

Complete Pipe Measuring and Inspection System

PROBIUS Ultimate

User manual

Rev. 2.1.1 20/10/2021

Laserscan LLP
mail@laserscan.kz
www.laserscan.kz

Index

1. Safety precautions 3
2. Signs used in the manual 3
3. Electromagnetic compatibility 3
5. Application 4
6. Specification 5
   6.1. Features and Measurable parameters 5
   6.2. Metrological characteristics 5
   6.3. Power 5
   6.4. Recommended operation conditions 6
   6.5. Contents of delivery 6
7. Design and principle of operation 7
7.1. Basic 7
7.2. Centering 9
7.3. Communication unit 11
7.4. Calibration stand 11
7.5. Software 13
8. Operation 18
8.1. Preparation for work 18
8.2. Measurement of the diameter and other geometric values 21
8.3. Working with the measurement results 23
8.4. Shutting down procedure 28
9. Maintenance 28
9.1. General instructions 28
9.2. Maintenance of the cable connectors 28
9.3. Checking device functionality 28
10. Calibration of a rotating scanner 29
11. Storage and preservation 31
12. Repairs and troubleshooting 31
13. Warranty 32
14. Recycling 32
Appendix A – Probius connection schematics 33

1. Safety precautions

- Before you begin working with PROBIUS carefully study the user manual and other documents supplied with the system.
- Use a standard power supply and cables listed in the specifications.
- When connecting/disconnecting cables, the power supply must be turned off.
- Do not use cables with damaged insulation and connectors.
- Do not take measurements on dirty surfaces or lubricated surfaces.
- Keep measuring device away from rain and direct sunlight.
- Avoid direct eye and skin exposure to the laser beam.

2. Signs used in the manual

The "Attention" sign: pay attention to the warning signs to avoid typical mistakes when operating the device.

The "Information" sign: Useful information.

3. Electromagnetic compatibility

The system is designed for use in industry sectors and compliant with the following standards:

- EN 55022:2006 Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement.
- EN 61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments.
- EN 61326-1:2006 Electrical equipment for measurement, control and laboratory use. EMC requirements. Particular requirements. Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications.

4. Laser safety

Rotating laser scanner and straightness laser module contains a visible laser diode emitting continuous radiation. Both lasers meet the following laser safety classes according to IEC/EN 60825-1:2014.

	Wavelength	Power	Safety class
Profile scanner	660 nm	≤4.8 mW	3R

Warning labels are placed on the probe body.

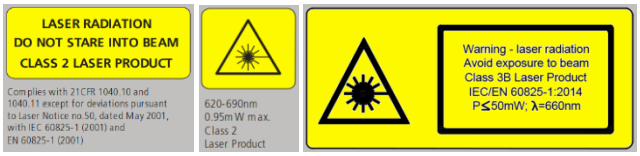


Fig.1 Labels

When working with the instrument take the following safety measures:

- do not aim the laser beam at people;
- do not look into the laser beam directly or through optical instruments;
- install the system in such a way so that the laser beam is above or below eye level;
- when working with the device, it is highly recommended to use protective goggles;
- do not disassemble the probe, laser module;

5. Application

The system is designed for semi-automatic measurement and check of geometrical parameters of the inner surface of the cylindrical objects.

The system can be used as a tool for quality control of various products and equipment with parts of cylindrical shape with smooth inner surface. The system can also be used to check geometry and assess wear and tear of:

- smooth pipes;
- extruders;
- hydraulic cylinders;
- precision cylinders, etc.

6. Specification

6.1. Features and Measurable parameters

	Basic	Option
Fully automatic non-contact measurement Measurable parameters		
- Internal diameters of the cylindrical elements	*	
- Deviation from the form,i.e.,roundness (ovality,etc.)	*	
- Angle of probe rotation around pipe longitudinal axis relative to the horizon	*	
Calibration of the system		
- Calibration module for laser scanner self-calibrating	*	
Other features and functions		
- Local database for measured results	*	

6.2. Metrological characteristics

Parameter	Value
Inner pipe diameter, mm:	65-125
Max pipe length, m	Up to 20
Distance from the pipe end to the checked section, mm	170...20 000
Angular resolution of the scanner (points per 360°)	18000
Accuracy	**Value**
Inner pipe diameter, mm:	± 0,01
Deviation from roundness, mm	± 0,01
Deviation of shape of the profile (2σ), mm	± 0,03

6.3. Power

Parameter	Value
Voltage	110V 60Hz ,220 V 50 Hz
Power consumption, not more	200 W

6.4. Recommended operation conditions

Parameter	Value
Operating temperature	+10...+ 35 ^{O}S.
Storage temperature	- 50...+ 65 $^{\circ}$ C
Humidity at +35 $^{\circ}$ C	up to 98 %
Atmospheric pressure	450..780 mm Hg.

6.5. Contents of delivery

Name	Quantity, pcs.
Measuring probe	1
Communication unit	1
Power supply	1
Set of connecting cables	1
Set of rings	1 per diameter
Case	1
Software	1
User manual	1
Quality Certificate	1
Calibration Certificate	1

Name	Quantity, PCs.
Rod for manual movement	4
Calibration stand for laser scanner	2

7. Design and principle of operation

7.1. Basic

A system in the basic configuration performs non-contact scanning of its radial sections, measuring the following geometric parameters:

- diameter;
- diameter at vertical section;
- diameter at diagonal section;
- ovality,

To begin measurements a probe is installed inside a pipe. The probe is centered inside the tube by interchangeable legs. Movement along the pipe is performed manually by multisection rod. Each section is 650 mm long. The power of the probe and data transmission from/to PC is supplied by the cable connected via the communication unit.

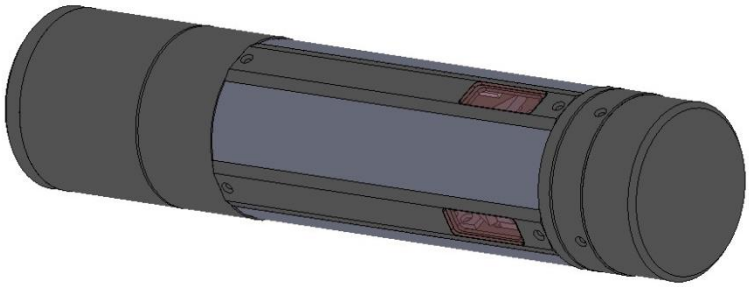


Fig.2 The probe. Basic configuration

To measure the pipe, the probeis consistently moved to the required cross-section. The position of the probe relative to the pipe edge is monitored by an operator using a marking with a step/increment of 2 mm.

The software allows to:

- see the values of calculated geometric parameters;
- enter manually the location of the check section relative to the pipe edge;
- configure the system;
- generate a data log of scanned pipe.

Measurements are performed by the probe, which consists of:

- rotating laser scanner;
- electronics unit;
- centering rings;
- back-end connector.

