OCULUS Keratograph® 5M

Dry Eye Evaluation and Topography

OCULUS®

OCULUS Keratograph® 5M

Dry Eye Evaluation and Topography

The multi-purpose topographer has become an integral part of the ophthalmological and optometric practice. Examiner-independent measurements provide reliable data, clear analysis, and full documentation. Clear and easy-to-understand representations facilitate communication with your patients and ensure a time-saving workflow.

"The Keratograph 5M is one of the most versatile instruments that we have in our practice. It is highly valuable and efficient for a very busy and technology-driven eye care practice such as ours."

Barry Eiden, O.D., USA

"I use the R-Scan for contact lens fitting and documentation of ocular changes – what a helpful visual consultation tool!"

(FH) Marc Schulze, PhD, Dipl. Eng., Canada

"Turn dry eye guesswork into a simple scientific equation for predictable outcomes. The new OCULUS Crystal TEAR Report brings the dry eye protocol to life. Get the outcome patients want in a time frame that fits into your flow!"

Crystal Brimer, O.D., FAAO

"The Keratograph 5M is the swiss army knife of ophthalmic equipment. A cornerstone of our dry eye protocols with a wide array of ocular surface disease testing and patient education capabilities. A tremendous value for patients and the practice!"

Carl Spear, O.D., MBA, FAAO

"The Keratograph 5M is the most versatile piece of equipment that I have ever used in my practice. I especially love to show patients their meibography images. They are often surprised, even stunned, when they see their gland dropout, and are much more likely to follow my recommendations. A picture is truly worth a thousand words!"

Marguerite McDonald, M.D., USA

"My Keratograph 5M is the core of my dry eye practice and one of our most used instruments. It's also a great topographer and an amazing patient education tool. I honestly don't know how I would practice without it."

Arthur Epstein, O.D., FAAO

OCULUS Keratograph® 5M – Versatile

Measurements With Placido Ring Illumination

White ring illumination is used to measure thousands of points on the entire corneal surface. Infrared ring illumination is also available for analyzing the tear film in order to prevent reflex tear secretion caused by glare.

LED Measurements

The Keratograph® 5M proudly offers the perfect illumination for each function: White diodes for tear film dynamics, blue diodes for fluorescein images and infrared diodes for meibography.

> white illumination

> infrared illumination

> blue diodes

Where to find?

- Crystal TEAR Report
- Meibography
- Classification of redness
- Tear film analysis

- Precise measurement of the corneal shape
- Extensive analysis and graphics
- Automatic keratoconus detection

- Course of disease displays
- Image and video documentation
- Measuring instruments

- Selection of contact lenses
- Fluorescein image simulation

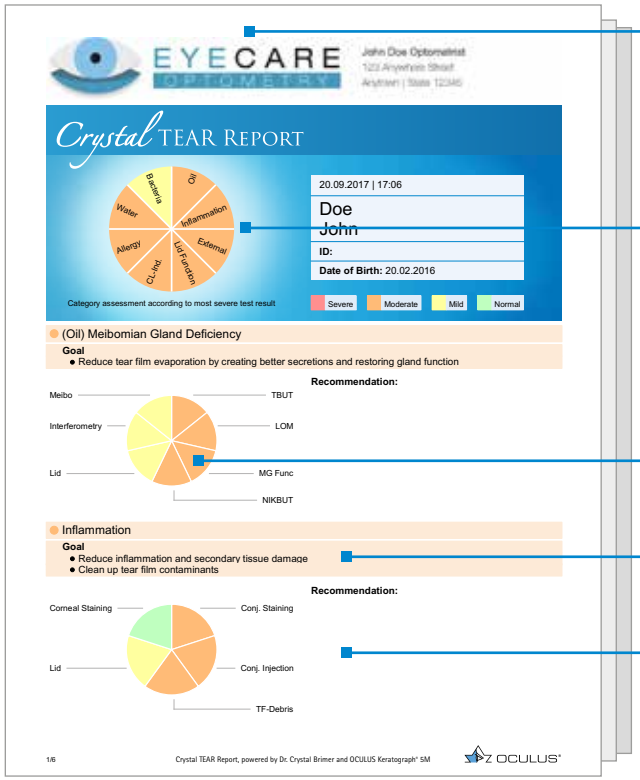
- Technical data
- Network connection ability
- Software overview

Dry Eye Evaluation	Topography	Documentation	Contact Lens Fitting	Technology & Software

NEW Crystal TEAR Report

Make Dry Eye Diagnosis Crystal Clear

Find out the cause of dry eye disease quickly and reliably with the assistance of the new Crystal TEAR Report in the Keratograph® 5M. Carry out a comprehensive analysis using the measurement results as a basis for your diagnosis. All results are summarized in a patient-friendly, neatly arranged printout, enabling you to combine documentation and patient education.


EYECARE OPTOMETRY

John Doe Optometrist
123 Anywhere Street
Anytown | State 12345

Crystal TEAR Report

20.09.2017 | 17:06

Doe
John

ID:

Date of Birth: 20.02.2016

Category assessment according to most severe test result

Severe | Moderate | Mild | Normal

(Oil) Meibomian Gland Deficiency

Goal
- Reduce tear film evaporation by creating better secretions and restoring gland function

Recommendation:

Meibo — TBUT
Interferometry — LOM
Lid — MG Func
NIKBUT

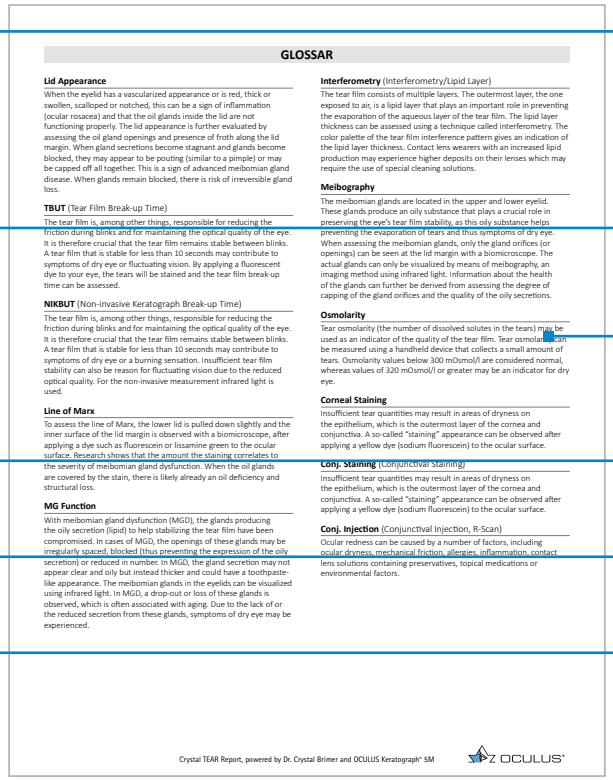
Inflammation

Goal
- Reduce inflammation and secondary tissue damage
- Clean up tear film contaminants

Recommendation:

Corneal Staining — Conj. Staining
Lid — Conj. Injection
TF-Debris

1/6 Crystal TEAR Report, powered by Dr. Crystal Brimer and OCULUS Keratograph® 5M


GLOSSAR

Lid Appearance
When the eyelid has a vascularized appearance or is red, thick or swollen, scalloped or notched, this can be a sign of inflammation (ocular rosacea) and that the oil glands inside the lid are not functioning properly. The lid appearance is further evaluated by assessing the oil gland openings and presence of froth along the lid margin. When gland secretions become stagnant and glands become blocked, they may appear to be pouting (similar to a pimple) or may be capped off all together. This is a sign of advanced meibomian gland disease. When glands remain blocked, there is risk of irreversible gland loss.

