	10							
2				-16.26		-38.55	1.62...	2.9							
3				-53.90		-133.65	1	2.38							

Fig. 10-15

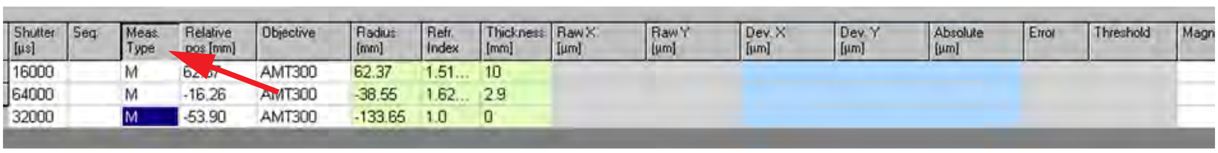
10.8 Measurement methods

The appropriate method for measuring the centration error must be determined for each separate surface and recorded.

Recommended for most measurements	**M** = Measurement The sample is rotated by 360°. During the rotation, the software detects the position of the reticle image. After rotation, the software automatically calculates the centration error.
If the intensity is low or the contrast is very weak and the "M" measurement is not successful	**S** = Select The sample is first rotated by 180°. The "Select a cross" message is displayed. – Click on the crosshair in the camera image. The software looks for a crosshair near where you clicked the mouse. Then the air bearing is turned by 180° back to the starting position. The "Select a cross" message is displayed. – Click on the crosshair in the camera image. The software automatically calculates the centration error.
If a good circle cannot be obtained through very specific aberrations (interfering reflections, several cross images)	**SA** = Select Automatically The sample is first rotated by 180°. The software automatically captures the image from the crosshair. Then the air bearing is turned by 180° back to the starting position. The software automatically captures the image from the crosshair. The software automatically calculates the centration error.

If a good circle cannot be obtained through very specific aberrations	**SG = Select and Grab** The sample is first rotated by 180°. The "Select a cross" message is displayed. – Click **precisely** on the crosshair in the camera image. The software adopts the position of the mouse click as the position of the crosshair. Then the air bearing is turned by 180° back to the starting position. The "Select a cross" message is displayed. – Click **precisely** on the crosshair in the camera image. The software automatically calculates the centration error. **Important!** If the mouse click is not precisely on the crosshair, incorrect positions will be used when calculating the centration error.
Optional measuring method for the measurement of cylindric lenses	**CX = cylindrical surface centration error in x direction**
Optional measuring method for the measurement of cylindric lenses	**CY = cylindrical surface centration error in y direction**
If changes have to be made during the measurement	**P = Pause** The P is written before the letters of the measurement method to produce a pause, e.g. "psg" or "pm". – To continue the measurement, click `Continue`.
If static interference occurs	**B = background subtraction** The B is written after the letters of the measurement method, for example "mb". The first image is taken as the background and subtracted from all subsequent images of this measurement.

1. Enter the desired measuring method in the `Meas. Type` column in the design data.



Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Error	Threshold	Magn
16000		M	[illegible]	AMT300	62.37	1.51...	10								
64000		M	-16.26	AMT300	-38.55	1.62...	2.9								
32000		M	-53.90	AMT300	-133.65	1.0	0								

Fig. 10-16

2. To save the changes, select `<File> <Save design file>`.

10.9 Setting the sequence

During the measurement, the measurement head moves to the relative position of each surface to be measured. Unless specified otherwise, the surfaces are measured in the sequence indicated in the "#" column.

Depending on the sample, the sensor may have to travel back and forth a lot if the centers of curvature are approached in the order of the lens surfaces.

To avoid unnecessary movements and thus save time, it is possible to set the sequence in which the surfaces are measured.

– Right click in the # column and select `Calculate Best Measurement Sequence`.

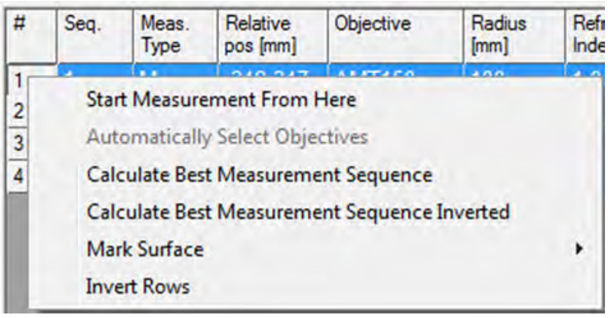


Fig. 10-17

The numbers in the `Seq.` column are changed.

> **NOTE**
>
> If you wish to measure a particular surface (e.g. the one on top) last, select `Calculate Best Measurement Sequence Inverted`. The best sequence is calculated and inverted.

Or:

– Enter the calculated figures for the new sequence into the `Seq.` column.

Fig. 10-18

– To save the changes, select `<File> <Save design file>`.

This concludes the preparations.

11. Conducting a MultiLens® Measurement

This chapter describes how to measure centration errors of individual surfaces within multi-lens optical systems with highest accuracy.

NOTE

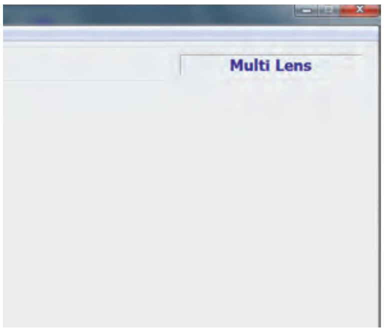
Ensure that the preparations described in chapter 10. are completed and that a .df file is available.

Conducting a MultiLens® measurement only requires the user rights of an operator (see chapter 6.4, page 64).

The measuring principle is described under Chapter 4.4, page 38.

11.1 Preparation

1. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
2. Power up the measurement system as described in Chapter 6.2, page 61.
3. Make sure that the MultiLens measuring mode is selected.

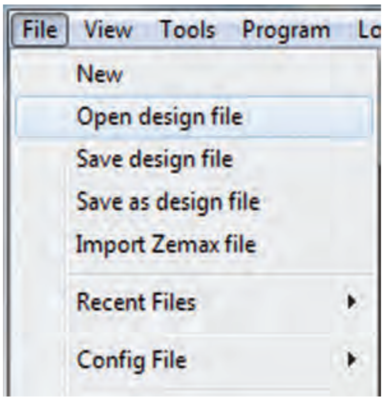


NOTE

Contact the administrator to change the measurement mode, if required.

11.2 Conducting measurements

1. Place the sample in the center of the air bearing or in the center of the tip-tilt-table.
2. To avoid collisions with the sample, move the safety limit switch (see chapter 6.6, page 65).
3. Select `<File> <Open Design File>`.
4. Select the file (*.df) and click `<Open>`.



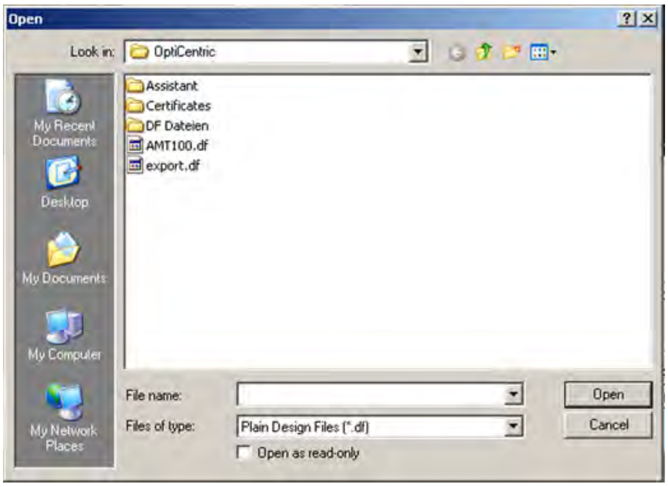
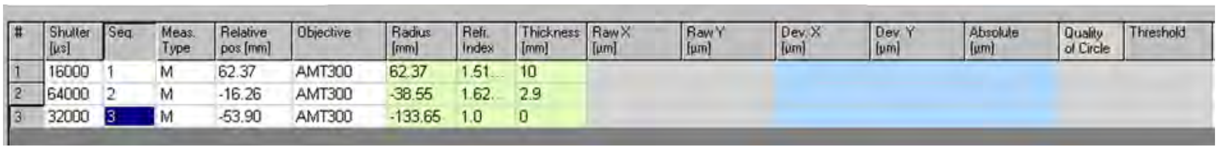


Fig. 11-1

This reads in and displays the data.



#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Dev. X [µm]	Dev. Y [µm]	Absolute [µm]	Quality of Circle	Threshold
1	16000	1	M	62.37	AMT300	62.37	1.51...	10							
2	64000	2	M	-16.26	AMT300	-38.55	1.62...	2.9							
3	32000	3	M	-53.90	AMT300	-133.65	1.0	0							

Fig. 11-2

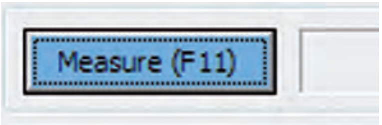
5. Select the head lens for the first surface to be measured (see chapter 10.6, page 95).
6. Focus on the topmost surface (see Chapter 6.8, page 66, "Manual focusing of a surface").
7. Click `Set Zero`.
8. Focus on the center of curvature of the first surface.
9. If necessary, move the sample on the air bearing until the crosshair is visible in the center of the monitor.

10. Click `Find Center`.

The air bearing performs one revolution. The image of the crosshair describes a circle.

NOTE

If the circle is very large, the sample must be moved more into the center of the air bearing.



11. Click `Measure (F11)`.

NOTE

Press the **Esc** key on the keyboard to abort the measurement.

The raw data `Raw X [mm]` and `Raw Y [mm]` are displayed during the measurement. These raw data are only correct for the first surface, because the measurement is affected by refraction and centration errors.

Once the measurement has been taken, the corrected values for all surfaces are entered in the design table.

#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Deviation X [µm]	Deviation Y [µm]	Total [µm]	Quality of Circle	Qual Thresh
1	8000	1	m	62.37	AMT150	62.37	1.518...	10	-2.78	-0.76	-2.78	-0.76			
2	64000	2	m	-16.26	AMT150	-38.55	1.629...	2.9	30.34	-9.52	35.52	-10.89		0.995	
3	8000	3	m	-53.90	AMT150	-133.65	1.0	0	55.49	-29.23	87.31	-42.80		0.995	

Fig. 11-3

11.3 Interpreting measurement results

The columns "Dev X [µm]" and "Dev Y [µm]" indicate the deviation from the center of curvature.

The column "Quality of circle" specifies an index indicating the deviation of the points from the perfect circle. The value is between 0 and 1, where "1" means that the values are 100% on the circle.

– If this value is below 0.8, the surface should be re-examined (see chapter 11.4, page 106).
– If no value can be determined, the centration error for this surface is very small or a measuring method was selected which does not include rotation by 360°.

NOTE

The measurement results can be examined more closely using the Advanced Analyzer (see chapter 12., page 109).

11.4 Measuring a single surface manually

1. Double-click the left mouse button on the surface number in the # column to focus the center of curvature.

#	Shutter [µs]	Seq.	Meas. Type	Relative pos [mm]	Objective	Radius [mm]	Refr. Index	Thickness [mm]	Raw X [µm]	Raw Y [µm]	Deviation X [µm]	Deviation Y [µm]	Total [µm]	Quality of Circle	Qual Thresh
1	8000	1	m	62.37	AMT150	62.37	1.518...	10	-2.78	-0.76	-2.78	-0.76			
2	[illegible]	2	m	-16.26	AMT150	-38.55	1.629...	2.9	30.34	-9.52	35.52	-10.89		0.995	
3	8000	3	m	-53.90	AMT150	-133.65	1.0	0	55.49	-29.23	87.31	-42.80		0.995	

Fig. 11-4

2. Look at the camera window:
   - Is the crosshair in the area of interest (AOI)? Enlarge the area of interest if necessary.
   - Is the focus position correct? Refocus if necessary.
3. Click `Measure Selected Surface`.

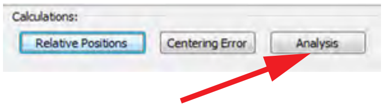
11.5 After completing the measurements

The following options are available:

– Save the measurement results in a certificate, as described in Chapter 6.12, page 73.
Or:

– Save the measurement results in the design file. Select `<File> <Save design file>`.
The results can be analyzed later on the measuring system or on a separate PC.

Or:



– Click the `Analysis` button to open the Advanced Analyzer.
The current measurement results are applied.

> **NOTE**
>
> For a detailed description of the Advanced Analyzer, refer to Chapter 12., page 109.

Or:

– Start the measurement of the next sample.

11.6 OptiSurf Thickness Report

> **NOTE**
>
> This option is only available for devices with OptiSurf (OC 3D).

After a single measurement or a MultiLens measurement, the values measured by OptiSurf (lens thickness and distances) can be exported to a .txt file.

Specify the directory and name of the file

1. Under <Tools> <Settings> select the <External Control> tab.

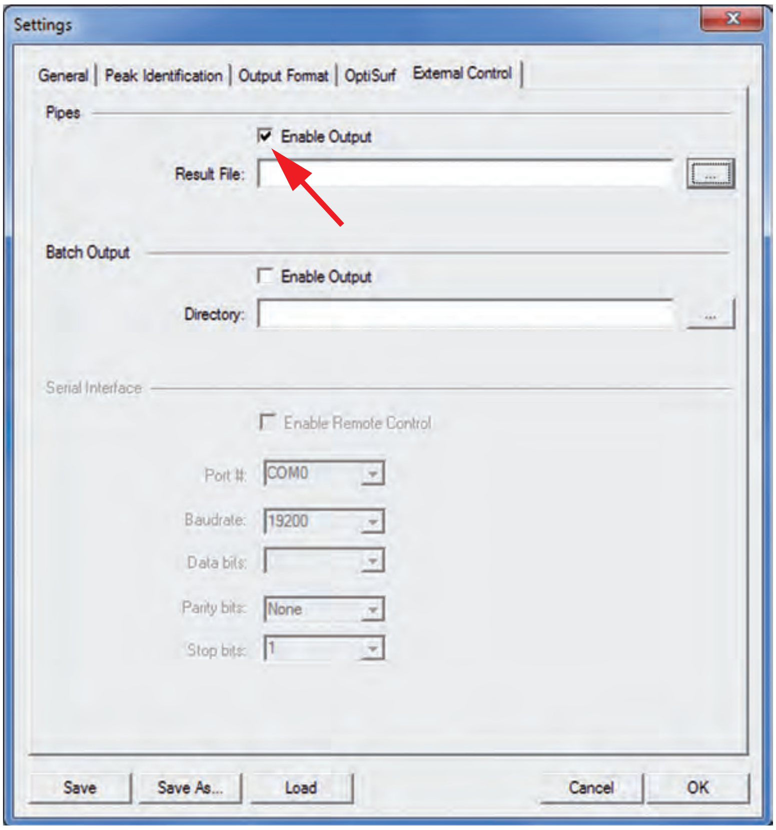


Fig. 11-5

2. Under Pipes, tick the checkmark next to Enable Output.
3. Click the ... button and select the path for the file.
4. Enter the name of the file under Result File.

Import a file

1. To import the file, right-click on the "Thickness" column in the design table and choose "Load Values From File".

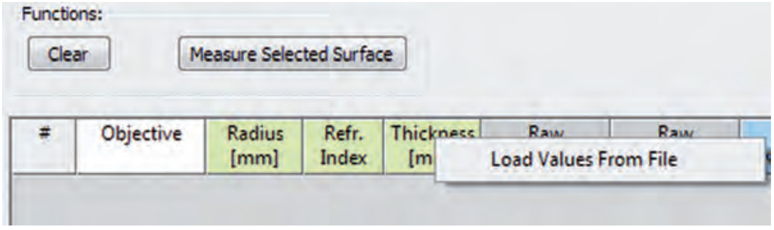


Fig. 11-6

2. Go to the corresponding directory and select the .txt file.
3. Confirm with **Save**.

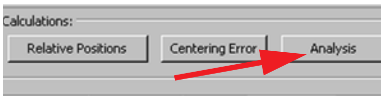
   The results of the thickness measurement are now exported to OC.

12. Advanced Analysis

This chapter describes how to analyze the results from a MultiLens® measurement in detail. A separate software, the Advanced Analyzer is used for this purpose.

The data can be analyzed on the measurement system or on a separate PC.

12.1 Opening Advanced Analyzer and transferring data



On the measurement system

– Once the MultiLens® measurement has finished, click the **Analysis** button.

  The Advanced Analyzer software starts. The data are transferred and sorted into the table.

  The top table shows the centration errors of the individual surfaces in relation to the axis of rotation. The number of lines is adjusted automatically.

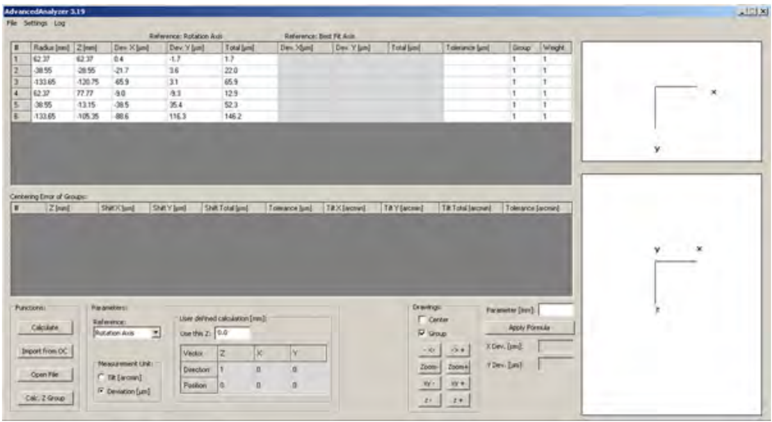
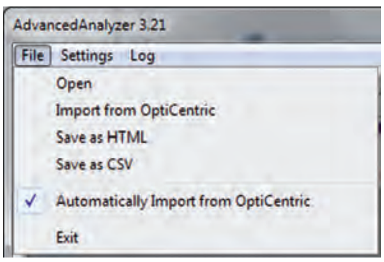


Fig. 12-1

Automatic data transfer

The data is transmitted to the Advanced Analyzer after each MultiLens® measurement.

> **NOTE**
>
> The data is only transferred automatically if the OptiCentric software and Advanced Analyzer are located in the same folder.

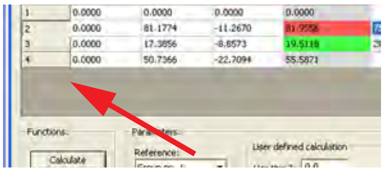


– To enable the automatic data transfer, tick the checkmark for the `<Automatically Import from OptiCentric>` option in the drop-down menu `<File>`.

On the PC

1. If you are working on a separate PC, insert the copy protection plug (hardware dongle) into one of the PC's USB ports.

2. Start the Advanced Analyzer software.



3. Select `<File> <Open>` or click the `Open File` button.

   A dialog appears prompting you to open a .df file.
4. Select the desired .df file and click `Open`.

   The top table shows the centration errors of the individual surfaces in relation to the axis of rotation.

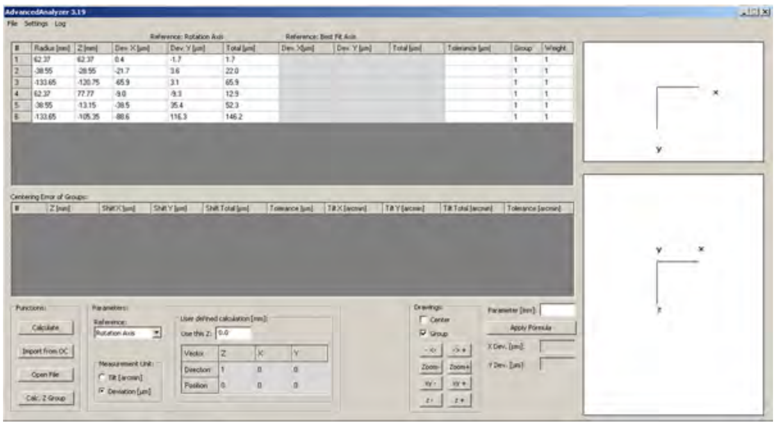


Fig. 12-2

12.2 Tolerances, PASS/FAIL

– Enter the maximum deviation for each surface in the `Tolerance [µm]` column.

> **NOTE**
>
> A value does not have to be set for every surface. Surfaces without a set tolerance will be ignored during the pass-fail query.

Fig. 12-3

- If the tolerance is observed, the measured value is highlighted in green.
- If all measurements are within their tolerance, "PASS" is displayed as the overall result.
- If the tolerance is exceeded, the measured value is highlighted in red.
- If at least one measurement is outside its tolerance, "FAIL" is displayed as the overall result.

12.3 Assigning surfaces to groups

Depending on the sample and what is being analyzed, it is helpful to combine the different surfaces of a sample into groups.

Example:

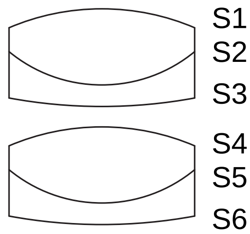


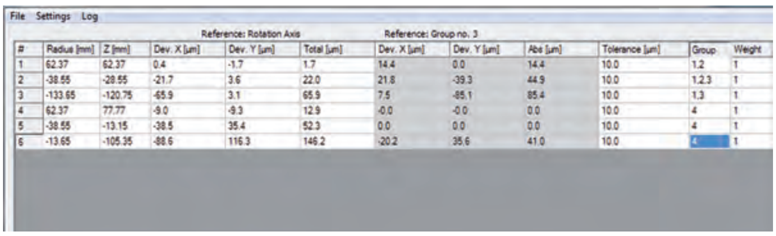
Fig. 12-4: Illustration sample

In the example shown above, it is possible to combine the following groups:

– top achromat = group 1:
  surfaces S1, S2, S3
– top lens of the top achromat = group 2:
  surfaces S1, S2
– bottom lens of the top achromat = group 3:
  surfaces S2, S3
– bottom achromat = group 4:
  surfaces S4, S5, S6

NOTE

If one surface belongs to several groups (such as in cemented surfaces), the group numbers are separated by commas.



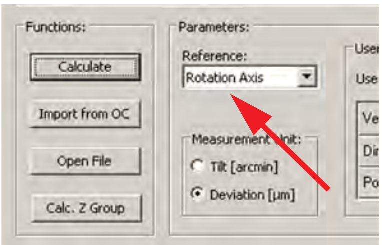
File Settings Log

		Reference: Rotation Axis				Reference: Group no. 3					
#	Radius [mm]	Z [mm]	Dev. X [µm]	Dev. Y [µm]	Total [µm]	Dev. X [µm]	Dev. Y [µm]	Abs [µm]	Tolerance [µm]	Group	Weight
1	62.37	62.37	0.4	-1.7	1.7	14.4	0.0	14.4	10.0	1,2	1
2	-38.55	-28.55	-21.7	3.6	22.0	21.8	-39.3	44.9	10.0	1,2,3	1
3	-133.65	-120.75	-65.9	3.1	65.9	7.5	-85.1	85.4	10.0	1,3	1
4	62.37	77.77	-9.0	-9.3	12.9	-0.0	-0.0	0.0	10.0	4	1
5	-38.55	-13.15	-38.5	35.4	52.3	0.0	0.0	0.0	10.0	4	1
6	-13.65	-105.35	-88.6	116.3	146.2	-20.2	35.6	41.0	10.0	4	1

Fig. 12-5

12.4 Selecting the reference axis

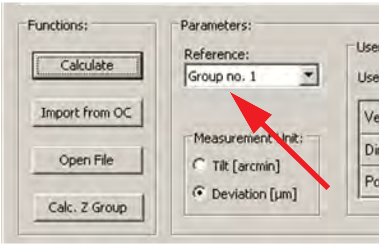
Different reference axes can be selected, depending on what is going to analyzed.



Example 1:

The position of the sample to the axis of rotation is to be tested.

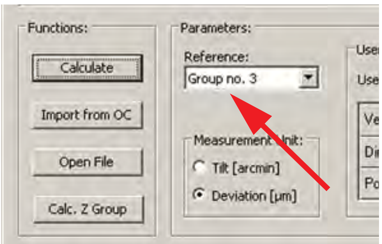
Reference: rotation axis



Example 2:

The position of the two achromats to each other is to be tested.

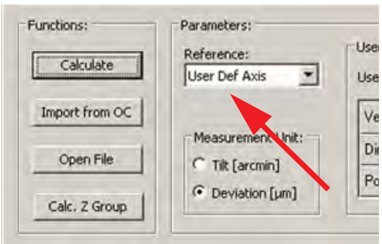
Reference: Group no. 1



Example 3:

The quality of the achromats (position of the individual lenses to each other) is to be tested.

Reference: Group no. 3



Example 4:

The position of the achromats in a mounting is to be tested.

Reference: User Def Axis (user defined axis)

NOTE

For information on the user defined axis, please refer to Chapter 14., page 125

12.5 Weight

This value describes the importance of a surface to the overall results:

– If the weighting is the same for all surfaces, each centration error has the same weight when calculating the total centration error.
– If one surface has a very high weight compared to the other surfaces, the centration error of this surface, relative to the associated group axis, is smaller.

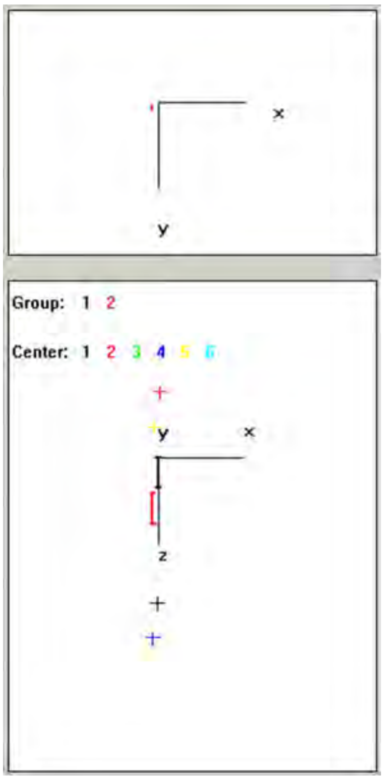
NOTE

The individual surfaces should be weighted by using the tolerance analysis and the lens design.

12.6 Graphical representation of the centration error

The graphical representation shows:

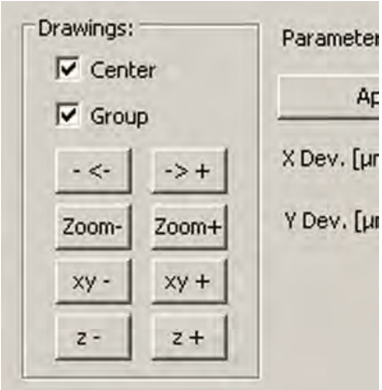
- the centers of curvature
- the optical axes of the groups
- the position of the groups' centration errors to each other



Top view

Side view

Fig. 12-6



– Click the `- <-` or `-> +` buttons in order to rotate the side view around the Z-axis.
– Click the `Zoom-` or `Zoom+` buttons in order to scale the views.
– Click the `xy-` or `xy+` buttons in order to scale the display in X-Y-direction. This function is comparable to the `Zoom` function, however, it only considers the X-Y-plane.
– To scale the display in z-direction, click on the buttons `z-` or `z+`. This function is comparable to zoom but only in the Z plane.

13. Measurement of Lens Thicknesses and Air Gaps

This chapter describes how to measure center thickness and air gaps of single lenses, plane optics and optical systems without contact.

In this measuring method, an autocollimator with head lens is used to focus on the sample surfaces ("Cats Eye Reflex") and read their position. The positions can be very precisely detected with the electronic autocollimator thanks to the auto focus function. The difference between two positions is proportional to the lens thickness.

NOTE

This measuring method is suitable for measuring 4 to 5 distances.

If the number of distances is greater or if a highly accurate result is expected, we recommend using OptiSurf®.

13.1 Preparation

1. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
2. Power up the measurement system as described in Chapter 6.2, page 61.
3. Log in as Supervisor (see chapter 6.4, page 64).
4. Select `<Program> <Thickness>`.

