GFMesstechnik GmbH
Competence in 3D Metrology

Manual

Optical 3D Measuring Device for cutting tools

MikroCAD

Customized system for automated measurement of cutting edge rounding

Version 5.0

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The Cutting edge module is available in different versions which differ in their functional extent. This manual describes the most complete version of the cutting edge module. With versions of reduced functionality, some of the functions described here will not be available.

The Lite version does not include the product database, the export functions for Q-DAS-files and some of the calculation functions inside the measurement programs.

Furthermore, there are versions with extended functionality:

- Q-DAS-Expansion (Interface to QS-STAT)
- Multiple measurement (Collecting several measurements within one process)
- Operation with axes

There is a chapter on each of those extensions, where differences to the basic version are explained.

Subject to technical changes for the purpose of improving the device!

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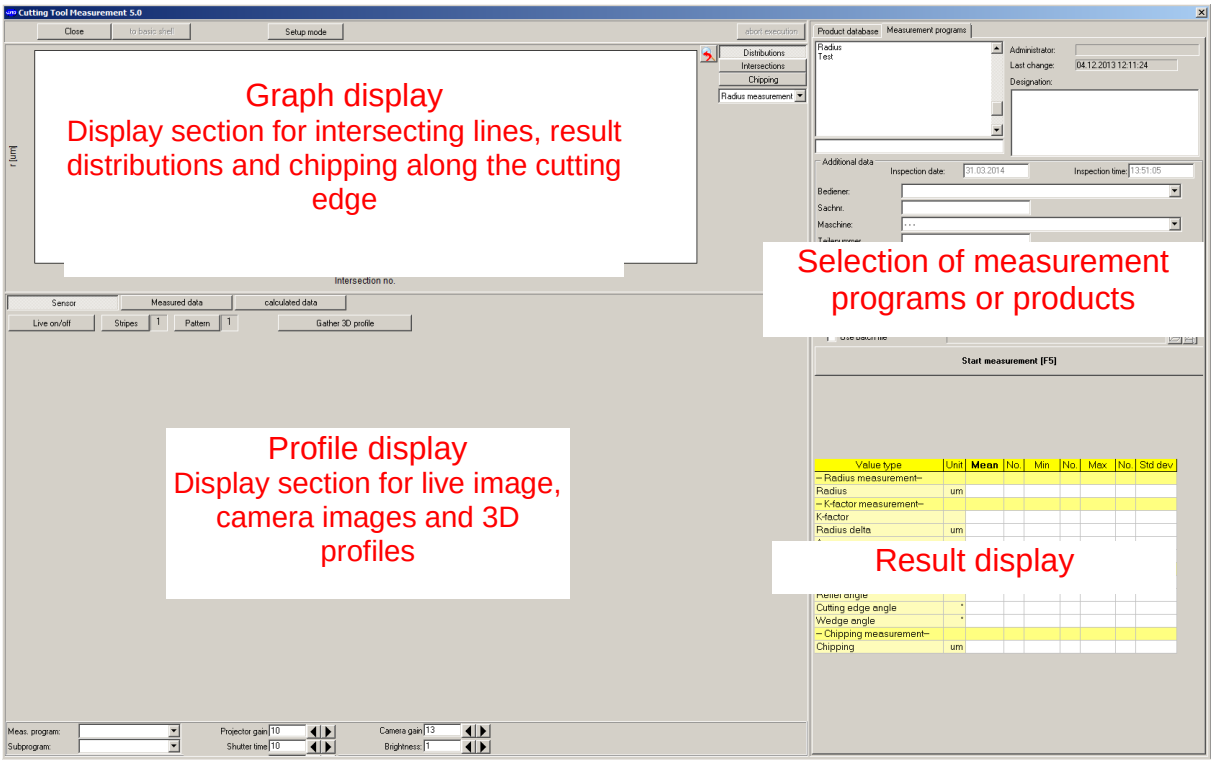
Content

1 Quick start – Measurements

1.1 System start

- Turn on the computer
- Turn on the cold light source
- Start the software ODSCAD



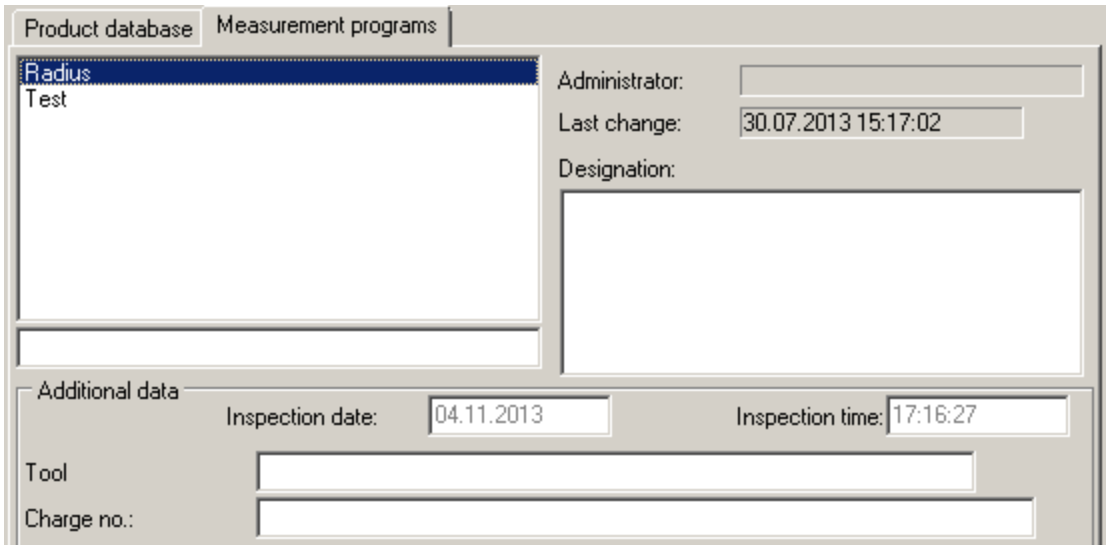
1.2 Measurement programs

There are measurement programs predefined by the manufacturer GFMesstechnik GmbH, as well as measurement programs created by trained personnel. They all have in common that a predefined sequence runs automatically after program selection and part positioning.

The user may choose to:

- Select predefined test sequences from the section ***measurement programs***.
- Select a product to be tested from the section ***product database***, where in addition to the predefined test sequence, tolerance limits for automatic “good – bad” – classification are associated.

☞ The process ***Measurement programs*** as well as ***Product database*** can be disabled in the basic settings and will then not be available at this place.



The selection of a measurement program is done by clicking in the list of programs.

The input box below the list serves as the target field for barcode scanner. If measuring objects are labeled with barcodes, this can be used to facilitate the measurement program selection. Upon scanning a barcode, the content of the measurement program list is limited to those items that are suitable for this object (see Chapter 9).

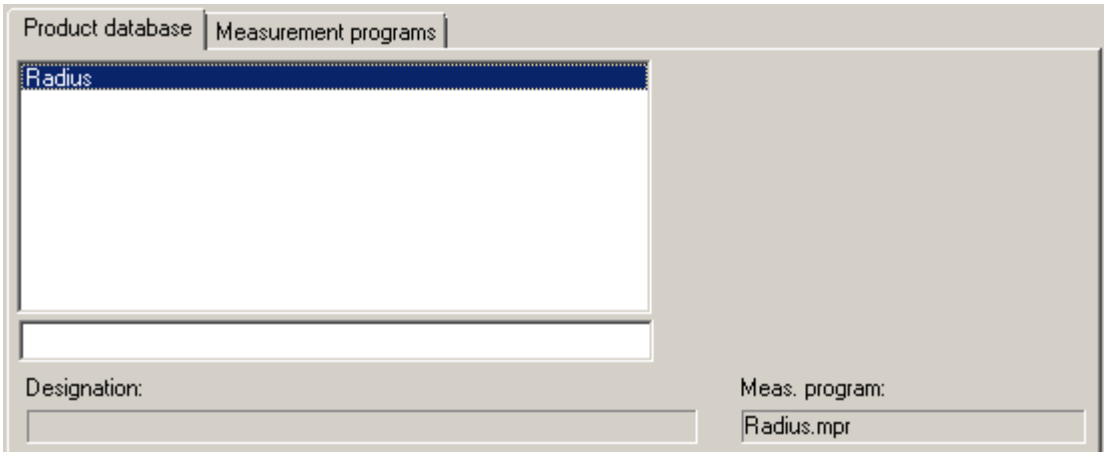
To the right of the list, additional information about the selected program is shown.

Value type	Unit	**Mean**	No.	Min	No.	Max	No.	Std dev
– Radius measurement–								
Radius	um							
– K-factor measurement-								
K-factor								
Radius delta	um							
A	um							
B	um							
– Angle evaluation–								
Cutting edge angle	°							
– Chipping measurement								
Chipping	um							

After selection of a measurement program, a table with the predefined evaluation extent will be displayed.

1.3 Product database

With the type designation of a product in addition to the measurement and evaluation extent, nominal values and tolerance limits are defined, serving for a classification of the component measured.

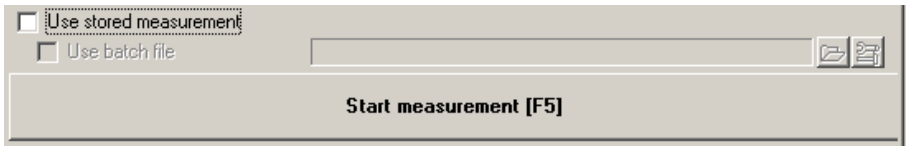


The selection of a product to be measured is done by clicking in the list of products.

The input box below the list serves as the target field for barcode scanner. When measuring objects are labeled with barcodes, then this can be used to facilitate the product selection. Upon scanning a barcode, the content of the product list is limited to those items that are suitable for this object (see Chapter 9)

1.4 Measurement

1.4.1 Start measurement



The measuring process is started by a mouse click on ***Start measurement*** or by the functional key [F5].

Instead of a real part measurement, it is possible to analyze saved 3d profiles. ***Use stored measurement*** must be activated for this. Upon starting the process, a selection dialog appears, where the profile to be processed can be chosen. With ***Open*** then chosen profile will be loaded and processed. Section 1.4.2 will be skipped.

By means of a batch file, several stored profiles can be evaluated in a sequence (e.g. for system tests), in which case the results are saved in the specified folder, in a text file (see Chapter 6).

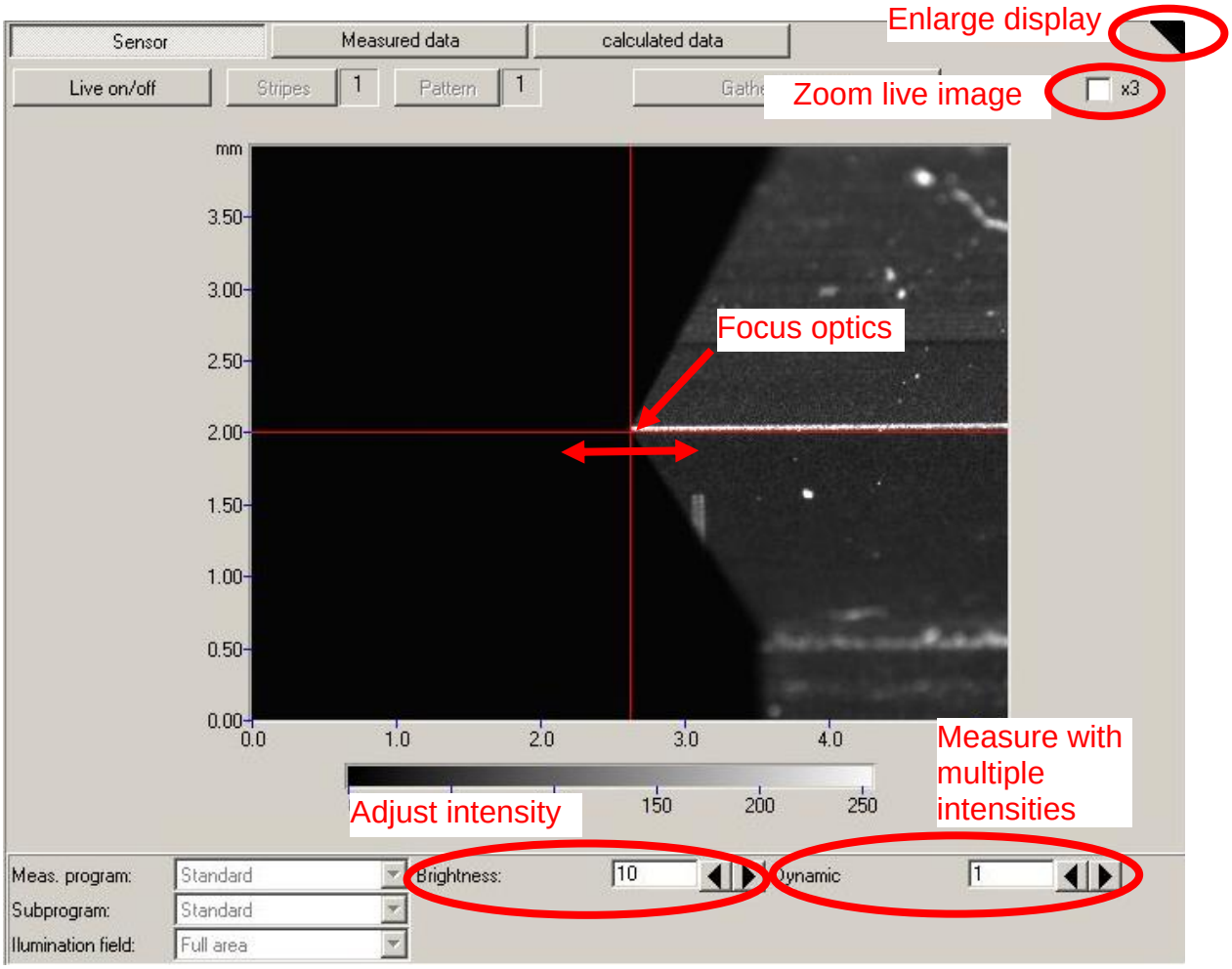
1.4.2 Sample positioning

Upon the start of the measurement process, a request to place an object under the sensor appears.

The object to measure has to be aligned so the edge runs horizontally from the left to the right side of the screen, and is centered vertically. All parts of the evaluation area should be in focus.

The left up-down buttons marked below can be used to adjust the exposure. If the cutting edge shows strong reflections and the flanks are very dark (i.e. a very high intensity range), it is possible to increase the dynamic of the sensor with the up-down buttons on the right by setting the value to 2 or 3. The profile measurement will then be repeated with different intensity settings, which provides a higher data quality but also takes more time.

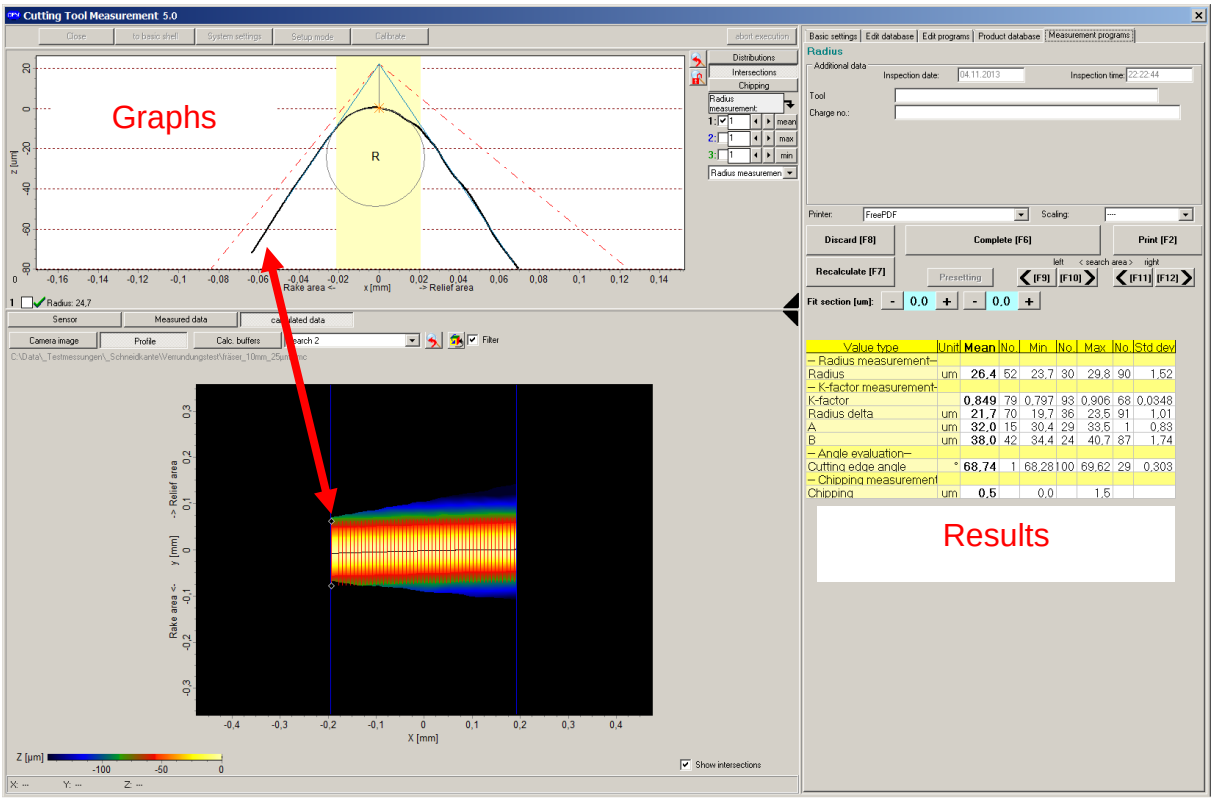
☞ A manual correction of the intensity settings is only possible if this option is enabled in the chosen measurement program.



Handling:

- By clicking on the black triangle at the upper right, the display can be enlarged or reduced, respectively. It is possible to enable an auto-enlargement of the display for positioning in the basic settings of the system.
- By activating the ***x3***-zoom-function, the center of the live image will be magnified by three. This provides easier focusing for systems with high-resolution cameras.
- For focusing, patterns or stripes can be projected. These have to be aligned by using the height adjustment wheel. The type of pattern can be preselected in the measurement program.
- A manual correction of the intensity settings is only possible if this option is enabled in the chosen measurement program.

1.4.3 Display of results



After calculations are done, the results are shown in a table (right). Cut lines, result distributions and chipping curves are shown in the graph display (upper left). With the controls to the left side of the graph display, different contents can be selected.

Up to this point in the process, no results have been stored. The operator can now decide how to continue:

- With ***Discard***, the whole measurement can be discarded. Neither profiles nor results will be stored.
- With ***Print***, a measurement protocol can be printed. The printer to be used can be selected in the selection list ***Printer***.
- ***Recalculate*** will start a new calculation of all results, e.g., if the measuring area has been changed by using the arrow-buttons ***F9*** to ***F12***. With ***Presetting*** the original measuring area as preadjusted in the measurement program can be restored. Changing the measuring area and recalculating is only possible if this option is enabled in the chosen measurement program..
- With the ***+/-*** - buttons at ***Fit section***, the left and right border of the fit region used for the radius calculation can be moved manually. An instant recalculation follows automatically. This function is only available if enabled in the chosen measurement program.
- With ***Complete***, the measurement cycle will be finished regularly. The system stores profiles and results according to the adjustments in the basic settings. Upon finishing the measurement cycle, printing or recalculation is not possible any more.

2 Graph displays, content and handling

2.1 Profile display

In the profile display, camera images and 3D-profiles are shown. The display shows raw data (profiles as measured) as well as processed profiles, which are used to evaluate the result parameters. Depending on the functions selected, intermediate profiles can also be shown. The camera image can be switched to live image.

- ☞ Camera images are two-dimensional planes. They do not contain height information, but show the brightness values obtained by the camera (like a photo).
- ☞ Profiles are three-dimensional surfaces. They consist of height information for every point of the surface. Profiles can't be gathered directly by the camera, they are always a calculation result based on a certain set of camera images taken with series of projected stripes patterns.

The camera images and profiles shown may be results from several settings or evaluation functions. These will be explained later, together with the related functions.

The profile display offers three selections, by the buttons shown below. More detailed descriptions can be found in the following subsections.

Some options with these display functions are only available in setup mode (see 3.1). Others are only available in normal mode, if the option ***Hand measurement without password allowed*** is activated (see 3.2),

For a more detailed view, the display area can be enlarged. Clicking on the black rectangle in the upper right corner will enlarge or reduce the display area.

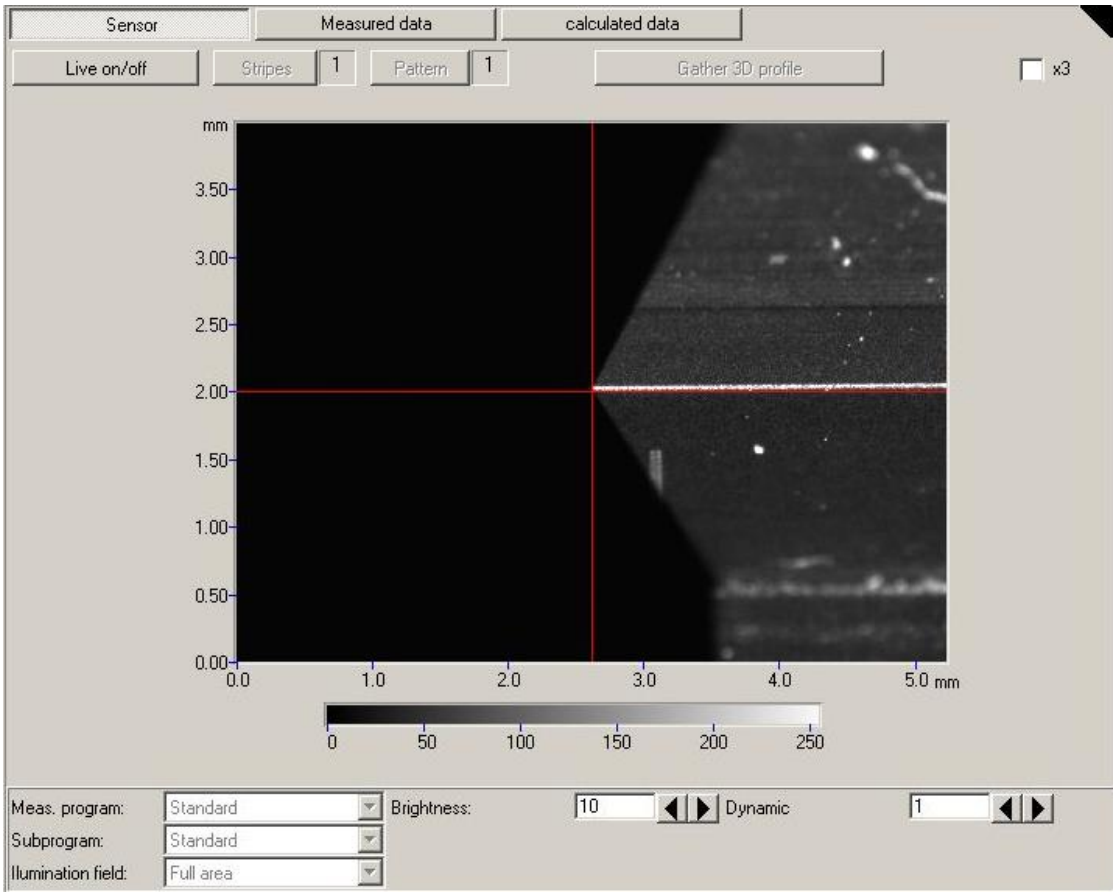
2.1.1 Profile display function "Sensor"

This display function directly refers to the sensor input (comparable to the measurement window in ODSCAD). All sensor settings (brightness, measurement programs, etc.) can be accessed directly.

A live image can be shown. Stripes and pattern, can be projected, making it easier to adjust, e.g., focus (sensor height above the measuring object) or brightness.

Single measurements (without any evaluation following) can be done. For these measurements, brightness, measurement program and illumination field can be selected individually. Please be aware that 'measurement 'program' here just refers to the current sensor settings, which are adjusted in the basic measurement module (ODSCAD), and these should not be confused with the 'measurement programs' for cutting tool analysis, which are complete prescriptions for the measurement and analysis of specific tools, defined in this software module (cutting edge module).

A click on the black triangle at the upper right corner will expand the display area.



Controls of the display function ***Sensor***:

Live on / off	Activates / deactivates display of a live image
Stripes	Activate / deactivate stripes: **left Mouse button** Select stripe width: **right Mouse button** or [Shift] + **right Mouse button**
Pattern	Activate / deactivate pattern: **left Mouse button** Select pattern type: **right Mouse button** or [Shift] + **right Mouse button**
Gather 3D-Profile	Perform a single measurement. When done, the display will automatically switch to the display function ***Measured data***, showing the gathered 3D-profile.
Meas. Program	Selection of the measurement program to be used. [1)]
Subprogram	Selection of the subprogram to be used. [1)]
Illumination field	Selection of the illumination field to be used. [1)]
Brightness	Adjustment of camera brightness. [2)]
Dynamic	Adjustment of the brightness dynamic. Values above 1 will increase the measurement time [2)]
x3	By activating the 'x3'-zoom function the center of the live image will be magnified by 3. Systems with high resolution cameras will then be easier to focus.

1) The options listed here are the same as in the measurement window in the basic software (ODSCAD). Please refer to the manual of ODSCAD.

2) Only available if supported by the sensor hardware used.

2.1.2 Profile display function “Measured data”

With this display function, the camera image and 3D-profile as gathered by the measurement can be viewed.

The images and profiles shown always are original data. They are never changed by any function for further calculations in any way.

When stored measurements are loaded, there might be no camera image. It is not needed for processing. It only severs as a visual control option for the user, or as an image for a printed protocol.

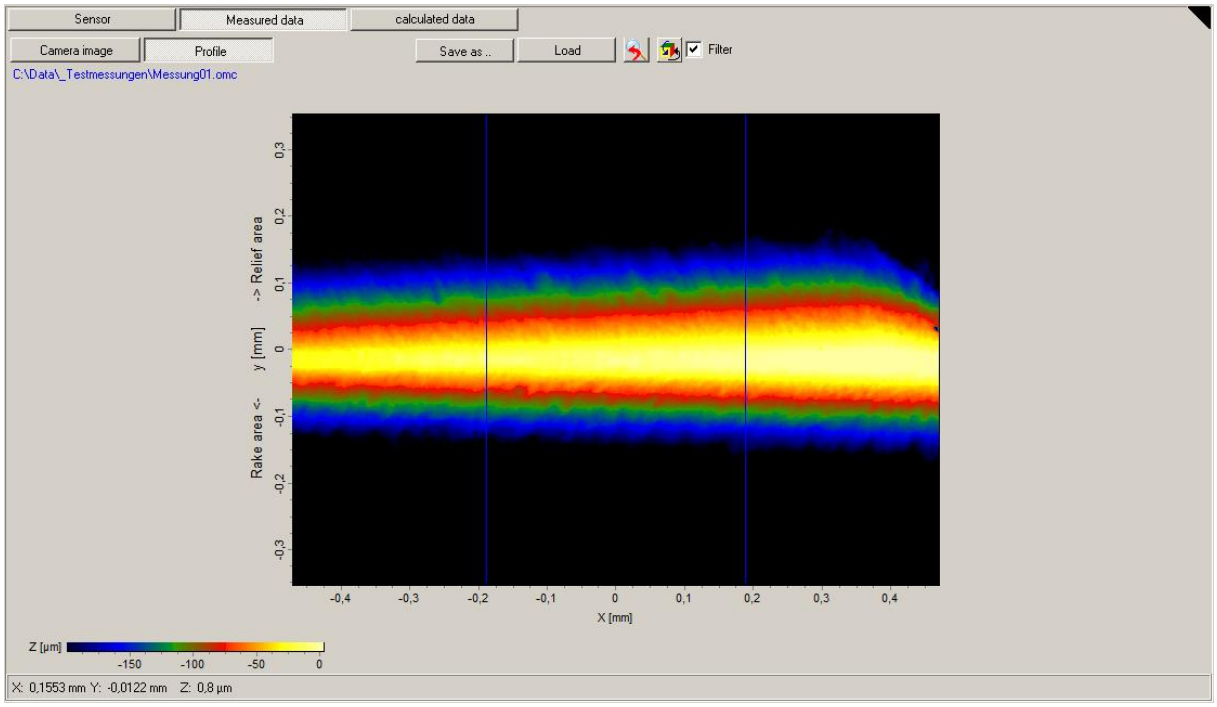
When the mouse cursor is moved over the image area, the corresponding coordinates (x, y and z) are shown below the image display. If this point is an invalid point of a 3D-profile, the z-values will change to red.