TBUT (Tear Film Break-up Time)
The tear film is, among other things, responsible for reducing the friction during blinks and for maintaining the optical quality of the eye. It is therefore crucial that the tear film remains stable between blinks. A tear film that is stable for less than 10 seconds may contribute to symptoms of dry eye or fluctuating vision. By applying a fluorescent dye to your eye, the tears will be stained and the tear film break-up time can be assessed.

NIKBUT (Non-invasive Keratograph Break-up Time)
The tear film is, among other things, responsible for reducing the friction during blinks and for maintaining the optical quality of the eye. It is therefore crucial that the tear film remains stable between blinks. A tear film that is stable for less than 10 seconds may contribute to symptoms of dry eye or a burning sensation. Insufficient tear film stability can also be reason for fluctuating vision due to the reduced optical quality. For the non-invasive measurement infrared light is used.

Line of Marx
To assess the line of Marx, the lower lid is pulled down slightly and the inner surface of the lid margin is observed with a biomicroscope, after applying a dye such as fluorescein or lissamine green to the ocular surface. Research shows that the amount the staining correlates to the severity of meibomian gland dysfunction. When the oil glands are covered by the stain, there is likely already an oil deficiency and structural loss.

MG Function
With meibomian gland dysfunction (MGD), the glands producing the oily secretion (lipid) to help stabilizing the tear film have been compromised. In cases of MGD, the openings of these glands may be irregularly spaced, blocked (thus preventing the expression of the oily secretion) or reduced in number. In MGD, the gland secretion may not appear clear and oily but instead thicker and could have a toothpaste-like appearance. The meibomian glands in the eyelids can be visualized using infrared light. In MGD, a drop-out or loss of these glands is observed, which is often associated with aging. Due to the lack of or the reduced secretion from these glands, symptoms of dry eye may be experienced.

Interferometry (Interferometry/Lipid Layer)
The tear film consists of multiple layers. The outermost layer, the one exposed to air, is a lipid layer that plays an important role in preventing the evaporation of the aqueous layer of the tear film. The lipid layer thickness can be assessed using a technique called interferometry. The color palette of the tear film interference pattern gives an indication of the lipid layer thickness. Contact lens wearers with an increased lipid production may experience higher deposits on their lenses which may require the use of special cleaning solutions.

Meibography
The meibomian glands are located in the upper and lower eyelid. These glands produce an oily substance that plays a crucial role in preserving the eye's tear film stability, as this oily substance helps preventing the evaporation of tears and thus symptoms of dry eye. When assessing the meibomian glands, only the gland orifices (or openings) can be seen at the lid margin with a biomicroscope. The actual glands can only be visualized by means of meibography, an imaging method using infrared light. Information about the health of the glands can further be derived from assessing the degree of capping of the gland orifices and the quality of the oily secretions.

Osmolarity
Tear osmolarity (the number of dissolved solutes in the tears) may be used as an indicator of the quality of the tear film. Tear osmolarity can be measured using a handheld device that collects a small amount of tears. Osmolarity values below 300 mOsmol/l are considered normal, whereas values of 320 mOsmol/l or greater may be an indicator for dry eye.

Corneal Staining
Insufficient tear quantities may result in areas of dryness on the epithelium, which is the outermost layer of the cornea and conjunctiva. A so-called "staining" appearance can be observed after applying a yellow dye (sodium fluorescein) to the ocular surface.

Conj. Staining (Conjunctival Staining)
Insufficient tear quantities may result in areas of dryness on the epithelium, which is the outermost layer of the cornea and conjunctiva. A so-called "staining" appearance can be observed after applying a yellow dye (sodium fluorescein) to the ocular surface.

Conj. Injection (Conjunctival Injection, R-Scan)
Ocular redness can be caused by a number of factors, including ocular dryness, mechanical friction, allergies, inflammation, contact lens solutions containing preservatives, topical medications or environmental factors.

Crystal TEAR Report, powered by Dr. Crystal Brimer and OCULUS Keratograph® 5M

Your personal logo on the Crystal TEAR Report

Easy to understand color-coded pie chart for assessment of dry eye disease

Explanations of abbreviations and technical terms that your patients can understand

Comprehensible presentation of individual measurements and their results

Clear explanation of the treatment goal along with the necessary therapeutic steps

Write your personal recommendations here

Bring Your Dry Eye Protocol to Life

Benefit from all the advantages of the new Crystal TEAR Report in the Keratograph® 5M: efficient screening, well-founded measurement results and greater patient loyalty.
With its preselection of recommendations and the option to manually adapt them, the Crystal TEAR Report allows you to draw up an effective treatment, according to the individual causes of dry eye, in the shortest time. The result: a comprehensive dry eye analysis.

Recording Made Easy

Up to 50 recordings can be carried out easily for documentation purposes. Readily understandable user tips and optimal auto-setting prior to each recording make it possible to delegate the entire measurement process. Despite the high degree of user guidance, you can directly delete faulty recordings as well as change settings and adapt the measurement sequence individually.

Excel With Your Dry Eye Diagnosis

The entire course of diagnosis is documented, providing you with an ideal basis for your treatment decisions. All necessary recordings that are required to grade the individual's dry eye state, can be viewed at the same time. Depending on the grade you obtain, you can then determine a suitable treatment plan.

Additionally, you can enter the data from other tests, such as Osmolarity, Schirmer's Test, Phenol Red Thread Test, and more.