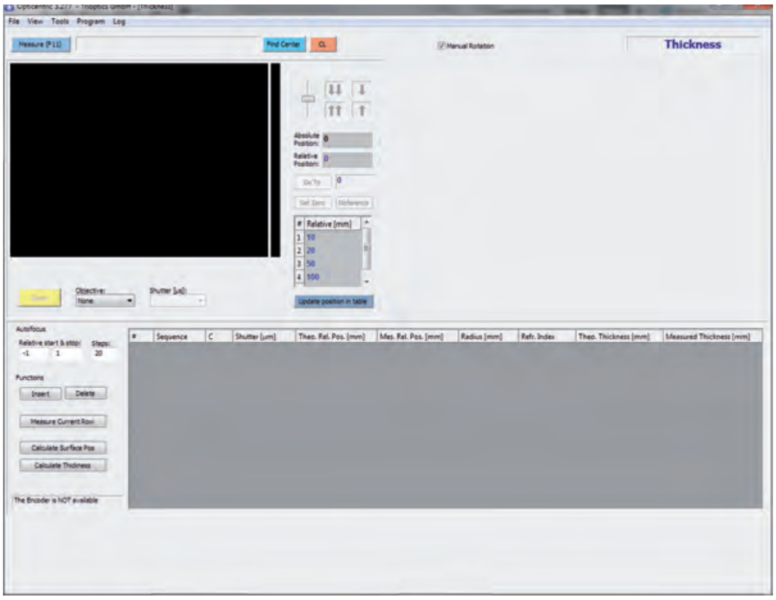


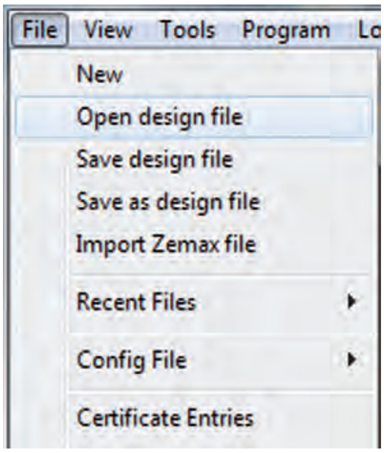
Fig. 13-1

13.2 Creating the design table

To create a design table, follow the steps as described in Chapter 10.2, page 90.

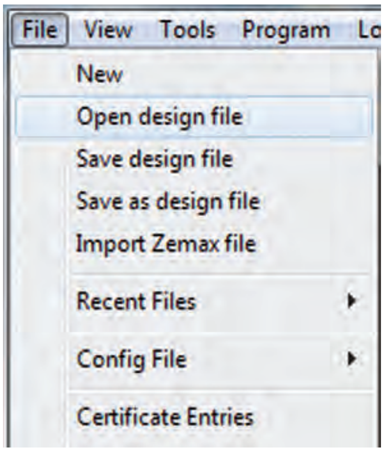
– To insert additional rows, click `<Insert>`.
  One row for each optical surface!
– To delete the selected row, click `<Delete>`.

13.3 Saving the design table



1. Select `<File> <Save as design file>`.
2. Select the directory and enter the file name (.df).
3. Click `<Save>`.

13.4 Opening the design table



1. Use a suitable mount to place the sample into the measurement system.
2. Select `<File>` `<Open Design File>`.
3. Select the file (*.df) and click `<Open>`.

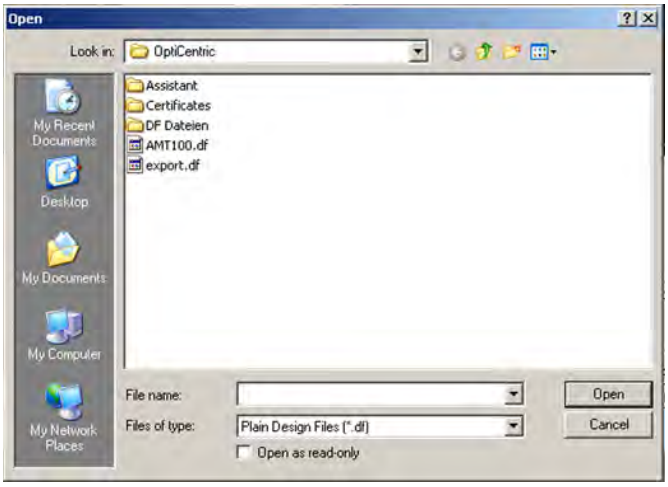


Fig. 13-2

This reads in and displays the data.

#	Sequence	C	Shutter [µs]	Theo. Rel. Pos. [mm]	Mes. Rel. Pos. [mm]	Radius [mm]	Refr. Index	Theo. Thickness [mm]	Measured Thickness [mm]
1	1	m		0	0	62.37	1.51872	10	0
2	2	m		0	0	-38.55	1.62953	2.9	0
3	3	m		0	0	-133.65	1	2.38	0

Fig. 13-3

13.5 Finding the zero position and calculating relative positions

NOTE

This measurement should be carried out with narrow-band light (interference filter).

The interference filter which is mounted in the autocollimator must have the correct wavelength – the same as that used for the refractive indices of the design table.

The head lens should have as large a numerical aperture (= small f-number) as possible.

The vertex is determined and set as the zero position. Using the information from the design table, the measurement system can automatically calculate the relative positions for all other surfaces.

The relative positions in the design table indicate the distance of a surface to the top lens vertex.

To find the vertex, focus must be on the top of the uppermost surface.

1. Place the sample on the tip-tilt-table
2. Select a suitable head lens for the measurement (strong magnification e.g. Mitutoyo 10x or AMT50).
3. Place a sheet of paper on the sample and use the arrow keys to move the stage until the crosshair can be clearly seen on the paper.
4. Remove the paper.
5. Now look at the camera image and use the arrow keys to move the stage until the crosshair can be clearly seen.

NOTE

Use the auto focus (`<Tools> <Autofocus>`) to find the exact position.

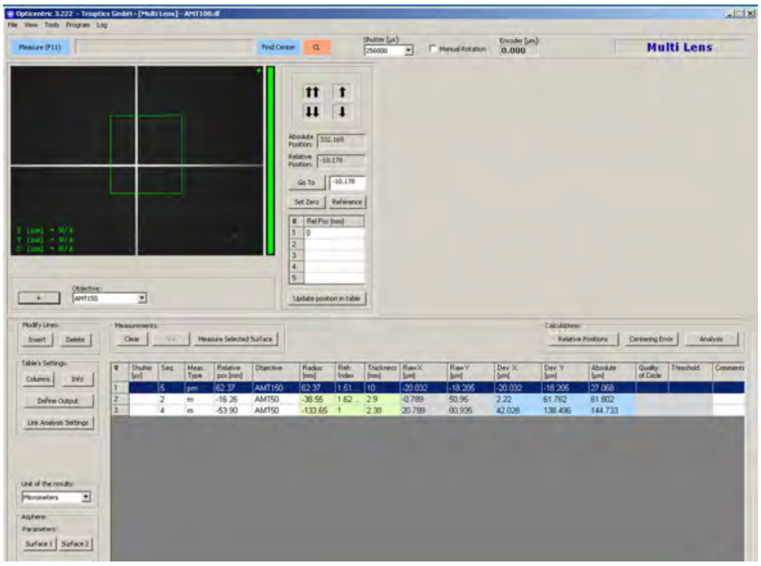


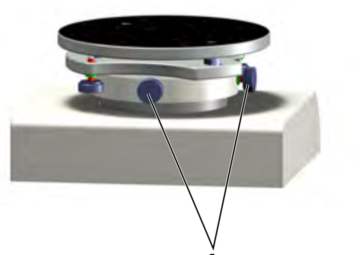
Fig. 13-4

NOTE

To ensure that the focus is on the surface, gently tap on the autocollimator. The cross in the camera view should not move.

The camera image should be **evenly** illuminated as shown in Fig. 13-4.

Should this not be the case (as shown in the example in Fig. 13-5), proceed as follows:



– Center the sample approximately by hand.
– Center the sample using the X/Y adjustment screws **1** of the tip-tilt-table.

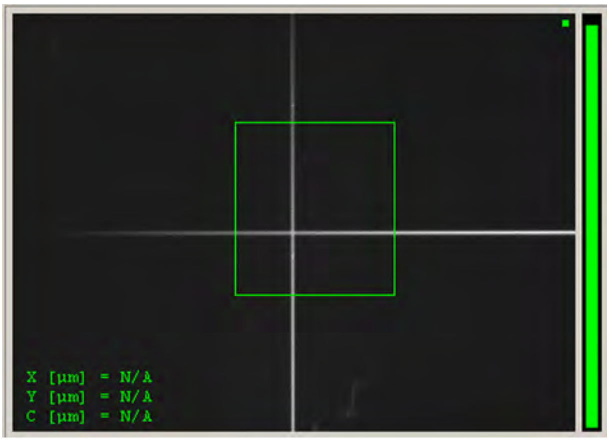


Fig. 13-5: Camera image is unevenly illuminated because the sample is not centered

6. Click `Set Zero`.

7. Confirm the prompt with `Yes`.

   The current position is set as the zero position.

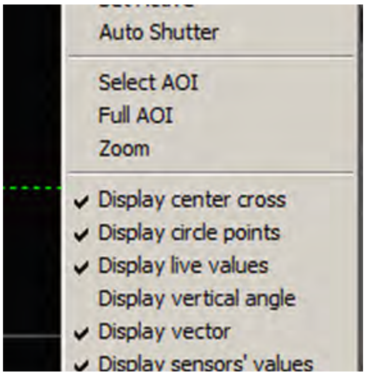
8. Click `Calculate Surface Pos`.

   The theoretical position of the surfaces is calculated and displayed in the `Theo. Ref. Pos.[mm]` column.

#	Sequence	C	Shutter [µs]	Theo. Rel. Pos. [mm]	Mes. Rel. Pos. [mm]	Radius [mm]	Refr. Index	Theo. Thickness [mm]	Measured Thickness [mm]
1	1	m		0.000	0	62.37	1.51872	10	0
2	2	m		6.939	0	-38.55	1.62953	2.9	0
3	3	m		8.967	0	-133.65	1	2.38	0

Fig. 13-6

13.6 Setting the area of interest (AOI)



1. Move the cursor on the camera window and click the right mouse button.
2. Choose <Select AOI>.
3. Use the cursor to select the area of interest.

> **NOTE**
>
> In this measurement a small symmetrical square should be placed around the center of the crosshair.
> Rule of thumb: edge length of the AOI 1/10 of the image width.

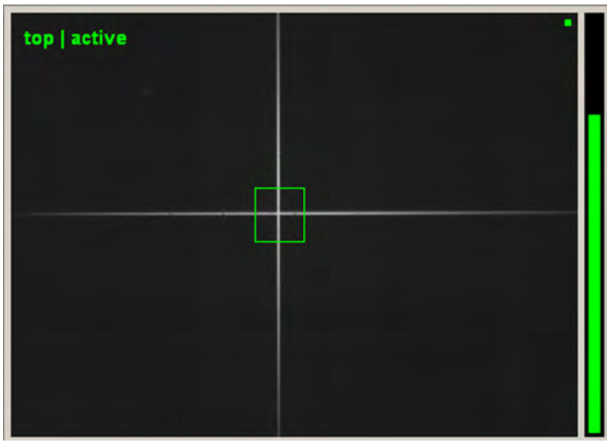


Fig. 13-7

13.7 Adjusting the exposure time

1. Double-click the `1` to focus on the first surface.

#	Sequence	C	Shutter [µs]	Theo. Rel. Pos. [mm]	Mes. Rel. Pos. [mm]	Radius [mm]	Refr. Index	Theo. Thickness [mm]	Measured Thickness [mm]
1	1	m	16000	0.000	0	62.37	1.51872	10	0
2	2	m	1600	6.939	0	-38.55	1.62953	2.9	0
3	3	m	1600	8.967	0	-133.65	1	2.38	0

Fig. 13-8

The crosshair should now be clearly seen in the camera image. If not, follow these steps:

2. If necessary, change the exposure time and enter the corresponding value in the `Shutter [µs]` column.
3. Repeat steps 1. to 2. for all other surfaces.
4. To save the changes, select `<File> <Save design file>`.

13.8 Measurement methods

NOTE

The `C` column must always contain an `M` for "Measurement" (default measurement).

13.9 Setting the sequence

NOTE

It is recommended to measure the surfaces from top to bottom in order to minimize the influence of the linear bearing mechanism.

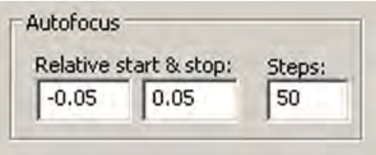
1. Enter the figures for the desired sequence into the `Seq` column.

#	Sequence	C	Shutter [µs]	Theo. Rel. Pos. [mm]	Mes. Rel. Pos. [mm]	Radius [mm]	Refr. Index	Theo. Thickness [mm]	Measured Thickness [mm]
1	1	m	16000	0.000	0	62.37	1.51872	10	0
2	2	m	1600	6.939	0	-38.55	1.62953	2.9	0
3	3	m	1600	8.967	0	-133.65	1	2.38	0

Fig. 13-9

2. To save the changes, select `<File> <Save design file>`.

13.10 Conducting measurements



1. Enter the `Autofocus settings`. Refer to Chapter 17. "Software", Page 153 for further details.
2. To perform a measurement, click on the button `Measure` or use the function key **F11**.

   The specified range around the first relative position is scanned for the position with the highest contrast (Best Focus Position).

   Subsequently, the best focus position is sought for the next relative position.

   The measured difference of the relative positions is used to determine the true geometric distance by means of optical calculation, related to the design data. This is displayed in the `Measured Thickness` column.

#	Sequence	C	Shutter [µs]	Theo. Rel. Pos. [mm]	Mes. Rel. Pos. [mm]	Radius [mm]	Refr. Index	Theo. Thickness [mm]	Measured Thickness [mm]
1	1	m	16000	0.000	-0.041	62.37	1.51872	10	10.033
2	2	m	1600	6.939	6.938	-38.55	1.62953	2.9	3.000
3	3	m	1600	8.967	9.017	-133.65	1	2.38	0.0

Fig. 13-10

14. Measurement and Alignment with a Probe

This chapter describes how the position of a mechanical support or the sample mount can be determined and adjusted, if necessary.

To do this, a probe is connected to the OptiCentric®100 via a serial interface.

The probe is based on the coordinate system of the measurement system. Since the centration error determination of the optics (measurements with the autocollimator) and mechanical measurements are based on the same coordinate system, the optical and mechanical measurements can be combined.

In this way you get a direct statement about the centration errors of the optics based on a mechanical reference (e.g. the mount).

14.1 Connecting and activating the probe

NOTE

The description only applies to external distance sensors (optical or tactile) with OptiCentric® MOT.

1. Place the foot **1** of the probe on the steel plate **3**.
2. Turn switch **2** to "+" to secure the foot.

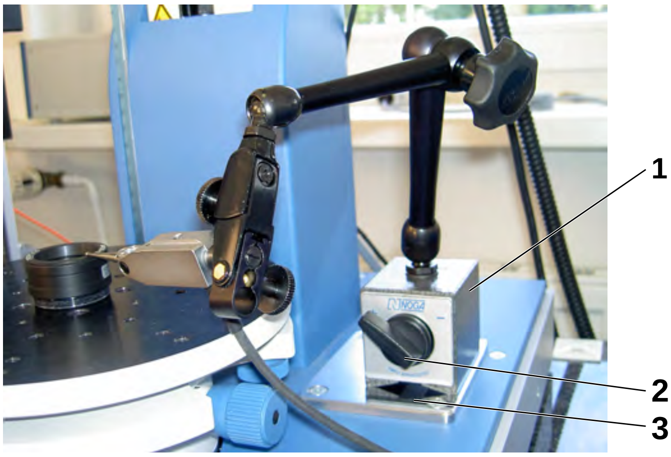


Fig. 14-1

3. Connect the cables and wires according to the labeling.

4. Under <Tools> <Settings> select the <Distance Sensor> tab.

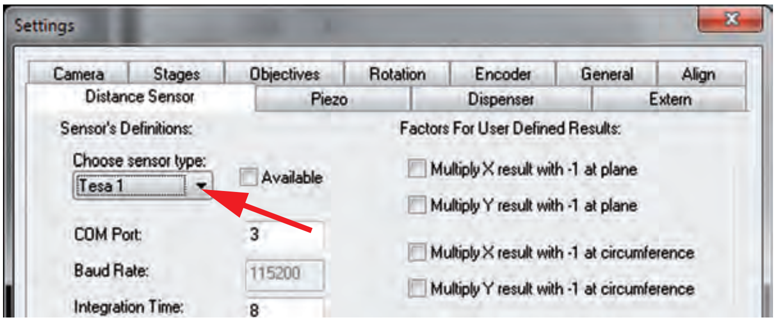


Fig. 14-2

5. Under `Choose sensor type` select the sensor `Tesa 1` or `Tesa 2`.
6. In `COM port` enter the number of the serial interface.
7. Tick the checkmark for `Available`.
8. Click `OK`.

14.2 Conducting measurements

1. Attach the mechanical bracket or the sample mount.

NOTE

The probe must always touch the sample from a defined side. Otherwise, the coordinate system does not match.

2. Roughly center the sample beforehand.
3. Select <View> <User Defined Axis>.

   This opens the following window in which the measurement with probe is triggered and evaluated.

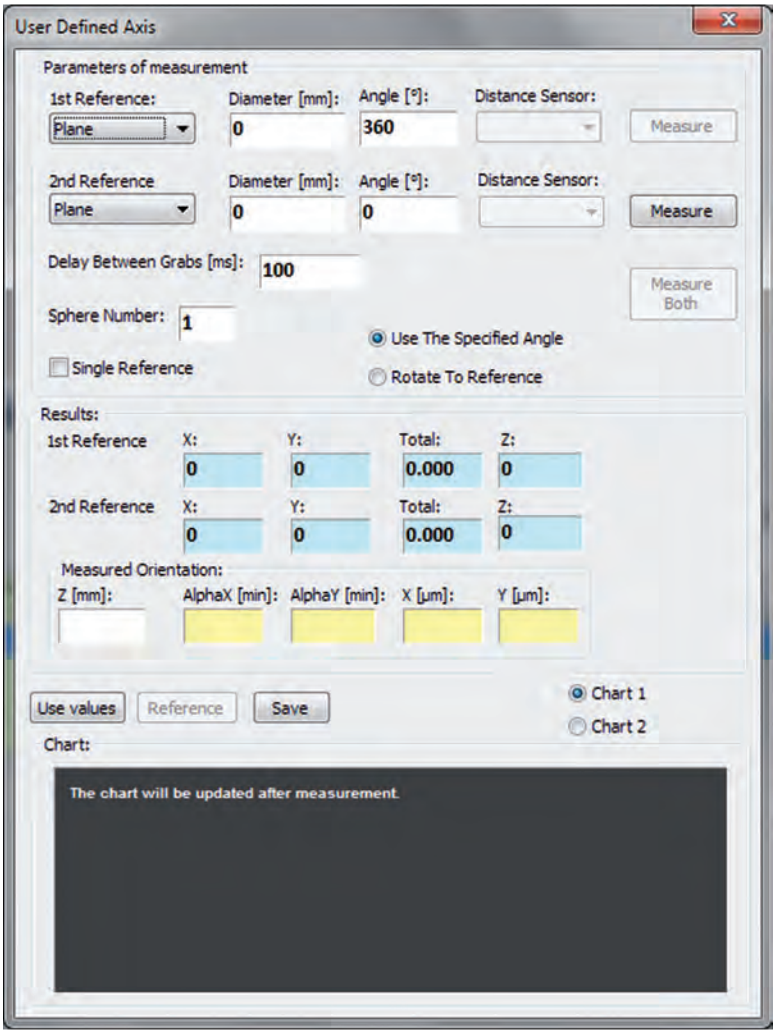


Fig. 14-3

NOTE

This window may remain open in parallel to the OptiCentric software main window and its functions can be accessed at any time.

Moving the probe head into position

1. For the rough setting: Loosen the star screw **1** and adjust the arm of the probe.
2. For the fine setting: Loosen the thumb screws **2** and **3** and adjust the arm of the probe.
3. Turn the probe head **4** so that the cable is pointing backwards or downwards.

Fig. 14-4

NOTE

Gently press the probe sensor at the start of a measurement.

The starting position of the probe sensor should be approximately in the center of the measuring range.

Example 1: Measurement of the radial runout at two defined positions

If you want to measure the position of a cylindrical mount in the space, then the radial runout of the mount has to be determined at two different heights.

1. To specify that the radial runout is to be determined, for `1st Reference` select `Circumference`.

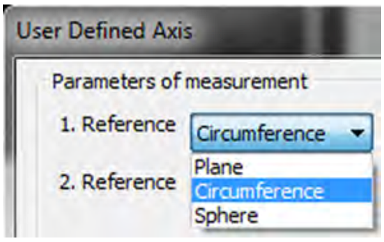


Fig. 14-5

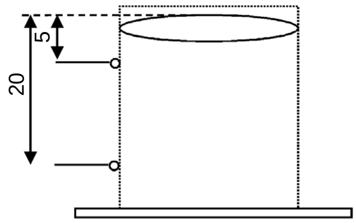


Fig. 14-6

2. In `Z Pos [mm]` enter the distance of the probe to the position of the lens vertex.

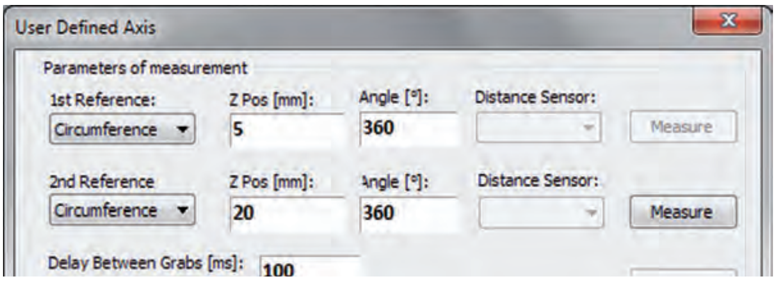


Fig. 14-7: Measurement of the radial runout at two defined positions

3. In `Angle [°]` enter the angle of rotation over which values are to be recorded.

> **NOTE**
>
> It is recommended that you always record values over a full rotation (360°).

4. Enter the values for the second reference in the `2nd Reference` row accordingly.

5. To measure the first reference, click the top `Measure` button.

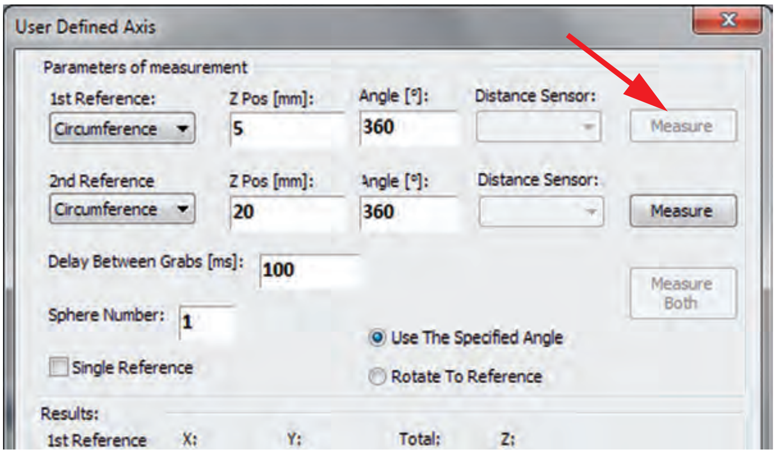
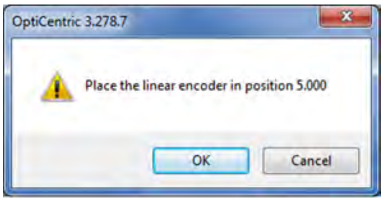


Fig. 14-8



The message `Place the linear encoder in position 5.000` appears.

6. Adjust the tip of the probe so that it is 5 mm away from the lens vertex and slightly pressing the surface from the outside.
7. Click `OK`.

   The measurement is carried out.

8. To measure the second reference, click the bottom `Measure` button.

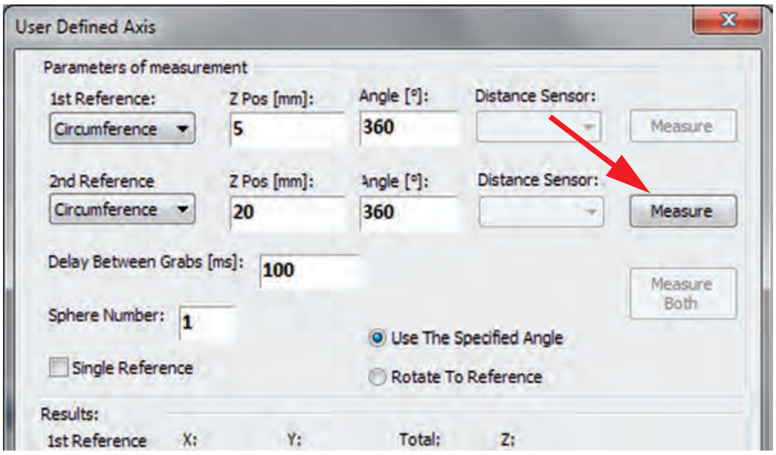
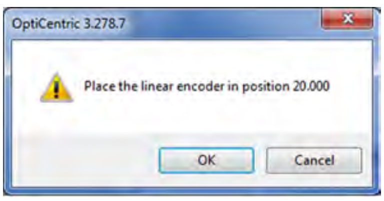


Fig. 14-9



The message `Place the linear encoder in position 20.000` appears.

9. Adjust the tip of the probe so that it is 20 mm away from the lens vertex and slightly pressing the surface from the outside.
10. Click `OK`.

    The measurement is carried out.

The result given is the X and Y position of the center of the circumference and the total distance to the axis of rotation.

Fig. 14-10

Example 2: Measurement of the radial runout at a defined position + measurement of the axial runout

1. To specify that the radial runout is to be determined, for `1st Reference` select `Circumference`.

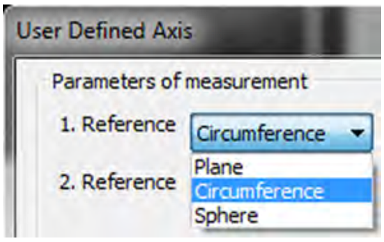


Fig. 14-11

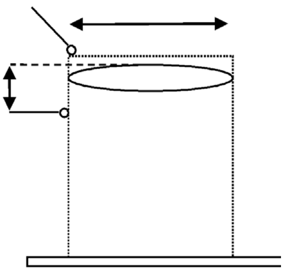


Fig. 14-12

2. In `Z Pos [mm]` enter the distance of the probe to the position of the lens vertex.

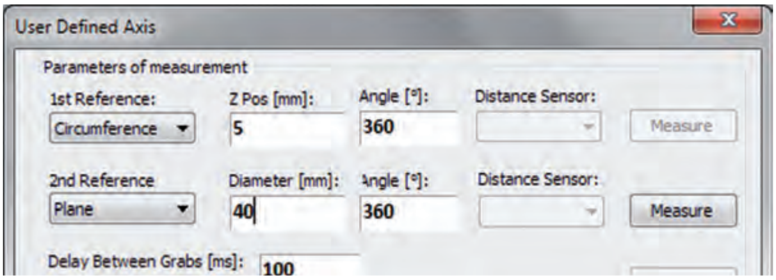
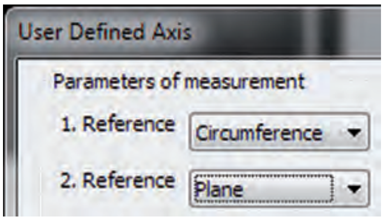


Fig. 14-13: Measurement of the radial runout at a defined position + measurement of the axial runout

3. In `Angle [°]` enter the angle of rotation over which values are to be recorded.

NOTE

It is recommended that you always record values over a full rotation (360°).



4. To specify that the axial runout is to be determined, for `2nd Reference` select `Plane`.
5. In the `Diameter` field, enter the diameter of the probe position.
6. To measure the first reference, click the `Measure` button.

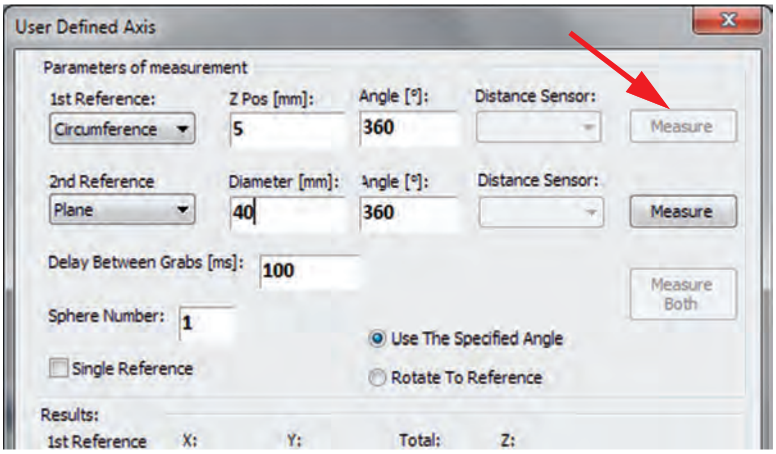
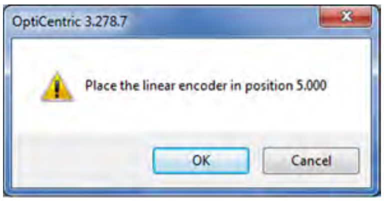


Fig. 14-14



The message `Place the linear encoder in position 5.000` appears.

7. Adjust the tip of the probe so that it is 5 mm away from the lens vertex and slightly pressing the surface from the outside.
8. Click `OK`.

   The measurement is carried out.
9. To measure the second reference, click the `Measure` button.

