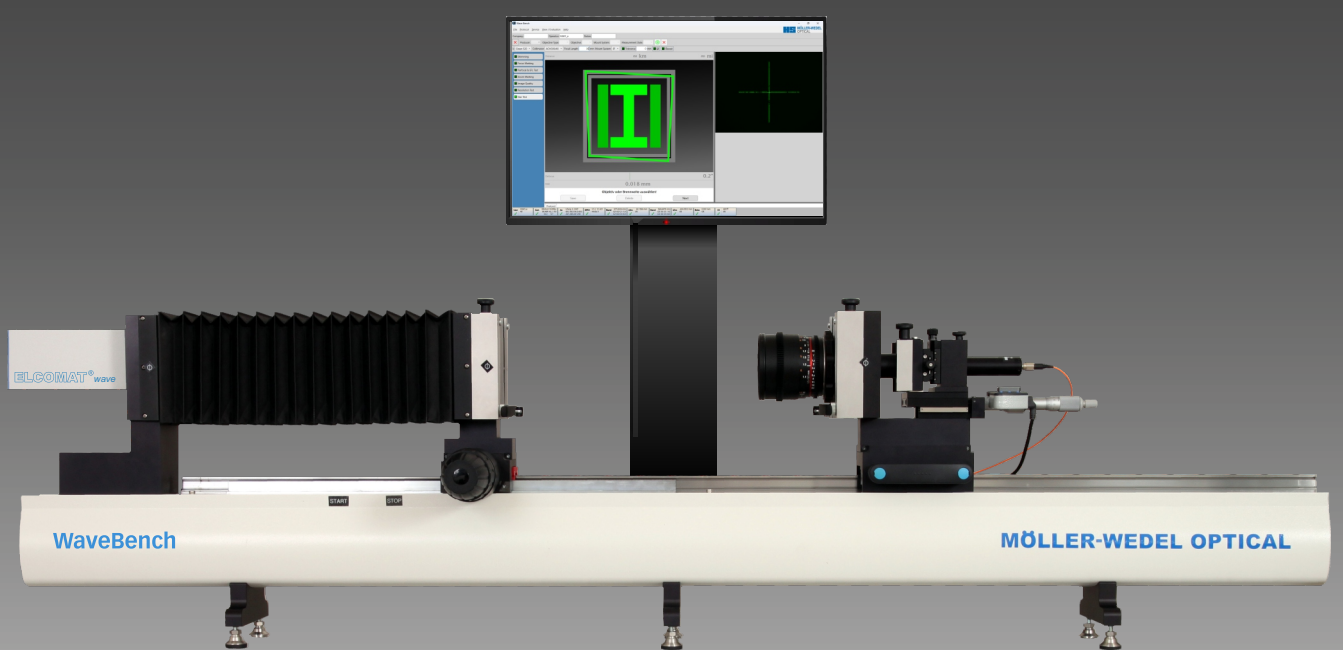


WaveBench

Cine Autocollimator

MÖLLER-WEDEL OPTICAL

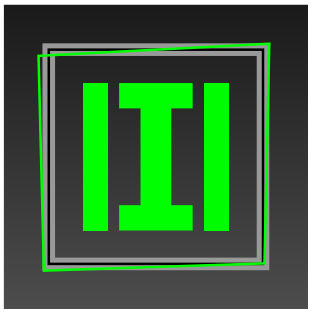
WaveBench, the Optical Bench for Cine, Broadcast, Photo, Rental and Factory

The WaveBench is a modular system developed for the cine-rental business, consisting of an optical bench with autocollimator and modular components for adaptation to the customer's measurement tasks. The new ELCOMAT®wave is used as the cine autocollimator. This is the digital successor to the well known Mark III-45S camera tester, developed by Möller-Wedel Optical, which has been used for decades in the rental and service sector for shimming.

