Measuring instruments for optical parameters

Lens Testing Equipment
Camera Testing Equipment
IIT Testing Equipment
Automated Lens Assembly
Lens Testing Services
MTF Measuring Systems
Professional evaluation of image quality and aberrations

About OEG GmbH
MTF measuring systems from OEG enable the automatic, software-controlled measurement of numerous parameters of many lens types. We supply special solutions for short and long focal lengths, small and large apertures, for telephoto lenses, telecentric lenses or fish eyes. Our measuring instruments are freely programmable or can be controlled interactively by joystick. Anyway, OEG GmbH can look back on 25 years of experience in the measurement of MTF and optical parameters.

Our experienced and well trained staff will find the right solution for you!

About MTF Measurement
MTF test systems enable the test of objectives under real application conditions, similar to actual applications. Field angle positions, spectral ranges, distances between object- and image plane can be replicated or simulated.

Apart from the MTF, numerous further parameters of the lens under test can be derived. These are, for example:
- Modulation Transfer Function (MTF)
- Line spread function
- Edge spread function
- Focal length
- Back focal length
- Flange focal length (relative)
- Symmetry
- Magnification
- Chromatic aberrations
- Image field curvature
- Distortion
- Astigmatism
- Telecentricity error
- Tilt
- Depth of focus
- Chief ray angle

Design your MTF test bench
Due to the variety of optical systems it is hardly possible to develop an universal MTF measuring device for all tasks. Therefore MTF measuring instruments are often customer specific. Building on existing solutions, the device is tailored to the special requirements. This reduces costs and ensures that the equipment meets the requirements.

MTF Master 200: Fully automatic MTF test bench for object angle up to 2w=200°

MTF Master 70/500-1000: The standard for MTF measurement for photo- and video objectives
MTF PentaTest
Real-time inline MTF measurement for robot-assisted assembly of camera modules

Miniature camera modules have been used for years increasingly in smartphones, tablets, automotive industry and other applications. The production of these high quantities requires automatic, robot-assisted assembly of the modules. This requires inline measuring systems for controlling the assembly robots.

MTF Pentatest meets these requirements and is already used in several production lines for camera modules. The hardware consists of a collimator block with 5 collimators. Each collimator creates an image at infinity at a certain angle for the optics of the camera module. The angles are dimensioned in such a way that a test chart image is produced in the center and in each corner of the sensor chip. The Pentatest-software evaluates these 5 images in real time and controls the robot so that the required resolution (MTF) is achieved in all measuring points.

The collimator block must be adapted to the test specimen requirements for different applications with regard to focal length and object angle. Other parameters, which can be adapted to the special demands are:
- wavelength for illumination
- MTF frequency for good / bad decision.

Of course, MTF Pentatest can be used also for other inline real time MTF test applications, even without the use of a robot.
**MTF MASTER IIT**

*Measurement of MTF and photometric parameters*

The MTF MASTER IIT performs automatic, software controlled measurement of MTF on different positions on the IIT screen, using 6 motorized axes. All 6 motorized axes have a resolution of 1µm. In the adjustment mode, they are controlled by joystick. In the measuring mode, they are moved automatic and software controlled.

The basic configuration features the measurement of MTF (Modulation Transfer Function). Optional additional functions are the following photometric parameters:

- Halo
- SNR
- Luminance gain
- Saturation level
- Back ground screen luminance

- EBI (equivalent background input)
- Photocathode luminous sensitivity

The MTF-MASTER IIT consists of 4 main components:

- Illumination unit with continuously adjustable and software controlled light intensity (1E-6lx...0,1lx);
- object generator with reticle and high resolution projection optics (2micron slit width in the photocathode plane);
- IIT-Mounting unit (3 motorized software controlled axes) with adjustable DC power supply (Voltages are software controlled turn on / turn off and can be applied with ramps)
- Analysing unit (measuring microscope with LWD objective, 3 motorized software controlled axes)

**OTS 200 / OTS 500**

*Optics Test Stations for single lenses and optical systems*

The Optics Test Stations are an indispensable tool for control of incoming goods and quality assurance in optics production!

