RIFTEK
Sensors & Instruments

WEDGE WIRE SCREEN INSPECTION MACHINE

User's manual

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Contents

1. Safety precautions

- Only persons who have studied this User's Manual are allowed to operate the Wedge Wire Screen Inspection Machine (hereinafter referred to as the "machine").
- Use supply voltage and interfaces indicated in the specification.
- When connecting/disconnecting cables, the machine must be powered off.

2. CE compliance

The machine has been developed for use in industry and meets the requirements of the following Directives:

- EU directive 2014/30/EU. Electromagnetic compatibility (EMC).
- EU directive 2011/65/EU, "RoHS" category 9.

3. General information

The machine is designed for non-contact automated control of the dimensions of gaps in wedge wire screens.

4. Controlled parameters

The figure below shows the types of wedge wire used in screens and the parameter to be controlled. Each gap is measured, the results are displayed both in digital and graphical form, and the machine monitors deviations beyond the specified tolerance.

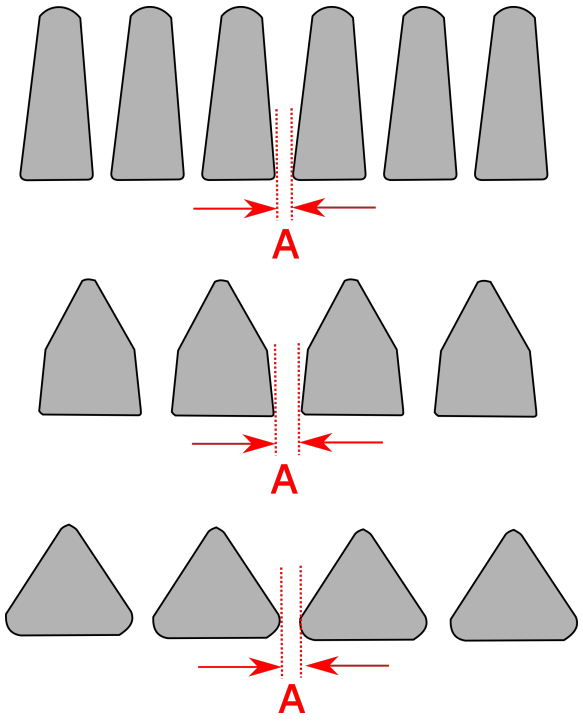


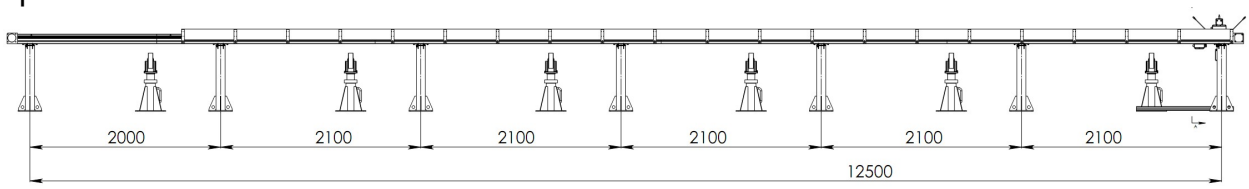
Figure 1 - Controlled parameters

Designations:
A – gap width.

5. Structure and operating principle

5.1. Structural diagram

The machine includes a linear motion system installed along the screen (2). The belt drive of the linear motion system carries a carriage on which an industrial camera (1) with LED illumination is mounted. The camera is focused on the screen (2) using a vertical linear drive. At the beginning of the linear motion system, a calibration template (3) is installed on a special platform. Power supply and control of the machine are provided through an automated workstation (hereinafter referred to as the AWS) using specialized software.



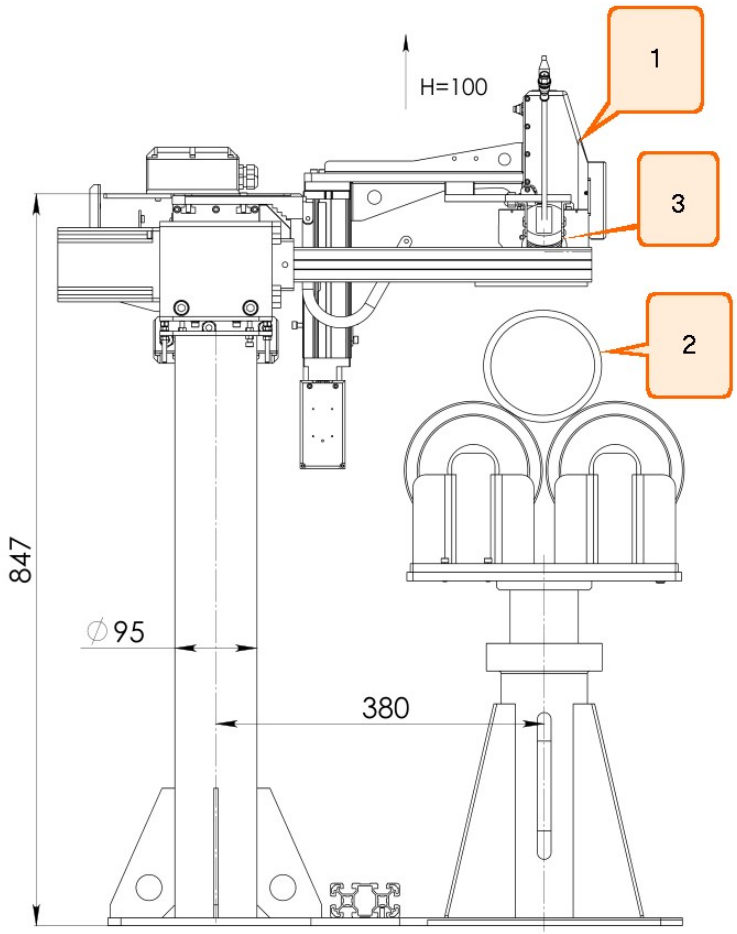


Figure 2 - Overall and mounting dimensions of the machine

5.2. Overall and mounting dimensions

Overall and mounting dimensions of the machine are shown in Figure 2. The AWS dimensions are shown in Figure 3.

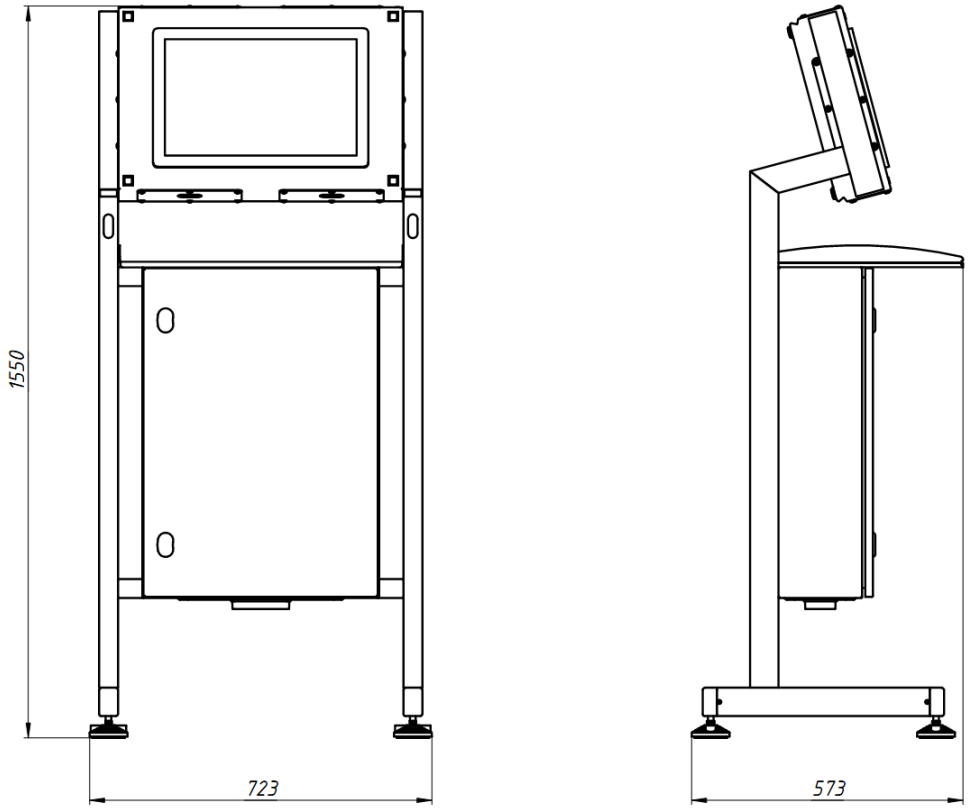


Figure 3 - Overall and mounting dimensions of the AWS

5.3. Operating principle

The linear motion system of the machine is installed along the screen. The industrial camera is positioned so that its field of view lies in the diametral section of the screen. Using the linear motion system, the camera moves along the screen, capturing images of its surface. The software analyzes the obtained images and calculates the gap dimensions. The process is repeated for different screen positions as it is gradually rotated around its axis.