The WaveBench covers the following measurement tasks, including documenting and storing the results in a database:

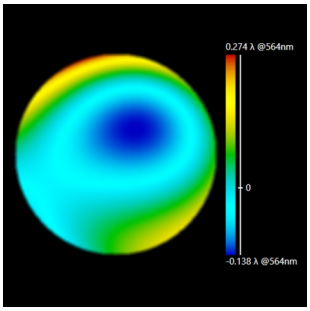
- Shimming - adjusting the flange focal length distance of lenses
- Parfocal Test - checking the back focus distance during zooming
- Focus marking - determination of the back!!! focus distance marks
- EFL and Zoom Mark – check focal length and zoom markers
- Image Quality - testing and tracing of image quality and optical errors
- Chromatic errors - objektive analysis of the image positions in RGB and white
- Resolution – measure resolution Performance with optional MTF Test module
- Star Test – alternative check for image errors (optional module)
- Camera flange – determination of camera flange distance (optional module)

Advantages and Benefits of the ELCOMAT®wave



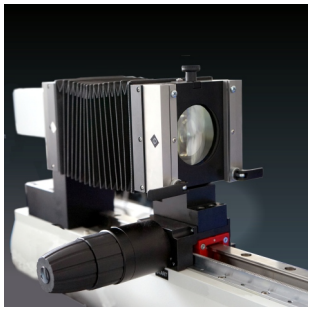
By using the ELCOMAT®wave, the transformation from analogue to digital inspection and shimming of lenses is achieved. For the first time, the uniquely high precision and objective measurement method can be used to test the much higher demands of today´s high-tech lenses to create a precisely calculated look. The measurement setup is also suitable for reproducing a specific bokeh of old classics in a defined way. The carefully coordinated interaction of all WaveBench components and modules has created a system that offers significant value added not only for service and rental, but also for the production and manufacture of cine lenses.

Shimming and proof of Image Quality in one step



With the ELCOMAT®wave, the focus position can now be determined with up to four apertures instead of two, as with the Mark III 45S autocollimator. This extends the test spectrum from shimming to digital testing of image quality test in one device without a projector. Optical errors and poor performance of lenses as a result of misalignment and decentration can now be qualitatively recorded, documented and, if necessary, corrected using the four apertures. Furthermore, anamorphic lenses can be checked for the most common optical errors like astigmatism and coma - an important aspect in service and testing.

Pioneering finite distance control and visual color inspection



Due to the adjustable distance, the ELCOMAT®wave can be used to test at any focus setting from infinity to close up. The integrated measuring sensors eliminate the requirement for a separate distance measuring device and allow finite distances to be set with millimetre accuracy. No extra-large test room and projector needed due to virtual distances. With the LED illumination of the ELCOMAT®wave, chromatic errors aberrations in red, green, blue and white can also be analysed and digitally classified to simple numbers. The LEDs cover the expanded BT.2020 spectrum and enable ITU conform UHD testing.

Interchangeable Collimator Lenses

IInterchangeable lenses in cassettes allow direct adaptation of the autocollimator to the focal length range and apertures of the lenses to be tested. Modules with focal lengths of 140 mm, 300 mm and 400 mm are available. These can be used to test a range of lens from approximately 14 mm to 200 mm focal length. A new software-based boost function extends the test range down to about 4 mm. This makes WaveBench suitable for broadcast applications.

Cassettes for Adapting the Mounts

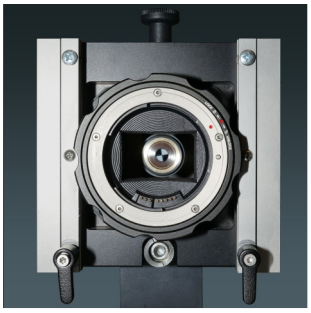
The mount system is also adaptable through interchangeable cassettes. Currently, modules are available for the mount types PL-, EF- and E-Mount. An universal cassette for standard camera adapters is available on request.The cassette system allows for easy expansion to include other mount types on demand.

Accessories for the Traceability and Referencing

The traceability of the back focus of the mount systems is ensured via associated measuring blocks or reference lenses (zero lenses). Existing conventional measuring blocks with dial gauges can also be used, if equipped with plastic tips. Another option for traceability of the flange focal distance can be realised with special optical accessories (plane plate and attachment optics) using the digital scale on the mount slide.