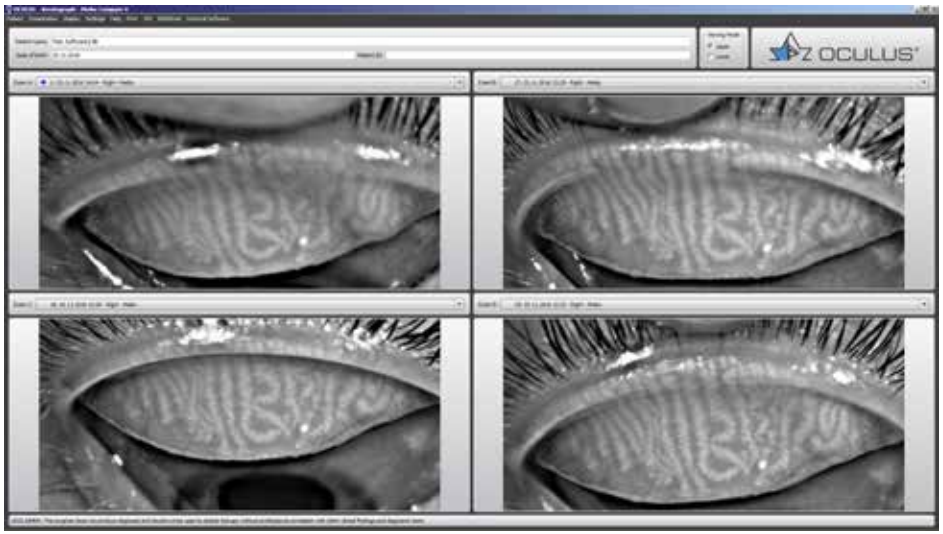
Documentation and Patient Education

The Crystal TEAR Report surely and safely walks you through all the necessary assessment criteria that make up a comprehensive dry eye analysis. To complete the treatment plan, you can manually enter your dosage recommendations for the individual therapeutic measures on the printout. Making it an easy-to-grasp, optimal means of patient education.

Meibo-Scan

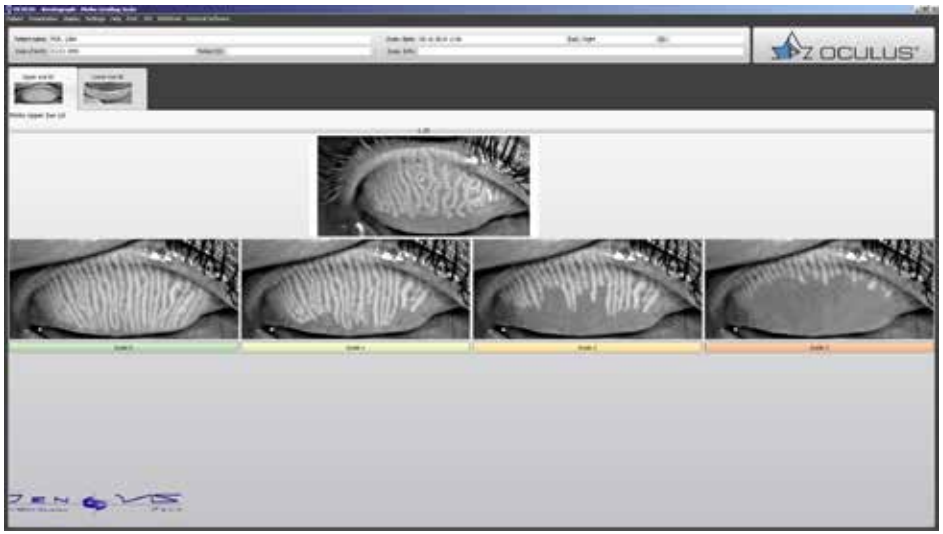
Meibography of the upper and lower eyelid

The new multi-functional Keratograph® 5M easily and efficiently integrates difficult examinations such as meibography. The dysfunction of meibomian glands is the most frequent cause of dry eye. Morphological changes in the gland tissue are made visible using the Meibo-Scan.



Intuitive Comparison of Meibography Findings

The "Compare Meibo Exams" function makes it possible to assess the condition of the glandular tissue over time and hence the success of treatment. It is also helpful in communicating with and educating patients.



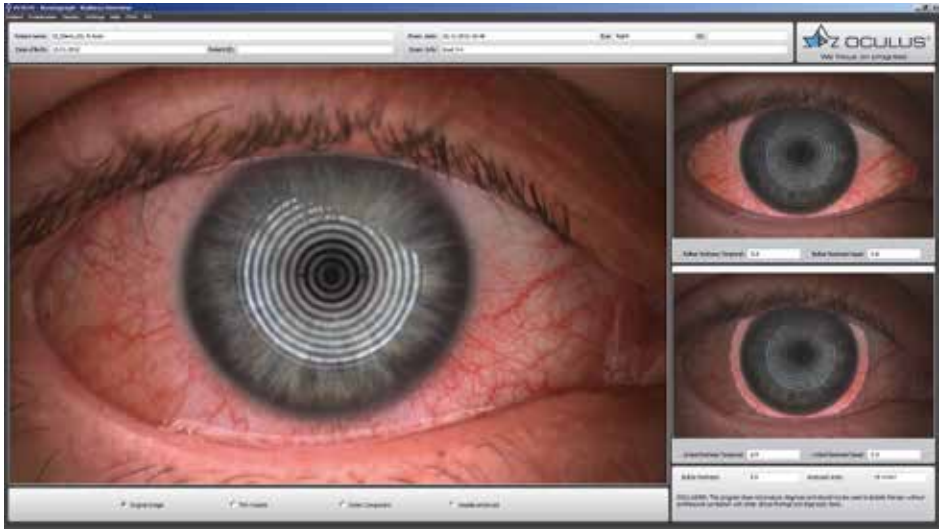
JENVIS Grading Scales

These four-point grading scales allow easy classification of MGD based on an individual meibography. Reference-state images assist in classifying the gland structure as normal or indicative of mild or severe MGD.

R-Scan

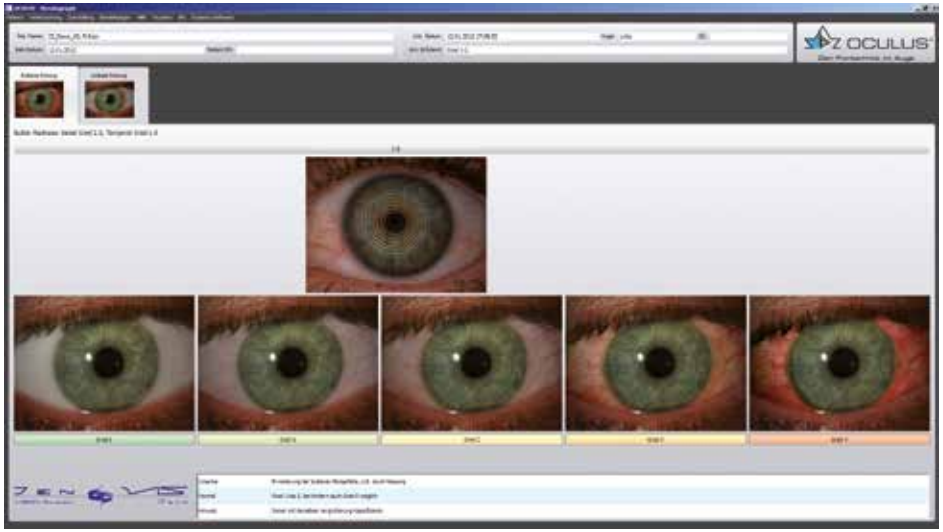
Automatic classification of conjunctival redness

Previously, conjunctival redness evaluation has been carried out subjectively and the results have varied according to the examiner's qualification. The Keratograph® 5M can classify the bulbar and limbal redness using the R-Scan. The R-Scan detects vessels in the conjunctiva and evaluates the degree of redness. This eliminates the need for time-consuming comparisons and provides greater reliability during evaluation.



