



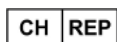
## Software Manual

# ZEISS ZEN core 3.9

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Original Manual

Carl Zeiss Microscopy GmbH  
Carl-Zeiss-Promenade 10  
07745 Jena  
Germany  
microscopy@zeiss.com  
www.zeiss.com/microscopy



Carl Zeiss AG  
Feldbachstr. 81  
8714 Feldbach  
Switzerland

### UK Responsible Person

Carl Zeiss Ltd  
1030 Cambourne Business Park, Cambourne  
CB23 6DW Cambridge  
United Kingdom



Carl Zeiss Microscopy GmbH  
Carl-Zeiss-Promenade 10  
07745 Jena  
Germany

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# 1 General Information

## 1.1 Welcome

**ZEN core** is the image acquisition and analysis software from ZEISS designed to support mainly industry & manufacturing markets. Its design and intuitive user interface help you examine samples quickly, easily, and reliably, especially in quality assurance environments. The software offers two main operating modes. In **Free Mode** you can configure and use the software freely to your personal needs. It is designed for expert microscopy users who exactly know what they want to do. The workflow-based approach of the **Job Mode** is used for repeatable experiments.

**See also**

- 📖 Basic Concepts [▶ 20]
- 📖 Special Modules & Extensions [▶ 681]
- 📖 First Steps [▶ 19]

## 1.2 Text Conventions and Link Types

Explanation	Example
Software controls and GUI elements.	Click <b>Start</b> .
Hardware controls and elements.	Press the <b>Standby</b> button.
Key on the keyboard.	Press <b>Enter</b> on the keyboard.
Press several keys on the keyboard simultaneously.	Press <b>Ctrl + Alt + Del</b> .
Follow a path in the software.	Select <b>Tools &gt; Goto Control Panel &gt; Air-lock</b> .
Text to be entered by the user.	Enter <i>example.pdf</i> in this field.
Anything typed in literally during programming, for example macro codes and keywords.	Enter <code>Integer</code> in the console.
Link to further information within this document.	See: <i>Text Conventions and Link Types</i> [▶ 14].
Link to a website.	<a href="https://www.zeiss.com">https://www.zeiss.com</a>

## 1.3 Explanation of Safety Notes and Safety Labels

The display of safety notes in the documentation and software follows a system of risk levels that are defined as follows:

**CAUTION**

**Risk of personal injury**


CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate personal injury.

NOTICE

Risk of property damage


NOTICE indicates a property damage message. In addition, NOTICE is used for data loss or corrupt data as well.

The safety icons/labels on the device or in the documentation refer to potential dangers or information that are defined as follows:

Icon/Label	Name	Description
	Crushing Fingers	This icon warns you of a potential risk of crushing fingers.

1.4 Calling up the Help

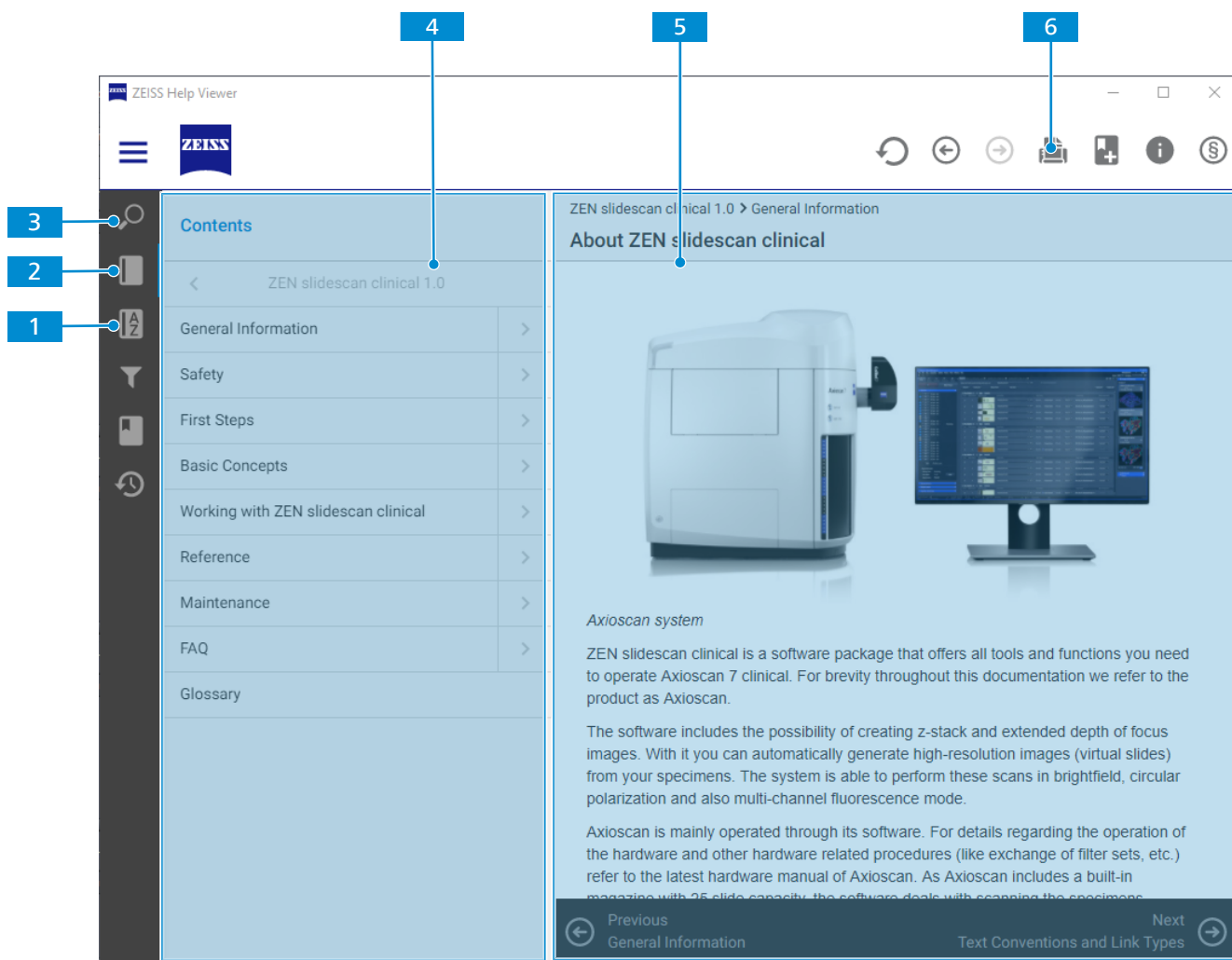
To call up the documentation,

- in the software open the menu **Help > Contents....**
- in the software press **F1**.
- in the software click  in the top right, write your search term and press **Enter**.
- in the Windows file browser go to **\\Program Files\\Carl Zeiss\\ZEN 2\\ZEN 2 (blue edition)\\Manuals**.

Additionally click on the **question mark** symbol **?** in the **Title bar**. The cursor then appears as a question mark symbol. Then click on an area in the software which you want to get help for. If there is a related help topic available, it will open directly.

ZEISS Help Viewer User Interface

The following screenshot indicates the main elements of the user interface:

**1 Index**

List of keywords to help you find topics and content quickly.

**2 Topics**

Contains the structure tree with a list of all the topics.

**3 Search**

Search through the entire text.  
It supports partial strings but not wildcards.

**4 Structure tree**

Enables you to navigate through topics sequentially. A > indicates a topic has subtopics.

**5 Content panel****6 Print**

Enables you to print the currently displayed topic.

**1.5 Intended Purpose**

**ZEN core** is a microscope software for microscope control, image acquisition, image processing and image analysis. The field of application of the software covers general tasks and applications in microscopy or image acquisition in routine and research, among others in the industrial or material science area.

The software is not intended to directly or indirectly produce medical diagnostic results.

## 1.6 Contact

If you have any questions or problems, contact your local ZEISS Sales & Service Partner or one of the following addresses:

### Headquarters

Phone:	+49 1803 33 63 34
Fax:	+49 3641 64 3439
Email:	info.microscopy.de@zeiss.com

### Microscopy Courses, Training, and Education

For information on microscopy courses, training, and education contact us on our homepage (<https://www.zeiss.com/microscopy/en/service-support/training-education/zeiss-academy-microscopy.html>).

### ZEISS Portal

The ZEISS Portal (<https://portal.zeiss.com/>) offers various services that simplify the daily work with your ZEISS systems (machines and software). It is constantly improved and extended to meet your needs and requirements better.

### ZEISS Sales & Service Partner

You can find a ZEISS Sales & Service Partner in your area under <https://www.zeiss.com/microscopy/int/website/forms/sales-and-service-contacts.html>.

### Service Germany

Phone:	+49 7364 20 3800
Fax:	+49 7364 20 3226
Email:	service.microscopy.de@zeiss.com

## 1.7 Legal Notes

ZEISS draws the user's attention to the fact that the information and references contained in these documentation may be subject to technical modifications, in particular due to the continuous further development of ZEISS products. The documentation enclosed does not contain any warranty by ZEISS with regard to the technical processes described in the documentation or to certain reproduced product characteristics. Furthermore, ZEISS shall not be held liable for any possible printing errors or other inaccuracies in this documentation, unless proof can be furnished that any such errors or inaccuracies are already known by ZEISS or that these are not known to ZEISS due to gross negligence and that furthermore ZEISS has for these reasons refrained from eliminating these errors or inaccuracies appropriately. ZEISS hereby explicitly draws the user's attention to the fact that this documentation only contains a general description of the technical processes and information, the implementation of which in any individual case may not be appropriate in the form described here. In cases of doubt, we recommend the user to consult ZEISS service and support.

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ZEISS explicitly draws attention to the fact that the information contained in this documentation will be updated regularly in compliance with the technical modifications and supplements carried out in the products and furthermore that this documentation only reflects the technical status of ZEISS products at the time of printing.

**Disclaimer**

Note that this software contains an extension that enables you to connect it with the third party software ImageJ. ImageJ is not a ZEISS product. Therefore ZEISS undertakes no warranty concerning ImageJ, makes no representation that ImageJ or derivatives such as Fiji or related macros will work on your hardware and will not be liable for any damages caused by the use of this extension. By using the extension you agree to this disclaimer.



## 2 First Steps

### 2.1 Starting Software

**Prerequisite** ✓ The software and all required licenses have been installed.

1. Double-click the program icon on your desktop.  
→ The software starts, and the login screen is displayed.
2. Click on the application you want to work with, e.g. **ZEN core**.  
→ The available applications depend on your licenses and system.  
→ During the program start the hardware settings will be initialized.
3. On the login screen, click on your name in the list of users, and enter your password. Click **Login**.  
If you forgot your password or do not know your user name, contact the System Administrator or Supervisor.


The **Home** Screen is displayed. You can start working with the software.

### 2.2 Working with ZEN starter

You can use the software without any license. The software is then run as the free version called **ZEN starter** with limited functionality. Nevertheless, you can still perform many typical actions, for example:

- Load and view existing microscope images
- Acquire images (Manual EDF, Panorama)
- Perform interactive measurements (reduced set of tools available)
- Create reports

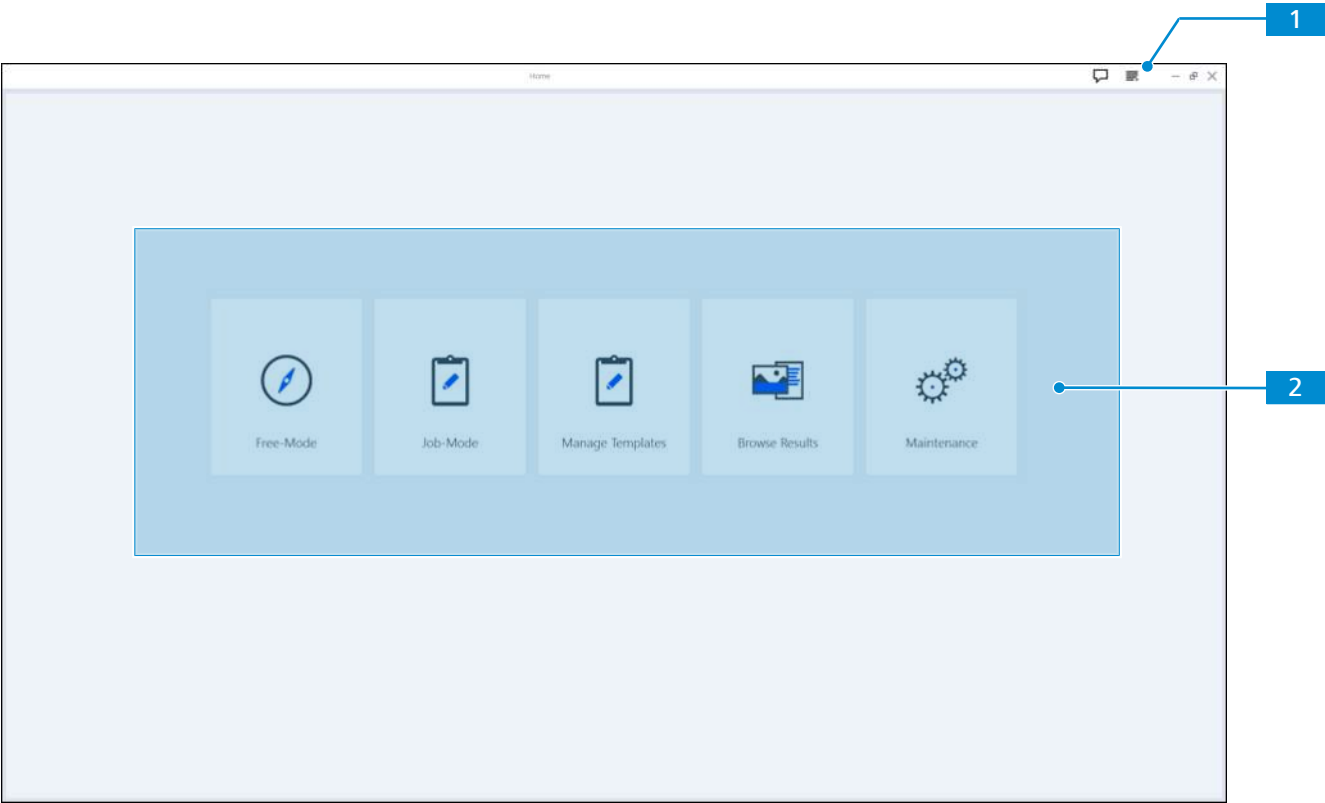
### 2.3 Closing Software

1. Click **Home**.  
→ The home screen is displayed.  
→ If you have unsaved documents (e.g. templates, analysis results, or reports), choose whether to save or discard them.
2. Click **Close**  in the upper right corner of the program window.  
→ The software will close. Any unsaved data is discarded.
3. If desired, turn off the microscope hardware.

## 3 Basic Concepts

### 3.1 User Interface - Home Screen



The **Home Screen** is displayed after you log in. The available operating modes depend on your user role.






- 1** Title Bar including **System Messages** icon, Workspace Zoom and **Help** icon.
- 2** **Operating Modes** selection, see *Operating Modes* [▶ 20].




### 3.2 Operating Modes

The software contains different operating modes that correspond to the different ways of working with the microscope. The modes that are available to you depend on your user role.

Icon	Mode	Description
	<i>Free Mode</i> [▶ 39]	Inspect a sample quickly, easily, and flexibly without defining examination tasks.
	<i>Job Mode</i> [▶ 51]	Run an examination on a sample according to the step-by-step tasks defined in the job template.  Also, define fixed examination steps to be performed each time a sample is examined.

Icon	Mode	Description
	<i>Manage Templates</i> [▶ 67]	Edit and manage templates in the archive: <ul style="list-style-type: none"> <li>Form templates</li> <li>Report templates</li> <li>Macro templates</li> <li>Image analysis settings</li> <li>Custom workbenches</li> <li>arivis Cloud modules</li> <li>Intellesis object classification models</li> <li>Intellesis segmentation models</li> <li>Standards technical cleanliness</li> <li>Intellesis denoising models</li> <li>AI models</li> </ul>
	<i>Browse Results</i> [▶ 84]	View and manage job results in the archive.
	<i>Maintenance</i> [▶ 699]	Configure global settings, manage users, calibrate measurements, etc..

**See also**

-  Operating Modes [▶ 20]
-  Free Mode [▶ 39]
-  Control Elements [▶ 51]

**3.3 Job Mode and Free Mode**

ZEN core is designed to support two fundamental ways of using your microscope:

- Working with jobs (creating, running, editing and managing jobs) in **Job Mode**
- Performing free examinations in **Free Mode**

**Job Mode** In the software, the term *job* refers to a collection of examination tasks. Jobs can be created to ensure that the same examination tasks are carried out each time the job is run, in the same manner, and with the same settings. Jobs are used mainly in routine quality control examinations where it is essential that identical examinations are performed for each sample.

**Free Mode** Free examinations can be used to inspect a sample quickly, easily, and flexibly without defining examination tasks. A typical use is to examine a faulty sample where the cause of the fault is unknown or for one-off examinations that will not be repeated. In such cases only the examination results, reports and images need to be saved rather than the examination tasks.

**See also**

 Free Mode [[▶ 39](#)]

 Job Mode [[▶ 48](#)]

### 3.4 User Roles

User management is an optional component. It is disabled by default. If user management is disabled, the user has all user rights at the same time. When user management is enabled, three types of user roles are defined initially in the software:


- **Administrator**
- **Supervisor**
- **Operator**

The available modes and tasks you can perform in the software depend on your user role. User roles can be added and modified under **Maintenance > User Management**.

User Role	Tasks
<b>Administrators</b>	Administrators install and configure the software. This includes: <ul style="list-style-type: none"> <li>▪ Managing system settings</li> <li>▪ Managing users</li> <li>▪ Specifying the connected hardware in the Microscope Tool Box application (MTB)</li> <li>▪ Configuring and managing the archives</li> </ul>
<b>Supervisors</b>	Supervisors perform the following main tasks: <ul style="list-style-type: none"> <li>▪ Creating job templates for the operators to run</li> <li>▪ Performing free examinations (<b>Free Mode</b>)</li> </ul> They are also able to perform the following tasks: <ul style="list-style-type: none"> <li>▪ Running jobs</li> <li>▪ Managing jobs in the archive (running, editing, deleting)</li> <li>▪ Defining and evaluating job reports</li> <li>▪ Releasing Job Templates</li> </ul>
<b>Operators</b>	Operators can only perform a limited number of tasks: <ul style="list-style-type: none"> <li>▪ Searching for a job</li> <li>▪ Running a job</li> <li>▪ Browsing the job results</li> </ul>

#### See also

 Change Microscope Configuration [[▶ 727](#)]

 User Interface - Home Screen [[▶ 20](#)]

 Creating and Managing User Accounts [[▶ 699](#)]

 Assigning a User to a Group [[▶ 702](#)]

### 3.5 Overview of Supervisor Tasks

As a supervisor, the way you perform the majority of individual tasks is independent of whether you are in **Free Mode** or within **Job Mode**.

For a detailed overview of the tasks in each mode see:

- *Operating Modes* [▶ 20]
- *Workflow Create Job Template* [▶ 54]
- *Workflow Free Mode* [▶ 40]

The tasks that are independent of a mode are described in a corresponding chapter in the order they are typically performed.

### 3.6 Workbenches and Workbench Categories

#### Info

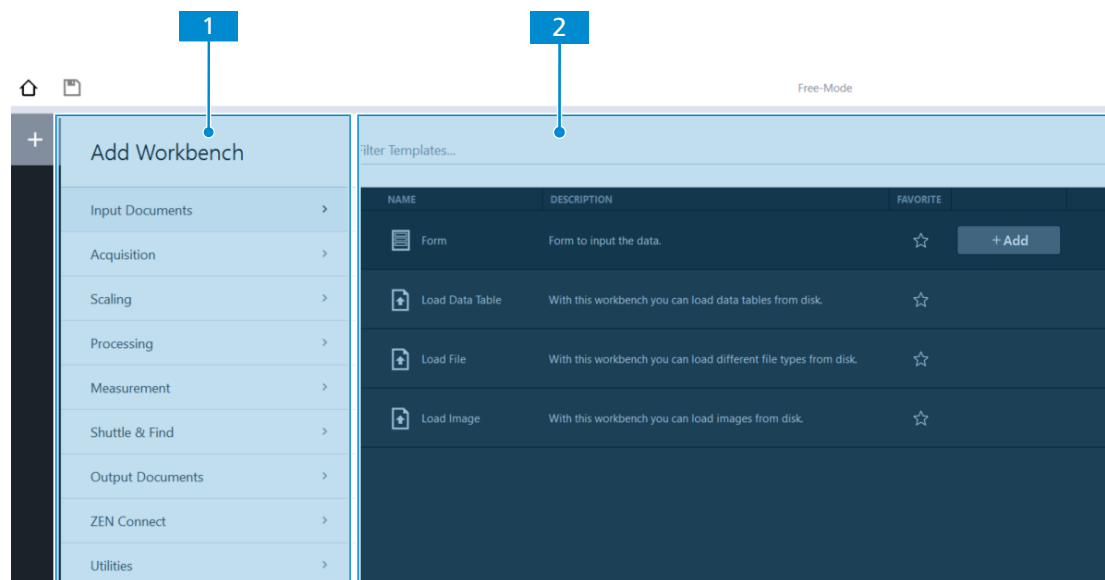
The workbenches that are available depend on the available hardware and licenses. The appearance of workbenches and how you use them depends on the current mode.

- ▶ In **Free Mode** click **Add Workbench**.
- ▶ In **Create Job Template** mode click **Add Task**.

The software is based around the concept of workbenches. In ZEN core, the term *Workbench* refers to a group of tools in the software. Furthermore, a workbench typically corresponds to a task in the software. Workbenches also affect the appearance of the **Center Screen Area**.

Workbenches in turn are grouped into categories. The categories correspond to the typical microscopy tasks, e.g.:

- Acquisition
- Processing
- Measurements, etc.



**1** Workbench category

**2** Workbenches

Typically, there are multiple workbenches in each category. For example, for image acquisition the following workbenches (amongst others) are available:

- Simple acquisition, e.g. 2D Acquisition
- Advanced acquisition, e.g. Tiles

Workbenches enable you to concentrate on your microscopy tasks by providing the tools you require while keeping the user interface uncluttered.

### Info

The tools contained in a workbench can also be present in multiple other workbenches. As a supervisor you can create new workbenches or modify existing ones by adding and removing tools according to your requirements. These customized workbenches can be saved as new workbenches and reused in other examinations or by other users.

### See also

- 📄 Creating and Using Custom Workbenches [► 24]
- 📄 Selecting Workbenches [► 41]
- 📄 Task Queue [► 56]

## 3.7 Creating and Using Custom Workbenches

You can add or remove tools from a workbench at any time. You can also save a workbench configuration as a custom workbench. This enables you to use it in other job templates or free examinations.

All custom workbenches are saved and managed in the **Archive**.

### Info

In **Create a new template and edit it** within **Job Mode**, each workbench is automatically saved in the job template in its current configuration. It is also displayed in the same configuration when running the job.

#### Creating a custom workbench

1. Customize your workbench by adding or removing tools.
2. Right-click the icon of a workbench and select **Save as custom workbench**.
3. Enter a name for the custom workbench.
  - ➔ The name is used to identify the workbench and must be unique within the system.
4. Enter a description for the workbench.
  - ➔ It should describe the purpose or special features of the workbench to help other users know when to select it.
5. Click **Save** to save the custom workbench.

#### Using a custom workbench

1. Click **+ Add Task**.
2. Select the **My Workbenches** category.
3. Select the desired custom workbench and click **+ Add**.

### Info

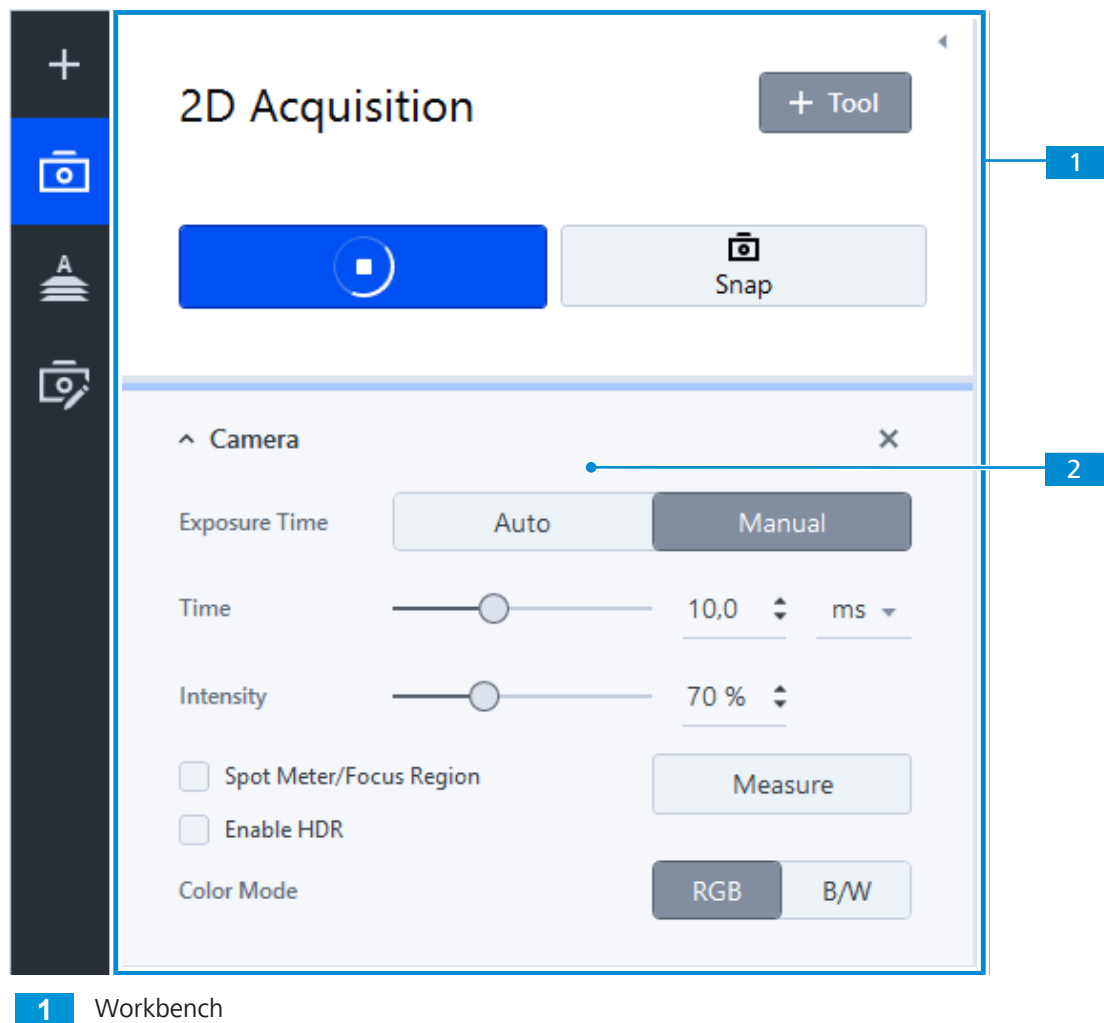
To ensure data integrity, it is not possible to overwrite existing default or custom workbenches.

## 3.8 Tools and Parameters

Tools enable you to perform a specific action in the software, for example:

- Acquiring an image
- Selecting a different hardware magnification

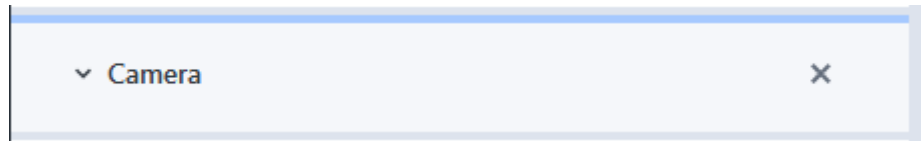
- Reducing the noise
- Measuring a length



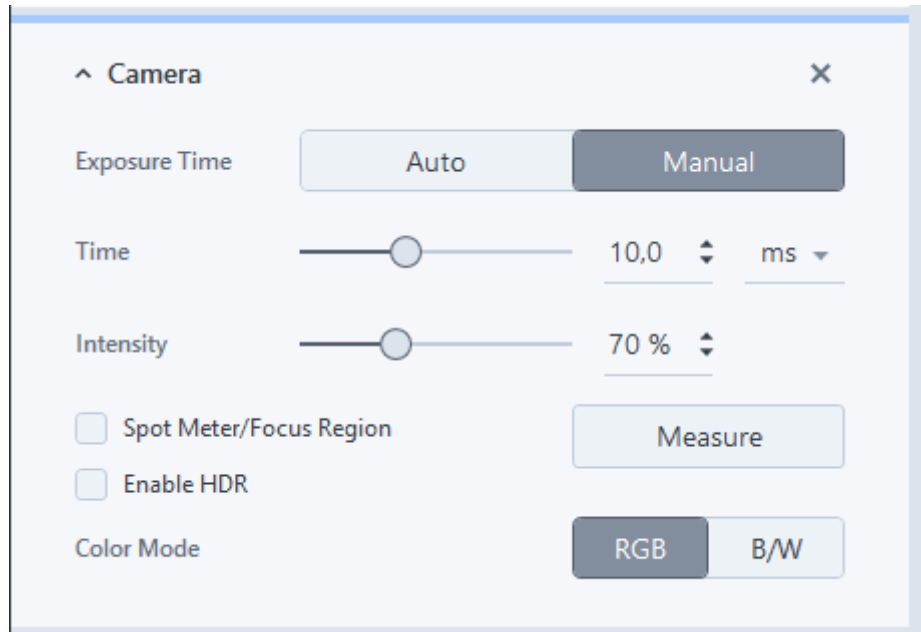


**2** Tool (e.g. Camera tool)

In order to prevent scrolling if you have added several tools, you can collapse the tools by clicking the tool header:



Click the tool header again to expand the tool:



Your settings are persisted. When you leave the Free Mode, the current state of each tool (collapsed/expanded) is saved.

**Info**

The tools contained in a workbench may also be present in multiple other workbenches. As a supervisor you can also create new workbenches or modify existing ones by adding and removing tools according to your requirements. These customized workbenches can be saved as new workbenches and reused in other examinations or by other users.

**3.9 Templates, Images, and Documents**

The software supports various kinds of objects. These can be grouped into the following categories:

- Templates
- Images and documents

The categories are treated differently in the software, for example where they are managed or how you interact with them.

**Templates** Templates contain pre-defined content, for example the tasks required to run a job, or the fields required to complete a form.

Templates include, for example, the following objects:

- Job templates
- Form templates

- Report templates
- Custom workbenches
- Image analysis
- Macros

Templates are managed in the **Archive**. When a user's workflow requires selecting one of the above items (e.g. choosing a job template to run or which report template to use), the user is presented with the items stored in the **Archive**. In general, users only interact with items in the **Archive**; they do not need to interact with the file system.

#### Images and documents

Images and documents refer to objects created during an examination.

Images and documents include the following objects:

- Images
- Measurement results and data tables
- Forms
- Reports

Images and documents are created by tools or tasks and are automatically stored either in the **Local Storage** or in the **Archive** as children of the corresponding job or free examination. However, you can also import and export images and documents to/from the file system using tools in workbenches. Furthermore, in **Free Mode**, all images and documents are additionally displayed in the **Documents Area**.

#### See also

📄 Supported File Formats ► 117]

### 3.10 Data Handling

ZEN core allows you to flexibly handle and store the data into the included archive. When you finish your work you can decide whether you want to keep the data readily available or store/upload it to the archive. The upload task is performed in the background; you can continue working in ZEN core while the data is being transferred. You can perform multiple transfer actions simultaneously.

Data are generated during a session in **Free Mode** or when executing a job in **Job Mode**. You store data in a result set that includes result items. The most important (but not the only ones) are the following:

- Images (\*.czi)
- Tables (\*.czt)
- Documents (\*.docx or \*.pdf)

Basically, you have the following options for data handling:

- **Save:** You want to pause your work and resume to it later without the need to download the data from the archive. This is only available in Free Mode.
- **Archive:** You have finished your work and want to archive the data.
- **Export:** You have finished your work and want to export all images and files in the current session.
- **Discard:** You have finished your work but you do not want to keep your unsaved changes.

When you are leaving the **Free Mode**, you can decide which option to choose. Job results are stored in the archive by default.

**See also**

- 📖 Archive [► 28]
- 📖 Local Storage [► 28]

**3.10.1 Local Storage**

The local storage is a dedicated folder location to save data during work before uploading them to the archive. Once uploaded successfully to the archive, the data are deleted from the local storage. If you download data from the archive, they are stored in the local storage.

Saved data are accessible in the **Browse Results**.

The local storage location is set in the **Archive Options**.

**See also**

- 📖 Browse Results [► 84]
- 📖 Archive Options [► 707]

**3.10.2 Archive**

The archive is the central location for storing and managing result sets and templates.

Basically, the archive can be split in three areas:

- Area for organizing all kind of templates except job templates which is found under **Manage Templates**.
- Area for all results which is found under **Browse Results**.
- Area for all jobs to be managed under **Job Mode**.

Access to the items in the archive depends on the current user's privileges, which can be set up in the software for each usergroup of the system. Technically the software supports the following archive types:

- Local archive: suitable for a single system (free)
- ZEN Data Storage archive: ZEN Data Storage provides a client/server database solution for microscopy customers who deal with the storage of large amounts of data originating from one or several microscopes. ZEN Data Storage allows the exchange of data and workflows and supports microscopists who want to separate image acquisition from post-acquisition work. In this way it also facilitates correlative workflows where the data of a sample can be accessed from a centralized location.

The archive is set in the **Archive Options**.

**See also**

- 📖 Archive Options [► 707]
- 📖 Manage Templates [► 65]
- 📖 Browse Results [► 84]
- 📖 Job Mode [► 48]
- 📖 Configuring a Local Archive [► 709]
- 📖 Configuring a ZEN Data Storage Archive [► 147]

## 3.11 Display Settings

### 3.11.1 Configuring the Center Screen Area

You can configure the appearance of the **Center Screen Area** according to your preferences. If you right-click on the image area, the following menu is displayed:

Property	Function
<b>Zoom</b>	<p>Adjusts the digital zoom factor of the image.</p> <ul style="list-style-type: none"> <li>▪ <b>Increase (F7)/Decrease (F8)</b> Enlarges the image in steps of 125% of the current size or reduces the image in steps of 80% of the current size.</li> <li>▪ <b>100%</b> zooms to a 1:1 depiction of the image.</li> <li>▪ <b>Fit to view</b> scales the image to completely fill the <b>Center Screen Area</b>.</li> </ul>
<b>Rulers</b>	<p>If activated, vertical and horizontal rulers next to the image are displayed.</p> <p>The zero point is the top left corner of the <b>Center Screen Area</b>.</p>
<b>Show Floating Scale Bar</b>	<p>Shows the current scale of the image.</p> <p>This is derived from the hardware setup (e.g. the magnification of the objective). You can also configure the scaling manually.</p>
<b>Draw Annotation Scale Bar</b>	<p>If clicked, a scale bare annotation is added to the image.</p>
<b>Navigator</b>	<p>Shows a miniature overview of the entire image.</p> <p>A blue frame indicates the section currently displayed. Drag the frame to navigate the image.</p>
<b>Graphics</b>	<p>If activated, all measurements or annotations in the image are displayed.</p>
<b>Grid</b>	<p>If activated, a grid is displayed over the image area.</p>
<b>Copy/Paste Display Settings</b>	

#### See also

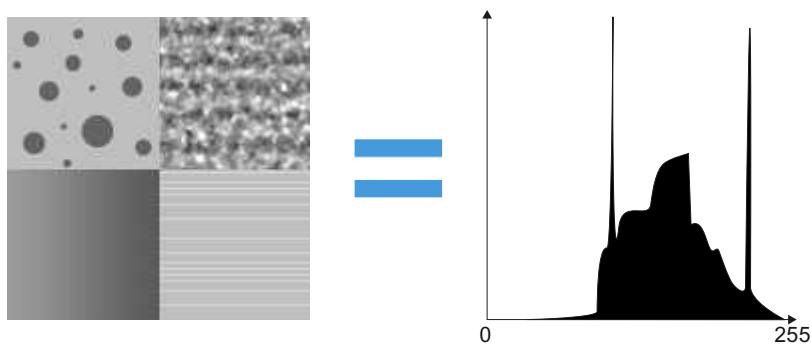
 Manage Scaling ► 724]

 Display Tab ► 29]

### 3.11.2 Display Tab

To change the appearance of the image in the **Center Screen Area** you apply a number of image settings in the **Display** tab. The display options are located at the bottom of the **Center Screen Area**.



Use the histogram to make an image appear lighter or darker, to change the contrast, or, for a multichannel image, adjust the balance between the channels by modifying the color channels individually.




Note that the settings are only applied to the image display and pixel values are not modified, e.g., to optimize the acquisition parameters or to find regions of interest. If you wish edit the image and change the respective pixel values, use the appropriate image processing tool.

Histogram

Parameter	Description
	Resets to the default display values.
Channels	Displays the available channels of the image.
Gamma	<p>Defines whether details in brighter or darker image regions are enhanced. Setting the gamma value causes the value of each pixel to be multiplied by an individual factor. This factor depends on the pixel value (brightness) itself.</p> <p>To adjust the display curve of the histogram, change the gamma value:</p> <ul style="list-style-type: none"><li>Value &lt; 1: Details in dark image regions are enhanced.</li><li>Value &gt; 1: Details in bright image regions are enhanced.</li></ul>
Range	<p>This setting specifies the range of visible gray values. Gray values below this range are displayed black, gray values above the range are displayed white.</p> <p>Adjustments help to solve display issues, e.g. if an image appears completely black.</p>
— Auto	<b>Activated:</b> Adjusts the range of displayed pixel values for each color channel using the selected method: <b>Min/Max</b> or <b>Best Fit</b> .
— Min/Max	Sets the contrast to normal: the range of displayed pixel values matches the minimum and maximum pixel values occurring in the image.
— Best Fit	Increases the contrast: the range of displayed pixel values is limited by the pixel values resulting from skipping 2% black and 0.01% white.
Histogram	<p>Graphical representation of the intensity (i.e. brightness) distribution of an image. The intensity is represented by the pixel value. For each pixel intensity value, the number of pixels in an image is counted. In the image histogram, the horizontal axis represents the pixel value and the vertical axis represents the number of pixels with that pixel value.</p> <p>To change the brightness, move the range of displayed pixel values by dragging the central handle in the histogram or use the slider.</p>



Parameter	Description
	To change the contrast, crop or extend the range of displayed pixel values.  If you are using a color camera and a multichannel setup, you adjust the range and curve for each color channel separately.
– 	Displays a slider to adjust the black and white values of the histogram.
– 	Displays the full histogram graphical representation to adjust the histogram.

### Dimensions

Parameter	Description
<b>Follow Acquisition</b>	Only visible during an acquisition. <b>Activated:</b> The current image is displayed.
Dimension Slider	<p>Depending on the available dimensions of the active image, different sliders are displayed. When acquiring the image, the progress of the acquisition is displayed here. When opening a multi dimensional image, with the slider, you can move to the position that you want to be displayed in the <b>Center Screen Area</b>. The range of the slider is defined by the values of the corresponding dimensions: Each slider offers as many steps as there are individual positions in the specified dimension.</p> <p>The slider is only visible with the following image types:</p> <ul style="list-style-type: none"> <li>▪ <b>Time series</b> Adjusts the desired time point.</li> <li>▪ <b>Z-stack</b> Adjusts the desired z-position.</li> <li>▪ <b>Position list</b> Adjusts the desired position of the list.</li> <li>▪ <b>Temperature series</b> Adjusts the desired temperature.</li> </ul>
– 	When the acquisition is finished or when you have loaded one of the documents, click <b>Play this dimension</b> to check them step by step.
<b>Channels</b>	<p>Displays the currently set channel and enables you to assign a single color to it or to display the selected channel in false colors using a look-up table.</p> <p>Color images are temporarily converted to a grayscale image before a color or look-up table is assigned to the resulting single grayscale image. The red, green, and blue channels of a color image cannot be modified individually. However, if you have a multi-channel image, you can apply different colors to each channel.</p> <p>The set channels are displayed in the image and in the histogram.</p>
– Color	Displays the image in a pre-defined color. Each pixel is displayed in a shade of the selected color, corresponding to the pixel's brightness.

Parameter	Description
– LUT	Displays the image in false colors of your choice. The false colors are stored in pre-defined look-up tables (LUT). Each pixel is displayed in one of the colors stored in the look-up table, depending on the pixel's brightness.
– Custom	Displays the image in a user-defined color selected from the RGB color palette. Each pixel is displayed in a shade of the selected color, corresponding to the pixel's brightness.
– None	The image is displayed as it is.
<b>Single Channel</b>	<b>Activated:</b> The channels are displayed separately.
<b>Range Indicator</b>	<b>Activated:</b> Bright pixels that appear to be overexposed are displayed red and dark pixels that appear to be underexposed are displayed blue. The <b>Channels</b> settings are deactivated.

### See also

-  Configuring the Center Screen Area [► 29]
-  Brightness/Contrast/Gamma Tool [► 801]

### 3.11.3 Data Zone Tab

On this tab metadata which are related to the acquired image are displayed, for example:

- **Modified date/time**
- **Microscope**
- **Camera/Detector**
- **Objective**
- **Company Name**
- **Address**
- **Name**
- **Create date/time**

The data to be displayed can be configured under **Maintenance > General Options > Documents > Image Data Zone Optional Data**.

### See also









-  Documents Options [► 718]

### 3.11.4 Topo Options Tab

Below the **Center Screen Area** with a loaded image in the **Topo** view, you can zoom in and out, rotate, and move a topographic image in the **Center Screen Area** according to your needs. This tab is only visible with topography images.

Parameter	Description
<b>Interaction Mode</b>	



Parameter	Description
– Panning 	Activates panning: <ul style="list-style-type: none"> <li>▪ Press left mouse. Pans the image.</li> <li>▪ Press right mouse. Rotates the image.</li> </ul>
– Rotate 	Activate rotation: <ul style="list-style-type: none"> <li>▪ Press left mouse. Rotates the image.</li> <li>▪ Scroll mouse wheel. Zooms in and out.</li> <li>▪ Press mouse wheel. Pans the image.</li> </ul>
<b>Visibility Axis</b>	
– Visibility Axis On 	Switches the visibility axis on.
– Visibility Axis Off 	Switches the visibility axis off.
<b>Reset Topo View</b>	
– 	Resets the 3-D surface representation in the Topo view to z-stretch factor 1.0 and positions the surface representation in the center of the view (default).
<b>Visibility Outline</b>	
– Visibility Outline On 	Switches the outline on.
– Visibility Outline Off 	Switches the outline off.
<b>Create Image</b>	
– 	Only available in <b>Free Mode</b> .  Takes a screenshot of the Topo Image and transfers it to the documents area. The screenshot you can e.g. add to a report or save to disk, e.g. in .png format.


Parameter	Description
<b>Z-Scaling</b>	Stretches or compresses the z-axis in the viewer between 1 and 100%. It defines the display ratio between the x/y extent and the z extent of the data. A value of 100% means the z data range is displayed with the same size on screen as the x/y extent of the data.
<b>Optimize</b>	Sets the z-scaling to 25%.
<b>Normalize</b>	Sets the z-stretch factor to 1.0.
<b>Z-Stretch Factor</b>	Displays the z-stretch factor for a given z-scaling. The z-stretch factor describes, how the <b>Topo</b> view display is stretched or compressed in relation to the real metric relation between x/y data and z-data. A value of 1 means that the surface display is most realistic and depicts to the real extent of x, y, and z-relation of the <b>Topo</b> view.

**See also**

 2.5D Topo View [► 687]


**3.11.5 Heightmap Tab**

To change the appearance of the image in the **Center Screen Area** you can apply a number of color schemes in the **Heightmap** tab. The display options are located at the bottom of the **Center Screen Area**. You can switch within the color scheme and take screenshots.

Parameter	Description
<b>Color scheme</b>	
— Gray	Displays the image in gray color scheme. A legend is displayed for your reference.
— Rainbow	Displays the image in rainbow color scheme. A legend is displayed for your reference.
<b>Create Image</b>	
— 	Only available in <b>Free Mode</b> . Takes a screenshot of the Height Map and transfers it to the documents area. The screenshot you can e.g. add to a report or save to disk, e.g. in .png format.








**See also**

 Heightmap View [► 686]

 Display Tab [► 29]

**3.11.6 Dimensions Tab**

Here you configure the settings for how the image is displayed on the screen. The available settings in the tab depend on the image.

Parameter	Description
<b>Z-Position</b>	Only visible in the case of z-stack images. Selects the displayed z-position.
<b>Global-Z</b>	Only visible for ZEN Connect projects with at least one z-stack. Sets the global value for the displayed z-slices. The range of the slider is defined by the z values of all stacks in the project. <b>Note:</b> When you use the <b>Global-Z</b> slider and are beyond the range of a certain image, only a frame for this image is displayed to show where the image is positioned.
<b>Time</b>	Only visible in the case of time series images. Selects the displayed time point.
<b>Scene</b>	Only visible if the image contains different scenes. Selects the displayed scene. If you deactivate the <b>Scene</b> checkbox, all scenes are displayed in an overview.
<b>Zoom</b>	
–  Fit to View	Automatically sets a zoom factor at which the entire image can be displayed on the screen. Alternatively, you can use the shortcut <b>Ctrl + 0</b> .
– <b>100%</b> Normal View (100%)	Displays the image without increasing or decreasing the zoom factor. One pixel of the image corresponds to one pixel on your screen. Alternatively, you can use the shortcut <b>Ctrl + 1</b> .
–  Decrease Zoom	Decreases the zoom factor. Alternatively, you can use the shortcut <b>Ctrl + F8</b> .
–  Increase Zoom	Increases the zoom factor. Alternatively, you can use the shortcut <b>Ctrl + F7</b> .
– Slider and input field	Sets the desired zoom factor with the slider or input field.
<b>Tools</b>	
–  Selection	Activates the selection mode.
–  Zoom Rectangle	Activates the zoom mode. Hold down the left mouse button and drag out a selection rectangle. When you release the left mouse button, the region within the rectangle is enlarged.
–  Panning	Activates the panning mode. Left-click inside an enlarged image to move the zoomed region. If you have a mouse with a mouse wheel, position the mouse pointer inside the image region and press the mouse wheel. The mouse pointer then appears automatically as a hand icon. You can now move the image region.
–  Show Values	Activates the show values mode. If you move the mouse pointer into the image region, a vertical arrow and a display field appear. The pixel values of the position to which the arrow is pointing are displayed in the display field.

Parameter	Description
<b>Channels</b>	Displays all channels of the currently selected image and toggles their visibility.
<b>Single Channel</b>	<b>Activated:</b> Only a single channel is displayed.
<b>Range Indicator</b>	<p><b>Activated:</b> Changes the display to single channel mode and the channel is displayed in monochrome.</p> <p>Displays pixels that are saturated in red and pixels that have no signal (values = 0) in blue. Note that with camera systems it is usually not possible to achieve pixel values of 0. The blue indicator is therefore usually not displayed.</p>

### 3.12 Scalings and Units

Scalings specify the number of pixels in an image that correspond to a certain actual length of an object in the image, for example that 100 pixels correspond to 1  $\mu\text{m}$ .

Units specify how lengths are displayed, e.g. in millimeters or inches.

As a supervisor you can perform the following actions:

- Create a new scaling by measuring an object of known length
- Add a scaling to existing images retrospectively
- Select whether a custom or a theoretical scaling is used for an image

The theoretical scaling is calculated automatically based on the properties of the hardware components (e.g. zoom of the objectives, number and separation of pixels on camera chip, etc.)

#### Info

The units used to display scalings and measurements are a global setting for all users and can only be changed by an administrator.

#### 3.12.1 Creating a Custom Scaling

You can create a custom scaling for the current hardware setup by measuring an object of known length. If enabled by the administrator, you can select that this custom scaling is used as the basis for current measurements with this hardware setup.

#### Info

This tool is typically only used in **Free Mode**. If you add it to a job template, a custom scaling will be created each time the job is run. Furthermore, only one scaling can be stored per hardware configuration, i.e. when a new custom scaling is created, the existing one is overwritten.

- Prerequisite**
- ✓ You are in **Free Mode**.
  - ✓ You have permission to overwrite custom scalings.
1. Place an object of known length on the microscope stage.
  2. Acquire an image of the object using any acquisition method.
  3. Add the **Create Measured Scaling** workbench from the **Calibration** category.
  4. Select the desired measurement tool:
    - ➔ **Line** tool

- **Parallel Line** tool
- For more information about using the tools, see the Workbench and Tool Reference.
- 5. Measure the object on the screen.
  - If you want the measurement tool to automatically snap to edges, activate **Automatic Line Detection**.
- 6. In **Correspond to [Value]** enter the actual length of the object and select the correct units.
  - The system calculates the scaling.
- 7. Enter a meaningful name for the scaling and click **Save Scaling**.

The current hardware configuration, including the selected objective, is automatically stored as part of the scaling. You can only apply the scaling in the future when the identical hardware configuration is used. Therefore, if you have multiple hardware configurations, you need to create a scaling for each one.

### See also

 Distance Tool [► 844]

## 3.12.2 Assigning a Scaling to an Acquired Image

If an image does not contain a scaling recognized by the software, for example because it was created on another device, you can assign a scaling retrospectively. Any measurements subsequently performed on the image use the assigned scaling.

- Prerequisite** ✓ You know the actual scaling of the image. You can calculate this by acquiring an image of an object of known length on the same external device and noting the number of pixels.
1. Load the image for which you want to assign a scaling.
  2. Add the **Assign Measured Scaling** workbench from the **Processing** category.
  3. Enter the known values for horizontal (**X**) and vertical (**Y**) scaling and select the corresponding units.
    - A pixel can correspond to different lengths in each direction.
  4. Click **Assign Scaling to Image**.

### Info

Measurements and scale bars that are burnt into the images are not updated.

## 3.12.3 Selecting a Scaling Method

As a supervisor you can specify how the scalings for images are calculated:

- **Theoretic**  
Based on the properties of the hardware components (e.g. zoom of the objectives, number and size of pixels on camera chip, etc.)
- **Custom scaling**  
Based on a manual (user-defined) measurement created using the **Create Scaling** tool.

This feature can be disabled by the administrator.

- Prerequisite** ✓ A custom scaling for the current hardware setup exists. If not, only the theoretical scale is available.
1. Acquire an image of the object using any acquisition method.
  2. Add the **Assign Measured Scaling** workbench from the **Processing** category.




3. In **Scaling** select the desired scaling method:
  - **Theoretic**
  - [Custom\_Name]
  - The settings of the hardware components used in the scaling are displayed below.
4. Click **Assign Scaling to Image**.

The selected scaling method is applied to all images in the current job with the current hardware setup.

### 3.12.4 Managing Custom Scalings

You can import/export custom scale presets, for example to copy them to another system.

1. Open **Manage Scalings**:
  - **Home Screen > Maintenance > Manage Scalings**
2. Perform the actions listed below as required.

Action	Description	Procedure
Export a preset scaling	The scaling values are saved in a file.	<ol style="list-style-type: none"> <li>1.  &gt; <b>Export</b></li> <li>2. Specify the location in the file system.</li> </ol>
Import a preset scaling	A preset from the file system is added to the list of scalings and the current parameter values are overwritten with those stored in the preset.	<ol style="list-style-type: none"> <li>1.  &gt; <b>Import</b></li> <li>2. Select the desired scaling file from the file system.</li> </ol>
Delete a preset scaling	<p>The currently selected scaling is deleted.</p> <p>The next scaling in the list is selected and the values from the scaling applied. If the list is empty, the default values are applied.</p>	<ol style="list-style-type: none"> <li>1.  &gt; <b>Delete</b></li> </ol>

### 3.12.5 Assigning a Scaling (Manual Hardware)

If an image does not contain a scaling, for example because it was acquired with manual hardware (i.e. a microscope where the individual hardware components cannot be detected), you can assign a scaling retrospectively. Any measurements subsequently performed on the image use the assigned scaling.

The total magnification of the microscope, and thus the scaling, is calculated based on the magnification of individual components.

**Prerequisite** ✓ You know the magnifications of the hardware components.

1. Acquire an image of the object using any acquisition method.
2. Add the **Assign Theoretical Scaling** workbench from the **Processing** category.
3. Select the magnification of each component.
4. Click **Assign Scaling to Image**.

**Info**

Measurements and scale bars that are burnt into the images are not updated.

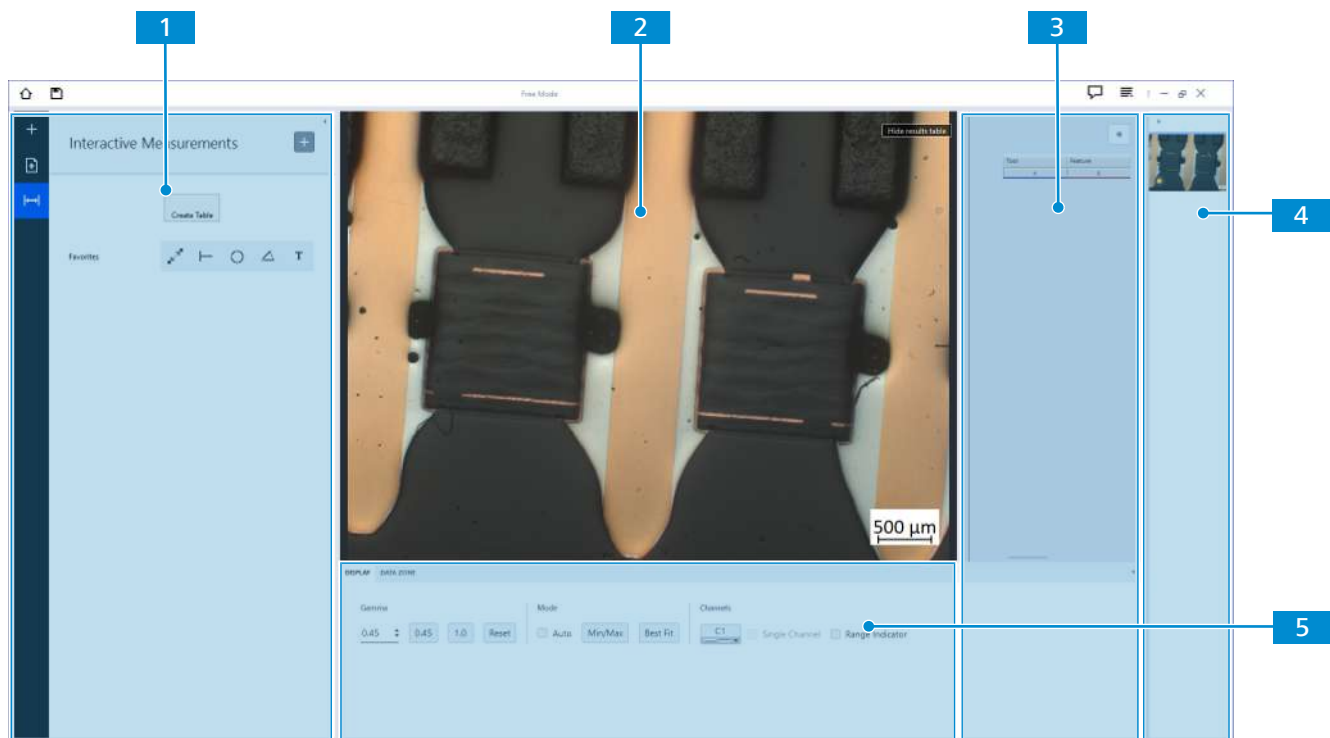
**3.13 Free Mode**

Free examinations (**Free Mode**) can be used to inspect a sample quickly, easily, and flexibly without defining a job consisting of multiple tasks in a fixed order. A typical use is to examine a faulty sample where the cause of the fault is unknown or for one-off examinations that will not be repeated.

This section provides an overview of typical actions in **Free Mode**, such as using workbenches, adding and removing tools and working with documents and images.

**3.13.1 User Interface - Free Mode**

The following figure shows the typical user interface when working in **Free Mode**.

**1 Workbench & Tool Area**

Displays the added workbenches and tools.

**2 Center Screen Area/Image Area**

Shows the current image, measurements and measurement results.

**3 Results Table**

Lists the results of all the measurements in the image. You can show/hide the table by clicking **Show/Hide results table**.

**4 Documents Area**

Contains a list of all documents (images, measurement results, reports and imported documents) within the examination.

Click a document to display it and select it in the open task. Each time you apply a tool a new document is generated.

Some document formats might not be supported within **ZEN core**, e.g. .txt or MS Excel files. A link is provided to open them externally.

### 5 Display Tab

Here, you can adjust how the image is displayed (i.e. **Gamma** value). For a detailed description, see *Display Tab* [▶ 29].

### Data Zone Tab

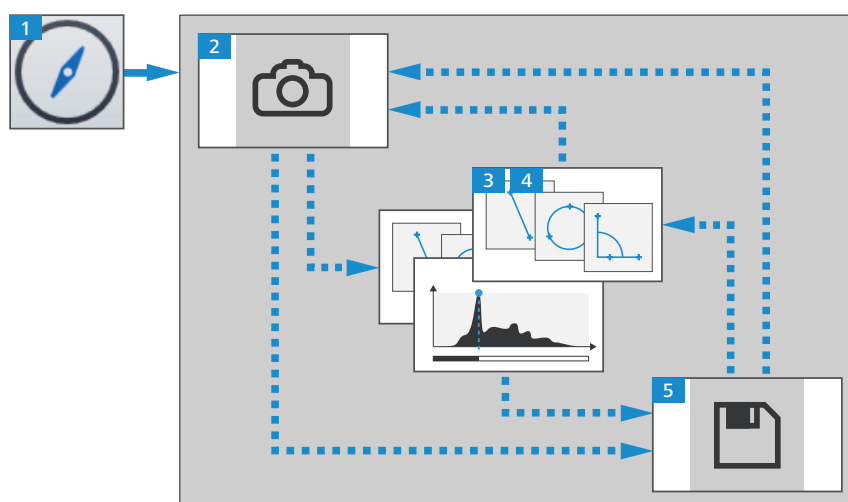
Here, you can configure the display of additional hardware and acquisition data which are related to the acquired image. The data to be displayed can be configured under **Maintenance > General Options > Documents > Image Data Zone Optional Data**.

### See also

- Free Mode [▶ 39]
- Workflow [▶ 40]

## 3.13.2 Workflow

In **Free Mode** there is no typical workflow. In this mode, workbenches can be used in any sequence.



- 1** Select **Free Mode** from the **Home Screen**.
- 2** Acquire an image.  
Acquire an image using the camera or load an image from the file system.
- 3** Process the image.  
Enhance the appearance of the image using various processing tools.
- 4** Analyze the sample.  
If desired, repeat steps 2 – 4.
- 5** Save or export the images and analysis results.

Each time you apply a tool a new image is generated in the **Documents Area**. You can apply any number of processing or analysis tools in any order.




### 3.13.3 Selecting Workbenches

In **Free Mode** you can change which workbenches are displayed in the **Workbench Area**. To be able to use the tools within a workbench it must be selected. However, you can add or remove a workbench from the **Workbench Area** at any time without affecting the examination results. The order of the workbenches also does not affect the examination results. Remove any workbenches you do not require to reduce the number of workbenches displayed in the **Workbench Area**.

#### Adding workbenches

To add a workbench to the **Workbench Area**:

1. Click the **Add Workbench** button.  

2. In the left pane, click the desired workbench category.
3. In center pane, click the desired workbench.  
 → A description of each workbench is displayed in the right pane.
4. Click **+ Add**.

#### Removing workbenches

To remove a workbench from the **Workbench Area**:

1. Right-click the icon of the workbench.
2. Click **Close workbench**.

#### Info

The next time you start a free examination the workspace is displayed as you left it.

#### See also

 Customizing Workspace [► 47]

### 3.13.4 Adding and Removing Tools

You can add and remove tools from a workbench so that a workbench only contains the required tools.


#### Adding tools

To add a tool to a workbench:


1. Select the workbench to which you wish to add a tool.
2. Click the **+ Add Tool** button in the **Workbench Area**.
3. In the overlay select the desired tool.  
 → The tools that are available depend on the current workbench.

#### Removing tools

To remove a tool from a workbench:

1. Click anywhere within the tool.
2. Click **Delete this tool** .  
 → The tool is deleted.

#### See also

 Customizing Workspace [► 47]

 Selecting Workbenches [► 41]

### 3.13.5 Documents

In **Free Mode**, user-created documents such as images, tables, forms, or reports are listed in the **Documents Area**. To have a good overview, the documents name is displayed permanently and the full name is displayed when you hover over it.

In the **Documents Area**, you can open a document by clicking on it. If you use a tool, it is applied to the currently selected image (rather than the most recent image). The resulting image is added to the bottom of the **Documents Area**. From the context menu, you can also close, rename or save documents.

#### See also

 Image Export Tool [► 857]

#### 3.13.5.1 Renaming Documents in the Documents Area

1. In the **Documents Area**, use the context menu to rename a document.  
→ The name you give to the document will be displayed on the **Data Zone** tab.

In the **Documents Area**, the image and the image name is displayed permanently. The full name is visible via mouse over.

#### 3.13.5.2 Saving Documents in the Documents Area

You can save one document or you multi-select documents to save them on a drive in different file types.

#### Info

If you save or export an EDF image in an image format that does not support multi channels, for example, jpg, and later you import it again and save it in czi format, the multi channel information will be lost. This might be confusing if you saved the imported image (jpg format) in the Archive in czi format and load it again, then, for example, the topography functionality is lost, but the image still looks like an image in EDF format.

1. In the **Documents Area**, right-click into the document and select **Save As**. To multi-select documents, press **Ctrl** while selecting the documents.  
→ The file browser opens.
2. Navigate to the directory, where you want to save the documents.
3. Under **File Name**, you can change the default file name. The default file name is the name that is used in the **Documents Area** and on the **Data Zone** tab.
4. Under **Save as type**, select the file type. By default, the file type is **CZI**.

- Depending on your selection for the file type, additional options will appear:
  - Use names of Documents Area:** Keeps the document names of each document. If you deactivate the checkbox, all documents will have the name of the document you selected first in the **Documents Area**. The new file name of all files is counted up. Check the name and type and change it, if necessary.
  - Set as Default:** Sets the currently selected file type as default.
  - Compression:** Sets a compression value for the image to reduce the file size (which will result in a loss of quality).
  - Burn-in annotations:** Saves the annotations with the image.
  - Burn-in Data Zone:** Saves the metadata displayed on the **Data Zone** tab with the image.
  - Save Metadata:** Saves the metadata with the image.
  - Save Tiles:** Allows to save tile images.
  - Full size:** Saves the image in full size. If the dimension of the source image is too big, it is sampled down by default to 8192 x 8192 pixels. You can change this default value by entering the desired value in the **Reduce to long edge to (pixel)** field.

5. Click **Save**.

The document is saved according to your settings. In case the results are not as expected or you want more control about the resizing, in the **Save File** workbench, use the **Image Export** tool, see *Image Export Tool* [▶ 857].

### 3.13.5.3 Loading Documents by Drag and Drop

You can load documents from your local disk via drag and drop.

**Prerequisite** ✓ You are in **Free Mode**.

1. Navigate to the documents on your computer you want to display in **Free Mode**, select the desired documents, e. g. images or tables. Drag these documents to the **Center Screen Area** or to the **Documents Gallery**.
  - The documents are added to the list of documents in the **Documents Gallery**.
  - The order of the documents is identical to the order of the documents in the source folder.
  - The document on top is selected and displayed in the **Center Screen Area**.

### 3.13.5.4 Display Order of Loaded Documents

After you have loaded documents, e.g. images, reports, forms or tables in **Free Mode**, they are displayed in the **Image Gallery**. The display order depends on how you have loaded the documents. Any time, the document on top in the **Image Gallery** is displayed in the **Center Screen Area**.

#### Acquisition

If you acquire several images, the order of the documents is chronologically. The most recent image taken is at the top.



#### Drag and Drop

If you load documents by drag and drop, the order of the documents is identical to the order of the documents in the source folder.

### Load Input Documents

If you load documents via a workbench, the order of the documents is alphabetical per loading process.

### See also

-  Loading Documents by Drag and Drop [▶ 43]
-  Input Documents [▶ 732]

#### 3.13.5.5 Setting Default Names of Documents


You can specify how images and tables should be named by default.

#### Specifying Default Names in General Options

1. Select **Home > Maintenance > General Options**.  
→ A dialog opens.
2. For more information, see *Naming Options* [▶ 717].

#### Specifying Default Names in Free Mode

**Prerequisite** ✓ You are in **Free Mode**.

1. In the **Documents Area**, click .
- A dialog opens.
2. For more information, see *Naming Options* [▶ 717].



#### 3.13.6 Saving Results in Free Mode Locally

You can save the results of the current job locally without the need to upload them to the archive.

#### Info

The **Save Results** dialog has to be enabled under **Home > Maintenance > Archive Options > Enable Saving to Local Storage in Save Results Dialog**.

**Prerequisite** ✓ You are in **Free Mode**.

- ✓ You have acquired an image, modified an existing image, or created other documents, for example, a report.
1. **To save the current experiment without leaving Free Mode:** Click .
  - The **Save Results** dialog opens.
  2. For **Name**, enter a name for the job result. Optionally, you can add a description under **Description**.
  3. Click **Save**.  
→ The current experiment is saved in the local storage. You can continue with the experiment.
  4. **To save the current experiment and leave the Free Mode:** Click , and click **Save Results**.  
→ The **Save Results** dialog opens.
  5. For **Name**, enter a name for the job result. Optionally, you can add a description under **Description**.

6. Click **Save**.

The result is saved in the local storage, the **Free Mode** session is closed, and the **Home Screen** opens.

#### See also


- 📖 Archiving Results And Keep them Locally in Free Mode [▶ 45]
- 📖 Exporting Results in Free Mode [▶ 46]
- 📖 Archiving Results in Free Mode [▶ 45]
- 📖 Discarding Results in Free Mode [▶ 47]

### 3.13.7 Archiving Results in Free Mode

You can upload the results of your job in the archive when leaving the **Free Mode**.

**Prerequisite** ✓ You are in **Free Mode**.

- ✓ You have acquired an image, modified an existing image, or created other documents, for example, a report.

1. Click , and click **Archive Results**.  
→ The **Archive Results** dialog opens.
2. For **Name**, enter a name for the job result. Optionally, you can add a description under **Description**.
3. Click **Archive**.

The result is uploaded to the archive in the background, the **Free Mode** session is closed, and the **Home Screen** opens. You do not need to wait until the upload is finished; you can continue with your work during the upload.

#### See also


- 📖 Archiving Results And Keep them Locally in Free Mode [▶ 45]
- 📖 Exporting Results in Free Mode [▶ 46]
- 📖 Saving Results in Free Mode Locally [▶ 44]
- 📖 Discarding Results in Free Mode [▶ 47]

### 3.13.8 Archiving Results And Keep them Locally in Free Mode

You can upload the results of your job in the archive and keep the results locally when leaving the **Free Mode**.





**Prerequisite** ✓ You are in **Free Mode**.

- ✓ You have acquired an image, modified an existing image, or created other documents, for example, a report.

1. Click , and click **Archive Results**.  
→ The **Archive Results** dialog opens.
2. For **Name**, enter a name for the job result. Optionally, you can add a description under **Description**.
3. Activate checkbox **Keep Results Locally**.
4. Click **Archive**.

The result is uploaded to the archive in the background and is also saved in the local storage, the **Free Mode** session is closed, and the **Home Screen** opens. You do not need to wait until the upload is finished; you can continue with your work during the upload.

### See also



-  Saving Results in Free Mode Locally [► 44]
-  Discarding Results in Free Mode [► 47]
-  Archiving Results in Free Mode [► 45]
-  Exporting Results in Free Mode [► 46]

## 3.13.9 Exporting Results in Free Mode

You can export all images and files in the current session when leaving the **Free Mode**.


**Prerequisite** ✓ You are in **Free Mode**.



- ✓ You have acquired an image, modified an existing image, or created other documents, for example, a report.

1. Click , and click **Export**.  
→ The **Export** dialog opens.
2. Activate **Keep Results Locally**, to store the exported results in the local storage as well.
3. Activate **Archive Results After Exporting** to upload the files to the archive as well.
4. To select the folder to which the files will be exported, click .  
→ A file browser opens.
5. Select or create the desired folder and click **OK**.
6. Select whether you want to export only the images or all documents.
7. In the preview, select the images you want to export.
8. Under **Image Settings**, you can select the image type.
9. Depending on your selection, you can activate further options for the export:
  - Set as Default**: Sets the currently selected file type as default.
  - Compression**: Sets a compression value for the image to reduce the file size (which will result in a loss of quality).
  - Burn-in Annotations**: Saves the annotations with the image.
  - Burn-in Data Zone**: Saves the metadata displayed on the **Data Zone** tab with the image.
  - Save Metadata**: Saves the metadata with the image.
  - Save Tiles**: Allows to save tile images.
  - Full size**: Saves the image in full size. If the dimension of the source image is too big, it is sampled down by default to 8192 x 8192 pixels. You can change this default value by entering the desired value in the **Reduce to long edge to (pixel)** field.
10. **To set the options to export files**: Select option **Export Files**.
11. In the preview, select the files you want to export.
12. Under **File Settings**, you can select the report type, the table type and the image type to set further options. **Note**: You cannot export a PDF report as a Word Data Report (\*.docx). A \*.pdf-> \*.docx conversion is not supported.
13. Click **Export**.

The results are exported accordingly, the **Free Mode** session is closed, and the **Home Screen** opens.

### See also





-  Saving Results in Free Mode Locally [► 44]
-  Archiving Results in Free Mode [► 45]


-  Archiving Results And Keep them Locally in Free Mode [► 45]
-  Discarding Results in Free Mode [► 47]

### 3.13.10 Discarding Results in Free Mode

You can discard all unsaved changes in the current session when leaving the **Free Mode**.





The effect of the discard-function depends on the specific situation:

- If you are editing an **existing result** and you have not saved your modifications in the current session by clicking **Save** , your changes are discarded and the original result is restored and available in the local storage.
- If you are editing an **existing result** and you have saved your modifications in the current session by clicking **Save** , then the last saved result is restored and available in the local storage.
- If you are in a **new session** and you have not saved your modifications in the current session by clicking **Save** , your changes are deleted.
- If you in a **new session** and you have saved your modifications in the current session by clicking **Save** , then the last saved result is restored and available in the local storage.

- Prerequisite**
- ✓ You are in **Free Mode**.
  - ✓ You have acquired an image, modified an existing image, or created other documents, for example, a report.
1. Click , and then click **Discard**.  
→ The **Discard** dialog opens.
  2. Click **Discard**.

Your unsaved changes are discarded.

#### See also

-  Archiving Results And Keep them Locally in Free Mode [► 45]
-  Exporting Results in Free Mode [► 46]
-  Saving Results in Free Mode Locally [► 44]
-  Archiving Results in Free Mode [► 45]

### 3.13.11 Customizing Workspace

The **Free Mode** workspace always starts with the same workbenches displayed in the **Workbench Bar** that were used for the previous free examination.

- If you have a set of workbenches that you commonly use for free examinations, you can simplify your work by adding them to the **Workbench Bar**.
- Furthermore, if there are workbenches you rarely need, you can remove these from the **Workbench Bar**.
- You can also modify existing workbenches by adding and removing tools.

By combining the methods above, you can configure the free examination workspace to your requirements.

#### See also

-  Selecting Workbenches [► 41]

### 3.13.12 Adding Documents to a Result

Note that this procedure is NOT possible when you have licenced and activated the **GxP module**.  
You can add further images or modified images as well as other documents to existing job results.

- Prerequisite**
- ✓ You are in **Free Mode**.
  - ✓ You have acquired an image, modified an existing image or created other documents, e.g. a report.
1. Click **Save**.
    - The **Save results to the archive** dialog opens.
  2. Select the **ADD TO OR MODIFY RESULT** tab, select the result you want to add the new or modified document to, and click **Save**.
  3. If the name of the document already exists, you will get a message to decide whether you want to save both documents or overwrite the existing document.
    - Activate **Keep both Documents** to keep both documents.
    - Activate **Replace Existing Documents** to keep the modified document.
    - Click **Update**.

The document is saved and added to the existing result.

### 3.13.13 Exporting Results

You can export images or measurements results, e.g. to publish them or to archive them on an external storage device.

1. Click **Add Workbench** and select the **Output Documents** category.
2. Select the **Save File** workbench and click **Add**.
3. Select the image to be exported, specify a filename in the **Save Image** tool, and click **Apply**.

Alternatively, you can right-click a document (such as an image or report) in the **Documents Area** and use the context menu to export it.

## 3.14 Job Mode

As an operator, your main task is to run jobs that have been created by a supervisor. When you log in as an operator, you can choose between selecting a job to run and viewing the results of a job you have run previously.

The job created by the supervisor contains all the steps to be performed, from image acquisition to processing, analysis, and how the results should be reported. When running the job you are guided through the required steps and automatically presented with the necessary tools to perform it.

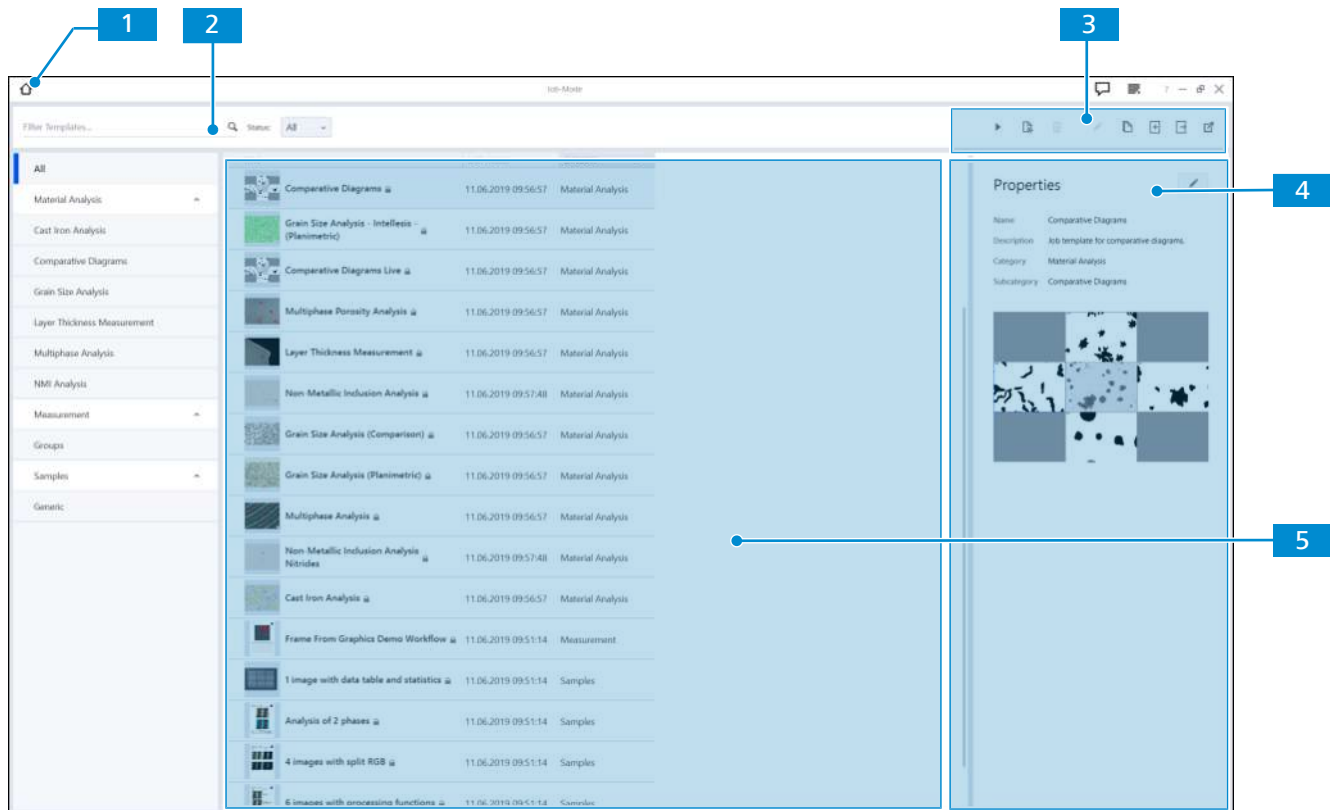
The text from the supervisor describes what to do for each task, for example where to perform an analysis on the sample. Furthermore, the supervisor can specify a default value for a tool and limit the range of values that you can apply. Values that may not be changed are locked or hidden.

Once you have completed all the steps in the job, the images and the measurement results are automatically saved in a job result. You can then repeat the job with another sample or select a different job to run.



### 3.14.1 User Interface - Job Mode

The following figure shows the typical user interface when working in **Job Mode**.



**1 Home icon**

Takes you to the **Home Screen**

**2 Filter Area**

Enables you to filter the list of templates by status or search term

**3 Tool Bar**

Enables you to perform several actions, see *Control Elements* [▶ 51].

**4 Properties**

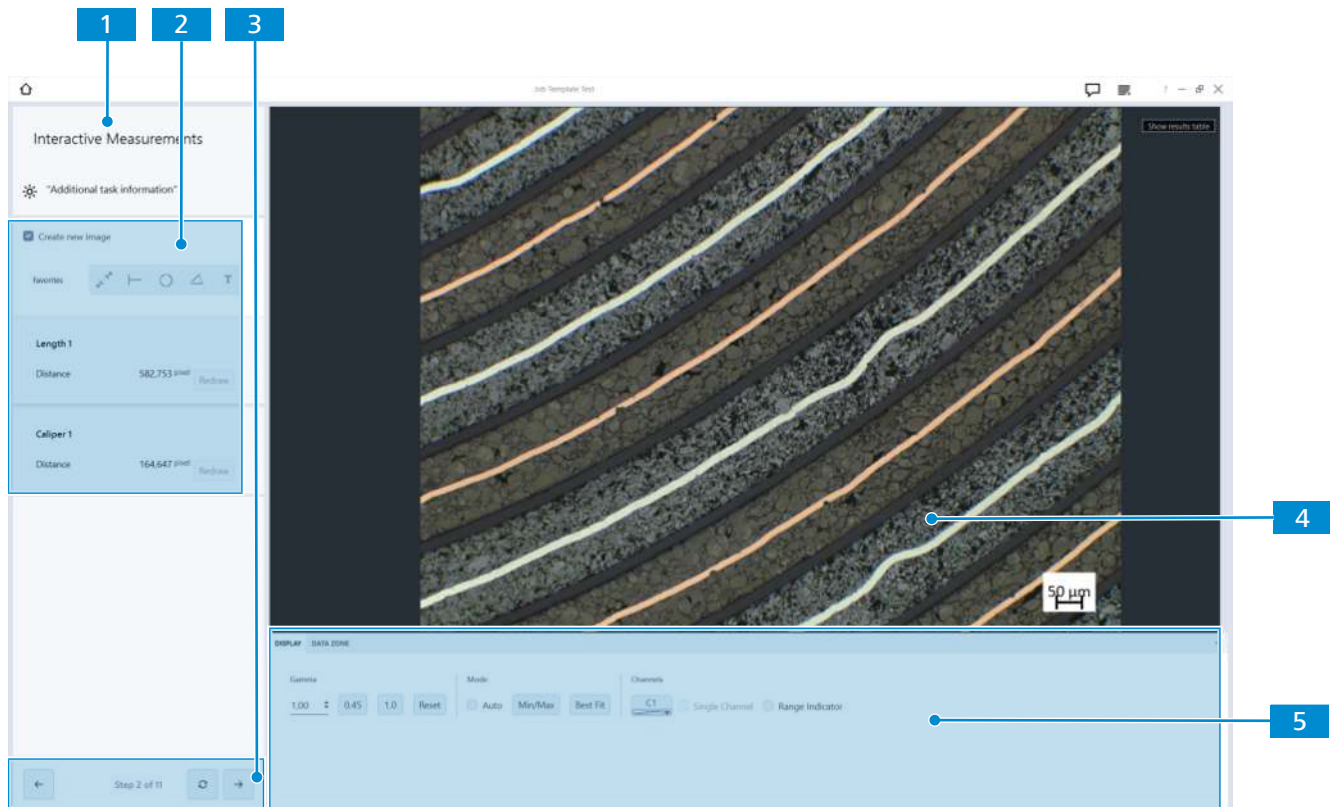
Allows to change the properties of the selected template, e.g. the name, category, and permissions, see *Job Template Properties* [▶ 63].

**5 Template List**

Displays all templates specified by the filter

### 3.14.2 User Interface - Run Job

The following figure shows the typical user interface when running a job in **Job Mode**.

**1 Task name**

Shows the name of the task and additional information.

**2 Tool area**

List of all tools available to perform the task.

**3 Navigation buttons**

By using these buttons you can navigate through the steps (individual tasks) of a job.

**4 Center Screen Area/Image Area**

Shows the current image and measurements.

**5 Display tab:**

Here you can adjust how the (live) image is displayed (i.e. **Gamma** value).

**Data Zone tab:**

Here you can configure the display of additional hardware and acquisition data which are related to the acquired image. The data to be displayed can be configured under **Maintenance > General Options > Documents > Image Data Zone Optional Data**.

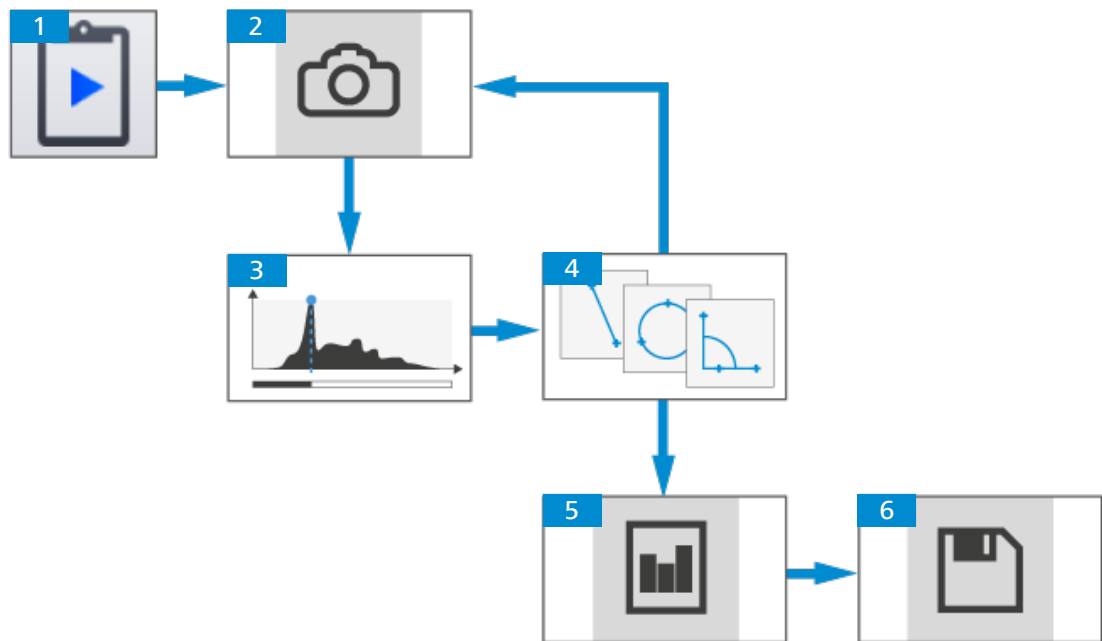
**See also**

📄 Control Elements [► 51]

📄 Workflow [► 50]

**3.14.3 Workflow**

The following diagram shows an example of the workflow when running a job. Any steps where no interaction is required are performed automatically in the background.

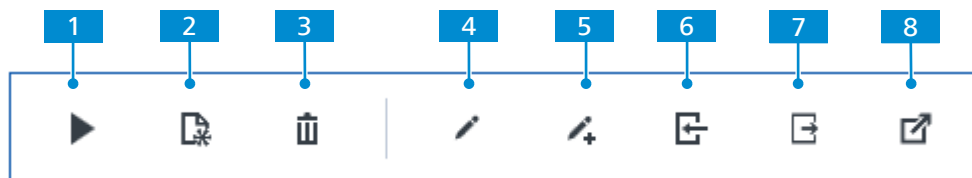


- 1** Select the appropriate job for the sample.
- 2** Acquire an image of the region defined by the supervisor.
- 3** Process the image as defined by the supervisor.
- 4** Perform the analyses defined by the supervisor.  
You are automatically guided through the analyses and presented with the appropriate tool.  
Repeat steps 2 - 4 for other areas of the sample as defined by the supervisor.
- 5** Check the information in the job report.
- 6** Save the job results.

### 3.14.4 Control Elements

In order to work with a selected job, use the group of icons located top right in **Job Mode**.

The operation of the icons depend on your user role and/or privileges. Most of the icons are only visible for users which have the **Can Run Job** privilege.



*Fig. 1: Icon bar - Job Mode*

- 1** Runs the selected job.
- 2** Creates a new job template.
- 3** Deletes the selected template.
- 4** Edits the selected template.
- 5** Copies and edits the selected template.

**6** Imports templates to the archive from disk.

**7** Exports the selected templates.

**8** Extracts template items.

### 3.14.5 Running a Job

**Prerequisite** ✓ You are logged in as an operator.

✓ You are on the **Home Screen**.

1. Click on **Job Mode**.
2. Click the desired job in the list.
3. Click on **Run**.
  - Alternatively, you can double-click the desired job.
  - The first step in the job is displayed (typically acquire an image).
4. To continue with the next step, click on **Next**.
5. When you have completed all the steps, select the saving or closing option of your choice.

If the job requires a different hardware configuration to your current setup, the system prompts you which components need to be changed. For more information about how to change components, see your microscope instruction manual.

### 3.14.6 Importing and Exporting a Job

All active templates stored in the **Archive** can be accessed by any user of the system. If you want to transfer a template between non-connected systems, you can export it from one **Archive** and import into in the other **Archive**.

**Prerequisite** ✓ The **Job Mode** is selected.

1. Select the template to be edited.
  - If you know the name of the template, you can enter the first few letters in the **Filter Templates** field to reduce the number of entries.
2. Click on the **Import** or **Export** button to perform the desired action.
3. Select the desired location on the file system.
  - If you import a template with the same name as an existing template, you can choose to overwrite it or import the template with a new name.

### 3.14.7 Extracting Items of a Job Template

Imported job templates often consist of several items such as forms, reports, macros or image analysis settings. The individual items can be extracted and provided as separate files in the archive. To extract items of a template proceed as follows:

**Prerequisite** ✓ The **Job Mode** is selected.

1. Select a **Job Template** which contains the item to be extracted (e.g. a specific macro).
2. In the upper right corner click on the **Extract Template Items** icon



- A dialog opens which shows a list of all items contained in the template.
- 3. In the column **Action** of the desired item select **Extract**.
  - Note that the other items must be set on **Ignore** if you do not want to extract them as well. If an item is set on **Rename**, it can be exported twice, e.g. if a newer version of the item exists.
- 4. Click on **Extract**.


The item will be extracted to the archive. Depending on what kind of item it is, it can be found in the corresponding categories of the archive.

### 3.14.8 Creating a Report

Reports enable you to collate all the information from your examination in a single document. Typical information includes:

- Images
- Measurement data
- Metadata (e.g. examination time, hardware setup)

Each report template contains placeholders for the above information to enable you to collate the information easily. The placeholders are usually filled automatically with the correct information. Depending on the settings applied when the job was created, you might be allowed to change the content of a placeholder.

1. Follow any instructions added by the supervisor in the workbench panel.
2. Check that all the information is included in the report (for example the correct images).
  - A preview of the report is displayed in the **Right Tool Area**.
3. To change the information in a placeholder, select the desired report template in the **Add Templates** tool.
  - Various placeholders are listed in the **Workbench Area**.
4. Click the arrow icon  in a placeholder and select the corresponding measurement information that you wish to add, for example image, measurement result, etc.
  - You can add multiple items to a single placeholder. The report preview updates accordingly.
5. If you require a paper copy, click **Print Report**.

### 3.14.9 Saving and Completing a Job

You save and complete the job, when you have completed the last examination step.

1. Run a job.
  - In the last step, you save your results, if desired.
2. Click **Save and Close** or **Save and Repeat** to complete and save the job.
  - The job results are saved to the archive.
3. If you do not want to save the job results, select one of the following options. Note, that these options are not available, if the job template is in GxP status **Active**.
  - **Close Without Saving**
  - **Repeat Without Saving**

### 3.14.10 Working with Job Templates

**Create a new template and edit it** within **Job Mode** is used for designing workflows (jobs) which then can be selected and performed in **Job Mode**. Create a job template containing all the necessary tasks to examine a sample. Each time the job template is run by an operator, the same tasks are performed.

This section provides an overview of the typical design steps in this mode. It describes how to create a job template, how to use workbenches to add and remove tasks, and how to modify the properties of individual tools in a workbench.

#### 3.14.10.1 Basics of Job Templates

##### See also

 [Loop Task](#)  748]

##### 3.14.10.1.1 Job Templates

A job template contains all the examination tasks to be performed when the job is run: e.g. acquiring an image, processing it, analyzing it and creating a report.

Each task to be performed by the operator is represented by an icon in the **Task List**.

By adding tasks to the **Task List** and structuring them you can create a workflow.

For each task you can also specify the following:

- Which tools are available
- Whether tool parameters can be changed
- The default values for parameters and the range of permitted values

##### See also

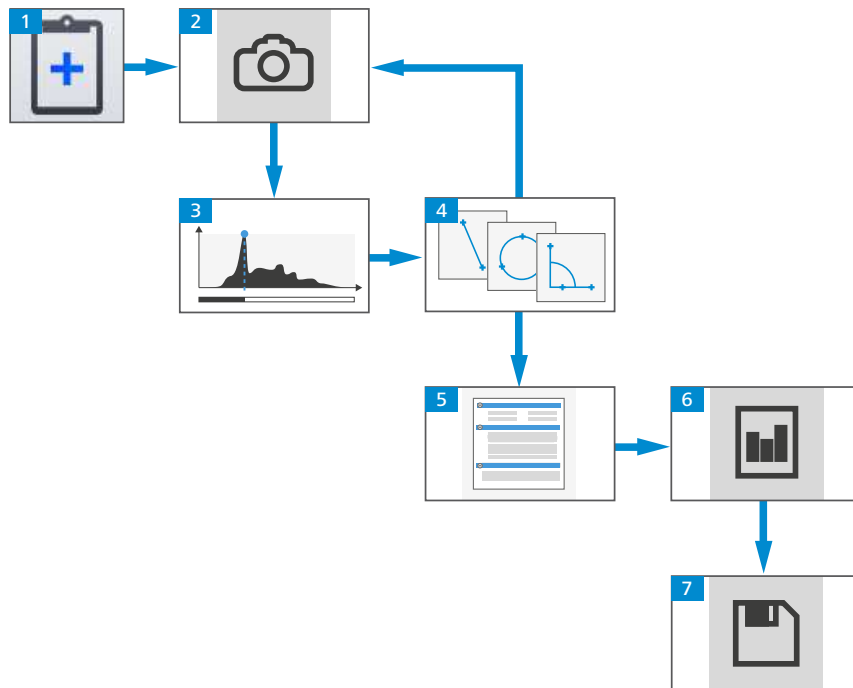
 [Specifying Permitted and Expected Values for a Tool](#)  59]

 [Configuring Tolerances for a Measurement](#)  60]

 [Task Queue](#)  56]

##### 3.14.10.1.2 Workflow

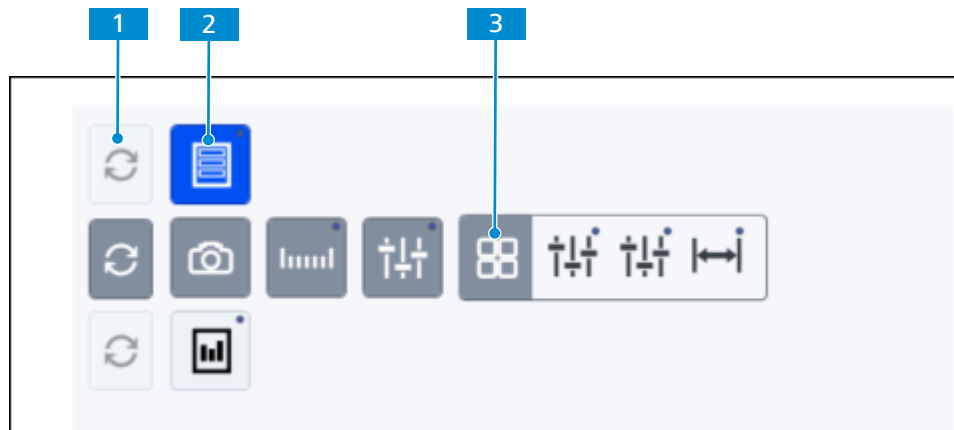
One typical workflow when creating a job template can be summarized in the following figure. Each step represents one task in the job template and is represented with an icon in the **Task List**.



- 1** Select **Job Mode** and click on **Create a new template and edit it.**
- 2** **Acquire an image**  
Use the microscope camera or load an image from the file system.
- 3** **Process the image**  
Enhance the image and configure which parameters can be modified, for example adjust the brightness and specify that contrast can only be altered +/- 10%.
- 4** **Analyze the image**  
Define the measurements to be performed and configure the accepted measurement tolerances.  
If desired, repeat steps 2 – 4.
- 5** **Configure the input form**  
Select a form template and specify the metadata to be recorded (e.g. sample ID, current time) and how it is entered (manually, automatically).
- 6** **Configure the report**  
Select a report template and configure how measurement results and metadata should appear in it.
- 7** **Save the job**  
Specify a name for the job template and which users are allowed to run it.

#### 3.14.10.1.3 Task List

The **Task List** indicates all the tasks to be performed when the job is run. Every time you add a task, the corresponding icon is added to the task list. The result is a graphical overview of tasks for each job template. When you right-click inside the task list area a context menu opens with all necessary parameters to edit the task list (e.g. Delete, Cut, Paste).



- 1** Update a Task
- 2** Single Task (e.g. Input Form)
- 3** Group of Tasks

**Loops & Groups** It is also possible to add **Workflow** relevant tasks like **Loops** and **Groups**. A detailed description of the loop task can be found under Loop Task. The idea of **Groups** is the possibility of putting certain tasks together to be able to arrange them more easily. For example you can collapse a group containing a few tasks for a better overview within the task list.

**Analysis Task Groups** Another application of groups is the more specific **Image Analysis Task Groups** which can be found in the **Measurement** tasks. If added to the job template you can load pre-defined image analysis settings (\*.czias files) which are then displayed inside the group.




Fig. 2: Empty Analysis Task Group



Fig. 3: Analysis Group with Settings

#### 3.14.10.1.4 Task Queue

In **Create a new template and edit it** within **Job Mode**, many of the image processing tools for an image are not applied immediately as they require processing time to calculate the resulting image. The refresh icon to the left of the image/document in the **Task List** indicates its current status:

-  Click the refresh icon to update the image/document


If a branch in the **Task List** contains multiple processing tools, they are all applied, from left to right. The output of a processing tool provides the input for subsequent processing tools.

#### 3.14.10.2 Creating a New Job Template

The software is supplied with example job templates which you can configure to your requirements.

However, you can also create a new job template from scratch.









- Prerequisite** ✓ You are logged in as a supervisor or you have the sufficient privileges to create a job template.
- ✓ The **Home Screen** is visible.
1. Open the **Job Mode** and click **Create a new template and edit it**.  
→ In the **Workbench Panel**, an empty job template is displayed. In the **Center Screen Area**, the **Add Task** view is displayed.
  2. Select the category of the first task to be performed, e.g. **Acquisition**.
  3. Select the workbench for the first task to be performed, and click **+ Add Task**. Alternatively, double-click the desired workbench.  
→ The first task is displayed in the **Task List** and the corresponding tools are displayed in the **Workbench Panel**.
  4. For some tools, e.g., **Save Image** tool, you can set inputs and parameters. To do so, click **Tool Setup**.  
  
→ The **Tool Setup** view is displayed.
  5. In the tool setup of the **Save Image** tool, for example, in the **Inputs** area, you can specify which state of an image you want to save, depending on where you are in the workflow. You could, e.g., save the acquired image or the processed image by default. When you have finished the job template, click **Save the current job template**.  
→ The **Save Job Template** dialog is displayed.
  6. On the **General** tab, enter the name of the new job template and select a category, if necessary, e.g. **Sample**. Click **Save**.

You have created a new job template. From now on it is displayed in **Job Mode**.

If you have selected a category when creating the job template, it will be displayed in this category, e.g. **Job Mode > Sample**.

### See also

-  Specifying Tools for a Task [► 58]
-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Adding Information for the Operator [► 60]
-  Configuring Tolerances for a Measurement [► 60]
-  Saving and Completing the Job Template [► 62]
-  Workflow [► 54]

### 3.14.10.3 Editing Job Templates

#### 3.14.10.3.1 Adding and Removing Tasks

By adding tasks to the **Task List** and structuring them you can create the workflow for the operator when running the job.

The position where the task is added depends on the item currently selected in the **Task List**:

Selected item	Position new task is added
Task (e.g. 2D Acquisition, Processing tasks)	At the right end of the current branch  Each branch can contain multiple processing or measurement tasks.
Image / document related tasks	As a new branch

**Selected item****Position new task is added**

This enables you to perform different tasks on the same image/document without needing to reacquire it.

**Adding a task** To add a task to the job template:

1. Ensure that the correct item in the **Task List** is selected for the location you want to insert a new task.
2. Click the **Add Task** button.
3. Select the desired workbench category.
  - The workbenches that are available depend on the currently selected task.
4. Select the desired workbench and click **Add**.
  - Alternatively, you can double-click the workbench.

The workbench is displayed in the **Workbench Area** and a corresponding icon is added to the **Task List**.

**Removing a task** When you remove a task from the **Task List**, all subordinate tasks are automatically removed.

1. Right-click the icon of the task in **Task List**.
2. Click **Delete Task**.

### 3.14.10.3.2 Specifying Tools for a Task

For each task to be performed when the job is run, you can specify which tools are available to complete the task. For example, for a processing task, you can specify that only the **White Balance** tool and **Gauss** tool are available.

This is done by adding and removing tools from the corresponding workbench so that only those required when running the job are included in the workbench.

#### Info

If a tool is required when running a job, it must be included in the workbench. However, if you do not want the operator to be able to change the values of the tool parameters, you can lock or hide individual parameters. To hide the entire task from the operator, right-click it and apply the **Run Silent** option. The task is then executed but not visible to the operator when the job is run.

#### Adding tools

To add a tool to a workbench:


1. Select the workbench to which you wish to add a tool.
2. Click the **Add tool** button in the workbench header.
3. Select the desired tool.
  - The tools that are available depend on the current workbench.

#### Info

If you wish to add large numbers of tools to a workbench, it may be advisable to add another workbench of the same type and to distribute the tools across the two workbenches.

### Removing tools

To remove a tool from a workbench:

1. Click anywhere within the tool.
2. Click **Delete this tool** .

If you remove a processing tool, the new processing result is not displayed until you click the corresponding  icon in the **Task List**.

#### 3.14.10.3.3 Specifying Permitted and Expected Values for a Tool

When creating a job template you can specify the range of values that an operator can enter for each parameter. The range of values is defined by the following:

- Minimum permitted value
- Maximum permitted value
- Expected value

**Measurement tools** For measurement tools you cannot limit the range of a parameter. However, you can configure tolerances between which the measurement value must lie. For more information, see *Configuring Tolerances for a Measurement* [► 60].

Furthermore, you can enter the expected value of the tool. This is the value that an ideal sample has; typically it is the value from the sample specifications.

1. Click the tools options icon.



2. Set the values as desired.

➔ The expected value must be between the minimum and maximum permitted values.

When the job is run, the value of the parameter is set to the expected value from above. The minimum and maximum values of each parameter are also adjusted accordingly in the user interface.

#### Info




If you do not want the operator to be able to change the value of a parameter, you can lock or hide the parameter.

### See also

- ▢ [Configuring Tolerances for a Measurement](#) [► 60]
- ▢ [Specifying Tools for a Task](#) [► 58]

#### 3.14.10.3.4 Locking and Hiding Parameters in Tools

When creating a job template you can specify the operator's privileges for each parameter individually. The privilege is indicated by the following icons:

-  Parameter can be seen and changed by the operator  
If the parameter can be changed by the operator, you can choose to limit the range of permitted values.
-  Parameter can be seen but not changed by the operator
-  Parameter is hidden from the operator (and thus cannot be changed)

To change the property of a parameter:

1. Click the icon until it has the desired state.  
→ The icon cycles between the three states in the above order.

If all the parameters in a workbench are hidden or locked, the corresponding task is performed automatically in the background when the job is run.

If you want an entire task to be performed automatically in the background without user interaction, you can use the **Run Silent** option. This overrides the settings of individual parameters within the task.

1. Right-click the icon of the task in the **Task List** and select **Run Silent**.

### See also

- ▢ Specifying Tools for a Task [► 58]
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]

#### 3.14.10.3.5 Adding Information for the Operator

When the job is run, the operator might need further information on what to do in a task. Therefore, for each task you can enter corresponding instructions and images. When the operator runs the job, these are displayed below the task name.

**Prerequisite** ✓ You have opened a job template to be edited.

1. Click in the **Instructions** field at the top of the workbench to enter instructions in the text field.  
→ The instruction will be displayed any time the operator runs the workflow.
2. To select images, click **Add image**.  
→ A dialog opens.
3. Click ... and navigate to the desired image.  
→ The image and the image path are displayed in the dialog box.
4. In the **Link Text** field, enter corresponding text, and click **OK**.  
→ The image is displayed in the workbench. The link text is displayed as a header of the image. You can delete the image from the workbench.
5. Save the job template.

The text is stored in the workbench description for the current job template. You can enter different instructions for the same workbench in different job templates.

### Info

- ▶ When running the job the operator does not see a copy of the image you acquired or the measurements you performed. Therefore, ensure that the text you enter is sufficiently descriptive and unambiguous to achieve the desired results.
- ▶ The images you add will help operators to perform their tasks.
- ▶ If you create a custom template, the workbench description is stored as the default instruction. However, you can modify this text individually for each job template as described above.

#### 3.14.10.3.6 Configuring Tolerances for a Measurement

For each measurement you can configure the following parameters:

- **Expected value**
- **Lower boundary**
- **Upper boundary**

The expected value is typically the theoretical value contained in the CAD data or sample specifications.

The boundaries specify the limits between which the measurement must lie, for example to fulfill quality control criteria. However, the user can measure the value freely and is not constrained by the boundaries (i.e. the software does not limit the measurement value). It is also possible to only specify one boundary.


You can easily see whether the measurement is within the boundaries via the color code next to the value:

- Green: Within boundaries
- Red: Outside boundaries

### Info

For tools other than measurement tools you can limit the range of a parameter. In this case, the user cannot select a value outside the range. For more information, see *Specifying Permitted and Expected Values for a Tool* [► 59].

**Prerequisite** ✓ A measurement tool is selected

1. Click the  icon.
2. Set the values as desired.
  - ➔ The expected value must be between the lower and upper thresholds.

### See also

📖 Specifying Permitted and Expected Values for a Tool [► 59]

#### 3.14.10.3.7 Moving and Copying Tasks

You can easily move and copy tasks in the task list when creating job templates. For example, this is useful if you want to apply processing tools in a different order or if you want to duplicate analysis tasks.

1. To move tasks, right-click on the desired task icon in the **Workbench Area**.
  - ➔ The context menu opens.
2. In the menu click on **Cut**.
3. Select another task, right-click on it and select **Paste**.
  - ➔ The task is inserted behind the selected task.
4. To copy a task, press **Ctrl** while dragging it.
  - ➔ A plus icon is displayed next to the icon while dragging.
  - ➔ All the settings of the task are also copied.

### See also

📖 Specifying Tools for a Task [► 58]

### 3.14.10.3.8 Adding a Loop to a Job Template

When adding a loop to a job template, you set the desired number of iteration of the loop, see *Settings Tool* [▶ 748].

You can also define for each workbench contained in a loop, if it should be interactive once or run silent.

- Prerequisite** ✓ You are logged in as a supervisor or you have the sufficient privileges to create a job template.
- ✓ You have opened a new job template or an existing one you want to edit.
1. Select **Add Task** view > **Workflow** > **Loop** > **Add**. Alternatively, double-click the **Workflow** workbench.
    - ➔ You have added the loop to the new job template. The task is displayed and the corresponding tools are displayed in the **Workbench Panel**.
  2. Click the **+** icon to add a workbench. Right click the workbench icon inside the loop, and select **Run silent**.
    - ➔ The workbench will be run silent when running the job template.
  3. Alternatively, select **Interactive Once**.
    - ➔ The workbench will be interactive in the first loop iteration and run silent in the resting iterations.

### 3.14.10.4 Saving and Completing the Job Template

You can save a job template at any time during its creation. The **Save Job Template** dialog enables you to specify the following:

- Job template properties (name and description)
- Category to which the job template is assigned
- Permissions (users that can run the job)

You can also modify the above in the **Archive** later.


For each job you can specify which users are allowed to run it. Typically, a group of users is specified, but you can also specify individual users. By default, a job can be performed by any user.

- Prerequisite** ✓ You are in **Create a new template and edit it** within **Job Mode**.
1. Click the **Save** button.
  2. In the **General** tab enter a meaningful **Name** and **Description**.
  3. In the **Security** tab specify which users or user groups should be allowed to run the job.
    - ➔ By default all users can run the job.

### 3.14.11 Copying and Editing Job Templates

You can customize existing job templates. To do this, you first create a copy, which you then edit. You can edit already customized job templates or those you created yourself at any time without creating a copy.


- Prerequisite** ✓ You are in **Job Mode**.
1. If you know the name of the job template, enter the first few letters in the **Filter Templates...** field to reduce the number of entries.
    - ➔ Suggestions are displayed.

2. Select the desired template, right-click and select the desired function. You have the following options:
3. **Edit:** This option is only active, if you selected a customized job template. Change values or settings, and click the **Save the current job template** icon.  
→ The existing job template is overwritten with your new values.
4. **Copy & Edit:** Change values or settings, and click the **Save the current job template**  icon.  
→ A dialog opens.
5. In the **Name** field, enter a name. Optionally, change the **Category** or **Subcategory** this job template should be assigned to.
6. Click **Save**.

You have edited the job templates. Both the overwritten job template and the edited copy are immediately available.

### 3.14.12 Job Template Properties

This section provides an overview of the properties of each template. Depending of the user rights, you can also edit the properties of the selected template here.

Parameter	Description
	Opens the editor for the properties. Note that you cannot edit job properties as an operator.
<b>Name</b>	Sets the name of the template but only for users with the <b>Can Edit Job</b> privilege.
<b>Description</b>	Sets a description of the template.
<b>Category</b>	Sets a category.
<b>Subcategory</b>	Sets a subcategory.
<b>Access Rights</b>	Sets the access rights.
— Allow all users	
— Allow only selected users	

## 3.15 ZEN Application Programming Interface

**ZEN API** is an interface to connect to a running ZEN application (with all its processes). Once connected, interaction is possible from an external process possibly running on another machine. The interaction includes, for example, the following:

- Monitoring, push-based where appropriate.
- Controlling
- Data streaming, for example, image data.
- Multi-client support

ZEN API is available in two modes:

- **Supervised API Mode**

When in Supervised API Mode, the system prevents concurrent actions initiated from UI and API. The user has two possibilities:

- To enter API Mode: This mode allows the usage of any API calls, but mostly locks the UI.
- To use UI: In this case the UI is enabled, while only uncritical monitoring APIs are allowed to be called. Such API calls do not change the state of the system and thus do not create conflicts when executed at any time.

- **Unsupervised API Mode**

This mode disables control synchronization and allows concurrent usage of UI and API (monitoring and controlling APIs), that is, it allows critical actions that may cause conflicts or errors when executed randomly, for example, moving the stage. This mode is meant for expert users.

Unsupervised API mode can be enabled under **Home Screen > Maintenance > General Options > ZEN API**.

To call ZEN API as a client, the following prerequisites must be fulfilled:

- The API client must always connect to the gateway.
- The API client must send API tokens.
- The API client must connect via TLS to the gateway.
- The API client must trust or know the certificate of the gateway.

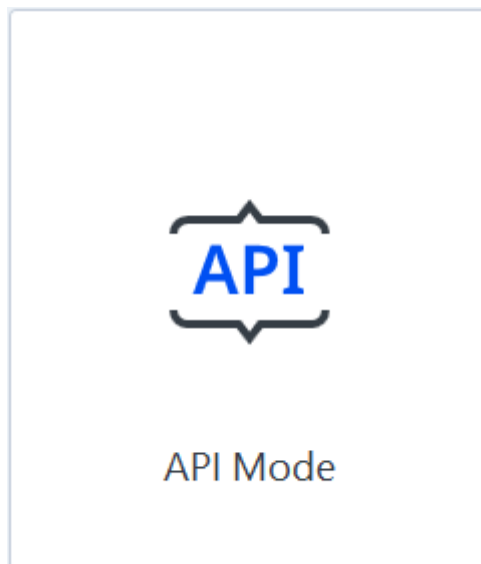
**See also**

 ZEN API Options [► 723]

### 3.15.1 ZEN API User Interface

#### 3.15.1.1 Supervised API Mode

In the **Supervised Mode**, you can open the API Server console for providing remote jobs and hardware control. This is done in the **Home Screen**:



**See also**

 ZEN API Options [► 723]



### 3.15.1.2 Unsupervised API Mode

In the **Unsupervised API Mode**, the following information is displayed to indicate that ZEN core is in unsupervised mode and that the API server is running:



#### Info

When the **Unsupervised API Mode** is enabled, the **API Mode** button in the **Home Screen** is hidden.

#### See also

- 📖 ZEN API Options [▶ 723]
- 📖 Enabling Unsupervised API Mode [▶ 65]

## 3.15.2 Enabling Unsupervised API Mode

You can switch between the Unsupervised and the Supervised API mode.

**Prerequisite** ✓ You are logged in as an administrator.

1. Click **Home Screen > Maintenance > General Options > ZEN API**.
2. Under **Unsupervised API Mode**, activate the checkbox **Enable Unsupervised API Mode**.

The Unsupervised API Mode is enabled after the application is restarted.

## 3.15.3 API Reference

For a detailed API reference, see the ZEN API reference documentation.

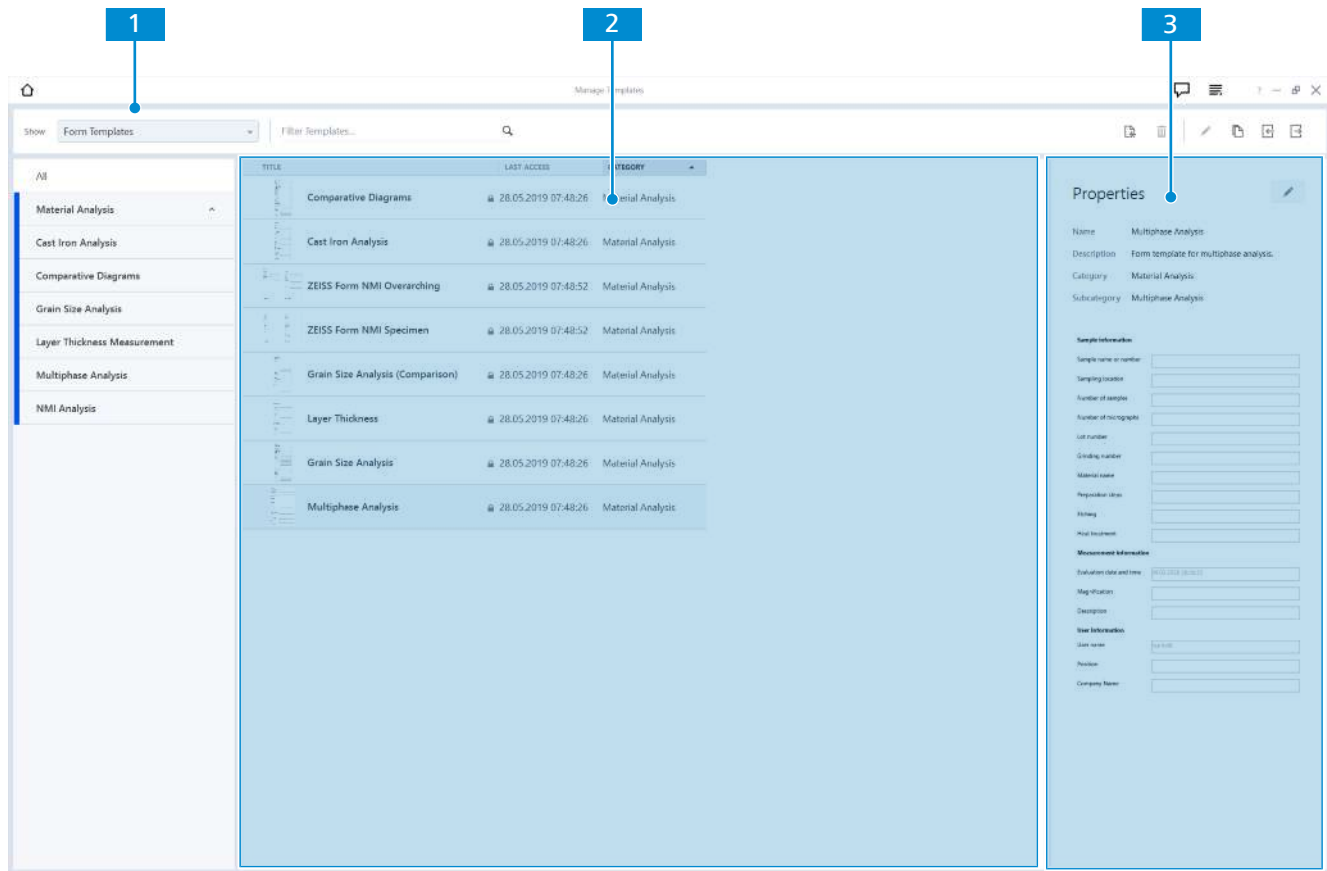
## 3.16 Manage Templates

Here you can manage the following templates:

- **Form Templates**
- **Report Templates**
- **Macros**
- **Image Analysis Settings**
- **Custom Workbenches**
- **arivis Cloud Modules**
- **Standards for NMI Analysis**
- **Standards for Technical Cleanliness**
- **AI Models**
- **Intellesis Denoising Models**
- **Intellesis Object Classification Models**
- **Intellesis Segmentation Models**

### 3.16.1 User Interface - Manage Templates

The following figure shows the user interface for managing templates.



#### 1 Filter Area

Enables you to filter the list of templates by type or search term

#### 2 Template List

Displays all templates specified by the filter, for details see *Template List and Options* [▶ 67].

#### 3 Properties

Allows to change the properties of the selected template, e.g. the name, category, and permissions, for details see *Template Properties* [▶ 70].

### 3.16.2 Forms and Reports

Forms provide a simple way to add user-defined information to a report. Reports enable you to get an overview of all relevant documents and information from your examination (including that entered in forms) in a single document.

As a supervisor, you can use templates to configure the properties of forms or reports. In form templates, you also specify the operator's tasks during job run.







- Form templates you create and manage within the software, see also *Form Designer* [▶ 74].
- Report templates you manage within the software, but you create them using the **ZEN Word Add-In** externally, see *Creating a New Report Template* [▶ 80].
- In **Free Mode** and in **Job Mode**, in the report template, you assign the form template to the form placeholder, see *Assigning Information to Report Placeholders* [▶ 121].

Typically, the information entered in a form should also be displayed in the job report. The software enables you to import a form template into the report template.




### 3.16.3 Tool Bar & Basic Controls

The main controls for template management are located in the toolbar right on top of the program window. On the left side you can display/hide specific types of templates depending on what is selected in the **Show** list. For example, when the entry **Form Templates** is selected only form templates are displayed in the templates list. Besides the **Show** list you can filter the templates list by entering a keyword. Just enter a keyword, e.g. "Grains" in the **Filter Templates** field and only templates which contain "Grain Size" in the title or description column will be shown independent of the selected category in the **Show** area. If the **GxP** module is licenced, an additional filter option is available which shows the status of job templates, for example **Draft** or **Released**.

Furthermore the following control buttons are available:

Button	Description
	Depending on which type of template is selected last, the software opens the corresponding mode for creating a new templates.
	Deletes the selected templates from the archive. You can also select multiple templates (hold <b>Ctrl</b> while selecting) and delete them at once.
	You can edit the selected template by clicking on this button. Note that predefined, default templates (delivered with the software) cannot be edited. In that case the button is grayed out. To edit such a template you have to copy and rename it first.
	Copies the selected template and opens it for editing. This is helpful if you want to edit an existing or locked template and do not want to lose the original data.
	Only visible when <b>arivis Cloud Modules</b> or <b>AI Models</b> is selected in the <b>Show</b> list. Opens a dialog to download an arivis Cloud module or AI model.
	With these two buttons you can import and export templates from the file system.

#### See also

-  Downloading AI Models [► 71]
-  Downloading an arivis Cloud Module [► 126]
-  Standard Template Editor [► 579]

### 3.16.4 Template List and Options

The template list is displayed in the central area of the program window. It has several pre-defined columns, e.g. Title, Last Access, etc. Depending on which type of template is selected, the columns can change.

Right-click on a template in the template list. The following functions are available.

Parameter	Description
<b>Edit</b>	Edits an existing item. You cannot edit pre-defined templates.
<b>Copy &amp; Edit</b>	<p>Duplicates an item and makes it editable.</p> <ul style="list-style-type: none"> <li>For editing a TCA standard template, see <i>Standard Template Editor</i> [▶ 579].</li> <li>For editing a report template, see <i>Copying and Editing a Report Template</i> [▶ 83].</li> <li>For editing <b>Intellesis Models</b>, the respective wizard for training a model opens.</li> </ul>
<b>Delete</b>	Deletes the selected item. You cannot delete pre-defined templates.
<b>Change Border Size</b>	<p>Only visible for <b>Intellesis Segmentation Models</b> and only available for neural networks.</p> <p>Opens the dialog to change the tile border size, see <i>Changing the Tile Border Size for Neural Networks</i> [▶ 312].</p>
<b>Create Analysis Setting</b>	<p>Only visible for <b>Intellesis Segmentation Models</b> and <b>AI Models</b>.</p> <p>Creates a new image analysis setting which uses this model for segmentation, see <i>Using a Trained Model for Image Analysis</i> [▶ 308] and <i>Creating an Image Analysis or Multiphase Setting From an AI Model</i> [▶ 73].</p>
<b>Create Multiphase Analysis Setting</b>	<p>Only visible for <b>Intellesis Segmentation Models</b> and <b>AI Models</b>.</p> <p>Creates a new multiphase analysis setting which uses this model for segmentation, see <i>Using a Trained Model for Multiphase Analysis</i> [▶ 311] and <i>Creating an Image Analysis or Multiphase Setting From an AI Model</i> [▶ 73].</p>
<b>Export</b>	<p>Only visible for <b>Intellesis Models</b>.</p> <p>Exports the model as a file without the training images and labels.</p>
<b>Export (with Images)</b>	<p>Only visible for <b>Intellesis Models</b>.</p> <p>Exports the model as a file including the training images and labels.</p>
The following options are available only when the <b>GxP</b> module was licenced (only available in <b>Job Mode</b> ):	
<b>Verify Files</b>	<p>Performs a verification of the signatures and files contained in a template. The verification results will be displayed in a separate dialog.</p> <p>Note that only templates with Status <b>Active</b> can be verified.</p>
<b>Publish</b>	<p>This command is used for the two signature release procedure of job templates. The publish command changes the status of a template from <b>Draft</b> to <b>Published</b>. If a template is once published, another signature is required to set is as <b>Active</b>. The template is then visible to any user (e.g. Operators) in the archive.</p>
<b>Reject</b>	<p>Using this command a supervisor can reject the publishing or activation of a template. The release process will be stopped.</p>
<b>Activate</b>	<p>Using this command a template can be activated. The template will be visible to all users in the archive.</p>
<b>Deactivate</b>	<p>Deactivates the selected template.</p>

### 3.16.5 Supported Template Formats

Templates contain pre-defined content, for example the tasks required to run a job, or the fields required to complete a form. You can import and export the templates within **Manage Templates**.



The following file formats are supported for each type of template:

Template type	File extension
Job templates	.czjob Only administrable in <b>Job</b> mode.
Form templates	.czform
Report templates	.docx
Image Analysis Settings	.czias
Custom workbenches	.czjob
Protocol templates	.czprotocol
OAD Macros	.czmac
Intellesis Denoising models	.czann
Intellesis Object Classification models	.cztoc
Intellesis Segmentation models	.czseg

### 3.16.6 Importing and Exporting a Template

All active templates stored in the **Archive** can be accessed by any user of the system. If you want to transfer a template between non-connected systems, you can export it from one **Archive** and import into the other **Archive**.

**Prerequisite** ✓ The **Manage Templates** mode is selected.

1. Select the type of template to be edited using the **Show** list.
2. Select the template to be edited.
  - ➔ If you know the name of the template, you can enter the first few letters in the **Filter Templates** field to reduce the number of entries.
3. Click on the **Import** or **Export**   icon to perform the desired action.
4. Select the desired location on the file system.
  - ➔ If you import a template with the same name as an existing template, you can choose to overwrite it or import the template with a new name.

### 3.16.7 Copying and Editing Templates

You can edit a template only, if you have copied a pre-defined template. In the **Manage Template** mode, you can copy and edit the following templates:

- Form templates. For more information, see [Creating or Modifying a Form Template](#).

- Report Templates. For more information, see *Copying and Editing a Report Template* [▶ 83].
- Intellesis models. For more information, see *User Interface - Training* [▶ 297].
- Standard technical cleanliness. For more information, see *Standard Template Editor* [▶ 579].

The template is copied and opened for editing. When you are finished editing, the template is overwritten with the new values. You can edit or delete this template. Right-click and select the desired function.

### 3.16.8 Template Properties

On the right side you can see and edit the properties of the selected template.

Parameter	Description
<b>Name/Description</b>	Enter or change the name and description of the selected template.
<b>Category/Subcategory</b>	Here you can assign the template to a specific category and subcategory.  Categories enable you to filter the items or templates list. If you create a new category by selecting the empty list entry and entering a new category name, it will appear in the Category list on the left side.
<b>Access Rights</b>	Here you can assign the template to specific user groups.

### 3.16.9 Modifying Template Permissions

For each template you can specify which users can access it. Typically, a group of users is specified, but you can also specify individual users. By default, each template can be executed by any user.

Permissions can be specified using the following methods:



- ZEN software internal users and user groups
- Windows Active Directory

**Prerequisite** ✓ The **Manage Templates** mode is selected.

1. Select the type of template to be edited using the **Show** list.
2. Select the template to be edited.
  - ➔ If you know the name of the template, you can enter the first few letters in the **Filter Templates** field to reduce the number of entries.
3. Select **Allow only selected users**.
  - ➔ Initially the list is empty.
4. Specify users or roles using the options described below:

#### ZEN Users and User Groups

To specify permissions based on ZEN software internal users and user groups:

1. Click on Add **+ Local**.
2. Select the user(s) and/or group(s) that can access the template.
  - ➔ : Users
  - ➔ : User Group
3. Activate the corresponding checkbox to select a user/user group.

### Windows Active Directory

To specify permissions based on Windows Active Directory settings:

1. Click on **+ Active Directory**.
  - ➔ The standard Windows Active Directory dialog box is displayed.
2. Specify the categories to be used to define permissions (e.g. users, user groups).
3. Enter the name(s) of the Windows user(s) or user group(s) that can access the template.
  - ➔ For more information, see the Windows instruction manual.

### 3.16.10 Modifying Template Properties and Category

Each template has the following properties:

- **Name**  
The name must be unique within the **Archive**
- **Description**.  
This should be a meaningful explanation of what the template is used for. It should enable users to select the correct template.

Furthermore, each template can be assigned to a category. Categories enable you to group similar templates together. You can create any number of categories, e.g. for types of samples or institutions in your company. However, each template can only be assigned to a single category and subcategory.

**Prerequisite** ✓ The **Manage Templates** mode is selected.

1. Select the type of template to be edited using the **Show** list.
2. Select the template to be edited.
  - ➔ If you know the name of the template, you can enter the first few letters in the **Filter Templates** field to reduce the number of entries.
3. Modify the **Name** and **Description** as desired.
4. Select the category to which the template should be assigned.
  - ➔ To create a new category, select the empty field and enter the name. The new category is added automatically to the categories list.

### 3.16.11 Downloading AI Models


#### Info

#### Powerful GPU

For AI models requiring a GPU for execution, the GPU needs to fulfil certain criteria, i.e. be powerful enough. For the use of AI models the recommended hardware configuration is 8GB GPU. Only Nvidia GPUs and the CPU are supported. For further reference, also refer to the requirements of the Intellesis functionality, see *Remarks and Additional Information* [▶ 313].

In ZEN core, you can download AI models from arivis Cloud, e.g. for instance segmentation. These models are packaged as Docker containers and therefore need the Docker Desktop software to work.

- Prerequisite** ✓ Docker Desktop is installed and running on your computer. For more information about Docker Desktop, see *Requirements for Docker Desktop* [▶ 729].
- ✓ You have the model(s) you want to download available on the arivis Cloud platform and your PC is connected to the internet.

- ✓ You have created an access token and entered it in ZEN core, see *Creating and Entering an Access Token* [► 125].
- ✓ You are in **Manage Templates**.
  1. In the **Show** dropdown list, select **AI Models**.
  2. In the tool bar, click on the cloud icon .
    - ➔ A browser opens to display and select the different models available on arivis Cloud.
  3. Activate the checkbox for the model and version you want to download, and click **OK**.
    - ➔ The download of the model starts and the progress is displayed. You also have the possibility to cancel the download.

After a successful download, the model is displayed in the **Manage Templates** list. It is available in ZEN core, even without an active internet connection. Note that the downloaded models are always saved locally on the computer, even if you have ZEN Data Storage configured as your archive.

You can now use the model in the **Automatic Segmentation** step of the image analysis, or create an analysis and multiphase setting out of it.

### See also

-  Importing AI Models [► 72]
-  Creating an Image Analysis or Multiphase Setting From an AI Model [► 73]


## 3.16.12 Importing AI Models

### Info

#### Powerful GPU

For AI models requiring a GPU for execution, the GPU needs to fulfil certain criteria, i.e. be powerful enough. For the use of AI models the recommended hardware configuration is 8GB GPU. Only Nvidia GPUs and the CPU are supported. For further reference, also refer to the requirements of the Intellesis functionality, see *Remarks and Additional Information* [► 313].

In ZEN core, you can import existing AI models, e.g. for instance segmentation, that you have exported from another application. These models are packaged as Docker containers and therefore need the Docker Desktop software to work.

- Prerequisite**
- ✓ Docker Desktop is installed and running on your computer. For more information about Docker Desktop, see *Requirements for Docker Desktop* [► 729].
  - ✓ You have the model(s) you want to import available on your PC.
  - ✓ You are in **Manage Templates**.
    1. In the **Show** dropdown list, select **AI Models**.
    2. In the toolbar, click .
      - ➔ A file browser opens.
    3. Select the model you want to import, and click **Open**.

After a successful import the model is displayed in **Manage Templates**. You can now use the model, e.g. in the **Automatic Segmentation** step of the image analysis.

### See also

-  Downloading AI Models [► 71]
-  Creating an Image Analysis or Multiphase Setting From an AI Model [► 73]



### 3.16.13 Creating an Image Analysis or Multiphase Setting From an AI Model

Once you have downloaded an AI model, you can use it for image or multiphase analysis by creating an analysis setting.

- Prerequisite**
- ✓ You have downloaded an AI model trained on one or multiple channels, see *Downloading AI Models* [► 71].
  - ✓ You are in **Manage Templates**.
    1. Select **AI Models** in the **Show** dropdown list.
    2. Right-click the model and select **Create Analysis Setting**. Alternatively, select **Create Multiphase Analysis Setting**.
      - ➔ A file browser opens.
    3. Enter a name for the setting and click **Save**.
      - ➔ The setting is saved as \*.czias file in the respective folder.

You can now use the setting for image analysis in ZEN core and select it in the **Image Analysis** tool in **Free Mode**, or in the **Load Setting Tool** in **Job Mode**.

Note that some parameters are pre-defined in this setting based on the model and cannot be changed, e.g. the number of classes and the segmentation method. If you need to create a more complex hierarchy level of classes (e.g. define sub-classes or Zone-of influence), set up an ordinary image analysis setting. In the **Automatic Segmentation** step of the setup, you can then select models trained on single channel images for the segmentation of the individual classes.

#### See also

- 📖 General Analysis Workflow for Multiphase [► 439]
- 📖 Automatic Segmentation [► 254]

### 3.16.14 Forms

Forms provide a simple way to add user-defined information to an examination. Information can be entered into a form automatically (e.g. current time and date) or manually by the operator (e.g. current sample number).

The software comes with several pre-defined form templates. As a supervisor you can create new form templates or modify existing ones. You can specify the following form template properties:

- The fields the form contains, and thus the information to be entered
- Whether the information is entered manually or automatically
- Source for automatic data
- Layout of the form

Typically, the information entered in the form should also be displayed in the job report. The software enables you to directly add the complete form template to a report. Therefore the report must have the corresponding **Form** placeholder.

You can also copy exported form templates to a different system to share them, for example with colleagues. All form templates are stored in the Archive where they can be accessed by other users.

### 3.16.14.1 Form Designer

The **Form Designer** is opened via **Home Screen > Manage Templates**. In the drop-down list under **Show** the entry **Form Templates** must be selected. If you click on the **New Template** button, the Form Designer will be opened automatically. The Form Designer enables you to interactively create form templates which can (or must) be filled out by an operator e.g. before starting a job.

The user interface is clearly structured into three main areas. On the left side you see the **Form Fields** **1** which represent different aspects of a form template (e.g. the header or a text field). The center area is the interactive **Editing Area** **2** of the Form Designer. There you can add and arrange the desired form fields freely. On the right side you see the **Form and Field Properties** **3** depending on which form field is selected. For important functions and further settings, e.g. **Redo**, **Save**, **Import** the **Tool Bar** is available on top of the window.

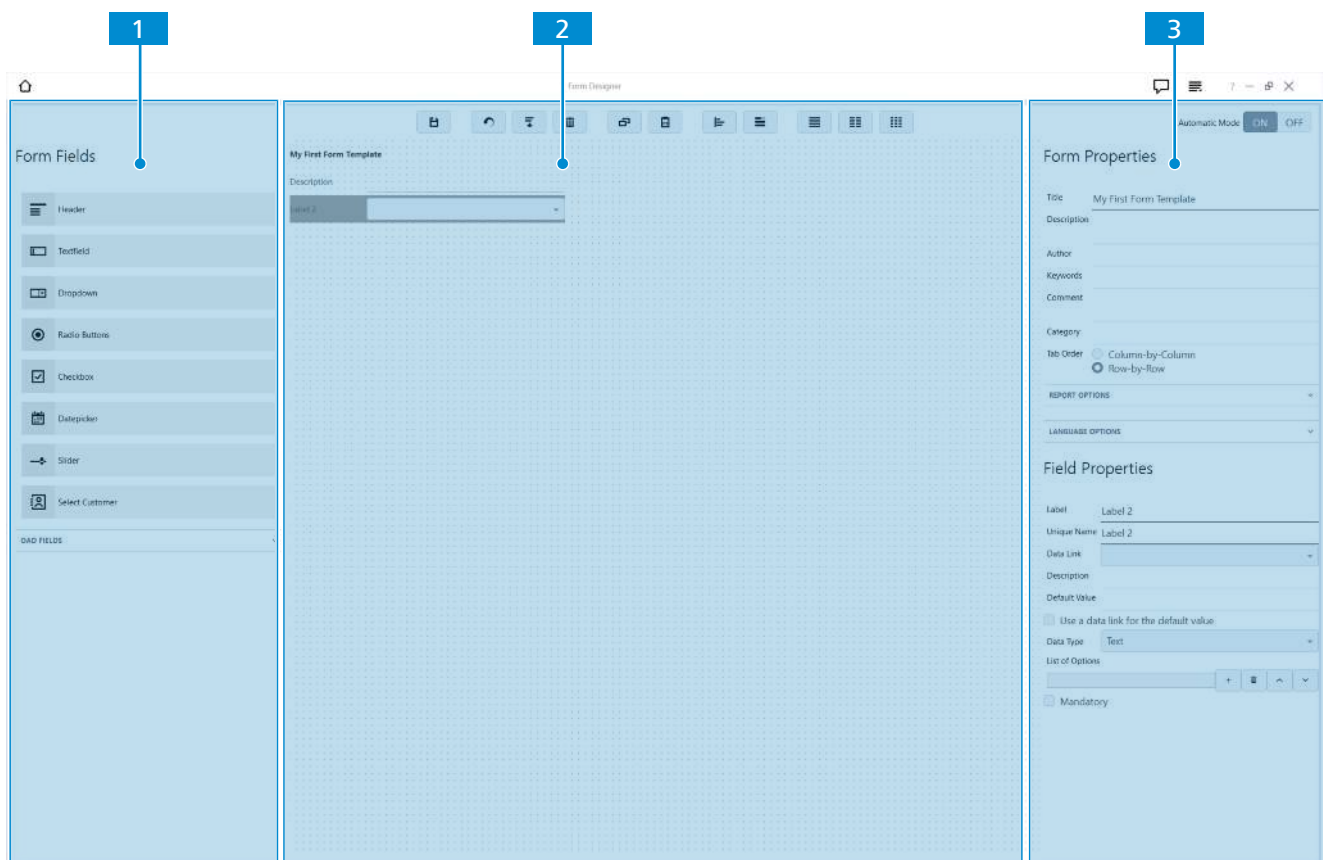


Fig. 4: Form Designer Overview

#### See also

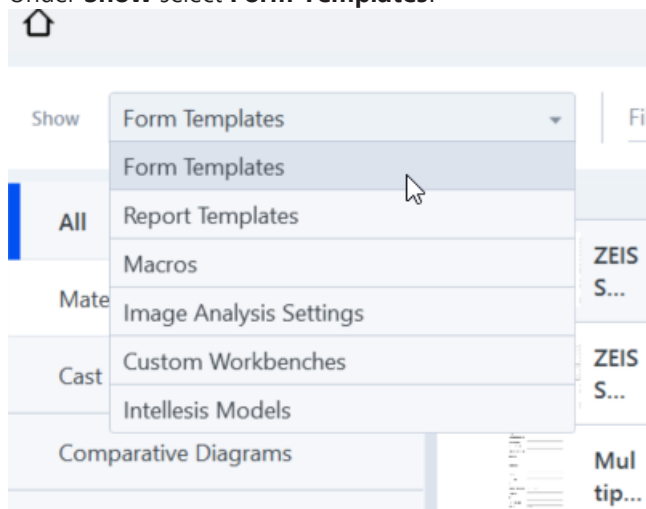
- Form Fields [▶ 76]
- Form Properties [▶ 78]
- Field Properties [▶ 79]

#### 3.16.14.1.1 Creating a New Form Template

- Prerequisite**
- ✓ You are logged in as **Administrator** or **Supervisor**.
  - ✓ You see the **Home** screen.
1. Click on **Manage Templates**.

→ The **Manage Templates** (Archive) window is shown.

2. Under **Show** select **Form Templates**.

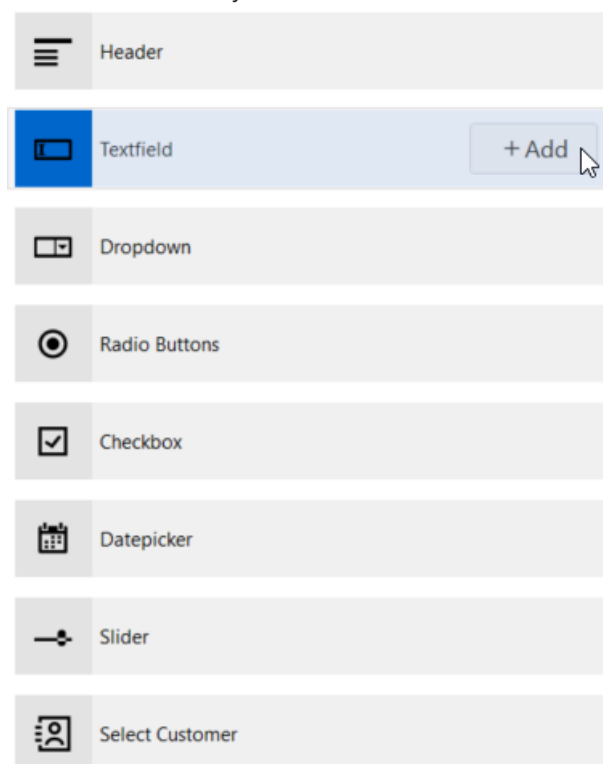


3. Click on **New Template**.



→ The **Form Designer** screen opens.

→ Under **Form Fields** you see different fields to add to the template.



4. Double-click on the desired fields or click on the **+ Add** button to add them to the editing area.




→ For example, to create a basic template you can add a **Header**, a **Text** and a **Datepicker** field.

→ The fields are then shown in the center screen and can be edited.

5. Click on **Save** to save the template file (\*.czform) in the file system.



### See also

-  Form Fields [► 76]
-  Form Properties [► 78]
-  Field Properties [► 79]

#### 3.16.14.1.2 Form Fields

Field	Description
<b>Header</b>	Adds a header field to the form template. With this field you can add a heading or sub heading to the form.
<b>Text Field</b>	Adds a text field to the form template. With this field you can enter plain text, e.g. a note or description.
<b>Drop-down</b>	
<b>Radio Buttons</b>	Adds a field for radio buttons to the form template. The individual radio buttons are created under <b>Field Properties/List of Options</b> .
<b>Checkbox</b>	Adds a checkbox field to the form template. With this field you can activate or deactivate a checkbox.
<b>Date Picker</b>	Adds a date field to the form template. With this field you can select the desired date from a calendar.
<b>Slider</b>	Adds a slider to the form template. With this field you can create a slider with a certain range. The range (Min/Max) and Increment can be configured under <b>Field Properties</b> .
<b>Select Customer</b>	Adds a button to the form template. With this field you can open a dialog with a list of customers to select.  The customers are managed with an Excel file. This file is stored per default here: C:\ProgramData\Carl Zeiss\ZENcore\CustomerContacts.xls

#### OAD Fields

Field	Description
<b>Folder Browser</b>	Adds a folder browser field to the form template. With this field you can select a certain folder from the computer's file system.
<b>File Browser</b>	Adds a file browser field to the form template. With this field you can select a certain file from the computer's file system.
<b>Image File Browser</b>	Adds a image file browser field to the form template. With this field you can select a certain image file from the computer's file system.

Field	Description
<b>Table File Browser</b>	Adds a table file browser field to the form template. With this field you can select a certain table file from the computer's file system.

#### 3.16.14.1.2.1 Select a Customer

Here, you can select one of your customers to be used in your form template. A **MS Excel** file containing the relevant columns is created automatically when you open the software the first time. Per default, the **MS Excel** file is saved under *C:\ProgramData\Carl Zeiss\ZENcore\Customer-Contacts.xls*.

In the role of an Administrator, you can set the path to the **MS Excel** file under **General Options > Customer Information**.

The following customer data is available for your form template. The parameters are used to create the textfields you will need on job template.

Parameter	Description
<b>Customer.Company</b>	Company name
<b>Customer.Contact</b>	Name of the contact
<b>Customer.StreetAndNumber</b>	Street name
<b>Customer.ZIP</b>	ZIP code
<b>Customer.Town</b>	City
<b>Customer.Country</b>	Country

#### 3.16.14.1.2.2 Adding the Select Customer Button and Additional Data to a Form Template

**Prerequisite** ✓ You have opened the **Form Designer**.

1. Add the **Select Customer** form field to the **Form Designer** view.  
→ A button placeholder is displayed on the form.

- Under **Field Properties**, in the **Label** field, enter a name for the button.

The screenshot shows the 'Field Properties' dialog box for a button field. The fields are as follows:

- Label:** Button Name
- Unique Name:** Button Name
- Data Link:** (Empty dropdown menu)
- Description:** (Empty text field)
- Default Value:** (Empty text field)
- ☐ Use a data link for the default value
- Data Type:** Text
- ☐ Mandatory

- For each customer data you want to add to the form, e.g. the contact at your customer's company, add a text field.
- Under **Field Properties**, in the **Label** field enter a name for the text field, e.g. "Contact Person". In the **Data Link** field, copy a table header from your **MS Excel** file.

The screenshot shows the 'Field Properties' dialog box for a text field. The fields are as follows:

- Label:** Contact Person
- Unique Name:** Contact Person
- Data Link:** Customer.Contact
- Description:** (Empty text field)
- Default Value:** (Empty text field)
- ☐ Use a data link for the default value
- Data Type:** Text
- ☐ Multiline
- ☒ Read-only
- ☐ Mandatory

- Save the form template.  
→ You have created a form template. You can use it when creating a new job template.

#### 3.16.14.1.3 Form Properties

Here you can enter relevant information (e.g. **Title**, **Description**, etc.) for the new form which you want to create. Under **Report Options** you can select different layouts which are used when creating a report.

Under **Language Options** you can activate more languages. The texts of the form fields can then be displayed in different languages. The language specific texts must be entered by yourself in the corresponding language fields. If you use given **Data Links**, the labels are translated automatically.

Note that the form will be automatically displayed in the GUI language which is set under **General Options > General**.

#### 3.16.14.1.4 Field Properties

Here you can edit the properties of the added form fields. To see the properties of a form field you first have to click on the desired field in the **Editing Area**. Depending on what kind of form field you have selected, different properties can be available. Properties like **Label**, **Unique Name**, **Data Link**, **Description** and **Default Value** are available for almost every form field.

Parameter	Description
<b>Label</b>	Defines a name for the added field.
<b>Unique Name</b>	Defines a unique name for the added field. By using a unique name it is possible to distinguish fields having the same label.
<b>Data Link</b>	Selects a specific value to link it with the selected field, e.g. the hierarchy level of your archive (having the prefix <b>[Hierarchy]</b> ). If you use ZEN Data Storage as your archive, you can also select your custom metadata marked by the prefix <b>[Custom]</b> .
<b>Description</b>	Sets a description for the field. The text is displayed as a tooltip when you move and hold the cursor over the field.
<b>Default Value</b>	Defines a default value that appears automatically in the field. If you activate <b>Use data link for default value</b> , the software automatically inserts the value selected under <b>Data Link</b> .
<b>Mandatory</b>	<b>Activated:</b> Defines that the field must be filled out. If the field is left blank, it is marked with a red rectangle.

#### Text field specific properties

Parameter	Description
<b>Multiline</b>	<b>Activated:</b> Activates line breaks, meaning the text breaks into a new line when reaching the field boundaries or if you insert a line break manually (with the <b>Return</b> key).
<b>Read-only</b>	<b>Activated:</b> Sets the field to read-only. The value which is set cannot be changed by the user.

#### Drop-down & Radio Button specific properties

Parameter	Description
<b>List of Options</b>	Enter an option item in the text field and press the <b>Return</b> key. Alternatively click on <b>+ Add</b> icon. To enter more options items repeat the steps above.

**Slider specific properties**

Parameter	Description
<b>Minimum/Maximum/Increment</b>	Adjusts the slider values. Simply enter the minimum and maximum value to be displayed in the corresponding field. The step size is entered under <b>Increment</b> .

**3.16.15 Reports**

Reports enable you to collate all the information from your examination in a single document. Typical information includes:

- Forms
- Images
- Measurement data tables
- Metadata (e.g. examination time, hardware setup)

This document serves as a protocol of your examination.

The software comes with several pre-defined report templates. Each report template contains placeholders for the above information to enable you to collate the information easily. The placeholders also ensure that each time the job is run, the same information is added to the report.

Creating a new report or modifying the layout and placeholders of an existing report template is performed in an external add-in for Microsoft Word 2010 or higher. Install the **ZEN Word Add-in** on a computer where **MS Word** is already installed. Using the templates in the software does not require an installation of **MS Word**.

You can also import and export report templates to copy them to a different system, for example to share them with colleagues. All report templates are stored in the Archive where they can be accessed by other users.

**3.16.15.1 Creating a New Report Template**

The software comes with several pre-defined report templates. If none of the available templates is suitable, you can create a new report template using the **ZEN Word AddIn** for Microsoft Word.

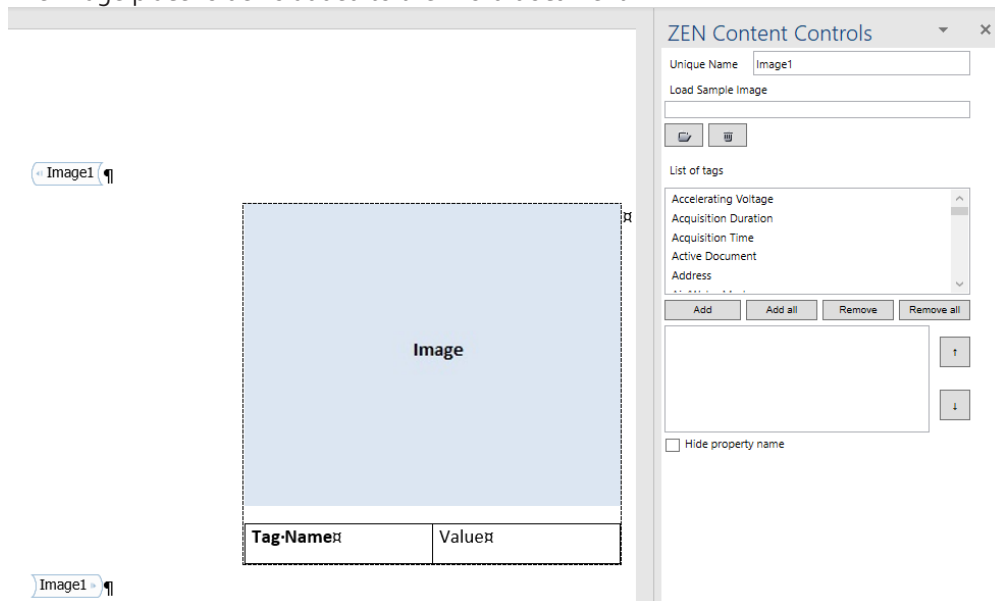
**Info**

To create a new report template, Microsoft Word 2010 or higher and the **ZEN Word AddIn** must be installed. Note that you always install the latest **ZEN Word AddIn**. The Add-In can be installed from the product DVD, see **Installation Guide**.

- Prerequisite** ✓ In the **MS Word** document, you have activated **File > Options > Add-Ins > ZEN Word AddIn**.
1. Start **MS Word**.
    - ➔ A new blank document is opened.
  2. In the menu ribbon, select the **ZEN Report Templates** tab.
    - ➔ The placeholder icons are shown.
  3. Click on a placeholder icon, e.g. **Image**, to add the specific placeholder to the document.




→ The image placeholder is added to the Word document.



In the **ZEN Content Controls** area, you can adapt the placeholder to your needs, in this example the presentation of the image. The options depend on the placeholder. From the **List of Tags**, you can add, e.g. the **Image Name** tag. It adds the image name to the report, and if there is no image name available, the file name is added.

4. Adapt the report template and/or the added placeholders according to your needs. You can use MS Word functions: You can add text between the placeholders and format it with the font of your choice. You can copy and paste the placeholders.  
**Note:** If you need columns for better structuring the report template, we recommend to use tables. Do not use the **Table** placeholders.



# Test Report

Report date

Customer

Comment

Project number	
Sample name	

Image1

Image

Properties 1

<Property Name> <Property Value>

Properties 1

Overview image	

We recommend **not** to use the field properties of **MS Word**. Instead, use tags from the **List of Tags** from the **ZEN Content Controls**. These tags you can create and manage within ZEN core, see *Document Tags Tool* [▶ 868].  
Note that if the report template is longer than one page, we recommend to use page breaks, because the dimensions of the placeholders differ from those in the generated report.  
For some placeholders, for example tables or images, you can use templates created from already existing results, see *Opening Selected Results in the Viewer* [▶ 92].

5. If you need to delete placeholders, check if you have deleted the complete placeholder.

6. Save the report template to your file system (\*.docx format).

You have created a new report template.

To use the template within the software, select **Manage Templates > Report Templates** and import the new report template.

**See also**


- Types of Placeholders [▶ 122]
- Importing and Exporting a Template [▶ 69]

**3.16.15.2 Editing a Report Template**

The software comes with several pre-defined ZEISS specific report templates. You cannot edit the ZEISS provided templates. If none of the available templates is suitable, you can copy and modify an existing report template to your individual user-defined report template. Once you have copied it or if you have created a new report template on your local PC, you can edit it.

**Info**

To create a new report template, Microsoft Word 2010 or higher and the **ZEN Word AddIn** must be installed. Note that you always install the latest **ZEN Word AddIn**. The Add-In can be installed from the product DVD, see **Installation Guide**.




- Prerequisite** ✓ You are in the **Manage Templates** Mode.
- ✓ You have made a copy of a pre-defined report template.
1. From the **Show** drop-down list, select **Report Templates** to filter the template list.  
→ The template list is updated.
  2. From the template list, select the desired report template and double-click, or right-click, and select **Edit**. Alternatively, in the **Toolbar**, click the **Edit** icon.  
  
→ The template is opened in **MS Word**.
  3. Make your changes and save the document.

**Editing a report template on your local PC**

- Prerequisite** ✓ You have exported the desired report template from the archive to your file system.
1. Open the report template document from your file system, make your changes, and save the document.
  2. To use the template in the software, you must import it into the archive. If you keep the filename of the report template, you will be asked whether you want to replace the existing report template in the archive.

You have modified a report template. It is available in the template list and at any place where you can select report templates.

**See also**

-  Archive [► 28]
-  Copying and Editing a Report Template [► 83]
-  Creating a New Report Template [► 80]

**3.16.15.3 Copying and Editing a Report Template**

You can edit a report template only, if you have copied a pre-defined report template. With this function, you automatically copy a report template and open it to edit it.

**Info**

To create a new report template, Microsoft Word 2010 or higher and the **ZEN Word AddIn** must be installed. Note that you always install the latest **ZEN Word AddIn**. The Add-In can be installed from the product DVD, see **Installation Guide**.

- Prerequisite** ✓ You are in the **Manage Templates** Mode.
1. From the **Show** drop-down list, select **Report Templates** to filter the template list.  
→ The template list is updated.

2. From the template list, select the desired report template and double-click, or right-click, and select **Copy & Edit**. Alternatively, in the **Toolbar**, click the **Copy & Edit** icon.



- The **Save Report** dialog opens.
3. In the **Name** field, enter the new report name, and click **Save**.
    - The template is opened in **MS Word**.
  4. Edit the template according to your needs and save it.

You have modified a report template. It is available in the template list and at any place where you can select report templates. You can modify it at anytime.

### See also

Reports Workbench [▶ 744]

## 3.17 Browse Results

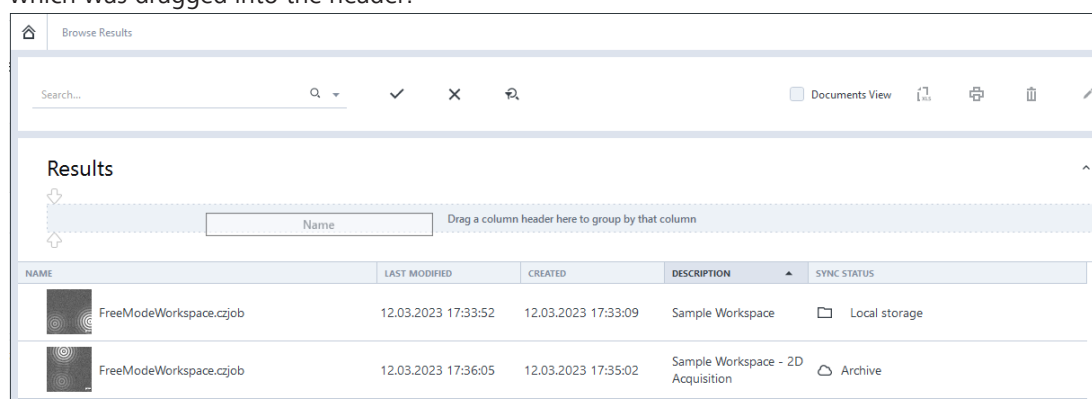
In the **Browse Results**, you view and manage your job results stored in the archive or the local storage. For example, you can check the quality of measurements or transfer job results to another system. You can also load a job result, change data, and store it under a new name, for example to correct a measurement.

A job result is created each time during a **Free Mode** session or when you run and complete a job template. The job result contains all images and measurement results that you have acquired or performed.

You can switch between the **Results** view and the **Documents** view. Your settings are saved, so the next time you browse your results, the settings are kept.

### Tip: Grouping by Column

You can group results by the desired column of the **Results** list (same for the Result Documents list). Click on the little arrow in the upper right corner of the results list and then drag the desired list column in the list header. The whole list will be sorted according to the column (e.g. NAME) which was dragged into the header.

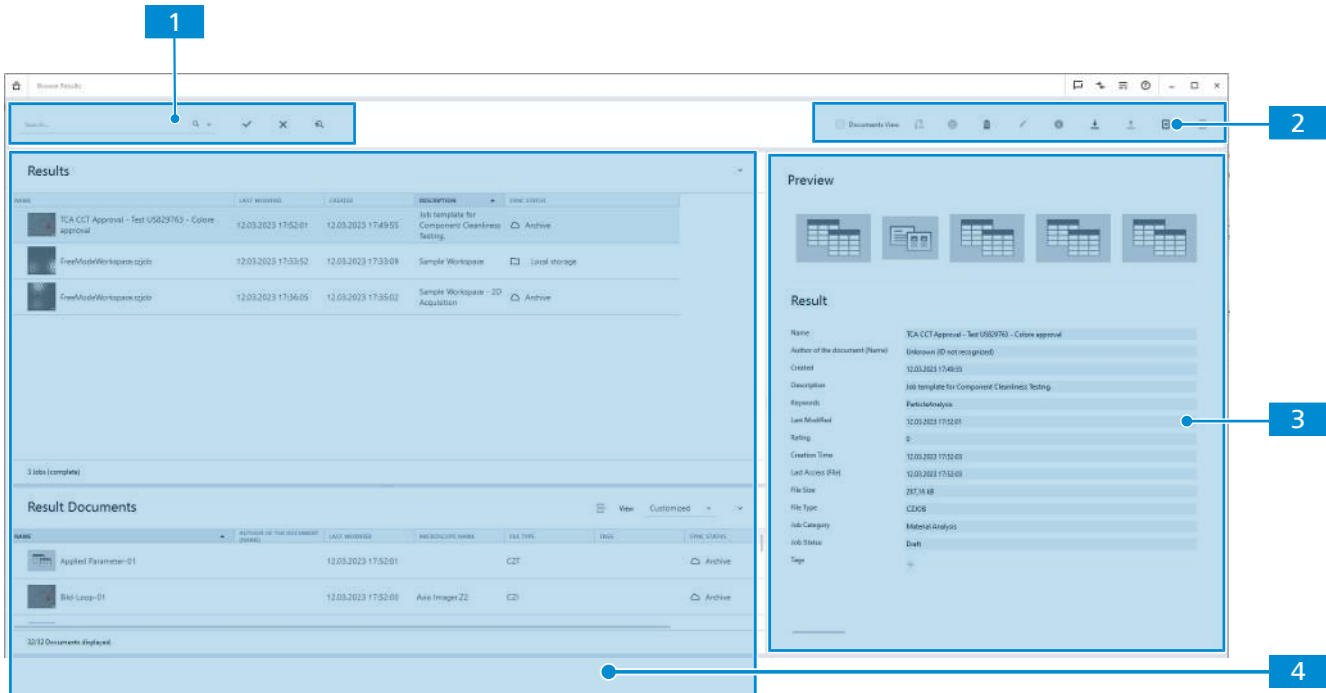


### 3.17.1 User Interface - Browse Results

The following figure shows the typical user interface when browsing job results.

## Info

In case that you have connected the archive to the ZEN Data Storage, you have more functions available. For more information, see *ZEN Data Storage Client* [▶ 147].



### 1 Search and Filter Area

Enables you to filter the list of job results or documents by type or search term, see *Filtering Results and Documents Using Metadata and Filter Criteria* [▶ 89].

### 2 Icon Bar

Enables you to perform actions with the selected job result or document.

For more information, see

- *Exporting Job Results to Excel* [▶ 89]
- *Printing Job Reports* [▶ 90]
- *Deleting Job Results and Documents* [▶ 91]
- *Editing Selected Job Results* [▶ 91]
- *Opening Selected Results in the Viewer* [▶ 92]
- *Downloading Result Documents from the Archive to the Local Storage* [▶ 92]
- *Uploading Result Documents from the Local Storage to the Archive* [▶ 93]
- *Adding Job Results to Collections in Browse Results* [▶ 154] (only with ZEN Data Storage)
- *Sharing Job Results Directly With Users and Groups* [▶ 154] (only with ZEN Data Storage)
- *Exporting and Importing Results* [▶ 93]








### 3 Preview Panel

Shows additional information about the selected job result and a preview of the documents contained in it. Here you can add tags to the image that are saved as metadata and can be found by searching and filtering documents.

#### 4 Results List

Lists all job results and result documents from free examination sessions in a hierarchical structure. You can switch between this view and the **Documents** view, see *Switching the Browse Result Views* [▶ 94].

The results list displays the synchronization status of the result jobs:

- : Local storage  
The data is only available in the local storage.
- : Archived  
The data is only available in the archive.
-    Synchronized with archive  
The data is available in the local storage and in the archive. The data is the same.
-  : Local and archive (different)  
The data is available in the local storage and in the archive. The data is different.

If you have the ZEN Data Storage configured as your archive, the result **External Images** in the **Results** view displays all single images in the database that are not part of a job result (e.g. images uploaded by ZEN or the uploader tool). To add a single image to an existing job result, see *Moving a Single Image from ZEN Data Storage to a Job Result* [▶ 155].

### 3.17.2 Customizing the Browse Results View

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Right-click the **Results** or **Result Documents** list header.  
→ The context menu is displayed.
2. Click **Select Columns**.

→ The following dialog is displayed.

Select Fields



Filter:

<input type="checkbox"/>	Name	Group
<input type="checkbox"/>	Author of the document (ID)	Document
<input type="checkbox"/>	Author of the document (Name)	Document
<input type="checkbox"/>	Comment	Document
<input checked="" type="checkbox"/>	Created	Document
<input type="checkbox"/>	Creation Time	File Information
<input checked="" type="checkbox"/>	Description	Document
<input type="checkbox"/>	File Name	File Information
<input type="checkbox"/>	File Size	File Information
<input type="checkbox"/>	Job Category	Job
<input type="checkbox"/>	Job Status	Job
<input type="checkbox"/>	Keywords	Document
<input type="checkbox"/>	Last Access (File)	File Information
<input checked="" type="checkbox"/>	Last Modified	Document
<input checked="" type="checkbox"/>	Name	Job
<input type="checkbox"/>	Rating	Document
<input type="checkbox"/>	Shared	Sharing
<input checked="" type="checkbox"/>	Sync Status	Status
<input type="checkbox"/>	Tags	Document

OK

Cancel

3. Activate the checkboxes to add new columns with the corresponding information (meta-data) to the **Results** or respectively in the **Result Documents** list, e.g. **Description**.  
→ The columns are displayed in the list.

Results				
NAME	LAST MODIFIED	CREATED	DESCRIPTION	SYNC STATUS
 2 images with processing function	13.03.2023 15:35:45	13.03.2023 15:35:15	Sample image is processed with enhance contour function.	 Archive

You have configured the **Results** list in the **Browse Results** view.

### 3.17.3 Search and Filter in the Archive and the Local Storage

Typically, the archive and the local storage contains a large number of job results and documents. You search and filter the list to find the desired result quickly. You search in **ZEN Data Storage** if licenced, in the local archive, or in the local storage. You search in the **Documents** view as well as in the **Results** view.

The search function is applied to all metadata of jobs and documents in the archive and the local storage. This means, that the search is applied not only to the visible list, but to all metadata available.

Note that if it is likely that you need to find results within different document types, it is necessary to combine some search terms. You can combine filtering and searching. This means, in case you activate filtering and searching, the concatenation is **AND**. If you use two or more search terms, the space between these terms means **OR**.

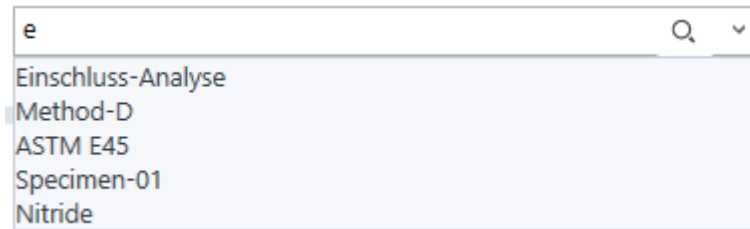
For example, you search for reports of **Cast Iron** and **Grains**, you type in the search field as follows: "**Cast Iron**" **OR** **Grains AND Report**. This means, you search for **Cast Iron** and **Report** as well as for **Grains** and **Report**. The result will show all reports of **Cast Iron** as well as those of **Grains**.


### 3.17.3.1 Searching for Results and Documents with Metadata

In the **Documents** view and in the **Results** view, you can search for complete metadata or just for parts of it. Note that not only those will be found, that are currently displayed in your list, but also metadata that are stored in the archive, the local storage, or in the **ZEN Data Storage**.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. In the field on the top left side, type the metadata or a part of it.  
→ The latest 10 terms you have searched for are shown in a drop-down list.



2. Select the desired term or type in a new one.
3. Click .  
→ The results and documents containing the desired metadata are displayed.  
→ If you have searched in the **Results** view, all results of a single job are displayed.


### 3.17.3.2 Filtering Results and Documents Using Quick Filters

You can filter results by selecting pre-defined quick filters. Additionally, you can define filter criteria and restrict the results.

#### Info

The quick filters **Today** and **Last 7 Days** do not filter third party documents.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select **Shows filter fields** .  
→ A pop up is displayed.
2. To apply a quick filter, in the **Quick Filter** area, click the desired filter.  
→ The filter criterion is displayed below the **Search** text box. The ✓ icon is highlighted.
3. To some quick filters, you can add conditions to restrict the results. In the **Filter Criteria** area, click the desired filter.  
→ The filter criterion is displayed below the **Search** text box.  
→ From a drop-down list, conditions and values are available. Depending on the properties, not every condition may be visible or selectable.



4. To apply the filters to the listed job results, click ✓.

The results are filtered according to your selections.


You can add more filter criteria.

### See also

 Filtering Results and Documents Using Metadata and Filter Criteria [► 89]

### 3.17.3.3 Filtering Results and Documents Using Metadata and Filter Criteria

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select **Shows filter fields** .
  - A pop up is displayed.
2. In the **Add Filter Criteria** area, click the desired filter.
  - The filter criterion is displayed below the **Search** text box.
3. To add more filter criteria, click **More**.
  - The **Select Fields** dialog opens.
4. Activate the checkboxes of the fields to be filtered by, and click **OK**.
  - The filter with the selected fields is displayed below the **Search** field.
5. Select a condition and value from the drop down list (depending on the properties, not every condition may be visible or selectable):
  - **=** The property value must be identical to the value. The value is not case-sensitive.
  - **< / >** The property must be smaller (<) or greater (>) than the value.
  - **<= / >=** The property must be smaller/equal (<=) or greater/equal (>=) than the value.
  - **AND**: The property contains all search terms, e.g. the first term and the second term. This applies only to the search function, not to the filter function. The only exception are tags: when filtering, you can combine them.
  - **OR**: The property contains any of the search terms, e.g. the first term or the second term. This applies only for the search function, not for the filter function.
  - **Contains**: The value must be contained somewhere in the property, e.g. "mag" matches "image". The value is not case-sensitive.
  - **Between**: The property must be between the lower and upper values.
  - **Before / After**: The date of the property must be before/after that of the value.
  - **" "**: The property value contains only the exact search terms.
6. Press **Enter**.
  - The **ZEN Data Storage** or the local archive and the local storage are searched and the results are displayed.

### 3.17.4 Job Results or Documents

#### 3.17.4.1 Exporting Job Results to Excel

You can export job results to excel in case that the job result contains result items that can be exported to excel. You can also export single result items.

Note that the decimals in tables are saved with full accuracy. But they are displayed according to your settings under **Maintenance > General Options > Data Tables > Data Table > Decimal Places**. By default, the decimals are clipped and not rounded.

If you export a table as **MS Excel** file to your local PC, you can change the settings within **MS Excel** when formatting the cell. You can rise the decimals, for example in case you want to reproduce the classification of a particle in **Technical Cleanliness Analysis**.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select the desired job result set or result item.
  - ➔ In the **Preview** area to the right, you can see the preview of images, documents and properties.
2. To export to Excel, click the **Excel Export** icon.



- ➔ In case that you have selected a **local job result set** or a **local result item**: The export dialog opens.
  - ➔ In case that you have selected a **job result set** or a **result item** from the **archive**: The files are downloaded to the local storage first. A download window opens displaying the progress of the download.
  - ➔ In case that you have selected a **job result set** or a **result item** that is **available in the local storage and the archive but not synchronized**: The local job result set/result item will be used for exporting to Excel.
3. Navigate to the folder where you want to save the Excel file and click **OK**.

You have exported a job result set or a single result item to Excel.

#### 3.17.4.2 Printing Job Reports

You can print the report documents in case that the job result set contains result items that can be printed. You can also print single result items.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select the desired job result set that contains printable result items or select a single result item.
  - ➔ In the **Preview** area to the right, you can see the preview of images, documents and properties.
2. To print the report documents, click the **Print Report Documents** icon.



- ➔ In case that you have selected a **local job result set** or a **local result item**: The **Print Report** dialog opens.
  - ➔ In case that you have selected a **job result set** or a **result item** from the **archive**: The files are downloaded to the local storage first. A download window opens displaying the progress of the download.
  - ➔ In case that you have selected a **job result set** or a **result item** that is **available in the local storage and the archive but not synchronized**: The local job result set/result item will be used for printing.
3. For **Printer**, select the print target and click **Print Report**.

The report documents are printed according to the selected printer.

### 3.17.4.3 Deleting Job Results and Documents

You can delete job result sets and documents from the local storage and from the archive. For synchronized job result sets/result items, only the files from the local storage will be deleted. In this case you have to execute the delete command twice to remove the results also from the archive.

You cannot restore deleted job result sets and documents.


#### Info

Job result sets which are currently being transferred cannot be deleted.

#### Info

If you have licenced and activated the **GxP** module, deleting job result sets or result items from the archive is not allowed.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select the desired job result set or job result item.
  - In the **Preview** area to the right, you can see the preview of images, documents and properties.
2. To delete a job result set or a result item, click the **Deletes the selected job results** icon .
  - A dialog opens to confirm the deletion.
3. Click **Yes**.

The job result set or result item is deleted.


### 3.17.4.4 Editing Selected Job Results

You can select job result sets and edit them in **Free Mode**.

#### Info

If you have licenced and activated the **GxP** module, editing job result sets is not allowed.

**Prerequisite** ✓ The **Browse Results** mode is selected.


1. Select a result set, and click **Edit** .
  - In case that you have selected a **local job result set**: The job result set opens in **Free Mode** in the **Center Screen Area**.
  - In case that you have selected a **job result set** from the **archive**: The files are downloaded to the local storage first. A download window opens displaying the progress of the download. Once downloaded, the job result set opens in **Free Mode** in the **Center Screen Area**.
  - In case that you have selected a **job result set** that is **available in the local storage and the archive**: The local job result set/result item will be used for editing.
  - In either case, in the **Documents Area**, the last modified document is displayed on top, the others are sorted chronologically downwards.
2. Continue your work, or change results and save the job result under a new name. In case you want to open a document or a file, for example MS Office documents, .txt or pdf, click on that file to open it.

- A message is displayed informing you that you can only open it externally. A link **Try to open externally** is provided.
  - 3. Click on the link.
    - The according software opens and you can edit the document.
- You have opened a result document and were able to edit it, either in **Free Mode** or externally.

#### 3.17.4.5 Opening Selected Results in the Viewer

You can open job results sets in the viewer to view the job result items. You can also open single result items.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. To check results in detail, select the result or the document and click **Info** .
  - In case that you have selected a **local job result set** or a **local result item**: The viewer opens. You can view all the documents/images contained in the job and the corresponding results. However, you cannot make any changes.
  - In case that you have selected a **job result set** or a **result item** from the **archive**: The files are downloaded to the local storage first. A download window opens displaying the progress of the download. Once downloaded, the viewer opens. You can view all the documents/images contained in the job and the corresponding results. However, you cannot make any changes.
  - In case that you have selected a **job result set** or a **result item** that is **available in the local storage and the archive**: The local job result set/result item will be used for viewing.
  - In either case, in the **Documents Area**, the last modified document is displayed on top, the others are sorted chronologically downwards.
  - You can save the results, for example a table, to your local drive. If you have installed the **Word-Add In**, you can use this table as a template for your report template.


#### See also




 Creating a New Report Template [► 80]

#### 3.17.4.6 Downloading Result Documents from the Archive to the Local Storage

You can download results and documents from the archive to the local storage, for example, for editing or viewing. You can perform a download as well to synchronize the local storage with the archive. In this case, the files in the local storage will be replaced with the files from the archive.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select a result or a document that is currently stored in the archive, and click **Download** .
  - A download window opens displaying the progress of the download. Once finished, the result set or document is available in the local storage and will be synchronized with the archive. This is indicated in the **SYNC STATUS** column:
 






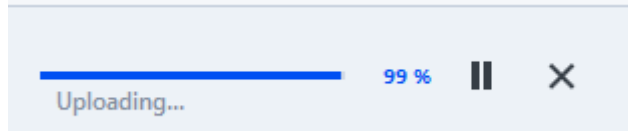
The result document is downloaded from the archive to the local storage.




### 3.17.4.7 Uploading Result Documents from the Local Storage to the Archive

You can upload results and documents from the local storage to the archive. You can perform a upload as well to synchronize the archive with the local storage. In this case, the files in the archive will be replaced with the files from the local storage.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Select a result or a document that is currently located in the local storage, and click **Upload** .  
→ The result or the document is uploaded to the archive. The progress of the upload is displayed in the **SYNC STATUS** column:



2. To cancel the upload, click . To pause the upload, click . To continue the upload, click .

The result or the document is uploaded to the archive. This is indicated in the **SYNC STATUS** column:



### 3.17.4.8 Exporting and Importing Results


Results stored in the local storage/archive can be accessed by any user with corresponding rights. If you want to transfer results between non-connected systems, you can export them from one local storage/archive and import them into the other local storage/archive. The controls for exporting and importing results are available in the upper right corner. You can export results and result documents as well as import results by multi-selection.

To export results from the archive, you have to download them to the local storage first.

#### Exporting


**Prerequisite** ✓ The **Browse Results** mode is selected.

- ✓ The job result is saved in or downloaded to the local storage.

1. Select the results or the result documents you want to export, and click  **Exports the selected job results into a folder**.  
→ You are prompted to select the export path.
2. Select the desired location on the file system, and click **OK**. If a document already exists in the export folder, you are prompted to decide if you want to overwrite or rename it. If you rename it, the name is kept and a number is added. Example: <Document name> (2). If you export results from the archive, the files are downloaded to the local storage first. A download window opens displaying the progress of the download.  
→ The documents are saved within the selected folder.

#### Importing

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Click  **Imports job results into the current archive**.  
→ The **Import job results** dialog opens.

2. Select the results to be imported, and click **Import**.  
 → The results are imported and saved in the **Results** list.

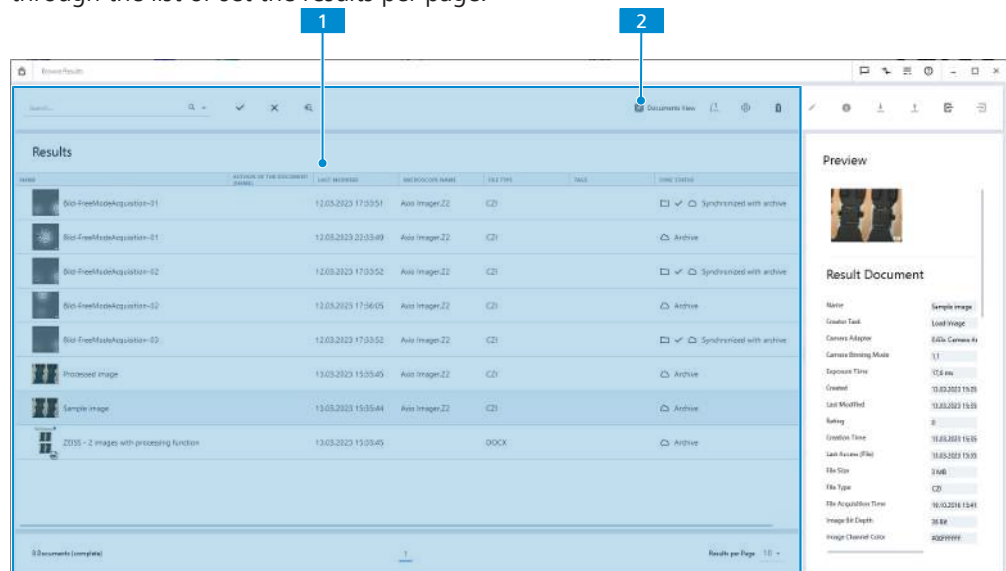
### 3.17.5 Results List

#### 3.17.5.1 Switching the Browse Result Views

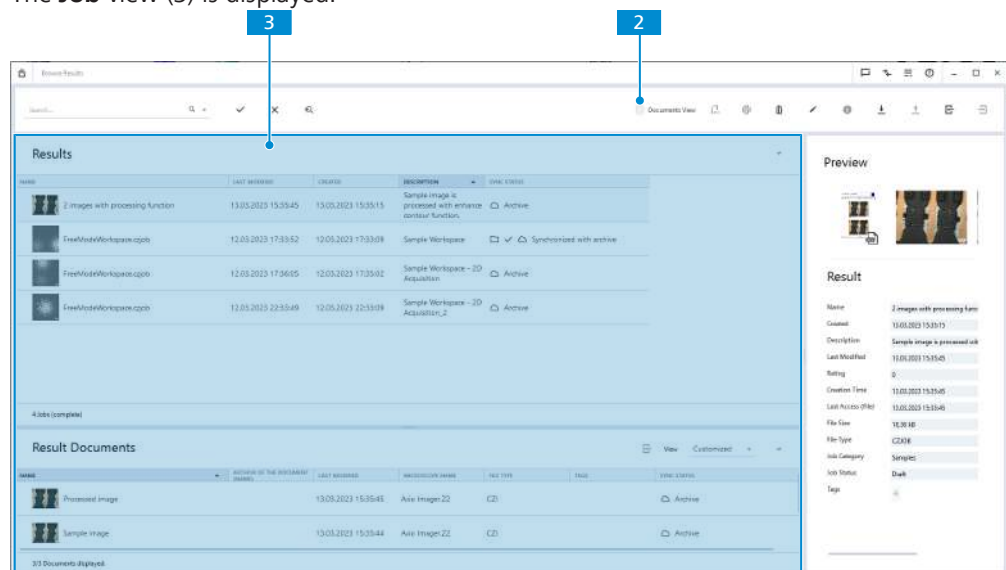
Note that this procedure is NOT possible when you have licenced and activated the **GxP module**.  
 You can switch between the views without losing your filter results.

**Prerequisite** ✓ You are in **Browse Results** mode.

1. In the **Icon Bar** of the **Browse Results** view, activate or deactivate the **Documents View** checkbox (2) to switch between the views.  
 → The **Documents** view (1) is displayed. It does not contain any jobs. You can browse through the list or set the results per page.



- The **Job** view (3) is displayed.




- The lists (3) display the job results in the **Results** list and the corresponding documents in the **Result Documents** list.

### 3.17.5.2 Adding Files to Job Results

Note that this procedure is NOT possible when you have licenced and activated the **GxP module**.

You can add all file formats to an existing job. You can add not only **ZEN** supported documents, but also other documents that you can open externally. You could keep them, just to manage them in a project and export them again at another time to continue your work. To add the files, import them to the local archive or to **ZEN Data Storage** respectively.

**Prerequisite** ✓ You are in **Browse Results** mode.

1. In the **Results** list, select a job.  
→ The **Results Documents** list is updated.
2. Drag and Drop the desired files into the **Result Documents** list. Alternatively, click **Add files to the results of the selected job** .  
→ A dialog opens.
3. Navigate to select the files. You can add one or more files at once.
4. Click **Open**.  
→ The selected files are imported to your local archive, the **ZEN Data Storage** or the local storage respectively. They are visible in the **Results Documents** list.

### 3.17.5.3 Renaming Documents

Note that this procedure is NOT possible when you have licenced and activated the **GxP module**.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. Double-click on the name in the **Result Documents** list within the column **Name**, type the desired name, and press **Enter**.  
→ Your requested change is saved.

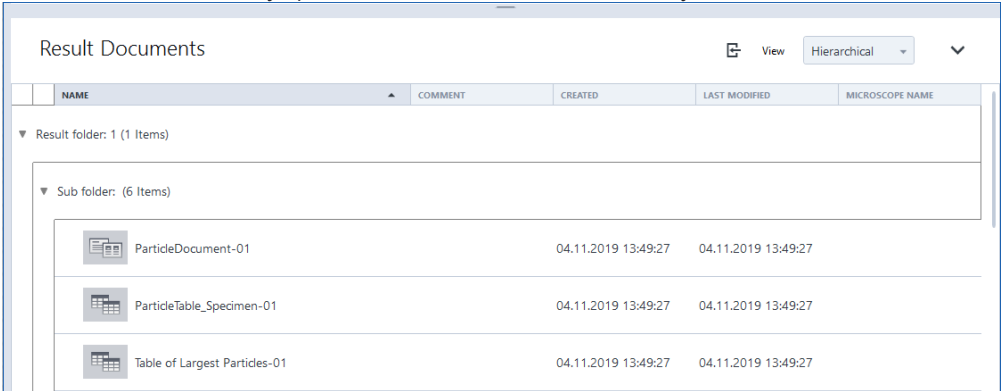
### 3.17.5.4 Sorting Result Documents Hierachically

You can sort the images of one job result hierarchically. This means, the results in the table are not sorted in alphabetical order. They are sorted in categories from general data to specific data.

**Prerequisite** ✓ The **Browse Results** mode is selected.

1. In the **Result Documents** section, in the **View** drop-down list, select **Hierarchical**.
2. In the **Result** section, select the desired job result.

→ In the **Result Document** section, a result folder with subordinated folders is displayed. If you are working for example with **Non-Metallic Inclusion Analysis**, the result folder shows joint results of a multi-specimen analysis, in the subordinated folder you would find the results sorted by specimen number and sub-sorted by relevant standards.



3.18 Image Acquisition

3.18.1 Basic Concepts

3.18.1.1 Acquisition Methods

You can acquire an image as follows:

- Load an existing image from the **Archive** or file system  
This enables you open a previously acquired image or to import an image from another system.
- Acquire a new image using the camera  
The software contains various acquisition workbenches depending on whether you want to simply acquire an image quickly, or whether you want to adjust image acquisition parameters. It also contains various workbenches tailored to different types of image. The available workbenches depend on your hardware and licenses.

3.18.1.2 Image Types

The following types of images are supported by the software. The types that are available to you depend on your hardware and licenses.

Image type	Description
Standard image	Simple snapshot of the sample.  Once you have created an image, you can process it, apply measurements, save, or export the image.
Extended depth of focus (EDF)	Takes images of various focal planes and renders the image stack together to create a single image where the entire sample surface is in focus, regardless of the height of the objects on it.
Tiles	Acquires multiple images (tiles) with a <i>motorized</i> stage and stitches them together to create one large image.



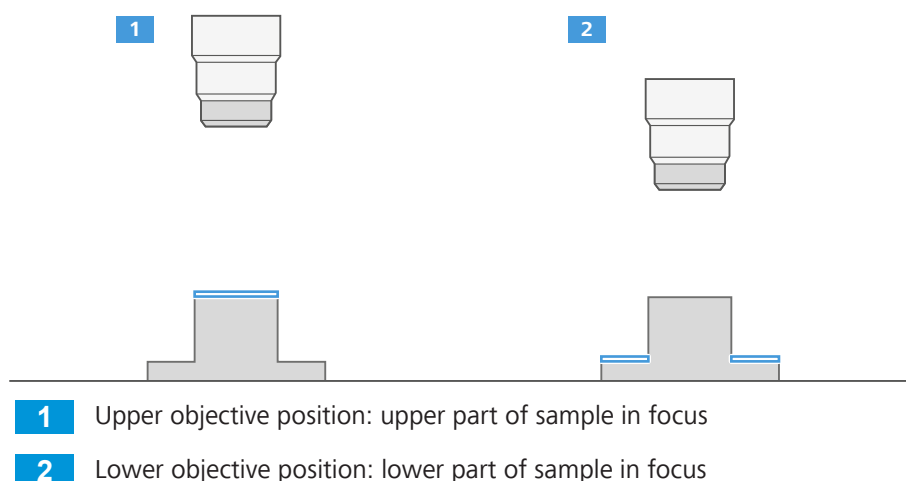
Image type	Description
	This is only available with a motorized stage (x/y direction).
Panorama	Acquires multiple images (tiles) with a <i>manual</i> stage and stitches them together to create one large image.
Linkam time series	Acquires a series of images at specific temperatures or intervals during temperature changes.  This is only available with a Linkam heated stage.

### 3.18.1.2.1 Extended Depth of Focus (EDF) Images

The depth of focus of the microscope optics is physically limited due to the high magnification. Therefore, objects cannot be imaged sharply over their entire physical height if their height exceeds the microscope's depth of focus.

An extended depth of focus (EDF) image helps to extend the physically limited depth of focus of the microscope:

First a Z-stack image is acquired, which consists of a sequence of images, each corresponding to a different focal plane. This is achieved by acquiring an image at various Z positions of the objective leading to a range of distances between objective and sample.



The in-focus regions of the individual images of the Z-stack image are then stitched together to a single EDF image. In the EDF image the entire acquired area of the sample surface is in focus, regardless of the height of the objects.

You can acquire an EDF image as follows:

- **Motorized**  
If a motorized z-axis or focus drive is available you can define a range of Z positions and the EDF image is acquired automatically. The software moves the z-axis to each Z position, acquires an image at each position, and calculates the EDF image.
- **Manually**  
If only a manual z-axis is available, you can move it to the desired positions and acquire an image at each position, thus obtaining the Z-stack image. The Software then calculates the EDF image.

In addition to a simple EDF image, you can combine EDF with tile images.

**See also**

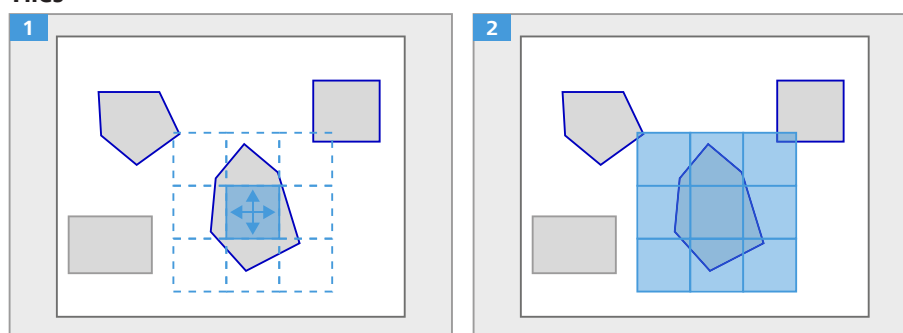
- 📖 EDF (manual focus) Workbench [▶ 734]
- 📖 EDF (motorized focus) Workbench [▶ 735]
- 📖 Tiles with EDF Workbench [▶ 191]
- 📖 Image Types [▶ 96]

**3.18.1.2.2 Tiles and Panorama Images**

Depending on your application, the field of view of your microscope might be too small for the sample area you wish to acquire. The software contains workbenches which enable you to acquire a panorama image exceeding the image size of a single image.

You can acquire such images as follows:

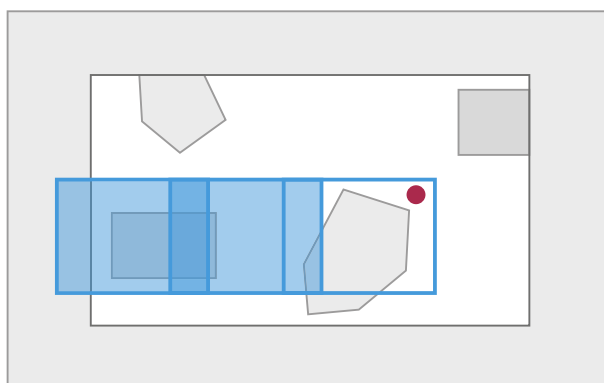
- **Tiles**



If a motorized stage is available, you can use one of the **Tiles** workbenches or the **Panorama (automatic)** workbench to define the area on the sample for which you wish to acquire an image. The tile image is then acquired and stitched together automatically.

For more information, see *Tiles (manual) Workbench* [▶ 190], *Tiles (interactive) Workbench* [▶ 189] or *Panorama (automatic) Workbench* [▶ 146]

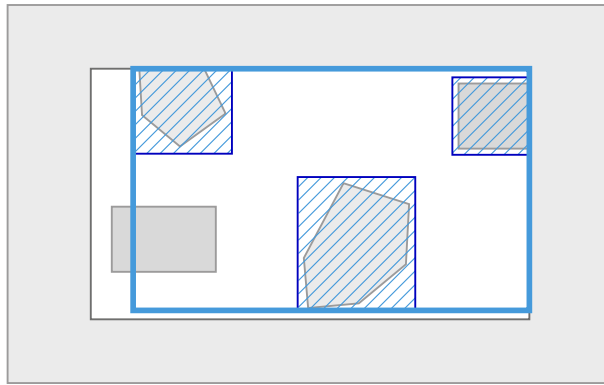
- **Panorama**



If only a manual stage is available, you can acquire an image with the **Panorama** workbenches. In this case, you acquire a set of connected, overlapping images (tiles) manually. The tiles are then stitched together to a single large image.

For more information, see *Panorama (interactive) Workbench* [▶ 146].

- **Position list**



If a motorized stage is available and you wish to acquire images at different positions on the sample without acquiring the entire enclosed area, you can use the **Position List** workbench. The images are saved to a single file along with their positions. The space between the images remains empty.

For more information, see *Position List Workbench* [▶ 737].

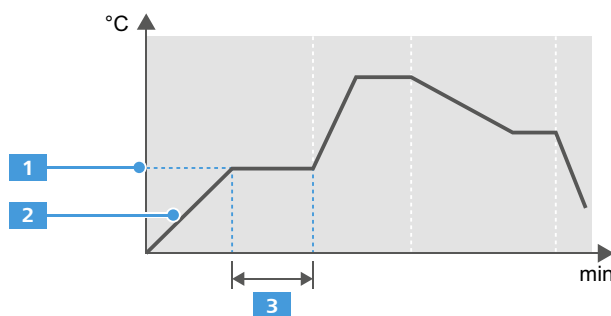
### See also

- 📄 Tiles (interactive) Workbench [▶ 189]
- 📄 Tiles (manual) Workbench [▶ 190]
- 📄 Position List Workbench [▶ 737]
- 📄 Acquiring a Panorama Image (automatic) [▶ 143]

#### 3.18.1.2.3 Time Series and Temperature Series (Linkam)

If you have a temperature-controlled Linkam stage, ZEN core enables you to acquire a series of images at different sample temperatures.

Within the limits of your hardware you can define an arbitrary temperature curve which is fed to the Linkam stage. A temperature curve consists of individual linear temperature ramps, which are connected one with another. Each ramp is defined by a heating or cooling rate and a target temperature, which can be sustained for a specified time interval before the next ramp starts.



- 1** Target temperature
- 2** Heating or cooling rate in °C/min
- 3** Time interval for which the temperature is sustained

For each ramp, you can acquire images as follows:

- Time series: the acquisition is triggered each time a defined time interval has elapsed.
- Temperature series: the acquisition is triggered each time the temperature has changed by a certain value.
- None: No images are acquired (for example until the heating stage has reached the start temperature)

**See also**

- Setting the Temperature and Vacuum [► 107]

3.18.1.3 Stage Movement

You can move the stage, and thus navigate the sample, as follows:

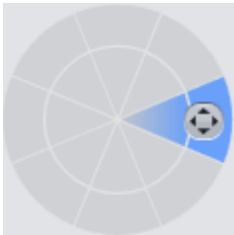
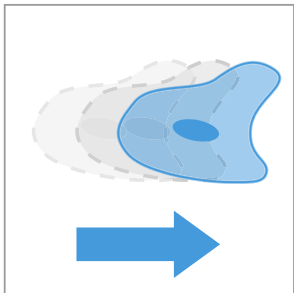
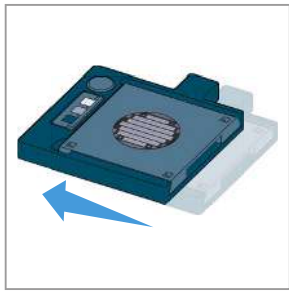
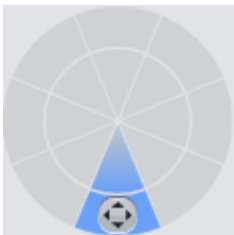
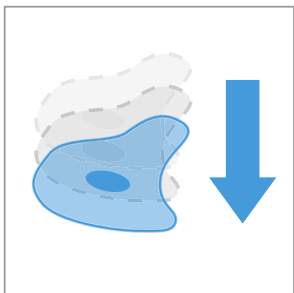
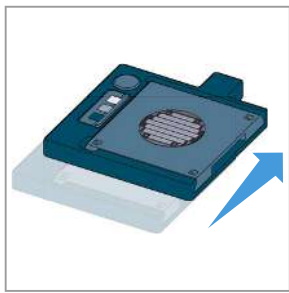
- By hand  
For more information, see your microscope instruction manual.
- Using the software  
This is possible if your microscope has a motorized stage.

In the software, the **Stage Navigation** tool enables you to navigate the sample freely or jump to a specific location.

The direction of the **Navigation Circle** (software joystick) corresponds to the movement of the image, not to the actual stage movement.

For example, a movement in the positive X direction means that the area shown in the image moves to the right. As the optical components of the microscope, including the camera, are fixed, the stage actually moves to the left.

Examples:

Direction	User action	Movement in camera image	Actual stage movement
+ X			
- Y			

**See also**

- Navigating the Sample [► 102]
- Stage Tool [► 795]

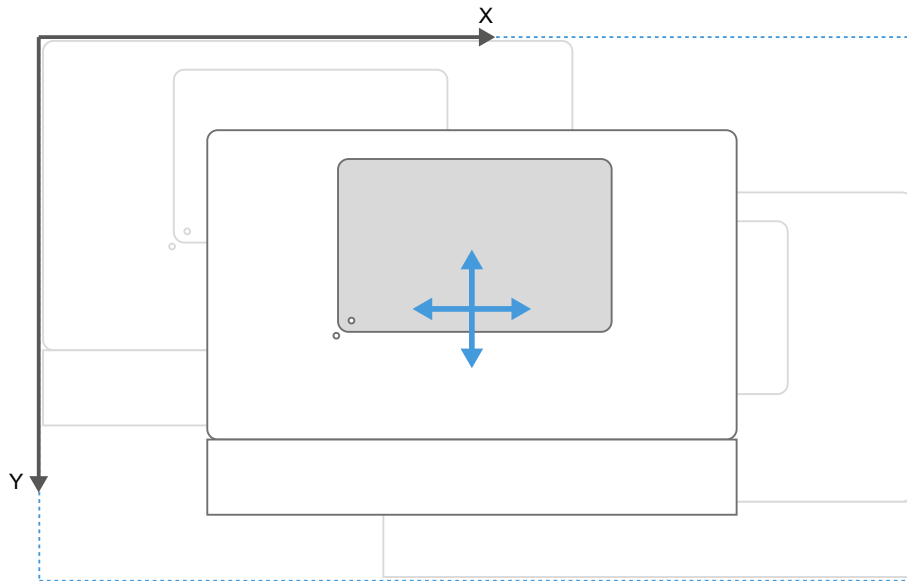
3.18.1.4 Coordinate Systems

The software contains the following coordinate systems:

- Stage coordinate system

- Image coordinate system
- World coordinate system

**Stage coordinates** The stage coordinate system describes the position of the stage.



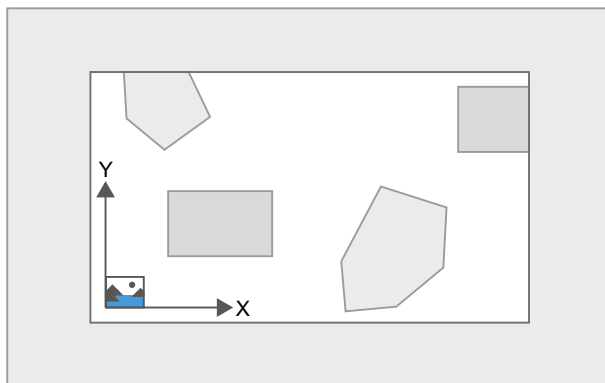
In ZEN core the coordinate values are sometimes relative and sometimes absolute. Each time a stage navigation or focus tool is loaded, the software coordinate values are set to zero in X, Y, and Z direction for the current stage position, regardless of its actual physical position. When the stage is then moved the relative displacement is displayed.

To use absolute coordinates you need to reference the coordinate values first. Click the **Home/ Calibrate** button of the corresponding tool. The stage is then moved to the end position and the coordinate value in the software is set to zero for this stage position. When the stage is then moved the absolute displacement is displayed.

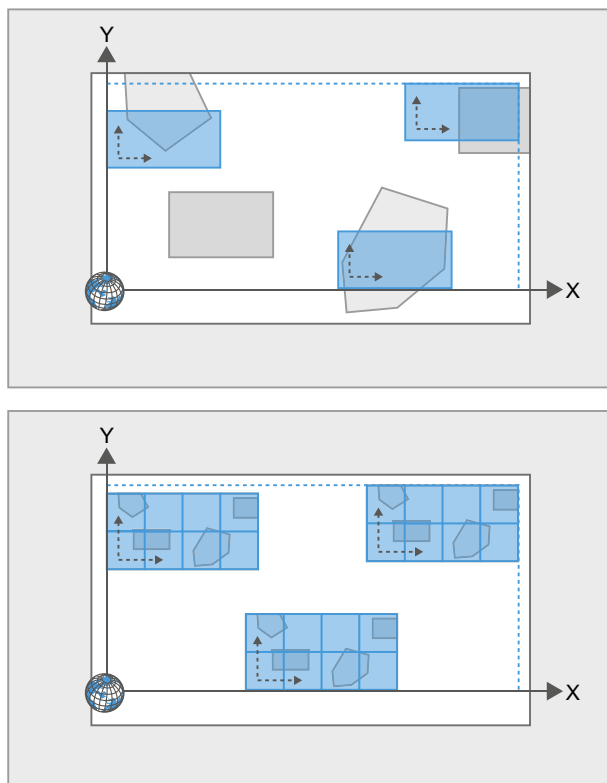
To move a motorized stage using one of the corresponding tools (e.g. **Focus tool**, **Stage Navigation tool**) you can either use the graphical elements, such as **Navigation Bar** and **Navigation Circle**, or you can enter the target coordinates directly.

The direction in which the stage moves for positive or negative coordinate values depends on the microscope type and the microscope setup and cannot be described generally.

**Image coordinates** The image coordinate system describes the position of a pixel within an individual image. The coordinates are absolute, based on the top left pixel in the image. In an oversize image (e.g. a tiled image), each acquired image has its own independent coordinate system.



**World coordinates** The world coordinate system describes the position of a pixel within an image. In individual images, the world coordinates are identical to the image coordinates. However, for an oversize image (e.g. a tiled image), the world coordinate is based on the complete image.



### See also

- 📖 Navigating the Sample [▶ 102]
- 📖 Stage Movement [▶ 100]

## 3.18.2 Preparations

### 3.18.2.1 Navigating the Sample

The **Stage** tool enables you to move the motorized stage as follows:

- Freely using the **Navigation Circle** (software joystick)
- To a specific location by entering coordinates on the sample

### CAUTION

#### Risk of Crushing Fingers

The drive of a microscope stage with a motorized horizontal stage axis (stage drive) is strong enough to crush fingers or objects between the stage and nearby objects (e.g. a wall).

- ▶ Remove your fingers or any objects from the danger area before moving the stage drive.
- ▶ Release the joystick immediately to stop the movement.

**Adding the Stage Navigation tool** To add the **Stage** tool to your acquisition workbench:

- Prerequisite**
- ✓ You are logged in as a supervisor.
  - ✓ An acquisition workbench is selected.

- ✓ The selected acquisition workbench allows usage of the **Stage** tool.
1. Click the **Add Tool** button.

2. In the tool overlay, select **Stage**.

Info

The tile acquisition tools have an additional navigation control. For more information, see Acquiring Tile Images.

**Free navigation** To navigate the sample freely:

1. Click the desired segment of the **Navigation Circle**.

→ You can switch between the two speed modes by right-clicking the central **Navigation Circle** button.
2. Release the mouse button to stop the stage movement.

Software joystick	Movement speed
	Slow
	Medium
	Fast
	Very fast

Info

You can also use the arrow keys to navigate the sample if the **Navigation Circle** is selected.

**Specific location** To jump to a specific location on the sample:

- Enter the target coordinates in the corresponding fields and press **Enter**.

### Info

You can stop the motion of the stage at any time by clicking the **Stop** button.

### See also

- Stage Movement [► 100]
- Stage Tool [► 795]
- Selecting Workbenches [► 41]

## 3.18.2.2 Focusing the Sample Manually

The **Focus** tool enables you to focus the sample by moving the stage up and down as follows:

- Freely using the **Navigation Bar**.
- To a specific Z coordinate.

This method is only possible, if your microscope has a motorized stage or a focus drive (inverted microscope). If no motorized stage is installed, you have to focus manually. For more information, see your microscope instruction manual.

### CAUTION

#### Risk of Crushing Fingers

The drive of a microscope stage with a motorized vertical axis (focus drive) is strong enough to crush fingers or objects between the stage and the microscope stand.

- Remove your fingers or any objects from the danger area before moving the focus drive.
- Release the joystick immediately to stop the movement.

**Adding the Focus tool** To add the **Focus** tool to your acquisition workbench:

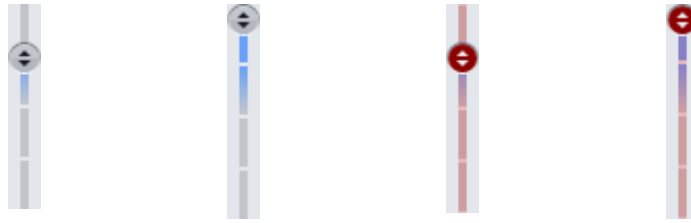
- Prerequisite**
- ✓ You are logged in as a supervisor.
  - ✓ An acquisition workbench is selected.
- Click the **Add Tool** button.
  - In the **Tool Overlay**, click **Focus tool**.

**Free focusing** To focus the sample freely:

- Prerequisite**
- ✓ The **Focus** tool is displayed.
- Click the desired **Navigation Bar** segment directly and keep the mouse button pressed.
    - Alternatively, you can click the **Navigation Bar** button and drag it to the desired segment.
    - You can switch between two speed modes by right-clicking the **Navigation Bar** button.
  - To stop the stage movement, release the mouse button or click the **Stop** button.

<b>Movement speed</b>	Slow	Medium	Fast	Very fast
-----------------------	------	--------	------	-----------



**Navigation Bar****Info**

You can also use the arrow keys to focus the sample once you have clicked the **Navigation Bar**.

**Specific stage position**

Initially, when you use the Focus tool, the exact position of the stage is not known. Therefore, the position indicated in **Current** is initially set to zero. If you enter a value, the stage moves by the entered amount relative to the current position.

If you want to move the focus to an absolute position, you must first click **Home** to move the stage to one of the end positions. The value of **Current** is set to this known position. You can then enter an absolute position.

**Info**

You can stop the motion of the stage at any time by clicking the **Stop** button.

**See also**

- 📖 Focus Tool [► 773]
- 📖 EDF (manual focus) Workbench [► 734]
- 📖 2D Acquisition Workbench [► 733]
- 📖 2D Acquisition (automatic) Workbench [► 733]
- 📖 Selecting Workbenches [► 41]

**3.18.2.3 Focusing the Sample Automatically**

If you have a motorized stage, you can focus the sample automatically, i.e. the area of interest is kept in focus without your intervention.

The software supports the following types of automatic focus:

- **Software autofocus**  
The system acquires images over a range of Z heights and compares them to find the one where the area of interest is sharpest.
- **Hardware autofocus**  
The system uses an integrated infrared camera sensor to judge the focus over a range of Z heights and to find the sharpest point.

The methods that are available to you depend on your hardware and license. It is possible to combine the methods, but the most recently selected method is used.

The autofocus methods can be enhanced by roughly focusing the sample before starting the autofocus.

**CAUTION****Risk of Crushing Fingers**

The drive of a microscope stage with a motorized vertical axis (focus drive) is strong enough to crush fingers or objects between the stage and the microscope stand.

- ▶ Remove your fingers or any objects from the danger area before moving the focus drive.
- ▶ Release the joystick immediately to stop the movement.

**Adding the Auto-focus tools** To add the **Software Autofocus** or **Hardware Autofocus** tool to your acquisition workbench:

- Prerequisite**
- ✓ You are logged in as a supervisor.
  - ✓ An acquisition workbench is selected.
1. Click the **+ Add Tool** button.
  2. In the **Tool Overlay**, double-click **Hardware Autofocus** or **Software Autofocus**.

**Software Autofocus** To focus the sample automatically using software autofocus:

- Prerequisite**
- ✓ The **Software Autofocus** tool is displayed.
1. Navigate to the region of interest of the sample.
  2. Set the following parameters as desired:
    - **Quality**
    - **Range Coverage**
    - **Sampling**
    - **Sharpness Measure**
  3. If you wish to detect the focus in the range around the current focus position, click **Relative Range**.
    - Deactivate **Automatic Range** and use **Range** to specify the height above/below within which the system finds the best focus point.
  4. If you wish to detect the focus in a specific range, click **Fixed Range**.
    - Move to the start of the range and click **Set First** and the end of the range and click **Set Last**.
  5. If only a section of the acquired image should be compared to find the focus, activate **Spot Meter / Focus ROI**.
    - Drag in the image to define the region of interest.
  6. To set the focus, click **Find Focus**.
    - The software autofocus is a one-off procedure. If you move the sample, repeat the above steps.

**Hardware Autofocus** To focus the sample automatically using hardware autofocus:

- Prerequisite**
- ✓ The **Hardware Autofocus** tool is displayed.
1. Navigate to the region of interest of the sample.
  2. Set the desired **Resolution and Speed** and **Sample Texture**.
  3. To set the focus, click **Once**.
  4. If you require a continuous autofocus, click **On** and set the autofocus frequency using **Period**.
  5. If the hardware consistently focuses at an incorrect height, activate **Handwheel on**, focus the sample manually, and click **Z-Pos > AF-Pos**.

- The system notes this offset and then keeps the correct height in focus even if you move the sample. This is useful if for example, the system focuses on the top surface of a transparent sample and you wish to focus on the bottom surface.

### See also

- 📖 Hardware Autofocus Tool [▶ 775]
- 📖 EDF (motorized focus) Workbench [▶ 735]
- 📖 2D Acquisition (automatic) Workbench [▶ 733]
- 📖 2D Acquisition Workbench [▶ 733]
- 📖 Selecting Workbenches [▶ 41]

#### 3.18.2.4 Selecting the Objective

You can change the magnification by changing the objective. The **Magnification** tool enables you to switch between objectives installed in your microscope.

##### Adding the Magnification tool

To add the **Magnification** tool to your acquisition workbench:

- Prerequisite**
- ✓ You are logged in as a supervisor.
  - ✓ An acquisition workbench is selected.
1. Click the **+ Add Tool** button.
  2. From the **Tool Overlay**, select **Magnification**.

##### Changing the objective

To change the objective:

- Prerequisite**
- ✓ The **Magnification** tool is selected.
1. Click the objective icon.
    - A list of available objectives with their main properties is displayed.
  2. Select the desired objective.
    - Motorized objective revolver: The revolver is turned automatically to the corresponding position.
    - Manual objective revolver: The revolver cannot be turned automatically. The software prompts you to turn it manually.
    - For more information, see your microscope instruction manual.
    - Coded objective evolver: Do not select the objective in the software. Change the objective by turning the objective revolver manually. The software recognizes the selected objective automatically.

### Info

If you need to be sure the magnification used during acquisition agrees with the magnification information stored in the image metadata, use a motorized or a coded revolver.

### See also

- 📖 Selecting Workbenches [▶ 41]

#### 3.18.2.5 Setting the Temperature and Vacuum

You can use the **Linkam Heating Stage** workbench to control the temperature and vacuum system of the Linkam heating stage, without acquiring a time series.

You can control the two systems independently of each other.

A typical use is to set a temperature or pressure that is used throughout an examination and which does not need to change over time.

**Prerequisite** ✓ The **Linkam Heating Stage** workbench is selected.

1. To use the temperature control: activate **Temperature control on** and set the target temperature in **Limit**.
2. To use the pressure control: activate **Vacuum control on** and set the target pressure in **Setpoint Pressure**.
3. Wait until the **Status** of the desired systems is **Holding**.

### See also

- 📖 Linkam Heating Stage Workbench [► 736]
- 📖 Selecting Workbenches [► 41]

## 3.18.3 Acquiring an Image

You can acquire an image using your microscope's camera. Depending on your microscope, you have to perform focus and positioning operations manually or by help of the software.

**Prerequisite** ✓ The microscope hardware and all components are set-up correctly and are ready to operate.  
 ✓ The MTB (MicroToolbox) configuration is set-up correctly.  
 ✓ The sample is illuminated sufficiently.




1. Click **Free Mode**.
2. Click **Add workbench**.
3. In the left area, click **+ (Add workbench)** and select **Acquisition**.  
 → The Acquisition workbenches are displayed in the center area.
4. Select **2D Acquisition** and click **+ Add**.  
 → The selected workbench with its default tools is displayed in the **Workbench Area**. A live image of the sample is displayed in the image area.
5. Focus the sample using one of the focus tools or focus manually.
6. If desired, add or remove tools from the workbench.
7. Adjust the parameters in the tools until you are satisfied with the result in the live image.
8. Click **Snap** to acquire the image.  
 In workbenches for more complex acquisition, a **Start** button instead of the **Snap** button is available to start the acquisition. In these workbenches an additional **Pause** button is available.  
 → In **Job Mode**: A progress bar and a **Cancel** button are displayed during acquisition. A finished acquisition is used as output. If you click **Cancel**, the image is discarded.  
 → In **Free Mode**: The image is added to the list of documents in the documents area. The last image taken is on top. Note that an unsaved image is marked with a light blue bar above the image, which helps to remember that you must save the file.

### Live mode

You can switch back to a live image at any time by clicking the **Live** icon.

### See also

- 📖 Navigating the Sample [► 102]
- 📖 Focusing the Sample Automatically [► 105]

-  Setting the Temperature and Vacuum [► 107]
-  2D Acquisition Workbench [► 733]
-  Selecting Workbenches [► 41]

### 3.18.4 Acquiring a "Best" Image

The **Best Image** workbench enables you to acquire several images with different microscope settings of the same sample position. After the acquisition you can select the image which suits you most.

**Prerequisite** ✓ The **Best Image** workbench is selected.

1. Click **Start**.
  - ➔ The software now acquires a set of images. After acquisition they are shown as thumbnails below the image area. Under each image you see the different settings the image was acquired with. If you click on a small image, the image is displayed in the image area. You can browse through all acquired images and select the image which suits you most.
2. Click **Select**, if you have found the image that suits you best.



#### See also

-  Best Image Settings Tool [► 752]

### 3.18.5 Acquiring a Temperature Series Image

The **Linkam Acquisition** workbench enables you to conduct a temperature-dependent experiment and to acquire images at pre-defined temperatures or time intervals.

**Prerequisite** ✓ A temperature-controlled Linkam stage is installed in your microscope (for more details, read the Linkam product information).  
 ✓ The **Linkam Acquisition** workbench is selected.  
 ✓ The sample is sufficiently illuminated and in focus.

1. In the **Temperature Profile Designer** click  to add a temperature ramp.
2. Specify the target temperature (**Limit**) and the change in temperature (**Rate**).
3. If desired, specify a **Hold Time**.
  - ➔ This is the duration the temperature is maintained before the next ramp starts.
4. In **Acquisition Type** specify how images are acquired during the ramp:
  - ➔ **None**: No settings
  - ➔ **Time**: Specify the time interval and the corresponding unit
  - ➔ **Temperature**: Specify the temperature step in °C.
5. Set up the camera for the selected temperature ramp using the **Camera** tool.
6. Click  to add more temperature ramps in the table and modify them as required.
7. Click **Start** on top of the workbench.

For more information on editing the temperature curve, see *Linkam Heating Stage Acquisition Setup* [► 778].

The temperature curve is applied to the Linkam stage and the images are acquired as defined for the individual temperature ramps. In the **Center Screen Area** a **Linkam View** is displayed. The **Linkam View** shows the temperature curve diagram, which is extended for each image acquired.

After acquisition of the temperature series you can move the blue vertical line along the time axis of the temperature curve. The image acquired at the corresponding temperature is shown on the right.

### See also

- 📖 Linkam Acquisition Workbench [► 736]
- 📖 Setting the Temperature and Vacuum [► 107]
- 📖 Selecting Workbenches [► 41]
- 📖 Specifying Tools for a Task [► 58]

## 3.18.6 Optimizing the Acquisition

### 3.18.6.1 Defining a ROI

In the **Extended Camera** tool, you can define a subset of the camera sensor to be acquired, the region of interest (ROI). The rest of the camera sensor area is omitted, thus speeding up the acquisition.

1. Enter the size of the ROI in pixels into the input fields **Size**.
  - ➔ The size of a pixel ( $\mu\text{m} \times \mu\text{m}$ ) is displayed below the **Acquisition ROI** overview window and depends on the physical dimensions of the camera sensor and your **Binning** setting.
2. To position the ROI, enter the **Offset** in X and Y directions.
  - ➔ The **Offset** has its origin in the upper left corner and increases to the right and downwards.

Alternatively, you can resize and move the ROI (the blue frame in the overview window) using the mouse.

### 3.18.6.2 Specifying the Microscope Setup

The **Light Path** tool serves the following purposes:

- Indicates the current microscope setup at a glance
- Enables you to change hardware components if the corresponding component is motorized

The light path setup may affect the behavior of the workbenches and tools and is stored in the image metadata.

- Prerequisite** ✓ The **Light Path** tool is selected.
- ✓ The component can be changed.  
This is indicated by the small arrow symbol in the lower right corner of the icon.
1. Click the component you wish to change.
  2. Select the settings of the new component from the list.
    - ➔ If the component is motorized, it is automatically moved into position on the microscope.
    - ➔ If the component is not motorized, the component cannot be changed automatically. This is indicated by a hand symbol in the icon. The software prompts you to change it manually. For more information on manually changing the component, see your microscope instruction manual.

If the component is coded, e.g. a coded objective revolver, you can change it manually without clicking in the **Light Path** tool. The **Light Path** tool is updated automatically. Using motorized microscopes same thing happens when using the TFT.






**See also**

 Light Path Tool [► 778]

**3.18.6.3 Working with Camera Presets**

The **Extended Camera** tool contains a **Settings** section. This allows you to select a set of preset values. You can also import or export these presets to use them on another system.

You can perform the following actions with presets:

Action	Description	Procedure
Apply preset	The current parameter values are overwritten with those stored in the preset.	<ul style="list-style-type: none"> <li>Select the desired preset from the list.</li> </ul>
Restore <i>preset</i> values	The current parameter values are reset to those stored in the preset.	<ul style="list-style-type: none"> <li>Click the <b>Reload</b> button.</li> </ul>
Restore <i>initial</i> value	The current parameter values are overwritten with the ZEISS default values.	<ul style="list-style-type: none"> <li>Click the <b>Default</b> button.</li> </ul>
Save changes to the current preset	The parameter values in the preset are overwritten with those of the current tool.	<ul style="list-style-type: none"> <li> &gt; <b>Save</b></li> </ul>
Save changes as a new preset	A new preset is created with the current parameter values.	<ul style="list-style-type: none"> <li>Select  &gt; <b>Save As</b> and enter the new name for the present.</li> </ul>
Export a preset	The parameter values stored in the preset are saved in a file.	<ul style="list-style-type: none"> <li>Select  &gt; <b>Export</b> and specify the location in the file system.</li> </ul>
Import a preset	A preset from the file system is added to the list of presets and the current parameter values are overwritten with those stored in the preset.	<ul style="list-style-type: none"> <li>Select  &gt; <b>Import</b> and select the desired preset file from the file system.</li> </ul>
Delete a preset	<p>The currently selected preset is deleted.</p> <p>The next preset in the list is selected and the values from the preset applied. If the list is empty, the default values for the tool are applied.</p>	<ul style="list-style-type: none"> <li> &gt; <b>Delete</b></li> </ul>

**Info**

Modified presets are indicated by a \* next to the name.

**See also**

 Supported File Formats [► 117]

### 3.19 Image Processing

Once you have acquired an image you can optimize its appearance by applying various image processing functions. These enable you to enhance the regions of an image that you are interested in analyzing.

In **Create a new template and edit it** within **Job Mode** you can specify which optimizations are available when the job is run. If you specify multiple image processing functions, they are applied in order from top to bottom in the **Task List**. For more information, see *Task Queue* [► 56].

#### Info

- ▶ Some acquisition workbenches enable you to optimize the image as part of the acquisition.
- ▶ The software also contains an interface for the ImageJ software. This standalone software contains many advanced processing possibilities.

#### See also

📄 Task Queue [► 56]

#### 3.19.1 Types of Image Processing Tools

The image processing tools enable you to enhance the image details you are most interested in by modifying the image after acquisition. The tools can be classified as follows:

- **Adjust**  
These tools enable you to adjust basic image settings like brightness, contrast or color settings.
- **Geometric**  
These tools enable you to apply basic image transformations such as flipping or rotating the image.
- **Sharpen**  
These tools enable you to make the image look sharper and to enhance details, e.g. contours or edges.
- **Smooth**  
These tools enable you to remove noise from the image by smoothing it. Most smoothing filters work in a similar way - possibly you have to try several filters to find the most suitable.
- **Utilities**  
These tools enable you to perform miscellaneous image operations, such as changing the color depth, splitting and combining color channels, or creating various test images.

#### See also

📄 Image Processing Workbench [► 739]

#### 3.19.2 Pixel Type

The pixel type specifies the amount of information stored in a grayscale or color image. This in turn is specified by the following:

- Number of channels
- Range of pixel values per channel
- Number format



**Number of channels** The number of channels specifies the number of colors supported by the image.

- 1 channel
  - Grayscale image
  - No color information
  - The pixel values of the channel specify relative shades of gray.
- 3 channels
  - Color image
  - One channel each for red, green and blue
  - The pixel values of each channel specify the relative shades of the corresponding color.

**Range of pixel values per channel** The range of pixel values per channel corresponds to the number of shades that can be distinguished in the channel. The larger the range, the more shades are distinguished, leading to a higher image quality.

This is also referred to as the bit depth or color depth.

**Number format** Specifies how pixel values are stored digitally. Typically integer values are used.

For processed images, where processing tools may result in non-integer values, real and complex number formats are available. However, when an image is displayed, the pixel values are always mapped to integer values. Therefore, real and complex values are only used internally and relevant if it is important to maintain the entire image information, for example if you wish to apply further processing tools at a later point in time.


- Real pixel values (Float) increase the precision of image calculations such as the ratio of two images.
- Complex pixel values (Complex) usually result from a transformation of the image into the Fourier space.
- Complex pixel values are stored with their real and imaginary part.

**Supported pixel types** The software supports the following pixel types:

Pixel Type	Number of channels	Range of pixel values per channel	Number format
8 Bit B/W	1 (gray value)	0 ... 255	Integer
16 Bit B/W		0 ... 65535	Integer
32 Bit B/W Float		0 ... $2^{32} - 1$	Real values
2 x 32 Bit Complex		<ul style="list-style-type: none"> <li>■ Real: 0 ... <math>2 \times (2^{32} - 1)</math></li> <li>■ Complex: 0 ... <math>2 \times (2^{32} - 1)</math></li> </ul>	Real and complex values
24 Bit RGB	3 (color)	0 ... $3 \times 255$	Integer
48 Bit RGB		0 ... $3 \times 65535$	Integer
3 x 32 Bit RGB Float		0 ... $3 \times (2^{32} - 1)$	Real values
3 x 64Bit RGB Complex		<ul style="list-style-type: none"> <li>■ Real: 0 ... <math>3 \times (2^{64} - 1)</math></li> <li>■ Complex: 0 ... <math>3 \times (2^{64} - 1)</math></li> </ul>	Real and complex values

### See also

- 📖 Change Pixel Type Tool [► 821]
- 📖 Grayscale Tool [► 825]

 Image Generator Tool [[▶ 826](#)]

### 3.19.3 Applying an Image Processing Tool

The software contains various image processing tools you can apply to your images. To apply an image processing tool, you must select the **Image Processing** workbench and add the desired tool (if not already available).

To add an image processing tool:





- Prerequisite**
- ✓ You are logged in as a supervisor.
  - ✓ The **Image Processing** workbench is selected.
1. Open the **Tool Overlay** by clicking the **+ Add Tool** button in the **Workbench Area**.
  2. Double-click the desired tool in the **Tool Overlay**.
    - ➔ The categories help you find the tool you need for your job.

The tool is added to the **Image Processing** workbench. You can now adjust it as required for the job, add more tools, or remove tools you do not need.

If you are working in **Create a new template and edit it** within **Job Mode** and a branch in the **Task List** contains multiple processing workbenches, they are all applied, from left to right. The output of a processing workbench provides the input for subsequent processing workbenches.

The same holds for the tools within one processing workbench: the processing tools are applied from top to bottom and the output of a processing tool provides the input for the subsequent processing tool.

#### See also

-  Image Processing Workbench [[▶ 739](#)]
-  Task Queue [[▶ 56](#)]
-  Selecting Workbenches [[▶ 41](#)]
-  Specifying Tools for a Task [[▶ 58](#)]

## 3.20 Image Analysis Basics

Once you have acquired or loaded an image you can analyze it using the analysis tools. The analysis results can then be added to a report.

If you create a new job template within **Job Mode**, you can specify which analysis tools are available when the job is run as well as tolerances (e.g. upper and lower limits for the measurement values).

The software contains the following types of analysis tools:

- **Interactive Measurements**  
These tools enable you to measure distances, angles, area, and intensities of pixels.
- **Automatic Measurements**  
Available only if you have licensed **Image Analysis** (2D Toolkit).  
Create image analysis measurement routines very easily. The **Image Analysis Wizard** guides you through the steps to create an image analysis program. Set up even complex measurement tasks fast & easily. The steps of the wizard include image segmentation, object separation and measurement of geometrical or intensity features. After you have completed the setup you can apply these settings to the data to be analyzed and obtain precise measurement results. You can display the results in table and list form and export them to csv-format. You will find a detailed description in the chapter *Image Analysis* [[▶ 242](#)].

- **Topography Measurements**

These tools help to measure horizontal or vertical distances along a profile line drawn on an EDF image.

### 3.20.1 Using Image Analysis Presets





#### Info

Modified presets are indicated by a \* next to the name.

Many tools contain a **Settings** section. This allows you to save and load typical parameter values, saving the need to enter the values each time you use the tool.

The presets are available for all users of the system. You can also import or export these image analysis programs to use them in another system.

You can perform the following actions with programs:

Action	Description	Procedure
Apply Image Analysis program preset	The current program values are overwritten with those stored in the preset.	1. Select the desired preset program from the list.
Save changes to the current preset	The parameter values in the preset are overwritten with those of the current program.	1.  > <b>Save As</b>
Save changes as a new preset	A new preset is created with the current parameter values.	1.  > <b>Save As</b> 2. Enter the new name for the Image Analysis program.
Import a preset	A preset from the file system is added to the list of presets and the current parameter values are overwritten with those stored in the preset.	1.  > <b>Import</b> 2. Select the desired preset program file from the file system.
Delete a preset	The currently selected preset is deleted.  The next program preset in the list is selected and the values from the preset applied. If the list is empty, the default settings for the image analysis are applied.	1.  > <b>Delete</b>

### 3.20.2 Analysis Results

#### 3.20.2.1 Displaying Analysis Values

You can view a table of the analysis results for all analyses performed for the current image.

- Prerequisite**
- ✓ A measurement workbench is selected.
  - ✓ You have performed at least one measurement.
1. Click **Show results table** in the **Center Screen Area**.

→ The **Results Table** is displayed on right of the center tool area.

### 3.20.2.2 Sorting Analysis Values

You can sort the analysis results so that the values of interest are displayed at the top of the list.


**Sorting single column** To sort analysis results according to one criterion:

**Prerequisite** ✓ The **Results Table** is displayed.

1. Click the header of the column you wish to sort.
2. Click the header again to sort the column in reverse order.

**Sorting multiple columns** To sort analysis results according to multiple criteria:

**Prerequisite** ✓ The **Results Table** is displayed.

1. Click on **Options**.  
→ 
2. Click **Sort Data**.
3. Select the first column to sort and the sort order (ascending, descending).
4. Click the plus icon and specify the next column to sort.



→ You can change the order of columns using the up and down arrow icons.




5. Click **Apply**.

### 3.20.2.3 Filtering Analysis Values


You can filter the analysis results so that only relevant values are displayed.

**Prerequisite** ✓ The **Results Table** panel is displayed.




1. Click the **Options** icon.  
→ 
2. Click **Filter Data**.
3. Select the column to be filtered and the filter criteria.  
→ **Equal**: the value of the cell must be identical to that in the filter string  
→ **Not equal**: the value of the cell is any value apart from the filter string  
→ **Contains**: the filter string is present in the value of the cell, e.g. "xel" matches "pixels"
4. Enter the filter string to be compared to the cell value.
5. If desired, add further criteria using the **AND** and **OR** buttons.  
→ **And**: The criteria in both the current and subsequent row must be fulfilled.  
→ **Or**: The criteria in either the current row, the subsequent row, or both must be fulfilled.
6. Activate the **Filter** checkbox.  
→ Only rows where the selected columns fulfill the criteria are displayed.

### 3.20.2.4 Saving and Exporting Analysis Results

You can export the results of analysis tools, for example to copy them to another system or to analyze them in a statistics program.

- Prerequisite**
- ✓ You have performed at least one measurement.
  - ✓ The **Save File** workbench is selected.
1. Select the **Save Table** tool.
  2. Click  and select the desired file type and location in the file system.

#### See also

-  Supported File Formats [▶ 117]
-  Selecting Workbenches [▶ 41]
-  Specifying Tools for a Task [▶ 58]

## 3.21 File & Document Management

You can import and export the following images and documents to/from the file system using tools into workbenches:

- Images
- Measurement results and data tables
- Tool presets

All other items, such as job templates, custom workbenches, image analysis, report templates and macros are managed in the **Archive**.

#### See also

-  Supported File Formats [▶ 117]

### 3.21.1 Supported File Formats

Images and documents refer to objects created during an examination.

Images and documents include the following objects:

- Images
- Measurement results and data tables
- Reports (which can be exported to an external storage device)

**Image formats** The following file formats are supported for images:

- **.dzi: Carl Zeiss Image**  
Contains the image and all associated measurements, settings, and metadata in a proprietary format.
- **.bmp: Windows Bitmap**
- **.gif: Graphics Interchange Format**
- **.jpg: Joint Photographic Engineering Group**
- **.png: Portable Network Graphic**
- **.zvi: AxioVision format for Carl Zeiss Image**  
This file format is supported to enable older Zeiss images to be loaded.

- .txm: File format of Transmission X-ray Microscopes.  
This file format needs to be imported with prior conversion. For information, see *Load Image (with Conversion) Tool* [▶ 750].

