

creating precision ...

Qsigma



Product Guide

providing innovation ...



All began with an idea: optical measurement systems for industrial applications. In research and development as well as in the harsh environment of a production floor.

Two young and eager technicians looked for their challenge. Electronic engineer Helmut Kuhn and physicist Dr. Stephan Werner joined to make their vision come true. Developing mature hardware and creating powerful software merged for engineering of industrial inspection systems.

The igniting spark was an inquiry from an automotive supplier, who was looking for an optical inspection system for automotive catalytic converters during the production process.

The field of application expanded. Global cooperation with customers became established. Eventually it led to the foundation of Qsigma in 2009. A company organized in a straight forward way to offer state-of-the-art measuring systems backed up with multilingual staff for straight and easy communication and support.

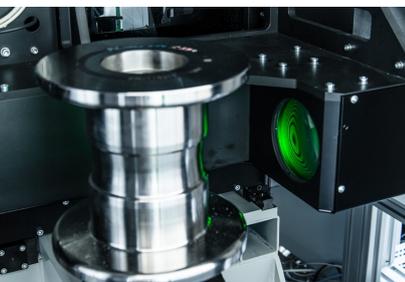
Providing user friendly, reliable and application specific inspection systems is Qsigma's business. Fulfilling customer's needs is the goal. Finding new pathways to innovation is the challenge.



Automotive catalytic converters



Alloy wheels



Sheet metal forming rolls

Quality control and product tracing has become an important measure for state-of-the-art production sites. Optical measurement technology offers highly valuable opportunities. Precise measurement combined with high duty cycle and comparable compact physical outlines allows superior efficiency together with ultimate precision.

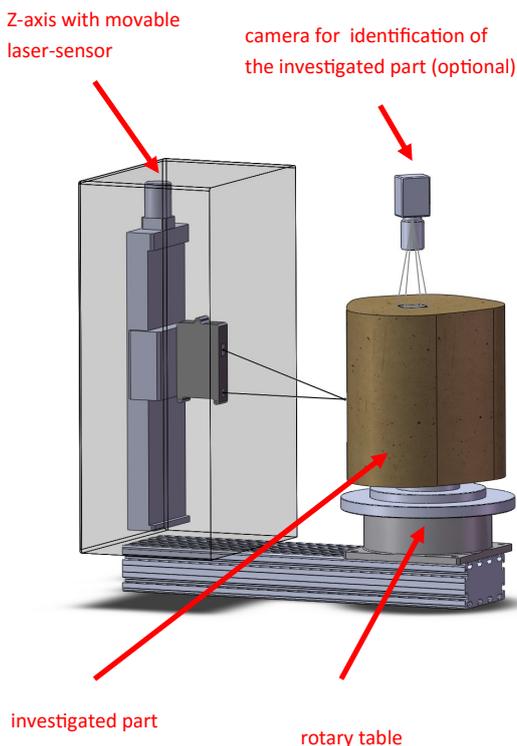
Fast, effective and confident evaluation is a necessity for data processing during the production course. However, to keep on track with product innovation steps, a flexible data processing structure is a must, as well as a secure communication with controlling and reporting equipment.

These keywords are essentials in many applications of Qsigma systems aiding a constant process of quality improvement and consequently enhancing efficiency.

Moreover, single sources development serves for maturity and long term support.

If your concern is quality and process improvement, Qsigma will be your reliable partner.

The InnoMeas CMS systems are designed with special respect to the inspection of automotive catalytic converters. Size and shape are measured before and after the canning process. Employing laser point triangulation preset sectional planes of the monolith and the canned converter can be measured. Additionally, with proper accessories installed, the mat weight and bar or DMC codes can be read. The gap bulk density (GBD) is evaluated as an important measure for quality control. With optional software reporting tools a surveillance of process parameters is possible. Not only round samples can be measured. Elliptic, sectional and even potatoe shaped are possible to be inspected



Basic Setup

The monolith or converter is put on a rotary table (no centering required). The triangulation laser sensor is mounted on a vertical positioning stage (z-axis), which allows automatic approach to the preset sectional planes for the particular measurement.

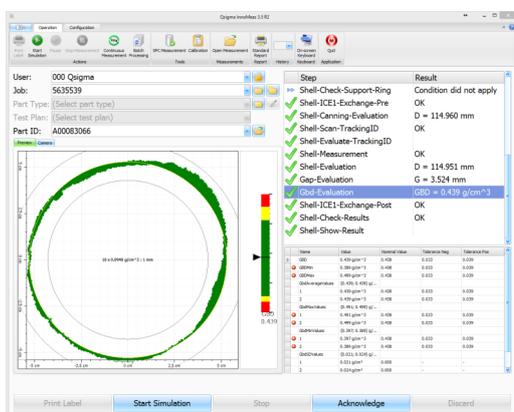
Z-axis including the sensor as well as all controllers and supplies for the entire measurement system is implemented in a dust proof shielded housing. The rotary table is accessible for loading the parts of investigation by robots or manually. The housed z-axis assembly and the rotary table are bolted on a bottom rail. Aligning the z-axis with respect to the rotary table, the measuring range of the laser sensor is adjusted.

All measuring features are software controlled and via communication ports prepared for automated operation.

Functions

- » precise detection of the shape in defined sectional planes
- » diameter (local, averaged), shape contour deviation,
- » circumference, maximum inscribed circle, form tolerance
- » continuous scanning of the complete shape with error detection: straightness of the shape and edge chipping *)
- » height, chunking, parallelism or imbalance of the end face, rectangularity of the shape and end faces *)
- » weight of the support mat, sheet thickness *)
- » clearance between substrate and sheet (gap), local and global gap bulk density (GBD) *)
- » contour target value, diameter target value, closing stroke of the canning process *)

*) optional and/or accessories required



GBD measurement



I-Type

Integrated model, focussed on widely automated applications.

It is reduced to its essential components, i.e. the measuring unit and the rotary axis actuator. Assembled on a mounting rail, their position can be easily changed with respect to customer requirements.

An IPC system including all controllers and supplies is mounted in the sealed off measuring unit.

InnoMeas CMS I-type is dedicated for the use in manufacturing facilities (e.g. "canning facilities"), where no permanent operator interaction is necessary. Acting as a component of e.g. a production line, the controlling is entirely put to a higher level operation control system. However, adding a monitor and other devices like keyboard, mouse and a screen the I-type version converts to a stand-alone manually controlled inspection system.



C-Type

Compact model, dedicated to semi-automated product lines.

InnoMeas C-type is laid out for manual control as well as for automatic control. Housed in small foot print rack on wheels, it contains the measuring unit, the IPC (mounted in the bottom case) and a touch screen .

The measuring unit comprises of the rotary table and the sealed off z-axis assembly both mounted to a bottom rail for alignment to each other. The z-axis assembly contains the vertical axis with the laser sensor and all electrical supplies and controllers.

Key feature is the system's versatility. Compact outlines combined with convenient access to all components. The rack wheels allow operation at different locations. Controlling can be done by a simple push button assembly (e.g. worker's mode), by the touch-screen (e.g. expert's mode) or by interfacing to superordinated computer system.

A variety of peripherals like barcode or DMC code reader, label printer, mat scale etc. can be implemented.