Image data processing is performed on the AWS using the installed software. If the parameter values exceed the specified limits, a corresponding warning is displayed on the AWS.

6. Basic technical data

6.1. Machine

Parameter	Value
Measurement object	Wire screens
Controlled screens length, up to, m	12
Screen diameter, mm	from 125 to 190
Controlled gaps, mm	from 0.05 to 2.1
Wire width, mm	from 1 to 5
Gap measurement error, mm	±0.015
Scanning speed, up to, mm/s	50 (programmable value)
Power supply	AC network with a frequency of (50 ± 1) Hz, rated voltage of 220V ±10%
Power consumption, not more than, W	400
Operating mode	Round-the-clock operation
Operating conditions	Workshop (temperature 10…30°C, relative humidity at T=25°C no more than 80%
Readjustment for measuring another part	Not required if the adjustment is not related to shifting the screen axis
Computer	Industrial computer, 19” touch screen, keyboard, mouse
AWS dimensions, mm	723x1550x573

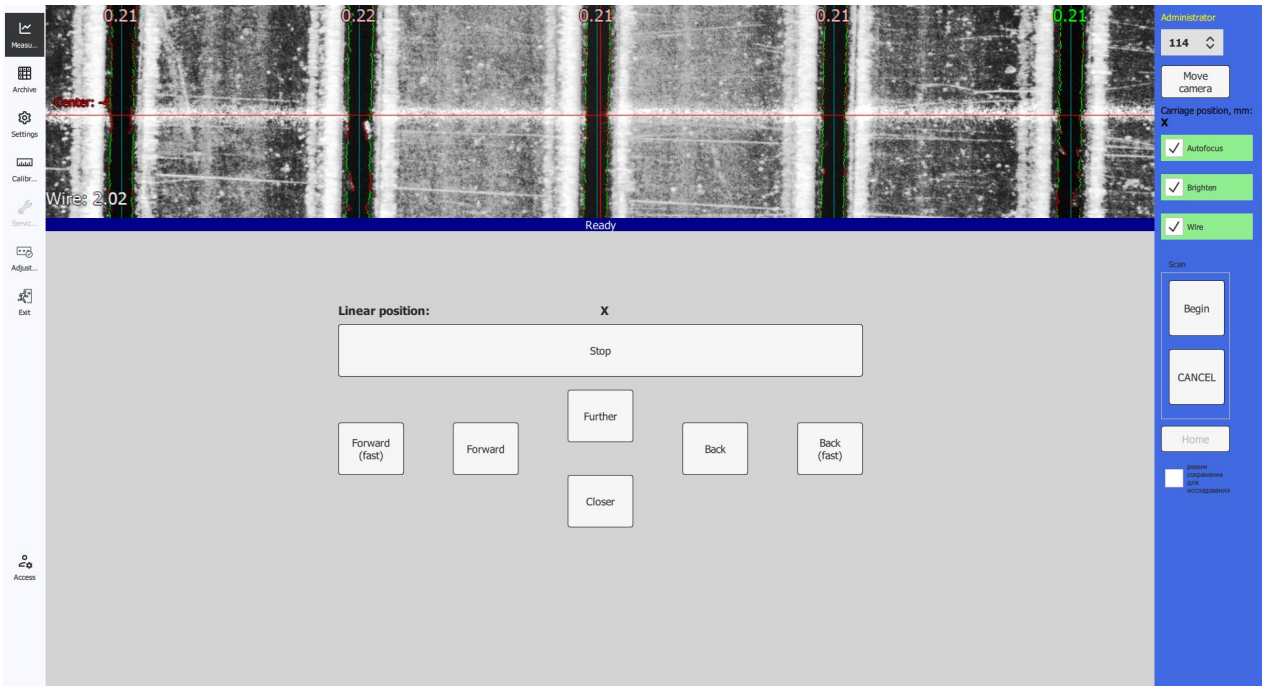
6.2. Camera

Parameter	Value
Industrial camera	
Scanning area size, pixels	1264x256
Compliance	RoHS, FCC Class B, CE, IP30, GenICam, UL, KC, EAC
Operating ambient temperature, °C	0…+50

7. Software

7.1. Main window

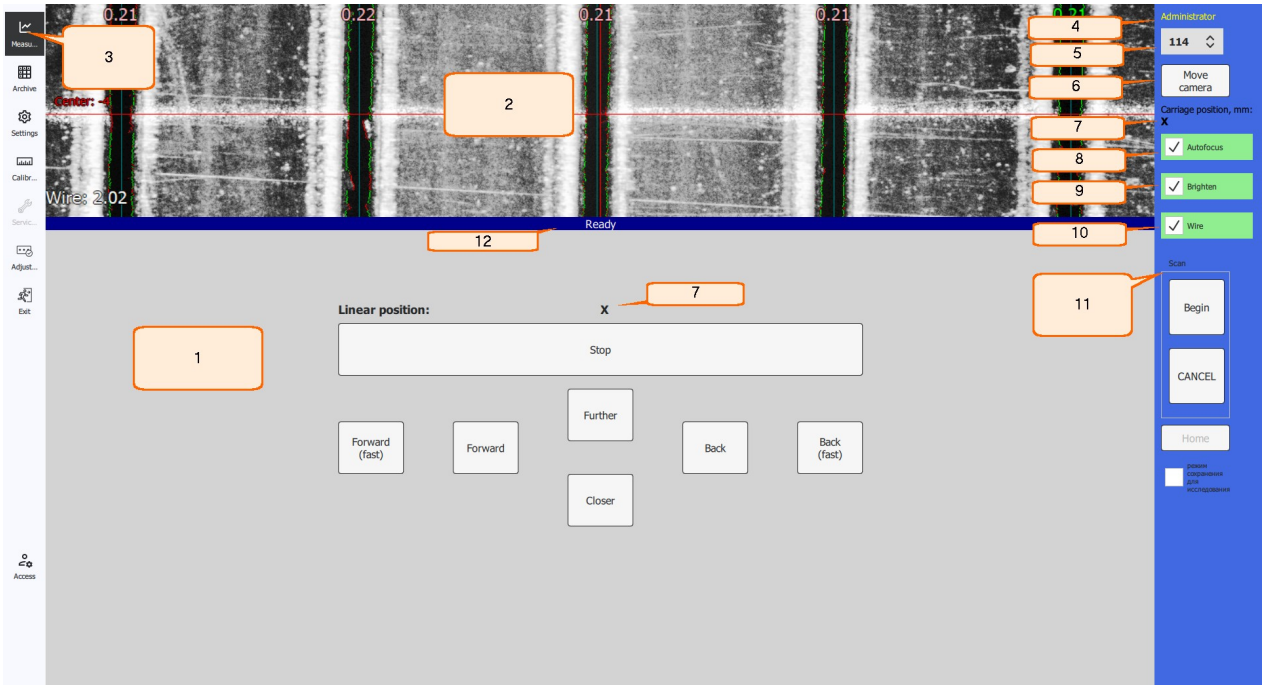
After the machine is powered on, the main program window appears on the screen:



On the left side of the window are the buttons for operating modes and system settings. In the central part, the camera image and the control buttons for the linear motion system motor and the camera's vertical position are displayed.

7.2. "Measurement" section

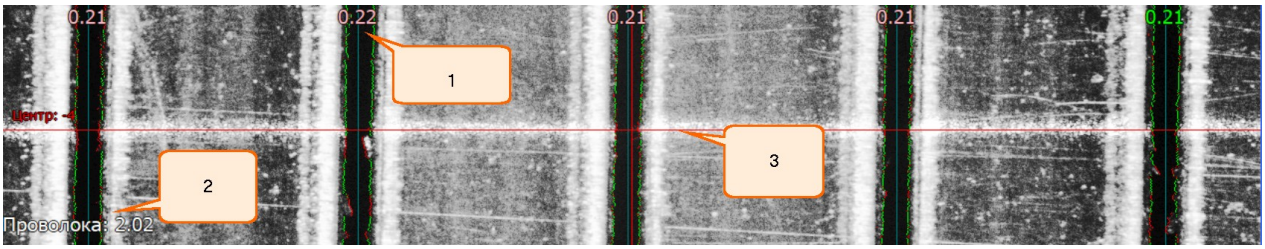
The **Measurement** section is designed to display the measurement results and control the geometric parameters of wire screen gaps.



