

StrainMatic®

User Manual



Basic Operation and Working Procedures

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The ilis gmbh cannot be made liable for incorrect use or incorrect operation of the instrument. Correct use requires among other things knowledge of the contents of this manual. Therefore the instructions in this manual and all other technical documentation belonging to the instrument must be complied with.

Based on the current state of the art, it is not possible to produce software that works free of errors in all application combinations. ilis gmbh is therefore not liable for damages arising through the use of the software or the hardware delivered with it.

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1 Introduction

This user manual is designed for the operating personnel of the STRAINMATIC. It describes the function and the operation of the STRAINMATIC. You will find a complete description of the operating interface in the Reference Manual.

NOTE: The STRAINMATIC device and the corresponding operating software is constantly being developed and improved. The illustrations in this documentation therefore may differ slightly from your version. It is also possible that some of the functions described in this manual are not applicable to your version.

1.1 Overview

In the General safety instructions section you will find generally valid information on the safe operation of the STRAINMATIC. Every operator must have read and understood this section and should work through it again at regular intervals.

The Construction and function section describes the basic construction of the STRAINMATIC and its mode of operation.

The Operation section describes all essential operating procedures on the STRAINMATIC, from the performance of measurements through setting up a measuring method up to setting basic parameters.

In the Validation chapter you will find the instructions for performing validation procedures.

The Inspection and cleaning section provides an overview of the necessary cleaning and inspection activities which the operating personnel should perform at regular intervals to assure correct operation of the STRAINMATIC.

In the Troubleshooting section the operating personnel finds an overview of possible malfunctions during operation, their cause and the measures required for their removal.

1.2 Device variants

At the time of the release of this manual the STRAINMATIC is available in the two variants M2 and M3. Differences in functionality or operation are pointed out in this manual.

1.3 Conventions

To make distinctions more clearly, different fonts and icons are used in the text:

Annotations and file names

User inputs

Cross-references

□ Enumerations

➔ User actions

1.4 Customer support

If you have questions on operation or functionality of the STRAINMATIC, please contact the following address. We will be pleased to provide you with further assistance!

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2 General safety instructions

NOTE: This section contains important information on the safe operation of the STRAINMATIC in accordance with the regulations. Read this section carefully. All persons who work with the STRAINMATIC must have read and understood this section of the manual and should work through this section anew at regular intervals.

If generally valid safety regulations and the instructions in this section are not observed, the operating permission of the instrument expires. In addition to the safety instructions in this section, all applicable general legal and statutory regulations for avoiding accidents and for protecting the environment have validity.

This manual and all further information and documentation relevant for the operation must always be accessible in the vicinity of the instrument.

2.1 Use in accordance with the regulations

The STRAINMATIC has been developed for the automatic measurement and display of birefringence in glass and other transparent materials. Use the STRAINMATIC in accordance with the regulations results from the contents of the technical documentation and, where necessary, additional documents.

Nothing on the instrument which could impair the safe operation of the instrument may be changed, added or removed mechanically or electrically without the written permission of the ilis gmbh. The operating software may not be changed in any way. If not approved changes are made to the instrument, the operating permission expires automatically.

2.2 Transport and installation

The instrument may be transported over longer distances only in the original packaging. A hoist with a lifting force of at least 150 kg must be used for a transport of the instrument. The instrument may be lifted only with the handles included in delivery by at least two persons.

When the unit is installed care must be taken that there is no risk of stumbling due to connected cables. The unit should be placed on a suitable workbench for better operation. The workbench must have a minimum load capacity of 150 kg. The workbench should not be higher than 72 cm for the unit type M2.

The installation location of the unit must fulfill the following requirements:

- The unit must always stand on a clean, level surface.
- The unit must not be subjected to any vibrations.
- Existing fans on the unit must not be blocked or covered. Maintain sufficient distance from the relevant wall on all sides of the unit.
- The main switch with emergency-off function must be well visible and quickly accessible at any time.
- The unit must not be installed in humid, dusty or oily ambient air.

- To avoid overheating, the unit must not be exposed to direct solar radiation or an ambient temperature of more than 30°C.
- To avoid disturbing scattered light influence, direct incidence of light in the compartment, especially from pulsating light sources, must be avoided.
- Before starting up the unit must have assumed ambient temperature to avoid formation of condensation.
- The supplied power cable with integrated residual current circuit breaker must always be used for connecting the unit to the power supply.

2.3 Safety information for the operating personnel

Only correspondingly trained and experienced personnel may operate the instrument. Only correspondingly trained and authorized personnel may perform repair or maintenance work on the instrument.

Persons who do not yet have the corresponding training and experience may receive access to the instrument only under the constant supervision of an experienced operator. The legal minimum age of the operating personnel must be complied with.

Only trained electricians or correspondingly trained personnel under the instruction and supervision of an electrician may work on the electrical system of the instrument.

Only correspondingly trained and authorized personnel may change settings in the operating software.

2.4 Safety instructions for operation

The machine may be put into operation only if all covers and safety devices are present, intact and installed properly at the correct position on the machine.

All functional disturbances or changes in the operating behaviour of the instrument (for example the production of unusual noises) must be examined and rectified immediately. If necessary stop the instrument immediately, secure it against unintentional switching back on and inform the responsible person about the malfunction.

No working procedures which circumvent the safety devices or require changes to the machine are allowed.

The instrument may be used only for the intended purpose.

Check the instrument regularly for visible damage. If recognizable damage exists, have this rectified immediately by a correspondingly authorized person.

Keep all safety-relevant documents at an easily accessible place on the instrument or in its vicinity.

To avoid damage in the electrical system of the instrument, the operating personnel may not be statically charged when operating the instrument.

To avoid injuries or damage to the instrument/the sample, it must be assured before moving the measuring head that the sample compartment is empty (M2 only). Close the sample compartment door before a measurement or before moving the measuring head (M2 only).

Do not look directly into the light source.

2.5 Information and danger symbols used

Information and danger symbols the meaning of which is explained below are used on the machine and in this manual. These symbols must be observed absolutely both on the machine and in the documentation!

Symbol	Meaning
	Wear protective gloves
	Wear protective goggles
	Pull out the mains plug before opening
	General warning about hazardous situation
	Danger of crushing
	Danger due to electricity

2.6 Safety devices

NOTE: Depending on the STRAINMATIC type and the serial number of your device the safety devices can be located in different positions than shown in this manual. Please familiarize yourself with the location of the safety devices before starting up the instrument! If necessary, consult the documentation that accompanied the device on delivery.

The STRAINMATIC has the following safety devices for protection against injuries or damage to the instrument. The following figure exemplarily shows the safety devices of the STRAINMATIC M2 type:



- | | | | |
|-----|----------------------------------|-----|-------------|
| (1) | Emergency stop linear unit drive | (2) | Main switch |
| (3) | Sample compartment door | | |

Emergency stop for linear unit drive (M2 as of M2-005)

A stop button (1) with which the drive of the linear adjustment of the measuring head is switched currentless is located on the front of the instrument. In order to restart the STRAINMATIC after having resolved the dangerous situation unlock the emergency stop switch and perform a self test of the device in the **Service** ⇒ **Status** area or restart the operating software.

Main switch

The main switch (2) for switching the instrument power on and off is located on the right-hand side of the instrument. In **Off** position the power supply of the instrument is completely disrupted. Always switch the instrument off and secure the main switch against unintended switching on before maintenance work.

Sample compartment door

If the sample compartment door (3) is open the following changes in the operating behaviour of the instrument are activated to prevent potential dangers:

- The intensity of the light source is reduced.
- The measuring head moves at lower speed (M2 only).
- No calibration and, according to default settings, no measurement is possible.

Sample compartment monitoring (M2 as of M2-005)

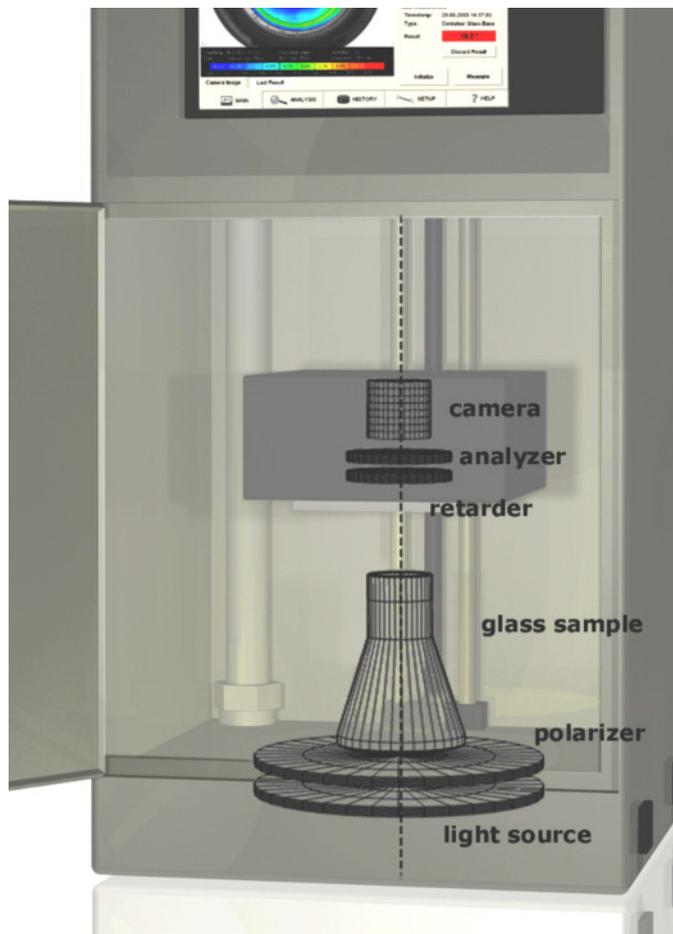
The M2 type is optionally equipped with a switching light grid for checking the sample compartment. The sample compartment monitoring is activated by default. It prevents the measuring head from moving down if an object is detected in the level of the light grid.

Line cord with residual current circuit-breaker (as of M2-005/M3-006)

The STRAINMATIC is provided with a residual current circuit-breaker integrated in the line cord that immediately disconnects the current entry to the device when residual current occurs. Use only this line cord to connect the device to the power supply.

3 Assembly and function

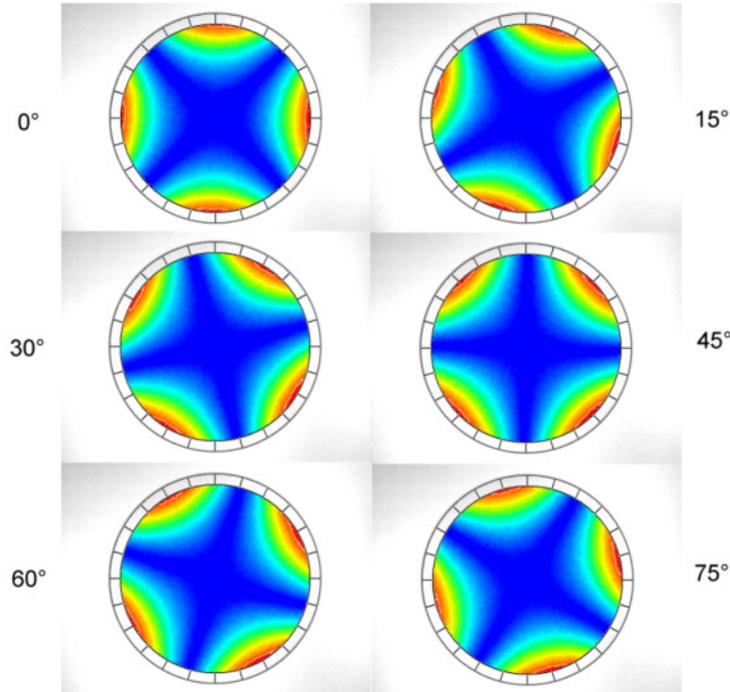
The following figure shows the basic construction of the STRAINMATIC (M2 type):



The sample in the sample compartment is illuminated with linearly polarized light which is generated by a quasi monochromatic light source and a polarizer. This linearly polarized light is converted into elliptically polarized light by birefringence in the sample. A retarder converts the elliptically polarized light back into linearly polarized light.

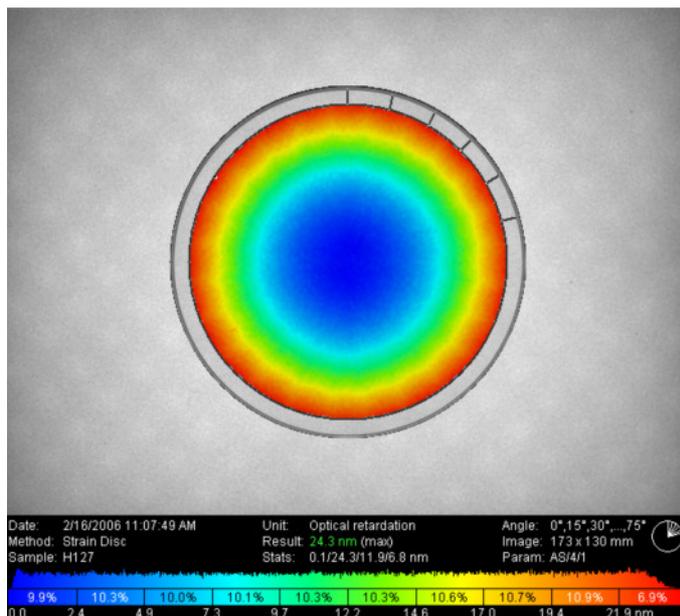
After the retarder the polarization plane is rotated compared with the original polarization direction by an angle from which the different birefringence values of the sample can be derived.

The polarizer can be rotated during a measurement. The intensity over the entire measuring range is recorded with a CCD-camera under different polarizer settings:



Intensity distribution at different polarizer settings

The result images are evaluated automatically and the resulting stress distribution over all measuring directions is displayed color-coded in the operating software:



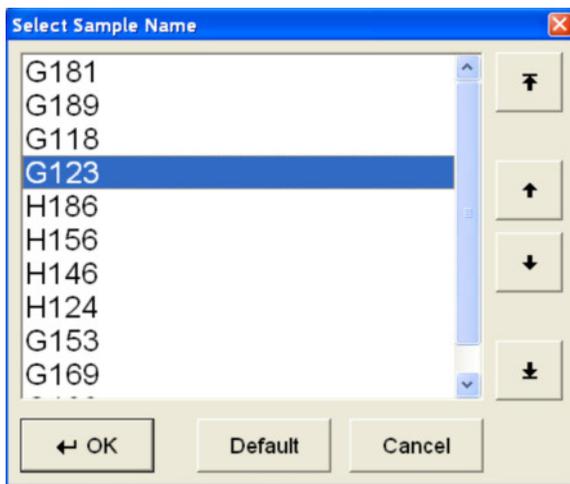
4 Operation

4.1 Principles of operation

You can operate the STRAINMATIC by onscreen keyboard or, for instance with an externally connected PC, with mouse and keyboard. As standard according to the nature of the selected cell (data, text, list entries) different entry windows for entering text, numbers or for selecting a value open. You can toggle between the two operating modes under **Service** ⇒ **System Setup** ⇒ **General**.

4.1.1 Selection from lists

On selection from a list of preset entries, the following window opens for example after selection of the input field:



OK: Accepts the selection and closes the window.

Default: Marks the default value of the list, if present.

Cancel: Cancels the entry and closes the window.

The arrow buttons are visible only if more than ten entries are present in the list.

↕: Marks the first entry of the list.

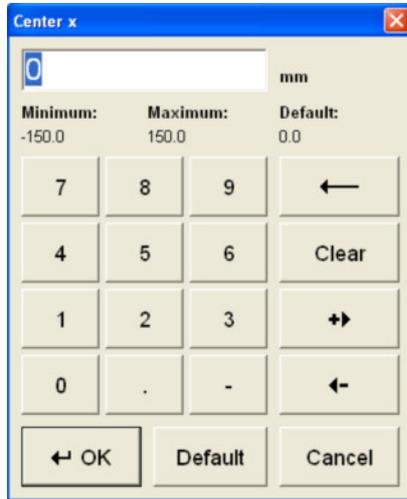
↑: Moves the marking by one entry up.

↓: Moves the marking by one entry down.

↕: Marks the last entry of the list.

4.1.2 Entering numbers

The following window opens for entering numbers after selection of the input field:



If present, the minimum and maximum value possible as well as the default value is displayed below the input field. If an invalid value is entered, the input field turns red and the entry cannot be completed.

OK: Accepts the entry and closes the window.

Default: Sets the value in the input field to the default value, if available.

Cancel: Cancels the entry and closes the window.

←: Deletes the last digit in the input field.

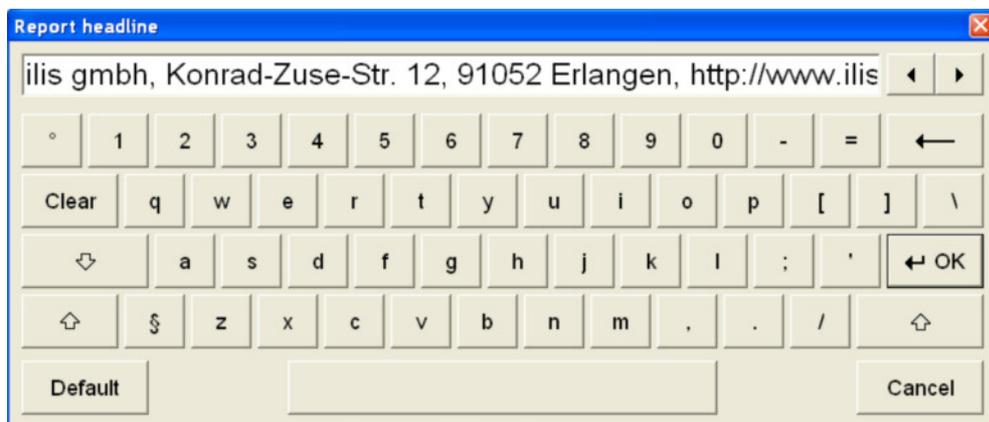
Clear: Deletes the contents of the input field.

→: Incrementally increases the value in the input field.

←: Incrementally reduces the value in the input field.

4.1.3 Entering text

The following window opens for entering text after selection of the input field:



OK: Accepts the entry and closes the window.

Cancel: Cancels the entry and closes the window.

Default: Enters the default value in the input field, if present.

Clear: Deletes the contents of the input field.

←: Deletes the character left to the cursor or the marked characters.

⬅: Moves the cursor one position to the left.

➡: Moves the cursor one position to the right.

⤴: Changes the keyboard mapping for the entry of the next character.

⤵: Changes the keyboard mapping until it is pressed again.

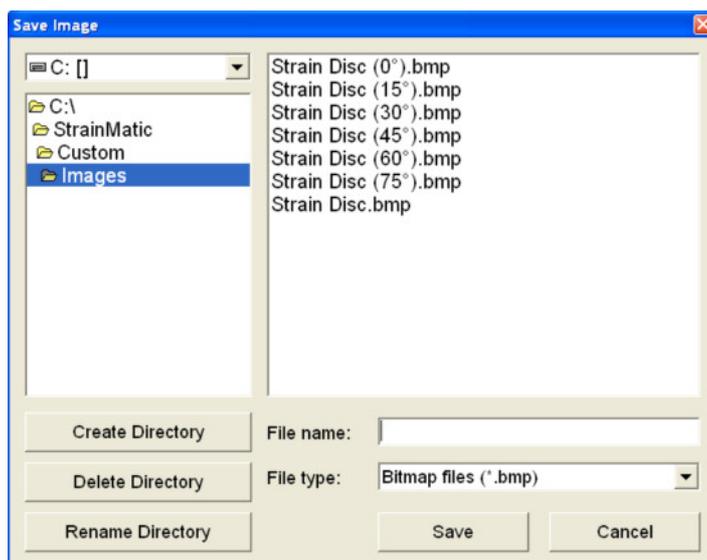
4.2 Loading and saving files

You can save, load, import or export data in different areas of the STRAINMATIC, for example:

- Saving images of measuring results as JPG, BMP or EMF files
- Saving and reloading measuring results as SMX files or exporting measuring results as TXT, ZIP or SLX files
- Importing and exporting measuring methods as SMT files
- Importing and exporting thickness profiles as TXT files

Saving files

Independently of which type of file you want to save, the following save file dialog always appears after you activate the corresponding button:



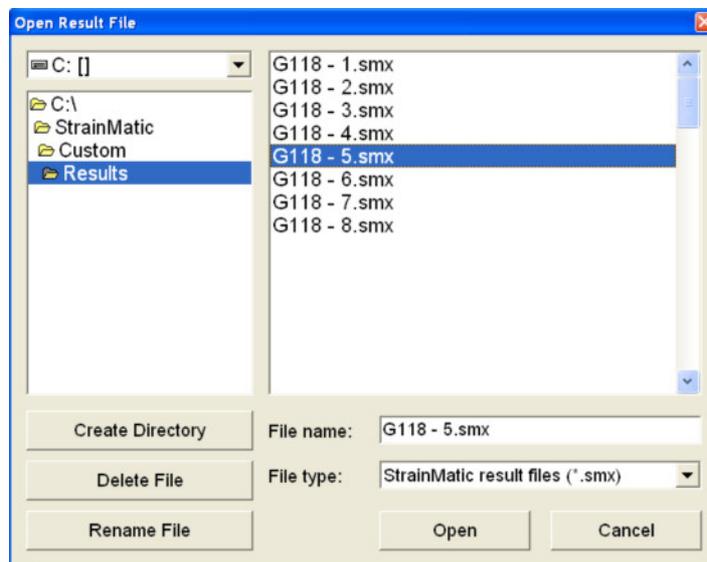
- ☞ You select the desired folder in the left half of the dialog. You can create a new folder under the marked folder with the **Create Directory** button. You can delete entire folders with the **Delete Directory** button. You can rename directories with the

Rename Directory button. If you want to delete or rename an individual file, select the file in the right half of the dialog. The button labels change to **Delete File** and **Rename File**, respectively.

- Enter a meaningful designation for the file in the **File name** field.
- Select the required file format if necessary under **File type**.
- Activate the **Save** button to save the data in the corresponding format.

Loading files

Independently of which type of file you want to load, the following open file dialog always appears after you activate the corresponding button:



- Select the folder in which the desired file is located in the left half of the dialog.
- Select a file format if necessary under **File type**, to display only files of this type.
- Mark the required file in the list on the right.
- Activate the **Open** button.

NOTE: Depending on the file type the software keeps the last accessed directory and activates this directory by default when saving or loading a file of the same type again. The following directories are used by default:

Result files (SMX):	C:\StrainMatic\Custom\Results
Images (BMP, JPG, EMF):	C:\StrainMatic\Custom\Images
Reports (PDF):	C:\StrainMatic\Custom\Reports
Exchange files (SMT, TXT, SLX):	C:\StrainMatic\Custom\Exchange
Database (MDB):	C:\StrainMatic\Custom\History
Backup files (SBK):	C:\StrainMatic\Custom\Backup
Polarimeter recording (RAW):	C:\StrainMatic\Custom\Recorder

4.3 Starting StrainMatic



WARNING: Risk of damage on overheating the instrument! Before operation make sure that the fans of the instrument, if existing, cannot be covered and are functioning.



CAUTION: Put the STRAINMATIC into operation only if all covers and protective devices have been installed correctly.



WARNING: Risk of injury and damage! Start the instrument only if the sample compartment is free and the cover of the measuring head is closed.

To start the STRAINMATIC:

- Switch the instrument on with the main switch on the right-hand side (**I-On** position).
The **POWER ON** lamp at the front side of the instrument turns on.
- If the device is controlled with an external operating PC, switch on the operating PC and the monitor.
The operating computer boots automatically and the operating software is started.
- Confirm the start of the self test with **OK**.

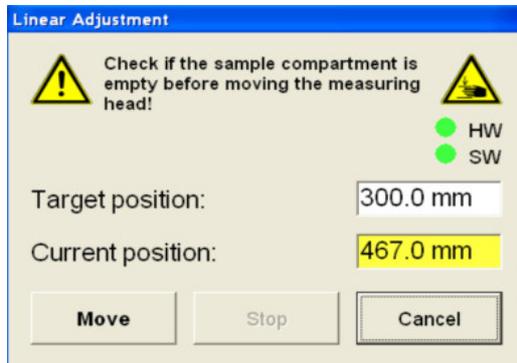


NOTE: If the self-test does not run free of error, save the log file with the corresponding button and send this to the manufacturer.

After the self test has been completed the **Select method** window appears.

- Select the desired measuring method from the list of methods and confirm your selection with **OK**.

If the measuring method requires a new position of the measuring head the **Linear Adjustment** window appears (M2 only):



- Confirm the adjustment of the measuring head with **Move**.

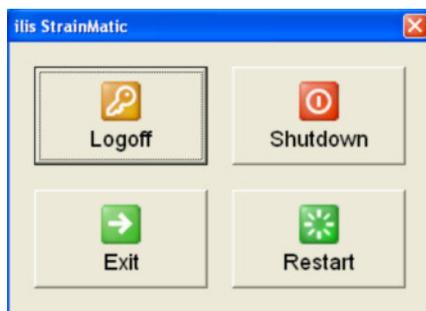
After the measuring head has reached its target position the **Linear Adjustment** window closes automatically and the instrument is ready for operation.

4.4 Ending StrainMatic

To switch the instrument off:

- Activate the Off button  in the right upper corner of the operating software.

The following window appears:



- Activate the **Shutdown** button to exit the operation software and to shut down the operating computer.
- Wait until the message "**It is now safe to turn off the computer**" appears or the display has switched off automatically.
- Set the main switch to **O-Off** to disconnect the instrument from the power supply.