The following table lists the advantages and disadvantages of each file format:

Property	czi	bmp	gif	jpg	png	zvi	txm
<b>Access</b>							
– Read	x	x		x		x	x
– Write	x	x		x	x		
<b>Advantages</b>							
– All raw image acquisition data retained	x						x
– Raw processed image data retained	x	x					
– Measurements usw. saved as extra layer	x				x		
– All metadata retained	x						x
– Small file size			x	x	x		
– High compatibility across devices (open format)		x	x	x	x		
– Lossless compression			x		x		x
– Transparency supported			x		x		
<b>Characteristics</b>							
– Can only be opened by Zeiss ZEN software	x						
– Large file size	x	x					
– No layers		x		x			
– No transparency		x		x			
– Loss of image quality due to compression				x			

Property	czi	bmp	gif	jpg	png	zvi	txm
– Measurements "burnt into" images and cannot be removed		x	x	x			
– No metadata		x	x	x	x		
– Only 256 colors			x				

**Table formats** Measurement results and data tables can be imported and exported in the following file formats.

File extension	Description
.czt	Zeiss Table Document
.csv	Comma Separated values
.xml	eXtended Markup Language Document

**Report formats** Reports can be exported in the following file formats.

File extension	Description
.docx	Microsoft Word 2010 format
.pdf	Adobe PDF format
.xps	Microsoft XML paper specification format


### See also

 Working with Camera Presets [► 111]


## 3.21.2 Loading an Existing Image

You can load any supported image type from the file system with the **Load File Workbench** [► 732].

**Prerequisite** ✓ The file you wish to import is supported by the software.  
 ✓ The **Load File** workbench is selected. You can find the workbench in the category **Input Documents**.

1. Click on **+Tools**.
2. Double-click on the desired tool.
3. Click on  to open the file browser and select the desired image.
4. Click on **Apply**.

➔ The image will be displayed in the image area.

➔ In **Create a new template and edit it** mode you must click the **Apply** icon . When the operator runs the job, this step is performed automatically in the background. Ensure that the operator has sufficient privileges to read the file.

### See also

 Supported File Formats [► 117]

### 3.21.3 Exporting Images

The **Save File** workbench enables you to export an image, e.g. to use it for publishing or to archive it on an external storage device.

The workbench contains several tools to export images. The basic **Save Image** tool is visible by default and enables you to export an image in the most common image formats such as .czi, .tif, .jpg, or png. You can select the image format in the dialog window that opens when you apply the tool.

For detailed control of the export settings such as resolution or compression, or if you wish to export a movie, you can add one of the more advanced export tools:

**Prerequisite** ✓ The **Save File** workbench is selected.

1. In the **Workbench Area**, click **+ Add Tool**.
2. Select the desired export tool.

For more information about the individual export tools, see *Save File Workbench* [► 745].

#### Info

If you are working in **Free Mode**, you can right-click the image you wish to export from the **Documents Area** and select **Save As....** In the system dialog, you can activate the **Burn in Annotations** checkbox to save the annotations. Note that you can add burn in annotations to any image format but czi. Activate the **Save Metadata** checkbox to save metadata. You can save several images simultaneously by selecting them with **Ctrl**.

#### See also

- Supported File Formats [► 117]
- Save File Workbench [► 745]
- Save Image Tool [► 855]
- Image Export Tool [► 857]

### 3.21.4 Creating Charts From a Table File

**Prerequisite** ✓ You have created or loaded a table file (\*.czt, \*.csv or \*.xml format).  
✓ The **Table Processing** workbench is selected and the **Create Chart** tool is opened.

1. Select the table file from the documents list in the right area.
2. Adjust all settings in the **Create Chart** tool to according to your needs for the resulting chart.
3. Click **Apply** to create a new image from the chart.

The resulting chart image is displayed in the documents list. You can export the chart image by right-clicking on the chart image in the documents list and selecting **Save As....**


Note that the chart can also be placed into a report. Therefore the report template must consist the "chart" placeholder. This placeholder can be filled by any chart.

### 3.21.5 Importing Multiple TIFF Files

In ZEN core you can import Tiff stacks created by Smart SEM and Metrotome.

**Prerequisite** ✓ You have added the **Import TIF(F) Stack** tool to the **Load File** workbench.



1. In the **Import TIF(F) Stack** tool, click .  
→ A file browser opens.
2. Select the tiff images you want to import as a stack. To select multiple images, press **Ctrl** while clicking on the files. Alternatively, you can also select a range of images by pressing **Shift** and clicking on the first and last image.  
**Note:** Select only images with consistent metadata with respect to number of pixels, image size, bit depth and spacing of the images.  
**Note:** To make sure the stack is composed/ordered correctly, watch out how the images are sorted in the explorer and in which order you select them.
3. If you import images without scaling information, deactivate **Read XY Scaling from File** and manually enter the information. Note that if reading the metadata information for xy scaling fails, the function uses the value that is set with the slider or input field even if the checkbox is activated.
4. You can set the slice distance manually if you deactivate **Read Z-Spacing from File**. This step is optional and should only be done if you have reason to believe the information calculated with the metadata is incorrect. When you set the spacing manually, the information in the metadata is ignored. Leave **Read Z-Spacing from File** activated and the z-spacing is automatically calculated with information saved in the metadata of the images. Note that if reading the metadata information for z-spacing fails, the function uses the value that is set with the slider or input field even if the checkbox is activated.
5. Click **Apply**.

The Tiff stack is now imported into ZEN core and a czi-file is created. A progress bar displays the status of the import. Note that importing larger image files may take some time.

### See also

 Import TIF(F) Stack Tool [► 751]

## 3.22 Forms and Reports

Forms provide a simple way to add user-defined information to a report. Reports enable you to get an overview of all relevant documents and information from your examination (including that entered in forms) in a single document.

As a supervisor, you can use templates to configure the properties of forms or reports. In form templates, you also specify the operator's tasks during job run.

- Form templates you create and manage within the software, see also *Form Designer* [► 74].
- Report templates you manage within the software, but you create them using the **ZEN Word Add-In** externally, see *Creating a New Report Template* [► 80].
- In **Free Mode** and in **Job Mode**, in the report template, you assign the form template to the form placeholder, see *Assigning Information to Report Placeholders* [► 121].

Typically, the information entered in a form should also be displayed in the job report. The software enables you to import a form template into the report template.

### 3.22.1 Assigning Information to Report Placeholders

Reports enable you to summarize all the information from your examination in a single document. Typical information includes:

- Images
- Measurement data tables
- Metadata (e.g. examination time, hardware setup)

Each report template contains placeholders for the above information to enable you to collate the information easily. The placeholders also ensure that each time the job is run, the same information is added to the report.




**Prerequisite** ✓ At least one report template is listed in the **Add Templates** tool.







1. Select the desired report template in the **Add Templates** tool.
  - ➔ Various placeholders are listed below the list of templates and a preview of the report is displayed in the **Center Screen Area**.
2. Click the arrow icon in a placeholder and select the corresponding data that you wish to add, for example an image or a table containing measurement results, etc.
  - ➔ As a rule you can add a single item to each placeholder. The image placeholder is an exception: you can add multiple images to a single image placeholder. Therefore simply select multiple images from the list. The selected images are highlighted grey.
  - ➔ The report preview updates accordingly.
3. Repeat the above step until you have added information to all the placeholders.
4. Click **Create Report** to create the document in the **Documents Area**.
  - ➔ You can export the report from the **Documents Area** by using the context-menu.
5. If you require a paper copy of the template, click **Print Report**.

### 3.22.2 Types of Placeholders

Each report template contains placeholders to enable you to collate examination information easily. You add the placeholders when creating the report template. The placeholders in the template ensure that each time the job is run, the report is generated using output images and tables.

The following types of placeholders are supported:

Parameter	Description
<b>Image</b> 	<p>Enables you to add any image from the current examination</p> <p>For either type of image, in the <b>ZEN Content Controls</b> area, you can do the following:</p> <ul style="list-style-type: none"> <li>▪ save the image placeholder with a unique name</li> <li>▪ load sample image</li> <li>▪ specify the metadata to be displayed, for example acquisition time, username, resolution, etc.</li> </ul>
<b>Table</b> 	<p>Enables you to add any measurement result from the current examination.</p> <p><b>Note:</b> Do not use this placeholder to structure the content of a report template. Use the <b>MS Word</b> tables instead.</p> <p>In the <b>ZEN Content Controls</b> area, you can do the following:</p> <ul style="list-style-type: none"> <li>▪ save the table placeholder with a unique name</li> <li>▪ load a file</li> <li>▪ link to an image so the table can be connected with an image to show the measurement data.</li> </ul>
<b>Chart</b> 	<p>Enables you to add charts. In the <b>ZEN Content Controls</b> area, you can add a unique name.</p>

Parameter	Description
<b>Form</b> 	<p>Enables you to add a form template to the report.</p> <p>In the <b>ZEN Content Controls</b> area, you can save the form with a unique name and load a sample form.</p> <p>Note that you create form templates only with the Form Designer in <b>Manage Templates &gt; Form</b>. You can link these form templates created with the form designer to the form placeholder in the report.</p>
<b>Properties</b> 	<p>Enables you to create a table of metadata, and specify the source, e.g. an image.</p> <p>In the <b>ZEN Content Controls</b> area, you can do the following:</p> <ul style="list-style-type: none"> <li>▪ save the property placeholder with a unique name.</li> <li>▪ specify the data source type, e.g. an image.</li> <li>▪ specify the metadata to be displayed, for example acquisition time, username or resolution.</li> <li>▪ link to an image so the property can be connected with an image.</li> </ul> <p>Note that if you want to structure the template with a side-by-side arrangement, e.g. an image next to a property, add a <b>MS Word</b> table instead of a table placeholder.</p>
<b>Signature Line</b> 	<p>Enables you to add a digital signature line. This is a <b>MS Windows</b> functionality. For more information, open the Online Help you can call in the pop up.</p>
<b>Label</b> 	<p>Enables you to add a text label that can have a different value in each of the languages supported.</p> <p>This is useful if your report template is used in different languages.</p>
<b>File</b> 	<p>Enables you to specify files (.txt, .rtf, .doc, .docx, .htm, .html) created during an examination that should be added to the report.</p>
<b>Group</b> 	<p>Enables you to bundle more than one placeholder to iterate results in a loop, for example <b>Image</b> and <b>Table</b> placeholders. You can add multiple placeholders.</p> <p><b>Example:</b> Inside a loop task with 5 iterations of one acquisition task and another interactive measurement task. The report should show one image with annotations and one table for each iteration. Solution: One group placeholder with one image placeholder and one table placeholder inside the group placeholder.</p>
<b>Info</b> <p>If you have any fixed element that should be included in each report in the same manner, such as a company logo, use the common Microsoft Word functions instead of a placeholder.</p>	

### 3.22.3 Selecting a Form Template

Forms provide a simple way to add information to a job when it is run by an operator. The software comes with several pre-defined form templates. These are stored in the **Archive**.

**Prerequisite** ✓ The desired form template is in the **Archive**.

- ✓ The **Forms** workbench is selected.
- 1. Click the "... " icon.
  - ➔ A list of the form templates in the **Archive** is displayed.
- 2. Select the desired form template and click **OK**.

If the available form templates in the **Archive** are not suitable for your purposes, you can create a new form template or modify an existing one by using the Form Designer. In the **Archive** you can also import form templates from the file system, e.g. to copy a template from another system.

#### 3.22.4 Selecting a Report Template

The software comes with several pre-defined report templates. Each report template contains placeholders to enable you to collate examination information easily into a single document.

- Prerequisite**
- ✓ The desired report template is in the **Archive**.
  - ✓ The **Reports** workbench is opened.

1. Click the folder icon .
  - ➔ A list of form templates from the **Archive** is displayed in the **Open Template** dialog.
2. Select the desired report template and click **OK**.

If the available report templates in the **Archive** are not suitable for your purposes, you can create a new report template or modify an existing one using the **ZEN Word Add-In**. In the **Archive** you can import report templates from the file system, e.g. to copy a report template from another system.

## 4 Basic Functionality

The following functionalities are included in the base software:

- *arivis Cloud (on-site)* [▶ 125]
- *CAD Import* [▶ 129]
- *ZEN Data Storage Client* [▶ 147]
- *Manual Extended Focus (EDF)* [▶ 141]
- Measurement
- Online Measurement
- *Panorama* [▶ 143]
- *QualData Export* [▶ 744]

### 4.1 arivis Cloud (on-site)

This module enables you to execute modules from arivis Cloud. arivis Cloud is an online platform to create customized workflows for image processing tasks of your microscopy images, see <https://www.arivis.cloud/home/>. The functionality provides the execution of certain demo modules as well as individual arivis Cloud modules.

#### 4.1.1 Preliminary Work & Prerequisites

The following prerequisites need to be fulfilled to use **arivis Cloud (on-site)**:

- **Create an arivis Cloud Account**  
In order to use the functionality and download the arivis Cloud modules, you need an account on the platform. Go to <https://www.arivis.cloud/home/> to sign up.
- **Install Docker**  
To be able to use your arivis Cloud modules locally on your machine, you have to install and run the software called Docker Desktop. For more detailed information, see *Requirements for Docker Desktop* [▶ 729].

#### 4.1.2 Creating and Entering an Access Token

To be able to connect ZEN core with **arivis Cloud**, you need an access token. Take the following steps to create the token and enter it in ZEN core.


- Prerequisite**
- ✓ Your PC has a connection to the internet and you are signed in on the arivis Cloud platform.
  - ✓ You are on the **Homescreen** in ZEN core.
1. Click **Maintenance > General Options > arivis Cloud**.
  2. Click the link below the input field (<https://www.arivis.cloud/app/user/client-keys>).  
→ In your browser, the page for your personal access tokens opens.
  3. Click **New Access Token** to create a new access token.
  4. In the **New Access Token** window, enter a name, an expiration date, and select the desired access scopes for the token.
  5. Click **Next**.  
→ Your personal access token is created and displayed.
  6. Copy your **Personal token**. Optionally, you can also consider storing the token in a secure location in case it needs to be recovered.

7. Go back to ZEN core to **Maintenance > General Options > arivis Cloud** and paste the token into the input field.
8. Click **OK**.

You have now created an access token and entered it in ZEN core. You can now use arivis Cloud functionality in ZEN core.

### 4.1.3 Downloading an arivis Cloud Module

If you have done all the preliminary work and created an access token, you can now download a module.

- Prerequisite**
- ✓ Your PC is connected to the internet.
  - ✓ You are in **Manage Templates** mode.
1. In the **Show** drop-down list, select **arivis Cloud Modules**.
  2. In the tool bar, click on the cloud icon .
    - ➔ A browser window opens.
  3. In the browser window, select the module(s) you want to download and click **OK**.
    - ➔ The download of the module starts.

After a successful download the module is displayed in the **Manage Templates** list. It can now be used in ZEN core.




#### Info

##### Archive

Your module is saved into the currently selected ZEN core archive. If you switch the archive (e.g. from **Local Archive** to the **ZEN Data Storage Archive**), your modules will no longer be shown in the **Manage Template** list. Also they cannot be loaded in the workbench. For information about the archive, see *Archive Options* [▶ 707].

To use your modules in such a case, either switch back to the archive which was configured during the initial download, or download the module again with the new archive configuration.


#### See also

-  arivis Cloud (on-site) [▶ 125]
-  Preliminary Work & Prerequisites [▶ 125]
-  Creating and Entering an Access Token [▶ 125]

### 4.1.4 Using arivis Cloud Modules Locally

Once you have downloaded an arivis Cloud module, you can use it locally on your machine. For this you need the *arivis Cloud Modules (on-site) Workbench* [▶ 128], which is available in **Free Mode** as well as in **Job Mode**.

- Prerequisite**
- ✓ You have downloaded an arivis Cloud module, see also *Downloading an arivis Cloud Module* [▶ 126].
  - ✓ You are in **Free Mode** or in **Job Mode**. If you are in **Job Mode**, you have already created and/or opened a job template at the position you want to use the module.
1. In **Free Mode**, click **+** (Add workbench). If you are in **Job Mode**, click **+** (Add Task to Job Template).


2. Click **Custom Solutions** and select **arivis Cloud Modules (on-site)**.
3. Click **+ Add**.
  - The **arivis Cloud Modules (on-site)** workbench is added.
4. Click .
  - The **Open Template** dialog opens.
5. Select the module you want to run locally and click **OK**.

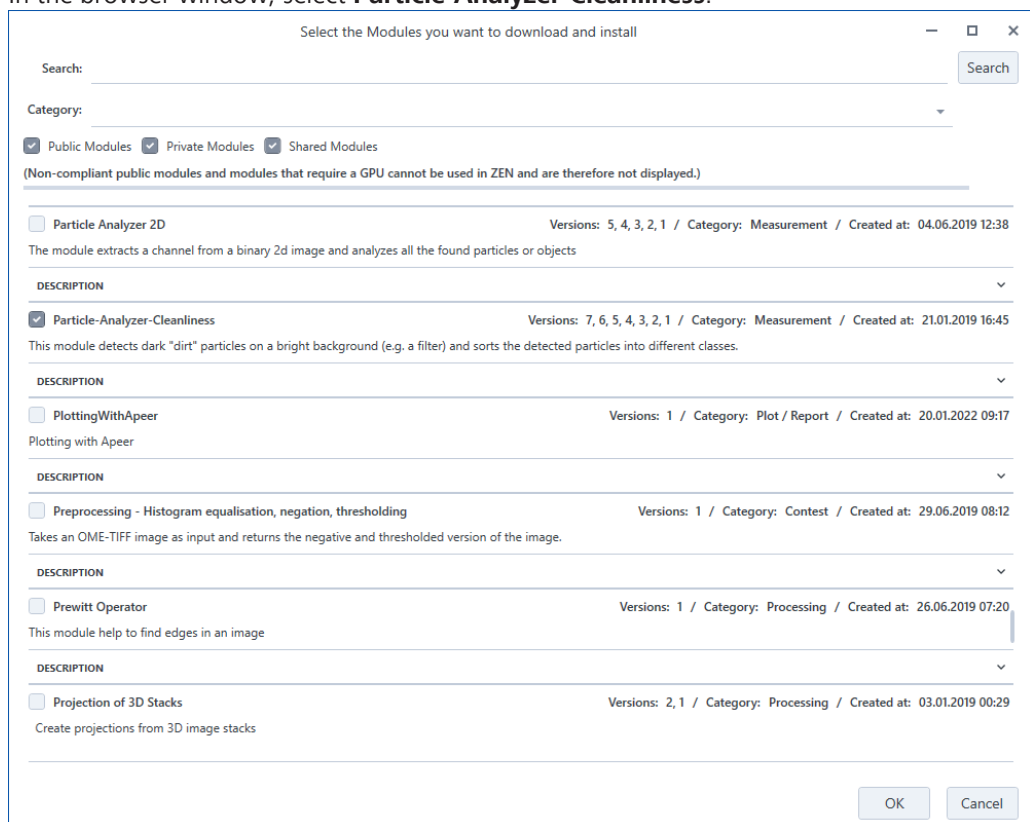
You have now added the arivis Cloud module and can use it locally in **Free Mode** or in your job template.

#### 4.1.5 Example for arivis Cloud (on-site)


This chapter shows you how to download an arivis Cloud module and use it locally. For the purpose of this example, the **Particle-Analyzer-Cleanliness** module is downloaded and added to the workbench in **Free Mode**.

- Prerequisite**
- ✓ Your PC is connected to the internet.
  - ✓ You are on the **Homescreen**.

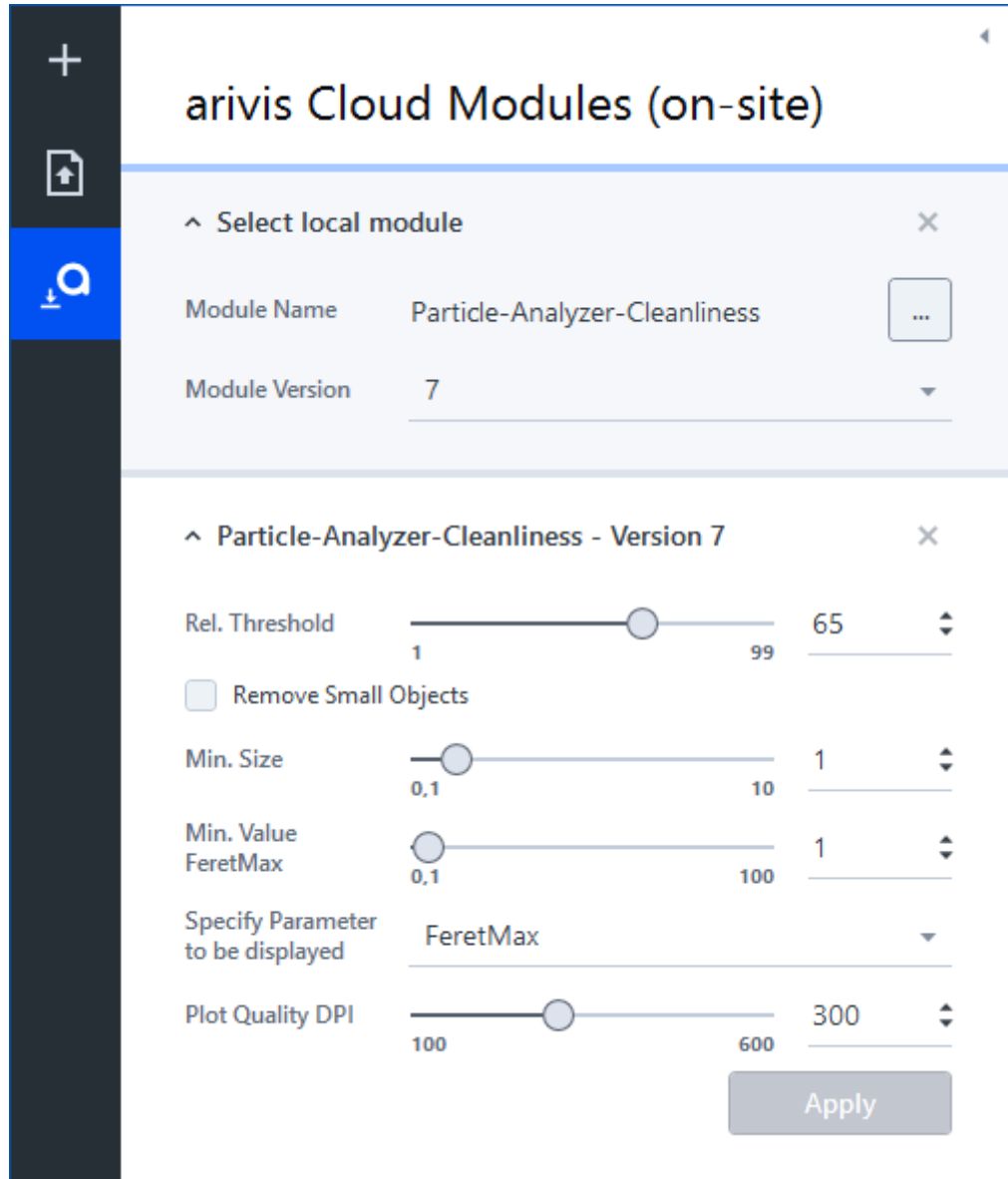
1. Click **Manage Templates**.
2. In the **Show** drop-down list, select **arivis Cloud Modules**.
3. In the tool bar, click on the cloud icon .
  - A browser window opens.
4. In the browser window, select **Particle-Analyzer-Cleanliness**.



5. Click **OK**.
  - The download of the module starts.
  - After a successful download the module is displayed in the **Manage Templates** list.
6. Go back to the **Homescreen** and click **Free Mode**.

7. Click **+ Add Workbench > Custom Solution > arivis Cloud Modules (on-site) > + Add**.  
→ You have now added the **arivis Cloud (on-site)** workbench.
8. On the workbench, click .  
→ The **Open Template** dialog opens.
9. In the **Open Template** dialog, select the module **Particle-Analyzer-Cleanliness** and click **OK**.


You have now added the **Particle-Analyzer-Cleanliness** module and can use it locally in **Free Mode**.





#### 4.1.6 arivis Cloud Modules (on-site) Workbench

With this workbench you can open your downloaded arivis Cloud modules and use them locally on your machine. The options displayed in the tools area of the workbench depend on the selected module.



Parameter	Description
<b>Module Name</b>	Displays the name of the selected arivis Cloud module. With the  button you can open a template list with all the available modules and select one.
<b>Module Version</b>	Selects the version of the module.

### See also

-  [arivis Cloud \(on-site\) \[► 125\]](#)
-  [Downloading an arivis Cloud Module \[► 126\]](#)

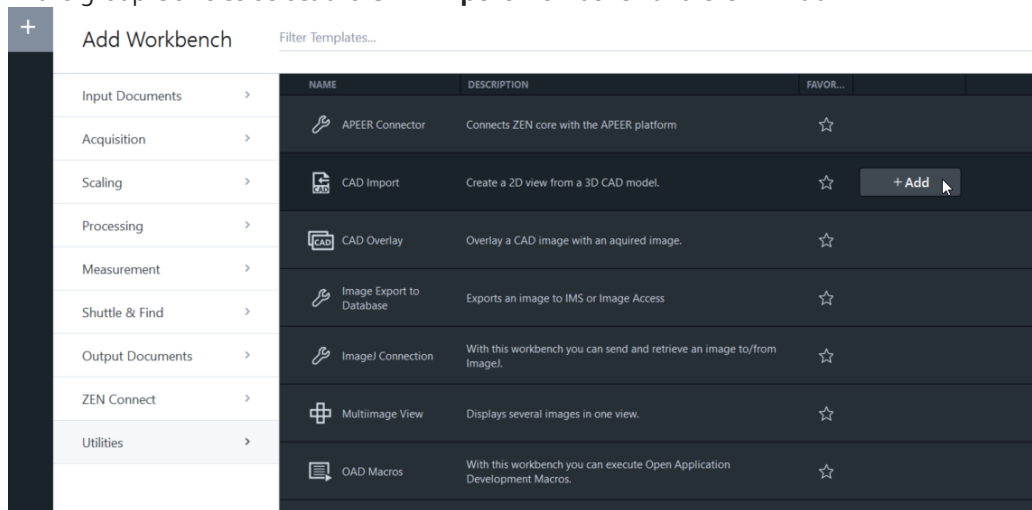
## 4.2 CAD Import


This module enables you to import CAD models to ZEN software and create overlay images with microscope images.

### 4.2.1 Importing a CAD Model

**Prerequisite** ✓ You are in **Free Mode**.

- In the group **Utilities** select the **CAD Import** workbench and click **+ Add**.



- In the **Load CAD** tool click on the  (Select File) icon.
- Select a CAD file (\*.brep, \*.step, \*.iges, \*.dxf) from the file system and click **Open**.

The CAD model is displayed in the image area. To change the view or display of the image use the **CAD Viewer** tool, see **CAD Viewer Tool [► 133]**. There you can also create a 2D image of the imported CAD model for further processing, e.g. measurements or overlay images. Note that currently only 2D views of the CAD models are supported.

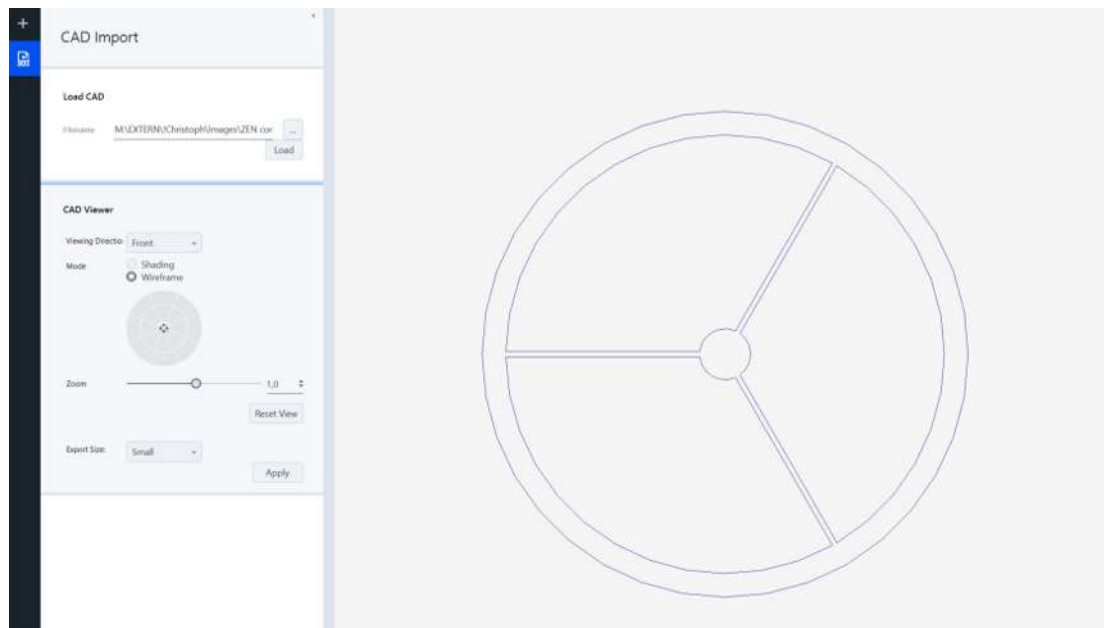
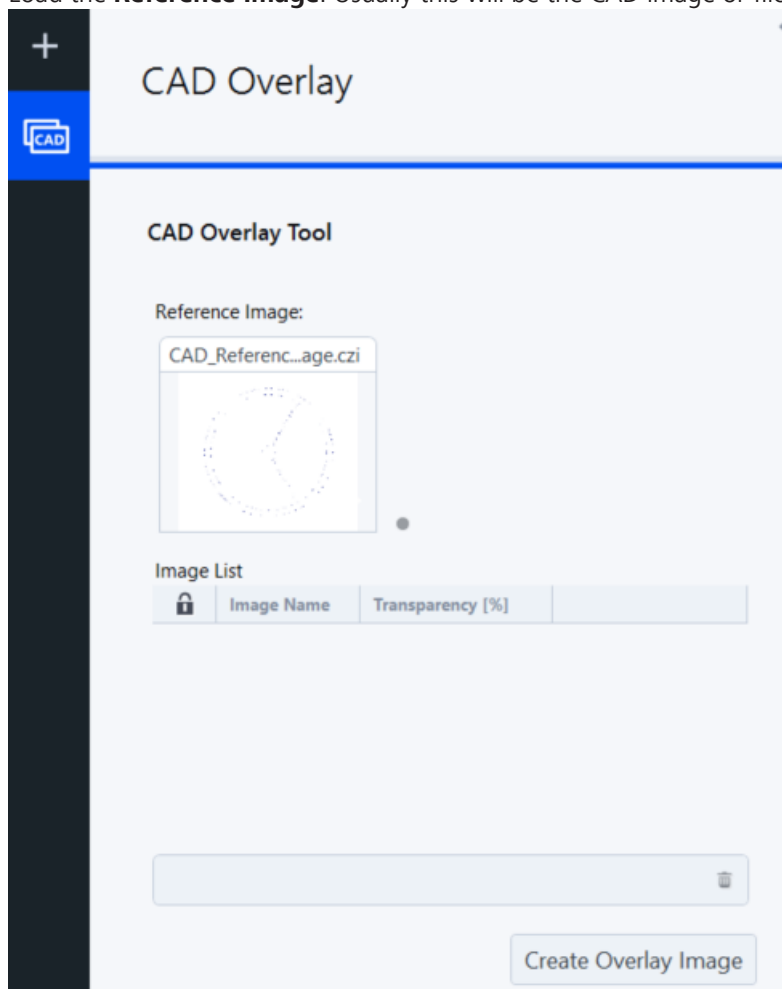


Fig. 5: Imported CAD model (2D view)

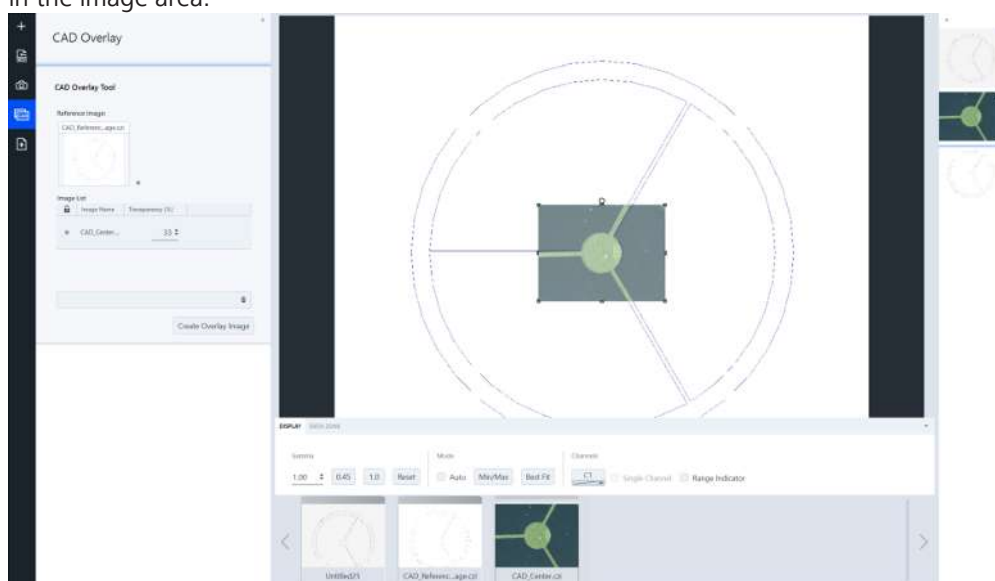
#### 4.2.2 Creating an Overlay Image

- Prerequisite**
- ✓ You are in **Free Mode**.
  - ✓ You have imported a CAD model and created a 2D image, see *Importing a CAD Model* [▶ 129].
  - ✓ You have acquired an microscope image from the sample which is displayed in the CAD model.

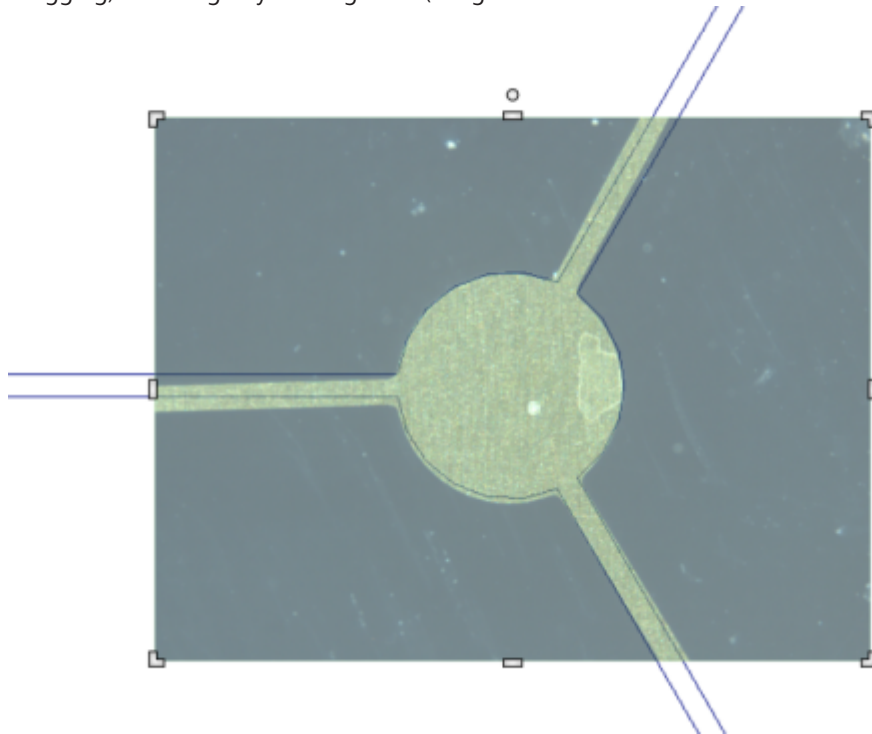
1. Load the **Reference Image**. Usually this will be the CAD image or file.



- Below the image area you will see an image browser. Make sure that the image (microscope image) is already loaded and displayed in the browser.
2. Double-click (or Drag & Drop) the microscope image in the image browser.
    - The image will be loaded to the **Image List** and automatically displayed as overlay image in the image area.



- Adapt the microscope image to fit the reference image. You can adapt (turning, resizing, dragging) the image by clicking on it (image frame with several handles will be visible).



- When you are satisfied with the positioning click on **Create Overlay Image**.

The overlay image will be created and is available in the image list (right side). Do not forget to save the image via right-click / **Save As...** function.

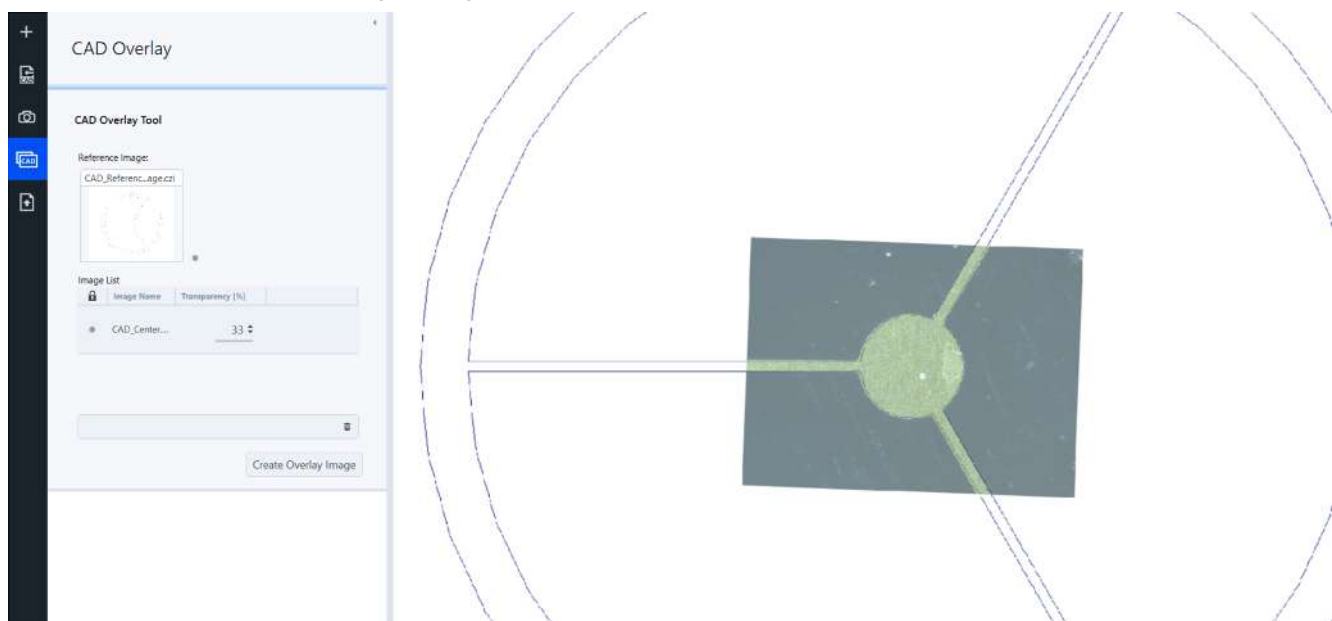


Fig. 6: CAD Overlay Image

### 4.2.3 Load CAD Tool

Using this tool you can import CAD data or images from the file system. To import a file, click on the **Open** icon (...) and select the desired file. If you click on **Load**, the CAD file will be imported.

The following CAD file formats can be imported:

- **AutoCAD** files (\*.dwg, \*.dxf)

- **Pro/E** files (\*.drw)
- **BREP** files (\*.brep, \*.rle)
- **STEP** files (\*.stp, \*.step)
- **IGES** files (\*.igs, \*.iges)

#### See also

 CAD Import Workbench [► 134]

### 4.2.4 CAD Viewer Tool

Parameter	Description
<b>Viewing Direction</b>	<p>Here you can set different (2D) viewing directions for the CAD image (e.g. <b>Front</b>, <b>Left</b>, <b>Right</b>, etc.). By selecting another entry from the list, the display of the CAD image will automatically change in the image area.</p> <p>Note that right now only 2D views are supported.</p>
<b>Mode</b>	Here you can select the display of the CAD image.
- <b>Shading</b>	Fills the CAD image and applies smooth shading.
- <b>Wireframe</b>	Displays the wireframe of the CAD image.
<b>Zoom</b>	Here you adjust the zoom factor of the CAD image. If you click on <b>Reset View</b> , the initial view is restored.
<b>Export Size</b>	<p>Here you can select the size of the export image. If you click on <b>Apply</b>, the current view of the CAD image will be exported.</p> <p>Note that the proportion width and height of the image remains the same as shown in the current view.</p>
- <b>Small</b>	The maximal side length of the resulting image is set to 1000 pixel.
- <b>Medium</b>	The maximal side length of the resulting image is set to 2000 pixel.
- <b>Large</b>	The maximal side length of the resulting image is set to 3000 pixel.

#### See also

 CAD Import Workbench [► 134]

### 4.2.5 CAD Overlay Tool

Parameter	Description
<b>Reference Image</b>	Here you can select the reference image which will be used for the background of the overlay image. We recommend to use the image that shows a larger area than the reference image.
<b>Lock/Unlock Reference Image</b>	If you click on the small dot next to the reference image, you can lock the reference image from editing.
<b>Image List</b>	The image list shows all images which can be used for the overlay image. To add an image to the list, double-click on the image in the image browser under the image area.

Parameter	Description
<b>Create Overlay Image</b> button	If you click on this button, the overlay image will be generated.





**See also**

 [CAD Overlay Workbench \[► 134\]](#)

**4.2.6 CAD Import Workbench**

This workbench enables you to import CAD data or images. Furthermore, you can view the 3D models in different 2D views for further processing, e.g. for measurements or overlay images.






**See also**

 [Load CAD Tool \[► 132\]](#)  
 [CAD Viewer Tool \[► 133\]](#)  
 [CAD Overlay Tool \[► 133\]](#)  
 [Importing a CAD Model \[► 129\]](#)

**4.2.7 CAD Overlay Workbench**

This workbench enables you to create overlay images using the CAD image on the one hand and an acquired microscope image on the other hand.

**See also**

 [CAD Overlay Tool \[► 133\]](#)  
 [Load CAD Tool \[► 132\]](#)  
 [CAD Viewer Tool \[► 133\]](#)  
 [Creating an Overlay Image \[► 130\]](#)  
 [Importing a CAD Model \[► 129\]](#)





**4.3 Interactive Measurements**

Interactive measurements enable you to measure the properties of a sample, for example, angles, area, and intensities of pixels. The tools can be classified as follows (the available tools depend on your hardware setup and licenses):

- **Annotations**  
Enable you to add text labels to an image, mark objects of interest, or determine the coordinates of a point in the standard or relative coordinate system.
- **Areas/Contours**  
The majority of these tools enable you to calculate the area (in pixels) enclosed by various shapes. Furthermore, the mean intensity of the enclosed pixels is also calculated. Some Area Tools are used to calculate the length of curves, such as the Spline Curve tool.
- **Distances**  
Enable you to measure angles and distances between lines, curves and points.

For more information on an individual tool, see the tool reference.


**See also**

-  Layering Interactive Measurements [► 136]
-  Adding an Annotation to Interactive Measurements [► 136]
-  Editing Interactive Measurements [► 137]
-  Hiding an Interactive Measurement [► 139]

### 4.3.1 Adjusting Interactive Measurements

You can adjust various properties of interactive measurements, for example:

- Line color, strength, and style
- Text font, color, and size
- Opacity
- Measurement results displayed in the in the **Center Screen Area** next to the interactive measurement and in the corresponding tool

- Prerequisite**
- ✓ An interactive measurement workbench is selected.
  - ✓ You have performed at least one interactive measurement.
1. Select the desired interactive measurement tool.
  2. Click the gear wheel icon.
    - 
  3. Adjust the parameters as desired.
    - The measurements are updated immediately.

### 4.3.2 Using Interactive Measurement Tools

Interactive measurement tools enable you to measure distances, angles, areas, and intensities of pixels. In the **Favorites** section you can arrange your favorite tools by simply dragging them from the tools selection to the favorites bar.

- Prerequisite**
- ✓ An image is displayed.
  - ✓ The **Interactive Measurement** workbench is selected.
1. Select the desired measurement tool from the tool selection. Note that by default the **Keep Measurement Tool** checkbox at the bottom of the tool selection is activated. This will keep the selected tool active after you have drawn in a measurement.
  2. Alternatively, select a tool from the **Favorites** bar.
    - If it is not visible, click **+ Add Tool** and double-click on the desired tool.  
Note that only parameters of the active tool are displayed in the workbench area.
  3. Click to place the measurement tool in the image.
    - For more information about how to use each tool, see *Interactive Measurements Workbench* [► 742].
  4. To add more measurements, repeat the above steps.
    - The selected tool remains active until you press **Esc** or close the window **Apply selected tool (Esc to abort)**.

If desired, you can modify the measurement as follows:

- Sorting interactive measurements
- Editing interactive measurements
- Adding an annotation to interactive measurements

- Repeating or correcting an interactive measurement

### See also

- ▢ Layering Interactive Measurements [► 136]
- ▢ Adding an Annotation to Interactive Measurements [► 136]
- ▢ Editing Interactive Measurements [► 137]
- ▢ Hiding an Interactive Measurement [► 139]

## 4.3.3 Layering Interactive Measurements

Each measurement is stored in an imaginary layer. By default, the first measurement is the bottom layer and the most recent measurement is the top layer. You can change the order of the layers, for example if two measurements overlap and one is obscuring the other.

To move a measurement up or down a layer:

1. Right-click the measurement.
2. Select how you want to move the measurement:
  - **Bring Forwards**: up one layer
  - **Send Backwards**: down one layer
  - **Bring to Front**: to top
  - **Send to Back**: to bottom

### See also

- ▢ Adding an Annotation to Interactive Measurements [► 136]
- ▢ Editing Interactive Measurements [► 137]
- ▢ Hiding an Interactive Measurement [► 139]

## 4.3.4 Adding an Annotation to Interactive Measurements

You can add an annotation to an interactive measurement, for example to label an area of the sample.

### Adding an annotation

To add an annotation:

**Prerequisite** ✓ At least one measurement is visible in the **Center Screen Area**.

1. Double-click the measurement in the **Center Screen Area**.
2. Enter the desired text.
  - To add an extra line of text press the **Enter** key.
3. Click outside the measurement.

### Info

You can change the formatting of the annotation in the same way as you change the appearance of the measurement result.

- You cannot apply different text formatting to the annotation and the measurement result.
- You cannot apply different formatting to individual words or characters of the annotation.

### Removing an annotation




To remove an annotation:

**Prerequisite** ✓ At least one measurement is visible in the **Center Screen Area**.



- 1. Double-click the desired measurement.
- 2. Delete all the text in the annotation.
- 3. Click outside the measurement.

See also

-  Layering Interactive Measurements [► 136]
-  Editing Interactive Measurements [► 137]
-  Hiding an Interactive Measurement [► 139]

4.3.5 Editing Interactive Measurements

You can change the following properties of an interactive measurement:

- Size and position of the entire measurement (measurement result and individual nodes)
- Position of measurement result
- Number and position of individual nodes

Info

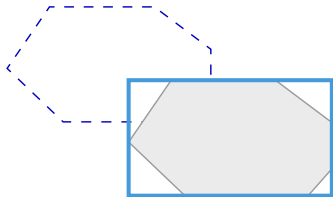

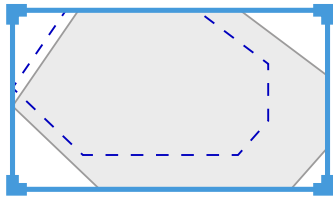
For some tools you can change their orientation (rotation or placement of the measurement arcs).

For more information, refer to the help topic for the corresponding tool.

**Entire measurement** To change the properties of the entire measurement:

**Prerequisite** ✓ At least one measurement is visible in the **Center Screen Area**.

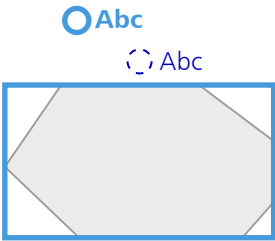
- 1. Click the desired measurement and perform one of the following actions:

Graphic	Aim	Action
	Move measurement	Click within the bounding box and drag
	Resize freely	Drag the sides of the bounding box
	Resize (proportional)	Press <b>Ctrl</b> and drag the corners of the bounding box

**Measurement result** To change the properties of the measurement result:

**Prerequisite** ✓ At least one measurement is visible in the **Center Screen Area**.

- 1. Click the desired measurement and perform the following action:

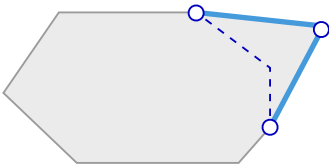
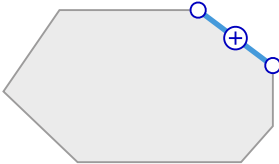
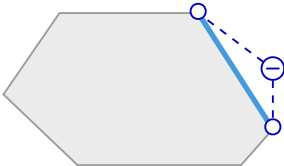
Graphic	Aim	Action
	Move measurement result	Drag the node of the measurement result

**Annotation position** To alter the position of an annotation:

- Prerequisite** ✓ At least one measurement is visible in the **Center Screen Area**.
1. Click the desired measurement.
  2. Place the cursor over the annotation node. The cursor changes to a hand icon.
  3. Drag the node to the new location.

**Individual nodes** To change the properties of individual measurement nodes:

- Prerequisite** ✓ At least one measurement is visible in the **Center Screen Area**.
- ✓ The measurement was created by defining multiple nodes.
1. Right-click the desired measurement.
  2. Click **Edit Points**.
  3. Perform one of the following actions:

Graphic	Aim	Action
	Move node	Drag node
	Add node	Click between two nodes
	Remove node	Press <b>Ctrl</b> and click node

**See also**

- 📖 Layering Interactive Measurements [► 136]
- 📖 Adding an Annotation to Interactive Measurements [► 136]
- 📖 Hiding an Interactive Measurement [► 139]

### 4.3.6 Hiding an Interactive Measurement

Normally, when a job is run, interactive measurements are automatically placed on the image at the location specified in **Create a new template and edit it** within **Job Mode**. However, it is also possible to create an interactive measurement task where the image has no measurements pre-placed. In this case, ensure that the operator knows where to perform the measurement (e.g. using a suitable workbench description).

1. Click the desired measurement.
2. Delete the measurement using the **DEL** key on your keyboard.

The tool remains in the **Workbench Area** but the measurement is no longer displayed in the image. The operator running the job later can create the measurement freely instead of modifying a pre-placed measurement.

#### Info

You can also use this feature to correct a faulty measurement while working in **Create a new template and edit it** within **Job Mode**:

- ▶ Delete the measurement from the image and click the **Redraw** button in the tool to repeat the measurement correctly.

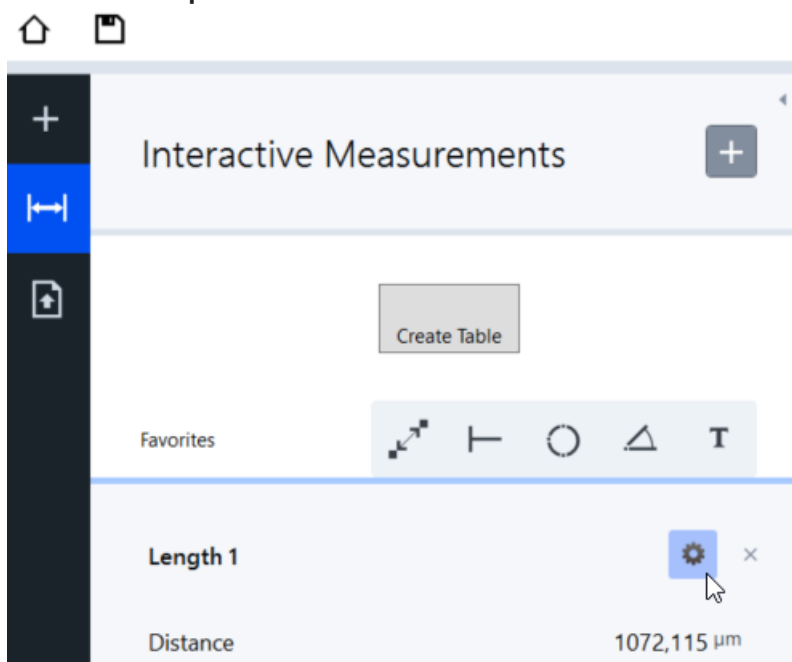
#### See also

- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]

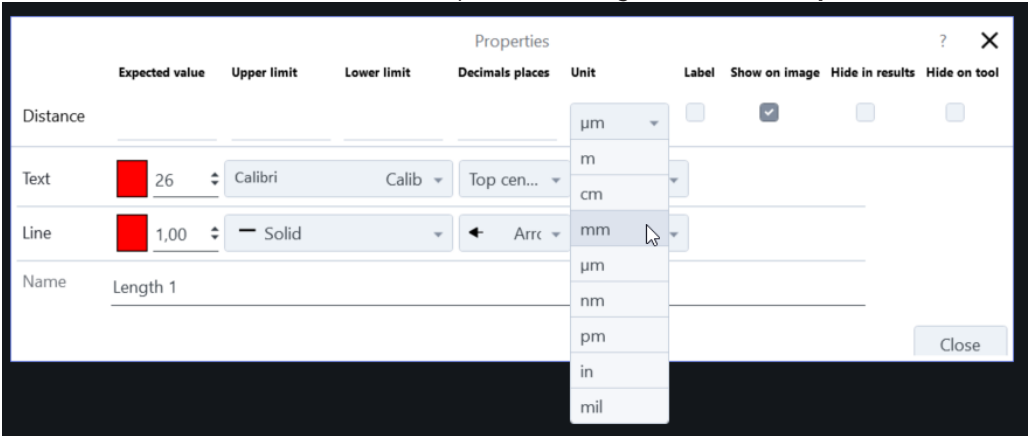
### 4.3.7 Changing Units of Measurements

**Prerequisite** ✓ You have drawn in a measurement to an image, e.g. a **Distance** measurement.

1. Select the measurement by clicking on it.
2. Click on the **Properties** icon in the measurement box.



- The **Properties** dialog opens.
3. Select the desired unit from the **Unit** drop-down list, e.g. **mm** instead of **µm**.



The changed unit will be displayed in the image and in the measurement box.



### 4.3.8 Adding Measurements to a Live Image

- Prerequisite** ✓ The **2D Acquisition** or **2D Acquisition (automatic)** Workbench is selected.
- ✓ You see the Live image of the microscope camera.
1. Click on **+ Add Tool**.  
→ The list of tools is displayed.
  2. Double-click on the desired measurement tool under **Areas/Contours** or **Distances**, e.g. **Distance**.  
→ The measurement tool is active.
  3. Draw in the measurement to the live image.  
→ If you click on **Snap**, the image will be acquired including the drawn in measurement. Do not forget to save the image to your file system.

### 4.3.9 Formatting Graphical Elements

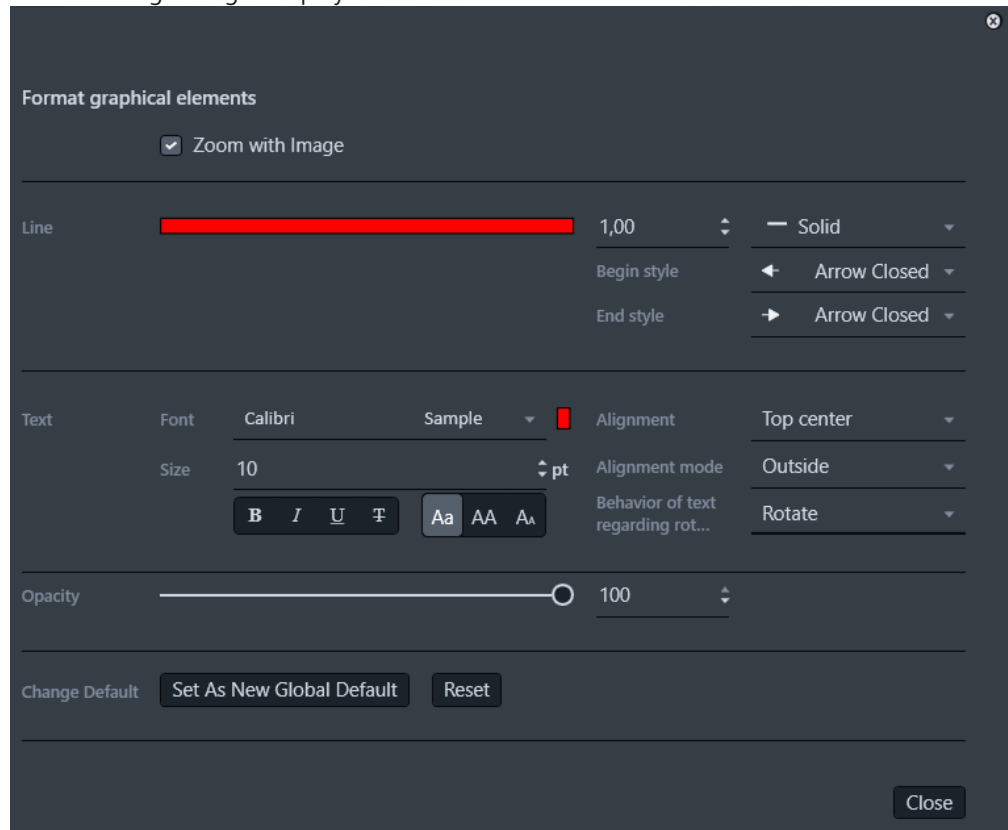
Once you have applied annotations, angles or other graphical elements to your image, you can format each of them separately. It is only possible to format the elements in the **Interactive Measurements** workbench. If the formatted element is available in the **Topography Measurements** workbench, the applied format will be used there as well. The following tools of the workbenches correspond:

Topography Measurements workbench	Interactive Measurements workbench
<b>Profile Distance</b> tool	<b>Distance</b> tool
<b>Profile Angel</b> tool	<b>Angle</b> tool
<b>Profile Line (x, y)</b> tool	Not available
<b>Profile Circle (Radius, In-Out)</b> tool	<b>Circle (Radius, In-Out)</b> tool

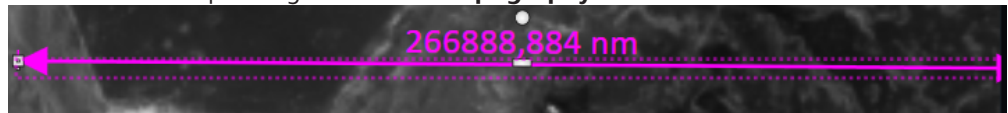
**Prerequisite** ✓ In the **Interactive Measurement** workbench, you have added text or measurements to an image, e.g. a distance measurement.



1. Select the element, and from the context menu, select **Format Graphical Elements**.  
→ The following dialog is displayed.



2. Format the graphical elements according to your needs, e.g., click on the red line and choose a different color. Note that it is not possible to adapt the font size for a tool of the **Topography Measurements** workbench. To use the new formats for any measurement of this tool in both workbenches, click **Set As New Global Default**, and click **Close**.  
→ From now on, the format settings are used for all measurements of the configured tool, and for the corresponding tools of the **Topography Measurements** workbench.



### See also

- Topography Measurements Workbench [► 743]
- Interactive Measurements Workbench [► 742]

## 4.4 Manual Extended Focus (EDF)

This module enables you to manually acquire an extended depth of focus (EDF) image.

#### 4.4.1 Acquiring EDF Images

You can acquire EDF (Extended Depth of Focus) images using one of the EDF acquisition workbenches. Depending on your microscope/license you can perform the focusing manually or by the help of the software semi-automatically.

##### See also

- 📄 Image Types [► 96]
- 📄 EDF (manual focus) Workbench [► 734]
- 📄 EDF (motorized focus) Workbench [► 735]
- 📄 Selecting Workbenches [► 41]
- 📄 Specifying Tools for a Task [► 58]

#### 4.4.2 Acquiring an EDF Image Manually

- Prerequisite**
- ✓ The **EDF (manual focus)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
1. Set up the camera using the **Camera** tool.
  2. Select the desired **Mode** in the **Manual Extended Depth of Focus** tool:
    - ➔ **Timer**: Enables you to specify the acquisition interval in seconds. Choose an interval that leaves you enough time to move the stage to the next position between two acquisitions.
    - ➔ **F12 Key**: Enables you to trigger the acquisition manually by pressing **F12** on your computer keyboard. This leaves you as much time as you need to move the stage between two acquisitions.
  3. Stereo Microscope: Choose the desired **Z-Stack Alignment** method.
  4. Start the acquisition by clicking the **Start** button at the top of the **Workbench Area**.
  5. Acquire your first image.
    - ➔ **Timer**: The image is acquired automatically after the specified **Interval**.
    - ➔ **F12 Key**: Press **F12** to acquire the image.
  6. Move the stage to the next Z-position.
    - ➔ For more information see your microscope instruction manual.
  7. Acquire the next image.
  8. Continue moving the stage another step and acquiring an image over the desired focus range.
  9. Finish the acquisition by clicking **Stop** in the **Workbench Area**.

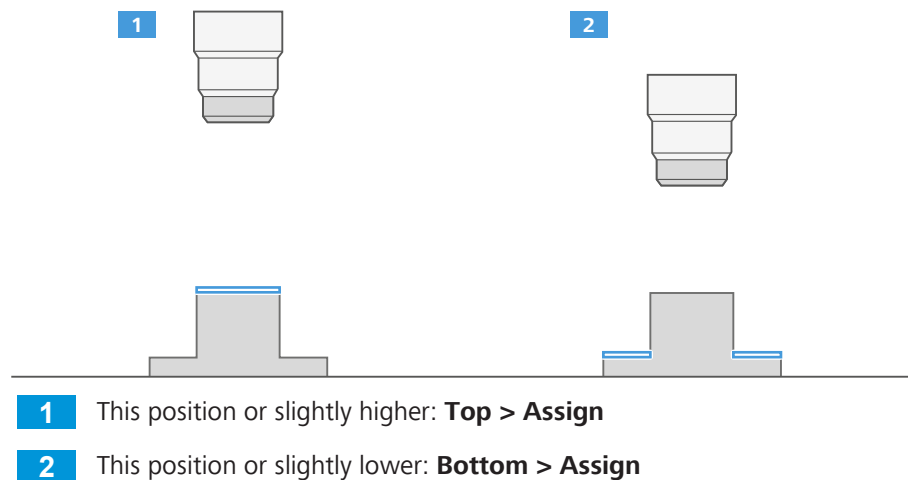
For more information on how to move the stage manually, see your microscope instruction manual.

#### 4.4.3 Acquiring an EDF Image Automatically

- Prerequisite**
- ✓ The **EDF (motorized focus)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
1. Set up the camera using the **Camera** tool.
  2. Set up the focus range over which to acquire the EDF image in the **Motorized Extended Depth of Focus** tool.

- Move the stage away from the sample until the top of the sample is no longer in focus. Define this focal plane position as the upper end of the range by clicking **Top > Assign**.
  - Move the stage towards the sample until the bottom of the sample is no longer in focus. Define this focal plane position as the lower end of the range by clicking **Bottom > Assign**.
3. The step size is calculated automatically. If you want another step size, set the value for the **Step Size** to specify the distance the stage travels between two acquisitions.
    - The number of images to be acquired is displayed automatically as **Slices**.
    - Alternatively you can use **Optimal**: The optimal **Step Size** is determined automatically depending on your microscope setup. The step size is calculated according to the Nyquist criteria.
  4. Start the acquisition by clicking the **Start** button in the **Workbench Area**.

ZEN core acquires the slices and calculates the EDF image automatically.



The algorithm used to calculate the EDF image works best if the acquired images differ significantly. Try to acquire as few images as possible. Make sure an acquired image contains focused areas which are not focused in the other images, i.e. each new image contains new information relevant for the EDF calculation.

## 4.5 Panorama

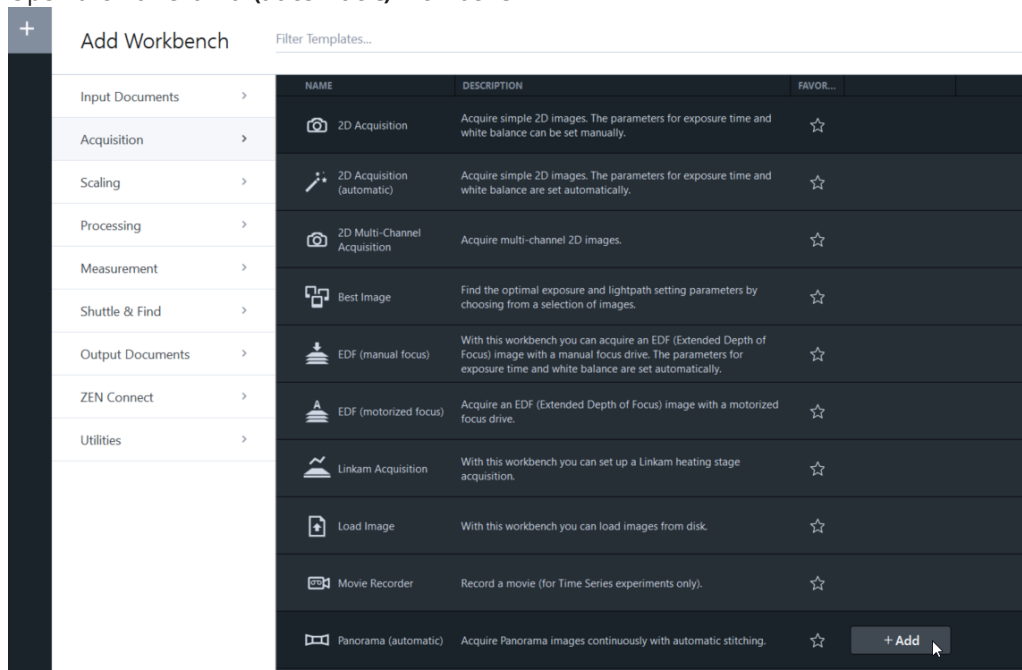
This module enables you to acquire an overview image (or panorama image) exceeding the image size of a single image. This is the case when the field of view of your microscope is too small for the sample area you wish to acquire. Acquire a set of connected, overlapping images (tiles) manually to stitch the tiles together to a single large image.

### 4.5.1 Acquiring a Panorama Image (automatic)

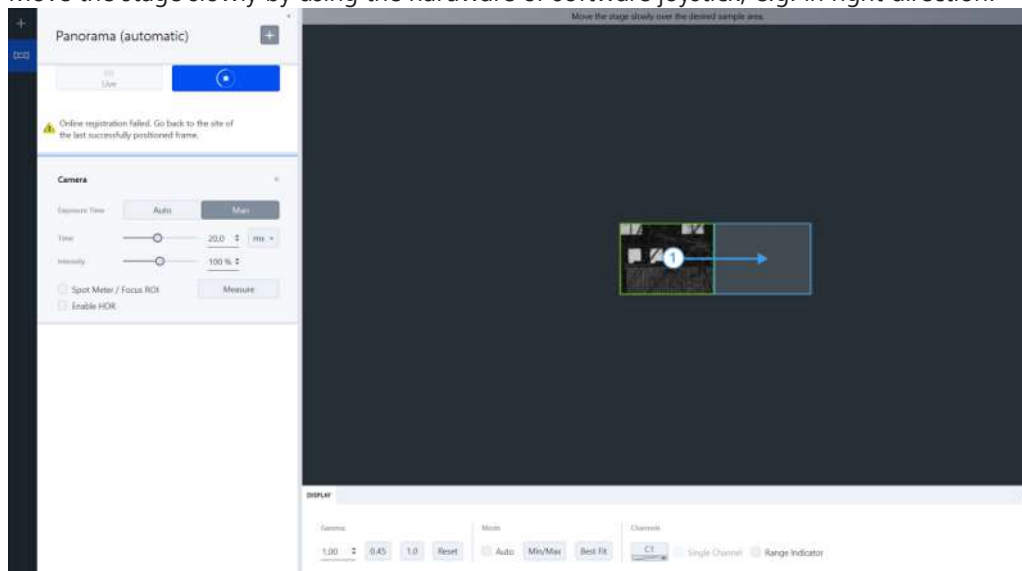
Using the **Panorama (automatic)** workbench you can automatically acquire panorama images from a sample area which is larger than the camera sensor can cover by a single snap. By moving the stage the software automatically acquires and stitches the individual images and creates a panorama image. Note that automatic panorama works also for coded and manual stages.

- Prerequisite**
- ✓ You have set-up and configured your microscope system correctly.
  - ✓ You have started the software and activated the module. In our guide we assume that **Free Mode** is used for the acquisition.

1. Open the **Panorama (automatic)** workbench.



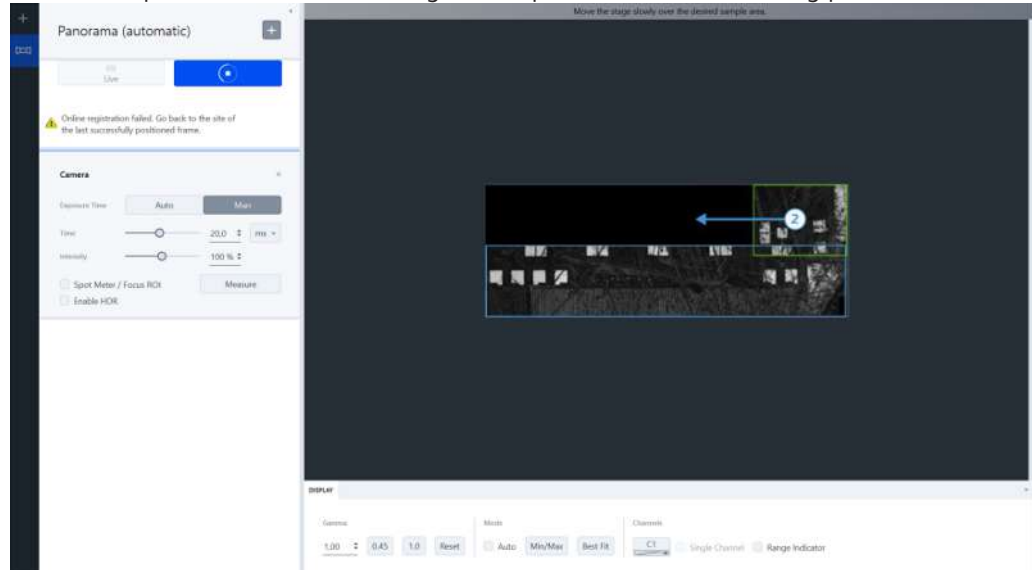
2. Click on **Live** to get a live image from the microscope camera. Adjust the camera and microscope settings to see a well illuminated and sharp live image.
3. Navigate to a specific area on your sample you want to image.
4. Click on **Start**.
  - ➔ After a short moment, the camera rectangle changes to green and the stage can be moved. The color of the rectangle changes to orange or red, when the software loses the stitching algorithm. Then you have to manually go back to the last "good" position.
  - ➔ The panorama acquisition starts. You see the live image of the sensor area.
5. Move the stage slowly by using the hardware or software joystick, e.g. in right direction.



- ➔ During the stage movement the software automatically acquires the panorama image.



6. In our example we now move the stage a bit up and back to the starting point.



7. To finish the acquisition click **Stop**.

The panorama image will be added to the **Documents Area**. Do not forget to save the final image on your file system.

#### 4.5.2 Acquiring a Panorama Image (interactive)

The **Panorama (interactive)** workbench enables you to acquire an image of a large sample area with a manual stage.

You acquire tiles (images of neighboring sample areas) and move the stage between two tile acquisitions manually.

- Prerequisite**
- ✓ The **Panorama (interactive)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
1. Set up the camera using the **Camera** tool.
  2. Select the desired objective in the **Magnification** tool.
  3. Set up the stitching method to be applied after acquisition using the **Tile Stitching** tool.
  4. Click **Start** in the **Workbench Area**. The following elements appear in the **Center Screen Area**:
    - ➔ The **Live Navigator**, a live preview image with tile overlay.
    - ➔ An acquisition tool to acquire tiles.
  5. Move the stage until the sample area of interest is visible in the **Live Navigator** image.
  6. Click **Acquire Tile Image** in the acquisition tool in the **Center Screen Area**.
  7. Double-click one of the eight neighbor fields next to the acquired tile.
    - ➔ The **Live Navigator** is placed accordingly. The preview image displayed inside the **Live Navigator** is identical to the last acquired tile.
  8. Match the **Live Navigator** image to the edge of the last acquired tile by moving the stage accordingly.
  9. Acquire the tile by clicking **Acquire Tile Image**.
    - ➔ Repeat the previous steps until you have acquired an image of the entire sample area of interest.
  10. Click **Stop** in the **Workbench Area**.

The acquired image is complete. If you have selected stitching, the software finishes the acquisition by aligning the tile images along their edges.

### Info

If you click on the Live image, it gets semi-transparent.

### See also

- 📖 Tiles Stitching Tool [▶ 188]
- 📖 Camera Tool [▶ 754]
- 📖 Selecting Workbenches [▶ 41]
- 📖 Specifying Tools for a Task [▶ 58]

## 4.5.3 Panorama (automatic) Workbench

This workbench enables you to acquire panorama images from a sample area which is larger than the camera's sensor can cover by a single snap. By moving the stage the software automatically acquires and stitches the individual images and creates a panorama image. Note that automatic panorama works also for coded and manual stages.

To learn how to acquire panorama images automatically, see *Acquiring a Panorama Image (automatic)* [▶ 143].

### See also

- 📖 Camera Tool [▶ 754]
- 📖 Panorama Acquisition Options Tool [▶ 146]

## 4.5.4 Panorama (interactive) Workbench

This workbench enables you to acquire a panorama image with a manual stage, for example if the total sample area to be acquired exceeds the area that can be acquired with a single acquisition. You can manually acquire multiple images (tiles) of neighboring areas on the sample, which then are stitched to a panorama image.

You can save the oversize image as tiles or you can stitch the tiles together into a single oversize image.

### See also

- 📖 Camera Tool [▶ 754]
- 📖 Lamp Tool [▶ 776]
- 📖 Light Path Tool [▶ 778]
- 📖 Tiles Stitching Tool [▶ 188]

## 4.5.5 Panorama Acquisition Options Tool

This tool can only be added to the **Panorama (automatic)** workbench. Note that the options should only be activated, if you have problems with the camera/live image during acquisition. It is only available for troubleshooting up and normally not needed.

The default state of the checkboxes is set to "undefined" (checkboxes are marked with a rectangle) which means the software tries to use a determined value for the current camera automatically. Meaning if you are unsure, if your camera supports the functionality, we recommend to leave the state to "undefined".

Parameter	Description
<b>Use Camera Streaming (if possible)</b>	If activated, the software uses the free running/streaming mode of the camera. This option is intended for slower cameras.
<b>Stop and Go</b>	<p>If activated, during acquisition you have to move the stage, e.g. about one camera frame, and then stop the movement. Then you have to move the stage for the next frame and stop again. Compared to the "default" mode, the images to be stitched are acquired only when the stage movement stops.</p> <p>This option is intended for cameras that produce motion artefacts (e.g. rolling shutter effect) and for exposure times greater than about 50 ms.</p>

### See also

 Panorama (automatic) Workbench  146]

## 4.6 Third Party Import

This module enables you to import the BIO-Formats by OME (Open Microscopy Environment). More details on the supported BIO-Formats, see <https://www.openmicroscopy.org/>.


## 4.7 ZEN Data Storage Client

### Info

#### Time Deviation

In the very unlikely event that there is a time deviation greater than five minutes between the client and the server, the authentication of the client fails for security reasons. In this case an error message is displayed and working with ZEN Data Storage is not possible. You have to fix the system time of the client and/or server before a retry.

In ZEN core, you can store your data on your computer's file system in your local archive, or you have the option to save your data in a database called ZEN Data Storage.

ZEN Data Storage is an additional product which has to be installed. For more information, refer to the installation guide of ZEN Data Storage. You also need configure ZEN Data Storage as your archive, see *Configuring a ZEN Data Storage Archive*  147].

### 4.7.1 Configuring a ZEN Data Storage Archive

The archive options enable you to specify how and where the **Archive** is stored, as well as the hierarchy of attributes that can be assigned to templates.


**Info**

The **Archive Setup** button needs to be clicked once for the first client to set up the database. On the second client, this is not necessary anymore, even though the button is active.


- Prerequisite** ✓ You are logged in as an administrator in **ZEN core**.
- ✓ You have configured a **ZEN Data Storage Server** and activated the **Data Storage Client** module in **Home Screen > Maintenance > Module Manager**.
1. Click **Home Screen > Maintenance > Archive Options**.  
→ The **Archive Options** dialog opens.
  2. As **Archive Type**, select **ZEN Data Storage Archive** from the drop-down list.  
→ Only if you have selected **ZEN Storage Archive** as archive type, you can setup the Archive.
  3. For **Settings > URL** specify the URL of the **ZEN Data Storage** server.  
→ The **Archive Setup** button is displayed.
  4. If you want to use an archive hierarchy, create your hierarchy elements by clicking **+**, see *Creating a Hierarchy for the Archive* [▶ 711] and *Using a Hierarchy for the Archive* [▶ 711] for general information.
  5. Click **Archive Setup**. This has to be done only on the first system which connects to the **ZEN Data Storage**.  
→ The storage is set up to work with the software and the standard users are created.
  6. Restart the software to update the user database.

You have set up the **ZEN Data Storage Archive** as your archive and the database is set up properly. You can now configure the user management, see Basics of User and Group Management.

#### 4.7.2 Opening an Image from ZEN Data Storage

- Prerequisite** ✓ You have added the **Load image from ZEN Data Storage** tool to the **Load File** workbench.
1. In the **Load image from ZEN Data Storage** tool, click .  
→ The **Browse ZEN Data Storage** dialog opens, see *Browse ZEN Data Storage Dialog* [▶ 155].
  2. If necessary, filter the displayed images from the database, see *Filtering Data in ZEN Data Storage* [▶ 148].
  3. Select an image in the list and click **OK**. Alternatively, double-click the respective image.  
→ The **Browse ZEN Data Storage** dialog closes.

#### 4.7.3 Filtering Data in ZEN Data Storage



- Prerequisite** ✓ You have added the **Load image from ZEN Data Storage** tool to the **Load File** workbench.
1. In the **Load image from ZEN Data Storage** tool, click .  
→ The **Browse ZEN Data Storage** dialog opens.
  2. Enter a term you are looking for in the **Search** field, e.g., the file name.  
→ The displayed images are filtered instantly based on your input.
  3. To filter images based on their tags, click **Tags**.  
→ An input field opens as drop-down.

4. In the search field, enter a term you want to filter for. Alternatively, in the list of available tags, activate all tags you want to filter for and activate **Or/And**, depending on whether the filtered images should contain all activated tags (**And**), or at least one of the tags (**Or**).  
→ The filter for tags is applied.

The available files are filtered and displayed accordingly.



#### 4.7.4 Creating a Collection for Data


You can create collections to structure your data and share it with others.

- Prerequisite** ✓ You have set up ZEN Data Storage as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].
- ✓ You have started the application with active user management to be able to add users or groups to a collection.
1. Click **Home Screen > Maintenance > Archive Options**.
  2. Click **Manage Collections**.  
→ The **Manage Collections** dialog opens.
  3. Click .  
→ The **Add Collection** dialog opens.
  4. Enter a name for the new collection.
  5. Click .  
→ The **Add Collection Access** dialog opens.
  6. On the **Groups** and/or **Users** tab, select the group or user you want to grant access to the collection. Selection of multiple users and groups is possible by pressing **Ctrl**.
  7. Select the **Access Level** for the currently selected users/groups.
  8. Click **OK**.  
→ The dialog closes and the selected users and/or groups are granted access based on the selection.
  9. You can now adapt the **Access Level** of individual users and groups of this collection, if necessary.
  10. Click **OK**.  
→ The **Add Collection** dialog closes.



You have created a collection for your data. You can now structure your data and share job results with the people having access to this collection, see *Adding Job Results to Collections in Browse Results* [▶ 154].

#### 4.7.5 Editing or Deleting a Data Collection

- Prerequisite** ✓ You have created a collection for your data. For more information, see *Creating a Collection for Data* [▶ 149].
- ✓ You have started the application with active user management to be able to add users or groups to a collection or edit them.
1. Click **Home Screen > Maintenance > Archive Options**.
  2. Click **Manage Collections**.  
→ The **Manage Collections** dialog opens.
  3. To delete a collection, select it and click .
  4. To edit a collection, select it and click .

- The **Edit Collection** dialog opens.
- 5. If you want to change the name, adapt it under **Collection Name**.
- 6. If you want to change the access of a particular user, change the **Access Level** with the respective dropdown.
- 7. To add a new user or group, click .
- The **Add Collection Access** dialog opens.
- 8. On the **Groups** and/or **Users** tab, select the group or user you want to grant access to the collection. Selection of multiple users and groups is possible by pressing **Ctrl**.
- 9. Click **OK**.
  - The dialog closes and the selected users and/or groups are granted access based on the selection.
- 10. Click **OK**.
  - The **Edit Collection** dialog closes.
- 11. Click **Close**.
  - The **Manage Collections** dialog closes.

#### 4.7.6 Sharing Job Results in Free Mode

- Prerequisite** ✓ ZEN Data Storage is configured as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].
- ✓ You are in **Free Mode** and have finished all your work.
- 1. In the Title Bar, click  and click **Archive Results**.
    - The **Archive Results** dialog page opens.
  - 2. Click **Select Collections to which saved Results should be added to**.
    - The section with all available collections is displayed. Every collection that is shared with other users/groups is marked with  in the **Shared** column.
  - 3. If you want to search for a particular collection, input your search term in the **Search for Collections** field.
    - The collections displayed in the table are updated accordingly.

4. In the table, activate the checkbox for each collection the result should be shared with.

Exit Free Mode

Save Results  
Archive Results  
Export  
Discard

Archive Results

☐ Keep Results Locally

Name: FreeModeAttachments.czjob

Description:

SELECT COLLECTIONS TO WHICH SAVED RESULTS SHOULD BE ADDED TO

Search for Collections

NAME	CREATED	SHARED
<input checked="" type="checkbox"/> Collection Test	28.05.2021	

Archive Cancel

5. Click **Archive**.

### See also

Archiving Results in Free Mode [► 45]

## 4.7.7 Sharing Job Results in Job Mode

- Prerequisite**
- ✓ ZEN Data Storage is configured as your archive, see *Configuring a ZEN Data Storage Archive* [► 147].
  - ✓ You are in **Job Mode** and have finished your Job.
1. Click **Save and Close**. Alternatively, click **Save and Repeat** if you want to repeat the job afterwards.
    - ➔ The **Save Results** dialog opens.
  2. Click **Select Collections to which saved Results should be added to**.
    - ➔ The section with all available collections is displayed. Every collection that is shared with other users/groups is marked with in the **Shared** column.
  3. If you want to search for a particular collection, input your search term in the **Search for Collections** field.
    - ➔ The collections displayed in the table are updated accordingly.

4. In the table, activate the checkbox for each collection the result should be shared with.

**Save Results** [X]

Name: Grain Size Analysis (Intercept)

SELECT COLLECTIONS TO WHICH SAVED RESULTS SHOULD BE ADDED TO [^]

Search for Collections [Q]

NAME	CREATED	SHARED
<input checked="" type="checkbox"/> Collection Test	28.05.2021	[User Icon]

[Archive]

5. Click **Archive**.

#### 4.7.8 Creating Custom Metadata

With **ZEN Data Storage**, you can create and use custom metadata in ZEN core.

- Prerequisite**
- ✓ You have ZEN Data Storage configured as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].
  - ✓ You are on the **Home Screen**.
1. Click **Maintenance > Archive Options**.  
→ The **Archive Options** dialog opens.
  2. Under **Settings**, click **Custom Metadata**.  
→ The **Custom Metadata** tab opens and all custom metadata entries are displayed.
  3. Click .  
→ A new empty field is created.
  4. Enter the name for your custom metadata and press **Enter**.
  5. Click **OK**.  
→ The **Archive Options** dialog closes and the new metadata entry is saved.

You have created custom metadata that are displayed in the **Custom Metadata** tab of the **Archive Options** dialog. Note that custom metadata are created case insensitive.

The custom metadata can be used for your jobs by adding them as a **Data Link** field property in the **Form Designer** when creating or editing a form template, see *Form Designer* [▶ 74].

When running a job which includes the form with custom metadata, you can enter a value for the metadata. Additionally, all previously entered values for the respective metadata are available as a dropdown list and sorted alphabetically.

The custom metadata can be displayed as a column in **Browse Results** and can be used as additional filter criteria for searching the job results, see *Filtering Results and Documents Using Metadata and Filter Criteria* [▶ 89].





### 4.7.9 Adding an Active Directory User

#### Info

##### Domain Administrator

It is not possible to use the initial Active Directory domain administrator as a user for ZEN Data Storage. The administrator account for the Active Directory domain should only be used for the administration of the Active Directory itself.

When you are using ZEN core with ZEN Data Storage, you can add individual Active Directory users to your user management.

- Prerequisite**
- ✓ ZEN core is open with active user management and you are signed in as administrator.
  - ✓ You have ZEN Data Storage configured as your archive and have configured an Active Directory group, see *Configuring a ZEN Data Storage Archive* [▶ 147] and *Setting up the Login with Windows Credentials (Active Directory)* [▶ 703] respectively.
  - ✓ During the installation of ZEN Data Storage, you have set the parameter **Enable Active Directory** to **True** on the **Settings** tab of the installer. For more information also refer to the installation guide for ZEN Data Storage.
  - ✓ The ZEN Data Storage server must be part of the same Windows domain from where the software tries to login with its Windows credentials.
1. Click **Maintenance > User Management**.
    - The **User and Group Management** dialog opens.
  2. Click **Users**.
    - The tab displays all currently configured users.
  3. Click .
    - The **New User** dialog opens.
  4. For **Type**, select **Active Directory**.
  5. For **Name**, click .
    - The **Select User** dialog opens.
    - The fields for object type and location are filled with a default. To change them, click **Object Types** or **Locations** to open another dialog to select the respective **Object Types** or **Locations**.
  6. In the text field below, enter the name of the user you want to select. If you are not sure if your name is correct, click **Check Names** to open a dialog and select the suitable entry.
  7. Click **OK**.
    - The name is displayed in the **New User** dialog.
  8. Click **OK** to close the **New User** dialog.
    - The respective **Active Directory** is added to the list of users.
  9. Click **OK** to close the **User and Group Management** dialog.

You have configured an **Active Directory** user. You can now assign this user to a group to grant him certain rights and privileges.


### 4.7.10 Browse Results with ZEN Data Storage


If you use ZEN Data Storage as your archive, you have the following additional functionalities in **Browse Results**:

#### 4.7.10.1 Searching and Filtering in Browse Results


- Prerequisite**
- ✓ You have ZEN Data Storage configured as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].
  - ✓ You are in **Browse Results**.
1. In the drop down below the **Search** field, select which data should be displayed and filtered or searched.
    - **All**: Displays all accessible data.
    - **My Data**: Displays only my data.
    - **Shared With Me**: Displays all files that are shared with me, including public documents.
    - **My Collections**: Enables you to select one of your collections and displays only those documents that are part of the this collection.
    - **Collections Shared With Me**: Enables you to select one of the collections that is shared with you and displays only those documents that are part of the this collection.
    - The displayed documents are updated accordingly.
  2. To search results and documents with metadata, follow the general instruction *Searching for Results and Documents with Metadata* [▶ 88].
  3. To filter results and documents with Quick Filters, follow the general instruction *Filtering Results and Documents Using Quick Filters* [▶ 88].
  4. To filter results and documents based on metadata and filter criteria, follow the general instruction *Filtering Results and Documents Using Metadata and Filter Criteria* [▶ 89].

#### 4.7.10.2 Adding Job Results to Collections in Browse Results

- Prerequisite**
- ✓ ZEN Data Storage is configured as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].
  - ✓ You have created or access to at least one collection, see *Creating a Collection for Data* [▶ 149].
  - ✓ You are in **Browse Results**.
1. Select the job result you want to share and click . Alternatively, right click the job result and select **Add to Collection**.
    - The **Add to Collection** dialog opens.
  2. In the table, activate the checkbox for every collection you want to share the data with.
  3. Click **Save**.

You have shared your job result with other users/groups that are part of the collection. They can now see the results as well. The job result is also marked with  in the **Shared** column of **Browse Results**.

#### 4.7.10.3 Sharing Job Results Directly With Users and Groups

- Prerequisite**
- ✓ ZEN Data Storage is configured as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].
  - ✓ You are in **Browse Results**.
1. Select the job result you want to share and click . Alternatively, right click the job result and select **Share and Manage Access**.
    - The **Share and Manage Access** dialog opens.
  2. Enter the name of the user or group you want to share the data with and select it from the list.

3. In the access dropdown, select the access level for the respective user or group and click **Add**.  
→ The user or group is added to the table and the access right is displayed.
4. Repeat the previous steps until all users and groups that you want to share your data with are added to the table.
5. Click **Save**.

You have directly shared your image or project with other users and groups. The shared job result is marked with  in the **Shared** column of **Browse Results**.

#### 4.7.10.4 Moving a Single Image from ZEN Data Storage to a Job Result

Note that this procedure is NOT possible when you have licenced and activated the **GxP module**.

**Prerequisite** ✓ ZEN Data Storage is configured as your archive, see *Configuring a ZEN Data Storage Archive* [▶ 147].

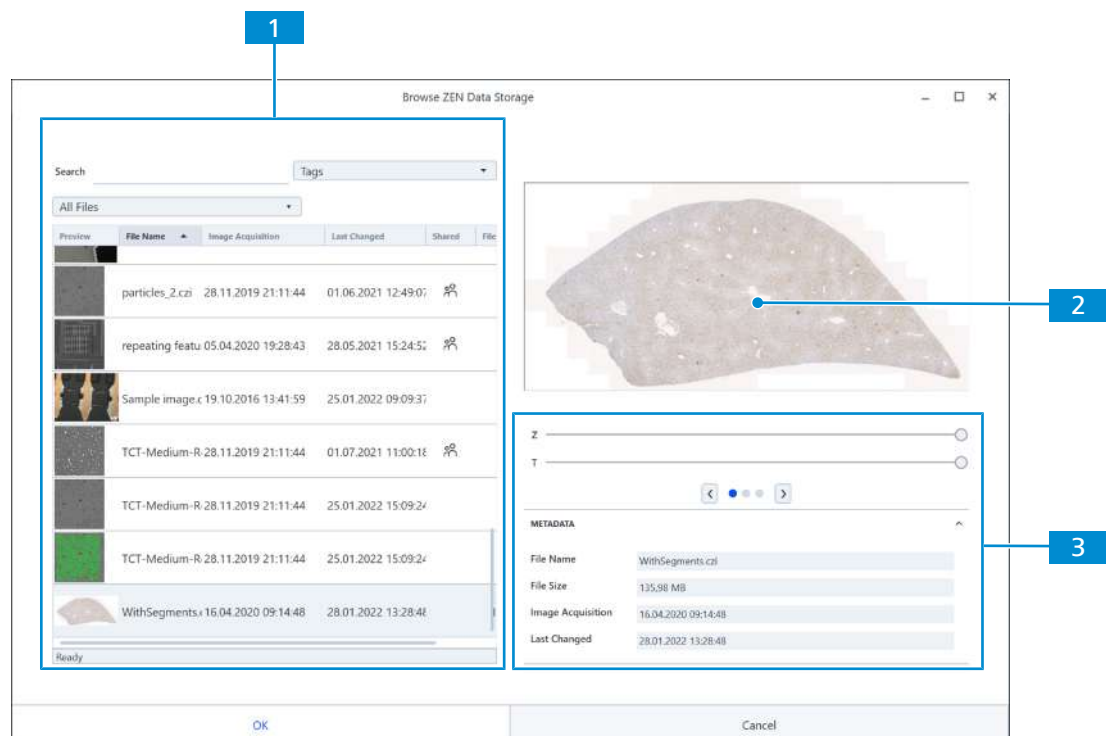
✓ You are in **Browse Results**.

1. Under Results, click **External Images**.  
→ The single images stored in the ZEN Data Storage archive are displayed under **Result Documents**.
2. Under **Result Documents**, right-click the image you want to add to a job result and select **Cut**.
3. Under **Results**, right-click the respective job result and select **Paste**.

You have added a single image from the ZEN Data Storage archive to a particular job result.

#### 4.7.11 Browse ZEN Data Storage Dialog

With this dialog you can open images saved in the ZEN Data Storage archive.



**1 Stored Data**

Displays the data available in ZEN Data Storage. For more information, see *Stored Data Section* [▶ 156].

**2 Image Preview**

Displays a preview of the currently selected image. For image documents that contain attachments like thumbnails, label or preview scans, a special control in the **Image Control Section** allows you to switch the view to those attachments.

**3 Image Control Section**


Controls for the image preview as well as the general controls to open the selected data or close the dialog. For more information, see *Image Control Section* [▶ 158].

**See also**


- 📖 Loading an Image and Adding it to the ZEN Connect Project [▶ 338]
- 📖 Opening an Image from ZEN Data Storage [▶ 148]
- 📖 Filtering Data in ZEN Data Storage [▶ 148]

**4.7.11.1 Stored Data Section**


Parameter	Description
<b>Search</b>	Searches the database for the term entered in the text field.
<b>Tags</b>	Opens an input field to filter images based on their tags.
– <b>Search Field</b>	Searches the image tags for the input of this field.
– <b>Or</b>	<b>Activated:</b> Applies a logical <b>Or</b> operator if multiple tags are selected in the list below and filters for all images that contain at least one of the selected tags.
– <b>And</b>	<b>Activated:</b> Applies a logical <b>And</b> operator if multiple tags are selected in the list below and filters only images that contain all selected tags.
– <b>Tag list</b>	Displays all available tags. Filters the documents in ZEN Data Storage based on the activated tags of this list.
– <b>Clear</b>	Clears all filter criteria for tags.
<b>File Dropdown</b>	Selects which files are displayed in the table below. If you have access to collections, they are also displayed as an option in the dropdown.
– <b>All</b>	Displays all accessible data.
– <b>My Data</b>	Displays only my images or projects.
– <b>Shared With Me</b>	Displays all files that are shared with me, including public images/projects.
<b>Document Table</b>	Displays all available images and information about them. The information for the images is extracted from the metadata. The table entries can be sorted according to each individual column. You can customize the view of the table with a right click into the header to toggle the visibility of individual columns.

Parameter	Description
	If you have configured ZEN Data Storage to extract custom metadata, they can also be displayed as columns. For information about configuring custom metadata, see the installation guide of ZEN Data Storage.
– <b>Preview</b>	Displays the preview of the image.
– <b>File Name</b>	Displays the file name and the format of the image. You can sort the file names alphabetically.
– <b>Original File Name</b>	Displays the original file name in case you have uploaded the image as a third party image with the ZEN Data Storage Uploader.
– <b>File Size</b>	Displays the file size.
– <b>Software Application</b>	Displays with which software application the image was acquired.
– <b>Software Application Version</b>	Displays the version of the software application.
– <b>Created Date</b>	Displays the creation day.
– <b>Last Changed</b>	Displays at what date the image was last changed.
– <b>Shared</b>	Displays  if the file is shared with others. For information on sharing job results, see <i>Adding Job Results to Collections in Browse Results</i> [▶ 154] or <i>Sharing Job Results Directly With Users and Groups</i> [▶ 154].
– <b>Comment</b>	Displays a comment.
– <b>Microscope Name</b>	Displays the name of the microscope.
– <b>System Name</b>	Displays the system name.
– <b>Objective Name</b>	Displays the name of the objective.
– <b>Objective Magnification</b>	Displays the objective magnification.
– <b>Reflector</b>	Displays the reflector.
– <b>Channel Name</b>	Displays the name of the channel.
– <b>Camera Name</b>	Displays the name of the camera.
– <b>Scaling</b>	Displays the scaling.
– <b>Imaging Light Source Name</b>	Displays the name of the imaging light source.

#### 4.7.11.2 Image Control Section

Parameter	Description
<b>Z</b>	Only available for z-stack images. Selects which z-slice is displayed in the preview.
<b>T</b>	Only available for time series images. Selects which time point is displayed in the preview.
 <b>Preview Image Control</b>	Only visible, if the selected image document contains attachments (e.g. a thumbnail, label or preview scans) like for Axioscan images. Selects which image is displayed in the preview area by using the arrows or clicking on the small circles. The small circles also display a tooltip indicating what kind of image it is (e.g. <b>Label</b> ).
<b>Metadata</b>	Displays a section with metadata for the currently selected image. The metadata is synchronized with the displayed columns in the stored data section on the left.
<b>OK</b>	Opens the image and closes the dialog.
<b>Cancel</b>	Closes the dialog without opening a file.

#### 4.7.12 Add to Collection Dialog

Parameter	Description
<b>Search for Collections</b>	Searches the collections according to the input.
<b>Table</b>	Displays all available collections.
— Name	Displays the name of the collection. <b>Activated:</b> The image is shared with the respective collection.
— Shared	Shared collections are marked with  .
<b>Manage Collections</b>	Opens the <b>Manage Collections</b> dialog to manage the collection.
<b>Save</b>	Saves the changes and closes the dialog.
<b>Cancel</b>	Closes the dialog without saving.




#### See also

 Adding Job Results to Collections in Browse Results [► 154]

#### 4.7.13 Manage Collections Dialog

Here you can manage collections for your data and specify their access.

Parameter	Description
<b>Collection table</b>	Displays the existing collections.



Parameter	Description
– Collection Name	Displays the name of the collection.
– Collection Owner	Displays the owner of the collection.
– Access Granted To	Displays the groups/users that have access to this collection.
–  Add	Opens the <b>Add Collection</b> dialog to add a collection.
–  Delete	Deletes the selected collection.
–  Edit	Opens the <b>Edit Collection</b> dialog to edit the selected collection.

**See also**

 Add/Edit Collection Dialog [▶ 159]

**4.7.14 Add/Edit Collection Dialog**

With this dialog you can add or edit a collection.

Parameter	Description
<b>Collection Name</b>	Sets the name for the collection.
Table	
– Name	Displays the group or user with access to this collection.
– Access Level	Displays and sets the access level of the user/group with the drop-down. For a description of the available access levels, see <i>Add Collection Access Dialog</i> [▶ 159].
–  Add Access	Only available if you have started the application with active user management. Opens the <b>Add Collection Access</b> dialog to add access for a user/group.
–  Remove Access	Only available if you have started the application with active user management. Removes the access for the selected user/group from the collection and deletes it from the list.
<b>OK</b>	Adds the defined collection and closes the dialog.
<b>Cancel</b>	Closes the dialog without adding a collection.

**4.7.14.1 Add Collection Access Dialog**

With this dialog you can select a group/user who should have access to the collection. It is only available if you have started the application with active user management.

Parameter	Description
<b>Groups</b>	Displays all currently configured groups.
<b>Users</b>	Displays all currently configured users.
<b>Access Level</b>	Sets the access level for the currently selected group/user with the dropdown.
– Read	Grants the group/user access to see, open or download a document.
– Write	Grants the group/user access to modify a document.
– Manage	Grants the group/user access to modify the access control list.
<b>OK</b>	Adds the selected group/user with the set access level to the collection and closes the dialog.
<b>Cancel</b>	Closes the dialog without adding any group/user to the collection.

#### 4.7.15 Share and Manage Access Dialog

Parameter	Description
<b>Enter Name</b>	Searches all available users and groups according to the input and selects a user or group from a dropdown.
<b>Access Rights dropdown</b>	
– Read	Grants the group/user access to see, open and download a document.
– Write	Grants the group/user access to modify a document.
– Manage	Grants the group/user access to modify the access control list.
<b>Add</b>	Adds the selected user or group with the selected access right to the table.
<b>User and Group table</b>	Displays all users and groups added for sharing the file.
– User or Group	Displays the name of the user or group.
– Access Right	Displays the access right for the respective user or group and allows you to change the access.
– Remove	Removes the entry by clicking the button.
<b>Save</b>	Shares the file with the users and groups defined here and closes the dialog.
<b>Cancel</b>	Closes the dialog without sharing the file.


#### See also

 Sharing Job Results Directly With Users and Groups [► 154]



4.7.16 Load image from ZEN Data Storage Tool

This tool enables you to load an image from the ZEN Data Storage.

Parameter	Description
<b>File Name</b>	Displays the name of the selected file.
<div><div>— </div><div>Browse</div></div>	Opens the <i>Browse ZEN Data Storage Dialog</i> [▶ 155] to select an image.
<b>Last Changed</b>	Displays information on when the file was last changed.

## 5 Acquisition Toolkits

Packages	Functionality
Base Acquisition	<ul style="list-style-type: none"> <li>▪ <i>Multi-Channel Acquisition</i> [▶ 162]</li> <li>▪ <i>Time Series</i> [▶ 175]</li> </ul>
Motorized	<ul style="list-style-type: none"> <li>▪ Motorized Extended Focus</li> <li>▪ Software Autofocus</li> <li>▪ <i>Tiles &amp; Positions</i> [▶ 177]</li> <li>▪ Z-Stack</li> </ul>
Smart Acquisition	<ul style="list-style-type: none"> <li>▪ <i>Guided Acquisition</i> [▶ 192]</li> </ul>

### 5.1 Multi-Channel Acquisition

This module enables you to acquire multi-channel images. The Smart Setup functionality delivers proposals for combinations of dyes or contrast methods based on the available hardware.

#### 5.1.1 Smart Setup

In **Smart Setup** you configure channels. Select the fluorescent dyes and/or contrast methods that you want to include from a large dye database. **Smart Setup** takes the configuration of your microscope hardware and the properties of the selected dyes into account. Based on this information, it makes one or more suggestions for acquisition.

Note that **Smart Setup** tries to configure the components of your system for the acquisition of multi-channel images.

To open **Smart Setup**, select **Free Mode > 2D Multi-Channel Acquisition** workbench > **Channels** tool > **Open Smart Setup**. You can also open it in **Job Mode**.

#### See also

- 📖 Buttons to Optimize Acquisition Parameters [▶ 172]
- 📖 Graphical Display of Proposals [▶ 174]
- 📖 Smart Setup Proposals [▶ 173]

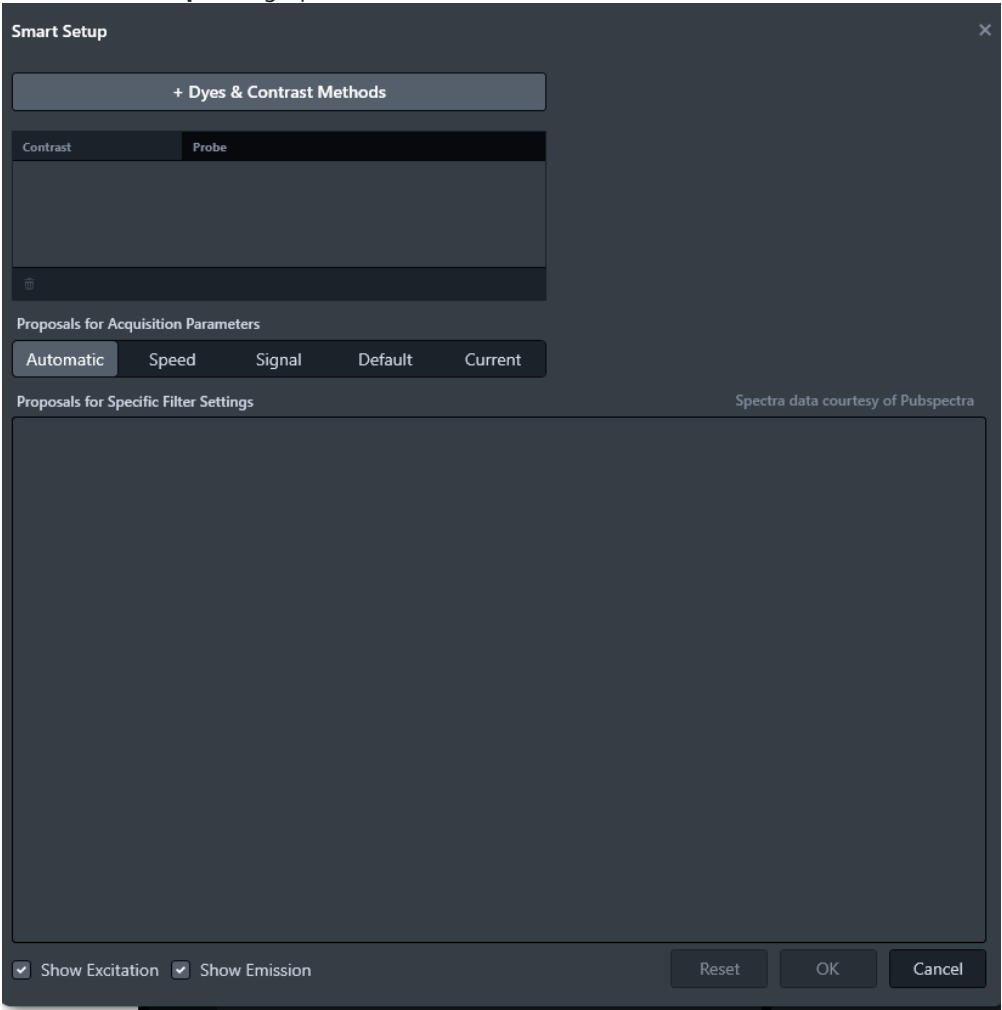
#### 5.1.2 Configuring Multi-Channel Acquisition with Smart Setup

##### Info

If **Smart Setup** is unable to make a proposal, it is not possible to use the selected combination of dyes and contrast methods with the current microscope hardware to make acquisitions. Select other dyes or another contrast method.

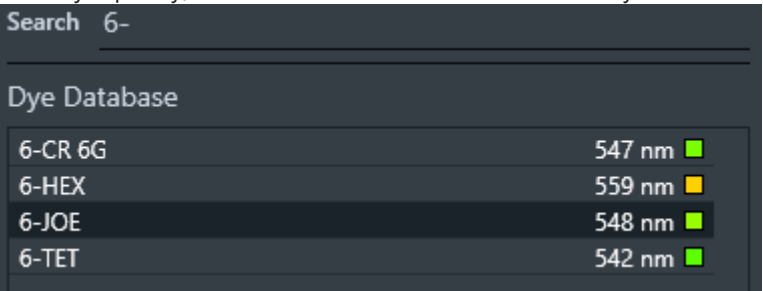
1. Select **Free Mode > 2D Multi-Channel Acquisition** workbench > **Channels** tool > **Open Smart Setup**.

→ The **Smart Setup** dialog opens.

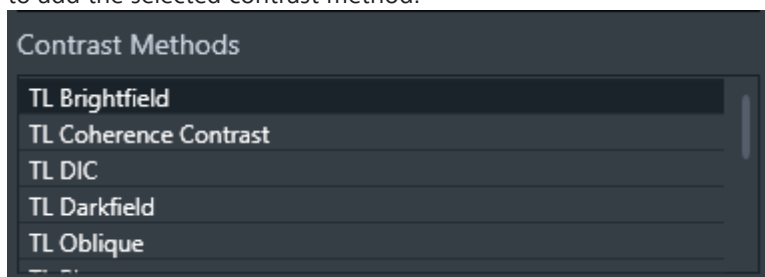


**Smart Setup** does not contain any dyes, contrast methods, or proposals.

2. To add a dye or contrast method, click **+ Dyes & Contrast Methods**.  
→ The **Add Dye or Contrast Method** dialog opens.
3. From the **Dye Database** list, select a fluorescent dye. Use the **Search** field to find the desired dye quickly, and double-click to add the selected dye.

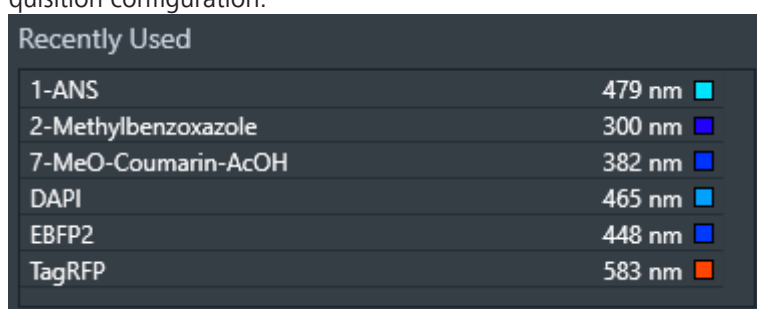








4. From the **Contrast Methods** list, select the corresponding contrast method, double-click to add the selected contrast method.



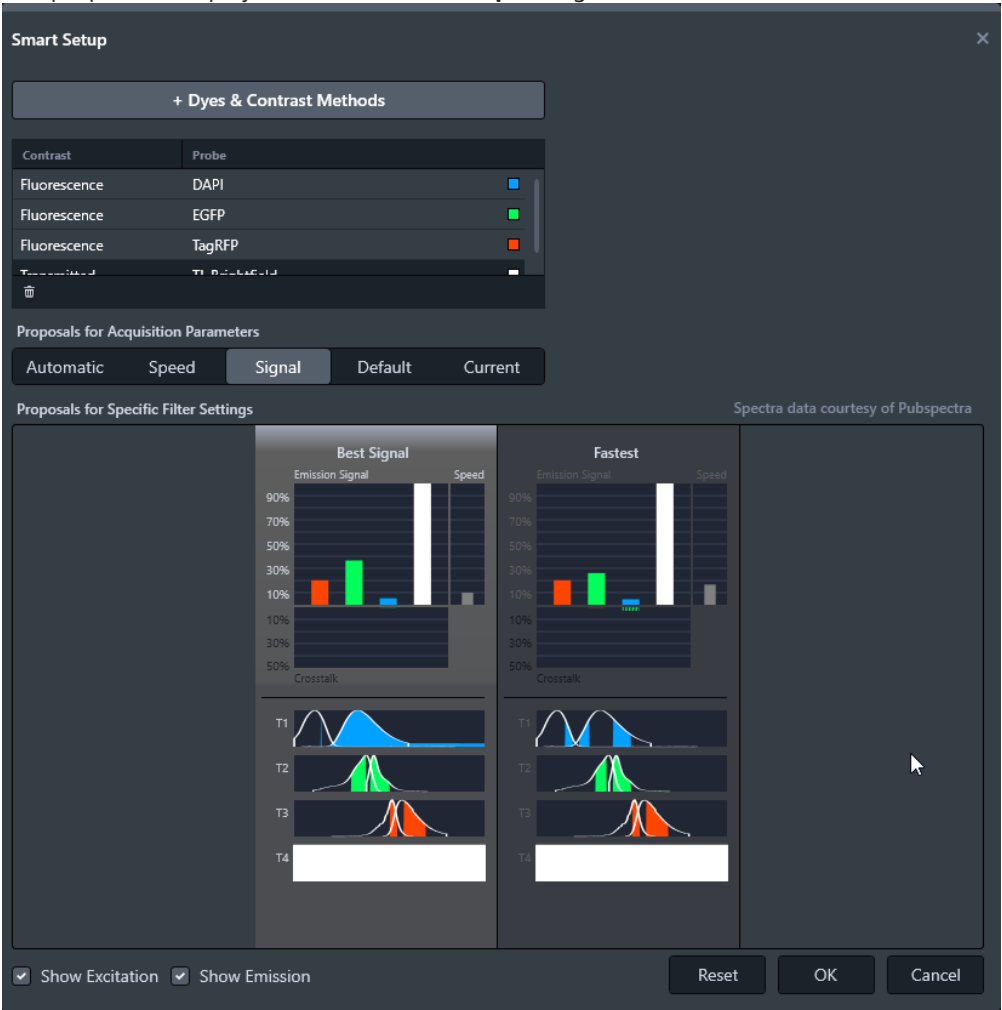
Note that you can only add channel combinations where a suitable proposal can be made based on the available hardware.

5. Close the dialog when you have selected the desired channels.
  - The selected dyes will be listed in the **Recently Used** list for your next multi-channel acquisition configuration.

A screenshot of a software dialog box titled "Recently Used". It displays a list of six dyes with their corresponding excitation wavelengths and color-coded icons.

Recently Used		
1-ANS	479 nm	
2-Methylbenzoxazole	300 nm	
7-MeO-Coumarin-AcOH	382 nm	
DAPI	465 nm	
EBFP2	448 nm	
TagRFP	583 nm	

→ The proposal is displayed in the **Smart Setup** dialog.



6. From the **Proposals for Acquisition Parameters**, select the desired parameter, see *Buttons to Optimize Acquisition Parameters* [▶ 172].

7. Click **OK**.

You have configured multi-channel acquisition with **Smart Setup**. Proceed in the **2D Multi-Channel Acquisition** workbench to acquire multi-channel images. In the **Channels** tool, a list with the selected dyes is displayed.

**See also**

Smart Setup Dialog [▶ 171]

**5.1.3 Operator Workflow - Counting Cells**

Operator workflows are designed by Supervisors. In the following you see the operator workflow **Counting Cells Live**, which allows to count fluorescently-labeled nuclei that can serve as a proxy for the cell number.












Tasks	Description	To Do
Form	The input form <b>ZEISS Cells</b> is provided. The form is displayed in the report.	The default form is displayed.  To change the form, in the <b>Form Selection</b> tool, select the form, see <i>Form Selection Tool</i> [▶ 750].

Tasks	Description	To Do
		Fill in relevant data according to your sample.
<b>2D Multi-Channel Acquisition</b>	Acquire images.	<p>To acquire multi-channel images, open <b>Smart Setup</b> and add dyes and contrast methods according to your sample. The first channel should be the fluorescently-labeled nuclei. <b>Smart Setup</b> provides proposals setting the light source, camera and filter setting, see <i>Configuring Multi-Channel Acquisition with Smart Setup</i> [▶ 162].</p> <p>Adjust the acquisition parameters, e.g. measure the exposure time, and then take a snap.</p>
<b>Image Segmentation</b>	Generate one mask for all nuclei per cell.	<p>Generate masks for nuclei, which are then counted, see <i>Automatic Segmentation</i> [▶ 254].</p> <p>To separate neighboring nuclei use a separation tool, e.g. <b>Watersheds</b>.</p> <p>If a large part of the image is selected initially, use background subtraction.</p>
<b>Region Filter</b>	Results are refined based on area and circularity of the objects.	To refine the selection to limit the analysis to one object or nucleus per cell, use region filters for area and circularity, see <i>Region Filter</i> [▶ 263].
<b>Measurement Data</b>	Check the results based on the previously conducted image analysis. The results are displayed in a table.	<p>To select an object, click a value in the table, and to check the size of a certain object, click the object in the <b>Center Screen Area</b>.</p> <p>For more information, see <i>Measurement Data Tool</i> [▶ 834].</p>
<b>Report</b>	<p>Creates a report document, see <i>Reports</i> [▶ 80]. You can print the report.</p> <p>The report contains the following information:</p> <ul style="list-style-type: none"> <li>▪ Form</li> <li>▪ Counts and counts/mm<sup>2</sup> for each image and their mean</li> <li>▪ Display of all images with the detected nuclei</li> </ul>	For your documentation, you create a report.

#### 5.1.4 2D Multi-Channel Acquisition Workbench

This workbench enables you to acquire 2D multi-channel images.

#### See also

-  [Configuring Multi-Channel Acquisition with Smart Setup \[▶ 162\]](#)
-  [Active Scaling Tool \[▶ 751\]](#)
-  [Camera - Global Settings Tool \[▶ 170\]](#)
-  [Channels Tool \[▶ 167\]](#)
-  [Focus Tool \[▶ 773\]](#)
-  [Hardware Autofocus Tool \[▶ 775\]](#)
-  [Light Path Tool \[▶ 778\]](#)
-  [Magnification Tool \[▶ 781\]](#)
-  [Software Autofocus Tool \[▶ 791\]](#)
-  [Stage Tool \[▶ 795\]](#)
-  [Export Experiment Tool \[▶ 798\]](#)

### 5.1.5 Channels Tool



With this tool you configure multi-channel acquisition.

#### Info

The Channels tool is available in **ZEN starter** as well.  
No coded or motorized components are supported here. However, you can adjust the camera.

Once you have selected the channels, it makes one or more suggestions for acquisition. You can adopt these as required and make further changes to them.

To use longer exposure times than 10 seconds when acquiring images, for some cameras, e.g. AxioCam 7xx series, you have to define and turn on a black reference for long exposure times under **2D Acquisition** workbench > **Extended Camera** tool > **Post Processing Section**, see *Post Processing Section* [▶ 765]. Black reference defined in the **2D Acquisition** workbench is also applied in the **2D Multi-Channel Acquisition** workbench.

Parameter	Description
<b>Open Smart Setup</b>	Opens the <b>Smart Setup</b> dialog, see <i>Smart Setup</i> [▶ 162].
<b>Measure Exposure</b>	Starts an exposure time measurement for all currently active channels.
<b>List of channels</b>	<p>Displays a list of channels you have selected from the <b>Add Dye or Contrasting Method</b> dialog, see <i>Configuring Multi-Channel Acquisition with Smart Setup</i> [▶ 162].</p> <p>If you change the selection of a channel, the live image is switched accordingly. If you modify light source or channel-specific camera settings, e.g. exposure time, the modification is immediately updated in the live acquisition.</p>
	Moves the selected channels up or down.
	Deletes the selected channels.
<b>Ref.</b>	Sets the selected channel as reference channel for focus actions or stitching during acquisition.

Parameter	Description
<b>Lightsource</b>	Displays a list with light source settings depending on the used light source. Adjusting the parameters of the light sources is possible without saving it to the hardware settings.
— HXP 120/200 V	<p>Adjusts the intensity in discrete steps with the arrow keys or the slider.</p> <ul style="list-style-type: none"> <li>▪ <b>Intensity</b> slider Sets the intensity of the sample illumination. <b>1.0</b>: Illumination off; <b>100.0</b>: Maximum illumination.</li> <li>▪ Adjusts the values in % with the arrow keys.</li> </ul>
— TL Lamp	<p>For Brightfield channel. LEDs refer to %.</p> <ul style="list-style-type: none"> <li>▪ <b>Manual</b> Use your individual settings.</li> <li>▪ <b>3200K</b> Adjusts the intensity to a color temperature of 3200K comparable to working with a halogen bulb.</li> <li>▪ <b>Standby</b> Sets the intensity to 0% or 0V.</li> <li>▪ <b>Intensity</b> slider Sets the intensity of the sample illumination. <b>0.0</b>: Illumination off; <b>12.3</b>: Maximum illumination.</li> <li>▪ Adjust the values in % or V with the arrow keys.</li> </ul>
— Colibri 7/5/3	<p>Up to 7 LEDs are displayed depending on the hardware. The number of available LEDs depends on the used Colibri version.</p> <p>The following Colibri 7 versions with the corresponding LEDs are available:</p> <ul style="list-style-type: none"> <li>▪ <b>RGB-UV</b> <b>630, 555, 475, 385</b></li> <li>▪ <b>RYB-UV</b> <b>630, 590, 475, 385</b></li> <li>▪ <b>R[G/Y]B-UV</b> <b>630, 590, 555, 475, 385</b></li> <li>▪ <b>R[G/Y]CBV-UV</b> <b>630, 590, 555, 511, 475, 430, 385</b></li> <li>▪ <b>FR-R[G/Y]BV-UV</b> <b>735, 630, 590, 555, 475, 430, 385</b></li> </ul> <p>The Colibri 5 version <b>RGB-UV</b> is with the corresponding <b>385, 475, 555, 630</b> LEDs available.</p> <p>It is possible to activate all LEDs simultaneously which means that either <b>555</b> or <b>590</b> nm can be turned on, if both are available.</p> <ul style="list-style-type: none"> <li>▪ <b>Intensity</b> slider Sets the intensity of the sample illumination.</li> <li>▪ Adjust the values in % with the arrow keys.</li> <li>▪ <b>Excitation Filter of LED 567</b> button</li> </ul>



Parameter	Description
	<p>The 567 nm LED is combined with an excitation filter, which determines whether <b>555 nm</b> (yellow) or <b>590 nm</b> (green) excitation is used in.</p> <p>The following Colibri 3 versions with the corresponding LEDs are available:</p> <ul style="list-style-type: none"> <li>▪ <b>UV-BGR</b> <b>385, 470, 555, 625</b></li> <li>▪ <b>UV-BG</b> <b>385, 470, 555</b></li> <li>▪ <b>BGR</b> <b>470, 555</b></li> </ul>
<b>Deactivate all LEDs/Reactivate LEDs</b>	<p>Only visible with Colibri 7/5 lightsource.</p> <p>De- or reactivates all active LEDs to the status when the deactivate button was last used.</p>
<b>Exposure</b>	
— Auto Exposure	The exposure time is calculated automatically every time an image is acquired. For color cameras of the Axiocam series in b/w mode, the exposure time is determined in the b/w mode. This might lead to overexposure of individual pixels. The histogram displays the b/w mode and therefore does not reflect overexposure of individual pixels, which can be detected in the RGB mode with the same exposure time.
— Set Exposure	Starts a one time measurement of the exposure time, which is then used for all subsequent images. Deactivates the <b>Auto Exposure</b> checkbox. For color cameras of the Axiocam series in b/w mode, the exposure time is determined in the RGB mode to avoid unintended overexposure of pixels. Depending on the light source, this might lead to less usage of the histogram, i.e. dimmer images, than specified by the intensity value. To compensate for under- or overexposure, the intensity value can be adjusted.
— Time	<p>Adjusts the exposure time for the camera. Use the slider or spin box.</p> <p>Select the unit of time from the drop down list:</p> <ul style="list-style-type: none"> <li>▪ <b>ms</b></li> <li>▪ <b>s</b></li> <li>▪ <b>µs</b></li> </ul>
— Intensity	<p>Defines the range of the histogram that is used for exposure determination and therefore compensates for underexposure or overexposure.</p> <ul style="list-style-type: none"> <li>▪ 5% - 100%: Darkens the image, compensates for overexposure.</li> <li>▪ 100% - 200%: Brightens the image, compensates for underexposure.</li> </ul> <p>Use the slider or spin box to adjust the value.</p>
<b>Shading</b>	
— Correction	Uses the calculated shading correction for this channel.

Parameter	Description
– Define	Automatically calculates the shading correction, see <i>Applying the Shading Correction</i> [▶ 594].
– Global	Performs an objective-specific shading correction.
– Specific	Default method. Performs channel-specific shading correction. The fluorescence filter block used is saved with the shading file. If the fluorescence channel is changed, a previously created reference image is also loaded.
<b>EM Gain</b>	Only visible for EMCCD camera models. Sets the EM gain value.

### See also

Flexible Acquisition Workbench [▶ 735]

2D Multi-Channel Acquisition Workbench [▶ 166]

## 5.1.6 Camera - Global Settings Tool

With this tool you configure the color mode for the selected camera. The tool is only available for color cameras.

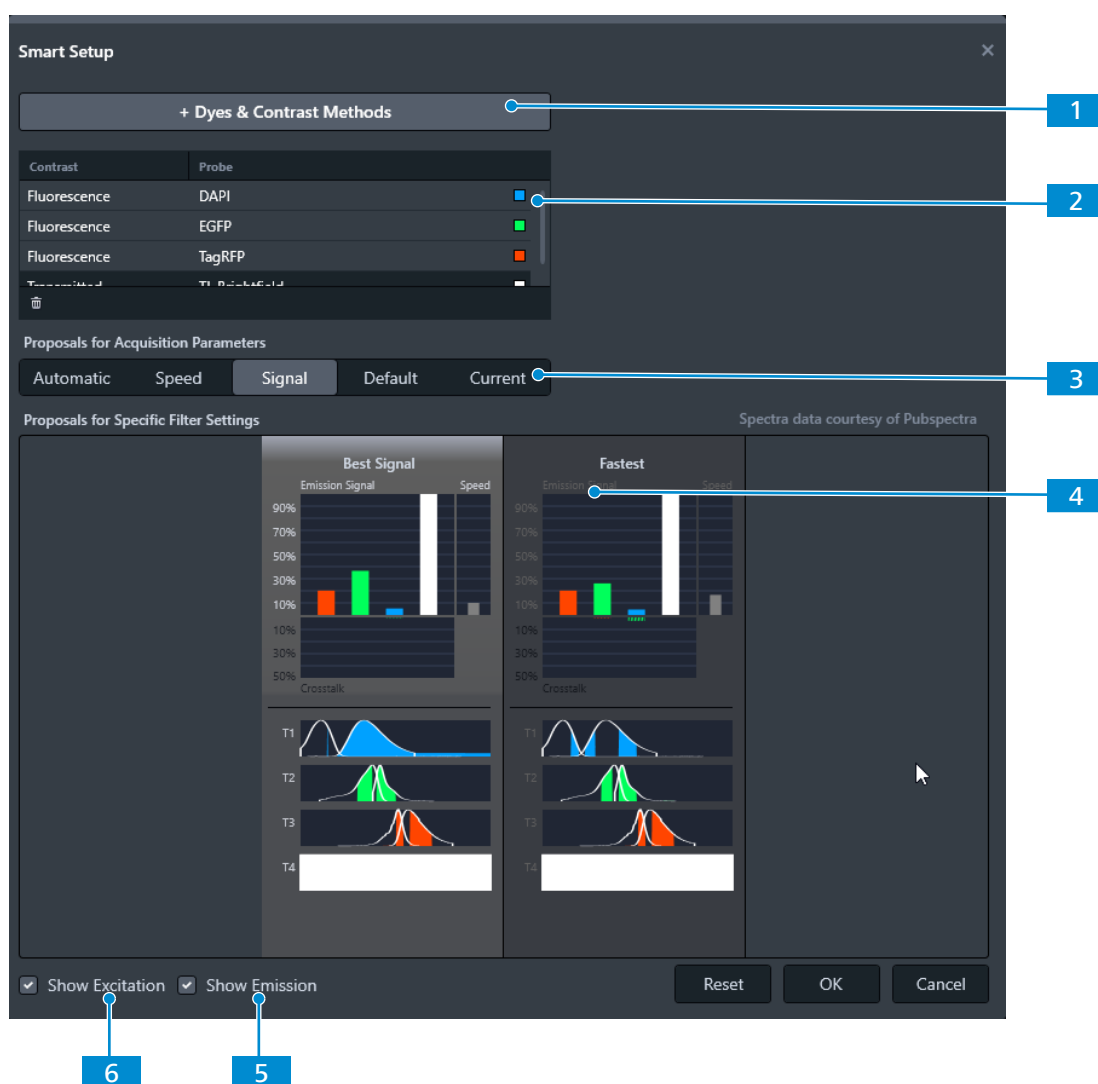
Parameter	Description
<b>Color Mode</b>	Switches to the desired color mode.
– RGB	Based on the RGB (Red-Green-Blue) color model. Transmits the image data of a color camera unchanged. This corresponds to the standard operating mode of a color camera.
– B/W	Treats the image data of the color channels as grayscale. The data of related color channels are averaged. The saturation of the camera appears reduced as a result. This process does not change the spectral properties of a color camera. The image information of the color sensor still undergoes color interpolation. An infrared filter also restricts the spectral sensitivity of the color camera compared to the spectral sensitivity of a genuine black and white camera.  Exposure time measurements with the auto exposure button use the <b>B/W</b> mode for calculations and therefore individual pixels of the color camera might be oversaturated, even if the histogram displaying the black and white calculation does not indicate overexposure. One time intensity measurements switch to the <b>RGB</b> mode for exposure time determination.

### See also

Flexible Acquisition Workbench [▶ 735]

2D Multi-Channel Acquisition Workbench [▶ 166]

### 5.1.7 Smart Setup Dialog



#### 1 + Dye & Contrast Methods

Opens the **Add Dye or Contrasting Method** dialog, see *Configuring Multi-Channel Acquisition with Smart Setup* [▶ 162].

#### 2 Table with selected channels

You can add up to 8 fluorescence channels and contrast methods. The added dyes or the contrast methods are shown in the list.

If necessary, change the color by clicking the arrow and select a user defined color.

#### 3 Buttons to optimize Acquisition Parameters

Click on a button to optimize image acquisition regarding particular requirements and to influence parameters like the camera, detector, and lighting settings, see *Buttons to Optimize Acquisition Parameters* [▶ 172].

#### 4 Proposals for Specific Filter Settings

Displays various **Smart Setup** proposals for further experiment settings.

See *Graphical Display of Proposals* [▶ 174] and *Smart Setup Proposals* [▶ 173].

#### 5 Show Excitation checkbox

**Activated:** Shows the excitation spectrum of the selected dyes in the graphical display.

**6 Show Emission** checkbox

**Activated:** Shows the emission spectrum of the selected dyes in the graphical display.

**5.1.7.1 Buttons to Optimize Acquisition Parameters**

The automatic settings you make through these buttons affect the settings displayed in the **Channels** tool, which are used for acquisition, see *Channels Tool* [▶ 167].

Parameter	Description
<b>Automatic</b>	<ul style="list-style-type: none"> <li>Sets power of Colibri-LEDs depending on wavelength and power of transmitted and reflected light sources to 10% or 3V.</li> <li>The system tries to set the optimal resolution for the camera by adjusting the binning if supported. The resolution is calculated from the total magnification at the camera adapter (objective + optovar + adapter).</li> <li>Sets the <b>Exposure Time</b>: <ul style="list-style-type: none"> <li>Transmitted light channel: 10 ms</li> <li>Reflected light channel: 10 ms</li> <li>Fluorescence channel: 150 ms</li> </ul> </li> <li>Sets the <b>Auto Exposure</b> to <b>Off</b></li> <li>Sets <b>Intensity</b> to the following: <ul style="list-style-type: none"> <li>Transmitted light channel: 70%</li> <li>Reflected light channel: 70%</li> <li>Fluorescence channel: 30%</li> </ul> </li> </ul>
<b>Speed</b>	<ul style="list-style-type: none"> <li>Sets power of Colibri-LEDs 100% and power of transmitted and reflected light sources to 10% or 3V.</li> <li>The system tries to set the optimal resolution for the camera by adjusting the binning if supported. The resolution is calculated from the total magnification at the camera adapter (objective + optovar + adapter).</li> <li>Sets the <b>Exposure Time</b>: <ul style="list-style-type: none"> <li>Transmitted light channel: 3 ms</li> <li>Reflected light channel: 3 ms</li> <li>Fluorescence channel: 50 ms</li> </ul> </li> <li>Sets the <b>Auto Exposure</b> to <b>Off</b></li> <li>Sets the <b>Intensity</b> to the following: <ul style="list-style-type: none"> <li>Transmitted light channel: 30%</li> <li>Reflected light channel: 30%</li> <li>Fluorescence channel: 15%</li> </ul> </li> </ul>
<b>Signal</b>	<ul style="list-style-type: none"> <li>Sets power of Colibri-LEDs 75% and power of transmitted and reflected light sources to 10% or 3V.</li> <li>The system tries to set the optimal resolution for the camera by adjusting the binning if supported. The resolution is calculated from the total magnification at the camera adapter (objective + optovar + adapter).</li> <li>Sets the <b>Exposure Time</b>: <ul style="list-style-type: none"> <li>Transmitted light channel: 20 ms</li> <li>Reflected light channel: 20 ms</li> </ul> </li> </ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>– Fluorescence channel: 300 ms</li> <li>▪ Sets the <b>Auto Exposure</b> to <b>Off</b></li> <li>▪ Sets the <b>Intensity</b> to the following: <ul style="list-style-type: none"> <li>– Transmitted light channel: 100%</li> <li>– Reflected light channel: 100%</li> <li>– Fluorescence channel: 60%</li> </ul> </li> </ul>
<b>Default</b>	<ul style="list-style-type: none"> <li>▪ Sets power of Colibri-LEDs 10% and power of transmitted and reflected light sources to 10% or 3V.</li> <li>▪ The system tries to set the optimal resolution for the camera by adjusting the binning if supported. The resolution is calculated from the total magnification at the camera adapter (objective + optovar + adapter).</li> <li>▪ Sets the <b>Exposure Time</b> to 20ms.</li> <li>▪ Sets the <b>Auto Exposure</b> to <b>Default</b></li> <li>▪ Sets the <b>Intensity</b> to 100%.</li> </ul>
<b>Current</b>	<p><b>NOTICE! If you changed hardware settings manually and do not want to lose them, click Current.</b></p> <ul style="list-style-type: none"> <li>▪ Sets power of Colibri-LEDs depending on wavelength and power of transmitted and reflected light sources to 10% or 3V.</li> <li>▪ The system tries to set the optimal resolution for the camera by adjusting the binning if supported. The resolution is calculated from the total magnification at the camera adapter (objective + optovar + adapter).</li> <li>▪ Transfers the following values from the current camera in use to the <b>Channels</b> tool: <ul style="list-style-type: none"> <li>– <b>Auto Exposure</b></li> <li>– <b>Exposure Time</b></li> <li>– <b>Intensity</b></li> </ul> </li> </ul>

### 5.1.7.2 Smart Setup Proposals

The number and type of proposals depend on the used microscope hardware, the selected dyes, and the contrast method.

Parameter	Description
<b>Best Signal</b>	Results in the best signal strength.
<b>Fastest</b>	Results in the fastest acquisition.
<b>Best Compromise</b>	Results in the best compromise between signal strength and acquisition speed.

## 5.1.7.3 Graphical Display of Proposals

**Info**

The bars in the graphs only show relative values. The actual strength of the emission signal and the crosstalk in the image can deviate substantially from this estimate, as Smart Setup has no knowledge of the strength with which the sample has been dyed with the individual dye components.

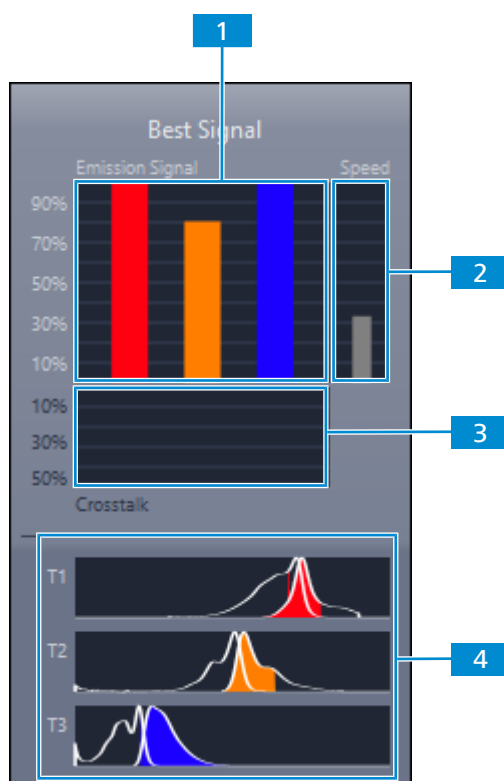


Fig. 7: Emission Signal, Speed, Crosstalk, and Tracks

**1 Emission Signal**

A filled, colored bar in the **Emission Signal** display field shows the relative emission signal to be expected for the corresponding channel. The channel color corresponds to the color of the selected dye in the **Configure Experiment** section.

**2 Speed**

A gray bar in the **Speed** display field represents the approximate acquisition speed that can be expected. This is the time required for the movement of microscope hardware during multichannel acquisition. Camera exposure times or parameters for other acquisition dimensions are not taken into account here.

**3 Crosstalk**

A hatched bar in the **Crosstalk** display field shows the expected relative crosstalk originating from one or more dyes for other channels.

**4 Tracks display**

Only visible if the **Show Excitation** and/or **Show Emission** checkboxes are activated.

The various tracks are labeled with **T1**, **T2** etc.. The white lines show the excitation and emission spectra of the dyes schematically. The spectra are filled in color in the places that will be acquired by the acquisition configuration suggested by **Smart Setup**. Transmitted light channels are displayed as a white field.

## 5.2 Time Series

This module enables you to acquire time series (time lapse) images. You can define the intervals between images, total acquisition duration and number of time points. Time series can be started and stopped manually, at fixed times or after a user-defined waiting period.

### 5.2.1 Time Series Workbench













With this workbench you acquire time series (time-lapse) images with defined intervals between images. The acquisition can be unlimited or limited by duration or number of time points. Time series can be started and stopped manually. The acquisition is limited only by free space on the hard drive. The images are acquired at maximum possible speed if the minimal interval is chosen shorter than acquisition speed.




The workbench is available in **Free Mode** and in **Job Mode**.

To acquire time series you need to license the **Time Series** module.

Parameter	Description
<b>Live</b>	Starts the live camera image.
<b>Start</b>	<p>Starts the acquisition. To stop the acquisition, click the button a second time.</p> <p>If you decide to stop the acquisition, depending on the settings in the <b>Time Series Setup</b> tool and on the mode you are working in, the time series will be saved or not:</p> <p>In <b>Free Mode</b>, with any limitation, the time series will be saved.</p> <p>In <b>Job Mode</b>, the following applies:</p> <ul style="list-style-type: none"> <li>▪ <b>Limit by none:</b> Time series is always saved.</li> <li>▪ <b>Limit by Cycle/Duration:</b> Time series is not saved when stopping before the defined time is finished.</li> </ul>
<b>Pause</b>	Pauses the recording and switches the button to <b>Continue</b> .
<b>Continue</b>	Continues the recording, if it has been paused. The button switches to <b>Pause</b> .

#### See also

-  Active Scaling Tool [▶ 751]
-  Extended Camera Tool [▶ 761]
-  Focus Tool [▶ 773]
-  Hardware Autofocus Tool [▶ 775]
-  Lamp Tool [▶ 776]
-  Light Path Editing Tool [▶ 777]
-  Light Path Tool [▶ 778]
-  Linkam Heating Stage Acquisition Setup [▶ 778]
-  Magnification Tool [▶ 781]
-  S&F Find (List) Tool [▶ 789]
-  S&F Find Tool [▶ 790]
-  Software Autofocus Tool [▶ 791]

-  Stage Tool [[▶ 795](#)]
-  Time Series Setup Tool [[▶ 176](#)]
-  Export Experiment Tool [[▶ 798](#)]

## 5.2.2 Time Series Setup Tool

With this tool you define time series. At the end the resulting time series image (CZI) is saved on hard drive or into the archive (as all other acquisition workbenches do). For exporting MPEG4 files, use the **Movie Export** tool, see **Output Documents > Export Tools > Movie Export Tool** tool, see *Movie Export Tool* [[▶ 860](#)].



To acquire time series you need to license the **Time Series** module.

Parameter	Description
<b>Limit by</b>	Sets the times series acquisition to a specific type.
– None	Default. No type is set. Acquisition has to be stopped manually. Click <b>Stop</b> to save the time series.
– Cycle	Limits the setup of the acquisition to a specific number.  In <b>Free Mode</b> : Click <b>Stop</b> to save the time series.  In <b>Job Mode</b> : If <b>Stop</b> is clicked before the cycle is expired, the time series is not saved.
– Duration	Limits the setup of the acquisition to a specific runtime.  In <b>Free Mode</b> : Click <b>Stop</b> to save the time series.  In <b>Job Mode</b> : If <b>Stop</b> is clicked before the duration is expired, the time series is not saved.
<b>Time Points</b>	Only visible, if for the limit <b>Cycle</b> is selected. Sets the number of time points for acquisition.
<b>Duration</b>	Only visible, if for the limit <b>Duration</b> is selected. Sets the length of the time series.
– ms	Sets the duration in milliseconds.
– s	Sets the duration in seconds.
– min	Sets the duration in minutes.
– h	Sets the duration in hours.
– Days	Sets the duration in days.
<b>Min. Interval</b>	Sets the cycle, e.g., <b>3 s</b> means, every three seconds an image is acquired. If the exposure time of your camera is longer, the interval is extended accordingly.
– ms	Sets the interval in milliseconds.
– s	Default: <b>1 s</b> . Sets the interval in seconds.
– min	Sets the interval in minutes.
– h	Sets the interval in hours.



Parameter	Description
– Days	Sets the interval in days.

### See also

-  Flexible Acquisition Workbench [► 735]
-  Time Series Workbench [► 175]

## 5.3 Tiles & Positions

This module enables you to acquire images that are made up of a number of individual images (tiles). To do this, it is possible to define tile regions and positions.



### 5.3.1 Acquiring a Tile Image

The tiles acquisition workbenches enable you to acquire an image of a large sample area. You define the area to be acquired and the system then acquires the corresponding tiles (images of neighboring sample areas) automatically and assemble them to a large image.

- Prerequisite**
- ✓ The **Tiles (manual)** or **Tiles (interactive)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
  - ✓ The microscope is equipped with a motorized stage.
1. Set up the camera using the **Camera** tool.
  2. Select the objective in the **Magnification** tool.
  3. Define and create the region of which you wish to acquire the tile image using the **Tiles Setup (manual)** or **Tiles Setup (interactive)** tool.
    - ➔ The **Center Screen Area** displays the area you wish to acquire and a preview of the tiles to be acquired, including overlap.
  4. Set up the stitching method to be applied after acquisition using the **Tile Stitching** tool.
  5. Add the **Focus Correction** tool to apply a supporting method for focusing such as **Software Autofocus** or **Focus Support Points / Focus Surface**.
  6. In the **Workbench Area**, click the **Start** button.

The software acquires the tiles and stitches (merging the individual images together) the tile image automatically.

### See also

-  Using Focus Support Points for Tile Images [► 178]
-  Focus Correction Tool [► 771]

### 5.3.2 Acquiring a Tile Image with Extended Depth of Focus

The **Tiles with EDF (interactive)** workbench enables you to combine a tile image with extended depth of focus (EDF) acquisition. A Z-stack image is acquired for each tile.

- Prerequisite**
- ✓ The **Tiles with EDF (interactive)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
  - ✓ The microscope is equipped with a motorized stage.
1. Set up the camera using the **Camera** tool.

2. Select the desired objective in the **Magnification** tool.
3. Define the region of which you wish to acquire the tile image using the **Tiles Setup (interactive)** tool.
4. Set up the focus range and number of slices to be acquired for each tile in the **Motorized Extended Depth of Focus** tool.
5. Set up the stitching method to be applied after acquisition of using the **Tile Stitching** tool.
6. In the **Workbench Area**, click the **Start** button.

The software acquires the tiles with extended depth of focus and assembles the tile image automatically.

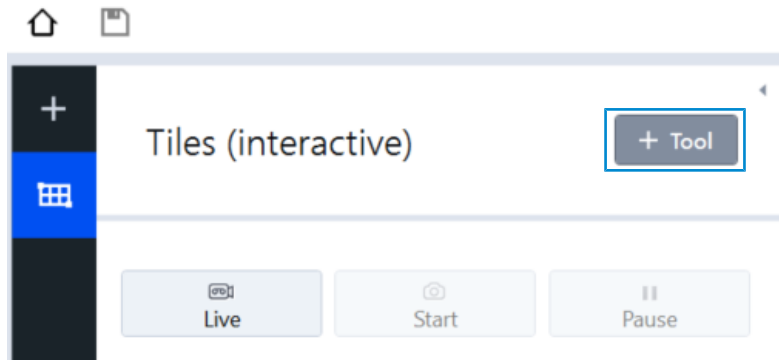
### Info

Each tile is acquired multiple times at different focus positions. Thus, combining tile acquisition with extended depth of focus increases the acquisition time considerably.

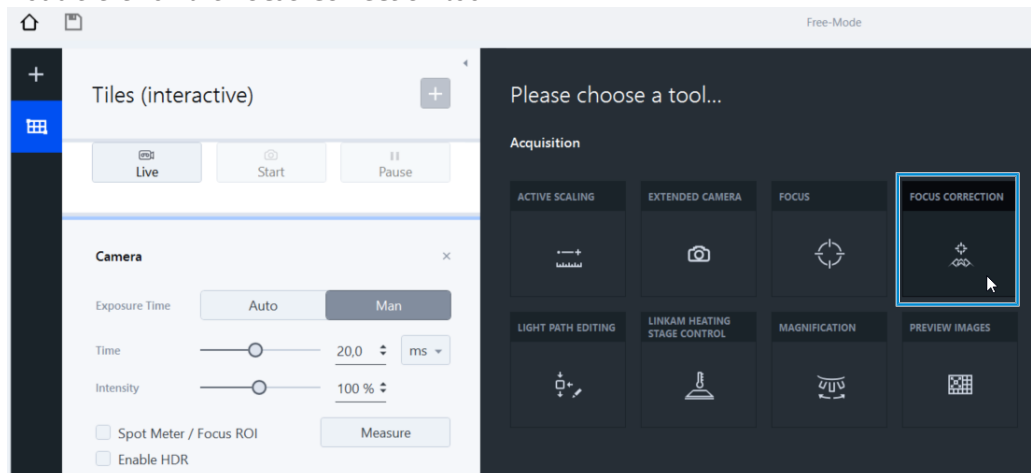
### 5.3.3 Using Focus Support Points for Tile Images

- Prerequisite**
- ✓ You have selected a tiles workbench e.g. **Tiles (interactive)**.
  - ✓ You have set up a tiles acquisition (e.g. 3x3 tiles).

1. Click on + to add a tool.

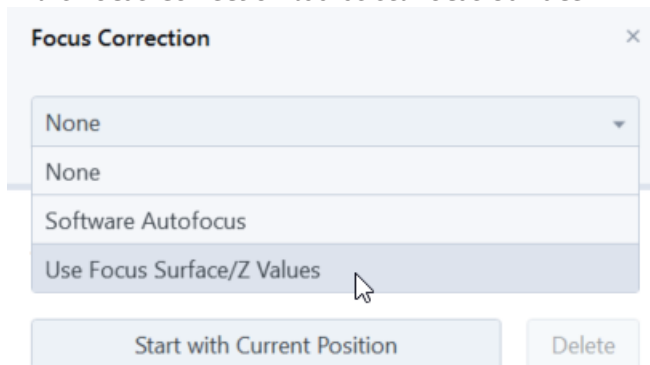


2. Double-click on the **Focus Correction** tool.

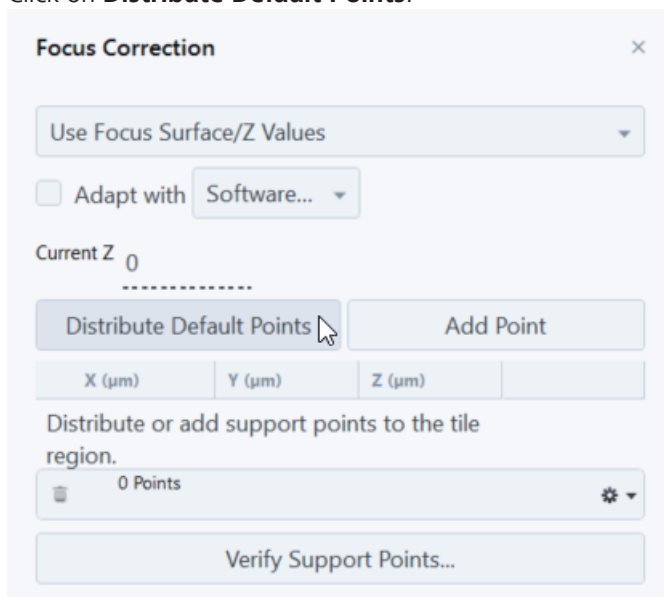


→ The tool will be added to the workbench.

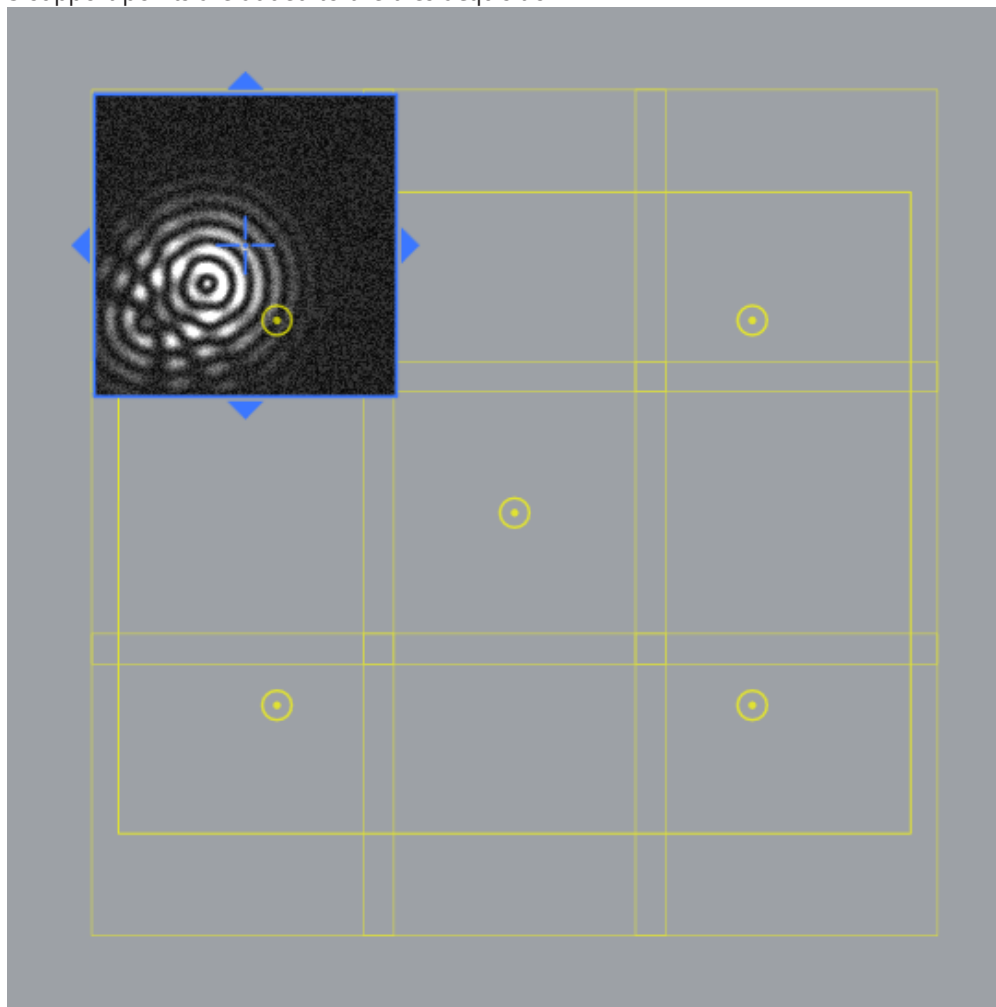
3. In the **Focus Correction** tool select **Focus Surface**.



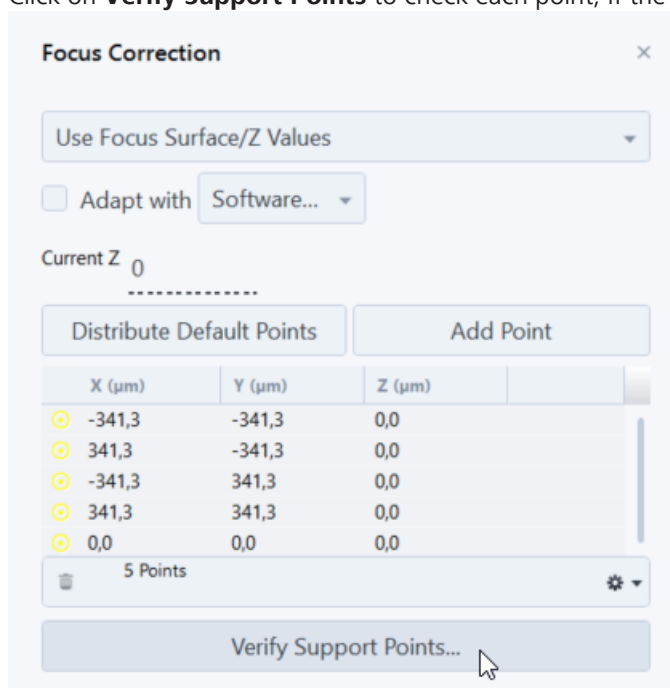
4. Click on **Distribute Default Points**.



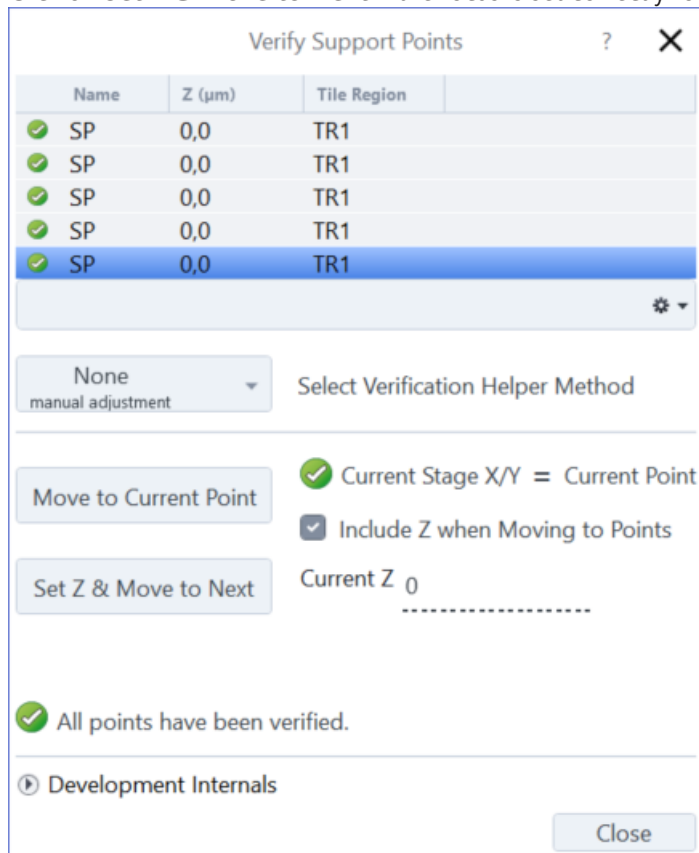
→ 5 support points are added to the tiles acquisition.



5. Click on **Verify Support Points** to check each point, if the focus is set correctly.



6. The **Verify Support Point** dialog will open and the stage moves to the first support point. Check if the image is in focus. If not, refocus the image. We recommend to use the **Software Autofocus** to help you find the correct focus setting. If the Software auto focus doesn't work fine, you can set the focus manually.
7. Click on **Set Z & Move to Next** if the focus is set correctly for the current support point.



8. The stage will move to the next support point. Repeat the verifying process until all support points are verified.

The message **All points have been verified** appears in the dialog. Click on **Close** to exit the dialog and start the tiles acquisition.

### 5.3.4 Preview Images Tool

Using this tool you can select an acquired or loaded image as a preview image for a tiles acquisition. Therefore you can create an image with a lower magnification and load it as preview image. The preview image can be then used for navigating to a specific area which you want to observe in detail. You now can switch to a higher magnification and acquire another tile image.

#### See also

Flexible Acquisition Workbench [► 735]

### 5.3.5 Tiles Options Tool

This tool enables you to add advanced options when acquiring tiles.

Parameter	Description
<b>Move Focus to Load Position Between Regions/Positions</b>	<p>Activated: To prevent possible damage, the focus drive is moved to the load position while moving to another tile region or position.</p> <p>This option is only available in the following workbenches:</p> <ul style="list-style-type: none"> <li>Position List Workbench</li> <li>Position List with EDF Workbench</li> <li>Tiles (measurement area) Workbench</li> </ul>
<b>Tile overlap</b>	<p>Defines the overlap of the re-tiled tiles in %.</p> <p>This option is only available in the following workbenches:</p> <ul style="list-style-type: none"> <li>Tiles (free drawing) Workbench</li> <li>Tiles (interactive) Workbench</li> <li>Tiles (manual) Workbench</li> <li>Tiles with EDF (interactive) Workbench</li> <li>Tiles (measurement area) Workbench</li> </ul>

**See also**

 Flexible Acquisition Workbench [► 735]

**5.3.6 Tiles Setup (interactive) Tool**


With this tool you can interactively setup a tile region simply by moving the stage. You just have to set the start and end position of the desired tile region and the tile region is generated automatically.


**Info**

If the sample height varies by a large amount, we recommend to add a focus correction method. Therefore you first have to add the **Focus Correction** tool. There you can select a focus correction method (e.g. Software Autofocus or Focus Surface) which is applied during the acquisition of the tile image.

Parameter	Description
<b>Start with Current Position</b>	<p>Adds the current x/y/z position as the starting point for the new tile region. The button then changes to <b>Extend to Current Position</b>. Move the stage to the desired end position and click on the button to setup the tile region.</p> <p>If you click on <b>Start</b> on top of the workbench, the final tile image will be acquired.</p>
<b>Delete</b>	Deletes the created tile region.

**See also**

 Specifying Permitted and Expected Values for a Tool [► 59]

 Configuring Tolerances for a Measurement [► 60]

5.3.7 Tiles Setup (free drawing) Tool

With this tool you can setup tile regions by drawing different contours (rectangle, ellipse, polygon) to create tile regions. The tile region is generated automatically according to the size of your drawing. When you click **Start** on top of the workbench, the final tile image is acquired.

**Note:** The **Tiles (free drawing)** workbench and the **Tiles Setup (free drawing)** tool are only visible in existing jobs where they were added in previous versions of ZEN core. They are not available any more for **Free Mode** or for new jobs.

Info

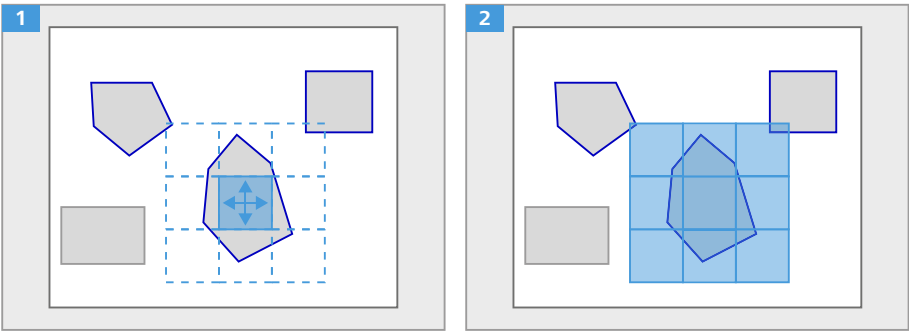
If the sample height varies by a large amount, we recommend to add a focus correction method. For this, you first have to add the **Focus Correction** tool. There you can select a focus correction method (e.g. Software Autofocus or Focus Surface) which is applied during the acquisition of the tile image.

5.3.8 Tiles Setup (manual) Tool

With this tool you can manually setup a tile region wether by entering the number of tiles (e.g. 3 x 3) or size of the tile region (e.g. 4000µm x 4000µm). The individual images (single tiles) are acquired and then stitched together to create the final tile image.

Info

If the sample height varies by a large amount, we recommend to add a focus correction method. For this, you first have to add the **Focus Correction** tool. There you can select a focus correction method (e.g. Software Autofocus or Focus Surface) which is applied during the acquisition of the tile image.



Parameter	Description
Create tile region	<p>Creates a preview of the tile region which you have setup. The tile region is created at the current stage position.</p> <p>The yellow grid shows the tiles to be acquired, including an overlap.</p> <p>The frame shows the total (sample) area of interest.</p> <p>If you click on <b>Start</b> on top of the workbench, the final tile image will be acquired.</p>
Tiles	<p>If selected, you can enter the number of tiles to be acquired, e.g. 3x3 tiles. The size of the tile region is calculated automatically.</p>

Parameter	Description
<b>Size</b>	If selected, you can enter the size of the tile region to be acquired in $\mu\text{m}$ , e.g. 4000 x 40000 $\mu\text{m}$ . The number of tiles is calculated automatically.





### See also

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

## 5.3.9 Tiles Setup (measurement area) Tool

Parameter	Description
<b>Contour</b>	Switches the option to select rectangular or circular contour shape.
<b>Field Size</b>	<p>Only visible with rectangular contour shape. Defines the sample measurement area size. You have the following options (in <math>\text{mm}^2</math>):</p> <ul style="list-style-type: none"> <li>▪ <b>0.126</b> (only in combination with a 20x objective and 200x total magnification) The measurement is conducted with a 20x objective and 200x total magnification. The resulting standard measuring field is <math>355 \mu\text{m} \times 355 \mu\text{m} = 0.126 \text{ mm}^2</math>.</li> <li>▪ <b>0.504</b> (only in combination with a 10x objective and 100x total magnification) Default value. The measurement is conducted with a 10x objective and 100x total magnification. The resulting standard measuring field is <math>710 \mu\text{m} \times 710 \mu\text{m} = 0.504 \text{ mm}^2</math>.</li> <li>▪ <b>2.016</b> (only in combination with a 5x objective and 50x total magnification) The measurement is conducted with a 5x objective and 50x total magnification, the resulting standard measuring field is <math>1420 \mu\text{m} \times 1420 \mu\text{m} = 2.016 \text{ mm}^2</math>.</li> <li>▪ <b>Custom</b> If you change the field size, the area is changed in relation.</li> </ul>
<b>Fields</b>	<p>Only visible with rectangular contour shape. Defines the number of standard measuring fields. Per default, the measurement is conducted with a 100 x total magnification, the resulting standard measuring field is <math>710 \mu\text{m} \times 710 \mu\text{m} = 0.5 \text{ mm}^2</math>.</p> <p>If you change the amount of standard measuring fields, the measurement area is changed accordingly.</p>
<b>Circle Diameter</b>	<p>Only visible with circular contour shape. Defines the diameter of the circle contour shape.</p>
<b>Area</b>	<p>Specifies the acquired measurement area in <math>\text{mm}^2</math>.</p> <p>If you change the measurement area, the amount of fields is changed accordingly.</p>



Parameter	Description
<b>Add Tile Region</b>	<p>Adds a new tile region with the specified size values. The region is added with the top left position at the current stage position. The contour geometry of the tile region is automatically adjusted to fit an integer multiple of the current field size. Therefore, the area might be a bit larger than expected.</p> <p>The region is created in a way that an integer multiple of the current field size fits into the contour geometry (in columns and rows). Example: If you enter a field count of 6, a tile region with 3 x 2 fields is created (3 columns, 2 rows). This has also the consequence that for certain field counts (all prime numbers), a region with exactly that field cannot be created. For example, if you enter a field count of 11, a tile region with 4 x 3 (= 12) fields is created. This in general means that, if you do not change the created tile regions manually, the regions are always integer multiple of the field size.</p>
<b>Tile Region Table</b>	This table provides an overview of all added tile regions. The checkbox in front of each entry activates the respective tile region. The following parameters are available in the table:
<b>Name</b>	Displays the name of the tile region. A click on the name allows you to edit it.
<b>Tiles</b>	Displays the number of tiles of the region.
<b>Z (µm)</b>	Displays and sets the z position of the region.
<b>Area</b>	Displays the area of the region in mm <sup>2</sup> .
<b>Size</b>	Displays the size of the region.
 Move Up	Moves up the entry one position in the list.
 Move Down	Moves down the entry one position in the list.
 Delete	Deletes the currently selected region.
 Options	
– <b>Set Current Z for Selected Tile Regions</b>	Sets the current z-position for all selected tile regions.
– <b>Set Current X/Y/Z for Selected Tile Region</b>	Sets the current x/y/z-position for all selected tile regions.
– <b>Delete</b>	Deletes the currently selected tile region.
– <b>Delete All</b>	Deletes all tile regions.
– <b>Activate</b>	Activates the current tile region for acquisition.

Parameter	Description
– <b>Deactivate</b>	Deactivates the current tile region for acquisition.
– <b>Sort</b>	Enables you to sort the entries in the tables.
– <b>Import Tile Regions</b>	Opens a file browser to import a list of already defined tile regions.
– <b>Export Tile Regions</b>	Opens a file browser to export the list of your currently defined tile regions as a file.
Parameter	Description
<b>Lock Contour of all Regions</b>	Specifies whether and how the contour geometry of all tile regions is locked.
– <b>None</b>	The contour of all tile regions is not locked.
– <b>Area</b>	The contour area of all tile regions remains constant.
– <b>Size</b>	The contour size and area of all tile regions cannot be changed.
<b>Adjust to Integer Multiple of Field Size</b>	Adjust the contour geometry of all tile regions to fit an integer multiple of the current field size. After that, the area might be slightly larger. If the size of the tile regions is not locked, you can modify the size of the tile regions manually by using the mouse handles in the graphical representation.

### See also



 Measurement Data Workbench [► 743]







### 5.3.10 Tiles Setup (multiple regions) Tool

With this tool you can setup multiple tile regions by drawing different contours (rectangle, ellipse, polygon). The tile regions are generated automatically according to the size of your drawings.

#### Info



If the sample height varies by a large amount, we recommend to add a focus correction method. For this, you first have to add the **Focus Correction** tool. There you can select a focus correction method (e.g. Software Autofocus or Focus Surface) which is applied during the acquisition of the tile image.

Parameter	Description
<b>Contour</b>	Selects which contour you want to use for drawing the tile region.
–  Selection Mode	Enables you to select an already created tile region to move or resize it.
–  Rectangle	Enables you to draw a rectangular tile region.

Parameter	Description
–  Ellipse	Enables you to draw an elliptical tile region.
–  Polygon	Enables you to draw a polygonal tile region.
<b>Tile Region Table</b>	This table provides an overview of all added tile regions. The check-box in front of each entry activates the respective tile region. The following parameters are available in the table:
<b>Name</b>	Displays the name of the tile region. A click on the name allows you to edit it.
<b>Tiles</b>	Displays the number of tiles of the region.
<b>Z (µm)</b>	Displays and sets the z position of the region.
<b>Area</b>	Displays the area of the region in mm <sup>2</sup> .
<b>Size</b>	Displays the size of the region.
 Move Up	Moves up the entry one position in the list.
 Move Down	Moves down the entry one position in the list.
 Delete	Deletes the currently selected region.
 Options	
– <b>Set Current Z for Selected Tile Regions</b>	Sets the current z-position for all selected tile regions.
– <b>Set Current X/Y/Z for Selected Tile Region</b>	Sets the current x/y/z-position for all selected tile regions.
– <b>Delete</b>	Deletes the currently selected tile region.
– <b>Delete All</b>	Deletes all tile regions.
– <b>Activate</b>	Activates the current tile region for acquisition.
– <b>Deactivate</b>	Deactivates the current tile region for acquisition.
– <b>Sort</b>	Enables you to sort the entries in the tables.
– <b>Import Tile Regions</b>	Opens a file browser to import a list of already defined tile regions.

Parameter	Description
– <b>Export Tile Regions</b>	Opens a file browser to export the list of your currently defined tile regions as a file.

### See also

-  Flexible Acquisition Workbench [► 735]
-  Tiles (multiple regions) Workbench [► 191]

## 5.3.11 Tiles Stitching Tool

This tool enables you to combine a set of tiles into one large image.

This tool takes a tile image with the individual tiles placed next to each other as input and returns a single large image. The tiles are shifted and rotated against each other to make the transitions between them as seamless as possible. In addition, the tool enables you to correct uneven exposure (shading), either automatically or by means of a reference image.

Parameter	Description
<b>Perform Stitching</b>	Activated: Stitching is performed after acquisition of the individual tiles
<b>Edge Detector</b>	When acquiring tiles to create a single large image, the stage movement is not precise down to the pixel level of the camera sensor. To bypass this technical limitation and to have a margin to compensate for this inaccuracy, tiles are usually overlapped by a few percent.  To align the tiles, the overlaps between neighboring tiles are analyzed. An edge detector may improve analysis results.
– <b>Yes</b>	Applies an edge detection algorithm to the tiles internally to improve analysis of the overlaps between neighboring tiles. This may improve the alignment of the tiles and thus the stitching result.
– <b>No</b>	Omits edge detection. The quality of alignment of the tiles may be reduced.
<b>Minimal Overlap</b>	The amount of overlap between neighboring tiles (in % of the area of a single tile) expected by the stitching tool. The tool evaluates this amount of overlap or more as required.  The value to the overlap that was used for acquisition of the tiles is set. Larger values may improve the result but increase calculation time.
<b>Max Shift</b>	Specifies the maximal extent of shift (in % of the area of a single tile) which can be applied to a tile during stitching.
<b>Comparer</b>	Specifies how the conformance of the tiles in the overlapping regions is evaluated.
– <b>Basic</b>	Basic comparison (faster)
– <b>Best</b>	Complex comparison (slower)
– <b>Optimized</b>	Optimized comparison

Parameter	Description
<b>Global Optimizer</b>	Specifies the number of overlaps evaluated during stitching. Evaluating more overlaps per tile yields a better stitched image, but requires more calculation time.
– <b>Basic</b>	Only one overlap per tile is evaluated.
– <b>Best</b>	All overlaps of a tile are evaluated.
<b>Defaults</b>	Resets all tool settings to the default values.
<b>Reset</b>	Enables you to return the output image back to its original form (input) after applying the stitching.
<b>Redo</b>	Enables you to return to the output form by reapplying the desired stitch settings.

**See also**

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Flexible Acquisition Workbench [► 735]

**5.3.12 Tiles (free drawing) Workbench**

This workbench enables you to create tile images on a motorized stage by setting up the tile region with freehand drawing tools.

**Note:** The **Tiles (free drawing)** workbench and the **Tiles Setup (free drawing)** tool are only visible in existing jobs where they were added in previous versions of ZEN core. They are not available any more for **Free Mode** or for new jobs.

**See also**











- ▢ Camera Tool [► 754]
- ▢ Focus Correction Tool [► 771]
- ▢ Preview Images Tool [► 181]
- ▢ S&F Find Tool [► 790]
- ▢ Software Autofocus Tool [► 791]
- ▢ Stage Tool [► 795]
- ▢ Tiles Options Tool [► 181]
- ▢ Tiles Setup (free drawing) Tool [► 183]
- ▢ Tiles Stitching Tool [► 188]

**5.3.13 Tiles (interactive) Workbench**

This workbench enables you to acquire an image of a large sample area composed of tiles: a tile corresponds to the area the camera is able to acquire with a single acquisition.

You can specify multiple areas of interest on your sample. The software defines the total area which needs to be acquired and thus the required number of tiles. The tiles are then acquired automatically (the stage movement is controlled by the software) and merged into a single image.

**See also**











-  Camera Tool [[▶ 754](#)]
-  Focus Tool [[▶ 773](#)]
-  Focus Correction Tool [[▶ 771](#)]
-  Hardware Autofocus Tool [[▶ 775](#)]
-  Lamp Tool [[▶ 776](#)]
-  Light Path Tool [[▶ 778](#)]
-  Stage Tool [[▶ 795](#)]
-  Tiles Options Tool [[▶ 181](#)]
-  Tiles Stitching Tool [[▶ 188](#)]
-  Export Experiment Tool [[▶ 798](#)]

### 5.3.14 Tiles (manual) Workbench

This workbench enables you to acquire an image of a large sample area composed of tiles: a tile corresponds to the area the camera is able to acquire with a single acquisition.

You specify the area of interest on your sample you wish to acquire by defining a corresponding region in the software. You can define the region by the number of tiles to be acquired or by the size in micrometers. The tiles are then acquired automatically (the stage movement is controlled by the software) and merged into a single image.

#### See also






-  Camera Tool [[▶ 754](#)]
-  Focus Tool [[▶ 773](#)]
-  Focus Correction Tool [[▶ 771](#)]
-  Hardware Autofocus Tool [[▶ 775](#)]
-  Lamp Tool [[▶ 776](#)]
-  Light Path Tool [[▶ 778](#)]
-  Stage Tool [[▶ 795](#)]
-  Tiles Options Tool [[▶ 181](#)]
-  Tiles Stitching Tool [[▶ 188](#)]
-  Export Experiment Tool [[▶ 798](#)]

### 5.3.15 Tiles (measurement area) Workbench

This workbench enables you to acquire one or more tile images using a motorized scanning stage by adding multiple tile regions with a defined measurement area. A number of specimens can be configured for automated tiles image acquisition. It is optimized for standard based **NMI Analysis**.

In case of multi-specimen-setup, you can define individual values for each sample.

#### See also

-  Focus Correction Tool [[▶ 771](#)]
-  Light Path Editing Tool [[▶ 777](#)]
-  Tiles Options Tool [[▶ 181](#)]
-  Tiles Setup (measurement area) Tool [[▶ 184](#)]
-  Export Experiment Tool [[▶ 798](#)]

### 5.3.16 Tiles (multiple regions) Workbench

This workbench enables you to create tile images on a motorized stage by setting up the tile region with freehand drawing tools. With this workbench you can draw multiple tile region, which are then acquired in a single acquisition.

#### See also

-  Active Scaling Tool [► 751]
-  Camera Tool [► 754]
-  Focus Correction Tool [► 771]
-  Focus Tool [► 773]
-  Lamp Tool [► 776]
-  Light Path Editing Tool [► 777]
-  Light Path Tool [► 778]
-  Stage Tool [► 795]
-  Tiles Options Tool [► 181]
-  Tiles Setup (multiple regions) Tool [► 186]
-  Tiles Stitching Tool [► 188]
-  Export Experiment Tool [► 798]

### 5.3.17 Tiles with EDF Workbench

This workbench enables you to acquire an image of a large sample area by specifying multiple tile regions on your sample which you wish to combine into a large image. For each tile region, a z-stack of images is acquired and merged afterwards into an extended depth of focus (EDF) image.

The stage movement and acquisition of the individual tiles is controlled automatically.

#### See also

-  Camera Tool [► 754]
-  Focus Tool [► 773]
-  Focus Correction Tool [► 771]
-  Hardware Autofocus Tool [► 775]
-  Lamp Tool [► 776]
-  Light Path Tool [► 778]
-  Magnification Tool [► 781]
-  Preview Images Tool [► 181]
-  S&F Find Tool [► 790]
-  Stage Tool [► 795]
-  Tiles Options Tool [► 181]
-  Tiles Stitching Tool [► 188]
-  Export Experiment Tool [► 798]
-  Tiles Setup (multiple regions) Tool [► 186]

## 5.4 Guided Acquisition

With the **Guided Acquisition** module for **ZEN core** you can setup automated jobs to acquire images (overview), detect relevant objects (image analysis) and re-image these positions, using another tiles acquisition e.g. with higher magnification.

Guided Acquisition Workflow:

1. Scan or inspect a large area or the whole sample.
2. Perform an analysis to detect interesting objects.
3. Acquire detailed images for every detected object.

A possible application is to detect sparse inclusions in a material. **Guided Acquisition** allows you to find these inclusions in a low-magnification overview scan using image analysis. Afterwards, at the detected positions high-magnification images are acquired.

### 5.4.1 Job Template for Guided Acquisition (Supervisor)

With this job template, you acquire an overview tiles image to detect objects using image analysis and then capture them again at a higher magnification. **Guided Acquisition** is supported in **Job Mode** only.



#### Form

In the **Form Selection** tool, an input form is provided.

1. To choose the form, in the **Name** field, select the form. See *Form Selection Tool* [▶ 750].



#### Tiles (manual)

To acquire an image of a large sample area composed of tiles, specify the area of interest.

A tile corresponds to the area the camera is able to acquire with a single acquisition.

Note: You can exchange the workbench with other tiles acquisition workbenches.

See

- *Camera Tool* [▶ 754]
- *Tiles (manual) Workbench* [▶ 190]
- *Tiles Setup (manual) Tool* [▶ 183]
- *Tiles Stitching Tool* [▶ 188]
- *Magnification Tool* [▶ 781]
- *Focus Correction Tool* [▶ 771]



#### Guided Acquisition Image Analysis

The demo job contains a Tiles (manual) workbench for acquisition of this overview image.

Acquire a tiles image that serves as an overview image. Typically, the overview scan is done using a lower magnification in combination with a tile image. Load an image analysis setting. A default setting file is provided: Guided Acquisition - Bright and Dark Regions.czias.

See *Load Setting Tool* [▶ 869].





### Class Setup

This step is not visible to the operator.

Sets up the measurement classes for the image analysis of the sample.

Default classes: **Bright Regions** and **Dark Regions**.

See *Classes* [▶ 251].



### Frame Setup

This step is not visible to the operator.

Specifies measurement frames and how regions at the edges of the frames are treated when analysis is performed.

See *Frame* [▶ 252].



### Image Segmentation

This step is not visible to the operator.

Specifies the class segmentation so that objects are extracted accordingly.

1. Adjust the settings to optimize the segmentation results.

See *Automatic Segmentation* [▶ 254].



### Region filter

This step is not visible to the operator.

Excludes detected objects depending on features of detected regions.

See *Region Filter* [▶ 263].



### Interactive Image Segmentation

This step is not visible to the operator.

Adds or removes individual objects or areas to be measured and allows manual modification of areas.

See *Interactive Segmentation* [▶ 265].



### Features Setup

This step is not visible to the operator.

Defines the properties of the detected objects to be measured.

For the detail scan, the position and extend of the segmented areas is needed and are automatically added. The following features are already set in the job template for each class:

- **ID**
- **Area**
- **Bound Children Center X Stage**
- **Bound Children Center Y Stage**

- **Bound Children Width  $\mu\text{m}$**
- **Bound Children Height  $\mu\text{m}$**

If you want to add more features of individual regions, click **Select** and select the desired features.

To display these measurements as annotations in the next step, activate **Display**.

See

- *Features* [[▶ 268](#)]
- *Measurement Features* [[▶ 274](#)]



### Measurement Data

Displays the measurement results of the selected class in a table.

No action required.



### Guided Acquisition Regions Creator

Filters the results of the **Image Analysis** and creates a tile region list from them.

Select the filter conditions, see *Region Filter Tool* [[▶ 197](#)].



### Tiles (measurement area)

Configures the settings of the acquisition. The tile regions are pre-filled from the previous step.

Set a magnification that is higher than that of the overview image.

Note: In order for **Guided Acquisition** to function, the **Tiles (measurement area)** workbench must not be exchanged.

See

- *Camera Tool* [[▶ 754](#)]
- *Tiles Setup (measurement area) Tool* [[▶ 184](#)]
- *Tiles Stitching Tool* [[▶ 188](#)]
- *Magnification Tool* [[▶ 781](#)]
- *Focus Correction Tool* [[▶ 771](#)]



### Split Image

This step is not visible to the operator.

We recommend not to change the default parameters.

Splits combined tile region images into individual overview images.

See *Split by Dimension Tool* [[▶ 532](#)].



### ZEN Connect

Allows to manage, align, and export images in correlation with images from other sources.

Get an overview of your acquisitions with an overlay of the detail scans on the overview image, see *ZEN Connect Tool* [▶ 356].



### Reports

Creates a Report with the file name  
ZEISS Report Guided Acquisition.docx.  
The following information is displayed:

- Project number
- Sample number
- User
- Date
- Overview image
- Image analysis results (default class: Bright)
- Detail images

No action required if you used class Bright. If you used class Dark, relink the image analysis results to the class Dark.

You can print the report.

See *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

## 5.4.2 Job Template for Guided Acquisition (Operator)

With this job template, you acquire an overview tiles image to detect objects using image analysis and then capture them again at a higher magnification. **Guided Acquisition** is supported in **Job Mode** only.

### Step 1: Form

In the **Form Selection** tool, an input form is provided.

1. To choose the form, in the **Name** field, select the form.

### Step 2: Image Acquisition

A tiles image serves as an overview image for **Guided Acquisition**. The demo job contains a **Tiles (manual)** workbench for acquisition of this overview image.

1. Acquire a tiles image that serves as an overview image. Typically, the overview scan is done using a lower magnification in combination with a tile image.

See

- *Tiles (manual) Workbench* [▶ 190]
- *Camera Tool* [▶ 754]

- *Tiles Setup (manual) Tool* [[▶ 183](#)]
- *Tiles Stitching Tool* [[▶ 188](#)]
- *Magnification Tool* [[▶ 781](#)]
- *Focus Correction Tool* [[▶ 771](#)]

### Step 3: Measurement Data

Displays the measurement results of the selected class in a table.

No action required.

### Step 4: Guided Acquisition Tile Regions Creator

Filters the results of the **Image Analysis** and creates a tile region list from them.

1. Select the filter conditions, see *Region Filter Tool* [[▶ 197](#)].

### Step 5: Tiles (measurement area)

Configures the settings of the acquisition. The tile regions are pre-filled from the previous step.

1. Set a magnification that is higher than that of the overview image.

Note: In order for **Guided Acquisition** to function, the **Tiles (measurement area)** workbench must not be exchanged.

See

- *Camera Tool* [[▶ 754](#)]
- *Tiles Setup (measurement area) Tool* [[▶ 184](#)]
- *Tiles Stitching Tool* [[▶ 188](#)]
- *Magnification Tool* [[▶ 781](#)]
- *Focus Correction Tool* [[▶ 771](#)]

### Step 6: ZEN Connect

Allows to manage, align, and export images in correlation with images from other sources.

1. Get an overview of your acquisitions with an overlay of the detail scans on the overview image.

### Reports

Creates a Report with the file name

ZEISS Report Guided Acquisition.docx.

The following information is displayed:

- Project number
- Sample number
- User
- Date
- Overview image
- Image analysis results
- Detail images

No action required.

You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### 5.4.3 Guided Acquisition Regions Creator Workbench

This workbench allows to filter the results of an image analysis which will be used to create a region list for further acquisitions.

This workbench is only visible in **Job Mode**.

#### See also

 Region Filter Tool [▶ 197](#)

### 5.4.4 Region Filter Tool

With this tool you filter the image analysis results before creating a tiles region list from them. Filtering image analysis regions is done by selecting a number of sorted list of items from a defined class. In the **Center Screen Area**, the full list of image analysis results is displayed. The filtered regions are marked in the list.

This tool is only visible in **Job Mode**.

Parameter	Description
<b>Class</b>	Selects a class for further filtering.
<b>Select Feature</b>	Selects the features for filtering from the list of features which have been set up in the <b>Image Analysis</b> in the <b>Feature Setup</b> step. See <i>Measurement Features</i> <a href="#">▶ 274</a> .  Not active, if <b>Random Selection</b> is activated.
<b>Sorting</b>	Sets the sorting order for the analysis region according to the defined image analysis features.  Not active, if <b>Random Selection</b> is activated.
– <b>Descending</b>	Sorts the analysis regions in the table in descending order.
– <b>Ascending</b>	Sorts the analysis regions in the table in ascending order.
<b>Random Selection</b>	<b>Activated:</b> Selects the analysis regions in the table randomly.  Not active, if <b>Select Feature</b> and <b>Sorting</b> are deactivated.
<b>Number</b>	Sets the desired number of analysis regions for details scans. The selection is reflected in the table in the <b>Center Screen Area</b> .

#### See also

 Guided Acquisition Regions Creator Workbench [▶ 197](#)

## 6 General Toolkits

Toolkit	Functionality
2D Toolkit	<ul style="list-style-type: none"> <li>▪ <i>Image Analysis</i> [▶ 242]</li> <li>▪ <i>Advanced Processing</i> [▶ 204]</li> </ul>
3D Toolkit	<ul style="list-style-type: none"> <li>▪ <i>3Dxl</i> [▶ 198]</li> <li>▪ <i>Advanced Processing</i> [▶ 204]</li> </ul>
AI Toolkit	<ul style="list-style-type: none"> <li>▪ <i>Intellesis</i> [▶ 292]</li> <li>▪ <i>Intellesis Object Classification</i> [▶ 322]</li> <li>▪ <i>Intellesis Denoising</i> [▶ 318]</li> </ul>
Connect Toolkit	<ul style="list-style-type: none"> <li>▪ <i>Connect</i> [▶ 337]</li> <li>▪ <i>Connect 2D Add-on</i> [▶ 337]</li> <li>▪ <i>Connect 3D Add-on</i> [▶ 337]</li> <li>▪ Third Party Import</li> </ul>
Developer Toolkit	<ul style="list-style-type: none"> <li>▪ ZEN API</li> <li>▪ <i>Macro Environment</i> [▶ 329]</li> </ul>
GxP	<ul style="list-style-type: none"> <li>▪ <i>GxP</i> [▶ 376]</li> </ul>

### 6.1 3Dxl

The 3D viewing functionality enables you to visualize 3D or 4D image data. It provides up to three clipping planes and features five different rendering methods, including a transparency mode for better visualization of dense structures, such as EM, XRM and dense fluorescent data. For full functionality, a dedicated current graphic card with full OpenGL support is required (NVIDIA recommended, AMD possible).

#### 6.1.1 Opening an Image in 3D

**Prerequisite** ✓ You have acquired or loaded a z-stack image.


✓ You have the **3D** workbench available.

1. In **Free Mode**, select your z-stack in the gallery on the right and click on the **3D** workbench. In **Job Mode**, enter the step with the **3D** workbench.  
→ The image is displayed as a three dimensional volume in the 3D view.
2. Use the settings on the view tabs below the image to adapt the view to your needs, e.g. by changing the rendering mode or by adding clipping planes.

You have opened an image in 3D and adapted the appearance. You can now interact with the volume and make additional settings with the view tabs or the toolbar above the view.

#### 6.1.2 Animating the 3D Volume

**Prerequisite** ✓ The **Rotation** mode  is enabled in the toolbar.

1. Make sure that  is activated in the toolbar.

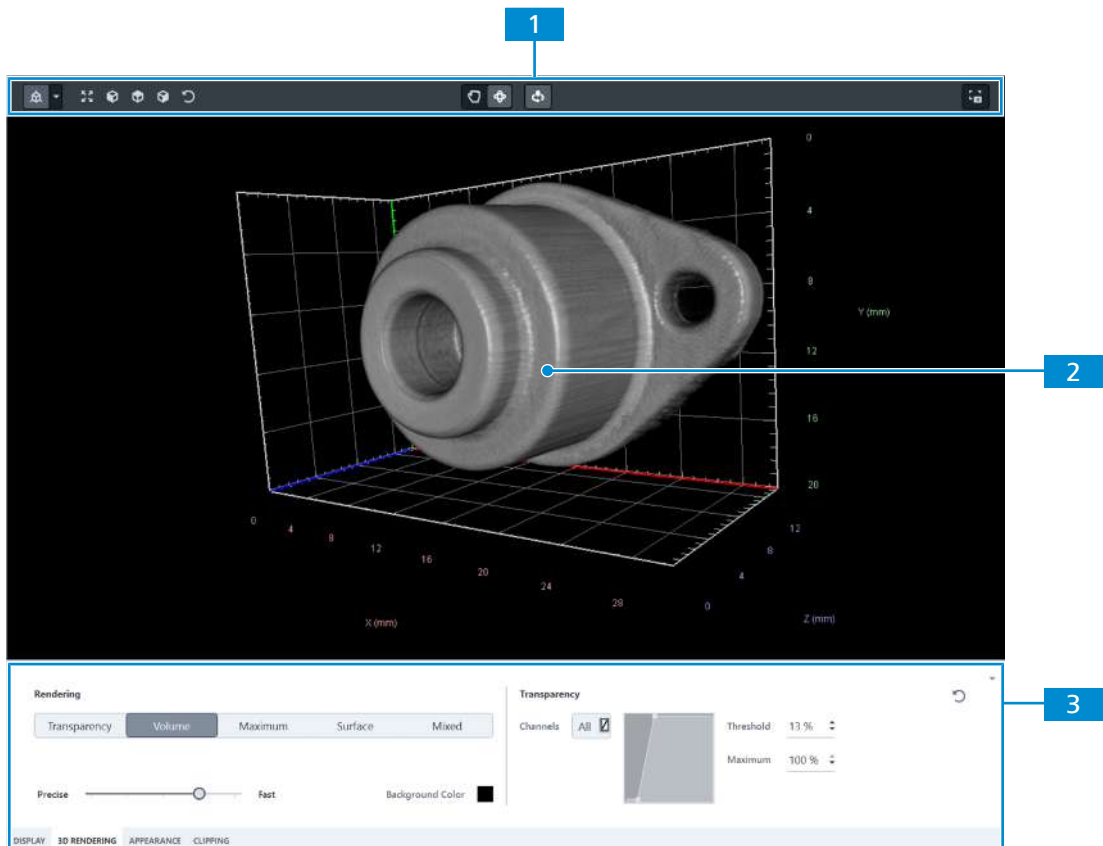
2. Move the mouse inside the image area.
3. Hold down the left mouse button and move the mouse.
4. Release the left mouse button again.

The 3D volume rotates continuously in the direction in which you moved the mouse. If you move the mouse quickly, the 3D volume rotates quickly. If you move the mouse slowly, the 3D volume rotates slowly.

To stop the animation, left-click again in the image area.

### 6.1.3 User Interface 3D View

The **3D** workbench enables you to view your image in 3D and interact with it.



#### 1 3D Toolbar

Toolbar to control the behavior of the 3D view and the image display, see *3D Toolbar* [► 200].

#### 2 3D View

Area that displays z-stack images three-dimensionally as a 3D volume and allows you to interact with the volume.











#### 3 View Options

Area where you have general and 3D specific view options with parameters to adjust the appearance and further settings of the 3D volume.


### See also

3D Workbench [► 203]

### 6.1.3.1 3D Toolbar

Parameter	Description
 <b>Toggle Axis and Bounding Box</b>	Toggles the visibility of the bounding box, coordinate axis and scale bar around the volume in the view. With the arrow on the right, you can toggle the elements individually.
– <b>Bounding Box</b>	<b>Activated:</b> Displays the bounding box around the volume.
– <b>Coordinate Axis</b>	<b>Activated:</b> Displays the coordinate axis in the image view.
– <b>Coordinate Axis Scale</b>	<b>Activated:</b> Displays the scale bar for coordinate axis in the image view.
 <b>Zoom to Fit</b>	Automatically sets a zoom factor where the entire image is displayed to fill the view.
 <b>Left View</b>	Displays the volume from the left.
 <b>Top View</b>	Displays the image from the top.
 <b>Front View</b>	Displays the image from the front.
 <b>Reset</b>	Resets the view to the default.
 <b>Panning Mode</b>	Activates the panning mode to fixate and move the volume in the view.
 <b>Rotation Mode</b>	Activates the rotation mode to rotate the 3D image in any way within the image view. This is the default mode when you switch to 3D view.
 <b>Spin Mode</b>	<b>Activated:</b> Enables the spin mode which allows you to set the 3D volume in continuous motion.
 <b>Screenshot</b>	Creates a 2D image of the current view and copies it to the clipboard.

### 6.1.3.2 Appearance Tab

Here you can define the appearance of the 3D volume. With the reset button  on top of the sections of the tab, you can reset the parameters to their default values.

#### Light

Parameter	Description
<b>Brightness</b>	Sets the brightness of the light source.



Parameter	Description
<b>Enable Directional Light</b>	<b>Activated:</b> Enables full lighting for volumetric rendering. A directional light illuminates all structures in a scene with parallel light rays from a specific direction, similar to sun light. The light disregards the distance between the light itself and the structures, so the light does not diminish with distance.
<b>Azimuth</b>	Sets the angle of the light source above the virtual horizon. Alternatively, you can use the control to the left to set the <b>Azimuth</b> together with <b>Elongation</b> manually.
<b>Elongation</b>	Sets horizontal angle of incidence for the light source. Alternatively, you can use the control to the left to set the <b>Elongation</b> together with <b>Azimuth</b> manually.
<b>Enable Tone Mapping</b>	<b>Activated:</b> Enables tone mapping during the rendering of the image data. Tone mapping refers to the compression of the dynamic range of high contrast images (HDR). The contrast range is reduced in order to display digital HDR images on output devices with a more limited dynamic range. In most cases, tone mapping increases brightness and contrast of the rendering result and makes colors more vibrant.

### Projection

Parameter	Description
<b>View Angle</b>	Adjusts the view angle of the projection.
<b>Scale Z</b>	Adjusts the scaling in z, i.e. the height of the displayed z stack.
<b>Reverse Z Axis</b>	<b>Activated:</b> Reverses the z axis for displaying the image. <b>Deactivated:</b> Uses the z axis direction that is automatically detected by ZEN core.

#### 6.1.3.3 3D Rendering Tab

On this tab you can specify which projection/rendering mode you want to use to display the 3D volume. There are 5 view modes available. Additionally, you have transparency settings for your displayed volume.

### Rendering

Parameter	Description
<b>Transparency</b>	Activates the Transparency rendering mode where the structures in the image are rendered in a similar fashion as in the Volume mode. The key difference is an applied edge enhancement filter to allow more focus on relevant structures within the data while simultaneously fading out homogenous and less important areas.
<b>Volume</b>	Activates the Volume mode where the structures in the image are rendered as three-dimensional objects and illuminated by means of a virtual light source. This allows a realistic and, in contrast to the maximum projection mode, a quantitative display of the volume.
<b>Maximum</b>	Activates the Maximum intensity projection mode where only the pixels with the highest intensity are displayed along the observation axis.

Parameter	Description
<b>Surface</b>	Activates the Surface mode where the program calculates solid surfaces ("isosurfaces") from the gray values, which emphasizes particularly flat structures (e.g. cell walls of plant cells).
<b>Mixed</b>	Activates a mixed mode which is a combination of transparency rendering and surface reconstruction mode. This means that even highly complex spatial relationships can be displayed convincingly.
<b>Precise/Fast</b>	Adjusts the level of detail of the 3D volume. <ul style="list-style-type: none"> <li>▪ If you select <b>Precise</b>, all the information present in the image is used to achieve the best possible display. The calculation time can increase accordingly.</li> <li>▪ If you select <b>Fast</b>, the image data are significantly reduced before the calculation. The calculation is fast, but only a very coarse 3D display of the volume is achieved.</li> </ul>
<b>Background Color</b>	Sets the background color for the 3D view by clicking on the color field and selecting the desired color.

### Transparency

Parameter	Description
<b>Channels</b>	Selects the channel of a multichannel image for which you want to set the transparency.
<b>Threshold</b>	Sets the lower threshold value in percent of the gray levels displayed. With this setting you specify the gray value range for the relevant channel that you want to be included in the rendered image.
<b>Maximum</b>	Sets the level of opacity (0-100 percent).

#### 6.1.3.4 Clipping Tab

On this tab, you can edit the visualization of the content of an active clipping plane. To display a clipping plane, click on the corresponding button. The options which you can use to modify the selected clipping plane get visible when you activate the specific clipping plane.

Parameter	Description
<b>Clipping Planes</b>	<b>Activated:</b> Displays all activated clipping planes and allows the editing of the different planes. <b>Deactivated:</b> Removes all clipping planes from the image view and blocks the editing for the individual planes.
<b>Show Detail Settings</b>	<b>Activated:</b> Displays more detailed settings for each individual clipping plane.
<b>X-Y, X-Z, Y-Z</b>	<b>Activated:</b> Displays the individual clipping plane(s) in the image and activates the settings below.
<b>Position</b>	Sets the position of the respective clipping plane.
<b>X Angle</b>	Only visible, if <b>Show Detail Settings</b> is activated. Sets the tilt angle of the clipping plane in x direction.

Parameter	Description
<b>Y Angle</b>	Only visible, if <b>Show Detail Settings</b> is activated. Sets the tilt angle of the clipping plane in y direction.
<b>Display</b>	Only visible, if <b>Show Detail Settings</b> is activated.
– <b>Front</b>	<b>Activated:</b> Clips the front of the 3D volume.
– <b>Back</b>	<b>Activated:</b> Clips the back of the 3D volume.
<b>Appearance</b>	Only visible, if <b>Show Detail Settings</b> is activated. Changes the appearance of the respective clipping plane. The following settings are available:
– <b>Colored</b>	The plane is displayed in color.
– <b>Textured Opaque</b>	Black pixels do not let any light through, meaning that the render data behind them are not displayed.
– <b>Transparent</b>	The data that are touched by the clipping plane are displayed as they are in <b>Transparency</b> render mode, but in 2 dimensions. The ramp for the transparency is linear here. Black pixels are transparent.
– <b>Binary</b>	The data above the threshold value that are touched by the clipping plane are displayed in binary form as a white area. Black pixels are non-transparent.
– <b>Invisible</b>	Sets the plane invisible.

#### 6.1.4 3D Workbench

This workbench enables you to display your z-stack images in 3D, see *User Interface 3D View* [▶ 199].

##### See also

 Create Image Tool [▶ 203]

#### 6.1.5 Create Image Tool

This tool enables you to take a screenshot of the current 3D view.

Parameter	Description
<b>Resolution</b>	Selects the resolution for the screenshot. The following resolutions are available: <ul style="list-style-type: none"> <li>▪ <b>Current View</b> (resolution of the current view)</li> <li>▪ <b>720 x 576 (SD)</b></li> <li>▪ <b>1024 x 768</b></li> <li>▪ <b>1920 x 1080 (HD)</b></li> <li>▪ <b>4096 x 3072 (4K)</b></li> </ul>

Parameter	Description
Apply	Only available in <b>Free Mode</b> . Takes the screenshot with the selected resolution and adds it to the gallery on the right. In <b>Job Mode</b> , the screenshot is automatically taken if you have added this tool and go to the next step of the job.

See also

 3D Workbench [► 203]

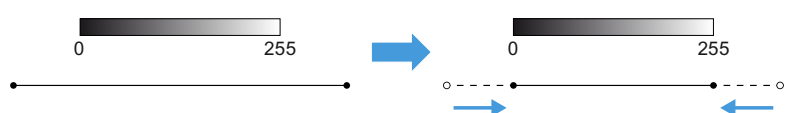
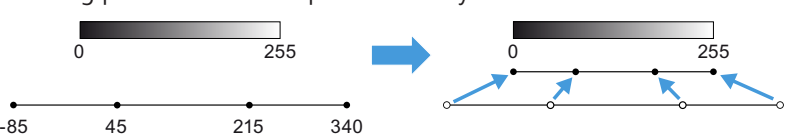
6.2 Advanced Processing

This module adds additional processing functions to the software. If licensed, the following groups and functions are available in the **Image Processing** workbench.

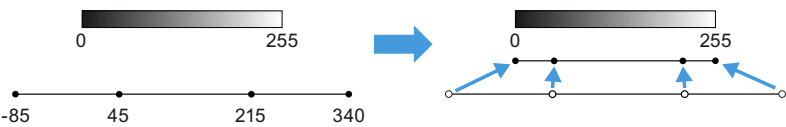
6.2.1 Arithmetics Group

6.2.1.1 Add Tool

This tool merges two images by adding the corresponding pixel values. Output values outside the range of available pixel values are normalized according to the selected normalization type.

Parameter	Description
Normalization	Defines how out-of-range pixel values are mapped.  The calculated pixel values of the output image may be out-of-range and are mapped into the available range.
— Clip	Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).  
— Automatic	Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.  
— Shift	Normalizes the output to the value "pixel value + maximum pixel value/2". As a result, all resulting values are mapped to the available value range.

The middle value of the pixel value range remains constant. Values left and right of the middle value are changed progressively, so that values inside the pixel value range are changed only slightly. Values outside the pixel value range are changed strongly and mapped to the fringes of the pixel value range.



– Wrap

If a resulting value is larger than the maximum pixel value of the image, the difference exceeding the maximum pixel value is added to 0. Similarly, if a resulting value is below 0, the resulting pixel value is the maximum pixel value minus the difference falling below 0.



See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.2 Add Constant Tool

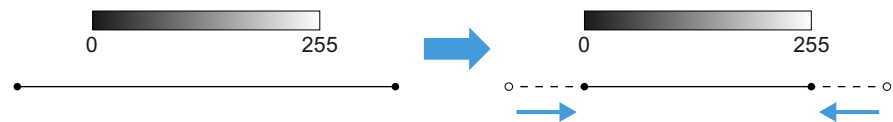
This tool increases or decreases the brightness of each pixel by a constant value, independent of neighboring pixels. Positive values increase the brightness, negative values decrease the brightness. The larger the value the larger the change.

Use this tool if a brightness adjustment in percent is not sufficient and you need to change the image brightness by a specific value.

Parameter	Description
Addend	Sets the constant value added to each pixel. For a color image, the value is added to each color channel separately. The value range depends on the pixel type.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.

If the resulting value lies outside the value range, it is set to the maximum or minimum value.



See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.3 Average Tool

This tool calculates the average gray values of two input images **in1** and **in2** pixel by pixel. The pixels of the output image are set to the corresponding average values.

You can use this tool to even out noise or deviations in brightness if you have two or more images of the same sample and area.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.4 Combine Tool

This tool calculates a weighted average of two images. The input images **in1** and **in2** are each multiplied by a scaling factor and then added to create the output image. If a factor is negative, one input image will be subtracted from the other.

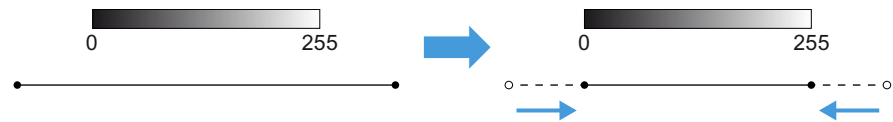
The brightness of the output image can be adjusted by adding an **Offset**.

You can use this tool to even out noise or deviations in brightness if you have two or more images of the same sample and area.

Parameter	Description
<b>Factor1, Factor2</b>	The scaling factors by which the input images <b>in1</b> and <b>in2</b> are multiplied before being combined.
<b>Offset</b>	The value which is added to each pixel of the output image, thus increasing or decreasing the brightness.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.

If the resulting value lies outside the value range, it is set to the maximum or minimum value.



See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.5 Divide Tool

This tool divides two images pixel by pixel.

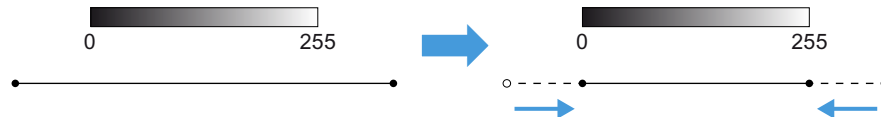
You can use the tool to emphasize differences between similar images or to extract areas from an image using a mask image.

Parameter	Description
<b>in1, in2</b>	The input image <b>in1</b> is divided by the input image <b>in2</b> .

Parameter	Description
<b>Factor</b>	The output image is multiplied by this factor. Adjust this factor to stretch the pixel value range of the output image if the pixel values lie too close together, or to compensate for negative output pixel values.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.

If the resulting value lies outside the value range, it is set to the maximum or minimum value.



### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

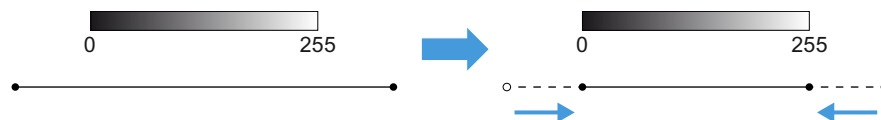
#### 6.2.1.6 Exponential Tool

This tool calculates the exponential function of the input image pixel by pixel.

Make sure the input image is in float format to get useful results.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.

If the resulting value lies outside the value range, it is set to the maximum or minimum value.



### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

#### 6.2.1.7 Invert Tool

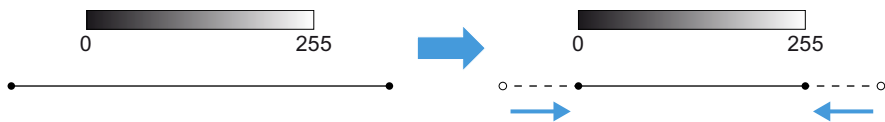
This tool subtracts each gray value of the input image from an adjustable constant.

The output image resembles the negative of the current image, as known from photography: bright pixels become dark and vice versa.

Parameter	Description
<b>Operand</b>	<p>The gray values of the input image are subtracted from this value:  <math>\text{output gray value} = \text{Operand} - \text{input gray value}</math></p> <p>Use 255 for the "standard negative" of the input image. A lower value reduces the overall brightness of the output image.</p>

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.

If the resulting value lies outside the value range, it is set to the maximum or minimum value.



See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.8 Logarithm Tool

This tool calculates the natural logarithm of the input image pixel by pixel.  
Make sure the input image is in float format to get precise results.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.9 Maximum Tool

This tool calculates the maximum values of the two images **in1** and **in2** pixel by pixel. The output image consists of the maximum values.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.10 Minimum Tool

This tool calculates the minimum values of the two images **in1** and **in2** pixel by pixel. The output image consists of the minimum values.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

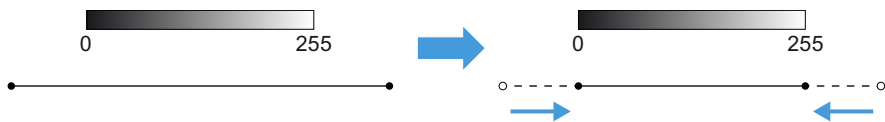
6.2.1.11 Multiply Tool

This tool multiplies two images pixel by pixel.  
You can use this tool to extract areas from an image using a mask image.

Parameter	Description
Factor	The output image is divided by this factor. Adjust this factor to keep the output image pixel values within the available range.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.  
If the resulting value lies outside the value range, it is set to the maximum or minimum value.





See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.12 Multiply Constant Tool

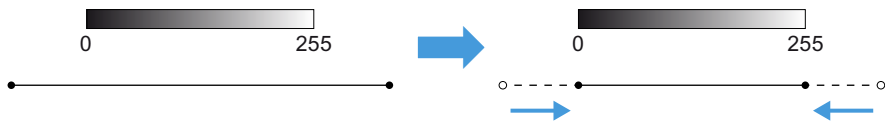
This tool multiplies the pixel values of an image by an adjustable factor.

The pixel value range is stretched or compressed and thus the overall contrast is increased or decreased.

Parameter	Description
<b>Factor</b>	The input image pixel values are multiplied by this factor. <ul style="list-style-type: none"><li>▪ &gt; 1: Contrast is increased, image appears brighter</li><li>▪ &lt; 1: Contrast is decreased, image appears darker</li></ul>

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.

If the resulting value lies outside the value range, it is set to the maximum or minimum value.



See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.1.13 Reciprocal Tool

This tool calculates the reciprocals of each pixel value of the current image and multiplies it by an adjustable factor.



The output image resembles the negative of the current image, as known from photography: bright pixels become dark and vice versa.

Make sure the input image is in float format to get precise results.

Parameter	Description
<b>Factor</b>	The reciprocals of the gray values of the input image are multiplied by this value.  Reciprocals of pixel values lie in the range of 0 to 1. Use the <b>Factor</b> to stretch the pixel value range of the output image and thus increase the contrast.

See also

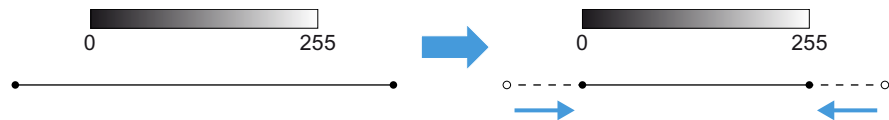
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]

 [Configuring Tolerances for a Measurement](#)  60]





6.2.1.14 Square Tool

This tool squares the values of each input image pixel.  
Make sure the input image is in float format to get useful results.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.  
If the resulting value lies outside the value range, it is set to the maximum or minimum value.



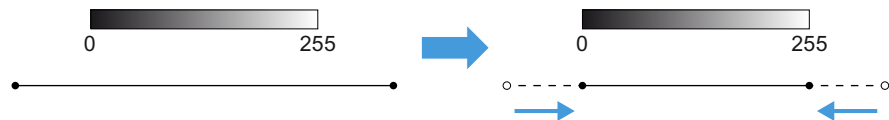
See also

-  [Specifying Permitted and Expected Values for a Tool](#)  59]
-  [Configuring Tolerances for a Measurement](#)  60]





6.2.1.15 Square Root Tool

This tool extracts the square root of each input image pixel value.  
Make sure the input image is in float format to get useful results.

**Values outside boundaries** The resulting pixel values cannot be outside the value range of the corresponding pixel type, e.g. for an 8 Bit B/W image, the values cannot fall below 0 or exceed 255.  
If the resulting value lies outside the value range, it is set to the maximum or minimum value.



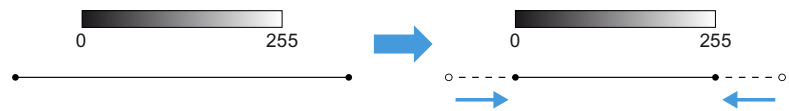
See also

-  [Specifying Permitted and Expected Values for a Tool](#)  59]
-  [Configuring Tolerances for a Measurement](#)  60]

6.2.1.16 Subtract Tool

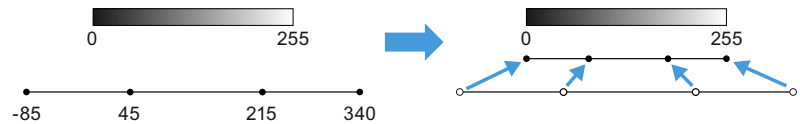
This tool emphasizes differences between two images by subtracting the pixel values of the two images from each other. Output values outside the range of available pixel values are normalized according to the selected **Normalization** type.

Parameter	Description
<b>Normalization</b>	Defines how out-of-range pixel values are mapped.  The calculated pixel values of the output image may be out-of-range and are mapped into the available range.
— Clip	Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).



– Automatic

Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.



– Wrap

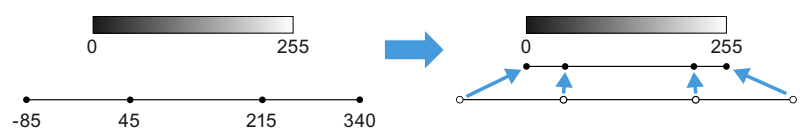
If a resulting value is larger than the maximum pixel value of the image, the difference exceeding the maximum pixel value is added to 0. Similarly, if a resulting value is below 0, the resulting pixel value is the maximum pixel value minus the difference falling below 0.



– Shift

Normalizes the output to the value "pixel value + maximum pixel value/2". As a result, all resulting values are mapped to the available value range.

The middle value of the pixel value range remains constant. Values left and right of the middle value are changed progressively, so that values inside the pixel value range are changed only slightly. Values outside the pixel value range are changed strongly and mapped to the fringes of the pixel value range.



– Absolute

Converts negative pixel values into positive values. Positive pixel values exceeding the maximum pixel value are set to the maximum pixel value.



### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

## 6.2.2 Binary Group

### 6.2.2.1 AND Tool



This tool performs a binary AND operation on the input images **in1** and **in2**. For each pixel, the gray values are compared in their binary representation bit by bit.

The table shows how each bit of each pixel is compared.

Bit 1	Bit 2	Output Bit
1	1	1
1	0	0
0	1	0
0	0	0

The tool is particularly useful for masking images where the pixel type is binary and supports 0 (black) and 1 (white) only. If a pixel is white in both input images, the output pixel is set to white. If a pixel is black in at least one of the input images, the output pixel is set to black.

#### See also



-  [Configuring Tolerances for a Measurement \[► 60\]](#)
-  [Specifying Permitted and Expected Values for a Tool \[► 59\]](#)

### 6.2.2.2 Apply Mask Tool

This tool enables you to isolate features in an image and to suppress image areas not of interest using a mask image.

Parameter	Description
<b>in1</b>	The input image from which you wish to isolate features or suppress areas not of interest.
<b>in2</b>	<p>The mask image that is applied to the input image.</p> <p>The mask is laid on top of the input image. Image regions of the input image. <b>in1</b> where the mask is white remain unchanged, image regions where the mask is black are blacked out and suppressed.</p> <p>Both images are aligned at the upper left corner. If the mask image is smaller than the input image <b>in1</b>, the mask is applied only to part of the input image, beginning at the upper left corner. The rest of the input image remains unchanged.</p>

#### See also

-  [Configuring Tolerances for a Measurement \[► 60\]](#)
-  [Specifying Permitted and Expected Values for a Tool \[► 59\]](#)

### 6.2.2.3 Distance Tool

This tool creates a distance map from a binary image.

The straight-line distance to the next background pixel (black, gray value zero) is calculated for each pixel within the white regions of the binary input image, and coded as a gray value. The brighter a pixel in the output image (high gray values), the higher its distance to the black background.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.2.4 Exoskeleton Tool

Increases the size of foreground structures (white) by adding white pixels around them and thus creates an exoskeleton around the structures.

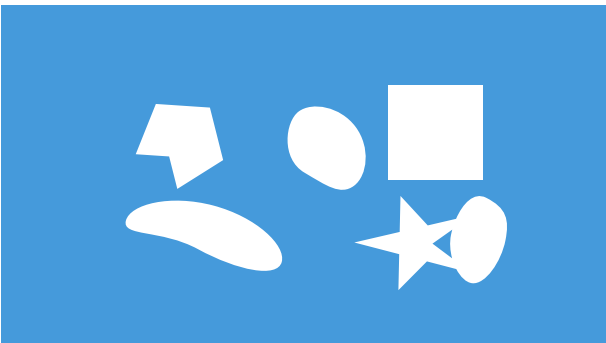
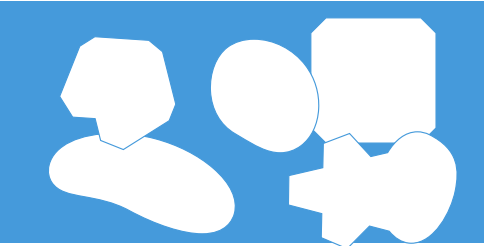
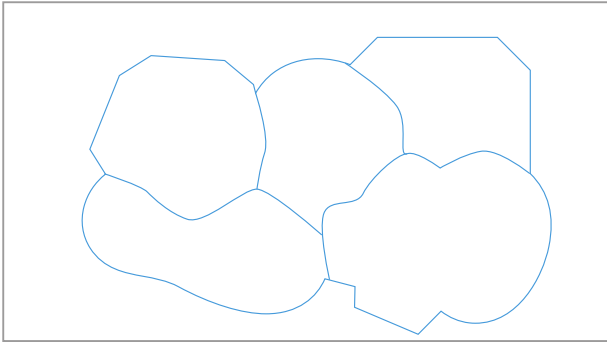




Fig. 8: Input image

Parameter	Description
Count	<p>Specifies the number of times the tool is applied.</p> <p>Each time the tool is applied more white pixels are added around white structures. The invisible pixels around the image borders are assumed to be white so that a white rectangular frame grows into the image.</p> <p>If two white regions would merge into a single structure, a single-pixel black border is maintained between the two regions.</p> <div></div>
Converge	<p><b>Activated:</b> The tool is applied until the image does not change anymore. As a result, the structures are extended to their maximum possible size, limited by single-pixel lines.</p>

Parameter	Description
	
<b>AxioVision Compatibility</b>	<p>The algorithm was re-implemented in ZEN. The results differ from the results produced using AxioVision.</p> <p><b>Activated:</b> A former version of the algorithm is used to get the same results as produced by AxioVision.</p>

See also



-  [Specifying Permitted and Expected Values for a Tool \[► 59\]](#)
-  [Configuring Tolerances for a Measurement \[► 60\]](#)

6.2.2.5 Fill Holes Tool

This tool removes background regions (black) that are completely enclosed by foreground structures (white). Black regions encircled by white pixels are interpreted as holes in foreground structures.

The area surrounding the image is assumed to be black: black regions on the border of the image are never interpreted as a hole, even if they appear to be enclosed by a white region.

See also

-  [Specifying Permitted and Expected Values for a Tool \[► 59\]](#)
-  [Configuring Tolerances for a Measurement \[► 60\]](#)



6.2.2.6 Label Image Tool

This tool identifies all foreground structures (white) in the input image and assigns individual gray values to them in the output image.

Parameter	Description
<b>Label Background</b>	<b>Activated:</b> The effect is inverted. All foreground structures in the input image are displayed black in the output image. To each separate background region in the input image an individual gray value is assigned in the output image.

The number of objects that can be counted is limited by the bit depth of the image.

See also



-  [Specifying Permitted and Expected Values for a Tool \[► 59\]](#)
-  [Configuring Tolerances for a Measurement \[► 60\]](#)

### 6.2.2.7 Mark Regions Tool

This tool enables you to copy a number of desired foreground structures (white) from the input image into an output image while the undesired structures are neglected. A marker image defines which structures are copied and which are neglected.

Parameter	Description
<b>in1</b>	The input image containing all structures
<b>in2</b>	The marker image  The marker image is black and contains white spots, the markers. Structures in the input image that overlap with one or more markers are neglected. All structures not overlapping with any marker are copied to the output image.
<b>Select Marked</b>	<b>Activated:</b> The effect is inverted. All marked structures are copied, all non-marked structures are neglected.

#### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

### 6.2.2.8 NOT Tool



This tool performs a binary NOT operation on all pixels of the current image. All bits in the binary representation of each pixel's gray value are inverted.

Input Bit	Output Bit
0	1
1	0

This corresponds to subtracting the current value of each pixel from the maximum pixel value and yields the "negative image" of the current image, as known from photography.

The tool is not suitable for non-integer pixel types such as Float and Complex.

#### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

### 6.2.2.9 OR Tool

This tool performs a binary OR operation on the input images **in1** and **in2**. For each pixel, the gray values are compared in their binary representation bit by bit.



The table shows how each bit of each pixel is compared.

Bit 1	Bit 2	Output Bit
1	1	1
1	0	1

Bit 1	Bit 2	Output Bit
0	1	1
0	0	0

The tool can be used to combine binary masks or regions where the pixel type is binary and supports 0 (black) and 1 (white) only. If a pixel is white in at least one of the two input images, the output pixel is set to white. If a pixel is black in both input images, the output pixel is set to black.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]



#### 6.2.2.10 Scrap Tool

This tool enables you to remove foreground structures (white) from the current image, depending on the size of the structures.

The size is defined as the number of pixels. Structures with a pixel size within a specified size interval are removed, structures with a pixel size outside the boundaries of the specified size interval are maintained.

Parameter	Description
<b>Minimum Area</b>	The minimum number of pixels of the foreground structures to be removed
<b>Maximum Area</b>	The maximum number of pixels of the foreground structures to be removed
<b>Select in Range</b>	<b>Activated:</b> The effect is inverted. Structures with a size within the interval are maintained, structures with a size outside the interval boundaries are removed.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]



#### 6.2.2.11 Separation Tool

This tool separates overlapping foreground structures automatically.

You can try this tool if separating the structures using segmentation does not yield the desired results.

Parameter	Description
<b>Separation Mode</b>	Specifies how overlapping objects are treated
— Morphology	Pixels are "eroded" from the edge of the shape until it splits into two shapes. The result is two rounded objects, potentially with a large gap between them.



Parameter	Description
	
– Watersheds	<p>The effect of this algorithm is best understood with an analogy:</p> <p>The shape is considered to contain two "valleys" with the two brightest pixels corresponding to the bottom of one valley each. If water were poured onto the shape, there would be a boundary ("watershed") that defines where water flows into one valley or the other.</p> <p>The shape is split along this boundary. The result is two shapes separated by a thin 1-pixel boundary. The rest of the shape perimeter remains unchanged.</p> 
Count	Specifies how many times the chosen separation method is applied successively.

### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

#### 6.2.2.12 Thinning Tool



This tool reduces the width of white lines on a black background until they are only a single pixel wide.

A common use of this tool is to tidy up output generated by an edge detector.

Parameter	Description
Thinning Element	Specifies the mask element used to apply the iterative thinning operation.
Count	Specifies the number of times the tool is applied consecutively. The higher the <b>Count</b> , the higher number of pixels by which the width of lines is reduced.
Prune	<p><b>Activated:</b> Parasitic lines, which can result from edge detection and which do not contribute to the detected shapes, are reduced in length.</p> <p>The number of pixels by which the length of lines is reduced is specified by <b>Count</b>.</p>
Converge	<b>Activated:</b> Independent of <b>Count</b> , the <b>Thinning</b> tool is applied consecutively until the image does not change anymore (i.e. the white lines are reduced to single pixel width).
AxioVision Compatibility	The algorithm was re-implemented in ZEN. The results differ from the results produced using AxioVision.

Parameter	Description
	<b>Activated:</b> A former version of the algorithm is used to get the same results as produced by AxioVision.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

#### 6.2.2.13 Ultimate Erode Tool






This tool reduces the size foreground structures (white) in the input image. Thin connections between structures are removed and the structures are separated.

The tool is very similar to the **Erode** tool. In contrast to the basic **Erode**, this tool can erode structures repetitively until they would be deleted by the next erosion step.

If the tool operates on pixels on the border of the image, the structure element touches pixels outside the image. These invisible pixels are assumed to be white.

Parameter	Description
<b>Structure Element</b>	Defines the shape of the neighborhood around each pixel taken into account while applying the erosion operation and thus to a certain degree the shape of the eroded structures.
<b>Count</b>	Enables you to increase the effective size of the structure element by controlling how many times the morphology operation is applied.  The higher the <b>Count</b> value, the more the structures are eroded. The erosion for each structure stops if this structure would be removed in the next step. The entire process stops if all structures are eroded to the maximum, even if the <b>Count</b> value would demand further repetitions.
<b>Converge</b>	The tool is applied until all structures are eroded to the maximum and would be removed in the next step.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Morphology Group [► 226]
-  Structure Elements [► 227]
-  Erode Tool [► 229]

#### 6.2.2.14 XOR Tool

This tool performs a binary XOR operation on the input images **in1** and **in2**. For each pixel, the gray values are compared in their binary representation bit by bit.

The table shows how each bit of each pixel is compared.

Bit 1	Bit 2	Output Bit
1	1	0

Bit 1	Bit 2	Output Bit
1	0	1
0	1	1
0	0	0

The tool can be used to combine binary masks or regions where the pixel type is binary and supports 0 (black) and 1 (white) only. If a pixel is white in one input image and black in the other input image, the output pixel is set to white. If a pixel is white in both input images or black in both input images, the output pixel is set to black.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.3 Edges Group

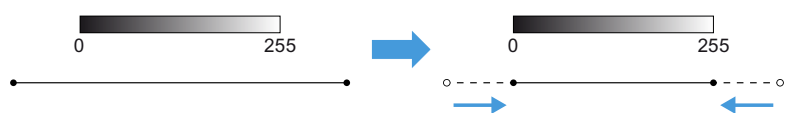
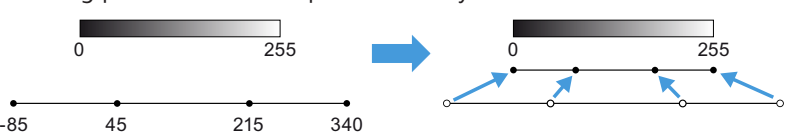
6.2.3.1 Gradient Max Tool

This tool creates a gradient image which emphasizes brightness changes (i.e. edges and transitions) in the current image.

A gradient image represents the rate at which the brightness changes in a given direction. The brighter a pixel, the steeper the change in brightness at the pixel's position in the considered direction.

The tool calculates gradient images of the current image in the x and y directions. Each pixel in the output image is set to the larger value of the two corresponding pixels of the gradients.

The edges are darker than those calculated by the **Gradient Sum** tool.

Parameter	Description
<b>Normalization</b>	Defines how out-of-range pixel values are mapped.  The calculated pixel values of the output image may be out-of-range and are mapped into the available range.
— Clip	Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).  
— Automatic	Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.  

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

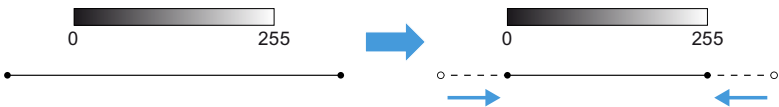

6.2.3.2 Gradient Sum Tool

This tool creates a gradient image which emphasizes brightness changes (i.e. edges and transitions) in the current image.

A gradient image represents the rate at which the brightness changes in a given direction. The brighter a pixel, the steeper the change in brightness at the pixel's position in the considered direction.

The tool calculates gradient images of the current image in the x and y directions. Each pixel in the output image is set to the sum of the two corresponding pixels of the gradients.

The edges are brighter than those calculated by the **Gradient Sum** tool.

Parameter	Description
<b>Normalization</b>	Defines how out-of-range pixel values are mapped.  The calculated pixel values of the output image may be out-of-range and are mapped into the available range.
— Clip	Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).  
— Automatic	Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.  

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.3.3 Highpass Tool

This tool emphasizes edges within an image.

Sharp changes in brightness often indicate edges. The high-pass filter enhances these areas and suppresses gradual changes in brightness. As a negative side-effect, the high-pass filter amplifies noise.

The high-pass is calculated as follows:

- A low-pass filter is applied to the input image

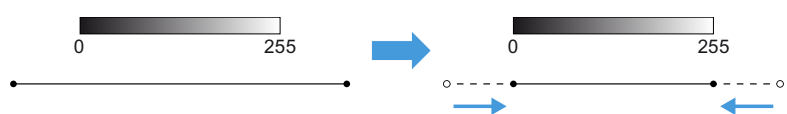
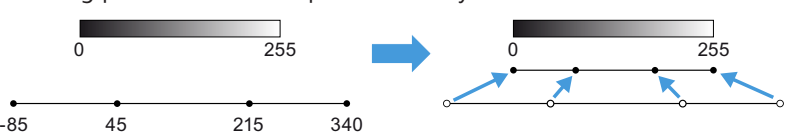

- The low pass-filtered image is subtracted from the input image

The tool parameters refer to the low-pass filter and to the subtraction.

Parameter	Description
Count	<p>The number of times the low-pass filter is applied that is used to calculate the high-pass filter.</p> <ul style="list-style-type: none"><li>▪ Small values: strong high-pass filtering</li><li>▪ Large values: weak high-pass filtering</li></ul> <p>The low-pass filter that is used to calculate the output is strong. Only large uniform image regions (low spatial frequency) are subtracted from the input image. Thus the high-pass filter is weak and the output looks similar to the input image. The uniform background is darkened and smaller foreground structures are emphasized against the background but remain unchanged for the rest.</p>

Kernel Size	<p>Determines the number of neighboring pixels taken into account.</p> <p>The kernel size must correspond to the pixel size of the contours to be emphasized.</p>
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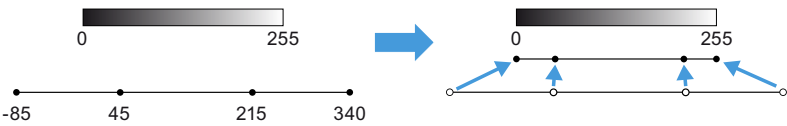
Parameter	Description
Normalization	<p>Defines how out-of-range pixel values are mapped.</p> <p>The pixel values that result from subtracting the low-pass filtered image from the input image may be out-of-range and are mapped into the available range.</p>

— Clip	<p>Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).</p> 
— Automatic	<p>Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.</p> 
— Wrap	<p>If a resulting value is larger than the maximum pixel value of the image, the difference exceeding the maximum pixel value is added to 0. Similarly, if a resulting value is below 0, the resulting pixel value is the maximum pixel value minus the difference falling below 0.</p> 

- Shift

Normalizes the output to the value "pixel value + maximum pixel value/2". As a result, all resulting values are mapped to the available value range.

