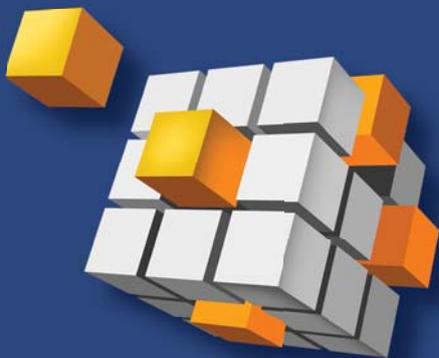




wylerSPEC

Software for flatness and
definition of machine tool geometry



WYLER AG

INCLINATION MEASURING SYSTEMS
NEIGUNGSMESSSYSTEME

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1. Introduction

Thank you for choosing the WYLER-Measuring software wylerSPEC (Machine Tool Inspection Software)

For additional Information concerning not only the software but also the corresponding instrumentation we kindly ask you to look up our homepage: www.wylerag.com. There you will always find the latest news and software updates.

It is our constant aim to serve you with the latest technologies on inclination measurement. We appreciate your comments to the software wylerSPEC and to our highly specialised hardware. Your information is of great importance to us, so we ask for your feedback via our website or through our distribution partner in your country.

Thank you for your support.

Sincerely

The management of WYLER AG

2. Structure of wylerSPEC



The software wylerSPEC is the ideal tool for measuring tasks related to the **geometry of objects and machines** such as straightness of guideways, flatness of surfaces including, both granite tables as well as machine tables, parallelism of guideways, or squareness of vertical machine elements compared to horizontal parts.

wylerSPEC incorporates the 2 packages [wylerELEMENTS](#) and [wylerPROFESSIONAL](#). While wylerELEMENTS covers the basic applications like straightness and flatness, is wylerPROFESSIONAL suited for more complex applications like the measurement of guideways or circular supports on machines.

The complete software wylerSPEC consists of the following integrated software programs:

1) Linie / Parallelen 2...4 Geradheit, Parallelität, Absolut, Ausrichthilfe, Referenzwechsel	7) Rotierende vertikale Achsen Absolut, Parallelität, Taumel
2) Linie mit Twist / Parallelen mit Twist 2...4 Geradheit, Parallelität, Ebenheit, Absolut, Ausrichthilfe, Referenzwechsel	8) Rotation von Maschinenelementen Nicken und Rollen inkl. Laser/Autokollimator (Nicken, Gieren) Zyklen hin und zurück
3) Rechter Winkel, Parallelen Vertikal 2 Geradheit, Parallelität, Rechter Winkel, Absolut, Ausrichthilfe, Referenzwechsel	9) Bezug von Flächen Ebenheit, Parallelität, Ko-Planarität Bedingt 4 ... 5
4) Fläche, Grid, Grid partiell, U-Jack Ebenheit, Absolut, Ausrichthilfe für Standardbasen, Flexbasis und 2-D Messbasen	10) Eigene Messfiguren Freie Zusammenstellung der Messaufgabe Bedingt 1 ... 9
5) Kreise, Kreise mit Twist Ebenheit, Parallelität, Absolut	11) Trends z.B. vorher/nachher Vergleich von zwei oder mehreren Messungen
6) Führungsbahnen vertikal und horizontal inkl. Laser/Autokollimator (Längs- und Fluchtlinie) Geradheit, Parallelität, Ebenheit, Absolut	Server Datenbank Eine Serverbasierte Datenbank, auf die von «überall» her zugegriffen werden kann

wylerSPEC consists of 11 modules dedicated to the parts **wylerELEMENTS** and **wylerPROFESSIONAL** and optional 1 server datenbase.

⇒ wylerELEMENTS and wylerPROFESSIONAL are designed modular:

The right package for your use:

		wylerSPEC										
		Modules wylerELEMENTS				Modules wylerPROFESSIONAL						
		Line	Line with twist	Perpendicularity	Flatness	Circles	Guide ways	Spindle	Rotation	Coplanarity of areas	Own measuring tasks	Trend analysis
Module	Name of package:	1	2	3	4	5	6	7	8	9	10	11
	wylerELEMENTS 1	√										
	wylerELEMENTS 2	√	√									
	wylerELEMENTS 3	√		√								
	wylerELEMENTS 4	√			√							
	wylerELEMENTS	√	√	√	√							
	wylerPROFESSIONAL 1	√	√	√	√	√						
	wylerPROFESSIONAL 2	√	√	√	√		√					
	wylerPROFESSIONAL 3	√	√	√	√	√		√				
	wylerPROFESSIONAL 4	√	√	√	√		√		√			
	wylerPROFESSIONAL 5	√	√	√	√	√	√	√	√	√		
	wylerSPEC	√	√	√	√	√	√	√	√	√	√	√

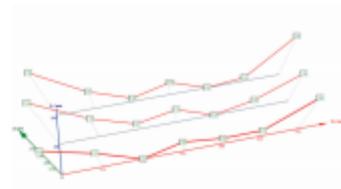
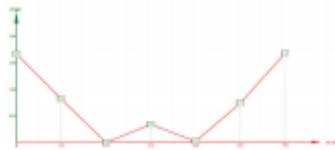
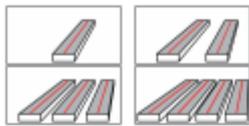
2.1 wylerELEMENTS



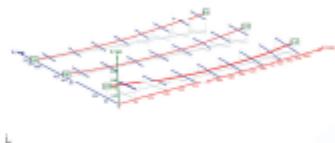
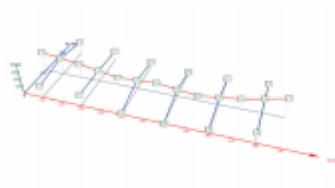
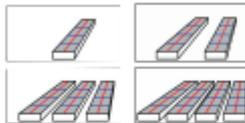
The base package wylerELEMENTS contains the measurement and documentation of geometrical figures, which are measured with our BlueSYSTEM SIGMA.

Modules wylerELEMENTS:

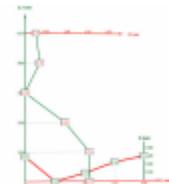
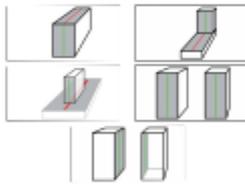
1	LINES/PARALLELISM	Measurement of straightness and parallelism
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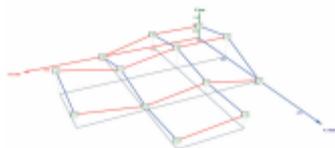
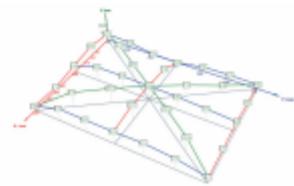
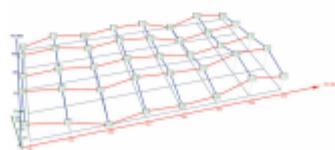
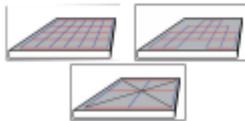
2	LINES/PARALLELISM WITH TWIST	Measurement of flatness and parallelism with twist
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3	PERPENDICULARITY	Measurement of perpendicularity on machines or a granite master
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4	FLATNESS	For measuring the flatness of a granite plate or machine tool table
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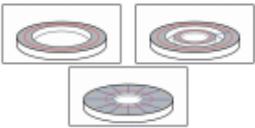
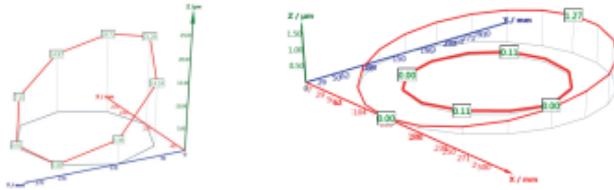
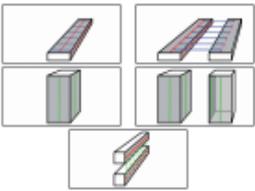
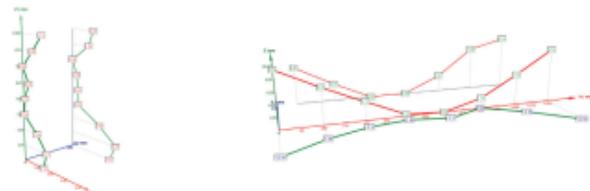
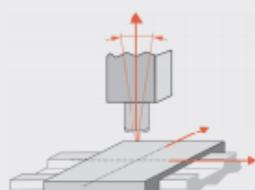


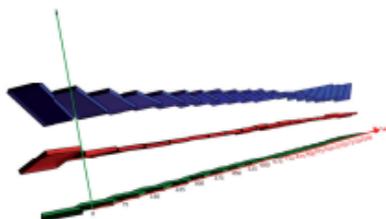
2.2 wylerPROFESSIONAL

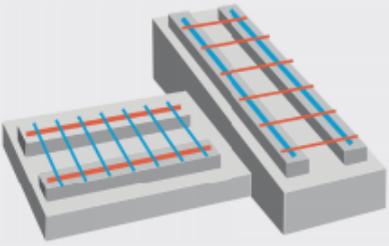
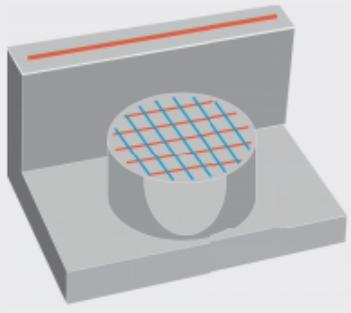


The package wylerPROFESSIONAL includes wylerELEMENTS and contains the measurement and documentation of geometrical figures and rotations, typically on a machine, which are measured with our BlueSYSTEM SIGMA. Measurements with a Laser interferometer and Autocollimator are supported as well.

Modules wylerPROFESSIONAL:

<p>5 CIRCULAR PATHS/ CIRCULAR PATHS WITH TWIST</p>	<p>Measurement of ring-shaped overlays consisting of one or two rings – with or without twist</p>
	
<p>6 GUIDEWAYS VERTICAL AND HORIZONTAL</p>	<p>Measurement of horizontal and vertical guideways</p>
	
<p>7 ROTATION VERTICAL AXIS</p>	<p>Measuring the perpendicularity of a vertical spindle to the machine table / Measuring the wobble of the spindle</p>
	
<p>8 ROTATION ROLL - PITCH - YAW</p>	<p>The pitch and roll movements can be recorded with the WYLER inclination measurement devices; the yaw movements can be recorded with laser interferometers or autocollimators. => Ask your WYLER representative if the interface to your tool is now available</p>



9	COPLANARITY - FLATNESS - SURFACES	Determining the coplanarity / Overall flatness of separately measured areas of a machine
<p>Determining the coplanarity of four different guideways of a machine. In doing so, two guideways on the X axis and two guideways on the Y axis can be compared</p>		
10	OWN MEASUREMENTS	Client-specific measurement tasks
<p>Client-specific measurement tasks can be defined using this module.</p> <p>Example: Determining the coplanarity of a ring and a guideway</p>		
11	TREND ANALYSIS (BEFORE / AFTER)	Comparison of two measurements (before / after)
<p>The curves measured [before] and [after] can be overlaid top of each other for comparison.</p> <p>Analysis of a series of measurements: For the purpose of trend analysis as well, the curves from a series of measurements can be compared in order to assess how the shape of the machine has changed over time.</p>		

⇒ Remark: Functions shown on gray backgrounds are not yet available

3. Measurement basics

[Measuring instruments and configurations](#)

[Measurement basics](#)

3.1 Measuring instruments and configurations

The inclination measuring instruments BlueLEVEL, BlueLEVEL 2D and BlueCLINO HP are especially well suited for all kind of measurements. Not only simple definitions of an inclination angle but also more complex measurements of straightness of lines, guide ways of machine tools with twist or surface flatness of small and large areas can be done.

Training seminars for the use of hardware and software are available at WYLER AG. Also training courses are possible at the users premises with detailed know how transfer specifically suited for the user's needs. Please contact your local WYLER representative for additional information and useful dates.



WYLER measuring configuration

A **typical measuring system** usually consists of the following components:

- One or two **electronic inclination measuring instruments** including cables or wireless data transmission modules
- **BlueMETER SIGMA** as Interface between the measuring instruments, respectively the display unit, and the Computer
- Computer or Laptop
- Software **wylerSPEC**

Remarks regarding the components:

- Electronic inclination measuring instruments with calibrated analogue output or with digital output measures slightest angular deviations in relation to the centre of gravity and delivers a corresponding signal to the analysing system
- With the instruments of the BlueSYSTEM family the BlueMETER SIGMA serves as the Interface to the PC

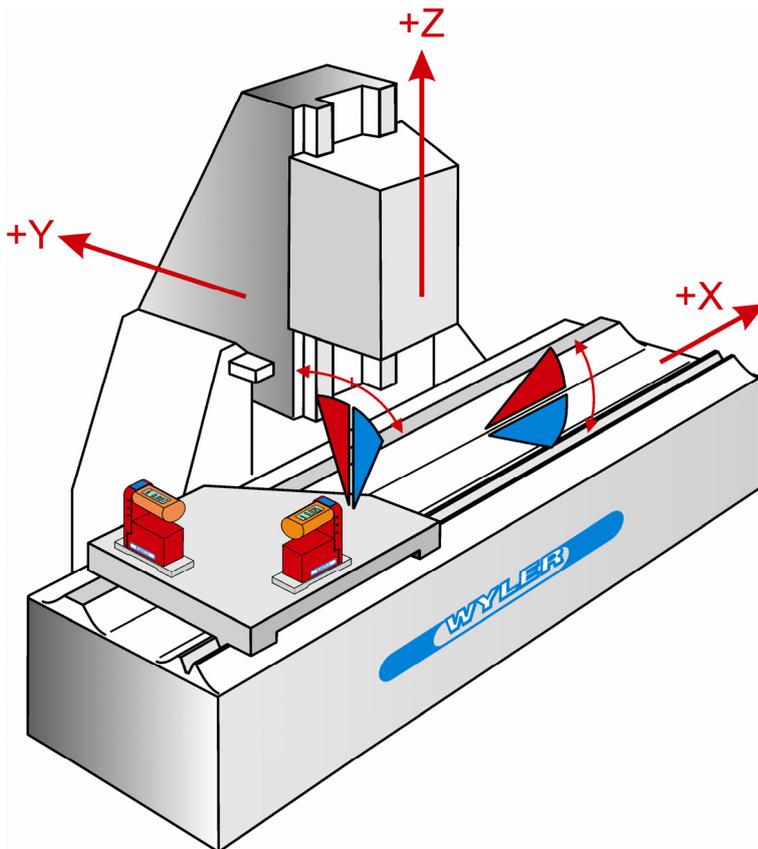
3.2 Measurement basics

In order to receive satisfactory results it is important to observe a few hints before starting to measure with the software **wylersPEC**.

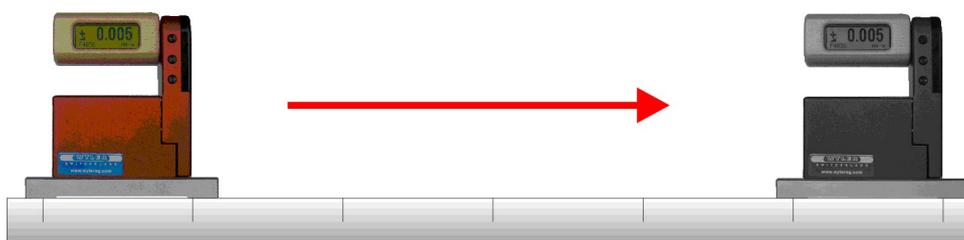
Consider the following topics:

- Measurement strategy / Orientation of measuring at machine tools
- Measurement strategy / Orientation of measuring at flatness measurements
- Verification of the system
- Choice of measuring base
- Influence of temperature differences
- Differential measurement / reference measurement
- Measuring errors
- Measurement / Layout of measuring pattern
- Methods of alignment
- Scatter limit
- Angular error of an instrument
- Absolute measurements

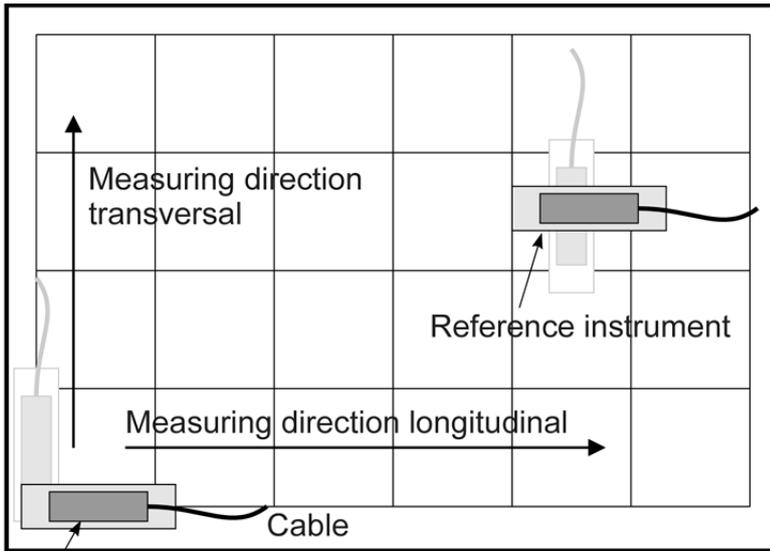
3.2.1 Measurement strategy / Orientation of measuring at machine tools



- Touch the instrument only at the handle (Temperature!!)
- Measurement always from left to right and from near to far
- Cable always in measuring direction, in case of wireless transmission, connector in measuring direction



3.2.2 Measurement strategy / Orientation of measuring at flatness measurements



Measuring instrument

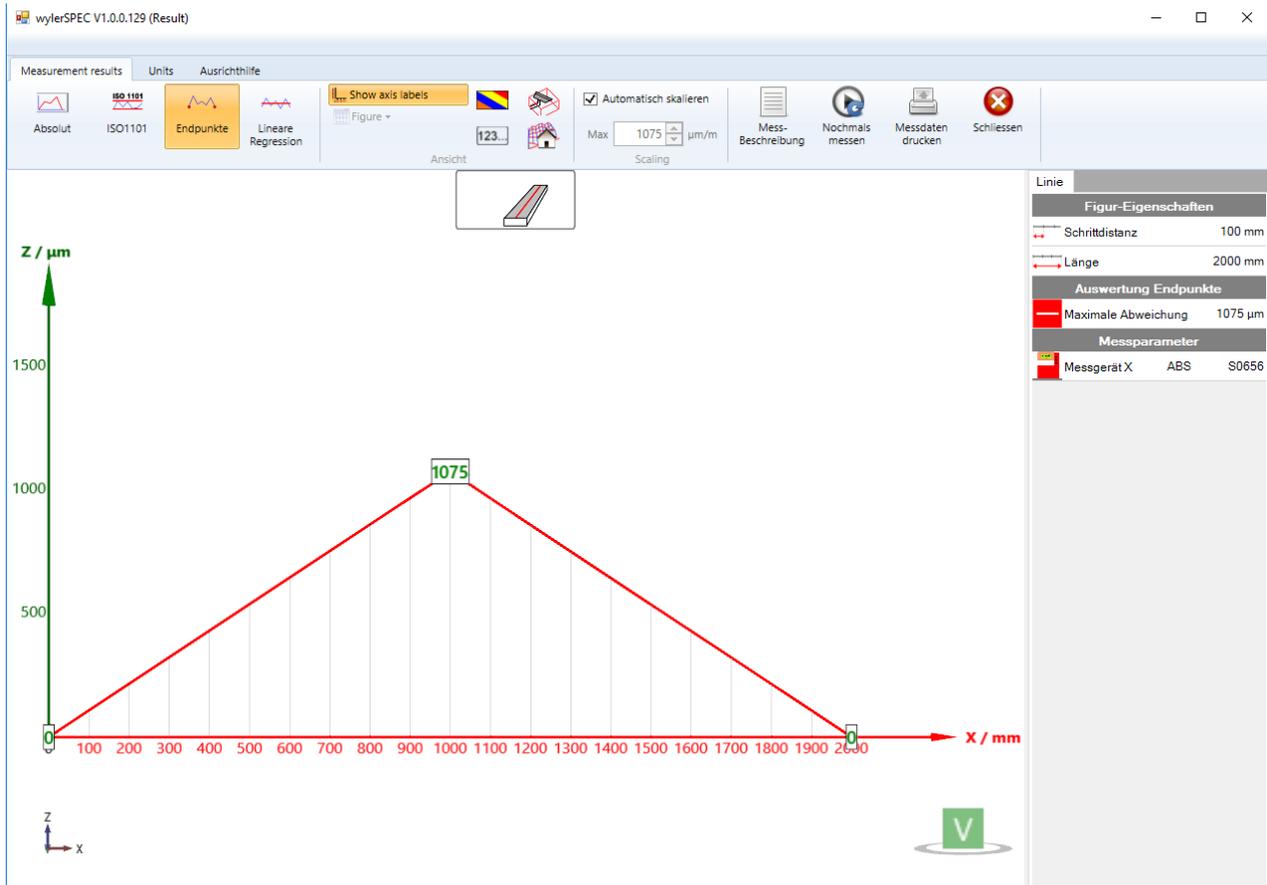
- Touch the instruments only at the handle (Temperature!!!)
- Measuring from left to right and from close to far
- Cable in measuring direction

3.2.3 Verification of the system

The measuring system can be approved using the following procedure:

- Install and power up the instruments and interface to PC according to the manual
- Start the software wylersPEC / "Measuring pattern new"
- Select Object "Line"
- Measurement device "ABS" / Way of measurement "Without reference"
- Step length longitudinal 100 mm / Number of measurements: 20
- Way of measuring, enter "1 Instrument" and <Start measurement>
- Perform reversal measurement
- Place a piece of newspaper (ca. 10 to 20 μm) under the right side of the measuring base.
- Without moving the electronic level read 10 values.
- Move the newspaper to the left side.
- Read the remaining 10 values without moving the instrument.

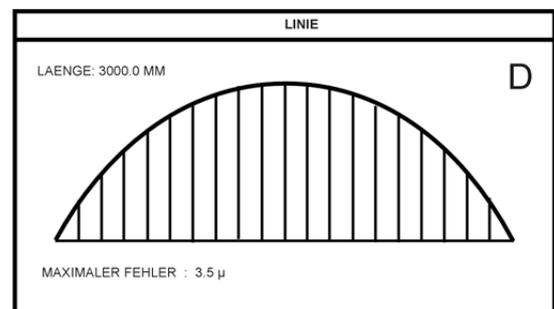
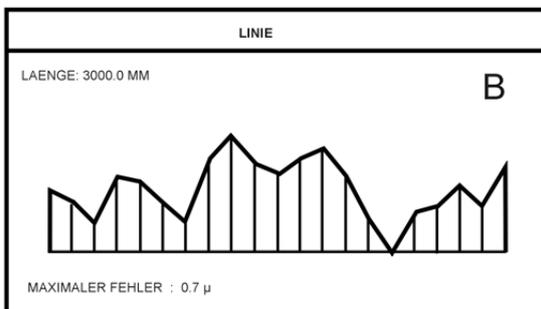
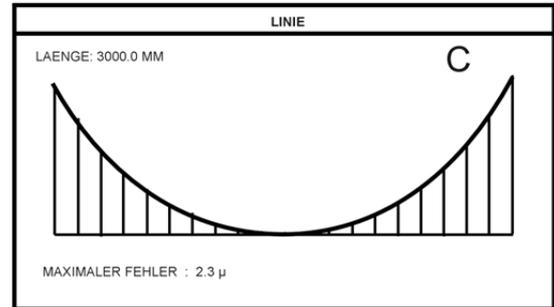
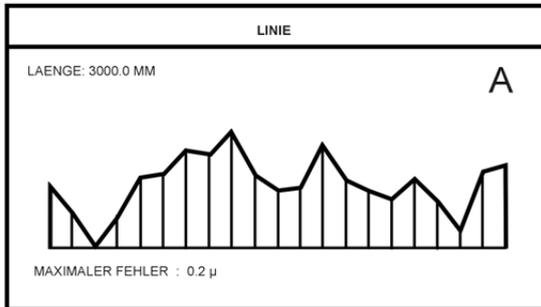
The result should look similar as shown below



If the measurement shows instead of a pyramide a V-valley, the newspaper has been placed under the wrong side of the measuring base.

Repeat the same measurements without placing any paper below the instrument's base and without moving the instrument, which means the instrument remains flat at the same spot. The following could result:

Possible results:



Interpretation of the results

Theoretically a straight line and a maximum error of "0" should be the result. This is however impossible due to unavoidable vibrations (movements of the object to be measured) and therefore changes in the measuring values on the electronic level. To obtain assertive measuring results the following conditions must be fulfilled:

For extremely precise measurements the maximum error must be less than 0.2 μ m and a line character as shown in "A" or "B" must be obtained.

For medium accuracy of measurements the maximum error must be less than 0.5 μ m and a line character as shown in "A" or "B" must be obtained. Such results can show up due to vibrations, these are random errors.

Line characteristics as per "C" or "D" must be avoided, as these are indication of temperature drift.

Possible causes

- Difference in temperature between the measuring base and the object.
- The whole system may not be at operating temperature or there are temperature differences within the object to be measured

(Warm-up time for the electronic unit for precise measurements is 15 min.

The adjustment of equal temperature within a measuring objects is depending on size and material and may need up to several hours.

Attention:

If a measurement is continued when line characteristic "C" or "D" are shown a time depending measuring error will show up. When the measuring task is time consuming the error will be quite large.

When measurement takes place after receiving curves similar to "A" or "B", even, when the errors are quite large, the displayed error must be added to the measuring uncertainty. These errors do not change over the period of time during the measurement. The errors may be influenced by other reasons, such as vibrations.

3.2.4 Choice of measuring base

For flatness measurements using a complete grid a [2D-Base](#) may be used. For all other measurements an appropriate [1D-Base](#) must be selected.

3.2.4.1 Choice of measuring base for 1D-devices

Measuring bases for measurements on horizontal guide ways:

As far as possible for flatness measurements no instrument with prismatic base should be used (except as reference instrument). This is especially important for surface measuring!

Because the contact surfaces of longitudinal, respectively transversal measurements do not or not sufficiently overlap, errors can occur.

Also, scraped bases tend to collect dirt because the scraping pockets run out shallowly allowing dust particles to enter easily between the two surfaces.

The **hardened steel measuring bases with knife-edged type, approx. 1 mm broad dust grooves** under 45 deg. angle to the measuring direction, have proven especially suitable for measuring on surface plates of Diabas.

The following table gives an insight into dimensions and application ranges:

Length of measuring base	Width of measuring base	Length of contact of base section	Optimal measuring step length	Recommended range of measuring step length
mm	mm	mm	mm	mm
110	45	20	90	85 - 105
150	45	24	126	120 - 145
200	45	30	170	160 - 190

The **WYLER Flexbase** is equipped with 3 contact points in the size of 10 mm diameter (0.4") whereas the length distance between the two major contact points can be adjusted according to the requirements.

Excellent results can be achieved with this measuring base on granite surface plates. When the measurements are done according to the U-Jack method, respectively according to the US Specs GGG-P-463b the **WYLER Flexbase** is a must! With the software wylerSPEC all the necessary requirements for this type of flatness measurements are also incorporated.



The **WYLER Flexbasis** 250mm is available in two ranges:
Standard range: 100mm ... 240mm
Extended range: 70mm ... 270mm

Variante B:

The flexible base of WYLER

For many years we have faced customers' requests for WYLER instruments with a measuring base allowing adjustable step length. Considering the technical requirements and in order to avoid any negative influence of such a base on the quality of the measuring results, intensive tests with a variety of models and versions have been performed.

As a result of this development series we are now in a position to launch the **WYLER Flexbase**. The users will be excited by the easy handling and the multiple options available. This base is conceptually adopted from the standardised 3-point-supported measuring bases, which also makes the use of the U-Jack-method a lot easier.

Particularly in combination with the latest version of our software **wylerSPEC** this measuring base is a convincing enhancement. This software allows the automatic calculation and proposal of a suitable measuring layout in an easy way, taking in account the high variety of possible step lengths provided by the Flexbase.

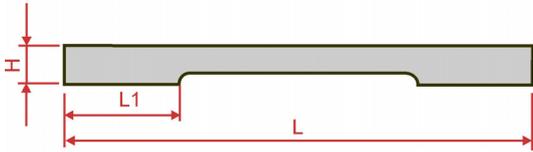
Measuring bases for measurements on horizontal guide ways

For measurements on machine tool guide ways made of steel or cast iron hardened steel bases with sharp edges are not very useful because of the possible scratches when moving a measuring instrument on the surface of the guide way.

Especially recommended for the measurement of finely ground or scraped surfaces **granite bases** are highly recommended. For the measurement of larger ranges granite screw on bases in the size of 200, 250, and 500 mm length are readily available, other dimensions are manufactured according to the requirements.

Most machine constructors have suitable equipment and well trained specialists available which enable the in house manufacture of suitable measuring bases of cast iron, adapted to the measuring object, for their production and maintenance needs.

Examples of suitable measuring bases:



It is important to make sure that a measured difference in height at the two measured points are resulting in an angular difference.



Examples of incorrectly designed bases:



Absolutely flat base

Error:

- No clearly defined contact points.
Full surface contact
- Tendency to wobble on uneven work piece surface, >> resulting in large measuring error.



Measuring surfaces not covering the same surface area

Error:

- Measuring errors by line- and flatness-measurements



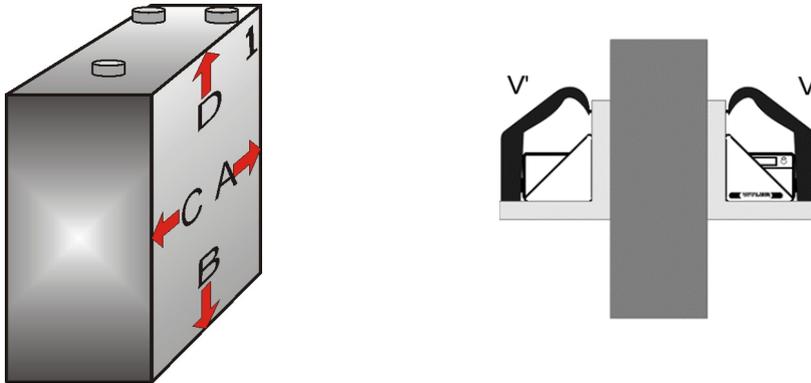
When designing and manufacturing specific measuring bases suited for clearly defined machine elements, it is useful to include positioning aids. Such positioning aids are particularly useful when the instrument must be guided parallel to another measured line or when, in defined distances, threads or holes are in the way. In these cases it is worthwhile to spend some time in the proper jig in order to drastically reduce the measuring time as well as to improve the accuracy.



Measuring bases for vertical measurements:

Different types of standard measuring bases suitable for horizontal and vertical measurements are available. If no measurements are planned on shafts or other cylindrical elements, it is recommended to abstain from the use of prismatic bases.

Angular measuring instruments with bases with magnetic inserts should possibly not be used for flatness measurements as the handling gets rather difficult. Bases with magnetic inserts should be used for placing the instrument at a specific spot for a certain time. Such a case could be the measurement of roll and pitch on a machine tool element.



Vertical measurements, where the results are later used for determination of rectangularity or for comparison with the geometry of other elements, should always be done in the absolute mode. This means the result must be a possible deviation of the true vertical.

For a precise vertical measurement it is inevitable to perform with the measuring instrument a reversal measurement using the vertical measuring base. For such a reversal measurement a calibration element with two absolute vertically parallel surfaces is required.

Such granite squares are available at WYLER's.

Length of measuring bases:

For straightness measurements of guide ways and for flatness measurements of surfaces the following criteria should be observed:

- Short measuring bases detect short waves (local error) and generate thus a dense information content
- Short measuring bases require more time during the measurement and create thus higher costs
- Short measuring bases used on large work pieces end up in a large number of measurements (Increases the total measuring error)
- Long measuring bases detect only long-wave errors
- Long measuring bases reduce the measuring time required and thus save costs
- Long measuring bases require a smaller number of measurements, thus reducing the possibilities for measuring errors. Therefore the measuring uncertainty in respect of the total dimension of a measured object is drastically reduced

Medium Information density

Short waves of 50 to 200 mm length.
 These can be the result of unsuitable machining methods in production, e.g. when too small lapping tools are used for the lapping of a surface plate.
 Local wear can also lead to errors of this type.
 This category of errors is interesting for the flatness measurement.



Example of an ideal measuring base
 Instrument with flat base with dust grooves

Low Information density

Long waves over the whole surface.
 The general shape of a surface.

Reasons for this category of errors are:

- Copied geometrical errors originating from the production machine
- Deformation due to clamping and support
- Distress of the material
- Thermal lamination within the work piece
- Deflection (bending) by the own weight



Example of an ideal measuring base
 Instrument with flat base mounted on a granite base

3.2.4.2 Choice of measuring base for 2D-devices

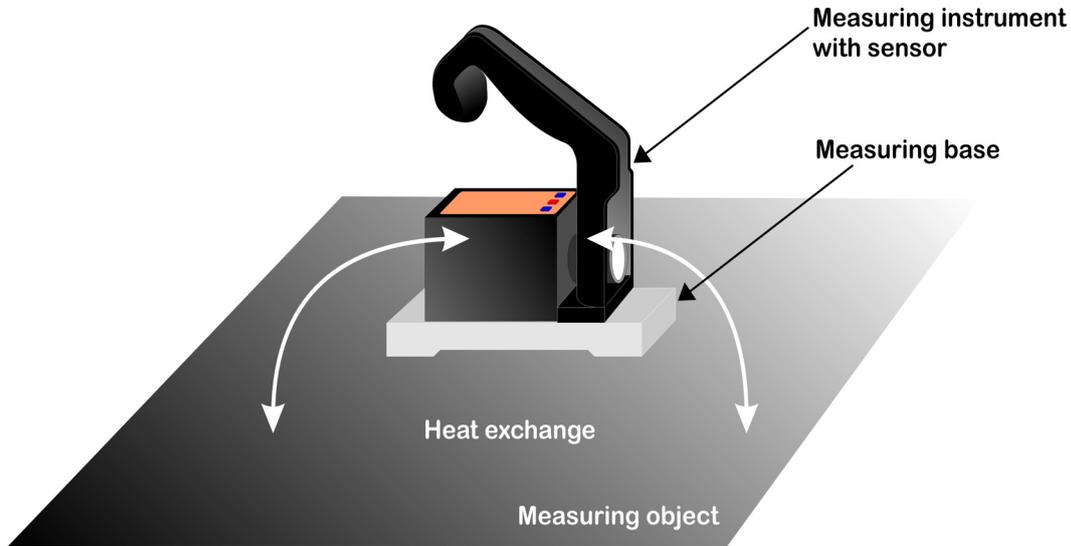
varioBASE-2D

3.2.5 Influence of temperature differences

Temperature difference within the work-piece or between the work-piece and the measuring base have a great influence on the accuracy of the measuring results. The following chapter will deal with some of these coherent problems.

The following chapter will deal with some of these coherent problems.

Influence of temperature differences between the measuring base and the object to be measured



A temperature difference between the measuring base and the object to be measured will cause a heat flow. The amount of such a heat flow is depending on the area of contact, the difference in temperature, the materials of base and object as well as on the base length and the cross section of the measuring base. In the base a temperature lamination will occur which will bend and warp the base because of material expansion. This will result in constantly changing the area of contact, which on the other side again will change the flow of heat. These partially brisk motions can be observed by the continuous changing of the instrument's display value.

The temperature dependant changes of the base's dimensions itself are also visible in the instrument's display value

Important:

- Before conduction of a precision measurement the temperature of the instrument and the object must be checked
- The time for temperature acclimatisation of the instrument's base is depending on the temperature difference and the material used and will be between $\frac{1}{2}$ and 2 hours

Influence of temperature differences within the measuring object

Similar statements are true of the temperature stability of the object to be measured, e.g. machine tool. Such temperature changes have a great impact on the quality of the measurement. It is therefore important to make sure to eliminate or minimize temperature changes during the measurements.

3.2.6 Differential measurement / reference measurement

Measurements conducted with the differential method allow the compensation of slight changes of an object's orientation during the measurement and the compensation of low frequency vibrations. These compensations are only satisfactory if the measuring object is of rigid design and the supports are of the three-point type. Also the surface on which the reference instrument is placed must be a solid part of the object to be measured and of good flatness so that the reference instrument is not wobbling. If these conditions are not fulfilled the planned compensation cannot be achieved.

Remarks:

Measurements **in absolute mode** in combination with a **reference instrument** take the change of the reference instrument in account only. This means that the difference of the current value to the first value of the measurement figure is subtracted from the current value of the main instrument.

Attention

Long machine beds with several bearing points have the tendency of following the shape of the foundation, this will also give false compensation readings. By this the reference instrument placed on the machine bed will supply incorrect values. In these cases it is not recommended to apply the differential measuring method.

3.2.7 Measuring errors

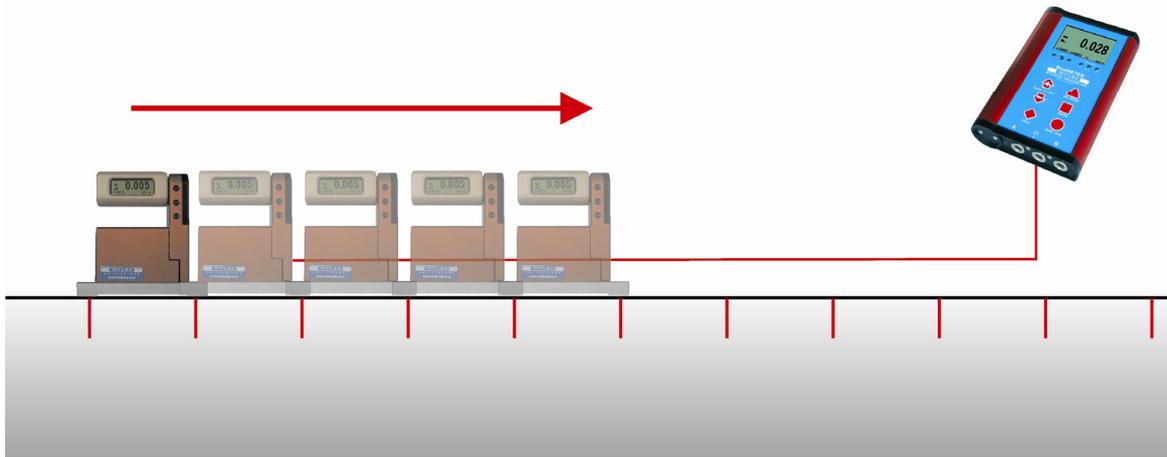
Possible causes of measuring errors, respectively closure errors of surface flatness measurements or poor repetition when measuring straight lines are:

- Temperature difference between measuring base and measuring object.
- Tilting of the object to be measured and/or vibrations during the measuring process.
- Careless measurement
- Dirt
- actuating the remote trigger before the instrument's read-out is stable
- insufficient overlapping of the measuring steps during the measurement
- careless positioning of the measuring instrument
- warped, worn or damaged measuring base
- uneven, short waved surface, bumps and burrs which cannot be covered accurately by the measuring base or result in wobbling of the measuring instrument

3.2.8 Measurement / Layout of measuring pattern

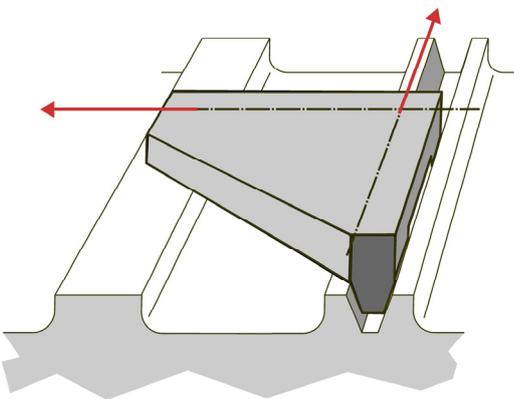
The object to be measured must be adjusted horizontally in both directions (longitudinal and transversal) as well as possible (within approx. 50 µm/m). If not done so measuring errors (**Twist error**) may occur if the measuring instrument is not placed exactly in line with the measuring direction. The use of a ruler or a straight edge may be helpful.

The object must now be divided in equally long measuring steps. The step length has to be such that an equal dimension of overlapping of the base length with each step is possible. See graph below.

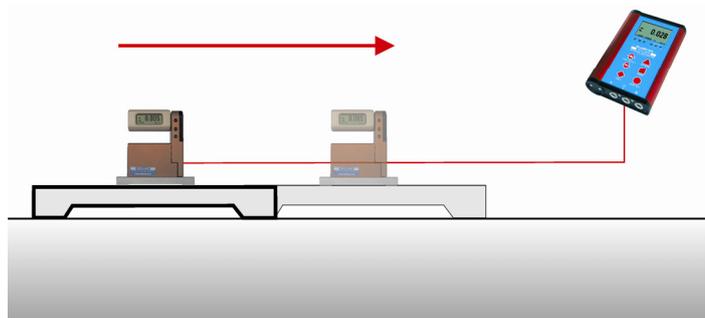


The definition of the overlapping is usually a compromise between the optimal step length as earlier described and the total distance to be measured.

The same applies when using a measuring JIG with an instrument placed on top. See below.



Measuring JIG for the measurement of a guide way



Side view of the JIG with instrument placed. The measuring steps must be overlapping

3.2.9 Methods of alignment

In the WYLER software the following methods of aligning the measuring objects are possible:

- Alignment "**ABSOLUTE**"
- Alignment according to the method "**ENDPOINTS**"
- Alignment according to the method "**ISO 1101**"
- Alignment according to the method "**LINEAR REGRESSION**"

The different methods are described next and a number of graphs are used for better understanding. The same applies to the following measuring objects:

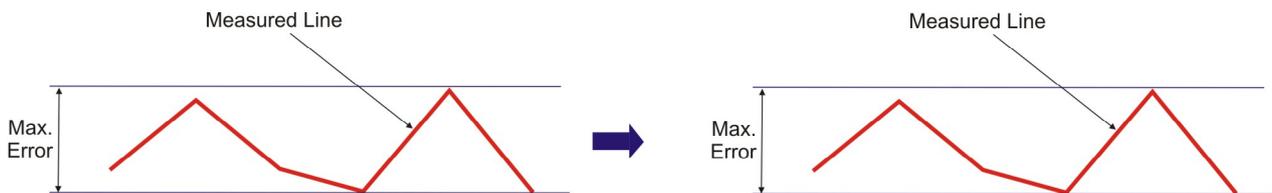
By aligning surfaces instead of straight lines flat surfaces are applied as borders.

Procedure of the measurement:

1. All the measuring parameters like e.g. step length, number of measurements etc. are entered.
2. At the end of the measurement the result may be viewed using the Menu point "Display".
3. The required alignment method may be set

Methods for aligning measuring objects, Overview:

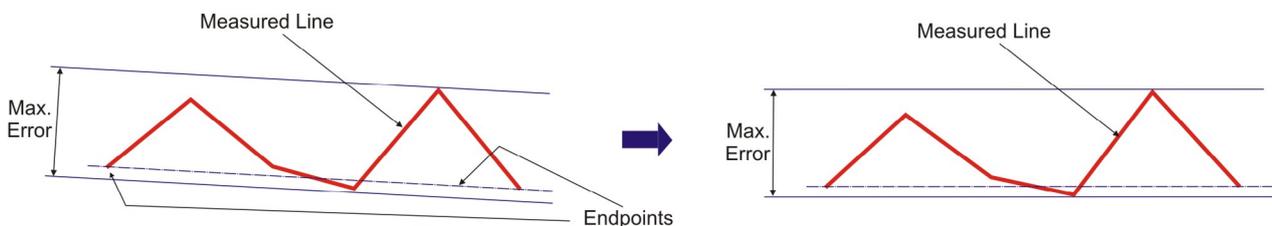
Alignment "**ABSOLUTE**" 



The method "**ABSOLUTE**" is important to use when elements of a machine must be compared at a later stage. Only in the absolute mode it is guaranteed that the individual positions can be compared.

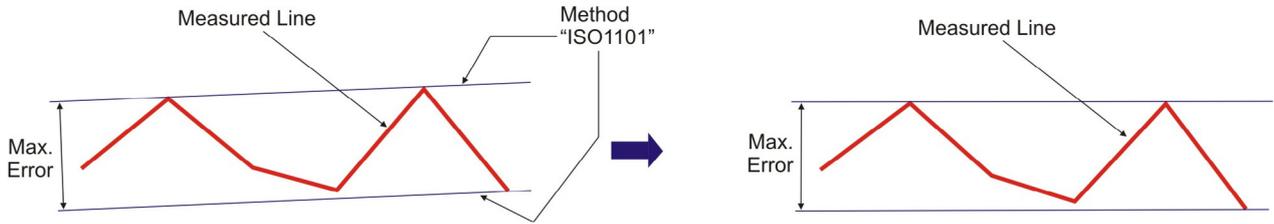
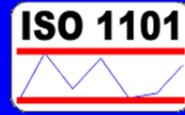
Precondition for a measurement in the absolute mode is the performance of a **reversal measurement** with the measuring instrument. The **reversal measurement is a part of the measurement procedure**.

Alignment according to the method "**ENDPOINTS**" 



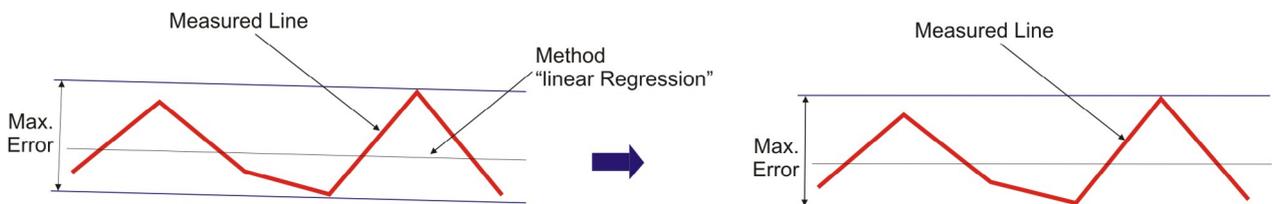
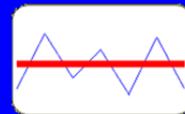
In this method the first and the last measured point are connected by a straight line. The whole figure is now turned horizontally. The connecting line is moved **parallel** to the highest and the lowest point of the object. The **vertical distance** between the two lines is the maximum error calculated according the method "Endpoints".

Alignment according to the method "ISO 1101"



In the method **ISO1101** two parallel lines are aligned in such way that the distance between them is the least possible.
 The **vertical distance** between the two lines is the smallest possible error according the method "ISO 1101"

Alignment according to the method "LINEAR REGRESSION"



Using the method "linear regression" a straight line is calculated out of a number of measuring points according to the method of least squares.
 The so calculated line is moved **parallel** to the highest and the lowest point of the object. The **vertical distance** between the two lines is the maximum error calculated according the method "Linear regression".

3.2.10 Limit of variation

Every measured value is computed out of a number individual values. The limit of variation is acting like a filter using only these values, which are within the set limit of variation.

During a measurement under true practical conditions a number of vibrations may be influencing the measurement in a way that the limit of variation needs to be adjusted. In most of the cases where such periodical vibrations are present this is a very efficient way to receive good measuring results because it will prevent relying on one individual measurement at a crucial time.

Under such measuring conditions it is recommended to start with a limit of variation of 3 $\mu\text{m}/\text{m}$. During aquisition of measured values the measuring system checks the variation constantly and as soon as the variation is below the scatter limit it takes the value. The scatter limit and the time how long the system waits for a stable value can be set within the system configuration.



Limit of variation exceeded



Limit of variation $\mu\text{m}/\text{m}$

		SN	Variation
		S0656	+24.4936 $\mu\text{m}/\text{m}$


Repeat measurement


Increase Limit of variation


Accept measurement

When the maximal waiting time has passed the system shows an error message. It offers the following options:

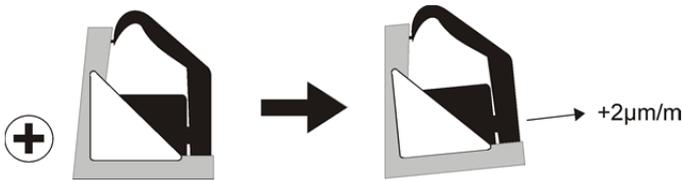
- Repeat measurement
- Increase limit of variation
- Accept measurement

If "Increase limit of variation" is selected, the system takes the current variation as new limit as long as the input field "Limit of variation" not has been changed. Otherwise it takes the variation entered manually.

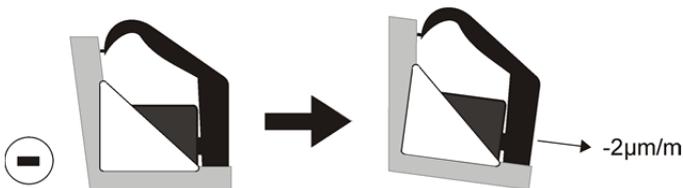
3.2.11 Angular error of an instrument

Remarks concerning “ANGULAR ERROR” of an instrument

Checking the squareness of an instrument with angular base



The angular error of a measuring instrument is “tapered off”. This is the case when the instrument is attached with the vertical base to an exactly vertical surface and the result would be without angular correction e.g. +2 µm/m.



The angular error of a measuring instrument is “obtuse”. This is the case when the instrument is attached with the vertical base to an exactly vertical surface and the result would be without angular correction e.g. -2 µm/m.

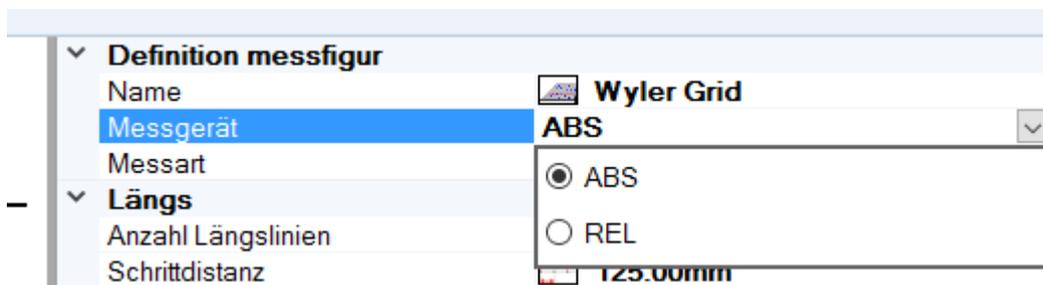
In the certificates of WYLER SWITZERLAND this value can be found in "Angular error vertical surface to surface horizontal". The determined value should be entered in the respective place <Angular error>. It is important to check the correct sign!!

3.2.12 Absolute measurements

Machine tool inspection is usually done by measuring in the **ABSOLUTE mode**. By doing so the true position of the objects to be measured are determined. This measurement in the absolute mode is inevitable when e.g. a horizontal guide way must be compared with a vertical spindle. When comparing the elements by using the MT□SOFT both elements must use the same machine serial number and saved by the same service engineer's name.

In contrary to the above said it is useful to measure an individual guide way by means of **differential measurement**. By doing so, e.g. existing vibrations in the surrounding of the measurement can be eliminated. However, such a measurement can not be compared later with other elements of a machine.

During the setup of a measurement it can be set, if a reversal measurement should be made before the actual measurement starts.



ABS means absolut measurement, i.e. before the actual measurement starts a reversal measurement will be done.

In case of a relative measurement, which is selected with REL, no reversal measurement is necessary.

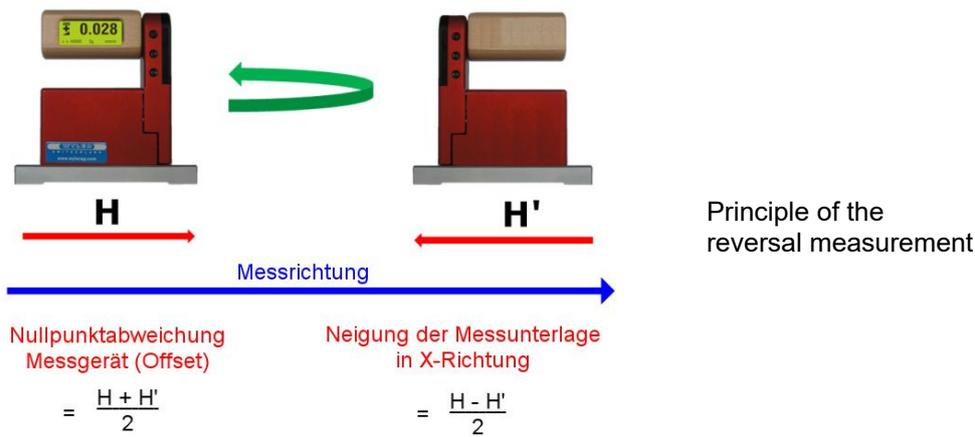
One has to distinguish between the horizontal reversal measurement and the vertical reversal measurement.

3.2.12.1 Absolute zero setting by reversal measurement in horizontal position

Machine tool inspection is usually done by measuring in the **ABSOLUTE mode**. By doing so the true position of the objects to be measured are determined. This measurement in the absolute mode is inevitable when e.g. a horizontal guide way must be compared with a vertical spindle. When comparing the elements by using the wylerSPEC both elements must use the same machine serial number and saved by the same service engineer's name.

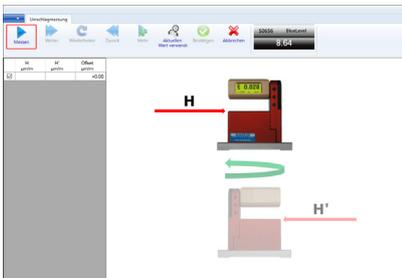
In contrary to the above said it is useful to measure an individual guide way by means of **differential measurement**. By doing so, e.g. existing vibrations in the surrounding of the measurement can be eliminated. However, such a measurement can not be compared later with other elements of a machine.

For the absolute measurement it is, as mentioned, inevitable to adjust the measuring instrument before the measuring task by doing a reversal measurement. See the description below:

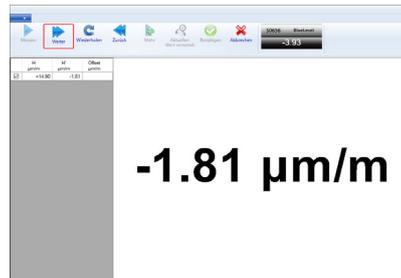
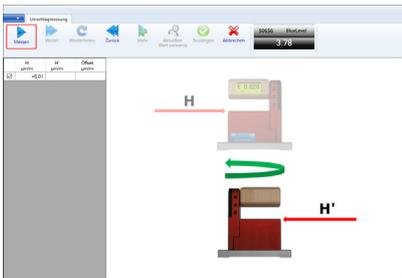


Process:

Measurement H: Horizontal in X-direction -->



Measurement H': Horizontal in -X-direction <--

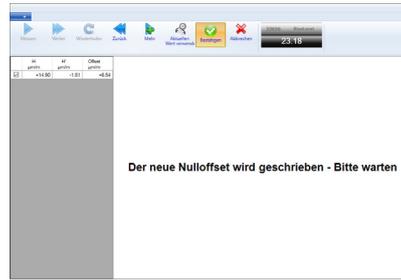
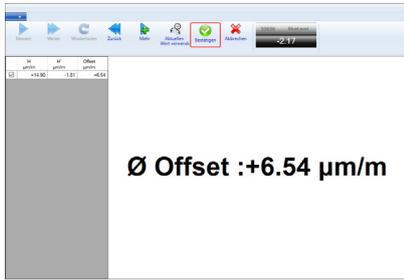


The measured values are listed in the table on the left side.



If the reversal measurement is insecure, using the button **Mehr** additional reversal measurements can be performed.

Using the button "Confirm" the mean value of all offsets are written into the instrument.



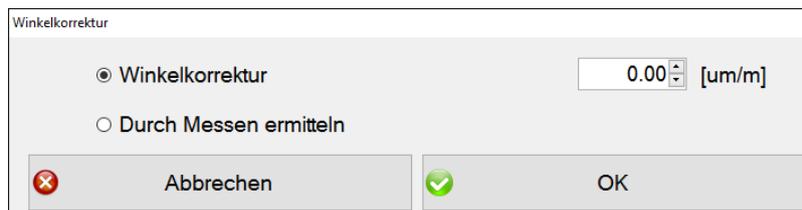
The process is analog in the Y-direction.

3.2.12.2 Angular correction by reversal measurement



When measuring a vertical guide way it is important to perform an **ABSOLUTE MEASUREMENT** when this measuring result should later be compared with any other object on the same machine such as e.g. a horizontal guide way in order to define the squareness.

Two options are possible to determine the angular error of the instrument



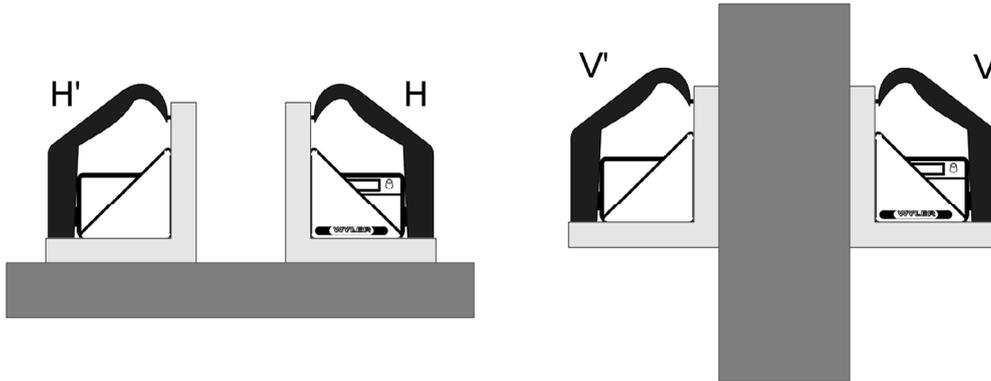
Option 1: manually

In case no high precision square block is available the zero setting can be done by applying the horizontal reversal measurement only, best possible on a granite setting plate.

After that the angular error of the instrument can be applied by manual input. The value of the angular error can usually be found on a calibration certificate. Is no calibration certificate available the only way is to enter the value "0" as angular error of the instrument. When doing so it must be noted that the measuring uncertainty is larger.

Option 2: reversal measurement

Ideally a vertical reversal measurement is done. This requires a high precision granite square block with two exactly parallel surfaces with none or smallest possible surface error. With this procedure it is possible to calculate the vertical zero offset of the instrument and, when previously the horizontal reversal measurement was done, **the angular error of the instrument is automatically determined**.



Berechnung des Korrekturfaktors, bzw. des Winkelfehlers (Anzeige-fehlers):

$$\text{Korrekturfaktor} = \frac{V + V'}{2} - \frac{H + H'}{2}$$

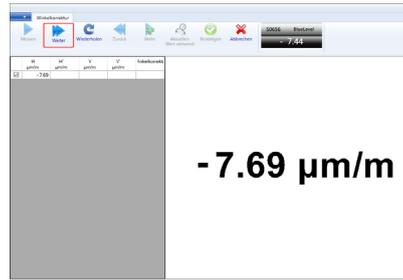
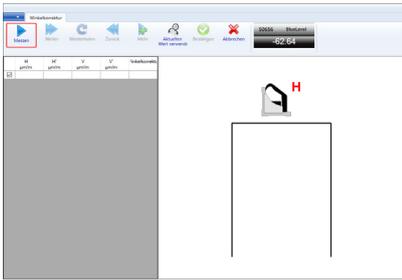
Remarks: For determining the angular correction of the instrument's error a **high precision parallel block (quality 000)**, preferably granite with flat top, is required. If required please contact your local WYLER partner or WYLER SWITZERLAND directly.

ATTENTION: If the measuring of a rectangular object is planned with two instruments (measuring and reference instrument), the **determination of the angular error of the measuring instrument must be performed with one instrument only**, the measuring instrument featuring an angular base. Please assign the measuring instruments as measuring respectively reference instrument well from the beginning when setting up the measuring configuration.

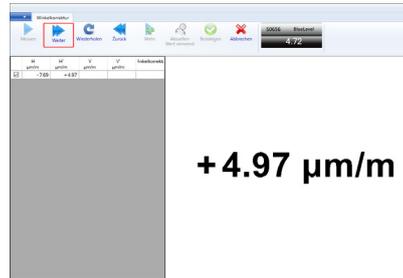
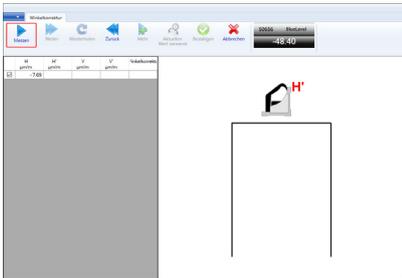
The reference instrument is deactivated during the determination of the angular error.

Procedure:

Measurement H: Horizontal in X-direction -->

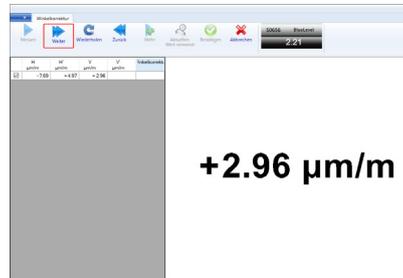
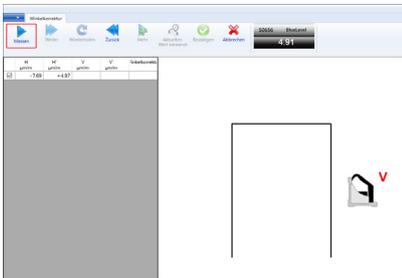


Measurement H': Horizontal in -X-direction <--

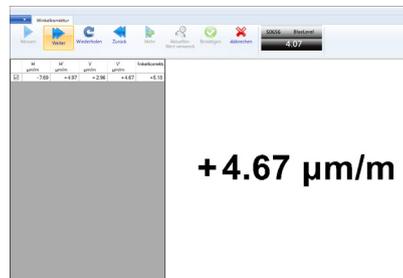
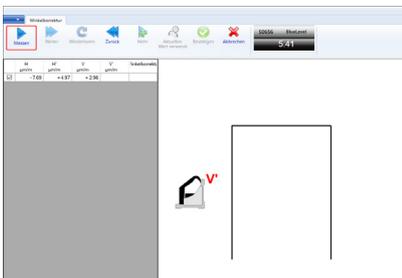


The measured values are listed in the table on the left side.

Measurement V: Vertical in X-direction -->



Measurement V': Vertical in -X-direction <--



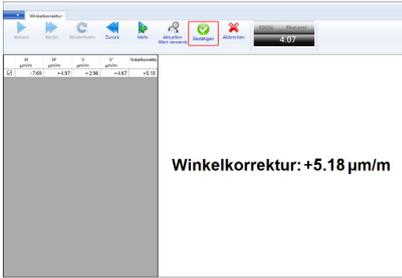
The measured values are listed in the table on the left side.

If the reversal measurement is insecure, using the button



additional reversal measurements can be performed.

Using the button "Confirm" the mean value of all offsets are written into the instrument.



4. Operation



In the main view there are the following tabs:

- [Start](#) Here you can setup, perform and analyze the measurements. Further you can adjust the licence or select the language.
- [Configuration](#) Here you can select the measuring settings, the display unit and the flatness standards
- [Import/Export](#) Import and export of measuring patterns or measurements.

4.1 Start



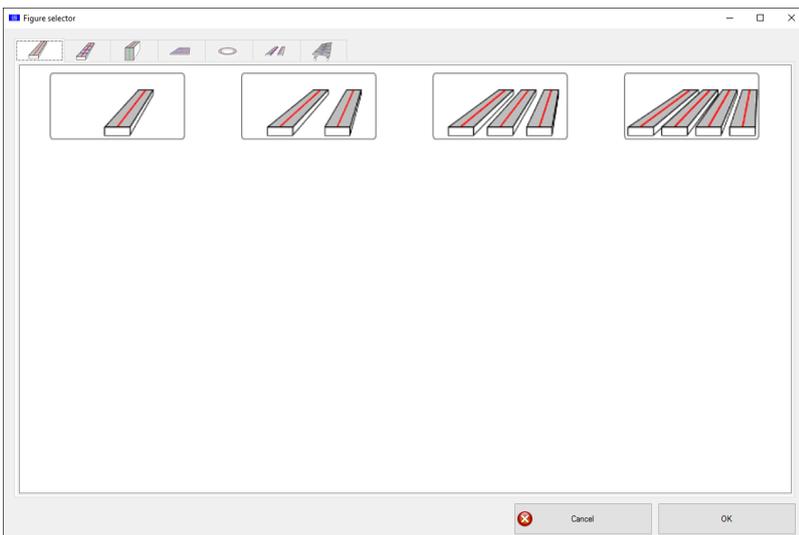
The Tab "Start" is the starting point for the following tasks:

	Measuring pattern new	Setup new measuring pattern
	Open measuring pattern	Load an existing measuring pattern
	Open measurement	Analyze an existing measurement
	Close application	terminate wylerSPEC
	Licence	Show the licence

Select the language

To use the language of the operating system check the checkbox "Use operating system language". Otherwise the language can be selected manually in the drop down.

4.1.1 Measuring pattern new



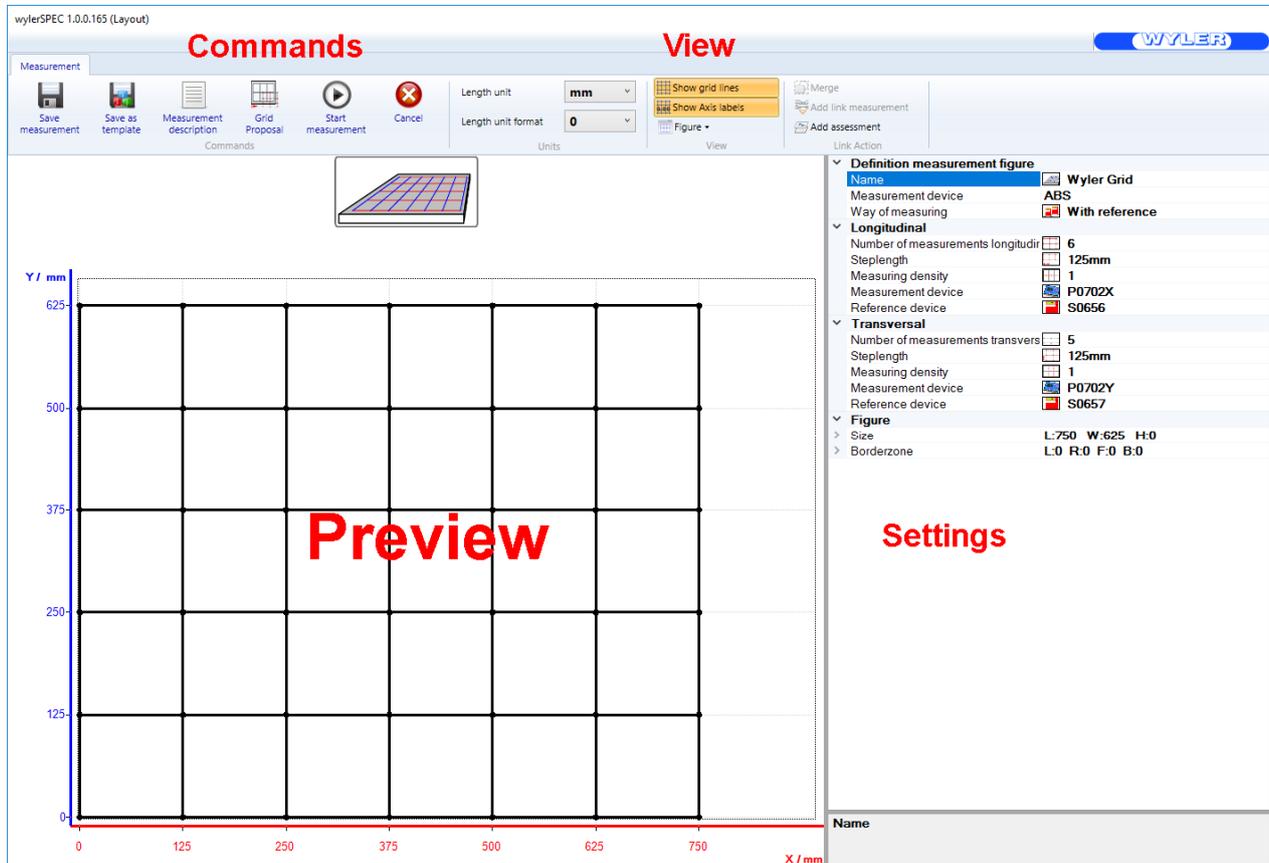
Selecting the measuring figure: Open the tab of the module double click on the Icon of the figure to open the measuring setup dialog.

The particular modules are described in the section "[Modules in wylerSPEC](#)".

4.1.1.1 Measurement setup

General settings to setup a measurement. The particular modules are described in the "[Modules in wylerSPEC](#)".

The dialog "Layout" is organized as follows: on top the button bar, on the left side the preview of the measurement setup and on the right side the list of the settings.



Commands

	Save measurement	Save measurement without data
	Save as template	Save measurement template
	Add figure	In module "Eigene Messfiguren" individual figures can be combined
	Measurement description	Open the measurement description dialog
	Grid proposal	In some figures wylerSPEC offers a proposal for the measurement setup
	Start measurement	Complete measurement setup and start measurement
	Cancel	Back to the main window

View

	Length unit	Length unit used by dimentions of the measurement figure
	Length unit format	Number of internal decimal places used by axis labeling
	Show grid lines	Show or hide grid lines in the preview
	Show axis labels	Show or hide axis labels in the preview

Settings

The settings are grouped in sections, which can be opened by a click on the symbol ">" or closed by a click on "<".

The settings differ at each figure. There are some common elements:

Groupe "Definition of measurement figure":

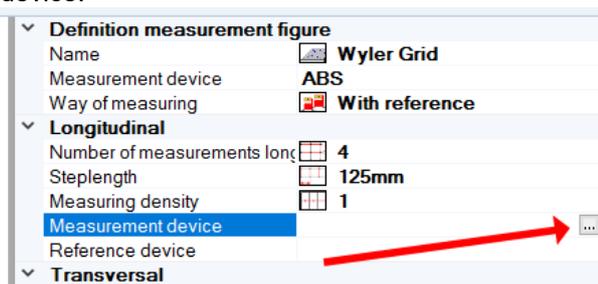
- Name of the figure
- Measurement device: ABS corresponds to absolut measurement, REL to relative measurement. When ABS is selected a [Reversal measurement](#) will be performed prior to the measurement.
- Way of measuring: Without Reference, With reference
- , Manual input. When measuring with reference for each measuring direction a reference device must be set.

Groupes "Longitudinal" and "Transversal":

Number of measurements	Number of inclination measurements, the number of heights is bigger by 1
Steplength	Steplength per measurement
Measuring density	Number of measurements zwischen transversal lines
Measurement device	Selection of the main measurement device
Reference device	Selection of the reference device

Selection of the measurement or reference device

To open the device selection dialog click on the small square on the right side in the field measurement device.



Select in the dialog "Device selector" the desired device and click "OK".

If the device is not shown, select the COM port on which the device is connected and click "Refresh". If the COM port is not shown, check the cables to the PC and the driver. Close and reopen the dialog.

Device selector

Serial Ports

COM4

Devices

	S0656	BlueLEVEL
	S0657	BlueLEVEL

Aktualisieren  Abbrechen  OK 

4.1.1.1 Measurement description

Measurement description

 Name of measurement engineer* James Bond   

 Measurement name Wyler Grid

 Company WYLER AG

 Customer Machines SA

 Order 1-7829A

 Machine type Plate 19762

 Serial number* 0815

Description

Additional Information|

  Cancel  OK

Mandatory fields are marked with *

wylerSPEC maintains a list of measurement engineers. With the buttons



their names can be created, changes or deleted.

wylerSPECV 1.0.0.165

First Name

Last Name

 Cancel  OK

4.1.1.1.2 Grid proposal

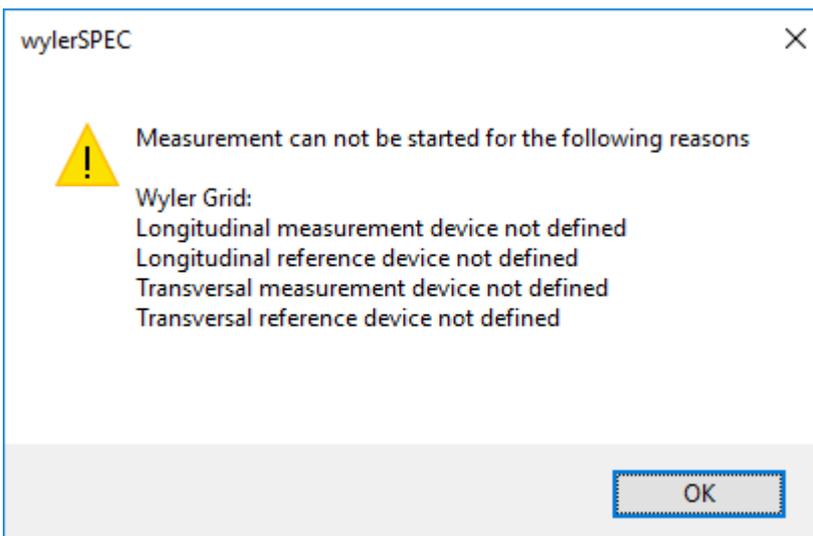
In the figures flattnes the programm calculates a grid proposal:

[Flattness with Grid](#)

[Flattness with U-Jack](#)

4.1.1.1.3 Start measurement

Before a measurement will be started wylerSPEC checks the inputs. If e.g. the measurement devices are not defined, the following error message pops up:



When the error is corrected the measurment can be started.