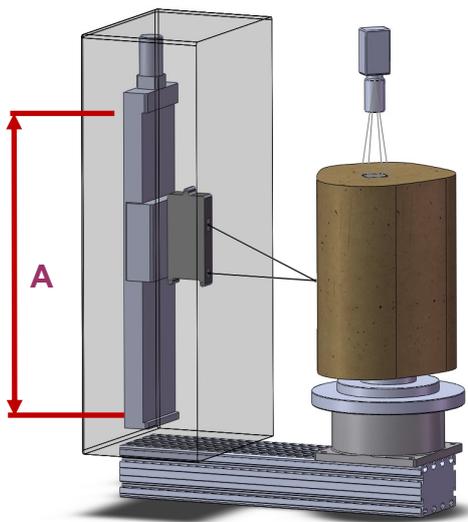
P-Type

Professional model, the comprehensive catalyst measurement system.

A large frame rack on wheels contains the measurement unit, IPC, screen, mouse, keyboard and all peripherals like mat scale, label printer, barcode or DMC code reader, electronic micrometer gauge etc.

It is the workhorse in a prototyping or validation laboratory. No matter if new types of catalytic converters have to be designed and validated or if samples of current product line have to be investigated extensively, the *P-type CMS system* can do it, due to its comprehensive layout.

However, a customized design for particular applications can be offered.



A: Z-axis traverse path



Rotary piston of a slurry pump
measured with a line scanning
sensor

Z-axis

Standard traverse path: 540mm

Optional traverse path: 340mm

The shorter traverse path is the choice whenever smaller converters are to be measured. It results in a more compact setup and is less costly.

PTS laser sensor

Standard is a laser point triangulation sensor. The advantage is a fairly low measuring time for the outer shape of a catalytic converter or DPF to allow a reasonable throughput. Measuring distance range: 100mm / 200mm

In most cases a distance range of 100mm is sufficient with the profit of a better optical solution. In some cases a bigger distance ranges required e.g. for truck catalytic converters or DPFs.

LTS laser sensor

Alternatively to the laser point triangulation sensor a laser line scanner can be used. In this case the sample height, the presence of dents, edge chipping, regularity of end faces etc. can be detected.

Multi-laser sensor

In special cases a tandem sensor setup comprising of a laser point triangulation and a laser line scanner can be mounted.



Top view of the rotary table with mounted axis camera



Code reader on positioning rail



Electronic mat scale

Axis Camera

The rotary stage can be equipped with a camera inside the center bore of the rotation axis. This camera recognizes code labels on monoliths and canned converters. Moreover, it will be an important assembly for matching the monolith's orientation during the canning process, if elliptical or asymmetric monoliths are used.

Code Reader

A scanner assembly unit, used for bar code and/or DMC code reading can be attached to the system rack. The scanner head is mounted to a positioning rail to align it for an optimum viewing angle onto the sample under investigation. Reading bar and/or DMC codes within the measurement cycle is more often required for product identification and product tracing.

Handheld Scanner

Alternatively to the fixed mounted code reader, a handheld scanner device to be manually used by operators can be employed.

Scale

Especially for GBD evaluation the particular mat weight needs to be measured and the result is to be forwarded to the canning machines. For this purpose an electronic scale can be implemented in *InnoMeas* systems. The scale can be employed to determine the weight of the catalyst substrate as well.



Label printer on rack tray

Label printer

A small foot print printer device, located on a rack mounted tray for printing bar code and/or DMC code labels for identification of measured samples. In combination with the axis camera printed labels are used for matching the orientation of elliptical or asymmetric substrates during the canning process.



Control button assembly

Control button assembly

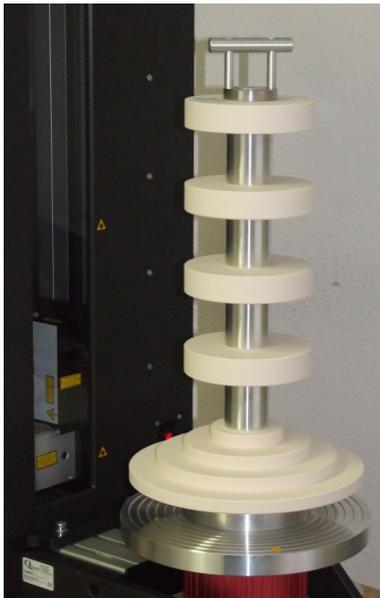
Robust, illuminated 4 buttons for operator control in a separate housing connected by a cable. A separate big green coloured start button is used for starting InnoMeas functions defined in the measurement plan template.



Stacked lamp assembly

Stacked lamp assembly

Conspicuous colored lamp mounted on top of the system rack for displaying the system status



Standard calibration tool for InnoMeas CMS systems



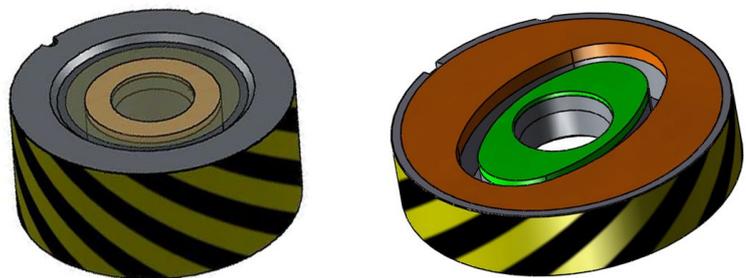
Special calibration tool for InnoMeas HS systems (see following page)

Calibration Tools

However, when hooking up an *InnoMeas CMS system*, the entire setup needs to be calibrated. A frequent repetition of this calibration procedure is recommended. The calibration procedure runs widely automatic guided by the software. It requires a certified calibration tool placed on the rotary table. Qsigma offers calibration tools, certified by a DKD authorized laboratory, dedicated to the particular system layout and the particular application.

Support rings for devices under test

Especially in production process, when the InnoMeas systems are manually loaded, Qsigma offers tool sets for holding the devices under test (DUT) in specified positions. These tooling parts will be machined according to detailed DUT drawings provided by the customer.



Customized support rings for a round and an oval automotive catalytic converter



Full automatic performance

Operated by robots

Very low measurement time

Low maintenance

High duty cycle

Small footprint

Designed as a component of a process chain

InnoMeas CMS HS

InnoMeas CMS HS is newly developed investigation system for automotive catalytic converters with a special respect to an enhanced duty cycle.

The set up of the measurement unit and the rotary table ist tilted by 90° into a horizontal position. The device under investigation is fixed by a special automated clamping device.

Loading and deloading are performed by a robot.

InnoMeas CMS HS shall be integrated into a fully automatic product line. The system IPC gets all commands from a superordinated computer, which controls the entire production process.

All capabilities are optimized for high throughput, low maintenance and high maturity.

The InnoMeas RMS systems are designed as stand alone comprehensive inspection systems. All processes like feeding the devices under investigation, coarse pre-inspection, inspection of particular details etc. are controlled internally by the InnoMeas RMS station itself. Part loading and deloading can be achieved by robots or manually. However, InnoMeas RMS systems can be embedded in an automated production line.



