PEC Flaw Detector PE4332

Operation Manual

Saint Petersburg

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+7(812) 385-54-28 info@oktanta-ndt.ru

Contents

PURPOSE

The Pulsed Eddy Current Flaw Detector PE4332 (PEC Flaw Detector PE4332) is designed to detect corrosion under insulation without removal of the latter. The Device is used to inspect such items as:

Insulated pipelines including pipelines in operation:

Figure 1. Pipelines.

Insulated tanks:

Figure 2. Tanks.

Oil platform supports:

Figure 3. Oil platforms.

LNG tank supports:

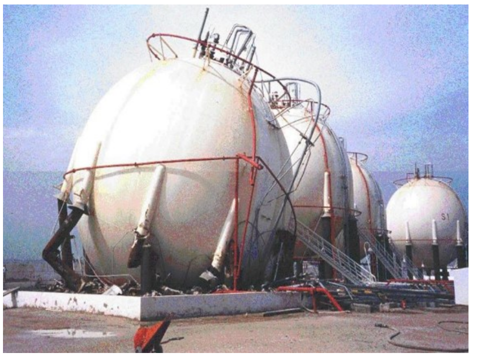


Figure 4. LNG tanks.

Ship hulls with thick paint or epoxy coating:

Figure 5. Ship hull.

The Device allows to test such items without preliminary surface preparation or insulation removal. The insulation can be represented with any non-conducting coating, such as polyurethane, mineral wool, plastics, paint, or air. An insulation casing can be made of aluminum or galvanized steel.

PRINCIPLE OF OPERATION

The Device operation is based on the pulsed eddy current technique of nondestructive inspection. A Device sensor generates a pulsed magnet field which magnetizes a test item area located beneath it. Time of magnetization and demagnetization of this area depends on the metal thickness.

The main tool that displays the demagnetization process is A-scan shown in Figure 6:

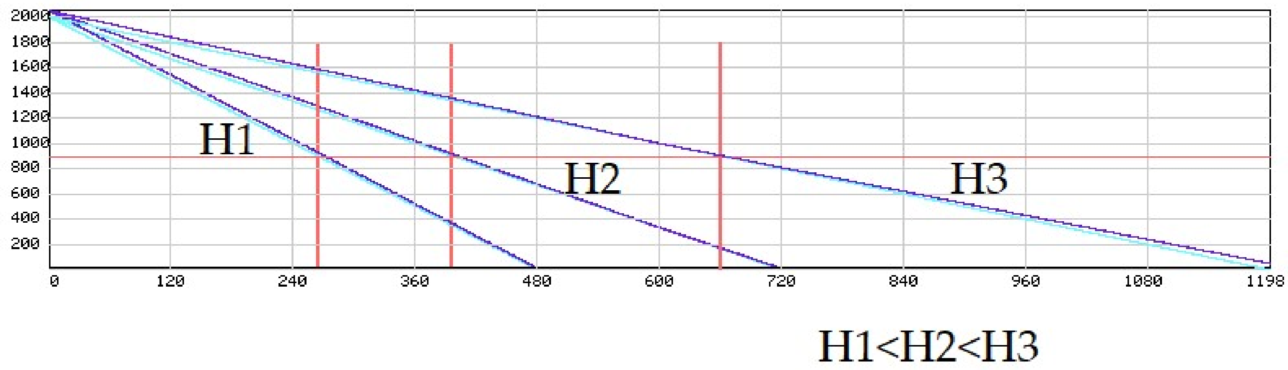


Figure 6. A-scan appearance.

The greater is the metal thickness under the sensor, the longer is the demagnetization process on A-scan and vice versa, the smaller is the metal thickness under the sensor, the faster the demagnetization occurs. The Device analyses parameters of the demagnetization process and, based on this analysis, measures the mean metal thickness under the sensor.

The Device is subject to mandatory calibration at the test item; for correct operation of the Device, it is necessary to know the nominal thickness of the test item.

