

Optical measurement system for smooth and rifled pipes

PROBIUS MICRO

User manual

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Index

1. Safety precautions 4
2. Signs used in the manual 4
3. Electromagnetic compatibility 4
5. Application 5
6. Specification 6
   6.1. Features and Measurable parameters 6
   6.2. Metrological characteristics 6
   6.3. Power 6
   6.4. Recommended operation conditions 7
   6.5. Contents of delivery 7
7. Design and principle of operation 8
7.1. Basic 8
7.2. Centering 10
7.3. Communication unit 10
7.4. Calibration stand 12
7.5. Software 13
7.5.1. Nport administrator setup 13
7.5.2. Probius software setup 14
7.5.3. Probius software 15
8. Operation 19
8.1. Preparation for work 19
8.2. Measurement of the diameter and other geometric values 22
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 29
9.3. Checking device functionality 29
10. Calibration of a rotating scanner 30
11. Storage and preservation 31
12. Repairs and troubleshooting 32

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

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;
- do not disassemble the probe;

5. Application

The system is designed for profile measurement and check of geometrical parameters of the inner surface of the cylindrical profiled objects.

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

- profiled pipes;
- extruders;

6. Specification

6.1. Features and Measurable parameters

	Basic
- Internal diameters of the cylindrical elements	*
- Deviation from the form, i.e., roundness (ovality, etc.)	*
- Width of the profile elements	*
- Height of the profile elements	*
- The distance between measurement plane and pipe end	- / option
- Angle of probe rotation around pipe longitudinal axis relative to the horizon	-
- Calibration module for laser scanner self-calibrating	*
- Local database for measured results	*

6.2. Metrological characteristics

Parameter	Value
Inner pipe diameter, mm:	15, 20, 23, 25, 30, 35 Each probe covers one ID +/-2 mm
Max pipe length, m	Up to 5
Distance from the pipe end to the checked section, mm	60
Angular resolution of the scanner (points per 360°)	20000
Accuracy	**Value**
Inner pipe diameter, mm:	± 0,01
Deviation from roundness, mm	± 0,01
Deviation of shape of the profile (2σ), mm	± 0,03
Width of the elements of a profile, mm	±0,05

6.3. Power

Parameter	Value
Voltage	110V 60Hz ,220 V 50 Hz

Power consumption, not more	60 W

6.4. Recommended operation conditions

Parameter	Value
Operating temperature	+5...+ 65 ^{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.
Measurement probe	1 (specified when ordering)
Moxa 5150 Communication unit	1
Power supply	1
Connection cable	1
Set of spacing rings	3 per diameter
Calibration module	1
Calibration rings	1 per probe
Calibration stopper	1
Case	1
Software	1
User manual	1
Quality Certificate	1
Calibration Certificate	1

7. Design and principle of operation

7.1. Basic

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

- diameter,
- ovality,
- groove and land widths

To begin measurements a probe is installed inside a pipe. The probe is centered inside the tube by interchangeable spacers. Movement along the pipe is performed manually by probe cable. The power of the probe and data transmission from/to PC is supplied by the cable connected via the communication unit.

Scanning is performed by a rotating laser sensor.

