Advanced Materialography

carat 930

Hardness Testing and Image Evaluation

part of VERDER scientific

ATM – Machines Are Our Passion

Machines and equipment for the materialographic laboratory

“Made in Germany”

Whatever you need for quality testing and material analysis, ATM has it all: As a manufacturer of high-quality machines for materialography (metallography), we offer the most comprehensive solution for your needs. We not only supply a wide range of instruments but also accessories, consumables, complete laboratories and tailor-made special-purpose solutions.

Our innovative cut-off machines, mounting presses, grinders, polishers/electrolytic etchers, as well as hardness testers and analysis systems provide maximum reliability and flexibility. Thanks to the most advanced engineering technologies and manufacture of components in our own factory, we are able to fulfill individual customer requirements by adapting our instruments to their needs.

Our R&D department for hard- and software works in close cooperation with our customers to ensure continuous optimization of our products.

Customers in more than 30 countries appreciate our comprehensive sales and service network as well as direct communication with our experts.

To provide you with solutions of consistently high-quality we rely on the expertise and creativity of our qualified and dedicated long-standing employees.

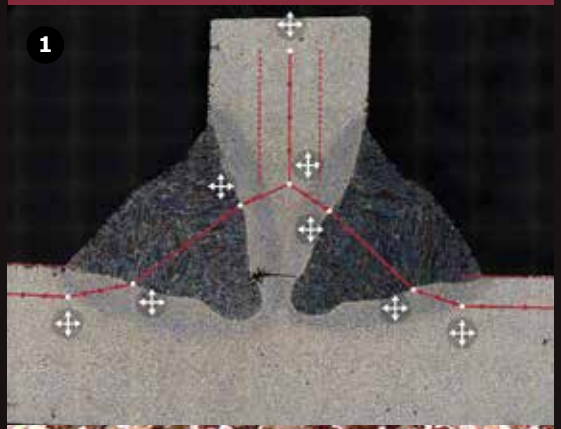
PREMIUM QUALITY

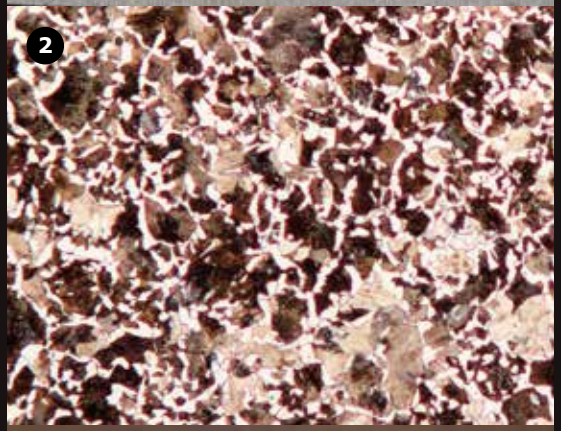
MADE IN GERMANY

Micro & Macro Hardness Testing

Flexible & reproducible

The continuous development and improvement of machines and products require high quality materials resistant to strong mechanical impact. Production components should therefore possess defined toughness or wear characteristics. Properties defined by the developer for the particular application area of the product have to be tested especially in the case of vital components in the manufacturing process. Examinations, for example hardness testing, not only have to be carried out quickly and in-process but should also be reproducible. Hardness testing equipment is used for quality control in production processes but also in R&D laboratories and for failure & damage analysis. Because quality deviations in components may lead to safety risks, implementation of a precise, reliable and, as far as possible, automated measuring device for hardness testing is a crucial prerequisite for premium product quality.

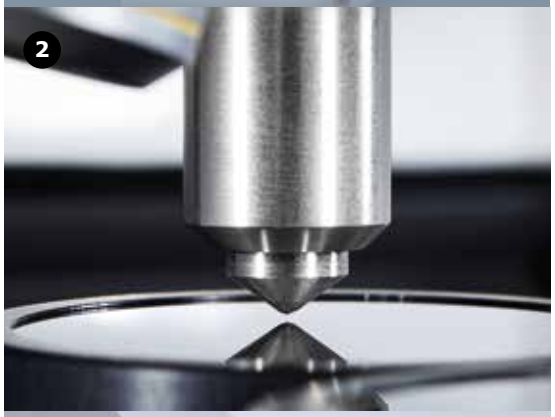




1.) Hardness testing on a double fillet weld with standard template

2.) Carbon steel with Ferrite / Perlite, 200:1

3.) Vickers indentation, viewed with polarisation (Leica DM 8000 M)



1.) CARAT 930 with 8-time revolver for automated multiple measuring and status display for operational status of the appliance

2.) Direct, revolver-independent coupling of the indenter to the force measurement system guarantees high precision and accuracy in measurement

3.) Self-levelling CARAT clamping system

carat 930

Hardness Tester with High Resolution Objectives for wide-ranging Measurement Tasks

The high flexibility of CARAT 930 allows automatic testing on up to 8 prepared samples. In the time the hardness tester performs its measuring tasks, the operator can make use of the time for other tasks. After a successful series of hardness tests, the results are automatically transferred into the reporting templates (individually compatible).
The integrated measurement software enables easy manual measurements on prepared samples (e.g. A-dimension, layer thickness measurements etc.) and collection of further structural properties without the need of an additional microscope.

The very latest technologies and intuitive operation provides the CARAT 930 with excellent capabilities for hardness testing and optical analysis of microstructure. The indenter is not integrated into the objective revolver, which accommodates up to 6 objectives (25 to 1000-times magnification). The robust basic unit can be configured to optimum functions with a number of software modules and CARAT sample mounting systems to meet your needs and is ideally suited for the evaluation of micro-structures.