TECHNICAL CHARACTERISTICS

Measured thickness range for steel (depends on insulation thickness and sensor, see Sensor Selection)	0 to 60 mm
Average thickness measurement error	10%
Thickness range for insulation coating (depends on insulation thickness and sensor, see Sensor Selection)	0 to 300 mm
Minimum diameter of tested pipes	50 mm
Temperature of test item metal	-100To° to +600°C
Temperature of casing surface in place of sensor contact	-20° to+60°C
Working ambient temperature range	-20 to +50°C
Time of continuous operation without battery recharging	8 hours
Cable length	1.5 m, 5.5 m
Overall dimensions	246 x 315 x 32 mm
Weight	5 kg

PEC FLAW DETECTOR APPEARANCE

Figure 7 shows the appearance of the PEC Flaw Detector PE4332. You can see the Device itself and the sensor connected with the Device using the cable.

Figure 7. PEC Flaw Detector PE4332 appearance.

Device

The Device is incorporated into a plastic impact-resistant housing with protective rubber inserts. The Device display is protected with a hardened impact-resistant glass. Figure 8 shows the detailed appearance of the Device.

Figure 8. Device appearance.

Numbers in the Figure stand for:

1 – Device carrying handle, 2 – Device display, 3 –Device keyboard, 4 – connector for transducers, 5 – USB-A and USB-B connectors, 6 – recharger connector, 7 – holder for Device installation on flat surfaces

For Device display appearance, see Figure 9.

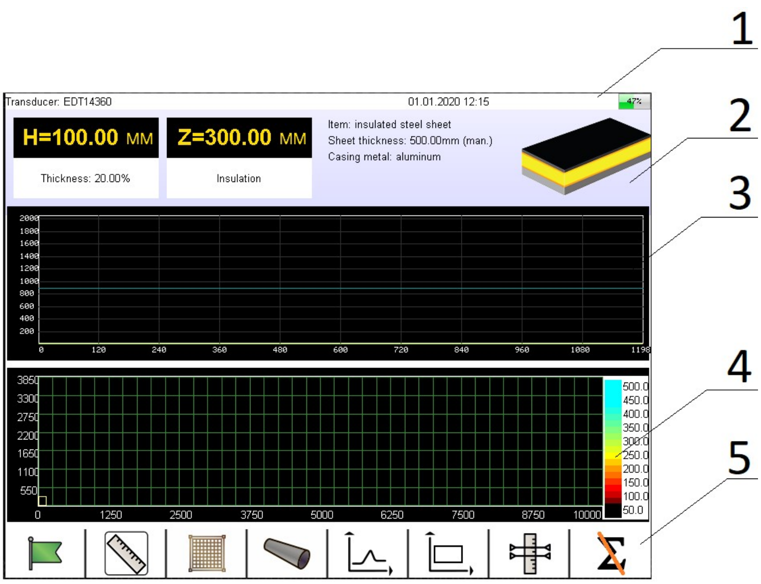


Figure 9. Device display.

There are 5 main screen panels. They are numbered and indicated in Figure 9:

Panel 1 This panel contains information on the connected sensor name, GPS coordinates, current date and time, battery charge level, as well as different indicators can be found at this panel. The indicators are as follows:

- Indicator of a switched-on light ,
- Indicator of a switched-on encoder ,
- Indicator of activated scan mode  .

Panel 2 This panel provides information on the test item as well as displays measured thickness of metal and current thickness of the item insulation.

Panel 3 This panel displays A-scan of the Device.

Panel 4 This panel displays C-scan of the Device.

Panel 5 This panel displays icons with functional keys.

The Device has the keyboard. The functional keys of the keyboard are described in Table 1.

Table 1. Keys of Device keyboard

Key	Key assignment	
	Name	Function
	ON/OFF key	Switching on and off the Device.
	Back key	Return to the previous menu items as well as closing the menu
	Left, Up, Down, Right navigation keys	Navigation through the Device menu
	OK key	Setting of the selected parameter in the menu of electronic module
	Menu key	Access to and exit from the main menu of the Device

	MIN key	Display and locking A-scan on the screen for a point with minimum metal thickness detected
	Multi-functional keys	Various functions specified by the icons

Sensor

Figure 10 shows the appearance of the sensor.

The sensor is made of impact-resistant plastics. Its display is protected with hardened glass.