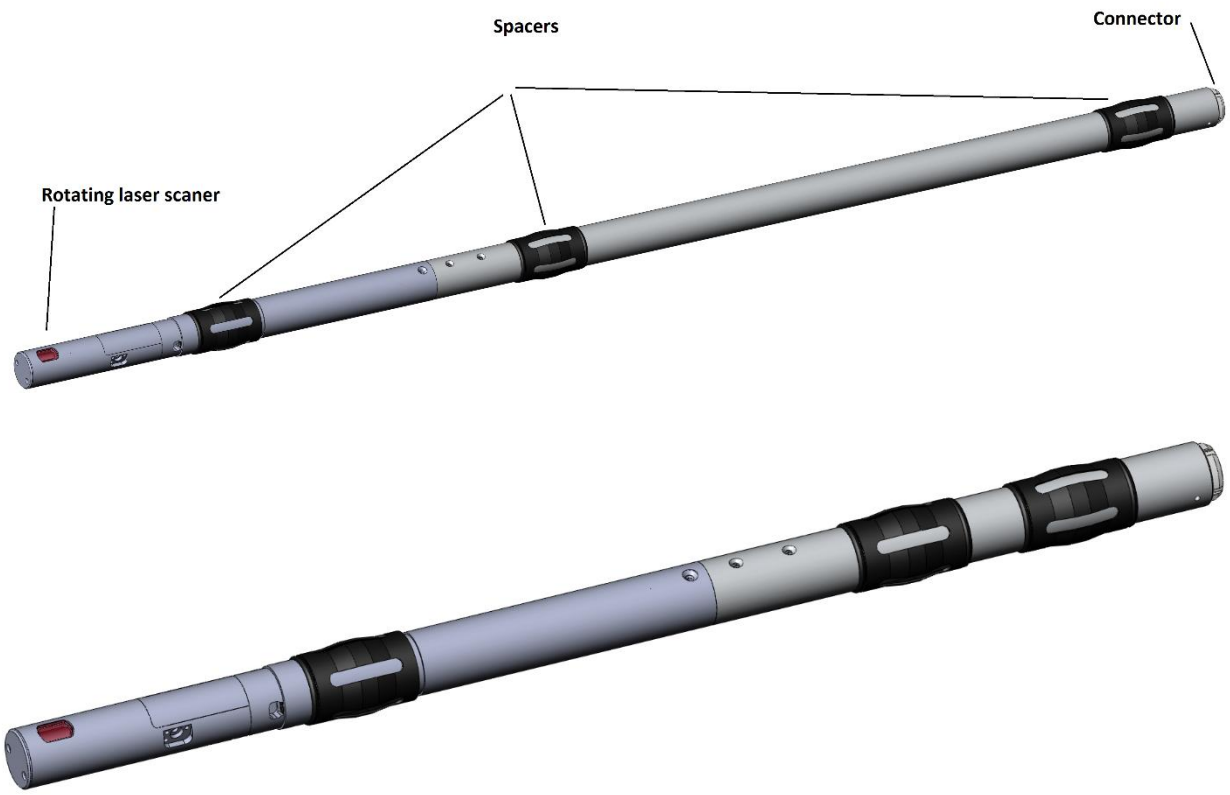


Fig. The probe. Basic configuration (long and short types)

To measure the pipe, the probe is consistently moved to the required cross-section. Measured data and is sent to PC where the algorithms calculate such parameters as inner diameter, ovality, deviation of the profile from the reference, etc.

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 ring spacers;
- back-end connector.

The main module of the probe is a rotating laser scanner. Each laser scanner contains one radially arranged laser triangulation sensors.

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.

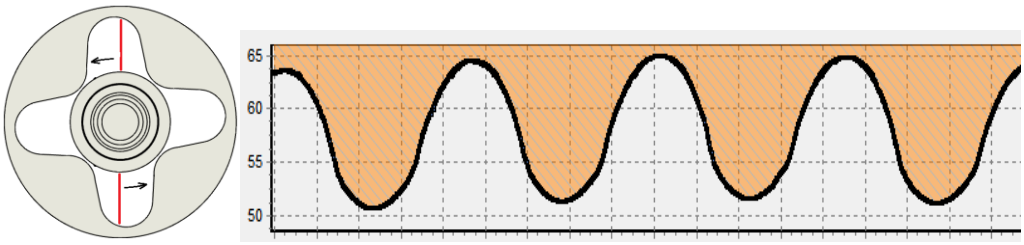


Fig. Cross-section profile

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

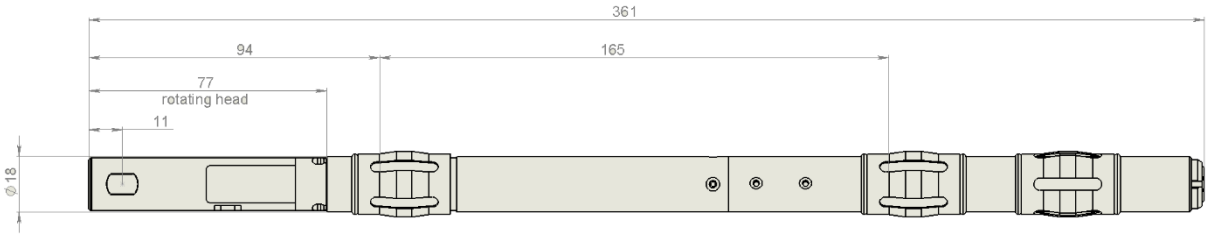
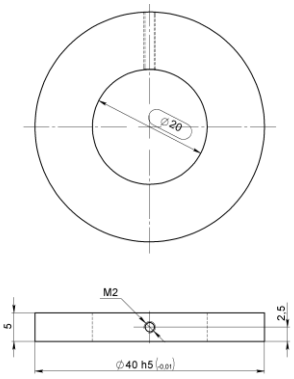


Fig. Overall dimensions of the probe (short type)

7.2. Centering

Current configuration of the probe is equipped with the simplest centering rings:



Centering elements 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. Centering spacers are made for the pipe diameters specified when ordering.

7.3. Communication unit

The Communication unit is designed to provide information exchange between PC and measurement system. It is a version of Moxa NPort5110 RS232-Ethernet data server slightly modified to supply power to measuring probe



Fig. Communication unit

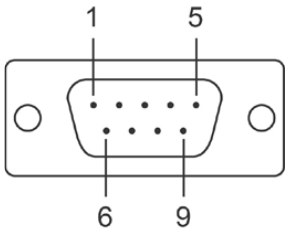
Connector	Function
Port 1	Connecting the measuring probe
RJ45	PC connection
12-48VDC	Power supply connection

LED Indicators—NPort 5100's top panel has three LED indicators, which are described in the following table.

LED name	LED Color	LED Function
Ready	Red	Steady on: Power is on and NPort is booting up. Blinking: Indicates an IP conflict, or DHCP or BOOTP server is not responding properly.
	Green	Steady on: Power is on and NPort is functioning normally. Blinking: The NPort has been located by NPort Administrator's Location function
	Off	Power is off, or power error condition exists.
Link	Orange	10 Mbps Ethernet connection.
	Green	100 Mbps Ethernet connection.
	Off	Ethernet cable is disconnected, or has a short.
Tx/Rx	Orange	Serial port is receiving data.
	Green	Serial port is transmitting data.
	Off	No data is being transmitted or received through the serial port.