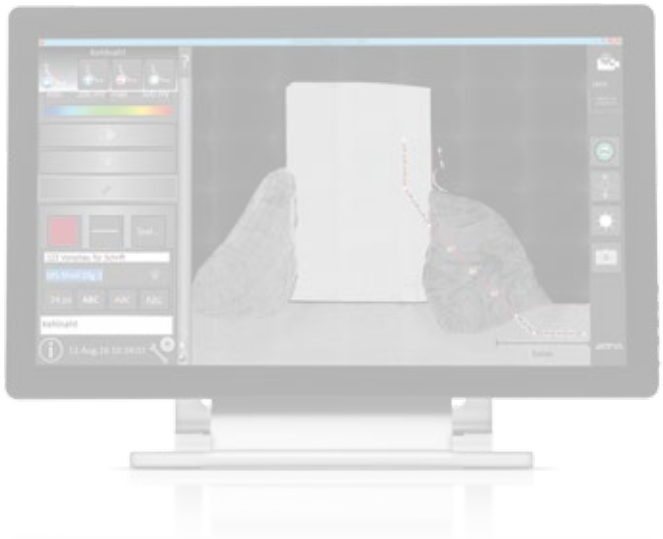
Hardness tester CARAT 930

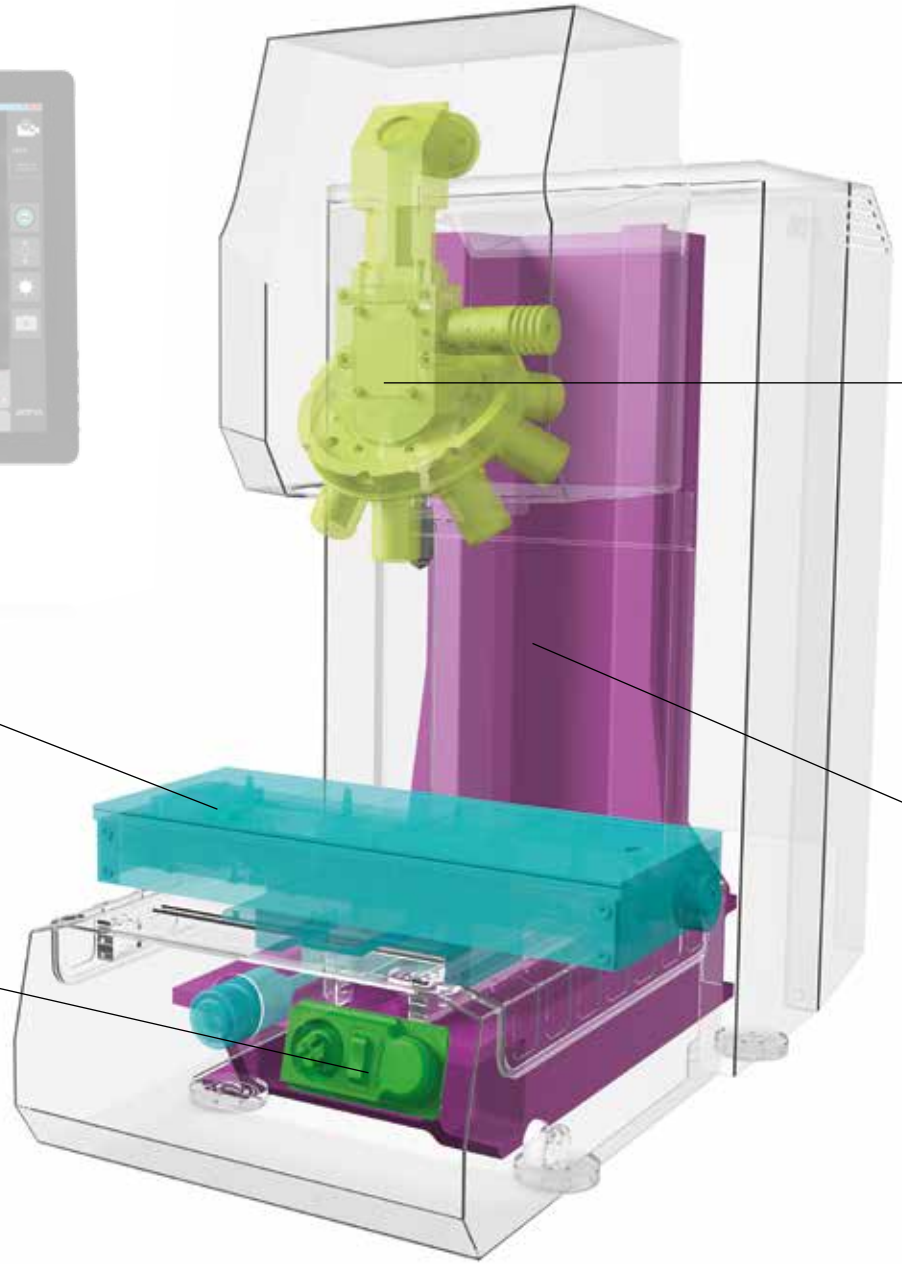
- Micro-processor driven load cell
- Fully automatic hardness testing
- Manual testing possibilities
- Robust cast-Aluminium construction
- Objective and illumination identical with brightfield microscope
- Testing methods:
  Vickers: HV 0.05 – HV 30 (DIN EN ISO 6507, ASTM E-384)
  Knoop: HK 0.05 – HK 2 (DIN EN ISO 4545, ASTM E-384)
- Standardized result documentation

PREMIUM QUALITY

MADE IN GERMANY

The design of the CARAT 930 allows use in a wide range of testing environments. Robust and space-saving, it finds application not only in the lab, but also in fabrication and quality management.





Automatic X/Y coordinate stage

- Travel max. 250 x 100 mm, resolution 0.1 µm
- Individual positioning for samples (up to 8 mounted samples)
- Max. permissible load 60 kg

Manual operating elements

- Dynamic joystick for positioning of the X/Y coordinate stage
- Rapid running key for travelling the testing head in the Z-axis (travel 150 mm)
- Precise focusing by means of fine drive (resolution 0.01 µm)

Optics

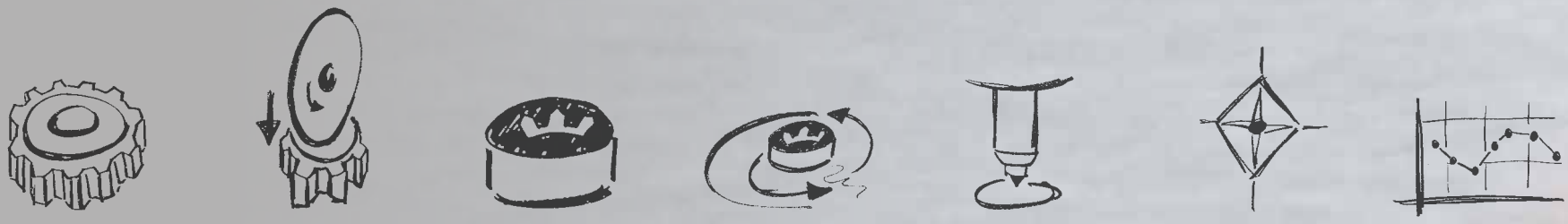
- High-quality microscope optics with flat plan achromat objectives
- Magnification 25 x-1000 x for hardness testing and microscopic measurements
- Homogenous focused image field based on the Köhler illumination principle
- Individually adjustable aperture diaphragm, USB 3 cameras up to 5 Megapixel resolution