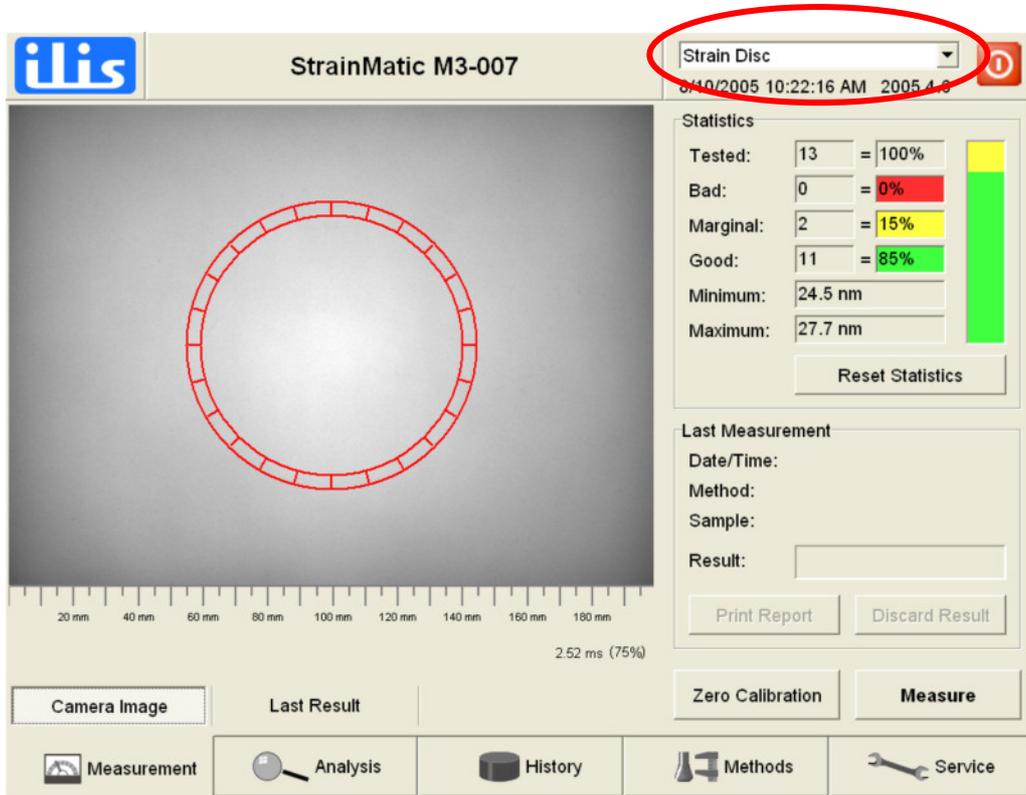


CAUTION: To prevent data loss and damage of the software and the operating computer always shut down the operating computer as described above before switching off the main switch (M2 only).

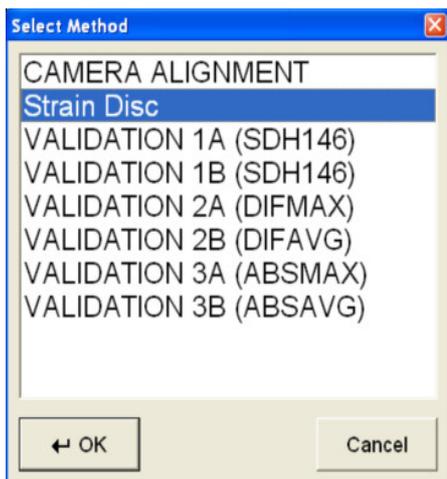
4.5 Selecting measuring methods

To activate a new measuring method for the measurement:

- ➔ Click on the drop down list of measuring methods in the status bar:



The list of available measuring methods appears:

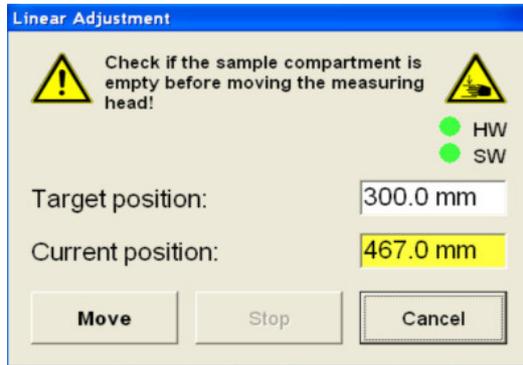


- ➔ Select the appropriate measuring method from the list and confirm your selection with **OK**.

The selected measuring method is displayed in the status bar.

NOTE: The following operating steps refer to the STRAINMATIC M2 only.

If the new measuring method requires a new position of the measuring head the **Linear Adjustment** window appears:

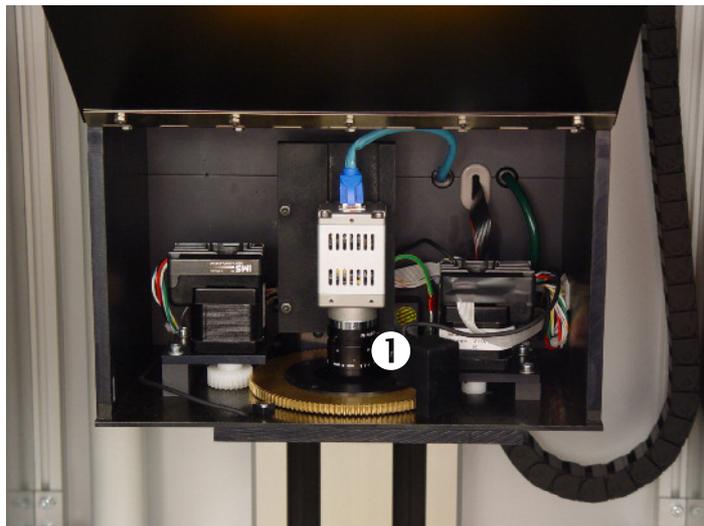


- Ensure that the sample compartment is empty and confirm the new position of the measuring head by activating the **Move** button.

The measuring head is moved to the new position.

NOTE: If the unit is equipped with automatic focus control and this is activated under **Service** ⇒ **System Setup** ⇒ **Accessories**, the focus is adapted automatically after moving the measuring head and the following steps are not required.

- If the final camera position is reached, adjust if necessary the camera lens so that a sharp image of the wanted measuring area is displayed in the **Measuring** ⇒ **Camera Image** operating area. Open the cover of the measuring head to adjust the camera lens:



(1) Camera focus

- Turn the focus adjusting ring until the camera image is displayed sharp-edged.

NOTE: When adjusting the camera focus always be careful not to change or close the lens aperture.

4.6 Installing sample holders

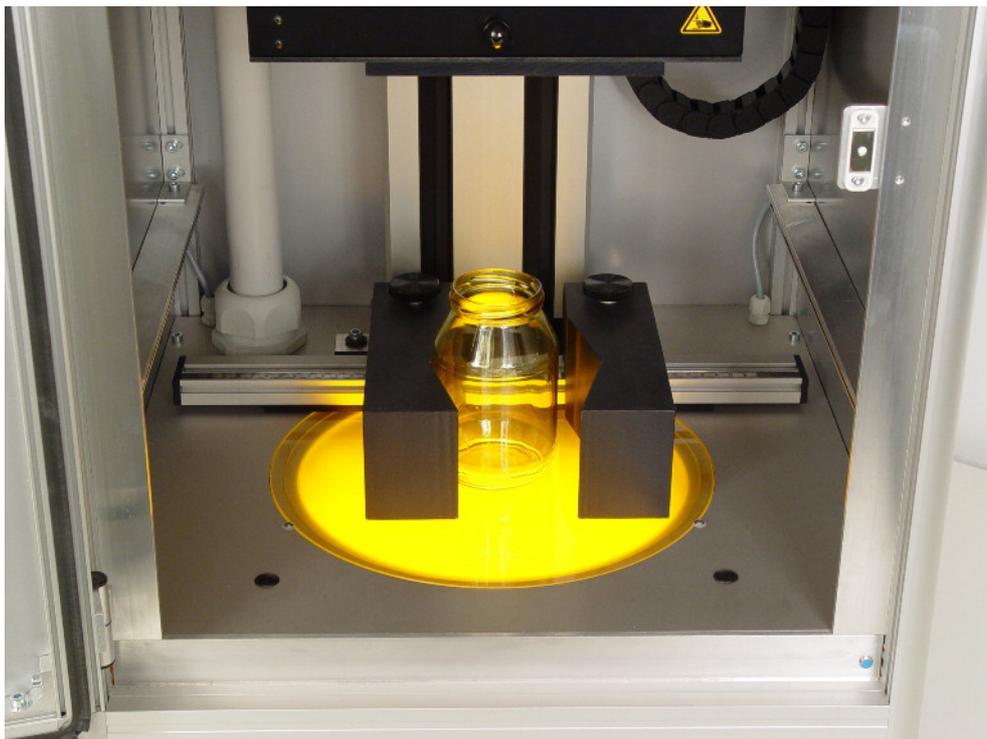
Some sample forms may require the use of a sample holder.

NOTE: You can obtain individual sample holders from the manufacturer.

For performing the validation and calibration procedures reference standards may be used. These reference standards are inserted into the sample compartment in the same way as a sample holder.

To insert a sample holder or a reference standard into the sample compartment:

- If necessary, remove the protection caps from the positioning holes (1).
- Insert the sample holder into the sample compartment by inserting the corresponding pins into the holes in the base plate. Use the screw in the middle for orientation (the sample holder has a cut-out for this screw):



Inserted sample holder

4.7 Performing measurements



WARNING: Risk of injury! Move the measuring head only if the sample compartment is free. Do not grasp into the sample compartment while the measuring head is moving (M2 only).



CAUTION: Risk of injury! If the stresses in the sample to be measured are high or unknown, wear protective goggles and gloves!

All functions for performing a measurement are available to you in the **Measurement** operating area.

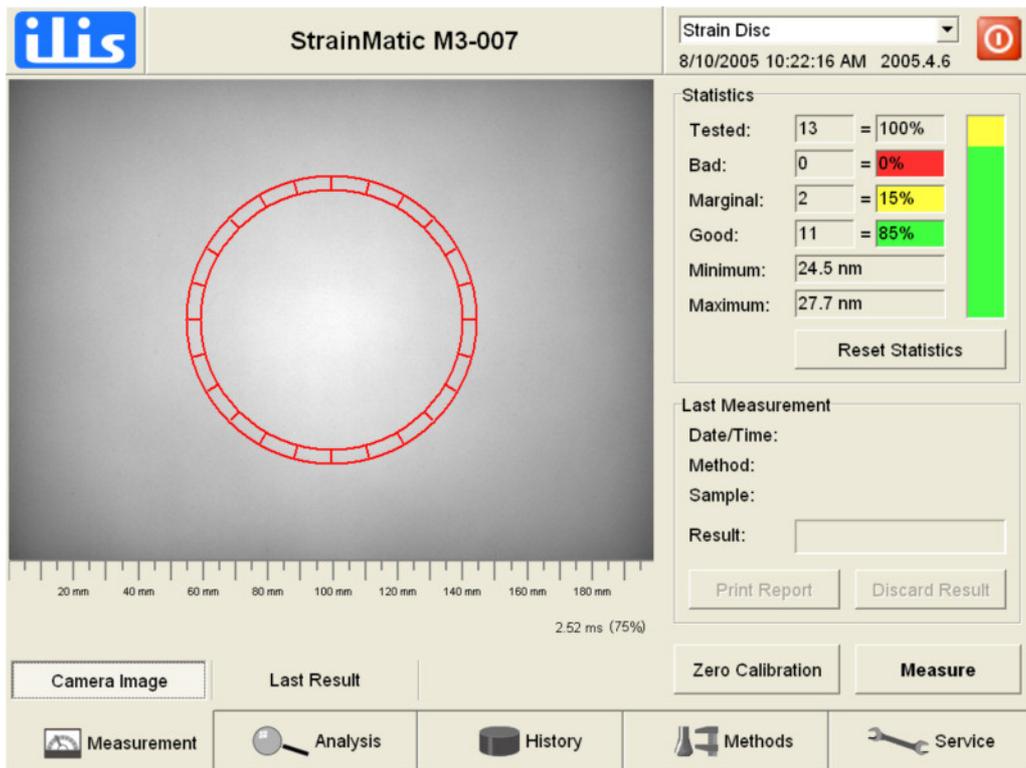
To perform a measurement:

- Select if necessary from the drop down list of measuring methods the measuring method belonging to the article (see section 4.5).
- If the **Measure** button is not yet available, first activate the **Zero Calibration** button.

During the zero calibration residual stresses in the sample plate and inhomogeneities of the illumination are compensated.

NOTE: The operating software determines automatically according to the presetting in the **Service** ⇒ **System Settings** ⇒ **Optics** area and the settings in the measuring method when zero calibration of the instrument is necessary. In addition, always calibrate the instrument if the optical system has changed due to a new sample holder or a new camera lens, for example.

- Wait until the instrument is ready again and then position the sample in the sample compartment. If necessary activate the **Camera Image** button to be able to see the current position of the sample on the screen.



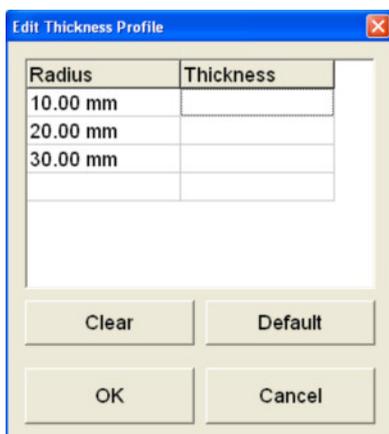
The sample should be located as far as possible in the center of the sample compartment or within a measuring area set in the measuring method. Use sample holders possibly also supplied. Secure the sample if necessary against movement (for example rolling away) during the measurement.

- Activate the **Measure** button.

If entry of a sample name is required according to the measuring method (see section 4.10.6), a window for selecting or entering the sample designation appears.

- Enter a sample name or select a predefined sample name and confirm your entry with **OK**.

If entry of sample-related thickness values is required according to the measuring method (see section 4.10.2), a window for entry/change of the thickness profile appears:

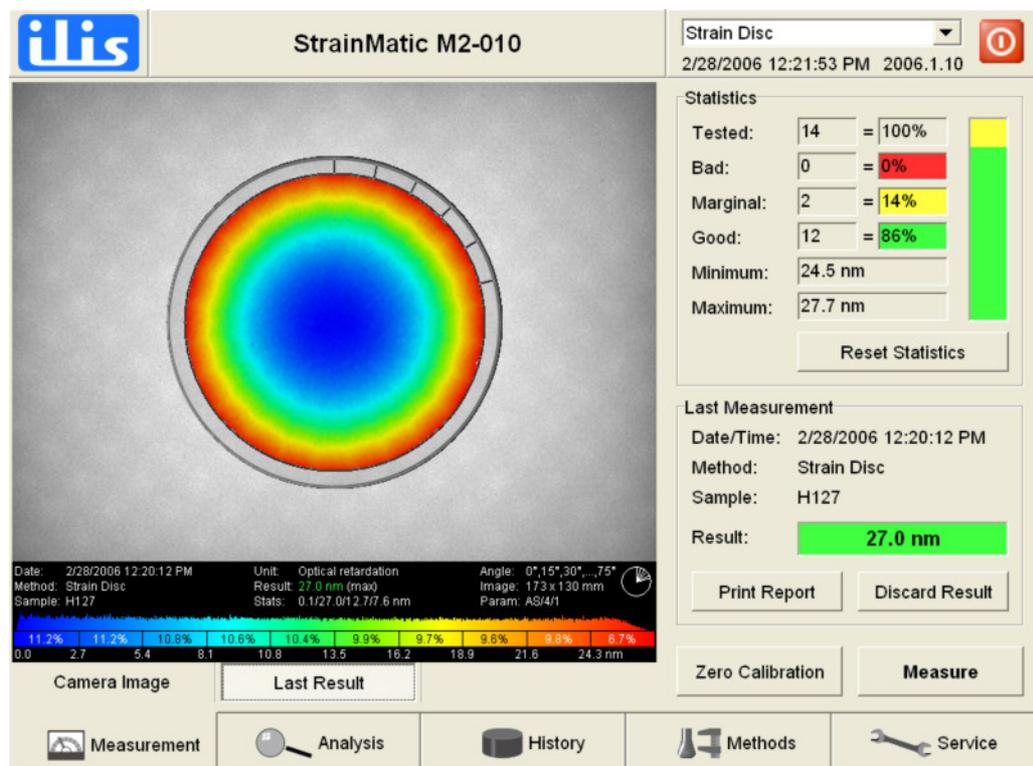


NOTE: Depending on the definition in the measuring method the window can also appear after the measurement.

- Enter the thickness values at the predefined positions. You can use an accessory for automatic thickness measurement, if connected.

The measurement is started. According to the settings in the measuring method, the measurement can last from a few seconds up to several minutes. The progress of the measurement is displayed on a progress bar.

After the measurement the result is displayed on the **Last Result** tab card.



The figure shows as an example the measuring result for a so called "strain disc". In this example limits for a good-bad assessment of the measuring results were filed in the measuring method (see section 4.10.5).

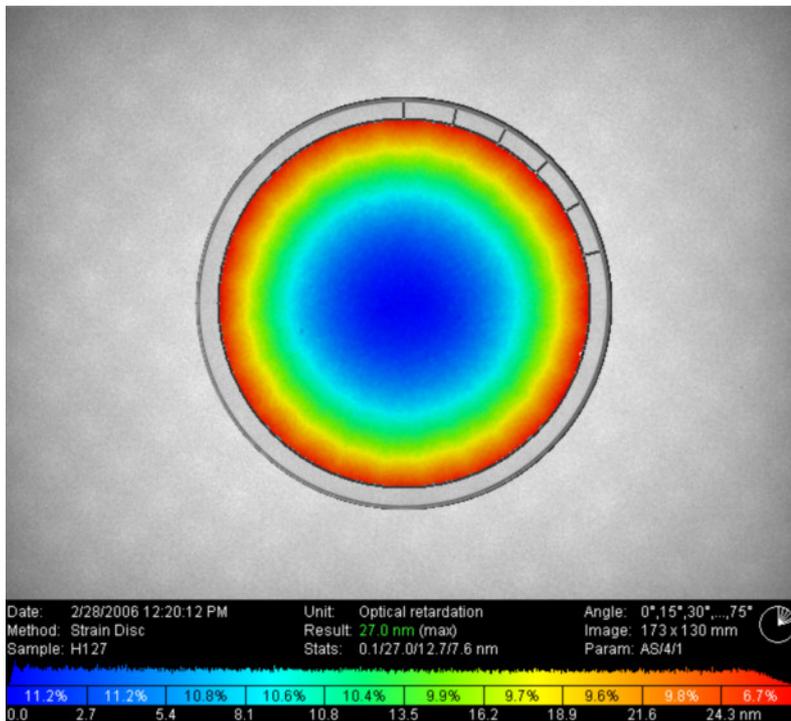
If the result value of the measurement is within the good limits, the result is shown with a green background in the **Result** field, in the case of marginal or bad assessment yellow or red, respectively.

- If you want to discard the measuring result, activate the **Discard Result** button.

In this case the result does not go into the article statistics and is also not saved in the database (**History** area, see section 4.9).

Evaluating the result

The different value ranges are displayed color-coded in the image itself. By default blue areas represent low values, red areas high values. The displayed colors can be adapted in the **Service** ⇒ **System** ⇒ **Miscellaneous** area. All pixels belonging to the measuring result are marked by a white frame as default.



You will find the following information in the legend below the image:

Date: Date and time at which the measurement was made.

Method: Name of the measuring method used.

Sample: If specified designation of the sample.

Unit: Unit in which the measurement was performed.

Result: Result value, if necessary in brackets the threshold defined in the measuring method. If limits for the measurement were set in the measuring method, the result value is displayed in the corresponding colors: good (green), marginal (yellow) or bad (red), see section 4.10.5.

Stats: Minimum/maximum/mean value/standard deviation over the measured values of all pixels in the measuring area.

Angle: Angle position of the polarizer in the current image (in the result image superimposition of all measured positions).

Image: Size of the displayed image (width x height).

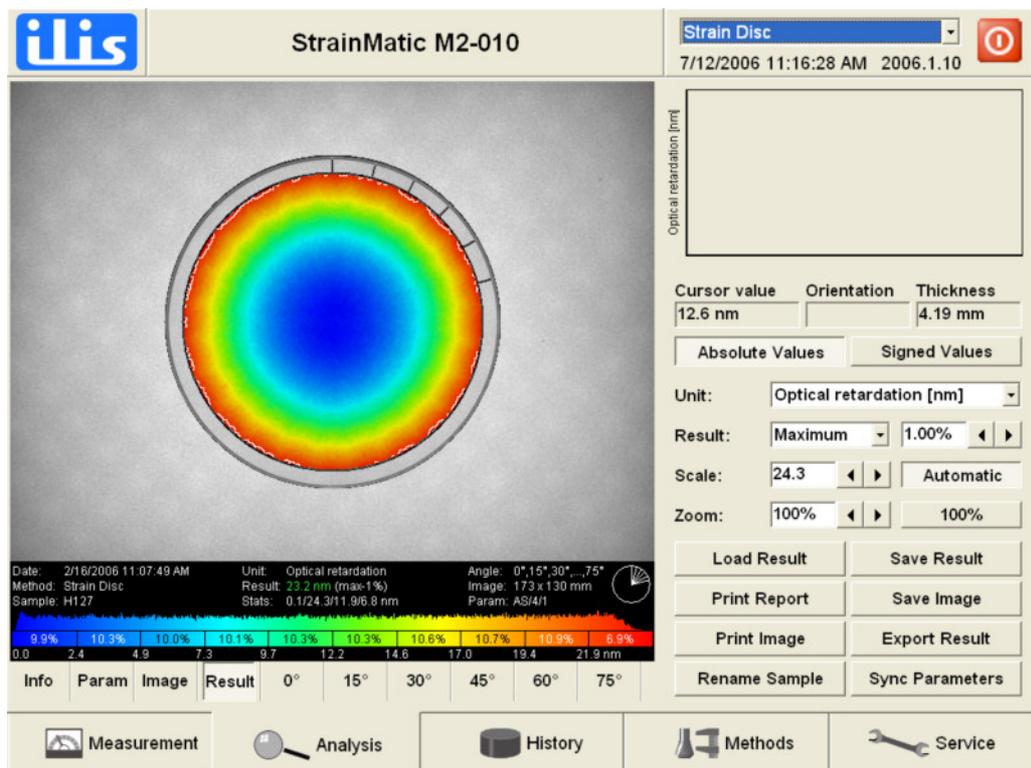
Param: Essential parameters of the measurement: Analyzer step width/Number of averages/Horizontal smoothing factor/Vertical smoothing factor (if different from horizontal).

You see the percentage distribution (histogram) of the measured values in the color scale. For this purpose the measured values between 0 and the maximum value set in the measuring method are divided into up to ten equal sections, and in each case the percentage share of the measuring points inside these levels is displayed.

4.8 Analysing measuring results

The **Analysis** operating area is available to you for further analysis of the measuring result.

The result of the last measured sample is displayed automatically on the **Result** tab:



However, in this area you can also print and save measuring results, configure the presentation of the measuring result, or reload saved measuring results.

4.8.1 Saving or loading measuring results

NOTE: You can save all data of a measuring result as SMX file or only the images of a measurement in the BMP, JPG or EMF format to send them for example by e-mail. However, note that only SMX files can be loaded back into the operating software, not image files.

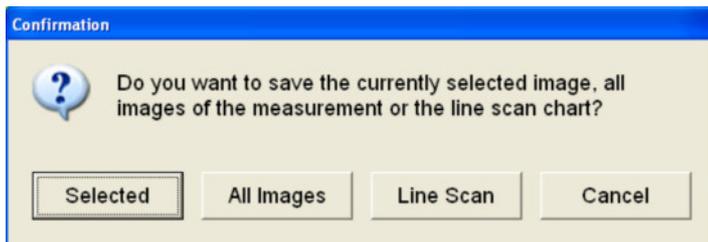
To save the entire measuring result:

- Activate the **Save Result** button.
- Select the required folder in the **Save Result File** dialog (by default **C:\StrainMatic\Custom\Results**).
- Enter a meaningful name for the measuring result in the **File name** field. The sample designation or the name of the measuring method is proposed as standard.
- Activate the **Save** button to save the data as SMX file.

The saved file contains all data of the measurement.

To save only the images of a measuring result:

- Activate the **Save Image** button.



- Choose if you want to save only the currently selected image, all images of the measurement including the camera image or the line scan diagram.
- Select the desired folder in the **Save Image** dialog.
- Enter a file name. The sample designation is proposed as standard. For identification the file names are extended by a suffix like, for example, "(image)", "(result)" or "(line scan)".
- Select from the **File type** drop down list whether the images should be saved in BMP, JPG or EMF format.

NOTE: JPG files require less storage space than BMP files, but also have lower image quality. Use the EMF format, for example, if you want to use a line scan diagram as a vector graphic.

- Activate the **Save** button to save the file(s).

When images are saved, the associated legend is also saved.

To load a measuring result:

- Activate the **Load Result** button.

- ⇒ Select the folder in which the required file is located from the **Open Result File** dialog.

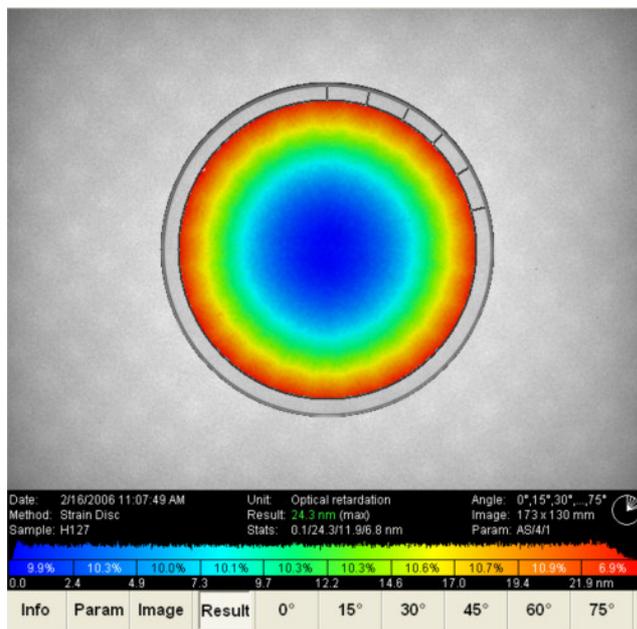
- ⇒ Activate the **Open** button.

The measuring result is loaded in the operating software and can be analysed.

4.8.2 Analysing the result

4.8.2.1 Viewing detail images of a measurement

Use the buttons under the result image to have the different images and data of the measurement displayed:



Info: Displays the most important data of the measurement as a table.

Param: Allows you to customize the presentation of the measuring result without changing the measuring method and repeating the measurement.

Image: Displays the camera image of the sample. Under the image you see a scale stating the size of the image. Furthermore the file path and the file name of the file are displayed under the image if the result was saved as SMX file or loaded from a SMX file.

