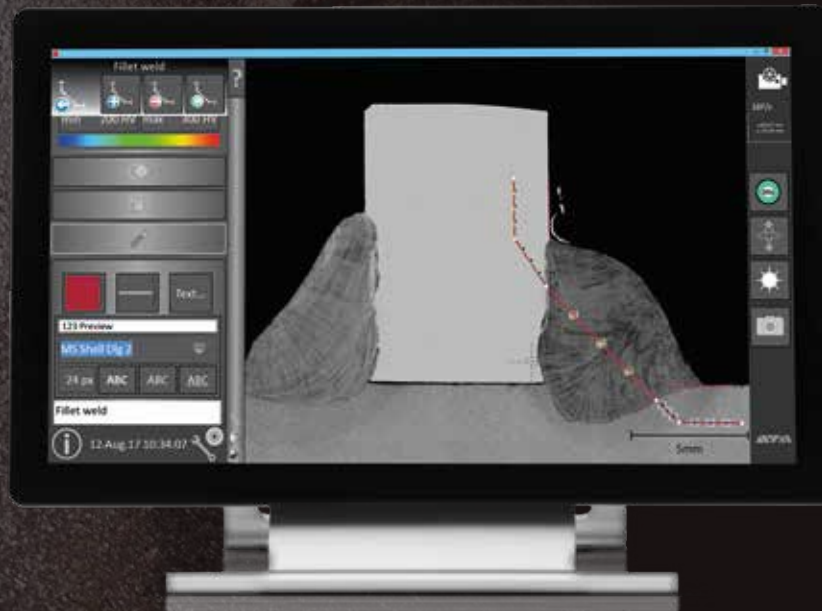




ADVANCED MATERIALOGRAPHY

carat 930/950

Hardness Testing and Image Evaluation





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

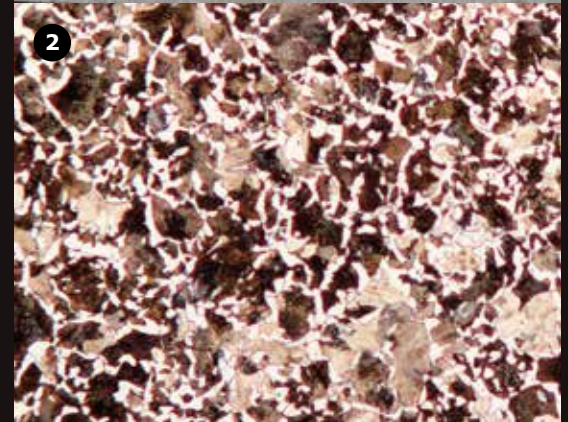
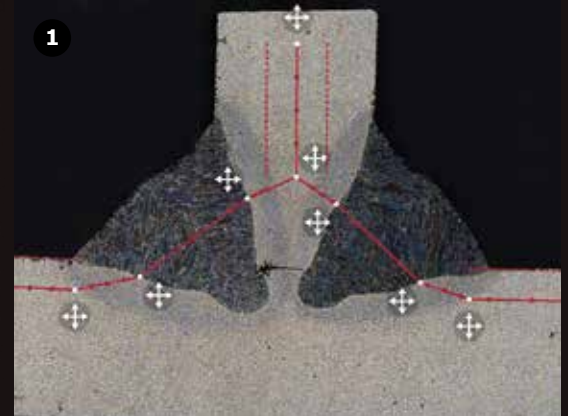


Micro & Macro Hardness Testing

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 930/950

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

The high flexibility of both models CARAT 930 and CARAT 950 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 CARAT 930 and CARAT 950

with excellent capabilities for hardness testing and optical analysis of microstructure. The indenter is not integrated in 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 microstructures.

The Carat 950 is equipped with a 5 Mpix overview camera, which takes homogenous illuminated images with a projection area of 42 x 42 mm. The enhanced performance spectra includes an enlarged loading range of up to 50 kgf.