There is also a possibility to store measured data, or to load them from a file. If the display shows loaded data, path and file name are shown above the image display.

Camera image and 3D-profile can be zoomed and panned using the mouse. Panning is done by moving the mouse while keeping the right mouse button pressed. Zooming is done by moving the mouse cursor to the upper left of the area of interest, then moving the mouse to the lower right of the area with the left mouse button pressed, and releasing the mouse button there. Zoom and Pan can be reset by doing the same from lower right to upper left anywhere in the image area or by clicking 

A click on the black triangle at the upper right corner will expand the display area.

With  the profile can be shown as a rotatable 3D-view (see 2.3).



Controls of the display function ***Measured data***:

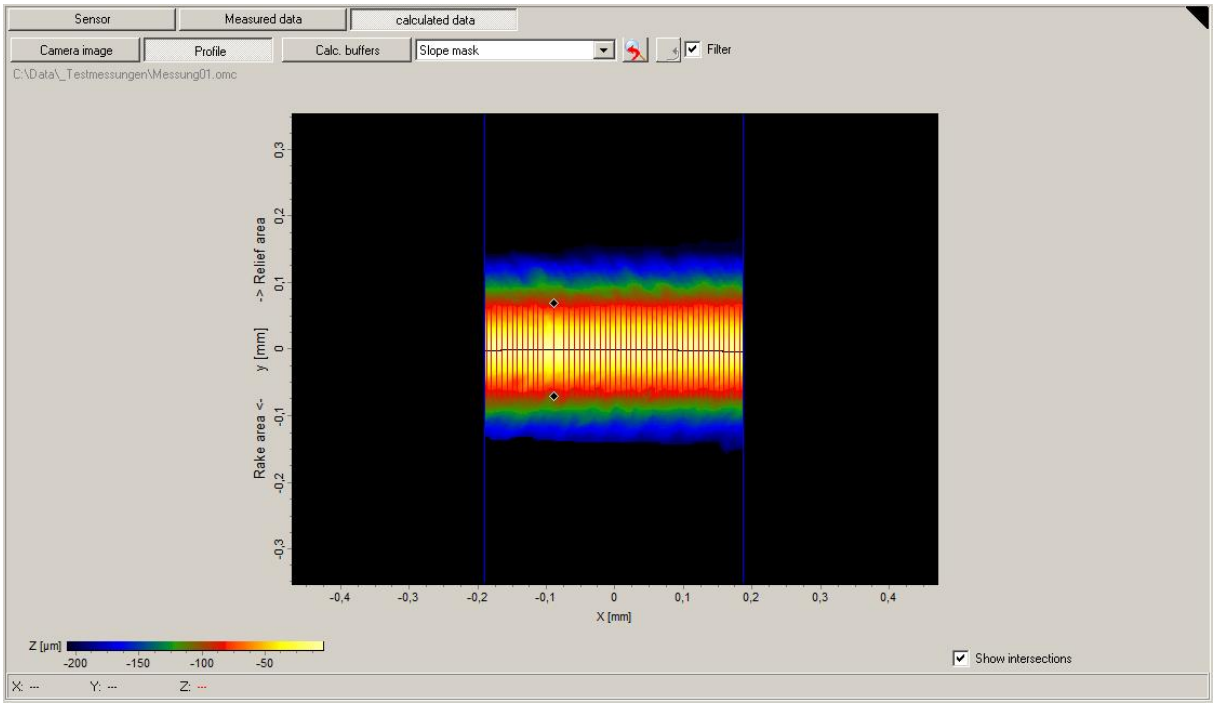
Camera image	Displays a loaded / measured camera image The display shows a b/w image
Profile	Displays a loaded / measured 3D-profile The display shows a color coded image, the colors represent height values.
Save as..	Stores a measured profile (**.omc*) together with the camera image (**.kam*) or a profile or camera image alone (**.fd3, *.omc, *.kam*)
Load	Loads a stored profile (**.omc*) together with the camera image (**.kam*) or a profile or camera image alone (**.fd3, *.omc, *.kam*)
	Resets zoom and pan.
	Switches to a 3D view of the profile
Filter	Optional smoothing filter for the 3D view. The filter only affects the 3D view, it will not change the original profile used for further processing.

2.1.3 Profile display function “calculated data”

With this display function, the preprocessed 3D-profile used for the evaluation of specified attributes can be viewed. It is leveled and truncated to the adjusted evaluation area. The camera image shown here (if available) is also processed to fit to the 3D-profile.

Beside that profile, some evaluation functions produce additional profiles or masks which could be viewed too. These are intermediate results that can be useful to check the processing.

☞ Masks are areas in which the points contain marking informations. Masks contain neither brightness nor height data. The marking information determines in which way points of profiles are handled by evaluation functions.



All profiles shown here are processed data, produced by evaluation functions by processing the measured original data.

Not all evaluation functions produce all types of profiles. Therefore some display options may remain empty after a calculation cycle.

The handling here is the same as with the display function ***Measured data*** (2.1.2). In addition, with the button ***Calc. buffers***, intermediate profiles and masks can be viewed upon selecting one from the list right beside the button.

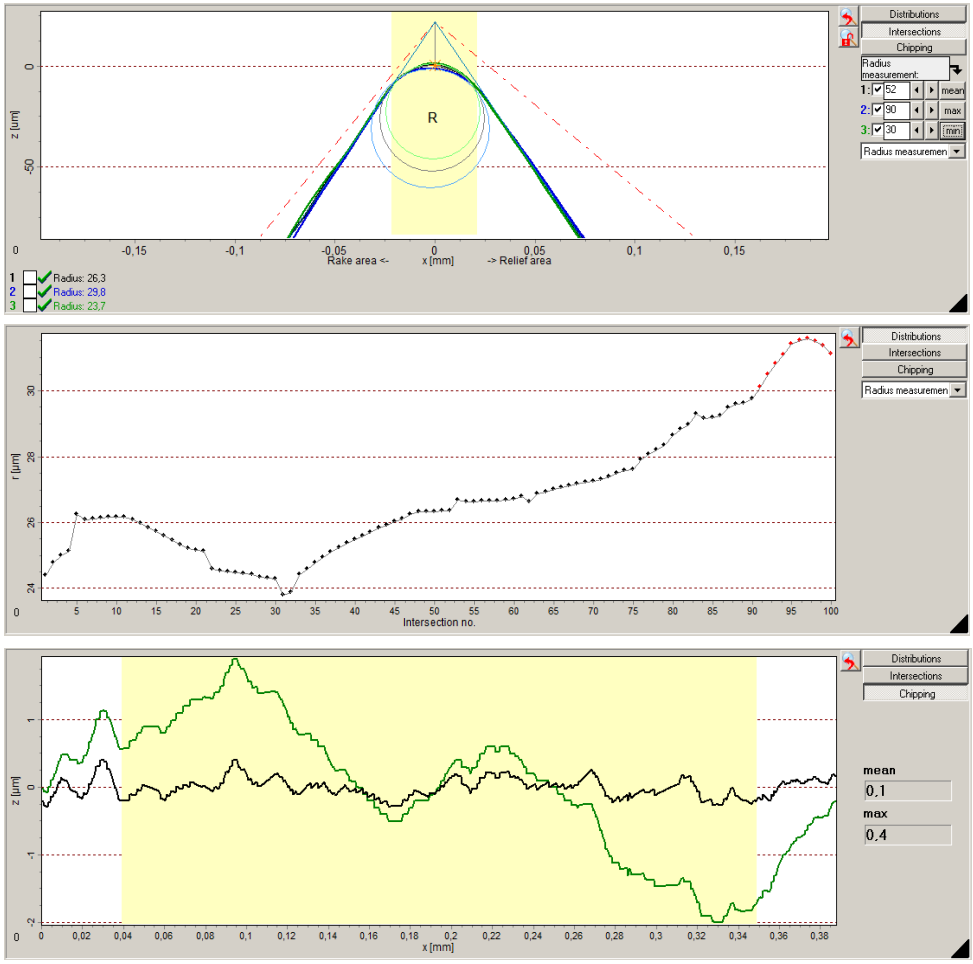
The positions of the cut lines are overlaying the display. If the density of cut lines is very high, only a certain amount will be displayed, to maintain visibility of the 3D profile. Colored rhombuses at the ends highlight those which are currently shown in the graph display above. The colors of the rhombuses correspond to the colors of the cut lines in the graph display. The check box ***Show intersections*** enables the overlay.

2.2 Graph display

The graph display contains views of section lines, result distributions and chipping curves, which can be selected by the controls to the right.

As all data are results, they can only be shown after calculation is finished.

For a more detailed view, the display area can be enlarged. Clicking on the black triangle in the lower right corner will enlarge or reduce the display area.



The graph display can be switched between three main views, a view for section lines, a view for result distributions and a view for the chipping. The set of controls to the right will change accordingly.

The graph area can be zoomed and panned using the mouse.

Panning is done by moving the mouse while keeping the right mouse button pressed.

Zooming is done by moving the mouse cursor to the upper left of the area of interest, then moving the mouse to the lower right of the area with the left mouse button pressed, and releasing the mouse button there.

Zoom and Pan can be reset by doing the same from lower right to upper left anywhere in the graph area or by clicking 

With  (toggle switch), the zoom and pan state can be frozen and will remain when skipping to other section lines.

Selecting the main view types:

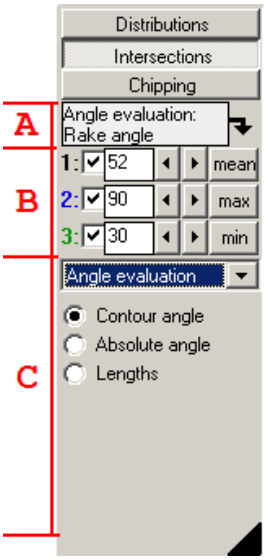
Distributions	Shows the result distribution of all intersecting lines
Intersections	Shows one to three intersecting lines out of all.
Chipping	Shows an intersecting line along the cutting edge

2.2.1 Intersecting lines display

In the intersecting lines display, up to three intersecting lines can be viewed at the same time. Length and amount of the intersecting lines depend on the setting in the measurement program. The zero point of the x-axes is at the cutting edge or at the center of the chamfer if the intersecting lines have a chamfer instead of a rounded cutting edge.

The display is adjusted by the controls shown in the image below. The upper part (A, B) contains controls for selection of intersecting lines, the lower part © contains controls to select what results to be shown as overlay.

Which controls are available at part C depends what kind of evaluation is selected in the list at the top of part C. The list contains all evaluations that are activated in the currently loaded measurement program.



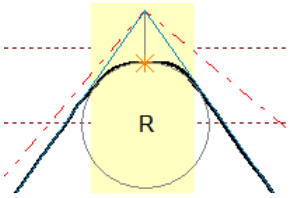
Selecting intersecting lines (Part A & B)

Text field in part A	Shows on which result types the actions of the buttons ***mean.***, ***max*** and ***min*** is based. If the results of an evaluation only contain one single result value (e.g. at radius calculation), the background color of the text field will be the same as the surrounding area. If there are several result values (e.g. at form deviation calculation), the background color will be a light gray (see image above) and the type of result value shown can be selected by: 1) Clicking on the text field with the left mouse button will switch through all result value types. 2) Clicking on the text field with the right mouse button opens a menu, where the type of result value can be selected.

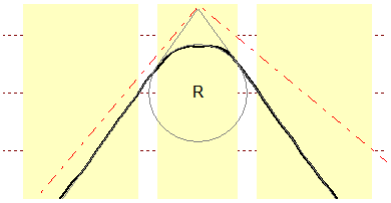
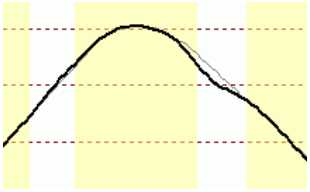
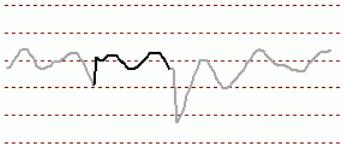
Check-boxes	Activates/deactivates the display of intersecting lines at line display 1, 2 or 3. The colors of the intersecting line correspond to the numbers left to the check-boxes.
Input fields	Shows the number of the currently displayed intersecting line. The number can be changed by typing in a number + [return] or by using the up-down-buttons.
Up-down-buttons	Increments or decrements the intersecting line number at line display 1, 2 or 3.
Mean	Sets line display 1 to the intersecting line, whose result is nearest to the calculated mean value.
Max	Sets line display 2 to the intersecting line with the highest result.
Min	Sets line display 3 to the intersecting line with the lowest result.

Selecting result types and display options (Part C)

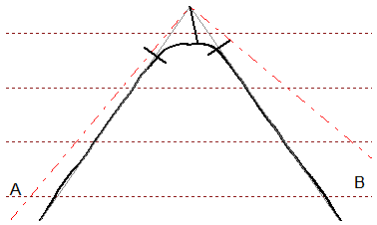
Radius measurement:

Intersecting line	Shows intersecting line of the ***Radius measurement***. Shown are the calculated radius, the bisecting line with intercept point (orange) and the reference system[1)] (dashed red). The area used for radius calculation is highlighted yellow. 

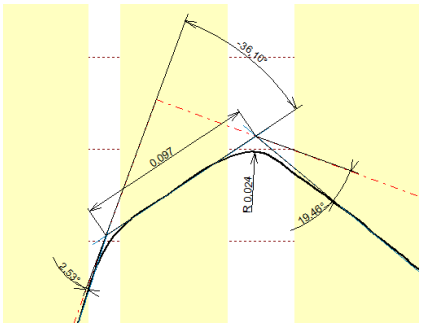
Form deviation:

Intersecting line	Shows intersecting line of the ***Form deviation***. Shown are the adjusted radius and the reference system[1)] (dashed red). The areas used for radius and flank calculation are highlighted yellow. 
Reference	Shows intersecting line of the ***Form deviation***. The reference contour is shown as a thin line. This is the ideal (calculated) line, used to calculate the form deviation. The areas used for radius and flank calculation are highlighted yellow. 
Form deviation	Shows the difference between the measured intersecting line and the calculated reference line. The flank areas are shown in pale color. 

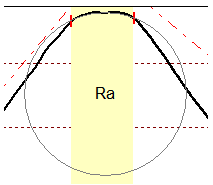
K-factor:

Intersecting line	Shows intersecting line of the ***K-factor*** calculation. Shown are the break-off-points (black lines, left and right), the radius-delta (black line, center), die identifiers A and B and the reference system[1] (dashed red). 

Angle evaluation:

Intersecting line	Shows intersecting line of the ***Angle evaluation***. Shown are the contour lines (blue) and the reference system[1] (dashed red). The areas used for contour line calculation are highlighted yellow. Widths, absolute angles and (if calculated) the radius are shown as dimensioning. 

Contour radii:

Intersecting line	Shows intersecting line of the ***Contour radii*** measurement. Shown are the calculated radius, the borders of the calculation area (red markers) and the reference system[1] (dashed red). The area used for radius calculation is highlighted yellow. Depending on the settings up to 5 radii (Ra..Re) are shown. 

Area measurement:

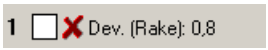
Intersecting line	Shows intersecting line of the ***Area measurement***. Shown are the break-off-points (black lines, left and right), the contour lines and the reference system[1] (dashed red). 

1) The reference system is the coordinate system in which absolute angles (rake angle, relief angle, ..) are measured. It consists of two line in rectangular position, where one is used as reference in the rake area, the other as reference in the relief area. To get a valid reference system, the angle evaluation has to be performed.

Below the graph display, area measurement results are shown according to the selected display options. A green check mark ✔ or a red cross ✘ indicate if a result value is included to the overall result calculation or not. If a result value could not be calculated, it is indicated by ⊘. If two or three intersecting lines are displayed at the same time, result values are shown in separate rows for each line. The number in front of each row indicates the number of corresponding line selector.

2.2.1.1 In-/exclude result values manually

If this option is activated, a rectangle appears left of each of the result values shown.



The color indicates, if the result value is forced into the overall result manually, or excluded manually, or if the decision is left to the program.

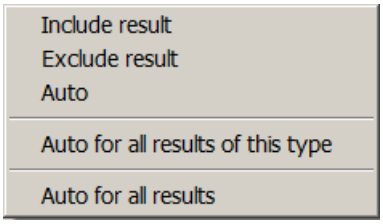
☐	white	The decision made by the Program is used.
■	green	The result value is part of the overall result.
■	red	The result value is not part of the overall result.

If the use of a result value has been set manually (green/red), the marking for the selection done by the program right beneath will be shown gray. In this case, it has no more influence on the use of this result value.

Clicking on the rectangle with the left mouse button will change its state. It will flip through all possible states. The recalculation of the overall result follows instantly.

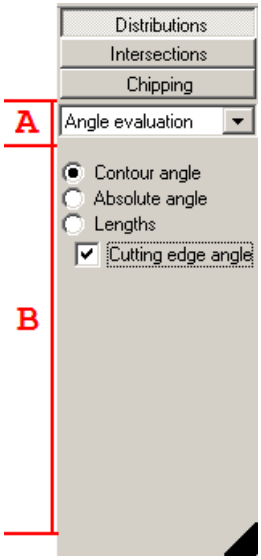
For result values that could not be calculated (⃠), the state can't be changed.

Another way of changing the state is by a menu that pops up when the rectangle is clicked on with the right mouse button. Here, as an additional possibility, all result values of the type clicked on, or all result values can be set back to program decision (Auto).



2.2.2 Distribution display

Result distributions are graphs with as much points as there are intersecting lines. The x-axis shows the intersecting line numbers. The values of these points represent result values of one type, of all intersecting lines.



The display is set up with the controls shown in the above image. The basic selection is done by choosing the evaluation function by which the results are to be displayed out of the list (A).

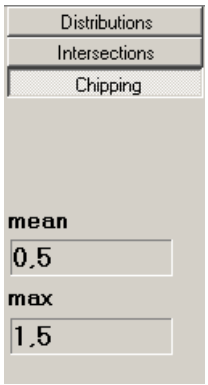
According to the selected evaluation function, additional controls will appear in the area below (B).

Different evaluation functions have different amounts of result values. The selection of these result values is done using the controls in part B. If more than one can be selected at once, the colors of the graphs correspond to the colors of the controls.

Result values that are excluded from the overall result will be colored red in the graph.

2.2.3 Chipping display

This display shows the height profile along the cutting edge, unfiltered (green graph) and filtered with a high-pass filter (black graph). The filtered graph is used for the chipping calculation. The results are shown in the control area to the right.

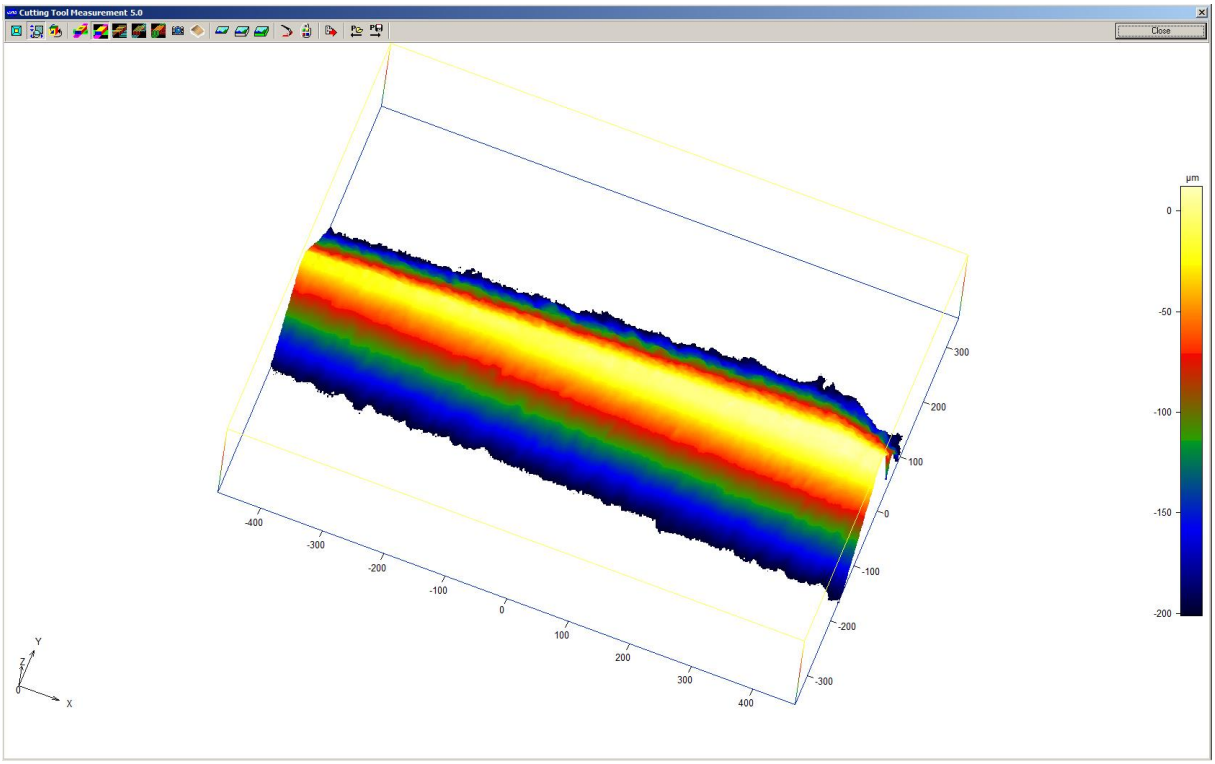


2.3 3D display

The 3D display shows profiles as a three-dimensional projection. Available display modes are grid, color-coded, photo realistic and with camera image as texture. The display can be zoomed, panned and rotated.

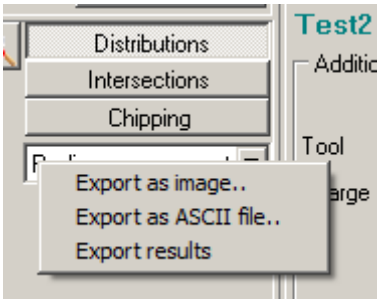
This display equals the one implemented in ODSCAD. Further advice can be found in the ODSCAD manual.

Close will close the 3D-display and return to the normal surface of the cutting tool module.



2.4 Export of intersecting lines, distributions and results

Intersecting lines and result distributions can be exported either as image or as text file (ASCII), the overall result as text file only. Export is initiated by a click with the right mouse button on the control area of the graph display. A menu then pops up where the desired type of export can be chosen.



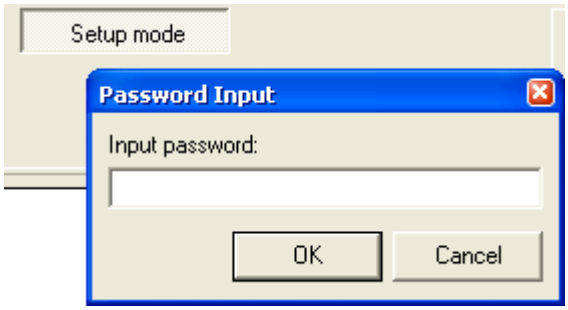
Export as image..	The currently adjusted display will be exported as an image. In the following save-file-dialog export as (*.bmp), meta file (*.wmf) or enhanced meta file (*.emf) can be selected.
Export as ASCII file..	The currently adjusted display will be exported as csv-file (column captions + list of value, can be imported into EXCE) or as line-file (only a list of x-y-coordinates, can be imported into ODSCAD).
Export results..	The overall result and the single result of all intersecting lines will be exported as a text file.

If an item is selected, a save-file-dialog will appear where location and file name can be entered. According to the selected item the type of file can be selected too. The export will be executed when the dialog is quitted with ***ok***.

3 Basic settings

3.1 Activate setup mode

In principle, basic settings should be changed only by trained users. For this reason they are protected and changes are only possible after entering the password.

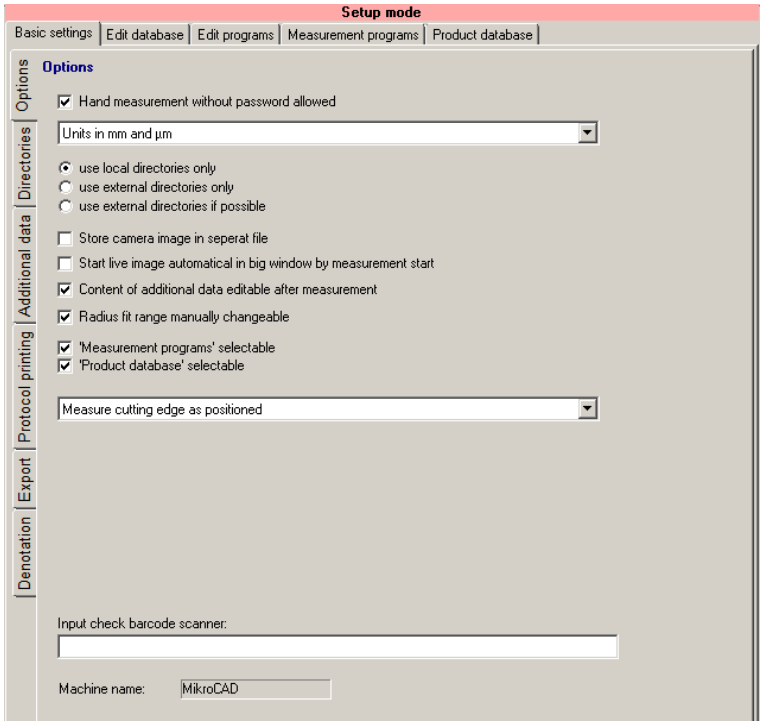


To enter setup mode, click on ***Setup mode*** and enter the password.

Another click on ***Setup mode*** will end the setup mode (toggle switch).

If the software is in setup mode, a hint ‘Setup mode’, highlighted in red, will be shown at the top of the right hand application window.

3.2 Options



Hand measurement without password allowed:
Capture of 3D-data outside of automated processes allowed without password.

Unit selection:
- metric, mm (X, Y) and µm (Z)
- metric, all in mm
- English units, all in inch

Directories:
All measurement programs, the product database and the results can also be saved on central network directories. This allows access from multiple MikroCAD systems to the same data source and may reduce administration work.

Store camera images in separate file:
If enabled, the camera image will be stored as a separate file (*.kam) when running automated processes. Otherwise, they are only stored in the profile files (*.omc).

Start live image automatically in big window by measurement start:
If enabled, the live image display will be automatically enlarged before the request to position a sample within automatic processes.

Content of additional data editable after measurement:
If enabled, the additional data can be edited after calculation is done in automatic processes (otherwise this is only possible before start).

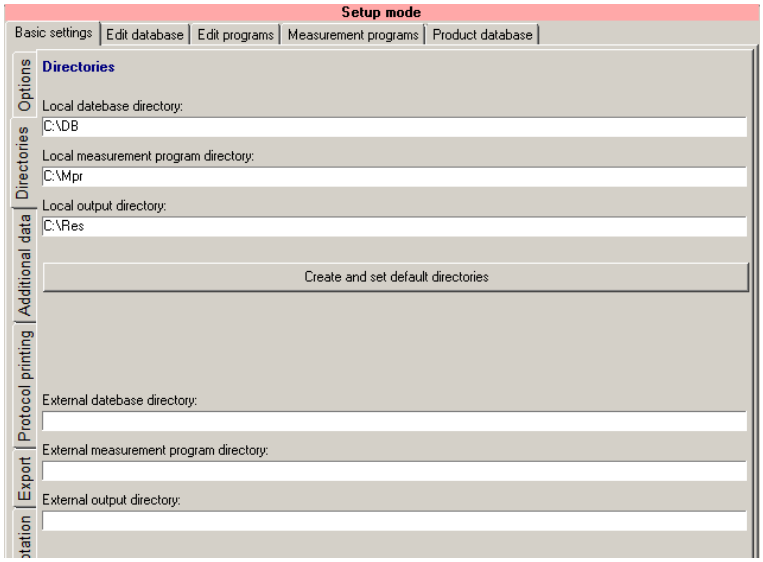
Radius fit range manually changeable:
If enabled, then the fit limits of the radius measurement within automatic processes can be changed manually after the evaluation. The radius will be recalculated to reflect the changes.

Measurement programs / Product database selectable:
Here can be selected, which of the automated processes (***Measurement programs*** and/or ***Product database***) are available in normal execution mode.

Probe positioning:
- Measurement as sample is positioned.
- Rake area always turned to the bottom (left at graph display)
- Rake area always turned to the top (right at graph display)

With the last two options, the software will rotate the gathered profile by 180°, if the orientation set in the measuring program is other than selected here (Sample positioning is always done as preset in the measuring program, the display will always work as set here).

3.3 Directories



Directories can be modified in a dialog that appears when double-clicking on an entry.

Database directories
These directories contain the content of the database (one file per entry).