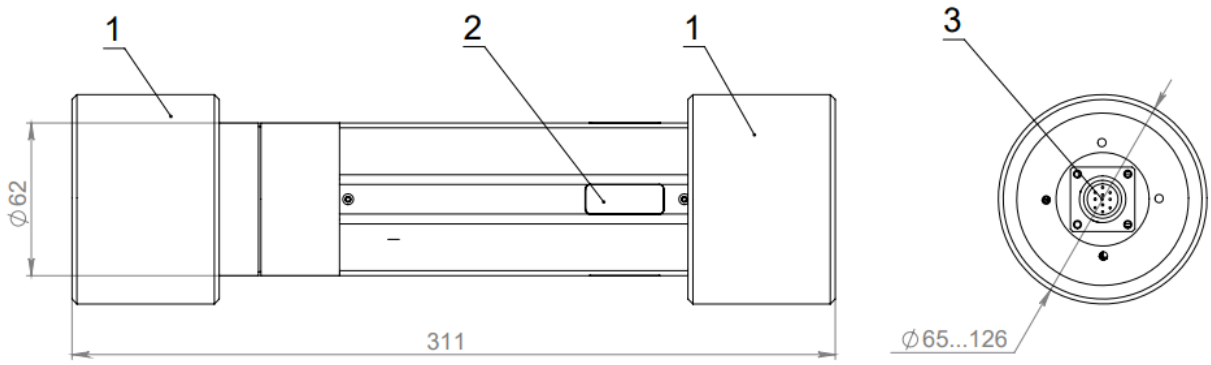


Fig.3 The probe (in basic configuration):

1.centering rings; 2. sensor window of the rotating laser scanner;3. back-end connector

The main module of the probe is a rotating laser scanner. Each laser scanner contains from one to six (depends on chosen configuration) radially arranged laser triangulation sensors (see. Figure).

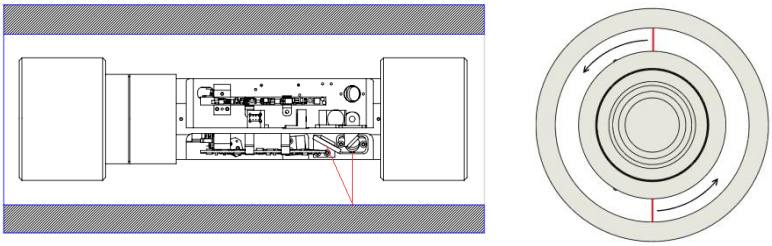


Fig.4 Location of triangulation sensors inside the measuring head.

To obtain a profile of a scanned cross-section, rotating laser scanner makes a few complete revolutions, thereby getting a full information of the cross-section.

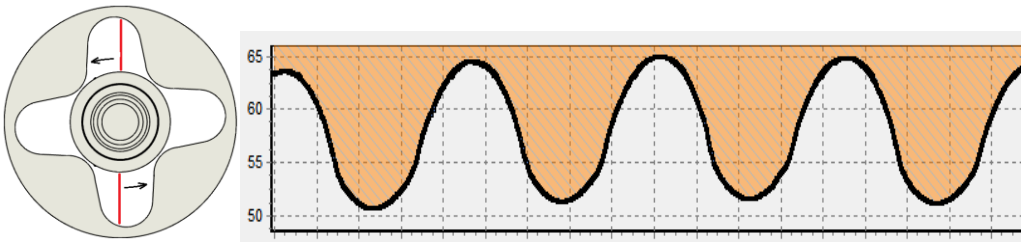


Fig.5 Cross-section profile

Depending on a controlled diameter, rotating laser scanner may contain from 1 to 6 sensors in order to cover a full measurement range. In this case, each sensor has a measurement range which overlaps the range of adjacent sensors.

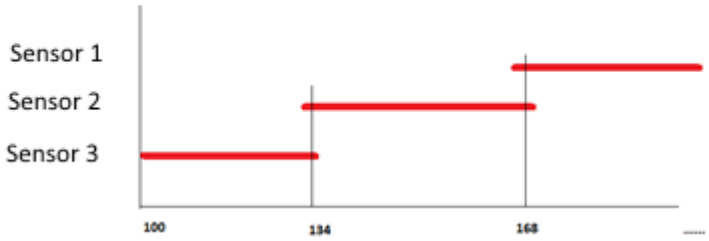


Fig.6 Overlapping measurement ranges

The magnetic ring encoder placed inside the laser scanner provides the value of the rotation angle.

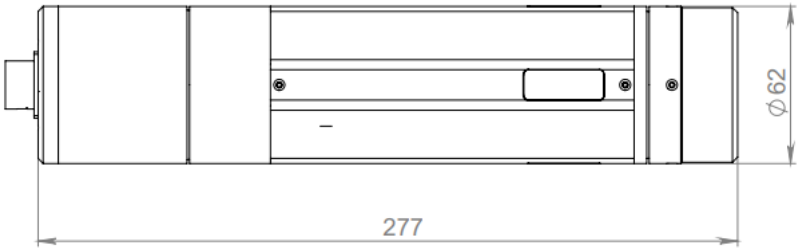


Fig.7 Overall dimensions of the probe

7.2. Centering

Basic configuration of the probe is equipped with the simplest centering elements.

Centering kit for one particular diameter include:

- 2centering rings
- 4 screws

Centering rings allow to stabilize the position of the probe inside the pipe, roughly align the axis of the device and the axis of the pipe, eliminate all the distortions of the probe which influence accuracy of the measurement.

Each centering ring allows taking measurements in tubes which diameter is up to +3 mm larger than the ring diameter.

Probe is equipped with the rings shown in the following table:

Ring #	material	Allowed diameter, mm
65	brass	65.0 – 68.0
70	brass	70.0 – 73.0
72	brass	72.0 – 75.0
73	brass	73.0 – 76.0
85	brass	85.0 – 88.0
87	delrin	87.0 – 90.0
88	delrin	88.0 – 91.0
90	delrin	90.0 – 93.0
100	delrin	100.0 – 103.0
105	delrin	105.0 – 108.0
106	delrin	106.0 – 109.0
107	delrin	107.0 – 110.0
116	delrin	116.0 – 119.0
117	delrin	117.0 – 120.0
120	delrin	120.0 – 123.0
124	delrin	124.0 – 127.0
125	delrin	125.0 – 128.0
126	delrin	126.0 -128.0

Centering elements of any kind are removable that allows you to replace them with the new ones when worn out or replace them when you tune the probe to another pipe diameter. The process of replacing is simple and takes just a few minutes.

- disconnect the probe from the communication unit
- remove 4 screws on the top and bottom of the probe
- remove centering ring
- install a new one
- fix 4 screws into their positions

7.3. Communication unit

The Communication unit is designed to provide information exchange between PC and measurement system, and generation of supply voltage to the probe.

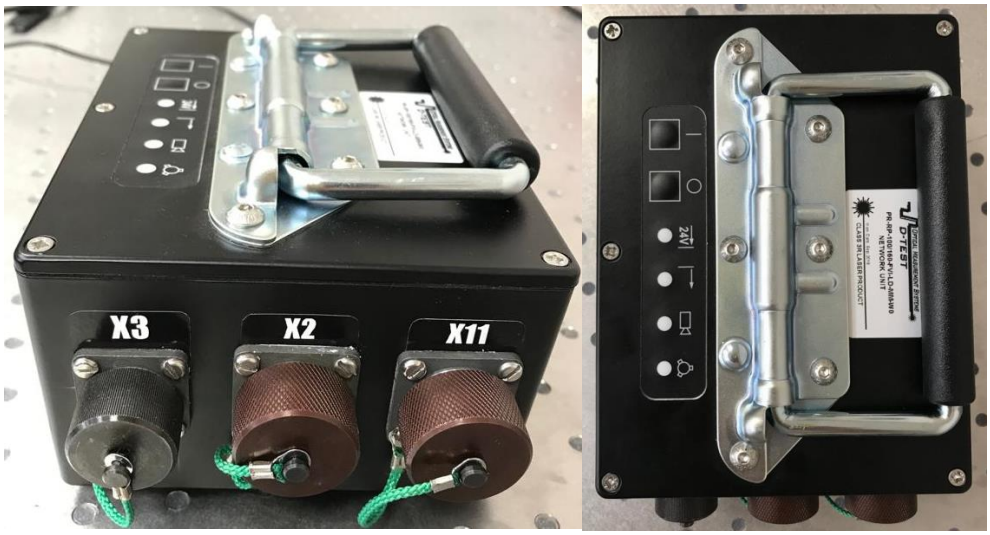
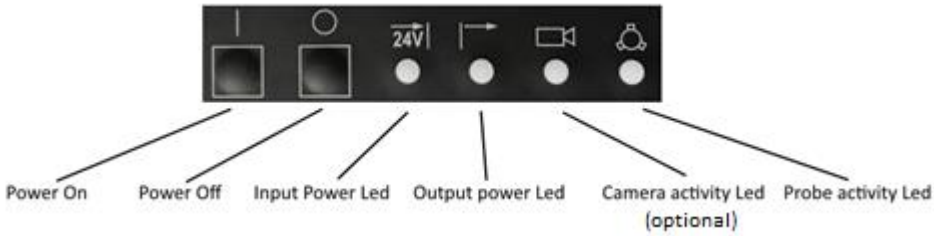