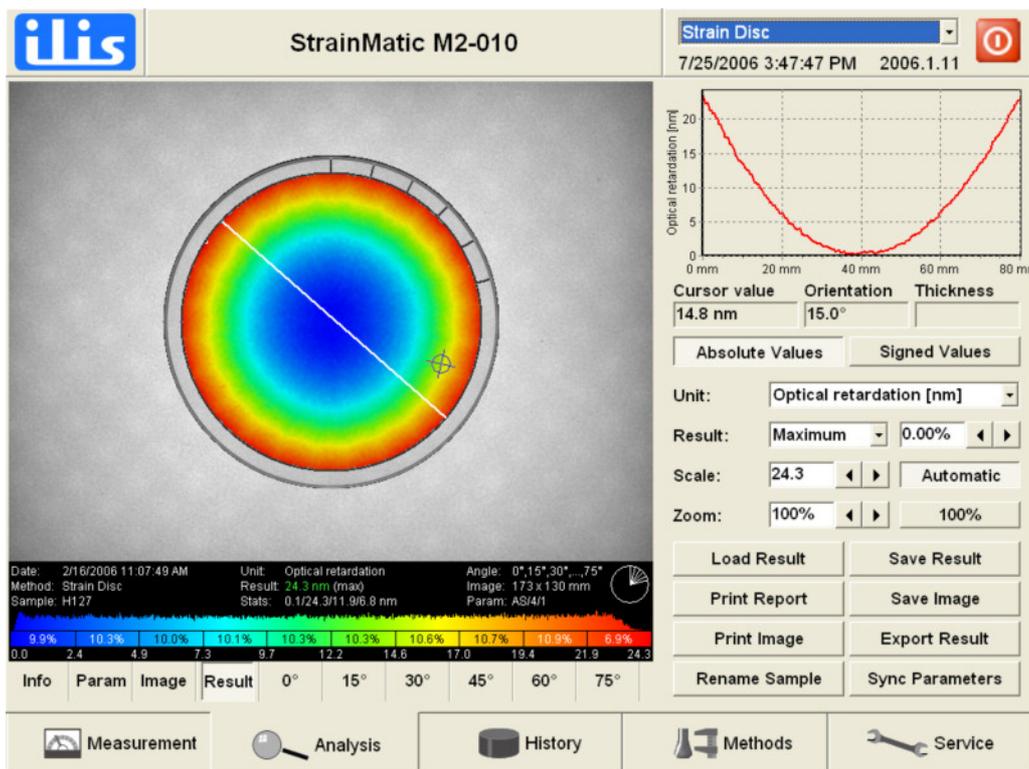
NOTE: The scale for displaying the image size is calculated automatically (according to the settings in the **Service** ⇒ **System Settings** ⇒ **Optics** area) depending of the camera position.

Result: Displays the result image of the measurement.

0°, 15° etc.: Displays the detail images of the measurement under the relevant polarizer position.

4.8.2.2 Evaluating result

NOTE: The display of the result image and the data displayed in the legend correspond to the display in the **Measurement** operating area (see section 4.7). However, in contrast to the **Measurement** area you can also subsequently adapt the display of the data in the **Analysis** area (for example maximum value of the scale or smoothing). The change of the appearance of the measurement display has no effect on the corresponding measuring method.



Displaying value profiles (Line Scan)

To display a profile of the measured values place the cursor at the starting point of a line inside the measuring area and draw the cursor to the ending point of the line.

The measured values along this line are displayed graphically.

Displaying result values (Cursor value, Orientation, Thickness)

In the **Cursor value** field the result value of the measurement at the current cursor position is displayed. If a thickness profile has been defined in the measuring method, the thickness defined at this particular position is displayed in the **Thickness** field. In the **Orientation** field the polarisation angle of the currently selected measuring value is displayed, if defined.

Displaying signed values

To display signed values instead of the absolute result values in the result image and in the line scan graphic, activate the **Signed Values** button.

Changing the measuring unit

To automatically convert the displayed result values into another unit select the desired unit from the **Unit** drop down list. Normalized units can be displayed only if a thickness profile has been defined for the current article.

Changing calculation of result values

If you want to display a result value different from the definition in the measuring method (for example, "average" instead of "maximum"), select the corresponding item from the **Result** drop down list. In the field beneath the drop down list you can additionally change the **threshold** (see section 4.10.4).

Changing the scale

To adapt the color scale of the result image and the legend enter a new maximum value for the color scale in the **Scale** field or change the value by using the ◀ and ▶ buttons, respectively. By activating the **Automatic** button, the color scale is automatically adapted to the maximum measured value.

Zooming result image

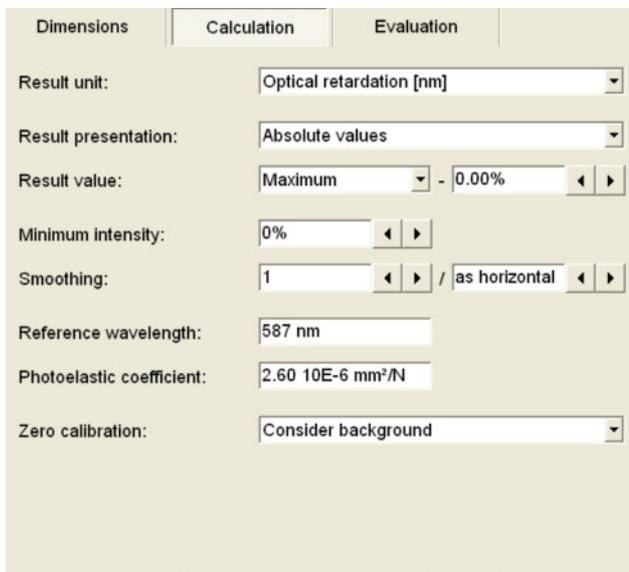
By using the **Zoom** parameter field you can enlarge the currently displayed image up to 400%.

4.8.2.3 Customizing the presentation of the measuring result

After the measurement you can customize the presentation of the measuring results by using the **Param** tab card without altering the measuring method or performing a new measurement.

Here you can find the most important measuring and evaluation parameters in the **Dimensions**, **Calculation** and **Evaluation** area, as they were defined in the measuring method for performing this measurement (see section 4.10). To change a value for the display of the result:

- Activate the required tab card, for example the **Calculation** tab.
- Change the desired value.



The screenshot shows the 'Calculation' tab selected in a software interface. The interface has three tabs: 'Dimensions', 'Calculation', and 'Evaluation'. The 'Calculation' tab is active. The parameters are as follows:

Parameter	Value
Result unit:	Optical retardation [nm]
Result presentation:	Absolute values
Result value:	Maximum - 0.00%
Minimum intensity:	0%
Smoothing:	1 / as horizontal
Reference wavelength:	587 nm
Photoelastic coefficient:	2.60 10E-6 mm ² /N
Zero calibration:	Consider background

- Activate the **Result** tab card to apply your changes.

NOTE: The changed settings in the **Param** area will be considered by the software when saving the result or printing a result report, but they do not affect the measuring template. To transfer the changed parameters to the currently loaded measuring template activate the **Sync Parameters** button.

4.9 Archiving measuring results

NOTE: The database module for archiving the measuring results is an optional module of the STRAINMATIC. If not ordered this module is not available in your version of the STRAINMATIC.

You can archive measuring results and analyse archived measurements in the **History** operating area.

The screenshot shows the StrainMatic M2-010 software interface. The main window is titled "StrainMatic M2-010" and displays a table of measurement results. The table has columns for Timestamp, Method, Name, Thickness, Rating, Result, and Unit. The data is sorted by Timestamp in descending order. A circled '1' points to the table. To the right of the table is a "Result" display area (circled '3') showing a circular color map of a strain disc. Above the result display is a "Statistics" button (circled '4'). Below the result display are "Save Image" and "Load Result" buttons. Below the table are filter criteria (circled '2') including Method, Rating, Unit, From, and To. At the bottom of the interface are navigation buttons for Measurement, Analysis, History, Methods, and Service.

Timestamp	Method	Name	Thickness	Rating	Result	Unit
4/28/2006 11:16:05 AM	Strain Disc	H127 90°	4.13	None	31.10	nm (OR)
4/28/2006 11:15:45 AM	Strain Disc	H127 90°	4.13	None	31.10	nm (OR)
4/28/2006 11:15:01 AM	Strain Disc	H127 45°	4.13	None	31.90	nm (OR)
4/28/2006 11:14:42 AM	Strain Disc	H127 45°	4.13	None	31.80	nm (OR)
4/28/2006 11:13:11 AM	Strain Disc	H127 30°	4.13	None	31.90	nm (OR)
4/28/2006 11:12:28 AM	Strain Disc	H127 30°	4.13	None	31.80	nm (OR)
4/28/2006 11:11:27 AM	Strain Disc	H127 15°	4.13	None	31.80	nm (OR)
4/28/2006 11:10:40 AM	Strain Disc	H127 15°	4.13	None	31.70	nm (OR)
4/28/2006 11:09:08 AM	Strain Disc	H127 10°	4.13	None	31.60	nm (OR)
4/28/2006 11:07:59 AM	Strain Disc	H127 10°	4.13	None	31.80	nm (OR)
4/28/2006 11:05:51 AM	Strain Disc	H127 5°	4.13	None	31.30	nm (OR)
4/28/2006 11:03:18 AM	Strain Disc	H127 5°	4.13	None	31.70	nm (OR)

- (1) Result table
 (2) Filter criteria
 (3) Result display
 (4) Statistics

All measurements in which this option is set in the measuring method are saved here (see section 4.10). If the images are also stored in the database the associated result image is displayed in the result display (3) when you mark a data record. You can display the image in original size, save it to a file or load the result into the **Analysis** area with the buttons below the display.

You can toggle between the result image and a statistics display with the buttons above the image display. A trend curve over all measuring results displayed in the result table is then displayed under **Statistics** (4).

Filtering the results table

To display only certain measurements in the table (1), select the required options from the filter criteria area (2).

Sorting the results table

To sort the displayed content of the results table select the required column heading from the **Sort sequence** drop down list.

Deleting results from the database

To delete only the marked measurement:

- Activate the **Delete Record** button.
- Confirm the following query with **Yes**.

To delete all displayed results:

- Activate the **Delete All** button.
- Confirm the following query with **Yes**.

4.10 Setting up measuring methods

Before measurements can be performed with the STRAINMATIC, measuring methods for the sample to be measured must be set up in the **Methods** operating area.

NOTE: In the standard operating mode all relevant parameters of the measuring method are available. Parameters for advanced operation are hidden when they are set to default values but can be made available by using the **Expert-Mode** button.

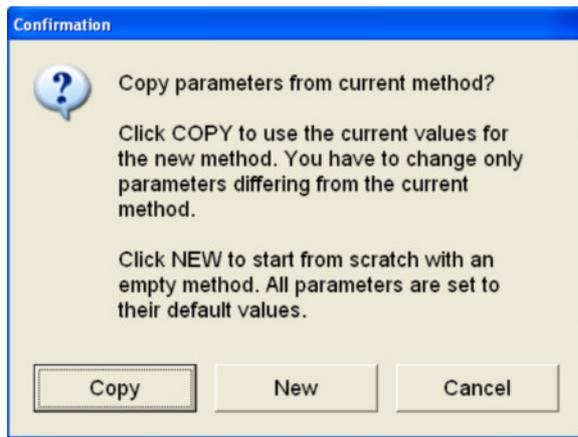
For most measurements the parameters available in standard mode are sufficient; a detailed description of all parameters is given in the reference manual.

4.10.1 Creating new measuring methods

NOTE: If you are not sure which settings are most suitable for the new sample to be measured, first perform a test measurement. After the measurement, you can adjust most parameters regarding dimension, evaluation and calculation in the **Analysis** ⇒ **Param** area and examine the results directly at the **Result** tab. Then use the **Sync Parameters** function to transfer the changed parameters to the currently loaded measurement method.

To create a new measuring method:

- Activate the **New** button in the **Methods** area.
- In the following confirmation window, select if you want to copy the values of the currently active measuring method or if you want to create a new method with default parameters.

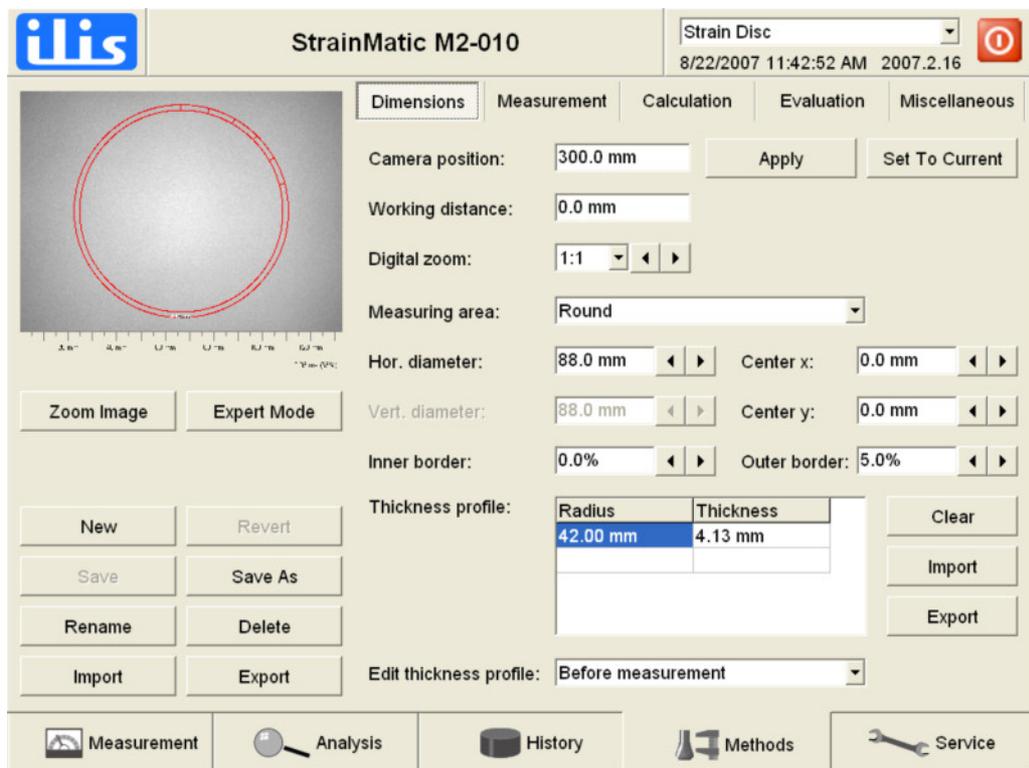


- Enter a meaningful name for the new measuring method, for example an article designation, and confirm your entry with **OK**.

The measuring method is created and displayed in the drop down list of measuring methods in the title bar.

4.10.2 Defining dimension parameters

You determine article-related data such as for example the shape and size of the measuring area on the **Dimensions** tab card in the **Methods** operating area:



4.10.2.1 Defining camera position (M2 only)



WARNING: Risk of injury! Move the measuring head only if the sample compartment is free. Do not grasp into the sample compartment while the measuring head is moving.

- Enter the required vertical position of the measuring head in the **Camera position** field.

The **Linear Adjustment** window opens.

- Activate the **Move** button.

The measuring head moves into the target position stated in the **Target position** field.

NOTE: Use the **Set to Current** button to copy the current position of the measuring head to the **Camera position** field.

NOTE: Check the camera position after moving by placing a sample in the sample compartment. The camera should deliver the largest possible but still sharp image of the area to be tested. By using the **Zoom Image** button you can activate a larger display of the camera image.

NOTE: If the unit is equipped with automatic focus control and this is activated under **Service** ⇒ **System Setup** ⇒ **Accessories**, the focus is adapted automatically after moving the measuring head and the following steps are not required.

- Once the final camera position is reached, adjust the camera lens so that a sharp image of the wanted measuring area is displayed. Open the flap in the measuring head to adjust the camera lens.

NOTE: When adjusting the camera focus always be careful not to change the lens aperture.

4.10.2.2 Defining measuring area

- Select from the **Measuring area** drop down list whether you want to evaluate only a certain area of the image or the entire image. Leave out areas of the sample which could falsify the measuring result, for example:

- Edges
- Curved areas or areas that are inclined against the measuring layer
- Opaque areas

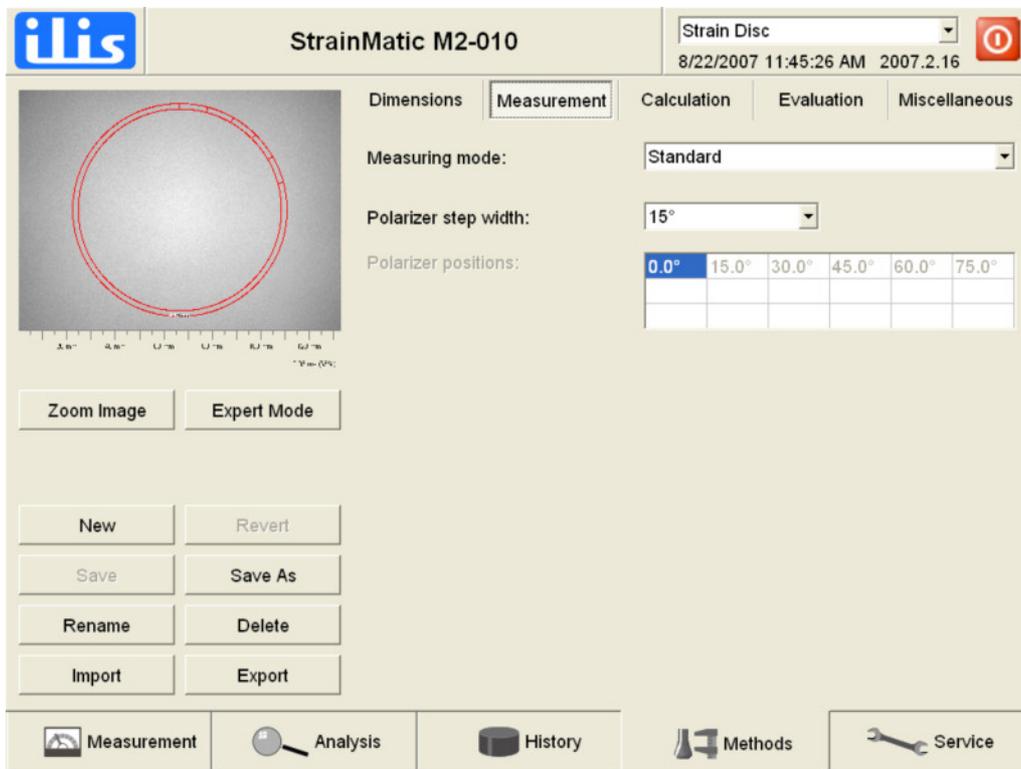
Furthermore a defined measuring area helps the operator to position the sample before the measurement exactly in the sample compartment.

- Once you have selected a region as measuring area, specify its size and position. For this purpose position a sample in the sample compartment to be able to set the accurate dimensions.
- If you want to normalize the measuring result, enter the thickness distribution of the area to be measured in the **Thickness profile** table. Measure the thickness of the sample especially at those areas where the highest stresses are expected.
- Select the **After measurement** option from the **Edit thickness profile** list if you can determine the sample thickness only after the measurement, e.g. because a non-destructive thickness measurement is impossible. The thickness profile defined in the measuring method can then be changed directly after the measurement. If you want to enter the sample thickness directly before the measurement starts, select the **Before measurement** option.

NOTE: If you have defined a thickness profile you should change the **Reference thickness** in the **Evaluation** area to the maximum thickness value accordingly.

4.10.3 Defining measuring parameters

You determine the measuring parameters for the relevant article on the **Measurement** tab card of the **Methods** operating area.



- If you expect high-order strain values (i.e. greater than approx. 300 nm optical retardation), activate **HOD** as **Measuring mode**, if available.

NOTE: The High-order determination is an optional module of the STRAINMATIC. If not ordered this module is not available in your version of the STRAINMATIC. Please note that the high-order determination can provide plausible results only if stresses with different orientations do not superpose.

- Enter the step width for the rotation of the polarizer in the **Polarizer step width** field. The step width depends upon the expected distribution of the stresses in the sample. For example, if you expect stress curves which run essentially parallel to the horizontal and vertical image axis, a step width of 90° is suitable. If the stresses are unequally oriented, you should select a small step width, for example, 15°. A step width of 30°, for example, means that images are recorded at polarizer positions of 0°, 30°, 60° and 90°.

By using the **User-defined** mode you can perform measurements at arbitrary polarizer positions. Therefore manually enter the required positions in the **Polarizer positions** table.

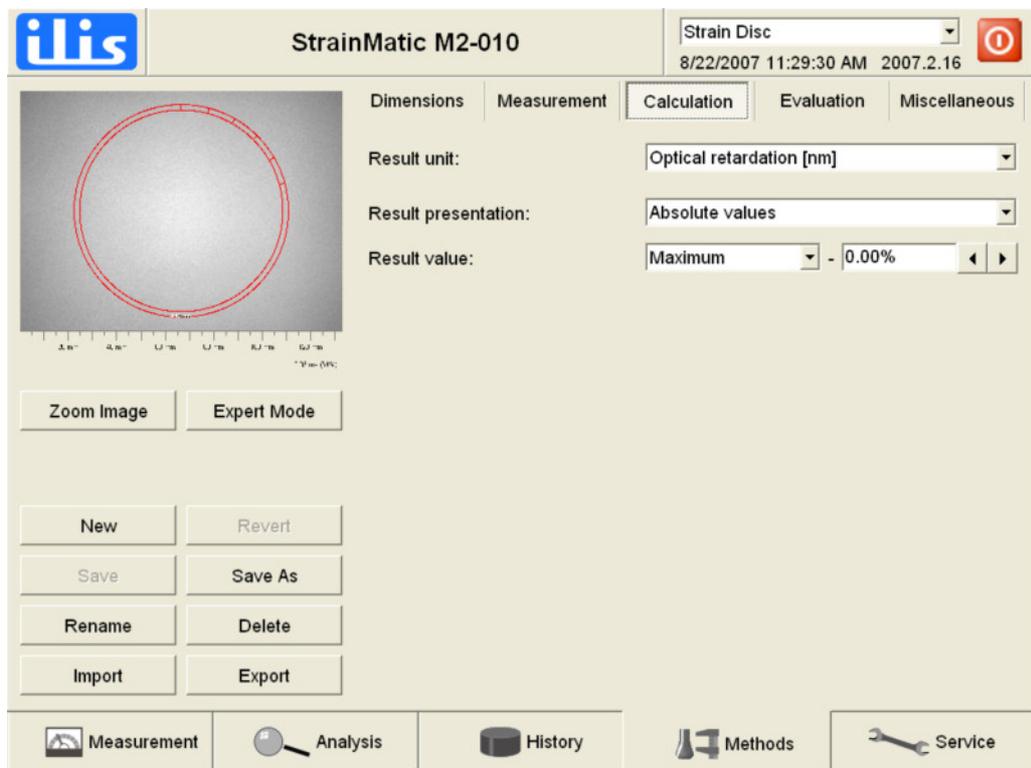
By using the **Interpolated** mode you can achieve a more detailed result for

relatively small expected measuring values. For a detailed description of the **Interpolated** mode please refer to the reference manual.

NOTE: If you do not know how the stresses in your sample are oriented, it is recommended that you perform a test measurement with a small polarizer step width of 15° for example. You can estimate the stress distribution based on this test measurement and determine the required step width for further measurements.

4.10.4 Defining calculation parameters

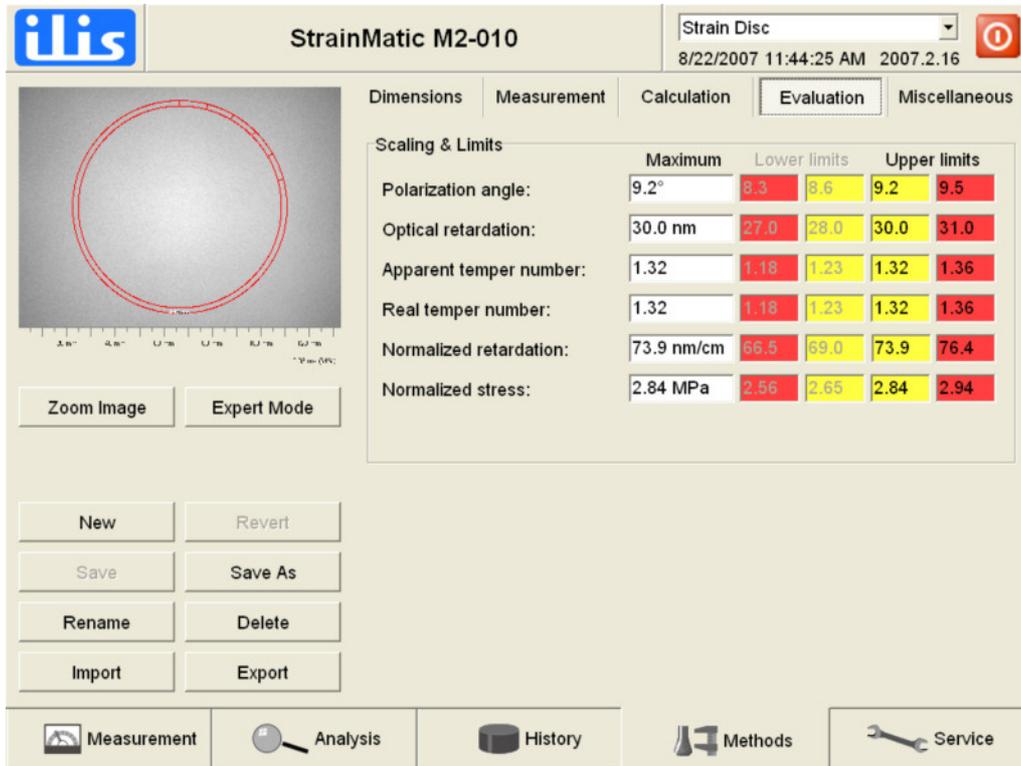
You determine the calculation parameters for the relevant article on the **Calculation** tab card of the **Methods** operating area.



- Select from the **Result unit** drop down list the unit in which the measuring results should be displayed as standard.
- Select from the **Result presentation** drop down list whether the measuring results should be displayed as standard as absolute value or signed.
- Select from the **Result value** drop down list which result value you want to determine in the measurement (maximum, minimum, mean value, standard deviation or none). Enter in the **Threshold** field which value should be output as result value of the measurement. In the default setting of 0% the highest measured value is output as maximum value. However, since this can have arisen due to an outlier, a percentage threshold can be stated here (see Reference Manual).

4.10.5 Determining evaluation parameters

You determine parameters for display and evaluation of the measuring results on the **Evaluation** tab card of the **Methods** operating area.



The screenshot shows the 'StrainMatic M2-010' software interface. The 'Evaluation' tab is active, displaying a table of 'Scaling & Limits' parameters. The table has columns for 'Maximum', 'Lower limits', and 'Upper limits'. The 'Maximum' column contains values for various parameters, while the 'Lower limits' and 'Upper limits' columns contain two values each, representing warning and intervention thresholds. The values are color-coded: red for 'bad', yellow for 'at the limit', and green for 'good'.