Bulbar and Limbal Redness

Different display options help to classify the degree of redness. Choose between the camera image, view of fine vessels in the conjunctiva, red-free or contrast-enhanced display options. Bulbar and limbal redness are evaluated in the temporal and nasal areas, and all results are saved automatically.



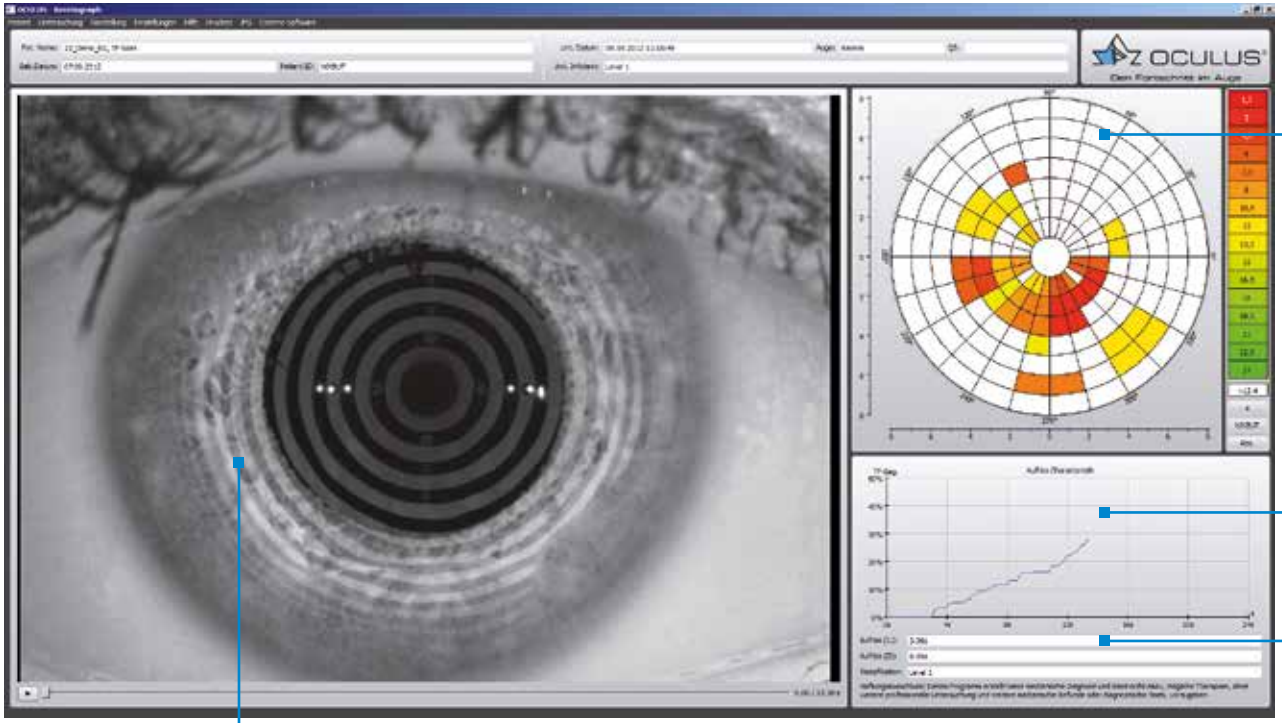
JENVIS Grading Scales

The degree of redness is based on the JENVIS Grading Scales. The comparison of your examination results with the actual-scale images of the JENVIS grading scale, facilitates the conversation when consulting with your patient. Further information on possible causes of redness, the normal condition as well as practical notes for capturing an image are provided below the actual-scale images.

TF-Scan

Evaluation of non-invasive tear film break-up time

The non-invasive tear film break-up time (NIKBUT) measures tear film stability. The NIKBUT is automatically measured within seconds, without fluorescein application. Human eyes are not able to perceive infrared illumination. Glare and reflex tear secretion are therefore avoided during the examination. The TF-Scan visualizes the results in an easy and understandable way – for you and your patients.



The Tear Map shows the affected areas: The respective break-up time is graphically illustrated for each segment in seconds and according to the principle of a traffic light.

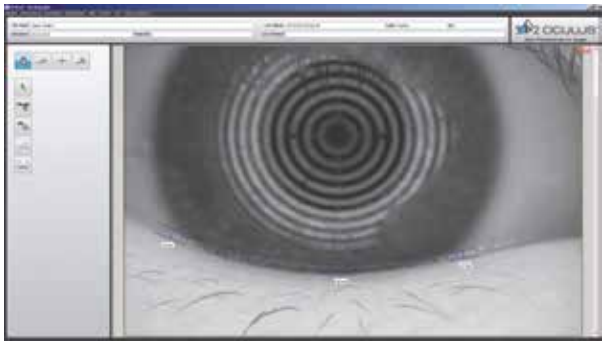
The graph shows percent of the examined area that is affected during the measuring period.

Data field showing tear film break-up time (NIKBUT) in seconds and the corresponding classification.

You can watch the video after the measurement. The break-up areas detected by the software are highlighted accordingly.

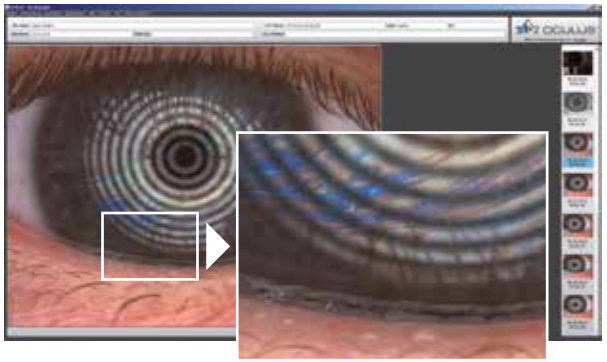
Quantity and Quality of the Tear Film

The high-resolution color camera makes the smallest structures visible. This enables you to measure the tear meniscus height and evaluate the lipid layer, as well as analyze the tear film dynamics. Not only do you gain very important findings about tear film break-up time, but also those about the quantity and quality of the tear film.



Tear Meniscus Height

Never has a precise measurement been so easy. You can evaluate the course of the tear meniscus along the eyelid by means of the new infrared illumination and precisely measure the tear meniscus height with the built-in ruler. Different magnification levels facilitate measurement and the resulting value is automatically saved in the patient file.