The middle value of the pixel value range remains constant. Values left and right of the middle value are changed progressively, so that values inside the pixel value range are changed only slightly. Values outside the pixel value range are changed strongly and mapped to the fringes of the pixel value range.



- Absolute

Converts negative pixel values into positive values. Positive pixel values exceeding the maximum pixel value are set to the maximum pixel value.



See also

- Specifying Permitted and Expected Values for a Tool [► 59]
- Configuring Tolerances for a Measurement [► 60]

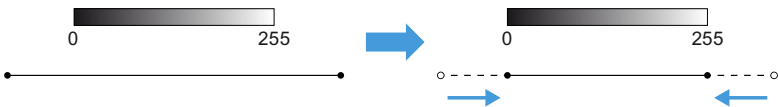
6.2.3.4 Laplace Tool

This tool creates a gradient image which emphasizes brightness changes (i.e. edges and transitions) in the current image. Large brightness differences between neighboring pixels are displayed as bright gray values, no changes are displayed black.

The gradient image is calculated by applying a 3 × 3 Laplace operator to the current image. The Laplace operator calculates the sum of the second derivatives in x and y directions of the central pixel's nearest neighbors.

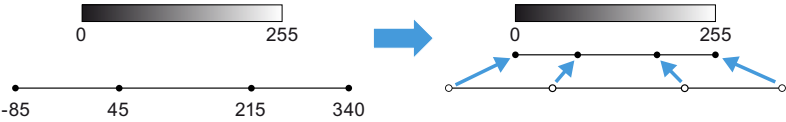
The Laplace tool is not suitable for emphasizing smooth brightness changes.

Parameter	Description
Normalization	<p>Defines how out-of-range pixel values are mapped.</p> <p>The calculated pixel values of the output image may be out-of-range and are mapped into the available range.</p>
Clip	<p>Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).</p>





Automatic

Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.



See also

-  Specifying Permitted and Expected Values for a Tool [ 59]
-  Configuring Tolerances for a Measurement [ 60]

6.2.3.5 Local Variance Tool

This tool creates an image which emphasizes brightness changes (i.e. edges and transitions) in the current image. Large brightness differences between neighboring pixels are displayed as bright gray values, small changes are displayed black.

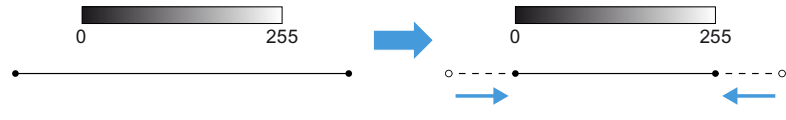
The tool calculates the statistical variance around each pixel using a specified number of pixels. The variance is calculated in the x and y directions and each pixel in the output image represents the average of the two variances.

Parameter	Description
<b>Kernel Size X, Kernel Size Y</b>	<p>Specifies the number of pixels in the x and y directions taken into account to calculate the variance.</p> <p>For optimum results, set <b>Kernel Size X</b> and <b>Kernel Size Y</b> roughly to the pixel size of the edges in the input image.</p>

Parameter	Description
<b>Normalization</b>	<p>Defines how out-of-range pixel values are mapped.</p> <p>The calculated pixel values of the output image may be out-of-range and are mapped into the available range.</p>

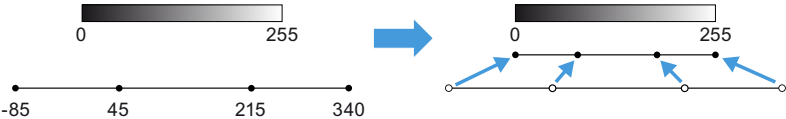
Clip

Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).



Automatic

Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.



See also

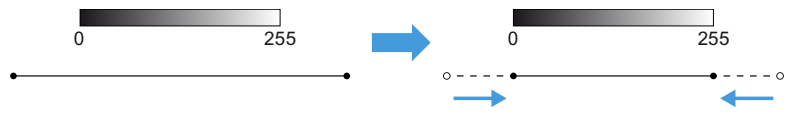
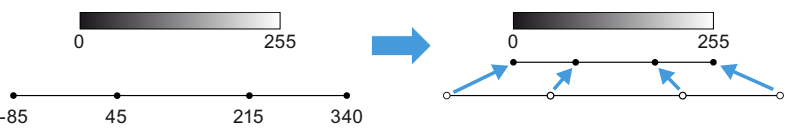
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.3.6 Roberts Tool

This tool creates a gradient image which emphasizes brightness changes (i.e. edges and transitions) in the current image. Large brightness differences between neighboring pixels are displayed as bright gray values, no changes are displayed black.

The gradient image is calculated by applying the Roberts operator to the current image. The Roberts operator calculates the sum of the squares of the differences between diagonally neighboring pixels within each 2 x 2 pixel segment of the current image.

The edges are thinner than those calculated by the **Sobel** tool. The **Roberts** tool is very sensitive to image noise.

Parameter	Description
Normalization	Defines how out-of-range pixel values are mapped.  The calculated pixel values of the output image may be out-of-range and are mapped into the available range.
— Clip	Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).  
— Automatic	Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.  

See also

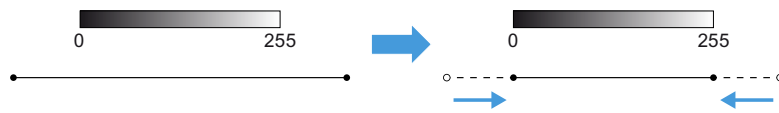
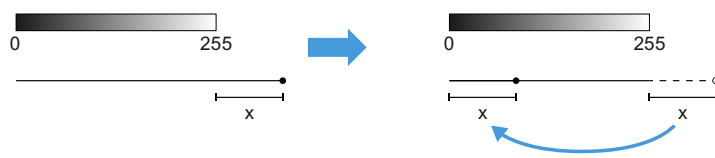
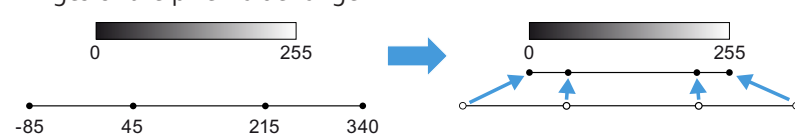
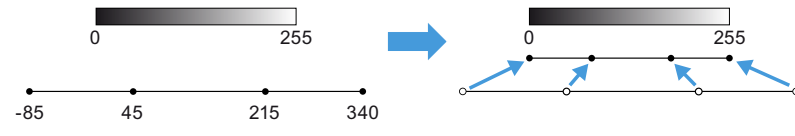
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

6.2.3.7 Sobel Tool

This tool creates a gradient image which emphasizes brightness changes (i.e. edges and transitions) in the current image. Large brightness differences between neighboring pixels are displayed as bright gray values, no changes are displayed black.

The gradient image is calculated by applying the 3 x 3 Sobel differential operator to the current image.



Parameter	Description
<b>Normalization</b>	<p>Defines how out-of-range pixel values are mapped.</p> <p>The calculated pixel values of the output image may be out-of-range and are mapped into the available range.</p>
— Clip	<p>Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).</p> 
— Wrap	<p>If a resulting value is larger than the maximum pixel value of the image, the difference exceeding the maximum pixel value is added to 0. Similarly, if a resulting value is below 0, the resulting pixel value is the maximum pixel value minus the difference falling below 0.</p> 
— Shift	<p>Normalizes the output to the value "pixel value + maximum pixel value/2". As a result, all resulting values are mapped to the available value range.</p> <p>The middle value of the pixel value range remains constant. Values left and right of the middle value are changed progressively, so that values inside the pixel value range are changed only slightly. Values outside the pixel value range are changed strongly and mapped to the fringes of the pixel value range.</p> 
— Automatic	<p>Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.</p> 

### See also

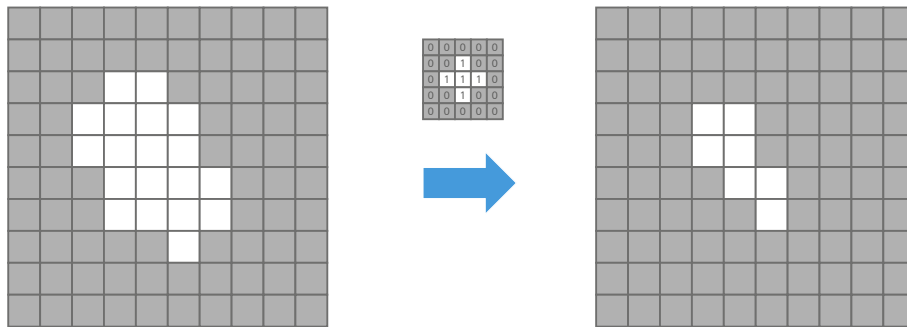
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

### 6.2.4 Morphology Group

Morphology transformations enable you to analyze and modify structures and shapes in an image. Morphology transformations are non-linear and thus allow you to modify the image selectively while other portions of the image remain unchanged. Typical fields of application are quality assurance or medical image processing.

Morphology transformations are a type of neighborhood transformation: the image is analyzed pixel by pixel and each pixel is transformed depending on its neighbors. Thus the results of a morphology transformations depend on two factors:

- The type of morphology operation: the mathematical function used to evaluate each pixel and its neighbors  
 The most common operations from which most others are derived are erosion (remove pixels from a bright structure) and dilation (add pixels to a bright structure).
- The structure element: the shape and size of the neighborhood taken into account for the analysis of each pixel  
 The structure element reflects the structures in the image you wish to analyze. For example, to find vertical structures use the **Vertical** structure element.



**Fig. 9: Erosion, one of the basic morphology transformations, using the structure element Cross**

You can imagine the structure element as a stencil which is moved over the image pixel by pixel. Only the pixels within in the stencil area are visible and taken into account for the morphology transformation. The applied operation (e.g. erosion or delusion) then determines if and how the central pixel within the stencil area is changed.

In the software you first the specify the morphology operation by selecting the corresponding tool. From the tool you then select the structure element and its size (defined by the number of repetitions the structure element is applied).

#### See also

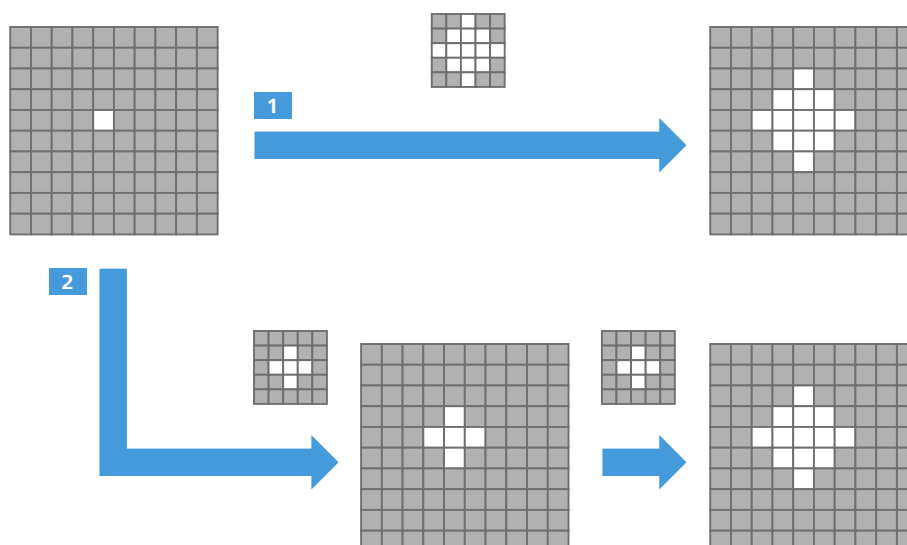
- Structure Elements [► 227]
- Close Tool [► 228]
- Dilate Tool [► 229]
- Erode Tool [► 229]
- Gradient Tool [► 230]
- Gray Reconstruction Tool [► 231]
- Open Tool [► 231]
- Top Hat Black Tool [► 232]
- Top Hat White Tool [► 232]
- Watersheds Tool [► 233]
- Morphology Examples [► 233]

### 6.2.4.1 Structure Elements

The shape of the structure element makes the morphology transformation sensitive to specific shapes in the input image.

Type	Appearance																									
Horizontal	<table><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table>	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
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Square	<table><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table>	0	0	0	0	0	0	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0
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The size of the structure elements is fixed to five times five pixels. You can increase the effective size by applying a structure element multiple times. This is equal to applying an equivalent larger structure element once.



- 1** Dilation applied once with a larger structure element.
- 2** Dilation applied twice with a smaller structure element yielding the same result.  
This method is used in the morphology tools.

### See also

Morphology Group [► 226]

#### 6.2.4.2 Close Tool

This tool connects bright structures on a darker background in the input image while the size of the structures is preserved as far as possible.

The **Close** tool applies **Dilate** to expand the structures and connect them and then **Erode** to restore their size.

Parameter	Description
<b>Structure Element</b>	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.
<b>Count</b>	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.
<b>Binary</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Increases calculation speed by creating a binary image before the morphology operation is applied. The resulting image contains black or white pixels instead of gray values.</li> <li>▪ <b>Deactivated:</b> Applies the morphology operation to a gray scale image. The results are finer graded compared to the results of the morphology operation applied to a binary image.</li> </ul>

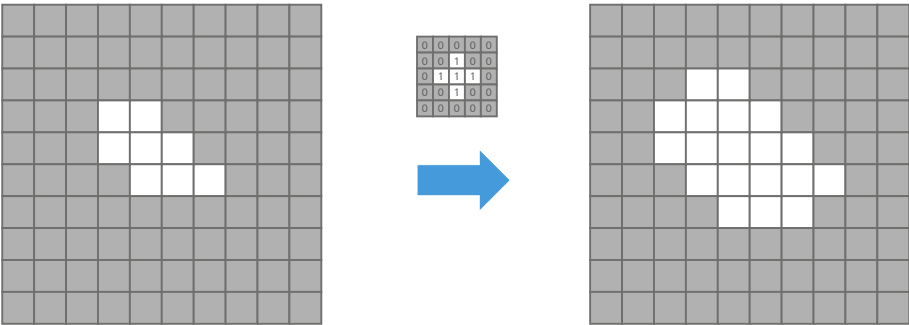
### See also

Specifying Permitted and Expected Values for a Tool [► 59]  
 Configuring Tolerances for a Measurement [► 60]  
 Morphology Group [► 226]

6.2.4.3 Dilate Tool

This tool expands bright structures on a darker background in the input image by adding pixels to the boundaries of these structures. Small gaps between structures are filled and these structures are connected.

If the structure element touches at least one bright pixel, the pixel currently operated on is turned into a bright pixel.



Parameter	Description
Structure Element	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.
Count	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.
Binary	<ul style="list-style-type: none"><li>▪ <b>Activated:</b> Increases calculation speed by creating a binary image before the morphology operation is applied. The resulting image contains black or white pixels instead of gray values.</li><li>▪ <b>Deactivated:</b> Applies the morphology operation to a gray scale image. The results are finer graded compared to the results of the morphology operation applied to a binary image.</li></ul>

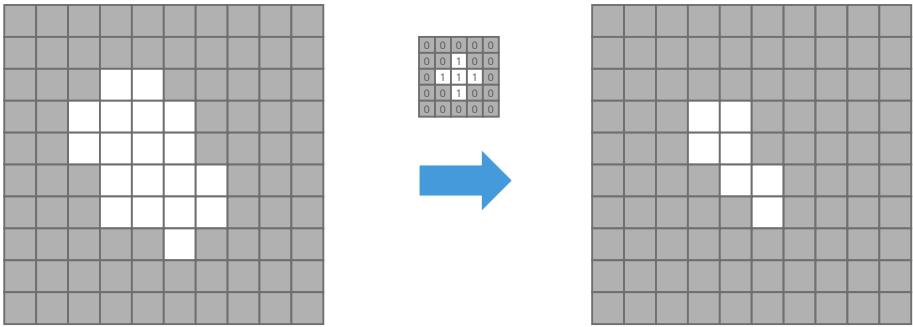
See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Morphology Group [► 226]

6.2.4.4 Erode Tool

This tool reduces the size of bright structures on a darker background in the input image. Thin connections between structures and smaller structures disappear.

If the structure element touches at least one dark pixel, the pixel currently operated on is turned into a dark pixel.



Parameter	Description
Structure Element	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.
Count	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.
Binary	<ul style="list-style-type: none"><li>▪ <b>Activated:</b> Increases calculation speed by creating a binary image before the morphology operation is applied. The resulting image contains black or white pixels instead of gray values.</li><li>▪ <b>Deactivated:</b> Applies the morphology operation to a gray scale image. The results are finer graded compared to the results of the morphology operation applied to a binary image.</li></ul>

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Morphology Group [► 226]

6.2.4.5 Gradient Tool

This tool emphasizes image areas of varying gray values (intensity). The results are similar to those of an edge detector.

A dilated and an eroded version of the input image is created using the same structure element. Then the two images are subtracted from each other. As a result, each pixel is replaced by the difference between the maximum and minimum gray value in its neighborhood. The difference is zero for regions of constant gray values and increases for larger changes in gray values (i.e. edges).

Parameter	Description
Structure Element	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.
Count	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.

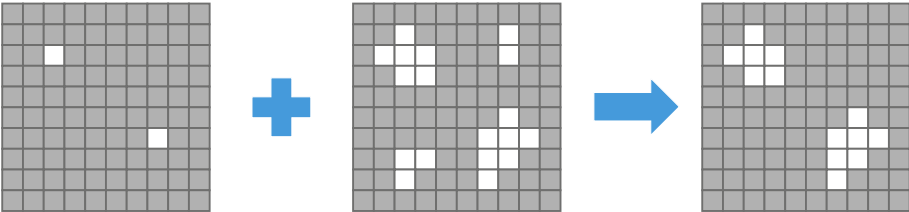
See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

 Morphology Group [► 226]

6.2.4.6 Gray Reconstruction Tool





This tool expands (i.e. dilates) bright structures on a darker background in one input image (marker) repetitively until the structures fill shapes provided by another input image (mask). The bright structures cannot expand beyond the areas defined by the mask shapes and the process stops automatically when the shapes are completely filled.



For example, you can use gray reconstruction to extract marked structures, to filter out structures touching the image border, or to detect or fill holes within a structure. You can find an example of use in *Morphology Examples* [► 233].

Parameter	Description
in1 (Marker)	The image to be reconstructed by dilation
in2 (Mask)	The image providing the shapes which constrain the dilation of the first image
Structure Element	Defines the shape and size of the neighborhood around each pixel taken into account while applying the dilations  This has an effect on how the structures originating from the "seed pixels" in the marker image are reconstructed. If you are unsure which one to use, try generic uniform structure elements like <b>Square</b> or <b>Octagon</b> first.

See also

-  Morphology Examples [► 233]
-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Morphology Group [► 226]

6.2.4.7 Open Tool

This tool separates bright structures on a darker background in the input image while the size of the structures is preserved as far as possible. Thin connections between structures and smaller structures disappear.

The **Open** tool applies **Erode** to remove the undesired pixels and then **Dilate** to restore the size of the desired structures.

Parameter	Description
Structure Element	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.

Parameter	Description
<b>Count</b>	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.
<b>Binary</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Increases calculation speed by creating a binary image before the morphology operation is applied. The resulting image contains black or white pixels instead of gray values.</li> <li>▪ <b>Deactivated:</b> Applies the morphology operation to a gray scale image. The results are finer graded compared to the results of the morphology operation applied to a binary image.</li> </ul>

**See also**

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Morphology Group [► 226]

**6.2.4.8 Top Hat Black Tool**

This tool retains the dark structures of the image that are smaller than the structuring element. You can use this tool to correct uneven illumination when the background is bright.

The black top-hat is defined as the morphological closing of an image minus the image itself.

Parameter	Description
<b>Structure Element</b>	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.
<b>Count</b>	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.

**See also**

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Morphology Group [► 226]

**6.2.4.9 Top Hat White Tool**

This tool retains the bright structures of the images that are smaller than the structuring element. You can use this tool to correct uneven illumination when the background is dark.

The white top-hat of an image is defined as the image minus its morphological opening.

Parameter	Description
<b>Structure Element</b>	Defines the shape of the neighborhood around each pixel taken into account while applying the morphology operation.
<b>Count</b>	Enables you to increase the effective size of the structure element by controlling how often the morphology operation is applied.



**See also**

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Morphology Group [► 226]

**6.2.4.10 Watersheds Tool**

This tool enables you to segment (i.e. to separate) touching structures within an image.

The image is interpreted as a topographic map in which gray values represent elevation. Bright pixels are interpreted as mountains and dark pixels as valleys. The tool virtually floods the valleys and finds the barriers encircling each valley. These barriers are the watersheds used for segmentation of the image.



A valley is defined as a local gray value minimum from which the gray value increases in any direction and is limited by local maxima. As a result, the degree of segmentation is often higher than expected by the visual impression of the image. To improve results you can increase the contrast by applying the **Top Hat White** and **Top Hat Black** tools in combination.

Parameter	Description
<b>Basins</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The output image is the area of the flooded valleys (i.e. basins). The valleys are displayed in different shades and thus can be distinguished from one another.</li> <li>▪ <b>Deactivated:</b> The output image is the plot of the watersheds as white lines on a black background.</li> </ul>

**See also**

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Morphology Group [► 226]

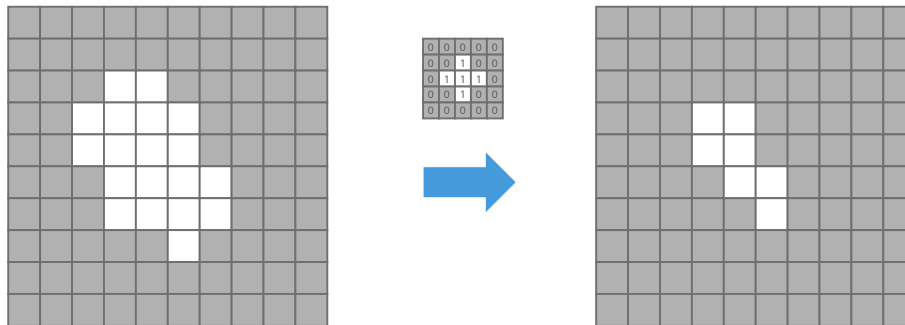
**6.2.4.11 Morphology Examples**

Most morphology transformations are based on erosion and/or dilation. The examples below show how a bright structure on a dark background can be expanded using dilation or made smaller using erosion. The structure element determines how the structure is modified and thus how the final result looks like. In the example the structure element **Cross** is used:

0	0	0	0	0
0	0	1	0	0
0	1	1	1	0
0	0	1	0	0
0	0	0	0	0

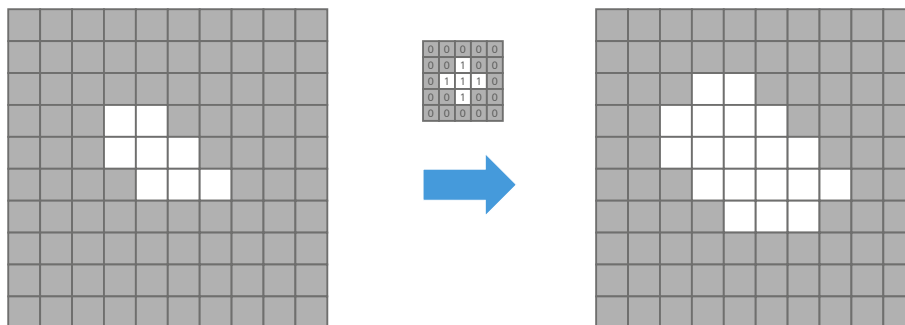
**Erosion** Erosion removes pixels from bright structures. The structure element scans the input image pixel by pixel. Each pixel is set to the minimum value of all neighboring pixels currently covered by the structure element.

The example below shows erosion applied to a binary image (i.e. only black or white and no gray scale). In this case, a pixel is set to black if at least one of the neighboring pixels covered by the structure element is black. If all neighboring pixels covered by the structure element are white, the central pixel remains white.

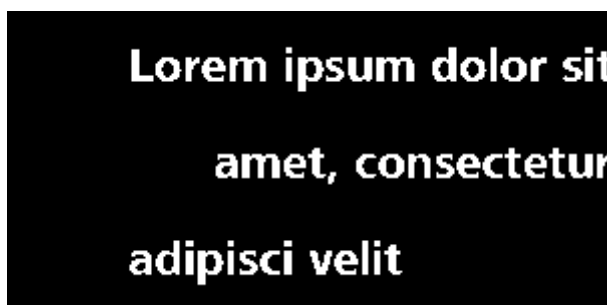


**Dilation** Dilation adds pixels to bright structures. The structure element scans the input image pixel by pixel. Each pixel is set to the maximum value of all neighboring pixels currently covered by the structure element.

The example below shows dilation applied to a binary image (i.e. only black or white and no gray scale). In this case, a pixel is set to white if at least one of the neighboring pixels covered by the structure element is white. If all neighboring pixels covered by the structure element are black, the central pixel remains black.

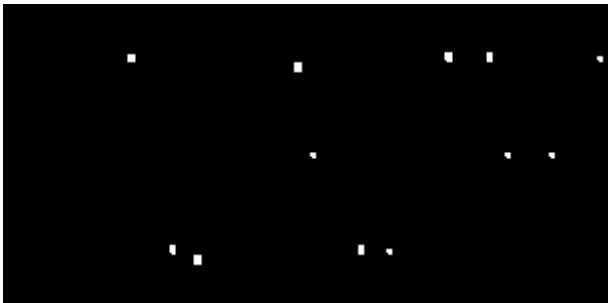


**Gray Reconstruction** Gray reconstruction can be used to extract elements with a characteristic feature. The example below shows how in two steps letters with long vertical features can be extracted from a text.



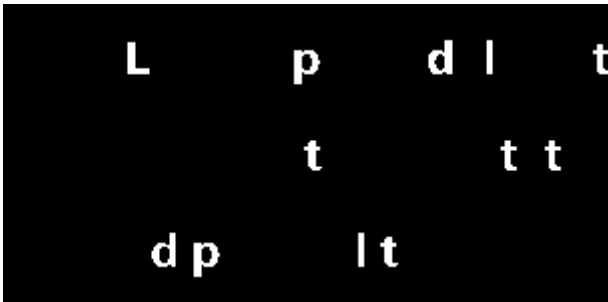
In the first step the image is eroded using the **Erode** tool so that only bright pixels of vertical structures are left, i.e. pixels of the vertical elements of letters such as L, p, or d. **Vertical** is used as the **Structure Element**.

In order to remove a sufficient number of bright pixels to isolate the lengthy elements but not to remove too many pixels, the effective size of the structure element is adjusted. A **Count** of six yields the image below:



In the second step all letters containing long vertical elements are reconstructed using the **Gray Reconstruction** tool. The image above is used as the marker (**in1**) and the original image is used as the mask (**in2**). To reconstruct the letters uniformly in both directions, the structure elements **Square** or **Octagon** are suited.

The gray reconstruction results in the image below:



**See also**

- ▢ Morphology Group [► 226]
- ▢ Erode Tool [► 229]
- ▢ Dilate Tool [► 229]
- ▢ Gray Reconstruction Tool [► 231]

**6.2.5 Segmentation Group**

**6.2.5.1 Canny Tool**

This tool detects edges in a gray scale image using the Canny algorithm, which is the most common, general-purpose edge detection algorithm. The tool enables you to specify how strong the input image is smoothed before edge detection is performed.

Parameter	Description
<b>Sigma</b>	<p>Specifies the extent of smoothing applied to the input image before the edges are detected.</p> <p>Smoothing reduces noise and thus the chance of obtaining false edges.</p>
<b>Threshold</b>	<p>Specifies the steepness an edge must possess to be recognized by the tool. The steepness is the rate at which the gray values change from bright to dark or vice versa.</p> <ul style="list-style-type: none"><li>■ Lower values: More edges are detected, including shallower and less pronounced ones.</li></ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>Higher values: Only steep and strongly pronounced edges are detected.</li> </ul>

### See also

- Configuring Tolerances for a Measurement [► 60]
- Specifying Permitted and Expected Values for a Tool [► 59]

#### 6.2.5.2 Marr Tool

This tool detects edges or regions in an image using the Marr–Hildreth algorithm, which smooths the image using a Gauss filter and then applies a Laplace filter to the smoothed image. The result is a measure for the second derivative of the image brightness at each position. Zero crossings of this second derivative are detected to obtain the edges.

Due to its detection method this tool is very sensitive to any change in image intensity. It is thus prone to detecting false edges, i.e. to detect noise or slight local changes in brightness as edges. Compared to other edge detectors, you might need to apply a larger amount of smoothing to obtain satisfying results.

You can display either the detected edges or the regions enclosed by the edges.

Parameter	Description
<b>Sigma</b>	<p>Specifies the extent of smoothing applied to the input image before the edges or regions are detected.</p> <p>Smoothing reduces noise and thus the chance of obtaining false edges.</p>
<b>Display Mode</b>	Specifies how the results are displayed:
– <b>Edges</b>	The edges around regions of bright pixels are displayed as thin white lines, all other pixels are displayed black.
– <b>Regions</b>	The regions of bright pixels are displayed white, the edges and the space between the bright regions are displayed black.

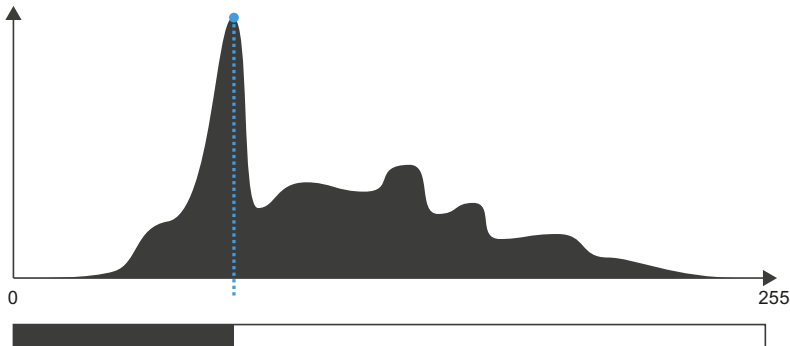
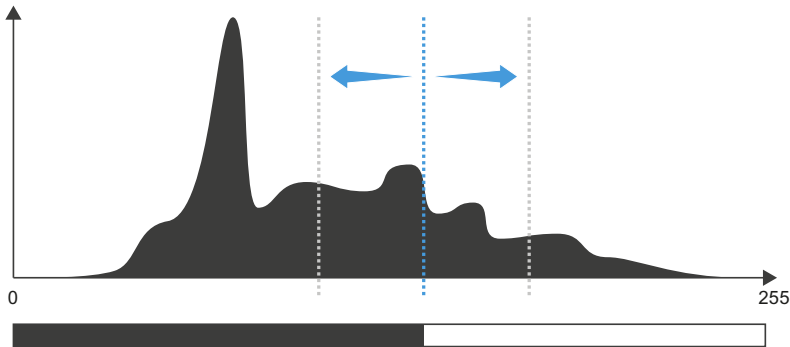
### See also

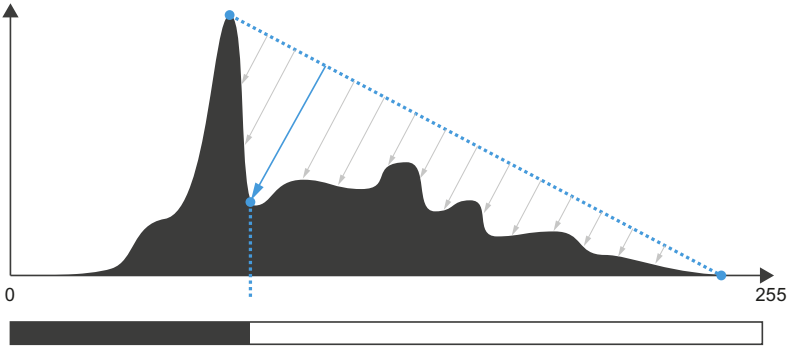
- Configuring Tolerances for a Measurement [► 60]
- Specifying Permitted and Expected Values for a Tool [► 59]

#### 6.2.5.3 Threshold Tool

This tool splits the image into foreground and background areas. Pixels within a specified range are considered foreground pixels and are not modified. All other pixels are considered background pixels and set to black. You can use an automatic method to determine the range or you can specify it manually. If the input image is a color image, you can set the brightness ranges for each color channel separately.

## Automatic range

Parameter	Description
<b>Method</b>	Specifies the algorithm used to automatically detect the threshold boundaries. The most suitable algorithm depends on your precise requirements.  The value also depends on the bit depth of the image.
— Otsu	The pixel values below the threshold are designated as background and those above the threshold as foreground. It iterates through all possible threshold values and for each value calculates the spread of the pixel intensities of the background and foreground pixels. The threshold is set at the value that minimizes both spreads.  This method is particularly suited to light objects on a dark background.
— Maximum Peak	The threshold is set to the pixel value that occurs most frequently.  
— Iso Data	The pixel values below the threshold are designated as background and those above the threshold as foreground. An initial threshold value is chosen, and the mean pixel intensity of the foreground and background pixels is calculated. These two mean values are averaged and the result serves as the input threshold for the next calculation. The process is repeated until the threshold value no longer changes.  
— Triangle Threshold	The algorithm constructs a line between the peak of the highest frequency pixel intensity and the lowest pixel intensity. The distance between the line and the histogram is computed for all values along the line. The pixel intensity where the line is longest is used as the threshold.  This method is particularly suited when the foreground pixels only have a weak peak in the histogram.

Parameter	Description
	
— Three Sigma Threshold	The pixel value that occurs most frequently is calculated. The standard deviation of the values in the peak is calculated. The threshold is set to the pixel intensity that is the sum of the peak value and three times the standard deviation.

Manual range

Parameter	Description
Level Low, Level High	<p>Specifies the lower and upper boundaries of the brightness range.</p> <p>All pixels with gray values outside the brightness range are considered to be background pixels and changed to black.</p> <p>If the input image is a color image, you can specify the boundaries for each color channel separately.</p>
Create Binary	<ul style="list-style-type: none"><li>▪ <b>Activated:</b> Pixels within the brightness range are changed to white, background pixels are changed to black. The resulting image is binary and can be used as a mask for subsequent image processing operations.</li><li>▪ <b>Deactivated:</b> Pixels within the brightness range remain unchanged, background pixels are changed to black.</li></ul>
Invert Result	<p>Reverts the way the pixels are treated.</p> <ul style="list-style-type: none"><li>▪ Pixels inside the brightness range: treated as background and changed to black.</li><li>▪ Pixels outside the brightness range: remain unchanged or changed to white if binary is activated.</li></ul>

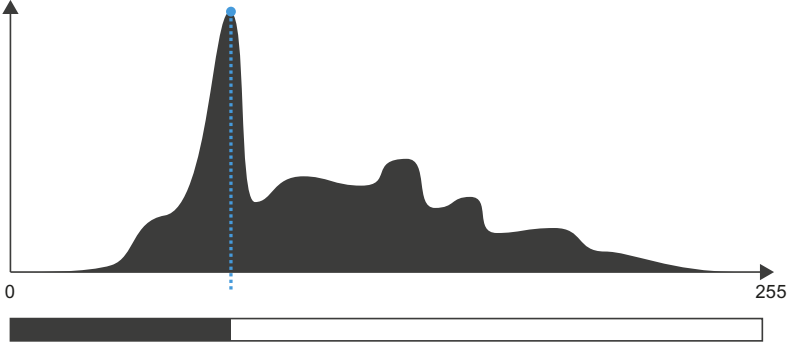
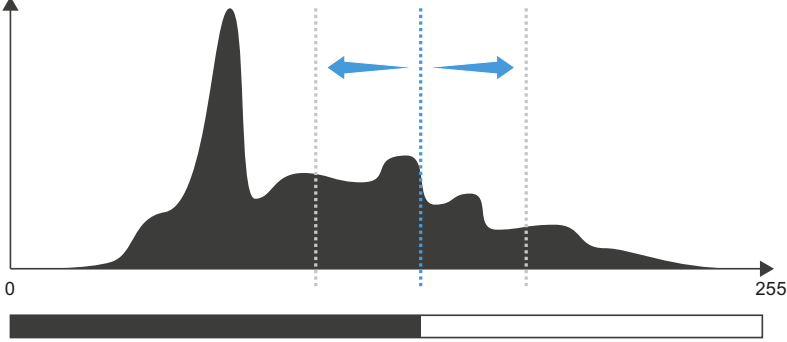
See also

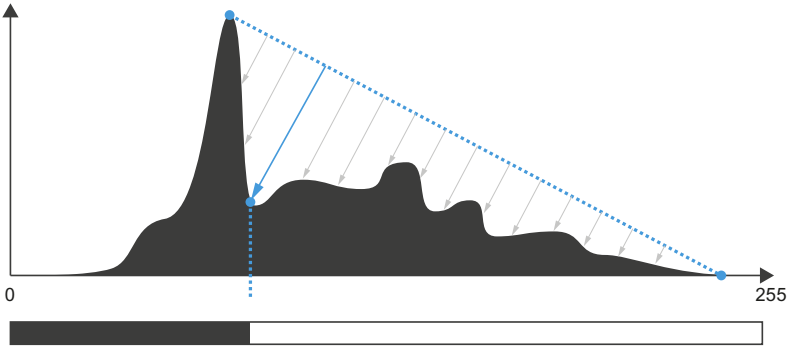
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]

6.2.5.4 Threshold Auto Tool

This tool splits the image into foreground and background areas. Pixels within a specified range are considered foreground pixels and are not modified. All other pixels are considered background pixels and set to black. The brightness range is determined by an automatic method.

Automatic range

Parameter	Description
Method	<p>Specifies the algorithm used to automatically detect the threshold boundaries. The most suitable algorithm depends on your precise requirements.</p> <p>The value also depends on the bit depth of the image.</p>
<div>— Otsu</div>	<p>The pixel values below the threshold are designated as background and those above the threshold as foreground. It iterates through all possible threshold values and for each value calculates the spread of the pixel intensities of the background and foreground pixels. The threshold is set at the value that minimizes both spreads.</p> <p>This method is particularly suited to light objects on a dark background.</p>
<div>— Maximum Peak</div>	<p>The threshold is set to the pixel value that occurs most frequently.</p> 
<div>— Iso Data</div>	<p>The pixel values below the threshold are designated as background and those above the threshold as foreground. An initial threshold value is chosen, and the mean pixel intensity of the foreground and background pixels is calculated. These two mean values are averaged and the result serves as the input threshold for the next calculation. The process is repeated until the threshold value no longer changes.</p> 
<div>— Triangle Threshold</div>	<p>The algorithm constructs a line between the peak of the highest frequency pixel intensity and the lowest pixel intensity. The distance between the line and the histogram is computed for all values along the line. The pixel intensity where the line is longest is used as the threshold.</p> <p>This method is particularly suited when the foreground pixels only have a weak peak in the histogram.</p>

Parameter	Description
	
— Three Sigma Threshold	The pixel value that occurs most frequently is calculated. The standard deviation of the values in the peak is calculated. The threshold is set to the pixel intensity that is the sum of the peak value and three times the standard deviation.

Manual range

Parameter	Description
Create Binary	<ul style="list-style-type: none"><li>▪ <b>Activated:</b> Pixels within the brightness range are changed to white, background pixels are changed to black. The resulting image is binary and can be used as a mask for subsequent image processing operations.</li><li>▪ <b>Deactivated:</b> Pixels within the brightness range remain unchanged, background pixels are changed to black.</li></ul>
Invert Result	Reverts the way the pixels are treated <ul style="list-style-type: none"><li>▪ Pixels inside the brightness range: treated as background and changed to black.</li><li>▪ Pixels outside the brightness range: remain unchanged or changed to white if binary is activated.</li></ul>

See also

- 📖 [Configuring Tolerances for a Measurement \[▶ 60\]](#)
- 📖 [Specifying Permitted and Expected Values for a Tool \[▶ 59\]](#)

6.2.5.5 Threshold Dynamic Tool

This tool splits the image into foreground and background pixels by performing an adaptive gray value segmentation. It is particularly suited to the segmentation of small structures on a varying background.

The tool initially applies a low-pass filter and then subtracts this low-pass-filtered image from the input image. The effect largely depends on the size of the filter matrix (**Kernel Size**).

Parameter	Description
Kernel Size	Specifies the matrix size of the low pass filter in X and Y direction symmetrically around the pixel currently processed and determines the extent of the smoothing effect.



Parameter	Description
	<p>Set a low <b>Kernel Size</b> value to segment small regions or regions with low gray value contrast from the background. Set a higher <b>Kernel Size</b> value to segment larger regions from the background.</p> <p>As the affected pixel is at the center, the edge length of the filter matrix is always an odd number. If you enter an even number via the keyboard, the value is always set to the next highest odd number.</p>
<b>Threshold</b>	<p>Defines the difference in brightness between the regions to be detected and the background.</p> <p>Segmented pixels are set to the maximum gray value (white), other pixels are set to zero (black).</p>
<b>Create Binary</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Pixels within the brightness range are changed to white, background pixels are changed to black. The resulting image is binary and can be used as a mask for subsequent image processing operations.</li> <li>▪ <b>Deactivated:</b> Pixels within the brightness range remain unchanged, background pixels are changed to black.</li> </ul>
<b>Invert Result</b>	<p>Reverts the way the pixels are treated.</p> <ul style="list-style-type: none"> <li>▪ Pixels inside the brightness range: treated as background and changed to black.</li> <li>▪ Pixels outside the brightness range: remain unchanged or changed to white if binary is activated.</li> </ul>

### See also

- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]

#### 6.2.5.6 Valleys Tool

This tool detects lines of dark pixels (valleys composed of low gray values) on a bright background. In the output image, the detected lines are displayed white on a uniform black background.

Parameter	Description
<b>Sigma</b>	<p>Specifies the extent of smoothing applied to the input image before the lines of dark pixels are detected.</p> <ul style="list-style-type: none"> <li>▪ Lower values: Thinner valleys are preserved, more valleys are detected, and more lines are visible in the output image.</li> <li>▪ Higher values: Thinner valleys are removed due to smoothing, fewer valleys are detected, and fewer lines are visible in the output image.</li> </ul>
<b>Threshold</b>	<p>Specifies the steepness a valley must possess to be recognized by the tool. The steepness is the rate at which the gray values increase starting from the bottom of a valley.</p> <ul style="list-style-type: none"> <li>▪ Lower values: More valleys are detected, including shallower and less pronounced ones.</li> </ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>Higher values: Only steep and strongly pronounced valleys are detected.</li> </ul>

### See also

- Configuring Tolerances for a Measurement [► 60]
- Specifying Permitted and Expected Values for a Tool [► 59]

## 6.3 Image Analysis

An image analysis enables you to analyze simple shapes based on their gray values. For example, you can automatically count and classify particles in the sample according to their size or color.

Setting up an image analysis consists of the following steps:

1. Classifying measurements
2. Specifying the region of an image to be analyzed
3. Configuring object detection
4. Automatically correcting object detection
5. Manually correcting object detection
6. Defining values to be measured
7. Previewing measurements

You are guided through these steps using the **Image Analysis Wizard**.

An image analysis can be run as follows:

- Interactively
- Automatically

When run interactively, the user can adjust the settings in each of steps 2-5 if enabled in the measurement definition. Since this mode requires a good knowledge of the sample and the software, it is typically used by supervisors in **Free Mode**.

When run automatically, the user cannot adjust any settings. The interaction is limited to acquiring or selecting the image and saving the analysis results. This is typical for inclusion in a job template. In this case, it is common to assign the image analysis to a macro and insert the macro into the template rather than the image analysis itself.



### See also

- Specifying Region of Image to be Analyzed (Frame) [► 244]
- Configuring Object Detection (Automatic Segmentation) [► 244]
- Automatically Correcting Object Detection (Condition) [► 245]
- Manually Correcting Object Detection (Interactive Segmentation) [► 246]
- Defining Values to be Measured (Features) [► 247]
- Previewing Measurement (Measure) [► 249]

### 6.3.1 Creating an Image Analysis Setting




To be able to automatically analyze a sample you first have to create a new image analysis or modify an existing one.

**Prerequisite** ✓ You have opened an image and the **Image Analysis** workbench is selected.

1. In the **Image Analysis** tool, click  to select a default setting file.
2. Click  to save the file in the **Archive** under a new name.
3. Click **Setup Image Analysis**.
  - ➔ The image analysis wizard opens, see *Image Analysis Wizard* [▶ 251].
4. Complete all the steps of the wizard and click **Finish**.

You have created an image analysis setting. You can now run the image analysis in **Free Mode**, use it in a job template, or execute it with a macro.

### See also

-  Operating the Image Analysis Wizard [▶ 243]
-  Selecting Workbenches [▶ 41]
-  Specifying Tools for a Task [▶ 58]

## 6.3.2 Running an Image Analysis

Image analysis can be run as follows:



**Prerequisite** ✓ An image is displayed.

✓ The **Image Analysis** workbench is selected.

1. Under **Settings File** select the desired image analysis file.
2. If you are in **Free Mode**, click **Analyze**. If you are in **Job Mode**, go to the first step of the analysis.
  - ➔ In **Free Mode**, you can change the parameters of every step where the **Interactive** checkbox was activated during setup. In **Job Mode**, you can change the parameters of every step that is not set to run silent. The rest of the image analysis is performed automatically.
  - ➔ If you have selected a settings file that you created from a machine learning or AI model, some parameters of the image analysis are already predefined and cannot be changed, e.g. the number of classes and the segmentation method.

The results of the image analysis are displayed in the image and a results table.

### See also

-  Selecting Workbenches [▶ 41]
-  Specifying Tools for a Task [▶ 58]

## 6.3.3 Operating the Image Analysis Wizard

### 6.3.3.1 Defining Measurement Classes

This step in the **Image Analysis Wizard** enables you to create measurement classes for the sample. A class corresponds to a type of object to be detected, for example objects with a specific brightness or shape.

This step enables you to define how many measurement classes are required. The properties of a class (i.e. how an object is detected) are defined in a later step. When you create a class it is added to the list of classes. The class itself contains the measurement values for each individual detected object. To define the classes for the image analysis:


1. Click **Add Class**.
  - ➔ The new class is always added below the currently selected item.
2. Enter a meaningful name for the class.
3. In a multichannel image, select which channel should be evaluated.
4. Select the color in which the detected objects should be displayed.
5. Click **Next**.

### See also

 [Classes](#)  251]

### 6.3.3.2 Specifying Region of Image to be Analyzed (Frame)

This step in the **Image Analysis Wizard** enables you to specify the following:

- The areas of the image to be measured (measurement frames)
  - How objects at the edge of the image or frame are treated
1. If you wish a user to be able to adjust the settings in this step when the job is run, activate **Interactive**.
  2. Specify the measurement area:
    - ➔ Use the drawing tools to create one or more new areas.
    - ➔ You can modify measurement areas by dragging them in the image or entering coordinates.
    - ➔ If you wish to measure the entire image, click the  icon to delete all measurement areas.
  3. In **Mode**, specify how objects at the edge of the image or the measurement area are treated.
  4. Click **Next**.

For detailed information about each parameter, see *Frame*  252].

### See also

 [Frame](#)  252]

### 6.3.3.3 Configuring Object Detection (Automatic Segmentation)

This step in the image analysis enables you to specify how objects are detected. All the objects detected with the current settings are highlighted in the image.

#### Info

- ▶ If not all objects are detected automatically, it is better to adjust the parameters so that too many objects are detected. You can then use the following steps to exclude objects, for example based on their size or roundness.
- ▶ You can manually add or remove objects that are difficult to detect in a later step.

1. If you wish this step to be included when the job is run, activate **Execute**.
  - ➔ Otherwise the step is skipped.
2. If you wish a user to be able to adjust the settings in this step when the job is run, activate **Interactive**.
3. Select the class for which you wish to modify the settings.
  - ➔ You can specify different settings for each class.

4. Click **Select**.
  - ➔ The dialog for segmentation method selection opens.
5. Select the Method you want to use for segmentation of the selected class.
6. Click **OK**.
  - ➔ The dialog closes and the available parameters are changed based on your method selection. For detailed information about each possible parameter, see *Automatic Segmentation* [▶ 254].
7. Use the displayed parameters to configure the segmentation of objects in your image.
  - ➔ The segmentation masks are displayed and updated in the image.
8. Use **Fill Holes** and **Separate** to specify how holes in objects and overlapping objects are treated.
9. Click **Next**.

#### 6.3.3.4 Automatically Correcting Object Detection (Condition)

This step in the **Image Analysis Wizard** enables you to specify which of the detected objects are measured, based on various properties such as area, intensity, or roundness.

All the objects detected with the current settings are highlighted in the image.

##### Info

You can manually add or remove objects that are difficult to detect in the next step.

1. If you wish this step to be included when the job is run, activate **Execute**.
  - ➔ Otherwise the step is skipped.
2. If you wish a user to be able to adjust the settings in this step when the job is run, activate **Interactive**.
3. Select the class for which you wish to modify the settings.
  - ➔ You can specify different settings for each class.
4. Click **Edit**.
5. Double-click the properties you wish to use to select detected objects.
  - ➔ The selected properties are added to a so-called block. The properties are joined by "And" conditions: only detected objects which fulfill all the properties in a block are measured; all the other detected objects are excluded.
  - ➔ You can filter the list by entering the first few letters of the property name in **Search Feature** or by selecting the corresponding category of property in the drop-down.
  - ➔ For more information about the properties and their values, see Feature Selection Dialog.
6. To create an alternative block, click **Add Block**.
  - ➔ The blocks are joined by an "Or" condition. Objects that fulfill all the conditions in at least one block are measured.
7. Double-click the properties to add to the new block.
8. Repeat steps 5-7 as desired.
9. When you have selected all the desired properties, click **OK**.
10. For each property, click a representative object in the image.
  - ➔ The threshold values for the property are set based on the values of the selected object.
11. If desired, correct the lower and upper threshold values in **Minimum** and **Maximum** respectively.
  - ➔ If the object's property is not between the thresholds, it is excluded.

- If you do not want to include a threshold for a property, deactivate the corresponding checkbox. In this case, the threshold is set to the minimum or maximum possible value respectively.

12. Click **Next**.

For detailed information about each parameter, see *Region Filter* [▶ 263].

### See also

 *Region Filter* [▶ 263]


#### 6.3.3.5 Manually Correcting Object Detection (Interactive Segmentation)

This step in the **Image Analysis Wizard** enables you to add or remove individual objects to be measured. The step can be considered a manual "fine-tuning" of the automatic detection results of the previous steps. After this step, all the objects you wish to measure should be selected and any you do not wish to be measured should be removed.

All the objects detected with the current settings are highlighted in the image.

#### Info

If you need to make large numbers of manual corrections, it might be quicker to try adjusting the parameters in the previous steps first.

1. If you wish this step to be included when the job is run, activate **Interactive**.
  - Otherwise the step is skipped.
2. Select the class for which you wish to modify the settings.
  - You can specify different settings for each class.
3. To add a new object or remove part an object, click **Draw** or **Erase** and use a drawing tool in the image.
  - **Draw**: Adds the area drawn as a new object
  - **Erase**: Removes the area drawn from any existing objects; the remaining parts of the objects are measured
  - For more information about how to use the drawing tools, see *Interactive Segmentation* [▶ 265].
4. To split an existing object into multiple objects click **Cut** and draw a line in the image where the object should be split.
  - The resulting objects are measured separately.
5. To extend the size of an object click **Merge** and use a drawing tool in the image.
  - If the area drawn overlaps an existing object, the area and object are joined into a single object.
6. To fill an object containing a hole, click **Fill** then click an object in the image.
  - The hole is filled and the complete object is measured.
7. To delete objects, click the desired action and then click an object in the image:
  - **Remove**: Deletes the selected object; the object is no longer measured
  - : Removes all objects; no objects are measured
8. To expand or reduce the size of an object based on the brightness of surrounding pixels, click **+** or **-** and click a representative area in the image. The amount by which the object expands or reduces depends on the brightness of the selected pixel, its proximity to other objects, and the values of the **Intensity** and **Color** parameters.
  - **+**: Expands the closest object
  - **-**: Reduces the closest object




9. Click **Next**.

For detailed information about each parameter, see *Interactive Segmentation* [▶ 265].

### 6.3.3.6 Defining Values to be Measured (Features)

This step in the **Image Analysis Wizard** enables you to define the properties of the detected objects to be measured, such as location, diameter, or intensity.

All the objects detected with the current settings are highlighted in the image.

- Prerequisite** ✓ The objects you wish to measure are selected. If not, change the values in the previous steps first.
1. Select the class for which you wish to modify the settings.
    - You can specify different settings for each class.
  2. Click **Edit**.
  3. Double-click the properties to be measured for the detected objects.
    - You can change the order of the measurements using the  and  icons.
    - You can remove a property from the list using the  icon.
  4. If you want a property to be measured but not displayed in the image, deactivate the corresponding **Display** checkbox.
    - This prevents the image becoming cluttered.
  5. When you have selected all the desired properties, click **OK**.
  6. If you wish the same measurements to be applied to all classes, click **Copy to All**.
  7. Click **Next**.

For detailed information about each parameter, see *Features* [▶ 268].

### 6.3.3.7 Creating Custom Features

- Prerequisite** ✓ You are in the **Features** step of the analysis wizard in **Free Mode** or the respective step in **Job Mode**.
1. Select a class in the list and click **Custom Feature**.
    - The **Custom Feature Editor** opens. All already defined features are displayed in the list, or on initial opening an empty default entry is already created.
  2. In the **Custom Features** list, click **+** to add a new entry. Alternatively, if no feature has been defined yet, select the automatically displayed default entry.
    - A new entry is added to the list.
  3. Under **Define Custom Feature**, define the **Name** for your feature and optionally specify a **Unit**, if applicable.
  4. In the **Define Operands** list, click **+** to add a new operand. Alternatively, if no operand has been defined yet, select the automatically displayed default entry.
    - A new operand entry is created.
  5. Select the **Class** which is used to generate the operand.
  6. In the **Features** dropdown list, select the measurement feature that you want to use to define the operand.
    - The selected class and measurement feature are displayed as **Expression**.
  7. Repeat the previous steps to define all operands you need to calculate your custom feature.
    - All defined operands are displayed in the **Define Operands** list.

8. Under **Define Custom Expression**, enter your operands and use the mathematical operators to define the calculation for your custom feature, e.g. **100\*(a/b+Math.Pow(c,2))**.
9. Click **Verify Expression**.
  - The syntax of your expression is checked and verified. In case the expression is not valid, an error message is displayed.
10. Repeat this whole workflow to create all custom features required for your image analysis.
  - All created features are displayed in the **Custom Features** list of the respective class.
11. Click **OK**.
  - The editor closes and saves the defined custom features. They are displayed in the list of the **Features** step of the wizard.
  - After analyzing an image with the setting, the custom features are displayed in the result table of the respective class.

### 6.3.3.8 Creating Custom Statistical Features

**Prerequisite** ✓ You are in the **Statistics** step of the analysis.

1. Select a class in the list and click **Define Custom Feature**.
  - The **Custom Feature Editor** opens. All already defined features are displayed in the list, or on initial opening an empty default entry is already created.
2. In the **Custom Features** list, click **+** to add a new entry. Alternatively, if no feature has been defined yet, select the automatically displayed default entry.
  - A new entry is added to the list.
3. Under **Define Custom Feature**, define the **Name** for your feature and optionally specify a **Unit**.
4. In the **Define Operands** list, click **+** to add a new operand. Alternatively, if no operand has been defined yet, select the automatically displayed default entry.
  - A new operand entry is created.
5. Select the **Class** which is used to generate the operand.
6. In the **Features** dropdown list, select the measurement feature that you want to use to define the operand.
7. Select the **Statistical Operation** the operand is used for.
  - The selected class and measurement feature are displayed as **Expression**.
8. Repeat the previous steps to define all operands you need to calculate your custom feature.
  - All defined operands are displayed in the **Define Operands** list.
9. Under **Define Custom Expression**, enter your operands and use the mathematical operators to define the calculation for your custom feature, e.g. **100\*(a/b+Math.Pow(c,2))**.
10. Click **Verify Expression**.
  - The syntax of your expression is checked and verified. In case the expression is not valid, an error message is displayed.
11. Repeat this whole workflow to create all custom features required for your image analysis.
  - All created features are displayed in the **Custom Statistic Features** list.
12. Click **OK**.
  - The editor closes and saves the defined custom statistical features. They are displayed in the list of the **Statistics** step of the wizard.
  - After analyzing an image with the setting, the statistical features are displayed in a result table.

#### See also

 Statistics [► 272]



### 6.3.3.9 Previewing Measurement (Measure)

This step in the **Image Analysis Wizard** displays a preview of the measurement results of the selected class. These results are calculated roughly and may differ from the actual results when the image analysis is performed.

1. Check the measurement results for each class.  
→ If you are not satisfied with the results, change the settings in the previous steps.
2. Click **Finish** to save the image analysis.

For detailed information about each parameter, see *Results Preview* [▶ 274].

#### See also

📄 Results Preview [▶ 274]

### 6.3.4 Analysis Tab

The **Analysis** tab is displayed at the bottom of each step of the **Image Analysis Wizard**.

The functionality of the tab is also displayed for every analyzed image opened in ZEN core (tab is called **Image Analysis Options** in that case).

It enables you to adjust the following global settings:

Parameter	Description
<b>Show Objects</b>	Shows/hides the detected objects in the image
<b>Fill</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Displays the detected objects as a filled shape</li> <li>▪ <b>Deactivated:</b> Displays the contour of detected objects</li> </ul>
<b>Opacity</b>	Adjusts the transparency of detected objects This only has an affect if <b>Show Objects</b> is activated.
<b>Show All Classes</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Displays the detected objects from all classes</li> <li>▪ <b>Deactivated:</b> Displays the detected objects from the selected class and subclasses</li> </ul>
<b>Object Classification</b>	Only visible, if you have executed an object classification, see <i>Using a Trained Model for Object Classification</i> [▶ 328]. Displays a table with the predicted objects for a specific class.

### 6.3.5 Operator Workflow - Counting Cells (Loaded Images)

Operator workflows are designed by Supervisors. In the following you see the operator workflow **Counting Cells (Loaded Images)**, which allows to count fluorescently-labeled nuclei that can serve as a proxy for the cell number.

Tasks	Description	To Do
<b>Form</b>	The input form <b>ZEISS Cells</b> is provided. The form is displayed in the report.	The default form is displayed.  To change the form, in the <b>Form Selection</b> tool, select the form, see <i>Form Selection Tool</i> [▶ 750].

Tasks	Description	To Do
		Fill in relevant data according to your sample.
<b>Load File</b>	Load images you acquired earlier.	<p>In the <b>Load Multiple Image</b> tool, load images from disk to display them in the <b>Center Screen Area</b>, see <i>Load Image Tool</i> [▶ 749].</p> <p>Loaded images have the fluorescently-labeled nuclei as first channel.</p>
<b>Image Segmentation</b>	Generate one mask for all nuclei per cell.	<p>Generate masks for nuclei, which are then counted, see <i>Automatic Segmentation</i> [▶ 254].</p> <p>To separate neighboring nuclei use a separation tool, e.g. <b>Watersheds</b>.</p> <p>If a large part of the image is selected initially, use background subtraction.</p>
<b>Region Filter</b>	Results are refined based on area and circularity of the objects.	To refine the selection to limit the analysis to one object or nucleus per cell, use region filters for area and circularity, see <i>Region Filter</i> [▶ 263].
<b>Measurement Data</b>	Check the results based on the previously conducted image analysis. The results are displayed in a table.	<p>To select an object, click a value in the table, and to check the size of a certain object, click the object in the <b>Center Screen Area</b>.</p> <p>For more information, see <i>Measurement Data Tool</i> [▶ 834].</p>
<b>Report</b>	<p>Creates a report document, see <i>Reports</i> [▶ 80]. You can print the report.</p> <p>The report contains the following information:</p> <ul style="list-style-type: none"> <li>▪ Form</li> <li>▪ Counts and counts/mm<sup>2</sup> for each image and their mean</li> <li>▪ Display of all images with the detected nuclei</li> </ul>	For your documentation, you create a report.

### 6.3.6 Image Analysis Workbench



This workbench enables set up and perform an image analysis. For example, you can automatically count and classify particles in the sample according to their size or color.

#### See also


- 📖 Automatic Measurement Tool [▶ 251]
- 📖 Image Analysis Wizard [▶ 251]

### 6.3.7 Automatic Measurement Tool

This tool enables you to set up and perform an automatic image analysis.

Parameter	Description
<b>Settings File</b>	Displays the selected settings file.
–  Open	Opens a dialog to select your image analysis setting.
–  Save	Saves the current setting to the <b>Archive</b> .
<b>Class tree</b>	Displays a preview of the classes to be analyzed.
<b>Setup Image Analysis</b>	Opens the <b>Image Analysis Wizard</b> to configure the image analysis.
<b>Analyze</b>	Runs the selected image analysis.

#### See also

 Image Analysis Wizard [► 251]

### 6.3.8 Image Analysis Wizard

This wizard guides you through the setup of an image analysis. The following basic controls enable you to move through the steps:

Parameter	Description
<b>Next</b>	Moves on to the next step of the wizard.
<b>Back</b>	Moves back to the previous step of the wizard.
<b>Cancel</b>	Cancels the wizard. No changes are applied to your settings.
<b>Finish</b>	Saves the setup and the changes based on your progress and closes the wizard.

#### 6.3.8.1 Classes

##### Info

##### Difference in Job Mode

The available functionality of the individual steps can differ between the wizard in **Free Mode** and the steps that can be added in **Job Mode**, e.g. the **Interactive** checkbox is not visible in **Job Mode**.

In this step you can define the classes into which the measured objects in the image are divided.

Parameter	Description
<b>Interactive</b>	<b>Activated:</b> The measurement frame definition can be changed interactively while the analysis setting is run.

Parameter	Description
<b>Class List</b>	Displays the defined classes. If you create a new analysis setting, a predefined set of classes is created automatically.  Each class also contains a summation class (not displayed in the class list). Each class contains the individual regions belonging to that class and in the class result table the defined measurement features for each individual object are displayed. The summation class on the other hand concerns all the objects belonging to the class. The corresponding result table contains "statistical" features such as the object count or the mean intensity of all objects belonging to the class.
<b>Add Class</b>	Adds a new individual class to the list on the base level.
<b>Add Subclass</b>	Adds a new subclass to the selected class.
<b>Remove Class</b>	Deletes the selected class from the list.
<b>Name</b>	Defines the name for the selected class in the list. Note that you must not use the name <b>Root</b> for one of your classes as this a reserved key-word.
<b>Channel</b>	Selects the channel that is used for image segmentation of the selected class in the class list.
<b>Object Color</b>	Selects a color to mark the objects of a class.
– <b>Random</b>	The objects found by the analysis will be colorized randomly.
– <b>Fixed</b>	Selects the fixed color to mark the objects of a class.


### 6.3.8.2 Frame

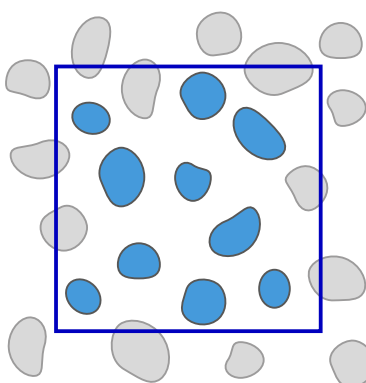
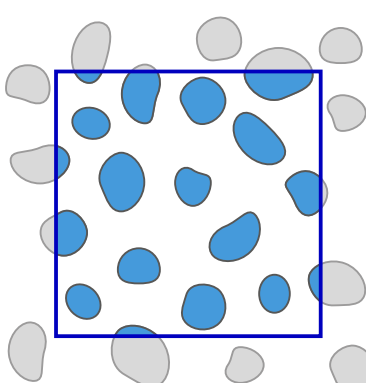
#### Info

##### Difference in Job Mode

The available functionality of the individual steps can differ between the wizard in **Free Mode** and the steps that can be added in **Job Mode**, e.g. the **Interactive** checkbox is not visible in **Job Mode**.

In this step you can define one or more measurement frames. Only the area within the measurement frames gets analyzed. You can also define how the analysis treats objects that are cut by the border of the image or the frame.

Parameter	Description
<b>Interactive</b>	<b>Activated:</b> The measurement frame definition can be changed interactively while the analysis setting is run.
 <b>Select Frame</b>	Enables you to select already created measurement frames. To select a measurement frame, click inside it. To select several measurement frames, press <b>Ctrl</b> and click inside the desired measurement frames. Once you have selected a measurement frame, you can change its size.
<b>Draw Rectangle</b>	Enables you to create a rectangle as a measurement frame in the current image.

Parameter	Description
<b>Draw Circle</b>	Enables you to create a circle as a measurement frame in the current image.
<b>Draw Contour (Polygon)</b>	Enables you to create a contour as a measurement frame in the current image.
<b>Remove All Frames</b>	Removes all drawn-in measurement frames in the current image. To delete single frames, select them and press <b>Del</b> .
<b>Maximize Circle</b>	<b>Activated:</b> Maximizes the drawn-in circle to the full image size. In the case of rectangular images the circle is adjusted to the shorter side.
<b>Center Circle</b>	<b>Activated:</b> Centers the drawn-in circle to the full images size.
<b>Mode</b>	Selects how the measurement frame should be applied. Note that this behavior is only applied when running the analysis (interactively) and not during the setup. The setup always uses the <b>Cut at Frame</b> mode. The following modes are available:
– <b>Inside Only</b>	Measures only those objects, that are lying completely within the measurement frame. Objects that are touching the frame or are intersected by the frame are not analyzed.
	
– <b>Cut at Frame</b>	Measures all objects that are lying within the measurement frame. Objects that are intersected by the measurement frame are measured precisely up to the measurement frame.
	
<b>Left</b>	Sets the starting point for the frame on the X axis in pixels.
<b>Top</b>	Sets the starting point for the frame on the Y axis in pixels.
<b>Width</b>	Sets the width of the frame in pixels.
<b>Height</b>	Sets the height of the frame in pixels.

Parameter	Description
<b>Color</b>	Selects the color of the frame.
<b>Show Frame On Analyzed Image</b>	<b>Activated:</b> Displays the frame on the image after the analysis has run.

### 6.3.8.3 Automatic Segmentation

#### Info

##### Difference in Job Mode

The available functionality of the individual steps can differ between the wizard in **Free Mode** and the steps that can be added in **Job Mode**, e.g. the **Interactive** checkbox is not visible in **Job Mode**.

In this step you can select the segmentation method that is applied and set parameters for the segmentation of the objects that you want to measure. All the objects detected with the current settings are highlighted in the image. Note that during the setup of the analysis (via **Setup Image Analysis** in **Free Mode**), the segmentation is only performed on the area visible in the viewport. If you enter the interactive analysis or are in **Job Mode**, the image will be fully segmented.

Parameter	Description
<b>Execute</b>	<b>Activated:</b> This step is included when the analysis is run. Otherwise the step is skipped.
<b>Interactive</b>	<b>Activated:</b> The segmentation can be changed interactively while the analysis setting is run.
<b>Class List</b>	Selects the class for which you want to define the segmentation. You can specify different settings for each class.
<b>Select</b>	Opens the selection for segmentation methods.

The visible parameters depend on the selected segmentation method. The following parameters sections can be available:

- *Smoothing Section* [▶ 255]
- *Sharpen Section* [▶ 255]
- *Threshold & Histogram Section* [▶ 256]
- *Variance Section* [▶ 259]
- *Model Section* [▶ 259]
- *Subtract BG Section* [▶ 260]
- *Object Size & Hole Section* [▶ 260]
- *Binary Section* [▶ 261]
- *Separate Section* [▶ 261]
- *Suppress Section* [▶ 262]

#### See also

- 📖 [Configuring Object Detection \(Automatic Segmentation\)](#) [▶ 244]

**6.3.8.3.1 Smoothing Section**

Parameter	Description
<b>Smoothing</b>	Selects how to smooth the image before the threshold values are set. The following methods are available:
- <b>None</b>	The image is not smoothed.
- <b>Lowpass</b>	Applies the Lowpass method. The lowpass filter compares the brightness of each pixel to the brightness of its neighboring pixels. If a pixel is brighter than its neighbors, the brightness of this pixel is reduced and the brightness of the neighboring pixels is increased. This suppresses sharp changes in brightness (i.e. contours) and leads to more gradual changes in brightness.
- <b>Gauss</b>	Applies the Gauss method. Each pixel is replaced by a weighted average of its neighbors. The weighting depends on the sigma value. The Gaussian filter is particularly useful for contour enhancement, which is very sensitive to noise. Using a Gaussian filter before finding contours greatly improves the results.
- <b>Median</b>	Applies the Median method. Each pixel is replaced by the median of its neighbors. The number of neighboring pixels taken into account depends on the size. In a set of values (in this case the pixel values taken into account), the median is the value for which the number of larger values is equal to the number of smaller values.
<b>Size</b>	Only visible, if you have selected <b>Low Pass</b> or <b>Median</b> . Sets the size of the filter matrix in the X and Y direction, i.e. the number of neighboring pixels taken into account. The size should correspond to the pixel size of the contours to be reduced.
<b>Sigma</b>	Only visible, if you have selected <b>Gauss</b> . Sets the sigma value that defines how much neighboring pixels contribute to the weighting. Larger values broaden the applied Gaussian distribution and lead to reduced noise but also to an increased loss of image information.

**6.3.8.3.2 Sharpen Section**

Parameter	Description
<b>Sharpen</b>	Select how to improve the sharpness by enhancing contrast at fine structures and edges of the image before the threshold values are set. The following methods are available:
- <b>None</b>	No sharpening algorithm is applied.
- <b>Delineate</b>	Applies the Delineate method. It emphasizes edges around structures in an image, which is useful for images where the gray value range of structures differs clearly from the gray value range of the pixels around them.
- <b>Unsharp Masking</b>	Applies the Unsharp Masking method.

Parameter	Description
<b>Threshold</b>	Only visible, if you have selected <b>Delineate</b> . Sets the threshold value for edge detection. The threshold value should correspond roughly to the gray value difference between objects and the background.
<b>Size</b>	Only visible, if you have selected <b>Delineate</b> . Sets the size of the edge detection filter, i.e. the size of image details which are enhanced. The smaller the <b>Size</b> value is, the finer are the details affected by the tool. The value should correspond to the size of the transition area between objects and the background.
<b>Strength</b>	Only visible, if you have selected <b>Unsharp Masking</b> . Sets the strength of the <b>Unsharp Masking</b> . The higher the value selected, the greater the extent to which small structures are enhanced.

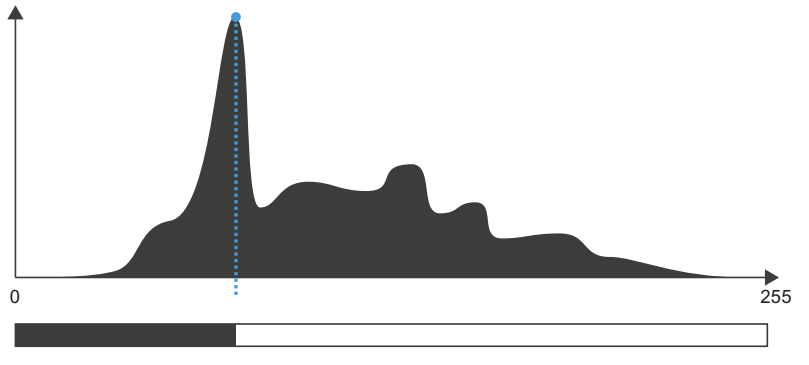
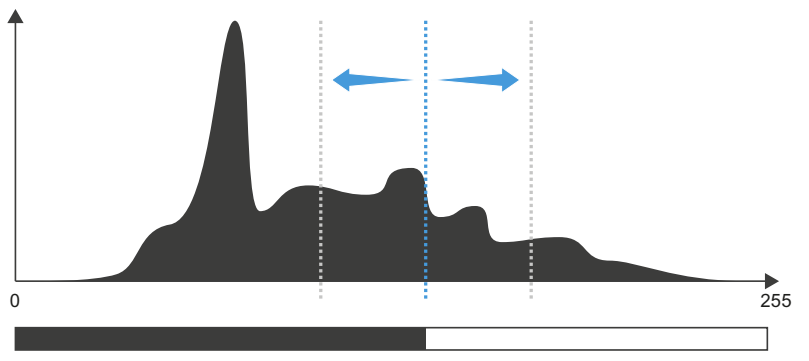
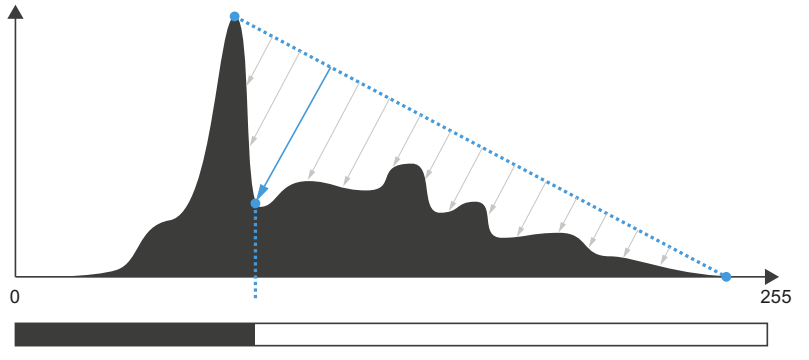
#### 6.3.8.3.3 Threshold & Histogram Section

Here you can define the threshold values for the selected class in the class list.

Parameter	Description
<b>Threshold</b>	Sets the brightness boundaries between which pixels are considered.
– <b>Reset</b>	Clears the upper and lower thresholds. No pixels are considered.
– <b>Undo</b>	Undoes the last change made to the threshold values.
– <b>Redo</b>	Restores the last undone change to the threshold values.
<b>Color Model</b>	Only visible if the image is a color image, see <i>Color Model</i> [▶ 259].
– <b>RGB</b>	In RGB mode you can define the threshold values for the red, green and blue color channels.
– <b>HLS</b>	In HLS mode you can define the threshold values for hue, saturation and lightness.
– <b>Low</b>	Sets the lower threshold. Only pixel values above this value are considered. The range of possible values depends on the bit depth of the image.
– <b>High</b>	Sets the upper threshold. Only pixel values below this value are considered. The range of possible values depends on the bit depth of the image.
– <b>Invert</b>	Only pixels outside the threshold boundaries are considered, i.e. those pixels below the lower threshold and above the higher threshold.
– <b>Full Range</b>	Sets the lower threshold to 0 and the upper threshold to the highest value (depending on bit depth). The entire range of pixel values is considered.
<b>Histogram</b>	In the histogram you can change the lower and upper threshold value for the activated value. Drag the lower or upper adjustment handle or shift the entire highlighted area between the lower and upper threshold value.






Parameter	Description
<b>Click</b>	Click in the image on the regions that you want to define as objects. The threshold values are adapted according to the pixel intensities at the clicked position in the image.
<b>Automatic</b>	The threshold values are determined automatically from the histogram. During setup only the part of the image displayed in the viewport is taken for the calculation of the threshold. After the automatic calculation of the threshold values you can further modify the threshold values found interactively by selecting <b>Click</b> for threshold value definition.
<b>Pick Behavior</b>	Only visible, if you have selected <b>Click</b> .
- +	Enables you to expand the currently segmented regions by the gray values/colors of the objects subsequently clicked on.
- -	Enables you to reduce the currently segmented regions by the gray values/colors of the objects subsequently clicked on.
<b>Tolerance</b>	Only visible, if you have selected <b>Click</b> . Specifies how many additional pixel values are included in the selection based on their brightness. A higher value means that more pixel values similar to the selected one are included. A lower value means that only the exact pixel value selected is included.
<b>Neighborhood</b>	Only visible, if you have selected <b>Click</b> . Specifies how many additional pixel values are included in the selection based on their physical proximity to the selected pixel. A higher value means that more pixels surrounding the selected pixel are included. The threshold boundaries are adapted so that all the pixel values of these neighboring pixels are included. A lower value means that the boundaries are adapted based on only the pixels directly next to the selected pixel.
<b>Method</b>	Only visible, if you have selected <b>Automatic</b> . Selects the algorithm that is used to automatically detect the threshold boundaries. The most suitable algorithm depends on your precise requirements. The value also depends on the bit depth of the image. The following methods are available:
- <b>Otsu</b>	The pixel values below the threshold are designated as background and those above the threshold as foreground. It iterates through all possible threshold values and calculates the variance of the pixel intensities of the background and foreground pixels for each value. The threshold is set at the value that minimizes both variances. This method is particularly suited to light objects on a dark background.
- <b>Maximum Peak</b>	Separates background and foreground pixels at the maximum value of the histogram.

Parameter	Description
	
<b>- Iso-Data</b>	<p>The pixel values below the threshold are designated as background and those above the threshold as foreground. An initial threshold value is chosen, and the mean pixel intensity of the foreground and background pixels is calculated. These two mean values are averaged and the result serves as the input threshold for the next calculation. The process is repeated until the threshold value no longer changes.</p> 
<b>- Triangle Threshold</b>	<p>The algorithm constructs a line between the peak of the highest frequency pixel intensity and the lowest pixel intensity. The distance between the line and the histogram is computed for all values along the line. The pixel intensity where the line is longest is used as the threshold. This method is particularly suited when the foreground pixels only have a weak peak in the histogram.</p> 
<b>- Three Sigma Threshold</b>	<p>Calculates the pixel value that occurs most frequently. The standard deviation of the values in the peak is calculated. The threshold is set to the pixel intensity that is the sum of the average peak value and three times the standard deviation.</p>

#### 6.3.8.3.1 Color Model




##### RGB

Here you can set the RGB channel threshold values.

Parameter	Description
 <b>Red</b>	Activates the red channel in the Expander <b>Histogram</b> .
 <b>Green</b>	Activates the green channel in the Expander <b>Histogram</b> .
 <b>Blue</b>	Activates the blue channel in the Expander <b>Histogram</b> .

##### HLS

Here you can set the hue, lightness and saturation threshold values.

Parameter	Description
 <b>Hue</b>	Activates the hue in the Expander <b>Histogram</b> .
 <b>Lightness</b>	Activates the lightness in the Expander <b>Histogram</b> .
 <b>Saturation</b>	Activates the saturation in the Expander <b>Histogram</b> .

#### 6.3.8.3.4 Variance Section

This section is only visible if **Variance-Based Thresholding** is selected.

Parameter	Description
<b>Kernel Size</b>	Sets the kernel size used to calculate the variance value of one pixel with its neighboring pixels.
<b>Variance</b>	Defines the lower and upper threshold for the variance.

#### 6.3.8.3.5 Model Section

This section is only visible if **Intellesis Trainable Class Segmenter** or **AI Instance Segmentation** is selected.

Parameter	Description
<b>Model Name</b>	Displays the name of the currently selected model.
– <b>Select Model</b>	Opens the dialog to select a segmentation model. Note that you can only use models trained on a single channel.

Parameter	Description
<b>Model Version</b>	Only visible if <b>AI Instance Segmentation</b> is selected. Displays the currently selected model version.
<b>Model Class</b>	Displays the name of the currently used model class.
– <b>Reset</b>	Resets/Deletes the selected model.
<b>Min. Confidence</b>	Sets the minimum value (in %) for the confidence that a certain pixel belongs to the segmented class. The default value is 51.

#### 6.3.8.3.5.1 Select Model Dialog

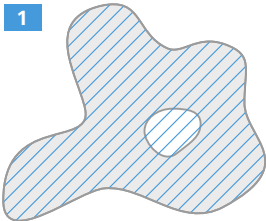
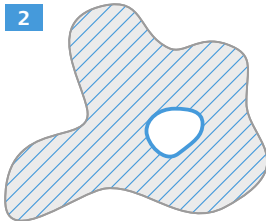
Parameter	Description
<b>Model Name</b>	Selects a model. Only models trained on one channel images are shown here because only those can be used to segment a specific class assigned to a specific channel.
<b>Model Class</b>	Selects the model class.
<b>Model Version</b>	Only visible for <b>AI Instance Segmentation</b> . Selects the version of the model.
<b>OK</b>	Selects the respective model.
<b>Cancel</b>	Cancels the model selection and closes the dialog.

#### 6.3.8.3.6 Subtract BG Section

Parameter	Description
<b>Subtract BG</b>	Only visible if <b>Segmentation with Background Subtraction</b> is selected. Selects which kind of background subtraction is performed.
- <b>None</b>	No background subtraction is performed.
- <b>Rolling ball</b>	The rolling ball background subtraction is performed.

#### 6.3.8.3.7 Object Size & Hole Section

Parameter	Description
<b>Min. Object Size</b>	Sets the minimum size in pixels that an object must have in order to be segmented.
<b>Min. Hole Size</b>	Sets the minimum size in pixels that a hole must have in order to be recognized for segmentation. This input is synchronized with the input for <b>Min. Object Size</b> , which must not be smaller than <b>Min. Hole Size</b> .
<b>Fill all Holes</b>	Specifies how holes in detected objects are treated.


Parameter	Description
	<div><div>1</div></div> <div><div>2</div></div>
- On	Fills holes in segmented objects (1).
- Off	Does not fill the holes in segmented objects (2).


6.3.8.3.8 Binary Section

Parameter	Description
Binary	Selects which morphological operations are performed on the segmented (binary) image.
- None	No operation is performed.
- Open	Performs first erosion and then dilation. The effect is smoothing and removing of isolated pixels.
- Close	Performs first dilation and then erosion. The effect is smoothing of the objects and filling of small holes.
- Dilate	Enlarges the boundaries of segmented regions. Areas grow in size and holes within the regions become smaller.
- Erode	Erodes boundaries of the segmented regions. The areas shrink in size and holes within the areas become larger.
Count	Sets how often the selected binary operation is performed with the slider or input field.

6.3.8.3.9 Separate Section

Parameter	Description
Separate	Selects whether you want to process the image further after segmentation. Objects that are touching one another can be separated using different methods.
- None	Objects are not separated.
- Morphology	Separates objects by first reducing and then enlarging them, making sure that once objects have been separated they do not merge together again.



Parameter	Description
- <b>Watersheds</b>	Separates objects that are roughly the same shape. The result is two shapes separated by a thin 1-pixel boundary. The rest of the shape perimeter remains unchanged. This method may however result in the splitting of elongated objects.
	
<b>Count</b>	Sets the count value, which is similar to a Sigma for Gauss applied to a binary image.

#### 6.3.8.3.10 Suppress Section

Parameter	Description
<b>Suppress Invalid</b>	<b>Activated:</b> Discards invalid pixels at the border of the image.
<b>Suppress Border</b>	Only visible if <b>Variance-Based Thresholding</b> is selected. <b>Activated:</b> Suppresses the border pixels which might be incorrect, as areas outside of the image are filled with zeros. The excluded area depends on the used kernel size.

#### 6.3.8.3.11 Segmentation Method Selection Dialog

Parameter	Description
<b>Source</b>	Selects the segmentation source. Depending on the selected segmentation source, the functionalities in the <b>Image Analysis Wizard</b> change accordingly.
- <b>From Image Channel</b>	Uses the channel of the multi-channel image defined in the <b>Classes</b> step for segmentation of the selected region class.
- <b>From Measurement Frame(s)</b>	Takes the regions from the measurement frame. You can modify the region in the interactive segmentation step.
- <b>Remaining to Frame</b>	Takes the pixels within the measurement frame that are not assigned to any other class. The resulting regions are not displayed to improve performance, but the results are contained in the table and chart.
- <b>Take from Parent Regions</b>	Takes the regions that fulfill a certain condition, defined in the <b>Region Filter</b> step, from the parent regions. <b>Note:</b> This does not work for intensity features as region filter.  This option is used to distribute objects from one class into several subclasses with the use of region filters. A parent class can be segmented with any method and refined via region filters. Region filters in the subclasses define the criteria of objects to include in this subclass. Each object belongs to the first subclass of the source where it fulfills all requirements. A subclass without region filters takes all objects from the parent class. Objects that are not contained in any of the subclasses are excluded from the analysis.

Parameter	Description
<b>Method</b>	Selects the segmentation method to be applied.
- <b>Segment by Global Thresholding</b>	A global threshold is applied to the image channel for image segmentation.
- <b>Segmentation with Background Subtraction</b>	A background subtraction is performed prior to a threshold-based image segmentation.
- <b>Segment Binary Images</b>	Segments binary images.
- <b>Variance-Based Thresholding</b>	Image segmentation via variance-based thresholding. Detects objects where there is a strong change in pixel intensities independent of the absolute intensity.
- <b>Dynamic Thresholding</b>	Dynamic thresholding or adaptive thresholding calculates a local threshold for small regions of the image. This is especially helpful for inhomogeneous illumination or background structures.
- <b>Intellesis Trainable Class Segmenter</b>	Uses machine-learning algorithms to segment the selected class by applying a trained Intellesis model or an imported neural network (e.g. trained on arivis Cloud).
- <b>AI Instance Segmentation</b>	Uses an AI model for instance segmentation. You need the Docker Desktop software running on your PC and have a suitable model available, see also <i>Downloading AI Models</i> [▶ 71].

**See also**

Automatic Segmentation [▶ 254]

**6.3.8.4 Region Filter****Info****Difference in Job Mode**

The available functionality of the individual steps can differ between the wizard in **Free Mode** and the steps that can be added in **Job Mode**, e.g. the **Interactive** checkbox is not visible in **Job Mode**.

**Info****Settings based on image view**

Note that during the setup of the analysis (via **Setup Image Analysis** in **Free Mode**), the segmentation is only performed on the area visible in the viewport. Therefore, if you adapt the region filter by clicking on the objects displayed in the viewport, and select objects that are cut by the current viewport, these objects will only be segmented partially. The region filter will only be adapted based on the part of the object that is in the viewport. In case you want to select objects that exceed the viewport, we suggest to adapt the region filter values manually.

If you enter the interactive analysis or are in **Job Mode**, the image will be fully segmented during the segmentation step, and therefore it is possible to adapt the region filters by clicking on the objects in the image.

In this step you can define the region filter conditions under which you want an object to be measured.

Parameter	Description
<b>Execute</b>	<b>Activated:</b> Uses the region filters when the analysis is run.
<b>Interactive</b>	<b>Activated:</b> The region filters can be changed while the analysis setting is run.
<b>Class List</b>	Selects the class for which you want to define the filter.
<b>Select Features</b>	Opens the <b>Region Filter Editor</b> to select region filters.
<b>Copy to All</b>	Copies the defined region filters to all classes.
<b>Region Filter Blocks</b>	If you have defined one or more blocks with region filters in the <b>Region Filter Editor</b> , you can select the block for which you want to set the filter. Select the relevant block and set the maximum/minimum values either by clicking on the objects in the image you want to include in the measurement, or by entering the maximum/minimum values separately.
– <b>Feature</b>	Displays the name of the respective filter feature.
– <b>Minimum</b>	Specifies the lower threshold of the filter. If an object's property is above this value, the object is measured. If you do not want to use this threshold, deactivate the checkbox. The threshold is set to the minimum possible value (typically 0).
– <b>Maximum</b>	Defines the upper threshold of the filter. If an object's property is below this value, the object is measured. If you do not want to use this threshold, deactivate the checkbox. The threshold is set to the maximum possible value.
<b>Undo</b>	Undoes the last change made to the filter.
<b>Redo</b>	Restores the last undone change to the filter.
<b>Reset</b>	Resets all settings for the filter.

#### 6.3.8.4.1 Region Filter Editor Dialog

All features in the list of selected features are calculated during image analysis. The results are displayed in the results table for all detected objects of the same class. The columns of the features are sorted according to the order they appear in the **Selected Features** list. You can create complex rules by joining blocks using **Or** conditions. The results of the settings you set here are displayed in the result table of the last step of the wizard.

For a detailed description of the individual features, see *Measurement Features* [► 274].

Parameter	Description
<b>Selected Features</b>	Displays the features that you have selected block by block. All features in a block are <b>And</b> -linked, i.e. an object is only measured if the values of each individual feature fall within the defined range.
<b>Add Block</b>	Adds an <b>Or</b> block. If several <b>Or</b> blocks are defined, an object is measured if it meets the condition in at least one block.



Parameter	Description
<b>Clear Block</b>	Deletes all features in an <b>Or</b> block.
<b>Delete Block</b>	Deletes the selected <b>Or</b> block.
<b>Delete All</b>	Deletes all <b>Or</b> blocks.
<b>Available Features</b>	Displays the list with all available features. Double-click on the feature or click <b>+</b> to add the feature to the list of selected features on the left.
<b>Search Field</b>	Searches for features by name.
<b>Filter Dropdown</b>	Filters the list of displayed features.
- <b>All</b>	Lists all available features.
- <b>Geometric Features</b>	Lists only the subset of geometric features.
- <b>Intensity Features</b>	Lists only the subset of intensity features.
- <b>Position Features</b>	Lists only the subset of position features.
- <b>Geometric Features Unscaled</b>	Lists only the subset of unscaled geometric features.
- <b>Position Features Unscaled</b>	Lists only the subset of unscaled position features.
<b>+</b> Add	Adds the selected feature to the list of selected features on the left.
<b>OK</b>	Saves the changes and closes the dialog.

#### 6.3.8.5 Interactive Segmentation

##### Info

##### Difference in Job Mode

The available functionality of the individual steps can differ between the wizard in **Free Mode** and the steps that can be added in **Job Mode**, e.g. the **Interactive** checkbox is not visible in **Job Mode**.

In this step you can post-process the segmented objects interactively. You can modify the results of the automated segmentation when you analyze your image data. Note that during the setup of the analysis (via **Setup Image Analysis** in **Free Mode**), the segmentation is only performed on the area visible in the viewport. If you enter the interactive analysis or are in **Job Mode**, the image will be fully segmented.

Parameter	Description
<b>Interactive</b>	Not available for <b>Technical Cleanliness Analysis</b> . <b>Activated:</b> The segmented objects can be post-processed interactively while the analysis setting is run.

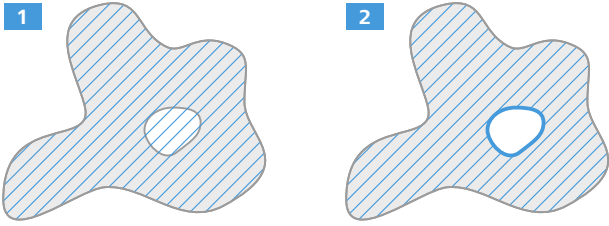
Parameter	Description
<b>Class List</b>	Not available for <b>Technical Cleanliness Analysis</b> . Selects the class whose objects you want to process.

### Edit Region section

Parameter	Description
<b>Draw</b>	Enables you to draw new objects of the selected class.
<b>Erase</b>	Enables you to erase parts of an object. While pressing the left mouse button, outline the parts of the object that you want to erase. Right-click to erase these parts of the object.
<b>Cut</b>	Enables you to separate connected objects. While pressing the left mouse button, draw in the separation line between the objects. Right-click to cut the objects.
<b>Merge</b>	Enables you to connect objects. While pressing the left mouse button, outline the parts of the object that you want to merge. Right-click to merge the objects.
<b>Fill</b>	Fills a hole. To fill a hole, left-click on the hole. If a selected object completely surrounds another potential area, then the enclosed area is also included (1). <div> </div>
<b>Remove</b>	Enables you to remove a drawn in object by clicking on it.
<b>Remove All</b>	Deletes all drawn objects.
<b>Draw Rectangle</b>	Enables you to add a rectangular object or cut a rectangular region from an object.
<b>Draw Circle</b>	Enables you to add a circular object or cut a circular region from an object.
<b>Draw Contour</b>	Enables you to add an object or cut a region from an object.
<b>Draw Contour (Spline)</b>	Enables you to add an object or cut a region from an object.
<b>Draw Active Contour</b>	Enables you to add an object or cut a region from an object.
<b>Draw Polyline Region</b>	Enables you to add a line-object.
<b>Draw Point</b>	Enables you to add a point object.

### Region Growing section

For the module **Technical Cleanliness Analysis**, only **Undo** and **Redo** are available.

Parameter	Description
<b>Mode</b>	Expands or reduces the size of an object based on the brightness of surrounding pixels
– +	Click on areas in the image you want to add to the selected object class.
– -	Click on areas in the image you want to remove from the selected object class.
<b>Intensity</b>	Sets the tolerance value for the intensity. The tolerance value specifies how much the intensity of a pixel may deviate from the average intensity of the selected object in order to still "grow" to become part of the object. A higher value means that more pixel values similar to the selected one are included. A lower value means that only the exact pixel value selected is included.
<b>Color</b>	Only active if your input image is a color image. Sets the tolerance value for the color. The tolerance value specifies how much the color value of a pixel may deviate from the average color value of the selected object in order to still "grow" to become part of the object. A higher value means that more colors similar to the selected one are displayed. A lower value means that only the exact color selected is displayed. The comparison is based on the RGB (red green blue) colorspace.
<b>Fill</b>	Fills holes that are created during region growing. <b>Activated (1):</b> If a detected object completely surrounds another potential area, then the enclosed area is also included. <b>Deactivated (2):</b> Only the detected object is included.
	
<b>Undo</b>	Undoes the last action.
<b>Redo</b>	Restores the last undone action.

### Post Processing section

Only visible for images with a size smaller than 10000 x 10000 pixel.

Parameter	Description
<b>Region Filter</b>	Reapplies the region filter you defined in the previous step to the post-processed image.

## 6.3.8.6 Features

## Info

**Difference in Job Mode**

The available functionality of the individual steps can differ between the wizard in **Free Mode** and the steps that can be added in **Job Mode**, e.g. the **Interactive** checkbox is not visible in **Job Mode**.

In this step you select the measurement features.




Parameter	Description
<b>Interactive</b>	<b>Activated:</b> The features can be changed interactively while the analysis setting is run.
<b>Class List</b>	Selects the class for which you want to define measurement features. You can specify different settings for each class.
<b>Features of Individual Regions/ Features of All Regions</b>	Displays the features for the currently selected class/all classes and allows you to select additional features.
– <b>Select</b>	Opens the dialog for feature selection.
– <b>Copy to All</b>	Copies the defined features to all other classes.
– <b>Feature</b>	Displays the feature name(s) added for the currently selected class.
– <b>Display</b>	If you activate <b>Display</b> in the feature selection dialog for a feature, the result of the measurement is displayed next to the corresponding object in the analyzed image. <b>Deactivated:</b> The measurement is performed but not displayed in the image. This prevents the image becoming cluttered.
<b>Annotations</b>	Allows you to add annotations to the image, for example to indicate areas of particular significance.
– <b>Select</b>	Opens the dialog to select or edit the image annotations.
– <b>Copy to All</b>	Copies the annotations to all other classes.
– <b>Feature</b>	Displays the names of the annotations.
<b>Annotation Options</b>	
– <b>Color</b>	<b>Activated:</b> Allows you to select the color for the region annotations.
<b>Custom Feature</b>	Opens the editor to define a custom feature, see <i>Custom Feature Editor</i> [► 271].
<b>Feature list</b>	Displays a list of all created custom features.

**See also**

📖 Creating Custom Features [► 247]

### 6.3.8.6.1 Select Features of Individual Regions Dialog




For a description of individual measurement features, see *Measurement Features* [▶ 274].

Parameter	Description
<b>Selected Features</b>	Displays all selected features that are calculated for the object during image analysis.
- <b>Name</b>	Displays the name of the respective feature.
- <b>Display</b>	<b>Activated:</b> The value of the feature for each object is displayed in the analyzed image.
- <b>Copy</b>	Only visible for <b>Classes</b> (collection of objects) and if more than one class exists. Selects where the feature is copied to. If the <b>Copy</b> column is empty, the selected feature is not copied to any result table.
-  <b>Delete</b>	Deletes the feature from the list.
-  <b>Move Up</b>	Moves the currently selected feature one position up in the list.
-  <b>Move Down</b>	Moves the currently selected feature one position down in the list.
<b>Available Features</b>	Displays the list with all available features. Double-click on the feature or click + to add the feature to the list of selected features on the left.
<b>Feature Search</b>	Here you can enter parts of the name of the feature that you are looking for. The features in which the entered character string occurs are listed.  Select a type of feature according to which you want the features to be filtered from the dropdown list.
- <b>All</b>	Lists all features.
- <b>Geometric Features</b>	Lists all geometric features.
- <b>Intensity Features</b>	Lists all features that analyze intensity values.
- <b>Image Features</b>	Lists all features that contain meta information about the measured image.
- <b>Position Features</b>	Lists all features that describe the position.
- <b>Geometric Features Unscaled</b>	Lists all features that describe unscaled geometric features.
- <b>Position Features Unscaled</b>	Lists all features that describe unscaled positions.
- <b>Polygon-based Features</b>	Lists all features polygon-based features.

Parameter	Description
<b>OK</b>	Saves the feature selection and closes the dialog.
<b>Cancel</b>	Cancels the feature selection without saving.



#### 6.3.8.6.2 Select Features of All Regions Dialog

For a description of individual measurement features, see *Measurement Features* [▶ 274].

Parameter	Description
<b>Selected Features</b>	Displays all selected features that are calculated for the object during image analysis.
- <b>Name</b>	Displays the name of the respective feature.
- <b>Display</b>	<b>Activated:</b> The value of the feature for each object is displayed in the analyzed image.
- <b>Copy</b>	Only visible for <b>Classes</b> (collection of objects) and if more than one class exists. Selects where the feature is copied to. If the <b>Copy</b> column is empty, the selected feature is not copied to any result table.
-  <b>Delete</b>	Deletes the feature from the list.
-  <b>Move Up</b>	Moves the currently selected feature one position up in the list.
-  <b>Move Down</b>	Moves the currently selected feature one position down in the list.
<b>Available Features</b>	Displays the list with all available features. Double-click on the feature or click + to add the feature to the list of selected features on the left.
<b>Feature Search</b>	Here you can enter parts of the name of the feature that you are looking for. The features in which the entered character string occurs are listed.  Select a type of feature according to which you want the features to be filtered from the dropdown list.
- <b>All</b>	Lists all features.
- <b>Geometric Features</b>	Lists all geometric features.
- <b>Intensity Features</b>	Lists all features that analyze intensity values.
- <b>Image Features</b>	Lists all features that contain meta information about the measured image.
- <b>Position Features</b>	Lists all features that describe the position.

Parameter	Description
- <b>Geometric Features Un-scaled</b>	Lists all features that describe unscaled geometric features.
- <b>Position Features Un-scaled</b>	Lists all features that describe unscaled positions.
<b>OK</b>	Saves the feature selection and closes the dialog.
<b>Cancel</b>	Cancels the feature selection without saving.

#### 6.3.8.6.3 Custom Feature Editor

Parameter	Description
<b>Custom Features</b>	Displays a list of the created custom features.
- <b>Name</b>	Displays the name of the created custom feature.
- <b>+ Add</b>	Adds a new custom feature that can be defined with the options on the right side.
-  <b>Delete</b>	Deletes the currently selected feature.
<b>Define Custom Feature</b>	
- <b>Name</b>	Defines the name of the feature.
- <b>Unit</b>	Specifies the unit of the feature as free text input. This input is optional.
<b>Define Operands</b>	Displays and defines the operands used for the calculation of the custom feature.
- <b>Operand</b>	Displays the name of the operand.
- <b>Class</b>	Selects the class that is used for the definition of the operand. For a single region class, also the classes of the children can be selected.
- <b>Feature</b>	Displays all available predefined measurement features for the selected class and selects which measurement feature should be used for the definition of the current operand. If you activate the checkbox behind the selection dropdown, the selected feature is also set visible in the result table.
- <b>Expression</b>	Displays the expression of the <b>Operand(s)</b> defined by the <b>Class</b> and <b>Feature</b> selection.
- <b>+ Add</b>	Adds a new operand to the list.
-  <b>Delete</b>	Deletes the currently selected operand.
<b>Define Custom Expression</b>	Defines the mathematical calculation of the feature, using the <b>Operands</b> and mathematical operators, e.g. <b>100*(a/b+Math.Pow(c,2))</b> .

Parameter	Description
– +	Adds the mathematical operator for summation to the calculation.
– -	Adds the mathematical operator for subtraction to the calculation.
– *	Adds the mathematical operator for multiplication to the calculation.
– /	Adds the mathematical operator for division to the calculation.
– <b>Pow</b>	Adds the mathematical operator to calculate the power of a certain base value. Note that this operator requires two input values (the base and power value) separated by a comma, e.g. <b>Math.Pow (2,3)</b> , which corresponds to $2^3$ .
– <b>Sqrt</b>	Adds the mathematical operator to calculate the square root of a value.
– <b>Abs</b>	Adds the mathematical operator to return the absolute number, i.e. non negative values.
– <b>PI</b>	Adds a mathematical operator for Pi.
<b>Verify Expression</b>	Checks the syntax of the <b>Expression</b> .
<b>OK</b>	Adds the defined custom features and closes the dialog.
<b>Cancel</b>	Closes the dialog without saving the changes.

### See also


 Creating Custom Features [▶ 247]

#### 6.3.8.7 Statistics

In this step you can define custom statistical features for your regions or objects.



Parameter	Description
<b>Interactive</b>	<b>Activated:</b> The features can be changed interactively while the analysis setting is run.
<b>Classes List</b>	Selects the class for which you want to define the custom statistical feature(s).
<b>Define Custom Feature</b>	Opens the editor to define a custom statistical feature.
<b>Custom Statistic Feature List</b>	Displays the created custom statistical features.
– <b>Name</b>	Displays the name of the feature.

### See also

 Creating Custom Statistical Features [▶ 248]





## 6.3.8.7.1 Custom Statistical Feature Editor

Parameter	Description
<b>Custom Features</b>	Displays a list of the created custom features.
– <b>Name</b>	Displays the name of the created custom statistical feature.
– <b>+ Add</b>	Adds a new custom feature that can be defined with the options on the right side.
–  <b>Delete</b>	Deletes the currently selected feature.
<b>Define Custom Feature</b>	
– <b>Name</b>	Defines the name of the feature.
– <b>Unit</b>	Specifies the unit of the feature as free text input. This input is optional.
<b>Define Operands</b>	Displays and defines the operands used for the calculation of the feature.
– <b>Operand</b>	Displays the name of the operand.
– <b>Class</b>	Selects the class that is used for the definition of the operand. For a single region class, also the classes of the children can be selected.
– <b>Feature</b>	Displays all available predefined measurement features for the selected class and selects which measurement feature should be used for the definition of the current operand. If you activate the checkbox behind the selection dropdown, the selected feature is also set visible in the result table.
– <b>Statistical Operation</b>	Selects the statistical operation used for the current operand, e.g. <b>Mean, Min, Max, Sum</b> and <b>Count</b> .
– <b>Expression</b>	Displays the expression of the <b>Operand</b> defined by the <b>Class</b> and <b>Feature</b> selection.
– <b>+ Add</b>	Adds a new operand to the list.
–  <b>Delete</b>	Deletes the currently selected operand.
<b>Define Custom Expression</b>	Defines the mathematical calculation of the statistical feature, using the <b>Operands</b> and mathematical operators, e.g. <b>100*(a/b+Math.Pow(c,2))</b> .
– <b>+</b>	Adds the mathematical operator for summation to the calculation.
– <b>-</b>	Adds the mathematical operator for subtraction to the calculation.
– <b>*</b>	Adds the mathematical operator for multiplication to the calculation.
– <b>/</b>	Adds the mathematical operator for division to the calculation.

Parameter	Description
– <b>Pow</b>	Adds the mathematical operator to calculate the power of a certain base value. Note that this operator requires two input values (the base and power value) separated by a comma, e.g. <b>Math.Pow (2,3)</b> , which corresponds to $2^3$ .
– <b>Sqrt</b>	Adds the mathematical operator to calculate the square root of a value.
– <b>Abs</b>	Adds the mathematical operator to return the absolute number, i.e. non negative values.
– <b>PI</b>	Adds a mathematical operator for Pi.
<b>Verify Expression</b>	Checks the syntax of the <b>Expression</b> .
<b>OK</b>	Adds the defined custom statistical features and closes the dialog.
<b>Cancel</b>	Closes the dialog without saving the changes.

### See also

-  Creating Custom Statistical Features [▶ 248]
-  Creating Custom Features [▶ 247]

#### 6.3.8.8 Results Preview

In this step you see a preview of the measurement results. The results table contains only the measurements performed in the current view port. These results may differ from the actual results when the complete image analysis is performed. This increases the performance during the setup.

The results in the table depend on the settings you made in the **Feature** step. The table contains all selected features for the highlighted class/classes. Click on a row of the table to highlight the corresponding object in the image or vice versa.

The following controls are only available in **Free Mode**:

Parameter	Description
<b>Class List</b>	Select the class for which you want to see the measured features.
<b>Highlight Box</b>	
– <b>Color</b>	Sets the color of the highlight box surrounding the selected object in the image.
– <b>Line Width</b>	Sets the line width of the highlight box around the selected object in the image.

#### 6.3.9 Measurement Features

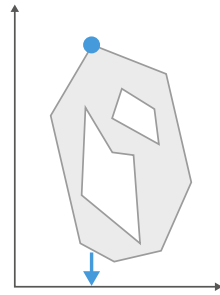
The software can automatically detect and measure various properties of objects.

Some general terms relevant for several feature descriptions are the following:

- **Filled**: A measurement feature with **Filled** in its name takes the entire region for the respective calculation, i.e. any holes the region might contain are included in the calculation.

- **Unscaled:** For features that are titled as **Unscaled**, the scaling of the image is not taken into account for the measurement. The values returned by these features have the unit pixel.

ACP X Un-scaled

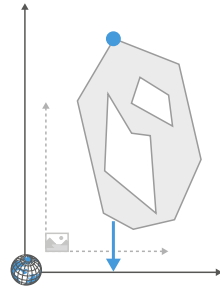


The x coordinate of the first pixel in the first line of a region

To identify measurement objects, the image is scanned from top left to bottom right. The so-called ACP (anti-coincidence point) is the first point that has been identified for a new object. The parameter **Acp X** indicates the x-coordinate of this point.

- Unit: pixels
- Value range: 1 ... image size in x-direction

ACP X Un-scaled WCS

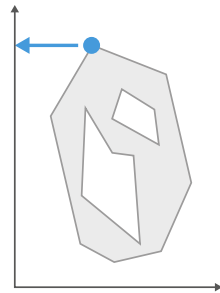


The x coordinate of the first pixel in the first line of a region

To identify measurement objects, the image is scanned from top left to bottom right. The so-called ACP (anti-coincidence point) is the first point that has been identified for a new object. The parameter **Acp X** indicates the x-coordinate of this point in the world coordinate system (WCS).

- Unit: pixels
- Value range: 1 ... image size in x-direction

ACP Y Un-scaled

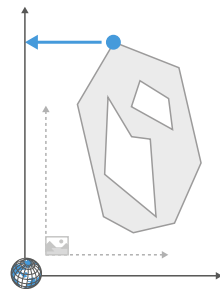


The y coordinate of the first pixel in the first line of a region

To identify measurement objects, the image is scanned from top left to bottom right. The so-called ACP (anti-coincidence point) is the first point that has been identified for a new object. The parameter **Acp Y** indicates the y-coordinate of this point.

- Unit: pixels
- Value range: 1 ... image size in y-direction

ACP Y Un-scaled WCS

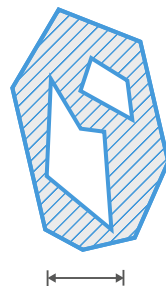


The y coordinate of the first pixel in the first line of a region

To identify measurement objects, the image is scanned from top left to bottom right. The so-called ACP (anti-coincidence point) is the first point that has been identified for a new object. The parameter **Acp Y** indicates the y-coordinate of this point in the world coordinate system (WCS).

- Unit: pixels
- Value range: 1 ... world coordinate size in y-direction

Area



Area of a region

Area of a region excluding any holes it may contain. The areas of the holes are not included in the measurement. If you want to include them, use the **Area filled** parameter.

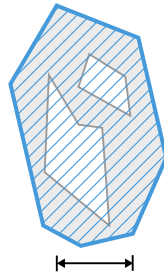
- Unit: Unit of area of the scaling assigned to the image (e.g.  $\mu\text{m}^2$ )

Area Convex

Area of convex hull of a region

The current region is surrounded by a convex polyline. The (filled!) area of the resulting region is then measured.

## Area Filled



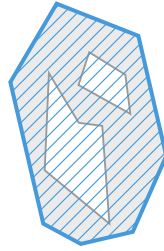
- Unit: Unit of area of the scaling assigned to the image (e.g.  $\mu\text{m}^2$ )

## Area of filled region

Area of a region including any holes it contains. The holes are interpreted as belonging to the region or are filled prior to the measurement. If you do not want the holes to be measured, use the **Area** parameter.

- Unit: Unit of area of the scaling assigned to the image (e.g.  $\mu\text{m}^2$ )

## Area Filled Unscaled



## Area of filled region

Area of a region including any holes it contains. The holes are interpreted as belonging to the region or are filled prior to the measurement. If you do not want the holes to be measured, use the **Area** parameter.

- Unit: pixels<sup>2</sup>

## Area Frame

Returns the area of the measurement frame used in the image. If a ROI is defined in the **Frame** step of the wizard, this area is displayed, otherwise the area of the entire image is indicated.

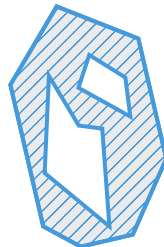
- Unit:  $\mu\text{m}^2$

## Area Frame Unscaled

Returns the area of the measurement frame used in the image. If a ROI is defined in the **Frame** step of the wizard, this area is displayed, otherwise the area of the entire image is indicated.

- Unit: pixels

## Area Un-scaled



## Area of a region unscaled

The **Area unscaled** parameter corresponds to the **Area** parameter. However, the scaling of the image is not taken into account for the measurement. The (unfilled!) area of a region is displayed in pixels in each case.

- Unit: pixels<sup>2</sup>

## Bound Back

Indicates the back coordinate (highest value in z-direction) of the bounding box of a region. The box is drawn in parallel to the x, y and z axis.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

## Bound Back Unscaled

Indicates the back coordinate (highest value in z-direction) of the unscaled bounding box of a region. The box is drawn in parallel to the x, y and z axis.

- Unit: pixels

## Bound Back Unscaled WCS

Indicates the back coordinate (highest value in z-direction) of the unscaled bounding box of a region in the world coordinate system (WCS). The box is drawn in parallel to the x, y and z axis.

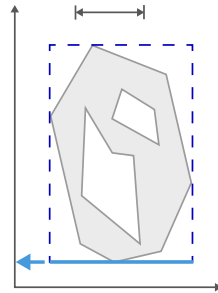
- Unit: pixels

Bound Back  
WCS

Indicates the back coordinate (highest value in z-direction) of the bounding box of a region in the world coordinate system (WCS). The box is drawn in parallel to the x, y and z axis.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Bound Bot-  
tom

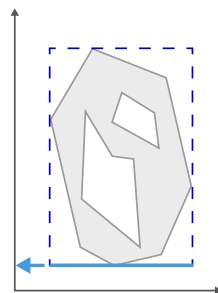


Minimum y-coordinate of the bounding box of a region

Indicates the y-coordinate of the bottom edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Bound Bot-  
tom Unscaled

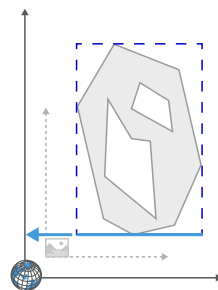


Minimum y-coordinate of the bounding box of a region

Indicates the y-coordinate of the bottom edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: pixels

Bound Bot-  
tom Unscaled  
WCS

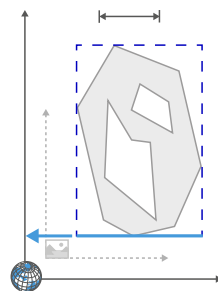


Minimum y-coordinate of the bounding box of a region

Indicates the y-coordinate in the world coordinate system (WCS) of the bottom edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: pixels

Bound Bot-  
tom WCS



Minimum y-coordinate of the bounding box of a region

Indicates the y-coordinate in the world coordinate system (WCS) of the bottom edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Bound Center  
X/Y/Z

Indicates the x, y or z coordinate of the center of the bounding box for a region.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Bound Center  
X/Y/Z Un-  
scaled

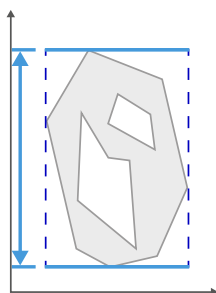
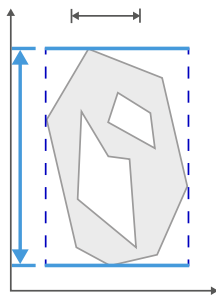
Indicates the x, y or z coordinate of the unscaled center of the bounding box for a region.

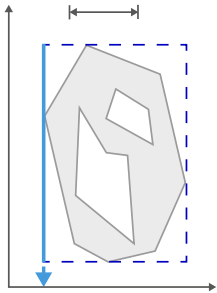
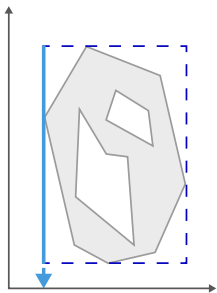
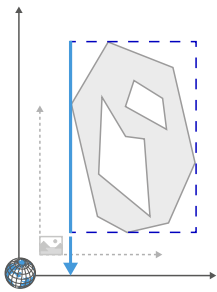
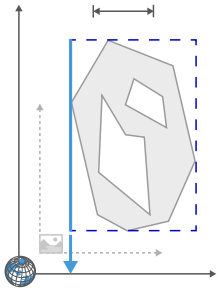
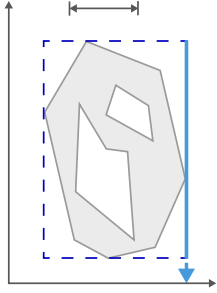
- Unit: pixels

Bound Center  
X/Y/Z Un-  
scaled WCS

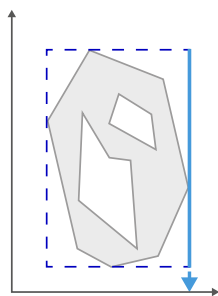
Indicates the x, y or z coordinate of the unscaled center of the bounding box for a region in the world coordinate system (WCS).

	<ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Bound Center X/Y/Z WCS	<p>Indicates the x, y or z coordinate of the center of the bounding box for a region in the world coordinate system (WCS).</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Bound Depth	<p>Indicates the depth of the bounding box of a region, i.e. the "length" of the bounding box in z.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Bound Depth Unscaled	<p>Indicates the depth of the unscaled bounding box of a region, i.e. the "length" of the bounding box in z.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Bound Front	<p>Indicates the front coordinate (smallest value in z-direction) of the bounding box of a region. The box is drawn in parallel to the x, y and z axis.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Bound Front Unscaled	<p>Indicates the front coordinate (smallest value in z-direction) of the unscaled bounding box of a region. The box is drawn in parallel to the x, y and z axis.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Bound Front Unscaled WCS	<p>Indicates the front coordinate (smallest value in z-direction) of the unscaled bounding box of a region in the world coordinate system (WCS). The box is drawn in parallel to the x, y and z axis.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Bound Front WCS	<p>Indicates the front coordinate (smallest value in z-direction) of the bounding box of a region in the world coordinate system (WCS). The box is drawn in parallel to the x, y and z axis.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Bound Height	<p>Indicates the height (size in y-direction) of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> <li>Formula: Bound top - Bound bottom</li> </ul>
Bound Height Unscaled	<p>Indicates the height (size in y-direction) of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> <li>Formula: Bound top - Bound bottom</li> </ul>



Bound Left		<p>Minimum x-coordinate of the bounding box of a region</p> <p>Indicates the x coordinate of the left-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Bound Left Unscaled		<p>Minimum x-coordinate of the bounding box of a region</p> <p>Indicates the x coordinate of the left-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Bound Left Unscaled WCS		<p>Minimum x-coordinate of the bounding box of a region</p> <p>Indicates the x coordinate in the world coordinate system (WCS) of the left-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Bound Left WCS		<p>Minimum x-coordinate of the bounding box of a region</p> <p>Indicates the x coordinate in the world coordinate system (WCS) of the left-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Bound Right		<p>Maximum x-coordinate of the bounding box of a region</p> <p>Indicates the x coordinate of the right-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>

Bound Right  
Unscaled

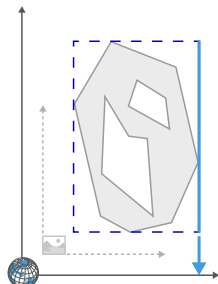


Maximum x-coordinate of the bounding box of a region

Indicates the x coordinate of the right-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: pixels

Bound Right  
Unscaled  
WCS

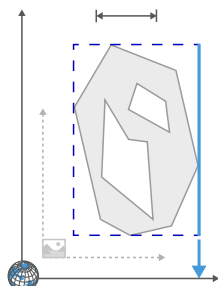


Maximum x-coordinate of the bounding box of a region

Indicates the x coordinate in the world coordinate system (WCS) of the right-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: pixels

Bound Right  
WCS

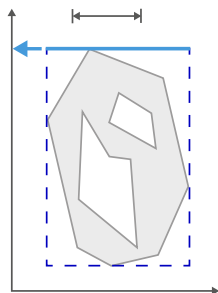


Maximum x-coordinate of the bounding box of a region

Indicates the x coordinate in the world coordinate system (WCS) of the right-hand edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Bound Top

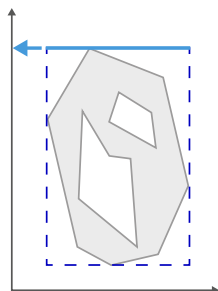


Maximum y-coordinate of the bounding box of a region

Indicates the y coordinate of the top edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Bound Top  
Unscaled

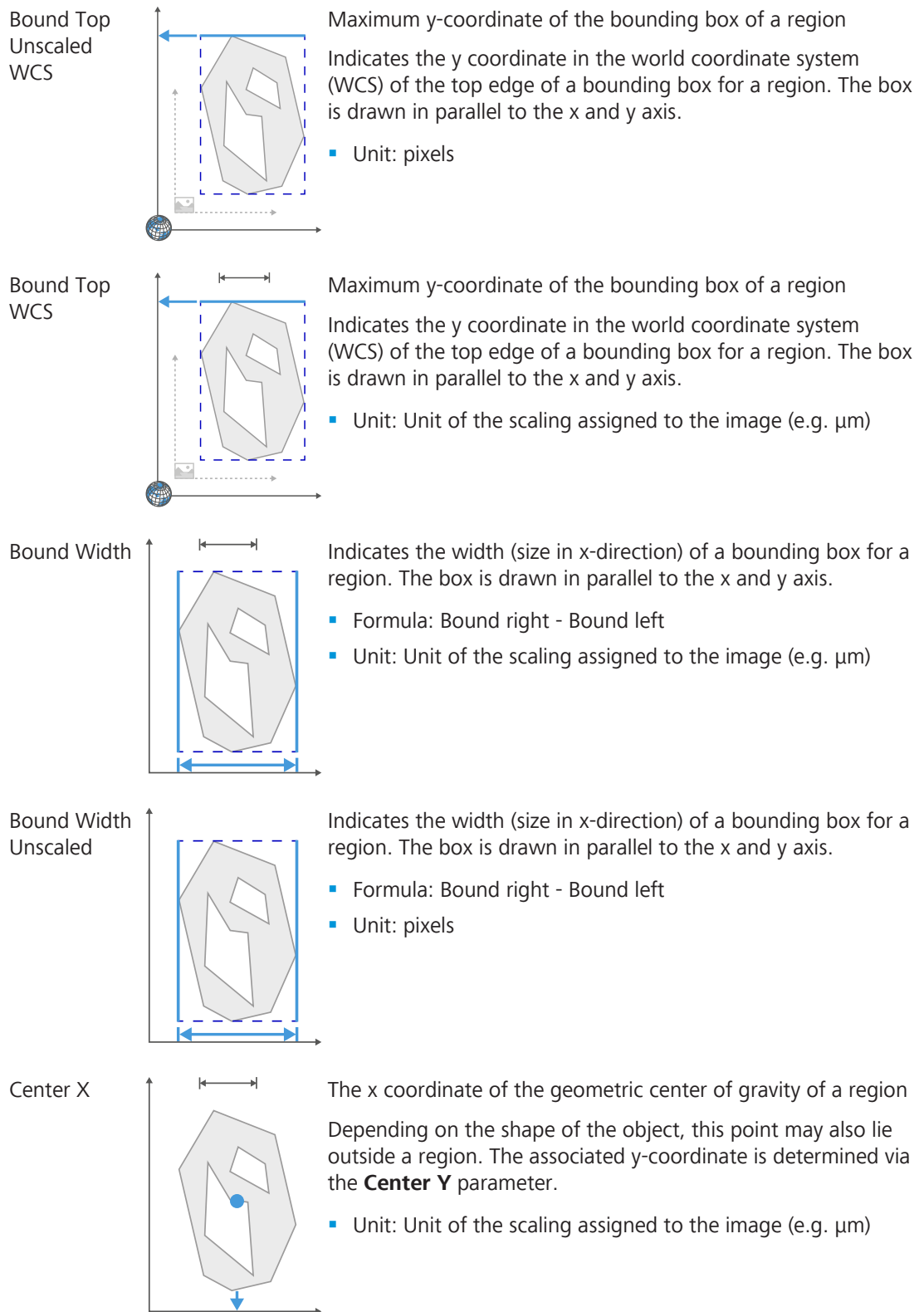


Maximum y-coordinate of the bounding box of a region

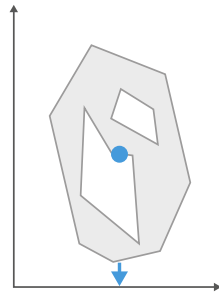
Indicates the y coordinate of the top edge of a bounding box for a region. The box is drawn in parallel to the x and y axis.

- Unit: pixels





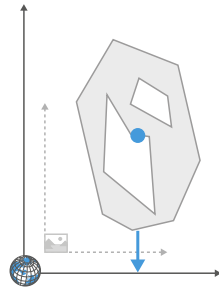
Center X Un-scaled



The x coordinate of the geometric center of gravity of a region  
Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the **Center Y** parameter.

- Unit: pixels

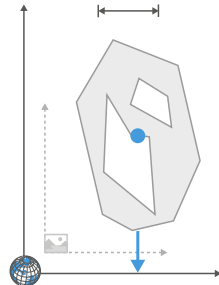
Center X Un-scaled WCS



The x coordinate in the world coordinate system (WCS) of the geometric center of gravity of a region  
Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the **Center Y** parameter.

- Unit: pixels

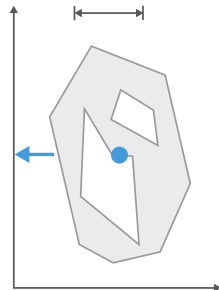
Center X WCS



The x coordinate in the world coordinate system (WCS) of the geometric center of gravity of a region  
Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the **Center Y** parameter.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

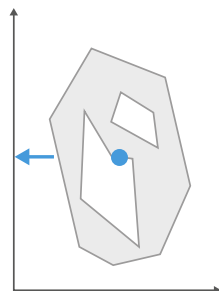
Center Y



The y coordinate of the geometric center of gravity of a region  
Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the **Center X** parameter.

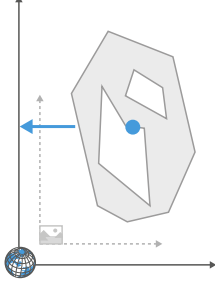
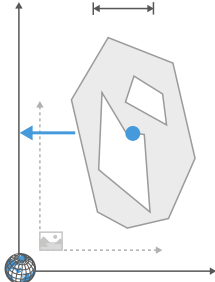
- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Center Y Un-scaled



The y coordinate of the geometric center of gravity of a region  
Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the **Center X** parameter.

- Unit: pixels

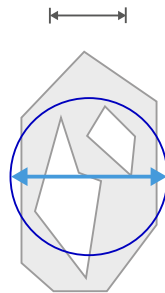
Center Y Un-scaled WCS	 <p>The y coordinate in the world coordinate system (WCS) of the geometric center of gravity of a region</p> <p>Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the <b>Center X</b> parameter.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Center Y WCS	 <p>The y coordinate in the world coordinate system (WCS) of the geometric center of gravity of a region</p> <p>Depending on the shape of the object, this point may also lie outside a region. The associated y-coordinate is determined via the <b>Center X</b> parameter.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Center Z	<p>Indicates the z coordinate of the geometric center of gravity of a region.</p> <p>Depending on the shape of the object, this point can also lie outside a region. The associated x and y coordinates are determined by the <b>Center X</b> and <b>Center Y</b> features.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Center Z Un-scaled	<p>Indicates the z coordinate of the unscaled geometric center of gravity of a region.</p> <p>Depending on the shape of the object, this point can also lie outside a region. The associated x and y coordinates are determined by the <b>Center X Unscaled</b> and <b>Center Y Unscaled</b> features.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Center Z Un-scaled WCS	<p>Indicates the z coordinate of the unscaled geometric center of gravity of a region in the world coordinate system (WCS).</p> <p>Depending on the shape of the object, this point can also lie outside a region. The associated x and y coordinates are determined by the <b>Center X Unscaled WCS</b> and <b>Center Y Unscaled WCS</b> features.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Center Z WCS	<p>Indicates the z coordinate of the geometric center of gravity of a region in the world coordinate system (WCS).</p> <p>Depending on the shape of the object, this point can also lie outside a region. The associated x and y coordinates are determined by the <b>Center X WCS</b> and <b>Center Y WCS</b> features.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Circularity	$\text{Sqrt(Roundness)} = \text{Sqrt}(4 \times \text{Area} / (\pi \times \text{FeretMax}^2))$
Compactness	$4 \times \pi \times \text{Area} / \text{PerimeterConvex}^2$

Convexity

PerimeterConvex / PerimeterCrofton

Count per  
mm<sup>2</sup>Returns the count of analyzed objects per mm<sup>2</sup>.

Diameter

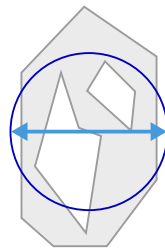


Diameter of a circle/sphere with an area/volume equal to that of the object.

The object is measured using the **Area** feature. A circle with the same area as the object is created. The diameter of this circle is returned.

In case of a three dimensional analysis, the equivalent sphere with the **Volume** of the region is measured and the diameter of the sphere is returned.

- Formula 2D:  $\text{Sqrt}((4/\pi) * \text{Area})$
- Formula 3D:  $\text{Pow}(6 * \text{Volume} / \pi, 1/3)$
- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Diameter Un-  
scaled

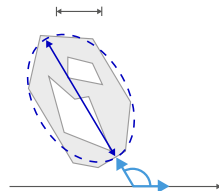
Unscaled diameter of a circle/sphere with an area/volume equal to that of the object.

The object is measured using the **Area Unscaled** feature. A circle with the same area as the object is created. The diameter of this circle is returned.

In case of a three dimensional analysis, the equivalent sphere with the **Volume Unscaled** of the region is measured and the diameter of the sphere is returned.

- Formula 2D:  $\text{Sqrt}((4/\pi) * \text{Area})$
- Formula 3D:  $\text{Pow}(6 * \text{Volume} / \pi, 1/3)$
- Unit: pixels

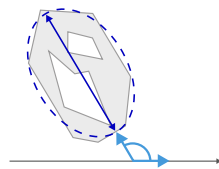
Ellipse Angle



Angle of the major axis of the ellipse

The major axis of an ellipse with the same geometric moment of inertia as the current region is determined in accordance with the **Ellipse major** parameter. The angle to the x-axis is then determined. The indication of the angle always relates to a counterclockwise direction.

- Unit: degrees
- Value range: 0 ... 180°

Ellipse Angle  
Unscaled

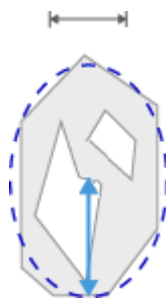
Angle of the major axis of the ellipse

The major axis of an ellipse with the same geometric moment of inertia as the current region is determined in accordance with the **Ellipse major** parameter. The angle to the x-axis is then determined. The indication of the angle always relates to a counterclockwise direction.

- Unit: degrees
- Value range: 0 ... 180°

This tool uses unscaled pixels for calculating the angle. The results may differ from the results of Ellipse Angle.

Ellipse Semi-Major



Length of the semi-major axis of the ellipse.

Length of the semi-major axis of an ellipse with the same geometric moment of inertia as the region. The moment of inertia is calculated about the center of gravity of the region.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Ellipse Semi-Major Un-scaled



Length of the semi-major axis of the ellipse.

Length of the semi-major axis of an ellipse with the same geometric moment of inertia as the region. The moment of inertia is calculated about the center of gravity of the region.

- Unit: pixels

Ellipse Semi-Minor



Length of the semi-minor axis of the ellipse.

Length of the semi-minor axis of an ellipse with the same geometric moment of inertia as the region. The moment of inertia is calculated about the center of gravity of the region.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Ellipse Semi-Minor Un-scaled



Length of the semi-minor axis of the ellipse.

Length of the semi-minor axis of an ellipse with the same geometric moment of inertia as the region. The moment of inertia is calculated about the center of gravity of the region.

- Unit: pixels

Ellipsoid Semi-Major



Calculates the length of the semi-major axis of the equivalent ellipsoid of the region.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Ellipsoid Semi-Major Unscaled



Calculates the length of the semi-major axis of the equivalent unscaled ellipsoid of the region.

- Unit: pixels

### Ellipsoid Semi-Mean

Calculates the length of the semi-mean axis of the equivalent ellipsoid of the region, i.e. half the length of the medium/middle axis of the three dimensional ellipsoid.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

### Ellipsoid Semi-Mean Unscaled

Calculates the length of the semi-mean axis of the equivalent unscaled ellipsoid of the region, i.e. half the length of the medium/middle axis of the three dimensional ellipsoid.

- Unit: pixels

### Ellipsoid Semi-Minor



Calculates the length of the semi-minor axis of the equivalent ellipsoid of the region.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

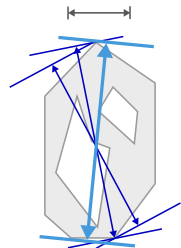
### Ellipsoid Semi-Minor Unscaled



Calculates the length of the semi-minor axis of the equivalent unscaled ellipsoid of the region.

- Unit: pixels

### Feret Maxi- mum

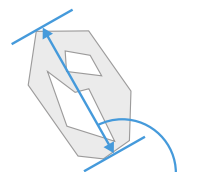


Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

### Feret Maxi- mum Angle

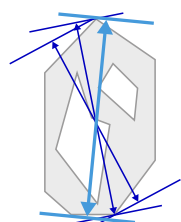


Angle of the maximum feret of a region in relation to the x-axis

The maximum feret is determined as described in **Feret Maximum**. The angle of the maximum feret in relation to the x-axis is then determined. The indication of the angle always relates to a counterclockwise direction.

- Unit: degrees
- Value range: 0 ... 180°

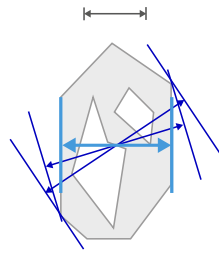
### Feret Maxi- mum Un- scaled



Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

## Feret Minimum

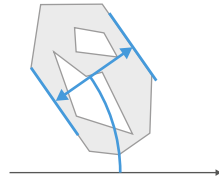


- Unit: pixels

## Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

## Feret Minimum Angle



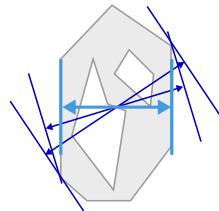
- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

## Angle of the minimum feret of a region in relation to the x-axis

The minimum feret is determined as described in **Feret Minimum**. The angle of the minimum feret in relation to the x-axis is then determined. The indication of the angle always relates to a counterclockwise direction.

- Unit: degrees
- Value range: 0 ... 180°

## Feret Minimum Un-scaled

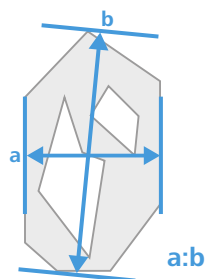


## Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: pixels

## Feret Ratio



## Feret ratio

The ratio of **Feret Minimum** to **Feret Maximum** is calculated. This ratio makes it possible to make statements on the form of the measured objects. If the feret ratio has a low value, long, elongated objects are present. Values approaching 1 indicate the presence of compact or circular objects, as in this case **Feret Minimum** and **Feret Maximum** have very similar values. The **Form circle** is also suitable for making statements on the circularity of an object.

- Formula: FeretMin / FeretMax (a / b)
- Unit: none
- Value range: 0 ... 1

## Feret Vertical to Maximum

The feret perpendicular to the maximum feret of a region.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

## Fiber Length

## Length of a fiber-like region

To calculate the fiber length, a structure that is actually similar to a fiber is required. Here it is not the distance between a start and end point that is determined. The check can be done using the **Form circle**, among other things.

- Formula:  $\frac{1}{4} \times (\text{Perimeter} + (\text{Sqrt}(\text{Perimeter}^2 - 16 \times \text{Area}))$
- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

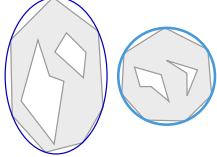
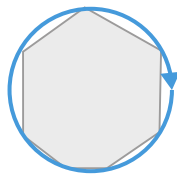
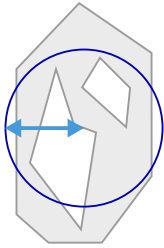
Fiber Length Unscaled	Length of a fiber-like region  To calculate the fiber length, a structure that is actually similar to a fiber is required. Here it is not the distance between a start and end point that is determined. The check can be done using the <b>Form circle</b> , among other things.  <ul style="list-style-type: none"> <li>Formula: <math>\frac{1}{4} \times (\text{Perimeter1} + (\text{Sqrt}(\text{Perimeter1}^2 - 16 \times \text{Area})))</math></li> <li>Unit: pixels</li> </ul>
Form Circle	 Form factor of a region  Describes the form of a region on the basis of its circularity. A perfect circle is given the value 1. The more elongated the region is, the smaller the form factor. The calculation is based on the <b>Area filled</b> and <b>Perimeter Crofton</b> parameters.  <ul style="list-style-type: none"> <li>Formula: <math>4 \times \pi \times \text{Area} / \text{PerimeterCrofton}^2</math></li> <li>Unit: none</li> <li>Value range: 0...1</li> </ul>
ID	Sequential ID of the object
ID Object Storage	Returns the ID of the segmented object that is saved in the object store.
ID of the Parent	Sequential ID of the object's parent
Image Acquisition Time	Returns the time stamp (date and time) of the image acquisition. This value is not equivalent to the time stamp of the image file, i.e. it does not change when saving, copying, re-saving the image files. It is formatted according to the settings of the operating system, e.g. mm/dd/yyyy would be typical in US based systems, whereas dd/mm/yyyy would be typical in EU based systems.
Image Channel Name	Indicates the name of the channel as selected by the user.
Image Container Category	Returns the container category (e.g. sample, control) of the current scene (well).
Image Focus Position	Indicates the position of the z-motor (in $\mu\text{m}$ ) at the time of image acquisition.
Image Height	Returns the total distance across the y-axis of the image, i.e. the height of the image.  <ul style="list-style-type: none"> <li>Unit: <math>\mu\text{m}</math></li> </ul>
Image Height Unscaled	Returns the total distance across the y-axis of the image, i.e. the height of the image.  <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>
Image Index Block	Index for the individual image slices of a multi-block image.  Multi-block images are composed of blocks of different dimensions.



Image Index Position	<p>Index for the individual image slices of a <b>Position List</b> image.</p> <p>If the image was acquired using the <b>Position List</b> tool, the <b>Image Index Position</b> returns the number of the image that contains the object.</p> <p>In contrast, the <b>ID</b> parameter is a global counter, i.e. the number of the object.</p> <p>The <b>Index Position</b> can be used to guarantee unambiguous assignment between measured regions in the image and the individual lines of a data table, especially in cases where several images are measured, as automatic assignment is then no longer possible. To achieve this, the <b>Index Region</b> parameter must also be selected as a region feature and also be inserted into the graphics plane as an annotation (Draw Features). It is also advisable to activate the <b>Image name</b> parameter as a region feature so that the correct original image can be reloaded.</p> <ul style="list-style-type: none"> <li>■ Restriction: This value is only available for images that have previously been acquired with AxioVision or saved in AxioVision ZVI format.</li> </ul>
Image Index Scene	<p>Index for the individual image slices of a scene image.</p> <p>Indicates the unambiguous number of the scene in an image. The word <b>Scene</b> refers to a coherent object on a slide that contains several objects for examination. The <b>Index Scene</b> can be used to guarantee unambiguous assignment between measured regions in the image and the individual lines of a data table, especially in cases where several images are measured, as automatic assignment is then no longer possible. To achieve this, the <b>Index Region</b> parameter must also be selected as a region parameter and must also be inserted into the graphics plane as an annotation (Draw Features). It is also advisable to activate the <b>Image name</b> parameter as a region parameter so that the correct original image can be reloaded.</p>
Image Index Time	Returns the time point (frame) in which the object was segmented.
Image Index Z	Returns the z-section (slice) at which an object was segmented.
Image Name	Returns the file name of the image.
Image Scene Name	Returns the name of the scene (well).
Image Width	<p>Returns the total distance across the x-axis of the image, i.e. the width of the image.</p> <ul style="list-style-type: none"> <li>■ Unit: <math>\mu\text{m}</math></li> </ul>
Image Width Unscaled	<p>Returns the total distance across the x-axis of the image, i.e. the width of the image.</p> <ul style="list-style-type: none"> <li>■ Unit: pixels</li> </ul>

Index	A running number of the object, in the order it was measured on the image. This is different from ID, which is a global identifier in the sense that it takes also into account the ID of the Classes Collections (i.e. the topmost "Classes" has the ID 1, and the "Base" has ID 0, and therefore the first detected object of the first class starts with 2). The index instead starts at 1 for every region, referring to the order of appearance of an object.
Intensity Maximum of channel "C1"	The pixel value of the brightest pixel in the object.
Intensity Mean Value of channel "C1"	The average brightness (pixel value) of the pixels in the object.
Intensity Min- imum of channel "C1"	The pixel value of the darkest pixel in the object.
Intensity Range of channel "C1"	The difference between the pixel value of the brightest and darkest pixels in the object, i.e. <b>Intensity Maximum of channel "C1"-Intensity Minimum of channel "C1"</b> .
Intensity Standard De- viation of channel "C1"	The standard deviation of the brightness (pixel value) of the pixels in the object.
Number of the region holes	Calculates the number of holes enclosed by the object.
Perimeter	<p>Perimeter of a region</p> <p>This parameter is specially optimized for measuring the perimeters of circles. If the measured region contains holes, the total perimeter including the perimeters of the hole structures is determined. If you only want the perimeter of the outside contour to be determined, use the <b>Perimeter filled</b> parameter.</p> <ul style="list-style-type: none"> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Perimeter Un- scaled	<p>Perimeter of a region</p> <p>This parameter is specially optimized for measuring the perimeters of circles. If the measured region contains holes, the total perimeter including the perimeters of the hole structures is determined. If you only want the perimeter of the outside contour to be determined, use the <b>Perimeter filled</b> parameter.</p> <ul style="list-style-type: none"> <li>Unit: pixels</li> </ul>



Radius	<p>Radius of a circle/sphere with an area/volume equal to that of the object.</p> <p>The object is measured using the <b>Area</b> feature. A circle with the same area as the object is created. The radius of this circle is returned.</p> <p>In case of a three dimensional analysis, the equivalent sphere with the <b>Volume</b> of the region is measured and the radius of the sphere is returned.</p> <ul style="list-style-type: none"> <li>Formula 2D: <math>\text{Sqrt}((1/\pi) * \text{Area})</math></li> <li>Formula 3D: <math>0.5 * \text{Pow}(6 * \text{Volume} / \pi, 1/3)</math></li> <li>Unit: Unit of the scaling assigned to the image (e.g. <math>\mu\text{m}</math>)</li> </ul>
Radius Un-scaled	 <p>Radius of a circle/sphere with an area/volume equal to that of the object.</p> <p>The object is measured using the <b>Area Unscaled</b> feature. A circle with the same area as the object is created. The radius of this circle is returned.</p> <p>In case of a three dimensional analysis, the equivalent sphere with the <b>Volume Unscaled</b> of the region is measured and the radius of the sphere is returned.</p> <ul style="list-style-type: none"> <li>Formula 2D: <math>\text{Sqrt}((1/\pi) * \text{Area})</math></li> <li>Formula 3D: <math>0.5 * \text{Pow}(6 * \text{Volume} / \pi, 1/3)</math></li> <li>Unit: pixels</li> </ul>
Region Class Color	Returns the color of the class to which the object is assigned
Region Class ID	Returns the ID of the region class which is assigned to the object according to the class tree.
Region Class Name	Returns the name of the region class to which the object is assigned and that was defined in the <b>Classes</b> step of the wizard.
Region Class Name Parent	Returns the name of the parent class to which the object is assigned and that was defined in the <b>Classes</b> step of the wizard.
Roundness	<p>Calculates a value for the roundness (between 0 and 1) of the region based on the <b>Area</b> and the <b>Feret Maximum</b> (FerretMax) features. In case of a three dimensional analysis, the roundness value is calculated based on the <b>Volume</b> feature of the region.</p> <ul style="list-style-type: none"> <li>Formula 2D: <math>4 * \text{Area} / (\pi * \text{FerretMax}^2)</math></li> <li>Formula 3D: <math>6 * \text{Volume} / (\pi * \text{FerretMax}^3)</math></li> </ul>
Sphericity	<p>Calculates and returns the value for sphericity of a region.</p> <p>Formula: <math>6 * \text{Sqrt}(\pi) * \text{Volume} / (\text{SurfaceArea} * \text{Sqrt}(\text{SurfaceArea}))</math></p>
Surface Area	<p>Calculates the surface area of a region excluding any holes it may contain. The areas of the holes are not included in the measurement. If you want to include them, use the <b>Surface Area Filled</b> feature.</p> <ul style="list-style-type: none"> <li>Unit: Based on the unit of the scaling assigned to the image (e.g. <math>\mu\text{m}^2</math>)</li> </ul>

Surface Area Filled	<p>Calculates the surface area of a region including any holes it contains. The holes are interpreted as if they belong to the region or are filled prior to the measurement. If you do not want the holes to be measured, use the <b>Surface Area</b> feature.</p> <ul style="list-style-type: none"> <li>Unit: Based on the unit of the scaling assigned to the image (e.g. <math>\mu\text{m}^2</math>)</li> </ul>
Surface Area Filled Un-scaled	<p>Calculates the surface area of an unscaled region including any holes it contains. The holes are interpreted as if they belong to the region or are filled prior to the measurement. If you do not want the holes to be measured, use the <b>Surface Area Un-scaled</b> feature.</p> <ul style="list-style-type: none"> <li>Unit: pixels<sup>2</sup></li> </ul>
Surface Area Unscaled	<p>Calculates the surface area of an unscaled region excluding any holes it may contain. The areas of the holes are not included in the measurement. If you want to include them, use the <b>Surface Area Filled Unscaled</b> feature.</p> <ul style="list-style-type: none"> <li>Unit: pixels<sup>2</sup></li> </ul>
Volume	<p>Calculates the volume of a region.</p> <ul style="list-style-type: none"> <li>Unit: Based on the unit of the scaling assigned to the image (e.g. <math>\mu\text{m}^3</math>)</li> </ul>
Volume Frame	<p>Calculates the volume of the measurement frame used in the image. If a ROI is defined in the <b>Frame</b> step of the wizard, this area is displayed, otherwise the volume of the entire image area is returned.</p> <ul style="list-style-type: none"> <li>Unit: Based on the unit of the scaling assigned to the image (e.g. <math>\mu\text{m}^3</math>)</li> </ul>
Volume Frame Un-scaled	<p>Calculates the unscaled volume of the measurement frame used in the image. If a ROI is defined in the <b>Frame</b> step of the wizard, this area is displayed, otherwise the volume of the entire image area is returned.</p> <ul style="list-style-type: none"> <li>Unit: pixels<sup>3</sup></li> </ul>
Volume Percentage	<p>Calculates the percentage of the volume of the regions according to the frame volume.</p>
Volume Un-scaled	<p>Calculates the volume of an unscaled region.</p> <ul style="list-style-type: none"> <li>Unit: pixels<sup>3</sup></li> </ul>

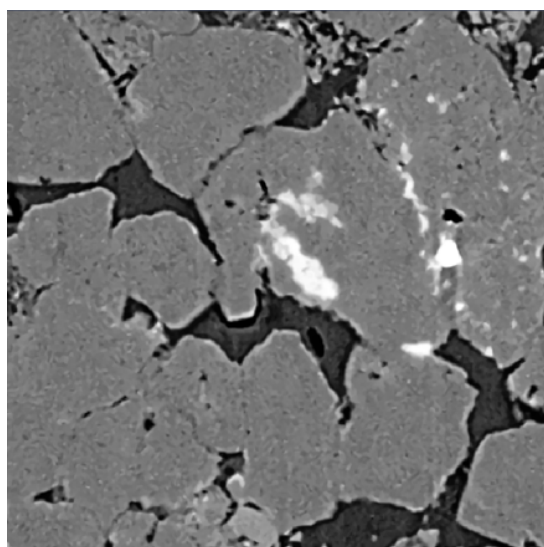
## 6.4 Intellesis

This module enables you to use machine-learning algorithms for segmenting images using pixel-classification. It uses different feature extractors to classify pixels inside an image based on the training data and the labeling provided by the user. There are a variety of use cases because the functionality itself is "data-agnostic", meaning it can be used basically with every kind of image data.

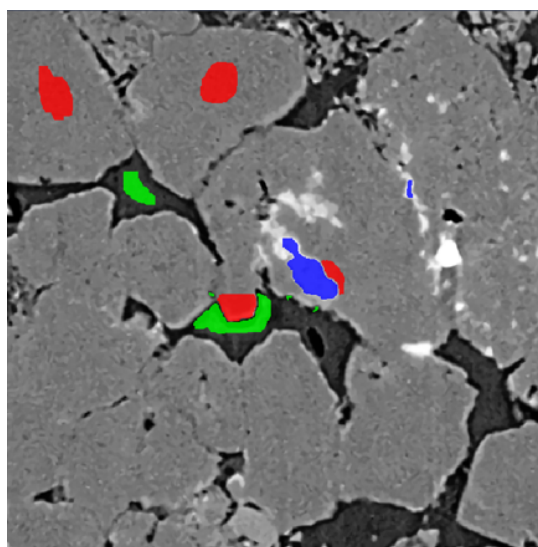
The extension has the following main functionality:

- Any user can intuitively perform image segmentation without advanced training by simply labeling what shall be segmented.
- Import of any image format readable by the software, incl. **CZI**, **OME-TIFF**, **TIFF**, **JPG**, **PNG** and **TXM** (special import required).
- Creation of pre-defined image analysis settings (\*.czias) using machine-learning based segmentation that can be used inside the ZEN measurement framework.
- Integration of the Trainable Segmentation processing function within the OAD environment.

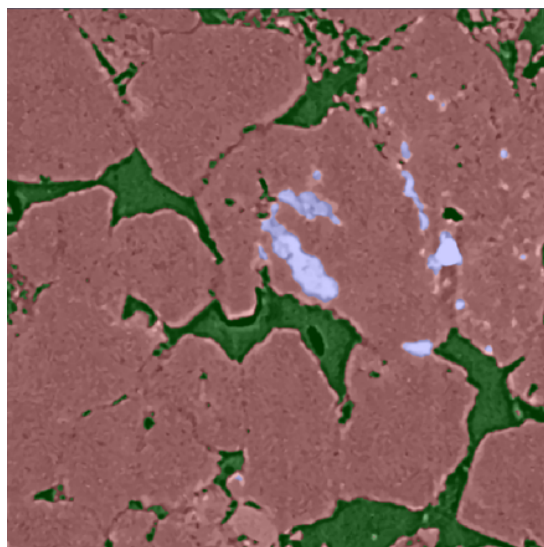
**Application** XRM (X-Ray Microscopy) image from sand stone showing the main steps when working with the  
**Example:** **Intellesis Trainable Segmentation** module.



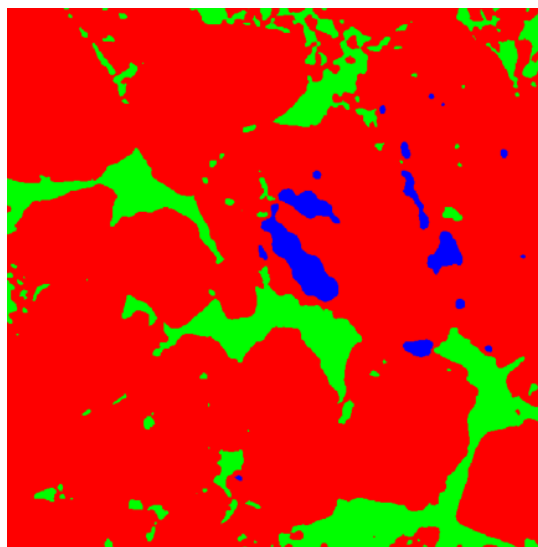
1 Original Image



2 Labeled Image

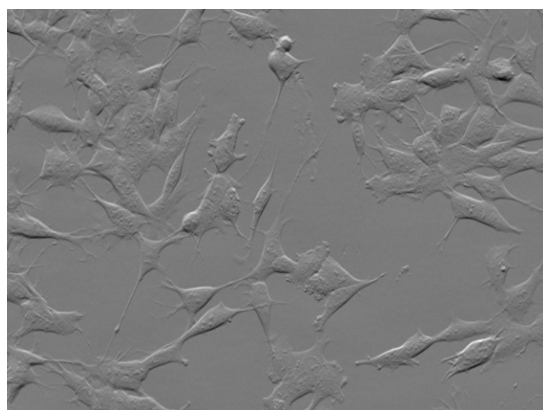


3 Overlay of Original Image and Segmentation Result

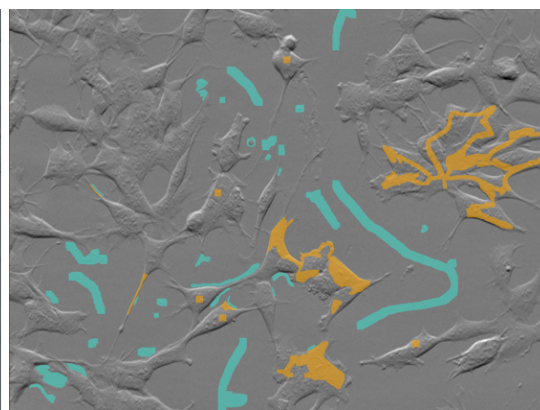


4 Segmented Image

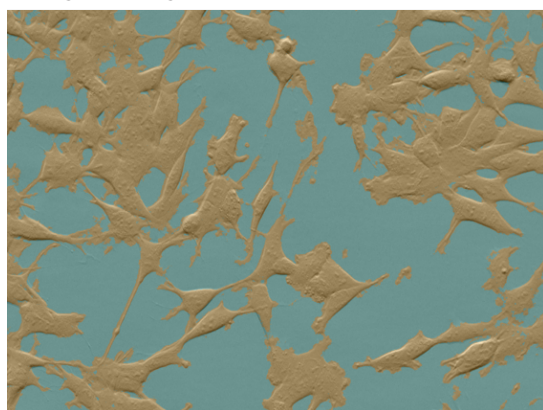
**Application** Cells image with Phase Gradient Contrast on the Celldiscoverer 7 and segmented using **Intellesis**  
**Example:** **Trainable Segmentation**.



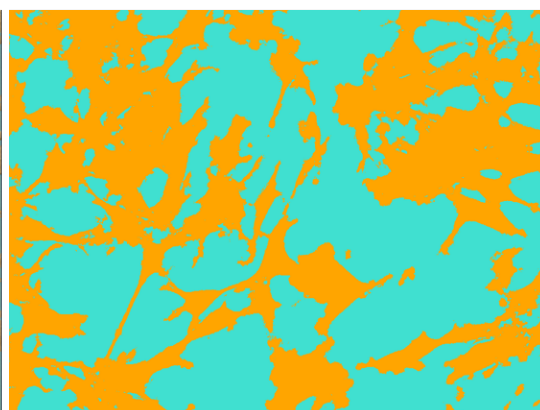
1 Original Image



2 Labeled Image



3 Overlay of Original Image and Segmentation Result



4 Segmented Image

**Note:**

The training of **Intellesis** models is CPU/GPU specific. A model trained on GPU only runs on a GPU machine. If a model trained on GPU is transferred to a CPU-only machine, the model has to be re-trained to run on this machine.

### 6.4.1 Workflow Overview

**ZEN Intellesis Trainable Segmentation** offers three main workflows. The general workflows and the basic steps involved are shown inside the diagram.

- Labeling and Training your images -> results in a **Trained Model**.
- Using the Trained Model to segment images -> results in **Binary Masks**.
- Using the Trained Model for image analysis -> results in classified pixel for subsequent segmentation and measurements of objects.



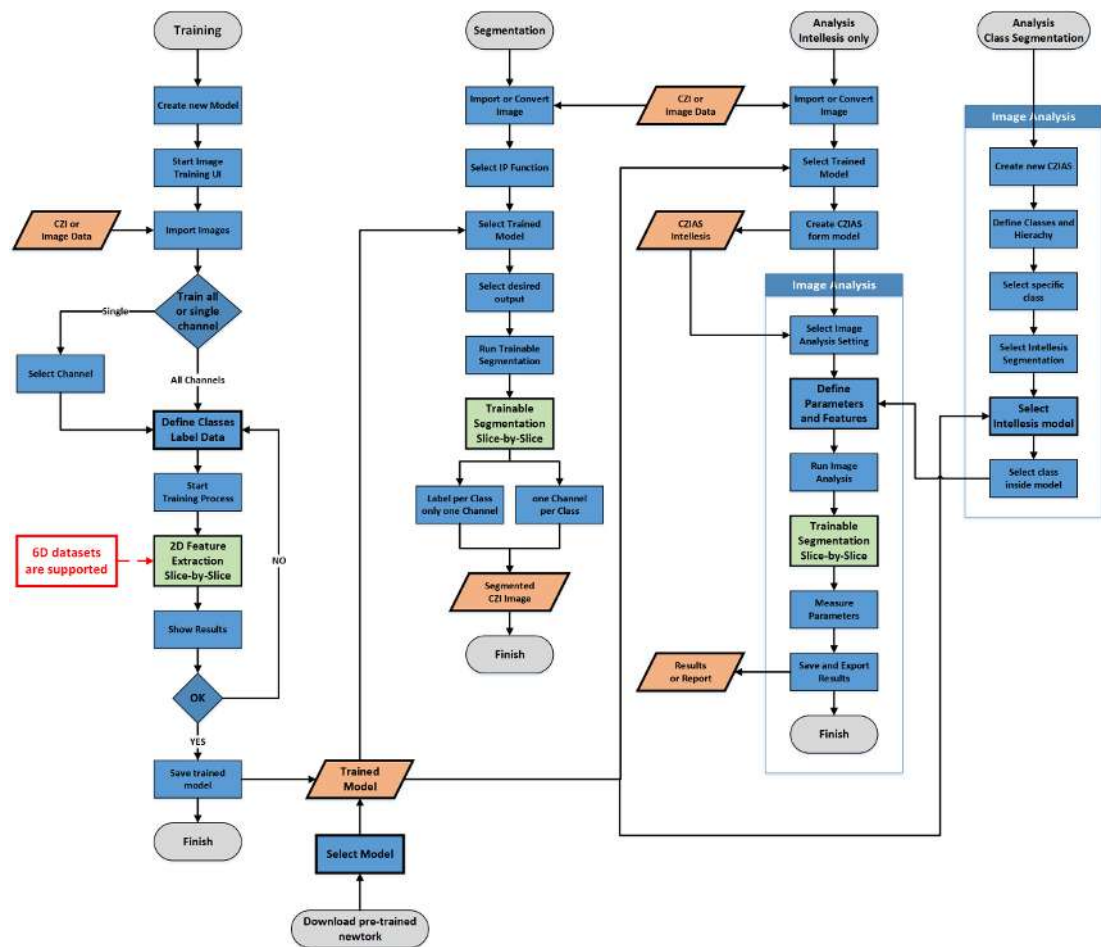


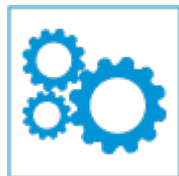
Fig. 10: Process description of the Intellesis workflow

## 6.4.2 Operating Concept

The operating concept can be generally split in three parts:



### Training



### Processing



### Analyzing

The **Training User Interface** which is accessed via **Manage Templates > Intellesis Models**. Within the training user interface you can label the images to be used as input for training a specific model, see *User Interface - Training* [▶ 297].

The **Image Processing (IP) function Intellesis Trainable Segmentation**, which can be used to segment images resulting in binary masks. Those masks can be used in subsequent ZEN workflows, such as 2D or 3D analytics or they can be exported for further use in external 3rd party software packages. You will find more details under *Using a Trained Model for Image Processing* [▶ 309].

The automatic creation of **Image Analysis (IA) settings (\*.czias)**, which allows to use a trained model for automated segmentation and measurement of image data within the ZEN **Image Analysis Wizard**. To familiarize with the basic steps take a look at our step-by-step guide in the chapter *Using a Trained Model for Image Analysis* [▶ 308].

### 6.4.3 FAQ/Terminology

Question/Term	Description
Machine Learning	The <b>Intellesis Trainable Segmentation</b> module uses machine learning to automatically identify objects within an image according to a pre-defined set of rules (the model). This enables any microscopy user to perform image segmentation even on complex data sets without programming experience or advanced knowledge on how to set up an image segmentation.
What is a "Model" ?	<p>A model is a collection of rules according to which the software attributes the pixels to a class. Such a class is mutually exclusive for a given pixel, i.e. a pixel can only belong to one class. The model is the result of (repeated) labeling and training a subset of the data. After the model is trained (the labels provided by the user were used to "train" the classifier), it can be applied to the full data set in image processing or it can be used to create an image analysis setting (*.czias) to be used with the ZEN image analysis module.</p> <p>In image processing the trained model can be applied to an image or data set and perform segmentation automatically. As result you will get two images, the segmented image on the one hand and a confidence map on the other.</p>
What is a "Class" ?	<p>A class is a group of objects (consisting of individual pixels) with similar features. According to the selected model the pixels of the image will be attributed as belonging to a certain class, e.g. cell nuclei, inclusions in metals, etc.</p> <p>Every model has by default already two classes built-in, because at least two classes are needed (e.g. cells and background or steel and inclusions). Of course, more classes can be defined if necessary.</p>
What is "Labeling" ?	Instead of using a series of complex image processing steps in order to extract the features of the image, you just need to label some objects in the image that belong to the same class. Based on this manual labeling the software will attribute the pixels of the image as belonging to a certain class. In order to refine the result, you can re-label wrongly attributed pixels to assign them to another class.
What is "Training" ?	<p>During the training process (within the training user interface) you can repeatedly label structures as belonging to one class, run the training, check if the result matches your expectation and if necessary refine the labeling in order to improve the result. The result is a trained model (a set of rules) which produce the desired result when applied to the training data.</p> <p>With the labeled pixels and their classes a classifier will be trained. The classifier will then try to automatically assign single pixels to classes.</p>
Training UI (User Interface)	The user interface for training is the starting point of the automatic image segmentation process. Here you import images, label and train the model which you can later use for automatic image segmentation. Within this interface you can load the training data, define the classes of objects found in your data and train the classifier to assign the objects to the correct classes.
What is "Segmenting" or "Segmentation"?	In general segmentation is the combination of pixels of the same class within an image. Before you can perform segmentation the segmentation model has to be trained. Within the Training UI you train the



Question/Term	Description
	<p>software by labeling specific objects or structures that belong to different classes. A pseudo-segmentation is performed each time you train the model so that you see if the feature extractor works for your image.</p> <p>One output of the <b>Intellesis Trainable Segmentation</b> processing function is the fully segmented image or data set using the trained model. The second output is the confidence map.</p>
Confidence Map	<p>The confidence map is one of two resulting images when you apply a trained model to an image by using the processing function <b>Intellesis Trainable Segmentation</b>.</p> <p>The (resulting) grayscale image encodes the reliability of the segmentation. Areas which can be addressed to a certain class with a high confidence will appear bright, whereas areas which have a lower confidence to belong to a certain class will appear dark. The confidence is represented by a percentage value, where 0 means "Not confident at all" (dark) and 100 "Very confident" (bright).</p>
What is a "Feature"?	A feature is a specific property of an image, that will be calculated by using a pre-defined set of filters and processing functions. This process results a so-called "Feature Vector" for every pixel. This is the information that will be used for training the model.
What is a "Feature Extractor"?	A feature extractor is a pre-defined set of processing functions that is used to create the feature vector for every pixel. A specific layer of a pre-trained neuronal network can be used as feature extractor as well.
Prediction	When the model that was trained on example data is applied to a new unlabeled data set the result is called a prediction.
Multi-Channel Images	<p>The <b>Intellesis Trainable Segmentation</b> module supports multi-channel data sets. It is important to understand that in case of multi-channel images every pixel can still only belong to one class, i. e. the classes are mutually exclusive.</p> <p>The additional information of having more than one intensity value per pixel (e.g. one for every channel) is also used for classification.</p> <p><b>Example:</b> If you have overlapping regions A and B in the image you want to classify, consider labeling three independent classes:</p> <ul style="list-style-type: none"> <li>▪ Class 1: A</li> <li>▪ Class 2: B</li> <li>▪ Class 3: A overlapping with B</li> </ul> <p>If you want to segment an individual channel from a multi-channel image, use the <b>Create Subset</b> IP function first to extract the desired channel.</p>

#### 6.4.4 User Interface - Training

The user interface for training a model is accessed via **Home Screen > Manage Templates**. Under **Show** select **Intellesis Models** to edit an existing model or to create a new model for training. Once a model is available in the list, double-click on it to open the Training user interface.

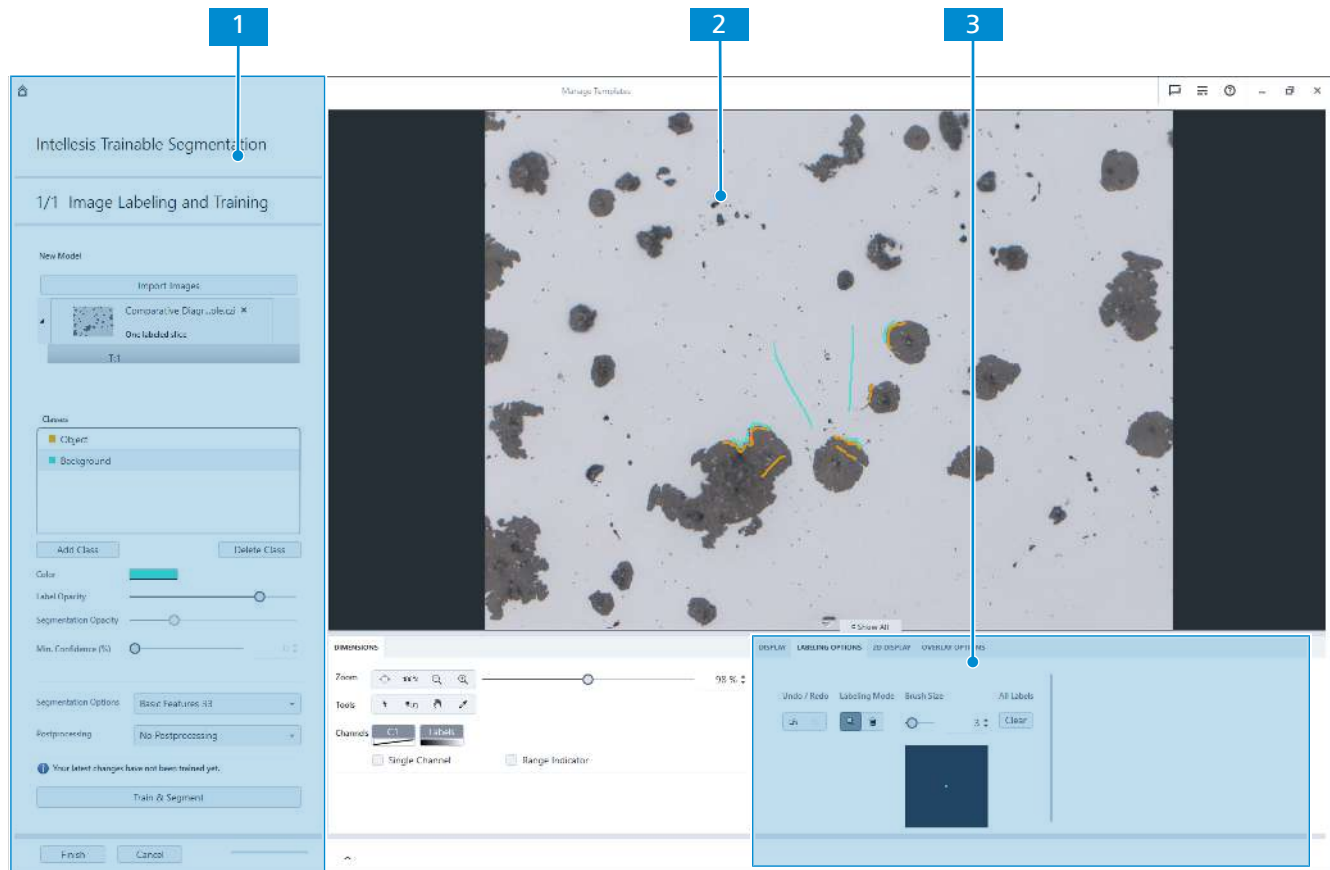


Fig. 11: User Interface for Training

### 1 Image Labeling and Training

Here you can load the desired images for training, set up the required classes and select the options for segmentation.

You can also change the label opacity and the segmentation opacity there by adjusting the corresponding sliders. Opacity determines to what degree it obscures or reveals labels or segmentation. Opacity of 1% appears nearly transparent, whereas 100% opacity appears completely opaque. Additionally, you can hide all segmented pixels where the confidence value is below a certain threshold set by the **Min. Confidence (%)** slider.

With the different parameters of the **Segmentation** options and the **Postprocessing** options it is possible to further improve the results of the training and the (pseudo-)segmentation. The **Train & Segment** button starts the automatic training algorithm and then performs the pseudo-segmentation of the defined classes in the image.

### 2 Image Area

Here you can add, delete and select a class and then start the labeling.

When you are inside the image, the actual brush size for labeling is represented by a square. If the brush size is very small, the square is changed into a dotted circle with a small point inside.

### 3 Labeling Options

Here you can adjust certain parameters like **Labeling Mode** (Draw or Delete) or **Brush Size**. To switch the **Labeling Mode**, you can also use the shortcut **Ctrl + D**.

**Info**

When you use images with large X/Y dimensions, e.g. large tile images, the segmentation will be only performed on a subset of the whole image in order to avoid long waiting periods. The current image subset maximum size in X/Y is 5000 pixels and is centered on the current view port. Nevertheless all labels inside the complete image will be used for training, but the segmentation preview (pseudo-segmentation) will be only applied to that subset.

**6.4.4.1 Segmentation Options**

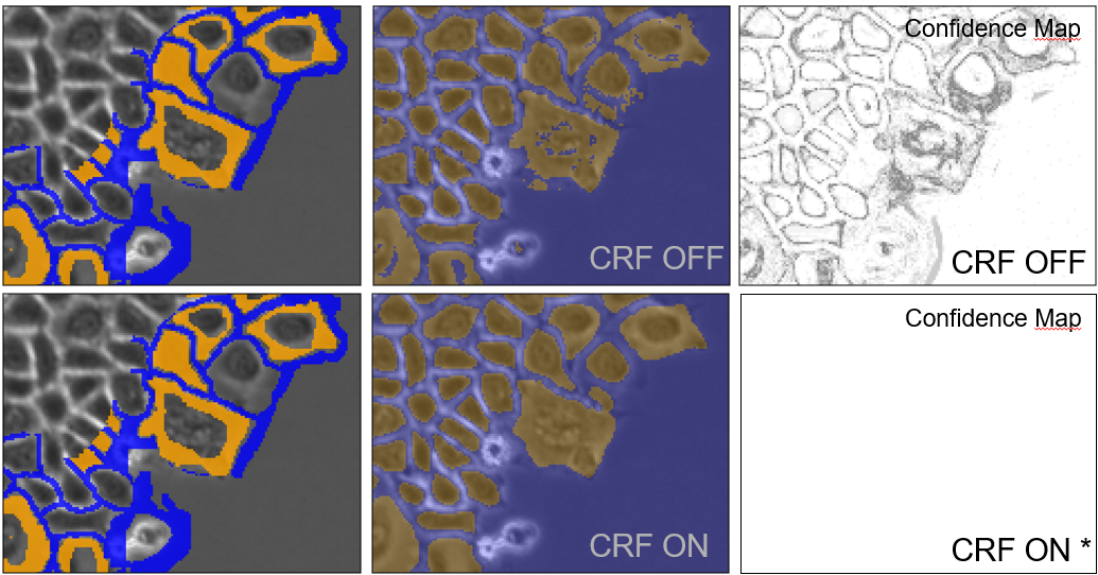
Parameter	Description
<b>Basic Features 25</b>	A pre-defined feature set using 25 features.
<b>Basic Features 33</b>	A pre-defined feature set using 33 features.
<b>Deep Features 50</b> <b>Deep Features 64</b> <b>Deep Features 70</b> <b>Deep Features 128</b> <b>Deep Features 256</b>	The complete or reduced feature set from either the 1st, 2nd or 3rd layer of a pre-trained network is used to extract the respective number of features. For more information see <i>Feature Extractors</i> [▶ 314] or the <a href="#">respective Zeiss Github page</a> .

**Info**

For the selection of the parameters note the following:  
There is no "right" selection. We recommend to always try different parameters for the same image to see which one works best.

**6.4.4.2 Postprocessing Options**

Parameter	Description
<b>No Postprocessing</b>	This parameter is set by default. No further postprocessing will be applied on the images.
<b>Conditional Random Field (CRF)</b>	<p>If selected, this post processing function is applied to the output of the pixel classification. This can improve the segmentation results, depending on your sample. The CRF algorithm tries to create smoother and shaper borders between objects by re-classifying pixels based on confidence levels in their neighborhood.</p> <p><b>Note:</b> If CRF is activated, the returned confidence map does not reflect the outcome of the majority votes of all decision trees of a specific class anymore. Therefore, a map containing only ones will be returned when the CRF postprocessing option is activated.</p>



6.4.4.3 Labeling Options

Parameter	Description
Undo/Redo	If you click on the arrows, you can undo/redo the last actions you have performed.
Labeling Mode	Here you can select between labeling and erase mode. To switch the Labeling Mode, you can also use the shortcut <b>Ctrl + D</b> .
Brush Size	Here you can set the brush size of the labeling or erasing tool. Note that the brush size can be changed alternatively by holding the <b>Ctrl</b> key and using the mouse wheel (when the cursor is inside the image area).
All Labels	If you click on <b>Clear</b> , all labels in the active image will be deleted.

6.4.4.4 Image Import Section

In the top left you find the area for handling the images to be used for training. Here you can load and select the images you want to use for training. When you click on a loaded image, the image will be visible in the **Image Area**.

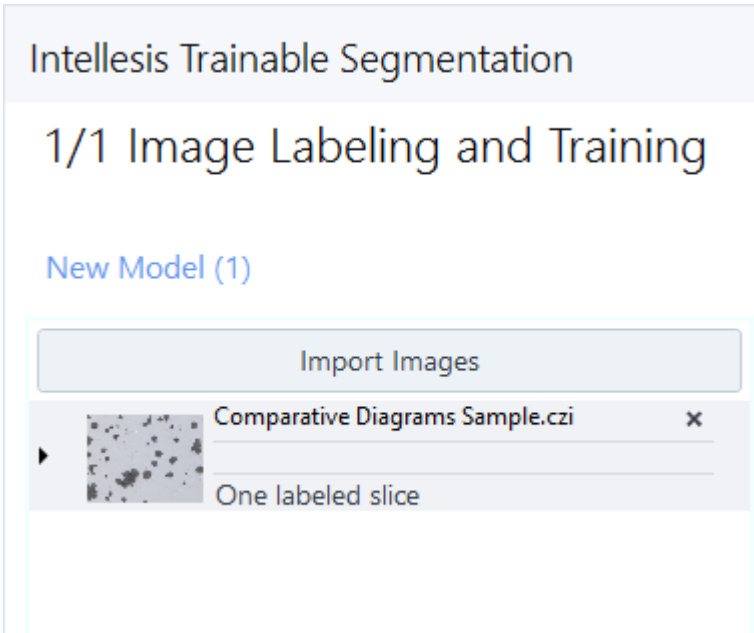


Fig. 12: Image Import & Handling

In the list of images you have certain possibilities to gain advanced information about the image. If you load a new image only the preview image, file name and type of image are displayed.

As soon as you have started to label an image of a larger data set, a small arrow appears on the left side of the preview image. If you click on the arrow, a list of the images that contain labels will be displayed, containing dimension and image number (e.g. for a Z-stack, Z:400 indicates that the slice number 400 contains labels).

If you click on this information, the corresponding image will be automatically displayed in the center screen area. This is very helpful when you are working with large data sets such as z-stacks, scenes or time-series and you want to quickly load the image you have already labeled.

6.4.4.5 Select Channel Dialog

This dialog is only displayed if a multi-channel image is imported.


Parameter	Description
<b>Training Mode</b>	Here you can select the mode for training.
– <b>Single Channel</b>	Only one channel of the image is imported for training. Such models trained on one channel can only be used inside the <b>Image Analysis Wizard</b> for the <b>Intellesis Class Segmenter</b> .
– <b>Multispectral</b>	All channels of the image are imported for training.
<b>Select Channel</b>	Only visible if <b>Single Channel</b> is chosen as the training mode. In the drop-down list you can choose the channel you want to import for training.
<b>OK</b>	Confirms the settings and imports the image accordingly.
<b>Cancel</b>	Cancels the image import and closes the dialog.

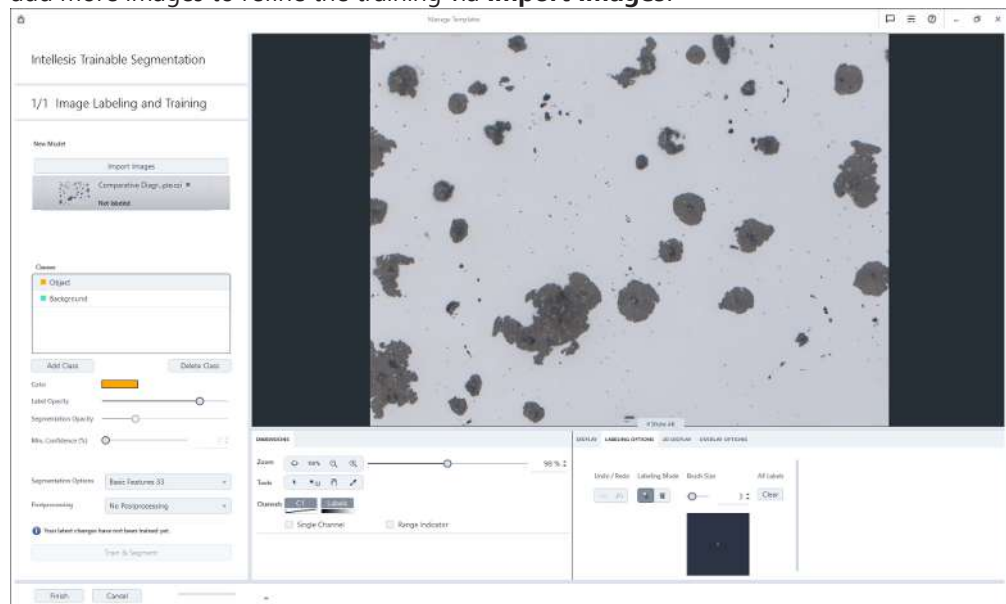
### 6.4.5 Creating a New Model

#### Info



##### For a good training result always note the following:

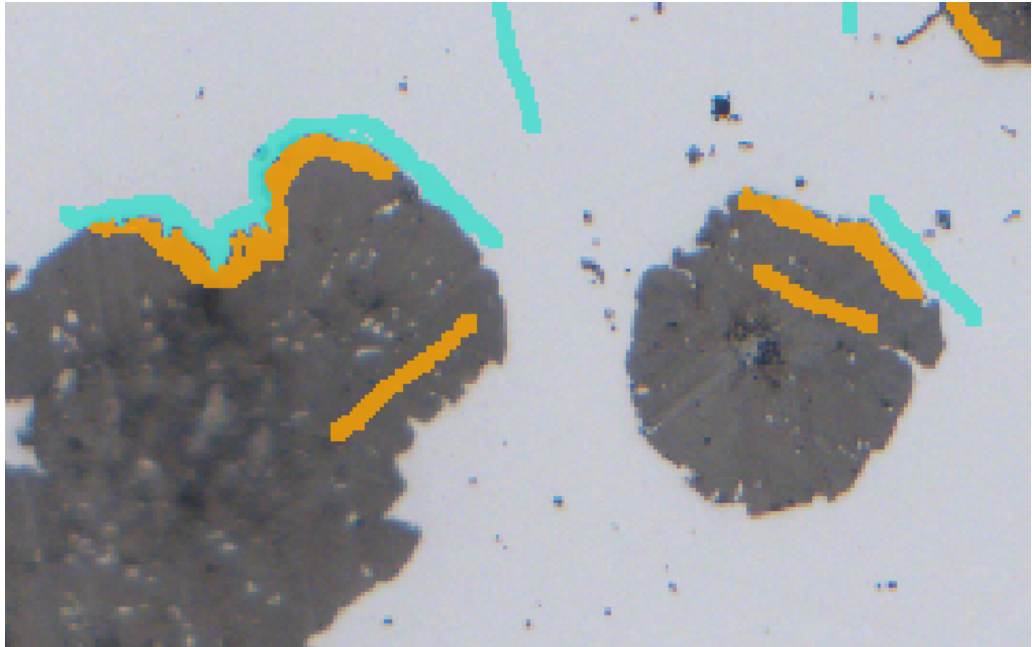
- ▶ The more accurate you perform the labeling the better the result will be. You can start with a coarse labeling and then check the result for problematic areas where you should refine the labeling.
- ▶ Accurate labeling is generally preferred over "just labeling everything" roughly.
- ▶ Take care to also label some areas which contain edges of objects and transitions between two classes.
- ▶ Really use an iterative approach: check the training results before labeling huge amounts of pixels.
- ▶ Try to label roughly the same amount of pixels per class.
- ▶ Do not label "very huge" homogenous areas.

1. Under **Manage Templates > Show**, select **Intellesis Segmentation Models**.
2. In the top right tool bar, click .
  - The user interface for training opens.
3. In the top left corner, click **Import Images**.
  - A file browser opens.
4. Select the image for training and click **Open**.
  - The image is added to the list. Note that all imported images are included to your training model.
5. Select an image from the list.
  - The image is displayed in the **Center Screen Area**. Note that on a later stage you can add more images to refine the training via **Import Images**.



6. Continue with the definition of the classes. Depending on your image and what you want to segment you can define a certain amount of classes. When you start with a new model you can see the two pre-defined classes **Object** and **Background**.
7. Add as many classes as you need for your object classification by clicking **Add Class**.
  - You have created the classes that you want to distinguish.

8. To rename a class, right click on the entry, select **Rename**, enter a new name and click . Alternatively, double click the name entry, enter a new one and click , or press **Enter**. Note that you must not use the name **Root** for one of your classes as this a reserved key-word from the image analysis.
9. Now move the courser inside the image and start labeling the areas which you want to assign to the selected class. To label within the image simply hold down the left mouse key and move the mouse.



10. After labeling a few areas with different classes click **Train & Segment**.
  - The software starts the training. The system tries to automatically recognize other areas of the same classes. Depending on the image, the pixel classification can take a while. When finished the image has the additional channel **Seg**(mentation) containing the segmentation preview.
11. If you are not satisfied with the result, you can label more details of the corresponding classes. Therefore you can zoom into the image or change the brush size of the courser. The more accurate you label the different classes within the image, the better the recognition will be. When you finished the labeling you have to click on **Train & Segment** again. You can repeat that process until you are satisfied with the segmentation result. Note that at this point as a result you only see a pseudo segmented image and only the area visible in the main window is segmented (max. area 5000 x 5000 px). For full segmentation of an image or data set, use the model in the **Intellesis Trainable Segmentation** tool for image processing, see *Using a Trained Model for Image Processing* [[▶ 309](#)].



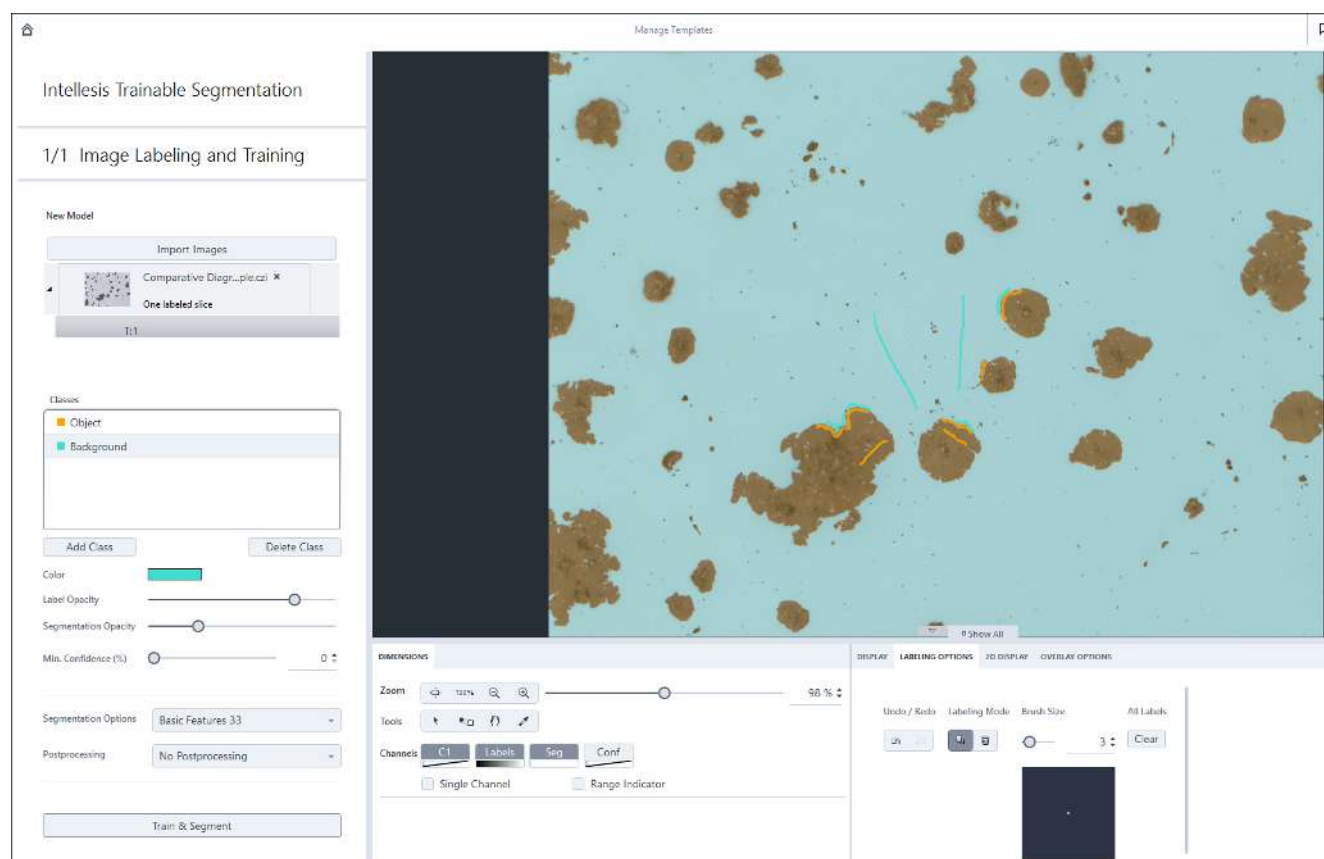


Fig. 13: Trained model with refined labeling and pseudo segmentation results

### 6.4.6 Editing Classes

1. To add a new class to the **Classes** list, click **Add Class**.




→ The classes have a random color by default.

The screenshot displays the 'Classes' management panel in the Intellesis Segmentation software. At the top, a list of classes is shown: 'Object' (represented by an orange square) and 'Background' (represented by a teal square). Below this list are two buttons: 'Add Class' and 'Delete Class'. Underneath the buttons, there are four settings: 'Color' (with an orange color swatch), 'Label Opacity' (a slider set to approximately 80%), 'Segmentation Opacity' (a slider set to approximately 50%), and 'Min. Confidence (%)' (a slider set to 0 with a numeric input field). Below these settings are two dropdown menus: 'Segmentation Options' (set to 'Basic Features 33') and 'Postprocessing' (set to 'No Postprocessing'). At the bottom of the panel is a large 'Train & Segment' button.

2. To change the color of a class, select the class and click on the colored rectangle next to **Color**.  
→ You see the **Color Selection** dialog.
3. Select a new color from the list.
4. To change the opacity of the labels within the image, adjust the **Opacity** slider.
5. To rename a class, double click on the class entry and enter a new name. Press **Enter** or click on **Save** icon to save the new name. Note that you must not use the name **Root** for one of your classes as this is a reserved keyword from the image analysis.
6. To delete the selected class, click **Delete Class**.

### 6.4.7 Importing a Model

**Prerequisite** ✓ You have a trained model or a pre-trained neural network available for import.

1. Under **Manage Templates > Show** select **Intellesis Segmentation Models**.
2. In the top right tool bar, click .

- A file browser opens.
- 3. In the file browser, select the model file or your network from the file system. The network can also be imported by selecting the respective JSON file.
- 4. Click **Import**.

You have imported a model and it is available in the list of segmentation models. You can now use it to segment your images, or open it (e.g. for training) by double clicking on it.

### See also

📖 Using a Trained Model for Image Analysis [▶ 308]

## 6.4.8 Importing Labels from Binary Mask

With this class specific function you can import binary images from an external source as labels for the current selected class. This is helpful when the "ground truth" for a specific image is available or when you want to use an image obtained by a different modality.

### Info

Be aware that this function overwrites existing labels for this class and that this functionality can possibly create a huge number of labels that might lead to memory issues depending on the system configuration and the selected feature extractor.

- Prerequisite** ✓ The label image to be imported has exactly the same dimension in XY as the currently selected training image.
- ✓ You have opened the **Intellesis Trainable Segmentation Wizard**. For more information, see [Creating a New Model](#).
1. Right-click a class and select **Import Labels from Binary Mask**.
    - The Explorer opens.
  2. Navigate to the label image you want to import, and click **Open**.

The imported image is displayed in the **Image** view. The displayed labels have the color of the selected class and fit exactly with the class of the loaded image.

## 6.4.9 Converting Segmentations to Labels

With this function you can convert the result of a segmentation directly to labels and thereby increase the number of labels for the next training step.

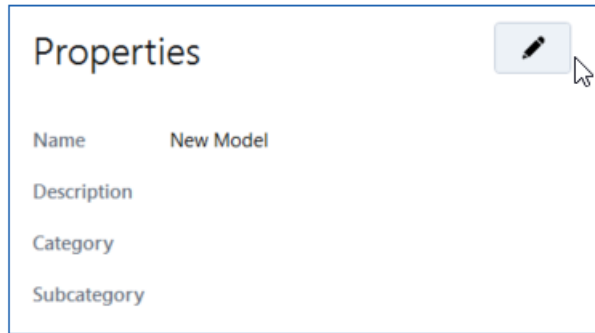
- Prerequisite** ✓ You have opened the **Training** user interface. For more information, see [Creating a New Model](#).
- ✓ You have performed a segmentation.
1. Right-click a class and select **Segmentation to Labels**.

The segmentations are converted to labels.

## 6.4.10 Renaming a Model

- Prerequisite** ✓ You have selected a training model.

1. Under **Manage Templates > Properties** click on the **Pen** icon.



- The **Name** field is now editable.
2. Enter a new name for the model and save it.

### 6.4.11 Using Neural Networks for Intellesis

In ZEN core you can use pre-trained neural networks as models for semantic image segmentation. You can use networks provided by ZEISS or load your own networks. Each network has to be imported into ZEN core. For detailed information, see *Importing a Model* [▶ 305]. After the import the network can be used as a normal semantic segmentation model for the following workflows:

- Segment single channel images using the respective image processing function, see *Using a Trained Model for Image Processing* [▶ 309].
- Create an image analysis setting based on the network (no hierarchy), see *Using a Trained Model for Image Analysis* [▶ 308].
- Segment a specific class in the steps of the Image Analysis Wizard, including hierarchical measurement.
- Segment a specific class in the material analysis modules for grain size, multiphase and layer thickness, see also *Grain Size Analysis with Intellesis Method* [▶ 414], *Multiphase Analysis with AI* [▶ 447] and *Layer Thickness Measurement with Intellesis* [▶ 430].

#### Using networks provided by ZEISS

Zeiss provides some pre-trained networks for you to use (subject to change without notice). These networks are available for download on the ZEISS GitHub page for Open Application Development (OAD) and can be found inside the [Machine-Learning section](#).

**Note:** These networks are copyright protected!

#### Condition of Use

These pre-trained networks were trained with "best-effort" on the available training data and is provided "as is" without warranty of any kind. The licensor assumes no responsibility for the functionality and fault-free condition of the pre-trained network under conditions which are not in the described scope. Be aware that no pre-trained network will perform equally good on any sample, especially not on samples it was not trained for. Therefore, use such pre-trained networks at your own risk and it is up to the user to evaluate and decide if the obtained segmentation results are valid for the images currently segmented using such a network. By downloading you agree to the above terms.

#### Detailed Information about pre-trained DNNs

Such networks are very specific for the application they have been trained for. Detailed information can be provided on demand.

### Using your own networks

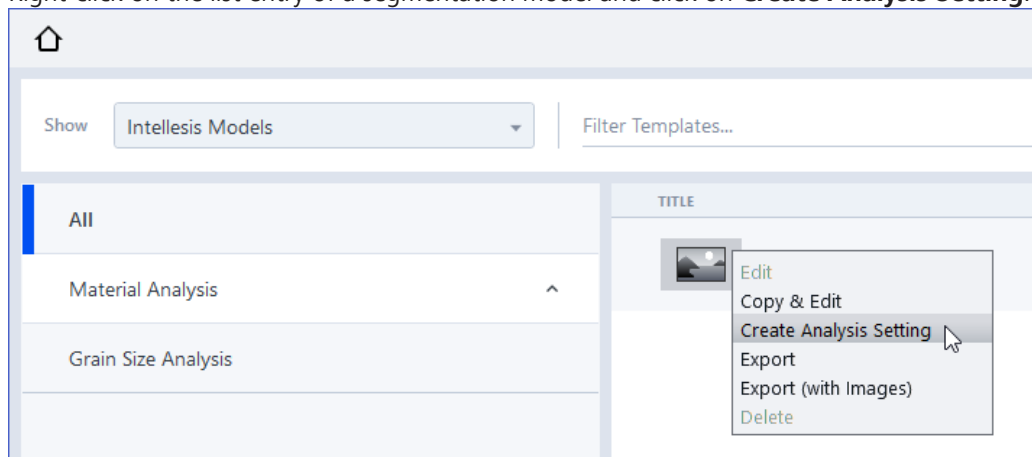
You can also train and use your own networks. To be able to use your own networks in ZEN core, your networks have to fulfill certain specifications detailed in the [ANN Model Specification](#). Additional information about ZEISS machine learning, including an example of how to train a model and convert it into a czmodel can be found in this [Readme](#) on GitHub. It also explains the usage of the PyPi package which is free to use for everybody.

#### 6.4.12 Using a Trained Model for Image Analysis

Once you have trained a model for segmentation, you can use it for **Image Analysis**. In order to use the trained model, you must first create a new image analysis setting (\*.czias format) first.

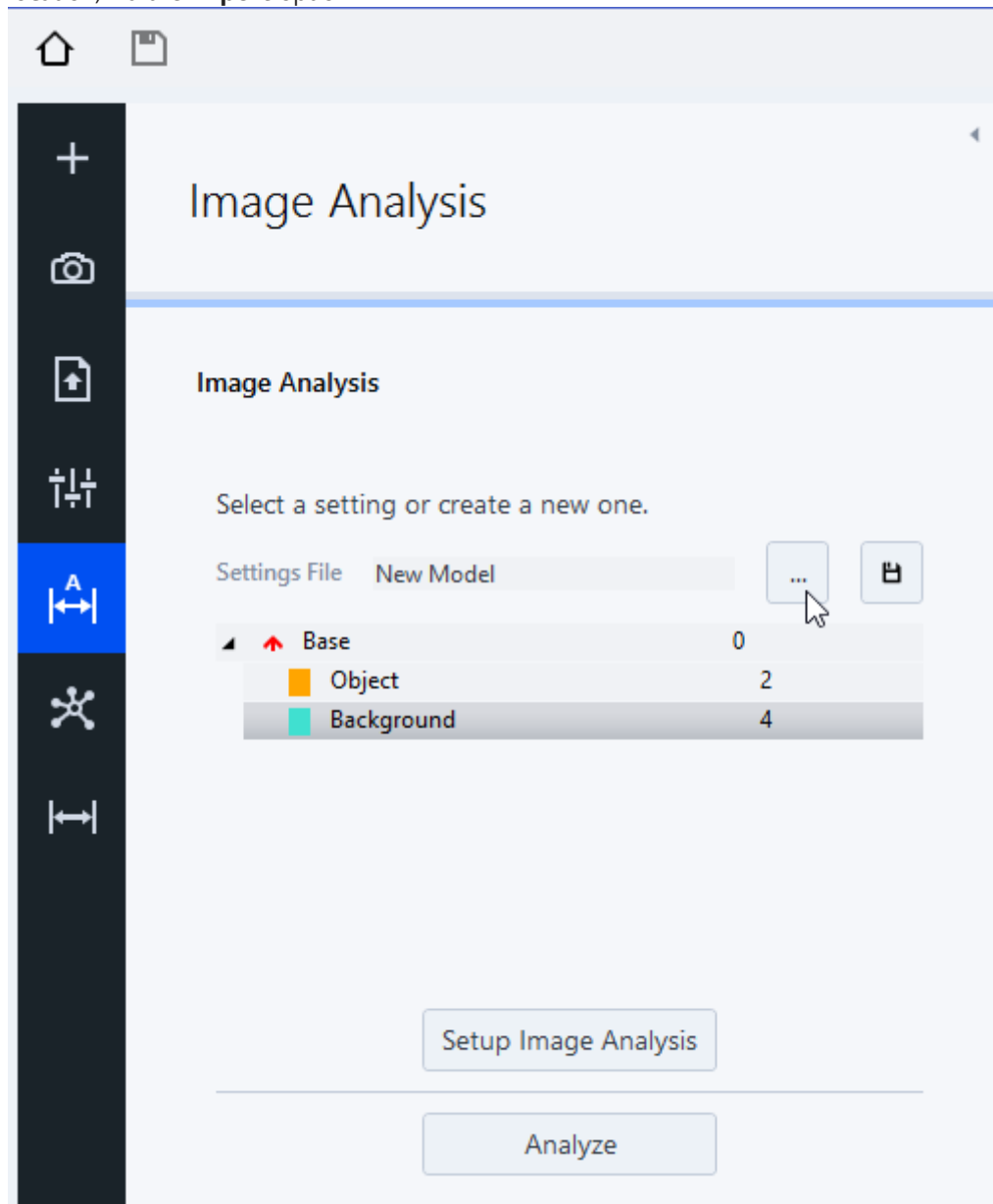
**Prerequisite** ✓ You are in the **Manage Templates** mode.

1. Select **Intellesis Models** in the drop-down list.
2. Right-click on the list entry of a segmentation model and click on **Create Analysis Setting**.



- The setting will be saved as \*.czias file in the ZEN default folder for image analysis settings (usually under **ProgramData/Carl Zeiss/ZENCore/UserArchive/Image Analysis Settings**).

3. When you now switch to a **Image Analysis** tool you can select the settings file from the dialog. Note that the setting will be only available in the dialog when you have used the default folder for saving. Otherwise the setting must be loaded from the file system (specific location) via the **Import** option.



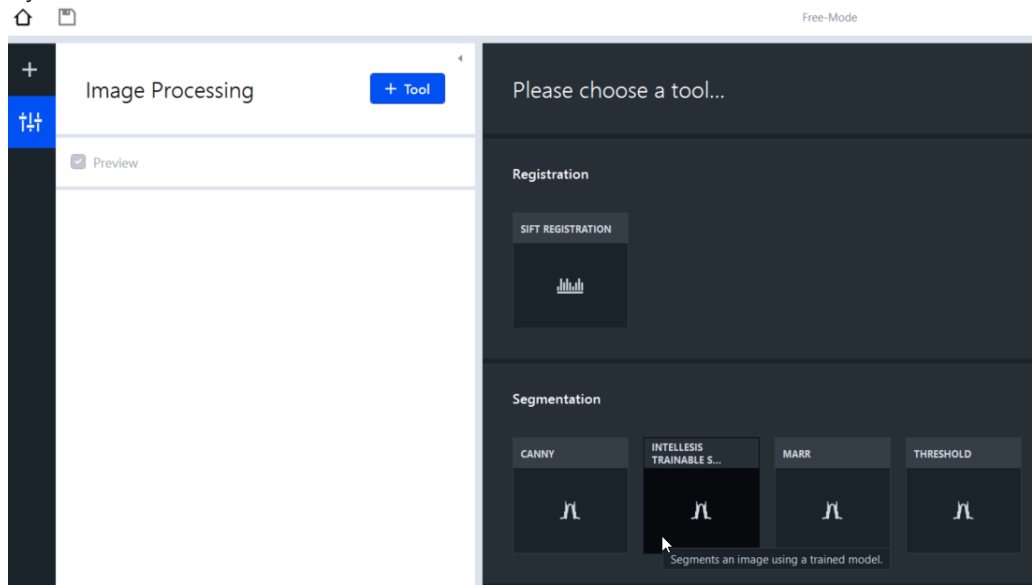
→ The model will be loaded with the pre-defined classes.

4. You can now continue with setting up an image analysis using the Intellesis trained segmentation model.

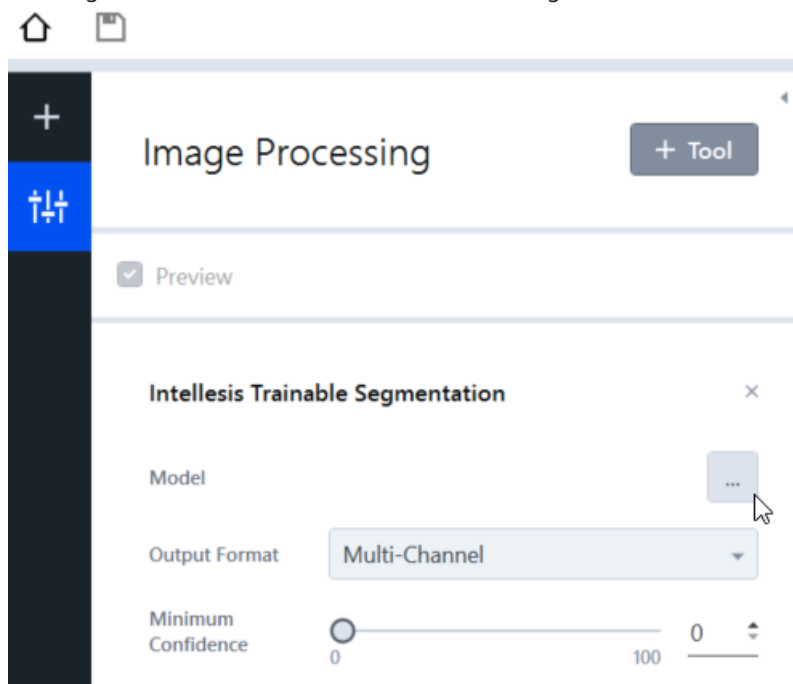
### 6.4.13 Using a Trained Model for Image Processing

- Prerequisite**
- ✓ You have a trained model available for automatic image segmentation.
  - ✓ You are in **Free Mode**.
  - ✓ You have loaded an image, e.g. via the **Load File** workbench. The image is visible in the image area.
1. Add the **Image Processing** workbench.

- Click on **Add Tool** and then double-click on the **Intellesis Trainable Segmentation** entry.



- Under **Model** select the desired model from the list. Note that the model must be trained on images with similar features otherwise the segmentation will not work properly.



- Select the desired **Output Format**.  
If you select **Multi-Channel**, the result will be a multi-channel image, where every class that was defined in the trained model will be in their own channel.  
If you select **Labels**, you will get an image with one channel, where the pixels belonging to the different classes will be labeled with different colors and will be represented by distinct pixel values.  
**Note:** Currently such an label image cannot be displayed inside the 3D view directly without any further processing steps.
- If necessary, adjust the **Minimum Confidence** slider. This will discard all pixels inside the resulting masks, where the confidence value is below the selected threshold.
- Click on **Apply**.  
→ The automatic image segmentation using the trained model is performed on the loaded image.

- After a short while you will get two resulting images, depending on the output format:
- the multi-channel or labels image and
  - the confidence map.

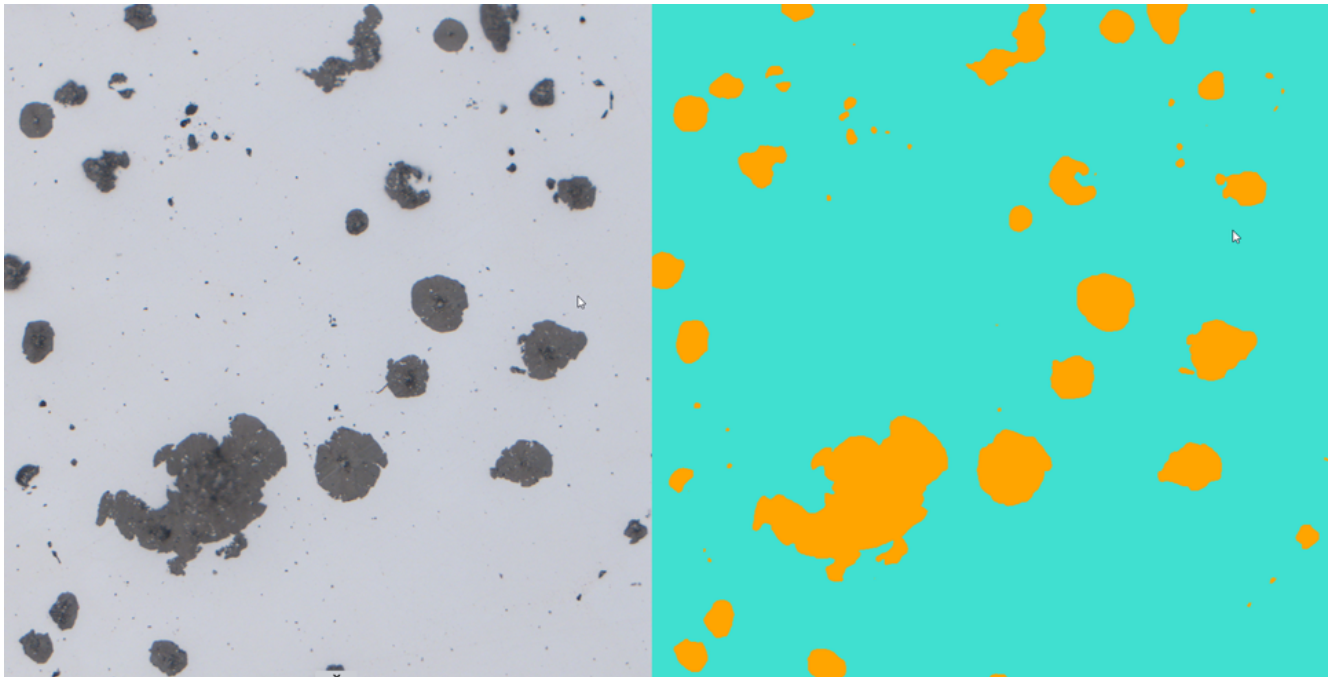



Fig. 14: The image shows (from left to right): original image, segmented image

#### 6.4.14 Using a Trained Model for Multiphase Analysis

Once you have a trained model for segmentation, you can use it for a Multiphase Analysis. In order to use the model, you have to create a new multiphase analysis setting (\*.czias format) first.

**Prerequisite** ✓ You are in **Manage Templates** mode.

1. In the **Show** drop-down list, select **Intellesis Models**.
2. Right-click on the list entry of a segmentation model and select **Create Multiphase Analysis Setting**.
  - The setting will be saved in the ZEN default folder for analysis settings (usually under ProgramData/Carl Zeiss/ZENCore/UserArchive/Image Analysis Settings).
3. Go to the **Home Screen** and click on **Job Mode**.
4. Right-click on the Multiphase job where you want to use your setting and select **Edit** or **Copy & Edit**. Alternatively, create a new job template (for general information on this, see *Creating a New Job Template* [▶ 56]).
5. Go to the **Load Setting** step where you select your setting.
6. Click on .
7. In the **Open Template** dialog, select your Multiphase setting and click on **OK**.

The trained model is now added to the Multiphase analysis job.

### 6.4.15 Changing the Tile Border Size for Neural Networks

#### Info

#### Undo Border Size Changes

There is no way to undo the change of the border size unless you remember the original value and change it back with the same workflow described here.

**Prerequisite** ✓ You are in Manage **Templates**.

✓ You have imported a neural network, see *Importing a Model* [▶ 305].

1. In the **Show** dropdown list, select **Intellesis Segmentation Models**.  
→ All available segmentation models and networks are displayed.
2. Right click on a network and select **Change Border Size**.  
→ The **Change Border Size** dialog opens.
3. Change the **Border Size** to fit your need. Note while increasing the border size reduces segmentation artifacts in the output, it also decreases the tiling speed.
4. Click **OK**.

You have changed the border size for tiling. If there are still tiling artifacts with the maximum border size, consider retraining the model with larger tiles.

#### See also

📄 Tile Border Size Example [▶ 317]

### 6.4.16 Using Intellesis within OAD

The **Intellesis Trainable Segmentation** module allows to use the **Trainable Segmentation** processing function within the ZEN **Open Application Development (OAD)** environment.

Method/Command	Description
Zen.Processing.Segmentation. <b>TrainableSegmentation</b> (Input, Model, Output Format)	Function to segment an image using a trained model. The output result is an image.
▪ Input	ZenImage - Defines the input image to be segmented.
▪ Model	ModelName - Defines the name of the model.
▪ Output Format: SegmentationFormat. <b>MultiChannel</b> SegmentationFormat. <b>Labels</b>	Function to segment an image using a trained model. The output result is an array of images containing the segmented image and the confidence map.
Zen.Processing.Segmentation. <b>TrainableSegmentationWithConfidenceMap</b>	Addresses the Trainable Segmentation function including a confidence map.
▪ Input	ZenImage - Defines the input image to be segmented.
▪ Model	ModelName - Defines the name of the model.

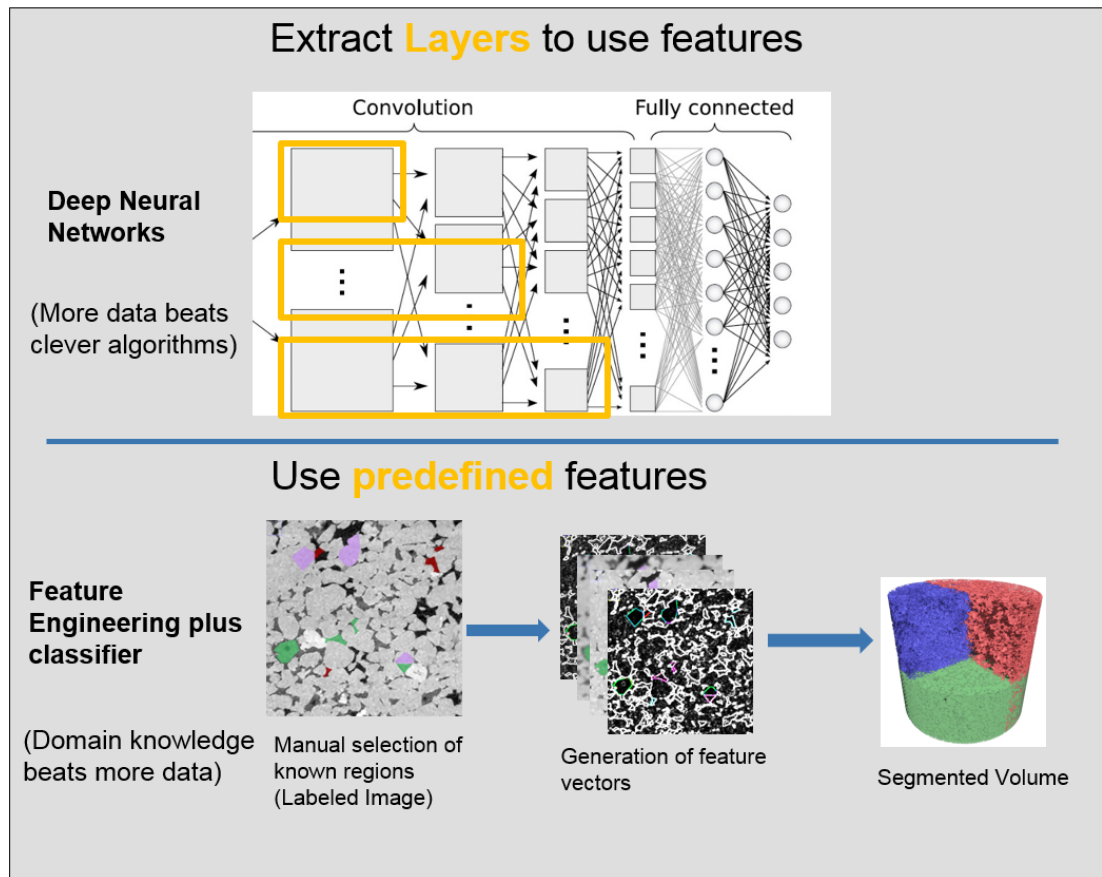


Method/Command	Description
<ul style="list-style-type: none"> <li>Output Format: SegmentationFormat.<b>MultiChannel</b> SegmentationFormat.<b>Labels</b></li> </ul>	SegmentationFormat - Optional argument; Defines the desired output format, e.g. Multi-Channel or Labels
Zen.Processing.Segmentation. <b>MinimumConfidence</b>	Addresses the Minimum Confidence function.
<ul style="list-style-type: none"> <li>Input</li> </ul>	ZenImage - Defines the input image to be segmented.
<ul style="list-style-type: none"> <li>Model</li> </ul>	ZenImage - Confidence map containing the confidence values in %.
<ul style="list-style-type: none"> <li>Threshold</li> </ul>	Minimum Threshold – value in % - only pixel inside mask $\geq$ this values will be kept.
ZenIntellesis. <b>GetAvailableFeatureSets()</b>	Returns all available feature sets as an array of strings.
ZenIntellesis. <b>GetAvailablePostProcessings()</b>	Returns all available post-processing options as an array of strings.
ZenIntellesis. <b>ImportModel</b> (modelfile, allowOverwrite)	Imports a model file into the model repository and overwrites an existing one, if the option was set to True. Returns a ZenIntellesisModel.
<ul style="list-style-type: none"> <li>modelfile</li> </ul>	File path to modelfile to be imported.
<ul style="list-style-type: none"> <li>allowOverwrite</li> </ul>	Allows overwriting an existing model.
ZenIntellesis. <b>ListAvailableSegmentationModels()</b>	Lists all available segmentation models. Returns an array of ZenIntellesisModels.

#### 6.4.17 Remarks and Additional Information

- Segmentation performance in general depends among other factors on the system performance, the **available and free RAM and GPU memory**.
- Whenever using ZEN Intellesis Trainable Segmentation it is strongly recommend not to use other memory- or GPU-intensive applications at the same time.**
- Deep Feature Extraction uses the GPU (NVIDIA only) if present on the system. It is recommended to use an GPU with at least 8GB of RAM.
- When installing the GPU libraries it is required to use the latest drivers which can be obtained from the NVIDIA homepage (<https://www.nvidia.com/Download/index.aspx?lang=en-us>).
- In case of using an approved ZEISS workstation, the latest drivers can be found on the installer.
- When using Deep Feature Extractor on a GPU system, Tensorflow will occupy only as much as GPU RAM as needed to ensure system stability. When the segmentation is finished this GPU memory is released automatically (with the current version).
- Therefore, when starting another GPU-intensive application, for example GPU-DCV, the GPU memory cannot be used by this new process and a CPU fallback will be used or performance issues may occur.
- In this case, restart ZEN to free all possible GPU memory and then start using GPU-DCV (or similar applications).

### 6.4.18 Feature Extractors



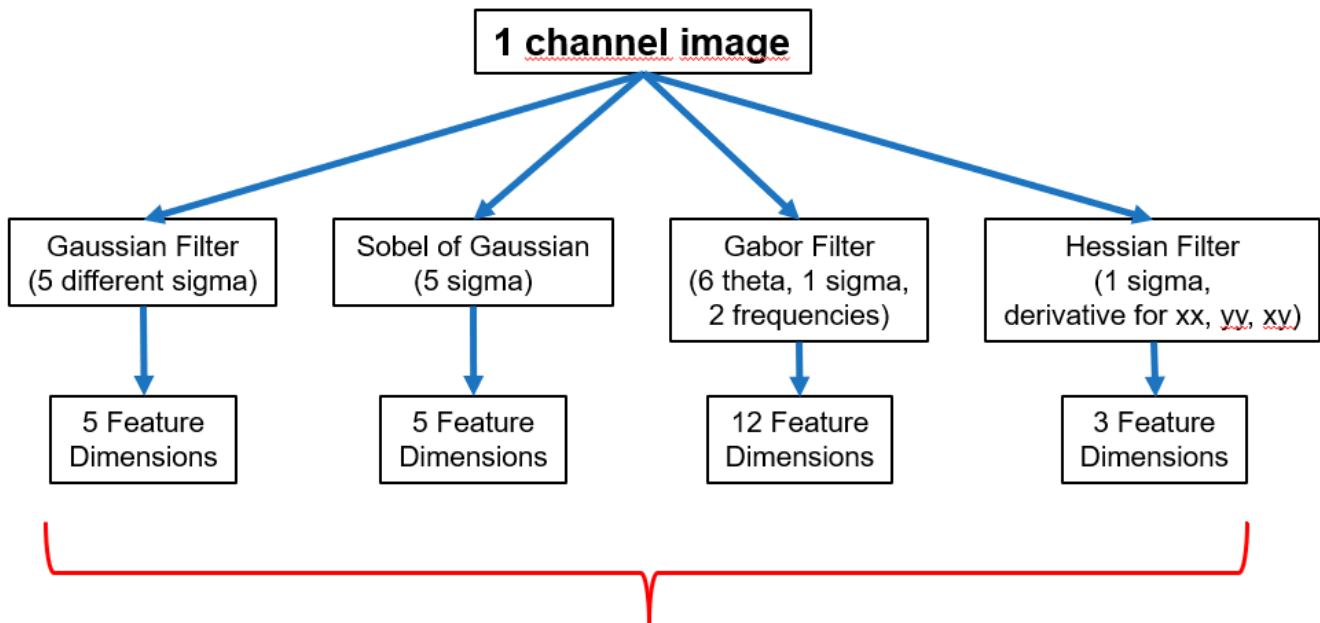
#### 6.4.18.1 Intellesis Basic Features

- For calculating the features various filters with various filter sizes and parameters are applied to the region around this pixel (2D Kernels).
- Results are concatenated and yield the final feature vector describing the pixel.

##### 6.4.18.1.1 Basic Features 25

Used Filters:

- Gaussian filter (5 different sigma) = 5 feature dimensions
- Sobel filter (5 sigma) = 5 feature dimension
- Gabor filter (6 theta, 1 different sigma, 2 different frequencies) = 12 feature dimensions
- Hessian filter (1 sigma) = 3 feature dimensions (one for derivative in direction xx, one for derivative in direction xy and one for derivative in direction yy)

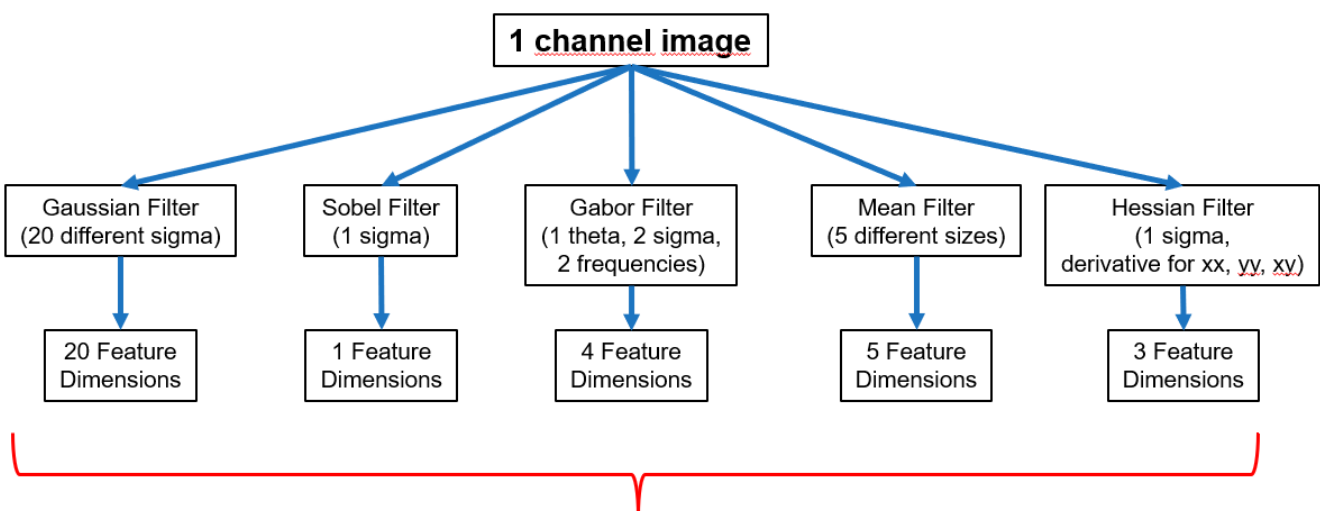


25 pieces of information per image pixel  
= feature vector with 25 dimensions

#### 6.4.18.1.2 Basic Features 33

Used Filters:

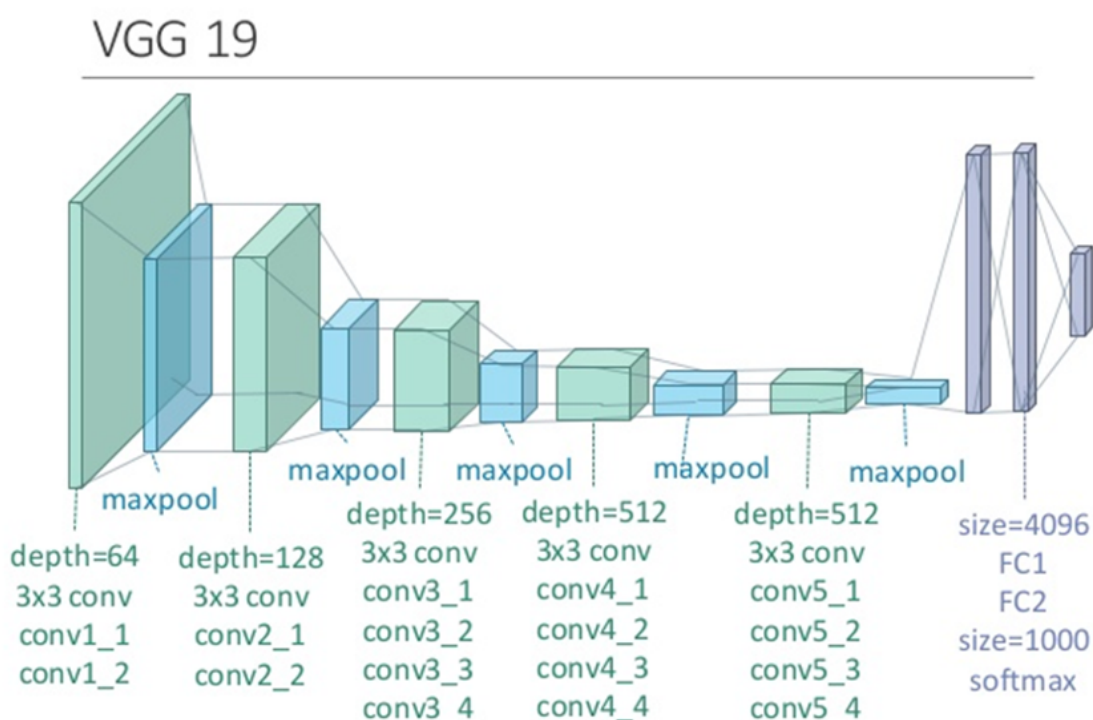
- Gaussian filter (20 different sigma) = 20 feature dimensions
- Sobel filter (1 sigma) = 1 feature dimension
- Gabor filter (1 theta, 2 different sigma, 2 different frequencies) = 4 feature dimensions
- Mean filter (5 different sizes) = 5 feature dimensions
- Hessian filter (1 sigma) = 3 feature dimensions (one for derivative in direction xx, one for derivative in direction xy and one for derivative in direction yy)



33 pieces of information per image pixel  
= feature vector with 33 dimensions

### 6.4.18.2 Intellesis Deep Features

- Entire image as input for pre-trained network.
- **Note:** If you use the CPU for segmentation with Deep Feature sets, the results can be different on different machines because they are hardware (CPU) dependent.
- Take the output from an intermediate layer of that network as feature vector, e.g. output from layer 3 was processed by preceding layers 1 and 2.
  - Deep Features 50: Using layer 2 with reduced feature dimension = 50
  - Deep Features 64: Using layer 1 with full feature dimension = 64
  - Deep Features 70: Using layer 3 with reduced feature dimension = 70
  - Deep Features 128: Using layer 2 with full feature dimension = 128
  - Deep Features 256: Using layer 3 with full feature dimension = 256



### 6.4.19 Change Border Size Dialog

Parameter	Description
<b>Total Tile Width</b>	Displays the total tile width used by the network.
<b>Total Tile Height</b>	Displays the total tile height used by the network.
<b>Border Size</b>	Sets the border size of the tiles. The lower limit of the border size is zero and the upper limit is a quarter of the smallest dimension of the tile.
<b>Tile Overlap</b>	Displays the tile overlap which is the sum of the overlap on the left and right side, see <i>Tile Border Size Example</i> [▶ 317]. It is updated according to changes of the border size.