Fig.8 Communication unit

Connector	Function
X2	Connecting the measuring probe
X3	PC connection
X11	Power supply connection



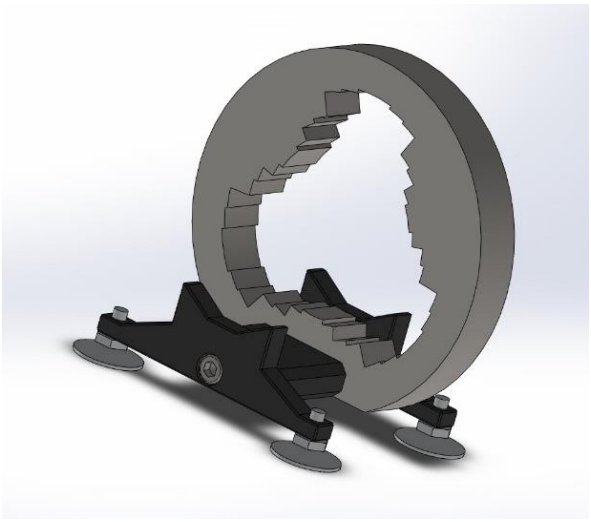
7.4. Calibration stand

Calibration stand is used to calibrate and check accuracy of the profile measurement included in specification by default. Stand consists of:

- step ring gauge;
- the cradle.

The diameter of the inner surface of the ring-the caliber is changed stepwise (3 steps for each diameter) and cover the entire working range of the scanner.

Ring caliber comes with a certificate of calibration to ensure traceability.



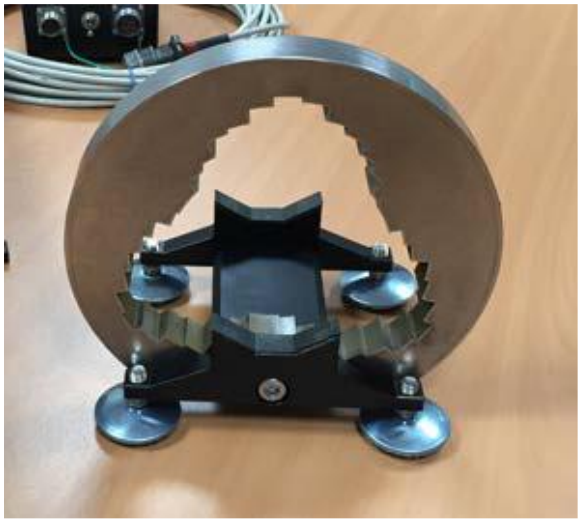


Fig.9 The appearance of the stand CAL1
for the calibration of a rotating laser head.

Due to large diameter measurement range the probe is equipped with 2 calibration stands #65-95 and #100-126.

The cradle of the stand is manufactured depending on the design of the probe (in MM or SMAC) and allows to put the probe coaxially with the ring of the caliber excluding the probability of an erroneous calibration.

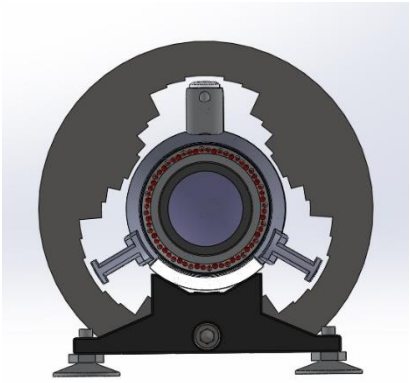


Fig.10 The calibration bench CAL1 with a probe

7.5. Software

Software is shipped in an executable file and can be installed on any PC with an Ethernet connector.

The composition of the working window of the program changes depending on the set options chosen for the device. Operator inputs information listed below:

- Parameters: pipe number, types of controlled pipes, side of measurement for twin extruders;
- the list of control sections to help user to position the probe inside a pipe;

Information transmitted from software to the operator:

- the measurement results protocol;
- device function or connection error messages.

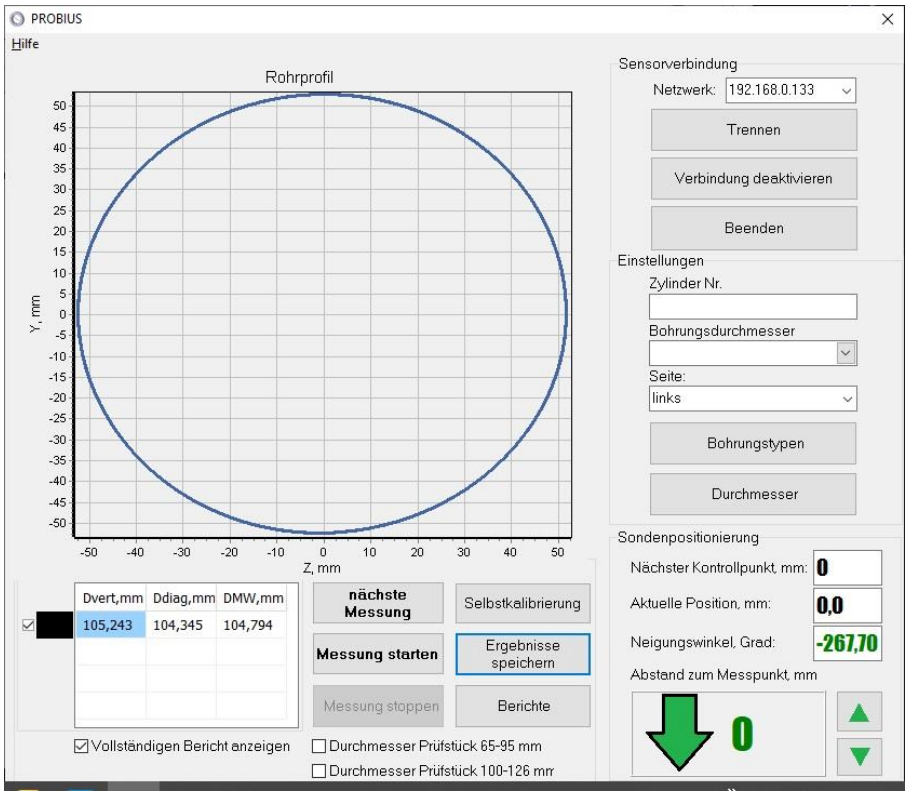


Fig.11 The appearance of the main application window

Main window of the program consists of the following blocks:

- The profile of the inner surface of the pipe;
- Wear measurement system;
- Positioning system;
- Connection to the probe;
- Parameters;
- Controlling the position of the probe



Fig.12 View of the *Probe connection* block in operator's software

Software block *the connection to the probe* consists of the following elements:

- Field “Network” specifies PC network adapter ip that is connected to the measurement system.
- buttons "Connect"/"Disconnect" performing connection / disconnection of the probe;
- button “Enable/Disable probe” enabling scanning subsystem of the probe;
- button "Exit" quits the program.