Port 1 pinout (probe connection)

Pin No.	Function
1	RS422 TXD-(A)
2	RS422 TXD+(B)
3	RS422 RXD+(B)
4	RS422 RXD-(A)
5	GND
9	+12V



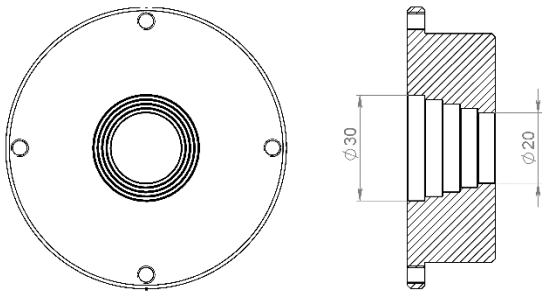
7.4. Calibration stand

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

- Interchangeable ring gauge;
- Cradle;
- Stopper pin;



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



Each ring Gauge has five calibrated setting rings (actual ring diameters are presented in calibration certificate for each gauge)

The stopper pin in conjunction with probes magnetic clamp allows to block the front part of the probe to make the scanner rotate.

The cradle of the stand allows to put the probe coaxially with the ring of the caliber. To exclude the probability of probe movement while rotating and as a result erroneous calibration probe is blocked inside the cradle by a blocking screw.

7.5. Software

Software consists of two parts:

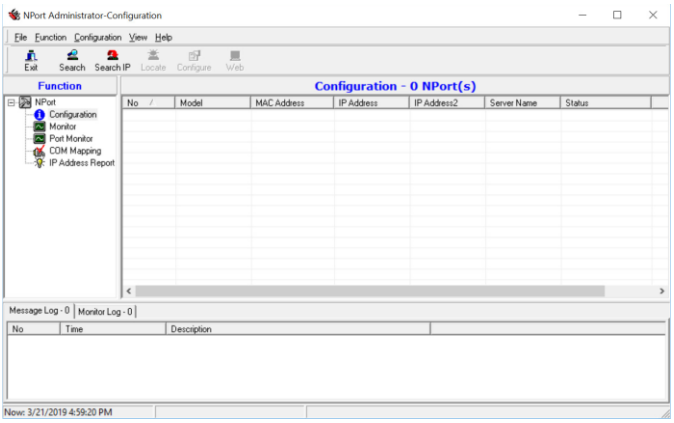
- Nport Administrator to connect communication unit to Windows based PC and create a virtual COM port to connect to the probe;
- Probius software executable

7.5.1. Nport administrator setup

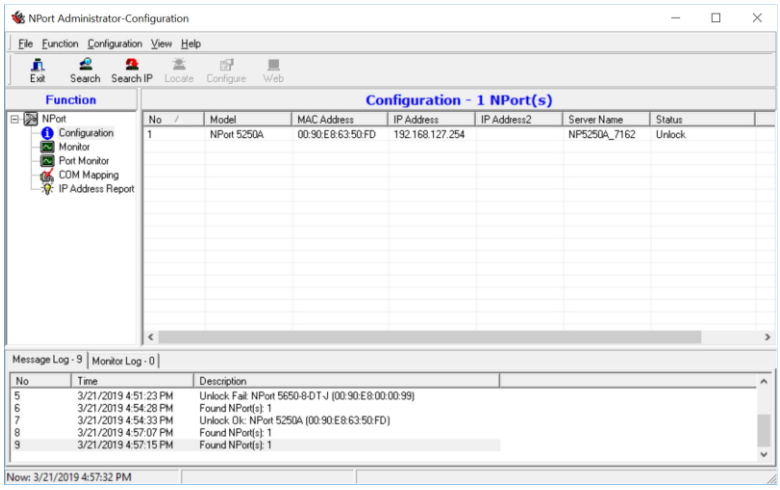
Download and run the setup program from Moxa's support website (https://www.moxa.com/support/). Run NPort Administrator when the installation has been completed.

Searching for Device Servers over a LAN

The Broadcast Search function is used to locate all NPort 5100 device servers that are connected to the same LAN as your computer. Since the Broadcast Search function searches by MAC address and not IP address, all NPorts connected to the LAN will be located, regardless of whether or not they are part of the same subnet as the host.

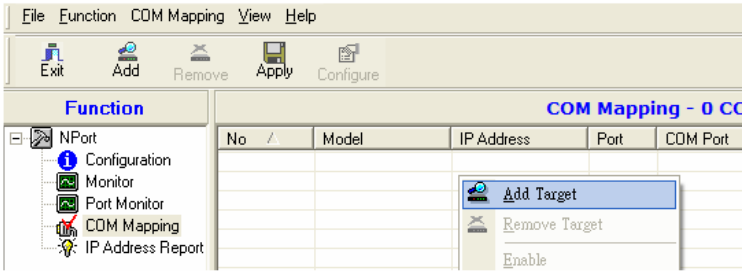


In NPort Administrator, click Search to search your LAN for NPort device servers. When your unit appears in the search results, you may click Stop to end the search. You may also wait a few more moments for the search to complete.