The general procedure of the measurement is described in the chapter [Perform measurement](#).

For each figur the procedure varies slightly, the description can be found in the corresponding [modules](#).

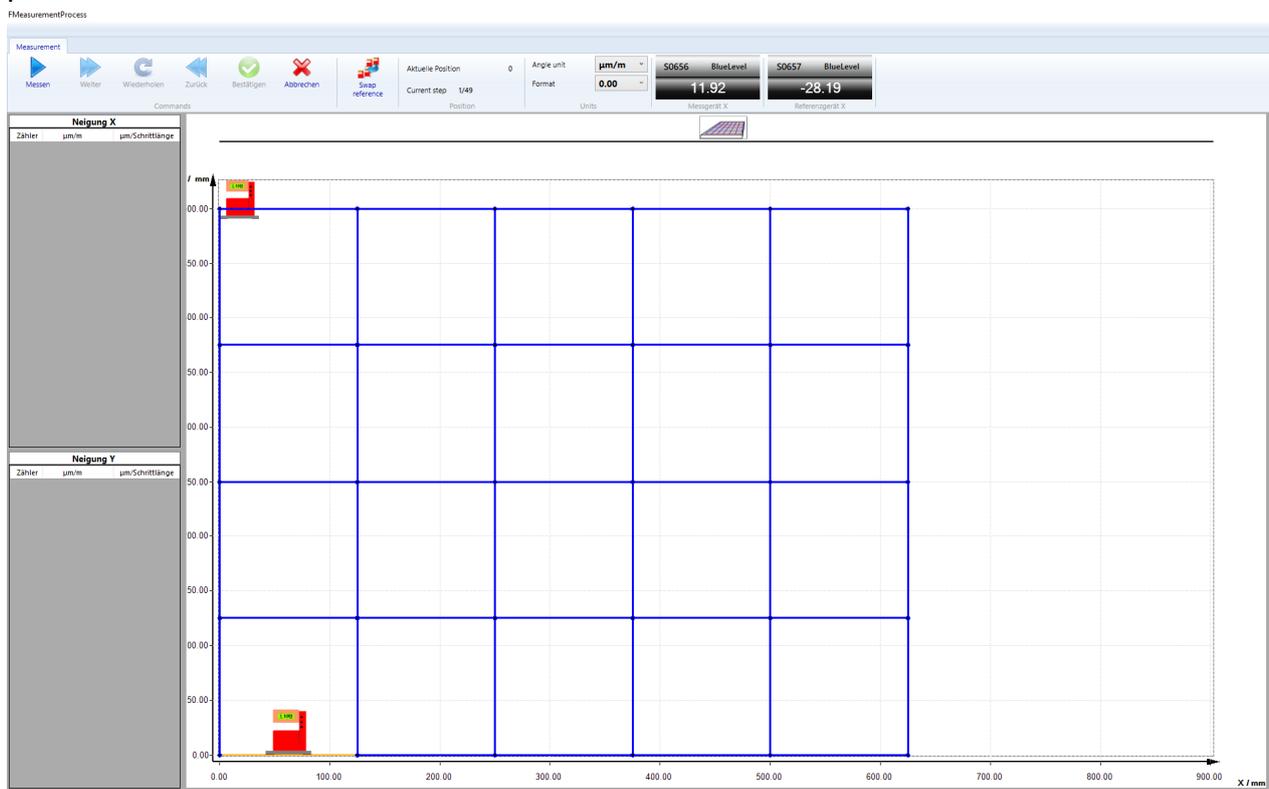
4.1.2 Perform measurement

General information to perform a measurement. The particular modules are described in the section "[Modules in wylerSPEC](#)".

wylerSPEC guides through the measurement. The measuring position is shown by the position of the BlueLEVEL-symbol.

Using the "Back" button each measurement can be repeated as often as needed.

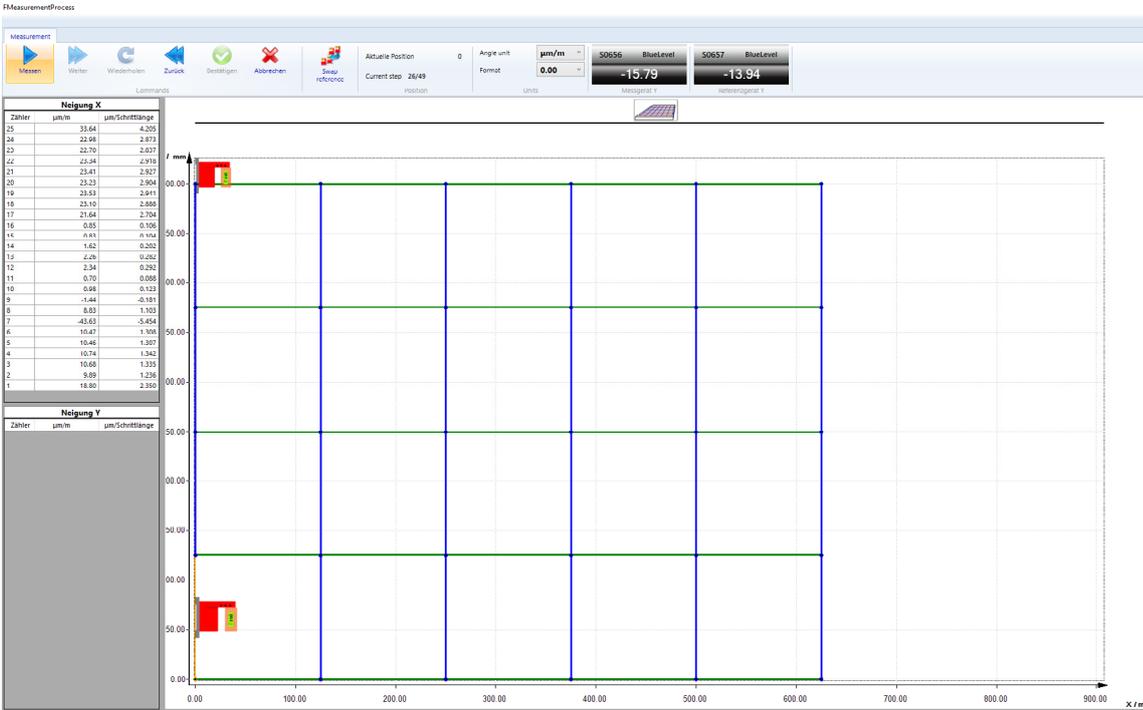
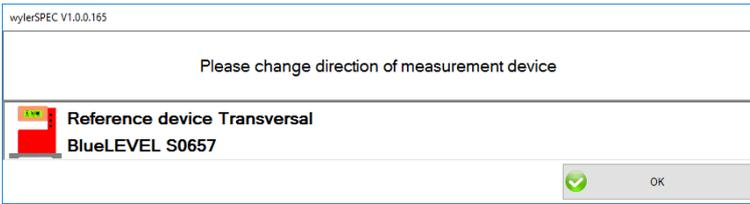
The measured values are written into the tables on the left side.



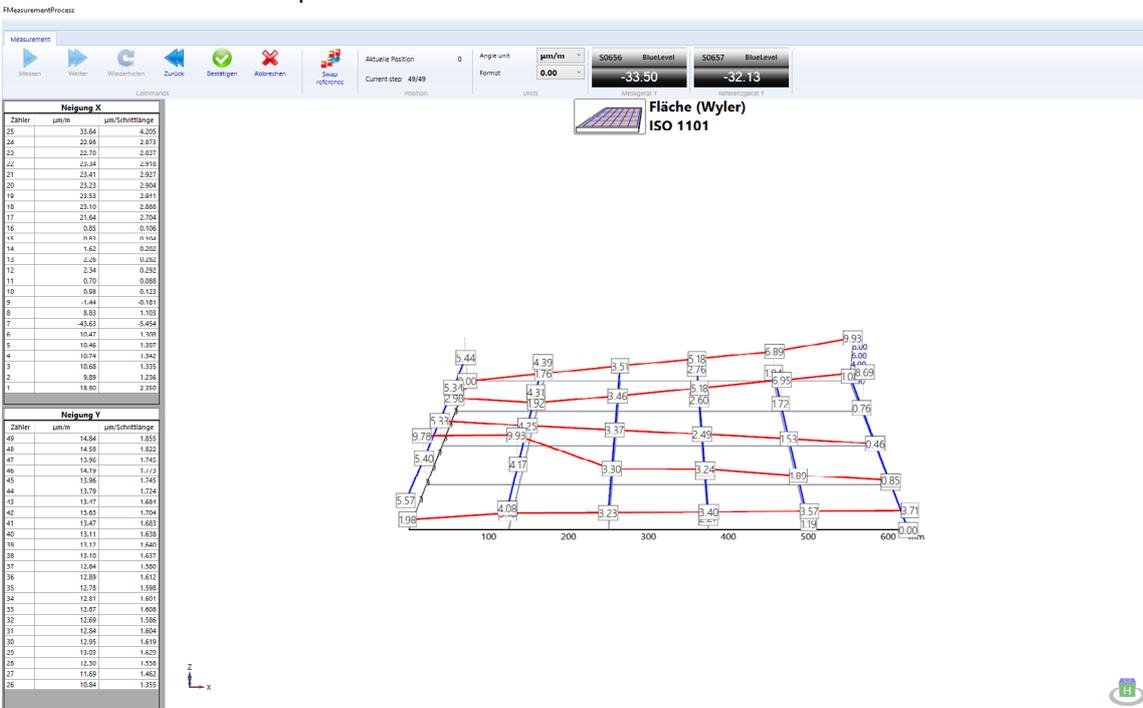
- 
Measure
Start the measurement of a single value.
- 
Continue
Accept the measured value and continue to the next measurement
- 
Repeat
Repeat the current measurement
- 
Back
One measuring step back
- 
Confirm
Confirm the whole measurement at the end before saving and leaving the procedure
- 
Cancel
Cancel the measurement and return to the setup
- 
Move Reference
Move the reference device. In some cases it is necessary to place the reference device at another location because it obstructs the further measurement. This is necessary particularly during 2D measurements.

At the end of the measurement of the longitudinal lines the reference device must be turned into the new measuring direction before measuring the transversal lines.

The measuring direction of measuring device and reference device must coincide.



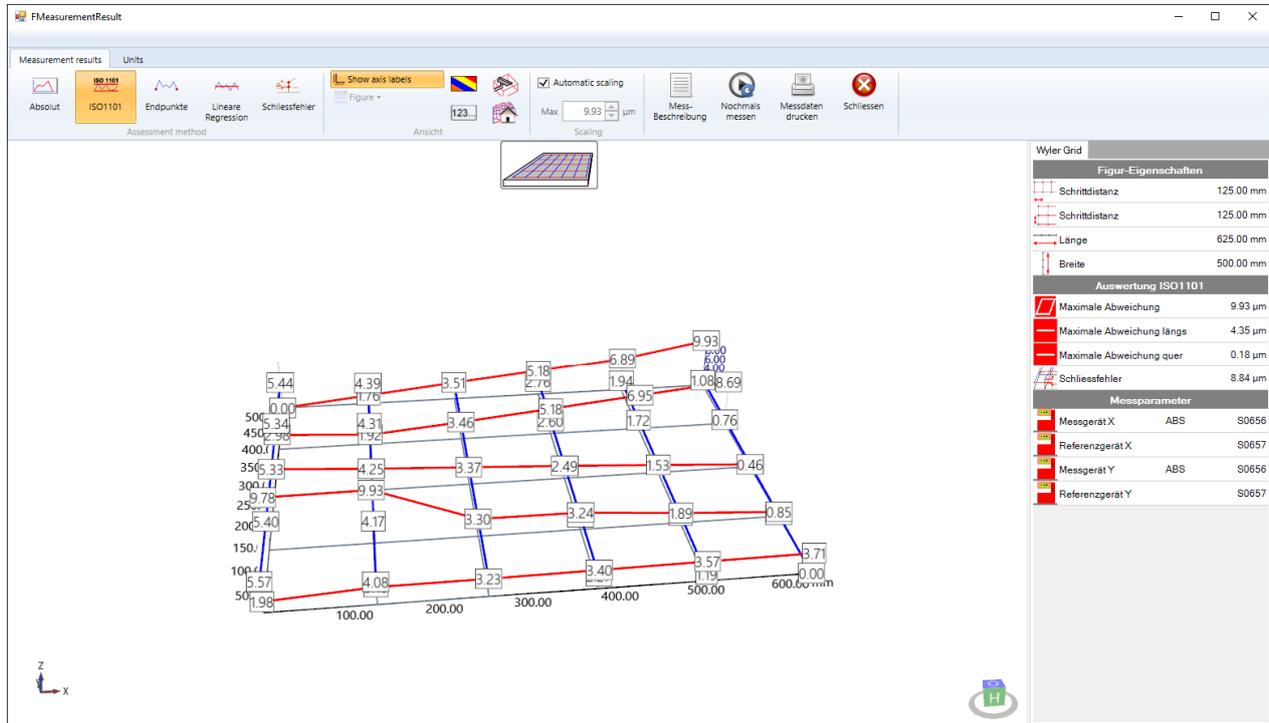
At the end of the measurement a preview is shown. When the measurement is ok, it must be accepted with the button "Confirm". With the button "Back" from the end back to the beginning the individual measurements can be repeated.



After confirming the measurement the analysis of the measurement opens.

4.1.3 Analyze measurement

General information about analysis of a measurement. The particular modules are described in the section "[Modules in wylerSPEC](#)".



There are different analysis methods adapted to each measuring figure. If a figure covers an area like flatness measurements or a circle the analysis is calculated in two dimensions. For lines the analysis is carried out in one dimension. In the [Description of the modules](#) there are further informations.

Available analyses

	Absolut	Display of the measurement as measured without turning the line/plain.
	ISO1101	The line/plain will be turned according to ISO1101 , i.e. it will be turned that way to get the smallest distance between the upper and lower bounding lines/plains.
	Endpoint	The line/plain will be turned that the end points / corner points in front and left are on the same height. If the closing error is not corrected, the lower points are taken.
	Linear regression	Plain/Line will be turned that the regression plain is horizontal. The regression plain is the plain/line to which the sum of the squares of the distances have a minimum.
	Closing error	Closing error, at surfaces with grid it is calculated according to the Method Phillips .

Display options and scaling

In the table on the right side the figure properties, the analysis and the measuring parameters are shown. Since they depend on the type of the figure, they are described in the section of particular measuring figure.

3D-Chart setup:

Turn

- keep the right mouse button pressed while moving the mouse
- use the arrow keys

Zoom

- turn the mouse wheel
- keep the right mouse button and the ctrl key pressed and move the mouse up or down
- <Ctrl>+W and <Ctrl>+S to zoom in and out

Move

- keep the right mouse button and the <Shift>-key pressed and move the mouse
- <Shift>-key pressed and use the arrow keys.



Shows the orientation of the chart. U: Up, D: Down, R: Right, L: Left, F: Front, B: Back

By clicking on a side the chart turns that this side gets parallel to the observer plain.

View:



Display in colour



Perspective on and off



Toggle the display of numbers



Home: Back to the original view

Actions:



Open [measurement description](#)



Measure again: Keep these settings and open [measurement setup](#)

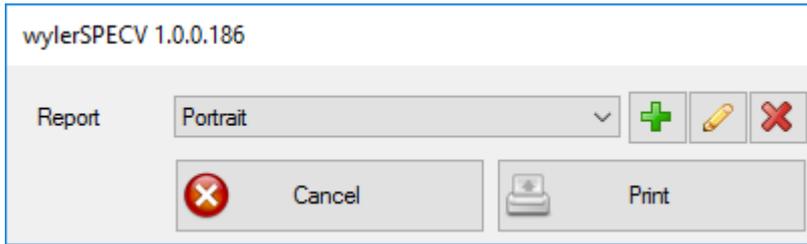


[Print report](#)



Close measurement analysis

4.1.3.1 Print report

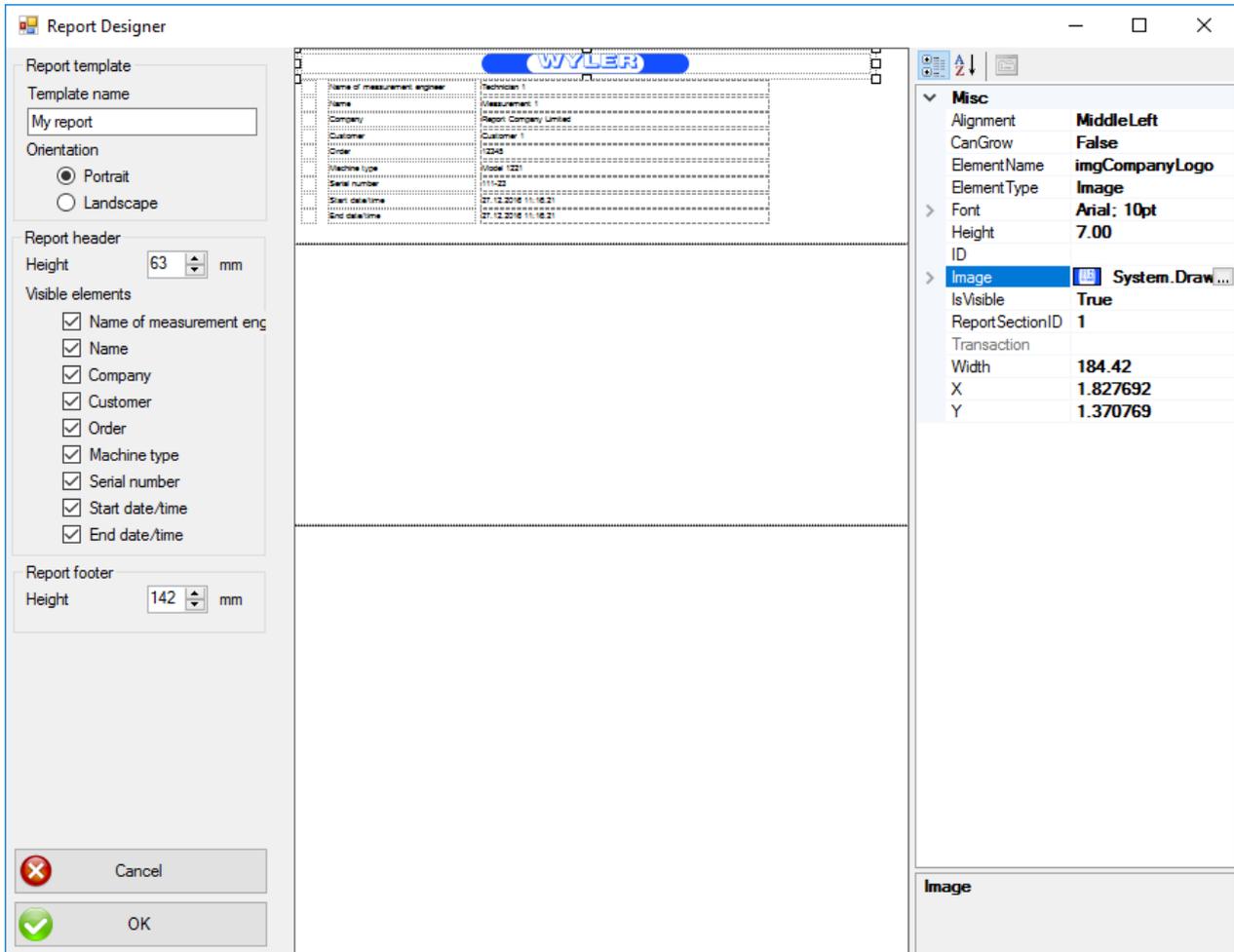


Actions:

-  Open new report
-  Edit report
-  Remove report
-  Print report
-  Cancel print report

Setup Report:

In the report designer you can add your own Logo, show or hide elements of the measurement description and place it anywhere on the report.



Actions:

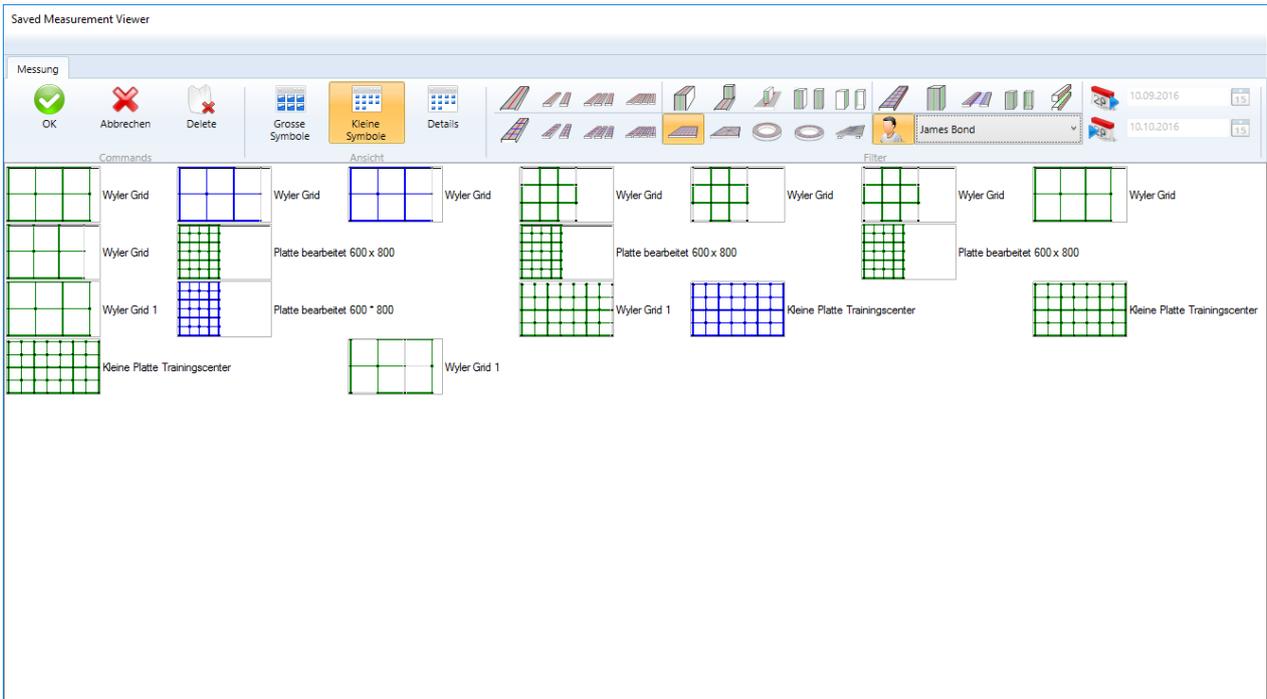
Add own logo In the middle part click on the top most element that it is framed by little squares
 On the right side click on "Image" and on the button  to open a file dialog.
 Select your own logo and click OK
 Make sure the filed "IsVisible" is set to "True"

Show/Hide elements On the left side check/uncheck the elements.

Move an element In the middle part click on the element to move. Keep the mouse pressed and drag the element to its destination.
 The exact position can be set precisely on the right side in the fields "X" and "Y" also.

4.1.4 Measurement pattern / Load measurement

The same procedure applies to opening a measuring template or a complete measurement.



Presentation



Large icons

Large icons to foretell the measurment pattern



Smal icons

Small icons to foretell the measurment pattern



Details

List the details of the measurement like measuring date or user. Finished measurements are marked green, not compleated measurements are marked orange.

Filter with figures

It is possible to select several figure types to filter existing measurements. If no figure is selected, the measurements of all figure types are listed.

Selected figure types are marked yellow.



line



two parallels



three parallels



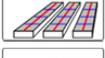
four parallels



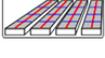
line with twist



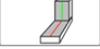
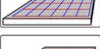
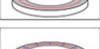
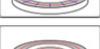
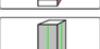
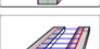
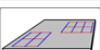
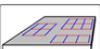
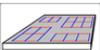
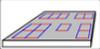
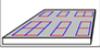
two parallels with twist



three parallels with twist



four parallels with twist

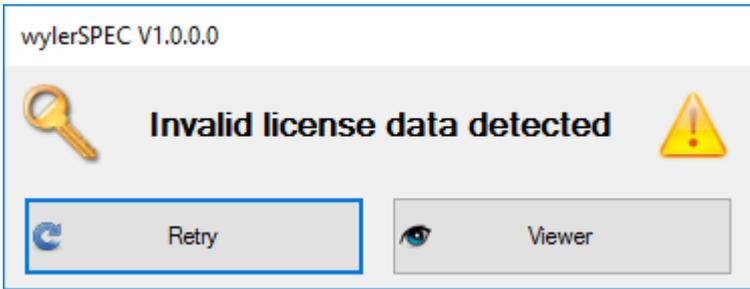
	exterior angle right
	interior angle right
	squareness
	two vertical lines side by side
	two vertical lines inside opposed
	surface with grid
	surface - U-Jack
	circle
	circle with twist
	concentric circles
	pitch and roll
	single guide way horizontal
	single guide way vertical
	guide ways horizontal
	guide ways vertical opposed
	guide ways vertical on top of each other
	two surfaces
	three surfaces
	four surfaces
	five surfaces
	six surfaces

other filter:

	user	if active, i.e. when marked yellow the selection in the adjacent dropdown list is active
	lower date limit	if active, i.e. when marked yellow the selection in the adjacent field is active
	upper date limit	if active, i.e. when marked yellow the selection in the adjacent field is active
	Search by a string	The search string may contain a *. A * stands for an arbitrary number of other characters. E.g. *Line* searches all enties containing somewhere the word "Line".

4.1.5 Licence

When you start the application the first time, an activation warning will be displayed. Without license wylerSPEC can be used in Viewer Mode only, e.g. no measurements will be possible.



There are two activation methods: Internet activation or USB-Dongle.

If you plan to use wylerSPEC on different computers, an USB Dongle will be useful. In opposite internet activation is restricted to one PC or Laptop but no dongle is needed.

A [trial version free of charge](#) limited to 14 days is available over internet.

The trial version can be changed into a [full license](#).

The activation is also possible using a [product key](#).

An [USB-Dongle](#) is available at WYLER AG.

4.1.5.1 Trial license

To use the software a license is required. However a trial license valid 14 days can be installed. This trial license can be obtained via internet. Contact a WYLER representative to get a full license.

To get a trial license follow the steps below.

In the main window click on the button  to open the license dialog.



Click on "Create license"

WYLER_CM_SPECProdukt Registrierung

Bitte wählen Sie eine der folgenden Optionen:

Installation als lokale Anwendung

Installation als Testversion

Bitte beachten Sie, daß der Softwarehersteller möglicherweise nicht erlaubt dieses Programm als Testversion zu nutzen. In diesem Fall müssen Sie Ihren Softwarehersteller kontaktieren um einen Produkt Key zu erhalten.

OK Abbrechen Hilfe

Select "Installation as "trial version"

Produkt Registrierung

Es werden noch einige Angaben benötigt um die Produkt Registrierung abzuschliessen. Bitte füllen Sie das untenstehende Formular aus. Einträge welche mit einem * markiert sind obligatorisch.

Es werden nur Daten an das Internet übermittelt, welche für die Produkt Registrierung erforderlich sind. Diese Informationen werden unter hohen Sicherheitsvorkehrungen von Microcosm gespeichert und werden nicht an Dritte weitergegeben.

Wenn Sie Microcosms Sicherheitspolice sehen möchten, dann klicken Sie auf den untenstehenden Schalter.

Firma Name * Meine Firma

Kunde Name * Mein Name

Haus Bezeichnung oder Nummer

Strasse

Ort

Land/Staat

Postleitzahl

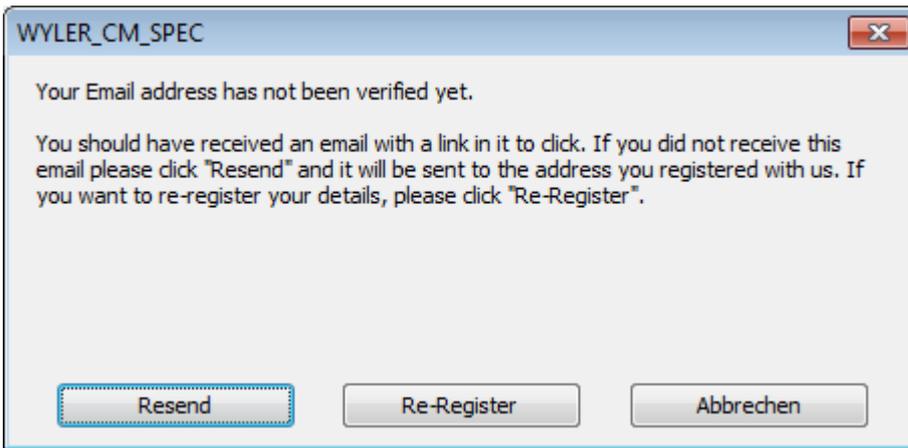
Land * Germany

Telefon

Email * mein.name@meinefirma

OK Abbrechen Geheimhaltungspolice

Fill in the information in the registration. The fields marked with * are mandatory.



To the registered email address an email is sent containing a link to verify the email address. Open the email and click on this link before proceeding with a click on "Resend".

CopyMinder Email Verification for product WYLER_CM_SPEC

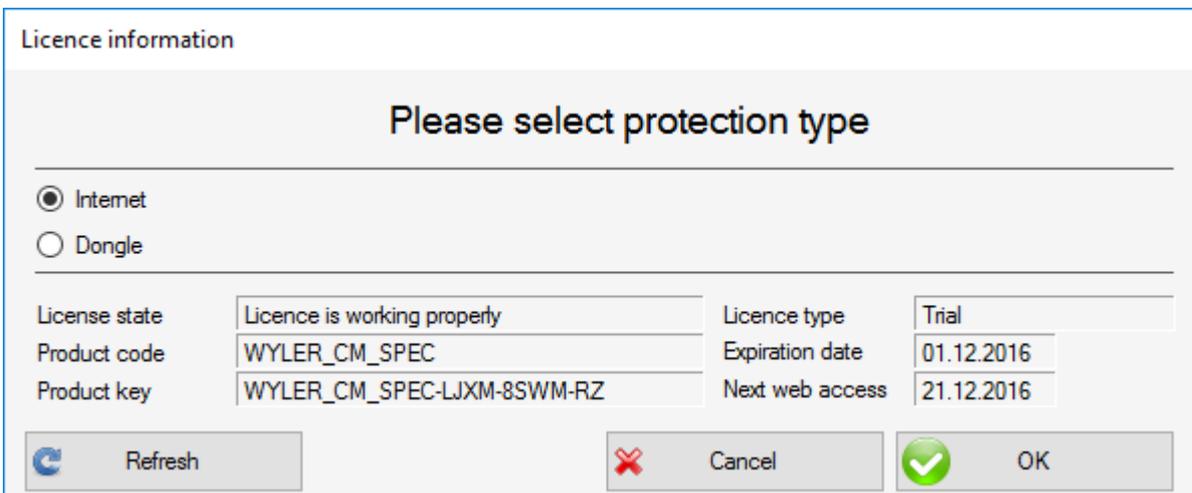
CopyMinder Verification [verification@copyminder.com]

An: Software

Your recently installed software package requires verification of your email address. Please use the link below to verify your email address:

http://primary.copyminder.com/verify.php?ProductCode=WYLER_CM_SPEC&ProductKey=YUGQ-QWWE-7X&DID=KF&VC=47854

After successfully registering the following informations are shown in the license dialog. If you like to buy the software contact your WYLER Representative and send him the product key.



4.1.5.2 Obtaining a full license

If you like to buy the software contact your WYLER Representative and send him the product key. You find the product key in the license information, which are displayed after clicking on the button  in the main window.

Licence information

Please select protection type

Internet
 Dongle

License state	Licence is working properly	Licence type	Trial
Product code	WYLER_CM_SPEC	Expiration date	01.12.2016
Product key	WYLER_CM_SPEC-LJXM-8SWM-RZ	Next web access	21.12.2016

After the purchase of the software on the license server the trial license will be turned into a full license. To get the full license from the server open the license dialog and click on "Refresh". The programm connects to the license server and retrieves the new license.

Licence information

Please select protection type

Internet
 Dongle

License state	Licence is working properly	Licence type	Full Licence
Product code	WYLER_CM_SPEC	Expiration date	01.12.2017
Product key	WYLER_CM_SPEC-LJXM-8SWM-RZ	Next web access	21.12.2017

4.1.5.3 License Internet

There is the possibility to get a license with a given license key. Contact your WYLER Representative to obtain a license key.

Open the license dialog with a click on the button  in the main dialog.

Licence information

Please select protection type

Internet
 Dongle

License state	No Licence found	Licence type	
Product code	WYLER_CM_SPEC	Expiration date	No expiration
Product key		Next web access	

 Refresh  Create license  Cancel  OK

Click on "Create license"

WYLER_CM_SPECProdukt Registrierung 

Bitte wählen Sie eine der folgenden Optionen:

Installation als lokale Anwendung
 Installation als Testversion

Bitte geben Sie den Licence Key ein. A Licence Key takes the form:
WYLER_CM_SPEC<XXXX><XXXX><XXXX>. If you don't have a Licence Key, please contact
your software supplier.

 OK  Abbrechen  Hilfe

Select "Installation with a valid license" and insert the product key into the input field.

4.1.5.4 License Dongle

To activate the program with an USB dongle plug in the dongle before starting the program. When the green LED is on, the dongle is ok and the program can read it.

If the program does not recognize the dongle, in the dialog License the program must be set to dongle protection manually.

To open this dialog in the main window click on the button .

Select "Dongle" .

Licence information

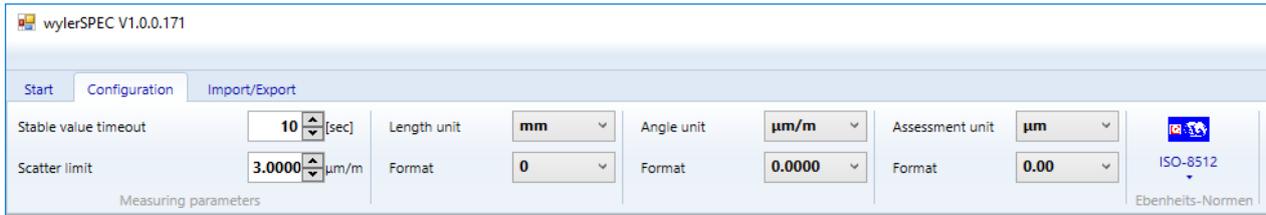
Please select protection type

Internet
 Dongle

License state	Licence is working properly	Licence type	Full Licence
Product code	WYLERSFT	Expiration date	31.12.2017
Product key	1857341676		

 Refresh  Cancel  OK

4.2 Configuration



measuring parameters

While reading the measurement values the system checks the variation of the signal constantly. When it is within the required limit of variation the current measurement value is taken. The field "Stable value timeout" contains the time span how long the system shall wait to get a valid measurement value. When this time span has passed the warning "[Limit of variation exceeded](#)", pops up. In the field "Scatter limit" the required value of the limit of variation can be set.

Unit

Length unit	Dimensions of the figures and the complete layout. Millimeter or Inch are possible units.
Angle unit	Unit for inclinations or angles.
Assessment unit	Deviations of the measured lines from the desired values. Because these deviations are very small, they can not the length unit of the figures.

In the field "Format" the precision of the values number, i.e. the number of positions after decimal point, can be set.

Flattness-Standard:

With this option the standard for the quality grade of flattnes can be choosen.

The folowing Standard can be choosen:

- **DIN 876**
- **JIS / Japanischer Standard**
- **GGG-P-463c / US-Standard**
- **BS 817 / British Standard**
- **ISO 8512**



Detailed information concerning the topic "Standards" / Quality of the measured object

Only relevant for flatness measurements (WYLER, U-Jack)

Length and width of the object must be seen on the protocol. The descriptions of "Length" and "Width" as used up to now must be replaced by

"Length of grid"

"Width of grid"

On the monitor as well as on the print out the following information is required:

Quality of measured flatness according to (Standard selectable) is e.g. Grade 00

Formulas for the different standards are as follows:

- **DIN 876:**
 - Grade 00 <math> < 2 \times (1+L/1000) \mu\text{m}</math> (L: Longer length of plate in mm)
 - Grade 0 <math> < 4 \times (1+L/1000) \mu\text{m}</math> (L: Longer length of plate in mm)
 - Grade 1 <math> < 10 \times (1+L/1000) \mu\text{m}</math> (L: Longer length of plate in mm)
 - Grade 2 <math> < 20 \times (1+L/1000) \mu\text{m}</math> (L: Longer length of plate in mm)

- **JIS**
 - Grade 00 <math> < L \times 0.0015 + 1.25 \mu\text{m}</math> (L: Diagonal of the plate in mm)
 - Grade 0 <math> < L \times 0.003 + 2.50 \mu\text{m}</math> (L: Diagonal of the plate in mm)
 - Grade 1 <math> < L \times 0.006 + 5 \mu\text{m}</math> (L: Diagonal of the plate in mm)
 - Grade 2 <math> < L \times 0.012 + 10 \mu\text{m}</math> (L: Diagonal of the plate in mm)

- **GGG-P-463c**
 - Grade AA <math> < 40 + (D/25)</math> D: Diagonal in inch
Result in 0,000xxx inch
 - Grade A <math> < [40 + (D/25)] \times 2</math> D: Diagonal in inch
Result in 0,000xxx inch
 - Grade B <math> < [40 + (D/25)] \times 4</math> D: Diagonal in inch
Result in 0,000xxx inch

- **BS 817**

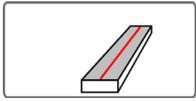
Length h plate in [mm]	Grade 0 in [μm]	Grade 1 in [μm]	Grade 2 in [μm]	Grade 3 in [μm]
180	3.0	Grade „0“ x 2	Grade „0“ x 4	Grade „0“ x 8
250	3.5	dito	dito	dito
400	4.0	dito	dito	dito
630	4.5	dito	dito	dito
1000	5.5	dito	dito	dito
1600	7.5	dito	dito	dito
2000	8.5	dito	dito	dito
2500	10.0	dito	dito	dito



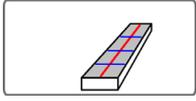
Import

Opens a file dialog to select the file to import.

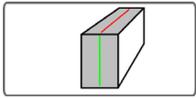
5. Modules in wylerSPEC



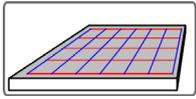
[Lines / Parallelism](#)



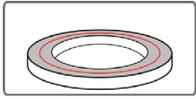
[Lines / Parallelism with twist](#)



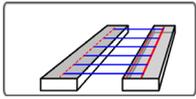
[Perpendicularity](#)



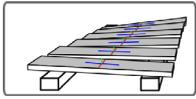
[Flatness](#)



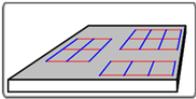
[Circular paths / circular paths with twist](#)



[Guide ways vertical and horizontal](#)



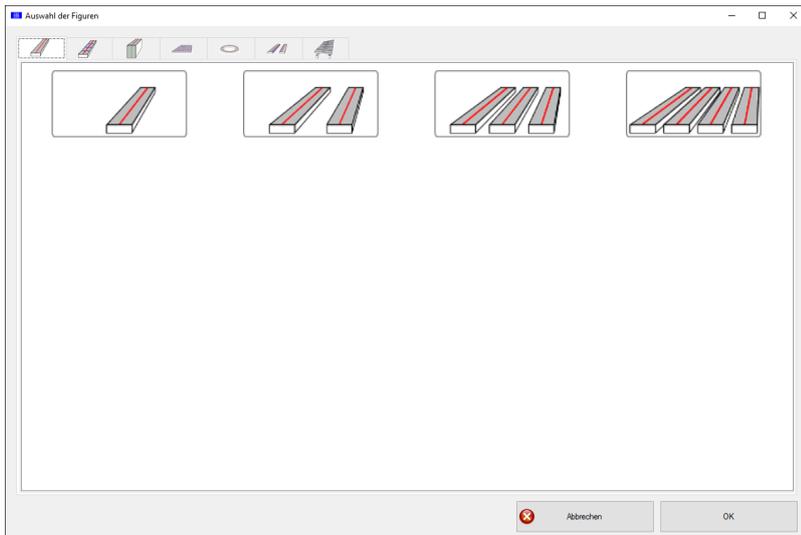
[Rotation roll - pitch - yaw](#)



[Surfaces Parallelism](#)

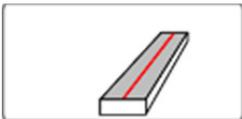
5.1 Lines / Parallelism

Measurement of straightness and parallelism

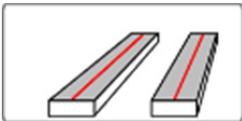


Up to 4 lines can be combined to parallels.

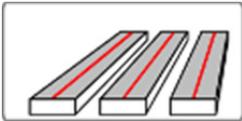
A double click takes you to the page to setup the corresponding measurement.



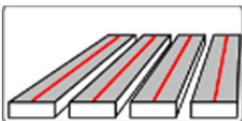
Measurement of one [Line](#)



Measurement of two [Parallels](#)

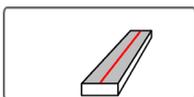


Measurement of three parallels are carried out analog to the measurement of two [Parallels](#)



Measurement of three parallels are carried out analog to the measurement of two [Parallels](#)

5.1.1 Lines



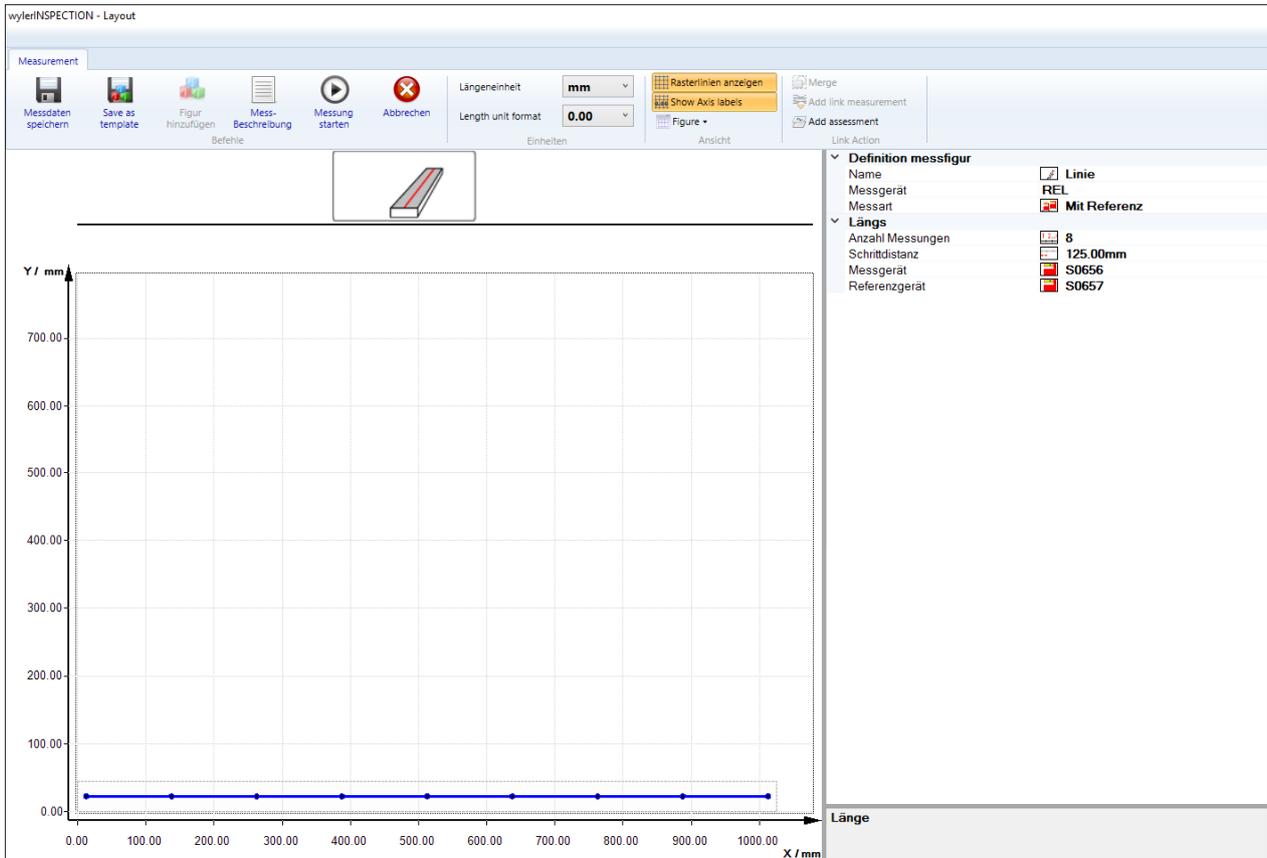
Measurement of single lines; alignment "Absolut", "ISO1101", "End points" and "Linear regression"

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.1.1.1 Line setup

Setup of the measurement of a single line.



Measuring parameter:

Definition measurement figure

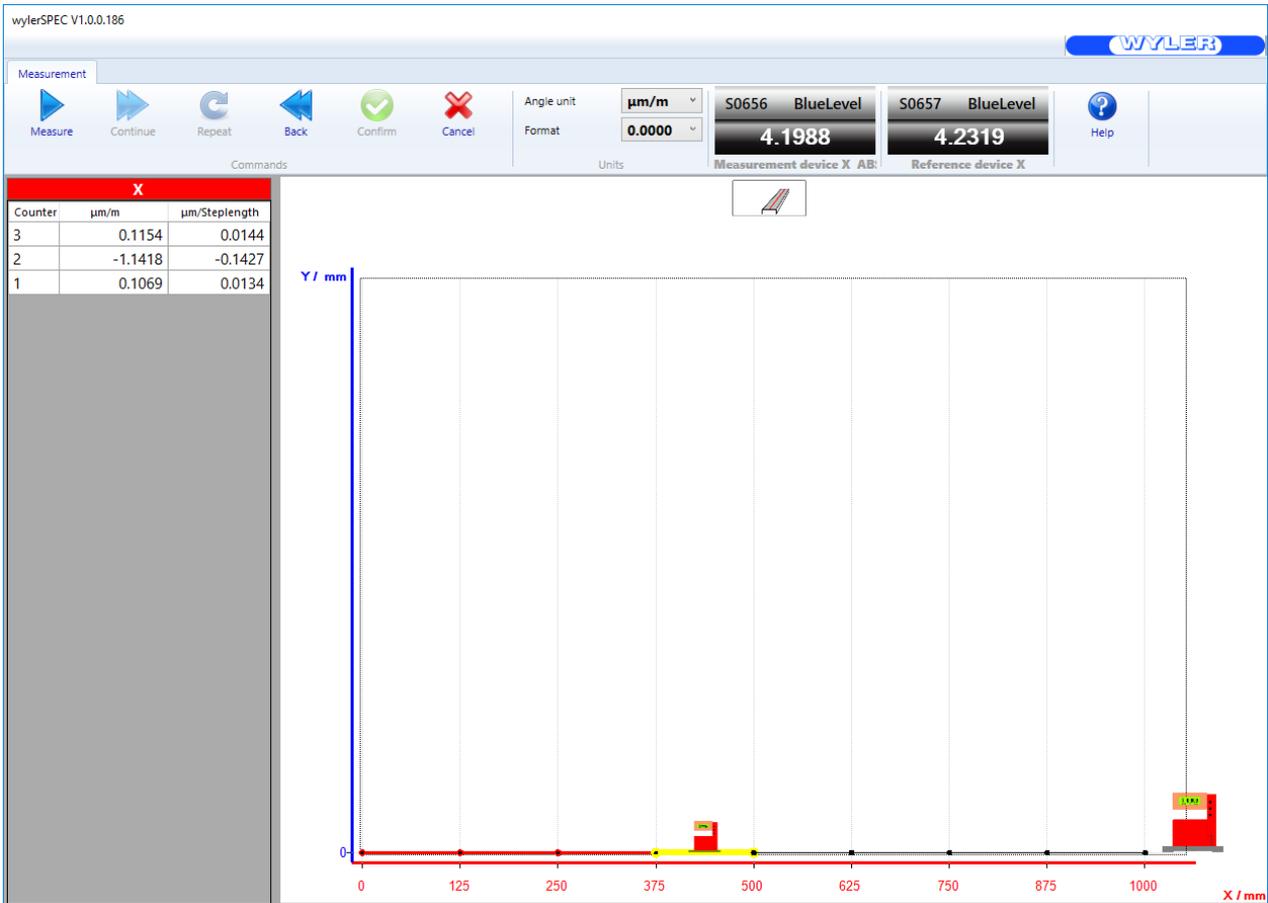
Name	Name of the line
Measuring device	Measurement method ABSolut, RELativ
Way of measurement	With reference Without reference Manual input

Longitudinal

Number of measurements	Number of inclination measurements, the number of heights is bigger by 1
Steplength	Steplength per measurement
Measuring device	Selection of the main measuring device
Reference device	Selection of the reference device

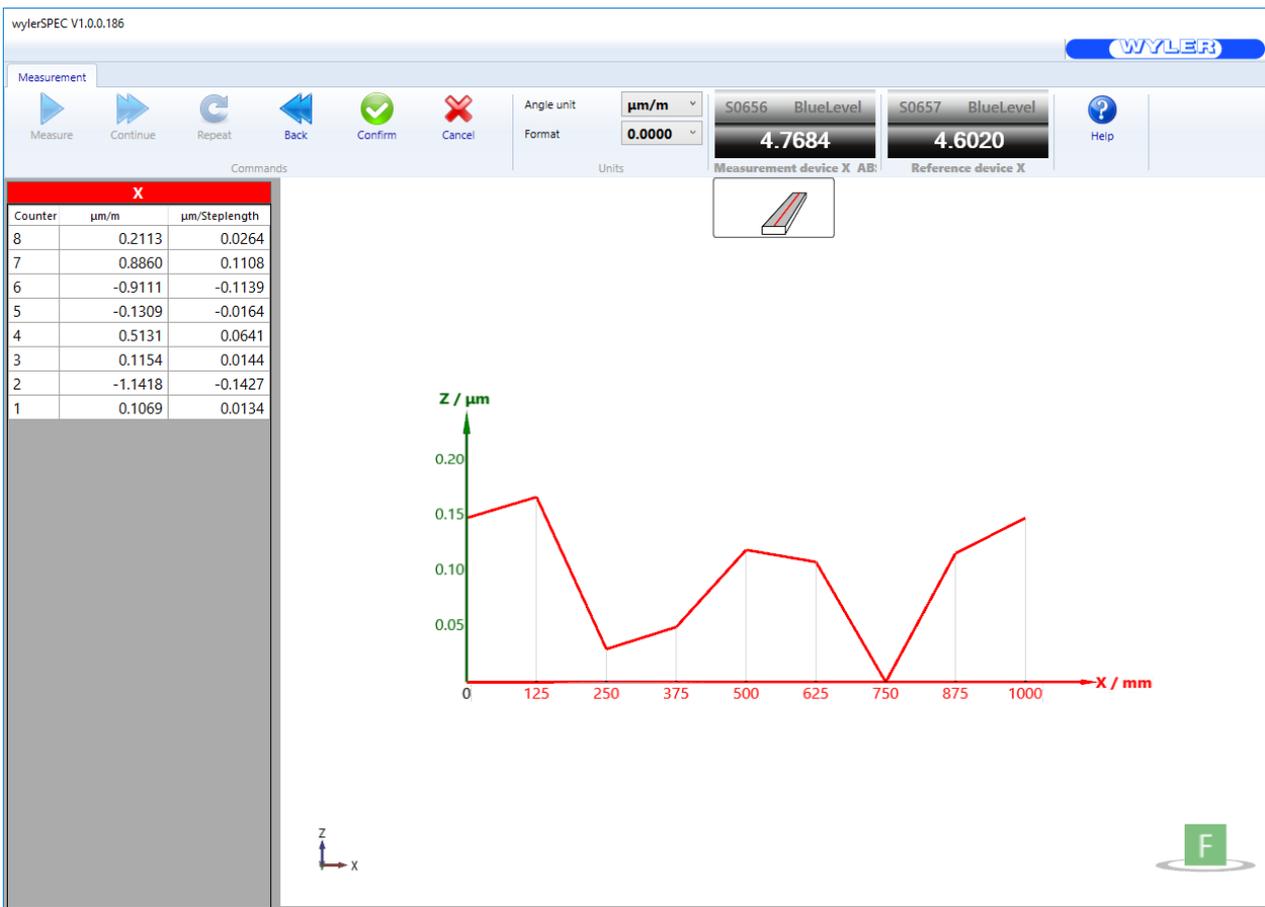
5.1.1.2 Line measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values are displayed in the table on the left.

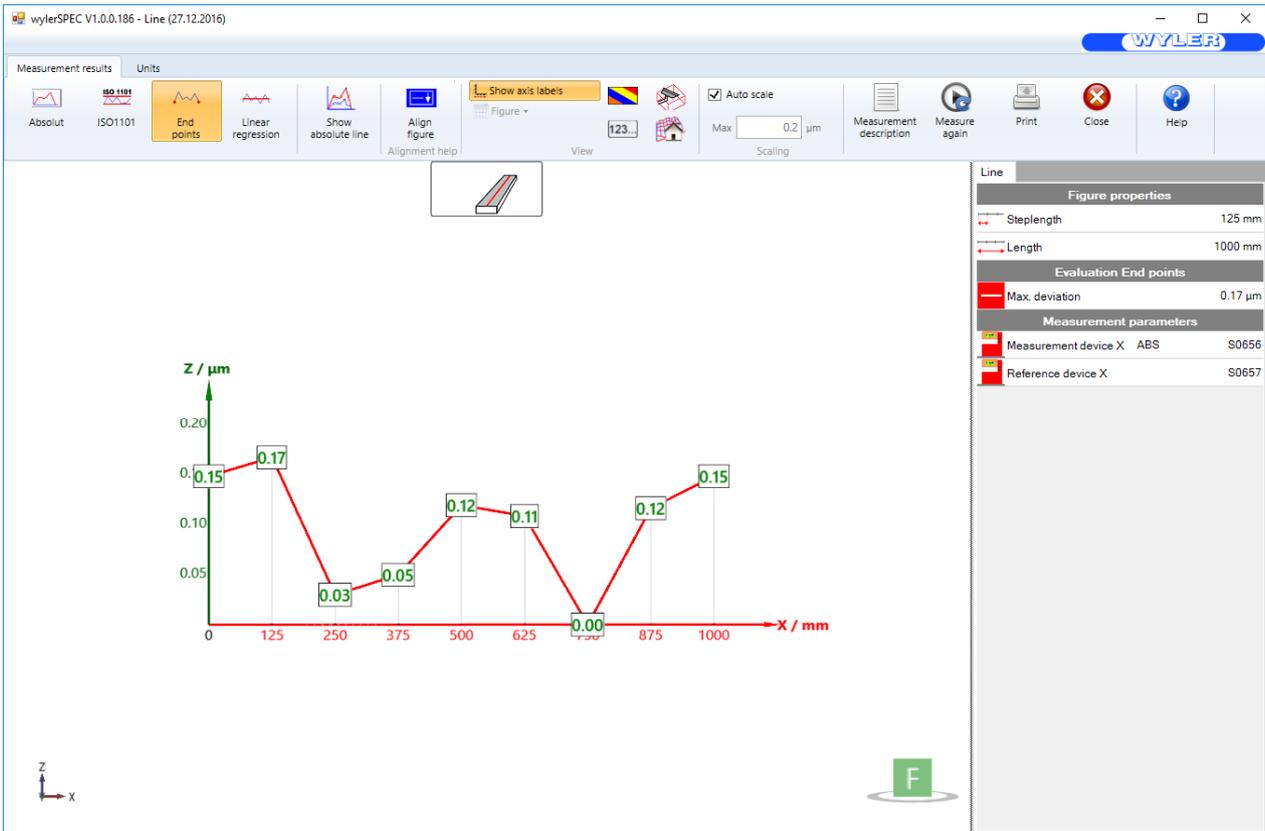
If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.1.1.3 Line analyze

Analysis mit ISO1101, Endpunkte oder Linear regression möglich.



 **Maximal deviation** = Biggest height difference in the line

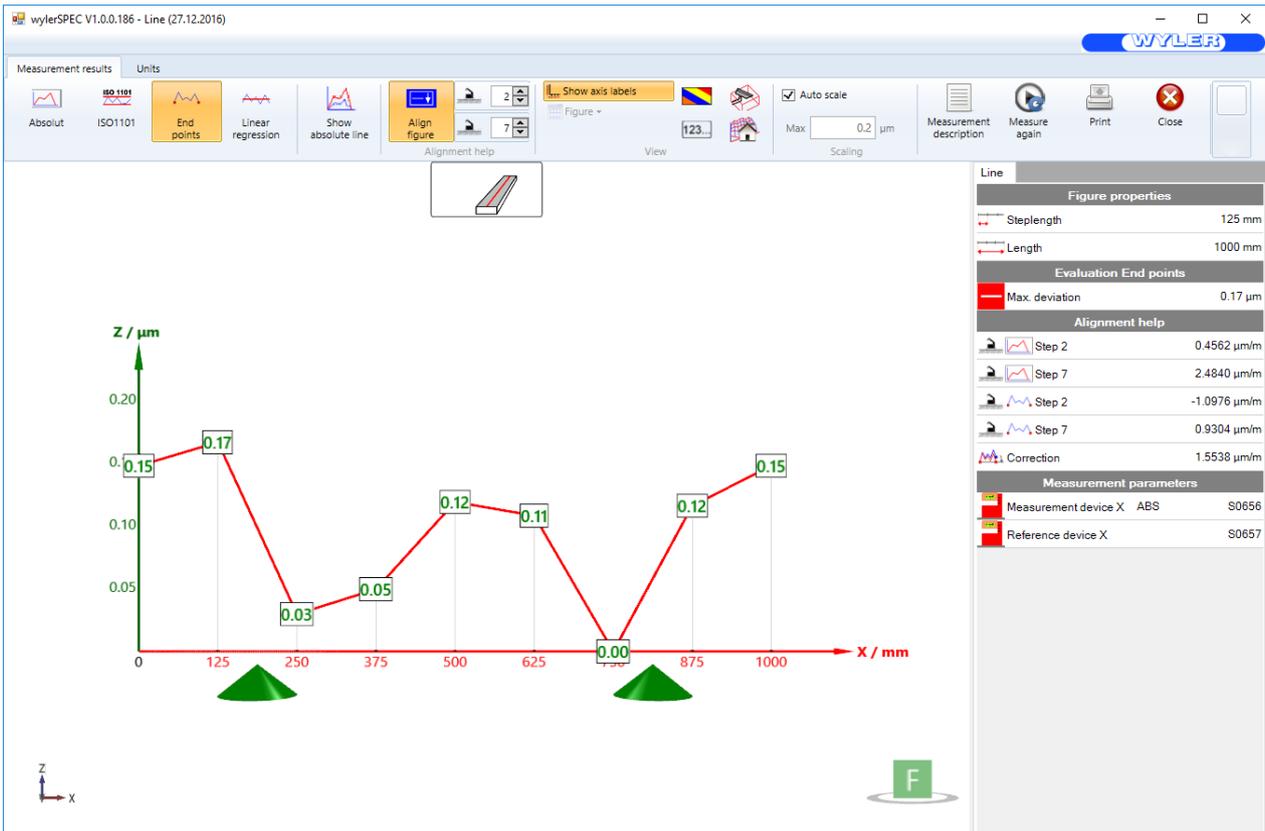
 **Alignment:**

The intention is to use a suitable measurement for setup an object to a horizontal position, respectively to define the actual position of an object in the space.

In order to do so a line is to be measured with absolute values determined. (Absolute in relation to the centre of the earth). After the measurement the object is to be aligned to setup horizontally.



Two adjusting pos can be defined the object has to be aligned with.



Step

2

Value measured at the first adjusting position during measurement (Absolut)



Step

7

Value measured at the second adjusting position during measurement (Absolut)



Step

2

Value to be on the first position after adjusting the object according to the selected alignment method



Step

7

Value to be on the first position after adjusting the object according to the selected alignment method

Correction

The complete object must be adjusted by this angle [µm/m]. The value corresponds to the display on the instrument at the adjusting positions BEFORE - AFTER

5.1.2 Parallelism



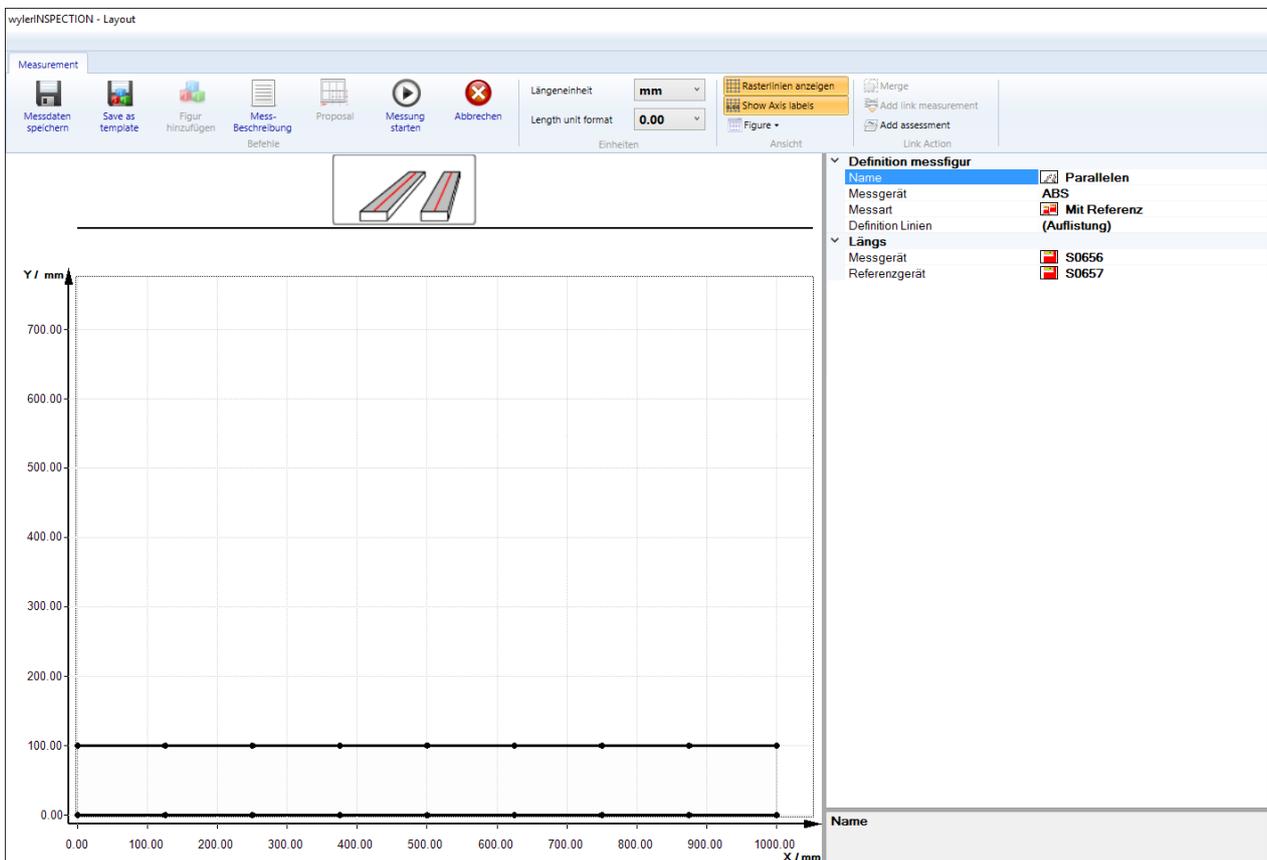
Measurement of up to four parallel lines; the reference line can be selected and it can be aligned according to the methods "Absolut", "ISO1101", "End points" and "Linear regression".

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.1.2.1 Parallelism setup

Setup of Parallelism:



Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires a Reversal measurement , before start of the measurement RELative not.
Way of measurement	With reference Without reference

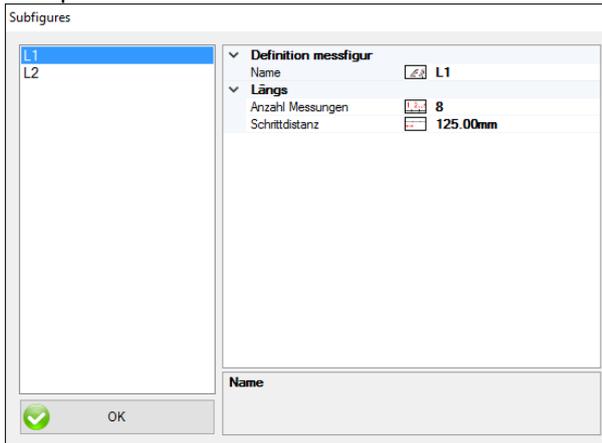
Manual input
 Definition Line n Öffnen eines weiteren Eingabedialogs, um die einzelnen Line n zu definieren

Longitudinal

Measuring device [Selection](#) of the main measuring device

Reference device [Selection](#) of the reference device

Setup of the lines:



On the left side the figure to setup can be selected.

Definition measurement figure

Name Name der Line

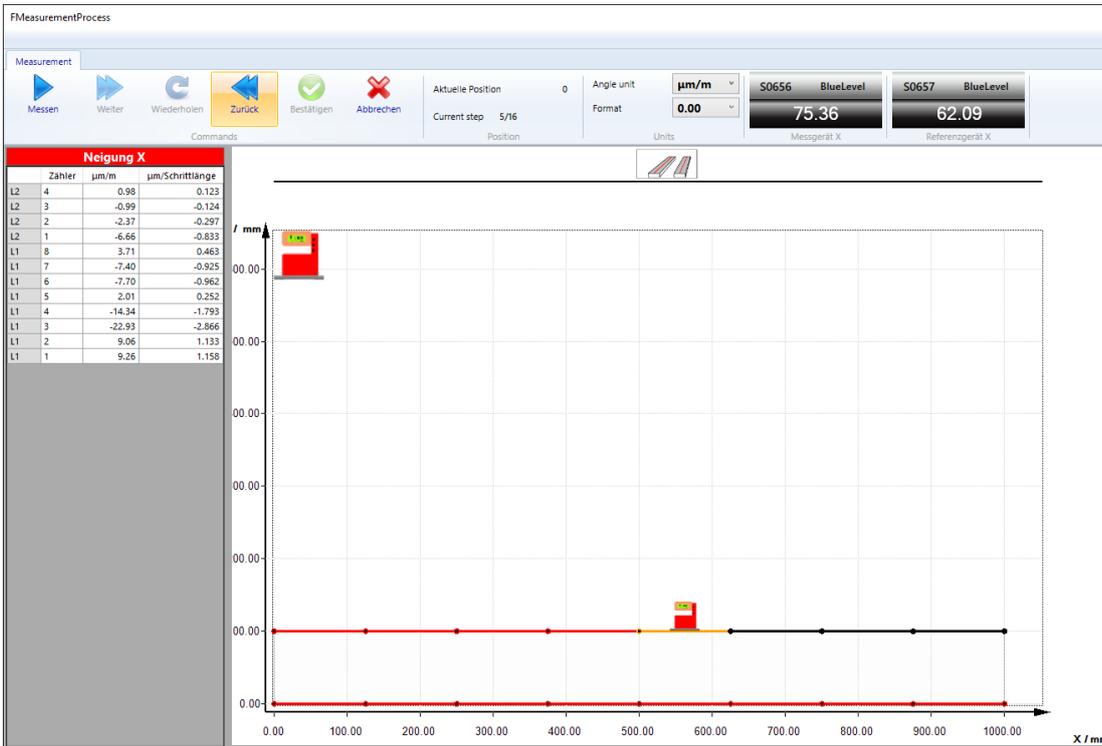
Longitudinal

Number of measurements Number of inclination measurements, the number of heights is bigger by 1.

Steplength Steplength per measurement

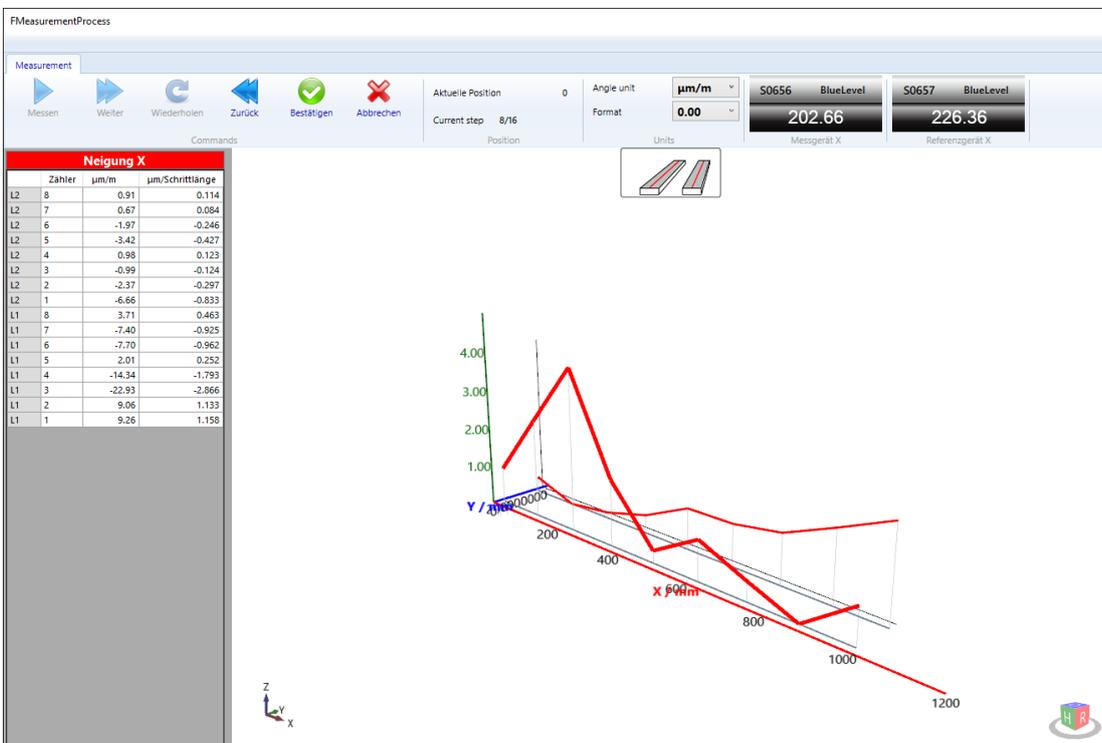
5.1.2.2 Parallelism measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values are displayed in the table on the left.

If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



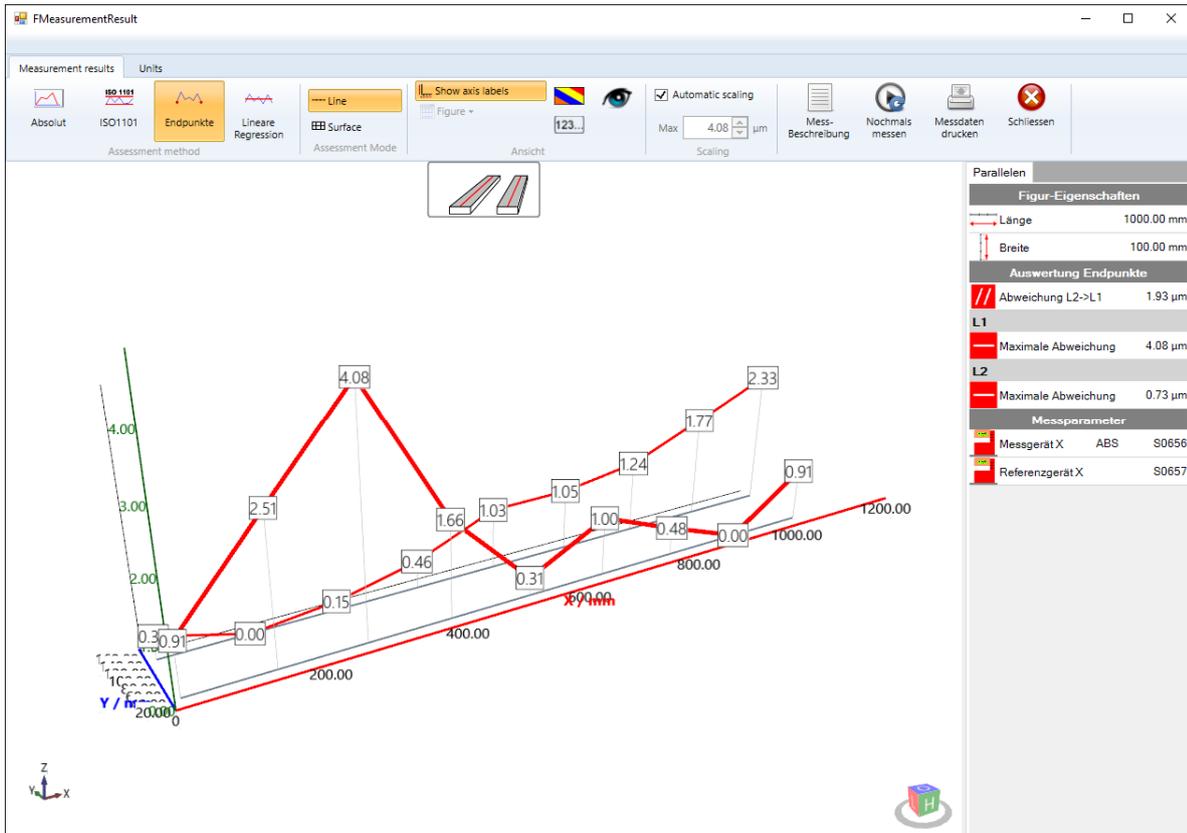
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.1.2.3 Parallelism analyze

Analysis Absolut, ISO1101, end points or linearer regression.