Figure 10. Sensor appearance.

Numbers in the Figure stand for:

1 – encoder, 2 – sensor display, 3 – sensor keyboard, 4 – cable connector.

Figure 11 shows the appearance of the sensor display.

Figure 11. Sensor display.

The sensor display shows the following information:

- Indicator of a switched-on light ,
- Indicator of a switched-on encoder ,
- Indicator of activated scan mode  ,
- Metal thickness,
- Insulation thickness,
- Coordinates of the current position on C-scan.

The Device sensor has its own keyboard. The keyboard keys are described in Table 2.

Table 2. Sensor keyboard.

Key designation	Key name	Key function
	Start or stop the continuous measuring mode	Switch on or off of the continuous measuring mode
	Start of the single measurement	Measurement of the test item thickness
	Navigation keys: Left Up, Down Right	Navigation through C-scan

	"Word wraparound" key	Wraparound on the C-scan
	"Light" key	Switching on and off of the light
	"Encoder" key	Switching on and off of the encoder

WARNING!

During operation of the PEC Flaw Detector PE4332, the sensor generates a large pulsed magnet field. Be careful when using the sensor as the field can magnetize such sharp tools as a knife, pricker, needle, etc. Do not keep the sensor close to any magnetic-field-sensitive equipment!!!

DEVICE MENU

Figure 12 shows the main window of the Device.

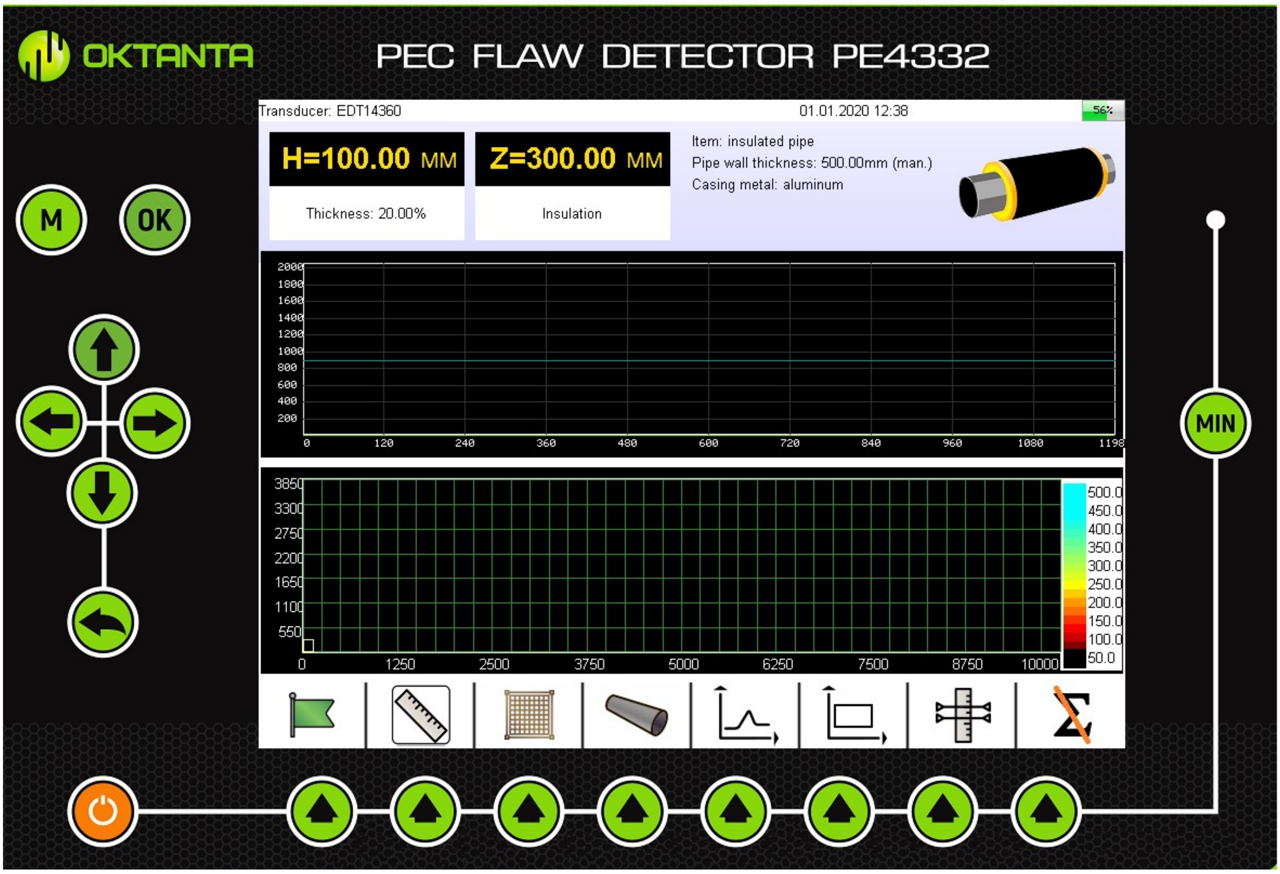
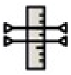