Evaluation of Lipid Layer

Hyper-evaporative dry eye is easily overlooked when using conventional tests. Thus, evaluating the lipid layer of the tear film is even more important. With the Keratograph® 5M you can record videos of interference patterns of the lipid layer. Distribution characteristics, morphology and thickness of the lipid film can be continuously evaluated.

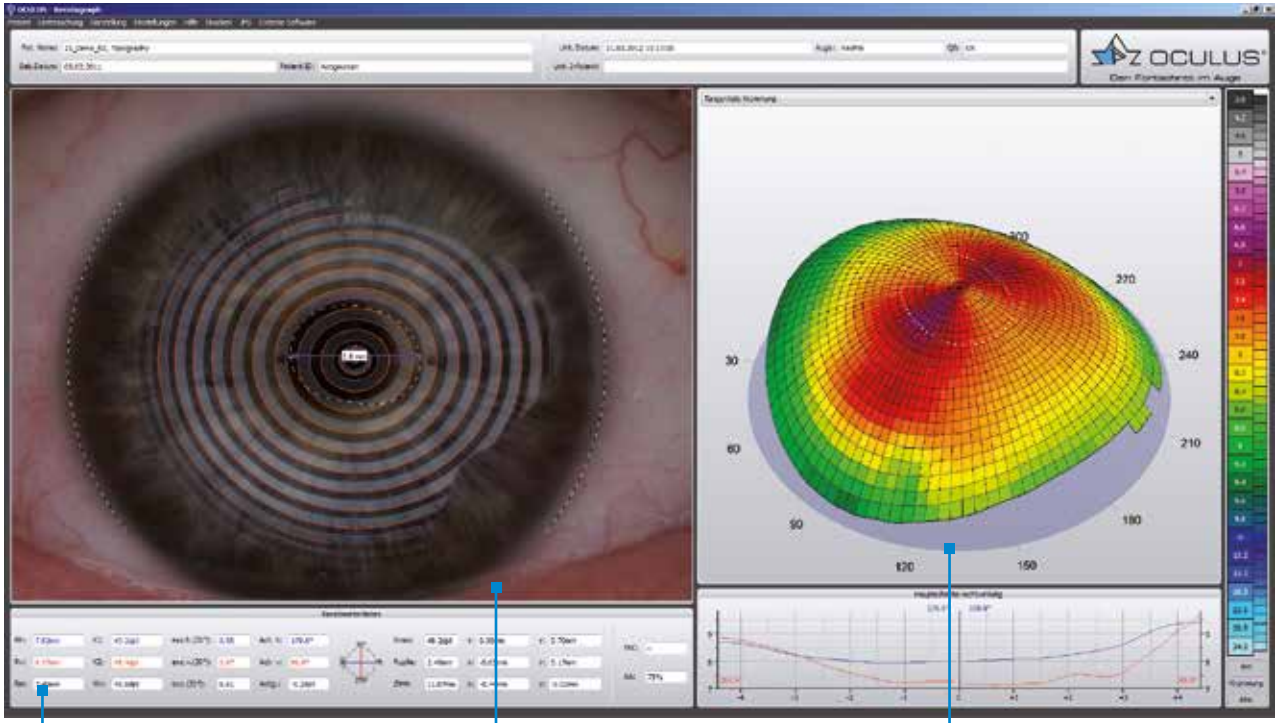
Tear Film Dynamics

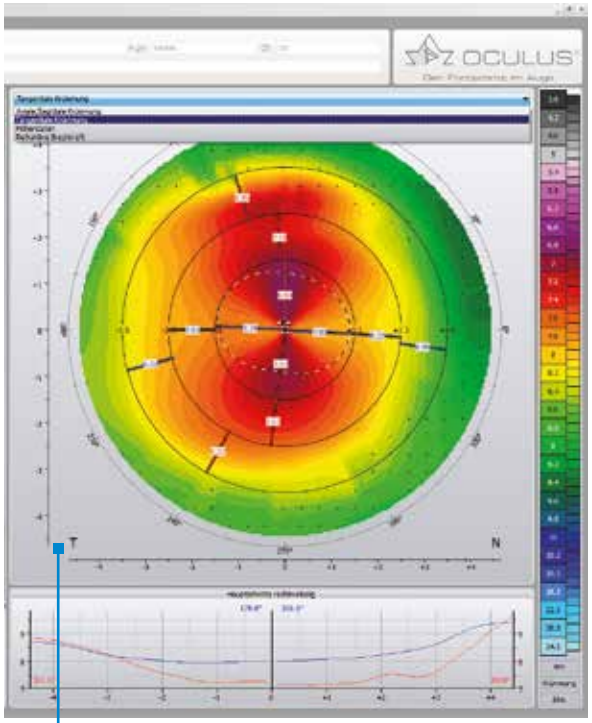
The tear film contains numerous particles. These can be made visible using a specific light source. These particles are distributed in the tear fluid from bottom to top during each blink. The velocity of these particles provides information on tear film viscosity. You can quickly and easily evaluate the quantity and movement of these tear film particles using the TF-Scan.

Topography

Quick, precise and clear

Aside from topography and automatic keratoconus detection, the Keratograph® 5M provides a large contact lens data base and many analyses for daily practice. The built-in keratometer and automatic measurement ensure the utmost accuracy and reproducibility. After completing the measurement, the overview display provides a detailed outline.





Keratometric data, diameter of the cornea and pupil, K-values and index for keratoconus detection, size of the analyzed surface

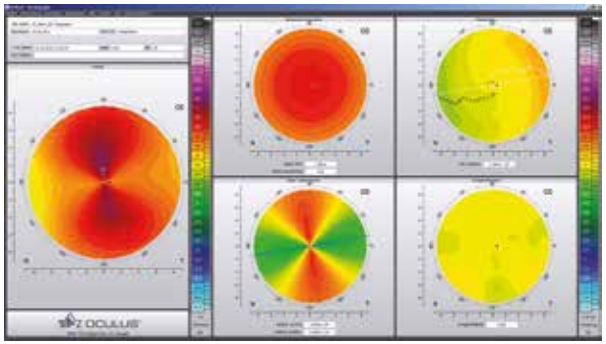
Built-in measuring instrument for measurements in the camera image

3D view can be selected and displayed directly beside the camera image

Display as sagittal or tangential curvature, elevation data or refractive power, overlay of apex position, pupil center and contour, numerical values and major meridians

Detailed Display of the Cornea

The Keratograph® software includes a reliable screening package for corneal disease detection, lens fitting and refractive surgery. The complex corneal surface structure is measured by means of mathematical analysis, which serves as the basis for accurate detection of irregularities like keratoconus. In addition, optical properties of the front surface of the cornea are exactly characterized.