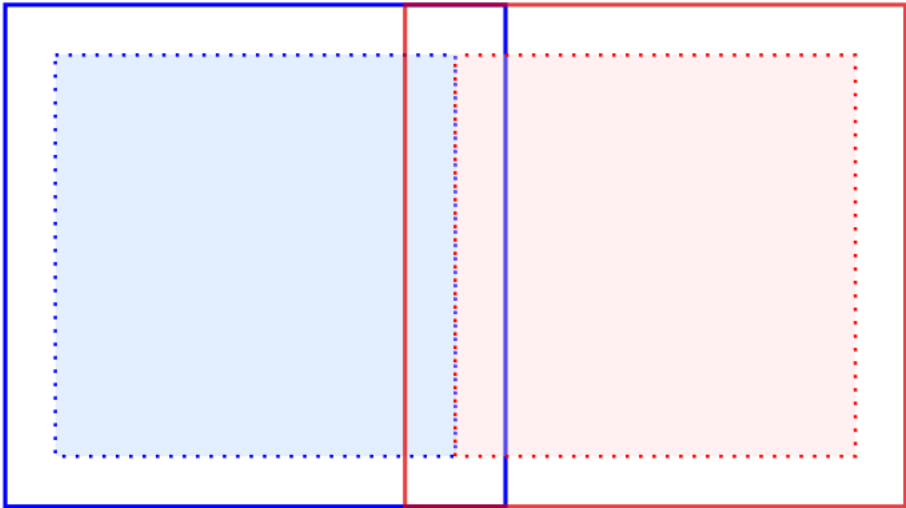
#### See also

- 📖 Changing the Tile Border Size for Neural Networks [▶ 312]

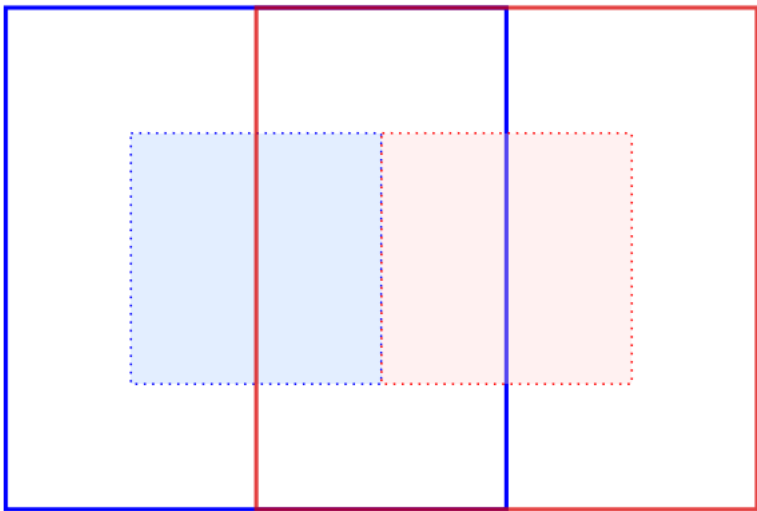
6.4.19.1 Tile Border Size Example

The tile overlap in % is the is the sum of the overlap on the left and right side. Consider the following two examples as illustration for the overlap:

Border Size of 10 % with a resulting overlap of 20 %



Border Size of 25 % with a resulting overlap of 50 %




6.4.20 Intellesis Trainable Segmentation Tool

Using the **Intellesis Trainable Segmentation** image processing tool, you can apply a trained segmentation model to an image or data set.

Parameter	Description
Model	Selects the trained model.
Output Format	When applying the <b>Segmentation</b> processing function to an image you always get an output image. The following output formats for the processed image are available.
- Multi-Channel	If selected, the output image will be a multi-channel image.

Parameter	Description
	Each class which is defined within the model will result in a separate channel.
- Labels	If selected, the output image will be a single-channel image in which a dedicated pixel value or color is attributed to each class.
- Minimum Confidence	Hides all segmented pixels where the confidence value is below the threshold set by the slider.

**See also**

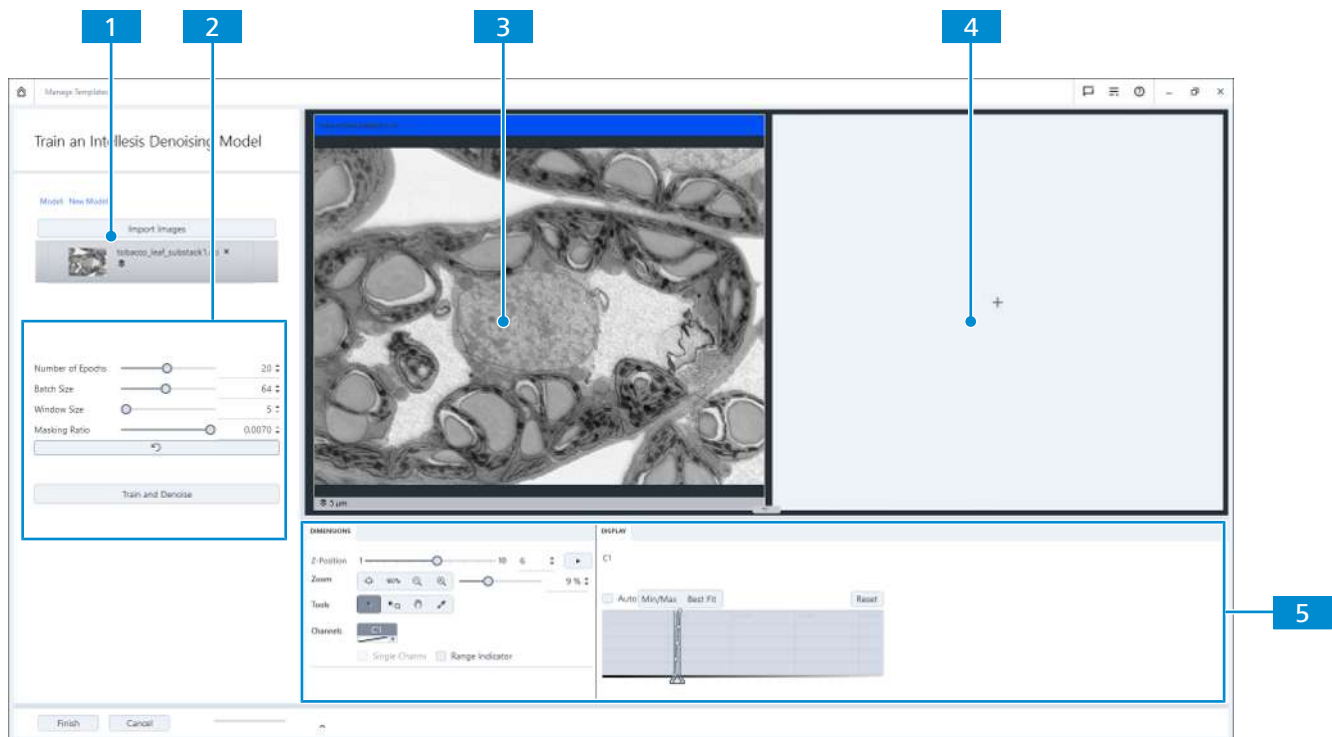
 Using a Trained Model for Image Processing [► 309]

**6.5 Intellesis Denoising**

This module allows you to train and use deep learning based models for the denoising of images. This method can be applied to any type on image and any dimensions and it is not dedicated to a special field of application. It should be used before applying processing functions that modify the pixel values to that image.

Denoising is an operation to reduce noise in an image, in case of ZEN Intellesis Denoising with the help of deep learning methods. In general, there are different ways to train a denoising model. Intellesis Denoising uses the approach called Noise2Void (N2V), which requires only a noisy input image for the training of a model and can thus be trained directly on the data that should be denoised. To give a simplistic explanation, this N2V method replaces pixels by masked pixel data randomly selected within a certain window/surrounding area. With this approach, the model is then trained to reconstruct the original pixels and to discard the implicit noise in the image. For detailed information on Noise2Void , see the paper "Noise2Void - Learning Denoising from Single Noisy Images" written by Alexander Krull, Tim-Oliver Buchhol and Florian Jug, see also <https://arxiv.org/abs/1811.10980>.

### 6.5.1 User Interface Training Intellesis Denoising



#### 1 Image Section

Here you can import and select the images you want to use for training the denoising. A click on an image opens it the left image container in the image view.

#### 2 Denoising Parameters

Here you have the parameters to configure your denoising training, see *Denoising Parameter Section* [▶ 319].

#### 3 Input Image

Displays the image that is selected in the **Image Section**.

#### 4 Prediction Image

Displays the prediction for the image with the current settings made in the **Denoising Parameters** section.

#### 5 View Options

Here you have some general view options on the **Dimensions** and **Display** tab to adapt the image display.

#### See also


📄 Creating and Training an Intellesis Denoising Model [▶ 320]

#### 6.5.1.1 Denoising Parameter Section

##### Info

##### Advanced Parameters


The parameters **Batch Size**, **Window Size** and **Masking Ratio** are three advanced parameters to adjust the NOISE2VOID (N2V) based training. For general information on denoising and N2V, see *Intellesis Denoising* [▶ 318].

Parameter	Description
<b>Model</b>	Displays the name of the current model.
<b>Number of Epochs</b>	Defines the number of times that the model is trained with the images.
<b>Batch Size</b>	Defines the batch size, a number of optimization steps that are executed simultaneously. Note that the higher you set the batch size, the higher is the memory usage.
<b>Window Size</b>	Defines the size of the window from which the pixels are taken.
<b>Masking Ratio</b>	Defines the ratio between pixels that are replaced and the overall number of pixels.
	Resets all parameters to their default values.
<b>Train and Denoise</b>	Trains the model based on the current parameter settings.
<b>Finish</b>	Saves the model and all changes and closes the wizard.
<b>Cancel</b>	Closes the wizard without saving.

**See also**

 Intellesis Denoising [► 318]

## 6.5.2 Creating and Training an Intellesis Denoising Model


- Prerequisite** ✓ You are in **Manage Templates**.
- ✓ If required, you have pre-processed your image(s) with the **Whitening** tool, see *Whitening Tool* [► 820].
- For **Show**, select **Intellesis Denoising Models**.
  - In the top right tool bar, click .
    - The user interface for training opens.
  - In the top left corner, click **Import Images**.
    - A file browser opens.
  - Select the image for training from the file system and click **Open**.
    - For images with multiple channels, a dialog opens to select the channel for denoising.
  - Select the channel you want to use for denoising and click **OK**.
    - The image is displayed in the list. Note that all imported images are added to your model.
  - Select the image from the list.
    - The image is displayed in the left image container.
  - In the parameter section, set the **Number of Epochs** and adapt the more advanced parameters, if necessary.
  - Click **Train and Denoise**.
    - Your model is trained based on the settings and the prediction is displayed in the right image container.
  - If you are satisfied with the result, click **Finish**.
    - All changes are saved and the wizard is closed.



You have successfully created and trained a model for denoising. You can now use it to denoise your images with the **Intellesis Denoising** tool, see *Using a Trained Model for Denoising* [▶ 321].

### 6.5.3 Importing an Intellesis Denoising Model

**Prerequisite** ✓ You have a trained model available for import.

1. Under **Manage Templates** > **Show**, select **Intellesis Denoising Models**.
2. In the top right tool bar, click .  
→ A file browser opens.
3. In the file browser, select the model file from the file system.
4. Click **Import**.

You have imported a model and it is available in the list of denoising models. You can now use it to denoise your images.

### 6.5.4 Exporting an Intellesis Denoising Model

**Prerequisite** ✓ You have a denoising model available.

✓ You are in **Manage Templates**.

1. For **Show**, select **Intellesis Denoising Models**.  
→ All denoising models are displayed.
2. Right-click the model you want to export and select **Export**.  
→ A file browser opens.
3. Select the file location and click **OK**.

The model is exported. It contains the trained routine to denoise an image and is not intended for the training process anymore.

### 6.5.5 Using a Trained Model for Denoising

#### Info

#### Denoising several channels in Job Mode


In Job Mode, you have the possibility to add the **Intellesis Denoising** tool multiple times if you want to denoise several but not all channels of your image, e.g. if you want to denoise three out of five channels, you can add the tool three times.

**Prerequisite** ✓ You have a denoising model available.

✓ You are in Free Mode or Job Mode and have added the **Intellesis Denoising** tool.

✓ You have opened the image(s) for which you want to use the model.


✓ If required, you have pre-processed your image(s) with the **Whitening** tool, see *Whitening Tool* [▶ 820].

1. In the **Intellesis Denoising** tool, click .  
→ The **Open Template** dialog opens.
2. Select the **Model** you want to use and click **OK**.
3. In Free Mode, click **Apply**.  
→ The objects in your image are denoised based on the trained model.

**See also**

 Intellesis Denoising Tool [▶ 322](#)

**6.5.6 Intellesis Denoising Tool**

Parameter	Description
<b>Channel</b>	Selects the image channel to which denoising should be applied.
<b>Model</b>	Displays the model used for denoising.
– 	Opens the <b>Open Template</b> dialog to select a model for denoising.

**See also**

 Intellesis Denoising [▶ 318](#)

 Using a Trained Model for Denoising [▶ 321](#)

**6.6 Intellesis Object Classification**

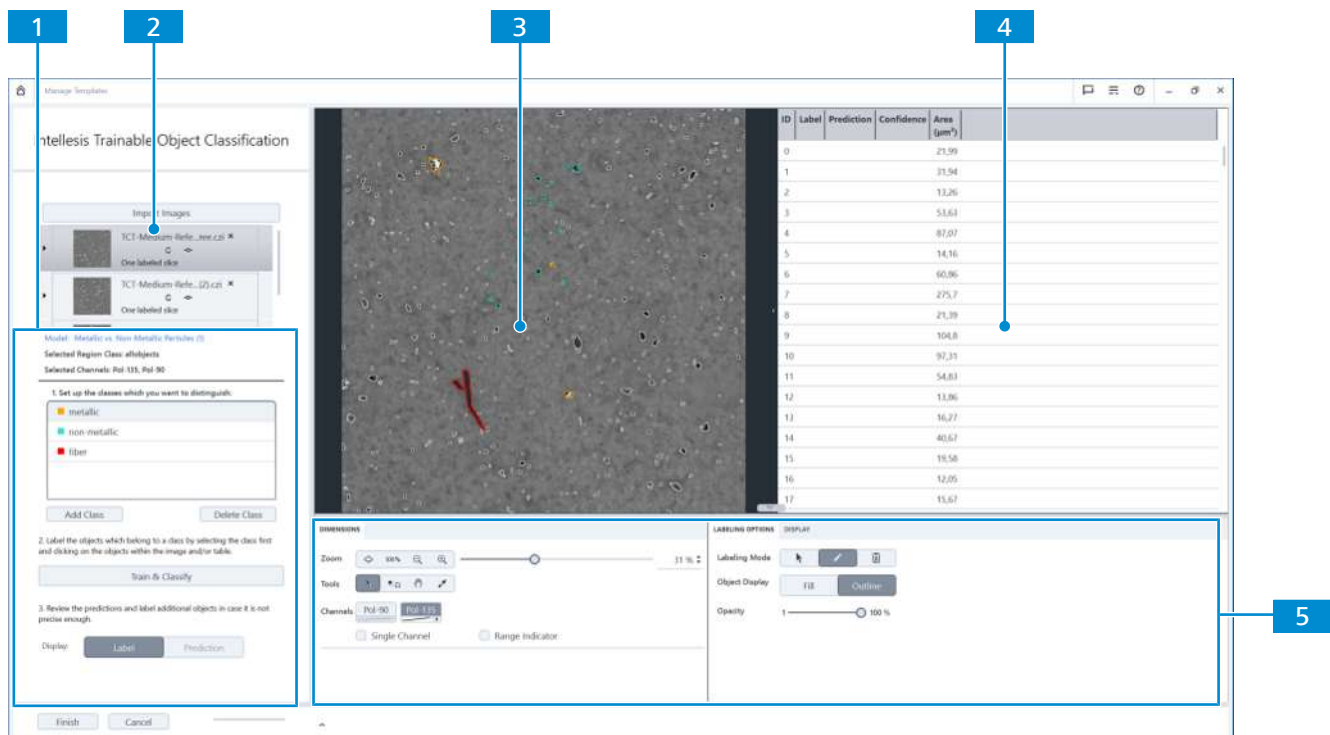
This module offers the functionality to classify objects based on measured parameters of an analyzed image using machine-learning algorithms and to create and to train such a model for object classification. Since the input for the object classification is an analyzed image containing a result table, the functionality of the **Image Analysis** module is also required for the complete workflow.

**6.6.1 Workflows Overview**

For the object classification functionality there are three main workflows:

- Analyzing an image (see *Image Analysis Basics* [▶ 114](#))
- Training an object classification model (see *Creating and Training an Object Classification Model* [▶ 325](#))
- Using the trained model to classify objects in analyzed images (see *Using a Trained Model for Object Classification* [▶ 328](#))

## 6.6.2 User Interface Training



### 1 Classification Settings

Here you can set the classes for labeling/classifying the objects, see *Classification Settings* [▶ 323].

### 2 Image Import Section

Here you can import and select the images you want to use for classification, see *Image Import Section* [▶ 325].

### 3 Image View

Here you have your analyzed image and can label the objects by clicking on them.

### 4 Table

This table displays your analysis results and can be used for labeling the objects in your image, see *Object Classification Table* [▶ 324].

### 5 View Options

Here you have some general view options on the **Dimensions** and **Display** tab, as well as specific labeling options on the **Labeling Options** tab, see *Labeling Options Tab* [▶ 324].

## See also

📄 Creating and Training an Object Classification Model [▶ 325]

### 6.6.2.1 Classification Settings




Parameter	Description
<b>Model</b>	Displays the model name.
<b>Selected Region Class</b>	Displays the region class selected for classification.
<b>Selected Channels</b>	Displays the channels selected for classification.

Parameter	Description
<b>Classes list</b>	Displays all the classes for classifying the objects. The color of the class can be changed by clicking on the color field. Renaming of a class is possible by right click menu.
<b>Add Class</b>	Adds a new class to the Classes list.
<b>Delete Class</b>	Deletes the currently selected class from the list.
<b>Train &amp; Classify</b>	Starts the training for the object classification setting.
<b>Display</b>	
– Label	Displays the labels in the image.
– Prediction	Only available after a training has been performed. Displays the predictions in the image.
<b>Finish</b>	Saves the classification setting and closes the setup.
<b>Cancel</b>	Closes the setup without saving the changes.

**See also**

 [Creating and Training an Object Classification Model \[► 325\]](#)

**6.6.2.2 Labeling Options Tab**

Parameter	Description
<b>Mode</b>	
–  Selection	Activates the selection mode to select objects in the image without labeling them.
–  Labeling	Activates the labeling mode to label the objects in your image.
–  Erase	Activates the erasing mode to delete the labels in your image.
<b>Object Display</b>	
– Fill	Displays the label as filled objects.
– Outline	Displays the label as an outline.
<b>Opacity</b>	Sets the opacity of the label in the image.

**6.6.2.3 Object Classification Table**

Here the analyzed objects of the image are displayed. You can also use the table to label the objects, see *Creating and Training an Object Classification Model* [► 325]. This table is linked to the image, which means selecting a row in the table centers the view on the respective object in the image and vice versa. If the image is not zoomed to extent, a click on an object in the table centers this object in the image view and adapts the zoom level if necessary (by zooming out). The table can be sorted by each column by simply clicking on the header.

The table only displays the measurements features selected inside the image analysis, not the ones that are used internally to classify the objects.

Parameter	Description
<b>ID</b>	Displays the unique ID of the objects in the analyzed image.
<b>Label</b>	Displays the label class attributed to the respective object.
<b>Prediction</b>	Displays the predicted label using all labels from all available images.
<b>Confidence</b>	The confidence value in % for the predicted label of every individual object.
<b>Measurement features</b>	Additionally to <b>ID</b> and <b>Label</b> , the table displays the values for <i>Measurement Features</i> [▶ 274] selected inside the image analysis, but not the ones that are used internally to classify the objects.


#### 6.6.2.4 Image Import Section

Here you can load and select the images you want to use for training. When you click on a loaded image, the image will be visible in the Image Area. Only images containing image analysis results can be opened to train an object classifier.

Parameter	Description
<b>Import Images</b>	Opens a file browser to select the image for import.
<b>Image list</b>	<p>Displays the list of imported images. If you load a new image only the preview image, file name and type of image are displayed. As soon as you have started to label an image of a larger data set, a list of the images that contain labels is displayed, containing dimension and image number (e.g. for a Z-stack, Z:400 indicates that the slice number 400 contains labels).</p> <p>If you click on this information, the corresponding image is automatically displayed in the center screen area. This is very helpful when you are working with large data sets such as z-stacks, scenes or time-series and you want to quickly load the image you have already labeled.</p>

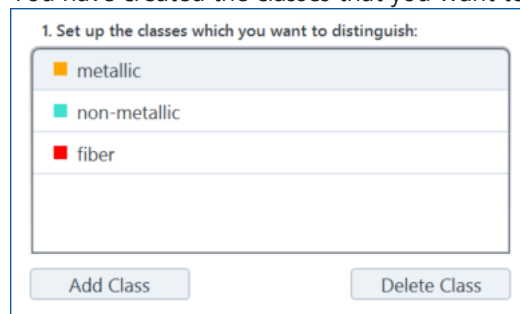
### 6.6.3 Creating and Training an Object Classification Model

**Prerequisite** ✓ You are in **Manage Templates**.



- For **Show**, select **Intellesis Object Classification Models**.
- In the top right tool bar, click .
  - The user interface for training opens, see *User Interface Training* [▶ 323].
- In the top left corner, click **Import Images**.
- Select the image for training from the file system and click **Open**.
  - The **Select Region Class and Channel(s)** dialog opens.
- Select the region class and the channels you want to use for classification and click **OK**.
  - The image is displayed in the list. Note that all imported images are included to your model.
- Select the image from the list.
  - The image is displayed and the table shows the data of the analysis result.

7. On the left side, add as many classes as you need for your object classification by clicking **Add Class**.

→ You have created the classes that you want to distinguish.



8. To change the label color for a class, click on the color field of the list entry and select one from the window.

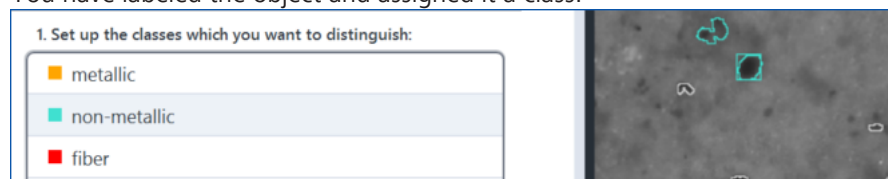
9. To rename a class, right click on the entry, select **Rename**, enter a new name and click . Alternatively, double click the name entry, enter a new one and click , or press **Enter**.

10. In the **Labeling Options** tab, click .

→ You are now in labeling mode.

11. In the classes list, select a class and click on an object that belong to this class in the image or in the table.

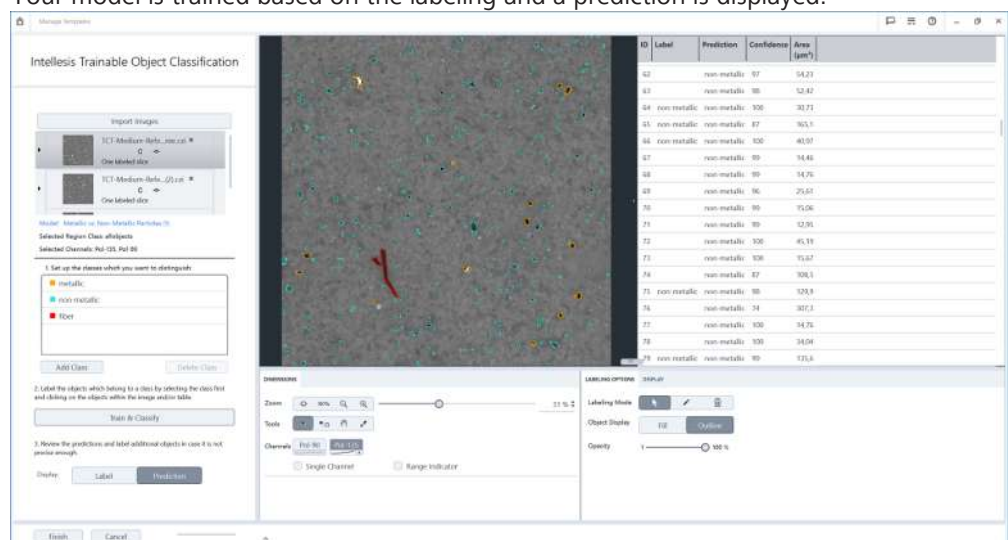
→ You have labeled the object and assigned it a class.



12. Repeat the labeling for the objects of the different classes you created.

13. Click **Train & Classify**.

→ Your model is trained based on the labeling and a prediction is displayed.



14. If you are not satisfied with the result you can label more objects.


15. If you are satisfied with the result, click **Finish**.

→ All changes are saved and the wizard is closed.

You have successfully created and trained a model for object classification. You can now use it to classify objects in your analyzed images with the **Intellesis Object Classification** tool, see *Using a Trained Model for Object Classification* [[328](#)].

### 6.6.4 Importing an Object Classification Model

**Prerequisite** ✓ You have a trained model available for import.

1. Under **Manage Templates > Show** select **Intellesis Object Classification Models**.
2. In the top right tool bar, click .  
→ A file browser opens.
3. In the file browser, select the model file from the file system.
4. Click **Import**.

You have imported a model and it is available in the list of object classification models. You can now use it to classify objects in your images, or open it (e.g. for training) by double clicking on it.

#### See also

 Using a Trained Model for Object Classification [► 328]

### 6.6.5 Exporting an Object Classification Model

#### NOTICE

##### Necessary retraining of models

In case of changes in Python libraries, trained models can stop working on a new version of ZEN and need to be retrained first. Retraining is only possible if the model contains the images or the images are generally still available. To be able to retrain your model, consider the following solutions:

- ▶ Export your model with your images (see *Exporting an Object Classification Model with Images* [► 327]).
- ▶ Make a backup of the images used for training the model, e.g. on your (external) hard drive.

**Prerequisite** ✓ You are in **Manage Templates**.

✓ You have created an object classification model, see *Creating and Training an Object Classification Model* [► 325].

1. For **Show**, select **Intellesis Object Classification Models**.
2. Right-click the model you want to export and select **Export**.  
→ A file browser opens.
3. Select the file location and click **OK**.

The model is exported to that location. It contains the trained classification routine. Such a model is meant to be used for classifying objects in an analyzed image, but not for the training process anymore.

### 6.6.6 Exporting an Object Classification Model with Images

**Prerequisite** ✓ You are in **Manage Templates**.

✓ You have created an object classification model, see *Creating and Training an Object Classification Model* [► 325].

1. For **Show**, select **Intellesis Object Classification Models**.
2. Right-click the model you want to export and select **Export (with Images)**.  
→ A file browser opens.




3. Select the file location and click **OK**.

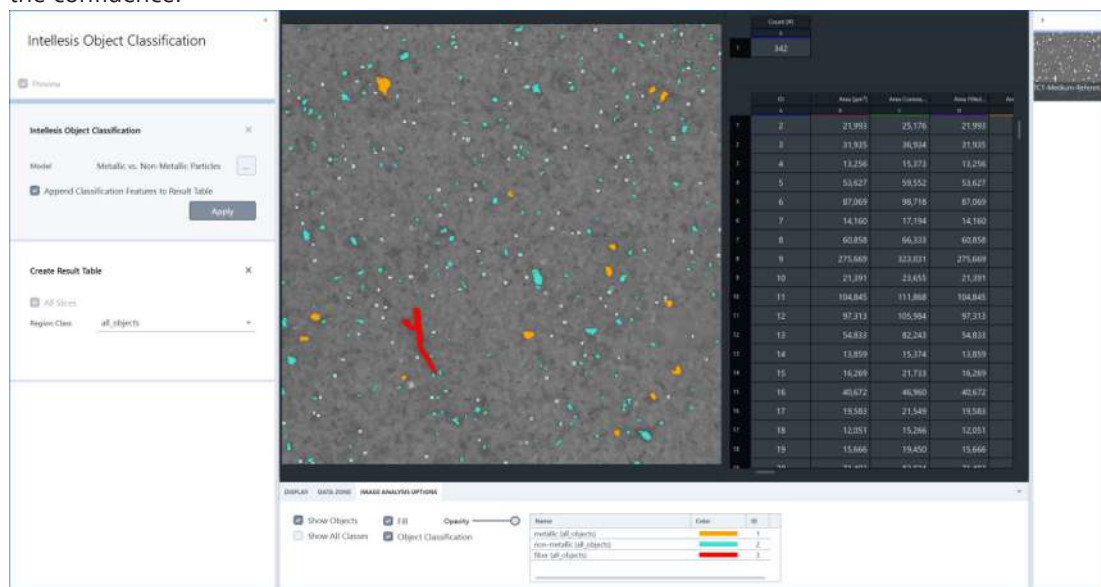
The model is exported to that location. It contains the trained classification routine. Such a model is meant to be used for classifying objects in an analyzed image, but not for the training process anymore.

### 6.6.7 Using a Trained Model for Object Classification

- Prerequisite**
- ✓ You have created and trained an object classification model, see *Creating and Training an Object Classification Model* [▶ 325].
  - ✓ You are in Free Mode or Job Mode and have added the **Intellesis Object Classification** tool.
  - ✓ You have opened the analyzed image(s) for which you want to use the classification model.

1. In the **Intellesis Trainable Object Classification** tool, click .
  - The **Open Template** dialog opens.
2. Select the **Model** you want to use for object classification and click **OK**.
3. If you want to display all statistical features in the result table (and not only the features that were selected in the image analysis), activate **Append Classification Features to Result Table**.
4. Click **Apply**.
  - The objects in your image are now classified based on the trained model.

The classified image is displayed and the table is updated, including the label for each object and the confidence.





You can now extract a result table (including classification result and analysis features) with the **Create Result Table** tool and subsequently create a table with only your classification result using the **Category Histogram** tool for table processing.

### 6.6.8 Intellesis Object Classification Workbench

This workbench enables you to perform an object classification on your analyzed image(s), see *Using a Trained Model for Object Classification* [▶ 328].

#### See also

-  Intellesis Object Classification Tool [▶ 329]
-  Create Result Table Tool [▶ 329]





### 6.6.9 Intellesis Object Classification Tool

With this tool you can classify the objects of your analyzed image based on a trained model.

Parameter	Description
<b>Model</b>	Selects the objects classification model.
<b>Append Classification Features to Result Table</b>	<b>Activated:</b> Displays the features from the images analysis and all statistical features used for the classification. <b>Deactivated:</b> Displays only the features that were selected in the image analysis.

#### See also

-  User Interface Training [► 323]
-  Intellesis Object Classification [► 322]

### 6.6.10 Create Result Table Tool

This tool creates a standalone table with the measurement results embedded in an image.

Parameter	Description
<b>All Slices</b>	<b>Activated:</b> Creates the table for all image slices. <b>Deactivated:</b> Creates the table only for the current slice.
<b>Region Class</b>	Selects the region class for which the table is created (e.g. for the detected <b>Object</b> , or the <b>Background</b> ).

## 6.7 Macro Environment

Macros are part of the Open Application Development (OAD) framework and enhance the software with the following features:

- Control every aspect of the user interface, such as automating repetitive tasks or routine tasks composed of several steps
- Interact with external software, such as ImageJ/Fiji

#### Basic Functionality

Note that all ZEN core versions (ZEN starter excluded) come with a basic macro functionality which allows to play existing macros within the software (**Free Mode** or **OAD Macro** tool).

#### Advanced Functionality

The **Macro Environment** module (licence required) enables you to load, preview, and run macros that are available on your system. It also contains the **Macro Editor**, which enables you to edit, run, or debug macros according to your needs or to write macros from scratch. The modular software interface of the software means that you can write macros but not record them automatically.

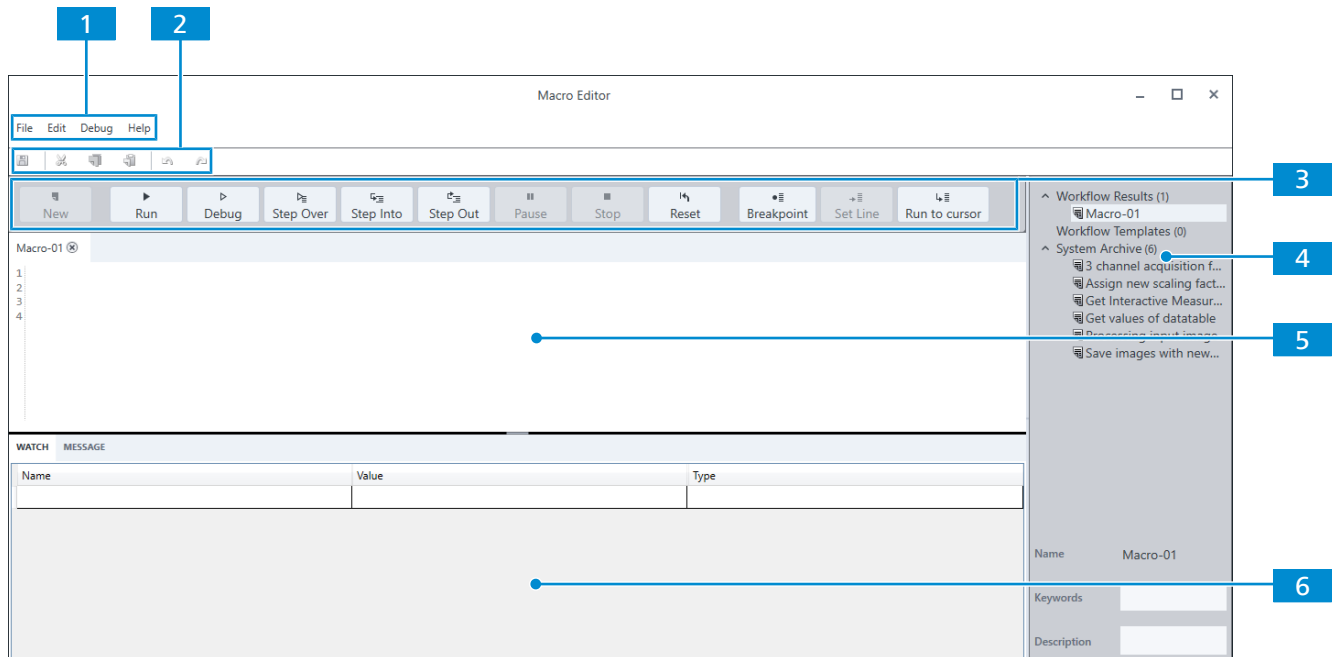
Python is used as the programming language for macros. The programming interface is implemented in the **Macro Object Model**. To open the **Macro Object Model** documentation, start the **Macro Editor** and navigate to **Help > Macro Object Model...**

#### See also

- 📄 Creating a Macro [▶ 334]
- 📄 Managing Macros [▶ 336]
- 📄 Debugging a Macro [▶ 336]
- 📄 OAD Macros Workbench [▶ 746]

### 6.7.1 Macro Editor

The **Macro Editor** is an integrated development environment that enables you to create, edit, and run macros. The editor also contains debugging functionality such as debugging line-by-line or using breakpoints.



#### 1 Menu bar

Here you have central menus, see *Macro Editor Menus* [▶ 331].

#### 2 Tool bar

With the icons you can quickly access the most important functions, like saving or editing macros.

#### 3 Button bar

Here you find the buttons to record and control macros, see *Button Bar* [▶ 333].

#### 4 User Documents

Displays all macros and folders. You can create new or edit existing macros via a right-click context menu, see *Macro List Context Menu* [▶ 333].

#### 5 Code Window





The central area of the macro editor shows the program code of the selected macro. Edit and write your macros in here. You can either use the **Record** button or type in the program code directly. Also a multi-document view is available, meaning that you can open several code windows at once. This central editor component supports syntax highlighting for Python, which is the language used for macros in the software.

**6 Watch/Message Window**

The **Watch** tab in the bottom area enables you to type the macro functions or variables you wish to observe while debugging a macro. Enter the variable directly in the column **Name**. You can also mark the variable in the macro and add it using **Add Watch** of the right-click context menu.

The **Message** window displays messages when using the print command in a macro.

**See also**

-  Creating a Macro [► 334]
-  Managing Macros [► 336]
-  Debugging a Macro [► 336]
-  OAD Macros Workbench [► 746]

**6.7.1.1 Macro Editor Menus****File Menu**

Menu item	Description	Short cut
<b>New Macro</b>	Opens the <b>New Macro</b> in the Macro programming area.	
<b>Import</b>	Opens a file browser to select and import a macro.	
<b>Save</b>	Saves the selected macro.	<b>Ctrl+S</b>
<b>Save As...</b>	Saves the macro under a new name.	
<b>Rename...</b>	Opens the <b>Rename</b> dialog window. Enter a new name for the macro.	
<b>Delete</b>	Deletes the selected macro.	
<b>Close</b>	Closes the selected macro.	

**Edit Menu**

Menu item	Description	Short cut
<b>Cut</b>	Cuts the selected line out of the macro.	<b>Ctrl+X</b> <b>Shift+Del</b>
<b>Copy</b>	Copies the selected line in the macro.	<b>Ctrl+C</b> <b>Ctrl+Ins</b>
<b>Paste</b>	Inserts the copied line into the macro.	<b>Ctrl+V</b> <b>Shift+Ins</b>
<b>Find</b>	Finds the entered text.	<b>Ctrl+F</b>
<b>Replace</b>	Replaces the detected text with the new text..	<b>Ctrl+H</b>
<b>Undo</b>	Undoes the last action.	<b>Ctrl+Z</b>

Menu item	Description	Short cut
<b>Redo</b>	Redoes the last action.	<b>Ctrl+Y</b>

**Record Menu**

Menu item	Description
<b>Record</b>	Starts recording.
<b>Stop Recording</b>	Stops the recording of the active macro.

**Debug Menu**

Menu item	Description	Short cut
<b>Start Debugging</b>	Starts the debugger and executes the macro up to a breakpoint or error.	<b>F5</b>
<b>Start Without Debugging</b>	Executes the macro up to a breakpoint or error without debugging.	<b>Ctrl+F5</b>
<b>Pause</b>	Pauses debugging.	<b>Shift+F5</b>
<b>*Continue (DEBUG)</b>	Continues debugging.	<b>Shift+F5</b>
<b>Stop</b>	Stops the running macro at the active command.	<b>Shift+F5</b>
<b>Step Into</b>	Starts the debugger stepwise, command by command, without stepping into function blocks.	<b>F11</b>
<b>Step Over</b>	Starts the debugger stepwise, command by command, and steps into function blocks.	<b>F10</b>
<b>Step Out</b>	Starts the debugger stepwise, command by command, and steps out of function blocks.	<b>Shift+F11</b>
<b>Toggle Breakpoint</b>	Sets/removes a breakpoint in the active line to stop/continue the macro in debug mode.	<b>F9</b>
<b>Set Line To Execute</b>	Sets the pointer in the next active command line.	<b>F8</b>
<b>Reset</b>	Resets all variables of the Python interpreter.	

**Help Menu**

Menu item	Description	Short cut
<b>Contents...</b>	Opens the <b>Online Help</b> dialog.	<b>Ctrl+F1</b>
<b>Macro Object Model...</b>	Opens the <b>Macro Object Model Online Help</b> dialog. This documentation includes descriptions of all objects available for the macro editor.	

Menu item	Description	Short cut
<b>Forum...</b>	Opens the OAD forum in your web browser. Internet access required.	
<b>GitHub</b>	Opens the ZEISS GitHub page for OAD in your web browser. Internet access required.	

#### 6.7.1.2 Button Bar

On this bar you find the buttons to record and control macros.

Parameter	Description
<b>New</b>	Creates a new empty macro.
<b>Record</b>	Starts macro recording.
<b>Run</b>	Executes the active macro completely.
<b>Debug</b>	Starts the debugger and executes the macro up to a breakpoint or error.
<b>Step Over</b>	Starts the debugger stepwise, command by command, without stepping into function blocks.
<b>Step Into</b>	Starts the debugger stepwise, command by command, and steps into function blocks.
<b>Step Out</b>	Starts the debugger stepwise, command by command, and steps out of function blocks.
<b>Pause</b>	Pauses macro recording.
<b>Stop</b>	Stops the running macro at the active command.
<b>Reset</b>	Resets all variables of the Python interpreter.
<b>Breakpoint</b>	Sets/removes a breakpoint in the active line, to stop/continue the macro in debug mode, in the active line.
<b>Set Line</b>	Sets the pointer in the next active command line.
<b>Run to cursor</b>	Sets the pointer to the current cursor position.

#### 6.7.1.3 Macro List Context Menu

This context menu is displayed if you right-click a macro in the macro list.

Parameter	Description
<b>New</b>	Creates a new macro.
<b>Save</b>	Saves the current changes.
<b>Save as</b>	Saves the macro with a new name.
<b>Rename</b>	Allows renaming the macro.

Parameter	Description
Delete	Deletes the macro.

### 6.7.2 Creating a Macro

**Prerequisite** ✓ You have opened the **OAD Macros** workbench with the **OAD Macro** tool.

1. Click **Macro Editor**.  
→ The **Macro Editor** dialog opens.
2. Right click **Workflow Templates** in the macro list on the right and select **Add Macro**. Alternatively, click **New** in the button bar, or click the **File** menu and select **New Macro**.  
→ A new macro is created and given a standard name composed of the string "Macro-" plus an ascending number.
3. Rename the macro and give it a meaningful name via right click on the new macro, or via the **File** menu.
4. Write your macro and save it.  
→ The first lines of a macro are displayed in the **Preview** section of the **OAD Macro** tool. Therefore, it is recommended to begin the macro with a comment of the macro's main features.
5. Close the editor.

#### See also

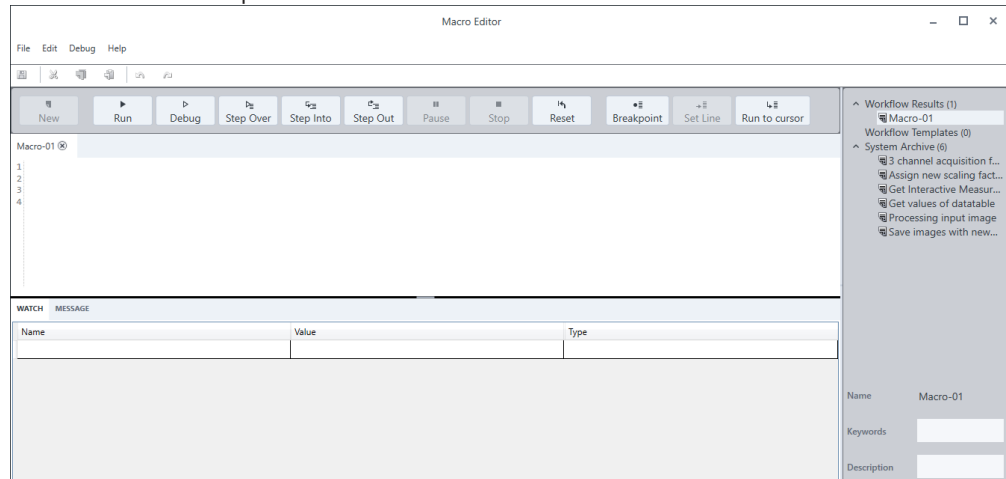
- 📖 Managing Macros [► 336]
- 📖 Debugging a Macro [► 336]
- 📖 OAD Macros Workbench [► 746]

### 6.7.3 Adding a Macro in Job Mode

As a supervisor, in **Job Mode**, you insert **OAD Macros** workbenches and tools. In the **Macro Editor** you edit the macros. In order to use macros, e.g. from the system archive, you copy the code into the respective macro of the **Workflow Results** section.

1. Add the **OAD Macros** workbench to the job template.  
→ In the **OAD Macro** tool > **Selection** section > **Workflow Results**, the macro is listed. If there are multiple macros in a job, they will all be listed in this section, where the first entry belongs to the first macro tool, the second belongs to the second macro tool in the job, and so on. The naming convention for the first macro is **Macro-01** and then continues to count up for each workbench you add to the job template. You cannot rename or delete it.  
In the **System Archive** section, existing macros are listed.
2. To use the macro, click **Macro Editor**.

→ The **Macro Editor** opens.



→ For each **OAD Macro** workbench you added to the job, a tab is displayed and is now tightly linked. The macros belonging to the job are listed in the workflow results section of the **Macro Editor**.

On the right side the same macros as in the **OAD Macros** tool are displayed.

- On each **Macro<n>** tab, add code into the macro of the **Workflow Results** section. You can either type in the program code directly or copy it from one of the available macros. To do so, on the right side, click on the desired macro, e.g., **Get values of datatable**.

→ A tab opens containing the macro code.

- Copy the complete code and paste it to the **Macro<n>** tab, and save it.

→ The macro contains the code.

→ You cannot close the **Macro** tab.

→ When the job is run, the first macro will be executed with the first workbench, the second macro will be executed for the next.

#### 6.7.4 Copying a Macro in Job Mode

As a supervisor, in **Job Mode**, you insert OAD Macros workbenches and tools. In order to use macros, e.g. from the system archive, you copy the code into the respective macro of the **Workflow Results** section.

- Add the **OAD Macros** workbench to the job template.

→ In the **OAD Macro** tool > **Selection** section > **Workflow Results**, the macro is listed. If there are multiple macros in a job, they will all be listed in this section, where the first entry belongs to the first macro tool, the second belongs to the second macro tool in the job, and so on. The naming convention for the first macro is **Macro-01** and then continues to count up for each workbench you add to the job template. You cannot rename or delete it.

In the **System Archive** and **Workflow Templates** section, existing macros are listed.

- Select the existing macro that you want to copy, and click **Copy to Task**.

→ A warning dialog opens informing you that you will overwrite the existing task macro with the selected macro.

- Click **Yes**.

→ A dialog opens that allows you to overwrite the name of the task macro with the name of the selected macro.

- Click **Yes**.

The code of the selected macro is added to the task macro and the name of the task macro is renamed according to the macro whose code has been copied.

### 6.7.5 Managing Macros

- Prerequisite** ✓ You have opened the **OAD Macros** workbench with the **OAD Macro** tool.
1. Click **Macro Editor**.  
→ The macro editor dialog opens.
  2. Right click the macro in the list on the right.  
→ A context menu is displayed.
  3. Select the action you want to perform for the respective macro, e.g. **Delete** or **Rename**.
  4. Alternatively, you can also use the **File** menu to manage the currently selected/open macro.

#### See also

- 📖 Creating a Macro [▶ 334]
- 📖 Debugging a Macro [▶ 336]
- 📖 OAD Macros Workbench [▶ 746]

### 6.7.6 Running a Macro

- Prerequisite** ✓ You are in **Free Mode** or **Job Mode** and have opened the **OAD Macros** workbench with the **OAD Macro** tool.
1. Select the macro in the **Selection** section.  
→ If you want to load a macro you have available in a file, you need to add it to the software first, see *Importing and Exporting a Job* [▶ 52].
  2. Click **Apply**. Alternatively, open the **Macro Editor** and click **Run**.  
→ The macro is executed.  
→ If the macro does not end automatically or does not work properly, you can enforce termination by clicking **Stop**.

#### See also

- 📖 Creating a Macro [▶ 334]
- 📖 Managing Macros [▶ 336]
- 📖 Debugging a Macro [▶ 336]
- 📖 OAD Macros Workbench [▶ 746]

### 6.7.7 Debugging a Macro

Macros are debugged from within the **Macro Editor**.

- Prerequisite** ✓ The macro to be debugged is opened in the **Macro Editor**.
1. Right-click a variable name in the macro source code and select **Add Watch**.  
→ The variable is added to the **Watch** tab.




After entering all variables and functions to be monitored, you can debug the macro using one of following actions:

Action	Description
<b>Run</b>	Runs the macro without debugging.
<b>Debug</b>	Runs the entire macro in debug mode.



Action	Description
	Execution of the macro halts at previously defined breakpoints.
<b>Step Over</b>	Runs the macro line by line. If the current line contains a function call, the function is executed. The debugger continues in the next line of the macro.
<b>Step Into</b>	Runs the macro line by line. If the current line contains a function call, the debugger jumps into the function. The function is then executed line by line. After the function has finished, the debugger jumps back into the macro to the next line after the function call.
<b>Stop</b>	Halts the debugger at the current line.
<b>Reset</b>	Deletes any macro or debugger memory entries. Use reset to ensure a clean debug run after having debugged before, e.g. if you made corrections to the code and wish to debug anew.
<b>Breakpoint</b>	Marks the current line as a breakpoint. If you wish to use simple debugging instead of the line-by-line debugging methods, execution halts at a breakpoint. This enables you to monitor your previously defined variables and functions at pre-defined positions. Debugging this way is usually faster than using the line-by-line debugging methods, but requires knowledge about where to look for possible bugs.
<b>Set Line</b>	Runs and debugs the current line, i.e. the line of the current cursor position.

### See also

-  Creating a Macro [► 334]
-  Managing Macros [► 336]
-  OAD Macros Workbench [► 746]

## 6.8 ZEN Connect

This module enables you to work with images from multiple sources: zoom in from the full macroscopic view of your sample down to nanoscale details. **ZEN Connect** is the efficient way to analyze and correlate images from multiple sources. It works with images from SEM, FIB-SEM, X-ray, light microscopes and any optical images, e.g. from your digital camera. Its sample-centric workspace lets you build a seamless multimodal, multiscale picture of your sample. Use it to guide further investigations and target additional acquisitions.

Understand your sample fully. **ZEN Connect** employs a novel graphical user interface concept that makes it easy to investigate all your samples. Design a workflow tailored precisely to the complexity of your experiment, no matter whether it's a simple one-step task or a compound experiment. A sophisticated workflow environment guides you all the way from the setup for automated acquisition to post processing and customized exports, and right on through to analysis.

**ZEN Connect** lets you manage, align, and export images in correlation with images from other sources.

### 6.8.1 Licensing and Functionalities of ZEN Connect

For working with **ZEN Connect** projects or images, you might need a separate license file. The basic **ZEN Connect** functionality is available for all versions. This functionality includes:

- **ZEN Connect** correlative workspace, including the display of images with their context.
- Manual alignment of captured images.
- Auto-registration of images using stage coordinates.
- Image acquisition into the project.
- Import of images into the correlative workspace.
- Interactive control of stage movement from the correlative workspace.

#### Licensed Functionality

If you have the necessary license, additional functionality is available.

- Import of Third-party images (Bio-Formats).
- Export of a **ZEN Connect** view as a single image.
- Movie export as fly-through video.
- S&F calibration.
- Definition of regions of interest in the correlative workspace.
- Retrieval of defined regions of interest.

### 6.8.2 Loading an Image and Adding it to the ZEN Connect Project

You can add simple images, such as camera images or more complex images, such as a light microscope image with overlays, into your **ZEN Connect** project.


You can use an imported image as a backdrop to navigate the region. You can correlate imported images with sample holder marks, e.g. fiducials or other images through the alignment process. The imported image is displayed according to its position in the **Graphical view** along with any other image in the project. **ZEN Connect** saves the results to the archive. You can restore results from the archive.

Any time you open an image with the **Load Image** or the **Load image from ZEN Data Storage** tool, it is added to the **ZEN Connect** project.

#### Info


Open the **ZEN Connect** workbench before performing a S&F calibration.

**Prerequisite** ✓ You have opened a **ZEN Connect** project.

1. On the **Load File** workbench, add the **Load Image** tool or the **Load image from ZEN Data Storage** tool if you want to add an image from the Data Storage.
2. Click on the browse button  to select an image in the respective tool.
  - ➔ In case of the **Load Image** tool, the usual Windows explorer opens to select the image. For the **Load image from ZEN Data Storage** tool, the **Browse ZEN Data Storage** dialog opens. It displays all images in the data storage and you can search the images and also sort the list of images, e.g. by name, size, etc.
3. Click on **Open** or **OK** to confirm your selected image.
4. Click on **Apply**.

- The image is loaded and displayed in the **Image view**. It is also displayed in the Documents Area on the right.
- In the **Project view**, the image is displayed in the tree, subordinated to **Imported Data** unless it contains session information.
- If Shuttle & Find-calibration is available for the image, the image is placed in the **Image view** according to the Shuttle & Find stage position. Take care that you select the correct sample holder when importing an S&F-calibrated image. The correct sample holder is the same sample holder that was used during acquisition. If no Shuttle & Find data is available, the image is displayed in the **Image view** according to its stage coordinates.

### See also

 User Interface - Free Mode [► 39]

## 6.8.3 Non Image Data

In Zen Connect, it is also possible to import (via drag & drop) non image data into your project, have a visual representation (marker) of it in your image area, and align the position of the data marker with respect to the images in the project. The data is listed under **Non-Image Data** in the tree of the **ZEN Connect** tool and represented by this marker in the image area:



Per default, the marker for this non image data is toggled invisible. To toggle data visible and invisible, see *Toggle the Visibility of Data* [► 343].

### EDS spectral images

EDS spectral images contain specific metadata that determine their handling in a ZEN Connect project. If you add EDS spectral images to a ZEN Connect project, they are added as non image data because they have the special document subtype metadata **ChartImageDocument**. In this case the marker is visible by default. EDS spectral images are also placed at a certain position in the ZEN Connect project, determined by the **SpatialRelations** and **Scaling** metadata information.

### See also

 Aligning Non Image Data [► 352]

## 6.8.4 Raman Images

If you have licensed **ZEN Connect**, the software supports the display of images with the specific **Horiba LabSpec HDF5 Raman** image format. These supported images basically represent a map (**score map**) of intensities of the different channels. This means the higher the concentration of a detected material, the higher the displayed color saturation. To display the data the image codec HDF5 is used.

### Info

HDF5 is only used as a standard image codec to display this specific type of image (**Horiba LabSpec HDF5 Raman** image format) and is **not** a HDF5 import!

### Display of Raman Images

- The image can be opened just as any other image. In the file explorer, make sure that the file type is set either to **HDF5 (\*.h5)** or to **Image files**. Then the file(s) with the **Horiba LabSpec HDF5 Raman** image format can be selected.
- The files of this format can only be displayed, but changes to the image cannot be saved. To save the file after changing parameters (e.g. the image display curve), you have to save the image in another format like **\*.czi**.
- To display the image(s) the FLOAT values of the original file are converted or mapped to 16 bit format. **Exception:** If the values in the file contain constant, **NAN** or **INF** values, no conversion to 16 bit is done.

## 6.8.5 Import and Export

### 6.8.5.1 Importing a ZEN Connect Project

You can load any of your **ZEN Connect** projects to continue with your work. There are limitations when you work with ZEISS Atlas 5 projects.

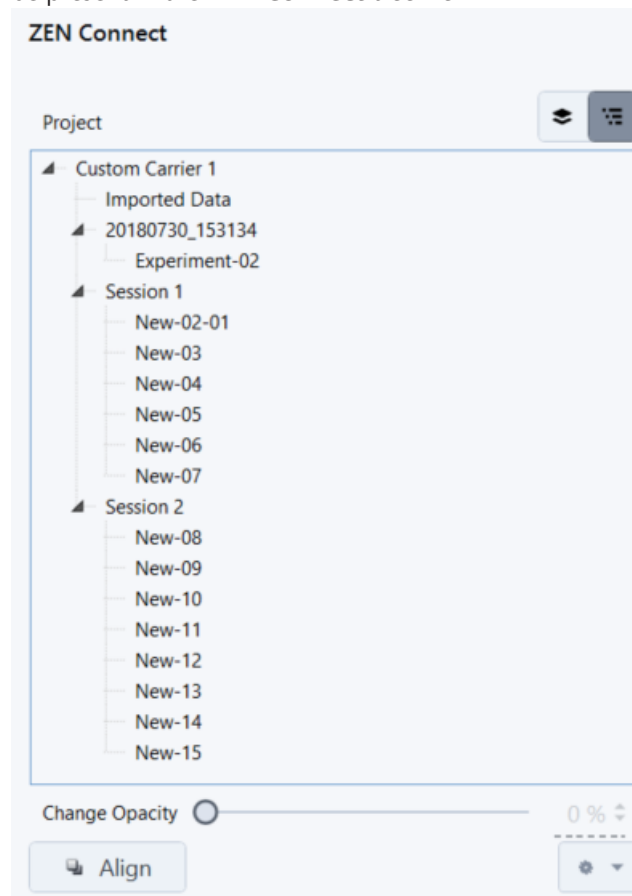
You can import a **ZEN Connect** project, even if an existing **ZEN Connect** project is loaded.

**Prerequisite** ✓ You have added the **Load File** workbench.

1. Add the **Import ZEN Connect Project** tool.
2. In the **Filename** field, navigate to the **.a5proj** project file and click **Open**.
  - ➔ A confirmation message is displayed. The currently opened **ZEN Connect** project will be replaced by the one to be opened. Note that all existing alignments and modifications will be lost, because your **ZEN Connect** project will be overwritten.
3. To continue, click **Yes**. To cancel the import, click **No**.


The project is imported and is loaded to the **ZEN Connect** tool. All images which are contained in the project are also loaded into ZEN core.

If a **ZEN Connect** project was added at the import time of a second project, the first project is discarded. Any images contained in this project will be integrated into the loaded project and will be present in the **ZEN Connect** tree view.





The newly imported second **ZEN Connect** project is displayed in the **Image view**.

### 6.8.5.2 Importing an Image into a Session

- Prerequisite**
- ✓ You have opened a ZEN Connect project.
  - ✓ You have added the **Import Images into Session** tool to the **Load File** workbench.
1. On the **Load File** workbench, in the **Import Images into Session** tool, click on the browse button  for **File Names**.  
→ A file browser opens.
  2. In the file browser, select the image(s) you want to import and click on **Open**.
  3. For **Correlative Session**, select the session of the ZEN Connect project where you want to import the image.
  4. If you want the image(s) to serve as background image, activate the checkbox **Background Image**.
  5. Click on **Apply**.

The images are imported into the selected session of the ZEN Connect project.

### See also

-  Import Images into Session Tool [► 360]
-  ZEN Connect [► 337]

### 6.8.5.3 Exporting Images from a ZEN Connect Project

You can export images from your **ZEN Connect** project as a single image for use in reports or publications. You can drag or resize the region to control the area that you want to export, or activate if image names and frames are shown on the exported image or not. You can pan and zoom using the mouse in the **Image view** to get fine control of the export area.

**Prerequisite** ✓ The **ZEN Connect Renderer** workbench is selected.  
 ✓ A **ZEN Connect** project is loaded.

1. In the **ZEN Connect Renderer** tool, select the images you wish to export and make your settings, see *ZEN Connect Renderer Tool* [▶ 357].
2. Click on **Apply**.

The image is added to the session and is displayed in the **Documents Area**.

To export an image to your computer, right-click the image in the **Documents Area** and select **Options > Save as**.

### 6.8.5.4 Exporting a ZEN Connect Project

You can export a **ZEN Connect** project to use it in **ZEN**.

**Prerequisite** ✓ You have loaded the **Save File** workbench and added the **Export ZEN Connect Project (for ZEN)** tool.

1. In the **Destination Folder** field, select the folder where you want to save the exported project file.
2. In the **Project Name** field, type in the **ZEN Connect** project name. The format is *<name>.a5proj*

The ZEN Connect project is exported to the destination folder. You can use it in **ZEN**.

### 6.8.5.5 Exporting a ZEN Connect Project as a Video

You can export your **ZEN Connect** project, an individual session, or an image from the project as a video.

**Prerequisite** ✓ You have opened the *ZEN Connect Video Renderer Workbench* [▶ 355] with the *Video Export Renderer Tool* [▶ 358].  
 ✓ You have loaded a **ZEN Connect** project.  
 ✓ In the loaded **ZEN Connect** project, you have activated and deactivated the respective areas of interest.

1. In the **Video Export** tool, select the image or the session you want to export in the **Project View**.
2. Choose your key frames by positioning the export area in the **Image View** and add them to the list of key frames by clicking on **Add current view as key frame**.
3. Make your settings and click on **Start Export**.  
 → A file browser opens.
4. In the file browser, name your video file and select a folder where your video should be exported to.
5. Click on **Save**.

Your video is now exported to the selected location. A progress bar indicates the status of the export.

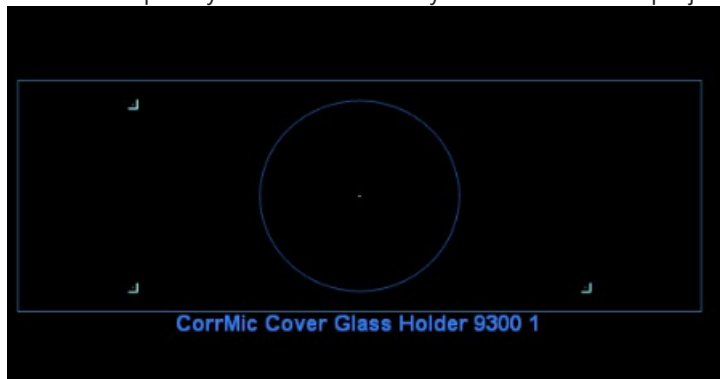
### 6.8.6 Selecting and Clearing Carrier/Holder

The sample is usually mounted on a carrier or directly on a sample holder. Select the appropriate sample holder for your configuration when you configure your project.

We offer specific sample holders and carriers with certain markers, e.g. "L"-markers or others. These CorrMic sample holders are necessary for a Shuttle & Find workflow. **Note:** If you change the carrier/holder after a S&F calibration, the S&F calibration needs to be redone.

**Prerequisite** ✓ You have loaded a **ZEN Connect** project.

1. In the button bar above the **Image view**, click the **Select Carrier/Holder** drop-down list.  
→ The **Select Template** dialog opens.
2. Select a template you want to add to your **ZEN Connect** project and click **OK**.



- The frame of the selected template is displayed in the **Image view** of your **ZEN Connect** project.
3. To deselect the carrier/holder, click the **Select Carrier/Holder** drop-down list and select **Clear/Carrier Holder**.

### 6.8.7 Toggling the Display of Region Caption and Frame

For a better overview, you can toggle the display of the image name and of the frame of images in the **Image view** of your **ZEN Connect** project.

**Prerequisite** ✓ You have loaded a **ZEN Connect** project.

1. To toggle the region caption, in the button bar above the **Image view**, click **Toggle Region Captions**



The region caption of the images are displayed or hidden.

### 6.8.8 Toggling the Visibility of Data

In the **ZEN Connect** tool you can toggle the visibility of data in the **Project view** as well as in the **Layer view**.

#### Project View

1. Right-click the image or non image data in the **ZEN Connect** tool and select **Show/Hide**. Alternatively, right-click the image or non image data marker in the image area and select **Show/Hide**.

You have toggled the data visible/hidden.

### Layer View

1. Click on the eye icon on the right of the data.

The data is toggled visible  or hidden .

## 6.8.9 Selecting Region

You select a region to later apply the **Alignment Mode** to the image contained in this region.

**Prerequisite** ✓ You have loaded a **ZEN Connect** project.

1. In the button bar above the **Image view**, click **Select Region**




The image in the selected region is activated.

Both in the **Project view** and in the **Layers view**, the image within the selected region is highlighted.

## 6.8.10 Panning & Zooming

**Prerequisite** ✓ You have loaded a **ZEN Connect** project and activated the alignment process.

1. In the button bar above the **Image view**, click .

With your mouse, or alternatively, with the pressed **Ctrl** key, you can pan and zoom in and out in the **Image view**.

## 6.8.11 Toggling View Modes

In ZEN Connect you can switch between two different view modes for your projects. The default is the carrier or holder view mode, where the coordinate system of the correlative workspace is aligned with the screen and images on the current system might be rotated. The second is the stage centric view mode, where the coordinate system of the current session and Field of View is aligned with the screen and the sample as well as other sessions might be rotated.

**Prerequisite** ✓ You have opened a ZEN Connect project.

1. In the button bar above the **Image View**, click on the button for the carrier/holder view mode  or the stage centric view mode .

The view is changed according to the selected view mode.

## 6.8.12 Alignment

The module **Shuttle & Find** allows the correlation of two images, see *Shuttle & Find* [▶ 366].

Additionally to that functionality, in a **ZEN Connect** project, you can manually align images in your workspace to correct their position or size with respect to the samples. To do so, you activate the alignment process and start aligning image data. Alternatively, you can use the **ZEN Connect Alignment** workbench for a detailed manual alignment, see *Aligning Images with ZEN Connect Alignment Workbench* [▶ 352].

### See also

 ZEN Connect Alignment Workbench [▶ 355]



### 6.8.12.1 Activating the Alignment Process

The alignment process lets you align your current session with fiducial marks or previous images. You can align image data manually.

**Prerequisite** ✓ A **ZEN Connect** project is loaded.

1. In the **Layer view**, or in the **Project view**, select the image you want to align. Alternatively, you can select a session node to select a couple of images or click **Select Region**



and select the image you want to align.

- ➔ The image is marked with a square in each frame corner. As long as the alignment process is not activated, this is indicated with a little lock next to the cursor.
2. On the selected image, right-click **Align Data**. Alternatively, in the **Project/Layers** tool, in the **Layers view** or in the **Project view**, right-click and select **Align Data**.

You have activated the alignment process for one or more images. The Alignment toolbar is displayed below the **Image view**. You can start aligning image data. If you start an alignment on a session node, the set alignment is used for all current and future images of the session. You can use this if you change your sample between different systems and want to align their coordinate systems to each other.

### 6.8.12.2 Aligning Image Data

In the alignment process, you have various options to align image data. Note that you can change the alignment mode during the alignment process. The alignment edits you have made are preserved, but you have to restart the pinning process if you have inserted any pins before changing the mode.

Note that the alignment process can be executed multiple times. Each time you run the alignment process, the end result of the last alignment is used as the starting point for the new alignment. If the initial image was far out of alignment at the start, it is easiest to do the alignment process once roughly, and then do the alignment process a second time with more precision. The second alignment will use the first alignment as a starting point, and will allow you to establish a more precise alignment quickly.

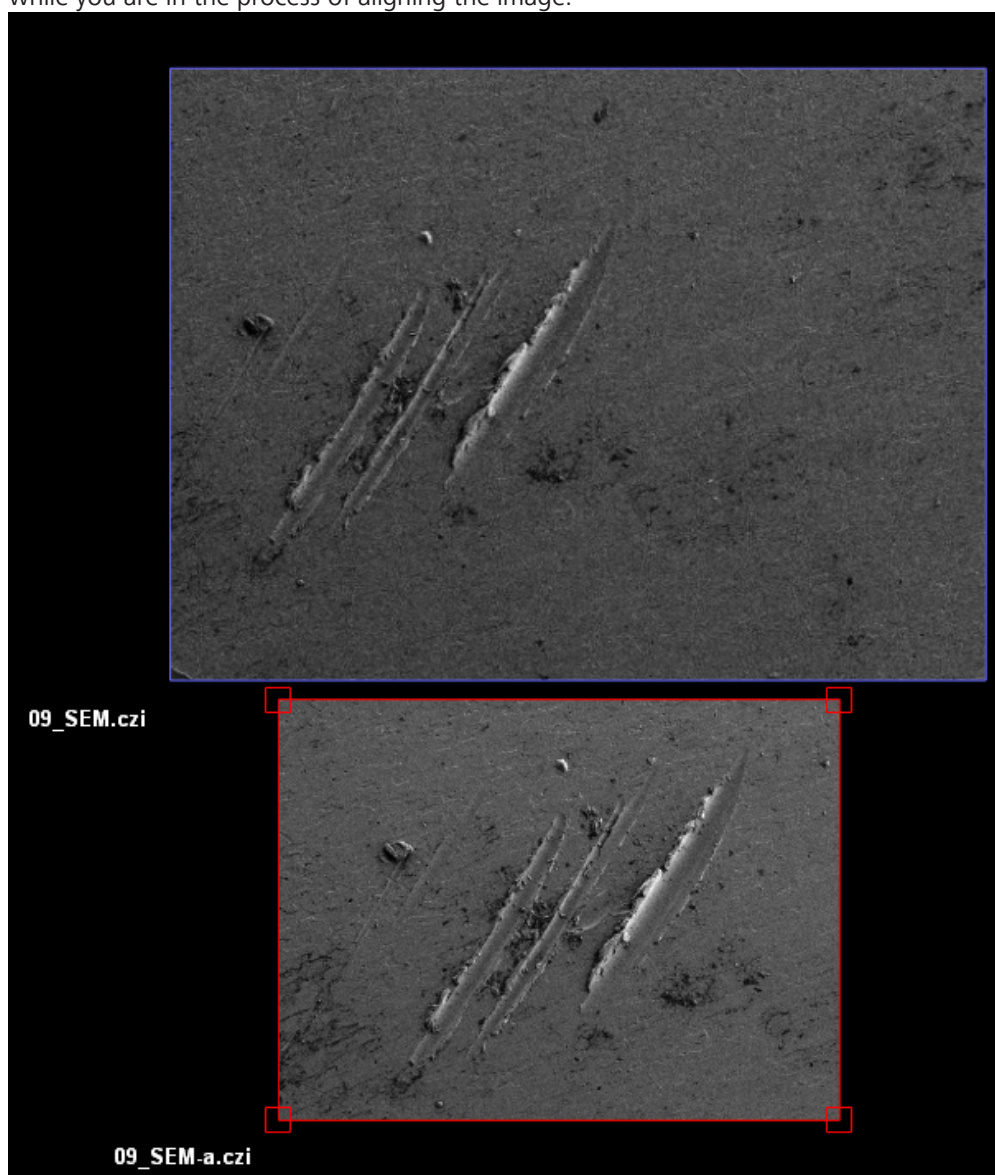
**Prerequisite** ✓ You have loaded a **ZEN Connect** project and activated the alignment process.

1. In the **Alignment** toolbar, select one of the following alignment modes, and select the region you want to align.

#### **Translate Only**

1. Click and drag with the mouse to translate the image you are aligning with respect to everything else.

- You can zoom in and out with the mouse wheel, or press and hold the **Ctrl** key to pan while you are in the process of aligning the image.



### Translate and Rotate Only

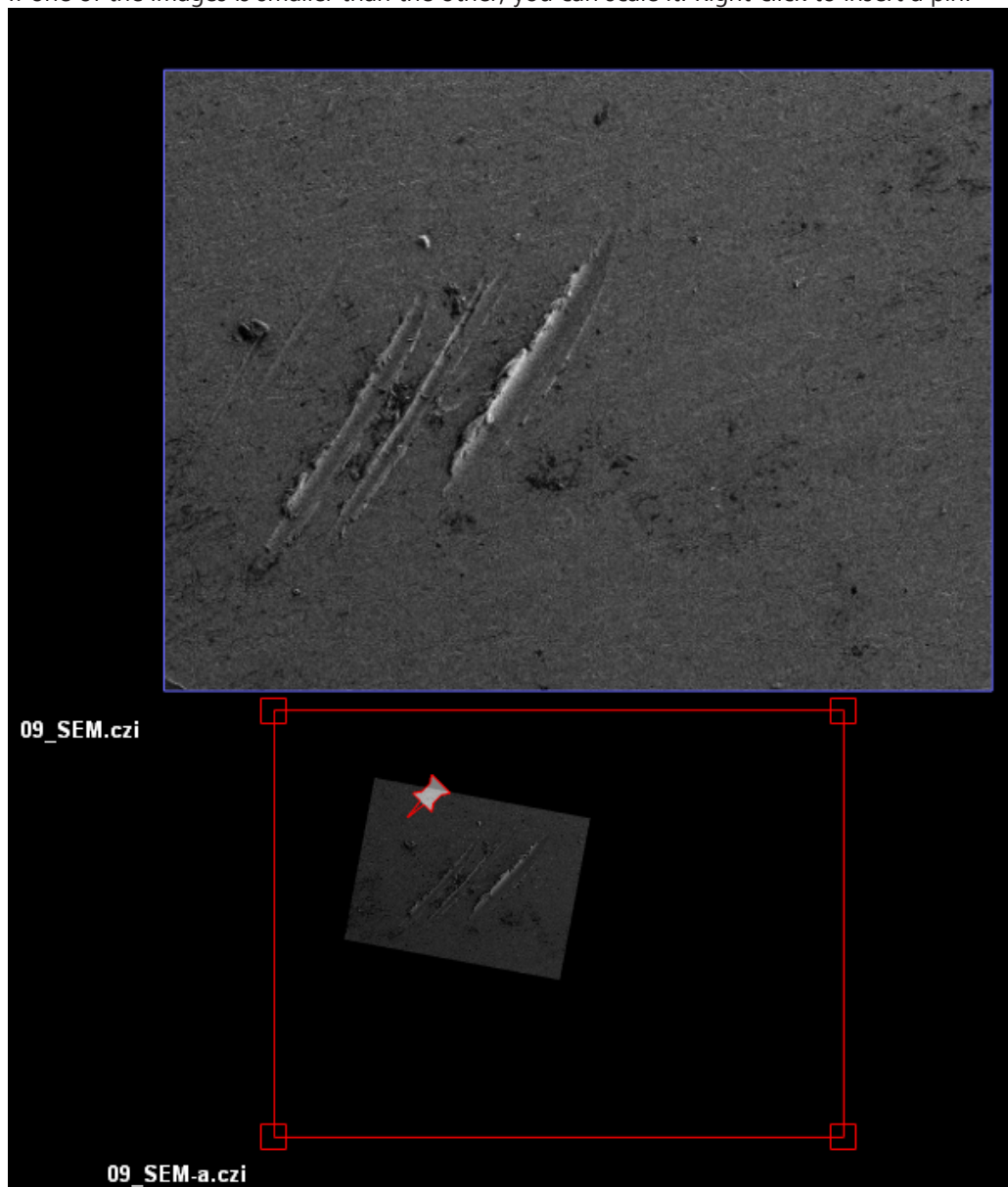
1. Right-click at the location you have lined up to insert the first pin, a red and grey pin icon. The pin locks the image to the reference at this location. Press **DEL** to remove the last pin you inserted.

- After you insert the first pin, your input will rotate the item around the first pin, when dragging it with the mouse.

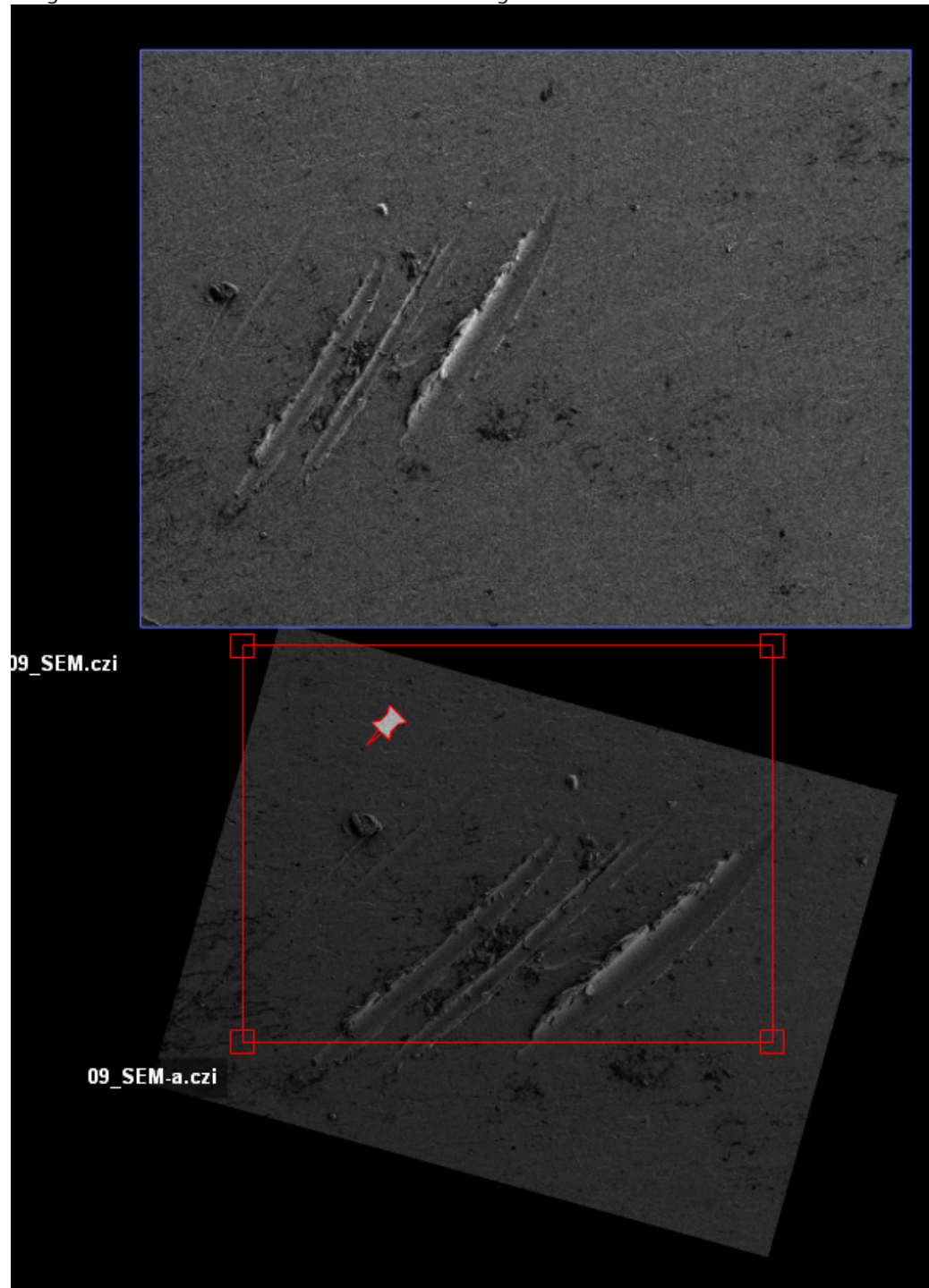


**Translate, Rotate and Scale Only**

1. If one of the images is smaller than the other, you can scale it. Right-click to insert a pin.



2. Drag with the mouse to scale and rotate the image.



### Translate, Rotate, Scale and Shear

1. Right-click to insert a second pin, and drag with the mouse to shear the image.



→ After you insert the second pin, your input will also stretch and shear the item.

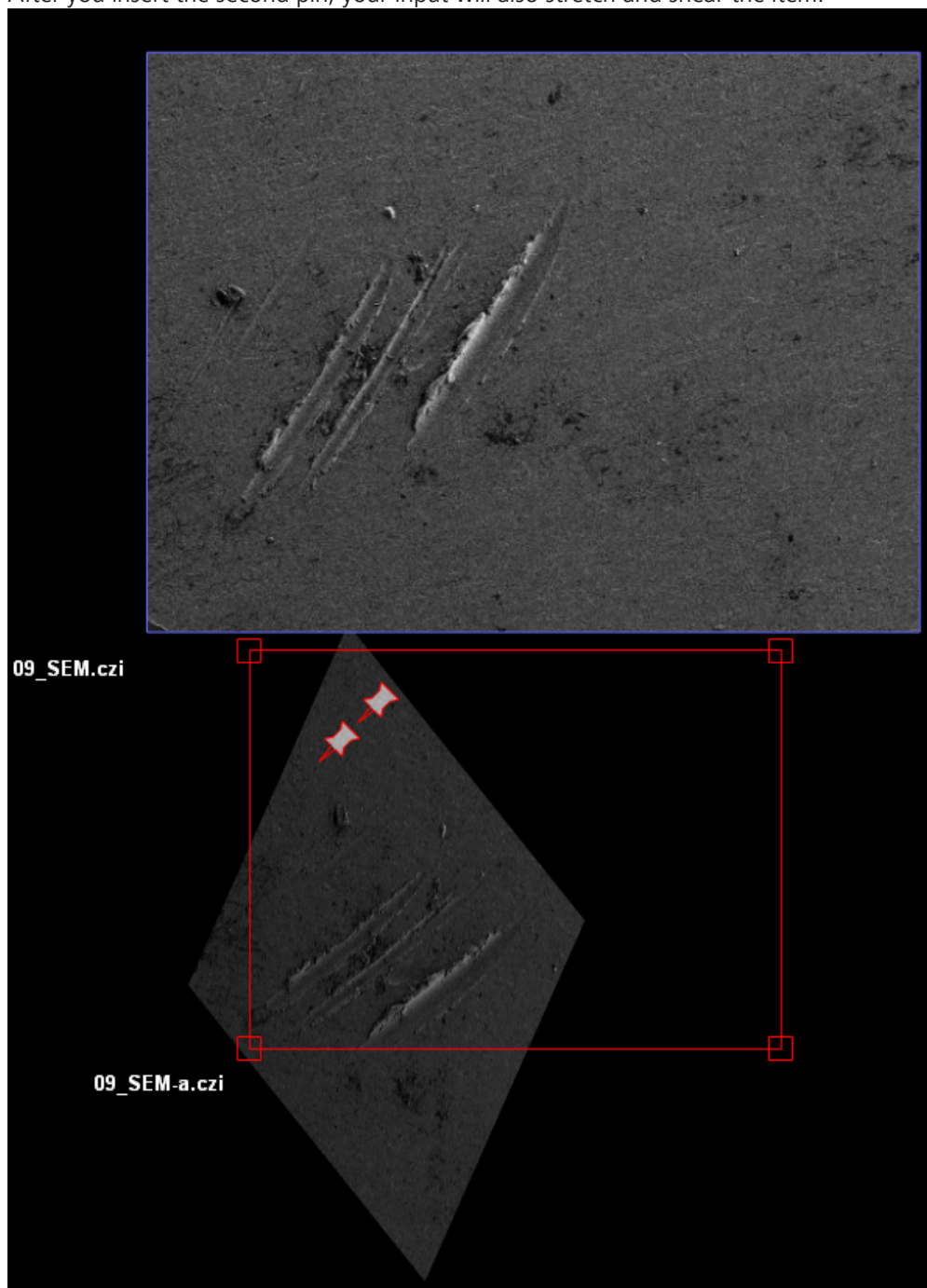
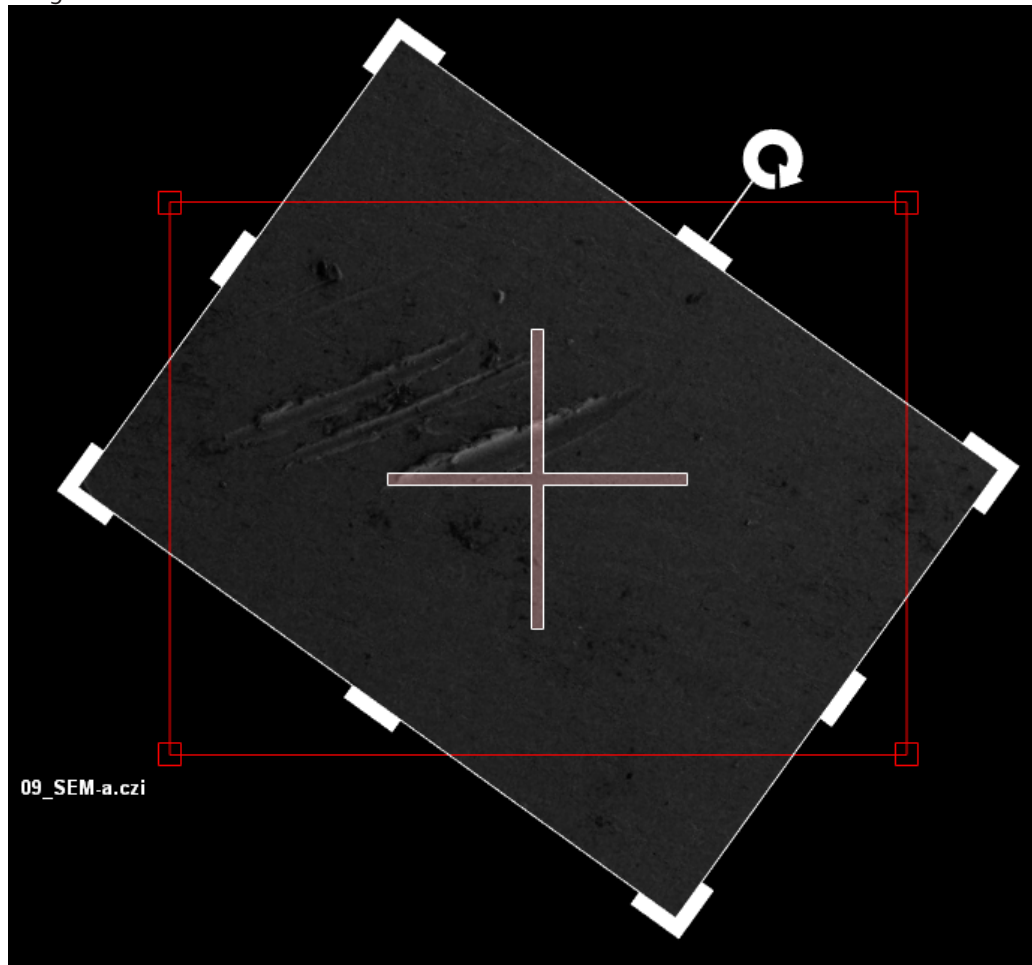


Image data from microscopes should not need to be stretched or sheared to perform alignment. If you need to provide much input after inserting the second pin, this might be an indication of other problems, such as equipment calibration issues.



### Alignment Handles

1. If you select **Alignment Handles**, you can use handles to rotate, translate, and scale the image.




### Flipping the image horizontally and vertically


You can flip your image, to mirror it.

1. To flip the image horizontally, click .
2. To flip the image vertically, click .

### Reset alignment

1. To reset the alignment you performed, click .
  - The alignment is reverted as it was when you started aligning. The Alignment mode is still activated.

### Cancel alignment

1. To cancel the alignment you performed, click .
  - The current alignment is cancelled and reverted to the alignment in place before you started the Alignment Mode. The alignment mode is not activated any longer.

### Finish alignment

1. Click **Apply** to finish the alignment mode and to apply the alignment information.

### 6.8.12.3 Aligning Non Image Data

**Prerequisite** ✓ You have opened a ZEN Connect project with non image data.



1. In the **ZEN Connect** tool or in the image view, right-click the non image data and select **Align Point Position**. Alternatively, in the **ZEN Connect** tool, select the non image data and click on the **Align** button.  
→ You enter the alignment mode and the marker color changes to blue.
2. In the image area, click at the position where you want to place the none image data.
3. Click on **Apply**.

You have aligned your non image data.

### 6.8.12.4 Aligning Images with ZEN Connect Alignment Workbench

**Prerequisite** ✓ You have opened a ZEN Connect project in the **ZEN Connect Alignment** workbench.

✓ You have added the necessary alignment tools to the workbench.

1. In the image area or in the tree of the **ZEN Connect Alignment** tool, select the image you want to align.
2. To translate the selected image, in the **Translate** tool, set the distance in x and y direction. Alternatively, translate the image via drag and drop in the image area.  
→ The translation is immediately displayed in the image area.
3. To scale the image, in the **Scale** tool, set the scaling factor in x and y. Alternatively, use the handles displayed around the image for scaling.  
→ The scaling is adjusted according to the input.
4. To rotate the image, in the **Rotate** tool, select the **Rotation Center** and then enter an **Angle**. The current rotation center is represented in the image by a pin. Alternatively, set the pin manually via drag and drop in the image and rotate the image with the handle.  
→ The selected image is rotated.
5. To flip/mirror the image horizontally, in the **Flip/Mirror** tool, click .
6. To flip/mirror the image vertically, in the **Flip/Mirror** tool, click .
7. If you want to shear your image, in the **Shear** tool, activate **Enable**.  
→ Additional shearing pins are displayed in the image. The two pins that form the "base-line" for shearing are connected by a line.
8. Use the two pins to position the baseline and then move the pinpoint to shear the image.  
→ The result is displayed instantly in the image area.
9. Click **Apply** to save all alignment changes.

You have aligned the selected image in the ZEN Connect project.

## 6.8.13 Using Regions of Interest in ZEN Connect

**ZEN Connect** offers the functionality to draw and delete regions of interest (ROI) in a project. The regions are shown in the project and they are saved and loaded together with the project.

### 6.8.13.1 Drawing a Region of Interest in ZEN Connect

**Prerequisite** ✓ You have loaded a **ZEN Connect** project.

✓ You have added the **ROI List** tool to the **ZEN Connect** workbench.

1. In the **ROI List** tool, click .




2. Draw a rectangular region into your project.

The Region of Interest is displayed in the **ROI List** tool.

#### 6.8.13.2 Deleting a Region of Interest in ZEN Connect

- Prerequisite**
- ✓ You have loaded a **ZEN Connect** project with Regions of Interest.
  - ✓ You have added the **ROI List** tool to the **ZEN Connect** workbench.


1. In the Image View or the **ROI List** tool, right-click the Region of Interest and select **Delete**.

Alternatively, select the region in the **ROI List** tool and click .

The selected region is deleted.

#### 6.8.13.3 Renaming a Region of Interest in ZEN Connect

- Prerequisite**
- ✓ You have loaded a **ZEN Connect** project with Regions of Interest.
  - ✓ You have added the **ROI List** tool to the **ZEN Connect** workbench.

1. In the **ROI List** tool, right-click the region in the **ROI List** tool and select **Rename**. Alternatively, select the region in the **ROI List** tool and click .
2. Type the new name and press **Enter**.

You have successfully renamed the Region of Interest.

#### 6.8.13.4 Zooming to a Region of Interest in ZEN Connect


- Prerequisite**
- ✓ You have loaded a **ZEN Connect** project with Regions of Interest.
  - ✓ You have added the **ROI List** tool to the **ZEN Connect** workbench.

1. In the Image View or the **ROI List** tool, right-click the Region of Interest and select **Zoom To**.

The view zooms to the selected region.

#### 6.8.13.5 Moving the Stage to a Region of Interest in ZEN Connect

- Prerequisite**
- ✓ You have loaded a **ZEN Connect** project with regions of interest.
  - ✓ You have added the **ROI List** tool to the **ZEN Connect** workbench.

1. In the Image View or the **ROI List** tool, double click on an entry of a region. Alternatively, select an entry and click , or right click the entry and select **Move to**.

The stage moves to the center of the respective region.

### 6.8.14 Adding Measurements to a ZEN Connect Project

- Prerequisite**
- ✓ You have loaded a **ZEN Connect** project.
  - ✓ You have added the **Measurements** tool to the **ZEN Connect** workbench.




1. In the **Measurement** tool, click on the button for the respective measurement tool.

2. In the image view, click to set the points for the measurement. For a distance measurement, set two points, for an angle three and for an area measurement create a polygon that covers the desired area.
3. In case of area measurements, the last click has to be at the first point to "close" the polygon. Alternatively, click with the right mouse button to finish the polygonal area.
  - The respective measurement is displayed in the view as well as the table of the **Measurement** tool.

You have added a measurement to your ZEN Connect project.

### 6.8.15 Editing Measurements in a ZEN Connect Project

**Prerequisite** ✓ You have opened a ZEN Connect project and added a measurement, see *Adding Measurements to a ZEN Connect Project* [▶ 353].

1. In the button bar above the **Image view**, click .
  - You are now in edit mode.
2. To resize measurements, click on the end points of a measurement to drag and drop them. In case of an area measurement, you cannot rescale the contour.
  - The measurement values are updated instantly.
3. To move a measurement, drag and drop the respective measurement in the **Image view**.
4. To change the **Name** of a measurement, in the **Measurement** tool, double click the current name in the table.
  - The name in the field gets editable.
5. Enter the desired name and press **Enter**.
  - The measurement is renamed.
6. To toggle the visibility of a measurement, click  for the respective entry in the list.
  - The measurement is toggled (in-)visible.
7. To delete a measurement, select the measurement in the list and click . Alternatively, select the measurement and press **Del**.
  - The measurement is deleted.

### 6.8.16 Using the Global-Z slider

In ZEN Connect you can use a mode called **Global-Z** if you have a project with at least one z-stack. In this mode, you can change the displayed z plane of all z-stacks in the project with only one slider, the **Global-Z** slider. The range of the slider is comprised of the z values of all stacks in the project. The displayed slice for each stack is always the one closest to the value set by the **Global-Z** slider, as long as the value is within the boundaries of the entire stack. When you use the **Global-Z** slider and are beyond the range of a certain z-stack, only a frame is displayed to show where the stack is positioned.

**Note:** If you have selected a particular z-stack, the **Global-Z** and **Z-Position** sliders are interdependent. Changing the value with one slider updates the other slider as well.


**Prerequisite** ✓ You have one or several z-stacks in the ZEN Connect project.

1. Activate the **Global-Z** checkbox on the **Dimensions** tab.
2. Use the slider or the input field to set a global value for z.

All the slices closest to the set value are displayed for all z-stacks. Z-stacks which are out of range are illustrated by an empty frame.

### 6.8.17 Creating a Snapshot of the Workspace

**Prerequisite** ✓ You have opened a ZEN Connect project.

1. Prepare the view according to your needs, e.g. zoom to a desired area, or hide images that should not be visible in the snapshot.
2. In the button bar above the **Image View**, click .

A snapshot of the current view in the workspace is created. In **Free Mode**, the snapshot image is added to the gallery on the right. In **Job Mode**, the snapshot image is added to the job result.

### 6.8.18 Workbenches/Tasks




#### 6.8.18.1 ZEN Connect Workbench

This workbench enables you to manage your data in a project structure tree combined with the viewer. Additionally, you can draw regions of interest into your project and add measurements to the project. Before loading any images, you need to open the **ZEN Connect** project to display images correlatively. Only within a **ZEN Connect** project, you can use all **ZEN Connect** functionalities. You can open only one **ZEN Connect** project at a time.

#### Info

Open first the **ZEN Connect** workbench before performing a S&F calibration.

#### See also

-  ZEN Connect Tool [▶ 356]
-  Measurements Tool [▶ 361]
-  ROI List Tool [▶ 360]

#### 6.8.18.2 ZEN Connect Renderer Workbench

This workbench enables you to configure the parameters of the image you want to export to the **Documents Area**, see also *ZEN Connect Renderer Tool* [▶ 357] and *Exporting Images from a ZEN Connect Project* [▶ 342].


#### 6.8.18.3 ZEN Connect Video Renderer Workbench






This workbench enables you to configure the parameter to export your ZEN Connect project or an individual session or image as a video, see *Video Export Renderer Tool* [▶ 358] and *Exporting a ZEN Connect Project as a Video* [▶ 342].

#### 6.8.18.4 ZEN Connect Alignment Workbench

This workbench enables you to align the images of your ZEN Connect project with various operations, see *Aligning Images with ZEN Connect Alignment Workbench* [▶ 352].

#### See also


-  ZEN Connect - Alignment Tool [▶ 361]
-  Translate Tool [▶ 362]

-  Rotate Tool [▶ 362](#)
-  Scale Tool [▶ 362](#)
-  Flip/Mirror Tool [▶ 363](#)
-  Shear Tool [▶ 363](#)
-  ZEN Connect [▶ 337](#)

## 6.8.19 Tools


### 6.8.19.1 Import Bioformats Image Tool

This tool enables you to use Bioformats as an integrated library for reading and writing image file formats. It is capable of parsing both pixels and metadata for a large number of formats. It achieves this by converting proprietary microscopy data into an open standard called the OME data model. With Bioformats, you can read proprietary formats and convert them. For example, it is possible to load simple images you can import, such as camera images or more complex images, such as a light microscope image with overlays, to **ZEN core**.

Parameter	Description
<b>File Name</b>	The path and filename of the table to be loaded Click on  to open the file browser and select the desired file.

For more information, see *ZEN Connect* [▶ 337](#).



### 6.8.19.2 Import ZEN Connect Project Tool


Parameter	Description
<b>Filename</b>	The path and filename of the project to be loaded. Click on  to open the file browser and select the desired project. For more information, see <i>Importing a ZEN Connect Project</i> <a href="#">▶ 340</a> .

For more information, see ZEN Connect Module.

### 6.8.19.3 ZEN Connect Tool

Within a **ZEN Connect** project, you manage your data in a project structure tree combined with the viewer.

Parameter	Description
 <b>Project /</b>  <b>Layers</b>	The <b>ZEN Connect</b> tool provides a <b>Layers view</b> and a <b>Tree view</b> of image data that you have acquired for the <b>ZEN Connect</b> project. Every image that you have acquired for the <b>ZEN Connect</b> project is listed. As you acquire or import more image data, the new image data will be listed in the views.
<b>Change Opacity</b>	Adjusts the opacity of detected objects.
<b>Align</b>	Activates the alignment process for the selected data, see <i>Activating the Alignment Process</i> <a href="#">▶ 345</a> .

Parameter	Description
<b>Align System</b>	Activates the alignment process for the current microscope session, see <i>Activating the Alignment Process</i> [▶ 345].
<b>New Session</b>	Creates a new session.
 <b>Context Menu</b>	Displays the context menu for ZEN Connect, see <i>Context Menu</i> [▶ 364].

For more information, see *ZEN Connect* [▶ 337].

### See also

 ZEN Connect Workbench [▶ 355]



#### 6.8.19.4 ZEN Connect Renderer Tool

Parameter	Description
<b>Tree View tool</b>	For more information, see <i>ZEN Connect Tool</i> [▶ 356].
<b>Color Style</b>	Controls the color format of the export. Select <b>RGB</b> (color) or <b>Intensity</b> (black and white).
— RGB Color	Based on the RGB (Red-Green-Blue) color model. Be aware that color files may be up to three times as large as intensity files.
— Intensity	Images are saved in 8-bit format.
<b>Export Format</b>	Selects the format for the exported file.
— CZI image (Single Channel)	Exports the image as a Carl Zeiss Image file. CZI files are not limited in size. The images are exported in a single channel CZI.
— CZI image (Multi-Channel)	Exports the image as a Carl Zeiss Image file. CZI files are not limited in size. The images are exported as a multi-channel CZI. Note that the resulting image might look different when reopened in <b>ZEN</b> than it does in <b>ZEN Connect</b> .
<b>Burn in Data Bar</b>	<b>Activated:</b> Burns the currently configured data bar into the exported image.
<b>Rotation</b>	Rotates the view to the desired orientation. Drag the slider, or in the text field, type in the value.
<b>Pixel Size</b>	Sets the pixel size of the export. The smaller the pixel size, the more disk space your export will take. The options <b>Low</b> , <b>Medium</b> and <b>High</b> only have an effect, if several images are exported as a single image.
— Smallest	Sets pixel size of the finest image, i.e. the smallest pixel size.
— Medium	Calculates and sets the pixel size to the log average of finest and coarsest image (i.e. $10^{(0.5 \cdot (\log(\text{fine}) + \log(\text{coarse}))})$ ).
— Largest	Sets pixel size of the coarsest image, i.e. the largest pixel size.
— Custom	Sets a custom pixel size which can be entered in the input field.
<b>Width (px)</b>	Sets the width to directly alter the export pixel count and export area (the pixel size is unchanged).

Parameter	Description
<b>Height (px)</b>	Sets the height to directly alter the export pixel count and export area (the pixel size is unchanged).
<b>Width (µm)</b>	Displays the full width of the export area in µm.
<b>Height (µm)</b>	Displays the full height of the export area in µm.
<b>Approx. Data Size</b>	Displays an approximation for the data size of the exported image. The actual file size after export may be less, depending on compression of some file formats.


For more information, see *Exporting Images from a ZEN Connect Project* [▶ 342].

#### See also

-  ZEN Connect [▶ 337]
-  ZEN Connect Renderer Workbench [▶ 355]

#### 6.8.19.5 Export ZEN Connect Project (for ZEN) Tool


This tool enables you to export a **ZEN Connect** project file to be used in **ZEN**.





Parameter	Description
<b>Destination Folder</b>	Displays the location on the disk where you want the project file to be saved.  Click on  to open the file browser and select the desired folder.
<b>Project Name</b>	Enter the project file name with the format <code>&lt;name&gt;.aproj</code>

For more information, see

- *ZEN Connect* [▶ 337]
- *Exporting a ZEN Connect Project* [▶ 342]



#### 6.8.19.6 Video Export Renderer Tool

Parameter	Description
 <b>Project / Layers</b>	The standard <b>ZEN Connect Layers view/Tree view</b> of image data that you have acquired for the <b>ZEN Connect</b> project. Every image that you have acquired for the <b>ZEN Connect</b> project is listed. As you acquire or import more image data, the new image data will be listed in the views. Select here what data you want to export.
<b>Show Data Bar</b>	<b>Activated:</b> Burns the currently configured data bar into the exported video.
<b>Show Region Caption</b>	<b>Activated:</b> Shows the image names in the exported video.
<b>Show Region Outline</b>	<b>Activated:</b> Shows the image frames in the exported video.

Parameter	Description
<b>Export Resolution</b>	<p>Sets the resolution and format for the video export. Resolutions available in the drop-down list:</p> <ul style="list-style-type: none"> <li>320 x 240 (4:3)</li> <li>428 x 240 (16:9)</li> <li>640 x 480 (4:3) (=default value)</li> <li>854 x 480 (16:9)</li> <li>960 x 720 (4:3)</li> <li>1280 x 720 (16:9)</li> <li>1440 x 1080 (4:3)</li> <li>1920 x 1080 (16:9)</li> </ul>
<b>Zoom to Extent</b>	Places the image to the center of the preview area.
<b>Rotation</b>	You can use the slider or the input field to rotate the view.
<b>Start Delay</b>	Sets the delay at the start of the video. The default setting is 1,0 seconds.
<b>Key Frames</b>	Lists the key frames, including the data of the position and FOV.
 <b>Move Up</b>	Moves the selected key frame up in the list.
 <b>Move Down</b>	Moves the selected key frame down in the list.
 <b>Delete</b>	Deletes the selected key frame.
<b>Go to key frame</b>	Displays the selected key frame.
<b>Reset key frame to current view</b>	Sets the values of the selected key frame to the current view.
 <b>Options</b>	
— Load Export Key Frames	Loads stored key frames.
— Save Export Key Frames	Saves the key frames in XML format.
<b>Transit to</b>	Sets the transition time (in seconds) for zooming to a selected key frame.
<b>Wait at</b>	Sets the time (in seconds) to stay at the selected key frames.
<b>Return to first at end</b>	<b>Activated:</b> Returns to the first key frame at the end of the video.
<b>Add current view as key frame</b>	Adds the current view as a key frame.
<b>Preview export</b>	Displays a real-time preview of the video.





Parameter	Description
<b>Start Export</b>	Exports and saves the video in the folder defined in the file browser.

**See also**



-  ZEN Connect Video Renderer Workbench [► 355]
-  Exporting a ZEN Connect Project as a Video [► 342]

**6.8.19.7 ROI List Tool**

In this tool, you can see a list of your regions of interest (ROI) and edit or rename them.

Parameter	Description
 <b>Add ROI</b>	Adds a region into the Image View.
<b>List of ROI</b>	Here you see a list of all ROI in your ZEN Connect project. A double click on an entry moves the stage to the center of the respective ROI.
 <b>Delete</b>	Deletes the currently selected region of interest.
 <b>Rename</b>	Allows you to rename the currently selected region of interest.
 <b>Move to</b>	Moves the stage to the center of the currently selected region.

**See also**



-  ZEN Connect Workbench [► 355]
-  Using Regions of Interest in ZEN Connect [► 352]

**6.8.19.8 Import Images into Session Tool**

This tool enables you to import an image directly into a ZEN Connect session (e.g. as a background image).







Parameter	Description
<b>File Names</b>	Selects and displays the files which are imported.
<b>Correlative Session</b>	Selects the session where the image(s) should be imported.
<b>Background Image</b>	<b>Activated:</b> Imports the image(s) as background image.

**See also**




-  Importing an Image into a Session [► 341]
-  ZEN Connect [► 337]



### 6.8.19.9 Measurements Tool

Parameter	Description
<b>Measurement Tools</b>	
–  Distance	Allows the user to add two points to measure a distance.
–  Angle	Allows the user to add three points to measure an angle.
–  Area	Allows the user to draw a polygon contour to measure an area.
–  Circle	Allows the user to draw a circle to measure a diameter.
<b>Measurement table</b>	
– Value	Displays the measured value.
– Type	Displays the icon of the measurement type.
–  Visibility	Toggles the visibility of each measurement.
– Name	Displays the name of each measurement.
–  Delete	Deletes the currently selected measurement.
<b>Create Table</b>	Creates and opens a table document with the current measurement values.

#### See also

-  ZEN Connect Workbench [► 355]
-  Adding Measurements to a ZEN Connect Project [► 353]
-  Editing Measurements in a ZEN Connect Project [► 354]

### 6.8.19.10 ZEN Connect - Alignment Tool



Parameter	Description
<b>Apply</b>	Applies the changes for alignment.
<b>Discard</b>	Discards all changes for alignment.
<b>Project/Layers</b>	The tool provides a <b>Layers</b> view and a <b>Project</b> tree view of image data that you have in your <b>ZEN Connect</b> project.

Parameter	Description
<b>Undo</b>	Reverses the last alignment action(s).
<b>Redo</b>	Restores the last undone action(s).

**See also**

 ZEN Connect Alignment Workbench [► 355]


**6.8.19.11 Translate Tool**

Parameter	Description
<b>Step Size</b>	Sets the step size for the translation in x and y.
<b>X-Direction</b>	Sets the translation in x direction. The reset button  resets the value to the default.
<b>Y-Direction</b>	Sets the translation in y direction. The reset button  resets the value to the default.

**See also**

 ZEN Connect Alignment Workbench [► 355]



**6.8.19.12 Rotate Tool**

Parameter	Description
<b>Rotation Center</b>	Defines the rotation center around which the image is rotated. It is indicated in the Image View with a pin.
<b>Custom</b>	Takes the custom rotation center defined by the pin in the image.
<b>Angle</b>	Sets the rotation angle. The reset button  resets the value to the default.

**See also**

 ZEN Connect Alignment Workbench [► 355]



**6.8.19.13 Scale Tool**

Parameter	Description
<b>X-Dimension</b>	Sets the scaling factor in x direction. The reset button  resets the value to the default.
<b>Y-Dimension</b>	Sets the scaling factor in y direction. The reset button  resets the value to the default.

**See also**

 ZEN Connect Alignment Workbench [► 355]

**6.8.19.14 Flip/Mirror Tool**

Parameter	Description
 <b>Horizontally</b>	Mirrors the image in horizontal direction.
 <b>Vertically</b>	Mirrors the image in the vertical direction.

**See also**

 ZEN Connect Alignment Workbench [► 355]

**6.8.19.15 Shear Tool**

Parameter	Description
<b>Enable</b>	<b>Activated:</b> Activates the shearing mode and displays the three shearing pins in the image.
<b>Reset Shearing Pins</b>	Resets the pins to the default location.

**See also**

 ZEN Connect Alignment Workbench [► 355]

**6.8.20 Field of View Width Dialog**

Parameter	Description
<b>FOV Width</b>	Displays the current width of the field of view and allows you to enter a value.
<b>OK</b>	Sets the width to the entered value.
<b>Cancel</b>	Closes the dialog box without setting the field of view.

**6.8.21 Pixel Size Dialog**

Parameter	Description
<b>Pixel Size</b>	Displays the current pixel size and allows you to enter a value.
<b>OK</b>	Sets the pixel size to the entered value.
<b>Cancel</b>	Closes the dialog box without setting the pixel size.

## 6.8.22 Context Menu


In a **ZEN Connect** project, from the context menu of the image, in the **Tree view** or with the  **Context menu** button, you can perform several functionalities.

	Image	Tree view	Context Menu button
<b>Zoom to</b> For more information, see <i>Zooming</i> [▶ 364]	X	X	X
<b>Zoom to 100%</b> For more information, see <i>Zooming</i> [▶ 364]	X	X	X
<b>Show/Hide</b> For more information, see <i>Moving or Hiding Images</i> [▶ 365]	X	X	X
<b>Remove Data</b> For more information, see <i>Removing Data</i> [▶ 365]	X	X	X
<b>Rename Data</b> For more information, see <i>Renaming Data</i> [▶ 365]	X	X	X
<b>Align Data</b> For more information, see <i>Activating the Alignment Process</i> [▶ 345]	X	X	X
<b>New Session</b> For more information, see <i>Starting a New Session</i> [▶ 366]	–	–	X
<b>Clear Alignment</b> For more information, see <i>Clear Alignment</i> [▶ 366]	–	–	X
<b>Zoom to Extent</b> For more information, see <i>Zooming</i> [▶ 364]	–	–	X

### 6.8.22.1 Zooming

You have different options to zoom images in **ZEN Connect**. You can zoom images in and out of a field of view (FOV). As a prerequisite, a **ZEN Connect** project is loaded.

#### Zooming to

1. In the **Project tree view**, select an image, right-click > **Zoom to**. Alternatively, click **Context menu**



and select **Zoom to**. The function is also available from the context menu of the image in the **Image view**.

The image is centered in the view space of the **Image view**.

### Zooming to 100%

1. In the **Project tree view**, select an image, right-click > **Zoom to 100%**. Alternatively, click **Context menu**



and select **Zoom to 100%**. The function is also available from the context menu of the image in the **Image view**.

The image is zoomed in the view space of the **Image view** to 100%.

### Zooming to extent

1. In the button bar above the **Image view**, click **Zoom to Extent**



Alternatively, click **Context menu**



and click **Zoom to Extent**.

In the **Image view**, the sample holder is centered. All images in the **ZEN Connect** project are displayed.

#### 6.8.22.2 Moving or Hiding Images

In the **Layers view**, you can move images over and under other images, or hide them completely.

**Prerequisite** ✓ You have loaded a Connect project with at least two images.

1. To change the image order, in the **Layers view**, move the image by dragging it up or down.  
→ In the **Image view**, the changed order is immediately visible.
2. To hide the image from the **Connect project**, in the **Layers view**, activate or deactivate the image by clicking the **Eye** icon on the right of the image name. Alternatively, in the **Project view**, right-click **Show/Hide**.

The results of your changes are displayed immediately in the **Image view**.

#### 6.8.22.3 Removing Data

You can remove images from your **ZEN Connect** project. The data files will not be deleted from your disk.

1. In the **Project tree view**, select an image, right-click **Remove Data**. Alternatively, click **Context menu**



and select **Remove Data**. The function is also available from the context menu of the image in the **Image view**.

The selected image is removed from the **ZEN Connect** project.

#### 6.8.22.4 Renaming Data

**Prerequisite** ✓ You have loaded a **ZEN Connect** project.

1. In the **Project view**, in the **Layer view**, or in the **Image view**, select an image to rename, and choose **Rename Data**. Alternatively, click the **Context Menu**



and choose **Rename Data** or press the **F2**.

→ The corresponding image name is activated in the **Project or Layer view**.

2. Rename the image.

You have renamed the image. It is updated either in the **Layer view** or in the **Project view** respectively, as well as in the **Image view**.

#### 6.8.22.5 Starting a New Session

To organize your work or if you have moved your sample, you can start a new session within your **ZEN Connect** project any time.

**Prerequisite** ✓ You have loaded a **ZEN Connect** project.

1. In **ZEN Connect** in the **Project or Layers view**, click the **Context menu**



and click **New Session**.

A new session is activated. As soon as you acquire a new image, a new session node is created, and the new image will be subordinated. Note that you have to perform again an alignment of the newly created session to the old data.

#### 6.8.22.6 Clear Alignment

**Prerequisite** ✓ You have activated the alignment process and have aligned images.

1. Click **Context menu > Clear Alignment**.  
→ The session is restored to its un-aligned state.

## 6.9 Shuttle & Find

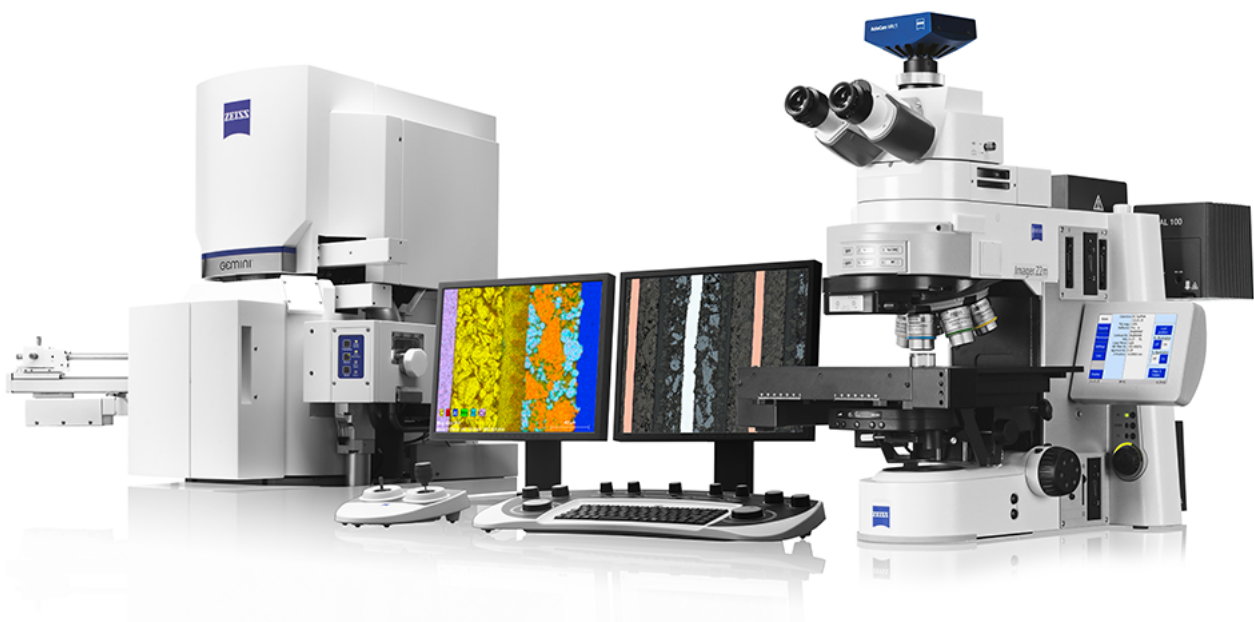


Fig. 15: SEM/LM system for correlative microscopy

This module enables you to relocate sample positions in two different microscopes, e.g. a light microscope and a scanning electron microscope (SEM), and the correlation of two images to one merged image. This technique is called correlative microscopy. It is used to combine the two worlds of scanning electron microscopy and light microscopy and brings them together in one image. Note that in the documentation and in the software GUI the abbreviation "S&F" is often used for "Shuttle & Find".

The samples can be mounted in specifically designed correlative holder systems (with three correlative calibration markers) from ZEISS. Also user-defined holder systems with three calibration markers can be used. As the shape and size of materials samples vary strongly, a range of flexible correlative holders were designed to fulfill customers' needs.

### 6.9.1 General Preparations

Before you start working with the Shuttle & Find module you must check the following:

- The **Shuttle & Find** module is activated under **Maintenance | Modules Manager**. Note that if **User Management** is enabled, the Module Manager can be only be accessed by an **Administrator**.

The screenshot shows the 'Modules Manager' window. At the top, it says 'ZEN core (Expire Days: 313)' and 'Host ID: 2044493645'. Below this, there's a dropdown menu for 'Available Products' set to 'ZEN core'. A table lists modules with columns: Module, Licensed, Expire Days, and Description. The 'Shuttle & Find' module is highlighted with a mouse cursor. Below the table, there are buttons for 'Unselect All', 'Select All', and 'Save Information...'. The 'Shuttle & Find' module is listed under 'Optional Software' and is currently checked.

Module	Licensed	Expire Days	Description
<input type="checkbox"/> Panorama	Yes	313	Acquire overview images from individual 2D images
<b>Optional Software</b>			
<input checked="" type="checkbox"/> Advanced Processing	Yes	313	Add acquisition-feedback capability and hierarchic
<input checked="" type="checkbox"/> Cast Iron Analysis	Yes	313	Analyze graphite particles in cast iron.
<input checked="" type="checkbox"/> Comparative Diagrams	Yes	313	Compare micrographs with comparative charts.
<input checked="" type="checkbox"/> Connect Advanced	Yes	313	Extend the functionality of Module Connect Entry.
<input checked="" type="checkbox"/> Data Storage Client	Yes	313	Data storage capabilities (Client).
<input checked="" type="checkbox"/> Extended Focus	Yes	313	Calculate a 2D image out of a 3D Zstack.
<input checked="" type="checkbox"/> Grain Size Analysis	Yes	313	Grain size analysis.
<input type="checkbox"/> GxP	Yes	313	Audit trail functionality according to 21 CFR Part 11
<input checked="" type="checkbox"/> Image Analysis	Yes	313	Create automatic measurement routines.
<input checked="" type="checkbox"/> IMS Client	Yes	313	Connect to the Imagic IMS Database Server.
<input checked="" type="checkbox"/> Intellesis	Yes	313	Image segmentation using pixel classification using
<input checked="" type="checkbox"/> Layer Thickness Measurement	Yes	313	Measurement of layer thickness.
<input checked="" type="checkbox"/> Macro Editor	Yes	313	Editor and Debugger for OAD mit Python.
<input checked="" type="checkbox"/> Macro Environment	Yes	313	Open Application Development (OAD) via Python
<input checked="" type="checkbox"/> Multi-Channel	Yes	313	Record different fluorescence and transmitted light
<input checked="" type="checkbox"/> Multiphase Analysis	Yes	313	Analyze multiphase samples.
<input type="checkbox"/> NEO pixel Connector	No	0	Measure images with the NEO pixel software.
<input checked="" type="checkbox"/> NMI Analysis	Yes	313	Non-Metallic Inclusion Analysis.
<input checked="" type="checkbox"/> Online Measurement	Yes	313	Online measurement.
<input checked="" type="checkbox"/> Qual Data Export	Yes	313	Create measurement files for Databases like ZEISS
<input checked="" type="checkbox"/> Shuttle & Find	Yes	313	Image recording and correlation on light and elect
<input checked="" type="checkbox"/> Software Autofocus	Yes	313	Determine the focus position of your specimen.
<input checked="" type="checkbox"/> Third Party Import	Yes	313	Import of 3rd-party microscopy images into ZEN.
<input checked="" type="checkbox"/> Tiles & Positions	Yes	313	Scanning of predefined sample areas.
<b>Optional Hardware</b>			
<input checked="" type="checkbox"/> Linkam	Yes	313	Support the Linkam devices.

Unselect All   Select All   Save Information...

## 6.9.2 Shuttle & Find Workflow

The Shuttle & Find (S&F) workflow can be described in the following steps:

### Image Acquisition on the Light Microscope (LM)

Before acquiring an image with the light microscope and using it for correlative microscopy, it is necessary to set up the system correctly e.g. stage calibration, camera orientation, calibrating objectives and setting the correct scaling. Note that we do not describe these topics within this guide as we focus on the Shuttle & Find workflow only.

- **Step 1: Calibrating the Holder**

After starting the software, you first need to calibrate the correlative holder for the LM system to setup the correlative coordinate system. Note that the holder calibration must be done twice on both systems the LM and the SEM. For the calibration you have to use the *S&F Holder Calibration Workbench* [▶ 743]. To learn how to calibrate a correlative holder, read the chapter *Calibrating the S&F Holder* [▶ 369].

- **Step 2: Acquiring the LM image**

Now you can perform the image acquisition on the LM. Note that you can easily move the stage by double-clicking on the live image. The double-clicked position is then moved to the center of the image area.

To learn more about image acquisition, read the corresponding topics of the Online Help.

- **Step 3: Drawing ROIs/POIs**

In this step you can draw in regions or points of interests onto your sample images. These are usually the positions you want to investigate further on the other (SEM) system. For drawing in the ROIs/POIs use the *S&F ROI/POI Drawing Workbench* [▶ 744].

- **Step 4: "Shuttling" the Sample to the SEM**

Now you can bring your sample to the SEM system. At this point do not remove the sample from the sample holder.

For transferring the image data we recommend to use the **Archive** functionality of the software. If both system PCs have access to a network, image data can be easily exchanged in that way. If there is no network connection, you must transfer the image data via a storage device (USB stick or external hard disc) and open the file via the **Load File** workbench.

### Image Acquisition on the Scanning Electron Microscope (SEM)

- **Step 1: Calibrating the Holder**

After bringing the image data and the sample holder including the sample to the SEM, again you first need to calibrate the correlative holder for the SEM system. For the calibration you have to again use the *S&F Holder Calibration Workbench* [▶ 743].

- **Step 2: "Finding" the Sample Positions on the SEM**

After calibration you can now start and relocate the sample positions with the *S&F Find Tool* [▶ 790] (in the **Acquisition** workbenches). Of course you should also bring the image data from the LM acquisition to recognize your drawn in ROIs/POIs. If you have loaded the LM image, you will see the ROIs/POIs in a list and can move the scanning stage to these positions by one click with the mouse.

Alternatively, you can use the *S&F Find (List) Tool* [▶ 789] to relocate the sample positions if you have a list of your positions in form of a .csv file.

- **Step 3: Acquiring the SEM image**

Now you can perform the image acquisition on the SEM.

- **Step 4: Generating the Overlay Image**

After having acquired the SEM image from the same ROIs/POIs as on the LM system, you now can combine both (or more) images together and generate an overlay image. Use the *S&F Image Overlay Workbench* [▶ 743] for this.

**See also**



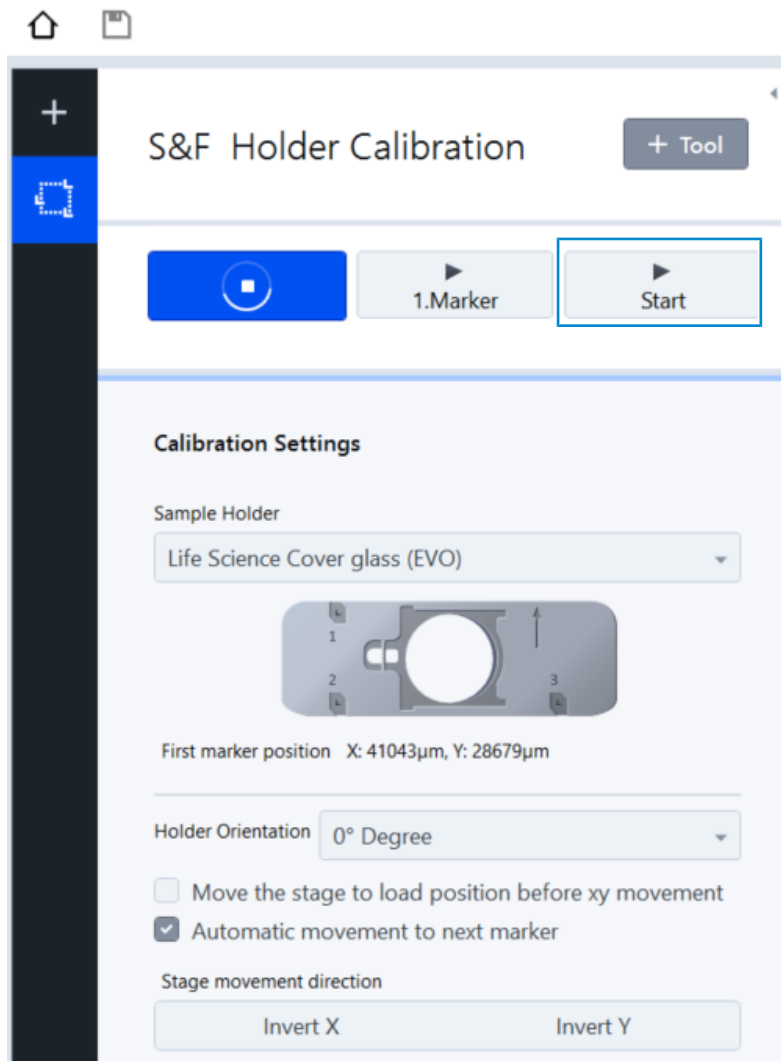
 Tips to Ensure Accuracy [[▶ 376](#)]

### 6.9.3 Calibrating the S&F Holder

Before you can start to acquire S&F images you first have to calibrate the correlative holder. Note that holder calibration must be performed on both systems (LM and SEM). During calibration the exact positions of the three small fiducial L-shaped markers must be detected (or set manually). For each marker you can decide if you want to use the automatic marker detection or if you want to manually set the marker position, e.g. if the auto detection failed. Since the auto detection usually works fine, we recommend always using it.

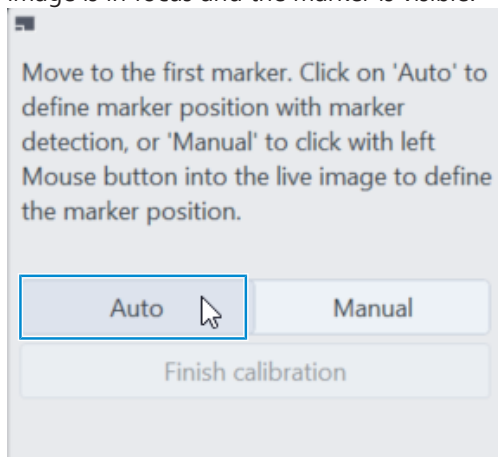
**Prerequisite** ✓ You have inserted the holder to be calibrated on the stage (example LM system).

1. Open the **S&F Holder Calibration** workbench.
2. In the **Calibration Settings** select the corresponding holder from the drop-down list. Make sure that the **Holder Orientation** setting within the software is the same like on the stage. If this is not the case, change the orientation in the software. We also recommend to activate **Automatic movement to next marker**, so the process will be more fluent.
3. Click on **Start** on top of the workbench.

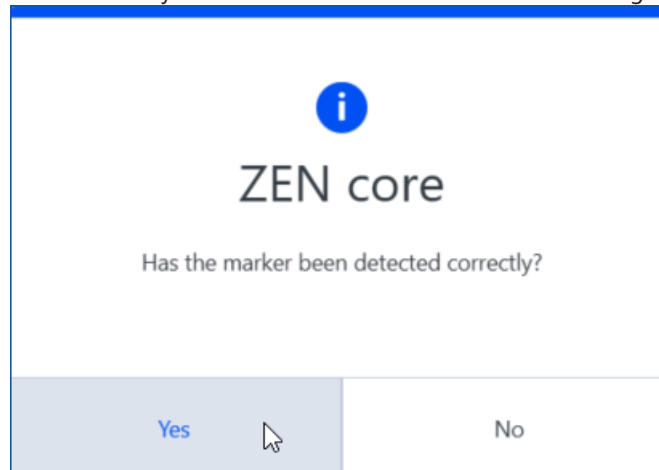


- ➔ A dialog will appear to choose whether you want to perform automatic or manual marker detection. We recommend to use the automatic marker detection which is performed as follows:

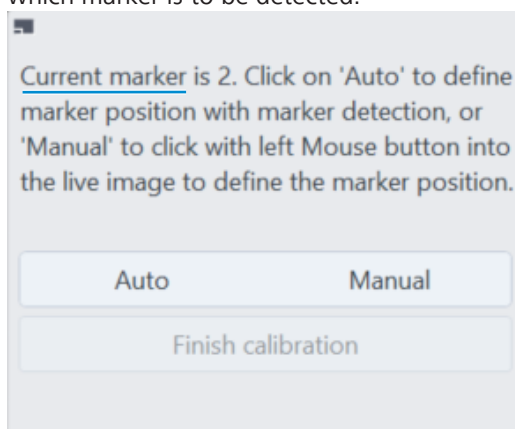
4. Move the stage in the area of the first marker and click on **Auto**. Make sure that the Live image is in focus and the marker is visible.



- The software will now try to detect the first marker on the inserted holder. The marker is detected correctly, when the red crosshair matches the corner of the smaller L-shaped marker exactly. After the detection a confirmation dialog will appear.

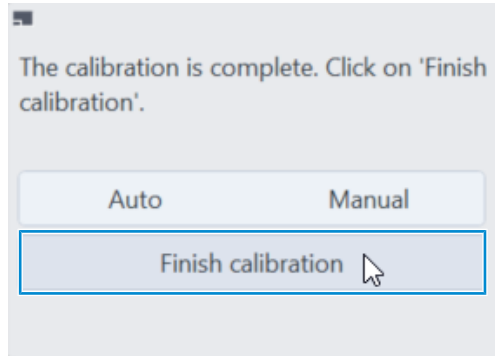


5. Click on **Yes**, if the marker was detected correctly. If the marker was not detected correctly, click on **No** and select **Manual** mode. Set the marker manually by left clicking with mouse on the outer corner of the small L shaped marker. The position will be saved and you can continue to the next marker. Repeat the last two steps for the next 2 markers. The dialog box will always show you which marker is to be detected.

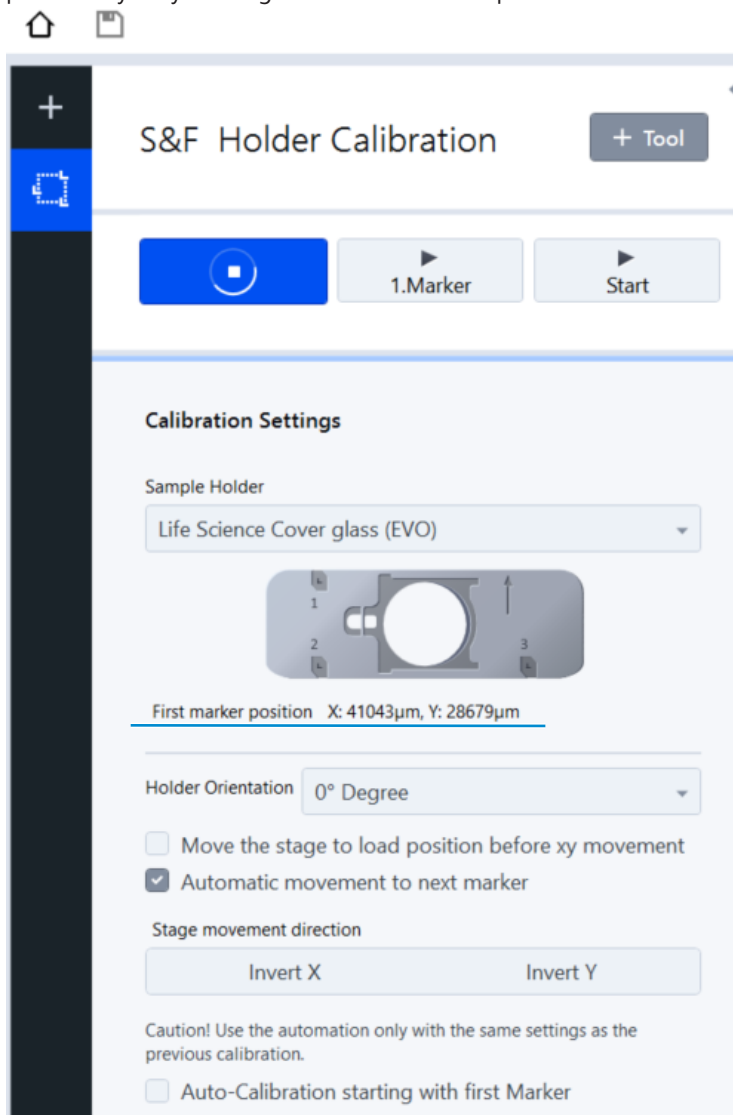


- If all three markers were detected correctly, the calibration is completed.

6. Click on **Finish Calibration** to close the wizard.



In the **Calibration Settings** tool you now will see the position data (X/Y) of the first marker. If the holder was calibrated once, you can always move the stage easily and fast to the first marker position by only clicking on **1.Marker** on top of the workbench.



You have calibrated the holder successfully. You can now acquire images of your sample. Note that the calibration process must be performed again, after the holder is transferred (shuttled) to the other system. Otherwise the sample positions (ROIs/POIs) cannot be found automatically.

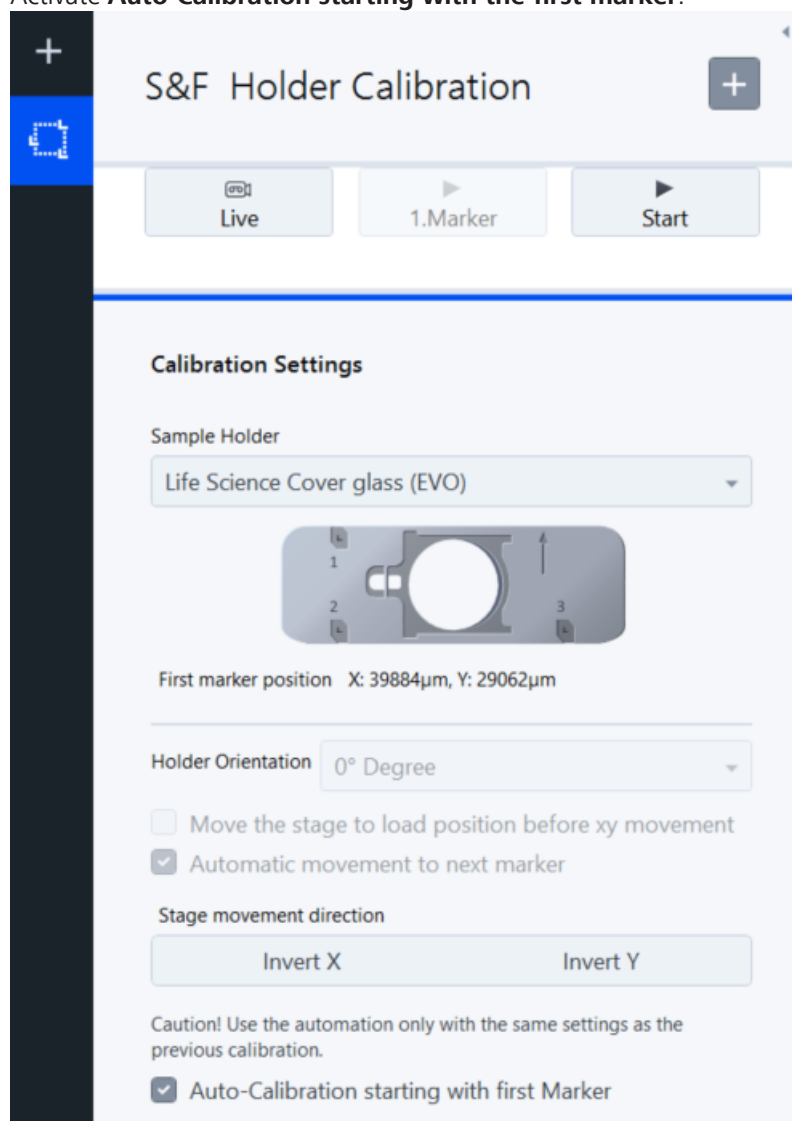
After you have completed the "default" calibration procedure once, you can perform an auto-mated calibration, e.g. if you have changed the sample on the calibrated holder. To learn more about the auto-calibration, read the chapter *Calibrating the S&F Holder Automatically* [▶ 372].

### 6.9.4 Calibrating the S&F Holder Automatically

If you want to perform the automatic calibration the holder must have been calibrated first by using the default calibration procedure, described in the chapter *Calibrating the S&F Holder* [▶ 369]. Performing auto-calibration the software tries to detect the exact positions of all three, small fiducial L-shaped markers on the holder automatically. The result of the detection will be presented afterwards. The automatic calibration is the easiest way to repeat the calibration process, e.g. if you have changed the sample on the holder and therefore removed the holder from the stage.

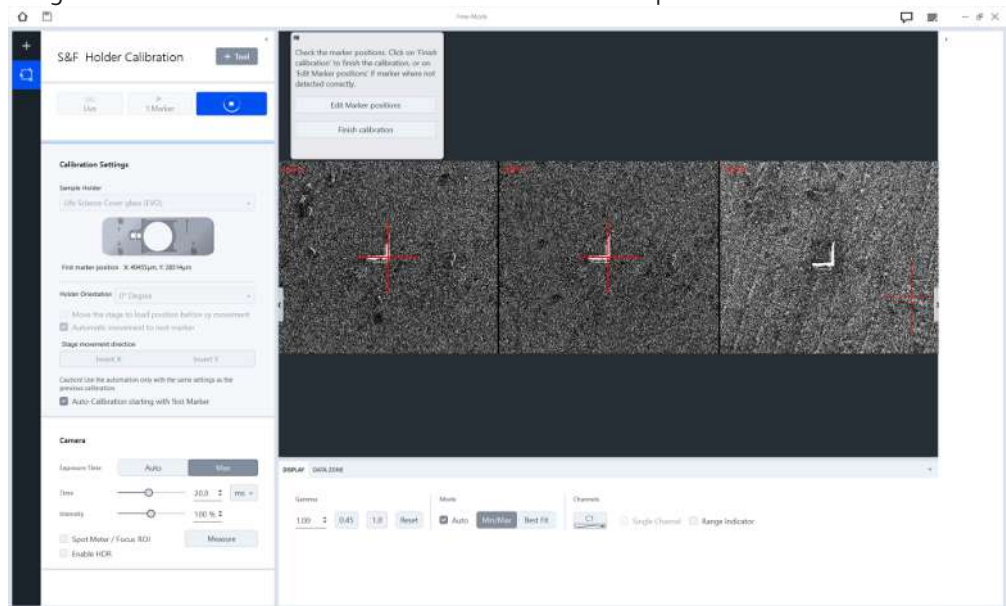
**Prerequisite** ✓ You have inserted the holder to be calibrated on the stage (example SEM stage).

1. Open the **S&F Holder Calibration** workbench.
2. Check if the holder is still selected under **Sample Holder**.
3. Activate **Auto-Calibration starting with the first marker**.

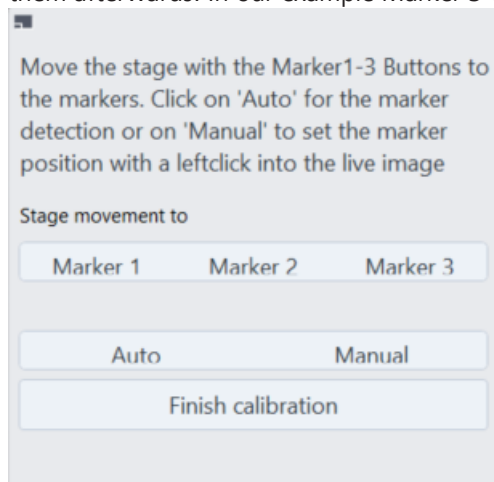


- The software will now start and try to detect all three positions of the small L-shaped markers.

- After the detection procedure you will see three preview images of the markers. On each image the red crosshair must be in the corner of the L-shaped marker.

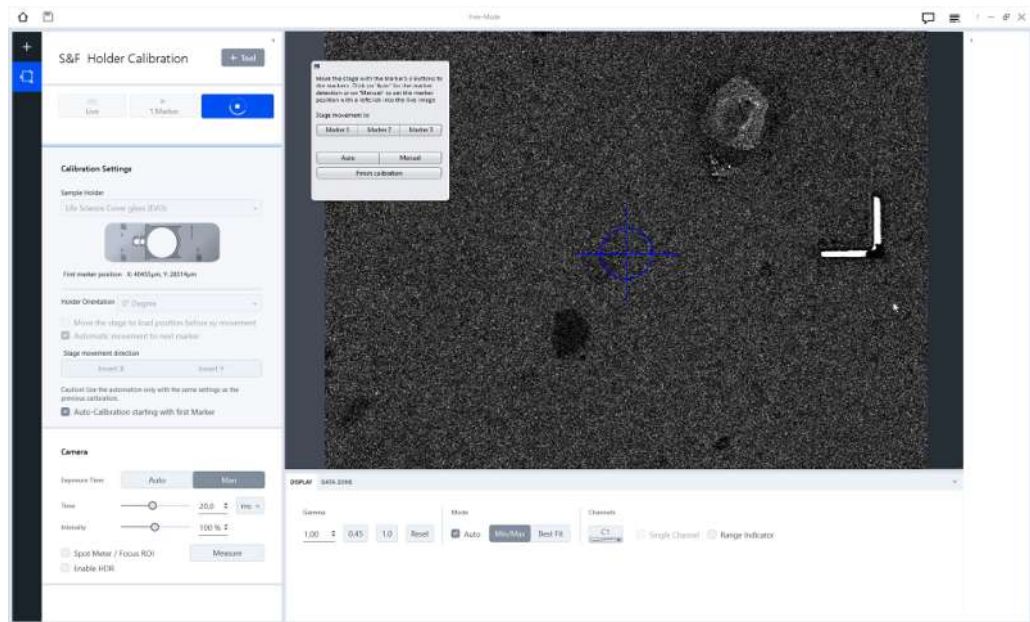


4. Click on **Finish calibration** as soon as all three markers were detected correctly.
  5. If a marker was not detected correctly, click on **Edit Marker Positions** to adjust the position manually.
- You will see a dialog which you can use to navigate to the detected positions and correct them afterwards. In our example Marker 3 was not detected correctly.



6. Click on **Marker 3**.
- The stage will move to the position which was not detected correctly.

7. Move the stage by the joystick so that the small L-shaped marker is visible in the Live image and click on **Manual**.



8. Determine the position manually by left clicking in the corner of the L-shaped marker.
9. Click on **Finish Calibration**. If you want to check if all three markers are detected correctly, you can navigate on the holder by clicking on the **Marker 1-3** buttons.

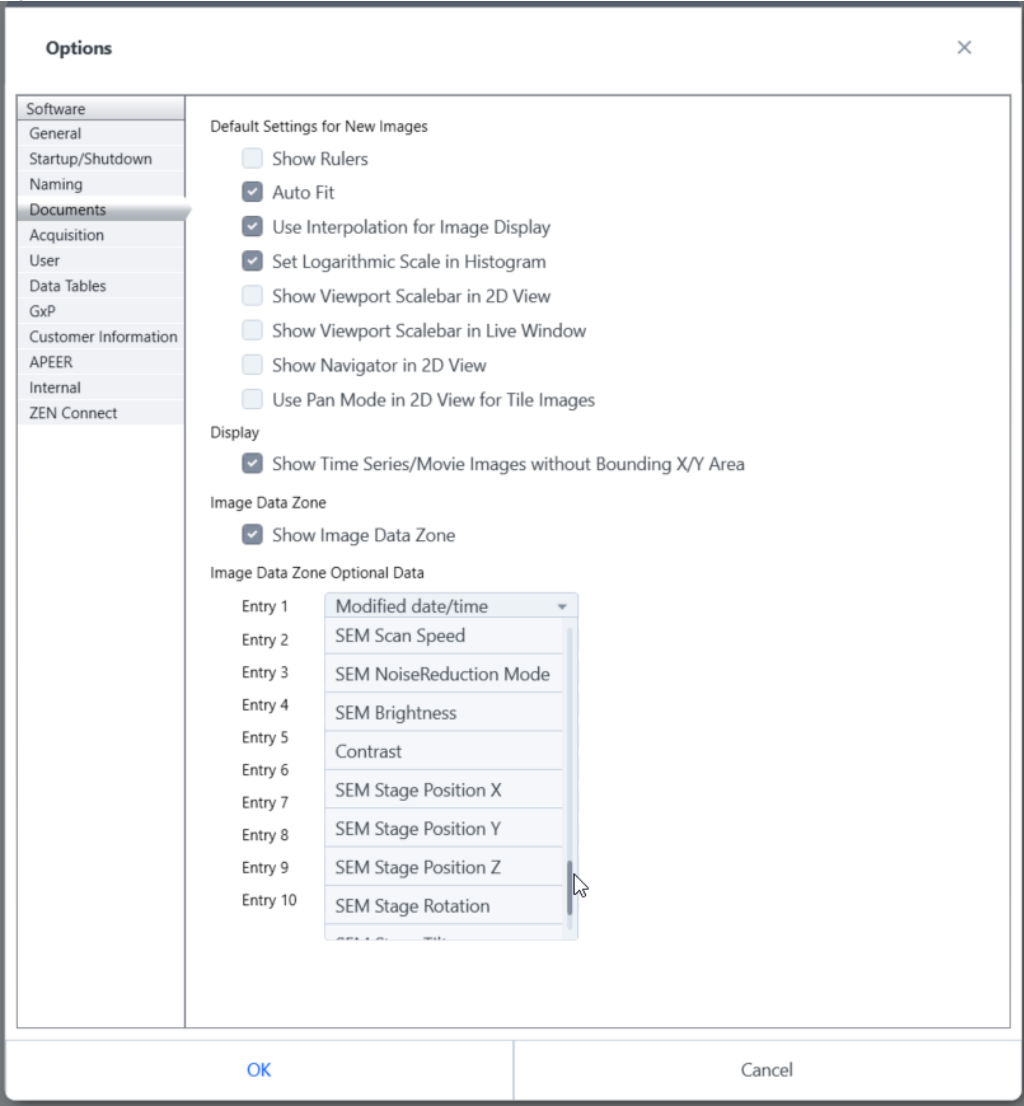
You have calibrated the holder successfully. You can now acquire images of your sample. Note the calibration process must be performed again, after the holder is transferred (shuttled) to the other system. Otherwise the same sample positions (ROIs/POIs) cannot be found automatically.

### 6.9.5 Showing SEM Acquisition Data

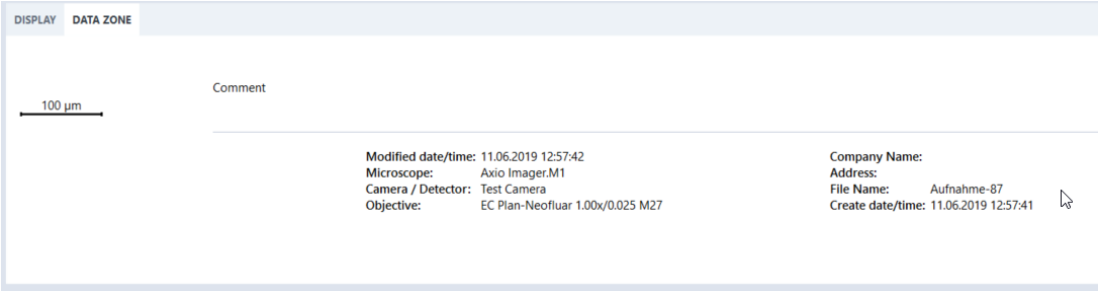
To show SEM acquisition data in the Image Area you can configure the **Data Zone** tab.

1. Click **Maintenance > General Options > Documents**.

2. Select the desired data to be displayed under **Optional Data**. Up to eight fields can be configured.



After an acquisition the fields will be visible in the **Data Zone** tab.



### 6.9.6 Correlative Sample Holders

Following ZEISS templates are available:

Field of Use	Holder Template
Life Science	Life Science Cover glass (EVO)
	Life Science Cover glass with fiducials

Field of Use	Holder Template
Material Science	Live Science Cover glass
	Life Science TEM grid
	MAT Flat samples 1a, 2a, 3a
	MAT Flat samples
	MAT Geo Slides
	MAT Particle 47 mm
	MAT Particle 50 mm
	MAT Universal A
	MAT Universal B (A-B) 1a, 2a, 3a
	MAT Universal B (A-B)
	MAT Universal B (C-D) 1a, 2a, 3a
	MAT Universal B (C-D)

### 6.9.7 Tips to Ensure Accuracy

#### On the light microscope

- To ensure good calibration, the objectives must be correctly calibrated.
- We recommend 20x magnification for the automatic marker detection.
- Due to potential objective shift, accuracy will be higher if you acquire images using the same objective that you used for calibration.

#### On the electron microscope

- The SE2 detector is well suited for marker detection.
- Switch off the beam shift and scan rotation.
- The "Stage only" setting should also be activated under Center Point or Feature.
- Use the stage backlash to increase the stage's accuracy in locating positions.

#### General Points

- For images on a SEM use conductible samples.
- Initialize the stages before using Shuttle & Find.
- Calibrate again each time the holder has been inserted into a microscope.
- If the marker is a little dirty, it can be helpful for detection purposes to de-focus it slightly.
- In the case of stitched tiles images accuracy is reduced.

## 6.10 GxP

This module enables you to make your microscope system compliant to 21 CFR part 11. It can also be used to make your production process more reproducible and traceable.



**Info**

The validation and the qualification procedures which are needed for a 21 CFR Part 11 system are not part of this module and need to be performed separately.

The module offers the following functionality:

- Audit Trail functionality, see *Audit Trail Concept* [▶ 378]
- Signing of job templates and job results
- Release procedure for job templates
- Electronic signature

**GxP** is a general term for **Good Practice** quality guidelines and regulations. These guidelines are used in many fields, including the pharmaceutical and food industries. The titles of these good practice guidelines usually begin with "Good" and end in "Practice", with the specific practice descriptor (x) in between.

**GxP** represents the abbreviations of these titles, where **x** (a common symbol for a variable) represents the specific descriptor. A "c" or "C" is sometimes added to the front of the initialism. The preceding "c" stands for "current." For example, cGMP is an acronym for "current Good Manufacturing Practices". The term GxP is frequently used to refer in a general way to a collection of quality guidelines.

**See also**

📄 GxP Options [▶ 723]

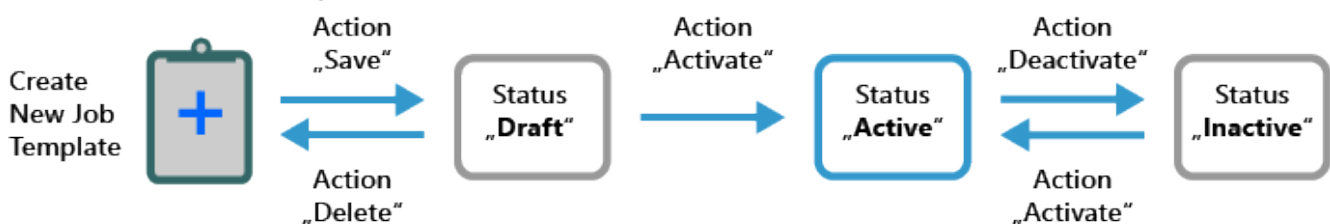
**6.10.1 Release Process of Job Templates and Job Results**

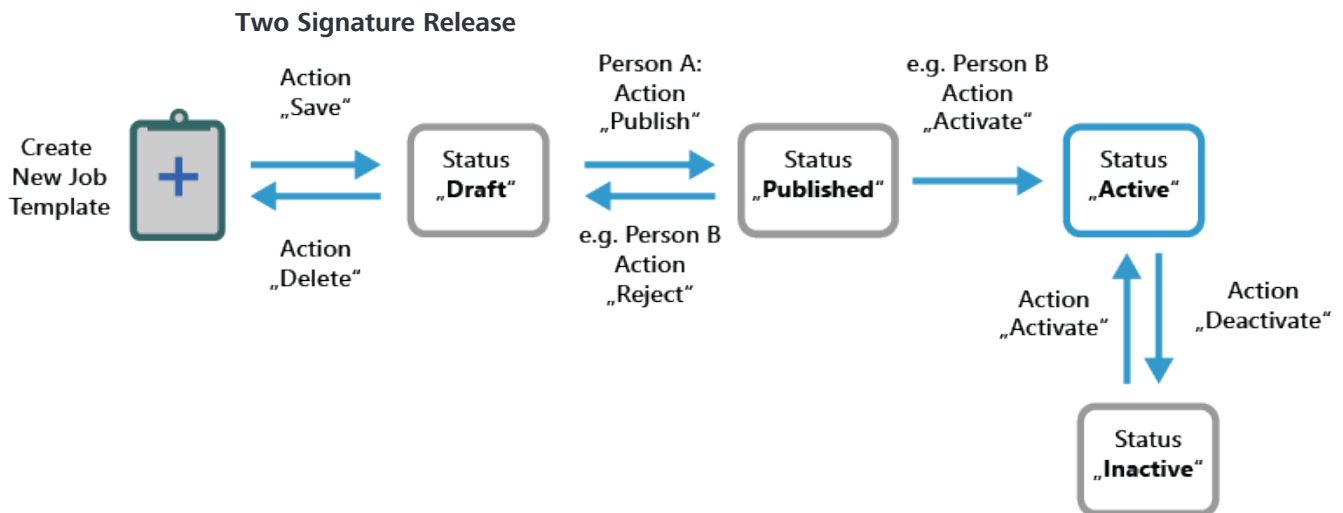
In general there are the following options to activate (release) job templates/results.

- **One Signature Release** (Default)  
This release process requires one electronic signature only. The signature is required, when you activate a job template from status **Draft** to **Active**. The electronic signature is bound to a personal certificate which will be automatically generated, if no other certificates exist on the computer. At this point you must enter your password to confirm the changing of the status.
- **Two Signature Release**  
This release process allows two signatures to release a job template (4-Eye Principle). Two persons are required and therewith two signatures for releasing a job template. The first signature is required, when you publish a job template from status **Draft** to **Published**. The second signature is required, when another person activates the job template from status **Published** to **Active**. As mentioned above, the user password must be entered each time the status of a job template is changed.

Activate the desired release process under **Maintenance > General Options > GxP** options.

Both release processes and the template status are displayed in the flow charts below.

**One Signature Release**

**See also**

- 📖 GxP Options [▶ 723]
- 📖 Status of Job Templates [▶ 378]

**6.10.2 Audit Trail Concept**

By licensing the **GxP** module the **Audit Trail** functionality becomes available in the software. It is accessed via the **Maintenance** tab.

The Audit Trail functionality allows to record and/or log all software specific actions performed by the user. Note that the functionality applies for the **Job Mode**. In **Free Mode** the functionality is not effective.

In the **Audit Trail** window you see the log entries in a list as soon as the module is active. You can export these log files in **.PDF** or **.html** format by clicking on the **Export** button. It is also possible to show the results of a particular date. Therefore under **Time Range** you can adjust the desired dates by the help of a calendar. Of course a **Search** by keywords is implemented as well.

**See also**

- 📖 Actions to be Recorded in the Audit Trail [▶ 379]

**6.10.3 Status of Job Templates**

You must be logged in with dedicated user rights (e.g. as **Supervisor**) to manage the status of job templates.

The status handling of job templates will be recorded in the Audit Trail. It ensures that an operator can only work with job templates which are activated (released) by a supervisor including an electronic signature. To activate a job template and assign an electronic signature the supervisor must enter his password.

There is also another release process which requires two signatures to release a job template. This process is described in the chapter *Release Process of Job Templates and Job Results* [▶ 377].

If you have licensed the **GxP** module, all job templates which are created new get a particular status. After you have created a new job template (see Basics of Create Job Template Mode) the template has the status **Draft**. To make the template available for operators the status has to be

changed to **Active**. If the template status was set to active, you cannot delete the template anymore. You can set the template status to **Inactive**, if you do not want the operators to work with the template.

#### 6.10.4 Actions to be Recorded in the Audit Trail

All audit relevant actions performed with the software are recorded and logged.

Note that changes in the **Ligth Path** tool are not tracked in the Audit Trail. For tracking hardware changes the **Light Path Editing** tool must be used.

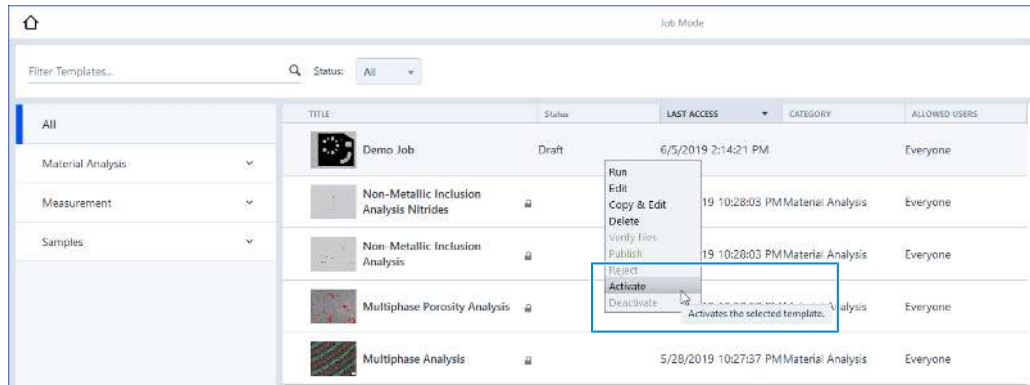
The following list shows the most important actions which are logged:

Actions to be logged	Text/Log (exemplary)
Starting up and shutting down the software	"Starting ZEN 2 core Version 2.0, MTB 2011 2.4.0.8"
Logging in/off (Category: Log-on/Log-off)	"User 'Z' has logged on."
Entering and exiting different modes (Category Enter/Exit Mode):	"User 'Admin' has entered Maintenance Mode."
Executing job templates (Category: Execute)	"Execute template 'XYZ' with Status 'Active'."
Changing of parameters (Category: Execute)	In task 2 "image Processing" the following parameters have changed: Brightness from "0" to "50".
Changing status of job templates (Category: Set/Status)	"Status of template 'XYZ' changed from 'Active' to 'Inactive'."
Changing the <b>Archive</b> location	"The archive location was changed to: ..."
Changing the <b>Local Storage</b> location	"The local storage location was changed to: ..."
Changing of Templates in the <b>Archive</b> (Manage Templates)	"Job template 'Template 2' was created."
User Management	"User 'XY' was created."
Messages and Errors (Category: Warning)	"Scaling is invalid."
Using the Electronic Signature	"Status of template 'XYZ' changed form 'Draft' to 'Active' (Electronic Signature)."

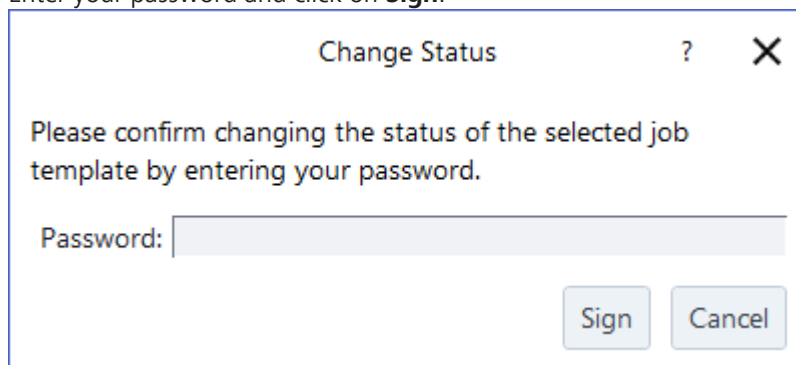
#### 6.10.5 Activating a Job Template

- Prerequisite**
- ✓ Under **Maintenance > General Options > GxP** the default release procedure **Enable release with one signature, only** is activated.
  - ✓ Under **Home > Manage Templates** you can see all available templates and their status.
1. Right-click on a template with the status **Draft**.

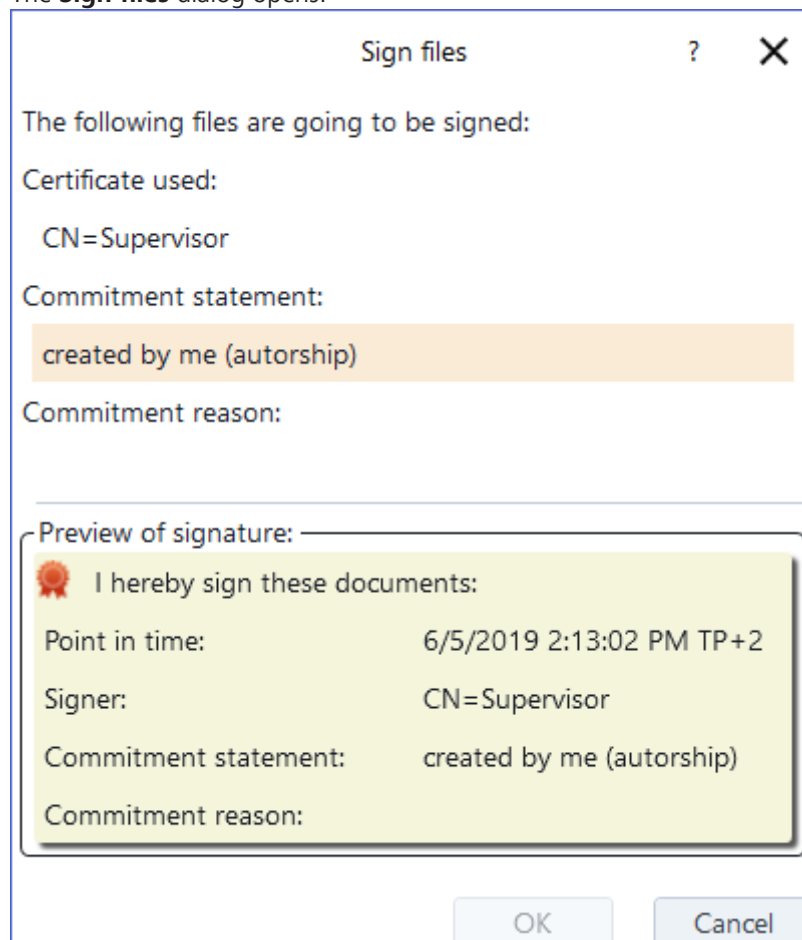
2. Click on **Activate**.



3. Enter your password and click on **Sign**.

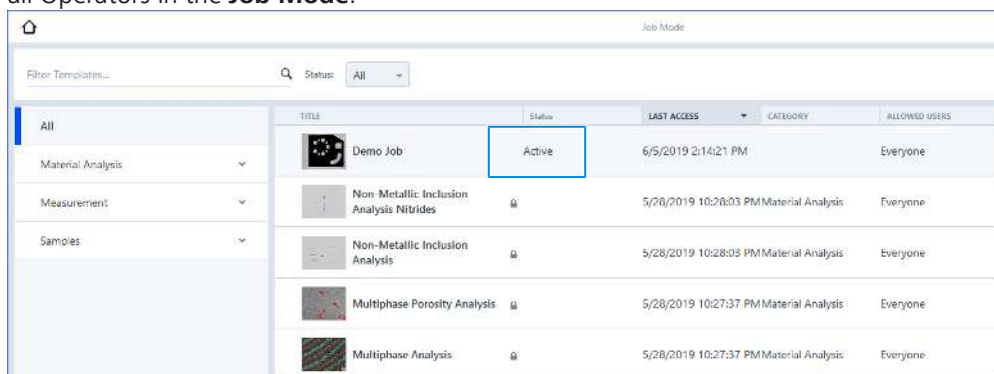


→ The **Sign files** dialog opens.



4. Click **OK** to confirm your signature and activate the template.

- The dialog closes and the status of the template changed to **Active**. It is now visible for all Operators in the **Job Mode**.



The screenshot shows the 'Job Mode' interface. On the left, there is a sidebar with a search bar 'Filter Templates...' and a status dropdown set to 'All'. Below this are three expandable sections: 'All', 'Material Analysis', and 'Measurement'. The main area displays a table of templates. The first row, 'Demo Job', has its status 'Active' highlighted with a blue box. The other rows show various analysis templates with their respective last access times and allowed users.

TITLE	Status	LAST ACCESS	CATEGORY	ALLOWED USERS
Demo Job	Active	6/5/2019 2:14:21 PM		Everyone
Non-Metallic Inclusion Analysis Nitrides	Locked	5/28/2019 10:28:03 PM	Material Analysis	Everyone
Non-Metallic Inclusion Analysis	Locked	5/28/2019 10:28:03 PM	Material Analysis	Everyone
Multiphase Porosity Analysis	Locked	5/28/2019 10:27:37 PM	Material Analysis	Everyone
Multiphase Analysis	Locked	5/28/2019 10:27:37 PM	Material Analysis	Everyone

You have successfully changed the status of the job template. The template is now visible for operators and can be executed. When the job template is executed, all actions and changes will be logged in the Audit Trail.

## 7 Application Toolkits

Toolkit	Functionality
Materials Apps	<ul style="list-style-type: none"> <li>▪ <i>Cast Iron Analysis</i> [▶ 382]</li> <li>▪ <i>Comparative Diagrams</i> [▶ 391]</li> <li>▪ <i>Grain Size Analysis</i> [▶ 398]</li> <li>▪ <i>Layer Thickness Measurement</i> [▶ 421]</li> <li>▪ <i>Multiphase Analysis</i> [▶ 436]</li> </ul>
NMI	<ul style="list-style-type: none"> <li>▪ <i>Non-Metallic Inclusion Analysis (NMI)</i> [▶ 451]</li> </ul>
TCA	<ul style="list-style-type: none"> <li>▪ <i>Technical Cleanliness Analysis (TCA)</i> [▶ 536]</li> </ul>

### 7.1 Cast Iron Analysis

This module enables you to analyze the size (1-8), shape (I-IV) and distribution (A-E) of graphite particles in cast iron samples in accordance with **DIN EN ISO 945 - 2019**. Additionally, you can investigate the nodularity, calculate the spheroidal number (including shape class IV) and analyze the area percentage of the graphite particles in the image. According to the standard, two options (by Number or by Area) for the calculation of the statistical results are available.

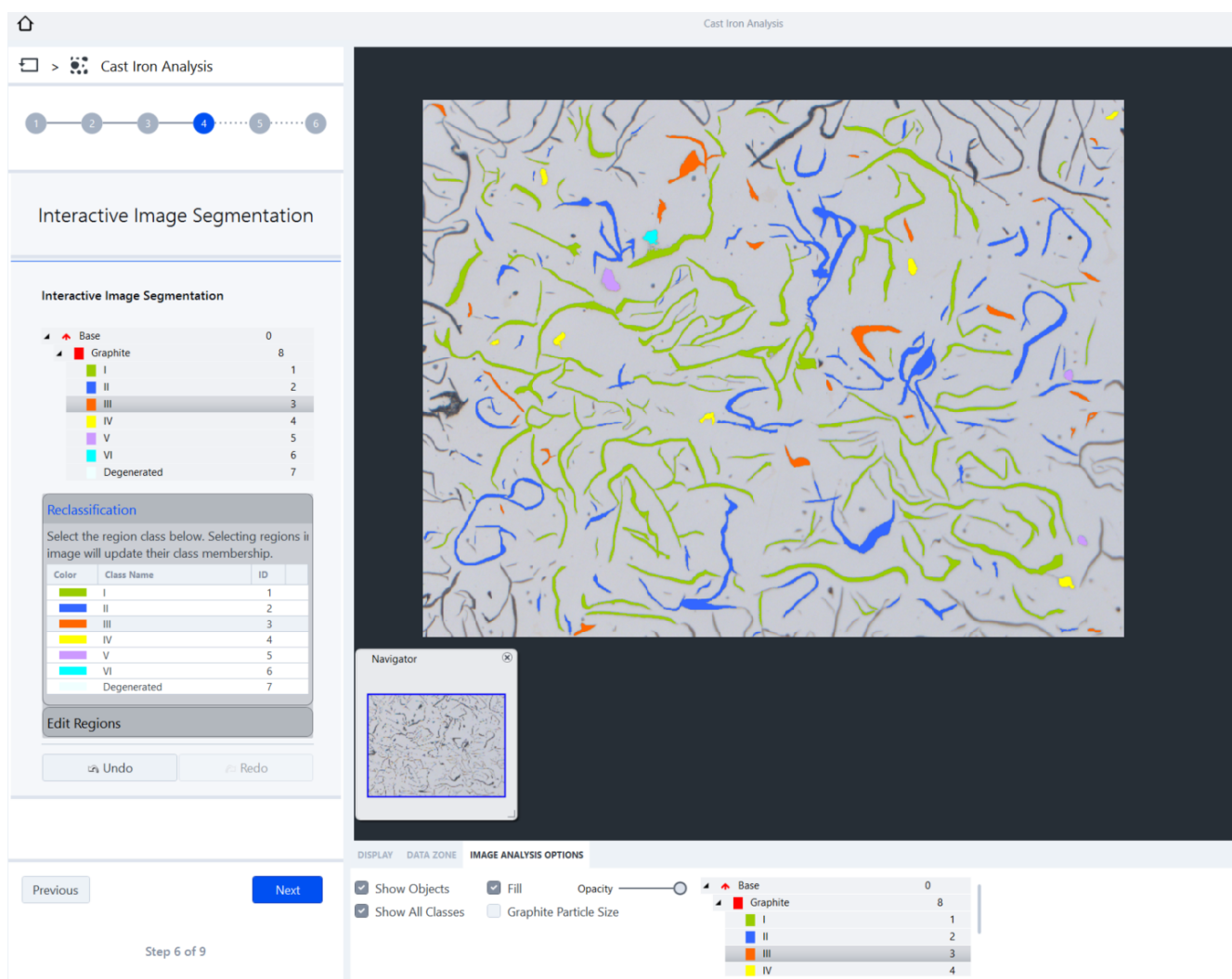


Fig. 16: Cast Iron Analysis

**See also**

 The Concept [► 383]

**7.1.1 The Concept**

The operating concept of the **Cast Iron Analysis** module is designed to make it possible to achieve a reproducible result with as little interaction as possible. The performance of a measurement can be automated to such an extent that only the project data need to be entered and the entire analysis process can run automatically.

To automate a measurement completely, you need extensive knowledge of systems engineering and the respective application. Carelessly made alterations of a setting can promptly lead to faulty measurement results. It is important, therefore, to prevent users not having such knowledge from changing the basic settings. This is achieved by dividing up the tasks involved into the definition of an analysis and the performance of an analysis. For this reason, the operation of the module sticks to the general operating concept of the software:

- **Creating and Managing Jobs (Supervisor)**  
Create job templates for cast iron analysis, manage templates, view job results, sign & release jobs (with GxP module only). Note that under **Job Mode** you will find a sample workflow within a pre-defined job template for cast iron analysis.
- **Running Jobs (Operator)**  
Performing cast iron analysis using pre-defined job templates.

**See also**

 Cast Iron Analysis [► 382]

 General Preparations [► 383]

 Basic Concepts [► 20]

**7.1.2 General Preparations**

A pre-defined job template is included in the software, when you have licenced the **Cast Iron Analysis** module. Of course the job template can be adapted individually. In this documentation we will explain the method according to the existing, pre-defined job templates.

As a **Supervisor** you can access/edit the job template under **Manage Templates**. On the left side in the **Categories** list under **Material Modules** select **Cast Iron Analysis**.

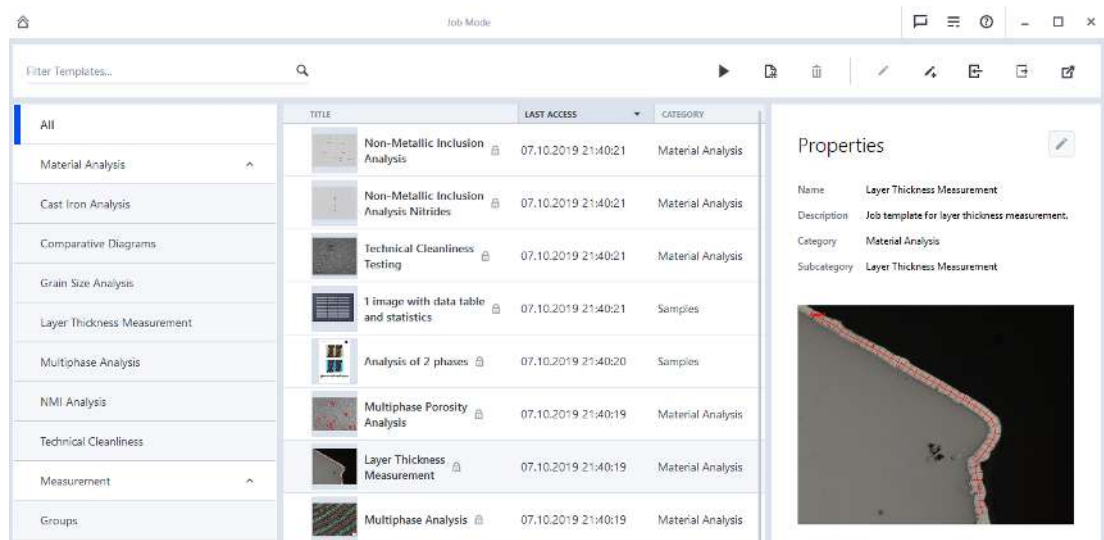


Fig. 17: Material Modules - Job Templates

In the templates list you see the available job template. When you double-click on the entry in the list, the corresponding job template it will be opened. The job templates always contain three major tasks:

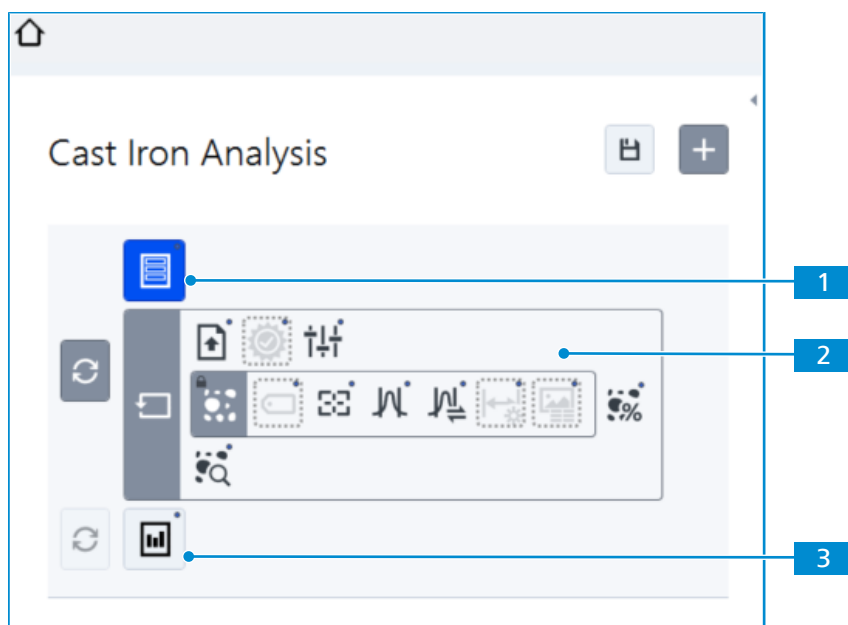


Fig. 18: Cast Iron Analysis Workflow

### 1 Filling out an Input Form

In this step the operator has to fill out the input form with user and sample specific information, e.g. Sample Information, User Name, etc.

### 2 Performing the Analysis

In this step the analysis will be performed according to the selected method. The detailed workflow will be described in the following chapters.

### 3 Creating a Report

After the analysis a report will be generated containing the job results (images, measurements, etc.).

## See also

General Analysis Workflow [► 403]



7.1.3 General Analysis Workflow

The analysis steps of the workflow contains the following substeps to be executed. In this example the substeps are created within a **Loop Task (1)**, meaning all included steps will be repeated depending on the loop settings. Regarding this you can easily fulfill the normative requirements of repeating the identical steps of an analysis for several times.

Info

Note that greyed out task icons are set to "Run silent". The tasks will not be shown when the workflow is executed. To activate them, right-click on the icon and deactivate the **Run silent** menu entry.

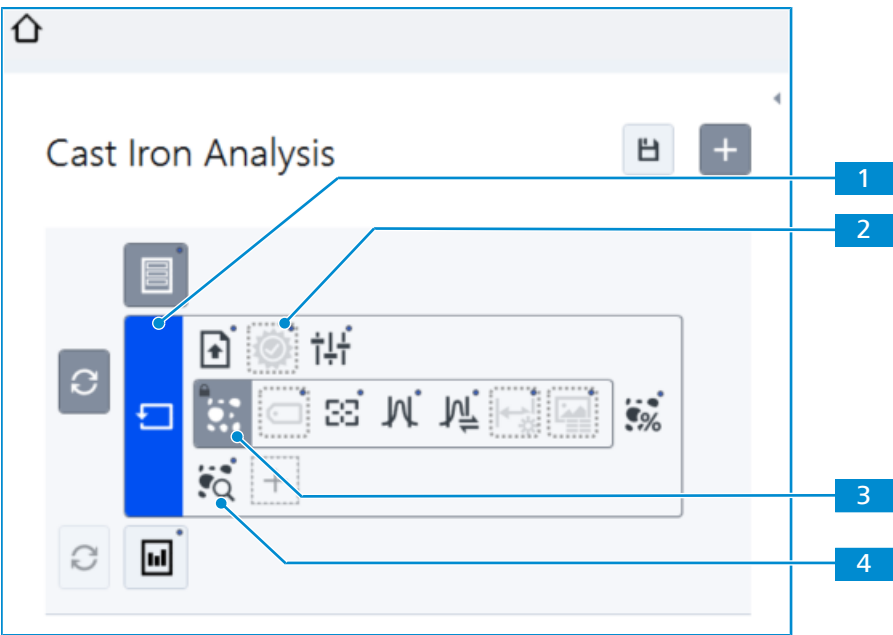













Fig. 19: Analysis Workflow

Workflow Step	Description
<b>Loading an Image</b> (2) 	Load your image you wish to analyze. The workflow can be adapted to perform image acquisition tasks here as well.
<b>Validating the input image</b> (2) 	This task is recommended to use right after loading or acquiring an image. Currently it will check if the input image has the correct scaling information. This is important to make sure the image can be processed correctly.
<b>Processing the Image</b> (2) 	Perform improvements on the image, e.g. change Brightness, Contrast and/or Gamma.
<b>Performing the Analysis</b> (3) including:	This step is the heart of each method. Each analysis can be stored as <b>Analysis Settings File</b> .

Workflow Step	Description
	Depending on the selected method the software will provide the specific parameters. Each method is described in detail in the following chapters.
<ul style="list-style-type: none"> <li>- <b>Setting Up the Classes</b>  </li> </ul>	For the sample workflow all necessary classes are pre-defined. This step is set to run silent because of that.
<ul style="list-style-type: none"> <li>- <b>Setting Up the Measurement Frame/Pattern</b>  </li> </ul>	Adjust the region/area which has to be analyzed.
<ul style="list-style-type: none"> <li>- <b>Segmenting the Image</b>  </li> </ul>	Segment the image automatically by clicking inside the image.
<ul style="list-style-type: none"> <li>- <b>Interactively Adjust the Segmentation Results</b>  </li> </ul>	Edit the segmentation result interactively.
<ul style="list-style-type: none"> <li>- <b>Setting up the features</b>  </li> </ul>	Apply specific measurement features to the image.
<ul style="list-style-type: none"> <li>- <b>Viewing the Measurement Data</b>  </li> </ul>	The segmented image and tables including measurement results are displayed.
<ul style="list-style-type: none"> <li>- <b>Determining the Graphite Distribution</b>  </li> </ul>	This step is another interactive step. You have to manually determine the graphite distribution by comparing the acquired image with the images from the standard. The results have to be entered in the <b>Graphite Distribution Setup</b> tool.
<b>Showing the Results View (4)</b> 	The <b>Results View</b> is displayed containing the analysis results and statistics.

#### 7.1.4 Cast Iron Analysis

This topic explains the specific image analysis part of the **Cast Iron Analysis** job template which is delivered with the software. We recommend that you read in advance the chapters "*General Preparations [▶ 383]*" and "*General Analysis Workflow [▶ 385]*" to make yourself familiar with the general workflow.

**Frame Setup** Setting up a frame for the cast iron analysis is an optional step. If you want to, you can add a specific measurement frame (e.g. rectangle area in the center of the sample) which then will be used for the analysis only. Whether you want to use a measurement frame is depending on your sample and individual processes. The tool offers everything you need to setup the frame properly. By using the tool parameters you can adjust the frame individually. The value **Inside Only** in the **Mode** field is required by the standard. For this reason, it is not editable.

Frame Setup

☐ Maximize circle

☐ Center circle

Mode

Inside Only

Left

0

Top

0

Width

2776

Height

2080

Angle

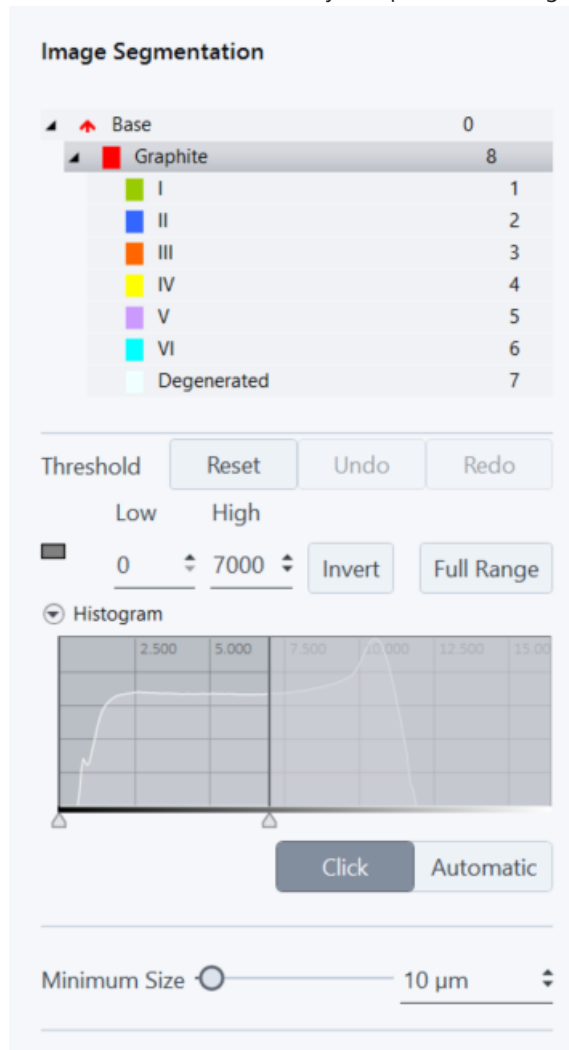
0

Color

☐ Show frame on analyzed image

**Image Segmentation Setup** In this step the software tries to segment the individual graphite particles of the cast iron sample. To start the segmentation you have to click on a graphite particle within the image. The software then displays the results according to the specified overlay colors for the different classes. Repeat the segmentation by clicking on not detected particles in the image, in case some areas have not been detected correctly.

To change the display of the segmentation (size instead of shape) activate the **Graphite Particle Size** checkbox in the **Image Analysis Options** tab below the image area. The tool offers all parameters which are necessary to optimize the segmentation result.

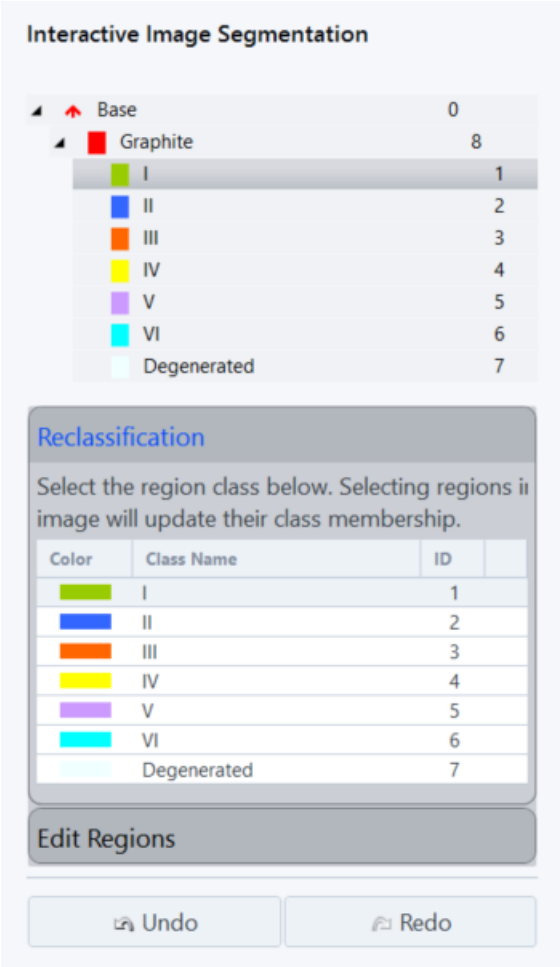


A minimum size of 10 µm (Feret max. diameter) is recommended by the standard **DIN EN ISO 945**.

#### Interactive Image Segmentation Setup

In this step you can adjust the segmentation result interactively. In the **Reclassification** tool you can easily correct wrongly classified particles. Simply select the correct class from the list and then click on the wrongly classified particle within the image. The particle will then be reclassified with the selected class. You can also mark degenerated graphite by selecting the class **Degenerated**

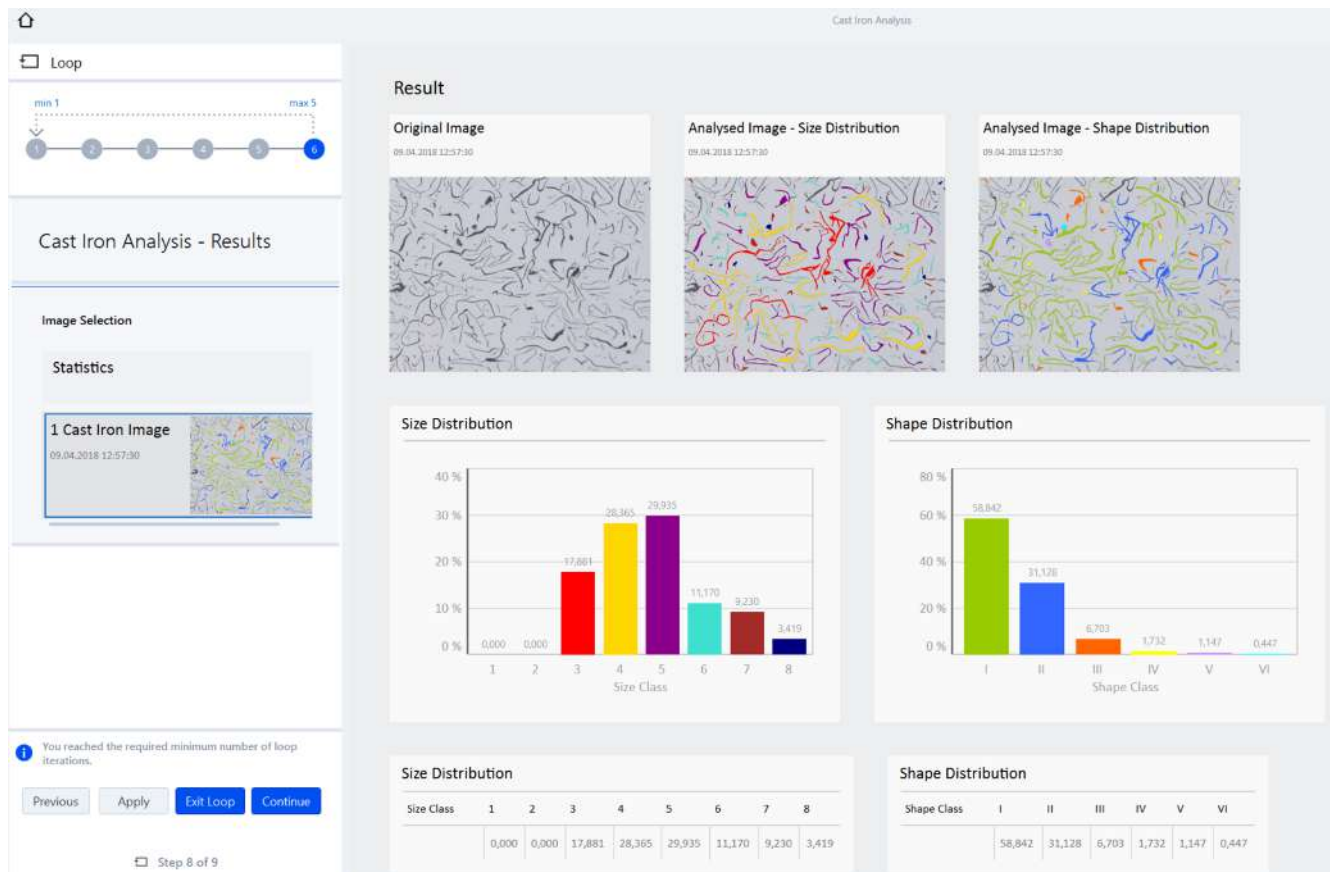
and then click on the degenerated particles in the image. To edit the segmentation results use the tools under **Edit Regions**.



- Graphite Distribution Setup

This is an optional step. Here you have to manually determine the graphite distribution by comparing the acquired and segmented image with the images from the standard. The results have to be entered in the corresponding input fields.
- Result View

At the end of each analysis the **Result** view is displayed. It shows all images and results of the analysis which was performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude images you do not want to have displayed within the result. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view.



### Additional Results

Parameter	Description
<b>Nodularity</b>	<p>The calculation of the nodularity depends on the selected statistic in the <b>Form</b> template.</p> <p><b>Activated: Statistic by number</b></p> <p><math display="block">\text{Nodularity} = (N_{VI} + N_V) / (N_{all}) * 100\% \rightarrow \% \text{ Nodularity}</math></p> <p><b>Activated: Statistic by area (default)</b></p> <p><math display="block">\text{Nodularity} = (A_{VI} + A_V) / (A_{all}) * 100\% \rightarrow \% \text{ Nodularity}</math></p> <p>The default value is recommended by Standard <b>DIN EN 945-4:2019</b>.</p>
<b>Spheroidal number &amp; Nodule count</b>	<p>The formula for the spheroidal number (according ISO 945-1) is as follows:</p> <p><math display="block">\text{Spheroidal number} = (N_{VI} + N_V) / \text{Area} \rightarrow \text{number of nodules (shape class V and VI + optional IV)}</math></p>
<b>Graphite Content %</b>	<p>Area fraction of graphite particles based on the measuring area. It will be calculated as follows:</p> <p><math display="block">A(\text{particles}) / A(\text{summation})</math></p> <p>Particles are cut at the measurement frame or image frame even though <b>inside only</b> is set for the frame by default.</p>
<b>Graphite particle count</b>	<p>Total number of graphite particles (segmented phases) divided by the test area in mm<sup>2</sup>.</p>

## 7.2 Comparative Diagrams

This module enables you to compare microscope images with chart series from the most important standards available. The following standards are supported:

Application	Standard
Grain Size Analysis	<ul style="list-style-type: none"> <li>▪ <b>ASTM E 112 - 13 (Plate I - IV)</b></li> <li>▪ <b>DIN EN ISO 643:2020</b></li> <li>▪ <b>GB/T 6394 - 2017 (Plate I-IV)</b></li> </ul>
Cast Iron Analysis	<ul style="list-style-type: none"> <li>▪ <b>DIN EN ISO 945 - 2019</b></li> </ul>
NMI Analysis (Non-Metallic Inclusions)	<ul style="list-style-type: none"> <li>▪ <b>ASTM E45:2018 (Plate I-II)</b></li> <li>▪ <b>DIN 50602:1987</b></li> <li>▪ <b>EN 10247:2017</b></li> <li>▪ <b>GB 10561 - 2005 / ISO 4967:2013-07</b></li> </ul>

The software will be shipped including the following functionality:

- **Comparative Diagrams**  
Using this workflow you can perform image comparison according to the available standards. Usually an image acquisition is performed followed by the comparison of the acquired (or loaded) image and the charts series from the desired standard, see *Comparative Diagrams* [▶ 394].
- **Comparative Diagrams Live**  
Using this workflow you can directly compare the live image from the microscope with the chart series from a selected standard, see *Comparative Diagrams Live* [▶ 395].
- **Chart Series Creator**  
Using the chart series creator you can create your own, customized chart series for comparing them with your images. This is helpful if you do not want to work with the default charts from the standards but use your own individual comparison images, see *Chart Series Creator* [▶ 395].

Please make yourself familiar with the common functions and operating principles of the software before you start working with the module. We recommend to read the full Online Help and User Manual carefully in addition to the specific chapters concerning this module.

### See also

- 📖 The Concept [▶ 391]

### 7.2.1 The Concept

The **Comparative Diagrams** module allows the comparison of a microscope image with images (chart series) from standard-based comparative diagrams. The result contains the original image and the selected chart.

Every analysis is managed within the archive as an independent project. The results can be printed in the form of a report.

Working with the module can be divided into three task areas:

- **Creating & Managing Jobs (Supervisor)**  
As **Supervisor** you set up the workflow for the comparison: e.g. specify the input form and job template.
- **Running Jobs (Operator)**

As an **Operator** you can perform the comparison workflow that was pre-defined by an Supervisor.

- **Creating user defined chart series**

Within the **Chart Series Creator** you can create own, customized chart series.

Please make yourself familiar with the common functions and operating principles of the software before you start working with the module. We recommend to read the full Online Help and User Manual carefully of course in addition to the specific chapters concerning this module.

### See also

📄 Comparative Diagrams [▶ 391]

## 7.2.2 General Preparations

Two pre-defined job templates are included in the software, when you have licenced the **Comparative Diagrams** module. Of course the job template can be adapted individually. In this documentation we will explain the method according to the existing, pre-defined job templates.

As a **Supervisor** you can access/edit the job template under **Manage Templates**. On the left side in the **Categories** list under **Material Modules** select **Comparative Diagrams**.

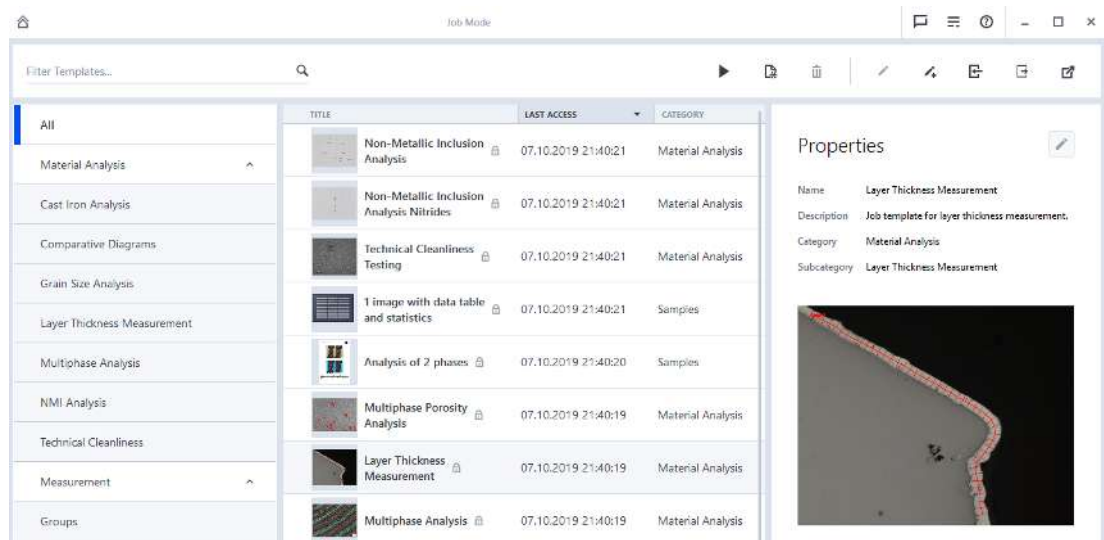


Fig. 20: Material Modules - Job Templates

In the templates list you see the two default, pre-defined sample workflows. If you double-click on the entry in the list, the corresponding job template will be opened. The job templates always contain three major tasks:

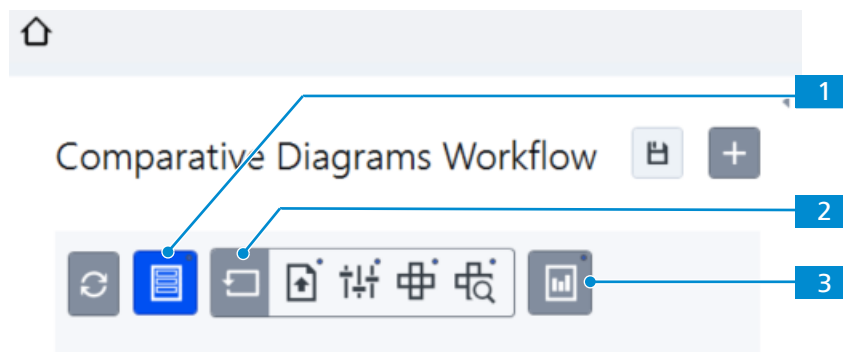


Fig. 21: Comparative Diagrams Workflow



**1 Filling out an Input Form**

In this step the operator has to fill out the input form with user and sample specific information, e.g. Sample Information, User Name, etc.

**2 Performing the Analysis**

In this step the analysis will be performed according to the selected method. The detailed workflow will be described in the following chapters.

**3 Creating a Report**

After the analysis a report will be generated containing the job results (images, measurements, etc.).

**See also**

 General Analysis Workflow [▶ 403]

**7.2.3 General Workflow**

The analysis steps of the workflow contain the following substeps to be executed. In this example the substeps are created within a **Loop Task 1**, meaning all included steps will be repeated depending on the loop settings. Regarding this you can easily fulfill the normative requirements of repeating the identical steps of an analysis for several times.

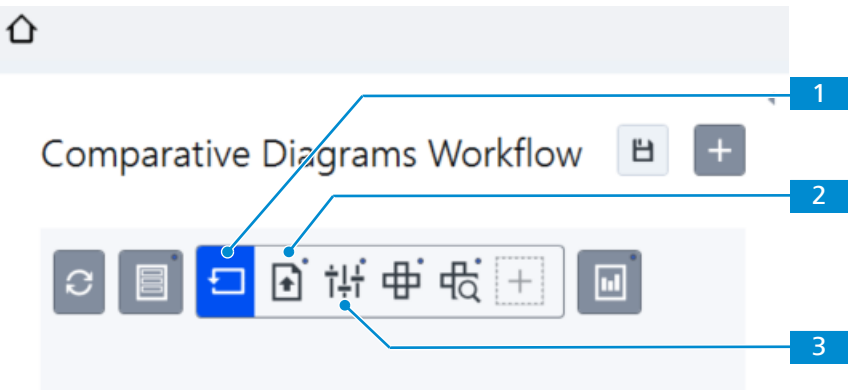








Fig. 22: Analysis Workflow Example

Workflow Step	Description
<b>Loading an Image</b> (2) 	Load your image you want to compare with a chart. The workflow can be adapted to perform image acquisition tasks here as well.
<b>Processing the Image</b> (3) 	Perform improvements on the image, e.g. change Brightness, Contrast and/or Gamma.
<b>Performing the Comparison</b> 	Set up and perform the image comparison with an acquired or loaded image. Select the matching chart image from the standard.

Workflow Step	Description
<b>Performing the Comparison LIVE</b> 	Set up and perform the image comparison with a live image from the microscopy camera. Select the matching chart image from the standard.
<b>Showing the Results View</b> 	The <b>Results View</b> is displayed containing the microscope image and the selected chart image as well as a resulting table containing the detailed parameters.

7.2.4 Comparative Diagrams

 This topic explains the specific comparison part of the **Comparative Diagrams** job template which is delivered with the software. We recommend that you read in advance the chapters "*General Preparations* [[▶ 392](#)]" and "*General Analysis Workflow* [[▶ 393](#)]" to make yourself familiar with the general workflow.

**Image Comparison** Comparing the microscope image with chart images from a standard is the central part of the **Comparative Diagrams** workflow. By the help of the **Comparative Diagrams Setup** tool in the left tool area you have all parameters available to select the desired application and standards. Of course you can adapt the comparison view to perfectly fit your requirements.

The image inside the blue frame is the image that will be used as the matching chart image. On the very right side of the window you find a gallery containing all chart images which are available for the selected standard. If you click on an image, it will be positioned in the blue frame. To select another image simply click on it and it will replace the previous selected image.

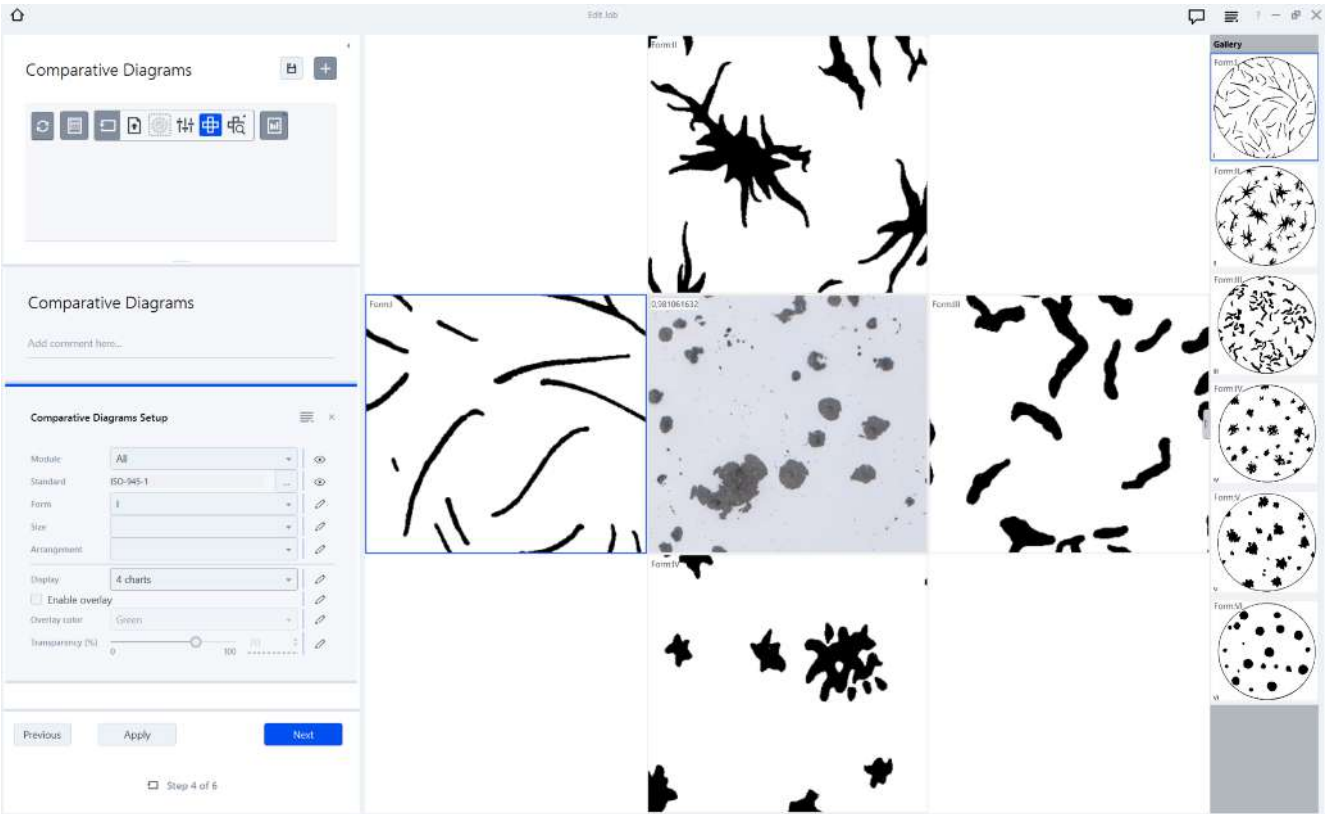


Fig. 23: Image Comparison with acquired image

**See also**

 Comparative Diagrams Setup Tool [[▶ 396](#)]

### 7.2.5 Comparative Diagrams Live



This topic explains the specific comparison part of the **Comparative Diagrams Live** job template which is delivered with the software. We recommend that you read in advance the chapters "*General Preparations* [[▶ 392](#)]" and "*General Analysis Workflow* [[▶ 393](#)]" to make yourself familiar with the general workflow.

#### Live Image Comparison

Comparing the live microscope image from the microscope camera with chart images from a standard is the central part of the **Comparative Diagrams Live** workflow. By the help of the **Comparative Diagrams Setup** tool in the left tool area you have all parameters available to select the desired application and standards. Of course you can adapt the comparison view to perfectly fit your requirements.

The image inside the blue frame is the image that will be used as the matching chart image. On the very right side of the window you find a gallery containing all chart images which are available for the selected standard. If you click on an image, it will be positioned in the blue frame. To select another image simply click on it and it will replace the previous selected image.

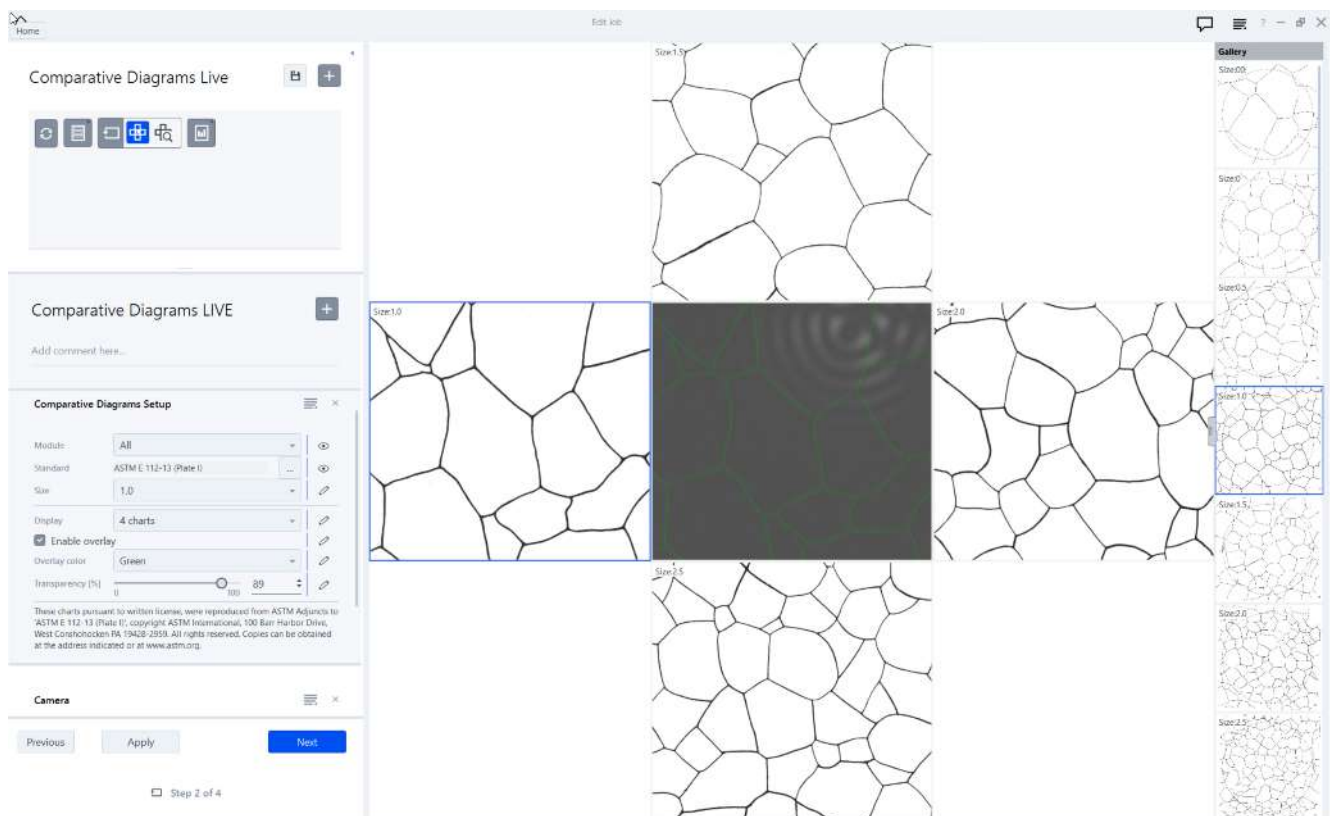


Fig. 24: Image Comparison with Live Image

#### See also

 Comparative Diagrams Setup Tool [[▶ 396](#)]

### 7.2.6 Chart Series Creator

Within this dialog you can see the available standards for the **Comparative Diagrams** module and you can create your own, customized chart series.

- **Chart Series (User defined)**

When you double-click on the entry **New Chart Series** a wizard will be opened to help you creating a chart series. Once you have created a new chart series, it can be used in the **Comparative Diagrams** module to compare it with microscope images.

- **Chart Series (Standards)**

The list shows the available standards provided with the software. They can be used in the **Comparative Diagrams** module to compare microscope images with chart series from the desired standard. Note that the chart series from the standards cannot be modified or edited.

On the right side of the standards list you see basic properties like **Name**, corresponding **Application**, **Description** and the relevant **Dimensions**.

### See also

 Chart Series Creator Wizard [► 396]

## 7.2.7 Chart Series Creator Wizard

Using this wizard you can create your own, customized chart series. You can easily navigate through the wizard steps by using the **Next** and **Back** buttons available. The wizard contains the following 4 steps:

### Step 1/4 Enter basic information

Within the first step you can enter basic information like **Name**, **Description** and the **Module**, for which the chart series should be used. Click on **Next** to continue.

### Step 2/4 Define dimensions & values

Within this step you define the **Dimensions** and the corresponding **Values** of your own chart series. By clicking on the **+ Add** buttons below, for each list a new dimension or value is added. If you have finished your individual definition, click on **Next**.

### Step 3/4 Add images

Now you have to add the images (charts series) you want to use for the comparisons. Again click on the **+ Add** button to add the desired images.

### Step 4/4 Assign values to images

Within this step you have to assign values to the corresponding images. You can assign the images by dragging & dropping the corresponding value fields on the box.

## 7.2.8 Comparative Diagrams Setup Tool

Parameter	Description
<b>Module</b>	Here you can select the module you are using for the comparison. Depending on the selection, specific standards (see below) and parameters are available.
<b>Standard</b>	Here you can set or load the desired standard (including the comparison images) you want to use for the compare.
<b>Size</b>	Only available for the <b>Grains</b> module. Specifies the grain size according to the selected graph.
<b>Display</b>	Here you can select up to 5 different settings for displaying the image and the comparative images.

Parameter	Description
- Enable Overlay	If activated, an overlay image of the selected comparative image and the sample image is displayed.
<b>Overlay Color</b>	Here you can select a certain color for the overlay image.
<b>Transparency</b>	Here you can adjust the transparency of the overlay image from 0-100%.


### See also

 Comparative Diagrams [► 391]

## 7.2.9 Comparative Diagrams Results Workbench

This workbench opens the **Comparative Diagrams Results** view.

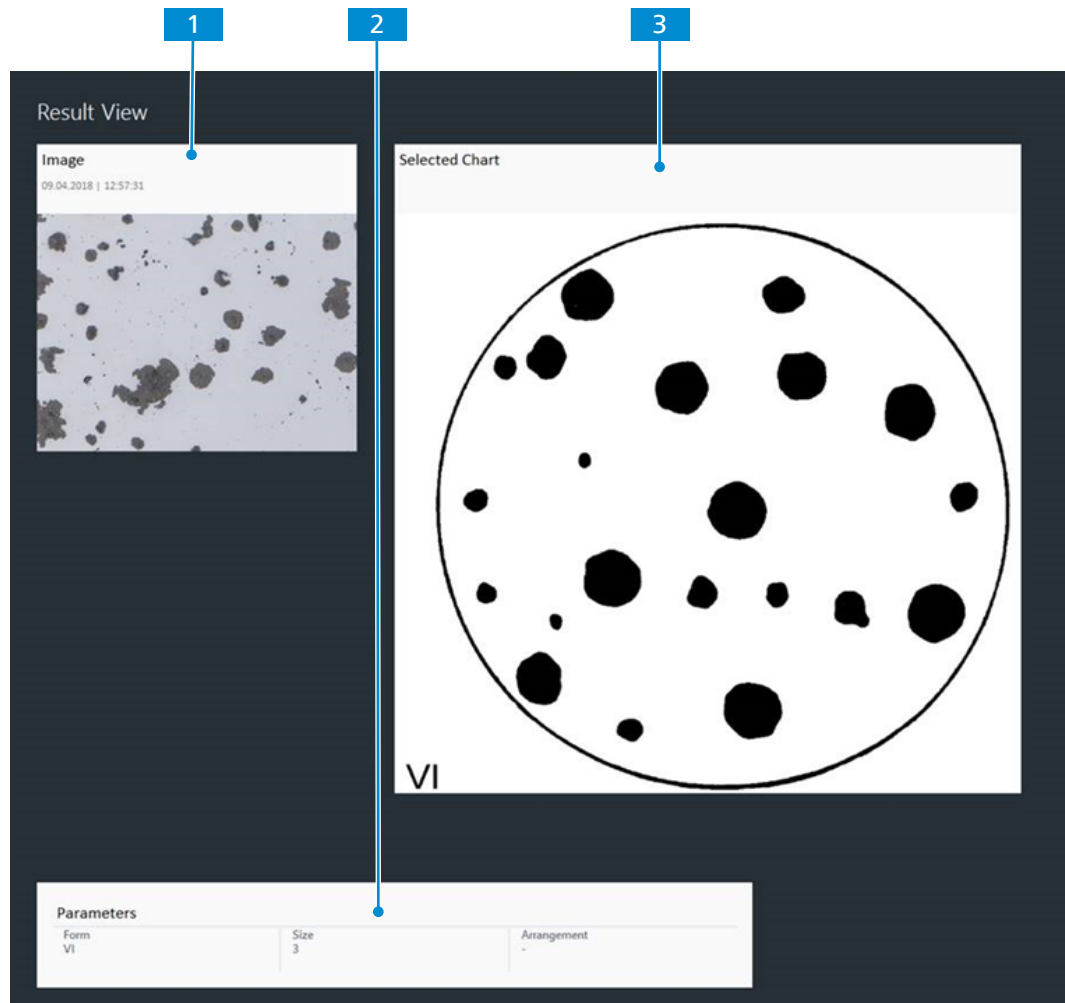
### See also

 Comparative Diagrams Results View [► 397]

 Comparative Diagrams [► 391]

### 7.2.10 Comparative Diagrams Results View

The **Result View** is displayed containing the microscope image and the selected chart image as well as a resulting table containing the detailed parameters. In the **Image Selection** tool, you can exclude images from the **Result View** and display statistics.



**1** Microscope image

**2** Parameters

**3** Selected chart

### See also

- 📄 Comparative Diagrams Results Workbench [▶ 397]
- 📄 Comparative Diagrams [▶ 391]

## 7.3 Grain Size Analysis

This module enables you to perform grain size analysis according to current international standards.

There is a choice of four different methods:

- **Planimetric Method**  
Using this method you can perform an automated analysis based on a reconstruction of grain boundaries, see *Planimetric Method* [▶ 399].
- **Intercept Method**  
Using this method you can apply various chord patterns to your images to detect and analyze the grain size, see *Intercept Method* [▶ 400].
- **Comparison Method**  
Using this method you can directly compare images with comparative diagrams from standards, see *Comparison Method* [▶ 400].



### ■ Intellesis Method

Using this method, you can perform an automated analysis based on machine learning algorithms and pre-trained models, see *Intellesis Method* [▶ 401].

Please make yourself familiar with the common functions and operating principles of the software before you start working with the **Grain Size Analysis** module. We recommend to read the full Online Help and User Manual carefully of course in addition to the specific chapters concerning this module.

#### 7.3.1 Planimetric Method

Using this method the grain boundaries will be detected and the individual grain sizes will be determined automatically. The grain size distribution is also available in addition to the average grain size. This method is suitable for samples with grain boundaries that are comparatively easy to detect. The analysis takes place in accordance with the following standards:

- **ASTM E 112 - 13**
- **ASTM E 1382 - 97**
- **DIN EN ISO 643:2020**
- **GB/T 6394 - 2017**

All data are saved and managed in one place – the **Archive** – which has search and filter functions. This ensures that the data can be relocated easily. The default workflow of the method is described in the next chapters.



Fig. 25: Grain Size Analysis - Planimetric Method

### 7.3.2 Intercept Method

Using this method the microscope image can be overlaid with different patterns (e.g. circle or parallel lines). The selected pattern can then be easily adjusted to fit the image. The intercept points with the grain boundaries will be recognized automatically. Additional intercept points can be added or removed interactively.

As the length of the pattern of lines is known, it is possible to determine the average grain size. This procedure corresponds to the requirements of the standard and the method is suitable for different kind of sample types. The analysis takes place in accordance with the following standards:

- **ASTM E 112 - 13**
- **ASTM E 1382 - 97**
- **DIN EN ISO 643:2020**
- **GB/T 6394 - 2017**



Fig. 26: Grain Size Analysis - Intercept Method

#### See also

Grain Size Analysis with Intercept Method [► 410]

### 7.3.3 Comparison Method

Using this method you can compare microscope images with comparative diagrams from the standard. This method is primarily suited for steel and metal samples, as the comparative diagrams have been created on the basis of steels. This is an interactive and visual method. The following comparative diagrams are available:

- **ASTM E 112 - 13 (Plate I - IV)**
- **GB/T 6394 - 2017 (Plate I - IV)**



- **DIN EN ISO 643:2020**

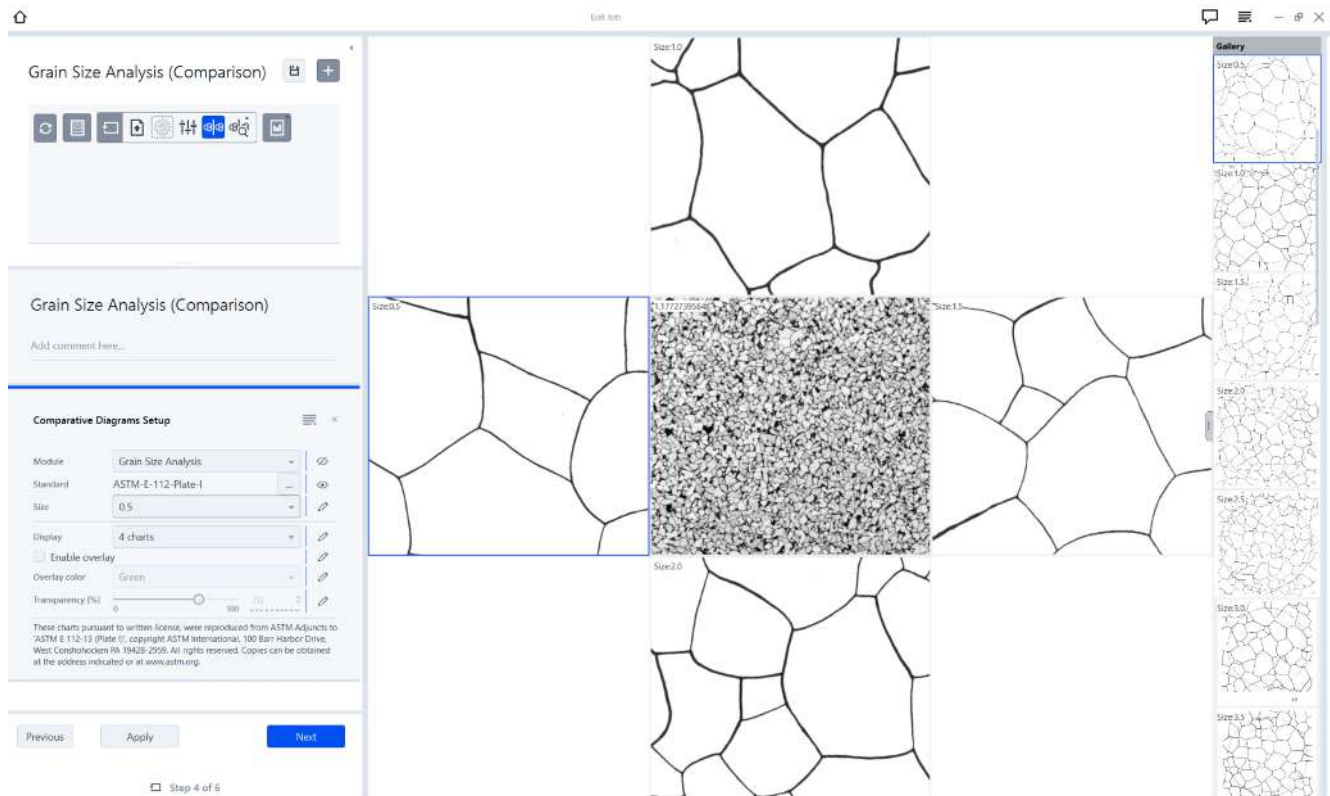


Fig. 27: Grain Size Analysis - Comparison Method

### 7.3.4 Intellesis Method

This method uses machine learning algorithms and pre-trained models to detect grain boundaries and determine grain sizes automatically. For general information, see *Intellesis* [▶ 292].

### 7.3.5 AI Instance Segmentation Method

This method uses pre-trained AI models for instance segmentation to detect grain boundaries and determine grain sizes automatically. Note that you need the software Docker Desktop running on your computer to be able to use the models. You also need to download your models to have them available, see *Downloading AI Models* [▶ 71].

### 7.3.6 The Concept

The operating concept of the **Grain Size Analysis** module is designed to make it possible to achieve a reproducible result with as little interaction as possible. The performance of a measurement can be automated to such an extent that only the project data need to be entered and the entire analysis process can run automatically.

To automate a measurement completely, you need extensive knowledge of systems engineering and the respective application. Carelessly made alterations of a setting can promptly lead to faulty measurement results. It is important, therefore, to prevent users not having such knowledge from changing the basic settings. This is achieved by dividing up the tasks involved into the definition of an analysis and the performance of an analysis. For this reason, the operation of the module sticks to the general operating concept of the software:

- **Creating and Managing Jobs (Supervisor)**

Create job templates for grains size analysis, manage templates, view job results, sign & release jobs (with GxP module only). Note that under **Job Mode** you will find pre-defined job templates for the three methods for grains analysis described.

- **Running Jobs (Operator)**  
Performing grains size analysis using pre-defined job templates

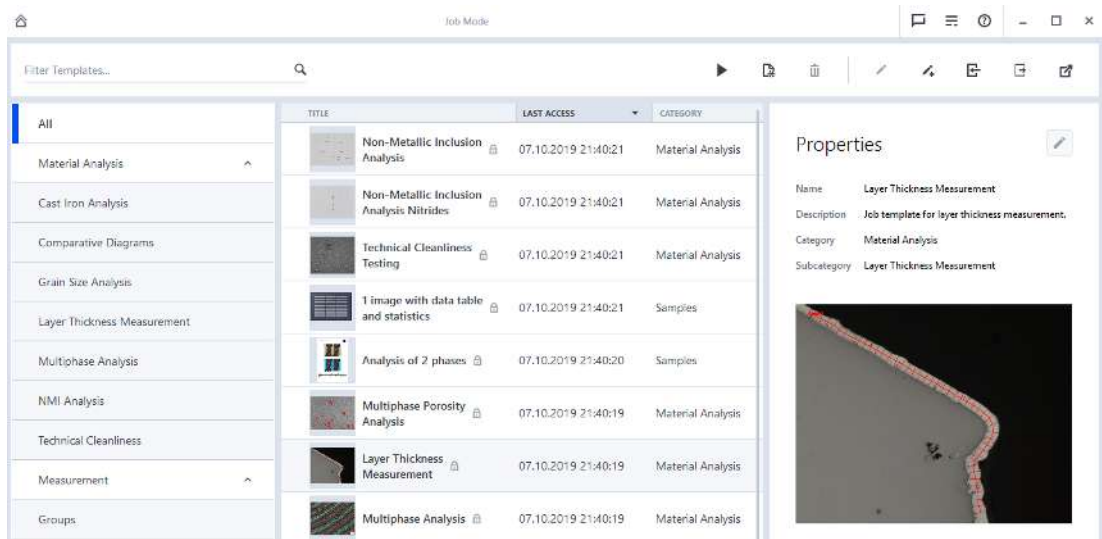
### See also

- 📄 General Preparations [▶ 402]
- 📄 General Analysis Workflow [▶ 403]
- 📄 Basic Concepts [▶ 20]

## 7.3.7 General Preparations

A pre-defined job template for each method is included in the software, when you have licenced the **Grain Size Analysis** module. Of course the job template can be adapted individually. In this documentation we will explain the method according to the existing, pre-defined job templates.

As a **Supervisor** you can access/edit the job template under **Manage Templates**. On the left side in the **Categories** list under **Material Modules** select **Grain Size Analysis**.



*Fig. 28: Material Modules - Job Templates*

In the templates list you will see the three available methods for **Grain Size Analysis**. When you double click on the entry in the list, the corresponding job template it will be opened. The job templates contain three major tasks by default (displayed task icons can differ for a specific method):

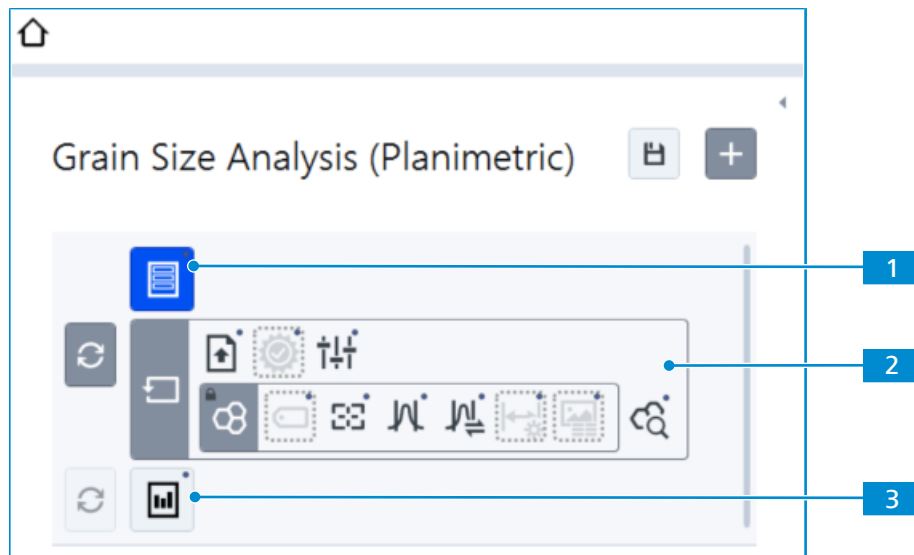


Fig. 29: Grain Size Analysis Workflow (Example: Planimetric Method)

### 1 Filling out an Input Form

In this step the operator has to fill out the input form with user and sample specific information, e.g. Sample Information, User Name, etc..

### 2 Performing the Analysis

In this step the grains size analysis will be performed according to the selected method. The workflow for each method will be described in detail in the following chapters.

### 3 Creating a Report

After the analysis a report will be generated containing the job results (images, measurements, etc.).

## See also

📄 General Analysis Workflow [► 403]

### 7.3.8 General Analysis Workflow

The analysis steps of the workflow contain the following substeps to be executed. In this example the substeps are created within a **Loop Task (1)**, meaning all included steps will be repeated depending on the loop settings. Regarding this you can easily fulfill the normative requirements of repeating the identical steps of an analysis for several times.

#### Info

Note that greyed out task icons are set to **Run silent**. The tasks will not be shown when the workflow is executed. To activate them, right-click on the icon and deactivate the **Run silent** menu entry.

