

## LAS X GRAIN EXPERT SOFTWARE: Structural analysis of steel and other materials

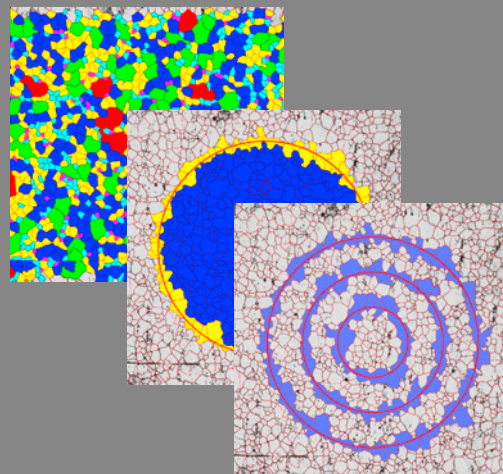
### Superior accuracy and reproducibility in grain analysis

LAS X Grain Expert provides an environment to rapidly execute structural analysis of steel and other materials.

The Leica software has a quick and easy-to-learn workflow that guides users through the individual analysis steps. A multitude of structures and sample preparation types can be studied using highly accurate edge detection algorithms.

This software module also includes traditional stereological methods, such as Heyn lineal intercepts, Jeffries planimetric, or the Abrams 3-Circle procedure. These patterns are applied completely automatically, resulting in the direct calculation of the grain size.

Where traditional stereological methods suffer from their 1-dimensional approach to approximate grain size, LAS X Grain Expert applies specific 2-dimensional algorithms to directly measure the grain area. This exceptional approach results in superior accuracy compared to traditional and non-digital methods.



#### International standards covered:

- > ASTM E112
- > ASTM E930 (within E112)
- > ASTM E1382 (within E112)
- > DIN/EN/ISO 643
- > GOST 5639
- > JIS G0551

#### References

- > Sign up for the free on-demand webinar **"Analyze grain size on microstructures the way you need"**  
<http://www.leica-microsystems.com/science-lab/free-webinar-on-demand-analyze-grain-size-on-microstructures-the-way-you-need/>

Superior accuracy and reproducibility in grain analysis



### Sample Preparation

Selection of samples according to a standardized sampling process. Preparation of clean and even surfaces using abrasives and diamond paste.



### Etching

Chemical or physical visualization of grain boundaries by material specific grain boundary etchants or ion milling.



### Visualization / Acquisition

Applying optical contrast methods and microscopic imaging techniques to acquire digital images of the grain structure.



### Digital Grain Size Analysis

Analyze grain size by using automatically applied traditional stereological methods or superior digital approaches. Analysis can be conducted according to various international standards.



### Reporting

Beyond grain size analysis for Quality Control, a wide variety of other parameters can be analyzed. Create customized, Excel-based report templates to also tailor analyses for advanced research purposes.

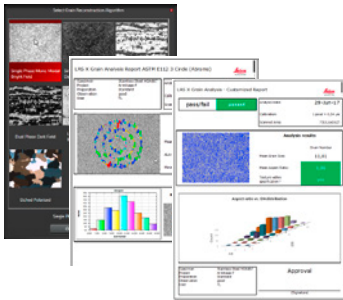


### Delivery of Quality Products

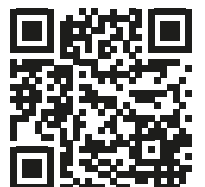


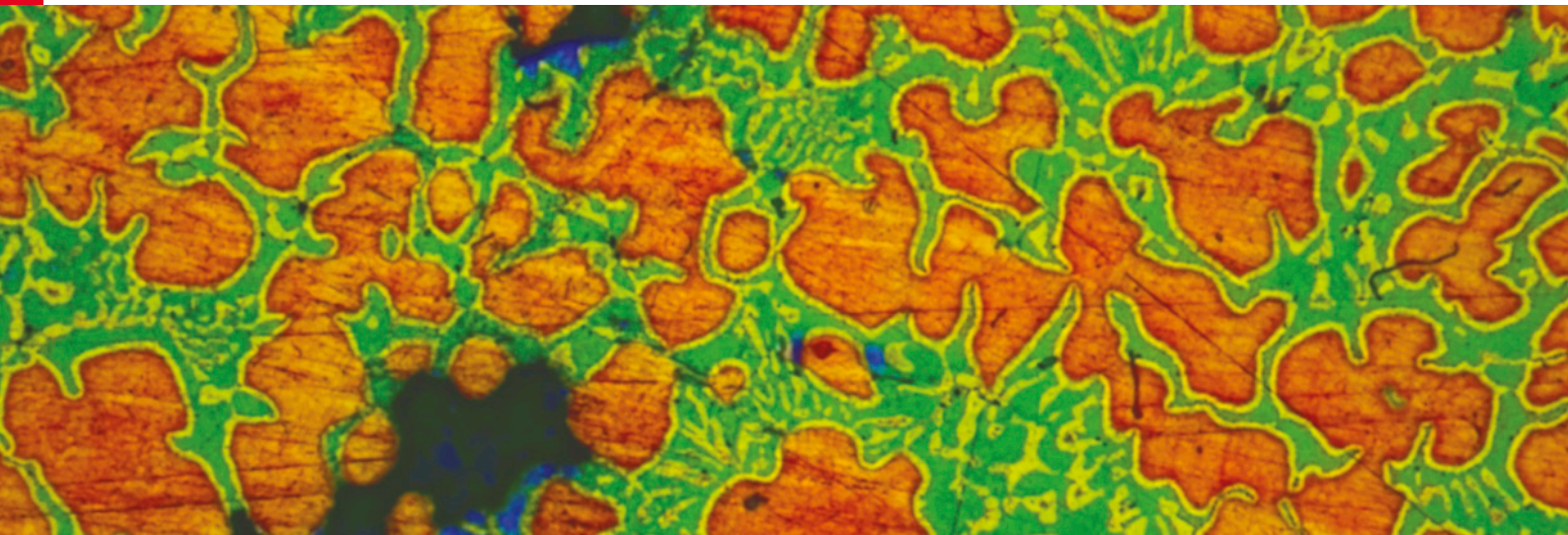
## Your benefits: Easy-to-use workflow & customizable reports