Measurement program directories
These directories contain all the measurement programs, that are used in the automated processes ***Measurement program*** und ***Product database***.

Output- directories
All outputs from the automated processes will be stored into these directories. If the system is set up to use subdirectories, all these subdirectories will be located here.

Local directories …
These directories shall be located on the computer of the measuring system. They are used for systems without connection to a network or, at systems with network connection, as a backup in case the network is down.

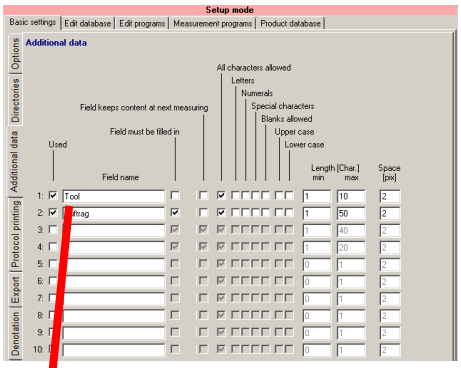
External directories …
These directories may be located anywhere within a network to which the measuring system is connected. This enables the use of common directories by multiple measuring systems. Results can be collected at a common place and measurement programs can be managed from one central point.

Create and set default directories
A click on this button will create directories in the way done within the installation process of this software and set them as local directories. It will create the subdirectory ‘\Data’ in the program directory of this software, and therein the subdirectories ‘\DB’, ‘\Mpr’ and ‘\Res’. Any content of eventually existing directories will be kept.

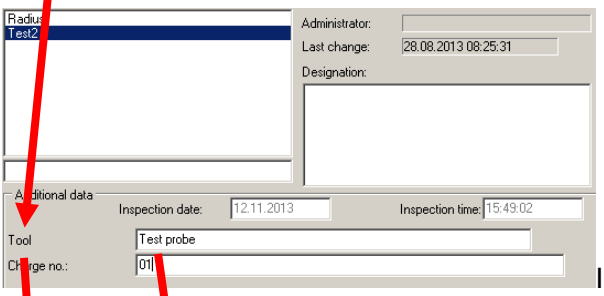
3.4 Additional data

These inputs allow a flexible selection and arrangement of additional data to be saved or printed in automatic processes:

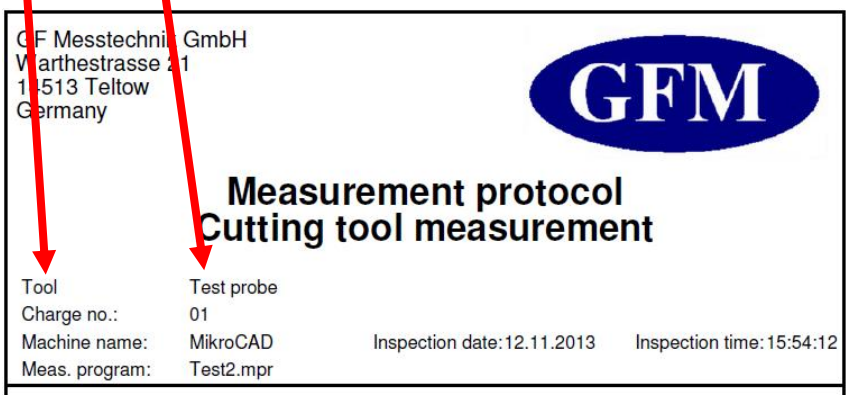
- Design of an input mask
- Inputs upon selecting a measurement program
- Protocol printing
- Storage



Setup page ***Additional data*** in ***Basic settings***



Input additional data in automated processes



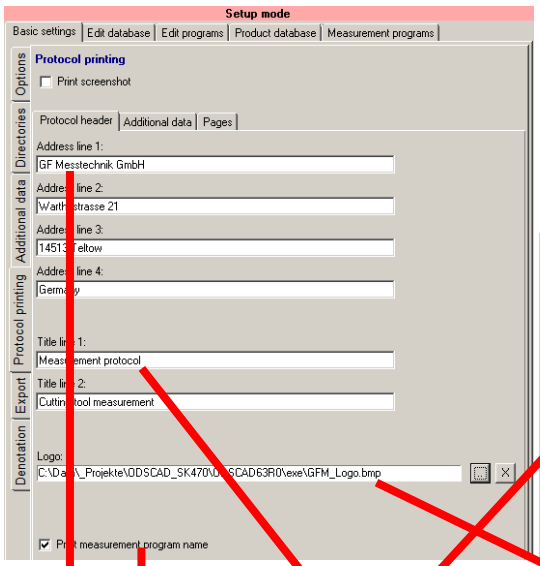
Head of a printed protocol

Instead of the simple input fields shown here, input fields of the additional data can also be set up as list fields. When running automated processes, the user can then choose from a given amount of alternatives. Chapter 10 shows how to set up list fields.

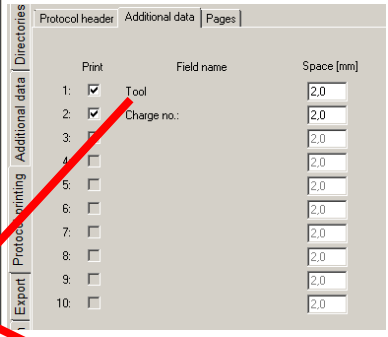
3.5 Protocol printing

With these settings, the layout of the printed protocol can be designed

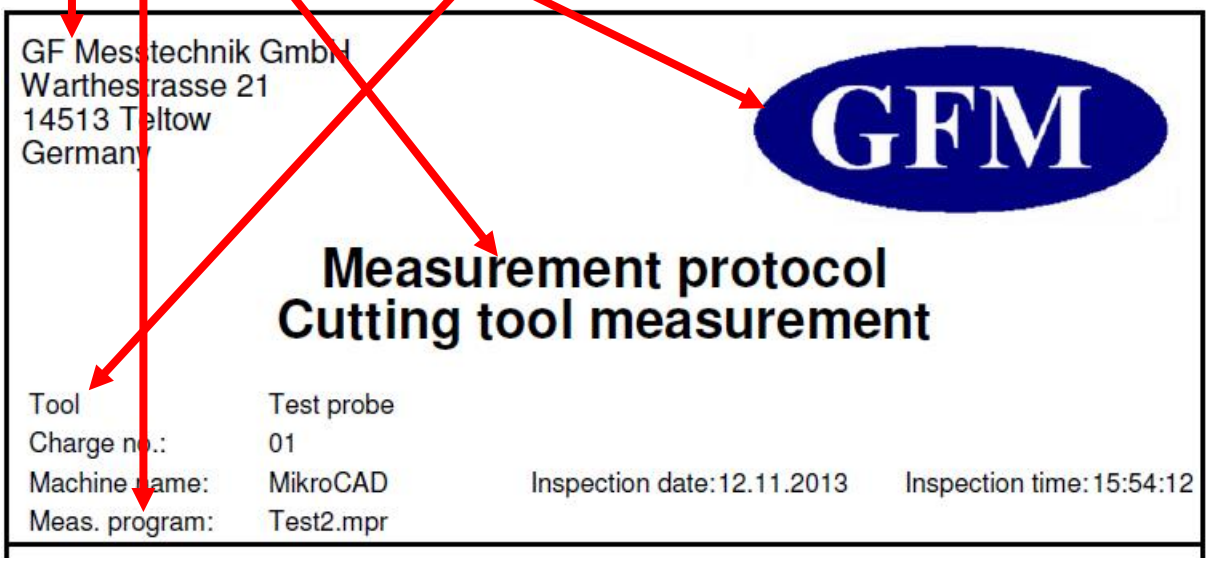
Content:



Setup page ***Protocol header*** in ***Protocol printing*** in ***Basic settings***

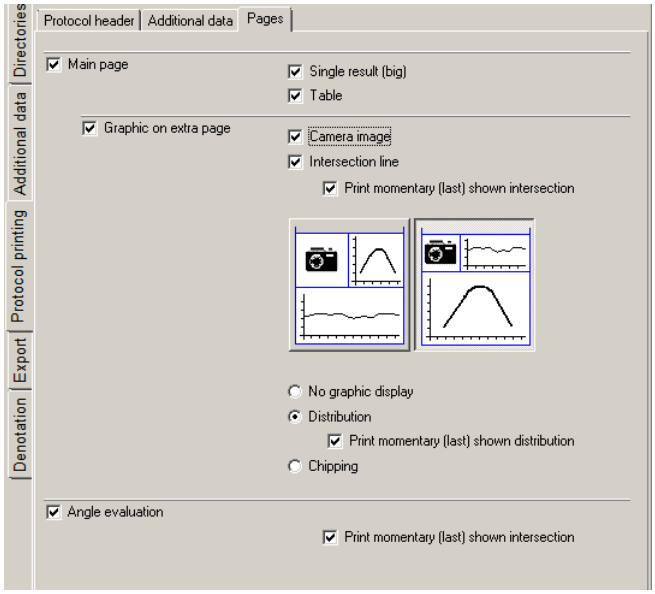


Setup page ***Additional data*** in ***Protocol printing*** in ***Basic settings***



Head of the printed protocol

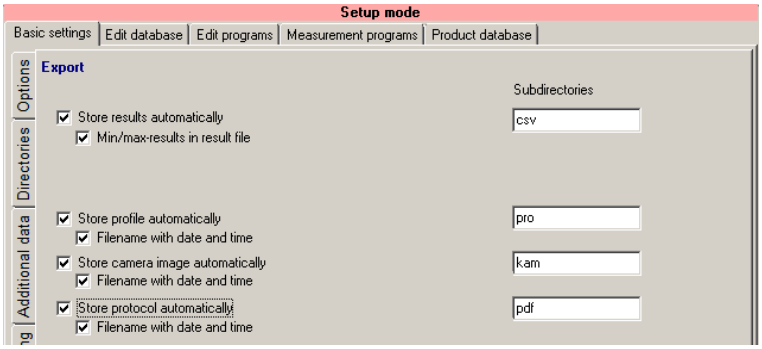
Layout and graphics:



Here, data can be selected to be in the printed protocol, and the graphics can be arranged.

3.6 Export

Here data can be selected to be stored upon a measurement, and also where files will be stored and how the files will be named.



At the upper section of this page, different types of data can be selected for export.

Data type	File type	Description
Results	.csv	Evaluation results as table in text format, can be imported by Excel.
Profile	.omc	Measured original profile
Camera image	.kam	Measured Camera image, integrated into the profile file or as additional separate file (see 3.2)
Protocol	.pdf	Protocol as print to a PDF file

For result export, one can also select if minimum and maximum values are included.

With ***Filename with date and time***, an automatic addition of date and time to the filenames can be enabled. These options are only available if ***Nested export paths*** is selected. The feature can be used to prevent overwriting files if this is not ensured by the selected rules for directory and name creation. (The protection is not necessary for result files. The files can't be overwritten, additional results stored under the same name are simply added to an existing file, as new lines of the chart.)

If needed, the different data types can be exported into different type specific subdirectories. For this, the desired names of the subdirectories are entered into the input fields right to the activation switches of the corresponding data types. Only one level of subdirectories is possible. The characters **\ / : * ? " < >** are not allowed. The subdirectories will be created automatically.

At the lower section of this page, the creation of names for the exported files as well as of extended subdirectories (if activated) can be adjusted. Two different methods are available:

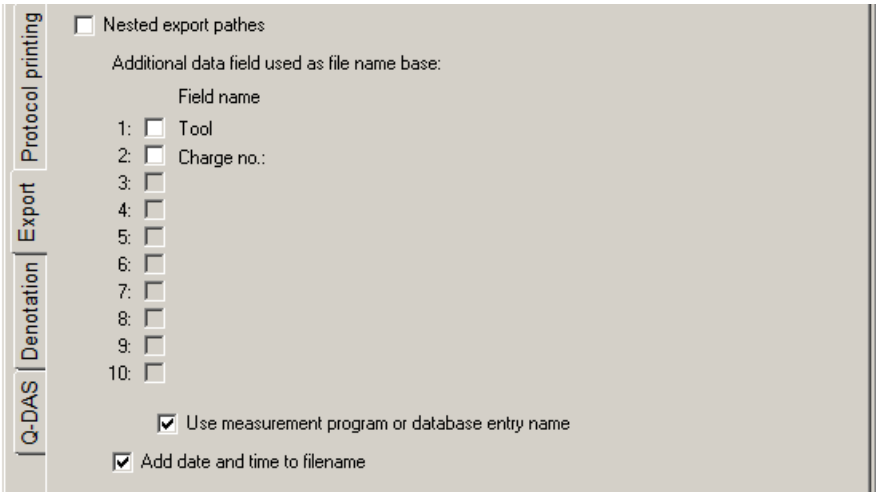
- A simple name generation, where all exports will be stored in the directory selected at the page ***Directories*** (or a type specific subdirectory located there).
- A more flexible name generation and an export into a process specific directory structure.

The generation of paths and file names follows the rules below:

Output directory	Same for all exported data, can be adjusted at the page ***Directories***
+	
Process specific subdirectory	Depending on the measuring process, optional
+	
Type specific subdirectory	Depending on the file type, optional
+	
File name	Depending on the measuring process
+	
File extension	Depending on the file type

3.6.1 Export with simple name generation

If the simple name generation is to be used, the option ***Nested export paths*** must be deactivated. The lower section of the page will then appear as shown below.



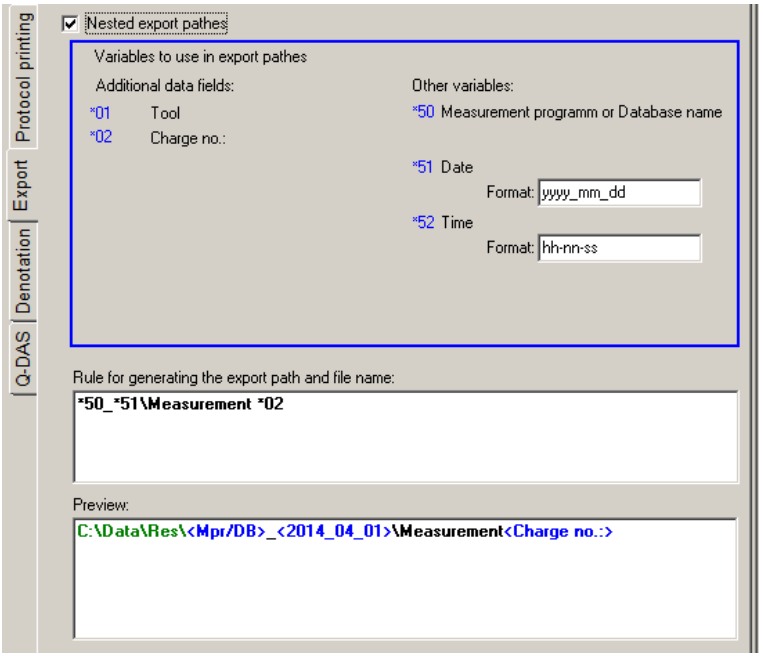
File names can be assembled from the content of the activated additional data fields, the name of the used measurement program or database entry, and the measurement timestamp (date and time). All components are separated with underscores and appear in the same sequence as shown here.

The measurement timestamp is always added with all file types except the ***Results*** (*.csv), to prevent overwriting data due to equal file names.

The ***Results*** are organized as a table, storing with the same file name here results in adding rows to that table.

3.6.2 Export with process specific subdirectories

If process specific subdirectories are to be used, the option ***Nested export paths*** must be activated. The lower section of the page will then appear as shown below.



The blue encircled section shows a list of variables which can be used to define a rule about how subdirectories and filenames are to be generated. Variables are information, which develop due to user inputs only while a measurement process is executed.

The list of additional data fields to the left depends on the actual setting for additional data. Only active fields are listed. The list shows the names of the input fields. When subdirectories and filenames are generated within a measurement process, the content entered to these fields will be used.

For the variables ***Date*** and ***Time***, the notation can be adjusted in ***Format*** (see following subchapters).

The rule for the assembly of directory and filename has to be entered in the input field ***Rule for generating the export path and fine name***

The characters **\ : ? “ < >** are not allowed. The character ***** followed by 2 digits is only used to insert variables, the character **** only to separate subdirectories and filename. All other characters can be used as part of subdirectories and filenames.

Variables are inserted with ***nn** (nn = number of the variable). Multiple use of variables is possible.

It is possible to arrange subdirectories with several levels (separated by ****), but it is also possible to omit subdirectories at all and only define a filename. The part of the rule behind the last **** defines the filename.

A preview of how the result of the entered rule will look like is shown in ***Preview***. the output directory is shown in green color, blue and in angled brackets are the variables, and black are additional inserted characters. Characters in the rule that can’t be interpreted (Error) are shown red. The variables ***Date*** and ***Time*** will display the actual date/time in a notation corresponding to the adjusted format.

All contents inserted via variables will be checked for illegal characters. These will be replaced by underscores.

The extensions to the filenames will be added automatically only when running a measurement process according to the type of file, as well as any preset type specific subdirectories.

In use with Q-DAS, a further option is possible (see chapter 11.1.1.1).

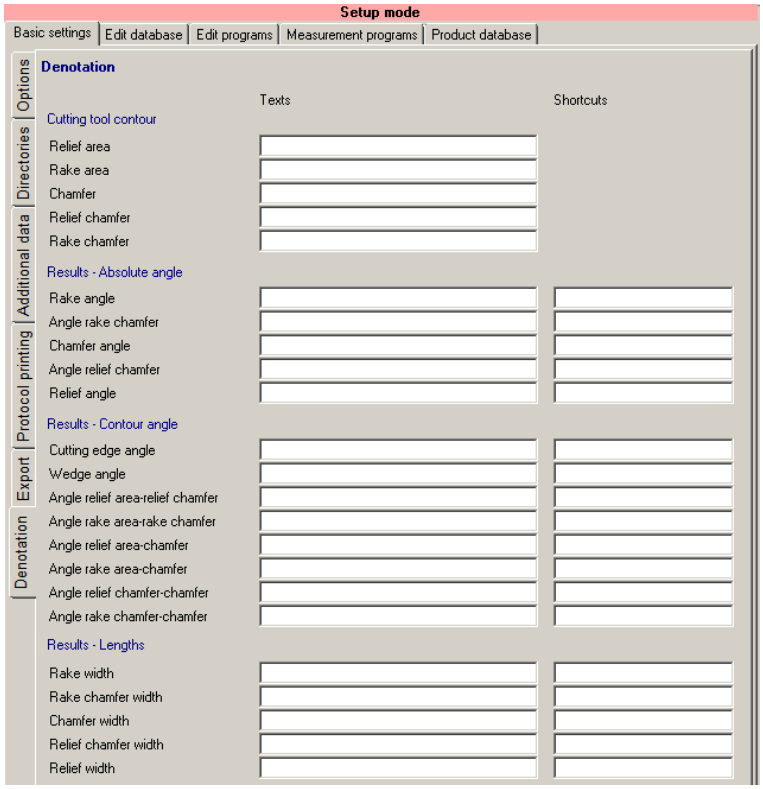
3.6.2.1 Date format

d	The day is shown without leading zero (1-31).
Dd	The day is shown with leading zero (01-31).
Ddd	The name of the day is shown as abbreviation (Su – Sa).
Dddd	The name of the day is shown in full (Sunday – Saturday).
M	The month is shown without leading zero (1-12). Must not be followed directly by a ‘h‘ (if need be, use. Single or double quotes)
mm	The month is shown with leading zero (01-12). Must not be followed directly by a ‘h‘ (if need be, use. Single or double quotes)
mmm	The name of the month is shown as abbreviation (Jan – Dec).
mmmm	The name of the month is shown in full (January – December).
Yy	The year is shown as two digits (00-99).
Yyyy	The year is shown as four digits (0000-9999).
‘xx’/”xx”	All characters enclosed in single or double quotes are shown unchanged and will not influence the formatting.

3.6.2.2 Time format

h	The hour is shown without leading zero (0-23).
Hh	The hour is shown with leading zero (00-23).
N	The minute is shown without leading zero (0-59).
Nn	The minute is shown with leading zero (00-59).
S	The second is shown without leading zero (0-59).
Ss	The second is shown with leading zero (00-59).
Am/pm	The time is shown in 12-hour format if this designator precedes h oder hh. All time indications before midday then come with the marker ‘am’, all other with the marker ‘pm’. The designator am/pm can be written in upper, lower or mixed case letters. The output will be according to that.
a/p	The time is shown in 12-hour format if this designator precedes h or hh. All time indications before midday then come with the marker ‘a’, all other with the marker ‘p’. The designator am/pm can be written in upper, lower or mixed case letters. The output will be according to that.
‘xx’/”xx”	All characters enclosed in single or double quotes are shown unchanged and will not influence the formatting.

3.7 Denotation



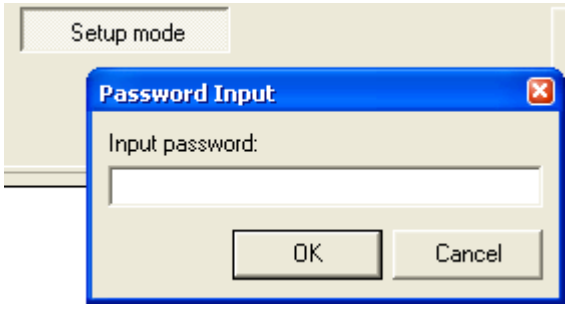
Here the denotations for different parts of the cutting edge contour used by the software (upper group) as well as dependent result names (lower three groups) can be changed.

If a denotation is entered for the result names, it is also required to enter a related shortcut.

4 Create measurement programs

4.1 Activate setup mode

In principle, measurement programs should be created or changed by trained users only. For that reason, they are protected and changes are only possible after entering the password.

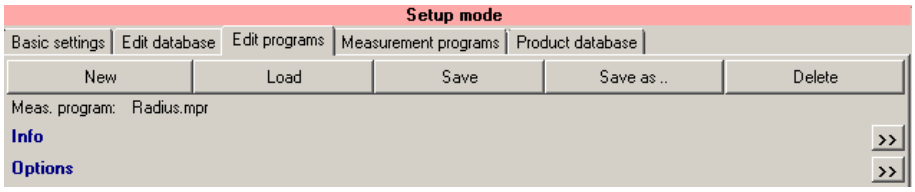


To enter setup mode, click on ***Setup mode*** and enter the password.

Another click on ***Setup mode*** will exit the setup mode (toggle switch).

If the software is in setup mode, the hint ‘Setup mode’ highlighted in red will be shown at the top of the right application window.

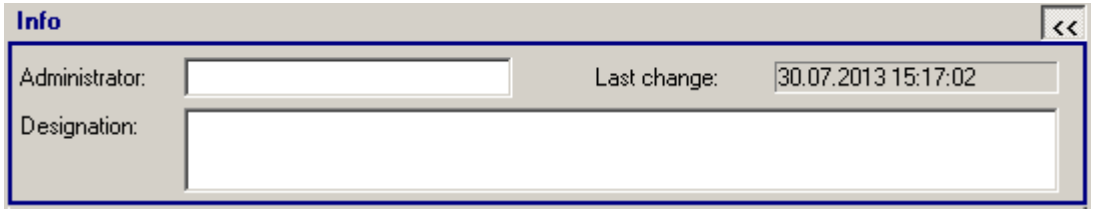
To enter the editor for measurement programs, select the tab ***Edit programs***.



The upper row of buttons is used to load, store or delete measurement programs or to create new ones. At ***Meas. Program***, the name of the measurement program currently loaded is shown. A name shown in red indicates changes in the measurement program are not saved yet.

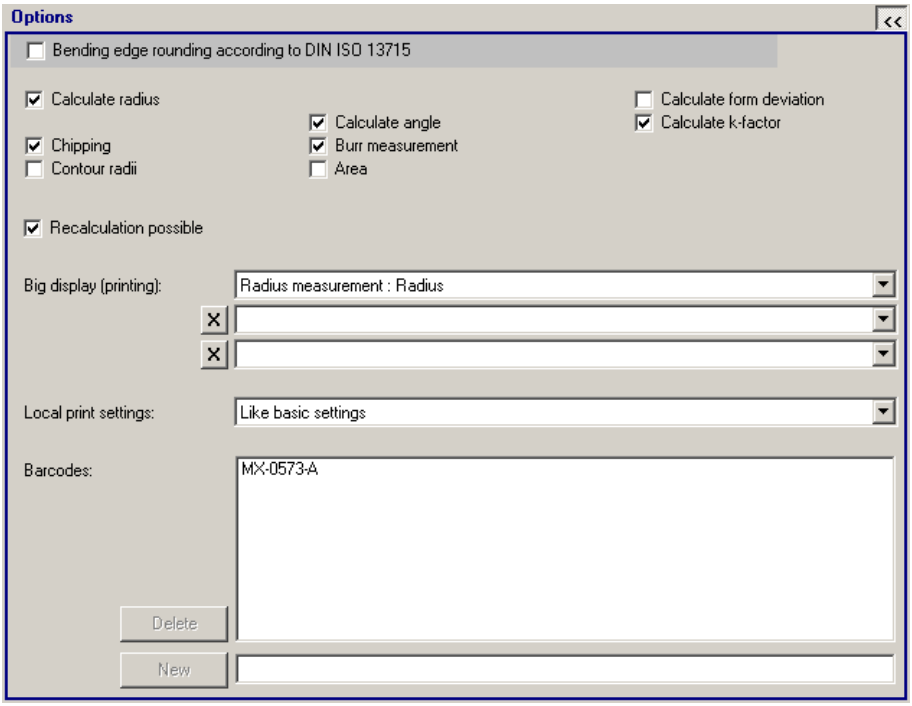
The arrow buttons to the right open and close the sub-windows for ***Info*** and ***Options***.

4.2 Info



Information about the measurement program can be provided here.

4.3 Options



With the option ***Bending edge rounding according to DIN ISO 13715***, the software can be switched to an operation mode where geometrical values will be calculated in a way to fulfill that norm. Currently, only the k-factor calculation is affected.

Below these selections, the kinds of evaluations to be performed by the measurement program are set. As not all kinds of evaluations can be performed with any shapes of cutting tools, the ***Form type*** has to be adjusted first.

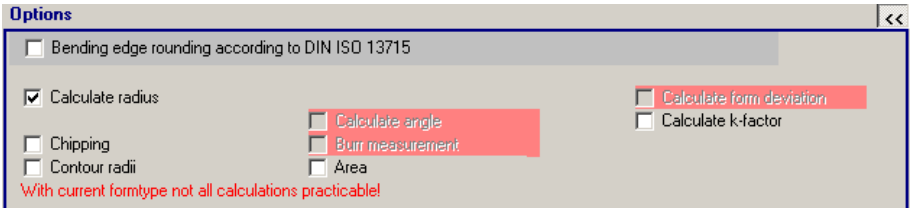
Recalculation possible enables the option to change the evaluation area manually within an automated process.

At ***Big display***, up to 3 result value types can be selected to be shown enlarged in the printed protocol.

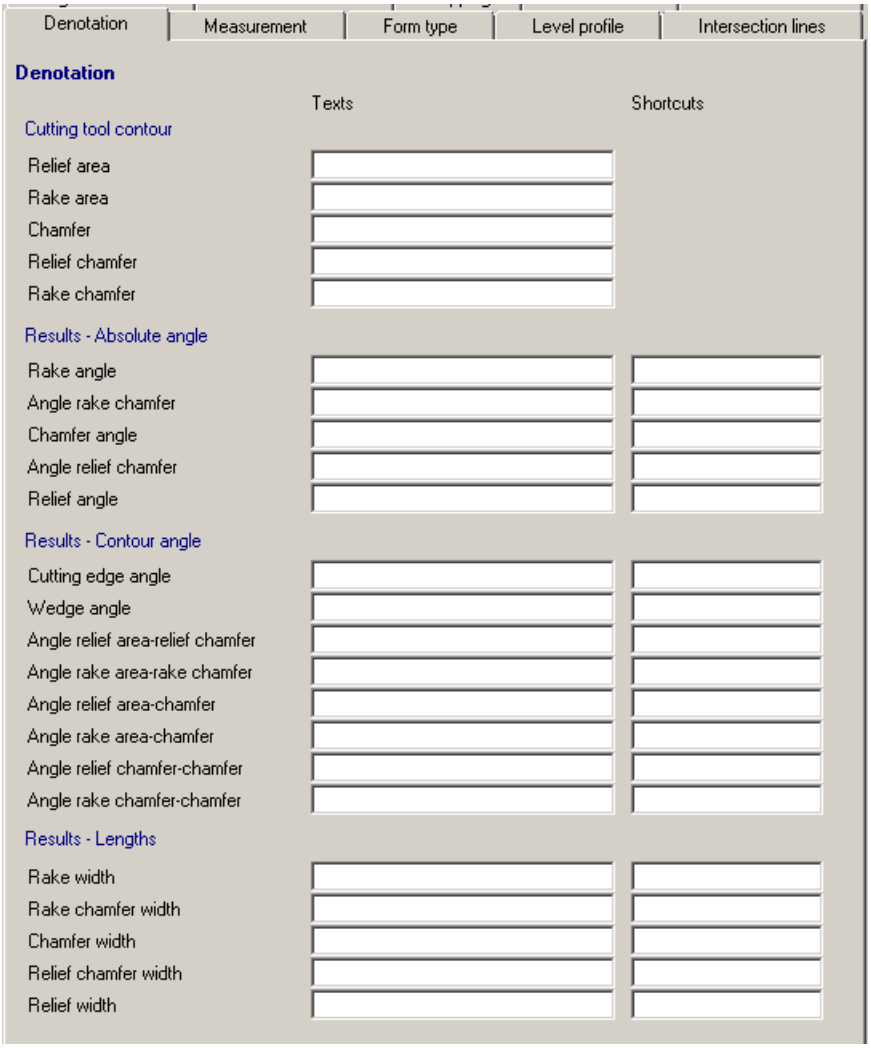
Local print settings allows to select if the printed protocol (contrary to the basic settings) will contain a distribution graph, a chipping graph or none of both.