Features

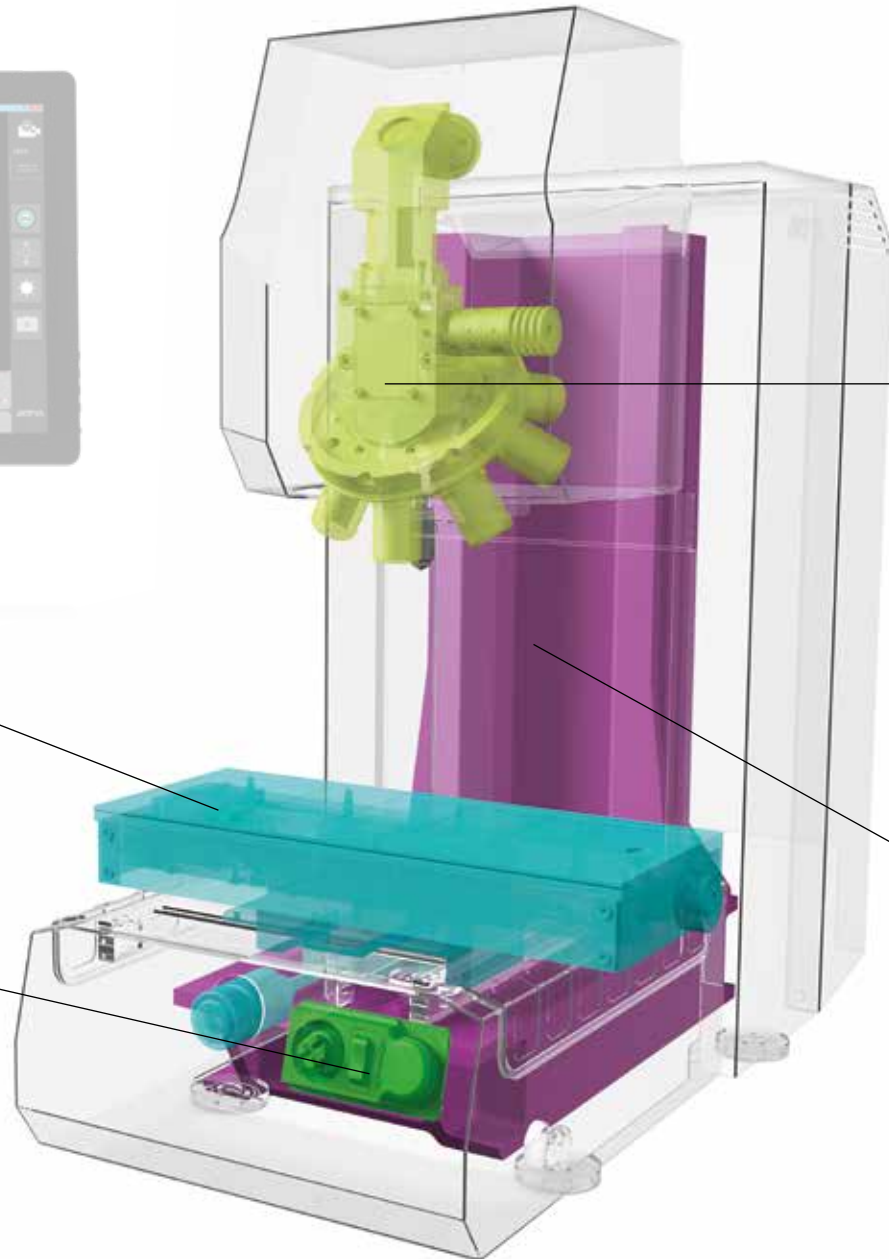
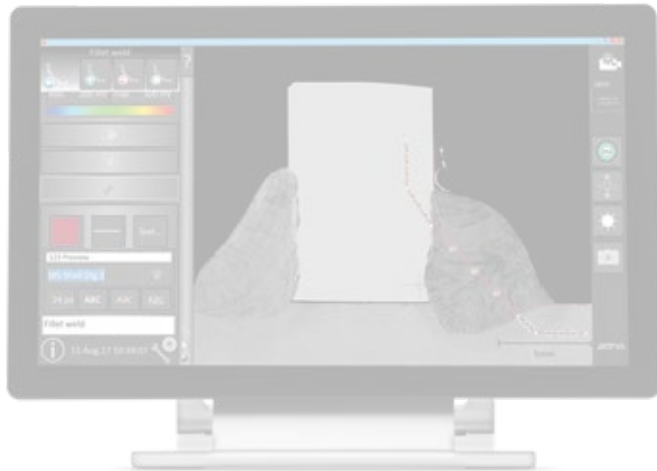
- ▶ Micro-processor driven load cell
- ▶ Fully automatic hardness testing
- ▶ Manual testing possibilities
- ▶ Robust cast-aluminum construction
- ▶ Overview camera (only CARAT 950)
- ▶ Objective and illumination identical with brightfield microscope
- ▶ Testing methods:

	Vickers	Knoop
CARAT 930:	HV 0.05 – HV 30	HK 0.05 – HK 2
CARAT 950:	HV 0.05 – HV 50	HK 0.05 – HK 2
- ▶ Standardized result documentation



PREMIUM QUALITY
— — —
MADE IN GERMANY

The design of CARAT 930 and CARAT 950 allows use in a wide range of testing environments. Robust and space-saving, they find 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 80 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

- Overview camera with 5.0 megapixel CMOS sensor (only CARAT 950)
- 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