#	Name	Description
1	"Motor control" panel	Designed to control the motor of the linear motion system and the vertical position of the camera.
2	"Camera image" panel	Displays the camera focus quality.
3	Button to navigate to this section	Main menu button for navigating to this section.
4	Operator	Current operator who is logged into the system.
5	"Filter size" list	Displays the size of the inspected screen.
6	"Move camera" button	Moves the camera to the surface of the inspected screen to a predefined position for the selected screen size using the horizontal and vertical motion systems.
7	"Carriage position" item	Displays the current position of the carriage of the linear motion system along the screen in millimeters.
8	"Autofocus" checkbox	Enables or disables the autofocus mode (maintains a fixed distance between the camera and the screen wall).
9	"Brighten" checkbox	Sets the display mode for images received from the camera: raw (unprocessed) or processed to enhance contrast.
10	"Wire" checkbox	Hides or displays the wire width between the gaps.
11	"Scan" button group	Scan control buttons.

7.2.1. Camera image

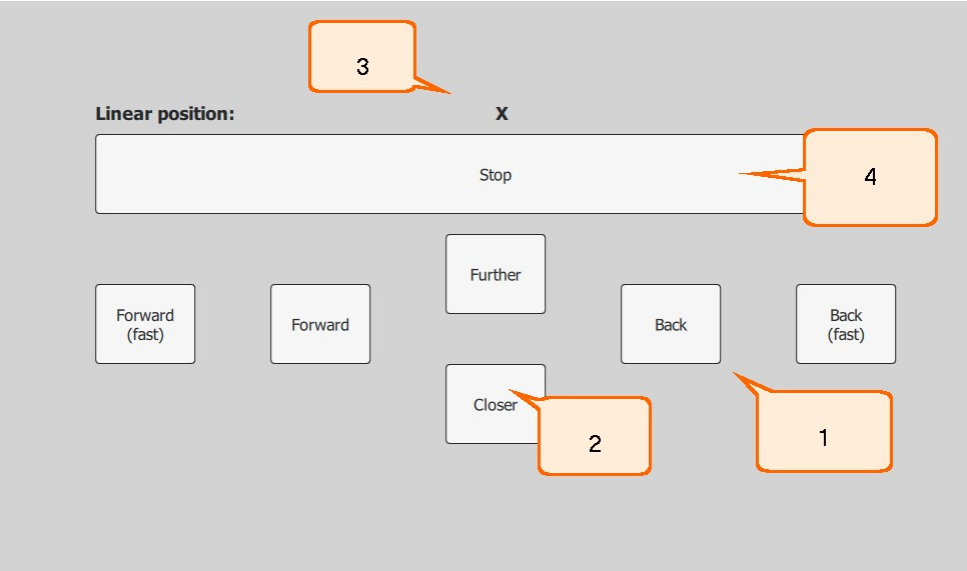
The window displays the camera image, including the gap width (1) and the wire thickness between the gaps (2). A distinctive feature of the machine is automatic camera focusing. The machine is designed so that when the screen is in focus, the laser beam (3) is positioned at the center of the frame (vertically). When the distance to the screen changes, the beam moves up or down. The software automatically adjusts the distance when the **Autofocus** checkbox is enabled, as well as during scanning.



#	Name	Description
1	Gap width, mm	Displays the measured width of the wire screen gaps.
2	Wire thickness, mm	Displays the average thickness of the wire between the gaps currently in the frame. The text color indicates whether the gap width is within the tolerance range.
3	Laser beam deviation from the center position, pixels	Displays the deviation of the laser beam from the central (vertical) position in pixels.

7.2.2. Motor control

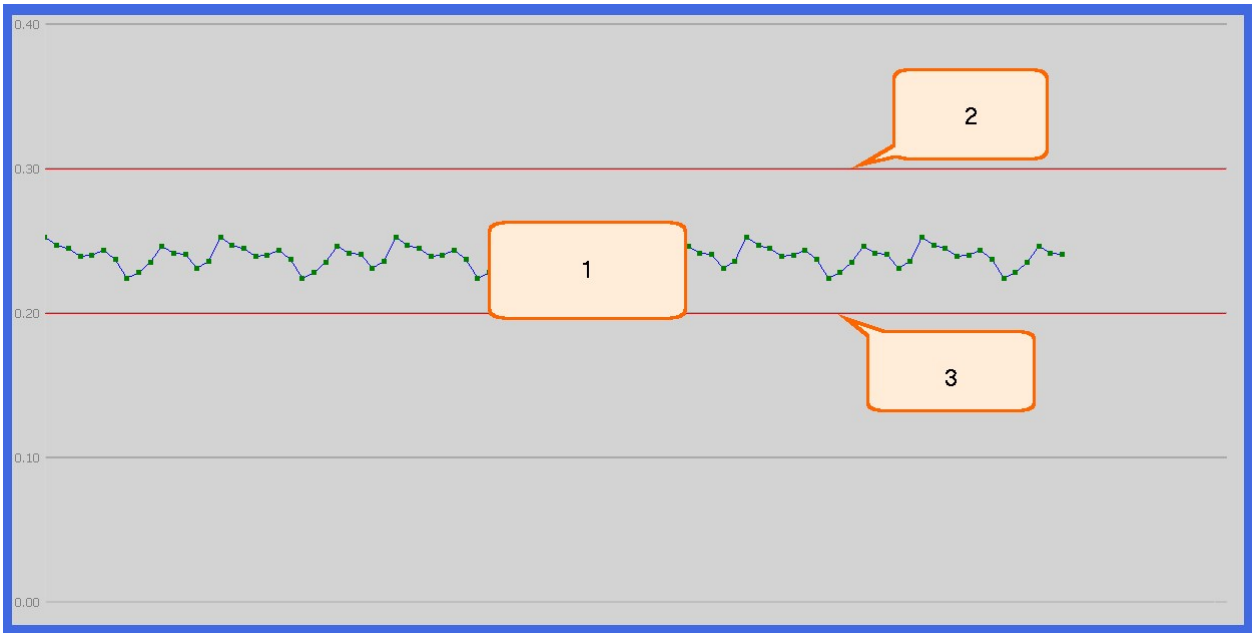
This panel is designed to control the motor of the linear movement system and the vertical position of the camera.



#	Name	Description
1	Linear motion buttons	Allow the camera to move linearly along the screen at high or low speed.
2	Vertical motion buttons	Allow the camera to move vertically to focus on the surface of the inspected screen or on the reference sample during calibration.
3	Current linear position	Displays the current linear position in millimeters.
4	Stop	Stops all motors.

7.2.3. Chart of gap sizes

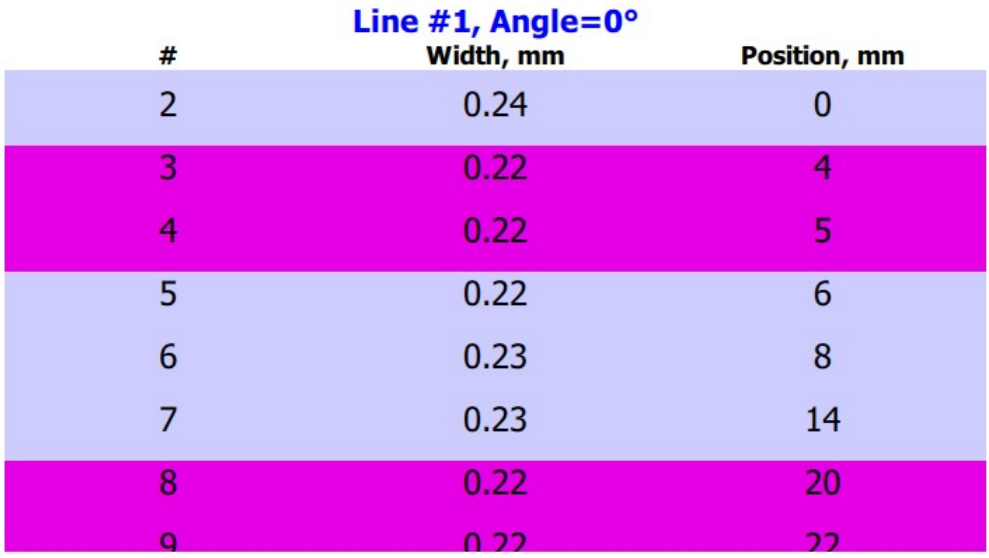
This panel is designed for graphical display and monitoring of measurement results. The figure shows one tolerance criterion. Up to three tolerance criteria can be set simultaneously, which will appear on the graph as horizontal lines of different colors.



#	Name	Description
1	Gap width graph	Displays the measured width of the wire screen gaps. Points are shown in green if the width is within tolerance and in red if it exceeds the limits.
2	Upper tolerance line	Displays the upper tolerance value as a horizontal line.
3	Lower tolerance line	Displays the lower tolerance value as a horizontal line.