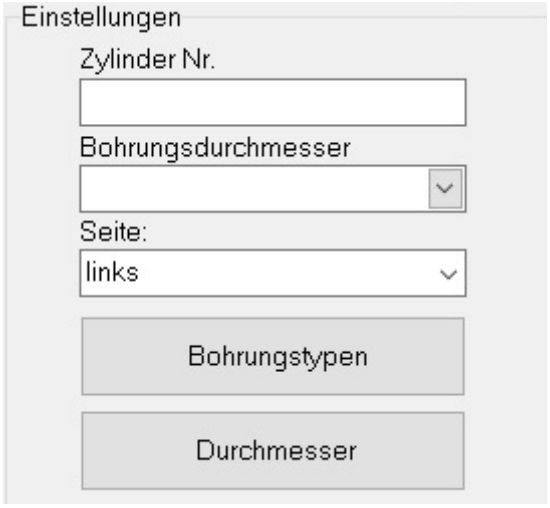


Fig.13 View of the *settings* system block in operator's software

Settings section consists of the following elements:

- the field "Cylider Nr", specifies the identifier of the tested pipe;
- the field "Bore type", allows you to select the type of the tested pipe;
- the field "Side", allows you to select the side of the measured twin extruder pipe;
- the button "Bore types" allows you to edit the data of the controlled tubes;
- the "Checkpoint setup" button allows you to change the list of sections of controlled pipe.



Fig.14 View of the positioning system block in operator's software

A software module *Probe positioning* consists of the following elements:

- field "Next checkpoint" that shows the location of the next control section relative to the front end in which you want to measure;
- field "Current position" is intended for USER input of the current position of the probe;
- fields "Slope angle" that displays the rotation angle of the probe along the pipe axis relative to the horizon;
- a close-up of the field "Required movement" that shows the distance between the current position of the probe and the next checkpoint. This field is intended to aid the operator during manual positioning of the probe;
- button "Nextpoint" ,when clicked, the next control section is selected;

- button "Previous point" , when clicked, the previous control section is selected;

A software block *Measurement system* represents the measured profile of the inner surface of the pipe, in the current control section. Is based upon measurement of the current section.

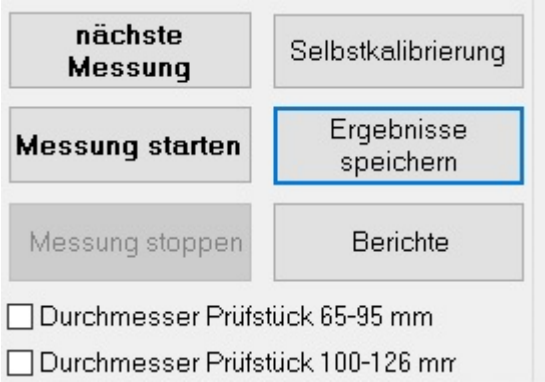


Fig.15 Measurementsystem block

Software block *measurement system* consists of the following elements:

- the "Start measurement" button, triggering internal pipe surface profile measurement;
- the button "Stop measurement" halts measurement of the profile of the inner surface of the pipe;
- the button “Next measurement” saves the current measurement results, switches to the next checkpoint;
- button "Save" by clicking on that you save the current measured values;
- the button "Report archive", opens the form of measurement protocols;
- the button "Self calibration" triggers calibration mode
- checkbox “Caliber measurement 65-95” is intended to indicate the software that the probe is installed into the calibration stand #65-95 to disable a software feature of vertical and diagonal diameter measurement;
- checkbox “Caliber measurement 100-126” is intended to indicate the software that the probe is installed into the calibration stand #100-126 to disable a software feature of vertical and diagonal diameter measurement;

Software block *measurement results* consists of the following elements:



Fig.16 View of the measurement system block in operator's software

- measurement results table:
  - each row of the table represents a ring (oval, ellipse) that was found in the pipe internal profile by the software algorithm
  - rows are as follows:
    - Dvert – vertical diameter of the profile of the tube
    - Ddiag – 120^{o} or 60^{o} diagonal diameter of the profile of the tube depending of the Side parameter selected by user
    - Davg – average diameter of the profile
- result selection checkbox  is intended to deselect erroneous measurement for tubes with highly ununiform profile;
- checkbox “show full report” is intended to select or not a software option to show report window each measurement;

8. Operation

8.1. Preparation for work

Preparing your system involves the following steps:

- External inspection.
- Installation and connection. ·
- Configuring system settings.

8.1.1. External examination

- To verify the completeness and proper operation.
- Check the condition of the cables and sockets connection.
- To inspect the elements of the alignment. In case of heavy wear and if there is a violation of integrity replace with new ones.

8.1.2. The installation of the system elements on the test object/

- Positioning the connecting unit and the PC close to the measured object.
- If necessary, install the centering spacers corresponding to the diameter of testing pipe.
- Assemble the device according to the schematic(see Annex A).
- To turn the device "On" switch on the Communication unit.
- Deploy software on your PC (see. Appendix b) or run if already installed.
- Connect to probe: click "Connect" in the window. In case of successful connection to the measuring system blocks "measurement System" "Probe positioning", "Control of the probe position" will become active . Errors identified during self-test (if available) will be displayed.
- Place the probe into the pipe. Adjust the position of the measuring probe inside the pipe so that the pipe end and rear cover of the probe align.
- Select tube type and input the bore ID number
- Select the “Side” for a twin extruder measurement
- Input the current probe position into the “current probe position” field

8.1.3 Setting pipe database

Before begin working with the device operator (technologist), must specify values and tolerances of the controlled parameters. To do this, you must open the bore database by clicking “Bore types” button in the main window.

– Pipe database consists of table (fig.) which contains values and tolerances of specific kinds of pipes. Structure of the table (structure and number of parameters) is configured according to technical requirements during starting-up and commission, information about them contained in the passport of the device. Parameter values can be edited by the operator. Thus, the operator has the ability to create, delete, and edit the reference parameters for each type of pipes.

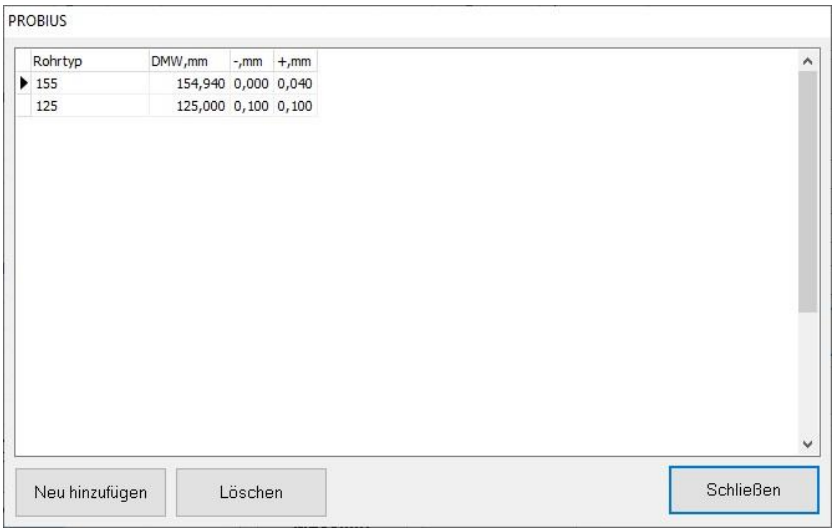


Fig.17 Pipe database window

The functionality of the buttons:

– "Add" button: When clicked a new entry appears in the table with null parameters and blank name. To edit, click the appropriate table cell and make changes. To confirm the changes press "Enter".
– "Delete" button: When clicked active row is deleted from the table with a mark in the first column of the table.
– "Close" button closes the form.