Basic construction

- Cast-Aluminium body
- Precision guidance systems in the drive axes
- Force measuring system with high quality measurement technology

Preparation Process

Integration of hardness testing & image evaluation



Sample ID | Cut-off | Mounting | Grinding & Polishing | Hardness testing | Evaluating → Documenting

Optical Measurement System

Microscope optics with Köhler illumination & aperture diaphragm

The optical measurement system forms the core component of a reliable hardness testing unit, as well as the precise regulation of force and the software. Through the specially developed optical design, an optimum, evenly spread illumination of the whole image field is achieved with additional increase in depth of focus. Not only does this show significant advantages for contrasted (etched) polished surfaces but it also aids in image analysis during hardness testing. The individually adjustable aperture diaphragm can additionally optimize the illumination system and adapt itself to every test situation.

Source reference / gear:
Induction hardening with EMAG eldec Induction GmbH

Accessories

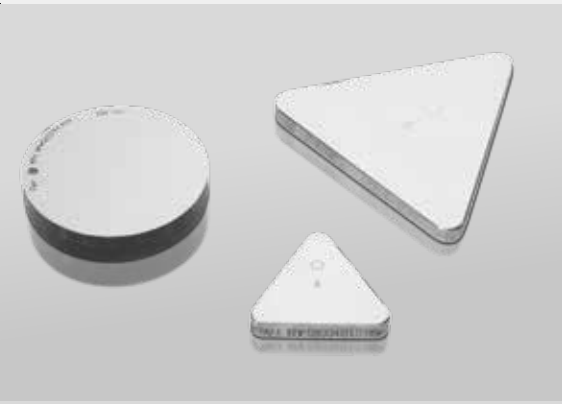
Hardness test blocks & object micrometer

Repeatability precision and limit deviations of a hardness testing unit should be inspected and documented by the user at regular intervals, and according to the corresponding standards, in order to prove the regular/prescribed operation of the ability to measure correctly. Even within the scope of microscopy, it is often necessary to check the optical measuring system using test blocks.

Calibration

Accredited & standardized

The CARAT 930 is factory calibrated and labelled with the corresponding certificate before shipment. The official on-site calibration according to the corresponding standards is offered by us in conjunction with an accredited calibration service.



The tried & tested ATM easy-clamping system enables efficient clamping of a wide range of sample geometries.

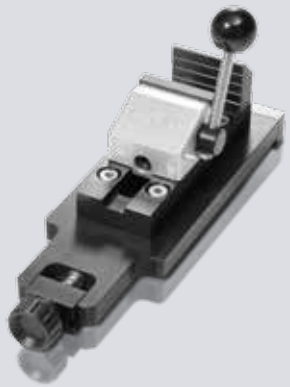
CARAT Easy Clamping System

Universal & user-friendly

The innovative & versatile Easy Clamping System for cut-off machines has also been adapted for the CARAT 930. The CARAT clamping base can be easily fixed on the stage and is not only the basis for non-mounted samples with quick-clamp 50 and universal clamp, but also for mounted samples for sample holder with diameters from 25 – 50 mm or 50 – 70 mm.

In the clamping rings, the self-levelling system ensures samples fit automatically plan parallel. This minimizes potential damage to the indenter and measurement unit during the testing process and increases the accuracy of measurement. The stage of the standard CARAT accommodates up to 3 CARAT Easy clamping bases for 6 samples, the larger stage (optional) offers space for 4 clamping bases with 8 samples.

1



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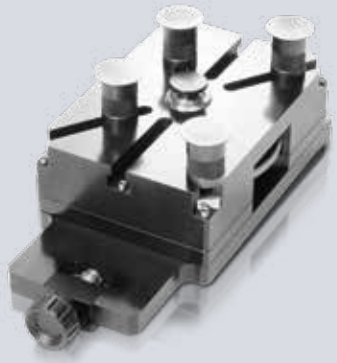


1.) CARAT-Easy-clamping base with quick-clamp 50

2.) CARAT-Easy-clamping base with sample holders and clamping rings for sample diameters 25 – 50 and 50 – 70 mm

3.) CARAT-Universal clamp for non-mounted samples

Single testing point

Measurement series of testing points

CHD-Measurement series

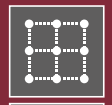
Measurement series with averaging for sinter materials

CHD-Measurement series with averaging for sinter materials

NHD-Measurement series

Measurement circle

Group of testing points



Regular test grid

Free line with support point

Butt weld measurement

Fillet weld measurement (right)

Fillet weld measurement (left)

Fillet weld measurement (both sides)

The measuring unit can be intuitively controlled by means of a joystick, mouse and touchscreen. This enables quick and flexible planning of measurement tasks and results. The operating masks are easy to read and clearly presented and offer the user the latest software tools.