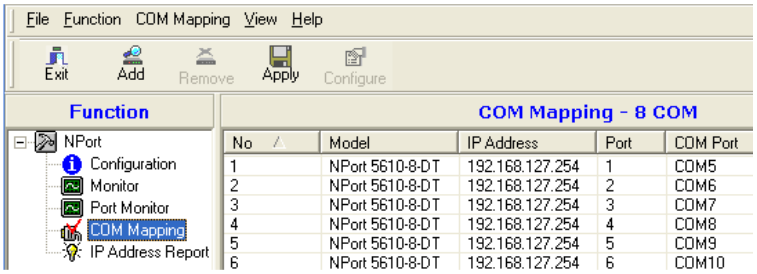


Mapping windows COM Port to Device This section covers how to map the COM ports on a Windows PC to NPort device ports. The mapping will allow Probius software to access serial probe over the network as if they were local COM devices, providing instant device networking without software migration.

Specifying the Target Device Server



In NPort Administrator, click COM Mapping in the Function panel to open the COM Mapping window. Right-click on an empty line in the COM Mapping window. Select Add Target in the pop-up menu to assign your device server as the mapping target.



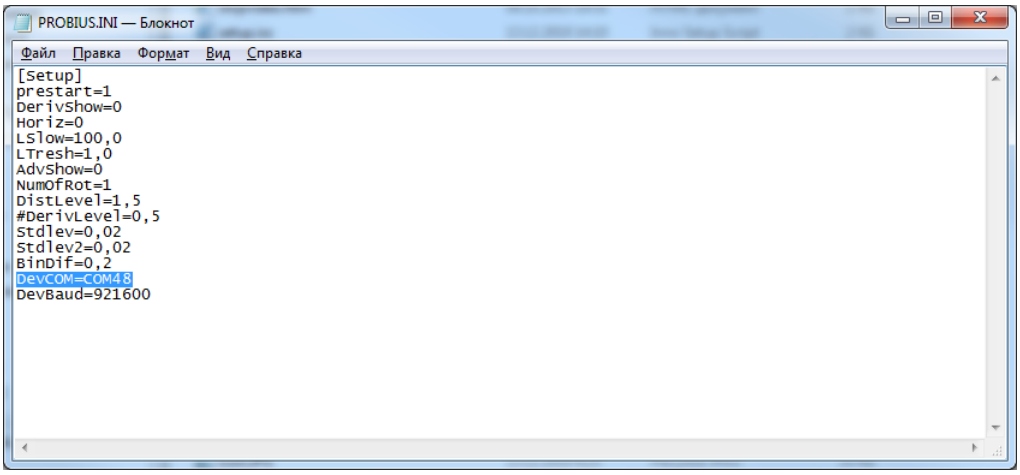
A list of NPort device servers that have been found by NPort Administrator will appear. Select your device server and click Finish.

As the Nport5110 has only one com port map it to any available Com port and **write down its number**.

7.5.2. Probius software setup

Probius software is shipped in an executable setup file and can be installed on any PC with an Ethernet connector. For installation please follow setup procedure.

After the software installation is complete open the software directory (ex c:\Program Files(x86)\Probius) and edit PROBIUS.INI file.



Write the Com port number mapped in the Nport Administrator sw to the DevCOM field

7.5.3. Probius software

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;
- the list of control sections (coordinate first and last control points and step of measurements);

Information transmitted from software to the operator:

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

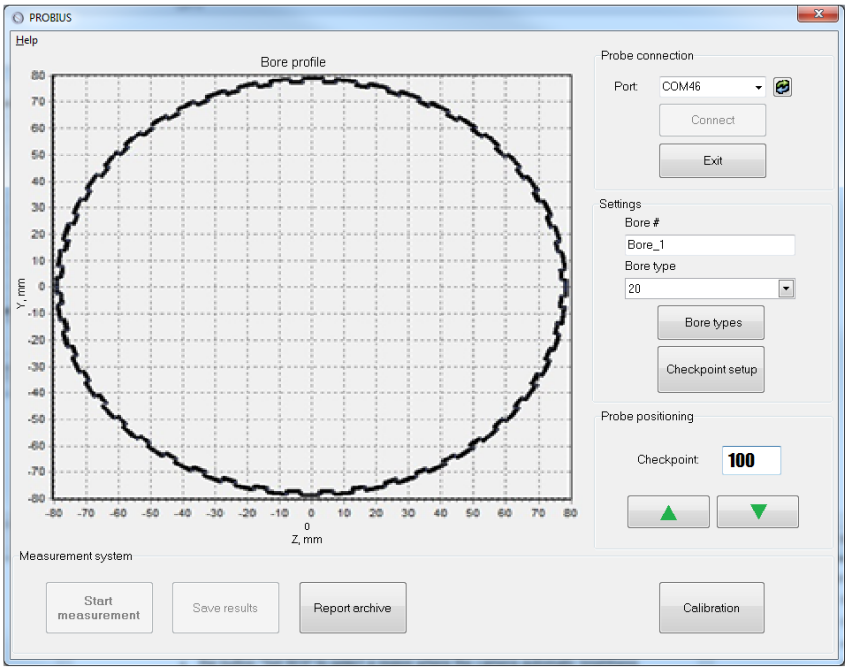


Fig. The appearance of the main application window

Main window of the program consists of the following blocks:

- The profile of the inner surface of the pipe;
- Profile measurement system;
- Positioning system;
- Parameters;