The workflow of LAS X Grain Expert software is easy to learn. Start by simply selecting an example image which best resembles the specimen and the correct analysis algorithm will be applied. All faint grain boundaries can be improved by applying binary modifications. Even with imperfect etching, the quality of your analyses will not be reduced. Customize the Excel-based report templates for your quality control or R&D purposes.



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## LAS X PHASE EXPERT SOFTWARE: Analysis of multiple phases and microstructure components

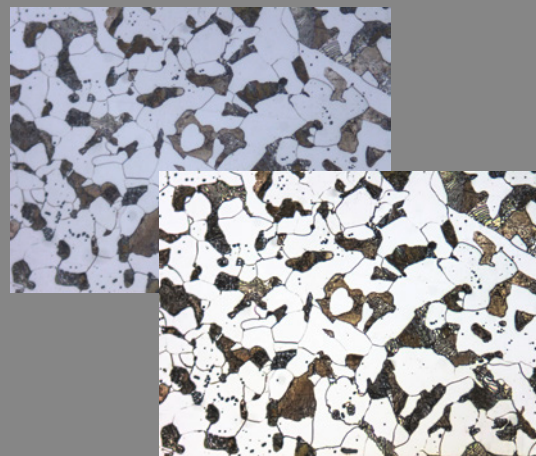
### Improve detection accuracy by up to 250 times

LAS X Phase Expert enables the advanced analysis of multiple phases and components of microstructures.

The Leica software's quick and easy to learn workflow rapidly guides the user through the individual analysis steps. Using high bit-depth or HDR images, highly accurate detection algorithms allow the investigation of faint differences in phases.

Whereas for traditional images the detection resolution is limited to 256 intensity levels, LAS X Phase Expert allows for an improvement in detection accuracy of up to 250 times.

Results are typically calculated as the percentage of individual phases in the observed microstructure. Beyond traditional phase analysis, the software also provides additional object measurement capabilities and an evaluation of a wide variety of other geometrical as well as morphological parameters.



#### Some use cases:

- > Materials: Components in metal alloys and ceramics
- > Materials: Particle density of dispersed solids in alloys
- > Mining: Ratio of extractable ores in minerals
- > Automotive: Porous surfaces of catalysts and the honeycomb structure in light weight construction materials

Improve detection accuracy by up to 250 times



### Sample Preparation

Selection of samples according to a standardized sampling process. Preparation of clean and even surfaces using abrasives or thin sections using microtomes.



### Etching

Chemical, electrochemical, or physical visualization of different phases and components by material specific etching methods.



### Visualization / Acquisition

Applying optical contrast methods and microscopic imaging techniques to acquire digital images of the sample's microstructure.



### Digital Phase Analysis

Analyze the sample's microstructure for area ratios (or various other parameter ratios) of up to 10 phases or a simple object count of the individual components.



### Reporting

Beyond traditional phase percentage and object count, a wide variety of other parameters can be analyzed, e. g. shape parameters and surface/interface areas. Create customized, Excel-based report templates to tailor analyses for advanced research purposes.