ATM CARAT Software

Complex testing tasks quickly & easily solved

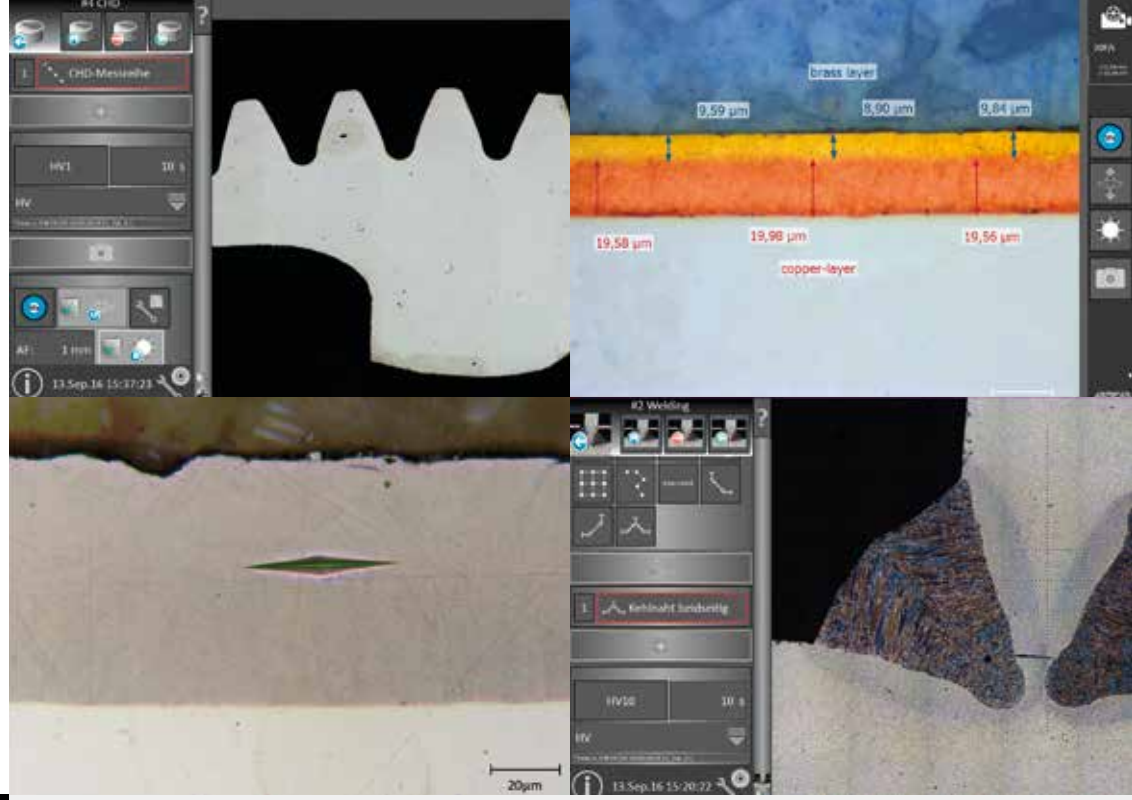
Practical orientated and user-friendliness compose the basic foundation of ATM CARAT software and offer client-related solutions for hardness testing and simple measurement tasks. With assistance from programmable testing templates, it is possible to plan & carry out a complete hardness test with only a few steps and automatically generate documentation.

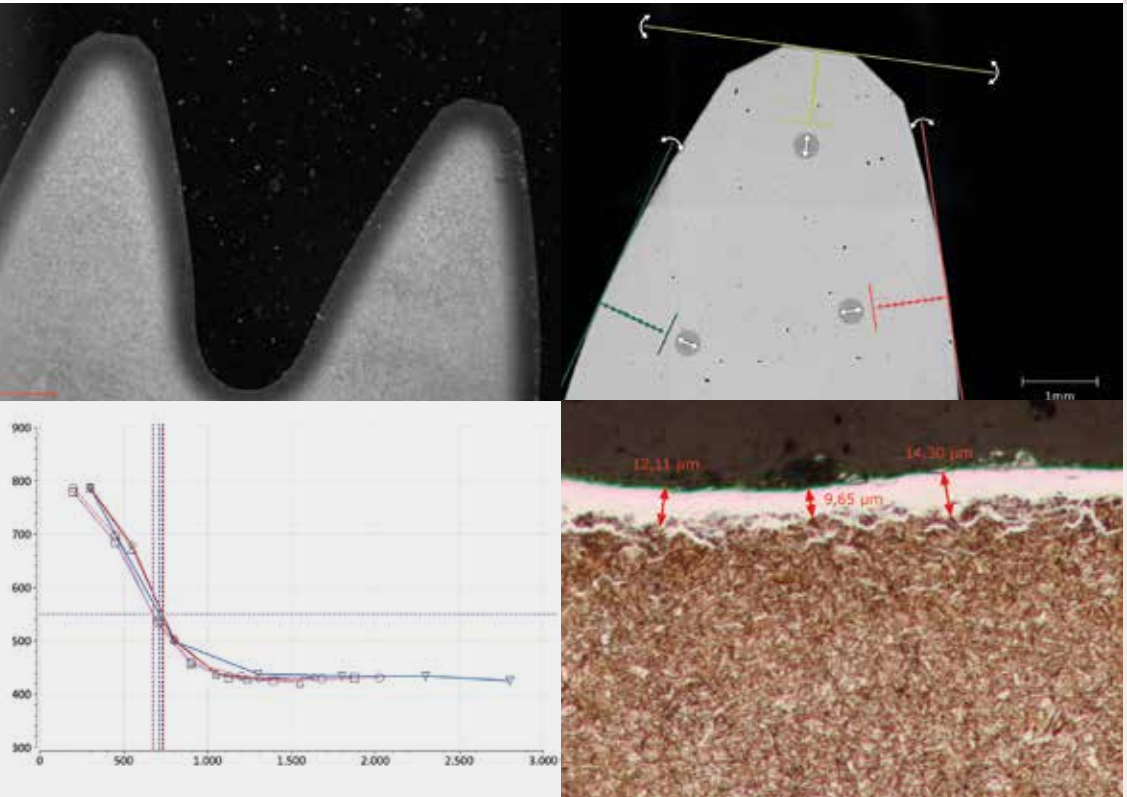
All templates for testing and documentation are reusable and can be customized or adapted depending on the task. The CARAT 930 software with professional calibrated optics enable geometric measurements in brilliant images. These can then be archived together with the measurement results, e.g. for documented measurements of layers or welded seams.

Modular Software Packages

CARAT-Collect, CARAT-Select, CARAT-Connect

Inside the CARAT software there are many different tools for hardness testing and measurement tasks available. These are available in separate software packages which allow configuration of an affordable and easy to use software solution for simple tasks, but also the ability to provide a full version with advanced functions. By updating the software at any time it is possible to integrate additional functions into the software as new testing tasks arise.