Table columns:

– “Bore type” type name; any text but blank is accepted;
– “DMW, mm” nominal diameter of the tube;

– “-“ and ”+” tolerances for the diameter;

8.1.4 Configuring system settings

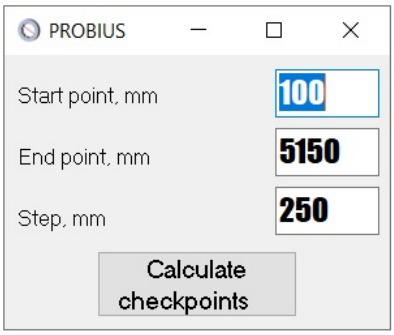


Fig.18 "Control sections" window

– Enter ID of the tested pipe,
– Select the type of the controlled pipe from the list
– Press «Edit control section» button to input coordinates of the first and last section and step between sections.

Important! The last section cannot be located closer to the pipe end than first. Between the first and last cross sections for the selected step there must be space for at least one section. (otherwise, the system will inform the operator about the error and prompt to re-enter data)

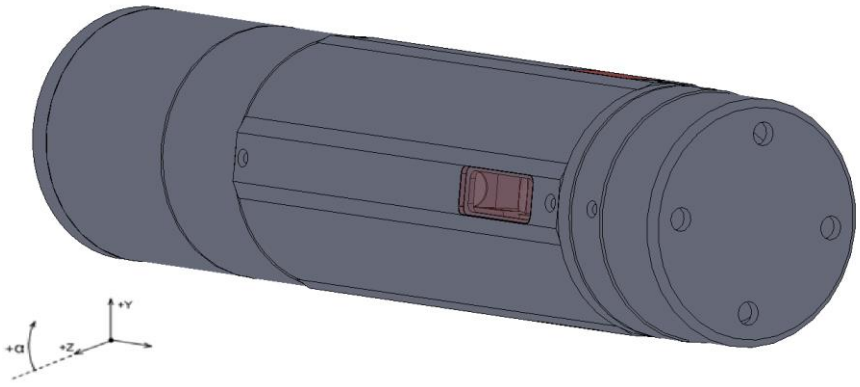


Fig.19 The system of coordinates of the probe

The first control section will be set as the current one, and will be shown in the "Control section» field of the software.

8.2. Measurement of the diameter and other geometric values

– To start using the scanning head press the "Start measurement" button of *measurement system* block. Scanner starts rotating and software begins calculation if pipe inner surface parameters depicting data as a graph in “Pipe channel profile”.During the measurement process, the scanner makes 2 full turns. The result window opens when measurement is complete.

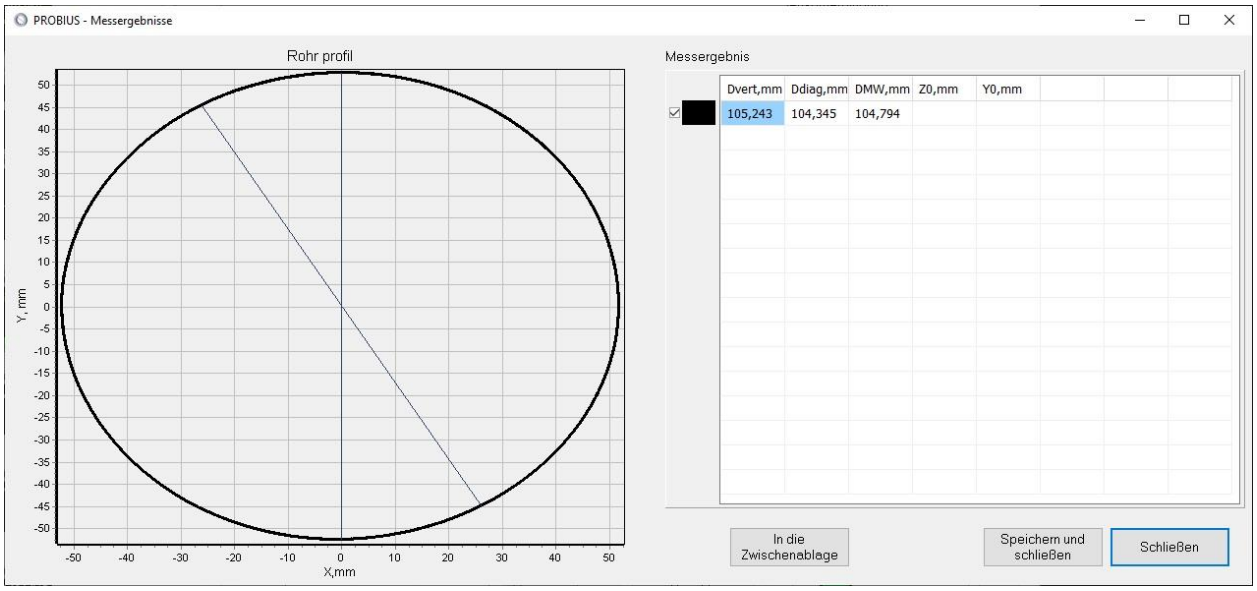


Fig.20 Window displaying the measurement results

Each row in the results table corresponds to the circumference found in the scanned point cloud (smooth tube – 1-line, rifled or profiled tube - 2, during calibration it corresponds to the number of calibration rings). The structure of parameters corresponds to the ones specified in the "Pipe database". Each corresponding measurement is color coded with the point on a measurement graph to show which points were used for which measurement.

Table columns during calibration:

– “D1” major axis of the ellipse approximated with points (maximum diameter);

– “D2” minor axis of the ellipse approximated with points (minimum diameter);

- “Davg” average diameter;
- “Z0”,”Y0” center of section relative to the rotation axis of the probe;

Table columns during measurement:

- “Dvert” diameter of the pipe in “vertical” section;
- “Ddiag” diameter of the pipe in “diagonal” section 120º or 60º to the horizon (on the profile plot two additional lines will also appear to indicate the measured positions);
- “Davg” average diameter;

  There are several actions available in the results window: "Exit" – closes the results table, "Save and exit" - saves the measured cross sections and closes the results table. Protocol can also be saved from the main window.

  - To exclude erroneous results from the protocol caused by reflections on the inside of the barrel, potholes, etc. you need to uncheck checkbox opposite the corresponding row.

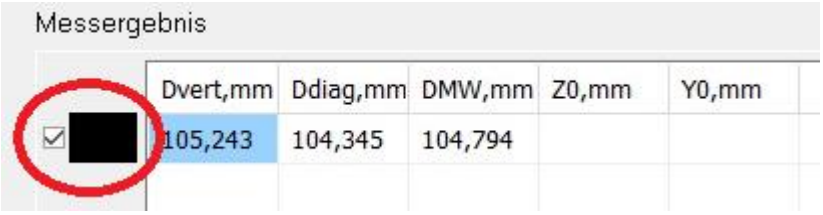


Fig.21 The exclusion of erroneous measurements from the protocol

- Save the results after all the measurements of the first control section. To do this, click the "save and exit" on the form of measurement results or "save results" in the main form of the program. This will trigger compilation and saving of the current section to the protocol.
- Click "Next point". "Distance to checkpoint" field will indicate distance to the next control section in mm. Move probe with a rod, using its scale or "Current position" field, which shows the distance from the scanning plane of the probe to the origin section.
- Click "Start measurement" button to start measurement. If measurement was correct, save the results. For manual switching between the control sections, operator can use buttons "Next point", "Previous point" of probe position control unit. Changes in any point can also be added to database by pressing "Save results" button in wear measurement block of the software.