### Delivery of Quality Products



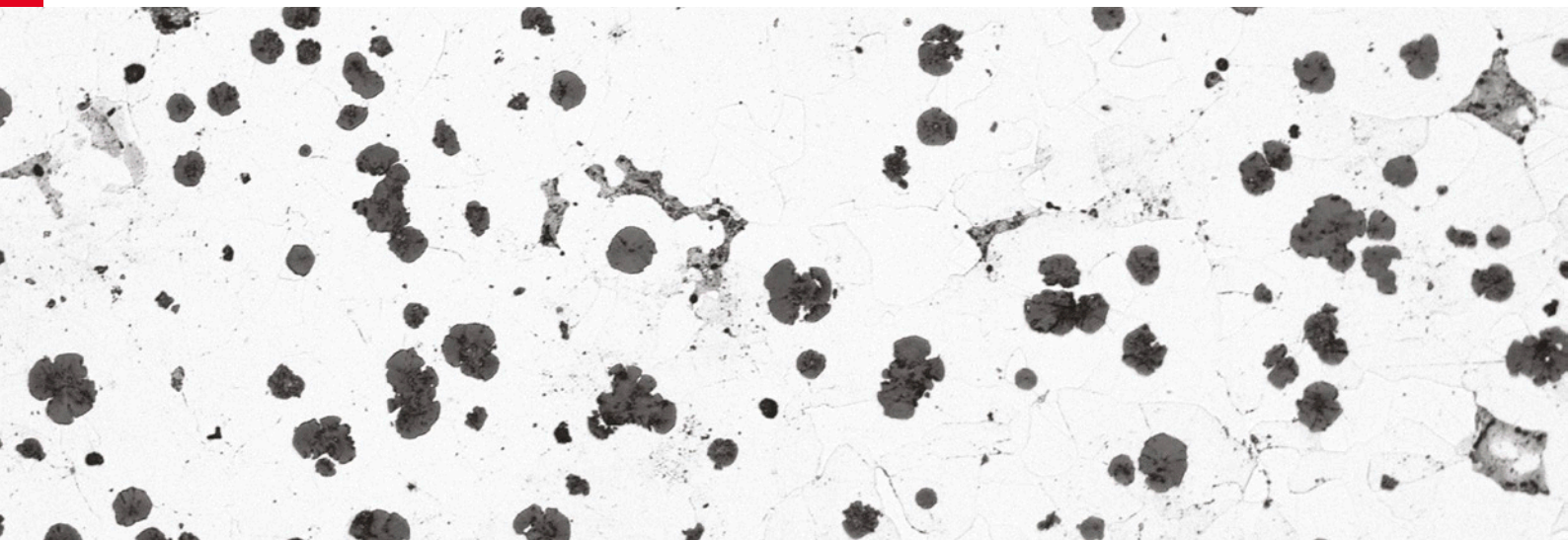
## Your benefits: Time savings due to an automated and precise workflow

LAS X Phase Expert software automatically and precisely measures the area percentage of metals, minerals, and other materials. Beyond traditional phase analysis, the software also provides additional object measurement capabilities and a wide variety of other geometrical and morphological result parameters.



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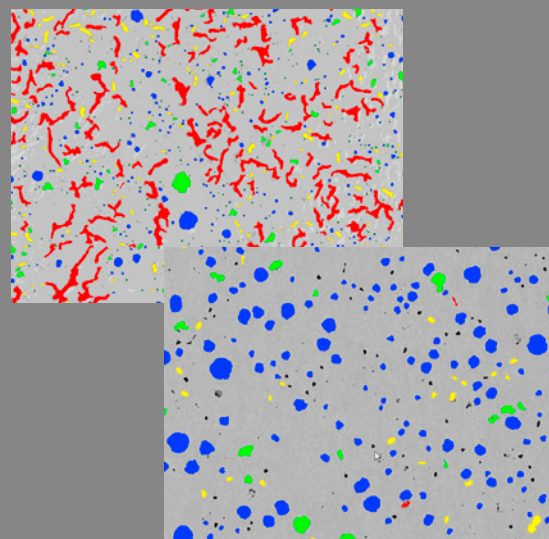
## LAS X CAST IRON EXPERT NODULAR SOFTWARE

### Structural analysis of nodular/ductile or compacted cast iron

LAS X Cast Iron Expert provides an environment for the quick analysis of graphite microstructures in cast iron, such as ductile/nodular or compacted. Operator interaction is minimized by a guided, easy-to-learn workflow. The module conforms to procedures described in various international standards. Unlike traditional comparison based approaches, the Cast Iron Expert module determines the type, shape, size, and distribution of graphite nodules automatically.

Results can be expressed according to multiple international standards (ASTM A247, ISO 945-2, JIS G 5502). Besides the analysis of graphite nodules on etched iron samples the software also assists in the determination of the ferrite/pearlite ratio. Utilizing high bit depth or HDR images and advanced contrast methods, the unique detection algorithms of Cast Iron Expert allows the rapid analysis of graphite, ferrite, and pearlite in parallel.

A wide variety of other geometrical and morphological parameters can be analyzed using the LAS X Cast Iron Expert module. By creating customized, Excel-based report templates this software offers the flexibility to also tailor analyses for advanced research purposes.



#### Covered Standards:

- > ASTM A247
- > ISO 945-2
- > JIS G 5502

## Structural analysis of nodular/ductile or compacted cast iron



### Sample Preparation

Selection of samples according to a standardized sampling process. Preparation of clean and even surfaces using abrasive methods or thin sections using microtomes.



### Etching

Chemical, electrochemical, or physical enhancement of different phases and components by material specific etching methods.