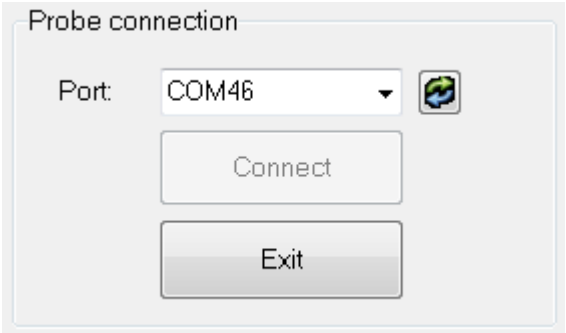


Fig. View of the *Probe connection* block in operator's software

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

- Field “Port” specifies PC COM port that is connected to the measurement system;
-  Port rescan button to scan for available COM ports
- buttons "Connect"/"Disconnect" performing connection / disconnection of the probe;
- button "Exit" quits the program.

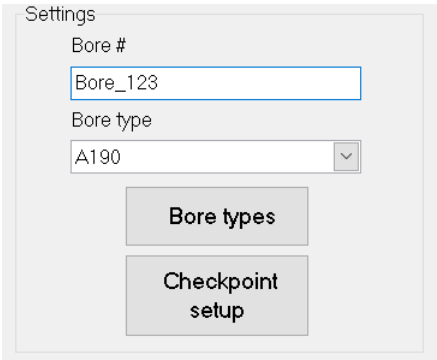


Fig. View of the *settings* system block in operator's software

Settings section consists of the following elements:

- the field "Bore#", specifies the identifier of the tested pipe;
- the field "Bore type", allows you to select the type of the tested 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.

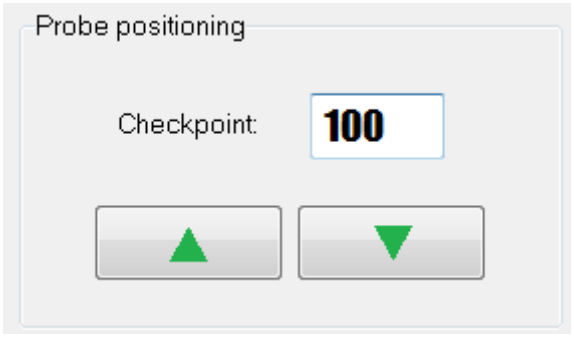


Fig. View of the positioning system block in operator's software

A software module *Probe positioning* indicates the position of the probe that due to the lack of any rangefinder is just a presentation of desired scan sections and consists of the following elements:

- button "Next point" , 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. Measurement system 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;
- button "Save" by clicking on that you save the current measured values;
- the button "Report archive", opens the form of measurement protocols;
- the button "Calibration" triggers calibration mode.

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.
- Examine the lenses and Windows, and in the presence of impurities, clean them with a soft, lint-free cloth.
- 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 probe supports and spacers corresponding to the diameter of testing pipe.
- Assemble the device according to the schematic (see Annex A).
- To turn the device "On" apply power to the communication unit.
- Deploy software on your PC or run if already installed.
- In the SW select the proper COM port (if installed properly it will appear automatically on SW start);
- Connect to probe: click "Connect" in the window. In case of successful connection to the measuring system blocks "measurement System" will become active . Errors identified during self-test (if available) will be displayed.
- Place the probe into the pipe (from the muzzle end) so that two of the spacers are in the pipe.
- Select bore type and input the bore ID number:

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.

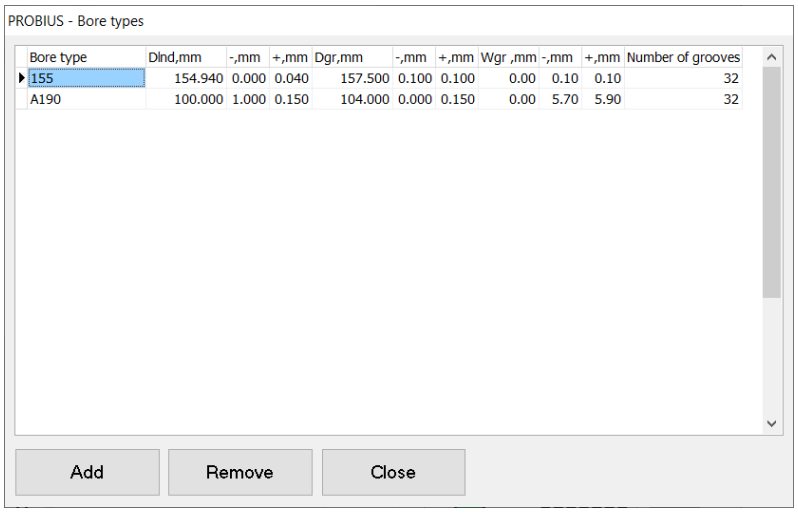


Fig. Pipe database window

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;
- “Dlnd, mm” Lands diameter nominal or bore diameter for smooth barrel;
- “-“ and ”+” tolerances for Lands diameter;
- “Dgr, mm” grooves diameter nominal (0 for smooth barrel);
- “-“ and ”+” tolerances for grooves diameter;

- “Wgr, mm” Grooves width nominal (0 for smooth barrel);
- “-“ and ”+” tolerances for Grooves width;
- “Number of grooves” barrels number of grooves (0 for smooth barrel).