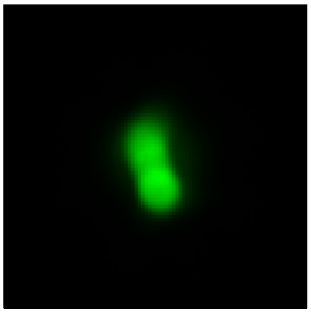
Resolution check for objective classification to HD, 4K or 8K

Optionally, the reference mirror can be replaced with a MTF test target. With the corresponding software module the MTF of the lens under test can be measured and the contrast at a given resolution can be evaluated. The MTF curves and contrast value for HD, 4K or 8K can be stored and compared with data from the database. In addition to testing with the ELCOMAT®wave for focus, astigmatism and coma the MTF test will also be sensitive to higher order optical errors such as opening errors and stray light. This makes the MTF test the ideal add-on for cine lens manufactures and services centers.



Star Test Module

The WaveBench can be equipped with a point image generator and thus a star test analysis can be carried out. Based on the changed shape of the light spot caused by the lens under test, conclusions can also be drawn about the dominant aberrations. Images can also be stored to the database and compared afterwards.



Basic Device

The basic device includes the electronic, variable focus autocollimator ELCOMAT®wave, a hub interface, an optical bench with high-precision guide rail and precise encoder system as well as the mount slide with cassette holders and digital dial gauge.

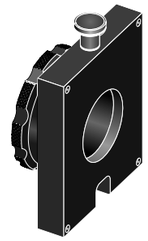
Cassettes with Collimation Lens

For optimum adaptation to the lens to be tested, a choice can be made between three collimation lenses with different focal lengths. Depending on the focal length and aperture range to be tested, the corresponding collimation lenses can already be selected when ordering. At least one collimation lens is required.

236 511 Cassette Achromat f=140 mm
236 512 Cassette Achromat f=300 mm
236 513 Cassette Achromat f=400 mm

Cassettes with Mount-System

Depending on the lens mount systems to be tested, the corresponding interchangeable cassettes with mounts precisely aligned to the measuring axis can be selected. There are currently three mount types available, these can be extended at any time on request.



236 551 Cassette PL-Mount
236 552 Cassette EF-Mount
236 553 Cassette E-Mount

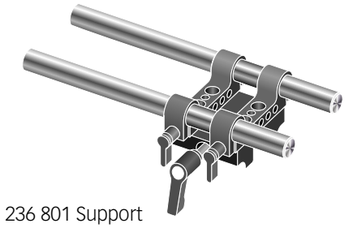
Cassettes with Reflectors

For the system, it is recommended to select the cassettes with plane mirror and with concave mirror in the configurator. The plane mirror is required for referencing the flange focal length with a dial gauge. The concave mirror allows to use all the functions of the bench.