7.2.4. Table of discrepancies

After scanning the current line, all gaps that exceed the tolerance limits are displayed in a table. The color indicates which tolerance limit the gap width has exceeded. When a row is selected, the corresponding gap image captured during scanning is shown. By clicking on the gap image, the carriage moves to the position where the gap becomes visible through the camera. This allows the operator to verify the gap width using alternative methods (for example, feeler gauges), remove any contamination that may have affected the measurement result, and, if necessary, repeat the scanning of that line.



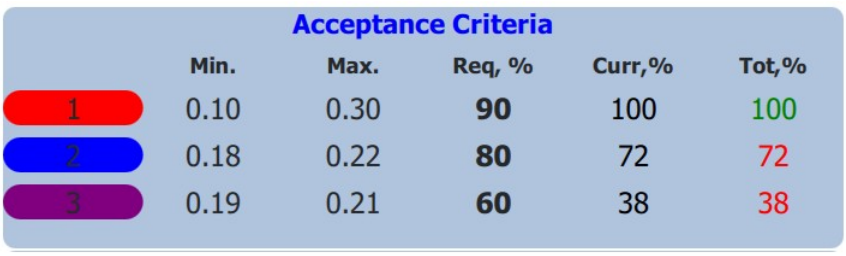
Line #1, Angle=0°

#	Width, mm	Position, mm
2	0.24	0
3	0.22	4
4	0.22	5
5	0.22	6
6	0.23	8
7	0.23	14
8	0.22	20
9	0.22	22

7.2.5. Statistics

The window displays the tolerance criteria (from one to three) and the current statistics:

- minimum value;
- maximum value;
- allowable percentage of the total number of gaps meeting the criterion for the current line;
- allowable percentage of the total number of gaps meeting the criterion for the entire pipe, including the current line.



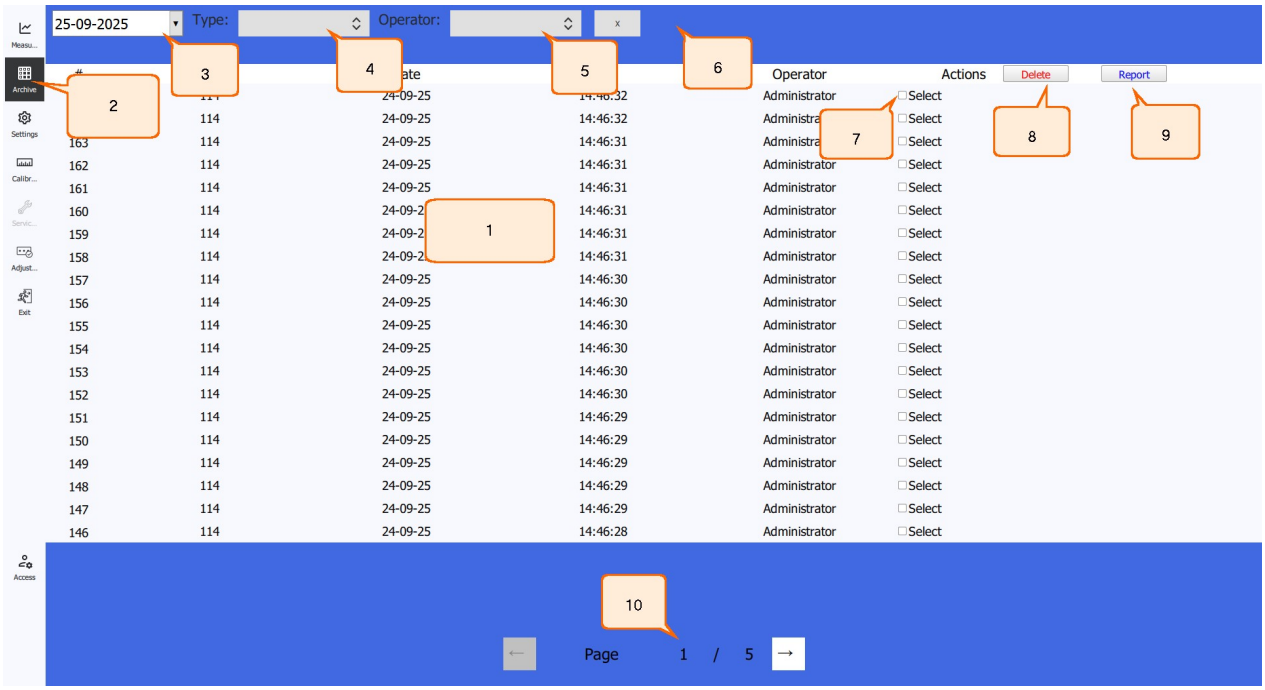
Acceptance Criteria

	Min.	Max.	Req, %	Curr,%	Tot,%
1	0.10	0.30	**90**	100	100
2	0.18	0.22	**80**	72	72
3	0.19	0.21	**60**	38	38

The statistics allow the operator to assess the percentage of gaps that exceed the criteria and, if necessary, repeat the scanning of the corresponding line.

7.3. "Archive" section

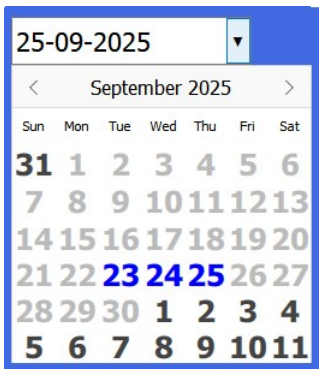
The **Archive** section is designed for displaying and editing measurement results, as well as filtering and displaying results by date, product type, operator name, and product serial number.



#	Name	Description
1	Table	Displays the latest measurements from the database in a tabular format.
2	Navigation button	Main menu button for navigating to this section.
3	Date	Filters results by measurement date.
4	Type	Filters results by product type.
5	Operator	Filters results by operator name.
6	"Reset" button	Clears filters and displays the latest measurements.
7	Database record selection checkbox	Selected database entries are displayed in (1) and (2) and can be deleted (8) or exported as a printable report (9).
8	Delete database entries	Deletes the selected entries (7) from the database.
9	Save report	Saves the selected entries (7) from the table (1) as a printable report.
10	Page	Scrolls through pages with scanning results. By default, 20 results are shown per page.

7.3.1. Date

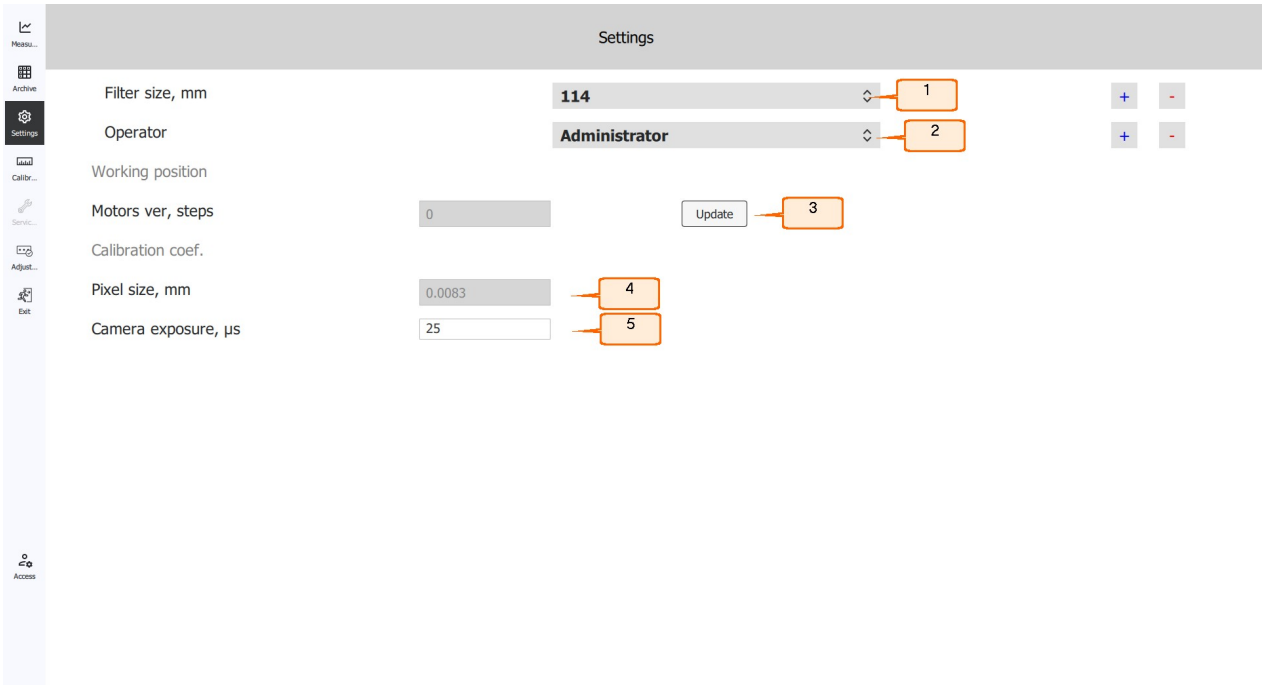
This panel is designed to select the measurement date from the database.