Select the reference line with a click on the desired line

Analysis:

▨ Deviation L2 -> L1

differs according to the evaluation method.

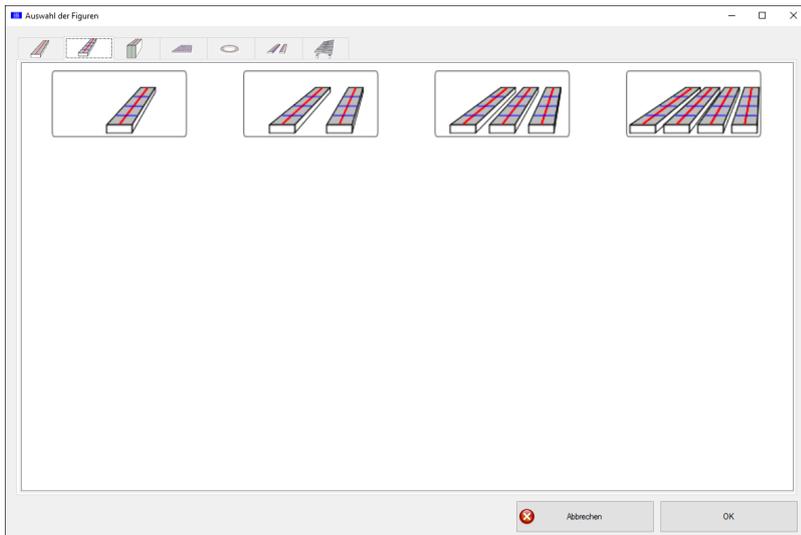
End points: Last value minus first value in L2

ISO1101: Highest value minus lowest value in L2

Linear regression: Height difference in the regression line L2

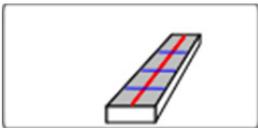
▬ Maximal deviation = Biggest height difference in the line

5.2 Lines / Parallelism with twist



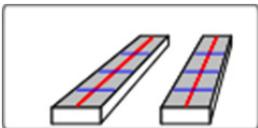
Up to 4 lines with twist can be combined to parallels with twist.

A double click takes you to the page to setup the corresponding measurement.

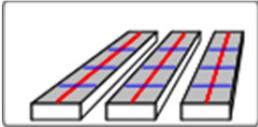


Eine [Line](#)

[mit Twist](#)

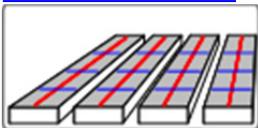


Zwei [Parallelen mit Twist](#)



Die Messung von drei Parallelen mit Twist erfolgt analog wie die Messung von zwei

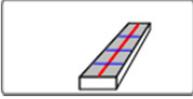
[Parallelen mit Twist](#)



Die Messung von vier Parallelen mit Twist erfolgt analog wie die Messung von zwei

[Parallelen mit Twist](#)

5.2.1 Lines with twist

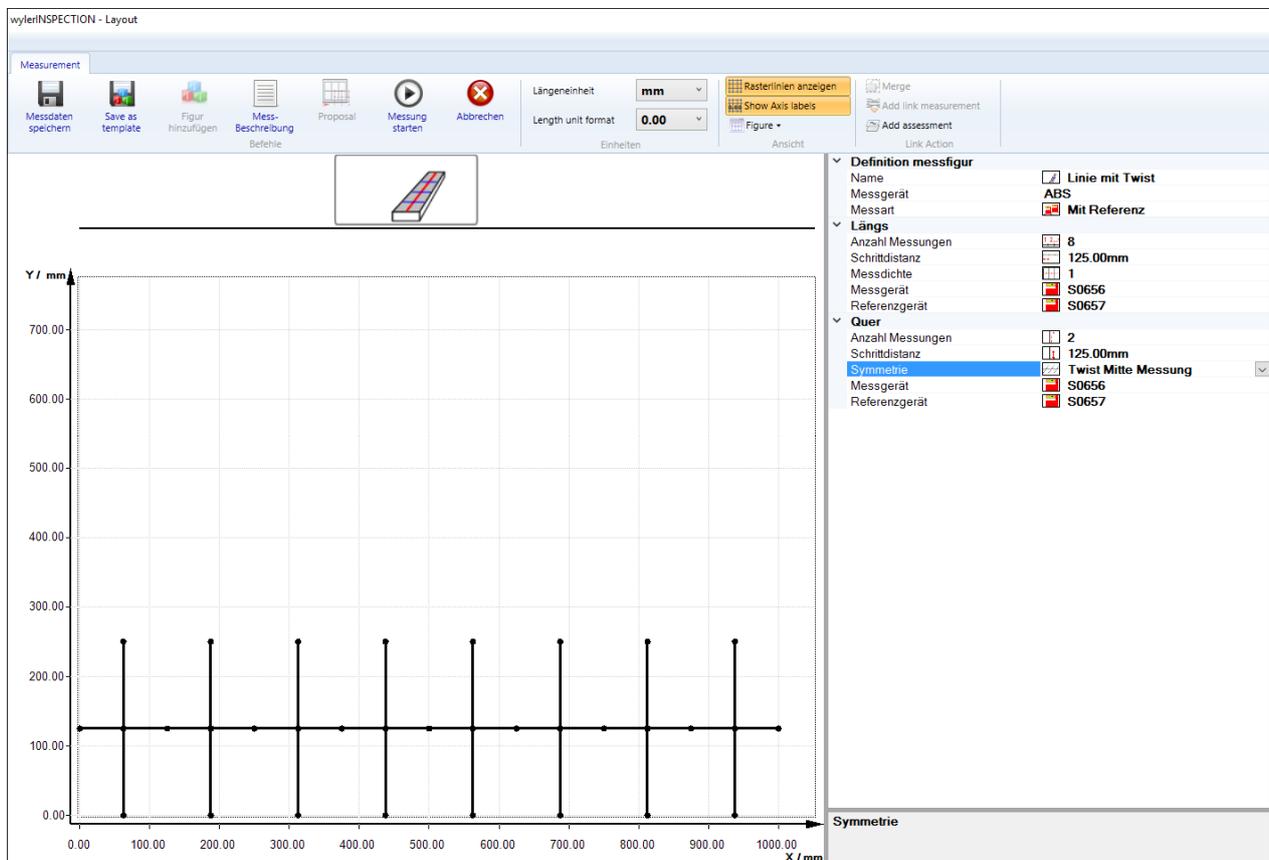


Measurement of single lines with twist; alignment in X and Y direction as a surface according to the methods "Absolut", "ISO1101", "End points" and "Linear regression". By default the first twist line is aligned.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyse](#)

5.2.1.1 Lines with twist setup



Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut, RELativ
Way of measurement	With reference Without reference Manual input
Longitudinal	
Number of	Number of inclination measurements, the

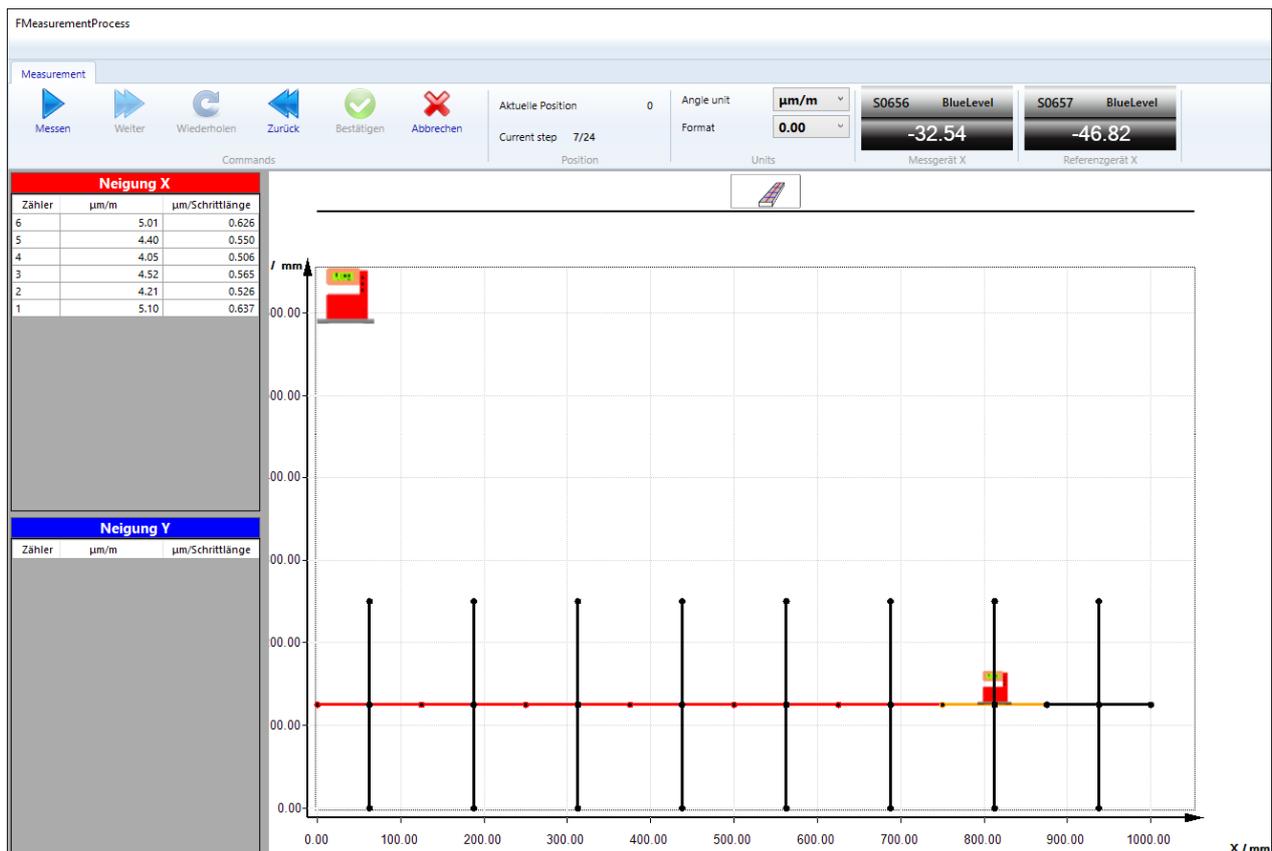
measurements number of heights is bigger by 1
 Steplength Steplength per measurement
 Measuring device [Selection](#) of the main measuring device
 Reference device [Selection](#) of the reference device

Transversal

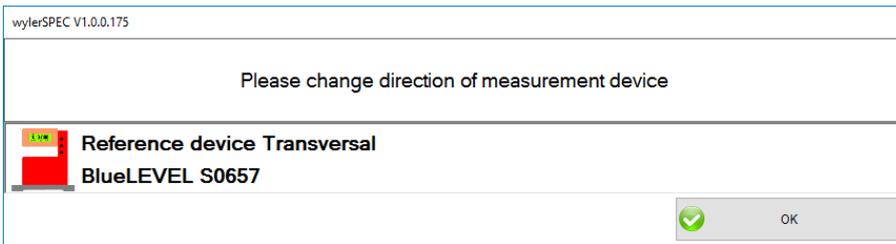
Number of measurements Number of inclination measurements, the number of heights is bigger by 1
 Steplength Steplength per measurement
 Symmetry Position of the transversal measurement relating to the measurement step. Beginning, middle or end of measuring step.
 Measuring device [Selection](#) of the main measuring device
 Reference device [Selection](#) of the reference device

5.2.1.2 Lines with twist measure

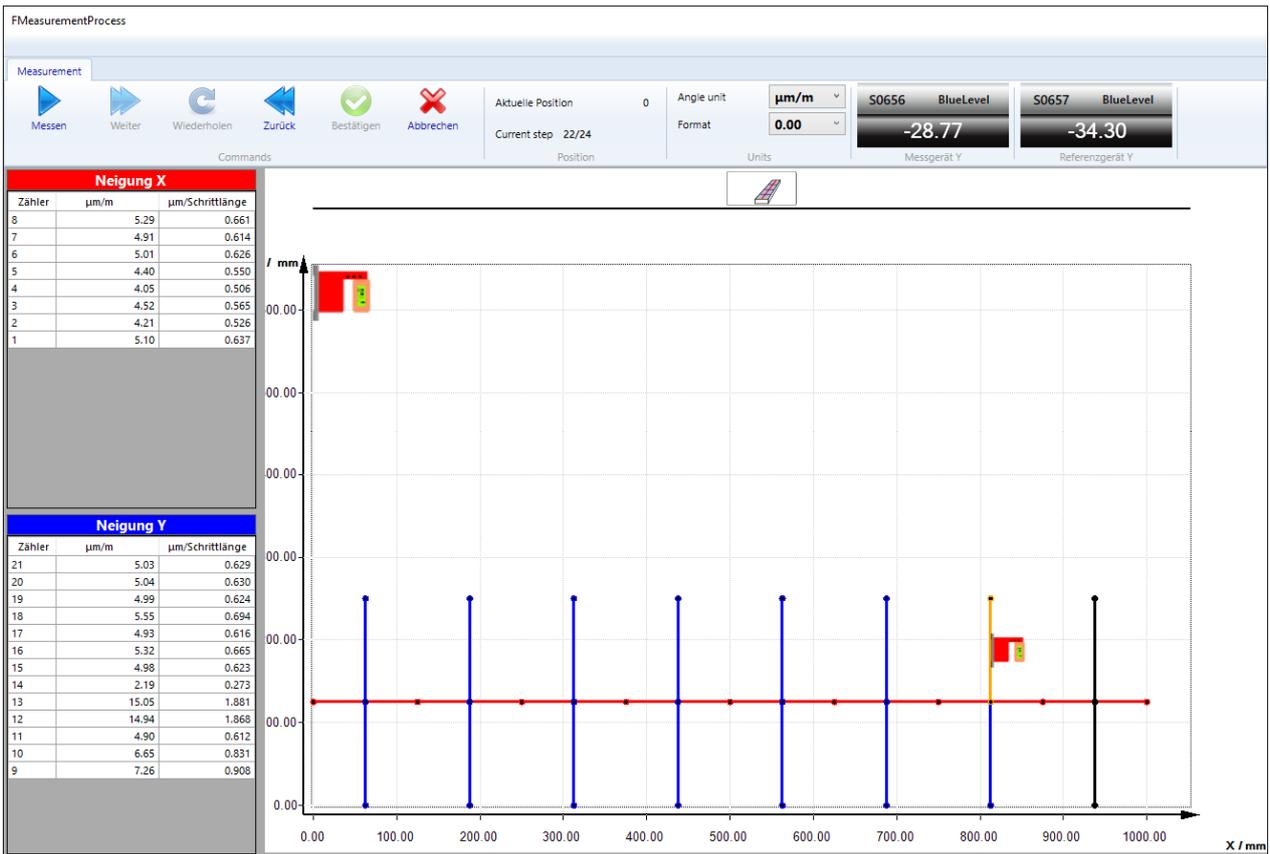
When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values are displayed in the table "X" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



At the change of the measurement of the longitudinal line to the measurement of the twist lines the reference device must change measuring direction.



During the measurement the values are displayed in the table "Y" on the left.

FMeasurementProcess

Measurement

Messen Weiter Wiederholen Zurück Bestätigen Abbrechen

Aktuelle Position 0 Angle unit $\mu\text{m}/\text{m}$ S0656 BlueLevel S0657 BlueLevel
 Current step 24/24 Position Format 0.00 -60.20 -84.90
 Messgerät Y Referenzgerät Y

Commands

Neigung X

Zähler	$\mu\text{m}/\text{m}$	$\mu\text{m}/\text{Schrittlänge}$
8	5.29	0.661
7	4.91	0.614
6	5.01	0.626
5	4.40	0.550
4	4.05	0.506
3	4.52	0.565
2	4.21	0.526
1	5.10	0.637

Neigung Y

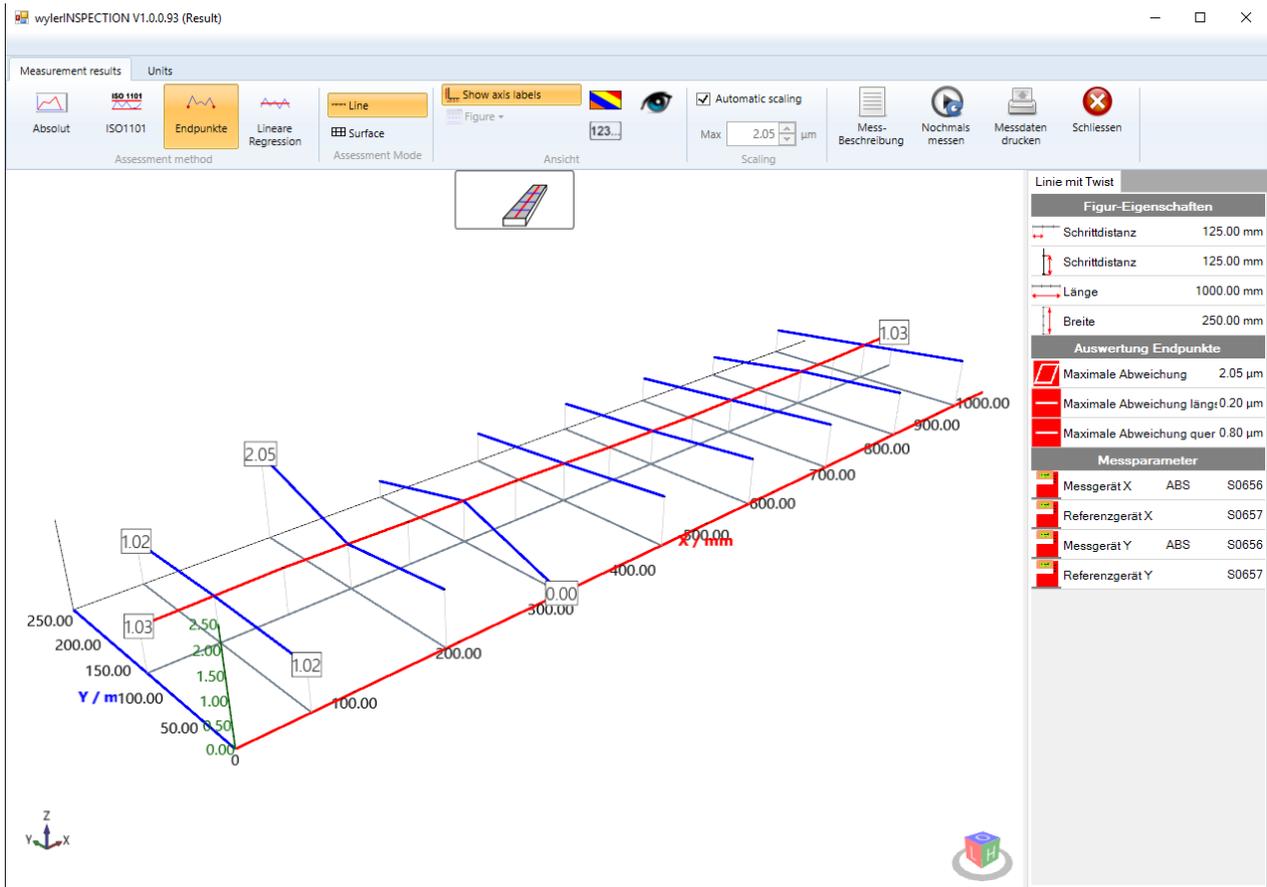
Zähler	$\mu\text{m}/\text{m}$	$\mu\text{m}/\text{Schrittlänge}$
24	4.51	0.564
23	4.41	0.552
22	3.82	0.477
21	5.03	0.629
20	5.04	0.630
19	4.99	0.624
18	5.55	0.694
17	4.93	0.616
16	5.32	0.665
15	4.98	0.623
14	2.19	0.273
13	15.05	1.881
12	14.94	1.868
11	4.90	0.612
10	6.65	0.831
9	7.26	0.908

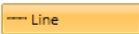
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.2.1.3 Lines with twist analyze



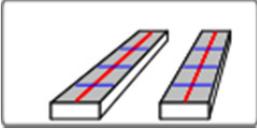
The figure "Line with twist" can be analysed as lines  as well as surface . With analysis as lines the longitudinal line and the first Transversal line are evaluated and the whole figure is turned corresponding to the determined values. With analysis as surface the figure as a whole is evaluated and turned.

 **Maximal deviation** = Biggest height difference in the figure

 **Maximal deviation längs** = Biggest height difference in the longitudinal line

 **Maximal deviation quer** = Biggest height difference in all transversal lines

5.2.2 Parallelism with twist



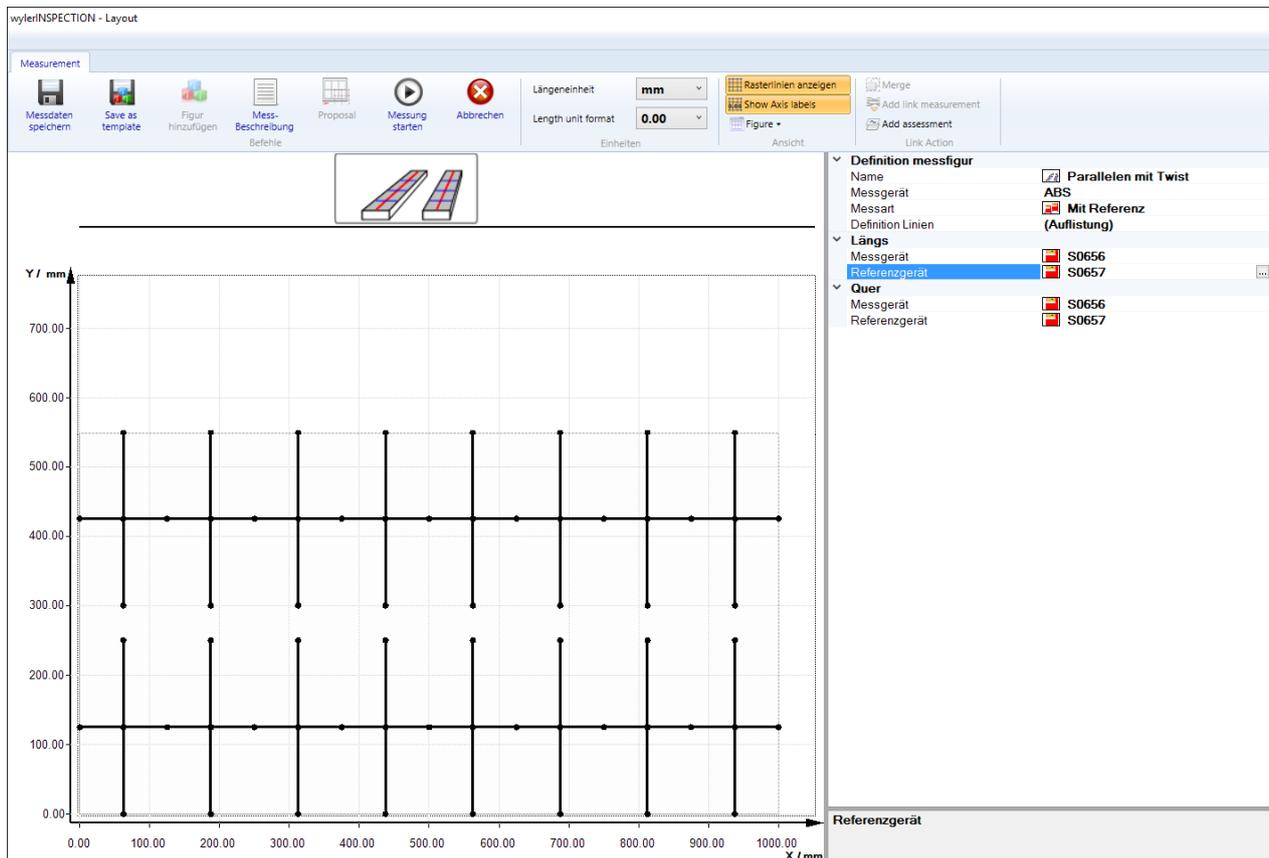
Measurement of up to 4 lines with twist; alignment in X and Y direction as a surface according to the methods "Absolut", "ISO1101", "End points" and "Linear regression". By default the first longitudinal line and the first twist line is the base of alignment.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.2.2.1 Parallelism with twist setup

Setup of Parallelen with Twist:



Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ nicht.
Way of	With reference

measurement Without reference
Manual input

Definition Lines Open a dialog to define each line

Longitudinal

Measuring device [Selection](#) of the main measuring device

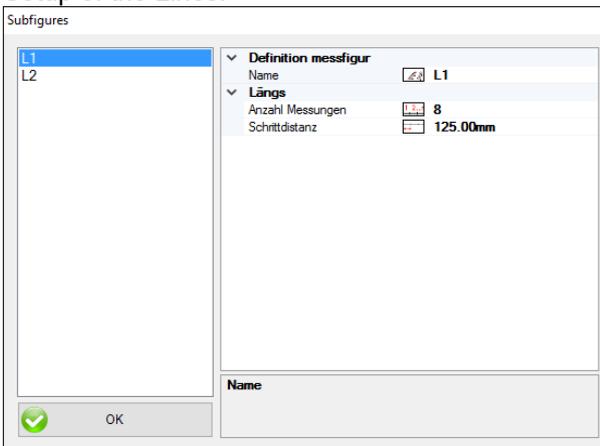
Reference device [Selection](#) of the reference device

Transversal

Measuring device [Selection](#) of the main measuring device

Reference device [Selection](#) of the reference device

Setup of the Lines:



Select the figure to define on the left side.

Definition measurement figure

Name Name of Line

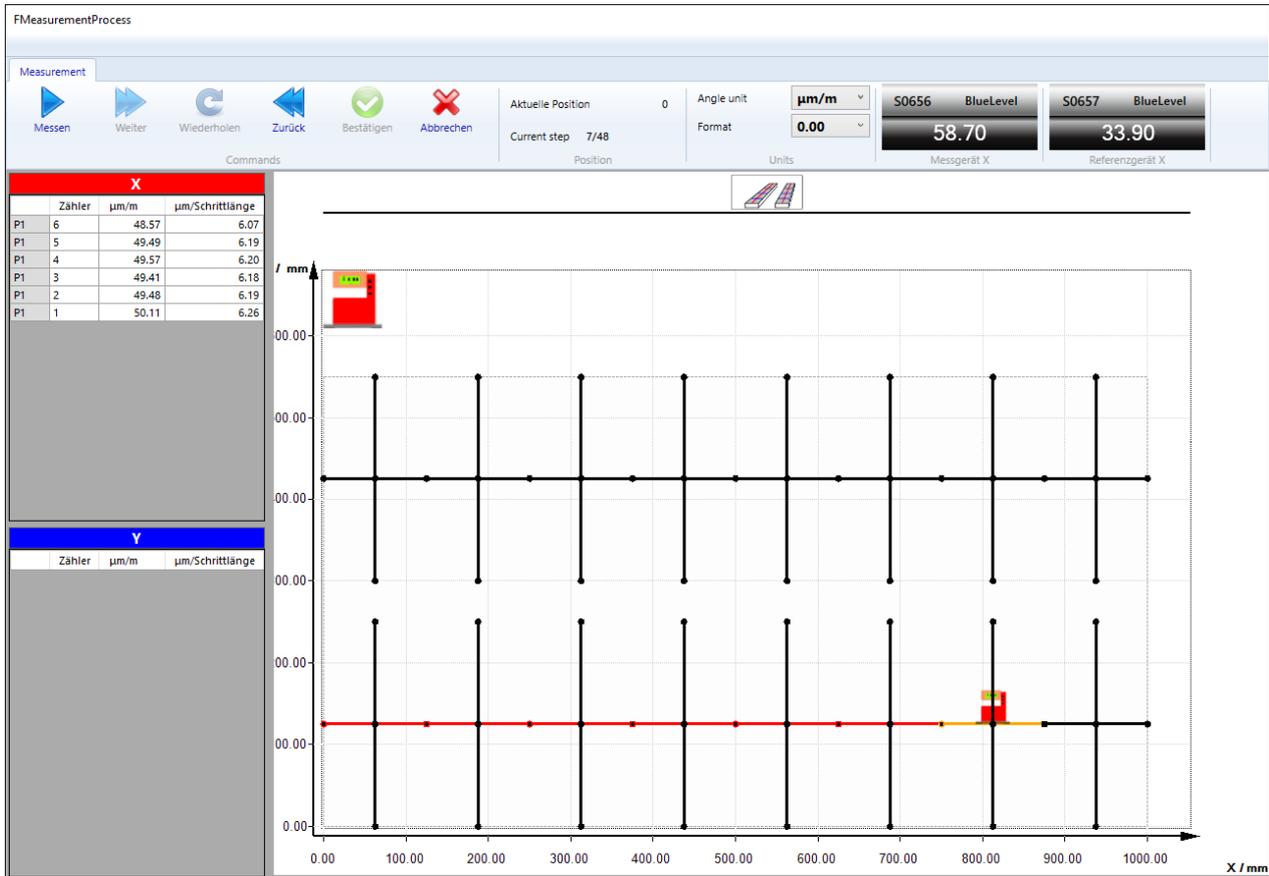
Longitudinal

Number of measurements Number of inclination measurements, the number of heights is bigger by 1.

Steplength Steplength per measurement

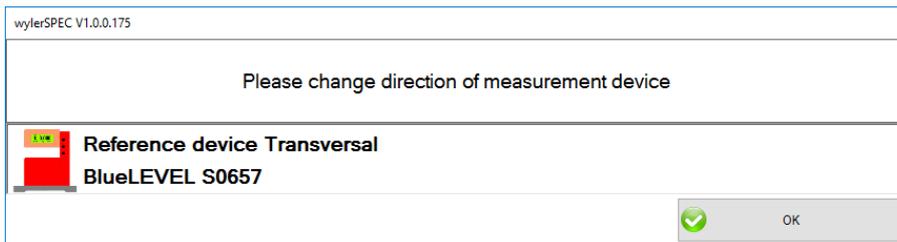
5.2.2.2 Parallelism with twist measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.

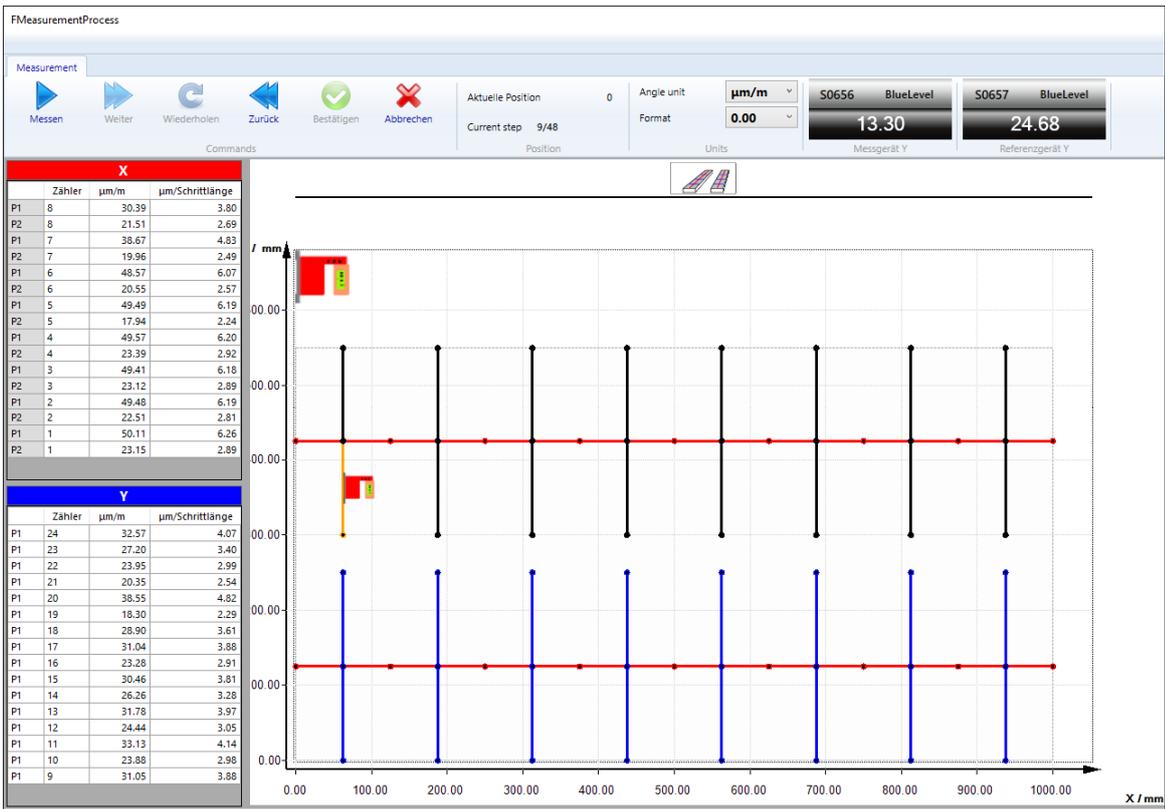


During the measurement the values are displayed in the table "X" on the left.

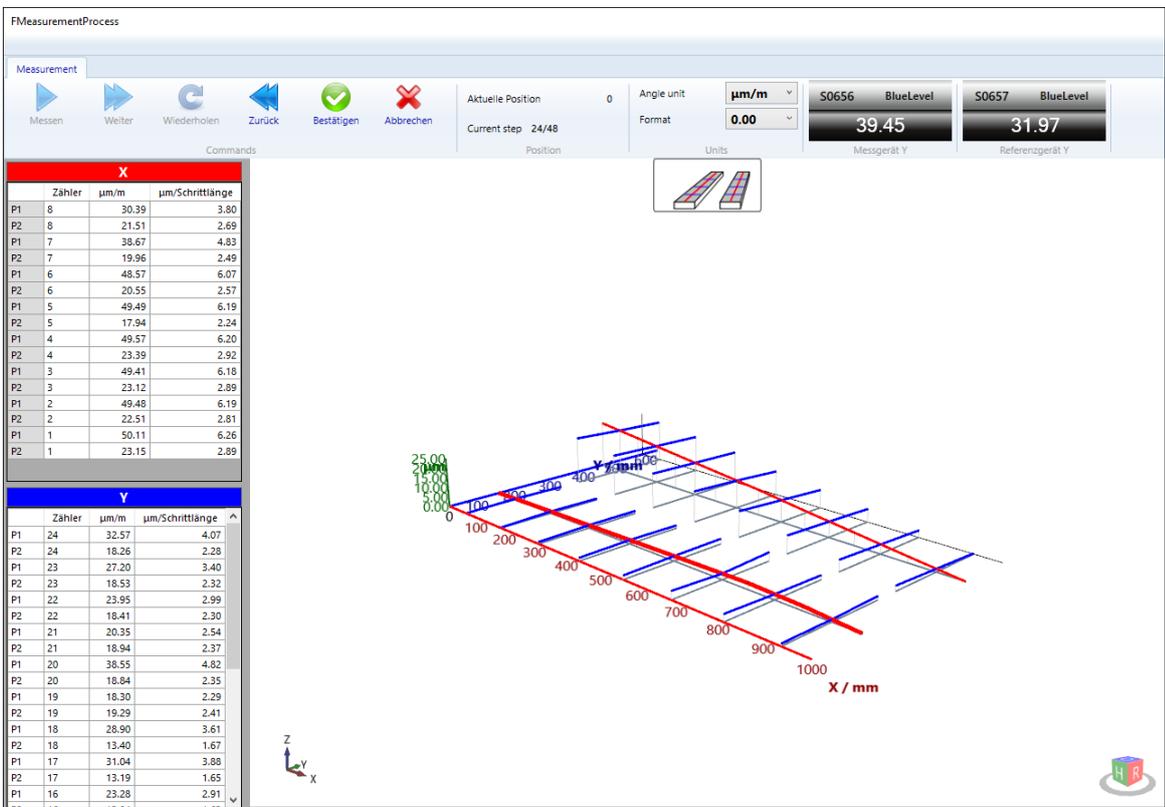
If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



At the change of the measurement of the longitudinal line to the measurement of the twist lines the reference device must change measuring direction.



During the measurement the values of the twist lines are displayed in the table "Y" on the left.



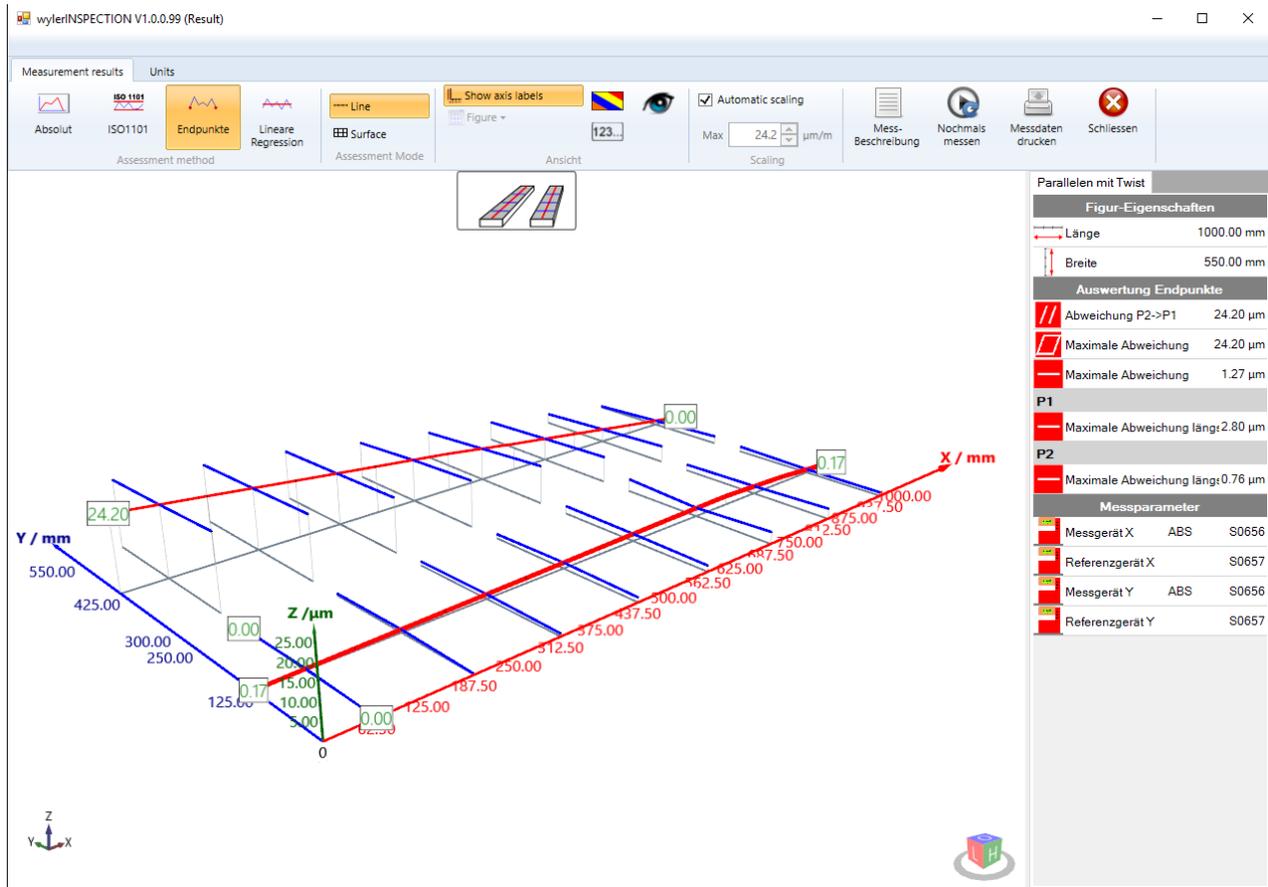
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.2.2.3 Parallelism with twist analyze

Analysis [Absolut](#), [ISO1101](#), [End point](#) or [Linear regression](#).



Select the reference line with a click on it.

Analysis:

// Deviation P2 -> P1

differs according to the evaluation method.

End points: Last value minus first value in P2

ISO1101: Highest value minus lowest value in P2

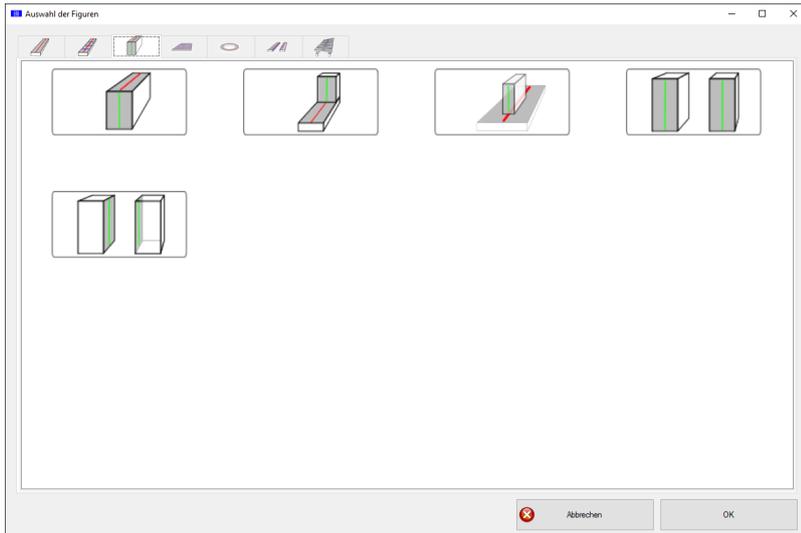
Linear regression: Height difference in the regression line P2

▮ Maximal deviation = Biggest height difference of both parallels inclusive transversal measurements

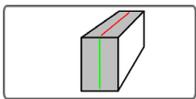
▮ Maximal deviation = Biggest height difference on the first parallel inclusive transversal measurements

▮ Maximal deviation längs = Biggest height difference auf der Longitudinallinie

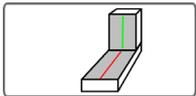
5.3 Perpendicularity



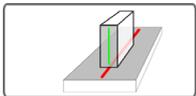
A double click takes you to the page to setup the corresponding measurement.



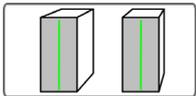
[exterior angle right](#)



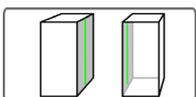
[interior angle right](#)



[squareness](#)

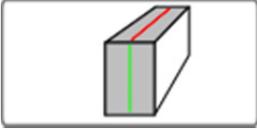


[Two vertical lines side by side](#)

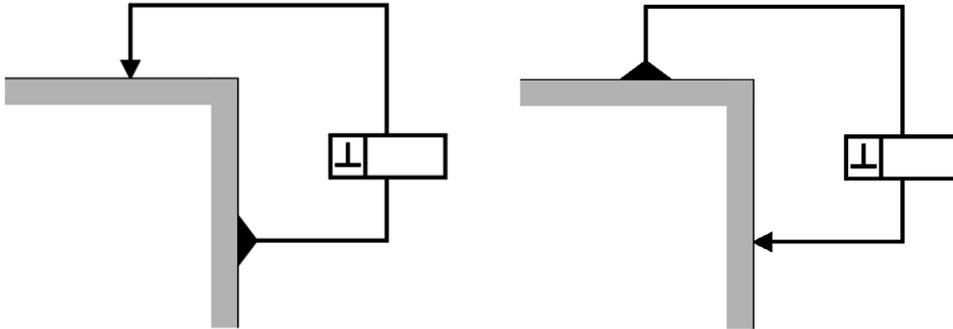


[Two vertical lines inside opposed](#)

5.3.1 Exterior angle right



Measuring task: Measurement of 90 degree angles (Squareness) with / or without previous determination of the instrument's angular error



General procedure of the measurement

- The existing angular error of the measuring instrument is to determine by using a master granite square (this is not a must)
- After this the actual measurement is done according to the requirements in different steps as described below.

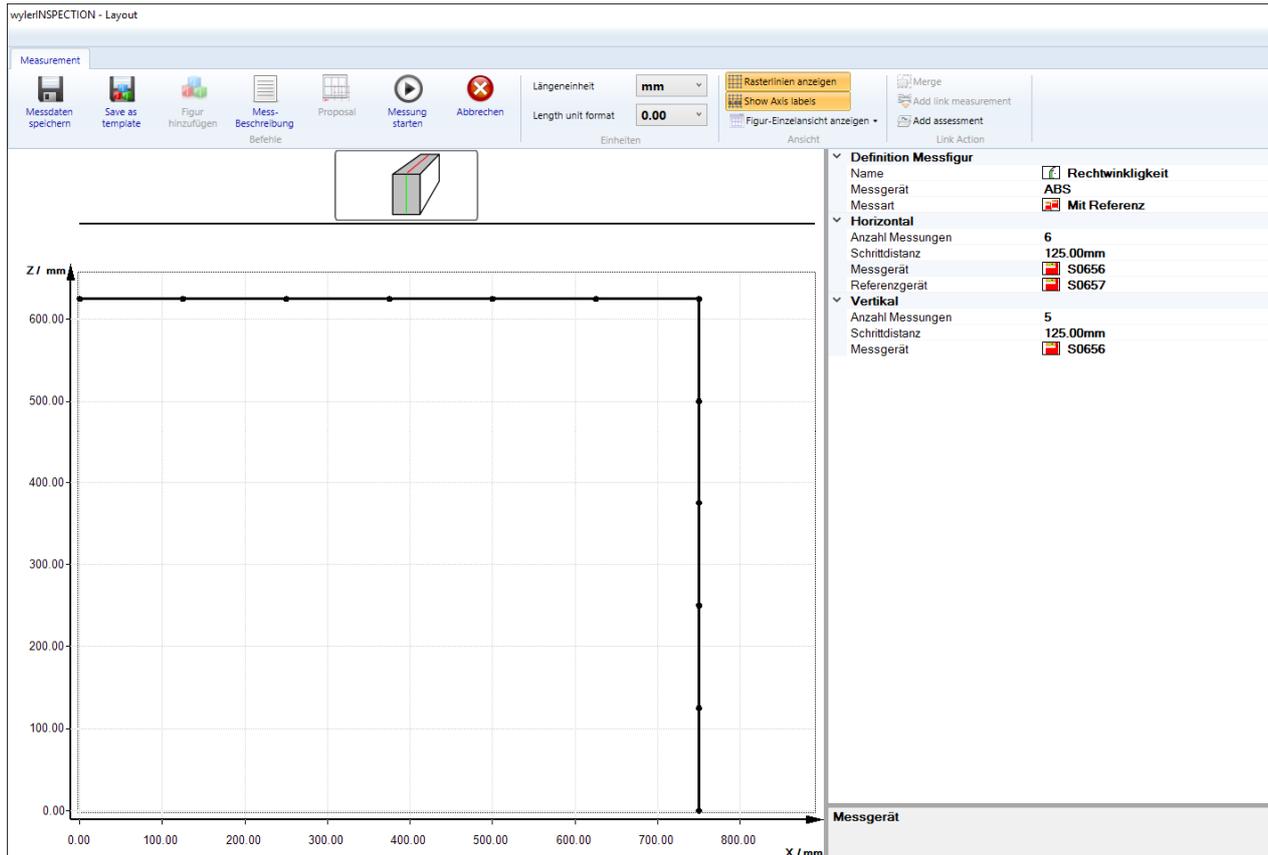
After the measurement is done different possibilities exist for the alignment of the reference measurement (reference line). The result of the measurement displayed will show three possible values depending on the alignment method chosen:

- Alignment according to the method "Endpoints"
- Alignment according to the method "ISO 1101"
- Alignment according to the method "linear Regression"

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.3.1.1 Exterior angle right setup



Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ nicht.
Way of measurement	With reference Without reference Manual input

Horizontal

Number of measurements	Number of inclination measurements, the number of heights is bigger by 1.
Steplength	Steplength per measurement
Measuring device	Selection of the main measuring device, typischerweise das selbe Gerät welches für die Vertikalmessung verwendet wird.
Reference device	Selection of the reference device

Vertikal

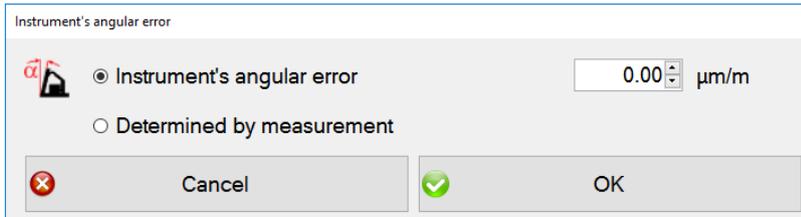
Number of measurements	Number of inclination measurements, the number of heights is bigger by 1.
Schrittweite	Steplength per measurement
Measuring device	Selection of the main measuring device, dies muss ein Winkelmessgerät sein.

5.3.1.2 Exterior angle right measure

Prior to the measurement angular error must be inserted or measured. In the dialog popping up this value can be inserted or measured via [vertical reversal measurement](#).

ATTENTION: If the measuring of a rectangular object is planned with two instruments (measuring and reference instrument), the **determination of the angular error of the measuring instrument must be performed with one instrument only**, the measuring instrument featuring an angular base. Please assign the measuring instruments as measuring respectively reference instrument well from the beginning when setting up the measuring configuration.

The reference instrument is deactivated during the determination of the angular error.



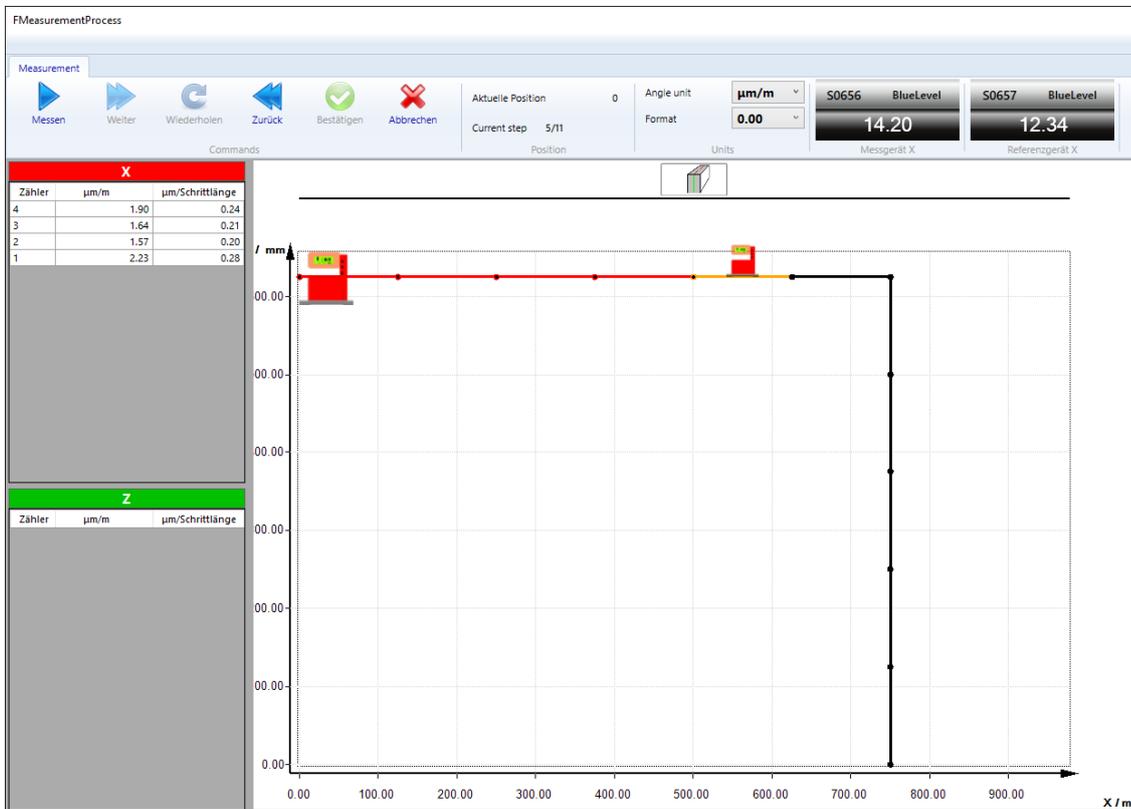
There are two possibilities:

Manual input: Select "Instrument's angular error" and insert into the field on the side the predefined value. This value can be found e.g. in a calibration certificate of the measuring device.

Determine: Select "Determine by measurement". The angular error of the measuring device will be determined via a [vertical reversal measurement](#), as described in a previous chapter.

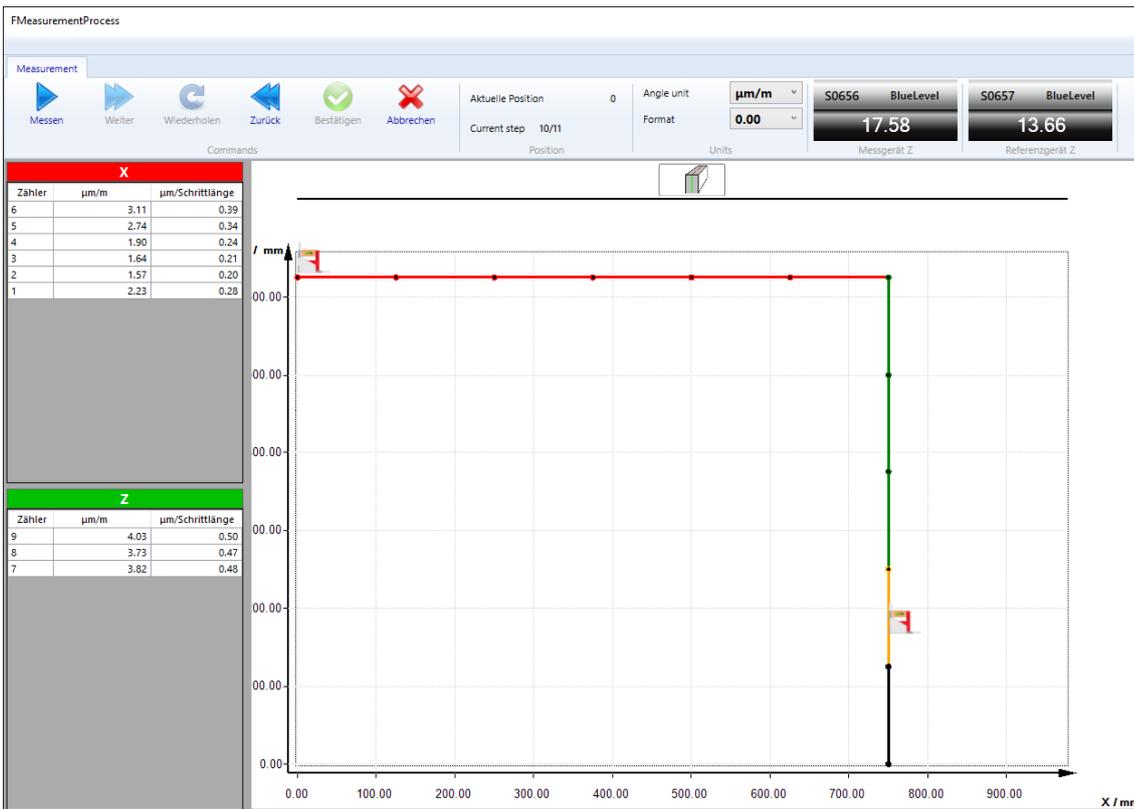
Confirm the selection with "OK".

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.

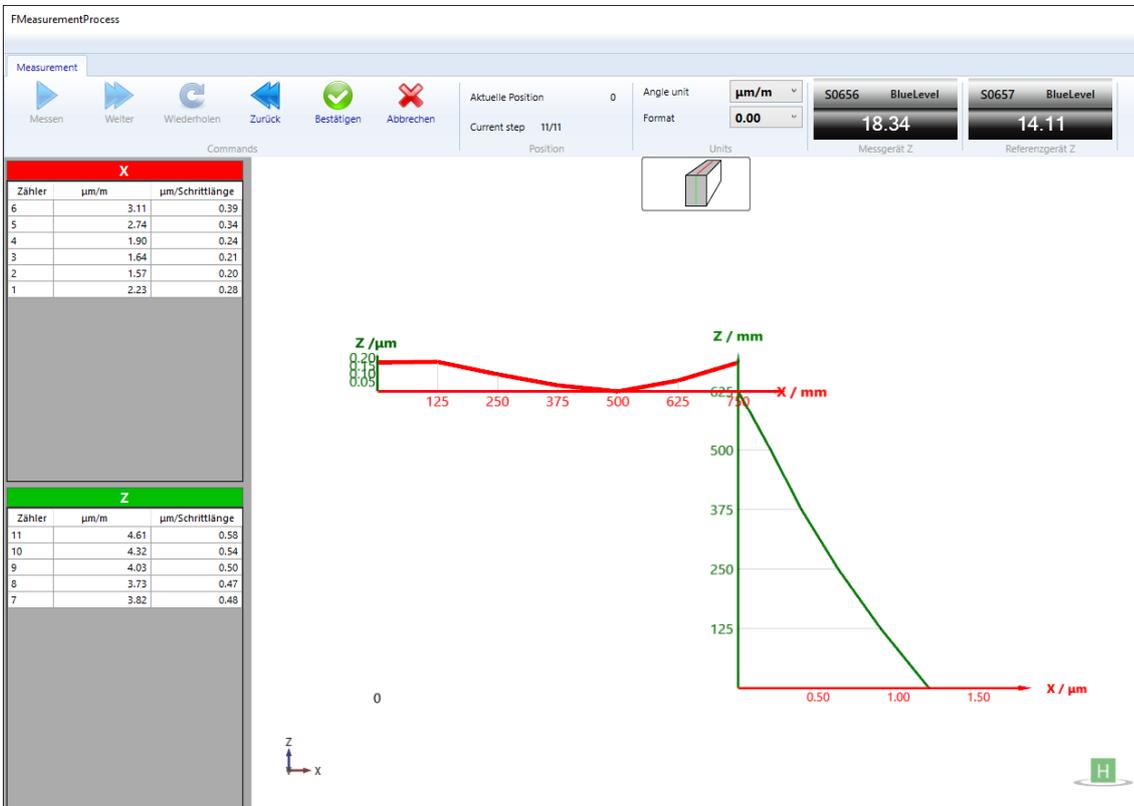


During the measurement the values of the horizontal line are displayed in the table "X" on the left.

If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



During the measurement the values of the vertical line are displayed in the table "Z" on the left.



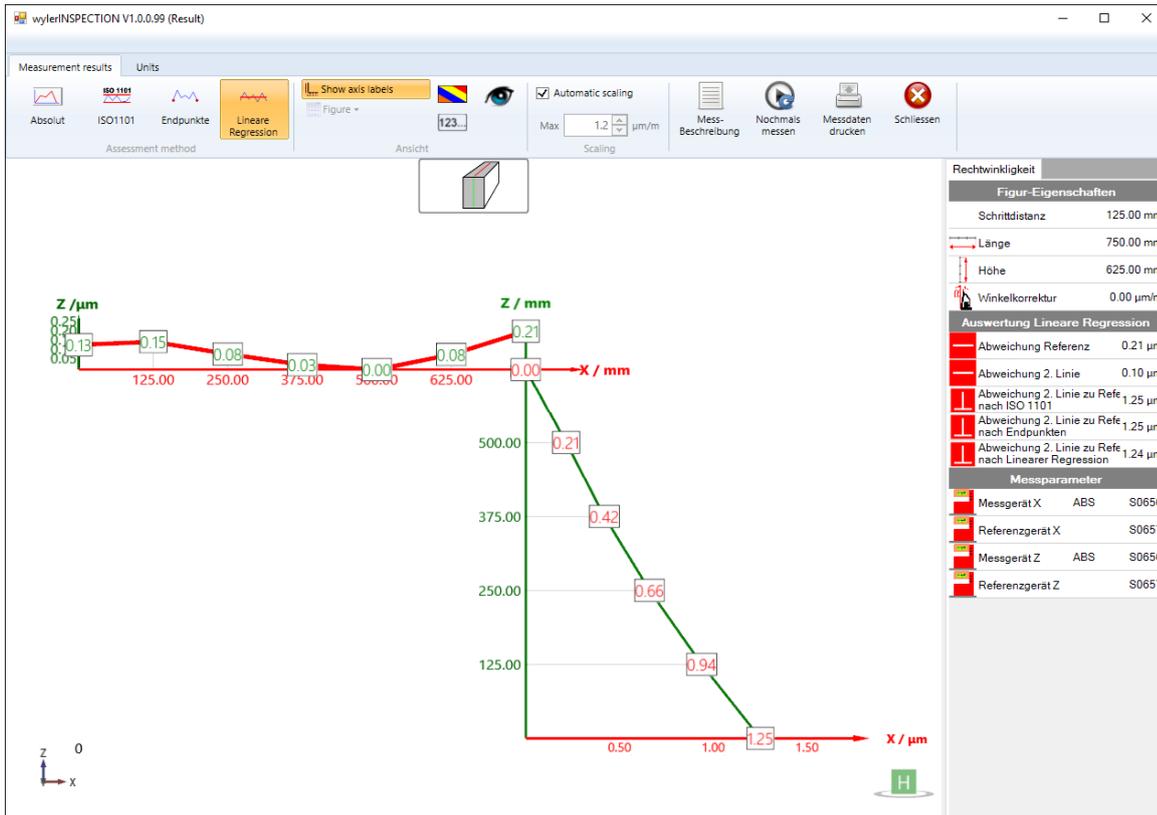
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on .

With  measurements can be repeated.

5.3.1.3 Exterior angle right analyze

Analysis ISO1101, Endpunkte or linear regression.



Select the reference line with a click on it.

Analysis:

— Deviation reference = Biggest height difference in the line
 Just this line according to the selected [evaluation method](#) without relation to the 2nd line.

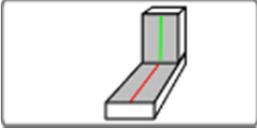
— Deviation 2nd line = Biggest height difference in the line
 Just this line according to the selected [evaluation method](#) without relation to the reference line.

⊥ Deviation 2nd line Reference ISO1101 = Highest value minus lowest value in L2.
 The reference line is evaluated according to the selected evaluation method, the 2nd line according to ISO1101.

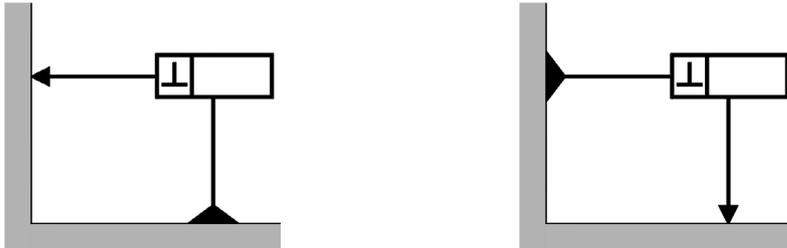
⊥ Deviation 2nd line Reference End points = Last value minus first value in L2.
 The reference line is evaluated according to the selected evaluation method, the 2nd line according to End points.

⊥ Deviation 2nd line Reference Linear Regression = Height difference of the regression line in L2.
 The reference line is evaluated according to the selected evaluation method, the 2nd line according to Linear regression.

5.3.2 Interior angle right



Measuring task: Measurement of 90 degree angles (Squareness) with / or without previous determination of the instrument's angular error



General procedure of the measurement:

- The existing angular error of the measuring instrument is to determine by using a master granite square (this is not a must)
- After this the actual measurement is done according to the requirements in different steps as described below.

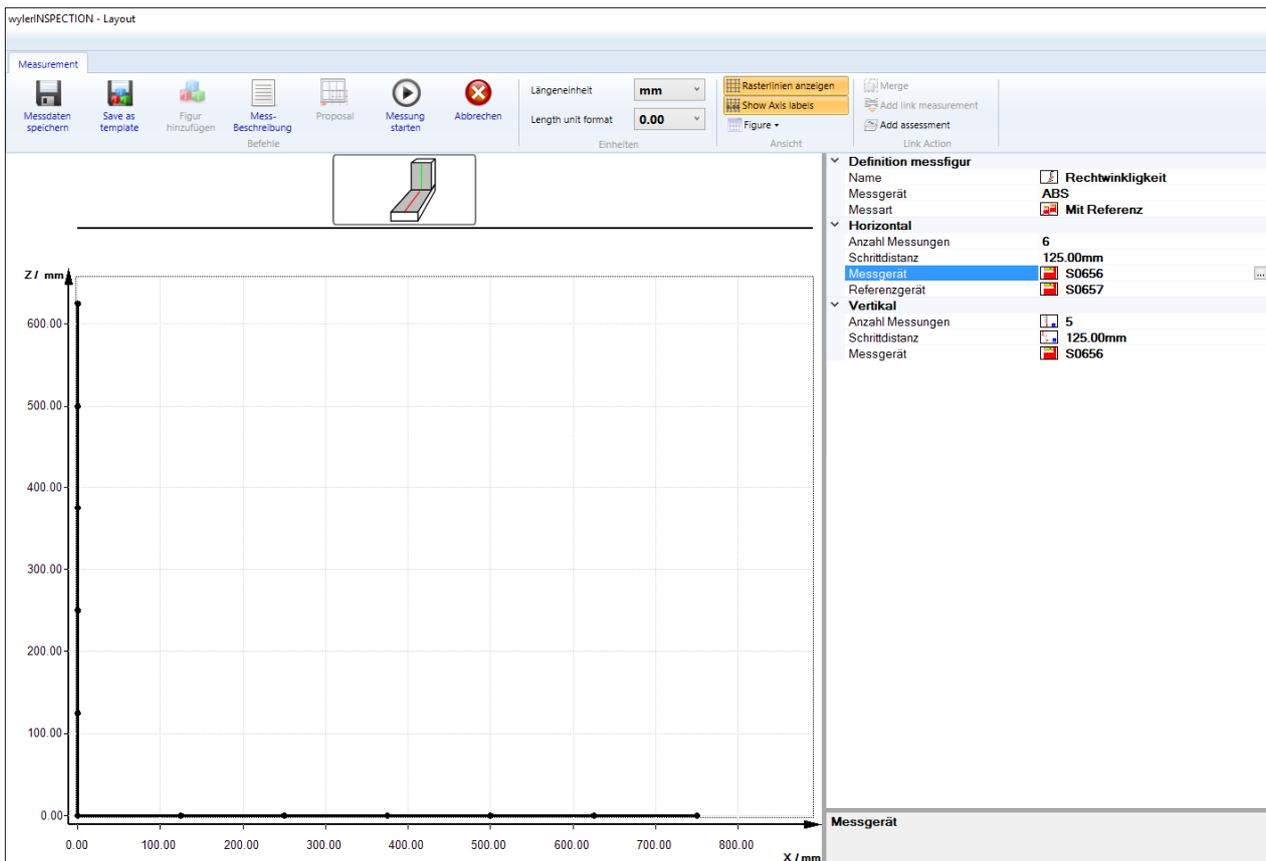
After the measurement is done different possibilities exist for the alignment of the reference measurement (reference line). The result of the measurement displayed will show three possible values depending on the alignment method chosen:

- Alignment according to the method Endpunkte
- Alignment according to the method ISO1101
- Alignment according to the method Lineare Regression

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.3.2.1 Interior angle right setup



Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ nicht.
Way of measurement	With reference Without reference Manual input

Horizontal

Number of measurements	Number of inclination measurements, the number of heights is bigger by 1.
Step length	Step length per measurement
Measuring device	Selection of the main measuring device, typischerweise das selbe Gerät welches für die Vertikalmessung verwendet wird.
Reference device	Selection of the reference device

Vertikal

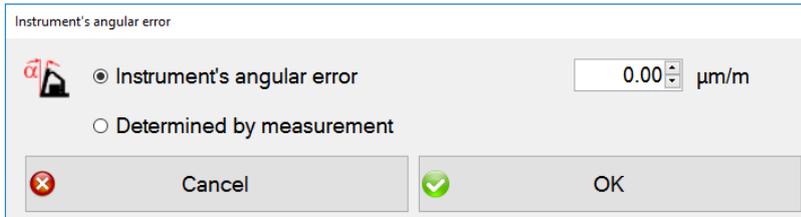
Number of measurements	Number of inclination measurements, the number of heights is bigger by 1.
Schrittweite	Step length per measurement
Measuring device	Selection of the main measuring device, dies muss ein Winkelmessgerät sein.

5.3.2.2 Interior angle right measure

Prior to the measurement angular error must be inserted or measured. In the dialog popping up this value can be inserted or measured via [vertical reversal measurement](#).

ATTENTION: If the measuring of a rectangular object is planned with two instruments (measuring and reference instrument), the **determination of the angular error of the measuring instrument must be performed with one instrument only**, the measuring instrument featuring an angular base. Please assign the measuring instruments as measuring respectively reference instrument well from the beginning when setting up the measuring configuration.

The reference instrument is deactivated during the determination of the angular error.



There are two possibilities:

Manual input: Select "Instrument's angular error" and insert into the field on the side the predefined value. This value can be found e.g. in a calibration certificate of the measuring device.

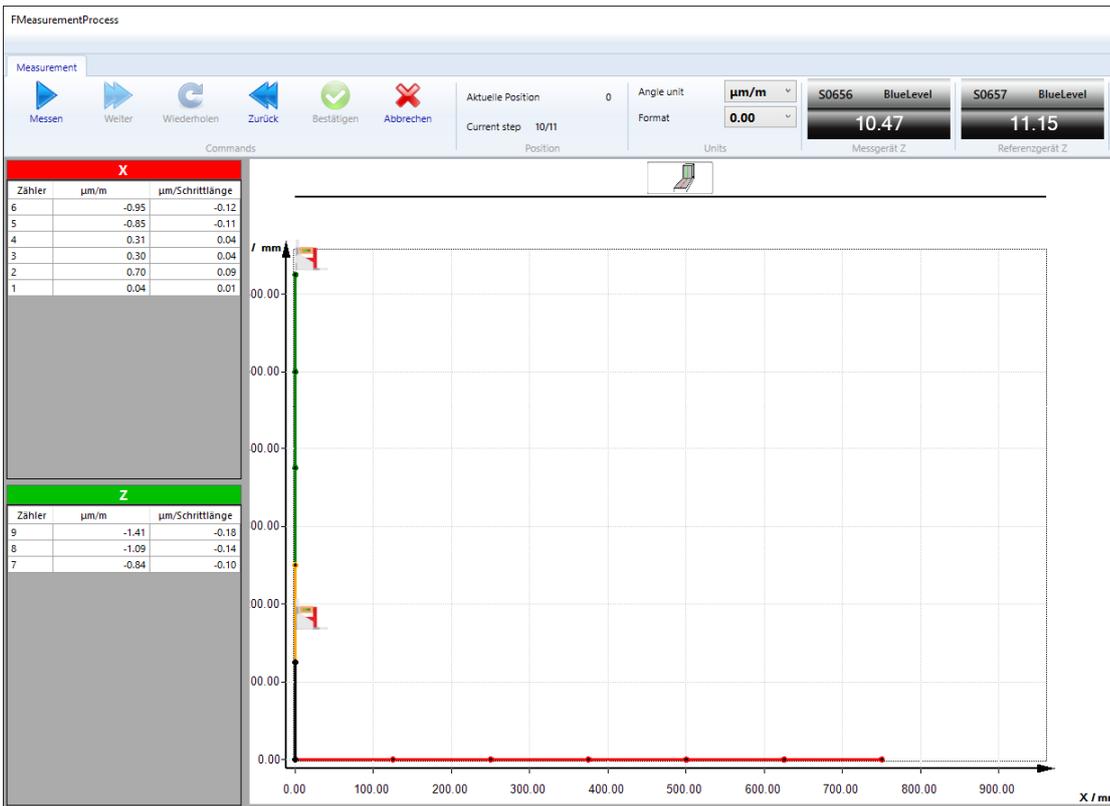
Determine: Select "Determine by measurement". The angular error of the measuring device will be determined via a [vertical reversal measurement](#), as described in a previous chapter.