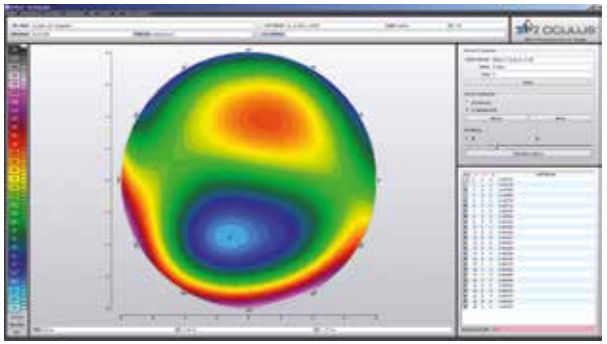


Fourier Analysis

The refractive power of the front surface of the cornea consists of different components. The Fourier Analysis identifies four of them which are shown in the following displays:

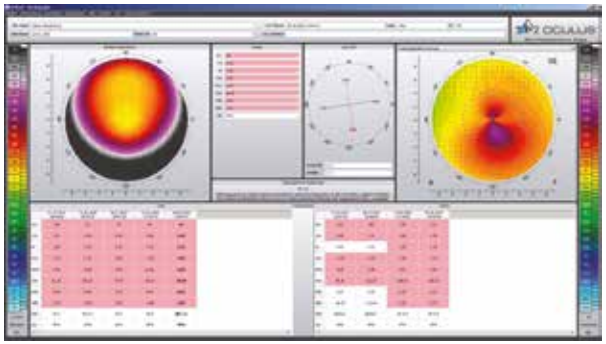
- Spherical component
- Decentration
- Regular astigmatism
- Irregularities

Pathological changes can be quantified and possible effects on visual acuity can be explained.



Zernike Analysis

Zernike polynomials are adapted to the elevation data of the cornea, which is crucial for locating the apex. The apex position is labelled with a cross. This display shows you if a rear surface toric lens is applicable to the particular case. Zernike polynomials and the aberration coefficient give you important indications of the imaging quality of the corneal surface. Abnormal values are marked in color.



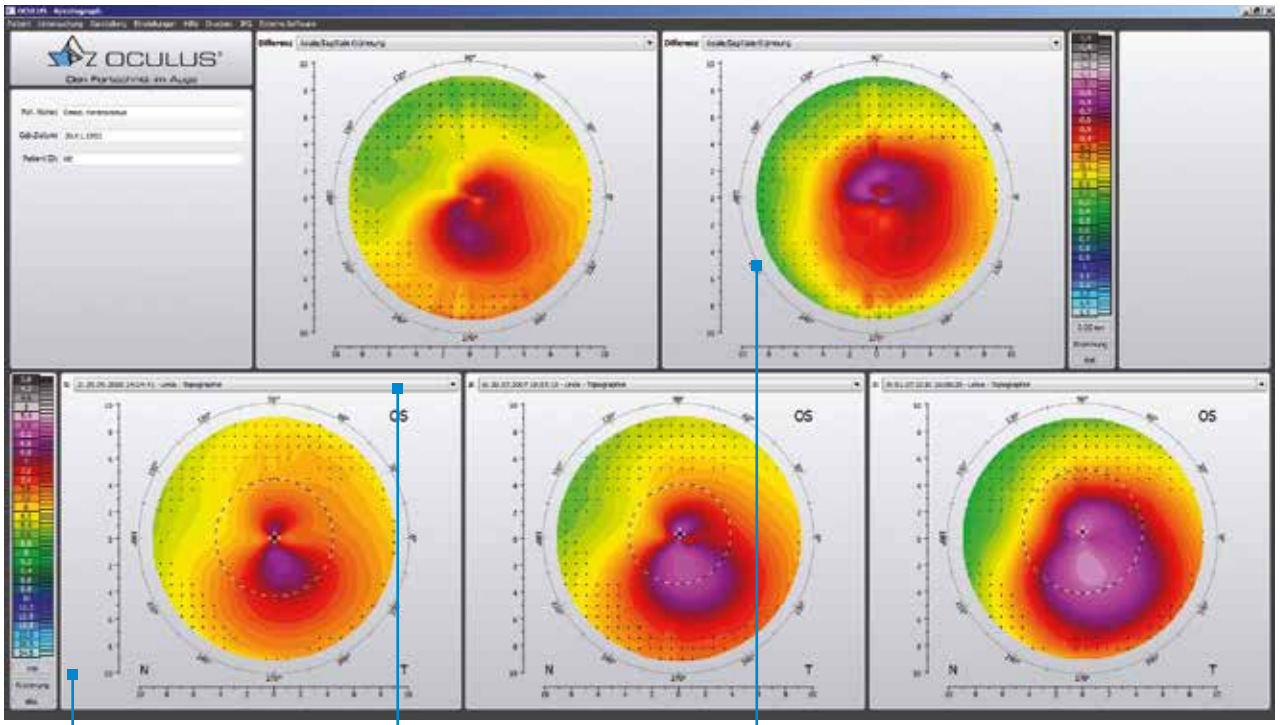
Topographic Keratoconus Screening

Keratoconus classification is based on numerous parameters. The Topographic Keratoconus Screening display merges these parameters. The colored label illustrates abnormal values. Temporal changes of the parameters are shown side by side in a table, to facilitate your follow-ups. The Amsler classification system is applied to the keratoconus domains.

Complete Documentation

Follow-ups provide reliability

Follow-ups require comparison of several examinations. In doing so, changes can be easily detected and fully documented. Regular follow-up examinations provide reliability and increase the trusting relationship between you and your patient. The Keratograph® software contains both data and image documentation.



"Course of Disease" display showing three examinations

Selection of examination from the patient data base

Graphic display of differences between individual examinations. Display as sagittal or tangential curvature, elevation data or refractive power.

Comparing Examinations

The Compare 3 Exams display shows changes over a certain period of time, e.g. the progressive course of disease of keratoconus. Choose between sagittal or tangential curvature and between elevation data or refractive power.
Use the Compare 2 Exams display for a right/left or before/after comparison. The easy-to-understand displays help you describe even complex contexts to your patient.

A Picture Is Worth a Thousand Words.

The Keratograph® 5M contains features that offer optimal conditions for your image documentation such as the high-resolution color camera and different illumination options. An image aids in communication with education of your patients, thus eliminating the need for long explanations. You save time with only one mouse click.

Precise Measurements Instead of Rough Guesses

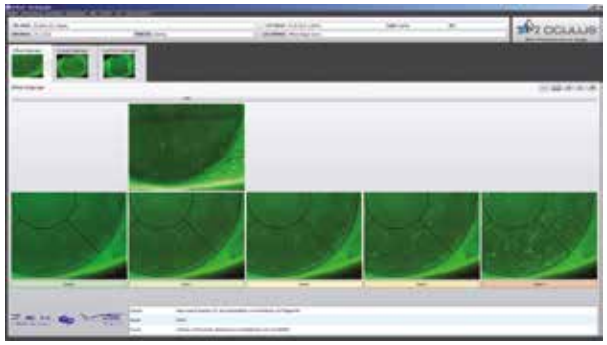
The Keratograph® 5M is the ideal device for your professional documentation. The imaging software includes features such as

- magnification function
- hand tool
- measuring tool
- angle measurement

Pathological changes can be exactly localized, and changes in size can be determined. This ensures that all of your patient's questions will be answered.