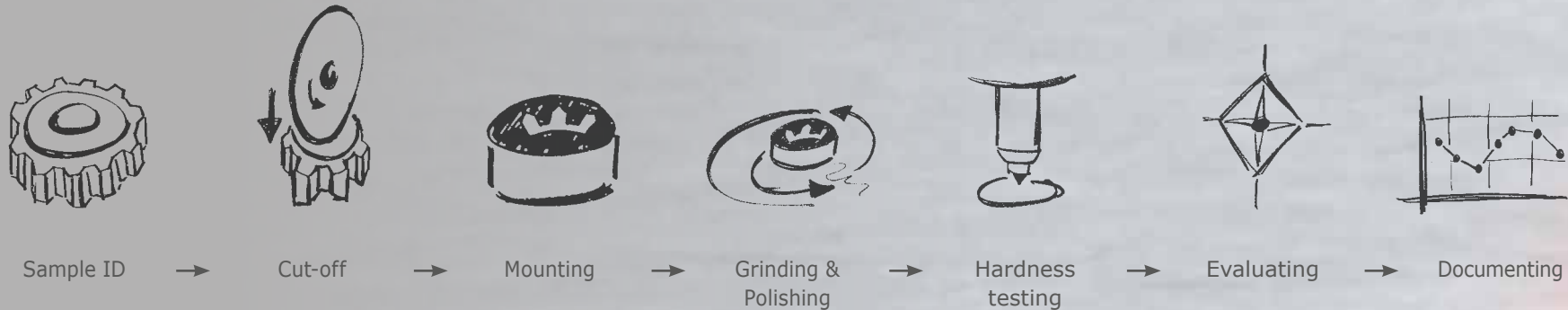
Basic construction

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



Preparation Process

Integration of hardness testing & image evaluation



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 overview camera integrated in the objective revolver shows the whole specimen at once (CARAT 950 only) and 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 and CARAT 950 are factory calibrated and labelled with the corresponding certificate before shipment.

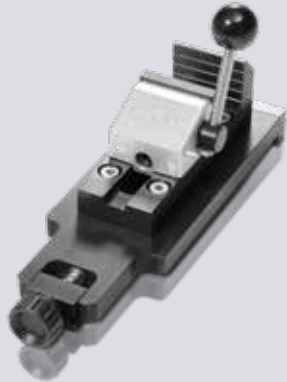
The official on-site calibration according to the corresponding standards is offered by us in conjunction with an accredited calibration service.



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



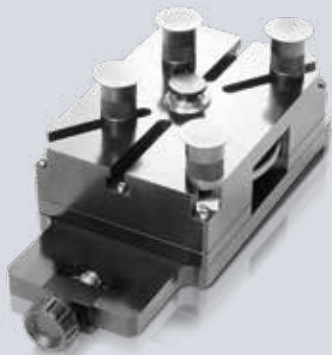
1



2



3



CARAT Easy Clamping System

Universal & user-friendly

The innovative & versatile Easy Clamping System for cut-off machines has also been adapted for the hardness testers of the CARAT series. 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.) 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.