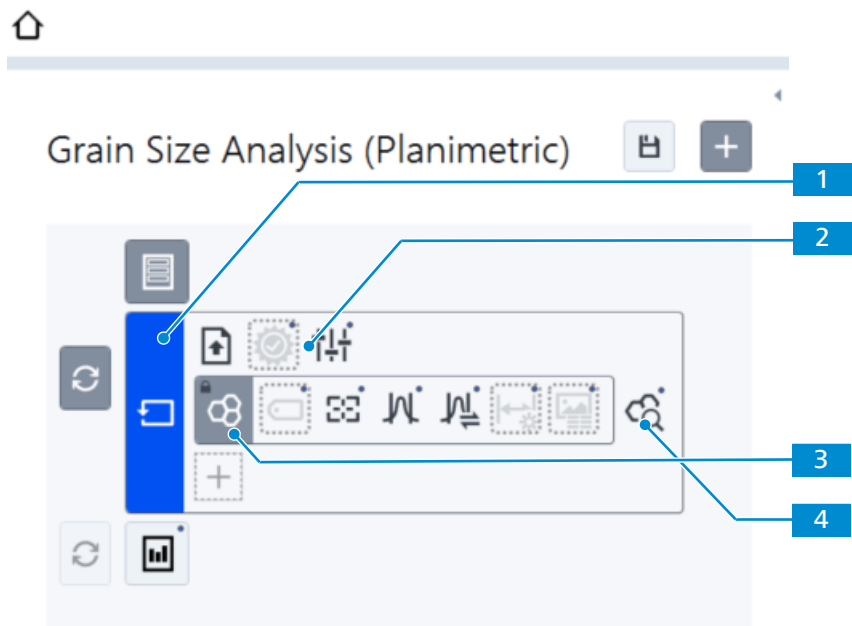










Fig. 30: Analysis Workflow (Example: Planimetric Method)

Workflow Step	Description
<b>Loading an Image</b> (2) 	Load your image you wish to analyze. The workflow can be adapted to perform image acquisition tasks here as well.
<b>Processing the Image</b> (2) 	Perform improvements on the image, e.g. change Brightness, Contrast and/or Gamma.
<b>Performing the Analysis</b> (3) including: <ul style="list-style-type: none"><li>- <b>Setting Up the Measurement Frame/Pattern</b> </li><li>- <b>Segmenting the Image</b> </li><li>- <b>Interactively Adjust the Segmentation Results</b> </li></ul>	<p>This step is the heart of each method. Each analysis can be stored as <b>Analysis Settings File</b>.</p> <p>Depending on the selected method the software will provide the specific parameters. Each method is described in detail in the following chapters.</p> <p>Adjust the region/area that has to be analyzed.</p> <p>Segment the image automatically by clicking inside the image.</p> <p>Edit the segmentation result interactively.</p>

Workflow Step	Description
<div>- <b>Setting up the features</b></div> <div></div>	Apply specific measurement features to the image.
<div>- <b>Viewing the Measurement Data</b></div> <div></div>	The segmented image and tables including measurement results are displayed.
<div><b>Showing the Results View (4)</b></div> <div></div>	The <b>Results View</b> is displayed containing the original and the analyzed images as well as the <b>Grain Sizes</b> chart and a resulting table containing detailed parameters.

7.3.9 Grain Size Analysis with Planimetric Method

This topic explains the method specific image analysis part of the **Grains Size Analysis - Planimetric** method using the job template which is delivered with the software. We recommend that you read in advance the chapters "*General Preparations [▶ 402]*" and "*General Analysis Workflow [▶ 403]*" to make yourself familiar with the general workflow.

**Frame Setup** Setting up a frame for the planimetric method is an optional step. You can add a specific measurement frame (e.g. rectangle area in the center of the sample) which then will be used for the analysis only. Whether you work with a measurement frame is depending on your sample and in-

dividual processes. The tool offers everything you need to setup the frame properly. By using the tool parameters you can adjust the frame individually.

Frame Setup

☐ Maximize circle

☐ Center circle

Mode

Inside Only

Left

0

Top

0

Width

2776

Height

2080

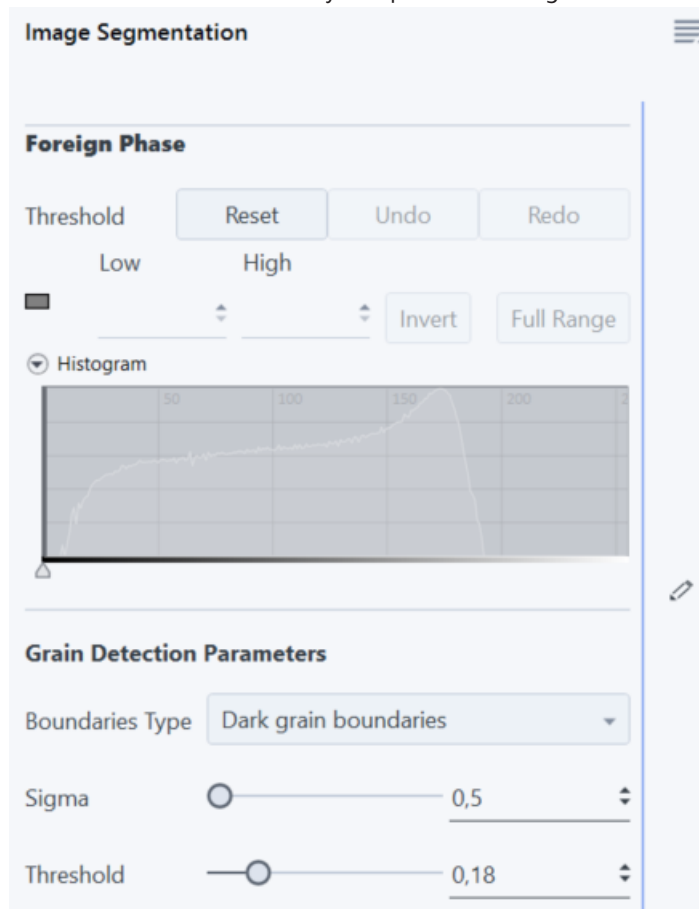
Angle

0

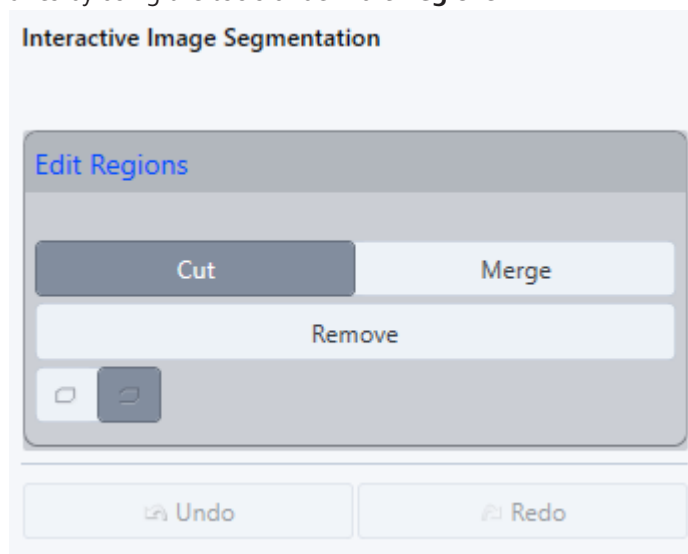
Color

☐ Show frame on analyzed image

**Image Segmentation Setup** In this step the software tries to detect the foreign phase and the grain boundaries. Therefore simply click within the image and mark the foreign phase first. On the **Image Analysis Options** tab you can then switch the display between **Foreign Phase** and **Grain**. The tool offers all parameters which are necessary to optimize the segmentation result.

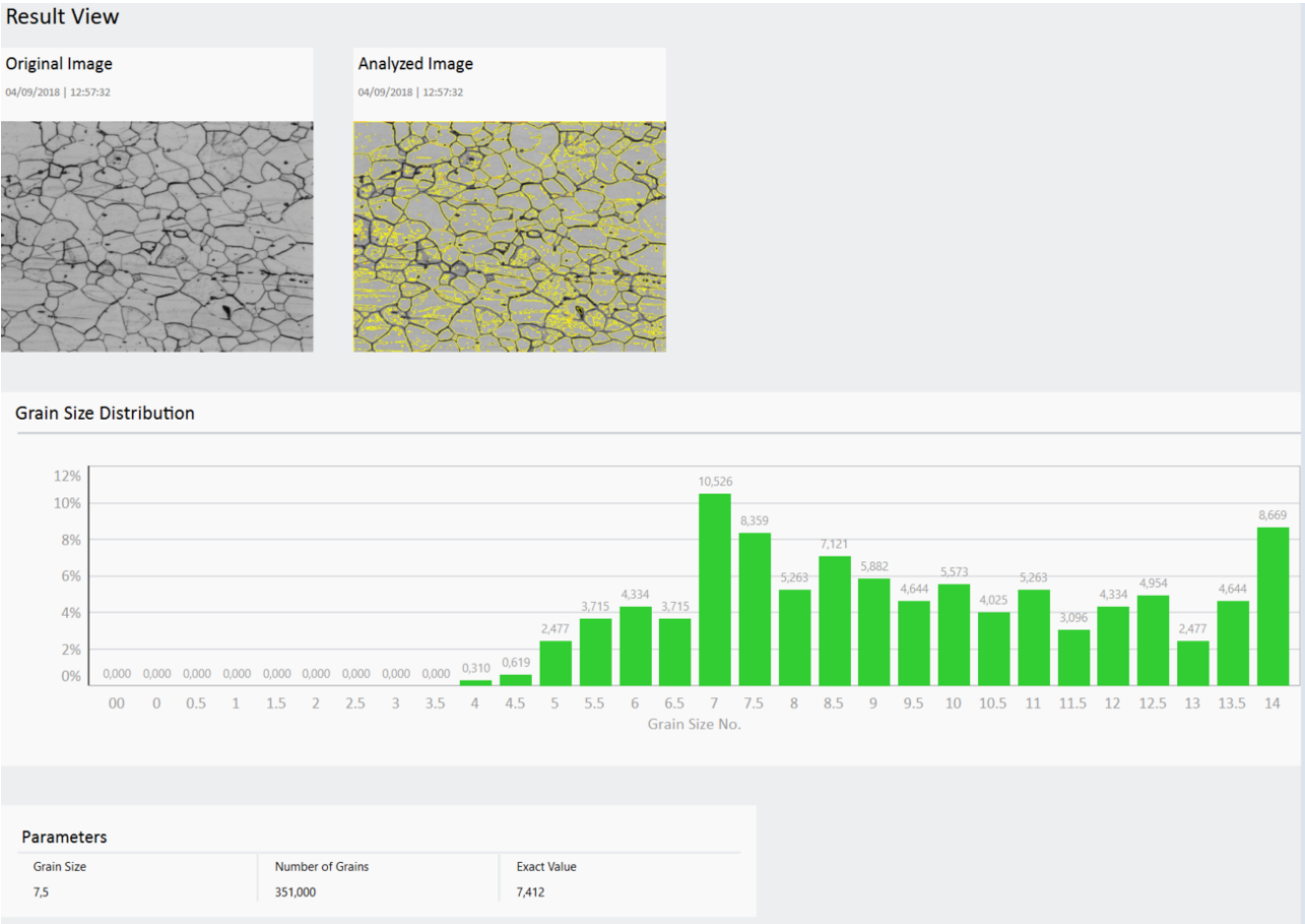


**Interactive Image Segmentation Setup** In this step you can correct the segmentation result interactively. You can **Cut** or **Merge** boundaries by using the tools under **Edit Regions**.



**Result View** At the end of each analysis the **Result** view is displayed. It shows all images and results of the analysis which was performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude iterations or loops which you do not want to have displayed within the result and the report. If you click on the **Statistics** section within the

tool, you can display all results of the analysis in a clearly structured table view as well as in a bar chart for the grain size distribution. On the x-axis the grain size classes are displayed and on the y-axes the number of grains for the respective class in percentage.



7.3.9.1 Grain Detection Parameters

This topic explains the different parameters for grain detection. There are four parameters to adjust. If you are in the **Grain Size Analysis (Planimetric)** workflow, the software automatically provides default values.

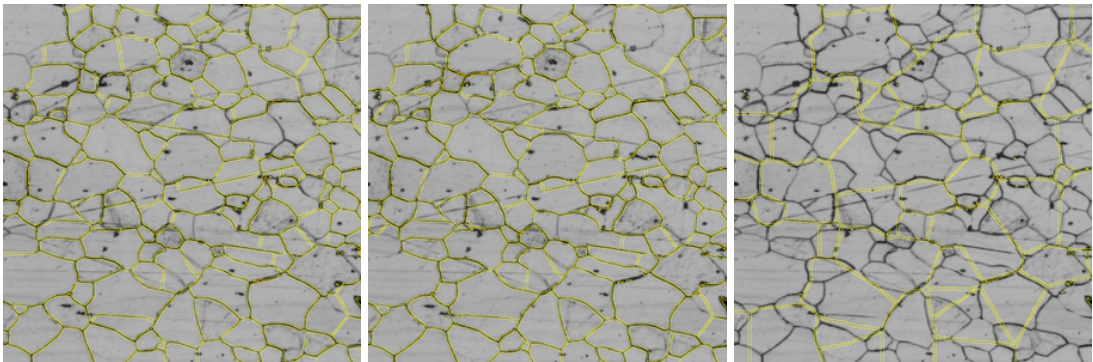
Parameter	Default Value	Type of Adjustment
Sigma	0,5	Rough Adjustment
Threshold	0,17	Rough Adjustment
Maximum Area	51	Fine Adjustment
Smoothing	5	Fine Adjustment

Algorithm for Grain Detection Parameters

**Sigma** This parameter uses the *Valleys Tool* [\[▶ 241\]](#) to specify the extent of smoothing to the input image before the lines of dark pixels are detected. Values lower than the default values lead to the detection of finer grains. Higher values lead to detection of coarse grains.

Parameter Low	Default	Parameter High
---------------	---------	----------------



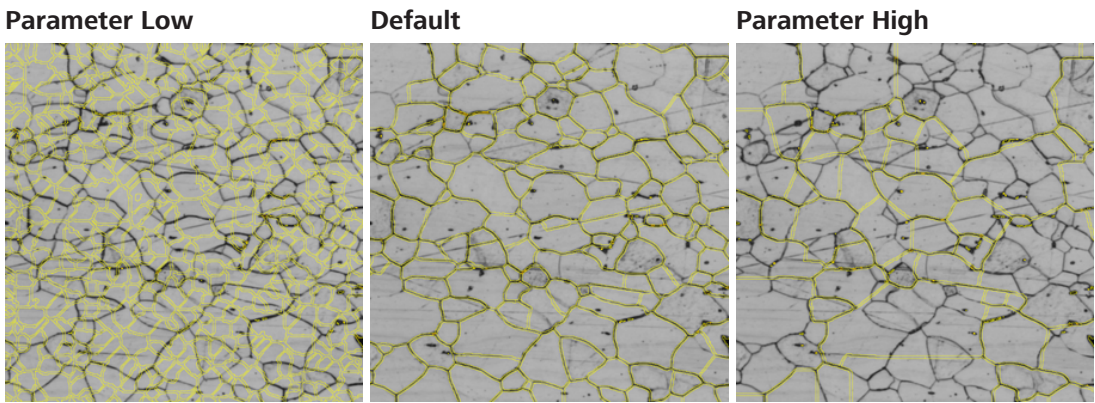


**Threshold** This parameter uses the *Valleys Tool* [▶ 241] to specify the steepness a valley must possess to be recognized by the tool.

Values lower than the default values lead to the detection of finer grains. Higher values lead to detection of coarse grains.

**Info**

We recommend moving the slider only in the front fifth of the bar to adjust the analysis results. Excessive deviations of the values from the default values distort the analysis results.



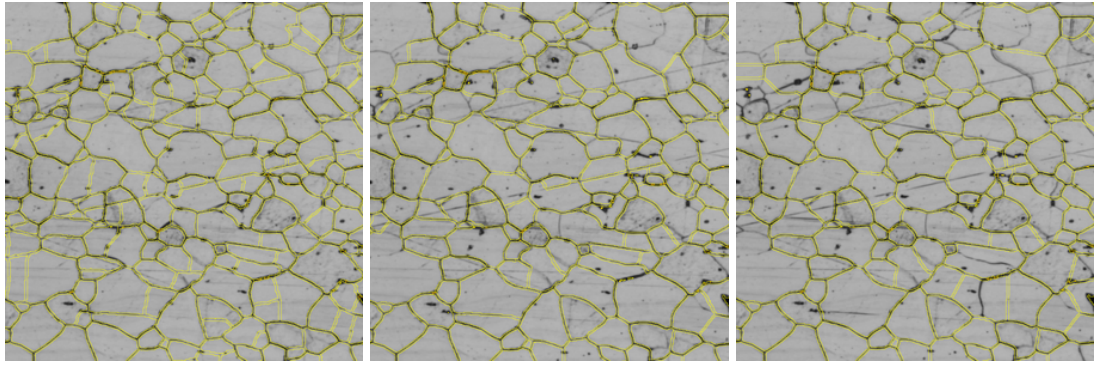
**Maximum Area** This parameter uses the *Scrap Tool* [▶ 216] to remove foreground structures (white) from the current image, depending on the size of the structures.

Values lower than the default values lead to the detection of finer grains. Higher values lead to detection of coarse grains.

**Info**

We recommend moving the slider only in the front third of the bar to adjust the analysis results. Excessive deviations of the values from the default values distort the analysis results.





**Smoothing** This parameter uses different Tools in a certain order:

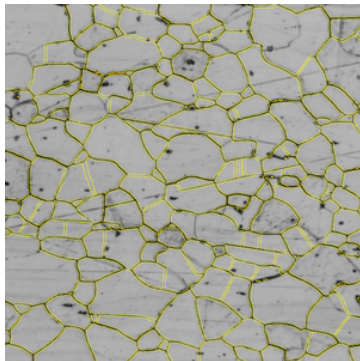
1. The **NOT Tool** [▶ 215] is applied to invert the image.
2. The **Distance Tool** [▶ 212] is applied to create a distance map from the image.
3. The **NOT Tool** [▶ 215] is applied to invert the image.
4. The **Lowpass Tool** [▶ 818] is applied to reduce noise in the image.

Values lower than the default values cause the selected grain boundaries to become straighter and more angular. Higher values round off the detected grain boundaries.

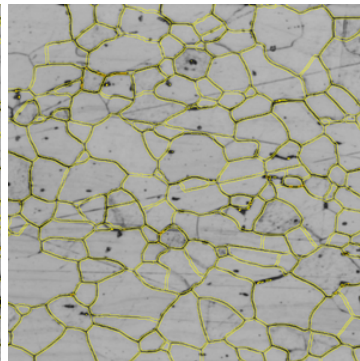
### Info

We recommend that you do not change the default value or change it only slightly in the front area of the bar. Excessive deviations of the values from the default values distort the analysis results.

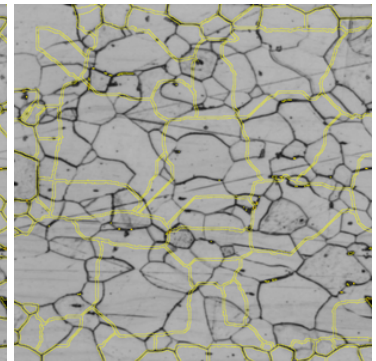
**Parameter Low**



**Default**



**Parameter High**

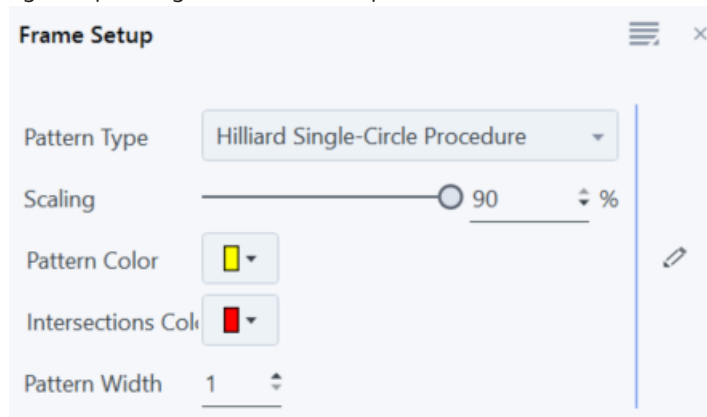


### 7.3.10 Grain Size Analysis with Intercept Method

This topic explains the method specific image analysis part of the **Grains Size Analysis - Intercept** method using the job template which is delivered with the software. We recommend that you read in advance the chapters "**General Preparations** [▶ 402]" and "**General Analysis Workflow** [▶ 403]" to make yourself familiar with the general workflow.

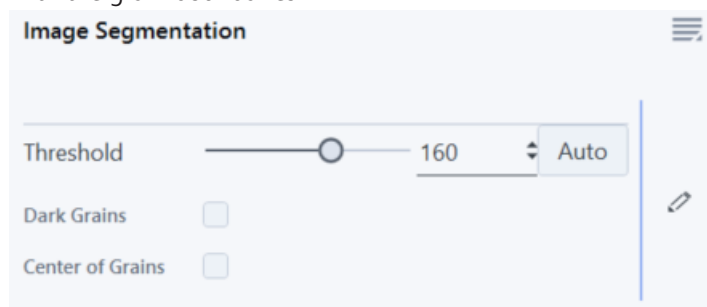
**Frame Setup** This is the first method specific step using the **Intercept** method. It enables you to setup the desired measurement pattern you want to use. Under **Pattern Type** you can select the different patterns (e.g. circle for the **Hilliard Single-Circle** procedure or parallel lines for the **Heyn Linear Intercept** procedure) according to your needs. The selected pattern will be automatically applied

to the image. By using the controls within the tool you can adjust the pattern according to the image. Depending on the selected pattern different controls to adjust the pattern are available.



#### Image Segmentation Setup

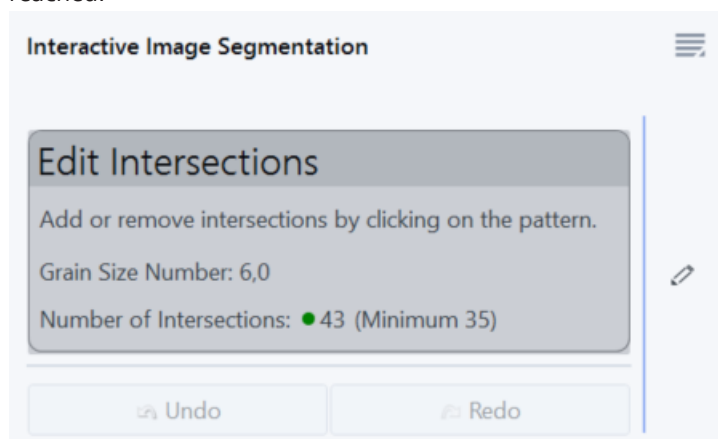
In this step the intersections with the grain boundaries and the selected pattern will be automatically detected. To start the detection click on the **Auto** button. To optimize the results of the automatic detection you can adjust the **Threshold** slider. Activate the checkbox **Dark Grains** for dark field images (grain boundaries are displayed white). If you activate the checkbox **Center of Grains**, the center of the grains will be used as measurement points instead of the intersections with the grain boundaries.



#### Interactive Image Segmentation Setup

In this step you can correct the detected (or not detected) intersections interactively. You can remove wrong intersections by clicking on the individual red marker. To add a new intersection click on the desired position on the pattern line. In the tool window you get a first result of the expected **Grain Size Number**.

The green dot under **Number of Intersections** indicates that the minimum recommended number of the required intersections, according to the standard and pattern, has been reached (in our example the minimum number is 35). A red dot indicates that the minimum number has not been reached.

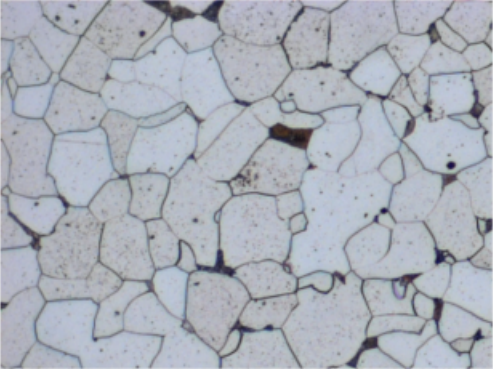


**Result View** At the end of each analysis the **Result** view is displayed. It shows all images and results of the analysis performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude iterations or loops you do not want to have displayed within the result and the report. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view.

Result View

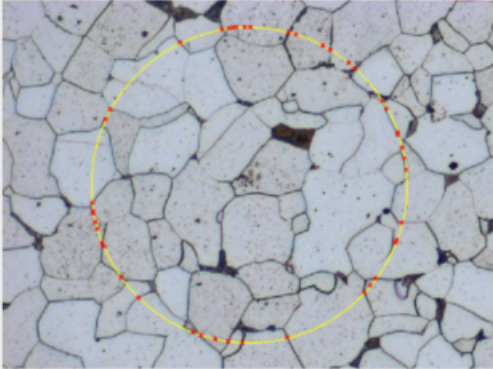
Original Image

04/09/2018 | 12:57:32



Analyzed Image

04/09/2018 | 12:57:32



Parameters

Grain Size No.	Number of Intersections	Pattern Length [µm]
6,0	43	1611,000

7.3.11 Grain Size Analysis with Comparison Method

This topic explains the method specific image analysis part of the **Grains Size Analysis - Comparison** method using the job template which is delivered with the software. We recommend that you read in advance the chapters "*General Preparations [402]*" and "*General Analysis Workflow [403]*" to make yourself familiar with the general workflow.

**Comparative Diagrams Setup** In this step you can compare the loaded (or acquired) image of your sample with comparative diagrams.

Comparative Diagrams Setup

Module

Grain Size Analysis

Standard

ASTM-E-112-Plate-I

Size

0.5

Display

1 chart

☐ Enable overlay

Overlay color

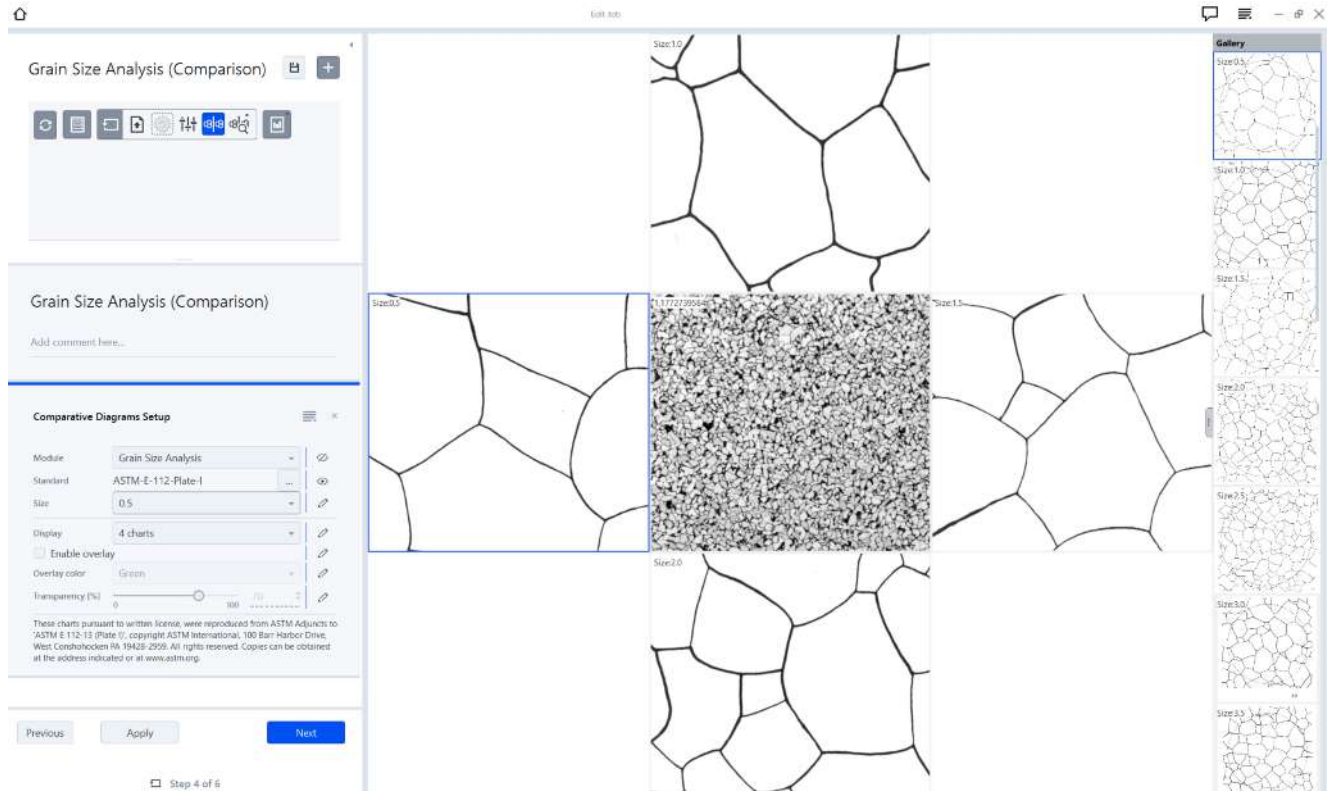
Green

Transparency [%]

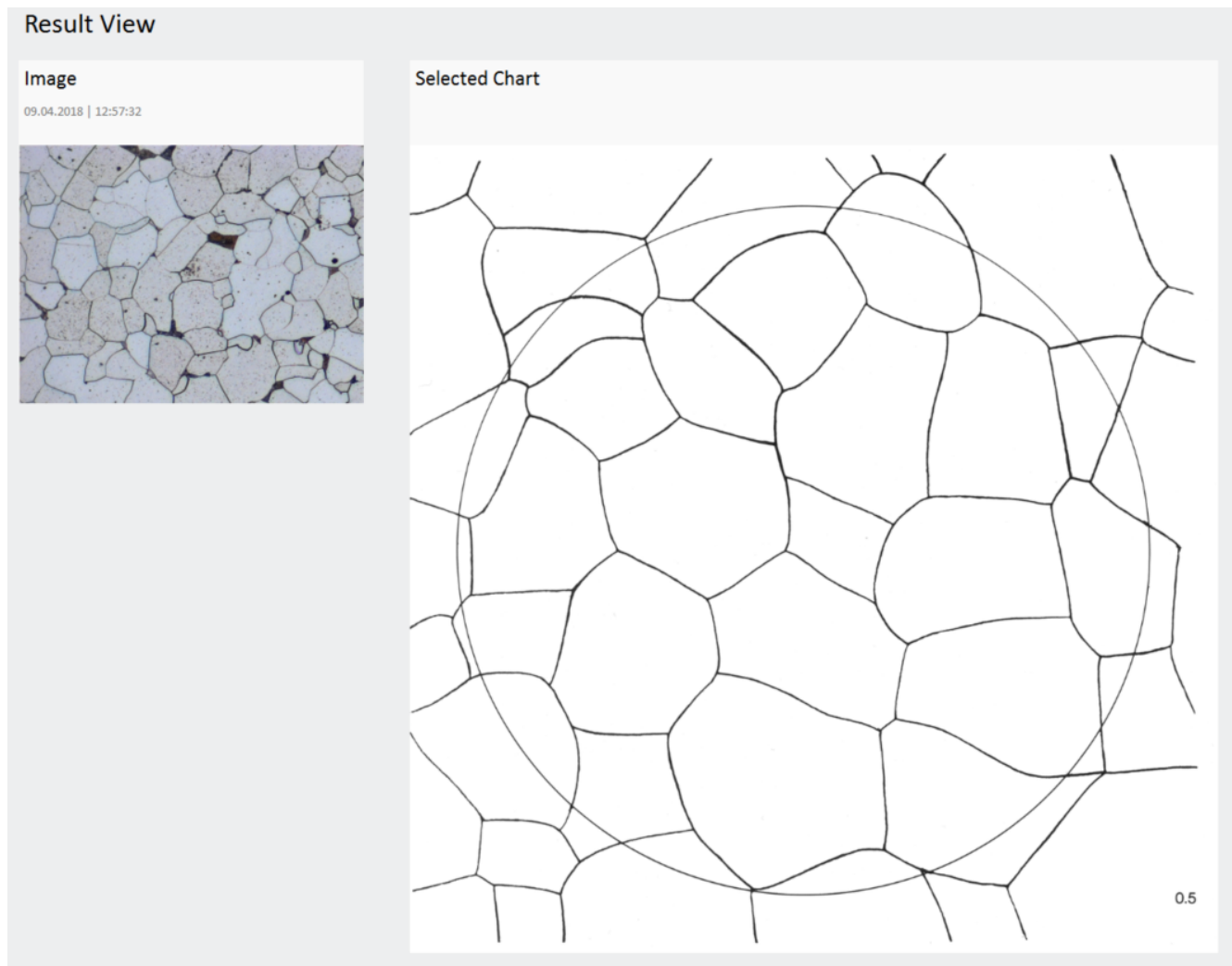
010070



Under **Standard** you can select the desired standard for your comparison. The corresponding comparative diagram images will be loaded automatically. Under **Display** you can adjust how the sample image and the comparative diagrams images are arranged. To select the best fitting comparison image from the standard simply click on it. The selected image will be always displayed within the blue frame.



**Result View** At the end of each analysis the **Result** view is displayed. It shows the original image and the selected comparison image. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view.



### 7.3.12 Grain Size Analysis with Intellesis Method






This topic explains the method specific image analysis part of the **Grains Size Analysis - Intellesis - (Planimetric)** job template which is delivered with the software. We recommend that you read *General Preparations* [▶ 402] and *General Analysis Workflow* [▶ 403] in advance to make yourself familiar with the general workflow.

#### Frame Setup

Setting up a frame is an optional step. You can add a specific measurement frame (e.g. rectangle area in the center of the sample) which is then used for the analysis only. Whether you work with a measurement frame is depending on your sample and individual processes. The tool offers ev-

everything you need to setup the frame properly. By using the parameters, you can adjust the frame individually.

Frame Setup



☐ Maximize circle

☐ Center circle

Mode

Inside Only

Left

0

Top

0

Width

2776


Height

2080

Angle

0

Color



☐ Show frame on analyzed image

Image Segmentation Setup

In this step, the software tries to detect the foreign phase and the grain boundaries using machine learning algorithms and a pre-trained model. A click on **Select Model** opens a dialog where you can select the pre-trained segmentation model and the class which should be segmented (either **Grain** or the **Foreign Phase**). For information on how to create a model, see *Creating a New Model* [▶ 302]. With the options you can adjust additional settings for segmentation, like

the **Min. Confidence**. For more information about those options, see also the description for *Automatic Segmentation* [▶ 254] of the analysis wizard.

Image Segmentation

Model NameGrains Model

Model ClassGrains

Select Model

Reset

Min. Confidence (%)

51

Minimum Area

1

Min. Hole Area

1

Fill Holes

☐

Binary

None

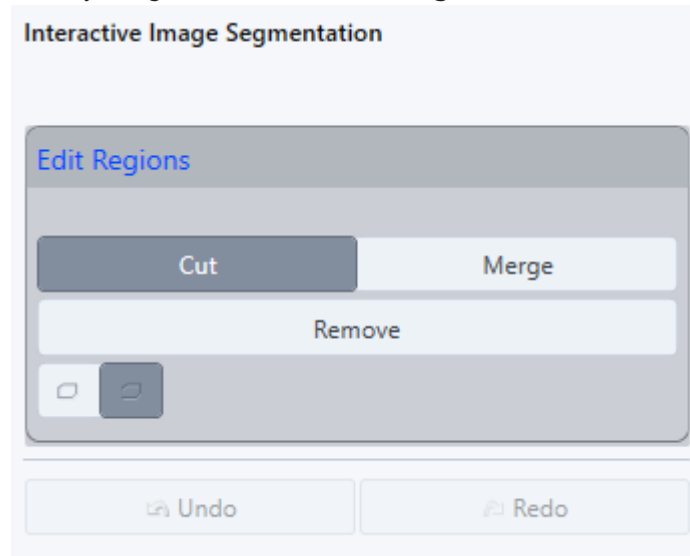
Separate

None



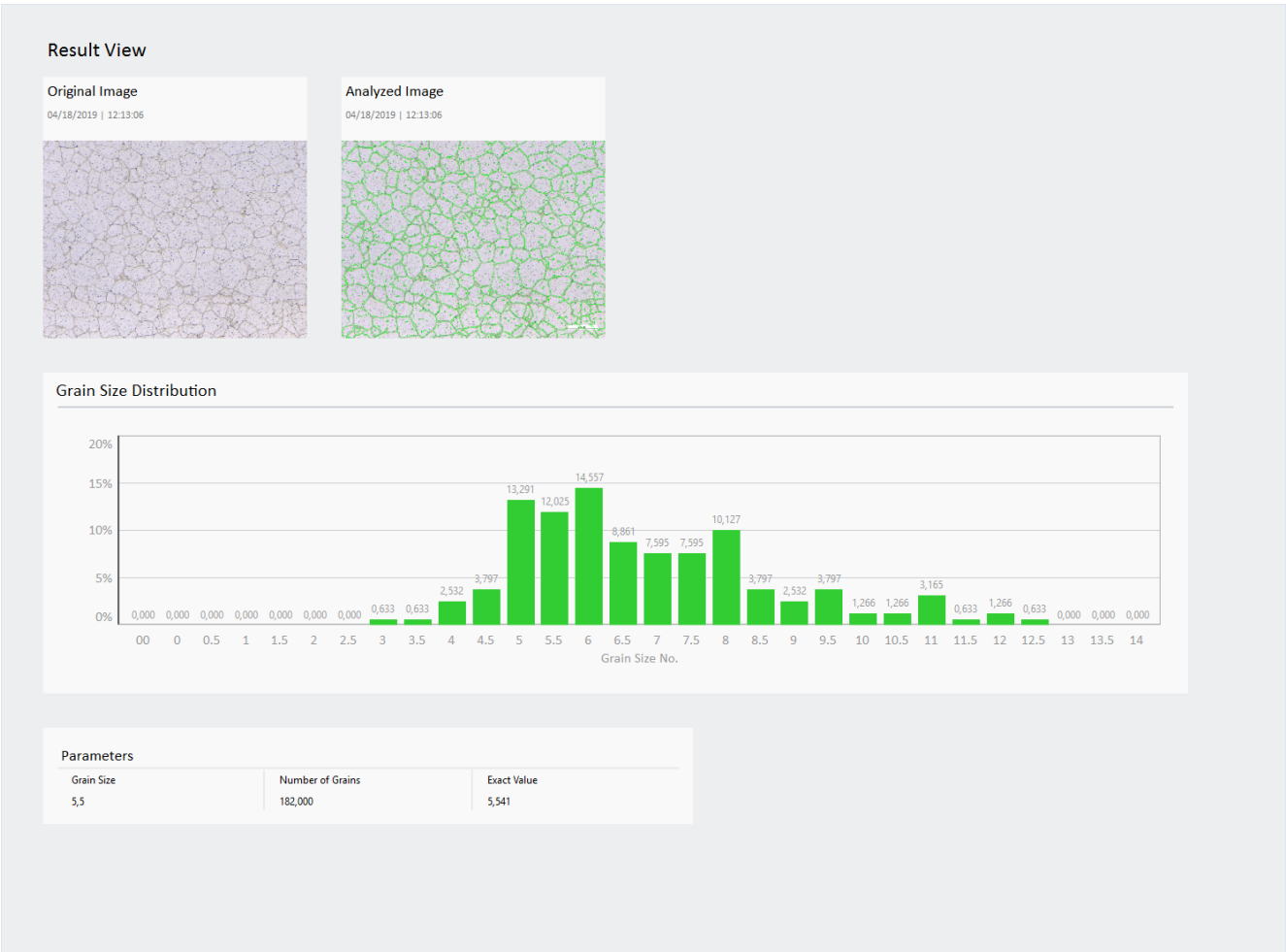
### Interactive Image Segmentation Setup

In this step you can correct the segmentation result interactively. You can **Cut** or **Merge** boundaries by using the tools under **Edit Regions**.



### Result View

At the end of each analysis the **Result View** is displayed. It shows all images and results of the analysis performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude iterations or loops you do not want to have displayed within the result and the report. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view as well as in a bar chart for the grain size distribution. On the x-axis the grain size classes are displayed and on the y-axis the number of grains of the respective class in percent.



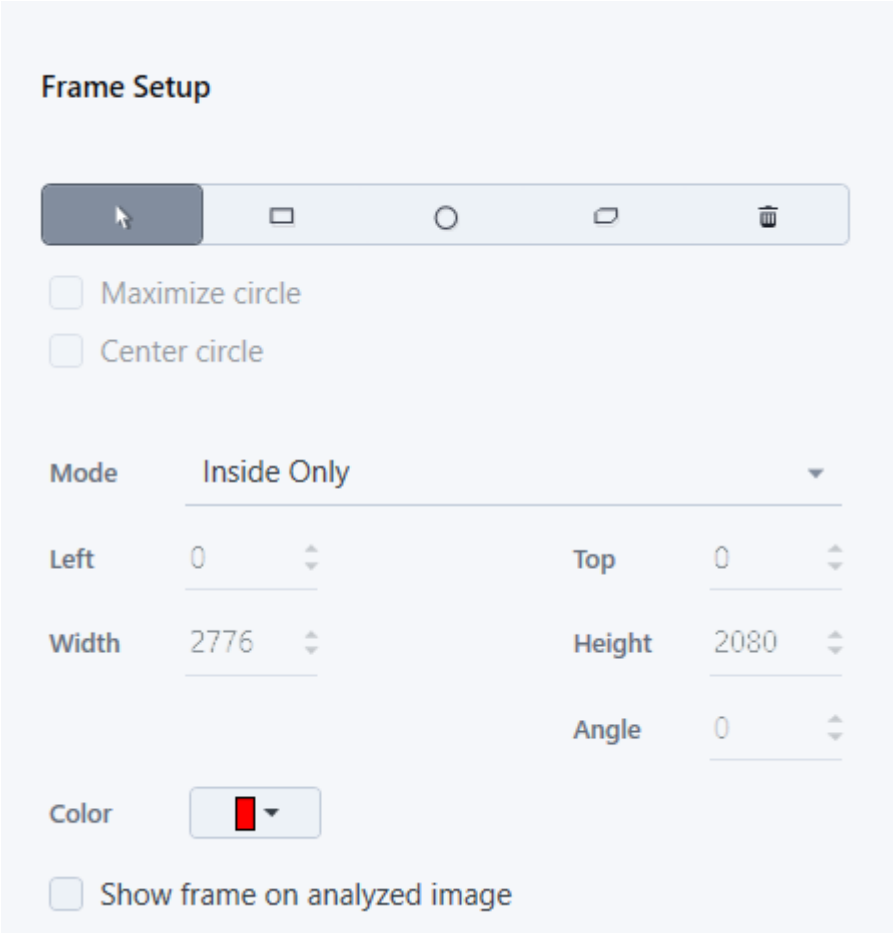
7.3.13 Grain Size Analysis with AI Instance Segmentation

This topic explains the method specific image analysis part of the **Grains Size Analysis - AI Instance Segmentation - (Planimetric)** job template which is delivered with the software. We recommend that you read *General Preparations* [▶ 402] and *General Analysis Workflow* [▶ 403] in advance to make yourself familiar with the general workflow.

Frame Setup

Setting up a frame is an optional step. You can add a specific measurement frame (e.g. rectangle area in the center of the sample) which is then used for the analysis only. Whether you work with a measurement frame is depending on your sample and individual processes. The tool offers ev-

everything you need to setup the frame properly. By using the parameters, you can adjust the frame individually.



The **Frame Setup** dialog box contains the following elements:

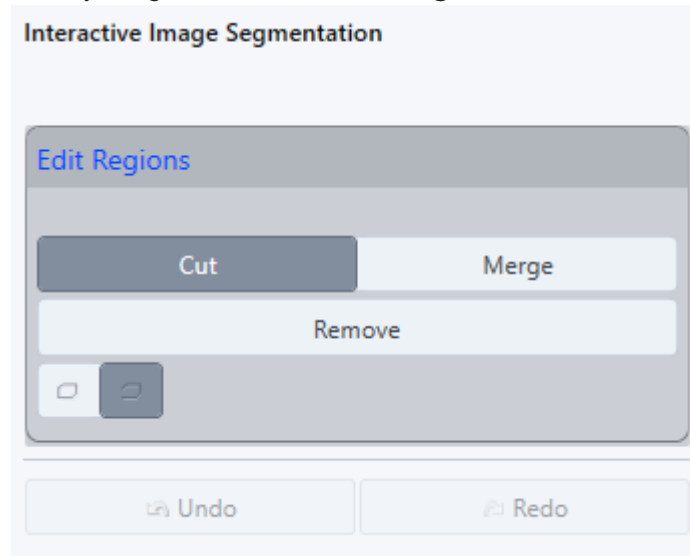
- A toolbar with five icons: a mouse cursor, a rectangle, a circle, a trapezoid, and a trash can. The mouse cursor icon is currently selected.
- Two unchecked checkboxes: **Maximize circle** and **Center circle**.
- A **Mode** dropdown menu set to **Inside Only**.
- Four numeric input fields with up/down arrows:
  - Left**: 0
  - Top**: 0
  - Width**: 2776
  - Height**: 2080
- An **Angle** input field with a value of 0.
- A **Color** dropdown menu showing a red color swatch.
- An unchecked checkbox labeled **Show frame on analyzed image**.

### Image Segmentation Setup

In this step, the software tries to detect the foreign phase and the grain boundaries using machine learning algorithms and a pre-trained model. A click on **Select Model** opens a dialog where you can select the instance segmentation model and the class which should be segmented (either **Grain** or the **Foreign Phase**). With the options you can adjust additional settings for segmentation, like the **Min. Confidence**. For more information about those options, see also the description for *Automatic Segmentation* [▶ 254] of the analysis wizard.

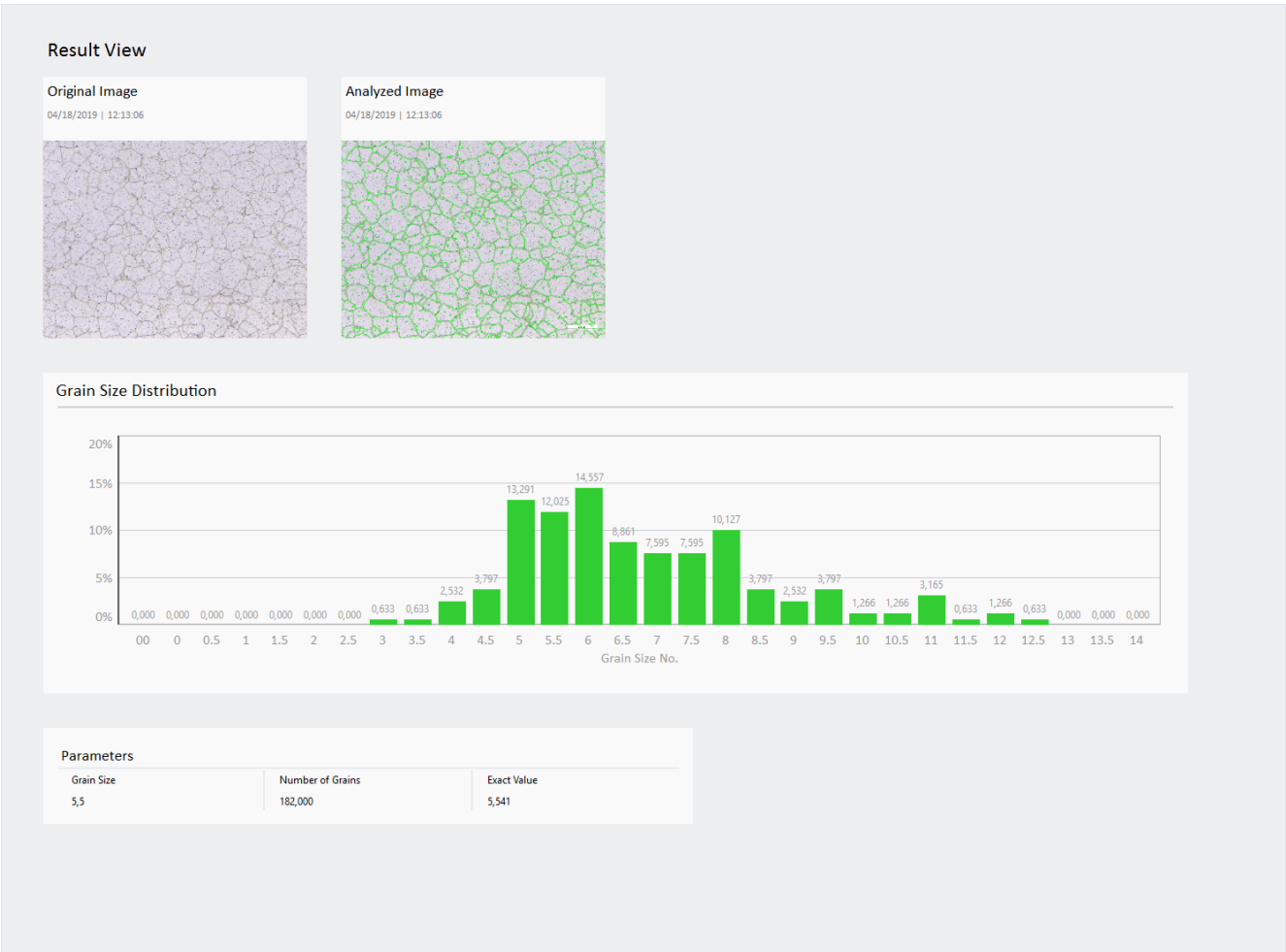
### Interactive Image Segmentation Setup

In this step you can correct the segmentation result interactively. You can **Cut** or **Merge** boundaries by using the tools under **Edit Regions**.



### Result View

At the end of each analysis the **Result View** is displayed. It shows all images and results of the analysis performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude iterations or loops you do not want to have displayed within the result and the report. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view as well as in a bar chart for the grain size distribution. On the x-axis the grain size classes are displayed and on the y-axes the number of grains of the respective class in percent.



### 7.4 Layer Thickness Measurement

This module enables you to measure simple and complex layers of sample images in accordance with the standards **ASTM B 487 - 2007** and **DIN EN ISO 1463 - 2004**. Layers to be measured are detected using image-analysis techniques and measured with the help of chords. The result of this measurement is a clearly structured report containing images and measurement data. In the following chapters the concept and general workflow will be explained.

Make yourself familiar with the common functions and operating principles of the software before you start working with the **Layer Thickness Measurement** module. We recommend to read the full Online Help and User Manual carefully of course in addition to the specific chapters concerning this module.

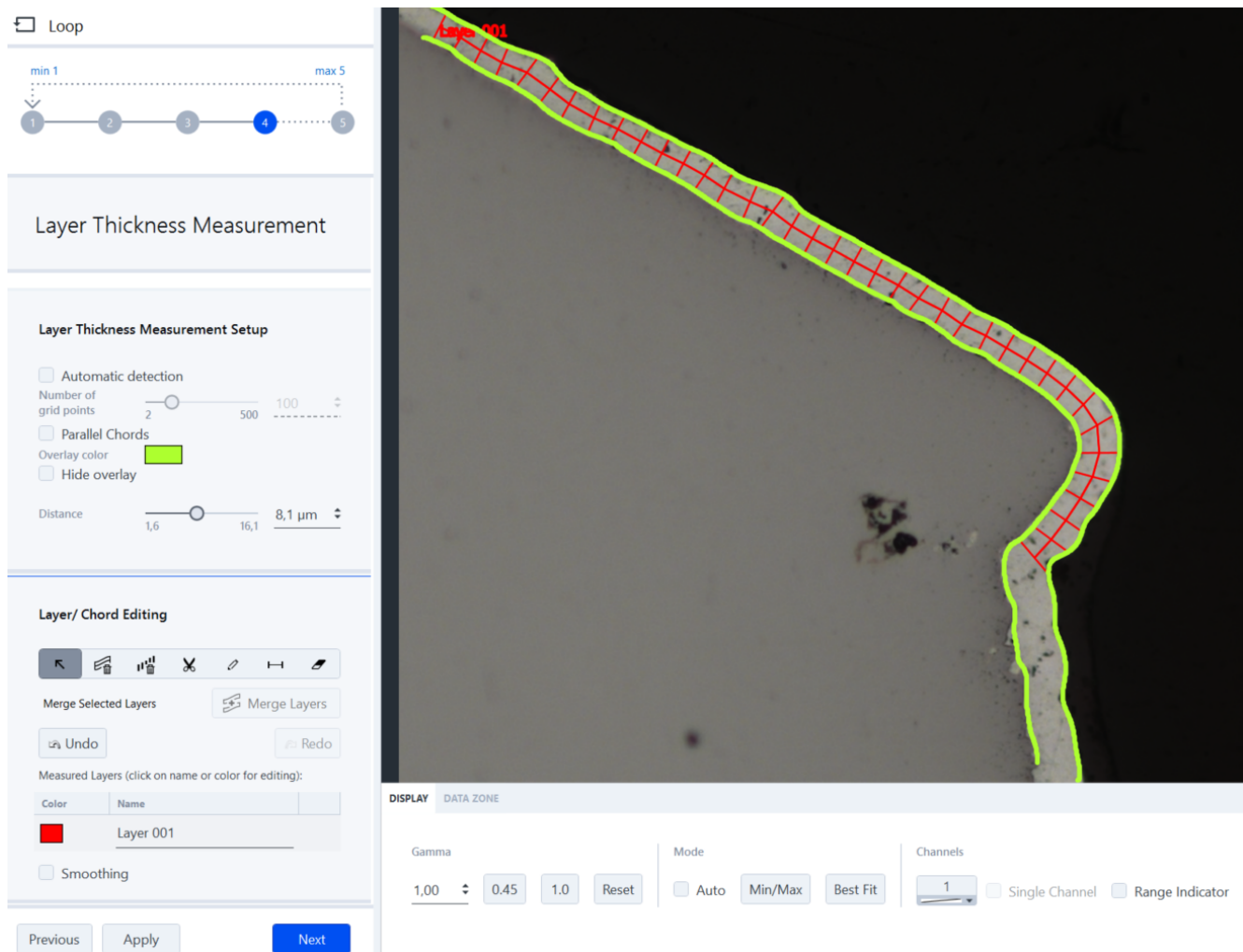


Fig. 31: Layer Thickness Measurement

**See also**

The Concept 422

**7.4.1 The Concept**

The operating concept of the **Layer Thickness Measurement** module is designed to make it possible to achieve a reproducible result with as little interaction as possible.

To perform a measurement, you need extensive knowledge of systems engineering and the respective application. Carelessly made alterations of a setting can promptly lead to faulty measurement results. It is important, therefore, to prevent users not having such knowledge from changing the basic settings. This is achieved by dividing up the tasks involved into the definition of an analysis and the performance of an analysis. For this reason, the operation of the module sticks to the general operating concept of the software:

- **Creating and Managing Jobs (Supervisor)**

Create job templates for layer thickness measurement, manage templates, view job results, sign & release jobs (with GxP module only). Note that under **Job Mode** you will find a sample workflow within a pre-defined job template for layer thickness measurement.

- **Running Jobs (Operator)**

Performing graphite analysis using pre-defined job templates.

**See also**

- 📄 Layer Thickness Measurement [▶ 421]
- 📄 Basic Concepts [▶ 20]
- 📄 General Preparations [▶ 423]

## 7.4.2 General Preparations

A pre-defined job template is included in the software, when you have licenced the **Layer Thickness Measurement** module. Of course the job template can be adapted individually. In this documentation we will explain the method according to the existing, pre-defined job template.

You can access/edit the job template under **Job Mode**. On the left side in the list, select **Layer Thickness Measurement**.

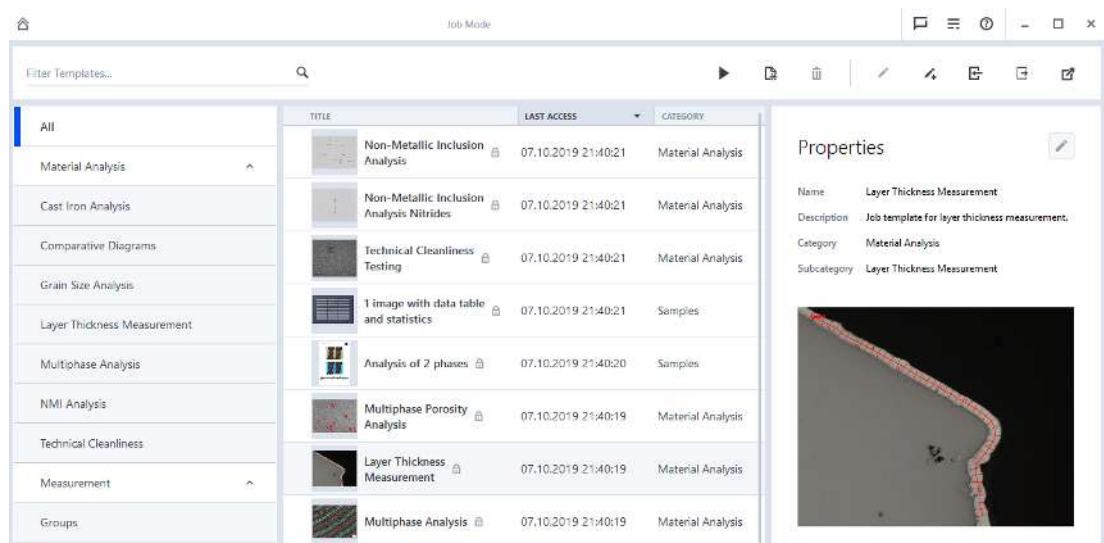


Fig. 32: Material Modules - Job Templates

In the templates list you see the available job templates. Select an entry in the list, and from the context menu, open the corresponding job template. The job templates generally contain three major tasks:

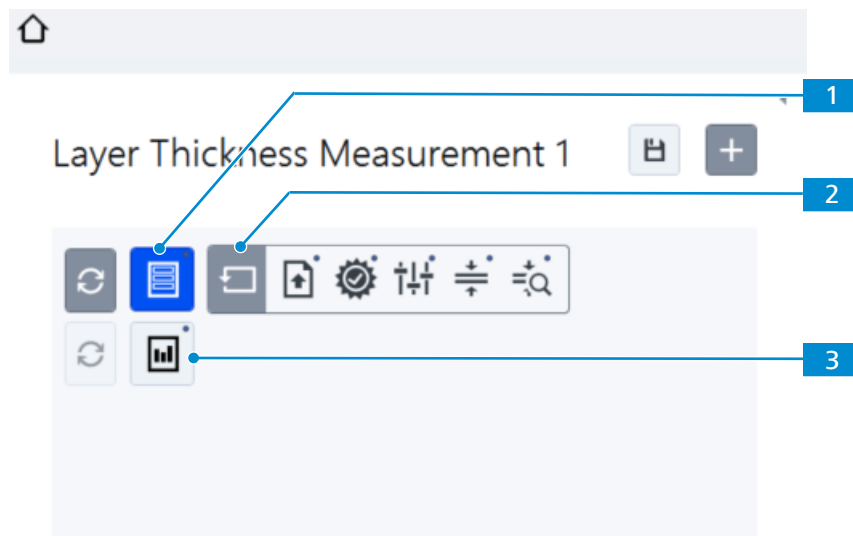


Fig. 33: Layer Thickness Measurement Workflow

**1 Filling out an Input Form**

In this step the operator has to fill out the input form with user and sample specific information, e.g. Sample Information, User Name, etc.

**2 Performing the Analysis**

In this step the analysis will be performed according to the selected method. The detailed workflow will be described in the following chapters.

**3 Creating a Report**

After the analysis a report will be generated containing the job results (images, measurements, etc.).

**See also**

 General Analysis Workflow [▶ 403]

**7.4.3 General Analysis Workflow**

The analysis steps of the workflow contain the following substeps to be executed. In this example the substeps are created within a **Loop Task (1)**, meaning all included steps will be repeated depending on the loop settings. Regarding this you can easily fulfill the normative requirements of repeating the identical steps of an analysis for several times.

**Info**

Note that greyed out task icons are set to **"Run silent"**. The task will not be shown when the workflow is executed. To activate them, right-click on the icon and deactivate the **Run silent** menu entry.

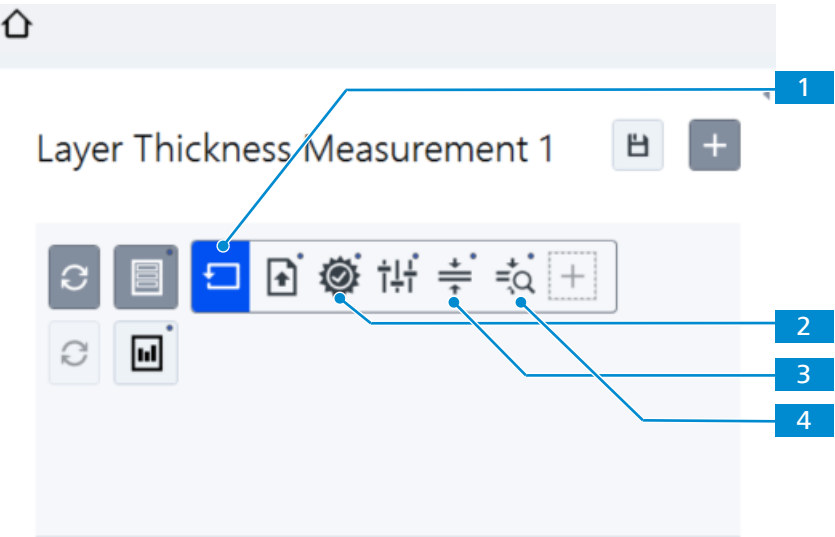







Fig. 34: Analysis Workflow

Workflow Step	Description
<b>Loading an Image</b> (2) 	Load your image which is to be analyzed. The workflow can be adapted to perform image acquisition tasks here as well.

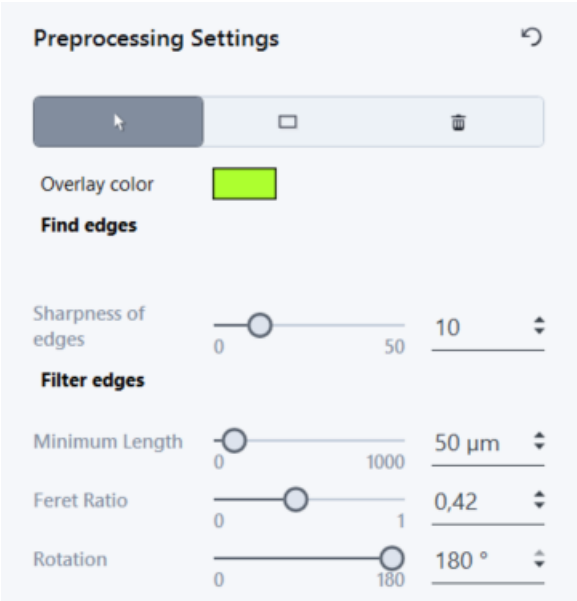


Workflow Step	Description
<b>Validating the input image</b> (2) 	This task is recommended to use right after loading or acquiring an image. Currently it will check if the input image has the correct scaling information. This is important to make sure the image can be processed correctly.
<b>Preprocessing the Image</b> (2) 	Perform preprocessing on the image, e.g. set parameters for finding or filtering edges.
<b>Performing the Measurement</b> (3) 	Perform the layer thickness measurement.
<b>Showing the Results View</b> (4) 	The <b>Results View</b> is displayed containing the measurement results and statistics.

7.4.4 Layer Thickness Measurement

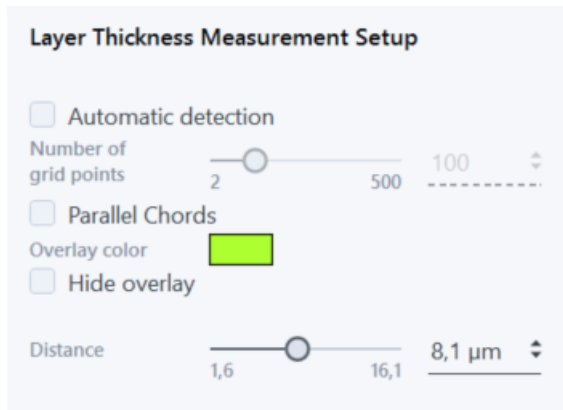
This topic explains the preprocessing and measurement part of the **Layer Thickness Measurement** job template which is delivered with the software, see *General Preparations* [▶ 423] and *General Analysis Workflow* [▶ 424].

**Image Preprocessing** Within this step you can preprocess the image using the available tool parameters. When entering this step the software tries to detect the layers automatically. The edges of the layer will be marked by an overlay color. You can change the color of the overlay within the tool. Using the **Rectangle** button on top of the tool you can set up a measurement frame. The parameters under **Find Edges** and **Filter Edges** help you to detect and display the layers correctly.

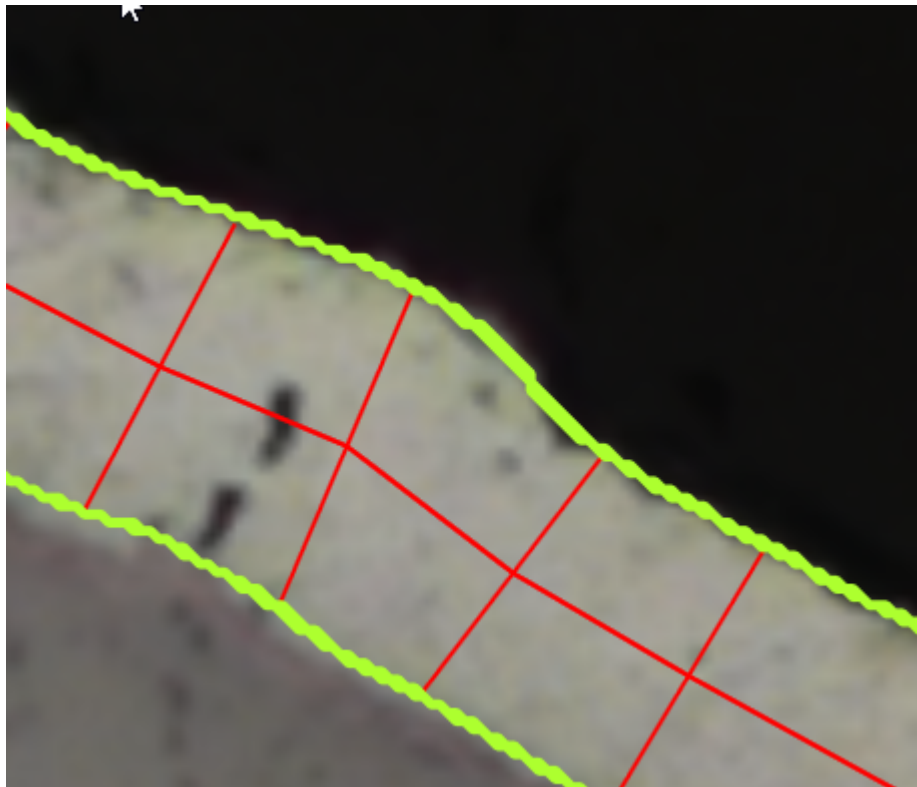


**Layer Thickness Measurement**

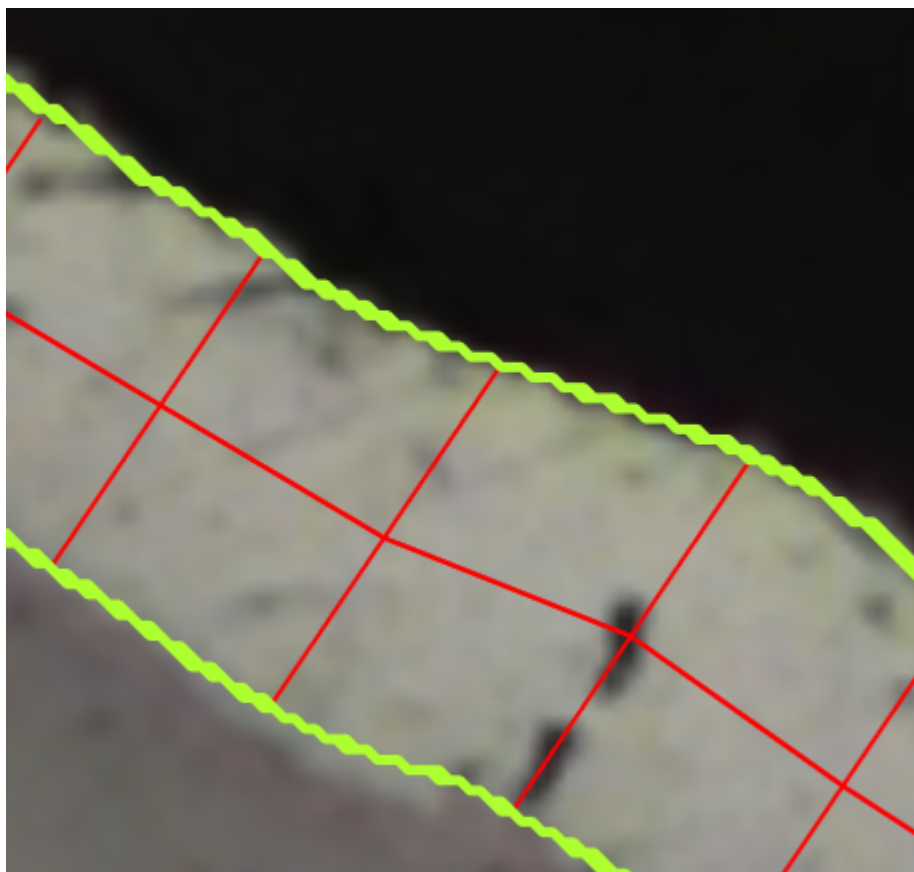
In this step you can set up the measurement and edit the detected layers/chords. To add a measurement click on the layer within two detected edges. The layer thickness measurement will be automatically applied to the image. Activate the **Automatic Detection** checkbox to add multiple layer thickness measurements automatically. This is needed if there are a lot of layers in your sample to be measured and you do not want to click on each of them separately.



If you activate the **Parallel Chords** checkbox, all chords will be brought in exact parallel order. It is deactivated by default. Activate the checkbox before clicking into the sample.

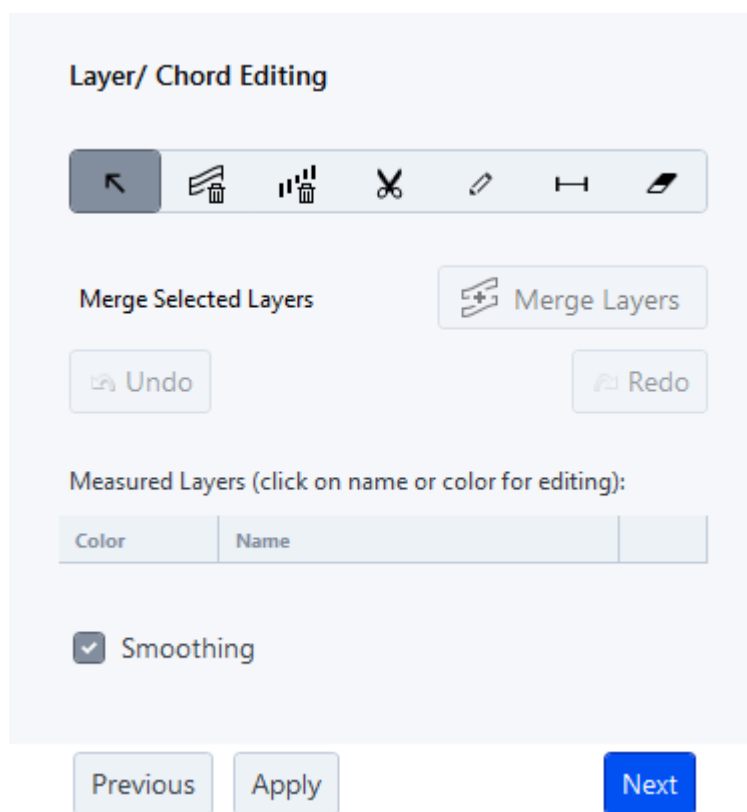


*Fig. 35: Example: Deactivated Parallel Chords*

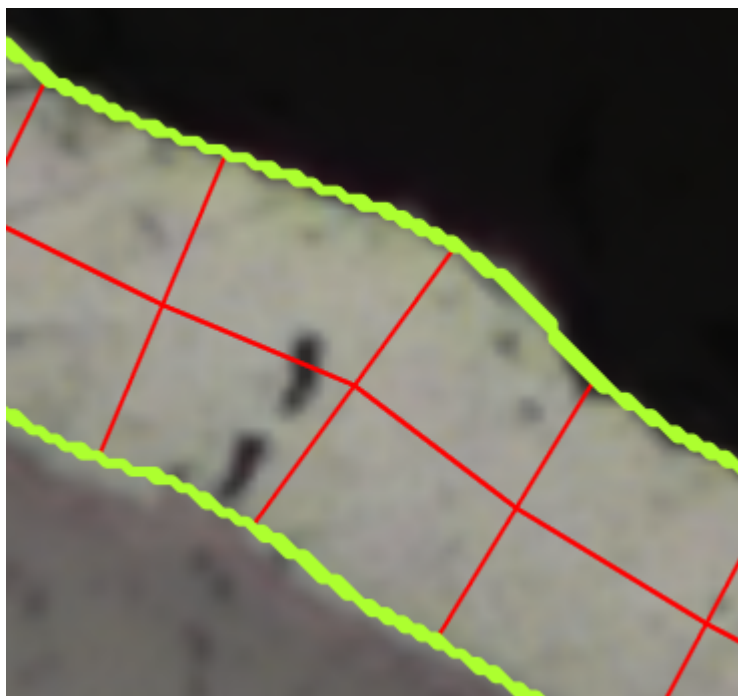


*Fig. 36: Example: Activated Parallel Chords*

The layer thickness measurement will be displayed in line with a set of chords. In the **Layer/Chord Editing** tool the software provides a set of tools to edit the layers and chords after they have been added. You can remove, merge or cut layers and even edit single measurement chords. Furthermore, you can use a pen for drawing missing layer edges or use the eraser for removing wrongly detected layer edges. As a result, you will get detailed layer thickness measurements for each specific sample.



To correct the midline of each specific sample, activate the **Smoothing** checkbox. It is deactivated by default. If you activate it, the midline will be smoothed, if necessary. Activate the checkbox before clicking into the sample, otherwise Smoothing is not possible. It is available for manual setting and **Automatic detection** alike.



*Fig. 37: Example: Deactivated Smoothing and deactivated Parallel Chords*

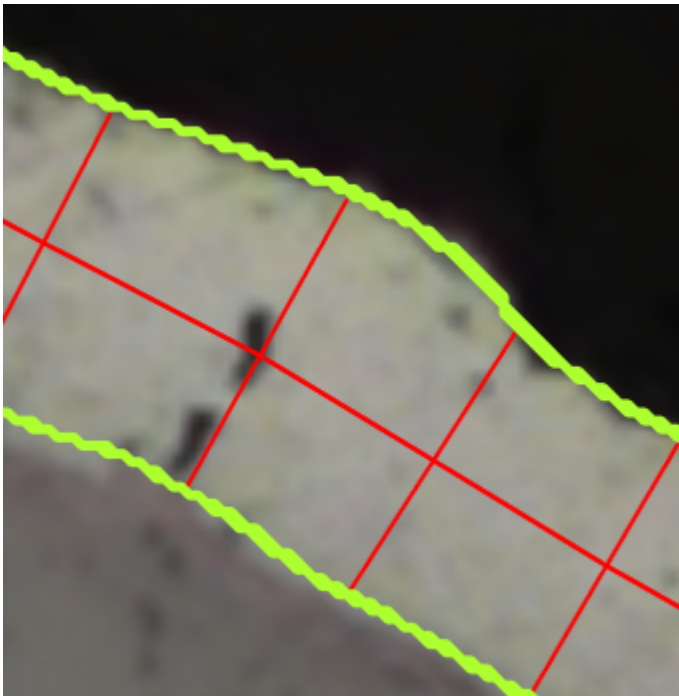


Fig. 38: Example: Activated Smoothing and deactivated Parallel Chords

**Result View** At the end of each analysis the **Results** view is displayed. It shows all images and results of the measurement performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude images you do not want to have displayed within the result. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view.

The **Length of section** is also displayed in the table view. It is referring to the midline between chords.

Loop

min 1

max 5

1

2

3

4

5

Layer Thickness Measurement - Results

Image Selection

Statistics

LT Image 01

09.04.2018 | 12:57:32

Layer Thickness Measurement - Results

Original Image

09.04.2018 | 12:57:32

Analyzed Image

Statistics

Name	Mean Layer Thickness [µm]	Minimum Layer Thickness [µm]	Maximum Layer Thickness [µm]
Layer 001	11,763	9,353	15,319

Chord Length

### 7.4.5 Layer Thickness Measurement with Intellesis

This topic explains the preprocessing and measurement part of the **Layer Thickness Measurement Intellesis** job template which is delivered with the software, see *General Preparations* [▶ 423]. For general information about Intellesis, see the chapter *Intellesis* [▶ 292].

#### Image Processing

In the third step you have your *Intellesis Trainable Segmentation* [▶ 317] step. Your input image is segmented based on a trained **Model** selected here. The segmentation output is fixed to **Labels** because this is required to detect the layer border in the later processing step.



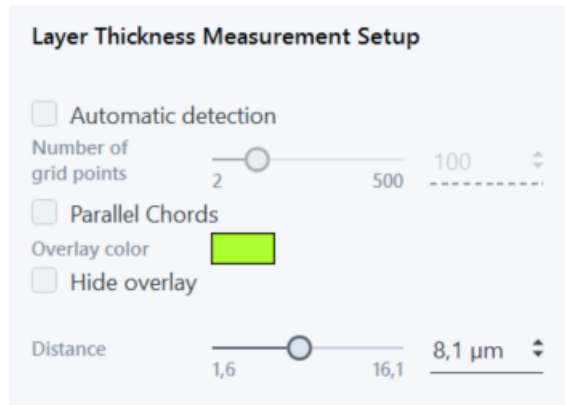
#### Image Preprocessing

In this step you can preprocess the image using the available tool parameters. When entering this step the software tries to detect the layers automatically. The edges of the layer will be marked by an overlay color. You can change the color of the overlay within the tool. Using the **Rectangle** button on top of the tool you can set up a measurement frame. The parameters under **Find Edges** and **Filter Edges** help you to detect and display the layers correctly. Under **Trainable Segmentation Overlay**, you can set the **Opacity** of the segmentation result in the image. An opacity of 0% displays only the image, an opacity of 100% displays only the segmentation result.

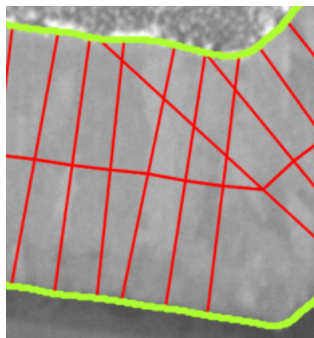


### Layer Thickness Measurement

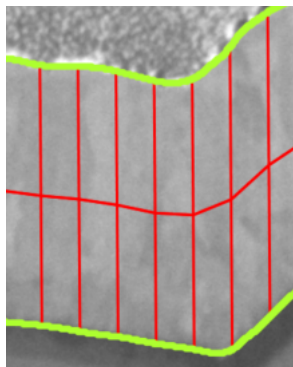
In this step you can set up the measurement and edit the detected layers/chords. To add a measurement click on the layer within two detected edges. The layer thickness measurement will be automatically applied to the image. Activate the **Automatic Detection** checkbox to add multiple layer thickness measurements automatically. This is needed if there are a lot of layers in your sample to be measured and you do not want to click on each of them separately.



If you activate the **Parallel Chords** checkbox, all chords will be brought in exact parallel order. Activate the checkbox before clicking into the sample.



*Fig. 39: Example: Deactivated Parallel Chords*



*Fig. 40: Example: Activated Parallel Chords*

The layer thickness measurement will be displayed in line with a set of chords. In the **Layer/Chord Editing** tool the software provides a set of tools to edit the layers/chords after they have been added. You can remove, merge or cut layers and even edit single measurement chords. Furthermore, you can use a pen for drawing missing layer edges or use the eraser for removing wrongly detected layer edges. As a result, you will get detailed layer thickness measurements for each specific sample.

### Layer/ Chord Editing

Merge Selected Layers

Merge Layers

Undo

Redo

Measured Layers (click on name or color for editing):

Color	Name

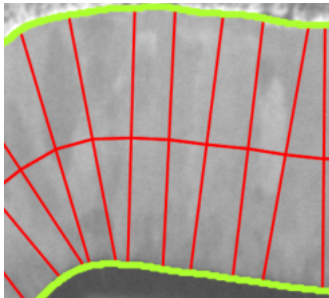
☒ Smoothing

Previous

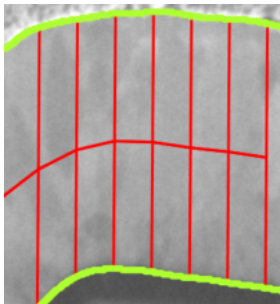
Apply

Next

To correct the midline of each specific sample, activate the **Smoothing** checkbox. It is deactivated by default. If you activate it, the midline will be smoothed, if necessary. Activate the checkbox before clicking into the sample, otherwise smoothing is not possible. It is available for both manual setting and **Automatic detection**.



*Fig. 41: Example: Deactivated Smoothing and deactivated Parallel Chords*



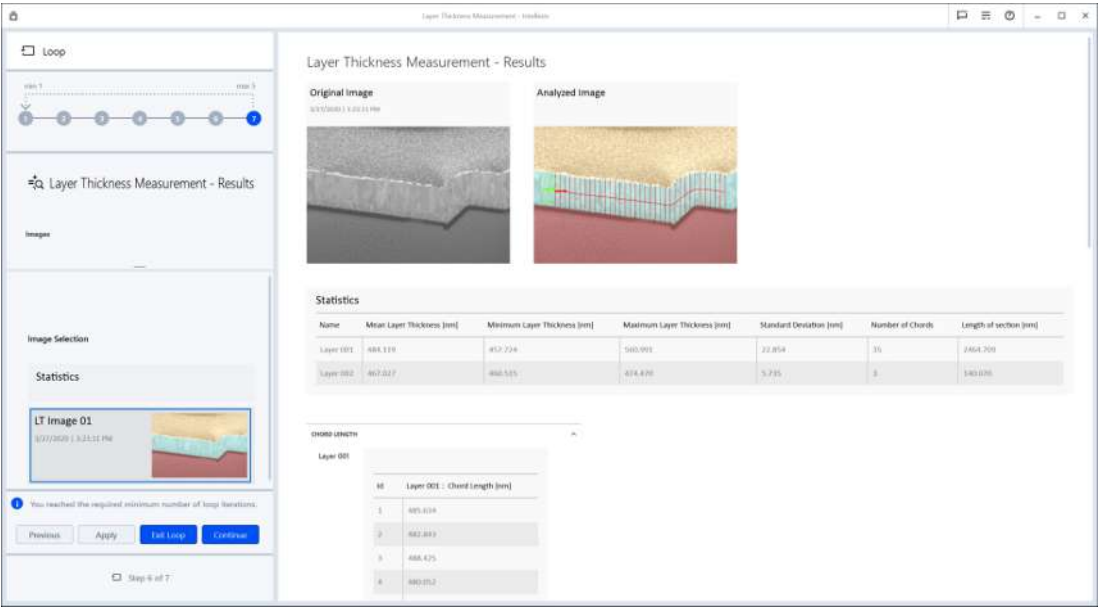
*Fig. 42: Example: Activated Smoothing and deactivated Parallel Chords*

### Result View

At the end of each analysis the **Results view** is displayed. It shows all images and results of the measurement performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude images you do not want to have displayed within the



result. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view. The **Length of section** is also displayed in the table view. It is referring to the midline between chords.



7.4.6 Adaptation of Detected Edges

Cleaning

Info

This adaption is only needed, if the image contains significant noise.

This adaption removes all isolated pixels to remove noise form the image.

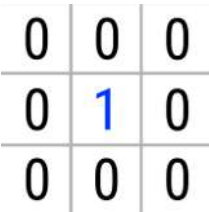
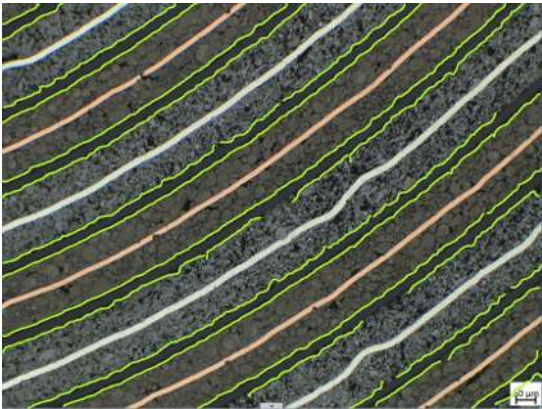


Fig. 43: Removing isolated pixels (number 1 in this pattern)

Effect without Cleaning



Effect with Cleaning



**Sharpness of Edges**

This parameter uses the *Canny Tool* [▶ 235] to sharpen the detected edges.

- Use a lower value if the detected edges are clearly determinable and have high contrast.
- Use a higher value if the detected edges are blurry.

**Minimum Length**

This filter regards the length. Note that this is not an IP function.

**Feret Ratio**

Low value applies the filter for round objects. Note that this is not an IP function.

**Rotation**

Filters round outliers in an image with primary parallel layers. Note that this is not an IP function.

**7.4.7 Layer Thickness Measurement Workbench**







With this workbench you can set up the measurement and edit the detected layers/chords. Note that this task is not available in the **Free Examination** mode. It can be added only to job templates in the **Create Job Template** mode.


**See also**

- ▢ Layer Thickness Measurement [▶ 425]
- ▢ Layer Thickness Measurement Setup Tool [▶ 435]
- ▢ Layer Chord Editing Tool [▶ 434]
- ▢ Preprocessing Settings Tool [▶ 435]



**7.4.8 Layer Chord Editing Tool**

This tool enables you to edit the detected layers/chords.

Parameter	Description
	<b>Activated:</b> Selects an element by clicking on it.
	Removes a layer. Click on the layer to remove it.
	Removes a measurement chord when you click on it.
	Cuts a layer when you click on it.
	Draws a layer with a polygon. Right-click to finish the process.
	Edits a chord of your choice.

Parameter	Description
	Erases a layer. Right-click to finish the process.
<b>Merge Layers</b>	Merges selected layers.
<b>Undo</b>	Undoes the last change.
<b>Redo</b>	Enables you to do the same process again.
<b>Measured Layers</b>	Lets you choose a color and a name for your selected layer.
<b>Smoothing</b>	<b>Activated:</b> Smooths the midline of your sample.

**See also**



-  Layer Thickness Measurement Workbench [► 434]
-  Layer Thickness Measurement [► 425]

**7.4.9 Layer Thickness Measurement Setup Tool**

Within this step you can set the number of grid points you want to have in your layer image automatically as well the parallel chords function, the overlay color and the distance between chords.




Parameter	Description
<b>Automatic detection</b>	<b>Activated:</b> Enables you to set the number of grid points.
<b>Number of grid points</b>	Sets the number of grid points for automatic detection. Use the slider to adjust the number.
<b>Parallel Chords</b>	<b>Activated:</b> All chords will be brought in exact parallel order. It is deactivated by default. The checkbox has to be activated beforehand.
<b>Overlay color</b>	Here you can select a certain color for the overlay image. Click on the colored field to select a desired color. You can choose one of the default colors or customize a color.
<b>Hide overlay</b>	<b>Activated:</b> The overlay color is not visible in the image.
<b>Distance</b>	Enables you to set the distance between chords. Use the slider to adjust the distance.

**See also**




-  Layer Thickness Measurement Workbench [► 434]
-  Layer Thickness Measurement [► 425]

**7.4.10 Preprocessing Settings Tool**

This tool enables you to preprocess the image using the available tool parameters. When entering this step the software tries to detect the layers automatically. The edges of the layer will be marked by an overlay color. You can change the color of the overlay within the tool.

Parameter	Description
	Selects a frame.
	Draws a frame.
	Removes a frame.
<b>Overlay color</b>	Here you can select a certain color for the overlay image.
<b>Sharpness of edges</b>	Sets the Sharpness of Edges.
<b>Minimum Length</b>	Sets the minimum length structures may have. Use the slider to adjust the length.
<b>Feret Ratio</b>	Sets the roundness of a structure. Feret = 1 is round, Feret = 0 is a line. Use the slider to adjust the Feret value.
<b>Rotation</b>	Sets the rotation deviance of structures from the main direction. Use the slider to adjust the deviance value.
<b>Opacity</b>	Only available for Layer Thickness Measurement with Intellesis. Sets the Opacity of the segmentation result in the image. An opacity of 0% displays only the image, an opacity of 100% displays only the segmentation result.

### See also

-  [Layer Thickness Measurement \[► 425\]](#)
-  [Layer Thickness Measurement with Intellesis \[► 430\]](#)
-  [Layer Thickness Measurement Workbench \[► 434\]](#)

## 7.5 Multiphase Analysis

This module enables you to determine phases based on both the size of the individual particles of a phase as well as the percentage of the area they represent. It is possible to determine up to 32 phases. One important use case is the investigation of the porosity in various samples e.g. aluminum castings, 3d printed samples, thermal sprayed coatings and powder metals.

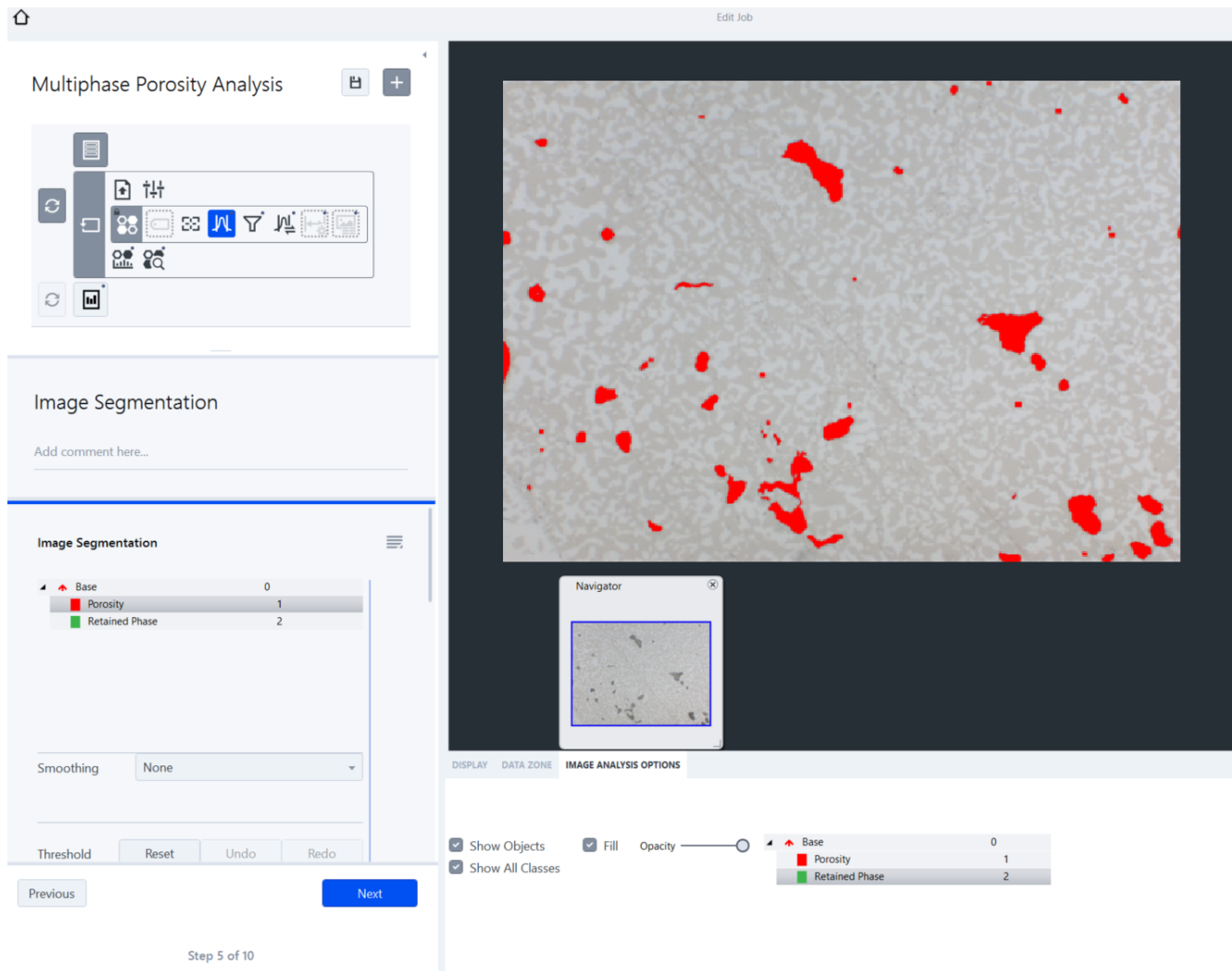


Fig. 44: Multiphase Porosity Analysis

## See also

The Concept 437

### 7.5.1 The Concept

The operating concept of the **Multiphase Analysis** module is designed to make it possible to achieve a reproducible result with as little interaction as possible. The performance of a measurement can be automated to such an extent that only the project data need to be entered and the entire analysis process can run automatically.

To automate a measurement completely, you need extensive knowledge of systems engineering and the respective application. Carelessly made alterations of a setting can promptly lead to faulty measurement results. It is important, therefore, to prevent users not having such knowledge from changing the basic settings. This is achieved by dividing up the tasks involved into the definition of an analysis and the performance of an analysis. For this reason, the operation of the module sticks to the general operating concept of the software:

- **Creating and Managing Jobs (Supervisor)**

Create job templates for multiphase analysis, manage templates, view job results, sign & release jobs (with GxP module only). Note that under **Job Mode** you will find a sample workflow within a pre-defined job template for multiphase analysis.

- **Running Jobs (Operator)**

Performing multiphase analysis using pre-defined job templates.

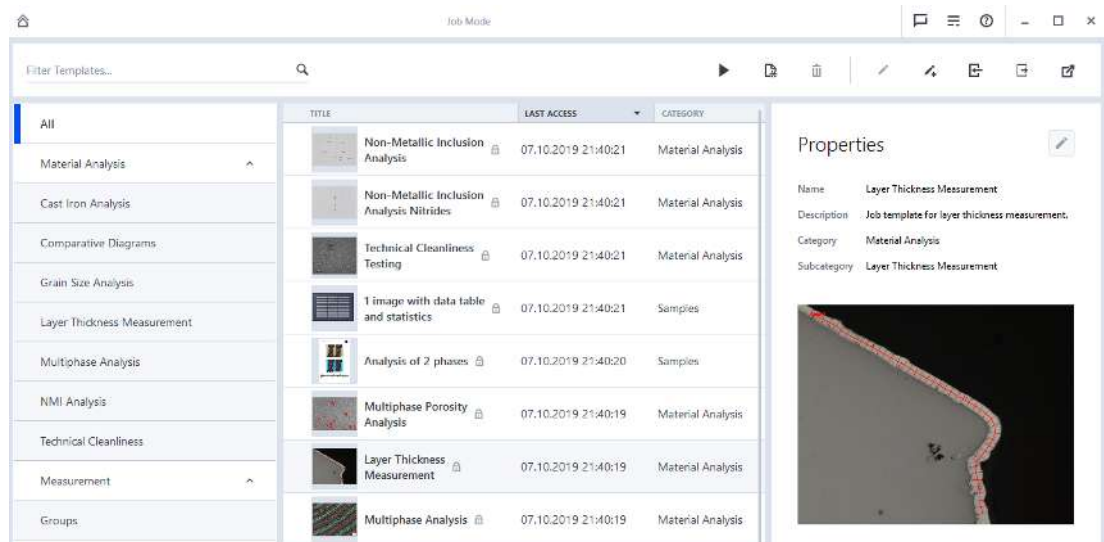
### See also

- Basic Concepts [► 20]
- Multiphase Analysis [► 436]
- General Preparations [► 438]

## 7.5.2 General Preparations

Two pre-defined job templates are included in the software, when you have licenced the **Multiphase Analysis** module. The job template can be adapted individually. In this documentation we will explain the method according to the existing, pre-defined job templates.

As a **Supervisor** you can access/edit the job template under **Manage Templates**. On the left side in the **Categories** list under **Material Modules** select **Multiphase Analysis**.



*Fig. 45: Material Modules - Job Templates*

In the templates list you see the available job templates. When you double-click on an entry in the list, the corresponding job template will be opened. The job templates always contain three major tasks (display can differ for a specific method):

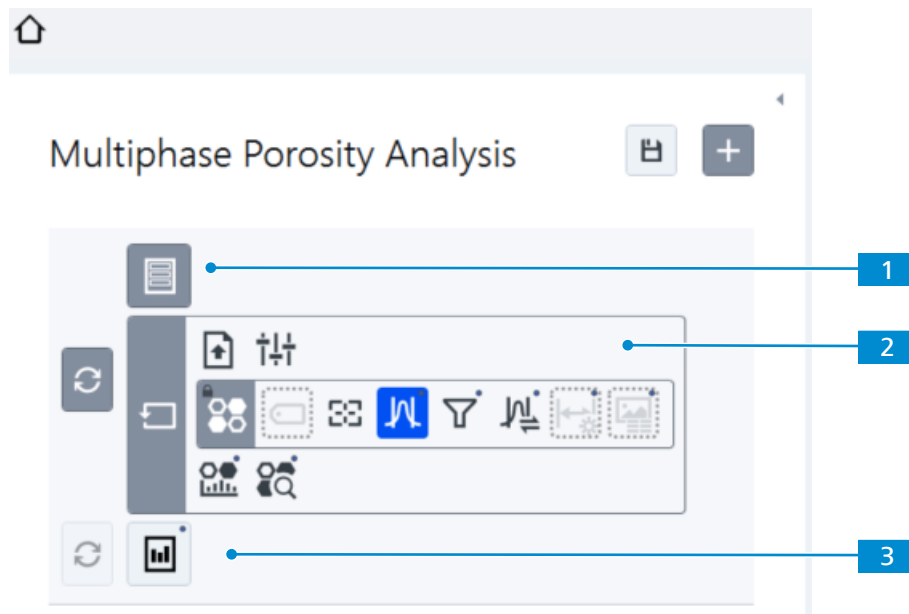


Fig. 46: Multiphase Analysis Workflow

#### 1 Filling out an Input Form

In this step the operator has to fill out the input form with user and sample specific information, e.g. Sample Information, User Name, etc.

#### 2 Performing the Analysis

In this step the analysis will be performed according to the selected method. The detailed workflow will be described in the following chapters.

#### 3 Creating a Report

After the analysis a report will be generated containing the job results (images, measurements, etc.).

### See also

📄 General Analysis Workflow [► 403]

### 7.5.3 General Analysis Workflow for Multiphase

The analysis steps of the workflow contain the following substeps to be executed. In this example the substeps are created within a **Loop Task (1)**, meaning all included steps will be repeated depending on the loop settings. Regarding this you can easily fulfill the normative requirements of repeating the identical steps of an analysis for several times.

#### Info

Note that greyed out task icons are set to **Run silent**. The tasks will not be shown when the workflow is executed. To activate them, right-click on the icon and deactivate **Run silent**.



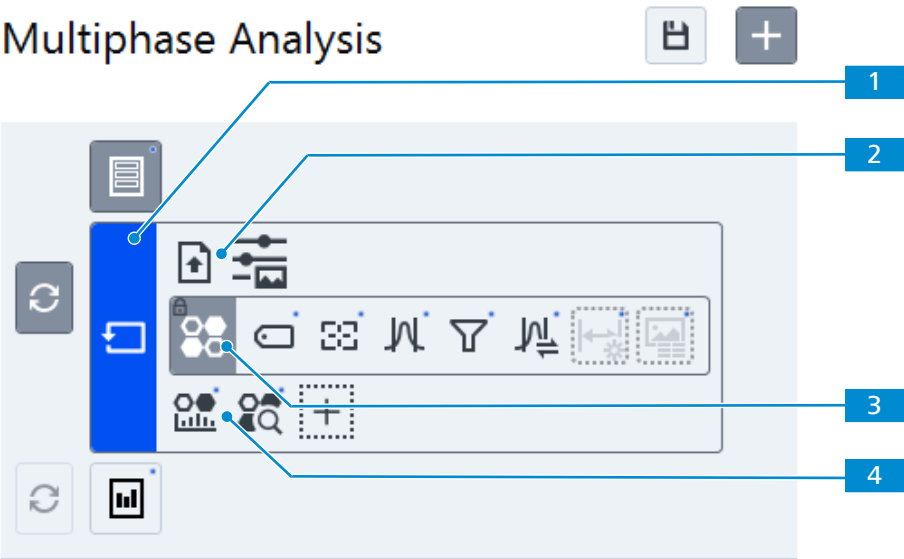













Fig. 47: Analysis Workflow

Workflow Step	Description
<b>Loading an Image</b> (2) 	Enables you to load your image you want to analyze. The workflow can be adapted to perform image acquisition tasks here as well.
<b>Processing the Image</b> (2) 	Enables you to process the image, e.g. change brightness, contrast and/or gamma.
<b>Performing the Analysis</b> (3) including: <ul style="list-style-type: none"><li>- <b>Setting Up the Classes</b> </li><li>- <b>Setting Up the Measurement Frame/Pattern</b> </li></ul>	<p>This step is the heart of each method. Each analysis can be saved as <b>Analysis Settings File</b>.</p> <p>In the <b>Load Settings Tool</b>, you can directly load a predefined setting, e.g. one that you have created from an Intellesis or AI model. In this case some parameters are pre-defined in the setting based on the model and cannot be changed in the next steps, e.g. the number of classes and the segmentation method.</p> <p>Depending on the selected method, the software provides specific parameters.</p> <p>Enables you to set up classes. For the sample workflow all necessary classes are pre-defined. This step is set to run silent because of that.</p> <p>Enables you to adjust the region/area which has to be analyzed.</p>



Workflow Step	Description
<ul style="list-style-type: none"> <li>- <b>Segmenting the Image</b>  </li> </ul>	Enables you to segment the image automatically by clicking inside the image, or manually by changing the parameters, or by choosing a machine learning model.
<ul style="list-style-type: none"> <li>- <b>Defining Region Filter</b>  </li> </ul>	Enables you to define region filter conditions for which an object should be measured.
<ul style="list-style-type: none"> <li>- <b>Interactively Adjust the Segmentation Results</b>  </li> </ul>	Enables you to edit the segmentation result interactively.
<ul style="list-style-type: none"> <li>- <b>Setting up the features</b>  </li> </ul>	Enables you to select specific measurement features.
<ul style="list-style-type: none"> <li>- <b>Viewing the Measurement Data</b>  </li> </ul>	Displays the segmented image and tables including measurement results.
<ul style="list-style-type: none"> <li>- <b>Defining the Settings for the Multiphase Histogram</b>  </li> </ul>	This step is another interactive step. You have to define the settings for creating the Multiphase histogram.
<b>Showing the Results View (4)</b> 	The <b>Results View</b> is displayed containing the analysis results and statistics.

#### 7.5.4 Multiphase Porosity Analysis

This topic explains the specific image analysis part of the **Multiphase Porosity Analysis** job template which is delivered with the software. We recommend that you read in advance the chapters "*General Preparations* [[▶ 438](#)]" and "*General Analysis Workflow* [[▶ 439](#)]" to make yourself familiar with the general workflow.

**Frame Setup** Setting up a frame for the multiphase analysis is an optional step. If you want to, you can add a specific measurement frame (e.g. rectangle area in the center of the sample) which will be then used for the analysis only. Whether you want to use a measurement frame is depending on your

sample and individual processes. The tool offers everything you need to setup the frame properly. By using the tool parameters you can adjust the frame individually.

Frame Setup

☐ Maximize circle

☐ Center circle

Mode

Inside Only

Left

0

Top

0

Width

2776

Height

2080

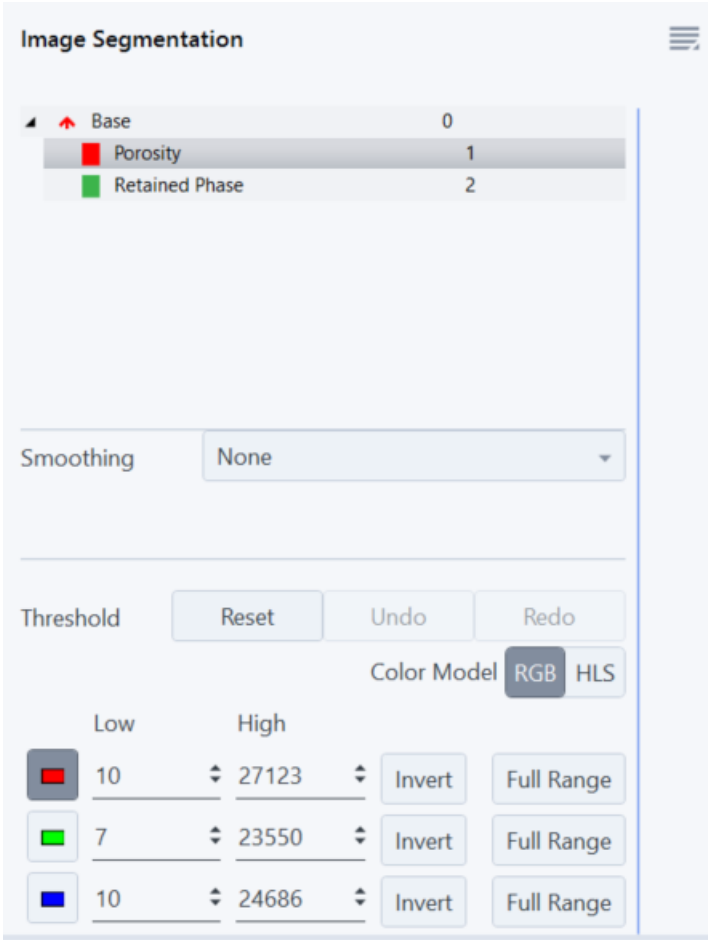
Angle

0

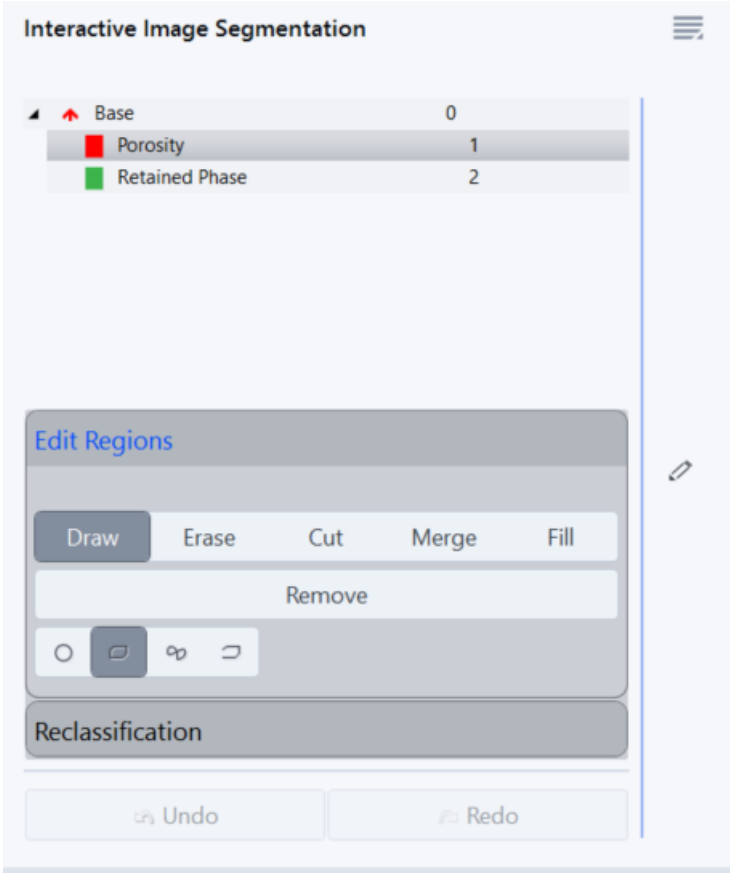
Color

☐ Show frame on analyzed image

**Image Segmentation Setup** In this step the software tries to segment the porosity structures and optionally the retained phase. In the **Image Segmentation Setup** tool you can adapt the segmentation result according to your needs. On the **Image Analysis Options** tab you can additionally adapt the display of the segmentation result.



**Interactive Image Segmentation Setup** In this step you can correct the segmentation result interactively. By using the tools under **Edit Regions** you can interactively edit the segmented areas.



**Multiphase Histogram** In this step you can define the parameters for the resulting table of the analysis. The table is displayed in the image area. The resulting multiphase histogram will be displayed in the next step (**Results view**). For a detailed description of the parameters to set up the histogram, see *Calculate Histogram Tool* [▶ 830].

Multiphase Histogram

☒ 2 : Area [μm²]

☐ 4 : Feret Maximum [μm]

☐ 5 : Diameter [μm]

☐ 6 : Ellipse Major [μm]

☐ 7 : Ellipse Minor [μm]

☐ 8 : Perimeter [μm]

☐ 9 : Feret Ratio

☐ 10 : Feret Vertical to Maximum [μm]

☐ 11 : Form Circle

☐ 12 : Roundness

Classification column(s)

>=, ..., <

Class Boundary Type

3

Class Count

1: -∞	5
2: 5	10
3: 10	∞

Class Boundaries

☐ Use equidistant boundaries

☒ Use open boundaries

☐ Logarithmic boundaries

Aggregate function

Percentage Sum

Info

The setting for **Classification Column** specifies the value for the x-axis of the resulting multiphase histogram, the setting for **Aggregate Function** specifies the value for the y-axis.

**Result View** At the end of each analysis the **Result view** is displayed. It shows all images and results of the analysis performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude images you do not want to have displayed within the result. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view.

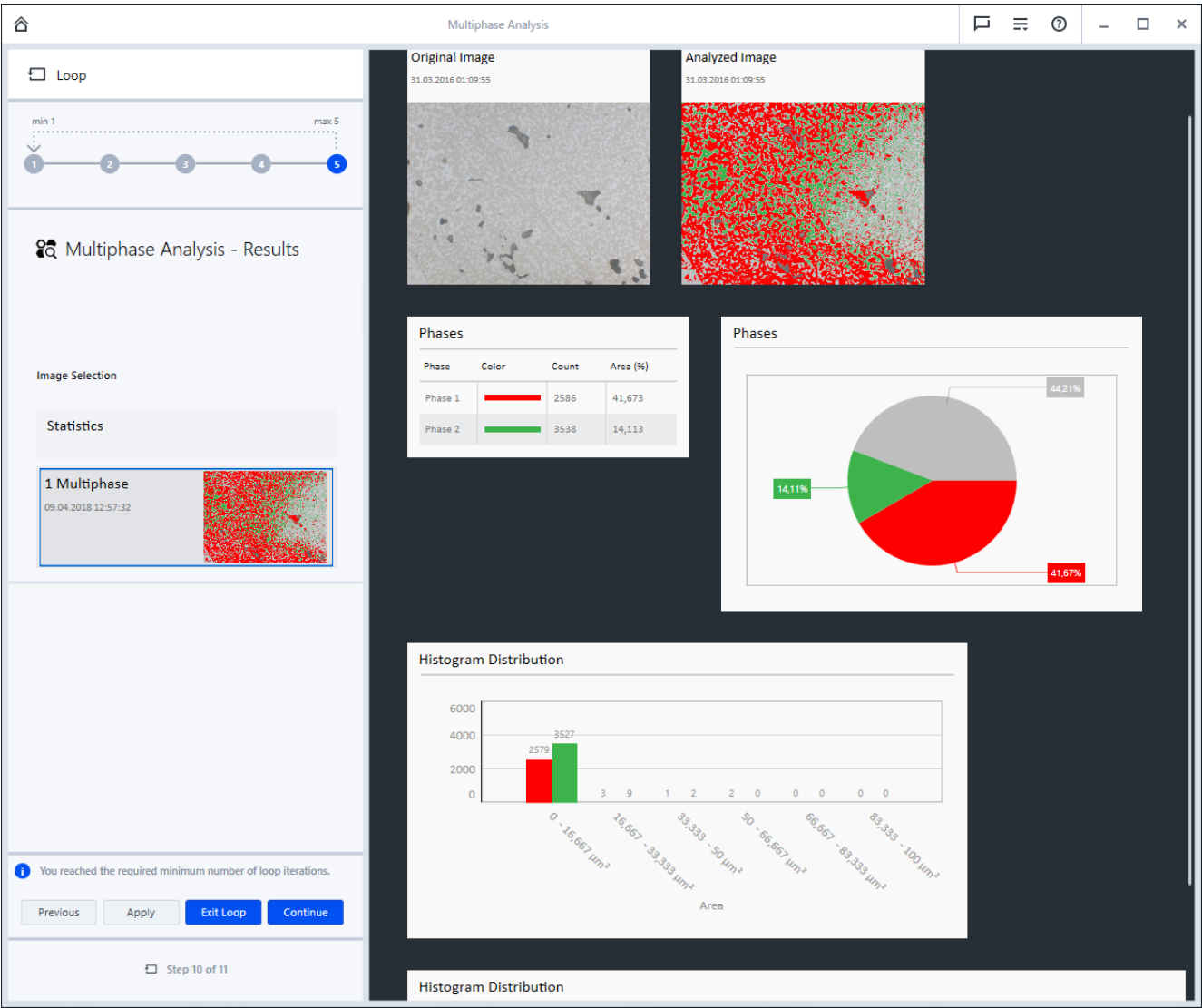


Fig. 48: Example: Result view of a multiphase analysis. The **Phases** table displays the area per phase in % in relation to the whole image, or, in case you are using the measuring frame, in relation to this. In case of overlapping phases the segmentation can overlap as well. The **Phases** pie chart displays the two phases in red and green. The gray part displays the not-segmented region which equals the retained regions.

Changes to ZEN core 3.1

Before ZEN core 3.1	Since ZEN core 3.1
Phase area in relation to the hole image area, also by using a measurement frame.	Phases in relation to the frame area by using a measurement frame.
<b>Area% -2</b> reflects the values in the pie chart which are always summed up the 100%.	No <b>Area% -2</b> shows the summed up values. The pie chart displays a gray part for the not-segmented regions which equals the retained phase.

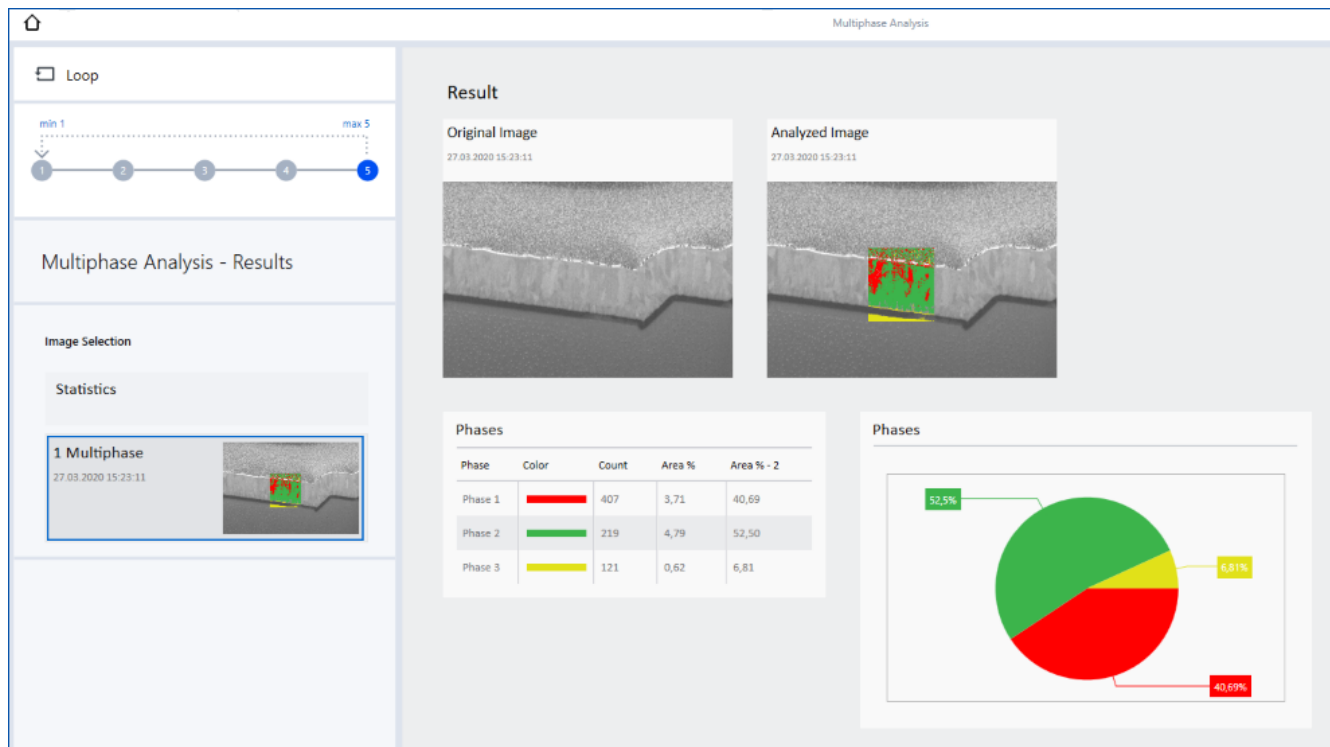


Fig. 49: Example: Result view of a multiphase analysis before ZEN core 3.1

### 7.5.5 Multiphase Analysis with AI

This chapter explains the specific image analysis part of the **Multiphase Analysis - AI** job template which is delivered with the software. We recommend that you read *General Preparations* [▶ 438] and *General Analysis Workflow* [▶ 439] to make yourself familiar with the general workflow. This job template uses the machine learning functionality of Intellesis or a deep learning AI model to perform the multiphase analysis. The idea is to use the Intellesis semantic segmentation or functionalities of deep learning AI models (e.g. instance segmentation) to distinguish different phases inside the image.

#### Frame Setup

Setting up a frame for the multiphase analysis is an optional step. If you want to, you can add a specific measurement frame (e.g. rectangle area in the center of the sample) which then will be used for the analysis only. If you want to use a measurement frame is depending on your sample

and individual processes. The tool offers everything you need to setup the frame properly. With the tool parameters you can adjust the frame individually.

Frame Setup

☐ Maximize circle

☐ Center circle

Mode

Inside Only

Left

0

Top

0

Width

2776

Height

2080

Angle

0

Color

☐ Show frame on analyzed image

Image Segmentation

In this step the software segments the structures with the segmenter. In the **Image Segmentation** tool you can adapt the segmentation result according to your needs. The available phases are directly derived from the Intellesis or deep learning AI model and reflect the classes used in-



side the model for segmentation. Depending on your model type, additional post-processing options allow you to further refine or narrow down the results of the segmentation.

Image Segmentation

^	Base	0
■	Austenite	2
■	Ferrite	4

Minimum Area

1

Min. Hole Area

1

Fill Holes

☐

Binary

None

Separate

None

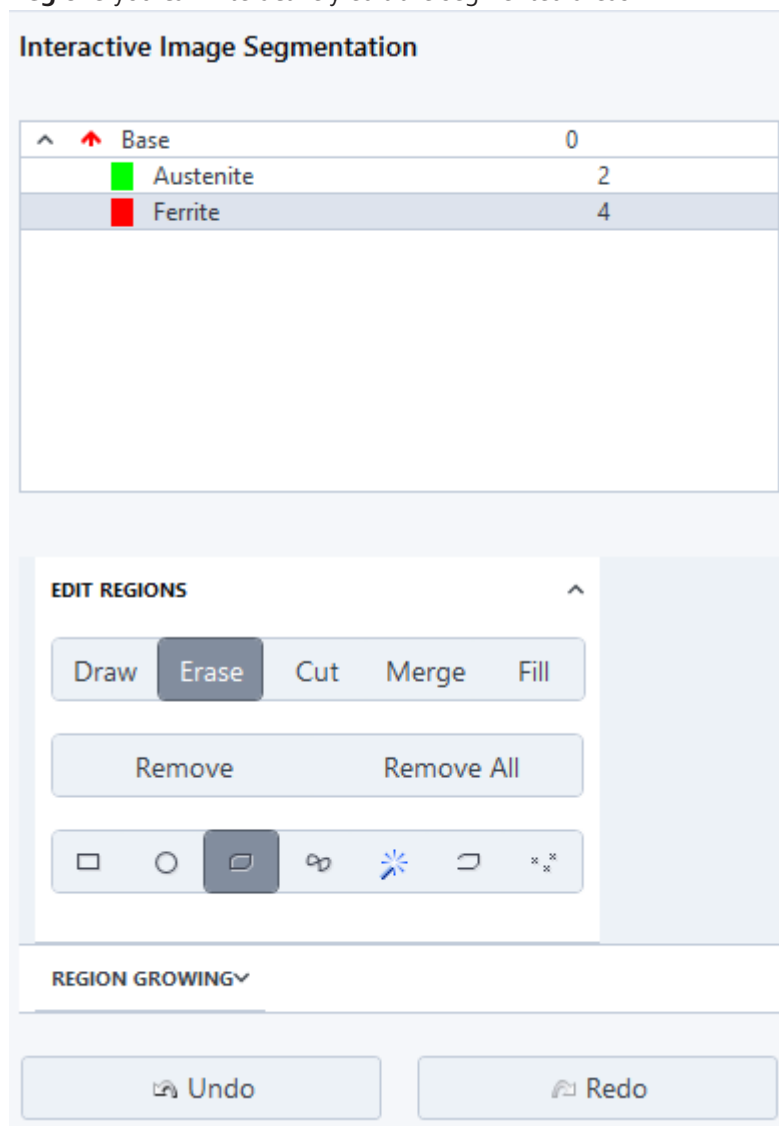
Apply to All Classes

Min. Confidenc...

0

### Interactive Image Segmentation

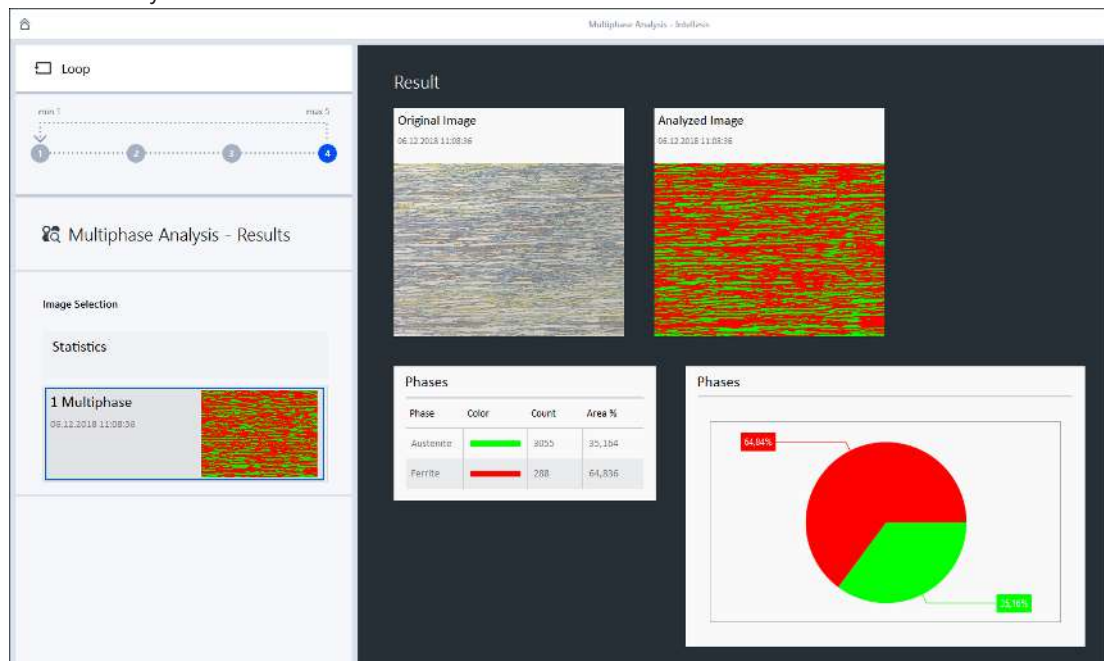
In this step you can correct the segmentation result interactively. By using the tools under **Edit Regions** you can interactively edit the segmented areas.



### Result View

At the end of each analysis the **Result view** is displayed. It shows all images and results of the analysis performed. Additionally, the original images are displayed as well. In the **Image Selection** tool on the left side you can exclude images you do not want to have displayed within the

result. If you click on the **Statistics** section within the tool, you can display all results of the analysis in a clearly structured table view.



### See also

- 📄 Creating an Image Analysis or Multiphase Setting From an AI Model [► 73]
- 📄 Intellesis [► 292]

## 7.6 Non-Metallic Inclusion Analysis (NMI)

This module enables you to evaluate and rate non-metallic inclusions in steel (Oxides, Sulfides and Nitrides). The following standards are supported: ASTM E45, ISO 4967, JIS G0555, GB/T 10561, EN 10247, SEP 1571 und DIN 50602.

### Overview

**NMI Analysis** (Non-Metallic Inclusion Analysis) is a module for fast inspection and evaluation of steel cleanliness. You can use it to detect and analyze steel impurities like non-metallic inclusions originating from the production process. The module is a standard based, automated workflow solution for specimen acquisition, inclusion classification, inclusion rating, result documentation and archiving. It offers interactive result views for reliable inclusion inspection and revision. Therefore it is part of a dedicated system solution focused on efficient steel cleanliness analysis and consisting of a microscope, motorized scanning stage, digital camera, high-end workstation. The module is used for quality control of steel products.

The **NMI Analysis** module further supports you analyzing the steel cleanliness of your products. It uses different standards with methods calculating the inclusion content based on standard templates which can be adapted in the standard template editor. The result is a set of standard specific characteristic values describing the steel cleanliness per inclusion type. The result is presented in the report evaluation document. The module displays for each selected standard the global results with an overview of detected oxides, sulfides and nitrides as well as artifacts.

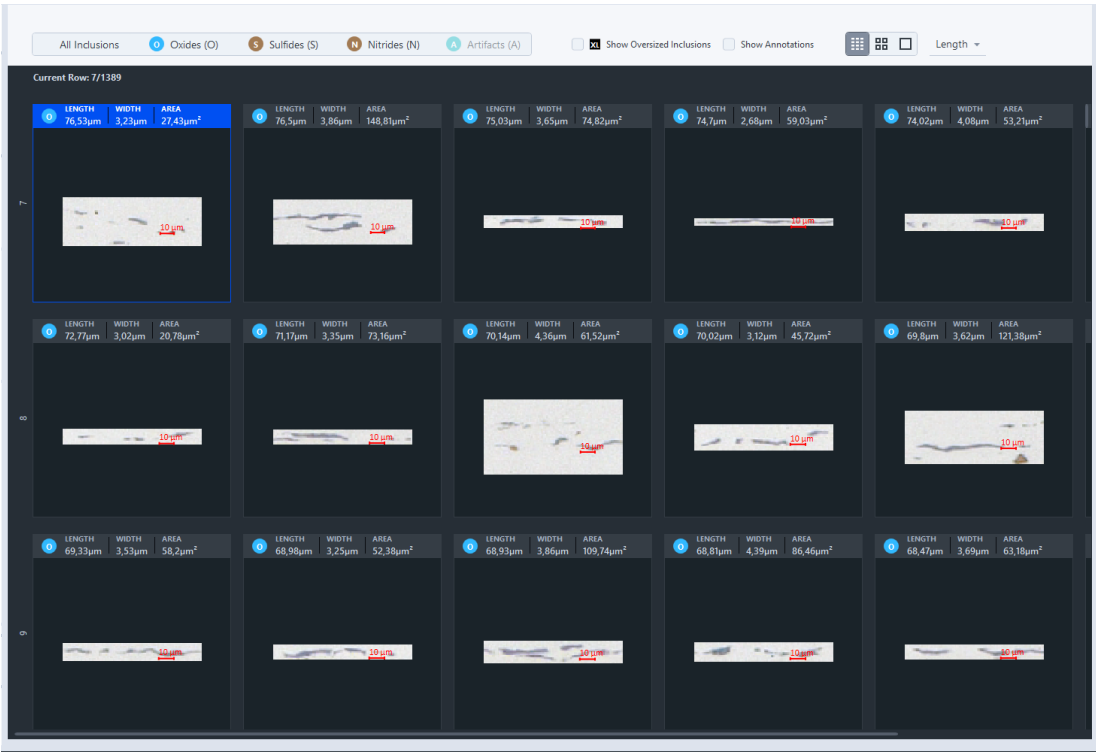


Fig. 50: Example: **NMI Analysis** global results with the option to toggle between the display of inclusion types: oxides, sulfides, and artifacts. Change of the inclusion type is possible.

In the next step, you can perform a detailed inspection of the complete specimen using a grid of standard measuring fields.



Fig. 51: Example: **NMI Analysis** Field based inspection with live navigation on the specimen to inspect standard specific inclusion types.

### 7.6.1 Introduction to Standards

The **NMI Analysis** module supports the following standards:

Standard	Method	Short Description	Long Description
<b>ASTM E45a</b>	A	Worst fields	Fields* with highest severity rating per inclusion type, based on largest total inclusion length per field and further categorization in thin and heavy based on inclusion width. True worst field identification.  For more information, see <i>ASTM E45a</i> <a href="#">[▶ 457]</a> .
<b>ASTM E45a</b>	D	Low inclusion content	For steels with low inclusion content. Number of fields per inclusion type and severity rating.
<b>ASTM E45a</b>	E	SAM rating	Only larger inclusions type of B and D are considered. Number of fields per severity rating for B thin, B heavy, D heavy. Weighted result, SAM rating for type B and D.
<b>ISO 4967</b>	A	Worst fields	Fields with highest severity rating per inclusion type, based on largest total inclusion length per field and further categorization in fine and thick based on inclusion width. True worst field identification.  For more information, see <i>ISO 4967</i> <a href="#">[▶ 459]</a> .
<b>ISO 4967</b>	B	Field assessment	Comparable to ASTM E45a, Method D. Total number of fields per inclusion type and severity rating.
<b>JIS G 0555</b>	A	Worst fields	Revision JIS G 0555:2003 is based on ISO 4967:1998 and revision JIS G 0555:2020 is based on ISO 4967:2013.  Worst fields: fields with highest severity rating per inclusion type, based on largest total inclusion length per field and further categorization in fine and thick based on inclusion width. True worst field identification.  For more information, see <i>JIS G 0555</i> <a href="#">[▶ 461]</a> .
<b>JIS G 0555</b>	B	Field assessment	Revision JIS G 0555:2003 is based on ISO 4967:1998 and revision JIS G 0555:2020 is based on ISO 4967:2013.  Total number of fields per inclusion type and severity rating.

Standard	Method	Short Description	Long Description
<b>GB/T 10561</b>	A	Worst fields	<p>Almost identical to ISO 4967:1998 with only small differences in size classification. Worst fields: fields with highest severity rating per inclusion type, based on largest total inclusion length per field and further categorization in fine and thick based on inclusion width. True worst field identification.</p> <p>For more information, see <i>GB/T 10561</i> [▶ 462].</p>
<b>GB/T 10561</b>	B	Field assessment	<p>Almost identical to ISO 4967:1998 with only small differences in size classification. Total number of fields per inclusion type and severity rating.</p>
<b>(DIN) EN 10247</b>	P	Largest inclusion	<p>Largest inclusion: inclusions with largest length, diameter, and area per inclusion type. Standardized size values.</p> <p>For more information, see <i>DIN EN 10247</i> [▶ 463].</p>
<b>(DIN) EN 10247</b>	M	Largest field	<p>Fields with the largest number, total length, diameter, and area per inclusion type. Standardized size values. For more information, see EN 10247, table 2. The largest field is based on the true worst field identification.</p>
<b>(DIN) EN 10247</b>	K	Mean inclusion content	<p>Mean inclusion content of the analyzed specimen area: inclusion content based on total number, length, diameter, and area per inclusion type. Standardized size values.</p>
<b>SEP 1571</b>	M	Maximum inclusion value	<p>Largest size class rating per inclusion type based on inclusion area. Single inclusion rating comparable to EN 10247, method P.</p> <p>For more information, see <i>SEP 1571</i> [▶ 465].</p>
<b>SEP 1571</b>	K	Mean inclusion value	<p>Size weighted and normalized Oxide and Sulfide content of the analyzed specimen area. Number of inclusions per size class and inclusion type. Single inclusion rating based on inclusion area.</p>
<b>DIN 50602</b>	M	Maximum inclusion value	<p>Withdrawn standard but in practice still in use. Fields with the largest characteristic value per inclusion type.</p> <p>For more information, see <i>DIN 50602</i> [▶ 466]</p>

Standard	Method	Short Description	Long Description
<b>DIN 50602</b>	K	Mean inclusion value	Withdrawn standard but in practice still in use. Normalized inclusion content per inclusion type.

Tab. 1: Supported standards in **NMI Analysis** module. \* Field is the abbreviation for "standard measuring field". For a total magnification of 100x, the standard measuring field is 0.5 mm<sup>2</sup>.

For detailed Information, check the respective standards.

All supported standards are visible in the standard template editor, see *Standard Template Editor* [▶ 510].

### 7.6.1.1 Basic Principles of Inclusion Groupings

The analysis of shape and morphology of individual particles is essential for the grouping into inclusions. For inclusion formation a particle is considered to have a round or elongated shape. The definition of where *round is getting elongated* depends on the standard. The particle shape in combination with the distance to next neighboring inclusion(s) is decisive for the grouping of single particles to aligned inclusions. Note: The shape definition and the grouping rules differ from standard to standard. Therefore, a direct comparison of standard results on the base of individual inclusions is usually complex.

As a Supervisor, you can copy and edit pre-configured standard templates, see *Standard Template Editor* [▶ 510].

For detailed information on inclusion inspection with the **NMI Analysis** module, see *NMI Global Results View* [▶ 512] and *NMI Field Based Inspection View* [▶ 516]

Each standard has its own grouping rules but the underlying principles are comparable and therefore described based on the definitions of EN 10247.

#### One single inclusion (particle)

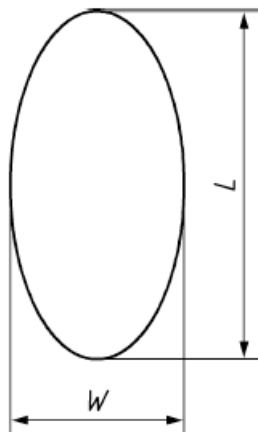


Fig. 52: Width (W) and Length (L) of an inclusion (particle). Source: DIN EN 10247 Micrographic examination of the non-metallic inclusion content of steels using standard pictures.

### Calculation of the nearest neighbor to group inclusions

The nearest neighbor is defined by the distance between the inclusions perpendicular to the main deformation direction ( $t$ ) and the distance between the inclusions in the main deformation direction ( $e$ ). If the distance criteria are fulfilled, one stringer is formed and rated as one inclusion. If the distance criteria are not fulfilled, two isolated inclusions are rated.

### Formation of Stringers

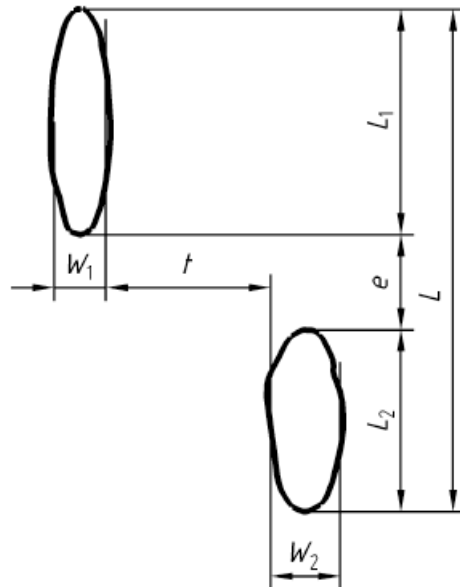


Fig. 53: Distance Criteria ( $t$ ) and ( $e$ ) between two particle. Source: DIN EN 10247 Micrographic examination of the non-metallic inclusion content of steels using standard pictures.

#### Two particles - one stringer -> Rated as one inclusion

If  $e \leq 40 \mu\text{m}$  and  $t \leq 10 \mu\text{m}$ :

$$L = L_1 + e + L_2$$

$$w = w_1 + t + w_2$$

#### Two particles - no stringer -> Rated as two inclusions

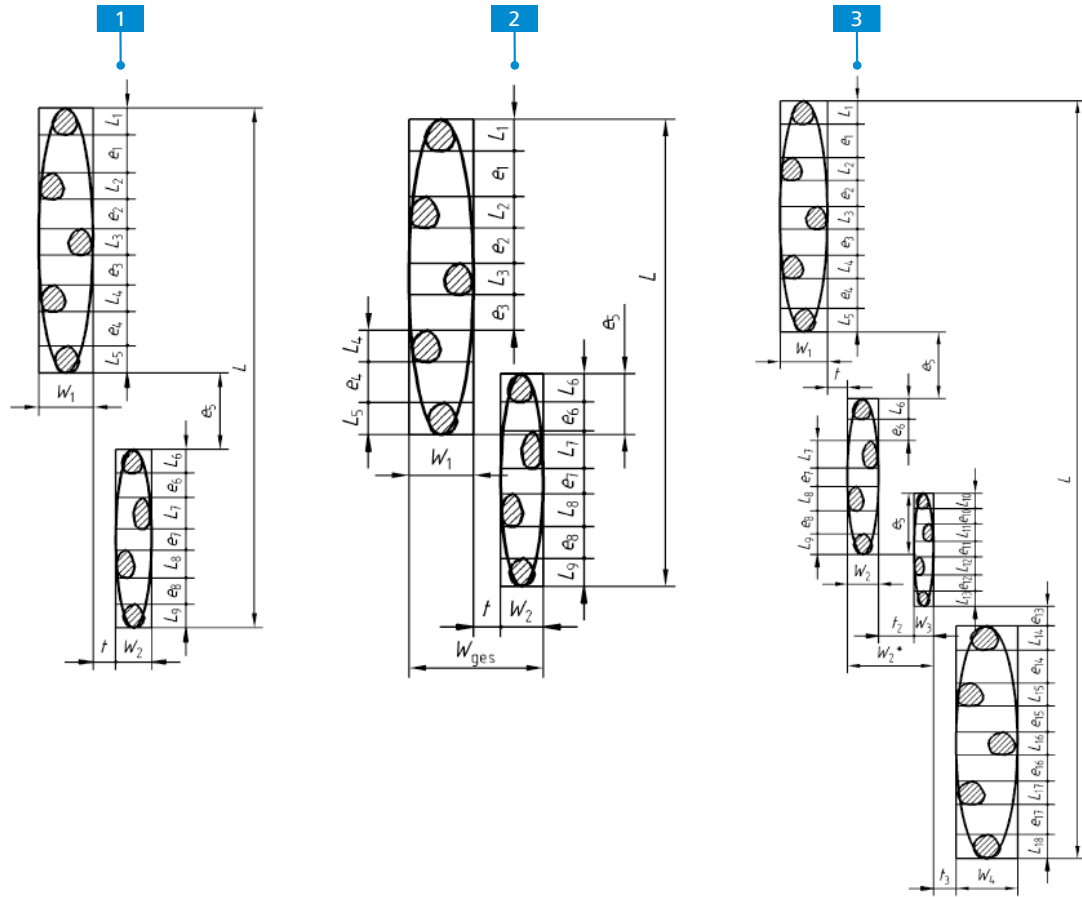
If  $e > 40 \mu\text{m}$  or  $t > 10 \mu\text{m}$ :

$$L_1 = L_1 \quad w_1 = w_1$$

$$L_2 = L_2 \quad w_2 = w_2$$

If the distance criteria are fulfilled, the two inclusions are combined to one inclusion stringer with two particles. The calculation of the total length and width for the inclusion stringer is shown according to the standard EN 10247 in the Figure above. Note: The calculation might differ depending on the standard and the standard specific inclusion type.



**Agglomeration of stringers to group inclusions**

**Fig. 54:** Source: DIN EN 10247 Micrographic examination of the non-metallic inclusion content of steels using standard pictures.

- |  |  |
|--|--|
| <p><b>1</b> Eight particles<br/>Two stringer<br/>One inclusion</p> | <p><b>2</b> Eight particles<br/>Two stringer<br/>One inclusion</p> |
| <p><b>3</b> 16 particles<br/>Four stringer<br/>One inclusion</p>   |  |

Based on the inclusion size calculation all inclusions are classified per type and size for each individual standard. The resulting standard specific ratings are used in the different methods for further calculation and result presentation. The ratings and calculated characteristic values determine the cleanliness of steel.

**See also**

Representation of Inclusions and Artifacts ► 518]

**7.6.1.2 ASTM E45a**

For detailed information, check the Standard *ASTM E45a:2018 Standard Test Methods for Determining the Inclusion Content of Steel*.

The ASTM E45a standard covers a number of test methods for determining the non-metallic inclusion content of wrought steel.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

### Inclusion assessment

For information on the inclusion classification by size and/or number, see the Standard in chapter *11 Classification of Inclusions and Calculation of Severities*, here section 11.5, here *Table 1* and *Table 2*. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

### Inclusion categories

According to the shape and arrangements of the inclusions, this standard defines the following inclusion types.

- **Inclusion type A** (sulfide inclusion type)  
Elongated sulfide, very similar to group **C**. Light gray when viewed under brightfield illumination.
- **Inclusion type B** (alumina inclusion type)  
Stringers consist of a number (at least three) of round or angular oxide particles with aspect ratios less than 2 that are aligned nearly parallel to the deformation axis.
- **Inclusion type C** (silicate inclusion type)  
Very similar to group **A**. Black when viewed under brightfield illumination. The stringers consist of one or more highly elongated oxides with smooth surfaces aligned parallel to the deformation axis.
- **Inclusion type D** (oxide inclusion type)  
Any oxides that have aspect ratios  $< 2$ , and are not part of an inclusion type B- or an inclusion type C stringer, are rated as inclusion type D. No other shape restriction is applicable. The criterion for this inclusion type is the number of oxides rather than their length.  
Inclusion types Ds and Dos: Ds are globular, gray type D inclusions. Dos are globular, gray and black type D inclusions. In Dos inclusions, the black area portion is larger than the gray area portion.

**NMI Analysis** provides the following test methods:

- Method A - Worst Fields
- Method D - Low Inclusion Content
- Method E - SAM Rating

Setup	Basic parameter
Measurement area	160 mm <sup>2</sup>
Total magnification	100x
Measuring field size	0.5 mm <sup>2</sup>

**Method A - Worst Fields**

This method reports the worst fields with the largest severity values per inclusion type. The worst field has the size of a standard measuring field and is located within the measurement area. According to the standard, the worst field can be located anywhere on the specimen and is usually not located on the grid of standard measuring fields. The **NMI Analysis** module calculates these *true worst fields*.

The **NMI Analysis** module reports for each inclusion type A, B, C, D, Ds and Dos (thin and heavy) for each severity from 0 to 5 in half-severity level increments.

Note that fields with inclusions below the smallest severity level (0.5) are not rated and indicated in the **Field Statistics** tool of the **Field Based Inspection** view as *non-ratable*. Empty fields without a specific inclusion type are presented as *n.a.* for this inclusion type.

**Method D - Low Inclusion Content**

This method evaluates steel specimens with a low inclusion content. The total number of fields of each inclusion type A, B, C, D, Ds and Dos (thin and heavy) per severity level are reported. The **NMI Analysis** module calculates for each standard measuring field the severity level from 0 to 5 in whole or half-severity level increments. For this method, the **NMI Analysis** module considers contiguous fields located on the grid of standard measuring fields.

**Method E - SAM Rating**

This method rates the inclusion content in a manner that reflects the severity and frequency of occurrence of the larger Type B and D inclusions. The method reports two measures describing the content of type B (thin and heavy) and inclusion type D (heavy) inclusions.

The number of type B fields recorded at each severity level multiplied by the severity level is summed and normalized by dividing by the total measurement area, in square inches. The **NMI Analysis** module records the nearest whole number as the rating. The number of D units is summed and normalized by dividing by the total rated area, in square inches. The **NMI Analysis** module reports all oversized inclusion types B and D along with their actual lengths or widths, or both. For more information, see the calculation of method E in the standard document.

**7.6.1.3 ISO 4967**

For detailed information, check the Standard *ISO 4967 Steel - Determination of content of non-metallic inclusions - Micrographic method using standard diagrams*. This standard is related to ASTM E45a.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

**Inclusion assessment**

For information on the inclusion classification by size and/or number, see the Standard in chapter *2 Principles*, here, *table 1* and *table 2*. To obtain a reasonable estimate of inclusion variations within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

**Inclusion categories**

According to the shape and arrangement of the inclusions, this standard defines the following inclusion types.

- **Inclusion type A** (sulfide inclusion type)  
Highly malleable, individual gray particles with a wide range of aspect ratios (length/width) and generally rounded ends.
- **Inclusion type B** (aluminate inclusion type)  
Numerous non-deformable, angular, low aspect ratio (generally < 3), black or bluish particles (at least three) aligned in the deformation direction.
- **Inclusion type C** (silicate inclusion type)  
Highly malleable, individual black or dark gray particles with a wide range of aspect ratios (generally > 3) and generally sharp ends.
- **Inclusion type D** (globular oxide inclusion type)  
Non-deformable, angular or circular, low aspect ratio (generally < 3), black or bluish, randomly distributed particles.
- **Inclusion type DS** (single globular inclusion type)  
Circular, or nearly circular, single particle with a diameter > 13 µm.

The **NMI Analysis** module provides the following test methods:

- Method A - worst fields
- Method B - field assessment

Setup	Basic parameter
Measurement area	200 mm <sup>2</sup>
Total magnification	100x
Measuring field size	0.5 mm <sup>2</sup>

#### Method A - Worst fields

This method reports the worst fields with the largest severity values per inclusion type. The worst field has the size of a standard measuring field and is located within the measurement area. According to the standard, the worst field can be located anywhere on the specimen and is usually not located on the grid of standard measuring fields. The **NMI Analysis** module calculates these *true worst fields*.

The **NMI Analysis** module reports for each inclusion type A, B, C, D and Ds (fine and thick) for each severity from 0 to 3 in half-severity level increments.

Note that fields with inclusions below the smallest severity level (0.5) are not rated and indicated in the **Field Statistics** tool of the **Field Based Inspection** view as *non-ratable*. Empty fields without a specific inclusion type are presented as *n.a.* for this inclusion type.

#### Method B - Field assessment

This method evaluates steel specimens with a low inclusion content. The total number of fields of each inclusion type A, B, C, D, Ds (fine and thick) per severity level are reported. The **NMI Analysis** module calculates for each standard measuring field the index number from 0 to 3 in whole or half-index number increments. For this method, the **NMI Analysis** module considers contiguous fields located on the grid of standard measuring fields.

#### See also

📖 ASTM E45a [► 457]

#### 7.6.1.4 JIS G 0555

For detailed information, check the Standard *JIS G 0555 Microscopic testing methods for the non-metallic inclusions in steel*. JIS G 0555: 2003 is based on ISO 4967:1998. JIS G 0555: 2020 is based on ISO 4967:2013.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

##### Inclusion assessment

For information on the inclusion classification by size and/or number, see the Standard in chapter 2 *Principle*, here *table 1* and *table 2*. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

##### Inclusion categories

According to the shape and arrangement of the inclusions, this standard defines the following inclusion types.

- **Inclusion type A** (sulfide inclusion type)  
Highly malleable, individual gray particles with a wide range of aspect ratios (length/width) and generally rounded ends.
- **Inclusion type B** (aluminate inclusion type)  
Numerous non-deformable, angular, low aspect ratio (generally < 3), black or bluish particles (at least three) aligned in the deformation direction.
- **Inclusion type C** (silicate inclusion type)  
Highly malleable, individual black or dark gray particles with a wide range of aspect ratios (generally ≥ 3) and generally sharp ends.
- **Inclusion type D** (globular oxide inclusion type)  
Non-deformable, angular or circular, low aspect ratio (generally < 3), black or bluish, randomly distributed particles.
- **Inclusion type DS** (single globular inclusion type)  
Circular, or nearly circular, single particle with a diameter ≥ 13 µm.

The **NMI Analysis** module provides the following test methods:

- Method A - worst fields
- Method B - field assessment

Setup	Basic parameter
Measurement area	200 mm <sup>2</sup>
Total magnification	100x
Measuring field size	0.5 mm <sup>2</sup>

**Method A - Worst fields**

This method reports the worst fields with the largest severity values per inclusion type of the examined specimen. The worst field has the size of a standard measuring field and is located within the measurement area. According to the standard, the worst field can be located anywhere on the specimen and is usually not located on the grid of standard measuring fields. The **NMI Analysis** module calculates these *true worst fields*.

**NMI Analysis** reports the number and size of each inclusion type A, B, C, D and Ds (fine and thick) for each index number from 0 to 3 in half-severity level increments.

Note that fields with inclusions below the smallest severity level (0.5) are not rated and indicated in the field statistics of the field based inspection as *non-ratable*. Empty fields without a specific inclusion type are presented as *n.a.* for this inclusion type.

**Method B - Field assessment**

This method evaluates steel specimens with a low inclusion content. The total number of fields of each inclusion type A, B, C, D, Ds (fine and thick) per severity level are reported. The **NMI Analysis** module calculates for each standard measuring field the index number from 0 to 3 in whole or half-index number increments. For this method, the **NMI Analysis** module considers contiguous fields located on the grid of standard measuring fields.

**7.6.1.5 GB/T 10561**

For detailed information, check the Standard *ISO 4967 Steel - Determination of content of non-metallic inclusions - Micrographic method using standard diagrams*.

This standard is equivalent to ISO 4967 with the exception of slightly different class limits.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

**Inclusion assessment**

For information on the inclusion classification by size and/or number, see the Standard in chapter 2 *Principles, table 1* and *table 2*. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

The **NMI Analysis** module provides the following test methods:

- Method A - Worst fields
- Method B - Field assessment

Setup	Basic parameter
Measurement area	200 mm <sup>2</sup>
Total magnification	100x
Measuring field size	0.5 mm <sup>2</sup>

**Method A - Worst fields**

This method reports the worst fields with the largest severity values per inclusion type. The worst field has the size of a standard measuring field and is located within the measurement area. According to the standard, the worst field can be located anywhere on the specimen and is usually not located on the grid of standard measuring fields. The **NMI Analysis** module calculates these *true worst fields*.

The **NMI Analysis** module reports for each inclusion type A, B, C, D and Ds (fine and thick) for each severity from 0 to 3 in half-severity level increments.

Note that fields with inclusions below the smallest severity level (0.5) are not rated and indicated in the **Field Statistics** tool of the **Field Based Inspection** view as *non-ratable*. Empty fields without a specific inclusion type are presented as *n.a.* for this inclusion type.

**Method B - Field assessment**

This method evaluates steel specimens with a low inclusion content. The total number of fields of each inclusion type A, B, C, D, Ds (fine and thick) per severity level are reported. The **NMI Analysis** module calculates for each standard measuring field the index number from 0 to 3 in whole or half-index number increments. For this method, the **NMI Analysis** module considers contiguous fields located on the grid of standard measuring fields.

For more information on ISO 4967, see *ISO 4967* [▶ 459].

**7.6.1.6 DIN EN 10247**

For detailed information, check the Standard *DIN EN 10247 Micrographic examination of the non-metallic inclusion content of steels using standard pictures*.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

**Inclusion assessment**

For information on the inclusion classification by size and/or number, see the Standard in chapter 10, table 2. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

**Inclusion categories**

According to the shape and the arrangement, this standard defines the following inclusion types.

- **Inclusion type α**  
Elongated, scattered
- **Inclusion type γ**  
Elongated, aligned
- **Inclusion type β**  
Globular, aligned
- **Inclusion type δ**  
Globular, scattered

Additionally, the inclusions are classified according to their color.

- **Inclusion type α**  
Gray (EA), black (EC) or color (EFC)
- **Inclusion type γ**  
Gray (EA), black (EC) or color (EFC)

- **Inclusion type  $\beta$**   
Gray (EAB), black (EB) or color (EFB)
- **Inclusion type  $\delta$**   
Gray (EAD), black (ED) or color (EFD)

The **NMI Analysis** module provides the following test methods:

- Method P - Largest inclusion
- Method M - Largest field
- Method K - Mean inclusion content

Setup	Basic parameter
Measurement area	200 $\mu\text{m}^2$
Total magnification	100 x
Measuring field size	0.5 $\text{mm}^2$

#### Method P - Largest inclusion

For each type of inclusion, only the inclusion having the greatest value of the selected method parameter **L**, **d** or **a** is evaluated and recorded. The result of the evaluation is the average of the individual values of the assessed specimens.

The measured size values are related to and reported as standardized size values based on the size classification in rows (q) and columns (k), see *table 2* in the standard. The **NMI Analysis** module reports the largest inclusion length (L), diameter (d), area (a) per type for rating according to method PL, Pd and Pa.

#### Method M - Largest field

For each inclusion type, the largest field is determined for the method parameter: inclusion number (n), length (L), diameter (d), area (a). The largest field has the size of a standard measuring field and can be located anywhere within the measurement area ("True worst field"). The **NMI Analysis** module calculates the total values per field and reports the characteristic values Mn, ML, Md, Ma according to method M per inclusion type. The measured size values are related to and reported as standardized size values based on the size classification in rows (q) and columns (k), see *table 2* in the standard. The result of the evaluation is the average of the individual values of the assessed specimens.

#### Method K - Mean inclusion content

For each inclusion type, the mean inclusion content of the measurement area is determined based on the method parameter: inclusion number (n), length (L), diameter (d), area (a). The **NMI Analysis** module calculates the total values and reports the characteristic values Kn, KL, Kd, Ka according to method K per inclusion type. The measured size values are related to and reported as standardized size values based on the size classification in rows (q) and columns (k), see *table 2* in the standard.

The K value can be calculated in the following way:

- for number ( $K_n$ ), or number and length ( $K_n$ ,  $K_L$ ), or number and area ( $K_n$ ,  $K_a$ ) for elongated inclusions;



- for number ( $K_n$ ), or number and diameter ( $K_n$ ,  $K_d$ ), or number and area ( $K_n$ ,  $K_a$ ) for globular inclusions.

The total number of assessed fields  $N_j$  is counted, including empty fields.

#### 7.6.1.7 SEP 1571

For detailed information, check the Standard *SEP 1571 Evaluation of inclusions in special steels based on their surface areas – Part 1: Basics*. The scope of testing for *methods K and M* is described in *SEP 1571 Part 2*.

This standard specifies the examination of non-metallic inclusions in special steels.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

#### Inclusion assessment

For information on the inclusion classification by size, see the Standard in *Annex E*. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

#### Inclusion categories

According to the shape and arrangement of the inclusions, this standard defines the following inclusion types.

- **Inclusion type A** (sulfide inclusion type)  
Light gray elongated inclusion or stringer, usually MnS.
- **Inclusion type B** (aluminium or magnesium oxide inclusion type)  
Dark gray to black stringer that consists of at least three non-contiguous, predominantly globular particles, usually aluminum oxides or magnesium oxides.  
Dark gray to black compact, elongated inclusion consisting of at least three contiguous non-deformable particles.
- **Inclusion type C** (oxide inclusion type)  
Black elongated inclusion or inclusion line that consists of one or more deformable elongated particles, generally a silicate.
- **Inclusion type D** (aluminium or magnesium oxide inclusion type)  
Dark gray to black globular inclusion, randomly distributed, generally an aluminum oxide or magnesium oxide.
- **Inclusion type D<sub>sulf</sub>** (sulfide inclusion type)  
Gray globular inclusion, randomly distributed, e.g. CaS.

The **NMI Analysis** module provides the following test methods:

- Method M - Maximum inclusion value
- Method K - Mean inclusion value

Setup	Basic parameter
Measurement area	200 mm <sup>2</sup>
Total magnification	100x
Measuring field size	0.5 mm <sup>2</sup>

**Method M - Maximum inclusion value**

The **NMI Analysis** module evaluates the largest inclusion of each type for each specimen as described in *SEP 1571 - Part 2*. The result is the sum of these maximum rating values divided by the number of the examined specimen. Compared to DIN 50602, individual inclusions are inspected instead of a field based evaluation.

**Method K - Mean inclusion value**

The **NMI Analysis** module evaluates the non-metallic inclusions separately for the individual inclusion types. The frequency of each size class is recorded as described in *SEP 1571 - Part 2*. To determine the inclusion content, the individual frequencies are multiplied by a factor so that larger inclusions are weighted more heavily than smaller inclusions.

Depending on the agreement the summation or the reporting respectively begins with a certain size class, e.g. only inclusions of sizes 4 and greater are considered (method K4).

**7.6.1.8 DIN 50602**

For detailed information, check the Standard *DIN 50602 Metallographie test methods; microscopic examination of special steels using standard diagrams to assess the content of non-metallic inclusions*.

This standard specifies the examination of non-metallic inclusions in special steels.

The **NMI Analysis** module generates a report document showing the method results and corresponding characteristic values.

**Inclusion assessment**

For information on the inclusion classification by size, see the Standard in chapter 6, *tables 2* and *table 3*. To obtain a reasonable evaluation of the inclusion distribution within a lot, at least six locations, chosen to be as representative of the lot as possible, should be examined.

**Inclusion categories**

According to the shape and arrangement of the inclusions, this standard defines the following inclusion types.

- **Inclusion type SS** (sulfide inclusion type)  
Sulfide inclusions of elongated type, gray particles.
- **Inclusion type OA** (aluminium oxide inclusion type)  
Oxide inclusions, black particles of aligned type.
- **Inclusion type OS** (silicate inclusion type)  
Oxide inclusions of elongated type, dark-gray, black particles.
- **Inclusion type OG** (globular oxide inclusion type)  
Oxide inclusions of globular type, black, isolated particles.

The **NMI Analysis** module provides the following test methods:

- Method M - Maximum inclusion value
- Method K - Mean inclusion value

**Methode M**

The **NMI Analysis** module evaluates the field with the largest inclusion for each type and specimen. The result is the sum of these maximum rating values divided by the number of the examined specimen.

Setup	Basic parameter
Measurement area	200 mm <sup>2</sup>
Total magnification	100x
Measured field size	0.5 mm <sup>2</sup>

### Method K

The **NMI Analysis** module evaluates the non-metallic inclusions separately for the individual inclusion types. The frequency of each size class is recorded. To determine the inclusion content, the individual frequencies are multiplied by a factor so that larger inclusions are weighted more heavily than smaller inclusions. Depending on the agreement, the summation or the reporting respectively begins with a certain size class, e.g. only inclusions of sizes 4 (method K4) and greater are considered.

Setup	Basic parameter
Measurement area	min. 100 mm <sup>2</sup>
Total magnification	100x
Measured field size	0.5 mm <sup>2</sup>

## 7.6.2 Comparison of Standards

The following table gives a brief overview of methods K and M concerning SEP 1571 and comparable standards.

SEP 1571	DIN EN 10247 2007	ISO 4967 2013	ASTM E45* 2018	DIN 50602 1985
Results cannot be influenced by change of category (thin/heavy)	Results cannot be influenced by change of category (thin/heavy)	Shifting of marginal thin (thin) inclusions towards thick (heavy) is possible	Shifting of marginal thin (thin) inclusions towards thick (heavy) is possible	Results cannot be influenced by change of category (thin/heavy)
Free path proximity conditions in and transverse to the rolling direction	Free path proximity conditions in and transverse to the rolling direction	Free path proximity conditions in and transverse to the rolling direction	Distance 40 µm in rolling direction and 15 µm transverse to them, likely similar to ISO 4967	Proximity condition relative to the inclusion size; direction of distance is undefined
Definition of a smallest particle for forming lines of 5 µm <sup>2</sup>	Smallest particle 2 µm x 3 µm	Not available	According to chapter 11.4 inclusions thinner than 2 µm are not considered in the degree of severity.	Not available

SEP 1571	DIN EN 10247 2007	ISO 4967 2013	ASTM E45* 2018	DIN 50602 1985
Globular when $l/b < 2.0$	Globular when $l/w < 3.0$	Globular when $l/b < 3.0$	Globular when $l/b < 2.0$	Globular is not defined
No evaluation limits ( $g < 0$ , $g > 9$ possible)	Evaluation range is limited, optionally ex- pandable up- wards	Evaluation range is unlim- ited upwards (Annex D1)	Evaluation range is ex- pandable up- wards ( $> 3$ )	Restricted eval- uation limits from K0 to K9
Uniform evalua- tion criteria for all inclusion types: surface	Uniform evalua- tion criteria for all inclusion types: surface area or length or number	Different evalu- ation depend- ing on the in- clusion type (length, thick- ness, number)	Different evalu- ation depend- ing on the in- clusion type (length, thick- ness, number)	Uniform evalua- tion criteria for all inclusion types: surface
Oversized (not classifiable) types are not available, since an extension of the class limits is possible	Oversized is possible, in cur- rent revision without a de- fined measure (In the revision of 2017 the fol- lowing applies: Oversized only for excess lengths: they have to be eval- uated as the next lower class and noted sep- arately.)	Oversized is possible, sepa- rately noted	Oversized is possible, sepa- rately noted outside of the standard value table	Oversized are considered as macro-inclu- sions

Tab. 2: Source: SEP 1571 Part 1:2017-08: Evaluation of inclusions in special steels based on their surface areas – Part 1: Basics, Verlag Stahleisen GmbH, Düsseldorf 2017, Table 3: Comparison between the SEP 1571 method K and M and comparable test specifications, page 28.

\* Comparison is also valid for ASTM E45a because no basic definitions have been changed with the standard revision from ASTM E45:2018 to ASTM 45a:2018.

### 7.6.3 Concept

With the operating concept of the **NMI Analysis** module, pre-defined measurement workflows are adapted by the supervisor for the every day routine of the operator. The performance of a measurement can be automated to such an extent that only the project data need to be entered and the entire analysis process can run almost automatically. Due to these automated workflows, the operator influence on the measurement results can be reduced to a minimum. In addition to the quality gained, the time necessary for the measurement is reduced as well. Supervisors and operators can focus on their specific tasks.

The operation of the module is based on the following operating concept:

- **Modifying and Managing Job Templates (Supervisor)**

Copy and edit pre-configured NMI job templates in order to adapt the workflow to your needs and to the operator routine task, manage job templates, inspect and approve job results. Note that under **Job Mode** you find pre-defined job templates for non-metallic inclusion assessment according to the standards. For more information, see *Introduction to Standards* [▶ 453].

- **Running Job templates (Operator)**

Run NMI job templates created by the supervisor. Inspect und revise results if required using the results views.

- **Optional: Modifying and managing standard templates (Supervisor)**

Copy and edit **pre-configured standard templates** in order to adapt the standard according to company internal guidelines for non-metallic inclusion assessment. Standard adaption might be also beneficial for NMI analysis of non-steel metals. Define individual parameters for minimum particle size, shape determination (globular & elongated), next neighbor relationships, and for inclusion formation.

Note that under **Manage Templates** you can edit the find pre-configured standard templates: one per standard and method.

For more information, see *Standard Template Editor* [▶ 510]. For more information regarding available standards, see *Introduction to Standards* [▶ 453].

Note that for the initial operations you must select in the **Standard Selection** workbench (in the first step of your job template), the desired standard templates.

**Note:** In the role of a supervisor it is possible to perform functionalities of the operator.

### General Workflow preparations

A pre-defined job template is included in the software, when you have licenced the **NMI Analysis** module. In this documentation, we will explain the procedure according to the existing, pre-defined job templates. The following job templates are available by default:

Parameter	Description
<b>Non-Metallic Inclusion Analysis</b>	You load or acquire the images of specimen with oxides and sulfides, and analyze them.
<b>Non-Metallic Inclusion Analysis Nitrides</b>	You load or acquire the images of specimen with oxides, sulfides and nitrides and analyze them.

As a **Supervisor**, you can access/edit the job template under **Job Mode**. On the left side, in the **Categories** list under **Material Analysis**, select **NMI Analysis**.

In the templates list, you see the available job template. When you double-click on the entry in the list, the corresponding job template opens. The job templates generally contain four major tasks:

- **Filling out an Input Form**

In this step, the operator has to fill out the input form with user and specimen specific information, etc.

- **Image Acquisition**

Image acquisition of the pre-defined specimen area.

- **Performing the Analysis**

In this step particles are extracted by image segmentation and inclusions are grouped according to the selected standards. The detailed workflow is described in the following sections.

- **Creating a Report**

After the analysis, reports are generated containing the job results with characteristic values according to the selected standards. One report per specimen and one report displaying the summary statistic of all acquired images of the specimen per standard.

### 7.6.4 Operator Workflow

In general, the evaluation of steel cleanliness consists of the following steps.

- **Sampling and specimen preparation**  
Sectioning, hardening, grinding, mounting (not mandatory), and several polishing steps are performed. Usually, n-representative locations of one lot are cut out. The specimen size and the location are dependent on the steel product to be analyzed. Note that the polished surface must be parallel to the main deformation direction, otherwise the generated measurement results are not meaningful.
- **Specimen acquisition and analysis**  
Images of the prepared steel specimen are acquired, usually six test objects, originating from one lot. The inclusions are classified by size and type. Inclusions are rated based on standard specific test methods, usually several standards with the corresponding methods are applied.  
**Note:** The main deformation direction must be considered for a correct placement of the individual specimen on the microscope stage. In doing so, the elongated inclusions are oriented either horizontal or vertical related to the x-axis of the stage. Otherwise the generated measurement results are not meaningful.
- **Inspection and documentation of results**

#### General Workflow of the Operator

Step	Operator task
1	Place specimen (often up to six) on the scanning stage of the microscope using a stage insert with a steel specimen holder. <b>Note:</b> Consideration of the main deformation direction is required.
2	Select job template for <b>NMI Analysis</b> and executes job.
3	Fill in data in the overarching and specimen form.
4	<b>Optional:</b> Adjust acquisition pre-settings.
6	Inspect the results using the interactive result views and the report document view.
7	<b>Optional:</b> Modify results using the interactive views, ( <b>Global Result</b> view and <b>Field Based Inspection</b> ), i.e. changing the inclusion type or excluding artifacts.
8	Perform the final inspection of the test methods results in the <b>Report</b> view.
9	<b>Optional:</b> Re-open and/or export job results via <b>Browse Job Results</b> .

#### Best Practice

General remarks for image acquisition:

- Perform specimen acquisition in brightfield contrast, usually with a total magnification of 100x.
- Acquire specimen with oxides and sulfides in BW mode. Appropriate job template: **Non-Metallic Inclusion Analysis**.
- For nitrides, the image must be acquired in color mode. Appropriate job template: **Non-Metallic Inclusion Analysis Nitrides**.
- Adjust image brightness and exposure time so that also the light gray inclusions are well contrasted.

**Best practice for manual thresholding setting (segmentation)**

- Use the auto threshold as base setting.
- Select a specimen area which shows both Oxides and Sulfides.
- Zoom in using the mouse wheel until finer grey inclusions are clearly visible.
- Adjust the **Tolerance Upper Sulfide Threshold** to avoid artifacts from potential matrix background detection.
- Toggle with **Oxide**, **Sulfide** and **All** buttons to inspect the segmentation result; this at various positions.

If the result of thresholding is as expected, no further action is needed, otherwise adjust the thresholds for oxides and sulfides manually.

**Info**

The upper threshold value for the oxides determines automatically the lower threshold value for sulfides.

For this purpose, start adjusting the oxide threshold range and continue afterwards with setting of the upper sulfide threshold value. Fine tuning of the segmentation results is possible with the **Tolerance Sulfide Range**.

For more information, see *Control Elements* [► 51].

**7.6.5 Supervisor Workflow**

The **NMI Analysis** module offers different degrees of automation. It depends on the experience of the operator and the type of specimen, to which degree the workflow should be automated. In the role of the **Supervisor**, you create the workflows for the **Operators** based on pre-defined job templates in **Job Mode**. In general, the Supervisor modifies the degree of automation using following two options: Firstly, the Supervisor can set a task to **Run Silent**, i.e. the selected working step is performed but not visible to the Operator. The results of silent steps are saved as well in the archive. Secondly, the Supervisor can define which part of the tool shall be visible to the Operator.

**General Workflow of the Supervisor**

Step	Supervisor task
1	<p>Select standards relevant for specimen analysis.</p> <p><b>Optional:</b></p> <ul style="list-style-type: none"> <li>■ Select an existing overarching input form. Default: <b>ZEISS Form NMI Overarching</b></li> <li>■ Adjust the number of input forms with number of specimens to be analyzed. Default: Setting range <b>1</b> to <b>6</b></li> <li>■ Select an existing specimen input form. Default: <b>ZEISS Form NMI specimen</b></li> </ul>
2	<p>Configure default specimen acquisition settings. For more information, see section <b>Best practice for image acquisition</b> below.</p>
3	<p>Adjust delineation and if required segmentation settings. Default: <b>Auto Segmentation</b></p>

Step	Supervisor task
	<p>For more information, see section Best practice acquisition &amp; threshold setting below.</p> <p><b>Optional:</b></p> <ul style="list-style-type: none"> <li>Adjust artefact detection parameter.</li> <li>Define severity rating filter per standard, e.g. select the value <b>4</b> for K4 rating according to DIN 50601 or to SEP1571.</li> <li>Allow a manual change of the initially applied main deformation direction.</li> <li>Configure the presentation of the gallery images shown in the report.</li> </ul> <p><b>System:</b></p> <ul style="list-style-type: none"> <li>Automatic combination of the standard reports for the report document. This step is based on the standard selection in <b>Step 1</b> and represents the results per specimen.</li> <li>Automatic combination of the standard reports for the summary report document. This step is based on the standard selection in <b>Step 1</b> and represents the summary results over all specimen of one job run.</li> </ul>

### Best Practice for image acquisition

General remarks for image acquisition:

- Specimen acquisition is performed in brightfield contrast, usually with a total magnification of 100x.
- Specimen with oxides and sulfides shall be acquired in BW mode; appropriate job template: **Non-Metallic Inclusion Analysis**.
- For nitrides, the image must be acquired in color mode; appropriate job template: **Non-Metallic Inclusion Analysis Nitrides**.

Initial steps for image acquisition: Adjust exposure time and focus on the specimen surface.

Settings for **Light Path Editing** tool:

- Configure the microscope hardware and camera settings used for routine **NMI Analysis**.
- Adjust image brightness and exposure time so that also the light gray inclusions are well contrasted.
- Copy and edit the defined settings.

Settings for the **Extended Camera** tool:

- Adjust the white balance in case of using the color mode of the camera.
- Perform a shading correction.
- Close the extended camera tool.

### Best practice for manual thresholding setting (segmentation)

Manual threshold setting

- Use the auto threshold as base setting.
- Select a specimen area which shows both Oxides and Sulfides.
- Zoom in using the mouse wheel until finer grey inclusions are clearly visible.
- Adjust delineate to make sure that a potential Oxide-halo (a ring of lighter gray values around the border line of oxides) effect is minimized.



- Adjust the **Tolerance Sulfide Range** to avoid artifacts from potential matrix background detection.
- Toggle with **Oxide**, **Sulfide** and **All** buttons to inspect the segmentation result; this at various positions.

If the result of thresholding is as expected no further action is needed, otherwise adjust the thresholds for oxides and sulfides manually.

For this purpose, start adjusting the oxide threshold range and continue afterwards with setting of the upper sulfide threshold value. Fine tuning of the segmentation results is possible with the **Tolerance Sulfide Range**.

### Info

The upper threshold value for the oxides determines automatically the lower threshold value for sulfides.

### See also

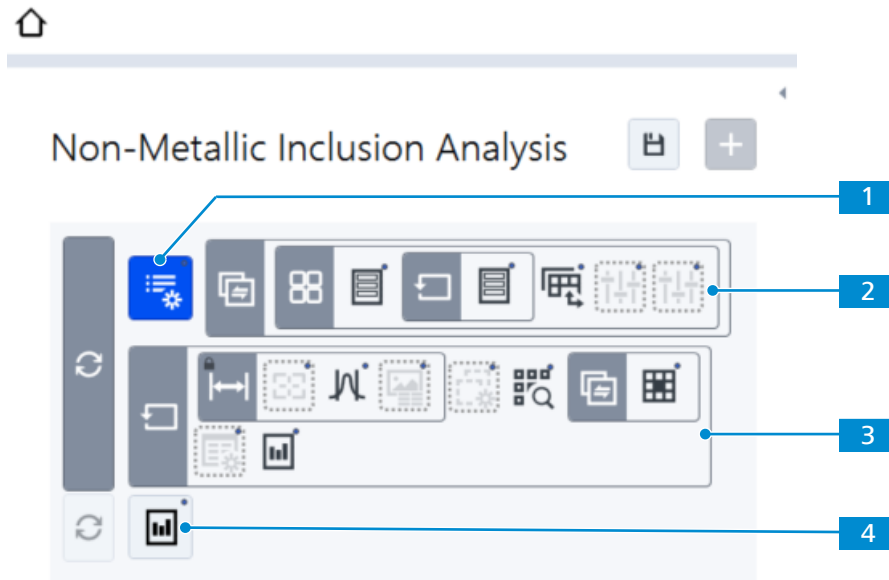
📄 Supervisor Workflow [▶ 471]

## 7.6.6 Supervisor Tasks - Workflow Configuration

The **NMI Analysis** module job template covers the complete analysis from image acquisition to archiving and shows in the task list two large main groups, see image (2)/(3). The **NMI Analysis** module workflow starts with standard selection (1) and ends with the summary report (4) presenting the results for the set of specimen.

### NMI Analysis task list

Each working step is represented by a workbench. For general information on workbenches and workbench categories, see *Basic Concepts* [▶ 20] to the basic concepts.



- 1 Represents the standard selection.
- 2 Represents the input forms, image acquisition and preprocessing.
- 3 Represents the image analysis and interactive result views and the report per specimen.
- 4 Represents the summary report.

In the **Manage Template** mode, the analysis steps of the **NMI Analysis** module workflow shows the described substeps to be executed. In this workflow, some substeps are created within a Loop Task, meaning all included steps will be repeated depending on the loop settings. Regarding this, you can easily fulfill the normative requirements of repeating the identical steps of an analysis for several times. For information on the task concept of job templates, see *Task List* [▶ 55].

Note that grayed out task icons are set to **Run silent**. For more information, see *Toggling the Visibility of "Run silent" Tasks* [▶ 474].

The following workflows are available:

- **Non-Metallic Inclusion Analysis**
- **Non-Metallic Inclusion Analysis Nitrides**

#### 7.6.6.1 Configuring the NMI Job Template by Switching the Active Branch

When you have started a job template, the default branch is the **Acquire Tiles Images** branch. But you can switch from the default branch to the **Load Images From File System**. If you switch between branches, note that you also have to switch the **NMI Field Based Inspection Live** and the **NMI Field Based Inspection** without live image. This functions help you to be flexible if you get images delivered to analyze or if you need to acquire an image.

1. To select the **Switch** workbench > **Select Branch** tool, click



You have the following options: Select **Acquire Tiles Images** or select **Load Images From File System**.

→ The workflow tasks change according to your selection.

2. Later within the workflow, click the icon again, select the corresponding inspection view. If you have selected **Acquire Tiles Images** before, select now **NMI Field Based Inspection Live**. If you have selected **Load Images From File System** before, select now **NMI Field Based Inspection**.

If you acquire images, you can check the specimen by the enabled live view. If you load images, the live view is not possible.

For more information, see *Select Branch Tool* [▶ 532].

#### 7.6.6.2 Toggling the Visibility of "Run silent" Tasks

**Run silent** tasks are not shown to the operator, but executed when the workflow is conducted and all results are saved in the archive. The reason is that these tasks have default parameter settings and you do not need to configure them. In the role of a **Supervisor**, you can toggle the visibility of the tasks in **Run** mode.

1. In the **Task List** of an **NMI Analysis** Workflow, right-click on a deactivated icon representing a **Run silent** task.
2. Open the **Context** Menu and select or deselect **Run silent**.

When the task is deactivated, in **Run** mode the task is not visible in the **NMI Analysis** module workflow.

#### 7.6.6.3 NMI Analysis: Overview of Supervisor Workflow with Image Acquisition

The following scheme describes the routine tasks you can modify.



### NMI Standard Selection

Provides a list of available standards for the **NMI Analysis** module that shall be used for the analysis.

1. Select the standards that are relevant for the operator's analysis, see *Standard Selection Tool* [▶ 533].



### Switch

Changes between the branches.

1. Select the branch according to the operator's needs, i.e. either with image acquisition or without, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### Acquire Tiles Images

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. The calculation is performed with default values in the background. Therefore, editing is not possible.



### Overarching Form

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

**Optional:**

1. Select the relevant template. In this form, the operator enters overarching data identical for all specimen, see *Form Selection Tool* [▶ 750].

The customers are managed with an Excel file. This file is stored per default here:  
C:\ProgramData\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



### Loop

**Loop** for **Specimen Forms**.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Specimen Form

**Specimen** input form. In the **Form Selection** tool, a specimen input form is provided.

**Optional:**

1. Select the relevant template. In this form, the operator enters information for each specimen, see *Form Selection Tool* [▶ 750].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Perform a shading correction.
3. Adjust the tile region to the specimen area to be analyzed.
4. Define the focus points.

See

- *Light Path Editing Tool* [[▶ 777](#)]
- *Extended Camera Tool* [[▶ 761](#)]
- *Tiles Setup (measurement area) Tool* [[▶ 533](#)]
- *Focus Correction Tool* [[▶ 771](#)]

The operator uses this settings for the specimen acquisition.



### Image Processing

Changes the image format.

**Default:** Run silent

**Default: 8 Bit B/W** in the job template **Non-Metallic Inclusion Analysis** for detection of oxides and sulfides.

**Default: 24 Bit RGB** in the job template **Non-Metallic Inclusion Analysis Nitrides** for detection of oxides, sulfides and nitrides.

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [[▶ 822](#)].



### Split Image

Splits n tiles regions into n images.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Split by Dimension Tool* [[▶ 532](#)].



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [[▶ 748](#)].



### Image Analysis for NMI

Provides the **NMI Analysis** module specific image analysis settings.

**Default:** The setting **NMI** is selected in the job template **Non-Metallic Inclusion Analysis** for detection of oxides and sulfides.

**Default:** The setting **NMI with Nitrides** is selected in the job template **Non-Metallic Inclusion Analysis Nitrides** for detection of Oxides, Sulfides and Nitrides.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### NMI Segmentation

Extracts objects from the background by thresholding.

**Default: Thresholds: Automatic**

1. Adjust the **Delineation** and **Tolerance Sulfide Range** filter to optimize the segmentation result.
2. **Optional:** Define the threshold settings manually.

The operator uses these values for the image segmentation, see *NMI Segmentation Tool* [▶ 529].



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### NMI Analysis Region Adaption

The region adaption algorithm enhances the detection and analysis of heterogenous inclusions.

**Activated:** Enable region adaption

**Default:** Region adaption deactivated

The operator will not see these settings.

See *NMI Analysis Region Adaption Tool* [▶ 531].



### NMI Standard Specific Calculation

Configures the calculation and rating of inclusions.

**Default:** Run silent

1. Adjust settings for automated artifact detection and automated removal of halo effects on sulfides.
2. Select a standard specific filter to exclude inclusions from a certain size range from the rating result. The filter is based on the corresponding characteristic value.

These settings are conducted automatically in the operator workflow.

See

- *Rolling Direction Detection Tool* [▶ 531]
- *Artifact Detection Tool* [▶ 524]
- *Characteristic Value Filter Tool* [▶ 525]



### Global Results

Shows the global results of the analysis.

**Optional:**

1. Change visibility of the **Rolling Direction** tool to allow the operator a manual change of the automated detected main deformation axis.

See

- *Standard Results Selection Tool* [▶ 524]
- *Specimen Overview Tool* [▶ 532]
- *Rolling Direction Tool* [▶ 532]
- *Detected Objects Tool* [▶ 526]



### Switch

Changes between the branches. The branch **NMI Field Based Inspection Live** is pre-defined. We recommend not to change this setting.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### NMI Field Based Inspection Live

Shows the field based results of the analysis.

No configuration options.

See

- *Standard Selection Tool* [▶ 533]
- *Specimen Overview Tool* [▶ 532]
- *Field Statistics Tool* [▶ 526]



### NMI Results Output

Configures the layout of the gallery images in the report document.

**Optional:** You can select more than one image per inclusion type in the report document.

**We recommend not to change the default parameters.**

See *Format Image Gallery (Report) Tool* [▶ 527].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a report for each individual specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a joint report with summary results considering all analyzed specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

#### 7.6.6.4 NMI Analysis: Overview of Supervisor Workflow with Loaded Image Files



### NMI Standard Selection

Provides a list of available standards for the **NMI Analysis** module that shall be used for the analysis.

1. Select the standards that are relevant for the operator's analysis, see *Standard Selection Tool* [▶ 533].



### Switch

Changes between the branches.

1. Select the branch according to the operator's needs, i.e. either with image acquisition or without, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### Load Images from File System

Branch for the load image from file system workflow.

The **Define Outputs** tool does not display any entries. The calculation is performed with default values in the background. Therefore, editing is not possible.



### Overarching Form

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

**Optional:**

1. Select the relevant template. In this form, the operator enters overarching data identical for all specimen, see *Form Selection Tool* [▶ 750].

The customers are managed with an Excel file. This file is stored per default here:

C:\ProgramData\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



### Loop

**Loop** for **Specimen Forms**.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Specimen Form

**Specimen** input form. In the **Form Selection** tool, a specimen input form is provided.

**Optional:**

1. Select the relevant template. In this form, the operator enters information for each specimen, see *Form Selection Tool* [▶ 750].



### Load Files

Loads one or multiple images from the file system.

Set whether the operator shall have an option to navigate in the file system to load the files.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Analysis for NMI

Provides the **NMI Analysis** module specific image analysis settings.

**Default:** The setting **NMI** is selected in the job template **Non-Metallic Inclusion Analysis** for detection of oxides and sulfides.

**Default:** The setting **NMI with Nitrides** is selected in the job template **Non-Metallic Inclusion Analysis Nitrides** for detection of Oxides, Sulfides and Nitrides.



**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### NMI Segmentation

Extracts objects from the background by thresholding.

**Default: Thresholds: Automatic**

1. Adjust the **Delineation** and **Tolerance Sulfide Range** filter to optimize the segmentation result.
2. **Optional:** Define the threshold settings manually.

The operator uses these values for the image segmentation, see *NMI Segmentation Tool* [▶ 529].



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### NMI Analysis Region Adaption

The region adaption algorithm enhances the detection and analysis of heterogenous inclusions.

**Activated:** Enable region adaption

**Default:** Region adaption deactivated

The operator will not see these settings.

See *NMI Analysis Region Adaption Tool* [▶ 531].



### NMI Standard Specific Calculation

Configures the calculation and rating of inclusions.

**Default:** Run silent

1. Adjust settings for automated artifact detection and automated removal of halo effects on sulfides.
2. Select a standard specific filter to exclude inclusions from a certain size range from the rating result. The filter is based on the corresponding characteristic value.

These settings are conducted automatically in the operator workflow.

See

- *Rolling Direction Detection Tool* [▶ 531]
- *Artifact Detection Tool* [▶ 524]
- *Characteristic Value Filter Tool* [▶ 525]



### Global Results

Shows the global results of the analysis.

#### Optional:

1. Change visibility of the **Rolling Direction** tool to allow the operator a manual change of the automated detected main deformation axis.

See

- *Standard Results Selection Tool* [▶ 524]
- *Specimen Overview Tool* [▶ 532]
- *Rolling Direction Tool* [▶ 532]
- *Detected Objects Tool* [▶ 526]



### Switch

Changes between the branches. The branch **NMI Field Based Inspection** is pre-defined. We recommend not to change this setting.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### NMI Field Based Inspection

Shows the field based results of the analysis.

No configuration options.

See

- *Standard Selection Tool* [▶ 533]
- *Specimen Overview Tool* [▶ 532]
- *Field Statistics Tool* [▶ 526]



### NMI Results Output

Configures the layout of the gallery images in the report document.

**Optional:** You can select more than one image per inclusion type in the report document.

**We recommend not to change the default parameters.**

See *Format Image Gallery (Report) Tool* [▶ 527].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a report for each individual specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a joint report with summary results considering all analyzed specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

#### 7.6.6.5 NMI Analysis: Overview of Supervisor Workflow Non-Metallic Inclusion Analysis (Sample by Sample)

This workflow is intended for users with smaller scanning stages. You acquire one sample at a time, replace it and acquire the next sample. The workflow supports only one tile region per loop iteration.



### NMI Standard Selection

Provides a list of available standards for the **NMI Analysis** module that shall be used for the analysis.

1. Select the standards that are relevant for the operator's analysis, see *Standard Selection Tool* [▶ 533].



### Switch

Changes between the branches. The branch **Acquire Tiles Image Loop** is pre-defined. We recommend not to change this setting.

This job template only supports the acquisition of one tiles region image per loop iteration.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### Acquire Tile Image Loop

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



### Overarching Form

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

#### Optional:

1. Select the relevant template. In this form, the operator enters overarching data identical for all specimen, see *Form Selection Tool* [▶ 750].

The customers are managed with an Excel file. This file is stored per default here:  
C:\ProgramData\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



### Loop

**Loop** for **Specimen Forms** and for **Tiles (measurement area)**.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Specimen Form

**Specimen** input form. In the **Form Selection** tool, a specimen input form is provided.

#### Optional:

1. Select the relevant template. In this form, the operator enters information for each specimen, see *Form Selection Tool* [▶ 750].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Adjust the tile region to the specimen area to be analyzed. Note that it is only possible to adjust one tile region.
3. Define the focus points.

See

- *Light Path Editing Tool* [▶ 777]
- *Extended Camera Tool* [▶ 761]
- *Tiles Setup (measurement area) Tool* [▶ 533]
- *Focus Correction Tool* [▶ 771]

The operator uses this settings for the specimen acquisition.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**Default:** 8 Bit B/W in the following job templates for detection of oxides and sulfides:

- **Non-Metallic Inclusion Analysis**
- **Non-Metallic Inclusion Analysis (Sample by Sample)**

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### NMI Analysis Task Group

Provides the **NMI Analysis** module specific image analysis settings.

**Default:** The setting **NMI** is selected in the job templates for detection of oxides and sulfides, but not for nitride.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### NMI Segmentation

Extracts objects from the background by thresholding.

**Default: Thresholds: Automatic**

1. Adjust the **Delineation** and **Tolerance Sulfide Range** filter to optimize the segmentation result.
2. **Optional:** Define the threshold settings manually.

The operator uses these values for the image segmentation, see *NMI Segmentation Tool* [▶ 529].



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### NMI Standard Specific Calculation

Configures the calculation and rating of inclusions.

**Default:** Run silent

1. Adjust settings for automated artifact detection and automated removal of halo effects on sulfides.
2. Select a standard specific filter to exclude inclusions from a certain size range from the rating result. The filter is based on the corresponding characteristic value.

These settings are conducted automatically in the operator workflow.

See

- *Rolling Direction Detection Tool* [▶ 531]
- *Artifact Detection Tool* [▶ 524]
- *Characteristic Value Filter Tool* [▶ 525]



### Global Results

Shows the global results of the analysis.

**Optional:**

1. Change visibility of the **Rolling Direction** tool to allow the operator a manual change of the automated detected main deformation axis.

See

- *Standard Results Selection Tool* [▶ 524]
- *Specimen Overview Tool* [▶ 532]
- *Rolling Direction Tool* [▶ 532]
- *Detected Objects Tool* [▶ 526]



### Switch

Changes between the branches. The branch **NMI Field Based Inspection Live** is pre-defined. We recommend not to change this setting.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### NMI Field Based Inspection Live

Shows the field based results of the analysis.

No configuration options.

See

- *Standard Selection Tool* [▶ 533]

- *Specimen Overview Tool* [▶ 532]
- *Field Statistics Tool* [▶ 526]



### NMI Results Output

Configures the layout of the gallery images in the report document.

**Optional:** You can select more than one image per inclusion type in the report document.

**We recommend not to change the default parameters.**

See *Format Image Gallery (Report) Tool* [▶ 527].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a report for each individual specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a joint report with summary results considering all analyzed specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

#### 7.6.6.6 NMI Analysis: Overview of Supervisor Workflow Non-Metallic Inclusion Analysis Nitrides with Image Acquisition

The following scheme describes the routine tasks you can modify.



### NMI Standard Selection

Provides a list of available standards for the **NMI Analysis** module that shall be used for the analysis.

1. Select the standards that are relevant for the operator's analysis, see *Standard Selection Tool* [▶ 533].



### Switch

Changes between the branches.

1. Select the branch according to the operator's needs, i.e. either with image acquisition or without, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### Acquire Tiles Images

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. The calculation is performed with default values in the background. Therefore, editing is not possible.



### Overarching Form

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

#### Optional:

1. Select the relevant template. In this form, the operator enters overarching data identical for all specimen, see *Form Selection Tool* [▶ 750].

The customers are managed with an Excel file. This file is stored per default here:  
C:\ProgramData\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



### Loop

**Loop** for **Specimen Forms**.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Specimen Form

**Specimen** input form. In the **Form Selection** tool, a specimen input form is provided.

#### Optional:

1. Select the relevant template. In this form, the operator enters information for each specimen, see *Form Selection Tool* [▶ 750].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Perform a shading correction.
3. Adjust the tile region to the specimen area to be analyzed.
4. Define the focus points.

See

- *Light Path Editing Tool* [▶ 777]
- *Extended Camera Tool* [▶ 761]
- *Tiles Setup (measurement area) Tool* [▶ 533]
- *Focus Correction Tool* [▶ 771]

The operator uses this settings for the specimen acquisition.





### Split Image

Splits n tiles regions into n images.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Split by Dimension Tool* [▶ 532].



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**Default: 24 Bit RGB** in the following job templates for detection of oxides, sulfides, and nitrides:

- **Non-Metallic Inclusion Analysis Nitrides**
- **Non-Metallic Inclusion Analysis Nitrides (Sample by Sample)**

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### NMI Analysis Task Group

Provides the **NMI Analysis** module specific image analysis settings.

**Default:** The setting **NMI with Nitrides** is selected in the job templates for detection of oxides, sulfides, and nitrides.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]

- *Tiles Setup (measurement area) Tool* [▶ 533]



### NMI Segmentation

Extracts objects from the background by thresholding.

**Default: Thresholds: Automatic**

1. Adjust the **Delineation** and **Tolerance Sulfide Range** filter to optimize the segmentation result.
2. **Optional:** Define the threshold settings manually.

The operator uses these values for the image segmentation, see *NMI Segmentation Tool* [▶ 529].



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### NMI Analysis Region Adaption

The region adaption algorithm enhances the detection and analysis of heterogenous inclusions.

**Activated:** Enable region adaption

**Default:** Region adaption deactivated

The operator will not see these settings.

See *NMI Analysis Region Adaption Tool* [▶ 531].



### NMI Standard Specific Calculation

Configures the calculation and rating of inclusions.

**Default:** Run silent

1. Adjust settings for automated artifact detection and automated removal of halo effects on sulfides.
2. Select a standard specific filter to exclude inclusions from a certain size range from the rating result. The filter is based on the corresponding characteristic value.

These settings are conducted automatically in the operator workflow.

See

- *Rolling Direction Detection Tool* [▶ 531]
- *Artifact Detection Tool* [▶ 524]
- *Characteristic Value Filter Tool* [▶ 525]



### Global Results

Shows the global results of the analysis.

**Optional:**

1. Change visibility of the **Rolling Direction** tool to allow the operator a manual change of the automated detected main deformation axis.

See

- *Standard Results Selection Tool* [▶ 524]
- *Specimen Overview Tool* [▶ 532]
- *Rolling Direction Tool* [▶ 532]
- *Detected Objects Tool* [▶ 526]

**Switch**

Changes between the branches. The branch **NMI Field Based Inspection Live** is pre-defined. We recommend not to change this setting.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].

**NMI Field Based Inspection Live**

Shows the field based results of the analysis.

No configuration options.

See

- *Standard Selection Tool* [▶ 533]
- *Specimen Overview Tool* [▶ 532]
- *Field Statistics Tool* [▶ 526]

**NMI Results Output**

Configures the layout of the gallery images in the report document.

**Optional:** You can select more than one image per inclusion type in the report document.

**We recommend not to change the default parameters.**

See *Format Image Gallery (Report) Tool* [▶ 527].

**Reports**

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a report for each individual specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

**Reports**

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a joint report with summary results considering all analyzed specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

#### 7.6.6.7 NMI Analysis: Overview of Supervisor Workflow Non-Metallic Inclusion Analysis Nitrides with Loaded Images



##### **NMI Standard Selection**

Provides a list of available standards for the **NMI Analysis** module that shall be used for the analysis.

1. Select the standards that are relevant for the operator's analysis, see *Standard Selection Tool* [▶ 533].



##### **Switch**

Changes between the branches.

1. Select the branch according to the operator's needs, i.e. either with image acquisition or without, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



##### **Load Images from File System**

Branch for the load image from file system workflow.

The **Define Outputs** tool does not display any entries. The calculation is performed with default values in the background. Therefore, editing is not possible.



##### **Overarching Form**

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

##### **Optional:**

1. Select the relevant template. In this form, the operator enters overarching data identical for all specimen, see *Form Selection Tool* [▶ 750].

The customers are managed with an Excel file. This file is stored per default here:

C:\ProgramData\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



##### **Loop**

**Loop** for **Specimen Forms**.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Specimen Form

**Specimen** input form. In the **Form Selection** tool, a specimen input form is provided.

#### Optional:

1. Select the relevant template. In this form, the operator enters information for each specimen, see *Form Selection Tool* [▶ 750].



### Load Files

Loads one or multiple images from the file system.

Set whether the operator shall have an option to navigate in the file system to load the files.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**Default: 24 Bit RGB** in the following job templates for detection of oxides, sulfides, and nitrides:

- **Non-Metallic Inclusion Analysis Nitrides**
- **Non-Metallic Inclusion Analysis Nitrides (Sample by Sample)**

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### NMI Analysis Task Group

Provides the **NMI Analysis** module specific image analysis settings.

**Default:** The setting **NMI with Nitrides** is selected in the job templates for detection of oxides, sulfides, and nitrides.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### NMI Segmentation

Extracts objects from the background by thresholding.

**Default:** Thresholds: Automatic

1. Adjust the **Delineation** and **Tolerance Sulfide Range** filter to optimize the segmentation result.
2. **Optional:** Define the threshold settings manually.

The operator uses these values for the image segmentation, see *NMI Segmentation Tool* [▶ 529].



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### NMI Analysis Region Adaption

The region adaption algorithm enhances the detection and analysis of heterogenous inclusions.

**Activated:** Enable region adaption

**Default:** Region adaption deactivated

The operator will not see these settings.

See *NMI Analysis Region Adaption Tool* [▶ 531].



### NMI Standard Specific Calculation

Configures the calculation and rating of inclusions.

**Default:** Run silent

1. Adjust settings for automated artifact detection and automated removal of halo effects on sulfides.
2. Select a standard specific filter to exclude inclusions from a certain size range from the rating result. The filter is based on the corresponding characteristic value.

These settings are conducted automatically in the operator workflow.

See

- *Rolling Direction Detection Tool* [▶ 531]
- *Artifact Detection Tool* [▶ 524]
- *Characteristic Value Filter Tool* [▶ 525]



### Global Results

Shows the global results of the analysis.

#### Optional:

1. Change visibility of the **Rolling Direction** tool to allow the operator a manual change of the automated detected main deformation axis.

See

- *Standard Results Selection Tool* [▶ 524]
- *Specimen Overview Tool* [▶ 532]
- *Rolling Direction Tool* [▶ 532]
- *Detected Objects Tool* [▶ 526]



### Switch

Changes between the branches. The branch **NMI Field Based Inspection Live** is pre-defined. We recommend not to change this setting.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### NMI Field Based Inspection Live

Shows the field based results of the analysis.

No configuration options.

See

- *Standard Selection Tool* [▶ 533]
- *Specimen Overview Tool* [▶ 532]
- *Field Statistics Tool* [▶ 526]



### NMI Results Output

Configures the layout of the gallery images in the report document.

**Optional:** You can select more than one image per inclusion type in the report document.

**We recommend not to change the default parameters.**

See *Format Image Gallery (Report) Tool* [▶ 527].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a report for each individual specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].



## Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a joint report with summary results considering all analyzed specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### 7.6.6.8 NMI Analysis: Overview of Supervisor Workflow Non-Metallic Inclusion Analysis Nitrides (Sample by Sample)

This workflow is intended for users with smaller scanning stages. You acquire one sample at a time, replace it and acquire the next sample. The workflow supports only one tile region per loop iteration.



## NMI Standard Selection

Provides a list of available standards for the **NMI Analysis** module that shall be used for the analysis.

1. Select the standards that are relevant for the operator's analysis, see *Standard Selection Tool* [▶ 533].



## Switch

Changes between the branches. The branch **Acquire Tiles Image Loop** is pre-defined. We recommend not to change this setting.

This job template only supports the acquisition of one tiles region image per loop iteration.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



## Acquire Tile Image Loop

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



## Overarching Form

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

### Optional:

1. Select the relevant template. In this form, the operator enters overarching data identical for all specimen, see *Form Selection Tool* [▶ 750].



The customers are managed with an Excel file. This file is stored per default here:  
C:\ProgramData\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



### Loop

**Loop** for **Specimen Forms** and for **Tiles (measurement area)**.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Specimen Form

**Specimen** input form. In the **Form Selection** tool, a specimen input form is provided.

**Optional:**

1. Select the relevant template. In this form, the operator enters information for each specimen, see *Form Selection Tool* [▶ 750].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Adjust the tile region to the specimen area to be analyzed. Note that it is only possible to adjust one tile region.
3. Define the focus points.

See

- *Light Path Editing Tool* [▶ 777]
- *Extended Camera Tool* [▶ 761]
- *Tiles Setup (measurement area) Tool* [▶ 533]
- *Focus Correction Tool* [▶ 771]

The operator uses this settings for the specimen acquisition.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**Default:** **8 Bit B/W** in the following job templates for detection of oxides and sulfides:

- **Non-Metallic Inclusion Analysis**
- **Non-Metallic Inclusion Analysis (Sample by Sample)**

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### NMI Analysis Task Group

Provides the **NMI Analysis** module specific image analysis settings.

**Default:** The setting **NMI with Nitrides** is selected in the job templates for detection of oxides, sulfides, and nitrides.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### NMI Segmentation

Extracts objects from the background by thresholding.

**Default: Thresholds: Automatic**

1. Adjust the **Delineation** and **Tolerance Sulfide Range** filter to optimize the segmentation result.
2. **Optional:** Define the threshold settings manually.

The operator uses these values for the image segmentation, see *NMI Segmentation Tool* [▶ 529].



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### NMI Analysis Region Adaption

The region adaption algorithm enhances the detection and analysis of heterogeneous inclusions.

**Activated:** Enable region adaption

**Default:** Region adaption deactivated

The operator will not see these settings.

See *NMI Analysis Region Adaption Tool* [▶ 531].



### NMI Standard Specific Calculation

Configures the calculation and rating of inclusions.

**Default:** Run silent

1. Adjust settings for automated artifact detection and automated removal of halo effects on sulfides.
2. Select a standard specific filter to exclude inclusions from a certain size range from the rating result. The filter is based on the corresponding characteristic value.

These settings are conducted automatically in the operator workflow.

See

- *Rolling Direction Detection Tool* [▶ 531]
- *Artifact Detection Tool* [▶ 524]
- *Characteristic Value Filter Tool* [▶ 525]



### Global Results

Shows the global results of the analysis.

**Optional:**

1. Change visibility of the **Rolling Direction** tool to allow the operator a manual change of the automated detected main deformation axis.

See

- *Standard Results Selection Tool* [▶ 524]
- *Specimen Overview Tool* [▶ 532]
- *Rolling Direction Tool* [▶ 532]
- *Detected Objects Tool* [▶ 526]



### Switch

Changes between the branches. The branch **NMI Field Based Inspection Live** is pre-defined. We recommend not to change this setting.

For information on the branch switches, see *Configuring the NMI Job Template by Switching the Active Branch* [▶ 474].



### NMI Field Based Inspection Live

Shows the field based results of the analysis.

No configuration options.

See

- *Standard Selection Tool* [▶ 533]
- *Specimen Overview Tool* [▶ 532]
- *Field Statistics Tool* [▶ 526]



### NMI Results Output

Configures the layout of the gallery images in the report document.

**Optional:** You can select more than one image per inclusion type in the report document.

**We recommend not to change the default parameters.**

See *Format Image Gallery (Report) Tool* [▶ 527].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a report for each individual specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].



### Reports

For each standard, a specific report template is provided showing the method results and characteristic values. Creates a joint report with summary results considering all analyzed specimen.

All selected standards are considered automatically, see *Add Templates Tool* [▶ 864].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

## 7.6.7 Operator Tasks - NMI Analysis Workflow

The operator's **NMI Analysis** module workflow is individually configured by the supervisor to the requirements of the working environment. For information on configuration options, see *NMI Analysis: Overview of Supervisor Workflow with Image Acquisition* [▶ 474].

For the Operator, the following default **NMI Analysis** job templates are available:

- **Non-Metallic Inclusion Analysis**
- **Non-Metallic Inclusion Analysis Nitrides**

### 7.6.7.1 NMI Analysis: Overview of Operator Workflow with Image Acquisition

#### Step 1: Standard Selection

Provides a list of available standards for **NMI Analysis** that shall be used for the analysis.

1. Select the relevant standards.

## Step 2: Overarching Form

### Overarching Input Form.

In the **Form Selection** tool, an overarching input form is provided.

1. In the **Customer** section of the overarching input form, click the **Select** button to choose the corresponding customer. Fill in the other relevant data. The entered data applies to all subsequent specimen specific input forms.

## Step 3: Specimen Form

### Specimen Input form

In the **Form Selection** tool, a specimen input form is provided.

The specimen form is part of a loop.

1. Enter the specimen name in the **Test Object** section.

## Step 4: Tiles (measurement area)

Provides pre-configured settings for the specimen acquisition.

1. Select an image acquisition setting and adjust the position of the tiles regions if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired tiles region images determines the number of workflow iterations of the following steps until the creation of the summary report document.

## Step 5: Image Segmentation

Extracts objects from the background by thresholding.

Use the pre-defined settings for the image segmentation.

## Step 6: Global Results

Shows the global results of the analysis.

1. Inspect the results and overall statistics. Change if required the global inclusion type and exclude artifacts. Use the filter functions per global inclusion type for fast inspection.

See *NMI Global Results View* [▶ 512].

## Step 7: NMI Field Based Inspection Live

Shows the field based results of the analysis.

1. Inspect the results and statistics based on standard measuring fields. Use individual selected fields in the grid to navigate in live mode on the sample. Change if required the global inclusion type and exclude artifacts. Use the filter options for fast inspection.

See *NMI Field Based Inspection View* [▶ 516].

## Step 8: Report

Creates a **report for each individual specimen**. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the results and characteristic values for all selected standards per specimen.
2. You can print the report.

**Step 9: Report**

Creates a joint report with summary results considering all analyzed specimen. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the joint method results and characteristic values for all selected standards in a summary report.
2. You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

**See also**

 NMI Global Results View [► 512]

 NMI Field Based Inspection View [► 516]

**7.6.7.2 NMI Analysis: Overview of Operator Workflow with Loaded Image Files****Step 1: Standard Selection**

Provides a list of available standards for **NMI Analysis** that shall be used for the analysis.

1. Select the relevant standards.

**Step 2: Overarching Form**

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

1. In the **Customer** section of the overarching input form, click the **Select** button to choose the corresponding customer. Fill in the other relevant data. The entered data applies to all subsequent specimen specific input forms.

**Step 3: Specimen Form**

**Specimen** Input form

In the **Form Selection** tool, a specimen input form is provided.

The specimen form is part of a loop.

1. Enter the specimen name in the **Test Object** section.

**Step 4: Load Files**

Loads images from the file system.

1. Load one or more image files to the gallery.

The image will be loaded to the **Image** view. The number of loaded images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step before the next iteration starts.

**Step 5: Image Segmentation**

Extracts objects from the background by thresholding.

Use the pre-defined settings for the image segmentation.

### Step 6: Global Results

Shows the global results of the analysis.

1. Inspect the results and overall statistics. Change if required the global inclusion type and exclude artifacts. Use the filter functions per global inclusion type for fast inspection.

See *NMI Global Results View* [▶ 512].

### Step 7: NMI Field Based Inspection

Shows the field based results of the analysis.

1. Inspect the results and statistics based on standard measuring fields. Use individual selected fields in the grid to navigate in live mode on the sample. Change if required the global inclusion type and exclude artifacts. Use the filter options for fast inspection.

See *NMI Field Based Inspection View* [▶ 516].

### Step 8: Report

Creates a **report for each individual specimen**. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the results and characteristic values for all selected standards per specimen.
2. You can print the report.

### Step 9: Report

Creates a joint report with summary results considering all analyzed specimen. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the joint method results and characteristic values for all selected standards in a summary report.
2. You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### See also

 *NMI Global Results View* [▶ 512]

 *NMI Field Based Inspection View* [▶ 516]

#### 7.6.7.3 NMI Analysis: Overview of Operator Workflow Non-Metallic Inclusion Analysis (Sample by Sample)

This workflow is intended for users with smaller scanning stages. You acquire one sample at a time, replace it and acquire the next sample. The workflow supports only one tile region per loop iteration.

**Step 1: NMI Standard Selection**

Provides a list of available standards for **NMI Analysis** that shall be used for the analysis.

1. Select the relevant standards.

**Step 2: Overarching Form**

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

1. In the **Customer** section of the overarching input form, click the **Select** button to choose the corresponding customer. Fill in the other relevant data. The entered data applies to all subsequent specimen specific input forms.

**Step 3: Specimen Form**

**Specimen** Input form

In the **Form Selection** tool, a specimen input form is provided.

The specimen form is part of a loop.

1. Enter the specimen name in the **Test Object** section.

**Step 4: Tiles (measurement area)**

Provides pre-configured settings for the specimen acquisition.

The **Tiles (measurement area)** workbench is part of a loop.

1. Select an image acquisition setting and adjust the position of the tile region if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired tiles region images determines the number of workflow iterations of the following steps until the creation of the summary report document.

**Step 5: Image Segmentation**

Extracts objects from the background by thresholding.

Use the pre-defined settings for the image segmentation.

**Step 6: Global Result**

Shows the global results of the analysis.

1. Inspect the results and overall statistics. Change if required the global inclusion type and exclude artifacts. Use the filter functions per global inclusion type for fast inspection.

See *NMI Global Results View* [[▶ 512](#)].

**Step 7: NMI Field Based Inspection Live**

Shows the field based results of the analysis.

1. Inspect the results and statistics based on standard measuring fields. Use individual selected fields in the grid to navigate in live mode on the sample. Change if required the global inclusion type and exclude artifacts. Use the filter options for fast inspection.

See *NMI Field Based Inspection View* [[▶ 516](#)].



**Step 8: Reports**

Creates a **report for each individual specimen**. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the results and characteristic values for all selected standards per specimen.
2. You can print the report.

**Step 9: Reports**

Creates a joint report with summary results considering all analyzed specimen. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the joint method results and characteristic values for all selected standards in a summary report.
2. You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

**7.6.7.4 NMI Analysis: Overview of Operator Workflow Non-Metallic Inclusion Analysis Nitrides with Image Acquisition****Step 1: Standard Selection**

Provides a list of available standards for **NMI Analysis** that shall be used for the analysis.

1. Select the relevant standards.

**Step 2: Overarching Form**

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

1. In the **Customer** section of the overarching input form, click the **Select** button to choose the corresponding customer. Fill in the other relevant data. The entered data applies to all subsequent specimen specific input forms.

**Step 3: Specimen Form**

**Specimen** Input form

In the **Form Selection** tool, a specimen input form is provided.

The specimen form is part of a loop.

1. Enter the specimen name in the **Test Object** section.

**Step 4: Tiles (measurement area)**

Provides pre-configured settings for the specimen acquisition.

1. Select an image acquisition setting and adjust the position of the tiles regions if required.

2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired tiles region images determines the number of workflow iterations of the following steps until the creation of the summary report document.

### Step 5: Image Segmentation

Extracts objects from the background by thresholding.

Use the pre-defined settings for the image segmentation.

### Step 6: Global Results

Shows the global results of the analysis.

1. Inspect the results and overall statistics. Change if required the global inclusion type and exclude artifacts. Use the filter functions per global inclusion type for fast inspection.

See *NMI Global Results View* [▶ 512].

### Step 7: NMI Field Based Inspection Live

Shows the field based results of the analysis.

1. Inspect the results and statistics based on standard measuring fields. Use individual selected fields in the grid to navigate in live mode on the sample. Change if required the global inclusion type and exclude artifacts. Use the filter options for fast inspection.

See *NMI Field Based Inspection View* [▶ 516].

### Step 8: Report

Creates a **report for each individual specimen**. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the results and characteristic values for all selected standards per specimen.
2. You can print the report.

### Step 9: Report

Creates a joint report with summary results considering all analyzed specimen. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the joint method results and characteristic values for all selected standards in a summary report.
2. You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### See also

📖 NMI Global Results View [▶ 512]

📖 NMI Field Based Inspection View [▶ 516]

### 7.6.7.5 NMI Analysis: Overview of Operator Workflow Non-Metallic Inclusion Analysis Nitrides with Loaded Image Files

#### Step 1: Standard Selection

Provides a list of available standards for **NMI Analysis** that shall be used for the analysis.

1. Select the relevant standards.

#### Step 2: Overarching Form

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

1. In the **Customer** section of the overarching input form, click the **Select** button to choose the corresponding customer. Fill in the other relevant data. The entered data applies to all subsequent specimen specific input forms.

#### Step 3: Specimen Form

**Specimen** Input form

In the **Form Selection** tool, a specimen input form is provided.

The specimen form is part of a loop.

1. Enter the specimen name in the **Test Object** section.

#### Step 4: Load Files

Loads images from the file system.

1. Load one or more image files to the gallery.

The image will be loaded to the **Image** view. The number of loaded images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step before the next iteration starts.

#### Step 5: Image Segmentation

Extracts objects from the background by thresholding.

Use the pre-defined settings for the image segmentation.

#### Step 6: Global Results

Shows the global results of the analysis.

1. Inspect the results and overall statistics. Change if required the global inclusion type and exclude artifacts. Use the filter functions per global inclusion type for fast inspection.

See *NMI Global Results View* [[▶ 512](#)].

#### Step 7: NMI Field Based Inspection

Shows the field based results of the analysis.

1. Inspect the results and statistics based on standard measuring fields. Use individual selected fields in the grid to navigate in live mode on the sample. Change if required the global inclusion type and exclude artifacts. Use the filter options for fast inspection.

See *NMI Field Based Inspection View* [[▶ 516](#)].

**Step 8: Report**

Creates a **report for each individual specimen**. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the results and characteristic values for all selected standards per specimen.
2. You can print the report.

**Step 9: Report**

Creates a joint report with summary results considering all analyzed specimen. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the joint method results and characteristic values for all selected standards in a summary report.
2. You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

**See also**

- 📖 NMI Global Results View [► 512]
- 📖 NMI Field Based Inspection View [► 516]

**7.6.7.6 NMI Analysis: Overview of Operator Workflow Non-Metallic Inclusion Analysis Nitrides (Sample by Sample)**

This workflow is intended for users with smaller scanning stages. You acquire one sample at a time, replace it and acquire the next sample. The workflow supports only one tile region per loop iteration.

**Step 1: NMI Standard Selection**

Provides a list of available standards for **NMI Analysis** that shall be used for the analysis.

1. Select the relevant standards.

**Step 2: Overarching Form**

**Overarching** Input Form.

In the **Form Selection** tool, an overarching input form is provided.

1. In the **Customer** section of the overarching input form, click the **Select** button to choose the corresponding customer. Fill in the other relevant data. The entered data applies to all subsequent specimen specific input forms.

**Step 3: Specimen Form**

**Specimen** Input form

In the **Form Selection** tool, a specimen input form is provided.

The specimen form is part of a loop.

1. Enter the specimen name in the **Test Object** section.

#### Step 4: Tiles (measurement area)

Provides pre-configured settings for the specimen acquisition.

The **Tiles (measurement area)** workbench is part of a loop.

1. Select an image acquisition setting and adjust the position of the tile region if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired tiles region images determines the number of workflow iterations of the following steps until the creation of the summary report document.

#### Step 5: Image Segmentation

Extracts objects from the background by thresholding.

Use the pre-defined settings for the image segmentation.

#### Step 6: Global Result

Shows the global results of the analysis.

1. Inspect the results and overall statistics. Change if required the global inclusion type and exclude artifacts. Use the filter functions per global inclusion type for fast inspection.

See *NMI Global Results View* [▶ 512].

#### Step 7: NMI Field Based Inspection Live

Shows the field based results of the analysis.

1. Inspect the results and statistics based on standard measuring fields. Use individual selected fields in the grid to navigate in live mode on the sample. Change if required the global inclusion type and exclude artifacts. Use the filter options for fast inspection.

See *NMI Field Based Inspection View* [▶ 516].

#### Step 8: Reports

Creates a **report for each individual specimen**. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the results and characteristic values for all selected standards per specimen.
2. You can print the report.

#### Step 9: Reports

Creates a joint report with summary results considering all analyzed specimen. For each standard a specific report template is provided showing the method results and characteristic values. All selected standards are considered automatically.

1. Inspect the joint method results and characteristic values for all selected standards in a summary report.
2. You can print the report.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**

- **Close Without Saving**
- **Repeat Without Saving**

### 7.6.8 Standard Template Editor

The standard template editor provides so-called standard templates. A standard template defines parameters for non-metallic inclusion assessment.

The default settings determine the formation and arrangement of inclusions based on the interpretation of rules and definitions in the underlying standard.

The standard template editor provides the option to adapt parameters for a company specific interpretation of a certain standard or the analysis of non-metallic inclusions in non-steel metals.

#### NOTICE

Changing default parameters might have a large impact on the rating results. It is highly recommended to compare the results of the adapted standard with the results of the default standard to fully understand the impact on the inclusion rating.

The results based on these definitions are displayed in the **NMI Global Results** view, see *NMI Global Results View* [▶ 512] and in the **NMI Field Based Inspection View**, see *NMI Field Based Inspection View* [▶ 516].

For each of the **supported standards one pre-configured standard template is provided**, see *Opening Standard Templates* [▶ 511].

#### Info

You can select all standard templates in the job template using the **Standard Selection** tool, see also *Standard Selection Tool* [▶ 533].

As a Supervisor, you can copy and edit standard templates to address company internal guidelines for non-metallic inclusion analysis.

### Work in the Standard Template Editor


To edit your copy of the standard template according to your needs, you set the following parameter values in the **Center Screen Area**.

#### Info

Hover the mouse above the parameter to open a tooltip with a short description of the parameter.

- Size (particle, isolated inclusion)  
Parameter: **Minimum particle length (µm)** and **Minimum particle width (µm)**
- Shape (particle, isolated inclusion)  
Parameter: **Globular / elongated particle (length/width)**
- Next neighbour relationship  
Parameter: **Particle distance in rolling direction (µm)** and **Particle distance perpendicular to rolling direction (µm)**
- Inclusion formation  
Parameter: **Minimum inclusion length (µm)** and **Minimum inclusion width (µm)**

Under **Explanation of Parameters**, you find more information about the basic principles of inclusion grouping. As well, hover the mouse over the explanations to get more information.

You save the standard template any time by leaving the standard template editor by clicking **Home**  and then saving your changes.


### 7.6.8.1 Opening Standard Templates

It is not possible to change standard templates provided with the NMI software - this is indicated by the lock icon:



To define your own standard template, you have to copy a pre-configured standard template and then modify it.

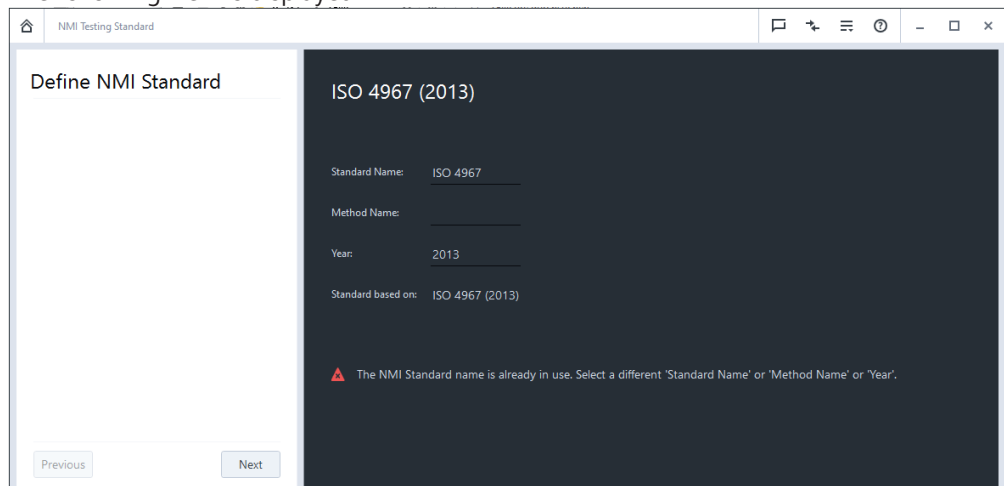
**Prerequisite** ✓ The **Manage Templates** mode is selected.

1. Select the list entry **Standards for NMI Analysis** using the **Show** drop-down list.  
→ The template list shows the provided standard templates.
2. Right-click the desired template and select **Copy & Edit**. Alternatively, in the **Toolbar**, click the **Copy & Edit** icon:  
  
→ The step **Configure NMI Standard** opens, see *Configuring a Modified Standard Template* [▶ 511].

### 7.6.8.2 Configuring a Modified Standard Template

**Prerequisite** ✓ The standard template editor is open.

1. Open step **Configure NMI Standard**.  
→ The following view is displayed.



2. Fill in data in the **Standard Name** field, **Method Name** field, and **Year** field. The method name is a supplementary information to the standard name.  
→ The selected template is used in the respective job template.  
→ The information is used for the template designation in the order *Standard name (year) method* when saving the template.  
→ The information is also used in the **NMI Standard Selection tool**. This tool is located in the first step of the job template.
3. Click **Next**.

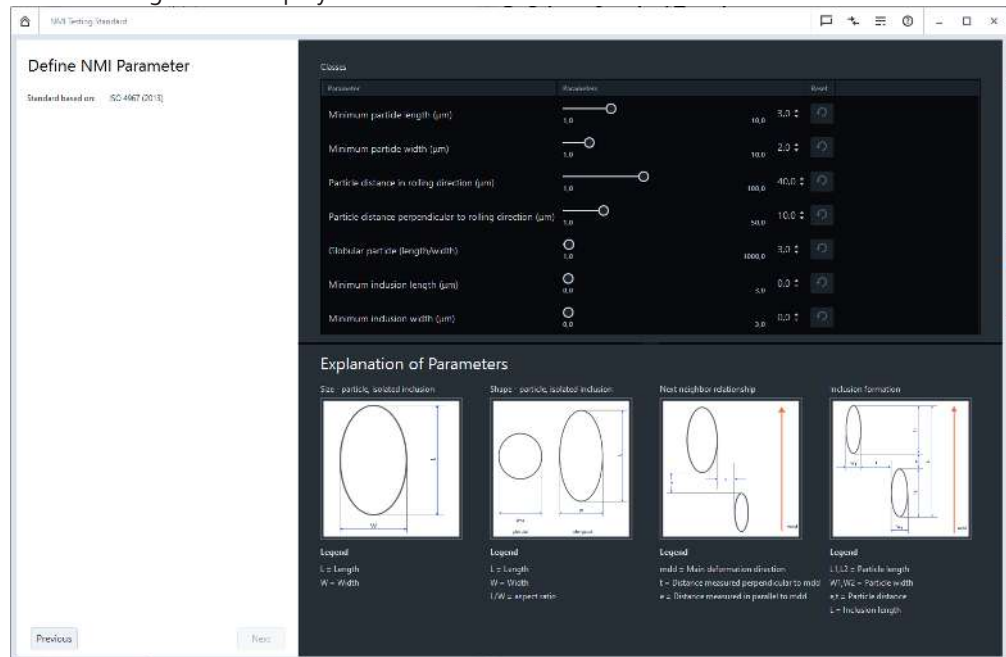
→ The step **Define NMI Parameters** opens, see *Adaption of NMI Parameter* [▶ 512].

### 7.6.8.3 Adaption of NMI Parameter

**Prerequisite** ✓ You have defined the name for the standard template.

1. Open step **Adapt NMI Parameter**.

→ The following view is displayed.



2. To change a parameter, use the slider or the spin box.

3. To reset a parameter value, click



4. To save your changes, click



→ The **Save Changes?** dialog opens.

5. Click **Yes**.

→ The new standard template with the adapted parameter(s) is now available.

### 7.6.9 NMI Global Results View

The **Global Results** view, the workbench and the view itself, provide an overview of the global inclusion types per standard and allows a fast inclusion inspection. In this view, you receive the information of the global inclusion types (Oxide, Sulfide, Nitride) and their size. In addition, artifacts, e.g. from scratches by specimen preparation, are identified.

Note that artifacts are not considered for further calculation and ratings.

By default, the following tools are active in the **NMI Global Results** on the left side of the workbench:

- **Standard Selection tool** [▶ 533]

The **Standard Selection** tool allows the selection of the desired standard results.

- **Specimen Overview tool** [▶ 532]

The **Specimen Overview** tool provides information on the specimen.



- **Detected Objects tool** [▶ 526]

The **Detected Objects** tool shows the standard specific global inclusion statistics.

### Info

Any time you change a selected standard, all galleries and statistic values are updated accordingly.

In the **NMI Global Results** view, you mainly perform these actions:

- Inspecting the results by filtering per object type, inclusion or artifact
- Changing the object type if required

For a better overview, in the **Minimized** view, you can use the arrow keys of your keyboard to move left and right. With the page up and down keys, you can scroll page wise through the gallery. If you selected a gallery image by clicking it, the currently selected row is displayed, e.g.

**Current row: 1/9115.**

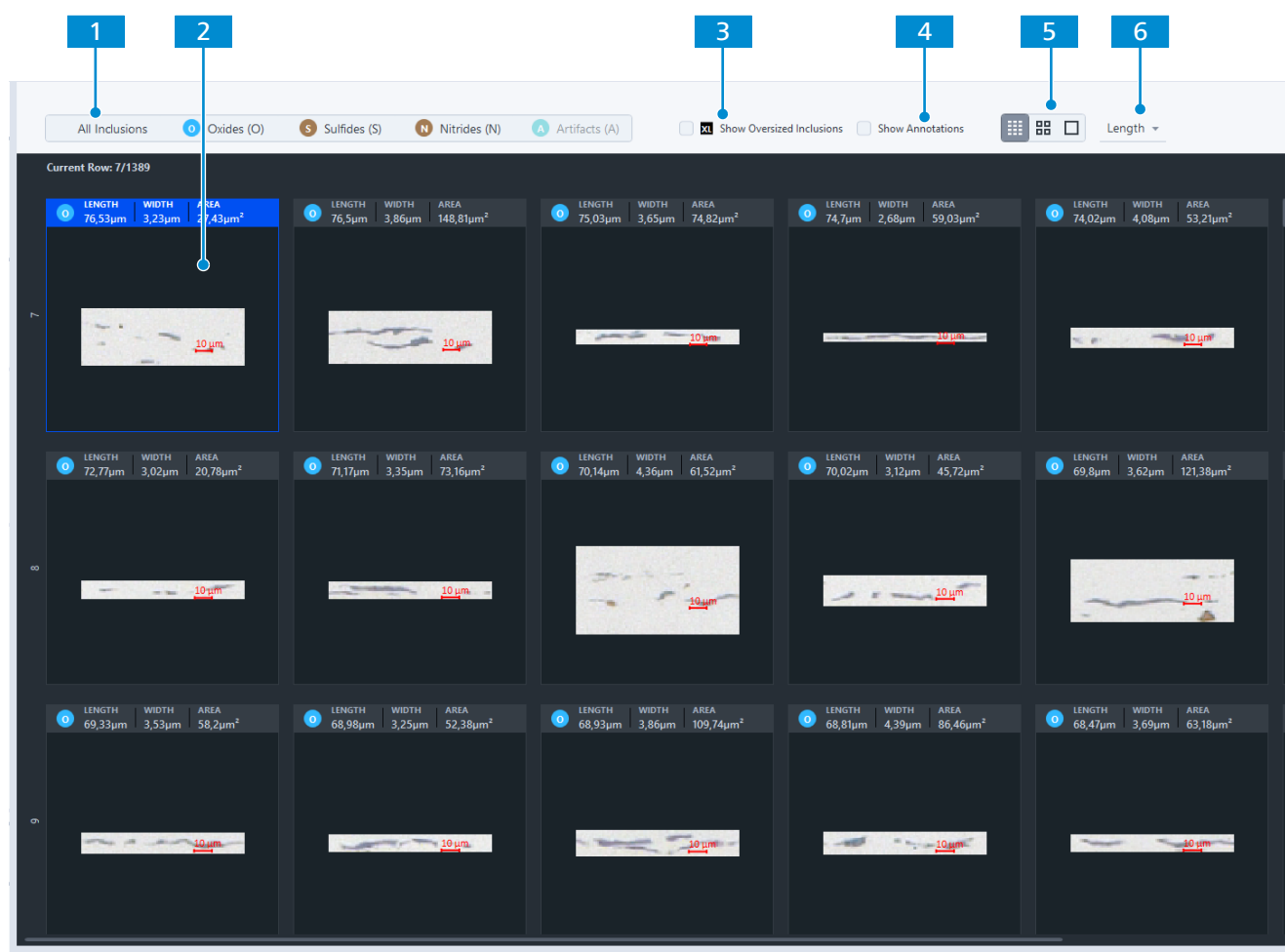




Fig. 55: Example: Shows the center part of Global Results view.