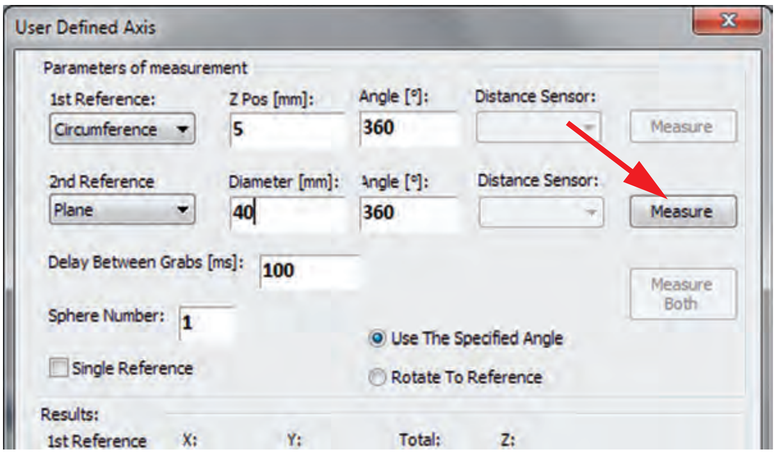


Fig. 14-15

The `Place the linear encoder on the plane surface with diameter 40.000` message appears.

10. Adjust the tip of the probe so that is slightly pressing on the surface with the 40 mm diameter from the **top**.

> **NOTE**
>
> The tip should touch as far as possible on the outside.

11. Click `OK`.

The measurement is carried out.

The results given are the X and Y position of the center of the circumference, the total distance to the axis of rotation and the angle of inclination of the planar surface.

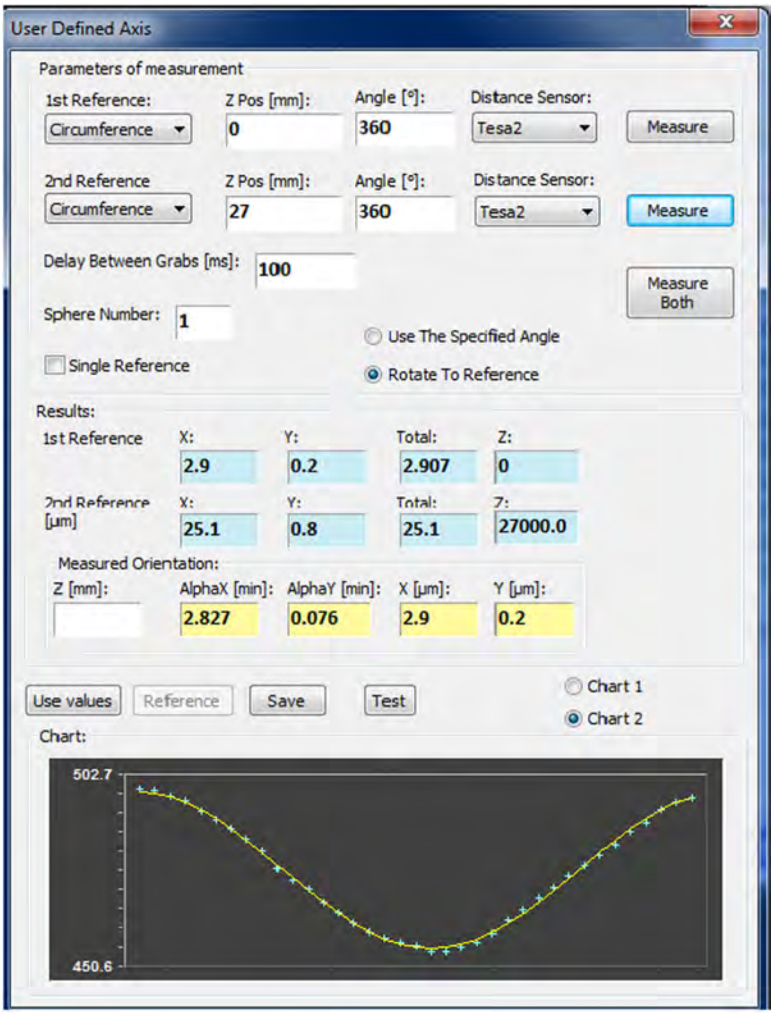


Fig. 14-16

15. Measurement of a Single Lens with Vacuum Unit

This chapter describes how to measure centration errors of individual lenses (spherical or plane) with highest accuracy.

15.1 Motorized lens rotation device with vacuum

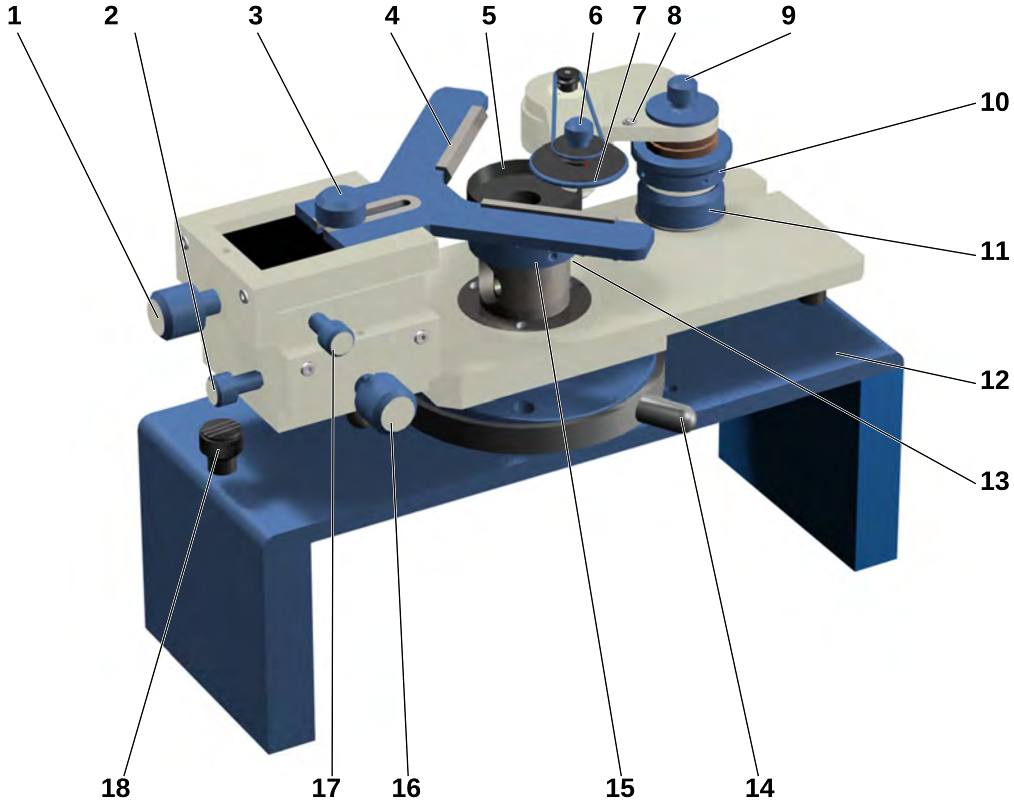


Fig. 15-1

1	**Thumb screw for displacement of the V-blade in X-direction**
2	**Clamp for screw 1** The clamping screw must be loosened to move the V-blade in X-direction.
3	**Fastening screw for V-blade**
4	**V-blade**
5	**Cup point**
6	**Handle for moving the pivot arm**
7	**Friction wheel**
8	**Pivot arm lock**
9	**Thumb screw for clamping the height adjustment**

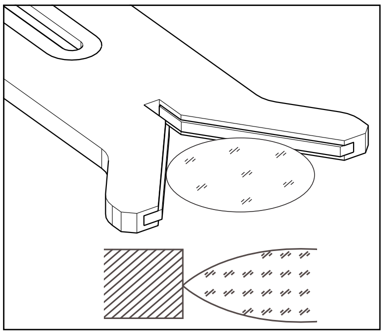
10	**Height adjustment of the pivot arm**
11	**Clamping screw** The clamping screw must be loosened to move the pivot arm in X-direction.
12	**Bridge** used to secure the vacuum unit above the air bearing
13	**Connection for vacuum hose (not visible)**
14	**Lever for locking the cone**
15	**Height adjustment of the cup point**
16	**Thumb screw for displacement of the V-blade in Y-direction**
17	**Clamp for screw 16** The clamping screw must be loosened to move the V-blade in Y-direction.
18	**For attaching the bridge**

15.2 Preparation

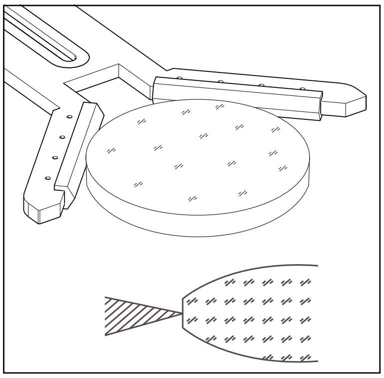
1. Install the bridge and the lens rotation device as described in Chapter 5.16, page 55.
2. Perform the checks prior to operating the unit as described in Chapter 6.1, page 61.
3. Power up the measurement system as described in Chapter 6.2, page 61.

15.3 Select V-blade

1. Choose a V-blade suitable for the sample. Please note the following:
   - The lens diameter must be within the range specified for the V-blade.
   - For lenses with a narrow rim (< 3 mm) use a V-blade with flat cutting edges.



   - In all other cases, use a V-blade with sharp cutting edges.



2. To change the V-blade, loosen the thumb screw **1** and pull the V-blade **2** out of the guidance.

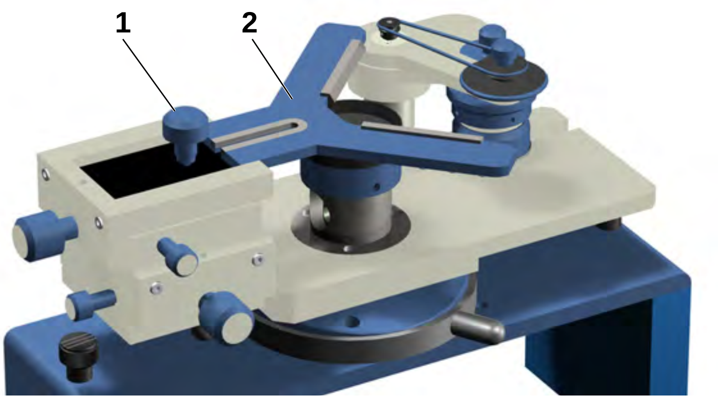


Fig. 15-2

3. Slide in the new V-blade.

15.4 Selecting a cup point

1. Choose a cup point suitable for the sample. Please note the following:
   - The cup point should be as large as possible, but smaller than the outer diameter of the sample.
   - The bevel must be on the inside, when putting a concave surface on the cup point.

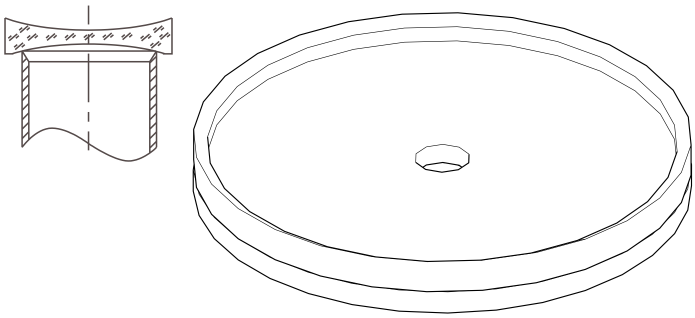


Fig. 15-3

   - The bevel must be on the outside, when putting a convex surface on the cup point.

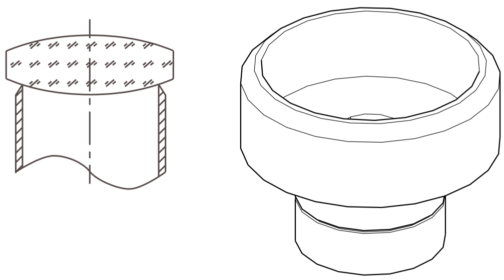


Fig. 15-4

NOTE!

If you produce your own cup points, please refer to the attached drawings. Suitable material is Delrin or Teflon.

2. Lock the pivot arm with the lever **2**.

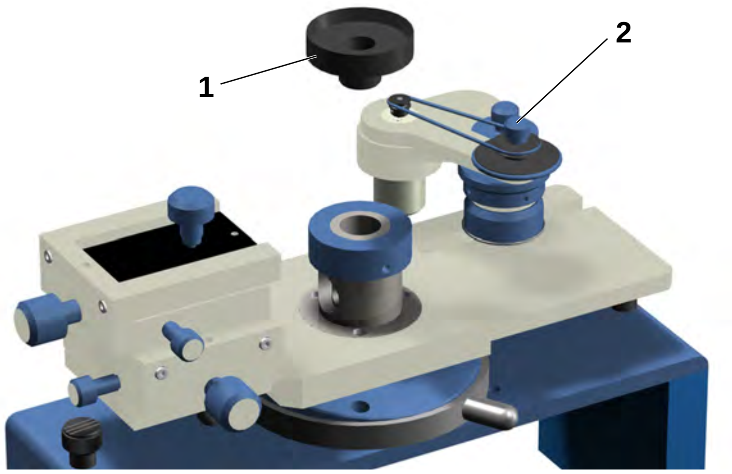


Fig. 15-5

3. Insert the cup point **1**.

15.5 Placing and aligning the sample

1. Place the sample onto the cup point.

> **NOTE!**
>
> The optical surface to be measured must be in **top** position when measuring in reflexion.

2. Switch the vacuum control unit on.

   The button **1** will turn green.

Fig. 15-6

3. Loosen the thumb screw **3** and push the V-blade **4** until it touches the lens. Re-tighten the thumb screw.

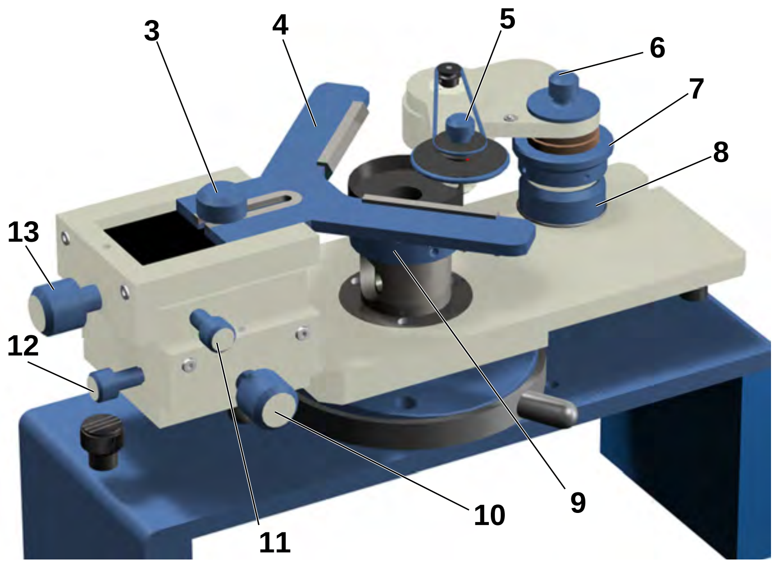


Fig. 15-7

4. Loosen the thumb screws **11** and **12** and adjust the adjusting screws **10** and **13** until the lens is visually centered to the V-blade and the cup point. Re-tighten the thumb screws.
5. Use the thumb nut **9** (Up/Down) to adjust the height of the cup point until the cutting edge has reached the center of the lens' outer surface.
6. Loosen the pivot arm.
7. Adjust the adjusting nut **7** until the friction wheel reaches the center of the lens' outer surface.
8. Loosen the thumb nut **8** and move the pivot arm as a complete unit until the V-blade **4**, the sample and the handle **5** are in one line. Retighten the thumb nut.

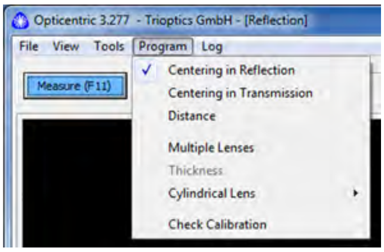
15.6 Selecting the head lens

– Choose an auxiliary lens suitable for the sample.

> **NOTE!**
>
> Please note chapter 6.9 "Selecting the head lens", page 69.

15.7 First measurement

1. Log in as Supervisor (see chapter 6.5, page 65).



2. Select `<Program> <Centering in Reflexion>`.
3. Focus the surface (see chapter 6.8, page 66).

   If the intensity distribution is off center (see Fig. 15-8), you must adjust either the sample or the head lens.

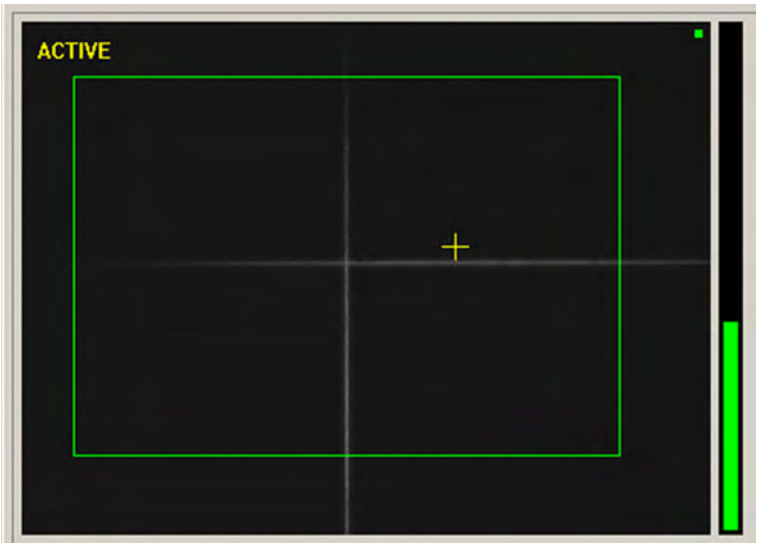
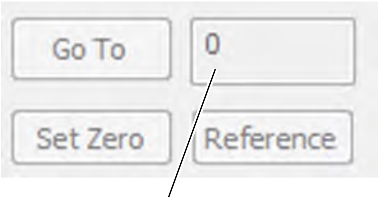


Fig. 15-8: Example: Intensity distribution off center

4. Click `Set Zero`.

5. Confirm the prompt with `Yes`.

   The current position is set as the zero position.



1

6. Focus the center of curvature of the surface.

   Use the arrow keys to do this.

   Or:

   Enter the radius in field **1** and click `Go To`.

> **NOTE!**
>
> When reflexion is low, it is advisable to set the shutter to the maximum speed. Reduce the shutter speed once the crosshair was found.

7. To prevent the air bearing from turning, tick the checkmark for "Manual Rotation".

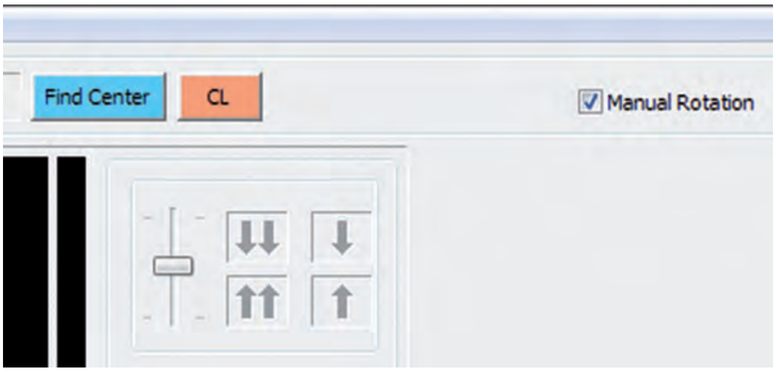


Fig. 15-9

8. Start the motor on the vacuum control unit.

   The button **3** will turn green.

9. To change the speed, turn the speed button **4**.

Fig. 15-10

10. Turn on the vacuum and check that the lens rotates smoothly.
    - If the rotation is uneven, increase the vacuum pressure.
    - If the lens rotation slows down, decrease the vacuum pressure.

11. To start the measurement, click **Measure (F11)**.

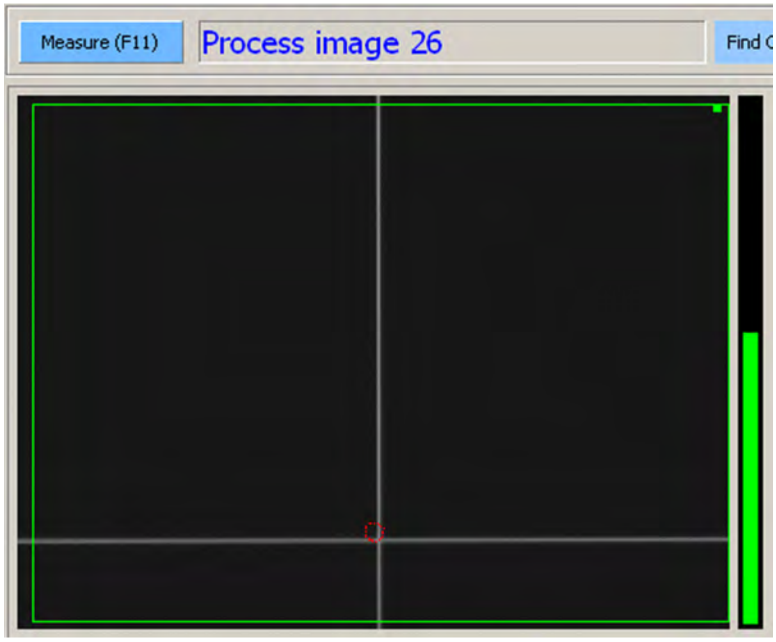
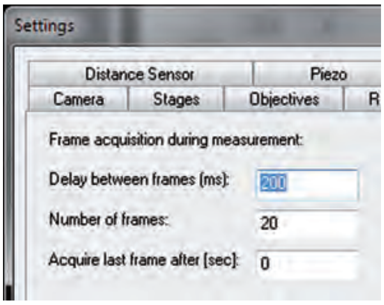


Fig. 15-11

If the result is not shown in the center of the camera image, you need to adjust the head lens.



If the measurement does not produce a full circle, increase the number of recorded frames or change the rotation speed.

- Log in as an administrator.
- Select `<Tools>` `<Settings>` and then the tab `<General>`.
- Enter a higher value in the field `Number of frames`.
- Repeat the measurement.

15.8 Conducting further measurements

1. Turn off the motor.
2. Lock the pivot arm.
3. Place the sample onto the cup point.
4. Loosen the pivot and swing it in.
5. Turn on the motor.
6. Click **Measure (F11)**.

16. Centration Errors in Aspherical Lenses

In contrast to spherical surfaces, rotationally symmetrical aspherical surfaces have an axis of symmetry. The aim of centration error measurement is therefore to determine to location of this axis of symmetry to the reference axis.

To do this, for an aspherical surface the following two values (each with an x and y component) must be determined:

- The shift of the paraxial center of curvature to the reference axis
- The angle of the aspherical axis of symmetry to the reference axis

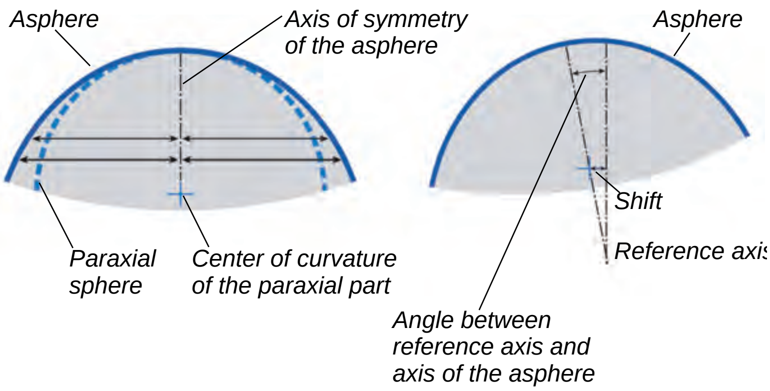


Fig. 16-1: Design of an aspherical lens

The shift corresponds to the classic centration error of spherical surfaces and is measured in the same way by the electronic autocollimator.

An additional sensor is needed to measure the angle of the aspherical lens – the AspheroCheck® by TRIOPTICS. This measures the runout at the outer edge of the aspherical surface.

Once the shift and the angle of the aspherical surface have been determined, these data can be used to calculate the following parameters:

- Distance and tilt of the asphere with respect to the primary reference axis of the measurement system (equivalent to the axis of rotation)
- Distance and tilt of the asphere with respect to the optical axis of a single lens. The optical axis is the line passing through the centers of curvature of the spherical parts of the lens.
- Where the lens has two aspherical surfaces: the angle and distance of both asphere axes.

NOTE!

Please refer to the separate documentation for the AspheroCheck module, which describes its operation and the additional software functions.

17. Software

17.1 The program windows

The program window opens after the software has been launched.

NOTE

The illustrations in this section show software version OptiCentric 3.277.

If you are using a different software version, it may look slightly different.

The windows vary depending on the selected program.

Program window "Centering in Reflection"

This mode measures the wobble of a plane face and the centration error of a spherical (lens) surface.

The exact procedure is described under Chapter 7. "Centration error Measurement in Reflection".

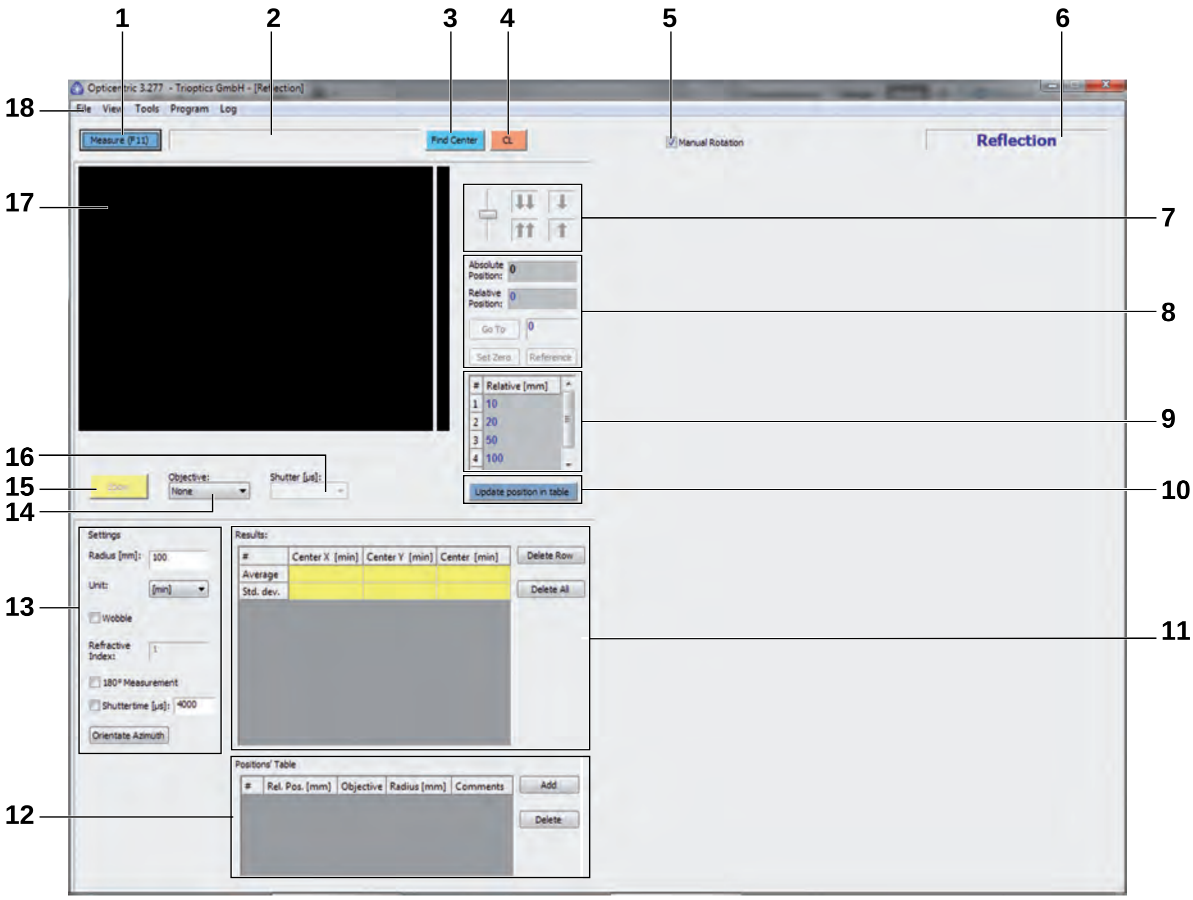


Fig. 17-1

1	Button `Measure F11` Start measurement
2	Status bar Displays information about the movements and measurements currently being executed by the measurement system.
3	`Find Center` button Rotate the air bearing by 360° to find the center of the circle radius of the reflection.
4	`CL` button Only for TRIOPTICS employees

5	`Manual rotation` Tick the checkmark for measuring lenses with a rotary device and a vacuum or when the air bearing is rotated by hand Deselect the checkmark for measuring with motorized air bearing
6	Display of the selected measurement program
7	Arrow keys for moving the measuring head
	 Double arrow: Moves the measuring head up or down quickly
	 Single arrow: Moves the measuring head up or down slowly
	 Slider: Change velocities. Slider to the top = maximum velocity
8	`Absolute position:` Distance to the absolute zero position of the measurement system (uppermost position of the linear stage)
	`Relative position:` Distance from the defined zero position
	`Go To` button The linear stage is moved to the specified position (relative to the set zero position).
	Input field for `Go To` button
	`Set Zero` button Set current measurement head position as the zero position
	`Reference` button (no function)
9	`Rel. Pos. [mm]` 5 relative positions may be entered in this table and selected by double clicking the row number.
10	`Update position in table` button (without function here; only used in measurement program "MultiLens")

11	Results: Displays the results of a measurement
	Delete Row button: Deletes the selected row in the results list.
	Delete All button: Deletes all rows in the results list.
12	Positions Table An unlimited number of relative positions with radius specification (sample), the selected head lens and comments may be entered in this table and selected by double clicking the row number. The table can be saved (<File> Config> <Save>).
	Add button: Adds one row
	Delete button: Deletes the selected row
13	Settings
	Radius [µm] input field: Lens radius (without test surface)
	Option menu Unit: Units for the results (µm, mm, min, sec)
	Wobble Tick the checkmark for measuring the wobble of a test surface
	Display Deviation Cross: (not yet implemented)
	Refractive Index: (without function here)
	180° Measurement Tick the checkmark for a 180° measurement
	Shutter time [µs] input field: Tick the checkmark to select the exposure time of the camera entered here (this only makes sense if both camera windows are active and the measurement is supposed to use two different exposure times).
	Orientate azimuth: When a lens is to be aligned in the mount, the specimen is turned after the measurement so that it only has to be moved in the X direction.
14	Option menu Objective: List of available objective lenses. Input via <Settings> <Objectives>.
15	Zoom / + button – Click the button Zoom or + to increase the area of interest (AOI) to the entire camera image area. The camera window will display "ZOOM". The button changes to –. – Click the button – to undo the magnification. The button changes to +.
16	Shutter [µs]: Display of the exposure time of the camera in µs Select the exposure time from the list

17	Camera image
18	Menu bar

Program window "Centering in Transmission"

This mode measures the total centration error of multi-lens optical systems.