8.1.4 Configuring system settings

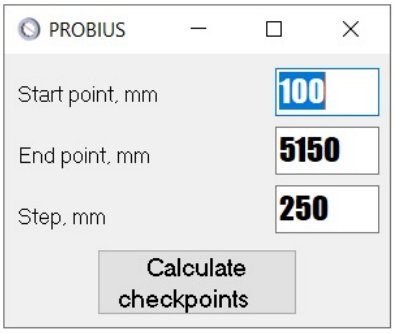


Fig. "Control sections" window

- 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)

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.

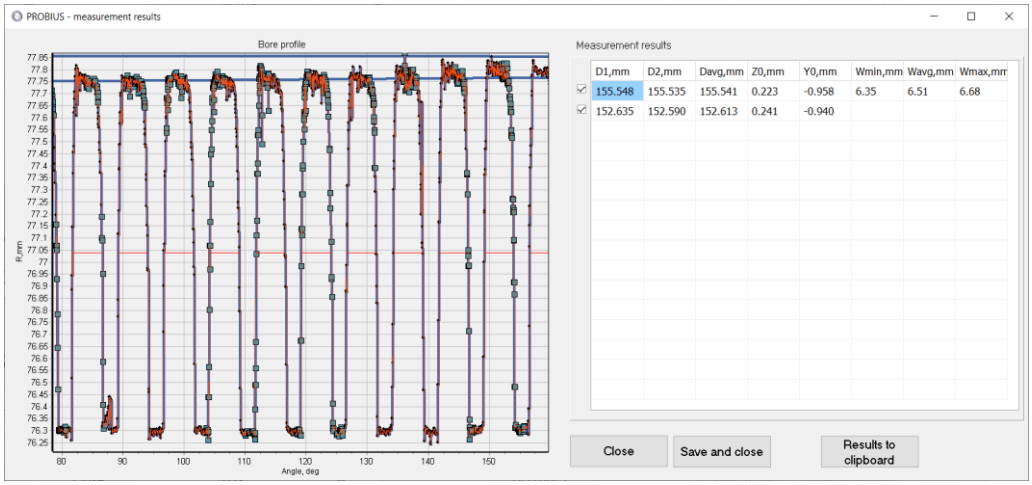


Fig. Window displaying the measurement results

Each row in the results table corresponds to the circumference found in the scanned point cloud (smooth barrel – 1-line, rifled barrel - 2, during calibration it corresponds to the number of calibration rings). The structure of parameters corresponds to the ones specified in the "Pipe database".

Table columns:

– “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;
– “Wmin”,”Wmax”,”Wavg” rifling width (minimum, maximum, average).

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.

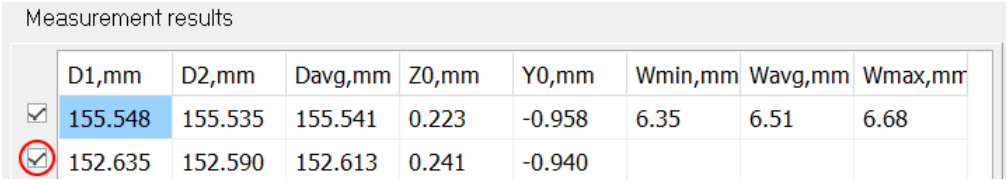


Fig. The exclusion of erroneous measurements from the protocol

- 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.
- 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.

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.

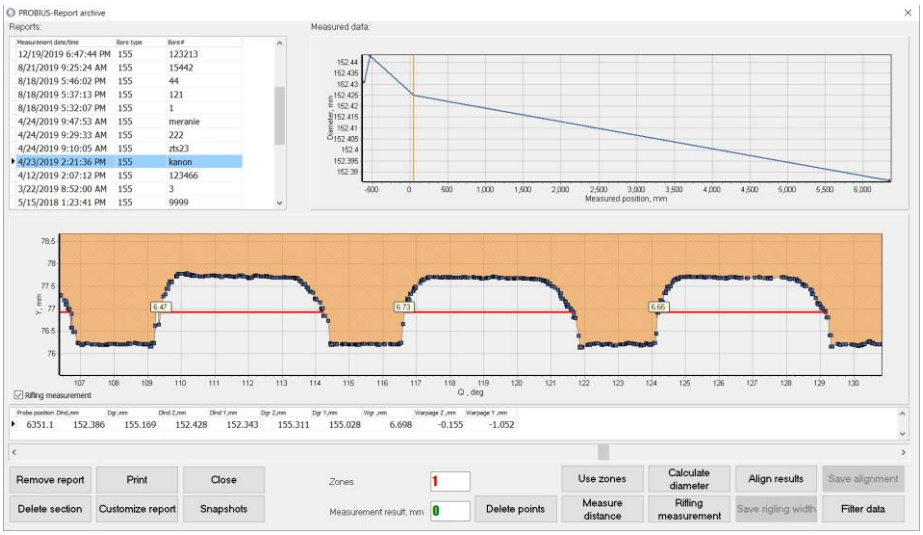


Fig. Report archive window

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. When rifled bore is selected each grove width is measured and showed on the graph (if width lies within the tolerance for the bore type width is shown as a green line red otherwise). User can disable this feature by deselecting “Rifling measurement” checkbox.