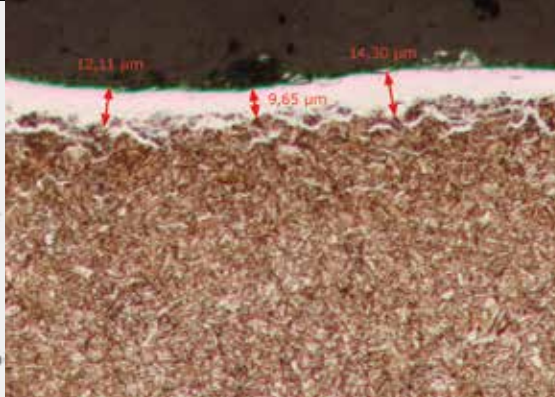
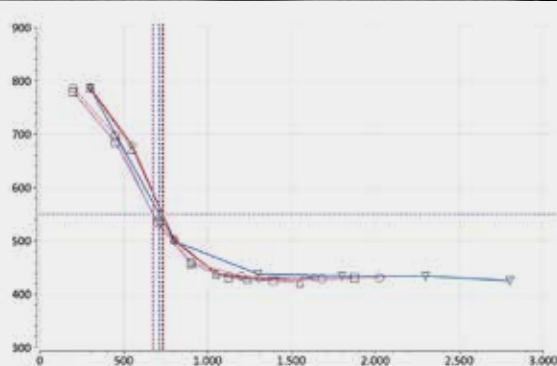
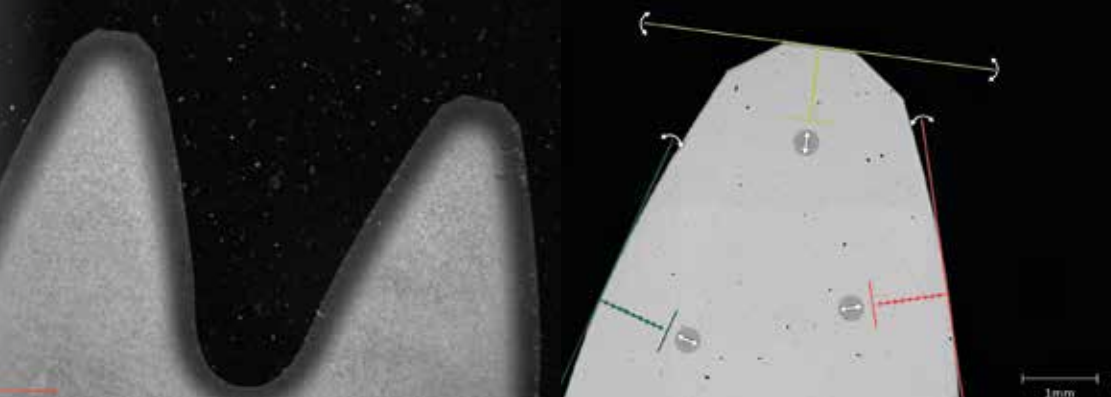
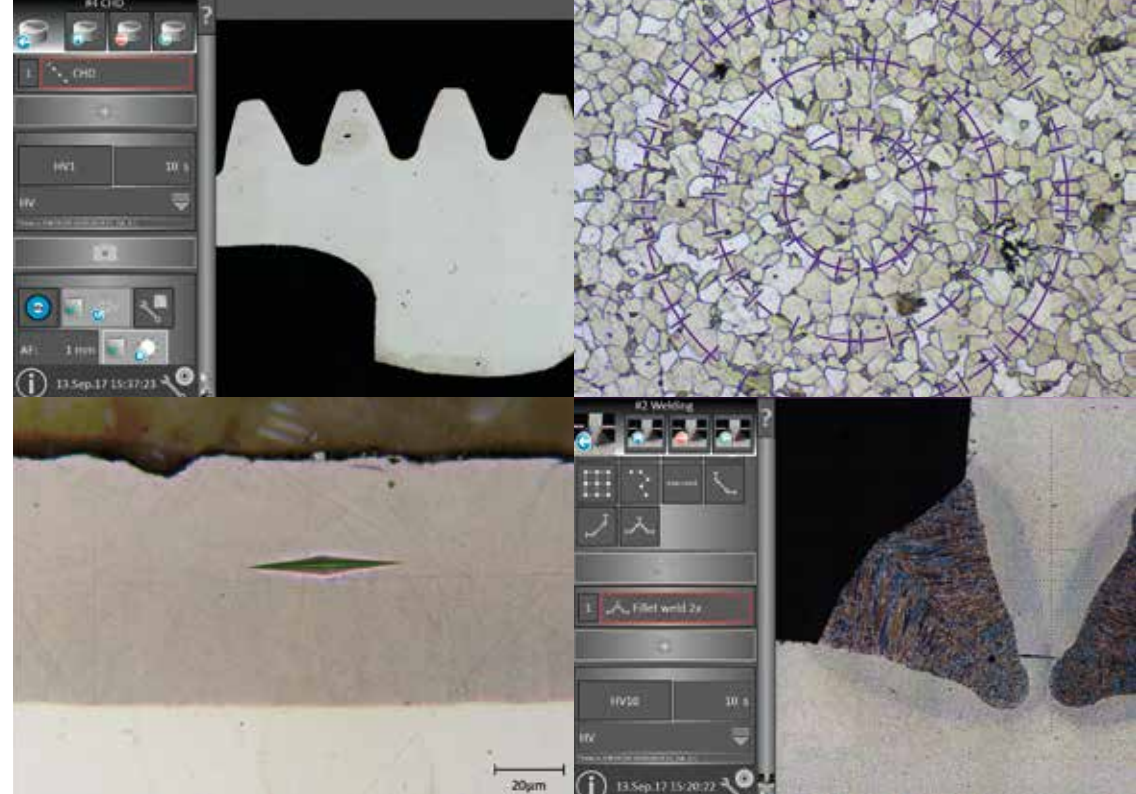
All templates for testing and documentation are reusable and can be customized or adapted depending on the task. Together with the professional calibrated optics the CARAT software enables geometric measurements in brilliant images. These can then be archived together with the measurement results, e.g.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