	Maximum	Lower limits		Upper limits	
Polarization angle:	9.2°	8.3	8.6	9.2	9.5
Optical retardation:	30.0 nm	27.0	28.0	30.0	31.0
Apparent temper number:	1.32	1.18	1.23	1.32	1.36
Real temper number:	1.32	1.18	1.23	1.32	1.36
Normalized retardation:	73.9 nm/cm	66.5	69.0	73.9	76.4
Normalized stress:	2.84 MPa	2.56	2.65	2.84	2.94

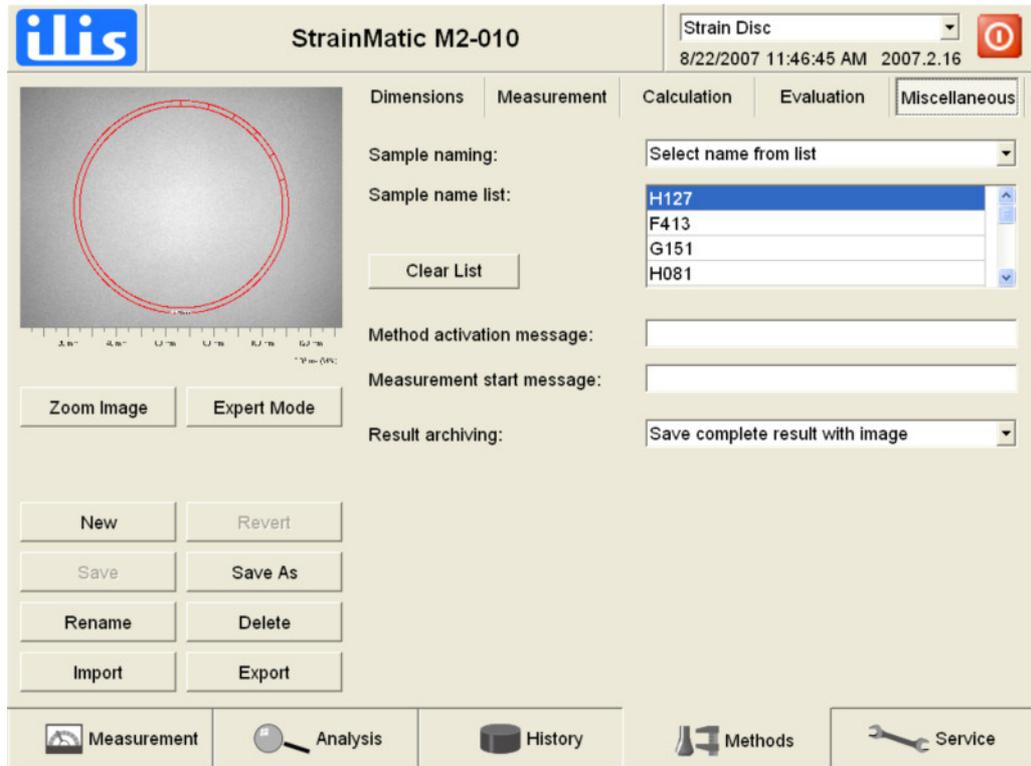
Below the table, there are buttons for 'New', 'Revert', 'Save', 'Save As', 'Rename', 'Delete', 'Import', and 'Export'. At the bottom of the interface, there are tabs for 'Measurement', 'Analysis', 'History', 'Methods', and 'Service'.

- Enter in the **Maximum** column the expected maximum result value in the required unit. If you enter a value in one of these units, it is converted automatically into the other units. The value stated here is used as maximum value for the legend of the result image (see section 4.8). If you select the default value **Automatic** the color scale will be adapted automatically according to the maximum measured value.
- If you want to obtain statistics about the quality of the measured test specimen, enter the upper warning and intervention limits in the **Upper Limits** columns. A decision is made by reference to these limits whether a measurement is classified as "good", "at the limit" or "bad".

NOTE: If you want to define additional **Lower Limits**, activate the **Expert Mode**.

4.10.6 Defining miscellaneous parameters

You determine general parameters on the **Miscellaneous** tab card of the **Methods** operating area.



- Select from the **Sample naming** drop down list whether a sample name should be entered or selected before each measurement and enter predefined sample names in the **Sample name** list if necessary.
- If necessary, enter messages that are to be displayed when selecting the method or before starting each measurement.
- Select from the **Result archiving** list which data of the measurement shall be saved in the **Archive** (see section 4.9).

4.11 Setting up basic parameters

You determine the basic parameters for the STRAINMATIC on the **System Setup** tab card in the **Service** operating area.

The settings here are independent of the currently selected measuring method and apply to all measurements.

4.11.1 Changing the language of the user interface

Under **User Interface** you can select different languages for displaying the user interface of the operating software, for example.

- Select the wanted language for the user interface from the **Language** drop down list. With the **Automatic** setting, the language of the operating system is used if possible for the display of the user interface.

4.11.2 Changing operating mode

You can select under **User Interface** whether the STRAINMATIC should be operated by touch operation or, with an externally connected PC, by mouse and keyboard:

- Select the operating mode for the user interface from the **Input mode** dropdown list.

4.11.3 Activating the terminal lock

If the screen saver of the operating PC is activated after a certain time without operating activities, the terminal lock can prevent unintended operation by touching the display.

- Enter the time in minutes after which the user interface should be locked in the **Terminal lock time** field under **User Interface**. When you select the default value **Never** the user interface is not locked at any time.

If the user interface is locked after the end of this time, a corresponding message appears.

- To enable the user interface again, activate the **OK** button of the message dialog.

4.11.4 Allocating access codes for different operating levels

Under **Access Codes** you can define access codes for the different operating levels in the operating software which must be entered when executing functions or changing settings in the relevant operating area. An access code in the STRAINMATIC user interface consists of a number combination.

The operating areas of the STRAINMATIC are:

Level 1 (Measurement): Access to the **Measurement** operating area.

Level 2 (Analysis): Access to the **Analysis** operating area.

Level 3 (History): Access to the **History** operating area.

Level 4 (Methods): Access to the **Methods** operating area.

Level 5 (Service): Access to the **Service** operating area.

NOTE: Some parameter settings in the **Service** area are not available with level 5 access code. These settings are only accessible by ilis service personnel or at disposition of ilis.

One level always includes the subordinate levels in each case. Thus an operator with access to level 3 also has automatically access to the levels 1 and 2.

If no access code was allocated for the upper levels, the highest allocated access code also applies for these levels. For example, if no access code was allocated for level 5, but one for level 4, then one receives on entry of the access code for level 4 also access to the functions of level 5.

Example:

You want to set up the following two operators:

- One operator should have access to the **Measurement, Analysis** and **History** operating areas without entry of an access code.
- Another operator should have access to all functions for service activities. However, in this case the **Methods** and **Service** operating areas should be protected by an access code.

In this case allocate an access code in the **Level 4 (Methods)** field, which must be known to the service personnel.

NOTE: For level 5 an access code has to be defined at any time to prevent unwanted changes of basic settings. By factory default, an appropriate access code of **91052** is defined that should be changed at first start-up (see Service Manual).

5 Validation

You should check the correct function and settings of the instrument at regular intervals with the integrated validation methods.

The validation protocols describing the currently valid result values of the different validation procedures are delivered with the instrument, if ordered. The validation protocols are not integrated into this documentation, since for example after a spare part change other validation values can be necessary.

5.1 General procedure

To ensure the correct function of the instrument always perform the validation procedures at least in the below mentioned time intervals:

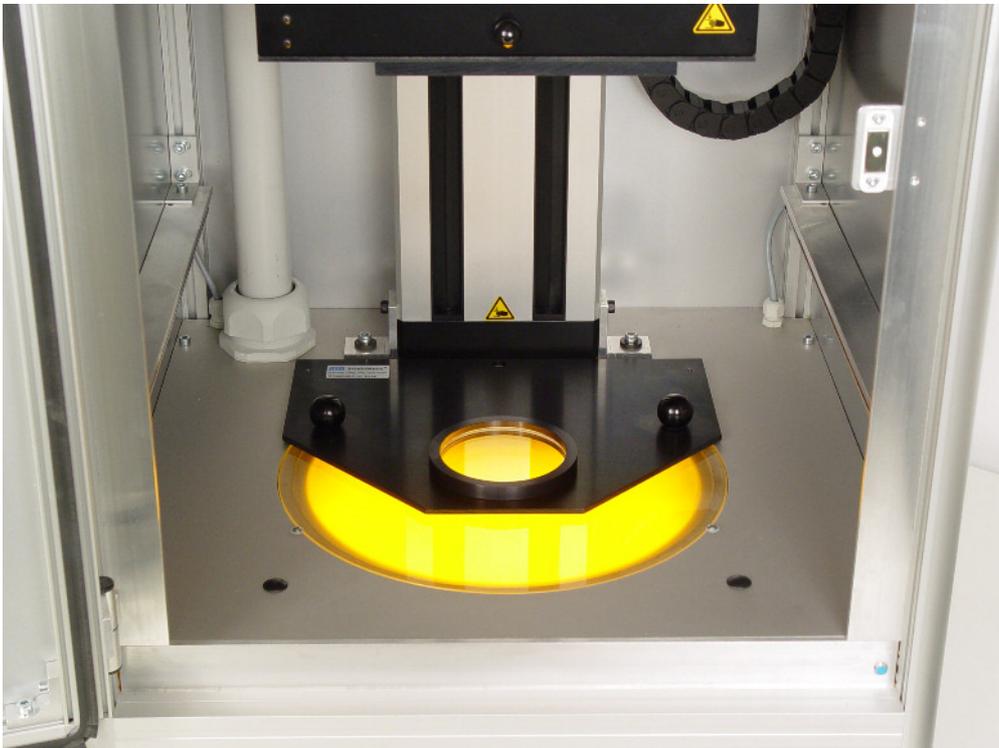
- Initial start-up and start-up after a longer downtime
- After transportation of the instrument
- In regular time intervalls, for example, once a month

Perform each validation at least once. None of the results should be BAD (red). If the result of a validation is classified as BAD (red) in the operating software, save the result file in the **Analysis** area with the **Save Result** function and send it by e-mail to the manufacturer for analysis. You can find the contact address in section 1.4.

5.2 Performing validation procedure 1

To perform validation procedure 1A or 1B:

- Select the **VALIDATION 1A** or **VALIDATION 1B** method from the drop down list of measuring methods.
- If the measuring head has to be adjusted, confirm the linear adjustment with **Move** (M2 only).
- Focus the camera image until a sharp-edged image is displayed (M2 only).
- If the **Measure** button on the **Measurement** tab card is not yet available first activate the **Zero Calibration** button.
- Insert the reference standard **STRAIN DISC VALIDATION STANDARD** into the sample compartment (see section 4.6).



- Activate the **Measure** button on the **Measurement** tab card and follow the further instructions of the operating software.

The validation is being performed.

Validation Result	Possible Reason	Remedy
Measuring area intersects measuring window.	Camera not centered.	Adjust camera (see service manual).
	Position of standard not correct.	Insert standard correctly (see section 4.6).

Horizontal and vertical edges of the measuring window not parallel to the image axes.	Camera not aligned.	Adjust camera (see service manual).
Diameter of the measuring area is too big or too small.	Incorrect image width calculation.	Define image width (Service ⇔ System Settings ⇔ Optics area).
	Position of the camera is incorrect (M2 only).	Failure in linear adjustment system: Please contact the manufacturer.
Measuring value too big or too small.	Sample plate, validation standard, filter or optics polluted.	Clean carefully with a soft and fluff-free cloth and if necessary a suitable cleaning agent.
	Optics misadjusted or failure of opto-mechanical components.	After consultation with the manufacturer calibrate analyzer and polarizer if necessary.

5.3 Performing validation procedure 2

To perform validation procedure 2A or 2B:

- Select the **VALIDATION 2A** or **VALIDATION 2B** method from the drop down list of measuring methods.
- If the measuring head has to be adjusted, confirm the linear adjustment with **Move** (M2 only).
- If the **Measure** button on the **Measurement** tab card is not yet available first activate the **Zero Calibration** button.
- Activate the **Measure** button on the **Measurement** tab card and follow the further instructions of the operating software.

The validation is being performed.

Validation Result	Possible Reason	Remedy
Measuring value too big or too small.	Sample plate, filter or optics polluted.	Clean carefully with a soft and fluff-free cloth and if necessary a suitable cleaning agent.
	Optics misadjusted or failure of opto-mechanical components.	After consultation with the manufacturer calibrate analyzer and polarizer if necessary.

5.4 Performing validation procedure 3

To perform validation procedure 3A or 3B respectively:

- Select the **VALIDATION 3A** or **VALIDATION 3B** method from the drop down list of measuring methods.
- If the measuring head has to be adjusted, confirm the linear adjustment with **Move** (M2 only).
- Activate the **Measure** button on the **Measurement** tab card and follow the further instructions of the operating software.

The validation is being performed.

Validation Result	Possible Reason	Remedy
Measuring value too big.	Sample plate, filter or optics polluted.	Clean carefully with a soft and fluff-free cloth and if necessary a suitable cleaning agent.
	Sample plate deformed or damaged.	Change sample plate (see section service manual).
	Optics misadjusted or failure in opto-mechanical components.	After consultation with the manufacturer calibrate analyzer and polarizer if necessary.
	Light source defect.	If the error continues to exist: Change defect LED-module.

6 Inspection and cleaning

Inspection and cleaning activities that the operating personnel should perform during operation are described in this section.



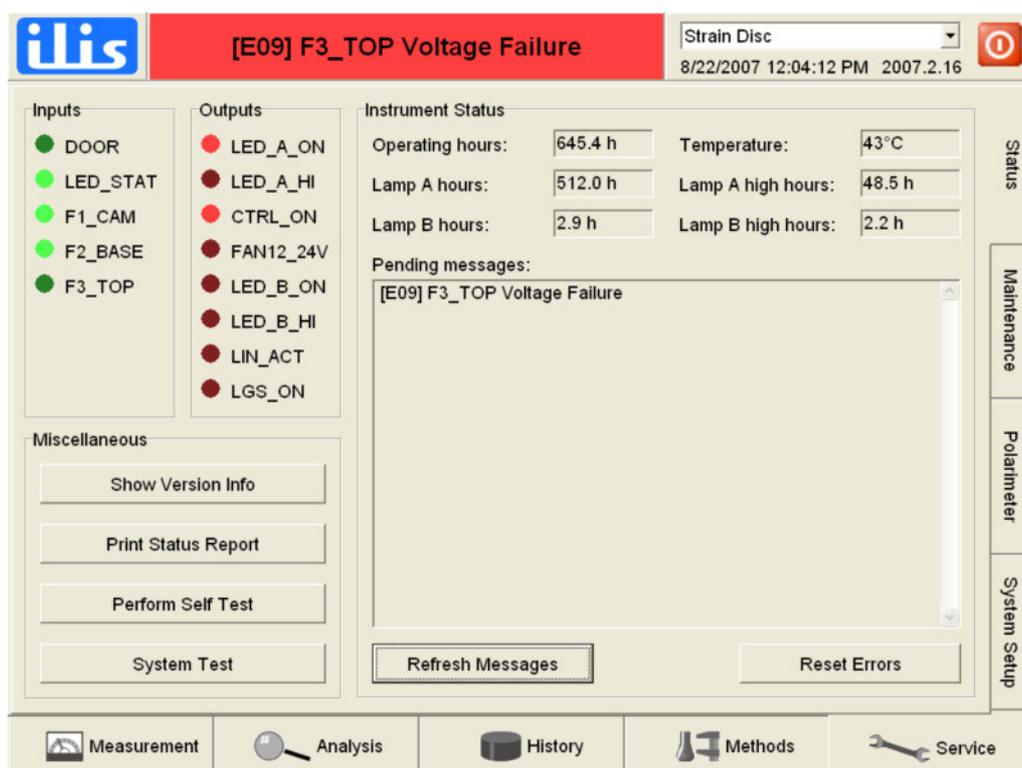
WARNING: Risk of crushing and due to electricity on unintended switching on of the instrument! Before every inspection or cleaning work, switch the instrument off with the main switch and protect it against unforeseeable switching back on.

When	To do	Action
Once per week	Check existing fans for contamination and correct function.	Change filters, if necessary. Have the fan changed by service personnel if necessary.
	Check sample plate for cleanliness and visible defects.	Clean the sample plate with glass cleaner and a soft, fluff-free cloth if necessary. Have the sample plate changed by the service personnel if necessary.
As required	Check the touch screen for cleanliness, if existing.	Clean the touch screen with a soft, fluff-free cloth and if necessary a suitable cleaning agent.
As required, at least as stated in section 5	Perform validation.	See section 5.

7 Troubleshooting

7.1 Error messages in the status bar

The following table contains all possible error and warning messages and the appropriate remedy. If more than one message is displayed they are queued in the status bar of the operating software. You can see all current messages on the **Service** ⇨ **Status** area:



Message	Remedy	Note
[E07] Camera Exception	Shut down, turn off and restart the instrument (see section 4.3). If the error continues to occur, please contact the manufacturer.	4)
[W08] Software Exception	Contact manufacturer with status report.	2)
[E09] F3_TOP Voltage Failure	Check if the emergency stop of the linear unit has been activated. If so, unlock emergency switch and perform system test.	3)
[E09] F3_TOP Voltage Failure	Check power supply and fuses.	3)
[E10] F2_BASE Voltage Failure	If necessary, change the appropriate fuse (see service manual).	
[E11] F1_CAM Voltage Failure	If more than one message appears at the same time please contact the manufacturer with status report.	

[W12] Over-Temperature	Check environmental temperature. If the error continues to occur, please contact the manufacturer.	1)
[W13] Camera Image Timeout	If the error occurs frequently, please contact the manufacturer with status report.	2)
[W14] Polarizer Drive Stall	If the error occurs frequently, please contact the manufacturer with status report. If necessary increase the drive power and/or reduce the speed.	2)
[W15] Retarder Drive Stall		
[W16] Analyzer Drive Stall		
[W17] Linear Drive Stall		
[E18] Optics Not Initialized	Perform self test or restart the instrument.	3)
[E19] Linear Drive Not Initialized		
[E20] Polarizer Communication Failure	Check communication settings and cables.	3)
[E23] Retarder Communication Failure	Perform self test.	
[E26] Analyzer Communication Failure	If the error occurs after restarting the instrument, please contact the manufacturer with status report.	
[E29] Linear Communication Failure		
[E34] Self Test Not Completed	Perform self test or restart instrument.	3)
[W35] Defect Lamp Module	Check for defect LED modules and exchange modules if necessary. Do not perform measurements if LED modules in the measuring window are defect.	1)
[W36] Invalid Camera Image	If the error occurs frequently, please contact the manufacturer with status report.	2)
[E38] Image Acquisition Failure	If the error occurs after restarting the instrument, please contact the manufacturer with status report.	4)
[W39] Focus Adjustment Failure	If the error occurs frequently, please contact the manufacturer with status report.	2)

- 1) Message resets automatically when the error has vanished. Measurements can be performed while the message is pending.
- 2) Message can be resetted manually by activating **Reset Errors** or starting a measurement or zero calibration. Measurements can be performed while the message is pending.
- 3) Self test is required (Message will be resetted by activating the **Perform Self Test** button). Measurement not possible while the message is pending.
- 4) Restart is required (Message will be resetted after restarting the operating software). Measurement not possible while the message is pending.

7.2 Trouble shooting

Problem	Remedy
User interface does not respond to user input.	Wait a few minutes. If the error continues to occur press the Power Switch of the operating PC and restart the operating software orderly. If the error continues to occur activate the Reset switch of the operating PC to reboot the PC.
Signal strength not sufficient for the camera (Measuring signal is displayed red in the Measuring ⇒ Camera image area)	Check if the aperture (lens iris) is opened sufficiently.
Device does not start up after activating the main switch (POWER ON lamp remains off)	Activate the Reset switch of the residual current circuit-breaker.

StrainMatic®

Reference Manual



Reference of the Operating Software

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No responsibility is accepted for the accuracy of the information and data contained in this documentation which can be changed without prior announcement.

The ilis gmbh cannot be made liable for incorrect use or incorrect operation of the instrument. Correct use requires among other things knowledge of the contents of this manual. Therefore the instructions in this manual and all other technical documentation belonging to the instrument must be complied with.

Based on the current state of the art, it is not possible to produce software that works free of errors in all application combinations. ilis gmbh is therefore not liable for damages arising through the use of the software or the hardware delivered with it.

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1 Introduction

This reference manual provides a complete description of the STRAINMATIC user interface.

NOTE: The STRAINMATIC device and the corresponding operating software is constantly being developed and improved. The illustrations in this documentation therefore may differ slightly from your version. It is also possible that some of the functions described in this manual are not applicable to your version.

1.1 Device variants

At the time of the release of this manual the STRAINMATIC is available in the variants M2, M3 and M4. Differences in functionality or operation are pointed out in this manual.

1.2 Conventions

To make distinctions more clearly, different fonts and icons are used in the text:

Annotations and file names

User inputs

Cross-references

- Enumerations
- ↷ User actions

1.3 Customer support

If you have questions on operation or functionality of the STRAINMATIC, please contact the following address. We will be pleased to provide you with further assistance!

ilis gmbh

Konrad-Zuse-Str. 12
91052 Erlangen
Germany

Phone: +49 (9131) 974779 0
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Internet: www.ilis.de

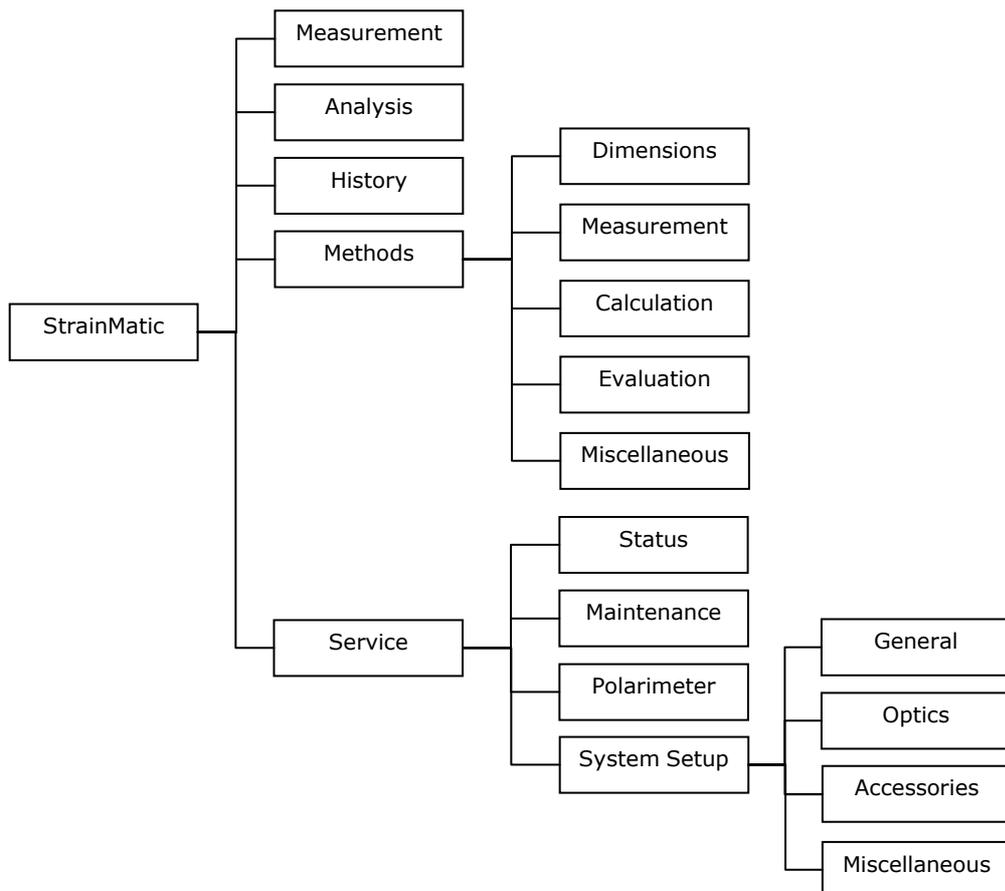
2 Layout of the user interface

The user interface of the STRAINMATIC is divided into several operating areas which you reach by selecting the tab cards at the lower edge of the screen:



- Measurement (see section 3)
- Analysis (see section 4)
- History (see section 5)
- Methods (see section 6)
- Service (see section 7)

Some of these areas are divided into further subareas. The following picture shows a schematic overview of the navigation structure of the user interface:



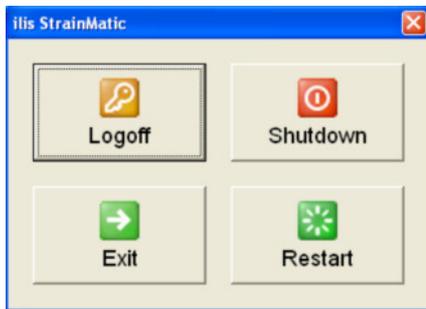
The status bar at the upper edge of the user interface is always displayed independently of the operating area in which you happen to be.



Warning and error messages of the STRAINMATIC are displayed in the message line (1). An overview of all messages and possible remedies are given in the user manual.

The measuring method selected in each case for the article to be measured is displayed in the drop down list of available measuring methods (2). You define measuring methods in the **Methods** area (see section 6).

You end the software or log off the current user with the **Off** button (3). The following window appears after activating the button:



Logoff: Resets the current access level. In the next selection of an operating element an access code may have to be entered.

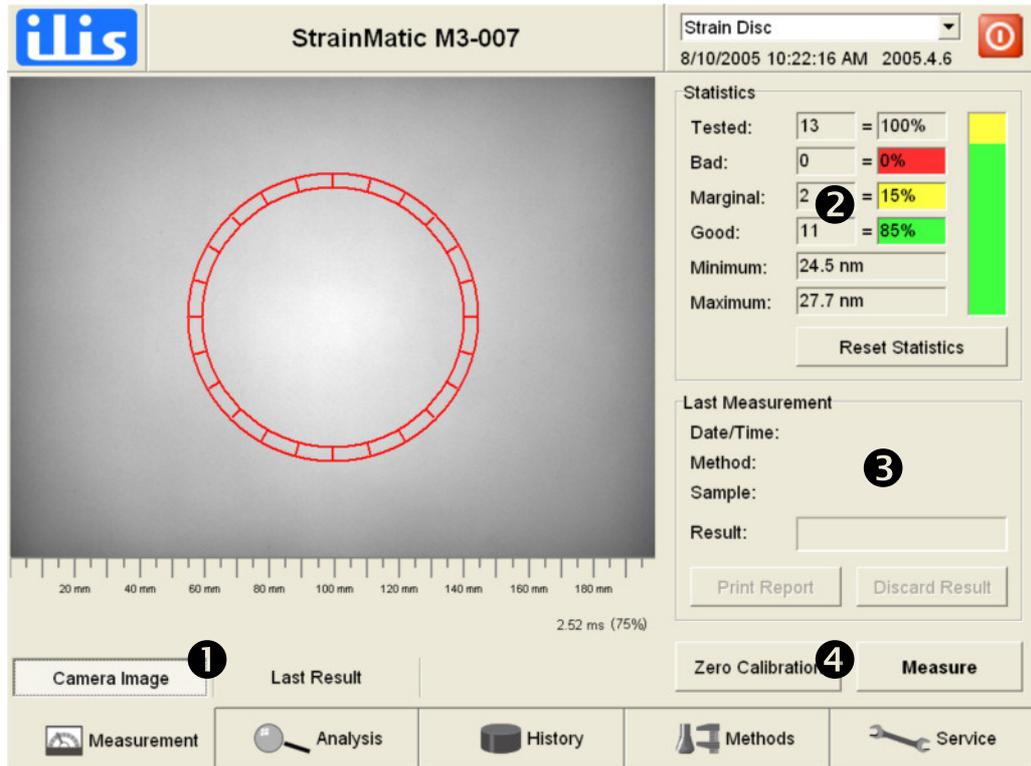
Shutdown: Ends the operating software and shuts down the operating computer.