Dates for which measurements are available are highlighted in blue. The selected day is highlighted in red.

7.4. "Settings" section

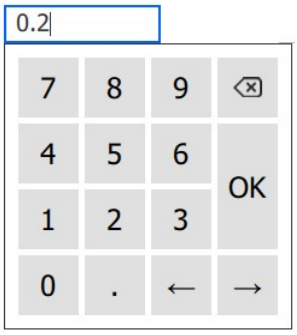
The **Settings** section is designed to change the software settings.



#	Name	Description
1	Filter size, mm	Dropdown menu for selecting the screen size. New data can be added or removed using the "+" and "-" buttons. After selecting the current size, the vertical motor step values (3) are loaded from the configuration file, moving the camera to the measurement position (focused on the inspected side of the screen). The values (3) are defined in the "Positioning" mode.
2	Operator	Drop-down menu for selecting the operator name. Possible values are taken from the database. New data can be added or deleted using the "+" and "-" buttons.
3	Working position	This parameter sets the vertical motor steps that will move the camera to the measurement position (the camera is focused on the screen side being measured). To change these parameters, switch to "Positioning" mode, focus the camera on

#	Name	Description
		the screen surface being measured, return to the "Settings" section, and click the "Update" button.
4	Pixel size, mm	The pixel size used when converting a measured value from pixels to millimeters. This is set in the "Calibration" section. The "Correction" parameter specifies a constant correction value in millimeters that is added to each screen slit width measurement. It can have a negative value. The default value is zero, meaning no correction.
5	Camera exposure	The current camera exposure value.

To change the value, select the input field. The virtual keyboard will appear below the input field.



After editing, click the **OK** button on the virtual keyboard. The value will be changed and the virtual keyboard will be hidden.

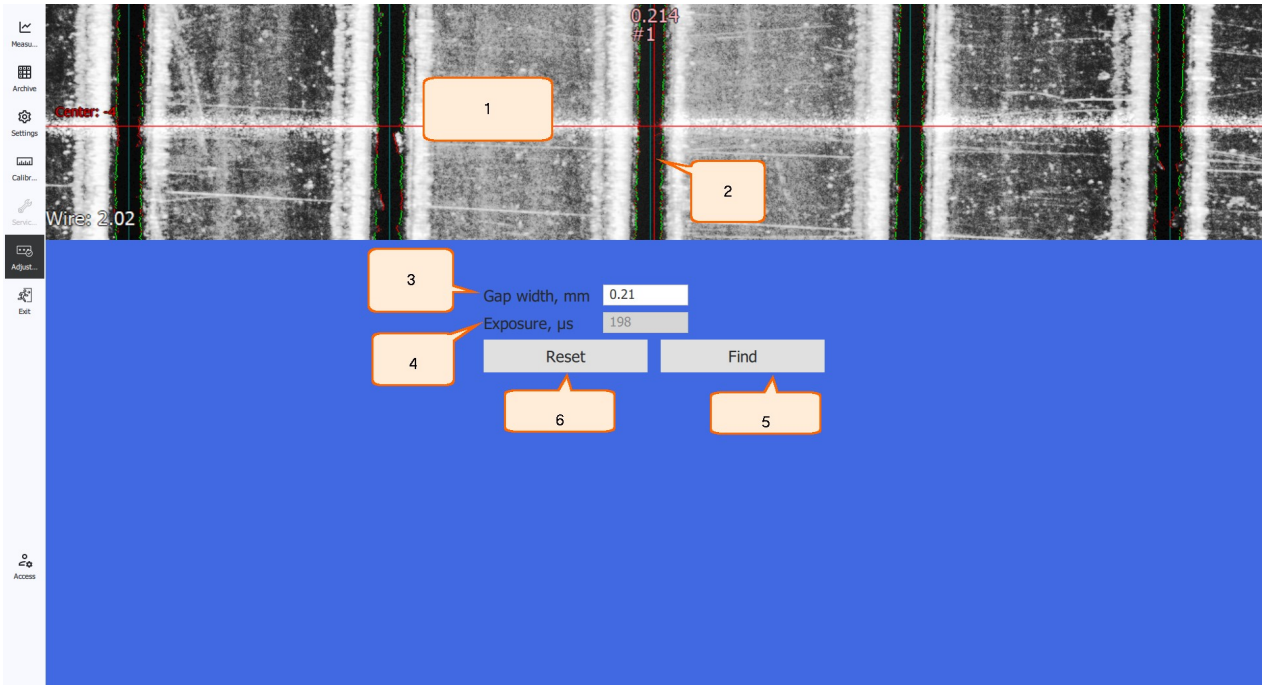
7.5. "Calibration" section

The **Calibration** section is intended for calibration of the machine using a calibration template, which is pre-installed on the protective cover of the camera lens.

#	Name	Description
1	Verification table	Displays the verification results: gap number, reference value, measured value, and their difference in millimeters.
2	Calibration line	The line along which calibration is performed. It must pass through the main divisions of the reference scale (0.1 mm) either at the top or bottom of the standard. The detailed calibration procedure is described in the corresponding section.
3	"Image" switch	Switches the display mode between the original image ("Original") and the enlarged image section used for calibration and verification ("Enlarged").
4	Measurement line movement buttons	Control the vertical movement of the line along which calibration is performed. It must pass through the main divisions of the reference scale (0.1 mm) either at the top or bottom of the standard. The detailed calibration procedure is described in the corresponding section.
5	Pixel size	Displays the calibration result – the pixel size in millimeters.
6	"Calibration" button	Performs calibration. This button is active when the calibration line (2) is located on the main divisions of the standard.
7	"Save" button	Saves the calibration result (pixel size in millimeters) to the configuration file.
8	Region of interest movement buttons	Move the current region of interest so that the reference image is positioned within it.
9	Calibration line movement buttons	Move the calibration line so that it passes between the intermediate (0.05 mm) and main (0.1 mm) divisions of the scale. The line may pass through either the lower or upper part of the standard.

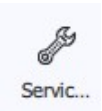
7.6. "Adjustment" section

The **Adjustment** section is intended for selecting the optimal camera exposure value at which the measured gap width most closely matches the width measured by an alternative method (for example, using feeler gauges). The exposure adjustment procedure is described in the corresponding section.



#	Name	Description
1	"Camera image" panel	Displays the camera image.
2	Frame center	A red vertical line in the center of the frame.
3	"Gap width" parameter	Gap width measured by an alternative method, used for adjustment.
4	"Exposure" parameter	Selected exposure value, μs.
5	"Find" button	Adjusts the exposure.
6	"Reset" button	Resets the camera exposure to 100 μs.

7.7. Other menu items

Button	Description
	Activates the button to open menu items. The default password is 121.
	Opens the service menu page. Disabled by default.
	Exit the program.

8. Indended use

8.1. Preparation for use

Preparation of the machine includes:

- Visual inspection.
- Turning on the machine.

8.1.1. Visual inspection

Before operating, make sure that there is no external damage to the machine:

1. Check the condition of cables and ground wires.
2. Check the condition of the camera lens and, if necessary, cleanse it with a soft cloth.

The industrial camera is virtually maintenance-free. Like other optical systems, the camera is sensitive to dust and spatter on the glass. Cleaning should be done with a soft cloth. Do not use aggressive cleaning agents.