8.3. Working with the measurement results

To view and analyze the results of both current and previously conducted measurements, you open the "Report archive" window by clicking the corresponding button of the Measurement system block.

In upper left corner of the window there is an archive of protocols that are stored in the program. Current protocol is chosen as a default, to select a different protocol click on the desired protocol row.

For a twin extruder each protocol consists of two parts for a left tube and for the right

Selection of the protocol to show is handled by “Side” field



In upper-right part of the window there is a box with a graph of measured value changes for the selected protocol. You can choose the graph of required value by clicking a table cell at the bottom of the window.

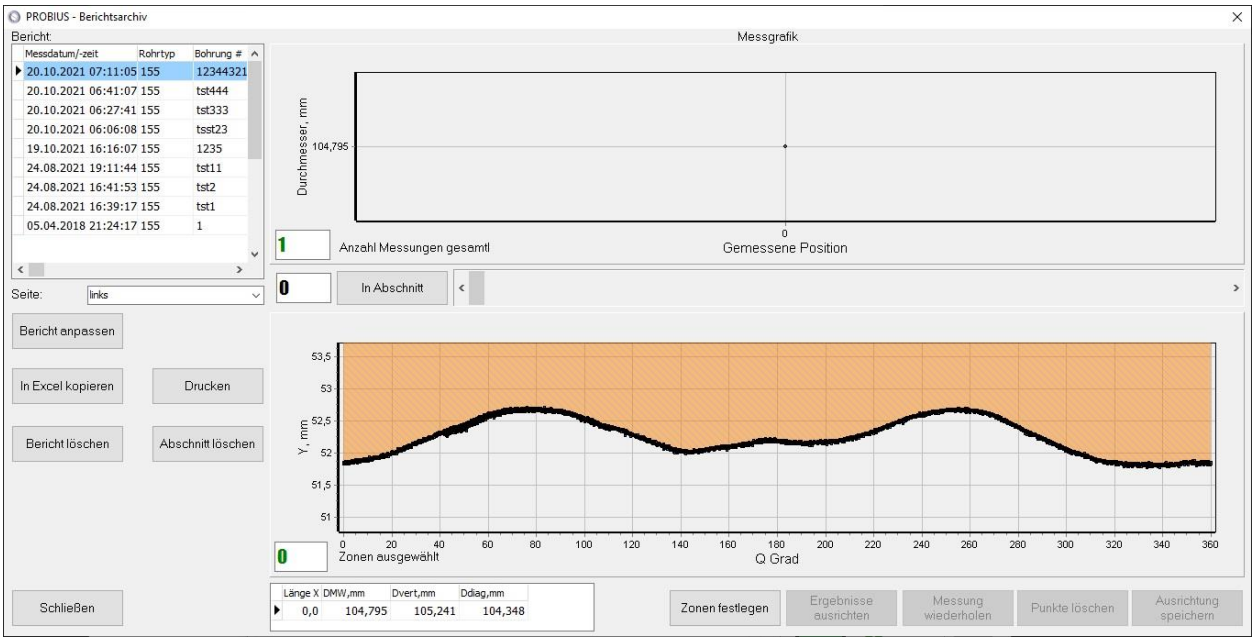


Fig.22 Report archive window

In the lower part of the window there is a strip graph that shows relation of the diameter to the rotation angle of the selected section. To the left of the chart there is a radius scale with corner. Bottom of the section is considered zero degrees line. The choice of the cross section is made by moving the engine on the scrollbar located at the bottom of the protocol measurement window, the coordinate of the

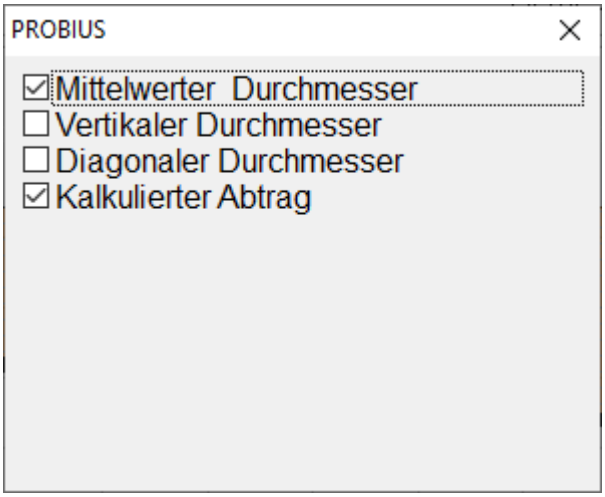
selected section is displayed in the appropriate cell of the table. The left position of the slider corresponds to the pipe end, in which a probe is mounted, right position – the other end of the tube.

The shaded yellow part of the graph corresponds to the wall of pipe, transparent part corresponds to the pipe opening. For a more accurate measurement of defects you can zoom in the desired area of the graph. This requires holding down the left button of the mouse/touchpad to highlight the desired area of the chart starting at the top-left and move the pointer to the right down position (figure). Hold down the right button of pointing device to move the zoom area left or right.The reverse movement from the bottom-right up-left, hold down the left button of the pointing device returns to the original state graph.

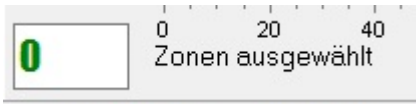
A similar function is implemented on the graph of the profile of the inner surface of the pipe in the main window of the program.

The functionality of the buttons:

- "Remove report" deletes the selected report;
- "Delete section" deletes currently active section from the protocol;
- "Print" generates a printed version of the report;
- "Customize report" opens a window for user to select data that will be used in the printed version;



- *Data manipulation* block allows to recalculate diameters, recalculate center of sections

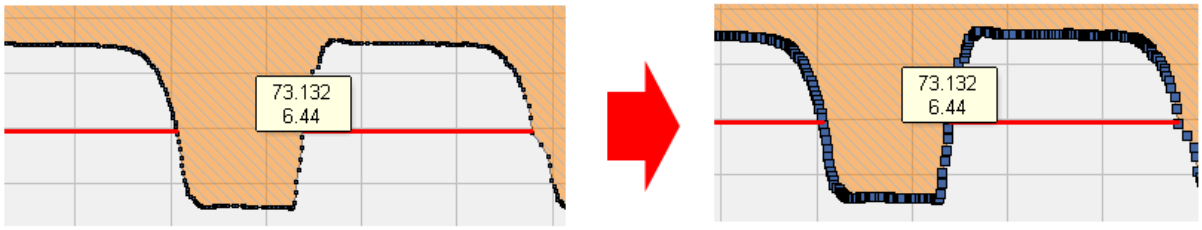




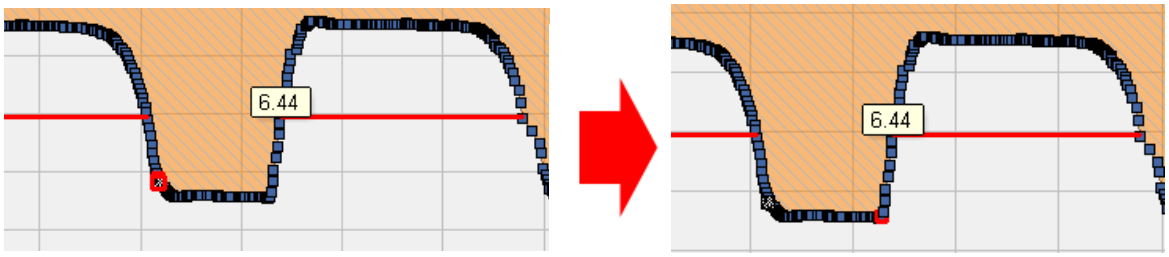
– “Set zones | Use zones” button enables point zones selection that will be used for calculations, aligning etc. Zone selection procedure allows to exclude parts of the scan with erroneous data (grooves filled with mud, etc.).

