MarOpto MFU 200-3D

High-precision 3D measuring station for optical components



The close-to-production 3D measuring station – ultraprecise and universal

The MarOpto MFU 200-3D is a universal machine for measuring contour, roughness, axis offset, radial runout and tilt errors in lenses in one setup. It is thus ideal for spheres, aspheres, cylinder lenses and freeforms. Measurements are taken automatically, quickly and close to production in 2D and 3D. Thanks to the unique combination of optical and tactile probe arms, a reference surface of the component can be used to determine the form and position of the other surfaces. Mahr's tried and tested software platform MarWin provides the basis for various, modular evaluation options of the lenses. There is a new software package - AnyShape - available for this.

Users benefit from the following advantages:

- Increased productivity thanks to minimal calibration due to greater temperature stability
- Close-to-production option available thanks to measuring cabinet with attenuation
- Accuracy due to dynamic realtime compensation (measurement uncertainty < 100 nm [PV])
- Reference system on the component itself thanks to combination of optical and tactile sensors
- Flexibility thanks to measurable gradient angle of up to 45°
- Standard evaluation as per ISO 10110-5
- Universal thanks to automation of different measuring tasks on one machine



Shorter measuring times

The new quick-clamping device allows individual adjustment to the measuring object.

Maximum diameter

180 mm

X-axis

Noise figure

< 5 nm

Roundness deviation

< 20 nm

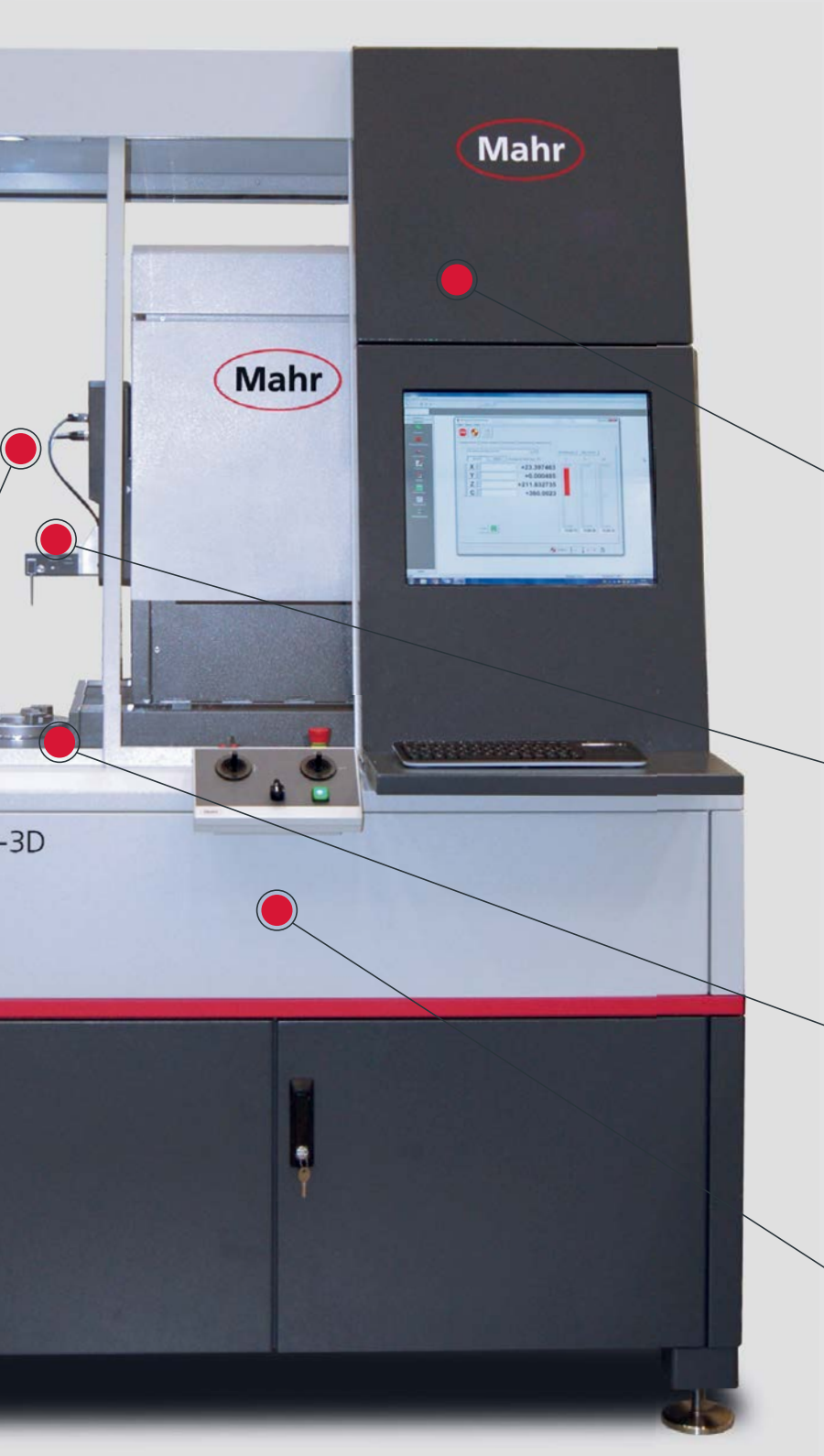
Measurement uncertainty

< 100 nm PV

Measurable gradient up to

45°

on rotationally symmetrical parts



Most reliable repeatability

Even better drives guarantee maximum reproducibility in the positioning range.

Flexible multisensor system

The flexible motorized probe measures alternately with the tactile probe arm or the optical sensor.

Automated measuring routine