The exact procedure is described under Chapter 8. "Centration error Measurement in Transmission".

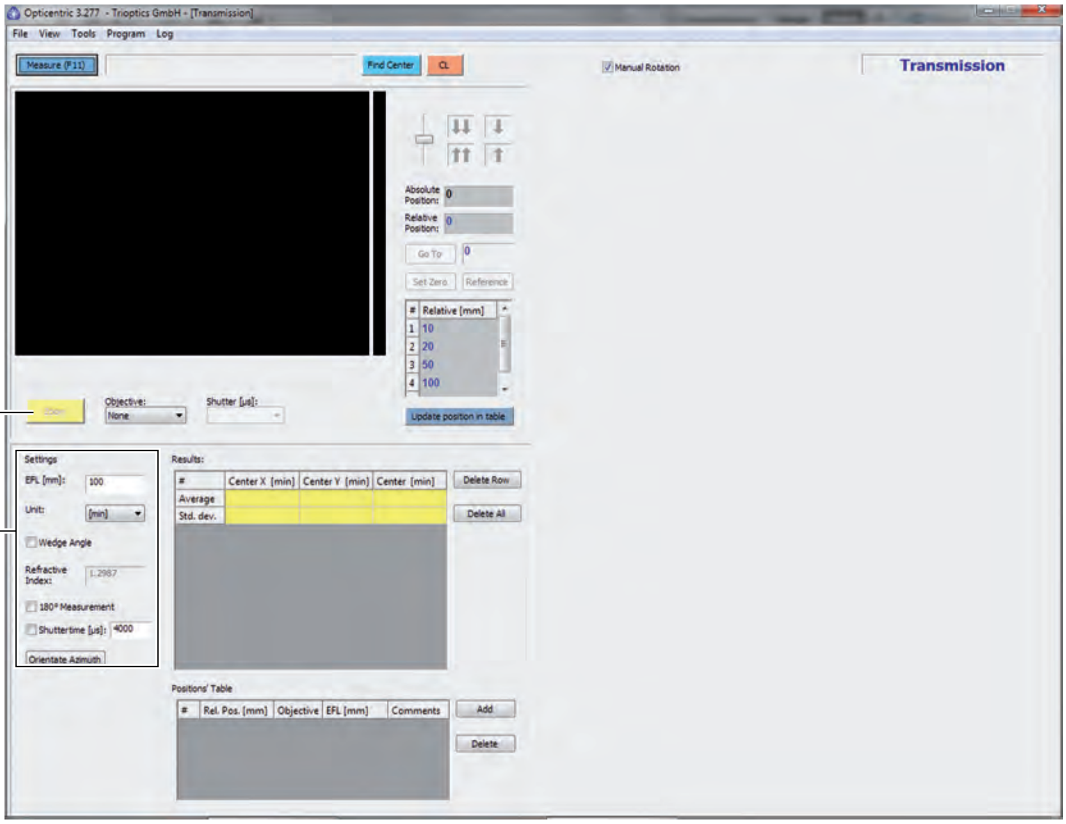


Fig. 17-2

1	`Settings`
	Input field `EFL [mm]`: Effective focal length of the sample (design value)
	Option menu `Unit`: Units for the results (µm, mm, min, sec)
	`Wedge Angle`: Tick the checkmark for measuring wedge errors (plano optics) in transmission
	Input field `Refractive Index:` Refractive index n_e of the material (enabled when selecting Wedge Angle)
	`180° Measurement`: Tick the checkmark for a 180° measurement
	Input field `Shutter time` Tick the checkmark to select the exposure time of the camera entered here (this only makes sense if both camera windows are active and the measurement is supposed to use two different exposure times).
	`Orientate azimuth:` When a lens is to be aligned in the mount, the specimen is turned after the measurement so that it only has to be moved in the X direction.
2	+ button – Click the button + to increase the area of interest (AOI) to the entire camera image area. The camera window will display `ZOOM`. – Click the button – to undo the magnification.

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

Program window "Distance"

This mode measures radii, for example.

The exact procedure is described under Chapter 9. "Measurement of Radii".

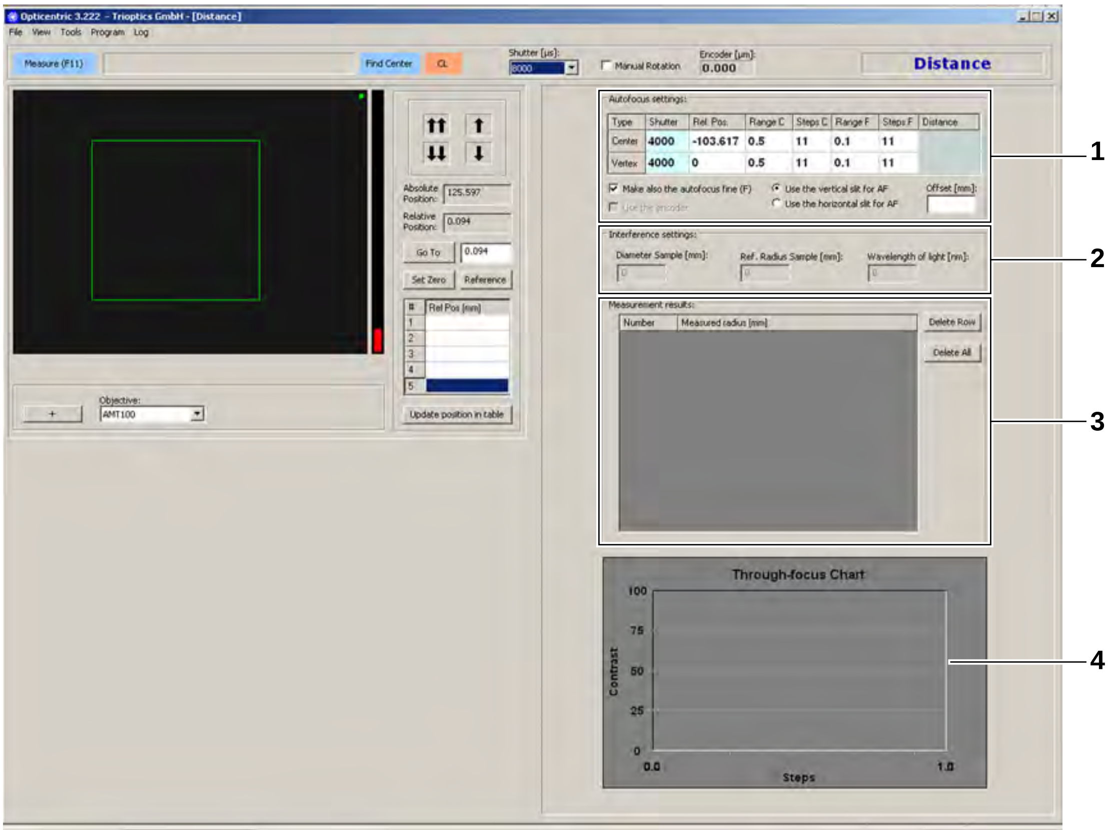


Fig. 17-3

1	Autofocus settings
	Type Center: Information on the center of curvature of the lens Vertex: Information on the surface point/apex point Shutter Exposure time Rel.Pos. Relative position Range C Autofocus area for coarse scan Steps C Number of measurement steps for coarse scan Range F Autofocus area for fine scan Steps F Number of measurement steps for fine scan Distance
	Make also the autofocus fine (F) Checkmark ticked: A fine scan is performed after the coarse scan.
	Use the encoder Checkmark ticked: Position measurement of the measurement head position with external encoder (optional)
	Use the vertical slit for AF Selected: The vertical slit is used for the autofocus.
	Use the horizontal slit for AF Selected: The horizontal slit is used for the autofocus.
	Offset [mm] Offset
2	Interference Settings: additional output for circular radius measurement; can be activated under <Tools> Settings> <General> <Calculate Interference Ring>
	Diameter Sample [mm]: Lens diameter
	Ref. Radius Sample [mm]: Nominal radius
	Wavelength of light [nm]: Wavelength, typically 633 nm
3	Measurement Results (Display of the measurement results)
	Delete Row button: Deletes the selected row in the results list.
	Delete All button: Deletes all rows in the results list.
4	Through-focus Chart Autofocus curve showing the best focus position

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

Program window "MultiLens"

This mode precisely measures centration errors of the individual areas within multi-lens optical systems.

The exact procedure is described in Chapter 10. "Preparation for a MultiLens® Measurement" and Chapter 11. "Conducting a MultiLens® Measurement".

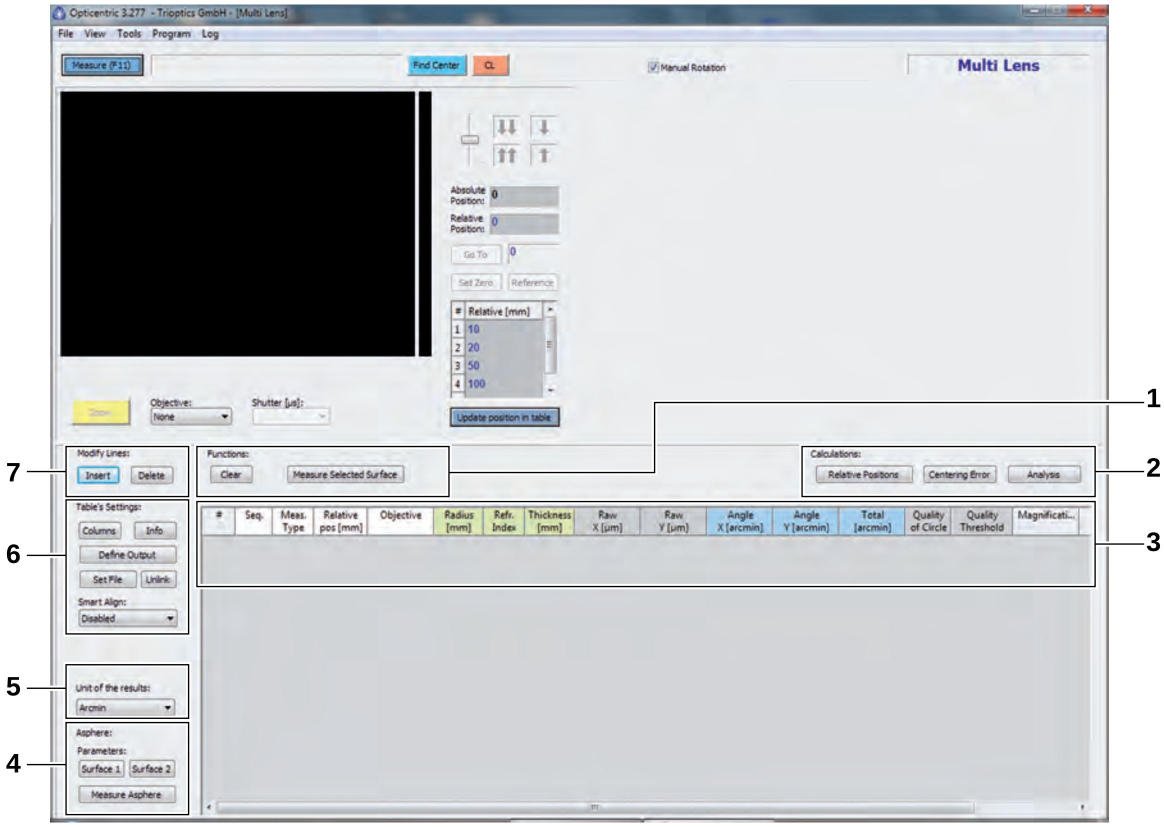


Fig. 17-4

1	`Functions:`
	`Clear` button: Deletes the results
	`Measure Selected Surface` button: Single measurement of the selected area/row of the design table
2	`Calculations:`
	`Relative Positions` button: Calculate relative positions
	`Centration error` button: Calculates centration errors, for example after a single surface was subsequently measured via `Measure Selected Surface`
	`Analysis` button: Starts the Advanced Analyzer, check results
3	Design table

4	`Asphere:`
	Parameters `Surface 1` button: Opens an input window for the parameters of the aspheres of the first surface `Surface 2` button: Opens an input window for the parameters of the aspheres of the second surface `Measure Asphere` button: Starts the measurement
5	`Unit of the results:`
	Option menu for selecting the unit of the results (µm or arcmin)
6	`Table Settings:`
	`Columns` button: Opens windows for selecting the parameters to be displayed in the design table
	`Info` button: Shows the path of the design file
	`Define Output` button: Defines which result is provided in the certificate
	`Link Analysis Settings` button: Combines a settings file of the program Advanced Analyzer with the design file of the OptiCentric software

	`SmartAlign option menu:`
	`Disabled`
	`Optical Axis`
	`To Second Surface`
	`To User Defined Axis`

7	`Modify Lines:` `Insert` button: Adds a row to the design table `Delete` button: Deletes the selected row from the design table

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

Program window "Thickness"

This mode measures airspaces and lens thicknesses.

The exact procedure is described under Chapter 13. "Measurement of Lens Thicknesses and Air Gaps".

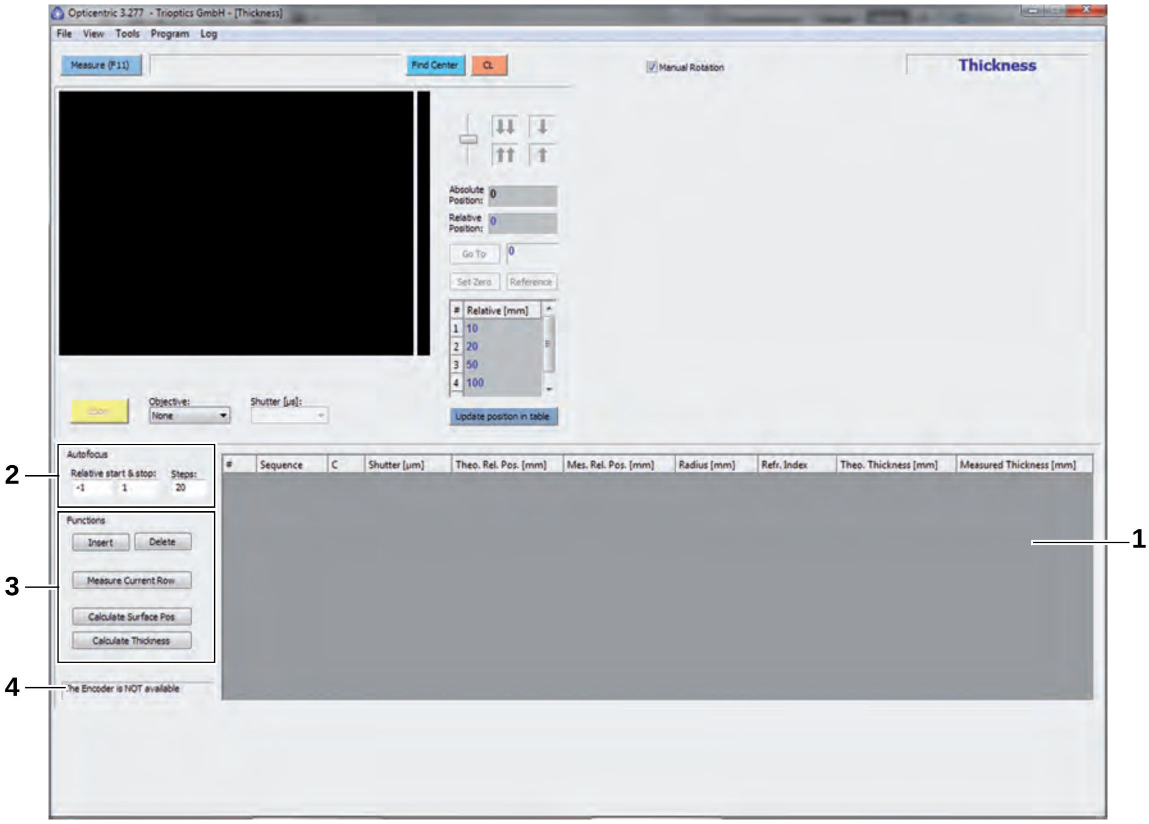


Fig. 17-5

1	Position table can be loaded from MultiLens
2	`Autofocus` `Relative start & stop:` Autofocus range `Steps:` Number of measurement steps
3	`Functions`
	`Insert` button: Inserts a row
	`Delete` button: Deletes a row
	`Measure Current Row` button: Measures the selected row
	`Calculate Surface Pos` button: Calculates the surface position
	`Calculate Thickness` button: Calculates the distance and/or the center thickness
4	Indicates if the (optional) linear encoder is properly connected

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

Program window "Cylindrical Lens, Tilt with Respect to Edge"

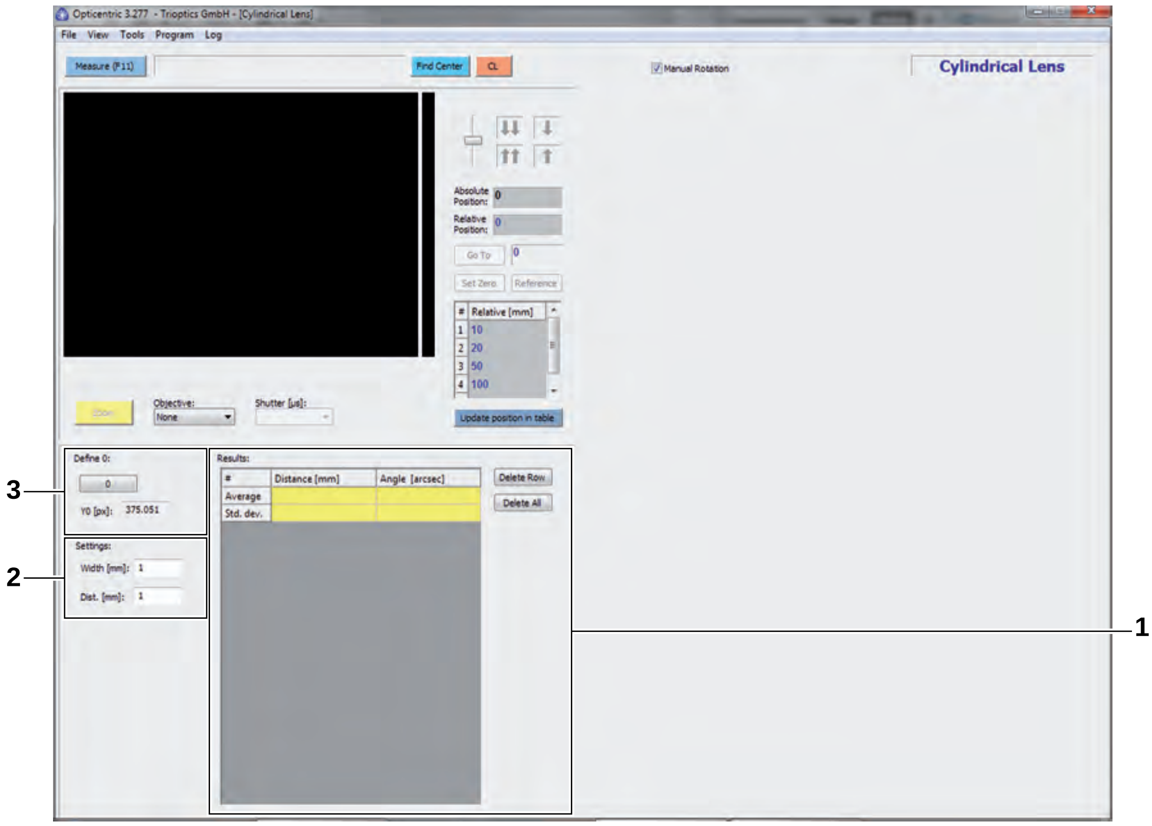


Fig. 17-6

1	`Results:` Displays the results of a measurement
	`Delete Row` button: Deletes the selected row in the results list.
	`Delete All` button: Deletes all rows in the results list.
2	`Settings:`
	`Width [mm]`: exact width of the master specimen
	`Dist. [mm]`: Distance between two measuring points
3	`Define 0:` Starts calibration with master sample
	0 button
	`Y0 [px]`: Output of the position of the zero line in pixels

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

Program window "Cylindrical Lens, Tilt with Respect to Bottom Surface"

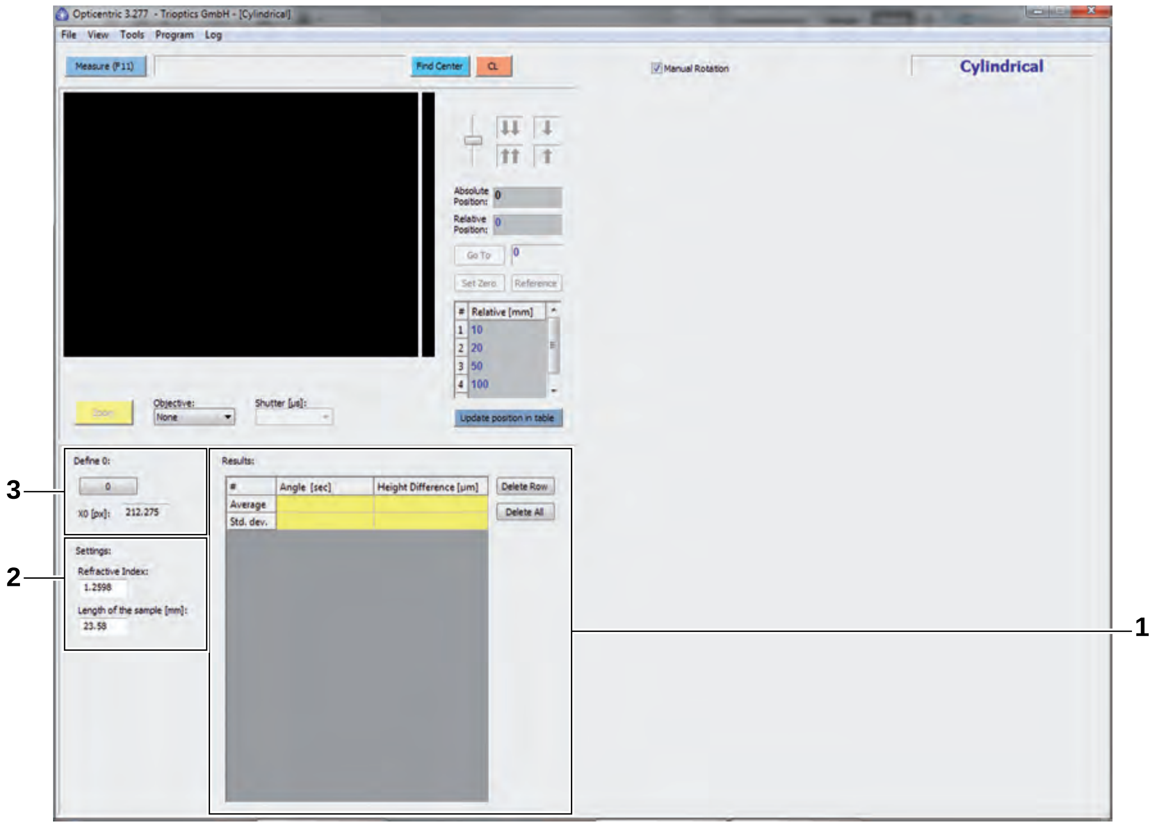


Fig. 17-7

1	`Results:` Displays the results of a measurement
	`Delete Row` button: Deletes the selected row in the results list.
	`Delete All` button: Deletes all rows in the results list.
2	`Settings:`
	`Refractive Index:` Refractive index n_e of the sample at 546 nm
	`Length of the sample [mm]:` Length of the sample
3	`Define 0`
	Button `0`: Determines the position of the reflected reticle (reference) in absence of a sample
	`Y0 [px]`: Output of the zero position in pixels (only for informational purposes)

> **NOTE**
>
> All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

"Cylindrical Lens, Clocking Angle of Single Surface" program window

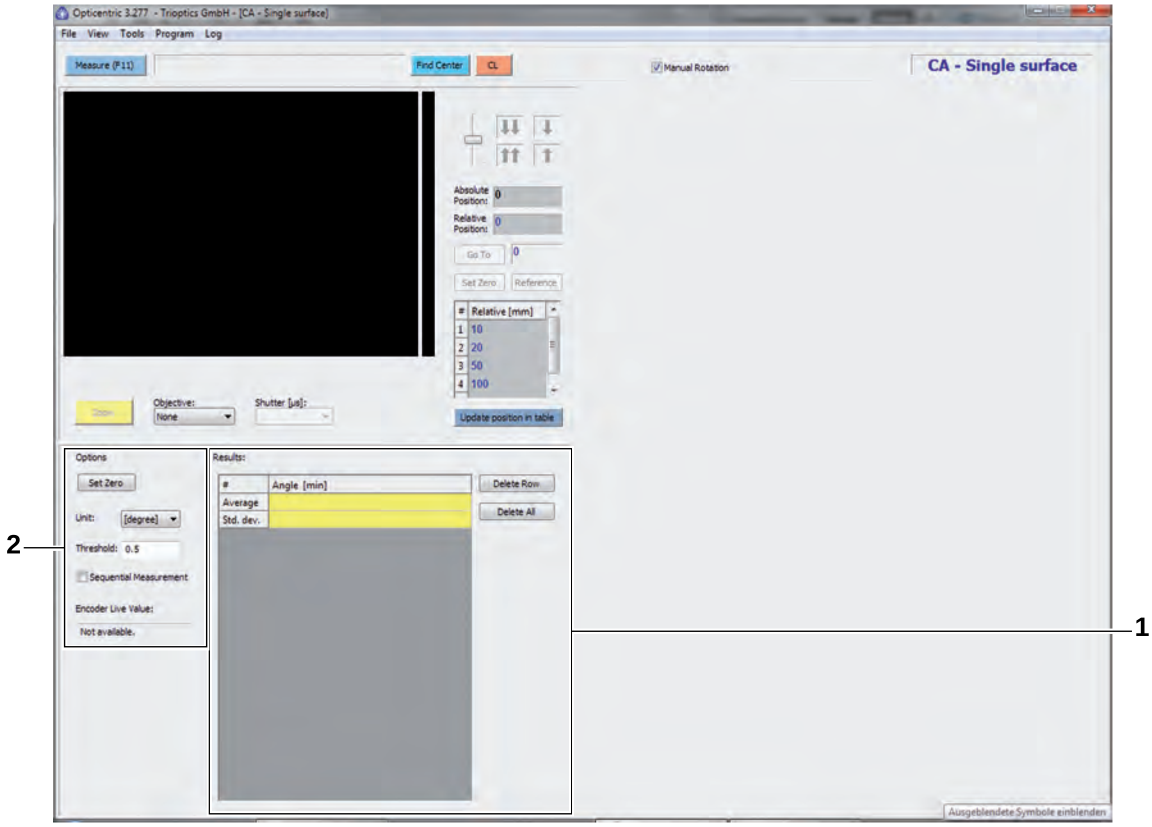


Fig. 17-8

1	`Results:` Displays the results of a measurement
	`Delete Row` button: Deletes the selected row in the results list.
	`Delete All` button: Deletes all rows in the results list.
2	`Options`
	`Set Zero` button: The current cylinder orientation is used as a reference.
	`Unit:` Unit of the displayed angle
	`Threshold:` Limit value

	`Sequential measurement:` no function with "Single Surface" measurement
	`Encoder Live Value:` Displays the position of the rotary table

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

"Cylindrical Lens, Clocking Angle between two Cylinders" program window

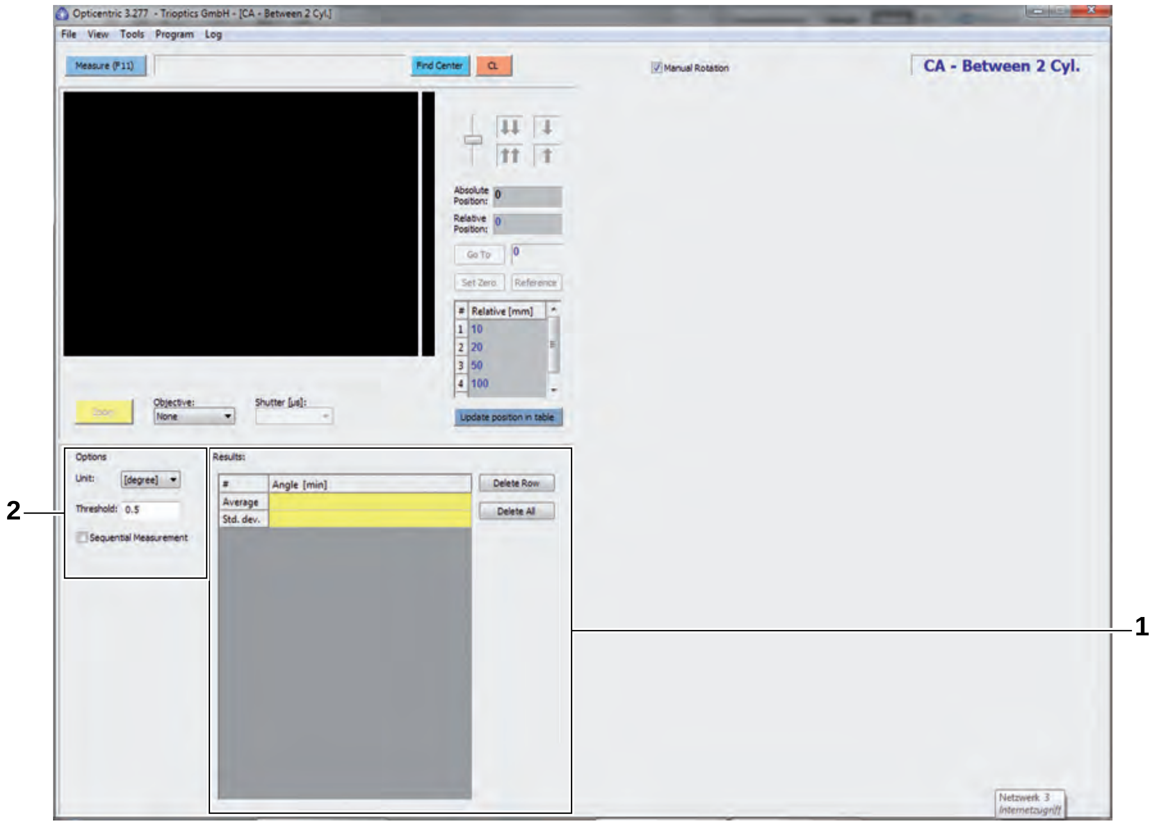


Fig. 17-9

1	`Results:` Displays the results of a measurement
	`Delete Row` button: Deletes the selected row in the results list.
	`Delete All` button: Deletes all rows in the results list.