Confirm the selection with "OK".

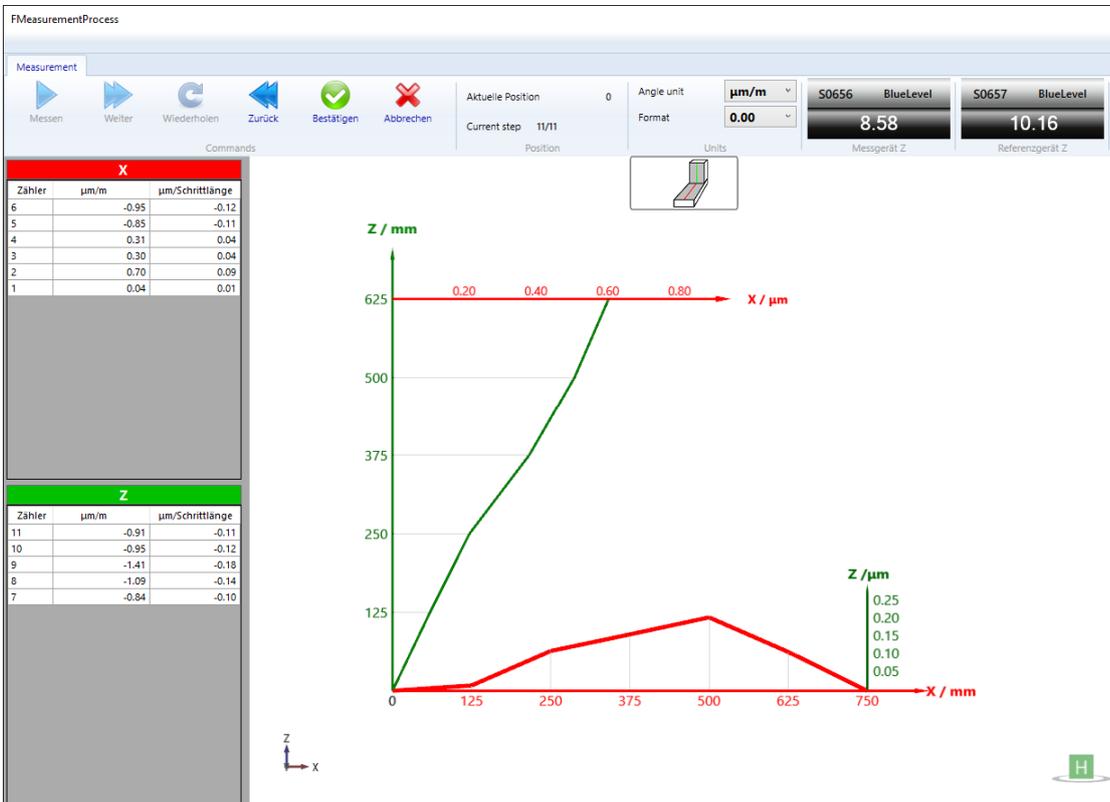
When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values of the horizontal line are displayed in the table "X" on the left.



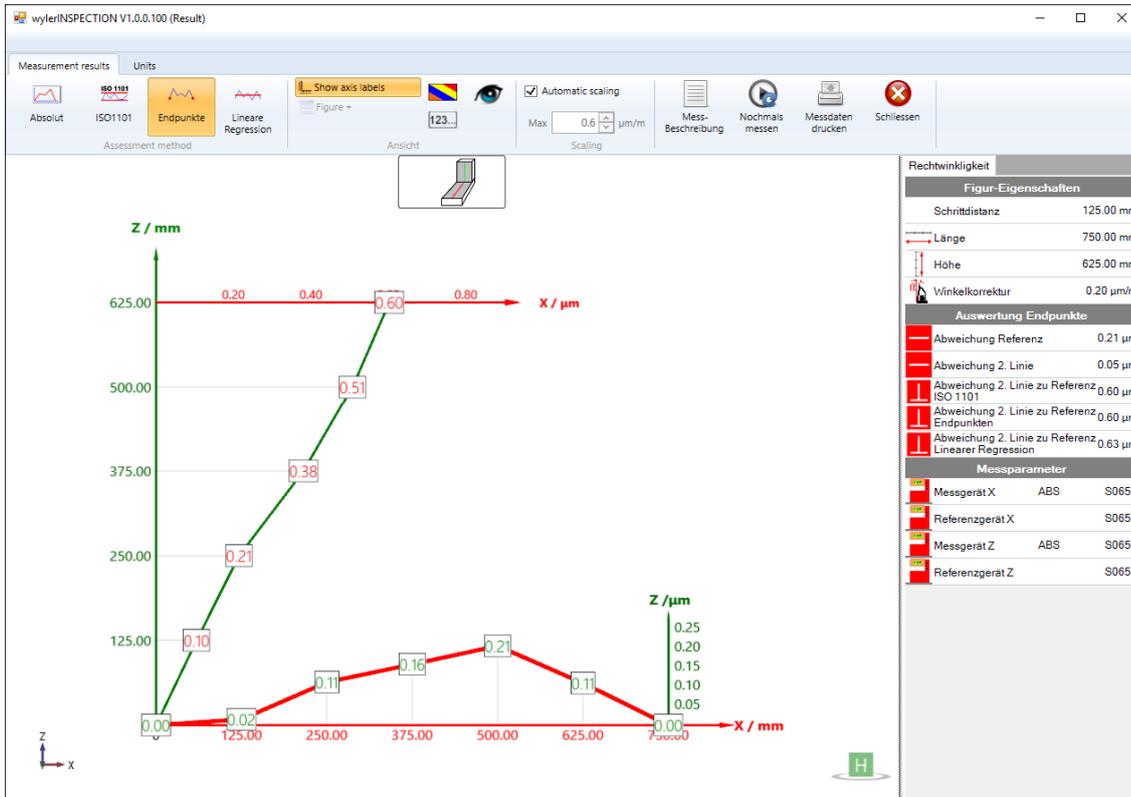
During the measurement the values of the vertical line are displayed in the table "Z" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown. If the measurement is okay it has to be confirmed by clicking on . With measurements can be repeated.

5.3.2.3 Interior angle right analyze

Analysis ISO1101, End points or Linear Regression.



Select the reference line with a click on it.

Analysis:

— Deviation reference = Biggest height difference in the line
Just this line according to the selected [evaluation method](#) without relation to the 2nd line.

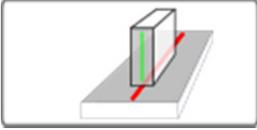
— Deviation 2nd line = Biggest height difference in the line
Just this line according to the selected [evaluation method](#) without relation to reference line.

⊥ Deviation 2nd line Reference ISO1101 = Highest value minus lowest value in L2.
The reference line is evaluated according to the selected evaluation method, the 2nd line according to ISO1101.

⊥ Deviation 2nd line Reference End points = Last value minus first value in L2.
The reference line is evaluated according to the selected evaluation method, the 2nd line according to End points.

⊥ Deviation 2nd line Reference Linear Regression = Height difference of the regression line in L2.
The reference line is evaluated according to the selected evaluation method, the 2nd line according to Linear regression.

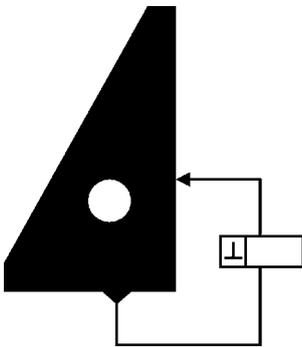
5.3.3 Squareness



Measurement of the squareness of a granite master square

Measuring task: Measurement of the squareness of a granite master square with previous determination of the instrument's angular error by using a granite parallel block in quality 000.
Procedure as per WYLER / SCS standard

[A detailed calibration procedure is available upon request for this standard procedure, developed by WYLER AG and accredited by the Swiss Accreditation Service. Such a calibration procedure will be supplied at a nominal charge.](#)



Remarks:

The calibration procedure mentioned is especially for the squareness measurement of different objects, mainly for master squares (WYLER Standard delivery programme) and similar objects.

Requirements:

- Accessories
 - Granite surface plate / the flatness of the reference surface must be better than 50% of the expected angular error
 - Master granite parallel block (Quality 000)
 - The reference surface of the square to be measured must be concave, this means the master square to be measured must have the contact points close to the end of the reference surface.
- Environmental conditions
 - Climate controlled measuring laboratory
 - The measuring instruments as well as the object to be measured must have been for at least two hours in the laboratory for proper acclimatization.

Restrictions:

- The procedure is only acceptable for objects with surfaces min. 50 mm wide
- If the angular error is more than 2 $\mu\text{m}/\text{m}$, then the allowable error of each of the surfaces of the square must be less than 60% of the angular error.
- The max. angular error must be less than +/- 100 $\mu\text{m}/\text{m}$

Principle of the measurement

- The flatness of both surfaces of the object enclosing the 90 degree angle must be measured according the standard calibration procedure WYLER "SCS_03.doc"
- The angular error of the measuring instrument must be determined according to the calibration procedure "SCS_WI1.doc"
- Measurement of the 90 degree angle of the master square and computing the angular error considering the calibration procedure "SCS_WI2.doc", the definition of the angular error is done according to ISO 1101.

General procedure of the measurement

- The existing angular error of the measuring instrument is to determine by using a master granite square (this is not a must)
- After this the actual measurement is done according to the requirements in different steps as described below.

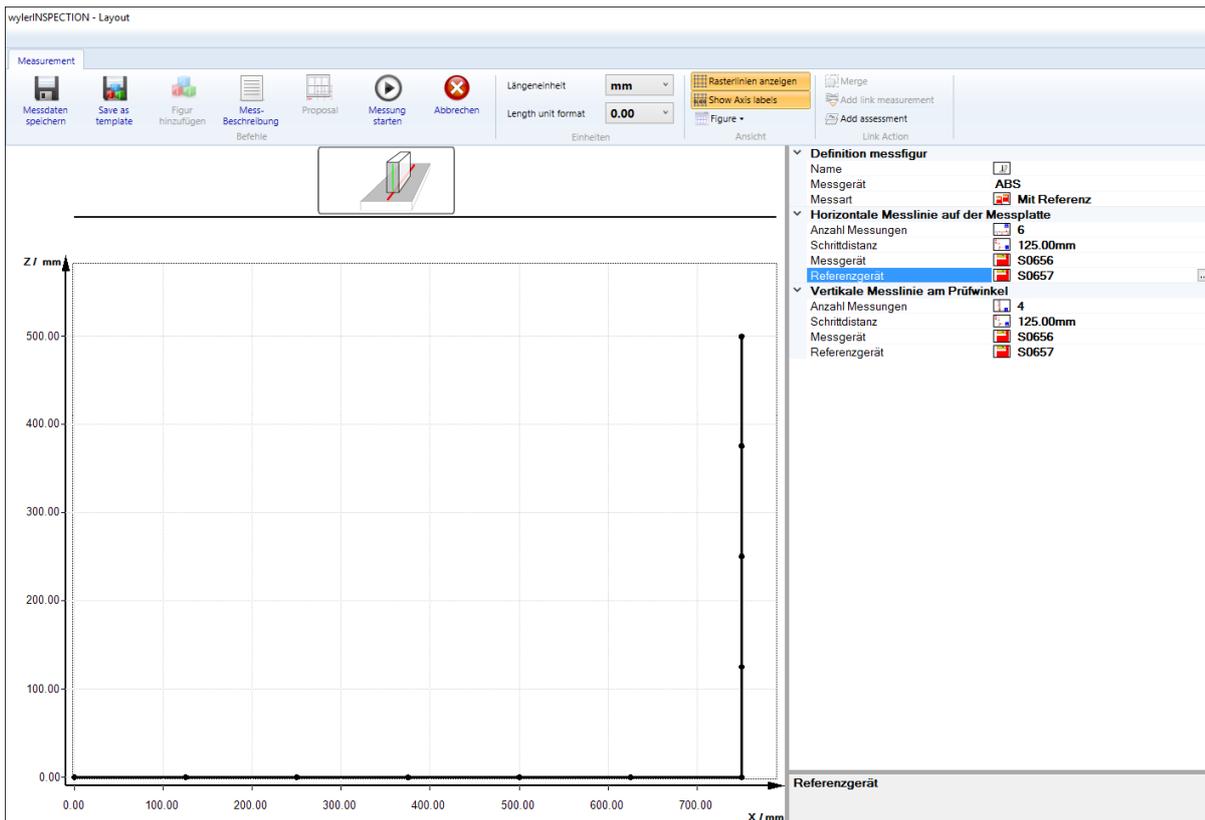
The measurement of the reference line is done according to the END POINT method. After the measurement is done different possibilities exist for the alignment of the second line. The result of the measurement is displayed will show three possible values depending on the alignment method chosen:

- Alignment according to the method "Endpoints"
- Alignment according to the method "ISO 1101"
- Alignment according to the method "linear Regression"

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.3.3.1 Squareness setup



Measuring parameter:

Definition measurement figure

Name Name of the figure
 Measuring device ABSolut requires at the begin of the measurement a [reversal measurement](#), RELativ nicht.

Way of measurement With reference
 Without reference
 Manual input

Horizontale Messlinie auf der Messplatte

Number of measurements Number of inclination measurements, the number of heights is bigger by 1.
 Steplength Steplength per measurement
 Measuring device [Selection](#) of the main measuring device, typischerweise das selbe Gerät welches für die Vertikalmessung verwendet wird.
 Reference device [Selection](#) of the reference device

Vertikale Messlinie am Prüfwinkel

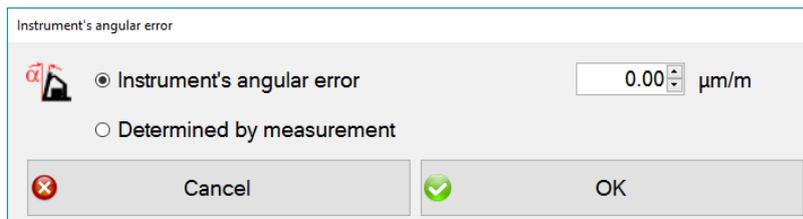
Number of measurements Number of inclination measurements, the number of heights is bigger by 1.
 Schrittweite Steplength per measurement
 Measuring device [Selection](#) of the main measuring device, dies muss ein Winkelmessgerät sein.
 Reference device [Selection](#) of the reference device

5.3.3.2 Squareness measure

Prior to the measurement angular error must be inserted or measured. In the dialog popping up this value can be inserted or measured via [vertical reversal measurement](#).

ATTENTION: If the measuring of a rectangular object is planned with two instruments (measuring and reference instrument), the **determination of the angular error of the measuring instrument must be performed with one instrument only**, the measuring instrument featuring an angular base. Please assign the measuring instruments as measuring respectively reference instrument well from the beginning when setting up the measuring configuration.

The reference instrument is deactivated during the determination of the angular error.



There are two possibilities:

Manual input: Select "Instrument's angular error" and insert into the field on the side the predefined value. This value can be found e.g. in a calibration certificate of the measuring device.

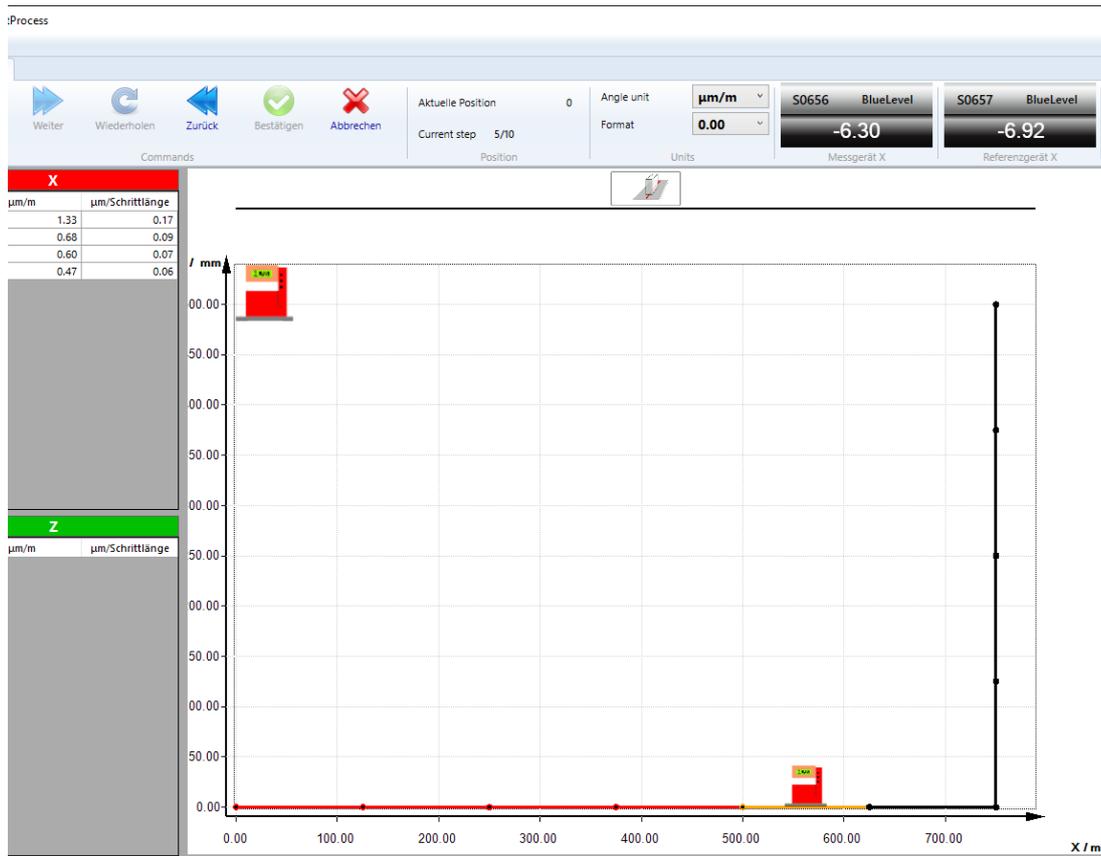
Determine: Select "Determine by measurement". The angular error of the measuring device will be determined via a [vertical reversal measurement](#), as described in a previous chapter.

Confirm the selection with "OK".

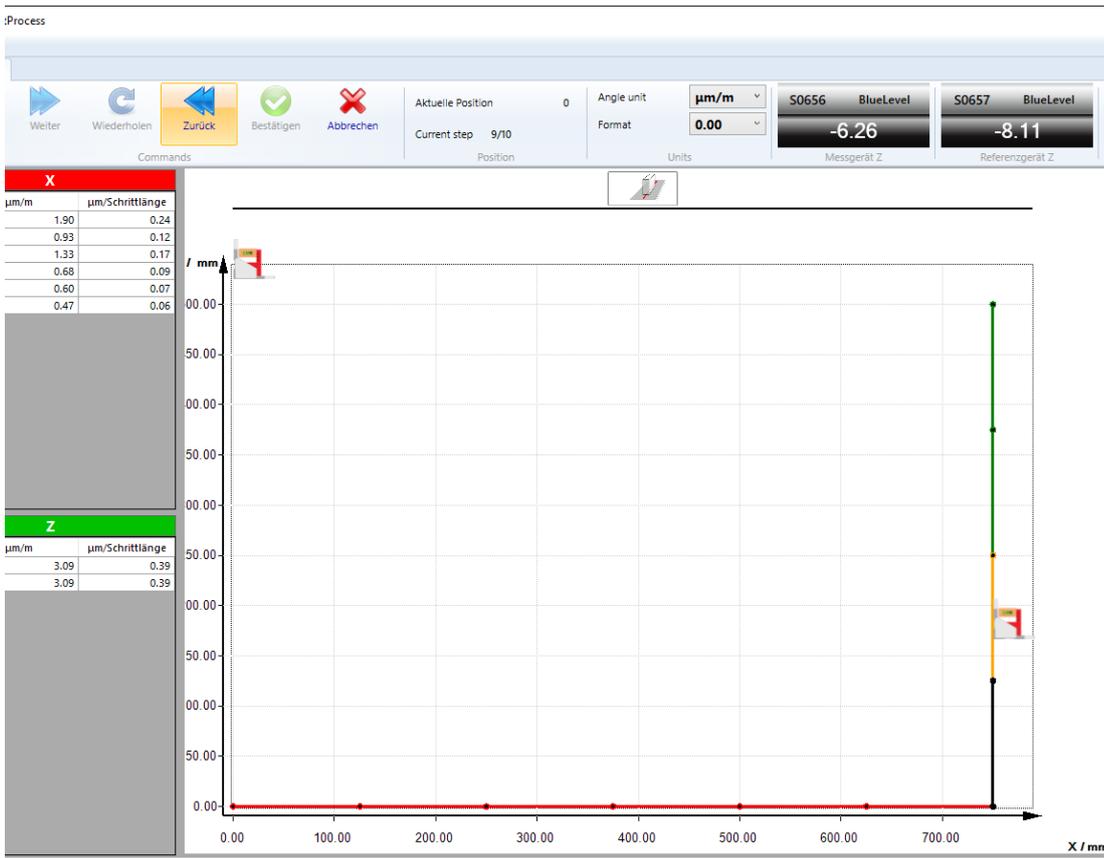
Important remark:

For master squares planned to be used mainly in "upright" position on a reference surface the measurement of one side can be done on a defined reference area of a surface plate. The flatness of this reference area must be better than 50% of the expected angular error. It is important that the contact points of the master square to be measured must be close to the end of the reference side (defined support).

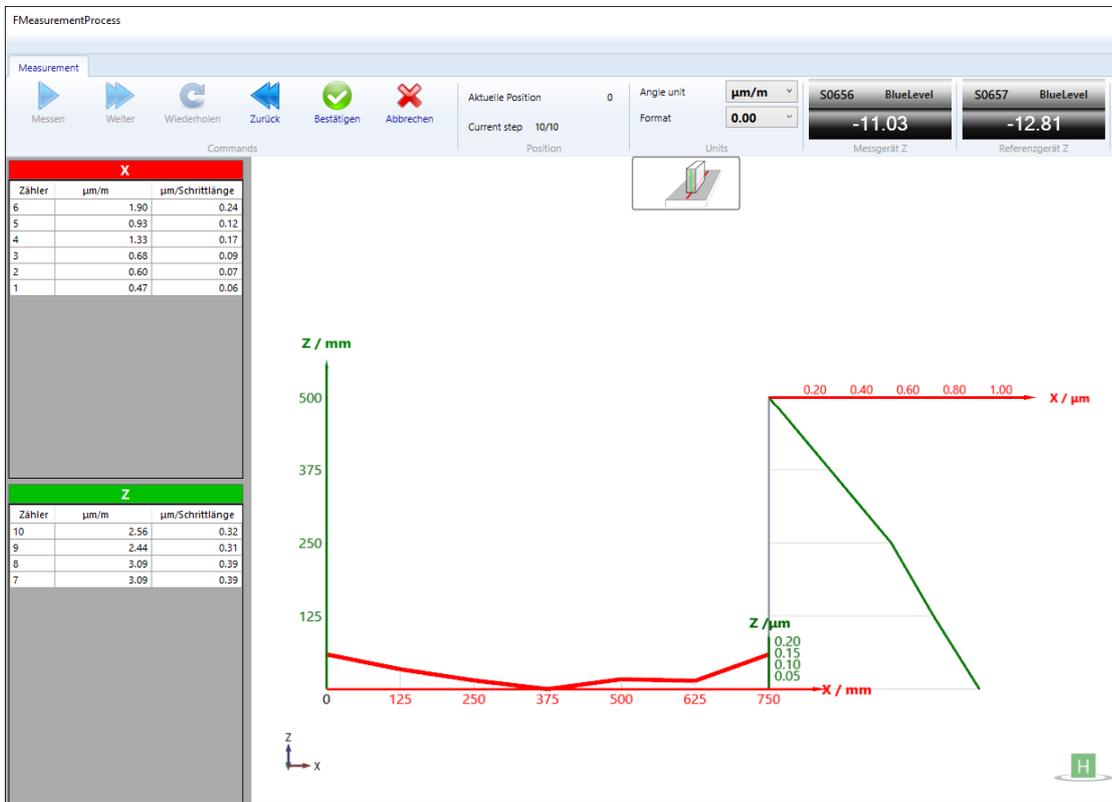
When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values of the horizontal line are displayed in the table "X" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



During the measurement the values of the vertical line are displayed in the table "Z" on the left.

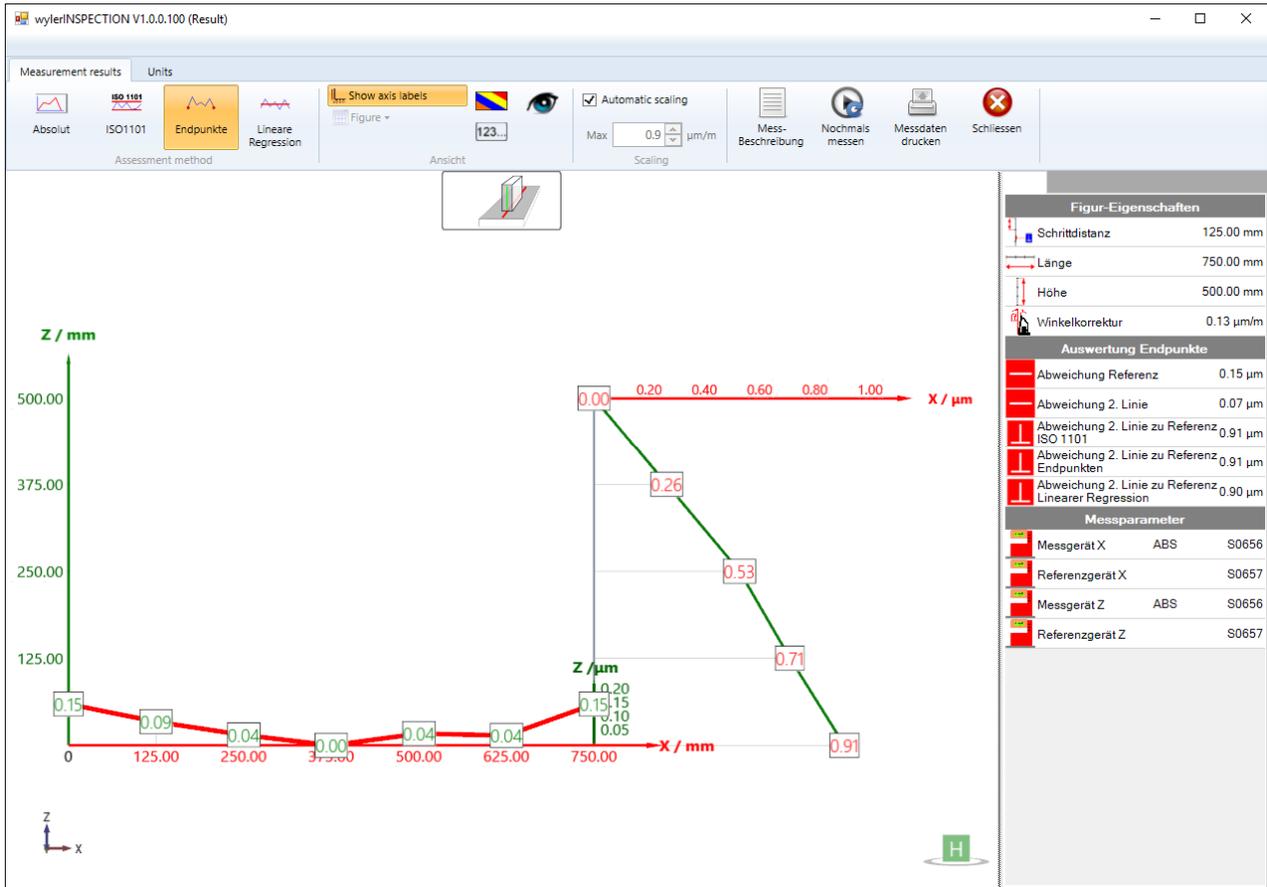


After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.3.3.3 Squareness analyze



Contrary to the other measurements of 90 degree angles the alignment method used for **the reference line of the master squares** is exclusively according to **“ENDPOINTS”**. The mayor reason being the fact that the reference line is required to be concave. Therefore the results would be the same no matter what alignment chosen.

The angular error of the second line is displayed in 3 different ways. Thereby please be aware that in case of the SCS calibration the alignment method used is according to ISO 1101 or according to the method “Endpoints”. The error according to "linear regression" is for information purposes only.

Analysis:

— **Deviation reference** = Biggest height difference in the line
Just this line according to the selected [evaluation method](#) without relation to 2nd line.

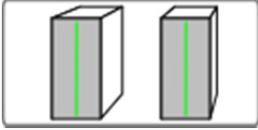
— **Deviation 2nd line** = Biggest height difference in the line
Just this line according to the selected [evaluation method](#) without relation to reference line.

⊥ **Deviation 2nd line Reference ISO1101** = Highest value minus lowest value in L2.
The reference line is evaluated according to the selected evaluation method, the 2nd line according to ISO1101.

⊥ **Deviation 2nd line Reference End points** = Last value minus first value in L2.
The reference line is evaluated according to the selected evaluation method, the 2nd line according to End points.

⊥ **Deviation 2nd line Reference Linear Regression** = Height difference of the regression line in L2.
The reference line is evaluated according to the selected evaluation method, the 2nd line according to Linear regression.

5.3.4 Two vertical lines side by side

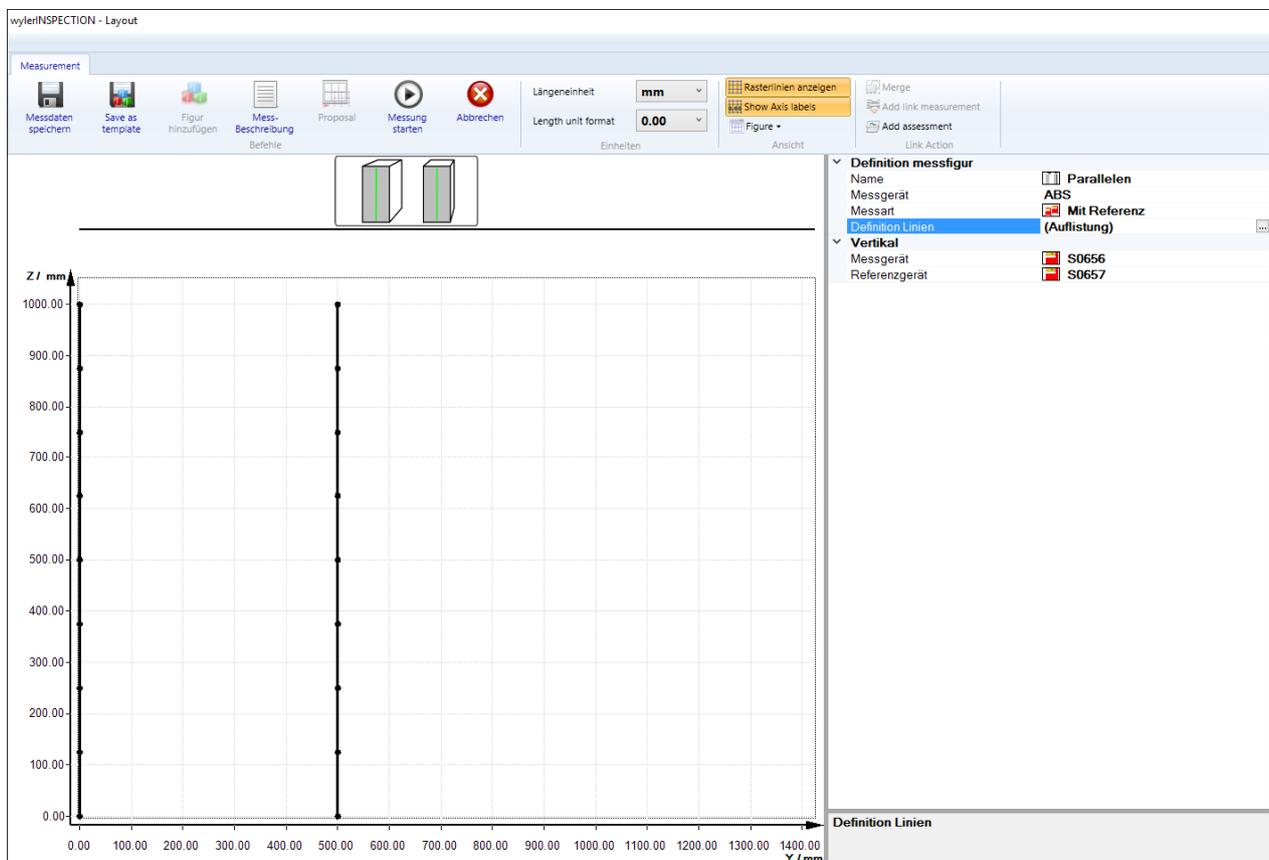


Measurement of two vertical lines side by side. Alignment according to a selectable line following the methods **End points**, **ISO1101** or **linear Regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyse](#)

5.3.4.1 Two vertical lines side by side setup



Measuring parameter:

Definition measurement figure

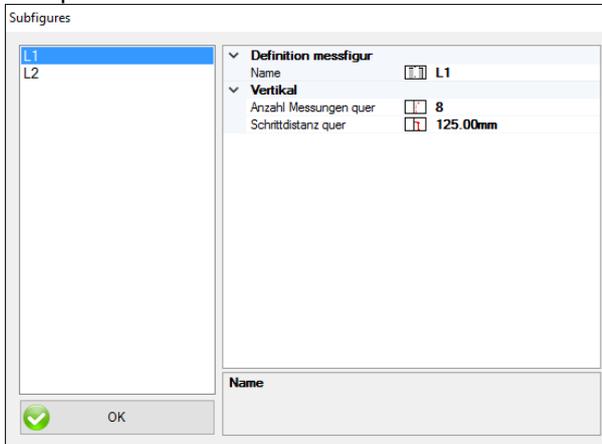
Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ nicht.
Way of measurement	With reference Without reference Manual input
Definition Lines	Open a dialog to define each line

Vertical

Measuring device [Selection](#) of the main measuring device

Reference device [Selection](#) of the reference device

Setup of the lines:



On the left side the figure to setup can be selected.

Definition measurement figure

Name Name of the line

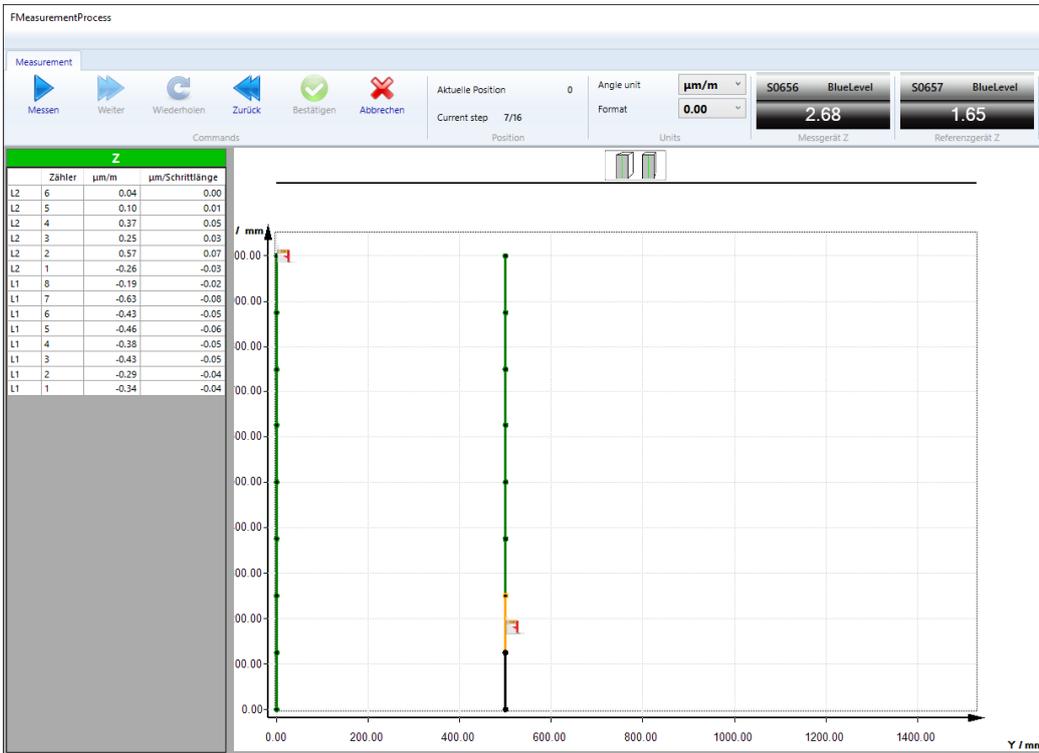
Vertical

Number of measurements quer Number of inclination measurements, the number of heights is bigger by 1.

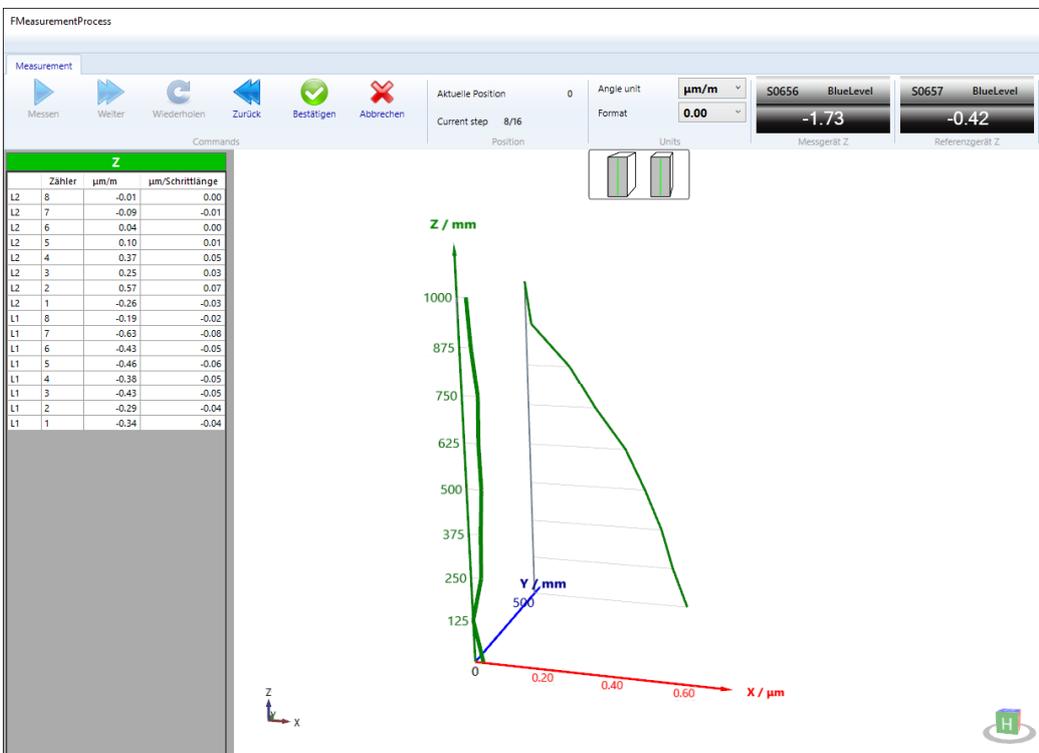
Steplength quer Steplength per measurement

5.3.4.2 Two vertical lines side by side measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.

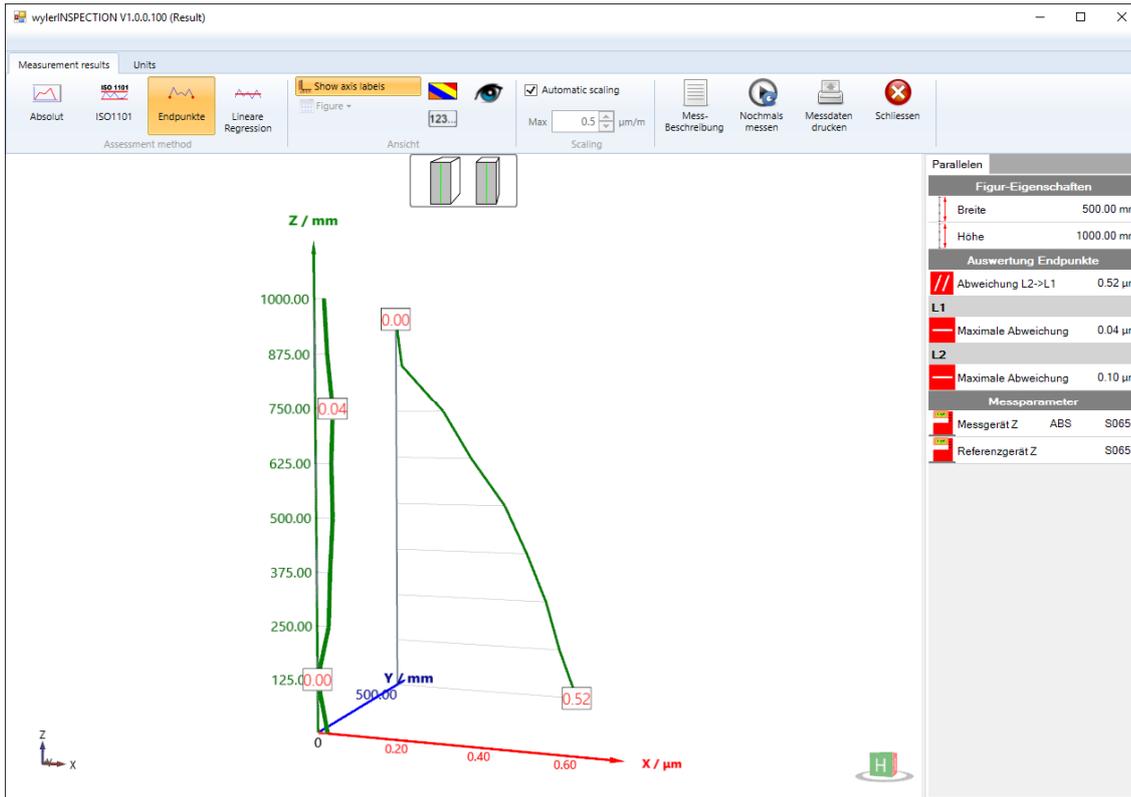


During the measurement the values of the vertical lines are displayed in the table "Z" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown. If the measurement is okay it has to be confirmed by clicking on . With measurements can be repeated.

5.3.4.3 Two vertical lines side by side analyze



Select the reference line with a click on it.

Analysis:

/// Deviation L2 -> L1

differs according to the evaluation method.

End points: Last value minus first value in L2

ISO1101: Highest value minus lowest value in L2

Linear regression: Height difference in the regression line L2

— Maximal deviation = Biggest height difference in the line

5.3.5 Two vertical lines inside opposed



Measurement of two vertical lines inside opposed. Alignment according to a selectable line following the methods **End points**, **ISO1101** or **linear Regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.3.5.1 Two vertical lines inside opposed setup

The screenshot shows the wylerSPEC 1.0.0.158 (Layout) software interface. The main window displays a 2D coordinate system with a vertical Z-axis (0 to 1000 mm) and a horizontal Y-axis (0 mm). Two vertical lines are plotted, representing the measurement setup. The right sidebar shows the 'Definition Messfigur' panel with the following settings:

- Name: Parallelen
- Messgerät: ABS
- Messart: Mit Referenz (Aufstufung)
- Definition Linien: (empty)
- Vertikal: (empty)
- Messgerät: S0657
- Referenzgerät: S0656
- Figur: (empty)
- Größe: L:0 W:1000 H:1000

Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ nicht.
Way of measurement	With reference Without reference Manual input
Definition Lines	Open a dialog to define each line

Vertical

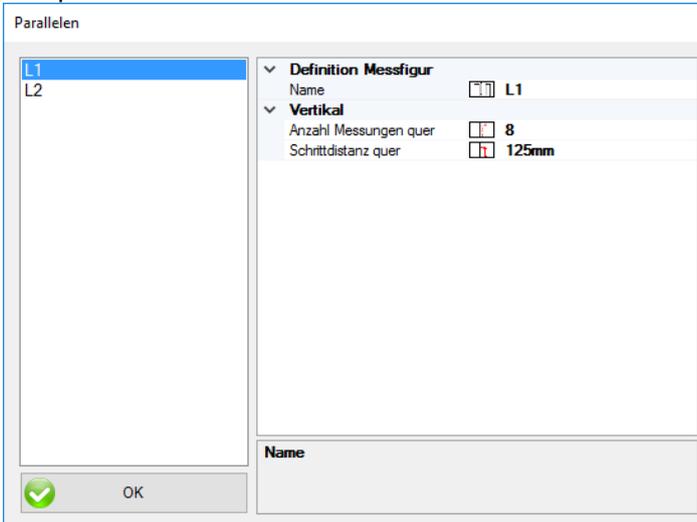
Measuring device [Selection](#) of the main measuring device

Reference device [Selection](#) of the reference device

Figur

Size Length, width and height of the figure

Setup of the line:



On the left side the figure to setup can be selected.

Definition measurement figure

Name Name of the line

Vertical

Number of measurements quer Number of inclination measurements, the number of heights is bigger by 1.

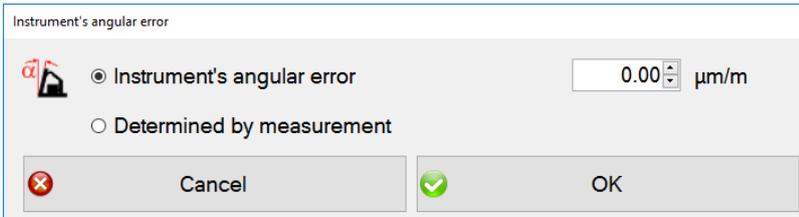
Steplength quer Steplength per measurement

5.3.5.2 Two vertical lines inside opposed measure

Prior to the measurement angular error must be inserted or measured. In the dialog popping up this value can be inserted or measured via [vertical reversal measurement](#).

ATTENTION: If the measuring of a rectangular object is planned with two instruments (measuring and reference instrument), the **determination of the angular error of the measuring instrument must be performed with one instrument only**, the measuring instrument featuring an angular base. Please assign the measuring instruments as measuring respectively reference instrument well from the beginning when setting up the measuring configuration.

The reference instrument is deactivated during the determination of the angular error.



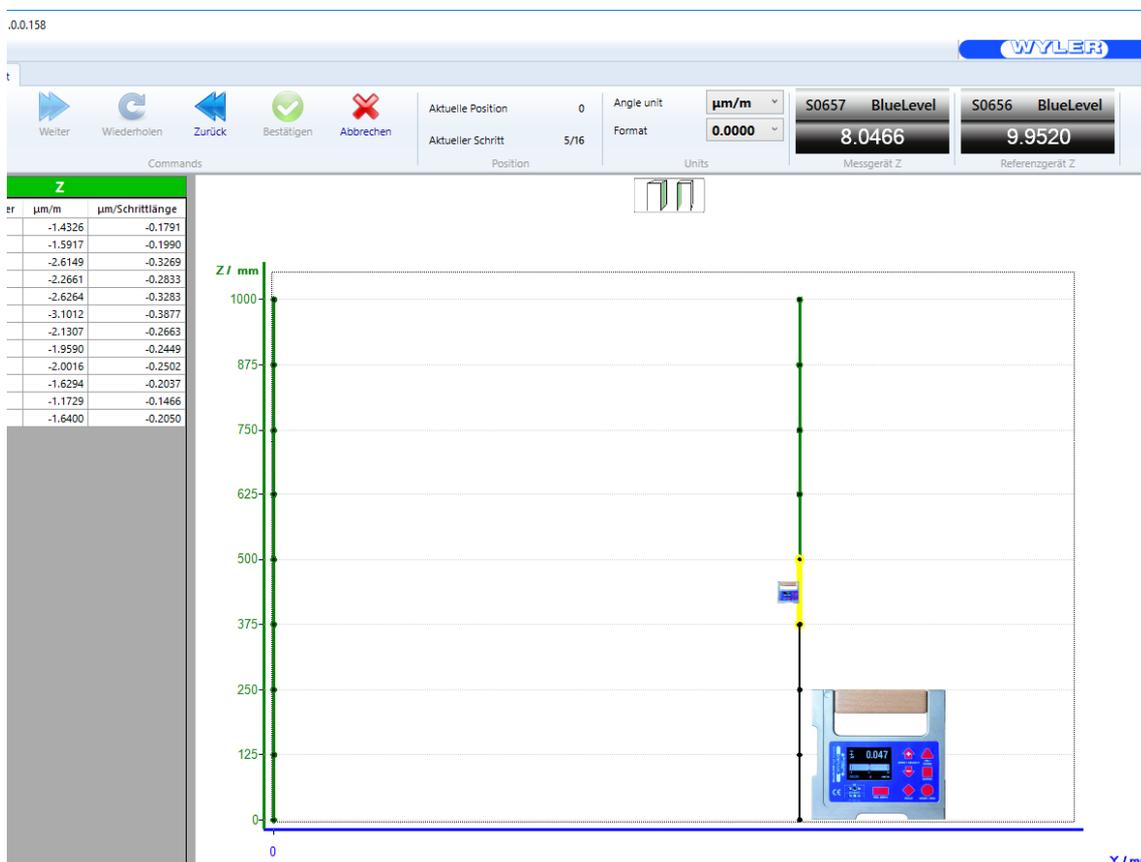
There are two possibilities:

Manual input: Select "Instrument's angular error" and insert into the field on the side the predefined value. This value can be found e.g. in a calibration certificate of the measuring device.

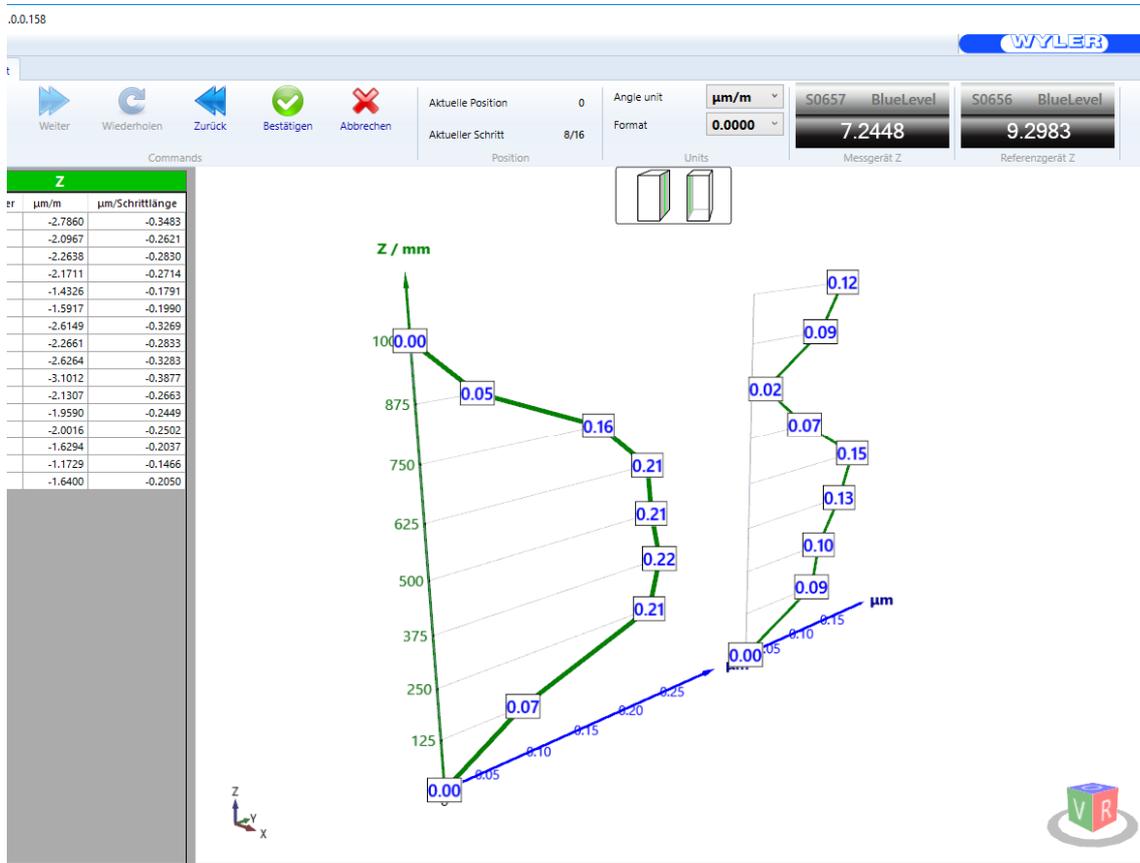
Determine: Select "Determine by measurement". The angular error of the measuring device will be determined via a [vertical reversal measurement](#), as described in a previous chapter.

Confirm the selection with "OK".

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.

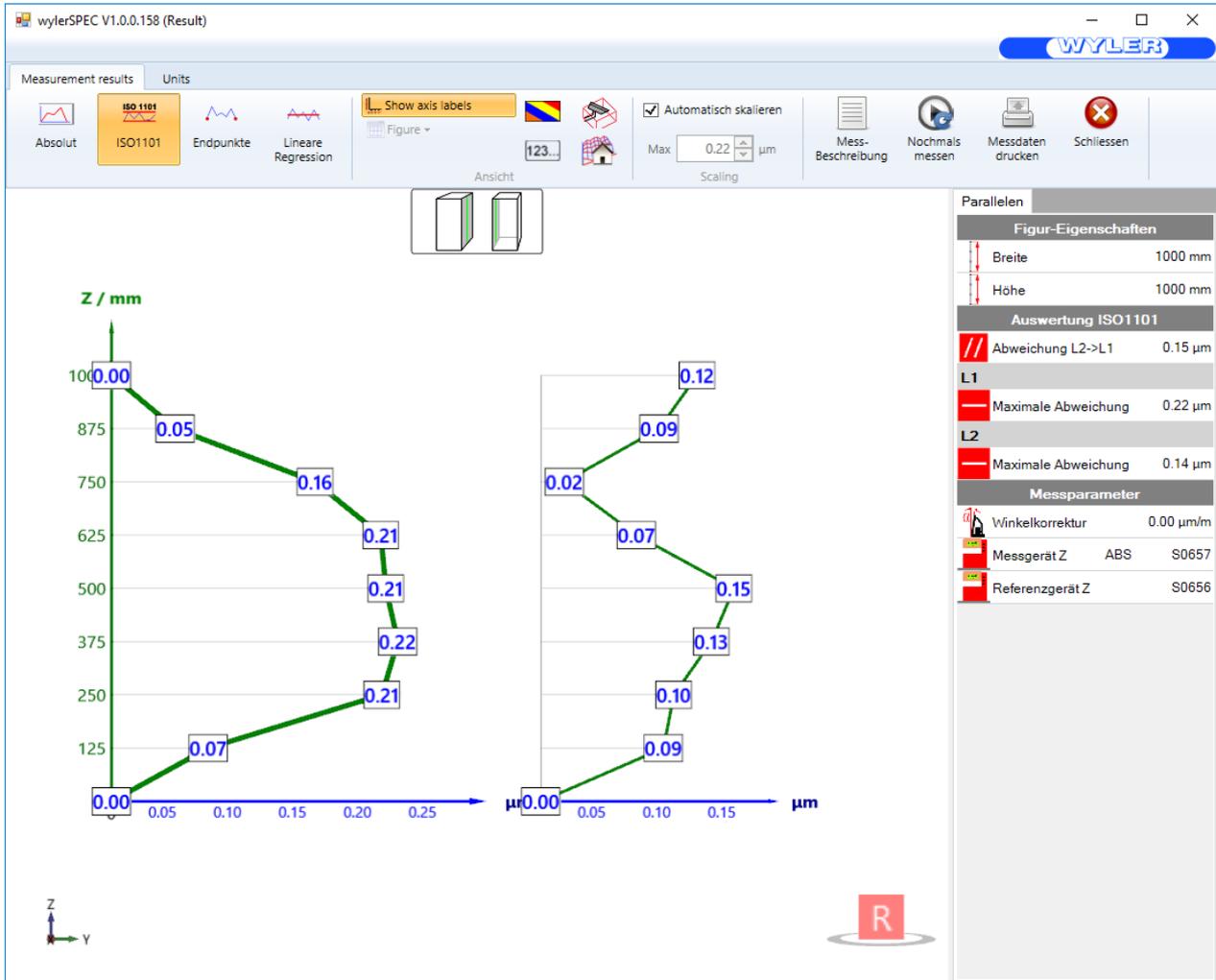


During the measurement the values of the vertical lines are displayed in the table "Z" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown. If the measurement is okay it has to be confirmed by clicking on . With  measurements can be repeated.

5.3.5.3 Two vertical lines inside opposed analyze



Select the reference line with a click on it.

Analysis:

// Deviation L2 -> L1

differs according to the evaluation method.

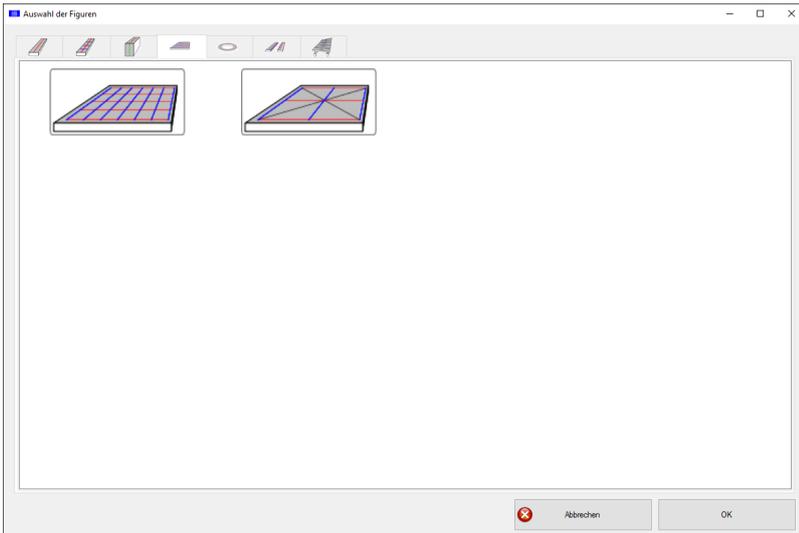
End points: Last value minus first value in L2

ISO1101: Highest value minus lowest value in L2

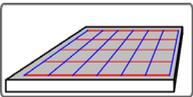
Linear regression: Height difference in the regression line L2

— Maximal deviation = Biggest height difference in the line

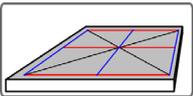
5.4 Flattness



A double click takes you to the page to setup the corresponding measurement.

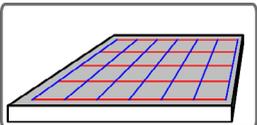


[Flattnes with Grid](#) / [Flattness partial](#)



[Flattnes - U-Jack](#)

5.4.1 Flattnes with grid



Measurement flattness of sufaces; alignment "Absolut", "ISO1101", "End points" in X and Y direction and "Linear regression".

Procedure:

1. [Setup](#)
 - 1D-Device**
 - 2a [Measure](#)
 - .
 - 3a [Analyze](#)
 - .
 - 2D-Device**
 - 2b [Measure 2D](#)
 - .
 - 3b [Analyze 2D](#)
 - .

Remarks concerning the flatness measurement:

a) Standards

Please consult DIN 876 / Part 1, when measuring flatness

b) Measuring steps

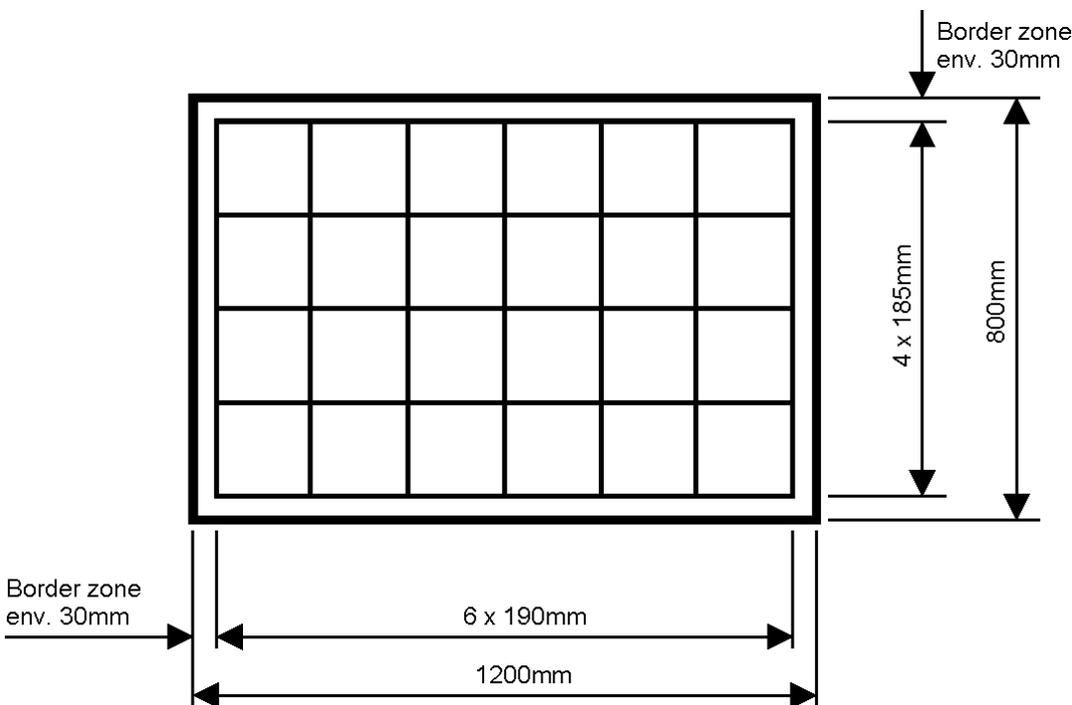
The object to be measured must be adjusted horizontally in both directions (longitudinal and transversal) as well as possible (within approx. 50 µm/m). If not done so measuring errors may occur if the measuring instrument is not placed exactly in line with the measuring direction.

The object must now be divided in the measuring step length. The step length has to be such that an equal dimension of overlapping of the base length with each step is possible. At the same time the optimal step length as described earlier must be considered.

The best possible step length when using a 150 mm base is 126 mm.

As a guideline it should be noted that the worse the surface quality (roughness, buckling) the more important is a precise overlapping in order to avoid measuring errors. When calculating the measuring steps it is important to make sure that the base as a whole comes to lay on the surface when placed at the first and last measuring position (no protrusion) as this would also cause unacceptable measuring errors.

The grid is to be marked on the surface plate with a pencil that does not apply a thick layer. This is especially important doing high precision measurements.



In our example the calculation was based on the border zone of 20, resp. 30 mm on the side. The remaining distance is divided by the optimal step length, and then the figure set to either the next higher or lower round figure. The originally defined remaining distance must now be divided by the new fixed number of steps whereas the newly calculated figure is the step length to chose.

$$1200 \text{ mm} - (2 \times 30 \text{ mm}) = 1140 \text{ mm}$$

$$1140 \text{ mm} / 170 \text{ mm} = 6.7 \text{ steps} = 6 \text{ Steps}; 1140 \text{ mm} / 6 = \underline{\underline{190 \text{ mm step length longitudinal}}}$$

The same method is to be applied for the other direction with a length of 800 mm

On the side of the base the step length may be marked. Also the middle of the base may be marked at the front and at the end. By doing so it is assured that the measuring instrument is always placed correctly at the spot required.

See also DIN 876 / Part 1

Optimal step length in relation to the base length

Length of measuring base	Optimal measuring step length	Recommended range of measuring step length
110 mm	90 mm	85 ... 105 mm
150 mm	126 mm	120 ... 145 mm
200 mm	170 mm	160 ... 190 mm

As an alternative the “Grid Proposal” can be used for a possible layout of the grid to be measured. See details in the following example.

5.4.1.1 Flattnes with grid setup

When measuring a surface with measuring grid wylerSPEC offers proposals for possible grid dispositions.

The button  leads to [these proposals](#).

Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut, RELative
Way of measurement	With reference Without reference Manual input

Longitudinal

Number of measurements	Number of inclination measurements, the number of heights is bigger by 1
Steplength	Steplength per measurement

Measuring density Number of measurements between transversal lines
 Measuring device [Selection](#) of the main measuring device
 Reference device [Selection](#) of the reference device

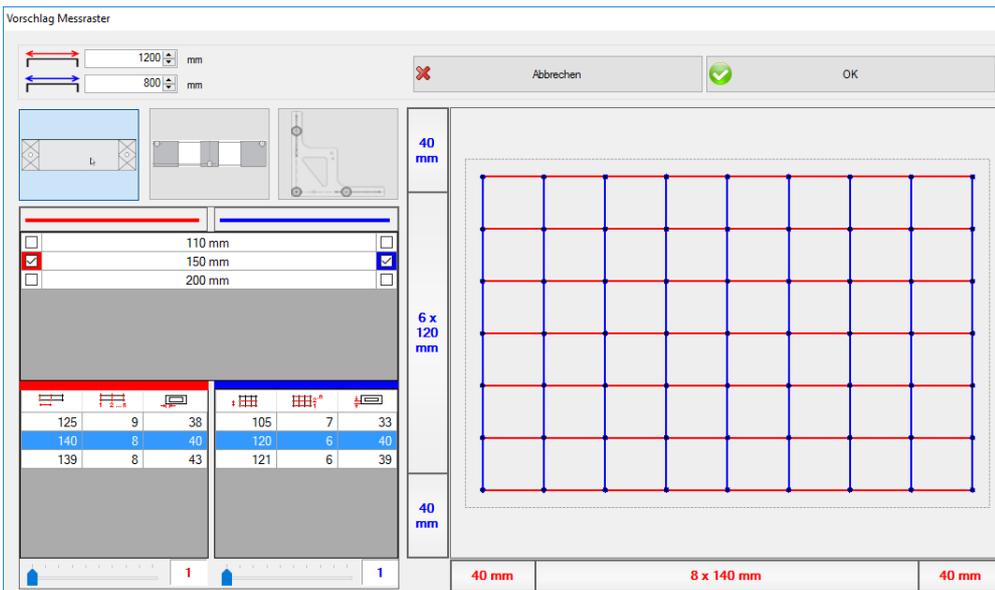
Transversal

Number of measurements Number of inclination measurements, the number of heights is bigger by 1
 Steplength Steplength per measurement
 Measuring density Number of measurements between longitudinal lines
 Measuring device [Selection](#) of the main measuring device
 Reference device [Selection](#) of the reference device

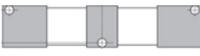
If a BlueLEVEL-2D is used and its X- and Y-measuring direction corresponds to the longitudinal and transversal direction, then the longitudinal and the transversal direction are measured at the same time. The [procedure of the measurement](#) differs accordingly.

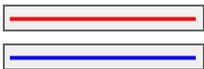
5.4.1.1.1 Grid proposal

wylerSPEC can calculate a proposal for a given plate and a selectable measuring base.



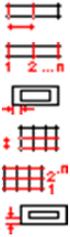
Inputs:

-  Length of the plate (x-direction)
-  Width of the plate (y-direction)
-  Flat base
-  Flex base
-  Variobasis 2D



Choice of steplength in x-direction
Choice of steplength in y-direction

Rastervorschlag:



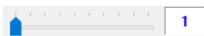
Steplength longitudinal (x-direction)
Number of steps longitudinal (x-direction)
Border zone longitudinal to middle of measuring base
Steplength transversal (y-direction)
Number of steps transversal (y-direction)
Border zone transversal to middle of measuring base

Measuring density



Measuring density longitudinal (x-direction)

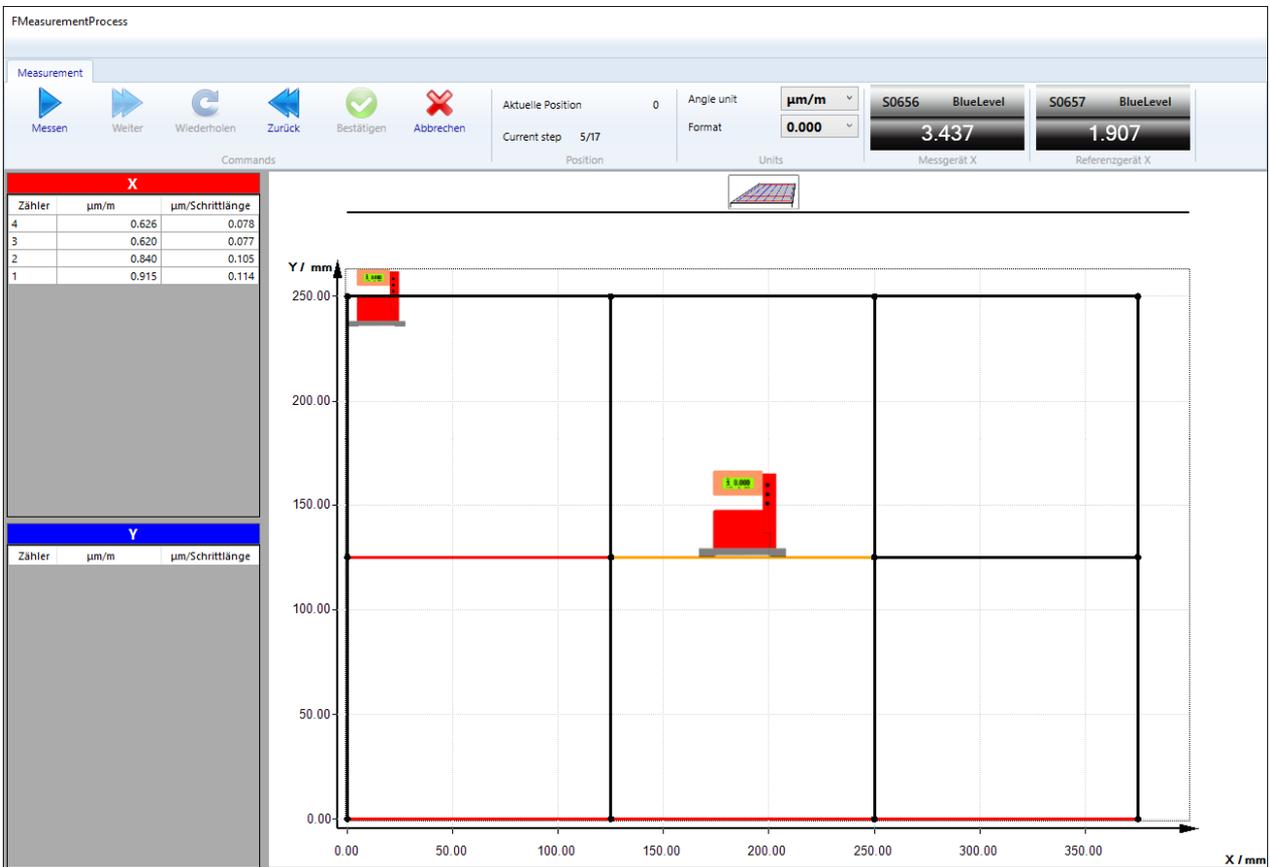
Move the control button with the mouse. Whole numbers only can be used as relations to the number of steps.



Measuring density transversal (y-direction)

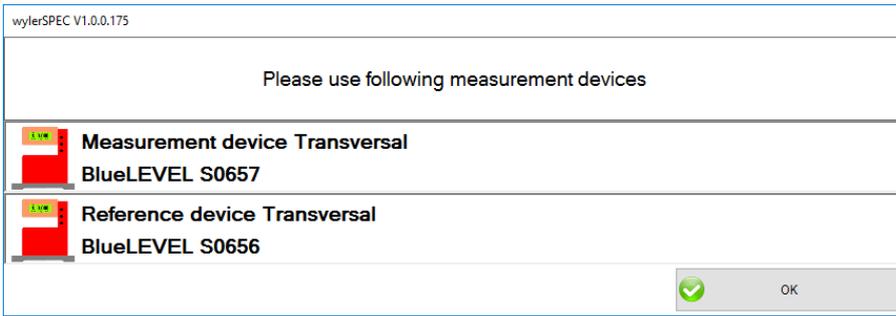
5.4.1.2 Flattnes with grid measure 1D-Devices

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.