1: Measuring chamber

2: Feeding station

**3: Device under test (DUT):
i.e. car alloy wheel**

**4: Monitor for DUT
position & centering**

5: Safety light curtain

6: Operator's push button assembly

**7: Handheld scanner for DUT
identification**

8: Monitor for displaying results

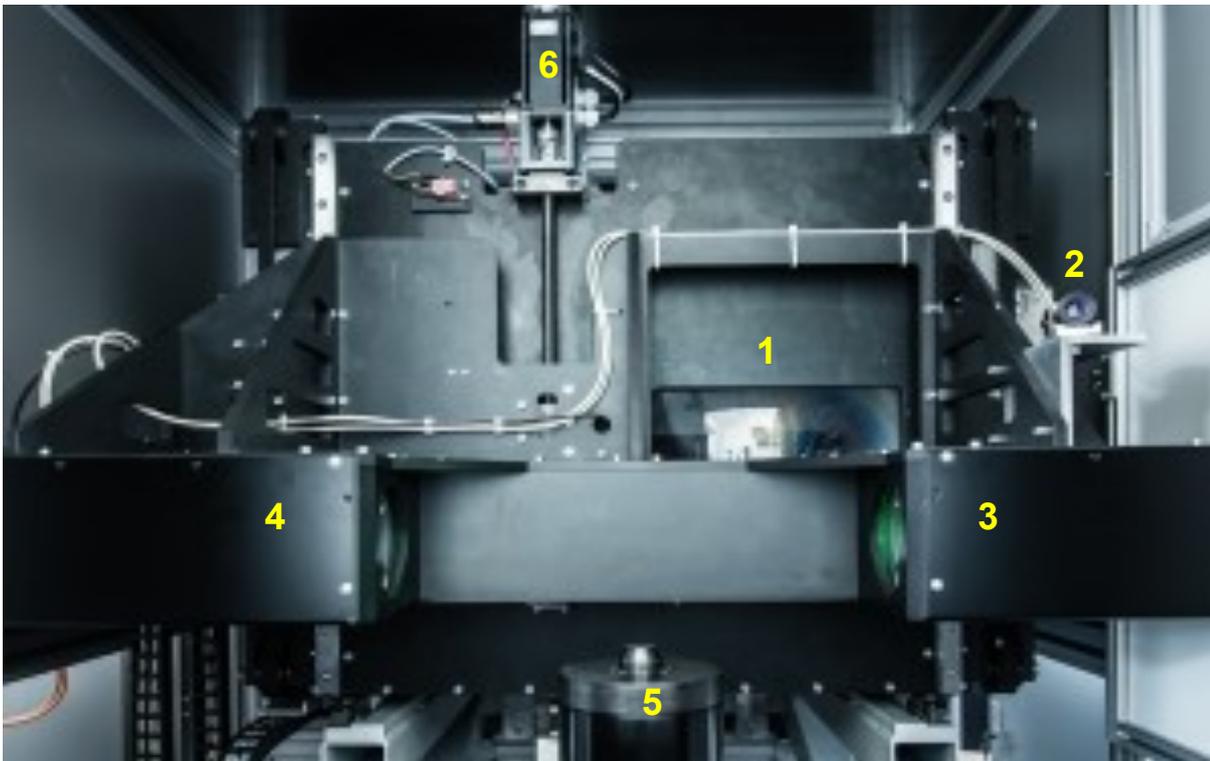
Measurement Chamber

When the device under investigation has been moved into the measurement chamber it is set to a fixed position, e.g. on a rotary stage for widely rotational symmetric parts,

A dedicated measurement procedure is launched. Usually this procedure consists of a sequence of application related measurement steps, e.g. a coarse overall pre-inspection followed by a precise measurement of particular features of the device under test. Intermediate results are displayed and compared with related reference values.

Final results can be displayed and stored as local values (e.g. in polar, cylindric or Cartesian coordinates) or as averaged over height and/or circumference with a survey of local deviations. Restrictive or warning limits can be preset. Related alerts are displayed on the screen.

Example for a setup of a measurement chamber



Coarse inspection system:

- 1: Illumination assembly
- 2: Imaging camera

Precise measurement system:

- 3: Telecentric illumination
- 4: Telecentric imaging

Positioning system:

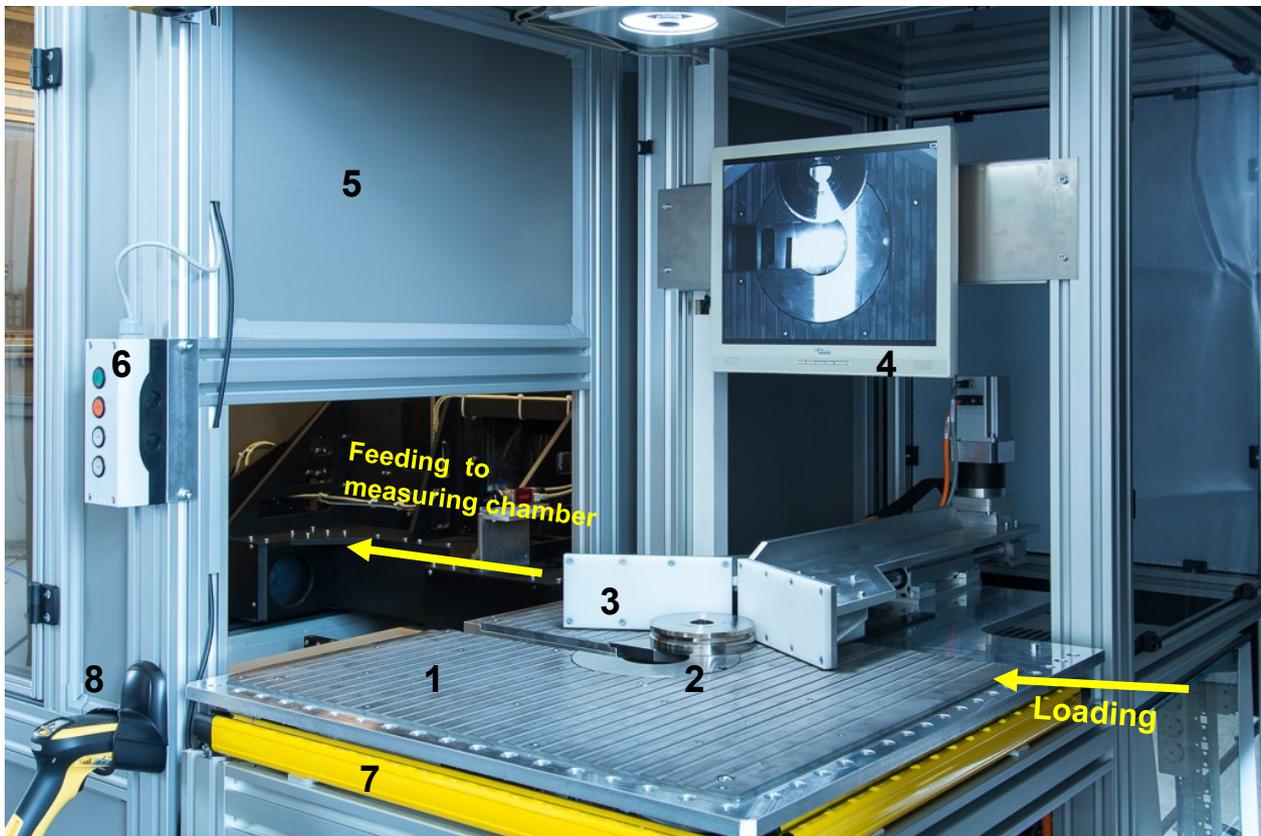
- 5: Rotary stage
- 6: Traverse assembly for height adjustment

Feeding station

Especially, when the parts under investigation are manually loaded and unloaded, a precise positioning is required. In the measuring chamber a reasonable space for illumination and vision angles is required. Additionally geometrical suppression of straylight and ambient light must be achieved and needs space as well. Contamination by e.g. dust particles must be drawn to a minimum at that.