At ***Barcodes***, one or more barcodes can be added. Barcodes can be used for an easier selection of measurement programs before running an automatic process (see chapter 9).

According to the selected ***Form type***, some evaluations might not be available. A hint will be shown and the effected evaluations will be blocked.



4.4 Denotations

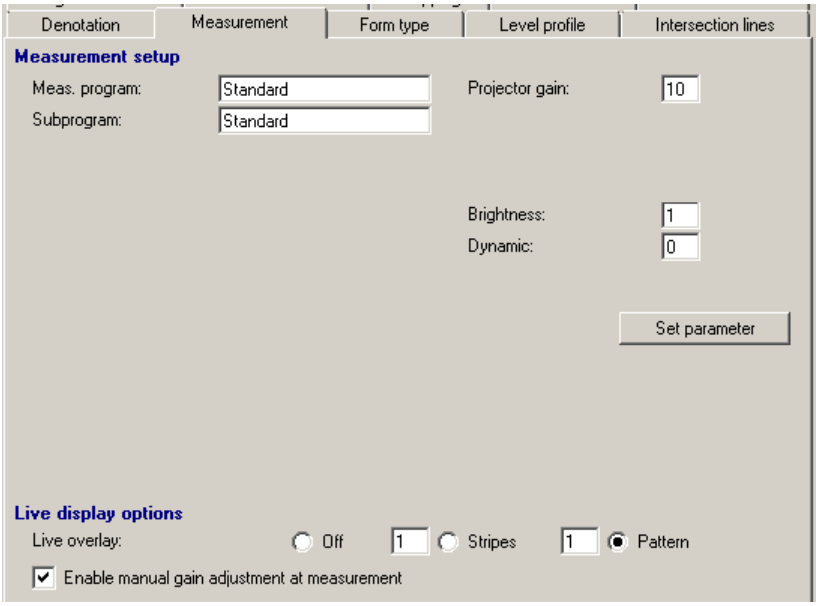


Here the denotations used by the system can be customized, for different sections of the cutting tool contour (upper group) as well as dependent result denotations (lower three groups).

For entries in result denotations, adding an according shortcut is mandatory.

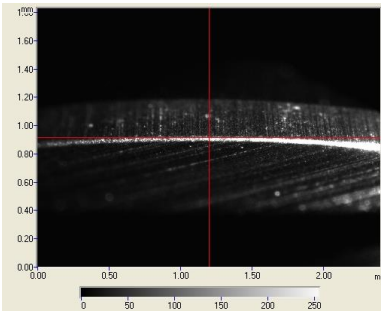
The adjustments here in the measurement program have a higher priority than those made in the basic settings. This enables the creation of measurement programs for exceptional measurements, which require different denotations.

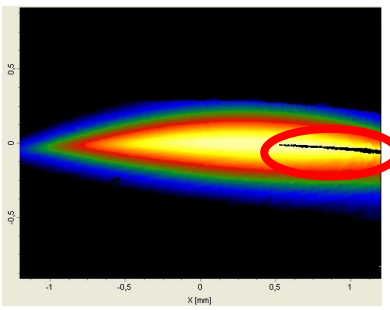
4.5 Measurement

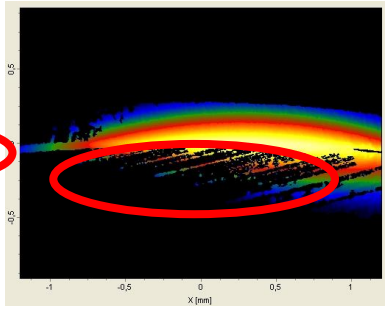


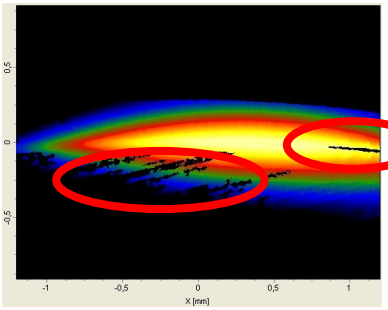
➢ For optimization of the measuring parameters, it is recommended to make some test on the sample and use the optimized parameters for the program.

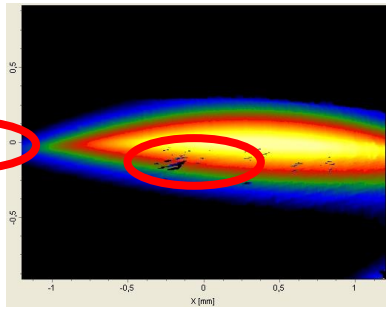
Optimization of parameters for a polished and very shiny milling tool (45° position):

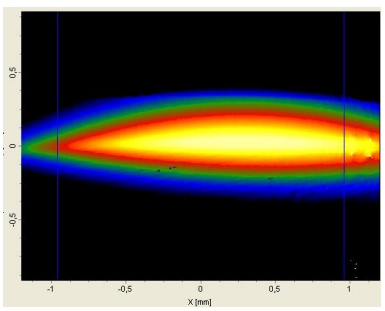

Camera image


Partially to bright


Partially to dark


Dynamic too low


Reflection


Optimal result

Especially for tools with a combination of very smooth surfaces, sharp edges, precipitous flanks and complex geometries, an optimization of parameters is

necessary. If this is done properly, it will later on save time because of a more stable profile acquisition.

Invalid points:

- The program checks the data quality while gathering a 3D profile. If too low, there will be no data in the affected areas (invalid points), to avoid faulty evaluations.
- Reasons for low data quality are:
  - Shadowing
  - Surface partially too dark.
  - Surface partially too bright.
  - Reflections by nearby edges.

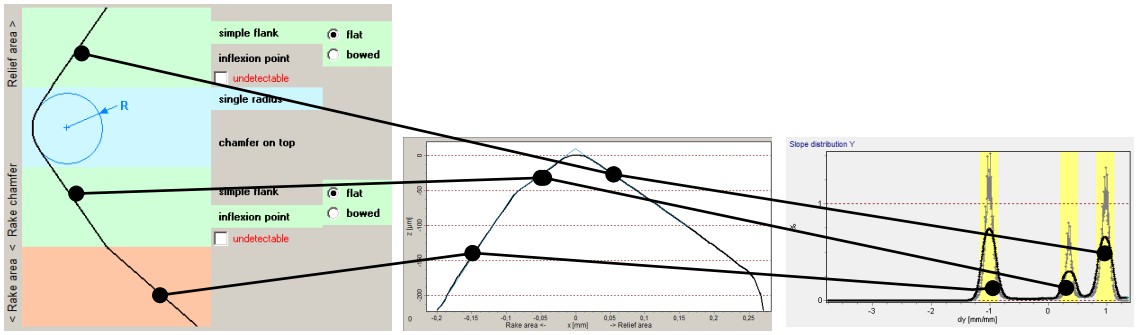
Shadowing:
To avoid shadowing, the cutting edge must be centered horizontally. The sensor must be adjusted upright to the bisecting line of the wedge angle, with little horizontal tilting. A correct alignment will simplify the adjustment of the measuring parameters. Except for samples with shiny flanks and a small wedge angle, a highly precise alignment is not necessary, because the 3D profile will be leveled by mathematical transforms afterwards, so the intersecting lines will always become perpendicular to the cutting edge.

Optimizing the brightness:
By comparison of camera image and color coded 3D profile one can see if areas too bright or too dark have caused invalid areas. The brightness can then be adjusted appropriately. If too bright and too dark regions occur at the same time, the dynamic can be raised up to two steps. As the illuminated area, especially with the zoom-sensor, is much bigger than the field of view of the camera, nearby edges may also be illuminated and disturb the measurement by their reflections. This can be avoided by reducing the illumination field.

4.6 Form type

To correctly evaluate characteristics of a cutting tool, it is necessary to predefine the type of shape. The acquisition of the 3D profile is followed by a slope analysis, where flat areas will show up with identical slope values for each of their points. By comparing profile slope to the adjusted form type it can be ensured that leveling and setting the regions for calculation of radii, angles, etc. is done as defined in the measurement program.

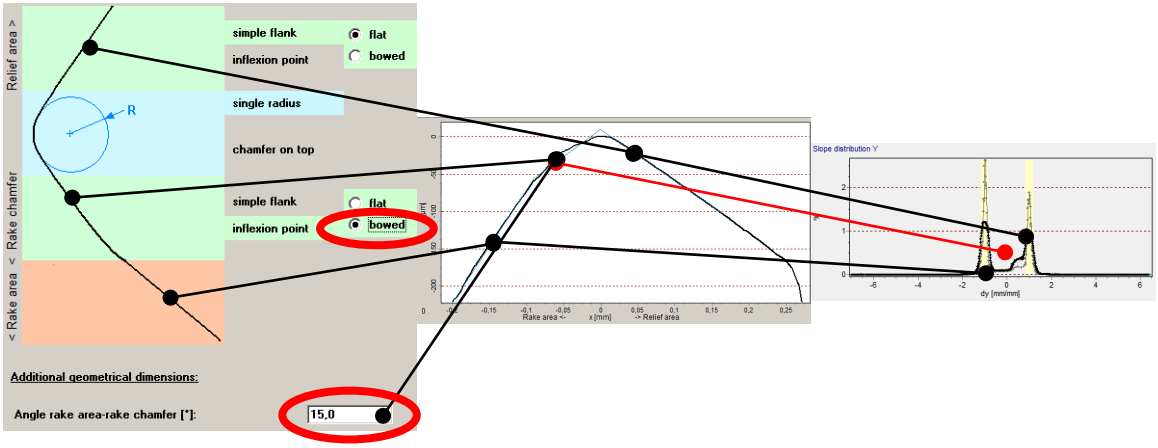
Example 1:
Cutting insert with rake chamfer



In this example, the profile consists of rake area, rake chamfer, radial area and relief area. The rake chamfer and the relief area will be used for leveling.

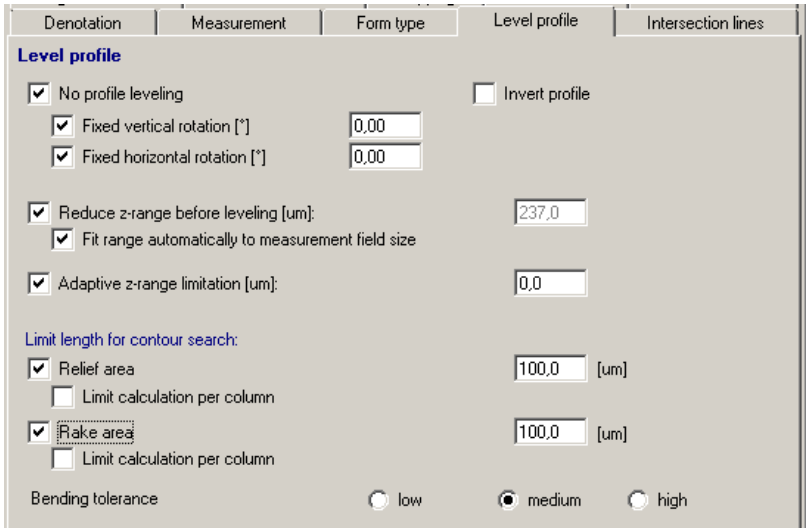
If an area used for leveling is rounded (and therefore not detectable as an area of equal profile slope), it can alternative be evaluated by using a neighboring area as reference. In this case, the angle towards the neighboring area needs to be preset.

Example 2:
Cutting insert with bowed rake chamfer



Same as example 1 except that here the rake chamfer is bowed. The area, where the rake chamfer is located, does not cause a significant peak in the slope distribution and can't be detected automatically. Therefore the rake chamfer is marked ***bowed*** and the angle towards the rake area is adjusted. The system will fit a contour line into the intersecting line using this angle.

4.7 Level profile



No profile leveling:
If the sample position is known (e.g. by using a fixture), the evaluation process can be accelerated by enabling this option. Moreover, an algorithmic imprecision at samples without pronounced flat flank areas can be avoided this way.

If necessary, a specific horizontal and vertical rotation can be set (e.g. if the same fixture is used for different shaped samples).

Invert profile:
This option can be used if replicas or press moulds for cutting inserts are measured.

Reduce z-range before leveling:
In the evaluation region, the z-range can be restricted relative to the cutting edge. Profile regions below of this are excluded from evaluation. With manual focusing, the distance between sensor and sample can vary a little, and the measured length at the flanks of the sample than may also vary, due to the limited height range of the sensor. To avoid influence on the fit regions and the results, the reduce z-range feature leads to a defined height of the area below the cutting edge, that is used for leveling.

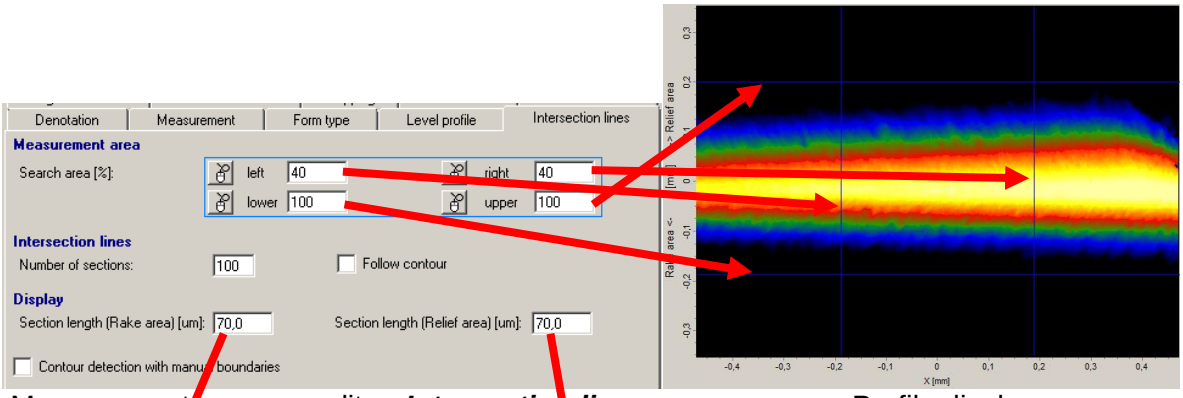
Adaptive z-range limitation:
The adaptive z-range limitation work in the same way as the option ***Reduce z-range before leveling***, with the difference that the limitation is done with respect to the tilting of the cutting edge in x-direction.

Limit length for contour search:
Here the maximum length of the regions used for the calculation of the flanks (regression lines) can be adjusted for rake and relief separately. The regions start at the transition from flank to rounded area (btw. inflection points) and run all along the flanks away from the cutting edge.

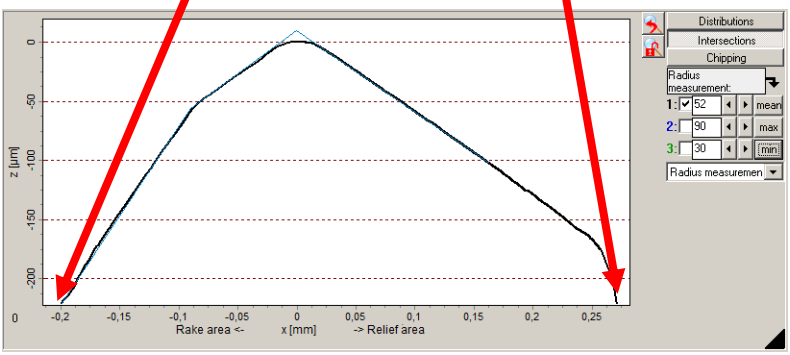
The starting point for each intersecting line can also be calculated separately (instead of a mean value). Attention: this takes a lot more calculation time and is an improvement on rare occasions only.

Bending tolerance:
Here can be adjusted up to which level a slight bending of the flanks will be tolerated.

4.8 Intersection lines



Measurement program editor, ***Intersection lines*** Profile display



Graph display

Limiting the measurement area to the left and right is necessary if the area of interest on the sample is smaller than the measurement field size of the sensor. Limiting the measurement area at the top and the bottom can suppress influences of the surroundings (e.g. a sample holder) that might be affecting the evaluation.

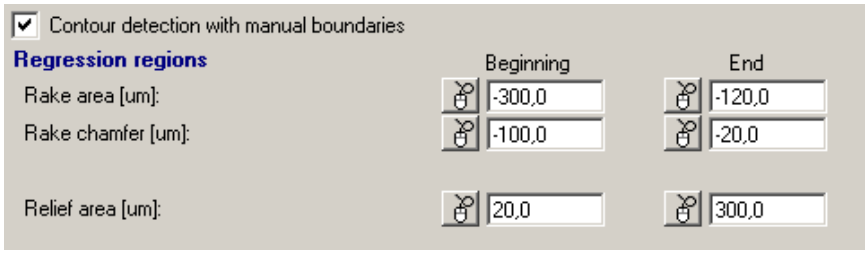
A large number of intersecting line can increase the repetition accuracy of measurements if the results of the single intersecting lines vary a lot (e.g. due to a rough sample surface) and the line positions varies a little bit (in the scale of the surface roughness) due to imprecise sample positioning. In most cases, 100 lines are sufficient. For system tests, 400 are sometimes better. With 1000 lines, they already start to overlap.

With ***Follow contour***, intersecting lines are always perpendicular to the cutting edge, even if it is curved.

Section length adjusts only the graph display proportions and has no influence on the evaluation.

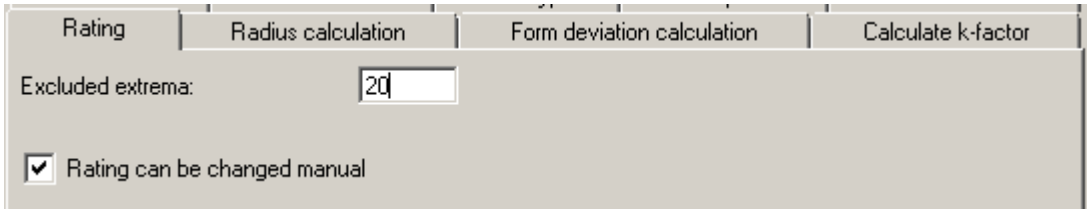
Alternative to an automatic detection of the different contour sections, these sections can be adjusted manually. This is recommended if:

- Some of the contour sections are very small
- Contour sections are rounded
- Surface roughness is very high or nicks occur



The contour sections automatically detected or manually adjusted, will be marked as being used for the calculation of regression lines.

4.9 Rating



Contamination of the cutting edges can cause the measurement results for individual intersecting lines to differ significantly, and therefore greatly affect the mean result, even though there is no influence on the functional behavior of the cutting edge. To prevent this, outliers can be excluded from the averaging.

If the option ***Rating can be changed manual*** is enabled, individual results of intersecting lines can be in- or excluded from the averaging (see 2.2.1.1).

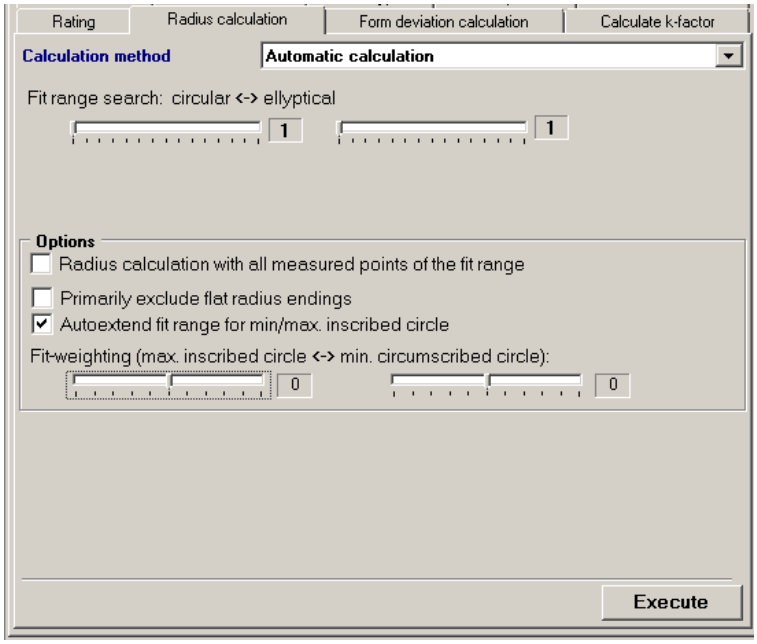
Mode of operation:

- Averaging
- Marking the individual results that differ most from the average result
- New averaging with the marked results excluded

Hint:

- Practically, about 20 % of the adjusted amount of intersecting lines should be set here (100 lines –> 20 outliers, 400 lines -> 80 outliers)
- At system checks or confirmatory measurements on radius references, zero outliers should be set. A good cleaning of the samples is mandatory.

4.10 Radius calculation



There are three ***calculation methods*** available for the radius calculation. They differ in the way they determine the fit region used for the radius calculation.

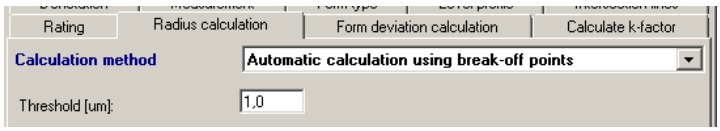
Automatic calculation
With automatic calculation, radii are determined by the following steps:

- Separate the contour into flank – radius region – flank
- Radius calculation
- Exclude contour points with a higher divergence to the calculated radius
- New radius calculation without the outliers

The system automatically evaluates a useful fit region by repeating these steps several times.

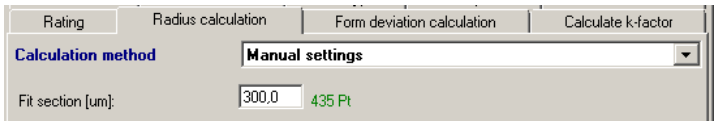
If only strictly circular sections of the contour are part of the fit region, or if more elliptical sections are allowed as well, can be adjusted separately for both sides.

Automatic calculation using break-off points



The fit region begins and ends at locations where the difference between the contour and the contour lines starts to exceed the set ***threshold***.

Manual settings



Here the width of the fit region is set manually. The region will be centered at the intercept point between contour and bisecting line. This method is useful if the other methods don't lead to stable results. This may for example be the case with worn cutting edges, very irregularly rounded edges, or extreme surface roughness.

Options (for all methods):

Radius calculation with all measured points of the fit range
There is no weighting of the contour points. All contour points in the fit range will equally be used for calculating a circle.

If this option is selected, all other options are ineffective.

If it is not selected, a weighting of the points by their distance towards the calculated circle is done. Points which lie outside a predetermined tolerance range are excluded from the calculation.

Primarily exclude flat radius endings
The rating tolerance at the ends of the fit region is set tighter. This leads to a stronger suppression of straight contour sections at both ends of the radius. This option is particularly useful for manually adjusted fit regions.

Autoextend fit range min/max inscribed circle
If this option is enabled, the fit region will automatically widen, the further the controls for fit-weighting are moved from their zero position (max. 20%). This can enhance the effectiveness of the fit-weighting control at some contour shapes, but it is important to ensure that the fit region is not being extended into straight portions of the contour.

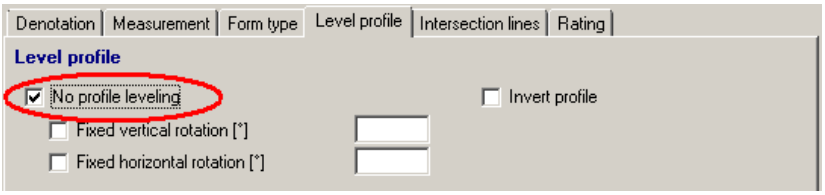
Fit-weighting (max. inscribed circle ↔ min. circumscribed circle)
Here the weighting of the measuring points can be changed in the left and right half of the fit region. This allows an approximation to the envelope or inscribed circle.

4.10.1 Radius calculation with form type ‘Radius without flanks’

If the form type ***Radius without flanks*** is selected, an additional option is available for the radius calculation. The offset between the radius center and the center or sides of the measured object can be calculated.

This option is meant for objects with a rounded side which can be captured to their full width by a single measurement (Upper and lower edge visible in the measured profile are also the edges of the object). At the same time it must be possible to adjust the object in a known orientation (e.g. a holder), because the orientation can’t be evaluated without visible flanks.

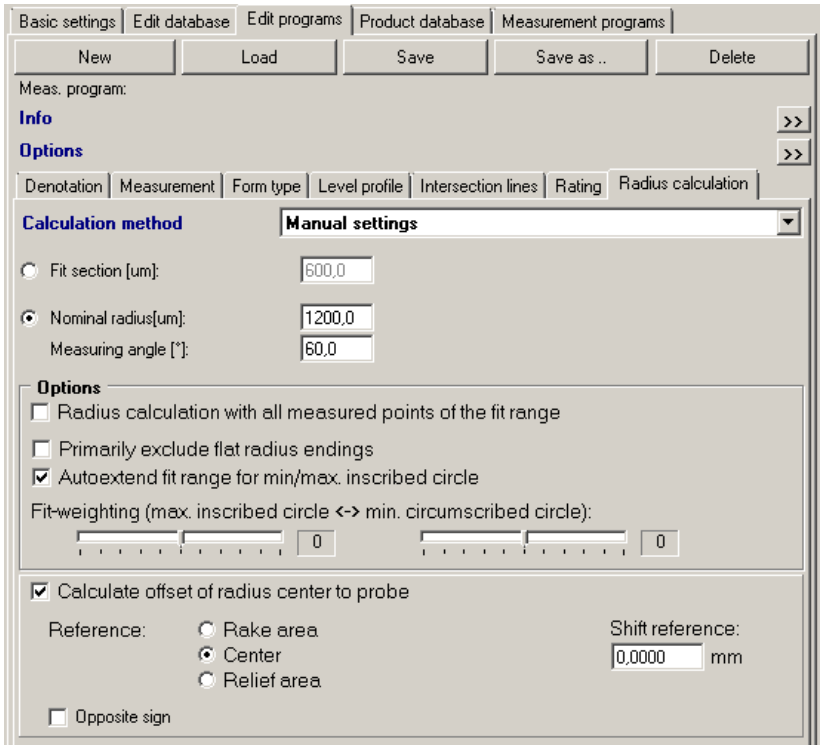
At the tab ***Level profile***, the option ***No profile leveling*** must be activated. Fixed vertical or horizontal rotations may be used.



There are two ***calculation methods*** available, ***Automatic calculation*** and ***Manual settings***. With manual settings, the ***Fit section*** for the calculation of the radius can be manually adjusted. The fit section is positioned symmetrically around the intersection line center.

Alternatively, the fit section can also be adjusted by a ***Nominal radius*** and the ***Measuring angle***. Here a circle with the preset radius is assumed whose center is on the center line of the intersection line (x = 0) and which touches the intersection

line here. The ***Measuring angle*** defines a sector on this circle, symmetrically around the intersection line center, that adds up as fit section.



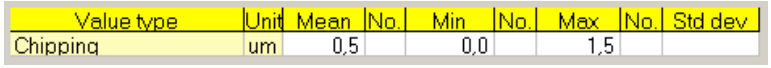
If the offset of the radius center is to be calculated, the option ***Calculate offset of radius center to probe*** must be activated.

Reference determines to which reference the offset will be calculated. With a preset at ***Shift reference***, the chosen reference can be shifted.

By activating the option ***Opposite sign***, the sign of the resulting radius offset can be inverted.

4.11 Chipping calculation

There are two methods of chipping calculation. One is based on an intercepting line along the cutting edge, the other on a delta-r progression. At ***Measuring method***, the calculation method can be selected. ***Execute*** will start the calculation. The result is shown in a table.