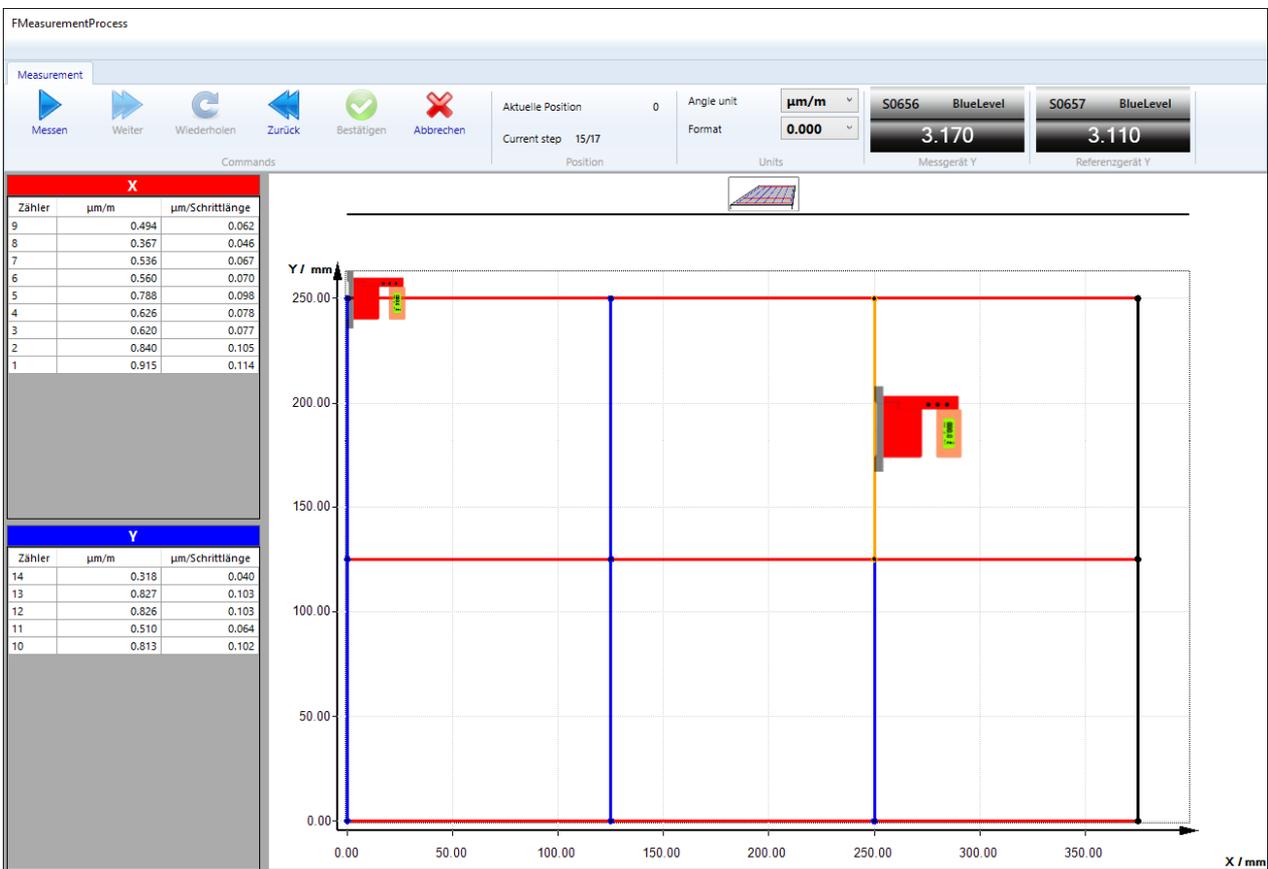


During the measurement the values are displayed in the table "X" on the left.

If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



For the measurements in X and Y direction it is possible to use different devices. At the change of the measuring direction there is a message telling to use the other device.



During the measurement the values are displayed in the table "Y" on the left.

FMeasurementProcess

Measurement

Messen Weiter Wiederholen Zurück Bestätigen Abbrechen

Commandes

Aktuelle Position 0 Angle unit $\mu\text{m}/\text{m}$ S0656 BlueLevel S0657 BlueLevel

Current step 17/17 Position Format 0.000

Messgerät Y 0.888 Referenzgerät Y 1.436

Units

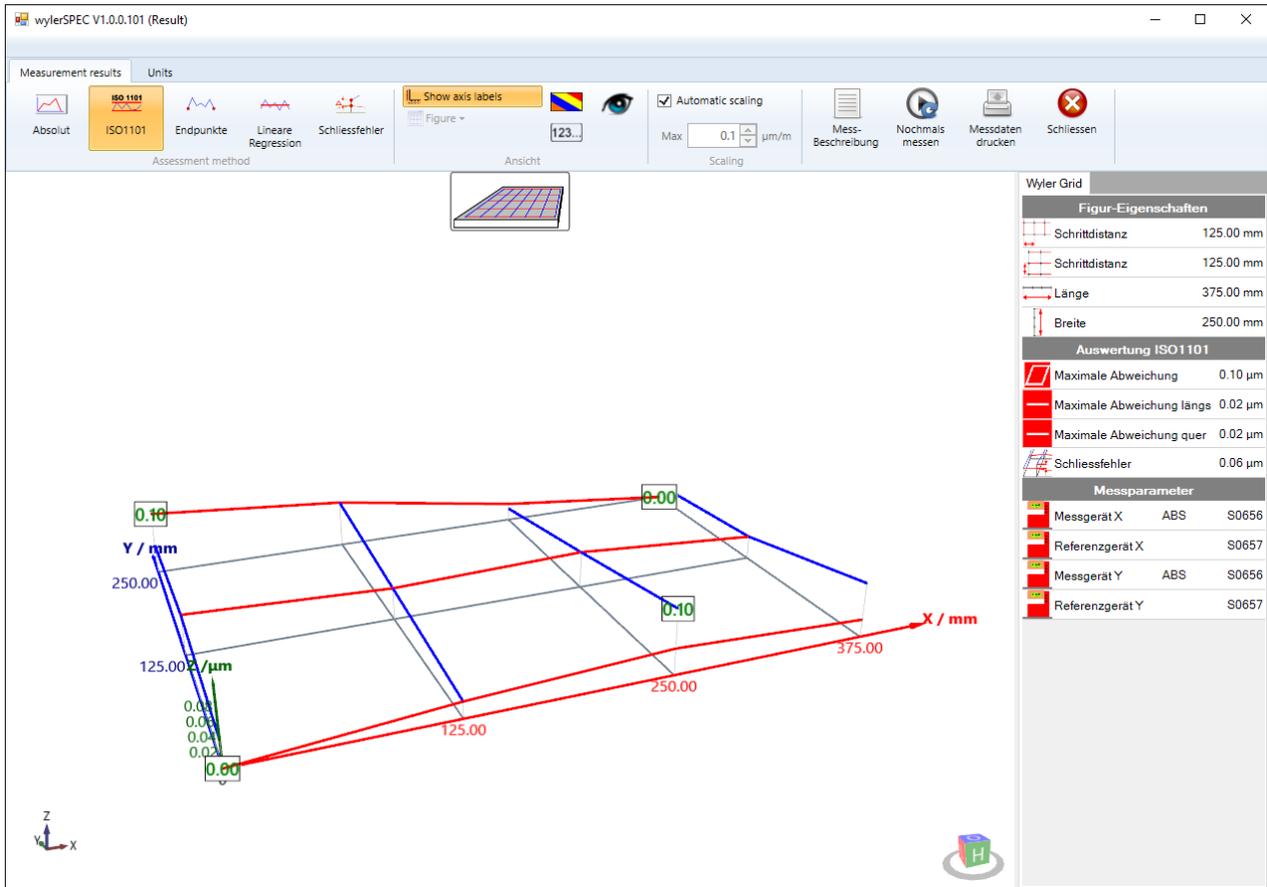
X		
Zähler	$\mu\text{m}/\text{m}$	$\mu\text{m}/\text{Schrittlänge}$
9	0.494	0.062
8	0.367	0.046
7	0.536	0.067
6	0.560	0.070
5	0.788	0.098
4	0.626	0.078
3	0.620	0.077
2	0.840	0.105
1	0.915	0.114

Y		
Zähler	$\mu\text{m}/\text{m}$	$\mu\text{m}/\text{Schrittlänge}$
17	0.519	0.065
16	0.275	0.034
15	0.342	0.043
14	0.318	0.040
13	0.827	0.103
12	0.826	0.103
11	0.510	0.064
10	0.813	0.102

After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.4.1.3 Flatness with grid analyze 1D-Devices

Analysis [Absolut](#), [ISO1101](#), [End points](#) or [linear regression](#).



Analysis without [Closing error](#):

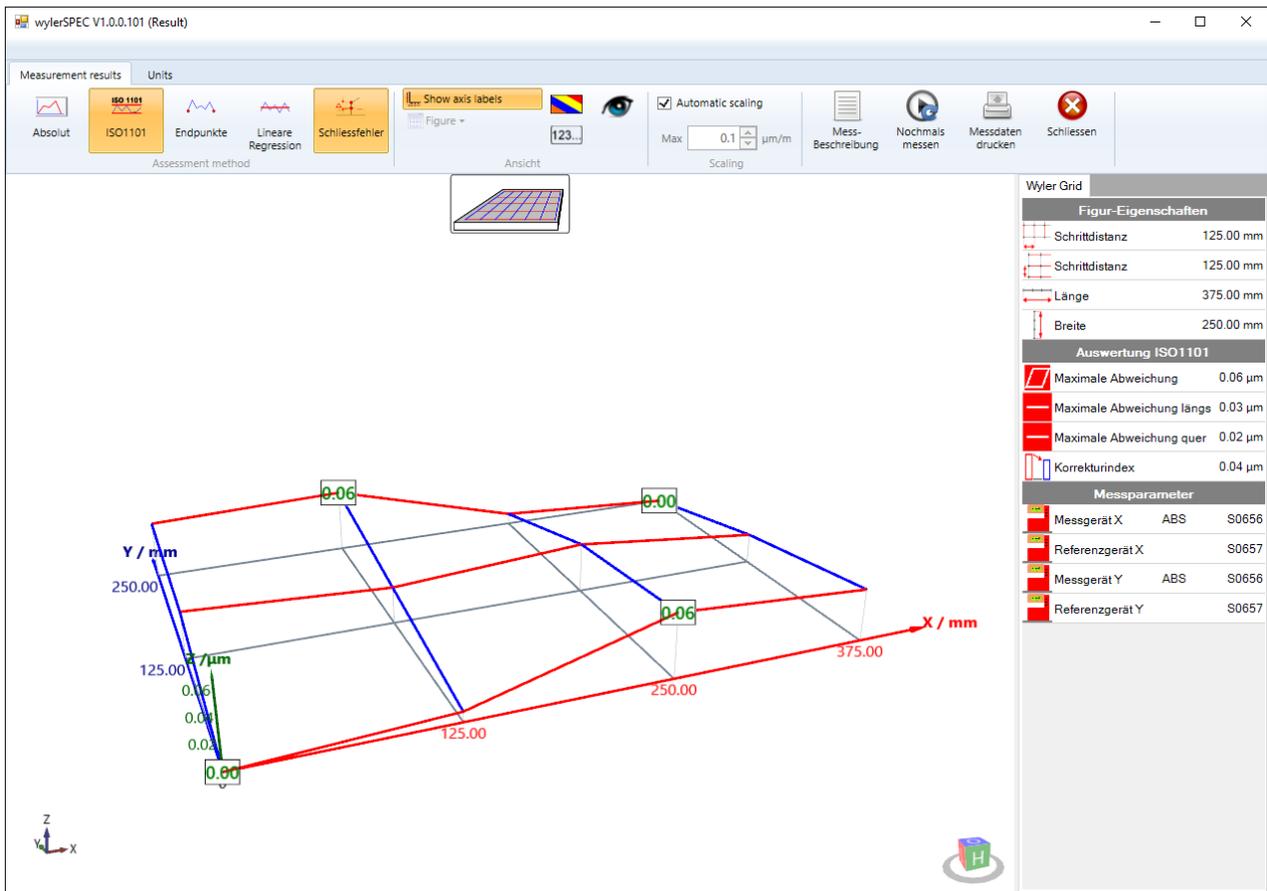
 **Maximal deviation** = Biggest height difference with the selected evaluation method (End points, ISO1101 or linear regression)

 **Maximal deviation longitudinal** = Maximum error of the lines longitudinal

 **Maximal deviation transversal** = Maximum error of the lines transversal

 **Closing error** = Maximal closing error. As a general rule the closure error should not be more than 20% to 25% of the maximum error. If the maximum error is less than 4 μm the closure error may exceed the above-mentioned values.

 **Quality standard** = Grading according to the selected [Quality standard](#)



Analysis with [Closing error](#):

 **Maximal deviation** = Biggest height difference with the selected evaluation method (End points, ISO1101 or linear regression)

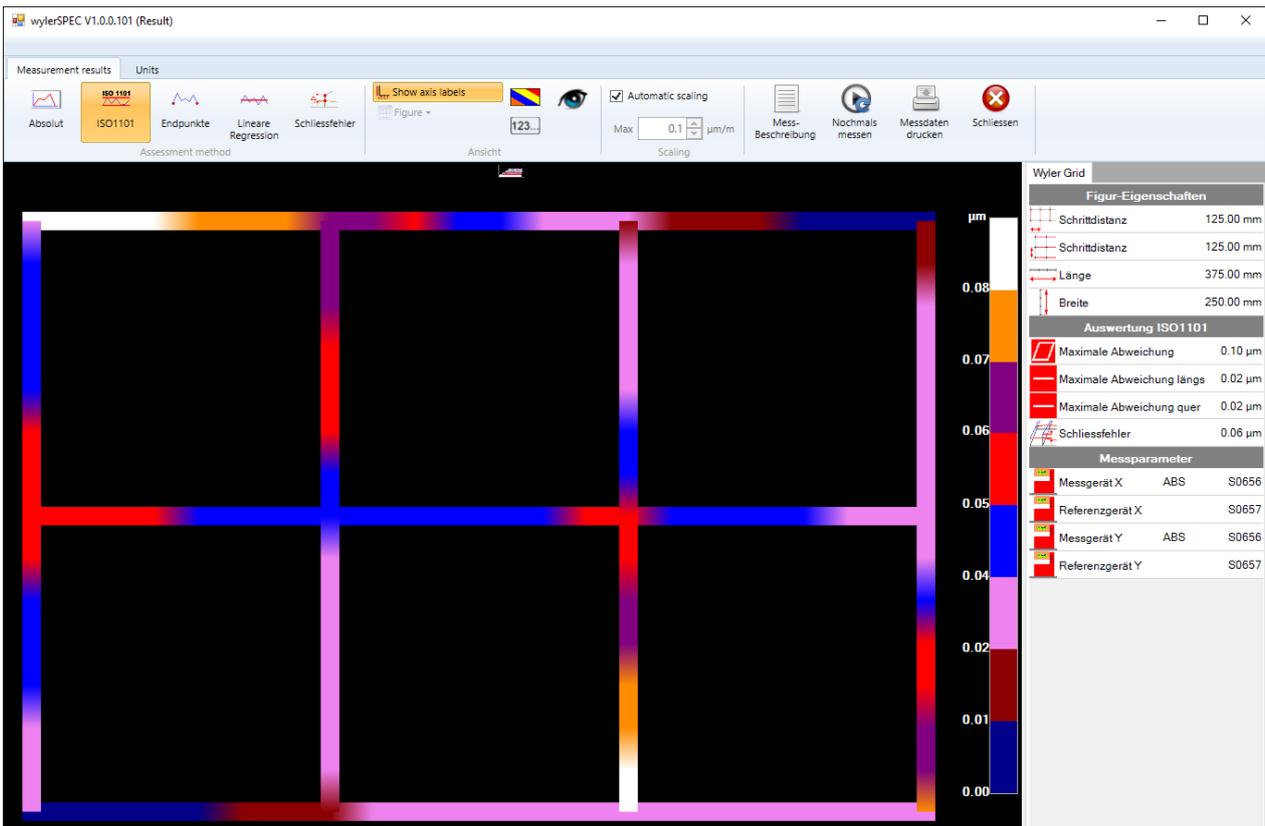
 **Maximal deviation longitudinal** = Maximum error of the lines longitudinal

 **Maximal deviation transversal** = Maximum error of the lines transversal

 **Index of correction** = Index of the closing error correction. The index of correction is the result of all the standard deviations of the closure errors.

 **Quality standard** = Grading according to the selected [Quality standard](#)

With the button  differently colored representations can be selected.



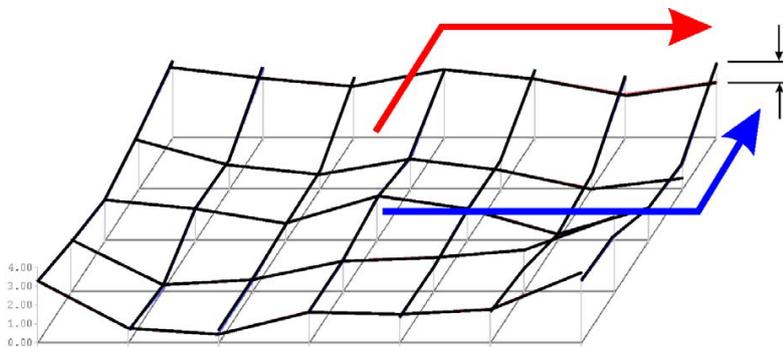
5.4.1.3.1 Closing error

The closure error correction according to “PHILIPS” is used in the WYLER grid flatness measuring method.

At the end of a measurement the result (flatness of a surface) can be displayed in two versions:

- without correction of the closure error
- with the correction of the closure error

When the version is used without the correction of the closure error all these error will be seen in numerical and graphical form. The so called closure error is an indication of the quality of the measurement.



The CLOSURE ERROR is the LARGEST DEVIATION of a measuring point in a overly defined grid when the calculation of such a height at this measuring point is done by using different paths. (see sketch below)

Reasons respectively the source of such closure errors are:

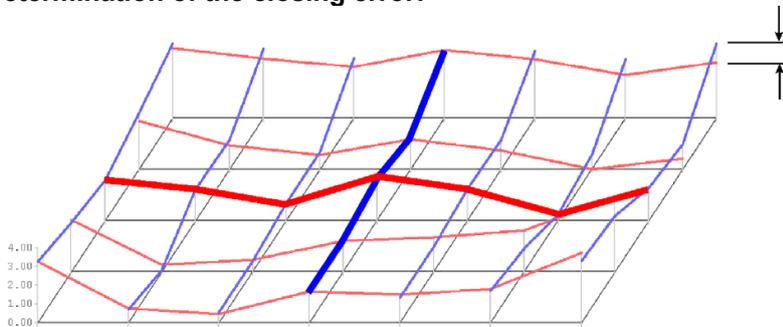
- Difference of temperature between the measuring object and the measuring base
- Changing of the position of the measuring object or vibrations

- The measurement is not done with the required care
- Dirt on the measuring object or on the instrument's base
- Settling time of the instrument disregarded before collecting the data
- Correct overlapping of the measuring steps disregarded (large closure errors will occur when the measuring points of the longitudinal and the transversal line measurements do not have a minimal correct overlapping)
- Inaccurate positioning of the instrument on the grid
- Worn or distorted measuring base
- Short-wave humpy surface error which can not correctly treated with the available measuring base, no correct positioning is possible (wobbling of the measuring base>>bad repetition)

The correction of the closure error according to „PHILIPS“ is a mathematical process with which a closure error of linearly spreading characteristic can be successfully corrected and the closure error eliminated. After the closure error correction a so called “Index of correction” is an indication of the “success” of the mathematical treatment. (the “Index of correction” is the result of the standard deviations of all the closure error corrections)

The larger the index of correction, the larger the measuring uncertainty!

Determination of the closing error:



- The angular relationship of all measurements taken in the longitudinal and the transversal direction must remain unchanged.
- Both lines in the centre of the longitudinal and the transversal directions are used as reference lines. Should the number of lines in a direction be even, the one line closer to the first longitudinal respectively transversal line used as reference line.
- Both reference lines are adjusted to connect at an even elevation at their intersection. (same height)
- All other longitudinal and transversal lines are moved up or down until they cross the reference line at the even elevation.
- The largest deviation in height of two lines crossing is the closure error of the measurement.

Closing error correction:

At every intersection the average height between the longitudinal and the transversal line will be calculated, i.e. the upper point is lowered and the lower point is lifted by half of the height difference. When the measuring density is higher than one the intermediate points are lowered or raised proportionately. The **Index of correction** is an index of the closing error correction and corresponds to the standard deviation of the closing errors in all closed partial areas.

Remarks:

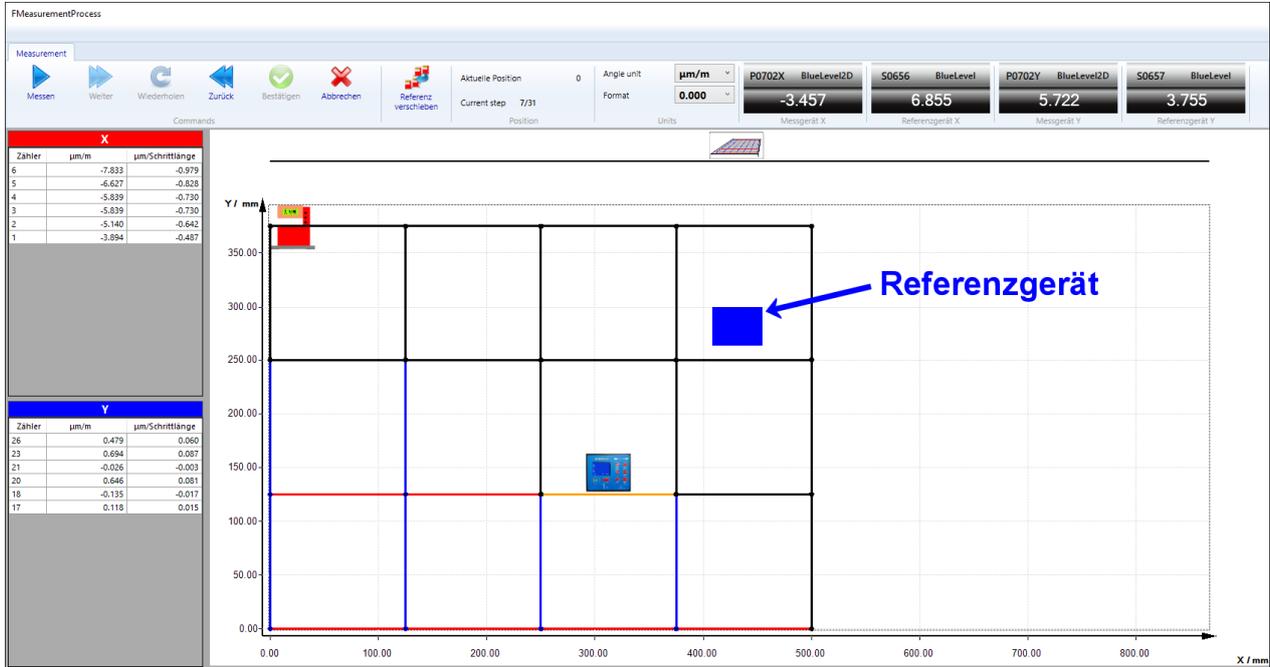
- Measurements not done with the required care will lead to excessive corrections and the index of correction will be high.
- Careful taken measurements will lead to even and minimal corrections and the index of correction will be quite low.

If the measurement has undergone a correction according to PHILIPS this can be seen when the “Index of correction” is displayed in the graph.

5.4.1.4 Flattnes with grid measure 2D-Devices

Platzierung Reference device wenn möglich ausserhalb der Messfläche. ist dies nicht möglich, muss während der Messung das Reference device verschoben werden. Idealerweise wird das Reference device bei Beginn der Messung oben rechts platziert.

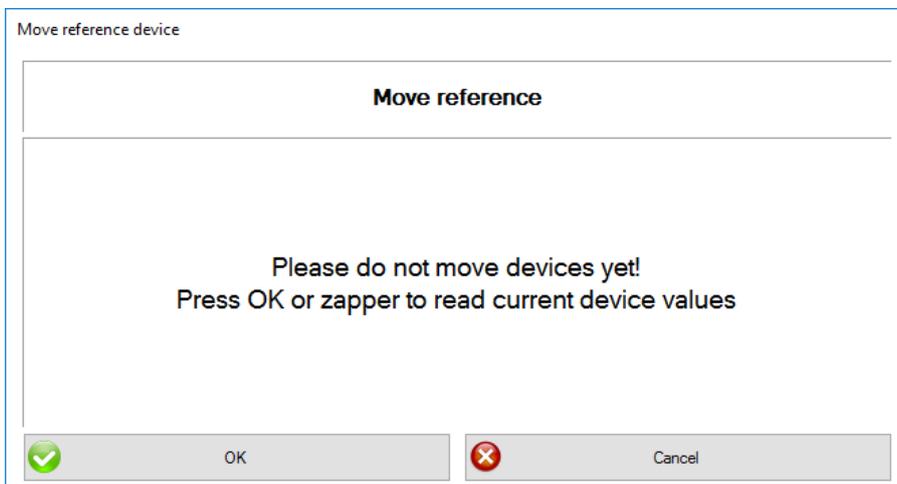
When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed for X and Y direction.



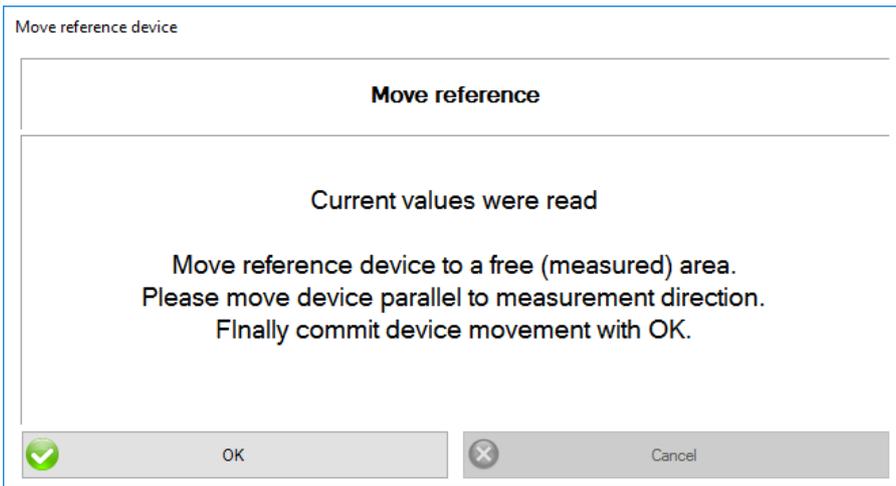
During the measurement the BlueLEVEL-2D is displaced along the longitudinal lines. With every measuring step both the step on the longitudinal line as well as the step on the transversal line is measured. If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.

If the reference device interferes the measuring device, it must be displaced.

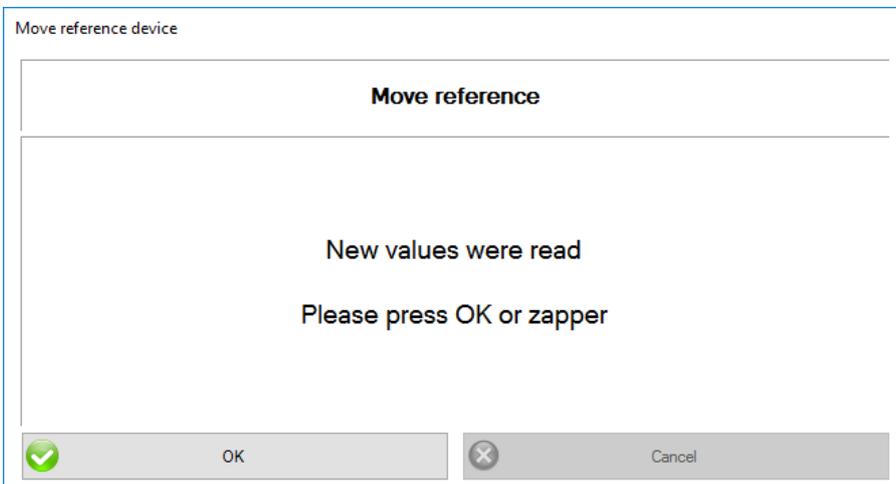
The action "Move reference" is started with . With additional measurements the change of the measuring plate must be determined to take it in account in the remaining measurements.



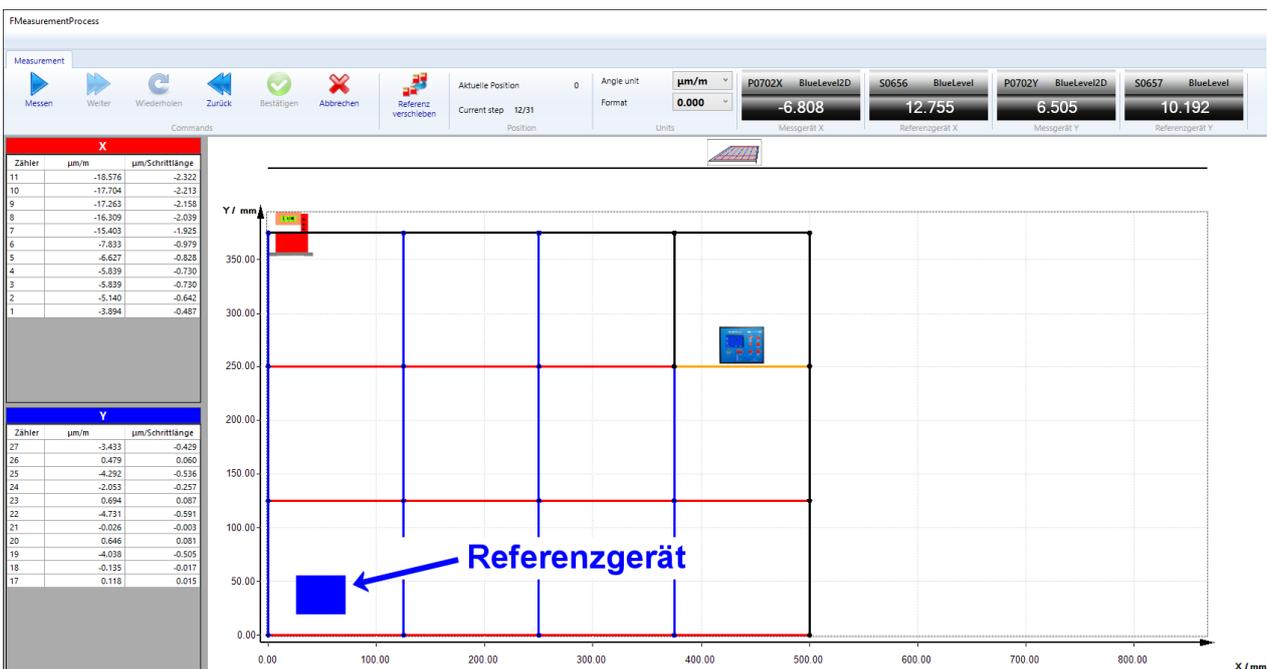
Measurement before displacement of the reference.



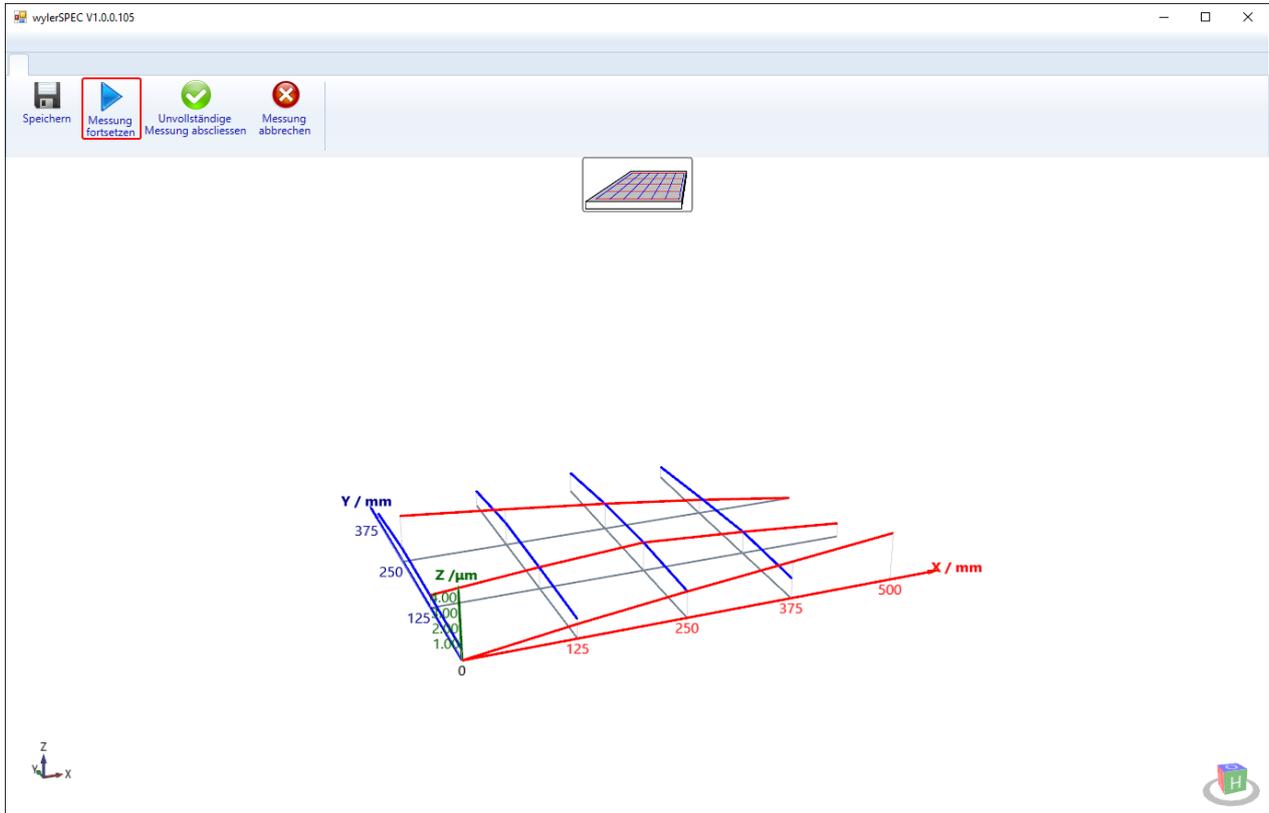
Move the reference device to the new location.
 The new location should not interfere with the remaining measurement of the plate. A suitable position is the lower left corner at the first longitudinal and transversal line.



After displacement of the reference the measurement of the plate can continue.

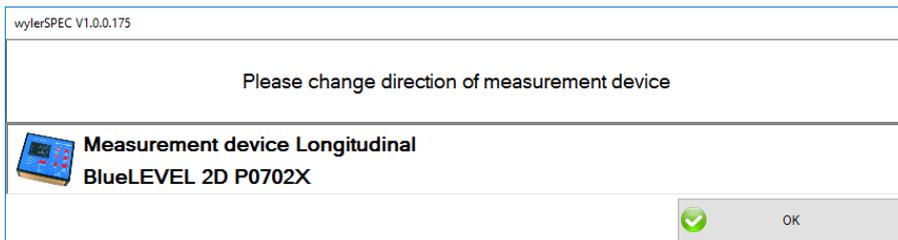


Before the upper and right border line are measured a preview is shown to estimate the quality of the plate early.

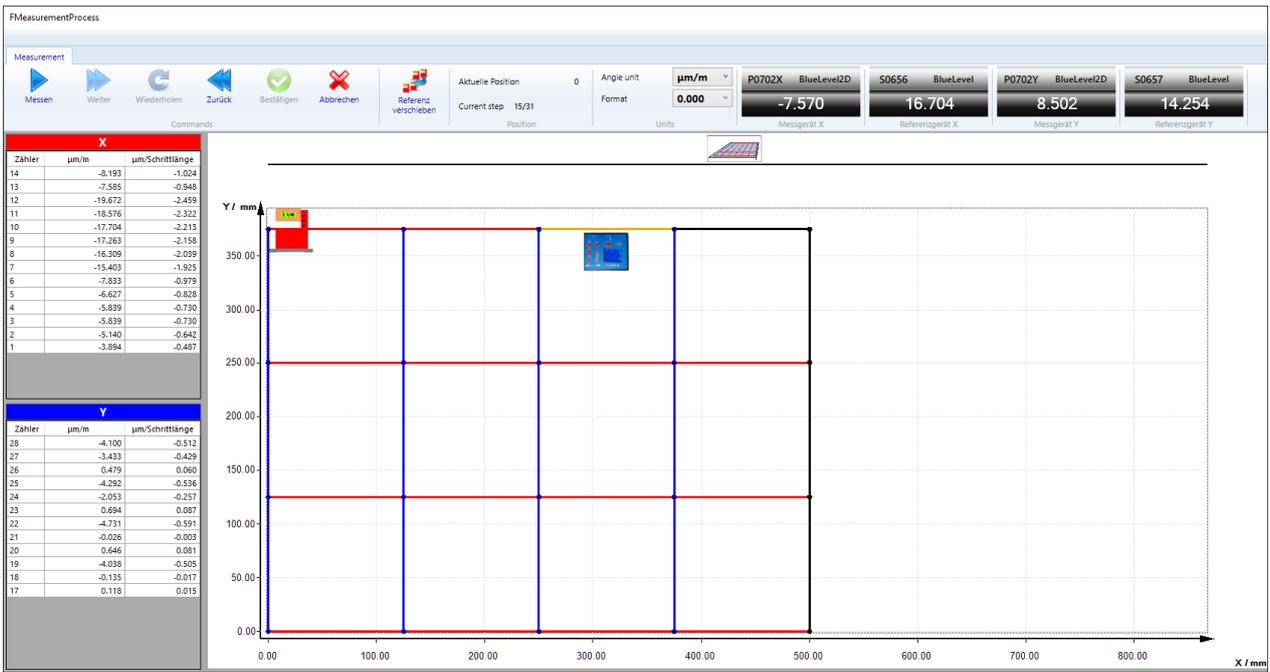


At this point with  the measurement can be saved or canceled with .

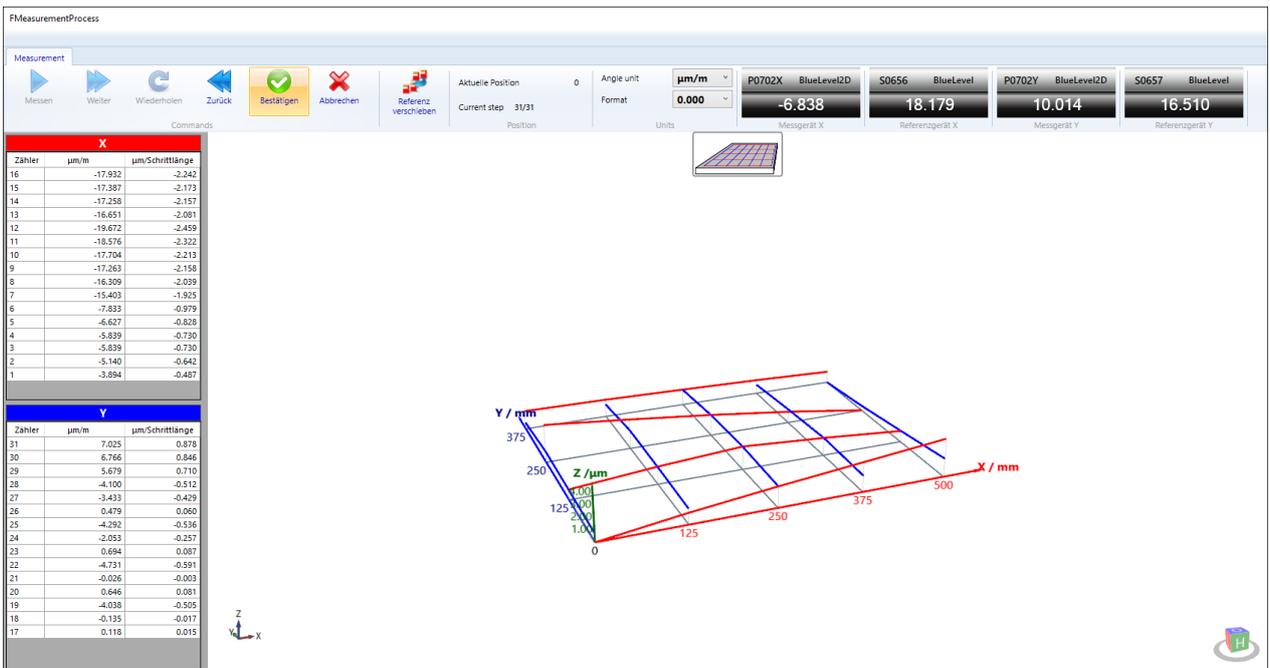
Continue the measurement with .



Turn the reference device into measuring direction.



Measurement of the outer border lines.

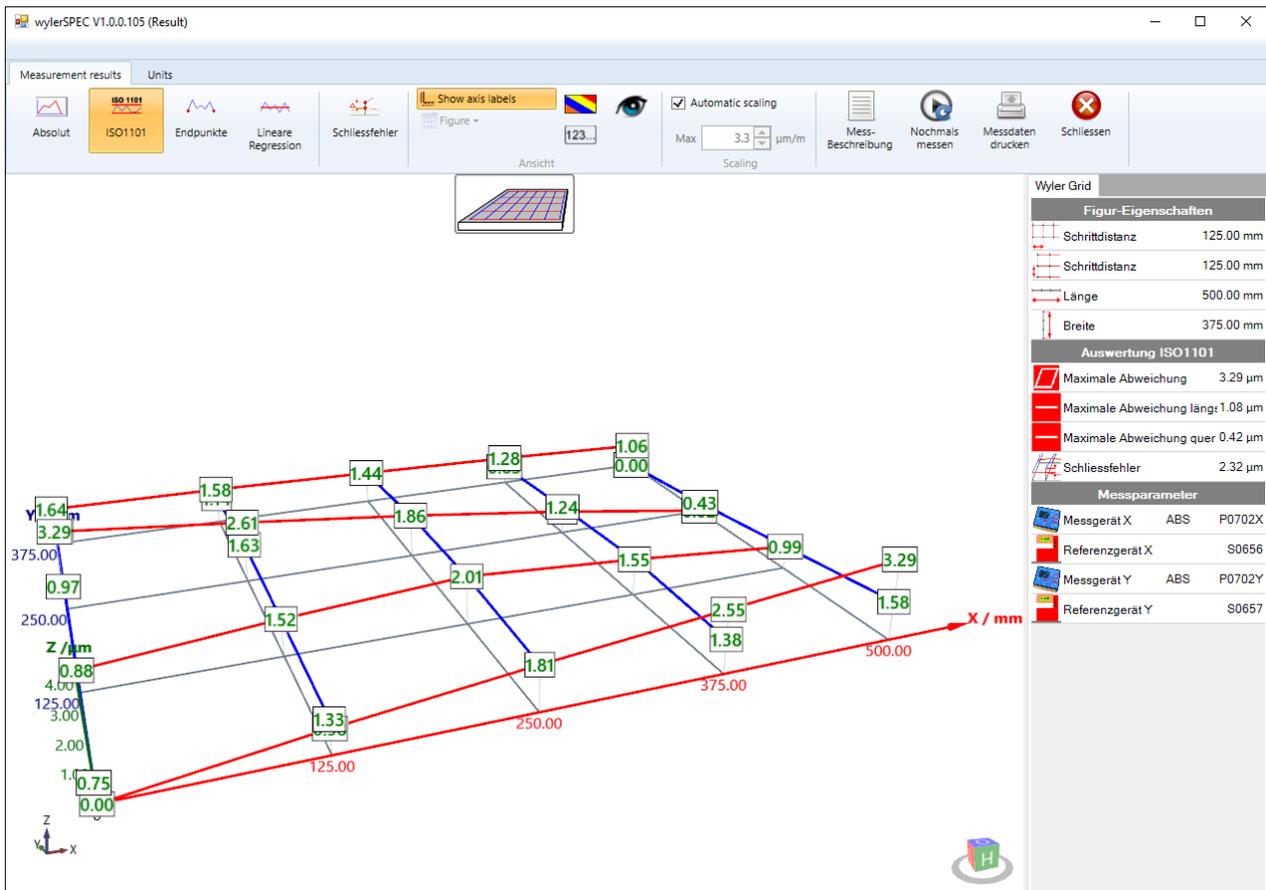


After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.4.1.5 Flatness with grid analyze 2D-Devices



Analysis without [Closing error](#):

 **Maximal deviation** = Biggest height difference with the selected evaluation method (End points, ISO1101 or linear regression)

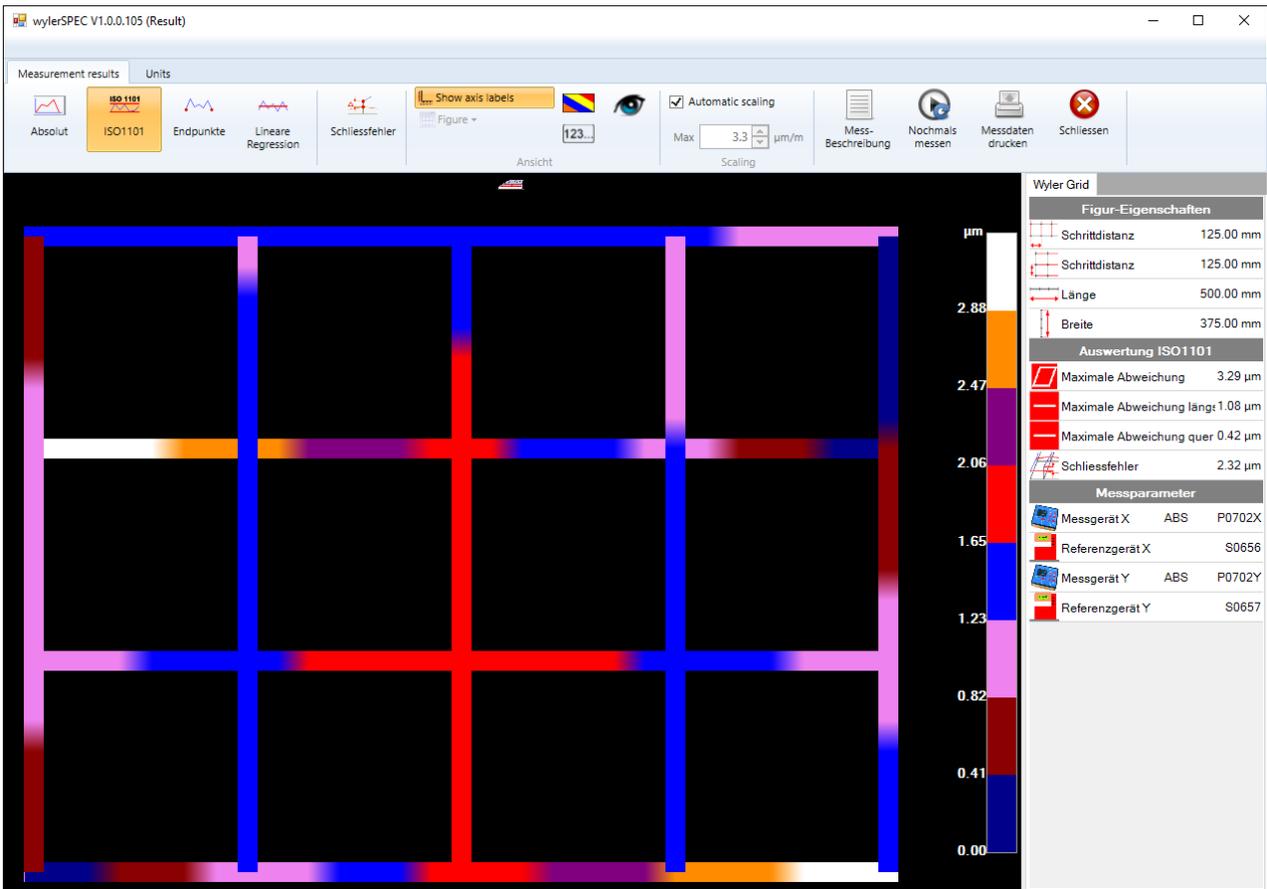
 **Maximal deviation longitudinal** = Maximum error of the lines longitudinal

 **Maximal deviation transversal** = Maximum error of the lines transversal

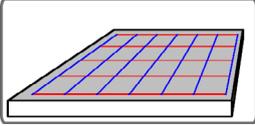
 **Closing error** = Maximal closing error. As a general rule the closure error should not be more than 20% to 25% of the maximum error. If the maximum error is less than 4 μm the closure error may exceed the above-mentioned values.

 **Quality standard** = Grading according to the selected [Quality standard](#)

With the button  differently colored representations can be selected.



5.4.2 Flatness partial



Fläche partiell entspricht weitgehend der Fläche mit Grid. Einzelne Teilstrecken können bei der Messung weggelassen werden. Partielle Flächen können nicht mit 2D-Messgeräten gemessen werden, d.h. nicht X- und Y-Richtung können nicht gleichzeitig erfasst werden.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.4.2.1 Flatness partial setup

wylerSPEC 1.0.0.105 (Layout)

Measurement

Messdaten speichern Save as template Figur hinzufügen Mess-Beschreibung Befehle Proposal Messung starten Abbrechen

Längeneinheit **mm** Length unit format **0.00** Einheiten

Rasterlinien anzeigen Rasterlinien anzeigen Show Axis labels Figure - Ansicht

Merge Add link measurement Add assessment Link Action

Y / mm

X / mm

Definition messfigur

Name	Wyler Grid
Messgerät	ABS
Messart	Mit Referenz

Längs

Anzahl Längslinien	4
Schrittdistanz	125.00mm
Messdicke	1
Messgerät	S0656
Referenzgerät	S0657

Quer

Anzahl Querlinien	4
Schrittdistanz	125.00mm
Messdicke	1
Messgerät	S0656
Referenzgerät	S0657

Messgerät

Clicking on a line segment removes it from or adds it to the figure. Dragging the mouse over a part of the figure removes or adds all line segments touched by the rectangle.

Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measurement device	Measurement method ABSolut, RELative

Way of measurement
 With reference
 Without reference
 Manual input

Longitudinal

Number of measurements
 Number of inclination measurements, the number of heights is bigger by 1

Steplength
 steplength pro Messung

Measuring density
 Number of measurements zwischen transversal lines

Measuring device
[Selection](#) of the main measuring device

Reference device
[Selection](#) of the reference device

Transversal

Number of measurements
 Number of inclination measurements, the number of heights is bigger by 1

Steplength
 steplength pro Messung

Measuring density
 Number of measurements zwischen longitudinal lines

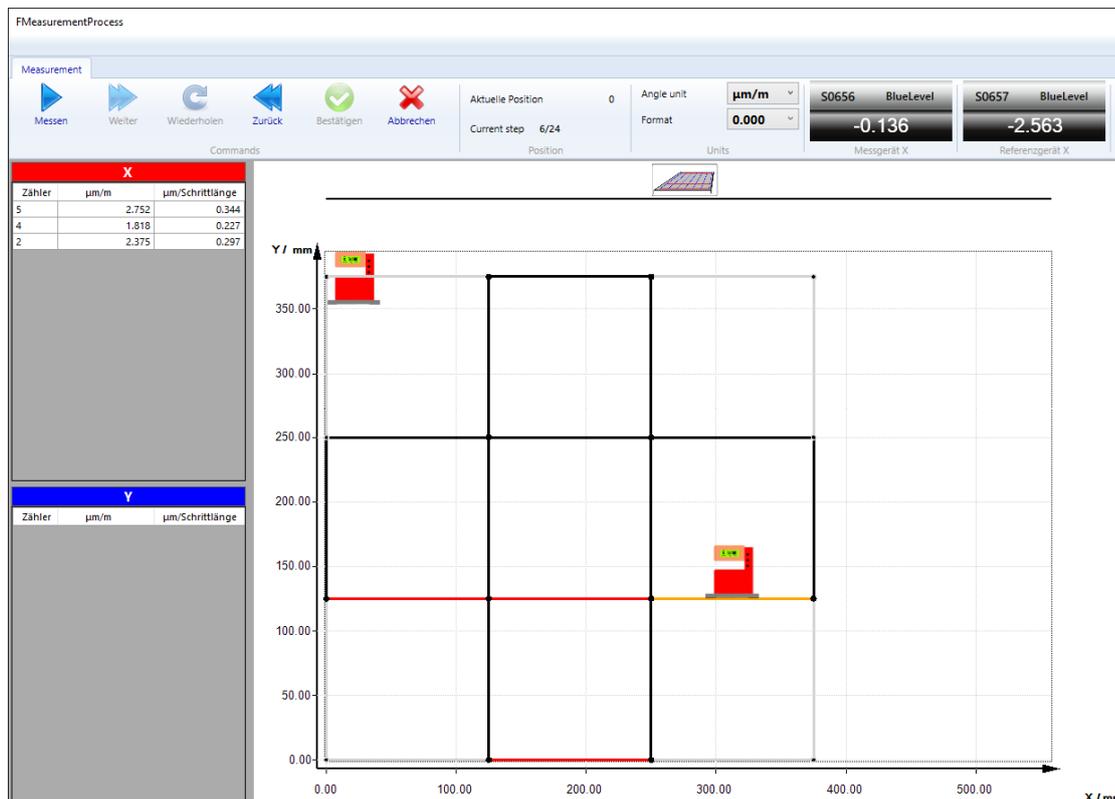
Measuring device
[Selection](#) of the main measuring device

Reference device
[Selection](#) of the reference device

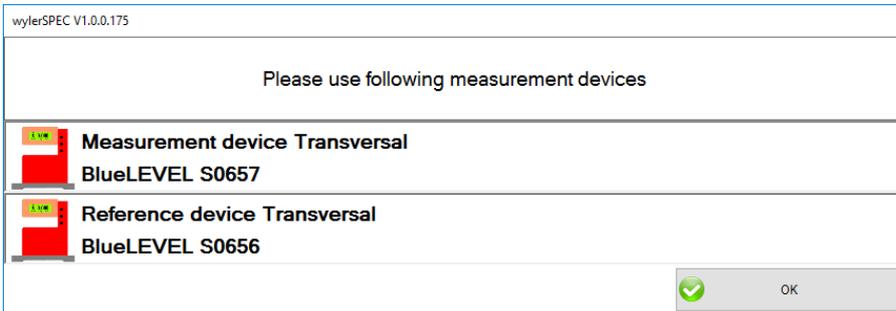
Concurrent measurement of X- an Y-axis provided by a BlueLEVEL-2D is not allowed.

5.4.2.2 Flatness partial measure

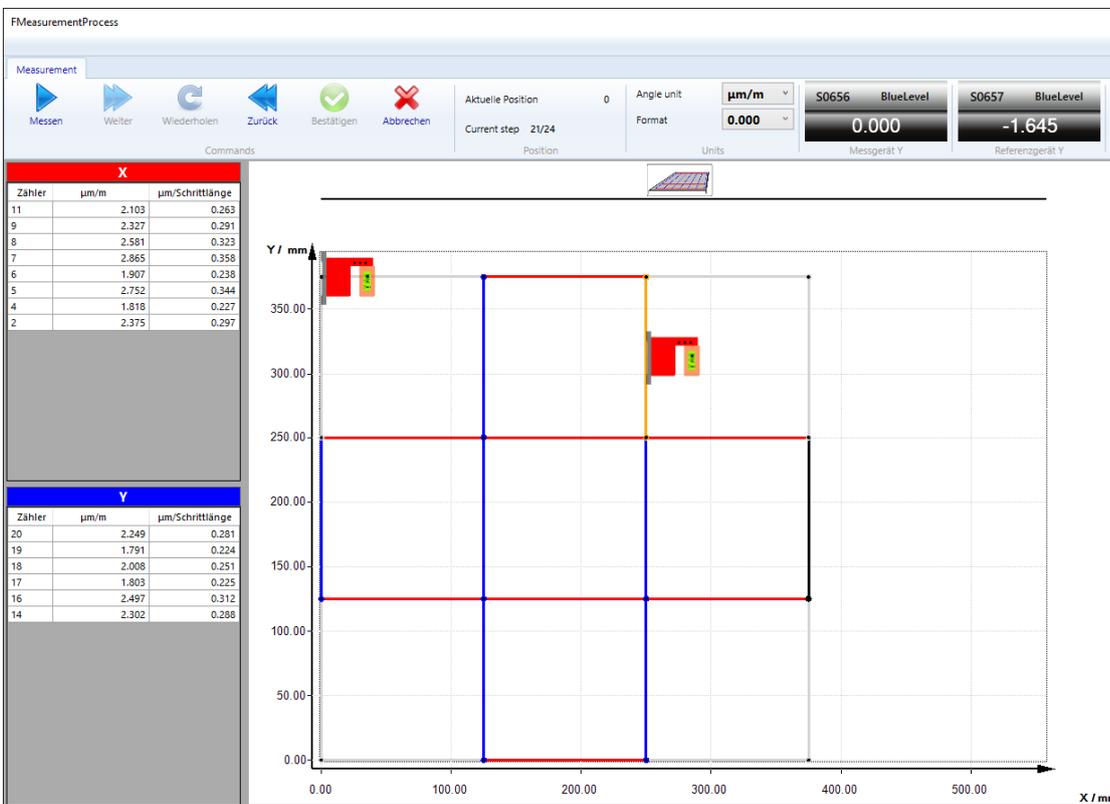
When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values are displayed in the table "X" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



For the measurements in X and Y direction it is possible to use different devices. At the change of the measuring direction there is a message telling to use the other device.



During the measurement the values are displayed in the table "Y" on the left.

FMeasurementProcess

Measurement

Messen Weiter Wiederholen Zurück Bestätigen Abbrechen

Commands

Aktuelle Position 0 Angle unit $\mu\text{m}/\text{m}$ S0656 BlueLevel S0657 BlueLevel
 Current step 23/24 Format 0.000 -0.536 -2.825
 Position Units Messgerät Y Referenzgerät Y

X		
Zähler	$\mu\text{m}/\text{m}$	$\mu\text{m}/\text{Schrittlänge}$
11	2.103	0.263
9	2.327	0.291
8	2.581	0.323
7	2.865	0.358
6	1.907	0.238
5	2.752	0.344
4	1.818	0.227
2	2.375	0.297

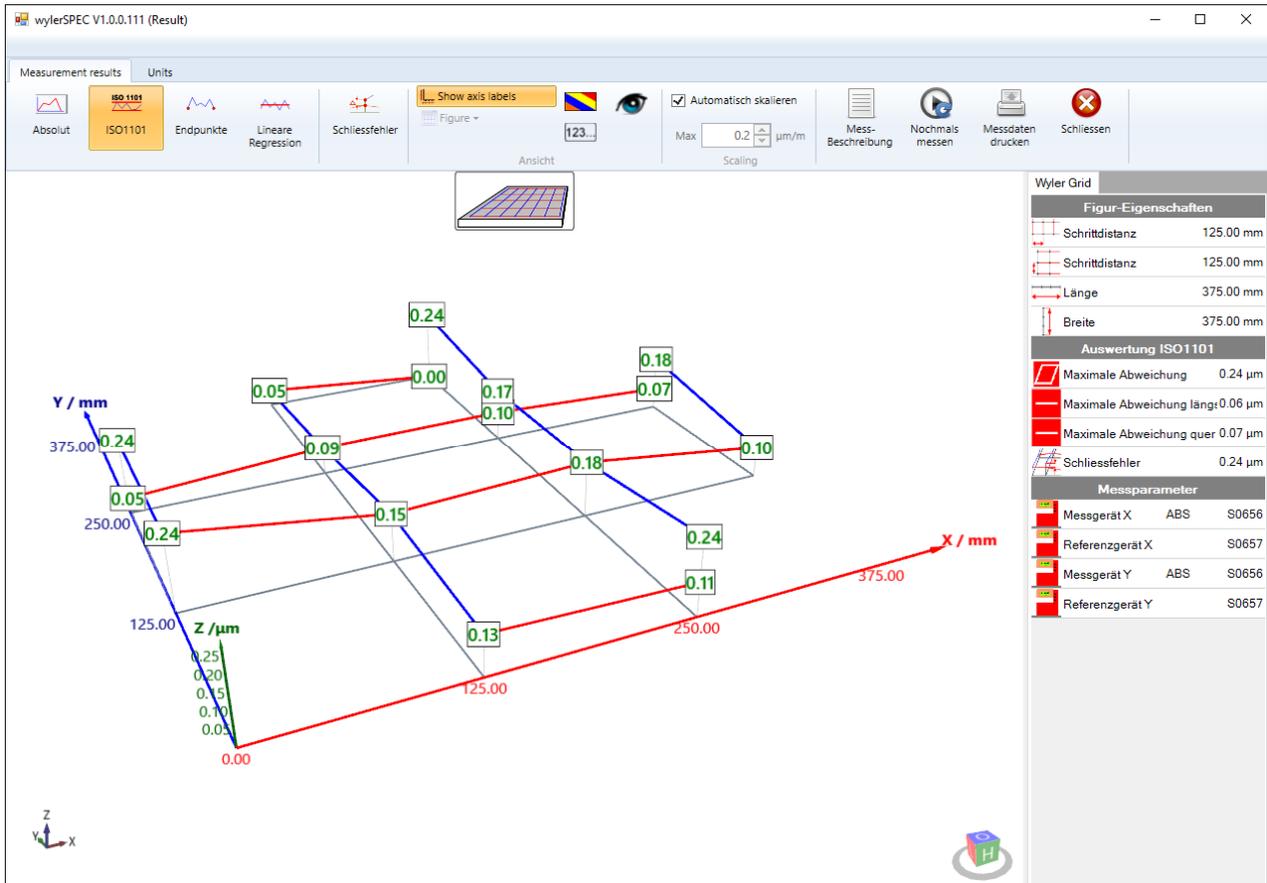
Y		
Zähler	$\mu\text{m}/\text{m}$	$\mu\text{m}/\text{Schrittlänge}$
23	2.937	0.367
21	2.858	0.357
20	2.249	0.281
19	1.791	0.224
18	2.008	0.251
17	1.803	0.225
16	2.497	0.312
14	2.302	0.288

Y / mm 375 250 125
 Z / μm 0.25 0.20 0.15 0.10 0.05 0
 X / mm 375 250 125

After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on .
 With measurements can be repeated.

5.4.2.3 Flatness partial analyze

Analysis [Absolut](#), [ISO1101](#), [end points](#) or [linear regression](#).



Analysis without [Closing error correction](#):

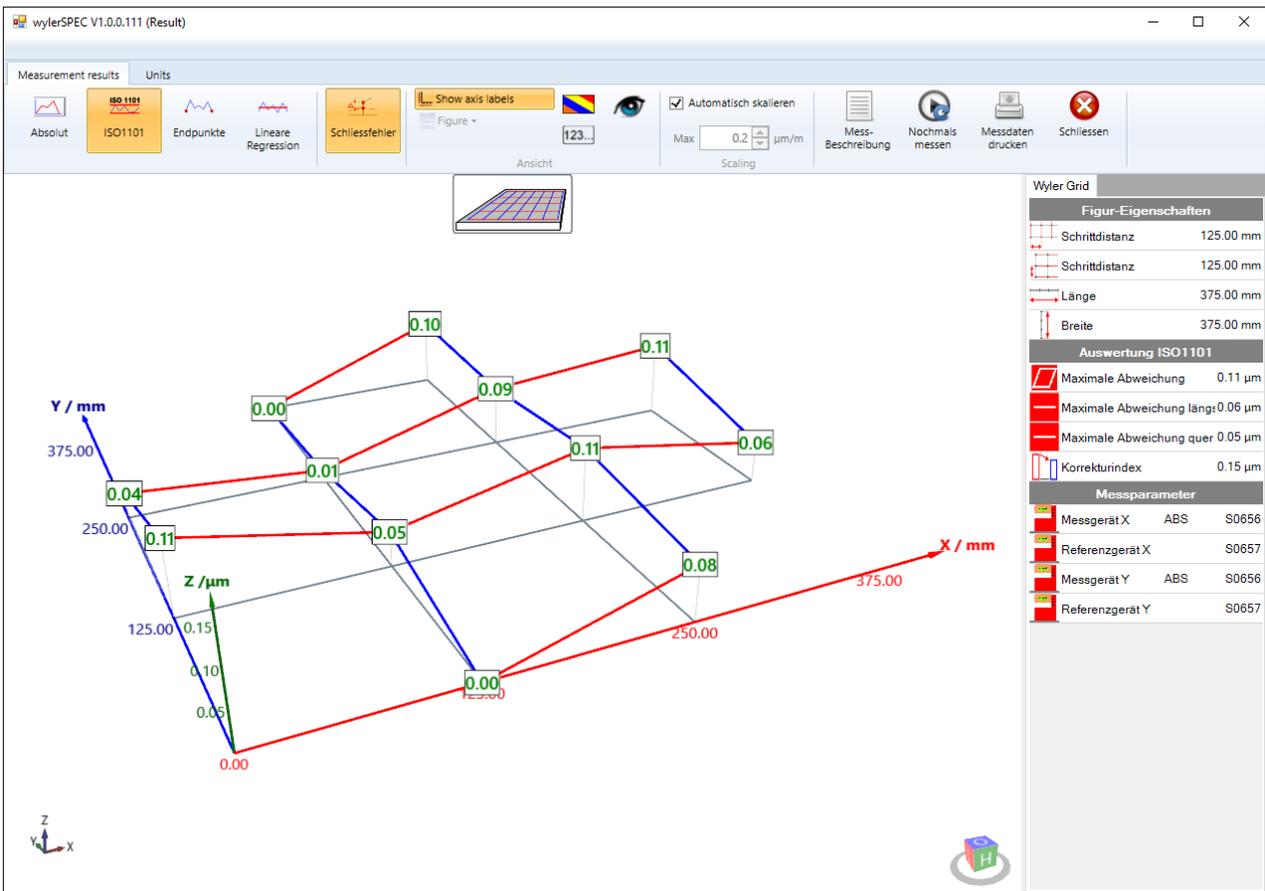
 **Maximal deviation** = Biggest height difference with the selected evaluation method (End points, ISO1101 or linear regression)

 **Maximal deviation longitudinal** = Maximum error of the lines longitudinal

 **Maximal deviation transversal** = Maximum error of the lines transversal

 **Closing error** = Maximal closing error. As a general rule the closure error should not be more than 20% to 25% of the maximum error. If the maximum error is less than 4 μm the closure error may exceed the above-mentioned values.

 **Quality standard** = Grading according to the selected [Quality standard](#)



Analysis with [Closing error correction](#):

 **Maximal deviation** = Biggest height difference with the selected evaluation method (End points, ISO1101 or linear regression)

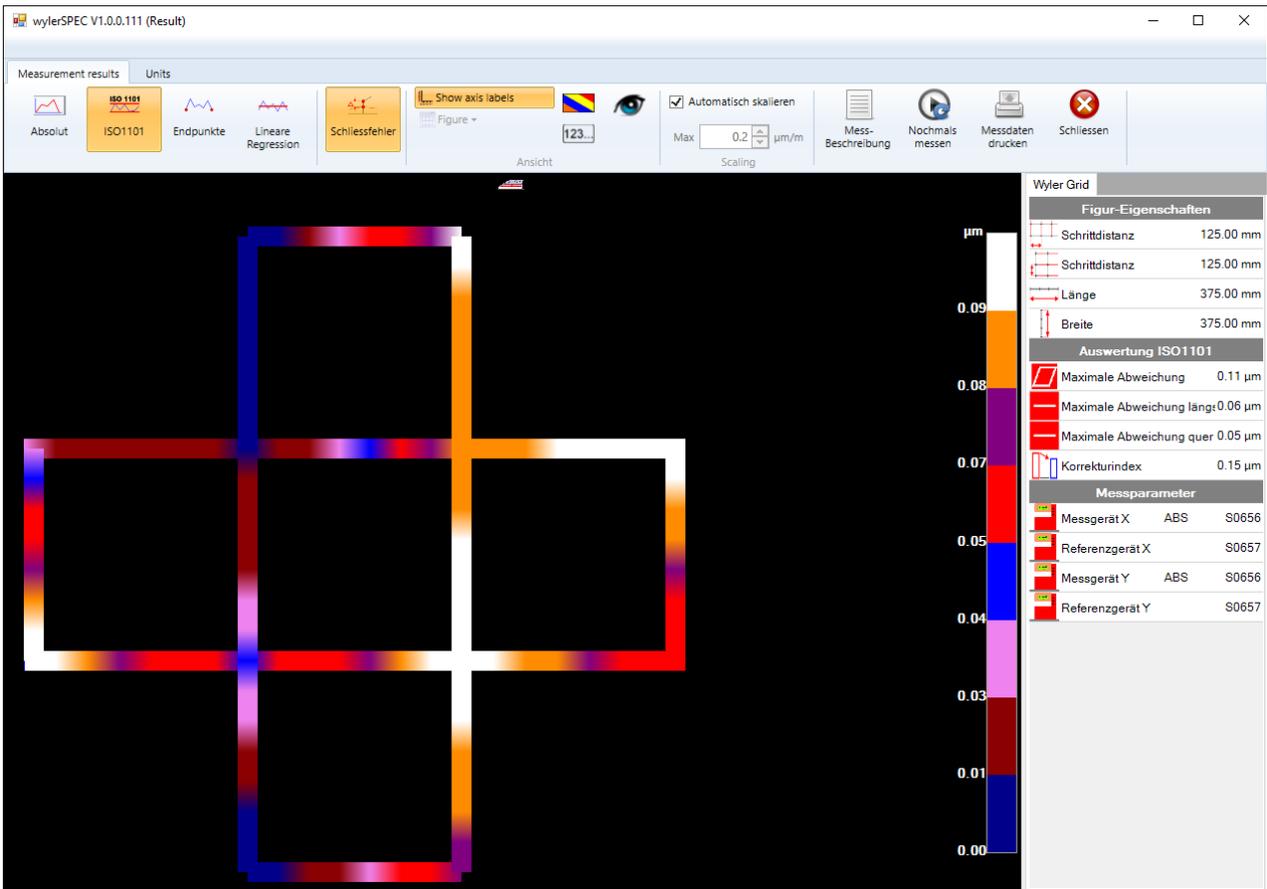
 **Maximal deviation longitudinal** = Maximum error of the lines longitudinal

 **Maximal deviation transversal** = Maximum error of the lines transversal

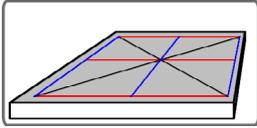
 **Index of correction** = Index of the closing error correction. The index of correction is the result of all the standard deviations of the closure errors.

 **Quality standard** = Grading according to the selected [Quality standard](#)

With the button  differently colored representations can be selected.



5.4.3 Flatness - U-Jack

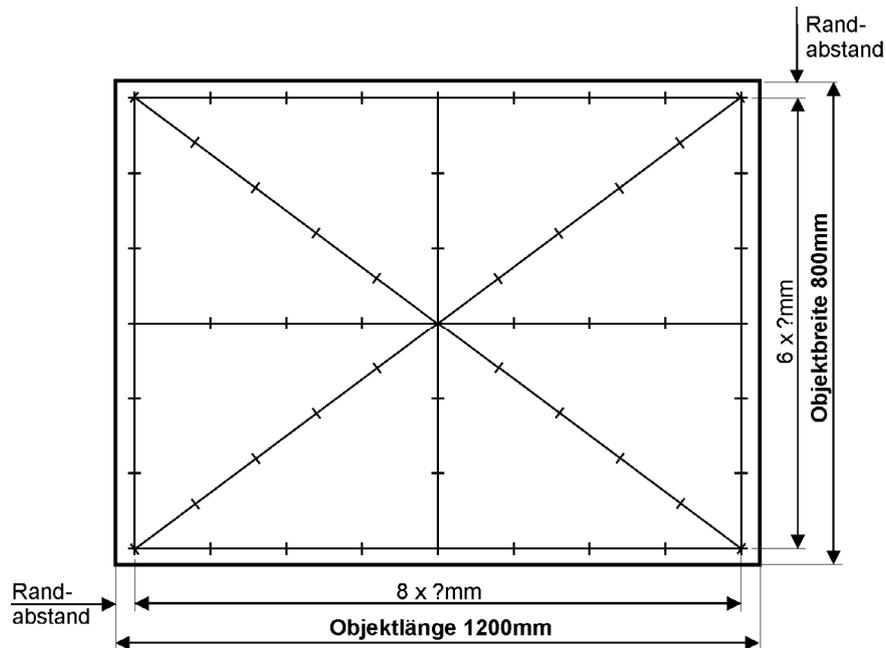


Fläche Union Jack können nicht mit 2D-Messgeräten gemessen werden, d.h. nicht X- und Y-Richtung können nicht gleichzeitig erfasst werden.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

Aufgrund der Abmessungen des zu messenden Objektes sowie der zur Verfügung stehenden Messgeräte ermittelt wylerSPEC Rastervorschläge. Der Vorschlag, der dem Benutzer am besten zusagt, kann übernommen werden.