2	`Options`
	`Unit:` Unit of the displayed angle
	`Threshold:` Limit value
	`Sequential measurement:` Checkmark ticked: The measurements with the top and bottom collimator are performed sequentially (e.g. if the images overlap during simultaneous measurement).

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

Program window "Check Calibration"

This mode checks the calibration of the measurement system.

The exact procedure is described in Chapter 18.2 "Calibrate the measurement system".

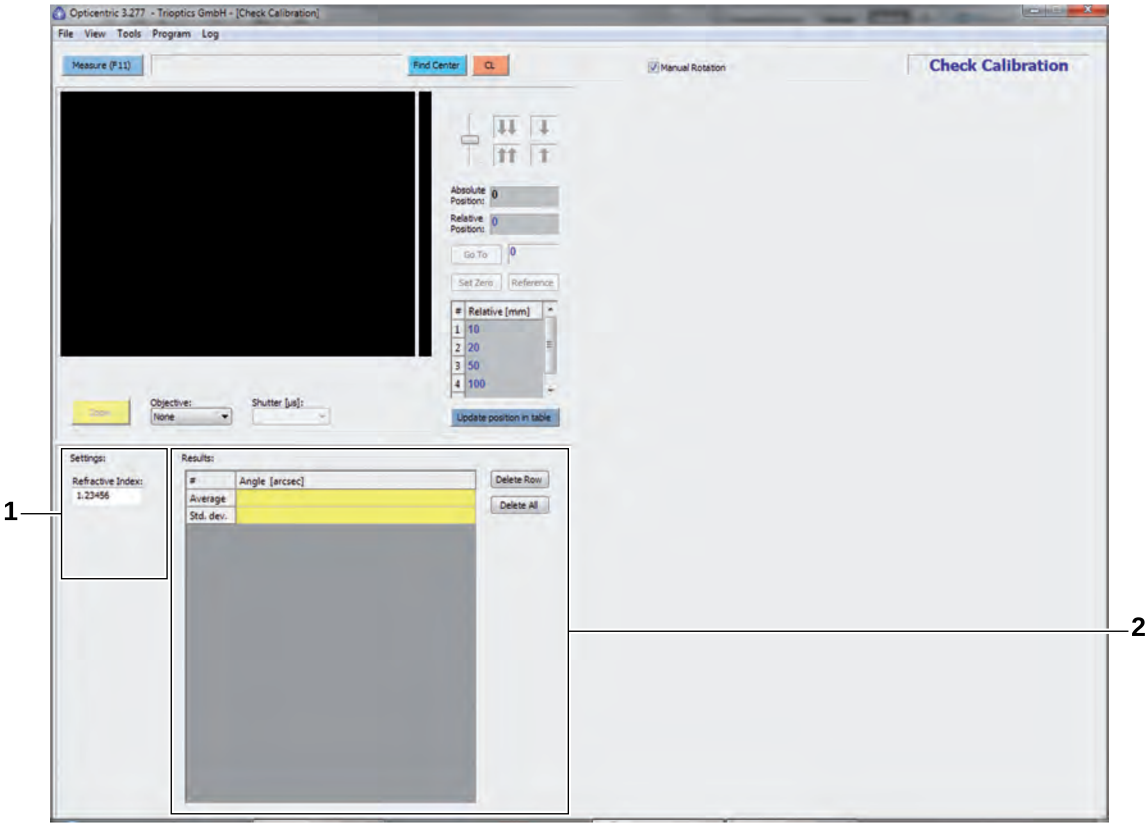


Fig. 17-10

1	`Settings`
	`Refractive Index:` Enter the refractive index n_e of the wedge
2	`Results:` Displays the results of a measurement
	`Delete Row` button: Deletes the selected row in the results list.
	`Delete All` button: Deletes all rows in the results list.

NOTE

All buttons and displays not explained here are identical to those for the program window for "Centering in Reflection" (see page 148).

17.2 The camera view and the context menu in the camera view

– Click the right mouse button in the camera window to open the context menu.

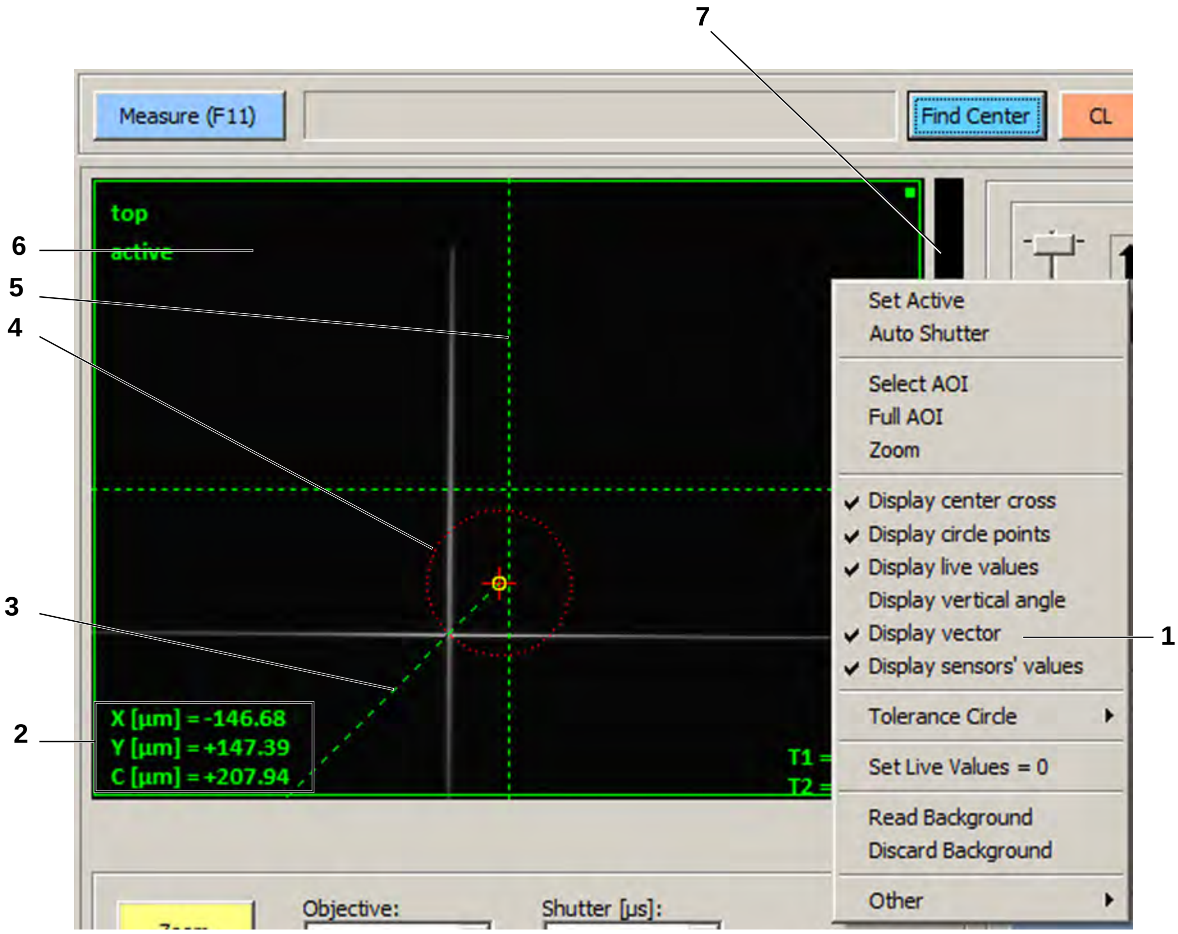
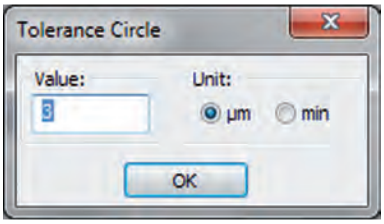


Fig. 17-11

1	Context menu in the camera window
	`Set Active`: Selects active camera window (if there are several windows available)
	`Auto Shutter:`
	`Select AOI`: Changes the area of interest (AOI) **6**
	`Full AOI`
	`Zoom`: Enlarge view (AOI) to the size of the measurement window
	`Display center cross`: Displays the center of the camera **5**
	`Display circle points`**:** Displays the measuring points of the centration error measurement
	`Display live values`: Displays the current readings **2** in the camera window
	`Display vertical angle`: Only for TRIOPTICS staff, for aligning the camera
	`Display vector`: Display vector **3**.
	Display sensor's value:
	`Tolerance circle` `Display:` Displays the tolerated centration error **4** `Change Value:` Changes the tolerance 
	`Set live values = 0`: Resets live values to "0"
	`Read Background:` Reads background
	`Discard Background:` Discards background

	`Other`
	`Adjust Using Smart Align (Yellow Cross):` Adjusts the center of curvature to the calculated axis
	`Adjust To Rotation Axis:` Adjusts the center of curvature to the rotation axis
	`Store Cross Position:` Saves the current cross position
	`Discard Cross Position`: Discards the current cross position
	`Save Image`: Saves the camera image
	`Switch Cameras:`

2	`Live values` `X:` Current centration error in direction of the X-axis `Y:` Current centration error in direction of the Y-axis `C:` Total error

3	Vector indicating the location of the centration error in relation to the coordinate system
4	Tolerance circle
5	Center Cross
6	Area of interest During measurement the reticle must remain within the area of interest (AOI) at any time. Please note: The reticle may move out of the AOI while rotating when measuring large centration errors.
7	Bar graph of light intensity in the measurement window (AOI) Green readout when saturation level within the predefined limits Red readout if saturation level exceeded or not reached

17.3 User rights

Some software functions are only available to the supervisor or the administrator.

Unavailable functions are shown in gray and cannot be selected (see figure below).

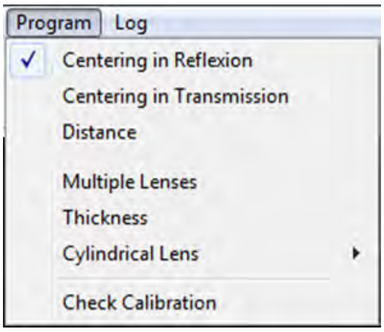


Fig. 17-12

17.4 Menu bar

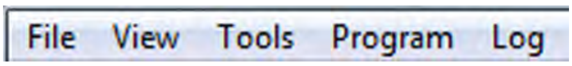


Fig. 17-13

The menu bar contains several menus from which submenus or functions can be invoked.

17.5 <File> menu

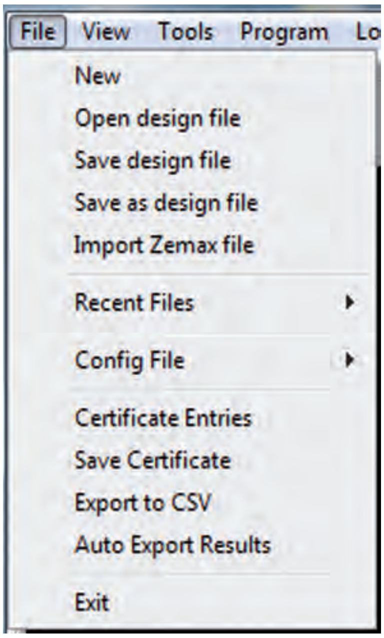


Fig. 17-14

New

Creates a new design file (.df) (for the measurement programs MultiLens® and Thickness)

> **NOTE**
>
> The command `<File> <New>` deletes all current design data, results and certificates.

Open design file

Opens the design file (.df)

Please consult chapter 11.2 "Conducting measurements", page 104 for a detailed description.

Save design file

Saves the design file

Save as design file

Saves the design file under a new name (.df)

Import Zemax file

Imports a Zemax file (.zmx)

Recent Files

Displays recently opened design files

Config File

Open: Opens the configuration file (for measurement programs "Reflection" and "Transmission")

Save: Saves the configuration file

Certificate entries

Opens the `Certificate Entries` window.

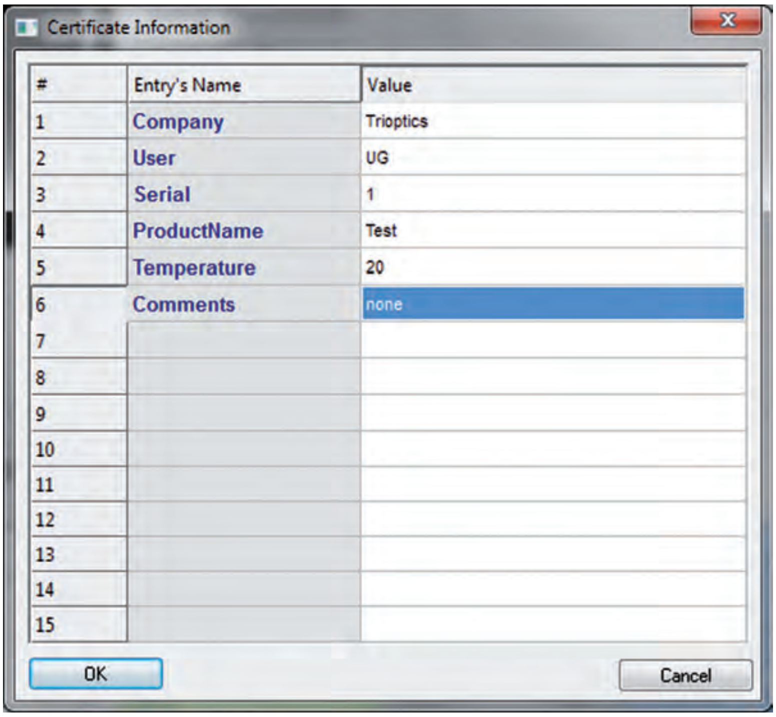


Fig. 17-15: Example for certificate entries

> **NOTE**
>
> The columns "Entry name" and "Value" are free text fields. The maximum number of rows is 15.

Save Certificate

Saves measurement results in an HTML file (.mht)

Export to CSV

Saves measurement results in table format .csv (for use in Excel, for example)

Auto Export Results

Automatically save all measurement values in a file.

1. Tick the checkmark by `Auto Export Results`.
2. Select `Certificate Entries` and click `OK`.
3. Perform the measurements.

   This creates a text file whose name is assigned automatically and which includes the date and the serial number of the measurement system.
   Example: 20131119_4-151-008.txt

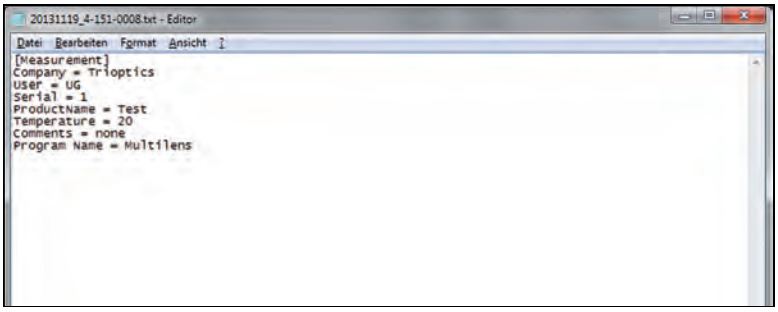


Fig. 17-16

Exit

Exits the program. The following data are stored and recalled the next time the program starts:

- the selected measurement program
- any changed settings
- the appearance and position of windows and menus

17.6 <View> menu

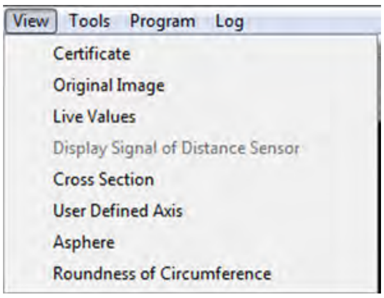
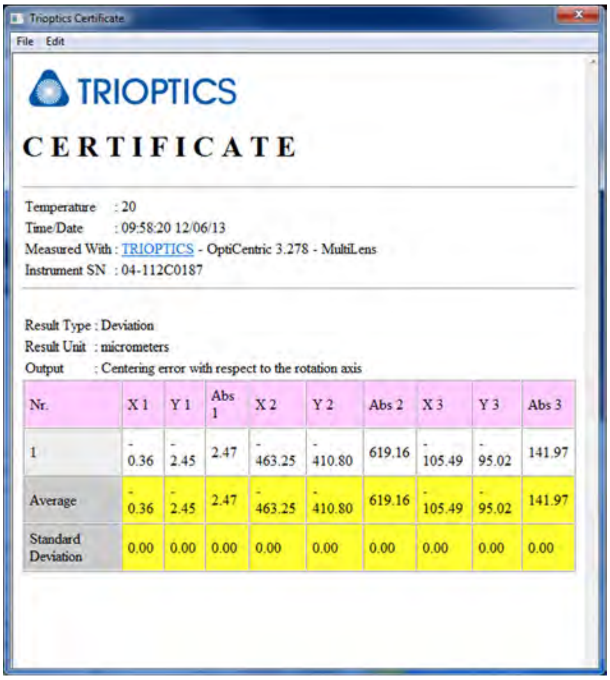


Fig. 17-17

Certificate

Displays the certificate



Trioptics Certificate

File Edit

TRIOPTICS

CERTIFICATE

Temperature : 20
Time/Date : 09:58:20 12/06/13
Measured With : TRIOPTICS - OptiCentric 3.278 - MultiLens
Instrument SN : 04-112C0187

Result Type : Deviation
Result Unit : micrometers
Output : Centering error with respect to the rotation axis

Nr.	X 1	Y 1	Abs 1	X 2	Y 2	Abs 2	X 3	Y 3	Abs 3
1	-0.36	-2.45	2.47	-463.25	-410.80	619.16	-105.49	-95.02	141.97
Average	-0.36	-2.45	2.47	-463.25	-410.80	619.16	-105.49	-95.02	141.97
Standard Deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Fig. 17-18

Original Image

Displays the camera image at full screen size

Live Values

Additional window for displaying live values in large numbers

Display Signal of Distance Sensor

Display signal for the distance sensor

Cross Section

Representation of the intensity profile in X and Y direction across the area of interest (AOI)

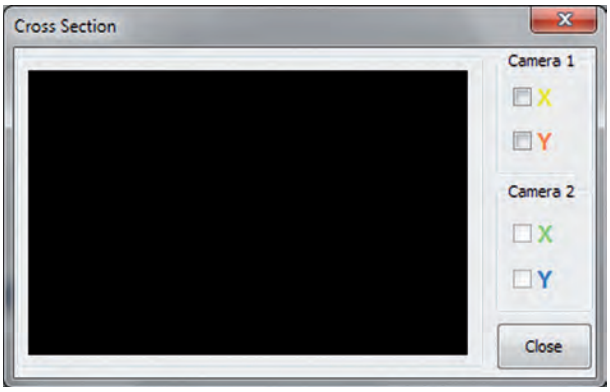


Fig. 17-19

User Defined Axis

Control box for the sensor, is used for determining a reference axis (for the mechanical mount of a sample, for example) for a MultiLens® measurement

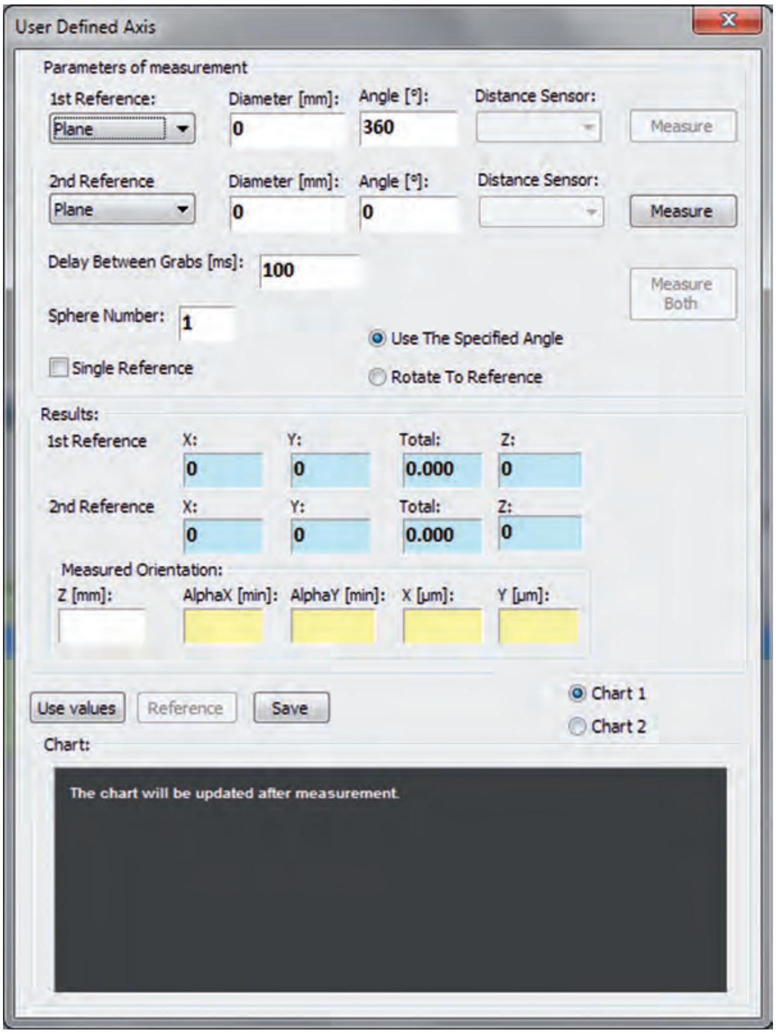


Fig. 17-20

Asphere

Dialog for extended asphere measurement

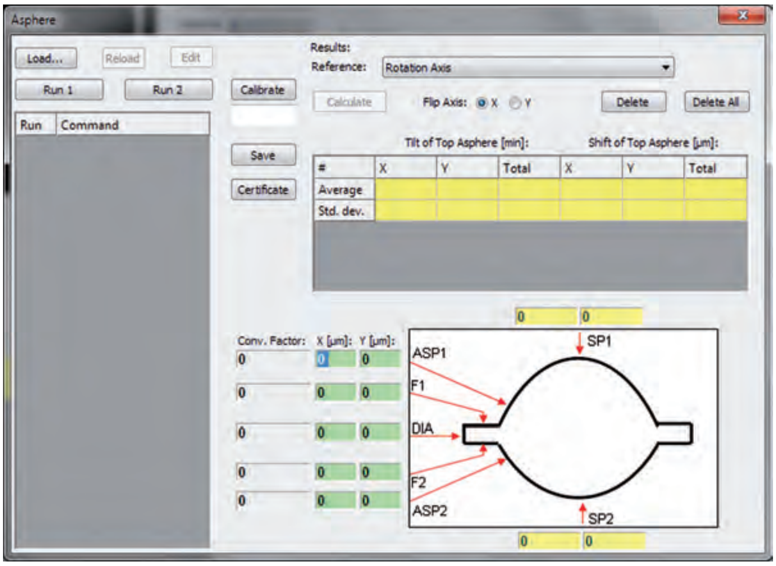


Fig. 17-21

Roundness of Circumference

Dialog for testing the roundness of the lens and housing circumference

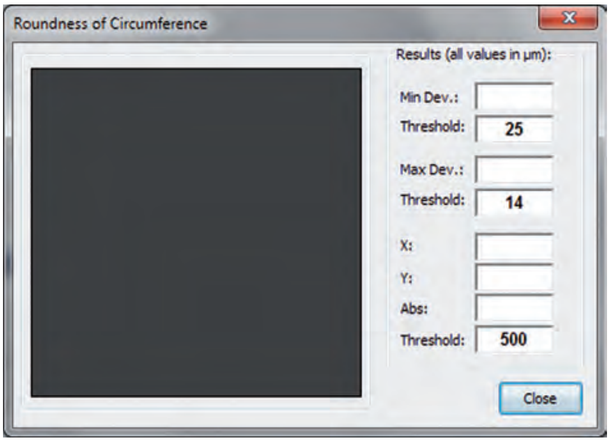


Fig. 17-22

17.7 <Tools> menu

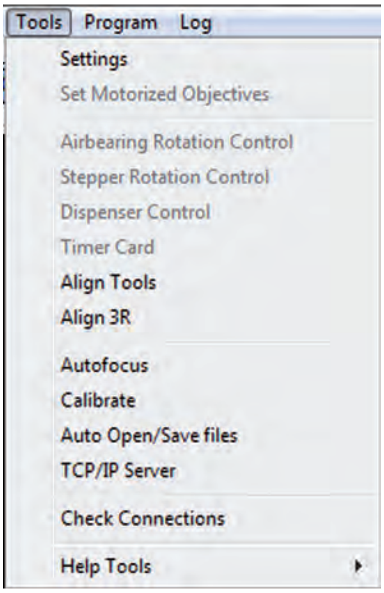


Fig. 17-23

Settings

Opens the `Settings` window.