Exit: Ends the operating software without shutting down the operating computer.

Restart: Ends the operating software and restarts the software.

3 Measurement

The **Measurement** operating area is the most important page for the operator for performing measurements.



- | | |
|--|--|
| (1) Camera image – result image toggle | (3) Result of the last measurement |
| (2) Statistics | (4) Zero calibration/start measurement |

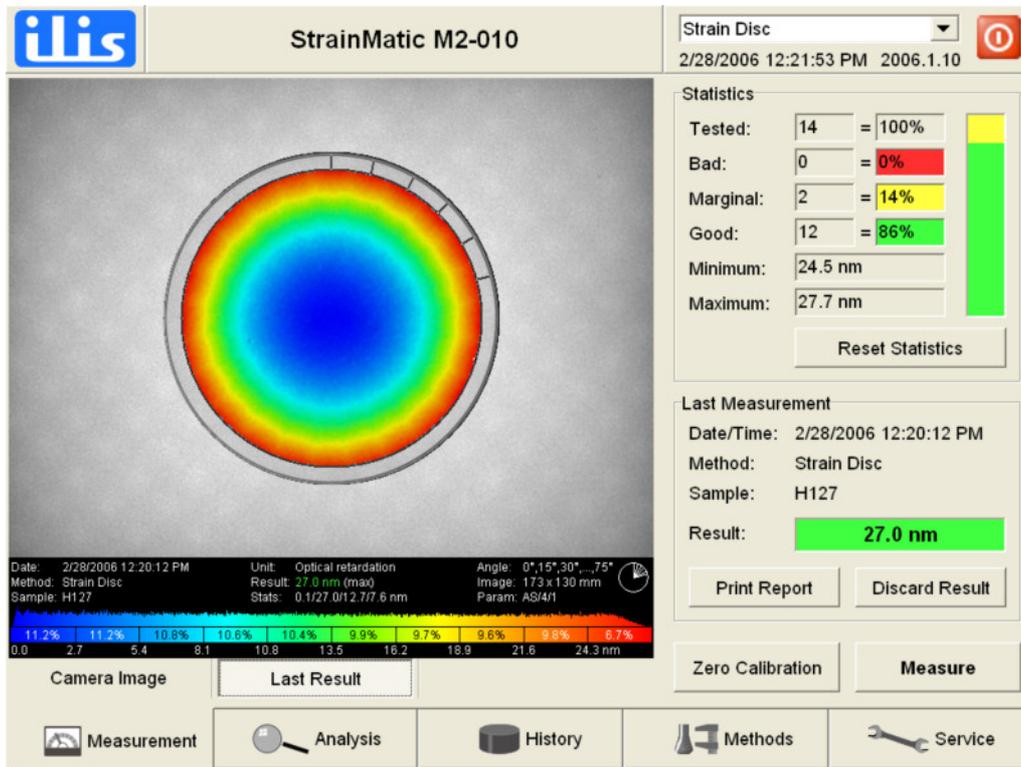
Camera image – result image toggle (1)

You can toggle between the display of the live image of the camera and the result image of the last measurement with the **Camera Image** and **Last Result** buttons.

Camera Image: With the aid of the live image you can position the sample exactly in the sample compartment. The current image size as well as the current exposure time and signal strength is displayed below the image. The signal strength value normally is in between 50% and 100% and should not fall below 10%.

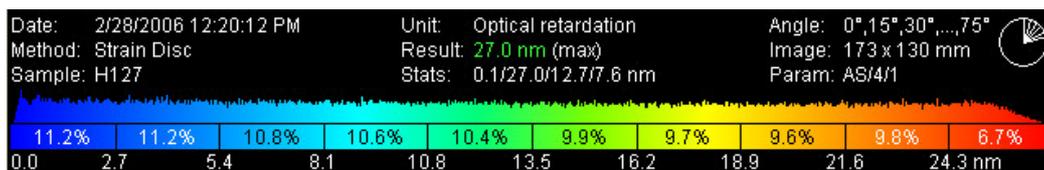
The image size is calculated automatically on the basis of the camera settings (see section 0).

Last Result: The result of the last performed measurement is displayed graphically here.



The legend shows color-coded the percentage distribution of the measured values. By default, red areas in the legend and in the image represent high values, yellow/green areas average values and blue areas low values.

The following information is displayed in the legend:



Date: Date and time at which the measurement was made.

Method: Name of the measuring method used.

Sample: If specified designation of the sample.

Unit: Unit in which the measurement was performed.

Result: Result value, if necessary in brackets the threshold defined in the measuring method. If limits for the measurement were set in the measuring method, the result value is displayed in the corresponding colors: good (green), marginal (yellow) or bad (red), see section 6.4.

Stats: Minimum/maximum/mean value/standard deviation over the measured values of all pixels in the measuring areas.

Angle: Angle position of the polarizer in the current image (in the result image superimposition of all angle positions).

Image: Size of the displayed image (width x height).

Param: Essential parameters of the measurement: Analyzer step width/Number of averages/Horizontal smoothing factor/Vertical smoothing factor (if different from horizontal).

Statistics (2)

Statistical overview of the last measurements of an article:

Tested: Number of measurements taken into account in these statistics.

Bad: Of these measurements those assessed as "bad" (red).

Marginal: Of these measurements those assessed as "marginal" (yellow).

Good: Of these measurements those assessed as "good" (green).

Minimum: Minimum result value over all measurements.

Maximum: Maximum result value over all measurements.

Reset Statistics: Resets the display to zero. A new statistic is started with the next measurement.

The settings within which limits the measuring results are designated as "good", "bad" or "marginal" are defined in the **Methods** operating area on the **Evaluation** tab card (see section 6.4).

Last Measurement (3)

Date/Time: Date and time of the last measurement.

Method: Measuring method of the last measurement.

Sample: If specified designation of the sample.

Result: Result value of the last measurement. With red background if the result was assessed as "bad", with yellow background if the result was assessed as "marginal", with green background if the result was assessed as "good".

Print Report: Prints the measuring result in report form.

Discard Result: Prevents that the current measuring result is included in the statistics and saved in the database.

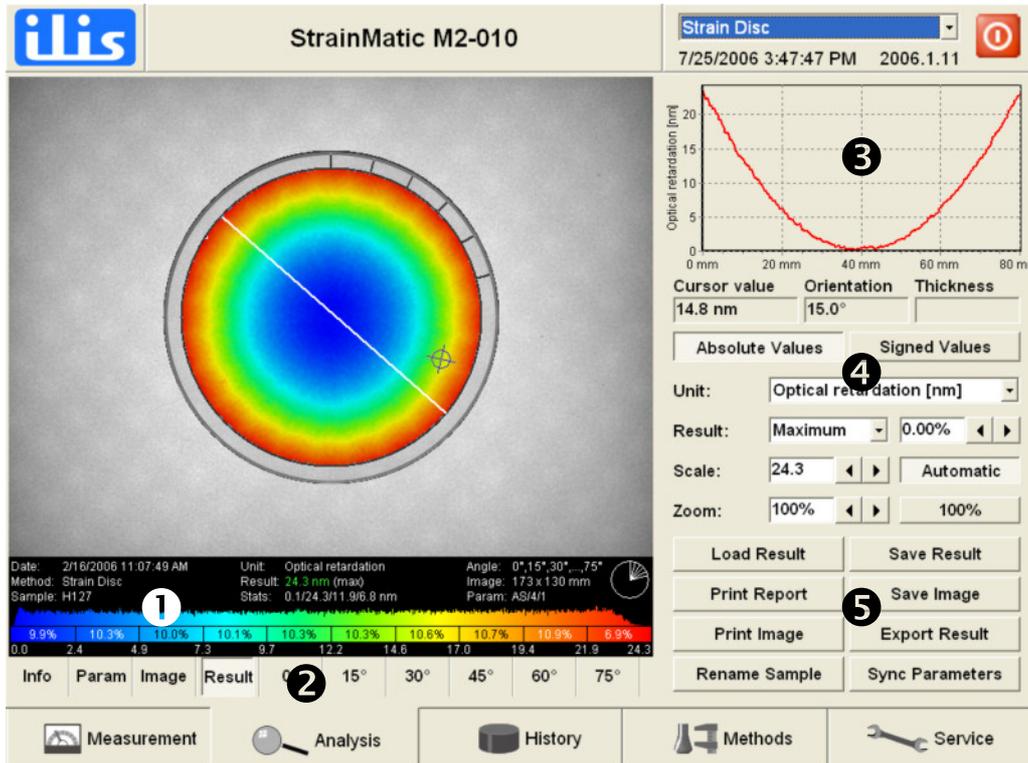
Zero Calibration/Measure (4)

Zero Calibration: Performs a zero calibration. Zero calibration is necessary if measuring parameters influencing the measuring result have been changed, for example by changing the position of the measuring head. During zero calibration a background measurement of the sample plate is performed to compensate for possibly existing stresses and inhomogeneities of the illumination.

Measure: Starts the measurement.

4 Analysis

In the **Analysis** operating area you can evaluate the measuring result of the last measurement in detail, save the measurement and reload saved measurements.



- | | |
|---------------------|------------------------------|
| (1) Result image | (4) Result display and value |
| (2) Image selection | (5) Save/load results |
| (3) Stress profile | |

Result image (1)

Two-dimensional graphical display of the measured values. The displayed image depends upon the selection in (2). An explanation of the data shown in the legend is given in section 3.

You can also still change the display of the result after the measurement subsequently in order for example to adapt the color scale to your ideas.

Buttons for image selection (2)

Toggle between different displays of the result:

Info: Displays the most important parameters of the measurement.

Param: Parameter for supplementary changes of the result presentation and evaluation. Here you can change the display in the **Result** area without changing the measuring method or performing a new measurement. For this purpose three tab cards are available:

- In **Dimensions** you can subsequently change the measuring area and the thickness profile (also see section 6.1).
- In **Calculation** you can change all parameters that are also defined in the measuring method in the **Methods** ⇒ **Calculation** area (see section 6.3). In addition, the **Zero calibration** parameter allows you to select if the background is being considered when the result values are calculated.
- In **Evaluation** you can change all parameters that are also defined in the measuring method in the **Methods** ⇒ **Evaluation** area (see section 6.4).

Image: Displays the camera image of the sample.

Result: Displays the result image of the measurement.

0°, 15° etc.: Displays the individual part images at the relevant polarizer position. The number of buttons available here depends upon the polarizer step width as defined in the measuring method (see section 6.2).

Value profile (Line Scan) (3)

Display of the measured values along a line drawn through the result image.

You can draw a line in arbitrary direction through a result image with the cursor to display the measured values along this line.

Result display and result value (4)

Functions for quick customization of the result display:

Cursor value: Result value at the current cursor position.

Orientation: Polarization angle at the current cursor position, if defined.

Thickness: If a thickness profile has been defined for the measurement, the thickness specified at this position is displayed additionally.

Absolute Values/Signed Values: Changes the display of the result values between absolute values and signed values.

Unit: Unit for display of the result image and the line scan.

Result: Result value and corresponding threshold that is displayed in the result image.

Scale: Maximum value of the color scale in the legend of the result image. By using the **Automatic** button the display is adapted automatically to the maximum measured value.

Zoom: Magnification of the displayed result image. By using the **100%** button the display is reset to the original size.

Buttons (5)

Load Result: Loads a saved measurement back into the user interface.

Save Result: Saves the data of the measurement as SMX file. You can select if the complete result data or the masked result is saved. When saving the masked result only the result pixels within the measuring area are saved. Thereby the file size can

be reduced significantly, but the measuring area can not be enlarged subsequently in the Analysis area.

Print Report: Prints the measuring result in report form.

Save Image: Alternatively saves the currently displayed image, all images of the measurement (including the camera image) or the line scan image in the JPG, BMP or EMF format.

Print Image: Prints the currently displayed image.

Export Result: Exports the result data in the following form as TXT or SLX file.

In the case of export as TXT file it is possible to choose whether the data should be saved directly as TXT file or compressed as ZIP file. Furthermore you can choose whether the data should be exported in list form or as a matrix. The configuration of the export file (column separator, decimal separator etc.) can be configured under

Service ⇒ **System Setup** ⇒ **General** (see Section 7.4.1).

The content of an exported TXT file as matrix is structured as follows:

```
<value_1_1><tab><value_1_2><tab>...<tab><value_1_m>  
<value_2_1><tab><value_2_2><tab>...<tab><value_2_m>  
...  
<value_n_1><tab><value_n_2><tab>...<tab><value_n_m>
```

whereby <value_2_3> is the result value of the pixel in row 2, column 3 etc. Values that are not included in the measuring area are exported as empty values in the export file (<tab><tab>).

On export of a TXT file as list, the data are arranged in the following columns:

X: Abscissa of the result value in the Cartesian coordinate system in mm, relative to the center point of the measuring area

Y: Ordinate of the result value in the Cartesian coordinate system in mm, relative to the center point of the measuring area

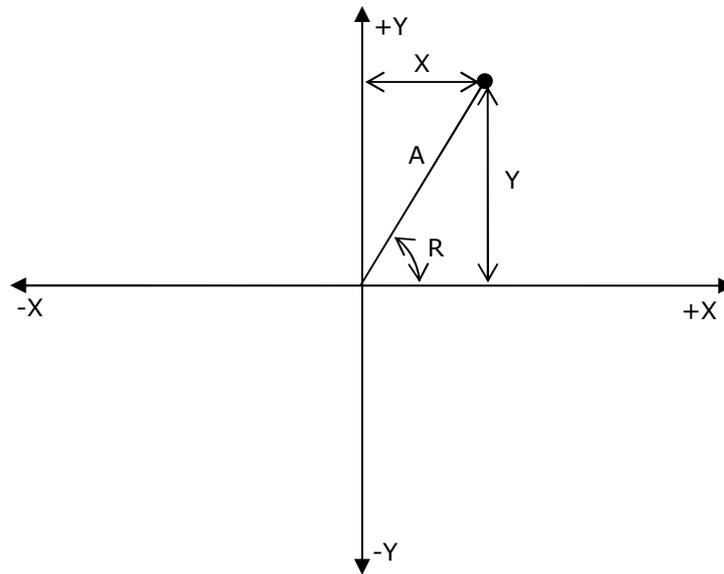
R: Radius of the result value in the polar coordinate system in mm, relative to the center point of the measuring area

A: Azimuth of the result value in the polar coordinate system in degrees, relative to the center point of the measuring area

L: Position of the result value on the line scan, relative to the starting point

PA/OR/TA/TR/NR/NS: Result value in the selected result unit

O: Orientation of the result value in degrees, if available



When exporting to a SLX file the measuring data is saved in binary format as follows:

3 bytes:	file extension ("SLX")
1 byte:	version number (0)
1 byte:	number of single images (i.e. 3)
1 byte:	unused (0)
1 single:	polarizer position 1. sub-image (4 Bytes)
1 single:	polarizer position 2. sub-image
[...]	
640x480 singles:	polarizer angle 1. sub-image (column by column)
640x480 singles:	polarizer angle 2. sub-image
[...]	
1 byte:	result unit:
	0 = polarization angle (°)
	1 = optical retardation (nm)
	2 = apparent temper number
	3 = real temper number
	4 = normalized retardation (nm/cm)
	5 = normalized stress (MPa)
1 byte:	reserved (0)
640 x 480 singles:	result image of measuring values in result unit
640 x 480 singles:	result image of orientations in degrees
640 x 480 singles:	result image of sample thickness values in mm
640 x 480 words:	camera image (column by column, 12 bits per pixel)

Rename Sample: Opens a screen keyboard for entering a different sample designation.

Sync Parameters: If parameters under **Param** have been changed compared to the measuring method, all or a selection of the changed parameters can be copied to the currently loaded measuring method. Vice versa, the analysis parameters can be overwritten with the values from the measuring method.

Export Table: Exports the table contents visible corresponding to the filter criteria as TXT file.

Rename Sample: Opens the screen keyboard for renaming the marked sample.

Import Result: Imports a selected result file into the history database.

Delete Record: Deletes the selected measurement from the database.

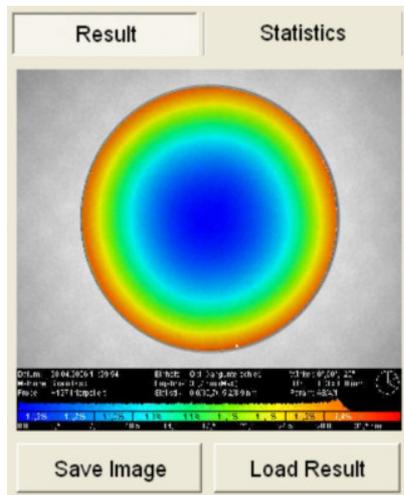
Delete All: Deletes all the measurements corresponding to the filter criteria.

↑: Selects the previous entry in the table.

↓: Selects the next entry in the table.

Result display (3)

Displays the result image of the measurement currently marked in the result table.



Save Image: Saves the result image in the JPG format.

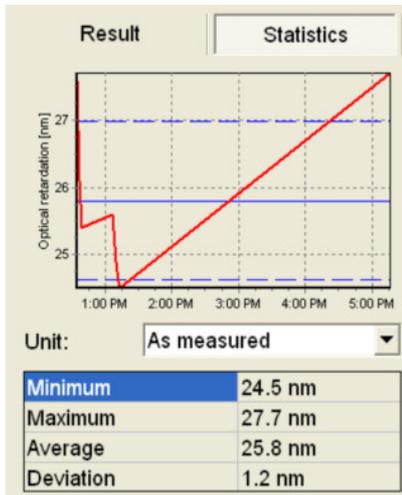
Load Result: Loads the selected result in the **Analysis** area.

You can magnify the image by clicking into the image display with the cursor.

NOTE: The **Save Image** and **Load Result** buttons are only available, if the corresponding setting was selected in the measuring method for the **Result archiving** parameter (see section 6.5).

Statistics (4)

Displays a trend curve over all measuring results displayed in the result table according to the filter criteria.



Unit: Selection of the unit for the display of the trend display.

Table: Maximum, minimum, mean value and standard deviation over all displayed result data.

Filter criteria (4)

Restriction of the measuring result displayed in the table. The selected filter criteria act additively, i.e. only the measuring results fulfilling all criteria simultaneously are displayed.

Method: Displays only results that belong to a certain measuring method.

Result: Displays only results of the selected assessment result.

Unit: Displays only results in a certain measuring unit.

From/To: Displays only results that were measured within a certain period.

6 Methods

You define measuring methods and basic system settings in the **Methods** operating area.

NOTE: Please note that in standard operation mode some parameters of the **Methods** area are disabled. If necessary, activate the **Expert Mode** to access all method parameters.

The **Methods** operating area is divided into the following subareas:

- Dimensions (see section 6.1)
- Measurement (see section 6.2)
- Calculation (see section 6.3)
- Evaluation (see section 6.4)
- Miscellaneous (see section 6.5)

The following buttons are available to you in the **Methods** area for creating and editing measuring methods:

Zoom Image: Opens the preview image in original size in its own window. To close the preview window, click in the window at any place.

Expert Mode: Toggles between standard and expert input mode. To simplify the operation, in standard mode all parameters for advanced functions are hidden or deactivated, if they differ from their default values.

New: Generates a new measuring method from scratch or by copying the values of the current method as a starting point.

Revert: Reverts the recent changes and restores the last saved status of the currently active measuring method.

Save: Saves the current measuring method.

Save as: Saves the current measuring method under a new name.

Rename: Opens a screen keyboard for renaming the currently loaded measuring method.

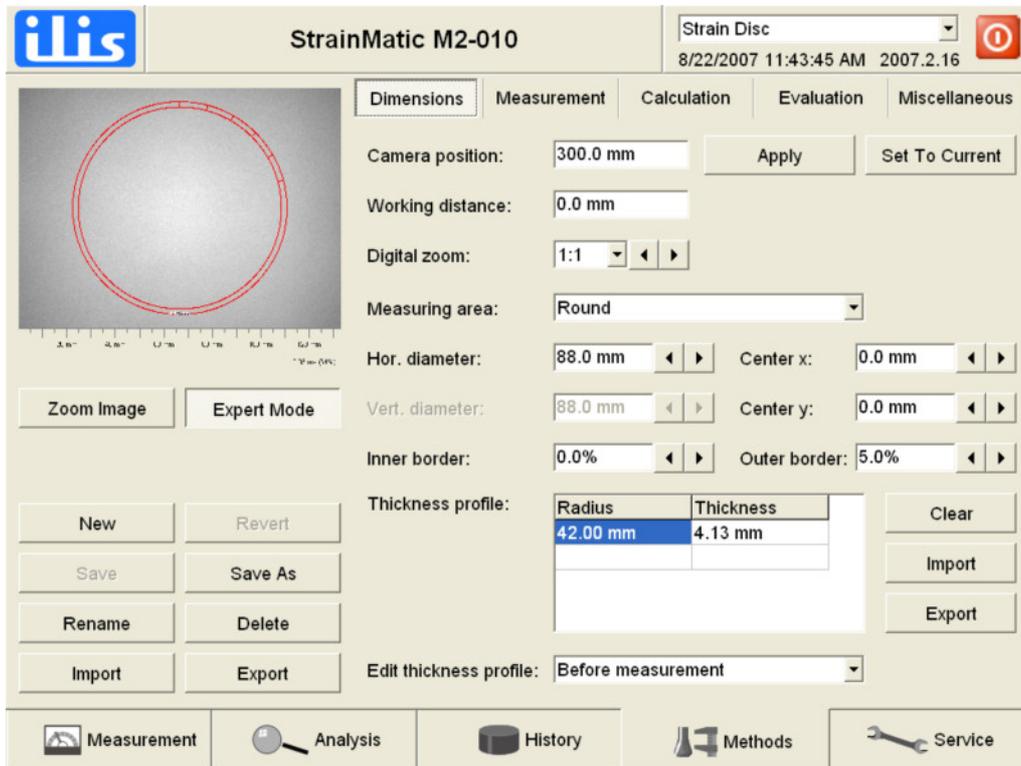
Delete: Deletes the currently loaded measuring method.

Import: Imports a measuring method from a SMT file.

Export: Exports a measuring method in a SMT file.

6.1 Dimensions

You set parameters for defining the measuring range on the **Dimensions** tab card.



Camera position

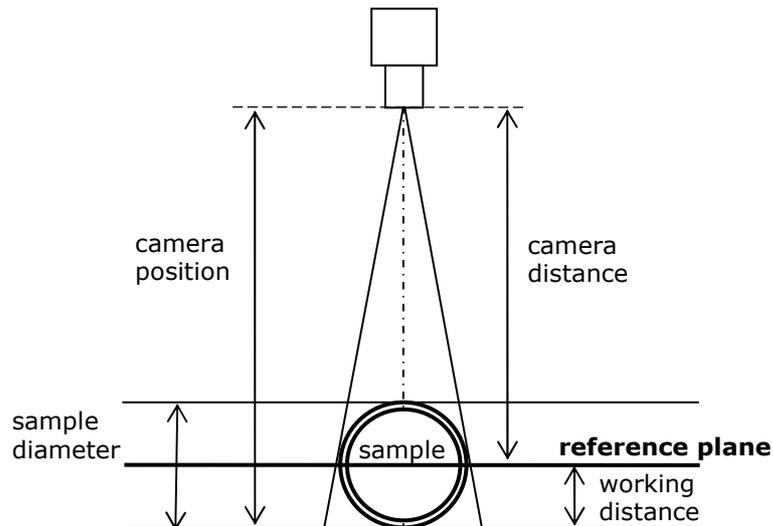
Distance from the lower edge of the measuring head to the base plate. The measuring head position should be selected so that the wanted measuring area is imaged completely and filling the screen as far as possible, but the image can still be focussed.

Apply: Moves the measuring head to the specified position (M2 only).

Set To Current: Copies the current position of the measuring head into the **Camera position** field (M2 only).

Working distance

Distance from the reference plane (plane to which the definition of the measuring area refers) to the base plate. The working distance should be selected so that the reference plane is imaged sharply in the test specimen, e.g. for thick samples, tubes or when using a sample holder.



Digital Zoom:

Digital magnification of the recorded image, e.g. for the measurement of small samples. The selected zoom factor also affects the display of the result images in reports and saved images.

NOTE: The digital zoom function only enlarges the recorded image but does not increase the image resolution.

Measuring area

Form of the measuring area: Measuring the entire image or a rectangular, round or elliptical section or an intersection of these forms.

The measuring area should be adapted to the form of the article to be measured. According to selected form of the measuring area, different parameters are available to you for positioning the area:

Measuring area: Rectangular

Area width/Area height: Width and height of the measuring area.

Center x/Center y: Distance of the measuring area from the image centre point in X and Y direction.

Inner border/Outer border: Inner and outer border of the measuring area in percentage of the width and height, respectively.

Measuring area: Round/Elliptical

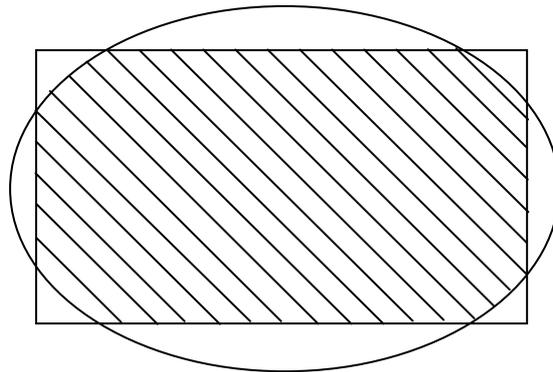
Horizontal diameter/Vertical diameter: Horizontal or vertical diameter of the measuring area. The **Vert. diameter** field is available only for an elliptical measuring area.

Center x/Center y: Distance of the measuring area from the image centre point in X and Y direction.

Inner border/Outer border: Inner or outer border of the measuring area in percentage of the radius. For example, you can define annular measuring areas with these data.

Measuring area: Intersection

With the **Intersection** measuring area you can define the intersection of circle or ellipse and rectangle as measuring area. For this purpose first select the **circular** or **elliptical** measuring area and enter the corresponding parameters. Then you define analogously a **rectangular** measuring area. Then select the **Intersection** measuring area. If you want to file a thickness profile for this intersection, enter it during the definition of the associated circle/ellipse or rectangle. If you have entered a thickness profile in both shapes, the circle or the ellipse will be used for the intersection.