### Visualization / Acquisition

Applying optical contrast methods and microscopic imaging techniques to acquire digital images of the sample's microstructure.



### Digital Graphite Shape Analysis

Analyze the sample's microstructure for size and shape of graphite nodules and classify them according to international standards (ASTM A247, ISO 945-2, JIS G 5502). Additionally analyze the area ratios of graphite, ferrite, and pearlite.



### Reporting

Beyond traditional phase percentage and object count, a wide variety of other parameters can be analyzed, e. g. shape parameters and surface/interface areas. Create customized, Excel-based report templates to also tailor analyses for advanced research purposes.



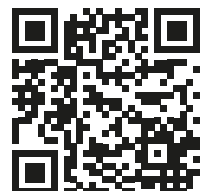
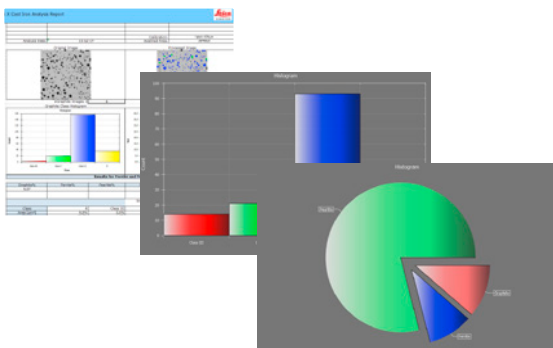
### Delivery of Quality Products

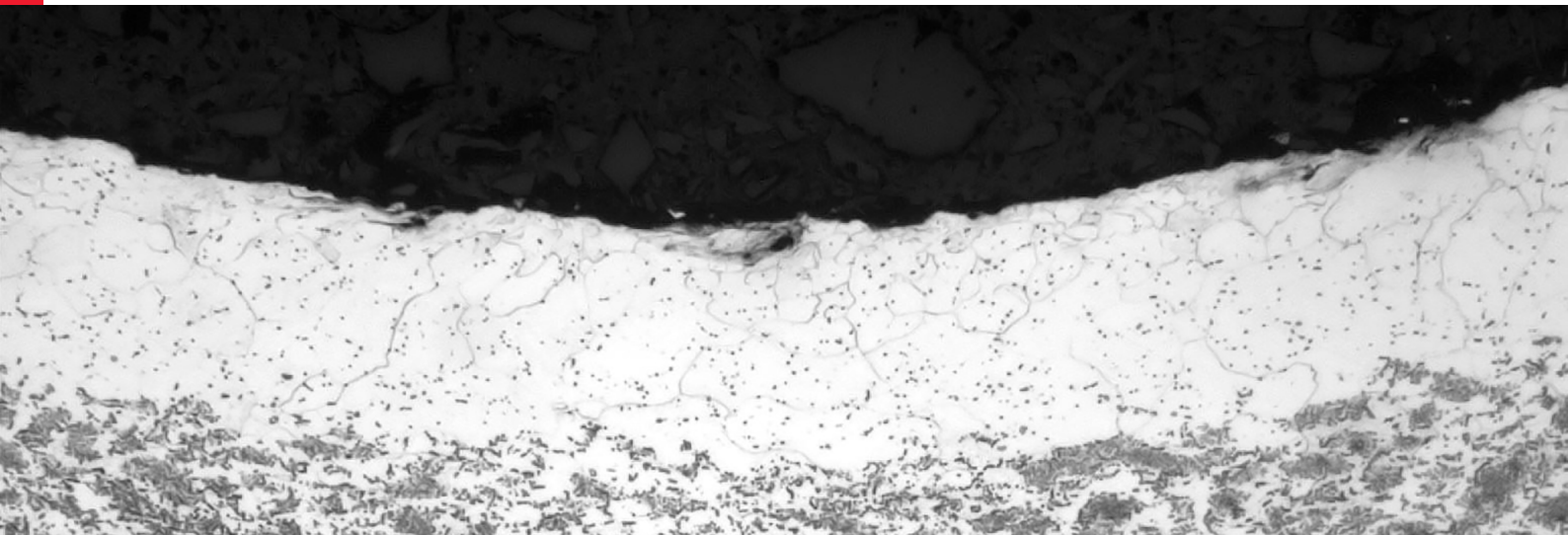
Stay confident about your product quality. Ensure that your customers receive high quality products.



## Your benefits: Easy-to-use workflow & customizable reports

The LAS X Cast Iron Expert Nodular software automatically and precisely analyzes ductile cast iron according to methods and parameters compliant with international standards for the classification of Graphite Nodules. In addition, the unique workflow also allows the analysis of the ferrite/pearlite ratio in one step.