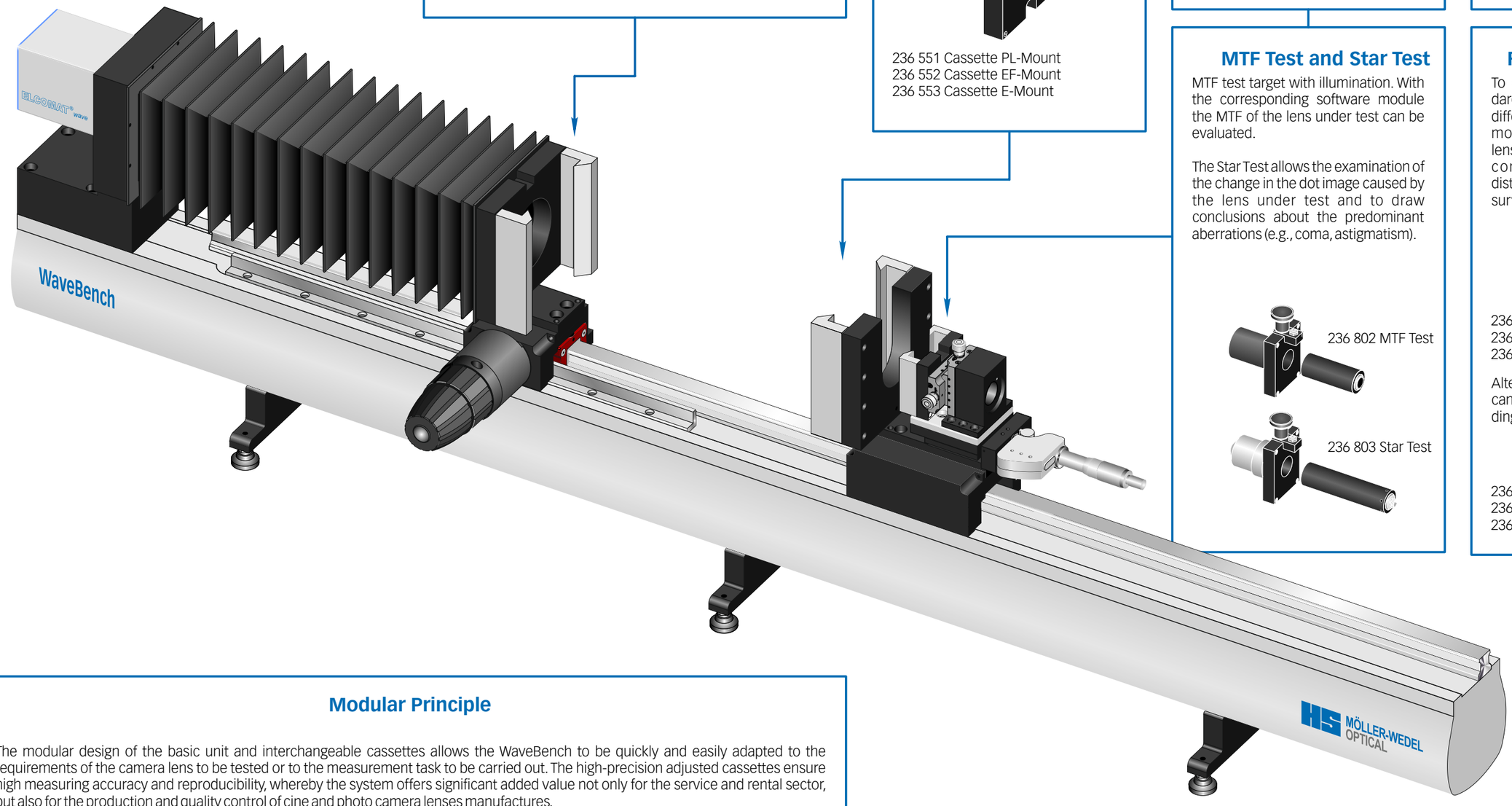
236 531 Cassette Plane Mirror
236 532 Cassette Concave Mirror

Accessories

With the help of the support, large and heavy lenses can be supported, or the flange focal distance of the camera mount can be checked directly by placing a cine or photo camera on the support.



236 801 Support



MTF Test and Star Test

MTF test target with illumination. With the corresponding software module the MTF of the lens under test can be evaluated.

The Star Test allows the examination of the change in the dot image caused by the lens under test and to draw conclusions about the predominant aberrations (e.g., coma, astigmatism).

236 802 MTF Test

236 803 Star Test

Reference Equipment

To adjust the system and the standardized flange focal distance of the different mount systems (e.g., PL, EF, E mount), corresponding reference lenses can be used, which enable a contactless adjustment of the distance and thus protect the reflector surface / coating of the mirror.

236 651 Reference Lens PL f=75 mm
236 652 Reference Lens EF f=75 mm
236 653 Reference Lens E f=75 mm

Alternatively, the flange focal distance can be set classically with corresponding measuring blocks.