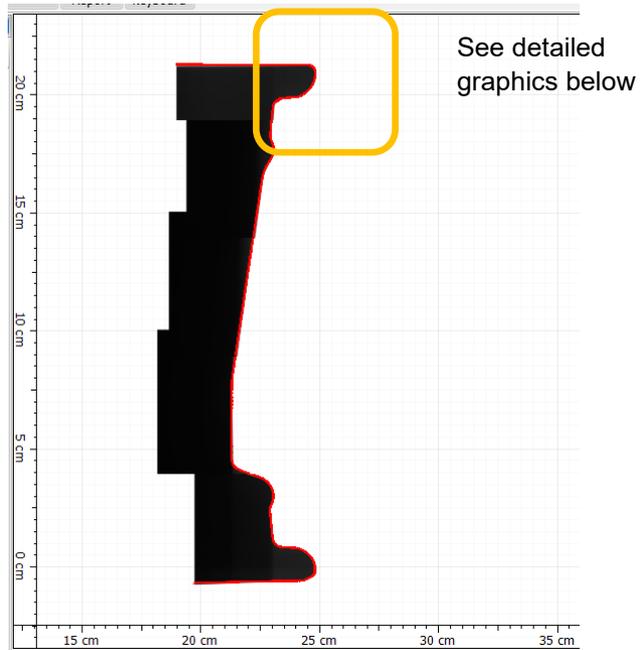
Therefore centering and positioning devices are placed outside the measuring chamber. Moreover, it allows convenient and safe handling of even heavy samples. The samples only need to be placed on the loading desk. Positioning and subsequent feeding to the measuring chamber will follow under computer control.

Potential layout of a feeding station

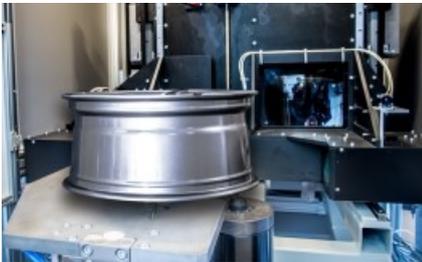


- | | |
|--|---|
| <ul style="list-style-type: none">1: Loading desk2: Sample holder for centering & feeding to the measuring chamber (in downward position)3: Pushing actuator for placing the sample onto the sample holder | <ul style="list-style-type: none">4: Observation screen5: Door to measurement chamber (in upward position)6: Operator's push button assembly7: Light curtain for worker's safety8: Handheld scanner (sample identification) |
|--|---|

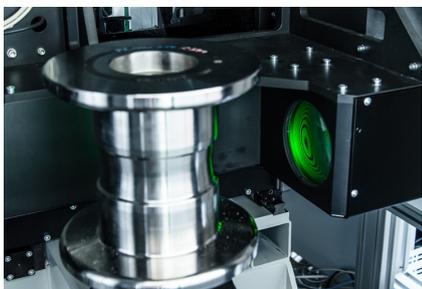
- Rolls and reels
- Spindels and shafts
- Gear wheels
- Cartridges
- Pistons
- Wheels
- Containers e.g. for foods or chemicals
-



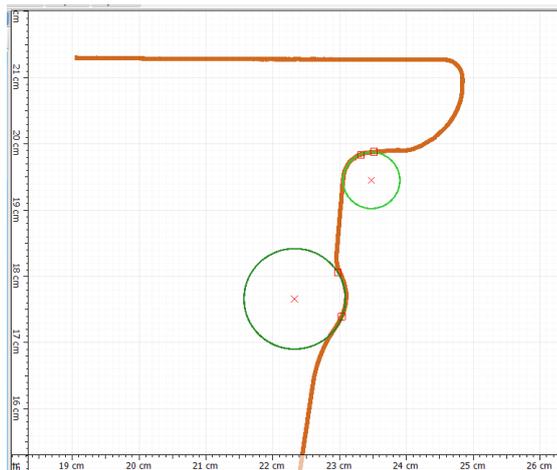
Evaluation of the contour of car a alloy wheel



Alloy wheels



Sheet metal forming rolls

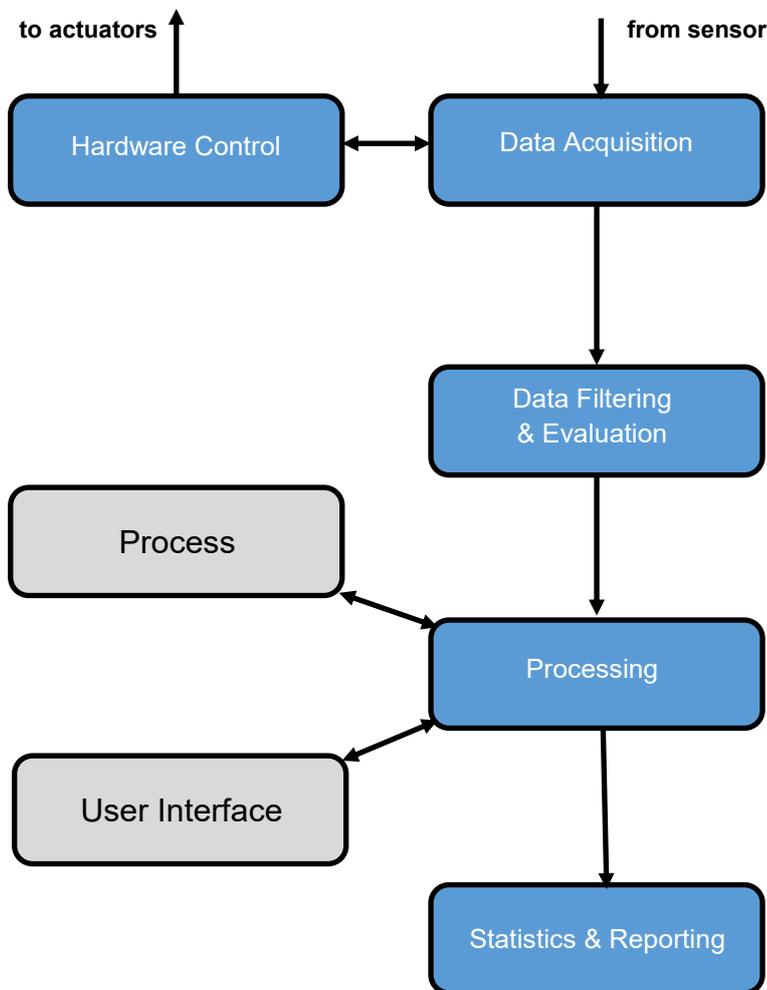


Evaluation of the contour of a car alloy wheel
i.e.: determination of contour slope radii



The brain of Qsigma's inspection systems is the *InnoMeas* software. Its modularity warrants keeping pace with changing requirements. Based on Windows operating systems the programming architecture is compatible to newly launched Windows operating systems using Microsoft Dot Net Framework.

Flexible window structures provide adaptations to the particular user requirements, different operational levels can be set and stored. Measurement templates can be created by the user himself or, alternatively, Qsigma offers it as a part of the comprehensive after sales support. The creation of templates as well as entire measurement and evaluation sequences is supported by dedicated wizards.