Hardness Curves

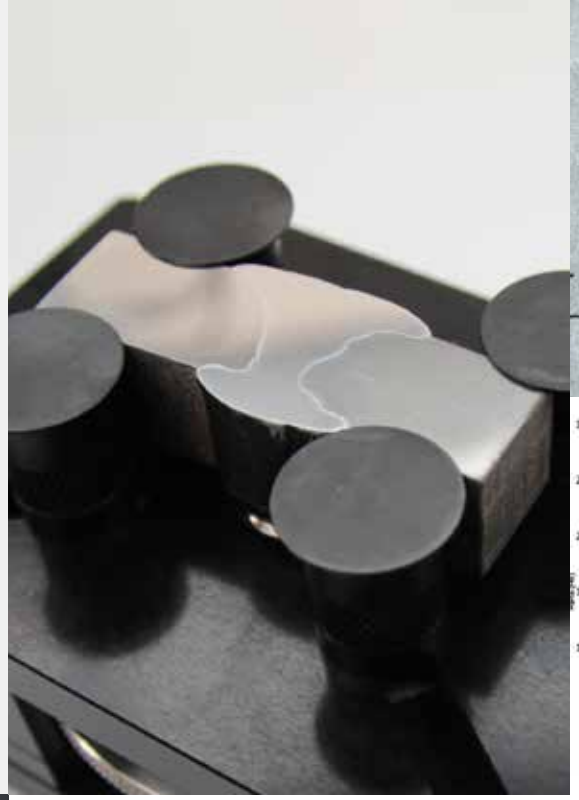
Measurements going deep

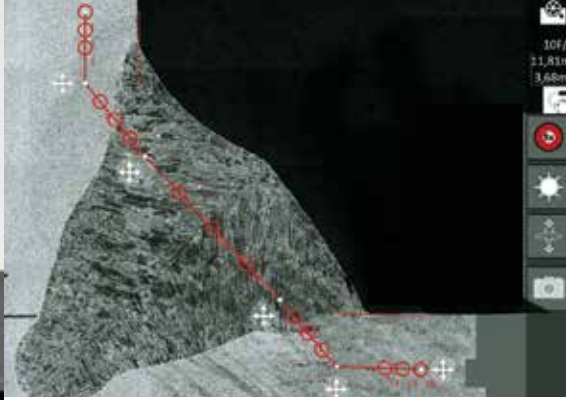
Standard testing procedures for the determination of hardness curves (CHD, NHD; Sinter-CHD) create the prerequisites for rapid single & series testing. Testing results that fall outside pre-defined tolerance specifications are clearly presented in the reporting documentation, simplifying the quality evaluation of tested samples.

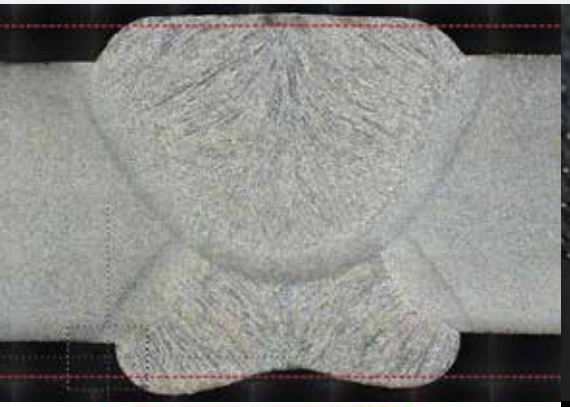
Hardness Testing

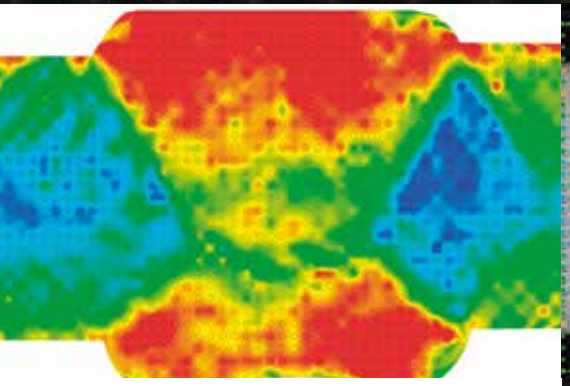
Welded seams according to DIN EN ISO 9015-1

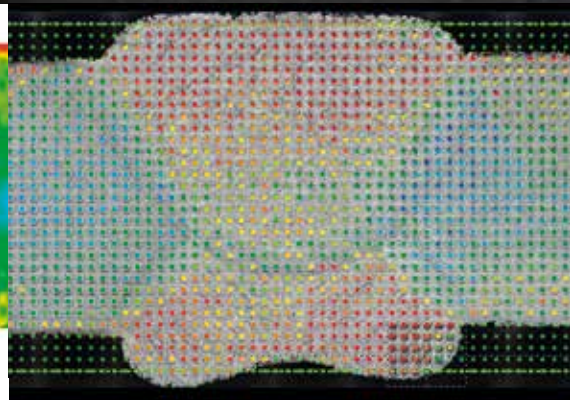
Templates which can be individualized for butt & fillet welds enable a quick entry into welded seam measurement. If the transitions between the basic material, the heat-affected zone (WEZ) and the welded seam are well contrasted, then a start can be made directly after the usual testing configuration.











Regular Test Grid

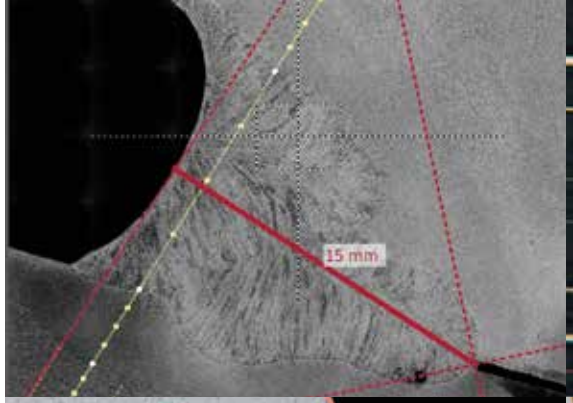
Tool for 2-dimensional hardness curves

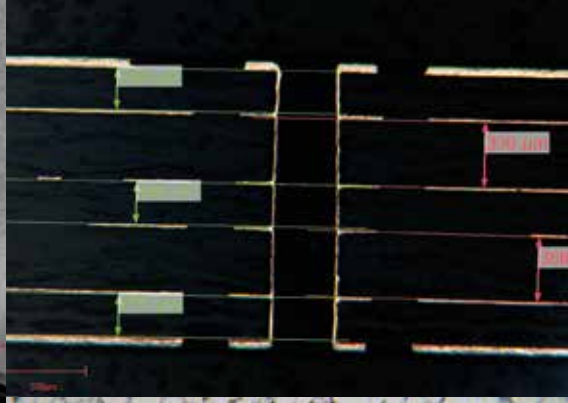
The measurement objects available in the software can be offered for complicated hardness measurements with many testing points. They enable the measurement of hardness curves in the zone with graphic presentation of the results and are therefore an excellent tool for examinations of the homogeneity of welded samples.