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.

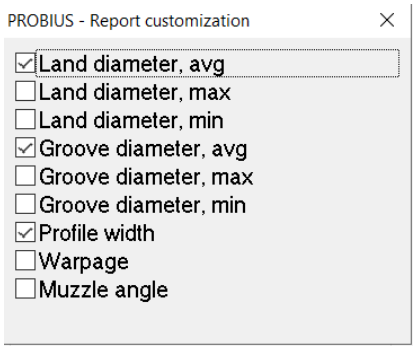
The shaded yellow part of the graph corresponds to the wall of pipe, transparent part corresponds to the pipe opening. For a more accurate measurement of defects you can zoom in the desired area of the graph. This requires holding down the left button of the mouse/touchpad to highlight the desired area 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;



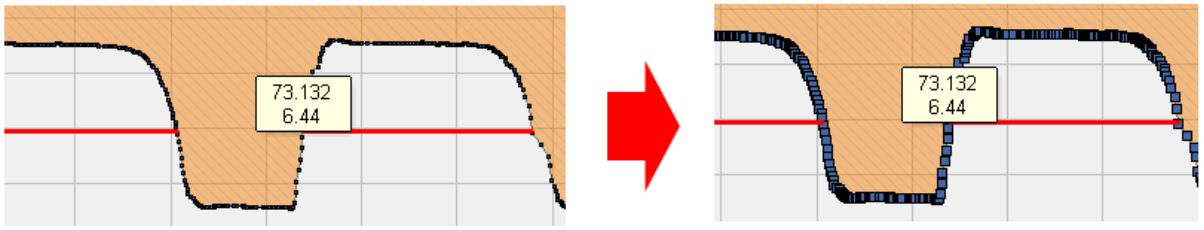
- "Snapshots" opens the folder with the saved pictures from the video inspection;
- *Data manipulation* block allows to filter , recalculate diameters, recalculate center of sections and delete outlier points from the scan



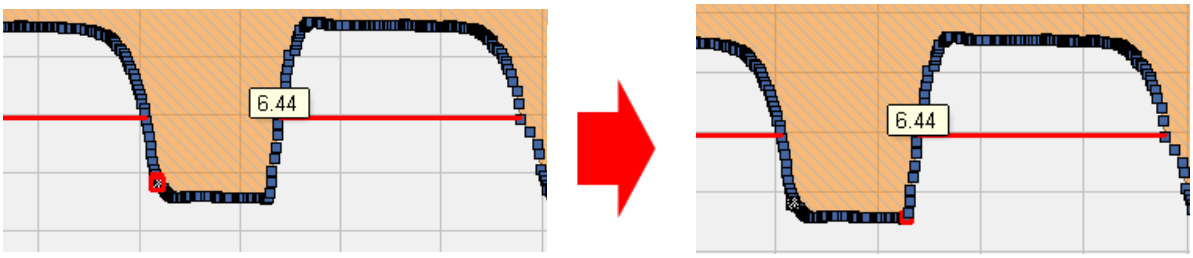
- "Set zones | Use zones" button enables point zones selection that will be used for calculations, aligning etc. Zone selection procedure allows to exclude parts of the scan with erroneous data (grooves filled with mud, crashed out rifling , etc.).

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.

– "Filter data" applies a predesigned lowpass filter to the selected zones data to remove spikes and high frequency noise.

– "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.

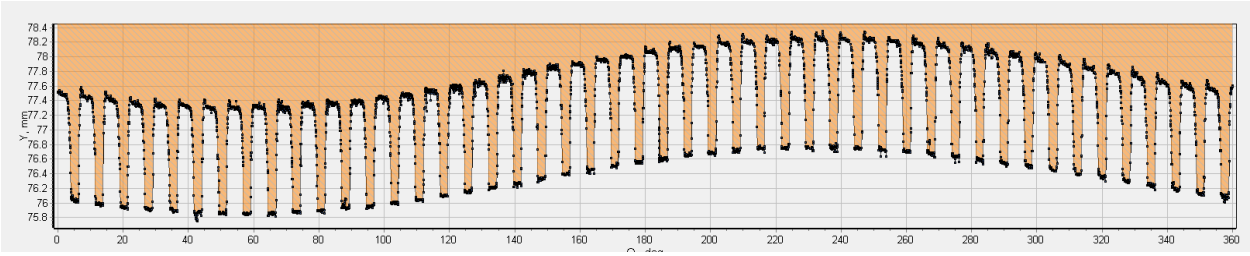


Fig. Badly aligned data

– "Save alignment" button is set active after "Align result is pressed" and saves the current alignment to the database

– “Rifling measurement” allows user to measure rifling width manually. Point selection sequence is similar to zones selection but 4 points representing trapezoid tops are selected from left to the right. Result of measurement is shown in the “Measurement result” field.