8.1.2. Turning on the machine

1. Power on the AWS according to the power supply diagram (see par. 8.4).
2. Launch the software on the AWS.

8.2. Setup procedure

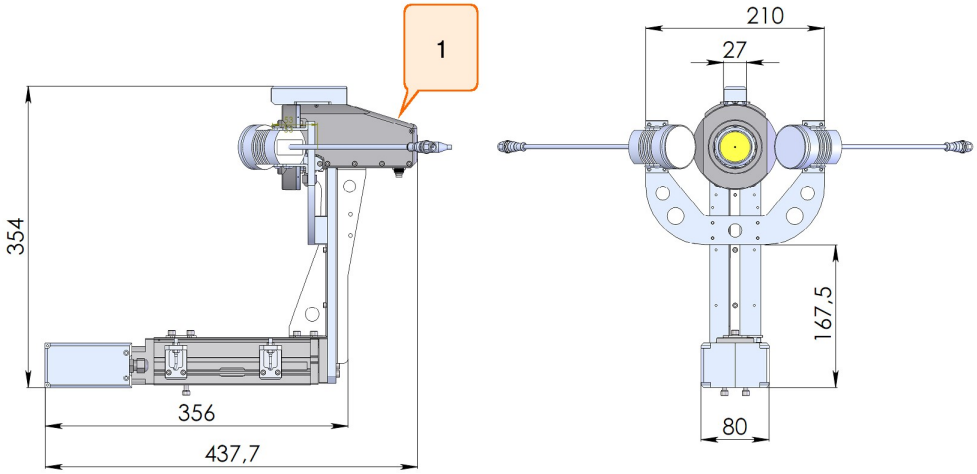
8.2.1. Adding a new size

1. Install the screen.
2. Go to the **Measurement** section and aim the camera at the inspected surface using the motor control buttons (see par. 7. 2. 2).
3. Go to the settings (see par. 7.4), select the current screen size or create a new one, and click the **Update** button. The position of the camera's vertical

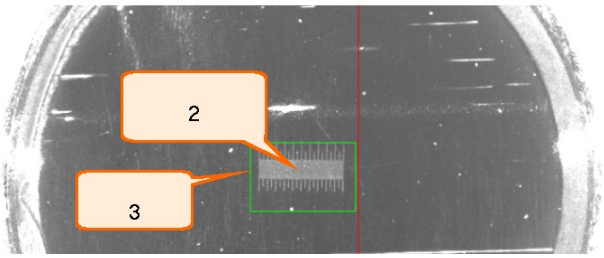
motor will be saved in the settings. Later, when the current screen size is selected, the vertical motor position will be automatically loaded, positioning the camera at the screen wall.

8.2.2. Calibration

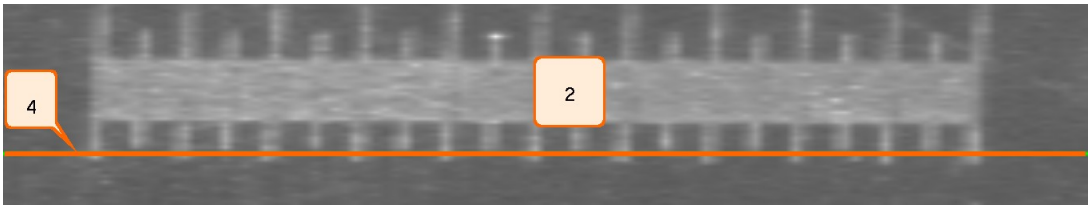
1. Go to the **Calibration** section (see par. 7.5).

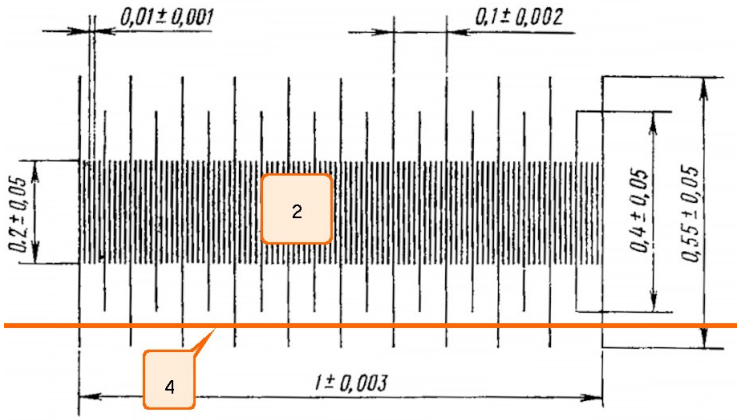


2. Move to the starting position using the linear motion system ("Back" or "Home" button), or restart the program. A calibration template is installed on a special platform at the beginning of the linear motion system.
3. Focus on the calibration standard (2).



4. Go to the **Calibration** section and, in the "Original" image mode (see par. 7.5), make sure that the reference (2) is within the calibration area (3).





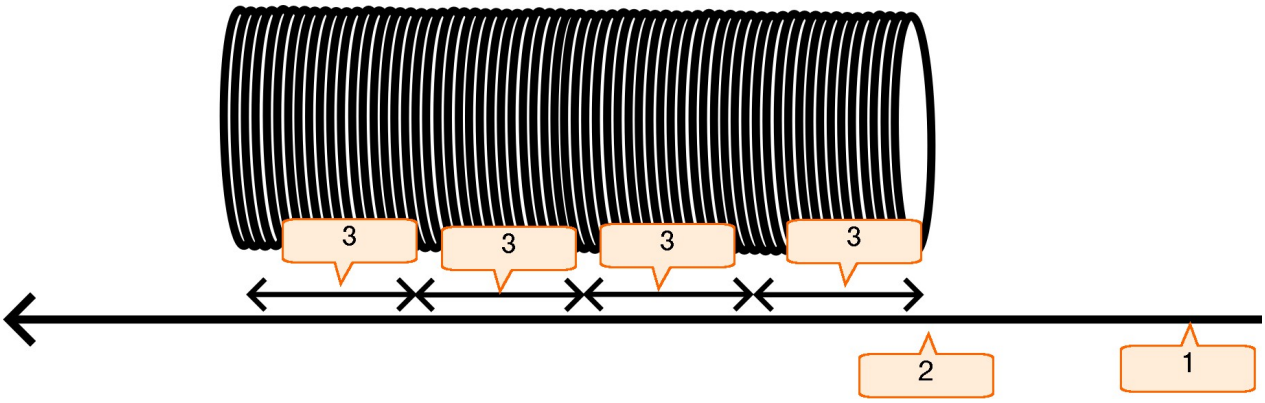
5. Switch to the "Enlarged" image mode and, using the movement buttons, position the measurement line (4) so that it passes between the intermediate (0.05 mm) and main (0.1 mm) divisions of the reference. The line may pass through either the lower or upper part of the reference.
6. If the measurement line (4) is positioned correctly, the **Calibration** button becomes active. After tapping the button, the pixel size in millimeters is calculated, and the verification results are displayed in a table (see par. 7.5).
7. If the difference between the reference and measured values is within the acceptable range, tap the **Save** button to save the calibration result (pixel size in millimeters) to the configuration file.

8.2.3. Adjustment

The adjustment procedure is intended for selecting the optimal camera exposure value at which the measured gap width most closely matches the width measured by an alternative method (for example, using feeler gauges). Differences may occur due to the complex (wedge-shaped) geometry of the wire used in screens, which makes the gap boundaries less distinct for the camera.

1. Go to the **Positioning** section and aim the camera at the inspected surface using the motor control buttons (see par. 7.2.2). The current gap must be centered in the frame.
2. Measure the gap width at the center of the frame using an alternative method (for example, with feeler gauges).
3. Go to the **Adjustment** section (see par. 7.6) and enter the gap width to be used for adjustment.
4. After tapping the **Find** button, the camera exposure is iteratively tested within the 20–150 µs range, simultaneously measuring the gap width in millimeters. As a result, the selected optimal exposure value is displayed.
5. After tapping the **Save** button, the camera exposure is updated, and the parameter is saved to the configuration file.

8.3. Measurement procedure



#	Name	Description
1	Zero position	Carriage zero position.
2	Scan start	Beginning of the scanning range.
3	Line length	Four scanning lines are shown.

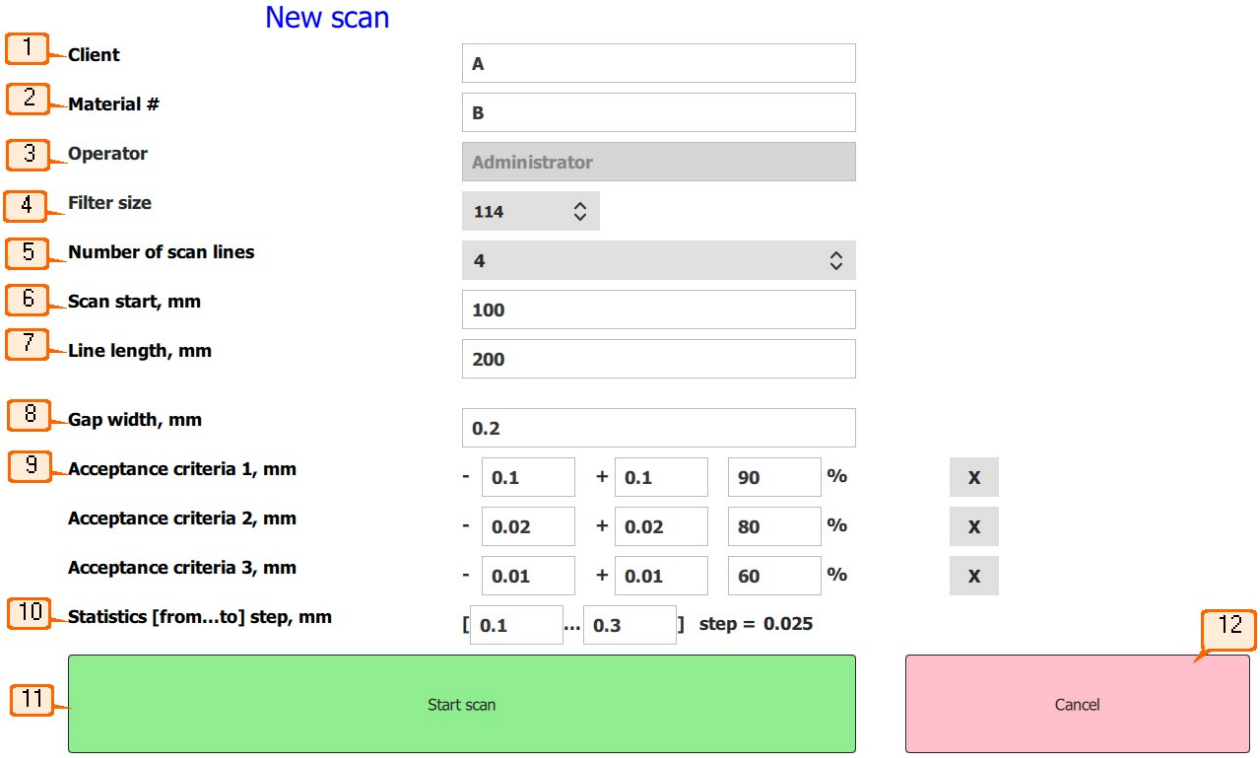
Scanning procedure:

1. Power on the system according to this manual (see par. 8.1.2).
2. Place the inspected wire screen along the linear motion system on the support stands. **WARNING: The presence of debris, chips, or coolant in the measurement area may affect the measurement results.**
3. Switch to the **Measurement** mode (see par. 7.2).
4. Tap the **Begin** button and fill in the fields in the **New scan** dialog. **WARNING: Incorrect selection of the screen size may result in collision between the camera and the screen being measured.**

After filling in all the fields, tap the **Start scanning** button. The carriage will move to the starting position, and the camera will focus on the screen surface according to the predefined positions of the horizontal and vertical motors (see par. 8.2.1 and 7.2.2).

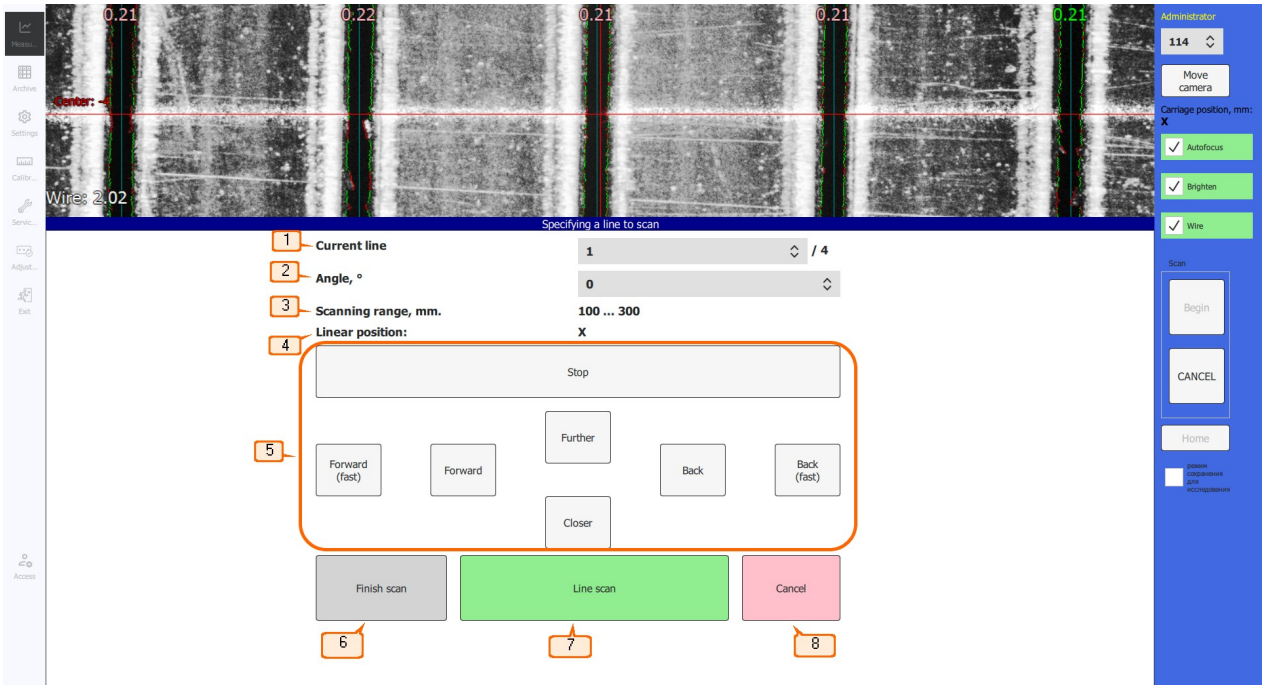
5. It is recommended that the camera faces the screen, allowing the operator to visually monitor the scanning area and focus. At this stage, manual adjustment of the camera position (if necessary) is allowed using the motor control buttons. The scanning of the current line will then begin.
6. After completing the scan of a line, the operator can view the statistics for that line. Poor statistics may indicate the presence of dirt on the scanned screen. After inspecting the gaps that are out of tolerance, the operator may repeat the scan of that line. If the statistics are satisfactory, the operator can rotate the screen and scan the next line (see step 5).
7. Upon completion of scanning, the measurement results are recorded in the database, and a report is generated.

8.3.1. Step 1



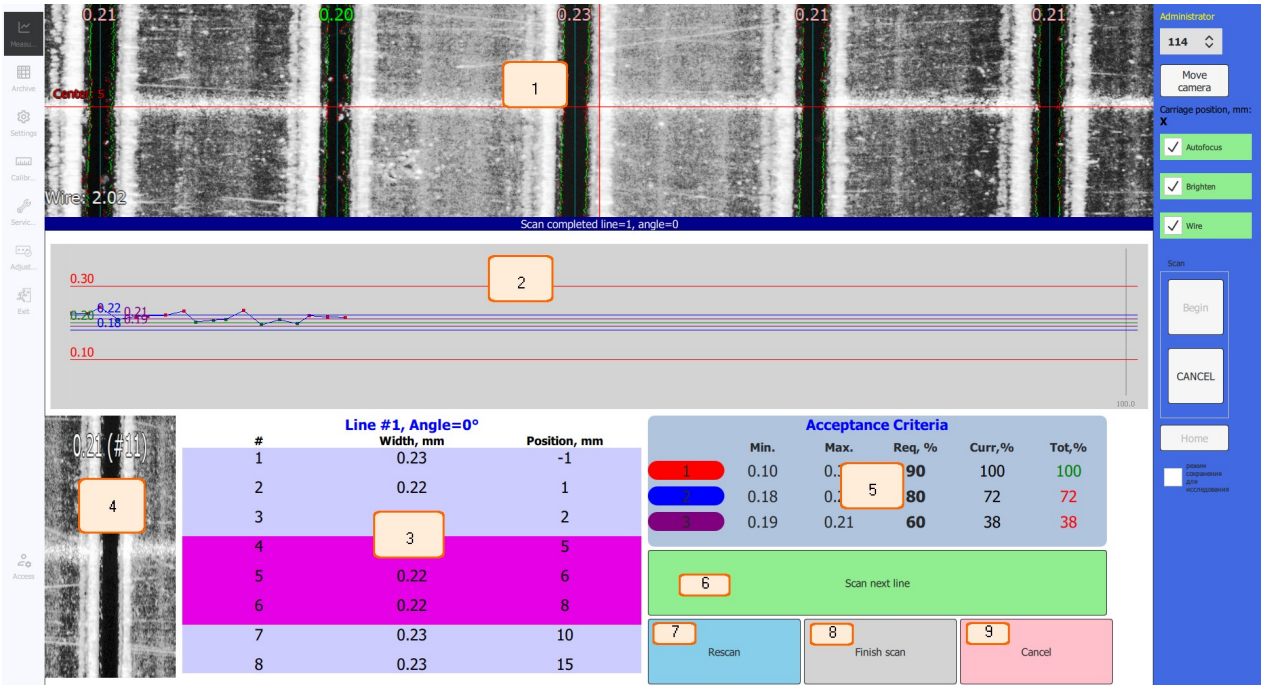
#	Name	Description
1	Client	Client name. Used for the report.
2	Material	Material type. Used for the report.
3	Operator	Current operator name.
4	Filter size	Screen size is selected from the list (see par. 8.2.1).
5	Number of scan lines	Specifies how many lines the entire scanning range will be divided into. To perform the scan in a single pass, set the value to 1. To scan in multiple passes (with screen rotation), specify the desired number of lines. After completing each line scan, the program pauses, waiting for the screen to be rotated before continuing.
6	Scan start, mm	Specifies the carriage position for the beginning of the scan.
7	Line length, mm	Specifies the length of one line measured from the scan start point.
8	Gap width, mm	Filled in manually.
9	Acceptance criteria	Each criterion consists of three values: negative and positive gap width tolerances and the allowable percentage of total gaps meeting the criterion. The "X" button clears the criterion fields. Up to three acceptance criteria can be set.
10	Statistics	Specifies the upper and lower gap width limits used to generate the statistics table. The entire range is divided into 10 intervals. The interval step is calculated automatically and displayed as the third value.
11	"Start scan" button	Begins scanning if all fields are filled in. Otherwise, a warning is displayed indicating that not all fields are filled in.
12	"Cancel" button	Stops the scanning process without saving the results or generating a report.