Thickness profile

If a measuring area has been defined, an additional **Thickness profile** table appears for the optional entry of a typical thickness profile of the article. The measured values are then normalized.

For round measuring areas you enter the thickness profile radially. The **Radius** column contains in this case the distance of a concentric circle from the centre point. You enter in each case the associated thickness along this circle in the **Thickness** column.

For elliptical measuring areas you enter the thickness profile radially. The **Radius** column contains in this case the distance of an ellipse from the centre point, measured at the horizontal diameter. You enter in each case the associated thickness along this ellipse in the **Thickness** column.

For rectangular measuring areas you enter the X and Y coordinates of a certain point of the article proceeding from the centre point of the measuring area. You then enter the thickness of the article at this point in the **Thickness** column.

NOTE: If you have defined a thickness profile you should change the **Reference thickness** in the **Evaluation** area to the maximum thickness value accordingly.

Import/Export

By using the **Import**, **Export** and **Clear** buttons next to the **Thickness profile** table you can export or import a thickness profile which you have for example created with an editor and saved as TXT file or clear the contents of the **Thickness profile** table.

The data in the TXT file must have the following format:

Round/Elliptical:

```
<radius_1><tab><thickness_1>  
<radius_2><tab><thickness_2>  
...  
<radius_n><tab><thickness_n>
```

Rectangular:

```
<x_1><tab><y_1><tab><thickness_1>  
<x_2><tab><y_2><tab><thickness_2>  
...  
<x_n><tab><y_n><tab><thickness_n>
```

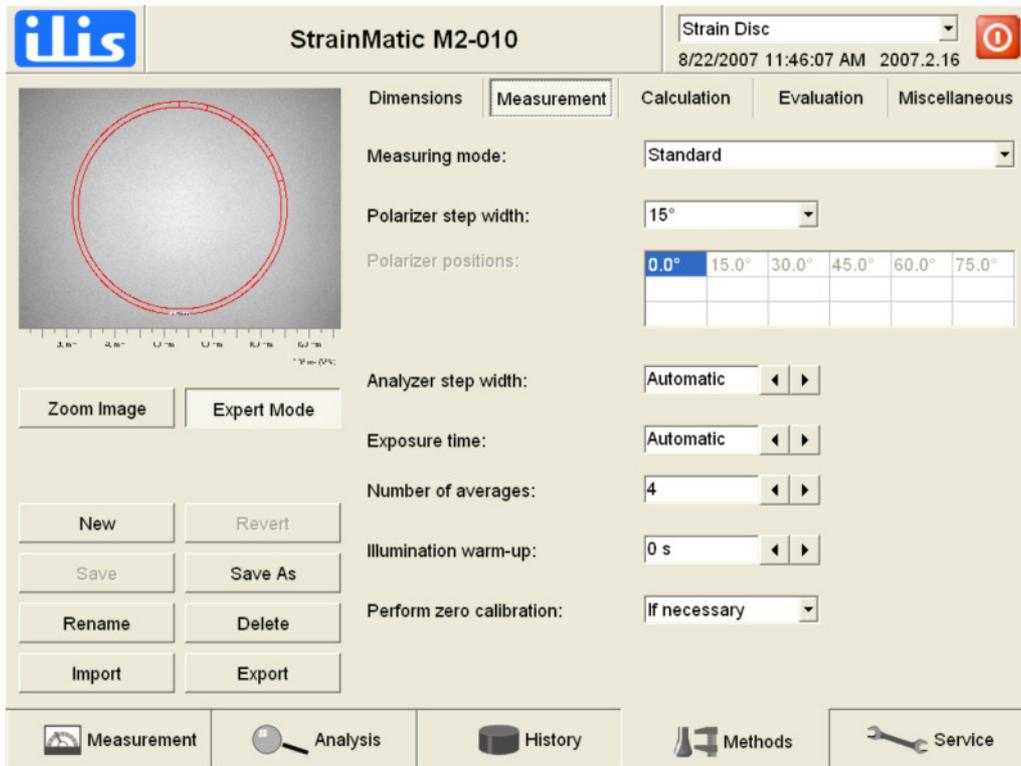
The period must be used as decimal separator.

Edit thickness profile

If the thickness profile varies from sample to sample or the thickness profile can not be measured non-destructively you can select if the thickness profile defined in the measuring method can be edited directly before or after the measurement.

6.2 Measurement

You set parameters for the measurement on the **Measurement** tab card.

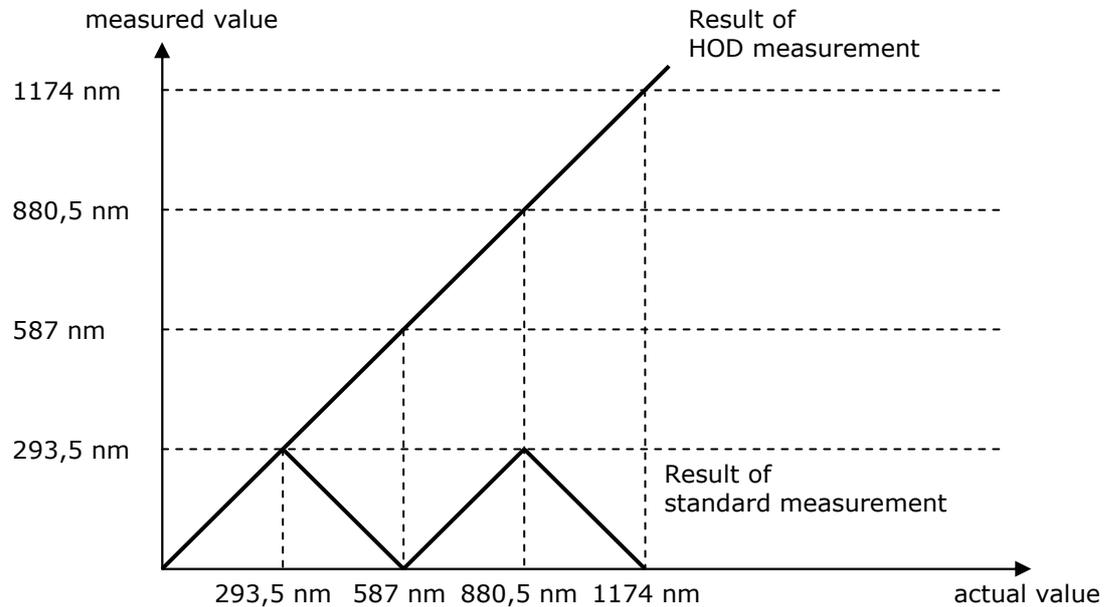


Measuring mode: Selection of the method with which the measurements should be performed:

- Standard:** Standard measuring method
- Double intensity:** Measurement with double light intensity (optional module)
- Secondary wavelength:** Measurement with secondary wavelength (optional module)
- HOD (high-order determination):** To measure stresses of higher order, for instance in plastic.

NOTE: The High-Order Determination is an optional module of the STRAINMATIC. If not ordered this module is not available in your version of the software. Please note that the high-order determination can only give plausible results when stresses with different orientations do not superpose.

The following figure illustrates the correlation between the measured and the actual signal with and without use of HOD:



Polarizer step width: Step width of the polarizer in angle degrees. The step width of the polarizer can be selected between 5° and 90° according to the orientation of the expected stresses.

If a polarizer step width of 15° is selected, for example, result images are calculated for polarizer positions of 0° , 15° , 30° , 45° , 60° and 75° .

In the **User-defined** mode measurements can be performed at arbitrary polarizer positions that are manually defined in the **Polarizer positions** table.

In the **Interpolated** mode the result image is not calculated by superposition (maximum value) of the sub-images but by interpolation of three result images that have been taken at certain polarizer positions. For relatively small measuring values these method achieves the best results. For higher measuring values this method is not applicable.

Polarizer positions: Display and entry of the polarizer positions according to the selection in the **Polarizer step width** drop down list.

Analyzer step width: Step width of the analyzer in angle degrees. States which stress difference can be measured as a minimum. In the **Automatic** mode the required analyzer step width is selected automatically by the instrument. It is recommended to use the automatic mode to achieve the best possible measurement results.

Exposure Time: Exposure time of the camera. In the **Automatic** setting the required exposure time is selected automatically by the camera. In manual setting the exposure time can be selected between 0.01 and 65 ms.

Number of averages: Number of images which should be recorded and averaged per analyzer position. The measurement is slowed down by exposing several images, but the signal-to-noise ratio is improved.

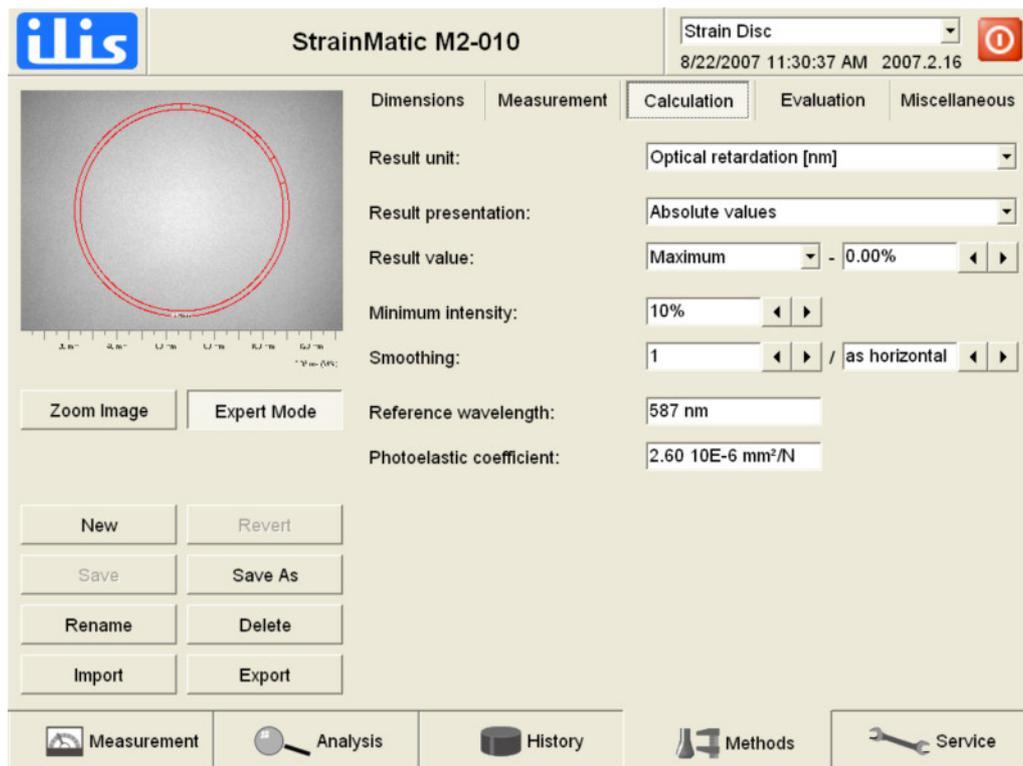
Illumination warm-up: Warm-up time of the light source at high intensity before a measurement starts. If necessary increase the warm-up time when very small optical retardation are measured (e.g. up to 60 seconds), so that the light source can reach its operating temperature.

Perform zero calibration: Selection when a zero calibration should be performed:

- If necessary:** Whenever settings are changed that require a new zero calibration (e.g. camera position or polarizer step width).
- Always:** Before each measurement.
- Never:** No zero calibration will be performed, i.e. residual stresses in the optical system are not considered in the measurement.

6.3 Calculation

You set parameters for calculating the measuring result on the **Calculation** tab card.



Result unit: Unit in which the measuring results are displayed as standard. The **Real temper number**, **Normalized retardation** and **Normalized stress** units are only possible if you have filed a thickness profile of the article in the **Dimensions** subarea.

The different units are calculated from the measured analyzer angle α as follows:

Polarization Angle (PA)	$PA = \alpha \cdot \frac{\lambda_{\text{dom}}}{\lambda}$
Optical Retardation (OR)	$OR = PA \cdot \frac{\lambda}{180^\circ}$
Apparent Temper Number (TA)	$TA = \frac{OR}{22.8\text{nm}}$
Real Temper Number (TR)	$TR = TA \cdot \frac{4.06\text{mm}}{d}$
Normalized Retardation (NR)	$NR = OR \cdot \frac{10\text{mm}}{d}$
Normalized Stress (NS)	$NS = \frac{OR}{d \cdot C}$

d = sample thickness in mm

C = photoelastic coefficient in $10^{-6} \text{ mm}^2/\text{N}$

λ_{dom} = dominant wavelength of the light source in nm

λ = Reference wavelength in nm

α = Measured analyzer angle in angle degrees

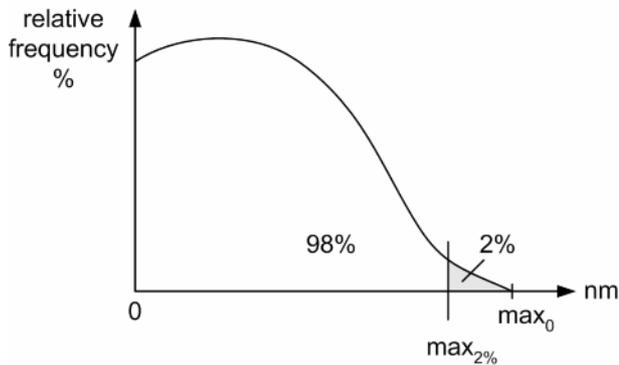
Result presentation: Selection whether the result values of the single measurements in the **Analysis** area are displayed as absolute values or as signed values.

Result value: Selection whether the maximum, the minimum, the mean value or the standard deviation of the measured values of all pixels in the measuring area is used as result value of a measurement. When selecting **none** no result value will be calculated.

Threshold: The **Threshold** field is displayed only if the **Maximum** or **Minimum** entry was selected under **Evaluation method**.

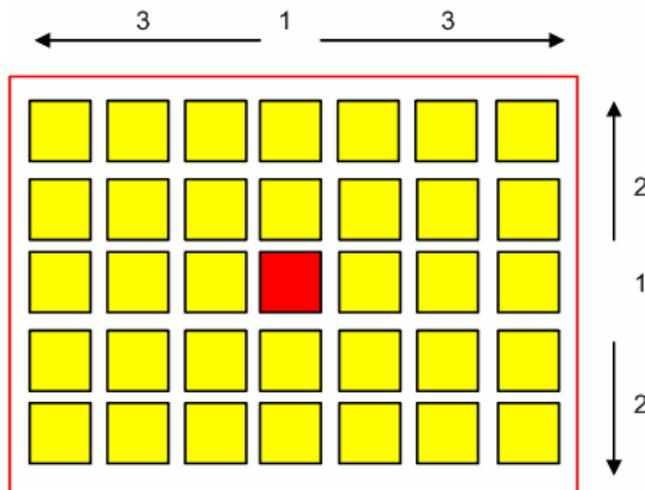
Defines which value should be output as result value of the measurement. In the default setting of 0% the highest measured value is output as maximum value. However, since this can have arisen due to an outlier, a percentage threshold can be stated here.

At a **Threshold** of for example 2%, the value which is greater than 98% of all measured single values is output as result value, therefore 2% of all measured values are greater than the result value.



Minimum intensity: States the relative brightness from which the pixels should be included in the calculation of the result image. At a minimum intensity of 10% for instance, only result pixels that have reached a brightness of at least 10% of the maximum possible value are included in the calculation.

Smoothing: Horizontal / Vertical smoothing factors for the display and evaluation of the measuring results. For example, at a value of 3 for horizontal smoothing and a value of 2 for vertical smoothing, 35 image pixels ($35 = (3+1+3) \times (2+1+2)$) are averaged to one result value:



$$35 \text{ Pixel} = (3+1+3) \times (2+1+2)$$

Reference wavelength: Basic wavelength for determination of the polarization angle. The default setting is the dominant wavelength of the light source. This value may be adapted if, for example, special rules or regulations are to be observed. If the value in this field is different from the dominant wavelength of the light source, the angle is corrected according to the above mentioned formula.

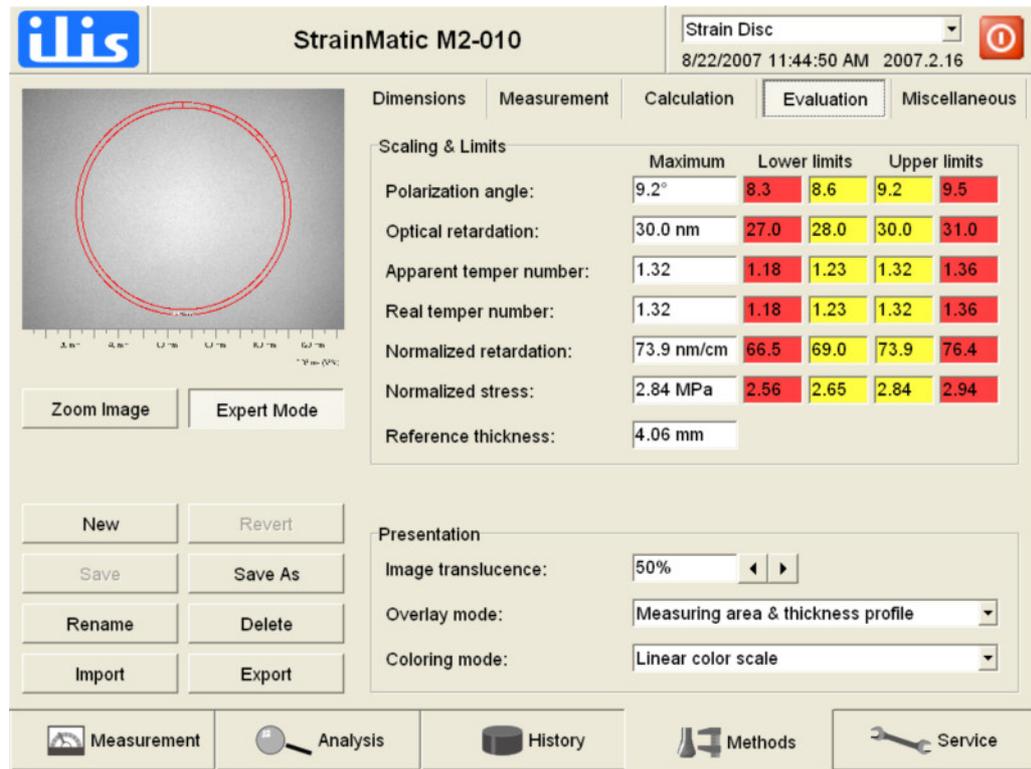
Photoelastic coefficient: Photoelastic coefficient of the material to be measured. The photoelastic coefficient only is relevant if **Normalized Stress (MPa)** is selected as measuring unit.

Analysis mode: Only available when high-order determination is available and selected as **Measuring mode** (see section 6.2). Select if the measurement shall be evaluated as HOD measurement or as standard measurement.

Filter (amplitude/offset): HOD parameters for filtering invalid result values. Normally, it is not necessary to change the preset values. The filter parameters are only available if **HOD with filter** was selected as **Analysis mode**.

6.4 Evaluation

You set parameters for evaluating the measuring results on the **Evaluation** tab card.

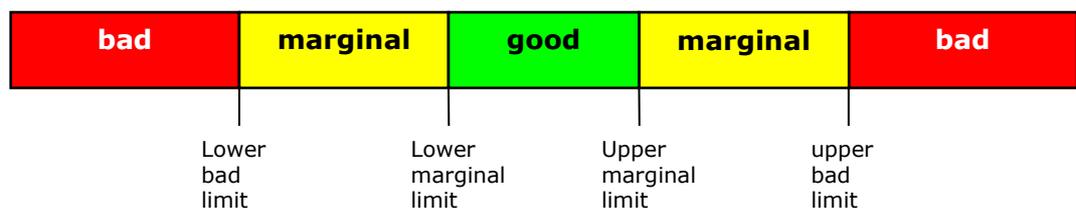


Scaling & Limits

Maximum: Expected maximum value in the respective unit. The maximum value is used for color scaling of the value distribution in the result image. If you enter the maximum value in one unit, it is converted automatically into the other units.

In **Automatic** mode the color scale is adapted automatically based on the maximum measured value.

Lower limits/Upper limits: Limits for the assessment of the measurements in good-bad categories.



Reference thickness: Thickness used for conversion of the normalized units into the unnormalized units and vice versa. The default value of 4.06 mm complies with the factor of proportionality between apparent and real temper number according to ASTM C148-00. If a thickness profile has been defined in the measuring template, the reference thickness should be changed to the maximum value of the thickness profile.

Presentation

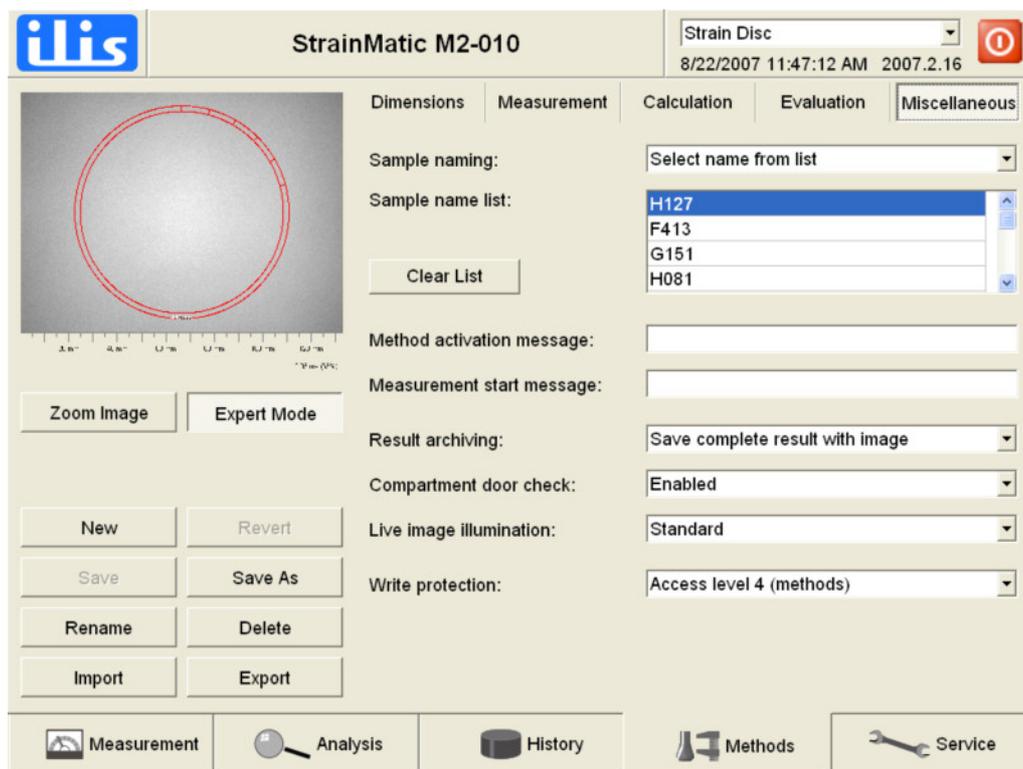
Image translucence: Transparency of the result image in percent. Here you control how much of the camera image, which is laid under the result image, you can see in the measuring result.

Overlay mode: Selection of which data should be displayed in the result image. The measuring area, the possibly defined thickness profile or both.

Coloring mode: States whether the color scale in the legend of the result image is displayed as continuous or linear color scale or whether fixed color stages are used.

6.5 Miscellaneous

You set general parameters on the **Miscellaneous** tab card.



Sample naming: Selection whether a sample name should be entered or selected before each measurement. With the **Serially numbered** setting a once entered sample number is automatically incremented in following measurements.

Sample name list: If the **Select name from list** or **Select or enter name** entry was selected under **Sample naming**, you can specify sample names here which can later be selected from a list before the measurement.

Clear list: Deletes all entries from the **Sample name list**.

Method activation message: Here you can define a message which is output in a message window after selection of the measuring method, for example if inserting a certain sample holder is necessary for this article.

Measurement start message: Here you can define a message which is output in a message window before starting each measurement.

Result archiving: Selection whether the results and the images of the measurements should be saved in the database. You can view and evaluate saved results on the **History** tab card (see section 5). If the **Save masked result with image** option is used, only the results pixels within the measuring area are saved. Thereby the file size can be reduced significantly, but the measuring area can not be expanded subsequently in the Analysis area.

NOTE: When using the **Save masked/complete result with image** setting the complete measurement data is saved on the hard disc (approx. 1 up to 100 MB per measurement). Therefore only use this option when performing only a small number of measurements. To save single results as a file use the **Save Result** function in the **Analysis** operating area.

Compartment door check: When enabled, measurement can only be performed with closed compartment door. When measurements are performed with open compartment door, ensure that no external light, particularly from pulsating light sources, can falsify the measurement.

NOTE: Monitoring the compartment door can be activated or deactivated system-wide under **Service** ⇒ **System Setup** ⇒ **Miscellaneous**.

Live image illumination: Switches the intensity of the light source in the live mode to high intensity. This can be necessary for very dark samples, for instance.

Write Protection: If necessary selection of an access code for protecting this measuring method against unauthorized changes. In the **Access Level 4 (methods)** default setting, everyone who also has access to the **Methods** area can edit the measuring method. **Read-only** is reserved for service personnel of the ilis company.

Compartment check window: Definition of an area for the automatic check of the sample compartment before moving the measuring head. For example, if you have fitted a sample holder in the sample compartment, you define here a correspondingly restricted area that is not covered by the sample-holder.

Width/Height: Width and height of the measuring area.

Center x/Center y: Distance of the measuring area from the image centre point in X and Y direction.

7 Service



CAUTION: Fundamental settings of the STRAINMATIC are defined in the **System Settings** area. This area should be accessible only to service personnel. Define corresponding access codes to prevent unauthorized access (see section 7.4.1).

The **Service** subarea is divided into four tab cards:

- Status (see section 7.1)
- Maintenance (see section 7.2)
- Polarimeter (see section 0)
- System Setup (see section 7.4)

7.1 Status

Inputs/Outputs

Status display of the digital inputs and outputs.

Instrument Status

Operating hours: Total operating hours of the STRAINMATIC.

Temperature: Current operating temperature of the camera electronics.

Lamp A/B hours: Operating hours of the primary and secondary (if available) light source.

Lamp A/B high hours: Operating hours in which the primary and secondary (if available) light sources were operated with high intensity.

Pending messages: Pending status messages.

Refresh Messages: Refreshes the display of the status messages.

Reset Errors: Clears the manually resettable errors (see user manual).