- `Camera` tab

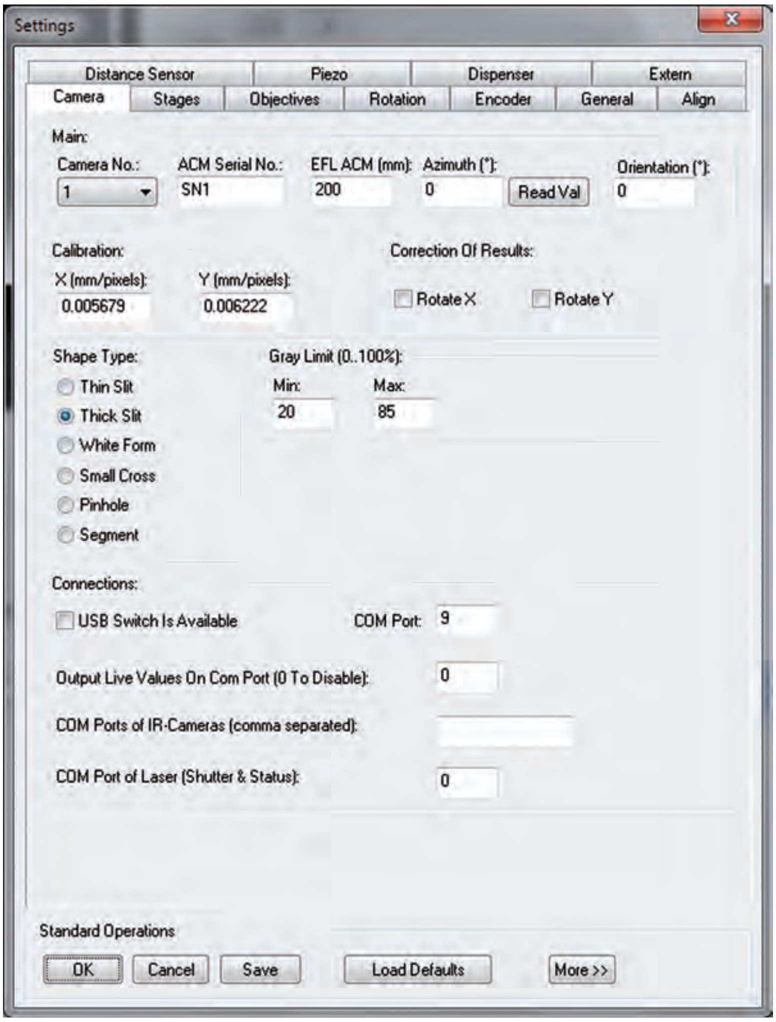


Fig. 17-24

`Main`	
`Camera No.:`	Select the camera for which the settings are made 1: top camera 2: bottom camera
`ACM Serial No.:`	Serial number
`EFL ACM (mm)`	Enter effective focal length of the autocollimator
`Azimuth (°)`	Rotation of the two autocollimators to each other
`Read Val`	Read current value
`Orientation`	

Calibration: X(mm/pixels): Y(mm/pixels):	 Value from calibration (applied automatically) Value from calibration (applied automatically)
Correct Results Rotate X Rotate Y	(only for service staff)
ShapeType Thin Slit Thick Slit White Form Small Cross Pinhole Segment	Algorithm for cross recognition
Gray Limit (0..100%) Min: Max:	Bar graph of light intensity in the area of interest (AOI) turns red if the saturation falls below `Min.` or rises above `Max.`
Connections	
USB Switch Is Available	Enable USB
COM Port	COM port
Output Live Values On COM Port (0 To Disable)	Enable live values output
COM Ports Of IR-Cameras (comma separated)	COM ports of the IR camera (only with OC IR)
COM Port of Laser (Shutter & Status)	COM port for laser shutter and status
Standard operations OK Cancel Save Load Defaults More>>/Hide<<	 Accept changes, but do not save Cancel, changes are not applied Apply and save changes Load default values Expand/hide window

`Customer's Configuration File`	
`Load`	Load customized configuration file
`Save`	Save customized configuration file

- `Stages` tab

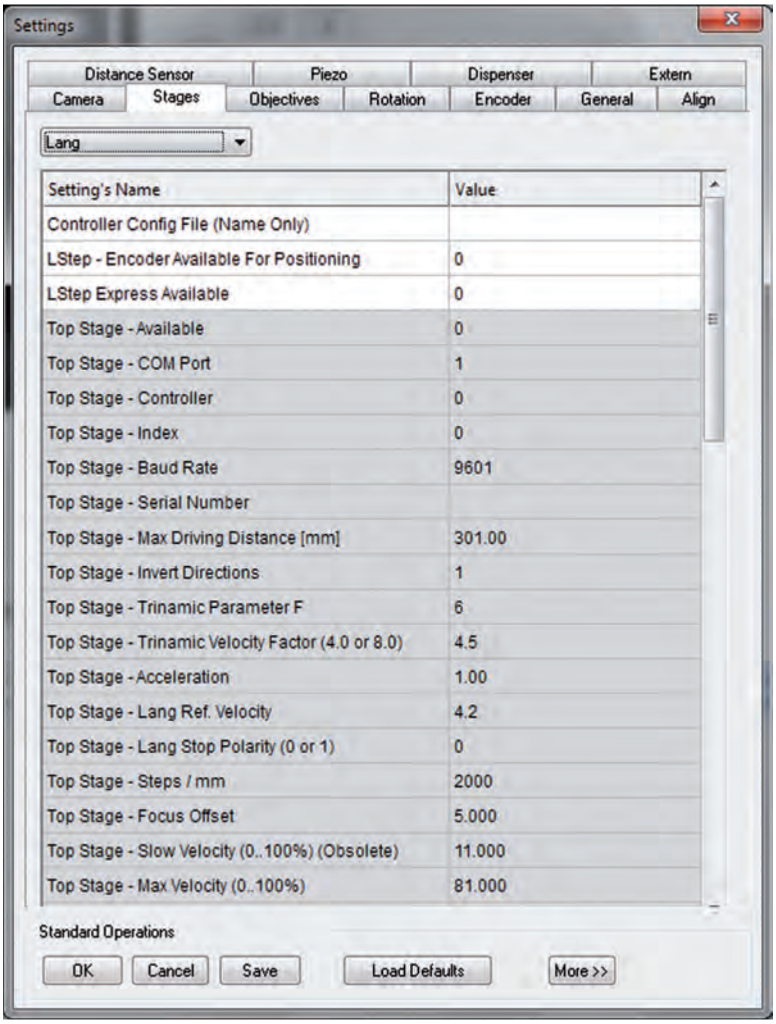


Fig. 17-25

Option menu	Select the stage for which the settings are made
`Setting's Name`	Setting
`Value`	Value

NOTE

This section is used for defining general settings for motors and drives.
Do not modify the settings without consulting TRIOPTICS.

- `Objectives` tab (head lenses)

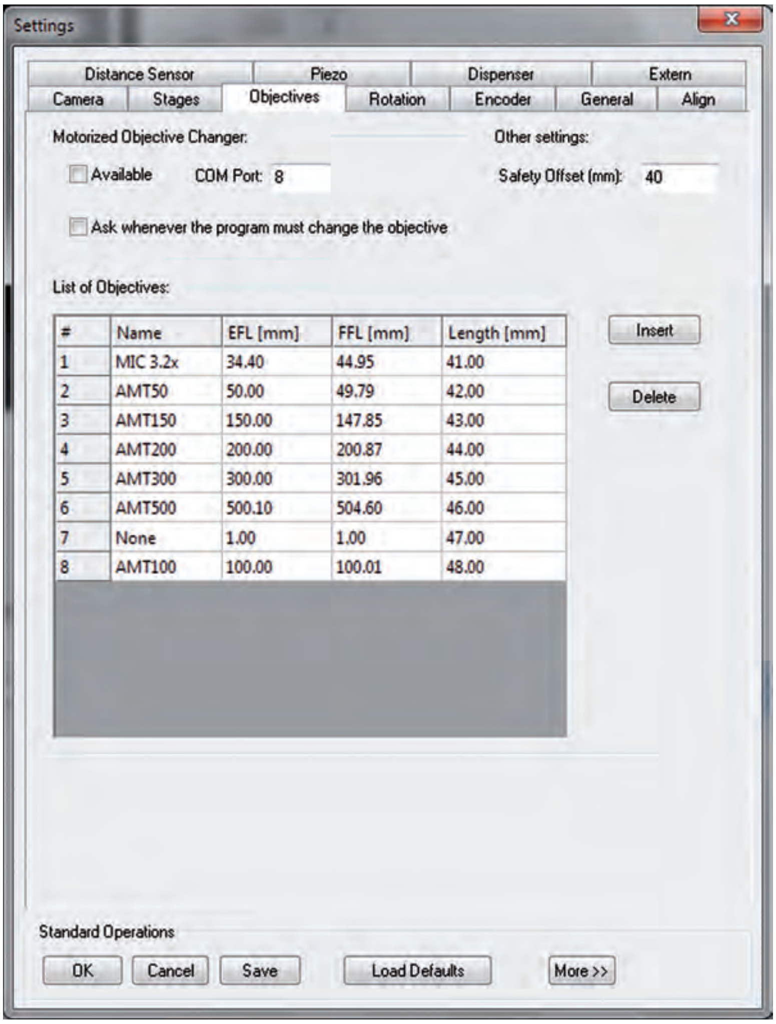


Fig. 17-26

`Motorized Objective Changer`	Motorized objective changer
`Available`	Tick the checkmark, if available
`COM Port`	Serial port number
`Ask whenever the program must change the objective`	Tick the checkmark if a confirmation is required by the user before each change of objective.

Other settings	
Safety Offset (mm)	A safety offset can be specified in order to prevent the head lens colliding with the sample. The following applies: Relative position < f_{ACM} +safety offset If the head lens cannot keep to the safety offset, the movement is not performed. The message "The stage can't drive more than the current objective EFL" is displayed. Confirm with **OK** and select a different head lens.
List of Objectives	List and calibration of all the head lenses provided with the device
Insert	Inserts one row (= one new head lens)
Delete	Deletes a row

- `Rotation` tab (rotation of the air bearing)

Fig. 17-27

Option menu	Select the control unit for which the settings are made

`LStep`
`Limited Range (0..200°)`
`Invert Dir. of Reference`
`Reference Vel. (%)`
`Working Vel. (%)`
`Acceleration`
	
	Tick the checkmark for limiting the rotation range between 0 and 200°
	Tick the checkmark for reversing the direction of the reference
	Velocity when searching reference marks
	Velocity during the measurement
	Acceleration

`Calib Offset (mm)`	Calibration offset (mm)
`Before Calib (°)`	Before calibration

EPOS	
Interface	Interface
COM Port:	Serial port number
Steps of 1°	Number of steps for a rotation of 1°
Velocity (%)	Velocity
Sr. Number	Serial number
Home Offset (mm)	Offset position to the limit switch
Reference	Direction of the reference cycle
Delta Tau	
Velocity (%)	Velocity
Max. Vel. (%)	Max. permissible velocity in (%)
MIP-10	Settings for the motor control unit
COM Port:	Serial port number
Steps/360°:	Number of steps for 360°
Velocity (0..30):	Velocity (100% = maximum velocity)
Reference Offset:	Offset between the reference position and the photoelectric sensor position
Rotation Button	Allocation of the buttons for "Air bearing Rotation Control"
Invert Directions	Reversing the direction of rotation
Short(°):	Angle of rotation for a small rotation step
Long(°):	Angle of rotation for a large rotation step
Concentricity	
LStep Available	Enable LStep
COM	COM port
Baud	Baudrate
Load	
Push	
Unload	
Encoder:	Option menu for rotary encoder (if available)
COM Port:	Serial port number
Set Offset	Fixed offset relationship between reference mark and rotary encoder

Other:	
Manual Rotation	Tick the checkmark for measuring lenses with a rotary device and a vacuum or when the air bearing is rotated by hand Deselect the checkmark for measuring with motorized air bearing
360° Rot. Instead Of Reference	Tick the checkmark if the 360° rotation shall be controlled by the stepper motor instead of the reference mark
Rotate 180° And Back (com S)	Checkmark ticked: When using the measurement method "S" (see chapter 10.8, page 99, the device is rotated back and forth by 180° only. This is used, for example, if the range of rotation is restricted.
Fast 180° Measurement	Checkmark ticked: When using the measurement method "S" (see chapter 10.8, page 99, the device is rotated back and forth by 180° alternately for each surface. While the sample is rotated back by 180°, the next surface is already measured.

- `Encoder` tab

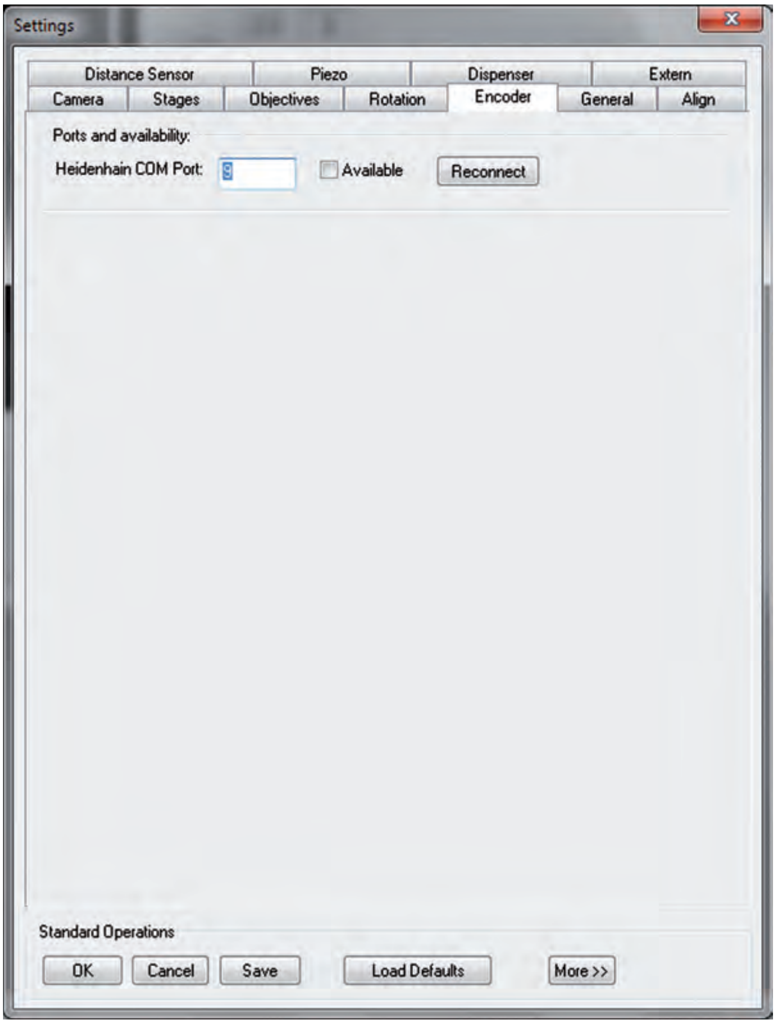


Fig. 17-28

`Ports and availability`	Ports and availability
`Heidenhain COM Port:`	Number of the serial interface for the Heidenhain position encoder
`Available`	Tick the checkmark, if available
`Reconnect`	Reconnect

- `General` tab

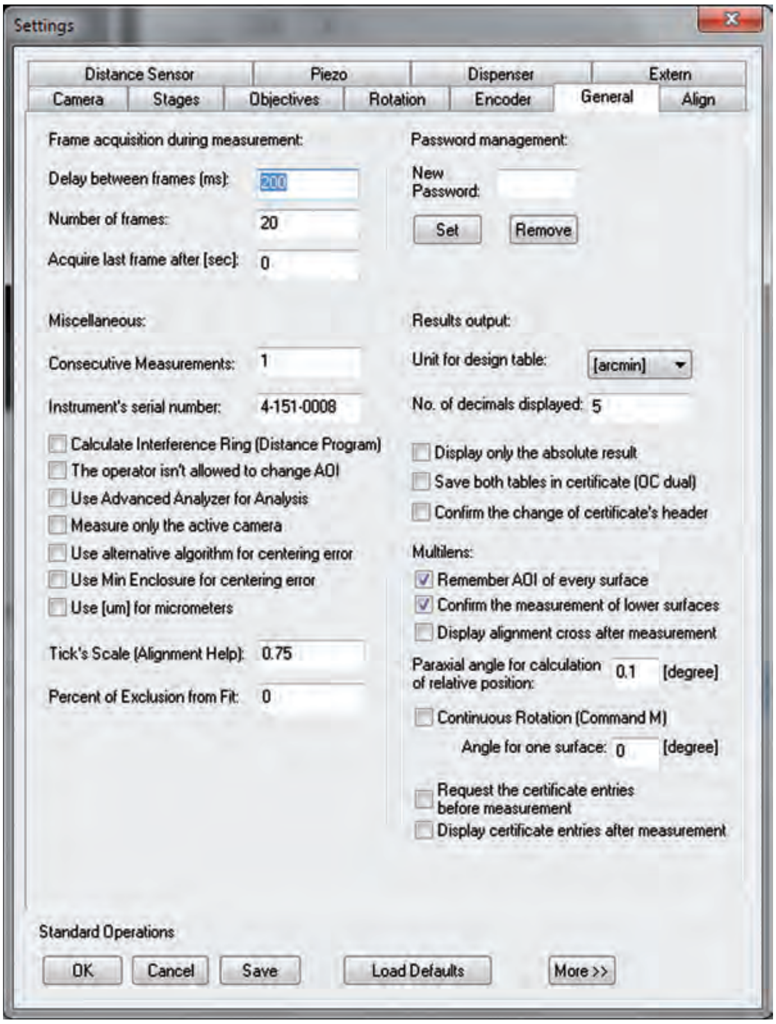


Fig. 17-29

`Frame acquisition during measurement`	Captures images during the measurement
`Delay between frames (ms)`	Time period between two image recordings
`Number of frames`	Number of measurement points when using manual rotation Should be defined so that a full circle is measured at the predetermined rotational speed.
`Acquire last frame after (sec):`	Record the last image after ... seconds

`Password management`	Management of passwords
`New Password`	New password
`Set`	Set The password must be at least 6 characters.
`Remove`	Reset password to factory settings.
`Miscellaneous:`	Miscellaneous settings
`Consecutive Measurements:`	Number of measurements to be performed in succession
`Instrument's serial number:`	Serial number
`Calculate Interference Ring (Distance Program)`	Tick checkmark if interference ring is to be calculated (radius program)
`The operator isn't allowed to change AOI`	Tick the checkmark if the operator is not allowed to change the area of interest (AOI).
`Use Advanced Analyzer for Analysis`	Uses the Advanced Analyzer for Multi-Lens analysis
`Measure only the active camera`	Uses only the active camera for the measurement
`Use alternative algorithm for centration error`	Uses alternative algorithm for centration error
`Use Min Enclosure for centration error`	Tick checkmark if an algorithm is to be used that determines a circle around all measured points. (Specific DLLs are required for this.)
`Use (um) for micrometers`	Tick checkmark for better display on other Windows systems
`Tick's scale (Alignment Help):`	Internal conversion factor for scale divisions in displacement during alignment
`Percent of Exclusion from Fit:`	Specification of the data points in % that should not be considered for the fit
`Results output:`	Output of the results of a measurement
`Unit for design table:`	Unit

No. of decimals displayed	Number of decimal places displayed
Display only the absolute result	Tick the checkmark to display only the radial centration error.
Save both tables in certificate (OC dual)	Tick the checkmark to save both tables in the certificate when using an OC Dual.
Confirm the change of the certificate's header	Tick the checkmark if changes to the certificate entries require confirmation<
Multilens	
Remember AOI of every surface	Saves the area of interest (AOI) for each surface
Confirm the measurement of lower surfaces	Checkmark ticked: when using systems with a dual measurement head, the measurement with the bottom measurement head must be confirmed.
Display alignment cross after measurement	Smart Align®: Projection of calculated optical or housing axis into the analyzed plane
Paraxial angle for calculation of relative position:	Paraxial angle used for calculating the location of the relative positions
Continuous Rotation (Command M)	Tick the checkmark to continuously rotate during a MultiLens measurement (only possible if rotary encoder is available).
Angle for one surface	Angle for a surface
Request the certificate entries before measurement	Tick the checkmark if the certificate entries should be queried before the measurement.
Display certificate entries after measurement	Tick the checkmark if the certificate entries should be displayed after the measurement.

- `Align` tab

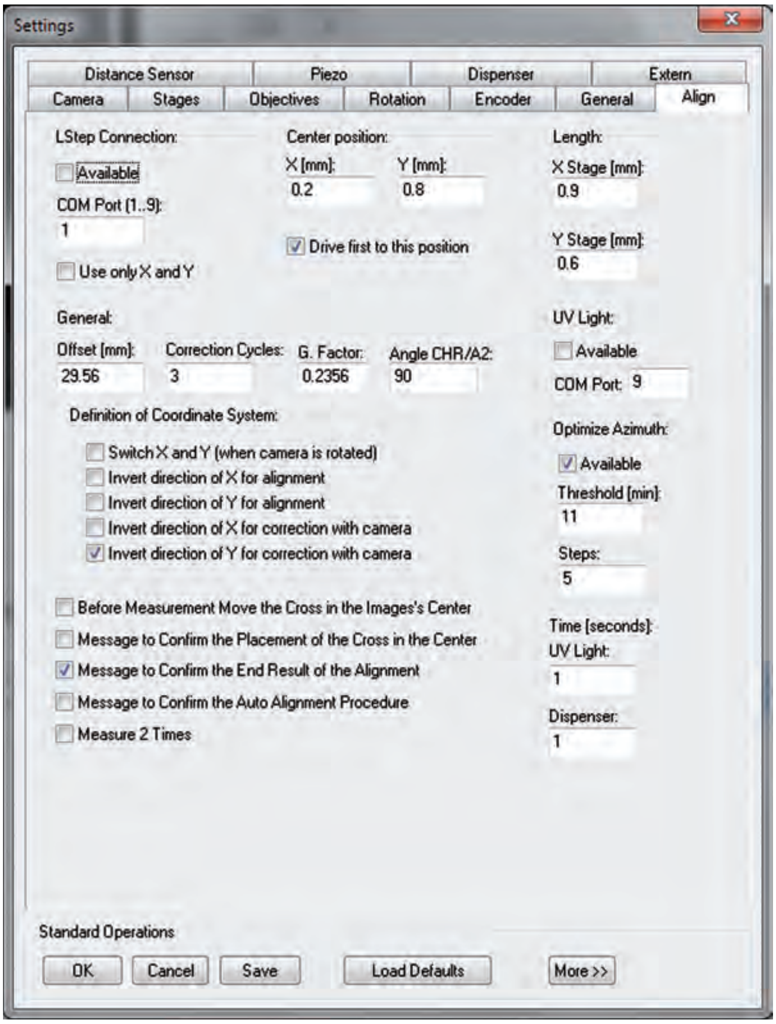


Fig. 17-30

NOTE

The settings on this tab only apply to systems with a motorized, dual axis alignment control.

- `Distance Sensor` tab

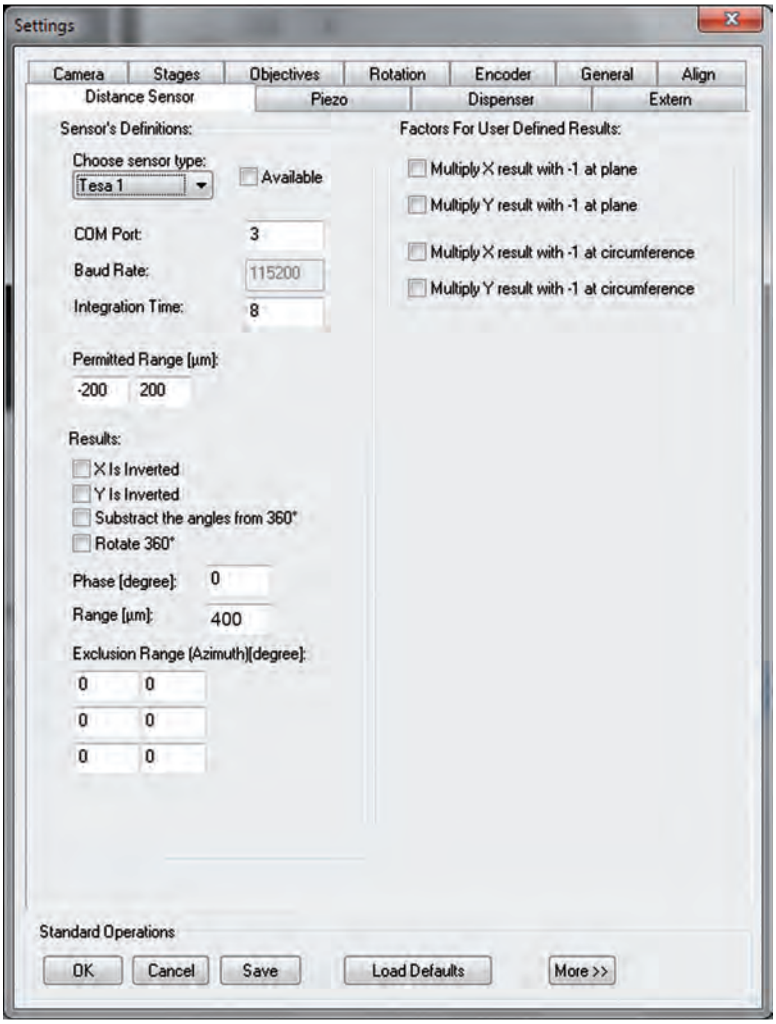


Fig. 17-31

`Sensor's Definition:`	
`Choose sensor type`	Select sensor type
`Available`	Tick the checkmark, if available
`COM Port:`	Serial port number
`Baud Rate:`	Transfer rate
`Integration Time:`	Shutter time
`Permitted Range (µm)`	Range in which the sensor signal is permitted

Results:	Results
X is inverted	Tick the checkmark to align the coordinate systems.
Y is inverted	Tick the checkmark to align the coordinate systems.
Subtract the angles from 360°	Tick the checkmark to align the coordinate systems.
Rotate 360°	Tick the checkmark to rotate the motor by the nominal value of 360° (regardless of the reference mark).
Phase (degree)	Azimuthal phasing of the coordinate system (default 0)
Range (µm)	Measurement range (default 400 µm)
Exclusion Range (Azimuth)(degree)	Beginning and end of three areas within which the measured values are to be ignored
Factors For User Defined Results	Change the preceding + or - sign of the results
Multiply X result with -1 at plane	
Multiply Y result with -1 at plane	
Multiply X result with -1 at circumference	
Multiply Y result with -1 at circumference	

- `Piezo` tab

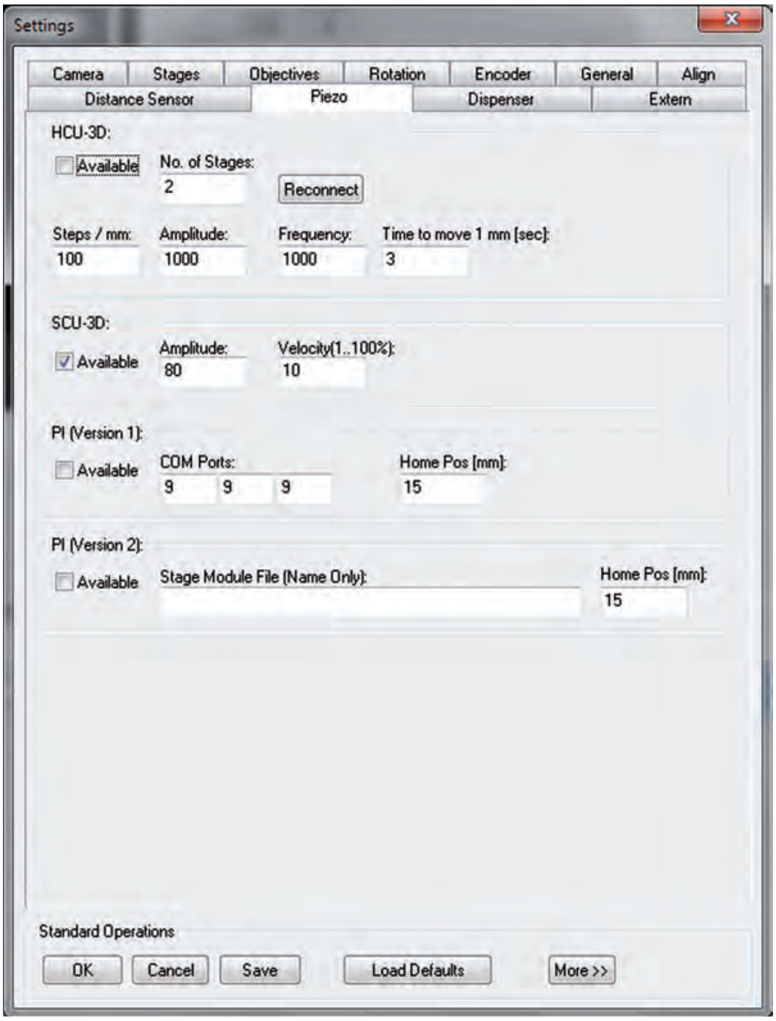


Fig. 17-32

`PI:` `Home Pos (mm)`	Reference position (default 0 mm)

NOTE

This hardware system parameters are entered on this tab. These parameters should not be changed.