236 701 Measuring Block PL
236 702 Measuring Block EF
236 703 Measuring Block E

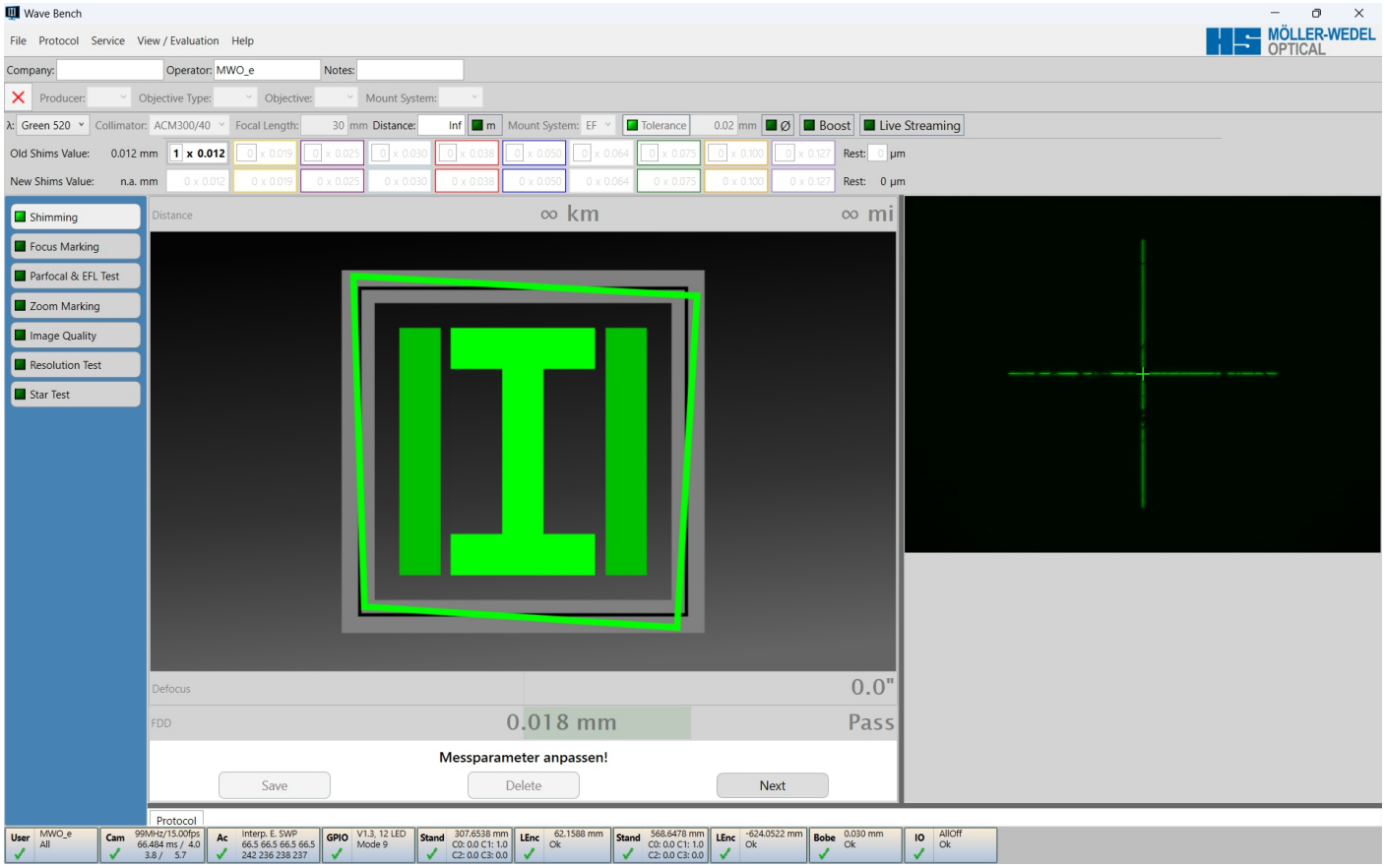
Modular Principle

The modular design of the basic unit and interchangeable cassettes allows the WaveBench to be quickly and easily adapted to the requirements of the camera lens to be tested or to the measurement task to be carried out. The high-precision adjusted cassettes ensure high measuring accuracy and reproducibility, whereby the system offers significant added value not only for the service and rental sector, but also for the production and quality control of cine and photo camera lenses manufactures.

Software Functions

All hardware functions are mapped by the WaveBench software.
The software has several user levels. The simplest level provides clear user guidance through the measurement process. Basic computer knowledge is sufficient to perform the measurement tasks without errors. Higher user levels allow complex analyses beyond everyday measurement tasks. All measurements can be logged and performed easily without using the integrated database. Optional use of the database in the measurement software allows recurring measurement parameters to be retrieved and current measurement results to be compared with old measurement results.
Independent measurement processes e.g. for shimming are available for the various tasks.

Shimming



In addition to precise shimming at any distance, the software can calculate the best new shim combination for the lens being tested. When shimming, the square deviation gives a first impression of the image quality. If the square does not look good enough, the image quality can be assessed in detail in terms of astigmatism, coma and overall image quality.

Database Editor

A separate, stand-alone editor software can be used to access stored measurement data records. These can then be used by sales, quality control or service technicians to monitor the condition of the lenses over the lifecycle, to determine the special features of an individual lens or series in comparison and thus to meet special quality requirements of an individual customer.