Miscellaneous

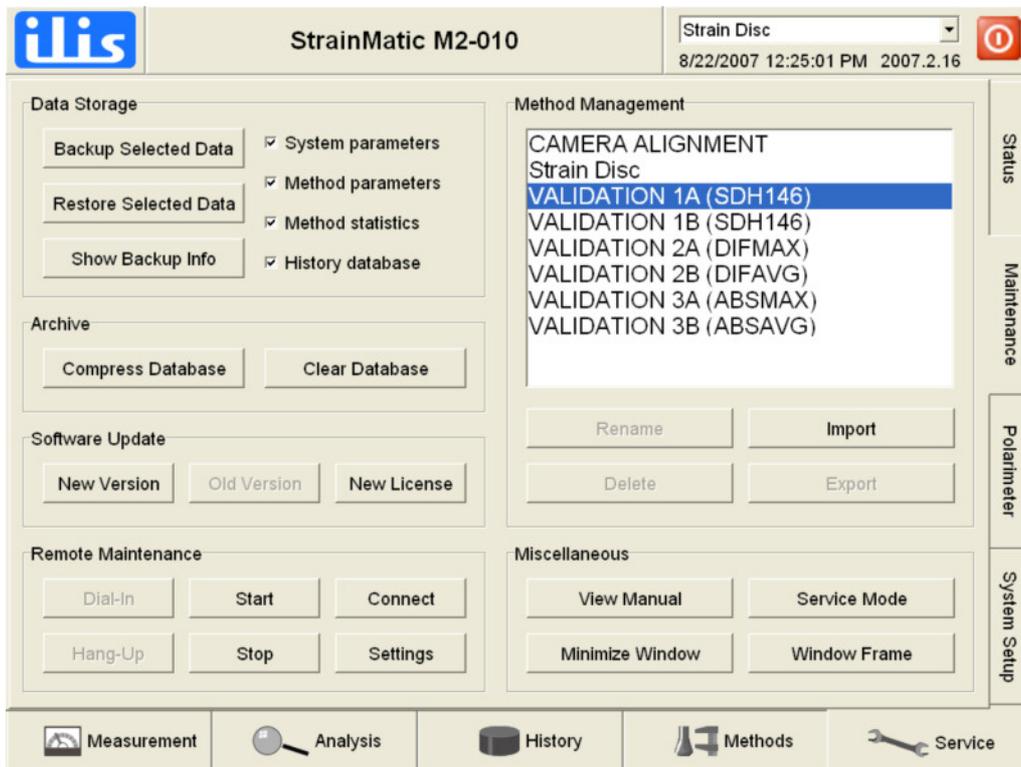
Show Version Info: Opens a window with version and licence information of the STRAINMATIC operating software.

Print Status Report: Prints a status report with the current basic settings and operation settings of the STRAINMATIC.

Perform Self Test: Starts manually performance of the self test as it is also performed automatically on starting the STRAINMATIC.

System Test: Starts a test program for endurance testing of all opto-mechanical components.

7.2 Maintenance



Data Storage

Backup Selected Data: Produces a backup file with the selected data: **System parameters, Type parameters, Type statistics, History database**. You select the required data by activating the corresponding checkbox.

NOTE: Always archive backups on an external storage medium (for example memory stick) not on the hard disk of the operating computer.

Restore Selected Data: Restores the selected data from a backed up backup file. If not all selected data are present in the backup file, there is a corresponding warning.

Show Backup Info: After selecting a backup file a window opens that displays the data that is available in the backup file.

Archive

Compress Database: Compresses the history database. On compression "blanks" which have arisen due to deletion of data records are removed. You should compress the database from time to time to save storage space on the operating computer.

Clear Database: Deletes the entire history data. Before the database is cleared, you can select if the result files that are linked to the database entries are deleted, too. (Only when **Save complete result and image** is selected in the measuring method)

NOTE: When you decide to delete the result files with the database please note that the result files are not included in the database backup file and therefore can not be restored.

Software Update

New Version: Imports a new version of the operating software made available to you by the manufacturer.

Old Version: Restores the previous version of the operating software.

New License: Imports a new version of the software license made available to you by the manufacturer.

Remote Maintenance

With remote maintenance the ilis service personnel can support you directly on site in the case of possibly occurring malfunctions and analyse the system.

NOTE: How to conduct a remote maintenance session is described in detail in the service manual.

Dial-In: Builds up an Internet connection.

Hang-Up: Disconnects the Internet connection.

Start: Starts the remote maintenance session.

Stop: Stops a remote maintenance session. After ending the remote maintenance the Internet connection can be interrupted again.

Connect: Makes the connection to the ilis gmbh.

Settings: Calls up the setting dialog of the remote maintenance software.

Method Management

Enables you to administer measuring methods quickly and simply. All measuring methods defined in the STRAINMATIC are displayed in the drop down list.

Rename: Opens the screen keyboard for renaming the selected measuring method.

Delete: Deletes the selected measuring method.

Import: Imports a measuring method from a SMT file.

Export: Exports the measuring method to a SMT file.

Miscellaneous

View Manual: Opens a dialog for selection of the required documentation.

Toggle Window Frame: Toggles the display of the user interface between screen-filling and a moving window.

Minimize Window: Minimizes the window in which the operating software is running.

Service Mode: Activates/deactivates the service mode of the operating software.

7.3 Polarimeter

On the **Polarimeter** tab card the functionality of a polarimeter is available for testing the basic functions of the STRAINMATIC, for example.



WARNING: Danger of injury and damage! When the linear unit is moved in the **Polarimeter** area, all warning messages are deactivated. Always check if the sample compartment is empty before moving the measuring head! (M2 only)

Illumination: Controls the intensity of the light source.

Exposure Time: Exposure time for image acquisition.

Averages: Number of images which should be recorded and averaged per analyzer position. The measurement is slowed down by exposing several images, but the signal-to-noise ratio is improved.

Threshold: Specifies which value is displayed at **MaxT**. In the default setting 0% the maximum measured value is displayed. However, since this can have arisen due to an outlier, a percentage threshold can be stated here (see section 6.3).

Frame width/height: Width and height of a freely definable measuring window. The values displayed below the image only relate to this measuring window.

Frame center x/y: Offset of the measuring window from the image center in X and Y direction. The values displayed below the image only relate to this measuring window.

Linear position: Current position of the measuring head.

Focus setting: Current focus setting with activated focus control.

Analyzer position: Current position of the analyzer relatively to its zero position. Can be moved clockwise or counterclockwise by using the arrow buttons.

Retarder position: Current position of the retarder relatively to its zero position. Can be moved clockwise or counterclockwise by using the arrow buttons.

Polarizer position: Current position of the polarizer relatively to its zero position. Can be moved clockwise or counterclockwise by using the arrow buttons.

0/0/0°: All filters will be moved automatically to zero position (measuring position).

90/0/0: The analyzer will be moved to 90° position, retarder and polarisator will be moved to zero position (live image position).

Rotate all: All filters will be moved synchronously by a certain angle. After activating the button a window is opened where the rotation angle can be entered.

Image Recorder: If the selection in the **Image Recorder** drop down list complies with the display mode, an image file of every displayed image is recorded and saved in the **Recording** directory of the STRAINMATIC.

Live: The live image of the camera is displayed.

Single: At each activation of this button the current freeze image of the camera is displayed.

CCW: Rotates the analyzer incremental counter clockwise for a selectable angle and records an image after each step.

CW: Rotates the analyzer incremental clockwise for a selectable angle and records an image after each step.

Min: Minimum gray value in the measuring window.

Max: Maximum gray value in the measuring window.

MaxT: Maximum gray value in consideration of **Threshold**.

Mean: Mean value over all gray values in the measuring window.

7.4 System Setup



CAUTION: The **System Setup** area may be used only for service and diagnostic purposes by correspondingly authorized personnel or ilis service personnel. Define corresponding access codes to prevent unauthorized access (see section 7.4.3).

The **System Setup** area is divided into four subareas:

- General (see section 7.4.1)
- Optics (see section 0)
- Accessories (see section 7.4.3)
- Miscellaneous (see section 7.4.4)

7.4.1 General

User Interface

Language: Selection of the language of the STRAINMATIC user interface.

Input mode: Selection between input mode by touch screen or external mouse and keyboard.

Terminal lock time: Time without operation in minutes after which the user interface is locked, for example, because a screen saver was activated. The user interface can be released again by confirming the corresponding message.

History size warning limit: If the specified size of the history database is exceeded, a warning message occurs when starting the operating software.

Access Codes

An access code in the STRAINMATIC user interface consists of a number combination.

Duration of validity: Period in minutes after which an access code becomes invalid if there was no operation in this period.

Level 1 (Measurement): Access to the **Measurement** operating area.

Level 2 (Analysis): Access to the **Analysis** operating area.

Level 3 (History): Access to the **History** operating area.

Level 4 (Methods): Access to the **Methods** operating area.

Level 5 (Service): Access to the **Service** operating area.

A level always includes the lower ranking levels in each case. Thus an operator with access to level 3 automatically also has access to levels 1 and 2.

If no access code was allocated for the upper levels, the highest allocated access code also applies for these levels. For example, if no access code was allocated for level 5, but one for level 4, then one receives on entry of the access code for level 4 also access to the functions of level 5.

NOTE: Due to the allocation of access codes, the selection of the relevant area is not blocked, but only the selection of important functions or changing of settings in this area is prevented.

Data Export

Column separator: Column separator for data export.

Decimal separator: Decimal separator for data export.

Data density: Data density in horizontal and vertical direction in the data export. For instance, at a value of **2** only every 2nd measuring point in horizontal and vertical direction is exported.

Decimal Places

Here you can state with how many decimal places the result values can be output in the different units.

7.4.2 Optics

The screenshot shows the 'Optics' configuration tab for the StrainMatic M2-010. The interface is divided into several sections:

- Camera & Illumination:**
 - Live image brightness: 50%
 - Live image exposure time: Automatic
 - Light source switch-off: 30 min
 - Fan after-run time: 5 min
- Automatic Validation:**
 - Zero calibration monitoring: Enabled

Diameter [mm]	Maximum [nm]	Average [nm]
35.0	3.0	2.0
100.0	5.0	2.5
150.0	10.0	3.5
250.0	15.0	5.0
- Zero Calibration:**
 - Duration of validity: 30 min
 - Exposure time: Automatic
 - Number of averages: 4
 - Minimum intensity: 10%
 - Smoothing: 1
- Image Size Calibration:**
 - Active lens setting: 16 mm

Lens	Pos 1	Width 1	Pos 2	Width 2
12 mm	150 mm	93.7 mm	350 mm	195.9 mm
16 mm	150 mm	73.1 mm	450 mm	193 mm
25 mm	150 mm	44.2 mm	450 mm	121.2 mm
35 mm	250 mm	51.1 mm	450 mm	88.5 mm
50 mm	350 mm	40 mm	450 mm	53 mm
75 mm	300 mm	22.9 mm	450 mm	36.9 mm
user1				
user2				

The bottom navigation bar includes icons for Measurement, Analysis, History, Methods, and Service.

Camera & Illumination

Live image brightness: Brightness setting of the camera in live mode.

Live image exposure time: Exposure time of the camera in the live image mode.

Light source switch-off: Switches off the light source if no operation occurred in the here defined time interval.

Fan after-run time: After-run time of the fans when switching over from high light intensity to low light intensity. The fans are deactivated in the **0** setting.

Zero Calibration

Duration of validity: Period in minutes after which a zero calibration becomes invalid in any event and a new calibration must be performed.

Exposure time: Exposure time of the camera for zero calibration. Will be set automatically when **Automatic** is selected.

Number of averages: Number of images which should be recorded and averaged per analyzer position. The measurement is slowed down by exposing several images, but the signal-to-noise ratio is improved.

Minimum intensity: States the relative brightness from which the pixels should be included in the calculation of the result image. At a minimum intensity of 10% for instance, only result pixels that have reached a brightness of at least 10% of the maximum possible value are included in the calculation.

Smoothing: Smoothing value for the display and evaluation of the measuring results. For example, at a value of 3, 49 image pixels ($49 = (3+1+3)^2$) are smoothed to one result value.

Automatic Validation

Zero calibration monitoring: Enables or disables the plausibility-check of the zero calibration. In the table below you can define maximum and average limiting values along certain radii of the measuring area for zero calibration. If the here defined values are exceeded a corresponding warning message occurs.

Image Size Calibration

If you use different lenses or cameras, you enter here two image widths for each lens, so that the image width for the display of the measuring result can be calculated automatically. To determine the values:

- Move the camera to a first reference position, for example 150 mm, and enter the height value in the **Pos 1** field.
- Measure the image width at this camera position, for example, by placing a transparent ruler in the sample compartment and reading off the width under **Measurement** ⇒ **Live Image** and enter the value in the **Width 1** field.
- Move the camera to a second reference position, for example 300 mm, and proceed analogously for the **Pos 2** and **Width 2** fields

Under **Active lens setting**, select the suitable setting for the lens fitted in each case.

NOTE: For devices with telecentric lenses (M4) you can enter the same value twice for **Width 1** and **Width 2** and for **Pos 1** and **Pos 2**, respectively.

7.4.3 Accessories

Automatic Focus Control

Activates or deactivates the control of the camera focus module. You fill in the three columns the reference data for a maximum of three different camera lenses.

So that the reference plane can be focused automatically in every camera position, enter in the corresponding cells a camera distance (distance of the camera from the reference plane) and the associated position of the focus wheel on the lens for each lens in each case. You can use the **Linear position** and **Focus setting** parameters on the **Polarimeter** tab card for the correct setting (see Section 7.3).

Select the lens used from the **Lens** dropdown list. When automatic focus control is activated, the image width calibration on the **Optics** tab card is then adapted automatically and vice versa.

Thickness Measurement

Active gage: Selection of the connected thickness measurement device.

Interface: Interface where the device is connected to the operating PC.

Test: Opens the **Edit Thickness Profile** dialog where you can measure a thickness for testing purposes.

Value format: Unit for measuring the thickness.

7.4.4 Miscellaneous

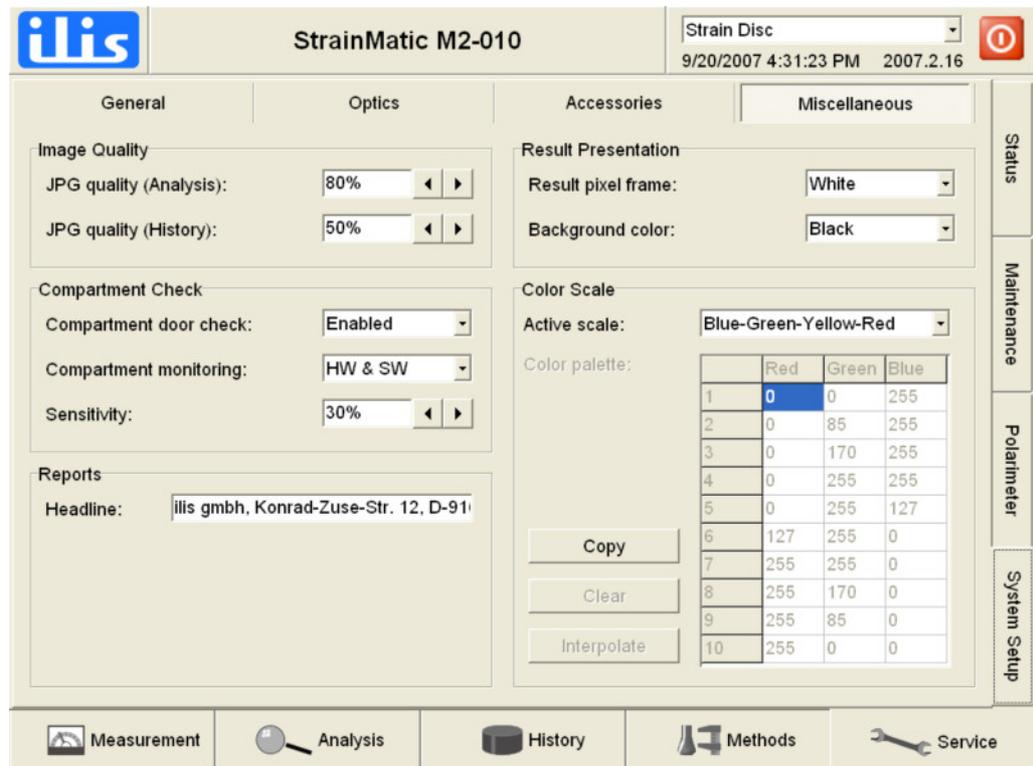


Image Quality

JPG quality (Analysis): Quality of the JPG images on saving in the **Analysis** area. You can control the size of the saved images through the quality of the images.

JPG quality (History): Quality of the JPG images on saving in the **History** area. You can control the size of the saved images through the quality of the images.

Compartment Check

Compartment door check: Activates or deactivates the check of the condition of the compartment door (open/closed) before the measurement.

Compartment monitoring: Enables or disables the compartment check by the software and/or by the light grid (hardware), if available.

Sensibility: Sensitivity of the software compartment monitoring.



CAUTION: Since the **Compartment check** can be deactivated, this function can have no safety function! Even if the sensitivity is set to the maximum value, you must always check before moving the measuring head that the sample compartment is also really empty! (M2 only)

Reports

Headline: Headline for the output in reports.

Result Presentation

Result pixel frame: Color of the border of the result pixels in the result image.

Background color: Background color of the result image legend.

Color Scale

Active scale: Selection of a color scheme for displaying the image caption in the **Measurement** and **Analysis** areas. On selection on the **Custom** entry, you can define your own color scheme in the **Color palette** table.

Color palette: Definition of the color distribution for each of the ten sections of the caption as RGB values (value range 0 – 255).

Copy: Transfers the values of a predefined color scheme into the **Custom** entry.

Clear: Deletes all entries in the **Color palette** table.

Interpolate: Interpolates the missing color values if colors were not stated in all fields.

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StrainMatic®

Service Manual



Start-Up, Maintenance and Service

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No responsibility is accepted for the accuracy of the information and data contained in this documentation which can be changed without prior announcement.

The ilis gmbh cannot be made liable for incorrect use or incorrect operation of the instrument. Correct use requires among other things knowledge of the contents of this manual. Therefore the instructions in this manual and all other technical documentation belonging to the instrument must be complied with.

Based on the current state of the art, it is not possible to produce software that works free of errors in all application combinations. ilis gmbh is therefore not liable for damages arising through the use of the software or the hardware delivered with it.

The names of products and companies cited in this documentation may be protected by trade marks of their respective proprietors.

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1 Introduction

This service manual is designed for the maintenance and service personnel of the STRAINMATIC. It describes the initial start-up and the fundamental maintenance tasks.

You will find a description of the design and functionality of the STRAINMATIC in the user manual. A complete description of the operating interface is given in the Reference Manual.

NOTE: The STRAINMATIC device and the corresponding operating software is constantly being developed and improved. The illustrations in this documentation therefore may differ slightly from your version. It is also possible that some of the functions described in this manual are not applicable to your version.

1.1 Overview

In the General safety instructions section you will find generally valid information on the safe maintenance and service work of the STRAINMATIC. Everyone who works with the STRAINMATIC must have read and understood this section and should work through it again at regular intervals.

The Start-Up section describes the build-up, the connection and the first start-up of the STRAINMATIC.

In the Maintenance section the most important tasks for the maintenance and service personnel are described. This leads from performing remote maintenance to changing spare parts.

1.2 Device variants

At the time of the release of this manual the STRAINMATIC is available in the two variants M2 and M3. Differences in functionality or operation are pointed out in this manual.

1.3 Conventions

To make distinctions more clearly, different fonts and icons are used in the text:

Annotations and file names

User inputs

Cross-references

□ Enumerations

➞ User actions

1.4 Customer support

If you have questions on maintenance or functionality of the STRAINMATIC, please contact the following address. We will be pleased to provide you with further assistance!

ilis gmbh

Konrad-Zuse-Str. 12
91052 Erlangen
Germany

Phone: +49 (9131) 974779 0

Fax: +49 (9131) 974779 9

E-Mail: support@ilis.de

Internet: www.ilis.de

2 General safety instructions

NOTE: This section contains important information on the safe operation of the STRAINMATIC in accordance with the regulations. Read this section carefully. All persons who work with the STRAINMATIC must have read and understood this section of the manual and should work through this section anew at regular intervals.

If generally valid safety regulations and the instructions in this section are not observed, the operating permission of the instrument expires. In addition to the safety instructions in this section, all applicable general legal and statutory regulations for avoiding accidents and for protecting the environment have validity.

This manual and all further information and documentation relevant for the operation must always be accessible in the vicinity of the instrument.

2.1 Use in accordance with the regulations

The STRAINMATIC has been developed for the automatic measurement and display of birefringence in glass and other transparent materials. Use the STRAINMATIC in accordance with the regulations results from the contents of the technical documentation and, where necessary, additional documents.

Nothing on the instrument which could impair the safe operation of the instrument may be changed, added or removed mechanically or electrically without the written permission of the ilis gmbh. The operating software may not be changed in any way. If not approved changes are made to the instrument, the operating permission expires automatically.

2.2 Transport and installation

The instrument may be transported over longer distances only in the original packaging. A hoist with a lifting force of at least 150 kg must be used for a transport of the instrument. The instrument may be lifted only with the handles included in delivery by at least two persons.

When the unit is installed care must be taken that there is no risk of stumbling due to connected cables. The unit should be placed on a suitable workbench for better operation. The workbench must have a minimum load capacity of 150 kg. The workbench should not be higher than 72 cm for the unit type M2.

The installation location of the unit must fulfill the following requirements:

- The unit must always stand on a clean, level surface.
- The unit must not be subjected to any vibrations.
- Existing fans on the unit must not be blocked or covered. Maintain sufficient distance from the relevant wall on all sides of the unit.
- The main switch with emergency-off function must be well visible and quickly accessible at any time.
- The unit must not be installed in humid, dusty or oily ambient air.

- To avoid overheating, the unit must not be exposed to direct solar radiation or an ambient temperature of more than 30°C.
- To avoid disturbing scattered light influence, direct incidence of light in the compartment, especially from pulsating light sources, must be avoided.
- Before starting up the unit must have assumed ambient temperature to avoid formation of condensation.
- The supplied power cable with integrated residual current circuit breaker must always be used for connecting the unit to the power supply.

2.3 Safety information for the operating personnel

Only correspondingly trained and experienced personnel may operate the instrument. Only correspondingly trained and authorized personnel may perform repair or maintenance work on the instrument.

Persons who do not yet have the corresponding training and experience may receive access to the instrument only under the constant supervision of an experienced operator. The legal minimum age of the operating personnel must be complied with.

Only trained electricians or correspondingly trained personnel under the instruction and supervision of an electrician may work on the electrical system of the instrument.

Only correspondingly trained and authorized personnel may change settings in the operating software.

2.4 Safety instructions for operation

The machine may be put into operation only if all covers and safety devices are present, intact and installed properly at the correct position on the machine.

All functional disturbances or changes in the operating behaviour of the instrument (for example the production of unusual noises) must be examined and rectified immediately. If necessary stop the instrument immediately, secure it against unintentional switching back on and inform the responsible person about the malfunction.

No working procedures which circumvent the safety devices or require changes to the machine are allowed.

The instrument may be used only for the intended purpose.

Check the instrument regularly for visible damage. If recognizable damage exists, have this rectified immediately by a correspondingly authorized person.

Keep all safety-relevant documents at an easily accessible place on the instrument or in its vicinity.

To avoid damage in the electrical system of the instrument, the operating personnel may not be statically charged when operating the instrument.

To avoid injuries or damage to the instrument/the sample, it must be assured before moving the measuring head that the sample compartment is empty (M2 only). Close the sample compartment door before a measurement or before moving the measuring head (M2 only).

Do not look directly into the light source.

2.5 Safety instructions to maintenance and service

Maintenance and service tasks are to be performed according to the instructions in this manual or in other documentations of the manufacturer (for example assembly instructions for spare parts). Only correspondingly trained and experienced personnel may maintain the instrument.

The basic parameters of the instrument were carefully adjusted before delivery. These basic settings may only be changed by correspondingly instructed personnel.

Spare parts must fulfil the technical specifications of the manufacturer. The proper function of the instrument can be guaranteed only when original spare parts of the manufacturer are used.

Inform the operating personnel before maintenance or service. For all maintenance and service tasks a supervisor has to be nominated.

Before connecting or disconnecting electrical or electronical connections always ensure that the instrument is switched off and that all parts are free of electrical voltage.

When you switch off the instrument for maintenance or service, secure the instrument against unexpected switching on:

- Turn main switch on position **0-Off**.
- Secure main switch with a padlock.
- Pull out power plug.

All parts with a voltage of 230 V or 115 V respectively are labelled accordingly. Only correspondingly trained and instructed electricians may work at these parts of the instrument.

After finishing the maintenance always ensure that all screws that were loosened have been tightened again.

If security devices were removed for maintenance work these have to be remounted and checked for correct function.

Remove tools and supplies for work and replaced parts safely and environmentally save.

Check all cables, conductions and screw joints for externally viewable damages at regular intervals. Any damage must be repaired promptly.

Check the electrical system of the instrument at regular intervals. All damages like loose connections, missing isolations or signs of melting cables, for example, must be repaired promptly.

Ensure that the instrument is covered if any dust producing work takes place.

2.6 Information and danger symbols used

Information and danger symbols the meaning of which is explained below are used on the machine and in this manual. These symbols must be observed absolutely both on the machine and in the documentation!

Symbol	Meaning
	Wear protective gloves
	Wear protective goggles
	Pull out the mains plug before opening
	General warning about hazardous situation
	Danger of crushing
	Danger due to electricity

2.7 Safety devices

NOTE: Depending on the STRAINMATIC type and the serial number of your device the safety devices can be located in different positions than shown in this manual. Please familiarize yourself with the location of the safety devices before starting up the instrument! If necessary, consult the documentation that accompanied the device on delivery.

The STRAINMATIC has the following safety devices for protection against injuries or damage to the instrument. The following figure exemplarily shows the safety devices of the STRAINMATIC M2 type:



- | | | | |
|-----|----------------------------------|-----|-------------|
| (1) | Emergency stop linear unit drive | (2) | Main switch |
| (3) | Sample compartment door | | |

Emergency stop for linear unit drive (M2 as of M2-005)

A stop button (1) with which the drive of the linear adjustment of the measuring head is switched currentless is located on the front of the instrument. In order to restart the STRAINMATIC after having resolved the dangerous situation unlock the emergency stop switch and perform a self test of the device in the **Service** ⇒ **Status** area or restart the operating software.

Main switch

The main switch (2) for switching the instrument power on and off is located on the right-hand side of the instrument. In **Off** position the power supply of the instrument is completely disrupted. Always switch the instrument off and secure the main switch against unintended switching on before maintenance work.

Sample compartment door

If the sample compartment door (3) is open the following changes in the operating behaviour of the instrument are activated to prevent potential dangers:

- The intensity of the light source is reduced.
- The measuring head moves at lower speed (M2 only).
- No calibration and, according to default settings, no measurement is possible.

Sample compartment monitoring (M2 as of M2-005)

The M2 type is optionally equipped with a switching light grid for checking the sample compartment. The sample compartment monitoring is activated by default. It prevents the measuring head from moving down if an object is detected in the level of the light grid.