**1 Inclusions button bar**

Filters inclusions or artifacts per type. You can view all inclusions clicking the **All** button, or filter the results with the following buttons:

**Oxides (O)** button 

**Sulfides (S)** button 

**Artifacts (A)** button 

**Nitrides (N)** button 

**2 Gallery image with detected inclusion**

The data in the Info bar in the **Minimized** view and **Mid-Sized** view is only visible if you hover with your mouse over the gallery image. The data bar shows the inclusion size by length, width and area.

In **Minimized** and **Mid-Sized** views, with the buttons **O**, **S**, **N** and **A**, you can change the inclusion type.

In the **Maximized** view, with the buttons **Oxide**, **Sulfide**, and if existent **Nitrides**, as well as **Artefact**, you can change the inclusion type or revise an object as artifact.

In **Maximized** view, the inclusion information is always visible.

If you hover with your mouse over the gallery image, the field ID of the inclusion is displayed in a popup:

**3 Show Oversized Inclusions checkbox**

Displays inclusions that are in their width or length out of the range of the selected standard calculation.

**4 Show Annotations**

Displays the shape of the inclusion with a red line.

**5 View buttons bar**

Changes the number of gallery images per row. The following views are possible:



Displays a minimized view.



Displays a mid-sized view.



Displays a maximized view.

**6 Drop-down menu**

Changes the sorting in the image gallery by inclusion length, width, area and ID. The default sorting order is descending for size: length, area, width, and ascending for the inclusion ID.

You can open the **NMI Global Results** view from the **Browse Job Results**, when an **NMI Inspection** view document with the file name convention `<job-result>.db` is selected.

**7.6.9.1 Changing Inclusion Type**

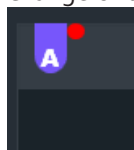
In the **Global Result** view you can check and, if necessary, change the results of the inclusion typification.

**Info**

It is not required to do the revision per standard. Each type revision has effect on the results of all standards.

**Prerequisite** ✓ You have run the **NMI Analysis** either with image files or you acquired the images within the workflow.

1. In the **NMI Global Results** view, hover with your mouse over the desired gallery image.
  - ➔ The following information about the inclusions is displayed on top of the image: length, width and area. On the bottom of the image, icons to change the inclusion type are displayed.
2. To display additional information, hover with your mouse over the inclusion or artifact image.
  - ➔ The inclusion image is shown zoomed out, the inclusion ID and X,Y inclusion coordinates are displayed on top of the zoomed out image.
3. In the image, click the desired icon on the bottom to change the inclusion type or revise an object as artifact.
  - ➔ The gallery image is marked by a red dot on the top left side to indicate a planned change of the inclusion type.



4. To assign the new typification to the image, click on one of the filter buttons **O**, **S**, **N**, **A**, or click the **Apply** button.

- The red dot disappears, the gallery is refreshed and the statistics is recalculated accordingly. This also happens, when you take the next step.

You have changed the inclusion type.

You can proceed with the **NMI Analysis** module workflow.

### 7.6.10 NMI Field Based Inspection View

As a user, after reviewing the global inclusion types (oxide, sulfide, nitride) in the **Global Results** view, you want to retrieve standard specific inclusion types in the **Field Based Inspection** view.

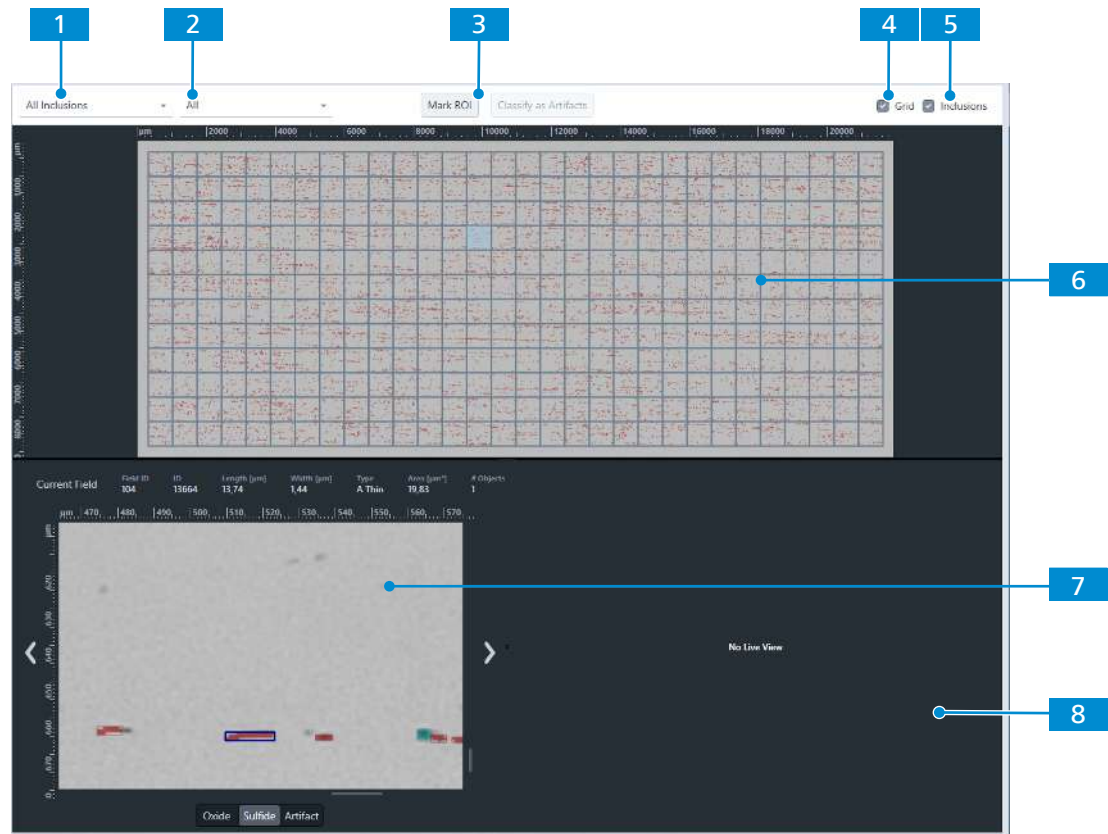
The acquired tiles region image is shown in the upper area of the **Field Based Inspection** view. The grid indicates the complete measurement area which is the base for the calculation of standard specific method results as shown in the report document. An individual field has the size of a standard measuring field as defined in the tiles region setup, i.e. the complete measurement area is an integer multiple of the standard measuring fields. You can filter the detected inclusions by various criteria. The **NMI Analysis** module specific tools support you to interpret the results.

By default, the following tools are active in the **Field Based Inspection** view:

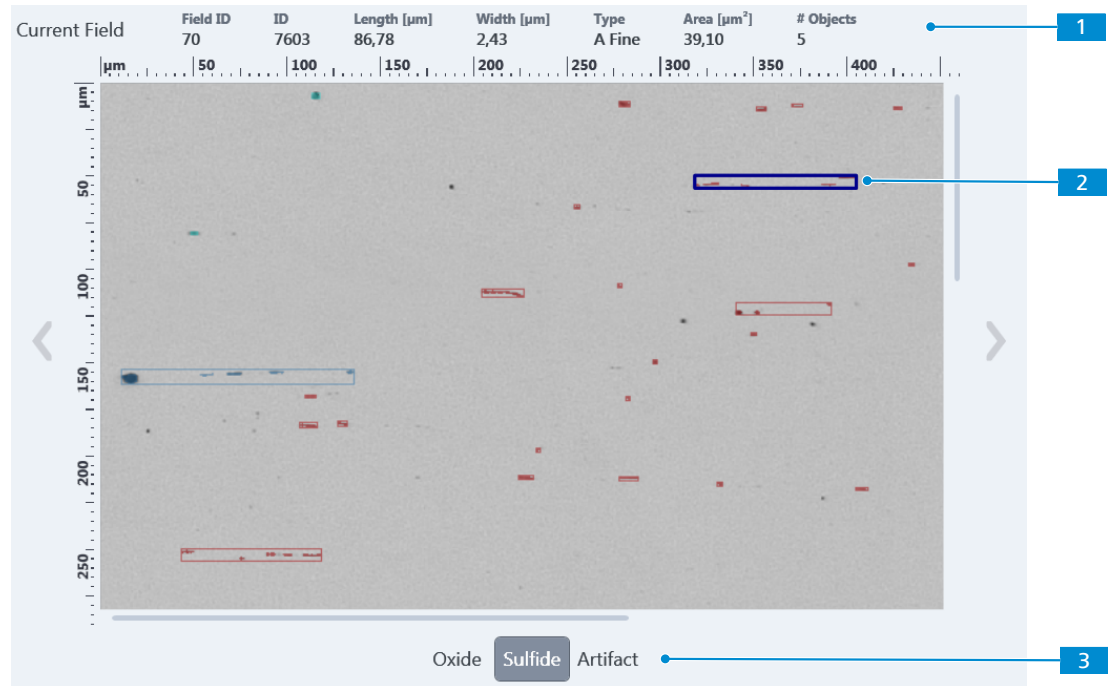
- The **Analysis Results** tool allows the selection of the desired standard results, see *Standard Results Selection Tool* [▶ 524].
- The **Specimen Overview** tool provides information on the specimen, see *Specimen Overview Tool* [▶ 532].
- The **Field Statistic** tool shows the field based results for all standard specific inclusion types with field ratings, see *Field Statistics Tool* [▶ 526].

#### Info

Every time you change a selected standard, the detected standard specific inclusions in the upper area of the **Field Based Inspection** view and in the field based statistics are updated accordingly.



- 1** Filters for inspection of global inclusion types and the fields with the highest rating (worst fields).
- 2** Filter for inspection of standard specific inclusion types.
- 3** Activates the option to mark a ROI to classify multiple objects as artifacts in one step, see *Reclassifying Inclusions in ROIs to Artifacts* [▶ 520].
- 4** Activates and deactivates the grid overlay.
- 5** Activates and deactivates the annotations overlay.
- 6** Acquired tiles region image with the overlay grid of standard measuring fields.
- 7** Shows the selected field zoomed out in the **Current Field** view.
- 8** Live view of the camera showing the currently selected field. In the **Current View**, selected inclusions are shown centered. The live view is only available by using the acquisition workflow.

**Current Field View**

- 1 Info bar with inclusion data
- 2 Selected inclusion (highlighted in color)
- 3 Buttons for inclusion revision

**7.6.10.1 Updating Live View by Interactive Stage Movement**

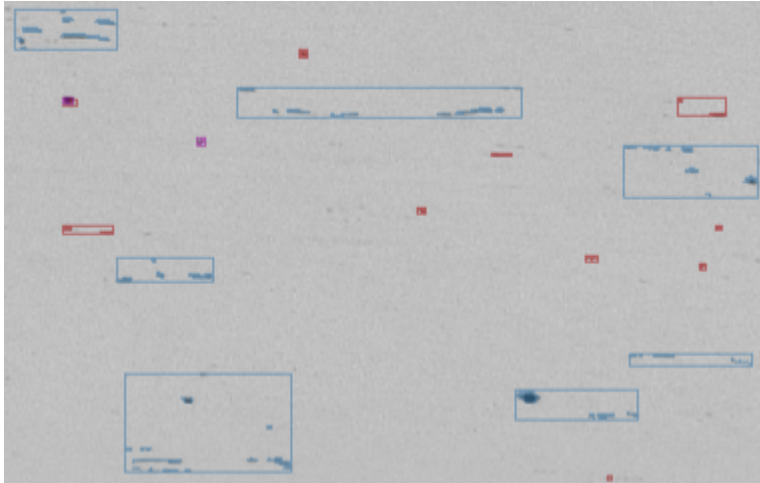
In the **NMI Field Based Inspection Live** workbench, you can check each measure field in the **Current Field** view and in the **Live** view.

**Prerequisite** ✓ **NMI Field Based Inspection Live** workbench is loaded.

1. In **Current Field** view, select one of the **Grid** fields.
  - The motorized scanning stage moves to the corresponding position on the specimen showing this field centered in the **Live** view. Note that the presented specimen area in the **Live view** is usually larger compared to the standard measuring field area.
2. In the **Current Field** view, select a specific inclusion.
  - The motorized scanning stage moves to the corresponding position on the specimen showing this inclusion centered in the **Live** view.

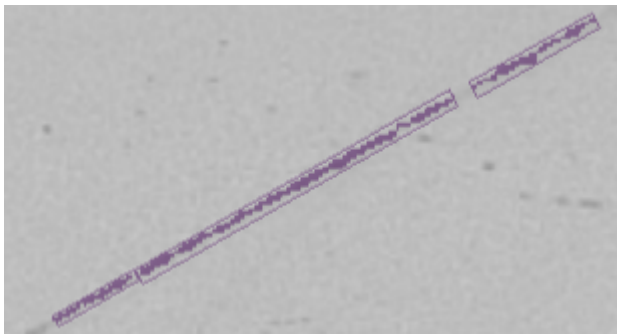
**7.6.10.2 Representation of Inclusions and Artifacts**

In the **Field Based** view, you can check inclusions and artifacts. To make them more visible, all particles being part of an inclusion (or agglomerate of inclusions) are surrounded by a bounding box. The color of the bounding box is related to the standard specific inclusion type. The orientation of the bounding box surrounding of the inclusions depends on the main deformation direction.



**Fig. 56: Example: Inclusions**

The box surrounding of the artifacts is a rotated rectangle, depending on the direction of the artifacts.



**Fig. 57: Example: Artifacts**

For information on grouping of inclusions, see *Basic Principles of Inclusion Groupings* [▶ 455].

### 7.6.10.3 Filtering the Field Based Inspection View

For a better orientation on the grid the current selected field is indicated by a blue and transparent color. Fields which contain a filtered inclusion type are presented with a thick, dark gray rectangle; this provides a fast overview on the location of certain inclusion types. You can filter the detected inclusions by the following global types:

- Oxides
- Sulfides
- Artifacts
- Worst Fields

Additionally, you can filter by standard specific inclusion types. The list content depends on the selected standard. For example for ASTM E45a, you can filter by the following types:

- A Thin
- A Heavy
- B Thin
- B Heavy
- C Thin
- D Thin

- D Heavy
- Ds Heavy
- Ds Thin
- Dos Heavy
- Dos Heavy

### Filtering inclusions

**Prerequisite** ✓ You have performed an analysis.

✓ You are in the **Field Based Inspection** view.

1. From the **All Inclusions** drop down list, and, if desired, from the **All** drop-down list, select the desired filter criteria.

Only the filtered inclusions are displayed with their annotations.

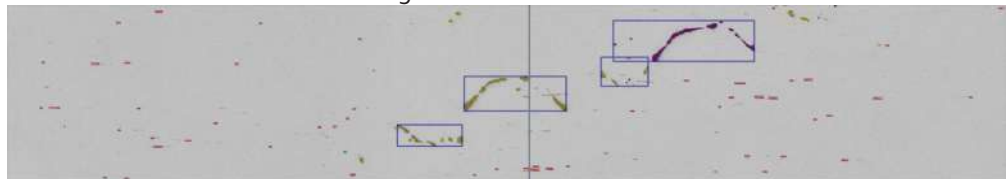
#### 7.6.10.4 Reclassifying Inclusions in ROIs to Artifacts

You have the option to reclassify multiple inclusions as artifacts in one step. We recommend this procedure if artifacts are falsely detected as inclusion, e.g. if the specimen was prepared sub optimally (scratches etc.).

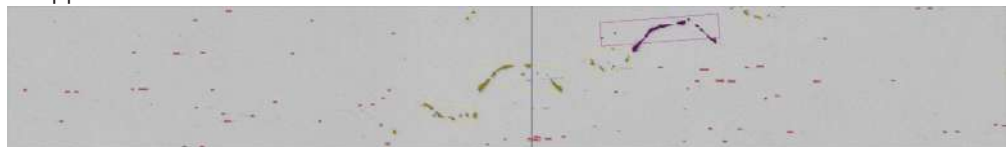
**Prerequisite** ✓ You have performed an analysis.

✓ You are in the **Field Based Inspection** view.

1. In the tiles region image, zoom in to identify objects which should be marked as artifacts, and click **Mark ROI**.
  - The cursor is activated.
2. Click the left mouse button to draw a polygon line around the detected inclusions that you want to reclassify. This is indicated by a red polygon line. Click the right mouse button to confirm the drawing.
  - All inclusions within the frame and those touched by the frame are aligned to X- and Y axes and marked with violet rectangles for reclassification.



3. Click **Classify as Artifacts**.
  - The marked inclusions in the drawn region have changed to type **Artifact**. The polygon disappears.



→ The results in the **Field Statistics** tool are updated accordingly.

#### 7.6.10.5 Understanding the Statistic

The **Field Statistics** tool displays an overview of the field values. Each field can be identified by a unique ID. For a selected field in the grid, all results are presented per inclusion type, this includes the field ratings and the total number and size of inclusions.



For more information, see *Filtering the Field Based Inspection View* [► 519].

**Prerequisite** ✓ You are in the **NMI Field Based Inspection** view.

1. In the top window pane, activate a field and/or in the **Analysis Results Selection** tool, select a standard.  
→ In the **Field statistics** tool, the values are updated immediately.

## 7.6.11 Reference

### 7.6.11.1 Workbenches & Tasks

#### 7.6.11.1.1 Acquire Tiles Images Workbench

This workbench allows you to configure the image acquisition settings, the tiles regions and the focus correction during tiles acquisition.

This workbench enables you to define one or more tile regions which define a given measurement area. The measurement area consists of standard measuring fields of a given size. You can specify the tiles region by setting up the total area or by defining the number of standard measuring fields covering the total area.

#### 7.6.11.1.2 Frame Setup Workbench

This workbench enables you to specify the measurement area you want to take into account for your analysis. You can use the tile region geometry which is automatically defined with the tiles setup. This is the default setting. As an option you can use the setup frames which allows the manual configuration of measurement area.

##### See also

- 📖 Frame Setup Tool [► 527]
- 📖 Tiles Setup (measurement area) Tool [► 533]
- 📖 Technical Cleanliness Analysis (TCA) [► 536]

#### 7.6.11.1.3 Image Analysis for NMI Workbench

This workbench provides the pre-defined analysis setting for NMI analysis.

##### See also

- 📖 Load Setting Tool [► 869]

#### 7.6.11.1.4 Image Segmentation Workbench

This workbench for NMI Analysis enables you to detect particles in the image. Per default, **Auto thresholding** is selected. As an option a manual change of the default threshold settings for Oxides, Sulfides and Nitrides is available.





##### See also

- 📖 NMI Segmentation Tool [► 529]

#### 7.6.11.1.5 NMI Field Based Inspection Live Workbench

This workbench enables you to inspect the inclusions in each measuring field of the specimen using the live view and to change their classification type if necessary. The displayed results are dependent on the selected standard.




##### See also

-  Standard Results Selection Tool [► 524]
-  Specimen Overview Tool [► 532]
-  Field Statistics Tool [► 526]
-  Updating Live View by Interactive Stage Movement [► 518]

#### 7.6.11.1.6 NMI Field Based Inspection Workbench

This workbench enables you to inspect the inclusions in each measuring field of the sample and to change their classification type if necessary. The displayed results are dependent on the selected standard. No **Live** view available.





##### See also

-  Standard Results Selection Tool [► 524]
-  Specimen Overview Tool [► 532]
-  Field Statistics Tool [► 526]

#### 7.6.11.1.7 NMI Global Results Workbench

This workbench enables you to inspect individual inclusions using the inclusions gallery and change their classification type if necessary. The displayed results are dependent on the selected standard.

##### See also

-  Standard Selection Tool [► 533]
-  Specimen Overview Tool [► 532]
-  Rolling Direction Tool [► 532]
-  Detected Objects Tool [► 526]

#### 7.6.11.1.8 NMI Results Output Workbench

This workbench enables you to adjust the settings for the images in the report document.

##### See also

-  Format Image Gallery (Report) Tool [► 527]

#### 7.6.11.1.9 NMI Standard-Specific Calculation Workbench

This workbench enables you to change the parameters of the standard-specific calculation of the inclusions.

##### See also

-  Rolling Direction Detection Tool [► 531]

- 📖 [Artifact Detection Tool \[► 524\]](#)
- 📖 [Characteristic Value Filter Tool \[► 525\]](#)

#### 7.6.11.1.10 NMI Analysis Region Adaption Workbench

This workbench enables you to handle heterogenous inclusions. The region adaption algorithm enhances the detection and analysis of heterogenous inclusions. This type of inclusion contains both oxidic and sulfidic phase fractions.

##### See also

- 📖 [NMI Analysis Region Adaption Tool \[► 531\]](#)
- 📖 [Non-Metallic Inclusion Analysis \(NMI\) \[► 451\]](#)

#### 7.6.11.1.11 Split Image Workbench

This workbench enables you to extract certain dimensions from your image and export them as a collection of images.

##### See also

- 📖 [Split by Dimension Tool \[► 532\]](#)

#### 7.6.11.1.12 Standard Selection Workbench

This workbench enables you to select the relevant standard for your analysis.

##### See also

- 📖 [Standard Selection Tool \[► 533\]](#)

#### 7.6.11.1.13 Switch Workbench

This workbench enables you to select execution branches. A branch activates a pre-defined task group.

##### See also

- 📖 [Select Branch Tool \[► 532\]](#)
- 📖 [Configuring the NMI Job Template by Switching the Active Branch \[► 474\]](#)



#### 7.6.11.1.14 Tiles (measurement area) Workbench

This workbench enables you to acquire one or more tile images using a motorized scanning stage by adding multiple tile regions with a defined measurement area. A number of specimens can be configured for automated tiles image acquisition. It is optimized for standard based **NMI Analysis**.

In case of multi-specimen-setup, you can define individual values for each sample.

##### See also

- 📖 [Focus Correction Tool \[► 771\]](#)
- 📖 [Light Path Editing Tool \[► 777\]](#)
- 📖 [Tiles Options Tool \[► 181\]](#)

-  Tiles Setup (measurement area) Tool [► 533]
-  Export Experiment Tool [► 798]



### 7.6.11.2 Tools

#### 7.6.11.2.1 Standard Results Selection Tool

This tool enables you to select the analysis result of a certain standard. It is displayed in the **Global Results view** and the **Field Based Inspection view**.

Parameter	Description
<b>Standard</b>	Selects one of the standards you have made the analysis with.

#### See also

-  NMI Field Based Inspection Workbench [► 522]
-  NMI Global Results Workbench [► 522]

#### 7.6.11.2.2 Artifact Detection Tool

This tool enables you to configure the artifact detection. You can choose between automatic and manual detection. The calculation of the artifact filter is based on the minimum angle deviation and the minimum form factor which can be adjusted by length and width.

Parameter	Description
<b>Automatic Artifact Detection</b>	<b>Activated:</b> Detects artifacts automatically.
<b>Min. Angle Deviation</b>	Value range: 0 to 90 Use the slider to adjust the desired value.
<b>Min. Length</b>	Value range: 1 to 1000 Use the slider to adjust the desired value.
<b>Max. Width</b>	Value range: 1 to 50 Use the slider to adjust the desired value.
<b>Minimum Form Factor</b>	Automatically computed from the minimal length and maximal width parameters.
<b>Mode</b>	
– <b>Original</b>	No specific sulfide-halo detection available.
– <b>Advanced</b>	Specific filter function for improved sulfide-halo detection is activated.
<b>Halo Gray Range</b>	The gray values range of sulfide halos is not considered for calculation. Value range: 0 to 20 Use the slider to adjust the desired value.

#### See also

 NMI Standard-Specific Calculation Workbench [[▶ 522](#)]

### 7.6.11.2.3 Characteristic Value Filter Tool

This tool applies calculation filters on standard specific results. The characteristic value filter is only applied if the filter is activated for the corresponding standard.

Parameter	Description
<b>ASTM E45a</b>	
- Filter inclusion length by minimal severity level	<b>Activated:</b> Inclusions with severity below this value are not considered for the result calculation.
- Severity:	Value range: <b>0.5 to 5</b> Use the slider to adjust the desired value.
<b>ISO 4967</b>	
- Filter inclusion length by minimal index	<b>Activated:</b> Inclusions with inclusion length below this index value are not considered for the result calculation.
- Indices $i \geq$ :	Value range: <b>0.5 to 3</b> Use the slider to adjust the desired value.
<b>DIN 50602</b>	
- Filter inclusion size by minimal size class	<b>Activated:</b> Inclusions with inclusion size class below this value are not considered for the result calculation.
- Class $\geq$ :	Value range: <b>0 to 9</b> Use the slider to adjust the desired value.
<b>JIS G 0555</b>	
- Filter inclusion length by minimal index	<b>Activated:</b> Inclusions with inclusion length below this index value is not considered for the result calculation.
- Indices $i \geq$ :	Value range: <b>0.5 to 3</b> Use the slider to adjust the desired value.
<b>GBT 10561</b>	
- Filter inclusion length by minimal index	<b>Activated:</b> Inclusions with inclusion length below this index value are not considered for the result calculation.
- Indices $i \geq$ :	Value range: <b>0.5 to 3</b> Use the slider to adjust the desired value.
<b>EN 10247</b>	

Parameter	Description
- Filter inclusion length by minimal row	<b>Activated:</b> Inclusions with inclusion length below this row number are not considered for the result calculation.
- Rows $q \geq$ :	Value range: <b>1</b> to <b>9</b> Use the slider to adjust the desired value.
<b>SEP 1571</b>	
- Filter inclusion length by minimal row	<b>Activated:</b> Inclusions with inclusion length below this size class are not considered for the result calculation.
- Class $q \geq$ :	Value range: <b>0</b> to <b>9</b> Use the slider to adjust the desired value.

**See also**

 NMI Standard-Specific Calculation Workbench [► 522]

**7.6.11.2.4 Define Outputs Tool**


This tool defines the required output documents that are essential for the functionality of the workflow. The document selection cannot be adapted. The calculation is performed in the background with default values. Therefore, editing is not possible.

**7.6.11.2.5 Detected Objects Tool**

This tool displays in a table an overview of detected inclusions count, the total area in mm<sup>2</sup> and the % of the area per inclusion type. All inclusion types are taken into account.

This tool is available if you work with **NMI Analysis** in the **Global Results** view.

**See also**

 NMI Global Results Workbench [► 522]



**7.6.11.2.6 Field Statistics Tool**

This tool is available if you work with **NMI Analysis** in the **Field Based Inspection** view.

Parameter	Description
<b>Statistics</b>	Displays data.
<b>Field ID</b>	Displays the field ID of the current selected field. The field ID is a unique number for a standard measuring field in the grid view.
- Rating	Displays the rating of the field.
- Overall count	Displays the total number of a certain inclusion type.
- Overall length [µm]	Displays the total length of a certain inclusion type.

Parameter	Description
- Overall area of each inclusion type [ $\mu\text{m}^2$ ]	Displays the total area of a certain inclusion type.

**See also**

-  NMI Field Based Inspection Live Workbench [► 522]
-  NMI Field Based Inspection Workbench [► 522]

**7.6.11.2.7 Format Image Gallery (Report) Tool**

Parameter	Description
<b>Number of images per inclusion type</b>	Maximal number of inclusion images per type and standard which is included in the report.
<b>Max. image size</b>	The maximal width of each inclusion image in the report. Too large images will be scaled to this value.
<b>Image padding</b>	The additional space around an inclusion in the inclusion image.

**See also**

-  NMI Results Output Workbench [► 522]

**7.6.11.2.8 Frame Setup Tool**

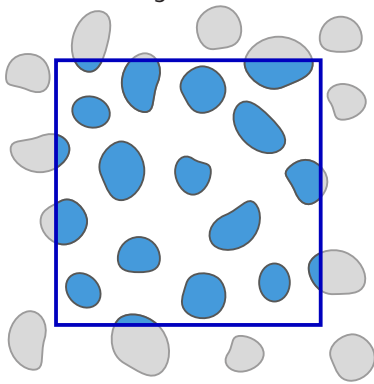
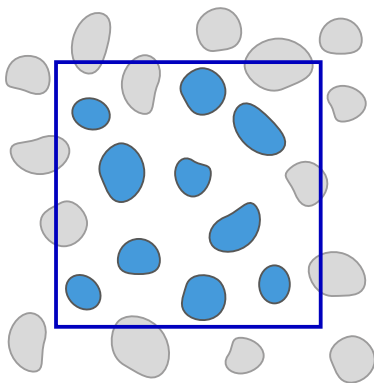
This tool enables you to set up a measurement frame for the analysis with **Non-Metallic Inclusion Analysis (NMI)** and **Technical Cleanliness Analysis (TCA)**. You can add a specific measurement frame which then will be used for the analysis only.

For **NMI**, the default setting is the automatic created measurement frame based on the tiles region definition using the **Tiles (measurement area)** workbench. The default frame size is an integral value of the standard measuring field, e.g. 0.5 mm<sup>2</sup>, 10x objective magnification.

**TCA** does not refer to a grid of standard measuring fields.





As an option you can use the tool parameters to define an individual measurement frame.

Parameter	Description
<b>Use Tile Region Geometry</b>	<p><b>NMI</b> only.</p> <p>Extracts the tile geometry from the image and sets it as rectangular measurement frame. The frame size is an integral value of the standard measuring field.</p> <p><b>TCA</b> only.</p> <p>Extracts the tile geometry from the image and sets it as round measurement frame. The frame size does not refer to a grid of the standard measuring field.</p>
<b>Select Frame</b>	Selects a frame in the image.
<b>Draw rectangle</b>	Creates a rectangle shaped measurement frame in the image.
<b>Draw circle</b>	Creates a circle shaped measurement frame in the image.

Parameter	Description
<b>Draw contour (polygon)</b>	Creates a polygon shaped measurement frame in the image.
<b>Remove all frames</b>	Removes all activated and inactivated measurement frames from the image.
<b>Maximize circle</b>	<b>Activated:</b> The currently selected circle is expanded to fill the entire image
<b>Center circle</b>	<b>Activated:</b> The currently selected circle is centered horizontally and vertically
<b>Mode</b>	Specifies how objects at the edge of the image or frame are treated
- <b>Cut at Frame</b>	Takes the image frame into account for the analysis. 
- <b>Inside only</b>	Takes the inner space of the image frame into account for the analysis. 
<b>Left</b>	Top left coordinates of the currently selected measurement frame (in pixels).
<b>Top</b>	Sets the position of the setup frame from the top (in pixels).
<b>Width</b>	Dimensions of the currently selected frame (in pixels).
<b>Height</b>	Dimensions of the currently selected frame (in pixels).
<b>Color</b>	Selects the color of the measurement frame.
<b>Show frame on analyzed image</b>	If activated, the set up measurement frame is shown on the acquired image.

**See also**



-  Frame Setup Workbench [[▶ 521](#)]
-  Non-Metallic Inclusion Analysis (NMI) [[▶ 451](#)]
-  Tiles Setup (measurement area) Tool [[▶ 533](#)]
-  Technical Cleanliness Analysis (TCA) [[▶ 536](#)]

#### 7.6.11.2.9 NMI Segmentation Tool

The tool offers all parameters which are necessary to optimize the segmentation result. The display options helps to verify the segmentation results according to the flicker method of switching back-and-forth between the inclusion image with and without segmentation overlay.

The auto-threshold setting is optimized for **NMI Analysis**.

Parameter	Description
<b>Color Legend</b>	Red: Oxid Phase Blue: Sulfide Phase Orange: Nitride Phase
<b>Display Options</b>	You can toggle all buttons between fading in and out the segmentation annotations.
- Nothing	Nothing is displayed.
- All Phases	All phases are displayed.
- Oxides	Only oxides are displayed.
- Sulfides	Only sulfides are displayed.
- Nitrides	Only nitrides are displayed.
<b>Thresholds</b>	
- Manual	The threshold boundaries are adjusted depending on the values.
- Automatic	Specifies how objects are detected automatically based on their brightness. For this a black and white image is generated (the original image stays untouched) and the algorithm detects groups of pixels based on their brightness compared to neighboring pixels. Note that the calculation of the objects is based on the part of the image shown in the image view. Drag the area section in the navigator to recalculate the results. These results are temporarily. Click <b>Next</b> to recalculate on the basis of the whole image. The final calculation refers to the complete image.
<b>Threshold</b>	<b>Manual</b> thresholds only.
- Undo	Undoes the last change made to the threshold values.
- Redo	Restores the last undone change to the threshold values.
- Low	Only pixels with values larger than <b>Low</b> are considered as part of an object.
- High	Only pixels with values lower than <b>High</b> are considered as part of an object.
- Invert	Only pixels outside the threshold boundaries are considered, i.e. those pixels below the lower threshold or above the higher threshold.

Parameter	Description
- Full Range	Sets the lower threshold to <b>0</b> and the upper threshold to <b>255</b> .
<b>Histogram</b>	<p><b>Manual</b> thresholds only.</p> <p>Shows/hides the histogram.</p> <p>Use the sliders under the histogram to adjust the <b>Low</b> and <b>High</b> threshold values.</p>
<b>Pick Behavior</b>	<b>Manual</b> thresholds only.
- +	Adds further objects by increasing the threshold boundaries to include the brightness values of the selected object.
- -	Removes objects with the selected brightness values and reduces the threshold boundaries.
<b>Tolerance</b>	<p><b>Manual</b> thresholds only.</p> <p>Specifies how many additional pixel values are included in the selection based on their brightness. A higher value means that more pixel values similar to the selected one are included. A lower value means that only the exact pixel value selected is included.</p>
<b>Neighborhood</b>	<p><b>Manual</b> thresholds only.</p> <p>Specifies how many additional pixel values are included in the selection based on their physical proximity to the selected pixel.</p> <p>A higher value means that more pixels surrounding the selected pixel are included. The threshold boundaries are adapted so that all the pixel values of these neighboring pixels are included. A lower value means that the boundaries are adapted based on the pixels directly next to the selected pixel only.</p>
<b>Tolerance Sulfide Range</b>	<p><b>Automatic</b> thresholds only. <b>NMI Analysis</b> only.</p> <p>Value range from <b>0</b> to <b>30</b></p> <p>This value is subtracted from the upper sulfide thresholds. A high tolerance value implies that bright particles are not classified as sulfides. As a result, less objects are detected as Sulfides with increasing value for the Tolerance Sulfide Range.</p>
<b>Nitrides</b>	<p><b>Automatic</b> thresholds only.</p> <p>Sets the hue thresholds for the nitride phase. Objects with hue values inside a symmetric interval around this value are considered as nitrides.</p>
<b>Thresholds</b>	<p><b>Automatic</b> thresholds only.</p> <p>Under <b>Display Options</b>, select <b>All Phases</b> or singles phases to display the detected objects according to the selected standard.</p>
- H Low	<p>The thresholds of the color channel.</p> <p>Only pixels with values larger than <b>Low</b> are considered as part of an object.</p>
- H High	<p>The thresholds of the color channel.</p> <p>Only pixels with values lower than <b>High</b> are considered as part of an object.</p>

Parameter	Description
- L Low	The thresholds of the brightness channel. Only pixels with values larger than <b>Low</b> are considered as part of an object.
- L High	The thresholds of the brightness channel. Only pixels with values lower than <b>High</b> are considered as part of an object.
<b>Delineation Size</b>	Adjusts the filter size in $\mu\text{m}$ . Range: <b>0</b> to <b>5</b> .
<b>Delineation threshold</b>	Adjusts the threshold in %. Range: <b>0</b> to <b>50</b> .

**See also**

 Image Segmentation Workbench [▶ 521](#)

**7.6.11.2.10 NMI Analysis Region Adaption Tool**

This tool enables you to handle heterogenous (complex) inclusions.

Parameter	Description
<b>Enable Region Adaption</b>	The task has only one tool with a checkbox for region adaption activation.  <b>Default:</b> Not active

**See also**

 Non-Metallic Inclusion Analysis (NMI) [▶ 451](#)

 NMI Analysis Region Adaption Workbench [▶ 523](#)

**7.6.11.2.11 Rolling Direction Detection Tool**

Parameter	Description
<b>Automatic Rolling Direction Detection</b>	
<b>Rolling Direction</b>	Only active, if <b>Automatic Artefact Detection</b> is not activated.
- Horizontal	Identifies the main orientation direction of all detected elongated inclusions as horizontal.
- Vertical	Identifies the main orientation direction of all detected elongated inclusions as vertical.

**See also**


 NMI Standard-Specific Calculation Workbench [▶ 522](#)

**7.6.11.2.12 Rolling Direction Tool**

This tool enables you to change the automatically calculated rolling direction from horizontal to vertical and vice versa.

The **Rolling Direction** tool is available in the **Global Result** view.

**See also**


 NMI Global Results Workbench [► 522]

**7.6.11.2.13 Select Branch Tool**

This tool enables you to select an execution branch. A branch activates a pre-defined task group.

**See also**

 Switch Workbench [► 523]

 Configuring the NMI Job Template by Switching the Active Branch [► 474]

**7.6.11.2.14 Specimen Overview Tool**

This tool for **NMI Analysis** displays in a table an overview of specimen data. The following data is displayed.

Parameter	Description
<b>Specimen Name</b>	Displays the specimen name you entered in the specimen specific input form.
<b>Specimen Number</b>	Displays the current specimen number in relation to the total number of specimens to be analyzed in one job template run, e.g. specimen <b>1 of 6</b> .
<b>Measured Area</b>	Displays the defined area which is base for all standard calculations in mm <sup>2</sup> .
<b>Scaling Factor</b>	Displays the scaling in µm per pixel.
<b>Rolling Direction</b>	Displays the active rolling direction, either <b>Horizontal</b> or <b>Vertical</b> .
<b>Total Number of Inclusions</b>	Displays the total amount of inclusions.

**See also**

 NMI Field Based Inspection Workbench [► 522]


 NMI Global Results Workbench [► 522]

**7.6.11.2.15 Split by Dimension Tool**

Parameter	Description
<b>Select Dimension</b>	
- Scene	Extracts scenes in the image and exports each of them as a separate image.

Parameter	Description
- None	Does not split the image.
<b>Scene</b>	
- Extract All	Default value. <b>Activated:</b> All scenes of the corresponding image are extracted.
- Extract Single	<b>Activated:</b> You can select a single image to be extracted.
- Extract Range	<b>Activated:</b> You can select a certain range of images to be extracted.
- Extract Multiple	<b>Activated:</b> You can select several continuous ranges and individual sections.
<b>Keep tiles</b>	<b>Activated:</b> Tiles are kept for each image.
<b>Default</b>	Selects the default value of the <b>Scene</b> options.

**See also**

 Split Image Workbench [► 523]

**7.6.11.2.16 Standard Selection Tool**

Parameter	Description
<b>Selected</b>	<b>Activated:</b> The standard is used for <b>NMI Analysis</b> .
<b>Standard</b>	Displays the standard.
<b>Version</b>	Displays the version of the standard. If more than one version is available, select the desired version. Note that you can only select one version for the workflow. If you need the calculation of more than one version, create another workflow.
<b>Method(s)</b>	Displays the methods that are used for the calculation in the <b>NMI Analysis</b> .





**See also**

 Standard Selection Workbench [► 523]

**7.6.11.2.17 Tiles Setup (measurement area) Tool**

Parameter	Description
<b>Contour</b>	Switches the option to select rectangular or circular contour shape.
<b>Field Size</b>	Only visible with rectangular contour shape. Defines the sample measurement area size. You have the following options (in mm <sup>2</sup> ): <ul style="list-style-type: none"> <li>▪ <b>0.126</b> (only in combination with a 20x objective and 200x total magnification) The measurement is conducted with a 20x objective and 200x total magnification. The resulting standard measuring field is 355 µm x 355 µm = 0.126 mm<sup>2</sup>.</li> </ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>▪ <b>0.504</b> (only in combination with a 10x objective and 100x total magnification) Default value. The measurement is conducted with a 10x objective and 100x total magnification. The resulting standard measuring field is <math>710\text{ }\mu\text{m} \times 710\text{ }\mu\text{m} = 0.504\text{ mm}^2</math>.</li> <li>▪ <b>2.016</b> (only in combination with a 5x objective and 50x total magnification) The measurement is conducted with a 5x objective and 50x total magnification, the resulting standard measuring field is <math>1420\text{ }\mu\text{m} \times 1420\text{ }\mu\text{m} = 2.016\text{ mm}^2</math>.</li> <li>▪ <b>Custom</b> If you change the field size, the area is changed in relation.</li> </ul>
<b>Fields</b>	<p>Only visible with rectangular contour shape. Defines the number of standard measuring fields. Per default, the measurement is conducted with a 100 x total magnification, the resulting standard measuring field is <math>710\text{ }\mu\text{m} \times 710\text{ }\mu\text{m} = 0.5\text{ mm}^2</math>.</p> <p>If you change the amount of standard measuring fields, the measurement area is changed accordingly.</p>
<b>Circle Diameter</b>	<p>Only visible with circular contour shape. Defines the diameter of the circle contour shape.</p>
<b>Area</b>	<p>Specifies the acquired measurement area in <math>\text{mm}^2</math>.</p> <p>If you change the measurement area, the amount of fields is changed accordingly.</p>
<b>Add Tile Region</b>	<p>Adds a new tile region with the specified size values. The region is added with the top left position at the current stage position. The contour geometry of the tile region is automatically adjusted to fit an integer multiple of the current field size. Therefore, the area might be a bit larger than expected.</p> <p>The region is created in a way that an integer multiple of the current field size fits into the contour geometry (in columns and rows). Example: If you enter a field count of 6, a tile region with 3 x 2 fields is created (3 columns, 2 rows). This has also the consequence that for certain field counts (all prime numbers), a region with exactly that field cannot be created. For example, if you enter a field count of 11, a tile region with 4 x 3 (= 12) fields is created. This in general means that, if you do not change the created tile regions manually, the regions are always integer multiple of the field size.</p>
<b>Tile Region Table</b>	<p>This table provides an overview of all added tile regions. The checkbox in front of each entry activates the respective tile region. The following parameters are available in the table:</p>
<b>Name</b>	Displays the name of the tile region. A click on the name allows you to edit it.
<b>Tiles</b>	Displays the number of tiles of the region.
<b>Z (<math>\mu\text{m}</math>)</b>	Displays and sets the z position of the region.
<b>Area</b>	Displays the area of the region in $\text{mm}^2$ .

Parameter	Description
<b>Size</b>	Displays the size of the region.
 Move Up	Moves up the entry one position in the list.
 Move Down	Moves down the entry one position in the list.
 Delete	Deletes the currently selected region.
 Options	
– <b>Set Current Z for Selected Tile Regions</b>	Sets the current z-position for all selected tile regions.
– <b>Set Current X/Y/Z for Selected Tile Region</b>	Sets the current x/y/z-position for all selected tile regions.
– <b>Delete</b>	Deletes the currently selected tile region.
– <b>Delete All</b>	Deletes all tile regions.
– <b>Activate</b>	Activates the current tile region for acquisition.
– <b>Deactivate</b>	Deactivates the current tile region for acquisition.
– <b>Sort</b>	Enables you to sort the entries in the tables.
– <b>Import Tile Regions</b>	Opens a file browser to import a list of already defined tile regions.
– <b>Export Tile Regions</b>	Opens a file browser to export the list of your currently defined tile regions as a file.
Parameter	Description
<b>Lock Contour of all Regions</b>	Specifies whether and how the contour geometry of all tile regions is locked.
– <b>None</b>	The contour of all tile regions is not locked.
– <b>Area</b>	The contour area of all tile regions remains constant.
– <b>Size</b>	The contour size and area of all tile regions cannot be changed.
<b>Adjust to Integer Multiple of Field Size</b>	Adjust the contour geometry of all tile regions to fit an integer multiple of the current field size. After that, the area might be slightly larger. If the size of the tile regions is not locked, you can modify the size of the tile regions manually by using the mouse handles in the graphical representation.

### See also

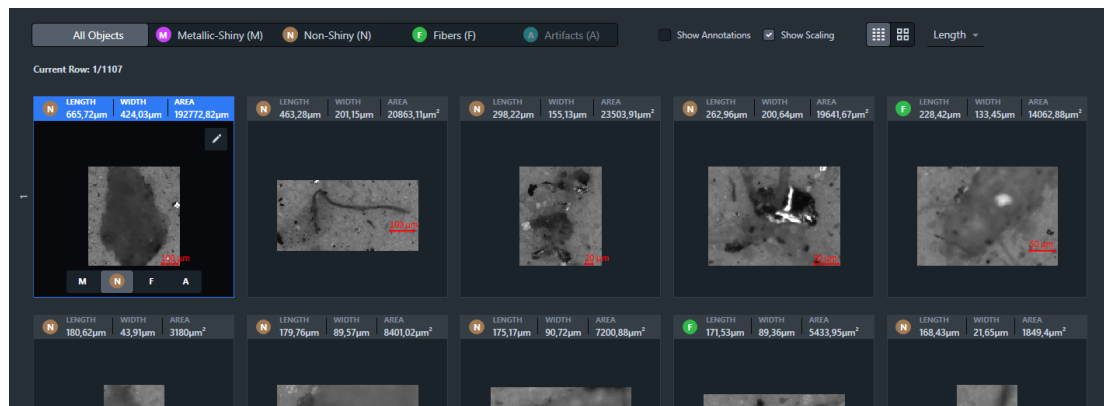
Measurement Data Workbench [▶ 743]

## 7.7 Technical Cleanliness Analysis (TCA)

This module enables you to evaluate particulate contamination on prepared specimen. The following standards for component cleanliness, oil cleanliness and cleanliness of medical products are supported: VDA 19.1, ISO 16232, ISO 4406, ISO 4407, NAS 1638, SAE AS 4059, VDI 2083 (Blatt 1).

### Overview

**Technical Cleanliness Analysis (TCA)** is a software module to evaluate the technical cleanliness of engine components, medical devices, and of fresh and used oils and lubricants.



**Fig. 58: Example: Technical Cleanliness Analysis (TCA) results of component cleanliness analysis:** The gallery shows the detected objects classified by type and ordered top down by length with the option to switch between the display of particle type metallic-shiny (M), non-shiny (N), fibers (F) and artifacts (A). The corresponding particle types for oil cleanliness analysis are fiber (F), particle (P) and artifacts (A).

You can perform rapid particle inspection and revision by using dedicated result views with various filter and sorting options.

### 7.7.1 Overview of Functionality

The following functional scope is covered.

#### Functional scope of software module ZEN core Technical Cleanliness Analysis (TCA)

- Job templates for measurement of particulate contamination with image acquisition and as alternative from earlier acquired images. The result calculation is based on standard templates which can be adapted in the **Standard Template Editor**.
- The workflow covers the following:
  - Image acquisition
  - Image analysis
  - Image processing
  - Standard-based result calculation
  - Result presentation in interactive views for fast inspection and revision of detected particles
  - Reports with results of characteristic values and standard specific methods per tested specimen
  - Automated storage of generated results in the data archive
  - Inspection and export of archived data



**Functional scope for Correlative Technical Cleanliness Analysis (TCA)**

In addition to the described functional scope for TCA, the following features are part of a correlative **Technical Cleanliness Analysis** workflow:

- Holder calibration with L-markers.
- Automated selection of particles from the standard template editor for SEM/EDS analysis.
- Manual selection of particles from the gallery in the size distribution view for SEM/EDS analysis.
- Joint particle selection table from 2. and 3. as input for **S&F Find (List)** tool.

**7.7.2 Applications in Technical Cleanliness****7.7.2.1 Component Cleanliness**

This application is used for evaluation of particulate contamination on inner and outer surfaces of engine components originating from the production process and environmental conditions.

The degree of surface contamination with residual dirt particles is directly linked to the function and lifetime of the engine components. Component cleanliness testing helps reducing engine failures and start-up breakdowns and improves the product quality.

The inspection is an indirect test method that requires a sampling step in which a test lot of the pre-cleaned component is taken and cleaned under defined conditions once more again. The resulting extraction fluid is filtered by a laboratory process and the residual dirt particles are collected on a filter membrane.

The particle distribution is analyzed in terms of size and type, and are expressed in cleanliness classes (level).

Relevant industrial sectors: automotive industry, automotive supplier chain, service labs, facilities for testing and verification, as well as aviation and space industry.

**See also**

 Comparison of Standards [► 567]

**7.7.2.2 Environmental Cleanliness**

This application is used for monitoring the cleanliness of the production environment and helps identifying potential particle sources. Processes and influencing variables which might be a source for particulate contamination can be identified, documented and monitored to guarantee clean manufacturing.

To validate the environmental and air cleanliness several particle traps are distributed close to the manufacturing and assembly sites. After a defined time period the particle traps are collected and analyzed.

The particle distribution is analyzed in terms of size and type, and are expressed in cleanliness classes (level).

Relevant industrial branches: automotive industry, the automotive supplier chain, service labs, facilities for testing and verification, as well as aviation and space industry.

### 7.7.2.3 Oil Cleanliness



This application is relevant for direct testing of fresh and used oils (mineral, synthetic, hydraulic) and lubricants for engines, gear boxes and hydraulic systems.

The presence of particulate contamination in lubricating and hydraulic oils interferes with its ability to lubricate and causes wear to the components. The level of contamination in the liquid has a direct bearing on the performance and reliability of the system.

For the analysis a defined amount of oil or lubricant is filtered by a laboratory process and the remaining particles are collected on a filter membrane. The particle distribution is analyzed in terms of size and type and are expressed in cleanliness classes (level).

Relevant industrial branches: the oil and lubricants manufacturer, the automotive industry, service labs, facilities for testing and verification, as well as aviation and space.

#### See also

 Occupancy Rate (Oil, Lubricants) Tool  668]

### 7.7.2.4 Cleanliness of Medical Devices

This application is used for evaluation of particulate contamination on medical devices originating from the production process and environmental conditions.

The degree of surface contamination with residual dirt particles might affect the tissue compatibility in terms of transplantation and the function of medical devices. Testing of cleanliness of medical devices can help reducing tissue intolerance or rejection and optimizing product quality.

The inspection is an indirect test method that requires a sampling step in which a test lot of the pre-cleaned medical device is taken and cleaned under defined conditions once more. The resulting extraction fluid is filtered by a laboratory process and the residual dirt particles are collected on a filter membrane.

The particle distribution is analyzed in terms of size and type, and are expressed in cleanliness classes (level).

By default, testing of medical products should be combined with the **GxP** module.

#### See also

 GxP  376]

### 7.7.2.5 Correlative Analysis in Technical Cleanliness

This application is used for correlative analysis of particulate contamination on membrane filters and delivers complementary particle results depending on the used instrument. The correlative workflow starts with light microscopy (LM) analysis for particle detection and continues with electron microscopy (EM) and energy dispersive spectroscopy (EDS, often also called EDX) for extended material characterization on selected potential critical particles.

EM/EDS analysis extends the achievable results for LM analysis by reliable material characterization based on the element composition. The correlative approach results in a unique identification of metallic particles.

### 7.7.3 Introduction to Standards

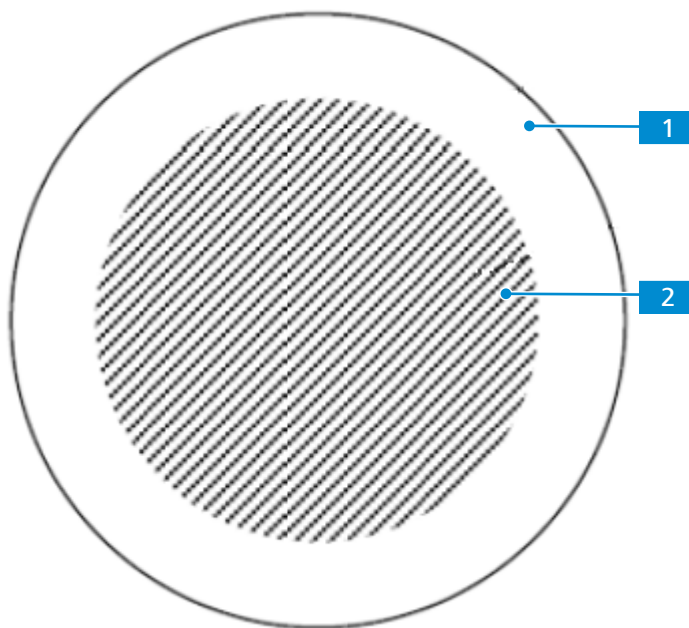
#### 7.7.3.1 Common Characteristics

The supported standards have common characteristics.

- **Distribution of particle size classes**
  - Definition of particle size classes as cumulative (open size intervals) or differential (closed size intervals) particle counts
  - Core measurement parameter (in general: Feret Max) which is used for particle size classification
- **Translation of particle numbers in cleanliness level (cleanliness codes or levels)**
  - Definition of particle numbers as cleanliness classes
- **Normalization and Standardization of particle counting results**
  - Normalized particle number (absolute particle number divided by a factor)
  - Standardized particle number (expressing normalized particle numbers in terms of a given standard value of normalized particle numbers to a standard value)

#### Effective Filter Area

Analysis of the complete flow through area (effective filter area) is mandatory for component cleanliness standards, oil cleanliness allows the analysis of a smaller area and extrapolation of the results to consider the effective filter area.



**1** Filter Area

**2** Effective Filter Area

The measurement frame which is defined in the **Tiles (measurement)** workbench by the diameter is the base for the standard specific calculation of: (1) normalized and standardized values; (2) occupancy rate.

**Info**

Cleanliness testing of components or medical devices: the measurement frame must cover as a minimum the effective filter area. Note that according to VDA 19.1 or ISO 16232 the complete effective filter area must be analyzed.

Cleanliness testing of oils and lubricants: the measurement frame can be smaller as the effective filter area and the particle results are extrapolated to a larger area, usually to the effective filter area (according to common oil standards).

**See also**

 Extrapolation Tool [▶ 674](#)

**7.7.3.2 Supported Standards**

The TCA module supports the following standards:

Standard	Description
<b>VDA 19.1</b>	Refers to component cleanliness. For more information, see <i>VDA 19 Part 1; Inspection of Component Cleanliness</i> <a href="#">▶ 541</a>
<b>ISO 16232</b>	Refers to component cleanliness. For more information, see <i>ISO 16232 Road Vehicle. Cleanliness of Components and Systems</i> <a href="#">▶ 547</a>
<b>VDA 19.2 (Illig)</b>	Refers to environmental cleanliness. For more information, especially on the Illig Value, see <i>VDA 19.2 Technical Cleanliness in Assembly - Environment, Logistics, Personnel and Assembly Equipment</i> <a href="#">▶ 546</a> .
<b>VDI 2083, Part 21</b>	Refers to cleanliness of medical products. For more information, see <i>VDI 2083 Part 21; Cleanroom Technology. Cleanliness of Medical Devices in the Manufacturing Process</i> <a href="#">▶ 552</a>
<b>ISO 4406</b>	Refers to oil cleanliness. For more information, see <i>ISO 4406 Hydraulic Fluid Power. Fluids. Method for Coding the Level of Contamination by Solid Particles</i> <a href="#">▶ 557</a>
<b>ISO 4407</b>	Refers to oil cleanliness. For more information, see <i>ISO 4407 Hydraulic Fluid Power - Fluid Contamination - Determination of Particulate Contamination by the Counting Method Using an Optical Microscope</i> <a href="#">▶ 560</a>
<b>NAS 1638</b>	Refers to oil cleanliness in the aerospace industry. Cleanliness requirements of fluids used in hydraulic systems. For more information, see <i>NAS 1638 National Aerospace Standard</i> <a href="#">▶ 562</a>
<b>SAE AS 4059</b>	Refers to oil cleanliness in the aerospace industry. Cleanliness requirements of fluids used in hydraulic systems.

Standard	Description
	For more information, see <i>SAE AS 4059F Aerospace Fluid Power - Contamination Classification for Hydraulic Fluids</i> [▶ 564]

Tab. 3: Supported standards in TCA module.

For detailed information, check the respective standards.

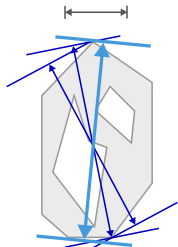
All supported standards are visible in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579]. **VDA 19.2 (Illig)** is an exception, it is provided as individual job template, see *Understanding the Illig Method* [▶ 641].

7.7.3.3 VDA 19 Part 1; Inspection of Component Cleanliness

1. Core parameter for size class distribution

Length = Feret Max (default use case)

Feret Maximum



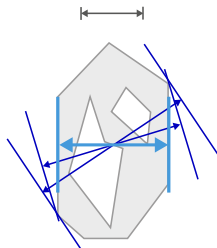
Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g. μm)

Width = Feret Min (default use case)

Feret Minimum

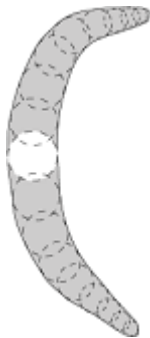


Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g. μm)

Diameter Maximum Inscribed Circle



Diameter of the largest circle that can be inscribed inside an area

The object is measured using the **Area** parameter. A circle inscribed inside an object is created. Multiply the radius by 2 equals the diameter of the maximum inscribed circle. The diameter of this circle is returned.

- Unit: Unit of the scaling assigned to the image (e.g. μm)

**Note:** Parameter for fiber classification (VDA 19.1, ISO 16232)

Fiber Length

Length of a fiber-like region

To calculate the fiber length, a structure that is similar to a fiber is required. Here it is not the distance between a start and end point that is determined. The check can be done using the **Form circle**, among other things.

- Formula:  $\frac{1}{4} \times (\text{Perimeter} + (\text{Sqrt}(\text{Perimeter}^2 - 16 \times \text{Area}))$

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

**Note:** Parameter for fiber classification (VDA 19.1, ISO 16232)

Particle Size Class	Size x in $\mu\text{m}$
<b>B</b>	$5 \leq x < 15$
<b>C</b>	$15 \leq x < 25$
<b>D</b>	$25 \leq x < 50$
<b>E</b>	$50 \leq x < 100$
<b>F</b>	$100 \leq x < 150$
<b>G</b>	$150 \leq x < 200$
<b>H</b>	$200 \leq x < 400$
<b>I</b>	$400 \leq x < 600$
<b>J</b>	$600 \leq x < 1.000$
<b>K</b>	$1.000 \leq x < 1.500$
<b>L</b>	$1.500 \leq x < 2.000$
<b>M</b>	$2.000 \leq x < 3.000$
<b>N</b>	$3.000 \leq x$

## 2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	Particle Count per $1000\text{cm}^2$ or $100\text{cm}^3$ up to including
<b>00</b>	0.00
<b>0</b>	1.00
<b>1</b>	2.00
<b>2</b>	4.00
<b>3</b>	8.00
<b>4</b>	16.00
<b>5</b>	32.00
<b>6</b>	64.00
<b>7</b>	130.00
<b>8</b>	250.00
<b>9</b>	500.00
<b>10</b>	1000.00

Cleanliness Level	Particle Count per 1000cm <sup>2</sup> or 100cm <sup>3</sup> up to including
11	2000.00
12	4000.00
13	8000.00
14	16000.00
15	32000.00
16	64000.00
17	130000.00
18	250000.00
19	500000.00
20	1000000.00
21	2000000.00
22	4000000.00
23	8000000.00
24	16000000.00
> 24	∞

### 3. Normalization

The absolute particle number is divided by a normalization factor:

- Number of components N
- Wetted component area A or
- Wetted component volume V

#### Number of Components (N)

*absolute number of particles / component number = normalized particle numbers*

**Result expression: normalized particle numbers**

#### Wetted component area (A) in mm<sup>2</sup>

*absolute number of particles / wetted component surface and normalization to standard area:  
1000 cm<sup>2</sup>*

**Result expression: normalized cleanliness code**

#### Wetted component volume (V) in cm<sup>3</sup>

*absolute number of particles / wetted component surface and normalization to standard area:  
100 cm<sup>3</sup>*

**Result expression: normalized cleanliness codes**

#### Example:

The cleanliness codes always refer to normalized and standardized particle results.

- Number of components = 10
- Wetted component Area = 200 cm<sup>2</sup>
- Wetted component Volume = 50 cm<sup>3</sup>

Particle Length	B (5≤X<15)	C (15≤X<25)	D (25≤X<50)	E (50≤X<100)	F (100≤X<150)	G (150≤X<200)	H (200≤X<400)	I (400≤X<600)	J (600≤X<1000)	K (1000≤X<1500)	L (1500≤X<2000)	M (2000≤X<3000)	N (3000≤X<∞)
<b>All without Fibers</b>													
Absolute Count	605	287	121	20	6	0	0	0	1	0	0	0	0
Normalized Count per Component (N)	60.5	28.7	12.1	2	0.6	0	0	0	0.1	0	0	0	0
Cleanliness Level N	60	29	12	2	1	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	302.5	143.5	60.5	10	3	0	0	0	0.5	0	0	0	0
Cleanliness Level A	9	8	6	4	2	00	00	00	0	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	121	57.4	24.2	4	1.2	0	0	0	0.2	0	0	0	0
Cleanliness Level V	7	6	5	2	1	00	00	00	0	00	00	00	00
<b>Metallic Shiny</b>													
Absolute Count	13	29	20	2	2	0	0	0	0	0	0	0	0
Normalized Count per Component (N)	1.3	2.9	2	0.2	0.2	0	0	0	0	0	0	0	0
Cleanliness Level N	1	3	2	0	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	6.5	14.5	10	1	1	0	0	0	0	0	0	0	0
Cleanliness Level A	3	4	4	0	0	00	00	00	00	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	2.6	5.8	4	0.4	0.4	0	0	0	0	0	0	0	0
Cleanliness Level V	2	3	2	0	0	00	00	00	00	00	00	00	00
<b>Non-Shiny</b>													
Absolute Count	592	258	101	18	4	0	0	0	1	0	0	0	0
Normalized Count per Component (N)	59.2	25.8	10.1	1.8	0.4	0	0	0	0.1	0	0	0	0
Cleanliness Level N	59	26	10	2	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	296	129	50.5	9	2	0	0	0	0.5	0	0	0	0
Cleanliness Level A	9	7	6	4	1	00	00	00	0	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	118.4	51.6	20.2	3.6	0.8	0	0	0	0.2	0	0	0	0
Cleanliness Level V	7	6	5	2	0	00	00	00	0	00	00	00	00
<b>Fiber</b>													
Absolute Count	0	0	0	1	0	1	1	0	0	0	0	0	0
Normalized Count per Component (N)	0	0	0	0.1	0	0.1	0.1	0	0	0	0	0	0
Cleanliness Level N	0	0	0	0	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	0	0	0	0.5	0	0.5	0.5	0	0	0	0	0	0
Cleanliness Level A	00	00	00	0	00	0	0	00	00	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	0	0	0	0.2	0	0.2	0.2	0	0	0	0	0	0
Cleanliness Level V	00	00	00	0	00	0	0	00	00	00	00	00	00

### Method: Standard Analysis

The standard analysis is fully parameterized from component extraction to filter analysis.

Advantages: The standard analysis has a good degree of result compatibility and is system and operator independent. No further agreement between customer and supplier is required.

Parameter	Description
Measurement of particles	Length and/or width ≥ 50 µm
Length	Feret Max
Width	Feret Min
Relative image brightness	50 - 60%. Default value: 55%
Relative threshold	70%
Particle typification	Metallic shine as option (Multi Channel 90°/135°)
Contrast	Polarized light
Particle type class <b>All</b> does <b>exclude</b> fibers by default.	
Specific fiber criterion based on elongated fiber length and maximum inner circle	
Calculation on complete measurement area (effective filter diameter)	



For more information, see *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

### Method: Extended Analysis

The extended analysis is applied whenever supplementary particle information is required:

- Smaller particle size classes
- Particle height measurement

Any changes from the standard method must be documented in detail. You can use the extended analysis with the scope of the following:

- Cause study for critical particles
- Process optimization
- Cleanliness specification beyond standard analysis, for example smaller size classes or 3<sup>rd</sup> dimension.

Parameter	Description
Measurement of particles	Length and/or width $\geq 5 \mu\text{m}$
Length	Feret Max
Width	Feret Min
Individual relative image brightness	50 - 60%. Default value: 55%. Can be defined individually.
Individual relative threshold	70%. Can be defined individually.
Particle typification	Metallic shine as option (Multi Channel 90°/135°)
Contrast	Polarized light
Particle type class <b>All</b> does <b>exclude</b> fibers by default.	
Specific fiber criterion based on elongated fiber length and maximum inner circle	
Calculation on complete measurement area (effective filter diameter)	

### Default Values for Particle Typification

Parameter	Description
Metallic-Shiny	(Mean gray value $> 200.0$ ) or (Max. gray value $\geq 240.0$ )
Non-Shiny	Objects which are not fiber and not metallic-shiny.
Fiber	(Max. Inscribed Circle $\leq 50.0$ ) and (Fiber Length/Max. Inscribed Circle $> 20.0$ )

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

### Particle Load

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

For more information, see

- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Components) Tool* [▶ 668]

#### 7.7.3.4 VDA 19.2 Technical Cleanliness in Assembly - Environment, Logistics, Personnel and Assembly Equipment

The Illig method, as described in the VDA 19.2 standard, is used to test the cleanliness of a certain location with its environmental conditions, e.g., air or working benches. By means of particle traps the amount of sedimented particles per time unit (Illig Value) can be analyzed.

The detected particle number per size class is multiplied by a weighting factor, see the first table, summed up and normalized to calculate the Illig value, see table **Illig weighting factors**. The sum value is normalized to an area of 1000 cm<sup>2</sup> and related to a measuring time of 1 h. The result is the Illig Value. The calculated Illig value creates a comparison basis for the collected particulate contamination at different locations over a certain time periode. With the Illig formular, larger particles are stronger weighted than smaller ones, because it is more likely that the larger ones have a higher damage potential.

Particle Size Class	Size x in µm	Weighting Factor
<b>B</b>	$5 \leq x < 15$	0
<b>C</b>	$15 \leq x < 25$	0
<b>D</b>	$25 \leq x < 50$	0
<b>E</b>	$50 \leq x < 100$	1
<b>F</b>	$100 \leq x < 150$	4
<b>G</b>	$150 \leq x < 200$	9
<b>H</b>	$200 \leq x < 400$	16
<b>I</b>	$400 \leq x < 600$	64
<b>J</b>	$600 \leq x < 1.000$	144
<b>K</b>	$1.000 \leq x$	400

#### Example calculation: Illig weighting factors

Size x in µm	Result	Weighting Factor	Weighted Particle No.
$5 \leq x < 15$	--	0	0
$15 \leq x < 25$	--	0	0

Size x in $\mu\text{m}$	Result	Weighting Factor	Weighted Particle No.
$25 \leq x < 50$	1620	0	0
$50 \leq x < 100$	374	1	374
$100 \leq x < 150$	57	4	228
$150 \leq x < 200$	43	9	387
$200 \leq x < 400$	15	16	240
$400 \leq x < 600$	7	64	448
$600 \leq x < 1.000$	2	144	288
$1.000 \leq x$	3	400	1200
		<b>Result:</b>	<b>3165</b>
		Normalized for 1000 $\text{cm}^2$ and 1 h $\times 0.39$ *	1234
		Illig Value [1/1000] $\text{cm}^2$ h	

#### Applying the Illig formular

$1\text{h} / \text{measuring time [h]} \times 1000 \text{ cm}^2 / \text{measuring area [cm}^2] = 0.39$

Time of sedimentation: 1 week = 168 h

Measuring area ( $\pi r^2$ ) 15.2  $\text{cm}^2$

**Measuring area:** Filter membrane area used for analysis.

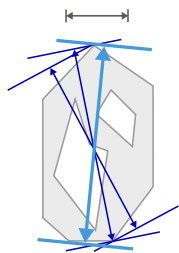
**Sedimentation time [h]:** Defined the time frame of the sample exposure to air.

### 7.7.3.5 ISO 16232 Road Vehicle. Cleanliness of Components and Systems

#### 1. Core parameter for size class distribution

Length = Feret Max (default use case)

Feret Maximum



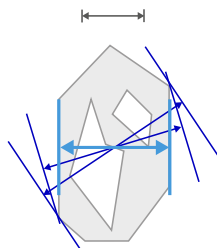
Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Width = Feret Min (default use case)

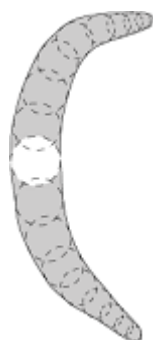
Feret Minimum



Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

Diameter  
Maximum In-  
scribed Circle



- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Diameter of the largest circle that can be inscribed inside an area

The object is measured using the **Area** parameter. A circle inscribed inside an object is created. Multiply the radius by 2 equals the diameter of the maximum inscribed circle. The diameter of this circle is returned.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

**Note:** Parameter for fiber classification (VDA 19.1, ISO 16232)

Fiber Length

Length of a fiber-like region

To calculate the fiber length, a structure that is similar to a fiber is required. Here it is not the distance between a start and end point that is determined. The check can be done using the **Form circle**, among other things.

- Formula:  $\frac{1}{4} \times (\text{Perimeter} + (\text{Sqrt}(\text{Perimeter}^2 - 16 \times \text{Area})))$
- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

**Note:** Parameter for fiber classification (VDA 19.1, ISO 16232)

Particle Size Class	Size x in $\mu\text{m}$
<b>B</b>	$5 \leq x < 15$
<b>C</b>	$15 \leq x < 25$
<b>D</b>	$25 \leq x < 50$
<b>E</b>	$50 \leq x < 100$
<b>F</b>	$100 \leq x < 150$
<b>G</b>	$150 \leq x < 200$
<b>H</b>	$200 \leq x < 400$
<b>I</b>	$400 \leq x < 600$
<b>J</b>	$600 \leq x < 1.000$
<b>K</b>	$1.000 \leq x < 1.500$
<b>L</b>	$1.500 \leq x < 2.000$
<b>M</b>	$2.000 \leq x < 3.000$
<b>N</b>	$3.000 \leq x$

## 2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	Particle Count per 1000cm <sup>2</sup> or 100cm <sup>3</sup> up to including
00	0.00
0	1.00
1	2.00
2	4.00
3	8.00
4	16.00
5	32.00
6	64.00
7	130.00
8	250.00
9	500.00
10	1000.00
11	2000.00
12	4000.00
13	8000.00
14	16000.00
15	32000.00
16	64000.00
17	130000.00
18	250000.00
19	500000.00
20	1000000.00
21	2000000.00
22	4000000.00
23	8000000.00
24	16000000.00
> 24	∞

### 3. Normalization

The absolute particle number is divided by a normalization factor:

- Number of components N
- Wetted component area A or

- Wetted component volume V

### Number of Components (N)

*absolute number of particles / component number = normalized particle numbers*

**Result expression: normalized particle numbers**

### Wetted component area (A) in mm<sup>2</sup>

*absolute number of particles / wetted component surface and normalization to standard area:  
1000 cm<sup>2</sup>*

**Result expression: normalized cleanliness code**

### Wetted component volume (V) in cm<sup>3</sup>

*absolute number of particles / wetted component surface and normalization to standard area:  
100 cm<sup>3</sup>*

**Result expression: normalized cleanliness codes**

### Example:

The cleanliness codes always refer to normalized and standardized particle results.

- Number of components = 10
- Wetted component Area = 200 cm<sup>2</sup>
- Wetted component Volume = 50 cm<sup>3</sup>

Particle Length	B (5≤X<15)	C (15≤X<25)	D (25≤X<50)	E (50≤X<100)	F (100≤X<150)	G (150≤X<200)	H (200≤X<400)	I (400≤X<600)	J (600≤X<1000)	K (1000≤X<1500)	L (1500≤X<2000)	M (2000≤X<3000)	N (3000≤X<∞)
<b>All without Fibers</b>													
Absolute Count	605	287	121	20	6	0	0	0	1	0	0	0	0
Normalized Count per Component (N)	60.5	28.7	12.1	2	0.6	0	0	0	0.1	0	0	0	0
Cleanliness Level N	60	29	12	2	1	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	302.5	143.5	60.5	10	3	0	0	0	0.5	0	0	0	0
Cleanliness Level A	9	8	6	4	2	00	00	00	0	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	121	57.4	24.2	4	1.2	0	0	0	0.2	0	0	0	0
Cleanliness Level V	7	6	5	2	1	00	00	00	0	00	00	00	00
<b>Metallic Shiny</b>													
Absolute Count	13	29	20	2	2	0	0	0	0	0	0	0	0
Normalized Count per Component (N)	1.3	2.9	2	0.2	0.2	0	0	0	0	0	0	0	0
Cleanliness Level N	1	3	2	0	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	6.5	14.5	10	1	1	0	0	0	0	0	0	0	0
Cleanliness Level A	3	4	4	0	0	00	00	00	00	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	2.6	5.8	4	0.4	0.4	0	0	0	0	0	0	0	0
Cleanliness Level V	2	3	2	0	0	00	00	00	00	00	00	00	00
<b>Non-Shiny</b>													
Absolute Count	592	258	101	18	4	0	0	0	1	0	0	0	0
Normalized Count per Component (N)	59.2	25.8	10.1	1.8	0.4	0	0	0	0.1	0	0	0	0
Cleanliness Level N	59	26	10	2	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	296	129	50.5	9	2	0	0	0	0.5	0	0	0	0
Cleanliness Level A	9	7	6	4	1	00	00	00	0	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	118.4	51.6	20.2	3.6	0.8	0	0	0	0.2	0	0	0	0
Cleanliness Level V	7	6	5	2	0	00	00	00	0	00	00	00	00
<b>Fiber</b>													
Absolute Count	0	0	0	1	0	1	1	0	0	0	0	0	0
Normalized Count per Component (N)	0	0	0	0.1	0	0.1	0.1	0	0	0	0	0	0
Cleanliness Level N	0	0	0	0	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm <sup>2</sup> (A)	0	0	0	0.5	0	0.5	0.5	0	0	0	0	0	0
Cleanliness Level A	00	00	00	0	00	0	0	00	00	00	00	00	00
Normalized Count per 100 cm <sup>3</sup> (V)	0	0	0	0.2	0	0.2	0.2	0	0	0	0	0	0
Cleanliness Level V	00	00	00	0	00	0	0	00	00	00	00	00	00

### Method: Standard Analysis

The standard analysis is fully parameterized from component extraction to filter analysis.

Advantages: The standard analysis has a good degree of result compatibility and is system and operator independent. No further agreement between customer and supplier is required.

Parameter	Description
Measurement of particles	Length and/or width $\geq 50 \mu\text{m}$
Length	Feret Max
Width	Feret Min
Relative image brightness	50 - 60%. Default value: 55%
Relative threshold	70%
Particle typification	Metallic shine as option (Multi Channel 90°/135°)
Contrast	Polarized light
Particle type class <b>All</b> does <b>exclude</b> fibers by default.	
Specific fiber criterion based on elongated fiber length and maximum inner circle	
Calculation on complete measurement area (effective filter diameter)	

For more information, see *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

#### Method: Extended Analysis

The extended analysis is applied whenever supplementary particle information is required:

- Smaller particle size classes
- Particle height measurement

Any changes from the standard method must be documented in detail. You can use the extended analysis with the scope of the following:

- Cause study for critical particles
- Process optimization
- Cleanliness specification beyond standard analysis, for example smaller size classes or 3<sup>rd</sup> dimension.

Parameter	Description
Measurement of particles	Length and/or width $\geq 5 \mu\text{m}$
Length	Feret Max
Width	Feret Min
Individual relative image brightness	50 - 60%. Default value: 55%. Can be defined individually.
Individual relative threshold	70%. Can be defined individually.
Particle typification	Metallic shine as option (Multi Channel 90°/135°)
Contrast	Polarized light
Particle type class <b>All</b> does <b>exclude</b> fibers by default.	

Parameter	Description
	Specific fiber criterion based on elongated fiber length and maximum inner circle
	Calculation on complete measurement area (effective filter diameter)

Default Values for Particle Typification

Parameter	Description
Metallic-Shiny	(Mean gray value > 200.0) or (Max. gray value ≥ 240.0)
Non-Shiny	Objects which are not fiber and not metallic-shiny.
Fiber	(Max. Inscribed Circle ≤ 50.0) and (Fiber Length/Max. Inscribed Circle > 20.0)

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

Particle Load

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

For more information, see

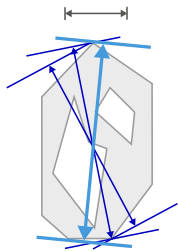
- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Components) Tool* [▶ 668]

7.7.3.6 VDI 2083 Part 21; Cleanroom Technology. Cleanliness of Medical Devices in the Manufacturing Process

1. Core parameter for size class distribution

Length = Feret Max (default use case)

Feret Maximum



Maximum feret of a region

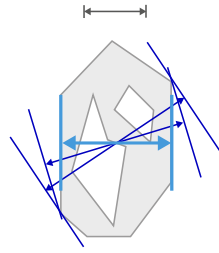
The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g. µm)

Width = Feret Min (default use case)



## Feret Minimum



## Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

## Diameter Maximum Inscribed Circle



## Diameter of the largest circle that can be inscribed inside an area

The object is measured using the **Area** parameter. A circle inscribed inside an object is created. Multiply the radius by 2 equals the diameter of the maximum inscribed circle. The diameter of this circle is returned.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

**Note:** Parameter for fiber classification (VDA 19.1, ISO 16232)

## Fiber Length

## Length of a fiber-like region

To calculate the fiber length, a structure that is similar to a fiber is required. Here it is not the distance between a start and end point that is determined. The check can be done using the **Form circle**, among other things.

- Formula:  $\frac{1}{4} \times (\text{Perimeter} + (\text{Sqrt}(\text{Perimeter}^2 - 16 \times \text{Area}))$
- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

**Note:** Parameter for fiber classification (VDA 19.1, ISO 16232)

Particle Size Class	Size x in $\mu\text{m}$
<b>B</b>	$5 \leq x < 15$
<b>C</b>	$15 \leq x < 25$
<b>D</b>	$25 \leq x < 50$
<b>E</b>	$50 \leq x < 100$
<b>F</b>	$100 \leq x < 150$
<b>G</b>	$150 \leq x < 200$
<b>H</b>	$200 \leq x < 400$
<b>I</b>	$400 \leq x < 600$
<b>J</b>	$600 \leq x < 1.000$
<b>K</b>	$1.000 \leq x < 1.500$
<b>L</b>	$1.500 \leq x < 2000$
<b>M</b>	$2.000 \leq x < 3.000$
<b>N</b>	$3.000 \leq x$

## 2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	Particle Count per 1000cm <sup>2</sup> or 100cm <sup>3</sup> up to including
00	0.00
0	1.00
1	2.00
2	4.00
3	8.00
4	16.00
5	32.00
6	64.00
7	130.00
8	250.00
9	500.00
10	1000.00
11	2000.00
12	4000.00
13	8000.00
14	16000.00
15	32000.00
16	64000.00
17	130000.00
18	250000.00
19	500000.00
20	1000000.00
21	2000000.00
22	4000000.00
23	8000000.00
24	16000000.00
> 24	∞

### 3. Normalization

The absolute particle number is divided by a normalization factor:

- Number of components N
- Wetted component area A or
- Wetted component volume V

#### Number of Components (N)

*absolute number of particles / component number = normalized particle numbers*

**Result expression: normalized particle numbers**

#### Wetted component area (A) in mm<sup>2</sup>

*absolute number of particles / wetted component surface and normalization to standard area:  
1000 cm<sup>2</sup>*

**Result expression: normalized cleanliness code**

#### Wetted component volume (V) in cm<sup>3</sup>

*absolute number of particles / wetted component surface and normalization to standard area:  
100 cm<sup>3</sup>*

**Result expression: normalized cleanliness codes**

#### Example:

The cleanliness codes always refer to normalized and standardized particle results.

- Number of components = 10
- Wetted component Area = 200 cm<sup>2</sup>
- Wetted component Volume = 50 cm<sup>3</sup>

Particle Length	B (5≤X<15)	C (15≤X<25)	D (25≤X<50)	E (50≤X<100)	F (100≤X<150)	G (150≤X<200)	H (200≤X<400)	I (400≤X<600)	J (600≤X<1000)	K (1000≤X<1500)	L (1500≤X<2000)	M (2000≤X<3000)	N (3000≤X<∞)
All without Fibers													
Absolute Count	605	287	121	20	6	0	0	0	1	0	0	0	0
Normalized Count per Component (N)	60.5	28.7	12.1	2	0.6	0	0	0	0.1	0	0	0	0
Cleanliness Level N	60	29	12	2	1	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm² (A)	302.5	143.5	60.5	10	3	0	0	0	0.5	0	0	0	0
Cleanliness Level A	9	8	6	4	2	00	00	00	0	00	00	00	00
Normalized Count per 100 cm³ (V)	121	57.4	24.2	4	1.2	0	0	0	0.2	0	0	0	0
Cleanliness Level V	7	6	5	2	1	00	00	00	0	00	00	00	00
Metallic Shiny													
Absolute Count	13	29	20	2	2	0	0	0	0	0	0	0	0
Normalized Count per Component (N)	1.3	2.9	2	0.2	0.2	0	0	0	0	0	0	0	0
Cleanliness Level N	1	3	2	0	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm² (A)	6.5	14.5	10	1	1	0	0	0	0	0	0	0	0
Cleanliness Level A	3	4	4	0	0	00	00	00	00	00	00	00	00
Normalized Count per 100 cm³ (V)	2.6	5.8	4	0.4	0.4	0	0	0	0	0	0	0	0
Cleanliness Level V	2	3	2	0	0	00	00	00	00	00	00	00	00
Non-Shiny													
Absolute Count	592	258	101	18	4	0	0	0	1	0	0	0	0
Normalized Count per Component (N)	59.2	25.8	10.1	1.8	0.4	0	0	0	0.1	0	0	0	0
Cleanliness Level N	59	26	10	2	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm² (A)	296	129	50.5	9	2	0	0	0	0.5	0	0	0	0
Cleanliness Level A	9	7	6	4	1	00	00	00	0	00	00	00	00
Normalized Count per 100 cm³ (V)	118.4	51.6	20.2	3.6	0.8	0	0	0	0.2	0	0	0	0
Cleanliness Level V	7	6	5	2	0	00	00	00	0	00	00	00	00
Fiber													
Absolute Count	0	0	0	1	0	1	1	0	0	0	0	0	0
Normalized Count per Component (N)	0	0	0	0.1	0	0.1	0.1	0	0	0	0	0	0
Cleanliness Level N	0	0	0	0	0	0	0	0	0	0	0	0	0
Normalized Count per 1000 cm² (A)	0	0	0	0.5	0	0.5	0.5	0	0	0	0	0	0
Cleanliness Level A	00	00	00	0	00	0	0	00	00	00	00	00	00
Normalized Count per 100 cm³ (V)	0	0	0	0.2	0	0.2	0.2	0	0	0	0	0	0
Cleanliness Level V	00	00	00	0	00	0	0	00	00	00	00	00	00

**Method: Standard Analysis**

The standard analysis is fully parameterized from component extraction to filter analysis.

Advantages: The standard analysis has a good degree of result compatibility and is system and operator independent. No further agreement between customer and supplier is required.

Parameter	Description
Measurement of particles	Length and/or width $\geq 50 \mu\text{m}$
Length	Feret Max
Width	Feret Min
Relative image brightness	50 - 60%. Default value: 55%
Relative threshold	70%
Particle typification	Metallic shine as option (Multi Channel 90°/135°)
Contrast	Polarized light
Particle type class <b>All</b> does <b>exclude</b> fibers by default.	
Specific fiber criterion based on elongated fiber length and maximum inner circle	
Calculation on complete measurement area (effective filter diameter)	

For more information, see *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

**Method: Extended Analysis**

The extended analysis is applied whenever supplementary particle information is required:

- Smaller particle size classes
- Particle height measurement

Any changes from the standard method must be documented in detail. You can use the extended analysis with the scope of the following:

- Cause study for critical particles
- Process optimization
- Cleanliness specification beyond standard analysis, for example smaller size classes or 3<sup>rd</sup> dimension.

Parameter	Description
Measurement of particles	Length and/or width $\geq 5 \mu\text{m}$
Length	Feret Max
Width	Feret Min
Individual relative image brightness	50 - 60%. Default value: 55%. Can be defined individually.
Individual relative threshold	70%. Can be defined individually.

Parameter	Description
Particle typification	Metallic shine as option (Multi Channel 90°/135°)
Contrast	Polarized light
Particle type class <b>All</b> does <b>exclude</b> fibers by default.	
Specific fiber criterion based on elongated fiber length and maximum inner circle	
Calculation on complete measurement area (effective filter diameter)	

#### Default Values for Particle Typification

Parameter	Description
Metallic-Shiny	(Mean gray value > 200.0) or (Max. gray value $\geq$ 240.0)
Non-Shiny	Objects which are not fiber and not metallic-shiny.
Fiber	(Max. Inscribed Circle $\leq$ 50.0) and (Fiber Length/Max. Inscribed Circle > 20.0)

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

#### Particle Load

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

For more information, see

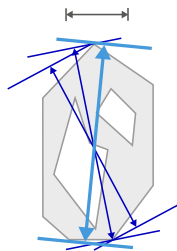
- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Components) Tool* [▶ 668]

### 7.7.3.7 ISO 4406 Hydraulic Fluid Power. Fluids. Method for Coding the Level of Contamination by Solid Particles

#### 1. Core parameter for size class distribution

Length = Feret Max (default use case)

Feret Maximum



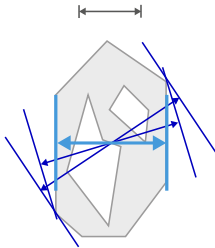
Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Width = Feret Min

Feret Minimum



Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g. µm)

Particle Size Class	Size x in µm
Class 1	$5 \leq x < \infty$
Class 2	$15 \leq x < \infty$

2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	Particle Count per 100ml up to including
0	1.00
1	2.00
2	4.00
3	8.00
4	16.00
5	32.00
6	64.00
7	130.00
8	250.00
9	500.00
10	1000.00
11	2000.00
12	4000.00
13	8000.00
14	16000.00
15	3200.000
16	64000.00
17	130000.00

Cleanliness Level	Particle Count per 100ml up to including
18	250000.00
19	500000.00
20	1000000.00
21	2000000.00
22	4000000.00
23	8000000.00
24	160000000.00
25	320000000.00
26	640000000.00
27	1300000000.00
28	2500000000.00
>28	∞

### 3. Normalization

The absolute particle number is divided by the applied oil volume and standardized to 100 ml.

#### Default Values for Particle Typification

Particle Type	Description
Fiber	Length (Feret Max) > 100 µm and Length/Width (Feret Max/Feret Min) > 10 µm
Particle	If the particle is not in the range of Fiber, it is a particle.

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

#### Particle Load

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

For more information, see

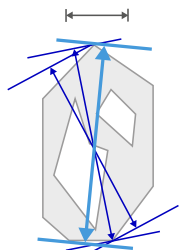
- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]

### 7.7.3.8 ISO 4407 Hydraulic Fluid Power - Fluid Contamination - Determination of Particulate Contamination by the Counting Method Using an Optical Microscope

#### 1. Core parameter for size class distribution

Length = Feret Max (default use case)

Feret Maximum



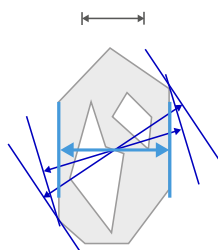
Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Width = Feret Min

Feret Minimum



Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

Particle Size Class	Size x in $\mu\text{m}$
Class 1	$2 \leq x < \infty$
Class 2	$5 \leq x < \infty$
Class 3	$15 \leq x < \infty$
Class 4	$25 \leq x < \infty$
Class 5	$50 \leq x < \infty$
Class 6	$100 \leq x < \infty$

#### 2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	Particle Count per 100ml up to including
0	1.00
1	2.00
2	4.00
3	8.00



Cleanliness Level	Particle Count per 100ml up to including
4	16.00
5	32.00
6	64.00
7	130.00
8	250.00
9	500.00
10	1000.00
11	2000.00
12	4000.00
13	8000.00
14	16000.00
15	3200.000
16	64000.00
17	130000.00
18	250000.00
19	500000.00
20	1000000.00
21	2000000.00
22	4000000.00
23	8000000.00
24	160000000.00
25	320000000.00
26	640000000.00
27	130000000.00
28	250000000.00
>28	∞

### 3. Normalization

The absolute particle number is divided by the applied oil volume and standardized to 100 ml.

**Default Values for Particle Typification**

Particle Type	Description
Fiber	Length (Feret Max) > 100 µm and Length/Width (Feret Max/Feret Min) > 10 µm
Particle	If the particle is not in the range of Fiber, it is a particle.

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

**Particle Load**

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

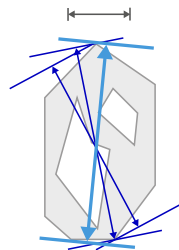
For more information, see

- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]

**7.7.3.9 NAS 1638 National Aerospace Standard****1. Core parameter for size class distribution**

Length = Feret Max (default use case)

Feret Maximum



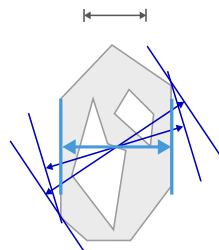
Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g. µm)

Width = Feret Min

Feret Minimum



Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g. µm)

Particle Size Class	Size x in µm
Class 1	$5 \leq x < 15$
Class 2	$15 \leq x < 25$

Particle Size Class	Size x in $\mu\text{m}$
<b>Class 3</b>	$25 \leq x < 50$
<b>Class 4</b>	$50 \leq x < 100$
<b>Class 5</b>	$100 \leq x$

## 2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	$5 \leq x < 15$	$15 \leq x < 25$	$25 \leq x < 50$	$50 \leq x < 100$	$100 \leq x$
<b>00</b>	125.00	22.00	4.00	1.00	0*
<b>0</b>	250.00	44.00	8.00	2.00	0.50*
<b>1</b>	500.00	89.00	16.00	3.00	1.00*
<b>2</b>	1.000.00	178.00	32.00	6.00	1.50*
<b>3</b>	2000.00	356.00	63.00	11.00	2.00
<b>4</b>	4000.00	712.00	126.00	22.00	4.00
<b>5</b>	8000.00	1425.00	253.00	45.00	8.00
<b>6</b>	16000.00	2850.00	506.00	90.00	16.00
<b>7</b>	32000.00	5700.00	1012.00	180.00	32.00
<b>8</b>	64000.00	11400.00	2025.00	360.00	64.00
<b>9</b>	128000.00	22800.00	4050.00	720.00	128.00
<b>10</b>	256000.00	45600.00	8100.00	1440.00	256.00
<b>11</b>	512000.00	91200.00	16200.00	2880.00	512.00
<b>12</b>	1024000.00	182400.00	32400.00	5760.00	1024.00
<b>&gt;12</b>	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$

Tab. 4: Particle Count per 100ml up to including.

\*These values differ from the standard values (0/0/1/1). With the standard values an automated assignment to a cleanliness level is not possible.

## 3. Normalization

The absolute particle number is divided by the applied oil volume and standardized to 100ml.

### Default Values for Particle Typification

Particle Type	Description
Fiber	Length (Ferret Max) > 100 $\mu\text{m}$ and Length/Width (Ferret Max/Feret Min) > 10 $\mu\text{m}$

Particle Type	Description
Particle	If the particle is not in the range of Fiber, it is a particle.

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

**Particle Load**

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

For more information, see

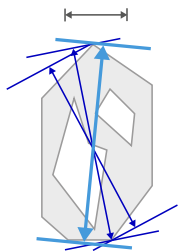
- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]

**7.7.3.10 SAE AS 4059F Aerospace Fluid Power - Contamination Classification for Hydraulic Fluids**

**1. Core parameter for size class distribution**

Length = Feret Max (default use case)

Feret Maximum



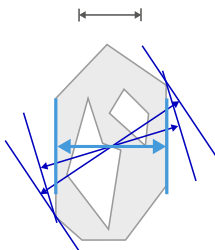
Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g. µm)

Width = Feret Min

Feret Minimum



Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g. µm)

Particle Size Class According to SAE AS 4059, Table 1	Size x in µm
Class 1	$5 \leq x < 15$
Class 2	$15 \leq x < 25$
Class 3	$25 \leq x < 50$
Class 4	$50 \leq x < 100$

Particle Size Class According to SAE AS 4059, Table 1	Size x in $\mu\text{m}$
Class 5	$100 \leq x$

Particle Size Class According to SAE AS 4059, Table 2	Size x in $\mu\text{m}$
Class 1	$1 \leq x < \infty$
Class 2	$5 \leq x < \infty$
Class 3	$15 \leq x < \infty$
Class 4	$25 \leq x < \infty$
Class 5	$50 \leq x < \infty$
Class 6	$100 \leq x < \infty$

## 2. Particle Concentration Classification

Depending on the normalization parameter the particle count per size class is expressed in cleanliness level as shown in the table:

Cleanliness Level	$5 \leq x < 15$	$15 \leq x < 25$	$25 \leq x < 50$	$50 \leq x < 100$	$100 \leq x$
00	125.00	22.00	4.00	1.00	0*
0	250.00	44.00	8.00	2.00	0.50*
1	500.00	89.00	16.00	3.00	1.00*
2	1.000.00	178.00	32.00	6.00	1.50*
3	2000.00	356.00	63.00	11.00	2.00
4	4000.00	712.00	126.00	22.00	4.00
5	8000.00	1425.00	253.00	45.00	8.00
6	16000.00	2850.00	506.00	90.00	16.00
7	32000.00	5700.00	1012.00	180.00	32.00
8	64000.00	11400.00	2025.00	360.00	64.00
9	128000.00	22800.00	4050.00	720.00	128.00
10	256000.00	45600.00	8100.00	1440.00	256.00
11	512000.00	91200.00	16200.00	2880.00	512.00
12	1024000.00	182400.00	32400.00	5760.00	1024.00

Cleanliness Level	$5 \leq x < 15$	$15 \leq x < 25$	$25 \leq x < 50$	$50 \leq x < 100$	$100 \leq x$
>12	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$

Tab. 5: Particle Count per 100ml up to including, according to SAE AS 4059, Table 1

\*These values differ from the standard values (0/0/1/1). With the standard values an automated assignment to a cleanliness level is not possible.

Cleanliness Level	$1 \leq x < \infty$	$5 \leq x < \infty$	$15 \leq x < \infty$	$25 \leq x < \infty$	$50 \leq x < \infty$	$100 \leq x < \infty$
000	195.00	76.00	14.00	3.00	1.0	0.00*
00	390.00	152.00	27.00	5.00	1.5	0.25*
0	780.00	304.00	54.00	10.00	2.00	0.50*
1	1560.00	609.00	109.00	20.00	4.00	1.00*
2	3120.00	1217.00	217.00	39.00	7.00	1.50
3	6250.00	2432.00	432.00	76.00	13.00	2.00
4	12500.00	4864.00	864.00	152.00	26.00	4.00
5	25000.00	9731.00	1731.00	306.00	53.00	8.00
6	50000.00	19462.00	3462.00	612.00	106.00	16.00
7	100000.00	38924.00	6924.00	1224.00	212.00	32.00
8	200000.00	77849.00	13849.00	2449.00	424.00	64.00
9	400000.00	155698.00	27698.00	4898.00	848.00	128.00
10	800000.00	311396.00	55396.00	9796.00	1696.00	256.00
11	1600000.00	622792.00	110792.00	19592.00	3392.00	512.00
12	3200000.00	1245584.00	221584.00	39184.00	6784.00	1024.00
>12	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$

Tab. 6: Particle Count per 100ml up to including, according to SAE AS 4059, Table 2.

\*These values differ from the standard values (0/0/1/1). With the standard values an assignment to a cleanliness level is not possible.

### 3. Normalization

The absolute particle number is divided by the applied oil volume and standardized to 100ml.

**Default Values for Particle Typification**

Particle Type	Description
Fiber	Length (Feret Max) > 100 µm and Length/Width (Feret Max/Feret Min) > 10 µm
Particle	If the particle is not in the range of Fiber, it is a particle.

As a Supervisor, you can edit the values in the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].

**Particle Load**

The particle load is a measurement value to describe the quality of the specimen preparation in terms of particle density, and the distribution of particles on the effective filter area. The calculation is performed as follows:

Sum of the particle area of all detected particles in relation to measurement frame area. Value in %.

For more information, see

- *About Filters and Occupancy Rate* [▶ 642]
- *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]

**7.7.3.11 Comparison of Standards**

Comparison by	Component Cleanliness	Oil Cleanliness
Relevant standards	<ul style="list-style-type: none"> <li>▪ VDA 19.1</li> <li>▪ VDA 19.2</li> <li>▪ ISO 16232</li> <li>▪ VDI 2083, Part 21 (medical products)</li> </ul>	<ul style="list-style-type: none"> <li>▪ ISO 4406</li> <li>▪ ISO 4407</li> <li>▪ NAS 1638</li> <li>▪ SAE AS 4059</li> </ul>
Job template	Job template: Component Cleanliness <ul style="list-style-type: none"> <li>▪ Component Cleanliness Testing</li> <li>▪ Component Cleanliness Testing with Object Classification</li> <li>▪ Component Cleanliness Testing with S&amp;F</li> <li>▪ Component Cleanliness Testing with S&amp;F and Object Classification</li> <li>▪ Technical Cleanliness (VDA 19.2 Joint Result)</li> </ul>	Job template: Oil Cleanliness <ul style="list-style-type: none"> <li>▪ Oil Cleanliness Testing</li> <li>▪ Oil Cleanliness Testing (Loaded Images)</li> <li>▪ Oil Cleanliness Testing with S&amp;F</li> </ul>
Effective area	Complete flow through area must be analyzed; i.e. extrapolation of results is not allowed	Extrapolation is allowed; e.g. scan D35 and extrapolation to D41

Comparison by	Component Cleanliness	Oil Cleanliness
Normalization	<ul style="list-style-type: none"> <li>Component number (N)</li> <li>Wetted component area (A)</li> <li>Wetted component volume (V)</li> </ul>	Applied oil volume (V)
Result interpretation	Focus on large particles and often in practice also on metallic-shiny particles.	Focus mainly on particle count
Analysis (in practice)	Particle size distribution and particle type (metallic-shiny, non-shiny, fiber)	Particle size distribution and particle types (particles and fibers)
Average particle size	5 µm up to $\geq 3000$ µm	1 µm up to $> 100$ µm
Particle size distribution	Differential particle counts Example: $\geq 5 - 15$ µm; $\geq 15 - 25$ µm Methods: <ul style="list-style-type: none"> <li><b>Standard</b> (50 µm and larger objects)</li> <li><b>Extended</b> (5 µm and larger objects)</li> </ul>	<ul style="list-style-type: none"> <li>Differential particle counts</li> <li>Cumulative particle counts</li> </ul> Example: $\geq 5$ µm $\geq 15$ µm No specific methods.
Cleanliness classes (levels or codes)	One cleanliness code table valid for all particle size classes.	Depending on the standard, one cleanliness code table is valid for all particle size classes or individual code tables per particle size class.
Relative image brightness (Luminosity) & Relative threshold	Image brightness adjustment using the luminosity value and image analysis setting with a corresponding relative threshold.	Image brightness adjustment by exposure time or luminosity and image analysis setting via independent definition of a threshold range or relative threshold.
Image acquisition and camera sensor pixel polarization (default setting)	One <b>multichannel</b> image with Pol- 90° and Pol-135°. For more information, see <i>Polarization Method</i> [► 571].	One <b>single-channel</b> image with Pol-90° (with AxioCam 705 pol). With other Axio-cams, polarization contrast is required.
Occupancy rate	Results refer to the complete measurement frame area (=effective filter area).	Results refer to the complete measurement frame area (=effective filter area).

For more information, see *Common Characteristics* [► 539].

### 7.7.3.12 Correlative Analysis

The EM/EDS analysis of the correlative workflow is based on the same standards like for LM analysis. The definitions for size classification, normalization and cleanliness codes are identical to LM analysis. This includes as well the default measurement parameter.



The guideline for material classification by EM/EDS is described very detailed in the standards for component cleanliness.

For further information on the technical requirements for material characterization with EM/EDS, refer to the **SmartSEM** and the **SmartPI** manual.

### See also

- 📖 VDA 19 Part 1; Inspection of Component Cleanliness [► 541]
- 📖 VDA 19.2 Technical Cleanliness in Assembly - Environment, Logistics, Personnel and Assembly Equipment [► 546]
- 📖 ISO 16232 Road Vehicle. Cleanliness of Components and Systems [► 547]
- 📖 VDI 2083 Part 21; Cleanroom Technology. Cleanliness of Medical Devices in the Manufacturing Process [► 552]

## 7.7.4 Understanding the Technical Background

### 7.7.4.1 New Technology POL Camera

Component Cleanliness Analysis is usually not only focused on particle counting results, but also on the differentiation by particle type.

Using a microscope, the established analysis is performed by sequential acquisition of two images. One image is recorded with the parallel orientation of two polarizer and a further image is recorded with the two polarizer in 90° orientation to each other (crossed polarization).

Metallic particles appear dark black when using crossed polarization whereas non-metallic particles often change their appearance from gray to darker gray or even do not show any reaction on polarization. This effect is used to differentiate between **metallic-shiny** and **non-shiny** particles.

The new camera technology with on-chip polarization allows **parallel acquisition of one dual channel image with both directions of polarization at the same time**. This leads to **time reduction by 100%** for the image acquisition step.

#### Info

This functionality is only available when using the Axiocam 705 pol.

### See also

- 📖 Applying Polarization Channel [► 569]

### 7.7.4.2 Applying Polarization Channel

The POL camera is a black and white camera and offers beside the raw image four selectable directions of polarization: 0°, 45°, 90°, 135° to acquire a multi-channel image. The raw image shows all directions of polarization. In color mode the images are displayed in false-color.

After image acquisition, the selected directions of polarization are extracted from the raw image and provided as multi-channel image.

The default value for multi-channel images shall be **Single Channel**. This is valid for all **TCA** job templates.

### Info

If single channel is not activated, the merged image is displayed. The merged image is an additive image of all selected channels and therefore much brighter than the single channel images.

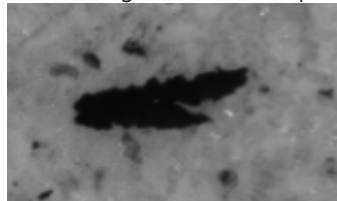
- Prerequisite**
- ✓ **Axiocam 705** pol is installed.
  - ✓ In the **Extended Camera** tool > **Mode** section, the camera mode **B/W** is selected.
  - ✓ In the **Extended Camera** tool > **Mode** section, **Live speed high** is selected.
  - ✓ In the **Extended Camera** tool > **Model Specific** section, the channels 90° and 135° are selected.
  - ✓ On the **Display** tab, **Single Channel** is activated. It is not possible to display more than one channel at the same time. You can switch between the two image channels to differentiate immediately between metallic and non-metallic particles. The Pol-90° channel and one additional channel, i.e. 0°, 45° 135° is mandatory for correct differentiation of the particle types metallic-shiny and non-shiny.
1. To display metallic particles bright shining, in the **Image View**, on the **Display** tab, select **Pol-135** channel. **Note:** Depending on the particle surface and its orientation on the filter membrane, it might be that only smaller areas of the metallic particle appear bright shining. This is a general effect using polarization and is independent of the applied technology. **Note:** Also, the 0° or the 45° channel can be selected to display metallic particles bright shining, but it is recommended to use the 135° channel. In this setting, metallic particles are not outshined which leads to a better image quality in the report. Furthermore, foamed filter membranes show less reflections.

→ In the image, the metallic particle is displayed in Pol-135 channel.



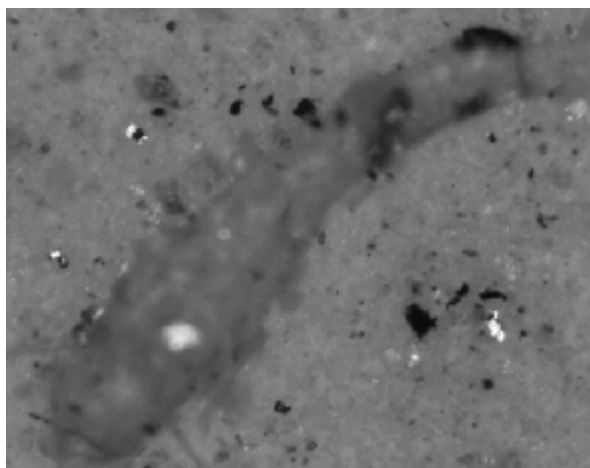
2. To display metallic particles dark black, in the **Image View**, on the **Display** tab, select **Pol-90**.

→ In the image, the metallic particle is displayed in Pol-90 channel.

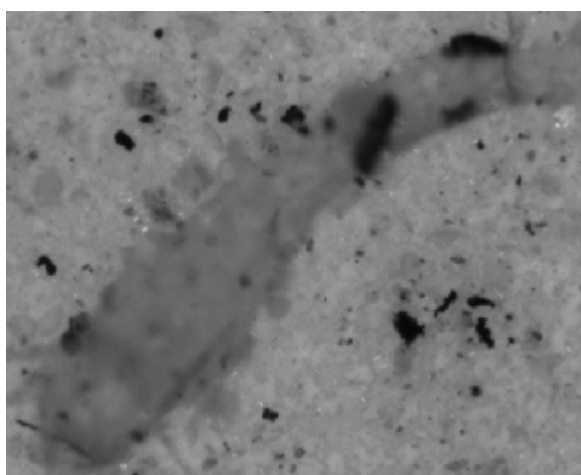


### Example: Non-metallic particle

Non-metallic particles do not react on polarization with a change in brightness from silver white to dark black. In most of the cases you can observe a change from gray to darker gray, even for those materials with reflecting brighter areas. They never get dark black when using crossed polarization.



*Fig. 59: Example: non-metallic particle is displayed in Pol-135*



*Fig. 60: Example: non-metallic particle is displayed in Pol 90*

#### See also

 [Extended Camera Tool \[► 761\]](#)

#### 7.7.4.3 Concept of Relative Image Brightness and Relative Threshold

The **Relative Image Brightness (Luminosity)** is adjusted to 55% which means that the filter background indicated by the largest peak (gray value with the highest intensity in pixel counts) appears in the middle of the gray value range:

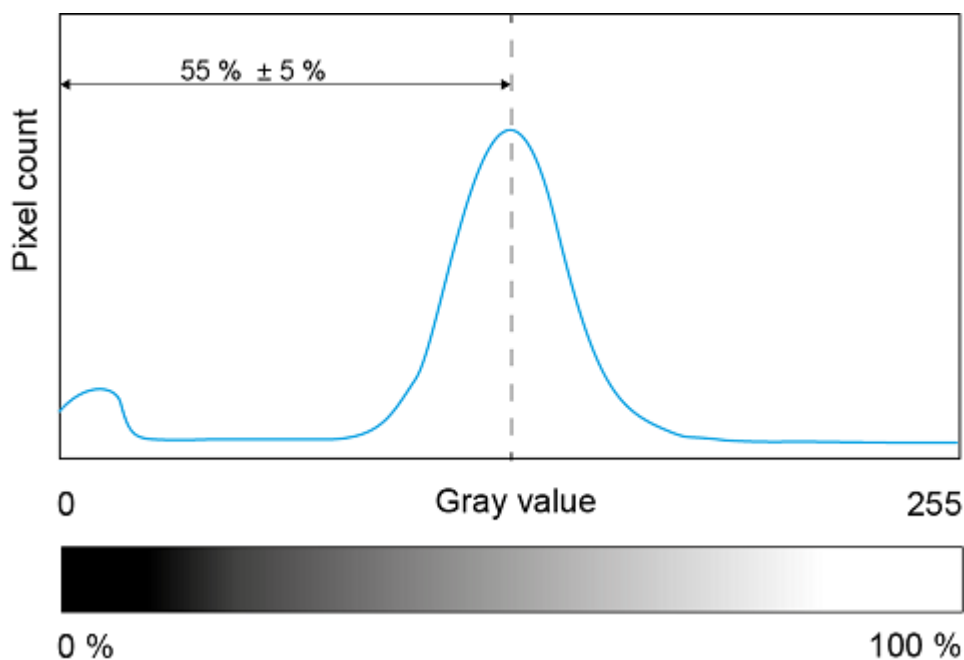


Fig. 61: Relative image brightness is adjusted to a Luminosity value of 55%. (Source: ISO 16232)

The **Relative Threshold** is set at 70% referring to the **Relative Image Brightness (Luminosity)** setting.

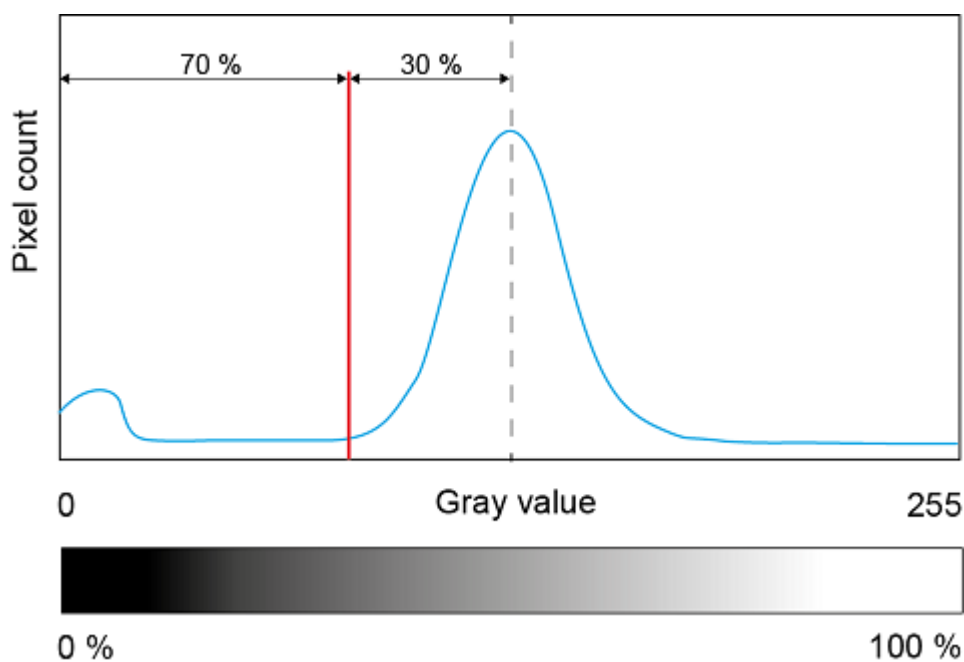


Fig. 62: Relative threshold is adjusted to a value of 70%. (Source: ISO 16232)

For information on setting the relative image brightness (Luminosity), see *Camera Tool* [▶ 754] and *Light Path Editing Tool* [▶ 777].

For information on relative threshold, see *Particle Segmentation Tool (Components)* [▶ 666].

## 7.7.5 Concept

### 7.7.5.1 Concept TCA

With the operating concept of the **TCA** module, pre-defined measurement workflows are adapted by the supervisor for the everyday routine of the operator. The performance of a measurement can be automated to such an extent that only the project data need to be entered and the entire analysis process can run automatically. Due to these automated workflows, the operator's influence on the measurement results can be reduced to a minimum. In addition to the quality gained, the time necessary for the measurement is reduced as well. Supervisors and operators can focus on their specific tasks.

The operation of the module is based on the following operating concept:

- **Modifying and managing standard templates (Supervisor)**  
Copy and edit **pre-configured standard templates** in order to adapt the particle size classification. Define specific acceptance criteria for particle results based on allowed particle numbers per size class or individual mathematical conditions in terms of length and/or width.  
Note that under **Manage Templates** you can edit the find pre-defined standard templates: one per standard and method.  
For more information, see *Standard Template Editor* [▶ 579]. For more information regarding available standards, see *Introduction to Standards* [▶ 539].  
Note that for the initial operations you must select in the **Standard Selection** workbench (in the first step of your job template), the desired standard templates.
- **Modifying and managing job templates (Supervisor)**  
Copy and edit pre-configured TCA job templates in order to adapt the workflow to your needs and to the operator routine task, manage job templates, inspect and approve job results.  
Note that under **Job Mode** you find pre-defined job templates for the assessment of particulate contamination according to the standards.  
For more information, see *Introduction to Standards* [▶ 539].
- **Running Job templates (Operator)**  
Run **TCA** job templates created by the supervisor. Inspect and revise particle results if required by using the result views.

Note: In the role of a supervisor it is possible to perform functionalities of the operator.

### General Workflow preparations

The following pre-defined job templates are included in the software, when you have licensed the **TCA** module. In this documentation, the procedure according to the existing, pre-defined job templates are described. The following job templates are available by default:

Parameter	Description
<b>Component Cleanliness</b>	You analyze loaded images or acquire images of filter membranes with particulate contamination originating from <b>engine components or medical devices</b> .
<b>Oil Cleanliness</b>	You analyze loaded images or acquire images of filter membranes with particulate contamination originating from <b>fresh and used oils and lubricants</b> , e.g. hydraulic, gear oils, or engine oils.

As a **Supervisor**, you can access/edit the job template in **Job Mode**.

The job templates always contain four major tasks:

- **Filling out an Input Form**

In this step, the operator must fill out the input form with user and specimen specific information.

- **Image Acquisition**

Image acquisition of the pre-defined specimen area.

- **Performing the Analysis**

In this step, particles are extracted by image segmentation and analyzed according to the selected standards. The detailed workflow is described in the following sections.

- **Creating a Report**

After the analysis, a report is generated containing the job results with characteristic values according to the selected standards.

Once you have finished the job, it is saved, and you can check it in the **Browse Results** view, see *Browse Results* [▶ 84].

For more information, see *Job Mode* [▶ 48].

### 7.7.5.2 Concept of S&F with TCA

#### Info

##### Shared access of LM and SEM

We recommend that light microscope and electron microscope workstations have shared access to the TCA archive using **ZEN Data Storage**. Otherwise the file transfer of the particle selection list must be done by USB stick or comparable.

The correlative workflow requires **ZEISS** hardware, software, and a correlative filter holder:

1. A suitable **ZEISS** Light Microscope (LM) for particle detection, analysis and type classification.
2. A suitable **ZEISS** Electron Microscope (EM) with EDS detector for material classification of selected particles which are considered to be potentially critical.
3. A **ZEISS** correlative filter holder with L-marker as base for LM-EM coordinate transformation.
4. Mandatory software for the correlative LM-analysis:
  - **ZEN core**
  - **ZEN core Technical Cleanliness Analysis**
  - **Connect Toolkit**
5. Mandatory software for the correlative EM/EDS analysis:
  - **SmartPI**
  - **ZEN core**
  - **Connect Toolkit**

**ZEN core Technical Cleanliness Analysis** provides two dedicated job templates for Correlative TCA LM-analysis:

- **Component Cleanliness Testing with S&F**
- **Oil Cleanliness Testing with S&F**

The correlative job template offers an additional step for the holder calibration and two options for the selection of particles for EDS analysis:

- Selection of certain particle size classes via the **Standard Template Editor**, see *Standard Template Editor* [▶ 579].
- Selection of individual particles via the in the particle gallery of the **Size Distribution View**, see *Size Distribution View* [▶ 643].

The correlative workflow starts with the LM analysis as described for Technical Cleanliness Analysis (TCA). The main differences are related to the correlative workflow, see *Correlative Workflows* [▶ 638].

After running the correlative LM Job template, all selected particles for EDS analysis are stored with their x, y-stage coordinates and the coordinates of the L-marker in the **Particle Selection EDS** file in the archive.

The EM/EDS analysis is conducted with SmartPI and operates in parallel the **Free Mode** of **ZEN core**. The **S&F Find (list)** tool is used to retrieve the selection of particles from the Particle Selection EDS file of the LM-analysis, see *S&F Find (List) Tool* [▶ 789].

### See also

- 📄 EDS File Export Tool [▶ 675]
- 📄 Particle Selection for EDS Analysis [▶ 653]

## 7.7.6 TCA with GxP

The **GxP** module enables traceable workflows through integrated microscopy hardware and software, and meets the requirements of regulated industries. If **GxP** is installed, **Technical Cleanliness Analysis** (TCA) supports it.

Any time you change a setting of a configured workflow, this is logged in an audit trail.

GxP logs if you do the following:

- If you change the standards to be applied.
- If you change data in the **Particle Segmentation** workbench, e.g. the threshold.
- If you change data in the **Size Distribution** workbench or in the **Edit View**. If you change particle types, edit, cut, merge or delete particles or parts of it.

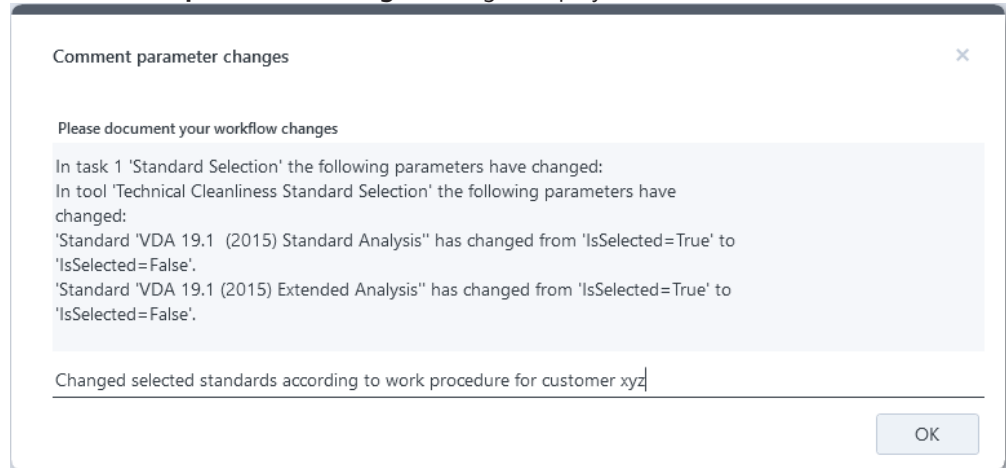
### Info

The result of conducted particle revisions is stored to the archive and to the audit trail. The resulting **Particle Revision Table** is visible in the **Browse Results** mode and generated independently of an installed **GxP** module.

### Example

- Prerequisite**
- ✓ **GxP** module is licensed.
  - ✓ Under **Maintenance > Options > GxP > GxP Options**, you have activated **Require comment on workflow changes**.
  - ✓ You have loaded a job template to run it.
1. In the **Standard Selection** workbench, change the default standard by deactivating one of the standards.

→ The **Comment parameter changes** dialog is displayed.



2. Type in a comment and click **OK**.

→ The parameter change is saved to the audit trail. If you do not add a comment, you cannot proceed or step back.

Under **Maintenance > Audit Trail**, you can display the logged changes.

The list of conducted particle revisions is stored additionally to the archive.

You can export the data to your local PC in PDF format.

### See also

GxP [▶ 376]

## 7.7.7 TCA with Intellesis Object Classification

You have the option to use **TCA** in combination with **Intellesis Object Classification** in case the particle type differentiation using the conventional method is not sufficient. This is recommended in case the metallic particles are in brightfield contrast by default very dark or almost black. **TCA** with **Intellesis Object Classification** improves the automated detection of metallic particles, especially the darker ones. As a Supervisor, you can adapt the provided job templates to your needs. For this purpose, the following job templates are provided:

- Component Cleanliness Testing with Object Classification
- Component Cleanliness Testing with Object Classification (Loaded Image)
- Component Cleanliness Testing with S&F and Object Classification

To exchange the model in TCA job templates, select the desired model in the **Intellesis Object Classification** workbench in the **Intellesis Object Classification** tool.

- Component Cleanliness Object Classification Model (Pol-90, Pol-0)
- Component Cleanliness Object Classification Model (Pol-90, Pol-45)
- Component Cleanliness Object Classification Model (Pol-90, Pol-135)

### NOTICE

#### Wrong polarization channel combination of model and image

The Pol channel combination of the selected model must be identical to the channel selection in the **Tiles Region** workbench, which is by default Pol-90 and Pol-135. To decide which channel selection is the best one for your microscope system, see *New Technology POL Camera* [▶ 569].



To tailor the pre-trained TCA **Component Cleanliness Object Classification Model** model to your needs, see *Retraining a Model for TCA* [▶ 577].

### See also

 Intellesis Object Classification [▶ 322]


## 7.7.8 Retraining a Model for TCA

To customize the pre-trained TCA **Component Cleanliness Object Classification Model**, you extend the provided ML (machine learning) ML based model by retraining with your own acquired images saved in a conventional TCA job run. To do so, export the archived image to your local file system.

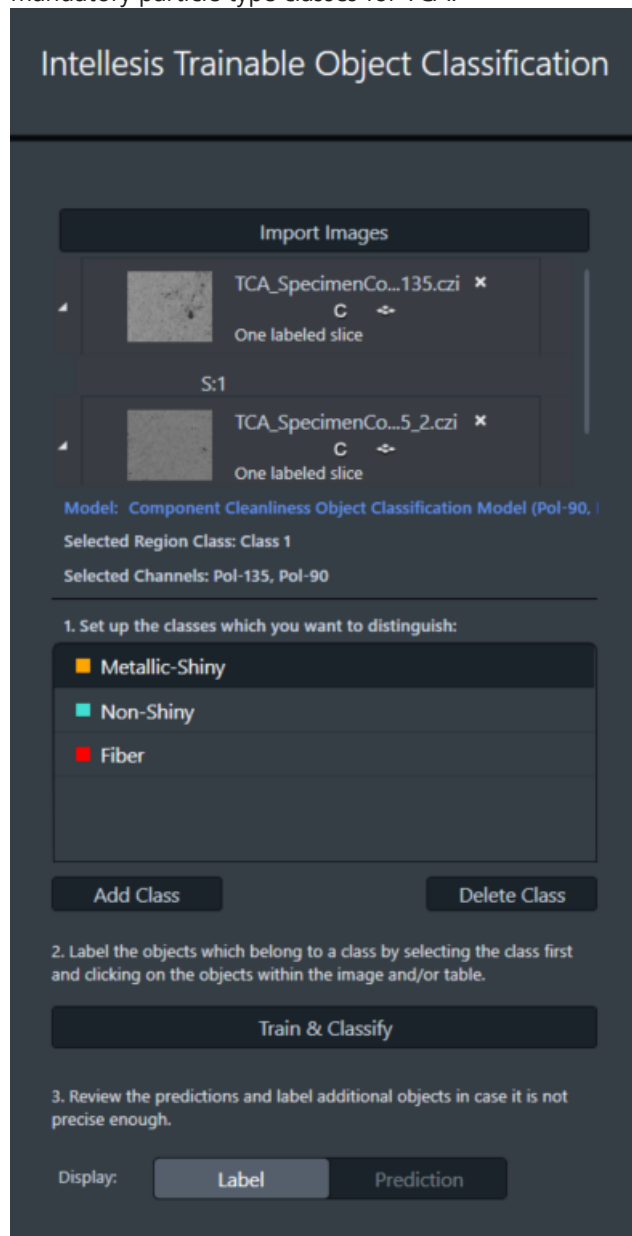
### NOTICE

#### Existing images in a pre-trained model

**Do not remove** existing images in a pre-trained ML (machine learning) based model, because the training information added with the corresponding image will be deleted from the model.

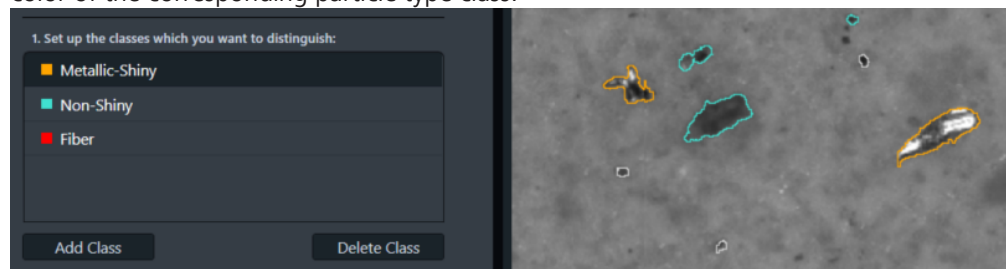
- Prerequisite**
- ✓ The TCA **Object Classification** images are installed using the **Microscopy Installer**.
  - ✓ The **Manage Templates** mode is selected.
1. From the **Show** drop-down list, select **Intellesis Object Classification Models**.  
→ The models are displayed.
  2. Select the desired TCA **Object Classification** model, and click **Copy and Edit** .

- The **Intellesis Trainable Object Classification** workbench is displayed showing the mandatory particle type classes for TCA.




3. Click **Import Images**.
  - The browser opens.
4. Select the exported image from the file system for training, and click **Open**. Be aware that the images you use for training were acquired with the same channel combination that is used in the selected model.
  - The image and a table containing the IDs of the objects in the image are displayed in the **Center Screen Area**.
5. In the classes list, select a class, and in the image, click on an object that belongs to this particle type class. Repeat this for a certain number of particles.

- You have labeled the object and assigned it to the selected class indicated by the same color of the corresponding particle type class.





6. Click **Train & Classify**.
  - The model is retrained based on the labeling. A prediction is displayed in the table.
7. Review the predictions. To do so, in the table, sort the **Prediction** column table class and then click a predicted object in the table. Check that the algorithm has correctly labeled the object in the image. If you are not sure whether an object is metallic-shiny or not, on the **Display** tab, activate **Single Channel**, and activate **Pol-135**. The metallic-shiny particles will appear with white areas. By selection of the Pol-90 channel, metallic particles must appear black throughout.  
If the results are not precise enough, label additional objects. Click again **Train & Classify**.

The model is retrained based on the labeling. The model is available at **Manage Templates > Intellesis Object Classification Models**, e.g. **Model Name (1)**. To change the model name, in the **Properties** area, click , and change the name.

Note that you must select the retrained model again in the **TCA** job template > **Intellesis Object Classification** workbench > **Intellesis Object Classification** tool.

### See also

-  Intellesis Object Classification Tool [▶ 329]
-  Applying Polarization Channel [▶ 569]

## 7.7.9 Standard Template Editor

The standard template editor provides so-called Standard Templates. A Standard Template defines rules for the particle size classification and definitions for acceptance criteria. The results based on these definitions are displayed in the **Size Distribution** view, see also *Size Distribution View* [▶ 643].

For each of the **supported standards one pre-configured standard template per method is provided**. A wizard guides you through the configuration in the standard template editor, see *Opening Standard Templates* [▶ 580].

### Info

You can select all standard templates in the job template using the **Standard Selection Tool**, see also *Technical Cleanliness Standard Selection Tool* [▶ 665].

As a Supervisor, you can copy and edit standard templates to address company internal guidelines. Note that the standard template is also saved in XML-format as a .cztct file on your local drive under <C:\ProgramData\Carl Zeiss\ZENCore\UserArchive\Technical Cleanliness Standards>.


### Work in the Standard Template Editor

To adapt the data according to your needs, set the value ranges for each particle size class in the **Center Screen Area**. Add acceptance criteria or select certain particle size classes for the particle height measurement in a subsequent job run. To select additionally particle size classes for EM/EDS measurement, active licenses for **ZEN Connect** and **ZEN connect 2D add-on** are required.

You can modify the existing size classification by length or width. This includes the option to add or delete size classes generating your own customized size classification.

Modify the selected standard template by the following:


- Changing the size classification for length or width. The default values are **Feret Max** and **Feret Min**.
- As an option: changing the measurement parameter for length and width. This is only recommended for **standard independent** particle size classification.
- Defining acceptance criteria for allowed particle number per size class.
- Defining acceptance criteria according to the logic defined. These criteria are based on mathematical conditions for particle length and/or width. The default values are **Feret Max** and **Feret Min**.

You save the standard template any time by leaving the standard template editor by clicking **Home**  and then saving your changes.

#### 7.7.9.1 Opening Standard Templates

It is not possible to change standard templates provided with the TCA software - this is indicated by a small lock icon. To modify it, create a copy and modify the copy.

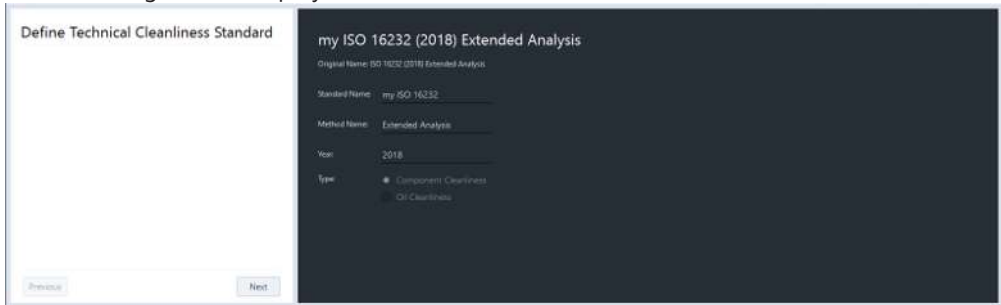
**Prerequisite** ✓ The **Manage Templates** mode is selected.

1. Select the list entry **Standards Technical Cleanliness** using the **Show** drop-down list.  
→ The template list shows the provided standard templates.
2. Right-click the desired template and select **Copy & Edit**. Alternatively, in the **Toolbar**, click the **Copy & Edit** icon:  
  
→ The step **Define Technical Cleanliness Standard** opens, see *Defining a Standard Template* [▶ 580].

#### 7.7.9.2 Defining a Standard Template

**Prerequisite** ✓ The **Standard Template Editor** is open.

1. Open step **Define Technical Cleanliness Standard**.  
→ The following view is displayed.



2. Fill in data in the **Standard Name** field, **Method Name** field, and **Year** field.

- The **Type** is preselected and depends on the application. The following types are available: **Component Cleanliness** and **Oil Cleanliness**
  - The selected template is used in the respective job template for oil or component cleanliness.
  - The information is used for the template name in the order *Standard name (year) method* when saving the template.
  - The information is also used in the **Technical Cleanliness Standard Selection** tool. This tool is located in the first step of the job template.
3. Click **Next**.
    - The step **Basic Template Settings** opens, see *Defining Basic Template Settings* [▶ 581].

### 7.7.9.3 Defining Basic Template Settings

**Prerequisite** ✓ You have defined the standard name.

1. Open step **Basic Template Settings**.
  - The following view is displayed.



2. Select the approval method and define individual acceptance criteria based on the following:
  - Select **Particle Numbers per Size Class** to display the results in the **Size Distribution** view in the class chart and in the class table diagram, see *Class Chart - Diagram* [▶ 645].
  - Select **Particle Size** to display the results in the **Size Distribution** view in the scatter plot, see *Scatter Plot* [▶ 647]. Note that only the selected approval criteria is applied. If you want to apply both approval criteria at the same time, generate a second standard template and add both standard templates to the job template.
  - The impact of the acceptance criteria is displayed in green color indicating particle results are below the defined limits; red color means that particle results are above defined limits.
  - To filter particles exceeding the defined limits, click the **Filter NOK** button in the **Size Distribution** view.
  - If no acceptance criteria is defined, the corresponding table and/or chart is colored in gray.
3. Click **Next**.
  - The **Define Length Classes** step is displayed, see *Defining Length and Width Classes (Workbench Area)* [▶ 581].

### 7.7.9.4 Defining Length and Width Classes (Workbench Area)

Define individual particle length and width size classes in the **Center Screen Area** if required, and select the desired acceptance criteria in the **Workbench Area**. The number of displayed columns is dependent on the settings in the workbench area.

Info

In the **Image Gallery**, all particles are displayed by default from 5 µm length and width onwards. As a Supervisor, you can change the minimum size of the displayed particles in the **Region Filter** tool in the **Region Filter** workbench. By default, the **Region Filter** workbench is set to run silent, see *Region Filter* [▶ 263].

**Prerequisite** ✓ You have defined the basic template settings.

1. Open step **Define Length Classes**.  
→ The following view is displayed.

**Define Length Classes**

Classification Parameter

Forest Map

Selection

☒ Particle Height Measurement

☐ EDS Measurement with SEM (Cumulative Workflow)

Operator for Size Classification

☐ ≤ Length <

☒ < Length ≤

Acceptance Criterion

☒ Allowed Number of Particles

Normalization Parameter (Component) Absolute Count

Operator for Acceptance Criterion

☐ <

☒ ≤

☐ ≥

Allowed Number of Particles

☐ Same for all Types

☒ Separate for each Type

Previous Next

**Classes**

Name	Color	Length [µm]		Allowed Number of Particles			Select for Particle Height Measurement		
		Lower Limit	Upper Limit	Min-Story	Max-Story	Filter	Min-Story	Max-Story	
B		5	15	0.00	0.00	0.00			
C		15	25	0.00	0.00	0.00			
D		25	50	0.00	0.00	0.00			
E		50	100	0.00	0.00	0.00			
F		100	150	0.00	0.00	0.00			
G		150	200	0.00	0.00	0.00			
H		200	400	0.00	0.00	0.00			
I		400	600	0.00	0.00	0.00			

- Define the settings. The parameters to be set are for length and width classification identical.

**Define Length Classes**

Classification Parameter 1

Feret Max

Selection 2

☒ Particle Height Measurement

☐ EDS Measurement with SEM (Correlative Workflow)

Operator for Size Classification 3

☐  $\leq$  Length <

☒ < Length  $\leq$

Acceptance Criterion 4

☒ Allowed Number of Particles

Normalization Parameter (Components) Absolute Count

Operator for Acceptance Criterion 5

☐ <

☒  $\leq$

☐ =

Allowed Number of Particles 6

☐ Same for all Types

☒ Separate for each Type

Previous Next

In the workbench area, define the length or width classes. Select the **Classification Parameter** (1).

You have the following options:

**Feret Max**, **Length X** (for length), **Length Y** (for width), **Fiber Length**, and **ECD**, see *Measurement Parameters for Length and Width Classification* [▶ 585].

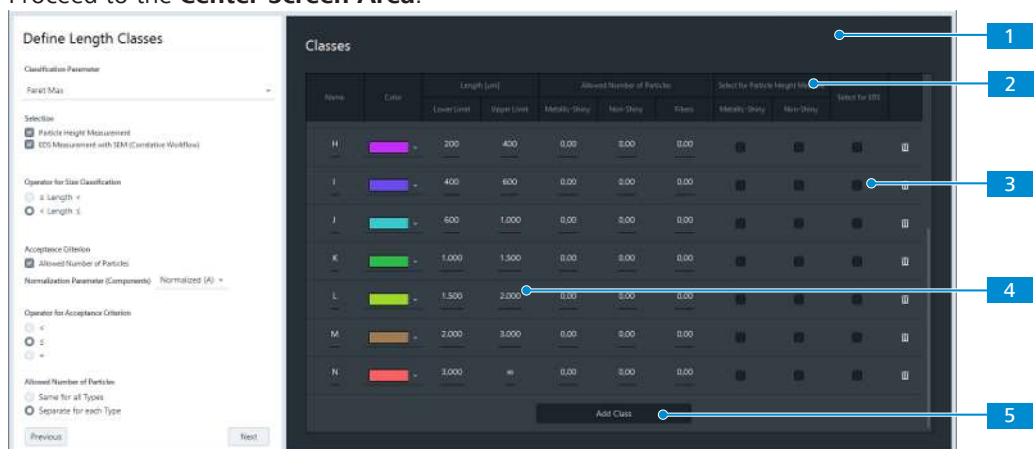
Note that the selection of other classification parameter than the default parameter is only recommended for non-standard based analysis.

3. Activate the **Selection** (2).  
You have the following options:  
Activate **Particle Height Measurement** to show additional columns in the center area to define the particles of certain size classes to be considered for particle height measurement.  
Activate **EDS Measurement with SEM (Correlative Workflow)** for a correlative LM/EM-EDS workflow using the **S&F Find (List)** tool. If activated, additional columns are shown in the **Classes** table to define the particles for selection of particles for EM/EDS analysis.
4. Select the **Operator for Size Classification** (3) to define the handling at the class border limits for the particle size classification.
5. In the **Acceptance Criterion** section, activate **Allowed Number of Particles** (4) for the definition of acceptance criteria based on the allowed maximum particle number per size class. You have the following options:  
**Absolut Count** (absolute particle number), **Normalized (N)** (= absolute particle number/component number), **Normalized (A)** (= absolute particle number/wetted component area[cm<sup>2</sup>]), **Normalized (V)** (= absolute particle number/wetted component volume [cm<sup>3</sup>]).
6. Select the **Operator for Acceptance Criterion** (5) to define the handling at the class border limit for the definition of acceptance criteria.
7. Select the **Allowed Number of Particles** (6). This function is only active, if in the **Acceptance Criterion** section **Allowed Number of Particles** is activated. Here you define whether to set the allowed number of particles per class separately for each particle type or to use the same value for all types. Keep in mind that the approval rating (OK, NOK) per size class is based on the single particle type approval and not on the absolute count of particles. This is important if you select analysis type **All** for your TCA report. Therefore, it is recommended to define the allowed number of particles separately for each type.  
Select **Same for all Types** to define the allowed particle number per size class and use the same definition for all particle types.  
Select **Separate for each Type** to define the allowed particle number per size class specific for each particle type. This option is recommended.  
→ The displayed columns in the **Classes** table is updated and depend on the settings in the workbench area.
8. Proceed to the **Classes** table, see *Defining Length and Width Classes (Center Screen Area)* [▶ 584]

### 7.7.9.5 Defining Length and Width Classes (Center Screen Area)

**Prerequisite** ✓ You have defined the settings in the **Workbench Area**.

1. Proceed to the **Center Screen Area**.



2. Define individual acceptance criteria by the allowed number of particles per size class (1).  
Add limit values for the allowed number of particles per size class.



- The result is displayed in the **Size Distribution** view, see *Class Chart - Length Class Table* [▶ 646]. The impact of the acceptance criteria is displayed in green color indicating particle results are below the defined limits; red color means that particle results are above defined limits.
- 3. Define particle size classes for height measurement of particles (2). Activate the size classes considered for particle height measurement.
  - The result is displayed in the gallery of the **Size Distribution** view. Optionally, mark or unmark desired particles manually in the **Particle Gallery**, see *Particle Height Measurement* [▶ 654].
- 4. For a correlative LM/EM-EDS workflow using the **S&F Find (List)** tool:
 

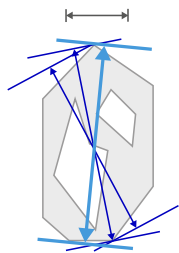
Define a selection of particles automatically provided for EM/EDS analysis in a correlative workflow (3).

  - By selection of a certain particle size class all particles belonging to this size class are added to the EDS particle selection table, see *Particle Selection for EDS Analysis* [▶ 653].
- 5. Define the particle size classification (4).
  - The red numbers indicate that the entered values are wrong. A tool tip informs you on the error.
- 6. To add a new row for defining the next particle size class, click **Add Class** (5).
- 7. Click **Next**.
  - The **Define Width Classes** step is displayed.
- 8. Define the particle width classification in the same way as described before.
- 9. Click **Next**.
  - The step **Define Approval Logic** is displayed, see *Defining the Approval Logic* [▶ 586].

#### 7.7.9.5.1 Measurement Parameters for Length and Width Classification

The following size classification parameters are available: The default value for length is Feret Max and the default value for the width is Feret Min.

Feret Maximum

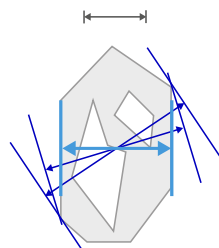


Maximum feret of a region

The maximum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The maximum value determined is the maximum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )

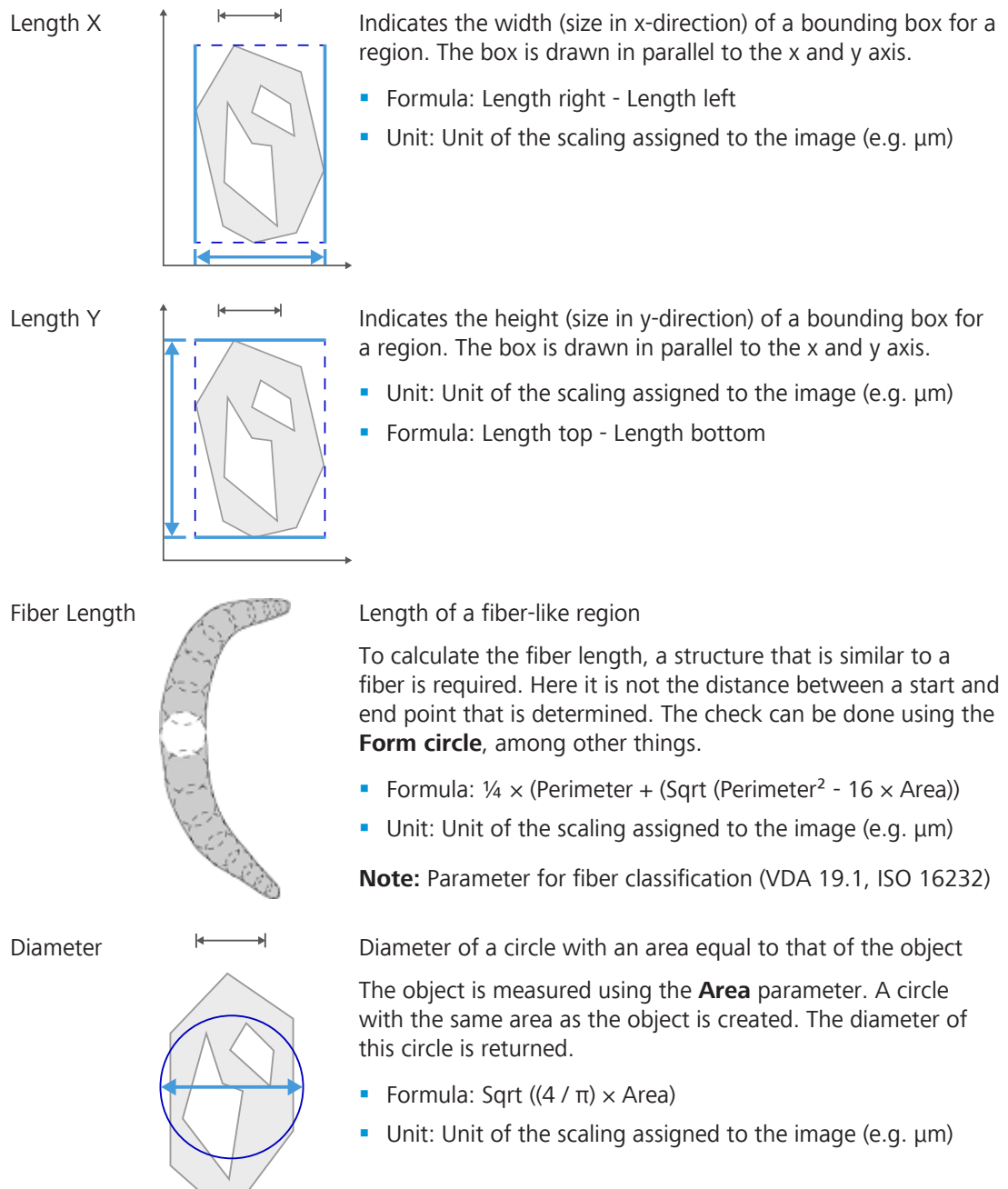
Feret Minimum



Minimum feret of a region

The minimum feret of a region is determined on the basis of distance measurements. Two straight lines are positioned on opposite sides of the object, like a sliding caliper, at 128 angle positions. The corresponding distance is measured for each angle position. The minimum value determined is the minimum feret.

- Unit: Unit of the scaling assigned to the image (e.g.  $\mu\text{m}$ )



#### 7.7.9.6 Defining the Approval Logic

The approval logic is based on definable conditions for particle length and width. Length and width are based on the definition of the measurement parameter in the steps **Define Length Classes** and **Define Width Classes**. Particles which exceed the defined size limits are colored in red. To filter them, click **Filter NOK** in the **Scatter Plot** of the **Size Distribution View**. All particles lying under the defined size limit are colored in green.

**Prerequisite** ✓ You have defined the length and width classes.

1. Open step **Define Approval Logic**.

→ The following view is displayed:

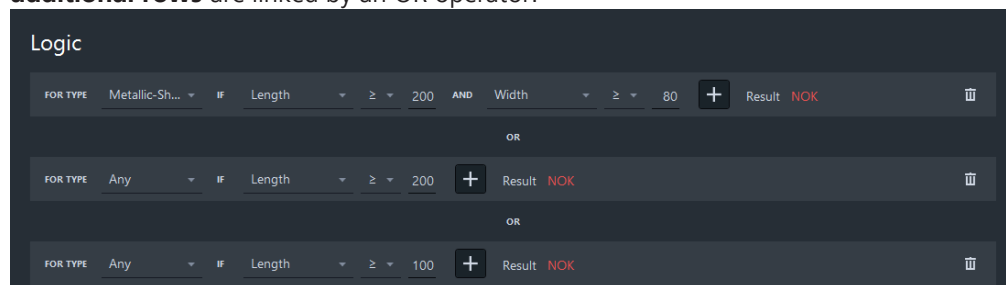


2. In the **FOR TYPE** drop down list, select the particle type. Add the condition, e.g., length or width, and use logical operations for defining the allowed size range. You can set further conditions using the + icon.

→ The displayed particles are indicated by red colored dots in the scatter plot of the **Size Distribution** view.

3. If desired, add a second approval definition. Click **Add Condition** to do so, and add a definition.

→ Multiple conditions within one row are linked by an AND operator. Further conditions in **additional rows** are linked by an OR operator.



→ All conditions are applied automatically and the result is presented in the **Scatter Plot** of the **Size Distribution View**.

4. Click **Next**.

→ You have adapted the standard to you needs.

→ The step Define Cleanliness Codes is displayed and read-only, see *Cleanliness Classification* [▶ 587] and *Cleanliness Codes* [▶ 589].

## See also

Scatter Plot [▶ 647]

### 7.7.9.7 Cleanliness Classification

For each of the supported standards the corresponding cleanliness classes are shown and cannot be modified. Cleanliness classes allocate normalized particle numbers into cleanliness level. For more information on the supported standards, see *Introduction to Standards* [▶ 539].

The screenshot shows a software window titled "Define Cleanliness Codes". It contains four main sections, each with a blue dot and a line pointing to a numbered blue box on the right:

- 1 Size Classes**: A dropdown menu currently showing "All".
- 2 Class Table Usage**: Two radio button options: "Identical Class Table for all Particle Size Classes" (selected) and "Individual Class Tables for each Particle Size Class".
- 3 Approval Condition for Number of Particles**: Three options: a radio button for " $\leq \dots <$ ", a selected radio button for " $< \dots \leq$ ", and a checked checkbox for "Include Lower Limit in Lowest Class".
- 4 Cleanliness Code Notation**: Two radio button options: "With Class Code Identifiers" (selected) and "Without Class Code Identifiers".

At the bottom of the window are two buttons: "Previous" on the left and "Next" on the right.

**1 Size Classes**

Displays size classes which are identical to the size class definition in the step **Define Length Classes**.

**2 Class Table Usage**

Displays the defined cleanliness classes and the corresponding cleanliness level (codes). Decides whether one or more cleanliness class tables are applied to the particle classification results:

**Identical Class Table for all Size Classes:** Applies one cleanliness code classification table to all particle size classes;

**Individual Class Tables for each Size Class:** Applies one individual cleanliness code classification table per particle size class, i.e. each particle size class has its own cleanliness classification table.

**3 Operator for Cleanliness Classes**

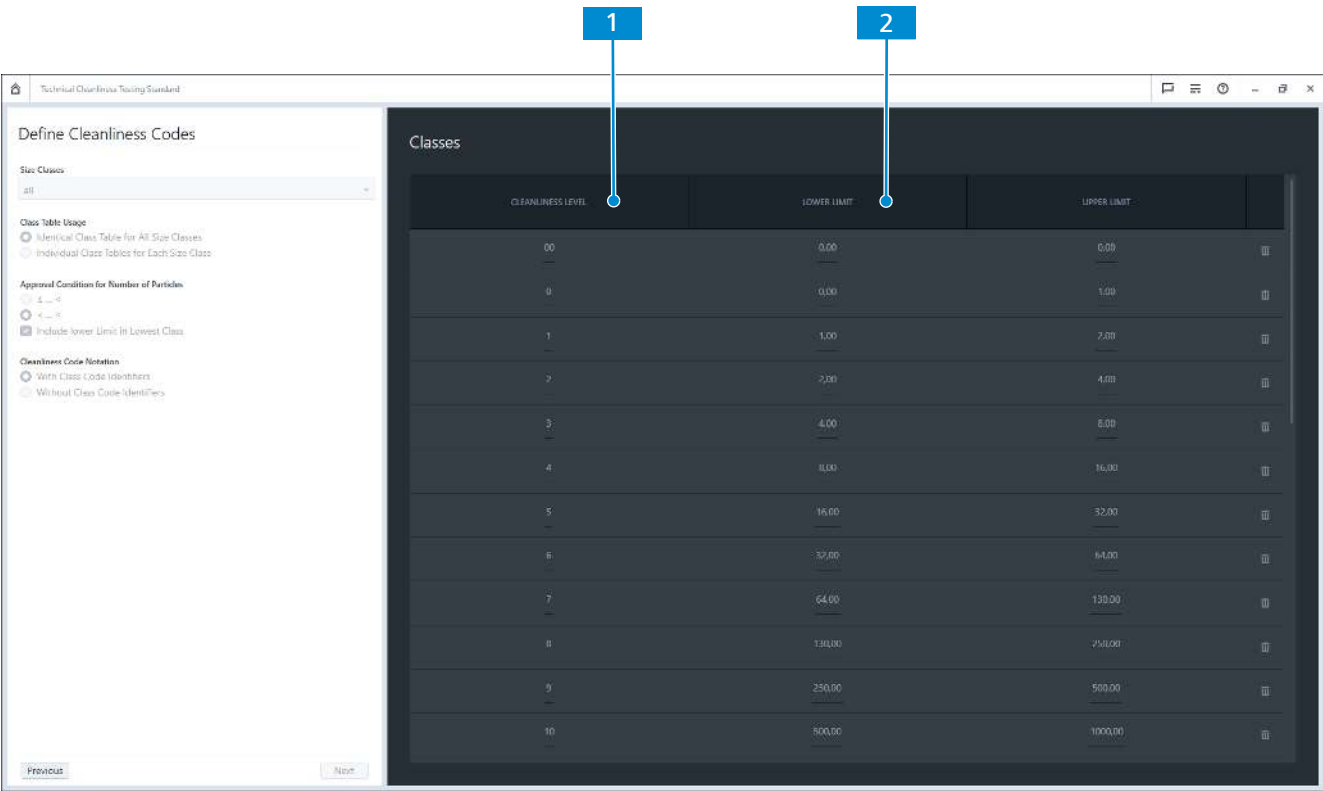
Defines the handling of the class border limits.

- 4
- Options for displaying the cleanliness classification in the condensed one-line notation with class names or without class names.

**Example:**  
**CCC=1/2/3/4** or **CCC=A1/B2/C3/D4**.

The latter example shows a notation in which the letter represents a certain particle size class and the number stands for the corresponding cleanliness level, indicating the detected and normalized number of particles which belong to this particle size class.

7.7.9.8 Cleanliness Codes



- 1
- Cleanliness Level**  
Displays the level and counts onwards when you add a cleanliness level.
- 2
- Lower Limit and Upper Limit**  
Defines the value range of the cleanliness classes.

**Note:** For **NAS 1638** and **SAE AS 4059** the cleanliness levels are not displayed in the **Width Class** tables of the **Size Distribution** view. This is indicated by **n.a.**

7.7.10 Tasks and Workflows

7.7.10.1 Overview of Workflows

Name of Job Template	Short Description	Description
Component Cleanliness Testing	Overview: Image Acquisition Workflow for Component Cleanliness Analysis	With this job template you analyze the particle size distribution and the particle types metallic-shiny, non-shiny, and fiber extracted

Name of Job Template	Short Description	Description
	<p><i>Operator Overview: Workflow with Image Acquisition (Components)</i> [▶ 632]</p> <p><i>Supervisor Overview: Workflow with Image Acquisition (Components)</i> [▶ 601]</p>	from components and medical devices by filtration. Use this job template if you acquire images of filter membrane samples.
Component Cleanliness Testing (Loaded Images)	<p>Overview: Workflow with loaded images for Component Cleanliness Analysis</p> <p><i>Operator Overview: Workflow with Loaded Image (Component)</i> [▶ 629]</p> <p><i>Supervisor Overview: Workflow with Loaded Image (Components)</i> [▶ 605]</p>	With this job template you analyze the particle size distribution and the particle types metallic-shiny, non-shiny, and fiber extracted from components and medical devices by filtration. Use this job template if you work with images loaded from your file system or archive.
Component Cleanliness Testing with ML based Object Classification (Loaded Images)	<p>Overview: Workflow with Loaded Images for Component Cleanliness Analysis with ML (machine learning) based Object Classification</p> <p><i>Operator Overview: Workflow with Loaded Image with AI based Object Classification (Components)</i> [▶ 637]</p> <p><i>Supervisor Overview: Workflow with Loaded Image with AI based Object Classification (Components)</i> [▶ 613]</p>	With this job template you analyze the particle size distribution and the particle types metallic-shiny, non-shiny, and fiber extracted from components and medical devices by filtration. For enhanced particle type differentiation the ML (machine learning) based Object Classification is used in combination with the selected standard. Use this job template if you work with images loaded from your file system.
Component Cleanliness Testing with S&F	<p>Overview: Correlative Workflow with S&amp;F for Component Cleanliness Analysis at the LM</p> <p><i>Overview: Image Acquisition Workflow TCA with S&amp;F at the LM for Correlative Analysis</i> [▶ 638]</p>	<p>With this job template you analyze the particle size distribution and the particle types metallic-shiny, non-shiny, and fiber, extracted from components and medical devices by filtration.</p> <p>You acquire an image with the LM that you continue to analyze on an EM with EDS. Use this job template for correlative component cleanliness testing at the LM.</p>
Component Cleanliness Testing with ML based Object Classification	Overview: Image Acquisition Workflow with ML based Object Classification for Component Cleanliness Analysis	With this job template you analyze the particle size distribution and the particle types metallic-shiny, non-shiny, and fiber extracted from components and medical devices by filtration. For

Name of Job Template	Short Description	Description
	<p><i>Operator Overview: Workflow with Image Acquisition with AI based Object Classification (Components)</i> [▶ 635]</p> <p><i>Supervisor Overview: Workflow with Image Acquisition with AI based Object Classification (Components)</i> [▶ 609]</p>	enhanced particle type differentiation the ML (machine learning) based Object Classification is used in combination with the selected standard. Use this job template if you acquire images of filter membrane samples.
Component Cleanliness Testing with S&F and ML based Object Classification	<p>Overview: Correlative Workflow with S&amp;F and ML based Object Classification for Component Cleanliness Analysis at the LM</p> <p><i>Overview: Correlative Workflow with TCA, S&amp;F and ML based Object Classification at the LM</i> [▶ 640]</p>	<p>With this job template you analyze the particle size distribution and the particle types metallic-shiny, non-shiny, and fiber, extracted from components and medical devices by filtration.</p> <p>You acquire an image with the LM that you continue to analyze on an EM with EDS. For enhanced particle type differentiation the ML (machine learning) based Object Classification is used in combination with the selected standard.</p>
Technical Cleanliness (VDA 19.2 Joint Result)	<p>Overview: Workflow for applying the Illig Method</p> <p><i>Operator Overview: Workflow for Illig Method</i> [▶ 634]</p> <p><i>Supervisor Overview: Workflow for Illig Method</i> [▶ 624]</p>	<p>Calculates the Illig Value for environmental cleanliness. This workflow uses data from already generated job results. This job template is only available for component cleanliness testing.</p>
Oil Cleanliness Testing	<p>Overview: Workflow for Oil Analysis</p> <p><i>Operator Overview: Workflow with Image Acquisition (Oil)</i> [▶ 630]</p> <p><i>Supervisor Overview: Workflow with Image Acquisition (Oil)</i> [▶ 617]</p>	With this job template you analyze the particle size distribution and of particle originating from oils and lubricants. Use this job template if you acquire images of filter membrane samples.
Oil Cleanliness Testing (Loaded Images)	<p>Overview: Workflow with loaded images for Oil Analysis</p> <p><i>Operator Overview: Workflow with Loaded Image (Oil)</i> [▶ 633]</p>	With this job template you analyze the particle size distribution and particle types originating from oils and lubricants. Use this job template if you work with images loaded from your file system or archive.

Name of Job Template	Short Description	Description
	<i>Supervisor Overview: Workflow with Loaded Image (Oil) [▶ 621]</i>	
Oil Cleanliness Testing with S&F	Overview: Correlative Workflow with S&F for Oil Analysis at the LM  <i>Overview: Image Acquisition Workflow TCA with S&amp;F at the LM for Correlative Analysis [▶ 638]</i>	With this job template you analyze the particle size distribution.  You acquire an image with the LM that you continue to analyze on an EM with EDS. Use this template for correlative oil cleanliness testing with an LM.

### 7.7.10.2 Supervisor Workflow

The **TCA** module offers different degrees of automation. It depends on the experience of the operator and the type of specimen, to which degree the workflow should be automated. In the role of the **Supervisor**, you create the workflows for the **Operators** based on pre-defined job templates in **Manage Templates**. In general, the Supervisor modifies the degree of automation using following two options: Firstly, the Supervisor can set a task to **Run Silent**, i.e. the selected working step is performed but not visible to the Operator. The results of silent steps are saved in the archive. Secondly, the Supervisor can define which part of the tool shall be visible to the Operator.

#### General Workflow of the Supervisor

Step	Supervisor task
1	<b>Optional:</b> Activate <b>GxP</b> for the cleanliness analysis. For more information, see <i>TCA with GxP</i> [▶ 575].
2	<b>Optional:</b> Modify existing standards to company needs. In case <b>no differentiation on metallic-shiny and non-shiny</b> particles is desired, the <b>oil cleanliness standard templates</b> is a good choice. For more information, see <i>Supported Standards</i> [▶ 540] and <i>Standard Template Editor</i> [▶ 579].
3	Select the corresponding job template (component or oil cleanliness). In case <b>no differentiation on metallic-shiny and non-shiny</b> particles is desired, the <b>oil cleanliness job template</b> is a good choice. For more information, see <i>Concept TCA</i> [▶ 573].
4	Select standards relevant for the application (component or oil cleanliness). For more information, see <i>Supported Standards</i> [▶ 540].  <b>Optional:</b> Select an existing input form.  <b>NOTICE! For particle height measurement and correlative analysis only single standard analysis is possible, only one standard must be selected</b>
5	Configure default image acquisition settings. Best practice for image acquisition, see below.



Step	Supervisor task
	Configure specimen acquisition settings. For more information, see <ul style="list-style-type: none"> <li>▪ <i>New Technology POL Camera</i> [▶ 569]</li> <li>▪ <i>Applying Polarization Channel</i> [▶ 569]</li> <li>▪ <i>Tiles (measurement area) Workbench</i> [▶ 523]</li> </ul>
6	Adjust standard specific parameter (normalization reference, particle load). For more information, see <ul style="list-style-type: none"> <li>▪ <i>Common Characteristics</i> [▶ 539]</li> <li>▪ <i>Supported Standards</i> [▶ 540]</li> </ul>
7	Configure default EDF acquisition settings. For more information, see <ul style="list-style-type: none"> <li>▪ <i>Light Path Editing Tool</i> [▶ 777]</li> <li>▪ <i>Defining an Image Acquisition Profile</i> [▶ 594]</li> </ul>

#### 7.7.10.2.1 Acquiring Images - Best Practice

**Technical Cleanliness Analysis** is a standard based application, this means that the minimum technical requirements, hardware and software settings shall be fulfilled. In order to receive results which are mainly operator independent, the initial hardware and software settings shall be pre-defined by the supervisor in the following way.

##### Info

For **Technical Cleanliness Analysis** with **Axiocam 705 pol** two Polarizer are mandatory. The **Axiocam 705** is one Polarizer and the second polarizer must be placed in the microscope light path as well. Both directions of polarization must be 90° to each other.

To set up the system, the following is performed:

- The desired job template and the standards to be analyzed are selected, see *Standard Template Editor* [▶ 579].
- The **Tiles (measurement area)** workbench is selected, see *Tiles (measurement area) Workbench* [▶ 523].
- The live image is well focused and shows a mean image brightness.
- In the **Extended Camera** tool, the **B/W** mode of the camera is selected, see *Extended Camera Tool* [▶ 761].
- To make sure that the single tiles are oriented correct to each other, the camera-stage alignment is performed.

On the **Tiles (measurement area)** workbench, perform the following steps:

1. *Applying the Shading Correction* [▶ 594]
2. *Defining an Image Acquisition Profile* [▶ 594]
3. *Defining the Tiles Region Setting* [▶ 595]
4. *Defining the Focus Correction Setting* [▶ 596]
5. *Optional: Using TCA Standard-Specific Calculation workbench* [▶ 596]

### 7.7.10.2.2 Applying the Shading Correction

- Prerequisite** ✓ You have set up the system. For more information, see *Acquiring Images - Best Practice* [► 593].
- ✓ The **Extended Camera** tool is selected, see *Extended Camera Tool* [► 761].
1. To perform the **Shading Correction**, in the **Extended Camera** tool, in the section **Model Specific**, select **Raw Image** in the **Polarization Channel Live**, open the section **Post Processing** and perform the shading correction, for example on a plain filter membrane. To do so, slightly defocus the membrane until the surface texture disappears.
  2. Click **Define**.
  3. Inspect the results of Shading Correction by switching between the channels using **Display Channels**.
    - ➔ The selected channel shows a comparable image brightness of the membrane filter for all selected polarization channels. Note that a shading effect has an impact on the image analysis results due to an inhomogeneous brightness distribution. The shading correction shall be applied to generate a homogeneous illuminated image as base for a successful automated image analysis.

You have applied and verified the **Shading Correction**.

In the next step, you define an image acquisition profile.

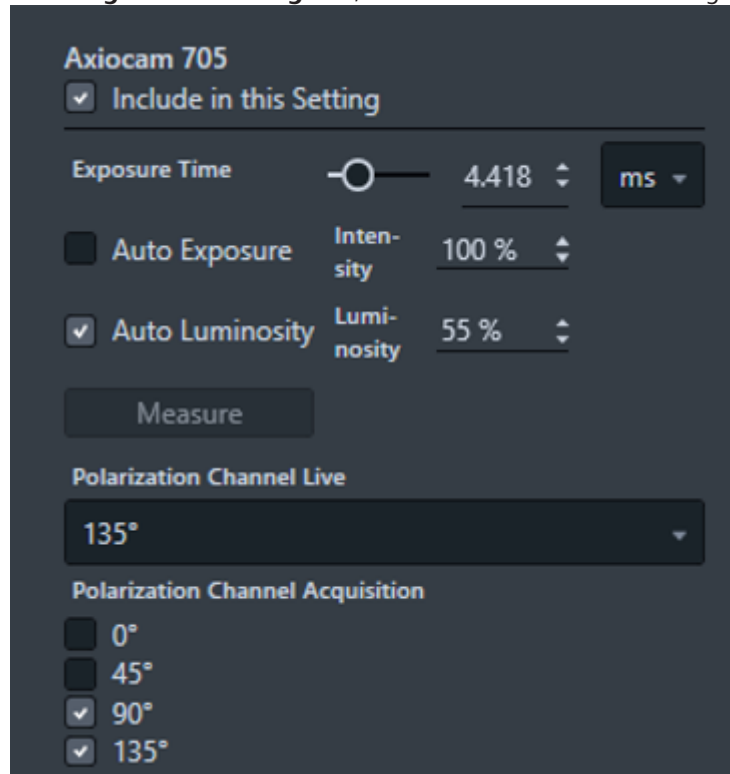
#### See also

- 📄 Defining an Image Acquisition Profile [► 594]

### 7.7.10.2.3 Defining an Image Acquisition Profile

- Prerequisite** ✓ You have applied the shading correction, see *Applying the Shading Correction* [► 594].
- ✓ The **Light Path Editing** tool is selected, see *Light Path Editing Tool* [► 777].

1. In the **Light Path Editing** tool, define the initial camera settings for **Axiocam 705 pol.**



2. To do so, perform the following:
  - Select a suitable luminosity value.
  - Click the **Measure** button.
  - Activate the **Auto Luminosity** checkbox.
 Note that the measure button is only active when **Auto Luminosity** is not activated. For more information, see *New Technology POL Camera* [▶ 569] and *Applying Polarization Channel* [▶ 569].

You have defined an **Image Acquisition Profile**.

You have configured initial image acquisition settings for your microscope hardware and camera. Settings recommended for ISO 16232 and VDA 19.1. For more information, see *VDA 19 Part 1; Inspection of Component Cleanliness* [▶ 541] and *ISO 16232 Road Vehicle. Cleanliness of Components and Systems* [▶ 547].

In the next step, you define the tiles region setting.

### See also

- 📖 Defining the Tiles Region Setting [▶ 595]
- 📖 Common Characteristics [▶ 539]
- 📖 TCA Standard-Specific Settings Workbench [▶ 663]
- 📖 Supported Standards [▶ 540]

#### 7.7.10.2.4 Defining the Tiles Region Setting



- Prerequisite**
- ✓ You have defined an image acquisition profile, see *Defining an Image Acquisition Profile* [▶ 594].
  - ✓ You have selected the **Tiles Setup (measurement area)** tool, see *Tiles Setup (measurement area) Tool* [▶ 533].

1. For each of your specimens define an individual tiles region. The basis for the tiles region definition is the **Diameter** setting which is used for calculation of the corresponding tiles region area. Adjust the diameter to your **effective filter area**. This is the smallest possible area for component cleanliness analysis according to common standards. For oil cleanliness, often a smaller diameter which is extrapolated to the effective filter area is used.

You have configured **N** tiles regions for **N** specimen.

In the next step, you define the focus correction setting.

### See also

-  Defining the Focus Correction Setting [▶ 596]
-  Common Characteristics [▶ 539]

#### 7.7.10.2.5 Defining the Focus Correction Setting

- Prerequisite**
- ✓ You have defined the tiles region setting, see *Defining the Tiles Region Setting* [▶ 595].
  - ✓ The **Focus Correction** tool is selected, see *Focus Correction Tool* [▶ 771].
1. Depending on the waviness of your specimen, more than five focus points are recommended. To define your focus points, use the **Onion Skin Model** in the section **Support Focus Point Distribution**.

You have defined a focus surface for your specimen.

#### 7.7.10.2.6 Optional: Using TCA Standard-Specific Calculation workbench

1. In the **TCA Standard-Specific Calculation** workbench, select the filter membrane in use.
2. Select one or more normalization parameter and configure your initial settings.
3. Decide whether fibers shall be part of the class **All** results. Default setting is without. For more information, see *Common Characteristics* [▶ 539].

#### 7.7.10.2.7 Creating Workflows Using the Workflow Creator Wizard

The Workflow Creator Wizard is a tool that helps you to select the correct job template for your application and measurement tasks. The Wizards guides you to the following steps:

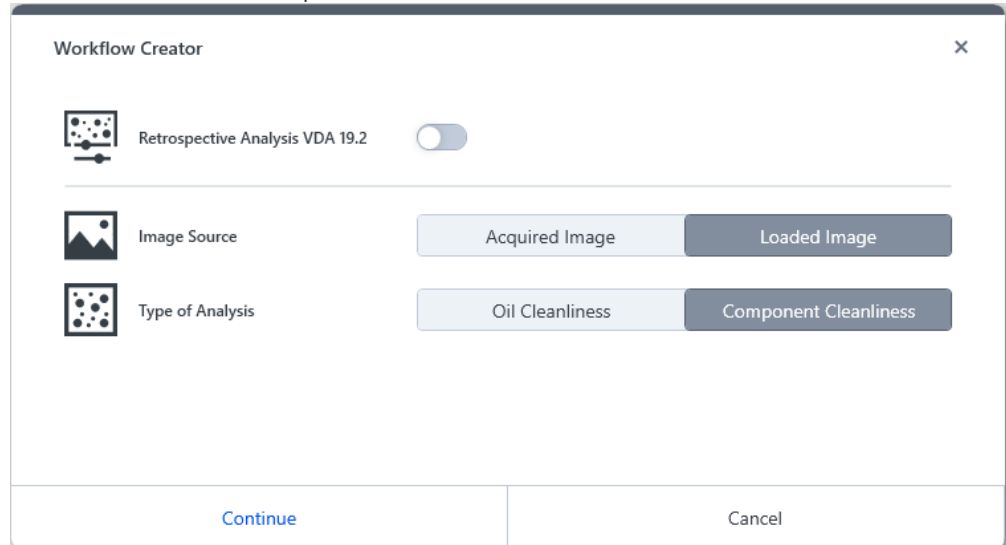
1. Selection of the image source and the type of analysis.
2. Selection of the following:
  - Enhanced type classification, a machine learning based approach for particle type classification.
  - Correlative LM/EM analysis
  - Particle height measurement

Once finished, the generated job template can be configured as usual in the different tasks and tools.

1. In **Job Mode**, under **Material Analysis**, select **Technical Cleanliness**.
2. On the top in the center area, click

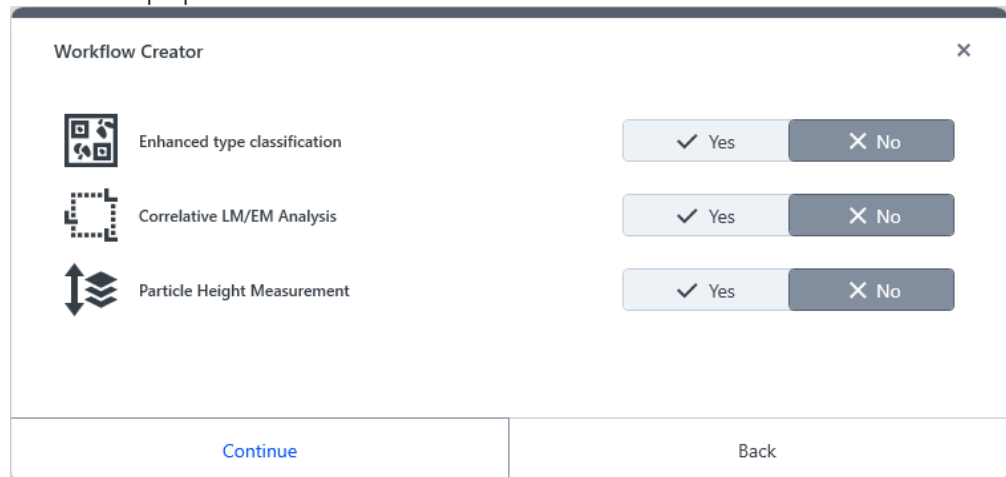
Create TCA Workflow

→ The **Workflow Creator** opens.



3. **To create a workflow for a retrospective analysis VDA 19.2:** Activate **Retrospective Analysis VDA 19.2**, click **Continue** and continue with step 8.
4. **To create any other workflow:** Under **Image Source**, select whether to create a workflow with an image to be acquired (**Acquired Image**) or an archived image (**Loaded Image**).
5. Under **Type of Analysis**, select whether to create an oil cleanliness or component cleanliness analysis.
6. Click **Continue**.

→ The next step opens:



7. Select which application needs to be addressed. **Note:** You can select one or a combination of options to generate a TCA job template matching best possible to your application and measurement tasks.  
 For an for analysis of dark metallic particles, select **Enhanced type classification** using a machine learning approach with a pre-trained object classification model.  
 For a subsequent SEM/EDS based material classification of selected particles, select **Correlative LM/EM analysis**. **Note:** This requires a ZEISS SEM with EDS detection. See also *Concept of S&F with TCA* [▶ 574].  
 For the analysis of gap sizes where information on the third dimension beside particle length and particle width is important, select **Particle Height Measurement**.
8. Select the desires settings, and click **Continue**.

→ The following dialog opens:

The screenshot shows a 'Workflow Creator' dialog box. It has a title bar with 'Workflow Creator' and a close button. The dialog contains four input fields: 'Name' with the value 'My Component Cleanliness Testing', 'Description' with the value 'Job template for Component Cleanliness Testing', 'Category' with a dropdown menu showing 'Material Analysis', and 'Subcategory' with a dropdown menu showing 'Technical Cleanliness'. At the bottom, there are two buttons: 'Save Template' and 'Back'.

9. Enter a name for the workflow. Additionally, add a description and select a category and subcategory for the workflow.

10. Click **Save Template**.

The workflow is created and can now be adapted.

### See also

Supervisor Workflow [► 592]

#### 7.7.10.3 Operator Workflow

Component cleanliness testing is used in industrial practice as part of the following process steps or in functional areas.

- Initial sampling and evaluation
- Outgoing and incoming inspection
- Quality control of monitoring cleanliness related manufacturing processes (e.g. cleaning or surface treatment)

In general, the cleanliness testing consists of the steps described below:

- Provision of the test object (= component or assembly)
- Extraction of the residual dirt particles from one or more pre-cleaned test lots
- Filtration of the extraction fluid
- Detection and analysis of residual dirt particles on the filter sample
- Particle inspection and if necessary, particle revision
- Documentation of results

For component cleanliness the filtration of the entire extraction liquid must be carried out with the aim as possible to extract all residual dirt particles from a defined pre-cleaned component area, which is considered critical to function. This also implies that the entire filter area (= effective filter area) must be recorded and analyzed; the analysis of partial areas and extrapolation of these to the effective filter area is not allowed for component cleanliness testing. It is also important to note that a repetition of the cleanliness test as described on the same test object is not possible. The analysis workflow for oil cleanliness testing is comparable to the described workflow for component cleanliness. The test fluid for oil cleanliness are so-called “fresh” oils/lubricants originating from the production process or “used” oils/lubricants which are tapped from hydraulic systems, gear boxes, shafts, etc.

The main differences in the workflow are the following:

- Oils and lubricants are directly filtrated (no upstream washing process).
- In oil cleanliness, the analysis of a smaller filter area and the extrapolation of the results to the effective filter area are allowed.

#### General Workflow of the Operator

Step	Operator task
1	Place the specimen on the scanning stage of the microscope. Use a stage insert with a specimen holder. Only one scan of the filter membrane area is required for component and oil cleanliness using the 705 pol camera.
2	Select a job template for <b>TCA</b> and execute the job.
3	Fill in data in the input form.
4	<b>Optional:</b> Adjust acquisition pre-settings.
6	Inspect the results using the interactive <b>Size Distribution</b> view.
7	<b>Optional:</b> Modify results using the interactive views, i.e. changing the particle type or excluding artifacts in the <b>Size Distribution</b> view. In the <b>Edit</b> view, you conduct more sophisticated particle revisions like merging, cutting, editing and removing.
8	Perform the final inspection of the results in the <b>Report</b> view.
9	<b>Optional:</b> Re-open and/or export job results via <b>Browse Job Results</b> .

#### 7.7.10.4 Supervisor Tasks - Workflow Configuration for TCA

##### 7.7.10.4.1 Configuring the TCA Job Template by Switching the Active Branch

When you have started a job template, the default setting in the first **Switch** workbench is the **Acquire Tiles Images** branch. But you can switch from the default branch to the **Load Images from File System**.

Note that you also have to configure the default branch setting in the second **Switch** workbench accordingly. You have the following options depending on your system configuration:

1. Switch/selected branch	2. Switch/selected branch
<b>Acquire Tiles Images</b>	<ul style="list-style-type: none"> <li>▪ <b>Size Distribution Live</b> For microscopes without a motorized focus drive.</li> <li>▪ <b>Size Distribution Live &amp; EDF/Position List</b> For fully motorized microscopes and to include the <b>Position List with EDF</b> workbench to the job template.</li> <li>▪ <b>Size Distribution Live with Height Measurement</b> For fully motorized microscopes and to include the <b>Height Measurement</b> workbench to the job template.</li> </ul>

1. Switch/selected branch	2. Switch/selected branch
	<ul style="list-style-type: none"> <li>▪ <b>Size Distribution Live &amp; EDF/Position List with Height Measurement</b> For fully motorized microscopes and to include the <b>Position List with EDF</b> and the <b>Height Measurement</b> workbench to the job template.</li> </ul>
<b>Loaded Images from File System</b>	<b>Size Distribution</b> For working without live image.

This functions help you to be flexible if you get images delivered to analyze or if you need to acquire an image.

### Info

The component cleanliness job template is designed to analyze images acquired with the Axio-cam 705 pol.

1. To select the **Switch** workbench, click



In the **Select Branch** tool, you have the following options: Select **Acquire Tiles Images** or select **Load Images from file System**.

→ The workflow tasks change according to your selection.

2. Later within the workflow, click the icon again and select the corresponding **Size Distribution** view.

If you have selected **Acquire Tiles Images** before, select now one of the following views:

- **Size Distribution Live**
- **Size Distribution Live & EDF/Position List**
- **Size Distribution Live & EDF/Position List with Height Measurement**

If you have selected **Load Images from File System** before, select now **Size Distribution**.

If you acquire images, you can check the specimen by the enabled live view. If you load images, the live view is not meaningful.

#### 7.7.10.4.2 Switching the Visibility of "Run silent" Tasks in TCA

**Run silent** tasks are not shown to the operator, but executed when the workflow is conducted and all results are saved in the archive. The reason is that these tasks have default parameter settings and you do not need to configure them. In the role of a **Supervisor**, you can switch the visibility of the tasks in **Run** mode.

1. In the **Task List** of an **TCT** Workflow, right-click on a deactivated icon representing a **Run silent** task.
2. Open the **Context** Menu and select or deselect **Run silent**.

When the task is deactivated, in **Run** mode, the task is not visible in the **TCA** module workflow.



#### 7.7.10.4.3 Supervisor Overview: Workflow with Image Acquisition (Components)

This workflow description explains the workflow steps including the **Switch** workbench to select an active branch, as well as groups and loops. Here, you configure the workflow for the operator who acquires the images. The first steps in the workflow are the same, but from the second **Switch** workbench on, you configure the workflow. However, the last steps are again the same for the different workflows.



##### Technical Cleanliness Standard Selection

Provides a list of available standards for the **TCA** module that shall be used for the analysis.

1. **Load** the available standards provided by the job template.
2. **Select** the standards that are relevant for the operator's analysis, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

**NOTICE! For particle height measurement and correlative analysis only one standard can be selected.**



##### Switch

Changes between the branches.

1. Select the active branch **Acquire Tiles Images**.

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



##### Acquire Tiles Region Images

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



##### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



##### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Select from the set of pre-defined input form templates an appropriate input form. For component cleanliness one input form per extraction method is provided and furthermore one general form with minimum content.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx

The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Perform a shading correction.
3. Adjust tile regions to the specimen area to be analyzed.
4. Verify the focus points

See

- *Extended Camera Tool* [▶ 761]
- *Light Path Editing Tool* [▶ 777]
- *Tiles Setup (measurement area) Tool* [▶ 533]
- *Focus Correction Tool* [▶ 771]

The operator uses this settings for the specimen acquisition.



### Split Image

Splits n tile region images into n individual overview images.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Split by Dimension Tool* [▶ 532].



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### Image Channel Mapping

Determines the channel allocation for image analysis.

**Default:** Run silent

No parameters are accessible.

See *Image Channel Mapping Tool* [▶ 667].



### TCA Analysis Task Group (Component)

Provides the image analysis setting for component cleanliness.

The **Technical Cleanliness Analysis** setting is applied by default to determine the particle types, i.e. metallic-shiny, non-shiny, and fiber.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869]



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### Particle Segmentation (Components)

Extracts objects from the background by applying the pre-defined relative threshold range.

1. Adjust the **Relative Threshold** if required. The **Relative Threshold** refers to the **Relative Image Brightness (Luminosity)**.

Methods defined by the standards for component cleanliness:

- **Standard Analysis**  
The threshold setting shall not be modified.
- **Extended Analysis**  
The threshold setting can be adjusted if required.

See *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

The operator uses these values for the image segmentation, see *Particle Segmentation Tool (Components)* [▶ 666].



### Region Filter

Applies a filter to Image Analysis results.

**Default:** Run silent. **Feret Maximum** is activated and set to a minimum of 5 µm for component cleanliness and to 1 µm for oil cleanliness.

In the **Image Gallery**, all particles are displayed from 5 µm length onwards.



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### Standard Specific Settings

Configures specific parameter for the standard based calculation.

**Default:** Run silent

1. Select the type of filter membrane in use.
  - ➔ This determines the allowed range for the occupancy rate as defined by the standard.
2. Adjust settings for the **Normalization Parameter**.
3. Select whether the particle size class **All** shall display the results including fibers or not.
4. Select how many of the largest particles per type you want to add to the report.
  - ➔ The coordinates of all pre-selected particles will be added to the position list with EDF.

These settings are conducted automatically in the operator workflow.

See

- *Occupancy Rate (Components) Tool* [▶ 668]
- *Normalization Parameter (Components) Tool* [▶ 669]
- *Type Classification for Class "All" Tool* [▶ 670]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Particle Gallery (Report) Tool* [▶ 671]



### TCA Report

Configures a TCA report for each specimen.

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
  - ➔ The TCA report is configured for the operator.

See

- *Template Selection Tool* [▶ 678]
- *Chart Selection Tool* [▶ 679]
- *Gallery Setting Tool* [▶ 680]



### Switch

Changes between the branches.

1. Select the active branch according to the operator's needs, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599]. You have the following options:  
**Size Distribution**. See *Size Distribution - Branch* [▶ 625]  
**Size Distribution Live**. See *Size Distribution Live - Branch* [▶ 626]  
**Size Distribution Live & EDF/Position List**. See *Size Distribution Live EDF/Position List - Branch* [▶ 626]

#### Available Branch Selection Options for the Size Distribution View

To follow the workflow steps description, see the description of the selected active branch:

- **Size Distribution**, see *Size Distribution - Branch* [▶ 625]
- **Size Distribution Live**, see *Size Distribution Live - Branch* [▶ 626]
- **Size Distribution Live & EDF/Position List**, see *Size Distribution Live EDF/Position List - Branch* [▶ 626]

#### 7.7.10.4.4 Supervisor Overview: Workflow with Loaded Image (Components)

This workflow description explains the workflow steps including the **Switch** workbench to select an active branch, as well as groups and loops. Here, you configure the workflow for the operator who loads already stored images. The first steps in the workflow are the same, but from the second **Switch** workbench on, you configure the workflow. However, the last steps are again the same for the different workflows.



#### Technical Cleanliness Standard Selection

Provides a default standard for **TCA** that shall be used for the analysis: **VDA 19.1 Extended Analysis**. Other standards are available.

1. **Load** the available standards provided by the job template.
2. **Select** the standards that are relevant for the operator's analysis, see *Technical Cleanliness Standard Selection Tool* [▶ 665].



#### Switch

Changes between the branches.

1. Select the active branch **Load Images from File System**.

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



#### Load Images from File System

Branch for the workflow using stored images as input source.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



#### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.

→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Select from the set of pre-defined input form templates an appropriate input form. For component cleanliness one input form per extraction method is provided and furthermore one general form with minimum content.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx

The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Load File

In the **Load Multiple Images** tool, loads multiple images from disk.

1. Load one or more image files to the gallery.
  - In the next step, the image will be loaded to the **Image** view.
  - The number of loaded images determine the number of workflow iterations of the following steps.
  - Each iteration finishes with the report step before the next iteration starts.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### Image Channel Mapping

Determines the channel allocation for image analysis.

**Default:** Run silent

No parameters are accessible.

See *Image Channel Mapping Tool* [▶ 667].



### TCA Analysis Task Group (Component)

Provides the image analysis setting for component cleanliness.

The **Technical Cleanliness Analysis** setting is applied by default to determine the particle types, i.e. metallic-shiny, non-shiny, and fiber.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869]



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### Particle Segmentation (Components)

Extracts objects from the background by applying the pre-defined relative threshold range.

1. Adjust the **Relative Threshold** if required. The **Relative Threshold** refers to the **Relative Image Brightness (Luminosity)**.

Methods defined by the standards for component cleanliness:

- **Standard Analysis**  
The threshold setting shall not be modified.
- **Extended Analysis**  
The threshold setting can be adjusted if required.

See *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

The operator uses these values for the image segmentation, see *Particle Segmentation Tool (Components)* [▶ 666].



### Region Filter

Applies a filter to Image Analysis results.

**Default:** Run silent. **Feret Maximum** is activated and set to a minimum of 5 µm for component cleanliness and to 1 µm for oil cleanliness.

In the **Image Gallery**, all particles are displayed from 5 µm length onwards.



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### Standard Specific Settings

Configures specific parameter for the standard based calculation.

**Default:** Run silent

1. Select the type of filter membrane in use.
  - ➔ This determines the allowed range for the occupancy rate as defined by the standard.
2. Adjust settings for the **Normalization Parameter**.
3. Select whether the particle size class **All** shall display the results including fibers or not.
4. Select how many of the largest particles per type you want to add to the report.
  - ➔ The coordinates of all pre-selected particles will be added to the position list with EDF.

These settings are conducted automatically in the operator workflow.

See

- *Occupancy Rate (Components) Tool* [▶ 668]
- *Normalization Parameter (Components) Tool* [▶ 669]
- *Type Classification for Class "All" Tool* [▶ 670]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Particle Gallery (Report) Tool* [▶ 671]



### TCA Report

Configures a TCA report for each specimen.

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
  - ➔ The TCA report is configured for the operator.

See

- *Template Selection Tool* [▶ 678]
- *Chart Selection Tool* [▶ 679]
- *Gallery Setting Tool* [▶ 680]



### Switch

Changes between the branches.

1. Select the active branch according to the operator's needs, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



2. Select **Size Distribution**. See *Size Distribution - Branch* [▶ 625]  
The following options are not relevant for the active branch **Load Images from File System**:  
**Size Distribution Live**  
**Size Distribution Live & EDF/Position List**

#### 7.7.10.4.5 Supervisor Overview: Workflow with Image Acquisition with AI based Object Classification (Components)



##### Technical Cleanliness Standard Selection

Provides a list of available standards for the **TCA** module that shall be used for the analysis.

1. **Load** the available standards provided by the job template.
2. **Select** the standards that are relevant for the operator's analysis, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

**NOTICE! For particle height measurement and correlative analysis only one standard can be selected.**



##### Switch

Changes between the branches.

1. Select the active branch **Acquire Tiles Images**.

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



##### Acquire Tiles Region Images

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



##### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



##### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Select from the set of pre-defined input form templates an appropriate input form. For component cleanliness one input form per extraction method is provided and furthermore one general form with minimum content.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx

The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Perform a shading correction.
3. Adjust tile regions to the specimen area to be analyzed.
4. Verify the focus points

See

- *Extended Camera Tool* [▶ 761]
- *Light Path Editing Tool* [▶ 777]
- *Tiles Setup (measurement area) Tool* [▶ 533]
- *Focus Correction Tool* [▶ 771]

The operator uses this settings for the specimen acquisition.



### Split Image

Splits n tile region images into n individual overview images.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Split by Dimension Tool* [▶ 532].



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### Image Channel Mapping

Determines the channel allocation for image analysis.

**Default:** Run silent

No parameters are accessible.

See *Image Channel Mapping Tool* [▶ 667].



### TCA Analysis Task Group (Component)

Provides the image analysis setting for component cleanliness.

The **Technical Cleanliness Analysis** setting is applied by default to determine the particle types, i.e. metallic-shiny, non-shiny, and fiber.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869]



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### Particle Segmentation (Components)

Extracts objects from the background by applying the pre-defined relative threshold range.

1. Adjust the **Relative Threshold** if required. The **Relative Threshold** refers to the **Relative Image Brightness (Luminosity)**.

Methods defined by the standards for component cleanliness:

- **Standard Analysis**  
The threshold setting shall not be modified.
- **Extended Analysis**  
The threshold setting can be adjusted if required.

See *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

The operator uses these values for the image segmentation, see *Particle Segmentation Tool (Components)* [▶ 666].



### Region Filter

Applies a filter to Image Analysis results.

**Default:** Run silent. **Feret Maximum** is activated and set to a minimum of 5 µm for component cleanliness and to 1 µm for oil cleanliness.

In the **Image Gallery**, all particles are displayed from 5 µm length onwards.



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### Intellesis Object Classification

After the image has been analyzed, you use a trained model for AI-based object classification; here, you classify particles. The results of the **Intellesis Object Classification** are integrated into the standard calculation, such that there are no further adjustments needed.

Depending on your specimen, retraining of the object classification model might be necessary to adapt the particle type differentiation to your needs. The training of object classification models requires licensing of the AI Toolkit.

See:

- *Retraining a Model for TCA* [▶ 577]

**Default:** Run silent.

The object classification model for POL-135 POL-90 images is preselected. If you use different POL channel combinations, select the corresponding object classification model accordingly.

See

- *Intellesis Object Classification Tool* [▶ 329]
- *Using a Trained Model for AI-based Object Classification* [▶ 328]



### Standard Specific Settings

Configures specific parameter for the standard based calculation.

**Default:** Run silent

1. Select the type of filter membrane in use.
  - ➔ This determines the allowed range for the occupancy rate as defined by the standard.
2. Adjust settings for the **Normalization Parameter**.
3. Select whether the particle size class **All** shall display the results including fibers or not.
4. Select how many of the largest particles per type you want to add to the report.
  - ➔ The coordinates of all pre-selected particles will be added to the position list with EDF.

These settings are conducted automatically in the operator workflow.

See

- *Occupancy Rate (Components) Tool* [▶ 668]
- *Normalization Parameter (Components) Tool* [▶ 669]
- *Type Classification for Class "All" Tool* [▶ 670]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Particle Gallery (Report) Tool* [▶ 671]



### TCA Report

Configures a TCA report for each specimen.

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.  
→ The TCA report is configured for the operator.

See

- *Template Selection Tool* [▶ 678]
- *Chart Selection Tool* [▶ 679]
- *Gallery Setting Tool* [▶ 680]



### Switch

Changes between the branches.

1. Select the active branch according to the operator's needs, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599]. You have the following options:  
**Size Distribution.** See *Size Distribution - Branch* [▶ 625]  
**Size Distribution Live.** See *Size Distribution Live - Branch* [▶ 626]  
**Size Distribution Live & EDF/Position List.** See *Size Distribution Live EDF/Position List - Branch* [▶ 626]

#### 7.7.10.4.6 Supervisor Overview: Workflow with Loaded Image with AI based Object Classification (Components)



### Technical Cleanliness Standard Selection

Provides a list of the available standards for the **TCA** module to be used for the analysis with AI-based object classification. Preselected is: **VDA 19.1 Extended analysis with Object Classification**. Only standards **with the addition "Object classification"** may be used for object classification.

1. **Load** the available standards provided by the job template.
2. **Select** the standards that are relevant for the operator's analysis, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

**NOTICE! For particle height measurement and correlative analysis only one standard can be selected.**



### Switch

Changes between the branches.

1. Select the active branch **Load Images from File System**.

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



### Load Images from File System

Branch for the workflow using stored images as input source.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Select from the set of pre-defined input form templates an appropriate input form. For component cleanliness one input form per extraction method is provided and furthermore one general form with minimum content.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx

The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Load File

In the **Load Multiple Images** tool, loads multiple images from disk.

1. Load one or more image files to the gallery.  
→ In the next step, the image will be loaded to the **Image** view.  
→ The number of loaded images determine the number of workflow iterations of the following steps.  
→ Each iteration finishes with the report step before the next iteration starts.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### Image Channel Mapping

Determines the channel allocation for image analysis.

**Default:** Run silent

No parameters are accessible.

See *Image Channel Mapping Tool* [▶ 667].



### TCA Analysis Task Group (Component)

Provides the image analysis setting for component cleanliness.

The **Technical Cleanliness Analysis** setting is applied by default to determine the particle types, i.e. metallic-shiny, non-shiny, and fiber.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869]



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### Particle Segmentation (Components)

Extracts objects from the background by applying the pre-defined relative threshold range.

1. Adjust the **Relative Threshold** if required. The **Relative Threshold** refers to the **Relative Image Brightness (Luminosity)**.

Methods defined by the standards for component cleanliness:

- **Standard Analysis**  
The threshold setting shall not be modified.
- **Extended Analysis**  
The threshold setting can be adjusted if required.

See *Concept of Relative Image Brightness and Relative Threshold* [▶ 571].

The operator uses these values for the image segmentation, see *Particle Segmentation Tool (Components)* [▶ 666].



### Region Filter

Applies a filter to Image Analysis results.

**Default:** Run silent. **Feret Maximum** is activated and set to a minimum of 5 µm for component cleanliness and to 1 µm for oil cleanliness.

In the **Image Gallery**, all particles are displayed from 5 µm length onwards.



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### Intellesis Object Classification

After the image has been analyzed, you use a trained model for AI-based object classification; here, you classify particles. The results of the **Intellesis Object Classification** are integrated into the standard calculation, such that there are no further adjustments needed.

Depending on your specimen, retraining of the object classification model might be necessary to adapt the particle type differentiation to your needs. The training of object classification models requires licensing of the AI Toolkit.

See:

- *Retraining a Model for TCA* [▶ 577]

**Default:** Run silent.

The object classification model for POL-135 POL-90 images is preselected. If you use different POL channel combinations, select the corresponding object classification model accordingly.

See

- *Intellesis Object Classification Tool* [▶ 329]
- *Using a Trained Model for AI-based Object Classification* [▶ 328]



### Standard Specific Settings

Configures specific parameter for the standard based calculation.

**Default:** Run silent

1. Select the type of filter membrane in use.
  - ➔ This determines the allowed range for the occupancy rate as defined by the standard.
2. Adjust settings for the **Normalization Parameter**.
3. Select whether the particle size class **All** shall display the results including fibers or not.
4. Select how many of the largest particles per type you want to add to the report.
  - ➔ The coordinates of all pre-selected particles will be added to the position list with EDF.

These settings are conducted automatically in the operator workflow.

See



- *Occupancy Rate (Components) Tool* [▶ 668]
- *Normalization Parameter (Components) Tool* [▶ 669]
- *Type Classification for Class "All" Tool* [▶ 670]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Particle Gallery (Report) Tool* [▶ 671]



### TCA Report

Configures a TCA report for each specimen.

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
  - ➔ The TCA report is configured for the operator.

See

- *Template Selection Tool* [▶ 678]
- *Chart Selection Tool* [▶ 679]
- *Gallery Setting Tool* [▶ 680]



### Switch

Changes between the branches.

1. Select the active branch according to the operator's needs, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].
2. Select **Size Distribution**. See *Size Distribution - Branch* [▶ 625]  
 The following options are not relevant for the active branch **Load Images from File System**:  
**Size Distribution Live**  
**Size Distribution Live & EDF/Position List**

#### 7.7.10.4.7 Supervisor Overview: Workflow with Image Acquisition (Oil)

This workflow description explains the workflow steps including the **Switch** workbench to select an active branch, as well as groups and loops. Here, you configure the workflow for the operator who acquires the images. The first steps in the workflow are the same, but from the second **Switch** workbench on, you configure the workflow. However, the last steps are again the same for the different workflows.



### Technical Cleanliness Standard Selection

Provides a list of available standards for the **TCA** module that shall be used for the analysis.

1. **Load** the available standards provided by the job template.
2. **Select** the standards that are relevant for the operator's analysis, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

**NOTICE! For particle height measurement and correlative analysis only one standard can be selected.**



### Switch

Changes between the branches.

1. Select the active branch **Acquire Tiles Images**.

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



### Acquire Tiles Region Images

Branch for the image acquisition workflow.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Select from the set of pre-defined input form templates an appropriate input form. For component cleanliness one input form per extraction method is provided and furthermore one general form with minimum content.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx

The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Tiles (measurement area)

Configures the settings of the specimen acquisition.

1. Configure the image acquisition and save it as individual setting.
2. Perform a shading correction.
3. Adjust tile regions to the specimen area to be analyzed.
4. Verify the focus points

See

- *Extended Camera Tool* [▶ 761]
- *Light Path Editing Tool* [▶ 777]
- *Tiles Setup (measurement area) Tool* [▶ 533]
- *Focus Correction Tool* [▶ 771]

The operator uses this settings for the specimen acquisition.



### Split Image

Splits n tile region images into n individual overview images.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Split by Dimension Tool* [▶ 532].



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### TCA Analysis Task Group (Oil)

Provides the image analysis setting for oil cleanliness.

The **Technical Cleanliness Analysis** setting is applied by default to determine the particle types.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### Particle Segmentation (Oil)

Extracts objects from the background by applying the pre-defined relative threshold range.

1. Adjust the **Threshold** if required.

The operator uses these values for the image segmentation, see *Particle Segmentation (Oil) Tool* [▶ 666].



### Region Filter

Applies a filter to Image Analysis results.

**Default:** Run silent. **Feret Maximum** is activated and set to a minimum of 5 µm for component cleanliness and to 1 µm for oil cleanliness.

In the **Image Gallery**, all particles are displayed from 5 µm length onwards.



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### Standard Specific Settings

Configures specific parameter for the standard based calculation.

**Default:** Run silent

1. Select the type of filter membrane in use.
  - This determines the allowed range for the occupancy rate.
2. Adjust settings for the **Normalization Parameter**.
3. Select whether the particle size class **All** shall display the results including fibers or not.
4. Select how many of the largest particles per type you want to add to the report.
  - The positions of all pre-selected particles will be added to the Position list with EDF.

These settings are conducted automatically in the operator workflow, see

- *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]
- *Normalization Parameter (Oil Cleanliness) Tool* [▶ 670]
- *Type Classification for Class "All" Tool* [▶ 670]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Particle Gallery (Report) Tool* [▶ 671]



### Switch

Changes between the branches.

1. Select the active branch according to the operator's needs, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599]. You have the following options:  
**Size Distribution**. See *Size Distribution - Branch* [▶ 625]  
**Size Distribution Live**. See *Size Distribution Live - Branch* [▶ 626]  
**Size Distribution Live & EDF/Position List**. See *Size Distribution Live EDF/Position List - Branch* [▶ 626]

### See also

- ▢ Concept of Relative Image Brightness and Relative Threshold [▶ 571]

#### 7.7.10.4.8 Supervisor Overview: Workflow with Loaded Image (Oil)

This workflow description explains the workflow steps including the **Switch** workbench to select an active branch, as well as groups and loops. Here, you configure the workflow for the operator who loads images. The first steps in the workflow are the same, but from the second **Switch** workbench on, you configure the workflow. However, the last steps are again the same for the different workflows.



#### Technical Cleanliness Standard Selection

Provides a default standard for **TCA** that shall be used for the analysis: **ISO 4406**. Other standards are available.

1. **Load** the available standards provided by the job template.
2. **Select** the standards that are relevant for the operator's analysis, see *Technical Cleanliness Standard Selection Tool* [▶ 665].



#### Switch

Changes between the branches.

1. Select the active branch **Load Images from File System**.

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



#### Load Images from File System

Branch for the workflow using stored images as input source.

The **Define Outputs** tool does not display any entries. Therefore, editing is not possible.



#### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
 ➔ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Select from the set of pre-defined input form templates an appropriate input form. For component cleanliness one input form per extraction method is provided and furthermore one general form with minimum content.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx

The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Load File

In the **Load Multiple Images** tool, loads multiple images from disk.

1. Load one or more image files to the gallery.
  - In the next step, the image will be loaded to the **Image** view.
  - The number of loaded images determine the number of workflow iterations of the following steps.
  - Each iteration finishes with the report step before the next iteration starts.



### Loop

Iteration of all working steps within the loop definition.

1. Select the number or range of loop iterations. The default value is **Batch processing**, i.e. the number of iterations is determined by the setting in the first loop.

**We recommend not to change the default values.**

The operator will not see these settings, see *Settings Tool* [▶ 748].



### Image Processing

Changes the image format.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Convert Pixel Format Tool* [▶ 822].



### Image Channel Mapping

Determines the channel allocation for image analysis.

**Default:** Run silent

No parameters are accessible.

See *Image Channel Mapping Tool* [▶ 667].



### TCA Analysis Task Group (Oil)

Provides the image analysis setting for oil cleanliness.

The **Technical Cleanliness Analysis** setting is applied by default to determine the particle types.

**We recommend not to change the default parameters.**

The operator will not see these settings.

See *Load Setting Tool* [▶ 869].



### Frame Setup

Sets up and adds a measurement frame to the image. Only the area inside the frame is used for the analysis. The area of the measurement frame is retrieved from the **Tiles (measurement area)** tool.

**Default:** Run silent

**Activated:** Uses **Tile Region Geometry**, i.e. the measurement frame is retrieved automatically from the configured tiles regions, see

- *Frame Setup Tool* [▶ 527]
- *Tiles Setup (measurement area) Tool* [▶ 533]



### Particle Segmentation (Oil)

Extracts objects from the background by applying the pre-defined relative threshold range.

1. Adjust the **Threshold** if required.

The operator uses these values for the image segmentation, see *Particle Segmentation (Oil) Tool* [▶ 666].



### Region Filter

Applies a filter to Image Analysis results.

**Default:** Run silent. **Feret Maximum** is activated and set to a minimum of 5 µm for component cleanliness and to 1 µm for oil cleanliness.

In the **Image Gallery**, all particles are displayed from 5 µm length onwards.



### Measurement Data

Shows measurement results for the detected particles after segmentation and image analysis.

**Default:** Run silent

The **Measurement Data** tool displays the particle results. The calculation is performed with default values in the background, see *Measurement Data Tool* [▶ 834].

The operator will not see these settings.



### Standard Specific Settings

Configures specific parameter for the standard based calculation.

**Default:** Run silent

1. Select the type of filter membrane in use.  
→ This determines the allowed range for the occupancy rate.
2. Adjust settings for the **Normalization Parameter**.
3. Select whether the particle size class **All** shall display the results including fibers or not.
4. Select how many of the largest particles per type you want to add to the report.  
→ The positions of all pre-selected particles will be added to the Position list with EDF.

These settings are conducted automatically in the operator workflow, see

- *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]
- *Normalization Parameter (Oil Cleanliness) Tool* [▶ 670]
- *Type Classification for Class "All" Tool* [▶ 670]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Particle Gallery (Report) Tool* [▶ 671]



### Switch

Changes between the branches.

1. Select the active branch according to the operator's needs, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].
2. Select **Size Distribution**. See *Size Distribution - Branch* [▶ 625]  
The following options are not relevant for the active branch **Load Images from File System**:  
**Size Distribution Live**  
**Size Distribution Live & EDF/Position List**

### See also

- Concept of Relative Image Brightness and Relative Threshold [▶ 571]

#### 7.7.10.4.9 Supervisor Overview: Workflow for Illig Method

The Illig Value is calculated using the measurement area, the sample location, and sedimentation time. This calculation process is performed as follows:

- Specimen analysis using the job template **Component Cleanliness Testing** with the following
  - Standard template **ISO 16232** or **VDA 19.1 Extended Analysis**.
  - Input form **Technical Cleanliness (Illig Value)**
- Combination of analysis results out of the step above using the job template **Technical Cleanliness (VDA 19.2 Joint Result)**



### Input Form

In the **Form Selection** tool, input forms are provided.

1. In the **Create Form Image** tool, configure the size of the input form image in the report.
2. Use the predefined Illig input form.
3. Add the customer data to the corresponding file. The Operator selects the customer data.

The customers are managed with an Excel file. This file is stored per default here: C:\Program-Data\Carl Zeiss\ZENcore\Customer.Contacts.xlsx



The form is displayed in the report, see *Form Selection Tool* [▶ 750] and *Create Form Image Tool* [▶ 674].



### Loop

**Loop** for Input Forms.

Iteration of all working steps within the loop definition.

1. Configure the number of loops the tasks in the next loop will perform.  
→ Sets the working steps for the operator, see *Loop Task* [▶ 748].



### Result Table Loading

Loads **length classification** tables from the archive to process the Illig value.

Note that you can only use the results of the standards VDA 19.1 Standard and VDA 19.1 Extended.

1. Select the tables to be processed from the archive, see *Load Table from Archive Tool* [▶ 677].



### Illig Calculation

Joint results are displayed in a table in the **Center Screen Area**.

See *Illig Parameter Tool* [▶ 676].



### Table Processing

Processes the selected tables of a job and displays a chart.

1. Set up the chart parameters, see *Create Chart Tool* [▶ 677].

The chart is displayed in the report.



### Reports

Creates a joint report document for all selected job results.

The calculated normalization factor and the Illig value are displayed per job result as a diagram and in a table, see *Add Templates Tool* [▶ 864] and *Reports* [▶ 658].

#### 7.7.10.4.10 Size Distribution - Branch

This workflow step is only visible for the active branch Size Distribution.



### Size Distribution

No further action required.

See:

- *Size Distribution View* [▶ 643]
- *Standard Result Selection Tool* [▶ 671]

- *Displayed Normalization Tool* [[▶ 673](#)]
- *Cleanliness Classification (Length) Tool* [[▶ 675](#)]
- *Specimen Overview Tool* [[▶ 532](#)]
- *Statistical Analysis Tool* [[▶ 672](#)]
- *Result Approval Tool* [[▶ 672](#)]
- *Occupancy Rate (Components) Tool* [[▶ 668](#)] or *Occupancy Rate (Oil, Lubricants) Tool* [[▶ 668](#)]

To follow the workflow steps description, see *Last Workflow Steps Independent of Active Branch* [[▶ 628](#)].

#### 7.7.10.4.11 Size Distribution Live - Branch



##### Size Distribution Live

Displays a group of tasks for workflow steps demanding hardware control. The corresponding task group is loaded.

No further action required.

See *Configuring the TCA Job Template by Switching the Active Branch* [[▶ 599](#)].



##### Size Distribution (Live)

These workflow steps are only visible for the active branch Size Distribution Live.

No further action required.

See:

- *Size Distribution View* [[▶ 643](#)]
- *Standard Result Selection Tool* [[▶ 671](#)]
- *Displayed Normalization Tool* [[▶ 673](#)]
- *Cleanliness Classification (Length) Tool* [[▶ 675](#)]
- *Specimen Overview Tool* [[▶ 532](#)]
- *Statistical Analysis Tool* [[▶ 672](#)]
- *Result Approval Tool* [[▶ 672](#)]
- *Occupancy Rate (Components) Tool* [[▶ 668](#)] or *Occupancy Rate (Oil, Lubricants) Tool* [[▶ 668](#)]

To follow the workflow steps description, see *Last Workflow Steps Independent of Active Branch* [[▶ 628](#)].

#### 7.7.10.4.12 Size Distribution Live EDF/Position List - Branch

These workflow steps are only visible for the active branch Size Distribution Live & EDF/Position List.



##### Size Distribution Live & EDF/Position List

Displays a group of tasks for workflow steps demanding hardware control.

The corresponding task group is loaded.

No further action required.

See *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



### Size Distribution (Live)

These workflow steps are only visible for the active branch Size Distribution Live.

No further action required.

See:

- *Size Distribution View* [▶ 643]
- *Standard Result Selection Tool* [▶ 671]
- *Displayed Normalization Tool* [▶ 673]
- *Cleanliness Classification (Length) Tool* [▶ 675]
- *Specimen Overview Tool* [▶ 532]
- *Statistical Analysis Tool* [▶ 672]
- *Result Approval Tool* [▶ 672]
- *Occupancy Rate (Components) Tool* [▶ 668] or *Occupancy Rate (Oil, Lubricants) Tool* [▶ 668]



### Switch

Changes between the branches.

1. Select the branch according to the operator's needs.  
You have the following options:  
**With Height Measurement**  
**Without Height Measurement**

For information on the branch switches, see *Configuring the TCA Job Template by Switching the Active Branch* [▶ 599].



### Interactive Height Measurement

Only visible with active branch **With Height Measurement**.

Enables to perform interactive height measurements.

To perform the interactive particle height measurement conduct manual focusing as described:

1. Define the z-position at the Filter membrane beside the selected particle as lowest position
2. Define the z-position at the top of the particle as highest position.

The absolute difference between both z-values is the estimated particle height.

See *Position List Tool* [▶ 787].



### Position List with EDF

#### Info

If zero particles are found, for example, in a blank test, this step is skipped.

An EDF image is created.

Acquires automatically an EDF image of the largest particle per type for the particle gallery in the report. The corresponding particle coordinates are saved by default in the **Position List** tool. The default number of particles per type cannot be modified in the EDF step. **Note:** The desired total number of particles for the report must be configured in the **Particle Gallery (Report)** tool.

Define the initial microscope and camera setting. Adjust the step size for the automated EDF acquisition.

See:

- *Light Path Editing Tool* [▶ 777]
- *EDF Setup (motorized focus) Tool* [▶ 756]
- *Extended Camera Tool* [▶ 761]
- *Position List Tool* [▶ 787]
- *Particle Gallery (Report) Tool* [▶ 671]



#### Reset Device Parameters

Changes the microscope hardware and camera settings. Restores the initial microscope and camera settings as defined in the **Tiles (measurement area)** workbench.

No further action required.



#### Split EDF Image

Splits n tiles regions into n images.

**Default:** Run silent

**We recommend not to change the default parameters.**

See *Split by Dimension Tool* [▶ 532].

To follow the workflow steps description, see *Last Workflow Steps Independent of Active Branch* [▶ 628].

### 7.7.10.4.13 Last Workflow Steps Independent of Active Branch

These last workflow steps are the same for all active branches.



#### Technical Cleanliness Results Output

Configures the layout of the gallery images in the report document. Enables HYDAC Process Data Extraction and the export of an EDS file with particle positions.

**We recommend not to change the default parameter for the gallery image layout.**

1. Add the file path to where the HYDAC parameter XML file is stored.

See:

- *HYDAC Data Extraction Tool* [▶ 675]
- *EDS File Export Tool* [▶ 675]



## Reports

Creates a report document for each specimen.

All selected standards are considered automatically.

See:

- *Add Templates Tool* [▶ 864]
- *Reports* [▶ 658]

### 7.7.10.5 Operator Tasks - TCA-Workflow

The operator's **TCA** module workflow is individually configured by the supervisor to the requirements of the working environment.

For the Operator, a **Component Cleanliness Testing** and an **Oil Cleanliness Testing** TCA job template is available.

#### 7.7.10.5.1 Operator Overview: Workflow with Loaded Image (Component)

##### Step 1: Technical Cleanliness Standard Selection

Provides a default standard for **TCA** that shall be used for the analysis: **VDA 19.1 Extended Analysis**. Other standards are available.

1. Select the relevant standards, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

##### Step 2: Input Form

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

##### Step 3: Load File

Loads images from the file system.

1. Load one or more image files to the gallery.

The image will be loaded to the **Image** view. The number of loaded images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step before the next iteration starts.

##### Step 4: Particle Segmentation

Extracts objects from the background by applying the pre-defined relative threshold range.

Use the pre-defined settings for the image segmentation.

##### Step 5: TCA Standard-Specific Settings

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

### Step 6: Size Distribution

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

### Step 7: TCA Report

The TCA report is displayed for each specimen. You can adapt the report. To do so, configure the following settings:

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
4. Click **Apply** to save your settings.
  - The adapted report is generated.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### See also

- Template Selection Tool [▶ 678]
- Chart Selection Tool [▶ 679]
- Gallery Setting Tool [▶ 680]

#### 7.7.10.5.2 Operator Overview: Workflow with Image Acquisition (Oil)

### Step 1: Technical Cleanliness Standard Selection

Provides a list of available standards for the TCA module that shall be used for the analysis.

1. Select the relevant standards. See *Technical Cleanliness Standard Selection Tool* [▶ 665].

### Step 2: Input Form

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.
  - The form is displayed in the report.

**Step 3: Tiles (measurement area)**

Provides pre-configured settings for the specimen acquisition.

1. Select an image acquisition setting and adjust the position of the tile regions if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired overview images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step.

**Step 4: Particle Segmentation**

Extracts objects from the background by applying the pre-defined threshold range.

Use the pre-defined settings for the image segmentation.

**Step 5: TCA Standard-Specific Settings**

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

**Step 6: Size Distribution (Live)**

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

**Step 7: Position List with EDF**

Performs automated EDF image acquisition on selected particles.

In general no further action is required.

**Step 8: Reports**

Creates a report document for each specimen.

1. Inspect for the selected standards the results for particle classification, approval status (if defined) and particle load.
2. See particle images of the largest particles per type.

You can print the report.

See *Reports* [▶ 658].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### 7.7.10.5.3 Operator Overview: Workflow with Image Acquisition (Components)

#### Step 1: Technical Cleanliness Standard Selection

Provides a list of available standards for the TCA module that shall be used for the analysis.

1. Select the relevant standards. See *Technical Cleanliness Standard Selection Tool* [▶ 665].

#### Step 2: Input Form

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

#### Step 3: Tiles (measurement area)

Provides pre-configured settings for the specimen acquisition.

1. Select an image acquisition setting and adjust the position of the tile regions if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired overview images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step.

#### Step 4: Particle Segmentation

Extracts objects from the background by applying the pre-defined relative threshold range.

Use the pre-defined settings for the image segmentation.

#### Step 5: TCA Standard-Specific Settings

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

#### Step 6: Size Distribution (Live)

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

#### Step 7: Position List with EDF

Performs automated EDF image acquisition on selected particles.

In general no further action is required.



### Step 8: TCA Report

The TCA report is displayed for each specimen. You can adapt the report. To do so, configure the following settings:

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
4. Click **Apply** to save your settings.  
→ The adapted report is generated.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### See also

- 📄 [Template Selection Tool \[▶ 678\]](#)
- 📄 [Chart Selection Tool \[▶ 679\]](#)
- 📄 [Gallery Setting Tool \[▶ 680\]](#)

#### 7.7.10.5.4 Operator Overview: Workflow with Loaded Image (Oil)

### Step 1: Technical Cleanliness Standard Selection

Provides a default standard for **TCA** that shall be used for the analysis: **ISO 4406**. Other standards are available.

1. Select the relevant standards, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

### Step 2: Input Form

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

### Step 3: Load File

Loads images from the file system.

1. Load one or more image files to the gallery.

The image will be loaded to the **Image** view. The number of loaded images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step before the next iteration starts.

### Step 4: Particle Segmentation

Extracts objects from the background by applying the pre-defined threshold range.

Use the pre-defined settings for the image segmentation.

**Step 5: TCA Standard-Specific Settings**

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

**Step 6: Size Distribution**

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

**Step 7: Reports**

Creates a report document for each specimen.

1. Inspect for the selected standards the results for particle classification, approval status (if defined) and particle load.
2. See particle images of the largest particles per type.

You can print the report.

See *Reports* [▶ 658].

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

**7.7.10.5.5 Operator Overview: Workflow for Illig Method****Step 1: Input Form**

In the **Form Selection** tool, a specific Illig form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

**Step 2: Result Table Loading**

In the **Load Table from Archive** tool, select length classification tables from the job results in the archive for Illig value processing.

Note that you can only use the results of the standards **VDA 19.1 Standard** and **VDA 19.1 Extended**.

1. Select **length classification tables** from the job results in the archive. You can add up to 10 tables, see *Load Table from Archive Tool* [▶ 677].

### Step 3: Illig Calculation

Joint results are displayed in a table in the **Center Screen Area**.

1. Enter the relevant data, see *Illig Parameter Tool* [▶ 676].

### Step 4: Reports

Creates a report document for each specimen.

1. Inspect for the selected standards the results for particle classification, approval status (if defined) and particle load.
2. See particle images of the largest particles per type.

You can print the report.

See *Reports* [▶ 658].

#### 7.7.10.5.6 Operator Overview: Workflow with Image Acquisition with AI based Object Classification (Components)

This operator workflow, in difference to the basic component cleanliness workflow, uses a pre-defined Intellesis object classification model for the particle type differentiation. Depending on your specimen, retraining of the object classification model might be necessary to adapt the particle type differentiation to your needs.

The training of object classification models requires licensing of the **AI Toolkit**.

### Step 1: Technical Cleanliness Standard Selection

Provides a list of available standards for the TCA module that shall be used for the analysis.

1. Select the relevant standards. See *Technical Cleanliness Standard Selection Tool* [▶ 665].

**NOTICE! For particle height measurement and correlative analysis only one standard can be selected.**

### Step 2: Input Form

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

### Step 3: Tiles (measurement area)

Provides pre-configured settings for the specimen acquisition.

1. Select an image acquisition setting and adjust the position of the tile regions if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction tool > Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired overview images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step.

**Step 4: Particle Segmentation**

Extracts objects from the background by applying the pre-defined relative threshold range.

Use the pre-defined settings for the image segmentation.

**Step 5: TCA Standard-Specific Settings**

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

**Step 6: Size Distribution (Live)**

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

**Step 7: Position List with EDF**

Performs automated EDF image acquisition on selected particles.

In general no further action is required.

**Step 8: TCA Report**

The TCA report is displayed for each specimen. You can adapt the report. To do so, configure the following settings:

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
4. Click **Apply** to save your settings.  
→ The adapted report is generated.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

**See also**

- 📖 Template Selection Tool [▶ 678]
- 📖 Chart Selection Tool [▶ 679]
- 📖 Gallery Setting Tool [▶ 680]

#### 7.7.10.5.7 Operator Overview: Workflow with Loaded Image with AI based Object Classification (Components)

This operator workflow, in difference to the basic component cleanliness workflow, uses a pre-defined Intellesis object classification model for the particle type differentiation. Depending on your specimen, retraining of the object classification model might be necessary to adapt the particle type differentiation to your needs.

The training of object classification models requires licensing of the **AI Toolkit**.

##### Step 1: Technical Cleanliness Standard Selection

Provides a default standard for **TCA** that shall be used for the analysis: **VDA 19.1 Extended Analysis**. Other standards are available.

1. Select the relevant standards, see *Technical Cleanliness Standard Selection Tool* [▶ 665].

##### Step 2: Input Form

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

##### Step 3: Load File

Loads images from the file system.

1. Load one or more image files to the gallery.

The image will be loaded to the **Image** view. The number of loaded images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step before the next iteration starts.

##### Step 4 Particle Segmentation

Extracts objects from the background by applying the pre-defined relative threshold range.

Use the pre-defined settings for the image segmentation.

##### Step 5: TCA Standard-Specific Settings

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

##### Step 6 Size Distribution (Live)

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

### Step 7: Position List with EDF

Performs automated EDF image acquisition on selected particles.

In general no further action is required.

### Step 8: TCA Report

The TCA report is displayed for each specimen. You can adapt the report. To do so, configure the following settings:

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
4. Click **Apply** to save your settings.
  - The adapted report is generated.

After performing the workflow, you have the following options:

- **Save and Close**
- **Save and Repeat**
- **Close Without Saving**
- **Repeat Without Saving**

### See also

- 📖 Technical Cleanliness Standard Selection Tool [▶ 665]
- 📖 Supervisor Tasks - Workflow Configuration for TCA [▶ 599]
- 📖 Size Distribution View [▶ 643]
- 📖 Reports [▶ 658]
- 📖 TCA Standard-Specific Settings Workbench [▶ 663]
- 📖 Supervisor Overview: Workflow with Loaded Image with AI based Object Classification (Components) [▶ 613]
- 📖 Template Selection Tool [▶ 678]
- 📖 Chart Selection Tool [▶ 679]
- 📖 Gallery Setting Tool [▶ 680]

## 7.7.10.6 Correlative Workflows

### 7.7.10.6.1 Overview: Image Acquisition Workflow TCA with S&F at the LM for Correlative Analysis

Run a Correlative LM job template for Component or Oil Cleanliness Analysis.

#### Step 1: Technical Cleanliness Standard Selection

Provides a list of available standards for the TCA module that shall be used for the analysis.

1. Select the relevant standards. See *Technical Cleanliness Standard Selection Tool* [▶ 665].

**NOTICE! For particle height measurement and correlative analysis only one standard can be selected.**

**Step 2: Input Form**

In the **Form Selection** tool, an input form is provided. The specimen form is part of a loop. This step is iterated with **Continue** until the last loop iteration is reached. The specimen number increases automatically by 1 with each iteration. **Exit Loop** activates the next step.

1. To choose the corresponding customer, in the **Customer/Supplier** field, click in the table to add the selected customer data.  
→ The form is displayed in the report.

**Step 3: S&F Holder Calibration**

Stores automatically the coordinates of the L-marker positions in the **Particle Selection EDS file** and is used later during the EM/EDS-analysis by the **S&F Find (List)** tool to retrieve the particle selection from the LM job run.

1. In the **Calibration Settings** tool, from the **Sample Holder** list, select the sample holder you are using now and you will be using later on the EM. Holder for correlative TCA:  
MAT Particle 47 mm  
MAT Particle 50 mm
2. On the live image, move the scanning stage to locate the L-markers and confirm the corresponding positions.

See *Calibrating the S&F Holder* [▶ 369].

**Step 4: Tiles (measurement area)**

Provides pre-configured settings for the specimen acquisition.

1. Select an image acquisition setting and adjust the position of the tile regions if required.
2. Verify **Support Points** of the tile regions. To conduct automated focusing in the background, activate **Focus Correction** tool > **Determine Z-Values with Software AF Before Acquisition**. Continue with **Start**.

The number of acquired overview images determine the number of workflow iterations of the following steps. Each iteration finishes with the report step.

**Step 5: Particle Segmentation**

Extracts objects from the background by applying the pre-defined relative threshold range.

Use the pre-defined settings for the image segmentation.

**Step 6: TCA Standard-Specific Settings**

Configures specific parameter for the standard based calculation.

1. Add values to the desired normalization parameter, if required.
2. Select how many of the largest particles per type you want to add to the report. The coordinates of all pre-selected particles will be added to the Position list with EDF.

See *TCA Standard-Specific Settings Workbench* [▶ 663]

**Step 7: Size Distribution (Live)**

Shows the absolute and normalized results of the particle size classification and approval status (if defined in standard template).

1. Inspect for the selected standards the results per particle type and overall statistics.
2. Change, if required, the particle type and exclude artifacts. Use the filter functions and approval display for rapid particle inspection.
3. Conduct particle revision using the **Edit** view and retrieve particles in live mode.

See *Size Distribution View* [▶ 643].

### Step 8: Position List with EDF

Performs automated EDF image acquisition on selected particles.

In general no further action is required.

### Step 9 (Component): TCA Report

The TCA report is displayed for each specimen. You can adapt the report. To do so, configure the following settings:

1. In the **Template Selection** tool, the default report template is selected.
2. In the **Chart Selection** tool, select a particle counting result, one or more chart types, and one or more particle types. Select **System Properties** to have the system properties displayed in the report.
3. In the **Gallery Setting** tool, set the image count per row.
4. Click **Apply** to save your settings.
  - The adapted report is generated.

### Step 9 (Oil): Reports

Creates a report document for each specimen.

1. Inspect for the selected standards the results for particle classification, approval status (if defined) and particle load.
2. See particle images of the largest particles per type.

You can print the report.

See *Reports* [▶ 658].

### See also

- 📄 Template Selection Tool [▶ 678]
- 📄 Chart Selection Tool [▶ 679]
- 📄 Gallery Setting Tool [▶ 680]

#### 7.7.10.6.2 Overview: Correlative Workflow with TCA, S&F and ML based Object Classification at the LM

Run a correlative LM job template for Component or Oil Cleanliness Analysis with **Object Classification**. The corresponding job templates automatically apply a pre-trained AI based object classification model so that no further adjustment is needed. The object classification step is per default run silent and not visible to the operator. Depending on your specimen, retraining of the object classification model might be necessary to adapt the particle type differentiation to your needs. The training of object classification models require licensing of the **AI Toolkit**.

- *TCA with Intellesis Object Classification* [▶ 576]
- *Retraining a Model for TCA* [▶ 577]
- *Overview: Image Acquisition Workflow TCA with S&F at the LM for Correlative Analysis* [▶ 638]



### 7.7.10.6.3 Overview: Performing Correlative Workflow with TCA and S&F at the EM

#### Info

It is mandatory to configure and calibrate the EM and EDS-detector in advance before starting the correlative EM workflow. The required procedures are described in detail in the **SmartSEM** and **SmartPI** manuals.

The following description is equally valid for Operators and Supervisors executing the correlative EM workflow for Component or Oil cleanliness.

1. Carry the correlative filter holder from the LM to the EM.
2. Open the free mode.
3. In the **SEM 2D Acquisition** workbench, load the required tools and adjust the settings.
4. Select **Shuttle & Find** workbench > **S&F Holder Calibration**.
5. In the **Calibration Settings** tool, from the **Sample Holder** list, select the same sample holder you have selected for the LM calibration. Holder for correlative TCA:
  - MAT Particle 47 mm
  - MAT Particle 50 mm
6. On the live image, move to the location of the L-markers and set the corresponding positions. For more information, see *Calibrating the S&F Holder* [▶ 369].
7. Select **SEM 2D Acquisition** workbench > **S&F Find (List)** tool.
8. From the drop down list, select the file location (archive or file path), and open the Particle List EDS file.
9. From the position list, select a particle and to retrieve the particle, click **Move to Selection**.
10. Use **SmartPI** for performing EDS analysis on the selected particle.