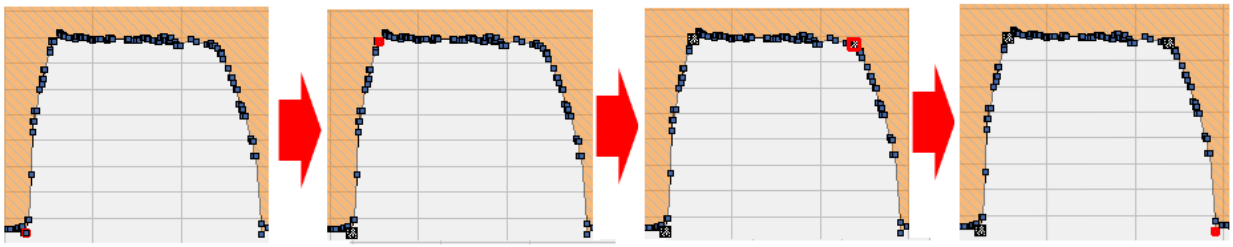


Fig. Point selection sequence

– “Measure distance” button is used for simple linear distance measurements. Point selection sequence is the same as zones selection procedure.
– “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.

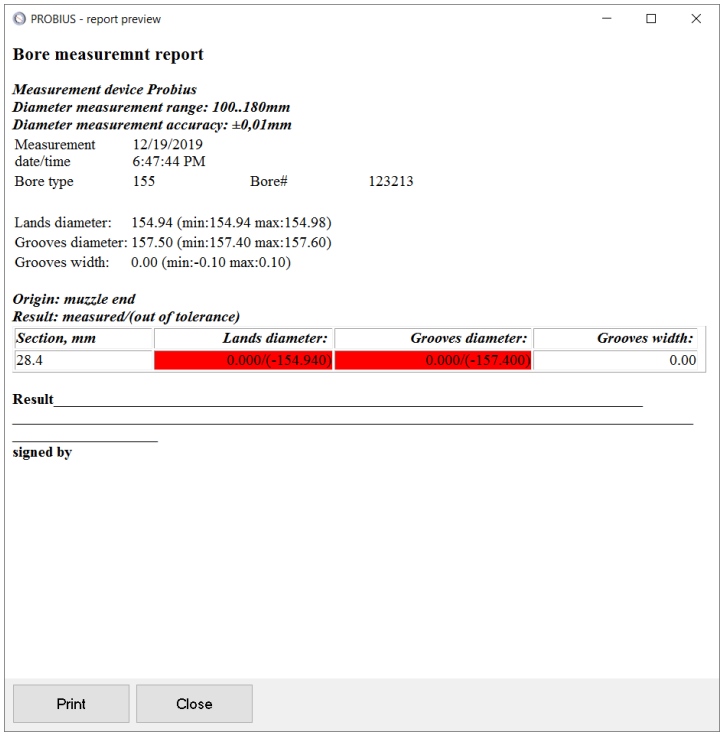


Fig. report preview window

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)

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;

- 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:

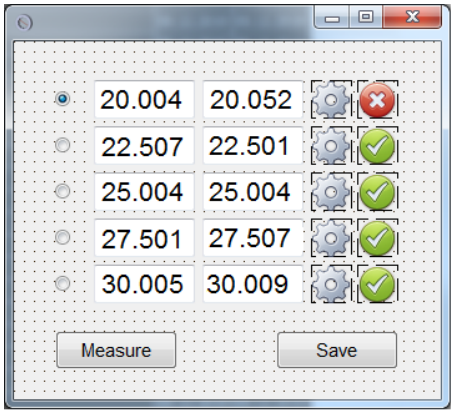
1. Put the probe inside the calibration stand. Rotating scanner sensors should be opposite the inner surface of the first (smallest) calibration ring. Magnetic clamp should fix on the stopper pin of the calibration device.
2. Fix the probe inside the calibration module using blocking screw.
3. Connect the Communication unit and PC.
4. Run the software on your PC.
5. Connect to the probe and start the measurement of the diameter.
6. Make sure that the rotating scanner works without jams, diameter sensor radiates light.
7. Upon receiving the measurement results make sure that:

   - Smooth profile of the control section is displayed without gaps,
   - measurement results window has opened,
   - measured diameter of calibration ring correspond to those specified in the passport of calibration ring. Diameter deviation should not exceed 0.02 mm;

8. Repeat the procedure for the last (biggest) calibration ring.

10. Calibration of a rotating scanner

1. Insert the calibration gauge of corresponding probe in the calibration cradle.
2. Put the probe inside the calibration stand.
3. Connect the Communication unit and PC.
4. Run the software on your PC.
5. Connect to the probe
6. Click on the “Calibration” button. Calibration window will open. And scanner laser will turn on allowing user to position the scanner in the center of calibration ring.



Calibration window

7. Rotating scanner sensors should be opposite the inner surface of the first (smallest) calibration ring. Magnetic clamp should fix on the stopper pin of the calibration device.
8. Fix the probe inside the calibration module using blocking screw.
9. Click the radio button corresponding to the smallest diameter. (diameter values are shown in the second column)
10. Measure the ring clicking “Measure” button. sign will appear in the opposite to the measured diameter
11. Repeat p6..p9 for all the rings in the gauge
12. After the last ring is measured the SW will calculate the new calibration and show the measured diameters in the third column. If the difference between the measured value and the real ring value is less then 0.01 mm sign will appear. Otherwise will be shown in the corresponding row. The user may then repeat measurement for the badly conditioned ring.

13. If all the rings are measured properly “Save” button will become active to save the calibration coefficients to the probe non-volatile memory.

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.
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

Appendix A – Probius connection schematics

Fig A.1 Basic probe connection schematics