Figure 12. Device main window

The icons shown in the main window of the Device are provided in Table 3:

Table 3. Icons above the keys in the main window of the Device

Icon	Purpose
	Access to scanning start/stop/continuation menu
	Access to Device calibration menu
	Access to C-scan grid edition menu
	Access to test item parameter change menu
	Access to A-scan navigation menu
	Access to C-scan navigation menu
	Access to rejection requirements (rejection thresholds) setting menu
	Switching on and off of accumulation

 Scanning start/stop/continuation menu.

This menu allows to start or interrupt the scan mode. The scan mode allows to measure the thickness in nodes of the pre-set grid. The scan mode is necessary to fill C-scan if it is required.

Figure 13 shows this menu.

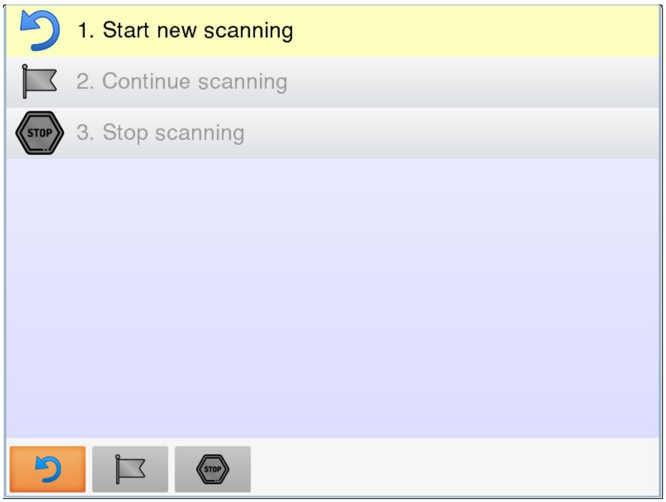


Figure 13. Scanning start/stop/continuation menu.

This menu has three menu items between which you can navigate using the keys of the Device keyboard. To select the appropriate menu item, press on the OK key. These menu items allow to start new scanning, stop scanning, as well as to continue the stopped scanning.

New scan

Figure 14 shows "Start new scanning" window. In this window you can set the name of the location where test is carried out; set the name of the site where test is carried out; set the test item name and the Operator name.

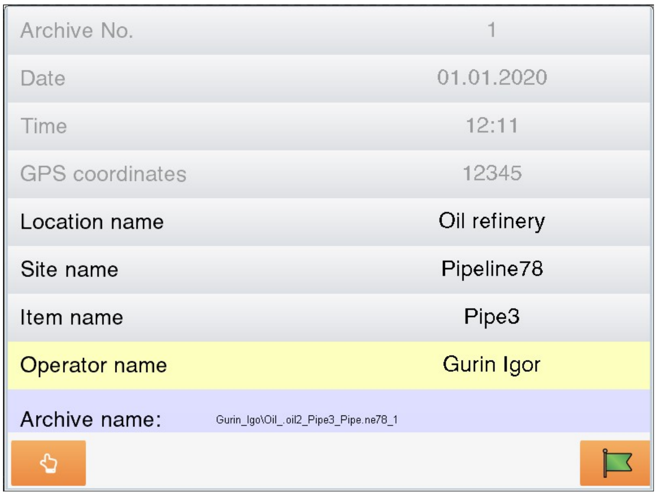


Figure 14. New scanning window

To start scanning, press on the key.