The motorized centering and tilting means that user intervention is no longer required, ensuring process stability.

Unique precision

The MarOpto MFU 200-3D is the most accurate polar coordinate measuring machine in the nm range for lens components.

Perfectly equipped for close-to-production form measurement

The optical industry in particular can benefit from Mahr's many years of expertise in form measurement with the MarOpto MFU 200-3D. The machine is optimized for precision and to save time and allows measurements to be made close to production. A range of automatic functions and processes and the appropriate accessories keep user intervention to a minimum to obtain reliable and reproducible measuring results.



Optical-tactile measurement of cylinder lenses, freeforms and off-axis lenses

The MarOpto MFU 200-3D can perform optical and tactile measurements of surfaces in one setup. The optical measurement is carried out using an interferometric point sensor. There is a wide selection of probe arms for tactile measurement. The user can easily and safely switch the probe using a magnetic fixture. When the two measuring procedures are combined, the surfaces are referenced in a coordinate system, which is particularly relevant for cylinders and freeforms. This innovative combination provides information about the position of the surfaces in relation to each other, which means that the alignment of the testpiece is of secondary importance.

Automatic centering and tilting table

Precise alignment of the workpiece is crucial for accurate and reproducible measurement of optical components, especially aspheres. The MarOpto MFU 200-3D has an automatic centering and tilting table, which both ensures high reproducibility and saves time.





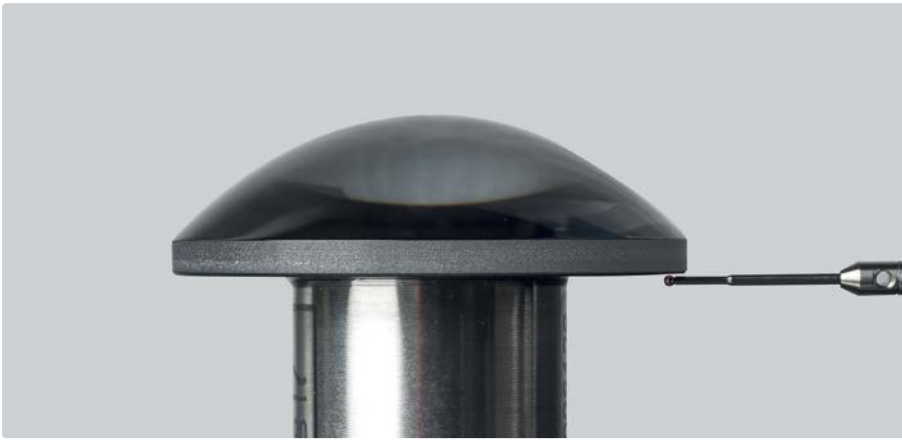
Mechanical reference surfaces (fiducials)

The position and form deviation of the optical surface can be evaluated in relation to mechanical reference surfaces by way of combined optical and tactile measurements. Decentration, tilt and twist errors can thus be identified.