Modular Software Packages

CARAT-Inspect: Grain size analysis, layer thickness measurement, phase analysis

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

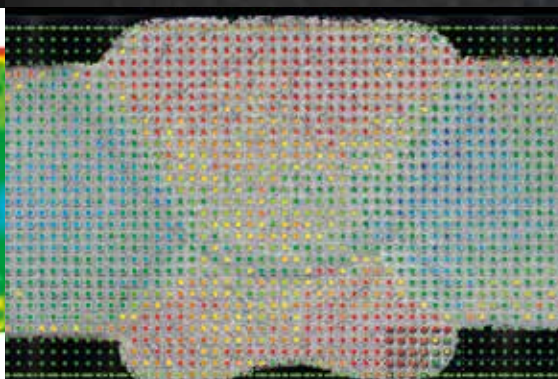
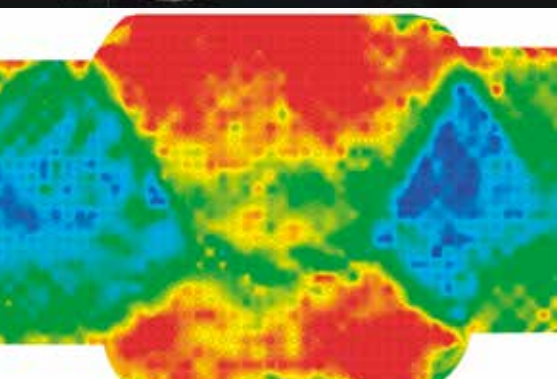
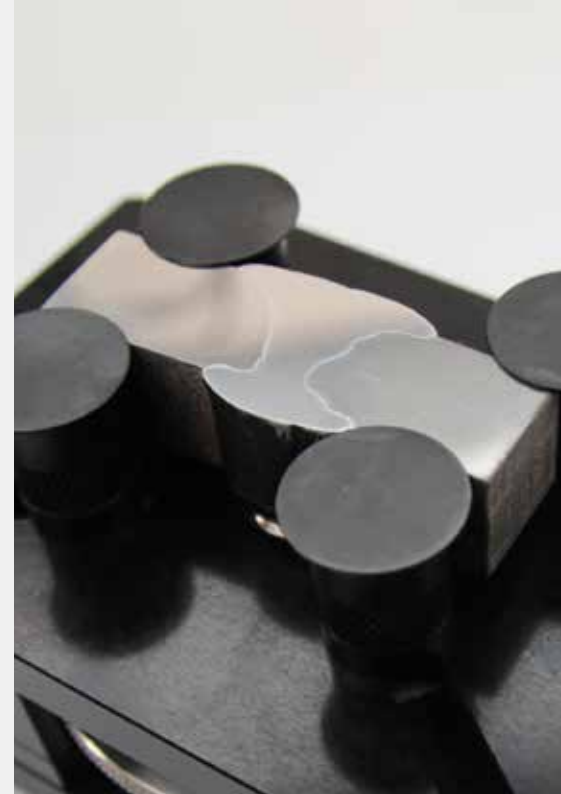
Measurements going deep

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 (HAZ) and the welded seam are well contrasted, then a start can be made directly after the usual testing configuration.