Line cord with residual current circuit-breaker (as of M2-005/M3-006)

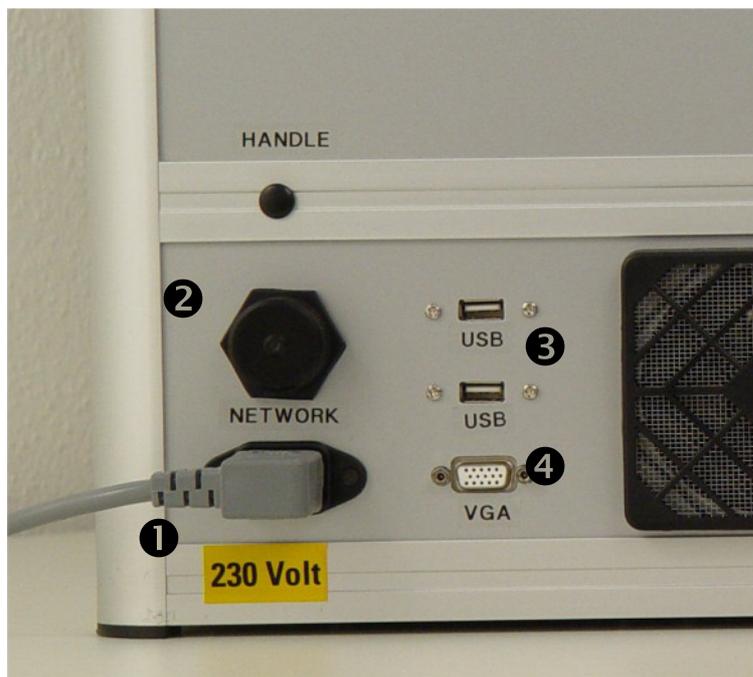
The STRAINMATIC is provided with a residual current circuit-breaker integrated in the line cord that immediately disconnects the current entry to the device when residual current occurs. Use only this line cord to connect the device to the power supply.

3 Start-Up

3.1 Connecting the instrument

3.1.1 StrainMatic M2 connectors

At the left side of the instrument the following connectors are available:



- | | | | |
|-----|---------------------------------------|-----|----------------|
| (1) | Power connector | (3) | USB connectors |
| (2) | Network connector (100 MBit Ethernet) | (4) | VGA connector |

3.1.2 StrainMatic M3 connectors

NOTE: When connecting the STRAINMATIC M3 mind that the colored marks at the connectors always match the marks at the instrument itself.

At the right side of the instrument the following connectors are available:



- | | | | |
|-----|------------------|-----|-------------------------|
| (1) | Power connector | (3) | I/O connector |
| (2) | Camera connector | (4) | Communication connector |

3.1.3 Connecting the power supply

To connect the instrument to the power supply:

- Connect the line cord (included in delivery) to the power connector (1) of the instrument.
- Connect the instrument to an applicable power supply (230 V/50 Hz or 115 V/60 Hz as indicated on the instrument).
- Press the **Reset** button of the residual current circuit-breaker at the end of the line cord, if existing.

NOTE: As far as possible operate the instrument by using an uninterruptible power supply (UPS) to avoid data loss by power failure.

3.1.4 Connecting to the company network

You can establish an access to the company network by using the network connector (2). In this way you can directly access the instrument to exchange data, for example, or to use printers in the company network to print reports and measuring results.

To establish the network connection:

- Connect an Ethernet cable with RJ45 connector to the network connector of the instrument (M2 type) or the network connector of the operating PC (M3 type), respectively, and the company network.

NOTE: In order to access the operating computer via the company network the operating system has to be configured accordingly. Please see the enclosed notes about the delivery status of the operating system.

3.1.5 Connecting external devices

NOTE: In order to use connected USB devices it can be necessary to install adequate software drivers. Please contact your responsible system administrator for installation.

StrainMatic M2

In addition to the USB-connectors of the operating PC, at the left side of the instrument two USB connectors (3) are available to connect, for example, a printer or other USB devices.

By using the VGA connector (4) you can connect an external monitor. Please note to connect and to switch on the screen before starting the instrument, or alternatively restart the instrument after connecting the monitor.

StrainMatic M3

With the StrainMatic M3 type, you can use the USB connectors at the front and back side of the operating PC to connect external devices.

3.2 Starting



WARNING: Risk of damage on overheating the instrument! Before operation make sure that the fans of the instrument, if existing, cannot be covered and are functioning.



CAUTION: Put the STRAINMATIC into operation only if all covers and protective devices have been installed correctly.



WARNING: Risk of injury and damage! Start the instrument only if the sample compartment is free and the cover of the measuring head is closed.

To start the STRAINMATIC:

- Switch the instrument on with the main switch on the side (**I-On** position).
The **POWER ON** lamp at the front side of the instrument turns on.
- If the device is equipped with an external operating PC (M3 type, for example), switch on the operating PC and the corresponding monitor.
The operating computer boots and the operating software is started.
- Confirm the start of the self test with **OK**.

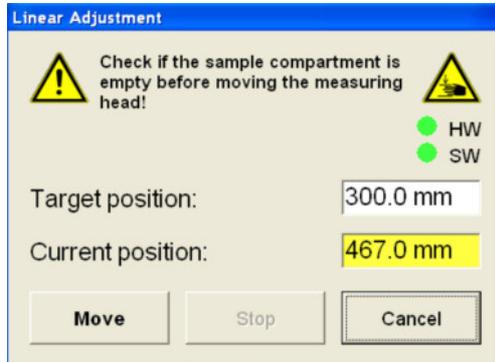


NOTE: If the self-test does not run free of error, save the log file with the corresponding button and send this to the manufacturer.

After the self test has been completed the **Select method** window appears.

- Select the desired measuring method from the list of methods and confirm your selection with **OK**.

If the measuring method requires a new position of the measuring head the **Linear Adjustment** window appears (M2 only):



- ⇒ Confirm the adjustment of the measuring head with **Move**.

After the measuring head has reached its target position the **Linear Adjustment** window closes automatically and the instrument is ready for operation.

- ⇒ To eliminate any possibility of damage or misadjustment due to the transport, perform all validation procedures as described in the user manual.
- ⇒ If necessary define access codes for the different operating areas in the **Service** ⇒ **System Setup** area on the **General** tab card.



CAUTION: Access codes must be defined at least for the operating level 5. The access code for level 5 is **91052** by default (factory setting). Change these access code before operating the instrument to prevent unauthorized changes of system parameters and misuses of service and maintenance functions.

4 Maintenance

NOTE: Some functions in the **Service** area are only accessible with access level 8 or higher. These parameters are only changeable by ilis service personnel or on instruction of ilis.

4.1 Locking operation after finishing maintenance work

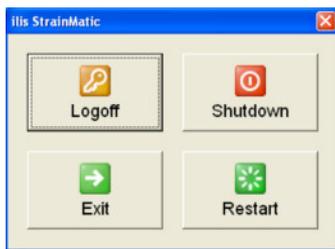
An access level of at least 5 is necessary for the most maintenance tasks in the operating software of the STRAINMATIC.

After finishing maintenance work you should lock the access to high-level functions in order to prevent unauthorized access.

To lock the access to high-level functions:

- Activate the  button in the right upper corner of the operating software.

The following window appears:



- Activate the **Logoff** button to clear the current access level.

4.2 Accessing the Windows user interface

For some maintenance tasks it may be required to leave the operating software and use programs and functions of the Windows user interface.

To access the Windows user interface:

- Activate the  button in the right upper corner of the operating software.

The following window appears:



- Activate the **Exit** button to quit the operating software and access the Windows user interface.

4.3 Remote maintenance

If the STRAINMATIC is connected to the Internet we can support you directly on the operating computer. For this purpose the **VNC** program is installed on the operating computer. This program enables us to see the outputs on your screen and to control the computer by keyboard and mouse. Problems can thus be recognized and dealt with straight away.

Configure Internet access

NOTE: Ask your responsible system administrator to obtain the necessary parameters for configuring the internet access.

To configure the internet access:

- Create a text file **StrainMatic.ini** (or edit this file if already existent) in the **C:\StrainMatic\Custom** folder with following content:

```
[RemoteMaintenance]
DialInPath=
DialInArgs=
HangUpPath=
HangUpArgs=
```
- Enter the complete file path of the Internet connection program at `DialInPath=` and the appropriate connection parameters at `DialInArgs=`
- Enter the complete file path of the program that closes the Internet connection at `HangUpPath=` and the appropriate parameters at `HangUpArgs=`

To start a remote maintenance session:

- Describe your problem to us on the phone or by e-mail and agree a time for the remote maintenance. You can find the contact address in section 1.4.
- If necessary, build up an online connection to the Internet. If you use a dial-up connection, activate the **Dial-In** button on the **Maintenance** tab in the **Service** operating area.

NOTE: If the **Dial-In** and **Hang-Up** buttons are not available either dialing-in is not necessary to access the Internet or the Internet access is not configured correctly. Please ask your system administrator, if necessary.

- When the Internet connection has been established activate the **Start** button and wait a few seconds.

The remote maintenance software is started.
- Activate the **Connect** button.

The connection to the ilis gmbh is being established. You should keep in contact with us by phone during the duration of remote maintenance. You can follow our activities on the screen.

To end remote maintenance:

- Activate the **Stop** button.

The connection to the ilis gmbh is closed and the remote maintenance software will be exited.

- If necessary, activate the **Hang-Up** button to close the Internet connection.

4.4 Performing updates

4.4.1 Updating the operating software

The manufacturer informs you about available updates of the STRAINMATIC operating software. You can obtain updates directly from the manufacturer.

When you have received a new software version (normally by e-mail or on CD) perform the following steps:

Backup all data

- Activate the **System parameters, Method parameters, Method statistics** and **History database** check boxes in the **Service** area on the **Maintenance** tab.
- Activate the **Backup Selected Data** button.
- Specify a file name under which the data has to be saved in the **Backup Data** dialog and activate the **Save** button.

The data will be saved as a SBK file in the specified directory.

NOTE: Always save the data on an external medium (network directory or USB stick, for example) instead on the operating computer, if possible.

Perform software update

- Activate the **New Version** button in the **Service** area on the **Maintenance** tab.
The **Import Software Update** dialog appears.
- Select the update file and activate the **Open** button.
- Restart the operating software.

4.4.2 Updating the license

When you have received a new license file (normally by e-mail or on CD) perform the following steps:

- Activate the **New License** button in the **Service** area on the **Maintenance** tab.
The **Select Software License File** dialog appears.
- Select the license file and activate the **Open** button.
The license data is updated.
- Restart the operating software.

4.5 Replacing parts

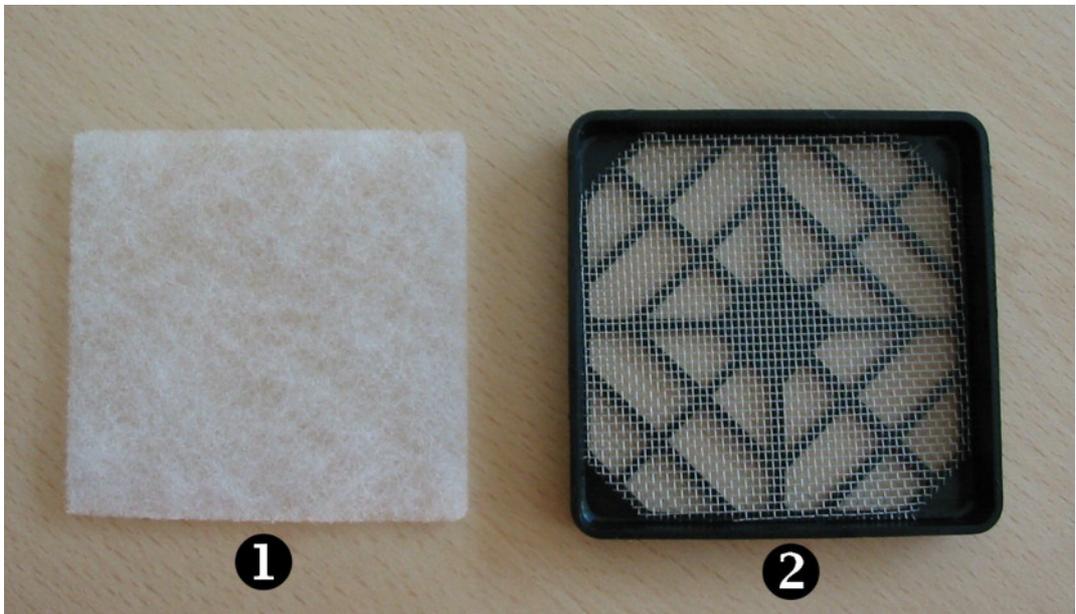
NOTE: Use only original spare parts of the manufacturer. Only original parts fulfil all technical specifications and guarantee reproducible and correct measuring results.

The following sections describe the most common tasks. If more complex parts have to be changed (drives, measuring head, etc.) you will receive a mounting description included in delivery of the spare part.

4.5.1 Changing fan filters

NOTE: Depending on your device type no fan filters may be existent.

To change the fan filters at the right-hand side of the instrument.



(1) Filter (2) Cover

- Pull off the fan cover (2).
- Take out the old filter (1).
- Insert a new filter.
- Mount the cover with the filter on the fan.

4.5.2 Changing the sample plate



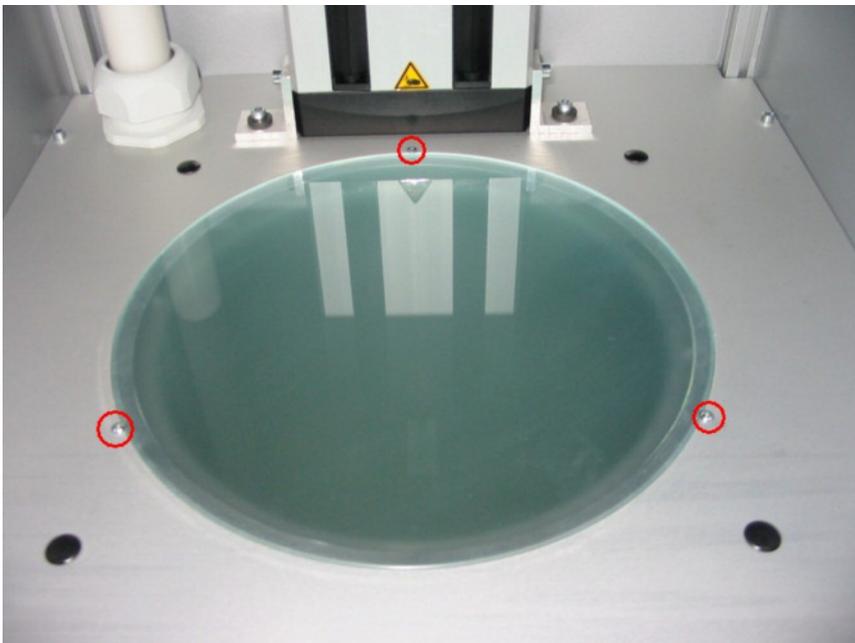
CAUTION: Do not touch the mattfinished bottom side of the diffusor plate. Otherwise the measuring results can be falsified by dirt and fingerprints.

Required tools:

- Allen key 2 mm
- Vacuum cup for handling the sample plate

To change the sample plate:

- ➔ Loosen the retaining screws of the sample plate.



- ➔ Carefully take out the sample plate using the vacuum cup.
- ➔ Carefully insert the new sample plate. The plain side of the plate has to be on top.
- ➔ Carefully tighten the retaining screws. In doing so, use the washers. The plate must not cant or distort.

4.5.3 Changing fuses

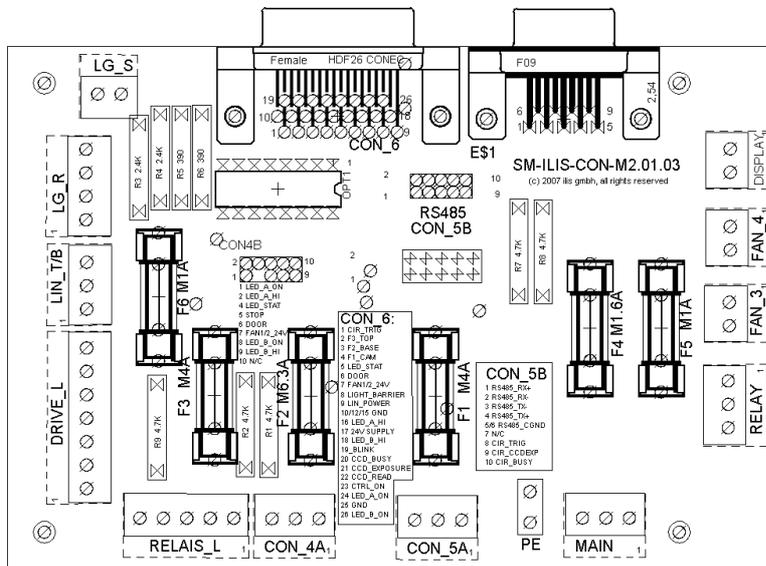


WARNING: Danger of injury by electricity! Switch off the instrument with the main switch, secure it against unexpected switching on and disconnect the instrument from the power supply.

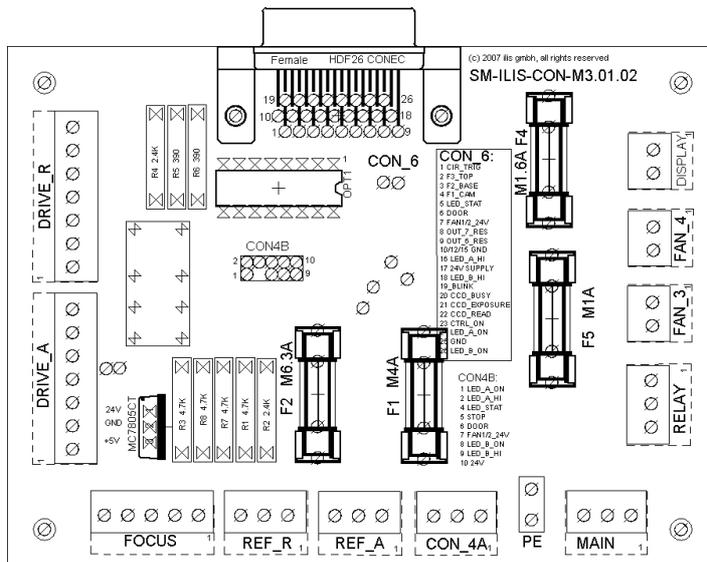
When a fuse is damaged an appropriate message is displayed in the operating software of the STRAINMATIC, for example "[E10] F2_BASE Voltage Failure".

The fuses are located on the control circuit board in the head of the instrument.

StrainMatic M2



StrainMatic M3



Reason for changing	Name on board	Note
Message "[E11] F1_CAM Voltage Failure"	F1 M4A	medium slow, 4 ampere
Message "[E10] F2_BASE Voltage Failure"	F2 M6.3A	medium slow, 6.3 ampere
Message "[E09] F3_TOP Voltage Failure" (M2 only)	F3 M4A	medium slow, 4 ampere
Display failed (M2 only)	F4 M1.6A	medium slow, 1.6 ampere
Multiple "communication failure" messages occur at the same time	F5 M1A	medium slow, 1 ampere
Message "[W13] Camera Image Timeout" occurs during the measurement	F6 M1A	medium slow, 1 ampere

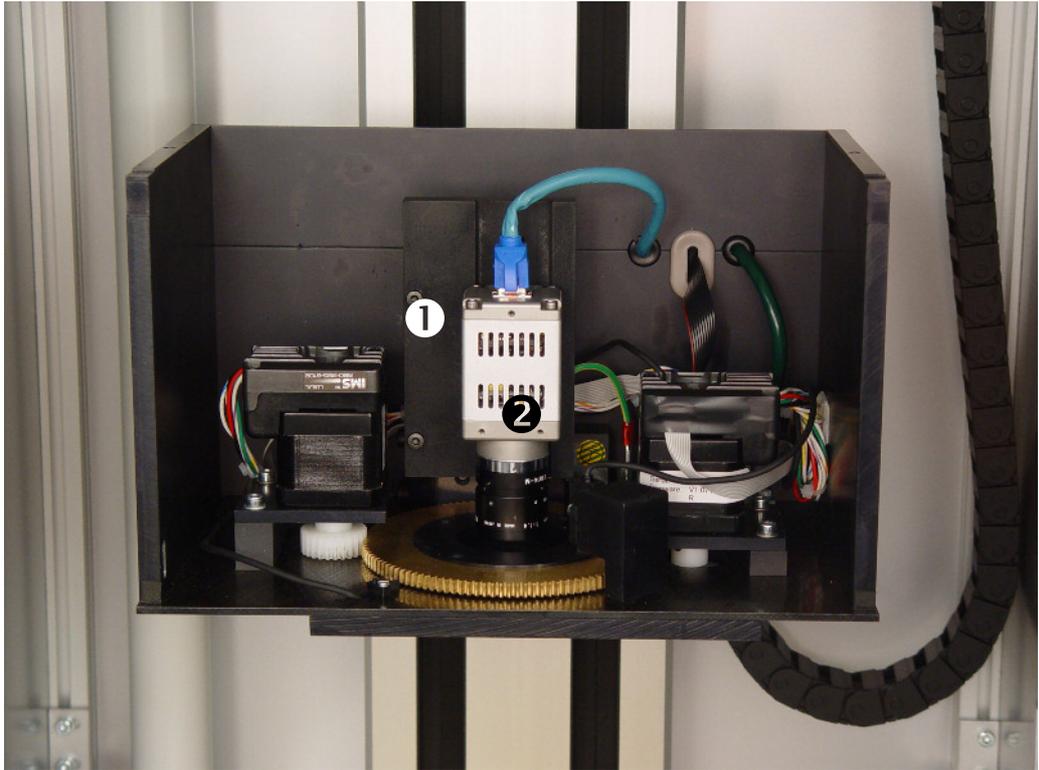
In order to replace a fuse:

- Loosen the eight tightening screws of the top cover and remove the top cover carefully by using the vacuum cup.
- Take out the fuse with an appropriate tool.
- Insert the new fuse.
- Remount the top cover.

4.5.4 Changing the camera lens

You can use different lenses with the STRAINMATIC to measure different sample forms and sizes, for example.

- Activate the **CAMERA ALIGNMENT** measuring method.
- Confirm the movement of the measuring head, of necessary (M2 only).
- Demount the covering of the measuring head (M2: covering hood; M3: covering screen).



- Cover the filter with a protective paper.
- Loosen the knurled head screw at the back of the holding plate (1) so that you can move the camera vertically. In doing so hold the camera (2) to prevent it from falling and damaging.
- Carefully move the camera upwards and clamp it with the knurled head screw in the topmost position.
- Carefully twist off the lens.
- Screw in the new lens.

NOTE: Please refer to the data sheet **StrainMatic Camera Lenses** that is part of your technical documentation if an intermediate ring is needed for mounting the lens.

- Adjust the focus of the lens so that the lens is fully extended.
- Hold the camera at the holding plate of the measuring head so that the lens has a distance of max. 1 mm to the protective paper. (The distance should allow the paper to be moved easily.)
- Tighten the camera with the knurled head screw at the holding plate (2).
- Remove the protective paper and ensure that the lens neither touches the upper gearwheel nor the filter.

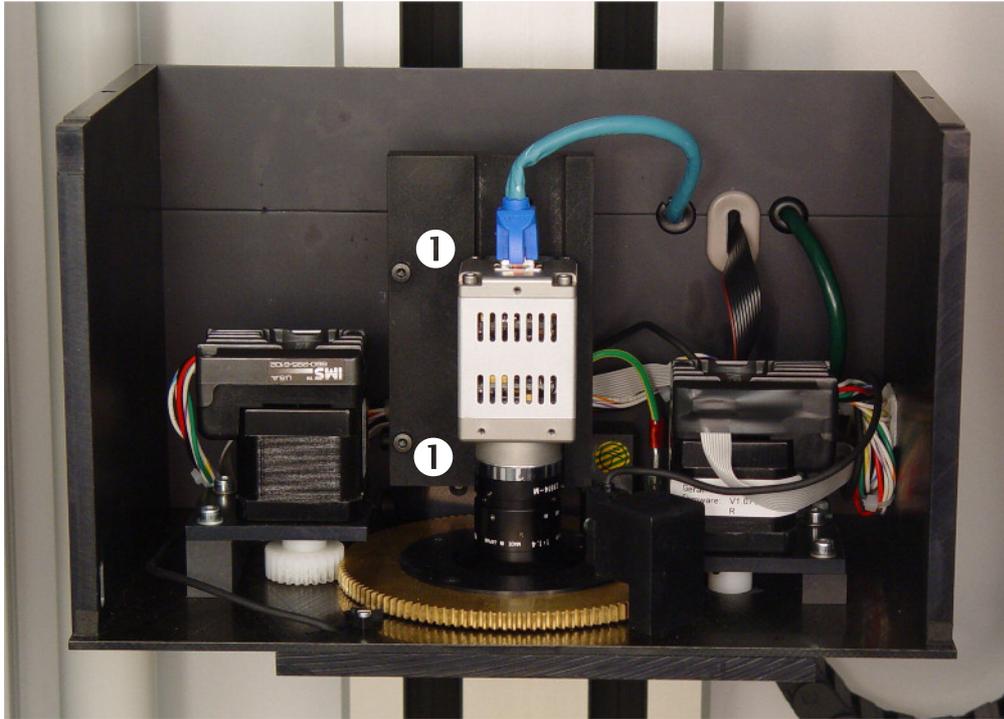
Adjusting the camera

- Select the correct **Active lens setting** for the automatic calculation of the image size in the **Service** ⇒ **System Setup** ⇒ **Optics** operating area.

The screenshot shows the 'Optics' tab in the 'System Setup' section of the StrainMatic M2-010 software. The 'Active lens setting' dropdown menu is highlighted with a red box and is set to '16 mm'. Below it is a table with columns for 'Lens', 'Pos 1', 'Width 1', 'Pos 2', and 'Width 2'.

Lens	Pos 1	Width 1	Pos 2	Width 2
12 mm	150 mm	93.7 mm	350 mm	195.9 mm
16 mm	150 mm	73.1 mm	450 mm	193 mm
25 mm	150 mm	44.2 mm	450 mm	121.2 mm
35 mm	250 mm	51.1 mm	450 mm	88.5 mm
50 mm	350 mm	40 mm	450 mm	53 mm
75 mm	300 mm	22.9 mm	450 mm	36.9 mm
user1				
user2				

- Insert the **CAMERA ALIGNMENT STANDARD** into the sample compartment to check the centering and the parallel alignment of the camera in the live image display.
- If necessary, correct the camera position carefully by using the knurled head screw or the adjusting screws (1) at the side of the holding plate, if necessary. The position of the measuring window has to fit the cut-out of the standard.



- ➡ After correct adjustment of the camera remount the cover of the measuring head.