8.3.2. Step 2



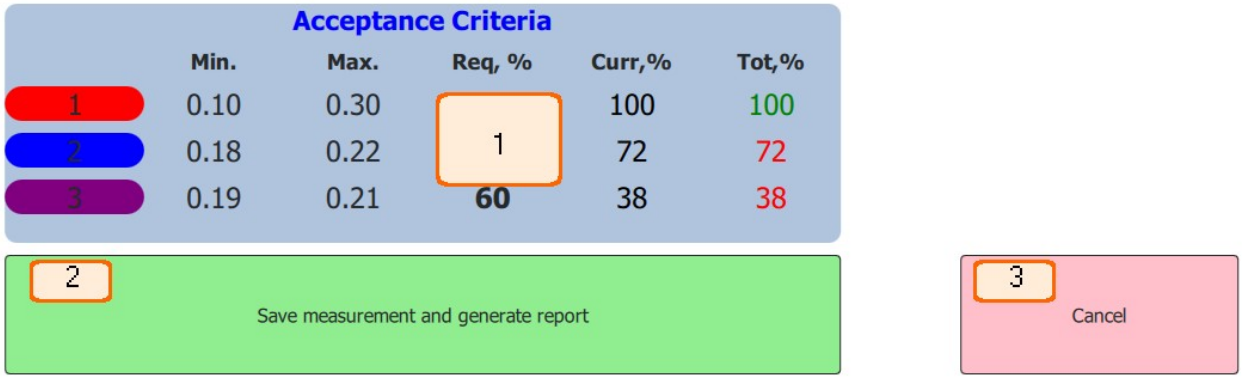
#	Name	Description
1	Current line	Number of the current line (for the report). The number of lines to be scanned was defined in the previous step.
2	Angle	Rotation angle of the scanned screen (for the report).
3	Scanning range	Linear travel range of the camera when scanning a line.
4	Linear position	Displays the current linear position in millimeters.
5	Motor control	See par. 7.2.2.
6	"Finish scan" button	Saves the scanning results of the current line and proceeds to the menu for saving the entire screen scan results and generating a report (see par. 8.3.4).
7	"Line scan" button	Scans the current line.
8	"Cancel" button	Cancels the scanning process.

8.3.3. Step 3



#	Name	Description
1	Camera image	See par. 7.2.1.
2	Measurement chart	Displays the measured gap width for the current line as a graph (see par. 7.2.3).
3	Discrepancy table	All gaps that exceed the tolerance limits are displayed in a table (see par. 7.2.4). When a row is selected, the corresponding gap image captured during scanning is shown. By clicking the gap image (4), the carriage moves to the position where the gap is visible through the camera. This allows the operator to verify the gap width using alternative methods (for example, feeler gauges), remove any contamination that may have affected the measurement result, and, if necessary, repeat the scanning of that line.
4	Image of the gap	Displays the image of the selected gap (3) captured during scanning. By clicking the gap image, the carriage moves to the position where the gap is visible through the camera. This allows the operator to verify the gap width using alternative methods (for example, feeler gauges), remove any contamination that may have affected the measurement result, and, if necessary, repeat the scanning of that line.
5	Statistics	Displays statistics for all criteria for the current line and for the entire pipe, including the current line (see par. 7.2.5). The statistics allow the operator to assess the percentage of gaps that exceed the criteria and, if necessary, repeat the scanning of the corresponding line.
6	"Scan next line" button	Saves the scanning results of the current line and proceeds to the menu for selecting the next line to scan (see par. 8.3.2).
7	"Rescan" button	Current line scan results are not saved and are not included in the report. This button rescans the current line.
8	"Finish scan" button	Saves the scanning results of the current line and proceeds to the menu for saving the entire screen scan results and generating a report (see par. 8.3.4).
9	"Cancel" button	Ends the scanning process without saving the results or generating a report.

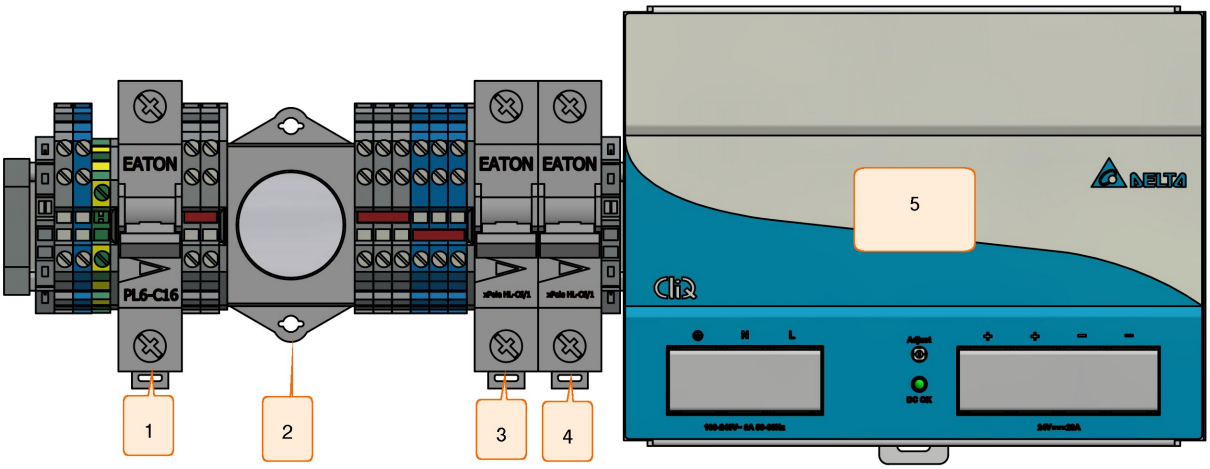
8.3.4. Step 4



#	Name	Description
1	Statistics	Displays statistics for all criteria for the last scanned line and for the entire pipe, including the last line (see par. 7.2.5).
2	"Save measurement and generate report" button	Saves the scanning results of all screen lines and generates a report.
3	"Cancel" button	Ends the scanning process without saving the results or generating a report.

8.4. Power supply diagram

The circuit breakers are located in the AWS control cabinet.



#	Name	Description
1	220V input	Circuit breaker for 220V input power.
2	220V indicator	Indicator showing the presence of 220V input voltage (white light).
3	24V output	Circuit breaker for powering the linear motion carriage and EtherCAT motor drive.
4	24V output	Circuit breaker for powering the router, computer, and camera motion system.
5	220V–24V converter	AC–DC 220V–24V power converter.

8.5. Turning off the machine

1. Exit the program (see par. 7.7, "Exit" button) and shut down the operating system.
2. Turn off the power to the AWS (see par. 8.4).

9. Maintenance

9.1. General instructions

Maintenance of the machine is carried out to ensure its constant readiness for operation and to prevent premature failure. Maintenance includes preventive measures aimed at identifying and eliminating defects, and at ensuring the normal operation of the system. It is necessary to carry out daily maintenance work.

9.2. Safety precautions

Observe the safety precautions outlined in Section 1 of this User's Manual.

9.3. Maintenance procedure

9.3.1. Daily maintenance work

Daily maintenance work includes:

- Visual inspection.
- Checking for completeness.
- Checking for damage to structural elements, power and measuring cables and connectors.
- Checking the linear motion modules and the windows of sensors for dirt and, if necessary, cleansing them with a soft, lint-free cloth.

10. Warranty policy

The warranty period of operation is 24 months from the date the machine is commissioned.

The storage warranty period is 6 months when stored in enclosed warehouse facilities.

The total warranty period, including both storage and operation, is 30 months from the date of manufacture. The storage warranty period precedes the operation warranty period. When the machine is put into operation, the storage warranty period ceases to apply.

11. Revisions

Date	Revision	Description
05.06.2024	1.0.0	Starting document.
01.10.2025	2.0.0	Changes have been made to the machine specifications and the software description.

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