Sequence of zones selection:

- Click “Set zones”, points of the graph become bold and clickable (the button changes its caption to “Use zones”)



- Click on the start point of the desired zone and then on the end point (start point has to be on the left from the end point)



- Zone counter “Zones” will increment and current selection will be saved. “Calculate diameter”, “Align results” buttons will become active.
- Repeat zones selection and at the end click “Use zones” button.

– “Calculate diameter” repeats diameter calculation based on selected zones. *Measurement results*window is showed.

– “Align results” button repeats scan data centering based on selected zones (used when algorithm failed to center results properly during the scan using all the points.

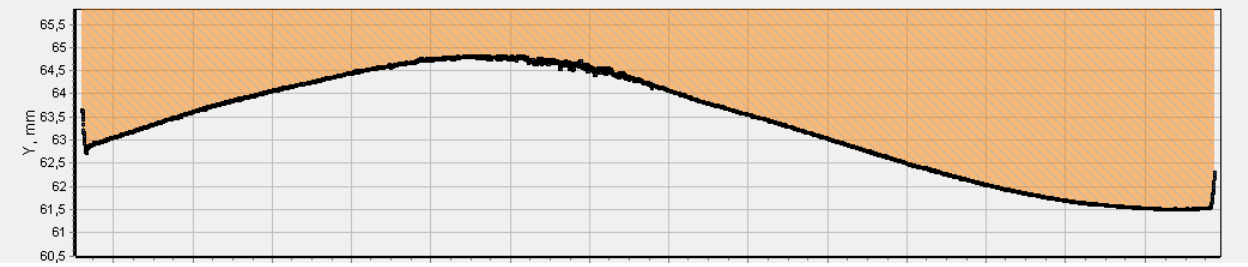


Fig.23 Badly aligned data

- "Save alignment" button is set active after "Align result is pressed" and saves the current alignment to the database
- "Delete points" is used to remove selected zones from the scan

To open printed version of report one should click "Print" button. Preview window will open.

Rohrmessbericht

Messdatum/-zeit	05.04.2018 21:24:17		
Rohrtyp	155	Bohrung #	1

Innendurchmesser 154,94 (min:154,94 max:154,98)

Messergebnisse (ausser Toleranz)

Abschnitt, mm	**links Seite**	**rechts Seite**
	Innendurchmesser avg	***Innendurchmesser avg***
100	55,010	4,980
200	4,980	-
300	-	55,843

Unterzeichnet durch

Drucken Schließen

Fig.24 report preview window

Printed form contains all the data defined by the user in customize report window.

Out of tolerance results are colored in red and presented in the form: measured value/(out of tolerance value)

As an alternative to this report an Excel spreadsheet report may be exported by clicking "Export to Excel". Data will be stored to the "Reports" folder of the software. The name of the report would be the same as the tube id.

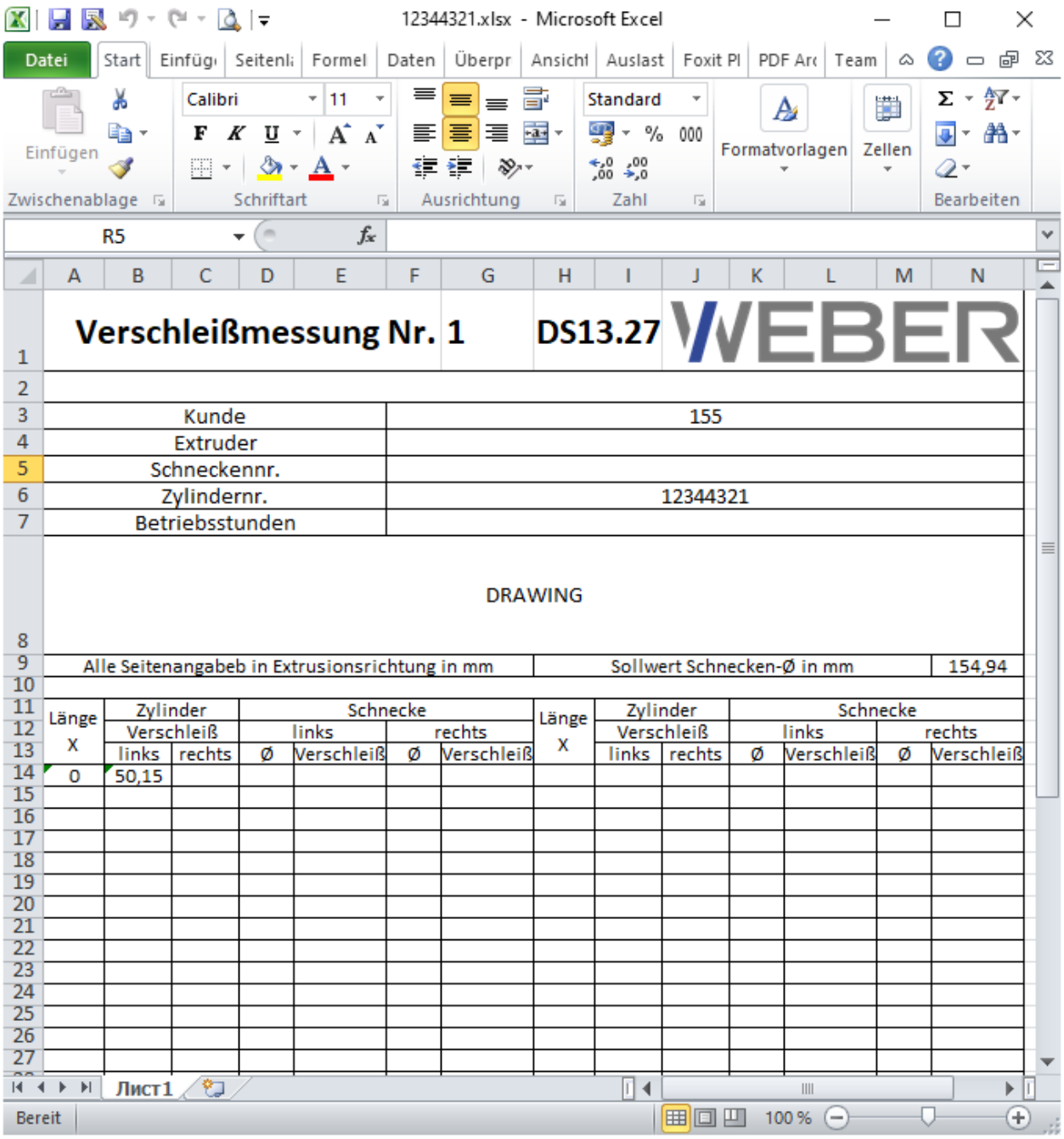


Fig.25 Excel report

8.4. Shutting down procedure

On completion of the measurements, you must:

-return the probe to end pipe, through which the probe was loaded in it;

- turn off probe in the software window;

- power off Communication unit;

- disconnect Communication unit from the power mains;

- remove the probe from the pipe, disconnect rod (MM) cable from the probe,

- clear support, the housing and lens of the probe from contamination and put it in the case;

- disconnect all cables, put the switching unit, the power supply and cables in the package;

- if necessary, shut down your PC.

9. Maintenance

9.1. General instructions

Maintenance of the device is needed to ensure its constant readiness for use and reliability when in compliance with the established technical standards and regulations.

Maintenance involves the checking of completeness, cleaning, checking of instrument calibrations and troubleshooting.

Cleaning the probe, the Communication unit and the power unit with a soft cloth without using solvents, kerosene, gasoline and other liquids. Protective glass of sensors and rangefinder should be wiped with a clean flannel cloth.