Das Raster für den U-Jack muss so ausgelegt werden, dass

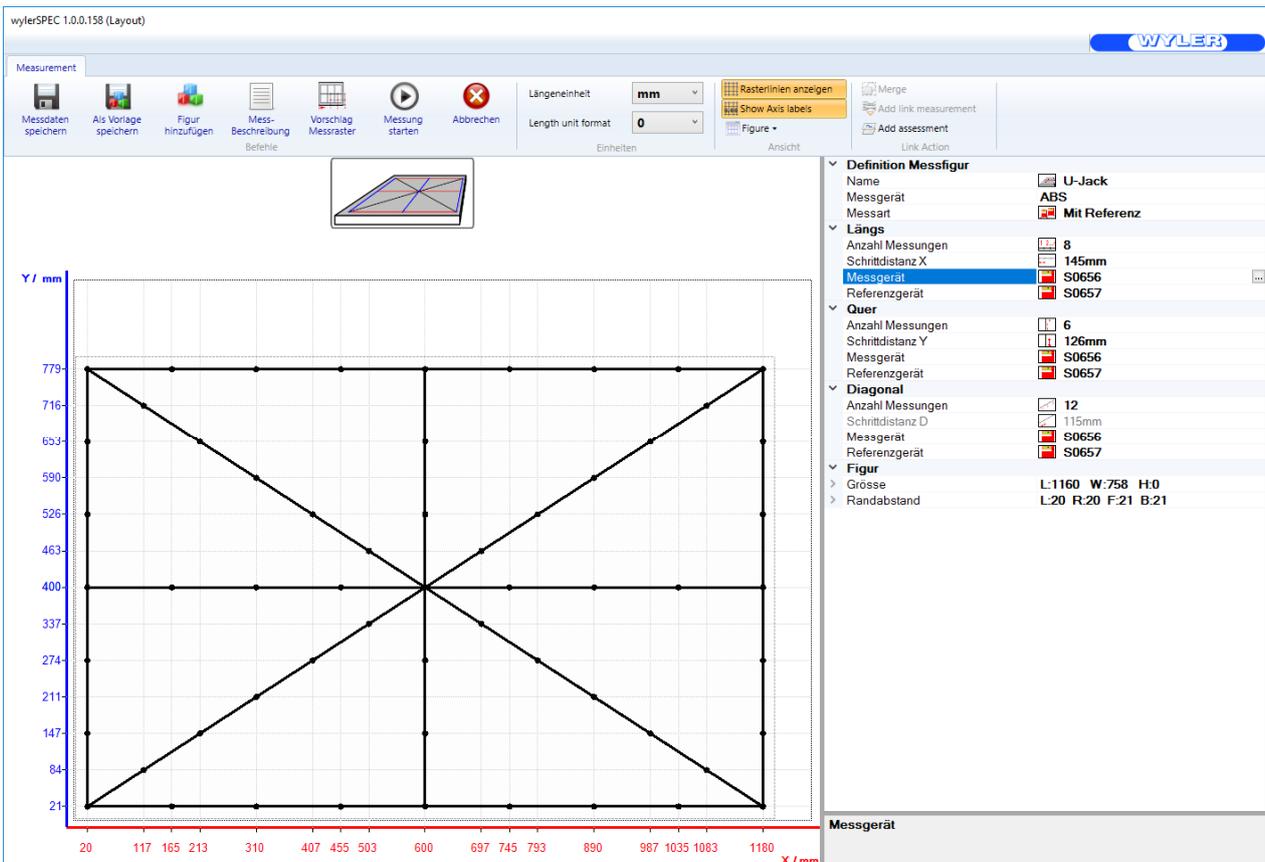
- die Schrittlänge auf die Basislänge des Messgerätes abgestimmt ist
- der Raster immer nach dem gleichen Muster (siehe oben) aufgebaut werden muss. Es dürfen die Anzahl Schritte und die Schrittlänge variiert werden (Die Schrittweiten der longitudinal lines, transversal lines und Diagonallinien dürfen unterschiedlich sein).
- die drei Longitudinal- und transversal lines symmetrisch verteilt sind (dementsprechend wird es immer eine gerade Anzahl von Messschritten geben)
- die US-Norm „**GGG – P – 463 c**“ eingehalten wird
 - Eine Line
 - soll mindestens 6 Messschritte aufweisen
 - Die Schrittweite soll nicht länger als 12 Zoll (300mm) sein
 - Jede Line
 - muss eine gerade Number of measurements aufweisen
 - Die Verknüpfungspunkte der einzelnen Line
 - n müssen innerhalb eines Kreises mit einem Durchmesser von 0.3 Zoll (8mm) sein
 - Randzone:

- Für Platten mit einer Diagonalenlänge von 12 bis 48 Zoll ist eine Randzone von 1 Zoll (25,4mm) zugelassen
- Für Platten mit einer Diagonalenlänge die länger als 48 Zoll (1219.2mm) ist, darf die Randzone 1.5 Zoll (38.1 mm) sein

Hinweis:

- Bitte konsultieren Sie die US-Norm „**GGG – P – 463 c**“
- Im Gegensatz zur Ebenheitsmessung nach dem Prinzip WYLER nach DIN 876 / Teil 1 (Raster) wird beim U-Jack jede einzelne Line als eigenständiges Element in der Rechnung behandelt (keine Parallelitätsinformation enthalten)

5.4.3.1 Flatness - U-Jack setup



When measuring a surface with measuring grid wylerSPEC offers proposals for possible grid dispositions.

The button  leads to [these proposals](#).

Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut, RELativ
Way of measurement	With reference Without reference Manual input

Longitudinal

Number of	Number of inclination measurements, the
-----------	---

- measurements number of heights is bigger by 1
- Steplength steplength pro Messung
- Measuring device [Selection](#) of the main measuring device
- Reference device [Selection](#) of the reference device
- Transversal**
- Number of measurements Number of inclination measurements, the number of heights is bigger by 1
- Steplength steplength pro Messung
- Measuring device [Selection](#) of the main measuring device
- Reference device [Selection](#) of the reference device
- Diagonal**
- Number of measurements Number of inclination measurements
- Steplength steplength pro Messung, wird aus der Anzahl Neigungsmessungen berechnet
- Measuring device [Selection](#) of the main measuring device
- Reference device [Selection](#) of the reference device

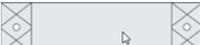
Concurrent measurement of X- an Y-axis provided by a BlueLEVEL-2D is not allowed.

5.4.3.1.1 Grid proposal U-Jack

<input checked="" type="checkbox"/>	70...150 mm
<input type="checkbox"/>	70...270 mm
<input type="checkbox"/>	100...180 mm
<input type="checkbox"/>	130...210 mm
<input type="checkbox"/>	160...240 mm
<input type="checkbox"/>	190...270 mm

115	10	25	115	12	75	10	25	
145	8	20	95	8	20	125	6	25
144	8	25	130	6	10	126	6	21

Eingaben:

-  Length of the plate (x-direction)
-  Width of the plate (y-direction)
-  Flat base
-  Flex base

<input checked="" type="checkbox"/>	70..150 mm	Selection of base length
<input type="checkbox"/>	70..270 mm	
<input type="checkbox"/>	100..180 mm	
<input type="checkbox"/>	130..210 mm	
<input type="checkbox"/>	160..240 mm	
<input type="checkbox"/>	190..270 mm	

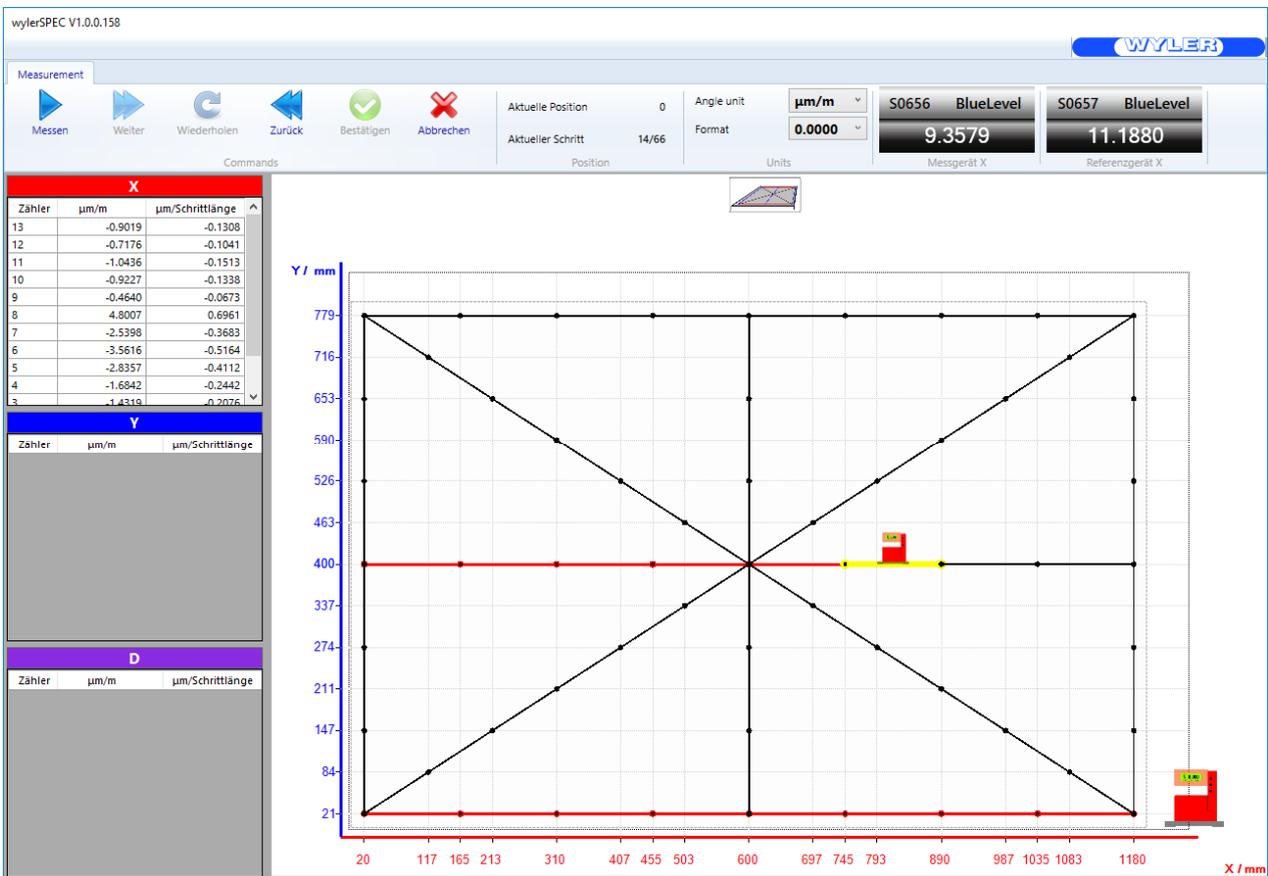
Rastervorschlag:

-  Steplength longitudinal (x-direction)
-  Number of steps longitudinal (x-direction)
-  Border zone longitudinal to middle of measuring base
-  Number of steps diagonal
-  Steplength transversal (y-direction)
-  Number of steps transversal (y-direction)
-  Border zone transversal to middle of measuring base

The beginning and endpoint of the diagonal is not in every case on exactly the same spot as the longitudinal respectively the transversal lines are. According to the specification the crossing points must lay within an area with a diameter of 8 mm respectively 0.3".

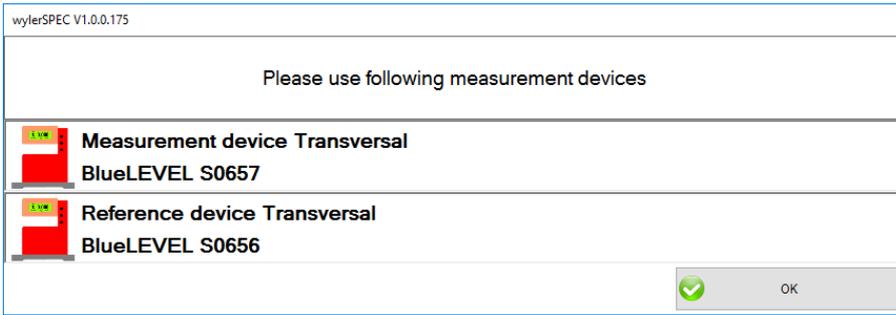
5.4.3.2 Flatness - U-Jack measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.

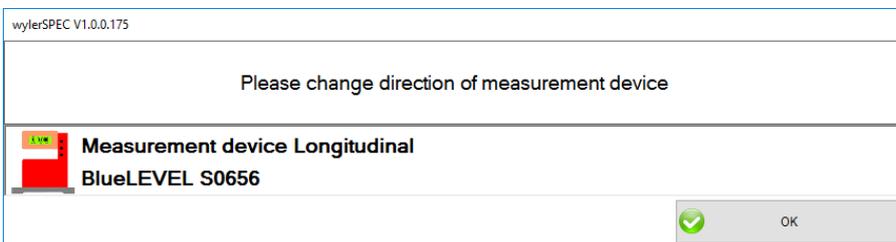


During the measurement the values are displayed in the tables on the left.

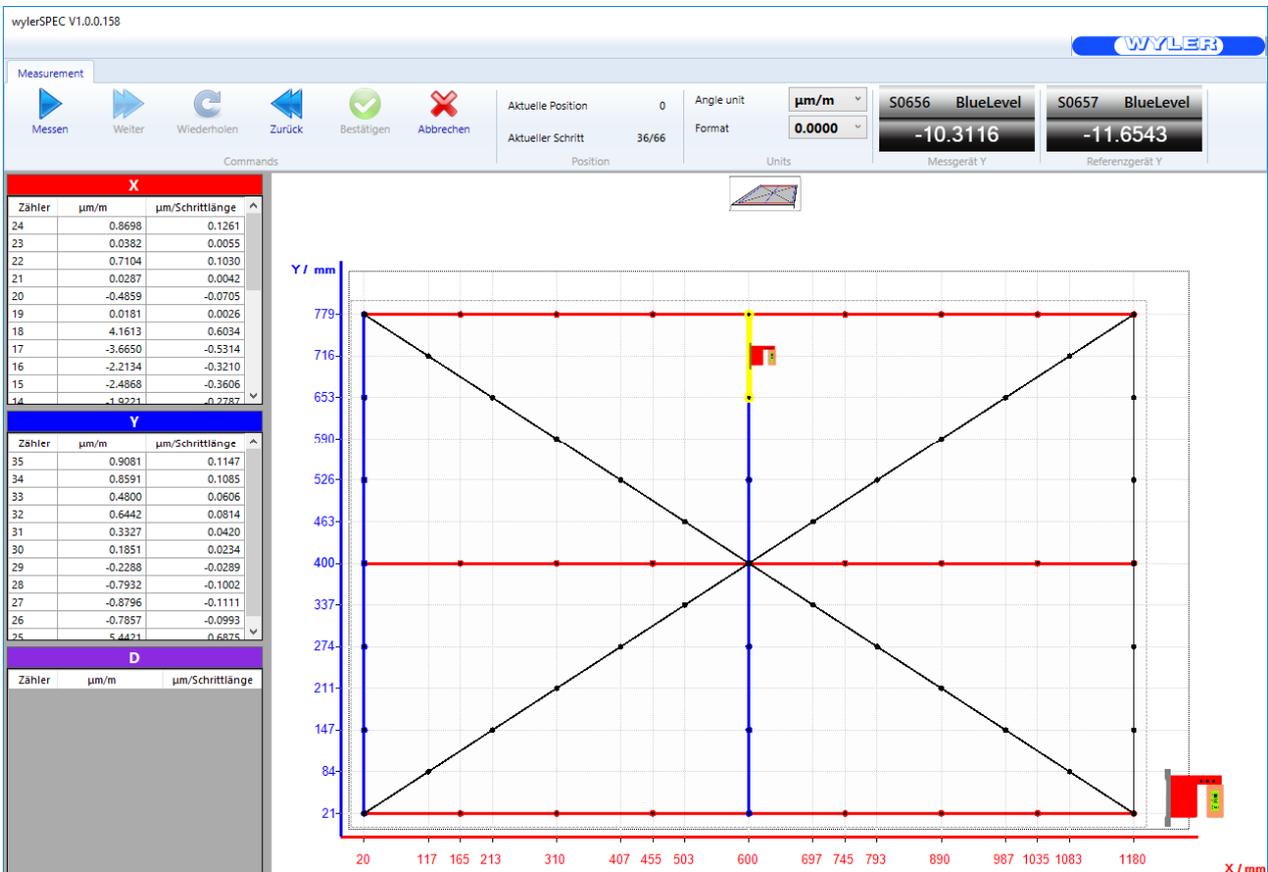
If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.

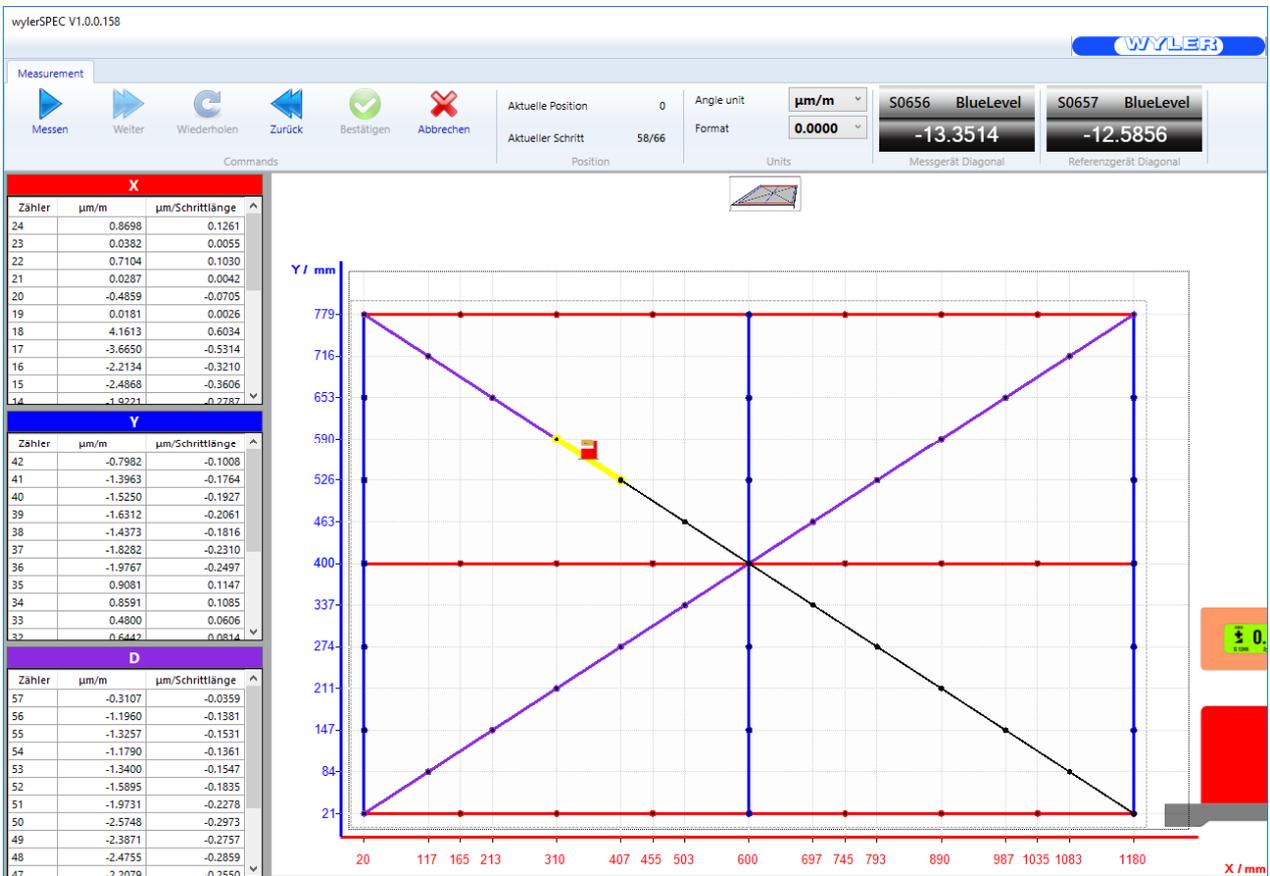
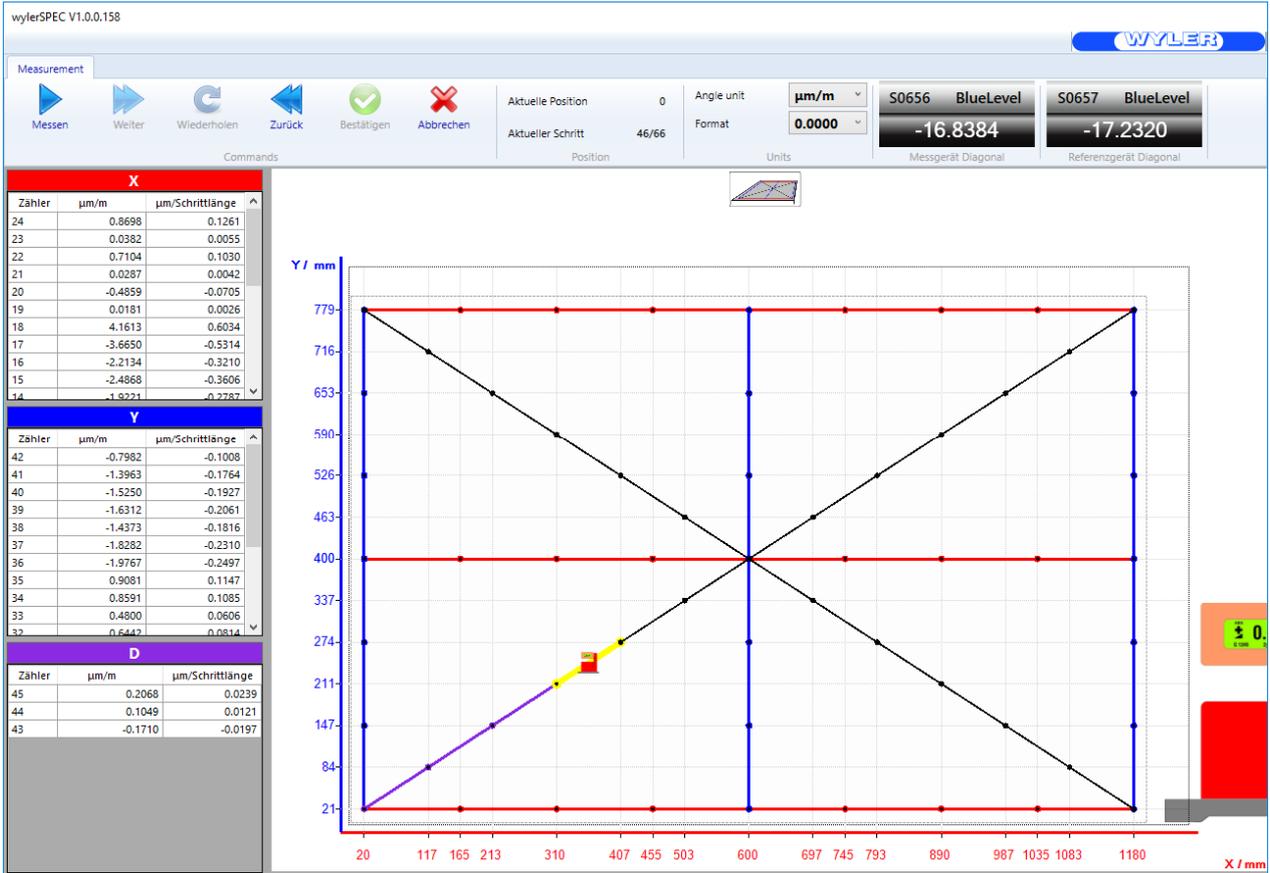


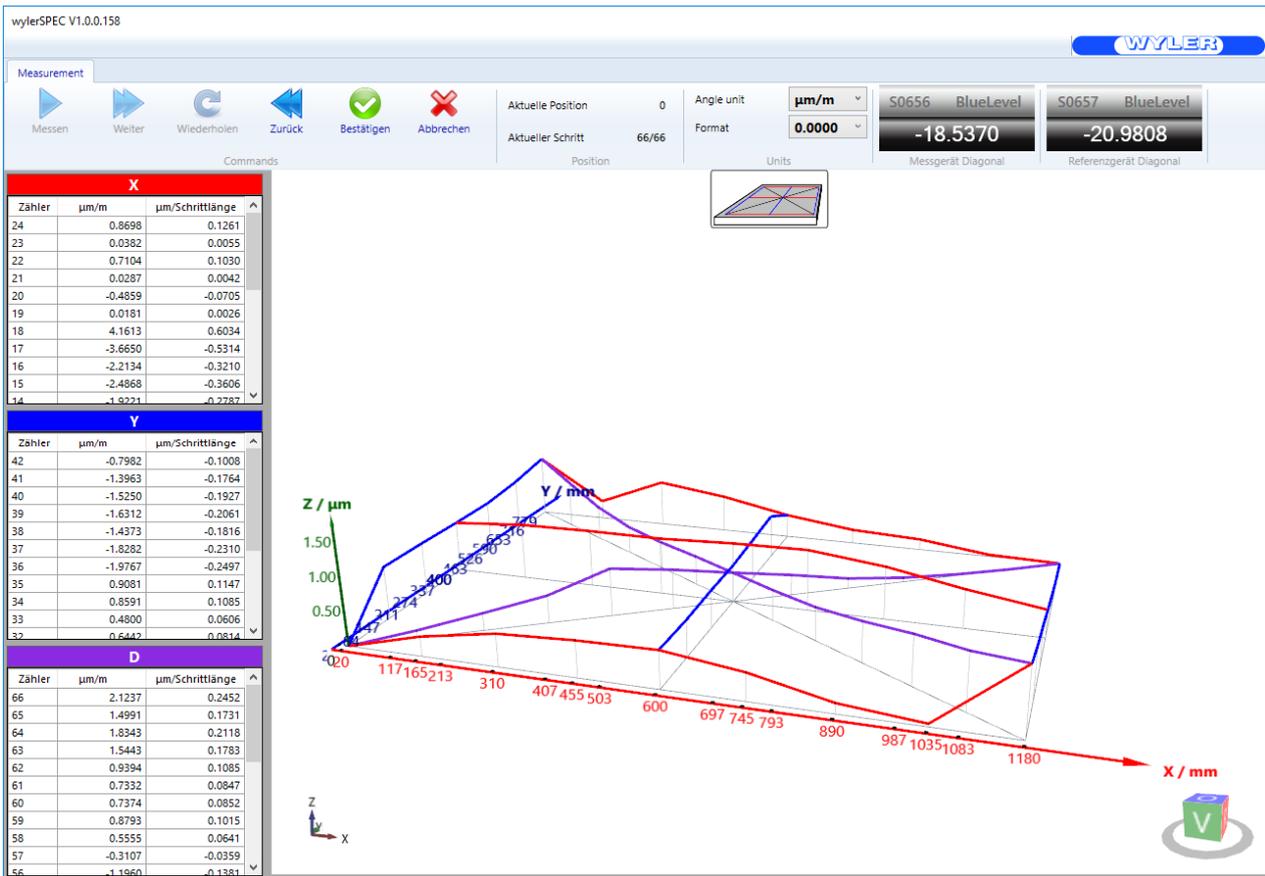
For the measurements in X and Y direction it is possible to use different devices. At the change of the measuring direction either from X to Y direction or from Y direction to the diagonal there is a message telling to use the other device.



When the measurement direction changes, the direction of the reference device has to be changed accordingly.

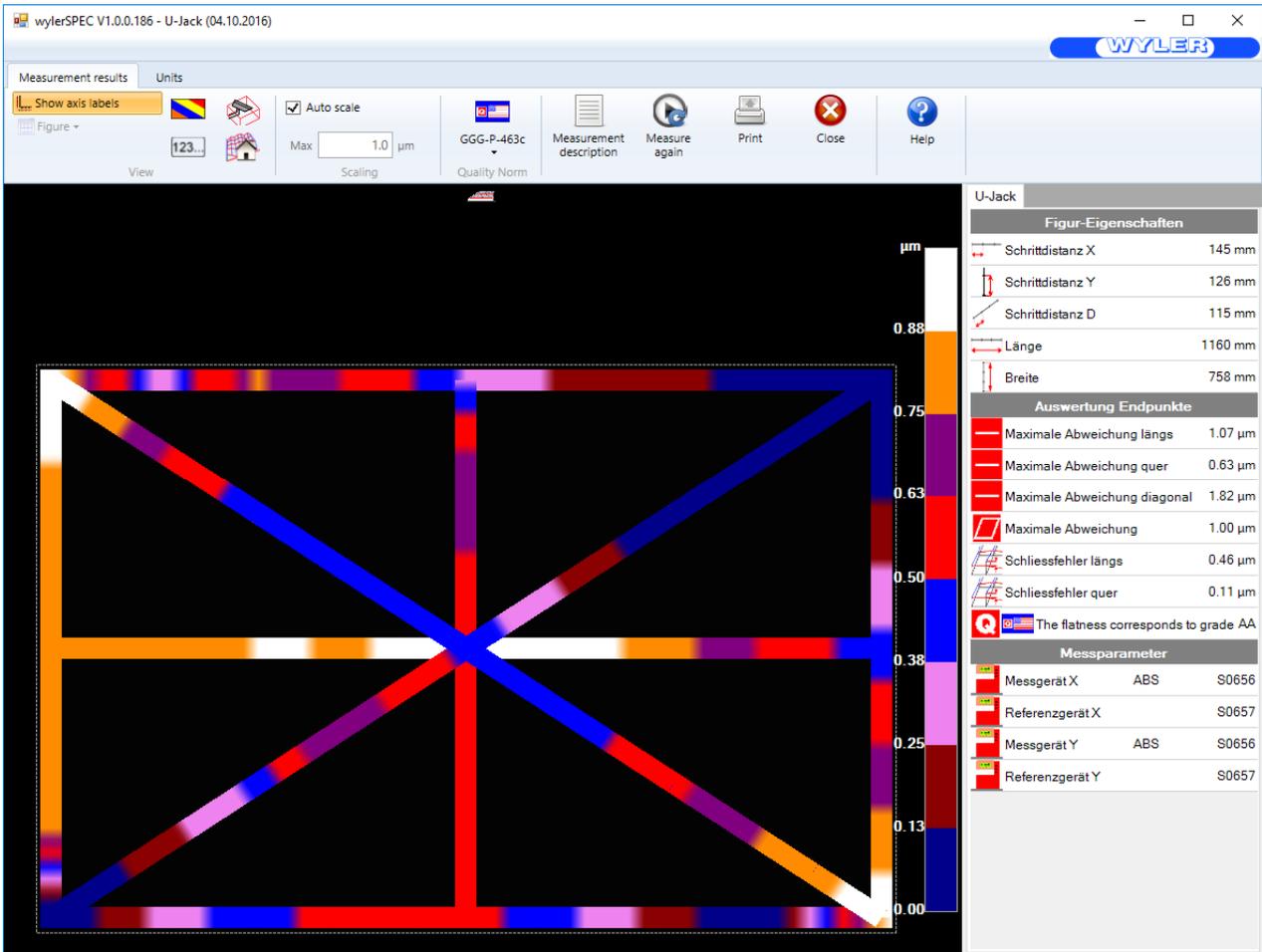




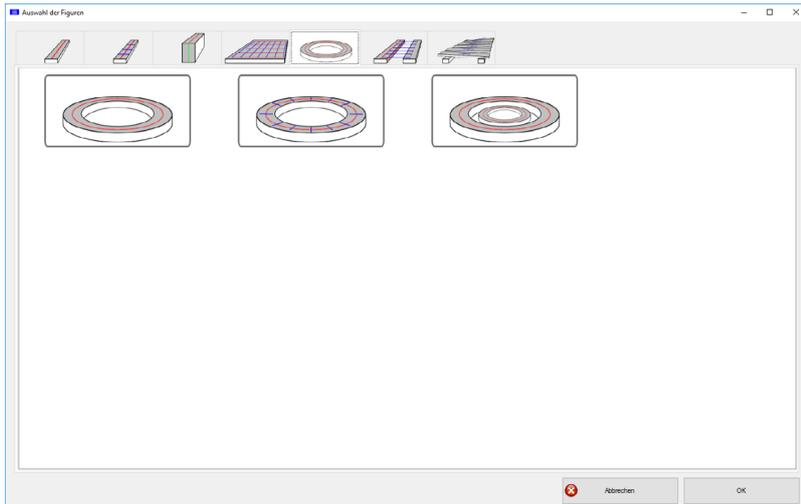


After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

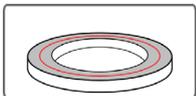
With the button  differently colored representations can be selected.



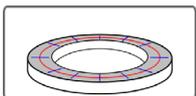
5.5 Circular paths / circular paths with twist



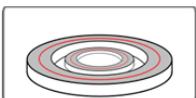
A double click takes you to the page to setup the corresponding measurement.



[Kreis](#)

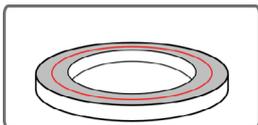


[Kreis mit Twist](#)



[Konzentrische Kreise](#)

5.5.1 Circular path



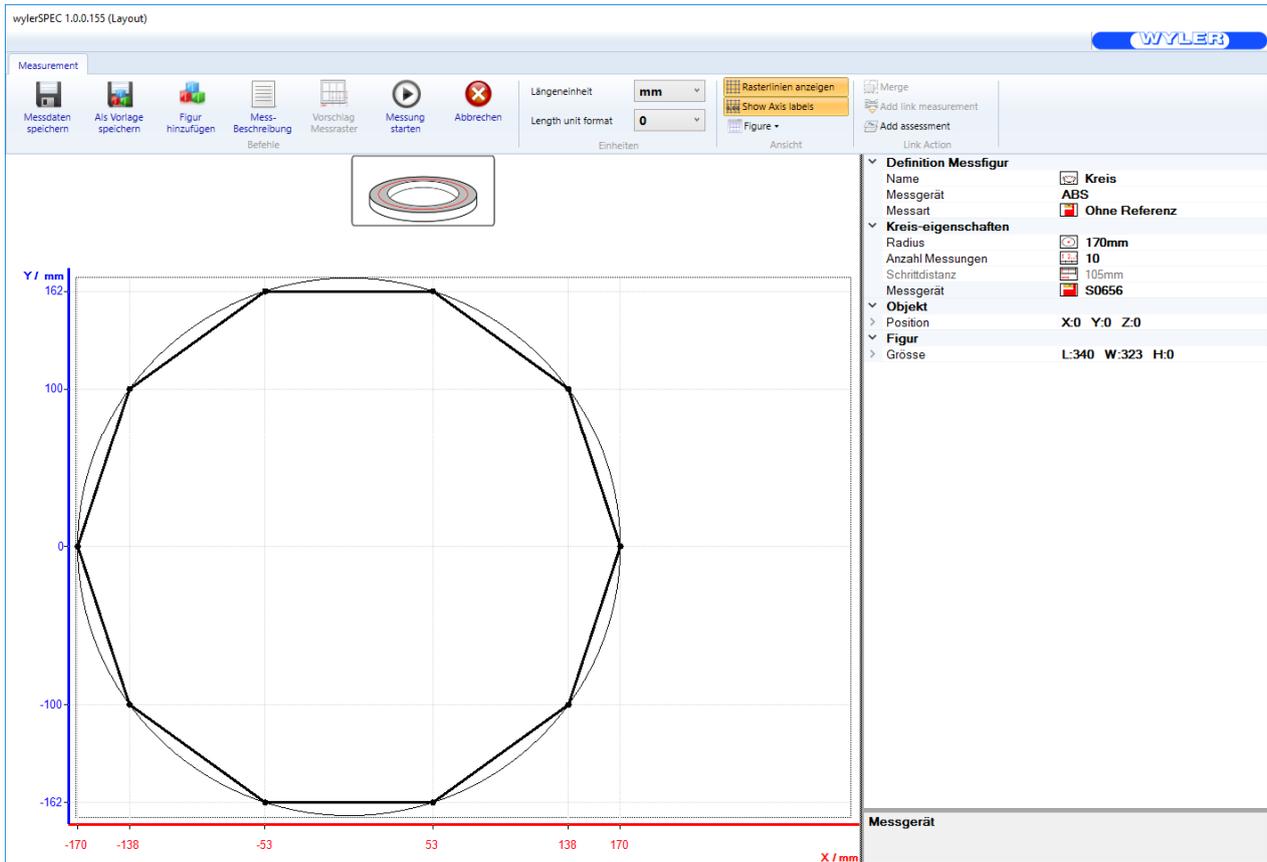
Flatness and position of a circular area in space. Deviation from the true vertical X and Y-axis. Evaluation according to **Absolut, ISO1101 or linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.5.1.1 Circular path setup

Setup of the measurement of a circular path:



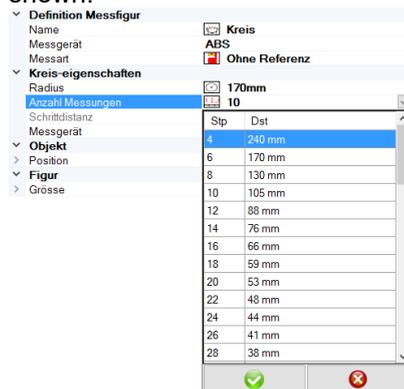
Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut
Way of measurement	Without reference Manual input

Circle properties

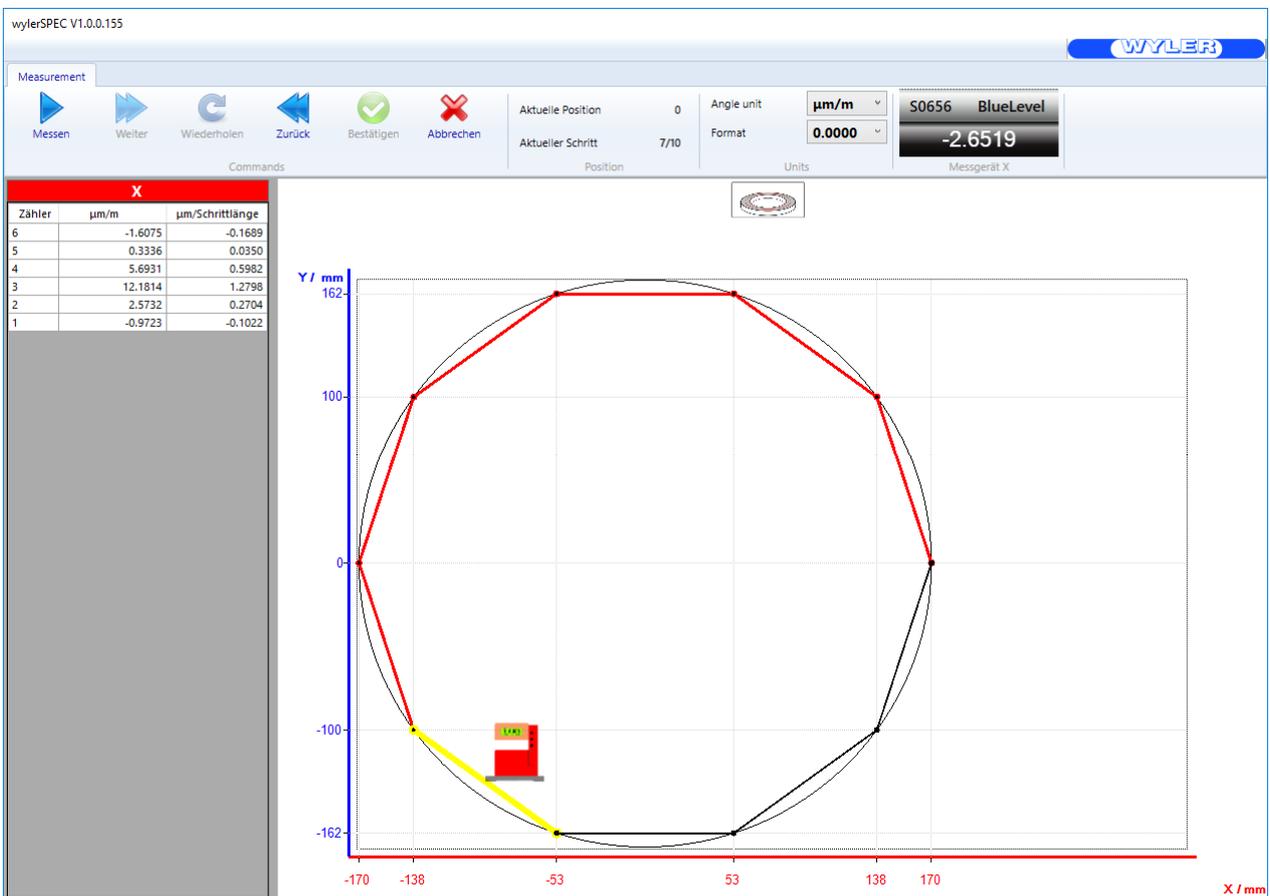
Radius	Radius of the middle pins of the bearing surface
Number of measurements	Number of inclination measurements. Even numbers are allowed only. A click on the symbole, which is shown when editing the field, a list with possible numbers of measurements and the corresponding steplengths is shown:



Steplength	steplength. It is calculated out of the radius and the number of measurements.
Measuring device	Selection of the main measuring device
Objekt	
Position	Position of the circle
Figur	
Size	Length, width and height of the figure

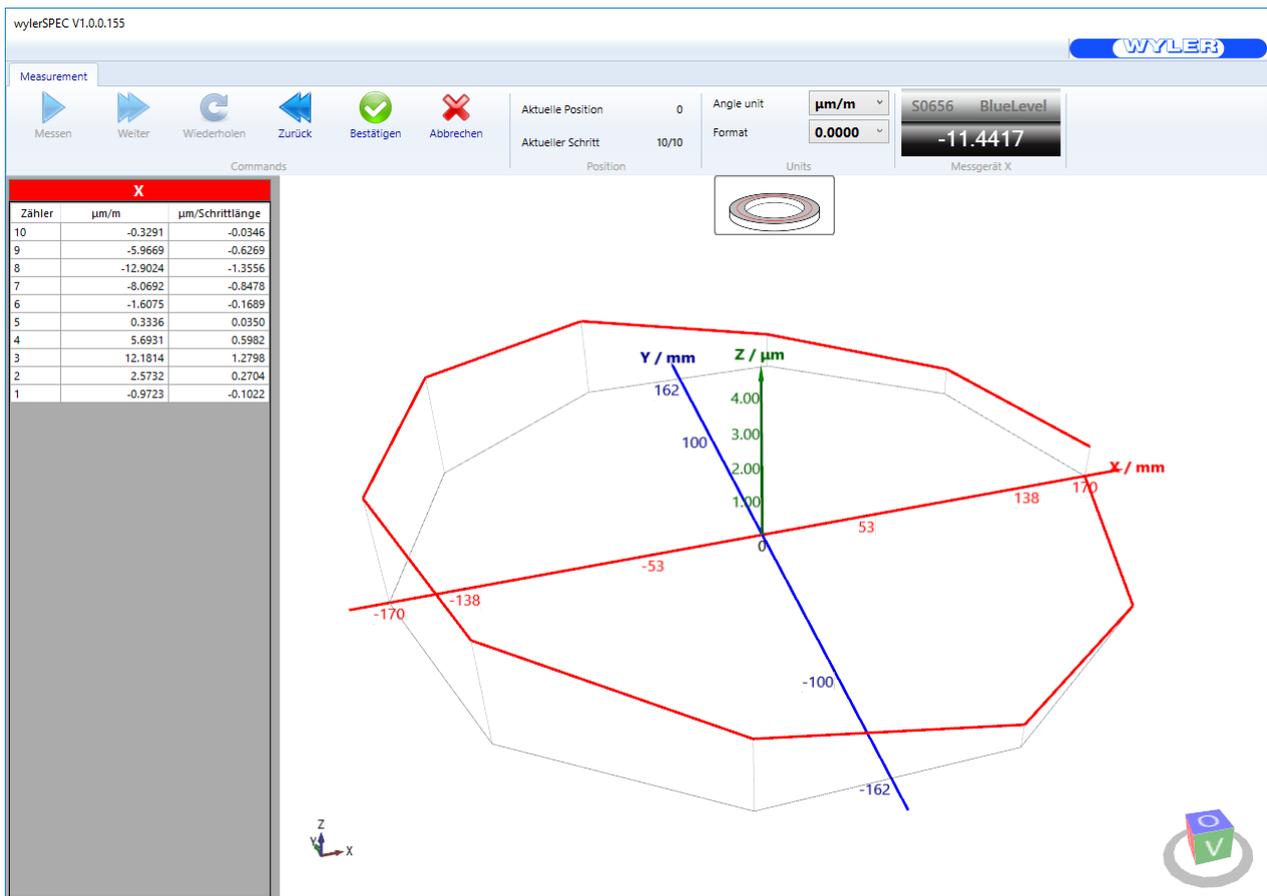
5.5.1.2 Circular path measure

A [reversal measurement](#) will be performed before the measurement starts.



During the measurement the values are displayed in the table "X" on the left.

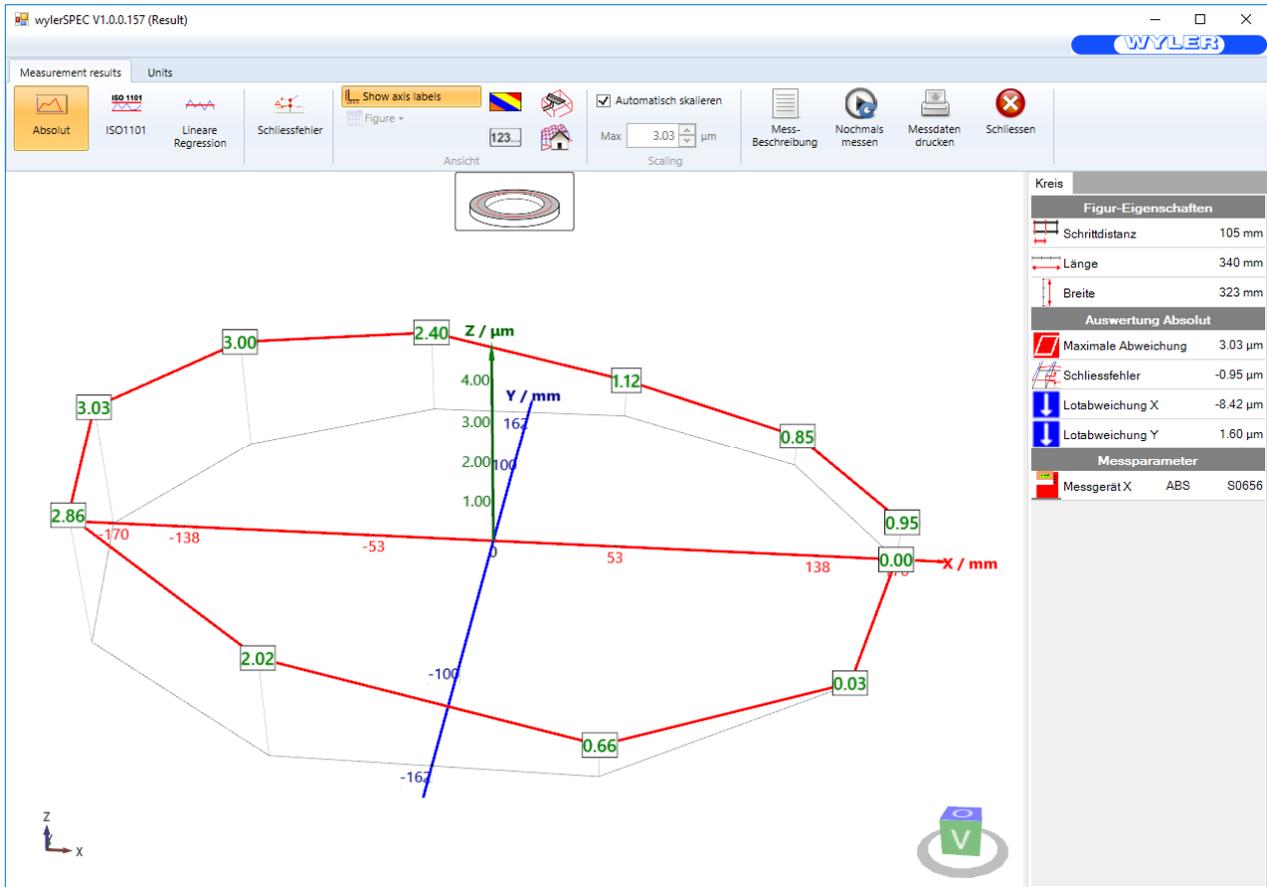
If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.5.1.3 Circular path analyze

Analysis Absolut, ISO1101 or Linear regression open or closed.



Analysis:

 **Maximal deviation**
Highest value minus lowest value

 **Closing error** of the circular path

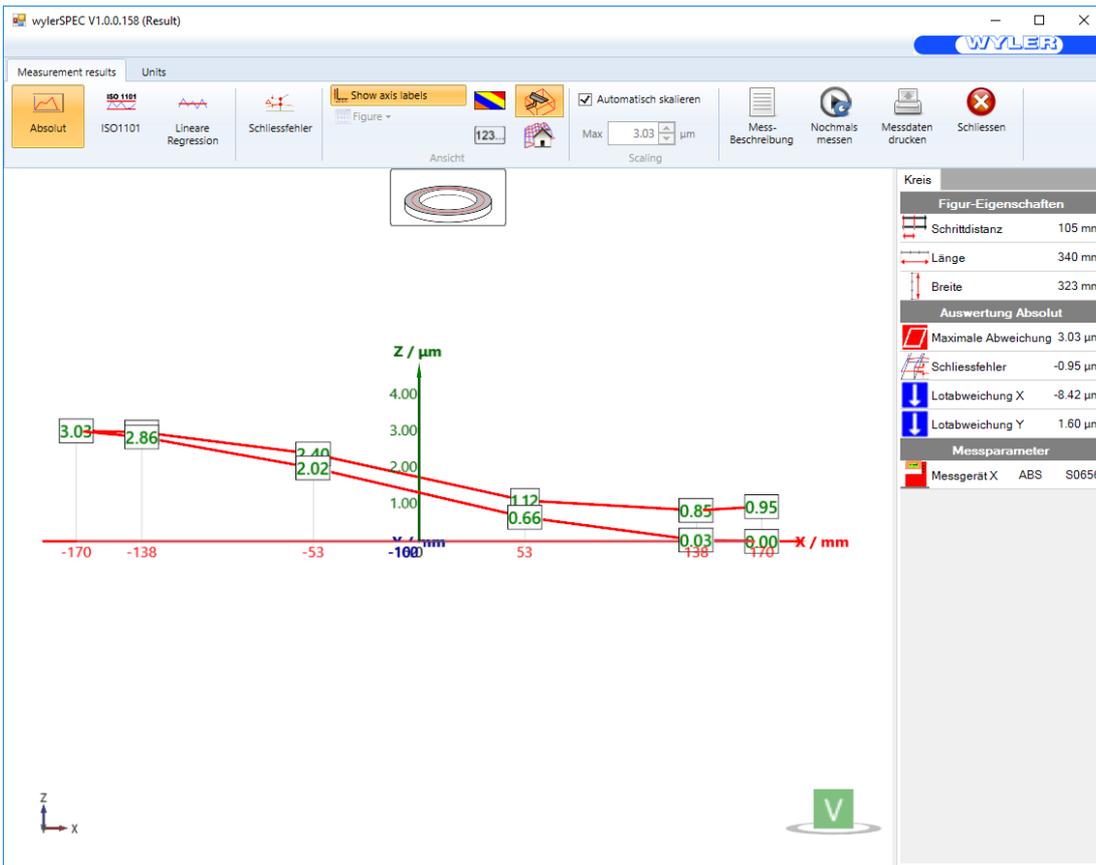
 **Deviation from the true vertical X**
Height difference in the regression plain in X-direction within 1m

 **Deviation from the true vertical Y**
Height difference in the regression plain in Y-direction within 1m

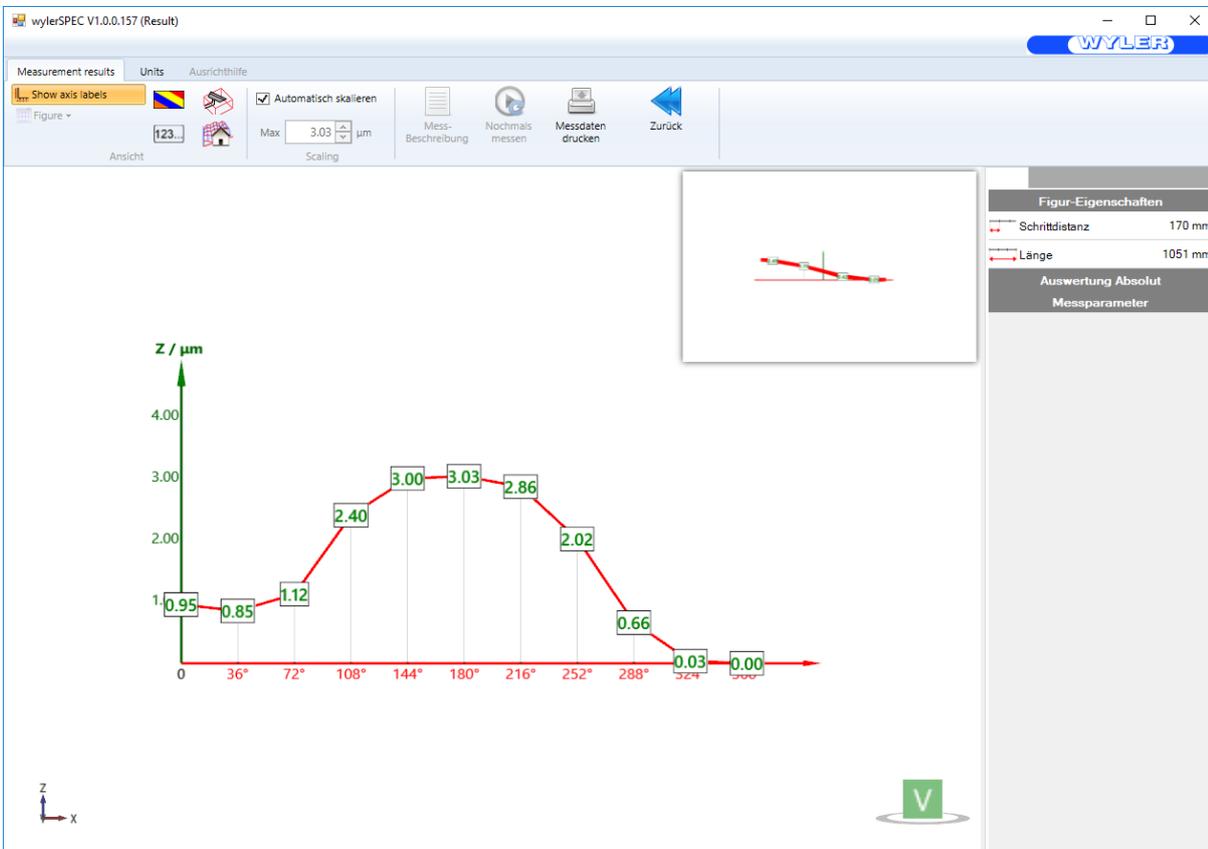
The chart can be turned the way that a **horizontal projection** can be seen. The procedure is as follows:

1. Turn off the perspective view by clicking on 

2. Turning the view. A click on "F" in the cube in the lower right corner  turns the view in frontside horizontal projection.

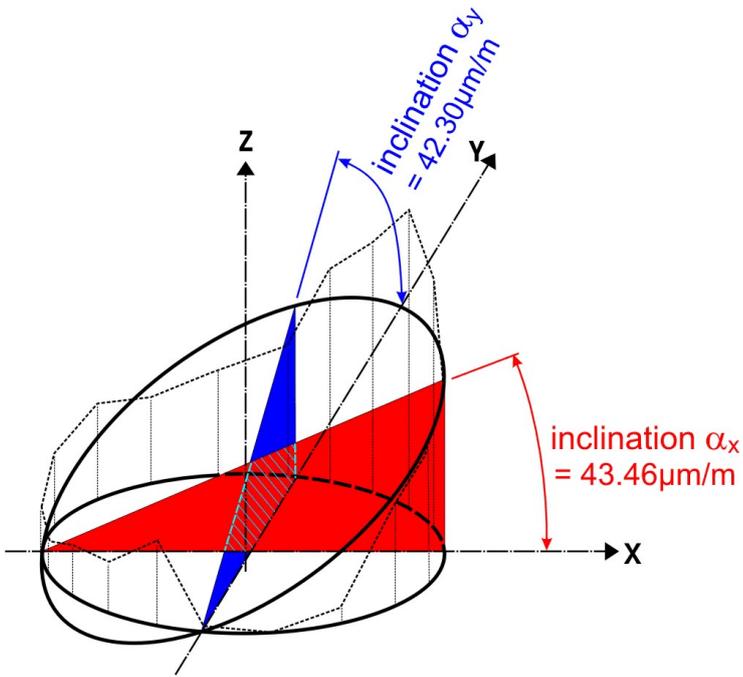


A double click on a circle displays the development drawing:



The button  leads back to the previous view.

5.5.1.3.1 Deviation from the true vertical



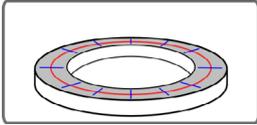
$$\alpha_x = 43.46 \mu\text{m/m}$$

and

$$\alpha_y = 42.30 \mu\text{m/m}$$

The displayed values (X-Axis, Y-Axis) below "Statistic" in the display window are the **deviation from the true vertical**.

5.5.2 Circular path with twist

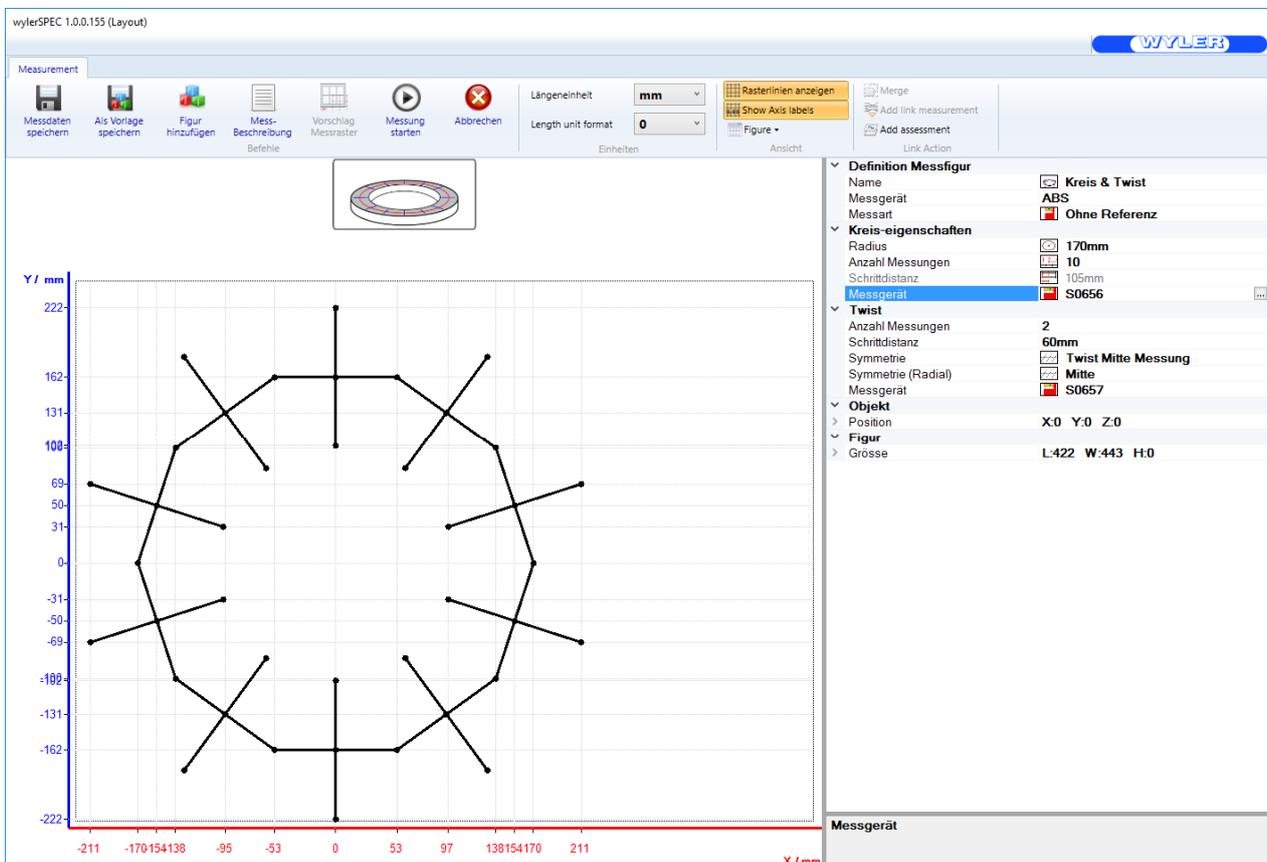


Flatness measurement of a horizontal circular area and defining the deviation from the true vertical X and Y-axis. Evaluation according to **Absolut, ISO1101 or linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.5.2.1 Circular path with twist setup



Measuring parameter:

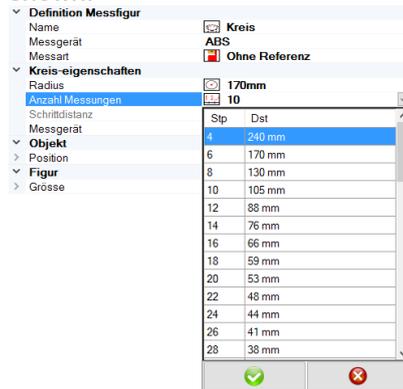
Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut
Way of measurement	Without reference Manual input

Circle properties

Radius	Radius of the middle poins of the bearing surface
--------	---

Number of measurements Number of inclination measurements. Even numbers are allowed only. A click on the symbole, which is shown when editing the field, a list with possible numbers of measurements and the corresponding steplengths is shown:



Steplength steplength . It is calculated out of the radius and the number of measurements.

Measuring device [Selection](#) des Hauptmessgerätes

Twist

Number of measurements Anzahl Transversalmessungen, die Anzahl ist begrenzt, siehe unten.

Steplength Steplength per measurement, bei Symmetry "Mitte" darf die Distanz der halben Anzahl Schritte mal die Schrittweite nicht grösser als der Kreisradius sein.

Symmetry Twistmessung in der Mitte einer Messung entlang dem Kreis oder bei den Auflagepunkten.

Symmetry (radial) "Mitte": Twistmessung symmetrisch innen und aussen.
"Aussen": Twistmessung nur nach aussen.

Measuring device [Selection](#) des Messgerätes für die Transversalmessung

Objekt

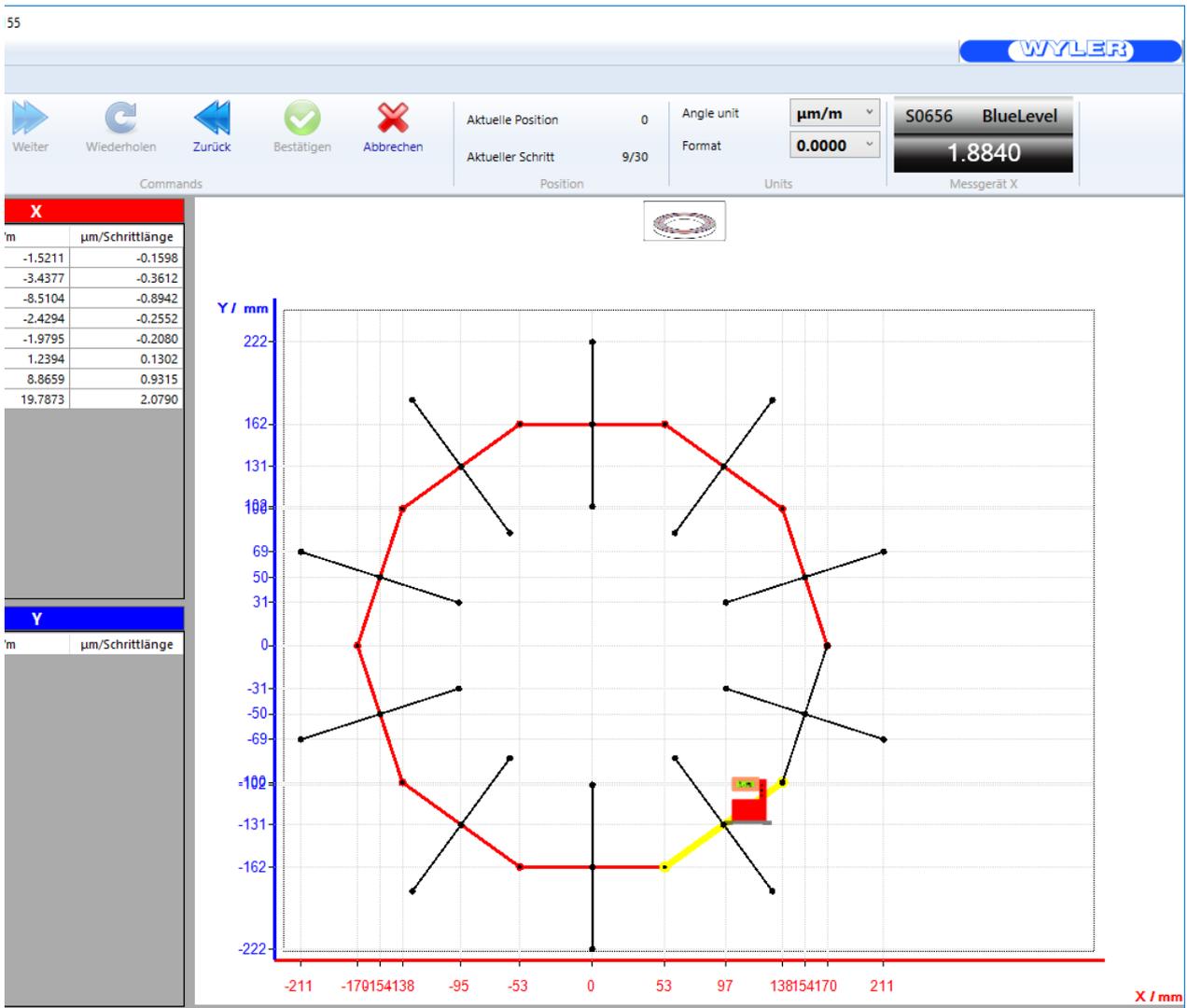
Position Koordinaten des Zentrums der Messfigur

Figur

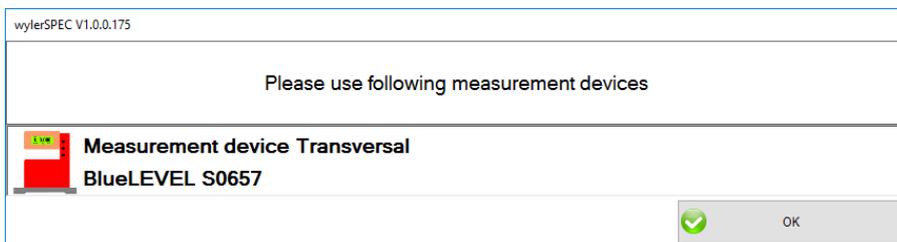
Size Length, width and height of the figure

5.5.2.2 Circular path with twist measure

A [reversal measurement](#) will be performed before the measurement starts.

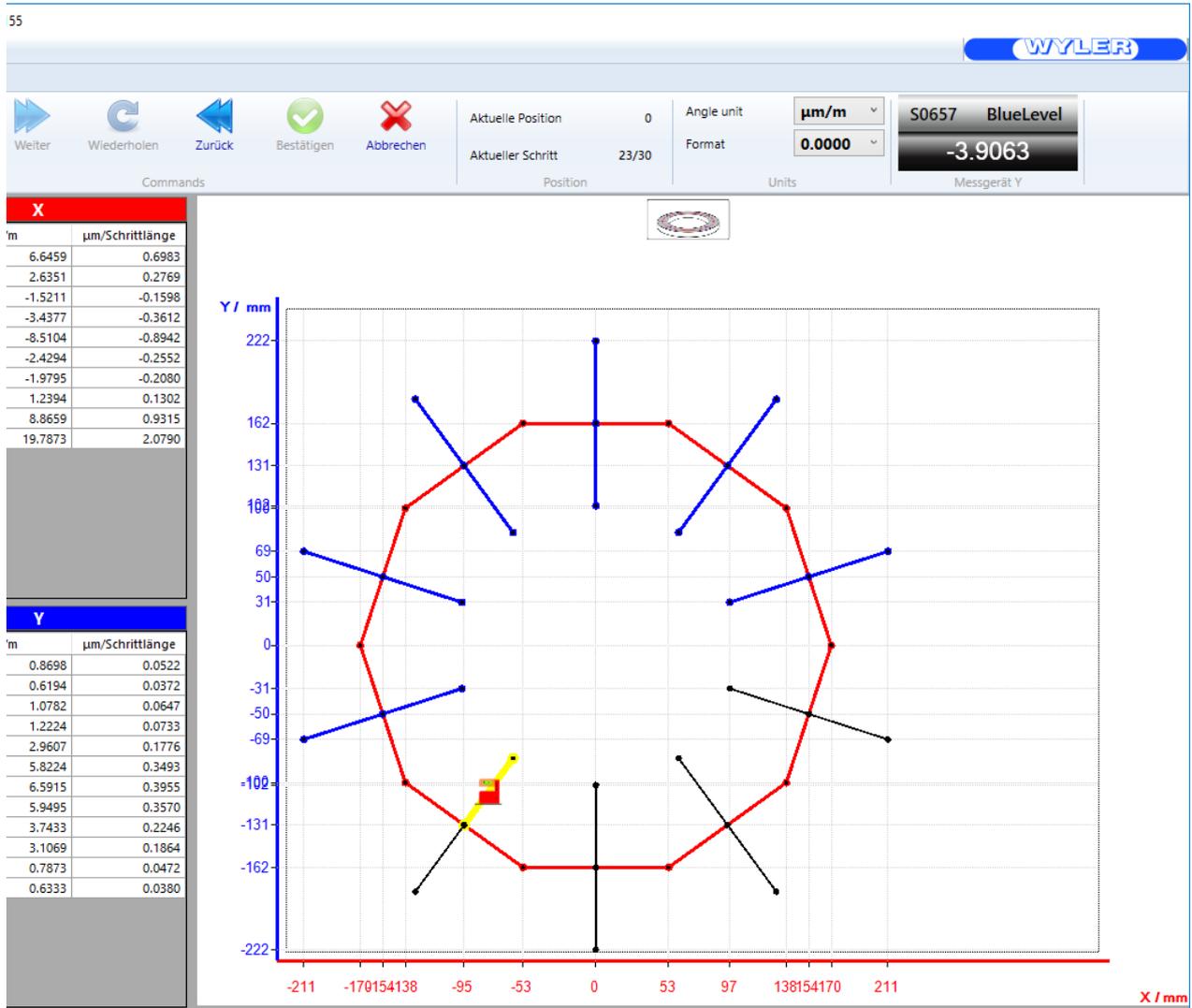


During the measurement the values are displayed in the table "X" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



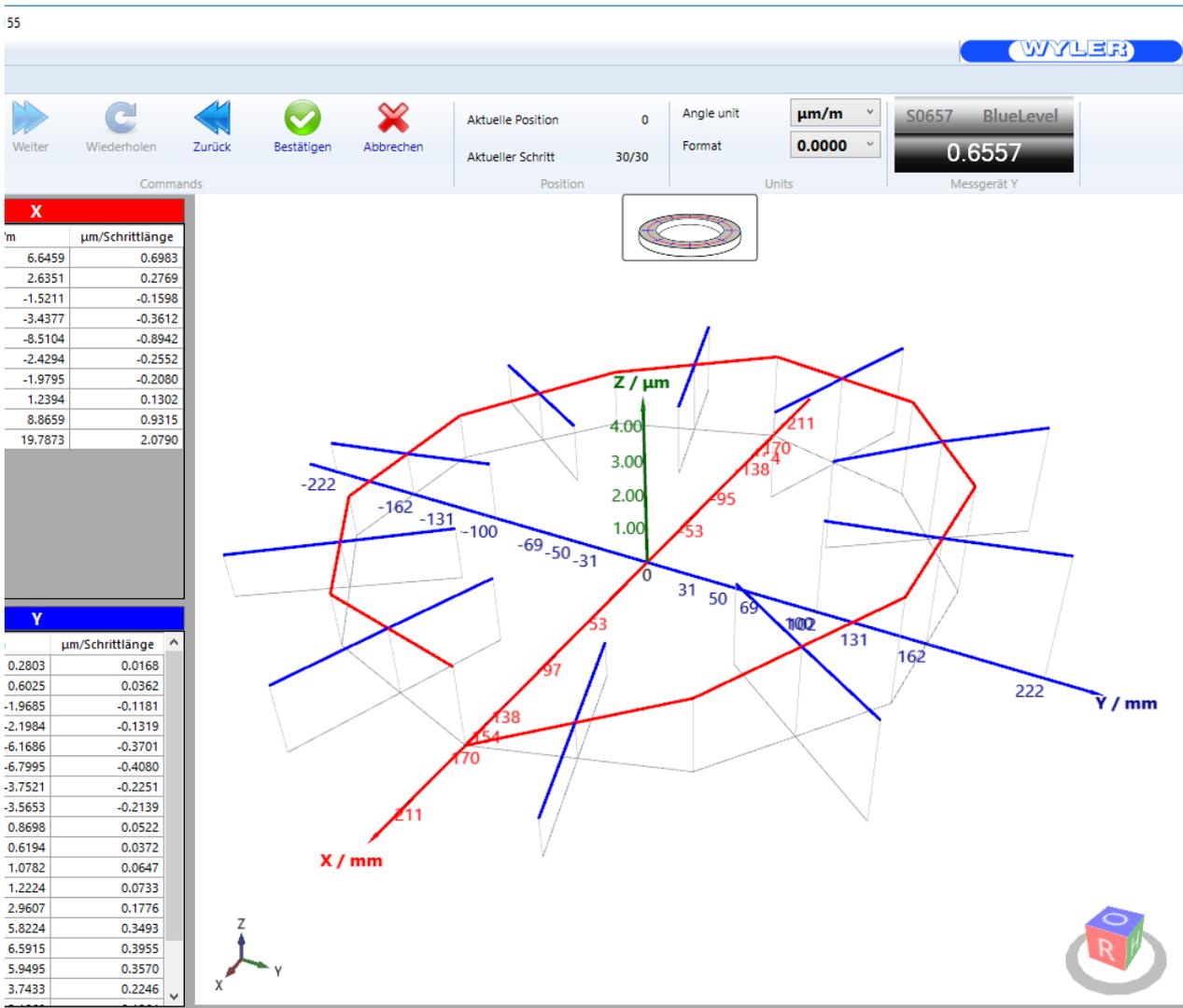
If a different device is defined to perform the measurement of the twist lines, the devices have to be changed now.