T7W probe system

The T7W probe system features a freely positionable probe holder. The individual probe arms can be easily switched by way of a magnetic fixture. Users can choose from various tactile probe arms and combine them with the optical sensor. The system is protected both mechanically and electronically against overload (collision).

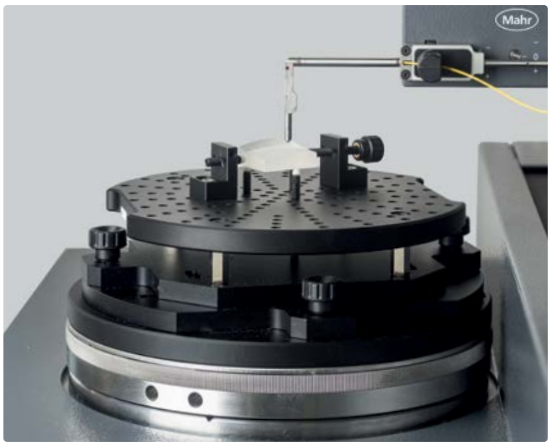


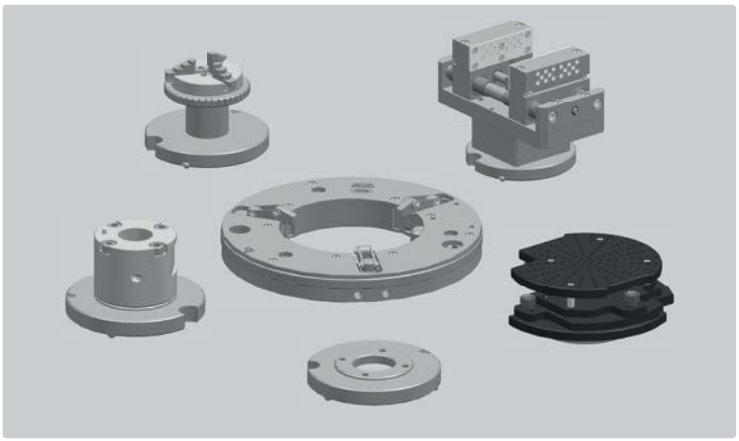




Calibration set

The calibration set for the MarOpto MFU 200-3D consists of an assortment of calibration cylinders and spheres, which can be mounted in HD25 clamps.





Innovative clamp set

The new clamp set for the MarOpto MFU 200-3D offers testpiece holders for the most diverse applications making it versatile for every purpose. This means that even users with a very wide range of workpieces are perfectly equipped. The individual clamping tools can be swapped quickly as no tools are required.

Powerful software
for measuring tasks in lens production

Mahr not only offers universal hardware with the MarOpto MFU 200-3D, but also the perfectly compatible measuring and evaluation software based on the MarWin platform for the special applications of the optical industry. The user interface of the software is clearly laid out and easy to navigate.

AnyShape AsphericLib		**Geometry** of lens surface	
		rotationally symmetrical	non-rotationally symmetrical
Outer aperture of the lens (reference measurement)	circular	asphere, sphere, optical flat...	cylinder lens, toroid, off axis...
	non-circular	asphere, sphere, optical flat...	cylinder lens, toroid, off axis...

AsphericLib

The AsphericLib software package measures spheres, aspheres and mounting surfaces and evaluates the results. Users can benefit from the following options:

- Automated 2D and 3D measurement
- Define nominal geometries using a clear software interface
- Analyze and display the surface form deviation and the slope error in a graph in accordance with ISO 10110-5
- Reverse engineering and simulation: Determine the asphere coefficients of unknown geometries
- Export profiles for correcting machine tools in file formats *.mod, *.txt, *.ascii, *.dat, *.xyz, *.zygo.dat, *.x3p
- Import geometry data from the machine tool
- Automatically create measuring records with ISO 10110-5 parameters

New: AnyShape

The AnyShape software package is optimized for more complex geometries such as off-axis lenses, toroids, special and freeform lenses and evaluates these. Users can benefit from the following options:

- Automatic 3D measurement
- Derive asphere coefficients
- Export profiles for correcting machine tools in file formats *.zygo.dat, *.xyz, *.txt, *.ascii, *.dat, *.x3p, *.fo+
- Evaluation in relation to calibrated reference marks
- Create measuring records automatically



Sample applications
for testing optical components

The software packages of the MarOpto MFU 200-3D enable the optimal testing of all the relevant optical components with regard to their relevant properties. The following measuring sequences are possible, for example:



Measuring aspheres with AsphericLib

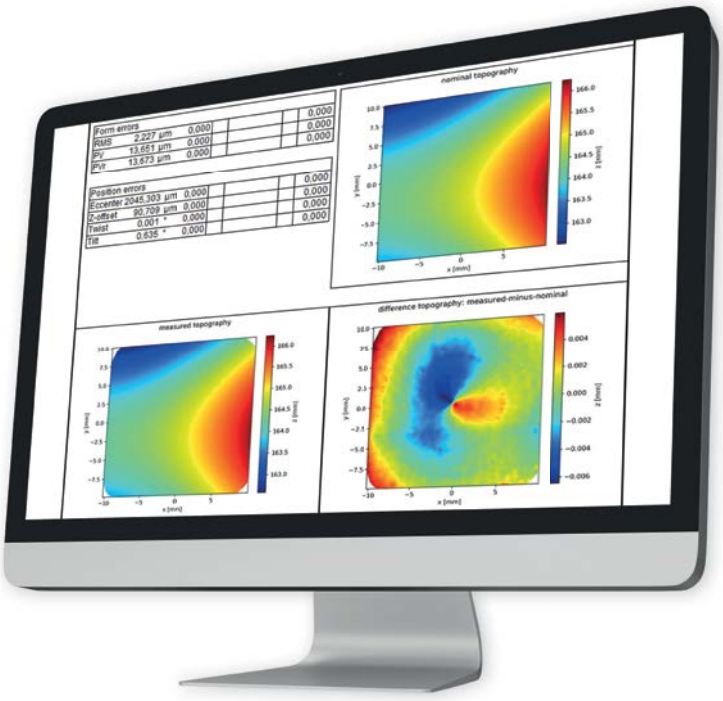
The following measuring routine is specified for testing aspheres with AsphericLib:

- Enter the target parameters (R, k, Ai)
- Automatic alignment of testpiece
- Measure the topography using circular paths
- Evaluate as 3D differential topography and 2D difference profile
- Evaluation as per ISO 10110-5
- Information about power, irregularity, RMSi, R0 etc.

Measuring freeforms with AnyShape

The following measuring routine is specified for testing freeforms with AnyShape :

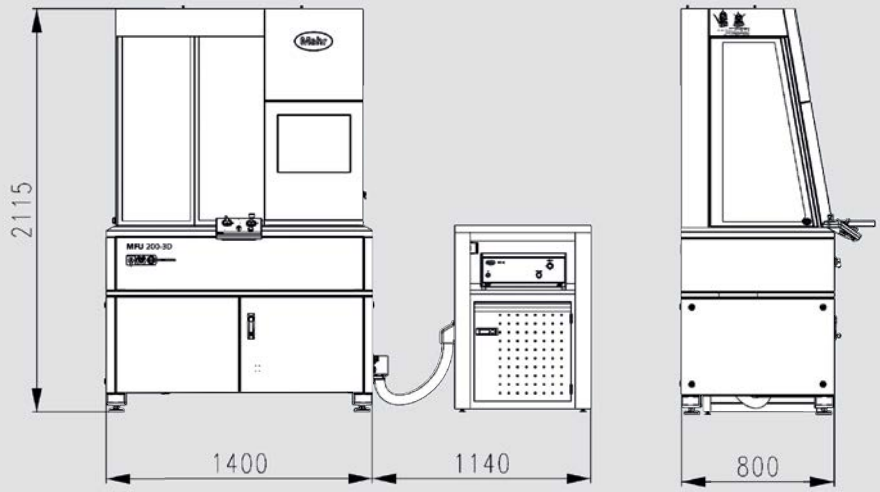
- Enter geometric parameters (Torus, Biconic, cylinder, off axis, free analytical description)
- Define mechanical fiducials
- Calibrate the workpiece position using fiducials
- Measure the topography using circular paths
- Evaluate as 3D differential topography (R, PV, RMS, Slope)
- Evaluate centering errors (optical axis against mechanical references)