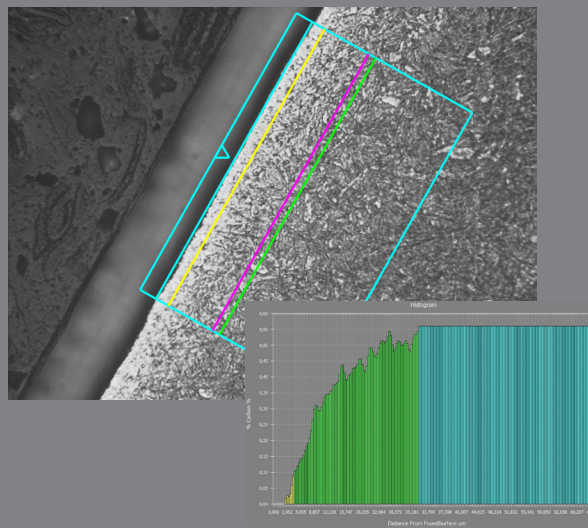
## LAS X DECARBURIZATION EXPERT SOFTWARE

### Structural analysis of surface carbon depletion in heat treated steel

The LAS X Decarburization Expert software is a dedicated environment for the analysis of carbon depletion due to tempering in air or thermal hardening of steel. Carbon depletion - or decarburization - affects the properties and hence the quality of the tempered steel. LAS X Decarburization Expert analyses for the functional decarburization depth, the depth at which the original material properties are unaffected.

The quick and easy to learn workflow guides the user through the individual analysis steps. In addition, a selection of advanced image pre-processing filters can aid users to overcome artifacts originating from sample preparation and etching.

Advanced analysis algorithms automatically correlate the parameters provided for material and product specifications to the samples microstructure. The final result for the functional decarburization depth is calculated according to various international standards.



#### Standards covered

- > ASTM E1077
- > ISO/DIN/EN 3887
- > JIS G 0558
- > DIN 50192

# Structural analysis of surface carbon depletion in heat treated steel



## Sample Preparation

Sample selection according to a standardized sampling process. Preparation of clean and even surfaces using abrasives or thin sections using microtomes.



## Etching

Chemical, electrochemical, or physical visualization of different phases and components by material specific etching methods. Reveals carbon rich and carbon depleted areas.



## Visualization / Acquisition

Apply optical contrast methods and microscopic imaging techniques to acquire digital images of the sample's microstructure.



## Digital Decarburization Analysis

Analyze the sample's microstructure for surface carbon depletion (decarburization) according to various standards (ASTM E1077, A247, ISO/DIN/EN 3887, JIS G 0558, DIN 50192). The functional decarburization depth is calculated automatically from the structural and compositional parameters.



## Reporting

Beyond traditional decarburization analysis, also additional simple intensity profiles, brightness, or reflectivity gradients can be analyzed. Create customized, Excel-based report templates to tailor analyses for advanced research purposes as well.



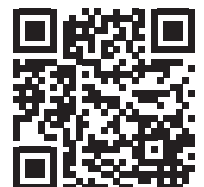
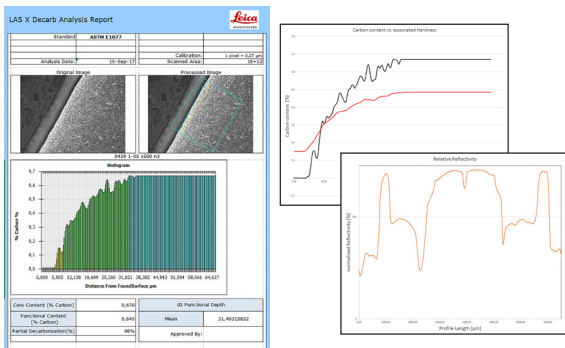
## Delivery of quality products