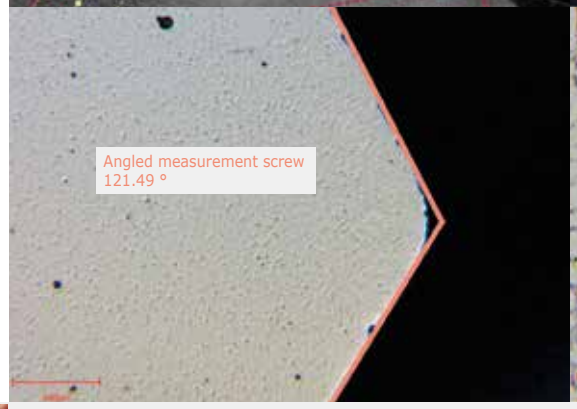
Measurement Tools

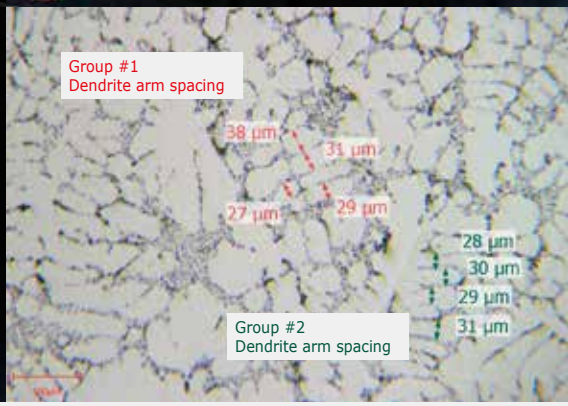
Simple instead of complicated

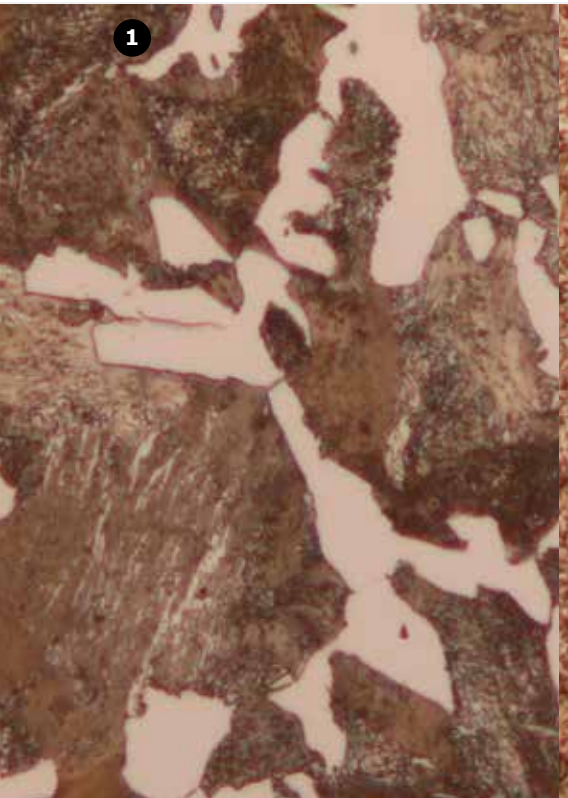
The calibrated optical system and the measurement tools integrated into the software allow a combination of hardness testing and measurements of geometries or structure constituents. The software allows hardness curves and the connecting layers to nitrided samples to be recorded and documented with the same testing unit, and to perform an examination of the A dimension and the hardness at welded seams within the framework of a metallographic examination.

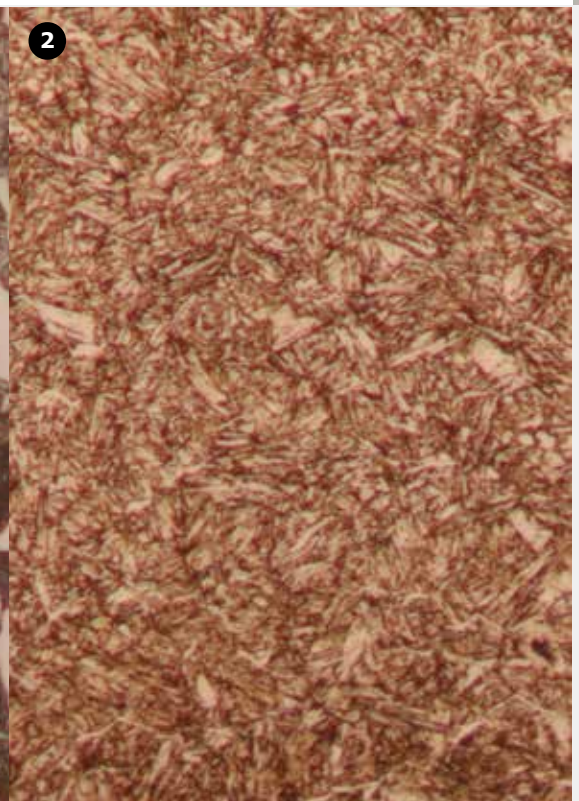












Structure Evaluation

Interpretation with CARAT 930

1.) Case-hardened steel C60, Ferrite / Perlite,
etched with 3% alcoholic nitric acid (Nital) brightfield,
magnification 500x

2.) Heat-treated steel C45, Tempered structure Martensite / Bainite,
etched with 3% alcoholic nitric acid (Nital) brightfield,
magnification 500x