OTS 200 and OTS 500 featuring the objective, motorized and software controlled measurement of optical parameters of single lenses and optical systems like:

- Effective Focal Length (EFL), positive and negative
- Back Focal Length (BFL)
- Radius of Curvature (R), positive and negative
  - Flange Focal Length (FFL)
  - Modulation Transfer function (MTF), on axis, tangential and sagittal
  - Centering error
- Lens center thickness
- large EFL up to 20m by auxiliary lens
- lens center thickness
- refractive index
- wedge angle / parallelism of plan optics, 90°-angle of prisms

The standard system is the OTS 200, which has a measuring range up to ±600 mm for EFL, FFL, BFL and Radius. The OTS 500 was developed in particular for the measurement of long focal length optics. It has a measuring range up to ±1200mm for EFL, BFL, FFL and Radius.

The length of the z-axis can also be adapted to other requirements depending on the application.
LensTest

Evaluation of complex lens assemblies and lens alignment for cementing process

LensTest is used both for the analysis of complex optical systems and for the active alignment of lenses in the production of optics. LensTest is a standalone software, which works in connection with the Optics Test Station OTS 200 by OEG GmbH.

Analysis functions of LensTest

LensTest serves for the quality assurance in optics production. It helps to find the reasons, why optical assemblies do not meet the expected imaging quality. Reasons for bad imaging quality are often differences between the optical design and the real optical assembly, for instance:

- wrong lens distances (air gaps)
- wrong lens thicknesses
- off centered lenses
- wrong radii

The Software LensTest serves for the evaluation of assembled optical systems and the analysis of the above mentioned errors.

Problems of error analysis

The essential problem is: a measuring system outside of the assembled optics under test can see only the image of a lens surface, not the surface itself. The image position is influenced from all lens surfaces, located before the surface under test. That means, the real physical position of a lens surface in an optical assembly can only calculated from relation to mechanical centring line (centring error)
- twist between cylinder axis and mechanical reference

Depending on the mechanical dimensions of the specimen, an according x/y stage must be used. Centring error and Twist can be measured with a reproducibility of ±5 micron.

The advantages of the optics test stations OTS 200, OTS 500 and OTS-Z are:

- objective, fast and high accurate measurement by electronic image evaluation;
- autofocus function avoid influence of operator on measurements;
- motorized, software controlled movement of the measuring head;
- optional control of measuring head by joystick;
- motorized reticle changer for measuring collimator;
- direct connection to Windows computer for creation of protocols and data storage;
- live video image of the measuring signal on the PC screen;
- easy operability by intuitive software interface;
- proven solution, worldwide used;
- unique concept to prove measuring accuracy.

OTS-Z Optics Test Station for cylindrical lenses

OTS-Z is a special solution of the standard OTS for the measurement of parameters of cylindrical lenses. The following parameters of cylindrical lenses are supported to measure:

- effective focal length (EFL)
- back focal length (BFL)
- radius of curvature (R, concave/convex)
- flange focal length (FFL)
- deviation of cylinder axis in relation to mechanical centring line (centring error)
- twist between cylinder axis and mechanical reference

Depending on the mechanical dimensions of the specimen, an according x/y stage must be used. Centring error and Twist can be measured with a reproducibility of ±5 micron.
the position of its image. The same is true for the centers of curvature.

LensTest was developed to solve this problem. LensTest calculates the expected image position of each physical lens surface from the optical design data of the optical system under test.

Knowing the image position of a lens surface, LensTest can recalculate the position of the real lens surface inside the optical system and compare the position with the optics design to find.

Analysis procedure

An automatic scan along the optical axis captures all reflexes and assigns a lens surface or center of curvature to the according reflex. That allows the comparison of the expected and actual position of a reflex and respectively the comparison of the real surface positions with the design data.