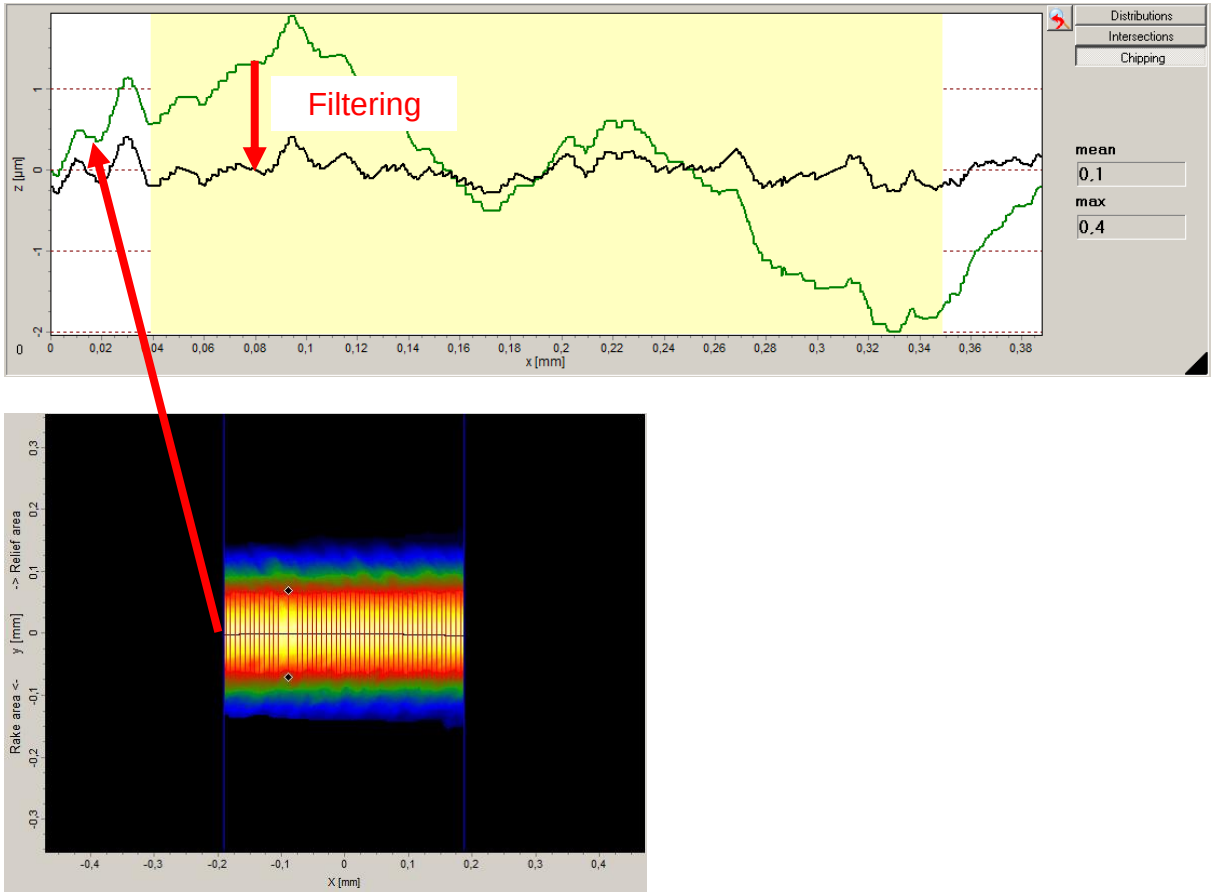
Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
Chipping	um	0,5		0,0		1,5		

Other settings and displays depend on the method chosen.

Calculation along the center cut line

This method of chipping calculation is no standard method, but is based on the average of the Ra calculation. The calculation is performed according to a fixed scheme, there are no further settings required.

The calculation is based on the height values (z) along the cutting edge (center line). The height values are arranged as a curve shown in green.

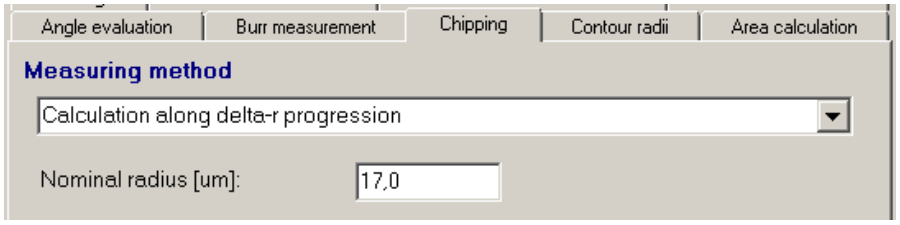


The curve is filtered with a high pass (Lorenz filter, lambda = 10 pixels). This eliminates the basic shape of the cutting edge, as well as inaccuracy in the alignment. The filtered curve is shown in black. 80% of the curve length (evaluation range) can be used to calculate the chipping. 10% on both sides are not used (“cut off”), since artifacts of the filtering could interfere with the calculation.

In the evaluation area, the average height is calculated. (Sum of all Z values / number of values). Next the unsigned deviation of all Z values against the average height is calculated. The average of all deviations gives the average chipping, the highest deviation is the maximum chipping.

The center line is determined in the aligned profile by finding the highest profile points per column along the X axis. In order to suppress fine asperities, noise, etc., a copy of the profile is used that is averaged in the X direction within 31 pixels. The Y values of the resulting center line are replaced by a quadratic polynomial.

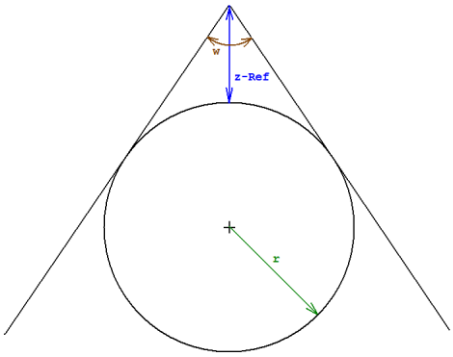
Calculation along delta-r progression



This method of chipping calculation works along the lines of the K-factor calculation. As a preset, the nominal radius of the cutting edge to be measured must be adjusted. From this specification, a reference altitude is computed during the evaluation. With an ideally shaped cutting edge and its nominal radius set, the chipping result would be zero.

The basis for the calculation are the contour lines (regression lines on the flanks at both sides of the cutting edge), which are calculated for all intersecting lines. At least two intersecting lines are necessary.

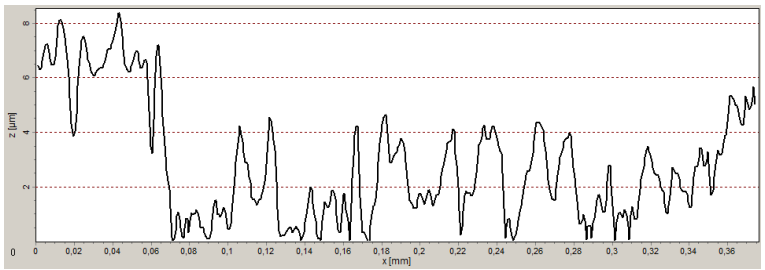
The intercept point of the contour lines is determined for all intersecting lines, and the aperture angle (w) is calculated as an average from all intersecting lines.



The Z reference height (z-Ref) is determined. For this purpose, a circle with the radius I, as specified in the settings, is fitted between two contour lines spanning the average opening angle (w). The Z reference height is the shortest distance between the intercept point of the lines and the circle.

The intercept points of all intersecting lines are connected to form a curve. With linear interpolation, a curve point for each column in the leveled 3D-profile is calculated. For each of these points, the shortest distance (delta-r) to the 3D-profile is sought. The search is performed in each case along an intersecting line or a line, whose direction has been interpolated from the directions of the two neighboring intersecting lines.

Finally the chipping curve is calculated: S_n = | delta-r_n – z-Ref |



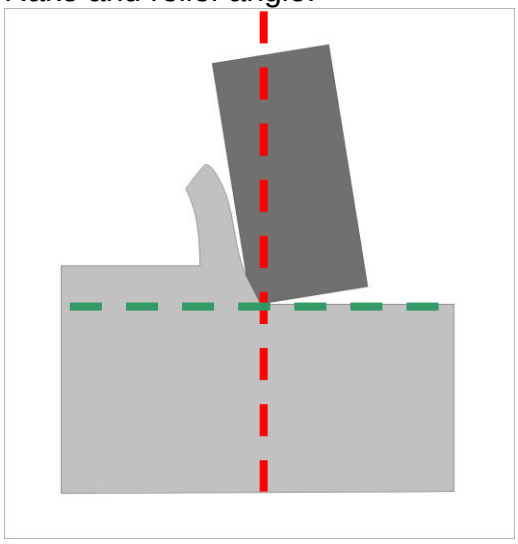
The average of all curve points gives the average chipping, the highest point is the maximum chipping.

4.12 Calculation of angles and chamfer length

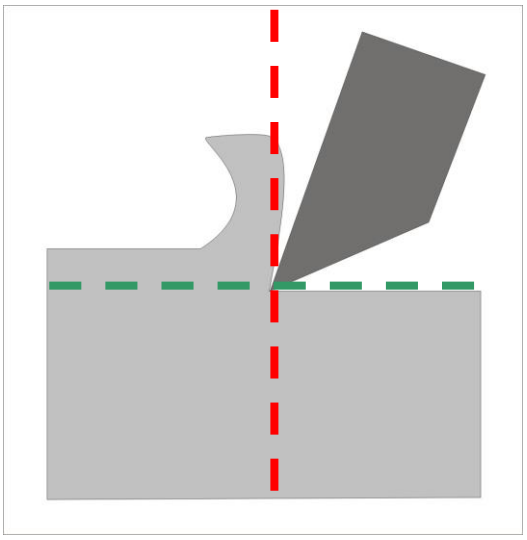
The calculation of angles, in particular, puts very high demands on the measuring system. Therefore, the use of optionally available, certified angle standards is recommended. In order to determine meaningful tolerances, chamfer length, surface roughness and, if present, the rounding of edges should be considered.

Besides the determination of relative angles within the cutting edge geometry, absolute angles (e.g. relief and rake angle) can only be determined if the orientation of the sensor to the sample is fixed in a defined manner and is adjusted in the measurement program.

Rake and relief angle:

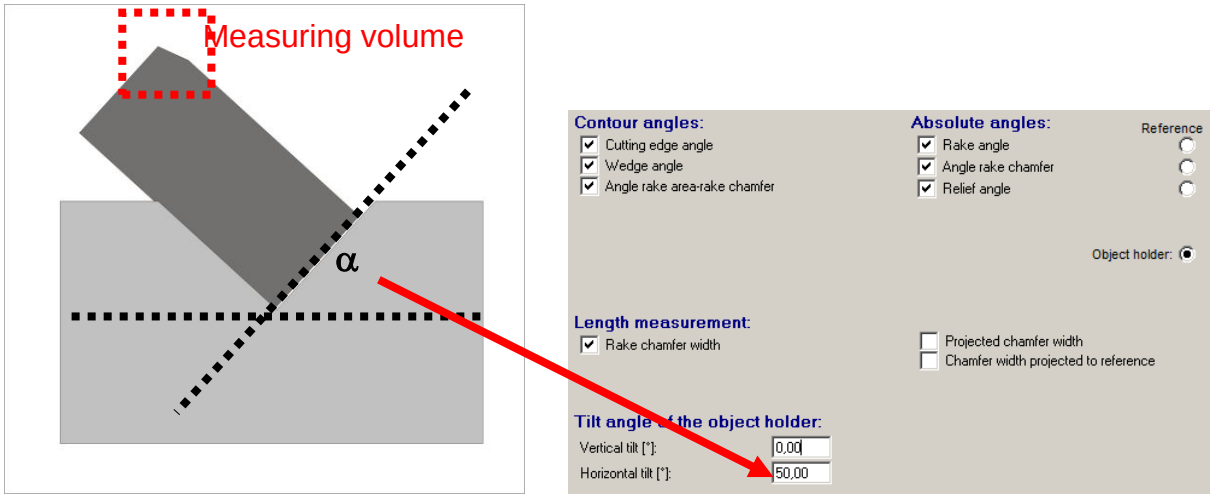


Rake angle negative



Rake angle positive

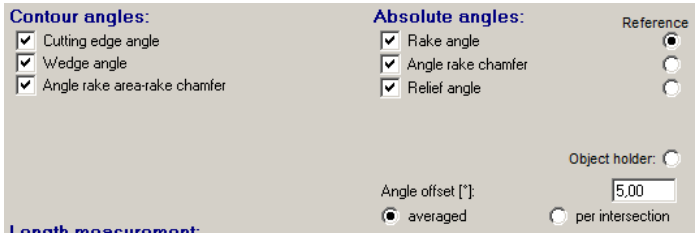
The reference line for the evaluation of the rake angle is marked red, for the relief angle it is green. Rake angles may have negative values.



Orientation towards measurement

For the measurement of relief and rake angles in relation to a sample fixture, the angular orientation of the sample in the fixture must be provided and the option ***Object holder*** enabled.

Another way is to calculate all angles with respect to one part of the cutting edge contour. As ***Reference***, all the available parts of the contour can be used, but it is best to choose a big contour part, safe to be measured.



The angle between this contour part and the corresponding reference line can be set at ***Angle offset***. Furthermore, it can be selected whether this reference is calculated separately for each intersecting line, or whether a mean angle of all lines is to be used as a reference.

Which contour parts are present and therefore which angles and distances can be calculated, depends on the selected form type.

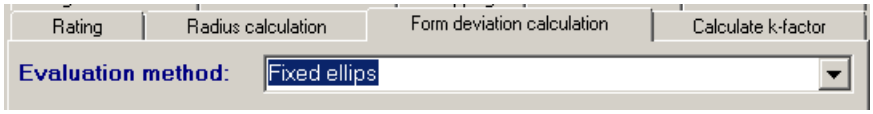
Lengths are determined by the intercept points of the respective regression lines. Rounded regions are not considered.

The results are displayed in tabular form.

Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
Rake angle	°	15,23	10	14,45	96	16,13	48	0,4558
Angle rake chamfer	°	-22,91	79	-23,28	65	-22,57	85	0,1756
Relief angle	°	5,01	92	4,62	1	5,45	59	0,2356
Cutting edge angle	°	107,91	93	107,47	52	108,37	81	0,2269
Angle rake area-rake chamfer	°	38,16	26	37,41	88	38,98	36	0,4995
Wedge angle	°	69,74	20	68,79	50	70,71	83	0,5896
Rake chamfer width	um	88,8	60	84,0	99	94,6	11	2,861

4.13 Form deviation calculation

Form deviations are calculated over an ideal geometry. Different types of ideal geometries can be used. The selection is made at ***Evaluation method***.

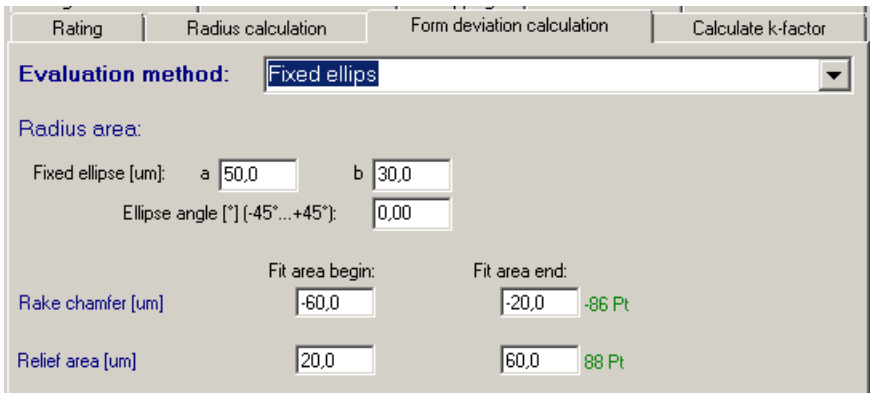


The methods ***Fixed radius*** and ***Fixed ellipse*** use a combination of basic geometrical elements as ideal geometry. For the flanks (rake and relief) straight lines are used, for the rounded section (cutting edge) a circle or ellipse with preset dimensions.

The lines are calculated using a regression method with adjustable ranges on the flanks. A circle or an ellipse with the preset geometry is the connecting piece between the lines inserted, so that a smooth transition occurs.

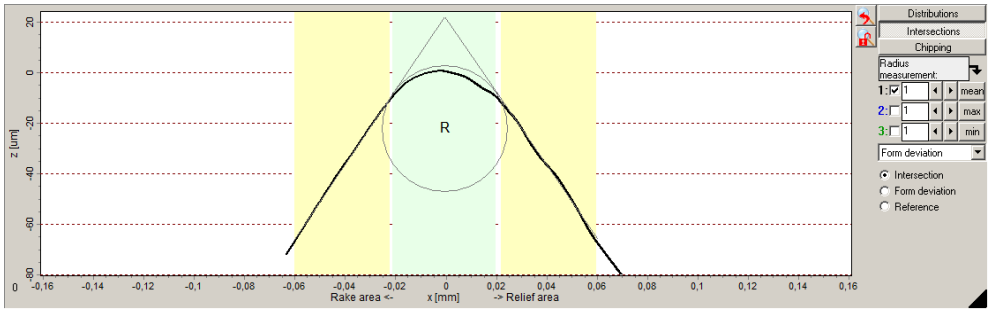
The evaluation method ***Reference intersection lines*** uses an intersecting line as the ideal geometry. This line can be obtained from a cutting edge measurement, or imported from an external source.

4.13.1 Fixed radius, fixed ellipse

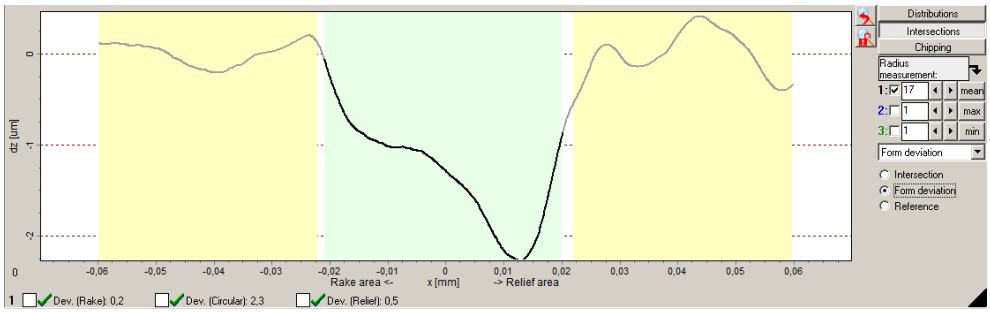


At **Radius area**, the geometry of the ellipse or of the circle to be used is adjusted (the only one radius adjustment).

For the rake and relief sections, the areas used to calculate the regression lines are shown.



These will be highlighted yellow.

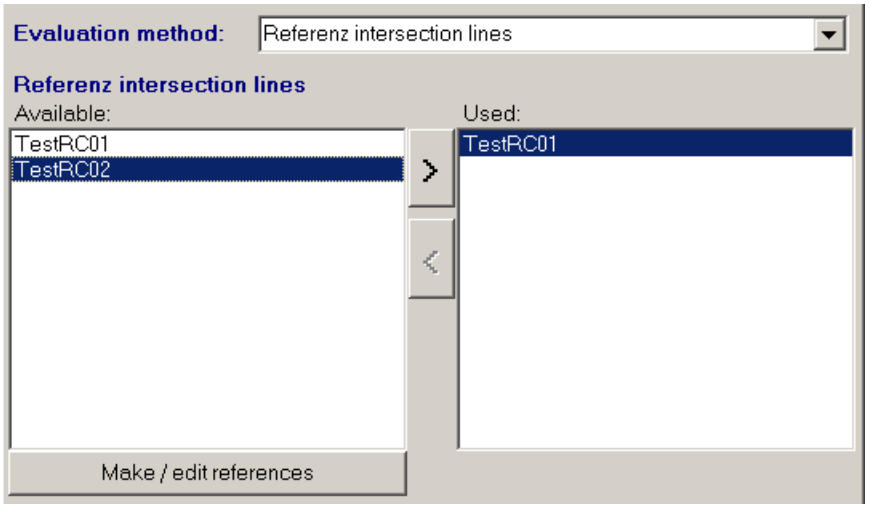


Deviations are calculated perpendicular to the reference curve.

Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
Radius	um	25,0						
Wedge angle	°	69,16	19	68,66	1	69,67	48	0,3099
Deviation (Rake area)	um	0,2	77	0,1	13	0,4	27	0,065
Deviation (Circular area)	um	2,4	71	1,4	31	3,4	3	0,619
Deviation (Relief area)	um	0,5	69	0,2	94	0,8	11	0,151
Deviation	um	2,4	71	1,4	31	3,4	3	0,619

The deviations shown here represent the average of all lines. The deviations are calculated separately for all three sections, as well as for all areas together.

4.13.2 Reference intersection lines



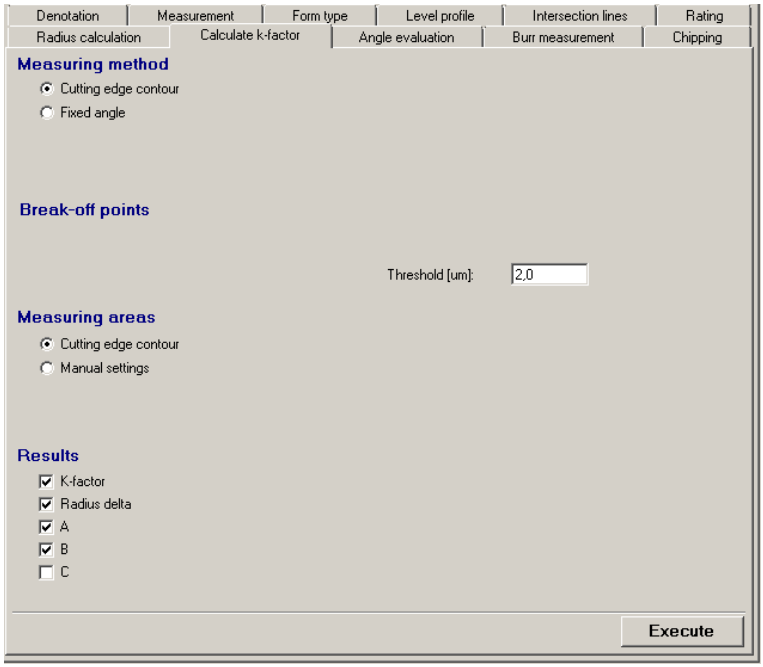
At the left side of the catalog, all available reference intersecting lines can be seen, to the right those selected for the measurement program.
Adding a reference is done by selecting an item to the left and then clicking **>**.
Similarly, a reference can be removed from the list of used references by selecting one to the right and clicking **<**.

Make/edit references will open a dialog to create, delete, modify, and rename reference intersecting lines (see Chapter 7)

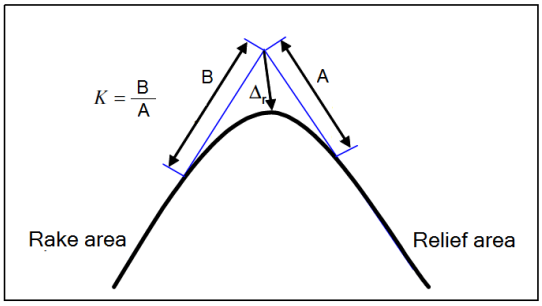
Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
Wedge angle	°	68,74	1	68,28	100	69,62	29	0,3034
Deviation (Rake area)	um	1,6	8	0,7	17	2,9	99	0,570
Deviation (Circular area)	um	1,2	20	0,2	58	2,1	93	0,573
Deviation (Relief area)	um	1,1	45	0,4	57	2,0	12	0,443
Deviation	um	1,7	40	0,8	56	2,9	99	0,549
Ref: TestRC01		0,75						
2.Ref: TestRC02		20,95						
3.Ref:								

In addition to the results which are also obtained for the other evaluation methods, here the three best matching reference intersecting lines are shown (***Ref***, ***Ref 2*** and ***Ref 3***). This dimension-less value is a measure for the “fit”. The smaller the value, the better the reference intersecting line fits. For analysis, the most suitable (***Ref***) is used.

4.14 Evaluation of asymmetric edges, k–factor



With the k-factor, asymmetrically rounded edges can be evaluated.



Calculation follows the steps listed below:

- Calculation of regression lines at the flanks
- Calculation of the intercept point of the lines
- Calculation of the cutoff-point from the intersecting line for both lines
- Evaluation of the Distances A and B between the cutoff-points and the intercept point
- Evaluation of the k-factor as the coefficient of the two distances
- Besides the k-factor, Δr is calculated as the smallest distance between the intercept point and the intersecting line in the radius region

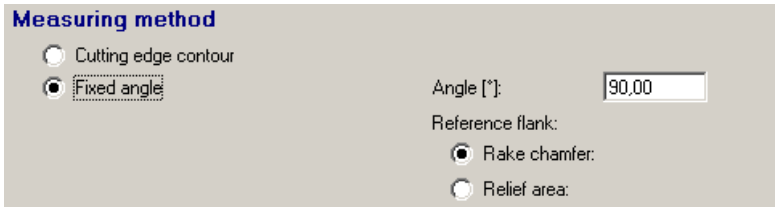
Limitations for the k-factor:

The calculation of the transition point between flank and radius region is hampered by the following:

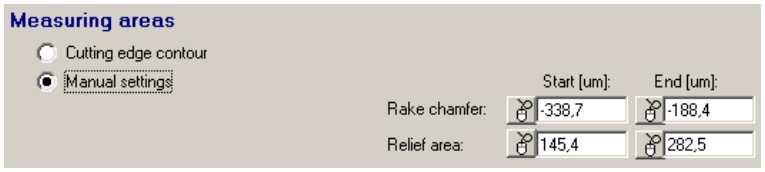
- Surface roughness too big to be ignored
- Before the actual radius region there is a transition region caused by the rounding process
- The required point density is no longer granted at radii below 10 µm

The limit used for the calculation of the cutoff-points can be adjusted.

It is possible to calculate a k-factor at a predetermined angle. Which edge is used as a reference, can be set.



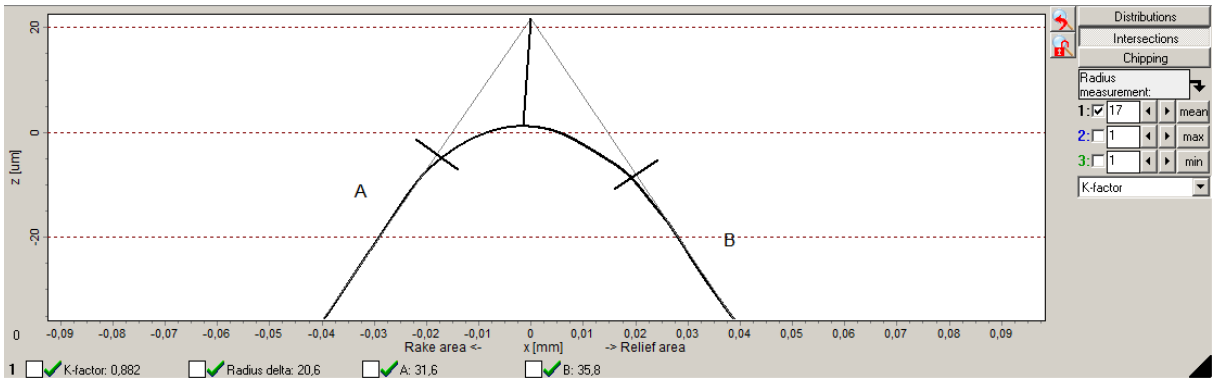
The areas in which the regression lines are calculated on the flanks can also be set manually. This will lead to a better fit between the contour lines and the intersecting line in the region where the K-factor is calculated, even if the flanks are generally curved, or shaped irregularly.



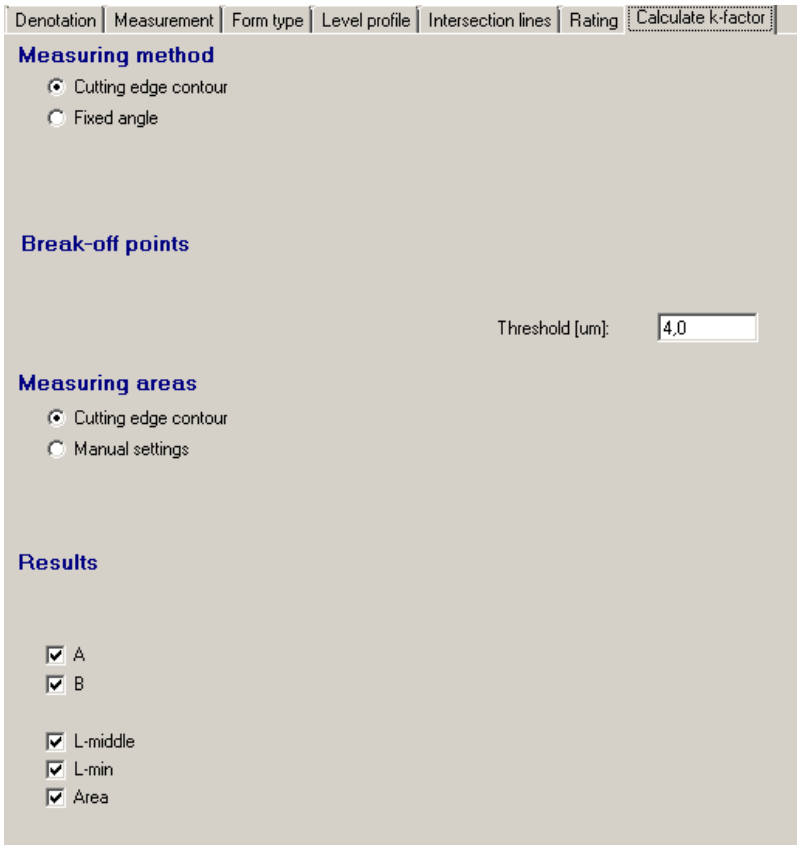
Which result values are to be calculated can be selected at ***Results***.