Other task-specific measurement processes

Focus Marking, Parfocal Test / EFL

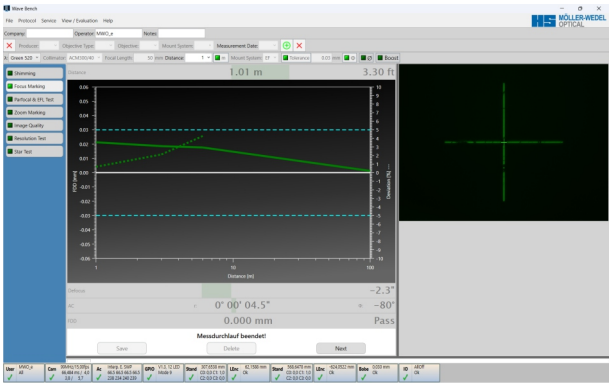
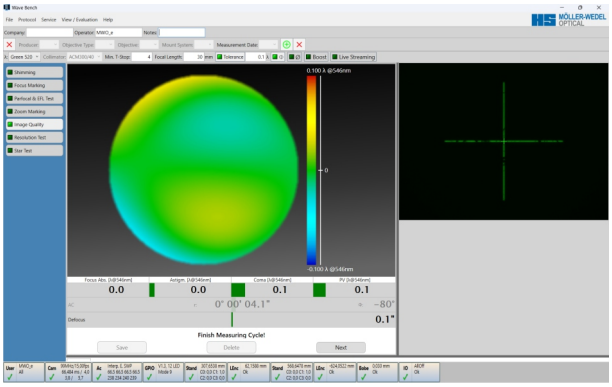
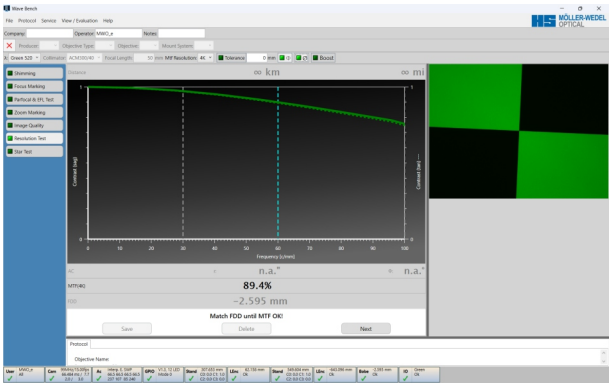


Image Quality

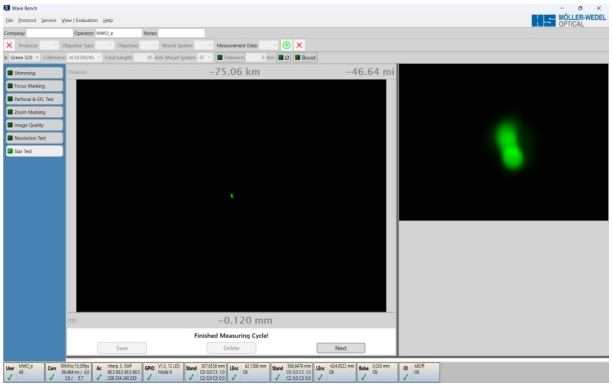


In addition to checking the focus marking or generating user marks for the follow focus, the bench can also check the parfocal tuning. Parfocal shimming can be performed as an option. With image quality, astigmatism, coma and overall image performance can be evaluated and recorded as comparable figures.

Resolution Test



Star Test



The optional tests can be used for detailed evaluation. Will the lens achieve the expected contrast at HD, 4K or 8K? The MTF evaluation provides contrast values for the selected resolution.

Technical Data

Focal Length and Apertures of Collimator Objectives

- 140 mm / 28 mm optimal for objectives from 4 mm to 40 mm
- 300 mm / 50 mm optimal for objectives from 40 mm to 75 mm
- 400 mm / 60 mm optimal for objectives from 75 mm to 200 mm

Testable Distance Range

- Zero to infinity - depending on lens under test and collimator objective

Illumination / LED

- RGB: red (624 nm; FWHM30), green (525 nm; FWHM25), blue (470 nm; FWHM20) BT.2020 conform