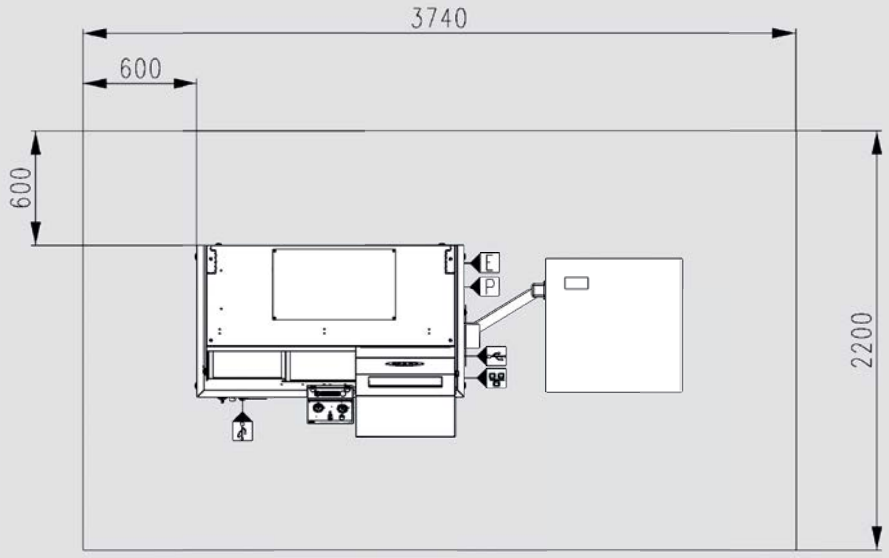


Device information

MarOpto MFU 200-3D

Item no. 5440581





Connection data	
Supply voltage (V)	230 (CEE connection)
Frequency (Hz)	50
Nominal output (VA)	1,800
Dimensions and weight	
Length x width x height (mm)	1,400 x 800 x 2,115
Machine weight (kg)	approx. 850

Rotationally symmetrical workpiece geometries (e.g. optical flat, sphere, asphere)		
2D scan	**optical**	**tactile**
max. measuring range in X (mm)	180	180
max. measuring range in Z (mm)	320	320
max. surface gradient (°)	± 45	± 45
Measurement uncertainty PV (f_{WI})[1] (nm)	< 100	< 150
Radial uncertainty[2] (mm)	0.0002 + (0.00002*R)	0.0002 + (0.00002*R)
Reproducibility[4] (nm)	± 50 (3 σ)	± 75 (3 σ)
3D scan	**optical**	**tactile**
max. measuring range in X (mm)	Ø 135 (max. Ø 180)	180
max. measuring range in Z (mm)	320	320
max. surface gradient (°)	± 45	± 45
Measurement uncertainty PV (f_{WI})[1] (nm)	< 100	< 150
Radial uncertainty[2] (mm)	0.0002 + (0.00002*R)	0.0002 + (0.00002*R)
Reproducibility[4] (nm)	± 50 (3 σ)	± 75 (3 σ)
Non-rotationally symmetrical workpiece geometries (freeform, e.g. cylinder lenses)		
3D scan	**optical**	
max. measuring range in X (mm)	Ø 135	
max. measuring range in Z (mm)	320	
max. surface gradient (°)	± 28 (max. ± 45)	
Measurement uncertainty PV (f_{WI})[1] (nm)	< 100	
Radial uncertainty[2] (mm)	0.0002 + (0.00002*R)	
Reproducibility[4] (nm)	± 50 (3 σ)	
Centering and tilting table		
Table diameter (mm)	180	
Table load capacity, centered[3] (N)	200	
Traverse path X,Y (mm)	± 1.8	
Tilting angle A, B (°)	± 0.6	

1 as per ISO 14999-4 (corresponds to ISO 10110-5 B [IRR]) on reference sphere R5 (median filter 0.1 mm, K1-2D filter 0.05)

2 as per ISO 10110-5

3 dependent on geometry up to max. 45°

4 calculated at factory

We reserve the right to make changes to the technical data. More detailed data on request.

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