Measuring the twist lines.



During the measurement the values are displayed in the table "Y" on the left.

If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



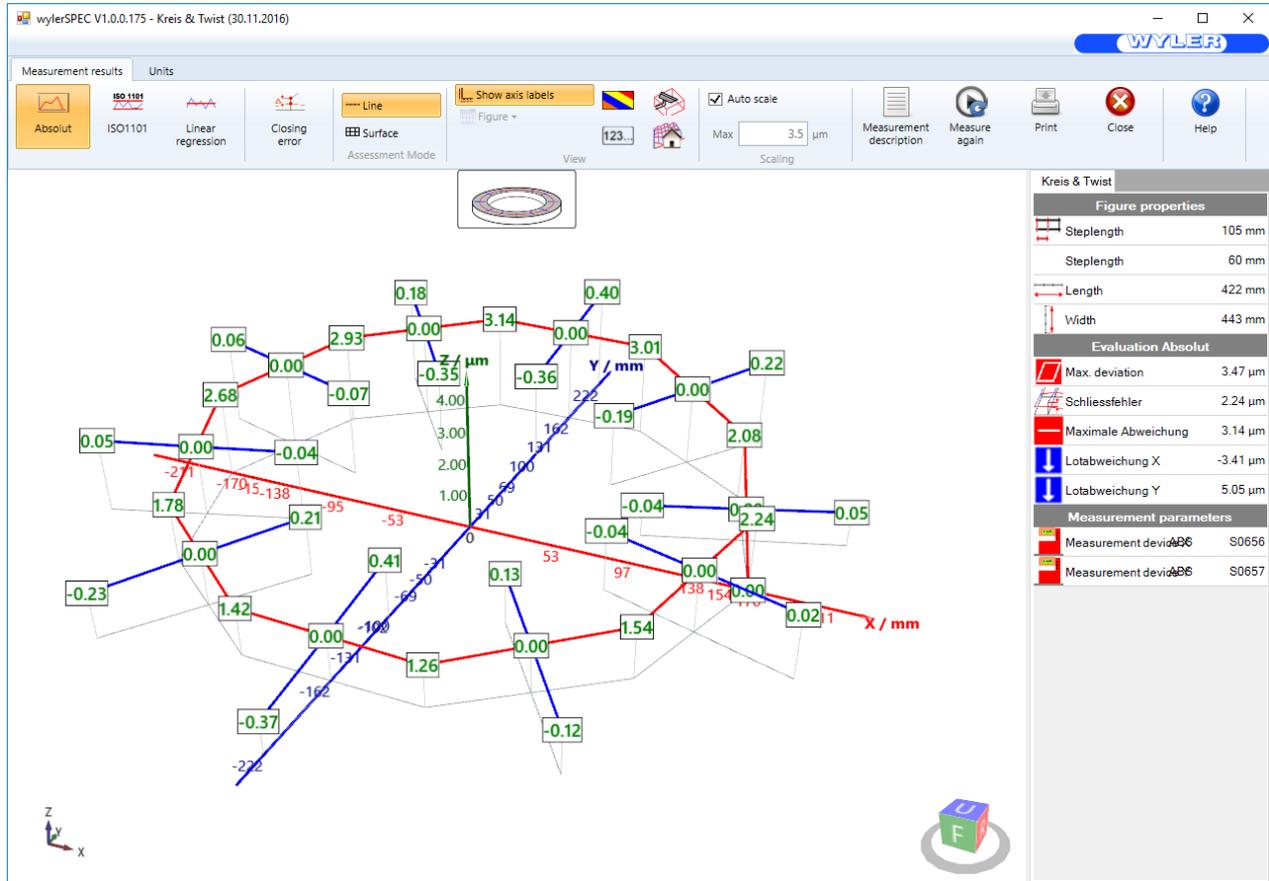
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.5.2.3 Circular path with twist analyze

Possible Analysis: Absolut, ISO1101 or Linear regression
 Circle closed or open, twist as line or all points as surface



Linie The twist lines are regarded as lines. The heights of the crossing points are set to zero to enhance the visibility of the twist.

Analysis:

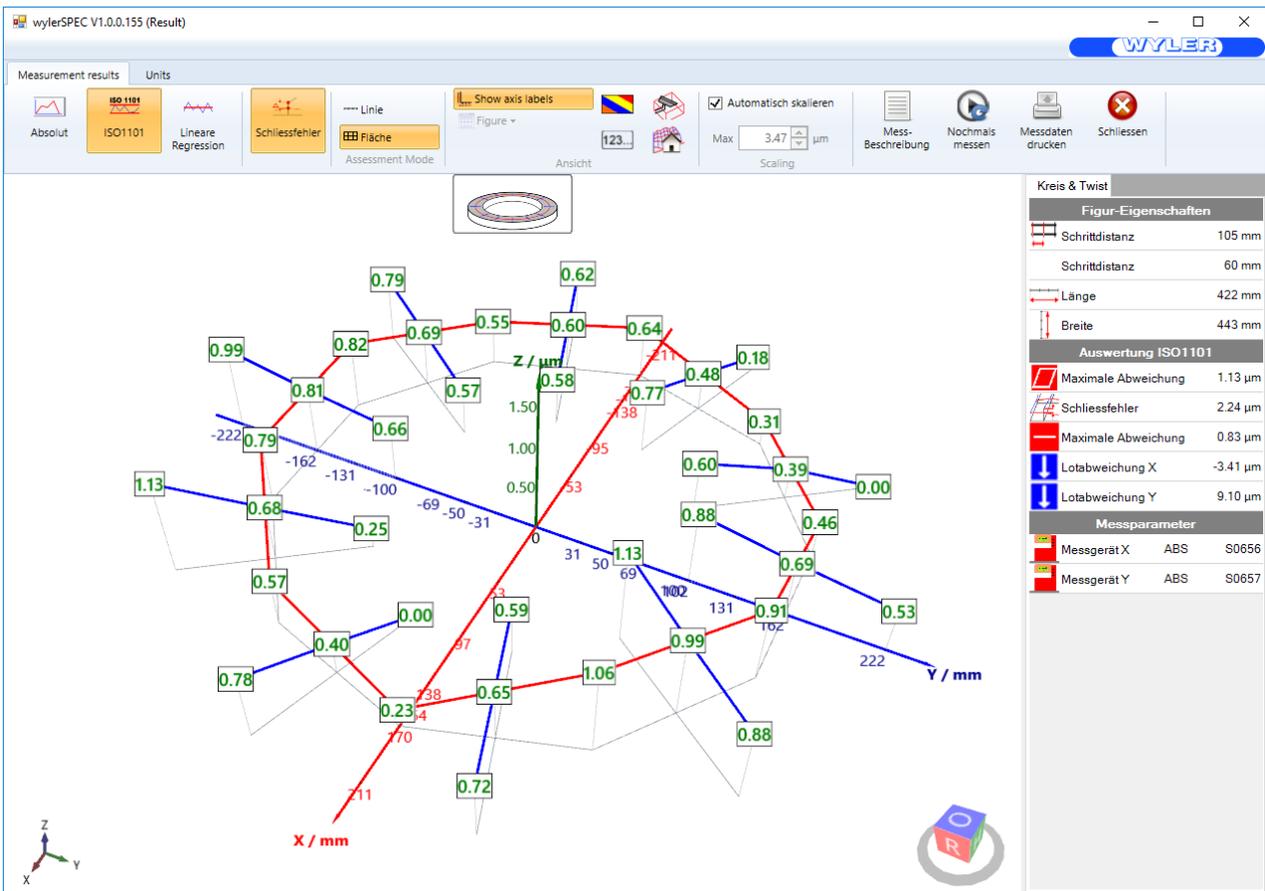
 **Maximal deviation** inclusive twist lines
 Highest value minus lowest value

 **Closing error** of the circular path

 **Maximal deviation** of the circular path
 Highest value minus lowest value

 **deviation from the true vertical X**
 Height difference in the regression plain in X-direction within 1m

 **deviation from the true vertical Y**
 Height difference in the regression plain in Y-direction within 1m

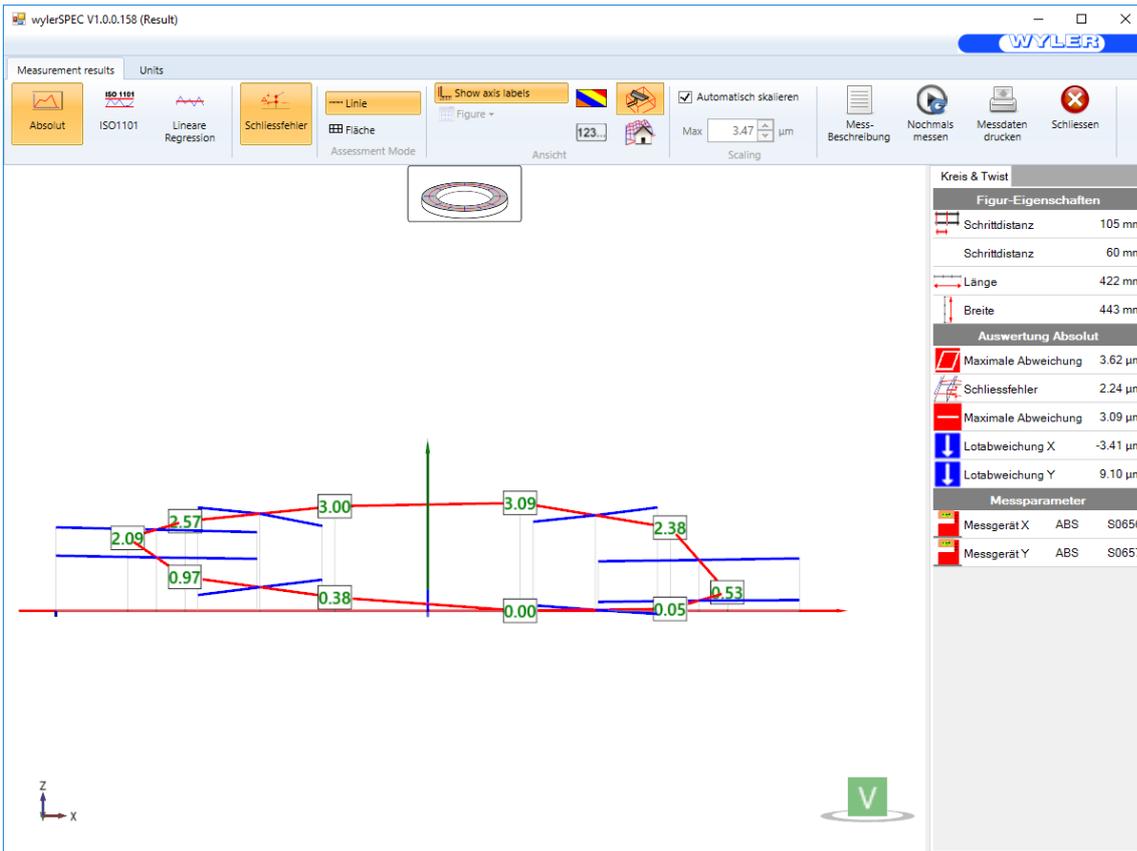


Fläche Twist and circle form together a surface. The heights of the crossing points correspond to the heights of the circle.

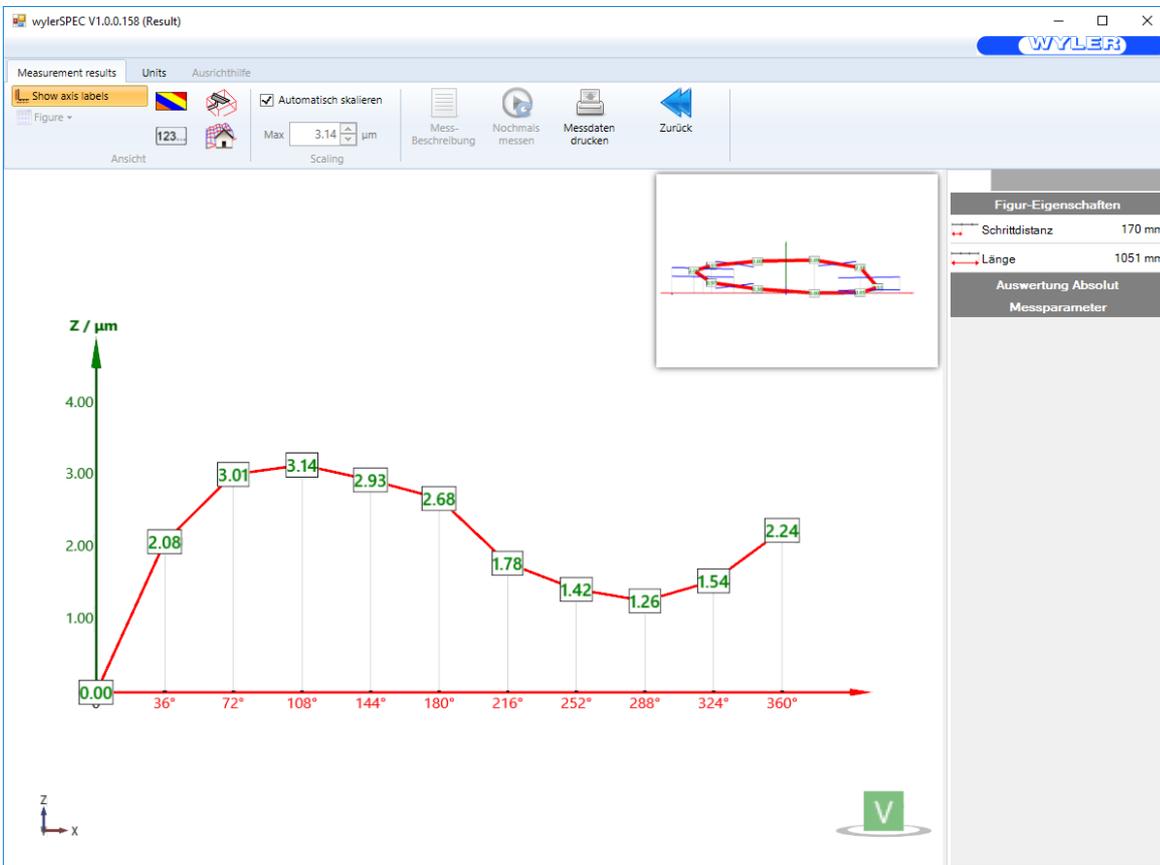
The chart can be turned the way that a **horizontal projection** can be seen. The procedure is as follows:

1. Turn off the perspective view by clicking on 

2. Turning the view. A click on "F" in the cube in the lower right corner  turns the view in frontside horizontal projection.

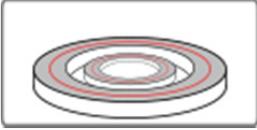


A double click on a circle displays the development drawing:



The button  leads back to the previous view.

5.5.3 Concentric Circular paths



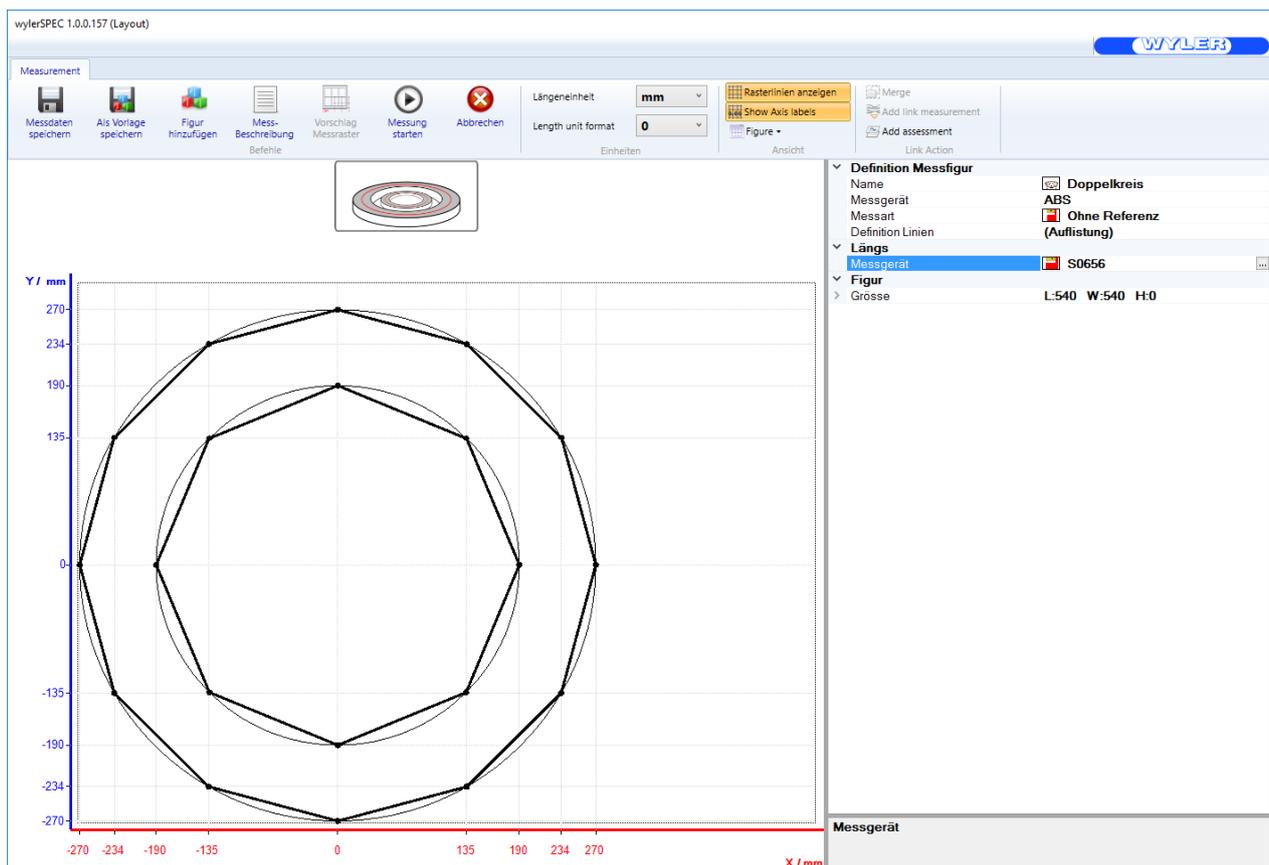
Flatness and position of two circular areas in space. Deviation from the true vertical X and Y-axis of the outer circle and definition of the co-planarity of the two circles. Evaluation according to **Absolut, ISO1101 or linear regression**. It is possible to select the reference circle.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.5.3.1 Concentric Circular paths setup

Setup der Messung von konzentrischen Kreisen:



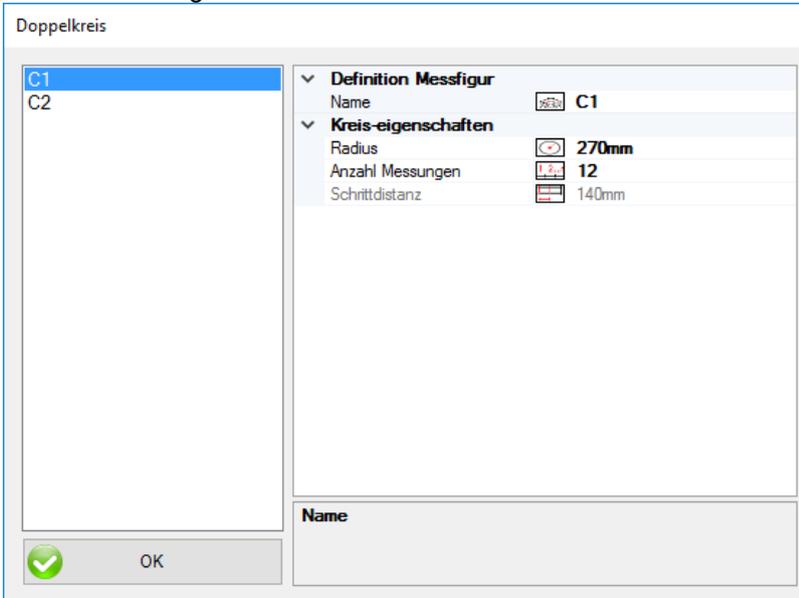
Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut oder RELativ
Way of measurement	Without reference oder Manual input

Definition Line n
Longitudinal
 Measuring device [Selection](#) of the main measuring device
Figur
 Size Length, width and height of the figure

Kreis-Einstellungen:



In der Liste links kann der Kreis ausgewählt werden, welcher eingerichtet werden soll.

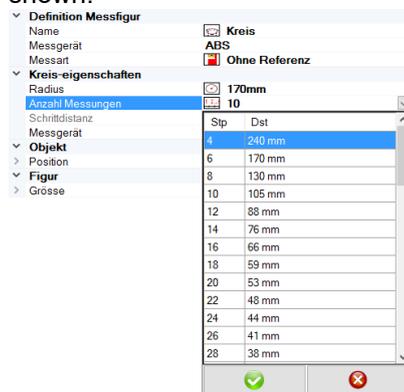
Definition measurement figure

Name Name des Kreises

Circle properties

Radius Radius of the middle points of the bearing surface

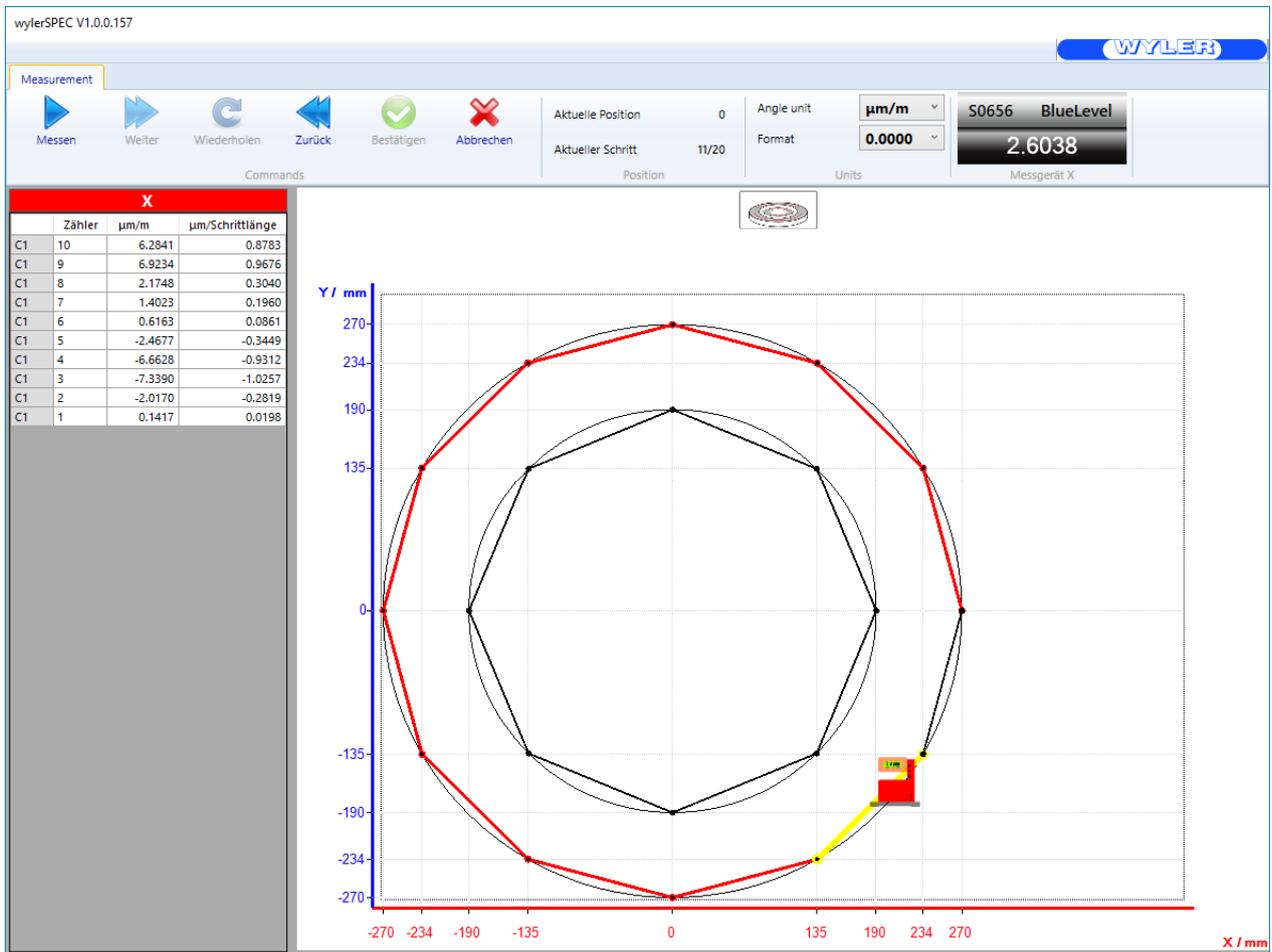
Number of measurements Number of inclination measurements. Even numbers are allowed only. A click on the symbol, which is shown when editing the field, a list with possible numbers of measurements and the corresponding steplengths is shown:



Steplength steplength . It is calculated out of the radius and the number of measurements.

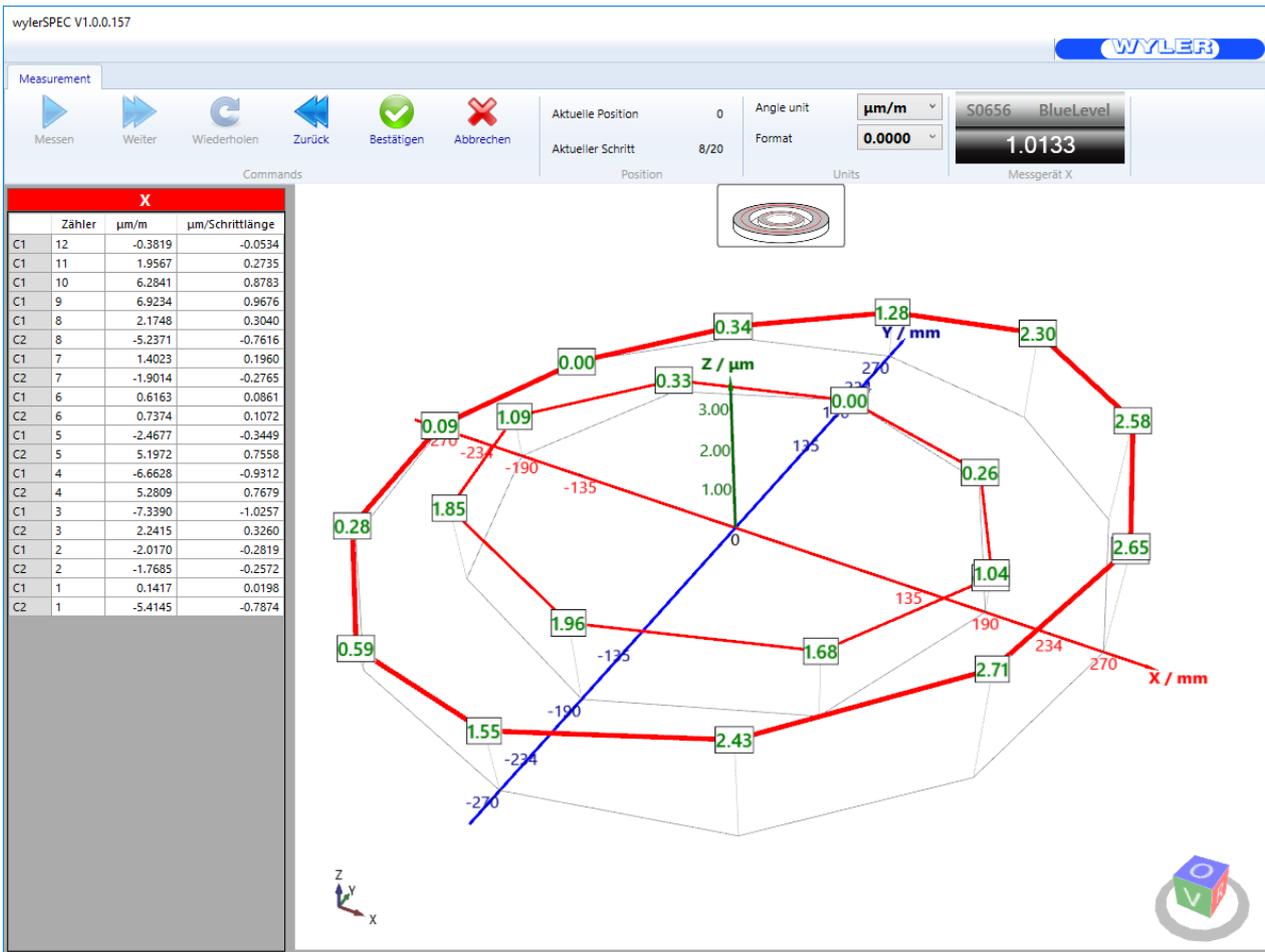
5.5.3.2 Concentric Circular paths measure

A [reversal measurement](#) will be performed before the measurement starts.



During the measurement the values are displayed in the table "X" on the left.

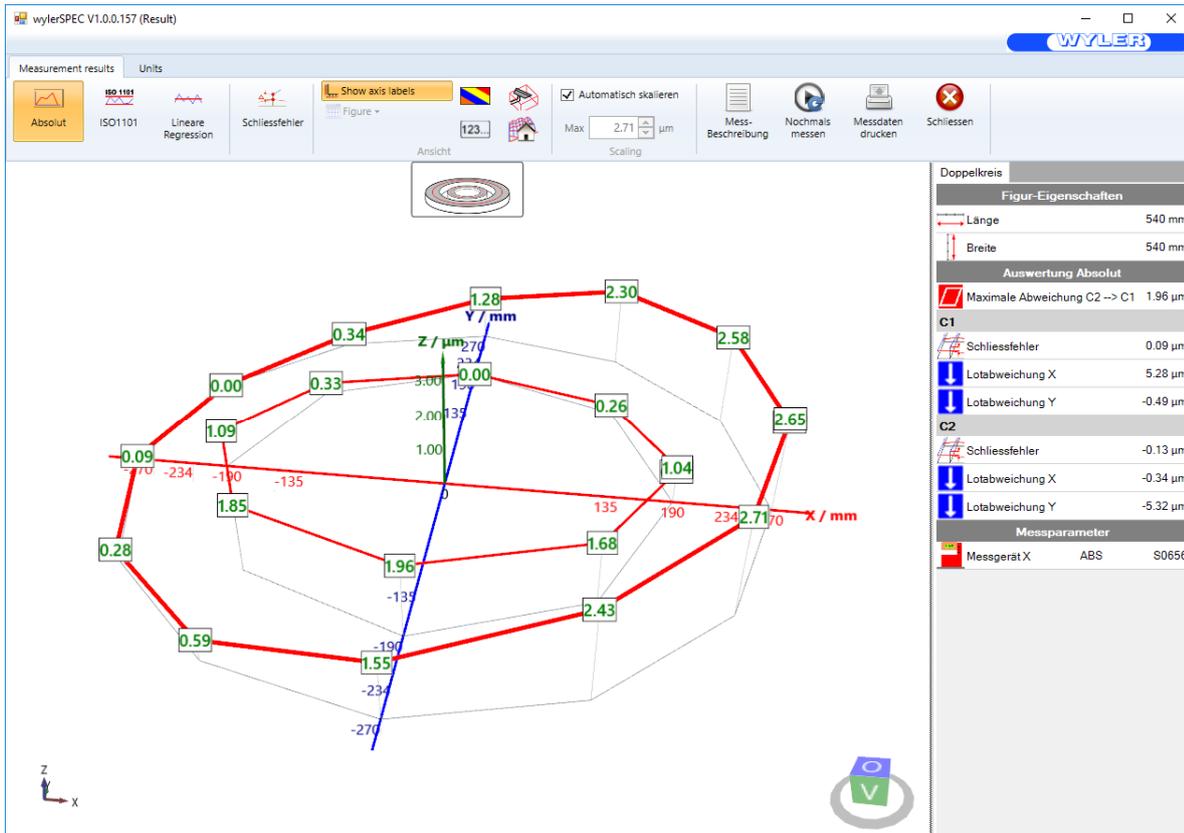
If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.5.3.3 Concentric Circular paths analyze

Analysis Absolut, mit ISO1101 oder mit Linear regression offen oder geschlossen möglich.



Analysis:

 **Maximal Deviation C2 - C1**
Highest value minus lowest value in Kreis 2

 **Closing error** of the circular path

 **Maximal deviation** of the circular path
Highest value minus lowest value

 **deviation from the true vertical X**
Height difference in the regression plain in X-direction within 1m

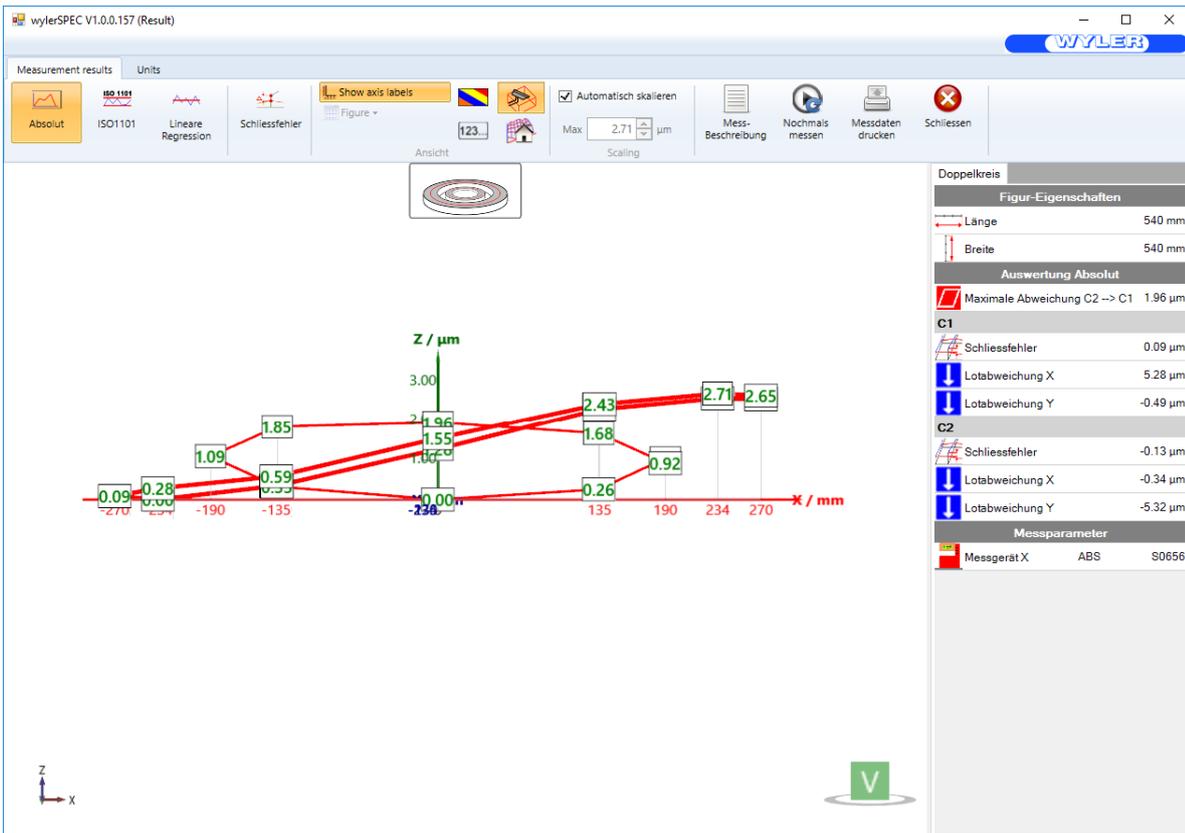
 **deviation from the true vertical Y**
Height difference in the regression plain in Y-direction within 1m

Change the reference circle with a click on the appropriate circle.

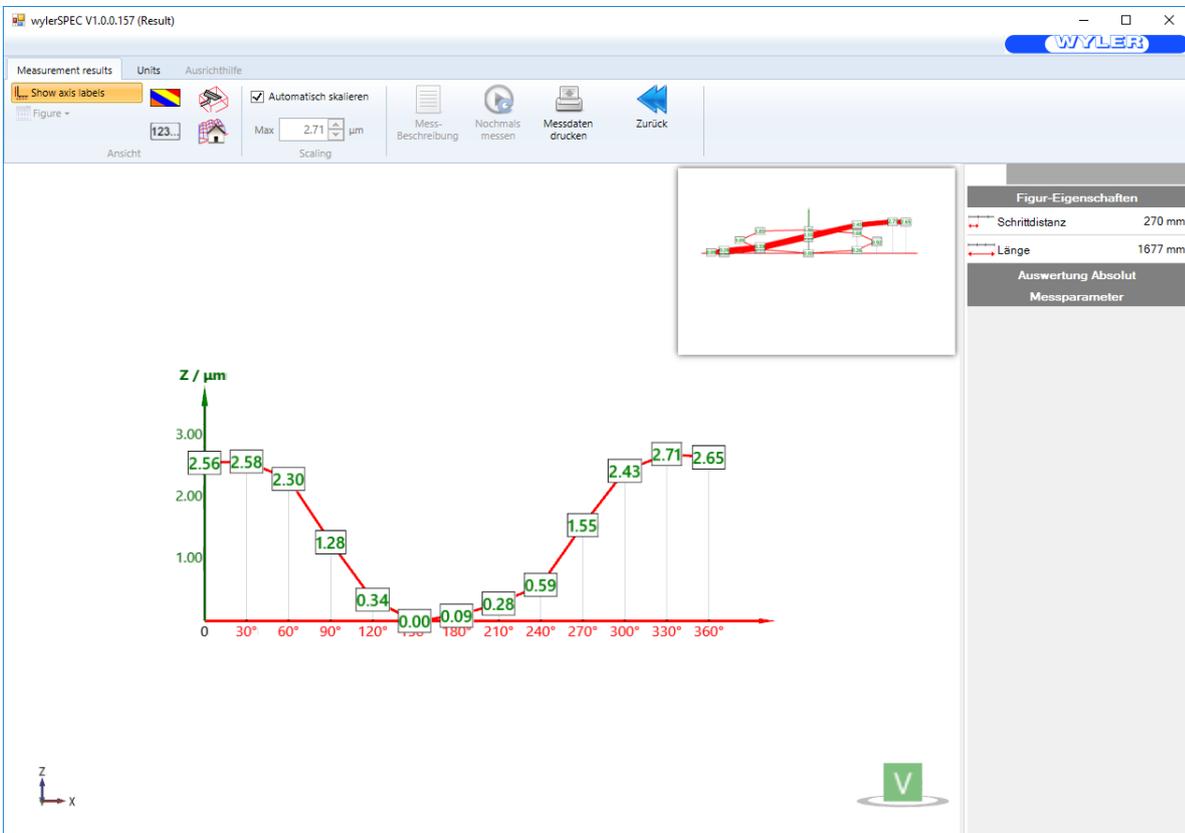
The chart can be turned the way that a **horizontal projection** can be seen. The procedure is as follows:

1. Turn off the perspective view by clicking on 

2. Turning the view. A click on "F" in the cube in the lower right corner  turns the view in frontside horizontal projection.

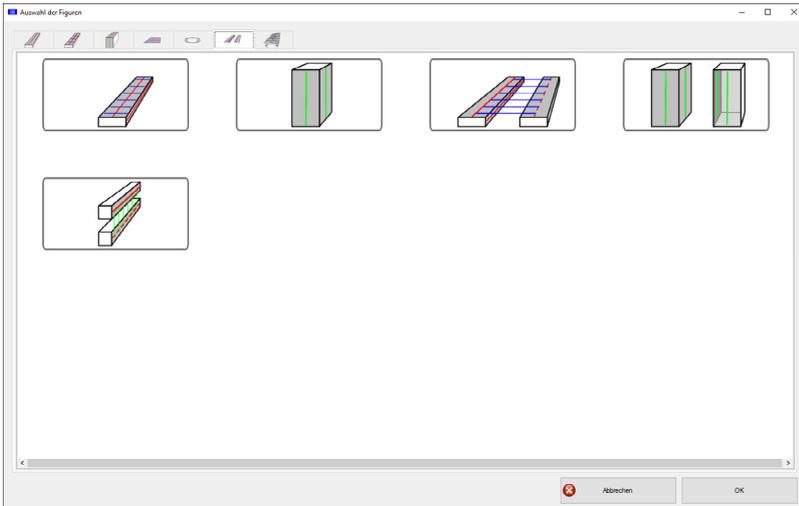


A double click on a circle displays the development drawing:

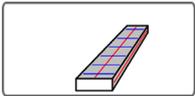


The button  leads back to the previous view.

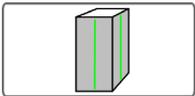
5.6 Guide ways vertical and horizontal



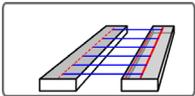
A double click takes you to the page to setup the corresponding measurement.



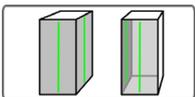
[guide way horizontal](#)



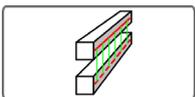
[guide way vertikal](#)



[2 guide wayen horizontal](#)

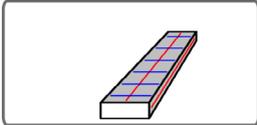


[2 guide wayen vertikal](#)



[2 guide wayen quer](#)

5.6.1 Guide way horizontal



Analysis of a horizontal guide way. Evaluations **Absolut**, **ISO1101**, **End points** or **linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.6.1.1 Guide way horizontal setup

Setup of a measurement of a horizontalen guide way:

Measuring parameter:

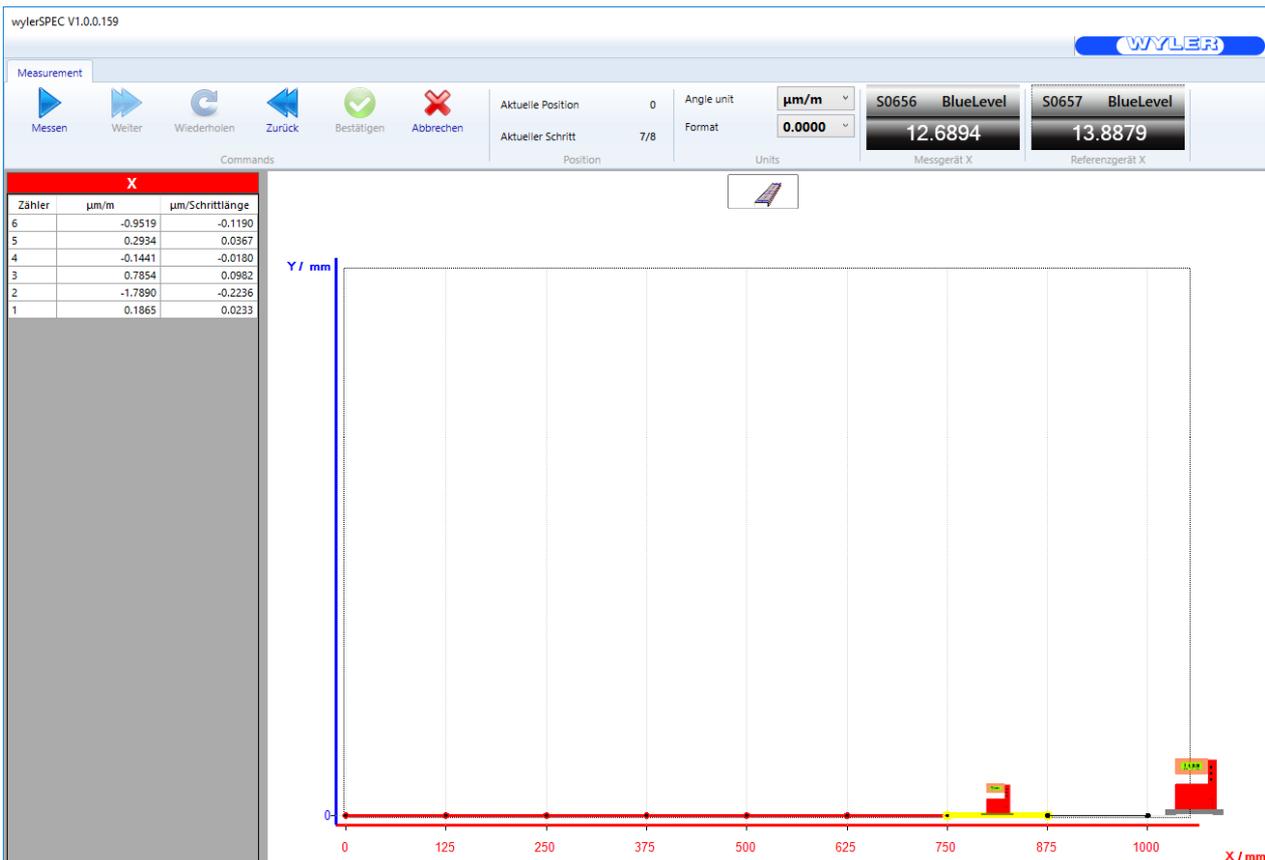
Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ not.
Way of	With reference

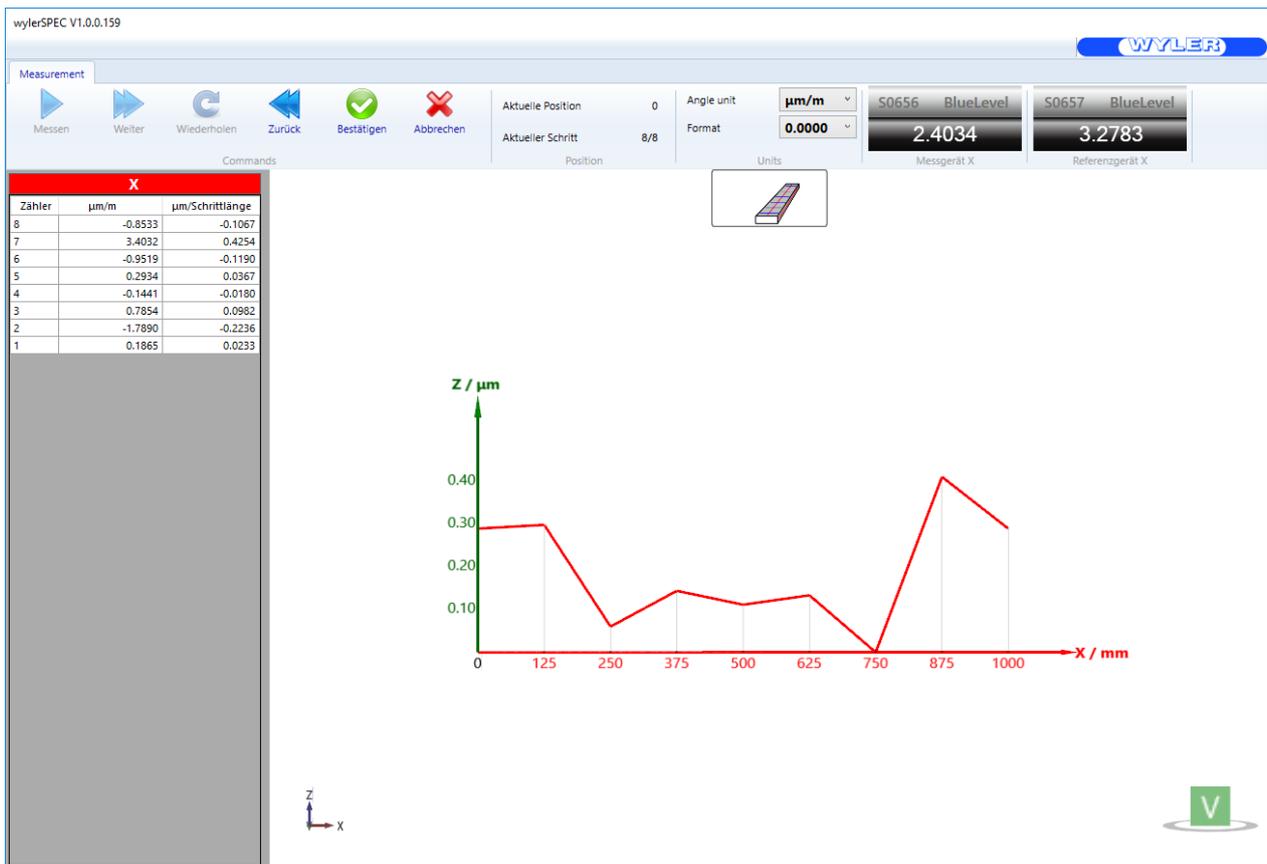
- measurement Without reference
Manual input
- Measurement JIG Used Measurement JIG, Measuring beam only
- Single-/multi-axis measurement Selection single axis only
- Longitudinal**
- Number of measurements Number of inclination measurements, the number of heights is bigger by 1
- Steplength steplength pro Messung
- Measuring device [Selection](#) of the main measuring device
- Reference device [Selection](#) of the reference device
- Figur**
- Size Length, width and height of the figure

5.6.1.2 Guide way horizontal measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



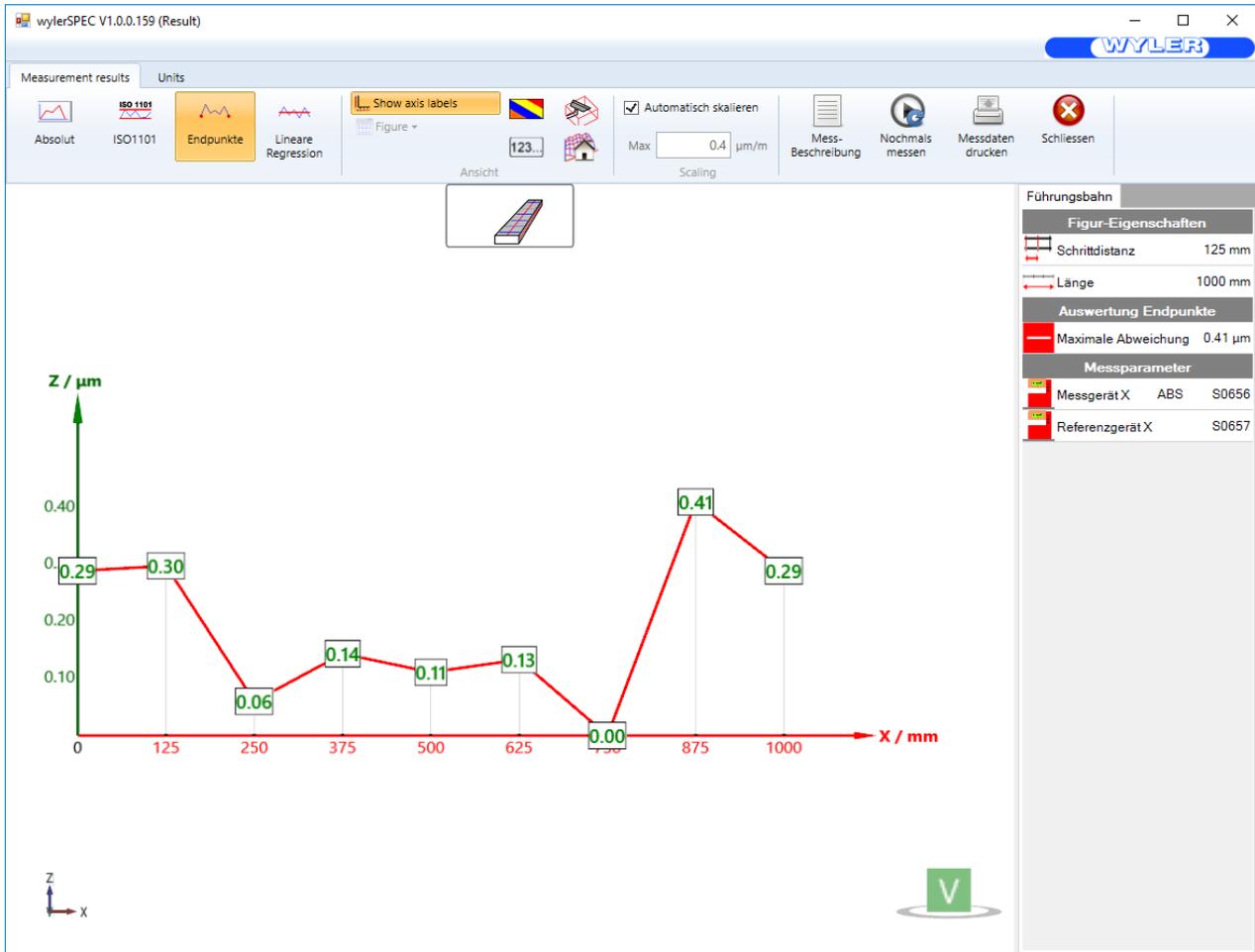
During the measurement the values are displayed in the table "X" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.6.1.3 Guide way horizontal analyze

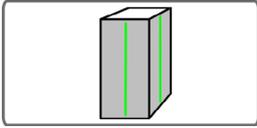
Analysis Absolut, ISO1101, End points or Linear regression.



Analysis:

 **Maximal deviation** = Biggest height difference auf der guide way

5.6.2 Guide way vertical



Analysis of a vertical guide way. Evaluations **Absolut**, **ISO1101**, **End points** or **linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.6.2.1 Guide way vertical setup

Setup der Messung einer vertikalen guide way

The screenshot shows the wylerSPEC 1.0.0.175 (Layout) software interface. The top toolbar includes buttons for Save measurement, Save as template, Measurement description, Grid Proposal, Start measurement, and Cancel. The main window displays a 3D model of a vertical guide way and a 2D plot of the Z-axis (mm) from 0 to 1000. The right-hand panel shows the 'Definition measurement figure' settings, including Name (Guide way), Measurement device (ABS), Way of measuring (With reference), Number of measurements transversal (8), and Steplength transversal (125mm).

Measuring parameter:

Definition measurement figure

Name Name of the figure
 Measuring device Measurement method ABSolut oder RELative. If absolut is selected at begin of

measurement a [reversal measurement](#) must be performed.

Way of measurement
 With reference
 Without reference
 Manual input

Vertikal

Number of measurements quer Number of inclination measurements

Steplength steplength per measurement step

Measuring device [Selection](#) of the main measuring device

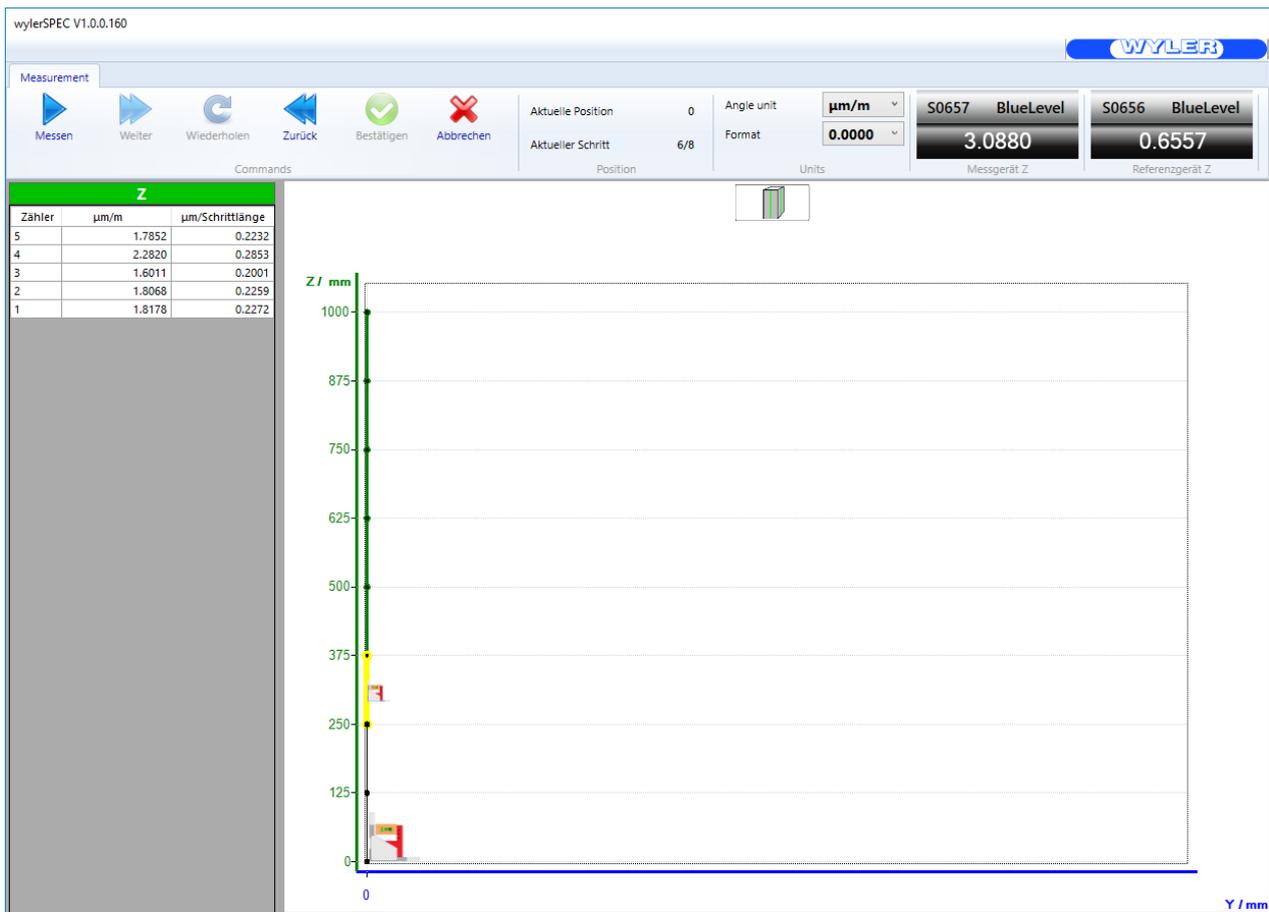
Reference device [Selection](#) of the reference measuring device

Figur

Size Length, width and height of the figure

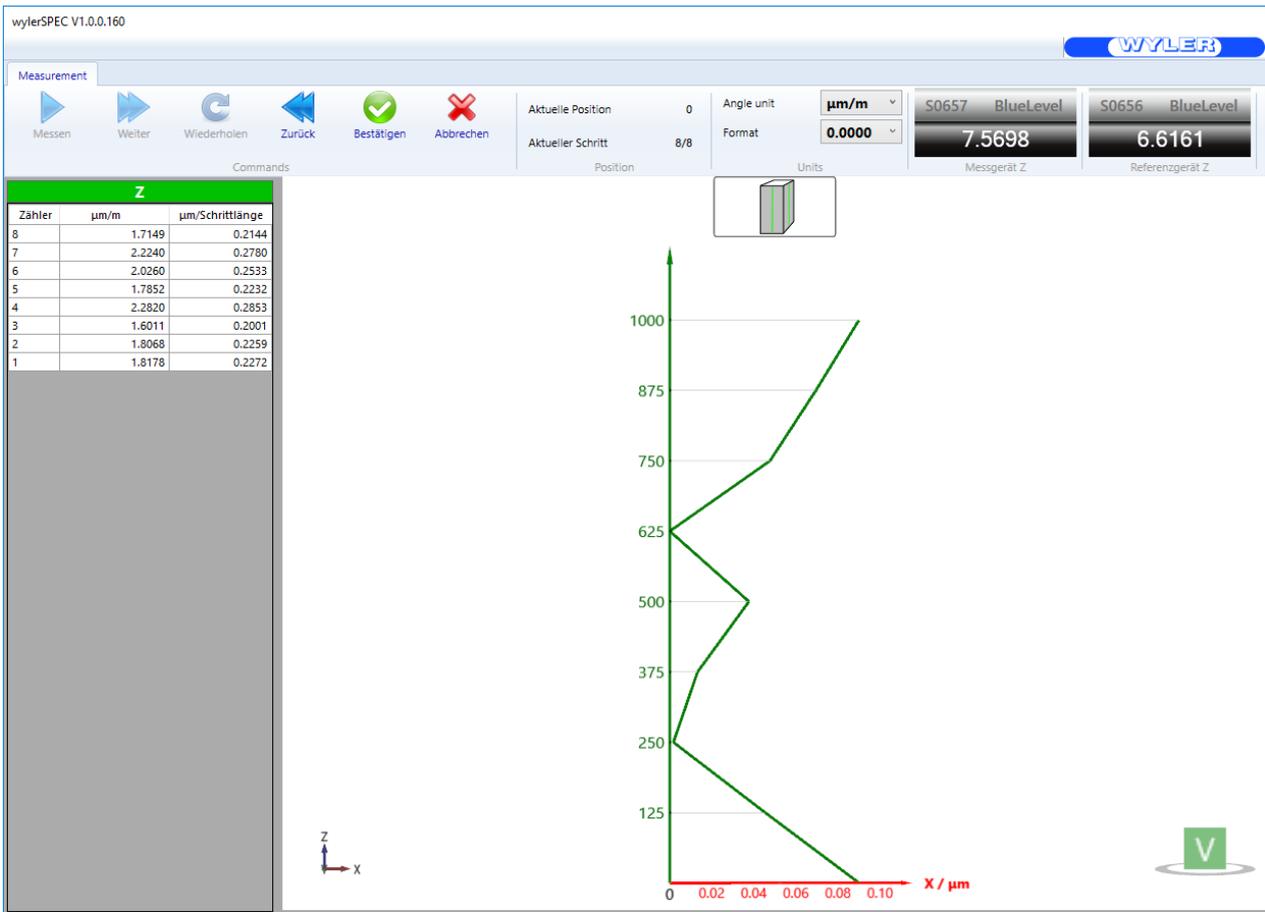
5.6.2.2 Guide way vertical measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values are displayed in the table "Z" on the left.

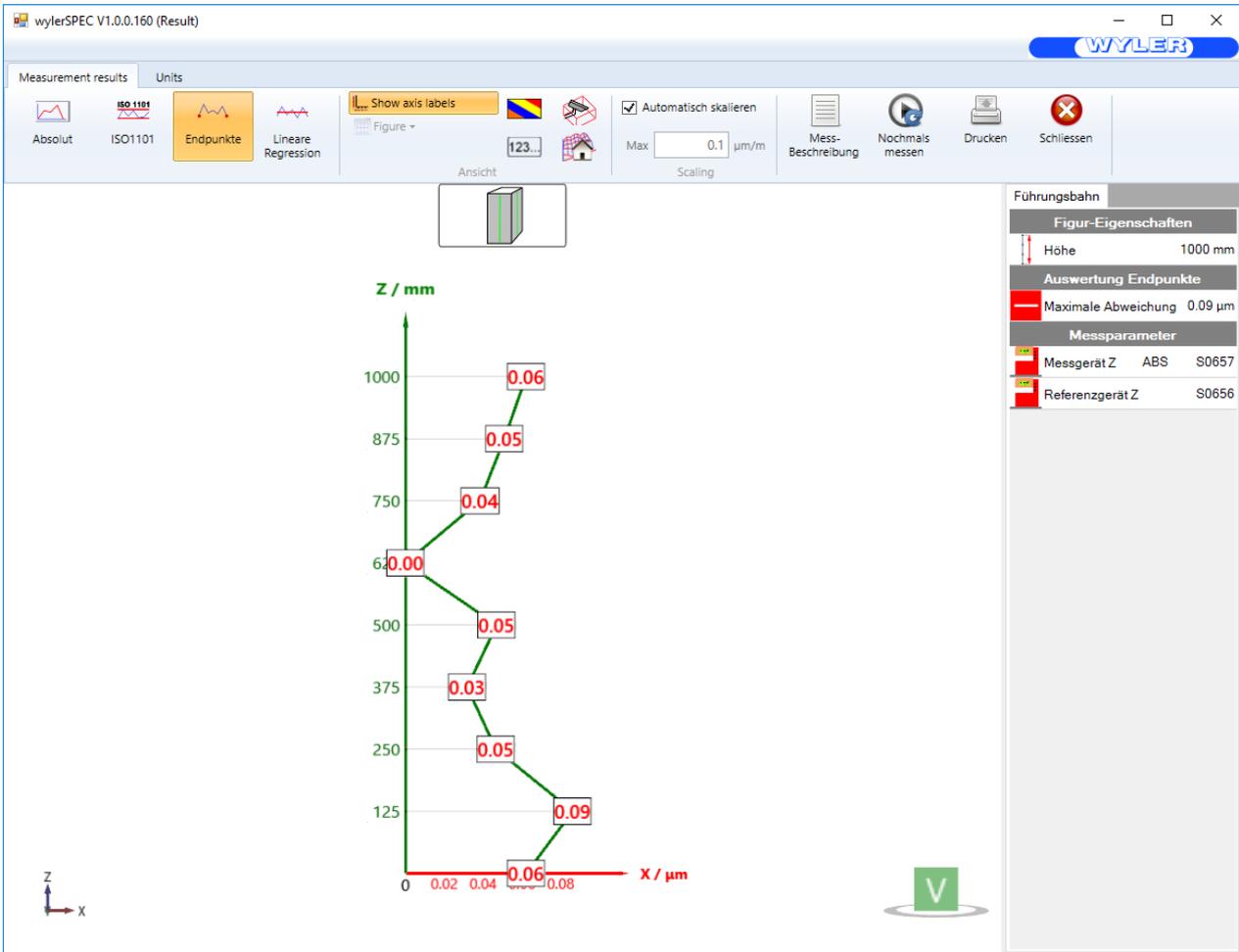
If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.6.2.3 Guide way vertical analyze

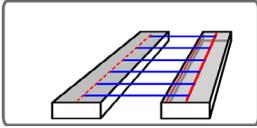
Analysis Absolut, ISO1101, end points or Linear regression.



Analysis:

 **Maximal deviation** = Biggest height difference auf der guide way

5.6.3 2 Guide ways horizontal



Analysis of two horizontal guide ways. Evaluations **Absolut**, **ISO1101**, **End points** or **linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.6.3.1 2 Guide ways horizontal setup

Setup of a measurement of two horizontal guide ways:

Measuring parameter:

Definition measurement figure

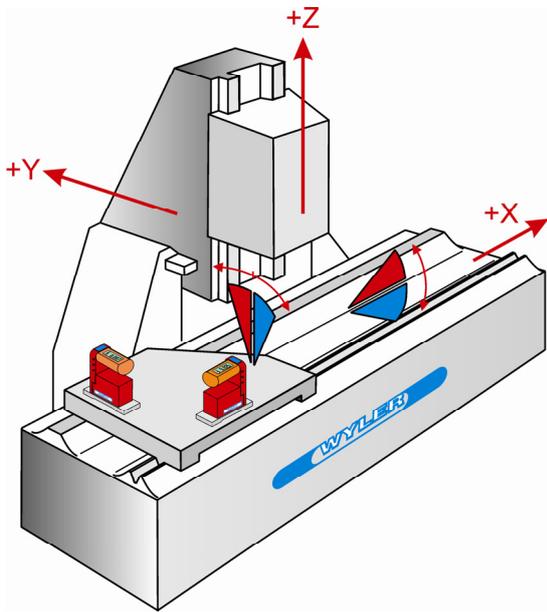
Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ not.
Way of	With reference

measurement	Without reference Manual input
Measurement JIG	Used Measurement JIG
Single-/multi-axis measurement	Selection of single or multi axis
Measure alignment	True, if transversal deviation should be measured
Longitudinal	
Number of measurements	Number of inclination measurements, the number of heights is bigger by 1
Steplength	Steplength of each measuring step
Measuring device	Selection of the main measuring device
Reference device	Selection of the reference device
Transversal	
Measuring device	Selection of the measuring device for the transversal deviation
Figur	
Size	Length, width and height of the figure

5.6.3.1.1 Measurement JIG

When measuring a guide way a specialised JIG is required.

Example: asymmetrical JIG for measuring a guide way



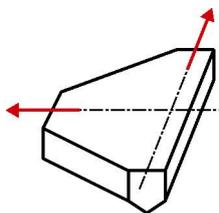
The JIG required for measuring this guide way must have one prismatic and one flat base.

With **wylerSPEC** and two measuring instruments, one for the X-direction and one for the Y-direction, both guide ways can be defined in **one run of measurements**.

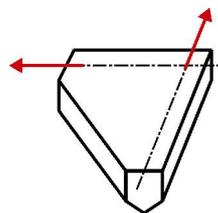
When one instrument only is available the same measurement with the same JIG can be done in **two measuring runs**.

Usually these JIGs are designed and manufactured by the machine tool manufacturer. It is however possible to be supplied by WYLER AG.

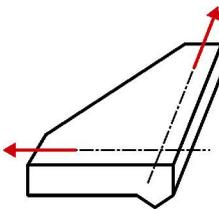
Other examples of possible JIGs



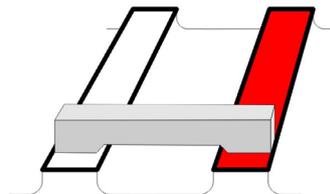
JIG with symmetrical base plate (position of cross direction at the centre of the base plate) and prismatic guide on one side



JIG with asymmetrical base plate "right" (position of cross direction at the end of the base plate) and prismatic guide on one side



JIG with asymmetrical base plate "left" (position of cross direction at the beginning of the base plate) and prismatic guide on one side

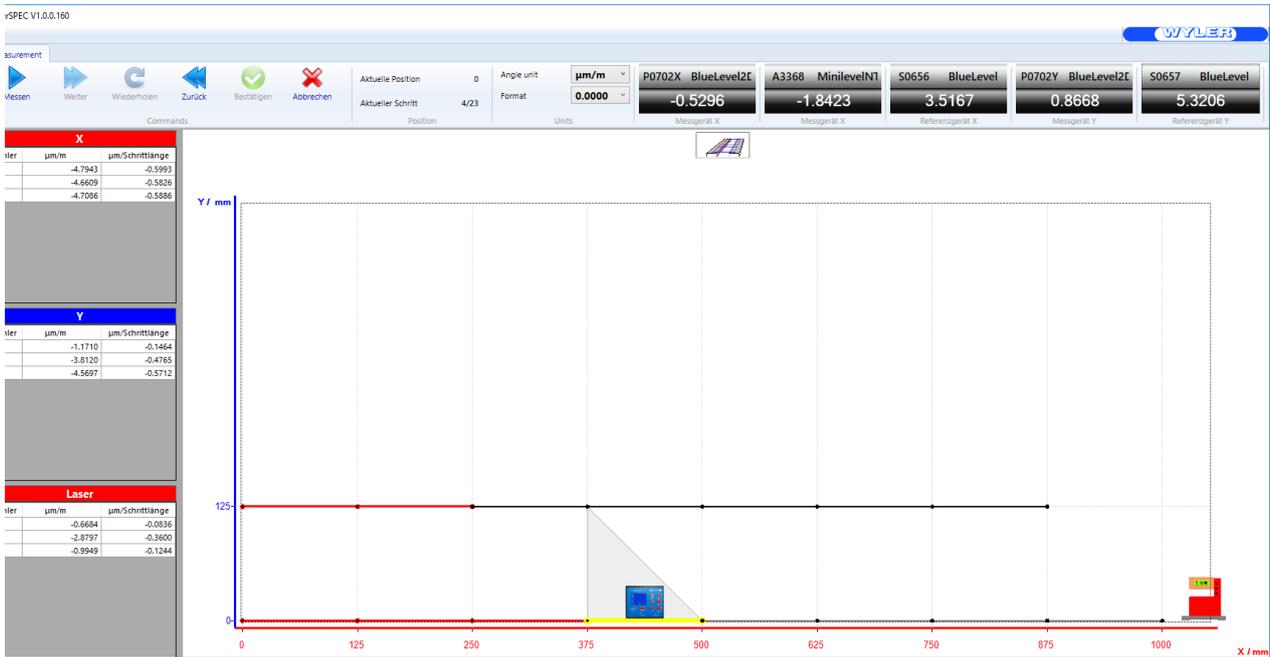


Granite straight edge, both ends flat

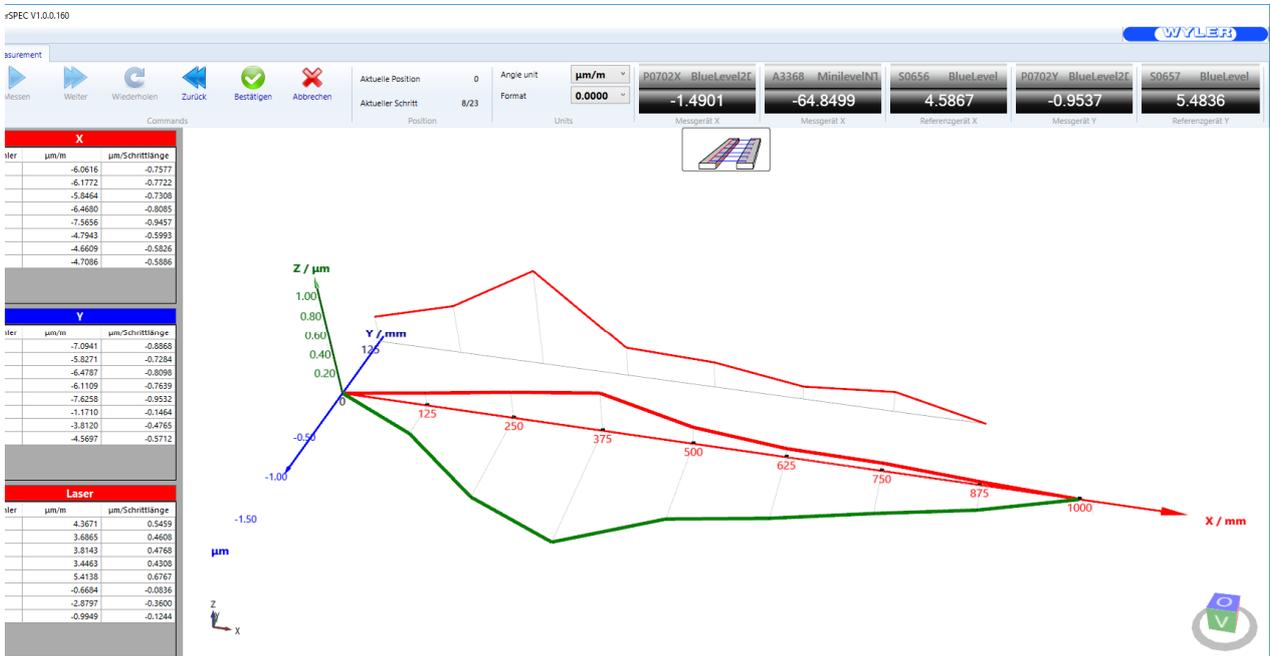
In this case three options of JIGs are possible. The pictures speak for themselves.