Sensors for Focus and Image Position

- Resolution 0.001 mm
- Accuracy: 0.005 mm over 1000 mm

Digital Micrometer

- Resolution 0.001 mm
- Accuracy: ±0.002 mm over 25 mm

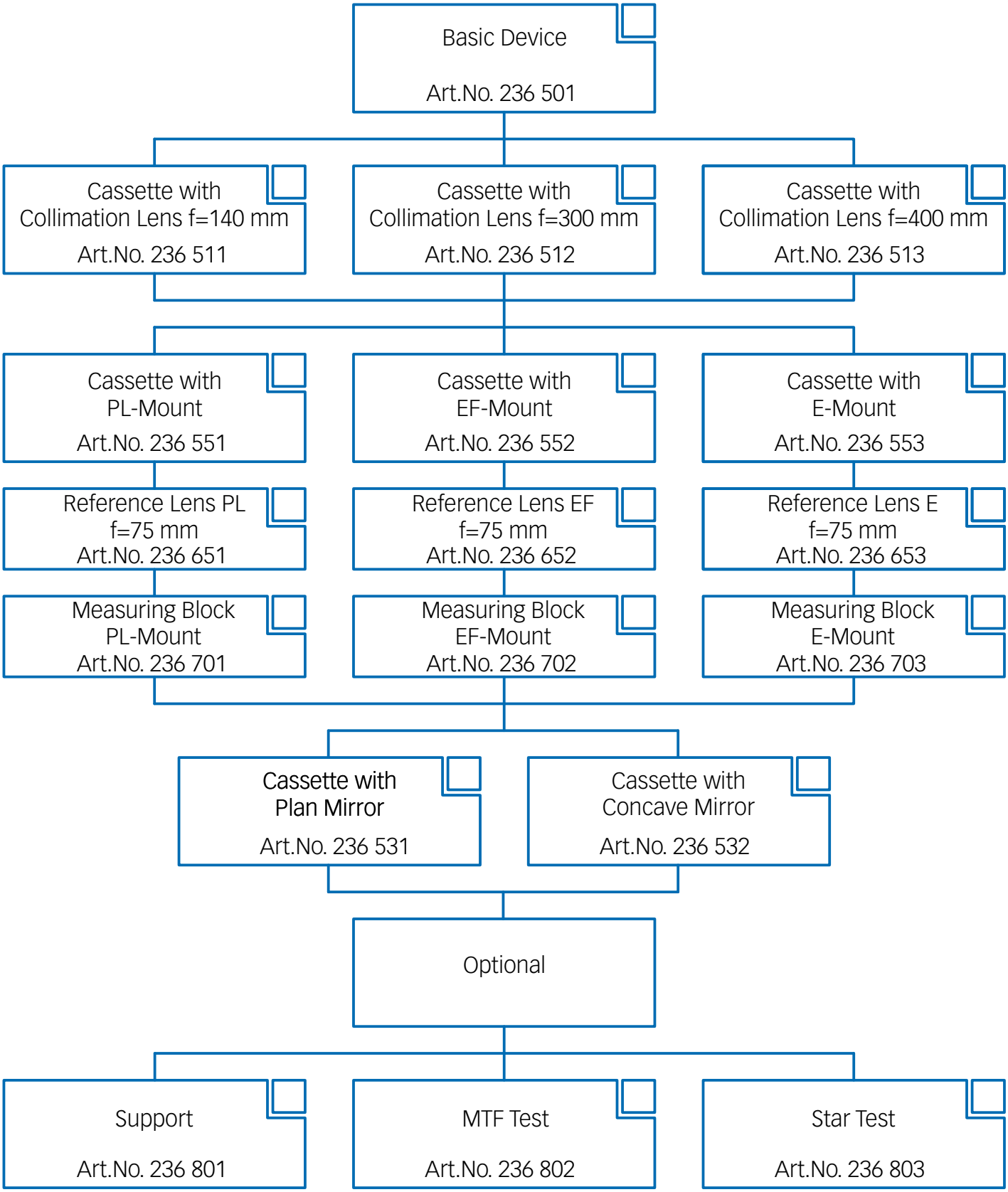
Evaluation Sensitivity

- Infinity up to 0.001 mm in the focal plane of the objectives under test

Dimensions and Weight

- Total length 1500 mm / rail length 1340 mm
- Height 410 mm x width 280 mm
- Weight 33 kg

Configurator



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