For information on the required set-up procedures, see the **SmartPI** manual.

### 7.7.10.7 Understanding the Illig Method

The Illig Workflow generates a joint result from previously performed job runs and consists of two phases:

- **Preparation phase:**  
Generates results for the Illig workflow, see steps 1-4 below.
  - **Illig calculation phase:**  
Summarizes several job results for calculation of the Illig value, see step 5 below.
1. Select **Job Mode** > job template with **VDA 19.1** or **ISO 16232 Method Extended Analysis**.  
**NOTICE! Don't modify the length size classes because the Illig calculation uses a predefined size classification.**
  2. Load the input form **Technical Cleanliness (Illig Value)**.  
**NOTICE! The sample location and sedimentation time are automatically read-out and applied by executing the Illig job template Technical Cleanliness (VDA 19.2 Joint Result).**
  3. Run the pre-configured **Component Cleanliness** job template to analyze your particle traps.
  4. Repeat steps 1-3 until all particle traps are analyzed.
  5. Perform calculation of the Illig value by using the job template **Technical Cleanliness (VDA 19.2 Joint Result)**.

### 7.7.11 About Filters and Occupancy Rate

The following filter types are used for technical cleanliness analysis:

- **Foamed Membrane Filter**

**Pro:** With a flat surface, these filters are suitable for light optical analysis.

**Con:** With their undefined sponge-like structure, this material filters particles which are a lot smaller than the nominal width of the filter pore. The particle load can darken the filter optically due to too many extremely fine particles. Therefore, the light optical evaluation is limited. Additionally, these filters absorb air humidity. If the filters are not dried carefully before starting the image acquisition at a microscope, this air humidity might affect the result of optical analysis.

- **Mesh Filter**

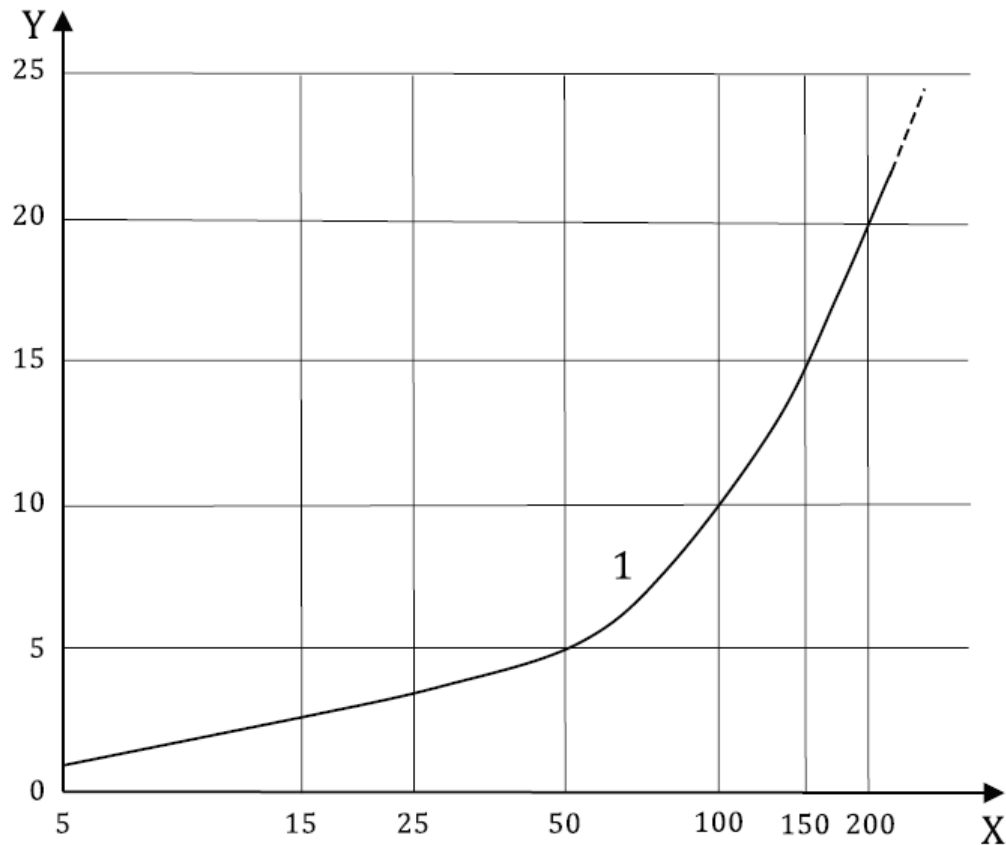
**Pro:** With defined geometrical pore width and a defined separation size, less particles are withheld. Therefore, this facilitates the light optical evaluation. Additionally, these filters absorb less air humidity.

**Cons:** With extreme enlargement or strongly oriented lighting, the structure of the fabric yarns can cause interferences or reflexes at light optical analysis.

#### Filter Pore Size

The function of the analysis filter is to retain the particles which are relevant to the analysis (ideally only these particles). The pore size of the analysis filter is selected according to the cleanliness specification, i.e. the filter shall be capable of reliably retaining the smallest particle size stipulated in the cleanliness specification. To ensure that elongated particles are also retained, the following rule of thumb applies (recommended by ISO 16232):

Filter pore size =  $1/10$  to  $1/5$  the size of the smallest particle size specified, with  $1/10$  being recommended for larger particles ( $>50\text{ }\mu\text{m}$ ) and  $1/5$  for smaller particles ( $<50\text{ }\mu\text{m}$ ). This is because smaller particles generally have a more compact shape than larger particles, which tend to have a highly diverse range of shapes (see also graph).



*Fig. 63: The curve (1) shows the filter pore size: 1/5 to 1/10 of the smallest particle size in  $\mu\text{m}$ . On the x-axis the smallest particle size in  $\mu\text{m}$  is represented and on the y-axis the filter pore size in  $\mu\text{m}$  is represented. (Source: ISO 16232)*

### Occupancy Rate

The occupancy rate is a measure for the quality of specimen preparation with respect to a certain particle load and estimates the number of particles being still acceptable for an effective, automated image analysis. In general, the inspection time for one filter specimen is getting more and more time-consuming if the recommended occupancy rates per filter type are exceeded or close to the defined limits (mesh filter: ca. 3%; foamed membrane filter: ca. 1.5%). The result are measurement mistakes and the need for increased particle revision steps. As a consequence, the comparability of the analysis results between different systems goes down.

The basis for standard based calculation is the effective filter area. For more information, see *Common Characteristics* [▶ 539].

### See also

- ▢ Occupancy Rate (Components) Tool [▶ 668]
- ▢ Occupancy Rate (Oil, Lubricants) Tool [▶ 668]

## 7.7.12 Views for Inspection

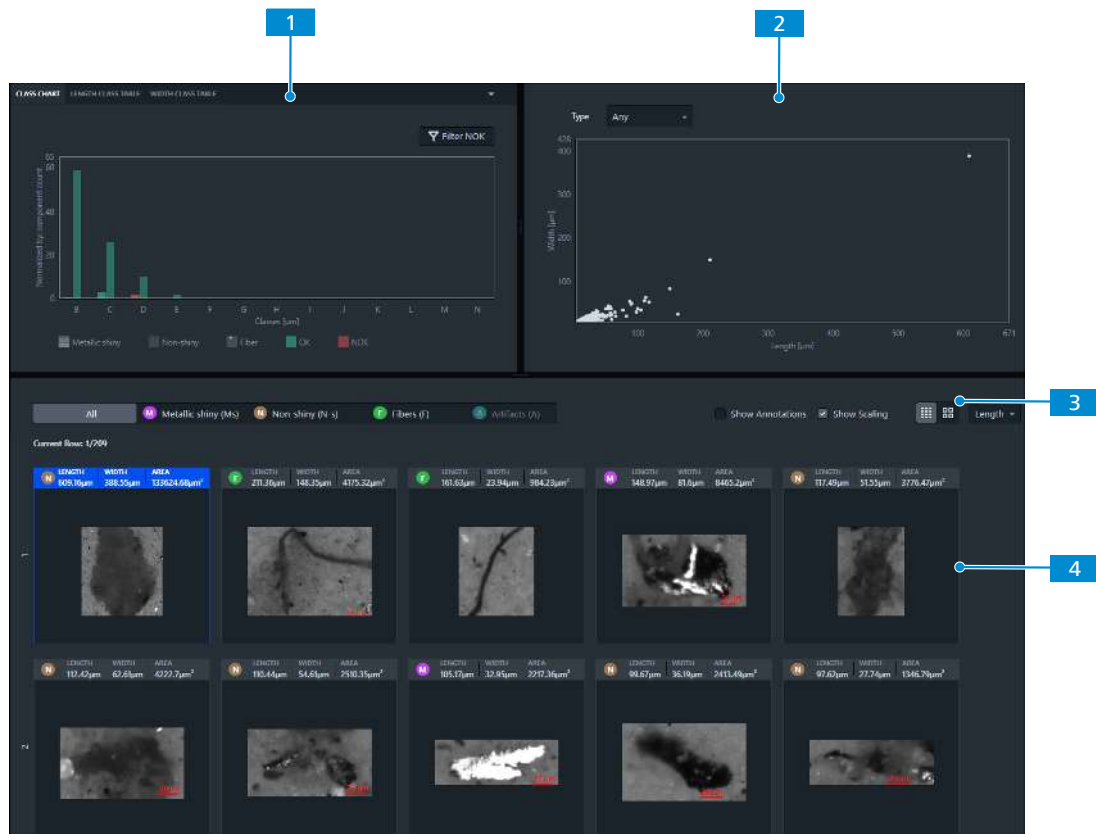
### 7.7.12.1 Size Distribution View

The **Size Distribution** view displays the particle results for the selected standard. You can filter the results by approval status, particle type or particle size class.

## Info

In the **Image Gallery**, all particles are displayed from 5 µm length and width onwards. As a Supervisor, you can change the minimum size of the displayed particles in the **Region Filter** tool in the **Region Filter** workbench. By default, the **Region Filter** workbench is set to run silent, see *Region Filter* [▶ 263].

For individually created job templates it is recommended to display only standards with the same smallest particle size in the **Standard Selection** tool and adapted the **Region Filter** tool accordingly.



### 1 Class Chart

Displays the number of particles sorted in size classes and particle types according to their size in µm. You can filter by particle type and by approval status. Further tables are available to inform you about the test results in respect of length and width classes.

See

- *Class Chart - Diagram* [▶ 645]
- *Class Chart - Length Class Table* [▶ 646]
- *Class Chart - Width Class Table* [▶ 647]

### 2 Scatter Plot

Displays the particle values for length versus width. You can filter by particle type and by approval status. See *Scatter Plot* [▶ 647].

### 3 Particle Button bar

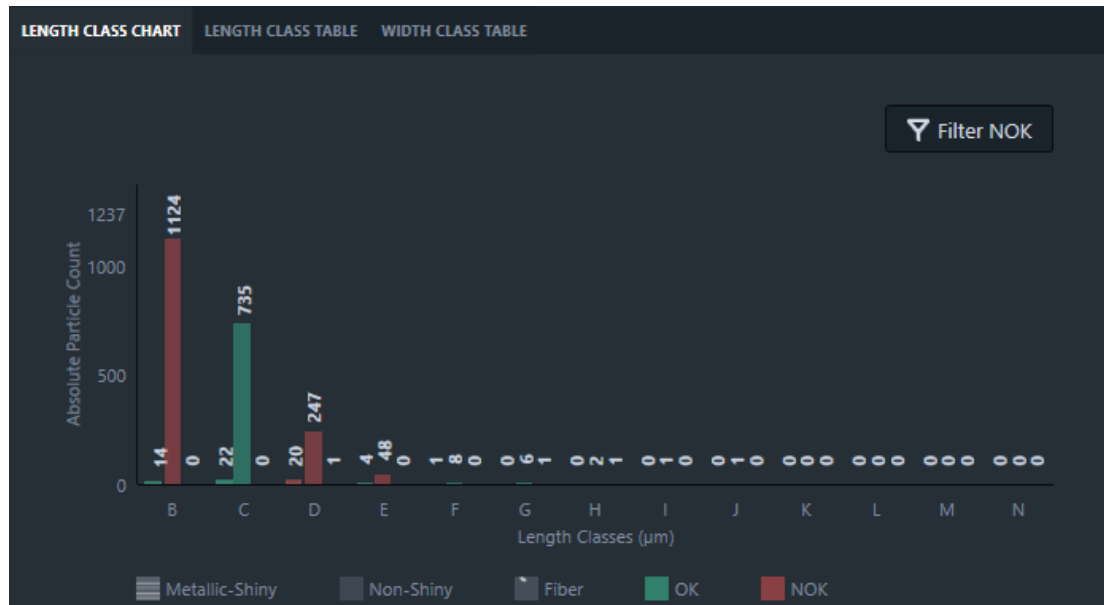
Filters artifacts or particles by type. You can view all particles clicking the **All** button. See *Particle Button Bar* [▶ 648] and *Filtering Particles* [▶ 649].

#### 4 Image Gallery

Displays all detected particles. Default: **Minimized** view. The **Mid-Sized** view shows the particle images with an enlarged zoom level. See *TCA Image Gallery* [▶ 648].

##### 7.7.12.1.1 Class Chart - Diagram

This diagram displays the particle size distribution and the approval status by particle type. The capital letters at the x-axis are representative for the particle size classes according to ISO 16232 and VDA 19.1.



The bars are either displayed in green or red color corresponding to the approval status **OK** or **NOK**. The coloring and the corresponding approval status are dependent on the acceptance criteria as defined in the **Standard Template**. If no approval is defined, the bars are represented in gray color.

Click the **Filter NOK** Button to show only those particles in the **Image Gallery** that exceed the limits as defined by the acceptance criteria.

Click one or more bar(s) in the diagram to filter the **Image Gallery** accordingly.

#### See also

- Filtering Particles [▶ 649]
- Standard Template Editor [▶ 579]

7.7.12.1.2 Class Chart - Length Class Table

This table displays the particle size distribution by particle type. The default length classification parameter is Feret Max.

LENGTH CLASS CHART   LENGTH CLASS TABLE   WIDTH CLASS TABLE							
Classification Parameter: <b>Feret Max</b>							
Particle Length	B (5≤X<15)	C (15≤X<25)	D (25≤X<50)	E (50≤X<100)	F (100≤X<150)	G (150≤X<200)	H (200≤X<400)
<b>All with Fibers</b>							
Normalized Count per Component (N)	633,57	108,14	38,29	7,43	1,29	1,00	0,43
Cleanliness Level (N)	634	108	38	7	1	1	0
Approval Normalized (N)	OK	OK	OK	OK	OK	NOK	NOK
<b>Metallic-Shiny</b>							
Normalized Count per Component (N)	3,57	3,14	2,86	0,57	0,14	0,00	0,00
Cleanliness Level (N)	4	3	3	1	0	0	0
Approval Normalized (N)	OK	OK	OK	OK	OK	OK	OK
<b>Non-Shiny</b>							
Normalized Count per Component (N)	630,00	105,00	35,29	6,86	1,14	0,86	0,29
Cleanliness Level (N)	630	105	35	7	1	1	0
Approval Normalized (N)	OK	OK	OK	OK	OK	NOK	NOK
<b>Fiber</b>							
Normalized Count per Component (N)	0,00	0,00	0,14	0,00	0,00	0,14	0,14
Cleanliness Level (N)	0	0	0	0	0	0	0
Approval Normalized (N)	OK	OK	OK	OK	OK	OK	OK

The particle size classification table shows the following information:

- The absolute or normalized particle counts, according to the selection in the **Displayed Normalization** tool.
- The allowed number of particles as defined in the standard template.
- The corresponding cleanliness level as defined in the standard.
- The approval result (**OK/NOK**).

The table is saved to the archive and shown in the report.

Note that there is no interaction with the **Image Gallery**.

See also

- 📖 Standard Template Editor [▶ 579]
- 📖 Normalization Parameter (Components) Tool [▶ 669]

7.7.12.1.3 Class Chart - Width Class Table

This table displays the particle size distribution by particle type. The default width classification parameter is Feret Min.

CLASS CHART LENGTH CLASS TABLE WIDTH CLASS TABLE

Classification Parameter: Feret Minimum [µm]

Particle Width	B (5≤X<15)	C (15≤X<25)	D (25≤X<50)	E (50≤X<100)	F (100≤X<150)	G (150≤X<200)
All without Fibers						
Normalized Count per Component (N)	88.4	10.1	2.1	0.5	0	0
Cleanliness Level (N)	88	10	2	0	0	0
Metallic Shiny						
Normalized Count per Component (N)	4.3	1.5	0.5	0.1	0	0
Cleanliness Level (N)	4	2	0	0	0	0
Non-Shiny						
Normalized Count per Component (N)	84.1	8.6	1.6	0.4	0	0
Cleanliness Level (N)	84	9	2	0	0	0
Fibers						
Normalized Count per Component (N)	0	0.2	0	0	0.1	0
Cleanliness Level (N)	0	0	0	0	0	0

The particle size classification table shows the absolute particle counts and the corresponding normalized values which depend on the settings in the **Normalization Parameter** tool on the **TCA Standard-Specific Calculation** workbench. Furthermore, the result for the applied acceptance criteria as defined in the standard template.

The table is saved to the archive and shown in the report.

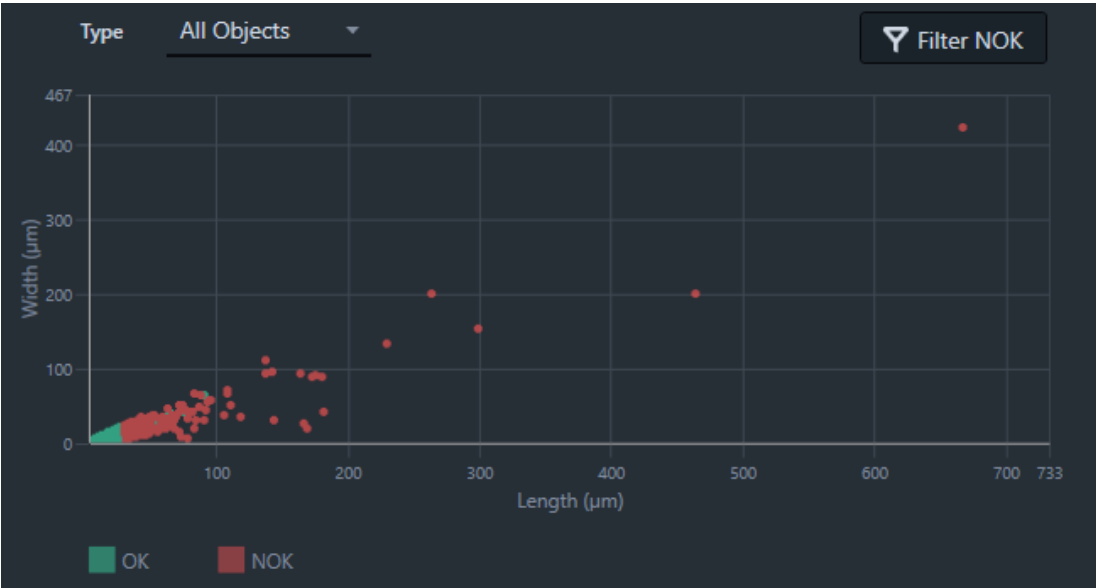
Note that there is no interaction with the **Image Gallery**.

See also

- Standard Template Editor [▶ 579]
- Normalization Parameter (Components) Tool [▶ 669]

7.7.12.1.4 Scatter Plot

This diagram displays the distribution of particles in relation to their length and width.



Each particle is indicated by a measuring point and is either displayed in green or red color corresponding to the approval status **OK** or **NOK**. The coloring and the corresponding approval status is dependent on the acceptance criteria as defined in the standard template.

If no acceptance criteria are defined, the measuring points are displayed in gray color.

Click **Filter NOK** to show those particles in the **Image Gallery** that exceed the limits as defined by the acceptance criteria. From the **Type** drop-down list, select a certain particle type in the scatter plot to filter the particle gallery accordingly.

Filtering the image gallery by scatter plot or by particle bar, they update one another.

**See also**

 Standard Template Editor  579]

**7.7.12.1.5 Particle Button Bar**

In the **Particle Button Bar**, you filter artifacts and particles per type to synchronize the **Image Gallery** in parallel. You can view all particles by clicking the **All** button.

If you filter the **Image Gallery** via the bar diagram or the scatter plot, a description of the applied filter(s) is shown above the **Image Gallery**. You can use the filter description to remove applied filters selectively.

Particle types for component cleanliness

- **Metallic-shiny (M)**
- **Non-shiny (N)**
- **Fiber (F)**
- **Artifacts (A)**

Particle types for oil cleanliness

- **Particle (P)**
- **Fiber (F)**
- **Artifacts (A)**

Parameter	Description
Show Annotations	Surrounds and displays the shape of the particle with a red line.
Show Scaling	Displays the size of the particle based on the scaling factor.
Drop-down menu	Changes the sorting in the image gallery by particle length, width, area and ID. The default sorting order is descending for size: length, area, width, and ascending for the particle ID.

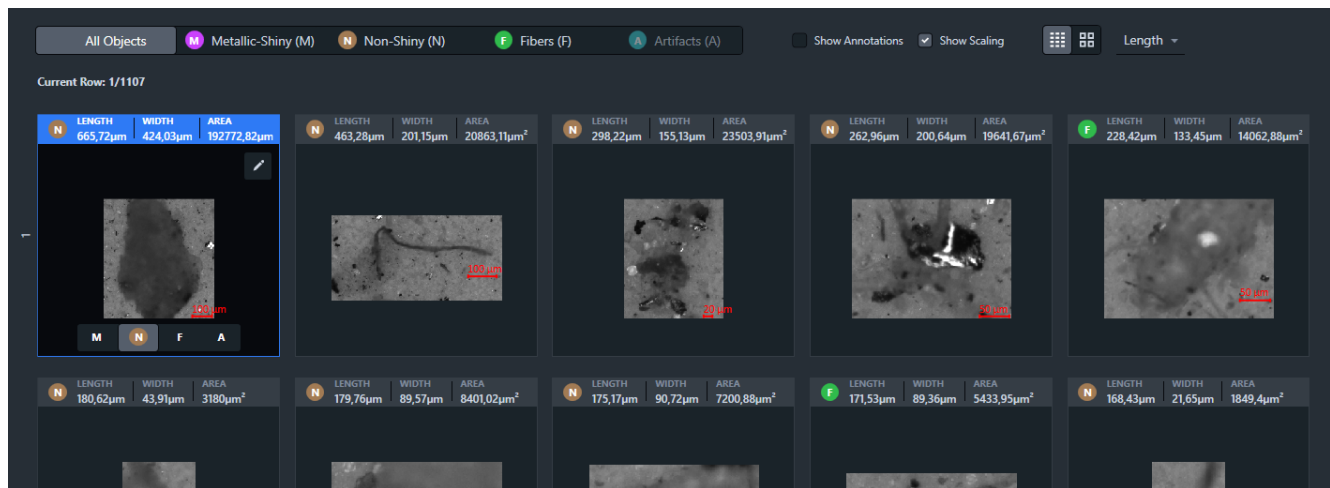
**7.7.12.1.6 TCA Image Gallery**

The **Image Gallery** displays all detected particles. The top data bar of the gallery image shows for each particle the corresponding particle type, length, width and area.

You can change the particle type, exclude particles from the result as artifact, and open the **Edit View**.

Hover with your mouse over the gallery image in the **Minimized** or **Mid-Sized** view to enlarge the image. The additional data bar appears on top with information on particle ID as well as X and Y coordinates.





## Info

In the **Image Gallery**, all particles are displayed from 5 µm length and width onwards. As a Supervisor, you can change the minimum size of the displayed particles in the **Region Filter** tool in the **Region Filter** workbench. By default, the **Region Filter** workbench is set to run silent, see *Region Filter* [▶ 263].

## See also

- ▶ Editing Particle Analysis Results in the Particle Edit View [▶ 651]
- ▶ Filtering Particles [▶ 649]
- ▶ Changing Particle Revision Type [▶ 650]

### 7.7.12.1.7 Filtering Particles

In the **Size Distribution** view, various methods are available for filtering particles to enable rapid particle inspection.

#### Filtering by particle size class

**Prerequisite** ✓ You are in the **Size Distribution** view.

1. Click on one or more bar(s) in the **Class Chart** diagram tab.
  - ➔ The images displayed in the **Image Gallery** are filtered according to the selected data.

The filter buttons in the **Particle Button** bar above the **Image Gallery** are replaced by the filter description, e.g. **Class Chart Filter: B Non-shiny**.

#### Filtering by acceptance criteria

You can obtain a rapid overview on potentially critical particles by filtering over the approval status **NOK**.

**Prerequisite** ✓ You have defined acceptance criteria in the **Standard Template** to display **OK** or **NOK** in the **Size Distribution** view. For more information, see *Standard Template Editor* [▶ 579].

✓ You are in the **Size Distribution** view.

1. In the **Class Chart** diagram, click on the toggle button to switch between the approval status **NOK** or **OK**.
  - ➔ The **Class Chart** diagram and the **Image Gallery** are adapted.

- The filter buttons in the **Particle Button** bar above the **Image Gallery** are replaced by the filter description, e.g. **NOK Filter active**.
- 2. In the **Scatter Plot**, click the toggle button to switch between **OK** and **NOK**.
  - The **Scatter Plot** and the **Image Gallery** are updated.
  - The filter buttons in the **Particle Button Bar** above the **Image Gallery** are replaced by the filter description, e.g. **NOK Filter Active**.

### Filtering by particle type

You can filter your results by particle types.

**Prerequisite** ✓ You are in the **Size Distribution** view.

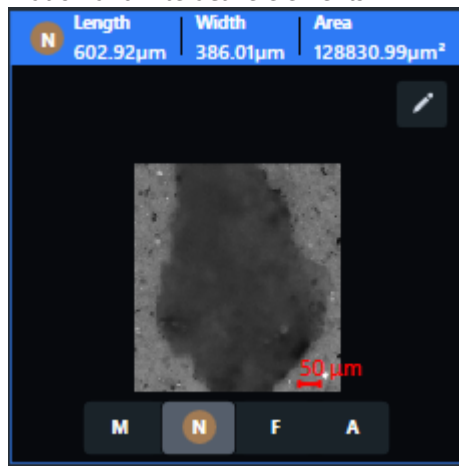
1. In the **Particle Button** bar above the **Image Gallery**, click the particle type button you want to filter the **Image Gallery** by.
  - The **Image Gallery** and the **Class Chart** diagram are adapted.

#### 7.7.12.1.8 Changing Particle Revision Type

In the **Size Distribution** view, you can check and, if necessary, change the results of the particle typification. Optionally, you can click the **Opens the Edit View** icon on the gallery image to open the **Edit** view and change the type there.

**Prerequisite** ✓ You run **TCA** either with image files or you acquire the images within the workflow.  
 ✓ You are in the **Size Distribution** view.

1. In the **Image Gallery** each particle is displayed in a picture frame containing particle information and interactive elements:

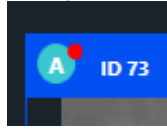


On top of the picture frame, the following information about the particle is displayed:  
**Length, Width and Area.**

Hover with your mouse over the picture frame of the particle of interest.

- On the bottom, the icon bar **M**, **N**, **F**, and **A** is displayed to enable changing the particle type.
2. To display additional information, hover with your mouse over the image.
    - The particle image is shown zoomed out, the particle ID and X and Y particle coordinates are displayed on top of the zoomed out image.
  3. In the **Image Gallery**, in the image, click the desired icon on the bottom to change the particle type or revise an object as artifact.

- The gallery image is marked by a red dot on the top left side to indicate a planned change of the particle type.




4. Click **Apply**.

- The red dot disappears, the image gallery is updated, and the statistics is recalculated accordingly. This also happens, when you click **Next** to proceed.

You have changed the particle type.

### See also

 Editing Particle Analysis Results in the Particle Edit View [► 651]

#### 7.7.12.1.9 Editing Particle Analysis Results in the Particle Edit View

You can display sections of the original tile images instead of a thumbnail image in 2D view and edit them. In case the quality of the result is not satisfactory because for instance adjacent particles touch each other, you edit the analysis result. In the **Image Gallery**, you use the arrow key to scroll through the particle images, to update the **Edit View**.

The **Edit View** is available with or without the option to inspect and retrieve particles in live mode, see *Configuring the TCA Job Template by Switching the Active Branch* [► 599].

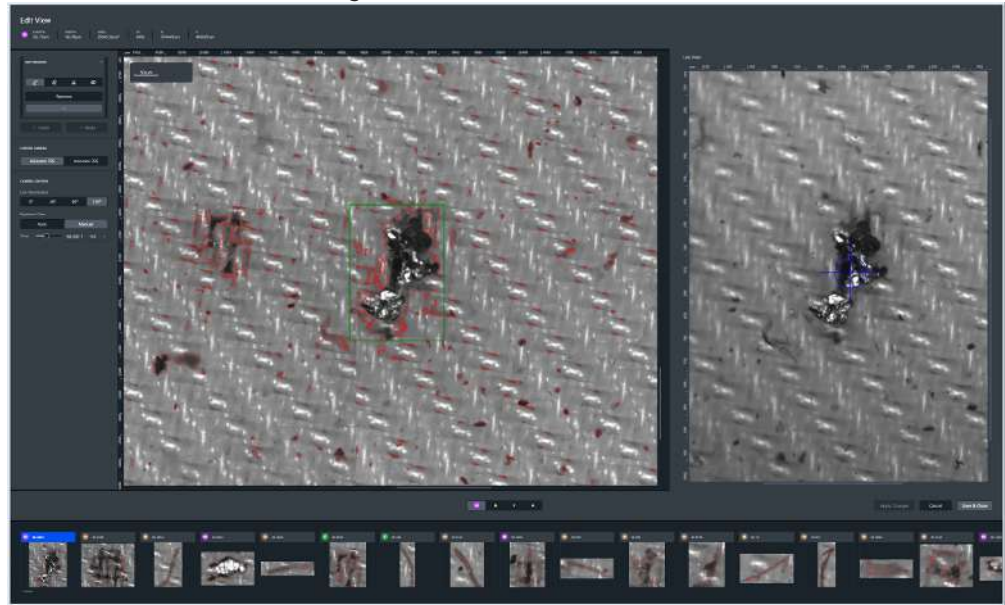
**Prerequisite** ✓ You are in the **Size Distribution** view.

1. In the **Image Gallery**, hover the mouse over the picture frame of a gallery image.
  - The **Opens the Particle Edit View** icon in the upper right side of the picture frame is displayed.

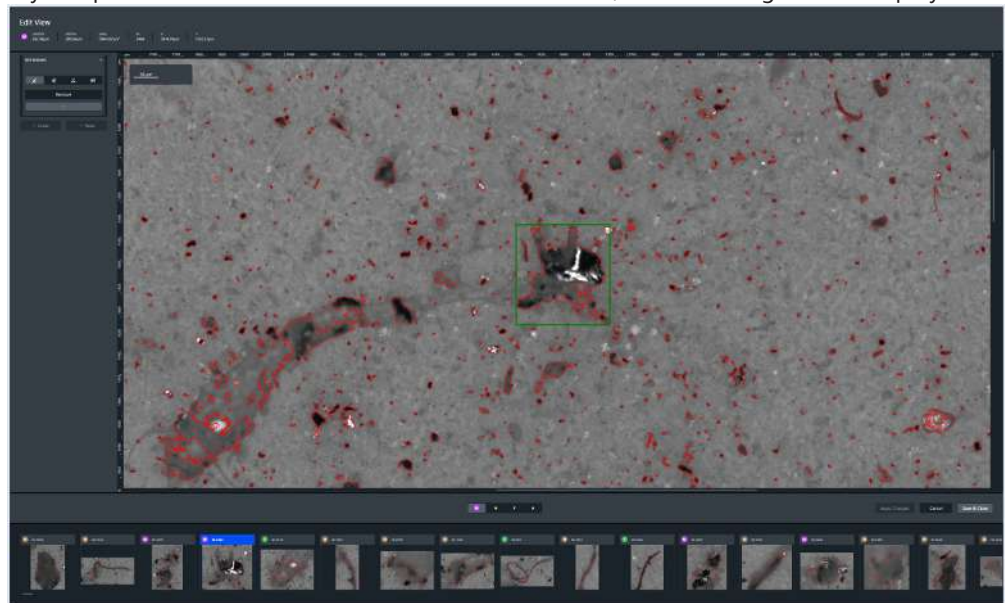


2. Click the icon.

- The **Edit View** appears and the tile image section with the selected particle is displayed in the left window of the center area. The **Live** mode is displayed in the right window of the center area and shows the selected particle centered. The **Edit View** with camera in **Live** mode is the default setting.




- If you open the **Edit View** without camera **Live** mode, the following view is displayed.



- The selected particle is displayed with a green frame.
- With the **Edit Regions** tool, edit the selected particle. For more information, see *Interactive Segmentation* [▶ 265].  
You have the following options:
    - **Draw** button: Adds the area drawn as a new object which extends an existing object.
    - **Erase** button: Removes the area drawn from an existing object.
    - **Cut** button: Splits an object into multiple objects along the line drawn.
    - **Connect** button: If the area drawn overlaps an existing object, the area and object are joined into a single object.
    - **Remove** button: Removes the selected object.**Note:** Keep the middle mouse button pressed and drag the mouse to move the image in the view.

4. **For Component Cleanliness workflows:** Under **Live Polarization**, select the desired polarization orientation channel (0°, 45°, 90°, 135°). Under **Exposure Time**, click **Auto** to apply the exposure time automatically or click **Manual**, then set the exposure time manually. Under **Choose Camera**, you can select between the **Axiocam 705pol** and the **Axiocam 305**. The Axiocam 305 is useful to identify the origin of certain particle classes (colored fibers, different metals and plastics) and to add color images to the report. **Note:** Only available in combination with Axiocam 705pol and in live mode.
5. Click **Apply Changes** to save after all desired revision steps are finalized. Note that editing of particles requires a confirmation by **Apply of Changes** before particle types can be changed in the **Edit View**.
  - The edited particle is displayed with the applied revisions steps.
6. To save and leave the **Edit View**, click **OK**.
  - The segmentation annotation is updated and the revised particle shown in the **Image Gallery** of the **Size Distribution** view.
  - The particle results, classification data and statistics are updated accordingly.
  - The revised particle gets a new **Particle ID**, which is represented by the largest number in the **Particle Result** table.

### See also

 Applying Polarization Channel [▶ 569](#)

#### 7.7.12.1.10 Particle Selection for EDS Analysis

For EDS analysis you preselect particles, and the coordinates of these particles are saved for later EM/EDS analysis after execution of the correlative LM job template. The EDS particle selection list is loaded in **Free Mode** via the **S&F Find (List)** tool in **ZEN core**, to continue the correlative workflow with the EM.

See *Concept of S&F with TCA* [▶ 574](#)

You have the following options for particle selection:

- Automatically configured in the **Standard Template Editor**, see *Defining Length and Width Classes (Workbench Area)* [▶ 581](#).
- Additionally, within the workflow: In the **Size Distribution (Live)** view, you can manually mark or unmark desired particles in the **Particle Gallery**.

If desired you can use both selection methods in combination or only one of them. Independent of the used selection method, all particle coordinates are saved into one file.

##### 7.7.12.1.10.1 Marking Particles for EDS Analysis Automatically

1. Select **Standard Template Editor > Define Class** step > activate **Enable EDS Selection**.
  - An additional column for particles per size class to be marked for EM/EDS measurement is displayed.
  - The automated selection of particles for EDS analysis is activated.
  - By default the coordinates of the particles are stored to the archive in the file **Particle Selection EDS**.
  - As option the particle coordinates are exported in addition to a predefined file path on your computer, see *EDS File Export Tool* [▶ 675](#).
2. Add the modified standard template to the correlative LM job template.

### See also

 Standard Template Editor [▶ 579](#)

#### 7.7.12.1.10.2 Marking Particles for EDS Analysis Manually

Even though you have configured the automatically marking of particles for EDS analysis, you can add desired particles or remove them from the EDS particle selection list.

- Prerequisite**
- ✓ You have selected a correlative LM job template.
  - ✓ You are in **Size Distribution (Live)** view.

1. In the **Image Gallery**, in the desired image, click **Mark for EDS**



- By default the coordinates of the particles are stored to the archive in the file **Particle Selection EDS.csv**.
  - As option the particle coordinates are exported in addition to a predefined file path on your computer, see *EDS File Export Tool* [▶ 675].
2. To unselect the particle for EDS measurement, click **Mark for EDS** a second time.

#### 7.7.12.1.11 Particle Height Measurement

For measuring the height of particles, you select the particles and perform interactive measurement in the **Particle Height Measurement** view. The marked particles are saved in a table and stored in the archive. The report displays the three largest particles per type independent of the particle selection for height measurement. If a height measurement was conducted for these particles, the report shows the values for particle height in addition to length and width.

You have the following options for particle selection:

- In advance: By configuration in the **Standard Template Editor**.
- Additionally, within the workflow: In the **Size Distribution (Live)** view, you can manually mark or unmark desired particles in the **Particle Gallery**.
- If desired, you can use both selection methods in combination or only one of them. Independent of the used selection method all particles are saved into one file.

#### See also

- 📖 Defining Length and Width Classes (Workbench Area) [▶ 581]

#### 7.7.12.1.11.1 Marking Particles for Height Measurement Automatically

1. Select **Standard Template Editor** > **Define Length Classes** step > activate **Automatic Particle Height Measurement**.
  - Two additional columns for particle height measurement are displayed per size class: one for metallic-shiny and the second for non shiny particles.
2. Activate the desired particle size classes for height measurement.
  - The automated selection of particles for interactive height measurement in the workflow is activated.

#### See also

- 📖 Standard Template Editor [▶ 579]

#### 7.7.12.1.11.2 Marking Particles for Height Measurement Manually

Even though you have configured the automatical marking of particles for height measurement, you can add desired particles or remove them from the height measurement selection list.

**Prerequisite** ✓ You are in **Size Distribution (Live)** view.

1. In the **Image Gallery**, in the desired image, click



The particle is selected for height measurement. A second mouse click on this icon removes this particle from the height measurement selection list.

### See also

- 📄 EDS File Export Tool [▶ 675]
- 📄 S&F Find (List) Tool [▶ 789]


## 7.7.12.2 Particle Document

As an **Operator**, after running the job, you want to inspect the saved results of the **Size Distribution** view. This view is similar to the **Size Distribution** view, but without the acquisition and particle revision functionality.

### 7.7.12.2.1 Inspecting Results

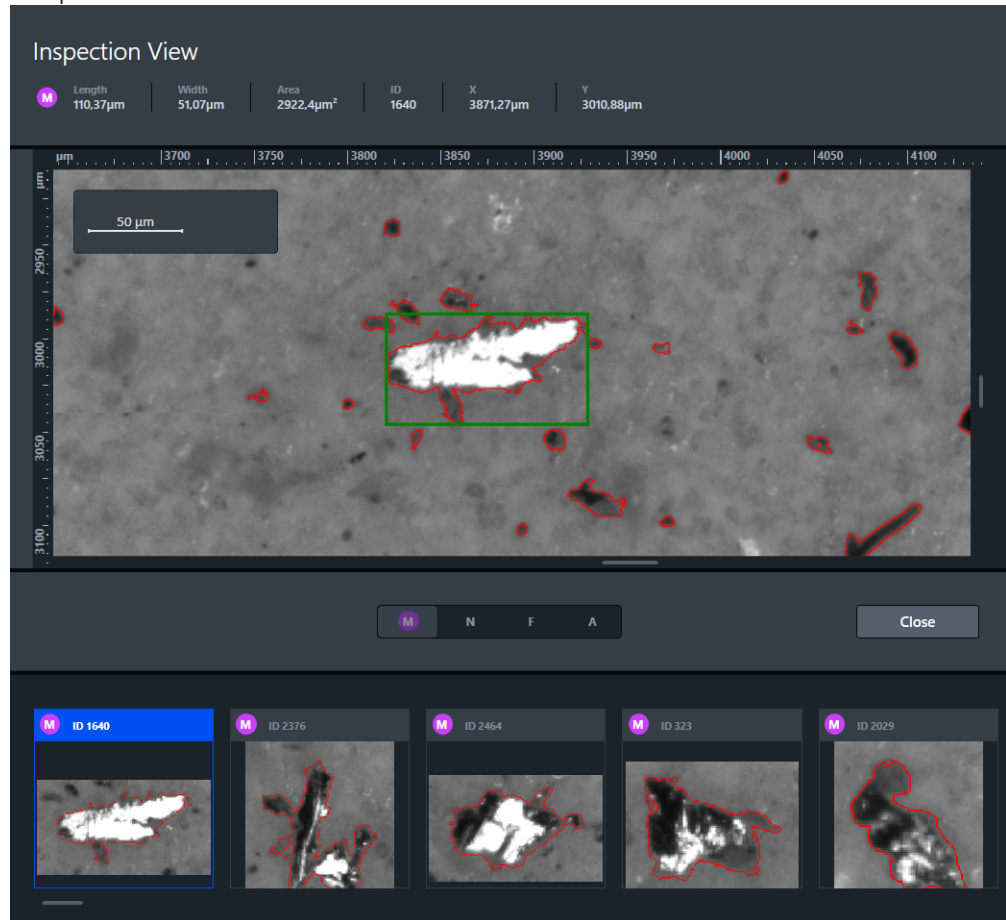
**Prerequisite** ✓ You have run a TCA job and saved it to the archive.

- ✓ You are in **Browse Results** mode.

1. Select the Inspection-View-Document in the format .PADB and click .
  - ➔ A view very similar to the **Size Distribution** view is displayed. The tools display statistical and approval information. You can use all filter functions.
2. In the **Image Gallery**, select a particle and click the icon in the top right corner.
  - ➔ The **Inspection View** view opens.
3. In the **Image Gallery**, select the particle you want to inspect.



→ The particle is centered in the view.



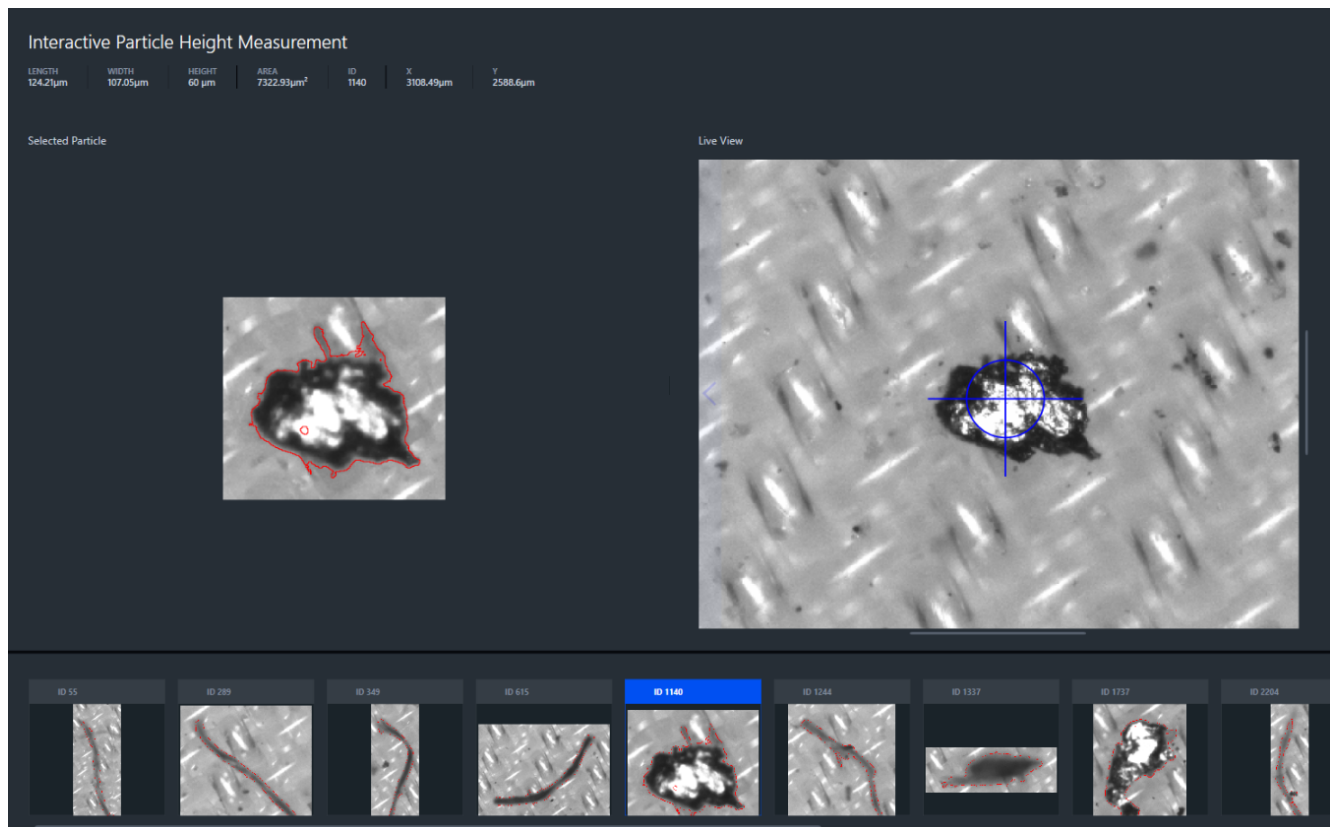
→ You can zoom in and out to inspect the particle.

4. When you have finished the inspection, click **Close**.

### 7.7.12.3 Interactive Particle Height Measurement View

The **Interactive Particle Height Measurement** view displays the particles that are intended for height measurement. In the **Interactive Height Measurement** workbook, in this view, you perform the height measurement.





### See also

- 📄 Particle Height Measurement [▶ 654]
- 📄 Interactive Particle Height Measurement Tool [▶ 678]
- 📄 Interactive Height Measurement Workbench [▶ 664]

### 7.7.13 Saving Job Results

When you have finished your analysis, you save your job results to the archive. In the **Browse Results** mode, you have an overview over your jobs and documents. Here, you can export documents you cannot open in **ZEN core**, e. g. MS Excel files.

1. In the **Report** workbench, click **Exit Loop**.
  - ➔ The next view is displayed.
2. Click **Save and Close**.
  - ➔ The job and the corresponding documents containing the results are saved to the archive.

### Saving Tables

Note that the decimals in tables are saved with full accuracy. But they are displayed according to your settings under **Maintenance > General Options > Data Tables > Data Table > Decimal Places**. By default, the decimals are clipped and not rounded.

If you export a table as **MS Excel** file to your local PC, you can change the settings within **MS Excel** when formatting the cell. You can rise the decimals, for example in case you want to reproduce the classification of a particle in **Technical Cleanliness Analysis**.

### See also

- 📄 Browse Results [▶ 84]

### 7.7.14 Documentation in Reports

#### 7.7.14.1 Creating EDF Images for the Report

You acquire automatically an EDF (Extended Depth of Focus) image after the step **Size Distribution**. In the position list, the largest particles per particle type are displayed. These are provided from the size distribution results. Note that artifacts are not considered. The results from the position list are used to acquire an EDF image, that is stored in the report. **Note:** The default number of largest particles cannot be modified.

- Prerequisite**
- ✓ In the first **Select Branch** workbench, the active branch **Acquire Tiles Images** is selected.
  - ✓ In the second **Select Branch** workbench, the active branch **Size Distribution Live & EDF/Position List** is selected.
  - ✓ You have defined individual settings for your microscope hardware and camera in **Light Path Editing** tool. This configuration is applied automatically before the EDF acquisition starts.
1. In the **EDF Setup (motorized focus)** tool and in the **EDF Processing** tool, make your settings, and click **Next**.
    - ➔ One EDF image per particle type is acquired.
    - ➔ The EDF scene image is splitted into individual EDF images per particle type and is displayed in the report.
    - ➔ For your information, the ID of the particle, the particle type as well as length and width data are added below the particle image.
    - ➔ The image name has the following convention: Image-Loop-< 0n+1>, e.g. **Image-Loop-05**.

#### See also

📖 Light Path Editing Tool [▶ 777]

#### 7.7.14.2 Reports

The information displayed in your reports is based on the report template and differs if you performed an oil cleanliness analysis, or a component cleanliness analysis. For a component analysis, you can customize your report with the **TCA Report** workbench, see *TCA Report Workbench* [▶ 664].

If you have licensed the **GxP** module, you need to sign a report before saving it.

#### General Information

- The report displays some general information, including the information entered into the input form. Additionally, it displays the signature field.
- **For components:** The report additionally displays some general particle information.
- **For oil:** The input form is added to the report as an image. The parameter can be modified in the **Create Form Image** tool, see *Create Form Image Tool* [▶ 674].

#### Results Presentation

- The report contains a **Particle Gallery** displaying a set number of the largest particles with additional information.
- **For components:** Depending on your report configuration, the analysis results for the different particles are displayed, including the classification tables, histogram charts and a scatter plot. Additionally, you have the **Cleanliness Classification** and the results of the Illig value calculation. For a component analysis, the results are displayed before the particle gallery.

- **For oil:** The report displays the particle classification table(s) according to the selected standards.

### Printing Reports

The **TCA Report Workbench** allows to print TCA reports: Click **Print Report**, under **Printer** select the printer, and click **Print Report**. Activate the **Automatic Printing in Run Mode to printer** check box to allow automatic report printing in run mode.

### Global Information

- The report contains an overview image with the **Occupancy Rate**.
- The report also contains a table with overall system properties. For a component analysis, you can also deactivate the display of this table.

### HYDAC Data (only for oil)

If you use cleaning cabinets of HYDAC INTERNATIONAL and extract process data, these data can be added to your report. This reporting option is available for all TCA specific workflows.

### See also

- 📄 Manage Templates [► 65]
- 📄 Selecting a Report Template [► 124]

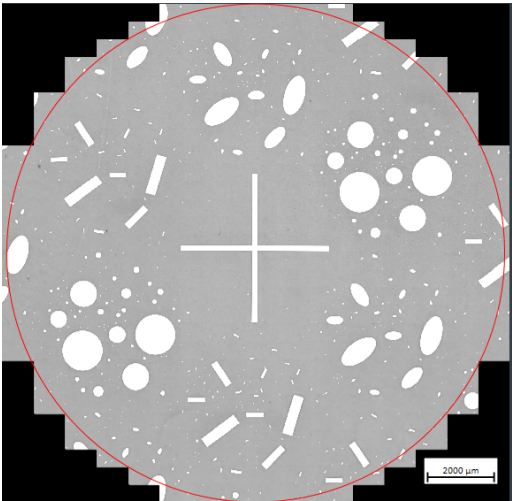
## 7.7.15 Particle Test Slide and Standard

To check the calibration/setup of your microscope system for a component cleanliness analysis, you can use a test slide (round glass slide) with a defined number of different objects. For this, ZEN core offers the following two test standards:

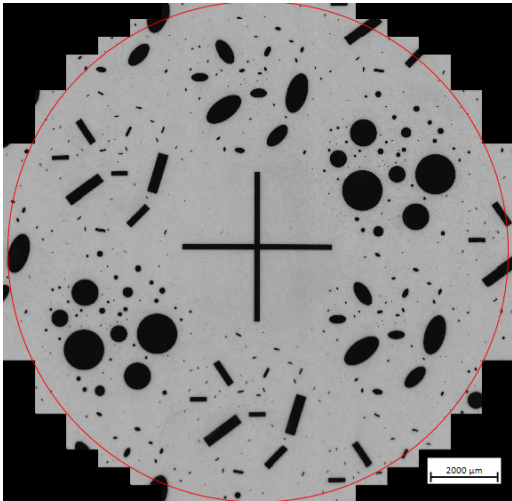
- **Particle Test Standard (CC) (2010) Slide D45**
- **Particle Test Standard (CC with OC) (2010) Slide D45**

The two standards are available in **Manage Templates**. You can acquire images of the test slide and use the standards together with the image analysis to determine if your microscope is configured as needed for the component analysis. To get a good and quick impression of the system status, we recommend to only image one group of objects on the slide.

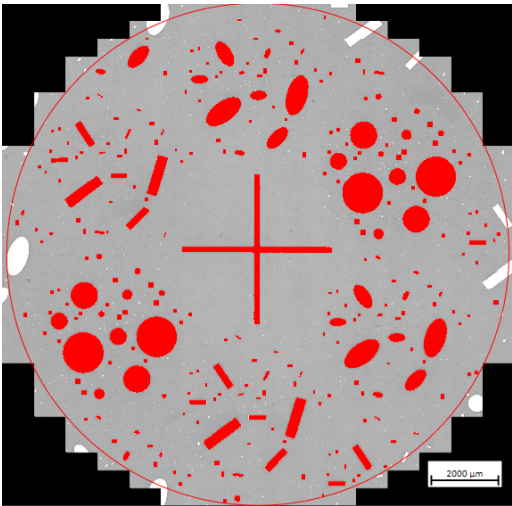
The following example shows an acquisition of the test slide with two polarization channels and the segmentation result with the detected objects inside the drawn measurement frame:



Test slide with Pol 0 channel



Test slide with Pol 90 channel



Segmentation result with detected objects inside the measurement frame

For accessing the information of your analysis, the table(s), report document(s) and particle documents are saved in **Browse Results**, and can be opened from there.

The following table shows an example result for Metallic Shiny Particles found on the test slide. The particle counting results are based on a measurement area with a diameter of 14.5 mm.

Example result for Metallic Shiny Particles (absolute particle counts)

Particle Length (Feret Max')	B (5≤X<15)	C (15≤X<25)	D (25≤X<50)	E (50≤X<100)	F (100≤X<150)	G (150≤X<200)	H (200≤X<400)	I (400≤X<600)	J (600≤X<1000)	K (1000≤X<1500)	L (1500≤X<2000)	M (2000≤X<3000)	N (3000≤X<∞)	Total
1	219	218	122	126	58	32	15	14	14	12	0	0	1	831
2	221	212	124	125	59	30	15	14	14	12	0	0	1	827
3	220	214	125	125	59	30	15	14	14	12	0	0	1	829
4	222	213	125	125	58	31	15	14	14	12	0	0	1	830
5	221	213	125	126	58	31	15	14	14	12	0	0	1	830
6	219	217	124	125	58	31	15	14	14	12	0	0	1	830
7	219	219	126	125	59	30	15	14	14	12	0	0	1	834
8	220	217	125	124	60	29	16	14	14	12	0	0	1	832
Mean value (arith.) abs. particle counts	220	215	125	125	59	31	15	14	14	12	0	0	1	830
Std. deviation particle counts	1,1	2,7	1,2	0,6	0,7	0,9	0,4	0,0	0,0	0,0	0,0	0,0	0,0	2,1
Std. deviation (%)	0,51	1,24	0,96	0,51	1,27	3,04	2,34	0,00	0,00	0,00	0,00	0,00	0,00	0,25

### 7.7.15.1 Best Practice for Particle Test Slide and Standard

Apply the best practice recommendation for point 1 each time you perform a measurement using the particle test standard. The configuration as described in points 2 and 3 are only required once in the beginning to receive a meaningful statistic data set for limit value determination. These are later used for routine measurements of the particle test slide. Point 4 describes how to interpret your results.

1. Preparation before using the particle test standard:
  - Moisten the slide carefully with a soaked, soft and lint-free cloth (water/detergent solution). Clean the slide afterwards in fresh water. Gently dry the slide with a second dry, soft and lint-free cloth.
  - It is recommended to insert a plain white CN-Derivate filter membrane on the holder underneath the particle test standard. Place the slide with the particles shimmering yellowish on top of the plain filter membrane in the slide holder and turn the top lid carefully until it is fixed.
  - Mount the filter holder in the stage insert and set a focus on the sample with the large cross in the center.
2. Configuration of your component cleanliness job template:
  - Define an appropriate acquisition setting in the light path editing tool.
  - Use the 10x objective magnification for the measurement.
  - Adjust the exposure time best suited for acquisition of the POL-90 image and bright image POL-0 and use the determined exposure time for further measurement.
  - Apply the shading correction on a particle free area, e.g. close to the cross in the center.
  - Define a tile region with a diameter of 14.5 mm with the cross in the center.
  - Set the parameter for the mode to **Inside only** in the **Frame Setup**.
  - Use the SW-Autofocus for the measurement. A good starting parameter is to focus on each 25th tile.
3. Dataset generation:
  - Run the configured job template ten times and archive the results.
  - Inspect the particle results in the size distribution. The particles on the slide are found in the absolute counts of the metallic shiny particles, see also the image of the particle gallery below. Artifacts like fibers or contaminant particles from the environment are detected in the type classes non-shiny particles or fibers.
  - Calculate the mean value for each particle size class and determine the limit values accordingly. Consider the **absolute count of the metallic shiny particles** for the limit value determination. See an example for measurement results and the mean value calculation in the table.
  - Create a new component cleanliness standard template with the determined limit values per particle size class. This defines your acceptance criterion for the allowed particle number per size class.
  - Add this standard template to your job template and save it.
4. Routine measurement and result interpretation:
  - Use the prepared and pre-configured component cleanliness job template as described in points 1-3 for routine measurement. For this purpose, run the job template once in a certain time period which best suits your needs, e.g. daily, weekly. Inspect the results size in the distribution view. The particles on the particle test standard are found in the class of absolute counts of the metallic shiny particles. Artifacts like fibers or contaminant particles from the environment are detected in the type class non-shiny particles and fibers.
  - The histogram chart and class table document with an ok/n.o.k display the measurement results. The scatter plot shows a regular pattern, see the second image below.

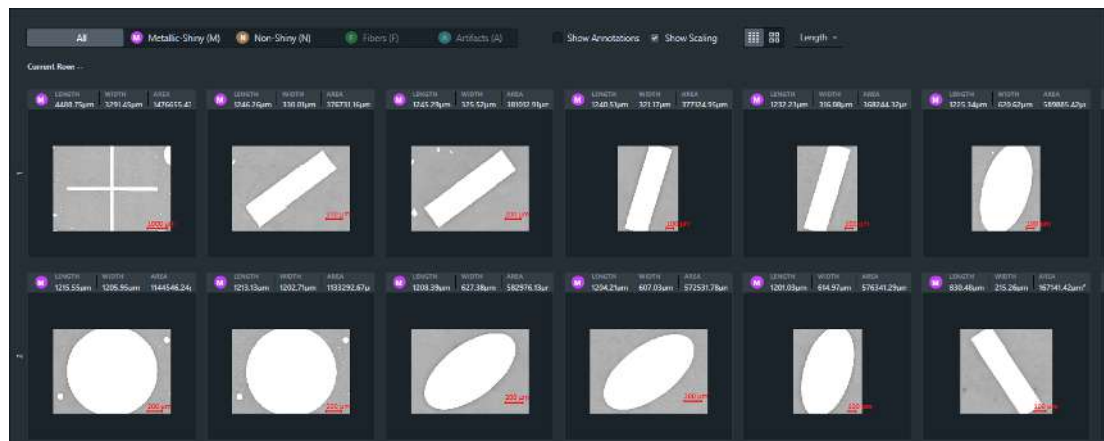


Fig. 64: Particle gallery of a test slide analysis

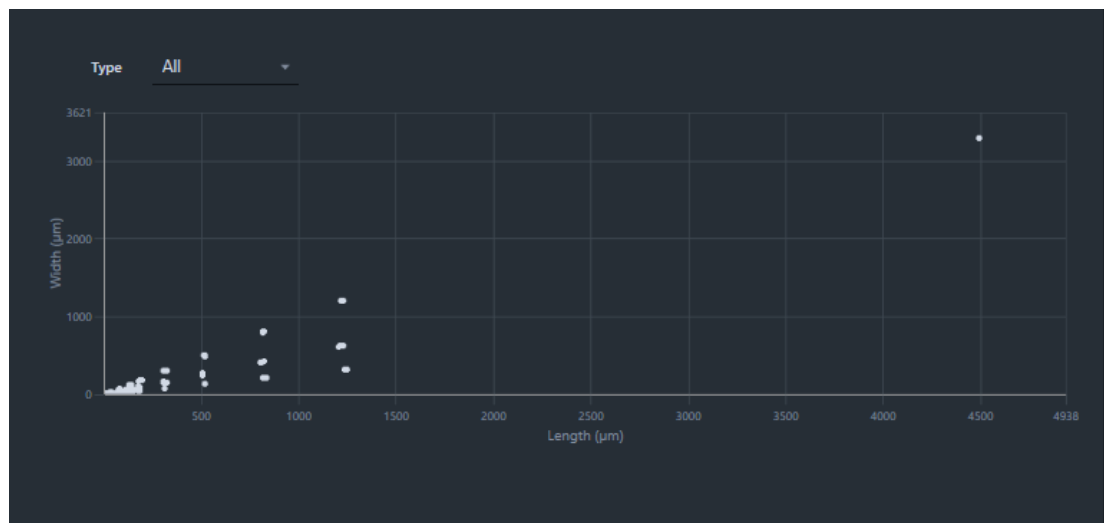


Fig. 65: Scatter plot of a test slide analysis (D 14.5 mm)

## 7.7.16 Reference

### 7.7.16.1 Workbenches & Tasks

#### 7.7.16.1.1 Technical Cleanliness Standard Selection Workbench

This workbench enables you to select a standard to be applied in your **TCA** workflow.

#### See also

- 📄 Technical Cleanliness Standard Selection Tool [► 665]
- 📄 Technical Cleanliness Analysis (TCA) [► 536]

#### 7.7.16.1.2 Image Channel Mapping Workbench

This workbench displays the **Channel Mapping** tool.




#### See also

- 📄 Image Channel Mapping Tool [► 667]
- 📄 Technical Cleanliness Analysis (TCA) [► 536]

#### 7.7.16.1.3 Particle Segmentation Workbench

This workbench enables you to modify the applied threshold range.









##### See also

-  Particle Segmentation Tool (Components) [▶ 666]
-  Particle Segmentation (Oil) Tool [▶ 666]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

#### 7.7.16.1.4 TCA Standard-Specific Settings Workbench

This workbench enables you to adjust the standard based parameter to be applied to **TCA** workflow.









##### See also

-  Occupancy Rate (Components) Tool [▶ 668]
-  Occupancy Rate (Oil, Lubricants) Tool [▶ 668]
-  Extrapolation Tool [▶ 674]
-  Normalization Parameter (Oil Cleanliness) Tool [▶ 670]
-  Normalization Parameter (Components) Tool [▶ 669]
-  Type Classification for Class "All" Tool [▶ 670]
-  Technical Cleanliness Analysis (TCA) [▶ 536]
-  Particle Gallery (Report) Tool [▶ 671]

#### 7.7.16.1.5 Size Distribution Workbench

This workbench enables you to inspect individual particles using the gallery and change their type classification if necessary. The displayed results are dependent on the selected standard.



##### See also

-  Standard Result Selection Tool [▶ 671]
-  Displayed Normalization Tool [▶ 673]
-  Cleanliness Classification (Length) Tool [▶ 675]
-  Specimen Overview Tool [▶ 671]
-  Statistical Analysis Tool [▶ 672]
-  Result Approval Tool [▶ 672]
-  Size Distribution View [▶ 643]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

#### 7.7.16.1.6 Technical Cleanliness Results Output Workbench

This workbench enables you to activate the extraction of process data of HYDAC cleaning cabinets.

##### See also

-  EDS File Export Tool [▶ 675]
-  HYDAC Data Extraction Tool [▶ 675]



#### 7.7.16.1.7 Result Table Loading Workbench

This workbench enables you to load a table from the Archive to further processing the Illig Value. Note that you can only use the results of the standards VDA 19.1 Standard and VDA 19.1 Extended for the Illig calculation.

##### See also

 Load Table from Archive Tool [\[▶ 677\]](#)

#### 7.7.16.1.8 Illig Calculation Workbench

This workbench enables you to calculate the joint results using the sampling location and the sedimentation time.

##### See also

 Illig Parameter Tool [\[▶ 676\]](#)

 Understanding the Illig Method [\[▶ 641\]](#)

#### 7.7.16.1.9 Table Processing Workbench

This workbench enables you to configure the result chart when processing values with the Illig method.

##### See also

 Create Chart Tool [\[▶ 677\]](#)

#### 7.7.16.1.10 Interactive Height Measurement Workbench

This workbench enables you to perform interactive height measurements on selected particles in the **Interactive Particle Height Measurement** view, see *Interactive Particle Height Measurement View* [\[▶ 656\]](#).

The displayed particles are the result of the configured selection of your standard template, see *Marking Particles for Height Measurement Automatically* [\[▶ 654\]](#).

If you have selected particles manually in the workflow, these are displayed here as well, see *Marking Particles for Height Measurement Manually* [\[▶ 654\]](#).

##### See also

 Interactive Particle Height Measurement Tool [\[▶ 678\]](#)

#### 7.7.16.1.11 TCA Report Workbench

The workbench is only available for component cleanliness testing.

The workbench enables you to configure reports. It features a form selection tool that enables you to enter information about the test object and the process parameter. The workbench provides report content such as CCC and Illig value calculations per sample. It performs the Illig calculation for the processed sample in the background and saves the Illig calculation table to the archive, where it can be accessed via **Browse Results**.



The workbench enables you to customize the information displayed in the report. You can select the particle counting result (absolute or normalized), chart types, one or more particle types, and the number of images per row. You also have the option of displaying system properties.

You can also create reports for results with zero particles, for example, for blank tests.

You are able to select a TCA report template within the workflow. The report template selection displays the properties and the content of the template.

You can also print the TCA report.

### See also

 Template Selection Tool [► 678]

 Chart Selection Tool [► 679]

 Gallery Setting Tool [► 680]




## 7.7.16.2 Tools

### 7.7.16.2.1 Technical Cleanliness Standard Selection Tool

This tool enables you to select the standard you want to use for the test. You can use one or more standards to be calculated in parallel.

Parameter	Description
<b>Selected</b>	Activate the checkboxes to select the standard. For a job template without image acquisition, a default standard is displayed.  For Particle Height Measurement, only one standard must be selected.
<b>Standard</b>	Displays the name of the standard. If you have created an individual template, it is displayed here after adding it to the job template.
<b>Version</b>	Displays the released version of the standard. If you have created an individual template, the version you entered is displayed.
<b>Method</b>	Displays the test method, for example <b>Extended Analysis</b> or <b>Standard Analysis</b> .
<b>Owner</b>	Displays the owner of the template. Either you are using a ZEISS standard template with default settings or you have copied and edited the template according to your needs.
<b>Import Possible Standards</b>	Imports the available standards provided by ZEISS and in addition standard templates created by the supervisor.  As a supervisor, import the standard templates that are relevant for the corresponding job template.  As an operator, select the standard templates pre-selected by the supervisor.
<b>Add new Standard</b>	As a supervisor, you can add one or more available standards provided by ZEISS and individually modified standard templates. No multi-selection available, the standards can be added one by another.
<b>Delete Selected Standard</b>	You can delete one or more displayed standards.

### See also



-  [Technical Cleanliness Standard Selection Workbench \[► 662\]](#)
-  [Standard Template Editor \[► 579\]](#)
-  [Technical Cleanliness Analysis \(TCA\) \[► 536\]](#)

#### 7.7.16.2.2 Particle Segmentation Tool (Components)

This tool allows you to adjust the threshold settings for segmenting the particles from the background. The relative threshold value is calculated in percent and refers to the relative image brightness (Luminosity) which is defined as 100%.

Parameter	Description
<b>POL Channel</b>	<b>Default: 90-POL</b> Only available with Axiocam 705 pol. Displays the direction of polarization. The threshold settings are based on the POL channel image.
<b>Luminosity (%)</b>	Displays the relative image brightness of the acquired image in %.
<b>Luminosity Gray Value</b>	Displays the corresponding gray value in relation to the <b>Luminosity (%)</b> .
<b>Lower Relative Threshold (%)</b>	<b>Default: 0%</b> Sets the relative threshold in %.
<b>Lower Relative Threshold Gray Value</b>	Displays the corresponding gray value in relation to the <b>Lower Relative Threshold (%)</b> .
<b>Upper Relative Threshold (%)</b>	<b>Default: 70%</b> Sets the upper relative threshold in %.
<b>Upper Relative Threshold Gray Value</b>	Displays the corresponding gray value in relation to the <b>Upper Relative Threshold (%)</b> .
<b>Show Segmentation Annotation</b>	<b>Activated:</b> Displays the segmentation annotations.
<b>Pick Gray Value From Image</b>	<b>Activated:</b> Selects the gray value and sets it as upper threshold.
<b>Histogram</b>	Sets the lower and upper thresholds defining the relative threshold value accordingly.

#### See also



-  [Camera Tool \[► 754\]](#)
-  [Technical Cleanliness Analysis \(TCA\) \[► 536\]](#)

#### 7.7.16.2.3 Particle Segmentation (Oil) Tool

This tool allows you to set the threshold settings for segmenting the particles from the background. The histogram is used as basis for the segmentation while applying the defined threshold values as lower and upper thresholds for gray values.

Parameter	Description
<b>Display Options</b>	
– Nothing	No segmentation phase is displayed.
– All Phases	Displays the existing segmentation phase.
<b>Threshold</b>	
– Undo	Undoes the last change made to the threshold values.
– Redo	Restores the last undone change to the threshold values.
– Low	<b>Default:</b> gray value. Sets the corresponding gray value as lower threshold.
– High	Sets the corresponding gray value as upper threshold. Only pixels with values lower than High are considered as part of an object.
– Invert	Exchanges the histogram values: sets the lowest threshold value to the highest and the highest to the lowest.
– Full Range	Sets the threshold of the histogram values from 0 to the highest value possible.
<b>Histogram</b>	Sets the lower and upper thresholds based on gray values. Use the sliders under the histogram to adjust the Low and High threshold values.
<b>Pick Behavior</b>	
– -	Adds further objects by increasing the threshold boundaries to include the gray values of the selected object.
– +	Removes objects with the selected brightness values and reduces the threshold boundaries.
<b>Tolerance</b>	Specifies how many additional pixel values are included in the selection based on their brightness. A higher value means that more pixel values similar to the selected one are included. A lower value means that only the exact pixel value selected is included.
<b>Neighborhood</b>	Specifies how many additional pixel values are included in the selection based on their physical proximity to the selected pixel.  A higher value means that more pixels surrounding the selected pixel are included. The threshold boundaries are adapted so that all the pixel values of these neighboring pixels are included. A lower value means that the boundaries are adapted based on only the pixels directly next to the selected pixel.

**See also**





-  Particle Segmentation Workbench ► 663
-  Technical Cleanliness Analysis (TCA) ► 536

**7.7.16.2.4 Image Channel Mapping Tool**

The mapping is performed in the background. Therefore, editing is not possible.

This tool maps the image channels for **Technical Cleanliness Analysis** in combination with **Axiocam 705 pol**.

#### See also

-  [Image Channel Mapping Workbench](#) [► 662]
-  [New Technology POL Camera](#) [► 569]
-  [Applying Polarization Channel](#) [► 569]
-  [Technical Cleanliness Analysis \(TCA\)](#) [► 536]





#### 7.7.16.2.5 Occupancy Rate (Components) Tool

This tool enables you to estimate the particle load on the filter membrane.

Calculation: Sum of the particle area in relation to measurement area (%). The calculated value refers to the complete measurement area.

Parameter	Description
<b>Filter Selection</b>	<ul style="list-style-type: none"> <li>▪ <b>Foamed Filter</b> Relevant Standards: VDA 19.1; ISO 16232</li> <li>▪ <b>Mesh filter</b> Relevant Standards: VDA 19.1; ISO 16232</li> </ul>
<b>Occupancy Rate (%)</b> <b>From/To</b>	<p>Defines data within the value range given by the standard.</p> <ul style="list-style-type: none"> <li>▪ <b>Foamed Filter</b> Value range: 0% to 1.5%</li> <li>▪ <b>Mesh filter</b> Value range: 0% to 3.0%</li> </ul> <p>The occupancy rate is displayed in the <b>Result Approval</b> tool of the <b>Size Distribution</b> view and in the report.</p>

#### See also

-  [TCA Standard-Specific Settings Workbench](#) [► 663]
-  [Size Distribution View](#) [► 643]
-  [Result Approval Tool](#) [► 672]
-  [Technical Cleanliness Analysis \(TCA\)](#) [► 536]

#### 7.7.16.2.6 Occupancy Rate (Oil, Lubricants) Tool

This tool enables you to estimate the particle load on the filter membrane.

Calculation: Sum of the particle area in relation to measurement area (%). The calculated value refers to one single tile.

Parameter	Description
<b>Filter Selection</b>	<ul style="list-style-type: none"> <li>▪ <b>Foamed filter</b> Relevant Standards: DIN 51455</li> <li>▪ <b>Other</b> Threshold values (from/to) are editable and your values are displayed in the <b>Result Approval</b> tool.</li> </ul>

Parameter	Description
<b>Occupancy Rate (%)</b> <b>From/To</b>	<p>Defines data within the value range: 0% to 7.0%.</p> <ul style="list-style-type: none"> <li>▪ <math>x &lt; 1\%</math> can be analyzed with relative thresholds of 75% or 80%</li> <li>▪ <math>1\% &lt; x &lt; 7\%</math> shall be analyzed with relative threshold of 75%</li> <li>▪ <math>x &gt; 7\%</math> is not recommended for further analysis</li> </ul> <p>The occupancy rate is displayed in the <b>Result Approval</b> tool of the <b>Size Distribution</b> view and in the report.</p>

**See also**

- 📖 TCA Standard-Specific Settings Workbench [▶ 663]
- 📖 Result Approval Tool [▶ 672]
- 📖 Size Distribution View [▶ 643]
- 📖 Technical Cleanliness Analysis (TCA) [▶ 536]

**7.7.16.2.7 Normalization Parameter (Components) Tool**

This tool enables you to normalize results to compare them. It is only visible, if you are using one of the following standards:




- **VDA 19.1**
- **ISO 16232**
- **VDA 2083, Blatt 1**

The results are displayed in the **Size Distribution** view and saved in the classification tables in the archive.

Parameter	Description
<b>Calculated from Number of Components (N)</b>	<b>Activated:</b> Normalized count per Component (N) = $\langle \text{Absolute count} \rangle / \langle \text{Number of components} \rangle$
– Number of Components	Enter the number of components. Maximum number of components is 100.000.
<b>Calculated from Wetted Area [cm<sup>2</sup>] (A)</b>	<b>Activated:</b> Normalized count per 1000cm <sup>2</sup> (A) = $\langle \text{Absolute count} \rangle / \langle \text{Wetted Area per component} \rangle \times 1000$
– Wetted Area per Component [cm <sup>2</sup> ]	Enter the wetted area per component.
– Wetted Area Total Number of Components [cm <sup>2</sup> ]	Read only. Displays the average of the wetted area in relation to the number of components. Standardized area is 1000 cm <sup>2</sup> .
– Standard Area [cm <sup>2</sup> ]	Read only. Displays the standard area.
<b>Calculated from Wetted Volume [cm<sup>3</sup>] (V)</b>	<b>Activated:</b> Normalized count per 100cm <sup>3</sup> (V) = $\langle \text{Absolute count} \rangle / \langle \text{Wetted Volume per component} \rangle \times 100$

Parameter	Description
– Wetted Volume per Component [cm <sup>3</sup> ]	Enter the wetted volume. The standardized volume is 100 cm <sup>3</sup> .
– Wetted Volume Total Number of Components [cm <sup>3</sup> ]	Read only. Displays the average of the wetted volume in relation to the number of components.
– Standard Volume [cm <sup>3</sup> ]	Read only. Displays the standard volume.

**See also**

-  TCA Standard-Specific Settings Workbench [▶ 663]
-  Size Distribution View [▶ 643]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

**7.7.16.2.8 Normalization Parameter (Oil Cleanliness) Tool**




This tool enables you to normalize results to compare them. It is only visible, if you are using one of the following standards:

- **ISO 4406**
- **ISO 4407**
- **NAS 1638**
- **SAE AS 4059**

The results are displayed in the **Size Distribution** view and saved in the classification tables in the archive.

Parameter	Description
<b>Applied oil volume [ml]</b>	Displays the oil volume of the sample.
<b>Standard volume [ml]</b>	Displays the standard volume of oil volume in ml. Default: Standardized to 100 ml.

**See also**

-  TCA Standard-Specific Settings Workbench [▶ 663]
-  Size Distribution View [▶ 643]
-  Technical Cleanliness Analysis (TCA) [▶ 536]




**7.7.16.2.9 Type Classification for Class "All" Tool**

This tool enables you to select or deselect fibers to be considered in your classification results shown in the **Size Distribution** view in the class tables. This applies only to the class **All**.

Parameter	Description
<b>Calculation of Class "All"</b>	

Parameter	Description
– With Fibers	<b>Activated:</b> Takes the particle type fiber into account.
– Without Fibers	<b>Activated:</b> Does not take the particle type fiber into account.

**See also**

-  TCA Standard-Specific Settings Workbench [▶ 663]
-  Size Distribution View [▶ 643]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

**7.7.16.2.10 Particle Gallery (Report) Tool**

This tool allows you to select the number of largest particles per type you want to display in the report.

Example: Selection of three results in the presentation of three shiny, three non-shiny particles and three fibers (if detected). They are first sorted by type and subsequent by size.

In the standard template you have defined the size of the particles that is considered for the analysis.

Parameter	Description
<b>Number of Largest Particles per Type for Report</b>	Defines the number of the largest particles from the analysis result displayed in the report. The display is grouped by particle type. The positions of all pre-selected particles will be added to the Position list with EDF.  Default value: 3

**See also**





-  TCA Standard-Specific Settings Workbench [▶ 663]

**7.7.16.2.11 Standard Result Selection Tool**

This tool enables you to select one of the standards you have selected in the **Technical Cleanliness Standard Selection** tool to inspect and modify the particle results.

Parameter	Description
<b>Standard</b>	Displays all available standards in a drop-down list.

**See also**



-  Size Distribution Workbench [▶ 663]
-  Technical Cleanliness Standard Selection Tool [▶ 665]
-  Supported Standards [▶ 540]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

**7.7.16.2.12 Specimen Overview Tool**

This tool displays an overview with information on the specimen.

Parameter	Description
<b>Specimen Name</b>	Displays the sample name.
<b>Measured Area</b>	Displays the measured area in mm <sup>2</sup> .
<b>Magnification</b>	Displays the objective magnification.
<b>Scaling Factor</b>	Displays the scaling of in µm per pixel.

**See also**



-  Size Distribution Workbench [► 663]
-  Technical Cleanliness Analysis (TCA) [► 536]

**7.7.16.2.13 Statistical Analysis Tool**

This tool displays a summary of the specimen results per particle type. The table is stored in the archive and is displayed in the **Size Distribution** view.

Parameter	Description
<b>Largest Length</b>	Displays the length value (Feret Max) and width value (Feret Min) per particle type in µm.
<b>Mean Length</b>	Displays the total area per particle type in mm <sup>2</sup> .
<b>Smallest Length</b>	The mean values are the arithmetic mean.
<b>Mean Width</b>	
<b>Total Number</b>	
<b>Total Length</b>	
<b>Total Width</b>	
<b>Total Area</b>	
<b>Legend below the table</b>	Explains the statistical analysis values.

**See also**

-  Size Distribution Workbench [► 663]
-  Technical Cleanliness Analysis (TCA) [► 536]

**7.7.16.2.14 Result Approval Tool**

This tool enables you to get an overview of the size distribution results based on the approval settings for length and width classification in the selected standard template.

Parameter	Description
<b>Overall Size Classification</b>	Displays the approval: <ul style="list-style-type: none"> <li>▪ <b>NOK</b></li> </ul>



Parameter	Description
	<p>The approval considers whether the acceptance criteria as defined in the <b>Standard Template Editor</b> are fulfilled. <b>NOK</b> approval for the size classification table means: the particle counts in <b>at least one</b> particle size class <b>do exceed</b> the defined limits.</p> <ul style="list-style-type: none"> <li>▪ <b>OK</b> <p>The approval considers whether the acceptance criteria as defined in the <b>Standard Template Editor</b> are fulfilled. <b>OK</b> approval for the size classification table means: the particle counts in all particle size classes <b>do not exceed</b> the defined limits.</p> </li> <li>▪ <b>n.d.</b> <p>No acceptance criteria is defined.</p> </li> </ul>
– Length	Approval status for <b>Length Class Table</b> .
– Width	Approval status for <b>Width Class Table</b> .
<b>Occupancy Rate</b>	The reference value range is defined in the Particle Load tool. For more information, see <i>Occupancy Rate (Components) Tool</i> [▶ 668] or <i>Occupancy Rate (Oil, Lubricants) Tool</i> [▶ 668].
– Target Value (%)	Displays the reference target value in %.
– Actual Value (%)	Displays the actual value in % and if the approval is ok, not ok, or not defined.

### See also

- 📄 Size Distribution Workbench [▶ 663]
- 📄 About Filters and Occupancy Rate [▶ 642]
- 📄 Technical Cleanliness Analysis (TCA) [▶ 536]







#### 7.7.16.2.15 Displayed Normalization Tool

With this tool you display the normalized approval results in the **Class Chart**, in the **Length Class Table**, and in the **Width Class Table** of the **Size Distribution** view. Changing the normalization type changes the results in the **Result** view accordingly. The displayed entries are based on the selected normalization parameters in the **Normalization Parameter** tool.

Parameter	Description
<b>Select Displayed Normalization</b>	Displays the class tables with absolute or normalized counts particle results, depending on the selection.
– Absolute Count	Number of particles per particle size class (real count). Displays the approval results in case that the approval of the selected standard is based on absolute counts.
– Normalized results (N)	Number of particles per particle size class (normalized count). Displays the approval results in case that the approval of the selected standard is based on normalized counts per component (N).
– Normalized results (A)	Number of particles per particle size class (normalized count). Displays the approval results in case that the approval of the selected standard is based on normalized counts by wetted area (A).

Parameter	Description
– Normalized results (V)	Number of particles per particle size class (normalized count). Displays the approval results in case that the approval of the selected standard is based on normalized counts by wetted volume (V).
<b>Approval based on:</b>	Displays the normalization method that has been applied to the standard template selected in the <b>Standards Result Selection</b> tool. If the acceptance criterion for the standard is based on absolute counts, <b>Not available</b> is displayed.

### See also



-  Result Table Loading Workbench [▶ 664]
-  Illig Calculation Workbench [▶ 664]
-  Size Distribution Workbench [▶ 663]
-  Normalization Parameter (Oil Cleanliness) Tool [▶ 670]
-  Normalization Parameter (Components) Tool [▶ 669]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

#### 7.7.16.2.16 Create Form Image Tool

With this tool you configure the size of the input form image in the report.

Parameter	Description
<b>Apply</b>	Creates an image of the selected form and applies it to the report.

### See also



-  Form Workbench [▶ 732]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

#### 7.7.16.2.17 Extrapolation Tool

This tool enables you to perform extrapolation on a defined measurement area. It is only relevant for oil cleanliness analysis. The result for extrapolated particle numbers is displayed in the result tables of the **Size Distribution** view.

Parameter	Description
<b>Current measurement area</b>	Displays the values that are defined in the <b>Tiles (measurement area)</b> workbench, see <i>Tiles (measurement area) Workbench</i> [▶ 523].
– D (mm)	Displays the current diameter in mm of the measurement area. Default: 38 mm.
– Area (mm <sup>2</sup> )	Displays the current size of the measurement area.
<b>Extrapolated measurement area</b>	Enter values to perform extrapolation.
– D (mm)	Diameter in mm of the desired measurement area to be extrapolated to.
– Area (mm <sup>2</sup> )	Size of the desired measurement area to be extrapolated to.

**See also**





-  TCA Standard-Specific Settings Workbench [▶ 663]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

**7.7.16.2.18 Cleanliness Classification (Length) Tool**

This tool displays cleanliness classification information on the specimen.

Parameter	Description
<b>Cleanliness Classification</b>	<p>Displays the results from the <b>Length Class Chart</b> diagram. A red number means that the normalized particle result for a certain particle size class is NOK (not okay). The applied acceptance criteria are defined in the standard template.</p> <p>For information on the cleanliness classification, check the description of the corresponding standard, see <i>Introduction to Standards</i> [▶ 539] and <i>Standard Template Editor</i> [▶ 579].</p>

**See also**


-  Size Distribution Workbench [▶ 663]
-  Result Table Loading Workbench [▶ 664]
-  Illig Calculation Workbench [▶ 664]
-  Technical Cleanliness Analysis (TCA) [▶ 536]

**7.7.16.2.19 HYDAC Data Extraction Tool**

With this tool you can, if you use hardware of HYDAC INTERNATIONAL, extract process data of HYDAC cleaning cabinets, e.g. the extraction control type or the size of the membrane. The corresponding data from HYDAC are provided in XML format. If extracted, the HYDAC process data are saved in a table and added to the job results.

Parameter	Description
<b>Enable Extraction</b>	Activates the extraction of HYDAC data.
<b>Extraction File</b>	Selects the location where the HYDAC XML file is stored. This file will be used to create the table that is added to the job results.

**See also**

-  Technical Cleanliness Results Output Workbench [▶ 663]

**7.7.16.2.20 EDS File Export Tool**


The **Particle Selection EDS** file is stored by default to the archive. You have in addition the option to export the **Particle Selection EDS** file to a desired file path. The particle selection list holds the particle coordinates for both selection methods - manually using the particle gallery in the **Size Distribution** view or automated via the standard template.

**Info**

The file export is not required if shared file access of LM and EM by using **ZEN Data Storage** is available.

Parameter	Description
<b>Output Directory</b>	<p>Defines the path to the output directory of the Particle Selection EDS.csv file. The default location is: C:\Users\Public\Documents\Carl Zeiss\ZENCore\ Correlative_data\Particle Selection EDS.csv.</p> <p>To continue the correlative workflow with the EM, load in <b>ZEN core SEM &gt; Free Mode &gt; S&amp;F Find (List)</b> tool.</p>

**See also**

 Technical Cleanliness Results Output Workbench [► 663]

**7.7.16.2.21 Illig Parameter Tool**

This tool calculates the Illig Value using the **measurement area and the sample location and sedimentation time**. This calculation process is performed as follows:


- Specimen analysis using the job template **Component Cleanliness Testing** with the following
  - Standard template **ISO 16232** or **VDA 19.1 Extended Analysis**.
  - Input form: **Technical Cleanliness (Illig Value)**.
- Combination of analysis results out of the step above using the job template **Technical Cleanliness (VDA 19.2 Joint Result)**.


**Info**

Only job results generated with the same standard can be combined!

Parameter	Description
<b>Job Result Name</b>	The selected tables of job result is displayed.
<b>Sampling Location</b>	The sampling location of the inspection you entered in the input form <b>Technical Cleanliness (Illig Value)</b> is displayed. However, you can change it here.
<b>Sedimentation Time [h]</b>	The time in h of the sedimentation you entered in the input form <b>Technical Cleanliness (Illig Value)</b> is displayed. However, you can change it here.
<b>Measurement Area [cm<sup>2</sup>]</b>	The measurement area is displayed.
<b>Acquisition Date</b>	Enter the acquisition date of the job result.

**See also**


 Illig Calculation Workbench [► 664]

 Understanding the Illig Method [► 641]

**7.7.16.2.22 Load Table from Archive Tool**

This tool loads a results table from the archive to process the Illig Value.

Note that you can only use the results of the standards VDA 19.1 Standard and VDA 19.1 Extended.

Parameter	Description
<b>File Name</b>	The path and filename of the table to be loaded. Click  to open the <b>Results</b> view and select the desired file.

**See also**

 Result Table Loading Workbench [▶ 664]

**7.7.16.2.23 Create Chart Tool**

This tool enables you to set up the chart parameters when processing values with the Illig method.

Parameter	Description
<b>Labels from</b>	
– Sampling Location	Displays the location where the particle trap was placed for testing of particulate contamination of room air.
– Job Result Name	Displays the name of the selected table.
– Analysis Date	Displays the date of the inspection.
– Total Particle Count (Weighted)	Displays the weighted total amount of particles.
– Measurement Area [cm <sup>2</sup> ]	Displays the size of the measurement area.
– Sedimentation Time [h]	Displays the time in h the particles sediment.
– Calculated Normalization Factor	Displays the normalized Illig result of particles.
– Illig Value 1/1000 [cm <sup>2</sup> h]	Displays the calculated Illig value.
<b>Data from</b>	
– Illig Value 1/1000 [cm <sup>2</sup> h]	Uses the Illig value to be displayed in the chart.
<b>Type</b>	
– Bar Chart	Displays the selected chart type.
– Line Chart	Displays the selected chart type.

Parameter	Description
– Pie Chart	Displays the selected chart type.
<b>Width (inch)</b>	Adapts the width of the chart.
<b>Height (inch)</b>	Adapts the height of the chart.
<b>Resolution</b>	
– Screen resolution (96ppi)	<b>Activated:</b> Optimizes the screen resolution of the chart.
– Printing resolution (300ppi)	<b>Activated:</b> Optimizes the resolution for printing the chart in a report.

### See also

 Table Processing Workbench [► 664]

#### 7.7.16.2.24 Interactive Particle Height Measurement Tool

With this tool you measure the height of selected particles. You have selected the displayed particles by pre-configuration in the standard template or by manual selection in the **Size Distribution** view. You determine the particle height by setting two focus positions: the first measures the z-value on the filter membrane beside the selected particle. The second measures the z-value at the top of the particle. The absolute difference of the z-values gives the estimated height of the particle. The resulting particle height is displayed at the top of the **Interactive Particle Height Measurement** view together with the length, width, and area. Determine the height of all desired particles in this way.

The results are written to a table and can be viewed in **Browse Results** mode.

Parameter	Description
<b>Focus Position</b>	
– Set First	Sets the focus position at the bottom position of the particle, i.e., the filter.
– Set Last	Sets the focus position at the top of the particle.
<b>Particle Height</b>	Displays the absolute difference between first and last position in $\mu\text{m}$ .
<b>Previous Particle</b>	Goes back to the previous particle of the Image Gallery.
<b>Next Particle</b>	Goes forward to the next particle in the Image Gallery and displays it in the <b>Interactive Particle Height Measurement</b> view.

### See also

 Interactive Height Measurement Workbench [► 664]

#### 7.7.16.2.25 Template Selection Tool

With this tool you select the desired template for your report configuration. The report template is preset by default.

Parameter	Description
<b>Template</b>	Selects the report template you want to configure.

**See also**

 TCA Report Workbench [► 664]

**7.7.16.2.26 Chart Selection Tool**

With this tool you define which chart type and analysis results you want to display in the report.

Parameter	Description
<b>Approval Display</b>	Displays the approval results if acceptance criteria have been defined.
– <b>Show Approval Indicator</b>	<b>Activated:</b> Displays the approval result ( <b>OK/NOK</b> ) in a separate column. <b>Deactivated:</b> Displays NOK particle count results in red color.
<b>Particle Counting Result</b>	Selects the particle counting result that is displayed in the report.
– <b>Absolute Count</b>	Displays the absolute number of particles.
– <b>Cleanliness Level (N)</b>	Only available if you activated the respective normalization parameter in the <b>Standard Specific Settings</b> step. Displays the number of particles normalized by component count and the corresponding cleanliness level.
– <b>Cleanliness Level (A)</b>	Only available if you activated the respective normalization parameter in the <b>Standard Specific Settings</b> step. Displays the number of particles normalized by wetted area and the corresponding cleanliness level.
– <b>Cleanliness Level (V)</b>	Only available if you activated the respective normalization parameter in the <b>Standard Specific Settings</b> step. Displays the number of particles normalized by vetted volume and the corresponding cleanliness level.
<b>Chart Type</b>	Selects which charts are displayed in the report.
– <b>Histogram Chart</b>	<b>Activated:</b> Displays histogram charts for the analysis results.
– <b>Scatter Plot Chart</b>	<b>Activated:</b> Displays a scatter plot chart for the analysis results.
<b>Particle Type</b>	Selects the particle types for which the analysis results are displayed in the report.
– <b>All</b>	The displayed results depend on the setting made in the <b>Type Classification for Class "All"</b> tool in the <b>Standard Specific Settings</b> step. <b>Activated:</b> If you have selected <b>With Fibers</b> , the analysis result for all particles including the fibers are displayed in the report. If you have selected <b>Without Fibers</b> , the analysis result for all particles without fibers is displayed in the report.
– <b>Metallic-Shiny</b>	<b>Activated:</b> Displays the analysis result for metallic-shiny particles.


Parameter	Description
– <b>Non-Shiny</b>	<b>Activated:</b> Displays the analysis result for non-shiny particles.
– <b>Fibers</b>	<b>Activated:</b> Displays the analysis result for fibers.
<b>Third-Party Settings</b>	
– <b>System Properties</b>	<b>Activated:</b> Displays system properties in the report.
– <b>Hydac Table</b>	<b>Activated:</b> Displays Hydac parameters in the report.

**See also**

 TCA Report Workbench [► 664]

**7.7.16.2.27 Gallery Setting Tool**

With this tool you define the number of images you want to display in one row in the report.

Parameter	Description
<b>Image Count per Row</b>	Sets the desired number of images per row with the slider or input field. The total number of particle images displayed in the report depends on the setting in the <b>Particle Gallery (Report)</b> tool in the <b>Standard Specific Settings</b> step. Click  to change the image count range in the <b>Tool Setup</b> .

**See also**

 TCA Report Workbench [► 664]




## 8 Special Modules & Extensions

### 8.1 Coded Microscope

This module supports manual and coded systems (no motorized systems). By that the status of coded components are displayed in **ZEN starter**. Additionally, in the **Light Path** tool, the configuration of the microscope used and the status is displayed.

#### See also

 Light Path Tool [► 778]

### 8.2 ImageJ

This extension integrates the ImageJ software into ZEN core. This enables you to make use of ImageJ's image processing capabilities from within your workflows.

You can send images to ImageJ and retrieve them back into the software with a single click each.

#### Info


The **Single Instance Listener**, a feature of ImageJ, is crucial for the ImageJ Extension to work. The **Single Instance Listener** does not work for the latest ImageJ 2 versions. We recommend to use one of the Fiji Life-Line versions you can find on the Fiji homepage for which the **Single Instance Listener** does work.

#### 8.2.1 Activating the ImageJ Extension

You activate the ImageJ extension via the **Extensions Manager** and then configure it in the **Options** dialog.

##### Configuring the Software

##### Prerequisite

- ✓ ImageJ is installed on your system.  
The Life-Line version of the Fiji distribution is recommended, which contains all necessary ImageJ plugins and works with ZEN core.
  - ✓ You are logged in as an administrator.
  - ✓ The **Home Screen** is displayed.
1. Activate the **ImageJ Extension** in the **Extensions Manager**:  
→ **Maintenance > Extensions Manager**
  2. Confirm the configuration by clicking the **Apply** button.  
→ If you activate ImageJ for the first time, a "missing path" warning is displayed. Confirm by clicking **OK**.
  3. Open the **Options** window:  
→ **Maintenance > Options**
  4. Select the **ImageJ** tab.
  5. Select the path to the ImageJ executable from the drop-down list:  
→ Select one of the paths suggested by the software.  
→ Click on  to specify a different path.

##### Configuring ImageJ

To configure how ImageJ interacts with the software:

- Prerequisite** ✓ ImageJ is installed on your system.  
The Life-Line version of the Fiji distribution is recommended, which contains all necessary ImageJ plugins and works with the software.
1. Open the ImageJ installation specified in the software options.
  2. Activate the **Single Instance Listener**:  
→ You find the **Single Instance Listener** under **Edit > Options > Misc...**

### 8.2.2 Installing and Preparing ImageJ

The ImageJ extension of ZEN core requires ImageJ to be installed and additionally to be configured correctly.

To prepare ImageJ for the use in ZEN core, perform the following steps:

1. Create a folder which can be fully accessed without Windows administrator rights.
2. Install ImageJ in the created folder. Check for ImageJ updates after installation.  
→ We recommend to use the Fiji distribution, which includes all required plugins. If you use Fiji, you can skip the next two steps.
3. Download the OME Bio-Formats library (LOCI Plugins for ImageJ).
4. Copy the downloaded file loci\_tools.jar to the ImageJ\plugins folder.
5. Make sure that **Run single instance listener** is activated in ImageJ.  
→ You find it under the **Edit > Options > Misc...**

ImageJ is now correctly installed and prepared to work with the software. If you have several ImageJ installations on your computer, make sure to direct the software to the above installation using the **General Options** dialog.

### 8.2.3 Adding the ImageJ Workbench

The ImageJ workbench enables you to connect ZEN core with ImageJ. The communication between the two programs is bidirectional. You can use ImageJ to complement the image processing tools available in ZEN core.

- Prerequisite** ✓ ImageJ is installed on your system and configured for ZEN core.  
✓ The **ImageJ Extension** is activated in the software and configured.  
✓ You are logged in as a supervisor.
1. Add the **ImageJ Connection** workbench:  
→ **+ Add Task > Utilities > ImageJ Connection > + Add**
  2. Use the **Send Image** and **Retrieve Image** buttons to send the image to ImageJ and to retrieve it back into the software after processing it with ImageJ.

#### See also

- 📖 ImageJ Connection [► 746]
- 📖 Selecting Workbenches [► 41]
- 📖 Specifying Tools for a Task [► 58]

### 8.2.4 Exchanging Images between ZEN core and ImageJ

The **ImageJ** tool enables you to send images to ImageJ or to retrieve images from ImageJ, e.g. after processing them with ImageJ.

**Sending or Retrieving Images**

**Sending an image to ImageJ** To send an image to ImageJ:

- Prerequisite**
- ✓ The **ImageJ** tool is selected.
  - ✓ An image is displayed.
1. Send the image to ImageJ by clicking the **Send Image** button.
    - ➔ The image is sent to ImageJ. Any modifications (e.g. processing or measurements) are applied before it is sent.
  2. Follow the instructions in ImageJ.
    - ➔ Depending on the image data, ImageJ shows an import dialog. For more information, see the ImageJ instruction manual.

**Retrieving an image from ImageJ** To retrieve an image from ImageJ:

- Prerequisite**
- ✓ The **ImageJ** tool is selected.
1. Open ImageJ and prepare the image you wish to retrieve.
  2. In ZEN core, click the **Retrieve Image** button in the **ImageJ** tool.

**Image Type Conventions**

ImageJ does not support all file types and pixel types that can be used in the software.

In these cases the image must be converted in the software before sending it to ImageJ.

See the tables below for further details.

**ZEN core to ImageJ**



ZEN core	ImageJ	Comments
.tif, .jpg, .bmp, .png, .gif	Original	The image is imported unchanged.
.ome.tif	Original	The image is imported unchanged.
.czi 2D 8/16 Bit B/W	32 Bit RGB	You can change the pixel type back to B/W in ImageJ using the <b>Image &gt; Type</b> command.
.czi 2D 12 Bit B/W	Not supported	Convert the image to 16 bit B/W using the <b>Change Pixel Type</b> tool before sending it to ImageJ.
.czi 24/48 Bit RGB	32 Bit RGB	
.czi 36/42 Bit RGB	Not supported	Convert the image to 24/48 bit RGB using the <b>Change Pixel Type</b> tool before sending it to ImageJ.
<ul style="list-style-type: none"> <li>■ Multi-channel</li> <li>■ Z stack</li> <li>■ Temperature/Time series</li> </ul>	MD image	If necessary, reassign the dimensions in ImageJ using <b>Image &gt; Hyperstacks</b> for example.
Tiled image	Partially supported	Only the first tile is imported.

**ImageJ to ZEN core**

ImageJ	ZEN core	Comments
.tif, .jpg, .bmp, .png, .gif	Original	The image is imported unchanged.

ImageJ	ZEN core	Comments
.ome.tif	Original	The image is imported unchanged.
2D images, B/W or RGB	.tif, B/W or RGB	Any 2D image other than the types listed above is received as a .tif-image.
<ul style="list-style-type: none"> <li>Multi-channel</li> <li>Z stack</li> <li>Temperature/Time series</li> </ul>	MD image	All channels or layers are imported into a corresponding multidimensional image.
Tiled image	Partially supported	Only the first tile is imported.

### See also

-  [Selecting Workbenches \[► 41\]](#)
-  [Specifying Tools for a Task \[► 58\]](#)

## 9 Systems & Components

### 9.1 Visioner

#### 9.1.1 Concept

**ZEISS Visioner** digital microscope system is designed to acquire real-time EDF and topography images. Based on either the image or a cross-sectional profile line, you can run measurements. In **Job Mode** you will be guided semi-automated through the inspection and reporting routines.

The **ZEN core Visioner** application for **ZEN core** is available with the corresponding license.

For your work with **ZEN core Visioner** you use the specific workbenches and the corresponding tools, but you are also free to use the **Topography Measurements** workbench with its tools to perform measurements, see *Topography Measurements Workbench* [[▶ 743](#)].

#### 9.1.2 Intended Use

The microscope is intended for industrial applications, e.g. quality control.

Improper use of the microscope and its components can easily lead to impairment of their function or even damage them. Damage caused by incorrect operation, negligence, or unauthorized intervention, in particular by removing, modifying, or replacing parts of the microscope or its components, cannot be held liable by the device manufacturer. Third-party devices or components that are not expressly approved by ZEISS may not be used.

### 9.1.3 Image Views

#### 9.1.3.1 EDF View

In this view, an EDF (extended depth of focus) image is displayed.

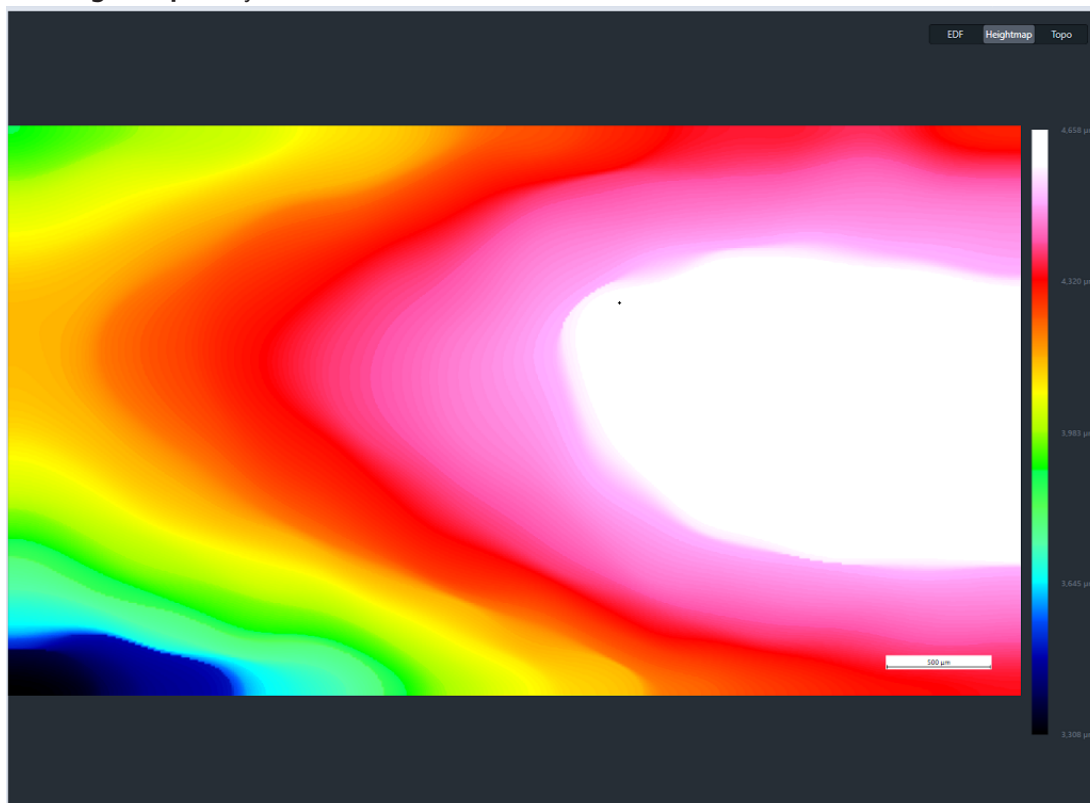


#### 9.1.3.2 Heightmap View



##### Info

We do not recommend to use the heightmap as an input for 2-dimensional measurements.

In this view you see the heightmap of the image. With the rainbow and the grayscale color scheme, a palette legend with the corresponding color code is displayed for your reference. On the **Heightmap** tab, you can select different color schemes.



### See also

-  Heightmap Tab [► 34]
-  Display Tab [► 29]

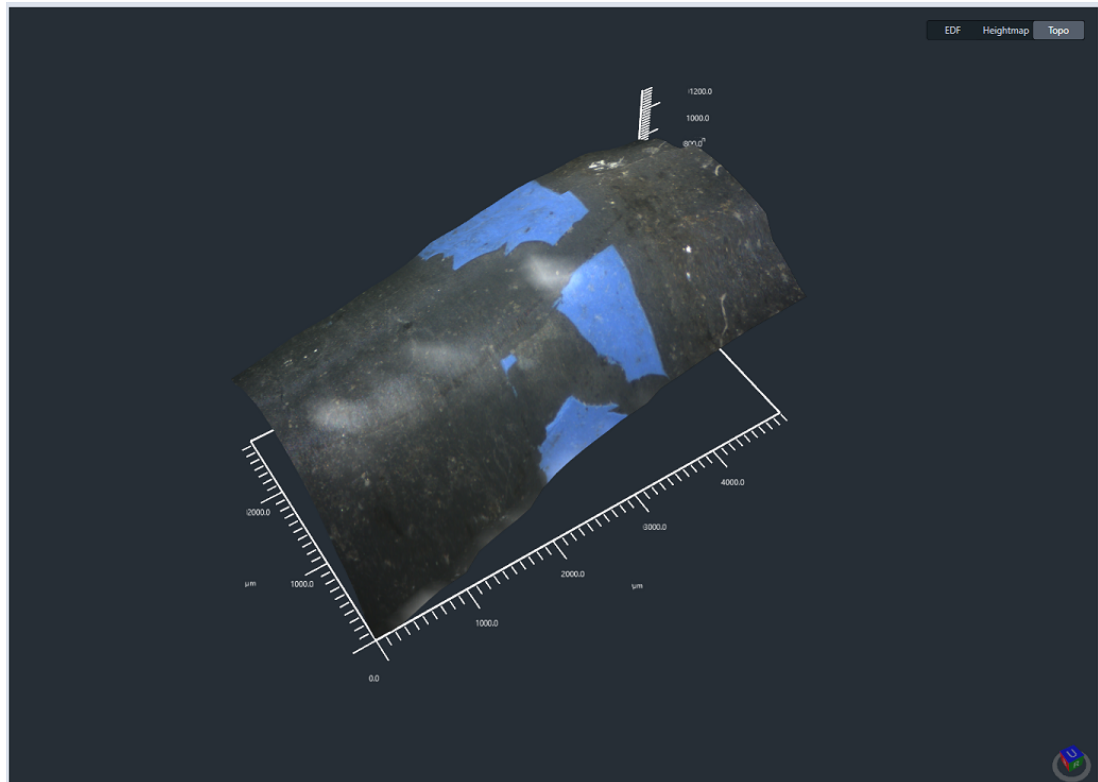
#### 9.1.3.3 2.5D Topo View

In this view you see the 2.5 D display of the image. You can move, zoom and rotate the view with the mouse. Optionally, the cube in the right hand corner has the same functionality.

#### Info

In reflected light, reflexes and texture of the sample might have an impact on the **Topo** view.

The **Topo** view is showing a 2.5D perspective for both snapped images and live acquisition.



### See also

Topo Options Tab [► 32]

## 9.1.4 Acquiring a Visioner EDF Panorama (interactive) with a Manual Stage

To acquire an image of a large sample area, you acquire tiles (images of neighboring sample areas) and move the stage between two tile acquisitions with a manual stage.

### Info

The **Visioner EDF Panorama (interactive)** workbench is optimized for the following magnifications:

- ▶ 2.5x
- ▶ 1.8x
- ▶ 1.3x
- ▶ 1.2x

- Prerequisite**
- ✓ The **Visioner EDF Panorama (interactive)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
  - ✓ In the **Camera Settings** tool, the camera is set up.
  - ✓ In the **Tile Stitching** tool, the stitching method to be applied after acquisition is set up. As default setting, the **Edge Detector** is set to **Yes**.
1. In the workbench area, click **Start**.
    - ➔ In the **Center Screen Area**, the **Live Navigator**, a live preview image with tile overlay and an acquisition tool to acquire tiles are displayed.
  2. Move the stage until the sample area of interest is visible in the **Live Navigator** image.



3. In the acquisition tool in the **Center Screen Area**, click **Acquire Tile Image**.
4. Double-click one of the eight neighbor fields next to the acquired tile.
  - ➔ The **Live Navigator** is placed accordingly.
  - ➔ The preview image displayed inside the **Live Navigator** is identical to the last acquired tile.
5. Match the **Live Navigator** image to the edge of the last acquired tile by moving the stage accordingly, and click **Acquire Tile Image**.
  - ➔ You have acquired the neighbor field.
6. Repeat the steps 4 and 5 until you have acquired an image of the entire sample area of interest. In the workbench area, click **Stop**.

The acquired image is complete. If you have selected stitching, the software finishes the acquisition by aligning the tile images along their edges.

### See also

- 📖 Camera Settings Tool [▶ 694]
- 📖 Selecting Workbenches [▶ 41]
- 📖 Tiles Stitching Tool [▶ 188]
- 📖 Visioner EDF Panorama (interactive) Workbench [▶ 692]

## 9.1.5 Acquiring a Visioner EDF Panorama (interactive) with a Motorized Stage

To acquire an image of a large sample area, you acquire tiles (images of neighboring sample areas) and move the stage between two tile acquisitions preferably with a motorized stage.

### Info

The **Visioner EDF Panorama (interactive)** workbench is optimized for the following magnifications:





- ▶ 2.5x
- ▶ 1.8x
- ▶ 1.3x
- ▶ 1.2x

- Prerequisite**
- ✓ The **Visioner EDF Panorama (interactive)** workbench is selected.
  - ✓ The sample is sufficiently illuminated and in focus.
  - ✓ In the **Camera Settings** tool, the camera is set up.
  - ✓ In the **Tile Stitching** tool, the stitching method to be applied after acquisition is set up. As default setting, the **Edge Detector** is set to **Yes**.
1. In the workbench area, click **Start**.
    - ➔ In the **Center Screen Area**, the **Live Navigator**, a live preview image and an acquisition tool to acquire tiles are displayed.
  2. Move the stage until the sample area of interest is visible in the **Live Navigator** image.
  3. In the acquisition tool in the **Center Screen Area**, click **Acquire Tile Image**.
    - ➔ The **Live Navigator** moves diagonal below the last acquired image.
  4. Position the **Live Navigator** to your interesting area with the mouse. For good results, the overlap between the individual tiles should be about 10%, and click **Acquire Tile Image**.
    - ➔ You have acquired the neighbor field.

5. Repeat step 4 until you have acquired an image of the entire sample area of interest. In the workbench area, click **Stop**.

The acquired image is complete. If you have selected stitching, the software finishes the acquisition by aligning the tile images along their edges.

### See also

-  Camera Settings Tool [\[▶ 694\]](#)
-  Selecting Workbenches [\[▶ 41\]](#)
-  Tiles Stitching Tool [\[▶ 188\]](#)
-  Visioner EDF Panorama (interactive) Workbench [\[▶ 692\]](#)

## 9.1.6 Operator Workflow: Multiple Interactive Measurements

Operator workflows are designed by Supervisors. In the following you see an example of an operator workflow.

Tasks	Description	To Do
Step 1 <b>Input Form</b>	Provides an input form in the <b>Form Selection</b> tool. If desired, change the input form.	One appropriate input form is displayed. Fill in the relevant data. The form is displayed in the report.
Step 2 <b>Visioner Topography Acquisition</b>	Provides tools with setting options to acquire optimal multiple images.	Adjust the settings according to your specimen, see <ul style="list-style-type: none"> <li>▪ <i>Acquisition Settings Tool</i> <a href="#">[▶ 693]</a></li> <li>▪ <i>Illumination Settings Tool</i> <a href="#">[▶ 694]</a></li> <li>▪ <i>Camera Settings Tool</i> <a href="#">[▶ 694]</a></li> </ul>
Step 3 <b>Interactive Measurements</b>	Displays the acquired image in the <b>Center Screen Area</b> .	In the <b>Center Screen Area</b> , make your measurements, see <i>Interactive Measurements</i> <a href="#">[▶ 834]</a> .  Additionally to the default interactive measurements, optional interactive measurements are available.  Activate <b>Create new Image</b> to save the annotations with the original image. The image is displayed in the report.
Step 4 <b>Reports</b>	Creates a report document for each job result.	The calculated measurement result are displayed as a diagram and in a table.  You can print the report.

## 9.1.7 Operator Workflow: Multiple Profile Line Measurements

Operator workflows are designed by Supervisors. In the following you see an example of an operator workflow.

Tasks	Description	To Do
Step 1 <b>Input Form</b>	Provides an input form in the <b>Form Selection</b> tool. If desired, change the input form.	One appropriate input form is displayed. Fill in the relevant data. The form is displayed in the report.
Step 2 <b>Visioner Topography Acquisition</b>	Provides tools with setting options to acquire optimal multiple images.	Adjust the settings according to your specimen, see <ul style="list-style-type: none"> <li>▪ <i>Acquisition Settings Tool</i> [► 693]</li> <li>▪ <i>Illumination Settings Tool</i> [► 694]</li> <li>▪ <i>Camera Settings Tool</i> [► 694]</li> </ul>
Step 3 <b>Topography Measurements</b>	Provides tools to measure profile lines (x, y). A histogram is displayed.  The <b>Create Image</b> tool creates a screenshot of the active image in the <b>Center Screen Area</b> and of the histogram. The screenshot image added to the report.	In the <b>Center Screen Area</b> , make your measurements, see <ul style="list-style-type: none"> <li>▪ <i>Profile Line (x, y) Tool</i> [► 849]</li> <li>▪ <i>Create Image Tool</i> [► 850]</li> </ul>
Step 4 <b>Reports</b>	Creates a report document for each job result.	You can print the report.







## 9.1.8 Reference

### 9.1.8.1 Visioner Topography Acquisition Workbench

This workbench enables you to acquire topography images. The image has two channels: one channel is the EDF image and the other channel is the height map image with scaled Z-values. Live and Snap mode are available.

#### See also




















- ▢ *Acquisition Settings Tool* [► 693]
- ▢ *Illumination Settings Tool* [► 694]
- ▢ *Camera Settings Tool* [► 694]
- ▢ *Advanced Acquisition Settings Tool* [► 695]
- ▢ *Stage Tool* [► 795]
- ▢ *Circle (Diameter) Tool* [► 837]
- ▢ *Circle (Points) Tool* [► 837]
- ▢ *Circle (Radius, In-Out) Tool* [► 838]
- ▢ *Circle (Radius, Out-In) Tool* [► 839]
- ▢ *Contour (Polygon) Tool* [► 839]
- ▢ *Rectangle Tool* [► 841]
- ▢ *Angle Tool* [► 842]
- ▢ *Angle (Disconnected) Tool* [► 843]
- ▢ *Caliper Tool* [► 843]
- ▢ *Curve (Polygon) Tool* [► 844]

-  Distance Tool [▶ 844]
-  Length Tool [▶ 845]
-  Line Tool [▶ 846]
-  Multi Calipers Tool [▶ 846]
-  Multi Distance Tool [▶ 847]
-  Multi-Interdistance Tool [▶ 847]

### 9.1.8.2 Visioner 2D Acquisition Workbench

This workbench enables you to acquire 2D images of the central slice of the z-stack for performing exact measurements. To improve acquisition speed, you can reduce the **Field of View**. The region is always centralized to the full frame.

#### See also

-  Illumination Settings Tool [▶ 694]
-  Camera Settings Tool [▶ 694]
-  Stage Tool [▶ 795]
-  Circle (Diameter) Tool [▶ 837]
-  Circle (Points) Tool [▶ 837]
-  Circle (Radius, In-Out) Tool [▶ 838]
-  Circle (Radius, Out-In) Tool [▶ 839]
-  Contour (Polygon) Tool [▶ 839]
-  Rectangle Tool [▶ 841]
-  Angle Tool [▶ 842]
-  Angle (Disconnected) Tool [▶ 843]
-  Caliper Tool [▶ 843]
-  Curve (Polygon) Tool [▶ 844]
-  Distance Tool [▶ 844]
-  Length Tool [▶ 845]
-  Line Tool [▶ 846]
-  Multi Distance Tool [▶ 847]
-  Multi Calipers Tool [▶ 846]
-  Multi-Interdistance Tool [▶ 847]

### 9.1.8.3 Visioner EDF Panorama (interactive) Workbench









This workbench enables you to acquire an overview image (or panorama image) exceeding the image size of a single image. This is the case when the field of view of your microscope is too small for the sample area you wish to acquire. Acquire a set of connected, overlapping images (tiles) manually to stitch the tiles together to a single large image.

This workbench is optimized for the following magnifications:

- 2.5x
- 1.8x
- 1.3x
- 1.2x

This workbench is **not** optimized for the magnifications 0.75x and 0.35x.

### See also

-  Acquiring a Visioner EDF Panorama (interactive) with a Manual Stage [[▶ 688](#)]
-  Acquiring a Visioner EDF Panorama (interactive) with a Motorized Stage [[▶ 689](#)]
-  Acquisition Settings Tool [[▶ 693](#)]
-  Illumination Settings Tool [[▶ 694](#)]
-  Camera Settings Tool [[▶ 694](#)]
-  Advanced Acquisition Settings Tool [[▶ 695](#)]
-  Stage Tool [[▶ 795](#)]
-  Tiles Stitching Tool [[▶ 188](#)]

#### 9.1.8.4 Acquisition Settings Tool

This tool enables you to choose the settings of the topography acquisition. The performance of the Z-Stack acquisition and the EDF calculation depend on these parameters.

Parameter	Description
<b>Objective</b>	Displays the currently used magnification.
<b>Z-Range</b>	Defines of the vertical spread of your EDF image range.
<b>Field of View</b>	To give you more flexibility and to improve acquisition speed, you can reduce the field of view. The region is always centralized to the full frame.
<b>Live Image Quality</b>	
— Regular	Optimizes Live image regarding speed.
— Accurate	Optimizes Live image regarding quality.
<b>Snap Image Quality</b>	
— Regular	Optimizes the Snap image regarding speed.
— Accurate	Optimizes the Snap image regarding quality.
<b>Live Reflex Correction</b>	
— On	Standard illumination is used.
— Off	Reflex mitigation by segmented illumination in different angles.
<b>Snap Reflex Correction</b>	
— On	Standard illumination is used.
— Off	Reflex mitigation by segmented illumination in different angles.
<b>Speed</b>	Displays the number of EDF images per second.

An "\*" after **Regular** and **Accurate** indicates that individual parameters of the **Advanced Acquisition Settings** tool are used, see *Advanced Acquisition Settings Tool* [[▶ 695](#)].

**See also**

 Visioner Topography Acquisition Workbench [► 691]

**9.1.8.5 Camera Settings Tool**

This tool enables you to set the white balance and exposure time to ensure a good image quality.

**Visioner** is equipped with a RGB camera. For controlling this camera the following controls are necessary.

Parameter	Description
<b>Selected White Balance</b>	With adjusting the white balance you can remove a color cast (e.g. a red or green tint) from the live image that may result from non-neutral lighting. As a result the colors appear neutral. For each objective, a white balance is automatically set.
– Default	Factory settings of white balance are used.
– Custom	White balance you created.
– New	Set a new white balance. You can store it as a custom white balance.
<b>White Balance</b>	
– Create	Click <b>Create</b> to create a new white balance.
– Store as Custom	Click <b>Store as Custom</b> to save the white balance value and to use it again.
<b>Auto Exposure</b>	Click <b>Perform</b> to calculate the exposure time based on the current light intensity, so the brightness of the image is consistent.
<b>Exposure Time</b>	Sets the exposure time manually with a slider.
<b>Gain</b>	Sets the gain. To ensure a good image quality, you might adjust the exposure time and the intensity.  If setting exposure time and intensity is not sufficient, you can use camera gain to increase the brightness.

**See also**

 Visioner 2D Acquisition Workbench [► 692]

 Visioner Topography Acquisition Workbench [► 691]

**9.1.8.6 Illumination Settings Tool**

This tool enables you to select the light source. All available light sources are displayed and can be selected as active illumination. A mixture between different light sources is not possible. The visibility of the optional light source (1-Ring -LED or VisiLED) depends on the settings in **MTB config**.

Parameter	Description
<b>3-Ring-LED</b>	
– Off	Switches the light source off.
– On	Switches the light source on.

Parameter	Description
<b>Intensity</b>	Adjusts the intensity of all subordinated sliders.
– Inner Ring slider	Adjusts the intensity of the inner ring segment of the LED.
– Middle Ring slider	Adjusts the intensity of the middle ring segment of the LED.
– Outer Ring slider	Adjusts the intensity of the outer ring segment of the LED.
<b>1-Ring-LED</b>	
– Off	Switches the light source off.
– On	Switches the light source on.
<b>Intensity</b>	With the slider, adjust the intensity.
<b>VisiLED</b>	
– Off	Switches the light source off.
– On	Switches the light source on.
<b>Intensity</b>	With the slider, adjust the intensity.
<b>Coaxial Light</b>	
– Off	Switches the light source off.
– On	Switches the light source on.
<b>Intensity</b>	With the slider, adjust the intensity.

### See also

 Visioner 2D Acquisition Workbench [► 692]

 Visioner Topography Acquisition Workbench [► 691]

#### 9.1.8.7 Advanced Acquisition Settings Tool

This tool is only active, if it is enabled in **Maintenance > General Options > Visioner**. You choose individual acquisition settings for the four calculation settings for a special specimen.

Parameter	Description
<b>Calculation Setting</b>	
– Live Regular	Optimizes Live image regarding speed.
– Live Accurate	Optimizes Live image regarding quality.
– Snap Regular	Optimizes the Snap image regarding speed.
– Snap Accurate	Optimizes the Snap image regarding quality.
<b>Reset</b>	Resets values to factory settings. To save the reset values, click <b>Save</b> .
<b>Save</b>	Saves your selected individual parameters for the selected calculation setting and of the reset values.

Parameter	Description
<b>Processing Mode</b>	
– Basic Topography Calculation	Performs a fast topography calculation based on acquired z-stack.
– Extended Topography Calculation	Allows to define different topography calculation parameters for texture (EDF) and heightmap (TOPO). In this mode more computational effort is needed and therefore should not be used in <b>Live Mode</b> .
<b>Acquisition Parameters</b>	
– Depth of Focus Step Size	Adjusts the resolution and number of slices of the z-stack with a slider.
<b>Basic Topography Parameters</b>	Only visible if in <b>Processing Mode</b> the <b>Basic Topography Calculation</b> is selected.
– Smoothing	Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.
– Pixelwise Iteration	Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.
– Depthwise Kernel Size	Larger values lead to a more robust heightmap, especially for areas with low contrast. Should only be used by small depth of focus step sizes. Use the slider to adjust the desired value.
– Bilateral Sigma Color	Special kind of filter for heightmap, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
– Bilateral Sigma Space	Special kind of filter for heightmap, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
<b>Texture Optimized Parameters</b>	Only visible if in <b>Processing Mode</b> the <b>Extended Topography Calculation</b> is selected.  You can adjust the same parameters as in <b>Basic Topography Parameters</b> for texture individually.
– Smoothing	Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.
– Pixelwise Iteration	Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.
– Depthwise Kernel Size	Larger values lead to a more robust heightmap, especially for areas with low contrast. Should only be used by small depth of focus step sizes. Use the slider to adjust the desired value.
– Bilateral Sigma Color	Special kind of filter for heightmap, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
– Bilateral Sigma Space	Special kind of filter for heightmap, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.



Parameter	Description
<b>Heightmap Optimized Parameters</b>	<p>Only visible if in <b>Processing Mode</b> the <b>Extended Topography Calculation</b> is selected.</p> <p>You can adjust the same parameters as in <b>Basic Topography Parameters</b> for heightmap individually.</p>
— Smoothing	Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.
— Pixelwise Iteration	Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.
— Depthwise Kernel Size	Larger values lead to a more robust heightmap, especially for areas with low contrast. Should only be used by small depth of focus step sizes. Use the slider to adjust the desired value.
— Bilateral Sigma Color	Special kind of filter for heightmap, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
— Bilateral Sigma Space	Special kind of filter for heightmap, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
<b>Postprocessing</b>	
— Texture Processing Mode	<p>Only visible if in <b>Processing Mode</b> the <b>Extended Topography Calculation</b> is selected.</p> <ul style="list-style-type: none"> <li>▪ <b>Default: Minimum Projection.</b> Select this value if the sample is acquired against a dark background.</li> <li>▪ <b>Maximum Projection</b> Select this value if the background is bright.</li> <li>▪ <b>Texture Optimized</b> Select this value if the sample covers the whole <b>Field of View</b>.</li> </ul>
— Spike Detection by Qualitymap Analysis	<b>Activated:</b> Reduces randomly occurring spikes. Default in <b>Live Mode</b> .
— Relative Threshold	Higher values lead to a more aggressive detection of spiky areas for which the heightmap is interpolated by the selected <b>Reconstruction Mode</b> . Use the slider to adjust the desired value.
— Spike Detection by Heightmap Analysis	<b>Activated:</b> Reduces randomly occurring spikes. Default in <b>Live Mode</b> .
— Outer Kernel Size	Adjusts the xy-extension of the spiky areas to detect. Use the slider to adjust the desired value.
— Inner Kernel Size	Adjusts the xy-extension of the spiky areas to detect. Use the slider to adjust the desired value.
— Reconstruction Mode	<ul style="list-style-type: none"> <li>▪ <b>Default Live: Linear Interpolation</b></li> <li>▪ <b>Default Snap: Partial Differential Equation</b></li> </ul>

### See also

 Acquisition Settings Tool  693]

 Visioner Topography Acquisition Workbench  691]

## 10 Maintenance

### 10.1 User Management

The software can be used with or without user management.

#### Without user management

User management is disabled by default. This means that every user has the same rights. No username or password is required and there are no user roles within the software (i.e. the user can perform any action).

#### With user management

If user management is enabled, each user has an account which is used to log into the software. Each user account is assigned to one or more user groups. User groups define the privileges (actions the user can perform in the software) for the users assigned to the group. Groups typically correspond to the roles in the software (e.g. Administrator, User). However, you can also create new user groups if required. Typically, one user is assigned to one group, but can also be assigned to multiple user groups if required. Users have the sum of all permissions of the groups to which they are assigned.

When you start the application with user management, you have to enter your username and password on the login screen. Additionally to the general login, the last three logged in users on this machine are displayed on the login screen.

You can also configure a login with your Windows account. In this case an additional login button with the for Windows accounts (USERNAME@DOMAIN) is displayed on the login screen.

#### ZEN Data Storage

If you use the ZEN Data Storage and user management, the users are the data storage specific ones.




#### Default user and password

If you have enabled the user management and not assigned/changed a password, the password for the default user is **zeiss**. If you are using ZEN Data Storage, the default users and passwords can be found in the installation guide of ZEN Data Storage.

#### 10.1.1 Creating and Managing User Accounts

Each user of the system must have a user account to be able to log in to the system. You can add new user accounts or modify existing ones as follows.

- Prerequisite**
- ✓ You are logged in as an administrator.
  - ✓ **Enable User Management** is activated.
1. Select **Home Screen > Maintenance > User Management**.
  2. Click **Users**.
  3. Perform one of the following actions.

Action		Parameter	Description
 Create new user account  A user account has no privileges until it is assigned to at least one user group.		<b>Name</b>	Specifies the user name used within the software.
		<b>Description</b>	Enables you to add user details.
		<b>Password, Confirm Password</b>	Specifies the initial password. Otherwise the initial password is blank.  There are no restrictions on the password length or characters.
		<b>User can change password</b>	<b>Deactivated:</b> Only Administrators can change the user's password.
		<b>User has to change password on next login</b>	After the next successful login, the user has to change their password.  Ensure <b>User can change password</b> is activated.
 Manage user account settings		<b>User Information</b>	Enables you to change the user name and the user details used within the software.
		<b>User may log in</b>	<b>Deactivated:</b> user cannot access the system  This enables you to quickly disable an account without deleting it.
		<b>User can change password</b>	<b>Deactivated:</b> Only Administrators can change the user's password
		<b>User has to change password on next login</b>	After the next successful login, the user has to change their password.  Ensure <b>User can change password</b> is activated.
		<b>Reset password</b>	Sets the password to a blank string.
 Delete user account from the system		-	This cannot be undone. However, data and objects created or modified by the user are not deleted.





### 10.1.2 Creating and Managing User Groups

User groups define the privileges (actions the user can perform in the software) for the users assigned to the group. Groups typically correspond to the roles in the software (e.g. supervisor or operator). However, you can also create new user groups if required. The groups have specific rights and users are assigned to a user group.

- Prerequisite**
- ✓ You are logged in as an administrator.
  - ✓ **Enable User Management** is activated.

1. Select **Home Screen > Maintenance > User Management**.

2. Click **Groups**.
3. Perform one of the following actions.

Action		Parameter	Description
 Create new user group  Initially, a user group has no privileges associated with it. You need to set the appropriate group privileges after creating the group.		<b>Name</b>	Specifies the group name used within the software. <b>Note:</b> Do not use a backslash (\) in the group name, except for an <b>Active Directory</b> group.
		<b>Description</b>	Enables you to add user group details, such as information about which privileges users have after being added to the group.
		<b>Type</b>	Specifies where the user group is stored and managed and also the method used to verify that a user is a member of the group. <ul style="list-style-type: none"> <li>▪ <b>Local</b> Within the software</li> <li>▪ <b>Active Directory</b> Using Windows Active Directory</li> </ul>
 Copy an existing user group		-	<p>All properties of the user group are copied.</p> <p>Users of the existing user group are not automatically assigned to the new group.</p>
 Manage group account settings		<b>Data &gt; Name</b>	Enables you to change the group name used within the software
		<b>Data &gt; Description</b>	Enables you to change user group details, such as information about which rights users have after being added to the group.
		<b>Privileges</b>	Defines which privileges are assigned to the group's members. Several pre-defined sets of privileges are available. It is also possible to select privileges manually from the list.
 Delete user group from the system		-	This cannot be undone. User accounts assigned to the user group are not deleted. However, the users do lose the privileges conferred by the group.



### See also

 Managing Group Privileges ► 702]

### 10.1.3 Assigning a User to a Group

Initially, a user is not assigned to any user groups. To be able to use the software, the user must be assigned to at least one user group. The user then inherits the privileges assigned to the user group.

A user can be a member of multiple user groups. Users have the sum of all permissions of the groups to which they are assigned.

- Prerequisite**
- ✓ You are logged in as an administrator.
  - ✓ **Enable User Management** is activated.
  - ✓ The group to which the user should be assigned exists and has the correct privileges.
1. Select **Home Screen > Maintenance > User Management**.
  2. Click **Users**.
  3. Select the user from the list and click .
  4. Click **Group**.
  5. Click  and select the user groups to which the user should be assigned.
  6. Click **OK**.

#### See also


 Creating and Managing User Accounts [▶ 699]

### 10.1.4 Managing Group Privileges

Privileges are assigned to user groups. They specify what actions members of the group can perform in the software.

The software contains various pre-defined roles, each with different sets of privileges. Typically, the software contains one user group for each role. However, you can create any number of user groups with arbitrary privileges. For information about the individual privileges, see also the chapter *Group Privileges* [▶ 704].

If you use ZEN Data Storage as your archive, the privileges displayed in the software are the ones for the user groups of ZEN Data Storage.

- Prerequisite**
- ✓ You are logged in as an administrator.
  - ✓ **Enable User Management** is activated.
1. Select **Home Screen > Maintenance > User Management**.
  2. Click on **Groups**.
  3. Select the desired user group and click on .
  4. Click on **Privileges**.
  5. Select the privileges of the user group.
    - ➔ You can click a pre-defined role or activate individual checkboxes to create a custom set of privileges.
  6. Click on **OK**.

If users are already assigned to the group, they inherit the modified privileges next time they log into the software.

#### See also

 Archive Options [▶ 707]

### 10.1.5 Setting up the Login with Windows Credentials (Active Directory)

You have the possibility to configure your user management to allow to log in with Windows user and password.



#### Info

##### Active Directory with ZEN Data Storage

If you are using Active Directory login with ZEN Data Storage, some special points need to be observed:




- ▶ During the installation of ZEN Data Storage, on the **Settings** tab of the installer, you have set the parameter **Enable Active Directory** to **True**. For more information, also refer to the installation guide for ZEN Data Storage.
- ▶ The ZEN Data Storage server must be part of the same Windows domain from where the software tries to login with its Windows credentials.

**Prerequisite** ✓ ZEN core is open with active user management and you are signed in as administrator.

1. Click **Maintenance > User Management**.  
→ The **User and Group Management** dialog opens.
2. Click **Groups**.  
→ The tab displays all currently configured user groups.
3. Click .  
→ The **New Group** dialog opens.
4. For **Type**, select **Active Directory**.
5. For **Name**, click .  
→ The **Select Group** dialog opens.  
→ The fields for object type and location are filled with a default. To change them, click **Object Types** or **Locations** to open another dialog to select the respective **Object Types** or **Locations**.
6. In the text field below, enter the name of the group you want to select. If you are not sure if your name is correct, click **Check Names** to open a dialog and select the suitable entry. For information on looking up the groups your own account belongs to, refer to the installation guide.
7. Click **OK**.  
→ The name is displayed in the **New Group** dialog.
8. Enter a **Description** for the group. This step is optional.
9. Click **OK** to close the **New Group** dialog.  
→ The respective **Active Directory** is added to the groups.
10. Click **OK** to close the **User and Group Management** dialog.

You have configured an **Active Directory** group. You can now log into ZEN core with your Windows credentials. An additional login button with the current Windows account (USERNAME@DOMAIN) is displayed on the login screen if at least one Active Directory group is configured. You can use this default entry but also edit the USERNAME@DOMAIN field to log in as another user than the current Windows account.

#### See also

-  Configuring a ZEN Data Storage Archive [▶ 147]
-  Assigning a User to a Group [▶ 702]
-  Managing Group Privileges [▶ 702]

### 10.1.6 Group Privileges

Privileges specify what kind of actions members of a group are allowed to perform in the software. The software contains various pre-defined roles, each with different sets of privileges.

Privileges	Account Manager	Supervisor role	Novice role	Operator role
Manage Users and Groups	X			
Create Jobs (within Job Mode)		X		
Manage Archive	X			
Manage Application Settings	X			
Free Examination (Free Mode)		X	X	
Edit Jobs (within Job Mode)		X		
Run Jobs (within Job Mode)		X	X	X
See All Results		X		X
See All Templates		X	X	X
See Job Results		X		
Release Job Templates		X		
Manage Scaling		X		
Counter Sign Job Results				

#### ZEN Data Storage

If you use ZEN Data Storage as your archive, the privileges displayed in the software are the ones for the user groups of ZEN Data Storage. Each privilege is displayed with its **Name**, a **Description**, and the **Application Name**. Here you can see which privilege is designated for groups in **ZEN**, **ZEN core**, or the **ZEN Storage Processing Server**. If the field **Application Name** is empty, the respective privilege is generally available.

#### See also

 Managing Group Privileges [► 702]



### 10.1.7 Options

The options apply to all users, regardless of the user groups to which the user is assigned.

Parameter	Description
<b>Check the following rules for a password</b>	<p>Here you can specify certain rules or criteria for a password that is created. If the checkbox is activated, the rules must be fulfilled when a new password is created.</p> <p>The following rules can be adjusted:</p>
– <b>Min. number of lower case characters</b>	Sets the minimal number of lower case letters a passwords must have. For example, if you set <b>2</b> , the password must contain at least two lower case characters, like <b>e</b> and <b>f</b> .
– <b>Min. number of upper case characters</b>	Sets the minimal number of upper case letters a passwords must have. For example, if you set <b>2</b> , the password must contain at least two upper case characters, like <b>C</b> and <b>G</b> .
– <b>Min. number of digit characters</b>	Sets the minimal number of digits a passwords must have. For example, if you set <b>3</b> , the password must contain at least three digits from 0 - 9, like <b>5</b> , <b>6</b> and <b>7</b> .
– <b>Min. number of special characters</b>	Sets the minimal number of special characters a passwords must have. For example, if you set <b>1</b> , the password must contain at least one special character, like <b>&amp;</b> .
– <b>Minimum length</b>	Sets the minimal length a passwords must have. For example, if you set <b>9</b> , the password must contain at least nine characters (any from above).
<b>Do not allow user name as password</b>	If activated, it is not allowed to use an existing user name as password for the software.
<b>Disable the reuse of last used passwords</b>	<b>Activated:</b> Disables the reuse of a specified number of last passwords.
– <b>Number</b>	Sets the number of passwords which cannot be reused after each other. For example, if you enter the number <b>3</b> , you have to assign 3 different passwords one after another before you can use (reuse) an old password.
<b>Disable the use of common passwords</b>	If activated, you can create and edit a list which contains passwords which you can lock for usage.
– <b>Edit</b>	Opens an editor to edit the list of common passwords. For example, if you add the entry "123456789Password" this password cannot be assigned from a user.
<b>Force users to change password after period of time</b>	<p><b>Activated:</b> The user must change his password after the specified period of time elapses.</p> <p><b>Deactivated:</b> The password never expires.</p>
– <b>Days before expiry</b>	Specifies the number of days after which the password expires.

Parameter	Description
<b>Lock user after wrong password entries</b>	<b>Activated:</b> Locks the user after a number of wrong password entries.
– <b>Maximum number of wrong entries</b>	Sets the number of attempts the user has if he enters a wrong password. For example, if you enter <b>3</b> , the user can enter a wrong password three times before his user account is locked.
<b>Lock screen after certain time span</b>	<b>Activated:</b> After a period of inactivity the screen is locked and the user must enter his/her password to continue working. <b>Deactivated:</b> The password never expires.
– <b>Minutes until screen lock</b>	Specifies the time span after which the screen is locked.
<b>Enable Auto-Login</b>	<b>Activated:</b> No password is required. The user is logged in automatically based on the Windows username. Create a user group in the software that is based on Windows Active Directory ( <b>Type = AD</b> ) and ensure that all relevant Windows users are present in the group and that the group has sufficient privileges in the software. <b>Deactivated:</b> Each user has to log in with their own password.
<b>Export/Import user database</b>	Not available for <b>ZEN Data Storage</b> . Enables you to export or import the user database, including all user groups and privilege sets, for example to exchange it with another system.
– <b>Export...</b>	Specify the location on the file system where the database should be exported.
– <b>Import...</b>	Select the database location on the file system.

### 10.1.8 Looking Up Active Directory Groups

If you want to set up the user management with Active Directory so that you can log in with your Windows credentials, it is useful to know the Active Directory groups to which your account belongs.

1. In the Windows search, enter **cmd**.  
→ Search results are displayed.
2. Click the entry for **Command Prompt**.  
→ The command prompt window opens.
3. Enter **net user username /domain** with your username in the window and press **Enter**, e.g. **net user MyUserName /domain**.  
→ Information about your user account are displayed.
4. You can now look for the information **Local Group Memberships** and **Global Group Memberships** to find the Active Directory groups you are a part of.

## 10.2 Archive Options

Using this dialog, you can set different settings for the archive, whether a local or a **ZEN Data Storage** archive is configured, and for the local storage. It is also possible to export an archive to another. Note that with the export wizard you can currently only export job results from one archive to another. Templates must be exported and re-imported to the new archive. To learn how to work with the archive options, read the following chapters.

For the local and ZEN Data Storage archive you can create a hierarchy for the archive, see *Using a Hierarchy for the Archive* [▶ 711].

Parameter	Description
<b>Compression</b>	The compression setting only affects the image data inside of image documents in *.czi format when saving them to the archive.
– <b>Original</b>	<p>If selected, the image data will be saved as they are (with unchanged/unmodified compression state).</p> <p>The compression state of the image data is not changed. The file size remains the same. The image quality remains the same, as the original data will be kept.</p>
– <b>Uncompressed</b>	If selected, the image data will be saved uncompressed. Meaning if a *.czi file contains compressed image data, it will be de-compressed.
– <b>Compressed (JPEG XR)</b>	<p>If selected, the image data will be saved compressed in case it was not compressed before.</p> <p>If the original data is uncompressed, it gets compressed (with the specified compression parameters). Image data which is already compressed is written in its current compression state (i.e. it does not get re-compressed).</p> <p>We recommend to set the quality value to <b>80%</b> for a good compromise between quality and image size.</p> <p>Note that for this setting the resulting image size will be smaller and thereby it helps to increase the upload time when using a server archive. The image quality will be reduced, the original data will not be kept. As for this setting compressed data will remain untouched, we would recommend this setting, if you want to gain smaller images.</p>
– <b>Force Compression (JPEG XR)</b>	<p>If selected, the image data is written with the specified compression parameters – independently of its current compression state. Meaning that if it was compressed before, it gets decompressed and compressed again – resulting in a loss of quality.</p> <p>We recommend to set the quality value to <b>80%</b> for a good compromise between quality and image size.</p> <p>Note that when compressed image data will be decompressed and compressed again you will always have a loss of quality. For a better image quality, we recommend to compress image data only once.</p>
– <b>Lossless Compressed (ZSTD)</b>	If selected, the image data will be saved lossless compressed in case it was not compressed before.
<b>Report Format</b>	Selects the file format for reports. Available formats are .docx and .pdf.

Parameter	Description
<b>Local Storage</b>	<p>Defines the location of the local storage which is a dedicated folder location to collect all documents before uploading them to the archive. The local storage can be located on the local or on a remote, e.g., very fast drive. We recommend not to locate the local storage on the network and that the location of the local storage has not exactly the same path as the archive.</p> <p>If GxP is licensed, any changes to the folder location is tracked.</p>
– <b>Use Default Location</b>	<p><b>Activated:</b> The local storage is in the default location: C:\Users\&lt;Username&gt;\AppData\Local\Carl Zeiss\ZENCore</p> <p>Deactivate to select an alternative folder location for the local storage, e.g., a faster and/or larger local drive, see <i>Configuring a Local Archive</i> [▶ 709].</p>
<b>Save Results Dialog</b>	
– <b>Enable Saving to Local Storage in Save Results Dialog</b>	<p><b>Activated:</b> Enables the <b>Save</b> button in the <b>Save Results Dialog</b>. This button provides the option to store the results in the local storage first instead of uploading them directly to the archive.</p>
<b>Archive Type</b>	Selects the type of archive that is used.
– <b>Local Archive</b>	Uses a local archive on the computer, see <i>Configuring a Local Archive</i> [▶ 709].
– <b>ZEN Data Storage Archive</b>	Uses an archive on <b>ZEN Data Storage</b> , see <i>Configuring a ZEN Data Storage Archive</i> [▶ 147].
<b>Settings</b>	Displays the settings for the selected type of archive. The displayed settings depend on the selected <b>Archive Type</b> .
– <b>Archive Path</b>	Only available for <b>Local Archive</b> . The location of the <b>Local Archive</b> on the file system.
– <b>URL</b>	Only available for <b>ZEN Data Storage Archive</b> . Sets the URL under which the <b>ZEN Data Storage</b> can be reached.
– <b>Archive Hierarchy</b>	Enables you to create a hierarchical structure of properties that can be assigned to job results.
– <b>+</b>	Adds a new archive hierarchy level below the currently selected one. The hierarchy is added to all job results and is used in <b>Browse Results</b> .
– <b>-</b>	Removes the currently selected archive hierarchy level and all levels below it.
– <b>Expand all</b>	Expands the hierarchical list so that all hierarchy levels are visible.
– <b>Custom Metadata</b>	Only available for <b>ZEN Data Storage Archive</b> . Displays and creates custom metadata, see <i>Creating Custom Metadata</i> [▶ 152].
<b>Manage Collections</b>	Only visible for <b>ZEN Data Storage Archive</b> . Opens the <i>Manage Collections Dialog</i> [▶ 158] to manage or add collections, see <i>Creating a Collection for Data</i> [▶ 149].

Parameter	Description
<b>Export Archive</b>	Starts the <b>Archive Export Wizard</b> to export the archive, see <i>Using the Archive Export Wizard</i> [▶ 713].
<b>Archive Setup</b>	Only visible for <b>ZEN Data Storage Archive</b> . Sets up the database archive.
<b>Ok</b>	Saves the changes and closes the window.
<b>Cancel</b>	Cancels all changes and closes the window.

### 10.2.1 Configuring a Local Archive

The archive options enable you to specify how and where the archive and the local storage are stored, as well as the hierarchy of attributes that can be assigned to templates.

**Prerequisite** ✓ You are logged in as an administrator.

1. Click **Home Screen > Maintenance > Archive Options**.

→ The **Archive Options** dialog is displayed.

2. In the **Compression** and in the **Report Format** sections, select your preferred formats.  
→ The selected formats will be used by default any time you save documents to the archive.

3. In the **Local Storage** section, select the folder where you can save files without uploading them to the archive.  
 Activate **Use Default Location**, to keep the default location.  
 To place the local storage in a different location, deactivate **Use Default Location**. Locate the local storage on a local, fast drive which is large enough to store the expected size of all documents to be stored into the archive. If you use a **Zeiss** High End Workstation and work with large images consider changing the local storage location to the D: drive to be sure that you do not run out of space while working.  
 → If GxP is licensed, any changes to the folder location is tracked.
4. From the **Archive Type** drop-down list, select **Local Archive**.
5. In the **Settings** section, select the archive location.
6. Click **OK** to confirm your configuration and to exit the window.  
 → You have configured the **Local Archive**.

To create an archive on **ZEN Data Storage**, see *Configuring a ZEN Data Storage Archive* [▶ 147].

To create a hierarchy for your archive, see *Using a Hierarchy for the Archive* [▶ 711] and *Creating a Hierarchy for the Archive* [▶ 711].

To export the archive, see *Using the Archive Export Wizard* [▶ 713].

### 10.2.2 Updating a Local Archive

If you have installed the **ZEN core** software with version 2.4 or older, from now on, with a software update the local archive will be updated once automatically. The local archive update starts as soon as you open the updated software.

- Prerequisite** ✓ The software and all required licenses have been installed.  
 ✓ Enough disk space as temporarily the archive size will be twice as big as the actual archive size.
1. Double-click on the program icon on your desktop.  
 → The software starts.
  2. Click on the button of the application you want to work with.  
 The available applications depend on your licenses and system.  
 → The current local archive is checked if it needs to be updated. If it is necessary, a dialog is displayed.
  3. Click **OK** to start the update. Note that if you decide to cancel the update, the software stops.  
 → The local archive is being updated, and the progress is shown.  
 → The next dialog is displayed.
  4. Click **Yes** to keep your old local archive, or click **No** to delete it.  
 → If you have decided to keep it, the new local archive is located here:  
   **C:\ProgrammData\CarlZeiss\ZENCore\UserArchive**  
   The old local archive is as a backup located here:  
   **C:\ProgrammData\CarlZeiss\ZENCore\UserArchive\_old**  
 → The login screen is displayed.
  5. Login to the software.

The **Home** Screen is displayed. You can start working with the software using the updated local archive.

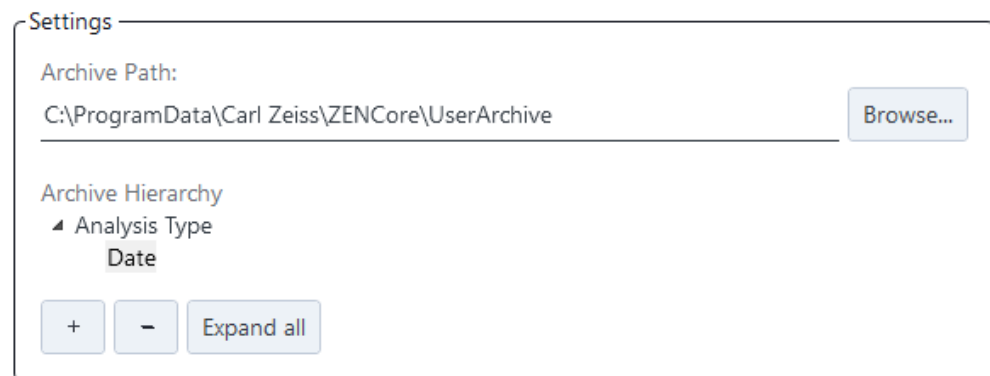
### 10.2.3 Using a Hierarchy for the Archive

You can structure the local and ZEN Data Storage archive by using hierarchies. You can set up a hierarchy which will then be added to all job results and is displayed in **Browse Results**. Additionally, it can also be used for the input fields in a form template.

#### 10.2.3.1 Creating a Hierarchy for the Archive

**Prerequisite** ✓ You are in the **Archive Options** dialog (**Home Screen > Maintenance > Archive Options**).  
 ✓ For **Archive Type**, you have selected **Local Archive** or **ZEN Data Storage Archive**.

1. Under **Settings**, click **+** to add an archive hierarchy level.  
 → A hierarchy level entry is added and editable.
2. Enter a name for the archive level and press **Enter**.
3. Click **+** to add another hierarchy level.
4. Enter a name for the archive level and press **Enter**.  
 → You have now created a second hierarchy level.



5. Repeat these steps to create as many hierarchy levels as you need.
6. Click **Ok** to save the changes and exit the **Archive Options** dialog.

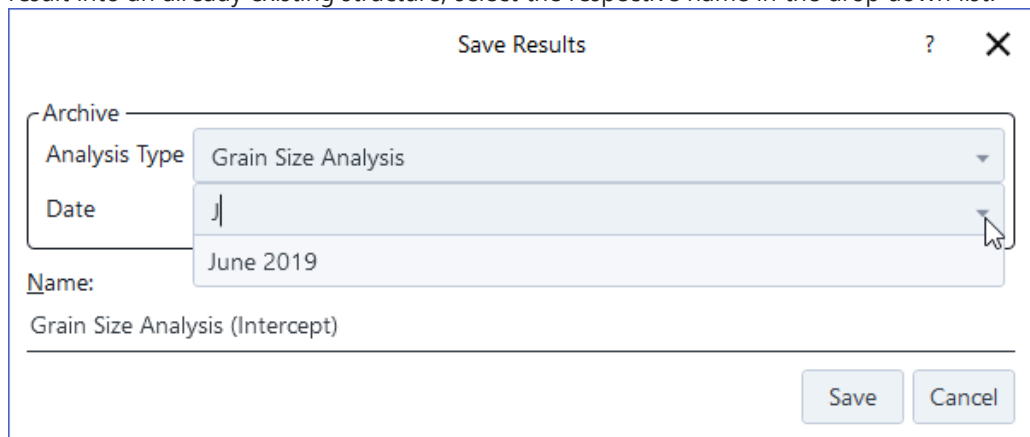
#### 10.2.3.2 Saving Job Results with Hierarchy

When you have run a job and created a hierarchy, you save the job result with hierarchy information.

**Prerequisite** ✓ You have run a job and are at the end of the workflow.

1. Click **Save and close** or **Save and Repeat**.  
 → The **Save Results** dialog opens. On the top, the section **Archive** with all your created levels is displayed.

- In the section **Archive**, enter a name for each of your archive levels. If you want to save the result into an already existing structure, select the respective name in the drop down list.



The screenshot shows a 'Save Results' dialog box. It has a title bar with a question mark and a close button. The 'Archive' section is expanded, revealing a form with 'Analysis Type' set to 'Grain Size Analysis' and 'Date' set to 'June 2019'. Below this, the 'Name' field contains 'Grain Size Analysis (Intercept)'. At the bottom right are 'Save' and 'Cancel' buttons.

- For **Name**, enter a name for your job result.
- Click **Save**.

You have saved your job result with hierarchy information.

### 10.2.3.3 Viewing Job Results With Hierarchy

If you have created a hierarchy and saved the job results accordingly, you can display your job results sorted by this hierarchy.

**Prerequisite** ✓ You are on the **Home Screen**.

- Click **Browse Results**.  
→ The view for the job results opens. Your defined hierarchy elements are shown as columns in the table of your results.
- Under **Results**, group your job results by hierarchy. To do so, click on the little arrow in the upper right corner and drag the column with the hierarchy level into the header. **Note:** Drag the hierarchy levels into the header in the same order you set in the **Archive Options**, i.e. the top level first, then each following sub-level.



The view of your results is now sorted according to your archive hierarchy levels.

Results						
	NAME	CREATED	DESCRIPTION	LAST MODIFIED	ANALYSIS TYPE	DATE
▼ Cast Iron Analysis (1)						
▼ May 2019 (1)						
	Cast Iron Analysis	05.06.2019 13:51:23	Job template for cast iron analysis.	05.06.2019 13:52:24	Cast Iron Analysis	May 2019
▼ Grain Size Analysis (2)						
▼ June 2019 (1)						
	Grain Size Analysis - Intellesis - (...)	05.06.2019 13:45:42	Job template for grain size analysis using...	05.06.2019 13:49:11	Grain Size Analysis	June 2019
▼ May 2019 (1)						
	Grain Size Analysis (Intercept)	05.06.2019 13:53:20	Job template for grain size analysis using...	05.06.2019 13:58:42	Grain Size Analysis	May 2019

See also

 Browse Results [► 84]

10.2.4 Using the Archive Export Wizard

This wizard guides you through exporting the archive to another. It contains several steps which help you to perform the export. Note that the wizard currently only exports job results. Other files such as templates and reports must be exported manually.

- Prerequisite** ✓ You are logged in as **Administrator**.
- ✓ The source archive and the target archive have the same hierarchical levels/structure (recommended). If this is not the case, see *Archive Mapping FAQ* [► 716].
1. Navigate to **Maintenance > Archive Options**.

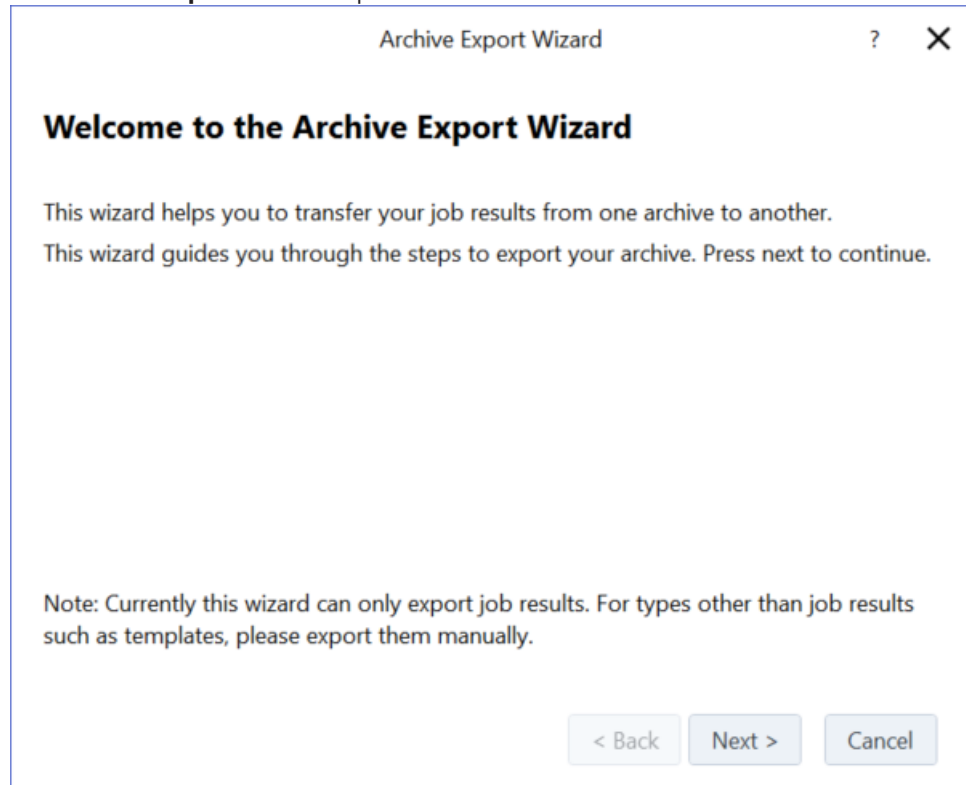
→ The **Archive Options** dialog is displayed.

The screenshot shows the 'Archive Options' dialog box with the following sections and controls:

- Compression:** A dropdown menu set to 'Original'. Below it, a note states: '(This compression setting is applied only to \*.czi files while saving archive)'.
- Report Format:** A dropdown menu set to 'MS-Word (.docx) format'. Below it, a note states: '(This format will be used by default for newly created reports)'.
- Local Storage:** A checkbox labeled 'Use Default Location' is checked. Below it, the path 'C:\Users\XGGSTARK\AppData\Local\Carl Zeiss\ZENCore' is displayed, followed by a 'Browse...' button.
- Archive Type:** A dropdown menu set to 'Local Archive'.
- Settings:** A section containing 'Archive Path:' followed by the path 'C:\temp\Local Storage' and a 'Browse...' button.
- Archive Hierarchy:** A large gray rectangular area containing the text: 'Save the archive options and restart the application for editing the archive structure.'
- Buttons:** At the bottom, there are three buttons: 'Export Archive' on the left, and 'OK' and 'Cancel' on the right.

2. Click **Export Archive**.

→ The **Archive Export Wizard** opens.

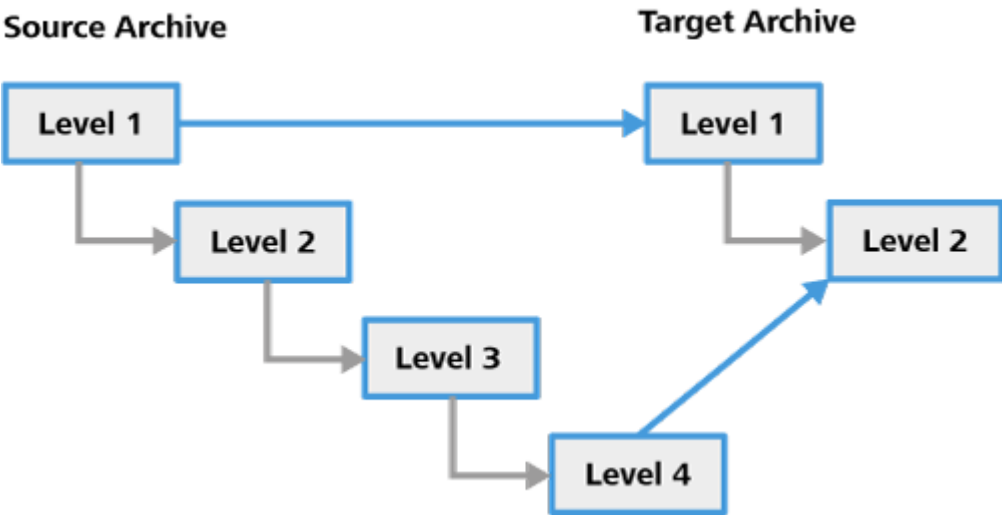


3. Click **Next** to start.
  - The next dialog in the **Archive Export Wizard** is displayed.
4. Select the source archive type from the **Archive Type** drop down.  
 In the **Settings** group box, select the **Archive Path**. By default, the user archive (local archive) is stored under  
 C:\ProgramData\Carl Zeiss\ZENCore\UserArchive.  
 Click **Next** to continue.
  - The **Archive Export Wizard** dialog is updated.
5. Select the target archive type from the **Archive Type** drop down. In the **Settings** area, select the **Archive Path**. Make sure that the Source Archive and the Target Archive have a different archive path. Otherwise, the wizard will not continue.  
 Click **Next** to continue.
  - The **Archive Export Wizard** dialog is updated.
6. In the **Hierarchy Mapping** group box, map the hierarchical level of the source archive structure to the target archive structure. You can keep the existing archive structure by mapping the hierarchical level of the source archive to the corresponding hierarchical level of the target archive.
7. Under **Target Name**, select the desired hierarchy level of the source archive to map it with the corresponding hierarchy level of the target archive. You can also rename the hierarchy levels by entering new names in the text boxes.  
 Click on **Next** to continue.
  - The export starts. You see the status of the export in the progress bar. After the export the export results are displayed.
8. Click **Save Log** to save the export results as text file (.txt) on your file system.
9. Click **Close** to finish the **Archive Export Wizard**.

10.2.5 Archive Mapping FAQ

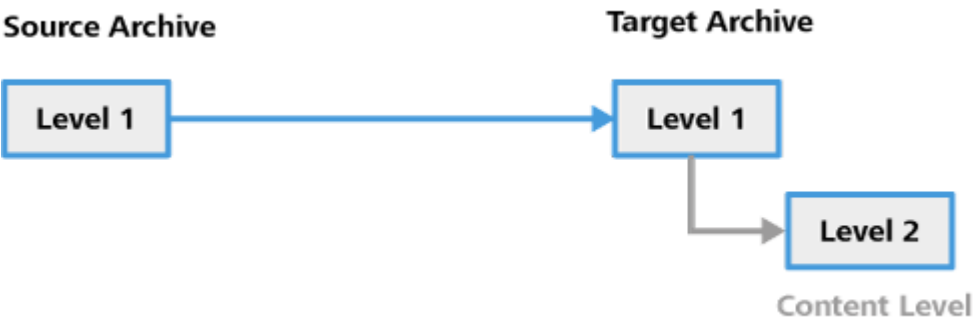
**My source archive has more hierarchy levels than the target archive. What shall I do?**

In this case, **Level 1** (top level) of the source archive is mapped to **Level 1** of target archive. The lowest level, in our case **Level 4**, of source archive (content level) is mapped to **Level 2** of target archive. The job results of the source archive are transferred to **Level 2** of the target archive. The levels in between will be removed.



**My source archive has less hierarchy levels than the target archive. What shall I do?**

In this case, the missing mapping values must be entered in the text box (Hierarchy Mapping). The values will then be used for the corresponding levels.





10.3 General Options

10.3.1 General Options

The following options enable you to specify the language of the user interface.

Parameter	Description
Language	Sets the language of the user interface. The language settings are set globally for all users.

Parameter	Description
– Select Automatically	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The user interface is displayed in the language of the user's operating system. If the language is not available, the default language (English) is used.</li> <li>▪ <b>Deactivated:</b> Value of <b>Fixed Language</b> will be used.</li> </ul> <p>You must restart the software for the language settings to take effect.</p>
– Fixed Language	<p>The specified language is used for all users, regardless of their user interface settings.</p> <p>This setting only applies if <b>Select Automatically</b> is deactivated.</p> <p>You must restart the software for the language settings to take effect.</p>
<b>Confirmations</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> A prompt is displayed after clicking the  icon.</li> <li>▪ <b>Deactivated:</b> The application closes when a user clicks the  icon. Nevertheless the user is prompted to save any unsaved work.</li> </ul>

### 10.3.2 Startup Options

The following options specify how the software starts.

Parameter	Description
<b>Show Splash Screen</b>	<b>Activated:</b> A splash screen is displayed while the software is loading.
<b>Stage/Focus Calibration</b>	<b>Activated:</b> Each time the software starts a dialog box is displayed which enables you to calibrate the motorized stage and/or focus.

### 10.3.3 Naming Options

The following options enable you to specify how items are named automatically.

Parameter	Description
<b>Category</b>	Select the item for which you wish to modify the automatic naming options. The other fields update accordingly. You can specify different settings for each type of item.
<b>Prefix</b>	<p>Specifies text to be displayed at the start of the automatic name.</p> <p>A typical prefix is the name of the item, e.g. <code>Image</code>.</p>
<b>Digits</b>	<p>Specifies the number of digits for the counter value.</p> <p>If the current counter value has fewer digits than this setting, the counter value is filled with leading zeroes.</p> <p>Example: <b>Digits</b> = 4, current counter value = 17, automatic name contains 0017.</p>
<b>Format</b>	<p>Specifies the main part of the automatic name.</p> <p>You can configure any name by entering text or using the placeholders.</p>

Parameter	Description
	<p>To add a placeholder, double-click it in the ID list or enter % and the desired placeholder ID.</p> <p>The results are displayed in the <b>Preview</b> field.</p> <p>Example: Enter %h-%m-%s if you want the exact creation time to be displayed in the automatic name. Example result: 14-53-07.</p>
<b>Initial Counter Value</b>	<p>Specifies the lowest value of the counter.</p> <p>The counter increments in integer steps. Leading zeroes are added according to the <b>Digits</b> setting.</p>
<b>Suffix</b>	Specifies text to be displayed at the end of the automatic name.
<b>Preview</b>	Shows how the automatic name will be displayed with the current settings.
<b>Save/Restore Counter Value</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The counter value will be increased across sessions and users.</li> <li>▪ <b>Deactivated:</b> The counter value resets each time you log in. A separate counter value is used for each user. Nevertheless, existing images are not overwritten.</li> </ul>
<b>Format-IDs</b>	<p>Enables you to create an automatic name using the placeholders.</p> <p>Double-click a placeholder to add it to the <b>Format</b> field.</p>

The changes to the names apply to all items created subsequently (i.e. existing items are not re-named).

### 10.3.4 Documents Options

The following options specify how images are displayed initially after being acquired as well as whether the DataZone is displayed and the information it contains.

Parameter	Description
<b>Default Settings for New Images</b>	Specifies how images are displayed initially after being acquired.
— Show Rulers	<b>Activated:</b> Rulers are displayed on the top and left of the <b>Center Screen Area</b> . The scale and units of the ruler depend on the settings in <b>Manage Scalings</b> .
— Auto Fit	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Image will be adjusted to fill the available <b>Center Screen Area</b>.</li> <li>▪ <b>Deactivated:</b> Images are displayed unscaled.</li> </ul>
— Use Interpolation for Image Display	<b>Activated:</b> Image will be smoothed when zooming in.
— Set Logarithmic Scale in Histogram	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The logarithmic scale emphasizes pixels in the histogram which occur with a lower frequency.</li> <li>▪ <b>Deactivated:</b> The linear scale emphasizes all pixels equally.</li> </ul>

Parameter	Description
– Show Viewport Scalebar in 2D View	<b>Activated:</b> An overlay window containing a viewport scale bar is displayed when the user zooms into an acquired or loaded image. The overlay window is closed automatically when the zoom is reset.
– Show Viewport Scalebar in Live Window	<b>Activated:</b> An overlay window containing a viewport scale bar is displayed when the user zooms into the live image. The overlay window is closed automatically when the zoom is reset.
– Show Navigator in 2D View	<b>Activated:</b> Displays the navigator in the <b>Center Screen Area</b> . The Navigator indicates the section of the image that is currently displayed in the <b>Center Screen Area</b> .
– Use Pan Mode in 2D View for Tile Images	Specifies how to pan a tiled image in 2D mode: <ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Drag using left mouse button.</li> <li>▪ <b>Deactivated:</b> Press the middle mouse button and then drag using left mouse button.</li> </ul>
<b>Image Data Zone</b>	
– Show Image Data Zone	<b>Activated:</b> Additional image data is displayed in a separate tab under the <b>Center Screen Area</b> .
<b>Image Data Zone Optional Data</b>	Here you can specify which metadata (hardware and acquisition) are displayed on the <b>Data Zone</b> tab under the image area. Up to 10 fields can be configured. Per field you will find default data, e.g. you can set that the name of a document is displayed on the <b>Data Zone</b> tab.

### 10.3.5 Acquisition Options

#### 10.3.5.1 General Section

This section specifies how manual hardware is treated.

Parameter	Description
<b>Show a Request to Move Manual or Coded Hardware Components</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> If a user changes the hardware setup in the software (for example using the <b>Light Path</b> tool) the software prompts the user to change the physical hardware setup.</li> <li>▪ <b>Deactivated:</b> No prompt is displayed. This may result in a discrepancy between the physical hardware setup and that indicated in the software.</li> </ul>
<b>Automatically Start Live when Entering Acquisition Workbenches</b>	If activated, the <b>Live</b> image is displayed as soon as an acquisition workbench is started.
<b>Show Stage Speed and Acceleration Options</b>	If activated, the parameters <b>Speed</b> and <b>Acceleration</b> of the stage are additionally displayed in the <b>Stage Control</b> tool.

### 10.3.5.2 Camera/Live Section

This section specifies global acquisition options

Parameter	Description
<b>Enable Stage/Focus Control in Live View</b>	<b>Activated:</b> Enables the position of the motorized stage to be set from within the Center Tool Area (instead of only using the <b>Navigation</b> tool).
<b>Automatically Add Scalebar Annotation at Snap</b>	<b>Activated:</b> A scale bar annotation is displayed in the lower right corner of the image.
<b>Show Camera Export Options</b>	<b>Activated:</b> A <b>Save</b> dialog is displayed after each acquisition.

### 10.3.5.3 Tiles & Positions Section

This section specifies global tile settings.

Parameter	Description
<b>Enable Stage Movement with Live Navigator</b>	If activated, the motorized stage will move according to the movement of the <b>Live Navigator</b> .
<b>Delimiter for CSV Export/Import</b>	Allows you to choose the character used for separating the entries when a list of tiles is exported into or imported from a text file.
<b>Activate Stitching During Acquisition for New Experiments</b>	<b>Activated:</b> Acquired tiles are stitched in the background while the remaining tiles are being acquired.
<b>Delay Time After Stage Movements</b>	Here you can enter a certain period of time that determines for how long you want the software to wait after the stage has been moved. For example if you enter 50 ms, the software will wait 50 ms after the stage has moved and then continue with the next acquisition of a tile image.
<b>Run Tiles Acquisition in Triggered Mode</b>	If activated, the Fast Acquisition in Triggered mode is activated. Tiles acquisition with AxioCam 705 pol is speed up. A configuration of an I/O card in the MTB is not needed.

### 10.3.5.4 Panorama Section

This section specifies global panorama settings.

Parameter	Description
<b>Automatically Start Live Mode in the Panorama View</b>	<b>Activated:</b> A live image is shown immediately after clicking <b>Start Panorama</b> .



Parameter	Description
<b>Show Information Title in the Panorama View</b>	No effect in the current software version.
<b>Show Acquisition Animation</b>	<b>Activated:</b> An animation is displayed during each tile acquisition.
<b>Automatically Move Stage/Live after an Acquisition</b>	<p><b>Activated:</b> The <b>Live Navigator</b> is moved after acquisition of a tile. This indicates that the acquisition of a tile is finished and that the stage is ready to be moved to the next position.</p> <p><b>Deactivated:</b> The <b>Live Navigator</b> will stay at the position where the last tile has been acquired. You have to move it to one of the neighboring positions manually before moving the stage.</p>
<b>Enable Transparency Effect on Selected Tile Image</b>	No effect in the current software version.

### 10.3.6 User Options

The following options enable you to specify personal and company information.

Parameter	Description
<b>User Information</b>	<p>Allows you to enter user information which will be displayed with your job templates.</p> <p>This is useful for single-user licenses (user management is deactivated).</p>
<b>Company Information</b>	Allows you to enter company information and upload the company logo.

### 10.3.7 ImageJ Options

The following options enable you to configure ImageJ.

Parameter	Description
<b>ImageJ Folder</b>	Shows the program folder of the currently selected ImageJ executable.
<b>ImageJ executable</b>	<p>Specifies the path to the main executable file of your ImageJ installation.</p> <p>The software automatically searches the standard windows program folders for ImageJ and shows the paths to all found ImageJ executables in the drop-down list.</p> <ul style="list-style-type: none"> <li>■ Your installation is found: Select the path from the drop-down list.</li> <li>■ Your installation is not found or you wish to use a different installation: Select ... from the drop-down list and specify the path of the ImageJ executable.</li> </ul>

Parameter	Description
– Shift Pixels to 16bit	Each color or gray channel is converted to 16 bit before export to ImageJ.
<b>Default preferred conversion</b>	Specifies the preferred conversion for images received from ImageJ
<b>Default preferred file format</b>	Specifies the file format in which the image is saved before being opened in ImageJ
– Automatic	Selects the format in which the file is saved automatically, depending on the image properties.
– CZI	Saves the file in the CZI format. This image is then imported in ImageJ.
– Ome Tiff	Saves the file in the OME TIFF format. This image is then imported in ImageJ.
– Tiff	Saves the file in the TIFF format. This image is then imported in ImageJ.
– Tiff With Display Mapping	Saves the file in the TIFF format including a display curve. This image is then imported in ImageJ.

### 10.3.8 Data Tables Options

Parameter	Description
<b>Start Import in Row No.</b>	If you import a data table, you can adjust here the starting row for the import. Simply enter the number of the row in the input field.
<b>Automatic CSV format detection</b>	<p>If activated, no further import options are available. The software will try to detect the CSV format of your data table automatically.</p> <p>If the automatic detection does not work, you must deactivate the checkbox and adjust the specific CSV settings of your data table manually.</p>
<b>Use column, decimal and list separator from windows regions settings</b>	If activated, the software will use the settings from the Windows Region Settings to recognize the CSV format.
<b>Column Separators</b>	If the Automatic CSV detection and Windows Region Settings checkboxes are deactivated, you can here set the specific separators which are used in your data table manually.
<b>Decimal Separator</b>	Here you can set the separator used for the decimal places (Comma or Point).
<b>Thousands Separator</b>	Here you can set the separator used for the thousands (Comma or Point).
<b>Decimal Places</b>	Here you can set the number of decimal places of numbers shown in tables or measurements.

### 10.3.9 GxP Options

Parameter	Description
<b>Release Process of Job Templates and Job Results</b>	
- Two signature release	If selected, two signatures from different persons are required for the release of a job template. This enables a 4-eye principle for the release process.
- One signature release	If selected, one signature for the release of a job template is sufficient.
<b>Require comment on workflow changes</b>	If activated, a comment must be entered when changing the status of a job template and saving it. Read more under <i>Release Process of Job Templates and Job Results</i> [▶ 377].
<b>Verify job template each time on run</b>	If activated, the job template will be validated for errors before it is run. If errors occur, a message appears.

#### See also

📖 Release Process of Job Templates and Job Results [▶ 377]

### 10.3.10 arivis Cloud Options

Parameter	Description
<b>Access Token</b>	Sets/displays your private access token which is required for the use of the arivis Cloud functionalities within ZEN core, see <i>Creating and Entering an Access Token</i> [▶ 125].
<b>Mount NVIDIA GPU</b>	<b>Activated:</b> Uses the NVIDIA GPU of your computer when executing models requiring a GPU. <b>Deactivated:</b> Disables the use of the GPU. Note that you can only execute models using CPU. Models that require a GPU will not work if this option is deactivated!

#### See also

📖 arivis Cloud (on-site) [▶ 125]

### 10.3.11 ZEN API Options

The following options enable you to set the ports, the gateway, and the API mode for the ZEN API interface.

Parameter	Description
<b>Gateway Port</b>	Allows to enter the port for the API gateway.
— Restrict Access to Local Machine	Restricts the access via the gateway to the local machine.

Parameter	Description
– Use Specific Ports for Internal Communication	Activated by default.
– ZEN Client	Sets the port for ZEN Client.
– ZEN Service	Sets the port for ZEN Service.
<b>Enable Unsuper-vised API Mode</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Enables the concurrent usage of the API and the user interface.</li> <li>▪ <b>Deactivated:</b> Enables the control synchronization that does not allow the concurrent usage of the API and the user interface.</li> </ul>

### 10.3.12 ZEN Connect

Parameter	Description
<b>Stage Size</b>	
– Stage Size in mm	<p>Positions the images initially in a better way in the correlative workspace. For example, for 130 x 100mm stage an image at stage position 65 x 50mm will be placed in the center of the correlative workspace.</p> <p>Note that the stage size will only be taken into account for better initial positioning if you have calibrated the stage upon startup or later, but before creating the ZEN Connect project.</p>
<b>Stage Move Confirmation</b>	
– Deactivate Confirmation	<p><b>Activated:</b> No confirmation dialog is shown when the stage is moved with double-click in the Correlative Workspace.</p> <p><b>Deactivated:</b> A confirmation dialog is shown each time the stage is moved with double-click in the Correlative Workspace.</p>

### 10.3.13 Visioner

You can enable the **Advanced Acquisition Settings** tool for the **Visioner Topography Acquisition** workbench.

## 10.4 Manage Scaling

As an administrator you can specify which units are used to display scales and measurements in images.

Furthermore, you can specify whether other users can select a scaling method.

- **Selection disabled**  
If a custom scale has been created for the current hardware configuration, it is in use. Otherwise the theoretical scale is used.
- **Selection enabled**  
Other users can choose to use the custom scale (if available) or the theoretical scale.

The theoretical scaling is calculated automatically based on the properties of the hardware components (e.g. zoom of the objectives, number and separation of pixels on camera chip, etc.)

- Prerequisite** ✓ You are logged in as an administrator.
- 1. Open **Manage Scaling** menu:  
→ **Home Screen > Maintenance > Manage Scaling**
  - 2. In **Units for Scaling** specify the metric or imperial units for all scales and measurements in images.
  - 3. Specify whether other users can select a scaling method:  
→ Selection *disabled* (**Automatic Scaling** activated)  
→ Selection *enabled* (**Automatic Scaling** deactivated)




**Info**

- ▶ After changing these settings, the units are applied to all measurements and images that are subsequently performed or acquired.
- ▶ Measurements in job templates, job results, and images that have already been acquired are not subsequently displayed in the new units.
- ▶ Images in which the measurements or scale are "burnt in" cannot be rescaled.
- ▶ Custom scales are hardware-specific. Such a scale is only available when the identical hardware is in use as when the scale was created.

10.4.1 Managing Custom Scalings

You can import/export custom scale presets, for example to copy them to another system.

- 1. Open **Manage Scalings**:  
→ **Home Screen > Maintenance > Manage Scalings**
- 2. Perform the actions listed below as required.

Action	Description	Procedure
Export a preset scaling	The scaling values are saved in a file.	1.  > <b>Export</b> 2. Specify the location in the file system.
Import a preset scaling	A preset from the file system is added to the list of scalings and the current parameter values are overwritten with those stored in the preset.	1.  > <b>Import</b> 2. Select the desired scaling file from the file system.
Delete a preset scaling	The currently selected scaling is deleted.  The next scaling in the list is selected and the values from the scaling applied. If the list is empty, the default values are applied.	1.  > <b>Delete</b>

## 10.5 Module Manager

Modules contain additional software functions. The modules that are available to you are controlled by licences. You can purchase additional licenses to enable additional modules. For more information, including how to install licenses, contact your ZEISS representative.

The available modules are managed in the **Module Manager**. There you can enable or disable modules. If a module is disabled, the corresponding features are hidden in the software.

- Prerequisite**
- ✓ You are logged in as an administrator.
  - ✓ The **Home Screen** is displayed.
1. Open the **Module Manager**:
    - ➔ **Maintenance > Module Manager**
  2. You can activate or deactivate any module via the corresponding checkbox.
  3. Some activated modules require further configuration:
    - ➔ Check for new options under **Maintenance > Options**.
    - ➔ Configure the newly activated modules accordingly.

## 10.6 Extension Manager

Extensions are optional software add-ons. For example, ZEN core is shipped with the ImageJ extension, an interface which enables you to integrate the ImageJ software into your workflow and thus make use of ImageJ's image processing capabilities.

You can activate the available extensions in the **Extensions Manager**.


- Prerequisite**
- ✓ You are logged in as an administrator.
  - ✓ The **Home Screen** is displayed.
1. Open the **Extensions Manager**:
    - ➔ **Maintenance > Extensions Manager**
  2. You can activate or deactivate any extension via the corresponding checkbox.
  3. Confirm the configuration by clicking the **Apply** button.
  4. Some activated extensions require further configuration:
    - ➔ Find more options under **Maintenance > Options**.
    - ➔ Configure the newly activated extensions accordingly.

### 10.6.1 Activating the ImageJ Extension

You activate the ImageJ extension via the **Extensions Manager** and then configure it in the **Options** dialog.

#### Configuring the Software

- Prerequisite**
- ✓ ImageJ is installed on your system.  
The Life-Line version of the Fiji distribution is recommended, which contains all necessary ImageJ plugins and works with ZEN core.
  - ✓ You are logged in as an administrator.
  - ✓ The **Home Screen** is displayed.
1. Activate the **ImageJ Extension** in the **Extensions Manager**:
    - ➔ **Maintenance > Extensions Manager**

2. Confirm the configuration by clicking the **Apply** button.
  - ➔ If you activate ImageJ for the first time, a "missing path" warning is displayed. Confirm by clicking **OK**.
3. Open the **Options** window:
  - ➔ **Maintenance > Options**
4. Select the **ImageJ** tab.
5. Select the path to the ImageJ executable from the drop-down list:
  - ➔ Select one of the paths suggested by the software.
  - ➔ Click on  to specify a different path.

**Configuring ImageJ** To configure how ImageJ interacts with the software:

- Prerequisite** ✓ ImageJ is installed on your system.  
The Life-Line version of the Fiji distribution is recommended, which contains all necessary ImageJ plugins and works with the software.
1. Open the ImageJ installation specified in the software options.
  2. Activate the **Single Instance Listener**:
    - ➔ You find the **Single Instance Listener** under **Edit > Options > Misc...**

## 10.7 Manage Features for Graphical Elements

For each type of measurement, you can configure which measurement results (features) are displayed by default in the **Center Screen Area** next to the measurement.

When performing a measurement you can override this setting and select different features to be displayed.

- Prerequisite** ✓ You are logged in as an administrator.  
✓ The **Home Screen** is displayed.
1. Open **Manage Features of Graphical Elements**:
    - ➔ **Maintenance > Manage Features for Graphical Elements**
  2. Select the desired type of measurement in the left panel.
  3. Specify which features can be selected or displayed by users using the checkboxes in the **Available** column.
  4. Specify which features are displayed by default using the checkboxes in the **Label** column.

## 10.8 Change Microscope Configuration

- Prerequisite** ✓ You are logged in as an administrator.  
✓ The **Home Screen** is displayed.
1. Open **Change Microscope Configuration**:
    - ➔ **Maintenance > Change Microscope Configuration**
    - ➔ After connecting to the MTB, all available hardware setups configured in the MTB are listed.
  2. Select the desired hardware setup.
    - ➔ Ensure that the microscope supports the new configuration.
  3. Click **Activate Selected Configuration**.

## 10.9 CorrMic Settings

The settings are accessed via **Home > Maintenance > CorrMic Settings** (CorrMic = Correlative Microscopy).

You see the list of all available correlative holder templates. You can create new holder files or export/load existing holder files here. Additionally, not-used holders can be deactivated. For an overview of the available holders, see *Correlative Sample Holders* [▶ 375].

### 10.10 Import/Export

Here you can backup and restore software specific settings. To generate a backup of all software specific settings (e.g. user settings, templates, etc.) simply click on **Backup**. The backup file (\*.zip) will be generated in the specified folder.

Before you can restore the settings, you need to have generated at least one backup file. If you click on **Restore**, you have to specify the backup file (\*.zip) location and click **Open**. All settings that are stored in the backup file will be restored.

We recommend to perform backups of the software settings on a regular base (e.g. each week or month) depending on your personal needs.

### 10.11 Chart Series Creator

Within this dialog you can see the available standards for the **Comparative Diagrams** module and you can create your own, customized chart series.

- **Chart Series (User defined)**  
When you double-click on the entry **New Chart Series** a wizard will be opened to help you creating a chart series. Once you have created a new chart series, it can be used in the **Comparative Diagrams** module to compare it with microscope images.
- **Chart Series (Standards)**  
The list shows the available standards provided with the software. They can be used in the **Comparative Diagrams** module to compare microscope images with chart series from the desired standard. Note that the chart series from the standards cannot be modified or edited.

On the right side of the standards list you see basic properties like **Name**, corresponding **Application**, **Description** and the relevant **Dimensions**.

#### See also

 Chart Series Creator Wizard [▶ 728]

#### 10.11.1 Chart Series Creator Wizard

Using this wizard you can create your own, customized chart series. You can easily navigate through the wizard steps by using the **Next** and **Back** buttons available. The wizard contains the following 4 steps:

##### Step 1/4 Enter basic information

Within the first step you can enter basic information like **Name**, **Description** and the **Module**, for which the chart series should be used. Click on **Next** to continue.



**Step 2/4 Define dimensions & values**

Within this step you define the **Dimensions** and the corresponding **Values** of your own chart series. By clicking on the **+ Add** buttons below, for each list a new dimension or value is added. If you have finished your individual definition, click on **Next**.

**Step 3/4 Add images**

Now you have to add the images (charts series) you want to use for the comparisons. Again click on the **+ Add** button to add the desired images.

**Step 4/4 Assign values to images**

Within this step you have to assign values to the corresponding images. You can assign the images by dragging & dropping the corresponding value fields on the box.

**10.12 Requirements for Docker Desktop**

For some functionality, you additionally need the software Docker Desktop on your PC to be able to use it. This includes the download and use of dedicated AI models (e.g. for instance segmentation) and the execution of arivis Cloud modules with the **arivis Cloud (on-site)** functionality. You have to install Docker Desktop by yourself (it is **not** provided by ZEISS via the ZEISS Microscopy Installer) and register/sign in with an account. Note that Docker also requires a paid subscription for commercial use, so you need to choose a correct license. For information on how to install Docker Desktop, always refer to the latest documentation provided by Docker itself, see <https://docs.docker.com/desktop/install/windows-install/>, or generally <https://docs.docker.com/>.

Docker Desktop has its own system requirements, which are detailed in their documentation (<https://docs.docker.com/desktop/install/windows-install/>). Always refer to the current information provided by Docker. As of November 2023 there are the following system requirements:

- Windows 10 64-bit: Home or Pro 22H2 (build 19045) or higher, or Enterprise or Education 22H2 (build 19045) or higher (Download: <https://www.docker.com/products/docker-desktop>). For Windows 10 Enterprise LTSC 2019 (version 1809) a docker version lower than 4.24.2 is required and can be downloaded from here: <https://docs.docker.com/desktop/release-notes/>
- BIOS-level hardware virtualization support must be enabled, see also <https://docs.docker.com/desktop/troubleshoot/topics/#virtualization>.
- 64 bit processor with Second Level Address Translation (SLAT)
- 4GB RAM
- The WSL 2 feature on Windows has to be installed and enabled, see also <https://docs.docker.com/desktop/windows/wsl/>.
- WSL version 1.1.3.0 or later.
- If your version of Windows does not support the WSL2 feature, Hyper-V and Containers Windows Features must be enabled.

If you cannot use WSL2, the resources allocated to Docker are not automatically managed by Windows and might not be big enough in certain instances. In such a case, you can also adapt the resource allocation manually.

Additionally, Docker Desktop has experimental features that are activated by default, which can lead to an increased resource consumption (e.g. disk space). Such features can also be deactivated manually.

If you work with Docker on a system with multiple Windows users, always sign-out from your Windows account to initiate a shutdown of Docker when you have finished your work. Otherwise the other users may have problems to use Docker with ZEN or ZEN core.

### Hyper-V System Performance Disclaimer

If Hyper-V is enabled in Windows, be aware that this might affect the overall PC system performance and, therefore, could lead to longer processing times or to reduced acquisition performance in the software. The ideal case would be to use **arivis Cloud (on-site)** on a dedicated, powerful workstation that is not directly attached to a microscope. Enabling the BIOS level hardware virtualization does not influence the system performance and can be left switched on.

### Hardware Recommendations:

- ZEISS MidRange Workstation
- 64 GB RAM or more (32 RAM dedicated to Docker Desktop)
- For the use of AI models the recommended hardware configuration is 8GB GPU and 64GB RAM. Only Nvidia GPUs and the CPU are supported.

### See also

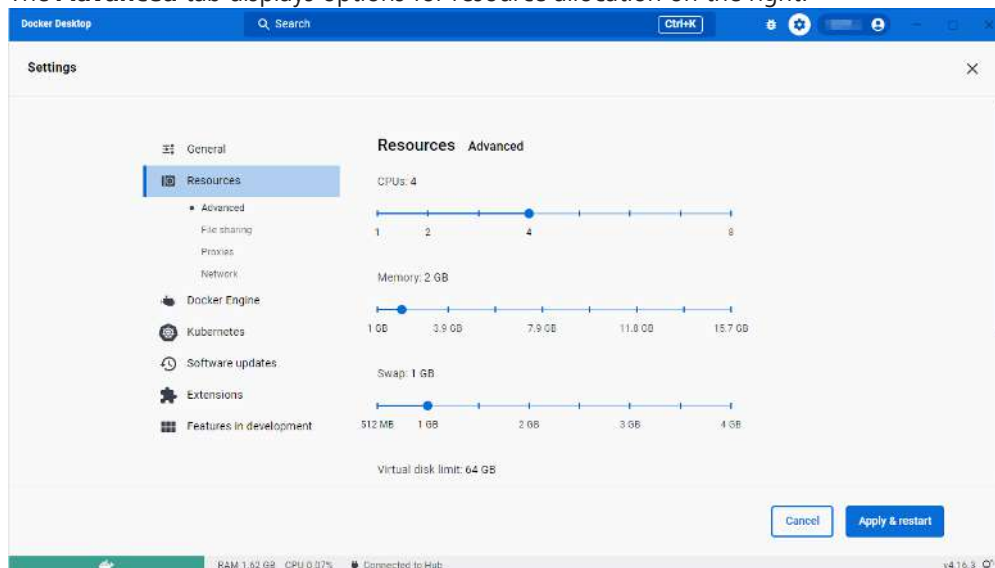
- 📖 arivis Cloud (on-site) [▶ 125]
- 📖 Downloading AI Models [▶ 71]

## 10.12.1 Adapting the Resource Allocation for Docker Desktop Manually

If you cannot use WSL2, the resources allocated to docker are not managed by Windows and might not be big enough in certain instances. In such a case, you can adapt the resources manually in Docker.

**Prerequisite** ✓ Docker is running on your PC.

1. Open **Docker Desktop** and go to the settings.
2. In the menu on the left, click **Resources**.
  - ➔ The **Advanced** tab displays options for resource allocation on the right.



3. Adapt the resources with the individual sliders.
4. Under **Resources**, click **File sharing**.
  - ➔ The option for file sharing is displayed on the right.
5. Enter any path where data is read from and put to.
6. Click **Apply & restart**.

### 10.12.2 Deactivating Experimental Docker Features

**Prerequisite** ✓ Docker is running on your PC.

1. Open **Docker Desktop** and go to the settings.
2. In the menu on the left, click **Features in development**.
3. Click **Experimental features**.  
→ The tab displays currently available experimental features.
4. Deactivate the feature(s) and click **Apply & restart**.

## 11 Reference

### 11.1 Workbenches & Tasks

#### 11.1.1 Input Documents

##### 11.1.1.1 Load Image Workbench

This workbench enables you to open an image from a storage device, e.g. a previously acquired and saved image.

##### See also

- ▢ Load Image Tool [► 749]
- ▢ Load from Archive Tool [► 750]
- ▢ Load Multiple Images Tool [► 751]

##### 11.1.1.2 Load File Workbench

This workbench enables you to load an image or table from the file system. You can then use the imported image or table in the current experiment.

##### See also

- ▢ Import Bioformats Image Tool [► 356]
- ▢ Import ZEN Connect Project Tool [► 356]
- ▢ Load from Archive Tool [► 750]
- ▢ Load Image (with Conversion) Tool [► 750]
- ▢ Load image from ZEN Data Storage Tool [► 161]
- ▢ Load Image Tool [► 749]
- ▢ Load Multiple Images Tool [► 751]
- ▢ Load Table Tool [► 750]
- ▢ Import Images into Session Tool [► 360]

##### 11.1.1.3 Form Workbench

The **Form** workbench enables you to select form templates and create forms.

Forms provide a simple way to add information to a job when it is run. Information can be entered into a form automatically (e.g. current time and date) or manually by the operator (e.g. current sample number).

##### See also

- ▢ Create Form Image Tool [► 674]
- ▢ Form Selection Tool [► 750]
- ▢ Technical Cleanliness Analysis (TCA) [► 536]















## 11.1.2 Acquisition

### 11.1.2.1 2D Acquisition Workbench

This workbench enables you to acquire an image using advanced settings according to your requirements. The **Camera** tool, which enables you to control camera settings such as exposure or white balance, is visible by default.

If you wish to change more settings, you can add all tools required for controlling the hardware such as focus tools, stage control tools, or tools to change parts of the microscope.

#### See also












-  [Active Scaling Tool \[► 751\]](#)
-  [Camera Tool \[► 754\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Editing Tool \[► 777\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Magnification Tool \[► 781\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Ring Light Tool \[► 789\]](#)
-  [S&F Find \(List\) Tool \[► 789\]](#)
-  [S&F Find Tool \[► 790\]](#)
-  [Stage Tool \[► 795\]](#)
-  [Export Experiment Tool \[► 798\]](#)

### 11.1.2.2 2D Acquisition (automatic) Workbench

This workbench enables you to acquire an image quickly with the most common settings and automatic camera exposure.

If you wish to change the settings, you can add all tools required for controlling the hardware such as camera tools, focus tools, stage control tools, or tools to change other microscope components settings.

#### See also












-  [Active Scaling Tool \[► 751\]](#)
-  [Camera Tool \[► 754\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Magnification Tool \[► 781\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Ring Light Tool \[► 789\]](#)
-  [Software Autofocus Tool \[► 791\]](#)
-  [Stage Tool \[► 795\]](#)

 [Export Experiment Tool \[► 798\]](#)

### 11.1.2.3 2D Multi-Channel Acquisition Workbench

This workbench enables you to acquire 2D multi-channel images.




#### See also

-  [Configuring Multi-Channel Acquisition with Smart Setup \[► 162\]](#)
-  [Active Scaling Tool \[► 751\]](#)
-  [Camera - Global Settings Tool \[► 753\]](#)
-  [Channels Tool \[► 167\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Magnification Tool \[► 781\]](#)
-  [Software Autofocus Tool \[► 791\]](#)
-  [Stage Tool \[► 795\]](#)
-  [Export Experiment Tool \[► 798\]](#)

### 11.1.2.4 Best Image Workbench

The **Best Image** workbench enables you to acquire several images with different microscope settings of the same sample position. Different pre-defined settings can be applied to the individual images. You can then select the most suitable one.

#### See also

-  [Best Image Settings Tool \[► 752\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Ring Light Tool \[► 789\]](#)





### 11.1.2.5 EDF (manual focus) Workbench

This workbench enables you to acquire an extended depth of focus (EDF) image if a manual focus drive or stage is installed on your microscope.

The software creates a single image from individual images acquired at different Z positions of the stage. The depth of focus of the resulting EDF image corresponds to the focus range of the individual images covered during acquisition. Stage movement and acquisition of the individual images is controlled manually.

#### See also

-  [Active Scaling Tool \[► 751\]](#)
-  [Camera Tool \[► 754\]](#)
-  [Extended Camera Tool \[► 761\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Editing Tool \[► 777\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Magnification Tool \[► 781\]](#)














-  EDF (manual focus) Tool [▶ 783](#)
-  Ring Light Tool [▶ 789](#)
-  S&F Find (List) Tool [▶ 789](#)
-  S&F Find Tool [▶ 790](#)

#### 11.1.2.6 EDF (motorized focus) Workbench

This workbench enables you to acquire an extended depth of focus (EDF) image if a motorized z drive is installed on your microscope.

The software creates a single image from individual images acquired at different Z positions of the stage. The depth of focus of the single image corresponds to the focus range of the individual images covered during acquisition. The stage movement and acquisition of the individual images is controlled automatically.

##### See also

-  Camera Tool [▶ 754](#)
-  Focus Tool [▶ 773](#)
-  Hardware Autofocus Tool [▶ 775](#)
-  Lamp Tool [▶ 776](#)
-  Light Path Tool [▶ 778](#)
-  Magnification Tool [▶ 781](#)
-  O-Inspect Autofocus Tool [▶ 782](#)
-  Preview Images Tool [▶ 181](#)
-  Ring Light Tool [▶ 789](#)
-  S&F Find Tool [▶ 790](#)
-  Stage Tool [▶ 795](#)
-  Tiles Stitching Tool [▶ 188](#)
-  Export Experiment Tool [▶ 798](#)




#### 11.1.2.7 Flexible Acquisition Workbench















This workbench allows the combination of different acquisition dimension, for example, multi-channel acquisition with tiles acquisition.

##### CAUTION

By default, the first channel in the channels list of the **Channels** tool is used as the reference channel for focus actions or stitching during acquisition. If two or more channels are created, you can assign the reference to one of these channels. It is possible to assign the reference channel to a channel that is not active for acquisition. For example, a brightfield channel is the reference, but is not to be imaged instead of being used only for SWAF (Software Autofocus) runs. In this case, activate the **Activate Stitching During Acquisition for New Experiments** option, see *Tiles & Positions Section* [▶ 720](#).

##### See also

-  Active Scaling Tool [▶ 751](#)
-  Camera - Global Settings Tool [▶ 753](#)
-  Channels Tool [▶ 167](#)









-  [Focus Correction Tool \[► 771\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Magnification Tool \[► 781\]](#)
-  [Position List Tool \[► 787\]](#)
-  [Preview Images Tool \[► 181\]](#)
-  [Software Autofocus Tool \[► 791\]](#)
-  [Stage Tool \[► 795\]](#)
-  [Tiles Options Tool \[► 181\]](#)
-  [Tiles Setup \(multiple regions\) Tool \[► 186\]](#)
-  [Tiles Stitching Tool \[► 188\]](#)
-  [Time Series Setup Tool \[► 176\]](#)
-  [Z-Stack Setup Tool \[► 797\]](#)
-  [Export Experiment Tool \[► 798\]](#)

#### 11.1.2.8 Linkam Acquisition Workbench

This workbench enables you to acquire a series of images at different temperatures. You can combine time-dependent or temperature-dependent acquisitions into one experiment.

The result is a series of images at each temperature or time, as well as a temperature profile of the experiment. You can display the corresponding image for each data point of the temperature profile.

##### See also

-  [Camera Tool \[► 754\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Ring Light Tool \[► 789\]](#)
-  [Stage Tool \[► 795\]](#)

#### 11.1.2.9 Linkam Heating Stage Workbench

This workbench enables you to control the temperature and vacuum of the Linkam heating stage.

#### 11.1.2.10 Movie Recorder Workbench


















With this workbench you record movies e.g. from the Live image.

Parameter	Description
<b>Live</b>	Starts the live camera image.
<b>Record</b>	Starts the recording. To stop and save the recording, click the button a second time.



Parameter	Description
	In <b>Free Mode</b> : You can save the acquired movie as <b>CZI</b> format via the Documents area   <b>Save As ...</b>
<b>Pause</b>	Pauses the recording and switches the button to <b>Continue</b> .
<b>Continue</b>	Continues the recording if it has been paused. The button switches to <b>Pause</b> .

### See also









-  [Active Scaling Tool \[► 751\]](#)
-  [Camera Tool \[► 754\]](#)
-  [Extended Camera Tool \[► 761\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Editing Tool \[► 777\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Linkam Heating Stage Control Tool \[► 780\]](#)
-  [Magnification Tool \[► 781\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Ring Light Tool \[► 789\]](#)
-  [S&F Find \(List\) Tool \[► 789\]](#)
-  [S&F Find Tool \[► 790\]](#)
-  [Software Autofocus Tool \[► 791\]](#)
-  [Stage Tool \[► 795\]](#)
-  [Export Experiment Tool \[► 798\]](#)





#### 11.1.2.11 Position List Workbench

This workbench enables you to define a set of images to be acquired at different positions of the sample. This is useful if you process a set of almost identical samples and know the positions of the sample areas from which you wish to acquire images.

The software moves the stage automatically to the defined positions and acquires an image at each position. The acquired images are stored into a single file along with their position information.

### See also



















-  [Camera Tool \[► 754\]](#)
-  [Focus Correction Tool \[► 771\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Position List Tool \[► 787\]](#)

-  [Ring Light Tool \[► 789\]](#)
-  [Stage Tool \[► 795\]](#)
-  [Tiles Options Tool \[► 181\]](#)
-  [Export Experiment Tool \[► 798\]](#)

#### 11.1.2.12 Position List with EDF Workbench

This workbench enables you to define a list of single tile positions to be acquired with an EDF (Extended Depth of Focus) on a motorized stage and focus.



##### See also

-  [Active Scaling Tool \[► 751\]](#)
-  [Camera Tool \[► 754\]](#)
-  [Extended Camera Tool \[► 761\]](#)
-  [Focus Correction Tool \[► 771\]](#)
-  [Focus Tool \[► 773\]](#)
-  [Hardware Autofocus Tool \[► 775\]](#)
-  [Lamp Tool \[► 776\]](#)
-  [Light Path Editing Tool \[► 777\]](#)
-  [Light Path Tool \[► 778\]](#)
-  [Magnification Tool \[► 781\]](#)
-  [O-Inspect Autofocus Tool \[► 782\]](#)
-  [Position List Tool \[► 787\]](#)
-  [Ring Light Tool \[► 789\]](#)
-  [S&F Find \(List\) Tool \[► 789\]](#)
-  [S&F Find Tool \[► 790\]](#)
-  [Software Autofocus Tool \[► 791\]](#)
-  [Stage Tool \[► 795\]](#)
-  [Tiles Options Tool \[► 181\]](#)
-  [Export Experiment Tool \[► 798\]](#)

#### 11.1.2.13 SEM 2D Acquisition Workbench

This workbench enables you to acquire 2D images with the SEM (Scanning Electron Microscope).

##### See also

-  [SEM Stage Tool \[► 852\]](#)
-  [SEM Detector Selection Tool \[► 853\]](#)

#### 11.1.2.14 Tiles with EDF Workbench

This workbench enables you to acquire an image of a large sample area by specifying multiple tile regions on your sample which you wish to combine into a large image. For each tile region, a z-stack of images is acquired and merged afterwards into an extended depth of focus (EDF) image.

The stage movement and acquisition of the individual tiles is controlled automatically.

**See also**

-  Camera Tool [► 754]
-  Focus Tool [► 773]
-  Focus Correction Tool [► 771]
-  Hardware Autofocus Tool [► 775]
-  Lamp Tool [► 776]
-  Light Path Tool [► 778]
-  Magnification Tool [► 781]
-  Preview Images Tool [► 181]
-  S&F Find Tool [► 790]
-  Stage Tool [► 795]
-  Tiles Options Tool [► 181]
-  Tiles Stitching Tool [► 188]
-  Export Experiment Tool [► 798]
-  Tiles Setup (multiple regions) Tool [► 186]

**11.1.3 Scaling****11.1.3.1 Assign Measured Scaling Workbench**

This workbench enables you to calculate the scale for images acquired with microscopes where the individual hardware components can be detected automatically.

**11.1.3.2 Assign Pixel Size Workbench**

This workbench enables you to assign a scale to an image retrospectively, for example if the image does not contain a scale recognized by the software because it was created on another device.

**11.1.3.3 Assign Theoretical Scaling Scaling Workbench**

This workbench enables you to calculate the scale for images acquired with manual hardware (i.e. a microscope where the individual hardware components cannot be detected automatically).












































**11.1.3.4 Create Measured Scaling Workbench**





































This workbench enables you to create a new scaling definition by measuring an object of known length.

**11.1.4 Processing****11.1.4.1 Image Processing Workbench**

This workbench enables you to optimize the appearance of an image by applying various image processing tools, for example to reduce noise or enhance a region of interest.

**See also**

-  [Add Constant Tool \[► 205\]](#)
-  [Add Tool \[► 204\]](#)
-  [AND Tool \[► 212\]](#)
-  [Average Tool \[► 206\]](#)
-  [Binomial Filter Tool \[► 817\]](#)
-  [Brightness/Contrast/Gamma Tool \[► 801\]](#)
-  [Canny Tool \[► 235\]](#)
-  [Change Pixel Type Tool \[► 821\]](#)
-  [Close Tool \[► 228\]](#)
-  [Color Balance Tool \[► 803\]](#)
-  [Color Temperature Tool \[► 803\]](#)
-  [Combine RGB Tool \[► 821\]](#)
-  [Combine Tool \[► 206\]](#)
-  [Copy Annotations Tool \[► 823\]](#)
-  [Copy Tool \[► 823\]](#)
-  [Delineate Tool \[► 814\]](#)
-  [Denoise Tool \[► 817\]](#)
-  [Dilate Tool \[► 229\]](#)
-  [Distance Tool \[► 212\]](#)
-  [Divide Tool \[► 206\]](#)
-  [Enhance Contours Tool \[► 814\]](#)
-  [Erode Tool \[► 229\]](#)
-  [Exoskeleton Tool \[► 213\]](#)
-  [Exponential Tool \[► 207\]](#)
-  [Fast Extended Depth of Focus Tool \[► 827\]](#)
-  [Fast Topography Tool \[► 828\]](#)
-  [Fill Holes Tool \[► 214\]](#)
-  [Gauss Tool \[► 818\]](#)
-  [Generate Image Pyramid Tool \[► 825\]](#)
-  [Gradient Tool \[► 230\]](#)
-  [Gray Reconstruction Tool \[► 231\]](#)
-  [Grayscale Tool \[► 825\]](#)
-  [Highpass Tool \[► 220\]](#)
-  [Histogram Equalization Tool \[► 804\]](#)
-  [Hue/Saturation/Lightness Tool \[► 805\]](#)
-  [Image Generator Tool \[► 826\]](#)
-  [Intellesis Denoising Tool \[► 322\]](#)
-  [Intellesis Trainable Segmentation Tool \[► 317\]](#)
-  [Invert Tool \[► 207\]](#)
-  [Label Image Tool \[► 214\]](#)
-  [Logarithm Tool \[► 208\]](#)
-  [Lowpass Tool \[► 818\]](#)
-  [Mark Regions Tool \[► 215\]](#)






-  Marr Tool [► 236]
-  Maximum Tool [► 208]
-  Median Tool [► 819]
-  Minimum Tool [► 208]
-  Mirror Tool [► 809]
-  Multiply Constant Tool [► 209]
-  Multiply Tool [► 208]
-  NOT Tool [► 215]
-  Open Tool [► 231]
-  OR Tool [► 215]
-  Orthogonal Projection Tool [► 809]
-  Reciprocal Tool [► 209]
-  Resample Tool [► 810]
-  Rotation Tool [► 811]
-  Scrap Tool [► 216]
-  Separation Tool [► 216]
-  Shift Tool [► 812]
-  Sigma Tool [► 819]
-  Single-Pixel Filter Tool [► 819]
-  Split into RGB Tool [► 826]
-  Square Root Tool [► 210]
-  Square Tool [► 210]
-  Structure Elements [► 227]
-  Subtract Tool [► 210]
-  Thinning Tool [► 217]
-  Threshold Auto Tool [► 238]
-  Threshold Dynamic Tool [► 240]
-  Threshold Tool [► 236]
-  Top Hat Black Tool [► 232]
-  Top Hat White Tool [► 232]
-  Ultimate Erode Tool [► 218]
-  Unsharp Masking Tool [► 816]
-  Valleys Tool [► 241]
-  Watersheds Tool [► 233]
-  White Balance Tool [► 808]
-  XOR Tool [► 218]

#### 11.1.4.2 Table Processing Workbench

This workbench enables you to merge results tables, create a histogram or chart or create statistics based on measurement results.

#### See also

-  Category Histogram Tool [► 833]

-  [Create Chart Tool \[► 831\]](#)
-  [Calculate Histogram Tool \[► 830\]](#)
-  [Join Multiple Tables Tool \[► 833\]](#)
-  [Statistics Table Tool \[► 832\]](#)
-  [Append Table Tool \[► 830\]](#)

#### 11.1.4.3 Split Image Workbench

This workbench enables you to extract certain dimensions from your image and export them as a collection of images.

##### See also

-  [Split by Dimension Tool \[► 833\]](#)





















### 11.1.5 Measurement





#### 11.1.5.1 Interactive Measurements Workbench

This workbench enables you to measure distances, angles, area, and intensities of pixels in images. You can also save the measurements results tables and images. With the **Shift** key, you can rotate your measurements.

Under **Favorites** you can save your favorite measurement tools for fast access. Simply click on **+ Add Tool** to see all available tools. Then move the desired tool per Drag & Drop on the favorites bar.

##### See also






-  [Active Contour Tool \[► 836\]](#)
-  [Active Curve Tool \[► 842\]](#)
-  [Angle \(Disconnected\) Tool \[► 843\]](#)
-  [Angle Tool \[► 842\]](#)
-  [Arrow Tool \[► 834\]](#)
-  [Caliper Tool \[► 843\]](#)
-  [Circle \(Diameter\) Tool \[► 837\]](#)
-  [Circle \(Points\) Tool \[► 837\]](#)
-  [Circle \(Radius, In-Out\) Tool \[► 838\]](#)
-  [Circle \(Radius, Out-In\) Tool \[► 839\]](#)
-  [Contour \(Polygon\) Tool \[► 839\]](#)
-  [Contour \(Spline\) Tool \[► 839\]](#)
-  [Contour with Holes Tool \[► 840\]](#)
-  [Curve \(Polygon\) Tool \[► 844\]](#)
-  [Distance Tool \[► 844\]](#)
-  [Events Tool \[► 834\]](#)
-  [Length Tool \[► 845\]](#)
-  [Line Tool \[► 846\]](#)
-  [Marker Tool \[► 835\]](#)
-  [Multi Calipers Tool \[► 846\]](#)

-  Points Relative Tool [[► 835](#)]
-  Rectangle Tool [[► 841](#)]
-  Spline Curve Tool [[► 848](#)]
-  Text Tool [[► 836](#)]

### 11.1.5.2 Topography Measurements Workbench

This workbench enables you to measure horizontal or vertical distances along a profile line drawn on an EDF image.



#### See also

-  Create Image Tool [[► 850](#)]
-  Profile Angle Tool [[► 848](#)]
-  Profile Circle (Radius, In-Out) Tool [[► 849](#)]
-  Profile Distance Tool [[► 849](#)]
-  Profile Line (x, y) Tool [[► 849](#)]

### 11.1.5.3 Measurement Data Workbench

This workbench displays the image analysis result for all detected particles in the image. No user-interaction is necessary.

#### See also

-  Technical Cleanliness Analysis (TCA) [[► 536](#)]
-  Measurement Data Tool [[► 834](#)]

## 11.1.6 Shuttle & Find

### 11.1.6.1 S&F Holder Calibration Workbench

This workbench enables you to calibrate your correlative holders before starting the image acquisition. On an LM system, the **Camera** tool, which enables you to control camera settings such as exposure or white balance, is visible by default. Other tools to control the microscope can be added to the workbench.



#### See also

-  S&F ROI/POI Drawing Workbench [[► 744](#)]

### 11.1.6.2 S&F Image Overlay Workbench

This workbench enables you to create overlay images from different microscopes, e.g. LM and SEM image files.


#### See also

-  S&F Holder Calibration Workbench [[► 743](#)]
-  S&F ROI/POI Drawing Workbench [[► 744](#)]

11.1.6.3 S&F ROI/POI Drawing Workbench

This workbench enables you to draw in ROIs or POIs to the image.

See also

 S&F Holder Calibration Workbench [► 743]

11.1.7 Output Documents

11.1.7.1 Qual Data Export Workbench

This workbench is available only if you have licensed and activated the module **Qual Data Export**.

Using this workbench you can export measurement data in standardized formats for statistical process control software products, e.g. PiWeb. You can then use these software products to create e.g. trend analysis from the measurement data. The software can export the following formats:

- Shared file (\*.dfq)
- Separate files (\*.dfd + \*.dfx)
- Values only (\*.dfx)

The workbench is located in the Group **Output Documents**. By clicking on **+ Add** you can simply add the workbench to your workspace. Select the desired export format, specify the target folder and click on **Apply**. The measurement data will be exported to the specified folder.

Parameter	Description
Write Mode	Sets the desired export format. Available formats are <b>*.dfq</b> , <b>*.dfd</b> and <b>*.dfx</b> .
Target folder	Specifies the desired target folder.
File Prefix	Here you can add a file prefix to the export file. Enter the desired text in the input field.
Encoding	Specifies the encoding of the files. We recommend to leave the default value (ASCII).
General Export Data	<p>If you expand the section, you can enter additional information to the export file, e.g. part number, part description, etc. The (meta-)information will be exported with the file.</p> <p>You can assign all measurement data from the <b>Interactive Measurement</b> workbench to the K-Values of the export files. The assignment has to be done while setting up a job template. When running the job template, the document is created automatically and stored to the pre-defined location. The respective other software (e.g. PiWeb) will import the file and will do further analysis.</p>

11.1.7.2 Reports Workbench

The **Reports** workbench enables you to open and use report templates and generate reports.

**Reports** enable you to collate all the information from your examination in a single document. This document serves as a protocol of your examination.



**See also**

 [Add Templates Tool \[► 864\]](#)

**11.1.7.3 Save File Workbench**

This workbench enables you to save the following objects to the file system in various supported formats.




- Images
- Measurement results
- Reports

Images and tables can also be exported in other file formats. In addition to specifying a file format, exporting enables you to adjust various other parameters such as scaling, compression, how annotations (graphics) are treated.

**See also**

 [Save Image Tool \[► 855\]](#)  
 [Save Report Tool \[► 854\]](#)  
 [Save Table Tool \[► 854\]](#)  
 [Image Export Tool \[► 857\]](#)  
 [OME TIFF Export Tool \[► 861\]](#)  
 [ZVI Export Tool \[► 863\]](#)  
 [Topo Export Tool \[► 862\]](#)  
 [Send to ConfoMap Tool \[► 862\]](#)





**11.1.8 Utilities****See also**

 [Load CAD Tool \[► 132\]](#)  
 [CAD Viewer Tool \[► 133\]](#)  
 [CAD Overlay Tool \[► 133\]](#)

**11.1.8.1 CAD Import Workbench**

This workbench enables you to import CAD data or images. Furthermore, you can view the 3D models in different 2D views for further processing, e.g. for measurements or overlay images.






**See also**

 [Load CAD Tool \[► 132\]](#)  
 [CAD Viewer Tool \[► 133\]](#)  
 [CAD Overlay Tool \[► 133\]](#)  
 [Importing a CAD Model \[► 129\]](#)

**11.1.8.2 CAD Overlay Workbench**

This workbench enables you to create overlay images using the CAD image on the one hand and an acquired microscope image on the other hand.

**See also**

-  CAD Overlay Tool [► 133]
-  Load CAD Tool [► 132]
-  CAD Viewer Tool [► 133]
-  Creating an Overlay Image [► 130]
-  Importing a CAD Model [► 129]

**11.1.8.3 Document Tags Manager**

This workbench enables you to add tags (terms) to a document or delete them.

**See also**

-  Document Tags Tool [► 868]

**11.1.8.4 ImageJ Connection**


This workbench enables you to send images to ImageJ or to retrieve (processed) images from ImageJ.

Parameter	Description
<b>Send Image</b>	<p>Sends the current image to ImageJ and enables you to apply image processing in ImageJ.</p> <p>ImageJ might display a comprehensive import options window, depending of the type of the sent image. For more information, see the ImageJ Online Help.</p>
<b>Retrieve Image</b>	Retrieves the image of the current ImageJ window.

**11.1.8.5 Multi-Image View Workbench**

This workbench enables you to compare between two or sixteen images in one multi-image. It is only available in **Free Examination** mode under **Utilities**.






**See also**

-  Multi-Image Setup Tool [► 866]
-  Create Multi-Image Tool [► 866]

**11.1.8.6 OAD Macros Workbench**

This workbench enables you to load, preview and edit macros.

**See also**

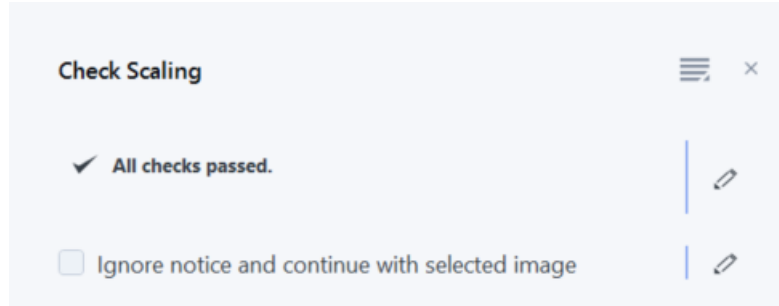
-  OAD Macro Tool [► 865]
-  Running a Macro [► 336]
-  Creating a Macro [► 334]
-  Managing Macros [► 336]
-  Debugging a Macro [► 336]

### 11.1.8.7 Validation



This task is only available in **Job Mode** under **Create a new template and edit it**.

We recommend to use this task right after you have loaded or acquired an image. Currently it will check if the input image has the correct scaling information. This is important to make sure the image can be processed correctly. You can check the validation result in the tool window.



If the input image has no scaling information, you will receive a corresponding message. If you want to continue anyways, you can activate the checkbox **Ignore notice and continue with selected image**.

### 11.1.8.8 Screenshot Taker Workbench

The workbench is only available in **Job Mode**.

This workbench allows to take screenshots of a topography view or a heightmap view of an EDF image.

#### See also

 Take Topography Screenshots Tool [► 868]

### 11.1.9 Material Modules

Note that this specific group is available only for **Create a new template and edit it** within **Job Mode**. The included tasks can only be used in job mode.

Within this group you find all individual tasks available for the material modules of ZEN core. Although you can select and add each task here separately we recommend to use the pre-defined job templates for each material module included with the software. You find a detailed description of the module specific tasks in the following chapters:

- *Cast Iron Analysis Module* [► 382]
- *Comparative Diagrams Module* [► 391]
- *Grain Size Analysis Module* [► 398]
- *Layer Thickness Measurement Module* [► 421]
- *Multiphase Analysis Module* [► 436]

### 11.1.10 Workflow



This group is only available in **Job Mode** under **Create a new template and edit it**. The included tasks (**Loop/Group**) can only be used in job mode.

### 11.1.10.1 Loop Task

By using the loop workbench or task, you can set up and execute one or more tasks for several times. In a loop workflow, you can set workbenches to be interactive just once.

The workbench will be interactive in the first loop iteration and run silent in the resting iterations.

#### See also

-  Adding a Loop to a Job Template [▶ 62]
-  Define Outputs Tool [▶ 749]

### 11.1.10.2 Group Task

This task enables the grouping of certain workbenches. They are variable and represented by the group icon



When you create a new group, use the **Define Outputs** tool to define or modify the output. If you do not use the **Define Outputs** tool, only the results of the last workbench of the group will be saved.

#### Example

In the module **Non-Metallic Inclusion Analysis** you can choose between acquiring an image or loading one. Dependent on your choice, the group workbench is called **Acquire Tiles Images** or **Load Images from File System**.

#### See also

-  Define Outputs Tool [▶ 749]

### 11.1.10.3 Settings Tool

When a loop task is added to a job template you have different options how the loop is executed.

Parameter	Description
<b>Exactly</b>	Enter the number of desired iterations (loops) in the input field. The loop will be executed exactly as often as entered, e.g. if you enter "5", the loop will be executed 5 times.
<b>Range</b>	Enter the desired minimum number of loops to be executed in the <b>Min. Loops</b> field. Enter the desired maximum number of loops to be executed in the <b>Max. Loops</b> field.
<b>Batch processing</b>	The loop content will be iterated once for every input document. The input document can vary at every job execution, e.g. you can use a position list containing various images as an input for a loop. The job will performed as many iterations as the number of images available from the position list.



#### 11.1.10.4 Define Outputs Tool

This tool defines the required output documents that are essential for the workflow functionality. This tool is only visible when creating or editing a loop or group workflow.

If you work with **NMI Analysis**, the document selection cannot be adapted. The calculation is performed in the background with default values. Therefore, editing is not possible.

Parameter	Description
<b>Mode</b>	
- All	Documents generated by all loop iterations are available in the further workflow and are stored in the archive.
- Last Iteration Only	Documents generated by the last loop iteration are available in the further workflow and are stored in the archive.
- None	Documents generated by loop iterations are not available in the further workflow and are not stored in the archive.
<b>Selected Outputs</b>	Displays a list of documents that are generated by the loop or group workflow. Select the documents you do want to save.

#### See also

-  Group Task [▶ 748](#)
-  Loop Task [▶ 748](#)

## 11.2 Tools


### 11.2.1 Input Documents

#### 11.2.1.1 Load Image Tool




This tool enables you to load an image from the file system. You can load any supported image file.

Note that BigTIFF images are not supported.

Note that if you save or export an EDF image in an image format that does not support multi channels, e.g., jpg, and later you import it again and save it in czi format, the multi channel information will be lost. This might be confusing if you saved the imported image (jpg format) in the Archive in czi format and load it again, then e.g., the topography functionality is lost, but the image still looks like an image in EDF format.


Parameter	Description
<b>File Name</b>	The path and filename of the image to be loaded Click on  to open the file browser and select the desired image.

#### See also

-  Specifying Permitted and Expected Values for a Tool [▶ 59](#)
-  Configuring Tolerances for a Measurement [▶ 60](#)
-  Supported File Formats [▶ 117](#)


### 11.2.1.2 Load from Archive Tool

This tool enables you to load files from the ZEN core archive.

Parameter	Description
<b>Document Type</b>	From the drop-down list you can select the type of document (image, table, etc.) you want to load from the archive.
<b>File Name</b>	Displays the path and file name of the document to be loaded Click on  to open the Archive browser and select the desired file.

### 11.2.1.3 Load Image (with Conversion) Tool

This tool enables you to load an image from the file system and convert it, if necessary (like for importing txd files).

Parameter	Description
<b>File Name</b>	The path and filename of the image to be converted and loaded. Click on  to open the file browser and select the desired image.

### 11.2.1.4 Form Selection Tool


Using this tool, you select a form template (created with the Form Designer), fill it out and create a form. This, for example, can be used for additional documentation of jobs by an operator. The form is added to the report.

#### See also




 Form Workbench [► 732]

### 11.2.1.5 Load Table Tool

This tool enables you to load a data table from the file system. You can load any supported file, regardless of whether it is a result table generated by the software or external software. For example, you could load a table containing theoretical measurement results to check whether the actual measurements are correct.

Parameter	Description
<b>File Name</b>	The path and filename of the table to be loaded Click on  to open the file browser and select the desired file.


#### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Supported File Formats [► 117]


11.2.1.6 Load Multiple Images Tool

This tool enables you to load multiple images all at once from the file system. You can load any supported image file.

Note that if you save or export an EDF image in an image format that does not support multi channels, e.g., jpg, and later you import it again and save it in czi format, the multi channel information will be lost. This might be confusing if you saved the imported image (jpg format) in the Archive in czi format and load it again, then e.g., the topography functionality is lost, but the image still looks like an image in EDF format.

Parameter	Description
File Names	<p>Shows the path of the images to be loaded.</p> <p>Click  to open the file browser and select the desired images. To select a range of images hold down the <b>Shift</b> key and click on the first and the last image of the range. Alternatively you can hold down the <b>Alt</b> key to select multiple single images.</p> <p>The images are added to the list of documents in the documents area, displayed in the list on top, and here, for each load of multiple images, sorted alphabetically.</p>

11.2.1.7 Import TIF(F) Stack Tool

Parameter	Description
File Names	<p>Displays the names of the selected files. Clicking  opens a file browser to select the images for import.</p>
Z-Spacing	<p>Sets the slice distance in z manually.</p>
– Read Z-Spacing from File	<p><b>Activated:</b> The distance in z is calculated automatically with information from the image metadata. Note that if reading the metadata information fails, the function uses the value that is set with the slider or input field.</p> <p><b>Deactivated:</b> Uses the value that is set with the slider or input field.</p>
XY-Scaling	<p>Sets the xy scaling manually.</p>
– Read XY Scaling from File	<p><b>Activated:</b> The xy scaling is calculated automatically with information from the image metadata. Note that if reading the metadata information fails, the function uses the value that is set with the slider or input field.</p> <p><b>Deactivated:</b> Uses the value that is set with the slider or input field.</p>

See also

 Importing Multiple TIFF Files [► 120]



















11.2.2 Acquisition

11.2.2.1 Active Scaling Tool

This tool displays the active scaling for the acquisition according to your system configuration.

Parameter	Description
<b>Objective</b>	Displays the name of the currently active objective you use for your acquisitions.
<b>Optovar Magnification</b>	Displays the magnification of the optovar.
<b>Reflector Magnification</b>	Displays the magnification of the reflector.
<b>Camera</b>	Displays the camera name.
<b>Pixel Distance</b>	Displays the size of the space between the pixels of the camera.
<b>Camera Adapter</b>	Displays the camera adapter.