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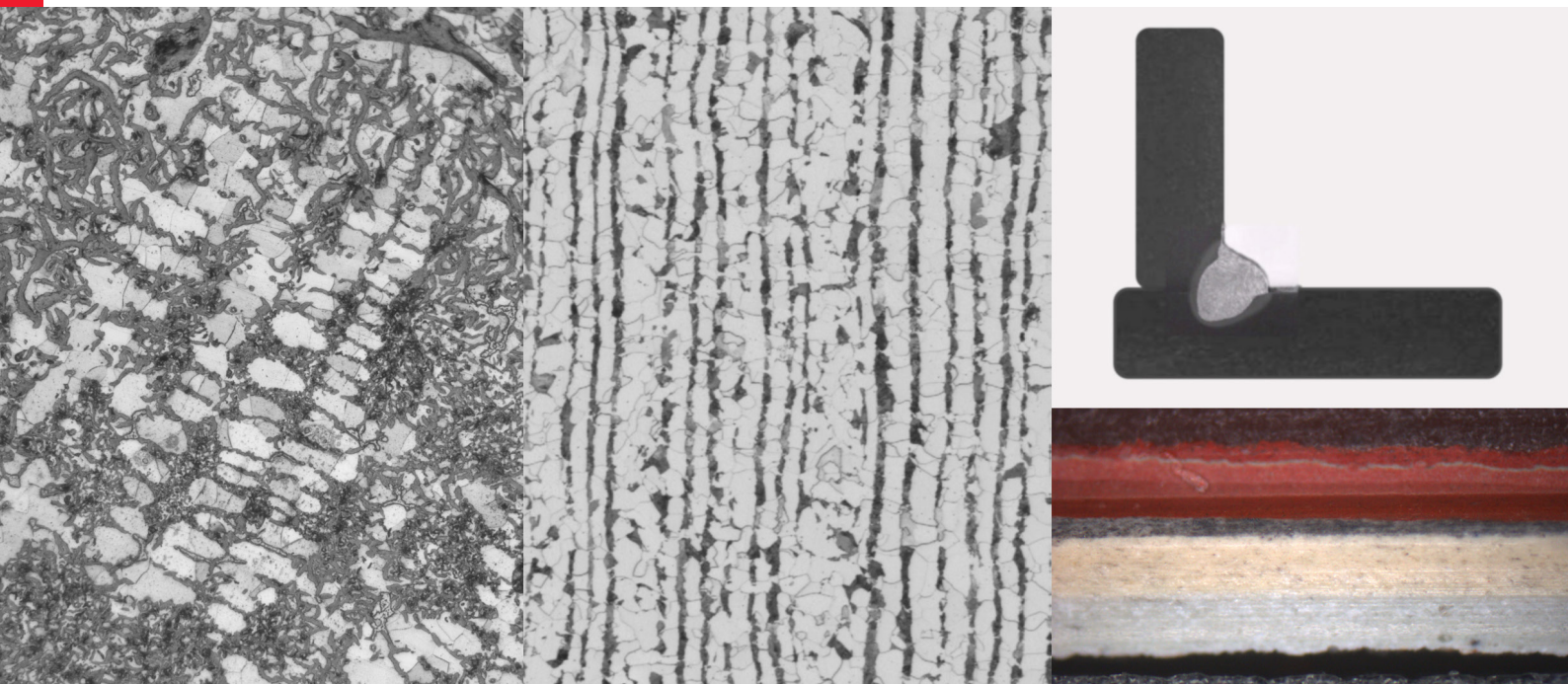


## Your benefit: Customize report templates to your analysis requirements

The LAS X Decarburization Expert software automatically and precisely analyzes the carbon depleted regions of steel according to international standards. Beyond microscope-based decarburization analysis, the customizable report templates also allow for intensity profile analysis.







## LAS X METALLOGRAPHY TOOLBOX

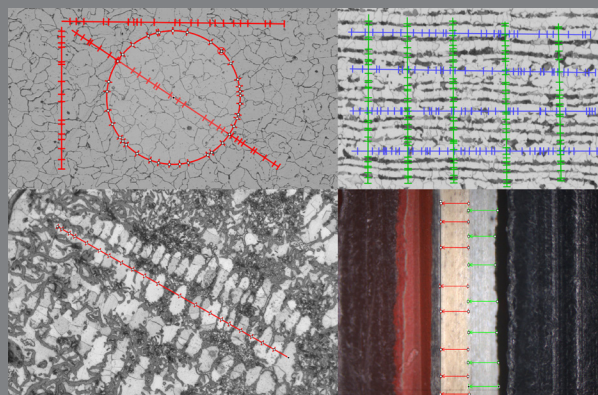
### Flexible-to-use tools for stereology-based structural analysis

The Metallography Toolbox add-on enhances the capabilities of the LAS X 2D Measurement software, making it a versatile tool for stereological analysis of metallographic/metallurgical samples.

It simplifies the manual tasks involved when deriving calibration parameters from measurements, such as baseline lengths, lineal intercepts, point counting, segments of circles, or multi-layer coating thickness.

Assigning individual classes to measurements, as well as comparative analysis of the related parameters, are made possible. Thus, component or phase specific results can be generated.

By taking advantage of the flexibility to customize the Excel-based report templates, the LAS X Metallography Toolbox software can be turned into a dedicated tool for a wide variety of applications in metallography and materials sciences. It also enables the experienced user to analyze samples according to various international standards.



#### Some example cases of analysis:

- > Grain Size using Heyn or Abrams Methods
- > Multi-Layer Thickness
- > Dendrite Arm Spacing
- > Banding

# Microstructure analysis by manual intercept and intersect methods



## Sample Preparation

Selection of samples according to a standardized sampling process. Preparation of clean and even surfaces using abrasives or thin sections using microtomes.



## Etching

Chemical, electrochemical, or physical etching methods which reveal different specific phases and components of a material, such as carbon-rich and carbon-depleted areas.



## Visualization / Image Acquisition

Applying optical contrast methods and microscopic imaging techniques to acquire digital images of the sample's microstructure.



## Digital Stereological Analysis

The stereological tools provided by the LAS X Metallography Toolbox add-on enables the experienced user to manually analyze the materials microstructure. Various approaches, like the planimetric or intercept ones based upon the Jeffries, Heyn and Abrams methods, can be utilized.



## Reporting

To go beyond the limitations of traditional stereological approaches, individual sample and feature measurements are also available. Create customized, Excel-based report templates to tailor analyses for advanced research purposes as well.