Measurement Results

Documentation & evaluation in a few clicks

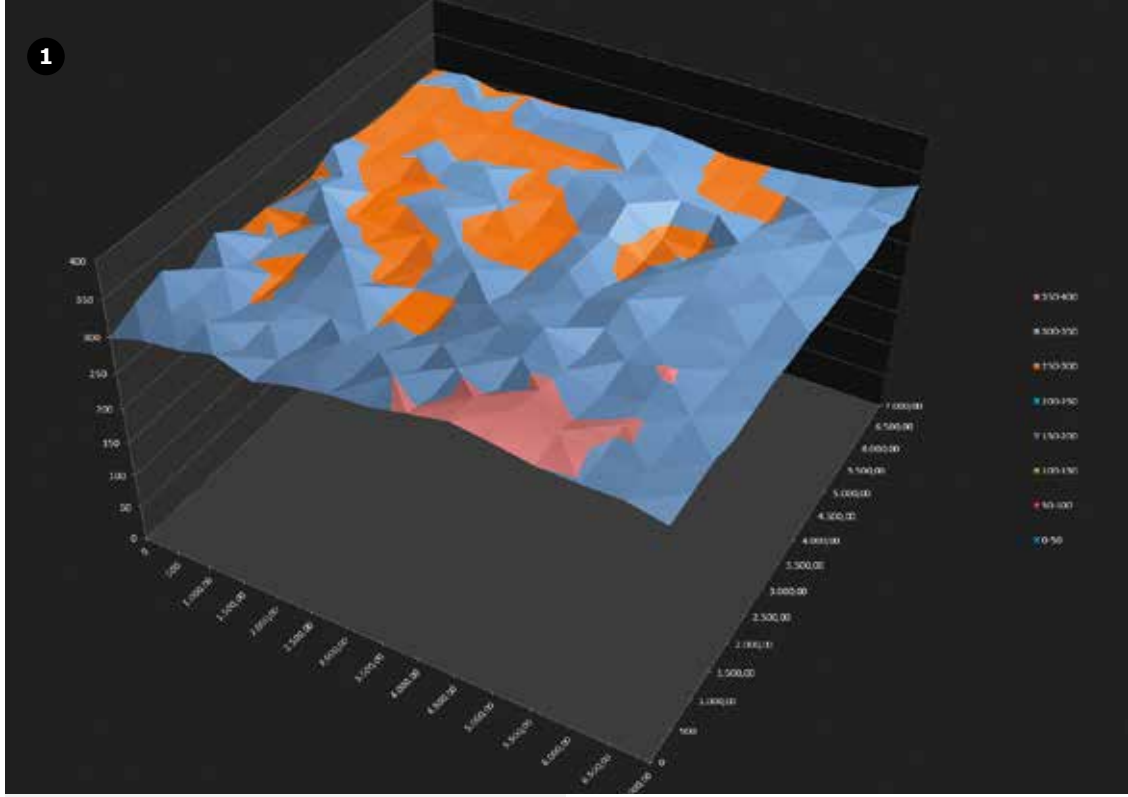
Documentation of the measurement results in accordance with stipulations and standards is often the most important component of the testing procedure. A report generator integrated into the software offers the possibility to create user-defined documentation, which can be edited and stored. Data collected during the measurements in the form of measured values, calculations, texts, images and graphs are displayed in the configured test report at the desired location.

SQL Q-DAS BMP JPG TIF PDF

The test report or single illustrations and results out of the software can be printed, saved or further edited via different export functions in databases or programs.

1.) CSV-Export of hardness testing results in Excel
2.) Report CHD-Hardness profile
3.) Report microstructure examination

1



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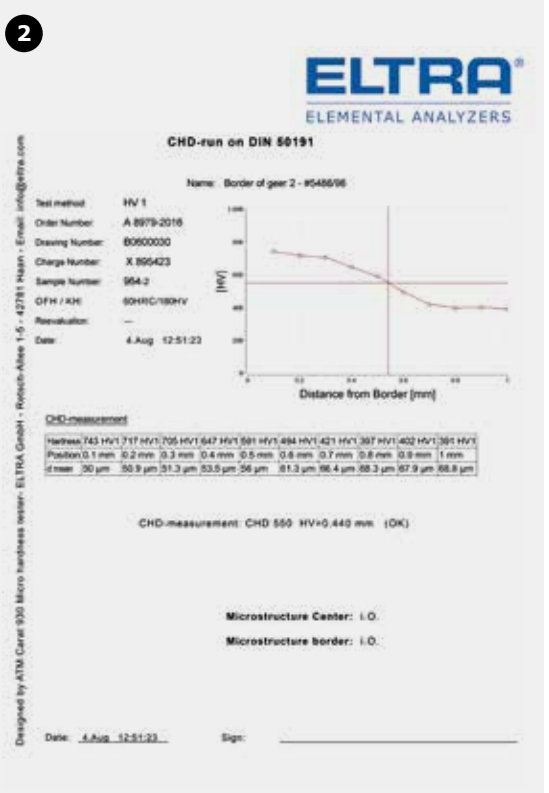

ELTRA
ELEMENTAL ANALYZERS
CHD-run on DIN 50191
Name: Border of gear 2 - #5488/96
Test method: HV 1
Order Number: A 8979-2016
Drawing Number: B0600030
Charge Number: X 895423
Sample Number: 954-2
DFH / XH: 60HRC/180HV
Reevaluation: –
Date: 4.Aug 12:51:23
[HV]
Distance from Border [mm]
CHD-measurement
Hardness 743 HV1 717 HV1 705 HV1 647 HV1 591 HV1 494 HV1 421 HV1 397 HV1 402 HV1 391 HV1
Position 0.1 mm 0.2 mm 0.3 mm 0.4 mm 0.5 mm 0.6 mm 0.7 mm 0.8 mm 0.9 mm 1 mm
d mean 50 µm 50.9 µm 51.3 µm 53.5 µm 56 µm 61.3 µm 66.4 µm 68.3 µm 67.9 µm 68.6 µm
CHD-measurement: CHD 550 HV=0.440 mm (OK)
Microstructure Center: i.O.
Microstructure border: i.O.
Date: 4.Aug 12:51:23
Sign:
Designed by ATM Carat 930 Micro hardness tester - ELTRA GmbH - Retsch-Allee 1-5 - 42781 Haan - Email: info@eltra.com

3


Report
Examination of microstructure
CARAT 930
Sample: Name
Material: Steel with scale layer
Sample ID: ID
Laboratory: Main lab
Tester: herbert Schmidt
Image steel, etched 8c, prepared on internal template,finished with diamond suspension

Software packages

CARAT-Collect

Image capture with dynamic live image

- Objective independent image in image function
- Live image freeze (e.g. for vibrations)
- Automatic brightness regulation
- Autofocus
- Sharpness reconstruction via flat scan
- Live image record (Save/Clipboard/ Export in default image format)
- Configuration of a sample for reproduction save and load with rapid recall (Favorites) in stage menu
- Freely configurable sample places (size, number, position) in stage menu with large overview image