Scanning stop

To stop scanning, select "Stop scanning" menu item and press on the OK key on the Device keyboard.

Scanning continuation

To continue scanning, select "Continue scanning" menu item and press on the OK key of the Device keyboard. This function can be used not only to continue the stopped scanning, however, to continue the previous scans that were not completed. For example, the user may have scanned only part of the test item and then he/she can return to the test item few days later and continue scanning. To do this, the user shall open the archive with non-completed scan (see Section "Main menu" / "Open file"), open menu of scanning start/stop/continuation and select "Continue scanning". Do not forget that in this case calibration shall be performed prior to scanning continuation.

WARNING! You can get access to "Scanning" menu through the M Device main menu key.

Calibration

Figure 15 shows the Device calibration window. To perform calibration, install the sensor on the test item section with thickness known and press on the OK key on the Device.

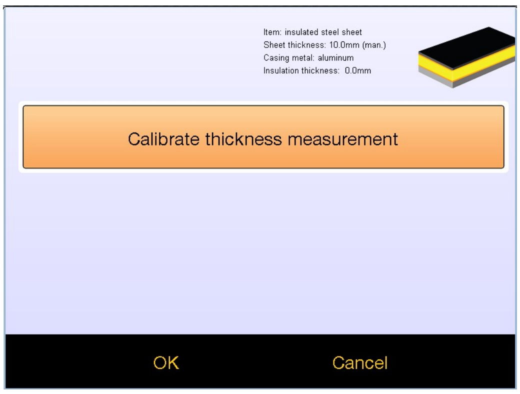


Figure 15. Device calibration window

Please note that before calibration, you must set the parameters of the test object in the menu “Test item parameters” .

Grid

When you use the scan mode, you shall put a measuring grid to the test item. We propose to use our special self-adhesive film with a grid. You can also draw the grid on the test item by yourself using, for example, a ruler and a marker. Figure 16 shows the window for grid parameters setting.

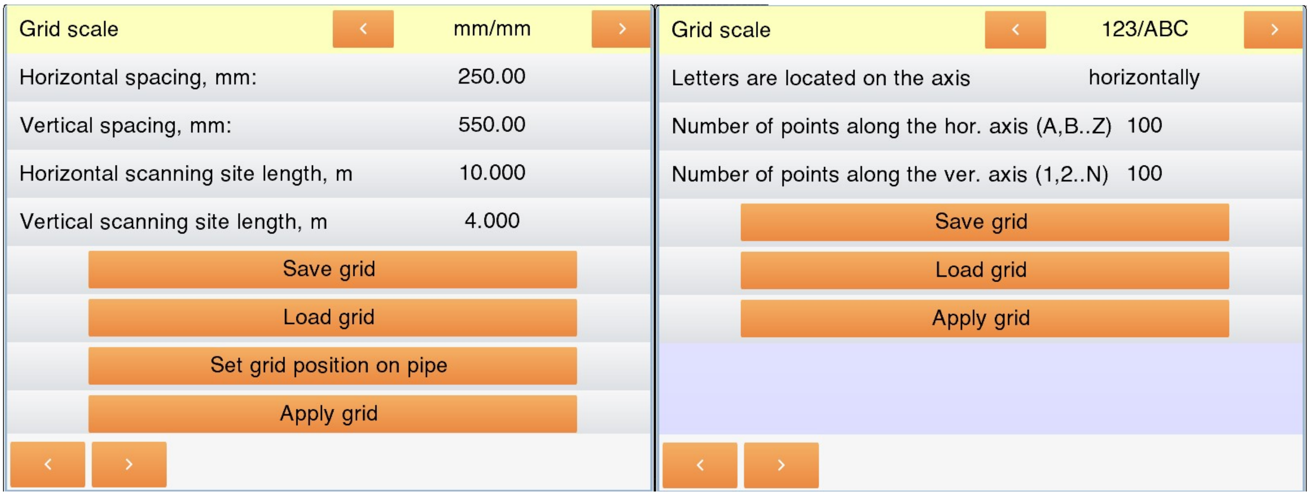


Figure 16. Window with grid parameters.