Updating the evaluation and its algorithms is self evident to improve the effectivity of computing. Even the evaluation process can be adapted to particular requirements.

Necessary requests of user interactions can be programmed. Alert values for quality control can be set.

Communication with the plant control system is important and of central value within the *InnoMeas* software. Interfacing with certain production line manufacturers already exists. The *InnoMeas* software supports interface to fieldbus systems (Modbus, EtherCAT, ProfiNet, etc.). A comprehensive data export structure (.csv, .pdf, .dfq, flexible data base input and output, export to Excel spread sheets etc.) rounds off the package.

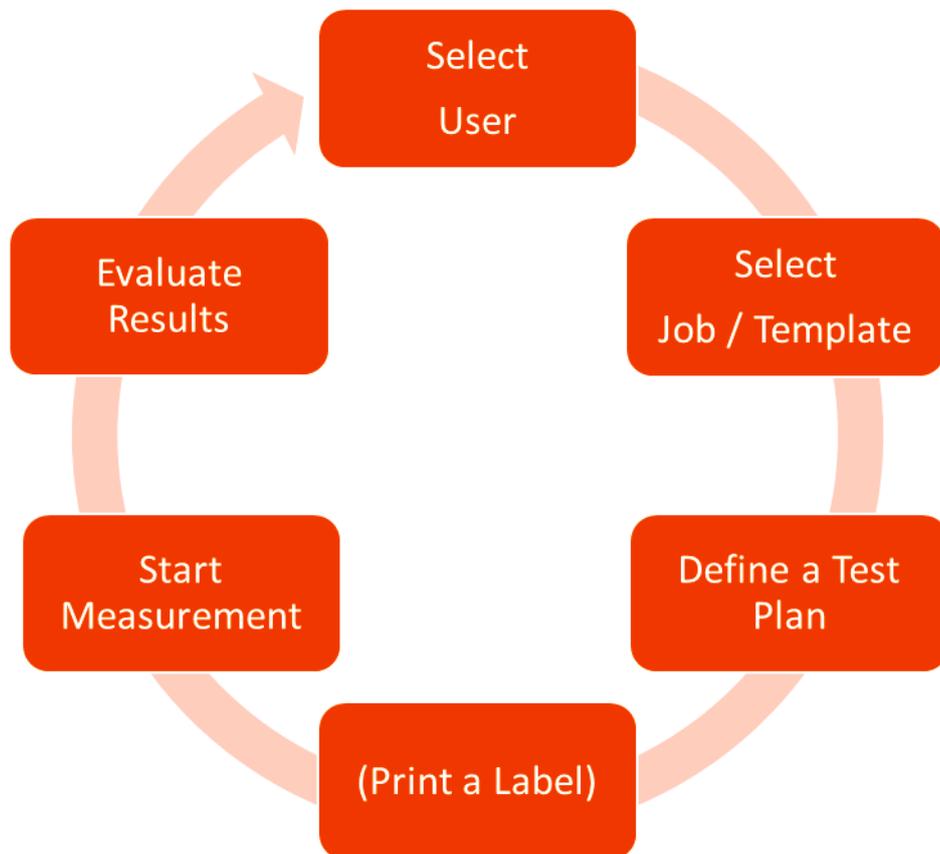
Optionally a package for statistic evaluation (e.g. process capability) and reporting can be added.



The operative scheme below displays functional steps of the InnoMeas software. They are to be worked off sequentially when starting InnoMeas. However individual steps can be skipped, e.g. if the same operator runs different measurements, the operator must not do a new login for each job.

After logging in, the operator selects a particular job and selects or defines a test plan. Label printing is not a compulsory step. The label serves for identifying parts under investigation and can be used for orientational matching of e.g. before and after processing.

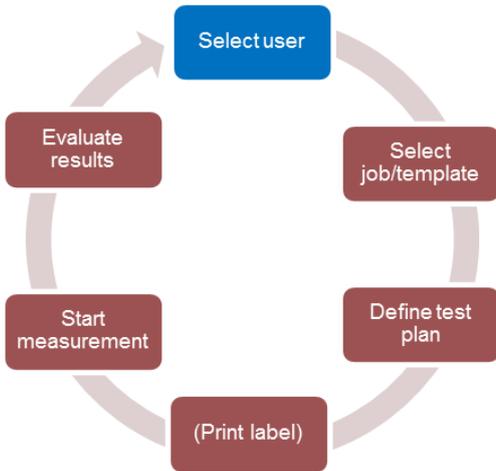
Starting a measurement activates sensors and actuators to perform according the measurement plan. After finishing the measurement, results are displayed and a variety of evaluation tools can be applied.



Operative Scheme of the InnoMeas Software

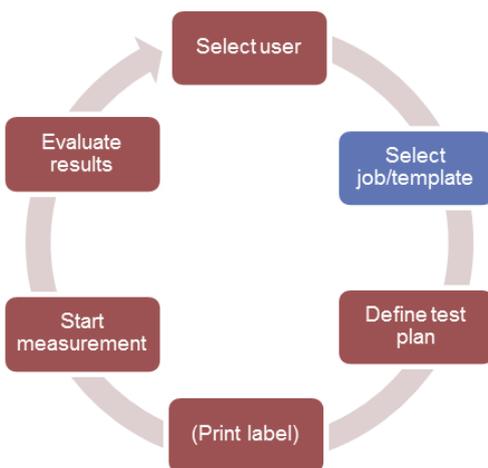


InnoMeas operation sequence



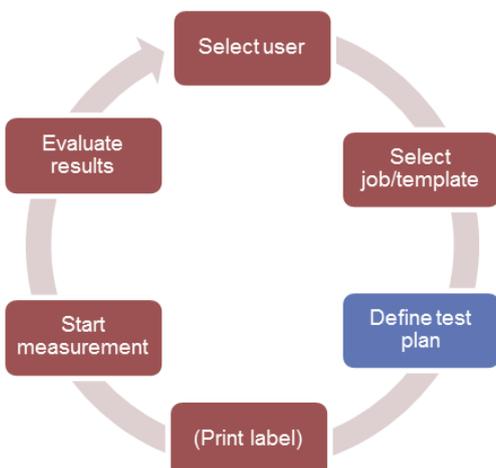
In the first step a user can be selected from a pull down menu. Automatically all allocated user attributes are set.

Alternatively a user can be added and attributes can be selected. There are certain user levels available ranging from a low level operator to a high level sophisticated supervisor.



The second step is the selection of a job (i.e. a group of similar measurement tasks)

However, new jobs can be created as well.

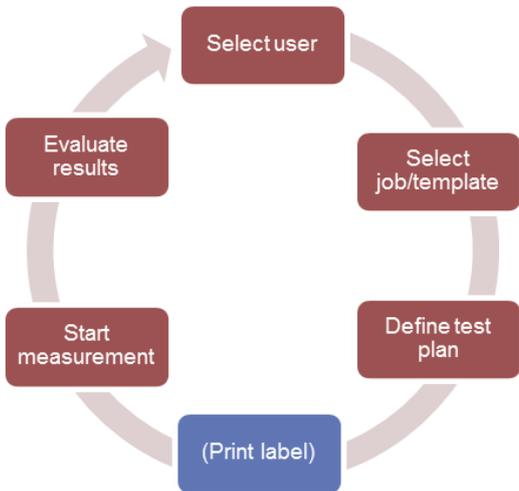


A measurement template is selected in the third step. A template defines the measurement parameters and controls the measurement process. A single part under test can have several templates e.g. offline „test“ measurement or a measurement with connection to the data base for filing the results.