Regular Test Grid

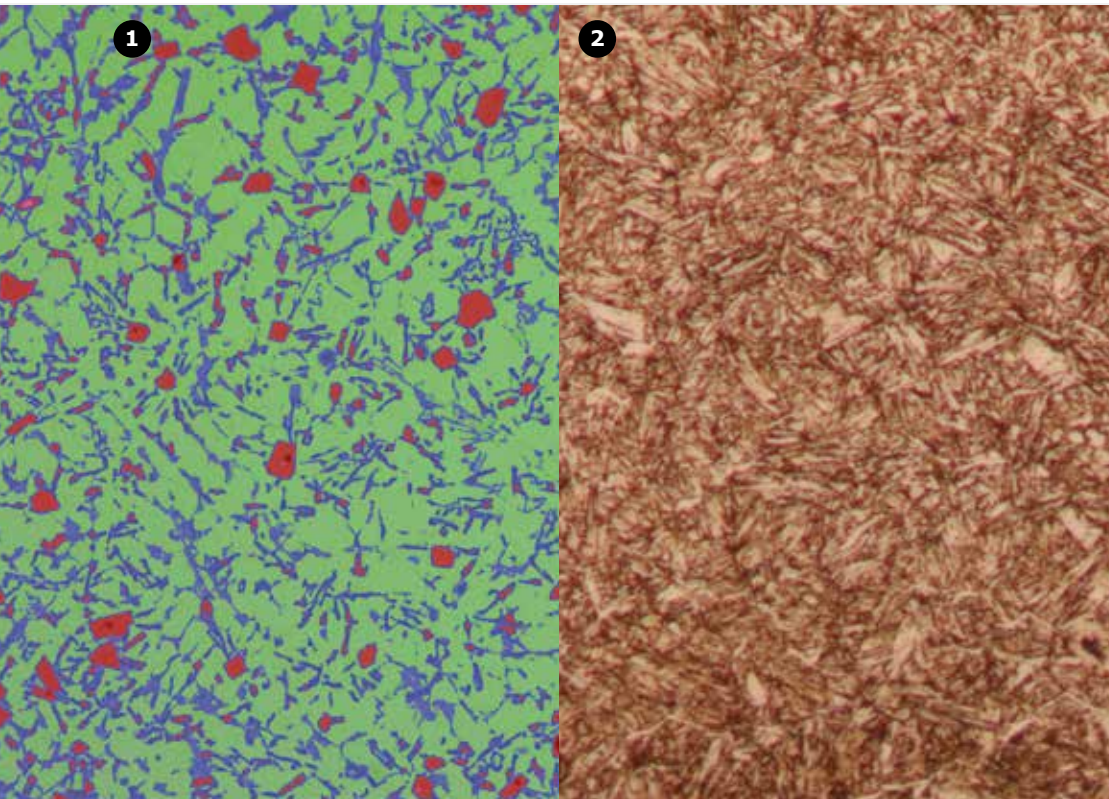
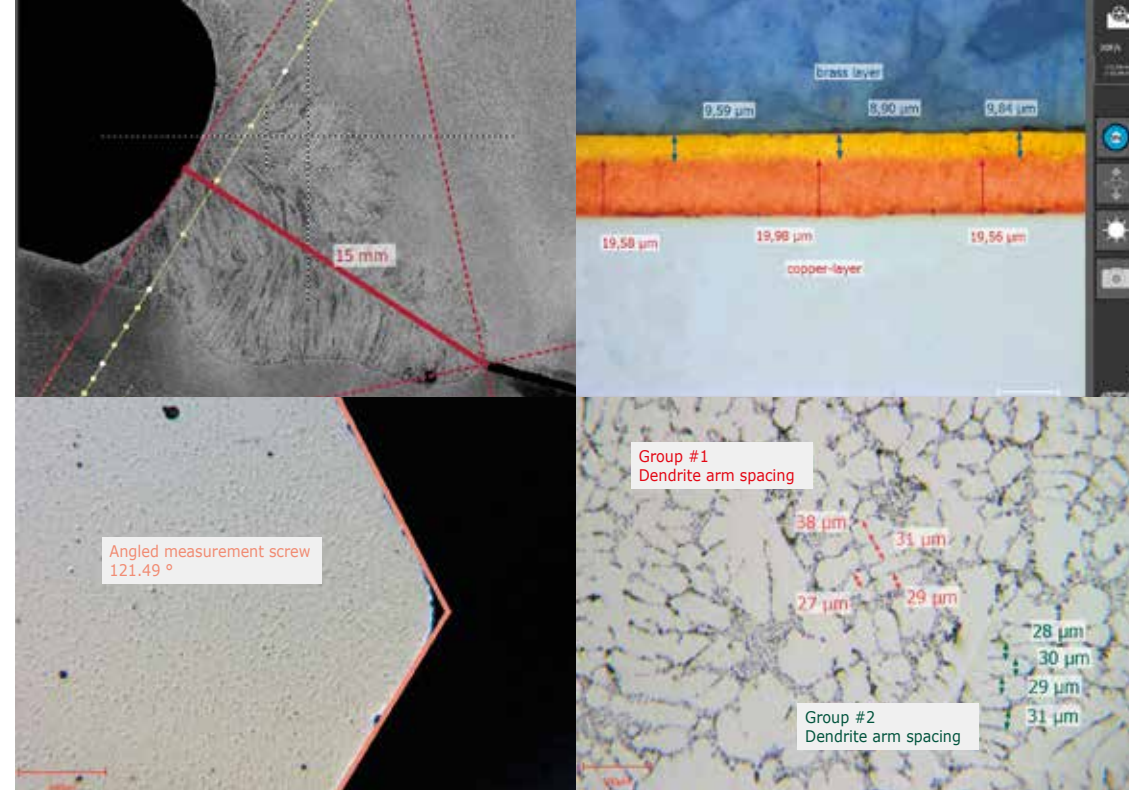
Tool for 2-dimensional hardness curves

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 and 950

- 1.) Microstructure AlSi, polished, brightfield, detected phases, magnification 200x
- 2.) Heat-treated steel C45, Tempered structure Martensite / Bainite, etched with 3% alcoholic nitric acid (Nital) brightfield, magnification 500x