High-Resolution Images

You can evaluate the wettability of contact lenses, without fluorescein application and determine the exact rotating of toric lenses. It is also possible to detect lipids and deposits on the lens surface, as well as corneal staining or vascularization. Show your patients images they have never seen before.



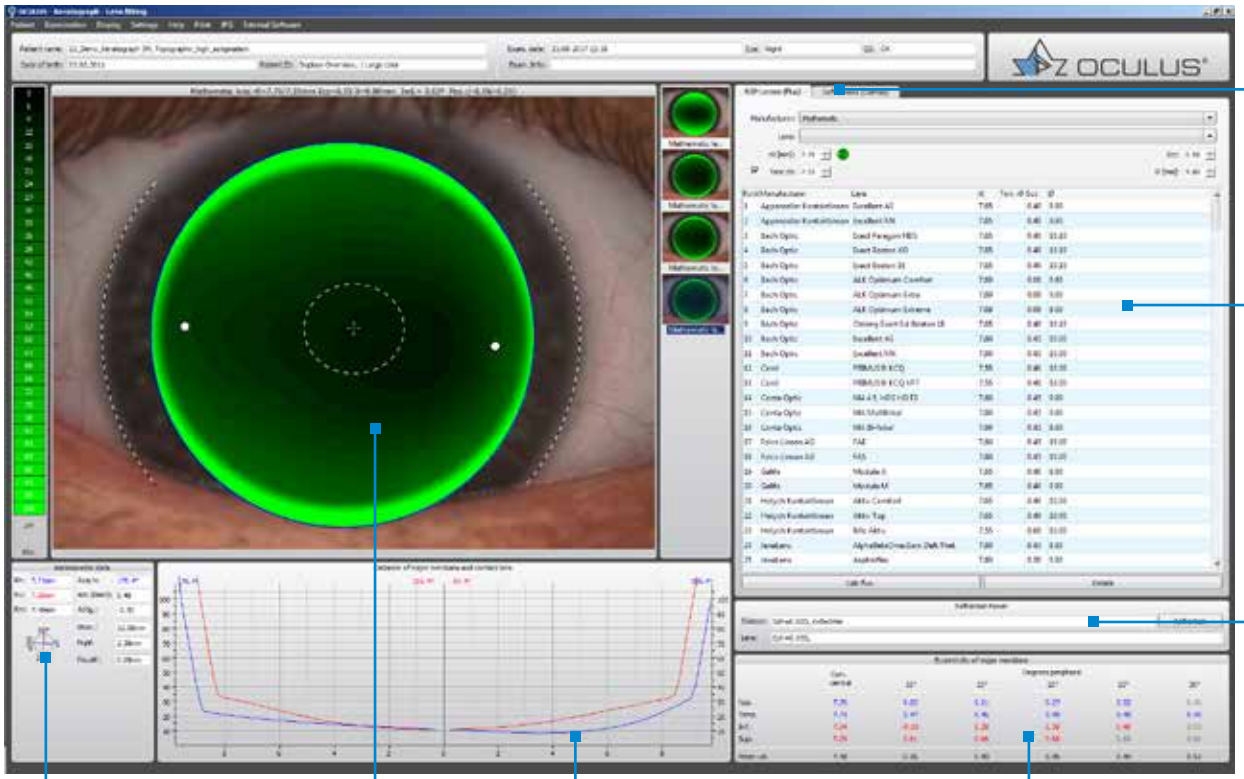
Reliable Diagnosis Documentation

The resulting classification from corneal staining requires well-trained examiners. It is difficult to estimate the number of hyper-fluorescent dots on the corneal surface, but the integrated JENVIS Grading Scales facilitates this evaluation. Every image taken can be compared with a sample image on the screen. Vessel injections can also be evaluated and documented in this way.

Contact Lens Fitting

Professionalism through innovation

An ideal lens is chosen from the large lens data base and is then suggested in the Lens Fitting display. Based on this topographic data, a simulated fluorescein image of this particular lens is created. You can then take real fluorescein images with the Keratograph® 5M and compare them with the simulated images.



Selection between RGP and soft lenses

Contact lens suggestion from the large data base

Subjective refraction data and CVD conversion

Keratometric data, diameter of the cornea and pupil, fixation deviation

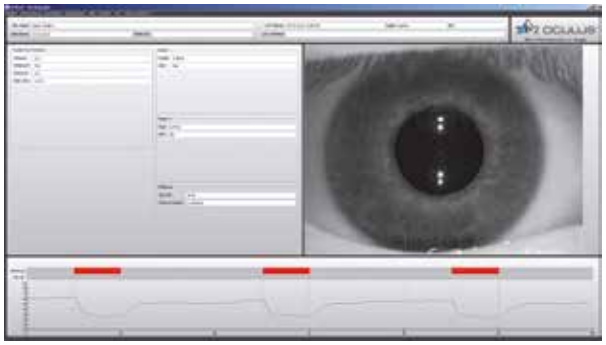
Simulated fluorescein image of a toric RGP lens

Distance of major meridians of the cornea from the lens

Eccentricity values for both major meridians

Multifocal, Bifocal, Toric

With the Keratograph® 5M you can quickly and precisely measure all of the data needed for multifocal, bifocal, and toric contact lenses. These measurements also facilitate the fitting of multifocal or bifocal lenses. Furthermore, the Keratograph® 5M software can be linked to fitting programs of various contact lens manufacturers.



Pupillometry

Using the "Pupillometry" option is a quick and easy way to measure the pupil size of your patients under different illumination conditions. This option not only supports you when fitting multifocal lenses, but also when measuring the optical zone before refractive or cataract surgery.

Near-Portion Height Measurement

The near-portion height of RGP bifocal lenses can be simulated and precisely determined with this software, even before ordering the first-fitting lens. This also facilitates the complex fitting of multifocal lenses.

Palpebral Angle Measurement

The imaginable angle of the nasal side of the lower eyelid can be measured to determine the expected nasal rotation when fitting lenses for astigmatism.