To navigate through the window, use the navigation keys.

This menu contains the following items:

Grid scale

There are two scale options: dimensional scale (mm/mm) and non-dimensional scale (123/ABC). The first option is used when the grid has fixed linear dimensions; the second one is used when linear dimensions are not important. To change the scale, use the keys or the keys with the icons.

Horizontal spacing

This parameter is used to set the grid spacing along the horizontal axis. This parameter can vary from 1 to 2000 mm.

To change the parameter, use the keys under the -1 +1 -10 +10 -100 +100 icons.

For quick entry, you can use the key under the icon. In this case, the window shown in Figure 17 will appear.

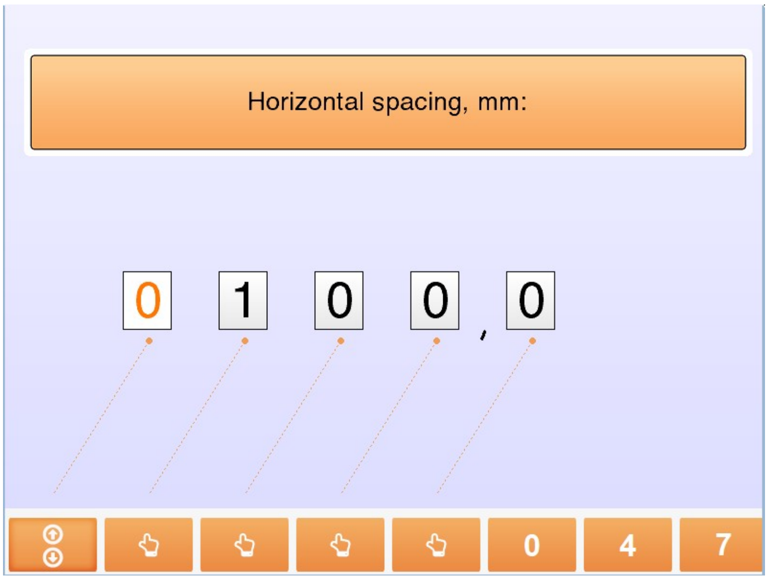


Figure 17. Quick entry window.

To change over the digit position, use the keys or the keys under the icons. To enter the given number, use the keys or the keys under the 4 0 7 icons.

Vertical spacing

This parameter is used to set the grid spacing along the vertical axis. This parameter can vary from 1 to 2000 mm. Navigation through this menu item is the same as through the "**Horizontal spacing"** menu item.

Horizontal scanning site length

This parameter is used to set the horizontal size of the scanning site. This parameter can vary from 1 to 50 m. Navigation through this menu item is the same as through the "**Horizontal spacing"** menu item.

Vertical scanning site length

This parameter is used to set the horizontal size of the scan site. This parameter can vary from 1 to 5 m. Navigation through this menu item is the same as through the "**Horizontal spacing"** menu item.

Save grid

The user can save the selected grid in the Device memory for further use. The grid saving window is shown in Figure 18.