Measurement Results

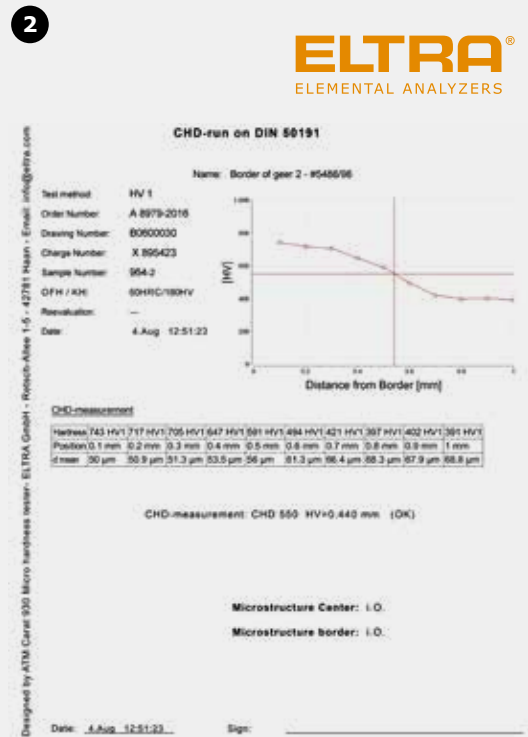
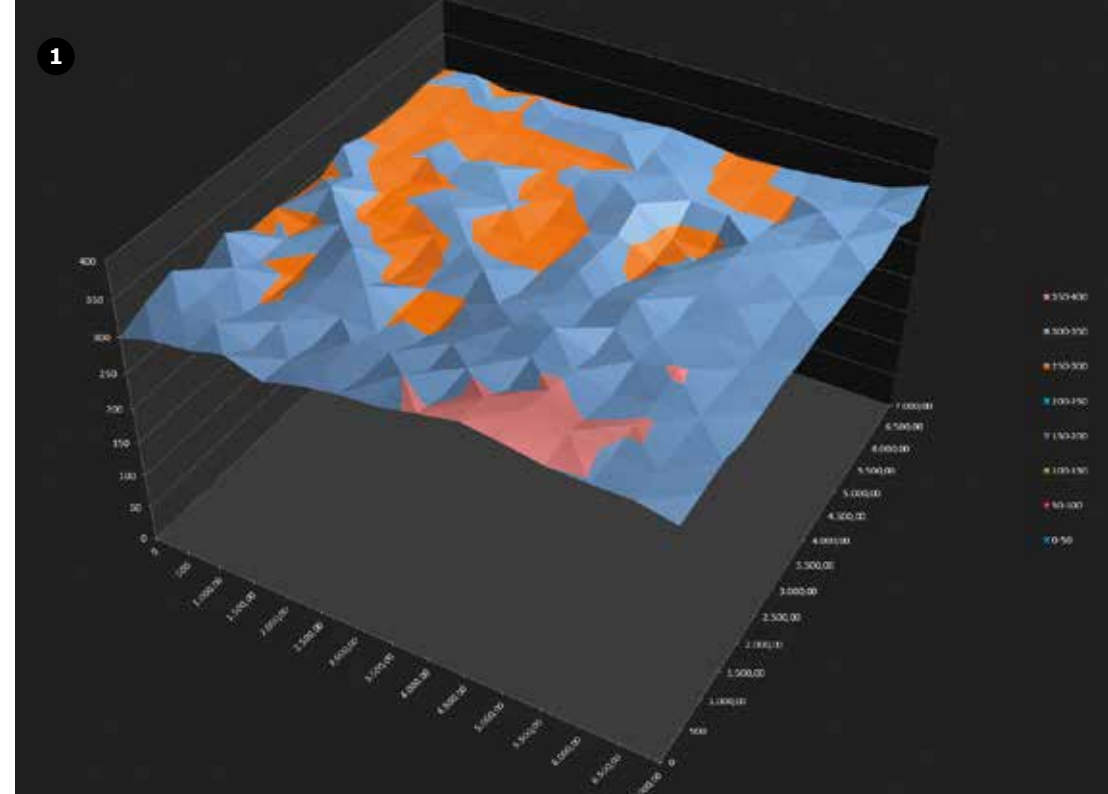
Documentation & evaluation in a few clicks

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.



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



Software packages

Hardness testing (Basic module)

Fully automatic and manual image evaluation and hardness calculation

Intuitive operation with touch & mouse function

Force transducer with microprocessor-controlled

Fully-automatic and manual image appraisal and hardness calculation acc. to Vickers or Knoop (DIN EN ISO 6507, ASTM E-384)

Automatic brightness control

Automatic focus

Multifocus with sharper construction

Periphery scan for overview images (dynamic real-time frame is integrated)

Dynamic live screen with image-in-image function independent of objective

Overview scan with semiautomatic contour detection

Brightness correction of the partial images of the overview scans

Live image acquisition (image saved and pasted into clipboard), images loaded default image formats: jpg, png, tif etc.

Correcting the tilt of a sample by scanning and focusing of several measuring points

Creating, saving and loading individual test programs

Preinstalled planning objects for single measurements, hardness profiles, grid measurements etc.