5.6.3.2 2 Guide ways horizontal measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



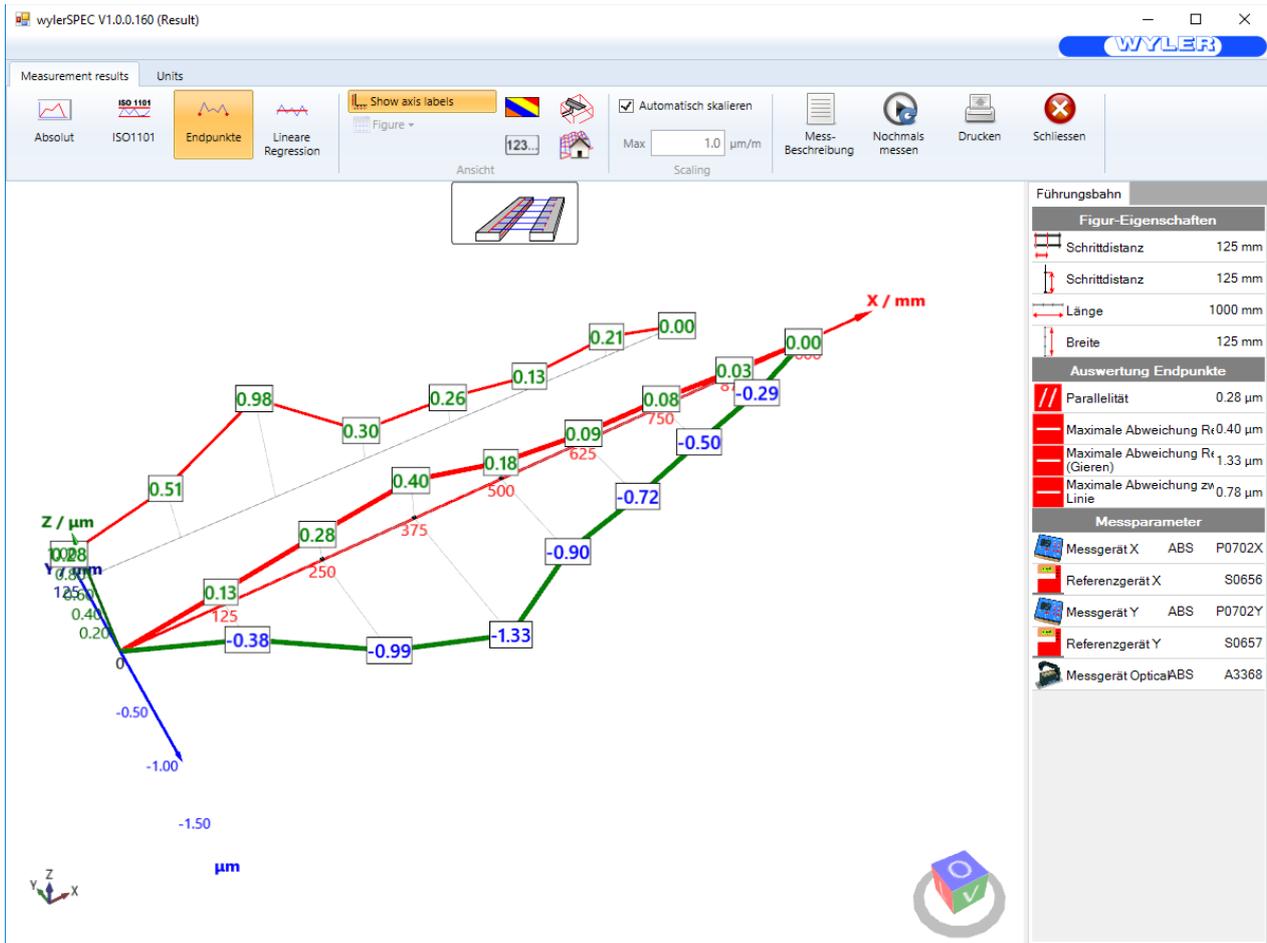
During the measurement the values are displayed in the tables "X", "Y" and "Laser" on the left. If a measurement is bad, it can be repeated. Click repeatedly on the button until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown. If the measurement is okay it has to be confirmed by clicking on . With measurements can be repeated.

5.6.3.3 2 Guide ways horizontal analyze

Analysis Absolut, ISO1101, End points or Linear regression.



Select the reference line with a click on it.

Analysis:

/// Deviation L2 -> L1

differs according to the evaluation method.

End points: Last value minus first value in L2

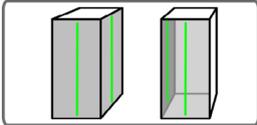
ISO1101: Highest value minus lowest value in L2

Linear regression: Height difference in the regression line L2



Maximal deviation = Biggest height difference in the line

5.6.4 2 Guide ways vertical



Analysis of two vertical guide ways. Evaluations **Absolut**, **ISO1101**, **End points** or **linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.6.4.1 2 Guide ways vertical setup

Setup of a measurement of two vertical guide ways:

Measuring parameter:

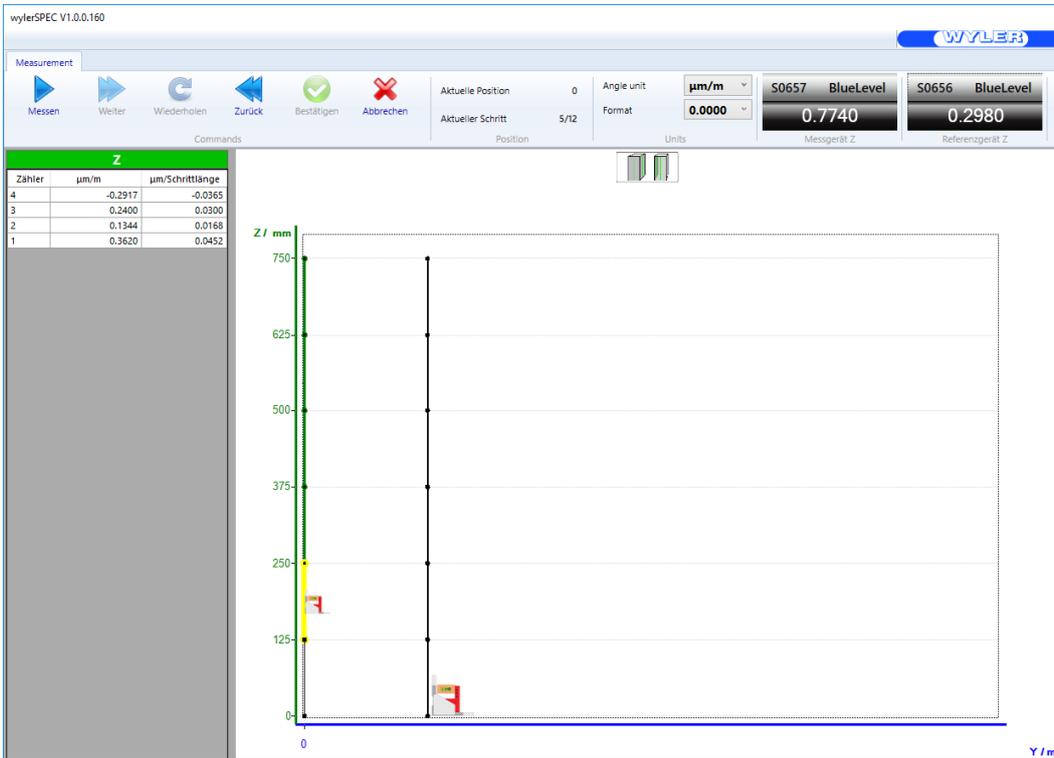
Definition measurement figure

Name	Name of the figure
Measuring device	ABSolut requires at the begin of the measurement a reversal measurement , RELativ not.

Reference	Left or right side
Way of measurement	With reference Without reference Manual input
guide way	
Number of measurements	Number of inclination measurements, the number of heights is bigger by 1
Steplength	steplength pro Messung
Abstand zwischen guide wayen	Horizontaler Abstand zwischen den guide wayen
Measuring device	Selection of the main measuring device
Reference device	Selection of the reference device
Figur	
Size	Length, width and height of the figure

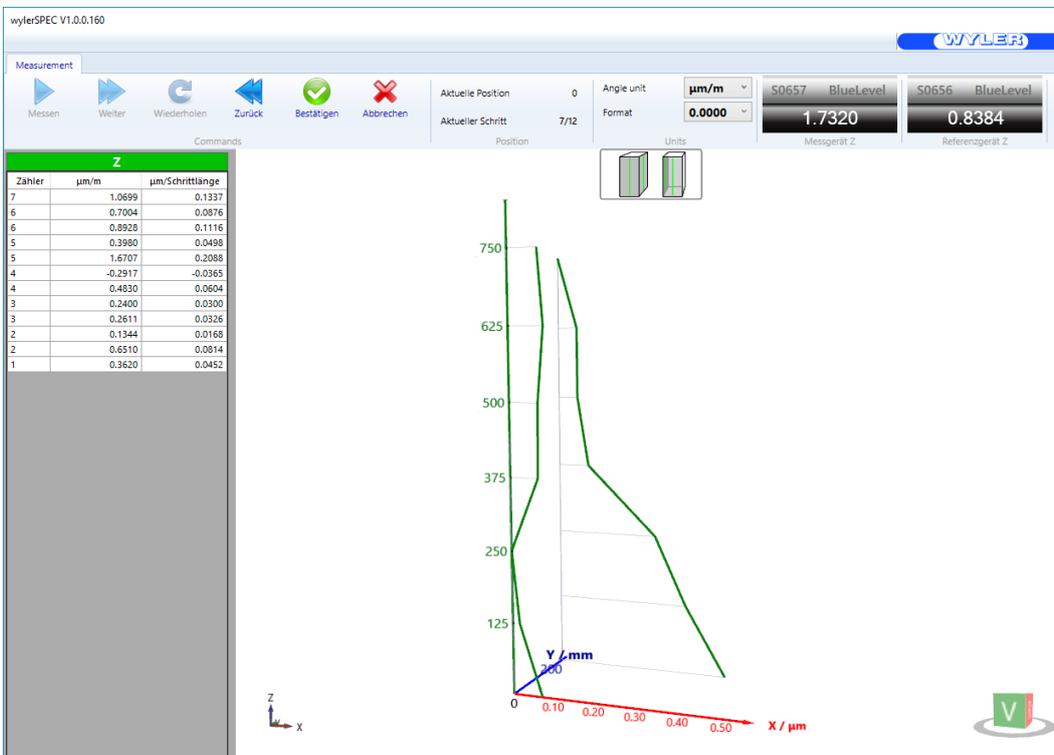
5.6.4.2 2 Guide ways vertical measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



During the measurement the values are displayed in the table "Z" on the left.

If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



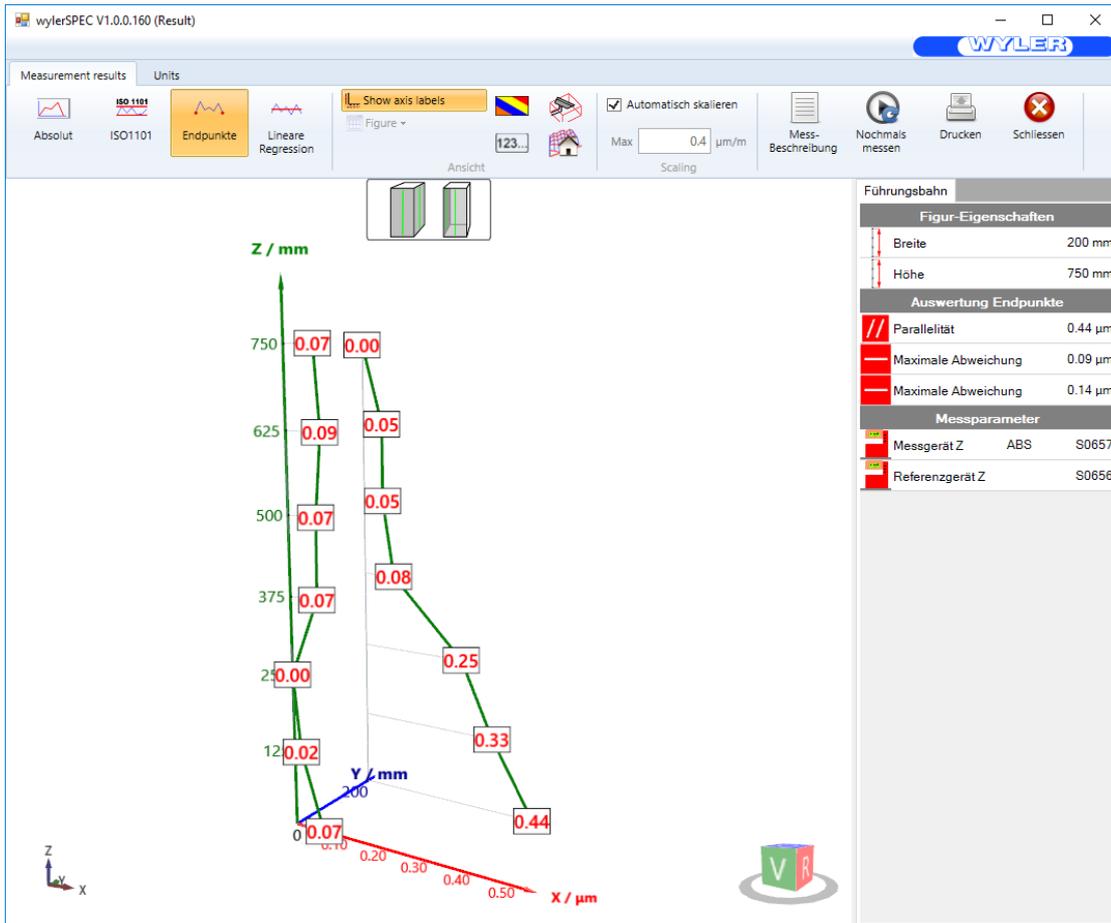
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on 

With  measurements can be repeated.

5.6.4.3 2 Guide ways vertical analyze

Analysis Absolut, mit ISO1101, Endpunkte oder mit Linear regression möglich.



Select the reference line with a click on it.

Analysis:

// Deviation L2 -> L1

differs according to the evaluation method.

End points: Last value minus first value in L2

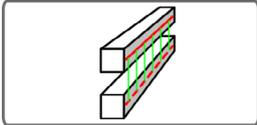
ISO1101: Highest value minus lowest value in L2

Linear regression: Height difference in the regression line L2



Maximal deviation = Biggest deviation on the line concerned

5.6.5 2 Guide ways transversers



Analysis of two transversal guide ways. Evaluations **Absolut**, **ISO1101**, **End points** or **linear regression**.

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.6.5.1 2 Guide ways transversers setup

Setup of a measurement of two horizontal guide ways:

Measuring parameter:

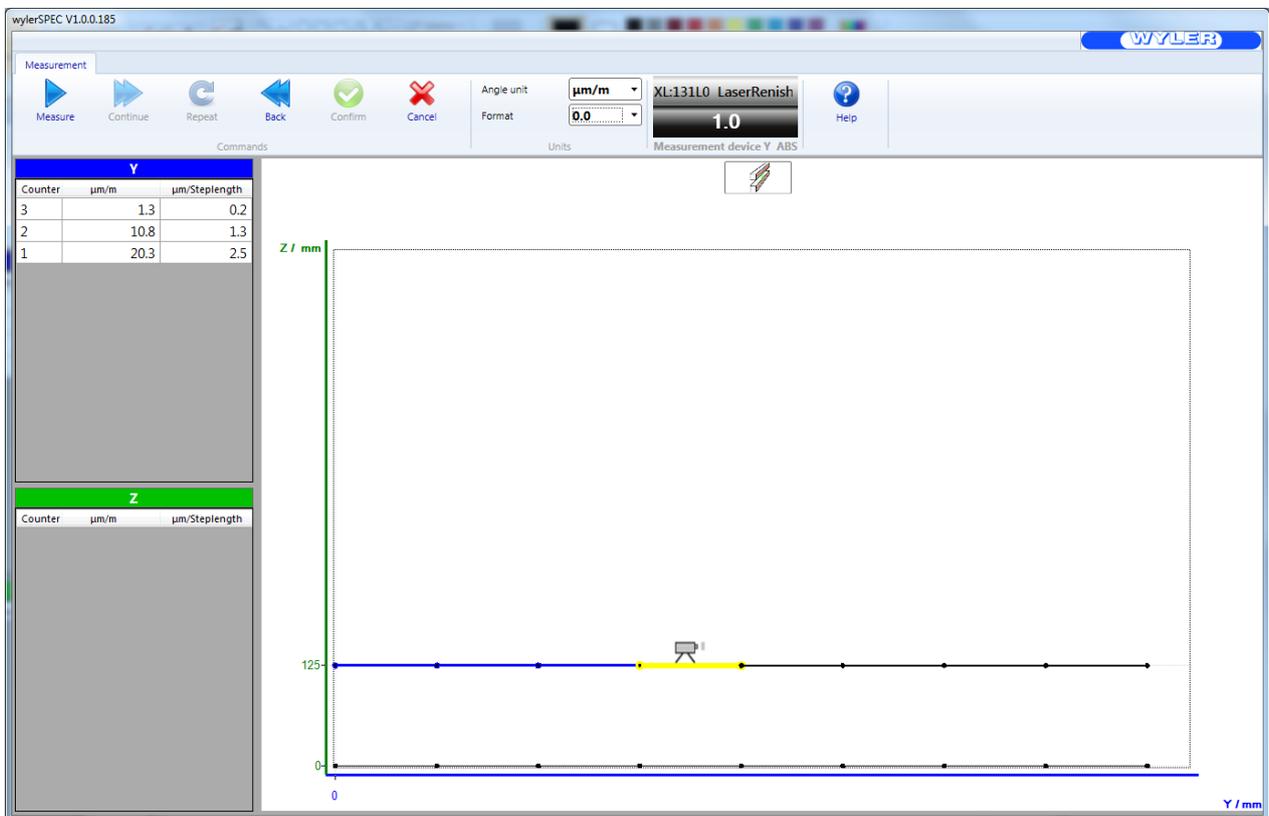
Definition measurement figure

Name Name of the figure
 Measuring device ABSolut requires at the begin of the measurement a [reversal measurement](#), RELativ not.

Way of measurement	With reference Without reference Manual input
Measurement JIG	Used Measurement JIG , straight edge only
Single-/multi-axis measurement	Single axis only
Longitudinal	
Number of measurements	Number of inclination measurements, the number of heights is bigger by 1
Steplength	of each measuring step
Measuring device	Selection of the main measuring device
Vertical	
Steplength transversal	Steplength corresponds to the distance of the two guide ways
Measuring device	Selection of the measuring device for the transversal deviation
Reference device	Selection of the reference device
Figur	
Size	Length, width and height of the figure

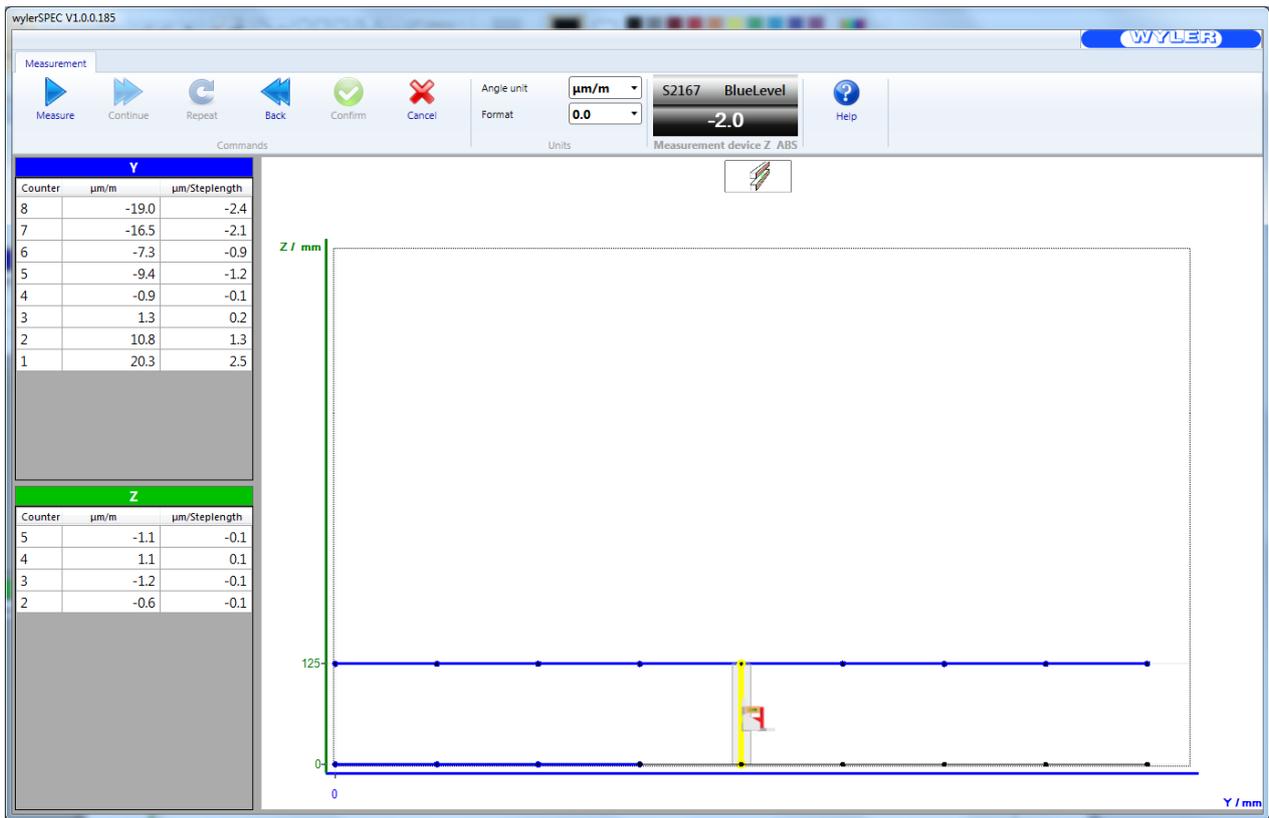
5.6.5.2 2 Guide ways transvers measure

When during the setup the measurement method "ABSolut" was selected, a [reversal measurement](#) will be performed.



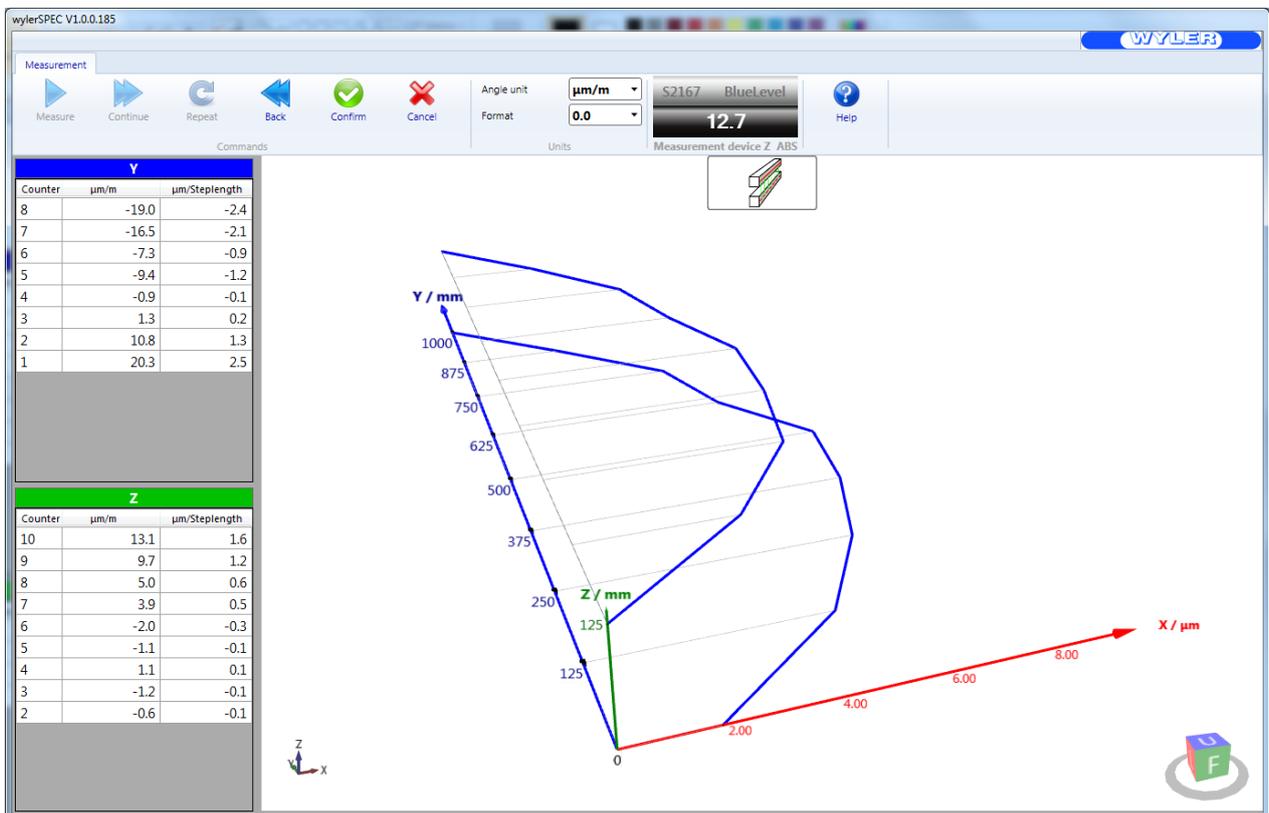
During the measurement the values are displayed in the table "Y" on the left.

If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



During the measurement the values are displayed in the table "Z" on the left.

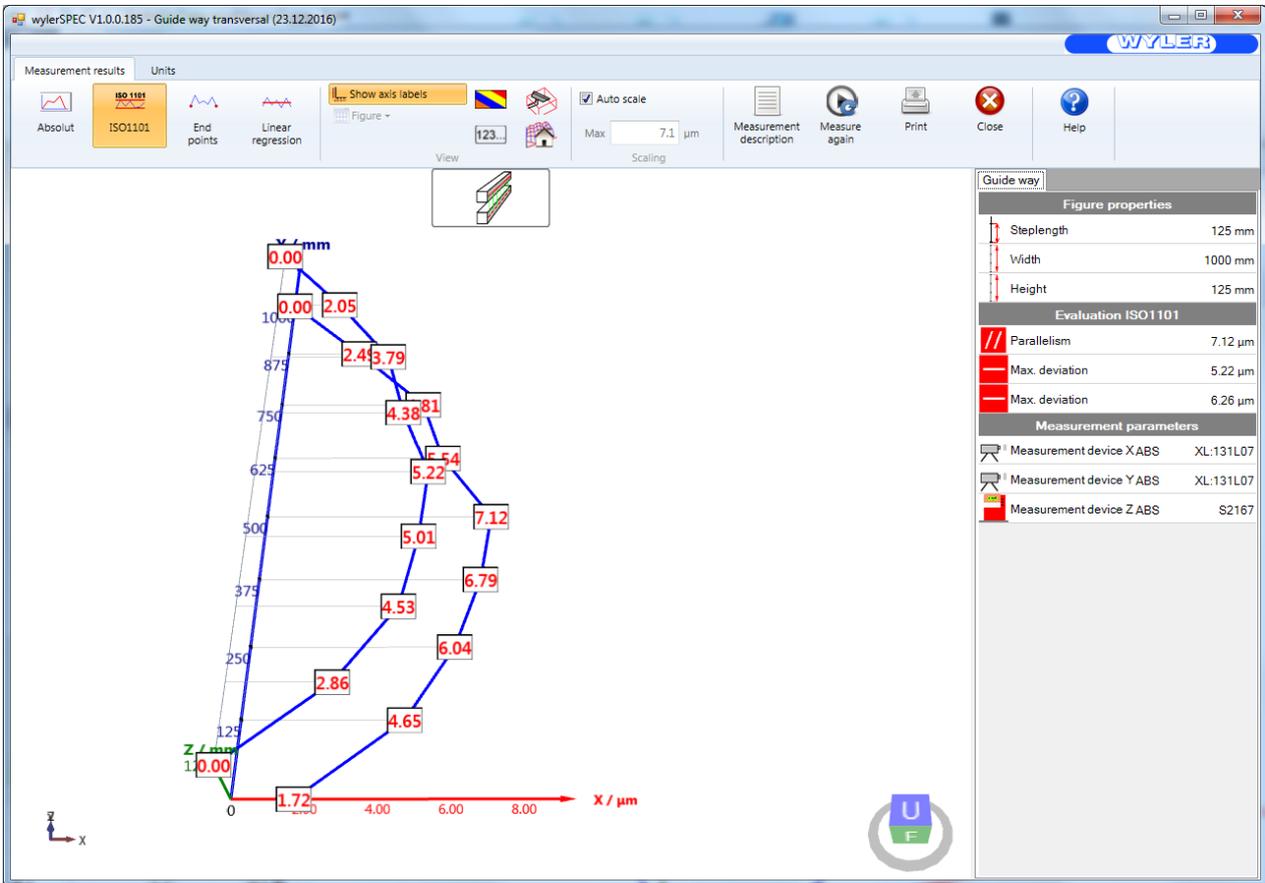
If a measurement is bad, it can be repeated. Click repeatedly on the button  until the position of the bad measurement is reached.



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

5.6.5.3 2 Guide ways transvers analyze

Analysis Absolut, ISO1101, End points or Linear regression.



Select the reference line with a click on it.

Analysis:

Parallelism

differs according to the evaluation method.

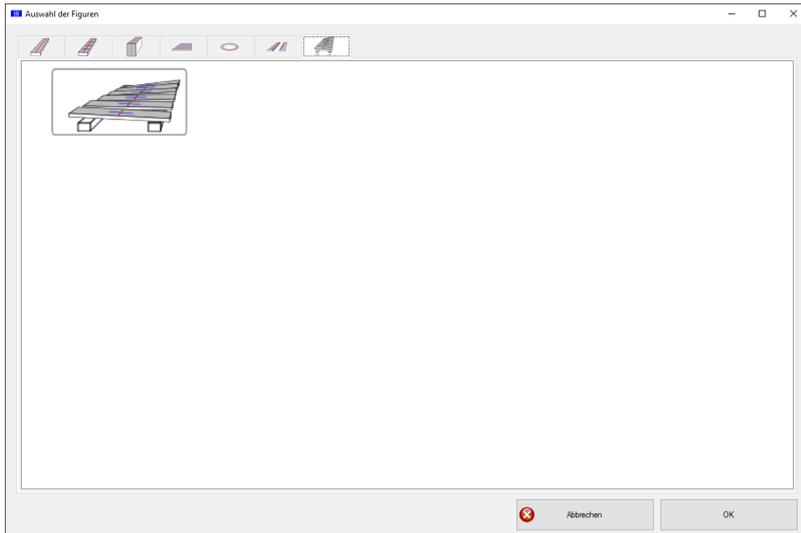
End points: Last value minus first value in L2

ISO1101: Highest value minus lowest value in L2

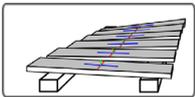
Linear regression: Height difference in the regression line L2

Maximal deviation = Biggest height difference in the line

5.7 Rotation roll - pitch - yaw

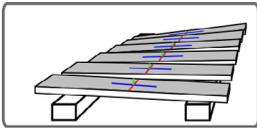


A double click takes you to the page to setup the corresponding measurement.



[Rotation horizontal](#)

5.7.1 Rotation horizontal



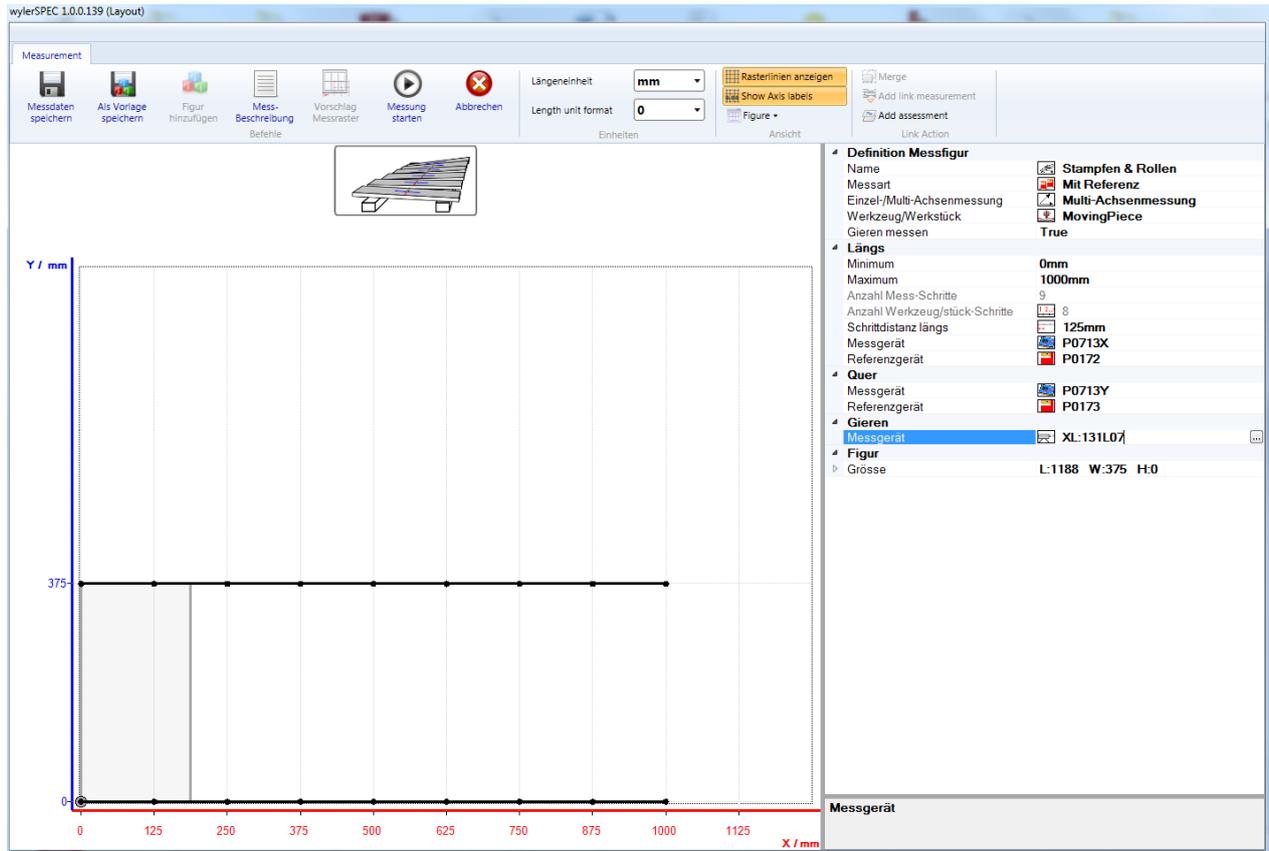
Vermessen und Registrieren der Geometriefehler "Stampfen", "Rollen" und "Gieren" an Maschinenelementen, welche sich auf horizontalen Führungssystemen bewegen

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.7.1.1 Rotation horizontal setup

Setup of the roll - pitch - yaw measurement



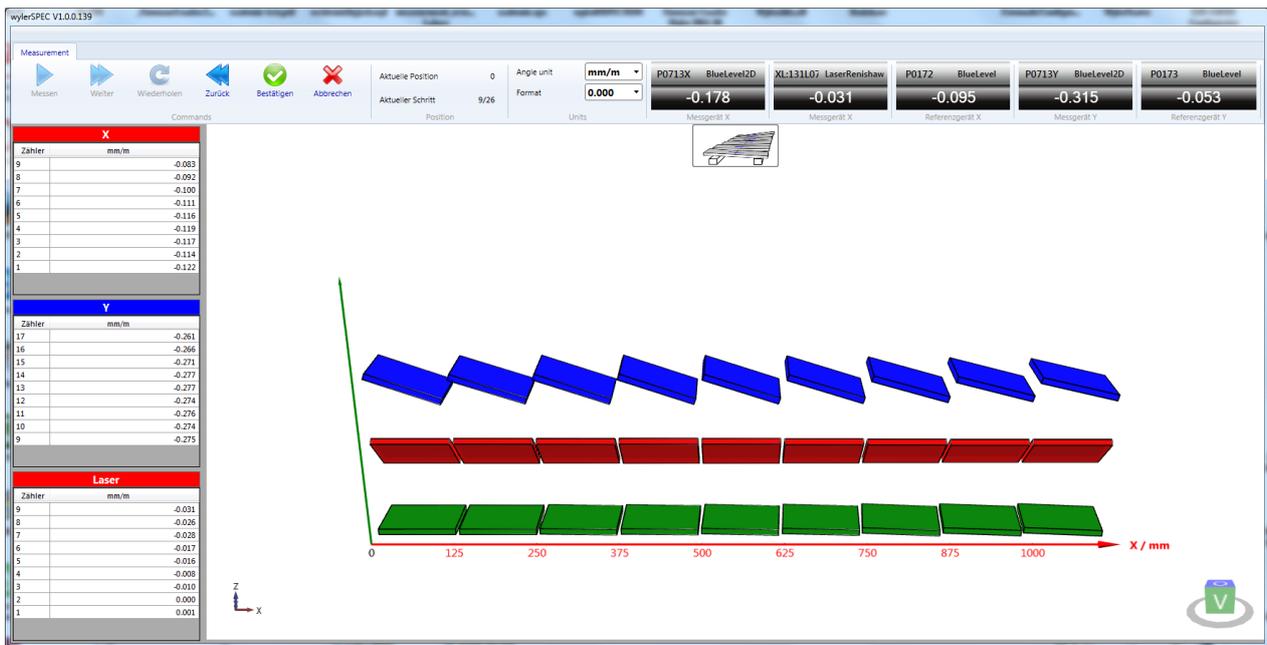
Measuring parameter:

Definition measurement figure

Name	Name of the figure
Measuring device	Measurement method ABSolut, RELativ
Way of measurement	With reference Without reference Manual input
Single-/multi-axis measurement	Single-axis measurement, X- and Y-axis one after the other Multi-axis measurement, X- and Y-Achse at the same time
Tool/Workpiece	Moving Tool, Moving Piece,
Measure yaw	True, measure transversal and vertical line rotation False, measure vertical line rotation only

Longitudinal

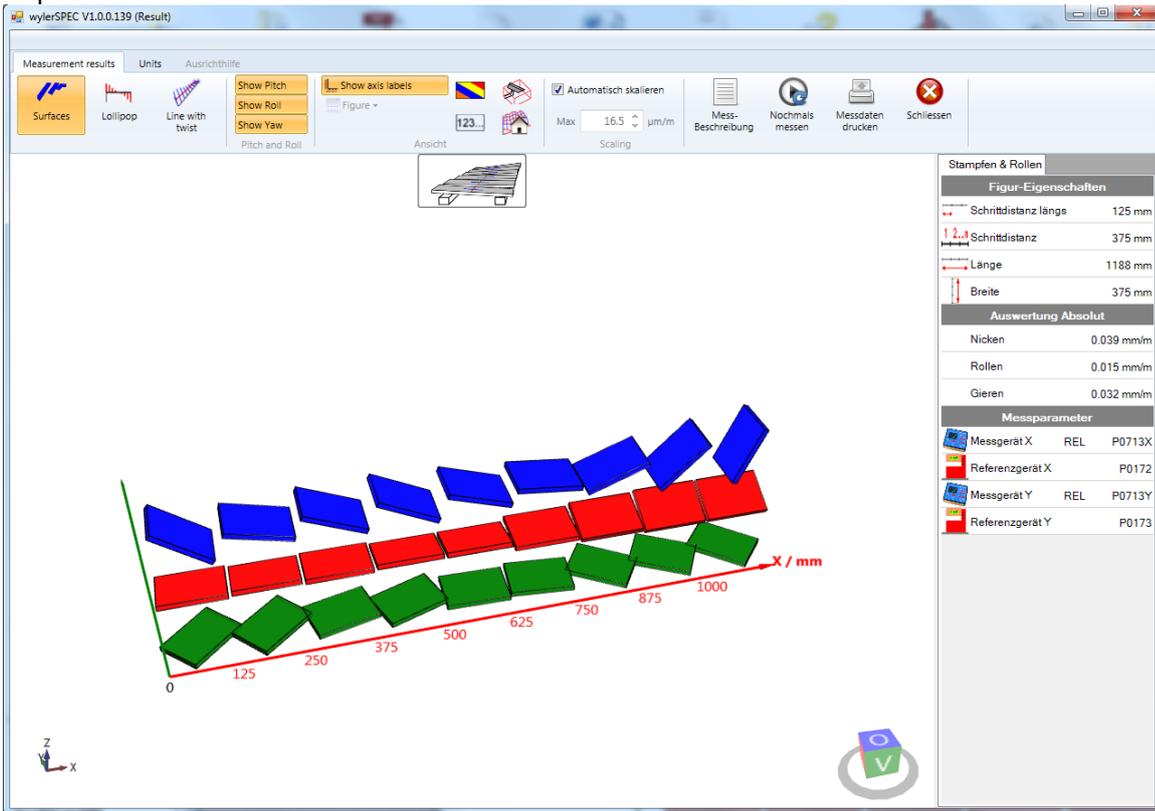
Minimum	First measuring position
Maximum	Last measuring position
Number of measuring steps	Number of inclination measurements
Number of tool/workpiece	Number of moves of the tool or the workpiece



After the last measurement a preview of the measuring results is shown.
 If the measurement is okay it has to be confirmed by clicking on 
 With  measurements can be repeated.

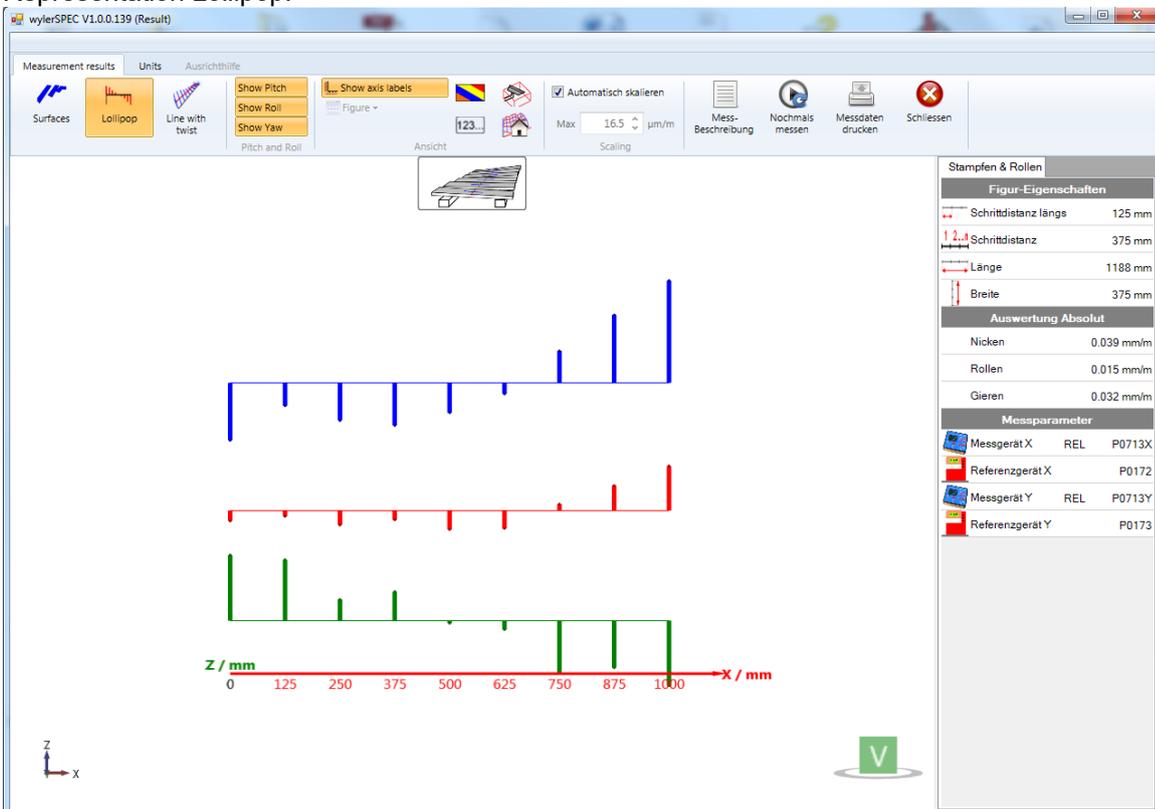
5.7.1.3 Rotation horizontal analyze

Representation Surfaces:



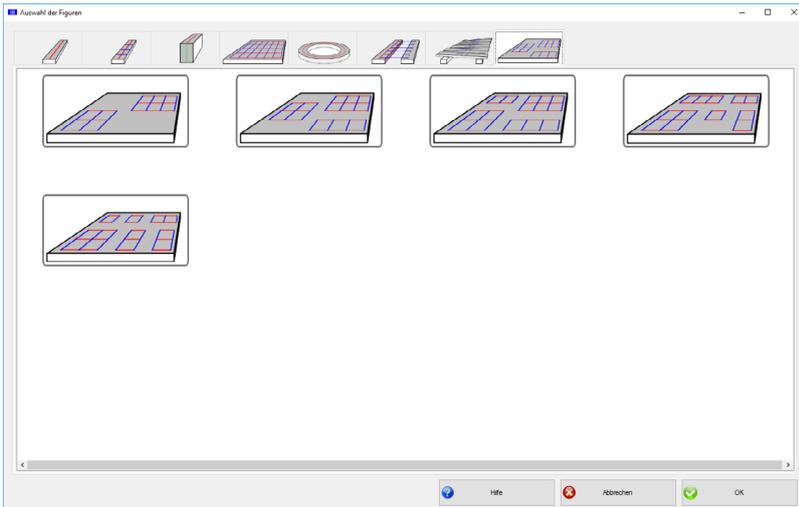
The tiles are turned according to the measured angles.

Representation Lollipop:

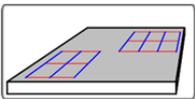


The heights of the pillars correspond to the measured angles. Blue Pitch, Red Roll, Green Yaw.

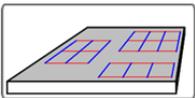
5.8 Surfaces Parallelism



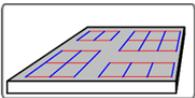
A double click takes you to the page to setup the corresponding measurement.



[Parallelism of 2 surfaces](#)

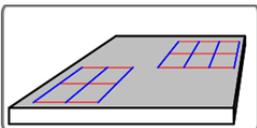


Parallelism of 3 surfaces, the procedure is similar to parallelism of 2 surfaces



Parallelism of 4 surfaces, the procedure is similar to parallelism of 2 surfaces

5.8.1 Parallelism of surfaces



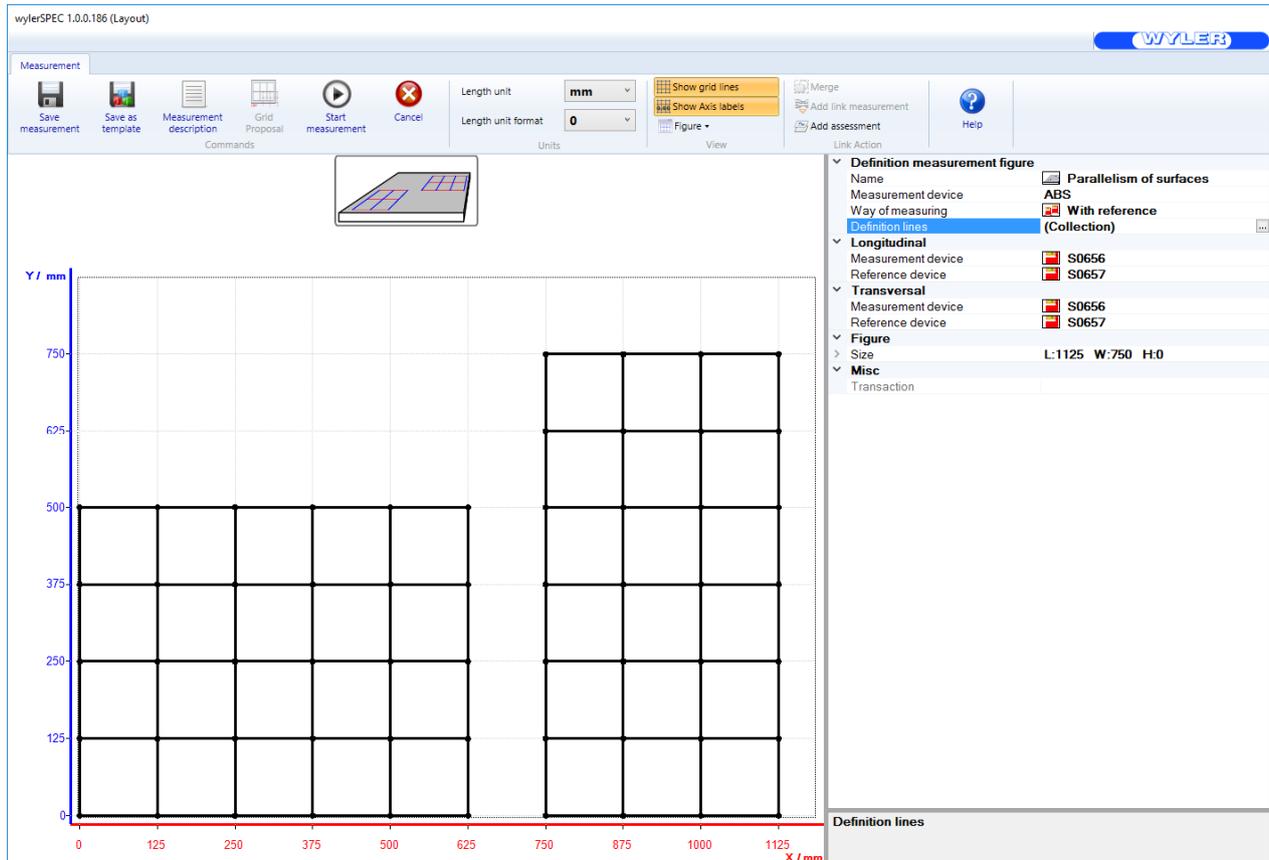
Measurement of up to 6 surfaces; evaluation methods "Absolut", "ISO1101", "End points" and "Linear regression".

Procedure:

1. [Setup](#)
2. [Measure](#)
3. [Analyze](#)

5.8.1.1 Parallelism of 2 surfaces setup

Setup of Parallelism of surfaces:



Measuring parameter:

Definition measurement figure

- Name Name of the figure
- Measuring device ABSolut requires at the begin of the measurement a [reversal measurement](#), RELativ nicht.
- Way of measurement With reference
Without reference
Manual input
- Definition Lines Open a dialog to define each line

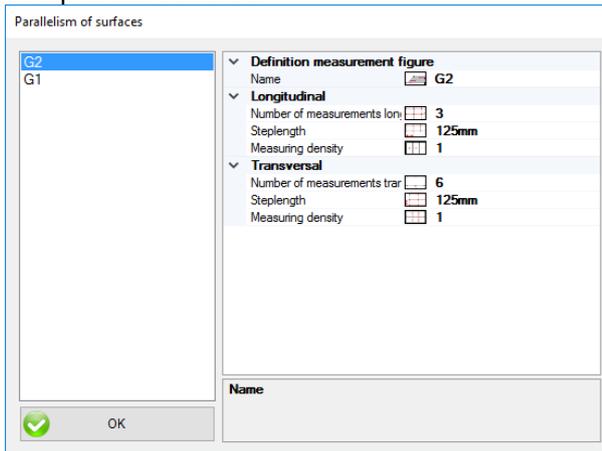
Longitudinal

- Measuring device [Selection](#) of the main measuring device
- Reference device [Selection](#) of the reference device

Transversal

- Measuring device [Selection](#) of the main measuring device
- Reference device [Selection](#) of the reference device

Setup of the surfaces:



Select the figure to define on the left side.

Definition measurement figure

Name Name of the surface

Longitudinal

Number of measurements Number of inclination measurements, the number of heights is bigger by 1.

Steplength Steplength per measurement

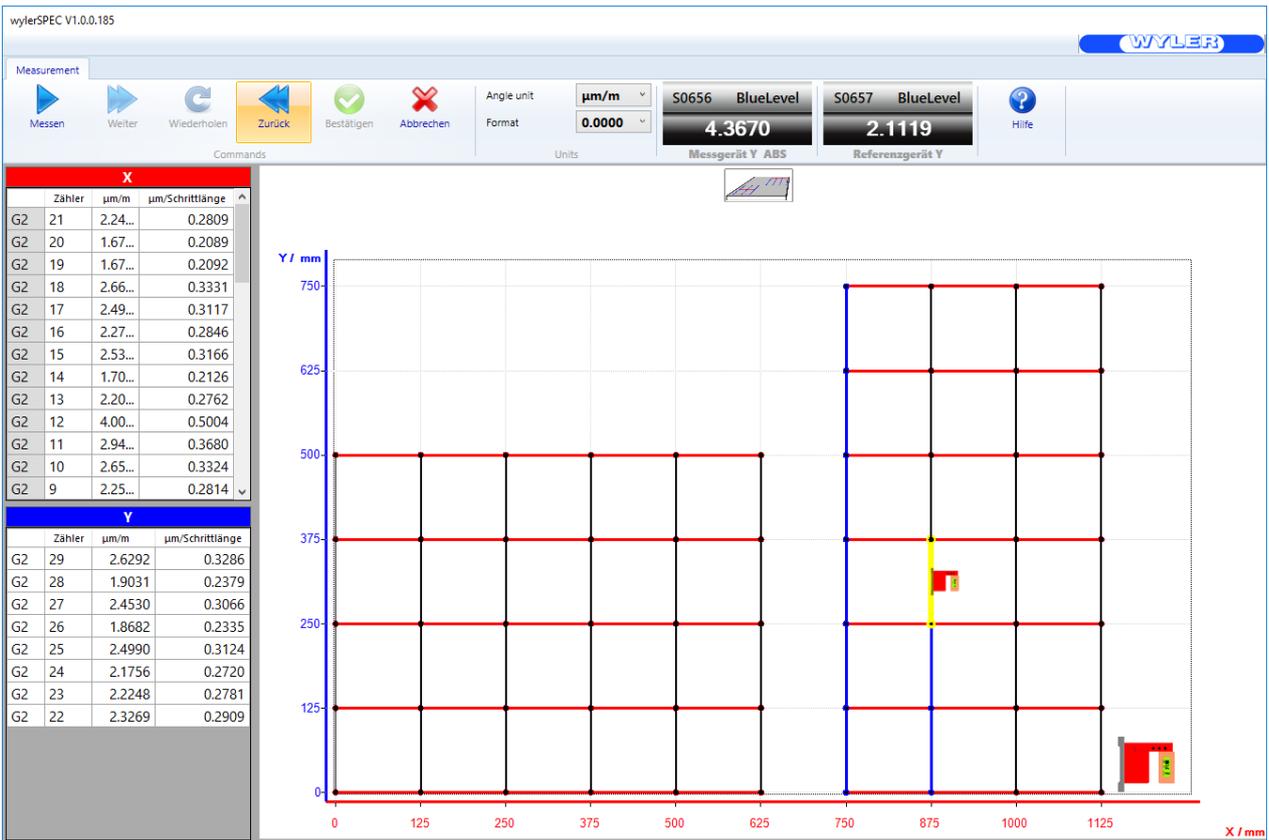
Measuring density Number of measurements between transversal lines

Transversal

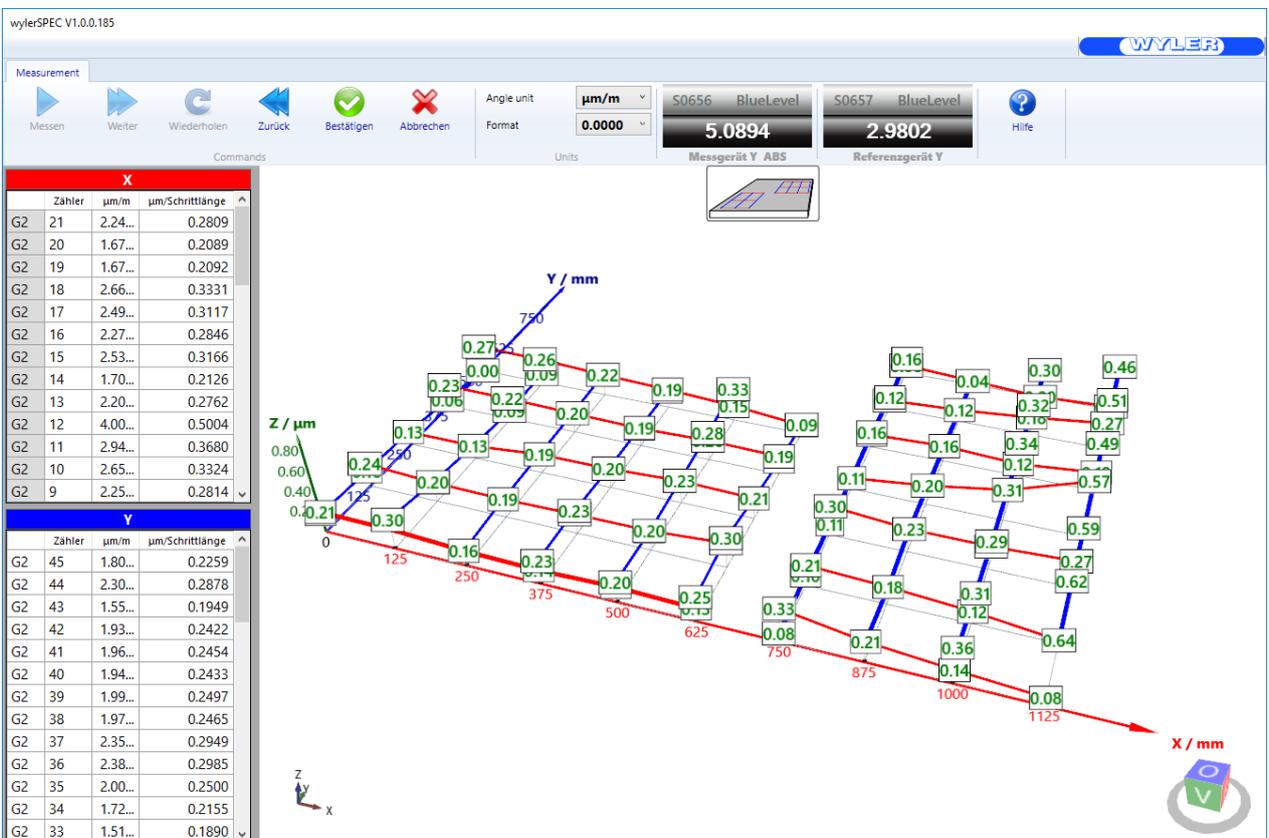
Number of measurements Number of inclination measurements, the number of heights is bigger by 1.

Steplength Steplength per measurement

Measuring density Number of measurements between longitudinal lines



During the measurement the values are displayed in the table "Y" on the left.



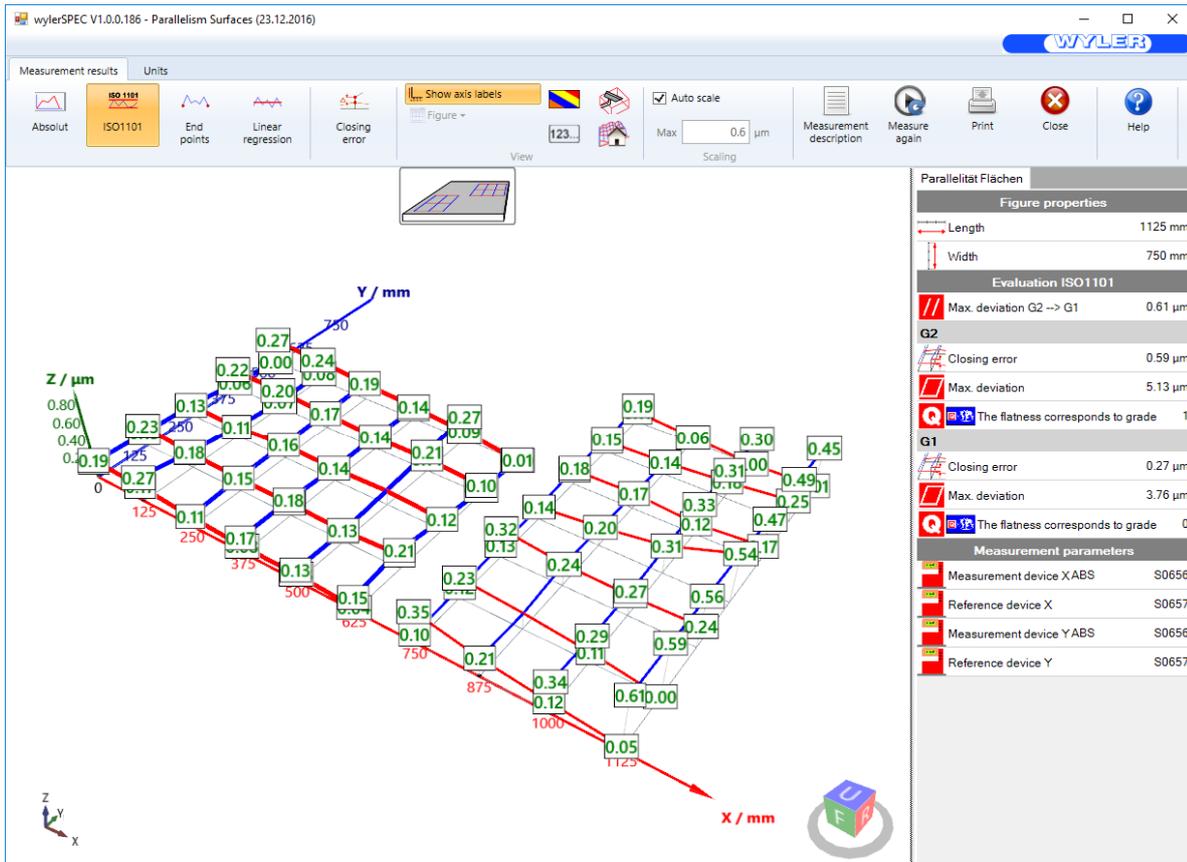
After the last measurement a preview of the measuring results is shown.

If the measurement is okay it has to be confirmed by clicking on

With measurements can be repeated.

5.8.1.3 Parallelism of 2 surfaces analyze

Analysis [Absolut](#), [ISO1101](#), [End points](#) or [linear regression](#).



Analysis without [Closing error](#):

/// Max. deviation **G2 -> G1**
 Highest value minus lowest value in G2

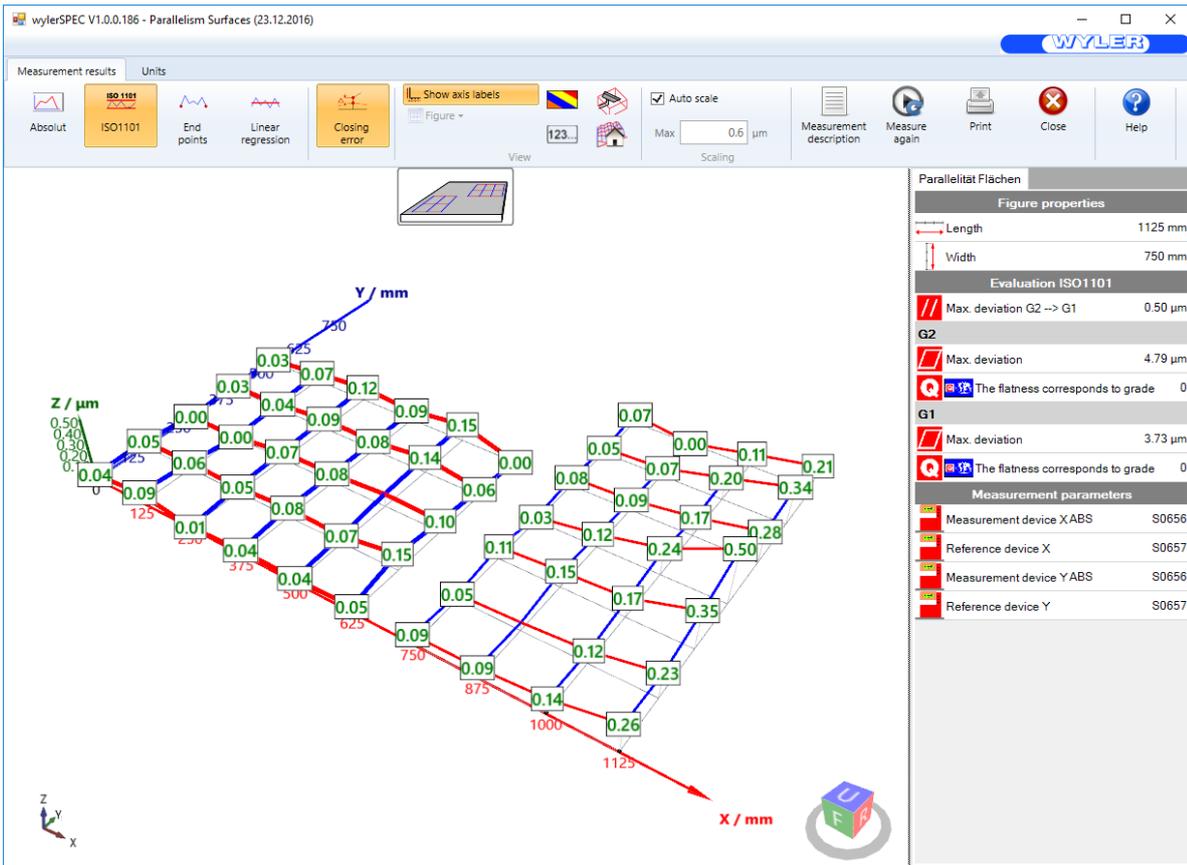
Evaluations for each surface:

/// **Closing error** = Maximal closing error. As a general rule the closure error should not be more than 20% to 25% of the maximum error. If the maximum error is less than 4 µm the closure error may exceed the above-mentioned values.

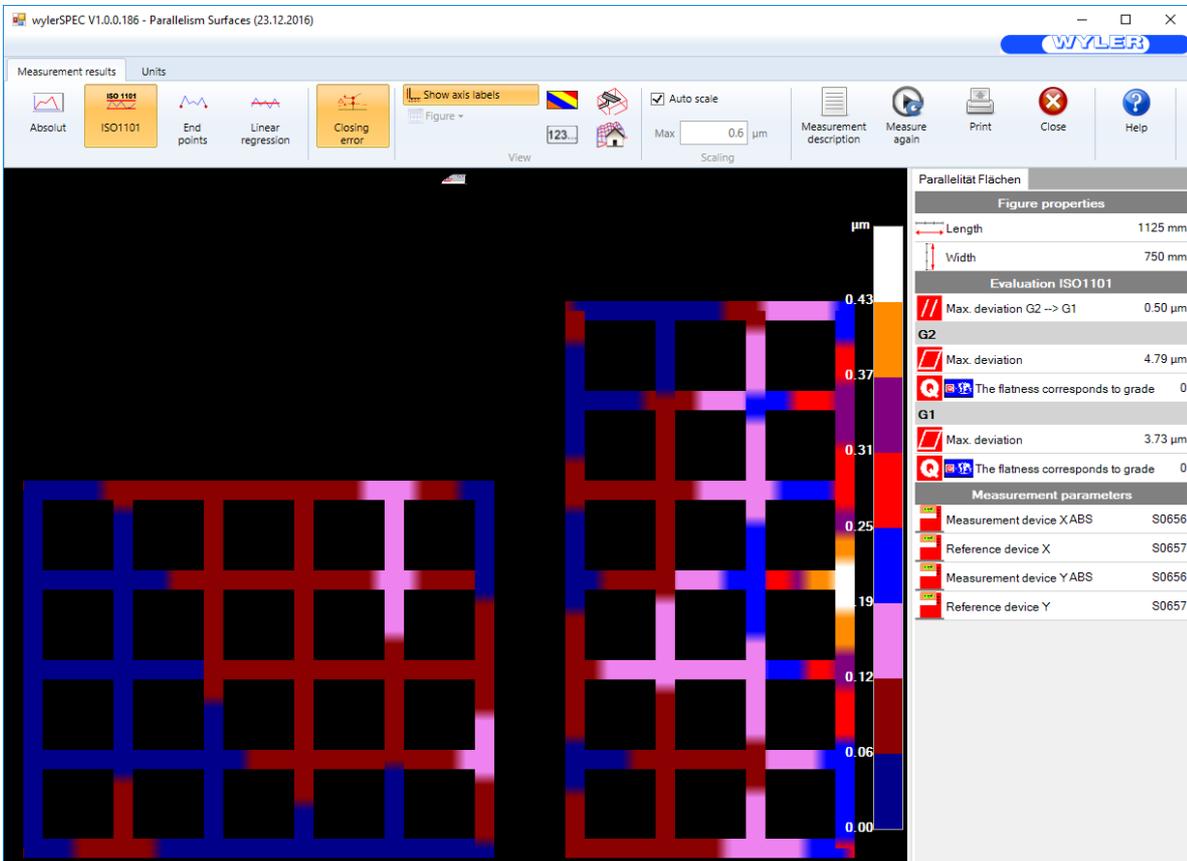
/// **Maximal deviation** = Biggest height difference with the selected evaluation method (End points, ISO1101 or linear regression)

Q **Quality standard** = Grading according to the selected [Quality standard](#)

Analizis with [closing error correction](#) is similar:



With the button  differently colored representations can be selected.



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Die Firma WYLER AG ist stets um Produkteverbesserungen bemüht und behält sich das Recht vor, die technischen Daten und das äussere Erscheinungsbild jederzeit und ohne Vorankündigung zu ändern. Aus diesem Grund können die Spezifikationen und die Abbildungen der Produkte zum Teil leicht vom Katalog abweichen.

The logo for WYLER, featuring the word "WYLER" in a bold, blue, sans-serif font. The letters are contained within a white, rounded rectangular shape that has a slight 3D effect with a dark blue shadow on the right side.

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NEIGUNGSMESSSYSTEME

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