The results are displayed as a table and inserted in the graph display.

Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
K-factor		0,849	79	0,797	93	0,906	68	0,03481
Radius delta	um	21,7	70	19,7	36	23,5	91	1,009
A	um	32,0	15	30,4	29	33,5	1	0,830
B	um	38,0	42	34,4	24	40,7	87	1,742

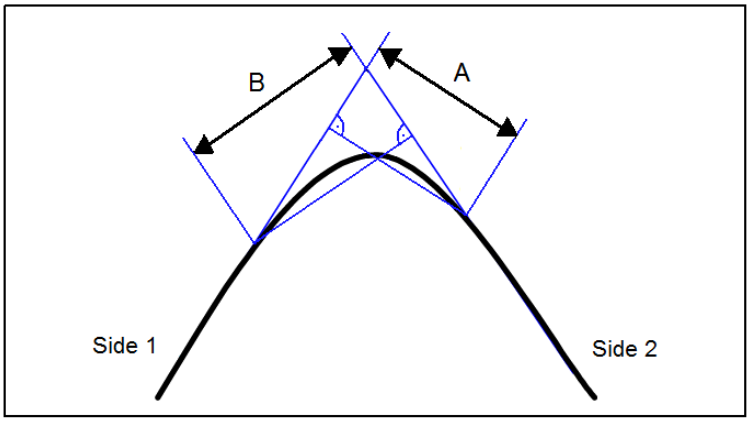


4.14.1 K-factor with option DIN ISO 13715

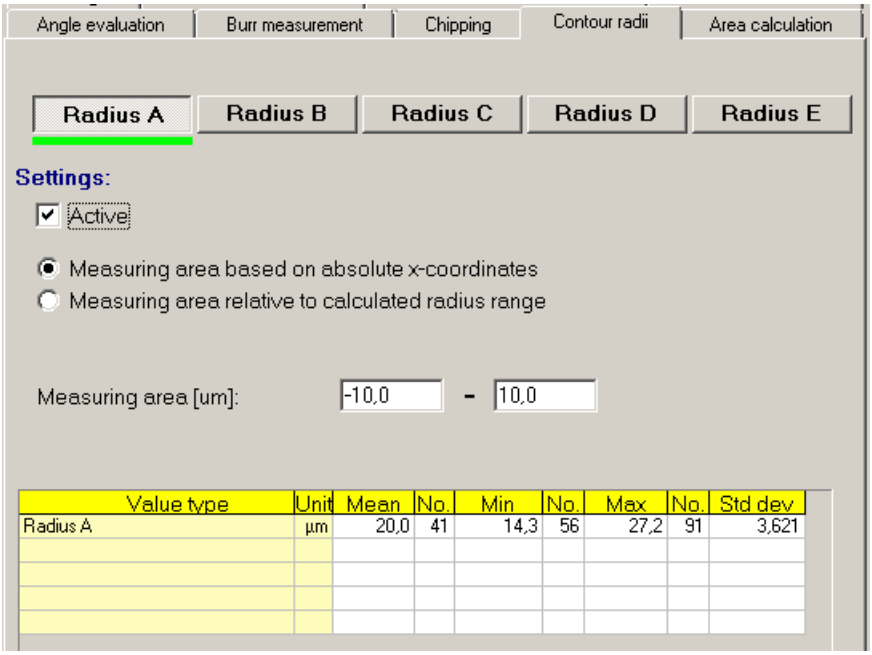


If the option ***Bending edge rounding according to DIN ISO 13715*** is enabled, the k-factor will not be fully calculated. The values A; B; Area; L-min and L-middle will be calculated. The area lies between the extended flanks and the contour. L-min is the shortest distance between the flank intersection point and the contour. L-middle is the distance between flank intersection point and the point on the bisecting line of the flanks.

Different to the normal k-factor calculation, where A and B are the distances between the intersection point of the flanks and the two break-off points, here A and B are the normal distances to the opposite flanks. In this way A and B represent values as used for dimensioning curved edges (e.g. bending edges) according to DIN ISO 13715.


B
A
Side 1
Side 2

4.15 Contour radii



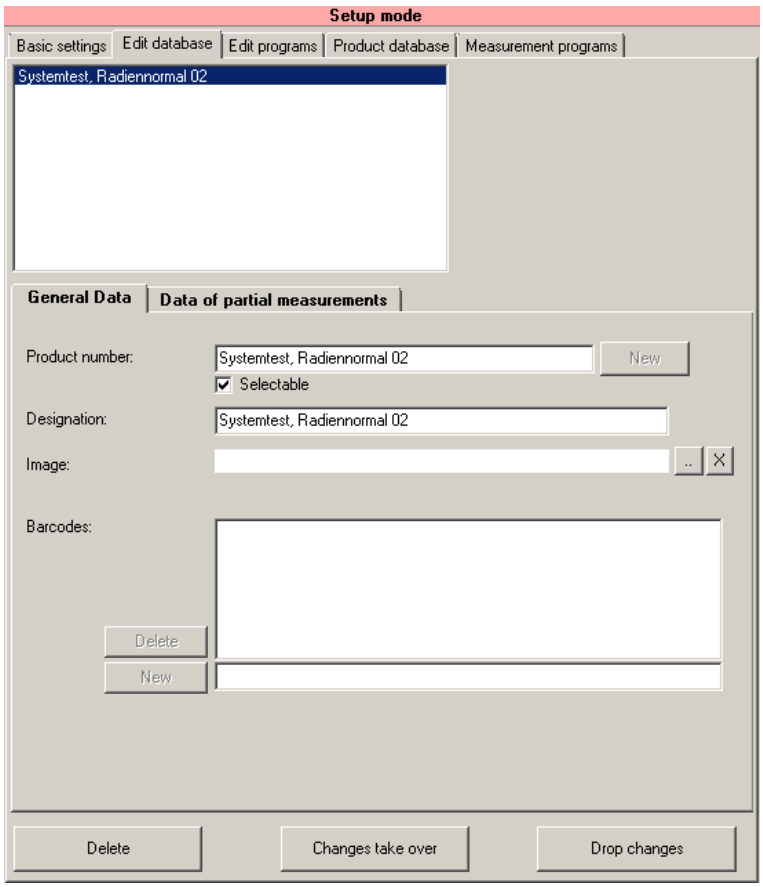
With this function radii can be evaluated for up to 5 arbitrary areas on the intersecting line. The buttons ***Radius A…E*** select which of the 5 areas are to be edited. Only areas where ***Active*** is checked will be evaluated. Green bars below the buttons show which areas are activated.

The location of the areas can be specified absolute or relative to a determined radius fit region (it presupposes, that the radius computation has been done).

5 Edit database

On this page, data sets for the various types of samples are created. These data sets contain nominal values and tolerances for the rating of measurement results, the name of the measurement program to be used, and the settings which result values are to be calculated.

The data sets are used for the selection of a measurement process in ***Product database*** (see 1.3).

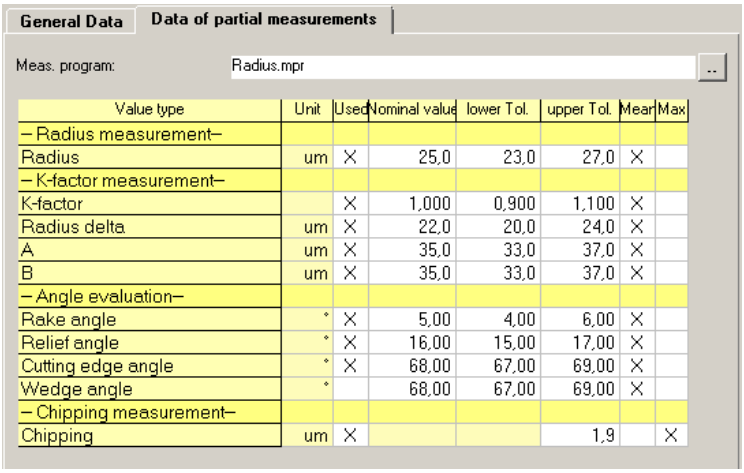


Basic controls

Selection list (upper left)	Shows all available entries. By clicking on a list entry, a data set can be selected. The content of the data set is then displayed in the input fields below and can be changed.
Delete	Deletes the currently selected data set.
Changes take over	Save changes in the currently selected data set.
Drop changes	Delete all just entered changes (not the saved data).

General data

Product number	Name of the sample type represented by this data set. The name is also the file name of the data set. If the name of an existing data set is entered, it will be marked in the selection list. All other input fields will stay unaffected.
Selectable	If checked, the data set will be visible in the selection list at ***Product database***.
New	Create a new data set with the name entered at ***Product number***. It will only work if there is not jet a data set with this name. The message appears that no measuring program is assigned to the database.
Designation	Space for additional information.
Image	Name of the image that will be show to the right of the selection list at ***Product database***. It may e.g. show where to measure or how to position the sample. The image must be located in the data base folder.
..	Opens a dialog to select an image (bitmap,150x100 pixel)
✕	Deletes the image selection
Barcodes	At ***Barcodes***, one or more barcodes can be added. Barcodes can be used to simplify the selection of database entries before running an automatic process (see chapter 9). With the ***Delete*** button beneath the list, a barcode selected in the list can be removed. With the ***New*** button beneath the list, a barcode entered in the field beneath can be added to the list.



Value type	Unit	Used	Nominal value	lower Tol.	upper Tol.	Mean	Max
– Radius measurement–							
Radius	um	X	25,0	23,0	27,0	X	
– K-factor measurement–							
K-factor		X	1,000	0,900	1,100	X	
Radius delta	um	X	22,0	20,0	24,0	X	
A	um	X	35,0	33,0	37,0	X	
B	um	X	35,0	33,0	37,0	X	
– Angle evaluation–							
Rake angle	°	X	5,00	4,00	6,00	X	
Relief angle	°	X	16,00	15,00	17,00	X	
Cutting edge angle	°	X	68,00	67,00	69,00	X	
Wedge angle	°		68,00	67,00	69,00	X	
– Chipping measurement–							
Chipping	um	X			1,9		X

Data of partial measurements

Meas. Program	Name of the measurement program to be used, The measurement program must be located in the measurement program folder as set in the basic settings.
..	Opens a dialog to select a measurement program.
Used.	If checked, this result value will be calculated
Nominal value	Nominal value for this result value.
Lower Tol.	Lower limit for this result value.
Upper Tol.	Upper limit for this result value.

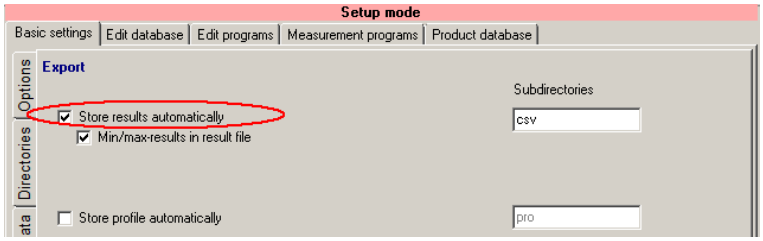
Mean	The average value will be rated
Max	The minimum and maximum value will be rated

6 Create batch files

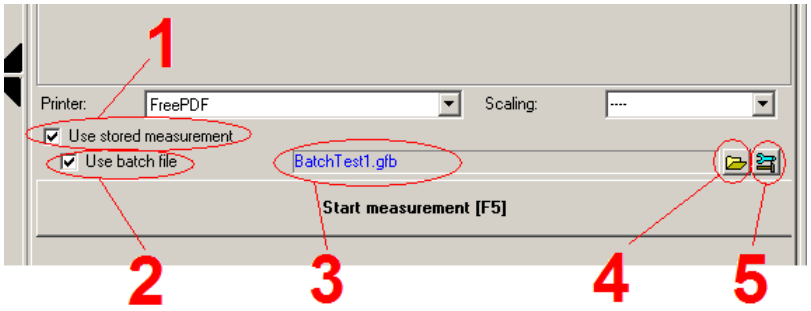
Lists of files can created and evaluated automatically. The function can be divided into two areas, on one hand in the execution of batch files, on the other hand in the creation of batch files (lists of files to be processed).

Executing batch files:

In order to make the results of the evaluation accessible afterwards, storing the results has to be enabled in the basic settings.



Batch files are executed at ***Measurement programs***.



1: If checked, only stored 3D profiles will be evaluated. If (2) is not checked, ***Start measurement*** will start a normal evaluation process with a file-open-dialog showing up instead of measuring a sample.
2: If checked, ***Start measurement*** will start the evaluation of all 3D-profiles listed in the batch file with the name shown at (3).
3: Currently chosen batch file.
4: Click at to select a batch file. (file-open-dialog)
5: Click at to create or edit a batch file (see next paragraph)

Edit or create a batch file:

Batch files are created or modified in the dialog shown below. If this dialog is opened, it displays the currently selected batch file (or an empty file if nothing was selected) . Batch files contain a list of file names, including paths. There are basically two different types of paths, relative and absolute.

Relative paths do not contain a drive specification and describe the location at which a measurement file is relative to the location where the batch file is stored.

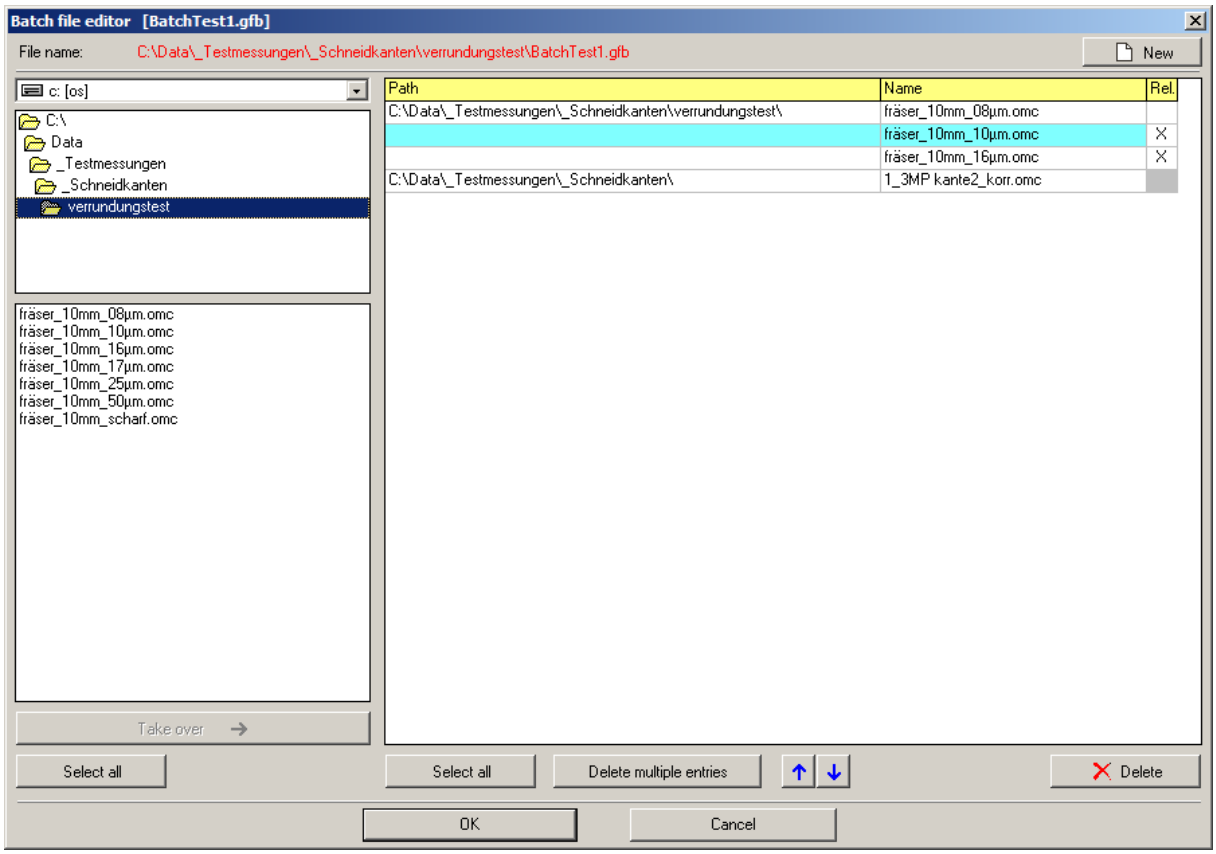
Absolute paths are full paths including a drive specification and describing the location of a measurement file completely, no matter where the batch file is located.

Relative paths are only possible for measurement files being in the same directory as the batch file, or in a subdirectory of the same. When using relative paths, the directory in which the batch file is located can be moved or renamed as desired,

along with the measurement files contained therein. The batch file remains executable.

Absolute paths to the measurement files can be at any location. Moving the batch file has no effect on their function. Moving or renaming the measurement files in contrast lead to the fact that they will no longer be found.

Mixed operation with relative and absolute paths is possible.



Handling of the dialog:
On top of the dialog path and name of the currently open batch file will be displayed. Red font indicates that changes to the file have not been saved. (A file will be saved when the dialog is closed with ***OK***).

With the ***New*** button to the right, a new file can be created or an existing one be opened for changes. A file-save-dialog will pop up. For creating a new file, select the desired directory and enter the desired name. The file extension ".Gfb" is always added automatically. To modify an existing file, select a file.

On the left side of the Dialog, files to be included in the batch file (right side of the dialog) can be selected. Multiple selections are possible, with ***Select all*** under the file selector, all files in the current directory will be selected. With ***Take over***, the selected files are copied to the batch file. Individual files can be copied by a double-click in the file selection list.

On the right side, the content of the batch file is displayed. Lines in red indicate that the measurement file listed here can't be found.

The right column shows whether a measurement file is to be searched by a relative or absolute path ("X " = relative). Switching between relative and absolute path is

done by clicking at the table element. A gray chart element indicates that the measurement file is stored at a location to which no relative path is possible.

By clicking the first or second column, lines of the batch file can be selected. Multiple selection is possible (using [Shift] and [Ctrl] as usual for Windows), ***Select all*** below the chart will select all rows.

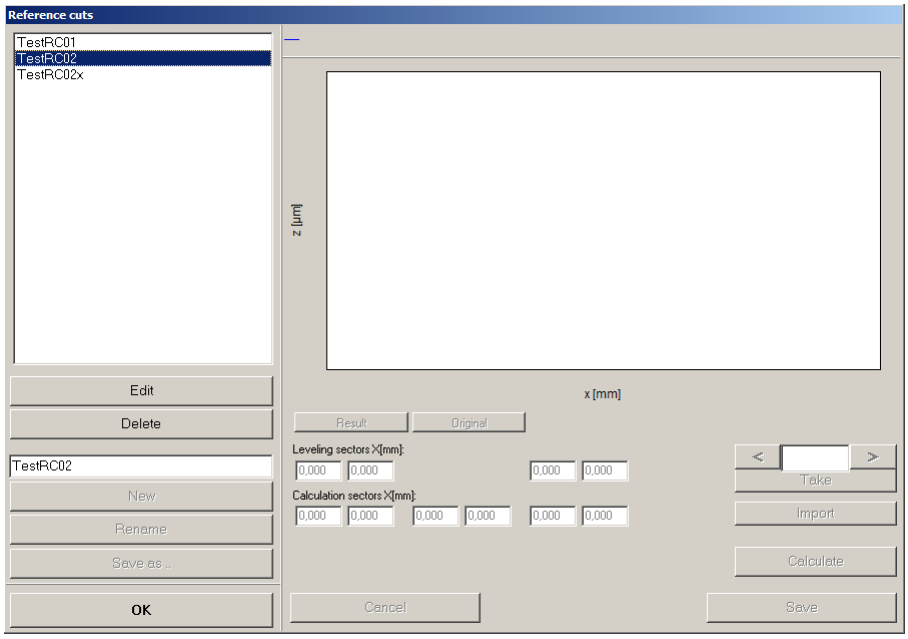
Delete will remove the selected rows, the arrow buttons will move them up or down.

Delete multiple entries will automatically reduce multiple entries of measurement files to a single one.

If the dialog is closed with ***OK***, the changes will be saved.

If the dialog is closed with ***Cancel***, all changes are discarded. Everything will be as it was before opening the dialog.

7 Create, edit, manage reference cuts



The reference cuts dialog is divided into two functional units. The left part is used to manage the catalog of reference intersecting lines, the right part for creating and editing of reference intersecting lines.

Managing functions (left side):

Create new reference intersecting lines

- Enter name of the new reference intersecting line into the input field
- Click at ***New***
- Create a new reference intersecting line at the right side of the dialog
- When the inputs at the right side are finished with ***Save***, the new reference intersecting line will appear in the catalog
- When the inputs at the right side are finished with ***Cancel***, the catalog will stay unchanged.

Edit a reference intersecting line

- Select a reference intersecting line in the list
- Click at ***Edit***
- Edit the reference intersecting line at the right side of the dialog
- When the inputs at the right side are finished with ***Save***, the reference intersecting line in the catalog will be replaced with the changed one
- When the inputs at the right side are finished with ***Cancel***, the reference intersecting line in the catalog will stay unchanged

Delete a reference intersecting line

- Select a reference intersecting line in the list
- Click at ***Delete***
- A request about deleting it appears. ***Yes*** will delete the reference intersecting line.

Rename a reference intersecting line

- Select a reference intersecting line in the list
- Enter the new name into the input field
- Click at ***Rename***
- The catalog entry gets the new name

Create a copy of a reference intersecting line with a new name

- Select a reference intersecting line in the list
- Enter the new name into the input field
- Click ***Save as***
- A copy of the reference intersecting line will appear in the catalog with the new name

Creating and editing reference intersecting line (right side):

Reference intersecting lines consist of three information units:

1) The reference intersecting line itself, consisting of a certain amount of x-y-values.
2) Reference coordinates. These define the location of the reference intersecting line in relation to the measured intersecting line at calculations. The intercept point of the contour line is used as lateral reference, the bisecting line (always vertical) is used as rotational reference.
3) Presetting of the three evaluation regions (left flank, radius region, right flank) in which the form deviation will be calculated.

➔ If a new reference line should be produced, then an intersecting line must exist which can be used as the basis. This can be in the form of a text file or in the form of a previously executed evaluation.
Text files must contain a number of pairs of x-y-values, which represent the contour of a cut line. They serve as a way to import desired contours of other programs (e.g. CAD systems).
In order to use cut lines from a measurement of the cutting edge software, an evaluation (with measured or loaded data) must be executed prior to opening the reference cuts dialogue, so that intersecting lines are present. In the measuring program editor, it is enough to just run ***Intersection lines***. The reference cuts dialog can then access these intersecting lines.

Editing an existing reference intersecting line:
At an existing reference intersecting line, only the three evaluation regions can be changed (see paragraph C „*Adjusting the evaluation regions*“)

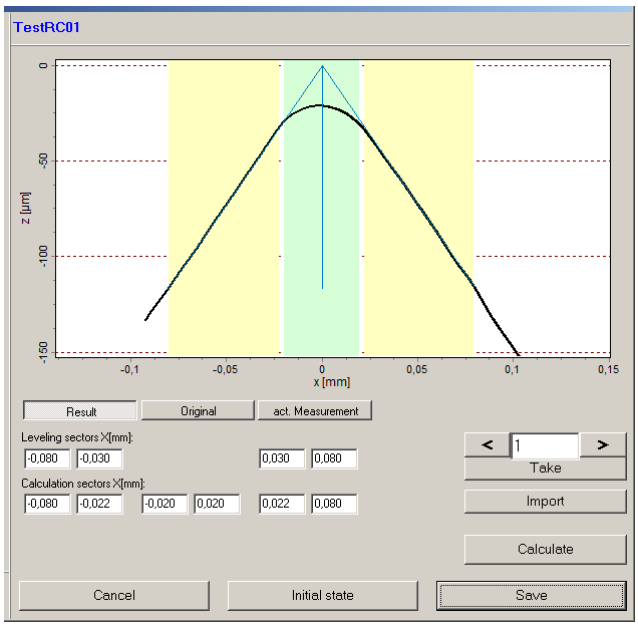
It is possible, even with a reference intersecting line opened for editing, to import a new intersecting line or take one from prior evaluation. This corresponds, however, to the creation of a new reference intersecting line under the existing name.

Creating a new reference intersecting line:

A) Select the intersecting line which is to be the basis for the reference intersecting line.

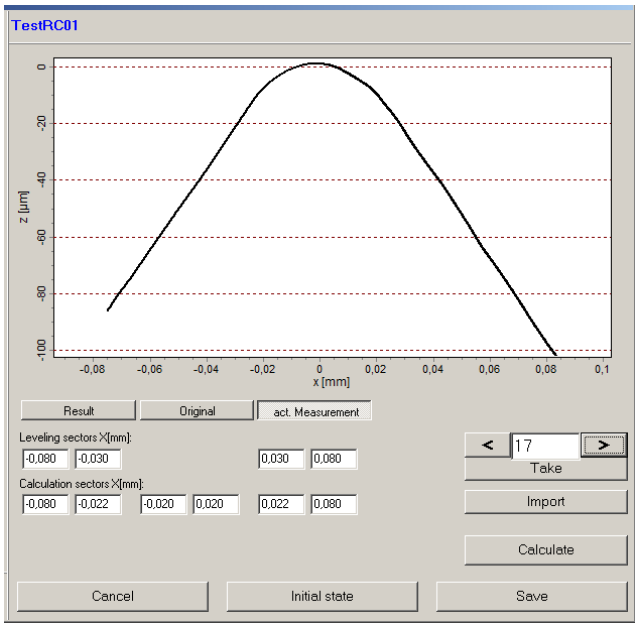
After the function ***New*** has been clicked at the left side of the dialog, the reference intersecting line currently selected in the catalog is shown at the right side of the dialog. When creating the first reference intersecting line (empty catalog), nothing is displayed and all input fields are set to 0.0. By selecting a “similar” reference intersecting line, the settings for alignment and calculation may be filled with useful values.

Changes will be saved under the new name, the reference intersecting line currently selected in the catalog remains unchanged.



To select a intersecting line from a measurement, click at ***act. Measurement***. One intersecting line of the measurement is displayed.

➔ If the Button ***act. Measurement*** is not visible, there are no intersecting lines available (no measurement done).



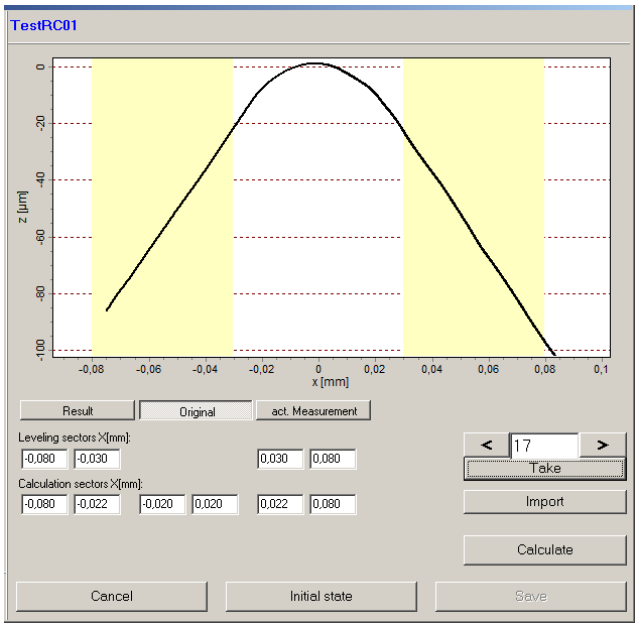
By clicking on **<** and **>** or by entering a number a certain intersecting line can be selected from the measurement. With ***Take*** the intersecting line is taken as the basis

for generating a reference intersecting line. The display changes to ***Original***, the operation continues with section *B)*.