Manual measurement functions

Presentation and output of measuring results via report generator (PDF, CSV)

Use of remote diagnostics and online operator-support (assuming Internet access)

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

Carat Software module AMS interface

Export function

Reads AMS input files from user-defined folder

Output of measurements to user-defined folder for further processing by AMS

Carat software QDAS connection

Export function

Connection of QDAS-interface to company's network/QDAS-data base

Carat ODBC-Interface

Export function

Direct connection to database by ODBC

CARAT-Inspect

Layer thickness measurement

Live image capturing / Loading and recalibration of stored images (PNG, JPG, TIFF, BMP)

Preprocessing filters (e.g. Blurring, Sharpen, Normalize)

Object definition by gray and / or color threshold

Morphological filters

Selection of image objects by predefined measures

Measurement of layer thickness according to DIN EN ISO 1463

Measurement of horizontally, vertically aligned and curved layers

Output of the layer thickness in terms of statistical quantities (e.g. mean, standard deviation, median, minimum, maximum) in tabular or graphical fashion

Two preinstalled layer thickness measurements as favorites

CARAT-Inspect

Phase analysis

Live image capturing / Loading and recalibration of stored images (PNG, JPG, TIFF, BMP)

Preprocessing filters (e.g. Blurring, Sharpen, Normalize)

Object definition by gray and / or color threshold

Morphological filters

Selection of image objects by predefined measures

Automatized image object measurement

Measurement of phase fractions according to ISO 9042 and ASTM E562 - 11

Output of analysis results in terms of the relative/absolute area in tables or graphs

Statistical quantities (e.g. mean, standard deviation, median, minimum, maximum)

Preinstalled phase analysis as favorite

CARAT-Inspect

Grain size analysis

Live image capturing / Loading and recalibration of stored images (PNG, JPG, TIFF, BMP)

Preprocessing filters (e.g. Blurring, Sharpen, Normalize)

Object definition by gray and / or color threshold

Morphological filters

Selection of image objects by predefined measures

Measurement of the grain size according to DIN EN ISO 643 and ASTM E112 -13 including lineal and circular intercept procedures as well as the planimetric procedure

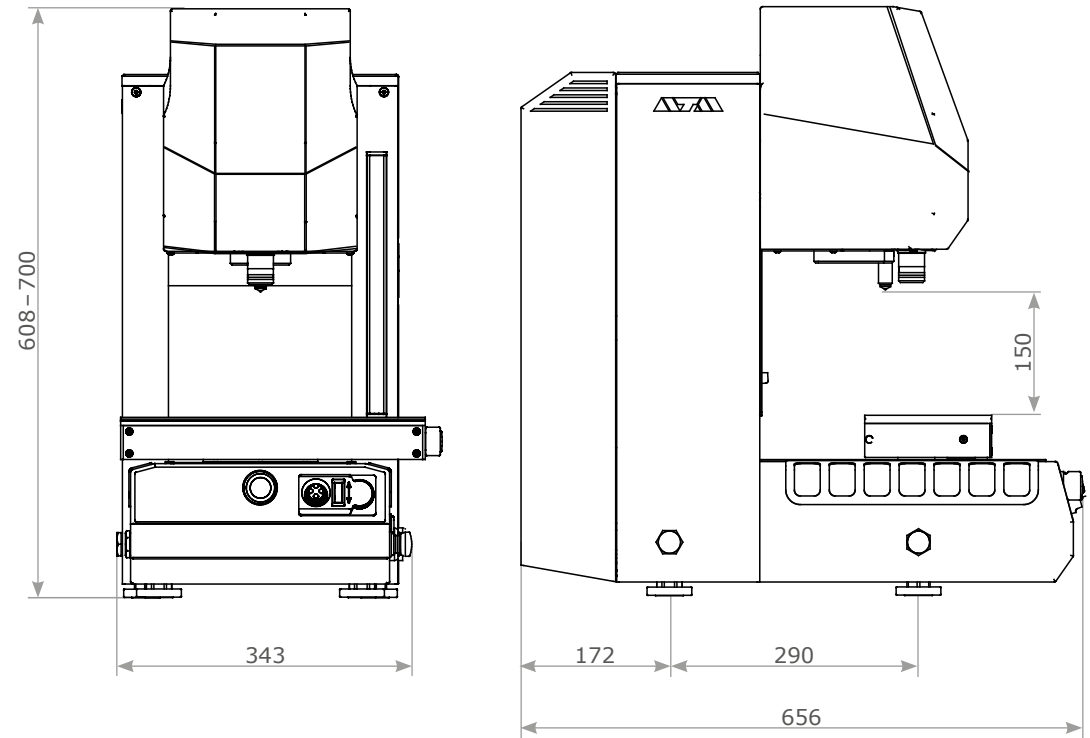
Output of analysis results in terms of tables and graphs

Acquisition of statistical quantities of the grain size as well as of the grain intercept lengths (e.g. mean, standard deviation, median, minimum, maximum)

Two preinstalled grain size analyses as favorites

Technical Data

Hardness tester	CARAT 930	CARAT 950
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	HV 0.05 – HV 50 HK 0.05 – HK 2
Total testing range	1 g – 30 kg	1 g – 50 kg
Max. loading CARAT stage	80 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)	
Overview camera	-	5.0 Megapixel (2464 x 2056 px), USB 3.0, CMOS camera
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	





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