9.2. Maintenance of the cable connectors

Use a brush to clean contaminated connector pins, wipe sockets clean with a cloth soaked in ethyl alcohol. When cleaning keep the connectors slightly tilted down so that the contaminated alcohol does not flow inside.

Wash contacts of connectors if the contacts cannot be detected during the process of operation (consumption of alcohol - 3 ml to rinse 100 contacts).

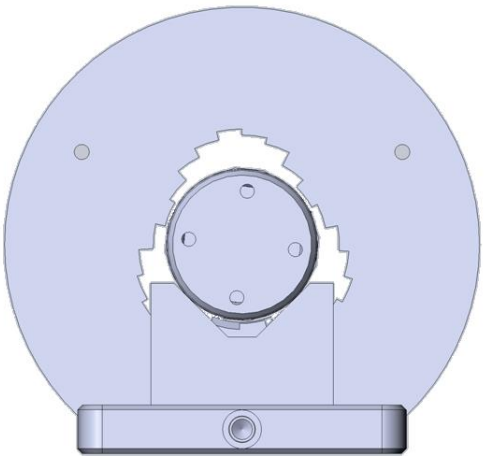
9.3. Checking device functionality

Verify that the device is functioning as follows:

1. Put the probe inside the calibration stand. Rotating scanner sensors should be opposite the inner surface of the calibration ring.
2. Connect the Communication unit and PC.
3. Run the software on your PC.
4. Connect to the probe and start the measurement of the diameter.
5. Make sure that the rotating scanner works without jams, diameter sensors and range finder are radiating light.
6. Upon receiving the measurement results make sure that:

   – profile of the control section is displayed,
   – measurement results window has opened,
   – measured parameters of calibration rings correspond to those specified in the passport of calibration ring. Diameter deviation should not exceed 0.02 mm;

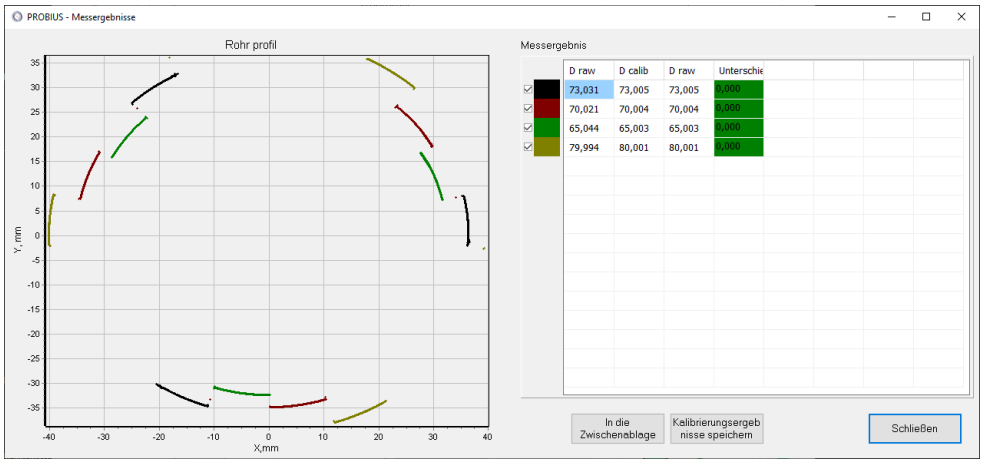
10. Calibration of a rotating scanner



1. Put the probe inside the calibration stand. Rotating scanner sensors should be opposite the inner surface of the calibration rings.
2. Connect the Communication unit and PC.
3. Run the software on your PC.
4. Connect to the probe.
5. Enable probe.
6. Select the checkbox corresponding to the caliber which is used

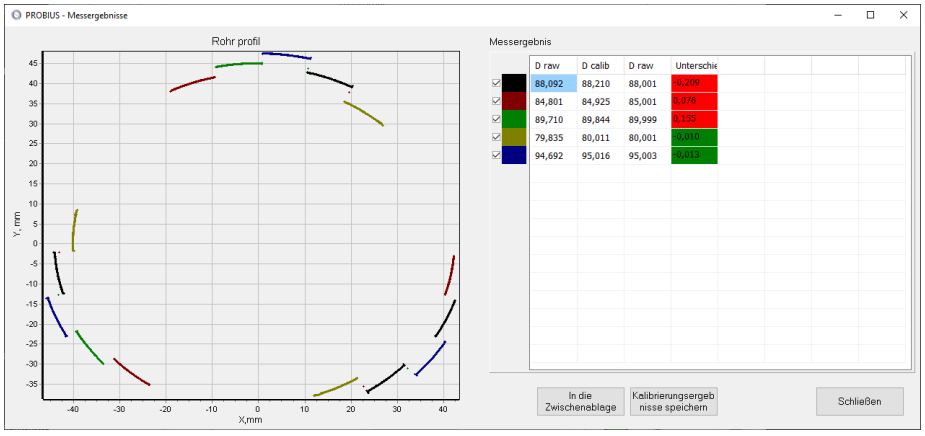


7. Click on the “Self calibration” button. When prompted confirm the calibration procedure. 2 scans will be taken.
8. A result window as follows will open



An additional “Save calibration” button will appear.

9. For each sensor a prompting window will appear. If the calibration result for the sensor are ok. All cells of the sheet will be green. If the calibration fails, some of the cells may become red. In that case check the positioning of the probe inside the calibration stand:
    - Check that the rotating part of the probe do not touch the prisms of the stand ;
    - The dot of the laser scans the central part of the calibration ring



10. If the results are OK . click on the “Save calibration” button.
11. Repeat p9, p10

11. Storage and preservation

Storage is one of the types of operation of the device in which it is not in use for a month or more. Serviceability during storage is supported through the implementation of special measures to protect circuits and equipment against external environment impact.

Device should be stored intact, complete and after it passed maintenance.

ATTENTION! Period between storage and the latest maintenance check shall not exceed 3 months.

Prior to long storage it is necessary to prepare the device for it.

Conservation:

1. Prepare materials for conservation.
2. Conservation should be done indoors with a minimum temperature of 15 º C and relative humidity above 70 %.
3. Contaminated contacts of the connectors should be cleaned with alcohol
4. Apply a thin layer of grease on the threaded parts of the connectors.
5. Screwed plugs or, if impossible, wrap connectors in anti-corrosive paper, secure the ends of paper with adhesive tape.
6. small spare parts and fasteners should be wiped with a napkin to remove dirt, grease stains, wrap them in anti-corrosive paper, edges of the paper should be covered with adhesive tape;
7. all the metal unpainted surfaces of device parts that are in boxes should be covered in a layer of grease, wrapped in paper.

Removal from long term storage:

1. remove paper from circuits and parts;
2. remove grease from assembly units, parts, threaded connections with napkins soaked in gasoline.

12. Repairs and troubleshooting

ATTENTION! All repairs are done by the manufacturer. Disassembly the device by the user is STRICTLY PROHIBITED.

List of possible malfunctions and troubleshooting

Malfunction	Actions
Communication units does not turn on	Check if there is power going from the power supply.
Measuring probe does not turn on	Check if all connectors are locked in and cables are not damaged.
Rotating block does not rotate	Make sure rotating block is not jammed, Clean the dirt out of the grease retainer.
No data from rangefinder	Contact manufacturer
Diameter data is not present or not correct	Contact manufacturer

13. Warranty

Warranty life – 24 months since the commission, storage warranty – 12 months.

14. Recycling

Device contains batteries that should be recycled apart from other waste. Turn batteries in at the specialized recycling facility.

Other parts of the device should be recycled at a designated recycling facility for electric waste.

Appendix A – Probius connection schematics

FigA.1 Basic probe connection schematics