New templates can be created by modifying existing templates or completely editing a new one. Implemented wizards give intuitive assistance.

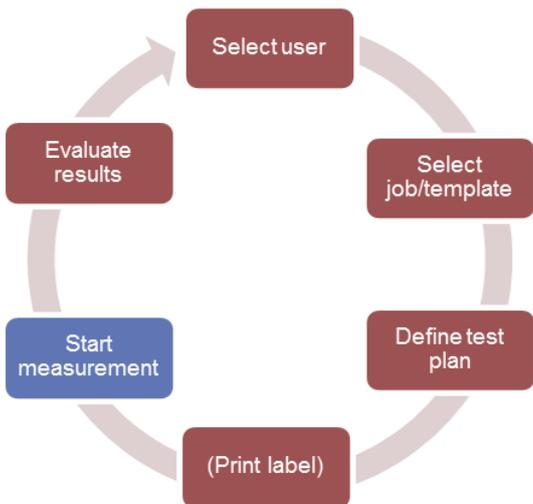


InnoMeas operation sequence

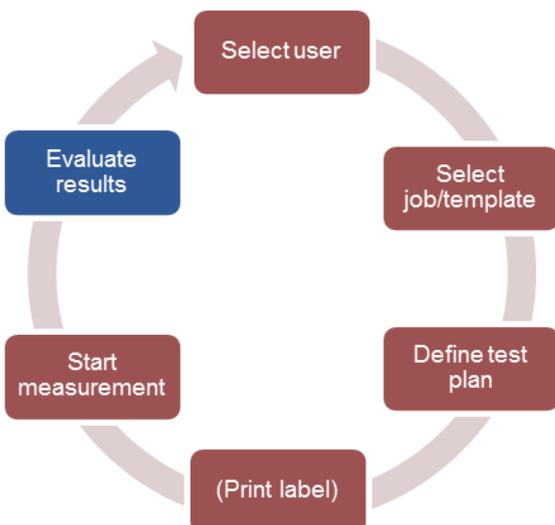


If desired, an identification label (e.g. DMC code) can be printed. The label serves for part identification as well as for orientational matching before and after processing the part under investigation

If no label is printed, the matching is achieved with respect to the nominal contours.



Depending in which way the measurement system is equipped, the measurement process itself can be started by a mouse click, a touchscreen command or a separate operator button, respectively.



After finishing the measurement process, the results are displayed. Colors can be set to display limit violations. More detailed evaluation can be done manually, if the automated evaluation set in the template requires further inspection.



After finishing the measurement process results are displayed. The screen shows summarized information about the selected operator, measurement job, test plan, part ID etc..

All computed values according the test plan are shown and collected in a spread sheet. Background colors in the spread sheet indicate, if the values are in the tolerated limits or if warning or tolerance limits given in construction drawings are violated. So the character of the results can be checked at a glance. Corresponding to the spread sheet important result values can be displayed in graphics with proper magnification. Violation of limits is color coded as well.

User: 999 Qsigma
 Job: 2015-06-22_Demo
 Part Type: Default-R09
 Test Plan: (Select test plan)
 Part ID: V_56524FG

10 x 0.065 g/cm³ : 1 mm

Step	Result
✓ Shell-Canning-Evaluation	CM = 6,54381...
✓ Shell-Measurement	OK
✓ Shell-Evaluation	Dev = 0,98994...
✓ Gap-Evaluation	G = 3.529 mm
✓ Gbd-Evaluation	GBD = 0.496 g...
✓ Shell-Calculate-GbdDeltas	OK
✓ Shell-Check-Results	OK
✓ Shell-PDE3-Traceability	Results commit...

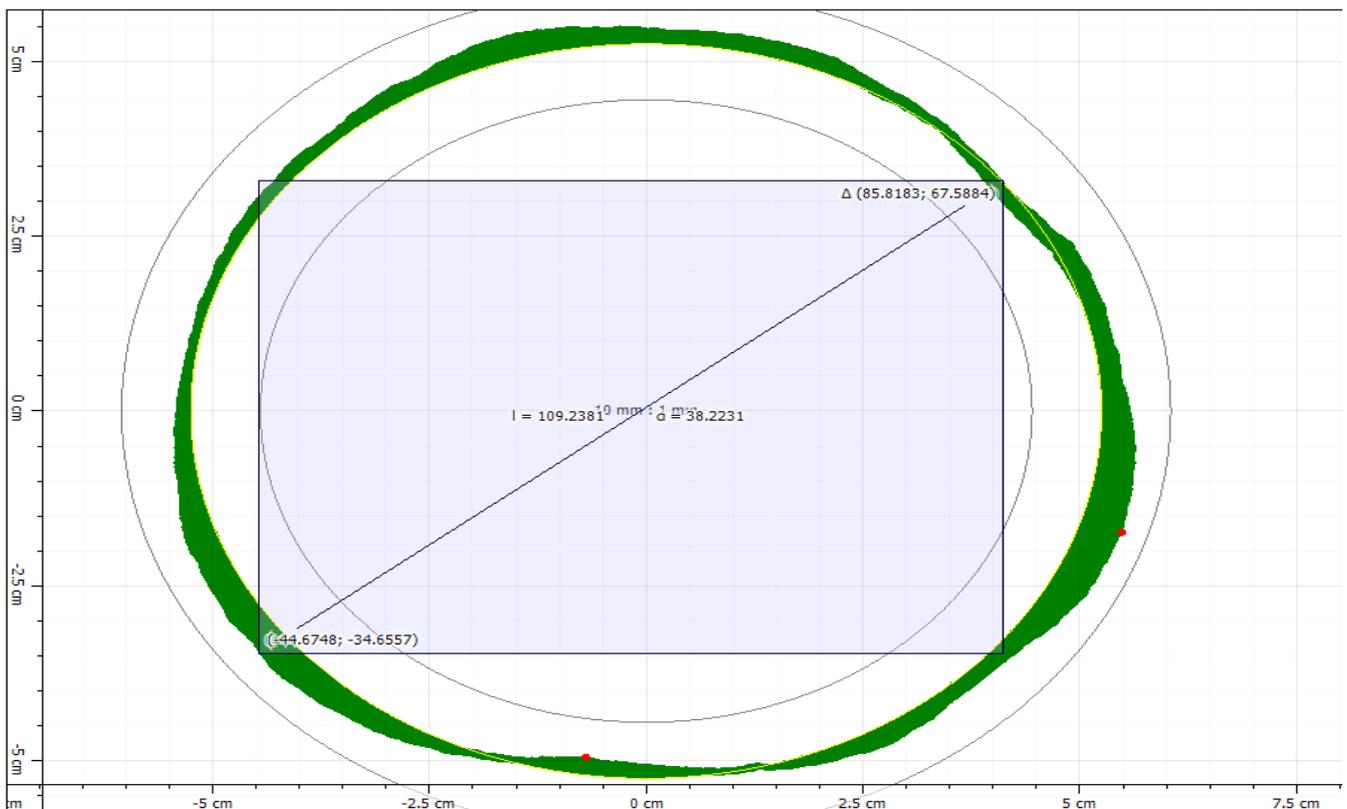
Name	Value	Nominal Value	Tolerance Neg	Tolerance Pos
GBD	0.496 g/cm ³	0.470	0.060	0.070
GBDMin	0.400 g/cm ³	0.470	0.060	0.070
GBDMax	0.632 g/cm ³	0.470	0.060	0.070
GbdAverageValues	{0.487; 0.505} g...			
1	0.487 g/cm ³	0.470	0.060	0.070
2	0.505 g/cm ³	0.470	0.060	0.070
GbdMaxValues	{0.589; 0.632} g...			
1	0.589 g/cm ³	0.470	0.060	0.070
2	0.632 g/cm ³	0.470	0.060	0.070
GbdMinValues	{0.400; 0.418} g...			
1	0.400 g/cm ³	0.470	0.060	0.070
2	0.418 g/cm ³	0.470	0.060	0.070
GbdSDValues	{0.044; 0.045} g...			
1	0.044 g/cm ³	0.000	-	-
2	0.045 g/cm ³	0.000	-	-