- `Dispenser` tab

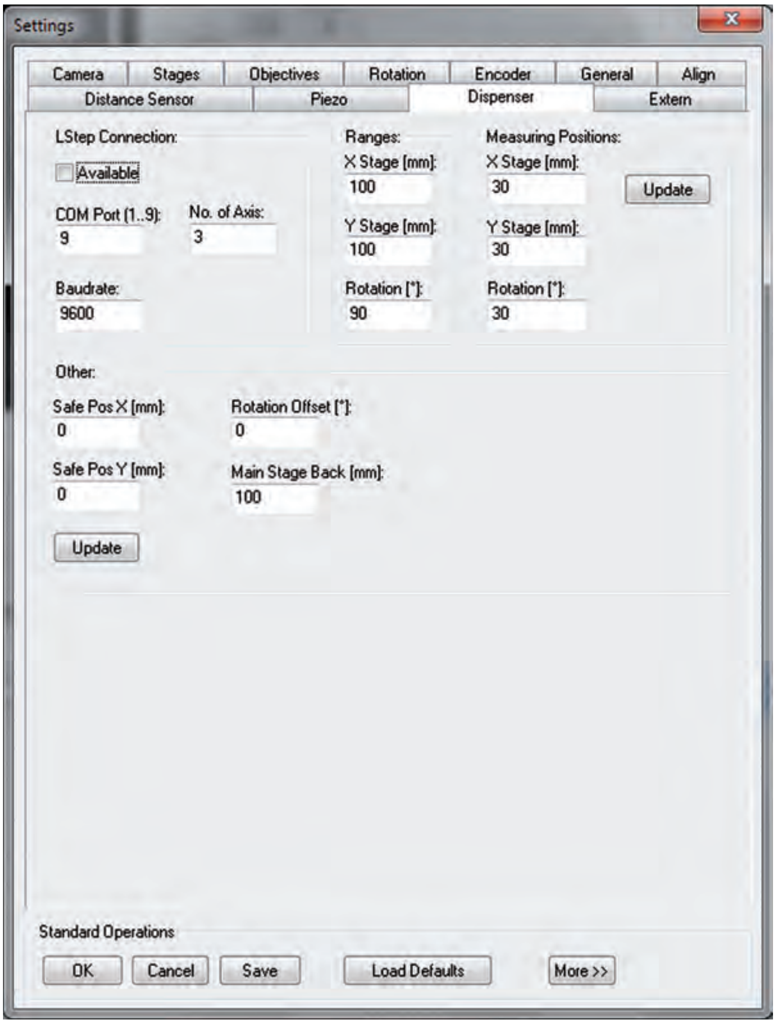


Fig. 17-33

NOTE

The settings on this tab are used only for special applications.

- `Extern` tab

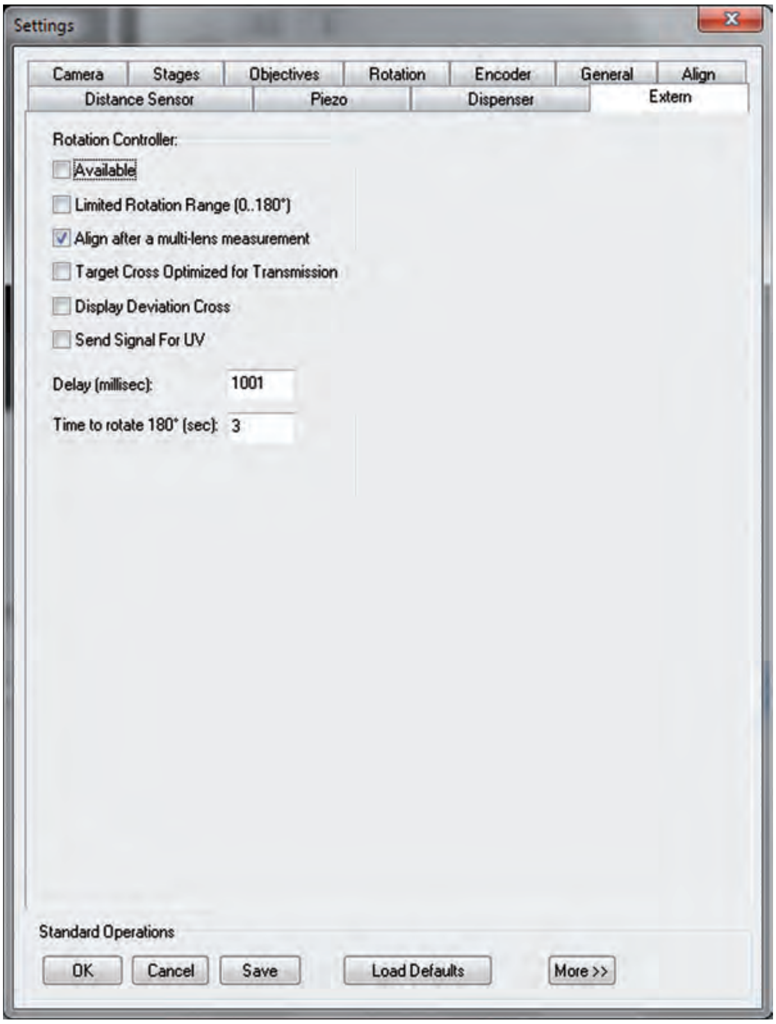


Fig. 17-34

`Rotation Controller`	Control unit for rotation
`Available`	Tick the checkmark, if available
`Limited Rotation Range (0..180°)`	Tick the checkmark for limited rotational range (0...180°)
`Align after a multi-lens measurement`	Tick the checkmark if you want to align after a Multilens measurement
`Target Cross Optimized for Transmission`	Tick the checkmark if the target cross is to be optimized for transmission
`Display Deviation Cross`	Special function when using an external controller
`Send Signal For UV`	Tick the checkmark if the signal is to be sent for UV

`Delay (millisec):`	Delay
`Time to rotate 180° (sec):`	Time for 180° rotation

Set Motorized Objectives

If a motorized objective changer is used, the mounted head lenses are entered here.

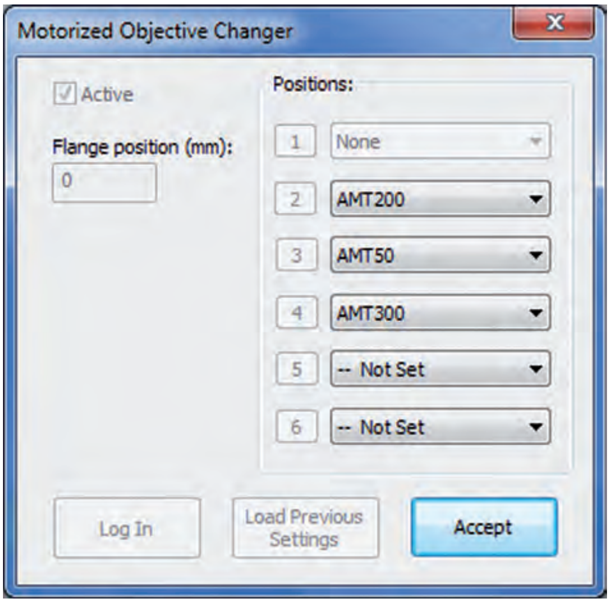


Fig. 17-35

Airbearing Control Unit

Manual control of the air bearing

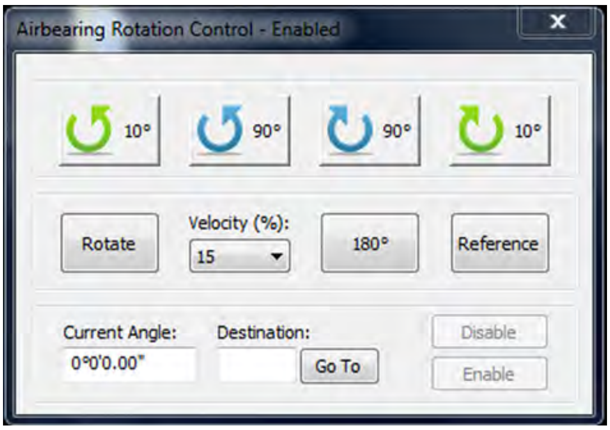


Fig. 17-36

Stepper Rotation Control

Special function, not used for this measurement system

Dispenser Control

Special function, not used for this measurement system

Timer Card

Special function, not used for this measurement system

Align Tools

Opens the `Align Tools` window.

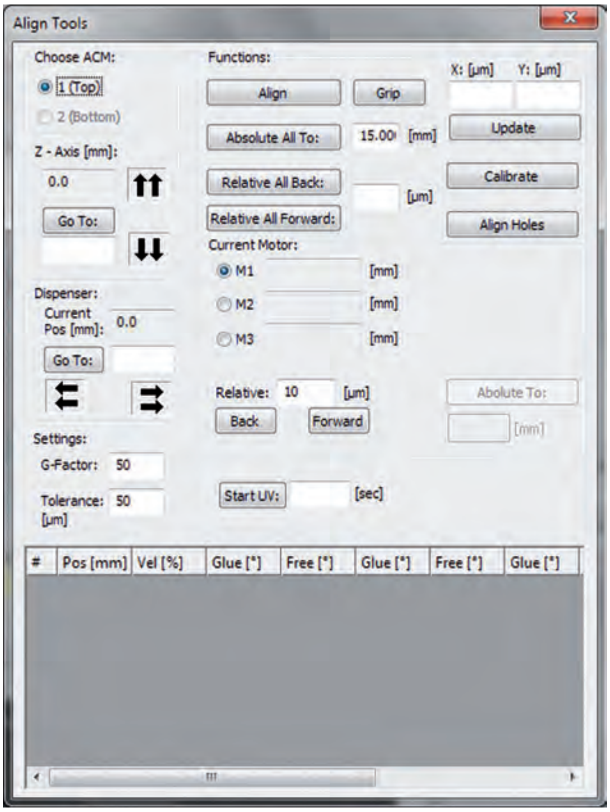


Fig. 17-37

Align 3R

Opens the `Alignment Control` window.

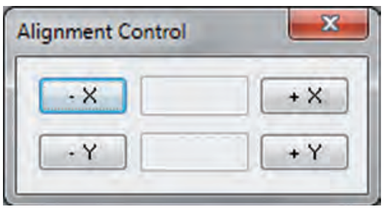


Fig. 17-38

Special function, not used for this measurement system

Autofocus

Perform autofocus of the upper measurement axis manually.

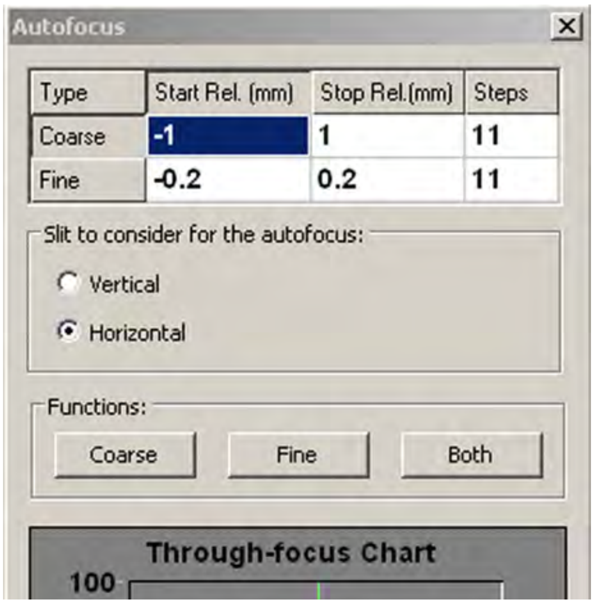


Fig. 17-39

NOTE

To cancel the autofocus process, press the ESC key or click on the X.

Calibrate

Calibrate the measurement system (see chapter 18.2, page 203

Auto Open/Save files

Automatically opens/save files

TCP/IP Server

Connection between the software and a measurement device via TCP/IP. The measurement is started externally.

Special function, not used for this measurement system

Check Connections

Reads values of the air bearing rotary encoder.

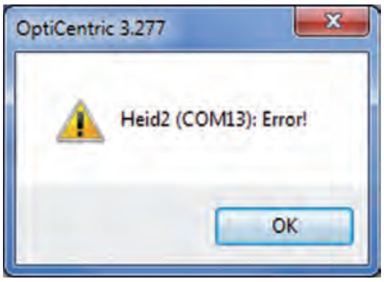


Fig. 17-40

Help Tools

Tilt Alignment

Opens the `Alignment Help` window. This wizard is used to align the specimen axis to the reference axis (the bearing's axis of rotation); this is particularly useful for example for OptiSurf measurements in the OC3D.

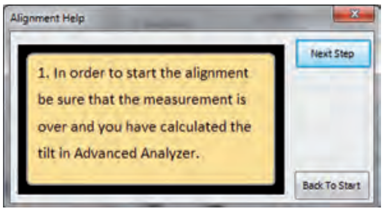


Fig. 17-41

17.8 <Program> menu

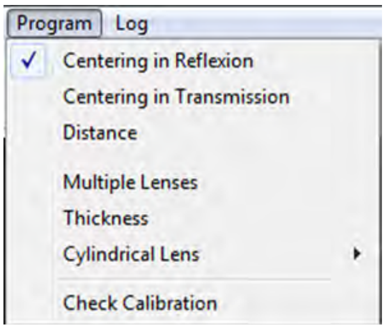


Fig. 17-42

Centering in Reflexion

Centration error Measurement in Reflection (see chapter 7., page 77

Centering in Transmission

Centration error Measurement in Transmission (see chapter 8., page 83

Distance

Distance measurement (e.g. measuring radii) (see chapter 9., page 87

Multiple Lenses

Measurement of multi-lens optical systems (see chapter 11., page 103

Thickness

Measurement of Lens Thicknesses and Air Gaps (see chapter 13., page 117

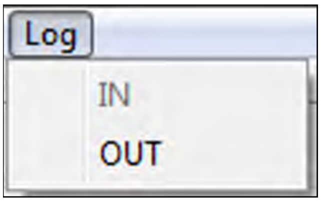
Cylindrical Lenses

Measurement of cylinder lenses

Check Calibration

Check calibration (see chapter 18.2, page 203

17.9 <Log> menu (login)



IN

Opens the "Login" window. Here you can log in as administrator or supervisor (see also chapter 6.5 "Login", page 65).

OUT

The administrator or supervisor is logged off. Then you will continue to have the restricted user rights of an operator.

17.10 Advanced Analyzer

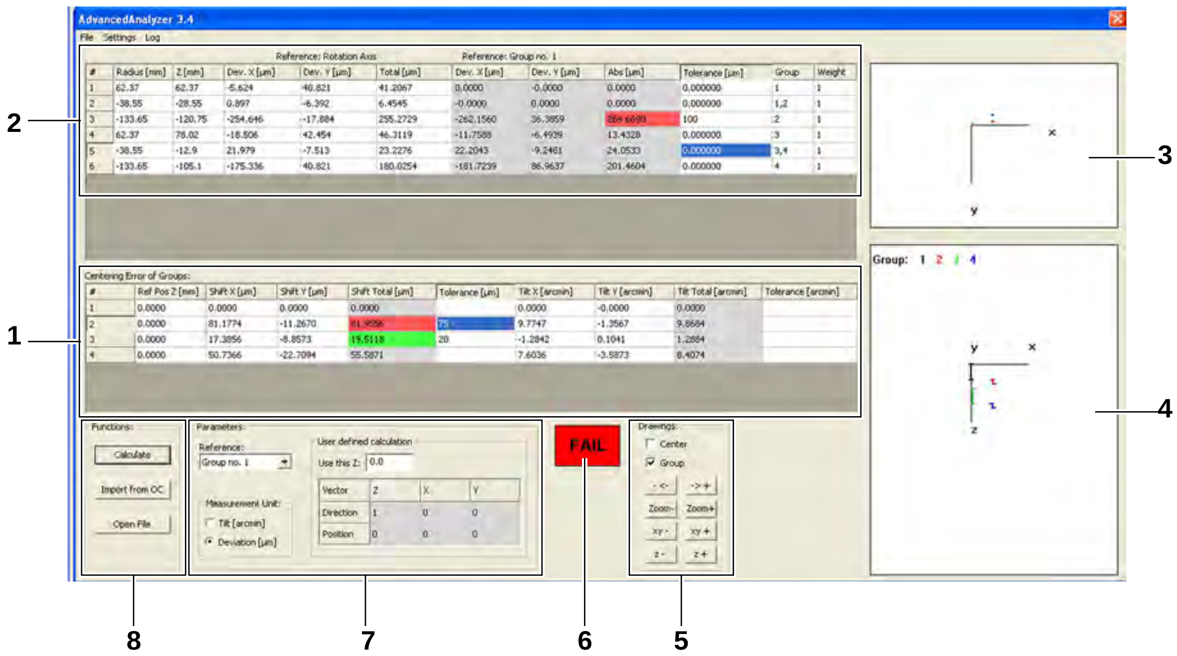


Fig. 17-43

1	Table for lenses and groups: • Displays shift and tilt for the groups defined in **2** • Input of the tolerances for shift and tilt In the example above, one measured value is shown in red, since the tolerance was exceeded.
2	Table for individual surfaces: • Display of the centration errors • Input of the tolerances • Definition of groups and weighting In the example above, one measured value is shown in red, since the tolerance was exceeded.
3	Graphical representation of the centration error: 2-dimensional top view
4	Graphical representation of the centration error: 3-dimensional side view
5	Action panes – Click the `- <-` or `-> +` buttons in order to rotate the side view around the Z-axis. – Click the `Zoom-` or `Zoom+` buttons to scale the views. – Click the `xy-` or `xy+` buttons in order to scale the display in X-Y-direction. This function is comparable to the `Zoom` function, however, it only considers the X-Y-plane. – To scale the display in z-direction, click on the buttons `z-` or `z+`. This function is comparable to zoom but only in the Z plane.

6	Display PASS/FAIL • If all valuesare within the specified tolerance, the overall result displayed is a "PASS". • If at least one of the entered values exceeds the tolerance, the overall result displayed is a "FAIL"
7	Parameters
8	Functions

18. Maintenance and Repairs

DANGER!

Danger to life due to electric shock

Electrical currents may pose a hazard.

– Unplug the system from the main power supply before working on electrical equipment.

WARNING!

Danger from compressed air

Flailing compressed air lines or pressurized components can result in crushing or impact injuries.

– Remove the pressure from all lines before maintenance, repair and troubleshooting work.

CAUTION!

Damage to the measurement system

– Never move the rotary air bearing and the linear air bearing without compressed air.
– Protect the contact surface of the linear air bearing against mechanical influences
– Make sure that moisture cannot penetrate into the housing of the measurement system.
– Do not consume beverages at the workplace.

CAUTION!

Measurement error following improper maintenance

The measurement system may only be maintained by correspondingly trained personnel.

WARNING!

Before you start work, make sure all sections of the housing are present and properly installed. Do not work on the measurement system if sections of the housing have been removed or are defective. Immediately reattach removed sections of the housing or notify the manufacturer or the responsible local subsidiary (see page 3).

18.1 Intervals

The components of the measurement system are largely designed to be maintenance free. However, changes to environmental parameters (temperature, humidity, etc.) may cause deviations in the alignment and thus the measurement results.

To promptly detect such deviations and to ensure the proper functioning of the components of the measurement system, please observe the following maintenance instructions:

Every 3 months

- Check calibration of the measurement system (see chapter 18.2, page 203)

Every 6 months

- Conduct a performance check (see chapter 18.3, page 206)

As required

- Replace the lamp (see chapter 18.4, page 207)

18.2 Calibrate the measurement system

Required tool

- Reference wedge

> **NOTE**
>
> The reference wedge is a plane-parallel surface with a known wedge error.

1. Remove the head lens of the camera.
2. Fasten the reference wedge **1** with screws.

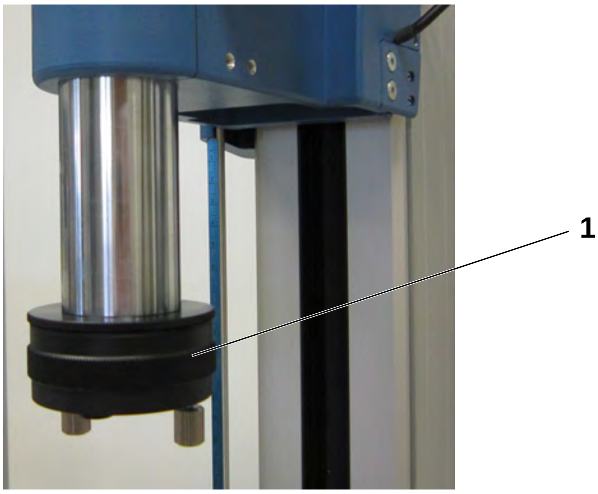
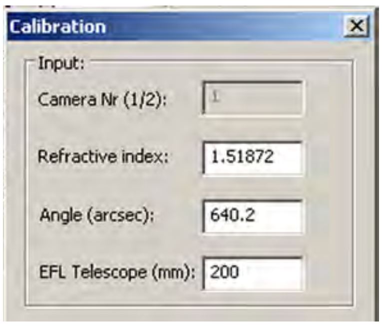


Fig. 18-1

3. Select `<Tools> <Calibrate>`.



4. Enter the following values:

`Refractive index`	refer to the specifications of the reference wedge
`Angle`	refer to the specifications of the reference wedge
`EFL Telescope`	nominal EFL of the autocollimator

5. To move the H-shaped calibration pattern to the center of the image area shown, turn the adjusting screws **2**.

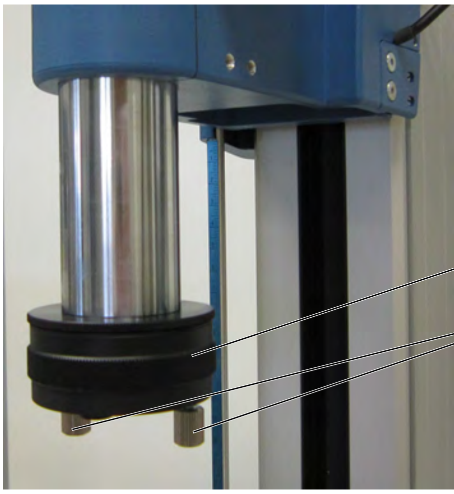


Fig. 18-2

6. Click on **Calibrate** to start the calibration.

   The message `Press OK when you see 2 horizontal slits` is displayed. Click OK when you see 2 horizontal lines.

7. Turn the knurled ring **1** of the reference wedge until you can see two horizontal lines (see Fig. 18-3).

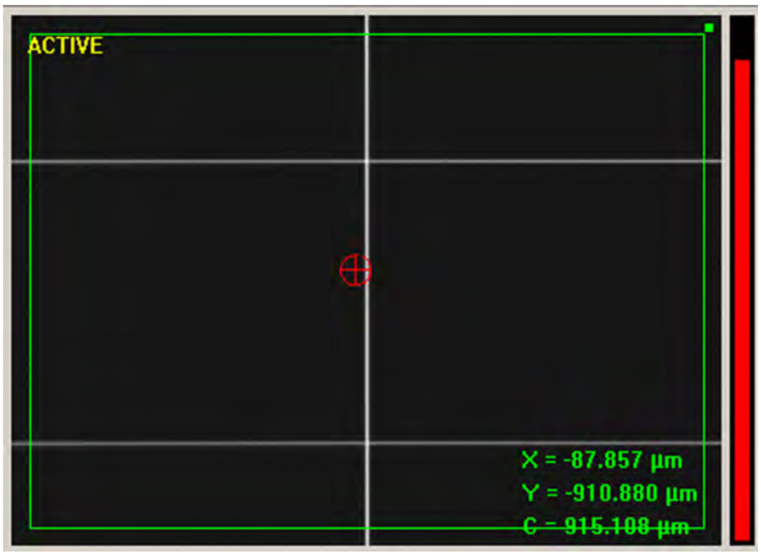


Fig. 18-3

8. Click **OK**.

   The message `Press OK when you see 2 vertical slits` is displayed. Click OK when you see 2 vertical lines.

9. Turn the knurled ring **1** of the reference wedge until you can see two vertical lines (see Fig. 18-4).

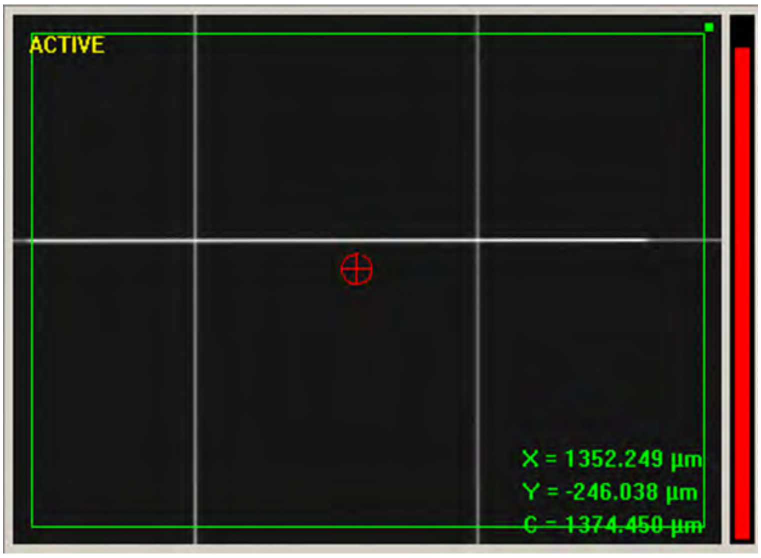


Fig. 18-4

10.Click **OK**.

11.Click **Update** to accept the values.

The following prompt is displayed: "`Are you sure you want to update the calibration's values?`"

12.Click **Yes** to calibrate the measurement system.

The following message is displayed: "`The calibration's values were updated.`".

The calibration process is completed.

18.3 Conduct a performance check

General information

To ensure proper functioning and consistent accuracy of the measurement system, TRIOPTICS recommends a regular performance check.

The values for the master sample are known. These are compared with the values determined with the measurement system. In this way, changes to the measurement system can be detected over a longer period of time.

Master sample

You can obtain a master sample from the measurement system manufacturer. This sample is especially certified and provides the same values under consistent measurement conditions.

However, you may also use your own sample for regular testing, for which you know the exact measurement values.

> **NOTE**
>
> **Storage conditions for consistent measurements**
>
> In order to obtain consistent measurement values, the master sample must always be stored under the same ambient conditions.

Test procedure

1. Make sure that the ambient conditions and the state of the master sample are exactly as in the previous measurements.

> **NOTE**
>
> **Optical measurements are sensitive to external influences**
>
> Avoid too much ambient light, contaminated samples (dust, grease or scratches), tilted samples, vibrations of the measurement system.

2. Determine the values for one or more master samples.
3. Repeat the measurement several times.
4. Print out the records.

Deviations

1. Compare the values with those of the master sample.
2. If you detect deviations, first check the ambient conditions and repeat the test procedure if necessary.

NOTE

If there are significant deviations in the measurement results, the measurement system must be calibrated.

Archiving

– Carefully check and archive the measurement results.
– Carefully store the printouts of the readings of the performance check.

18.4 Replace the lamp

WARNING!

Risk due to hot surfaces

The light source becomes very hot during operation.

– Read the enclosed documentation on the light source and follow the safety instructions.
– Do not disassemble the light source while hot, but leave to cool for 10 minutes.
– Do not operate the light source in the disassembled state.

– To replace the lamp, follow the instructions in the documentation for the light source.

18.5 PC and software

The measurement system is shipped with software that is installed under the Microsoft Windows® operating system.

The system operator is responsible for keeping the software free from viruses during operation of the machine.

18.6 Fuses

CAUTION!

Electrical hazards associated with the use of non-matching fuses

Always replace defective fuses with fuses of the same type.

Information about the fuses used can be found in the operator's manuals for each device.

18.7 Cleaning

In order to ensure proper operation and accurate measurement results, the measurement system, accessories, samples and the environment must be clean and dust free.

Cover the measurement system with the dust protection sheet supplied when not in use.

WARNING!

Risk of fire due to highly flammable alcohol used during cleaning work

Observe the manufacturer's safety data sheet.

Only store the quantity actually needed per day at the work station.

NOTE

If the measurement system is operated in a clean room, observe the cleaning guidelines in place.

Housing

NOTE

Risk of damage

Never use solvents or abrasives.

Do not spray the cleaning solution directly onto the measurement system.

- Use a solution of mild detergent and water for cleaning.
- Regularly wipe the housing of the measurement system with a soft damp cloth.

Sample holder

NOTE

Risk of inaccurate measurement results

A dirty sample holder can contaminate the sample or cause it to become misaligned. This will result in inaccurate measurement results.

– Use a solution of mild detergent and water or alcohol for cleaning.
– Regularly wipe the sample holder with a soft damp cloth.