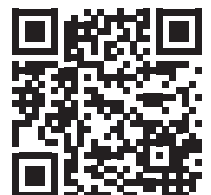
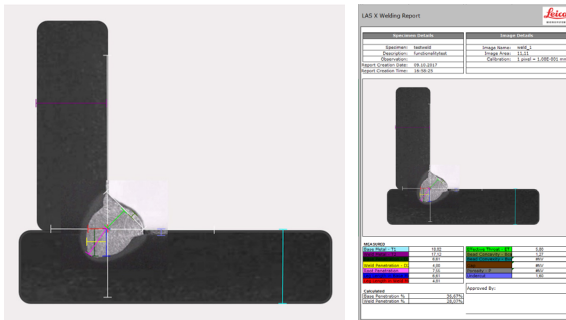
## Delivery of quality products

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## Your benefit: Customize report templates to your specific analysis needs

The LAS X Metallography Toolbox add-on provides the basic stereological tools in a flexible environment that allows for customized, case-specific analysis. It allows the skilled user to: overcome limitations of traditional stereological approaches and methods by combining tools; define individual sample or feature classes; achieve individual sample and class measurement; and report results using customizable Excel-based result templates.



Sample classification trainable for your specific needs



### Sample Preparation

Sample selection according to a standardized sampling process. Preparation of clean and even surfaces using abrasives and diamond paste.



### Etching

Chemical or physical visualization of sample features and regions of interest by localized, material specific reagents.



### Visualization / Acquisition

Applying optical contrast methods and microscopic imaging techniques to acquire digital images of the grain structure.



### Digital Sample Analysis

Analyze and measure multiple samples and their features automatically for a wide variety of geometrical parameters (size and shape), positions, and color parameters.



### Reporting

Beyond the standard analysis for quality control, a wide variety of other parameters can be analyzed. Create customized, Excel-based report templates to tailor analyses for advanced research purposes as well.



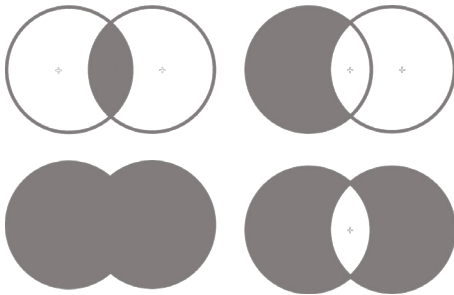
### Delivery of quality products

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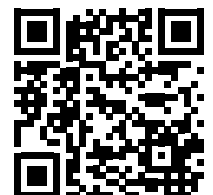
## Your benefit: Multichannel add-on for advanced analyses

The additional add-on to 2D Analysis, LAS X Multichannel Analysis, enables the user to boost the analytical power of 2D Analysis. Not only can various detection settings and sample classifications be used in parallel, but the individual results can also be combined using logical operators (AND, OR, XOR, etc.). This combined set of powerful analysis features renders 2D and Multichannel Analysis a must have tool for diverse purposes in quality control and advanced research.



Graphical representation of result sets that can be achieved using logical operators