Measurement results of an automotive catalytic converter

- Upper left: General selection of the user, measurement job and the device under test
- Upper right: Individual test steps of the measurement plan, worked off steps are marked with a green tick
- Lower left: Overview graphics about the measurement values (magnified)
The color indicates, whether the measurement results are within preset limits (green) or if a violation of warning limits (yellow) or tolerance limits (red) has occurred
- Lower right: Detailed measurement values including nominal values and tolerance limits are summarized in a table.
The background color indicate values within the preset limits (green) or violation of warning limits (yellow) or violation of tolerance limits (red)



After the overview display of results, e.g. in prototype development, some detailed data are to be extracted. *InnoMeas* offers detailed views with accompanied individual evaluation tools.



Detailed evaluation of measured substrate of an automotive catalytic converter

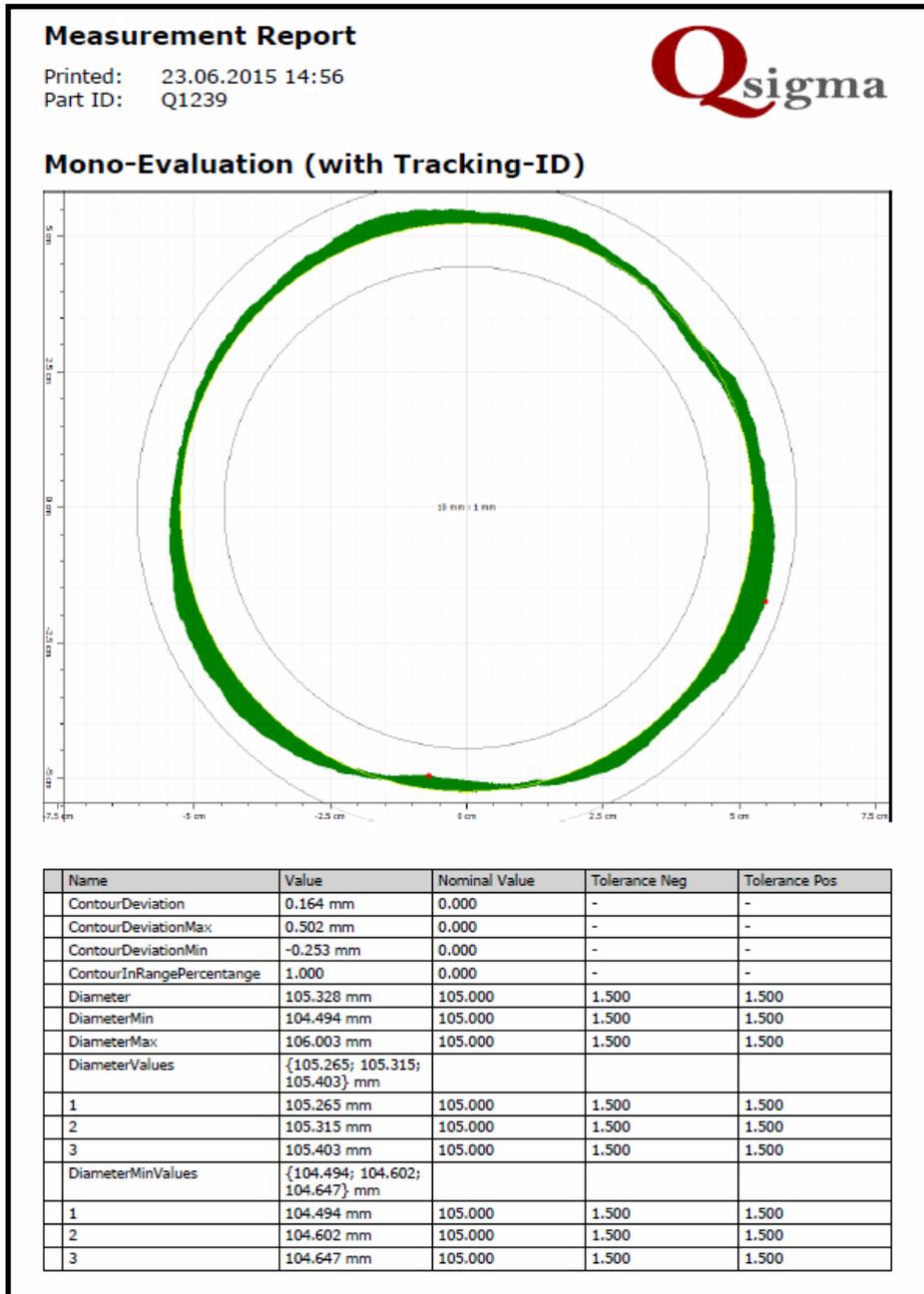
In the graphics above, a precise local diameter evaluation of an automotive catalytic converter's monolith is shown.

InnoMeas offers different tools for detailed manual evaluation like the measurement of dimensions, fitting tools, overlay of various contours etc..

All these particular analysis steps can be included in individually designed reports (see next page)