Floating License Key

More flexibility with the OCULUS license model

Activate Functions Exactly as You Need Them

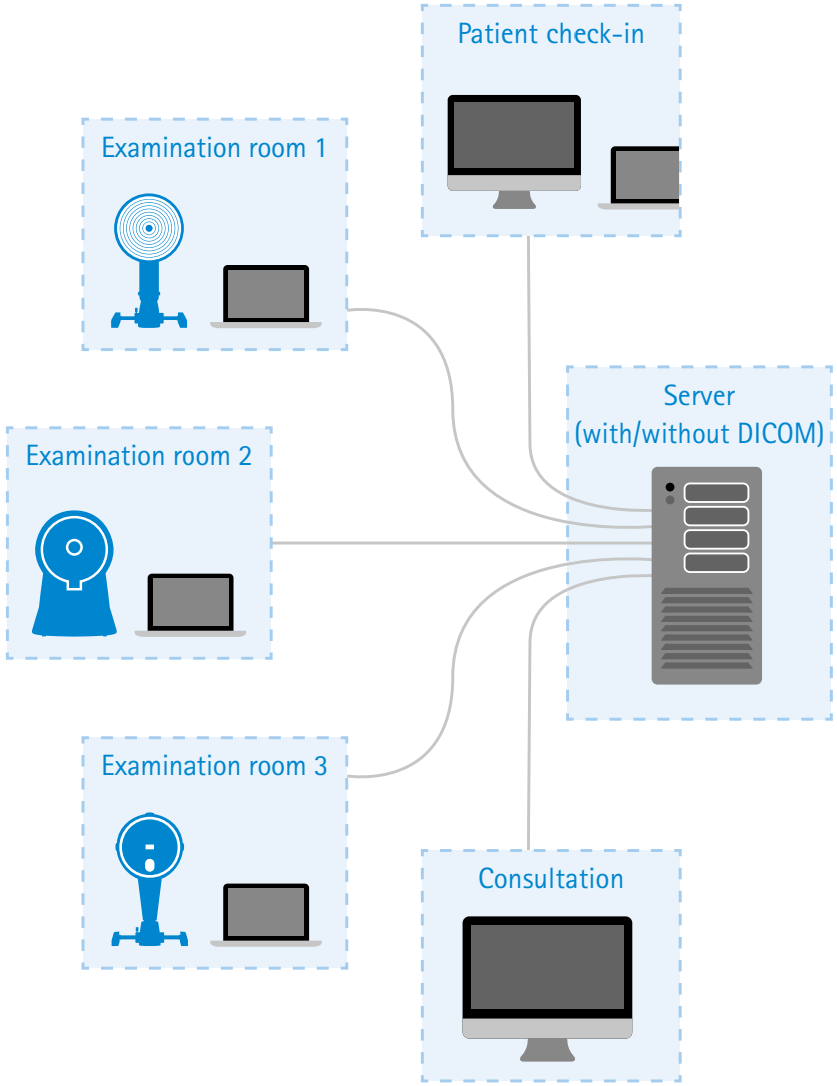
The choice is yours in how you use the Keratograph® 5M and which examination and evaluation functions you desire. You can order additional functions of optional evaluation functions, according to your modular design principle. After purchase, licenses for the respective evaluation functions are activated on the OCULUS Floating License Key and are provided in your network. It is possible to call and view previously performed examinations for free on all workstations within the network.

Optional functions:
You can decide which additional functions to allocate to each device.

Pupillometry *examination function*	**OxiMap®** *evaluation function*

Efficiency Through Networking

The OCULUS patient data management system enables you to merge all OCULUS devices in a local network. It allows you to collaborate with external data management systems (EMR) to optimize your workflows. DICOM interface is not necessary for device connection.



All Features at a Glance

Customize the OCULUS Keratograph® 5M to your own requirements!

Software included

Topography
CL Back Surface
Overview
1 Large Color Map
4 Maps Selectable
Camera Image
3D Cornea
Fourier Analysis
Zernike Analysis
Topographic Keratoconus Screening
Elevation Map
Corneal asphericity
Lens Fitting
Show 2 Exams
Compare 2 Exams
Compare 3 Exams

Examination functions

	Standard features	Optional features
TF-Scan *Evaluation of lipid layer and tear film dynamics, measurement of tear meniscus height and non-invasive tear film break-up time (NIKBUT)*	✓	
R-Scan *Automatic classification of bulbar and limbal redness*	✓	
Meibo-Scan *Meibography of upper and lower eyelid*	✓	
Pupillometry *Examination of pupillary response using the pupillometer, asymmetry test and manual measuring mode*		☐
Imaging *Image and video documentation with fluorescein imaging, near-portion height measurement and eyelid angle measurement*	✓	

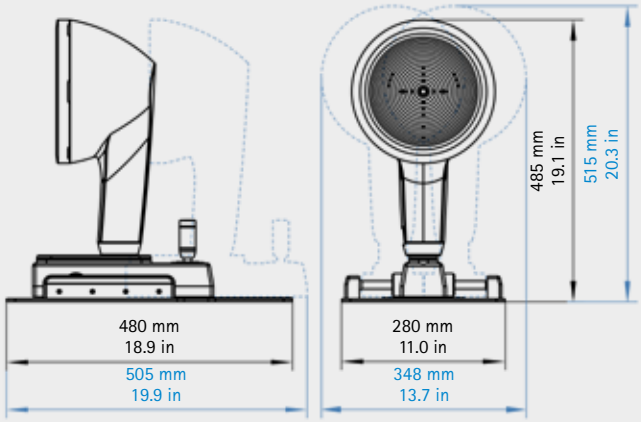
Evaluation functions

	Standard features	Optional features
Crystal TEAR Report (2 licenses included) *Comprehensive summary display of all available dry eye tests*	✓	
Keratoconus package (1 license included) *Includes Topographic Keratoconus Screening and Zernike Analysis*	✓	
Lens Fitting (1 license included) *Simulation of fluorescein images of RGP lenses*	✓	
OxiMap® *Graphic display of oxygen transmissibility (Dk/t value) of soft lenses*		☐

Technical Data

OCULUS Keratograph® 5M

General information		
Measuring range	3 - 38 mm 9 - 99 D	
Accuracy	± 0.1 D	
Reproducibility	± 0.1 D	
Number of rings	22	
Working distance	78 - 100 mm	
Number of evaluated data points	22 000	
Camera	Digital CCD camera	
Illumination source	Placido illumination: Placido illumination: Imaging illumination: Meibography: Tear film dynamics: Pupillometry illumination:	white diodes infrared diodes (880 nm) blue diodes (465 nm) infrared diodes (840 nm) white diodes infrared diodes (880 nm)
Technical specifications		
Dimensions (W x D x H)	280 x 480 - 505 x 485 - 515 mm (11 x 18.9 - 19.9 x 19.1 - 20.3 in)	
Weight	Measuring equipment: 3.2 kg (7.1 lbs) With base and sliding plate: 8 kg (17.6 lbs)	
Max. power consumption	18 W	
Voltage	90 - 264 V AC	
Frequency	47 - 63 Hz	
Recommended computer specifications	CPU Intel® Core™ i5-6600, 500 GB HDD, 8 GB memory, Windows® 7 - Windows® 10	



CE in accordance with Medical Device Directive 93/42/EEC

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MEDICAL TECHNOLOGIES

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