LensTest Features

- All measurements can be performed with assembled optical systems
- Centering measurement without rotation of the sample
- Large Measuring range because numerous measuring objectives
- Automatic scan of the complete lens and detection of all reflexes
- Exact position measurement by autofocus
- The optical setup can be extend with measuring functions for EFL, BFL, FFL, ROC and MTF on axis
- The surface images can be approached either automatically or manually
- The surface images are displayed in real time on a PC screen
- Illumination power can be adjusted according brightness of reflexes
- For the calculation of the positions of the centers of curvature, the decentering of the previous surfaces are considered
- LensTest considers the measuring wavelength and recalculates the design data accordingly

Technical Data

<table>
<thead>
<tr>
<th>LensTest with OTS-Standard-Hardware</th>
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<tbody>
<tr>
<td>Accuracy center thickness measurement</td>
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<tr>
<td>Accuracy centration measurement</td>
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<tr>
<td>Accuracy air gap measurement</td>
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The increase of the accuracy is possible, if the z-stage is equipped with a digital encodes. On inquiry, such solutions can be offered.

Lens alignment by LensTest for the cementing process

The analysis functions of LensTest can also be used for the active alignment of lens surfaces when the lenses are cemented.

An automatic scan along the optical axis captures all reflexes and assigns a lens surface or center of curvature to the according reflex. That allows the manual alignment of a lens surface to the optical axis of the other (fixed) lens surfaces. LensTest indicates, if the calculated ideal alignment is achieved and the lens can be cemented.
FLATSCAN
Inspection of any freeform shaped reflective optical components, wafers and glass substrates

Dependent on application, FLATSCAN can be equipped with different sensor types. Each sensor type has special characteristics that make it ideal for certain applications. In general, both types are very suitable for large test specimens. Both systems can characterize surfaces either by line scans and/or surface mapping measurements (grid scans).

1. FLATSCAN AC
   - based on auto collimation principle;
   - ideal for reflecting surfaces like mirrors, x-ray mirrors, silicon wafers;
   - for wafer application including module for thin film stress measurement;
   - software offers stitching for extremely large radius (slope-) measuring range;

2. FLATSCAN TA
   - based on triangulation sensor;
   - simultaneous measurement of flatness and thickness of glass substrates;
   - suitable for reflecting and some kind of non-reflective surfaces;

Testing Service
Since 1991 OEG GmbH develops and produces highly accurate optical measuring systems for industry and research. Our experience in optical metrology for many years guarantees reliable, and customer-oriented execution of the measuring task. OEG GmbH maintains testing capabilities for many optical parameters. We offer comprehensive modulation transfer function lens testing and testing services for other parameters. Many of our metrology products are available for contract metrology work.

To put OEG to work for you, call us or fill out the Optical Lens Testing Services questionnaire, which you can find on our website www.oeggmbh.com.
Wedge Angle Scanner
for HUD car windshields

Windshields for cars with head up display need an exact adjusted wedge angle in the field of view of the driver. The wedge angle scanner serves for the fully automatic, exact measurement of the wedge angle in the complete field of view of the car driver. The measurement is based on an highly accurate autocollimation principle, which enables the precise measurement of the beam deflection by the windshield. From that measurement, the wedge angle can be calculated in any point of the windshield. The scanned area can be defined by software. Measuring receipes for different types of wind shields can be created, saved and called by the operator.

CROSSDETECT
Increase the accuracy of your autocollimator by factor 10

CROSSDETECT is an image processing software, which was specially developed for use in connection with autocollimators.

Features
- Increases the measuring accuracy by a factor of 10 compared to visual autocollimators;
- can be retrofitted with existing autocollimators;
- complete package with camera, autocollimator and software can be supplied;
- many camera types available;
- adapter for eyepiece available;
- flexible software with many standard measuring functions;
- customized functions and interfaces can be supplied;
- different options for referencing;
- on request: multi cross detection available;
- standard computer or laptop can be used;
- windows operating system...