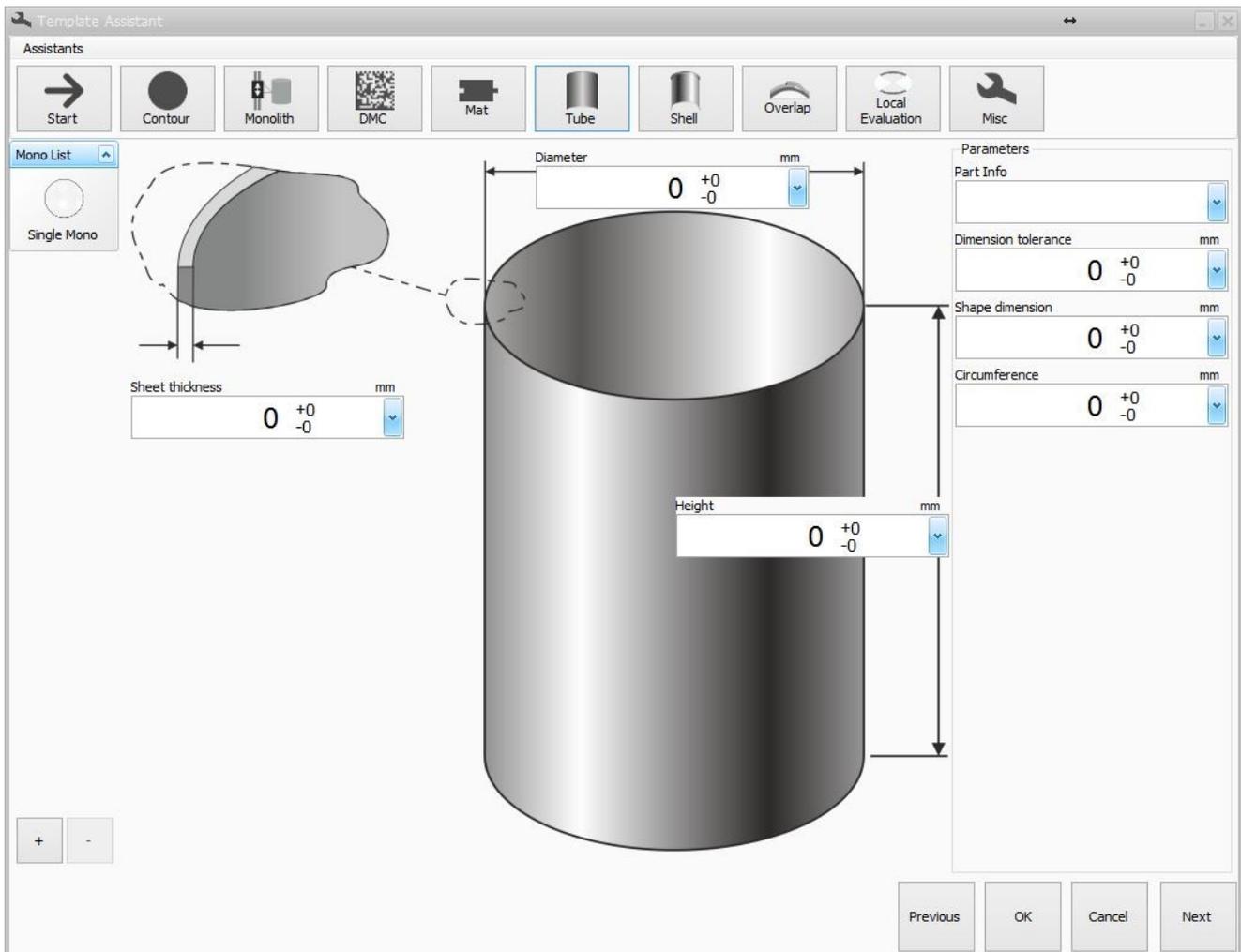
Beyond displaying and individual evaluation *InnoMeas* offers reporting capabilities, which may be utilized for statistical examination or quality control monitoring.



Example of a measurement report in .pdf format provided by the *InnoMeas* software. The report layout can be edited according customer's requirements. Except .pdf, export via other data formats like .xls, .cav etc. are possible additionally. Moreover, the format .dfq for reports with qs-STAT is available as well.



Creating measurement templates or recipes can be time consuming especially when there is a frequent change in produced parts or measurement task as it may occur in e.g. prototyping labs. Even in production lines, changing measurement templates must be done quick and easy. InnoMeas offers a variety of assisting wizards aiding intuitively the creation of measurement templates or recipes.



Example of a wizard assisted preparation of a measurement

With the above template wizard the measurement sections of a monolith of an automotive catalytic converter can be edited. Except this particular assistant, many steps in the *InnoMeas* software are guided by dedicated wizard assistance. So templates and measurement recipes can be easily and straight forward edited by the operating staff trained on a first level. No sophisticated knowledge of the measurement process itself is required.

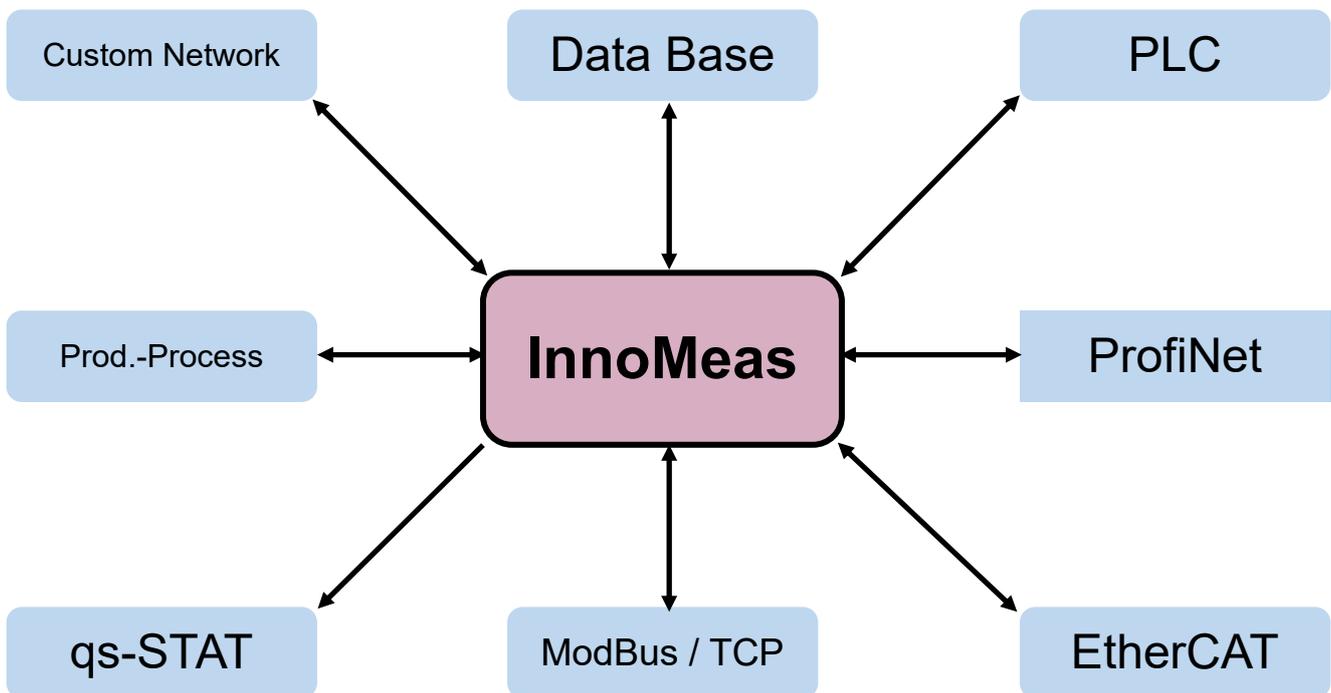
However, Qsigma offers training classes on several levels dedicated to the particular requirements of customer's staff.



InnoMeas communication capabilities

The InnoMeas software is not an isolated device. Communication is one of the key features of InnoMeas.

InnoMeas controls the measurement itself and cares for computing results with respect to customer's requirements. And, moreover, it implements a communication gateway for the exchange of production parameters, process line status messages, process control commands, data filing, data reporting etc..



Excamples of data exchange capabilities supported by InnoMeas software

Next to controlling the internal processes in the measurement system itself the *InnoMeas* software is the gateway of command and data interchange with external devices. *InnoMeas* supports a variety of interfaces and protocols as well as data exports using definite formats like e.g. .dfq for qs-STAT reporting and process statistics or simple Excel spread sheets.

Thus *InnoMeas* systems can be easily implemented in existing data and command structures of superordinated processes. Moreover, *InnoMeas* can keep pace with future innovation steps.