Optical components of the measurement system

NOTE

Risk of contamination

Do not touch the optical surfaces. Only use clean, oil-free compressed air for cleaning.

– Use compressed air to blow away dirt on optical components, using a spiral motion from the inside to the outside.
– For stubborn dirt, use a soft cloth with high-purity isopropyl alcohol. Wipe in a spiral motion from the inside to the outside.

18.8 Spare parts

Order no.	Description
98-001-149	Optical fiber Schott light source KL1500, 1.5 m
98-001-561	Optical fiber Schott light source KL1500, 2 m

19. What to Do If...?

WARNING!

Danger from compressed air

Flailing compressed air lines or pressurized components can result in crushing or impact injuries.

– Remove the pressure from all lines before maintenance, repair and troubleshooting work.

WARNING!

Risk of electric shock

Parts under tension pose a risk of electric shock.

– Any work on the electrical system must be performed by appropriately qualified persons.
– The use of insulated tools complying with DIN EN 60900 is required for any work under voltage.

WARNING!

Risk of injury from heavy components

There may be dangers due to heavy and tipping parts.

– Only use suitable lifting equipment.
– Never step under suspended loads.

<table>
<tr><th>Errors</th><th>Troubleshooting</th></tr>
<tr><td>No camera image</td><td>

Possible cause:

The image is too dark.

Remedies:

– Check if the Light intensity in the area of interest (AOI) is shown in the bar graph.
– If necessary, change the exposure time in the drop down menu `Shutter [µs]` until the bar graph for the light intensity is approximately at the center.
– Change the brightness at the light source.

</td></tr>
<tr><td>No camera image</td><td>

Possible cause:

Camera cable is not properly attached to the PC.

Remedies:

– Make sure that the camera cable is connected to the PC and that its plug is screwed to the corresponding connection.

</td></tr>
<tr><td>No camera image</td><td>

Possible cause:

FireWire card

Remedies:

1. Go to the Control Panel on the PC and open the Device Manager.
2. Check whether the FireWire card listed in the Device Manager is ready for use and shows no errors.

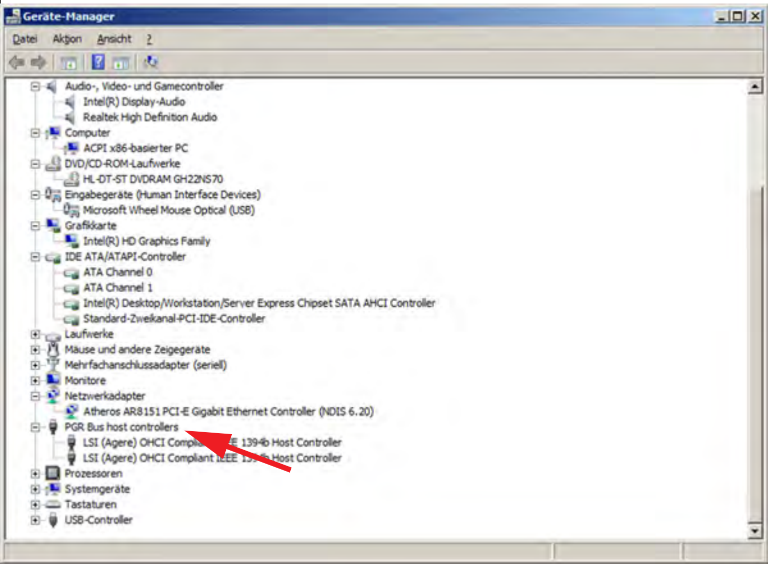
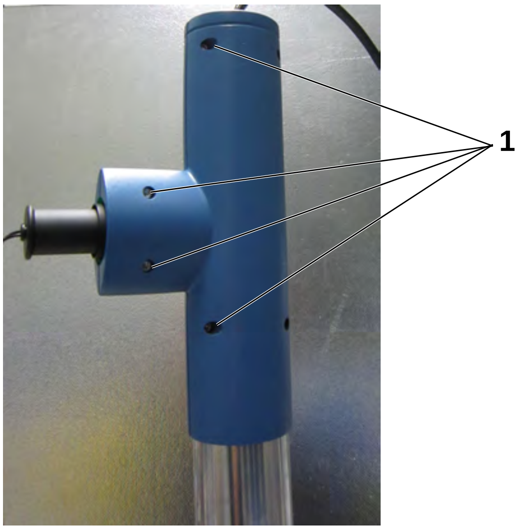
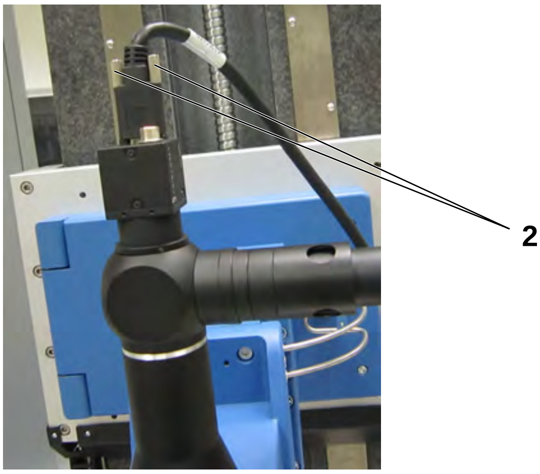
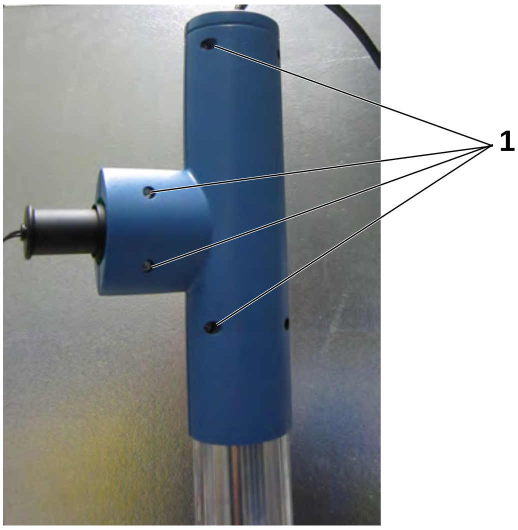
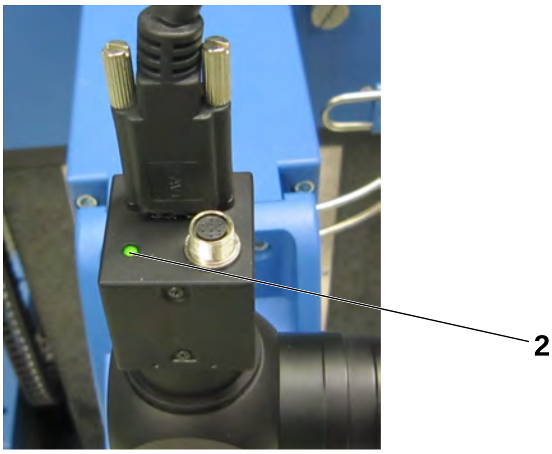


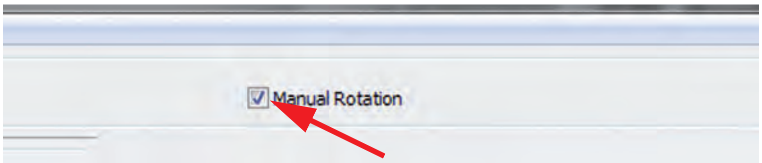
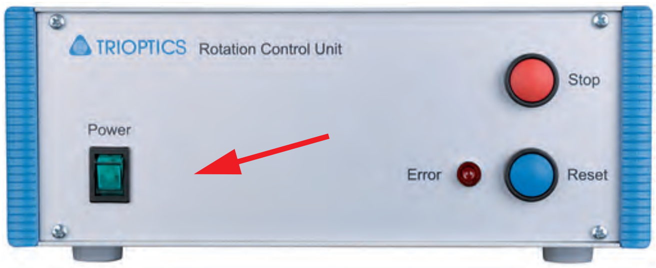
Fig. 19-1

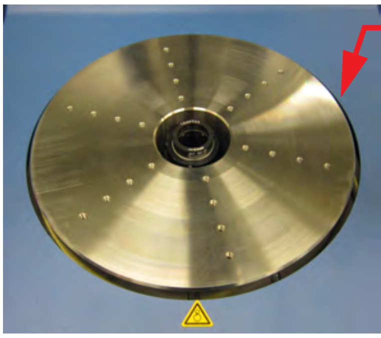
3. If the card is not listed, please contact the manufacturer or the responsible local subsidiary (see page 3).

</td></tr>
</table>

Errors	Troubleshooting
No camera image	**Possible cause:** Cable is damaged **Remedies:** 1. Unscrew the six screws **1** and remove the enclosure from the camera.  *Fig. 19-2* 2. Loosen the fastening screws from the camera cable.  *Fig. 19-3* 3. Screw on a new camera cable. 4. Remount the enclosure. 5. Remove the old cable from the PC and plug in the new cable.

Errors	Troubleshooting
No camera image	**Possible cause:** Camera is defective **Remedies:** 1. Unscrew the six screws **1** and remove the enclosure from the camera.  *Fig. 19-4* 2. Check whether the status LED **2** on the camera is illuminated during operation.  *Fig. 19-5: Top view, enclosure removed* If the LED is not illuminated, the camera is defective and must be replaced. Please contact the manufacturer or the respective local subsidiary (see page 3).

Errors	Troubleshooting
Air bearing does not rotate	**Possible cause:** "Manual rotation" mode is selected **Remedies:** – Remove the checkmark "Manual Rotation" in the software.  *Fig. 19-6*
Air bearing does not rotate	**Possible cause:** Control is not activated. **Remedies:** 1. Check whether the switch of the control is illuminated.  *Fig. 19-7* 2. If this is not the case, release the emergency stop button and turn on the controller.  *Fig. 19-8* 3. Close the software and restart it.

Errors	Troubleshooting
Air bearing does not rotate	**Possible cause:** Compressed air not turned on or not sufficient **Remedies:** – Check the compressed air supply. The pressure must be between 4 and 5 bar.
Air bearing does not rotate	**Possible cause:** Incorrect connections **Remedies:** – Check **all** connecting cables, connecting lines and pneumatic hoses. They must be undamaged and properly connected.
The air bearing does not stop rotating after a referencing cycle.	**Possible cause:** Something obstructs the photoelectric barrier. **Remedies:** 1. Check (with a flashlight if needed) if the periphery of the light bearing is dirty. The photoelectric barrier is located below the blue enclosure.  *Fig. 19-9* 2. Try to remove the object, use compressed air to carefully blow it off if required.
The air bearing does not stop rotating after a referencing cycle.	**Possible cause:** Photoelectric cell is defective **Remedies:** – Please contact the manufacturer or the respective local subsidiary (see page 3).

Errors	Troubleshooting
Control does not turn on, the switch is not illuminated.	**Possible cause:** Emergency stop pressed **Remedies:** – Release the emergency stop button and/or turn on the emergency stop box.
Control does not turn on, the switch is not illuminated.	**Possible cause:** Defective fuse **Remedies:** – Open the fuse compartment under the plug on the back of the controller and install a new fuse of the same type.  *Fig. 19-10*

<table>
<tr><th>Errors</th><th>Troubleshooting</th></tr>
<tr><td>Linear stage does not move</td><td>

Possible cause:

Control is not activated.

Remedies:

1. Check whether the switch of the control is illuminated.

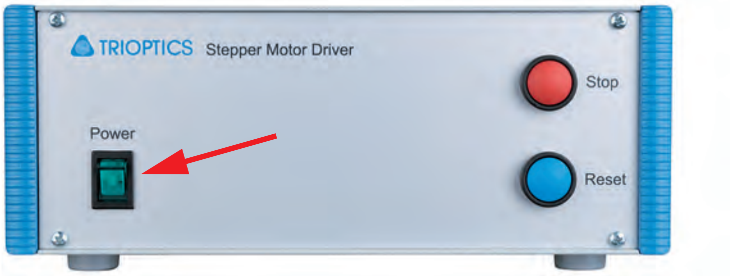


Fig. 19-11

2. If this is not the case, release the emergency stop button and turn on the controller.

Fig. 19-12

3. Close the software and restart it.

</td></tr>
<tr><td>Linear stage does not move</td><td>

Possible cause:

Safety limit switch is activated or not connected properly

Remedies:

– Check whether the safety limit switch has been triggered.

</td></tr>
<tr><td>Linear stage does not move</td><td>

Possible cause:

Incorrect connections

Remedies:

– Check **all** connecting cables, connecting lines and compressed air hoses if necessary (refer to the connection diagram in chapter 23. "Appendix", page 229).
They must be undamaged and properly connected.

</td></tr>
</table>

Errors	Troubleshooting
Poor reproducibility of the measurement results	**Remedies:** 1. Make sure that the sample is well mounted. 2. Make sure that the sample is pre-centered. 3. Make sure that the head lens is screwed tightly. 4. Choose a different head lens to achieve an optimal enlargement ratio. 5. Check whether the relative positions are correct and whether you can see the images properly focused. 6. Make sure that the lighting is sufficient. 7. Avoid light disturbances from the outside. 8. Measure the reference sample.

19.1 Customer Service

If you cannot resolve the errors yourself, please contact the customer service (see page 3).

Accessibility

The customer service is available five days a week during normal office opening hours in your respective region.

Costs

During the warranty period the service is free.

19.2 Starting a customer service inquiry

Any request for service must be made online.

1. Open the website http://www.trioptics.com/company/service.php.

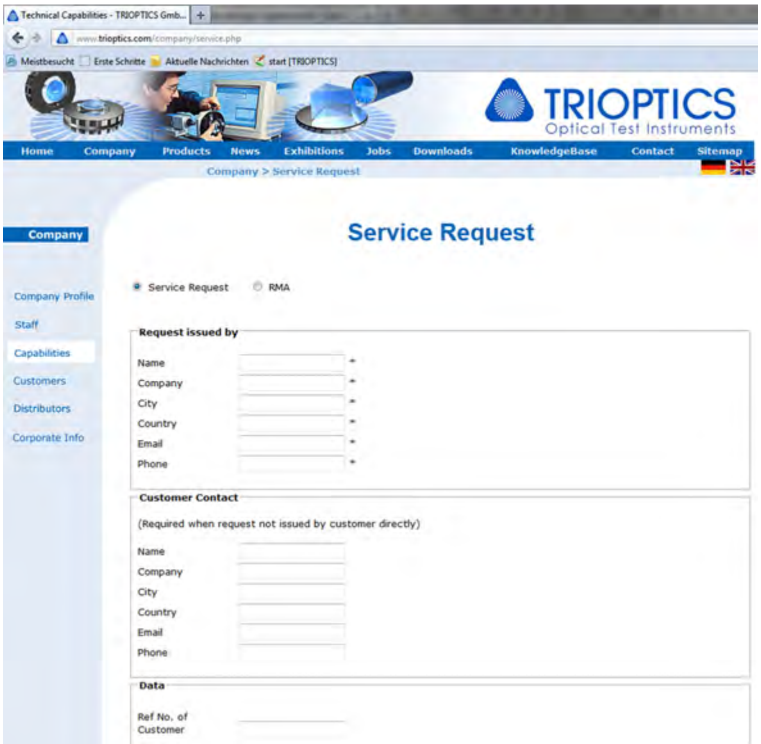


Fig. 19-13

2. Select **Service Request**.
3. Fill in the respective fields.

   All fields marked with an asterisk (*) are mandatory. If you do not know what to enter, fill in "None".

4. If necessary, select an attachment of the following file types: *.rar, *.zip, *.pdf, *.txt.

   The maximum size of the attachment is 5 MB.
5. Click `Submit Service Request`.

19.3 Returning spare parts

Please use an RMA number (Return Material Authorization) to return any parts to TRIOPTICS. You can retrieve this number online.

1. Open the website http://www.trioptics.com/company/service.php.
2. Select **RMA**.
3. Fill in the respective fields.

   All fields marked with an asterisk (*) are mandatory. If you do not know what to enter, fill in "None".
4. If necessary, select an attachment of the following file types: *.rar, *.zip, *.pdf, *.txt.

   The maximum size of the attachment is 5 MB.
5. Click `Submit Service Request.`

   Your RMA number will be mailed to you.
6. State your address and the RMA number on the return package to TRIOPTICS.

NOTE

An RMA number is required to ensure your parts are assigned and processed quickly.

20. Disassembly and Disposal

WARNING!

Risk of injury

Mechanical or electrical hazards can occur when disassembling the system. The system may only be disassembled by authorized specialist personnel.

– Please contact the manufacturer or the respective local subsidiary (see page 3).

NOTE

Observe local regulations and laws on the disposal of environmentally harmful substances.

20.1 Dispose of components

Components

The measurement systems mainly consist of steel and various copper and aluminum parts. Metallic materials are widely regarded as fully recyclable.

Separate the components for recycling according to the following categories:

- Steel and iron
- Aluminum
- Non-ferrous metal, such as motor windings
- Insulating materials
- Cables and wires
- Electronic scrap

Chemicals and additives

Sort the process chemicals and additives for disposal, for example by the following categories:

- Oil
- Fat
- Cleaners and solvents
- Paint residues
- Anti-corrosion agents

Dispose of the separated components according to local regulations or via a specialist disposal company. The same applies for cloths and cleaning substances which have been used to carry out work on the machine.

Packaging material

- If necessary, contact a specialist waste disposal company.
- Wooden packaging for sea transport consists of impregnated wood. Please note the local regulations.

NOTE

Should you have any questions about disposal, please contact the manufacturer or the responsible local subsidiary (see page 3).

21. Warranty

TRIOPTICS grants a one year warranty on materials and workmanship, beginning from delivery or installation at the customer's premises (where the installation was performed by TRIOPTICS).

Excluded from this are parts from suppliers, such as the CCD Array or the FrameGrabber board, whose manufacturer's warranty is shorter.

The warranty does not apply if the faults were caused by:

- Damage caused in transit
- Damage caused by incorrect installation (where the installation was not performed by TRIOPTICS)
- Accident, negligence or invalid operation on the measurement system
- Failure to comply with the operator's manual
- Damage caused by unauthorized modification of the programming
- Damage caused by unauthorized repair
- Use of incorrect replacement parts

In case of warranty TRIOPTICS is only obliged to replace or to repair the faulty parts. Consequential damages are not covered by this warranty. Transport costs are borne by the customer.

NOTE!

If the measurement system needs to be sent to TRIOPTICS for repair, please use the original transport packaging.

22. Index

23. Appendix

- CE Declaration of Conformity
- Hole pattern from the TRT and the air bearing
- Connection Diagram

EC-Declaration of Conformity

EC-Declaration of Conformity

in accordance with the EC-Directive 2006/42/EG (Machinery Directive) of 17 May 2006

Manufacturer

TRIOPTICS GmbH
Hafenstraße 35-39
22880 Wedel
Germany

CE authorised person

Simon Viets
TRIOPTICS GmbH
Hafenstraße 35-39
22880 Wedel
Germany

Description and identification of the machinery

Product / Article	OptiCentric®
Type	100
Serial number	04-112-xxxx
Project number	PRJ-2012-10-13-0001
Commercial name	OptiCentric® Standard / 100T

It is expressly declared that the machinery fulfils all relevant provisions of the following EU Directives.

2006/42/EG	Machinery Directive (MD)
2004/108/EC	Electromagnetic Compatibility Directive (EMC)
2006/95/EC	Low Voltage Directive (LVD)

Reference to the used harmonised standards

EN 349:1993+A1:2008; EN 12203:2003+A1:2009; EN ISO 13857:2008; EN ISO 13849-1:2008; EN ISO 12100:2010-11; EN 614-1:2006+A1:2009; EN 894-1:1997+A1:2008; EN 61326-1:2006; DIN EN 62471; EN ISO 4414:2010

DIN EN 55011; DIN EN 61000-3-2; DIN EN 61000-3-2 Berichtigung 1; DIN EN 61000-4-2; DIN EN 61000-4-3; DIN EN 61000-4-4; DIN EN 61000-4-6; DIN EN 61000-4-8; DIN EN 61000-4-11

DIN EN 61010-1

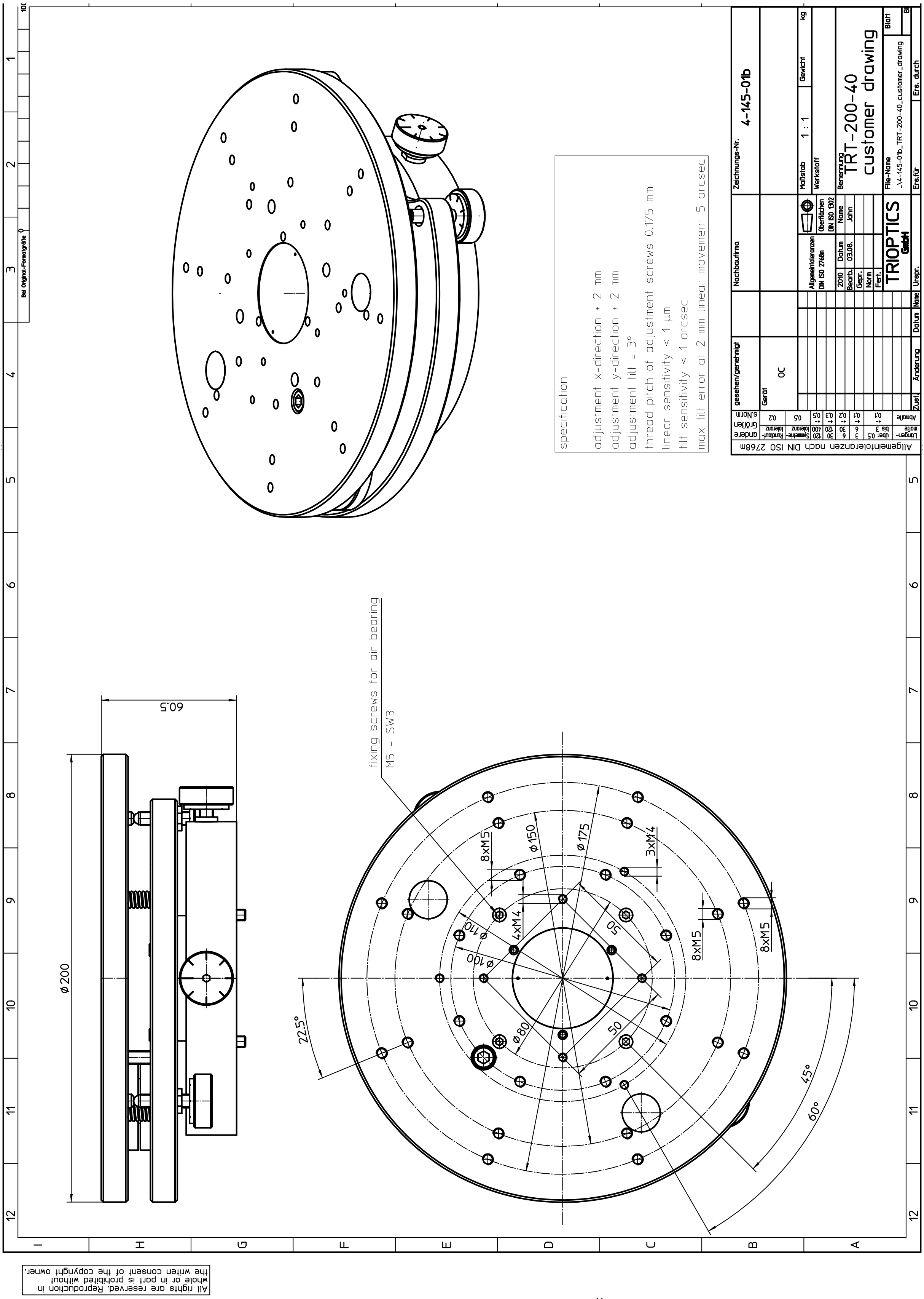
Reference to the used non-harmonised standards

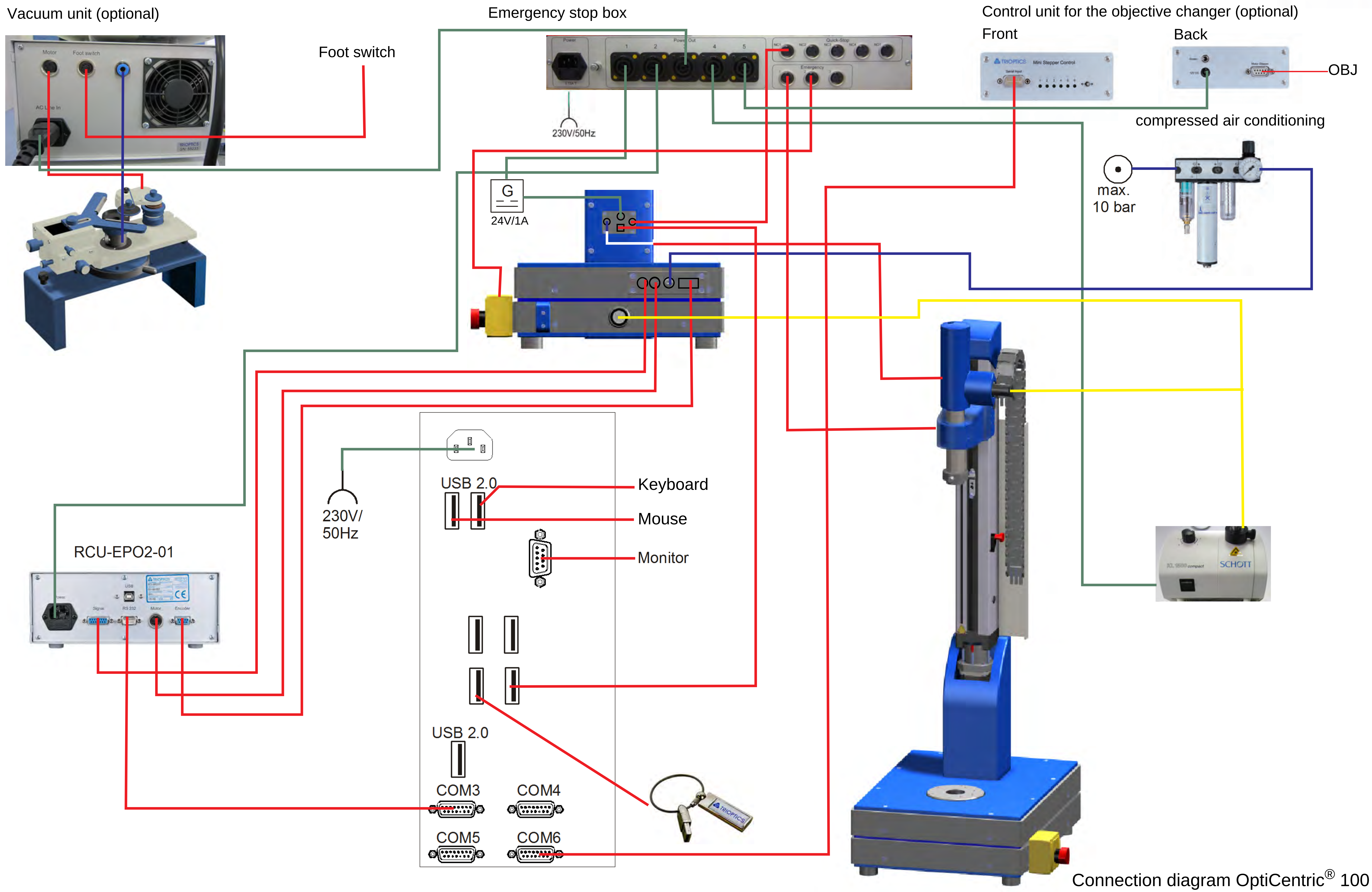
EN 62471:2008

Wedel, 15.08.2013
Place, Date

Eugen Dumitrescu
General Manager

Simon Viets
CE authorised person


specification
adjustment x-direction ± 2 mm
adjustment y-direction ± 2 mm
adjustment tilt ± 3°
thread pitch of adjustment screws 0.175 mm
linear sensitivity < 1 µm
tilt sensitivity < 1 arcsec
max tilt error at 2 mm linear movement 5 arcsec
fixing screws for air bearing
M5 - SW3
60.5
ø200
ø150
ø175
ø110
ø100
ø80
8xM5
4xM4
3xM4
50
22.5°
45°
60°
Zeichnungs-Nr. 4-145-01b
Maßstab 1 : 1
Benennung
TRT-200-40
customer drawing
TRIOPTICS GmbH
Allgemeintoleranzen nach DIN ISO 2768m
All rights are reserved. Reproduction in whole or in part is prohibited without the written consent of the copyright owner.



Connection diagram OptiCentric® 100

TRIOPTICS

TRIOPTICS GmbH·Optische Instrumente·Strandbaddamm 6·22880 Wedel, Germany
Phone: +49-4103 - 18006 - 0·Fax: +49-4103 - 18006 - 20
E-mail: info@trioptics.com·http://www.trioptics.com

97-003-002