### See also

-  2D Acquisition (automatic) Workbench [▶ 733]
-  2D Acquisition Workbench [▶ 733]
-  2D Multi-Channel Acquisition Workbench [▶ 734]
-  Best Image Workbench [▶ 734]
-  EDF (manual focus) Workbench [▶ 734]
-  EDF (motorized focus) Workbench [▶ 735]
-  Interactive Height Measurement Workbench [▶ 664]
-  Linkam Acquisition Workbench [▶ 736]
-  Movie Recorder Workbench [▶ 736]
-  Panorama (automatic) Workbench [▶ 146]
-  Panorama (interactive) Workbench [▶ 146]
-  Position List with EDF Workbench [▶ 738]
-  Position List Workbench [▶ 737]
-  Tiles (free drawing) Workbench [▶ 189]
-  Tiles (manual) Workbench [▶ 190]
-  Tiles (measurement area) Workbench [▶ 523]
-  Tiles with EDF Workbench [▶ 738]
-  Flexible Acquisition Workbench [▶ 735]

#### 11.2.2.2 Best Image Settings Tool

Here you can edit specific settings for the image acquisition. Click on the **Arrow** in front of **Edit Settings** to enlarge the window and show the settings. The following settings are available:

Parameter	Description
<b>Apply Display Settings for each Image</b>	If activated, the pre-defined display settings <b>Min/Max</b> and <b>Best Fit</b> will be automatically applied to the image (see <b>Display</b> tab). Each setting will be applied separately, with the result of two images. You can see the applied setting in the image description under the small pre-view image.



Parameter	Description
<b>Apply Unsharp Masking for each Image</b>	<p>If activated, the software will apply the image processing function <b>Unsharp Masking</b> on each image which is acquired. The function will be applied two times, with the result of two images. One image with a weaker and one image with a stronger effect, so that you can decide what suits you best.</p> <p>Note that there will be more images, if you have activated <b>Apply Display Settings</b>.</p>
<b>Drop-down list for saving and editing settings</b>	<p>Here you can save and edit your hardware settings. For creating a new setting open the <b>Options</b> menu and click <b>Add</b>.</p>
<b>Display of lightpath/lightpath settings</b>	<p>Here you can directly change important lightpath (e.g. changing the objective) and camera settings (e.g. adjusting the exposure time). If you want to work with different lightpath settings, we recommend to save it to single setting files. Then you can easily restore and apply different hardware setting by clicking on the <b>Checkmark</b> button.</p>

### See also

 Acquiring a "Best" Image [► 109]

#### 11.2.2.3 Camera - Global Settings Tool

With this tool you configure the color mode for the selected camera. The tool is only available for color cameras.

Parameter	Description
<b>Color Mode</b>	Switches to the desired color mode.
— RGB	<p>Based on the RGB (Red-Green-Blue) color model. Transmits the image data of a color camera unchanged. This corresponds to the standard operating mode of a color camera.</p>
— B/W	<p>Treats the image data of the color channels as grayscale. The data of related color channels are averaged. The saturation of the camera appears reduced as a result. This process does not change the spectral properties of a color camera. The image information of the color sensor still undergoes color interpolation. An infrared filter also restricts the spectral sensitivity of the color camera compared to the spectral sensitivity of a genuine black and white camera.</p> <p>Exposure time measurements with the auto exposure button use the <b>B/W</b> mode for calculations and therefore individual pixels of the color camera might be oversaturated, even if the histogram displaying the black and white calculation does not indicate overexposure. One time intensity measurements switch to the <b>RGB</b> mode for exposure time determination.</p>

### See also

 Flexible Acquisition Workbench [► 735]

 2D Multi-Channel Acquisition Workbench [► 734]




### 11.2.2.4 Camera Tool

This tool is the basic tool to control the camera. It contains options for exposure time and white balance of the acquired images.

Parameter	Description
<b>Exposure Time</b>	Enables you to control the exposure settings of your camera.
— Auto/Man	<ul style="list-style-type: none"> <li>▪ <b>Auto:</b> The exposure time is calculated automatically every time an image is acquired.</li> <li>▪ <b>Man:</b> If you are not satisfied with the automatic result, you can adjust the measured exposure time manually. The exposure time specified this way can be changed and adjusted manually at any time.</li> </ul>
— Time	<p>If the exposure time is set to manual, you can adjust the desired duration here.</p> <p>The weaker the illumination of the sample, the longer the required exposure time.</p>
— Use Luminosity	<p>Only visible with <b>ZEISS Axiocam 705 POL</b>.</p> <p><b>Activated:</b> Luminosity is available to apply the selected luminosity target value to the maximum intensity peak in the histogram. The target value is defined by the <b>Luminosity</b> slider.</p>
— Luminosity	<p>The <b>Luminosity</b> slider adjusts the image brightness in steps of 1%. A high value indicates a brighter image and vice versa.</p> <p>A Luminosity value of 100% corresponds to the full dynamic range of the camera.</p> <ul style="list-style-type: none"> <li>▪ <b>Auto Mode:</b> The selected Luminosity value adapts the maximum intensity peak to the Luminosity value and adjusts at once the exposure time accordingly.</li> <li>▪ <b>Manual Mode:</b> The selected Luminosity value adapts the maximum intensity peak to the Luminosity value and adjusts the exposure time after clicking the <b>Measure</b> Button.</li> </ul> <p>For more information, see <i>Concept of Relative Image Brightness and Relative Threshold</i> [► 571].</p>
— Measure	Measures the exposure time manually once, which is used for all subsequent images. The exposure time determined this way can be changed and adjusted manually at any time.
<b>Spot Meter / Focus ROI</b>	If activated, the exposure time and focus measurements use the intensity values within a specified area instead of the entire camera sensor area. This improves the results for the area to be acquired.
<b>Enable HDR</b>	If activated, HDR (High Dynamic Range) is applied when acquiring an image. Therefore, several images at increasing exposure times are acquired and merged together in one resulting HDR image. The HDR image has a higher dynamic range with 2 additional bits (e.g. a 12 bit camera would produce a 14 bit HDR image) and therefore can cover more image information from dark to bright areas within the image.
<b>Color Mode</b>	Switches to the desired color mode.

Parameter	Description
— RGB & B/W	<p><b>RGB:</b> Based on the RGB (Red-Green-Blue) color model. Transmits the image data of a color camera unchanged. This corresponds to the standard operating mode of a color camera.</p> <p><b>B/W:</b> Treats the image data of the color channels as grayscale. The data of related color channels are averaged. The saturation of the camera appears reduced as a result. This process does not change the spectral properties of a color camera. The image information of the color sensor still undergoes color interpolation. An infrared filter also restricts the spectral sensitivity of the color camera compared to the spectral sensitivity of a genuine black and white camera.</p> <p>The <b>Axiocam 705 pol</b> is a monochrome camera. In color mode, the camera displays each pixel in pseudo-colors based on the polarization direction.</p>
<b>White Balance</b>	<p>Only visible, if you are using a color camera.</p> <p>With adjusting the white balance, you can remove a color cast (e.g. a red or green tint) from the live image that may result from non-neutral lighting. As a result, the colors appear neutral.</p> <p>With the <b>Axiocam 705 pol</b>, white balance has no effect on the images acquired. The <b>Axiocam 705 pol</b> is a monochrome camera.</p>
— Auto	<p>Selects the reference point for white balance correction automatically and adjusts the hue of all other pixels accordingly. To use this function properly, a color neutral position must be visible on the sample. If the camera's field of view is full of colored structures, navigate to a color neutral spot or insert a color neutral surface under the objective.</p> <p>If you acquire images with the <b>Axiocam 705 pol</b>, adjustment with <b>Auto</b> has no effect on the acquired images. The <b>Axiocam 705 pol</b> is a monochrome camera.</p>
— Pick...	<p>Enables you to specify the reference point for white balance correction manually. The hue of all other pixels is adjusted accordingly.</p> <p>To achieve an optimum result, pick a color neutral spot (white or gray) on the sample.</p> <p>If you acquire images with the <b>Axiocam 705 pol</b>, adjustment with <b>Pick</b> has no effect on the acquired images. The <b>Axiocam 705 pol</b> is a monochrome camera.</p>
— Reset	<p>Resets any color changes and sets the white balance value to 6500 K.</p> <p>If you acquire images with the <b>Axiocam 705 pol</b>, a reset has no effect on the acquired images. The <b>Axiocam 705 pol</b> is a monochrome camera.</p>

### See also

-  Interactive Height Measurement Workbench [► 664]
-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

## 11.2.2.5 EDF Setup (motorized focus) Tool

**CAUTION****Risk of Crushing Fingers**

The drive of a microscope stage with a motorized vertical axis (focus drive) is strong enough to crush fingers or objects between the stage and the microscope stand.

- ▶ Remove your fingers or any objects from the danger area before moving the focus drive.
- ▶ Release the joystick immediately to stop the movement.

This tool creates an extended depth of focus (EDF) image by acquiring a sequence of images at different focus positions and combining the in-focus areas of each image.

The tool accepts a range of Z-positions of the stage and an interval/step size at which to acquire the individual images. The motorized stage is then automatically moved to the defined positions, at each position an image is acquired, and the in-focus areas of the acquired images are combined to an EDF image.

Parameter	Description
<b>Z-Stack</b>	Defines the upper and lower end of the range of focus positions used to acquire the individual images. Depending on whether multiple tile regions/positions are included and the used focus strategy, this may only define the relative range limit.
— <b>Last</b>	The current stage position is defined as the upper end of the range. Move the stage until the top of the sample is no longer in focus and then click <b>Set Last</b> .
— <b>First</b>	The current stage position is defined as the lower end of the range. Move the stage until the bottom of the sample is no longer in focus and then click <b>Set First</b> .
<b>Step Size</b>	Enables you to define the distance the stage travels between two image acquisitions
<b>Slices</b>	Displays the number of images to be acquired that results from the range ( <b>Focal Plane</b> ) and the <b>Step Size</b> .
<b>Optimal</b>	Sets the optimal <b>Step Size</b> and number of <b>Slices</b> depending on your microscope setup. The step size is calculated according to the Nyquist criteria.
<b>Create Raw Data Image (Z Slices)</b>	Specifies whether the acquired z-stack is preserved.

**EDF Processing Section**

Parameter	Description
<b>Fusion Methods</b>	Following methods for fusing the individual images are available.
<b>Maximum Projection</b>	By using this method, the brightest pixel along the stack will be taken, which may not necessarily be the sharpest.  It generally works good with fluorescence Z-stacks. Do not use on bright-field data or images.

Parameter	Description
	No <b>Alignment</b> available.
<b>Alignment</b>	<p>Alignment is selectable for all fusion methods but <b>Maximum Projection</b>.</p> <p>Adjust whether the individual images of the Z-stack image are aligned before being combined and at which quality.</p>
- <b>No Alignment</b>	The Z-stack image is not aligned before being combined. You should select this setting for any microscope other than a stereo microscope, e.g. a compound microscope.
- <b>Normal</b>	High speed with normal image quality.
- <b>High</b>	Low speed with high image quality.
- <b>Highest</b>	Lowest speed with best image quality.
<b>Contrast</b>	<p>By using this method, the value is the difference between the brightest and the darkest pixel value within the "Kernel". Additional parameter like Contrast, Smoothing and Reconstruction can be adjusted separately.</p> <p>Due to the derivative nature of this algorithm, noise can pose a problem. Therefore, it may not be suitable for noisy data such as fluorescence z-stacks.</p>
- <b>Length Scale</b>	<p>Sets the length scale (pixel units) at which the contrast for every slice is calculated. For images with small and sharp structures, a small contrast length scale provides good results. For images with larger structures with smoother edges, a larger contrast length scale is required.</p> <p>Value Range: <b>1 to 31</b></p> <p>Default Value: <b>7</b></p>
- <b>Smoothing</b>	<p>Specifies the factor to smooth the EDF image and thus reduce noise. Larger values lead to a smoother image.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0 to 51</b></p> <p>Default Value: <b>11</b></p>
- <b>Reconstruction</b>	<p>Defines the amount of image area with little contrast that needs to be reconstructed by an algorithm. If an image contains larger regions with little or no contrast information, the algorithm has to interpolate image information at a larger extent.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0 to 0.8</b></p> <p>Default Value: <b>0.15</b></p>
<b>Variance</b>	By using this method, the variance of the pixel values is calculated within the "Kernel". Additional parameter like Contrast, Smoothing and Reconstruction can be adjusted separately.

Parameter	Description
	Local variance acts on structures that fall within the support of a small neighborhood in that the maximum of the second order statistical moment determines in-focus content. Due to the derivative nature of this algorithm, noise can pose a problem. Therefore it may not be suitable for noisy data such as fluorescence stacks.
- <b>Length Scale</b>	<p>Sets the length scale (pixel units) at which the contrast for every slice is calculated. For images with small and sharp structures, a small contrast length scale provides good results. For images with larger structures with smoother edges, a larger contrast length scale is required.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>1</b> to <b>31</b></p> <p>Default Value: <b>7</b></p>
- <b>Smoothing</b>	<p>Specifies the factor to smooth the EDF image and thus reduce noise. Larger values lead to a smoother image.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>51</b></p> <p>Default Value: <b>11</b></p>
- <b>Reconstruction</b>	<p>Defines the amount of image area with little contrast that needs to be reconstructed by an algorithm. If an image contains larger regions with little or no contrast information, the algorithm has to interpolate image information at a larger extent.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>0.8</b></p> <p>Default Value: <b>0.15</b></p>
<b>Wavelets</b>	This method is used to detect the sharpest areas in the individual images. We recommend to always try this function first as it delivers the best results in most cases.
<b>With Heightmap</b>	<b>Activated:</b> Creates a heightmap. Only available for fusion methods <b>Wavelets</b> and <b>Fast EDF</b> .
<b>Texture Method</b>	Available for Fusion Method <b>Wavelets</b> and activated <b>With Heightmap</b> only:
- <b>Wavelets</b>	Three sub-band oriented Mallat type decimated Daubechies wavelets are used. Due to the decimation and proprietary sub-band selection heuristics, this is the fastest algorithm available in ZEN. Due to the associated scaling variance, the resulting height values are laterally not as accurate as with a stationary arrangement.
- <b>Stationery Wavelets</b>	Three sub-band oriented Mallat type un-decimated Daubechies wavelets are used. All sub-bands are kept within their original scale for similar proprietary selection rules. This wavelet decomposition scheme is also known to be fully shift invariant. This enables for a result that has a spatially finer detailed height map. However, this algorithm also has a computationally higher cost and is therefore slower in execution speed.

Parameter	Description
- <b>Complex Wavelets</b>	Six sub-band oriented complex valued Dual Tree Daubechies wavelets are used. This decomposition scheme, while decimated provides nearly shift invariant behavior, just like the stationary option. Additionally, the sub-bands appear in 6 distinct angles which allows more rotational freedom of structures which results in more accurate height maps, especially for angles between 45 and 90 degrees. This method is computationally more intensive than the decimated but less so than stationary wavelets.
<b>High Resolution</b>	Available for Fusion Method <b>Wavelets</b> and activated <b>With Heightmap</b> only:  If activated, the heightmap is continuously sub-pixel accurate concerning the height values. Every height value is always calibrated in $\mu\text{m}$ (microns). If deactivated, you will only get discrete height steps.
<b>Fast EDF</b>	Applies topography image settings. You set the settings in the <b>ADVANCED</b> section.
<b>Presets</b>	
- <b>Default</b>	Sets the default values.
- <b>Custom</b>	Sets the values you have specified manually.
- <b>Small Structures</b>	Sets optimized parameters for samples with small sized structures.
- <b>Medium Structures</b>	Sets optimized parameters for samples with medium sized structures.
- <b>Large Structures</b>	Sets optimized parameters for samples with large sized structures.
<b>Decay Flicker Correction</b>	Only visible if <b>Contrast</b> or <b>Variance</b> is selected as <b>Method</b> .  <b>Activated:</b> Equalizes the brightness and intensity of pixels over the entire z-stack. During the acquisition of fluorescence images, bleaching can lead to a difference in pixel brightness, also called decay. When acquiring an image with a lamp, flickering can lead to fluctuations in pixel intensity. This option tries to correct both effects through the equalization over the entire stack.

### ADVANCED Section

This section is only available, if **Fusion Method** > **Fast EDF** is selected.

Parameter	Description
<b>Smoothing</b>	Specifies the factor to smooth the topography image and thus reduce noise. Larger values lead to a smoother image.  Use the slider to adjust the desired value.  Value Range: <b>1 to 15</b>  Default values (depending on the selected preset): <ul style="list-style-type: none"> <li>▪ Preset = Default: 9</li> <li>▪ Preset = Small Structures: 7</li> </ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>▪ Preset = Medium Structures: 11</li> <li>▪ Preset = Large Structures: 15</li> </ul>
<b>Pixelwise Iteration</b>	<p>Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>16</b></p> <p>Default values (depending on the selected preset):</p> <ul style="list-style-type: none"> <li>▪ Preset = Default: 2</li> <li>▪ Preset = Small Structures: 2</li> <li>▪ Preset = Medium Structures: 3</li> <li>▪ Preset = Large Structures: 3</li> </ul>
<b>Depthwise Kernel Size</b>	<p>Larger values lead to a more robust heightmap, especially for areas with low contrast. Should only be used by small depth of focus step sizes.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>20</b></p> <p>Default values (depending on the selected preset):</p> <ul style="list-style-type: none"> <li>▪ Preset = Default: 1</li> <li>▪ Preset = Small Structures: 0</li> <li>▪ Preset = Medium Structures: 2</li> <li>▪ Preset = Large Structures: 2</li> </ul>
<b>Resize Ratio</b>	<p>Sets the scaling factor.</p> <p>Default Value: <b>0.25</b></p> <ul style="list-style-type: none"> <li>▪ <b>0.25</b></li> <li>▪ <b>0.5</b></li> <li>▪ <b>1.0</b></li> </ul>
<b>Bilateral Sigma Color</b>	<p>Only activated if <b>With Heightmap</b> is activated.</p> <p>Special kind of filter, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.</p>
<b>Bilateral Sigma Space</b>	<p>Only activated if <b>With Heightmap</b> is activated.</p> <p>Special kind of filter, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.</p>



### SPIKE TREATMENT Section

Parameter	Description
<b>QM Threshold</b>	<p>Quality map (QM) measures the reliability of height measurements. The QM threshold defines a level for which all areas with low reliability will be interpolated.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>20</b></p>



Parameter	Description
	Default Value: <b>2</b>
<b>Spike Width</b>	<p>Defines the lateral xy-size of spikes. These are wrongly defined height values which must be detected and eliminated.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>3</b> to <b>101</b></p> <p>Default Value: <b>9</b></p>
<b>Removal Strength</b>	<p>Defines the sensitivity for eliminating spikes.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>20</b></p> <p>Default Value: <b>1</b></p>
<b>Iterations</b>	Sets the countdown timer interval (in seconds), after which an image is acquired.
<b>Reconstruction</b>	
– <b>PDE</b>	Partial Differential Equation
– <b>Linear</b>	Interpolates linearly.
– <b>Non inpainting</b>	Holes in heightmaps will not be repaired.

**See also**

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

**11.2.2.6 Extended Camera Tool**

This tool enables you to apply advanced settings to the camera. Besides the usual options for exposure time, you can set different image properties or select a region of interest of the total camera sensor area. In addition, the tool contains several post processing options and camera-specific settings.

**Exposure Time & Binning**

If you use automatic exposure, you can select an area on the camera sensor which is used to calculate the exposure time.

Parameter	Description
<b>Time</b>	<p>Specifies the duration of the image acquisition.</p> <p>Select the unit of time (min, ms, s, <math>\mu</math>s) from the drop-down list on the right and enter the desired value.</p>
<b>Auto Exposure</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The exposure time is calculated automatically every time an image is acquired. For color cameras of the Axiocam NG series in b/w mode, the exposure time is determined in the b/w mode. This might lead to overexposure of individual pixels. The his-</li> </ul>

Parameter	Description
	<p>togram displays the b/w mode and therefore does not reflect overexposure of individual pixels, which can be detected in the RGB mode with the same exposure time.</p> <ul style="list-style-type: none"> <li>▪ <b>Deactivated:</b> You can set the exposure time manually.</li> </ul>
<b>Auto Exposure Intensity</b>	<p>Enables you to compensate for underexposure or overexposure if you are not content with the auto exposure result:</p> <ul style="list-style-type: none"> <li>▪ 5% - 100%: Darkens the image (compensates for overexposure)</li> <li>▪ 100% - 200%: Brightens the image (compensates for underexposure)</li> </ul>
<b>Set Exposure</b>	<p>Starts a one-off measurement of the exposure time which is then used for all subsequent images. Deactivates <b>Auto Exposure</b>.</p> <p>If you are not satisfied with the result, you can adjust the measured exposure time manually.</p>
<b>Spot Meter / Focus ROI</b>	<p><b>Activated:</b> The exposure time and focus measurements use the intensity values within a specified area instead of the entire camera sensor area. This improves the results for the area to be acquired.</p> <p>If the red <b>Spot Meter / Focus ROI</b> frame is not visible in the live image, right-click in the live image and select <b>Spot Meter / Focus ROI</b> from the context menu.</p>
Parameter	Description
<b>Binning</b>	<p>Here you can set the binning.</p> <p>Binning combines the information of neighboring camera pixels into a single larger pixel.</p> <p>For example, if the binning is set to 2 x 2, four pixels are combined to one.</p> <p>Increasing the binning means weaker signals can be detected for a given exposure time.</p> <p>For CCD cameras, binning increases sensitivity by improving the signal-to-noise ratio, with resolution being decreased by the same factor.</p> <p>Regarding CMOS cameras, only the signal intensity is increased and the pixel count and resolution gets reduced correspondingly.</p>
<b>Binning-independent Brightness</b>	<p>Because <b>Binning</b> generally increases signal intensity, the brightness of the image normally also increases correspondingly. By activating this checkbox, the brightness level is automatically fixed (depending on the camera, either through exposure time adjustment or averaging), no matter the binning setting.</p>
<b>IP Quality</b>	<p>Here you can select the color interpolation quality (IP Quality) for the acquired image. Please notice that this function does not apply to Live mode.</p> <p><b>Fast:</b> Color interpolation for optimum speed (shorter computation).</p> <p><b>High:</b> Color interpolation for optimum quality (less artifacts). This mode is only effective with binning factor 1.</p>

Parameter	Description
<b>Subsampling</b>	Here you can reduce the amount of data acquired to achieve faster framerates. By subsampling 2 x 2, the effective pixel pitch is increased by sampling only every other pixel, thus reducing the overall data size of your image.
<b>Resolution</b>	Here you see the camera resolution, e.g. 1024 x 1024 px.

### General

Parameter	Description
<b>Polarization</b>	<p>This section is only visible in case <b>Axiocam 705 pol</b> is available.</p> <p>For <b>Technical Cleanliness Analysis</b> it is recommended to use the POL 90° and POL 135° channels for particle typification into metallic-shiny and non-shiny particles.</p> <p><b>Note:</b> The following setting is a prerequisite: mode/Live speed: <b>high resolution</b></p>
— Live Polarization	<p>Selects a polarization channel for the live image.</p> <ul style="list-style-type: none"> <li>▪ 0°</li> <li>▪ 45°</li> <li>▪ 90°</li> <li>▪ 135°</li> <li>▪ Raw</li> </ul>
— 0°	<p><b>Activated:</b> Selection of N channels results in a multi-channel image with N images. On the <b>Display</b> tab, you can select which channel is displayed on the screen.</p> <p><b>Note:</b> If <b>Single Channel</b> is not activated, the merged image is displayed. The merged image is an additive image of all selected channels and therefore much brighter than the single channel images.</p>
— 45°	
— 90°	
— 135°	

### See also

- 📖 Interactive Height Measurement Workbench [▶ 664]
- 📖 Applying Polarization Channel [▶ 569]
- 📖 Specifying Permitted and Expected Values for a Tool [▶ 59]
- 📖 Configuring Tolerances for a Measurement [▶ 60]

#### 11.2.2.6.1 White Balance Section

This section is only visible if you are using a color camera; it is not accessible if you use the **Axiocam 705 pol**. The section enables you to adjust the color balance to a neutral hue independent of the light source used.

Save suitable white balance settings using the **Settings** section to ensure color reproducibility of images acquired in the future.

Parameter	Description
<b>Auto</b>	<p>Compensates for the color temperature of the light source automatically to yield a neutral hue</p> <p>The entire camera sensor area is measured. If there are no pure white areas on the sample and <b>Auto</b> does not yield the desired results, measure and compensate for the color temperature of the light source as follows:</p> <ul style="list-style-type: none"> <li>Transmitted light: Move the sample such that a clear and transparent region is illuminated or remove the sample from the microscope. Click the <b>Auto</b> button to perform the auto white balance.</li> <li>Reflected light: Use a neutral surface (e.g. a piece of white paper) as a sample. Click the <b>Auto</b> button to perform the auto white balance.</li> </ul> <p>You can now acquire white balanced images of your sample with the above settings.</p>
<b>Pick...</b>	<p>Enables you to select a reference pixel for white balance from the live image</p> <p>The selected pixel should be neutral white.</p>
<b>3200 K</b>	Applies a pre-defined color balance setting to compensate for the color temperature of a halogen light source at approximately 3200 K
<b>5500 K</b>	Applies a pre-defined color balance setting to compensate for the color temperature of an LED light source at approximately 5500 K
<b>Show Channels</b>	Enables you to set the color balance of each color channel (red/cyan, green/magenta and blue/yellow) individually to make the image appear neutral
<b>Color Temperature</b>	<p>Changes the overall color temperature of the image from cool (blue cast) to warm (red cast)</p> <p>The color channels (red/cyan, green/magenta and blue/yellow) are adjusted automatically. The <b>Color Temperature</b> setting can work against the settings applied using <b>Show Channels</b>.</p> <p>Use <b>Color Temperature</b> for fine tuning in combination with <b>Pick...</b> if <b>Pick...</b> does not give perfect results.</p>
<b>Reset</b>	Resets any color changes and sets the white balance value to 6500 K.
<b>Saturation</b>	Changes the color saturation of the image
<b>Reset</b>	Resets the color saturation to the default setting.

#### 11.2.2.6.2 Acquisition ROI Section

This section enables you to define a region of interest (ROI) on the camera sensor which is used for acquisition. A smaller ROI can increase the acquisition speed.

The region of interest is indicated by a blue frame in the preview window and can be moved and resized freely. The preview window always shows the entire camera sensor area which can be acquired.

The **Pixel Size**, shown in the preview window below, indicates the size in  $\mu\text{m}$  to which a pixel corresponds. This depends on the camera sensor properties and on the binning.

Parameter	Description
<b>Maximize</b>	Selects the entire available image sensor area as the region of interest
<b>Center</b>	Positions the region of interest precisely at the center of the image
<b>Size</b>	Sets the width and height of the region of interest in pixels
<b>Offset</b>	Specifies the position of the top left corner of the <b>Acquisition ROI</b> (blue frame) with respect to the top left corner of the preview window.
<b>Refresh Overview</b>	An image is acquired and displayed in the preview window with the current ROI settings. This has no effect on the image in the <b>Center Screen Area</b> .

#### 11.2.2.6.3 Gain Section

Using the gain adjustment amplifies the signal intensity and brightness of the camera image while reducing the available dynamic range at the same time.

#### 11.2.2.6.4 Post Processing Section

This section allows you to apply basic image processing functions (e.g. for image enhancement) while acquiring the image. This can be helpful if certain image processing steps are necessary for any acquired image and saves image processing work later in a job. It also enables you to compensate for constant offsets impeding the image quality.

Depending on the camera model, different settings are available. The following image processing functions are the most common:

- Black Reference
- Shading Correction
- Noise filter
- Unsharp mask

#### Info

For a comprehensive set of image processing tools, which can be applied after image acquisition, see *Image Processing workbench* [▶ 739].

Parameter	Description
<b>Black Reference</b>	<p>A camera-specific correction that compensates for camera sensor faults such as individual bright pixels that can occur at long exposure times. This correction is recommended for applications that involve low-light conditions and thus long exposure times, e.g. live cell imaging or fluorescence imaging.</p> <p>Some cameras, e.g. AxioCam 7xx series, require a black reference for exposure times longer than 10 seconds. Define and turn on a black reference for long exposure times. The settings also affect the settings in the <b>2D Multi-Channel Acquisition</b> workbench, see <i>2D Multi-Channel Acquisition Workbench</i> [▶ 734].</p>

Parameter	Description
	<p><b>Activated:</b> The acquired image correction data is applied to each acquired image in the <b>2D Acquisition</b> and in the <b>2D Multi-Channel Acquisition</b> workbench.</p>
– Define	<p>Acquires the reference image that is applied to subsequent images if <b>Black Reference</b> is activated. The reference image should be updated at certain intervals since the camera sensor properties could change over time.</p> <p>In order to measure the reference image make sure that no light can hit the camera sensor. Ideally, remove the camera from the microscope and seal it with its cap before performing the measurement.</p>
<b>Shading Correction</b>	<p>Compensates for uneven exposure of an image. The uneven exposure (shading) might be caused by non-uniform illumination (e.g. vignetting) or dirt and dust on glass (lens) surfaces.</p> <p><b>Activated:</b> The last acquired reference image is applied to each acquired image, depending on the <b>Global/Specific</b> setting.</p>
– Global	<p>Shading correction is applied only to images that are acquired with the same objective as the reference image. The following components are taken into account:</p> <ul style="list-style-type: none"> <li>▪ Objective and Optovar</li> <li>▪ Camera bit depth and RGB/BW mode</li> <li>▪ Camera model and port position</li> </ul> <p>This corresponds to objective-specific shading correction and is the standard setting. Fluorescence-specific components are not taken into account.</p> <p>To have a full set of reference images, you have to acquire a separate reference image for each objective available in the microscope. If you are using a motorized or coded objective revolver and no reference image is available for the current objective, <b>Shading Correction</b> is deactivated automatically.</p>
– Specific	<p>Shading correction is applied only to images that are acquired under the same fluorescence settings as the reference image. The following components are taken into account:</p> <ul style="list-style-type: none"> <li>▪ Contrasting method and condenser</li> <li>▪ Fluorescence reflector and beam splitter</li> <li>▪ Spinning disc fluorescence filter</li> </ul>
– Define	<p>Acquires a reference image that is applied to subsequent images if <b>Shading Correction</b> is activated.</p> <p>The reference image should contain information about the illumination only and no specific information, e.g. the structure of a sample. To achieve this, set the illumination intensity to medium, de-focus, and acquire an image of the empty light path (transmission), or de-focus and acquire an image of a uniform surface such as a piece of paper (reflection).</p> <p>To work properly, the reference image must not contain any overexposed areas.</p>

Parameter	Description
<b>Enable Noise Filter</b>	<b>Activated:</b> Noise in the acquired image is filtered according to the adjusted threshold. Affects acquired images only; the live image does not change.
– Threshold	<p>The noise filter reduces the extent to which individual pixels deviate from the average value of their nearest neighbors. The <b>Threshold</b> corresponds to a tolerance value. If the deviation of the middle pixel value from the average value of the pixels immediately surrounding it exceeds the tolerance value (i.e. it is interpreted as noise), it is replaced by the average value.</p> <p>The higher the value, the greater the tolerance for noise. The lower the value, the stronger the noise reduction.</p> <p>This technique reduces the noise of individual pixels, in particular with EMCCD cameras and CMOS cameras. The applied method reduces the noise of individual pixels without destroying fine structure in the image, as in most cases these are larger than individual pixels.</p> <p>This filter is also suitable for the dynamic removing of individual "hot pixels" from an image without having to acquire a reference image in advance.</p>
<b>Enable Unsharp Mask</b>	Enhances contrasts at fine structures and edges. Thus, the resulting image appears clearer and sharper.
– Strength	Controls the amount of contrast enhancement applied to fine structures and edges. The higher the strength, the darker or lighter the resulting edges, compared to the original image.
– Radius	<p>Determines the size of detail to be enhanced. A small radius enhances smaller details.</p> <p>The radius also affects the appearance of enhanced edges. A large radius leads to a visible halo along enhanced edges. The larger the radius, the broader the halo.</p>
– Color Mode	<p>Determines the calculation method, which affects the appearance of the output image.</p> <ul style="list-style-type: none"> <li>▪ <b>RGB:</b> <ul style="list-style-type: none"> <li>– The <b>Unsharp Mask</b> filter calculates the sharpness for each color channel individually.</li> <li>– The color saturation and the color of structures may be changed and color noise may occur.</li> </ul> </li> <li>▪ <b>Luminance:</b> <ul style="list-style-type: none"> <li>– The <b>Unsharp Mask</b> filter calculates the sharpness based on the luminance signal computed from the RGB channels.</li> <li>– This mode avoids possible color noise or shift in color saturation, which could be induced by certain image textures.</li> </ul> </li> </ul>
– Auto Contrast	<p><b>Activated:</b> You can adjust the <b>Contrast Tolerance</b> (0-20).</p> <p><b>Auto Contrast</b> only works in RGB color mode.</p>
– Contrast Tolerance	Increasing the contrast during unsharp masking is achieved by broadening the distribution of intensities. This corresponds to a spread of the image histogram.

Parameter	Description
	<p><b>Contrast Tolerance</b> controls how much the intensity distribution is spread and thus how strong the contrast is increased.</p> <ul style="list-style-type: none"> <li>▪ <b>Contrast Tolerance</b> = 0: No spread of intensities, no increase of contrast</li> <li>▪ <b>Contrast Tolerance</b> = 20: Maximum spread of intensities, maximum increase of contrast</li> </ul>
— Clip To Valid Bits	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The processed image is composed of the same colors as the original image (i.e. the value range of the output image is adjusted to the color range of the input image).</li> <li>▪ <b>Deactivated:</b> Colors not present in the original image may appear in the processed image.</li> </ul>

### See also

 2D Acquisition Workbench [► 733]




#### 11.2.2.6.5 Settings Section

The **Settings** section manages user-defined camera settings.



#### Info

Modified presets are indicated by a \* next to the name.

You can perform the following actions with presets:

Action	Description	Procedure
Apply preset	The current parameter values are overwritten with those stored in the preset	<ul style="list-style-type: none"> <li>▪ Select the desired preset from the list</li> </ul>
Restore preset values	The current parameter values are reset to those stored in the preset	<ul style="list-style-type: none"> <li>▪ Click <b>Reload</b>.</li> </ul>
Restore initial value	The current parameter values are overwritten with the ZEISS default values	<ul style="list-style-type: none"> <li>▪ Click <b>Default</b>.</li> </ul>
Save changes to the current preset	The parameter values in the preset are overwritten with those of the current tool	<ul style="list-style-type: none"> <li>▪  &gt; <b>Save</b></li> </ul>
Save changes as a new preset	A new preset is created with the current parameter values	<ol style="list-style-type: none"> <li>1.  &gt; <b>Save As</b></li> <li>2. Enter the new name for the preset</li> </ol>
Export a preset	The parameter values stored in the preset are saved in a file	<ol style="list-style-type: none"> <li>1.  &gt; <b>Export</b></li> <li>2. Specify the location in the file system.</li> </ol>



Action	Description	Procedure
Import a preset	A preset from the file system is added to the list of presets and the current parameter values are overwritten with those stored in the preset.	<ol style="list-style-type: none"> <li> &gt; <b>Import</b></li> <li>Select the desired preset file from the file system.</li> </ol>
Delete a preset	<p>The currently selected preset is deleted.</p> <p>The next preset in the list is selected and the values from the preset applied. If the list is empty, the default values for the tool are applied.</p>	<ul style="list-style-type: none"> <li> &gt; <b>Delete</b></li> </ul>

#### 11.2.2.6.6 Mode Section

The **Mode Section** determines how the software retrieves the camera sensor data.

Parameter	Description
<b>Color Mode</b>	This parameter is available for color cameras only.
— RGB	The image data of a color camera is transmitted unchanged. This corresponds to the standard operating mode of a color camera.
— B/W	<p>The color information of a color camera are discarded and converted into a grayscale image. The data of related color channels are averaged. The saturation of the camera appears reduced as a result.</p> <p>This process does not change the spectral properties of a color camera. The information of the colored pixel on the camera sensor are color interpolated for technical reasons prior to being changed in a monochrome image. The image information of the color sensor still undergoes color interpolation. An infrared filter also restricts the spectral sensitivity of the color camera compared to the spectral curve of the sensitivity of a black/white camera.</p>
<b>Live Speed</b>	<p>Specifies the live image update speed.</p> <p>Enables you to focus or to find regions of interest on a sample quickly. A high live image update speed reduces the exposure time of the live image, even at longer exposure times used for image acquisition.</p> <p>To achieve a similar impression of image brightness, however, the image data supplied must be adjusted digitally, which may generate a certain amount of noise or reduce the resolution of the live image.</p>
<b>Bit Depth</b>	<p>The Bit Depth function enables the reduction of the delivered camera bit depth. It is translating the 14 bit based camera data values into a smaller value of 12 bit or 8 bit. This has an visible effect of the number range in the image histogram, the dynamic range and the corresponding image file size in an uncompressed CZI image.</p> <p>As default, the Axiocam models deliver 14 bit per pixel (Axiocam 503/506/512/702) and 12 bit/pixel in case of the Axiocam 305. 14 bit and 12 bit per pixel values need to be stored in two bytes in an CZI image file. In case of an translation to 8 bit per pixel, only one byte is</p>

Parameter	Description
	<p>needed. Therefore it is possible to reduce the produced image file size by a factor of two. This is especially beneficial, if large amount of image data is acquired.</p> <p>By reducing the native camera bit depth to smaller values, the available number range for the digital image signal is decreased. Therefore, the available amount of resolvable intensities in one image scene is decreased accordingly.</p>
<p>– LUT min/LUT max (only available for 8 bit mode)</p>	<p>LUT stands for Look Up Table. It describes the translation method for quickly translating digital numbers in a different range. If the full swing of the input signal is not used, the reduction of bit depth can be adopted accordingly by the translation starting point "Lut min" and the translation end point "Lut max".</p> <p>If the used intensity range equals just an 8 bit value range, no information is lost and the unused bits can be excluded from being stored by an suitably adjusted translation table.</p> <p>Available range is 0 to 1. The value 0 equals 0% of the input range. The number 1 equals 100% of the input range.</p>
<p>– Gamma (only available for 8 bit mode)</p>	<p>The 14 bit to 8 bit translation is linear by default, which equals a Gamma value of 1. By assigning values larger or smaller than 1, the translation becomes non-linear.</p> <p>Values &lt;1 selectively reduce dim signal intensities.</p> <p>Values &gt;1 selectively amplify dim signal intensities.</p>

#### 11.2.2.6.7 Model Specific Section

This section of the **Extended Camera** tool contains additional, model-specific camera settings depending on which camera model you use on your system.

Parameter	Description
<b>Reset</b>	Resets all parameters to factory setting.
<b>Camera Identifier</b>	Displays a unique camera identifier for the active camera. The camera identifier consists of the product name and part of the serial number. It helps you to identify the image source if you use different cameras in one system.
<b>Orientation</b>	<p>Modifies the orientation of the camera image. Depending on the camera port properties, the acquired image may be displayed in an undesired orientation. Use this parameter to correct the orientation during the acquisition process.</p> <p>The orientation is performed by the camera driver. This enables you to correct the live image without using image processing operations from the software.</p> <p>The available orientation options vary with the camera model.</p>
– Original	No change
– Flip Horizontally	Mirrors the camera image about a vertical axis.
– Flip Vertically	Mirrors the camera image about a horizontal axis.

Parameter	Description
– Rotate 90 CW	Rotates the image 90 degrees clockwise.
– Rotate 90 CCW	Rotates the image 90 degrees counter-clockwise.
– Rotate 180	Rotates the image 180 degrees.
– Mirror at +45 Diagonal	Mirrors the camera image about the axis running from the lower left corner to the upper right corner.
– Mirror at -45 Diagonal	Mirrors the camera image about the axis running from the upper left corner to the lower right corner.

### 11.2.2.7 Focus Correction Tool

With this tool you select a focus correction method (or a focus strategy) and set the corresponding parameters.

#### Info

For height measurement in relative small tile regions you should always use the same z value for the whole tile region. Therefore, a focus strategy that will result in different z values, for example, **Software Autofocus** or **Use Focus Surface/Z Values** with supporting points, is not recommended. For larger tile regions, however, these strategies can be helpful, for example, to compensate a tilt.

The tool is available for all **Position List** workbenches and all **Tiles** workbenches. The following strategies are available.

Parameter	Description
<b>Focus strategies</b> drop-down list	
– <b>None</b>	This strategy is selected by default. Using this, the current z value is used during acquisition of one or more tile regions or positions.
– <b>Software Autofocus</b>	The focus position is determined via the sharpness calculation or intensity calculation of a series of images. For tile experiments, the focus surface and z values of tile regions/positions are ignored.
– <b>Use Focus Surface/Z Values</b>	Note that when using the <b>Positions List</b> workbench, this strategy is called <b>Use Values from Position List</b> . It is selected by default.  The focus surface/z values defined in the tiles setup are used.
<b>Determine Z-Values with Software AF Before Acquisition</b> checkbox.	<b>Activated:</b> Determines the initial z-values by a <b>Software Autofocus</b> run on each support point, position, and tile region, before acquiring the tile regions/positions.  The verifying process is as described for <b>Verify Support Points or Tile Regions</b> below.  You can use this function as an operator restriction for a job template. Either this checkbox should not be visible or the button <b>Verify Support Points or Tile Regions</b> should not be visible.
<b>Adapt with Software AF</b> checkbox	Specifies whether the focus (z values) are adapted by an additional action.

Parameter	Description
<b>Repeat Every &lt;value&gt; Time Point</b>	<p>Only visible with <b>Software Autofocus</b>.</p> <p><b>Activated:</b> Adjusts, that the calculation of the software autofocus is performed. Example: Enter the value <b>2</b>. The software autofocus will be calculated after every second time point.</p>
<b>Repeat Every &lt;value&gt; Tile</b>	<p>Only visible with <b>Software Autofocus</b>.</p> <p><b>Activated:</b> Adjusts, that the calculation of the software autofocus is performed. Example: Enter the value <b>2</b>. The software autofocus will be calculated after every second tile image which is acquired.</p>
<b>Current Z</b>	Displays the focus position of the support point.
– <b>Software AF</b>	<p>Only visible with <b>Use Focus Surface/Z Values</b>.</p> <p>Note that you must have set up the tile regions (e.g. 3 x 3 tiles) before you can add support points. You can edit these position points by clicking on the corresponding point and moving it via Drag&amp;Drop.</p> <p>Note that before you start an acquisition, each support point must be verified. This means you must check and confirm each support point if it is in focus.</p>
– <b>Hardware AF</b>	<p>Only visible, if a <b>Hardware Autofocus (HWAF)</b> device is available and configured in the MTB software. For a detailed description of the HWAF read the corresponding manual of the device.</p> <p>Activate the <b>Supported by Software Autofocus</b> checkbox to specify whether an additional software autofocus is performed in case the hardware autofocus was not successful.</p>
<b>Support Point Distribution</b>	Only visible with <b>Use Focus Surface/Z Values</b> .
– <b>Generic (5 points)</b>	Adds five support points to the tile region.
– <b>Onion Skin Model</b>	<p>This distribution method is used for larger tile regions.</p> <ul style="list-style-type: none"> <li>▪ <b>Density:</b> Defines the density in %.</li> <li>▪ <b>Margin:</b> Adjusts the distribution inward from tile region border. A value of 2, for example, approximates to a margin of two tiles.</li> <li>▪ <b>Max.:</b> Defines the maximum number of distribution points.</li> </ul>
<b>Distribute</b>	Distributes support points in all tile regions according to the selected method. All existing support points are deleted before. You are prompted to confirm that the existing support points will be deleted before the new ones will be created.
<b>Add Point</b>	Adds a single support point at the current stage position.
<b>List of support points</b>	<p>Displays the positions (X/Y) and focus position (Z) of each support point that was added.</p> <p>Click on an entry to select the corresponding support point in the image.</p> <p>Note that even though you have set different z values on your tiles, the current z value of the microscope will be set.</p>

Parameter	Description
<b>Verify Support Points or Tile Regions</b>	<p>You can use this function as an operator restriction for a job template. Either this button is not visible or the checkbox <b>Determine Z-Values with Software AF Before Acquisition</b> is not.</p> <p>Starts the verifying process for the support points. This process is necessary before you start the tiles acquisition.</p> <ol style="list-style-type: none"><li>1. The software starts always with the first support point. Check, if it is in focus and at the desired position.</li><li>2. Click <b>Next</b> to verify the point and to move to the next support point. Note that the verification of the focus points should be done before every new acquisition, as the focus drive might move during acquisition.</li></ol> <p>If all support points are verified, the message <b>Verified successfully</b> appears in the tool.</p> <p>You can start the tiles acquisition.</p>

See also

- Flexible Acquisition Workbench [► 735]
- Position List with EDF Workbench [► 738]
- Tiles (measurement area) Workbench [► 523]

11.2.2.8 Focus Tool

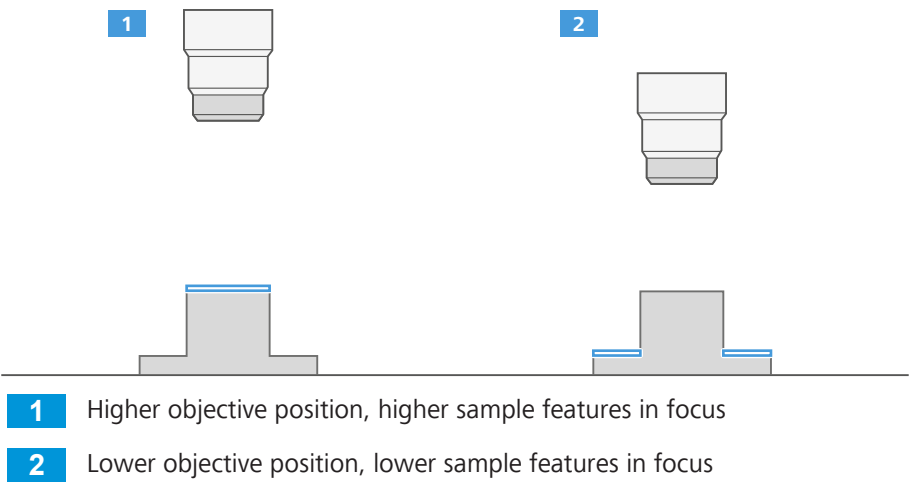
CAUTION



Risk of Crushing Fingers

The drive of a microscope stage with a motorized vertical axis (focus drive) is strong enough to crush fingers or objects between the stage and the microscope stand.

- Remove your fingers or any objects from the danger area before moving the focus drive.
- Release the joystick immediately to stop the movement.





This tool changes the vertical distance (i.e. Z direction) between stage and objective. This enables you to focus the sample, or, for a sample with an uneven surface, to focus the area of interest.



Parameter	Description
<b>Current</b>	<p>Displays the stage position in <math>\mu\text{m}</math></p> <p>Initially, when you use the <b>Focus</b> tool for the first time after switching on the microscope, the exact position of the stage is not known. Therefore, the position indicated by <b>Current</b> is initially set to zero. If you enter a value, the stage moves by the entered amount relative to the current position. If you want to move the focus to an absolute position, you must first click <b>Home</b> to move the focus to one of the end positions. The value of <b>Current</b> is set to this known position. You can then enter an absolute position.</p> <p>The <b>Current</b> input field defines the target position of the stage in <math>\mu\text{m}</math>. The stage starts moving immediately after the coordinates have been entered and confirmed by pressing the Enter key or by clicking anywhere outside the <b>Current</b> input field.</p>
<b>Navigation Bar</b>	<p>Enables you to move the stage freely in Z direction</p> <p>To move the stage, drag the <b>Navigation Bar</b> button in the desired direction. If released, the <b>Navigation Bar</b> button snaps back to the center and the stage stops.</p> <p>The <b>Navigation Bar</b> allows four speeds.</p> <div>  <p>Normal modes:</p> <ul style="list-style-type: none"> <li>Inner segments: Slow</li> <li>Outer segments: Medium</li> </ul> </div> <div>  <p>High-speed modes:</p> <ul style="list-style-type: none"> <li>Inner segments: Fast</li> <li>Outer segments: Very Fast</li> </ul> </div> <p>To enter the high-speed mode, right-click the <b>Navigation Bar</b> button. The <b>Navigation Bar</b> turns red. To return to normal speed, right-click the <b>Navigation Bar</b> again.</p>
<b>Stop</b>	Stops any stage movement immediately.
<b>Backlash Correction</b>	<b>Activated:</b> Enhances the positional accuracy by performing an extra movement. When activated the focusing takes slightly longer
<b>Handwheel on</b>	<ul style="list-style-type: none"> <li><b>Activated:</b> Turning the handwheel also adjusts the focus</li> <li><b>Deactivated:</b> The handwheel is deactivated: turning it does not affect the focus</li> </ul>
<b>Step Size</b>	<p>Defines the difference in <math>\mu\text{m}</math> by which the stage moves at each step. Indirectly this defines the speed of the stage movement.</p> <p>The <b>Step Size</b> also determines the accuracy of the focus position.</p>
<b>Home</b>	Moves the focus to one of the end positions. The value of <b>Current</b> is set to this known position.

Parameter	Description
	This ensures that the position shown as <b>Current</b> corresponds to the actual stage position.
<b>Work</b>	<p>Moves the stage back to the position it was in before using the <b>Load</b> button (i.e. the work position)</p> <p>If you have moved the stage (e.g. using the <b>Navigation Bar</b>) after moving it into the load position, the work position is lost and the <b>Work</b> button will not work.</p>
<b>Load</b>	<p>Increases the distance between objective and stage by 8,000 µm</p> <p>This aids you in exchanging the sample. After exchanging the sample, you can move the stage back into its work position by using the <b>Work</b> button.</p> <p>Make sure not to move the stage (e.g. using the <b>Navigation Bar</b>) after moving it into the load position. Otherwise, the previous position is lost and the <b>Work</b> button will not work.</p>
<b>Z-Position</b>	Specifies which position of the motorized z drive is used as the origin (zero value)
– Set Zero	Sets the current focus position as the origin (zero value)
– Calibrate	Performs an automatic calibration

### See also

-  Flexible Acquisition Workbench [► 735]
-  Interactive Height Measurement Workbench [► 664]
-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

#### 11.2.2.9 Hardware Autofocus Tool

This tool enables you to control the autofocus device, which constantly keeps the sample in focus. The autofocus device finds and regulates the focus position automatically, for example when you move the sample.

Parameter	Description
<b>On</b>	<p>Continuous or periodic activation of the autofocus device.</p> <p>The execution period is specified by <b>Period</b>.</p>
<b>Standby</b>	Deactivates the autofocus device and switches it to standby.
<b>Once</b>	Performs a one-off autofocus.
<b>Stop</b>	<p>Switches the autofocus device off.</p> <p>The focus is not monitored. You can use the <b>Software Autofocus</b> tool to find the focus position for a desired area on the sample.</p>
<b>Period</b>	Specifies the interval between two subsequent autofocus device measurements.
<b>Focus Position</b>	Indicates the focus distance determined by the autofocus device.

Parameter	Description
<b>Handwheel on</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The focus position can be overridden manually.</li> <li>▪ <b>Deactivated:</b> The handwheel on the microscope is deactivated. The focus position is only controlled by the autofocus device of the software.</li> </ul>
<b>Offset</b>	Displays the difference between the measured <b>Focus Position</b> and the current Z position of the microscope's stage/objective.
<b>Z-Pos -&gt; AF-Pos</b>	<p>Defines the current Z position as the new distance to be monitored and regulated by the autofocus device.</p> <p>This setting is useful if the sample is sandwiched between object slide and cover glass: You can use one of the surfaces as a reference point for the autofocus device. This way, the distance between objective and the reference point plus a defined offset can be maintained.</p>
<b>Reset</b>	Cancels the <b>Z-Pos -&gt; AF-Pos</b> setting and resets the autofocus device to default settings.
<b>Resolution and Speed</b>	Specifies how accurate the <b>Focus Position</b> is measured and how fast this can be done:
— Exact	Accuracy high, speed low
— Balance	Accuracy medium, speed medium
— Fast	Accuracy low, speed high
<b>Sample Texture</b>	Improves the autofocus measurement by taking the structure of the sample into account.
— Reflective	Use <b>Reflective</b> if the sample is composed of a smooth material which mostly reflects light, such as semiconductor materials or metals.
— Semi refl.	<p>Use <b>Semi refl.</b> if your sample cannot be classified as either reflective or non-reflective.</p> <p>If you are not sure about the sample's reflectivity, you can use this setting as a starting point.</p>
— Diffuse	Use <b>Diffuse</b> if your sample is composed of a rough material which mostly scatters light, such as paper.

### See also

- 📖 Interactive Height Measurement Workbench [▶ 664]
- 📖 Focusing the Sample Automatically [▶ 105]
- 📖 Specifying Permitted and Expected Values for a Tool [▶ 59]
- 📖 Configuring Tolerances for a Measurement [▶ 60]

#### 11.2.2.10 Lamp Tool




This tool enables you to control the illumination of your sample.

Parameter	Description
<b>Lamp list</b>	Selects the lamp if more than one lamp is available.



Parameter	Description
<b>Intensity</b>	Sets the intensity of the sample illumination in %. <ul style="list-style-type: none"> <li>0: Illumination off</li> <li>100: Maximum illumination</li> </ul>

### See also

-  Interactive Height Measurement Workbench [▶ 664]
-  Specifying Permitted and Expected Values for a Tool [▶ 59]
-  Configuring Tolerances for a Measurement [▶ 60]

#### 11.2.2.11 Light Path Editing Tool

This tool is only available if you work with motorized components, e.g. motorized reflector changer or objective revolver.

When you are logged in as a Supervisor, you can adjust different hardware settings. When you are logged in as an Operator, you can execute the adjusted hardware settings. If you select a hardware setting, it will be executed. You can adjust and execute up to four different hardware settings.

Parameter	Description
<b>Drop-down list Setting 1-4</b>	Here you select the hardware settings. If a hardware settings is assigned, the setting will be executed immediately.
<b>Options</b>	Here you can specify the hardware for the selected setting.
- Add	Adds a new and empty hardware setting to the collection.
- Rename	Renames the current hardware setting.
- Copy and Edit	Creates a copy of the current hardware setting.
- Remove	Removes the current hardware setting.
- Import	Imports a hardware setting from a selected location.
- Export	Exports and saves a hardware setting to a user defined location in .czhws file format.
<b>Apply</b>	Applies the current setting to hardware.
<b>Edit Setting</b> (Light-path representation)	Here you see the graphical representation of the light path of your microscope system (if supported and/or available). Each icon represents a component of the light path (e.g. filter wheel or reflector changer).  Here you can directly change important lightpath (e.g. changing the objective) and camera settings (e.g. adjusting the exposure time). If you want to work with different lightpath settings, we recommend to save it to single setting files.

### See also

-  Interactive Height Measurement Workbench [▶ 664]

11.2.2.12 Light Path Tool

This tool indicates the hardware components currently incorporated into the microscope setup. The tool serves the following purposes:

- Indicates the current microscope setup at a glance
- Enables you to change hardware components if the corresponding component is motorized

This may affect the behavior of the workbenches and tools.

An icon representing a microscope component may have additional icons:

Symbol	Description
<b>Hand</b> icon in the lower left corner	Indicates that the components are controlled manually. If you change the setting you must physically change the hardware component accordingly.  For example, if you change the software setting for the nosepiece, the software asks you to adjust the nosepiece at the microscope.
<b>Arrow</b> icon in the lower right corner	Indicates that the component represented by the component icon can be changed. The change can be automatic or manual (requires user action).  To change the component, click on the icon representing the component and select the desired option from the list.

See also

- 📖 Flexible Acquisition Workbench [▶ 735]
- 📖 Interactive Height Measurement Workbench [▶ 664]
- 📖 Specifying Permitted and Expected Values for a Tool [▶ 59]
- 📖 Configuring Tolerances for a Measurement [▶ 60]

11.2.2.13 Linkam Heating Stage Acquisition Setup

This tool enables you to set up a temperature-dependent experiment with a Linkam stage and to acquire images at set intervals.

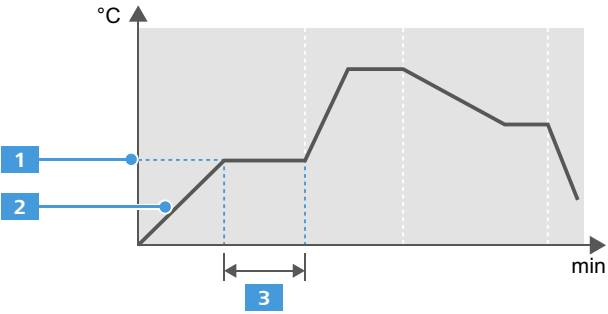
You can set up a temperature curve for the Linkam stage which is composed of individually defined temperature ramps connected to each other. For each temperature ramp you can define a condition when to acquire an image:

- Each time a defined time interval has elapsed
- Each time the temperature has changed by a defined value





As a result you obtain a time series or a temperature series of images per temperature ramp.

The temperature curve is represented by a table in the **Linkam Heating Stage Acquisition Setup** tool. Each row corresponds to one temperature ramp.

Temperature Profile Designer



- 1 Limit
- 2 Rate
- 3 Hold Time



Parameter	Description
Rate	<p>Specifies the heating or cooling rate of your Linkam stage in °C/min. For active cooling your stage must be equipped accordingly.</p> <p>You only need to define the <b>Rate</b> and the <b>Limit</b> (i.e. target temperature). The tool automatically determines whether to cool or to heat.</p>
Limit	<p>Specifies the target temperature of the Linkam stage. If this temperature is reached, it is sustained for the duration given by <b>Hold Time</b>.</p>
Hold Time	<p>Specifies the duration for which the temperature specified by <b>Limit</b> is sustained.</p> <p>After this, the next temperature ramp defined in the next table row starts.</p>
Icon Bar	Manages the temperature curve
– 	Moves the selected temperature ramp (table row) up
– 	Moves the selected temperature ramp (table row) down
– 	Duplicates the selected table row
– 	Removes the selected row

**Acquisition Type** Specifies whether a temperature or a time series is acquired for the currently selected ramp (i.e. table row).

Parameter	Description
None	No images are acquired during the selected temperature ramp.
Time	A time series is performed.
– Interval	An image is acquired whenever the time defined by <b>Interval</b> has elapsed.
Temperature	A temperature series is performed.
– Temperature Step	An image is acquired each time the temperature increases or decreases by this value.

Parameter	Description
<b>Focus Correction</b>	
– None	If selected, no focus correction is performed during the acquisition.
– Software Auto-focus	If selected, during the experiment an focus correction is performed via the software autofocus. Under <b>Repeat every</b> you can set how often the correction is performed (e.g. after each image or after 2 images).
<b>Show Annotations in Image</b>	<b>Activated:</b> Displays the annotations in the image.
<b>Generate Table</b>	Generates a result table from the Linkam experiment containing time, temperature, and pressure that will be available in the <b>Documents Area</b> .

**See also**

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

**11.2.2.14 Linkam Heating Stage Control Tool**



This tool enables you to control temperature and vacuum of the Linkam heating stage. You can control the two properties independently of each other.

**Temperature**

Parameter	Description
<b>Temperature control on</b>	<b>Activated:</b> Turns the heating stage on
<b>Temperature</b>	Indicates the current temperature
<b>Status</b>	
– <b>Heating</b>	Temperature increasing at the specified <b>Rate</b>
– <b>Cooling</b>	Temperature decreasing at the specified <b>Rate</b>
– <b>Holding</b>	Temperature is being maintained at the <b>Limit</b> value
– <b>Standby</b>	None of the above: ready for a command
<b>Rate (°C/min)</b>	Speed the temperature should change
<b>Limit (°C)</b>	Target temperature When it is reached the stage is maintained at this temperature
<b>Calibration</b>	This option is used for correction of temperature differences caused by using a particular sample holder or a large sample. It is possible to enter up to 5 calibration points which are numbered in the list.  Note that the entered temperature values from number 1 to 5 must increase.  The <b>Refresh</b> button reads the values currently used by the hardware/firmware and refreshes the control.  The <b>Set</b> button takes the values from the control and writes them to the hardware.

Vacuum	Parameter	Description
	<b>Vacuum control on</b>	<b>Activated:</b> Turns the vacuum pump on
	<b>Measured Pressure</b>	Indicates the current pressure
	<b>State</b>	
	– <b>Compressing</b>	Pressure increasing until <b>Setpoint Pressure</b> reached
	– <b>Expanding</b>	Pressure decreasing until <b>Setpoint Pressure</b> reached
	– <b>Holding</b>	Pressure is being maintained at the <b>Setpoint Pressure</b> value
	– <b>Standby</b>	None of the above: ready for a command
	<b>Setpoint Pressure</b>	Target pressure When it is reached the stage is maintained at this pressure.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]













#### 11.2.2.15 Magnification Tool

The **Magnification** tool enables you to set the objective, and thus the magnification, currently used on your microscope.

Parameter	Description
<b>Objective</b>	The behavior of the <b>Objective</b> icon depends on your type of objective revolver:
– <b>Manual objective revolver</b>	<ol style="list-style-type: none"> <li>Click the <b>Objective</b> icon and select the desired objective.</li> <li>Turn the objective revolver manually to the corresponding position.</li> </ol>
– <b>Motorized objective revolver</b>	<ol style="list-style-type: none"> <li>Click the <b>Objective</b> icon and select the desired objective.</li> </ol> <p>The objective revolver is turned to the corresponding position automatically.</p>
– <b>Coded objective revolver</b>	<ol style="list-style-type: none"> <li>Turn the objective revolver manually to the desired position.</li> </ol> <p>The objective is detected automatically by the software and displayed in the <b>Magnification</b> tool correspondingly.</p>
<b>Zoom Level</b>	<p>Only available for stereo or zoom microscopes.</p> <p>Use the slider to adjust the desired zoom level of your stereo or zoom microscope.</p>
<b>Zoom Factor</b>	<p>Only available for manual zoom.</p> <p>Adjust the desired zoom factor by selecting a fixed value.</p>
<b>Total Magnification</b>	<p>Only available for stereo or zoom microscopes.</p> <p>Shows the value of the total magnification of your microscope system. The value is calculated as follows:</p>

Parameter	Description
	Total Magnification = Magnification Objective * Magnification Camera Adapter (optional) * Zoom Level

### See also






-  2D Acquisition (automatic) Workbench [▶ 733]
-  2D Acquisition Workbench [▶ 733]
-  Best Image Workbench [▶ 734]
-  EDF (manual focus) Workbench [▶ 734]
-  EDF (motorized focus) Workbench [▶ 735]
-  Interactive Height Measurement Workbench [▶ 664]
-  Linkam Acquisition Workbench [▶ 736]
-  Linkam Heating Stage Workbench [▶ 736]
-  Movie Recorder Workbench [▶ 736]
-  Position List with EDF Workbench [▶ 738]
-  Position List Workbench [▶ 737]
-  Configuring Tolerances for a Measurement [▶ 60]
-  Specifying Permitted and Expected Values for a Tool [▶ 59]
-  Flexible Acquisition Workbench [▶ 735]






#### 11.2.2.16 O-Inspect Autofocus Tool

With this tool **O-Inspect** focuses the sample automatically. The ROI is kept in focus without your intervention.

Parameter	Description
<b>AF Find Focus</b>	Starts the autofocus search to determine the optimal focus.
<b>Range</b>	Sets the range that you want to be used for the autofocus search. Value range: <b>7.4 mm to 37 mm</b>
<b>Set Max</b>	Sets the maximal available autofocus range.
<b>Autofocus ROI</b>	Specifies which region of the camera sensor is used to find the in-focus position.
– <b>Full ROI</b>	Sets the full ROI for the autofocus.
– <b>1/4 ROI</b>	Sets 1/4 of the ROI for the autofocus.
– <b>1/16 ROI</b>	Sets 1/16 of the ROI for the autofocus.

### See also

-  2D Acquisition Workbench [▶ 733]
-  2D Acquisition (automatic) Workbench [▶ 733]
-  Best Image Workbench [▶ 734]
-  EDF (manual focus) Workbench [▶ 734]
-  Linkam Acquisition Workbench [▶ 736]

-  EDF (motorized focus) Workbench [[▶ 735](#)]
-  Linkam Heating Stage Workbench [[▶ 736](#)]
-  Movie Recorder Workbench [[▶ 736](#)]
-  Position List Workbench [[▶ 737](#)]
-  Position List with EDF Workbench [[▶ 738](#)]

### 11.2.2.17 EDF (manual focus) Tool

This tool increases the depth of focus by acquiring a sequence of images and combining them into a Z-stack image.

The tool combines the sharp regions of the individual images of the Z-stack into a single image. The depth of focus of this image is considerably larger than that of a single image.

In order to acquire images at different focus positions, you have to move the stage manually in Z-direction. Whenever you change the stage position, a different plane of the sample is focused by the objective. You can trigger the image acquisition of the individual images manually or automatically at certain time intervals.

Parameter	Description
<b>Mode</b>	Determines whether the acquisition is triggered by a countdown timer or manually.
– <b>Timer</b>	Acquires an EDF (Extended Depth of Focus) image automatically after a countdown timer interval.
– <b>F12 Key</b>	Acquires an EDF image when you press the <b>F12</b> .
<b>Interval</b>	Sets the countdown timer interval (in seconds), after which an image is acquired.  Only active in <b>Timer</b> mode.
<b>Create Raw Data Image (Z-Slices)</b>	If activated, the separate Z-slices of the acquisition are stored in a Z-stack image.

### EDF Processing Section

Parameter	Description
<b>Fusion Methods</b>	Following methods for fusing the individual images are available.
<b>Maximum Projection</b>	By using this method, the brightest pixel along the stack will be taken, which may not necessarily be the sharpest.  It generally works good with fluorescence Z-stacks. Do not use on bright-field data or images.  No <b>Alignment</b> available.
<b>Alignment</b>	Alignment is selectable for all fusion methods but <b>Maximum Projection</b> .  Adjust whether the individual images of the Z-stack image are aligned before being combined and at which quality.
– <b>No Alignment</b>	The Z-stack image is not aligned before being combined. You should select this setting for any microscope other than a stereo microscope, e.g. a compound microscope.

Parameter	Description
- <b>Normal</b>	High speed with normal image quality.
- <b>High</b>	Low speed with high image quality.
- <b>Highest</b>	Lowest speed with best image quality.
<b>Contrast</b>	<p>By using this method, the value is the difference between the brightest and the darkest pixel value within the "Kernel". Additional parameter like Contrast, Smoothing and Reconstruction can be adjusted separately.</p> <p>Due to the derivative nature of this algorithm, noise can pose a problem. Therefore, it may not be suitable for noisy data such as fluorescence z-stacks.</p>
- <b>Length Scale</b>	<p>Sets the length scale (pixel units) at which the contrast for every slice is calculated. For images with small and sharp structures, a small contrast length scale provides good results. For images with larger structures with smoother edges, a larger contrast length scale is required.</p> <p>Value Range: <b>1 to 31</b></p> <p>Default Value: <b>7</b></p>
- <b>Smoothing</b>	<p>Specifies the factor to smooth the EDF image and thus reduce noise. Larger values lead to a smoother image.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0 to 51</b></p> <p>Default Value: <b>11</b></p>
- <b>Reconstruction</b>	<p>Defines the amount of image area with little contrast that needs to be reconstructed by an algorithm. If an image contains larger regions with little or no contrast information, the algorithm has to interpolate image information at a larger extent.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0 to 0.8</b></p> <p>Default Value: <b>0.15</b></p>
<b>Variance</b>	<p>By using this method, the variance of the pixel values is calculated within the "Kernel". Additional parameter like Contrast, Smoothing and Reconstruction can be adjusted separately.</p> <p>Local variance acts on structures that fall within the support of a small neighborhood in that the maximum of the second order statistical moment determines in-focus content. Due to the derivative nature of this algorithm, noise can pose a problem. Therefore it may not be suitable for noisy data such as fluorescence stacks.</p>
- <b>Length Scale</b>	<p>Sets the length scale (pixel units) at which the contrast for every slice is calculated. For images with small and sharp structures, a small contrast length scale provides good results. For images with larger structures with smoother edges, a larger contrast length scale is required.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>1 to 31</b></p> <p>Default Value: <b>7</b></p>



Parameter	Description
- <b>Smoothing</b>	<p>Specifies the factor to smooth the EDF image and thus reduce noise. Larger values lead to a smoother image.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>51</b></p> <p>Default Value: <b>11</b></p>
- <b>Reconstruction</b>	<p>Defines the amount of image area with little contrast that needs to be reconstructed by an algorithm. If an image contains larger regions with little or no contrast information, the algorithm has to interpolate image information at a larger extent.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>0.8</b></p> <p>Default Value: <b>0.15</b></p>
<b>Wavelets</b>	This method is used to detect the sharpest areas in the individual images. We recommend to always try this function first as it delivers the best results in most cases.
<b>With Heightmap</b>	<b>Activated:</b> Creates a heightmap. Only available for fusion methods <b>Wavelets</b> and <b>Fast EDF</b> .
<b>Texture Method</b>	Available for Fusion Method <b>Wavelets</b> and activated <b>With Heightmap</b> only:
- <b>Wavelets</b>	Three sub-band oriented Mallat type decimated Daubechies wavelets are used. Due to the decimation and proprietary sub-band selection heuristics, this is the fastest algorithm available in ZEN. Due to the associated scaling variance, the resulting height values are laterally not as accurate as with a stationary arrangement.
- <b>Stationary Wavelets</b>	Three sub-band oriented Mallat type un-decimated Daubechies wavelets are used. All sub-bands are kept within their original scale for similar proprietary selection rules. This wavelet decomposition scheme is also known to be fully shift invariant. This enables for a result that has a spatially finer detailed height map. However, this algorithm also has a computationally higher cost and is therefore slower in execution speed.
- <b>Complex Wavelets</b>	Six sub-band oriented complex valued Dual Tree Daubechies wavelets are used. This decomposition scheme, while decimated provides nearly shift invariant behavior, just like the stationary option. Additionally, the sub-bands appear in 6 distinct angles which allows more rotational freedom of structures which results in more accurate height maps, especially for angles between 45 and 90 degrees. This method is computationally more intensive than the decimated but less so than stationary wavelets.
<b>High Resolution</b>	<p>Available for Fusion Method <b>Wavelets</b> and activated <b>With Heightmap</b> only:</p> <p>If activated, the heightmap is continuously sub-pixel accurate concerning the height values. Every height value is always calibrated in <math>\mu\text{m}</math> (microns).</p> <p>If deactivated, you will only get discrete height steps.</p>

Parameter	Description
<b>Fast EDF</b>	Applies topography image settings. You set the settings in the <b>ADVANCED</b> section.
<b>Presets</b>	
- <b>Default</b>	Sets the default values.
- <b>Custom</b>	Sets the values you have specified manually.
- <b>Small Structures</b>	Sets optimized parameters for samples with small sized structures.
- <b>Medium Structures</b>	Sets optimized parameters for samples with medium sized structures.
- <b>Large Structures</b>	Sets optimized parameters for samples with large sized structures.
<b>Decay Flicker Correction</b>	<p>Only visible if <b>Contrast</b> or <b>Variance</b> is selected as <b>Method</b>.</p> <p><b>Activated:</b> Equalizes the brightness and intensity of pixels over the entire z-stack. During the acquisition of fluorescence images, bleaching can lead to a difference in pixel brightness, also called decay. When acquiring an image with a lamp, flickering can lead to fluctuations in pixel intensity. This option tries to correct both effects through the equalization over the entire stack.</p>

### ADVANCED Section

This section is only available, if **Fusion Method** > **Fast EDF** is selected.

Parameter	Description
<b>Smoothing</b>	<p>Specifies the factor to smooth the topography image and thus reduce noise. Larger values lead to a smoother image.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>1 to 15</b></p> <p>Default values (depending on the selected preset):</p> <ul style="list-style-type: none"> <li>▪ Preset = Default: 9</li> <li>▪ Preset = Small Structures: 7</li> <li>▪ Preset = Medium Structures: 11</li> <li>▪ Preset = Large Structures: 15</li> </ul>
<b>Pixelwise Iteration</b>	<p>Larger values lead to a smoother heightmap. Use the slider to adjust the desired value.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0 to 16</b></p> <p>Default values (depending on the selected preset):</p> <ul style="list-style-type: none"> <li>▪ Preset = Default: 2</li> <li>▪ Preset = Small Structures: 2</li> <li>▪ Preset = Medium Structures: 3</li> <li>▪ Preset = Large Structures: 3</li> </ul>

Parameter	Description
<b>Depthwise Kernel Size</b>	<p>Larger values lead to a more robust heightmap, especially for areas with low contrast. Should only be used by small depth of focus step sizes.</p> <p>Use the slider to adjust the desired value.</p> <p>Value Range: <b>0</b> to <b>20</b></p> <p>Default values (depending on the selected preset):</p> <ul style="list-style-type: none"> <li>▪ Preset = Default: 1</li> <li>▪ Preset = Small Structures: 0</li> <li>▪ Preset = Medium Structures: 2</li> <li>▪ Preset = Large Structures: 2</li> </ul>
<b>Resize Ratio</b>	<p>Sets the scaling factor.</p> <p>Default Value: <b>0.25</b></p> <ul style="list-style-type: none"> <li>▪ <b>0.25</b></li> <li>▪ <b>0.5</b></li> <li>▪ <b>1.0</b></li> </ul>
<b>Bilateral Sigma Color</b>	<p>Only activated if <b>With Heightmap</b> is activated.</p> <p>Special kind of filter, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.</p>
<b>Bilateral Sigma Space</b>	<p>Only activated if <b>With Heightmap</b> is activated.</p> <p>Special kind of filter, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.</p>

### See also

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

#### 11.2.2.18 Position List Tool


This tool enables you to acquire tiles at arbitrary positions of your sample. In contrast to the tile acquisition tools, the tiles in the position list are not necessarily positioned next to each other. This applies also to EDF images.

#### Info






If the sample height varies by a large amount, we recommend to add a focus correction method. Therefore you first have to add the **Focus Correction** tool. There you can select a focus correction method (e.g. Software Autofocus or Focus Surface) which is applied during the acquisition of the tile image.

Use the **Live Navigator** window to define the desired positions. Drag the small blue-framed preview window to the areas of your sample where you wish to acquire a tile image.

After you have added the desired positions, we recommend to verify them by checking and confirming the individual focus positions. If all positions have been verified, you can start the acquisition of the positions by clicking on **Start** on top of the workbench.

Parameter	Description
<b>Current X/Y and Z</b>	Displays the current stage position represented by the Live Navigator window.
<b>Add Current Position to List</b>	Adds the current position to the position list. The X and Y values are defined by the Live Navigator position. To change the Z value you need to load the <b>Focus</b> tool.
<b>Position List</b>	Shows the current list of positions and their X, Y, and Z values Using the options you can modify the list and its entries, e.g. sort the positions or change their X, Y, or Z values retrospectively.
	
– <b>Set current Z for Selected Positions</b>	Sets the current Z-Position for all selected positions.
– <b>Set current X/Y/Z for Selected Position</b>	Sets the current X-Y-Z-Position for the selected position.
– <b>Delete</b>	Deletes the current position.
– <b>Delete All</b>	Deletes all positions.
– <b>Activate</b>	Activates the current position for acquisition.
– <b>Deactivate</b>	Deactivates the current position for acquisition.
– <b>Sort</b>	Sorts the list entries according to the chosen parameter. <ul style="list-style-type: none"> <li>■ By Position (X -&gt; Y) Sorts all positions according to their overall X position.</li> <li>■ By Position (Y -&gt; X) Sorts all positions according to their overall Y position.</li> <li>■ By Category Sorts all positions according to their category.</li> </ul>
– <b>Import Positions</b>	Imports positions in .csv-format and in .czsh-format.
– <b>Export Positions</b>	Exports positions in .csv-format and in .czsh-format. If you export a .czsh-file, all positions are included in the export file, also the state, no matter which positions you have activated.
<b>Verify Positions</b>	Opens the <b>Verify Positions</b> dialog. There you can check and/or confirm the individual focus positions (and correct it, if necessary). You will find a brief description of the verifying process under <b>Focus Correction Tool</b> [► 771] as well.

### See also










-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Flexible Acquisition Workbench [► 735]
-  Interactive Height Measurement Workbench [► 664]
-  Position List Workbench [► 737]

### 11.2.2.19 Ring Light Tool

With this tool you control the ring light illumination.

Parameter	Description
<b>Power Status</b>	Turns on or off the ring light components.
<b>Ring Selection</b>	
– <b>Inner Ring</b>	Activates or deactivates all segments of the inner ring.
– <b>Outer Ring</b>	Activates or deactivates all segments of the outer ring.
– <b>Synchronize Inner &amp; Outer Ring</b>	Activates or deactivates the synchronization of the inner and outer ring segments.
– <b>Mirror Ring Segments</b>	Activates or deactivates mirroring the state of the ring segments.
<b>Inner Ring Intensity</b>	Adjusts the intensity of the inner ring.
<b>Outer Ring Intensity</b>	Adjusts the intensity of the outer ring.

#### See also

-  2D Acquisition Workbench [► 733]
-  2D Acquisition (automatic) Workbench [► 733]
-  Best Image Workbench [► 734]
-  EDF (manual focus) Workbench [► 734]
-  EDF (motorized focus) Workbench [► 735]
-  Linkam Acquisition Workbench [► 736]
-  Movie Recorder Workbench [► 736]
-  Position List Workbench [► 737]
-  Position List with EDF Workbench [► 738]

### 11.2.2.20 S&F Find (List) Tool



With this tool you can reload (find) positions on your sample based on a list (.csv file) you can import in this tool or open from the archive (.czt file). This list needs to have a specific format. For more information, see *List Format for S&F Find (List) Tool* [► 790].

This tool can be added to each acquisition workbench.

Parameter	Description
<b>Position List Name</b>	Displays the position list.
– Load from File	Opens a file browser to select the .csv file with the position list.
– Load from Archive	Opens the <b>Load Documents from Archive</b> browser to select the .czt file with the position list from the archive.
<b>Position List</b>	Displays the information of the list. The following information are displayed:

Parameter	Description
– ID	The ID of the position.
– Stage X	The x stage position.
– Stage Y	The y stage position.
– Description	The description of the respective position.
<b>Move to Selection</b>	Moves the stage to the currently selected position.

### See also

-  Browse ZEN Data Storage Dialog [▶ 155](#)
-  Interactive Height Measurement Workbench [▶ 664](#)

#### 11.2.2.20.1 List Format for S&F Find (List) Tool

The list (csv file) used by the *S&F Find (List) Tool* [▶ 789](#) needs to contain the marker positions as well as the absolute stage positions (μm) for each point of interest.

#### Marker section

Each marker needs to be defined by the following information in the csv file (separated by semi-colon):

**MarkerID; MarkerPositionX; MarkerPositionY; MarkerPositionZ**

#### Stage Position section

Each stage position needs to be defined by the following information in the csv file (separated by semicolon):

**PositionID; StagePositionX; StagePositionY; Description**

#### Example

<b>MarkerID;MarkerPositionX;MarkerPositionY;MarkerPositionZ</b>			
1;	54566.208095890412;	36033.814479452056;	-1777.798
2;	54087.941385911945;	56288.173561509429;	56288.173561509429
3;	104055.55689041097;	57327.14221917808;	-1743.378
<b>PositionID; StagePositionX; StagePositionY; Description</b>			
1;	54566.208;	36033.814;	the center position
2;	54124.418;	35790.640;	top left position in the image
3;	54875.90;	36320.234;	bottom right position in the images

#### 11.2.2.21 S&F Find Tool

With this tool you can relocate (find) positions on your sample. First you have to acquire an image on the LM and usually you draw in certain ROIs/POIs. You can then bring the sample and the holder to the SEM. There you can relocate the sample positions by one click on the corresponding ROI/POI.

Note that the **S&F Find** tool can be added to each acquisition workbench. Therefore first add an acquisition workbench (e.g. 2D Acquisition) and click on **+ Add Tool**. Then double-click on the **S&F Find** tool in the list of tools. When running the software on a SEM system the **S&F Find** tool is available in one of the **Acquisition** workbenches.

Parameter	Description
<b>Reference Image</b>	Here you can load a reference image including ROIs/POIs.
<b>ROI/POI list</b>	In this list you see all the ROIs (regions of interest) and POIs (points of interest) which are drawn in the loaded reference image.
<b>Move stage to load position before xy movement</b>	If activated, the stage moves first to the load position before moving in x or y position (e.g. before moving to the next ROI/POI). Activate this option if you work with uneven samples to avoid collision of the objective and the sample.
<b>Move to center</b>	Moves the stage to the center position of the reference image.
<b>Move to selection</b>	Moves the stage to the selected region or position (the position must be selected in the list). In case a region was selected, the magnification will be adjusted to the extension of the ROI (on the SEM only).

#### See also

 Interactive Height Measurement Workbench [▶ 664]

#### 11.2.2.22 Software Autofocus Tool

##### CAUTION

##### Risk of Crushing Fingers

The drive of a microscope stage with a motorized vertical axis (focus drive) is strong enough to crush fingers or objects between the stage and the microscope stand.

- ▶ Remove your fingers or any objects from the danger area before moving the focus drive.
- ▶ Release the joystick immediately to stop the movement.

This tool automatically focuses the sample using software algorithms. The tool scans a defined Z-Range and acquires an image at defined heights. The resulting images are compared in order to find the focus, i.e. the Z-Position where the acquired image is as sharp as possible.

In the **2D Acquisition** workbench, the tool uses the current microscope hardware settings. In the **2D Multi-Channel Acquisition** workbench, the tool uses the hardware settings of the reference channel.

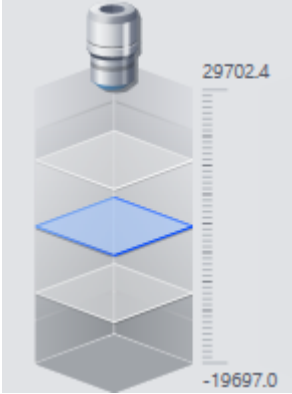
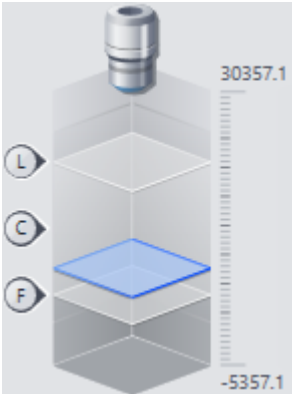
Use this tool after you have found the desired area on your sample and have prepared your sample for acquisition. You can accelerate the autofocusing process by roughly pre-focusing the sample manually.

Parameter	Description
<b>Find Focus</b>	Triggers the software autofocus to find the focus. In the <b>Light Path</b> tool, the path of light along the control elements is displayed, see <i>Light Path Tool</i> [▶ 778].
<b>Mode</b>	Selects the sharpness measurement mode.

Parameter	Description
– <b>Auto</b>	<p>Default. Maximizes either contrast or intensity depending on the hardware configuration. For Widefield approaches or transmitted light the sharpness measure is always <b>Contrast</b> based. For optical sectioning methods, e.g. Spinning Disk, an <b>Intensity</b> based approach to determine the sharpness values is selected.</p> <p>If the microscope configuration cannot be detected automatically, manually select the sharpness measurement mode.</p>
– <b>Contrast</b>	<p>Maximizes local contrast and is used for sharpness measurement.</p> <p>This is the standard setting for <b>Camera</b> acquisition.</p>
– <b>Intensity</b>	<p>Maximizes the total intensity and is used for sharpness measurement.</p> <p>This is the standard setting for <b>Confocal</b> acquisition.</p>
<b>Quality</b>	<p>Specifies the method to estimate the image sharpness and thus the precision of the calculated autofocus.</p> <p>Determines the merit function used to calculate the contrast value of the image when <b>Contrast</b> mode is used by the SWAF (Software Autofocus) run to measure sharpness.</p>
– <b>Default</b>	<p>Applies a simple and fast method to estimate the image sharpness at each autofocusing step. Uses a composite of weighted merit functions.</p> <p>Use this setting if the sample cover a greater part of the camera field of view.</p>
– <b>Low Signal</b>	<p>Applies a more complex, optimized method to estimate the image sharpness at each autofocusing step. Uses a single merit function to determine the value.</p> <p>Use this setting if the image is noisy or the sample covers a small area of the field of view, e.g., if you work with a calibration slide or beads.</p>
<b>Search</b>	<p>Specifies how the range is scanned. Defines a different type of primary maximizer used to run the SWAF, which in turn determines a number of additional characteristics and parameters of the entire process.</p>
– <b>Smart</b>	<p>Acquires images at different positions until a first sharpness maximum is measured. An alternative maximizer is used that searches in a bidirectional manner and stops when a local maximum is found in the sharpness values, e.g., a significant decrease of sharpness in both z-directions.</p> <p>This position is assumed to be the in-focus position.</p>
– <b>Full</b>	<p>Acquires images over the entire range of positions.</p> <p>The maximizer employed with this setting uses an unidirectional movement of the z-drive stepping through the entire relative or fixed search range defined in the SWAF tool. The Full maximizer returns a global maximum for the autofocus run.</p> <p>The in-focus position is defined by the position where the maximum sharpness was measured.</p> <p>The <b>Full</b> method requires more time than the <b>Smart</b> method but yields better results.</p>



Parameter	Description
– <b>Full No Checks</b>	Searches the whole range and selects the sharpest level. Does not apply validity criteria to maximum.
<b>Sampling</b>	<p>Defines the distance the stage/objective is moved between two auto-focus measurement positions. An image is acquired at each position and its sharpness is compared to the previously acquired image to determine the focus. The accuracy of the calculated focus increases with a smaller displacement per step, but the required total measurement time also increases.</p> <p>The <b>Step Size</b> that results from the <b>Sampling</b> setting depends on the microscope setup, e.g., on the objective used, and is calculated automatically.</p>
– <b>Fine</b>	Sets a small step size (0.5 x Depth of Focus) ( <b>0.5 * dz</b> ) between the individual focus images that are used to calculate the best focus position. This doubles the number of z-slices for the given range.
– <b>Default</b>	Sets a step size (1 x Depth of Focus) ( <b>dz = <math>1/\sqrt{2} * 2 * n * \lambda / NA</math></b> ).
– <b>Medium</b>	Sets a medium step size (2 x Depth of Focus) ( <b>0.5 * dz</b> ) between the individual focus images that are used to calculate the best focus position.
– <b>Coarse</b>	Sets a large step size (4 x Depth of Focus) ( <b>4 * dz</b> ) between the individual focus images that are used to calculate the best focus position. Reduces number of z-slices by a factor of four.
<b>Sharpness Measure</b>	Specifies how the focus position is calculated:
– <b>Contrast</b>	<p>Calculates the best focus position by maximizing the local contrast in the selected image area</p> <p>Use this method if the sample has structures with clearly visible edges leading to sharp intensity changes in the image.</p>
– <b>Intensity</b>	<p>Calculates the best focus position by maximizing the total intensity in the selected image area</p> <p>Use this method if the sample has uniform structures leading to slowly varying intensities in the image.</p>
– <b>Auto</b>	Decides automatically whether to use the contrast method or the intensity method, based on the image properties.
<b>Relative Range</b>	<p>The autofocus search range is defined by positions relative to the current objective position.</p> <p>This mode is recommended if you have already focused the sample roughly by hand.</p> <p><b>Automatic Range:</b></p> <ul style="list-style-type: none"> <li>■ <b>Activated:</b> The range for the autofocus search is calculated automatically, depending on the current objective.</li> <li>■ <b>Deactivated:</b> You set the range manually. <ul style="list-style-type: none"> <li>– <b>Range:</b> The total distance in <math>\mu\text{m}</math>.</li> <li>– <b>Step Size:</b> The distance between subsequent focus positions in <math>\mu\text{m}</math>.</li> </ul> </li> </ul>

Parameter	Description
	<p>The <b>Step Size</b> depends on the microscope setup and on the selected <b>Sampling</b>. It is calculated automatically.</p> <p><b>Overview image</b></p>  <p>The overview image indicates the objective and the stage. The blue plane indicates the stage, the light gray box indicates the current range.</p> <p>The scale adapts automatically.</p> <p>You can drag the blue plane to move the stage up or down.</p>
<b>Fixed Range</b>	<p>The autofocus search range is defined by absolute positions.</p> <p>This mode is useful if you have a rough estimate where to look for the in-focus position.</p> <ul style="list-style-type: none"><li>▪ <b>Set Last:</b> Defines the Z position where the <b>Range</b> ends. Use the current position as last position (L).</li><li>▪ <b>Set First:</b> Defines the Z position from where the <b>Range</b> starts. Use the current position as last position (F).</li></ul> <p><b>Overview image</b></p>  <p>The overview image indicates the objective and the stage. The blue plane indicates the stage, the light gray box indicates the current range.</p> <p>You can drag the blue plane to move the stage up or down. Alternatively you can click the flags to quickly move the stage into the first position (F), the center position (C), or the last position (L) of the range.</p>

Parameter	Description
	You can also use the overview image to set the first or last position: Move the blue plane outside the light gray box into the desired position and then click <b>Set First</b> or <b>Set Last</b> .
<b>Autofocus ROI</b>	Specifies which region of the camera sensor is used to find the in-focus position:
– <b>Spot Meter / Focus ROI</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> Only the image region within the <b>Spot Meter / Focus ROI</b> region is used to calculate the autofocus. You can set the <b>Spot Meter / Focus ROI</b> region by right-clicking on the live image and activating the <b>Navigator</b>. You can resize the red rectangle and move it to the region to be used for focusing.</li> <li>▪ <b>Deactivated:</b> The entire camera sensor area is used to calculate the autofocus.</li> </ul>

### See also

- 📖 Flexible Acquisition Workbench [► 735]
- 📖 2D Multi-Channel Acquisition Workbench [► 734]
- 📖 2D Acquisition Workbench [► 733]
- 📖 Focusing the Sample Automatically [► 105]
- 📖 Specifying Permitted and Expected Values for a Tool [► 59]
- 📖 Configuring Tolerances for a Measurement [► 60]

#### 11.2.2.23 Stage Tool

### CAUTION

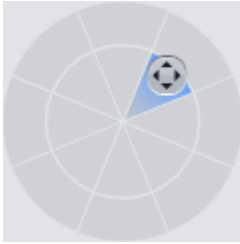
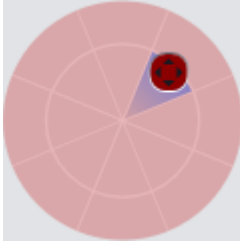
#### Risk of Crushing Fingers

The drive of a microscope stage with a motorized horizontal stage axis (stage drive) is strong enough to crush fingers or objects between the stage and nearby objects (e.g. a wall).

- ▶ Remove your fingers or any objects from the danger area before moving the stage drive.
- ▶ Release the joystick immediately to stop the movement.

This tool enables you to navigate the sample in a microscope equipped with a motorized stage. You can use the **Navigation Circle** (software joystick) to move the stage or enter the coordinates directly.

Parameter	Description
<b>Navigation Circle</b>	<p>Enables you to move the stage freely in the X and Y direction and in both diagonal directions.</p> <p>To move the stage, drag the <b>Navigation Circle</b> icon in the desired direction. If released, the icon snaps back to the <b>Navigation Circle</b> center and the stage stops.</p> <p>The <b>Navigation Circle</b> allows four speeds:</p> <ul style="list-style-type: none"> <li>▪ Normal modes: <ul style="list-style-type: none"> <li>– Inner segments: Slow</li> <li>– Outer segments: Medium</li> </ul> </li> </ul>

Parameter	Description
	<div><ul style="list-style-type: none"><li>High-speed modes:<ul style="list-style-type: none"><li>Inner segments: Fast</li><li>Outer segments: Very Fast</li></ul></li></ul><div></div><p>To enter the high-speed mode, right-click the <b>Navigation Circle</b> icon. The <b>Navigation Circle</b> turns red. To return to normal speed, right-click the <b>Navigation Circle</b> icon again.</p></div>
Stop	<p>Stops any stage movement immediately.</p> <p>Use this button if you entered <b>X-Position</b> and/or <b>Y-Position</b> and wish to interrupt the stage movement immediately (e.g. to prevent a collision).</p>
X-Position, Y-Position	<p>Specifies the target coordinates for the stage movement.</p> <p>The stage starts moving immediately after the coordinates have been entered and confirmed; either by pressing the <b>Return</b> key or by clicking anywhere outside the current input field.</p>

Info

You can also control the **Navigation Circle** and thus the motorized stage with the keyboard. To activate keyboard control left-click anywhere inside the segmented **Navigation Circle**. To change between the two speed modes, right-click the central **Navigation Circle** icon.

- ▶ To move the stage at the lower speed, use the arrow keys (diagonal movements are also possible).
- ▶ To move the stage at the higher speed, use **Shift + Arrow** keys.

The following parameters are only visible if the **Show All** mode is activated:








Parameter	Description
Speed	<p>Sets the moving speed of the stage in percent (100% = maximum possible speed).</p> <p>Note that the speed setting does not change the speed graduation of the SW joystick.</p>

Parameter	Description
	If you have activated the software triggered mode in <b>Maintenance &gt; General Options &gt; Options &gt; Acquisition &gt; Tools &amp; Positions</b> , for testing you should ensure that you use maximum speed and acceleration.
<b>Acceleration</b>	<p>Sets the acceleration of the stage in percent (100% = maximum acceleration value).</p> <p>If you have activated the software triggered mode in <b>Maintenance &gt; General Options &gt; Options &gt; Acquisition &gt; Tools &amp; Positions</b>, for testing you should ensure that you use maximum speed and acceleration.</p>
<b>X/Y-Position</b>	
- <b>Set Zero</b>	Sets the current position as the new zero point for the x-/y-coordinates.
- <b>Calibrate</b>	<b>CAUTION! Risk of Crushing Fingers.</b> Performs an automatic stage calibration. For this the stage moves to the limit switches to determine the zero points in the x and y direction and then returns to its starting position, which is now defined with its absolute coordinates.

### Marks section

This section shows a list where you can define **X/Y** positions (optional z value), so called marks. It is also possible to import a list of positions from the list into an experiment including the **Tiles** tool.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Stage Movement [► 100]
-  Navigating the Sample [► 102]
-  Flexible Acquisition Workbench [► 735]
-  Interactive Height Measurement Workbench [► 664]
-  Visioner 2D Acquisition Workbench [► 692]

#### 11.2.2.24 Z-Stack Setup Tool

With this tool you configure acquisitions that comprise several z-planes of your sample. You define the upper and lower end of the range of focus positions used to acquire the individual images. Depending on whether multiple tile regions/positions are included and the used focus strategy, this may only define the relative range limit.

You can set all parameters manually or have configuration performed automatically. If the Z-stack setup tool is used within the flexible acquisition workbench, the optimal distance is slightly different to the one used in the motorized EDF workbench. This value is basically a factor of the current depth of focus (similar to the optimal step width for the software autofocus) and takes into account the emission wave length of the used light source. In case of EDF images, the values differ due to the used reflected light configuration.


Parameter	Description
<b>Last</b>	Specifies the current stage position as the upper end of the range.
<b>First</b>	The current stage position is defined as the lower end of the range.
<b>Set Last</b>	Move the stage until the top of the sample is no longer in focus, and click <b>Set Last</b> .
<b>Set First</b>	Move the stage until the bottom of the sample is no longer in focus, and click <b>Set First</b> .
<b>Step Size</b>	Defines the distance the stage travels between two image acquisitions from 0.01 $\mu\text{m}$ onwards.
<b>Slices</b>	Displays automatically the number of images to be acquired.
<b>Optimal</b>	<p>The number displays the distance calculated for the set channels and the current microscope according to the Nyquist criterion. The Nyquist criterion states that a signal must be detected with at least double precision in order to reliably acquire all the frequencies in the signal. In the case of images acquired with coarser resolution, undesired effects such as aliasing may otherwise result. For the deconvolution of microscope images, this means, in practical terms, that images should be acquired with a pixel resolution that is at least double the optical resolution, both in the lateral and axial direction.</p> <ol style="list-style-type: none"> <li>Click <b>Optimal</b> to automatically set the optimal step size and number of slices depending on your microscope setup. <ul style="list-style-type: none"> <li>→ When you click this button once, it changes its color. This indicates that the system always uses the optimal interval as you continue to change acquisition parameters.</li> </ul> </li> <li>Click the button again, or manually edit the interval. <ul style="list-style-type: none"> <li>→ The permanently active state is deactivated.</li> </ul> </li> </ol> <p><b>Note:</b> If you change the objective while the button is activated, the value might not be updated correctly!</p>

### See also

 Flexible Acquisition Workbench [► 735]

#### 11.2.2.25 Export Experiment Tool

This tool is used to create \*.CZEXP files based on the settings of the current acquisition workbench.

Parameter	Description
<b>File Name</b>	Displays the name and the path where the export file is saved.
– 	Opens the file browser to enter a file name and to select a path for the export file.
<b>Apply</b>	Exports the current acquisition settings to the specified file.

### See also

- 2D Acquisition Workbench [▶ 733]
- 2D Acquisition (automatic) Workbench [▶ 733]
- 2D Multi-Channel Acquisition Workbench [▶ 734]
- EDF (motorized focus) Workbench [▶ 735]
- Flexible Acquisition Workbench [▶ 735]
- Movie Recorder Workbench [▶ 736]
- Position List Workbench [▶ 737]
- Position List with EDF Workbench [▶ 738]
- Tiles (interactive) Workbench [▶ 189]
- Tiles (manual) Workbench [▶ 190]
- Tiles (measurement area) Workbench [▶ 523]
- Tiles (multiple regions) Workbench [▶ 191]
- Tiles with EDF Workbench [▶ 738]
- Time Series Workbench [▶ 175]

11.2.3 Scaling

11.2.3.1 Assign Measured Scaling Tool

This tool enables you to calculate the scale for images acquired with microscopes where the individual hardware components can be detected automatically. The scale can be calculated using the following methods:

- Theoretic  
Based on the actual properties of the hardware components (e.g. zoom of the objectives, number and separation of pixels on camera chip, etc.)
- Custom scale  
Based on a manual (user-defined) measurement created using the **Create Measured Scaling** tool.


Parameter	Description
Scaling	Enables you to specify whether the theoretical or custom scale is used.
Scaling info	The name and properties of the hardware components of the current or selected hardware setup.
Assign scaling to image	Applies the selected scale to the image and all subsequent images in the job.

See also



- Specifying Permitted and Expected Values for a Tool [▶ 59]
- Configuring Tolerances for a Measurement [▶ 60]
- Distance Tool [▶ 844]

11.2.3.2 Assign Pixel Size Tool

This tool enables you to assign a scale to an image retrospectively, for example if the image does not contain a scale recognized by the software because it was created on another device.

Parameter	Description
<b>Scale Factor</b>	Enables you to enter the known horizontal ( <b>X</b> ) and vertical ( <b>Y</b> ) scale.
<b>Scale Unit</b>	Select the unit of the known scale (e.g. millimeters or inches).
	Locked: Keeps the Scale Factor of X and Y synchronizes. Open: Allows to adjust the Scale Factor of X and Y different.
<b>Assign scaling to image</b>	Applies the selected scale to the image and all subsequent images in the job.









**See also**

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]



**11.2.3.3 Assign Theoretical Scaling Tool**

This workbench enables you to calculate the scale for images acquired with manual hardware (i.e. a microscope where the individual hardware components cannot be detected automatically).

The total magnification of the microscope, and thus the scale, is calculated based on the magnification of individual components.

Parameter	Description
<b>Objective</b>	Select the magnification of the objective.  Click  or  to add or remove an objective magnification.
<b>Zoom</b>	Select the current zoom of the objective.  Click  or  to add or remove a zoom level.
<b>Camera Adapter</b>	Select the magnification of the camera adapter.  Click  or  to add or remove a camera adapter magnification.
<b>Total Magnification</b>	The theoretical magnification resulting from the individual magnifications of the above components.
<b>Camera pixel distance</b>	Select the corresponding pixel distance for your camera.  Click  or  to add or remove a cameras pixel distance.
<b>Assign scaling to image</b>	Applies the selected scale to the image and all subsequent images in the job.

**See also**




-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]



### 11.2.3.4 Create Measured Scaling Tool

This tool enables you to create a new scaling definition by measuring an object of known length. You can then use the scaling to perform the following:

- Scale images retrospectively
- Apply it as the standard scale for all future images and measurements acquired with an identical hardware setup

Parameter	Description
 <b>Select</b>	Enables you to select and modify existing measurements.
 <b>Draw Reference Line</b>	Enables you to specify a length by drawing a line. Use the Line tool for diagonal lines or to measure the distance between two points.
 <b>Draw Parallel Reference Line</b>	Enables you to specify a length by drawing parallel lines. The length is interpolated by calculating the "mid" line between the two parallel lines. Use the <b>Parallel Reference Line</b> tool when you, for example, wish to ensure that the measured length is in the middle of the ruler lines of an object micrometer.
<b>Automatic Line Detection</b>	<b>Activated:</b> The measurement tools automatically snap to edges/contours in the image.
[Measured value] <b>correspond to</b> [Value]	The measured number of pixels on the screen and the actual length of an object of known length.
<b>Units</b>	The units of the object of known length. This setting does not override the global units setting specified by the administrator.
<b>Scaling</b>	Displays the current scaling.
<b>Name</b>	Type in a custom name for the measured scaling.
<b>Save Scaling</b>	Saves the current scaling under the selected name. It can then be used by all other users.

#### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

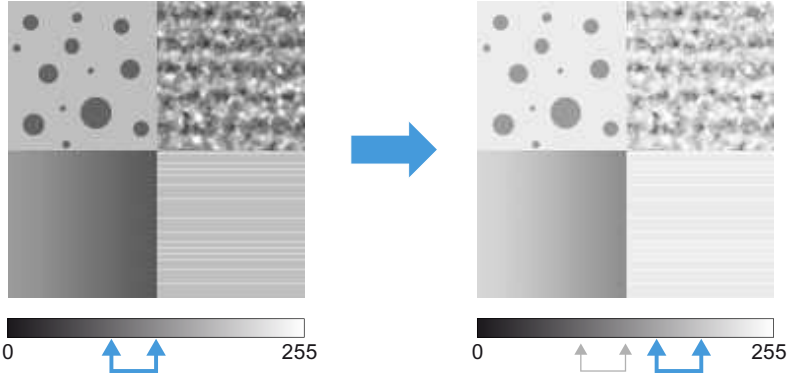
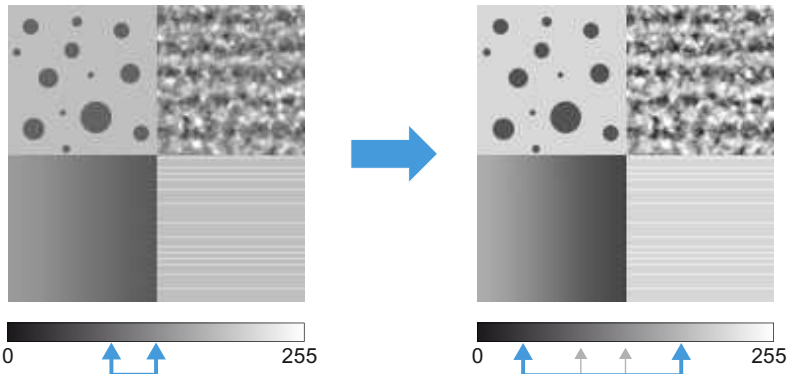
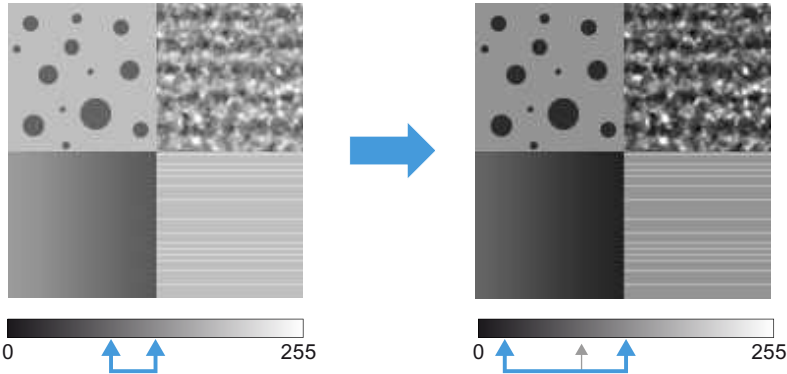
## 11.2.4 Processing

### 11.2.4.1 Image Processing

#### 11.2.4.1.1 Adjust

##### 11.2.4.1.1.1 Brightness/Contrast/Gamma Tool

This tool provides various methods to change the brightness and contrast of an image, depending on the pixels you want to adjust, e.g. all pixels, just darker pixels, etc.

Parameter	Description
Brightness	<p>Increases or decreases the value of each pixel by a constant value up to the limits (given by the pixel type).</p> <p>The range of brightness values (i.e. the relative brightness of light and dark areas of the image) remains constant.</p> 
Contrast	<p>Broadens or narrows the range of brightness values (i.e. the relative brightness of light and dark areas of the image). A high contrast helps distinguish the light and dark areas of the image. Increasing the contrast can cause subtle graduated tones to be lost, whilst decreasing the contrast can cause the image to look soft.</p> 
Gamma	<p>Enhances details in brighter or darker image regions. Setting the gamma value causes the value of each pixel to be multiplied by an individual factor. This factor depends on the pixel value (brightness) itself.</p>  <ul style="list-style-type: none"><li>Gamma &lt; 1:<ul style="list-style-type: none"><li>Details in bright image regions reduced</li><li>Details in dark image regions enhanced</li></ul></li></ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>Gamma = 1: No change</li> <li>Gamma &gt; 1: <ul style="list-style-type: none"> <li>Details in bright image regions enhanced</li> <li>Details in dark image regions reduced</li> </ul> </li> </ul>

**See also**

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

**11.2.4.1.1.2 Color Balance Tool**

This tool adjusts the hue of a color image. You can set the hue of each color channel for three pre-defined brightness ranges independently.

Parameter	Description
<b>Range</b>	Specifies the brightness range to which the hue settings apply
– Shadows	Dark pixels only
– Midtones	Intermediate pixels only
– Lights	Light pixels only
<b>Hue</b>	Sets the hue of each color channel for the selected brightness range

**See also**

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

**11.2.4.1.1.3 Color Temperature Tool**

This tool adjusts the color temperature of a color image by changing the hue.

Color temperature defines how a color appears dependent on the ambient lighting. If, for example, an image was acquired under light weighted towards the blue end of the spectrum, you can decrease the color temperature to make the image appear more like the sample would have been acquired in neutral lighting conditions.

Parameter	Description
<b>Temperature Delta</b>	<p>Specifies the hue by which the pixels are changed. Changing the value by 1 corresponds to a color temperature change of 10 Kelvin.</p> <ul style="list-style-type: none"> <li>Negative values reduce the color temperature, resulting in a warmer redder hue.</li> <li>Positive values increase the color temperature, resulting in a colder bluer hue.</li> </ul> <p>You can increase or decrease the color temperature by up to 3,000 Kelvin.</p>

See also

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

11.2.4.1.1.4 Enhance Local Contrast (CLAHE)

Enhance Local Contrast (CLAHE) Tone mapping is applied using the CLAHE algorithm. CLAHE is a tone mapping method which improves contrast and enhances edge definition, while avoiding over-amplification

Parameter	Description
Clip Limit	<p>Prevents the over-amplification of homogeneous areas by clipping a percentage of the higher frequency histogram data for redistribution across the histogram.</p> <p>A larger percentage value leads to more information being clipped for redistribution. A larger value will increase the overall contrast of the image.</p>
Region Size	<p>For processing, the image is divided into regions of a specified size at the same aspect ratio of the input image. The max region size is 50% of the X- or Y-dimension.</p> <p>For images with finer detail, a lower value is recommended. For images with large details, a higher value is recommended.</p>
Histogram Bins	<p>Determines the number of bins used to process the overall image. The larger the value, the finer the processing.</p>

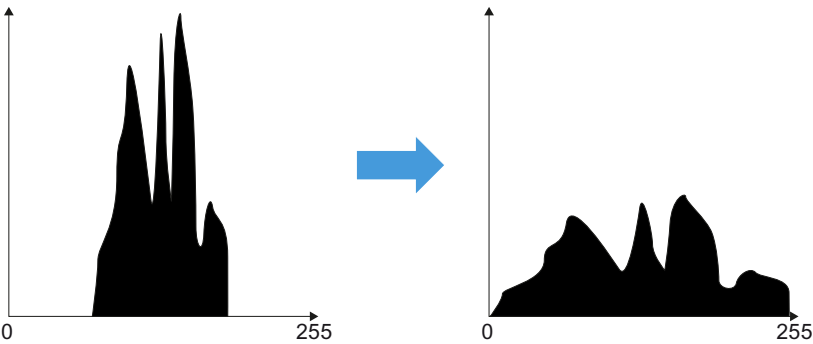
11.2.4.1.1.5 Histogram Equalization Tool

This tool increases the global contrast of an image.

Histogram equalization is particularly useful if the regions of interest and the background have similar pixel values, i.e. all the pixel values in the image lie close together.

Histogram equalization maps the highest occurring pixel value to the maximum pixel value given by **Upper Threshold** and the lowest occurring pixel value to the minimum pixel value given by **Lower Threshold**. The pixel values in between are mapped accordingly.

As a result, the pixel values are drawn apart and the contrast is increased.



Parameter	Description
All z-layers, All time points	Only visible, if the image is a Z stack/time series

Parameter	Description
	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The tool is applied to each image of the Z stack/time series.</li> <li>▪ <b>Deactivated:</b> The tool is applied to the currently selected image only.</li> </ul>
<b>Upper Threshold</b>	Defines the maximum value to which the highest occurring pixel value is mapped. <b>Upper Threshold</b> can be set to between 90% and 100% of the maximum pixel value.
<b>Lower Threshold</b>	Defines the minimum value to which the lowest occurring pixel value is mapped. <b>Lower Threshold</b> can be set to between 0% and 10% of the maximum pixel value.

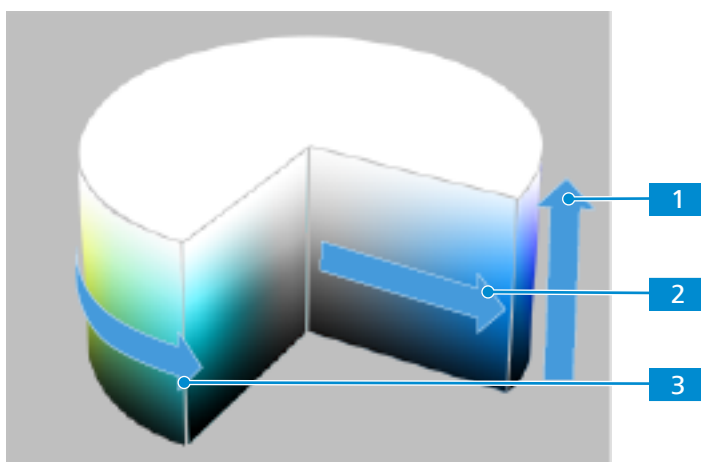
### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

#### 11.2.4.1.1.6 Hue/Saturation/Lightness Tool

This tool adjusts the color impression of an image by modifying the parameters in the HSL color space.

The HSL color space is an alternative color system. All colors available in the RGB color space are mapped to a cylinder.



- 1** Hue
- 2** Saturation
- 3** Lightness

In the HSL color space, a color is defined by the following (cylindrical) coordinates:

- Angle about the cylinder axis: Hue, which goes from red over green to blue.
- Radial distance from the cylinder axis: Saturation, which is a measure for the colorfulness.
- Height along the cylinder axis: Lightness, which expresses the brightness of a color relative to an equivalently illuminated white.

Parameter	Description
<b>Hue</b>	Shifts the color impression of the image towards red or blue.

Parameter	Description
	<ul style="list-style-type: none"> <li>Positive angles shift the hue towards red.</li> <li>Negative angles shift the hue towards blue.</li> </ul> <p>As shown above, the hue is defined by the angle about the HSL cylinder axis. The values -180 and +180 therefore have an identical effect.</p>
<b>Saturation</b>	Sets the colorfulness of the image between completely colorless (i.e. grayscale) at 0 and maximum colorful at 200.
<b>Lightness</b>	<p>Describes how bright or dark a color pixel appears.</p> <p>The lightness of a color pixel corresponds to the brightness of an equally bright gray pixel. It is the average of the red, green, and blue value of this pixel.</p> <p>The lightness slider is normalized such that -100 yields a uniform black image and +100 yields a uniform white image.</p>

**See also**

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

**11.2.4.1.1.7 Shading Correction Tool**

This tool compensates for uneven exposure of an image, such as vignetting. The uneven exposure (shading) might be caused by non-uniform illumination, non-uniform camera sensitivity, or dirt and dust on glass (lens) surfaces.

The tool loads a reference image and applies it to the unevenly exposed image. The reference image should contain information about the illumination only and no specific information, e.g. the structure of a sample. You can record the reference image as follows:

**Transmission microscope**

1. Remove the sample and sample holder from the light path.
2. Move the objective until the light source is out of focus.

A brightness distribution without any structural information is visible.

3. Acquire the image.

This image can be used as a reference image for the current light path. If you change any component of the light path, such as objective or beam splitter, you have to acquire a new reference image for the new light path settings.

**Reflection microscope**


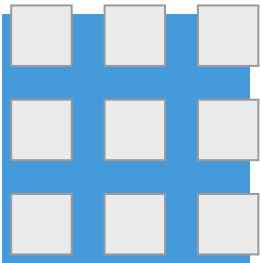
1. Use a white piece of paper as the sample.
2. Move the objective until the piece of paper is out of focus.

A brightness distribution without any structural information is visible.

3. Acquire the image.

This image can be used as a reference image for the current light path. If you change any component of the light path, such as objective or beam splitter, you have to acquire a new reference image for the new light path settings.

Parameter	Description
<b>in1</b>	Loads the input image which is exposed unevenly and needs to be corrected.

Parameter	Description
<b>in2</b>	loads the reference image containing the illumination pattern to be applied to the image from <b>in1</b>
<b>Shading Mode</b>	<p>The <b>Shading Mode</b> defines how ZEN core processes tile images used as <b>in1</b> input images. Tile images result from certain acquisition methods, such as tiles or panorama.</p> <p>If you apply <b>Shading Correction</b> to a simple image, you can ignore this setting.</p>
— Camera Shading 	<ul style="list-style-type: none"> <li>Applies the shading correction to each tile of a tile image separately.</li> <li>The size of the reference image (<b>in2</b>) should correspond to the size of a single tile.</li> </ul> <p><b>Automatic</b></p> <p><b>Activated:</b> Calculates a corrected image from the input image itself. The correction image from <b>in2</b> is ignored.</p> <p>If no reference image is available, such as a background image acquired without a sample, you can try this method.</p>
— Global Shading 	<ul style="list-style-type: none"> <li>Applies the shading correction globally to the whole input image composed of all tiles.</li> <li>The size of the correction image (<b>in2</b>) should correspond to the size of the whole input image composed of all tiles.</li> </ul>
<b>Display Mode</b>	Specifies how the reference image is applied
— Additive  — Multiplicative	<p>The reference image (<b>in2</b>) is normalized and then subtracted from the input image (<b>in1</b>).</p> <p>Use this if your reference image contains the (in-focus) background you wish to remove.</p> <p>The input image (<b>in1</b>) is divided by the normalized reference image (<b>in2</b>). This is the default setting.</p> <p>Use this if your reference image contains the illumination information as described above and you wish to correct for incorrect shading.</p>



Parameter	Description
<b>Offset</b>	Adjusts the brightness of the final image by adding a constant value to each pixel value.

### Info

If the input image and the reference image do not match in size, ZEN core acts in the following manner:

- ▶ If the reference image is smaller than the input image, the reference image is applied to the upper left corner of the input image.
- ▶ If the reference image is larger than the input image, the upper left corner of the reference image is applied to the input image.

### See also

-  Specifying Permitted and Expected Values for a Tool [▶ 59]
-  Configuring Tolerances for a Measurement [▶ 60]


#### 11.2.4.1.1.8 White Balance Tool

This tool enables you to adjust the colors of an image.



White balance enables you to remove a color cast (e.g. a red or green tint) from an image and to make the colors appear neutral. Poor white areas are changed to pure white.

The color temperature adjusts the overall hue of the image.

You can use white balance and color temperature to remove detrimental effects of ambient lighting. If, for example, an image was acquired under light weighted towards the blue end of the spectrum, you can use white balance and/or decrease the color temperature to make the image appear more like the sample would have been acquired in neutral lighting conditions.

Parameter	Description
<b>Automatic</b>	Selects the white balance point automatically and adjusts the hue of all other pixels accordingly.
 <b>Pick</b>	Enables you to specify the white balance point manually. The hue of all other pixels is adjusted accordingly.  To achieve an optimum result, pick a neutral white pixel.
<b>Temperature Delta</b>	Specifies the hue by which the pixels are changed. Changing the value by 1 corresponds to a color temperature change of 10 Kelvin. <ul style="list-style-type: none"> <li>▪ Negative values reduce the color temperature, resulting in a warmer redder hue.</li> <li>▪ Positive values increase the color temperature, resulting in a colder bluer hue.</li> </ul> <p>You can increase or decrease the color temperature by up to 3.000 Kelvin.</p>

### See also

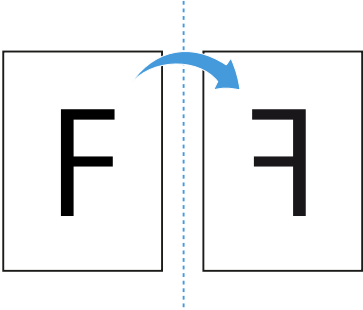
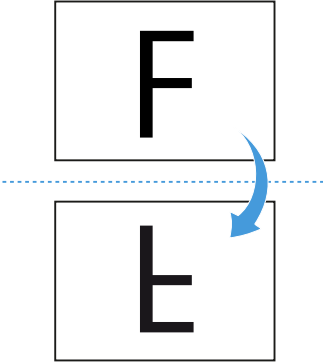
-  Specifying Permitted and Expected Values for a Tool [▶ 59]
-  Configuring Tolerances for a Measurement [▶ 60]



11.2.4.1.2 Geometric

11.2.4.1.2.1 Mirror Tool

This tool mirrors the image about a vertical or horizontal axis.

Parameter	Description
Display Mode	
- Horizontal	Mirrors the image about a vertical axis.
	
- Vertical	Mirrors the image about a horizontal axis.
	

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

11.2.4.1.2.2 Orthogonal Projection Tool


With this tool you extract specific parts of three-dimensional images. This is accomplished with three alternative projection planes, frontal in the XY direction, sagittal in YZ direction or transverse in XZ direction as seen from the observer of the image. You can choose between different projection methods. All methods have in common is that the pixels are analyzed by the observer along an imaginary projection beam. You can also determine the thickness of the projection planes, and thus the projection depth.

Info

In Job Mode, the start position and cut thickness settings are not taken into account. The projection is always executed there in its entirety.

Parameter	Description
<b>Projection Plane</b>	Choose the type of the projection plane: <ul style="list-style-type: none"> <li>▪ <b>Frontal (X/Y)</b></li> <li>▪ <b>Transverse (X/Z)</b></li> <li>▪ <b>Sagittal (Y/Z)</b></li> </ul>
<b>Method</b>	
– <b>Maximum</b>	Uses the brightest pixel along the projection beam.
– <b>Minimum</b>	Uses the darkest pixel along the projection beam.
– <b>Average</b>	Calculates the average of all pixel along the projection beam.
– <b>Weighted Average</b>	This method is related to the calculation of the extended depth of focus. It prefers structures with more lateral sharpness along the projection beam. The output image contains more significant details.
– <b>Standard Deviation</b>	Calculates the standard deviation of pixel gray values along the projection beam.
<b>Start Position</b>	Adjusts the starting position of the project plane in pixel units or z-stack positions depending on the chosen projection plane. The maximum range results automatically of the size of the input image.
<b>Thickness</b>	Adjust the thickness of the cutting plane in pixel or z-stacks depending on the chosen projection plane. The maximum range results automatically of the size of the input image.

### See also

 Image Processing Workbench [► 739]



#### 11.2.4.1.2.3 Resample Tool

This tool resizes an image in each direction separately.

Parameter	Description
<b>Adapt Sizes</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The image pane adjusts to the resized image. The entire resized image is visible.</li> <li>▪ <b>Deactivated:</b> The size of the image pane remains constant. If the image is enlarged, the parts of the image outside the image pane are cropped. Use <b>Shift in X</b> and <b>Shift in Y</b> to specify the section of the resized image that should be retained in the image pane.</li> </ul>
<b>Interpolation</b>	If the image is resized, the number of pixels changes. <b>Interpolation</b> defines the method used to calculate new pixels.
– Nearest Neighbor	<ul style="list-style-type: none"> <li>▪ Lowest quality</li> <li>▪ Shortest calculation time</li> </ul>
– Linear	<ul style="list-style-type: none"> <li>▪ Medium quality</li> <li>▪ Average calculation time</li> </ul>
– Cubic	<ul style="list-style-type: none"> <li>▪ Highest quality</li> </ul>


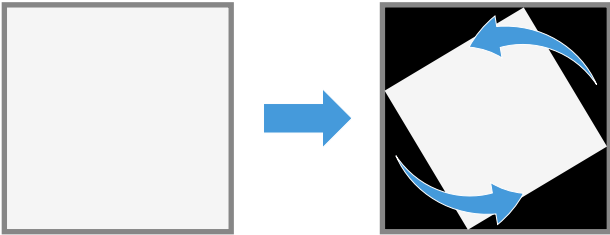
Parameter	Description
	<ul style="list-style-type: none"><li>Longest calculation time</li></ul>
Shift X, Shift Y	Use <b>Shift X</b> and <b>Shift Y</b> to display the desired section of the resized image.  Only available if <b>Adapt Sizes</b> is deactivated.
Scaling X, Scaling Y	Defines the scaling factor by which the image is resized. You can select the scaling factor for each direction separately.

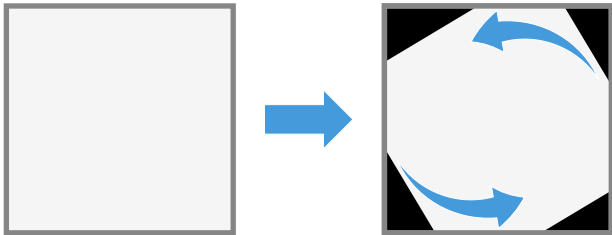
See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

11.2.4.1.2.4 Rotation Tool

This tool rotates the image counter-clockwise.

Parameter	Description
Horizontal Alignment	Enables you to correct a horizontal misalignment. If, for example, the sample was not aligned correctly on the motorized stage, it will appear rotated in the image. After clicking <b>Horizontal Alignment</b> , you can draw a line into the image to indicate which part of the sample should be parallel to the base of the image. The rotation angle is set accordingly.  
Angle	Sets the rotation angle by which the image rotates counter-clockwise.
Change Size	<ul style="list-style-type: none"><li><b>Activated:</b> The image pane is variable and adjusts to the rotated image. The image size varies and the corners are preserved. Empty areas are filled black.  </li><li><b>Deactivated:</b> The image pane is fixed and corresponds to the original image dimensions. The image size is preserved and corners rotated outside the fixed image pane are cropped. Empty areas are filled black.</li></ul>

Parameter	Description
	

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

11.2.4.1.2.5 Shift Tool

This tool shifts the content of an image horizontally or vertically. The size of the image pane (the area filled by the original image) does not change. Pixels shifted outside the image plane are deleted.

Parameter	Description
Shift X	Sets the number of pixels by which the image is shifted horizontally. <ul style="list-style-type: none"><li>▪ Positive values: The image is shifted to the right.</li><li>▪ Negative values: The image is shifted to the left.</li></ul>
Shift Y	Sets the number of pixels by which the image is shifted vertically. <ul style="list-style-type: none"><li>▪ Positive values: The image is shifted down.</li><li>▪ Negative values: The image is shifted up.</li></ul>

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

11.2.4.1.2.6 Stitching Tool

This tool enables you to combine a set of tiles into one large image. The maximum tile size is 32k x 32k.

This tool takes a tile image with the individual tiles placed next to each other as input and returns a single large image. The tiles are shifted and rotated against each other to make the transitions between them as seamless as possible. In addition, the tool enables you to correct uneven exposure (shading), either automatically or by means of a reference image.

Parameter	Description
Inplace	The stitching is applied to the original image.
New Output	A new image is generated as a result of the stitching process. The original image is not modified.
Fuse Tiles	Only available with <b>New Output</b> .

Parameter	Description
	<p><b>Activated:</b> All individual tile images are fused together after alignment.</p> <p><b>Deactivated:</b> The individual tile images are aligned but not fused.</p>
<b>Correct Shading</b>	<p>Only available with <b>New Output</b>.</p> <p><b>Activated:</b> Applies a shading correction to each image of prior to stitching.</p> <p><b>Deactivated:</b> The individual tile images are aligned but not fused.</p>
– Automatic	Automatically calculates a reference image from the input image.
– Reference	Uses an existing reference image. This must be selected in addition to the input image in the input tool of the image parameters section.
<b>Parameters</b>	
<b>Edge Detector</b>	<p>When acquiring tiles to create a single large image, the stage movement is not precise down to the pixel level of the camera sensor. To bypass this technical limitation and to have a margin to compensate for this inaccuracy, tiles are usually overlapped by a few percent.</p> <p>To align the tiles, the overlaps between neighboring tiles are analyzed. An edge detector may improve analysis results.</p>
– Yes	Applies an edge detection algorithm to the tiles internally to improve analysis of the overlaps between neighboring tiles. This may improve the alignment of the tiles and thus the stitching result.
– No	Omits edge detection. The quality of alignment of the tiles may be reduced.
<b>Minimal Overlap</b>	<p>The amount of overlap between neighboring tiles (in % of the area of a single tile) expected by the stitching tool. The tool evaluates this amount of overlap or more as required.</p> <p>The value to the overlap that was used for acquisition of the tiles is set. Larger values may improve the result but increase calculation time.</p> <p><b>Default:</b> 5%</p>
<b>Maximal Shift</b>	<p>Specifies the maximal extent of shift (in % of the area of a single tile) which can be applied to a tile during stitching.</p> <p><b>Default:</b> 10%</p>
<b>Comparer</b>	Specifies how the conformance of the tiles in the overlapping regions is evaluated.
– Basic	Basic comparison (faster)
– Best	Complex comparison (slower)
– Optimized	Optimized comparison
<b>Global Optimizer</b>	Specifies the number of overlaps evaluated during stitching. Evaluating more overlaps per tile yields a better stitched image, but requires more calculation time.
– Basic	Only one overlap per tile is evaluated.

Parameter	Description
– Best	All overlaps of a tile are evaluated.
<b>Defaults</b>	Resets all tool settings to the default values.
<b>Apply</b>	Combine the set of tiles into one large image.

**See also**

 Image Processing Workbench [► 739]

**11.2.4.1.3 Sharpen****11.2.4.1.3.1 Delineate Tool**

This tool emphasizes edges around structures in an image. It is useful for images where the gray value range of structures differs clearly from the gray value range of the pixels around them. In contrast to other sharpening tools, the halo effect around the emphasized edges is reduced.

Parameter	Description
<b>Threshold</b>	<p>The difference in gray values which specifies an edge between neighboring image regions</p> <p>The <b>Threshold</b> value should correspond roughly to the gray value difference between foreground objects and the background.</p>
<b>Size</b>	<p>Determines the size of image details which are enhanced – the smaller the <b>Size</b> value, the finer the details affected by the tool.</p> <p>The <b>Size</b> value should correspond to the size of the transition area between foreground objects and the background.</p>

**See also**

 Specifying Permitted and Expected Values for a Tool [► 59]

 Configuring Tolerances for a Measurement [► 60]

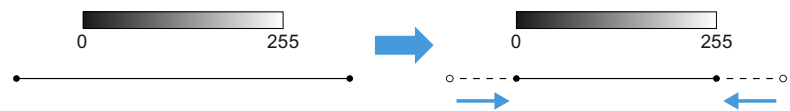
**11.2.4.1.3.2 Enhance Contours Tool**

This tool emphasizes fine structures in an image. It finds image regions where pixel values change rapidly, identifies these regions as contours and enhances them.

Parameter	Description
<b>Strength</b>	<p>Determines the size of image details which are enhanced - the higher the strength value, the finer the details affected by the tool.</p> <p>If you set the strength value too high, too many image details are enhanced. You obtain a grainy image and lose image information.</p>
<b>Parameter</b>	<b>Description</b>
<b>Normalization</b>	<p>Defines how out-of-range pixel values are mapped.</p> <p>The calculated pixel values of the output image may be out-of-range and are mapped into the available range.</p>

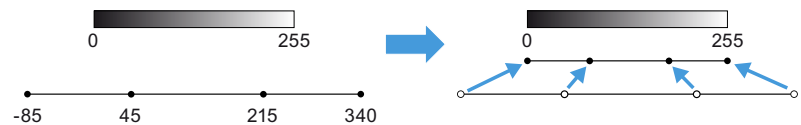
– Clip

Values exceeding the pixel value range are set to the highest value available (white), values falling short of the pixel value range are set to the lowest value available (black).



– Automatic

Normalizes the pixel values automatically to the available pixel value range. The highest resulting value is mapped to the maximum pixel value, the lowest resulting value to 0. As a result, the whole range of resulting pixel values is compressed evenly.



– Wrap

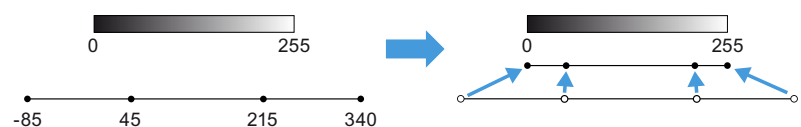
If a resulting value is larger than the maximum pixel value of the image, the difference exceeding the maximum pixel value is added to 0. Similarly, if a resulting value is below 0, the resulting pixel value is the maximum pixel value minus the difference falling below 0.



– Shift

Normalizes the output to the value "pixel value + maximum pixel value/2". As a result, all resulting values are mapped to the available value range.

The middle value of the pixel value range remains constant. Values left and right of the middle value are changed progressively, so that values inside the pixel value range are changed only slightly. Values outside the pixel value range are changed strongly and mapped to the fringes of the pixel value range.



– Absolute

Converts negative pixel values into positive values. Positive pixel values exceeding the maximum pixel value are set to the maximum pixel value.



### See also

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]

### 11.2.4.1.3.3 Unsharp Masking Tool

This tool enhances contrasts at fine structures and edges. Thus, the resulting image appears sharper.

Parameter	Description
<b>Strength</b>	Defines the amount of contrast enhancement applied to fine structures and edges. The higher the <b>Strength</b> , the greater the edge enhancement.
<b>Radius</b>	<p>Defines the size of detail to be enhanced and the appearance of enhanced edges</p> <ul style="list-style-type: none"> <li>Small radius: enhances small details</li> <li>Large radius: enhances large details</li> </ul> <p>A large radius leads to a halo along enhanced edges. The larger the radius, the broader this halo.</p>
<b>Color Mode</b>	Defines the calculation method, which affects the appearance of the output image
— RGB	<ul style="list-style-type: none"> <li>The sharpness is calculated for each color channel separately.</li> <li>The color saturation and the color of structures may be changed and color noise may occur.</li> </ul>
— Luminance	<ul style="list-style-type: none"> <li>The sharpness is calculated based on an average brightness signal of all color channels.</li> <li>This mode does not show any color noise or change of color saturation.</li> </ul>
<b>Threshold Mode</b>	<p>Specifies how the boundaries between sharpened image regions are calculated</p> <p>It is only effective if the <b>Threshold Low</b> value is not equal to 0 or the <b>Threshold High</b> value is not equal to 100.</p>
— None	No adjustment
— Binary	The boundaries follow the threshold values
— Linear	The boundaries follow a linear course calculated from the threshold values
<b>Threshold Low, Threshold High</b>	<p>Defines the minimum and maximum contrast along edges and structures which are to be affected by the <b>Unsharp Masking</b> filter</p> <p>Areas with a contrast in the range between <b>Threshold Low</b> and <b>Threshold High</b> are considered, areas showing a contrast outside the range are ignored.</p> <p>Use the threshold limits to avoid the following:</p> <ul style="list-style-type: none"> <li><b>Threshold High:</b> Setting it too high overemphasizes edges which already show a high contrast.</li> <li><b>Threshold Low:</b> Setting it too low leads to sharpening of false edges in relatively uniform areas. This can result in undesired speckles in low contrast areas.</li> </ul> <p>If you set <b>Threshold High</b> too low or <b>Threshold Low</b> too high, the <b>Unsharp Mask</b> filter will be reduced in its effect.</p>



Parameter	Description
<b>Clip To Valid Bits</b>	<ul style="list-style-type: none"> <li>▪ <b>Activated:</b> The output image is composed of the same colors as the input image (i.e. the value range of the output image is adjusted to the color range of the input image).</li> <li>▪ <b>Deactivated:</b> Colors not present in the original image may appear in the output image.</li> </ul>

### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

#### 11.2.4.1.4 Smooth

##### 11.2.4.1.4.1 Binomial Filter Tool

This tool reduces noise in an image. Each pixel is replaced by a weighted average of its neighbors. The weighting depends on the kernel size.

The binomial filter is very similar to a Gaussian filter in its effect. It is faster in terms of calculation time but offers fewer options.

Parameter	Description
<b>Kernel Size</b>	Sets the number of neighboring pixels taken into account. A higher kernel size leads to more noise reduction but also to a larger amount of blur in the resulting image.

### See also

- ▢ Gauss Tool [► 818]
- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

##### 11.2.4.1.4.2 Denoise Tool

This tool removes noise from an image using a real or a complex wavelet transformation. While common filter-based noise reduction tools always smooth the entire image and reduce details such as thin lines, the wavelet method preserves details as far as possible.

This tool uses the method of bivariate shrinkage with local variance estimation (thresholding) is used. [Bivariate Shrinkage with Local Variance Estimator, Levent Sendur and Ivan W. Selesnick, IEEE Signal Processing Letters, Vol. 9, No. 12, December 2012]

Parameter	Description
<b>Complex Wavelets</b>	<p>Uses the Dual-Tree Complex Wavelet Transform which provides extra coefficients (information) for analysis and yields better results</p> <ul style="list-style-type: none"> <li>▪ Lower probability of producing block artefacts</li> <li>▪ Computationally intense, slower</li> </ul>
<b>Real Wavelets</b>	Uses the discrete wavelet transform which has fewer coefficients (less information) for analysis

Parameter	Description
	<ul style="list-style-type: none"> <li>Higher probability to produce block artefacts</li> <li>Computationally easier, faster</li> </ul>

**See also**

- Specifying Permitted and Expected Values for a Tool [► 59]
- Configuring Tolerances for a Measurement [► 60]

**11.2.4.1.4.3 Gauss Tool**

This tool reduces noise in an image. Each pixel is replaced by a weighted average of its neighbors. The weighting depends on the sigma values.

The Gaussian filter is very similar to a binomial filter in its effect. It is slightly slower in terms of calculation time but allows you to define the strength by its sigma values instead of defining the filter size directly.

Parameter	Description
<b>Sigma X, Sigma Y</b>	<p>Determines how much neighboring pixels in horizontal and vertical direction contribute to the weighting.</p> <p>Larger values in sigma broaden the applied Gaussian distribution and lead to reduced noise in the corresponding direction, but also to an increasing loss of image information (blur).</p>

**Info**

The Gaussian filter is particularly useful for edge detection, which is very sensitive to noise. Using a Gaussian filter before detecting edges greatly improves the results.

**See also**

- Specifying Permitted and Expected Values for a Tool [► 59]
- Configuring Tolerances for a Measurement [► 60]
- Enhance Contours Tool [► 814]
- Binomial Filter Tool [► 817]

**11.2.4.1.4.4 Lowpass Tool**

This tool reduces noise in an image. Each pixel is replaced by the average of its neighbors. The area which contributes to the average value is determined by the kernel size.

Parameter	Description
<b>Count</b>	<p>Specifies the number of times the tool is applied</p> <p>More repetitions leads to stronger noise reduction but also to more loss of image detail.</p>
<b>Kernel Size X, Kernel Size Y</b>	Determines the number of neighboring pixels taken into account

**See also**

- 📖 Specifying Permitted and Expected Values for a Tool [► 59]
- 📖 Configuring Tolerances for a Measurement [► 60]

#### 11.2.4.1.4.5 Median Tool

This tool reduces noise in an image. Each pixel is replaced by the median of its neighbors. The number of neighboring pixels taken into account depends on the kernel size.

Parameter	Description
<b>Kernel Size X, Kernel Size Y</b>	Determines the number of pixels taken into account in horizontal and vertical direction.  Larger kernel sizes lead to reduced noise in the corresponding direction, but also to an increasing loss of image information (blur).

#### Info

In a set of values (in this case the pixel values taken into account), the median is the middle value for which the number of larger values is equal to the number of smaller values.

#### See also

- 📖 Specifying Permitted and Expected Values for a Tool [► 59]
- 📖 Configuring Tolerances for a Measurement [► 60]

#### 11.2.4.1.4.6 Sigma Tool

This tool reduces noise in an image. The noise is removed selectively in image areas that have a relatively uniform brightness. As a result, fine object structures are not modified.

Each pixel is replaced by an average of its neighbors. In order to calculate the average, only the brightness values that lie within a defined range (+/- sigma) around the brightness value of the central pixel are taken into account.

Parameter	Description
<b>Sigma</b>	Defines which neighboring pixels are taken into account.  For example, if <b>Sigma</b> equals 50, only neighboring pixels deviating by less than $\pm 50$ from the brightness value of the central pixel are used to calculate the new value of this pixel.
<b>Kernel Size X, Kernel Size Y</b>	Specifies the number of neighboring pixels taken into account for each pixel.

#### See also

- 📖 Specifying Permitted and Expected Values for a Tool [► 59]
- 📖 Configuring Tolerances for a Measurement [► 60]

#### 11.2.4.1.4.7 Single-Pixel Filter Tool

This tool removes single pixel phenomena.

Single pixel phenomena can occur due to a faulty exposure of single pixels or lines of pixels, resulting from one of the following:

- Adverse ambient conditions
- Adverse timing of successive image acquisitions
- The properties of the camera sensor itself

The incorrectly exposed pixels are typically recognizable as particularly light or dark points or lines.

Parameter	Description
<b>Threshold</b>	<p>Specifies if a single bright pixel is removed (i.e. adapted to its neighboring pixels). The effect of <b>Threshold</b> depends on the neighboring pixels.</p> <p>The higher the <b>Threshold</b>, the brighter a pixel has to be compared to its neighboring pixels to be removed by the filter.</p>

See also

- 📖 Specifying Permitted and Expected Values for a Tool [► 59]
- 📖 Configuring Tolerances for a Measurement [► 60]

11.2.4.1.4.8 Whitening Tool

**Info**

**Prerequisite**

This function is only available if you have installed the **3rd party Python Tools** during the installation of ZEN software.

This tool removes "correlated noise components" from an image, resulting in an image with so-called "white noise", where the noise in every pixel is not correlated with the noise found in neighboring pixels. Such an ideal noise is also called "White Noise". This tool should be used to pre-process image data that is later used to train an Noise2Void denoising model using the ZEN Intellesis Denoising. Keep in mind that applying a model trained on "whitened" datasets should be only applied to "whitened" images.

Parameter	Description
<b>Processing Direction</b>	Sets the direction in which the data is processed.
– <b>Horizontal</b>	Processes the image in horizontal vectors only.
– <b>Vertical</b>	Processes the image in vertical vectors only.
– <b>All</b>	Processes the image in all directions.
<b>Apply</b>	Applies the whitening to the image.

See also

- 📖 Creating and Training an Intellesis Denoising Model [► 320]
- 📖 Using a Trained Model for Denoising [► 321]

11.2.4.1.5 Utilities

11.2.4.1.5.1 Add Channels Tool

This tool combines the channels of two images into a multi-channel image. The number of resulting channels equals the sum of the channels of each image.

The color channels of an RGB color image are not considered separate channels, i.e. if you combine two RGB images the result is a multichannel image with two channels (and not six).

Parameter	Description
in1, in2	Specifies the two images to be combined into a multi-channel image

See also

- ▢ Specifying Tools for a Task [▶ 58]
- ▢ Configuring Tolerances for a Measurement [▶ 60]

11.2.4.1.5.2 Change Pixel Type Tool

This tool changes the amount of information stored in a grayscale or color image. For example, you can use this tool to change a color image into a gray scale image or a 24 Bit RGB image into a 48 Bit RGB image. This can be useful if you want to compare or combine images with different pixel types.

Parameter	Description
Pixel Type	<p>Specifies the following properties of the image:</p> <ul style="list-style-type: none"><li>▪ Number of channels</li><li>▪ Range of pixel values per channel</li><li>▪ Number format</li></ul> <p>For supported values, see <i>Pixel Type</i> [▶ 112].</p>

Info

Consider the following before changing the pixel type:

- ▶ If you select a pixel type smaller than the current pixel type, you might reduce the image quality and lose image information. This information cannot be restored later.
- ▶ If you select a pixel type larger than the current pixel type (e.g. 48 Bit RGB for an 24 Bit RGB image), the image quality does not improve. However, the range available for certain image processing operations is extended.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [▶ 59]
- ▢ Configuring Tolerances for a Measurement [▶ 60]

11.2.4.1.5.3 Combine RGB Tool

This tool generates a color image from three grayscale input images. Each grayscale image contains the pixel values of one of the color channels; red, green, and blue.

You can use this tool to create a color image as follows:

- Combine the individual channels of a color image  
If a color image is split into individual images for each channel (for example to modify one of them), you can recombine the images (channels) into a single color image.
- Combine images acquired using a B/W camera in combination with red, green, and blue color filters  
Acquire three grayscale images applying one of the filters for each image and combine them into a color image.

If you use a color image as an input for **Combine RGB**, the tool first converts it into a grayscale image. It does not extract the data from the corresponding color channel.

**Example:** If you use a color image as the input of the blue channel, the tool calculates a mean grayscale image and does not extract the data from its blue channel. This grayscale image for the blue channel is then combined with the input images for the red and green channels.

Parameter	Description
<b>in1, in2, in3</b>	Specifies the gray scale images representing the red, green, and blue channel of the output image. Avoid using color images as input.
<b>Output Pixel Type</b>	Sets the pixel type (i.e. color depth) of the output image. <i>Pixel Type</i> <a href="#">[▶ 112]</a>

#### See also

- 📖 Specifying Permitted and Expected Values for a Tool [\[▶ 59\]](#)
- 📖 Configuring Tolerances for a Measurement [\[▶ 60\]](#)
- 📖 Split into RGB Tool [\[▶ 826\]](#)

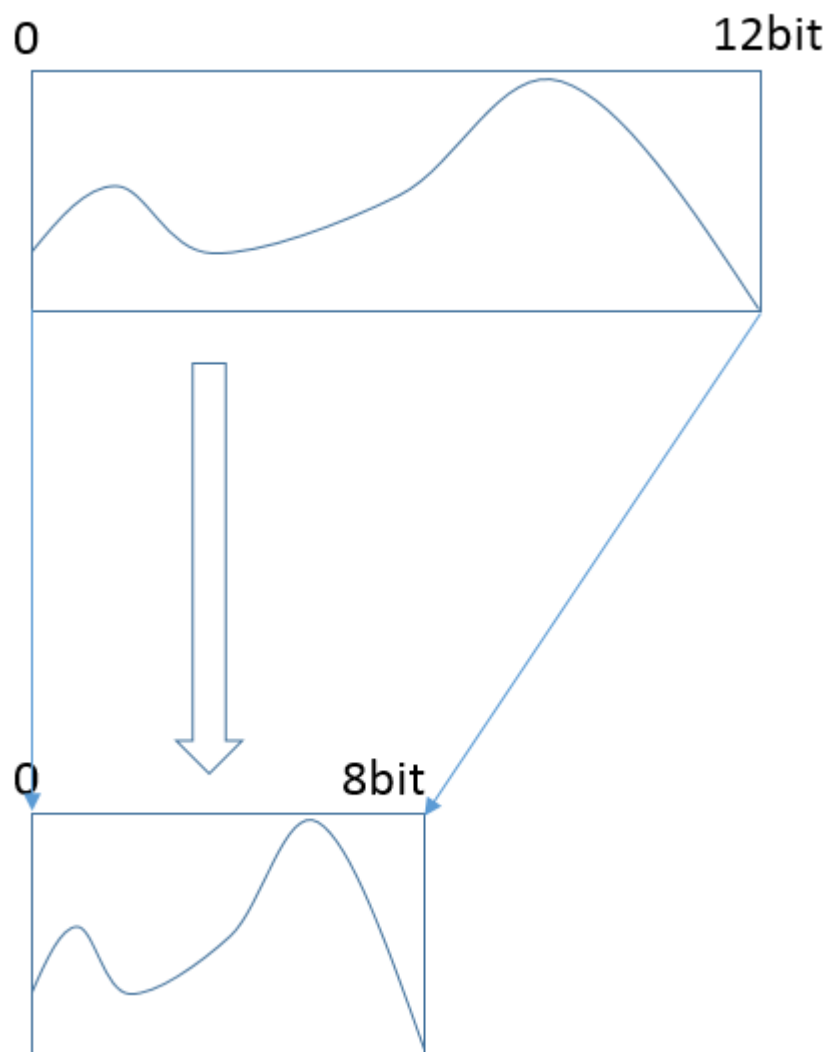
#### 11.2.4.1.5.4 Convert Pixel Format Tool

With this tool, you can convert pixel formats. If you work with **NMI Analysis**, **8 Bit B/W** and **24 Bit RGB** pixel types are relevant.

Parameter	Description
<b>Pixel Type</b>	<p>Select the pixel type depending on the image you want to process:</p> <ul style="list-style-type: none"> <li>▪ <b>8 Bit B/W</b> to process black and white images.</li> <li>▪ <b>16 Bit B/W</b></li> <li>▪ <b>32 Bit B/W Float</b></li> <li>▪ <b>2 x 32 Bit Complex</b></li> <li>▪ <b>24 Bit RGB</b> to process images with nitrides.</li> <li>▪ <b>48 Bit RGB</b></li> <li>▪ <b>3x 32 Bit RGB Float</b></li> <li>▪ <b>3 x 64 Bit RGB Complex</b></li> </ul> <p>For more information on pixel formats, see <i>Pixel Type</i> <a href="#">[▶ 112]</a>.</p>

#### Example:

You can convert a 12-bit image directly to the selected pixel type without internal conversion to 16-bit. In this case, the range from 0 to 4095 is mapped to a range from 0 to 256, if the target pixel type 8-bit.



If you work with **NMI Analysis**, **8 Bit B/W** and **24 Bit RGB** pixel types are relevant.

11.2.4.1.5.5 Copy Tool

This tool generates a copy of the current image. It includes the image contents only; any annotations, measurements, tables et cetera will be omitted.

See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

11.2.4.1.5.6 Copy Annotations Tool

This tool copies the annotations of one image into another image.

Parameter	Description
<b>Preserve Scaled Size</b>	Has an effect if the size of the target image is different from the size of the source image: <ul style="list-style-type: none"><li>▪ <b>Activated:</b> The copied annotations remain unchanged.</li></ul>

Parameter	Description
	<ul style="list-style-type: none"> <li>▪ <b>Deactivated:</b> The copied annotations are scaled according to the possible image size difference.</li> </ul>

### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]

#### 11.2.4.1.5.7 Create Image Subset Tool

This method allows you to extract parts from one image and use these to create a new image. You can select these parts freely from the individual dimensions of the image.

### Info

Each of the sections described below is only visible if the corresponding dimension is present in the input image.

### Parameter

Parameter	Description
<b>Channels</b>	Here you can select which channels of the input image you want to be used. All channels are selected by default. To deselect a channel, click on the relevant channel button.
<b>Z-Position, Time, Block</b>	Here you can select which parts of the input image you want to use for the resulting image.
- Extract All	If selected, all parts of the corresponding image are extracted.
- Extract Single	If selected, you can select a single image to be extracted.
- Extract Range	If selected, you can select a certain range of images to be extracted.
- Extract Multiple	<p>If selected, you can select several continuous ranges and individual sections.</p> <p>Enter one or more sections that you want to select in the input field. To do this, enter the first section, followed by a minus sign, and then the last section. If you want to define an interval, after the last section enter a colon and then the interval. The entry "2-10:2" means that every second section is selected from section 2 to section 10.</p> <p>Enter a comma after the first section if you want to define another section. You can also select individual sections separated by commas. By entering "2-10:2,14-18,20,23", you select every second section from section 2 to section 10, followed by sections 14 to 18, as well as sections 20 and 23.</p>
- Get current position	Adopts the position from the current display in the image area.
- Interval	<p><b>Activated:</b> Interval mode is active. The Interval spin box/input field appears.</p> <p>Enter the desired interval here. E.g. if you enter the value 2 only every 2nd value from the range is considered.</p>



Parameter	Description
<b>Region</b>	Here you can select if you want to use the entire image or just a region (ROI) of the input image.
- Full	If selected this option, the full image is used for the new image.
- Rectangle region (ROI)	If selected this option, you can draw in a rectangle region of interest which will be used for creating a new image.  If a rectangle region was drawn in you can see and change its coordinates by editing the <b>X/Y/W/H</b> input fields.
- Keep tiles	Has only an effect, if a region (ROI) is defined.  <b>Activated:</b> Extracts the drawn in region including the complete tiles. This setting is recommend when you want to apply DCV processing functions on the resulting image.

#### 11.2.4.1.5.8 Fuse Image Subset Tool



This method allows you to insert an image subset back into the original image. Its contents are replaced by the contents of the image subset. Using this method you can process a previously created image subset using image processing functions and copy the result back into the original image.

#### 11.2.4.1.5.9 Generate Image Pyramid Tool

This tool generates a set of images at different resolutions. This enables you to zoom in, out, and navigate efficiently even in very large tile images.

Parameter	Description
<b>Background</b>	Defines the background color used in the image pane when scaling down the image.

#### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]



#### 11.2.4.1.5.10 Grayscale Tool

This tool can generate various types of grayscale images. You can use this tool for creating test images, e.g. to test the effects of the different image processing tools.

Parameter	Description
<b>Pattern</b>	Specifies whether a uniform grayscale image or a grayscale gradient image is created.
— Uniform	Creates a uniform image from a single grayscale value
— 2D Gray Scale Horizontal	Creates a grayscale gradient in horizontal direction.

Parameter	Description
– 2D Gray Scale Vertical	Creates a grayscale gradient in vertical direction.
<b>Width, Height</b>	Sets the width and height of the output image in pixels.
<b>Min. Gray Value, Max. Gray Value</b>	Sets the upper and lower value of the grayscale gradient. A very small difference between the two values results in a visibly coarse gradient.
<b>Pixel Type</b>	Sets the pixel type (i.e. color depth) of the image.

**See also**

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

**11.2.4.1.5.11 Image Generator Tool**



This tool creates test images from scratch, in a variety of patterns.

**Info**

If you use this tool in a job after loading or acquiring and processing an image, any image data from previous steps is lost and cannot be exported.

Parameter	Description
<b>Width, Height</b>	Specifies the width and height of the generated image in pixels.
<b>Z-Slices</b>	Specifies the number of layers if you wish to create a Z-stack test image.
<b>Channels</b>	Specifies the number of channels if you wish to create a multi-channel test image.
<b>Time Slices</b>	Specifies the number of successive images if you wish to create a time series test image.
<b>Min. Gray, Max. Gray</b>	Sets the upper and lower pixel values of the selected pattern.
<b>Pixel Type</b>	Specifies the pixel type of the generated image, e.g. 8 Bit B/W or 24 Bit RGB, see also <i>Pixel Type</i> [► 112].
<b>Pattern</b>	Specifies the pattern of the output image.

**See also**

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

**11.2.4.1.5.12 Split into RGB Tool**

This tool generates three grayscale images from an RGB image. Each color channel (red, green, and blue) is copied and stored as a grayscale image.

This tool is useful if you plan to modify the color channels separately and recombine them to an RGB image afterwards.

Parameter	Description
<b>Output Pixel Type</b>	Specifies the following properties of the images: <ul style="list-style-type: none"> <li>Number of channels</li> <li>Range of pixel values per channel</li> <li>Number format</li> </ul>

**See also**

- 📄 Specifying Permitted and Expected Values for a Tool [► 59]
- 📄 Configuring Tolerances for a Measurement [► 60]
- 📄 Combine RGB Tool [► 821]

**11.2.4.1.5.13 Channels to Labels Tool**

This tool converts the channels of an image into labels.

Parameter	Description
<b>Output Pixel Type</b>	Selects the pixel type of the output image after applying this tool.
— 8 Bit B/W	Converts the image into a 8 Bit black and white image.
— 16 Bit B/W	Converts the image into a 16 Bit black and white image.

**11.2.4.1.5.14 Labels to Channels Tool**

This tool converts the labels of an image into channels.

Parameter	Description
<b>Labels (optional)</b>	Selects the labels which should be converted into channels.


**11.2.4.1.5.15 Fast Extended Depth of Focus Tool**

With this tool you define settings to acquire EDF images to inspect surfaces or surface structures.

Parameter	Description
<b>Presets</b>	
— <b>Default</b>	Sets the default values.
— <b>Custom</b>	Sets the values you have specified manually.
— <b>Small Structures</b>	Sets optimized parameters for samples with small sized structures.
— <b>Medium Structures</b>	Sets optimized parameters for samples with medium sized structures.
— <b>Large Structures</b>	Sets optimized parameters for samples with large sized structures.
<b>Smoothing</b>	Specifies the factor to smooth the image and thus reduce noise. Larger values lead to a smoother image.

Parameter	Description
	Use the slider to adjust the desired value. Value Range: <b>1</b> to <b>15</b> Default Value: <b>9</b>
<b>Pixelwise Iteration</b>	Use the slider to adjust the desired value. Larger values lead to a smoother image. Use the slider to adjust the desired value. Value Range: <b>0</b> to <b>16</b> Default Value: <b>2</b>
<b>Depthwise Kernel Size</b>	Larger values lead to a more robust image, especially for areas with low contrast. Should only be used by small depth of focus step sizes. Use the slider to adjust the desired value. Value Range: <b>0</b> to <b>20</b> Default Value: <b>0</b>
<b>Resize Ratio</b>	Sets the scaling factor. Default Value: <b>0.25</b> <ul style="list-style-type: none"> <li>▪ <b>0.25</b></li> <li>▪ <b>0.5</b></li> <li>▪ <b>1.0</b></li> </ul>

### See also

 Image Processing Workbench [► 739]

#### 11.2.4.1.5.16 Fast Topography Tool

With this tool you define settings to acquire topography images to inspect surfaces or surface structures.

Parameter	Description
<b>Presets</b>	
– <b>Default</b>	Sets the default values.
– <b>Custom</b>	Sets the values you have specified manually.
– <b>Small Structures</b>	Sets optimized parameters for samples with small sized structures.
– <b>Medium Structures</b>	Sets optimized parameters for samples with medium sized structures.
– <b>Large Structures</b>	Sets optimized parameters for samples with large sized structures.
<b>Smoothing</b>	Specifies the factor to smooth the image and thus reduce noise. Larger values lead to a smoother image. Use the slider to adjust the desired value.

Parameter	Description
	Value Range: <b>1</b> to <b>15</b> Default Value: <b>9</b>
<b>Pixelwise Iteration</b>	Larger values lead to a smoother image. Use the slider to adjust the desired value. Use the slider to adjust the desired value. Value Range: <b>0</b> to <b>16</b> Default Value: <b>2</b>
<b>Depthwise Kernel Size</b>	Larger values lead to a more robust image, especially for areas with low contrast. Should only be used by small depth of focus step sizes. Use the slider to adjust the desired value. Value Range: <b>0</b> to <b>20</b> Default Value: <b>0</b>
<b>Bilateral Sigma Color</b>	Special kind of filter, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
<b>Bilateral Sigma Space</b>	Special kind of filter, which helps to reduce waviness of plane areas but conserves steps. Use the slider to adjust the desired value.
<b>Resize Ratio</b>	Sets the scaling factor. Default Value: <b>0.25</b> <ul style="list-style-type: none"> <li>■ <b>0.25</b></li> <li>■ <b>0.5</b></li> <li>■ <b>1.0</b></li> </ul>
<b>QM Threshold</b>	Quality map (QM) measures the reliability of height measurements. The QM threshold defines a level for which all areas with low reliability will be interpolated. Value Range: <b>0</b> to <b>20</b> Default Value: <b>2</b>
<b>Spike Width</b>	Defines the lateral xy-size of spikes. These are wrongly defined height values which must be detected and eliminated. Value Range: <b>3</b> to <b>101</b> Default Value: <b>9</b>
<b>Removal Strength</b>	Defines the sensitivity for eliminating spikes. Value Range: <b>0</b> to <b>20</b> Default Value: <b>1</b>
<b>Iterations</b>	Sets the countdown timer interval. Value Range: <b>0</b> to <b>21</b> Default Value: <b>5</b>
<b>Reconstruction</b>	

Parameter	Description
- <b>PDE</b>	Partial Differential Equation
- <b>No inpainting</b>	Holes in heightmaps will not be repaired.
- <b>Linear</b>	Interpolates linearly.


**See also**

 Image Processing Workbench [► 739]

**11.2.4.2 Table Processing****11.2.4.2.1 Append Table Tool**

This tool enables you to merge tables of measurement results. You can select any results or data table in your current experiment. If you want to merge a table from your file system, you must first import it.

The resulting merged table can be included in a report, exported to the file system, or used to create a histogram.

Parameter	Description
<b>Placeholders</b>	<p>The placeholders enable you to select the tables to be merged. You can only merge two tables. The tables are merged in the order displayed (i.e. the table added to the right placeholder is appended below the table in the left placeholder).</p> <p>Click the  arrow in a placeholder and select the corresponding table.</p>
<b>Apply</b>	Merges the two tables and creates a new combined table

**See also**

 Specifying Permitted and Expected Values for a Tool [► 59]

 Configuring Tolerances for a Measurement [► 60]



**11.2.4.2.2 Calculate Histogram Tool**

This tool calculates a frequency distribution from a table of measurement results.

Parameter	Description
<b>Classification Column(s)</b>	Here you can select the column of the table of measurement results for which the frequency distribution is calculated, e.g. ID, Area Perimeter.
<b>Class Boundary Type</b>	Specifies how to establish the interval for the classification:
- <b>&gt;=,...,&lt;</b>	
- <b>&gt;,...,&lt;=</b>	
<b>Class Count</b>	

Parameter	Description
<b>Class Boundaries</b>	
<b>Determine minimum and maximum from the data</b>	
<b>Use equidistant boundaries</b>	
<b>Logarithmic boundaries</b>	<b>Activated:</b> Classes with a low number of elements are emphasized against classes with a high number of elements.
<b>Use classification columns for the output table</b>	
<b>Aggregate Function</b>	Specifies how the count of each class is displayed:
– <b>Count</b>	The number of elements in each class is displayed.
– <b>Count Cumulative</b>	For each class, the added up count from zero to this class is displayed.
– <b>Percentage</b>	The number of elements in each class is displayed as a percentage of the total count of elements.
– <b>Percentage Cumulative</b>	For each class, the added up percentage from zero to this class is displayed.
– <b>Sum</b>	The sum of the values of the elements in each class is displayed
– <b>Sum Cumulative</b>	For each class, the added up sum from zero to this class is displayed.
– <b>Percentage Sum</b>	The sum of values of the elements in each class is displayed as a percentage of the total sum of all values.
– <b>Percentage Sum Cumulative</b>	For each class, the added up sum from zero to this class is displayed as a percentage of the total sum of all values.

**See also**

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

**11.2.4.2.3 Create Chart Tool**

With this tool you can create different type of charts from a table, e.g. when you have created a table from an image containing measurements.

Parameter	Description
<b>Labels from</b>	Here you can select which row is used for the labels of the chart. Depending on the table file you have created, you can select different rows like <b>Tool</b> , <b>Feature</b> , etc.

Parameter	Description
<b>Data from</b>	Here you can select the row for the value of the chart.
<b>Type</b>	<p>Here you can select the chart type. Three different chart types are available:</p> <ul style="list-style-type: none"> <li>▪ <b>Bar Chart</b> The table is displayed as bar chart.</li> <li>▪ <b>Line Chart</b> The table is displayed as line chart.</li> <li>▪ <b>Pie Chart</b> The table is displayed as pie chart.</li> </ul>
<b>Width (inch)</b>	Select the desired output width of the chart (in inches) here.
<b>Height (inch)</b>	Select the desired output height of the chart (in inches) here.
<b>Resolution</b>	<p>Select the desired resolution for the chart image here.</p> <ul style="list-style-type: none"> <li>▪ Screen resolution (96 ppi) Recommended if you use the chart for digital (on-screen) publications.</li> <li>▪ Printing resolution (300 ppi) Recommended if you want to print out the chart.</li> </ul>
<b>Apply</b>	If you click on <b>Apply</b> , the chart image is generated. You will see it in the documents list on the right side of the screen. To export the chart right-click on the image in the documents list and select <b>Save As...</b>

### See also

 Creating Charts From a Table File [► 120]

#### 11.2.4.2.4 Statistics Table Tool

This tool enables you to create statistics tables. There will be statistics for all columns which contain numerical values.

The result table can be included in a report in which all **activated** parameters will be visible (see below).

Parameter	Description
<b>Tool Setup</b>	<p>Defines the input table for the Statistics Table Tool. Only available in <b>Job Mode</b>.</p> <p>In <b>Free Mode</b> the table selection has to be done by the user beforehand.</p>
<b>Minimum</b>	<b>Activated:</b> Sets the row with the minimum numerical value.
<b>Maximum</b>	<b>Activated:</b> Sets the row with the maximum numerical value.
<b>Mean</b>	<b>Activated:</b> Sets the row with the mean numerical value.
<b>Standard Deviation</b>	<b>Activated:</b> Sets the row with the standard deviation value.



**See also**

 Table Processing Workbench [▶ 741]

**11.2.4.2.5 Join Multiple Tables Tool**

This tool enables you to join multiple tables of the same table type. Those tables must be an output of a loop task. The Join Multiple Tables tool is not available in **Free Mode**, only in **Job Mode**. The result of the tool can be included in a report, used to create a histogram or a chart.

Parameter	Description
<b>Tool Setup</b>	Defines the input for the Join Multiple Tables tool.
<b>Placeholder</b>	Enables you to select the type of tables to be joined.

**See also**

 Table Processing Workbench [▶ 741]

**11.2.4.2.6 Category Histogram Tool**

This tool calculates the histogram for Category values.

Parameter	Description
<b>Category Column</b>	Selects the column with category values that should be used for creating the histogram.
<b>Apply</b>	Creates a table with which you can plot a histogram for the category values.

**11.2.4.3 Split by Dimension Tool**

Parameter	Description
<b>Select Dimension</b>	
- Scene	Extracts scenes in the image and exports each of them as a separate image.
- None	Does not split the image.
<b>Scene</b>	
- Extract All	Default value. <b>Activated:</b> All scenes of the corresponding image are extracted.
- Extract Single	<b>Activated:</b> You can select a single image to be extracted.
- Extract Range	<b>Activated:</b> You can select a certain range of images to be extracted.
- Extract Multiple	<b>Activated:</b> You can select several continuous ranges and individual sections.
<b>Keep tiles</b>	<b>Activated:</b> Tiles are kept for each image.
<b>Default</b>	Selects the default value of the <b>Scene</b> options.

See also

 Split Image Workbench [► 742]

11.2.5 Measurement


11.2.5.1 Image Analysis

11.2.5.1.1 Measurement Data Tool

This tool displays the particle data results based on the previous conducted image analysis by threshold segmentation.

See also


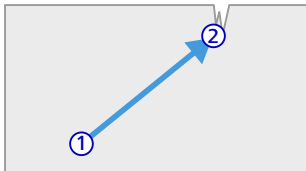
 Technical Cleanliness Analysis (TCA) [► 536]

 Measurement Data Workbench [► 743]

11.2.5.2 Interactive Measurements

11.2.5.2.1 Annotations


11.2.5.2.1.1 Arrow Tool

Icon	Description	Use
	Adds an arrow to the image to indicate a feature.	<ul style="list-style-type: none"><li>Click to specify the location of the tail and head of the arrow.</li></ul> 

See also


 Layering Interactive Measurements [► 136]

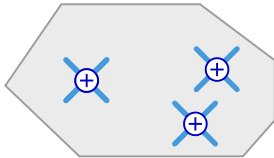
 Adding an Annotation to Interactive Measurements [► 136]

 Editing Interactive Measurements [► 137]

 Hiding an Interactive Measurement [► 139]

11.2.5.2.1.2 Events Tool


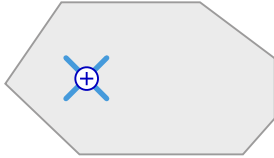
Icon	Description	Use
	Adds multiple crosses to the image to indicate the location of features.	<ul style="list-style-type: none"><li>Click to specify the location of the crosses.</li></ul> <p>The coordinates and intensity (pixel value) are displayed next to each cross.</p>

Icon	Description	Use
		

See also

- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]


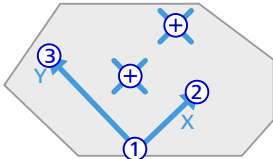
11.2.5.2.1.3 Marker Tool

Icon	Description	Use
	Adds a cross to the image to indicate the location of a feature and measures the intensity of the selected pixel.	<ul style="list-style-type: none"><li>Click to specify the location of the cross. The coordinates and intensity (pixel value) are displayed next to the cross.</li></ul> 

See also

- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]


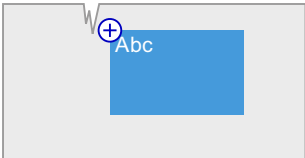
11.2.5.2.1.4 Points Relative Tool

Icon	Description	Use
	Enables you to draw perpendicular axes to define a relative coordinate system in the image. You can then mark points in the image and display the locations of the points in the relative coordinate system.	<ol style="list-style-type: none"><li>Click to set the origin of the relative coordinate system.</li><li>Click to set the direction of the positive x and y axes.</li><li>Click to define points in the new coordinate system.</li></ol> 

See also

- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]

11.2.5.2.1.5 Text Tool


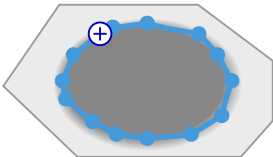
Icon	Description	Use
	Adds a text box to the image.	<ul style="list-style-type: none"><li>Click to specify the location of the top left corner of the text box.</li><li>To change the rotation of the text box, click and drag the node above the text box (<b>rotate</b> icon).</li></ul> 

See also

- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]

11.2.5.2.2 Areas/Contours


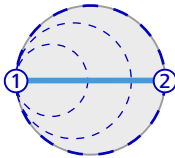
11.2.5.2.2.1 Active Contour Tool

Icon	Description	Use
	Measures the area enclosed by a line (in pixels) along a contour of constant brightness. It also measures the mean intensity of the enclosed pixels. The software tries to place the points on pixels with the closest intensity to the first point.	<ol style="list-style-type: none"><li>Hold down the left mouse button and move the cursor along the points through which the line should pass.</li><li>Right-click to complete the line.</li></ol> <p>The line is “closed”, i.e. the last node is joined to the first node by a straight line to create an enclosed shape.</p> 

See also

- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]


11.2.5.2.2 Circle (Diameter) Tool

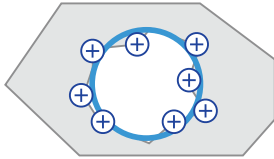
Icon	Description	Use
	Measures the diameter of a circle.	<ul style="list-style-type: none"><li>Click and drag to specify the location and size of the circle, starting at a point on the circumference.</li><li>To change the orientation of the diameter, click and drag the center node (<b>hand</b> icon).</li></ul> <p>By default, the diameter is measured horizontally in the image, regardless of how you draw the circle.</p> 

See also

- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]
- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]

11.2.5.2.3 Circle (Points) Tool


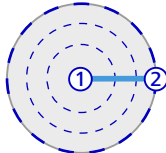
Icon	Description	Use
	Measures the area and diameter of a best fit circle defined by at least three points.	<p>Use this tool if, for example, only an arc of the circle (i.e. not the entire circle) is visible in the image.</p> <ol style="list-style-type: none"><li>Click several (at least three) positions at the circumference to specify the points describing the circle.</li><li>Finish editing by right-clicking.</li></ol> <p><b>Note:</b> This final click creates the last circle point.</p>

Icon	Description	Use
		<div>3. To change the orientation of the radius, click and drag the center node.</div> <div></div>

See also

- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]


11.2.5.2.4 Circle (Radius, In-Out) Tool

Icon	Description	Use
	Defines a circle measurement via the radius.	<div>1. Click to specify the center of the circle.</div> <div>2. Drag to specify the size and orientation of the radius.</div> <div>3. To change the orientation of the diameter, click and drag the center node (<b>hand</b> icon).</div> <div></div>



See also

- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]


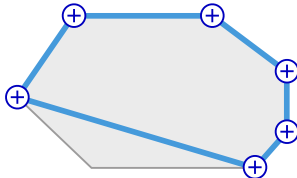
#### 11.2.5.2.2.5 Circle (Radius, Out-In) Tool

Icon	Description	Use
	Defines a circle measurement via the radius.	<ol style="list-style-type: none"> <li>1. Click to specify the center of the circle.</li> <li>2. Drag to specify the size and orientation of the radius.</li> <li>3. To change the orientation of the diameter, click and drag the center node (<b>hand</b> icon).</li> </ol>







#### See also

-  Visioner Topography Acquisition Workbench [► 691]
-  Visioner 2D Acquisition Workbench [► 692]


#### 11.2.5.2.2.6 Contour (Polygon) Tool

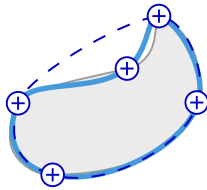
Icon	Description	Use
	Measures the area enclosed by a line that passes through all the selected points.	<ol style="list-style-type: none"> <li>1. Click multiple times to select the points through which the line should pass.</li> <li>2. Right-click to complete the line.</li> </ol> <p>The line is closed, i.e. the last node is joined to the first node by a straight line to create an enclosed shape.</p> 

#### See also





-  Adding an Annotation to Interactive Measurements [► 136]
-  Editing Interactive Measurements [► 137]
-  Hiding an Interactive Measurement [► 139]
-  Layering Interactive Measurements [► 136]
-  Visioner Topography Acquisition Workbench [► 691]
-  Visioner 2D Acquisition Workbench [► 692]

#### 11.2.5.2.2.7 Contour (Spline) Tool


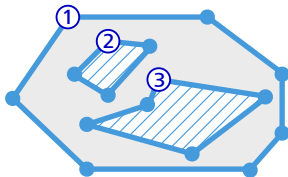
Icon	Description	Use
	Measures the area enclosed by a polynomial curve that passes through all the selected points.	<ol style="list-style-type: none"> <li>1. Click multiple times to select the points through which the polynomial curve should pass.</li> </ol>

Icon	Description	Use
		<div><div>2. Right-click to complete the curve.</div><div>The curve is closed, i.e. the last node is joined to the first node by a curve to create an enclosed shape.</div><div></div></div>

See also

-  Layering Interactive Measurements [► 136]
-  Adding an Annotation to Interactive Measurements [► 136]
-  Editing Interactive Measurements [► 137]
-  Hiding an Interactive Measurement [► 139]

11.2.5.2.8 Contour with Holes Tool


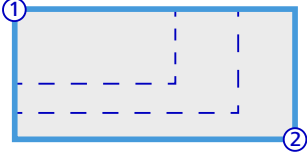
Icon	Description	Use
	Measures the area enclosed by a polygon less the area enclosed by multiple holes within the polygon.	<div><div><div>1. Click multiple times to define the edge of the outer polygon.</div><div>2. Right-click to complete the line.</div><div>The line is closed, i.e. the last node is joined to the first node by a straight line to create an enclosed shape.</div></div><div><div>3. Click within the shape to define a hole to be subtracted from the polygon.</div><div>4. Right-click to complete the hole.</div><div>5. Repeat steps 3 and 4 as desired.</div><div>6. Right-click outside the outer polygon to complete the measurement.</div></div><div></div></div>

See also



- Layering Interactive Measurements [▶ 136]
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]

11.2.5.2.9 Rectangle Tool


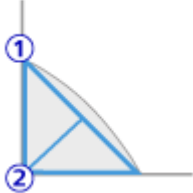
Icon	Description	Use
	Measures the area enclosed by a rectangle.	<ul style="list-style-type: none"><li>Click and drag to specify size and location of the rectangle.</li><li>To change the rotation of the rectangle, click and drag the node above it (<b>rotate</b> icon).</li></ul> 

See also


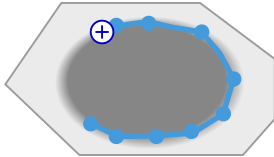
- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]

11.2.5.2.3 Distances





11.2.5.2.3.1 A-Dimension Tool

Icon	Description	Use
	Measures the throat thickness of a welding.	<ol style="list-style-type: none"><li>Click to define the starting point.</li><li>Adjust the size of the measurement by dragging the mouse cursor to fit the welding. The "A" value is represented by the height of the triangle.</li></ol> 


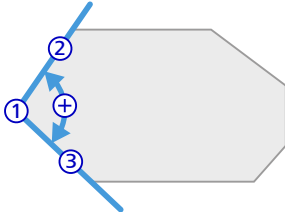
11.2.5.2.3.2 Active Curve Tool

Icon	Description	Use
	Measures the distance (in pixel) along a contour of constant brightness. The software tries to place the points on pixels with the closest intensity to the first point.	<ol style="list-style-type: none"><li>1. Hold down the left mouse button and move the cursor along the points through which the line should pass.  If the software detects a contour nearby, it automatically places the point on the contour.</li><li>2. Right-click to complete the line.  The line remains open, i.e. the last node is not joined to the first node.</li></ol> 




See also

-  Layering Interactive Measurements [► 136]
-  Adding an Annotation to Interactive Measurements [► 136]
-  Editing Interactive Measurements [► 137]
-  Hiding an Interactive Measurement [► 139]

11.2.5.2.3.3 Angle Tool


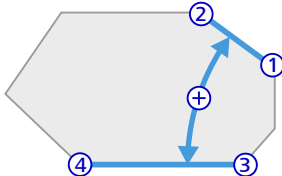
Icon	Description	Use
	Measures the angle between two connected lines.	<ol style="list-style-type: none"><li>1. Click to set the position where the two lines should meet.</li><li>2. Click to specify the end point of each line.</li><li>3. To change the location of the angle arc, click and drag the arc node (<b>hand</b> icon).</li></ol> 

See also

-  Adding an Annotation to Interactive Measurements [► 136]
-  Editing Interactive Measurements [► 137]
-  Hiding an Interactive Measurement [► 139]

- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]


11.2.5.2.3.4 Angle (Disconnected) Tool

Icon	Description	Use
	Measures the angle (<180°) between two lines that do not join.	<ol style="list-style-type: none"><li>Click to set the start and end points of the first line.</li><li>Click to define the start and end points of the second line.</li><li>To change the location of the angle arc, click and drag the arc node (<b>hand</b> icon).</li></ol> <p>The angle measured depends on the order or the points as shown below. You cannot measure an angle &gt;180°.</p> 

See also

- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]

11.2.5.2.3.5 Caliper Tool


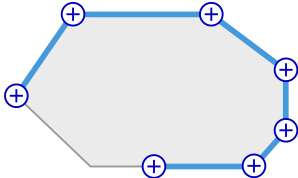
Icon	Description	Use
	Measures the perpendicular distance between a line and a point.	<ol style="list-style-type: none"><li>Click to define the start and end point of the line.</li><li>Click to define the location of the point.</li></ol> <p>The perpendicular distance between the line and the point is displayed.</p> <ol style="list-style-type: none"><li>To change the location of the distance indicator, click and drag the center node (<b>hand</b> icon).</li></ol>

Icon	Description	Use
		

See also

- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]


11.2.5.2.3.6 Curve (Polygon) Tool

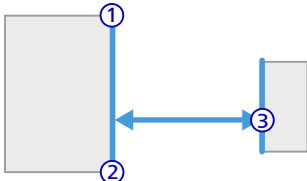
Icon	Description	Use
	Measures the distance along a line that passes through all the selected points.	<ol style="list-style-type: none"><li>Click to select the points through which the line should pass.</li><li>Right-click to complete the line.</li></ol> <p>The line remains open, i.e. the last node is not joined to the first node.</p> 

See also







- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]

11.2.5.2.3.7 Distance Tool


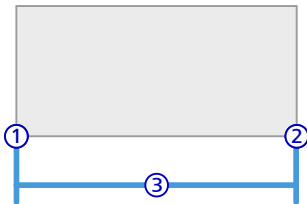
Icon	Description	Use
	Measures the distance between two parallel lines.	<ol style="list-style-type: none"><li>Click to define the start and end point of the first line.</li></ol>

Icon	Description	Use
		<div><div><div>2. Click to define the location of second parallel line.</div><div>3. To change the location of the distance indicator, click and drag the center node (<b>hand</b> icon).</div></div><div>The perpendicular distance between the lines is displayed at the location of the third click.</div><div></div></div>

See also

-  Visioner Topography Acquisition Workbench [▶ 691](#)
-  Visioner 2D Acquisition Workbench [▶ 692](#)
-  Layering Interactive Measurements [▶ 136](#)
-  Adding an Annotation to Interactive Measurements [▶ 136](#)
-  Editing Interactive Measurements [▶ 137](#)
-  Hiding an Interactive Measurement [▶ 139](#)

11.2.5.2.3.8 Length Tool


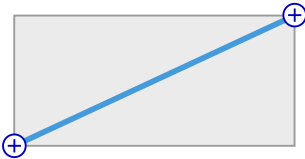
Icon	Description	Use
	Measures the distance between two points. The distance indicator is displayed with an offset.	<div><div><div>1. Click to specify the points to measure between.</div><div>2. Click to specify the location of the measurement line (i.e. the size of the offset).</div></div><div>The measurement is placed parallel to the distance to be measured.</div><div>3. To change the location (offset) of the distance indicator, click and drag the center node (<b>hand</b> icon).</div></div> <div></div>

See also

-  Adding an Annotation to Interactive Measurements [▶ 136](#)

- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]


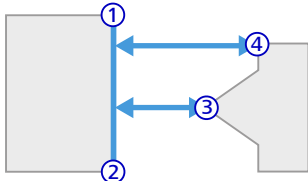
11.2.5.2.3.9 Line Tool

Icon	Description	Use
	Measures the distance between two points directly.	<ul style="list-style-type: none"><li>Click to specify the start and end points of the line</li></ul> 

See also

- Adding an Annotation to Interactive Measurements [▶ 136]
- Editing Interactive Measurements [▶ 137]
- Hiding an Interactive Measurement [▶ 139]
- Layering Interactive Measurements [▶ 136]
- Visioner Topography Acquisition Workbench [▶ 691]
- Visioner 2D Acquisition Workbench [▶ 692]


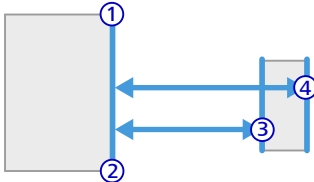
11.2.5.2.3.10 Multi Calipers Tool

Icon	Description	Use
	Measures the perpendicular distances between a line and multiple points.	<ol style="list-style-type: none"><li>Click to define the start and end point of the line.</li><li>Click to define the location of the first point.</li><li>Click to define the locations of the other points.</li><li>To change the location of the distance indicator, click and drag the center node (<b>hand</b> icon).</li></ol> <p>The perpendicular distances between the line and the points are displayed.</p> 

See also

- 📄 Visioner Topography Acquisition Workbench [▶ 691]
- 📄 Visioner 2D Acquisition Workbench [▶ 692]
- 📄 Layering Interactive Measurements [▶ 136]
- 📄 Adding an Annotation to Interactive Measurements [▶ 136]
- 📄 Editing Interactive Measurements [▶ 137]
- 📄 Hiding an Interactive Measurement [▶ 139]


11.2.5.2.3.11 Multi Distance Tool

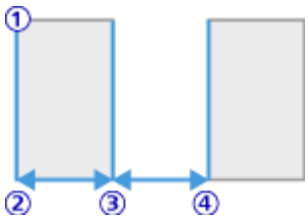
Icon	Description	Use
	Measures the distances between multiple parallel lines based on the first drawn line.	<ol style="list-style-type: none"><li>1. Click to define the start and end point of the first line.</li><li>2. Click to define the location of second parallel line.</li><li>3. Click to define the location of further parallel lines.</li><li>4. To change the location of a distance arrow, click and drag the center node (<b>double arrow</b> icon).</li></ol> <p>The perpendicular distances between the lines are displayed.</p> 

See also



- 📄 Adding an Annotation to Interactive Measurements [▶ 136]
- 📄 Editing Interactive Measurements [▶ 137]
- 📄 Hiding an Interactive Measurement [▶ 139]
- 📄 Layering Interactive Measurements [▶ 136]
- 📄 Visioner Topography Acquisition Workbench [▶ 691]
- 📄 Visioner 2D Acquisition Workbench [▶ 692]

11.2.5.2.3.12 Multi-Interdistance Tool


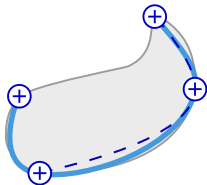
Icon	Description	Use
	Measures the distances between multiple parallel lines.	<ol style="list-style-type: none"><li>1. Click to define the start and end point of the first line.</li><li>2. Click to define the location of second parallel line.</li><li>3. Click to define the location of further parallel lines.</li></ol>

Icon	Description	Use
		<p>The perpendicular distances between the lines are displayed.</p> 





See also

-  Visioner Topography Acquisition Workbench [▶ 691]
-  Visioner 2D Acquisition Workbench [▶ 692]

11.2.5.2.3.13 Spline Curve Tool

Icon	Description	Use
	Measures the distance along a polynomial curve that passes through all the selected points.	<ol style="list-style-type: none"><li>Click to select the points through which the polynomial curve should pass.</li><li>Right-click to complete the curve.</li></ol> <p>The curve remains “open”, i.e. the last node is not joined to the first node.</p> 

See also

-  Layering Interactive Measurements [▶ 136]
-  Adding an Annotation to Interactive Measurements [▶ 136]
-  Editing Interactive Measurements [▶ 137]
-  Hiding an Interactive Measurement [▶ 139]

11.2.5.3 Topography Measurements

11.2.5.3.1 Profile Angle Tool

With this tool you measure the angle between two connected lines. Drag the handles to define the location and size of the angle, and click **Apply**.

To format your measurements, open the corresponding tool of the **Interactive Measurement** workbench, see *Angle Tool* [▶ 842].



Perform a measurement there and format it. ZEN will then also use the format in the **Topography Measurements** workbench.

**See also**

- Formatting Graphical Elements [▶ 140]
- Topography Measurements Workbench [▶ 743]

**11.2.5.3.2 Profile Circle (Radius, In-Out) Tool**

With this tool you measure the radius of a circle. Drag the handles to define the center and size of the circle, and click **Apply**.

To format your measurements, open the corresponding tool of the **Interactive Measurement** workbench, see *Circle (Radius, In-Out) Tool* [▶ 838].

Perform a measurement there and format it. ZEN will then also use the format in the **Topography Measurements** workbench.

**See also**

- Formatting Graphical Elements [▶ 140]
- Topography Measurements Workbench [▶ 743]

**11.2.5.3.3 Profile Distance Tool**

With this tool you measure the distance between two points. Drag the handles to specify the start and end of the line, and click **Apply**.

To format your measurements, open the corresponding tool of the **Interactive Measurement** workbench, see *Distance Tool* [▶ 844].

Perform a measurement there and format it. ZEN will then also use the format in the **Topography Measurements** workbench.

**See also**

- Formatting Graphical Elements [▶ 140]
- Topography Measurements Workbench [▶ 743]



**11.2.5.3.4 Profile Line (x, y) Tool**

With this tool you measure the horizontal and / or vertical distance along a profile line drawn on your EDF image. Therefore, you adjust the starting point and the end point within the EDF image. The height profile along the selected line is shown below the EDF image. You can set rulers to measure distances on that profile. These values are shown on the profile and will be sent to a table.

Note that you cannot format the measurements.

Parameter	Description
<b>Measure Horizontal Distance</b>	<b>Activated:</b> Measures the horizontal distance from one point to another based on the height profile.
<b>Measure Vertical Distance</b>	<b>Activated:</b> Measures the vertical distance from one point to another based on the height profile.

**See also**

-  Formatting Graphical Elements [► 140]
-  Topography Measurements Workbench [► 743]

**11.2.5.3.5 Create Image Tool**

This tool enables you to take a screenshot of the selected image and the corresponding profile line including the annotations.

Parameter	Description
<b>Apply</b>	Takes the screenshot.

**See also**

-  Topography Measurements Workbench [► 743]

**11.2.6 Shuttle & Find****11.2.6.1 Calibration Settings Tool**

Using this tool you can calibrate the correlative holder you will use in your experiment. Note that you have to calibrate the holder on both systems, the SEM and the LM. When working with the **Shuttle & Find** module the calibration is always the first step. To perform the calibration adjust the settings in the **Holder Calibration Settings** tool and click on the **Start** button above the tool. The software will then guide you through the calibration process.

Parameter	Description
<b>Sample Holder</b>	Here you need to select the correlative holder which shall be calibrated and used for your experiment. You will see a preview image of the selected holder under the drop-down menu.
<b>Holder Orientation</b>	Here you can change the orientation of the selected holder. The holder orientation within the software must be adjusted identically to the holder orientation within the SEM. If you change the orientation, it will be visible in the preview image of the selected holder as well.
<b>Move the stage to load position before xy movement</b>	If activated, the stage moves first to the load position before moving to the next marker. Activate this option if you work with uneven samples to avoid collision of the objective and the sample.
<b>Automatic movement to next marker</b>	If activated, the stage automatically moves to the next marker position after the last marker position was confirmed.
<b>Stage movement direction</b>	Here you can set the direction of the stage movement. Depending on the stage settings in the MTB 2011 configuration software it can be necessary to invert the stage axes. If you click on <b>Invert X</b> , the X axis is inverted. If you click on <b>Invert Y</b> , the Y axis is inverted.
<b>Auto-calibration starting with first marker</b>	Note that this function is only available, when the selected holder was already calibrated before.  If activated, the software will automatically perform the holder calibration.

Parameter	Description
	For more information, read the chapters <i>Calibrating the S&amp;F Holder</i> [▶ 369] and <i>Calibrating the S&amp;F Holder Automatically</i> [▶ 372].

### See also

 S&F Holder Calibration Workbench [▶ 743]

#### 11.2.6.2 ROI/POI Definition Tool

With this tool you can draw in ROIs or POIs to the acquired image. Select whether you want to draw in a ROI (rectangular shape) or POI (point) and mark the interesting areas of your sample.

Parameter	Description
<b>Arrow selection mode</b>	Activates the selection mode. If you click on a drawn in ROI/POI, you can move or change the size.
<b>Rectangle mode</b>	Using the rectangle mode you can draw in rectangular regions of interest. Click on the rectangle button and draw in the ROI in the image area.
<b>Points mode</b>	By using the points mode, you can draw in single points of interest. Click on the points button and draw in the POI in the image area.
<b>ROI/POI list</b>	Here you see all added ROIs/POIs. By double-clicking on an entry you can easily rename the corresponding ROI/POI.

### See also

 S&F ROI/POI Drawing Workbench [▶ 744]

#### 11.2.6.3 Image Overlay Tool

With this tool you create an overlay image of SEM (Scanning Electron Microscope) and LM (Light Microscope) images. Simply choose an reference image (e.g. the LM image) and move the desired SEM image(s) from the image gallery (below the image area) per drag and drop in to the image area. After you have adapted the SEM image(s) to match with the LM image click on **Create Correlation**. A new output image will be generated and appears in the image gallery. Note that all images you want to use for the overlay image have to be loaded and opened in the software in the first place.

Parameter	Description
<b>Reference Image</b>	<p>Here you select the reference image for the overlay image. The reference image is usually the LM image with a lower magnification. The reference image is always the image in the background and cannot be adapted.</p> <p>Right next to the reference image you find a small dot icon. If you click on it, you can lock the image from changes. The dot will change to a lock icon then. This helps an unexperienced user to accidentally delete all image adjustments when changing the reference image..</p>

Parameter	Description
<b>Image List</b>	<p>In the list you see the images which were added to the image area. We recommend to start with only one image. The added image can be adapted in its size and position. Therefore click on the image and use the buttons in the edges and on top of the image.</p> <p>Note that you can also set so called "Pins" to fix the added image at certain positions. To set a pin right-click within the added image (inside the green frame) and click on <b>Set Pin</b> in the context menu. Now you can move the added image around the "pinned" position.</p> <p>In the image list you have also the possibility to lock images from editing. Therefore click on the small dot icon in front of the image which you want to lock. This option is helpful if you have added more images to the overlay image and want to prevent that an image which is already adjusted is moved again.</p>
<b>Interpolation Mode</b>	<p>Here you can select the desired interpolation mode for the image generation. While the interpolation method and results depend on the images used, in most cases we recommend to use the linear interpolation mode.</p>
- Nearest Neighbor	<p>This is the simplest and fastest method.</p> <p><b>Calculation method:</b> The output pixel is given the gray value of the input pixel that is closest to it.</p>
- Linear	<p>This is our recommended method as it delivers good and fast results in most cases.</p> <p><b>Calculation method:</b> The output pixel is given the gray value resulting from the linear combination of the input pixels closest to it.</p>
- Cubic	<p>As the calculation method here is more complex this mode will take slightly longer. The results are not forcedly better than with the linear mode.</p> <p><b>Calculation method:</b> The output pixel is given the gray value resulting from a polynomial function of the input pixels closest to it.</p>

#### 11.2.6.4 SEM Stage Tool

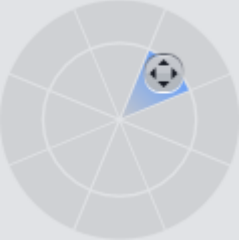
##### CAUTION

##### Risk of Crushing Fingers

The drive of a microscope stage with a motorized horizontal stage axis (stage drive) is strong enough to crush fingers or objects between the stage and nearby objects (e.g. a wall).

- ▶ Remove your fingers or any objects from the danger area before moving the stage drive.
- ▶ Release the joystick immediately to stop the movement.

This tool enables you to move the motorized stage of a SEM (Scanning Electron Microscope). You can use the **Navigation Circle** (Software Joystick) or enter the coordinates directly to move the stage.

Parameter	Description
Navigation Circle	<p>To move the stage, drag the icon in the center of the <b>Navigation Circle</b> in the desired direction. If released, the icon snaps back to the center and the stage stops.</p> <p>The <b>Navigation Circle</b> allows two speeds:</p> <ul style="list-style-type: none"><li>Inner segments: Slow</li><li>Outer segments: Medium</li></ul> 
Stop	<p>Stops any stage movement immediately.</p> <p>Use this button if you entered <b>X-Position</b> and/or <b>Y-Position</b> and wish to interrupt the stage movement immediately (e.g. to prevent a collision).</p>
X-Position, Y-Position	<p>Specifies the target coordinates for the stage movement.</p> <p>The stage starts moving immediately after the coordinates have been entered and confirmed; either by pressing the <b>Return</b> key or by clicking anywhere outside the current input field.</p>

Info

You can also control the **Navigation Circle** and thus the motorized stage with the keyboard. To activate keyboard control left-click anywhere inside the segmented **Navigation Circle**. To change between the two speed modes, right-click the central **Navigation Circle** icon.

- ▶ To move the stage at the lower speed, use the arrow keys (diagonal movements are also possible).
- ▶ To move the stage at the higher speed, use **Shift + Arrow** keys.

11.2.6.5 SEM Detector Selection Tool


Parameter	Description
Select Detector	Here you can select the desired SEM detector, e.g. HDBSD. Depending on your system configuration different detectors can be selected.
Brightness	Here you can adjust the brightness setting of the image. Simply move the slider to change the setting.
Contrast	Here you can adjust the contrast setting of the image. Simply move the slider to change the setting.

## 11.2.7 Output Documents




### 11.2.7.1 Save file tools

#### 11.2.7.1.1 Save Table Tool

This tool enables you to save the current measurement results table or data table to the file system in any supported file format.

Parameter	Description
<b>File Name</b>	The path and filename where the table should be saved  Click on  to open the file browser and select the desired location and file format.
<b>Add Counter</b>	Only in <b>Job Mode</b> .  <b>Activated:</b> Adds an index to the filename, e.g. File Name-001.csv.

#### See also


-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Supported File Formats [► 117]

#### 11.2.7.1.2 Save Report Tool




This tool enables you to save the current report to the file system. It can then be shared with users of other systems.

#### Info

Report templates are imported and exported using the **Archive**.

Parameter	Description
<b>File Name</b>	The path and filename where the report should be saved.  Click  to open the file browser and select the desired location and file format.
<b>Add Counter</b>	Only in <b>Job Mode</b> .  <b>Activated:</b> Adds an index to the filename, e.g. File Name-001.docx.

#### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]
-  Supported File Formats [► 117]


### 11.2.7.1.3 Job Outputs Tool

This tool enables you to select which job results you want to save to the archive. The displayed job results correspond to the output documents of the tasks in the current job. You can also change the name of your job result to be saved. This tool is located on the right side of the window in the results table.

Parameter	Description
<b>Loop</b>	
- Form - <E.g., <code>OutputForm</code> >	<b>Activated:</b> Saves the form to the archive.
<b>Reports</b>	
- E.g., <code>out</code>	<b>Activated:</b> Saves the report to the archive.

### 11.2.7.1.4 Save Image Tool

This tool enables you to save the current image to the file system in any supported file format. It can then be shared with users of other systems.

Parameter	Description
<b>File Name</b>	<p>Select the path where the image should be saved, and type in the file name.</p> <p>Click on  to open the file browser and select the desired location and file format.</p>
<b>Add Counter</b>	<p>Only in <b>Job Mode</b>.</p> <p><b>Activated:</b> Adds an index to the filename, e.g. File Name-001.jpg.</p>
<b>Save all Dimensions</b>	<p>If you save ZEN-specific images, additional files are always added. These keep information about the image or, if desired, of the respective dimensions of the image.</p> <p>You save the following ZEN-specific image types without loss of ZEN-specific image dimensions:</p> <ul style="list-style-type: none"> <li>▪ Multi-channel</li> <li>▪ EDF</li> <li>▪ Time series</li> <li>▪ Z-stack</li> <li>▪ Scenes</li> <li>▪ Tiles</li> </ul> <p>You can save these image types to the following file formats:</p> <ul style="list-style-type: none"> <li>▪ .jpg</li> <li>▪ .png</li> <li>▪ .tif</li> <li>▪ .bmp</li> <li>▪ .wdp</li> </ul> <p>Note that .gif and .wmp are not supported.</p>

Parameter	Description
	<p>When you import the image again, the relevant information is available and the system restores the image.</p> <p><b>Activated:</b> Default. Dimensions are kept. Saves the following files:</p> <ul style="list-style-type: none"> <li>▪ &lt;File name&gt;.&lt;format&gt;</li> <li>▪ &lt;File name&gt;.&lt;format&gt;_info.xml</li> <li>▪ &lt;File name&gt;.&lt;format&gt;_metadata.xml</li> <li>▪ All dimensions of the image in a separate folder, e.g., an image of each channel of a multi-channel image. The folder &lt;File name&gt;.&lt;format&gt;_files contains e.g. the following: <ul style="list-style-type: none"> <li>– &lt;File name, e.g., of channel 1&gt;.&lt;format&gt;</li> <li>– &lt;File name, e.g., of channel 1&gt;.&lt;format&gt;_metadata.xml</li> <li>– &lt;File name, e.g., of channel 2&gt;.&lt;format&gt;</li> <li>– &lt;File name, e.g., of channel 2&gt;.&lt;format&gt;_metadata.xml</li> </ul> </li> </ul> <p><b>Not activated:</b> Dimensions are not kept. Saves the following files:</p> <ul style="list-style-type: none"> <li>▪ Overview image: &lt;File name&gt;.&lt;format&gt;</li> <li>▪ &lt;File name&gt;.&lt;format&gt;_info.xml</li> <li>▪ &lt;File name&gt;.&lt;format&gt;_metadata.xml</li> </ul>
Compression Method	
– As is	<p>The compression setting affects the image data inside of image documents in *.czi format.</p> <p>If selected, the image data will be saved as they are (with unchanged/unmodified compression state).</p> <p>The compression state of the image data is not changed. The file size remains the same. The image quality remains the same, as the original data will be kept.</p>
– Uncompressed	<p>If selected, the image data will be saved uncompressed. Meaning if a *.czi file contains compressed image data, it will be decompressed.</p>
– Compressed	<p>If selected, the image data will be saved compressed if it was not compressed before.</p> <p>If the original data is uncompressed it gets compressed (with the specified compression parameters). Image data which is already compressed is written in its current compression state (i.e. it does not get recompressed).</p> <p>We recommend to set the quality value to <b>80%</b> for a good compromise between quality and image size.</p> <p>Note that for this setting the resulting image size will be smaller and thereby it helps to decrease upload time when using a ZEN Data Storage. The image quality will be reduced, the original data will not be kept. As for this setting compressed data will remain untouched, we would recommend this setting, if you want to gain smaller images.</p>
– Force Compressed	<p>If selected, the image data is written with the specified compression parameters – independently of its current compression state. Meaning that if it was compressed before, it gets decompressed and compressed again – resulting in a loss of quality.</p> <p>We recommend to set the quality value to <b>80%</b> for a good compromise between quality and image size.</p>



Parameter	Description
	Please note that when compressed image data will be decompressed and compressed again you will always have a loss of quality. For a better image quality, we recommend to compress image data only once.
<b>Quality</b>	Specifies the image sharpness and thus the precision of the image. Use the slider to adjust the desired value.
<b>Burn-In Data Zone</b>	<b>Activated:</b> Saves the metadata displayed on the <b>Data Zone</b> tab with the image.
<b>Burn-In Annotations</b>	<b>Activated:</b> Saves the annotations with the image. Note that you can add burn in annotations to any image format but <b>*.czi</b> .

### See also

- ▢ Specifying Permitted and Expected Values for a Tool [► 59]
- ▢ Configuring Tolerances for a Measurement [► 60]
- ▢ Supported File Formats [► 117]

## 11.2.7.2 Export tools

### 11.2.7.2.1 Image Export Tool

This tool exports an image in various formats.

Note that if you save or export an EDF image in an image format that does not support multi channels, e.g., jpg, and later you import it again and save it in czi format, the multi channel information will be lost. This might be confusing if you saved the imported image (jpg format) in the Archive in czi format and load it again, then e.g., the topography functionality is lost, but the image still looks like an image in EDF format.

Parameter	Description
<b>File type</b>	<p>Selects the file type of the exported image.</p> <ul style="list-style-type: none"> <li>▪ <b>JPEG File Interchange Format (JPEG)</b></li> <li>▪ <b>Windows Bitmap (BMP)</b></li> <li>▪ <b>Tagged Image File Format (TIFF)</b></li> <li>▪ <b>Tiff Format (64 bit) (Big TIFF)</b></li> <li>▪ <b>Portable Network Graphics (PNG)</b></li> <li>▪ <b>JPEG XR (WDP)</b></li> <li>▪ <b>DigitalSurf SUR (SUR)</b></li> </ul> <p>Depending on the selected file type, additional settings for image quality and compression are available.</p>
<b>Quality</b>	Only available for the file types <b>JPEG</b> and <b>JPEG XR</b> . Enter the image quality using the slider or input field to influence the size of the file. Although low values result in very small files, image quality may be considerably reduced.
<b>Resize</b>	Sets the resolution of the exported image in percent of the original image.

Parameter	Description
<b>Convert to 8 Bit</b>	Only available for the file types <b>TIFF</b> , <b>BigTIFF</b> , <b>PNG</b> and <b>JPEG XR</b> . <b>Activated:</b> Converts a 16 bit gray level image into an 8 bit gray level image, or a 48 bit color image into a 24 bit color image.
<b>Compression</b>	Only available for the file type <b>TIFF</b> and <b>BigTIFF</b> . Selects the compression method for reducing the data size.
- None	Retains the data size of the original image. No compression is performed.
- LZW	Only available for the file type <b>TIFF</b> . Performs lossless compression in accordance with the Lempel-Ziv-Welch algorithm (LZW).
- ZIP	Only available for the file type <b>TIFF</b> . Performs lossless compression in accordance with the ZIP method.
- Lossless	Only available for the file type <b>BigTIFF</b> . Performs lossless compression in accordance with the Lempel-Ziv-Welch algorithm (LZW).
- Lossy	Only available for the file type <b>BigTIFF</b> . Performs lossy compression in accordance with the JPEG XR (extended range) method.
<b>BigTIFF</b>	Only available for the file type <b>BigTIFF</b> . <b>Activated:</b> Generates a BigTIFF image. The maximum image size is larger than 4GByte. <b>Deactivated:</b> Generates a TIFF image with maximum size of 4GByte. Note that BigTiff images cannot be opened in ZEN core.
<b>Pyramid</b>	Only available for the file type <b>BigTIFF</b> . <b>Activated:</b> Calculates an image pyramid.
<b>TIFF Tiles</b>	Only available for the file type <b>BigTIFF</b> . <b>Activated:</b> Generates new rectangle tiles for internal data handling. <b>Deactivated:</b> Combines tiles as stripes for internal data handling.
<b>Shift Pixel</b>	<b>Activated:</b> The pixel are shifted to 16 bit before converting to 8 bit. For example, a 14 bit image is first transformed to a 16 bit image which is then converted to a 8 bit image. The 14 bit range is mapped to the whole 8 bit range. <b>Deactivated:</b> No shift takes place. A 14 bit image is treated as a 16 bit image and therefore the transformation to 8 bit covers only a reduced range.
<b>Merge All Scenes</b>	Only available for the file type <b>BigTIFF</b> . <b>Activated:</b> Generates one image including all scenes. <b>Deactivated:</b> Generates single scene images.
<b>Original Data</b>	<b>Activated:</b> Exports the image with the original channel colors and the original display characteristic curve.
<b>Apply Display Curve and Channel Color</b>	<b>Activated:</b> The current channel color and display curve are applied to the image before exporting, i.e. a modified image is exported. You can specify the channel color and display curve in the <b>View Options</b> .

Parameter	Description
<b>Burn-in Annotations</b>	<b>Activated:</b> Graphics and annotations, e.g. from measurements, will replace the underlying image pixels. The underlying image pixels will be lost in the process. Note that you can add burn-in annotations to any image format but <b>*.czi</b> .
<b>Burn-in Data Zone</b>	<b>Activated:</b> Metadata from the <b>Data Zone</b> tab is added to the image. Note that you can add burn-in data zones to any image format but <b>*.czi</b> .
<b>Resize</b>	Resizes the annotations in %.
<b>Accept Size</b>	Extracts current size of annotations in relation to the image.
<b>Use Full Set of Dimensions</b>	Exports the entire image region.
<b>Define Subset</b>	Enables you to export one of the following image subsets: <ul style="list-style-type: none"> <li>▪ Region</li> <li>▪ Tiles, optionally with overlap</li> </ul>
<b>Region</b>	Enables you to define an image region to be exported.
- Full	Exports the entire image area.
- Rectangle	Enables you to specify a rectangular subsection of the image to be exported.
<b>Tiles</b>	Enables you to export tiles where each tile is saved as a single image. You can use the tiles as represented in the software or you can specify a number of rows and columns to re-tile the image before export.
- Existing Tiles	If the current image is tiled, each tile is exported as a single image. Otherwise a single image is exported.
- Re-Tile	Splits the current image into a specific number of tiles. <ul style="list-style-type: none"> <li>▪ <b>Columns, Rows:</b> Number of equally spaced columns and rows the image is split into.</li> <li>▪ <b>Overlap:</b> Percentage by which neighboring tiles will overlap.</li> </ul>
<b>Export to</b>	Specifies the export path of the image. You can select any local or network path available on your machine.
<b>Create Folder</b>	Creates a folder at the path location specified above and saves all image data to that folder. The <b>Prefix</b> is used as the folder name.
<b>Generate xml file</b>	Creates an XML file containing the metadata of the image.
<b>Generate zip file</b>	Compresses all exported files. The result of <b>Export Image</b> is one single ZIP file.
<b>Prefix</b>	Enables you to specify a prefix that is added to all exported files.

### See also

- 📖 Specifying Permitted and Expected Values for a Tool [► 59]
- 📖 Configuring Tolerances for a Measurement [► 60]

### 11.2.7.2.2 Movie Export Tool

This tool creates a movie from time series images. It is available in **ZEN starter** as well.

#### Info



If you want to export **MOV** files (H264 or MPEG4 codec) successfully, download the latest release version of application **FFmpeg Version 4.0.2, Windows 64-bit, Static** (e.g. on <http://www.ffmpeg.org/>). Copy **ffmpeg.exe** into the same folder where **ZENcore.exe** is located (for example C:\Program Files\Carl Zeiss\ZEN core\).

**Prerequisite** You have acquired or opened an image from a Time Series.

Parameter	Description
<b>Format</b>	Sets the file type and codec of the exported movie. The available codecs depend on the file type.
<b>Size/Rate</b>	Sets the width and height, the frame rate, and the quality of the movie. The following formats are available:
— Pre-defined	Displays a list of preset formats corresponding to well-established TV or HD video formats. The number of available formats varies with the selected <b>Format</b> .
— User Defined	Sets the width, height, and frame rate freely.
— Original Size	Sets the width and height of the movie to the input image dimensions.
<b>Quality</b>	Refers to the compression of the video data. This setting is independent of <b>Format</b> and <b>Size/Rate</b> .
<b>Burn-in Annotations</b>	<b>Activated:</b> Graphics and annotations, e.g. from measurements, will replace the underlying image pixels. The underlying image pixels will be lost in the process. Note that you can add burn-in annotations to any image format but <b>*.czi</b> .
<b>Fitting</b>	Defines how the image data is scaled, zoomed, or cropped according to the movie format.
<b>Mapping</b>	Specifies whether the movie into which the images are combined has a fixed frame rate ( <b>1 Frame per Image</b> ) or a fixed duration ( <b>Fixed Duration</b> ).
— 1 Frame per Image	<ul style="list-style-type: none"> <li>One image will be mapped to one movie frame.</li> <li>The movie duration adapts to the number of images and the selected frame rate.</li> <li>Choose this mapping for optimum movie quality results.</li> </ul>
— Fixed Duration	<ul style="list-style-type: none"> <li>One image may be mapped to several frames</li> <li>The frame rate adapts to the number of images and the desired movie duration.</li> </ul>
<b>Image Count</b>	Displays the number of frames contained in the movie to be exported.
<b>Final Movie Length</b>	Displays the duration of the movie to be exported.
<b>Use Full Set of Dimensions</b>	Exports the entire image region into the movie.

Parameter	Description
<b>Define Subset</b>	Exports a region of the original images, or tiles of the images, optionally with overlap. A separate movie file is created for each tile.
<b>Region</b>	If you select a region, only that region of each original image will be exported to the movie.
<b>Tiles</b>	If you define tiles, each tile of the original images will be exported to a single movie.
— Existing Tiles	<b>Activated:</b> All tiles will be exported as represented in the software.
— Re-Tile	<b>Activated:</b> You can re-tile the original images into a desired number of columns and rows. An additional overlap of the tiles is optional.
<b>Export to</b>	Specifies the export path of the movie. You can choose any local or network path available on your machine.
<b>Prefix</b>	Enables you to specify a prefix that is added to all exported files.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]



#### 11.2.7.2.3 OME TIFF Export Tool

This tool exports an image in the OME (Open Microscopy Environment) TIFF format. You can use this image in other programs supporting this open format. The images are then available as a multi-page TIFF file. An image exported as a group of tiles is stored as a multi-page TIFF file.

Parameter	Description
<b>Resize</b>	Sets the resolution of the exported image (in % of the original image size).
<b>BigTIFF</b>	<b>Activated:</b> The image is stored in BigTIFF format. The BigTIFF format allows file sizes larger than 4 GiB. Note that BigTiff images cannot be opened in ZEN core.
<b>Compress</b>	<b>Activated:</b> The image data is compressed.
<b>Use Tiles</b>	If the exported image is a tile image, each tile is exported to a separate file.
<b>Merge all Scenes</b>	If the exported image is a scene image, all scenes are exported as one large image.
<b>Shift Pixel</b>	<b>Activated:</b> The pixel are shifted to 16 bit before converting to 8 bit. For example, a 14 bit image is first transformed to a 16 bit image which is then converted to a 8 bit image. The 14 bit range is mapped to the whole 8 bit range. <b>Deactivated:</b> No shift takes place. A 14 bit image is treated as a 16 bit image and therefore the transformation to 8 bit covers only a reduced range.
<b>Original Data</b>	<b>Activated:</b> Exports the image with the original channel colors and the original display characteristic curve.

Parameter	Description
<b>Apply Display Settings and Channel Color</b>	<b>Activated:</b> The current channel color and display curve are applied to the image before exporting, i.e. a modified image is exported. You can specify the channel color and display curve in the <b>View Options Area</b> .
<b>Burn-in Annotations</b>	<b>Activated:</b> Graphics and annotations, e.g. from measurements, will replace the underlying image pixels. The underlying image pixels will be lost in the process. Note that you can add burn-in annotations to any image format but <b>*.czi</b> .
<b>Use Full Set of Dimensions</b>	Exports the entire image region.
<b>Export to</b>	Defines the export path of the image. You can select any local or network path available on your machine.
<b>Prefix</b>	Enables you to specify a prefix that is added to all exported files.

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

#### 11.2.7.2.4 Send to ConfoMap Tool

This tool enables you to send a Topography image (heightmap and up to one texture) to the ConfoMap software which must be installed on the same computer. Simply open the topography image and click on **Apply**.

A new ConfoMap window is opened that contains a new document with a studiable for the heightmap and a studiable for the texture in the single topography data item of the input. For each studiable a default study (2D view) is added to the document.

Note that the maximum image size that can be exported is determined by the maximum size of a single in-memory bitmap (<~ 2GB). Inputs with multiple topography data items are not supported.

#### 11.2.7.2.5 Topo Export Tool

This tool enables you to export topography data from an image (if included).

Note that the maximum image size that can be exported is determined by the maximum size of a single in-memory bitmap (<~ 2GB). Inputs with multiple topography data items are not supported.

Parameter	Description
<b>File Name</b>	Add a file name.
<b>Add Counter</b>	Only in <b>Job Mode</b> . <b>Activated:</b> Adds an index to the filename, e.g. File Name-001-<additional data>.x3p.
<b>Folder</b>	Specifies the output folder on your file system.
<b>Format</b>	Selects the desired export format for the topography data. The following formats are available:

Parameter	Description
- SUR (Heighmap)	Exports a Sur file (extension: *.sur). This is the native file-format for studiabiles in ConfoMap (aka Digital Surf Mountains). The format is supported by ConfoMap Software Version <b>7.4.805</b> and higher.
- SUR (Heighmap) + Texture	Exports a Sur file (extension: *.sur). This is the native file-format for studiabiles in ConfoMap (aka Digital Surf Mountains). The format is supported by ConfoMap Software Version <b>7.4.805</b> and higher. Exports additionally the texture.
- SDF (text)	Exports a SDF file (extension: *.sdf). This is the file-format defined by ISO 25178-71:2012(E). Exports ASCII data.
- SDF (binary)	Exports a SDF file (extension: *.sdf). This is the file-format defined by ISO 25178-71:2012(E). Exports binary data.
- X3P (textual data)	Exports a X3P file (extension: *.x3p). This is a file exchange format based on ISO 25178-72 which augments and supersedes EN ISO 5436-2. Exports ASCII data.
- X3P (binary data)	Exports a X3P file (extension: *.x3p). This is a file exchange format based on ISO 25178-72 which augments and supersedes EN ISO 5436-2. Exports binary data.
- GOM G3D	Exports a G3D file (extension: *.g3d). This is a special internal file format supported by <b>GOM Inspect</b> software. You use it for inspection and dimensional analysis of 3D meshes of 3D objects. The format stores several types of 3D data in one file. The size of the file to be exported is set according to the GOM limits.

### See also

 Save File Workbench [► 745]

#### 11.2.7.2.6 ZVI Export Tool

This tool exports an image in the Zeiss AxioVision format (ZVI).

Parameter	Description
<b>Export to</b>	Defines the export path of the image. You can select any local or network path available on your machine.
<b>Prefix</b>	Enables you to specify a prefix that is added to the exported file.
<b>Add Counter</b>	Only in <b>Job Mode</b> . <b>Activated:</b> Adds an index to the filename, e.g. File Name-001.zvi.

### See also







 Specifying Permitted and Expected Values for a Tool [► 59]

 Configuring Tolerances for a Measurement [► 60]

### 11.2.7.3 Reports

#### 11.2.7.3.1 Add Templates Tool



This tool enables you to select **Report** templates and add them to the job template.

Parameter	Description
<b>Print Report</b>	Prints the <b>Report</b> to any local or network printer.
<b>Create Report</b>	<ul style="list-style-type: none"> <li>▪ <b>Free Mode:</b> Adds the report to the <b>Document and Images</b> area and saves the report template in the <b>Archive</b></li> <li>▪ <b>Create a template and edit it</b> within <b>Job Mode:</b> Saves the report template in the <b>Archive</b></li> </ul>
<b>Report template preview</b>	Preview of the selected report template and its name.
	<p>Allows you to select the <b>Report</b> template to be used.</p> <p>If you select multiple report templates, they are joined together into one document.</p>
	<p>Exchanges the selected template. If you have modified a job template containing a report, the link to the template containing the placeholders needs to be updated.</p> <p><b>Note:</b> In <b>Jobmode</b>, after smaller changes on the report template, it is recommended to click the icon instead of generating all links between output documents and report placeholders from scratch.</p>
	<p>Removes the current <b>Report</b> template.</p> <p>The report template is not deleted and can be selected again by clicking the  icon.</p>
<b>Placeholders</b>	<p>Each <b>Report</b> template contains placeholders to enable you to collate the information easily. The placeholders also ensure that each time the job is run, the same information is added to the report.</p> <ol style="list-style-type: none"> <li>1. Click  and select the desired report template. A preview of the form template is displayed in the <b>Center Screen Area</b> and in the <b>Add Templates</b> tool.</li> <li>2. Select the template preview in the <b>Add Templates</b> tool. The placeholders available for this template are displayed.</li> <li>3. Click the  arrow in a placeholder and select the corresponding measurement information that you wish to add, for example image, measurement result, etc.</li> </ol>
<b>Show/Hide Annotations</b>	If your image has drawn in graphical elements or annotations (measurements, etc.), you can show or hide these annotations in the report. To hide annotations simply deactivate the checkbox of the option <b>Show annotations</b> .
<b>Set layout options</b>	Allows you to set up the number of images you want to see in a row within your <b>Report</b> . The option is not available for report placeholders within groups.






Parameter	Description
<b>Use entire collection</b>	<p>Allows you to configure whether all available data of a loop task output should be used for a <b>Report</b> placeholder or the data of a single loop iteration only.</p> <p><b>Activated:</b> All data sets of each loop will appear in every report.</p> <p><b>Deactivated:</b> There will be one report for each data set</p> <p>The option is not available in <b>Free Mode</b>, only in <b>Edit the selected template</b> and <b>Runs the selected job</b> within <b>Job Mode</b>.</p>

### See also

-  Specifying Permitted and Expected Values for a Tool [► 59]
-  Configuring Tolerances for a Measurement [► 60]

## 11.2.8 Utilities

### See also









-  Load CAD Tool [► 132]
-  CAD Viewer Tool [► 133]
-  CAD Overlay Tool [► 133]

### 11.2.8.1 OAD Macro Tool

This tool enables you to use macros to automate tasks such as applying a series of processing tools to an image or batch converting images from one file type to another. You can use macros to connect the software with external software, e.g. ImageJ.

Parameter	Description
<b>Selection</b>	<p>Contains the <b>User Documents</b>: A list of all macro files available in the configured macro folder.</p> <p>To configure the macro folder, use <b>Manage Templates</b> from the <b>Home Screen</b>.</p>
<b>Preview</b>	<p>Displays the first lines of the selected macro.</p> <p>It is advisable to begin any macro with a comment describing the main functionality of the macro.</p>
<b>Properties</b>	Displays metadata specified for the selected macro.
– <b>Name</b>	The naming convention for the first macro created in the <b>Macro Editor</b> is Macro-01 and then continues to count up. The name of macros from the system archive are displayed and cannot be renamed.
– <b>Keywords</b>	Keywords can be used to further specify the selected macro.
– <b>Description</b>	A description of the macro's functionality.
<b>Macro Editor ...</b>	Opens the <b>Macro Editor</b> to create new macros, to edit, execute, debug and manage macros.
<b>Copy to Task...</b>	Copies the code of the selected macro to the tool macro.

**See also**

-  [Running a Macro \[▶ 336\]](#)
-  [Copying a Macro in Job Mode \[▶ 335\]](#)
-  [Adding a Macro in Job Mode \[▶ 334\]](#)
-  [Specifying Permitted and Expected Values for a Tool \[▶ 59\]](#)
-  [Configuring Tolerances for a Measurement \[▶ 60\]](#)
-  [Creating a Macro \[▶ 334\]](#)
-  [Managing Macros \[▶ 336\]](#)
-  [Debugging a Macro \[▶ 336\]](#)



**11.2.8.2 Multi-Image Setup Tool**

This tool enables you to modify the setting for the **Multi-Image View**. The standard setting are two columns and one row.

You cannot remove this tool from the **Multi-Image View** workbench.

Parameter	Description
<b>Columns</b>	Here you can set the number of columns.
<b>Rows</b>	Here you can set the number of rows.
<b>Synchronize Display</b>	<b>Activated:</b> The settings of the view options (i.e. <b>Gamma</b> ) will be applied synchronously to all images in the <b>Multi-Image View</b> .
<b>Synchronize Dimension</b>	<b>Activated:</b> The settings of the view options (i.e. zoom factor) will be applied synchronously to all images in the <b>Multi-Image View</b> .
<b>Reset</b>	To restore the original values of the <b>View Options</b> , click on the <b>Reset</b> button.

**See also**

-  [Multi-Image View Workbench \[▶ 746\]](#)
-  [Display Tab \[▶ 29\]](#)

**11.2.8.3 Create Multi-Image Tool**

This tool enables you to create a multi-image as czi file.

Parameter	Description
<b>Burn-In Annotations</b>	<b>Activated:</b> Burns in all annotations into the multi-image.
<b>Apply</b>	Creates a new multi-image generated from the images loaded in the <b>Multi-Image View</b> .

**See also**

-  [Multi-Image View Workbench \[▶ 746\]](#)

#### 11.2.8.4 Stitching Tool

This tool stitches tiles images.

Parameter	Description
<b>Inplace</b>	If selected, the loaded images will be stitched.
<b>New Output</b>	If selected, the loaded images will be stitched and a new output image will be generated.
<b>Fuse Tiles</b>	Only available with <b>New Output</b> . <b>Activated:</b> All individual tile images are fused together after alignment. <b>Deactivated:</b> The individual tile images are aligned but not fused.
<b>Correct Shading</b>	If activated, an automatic shading correction will be performed when stitching is performed.
<b>Edge Detector</b>	When acquiring tiles to create a single large image, the stage movement is not precise down to the pixel level of the camera sensor. To bypass this technical limitation and to have a margin to compensate for this inaccuracy, tiles are usually overlapped by a few percent. To align the tiles, the overlaps between neighboring tiles are analyzed. An edge detector may improve analysis results.
— Yes	Applies an edge detection algorithm to the tiles internally to improve analysis of the overlaps between neighboring tiles. This may improve the alignment of the tiles and thus the stitching result.
— No	Omits edge detection. The quality of alignment of the tiles may be reduced.
<b>Minimal Overlap</b>	The amount of overlap between neighboring tiles (in % of the area of a single tile) expected by the stitching tool. The tool evaluates this amount of overlap or more as required. The value to the overlap that was used for acquisition of the tiles is set. Larger values may improve the result but increase calculation time.
<b>Max Shift</b>	Specifies the maximal extent of shift (in % of the area of a single tile) which can be applied to a tile during stitching.
<b>Comparer</b>	Specifies how the conformance of the tiles in the overlapping regions is evaluated.
— Basic	Basic comparison (faster)
— Best	Complex comparison (slower)
— Optimized	Optimized comparison
<b>Global Optimizer</b>	Specifies the number of overlaps evaluated during stitching. Evaluating more overlaps per tile yields a better stitched image, but requires more calculation time.
— Basic	Only one overlap per tile is evaluated.
— Best	All overlaps of a tile are evaluated.

Parameter	Description
<b>Defaults</b>	Resets all tool settings to the default values.
<b>Apply</b>	Applies stitching to the images.

#### 11.2.8.5 Document Tags Tool

This tool enables you to add tags to documents in **Free Mode** as well as in **Job Mode**.

Parameter	Description
<b>Tag</b>	Type in a tag you want to add to the document. Each tag is limited to 50 characters.
<b>Add further tag</b>	Opens another field to add a tag.
<b>Apply</b>	Saves the tag to the document.  Once saved, the tag is displayed with the selected document under <b>Browse Results</b> in the <b>Preview</b> . You can search documents by these tags. To do so, select <b>Tags</b> in the <b>Select Fields</b> dialog.  Note that the tags are lost when you export the document, because they are not part of the metadata.

#### See also

 Document Tags Manager [► 746]

#### 11.2.8.6 Take Topography Screenshots Tool

This tool is only available in **Job Mode**.

This tool takes a screenshot of a topography or a heightmap view of an EDF image. An EDF image contains two channels (EDF and heightmap) and a 2.5 dimensionally displayable topography view. Move and rotate the topography image as desired or display the heightmap view. The screenshot is taken automatically when you proceed to the next step within the workflow. The screenshot you can e.g. add to a report or save to disk, e.g. in .png format. The image on the screenshot is not scaled.

#### See also

 Screenshot Taker Workbench [► 747]

### 11.2.9 Workflow

This group is only available in **Job Mode** under **Create a new template and edit it**. The included tasks (**Loop/Group**) can only be used in job mode.

#### 11.2.9.1 Settings Tool

When a loop task is added to a job template you have different options how the loop is executed.

Parameter	Description
<b>Exactly</b>	Enter the number of desired iterations (loops) in the input field. The loop will be executed exactly as often as entered, e.g. if you enter "5", the loop will be executed 5 times.
<b>Range</b>	Enter the desired minimum number of loops to be executed in the <b>Min. Loops</b> field.  Enter the desired maximum number of loops to be executed in the <b>Max. Loops</b> field.
<b>Batch processing</b>	The loop content will be iterated once for every input document. The input document can vary at every job execution, e.g. you can use a position list containing various images as an input for a loop. The job will performed as many iterations as the number of images available from the position list.

### 11.2.9.2 Define Outputs Tool

This tool defines the required output documents that are essential for the workflow functionality. This tool is only visible when creating or editing a loop or group workflow.

If you work with **NMI Analysis**, the document selection cannot be adapted. The calculation is performed in the background with default values. Therefore, editing is not possible.


Parameter	Description
<b>Mode</b>	
- All	Documents generated by all loop iterations are available in the further workflow and are stored in the archive.
- Last Iteration Only	Documents generated by the last loop iteration are available in the further workflow and are stored in the archive.
- None	Documents generated by loop iterations are not available in the further workflow and are not stored in the archive.
<b>Selected Outputs</b>	Displays a list of documents that are generated by the loop or group workflow. Select the documents you do want to save.

#### See also

 [Group Task \[► 870\]](#)

 [Loop Task \[► 870\]](#)

### 11.2.9.3 Load Setting Tool

Parameter	Description
<b>Analysis Setting File</b>	File that contains all the settings for the image analysis and processing. Can be saved and reused in a different job template.
...	Displays the <b>Open Template</b> dialog to select a template.
 <b>Save</b>	Saves the selected template to the archive.

**See also**


 Supervisor Tasks - Workflow Configuration [► 473]

**11.2.9.4 Loop Task**

By using the loop workbench or task, you can set up and execute one or more tasks for several times. In a loop workflow, you can set workbenches to be interactive just once.

The workbench will be interactive in the first loop iteration and run silent in the resting iterations.

**See also**

 Adding a Loop to a Job Template [► 62]

 Define Outputs Tool [► 869]

**11.2.9.5 Group Task**

This task enables the grouping of certain workbenches. They are variable and represented by the group icon



When you create a new group, use the **Define Outputs** tool to define or modify the output. If you do not use the **Define Outputs** tool, only the results of the last workbench of the group will be saved.

**Example**

In the module **Non-Metallic Inclusion Analysis** you can choose between acquiring an image or loading one. Dependent on your choice, the group workbench is called **Acquire Tiles Images** or **Load Images from File System**.

**See also**

 Define Outputs Tool [► 869]

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**Carl Zeiss Microscopy GmbH**  
Carl-Zeiss-Promenade 10  
07745 Jena  
Germany

phone: +49 3641 64 3161  
fax: +49 3641 64 3439  
[info.microscopy@zeiss.com](mailto:info.microscopy@zeiss.com)  
[www.zeiss.com/microscopy](http://www.zeiss.com/microscopy)