To import a contour from an ASCII-file (text file) click ***Import***. A file open dialog will appear, in which the desired file can be selected. After acknowledging the selection the ASCII-import-dialog opens (see Chapter 8), in which the file is read. After termination of the dialogue the display changes to ***Original***, the operation will continue with Section *B)*.

B) Adjusting leveling regions and reference intersecting line calculation

To display the primary intersecting line click ***Original***. The intersecting line imported or taken from a measurement will be shown.



With the input fields at ***Leveling sections***, regions serving as the basis for the calculation of regression lines can be set, for both sides. The regions set are highlighted yellow.

When the regions are set, ***Calculate*** will start the calculation of the reference intersecting line.

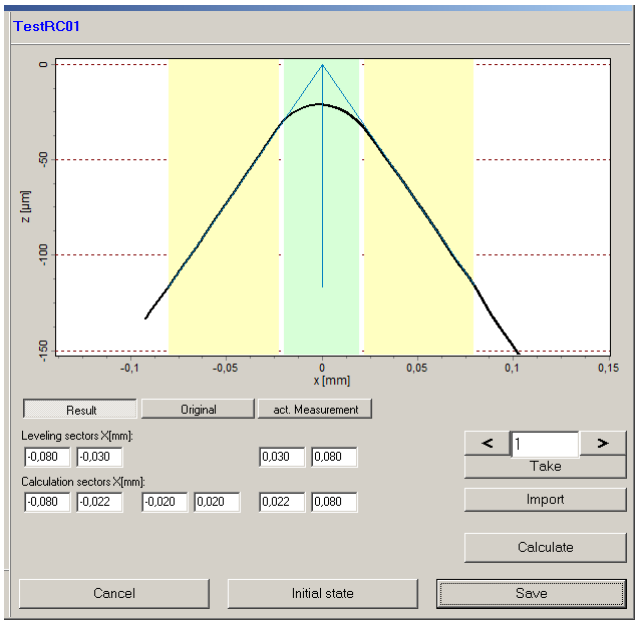
The regression lines are calculated and their intercept point as well as their bisecting line is determined. The intersecting line is oriented so that the bisecting line is perpendicular at x = 0.0.

The set regions for leveling are only used for this calculation. They are not relevant for the further use of the reference intersecting line.

After calculation has finished the display changes to ***Result***, and the operation will continue with Section *C)*.

C) Adjusting the evaluation regions

To display the calculated reference intersecting line, click ***Result***.



With the input fields at ***Calculation sections***, regions for both flanks and the radius section can be set. At the later use of the reference intersecting line, these are the regions in which the deviation to the intersecting lines will be calculated. The region must not overlap.

The regions set are highlighted yellow (flanks) and green (radius section) on the display.

Finally, with ***Save*** the reference intersecting line will be stored in the catalog.

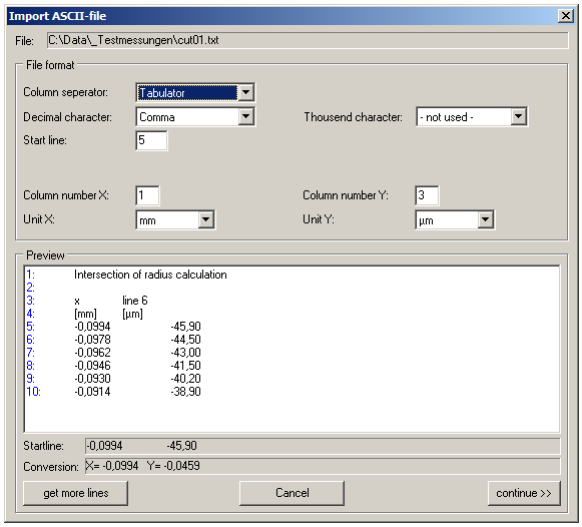
8 ASCII import dialog

With the ASCII import dialog, two-dimensional curves (nominal contours, intersecting lines, etc.) are read from text based files (ASCII files) and converted into a compatible format for the cutting tools software. Therefore the ASCII file must contain a number of x-y-coordinate pairs. Each pair of coordinates results in a curve point. The file must meet the following requirements:

- Tabular structure with a column for X values and a column for Y values. I.e. one pair of values per line.
- All columns must be separated by a uniform delimiter (space, semicolon, tab or comma).
- All values must use a uniform decimal marker (comma or period).
- Thousands markers are optional. If used, they must be uniform for all values and different from the decimal marker (comma, period, or none).
- X- and y-values may have different units (m, cm, mm, µm).
- There may be more than 2 columns, the order is irrelevant.
- The file may have header lines (text without values).
- There are no continuous X increments necessary.
- The order of the value pairs is irrelevant.
- Rows within or behind the table of values which contain no value pairs are skipped and displayed as not readable lines.

Handling of the dialog:

1) Adjusting the file format



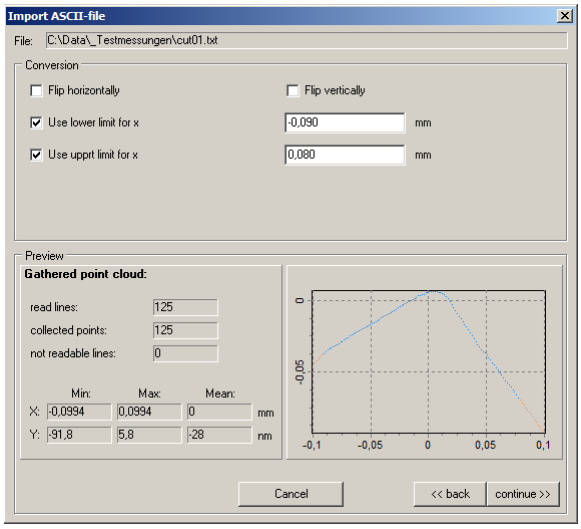
When opening the first 10 lines of the file can be seen in the preview. If this is not enough, more lines can be displayed with ***get more lines***. The blue line numbers shown in the preview are line numbers used by the dialog, they are not derived from the file read.

In the section ***file format***, the format of the file to be read is set. The functionality of these settings is automatically tested and displayed in the preview section. At ***Startline***, the contents of the line set as start line is displayed as it is in the file. At **Conversion** is displayed how this line is interpreted by the dialog. With proper format

setting the values for X and Y are displayed in millimeters (see picture). With wrong format settings, the values are either not what they are in the original line, or a message in red appears, if converting the line is impossible.

When the adjustments are done, reading can be started with ***continue*** (for large files this may take a moment).

2) Adjusting the options for conversion

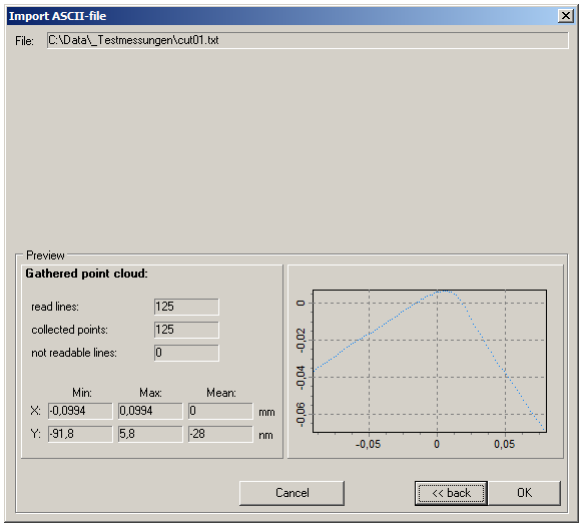


If the file has been completely read, a graphic display of the curve read appears in preview, along with some statistical information.

In the section ***Conversion***, options are available to adjust the curve. The curve can be mirrored horizontally or vertically. In addition, the curve can be cut in the X direction on both sides. The effects of this are instantly displayed in the preview. The original curve is shown red, the altered curve blue.

When the adjustments are done, proceed to the next step with ***continue***

3) Finishing the import



Here again the resulting curve is shown alone in the preview. When it is correct, then close the dialog with ***OK***.

9 Using a barcode scanner

By using a barcode scanner, the selection of measurement programs or database entries can be simplified. The barcode scanning is fast and avoids input errors. The selection lists for measurement programs or database entries are reduced to the entries matching the respective barcode. Especially with a large number of possible entries existing, this reduction is a substantial convenience. Supposed, of course, that part identification with barcodes is available.

9.1 Barcode input in a measurement process

For barcode input in measuring process, the input field below the select list is used. The following input methods are possible:

- **Input with a barcode scanner, that encloses the barcode with markers.**
  Here, the system automatically detects that a barcode has been scanned. The barcode is displayed and the selection list adjusted.
- **Input with a barcode scanner without markers.**
  Care must be taken that the input field for the barcode is empty and the write cursor is in it, before scanning the barcode.
- **Manual input**
  A barcode can be entered into the input field by keyboard.

If a barcode is scanned or entered, the measurement programs or database entries in which this barcode is referenced will be displayed.

Measurement programs or database entries with no barcode references stored are always displayed.

Removing the contents of the barcode input field will return to the listing of all the measuring programs or database entries.

9.2 Setting in the file ‘Module.ini’

In the file ‚Module.ini’ in the program directory, the system can be adapted to the used barcode scanner. Therefore the following entries are used:

BCLength=9
BCHead=036036
BCTerm=013

All entries belong to the section [CustomShell1] in that file. The values shown are for example only and must be adapted to the requirements.

BCLength specifies the length of the barcodes used. Only barcodes of this length will be accepted. The minimum length is 4 characters. A value of 0 disables the option of entering barcodes.

BCHead and *BCTerm* determine which markers the barcode scanner sets in front and behind the barcode read. For scanners not offering this function, both entries are left blank. If the function is supported, both entries must be set.

The markers can be any 1-4 characters (non-printable as well). Entered here are the ASCII codes in decimal form. A character is always set with 3 digits (for small

numbers, leading zeros are to be used). The range of values can go from 001 to 255. The example shown above is suitable for a scanner, that provides 2 $-characters prefixing the barcode and appends a final carriage return (Enter key).

10 Setup list fields for additional data

10.1 General

List fields for the additional data are set up using a setup file. The file will be loaded at the start of the cutting edge module. The file has to be in the program directory of ODSCAD and has to be named with the alias name of the module plus „Udata.ini“. The alias name is preset in the file „Module.ini“ (Example: Alias=GPCutTool).

10.2 Content of the setup file

The format of the setup file equals the format of windows-ini-files. To each of the 10 additional data fields, there is a section in which the functionality of the field is defined, and a section in which the content of the list is stated. The sections are optional and only needed for the fields that shall be altered beyond their normal functionality. The list section is only needed if a field is to become a list field.

10.2.1 Format of the setup section

```
[Settings_1]
isList=1
isFirstEmpty=0
useValue=1
hasEqualValues=0
ShowListMode=1
```

Section caption (in brackets): „Settings_“ followed by the number 1..10 for the additional data field 1..10.

isList:	Defines if the additional data field will be a list field (1) or not (0). When defined as a list field, a corresponding list section is needed where the content of the list is stated.
isFirstEmpty:	Defines whether a list entry must be selected (0) or not (1) when running a measuring process. If not, the first entry of the list is used as an empty entry. The text stated in the list section will appear in the list box but will neither be printed nor exported.
useValue:	Defines if the name of a selected list entry will be used in the printed protocol and the result file (0), or the value (1). For the latter, values must be assigned in the list definition.
hasEqualValues:	Defines if the assigned values in a list must be unique (0) or not (1). Only effective for useValue=1.
ShowListMode	Display modes for the list field: 0 = name, 1 = name (value) 2 = value (name), 3 = value Only effective for useValue=1.

10.2.2 Format of the list section

```
[List_1]
- - -=
F3_1=A1
F3_2=A2
F3_3=A3
```

Sections caption (in brackets): „List_“ followed by the number 1..10 for additional data field 1..10.

The section caption is followed by the list entries in the same order as they are to be shown in a list box. All entries have to be followed by an equal sign. Equal entries are not allowed.

Values behind the equal signs are only needed if the option `useValue` is enabled. In this case, the values will be used for the printed protocol and the result file. If `hasEqualValues` is enabled, equal values are allowed.

If the option `isFirstEmpty` is enabled, the first entry following the section caption is used as an empty entry. The example shown above would lead to three dashes as the first entry in a list box. If selected, the system will interpret it as an empty field, and the dashes would not appear at the printouts.

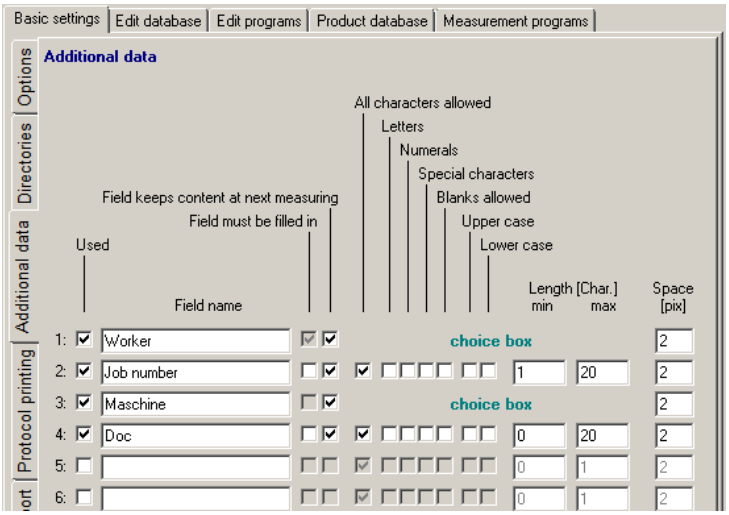
10.3 Appearance in the software

10.3.1 Setting up the additional data fields

If list fields are set up in the setup file, they will be labeled as „choice box“ in the setup page for additional data (see image, field 1 and 3). At the same time the amount of options for these fields is very much reduced, because the format is already preset in the setup file.

Setup options for list fields:

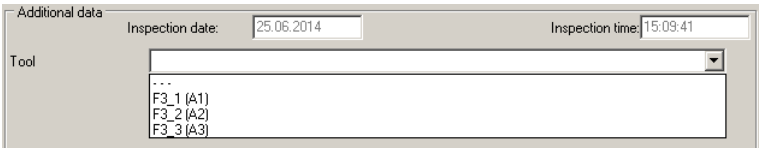
Settings	Description
Used	Activates the field to be used in measuring processes.
Field name	Name of the field.
Field must be filled in	Display only, cannot be changed here! This option is set by the entry „isFirstEmpty“ in the setup file.
Field keeps content at next measuring	The field will keep the last selection at the next measuring process when activated
Space	Distance in pixels to the field above on pages of the measuring processes.



10.3.2 Additional data fields at the measuring process

In measuring processes list fields appear as list boxes. A click on the down arrow on the right opens them.

The images show an opened list box where the first entry is an empty one (isFirstEmpty=1). The three dashes are preset in the setup file. They will not show up at printouts or exports.



11 Q-DAS-Extension

The cutting edge module is able to export data using the Q-DAS format to pass them to software like QS-STAT. The file formats *.dfd, *.dfq and *.dfx are supported.

The exported data can be summed up in three groups. Fixed information (e.g. name of the measuring system), Process specific information (e.g. amount and type of results, nominal values), and results.

The setup for the fixed information is done once here at the basic settings and will then be the same for all exports. Individual Q-DAS-keys can be overwritten with content from the additional data fields so that they become specific to a concrete measurement.

The process specific information is set up in the product database of the cutting edge module, separately for each entry. It is used to export data which is specific to a particular measuring process. Some of this data can be overwritten with content from the additional data fields and is then specific to a concrete measurement.

The results are all the values that are measured and calculated within a run of a measuring process. Amount and type result of values depend on the setup of that process. All result values that are activated in the database will be exported.

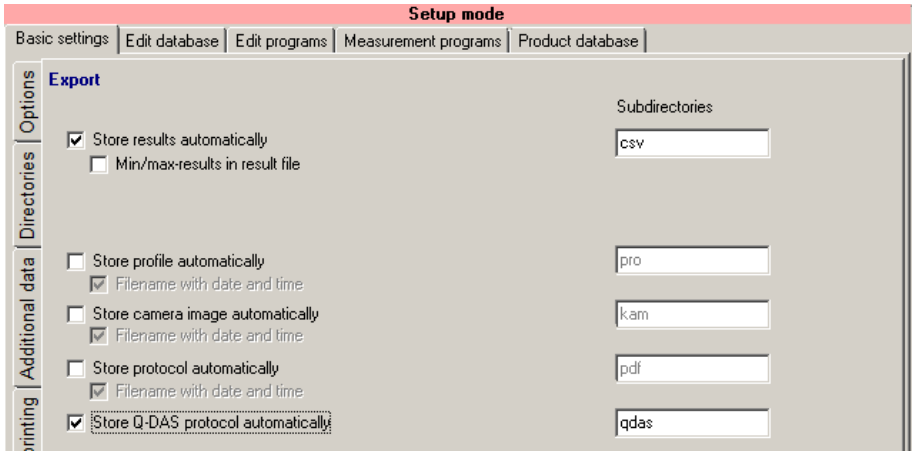
The following paragraphs of this chapter explain at with points in the cutting tool software are additional setup and handle options.

11.1 Basic settings (Q-DAS)

11.1.1 Activating the Q-DAS export

The Q-DAS-export can be enabled on the page ***Export*** in the basic settings by activating the option ***Store Q-DAS protocol automatically***.

Only if the Q-DAS-export is enabled, all options described in this chapter will be available. If disabled, the software will look and act like one without Q-DAS option.

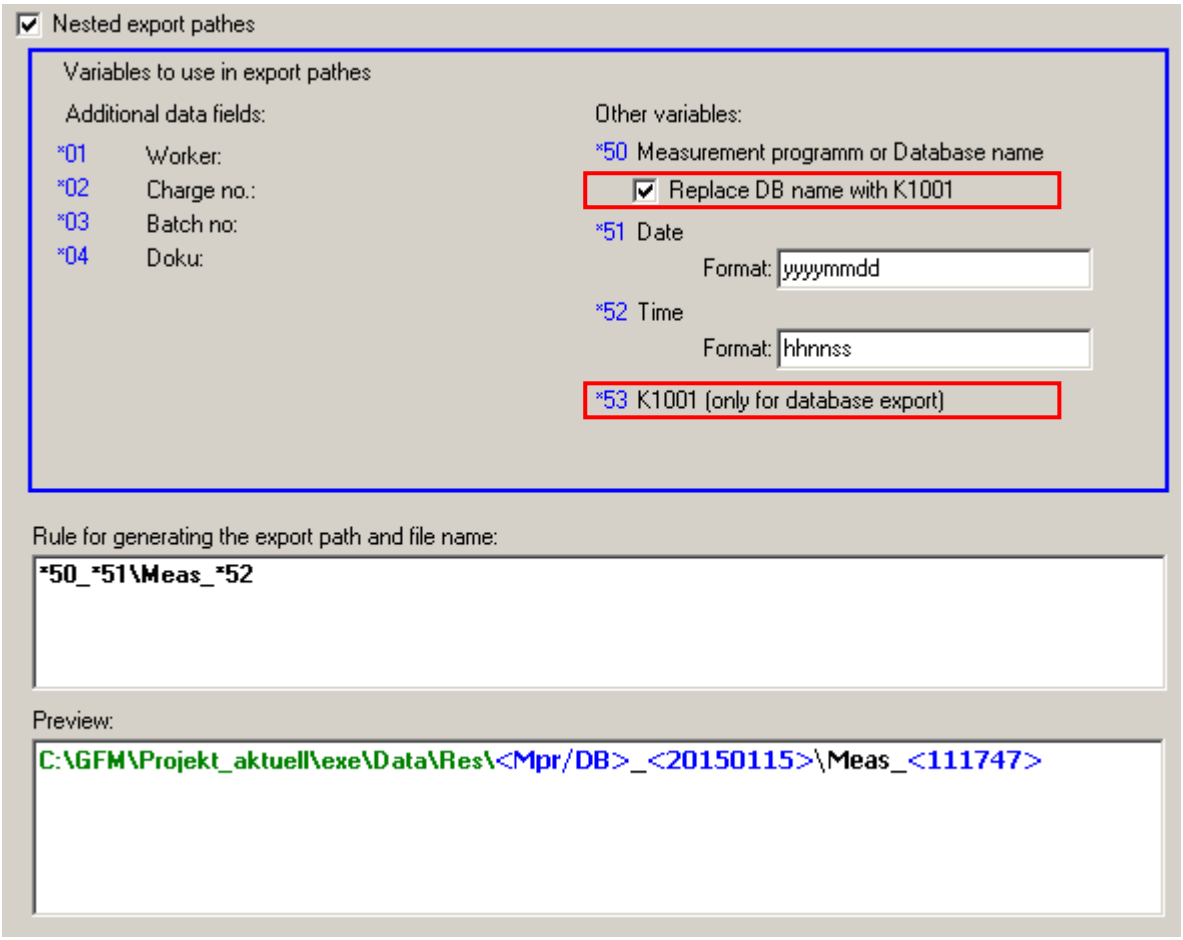


Like other types of data, the Q-DAS-exports also can be stored in a type specific subdirectory. The same rules apply (see 3.6).

An automatic addition of date and time to the filename is not available. There is no need to prevent files from being overwritten. Additional results stored with the same name are simply added to an existing file as additional lines.

The file formats *.dfd, *.dfq and *.dfx can be exported. Which ones are used is adjusted in the file ‘module.ini’.

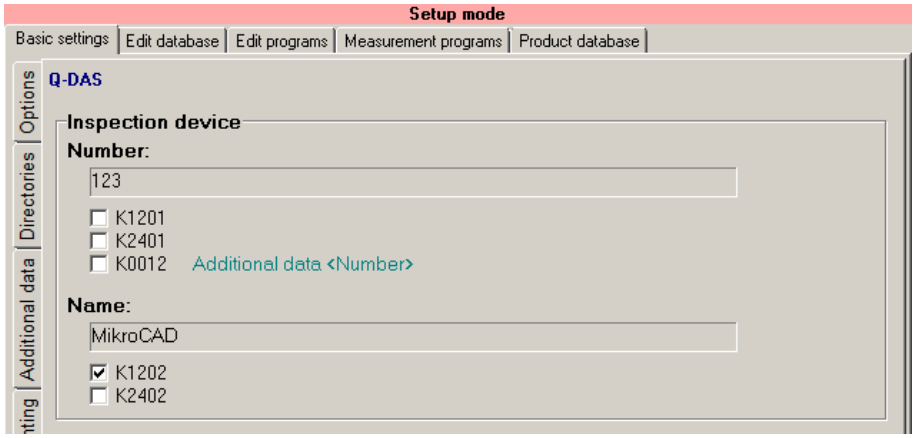
11.1.1.1 Extension of export with process specific information in use with Q-DAS



The nested export (see chapter 3.6.2) will be extended with the red marked options in above image in use with Q-DAS.

On the one hand the database name can be replaced through the value of part number K1001. The part number K1001 can also be a separate part of the export directory (then only on using database).

11.1.2 Adjusting the fixed information



On the page ***Q-DAS*** at ***Basic settings*** the export of the data fields ***Measuring device number*** (K0012, K1201, K2401) and ***Measuring device name*** (K1202, K2402) can be activated. The content of the fields is preset in the file “Module.ini” in the program directory of ODSCAD with the following entries:

```
MachineName=MikroCAD
MachineNoStr=123
```

„MaschineNoStr“ must be an integer value.

The content of the fields can be overwritten with content from the additional data fields so they become specific to a concrete measurement (see 11.1.3). If a field is linked to an additional data field, a hint will be shown right to the activation switch of the affected Q-DAS-key.

11.1.3 Additional data (Q-DAS)

Data entered into the additional data fields within a measurement process, can be channeled into the Q-DAS-exports. That is done by connecting additional data fields with Q-DAS-keys. The connections are adjusted in same setup file as list fields are (see chapter 10).

Complete set of adjustments for one field:

```
[Settings_1]
QdasKey=1222
VQdasKey=1221
IQdasKey=1223
isList=1
isFirstEmpty=0
useValue=1
hasEqualValues=0
ShowListMode=3
CatalogPFName=C:\Data\KATALOGE.DFD
CatalogKey=4090
```

According to the type of an additional data field and the desired connection only some of the adjustments are necessary. Not needed adjustments can be omitted.

Meaning oft the adjustments:
(Type: I = Input field, L = List field, C = List field, content defined via Q-DAS-catalog)

Adjustment	Description	Def.	Type
QdasKey	Key number to which inputs of an input field or the name of a list element will be transferred	0	I,L,C
VQdasKey	Key number to which the value of a list element will be transferred	0	L,C
IQdasKey	Key number to which the index of a list element will be transferred	0	L,C
isList	Type of an additional data field: 0 = Input field, 1 = List	0	L,C
isFirstEmpty	0 = Selection always necessary, 1 = first list element is an empty entry the represents „nothing selected“.	0	L
useValue	0 = The name of a selected list element will appear in the printed protocol and the result file, 1 = The value will appear there.	0	L,C
hasEqualValues	0 = all value in a list must be different, 1 = same values are allowed.	0	L,C
ShowListMode	Display modes for a list field. 0 = name, 1 = name (value), 2 = value (name), 3 = value Only effective if useValue=1	0	L,C
CatalogPFName	Path and name of a catalog file	empty	C
CatalogKey	Catalog identification key, currently only 4090 (worker catalog) possible.	0	C

The data from the additional data fields is transferred to the input fields at the database setup, which can then export the data through the enabled key numbers. If a database input field can export its content through multiple keys, it will do so for all enabled keys. The means, the key number adjusted in the setup file only defines, which field in the database will receive the data. If, and via which key numbers that data will be exported, is adjusted by which key numbers are enabled in the database setup.

All key numbers of the fixed and measurement process dependent information can be used.

Along with the Q-DAS-export there is an extended way to define the content of a list in the setup file:

```
[List_1]
- - -=
F3_1=A1=1
F3_2=A2=2
F3_3=A3=3
```

The first element is an empty entry, it's omitted if `isFirstEmpty` is set to 0.

At regular list elements the element index can be set explicit following a second equal sign. It has to be an integer value with a maximum of 5 digits. The values can be chosen freely, but no similar values are allowed. Without explicit definition the indices will be generated internally as an ascending numeration.

11.1.3.1 Input fields

Simple input fields are connected to a database field by setting the key number. `isList` must be set to 0 or can be omitted because that's the default value.

Complete set of adjustments for one list field:

```
 [Settings_1]
QdasKey=1222
isList=0
```

11.1.3.2 List fields

At list fields there are three different types of data, which can be connected to different database field separately. These are the name, value and index of a list element. Therefore three different key number can be set here. They are not allowed to connect to the same database field. Unused connections are set to 0 or are omitted.

`isList` must be set to 1, so that the additional data field is a list field.

In addition to the list field definition, there also has to be a definition of the list content. If the values of list elements are to be exported (VQdasKey is set), these values have to be included in the list content.

Complete set of adjustments for one list field:

```
 [Settings_1]
```

```
QdasKey=1222
VQdasKey=1221
IQdasKey=1223
isList=1
isFirstEmpty=0
useValue=1
hasEqualValues=0
ShowListMode=3
```

11.1.3.3 Q-DAS catalog as list field

All adjustments are the same as for the list field described in the article before. Only the definition of the list content is not done in the setup file. Instead there is adjusted, from which catalog file the content is to be retrieved, and which type of catalog it is.

Currently only the worker catalog (key 4090) can be used.

Complete set of adjustments for one list field:

```
[Settings_1]
QdasKey=1222
VQdasKey=1221
IQdasKey=1223
isList=1
isFirstEmpty=0
useValue=1
hasEqualValues=0
ShowListMode=3
CatalogPFName=C:\Data\KATALOGE.DFD
CatalogKey=4090
```

Example for a worker catalog:

```
K4090/0 Prüferkatalog
K4092/1 P001
K4093/1 Prüfer 1
K4092/2 P002
K4093/2 Prüfer 2
K4092/3 P003
K4093/3 Prüfer 3
K4092/4 P26-004
K4093/4 S. Conrad
K4092/5 P53-005
K4093/5 G. Schröder
```

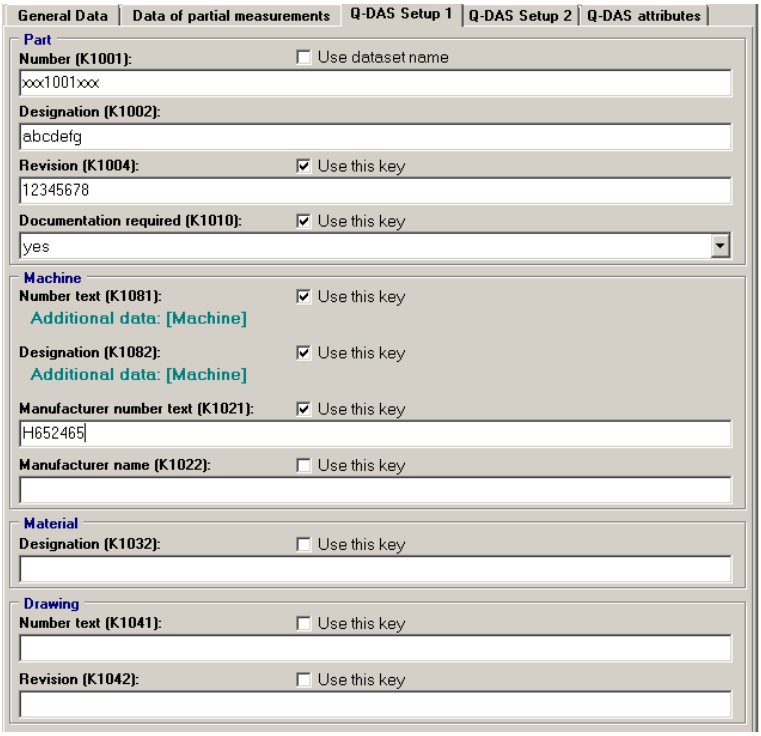
K4093 defines the names of the list elements, K4092 the values and the number behind the slashes the indices.