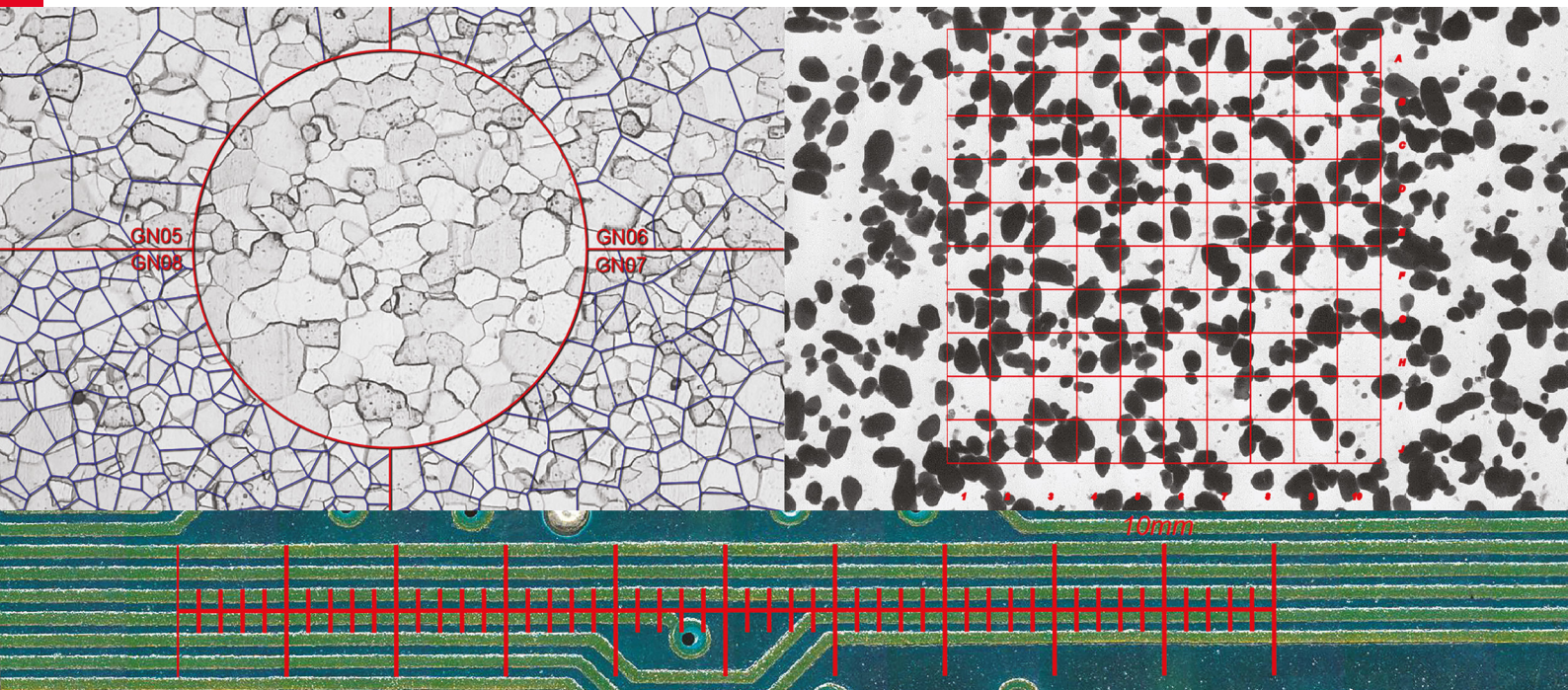
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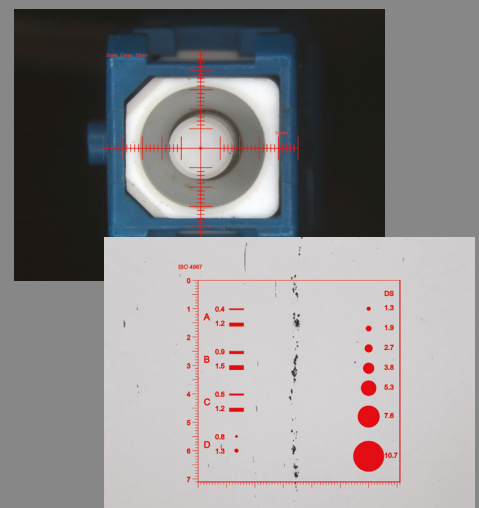
## LAS X RETICULES: Comparative Analysis and Documentation

### Superior ergonomics with digital reticule overlays

For quick comparison-based measurements and analysis, the usage of traditional eyepiece graticules/reticules over long hours can lead to eyestrain and decreasing accuracy. For analysis, digital reticules offer a significant improvement in terms of ergonomics and maintaining accuracy of measurements over time.

A digital reticule projects a grid or reference overlay directly onto the camera image displayed on a PC's monitor. It can be exchanged with a simple mouse click, so there is no need to physically interfere with optical components. Beyond providing a more pleasurable and time-saving analysis workflow, the LAS X Reticule module is also more cost-effective than the traditional eyepiece solution. There is no need to buy individual graticules or combinations of them with eyepieces. This application provides more than 50 digital reticule files, including specific solutions for Phase Analysis, Grain Size Analysis, and Non-Metallic Inclusion Rating according to various international standards. The digital reticule files can be edited and additional files can be designed also using open source drawing software.

For documentation of analyses conducted with the LAS X Reticules, they can also be saved as an electronic overlay with the respective investigated image or region of interest.



#### Some example use cases:

- > Grain Size Analysis (ASTM E112, DIN/EN/ISO 643)
- > Non-metallic inclusion rating (ASTM E45, ISO 4967, EN 10247 (2007))
- > Quick comparative live measurements
- > Quick calibration check

## Microstructure analysis by digital visual comparison methods



### Sample Preparation (optional for metallography)

Selection of samples according to a standardized sampling process.  
Preparation of clean and even surfaces using abrasives and diamond paste.



### Etching (optional for metallography)

Chemical or physical visualization of a sample's microstructure using specific etchants or ion milling.



### Visualization / Acquisition

Applying optical contrast methods and microscopic imaging techniques to acquire digital images of the sample or microstructure.



### Digital Comparative Analysis

Analyze metallographic samples or manufactured products by visual comparison or production samples by quick comparative measurements. Merge digital overlays with the image for documentation purposes.



### Reporting of Results

Professional documentation and report generation with just a few clicks. Create customized, Word-based report templates to tailor reports to your needs.



### Delivery of quality products

Stay confident about your product quality. Ensure delivery of high quality products to your customers.



### Your benefit: Customize in a flexible way

The LAS X Reticule module allows you to draw your own digital reticules with any open source, vector graphics capable, drawing program and import them into a plain .svg file format.

Moreover, by converting CAD data into 2D projections using the .svg format, you can compare actual and nominal shape and dimension data of your manufactured products directly at the microscope.