CARAT-Select

Measurement module

- Measurement functions: paths, angles, areas, loops and polygons with assessment
- Display grid
- Block single measurement objects
- Define zero point of coordinates
- Adjust measuring elements with coordinates input
- Re-import movement coordinates step-by-step with `Enter`
- Edit color and text of measuring object

CARAT-Connect

Report generator for the documentation of results

- Issue overview images, value tables and diagrams
- Dynamic overview image (e.g. for change in live image excerpt)
- Constant update of measurement results in report
- Choice of parameters of a table and different compilation for more tables in a report
- Templates for hardness testing report acc. to DIN EN ISO 6507 and ASTM E-384
- Import drawing elements, such as rectangles and lines
- Define formula fields
- Assign barcode scan
- Issue formats: PDF, CSV and clipboard
- Optional interface module: QDAS, ODBC/SQL
- Compiling, saving of report templates

Hardness testing module

Fully automatic and manual image evaluation and hardness calculation

- Compile single measurement points and series thereof
- Adjust test objects visually or parametrically
- Adaptation and rotation of the CHD (i.e. NHD measurement series)
- Set axis to edge line of the CHD-/NHD-measurement series (Standard 90 °)
- Allocate different indentation features (planned, finished and faulty print)
- Import and save already processed measurement sequences for reproduction
- Misalignment of a sample through targeted sequences and focusing correct more measurement points
- CHD-Measurement series: define point shift 1- or more paths
- Sinter measurement series
- Define tolerance field for hardness- as well as CHD curve
- Circle (i.e. circular segment) with concentric auxiliary circles
- Spot group for hardness testing
- Colored presentation of measurement results in overview image

Free-handed measurement series module

Hardness testing along a polygon line

- Freely select number of spots and angle of the line segment
- Adjust misalignment (e.g. to sample edge)
- Relocate points singly, attach or delete

Regular test grid

2-dimensional hardness sequences

- Up to 6,000 testing points
- Adjust number of points and separation adjustable
- Speeding up the testing process through calculation in background
- Colored 2D presentation of measurement results

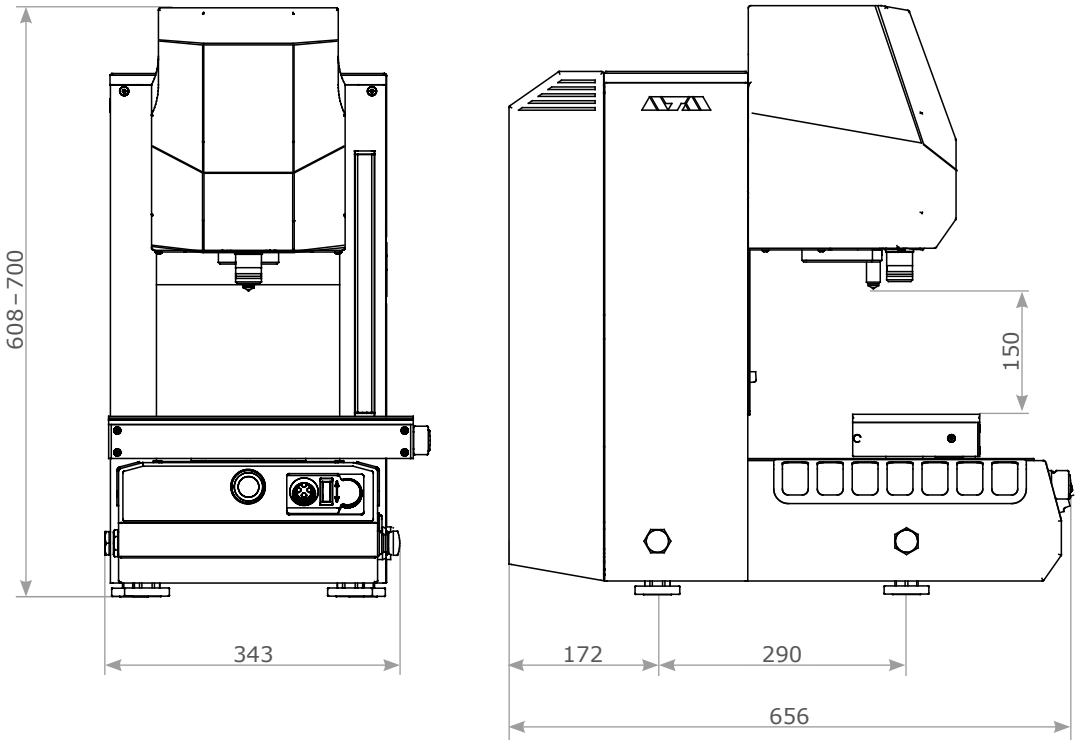
Welded seam module

For hardness testing at welded seams (butt weld, fillet weld and double fillet weld)

- Adjust the 5 zones of the test line in number of points, length and alignment (left & right flush, middle)
- Show standard tolerance of edge distances with border help lines
- Change fillet weld tool outside angle
- Results will be issued with labelling of the zones in the evaluation

Hardness tester CARAT 930

Test method	Vickers, Knoop
Loading range (DIN EN ISO 6507 + ASTM E-384) (DIN EN ISO 4545 + ASTM E-384)	HV 0.05 – HV 30 HK 0.05 – HK 2
Total testing range	1 g – 30 kg
Max. loading CARAT stage	60 kg
X-axis (coordinate stage)	160 mm or 250 mm
Y-axis (coordinate stage)	100 mm
Z-axis	150 mm
Weight	~ 65 kg
W x H x D	375 x 650 x 670 mm
Electrical connection data	100 – 240 V, 50/60 Hz (1 Ph/N/PE)
Optic	Microscopic measurement system with digital CMOS camera
Objectives	Infinite corrected plan achromat objectives
Illumination	Köhler LED illumination and aperture diaphragm
Illumination type	Brightfield
Magnification	25 x – 1000 x (25 x / 50 x / 100 x / 400 x / 500 x / 1000 x)
Camera resolutions	1280 x 1024 px, 1600 x 1200 px
PC System	Micro-PC-System incl. full-HD 23" Touch-Screen, rem. keypad & mouse, Windows op. system



Advanced Materialography

part of VERDER scientific

PREMIUM QUALITY

MADE IN GERMANY

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