11.2 Edit database (Q-DAS)

If the Q-DAS export is enabled in the ***basic settings*** on the page ***Export***, there are 3 additional pages accessible on which the export of process specific information can be adjusted.

The pages ***Q-DAS Setup 1*** and ***Q-DAS Setup 2*** show data fields, which content can be setup at will. The export of all keys (K-numbers) can be enabled separately. The keys K1001 and K1002 are exceptions, they are mandatory and will always be exported.

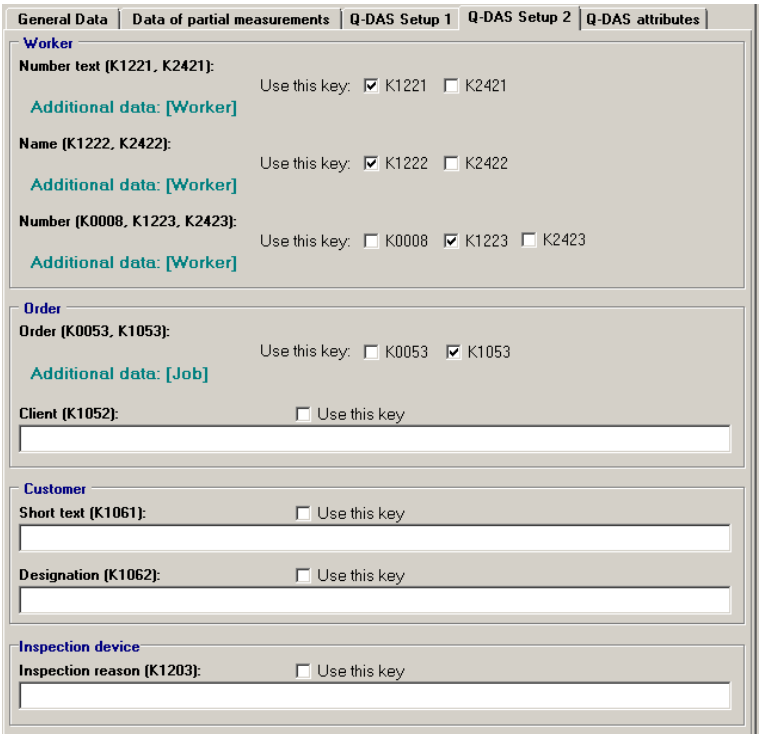
There is a specialty with the key K1001. With the option ***Use dataset name*** can be selected, if the content will be adjusted here or if the name of the dataset will be used. If the latter is selected, the input field will be hidden.



It is also possible to replace the content of data fields with inputs to the additional data fields. This happens if a key is assigned to an additional data field in the setup file (see chapter 11.1.3). These keys will have no data field here but the hint „Additional data“, followed by the field name in brackets instead.

If the content of a data field is set via an additional data field and the additional data field is set up as list field, there are up to 3 values available. These are the Name of the list entry, the value assigned to it, and number of the entry (list index). All 3 values can be assigned to different keys, so that the hint towards the same additional data field may appear up to 3 times.

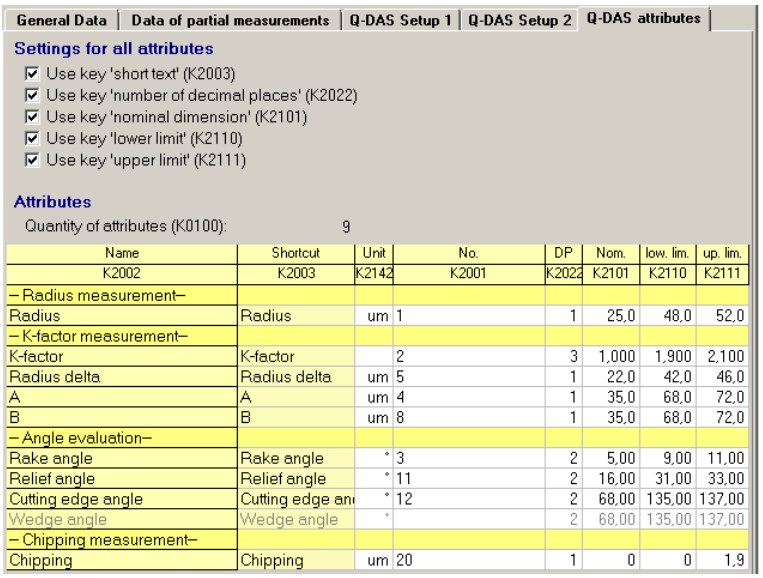
For some data there are several keys available and therefore there is the option to enable any of them. It is possible to enable several of them concurrently.



☞ Keys with are called ***Number*** can only contain integer values up to 5.

The page ***Q-DAS attributes*** shows in a table which results will be exported. Some information to the results is optional. Their export can be enabled with the check boxes above the table. The adjustments are valid for all the attributes likewise.

The attribute numbers K2001=characteristic number and K2022= decimal places can be set in the table for all attributes separately. The decimal places are only for Q-Das export.



Name	Shortcut	Unit	No.	DP	Nom.	low. lim.	up. lim.
K2002	K2003	K2142	K2001	K2022	K2101	K2110	K2111
– Radius measurement–							
Radius	Radius	um	1	1	25,0	48,0	52,0
– K-factor measurement–							
K-factor	K-factor		2	3	1,000	1,900	2,100
Radius delta	Radius delta	um	5	1	22,0	42,0	46,0
A	A	um	4	1	35,0	68,0	72,0
B	B	um	8	1	35,0	68,0	72,0
– Angle evaluation–							
Rake angle	Rake angle	°	3	2	5,00	9,00	11,00
Relief angle	Relief angle	°	11	2	16,00	31,00	33,00
Cutting edge angle	Cutting edge an	°	12	2	68,00	135,00	137,00
Wedge angle	Wedge angle	°		2	68,00	135,00	137,00
– Chipping measurement–							
Chipping	Chipping	um	20	1	0	0	1,9

☞ Measurement values, which are not activated in the database, are shown in gray here. They will not be exported.

11.3 List of all exportable Q-DAS keys

Key	Denomination	opt.
Fixed information		
K0012	Measuring device, Number	X
K1201	Measuring device, Number	X
K1202	Measuring device, Name	X
K2401	Measuring device, Number	X
K2402	Measuring device, Name	X
process specific information		
K0008	Worker, Number	X
K0053	Order, Order	X
K1001	Part, Number	
K1002	Part, Designation	
K1004	Part, Revision	X
K1010	Part, Documentation required	X
K1021	Machine, Manufacturer number text	X
K1022	Machine, Manufacturer name	X
K1032	Material, Designation	X
K1041	Drawing, Number text	X
K1042	Drawing, Revision	X
K1052	Order, Client	X
K1053	Order, Order	X
K1061	Customer, Short text	X
K1062	Customer, Designation	X
K1081	Machine, Number text	X
K1082	Machine, Designation	X
K1203	Measuring device, testing reason	X
K1221	Worker, Number text	X
K1222	Worker, Name	X
K1223	Worker, Number	X
K2421	Worker, Number text	X
K2422	Worker, Name	X
K2423	Worker, Number	X
results		
K0100	Quantity of attributes	
K2001	Attribute, Number	
K2002	Attribute, Designation	
K2003	Attribute, Short text	X
K2022	Attribute, Number of decimal places	X
K2101	Attribute, Nominal dimension	X
K2110	Attribute, lower limit	X
K2111	Attribute, upper limit	X
K2142	Attribute, Unit	

12 Multiple measurements

With multiple measurements, several measurements can be performed within one measurement process and deliver the results in one result file and one printed protocol.

The number of measurements is not previously adjusted and the measurement process can be completed after any measurement.

The last measurement can be repeated if necessary.

There are two versions of the multiple measurements available. One will produce an average result of the single measurements, the other will not. There is no difference in the handling.

The result file is always created for one specific process. Therefore date and time will be added to the filename automatically.

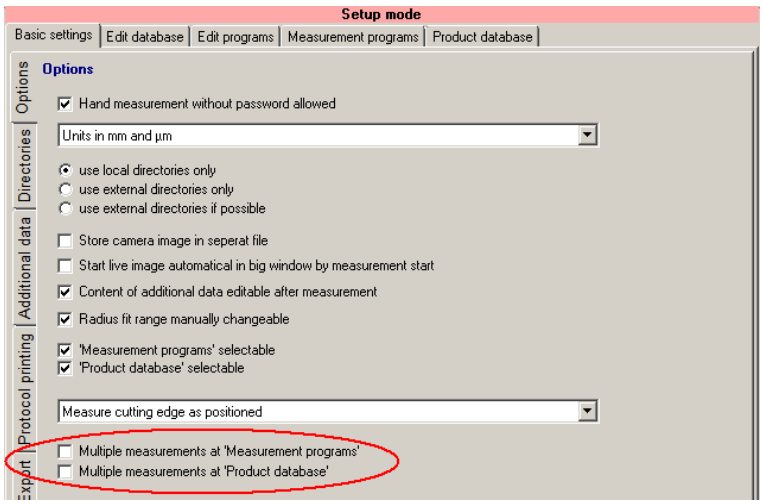
The following paragraphs of this chapter will explain at with points in the cutting tool software are additional setup and handle options for the multiple measurement.

12.1 Basic settings (multiple measurements)

The additional setup options are only available on software version where the multiple measurements option is unlocked.

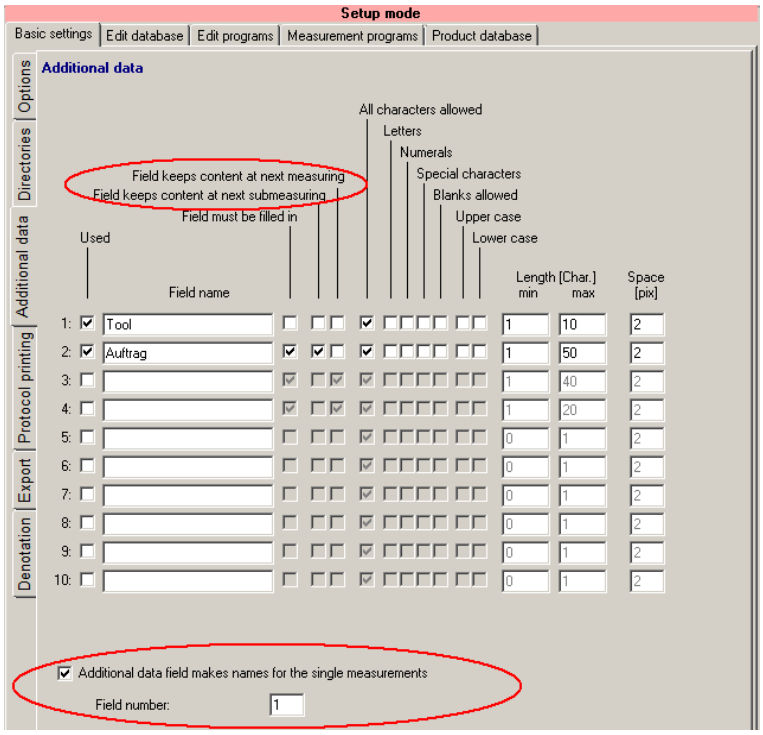
12.1.1 Activating multiple measurements

Multiple measurements can be enabled separately for the measurement processes ***Measurement programs*** and ***Product database***.



12.1.2 Additional data (multiple measurements)

For each additional data field it can be adjusted if the content will be kept only for one single measurement within the process, or on to the next measurement process.
It also can be adjusted that one specific additional data field is used to generate the captions shown in the result table for the single measurements.



12.2 Measurement (multiple measurements)

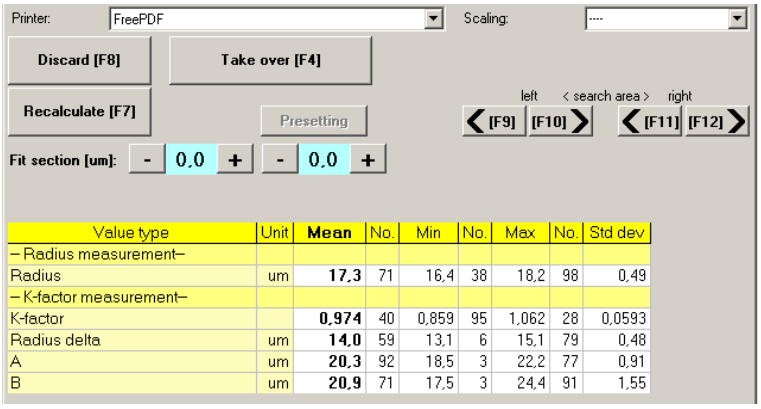
The measurement processes at ***Measurement programs*** and ***Product database*** are mostly like the normal single measurement processes. The main difference is an additional step where the decision is made if the next measurement shall be performed or if the process shall be finalized. The following paragraphs will describe that additional step for both measurement processes.

One process of the multiple measurements can contain up to 40 single measurements. If this number is approached, the button to add a new measurement will be blocked by an according hint.

If a multiple measurement contains only one measurement, the printed protocol will be the same as at a normal single measurement. If it contains more the printed protocol will not include graphics but a result table where all measurements are shown.

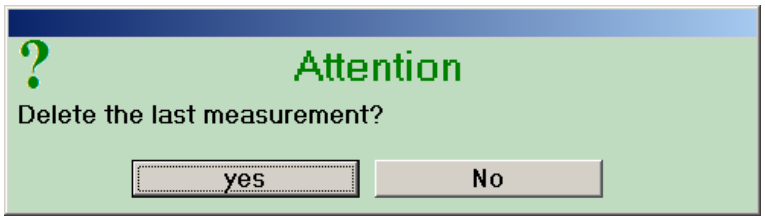
A measurement process starts as described in paragraph 1.2 to 1.4 by selecting a measurement program or database entry, entering the additional data and performing a measurement.

When the calculation is done, the results are displayed. From here on, the handling starts to differ from the way described in paragraph 1.4.



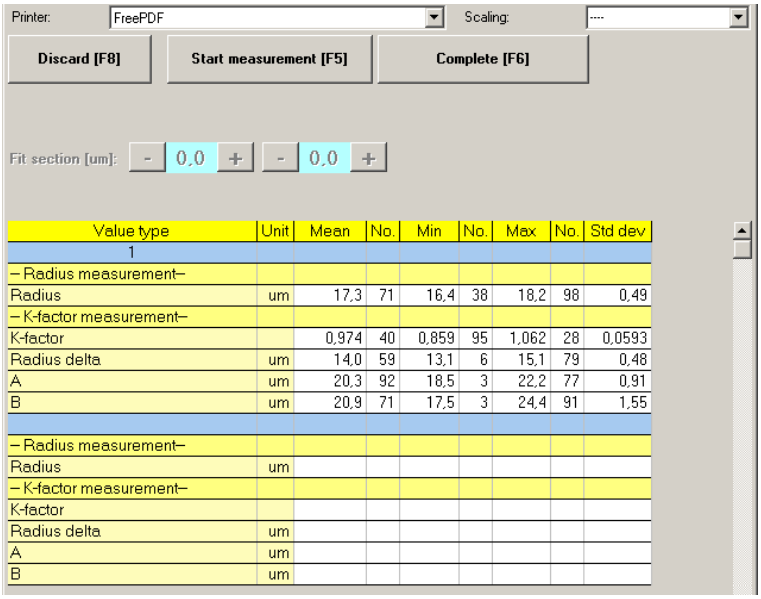
Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
– Radius measurement–								
Radius	um	17,3	71	16,4	38	18,2	98	0,49
– K-factor measurement–								
K-factor		0,974	40	0,859	95	1,062	28	0,0593
Radius delta	um	14,0	59	13,1	6	15,1	79	0,48
A	um	20,3	92	18,5	3	22,2	77	0,91
B	um	20,9	71	17,5	3	24,4	91	1,55

With ***Discard***, the measurement performed can be discarded. As a protection, a request will appear if the last measurement shall be deleted.



If the request is answered with ***yes***, the results of the last measurement will be deleted and the System offers the possibility for a new measurement.

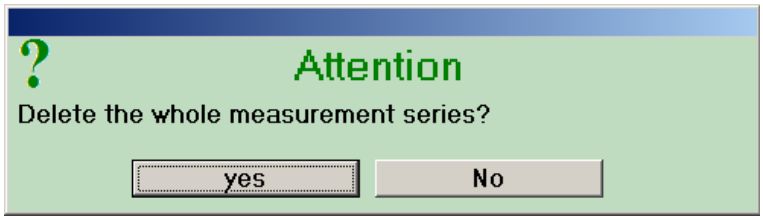
If ***Take over*** has been selected, the results of the last measurement are added to the overall result and the System offers the possibility for a new measurement if the maximum count of measurement has not yet been reached.



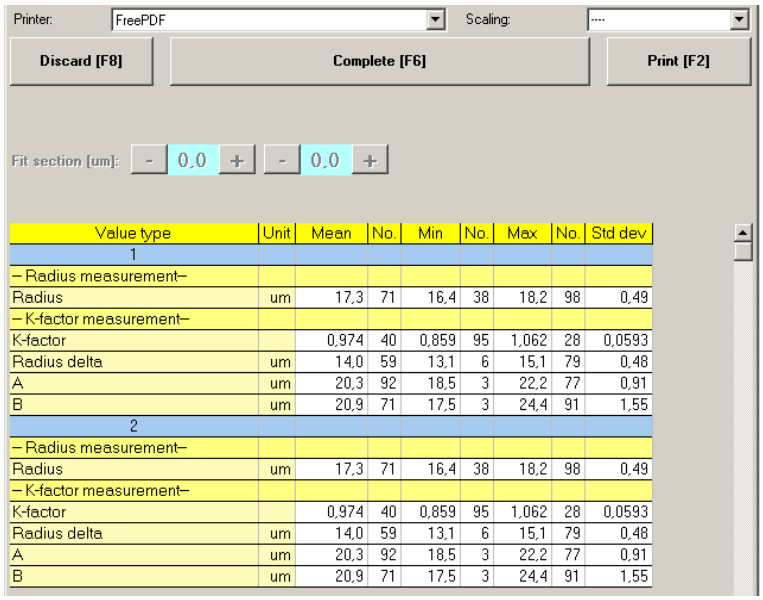
Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
1								
– Radius measurement–								
Radius	um	17,3	71	16,4	38	18,2	98	0,49
– K-factor measurement–								
K-factor		0,974	40	0,859	95	1,062	28	0,0593
Radius delta	um	14,0	59	13,1	6	15,1	79	0,48
A	um	20,3	92	18,5	3	22,2	77	0,91
B	um	20,9	71	17,5	3	24,4	91	1,55
– Radius measurement–								
Radius	um							
– K-factor measurement–								
K-factor								
Radius delta	um							
A	um							
B	um							

With ***Start measurement***, a new measurement can be triggered. After calculation is done, the handling will repeat from the beginning of this paragraph.

With ***Discard***, the whole measurement process can be canceled. As a protection, a request will appear if the whole measurement results shall be deleted.



With ***Complete***, the execution of measurements can be closed. After this step, no more measurements can be started. All results will be shown in a table.



Value type	Unit	Mean	No.	Min	No.	Max	No.	Std dev
1								
– Radius measurement–								
Radius	um	17,3	71	16,4	38	18,2	98	0,49
– K-factor measurement–								
K-factor		0,974	40	0,859	95	1,062	28	0,0593
Radius delta	um	14,0	59	13,1	6	15,1	79	0,48
A	um	20,3	92	18,5	3	22,2	77	0,91
B	um	20,9	71	17,5	3	24,4	91	1,55
2								
– Radius measurement–								
Radius	um	17,3	71	16,4	38	18,2	98	0,49
– K-factor measurement–								
K-factor		0,974	40	0,859	95	1,062	28	0,0593
Radius delta	um	14,0	59	13,1	6	15,1	79	0,48
A	um	20,3	92	18,5	3	22,2	77	0,91
B	um	20,9	71	17,5	3	24,4	91	1,55

From here on, the handling is the same again as described in paragraph 1.4. With ***Print***, a protocol can be printed, ***Complete*** will store the results and finish the process, and ***Discard*** will finish the process without storing, after a safety request.

13 Operation with Axes

The cutting tool software can be operated with motor-driven axes, such as a cross table.

The operation of the axes is done by a different software module (motor module). Different motor modules are available for different types of axes. The motor module is connected to the cutting tool module through an internal interface.

The following paragraphs of this chapter will explain at which points in the cutting tool software are additional setup and handling options for the operation with axes.

13.1 Control Area

The current positions of the axes are shown in the control area and there are additional buttons.

Positions shown in red indicate that the axes have not yet performed a reference drive and are not ready for a measurement process.

With ***Move stage***, the control window of the motor module can be opened. That window provides controls to move the axes. Appearance and content of the window depend on the type of motor module used.

With ***Search reference***, a search for the reference position of the axes will be started. The motor module will perform that task. After successful execution, the current positions will be shown in black.

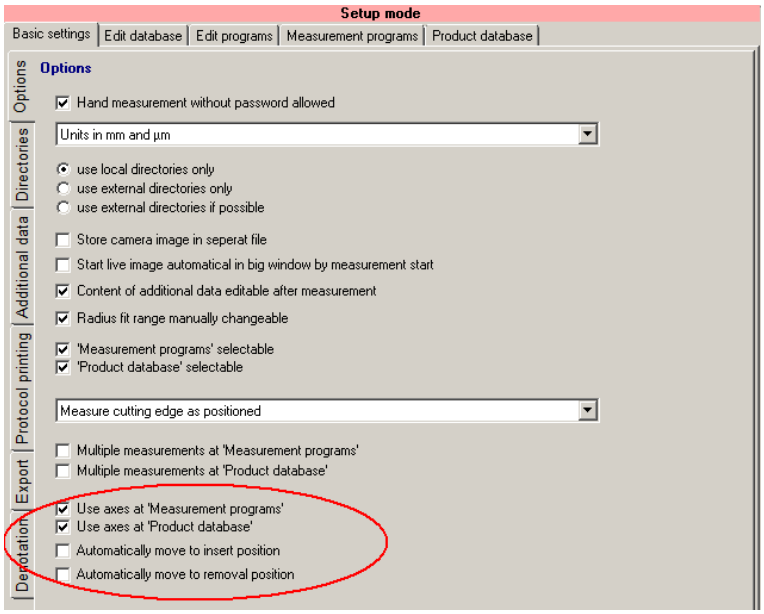
With ***Handling position***, the axes can be moved to a position allowing for an easy insertion of samples. The position coordinates are adjusted in the setup of the motor module.

13.2 Basic settings (axes)

With ***Use axes at ‚Measurement programs‘*** and ***Use axes at ‚Product database‘,*** the use of axes can be enabled for both measurement processes separately. If enabled. The coordinates adjusted in the measurement programs will be approached before taking a measurement.

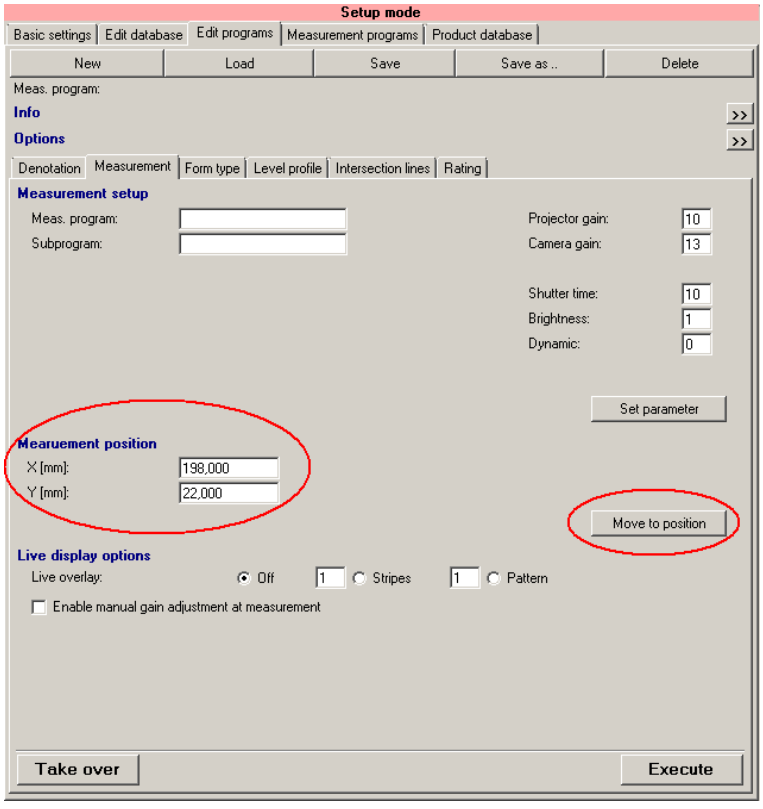
If ***Automatically move to insert position*** is enabled, the axes will move to the handling position automatically, at the start of a measurement process. If the option is disabled, moving to the handling position can be triggered manually with a button.

If ***Automatically move to removal position*** is enabled, the axes will move automatically to the handling position at the end of a measurement process. If the option is disabled, moving to the handling position can be triggered manually with a button.



13.3 Create measurement programs (axes)

In the setup of a measurement program at the page ***Measurement*** coordinates for the axes which are to be approached to perform a measurement, can be adjusted.



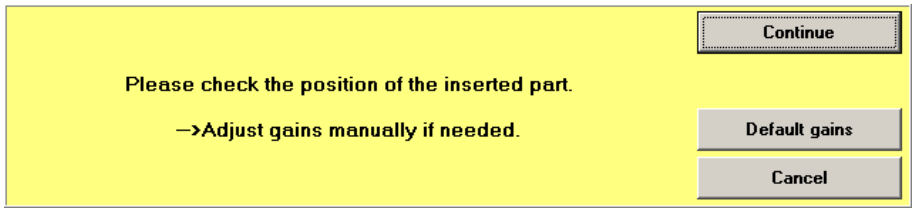
With ***Move to position*** the axes can be moved to the adjusted coordinates.

13.4 Measurement (axes)

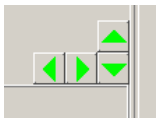
The handling of the measurement processes differs only very little from what has been described in chapter 1.4, with a few additional buttons.

If the automatic approach of the insert position is disabled, there will be an additional button in the request to insert the part, by which the approach can be triggered manually.

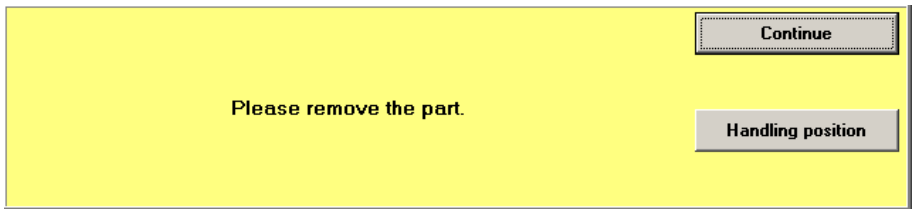
The request to check the gains also requests to check the positioning of the part.



There are four buttons at the lower right corner of the simultaneously shown live image, by which the axes can be moved by 3% of the measurement area with each click (9% while pressing shift). Small position inaccuracies can be corrected this way.



If the automatic approach of the removal position is disabled, there will be an additional button in the request to remove the part, by which the approach can be triggered manually.



14 Changes

14.1 Cutting tool module issue date 24. October 2014

1. The k-factor option DIN ISO 13715 has gotten the 3 new results Area; L-min and L-middle (see chapter 4.14.1).

14.2 Cutting tool module issue date 15. January 2015

1. The decimal places (K2022) are adjustable for every characteristic for database Q-DAS export (see chapter 11.2).
2. In use with Q-DAS, the part number could be used as part of the nested export directory (see chapter 11.1.1.1).