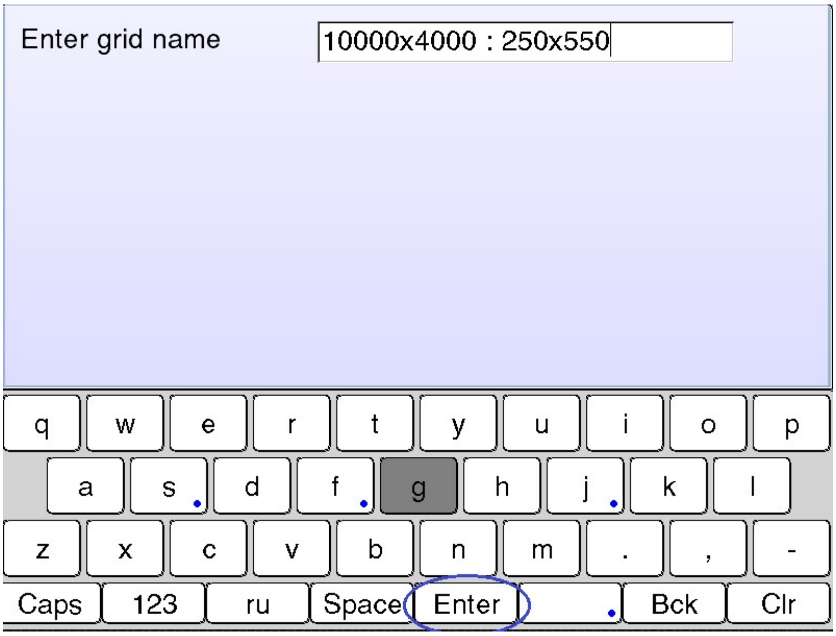


Figure 18. Grid saving window.

By default, the grid name is automatically generated from the grid parameters; however, you can change the grid name as you wish. To this end, the Device has the keyboard mode (see Figure 12). To navigate through the keyboard, use the  keys. The selected character is entered when the  key is pressed on. To complete entry of the name and to exit from this window, press on the  key under the  icon (see Figure 18).

Table 4 shows the icons used for text entry.

Table 4. Keyboard icons

Icon	Purpose
Caps	Switching on or off of the upper case
123 or ABC	Change-over between letter mode and number mode
en or ru	Change-over of the language: English or Russian
Space	Space key
Enter	Saving information and exit from the keyboard mode
•	Quick change-over between the keys similarly marked on the keyboard
Bck	Erasion of one character
Clr or Undo	Complete clearing of the entry field or cancellation of entry field clearing

Grid loading

You can load the pre-saved grid for the test item. Figure 19 shows the window in which you can select the pre-saved grid.

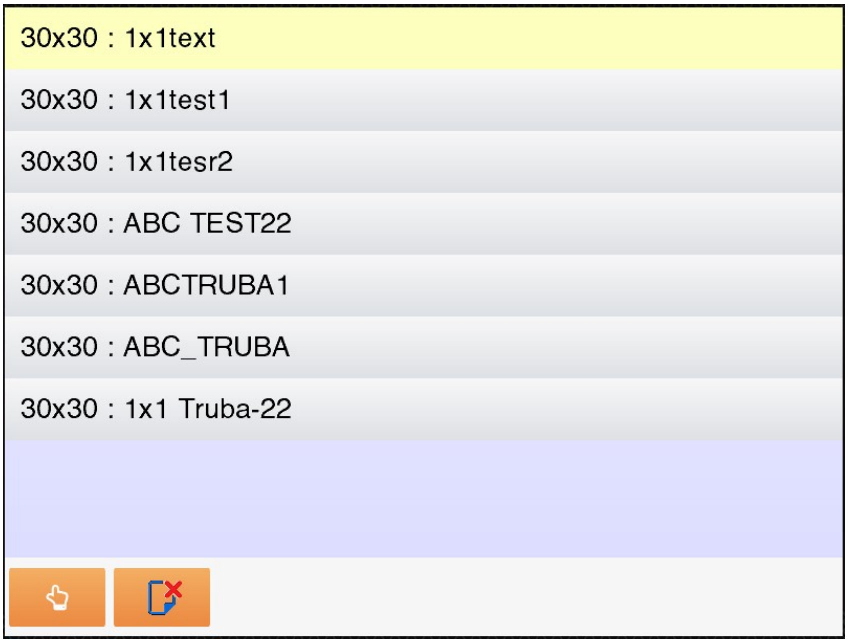


Figure 19. Grid selection

To select the required grid, select its name from the list using the keys and press on the key or the key under the icon.

In addition, you can use this window to delete the unnecessary grid. To this end, select its name from the list using the keys and press on the key under the icon.

To quit the menu, press on the key.

Set grid position

For correct display of vertical axis degrees on C-scan, it is necessary to specify the degrees where the scanning site (grid) is located. The appearance of the window for grid positioning is shown in Figure 20.

Warning! This parameter can be set only for the test item "pipe".

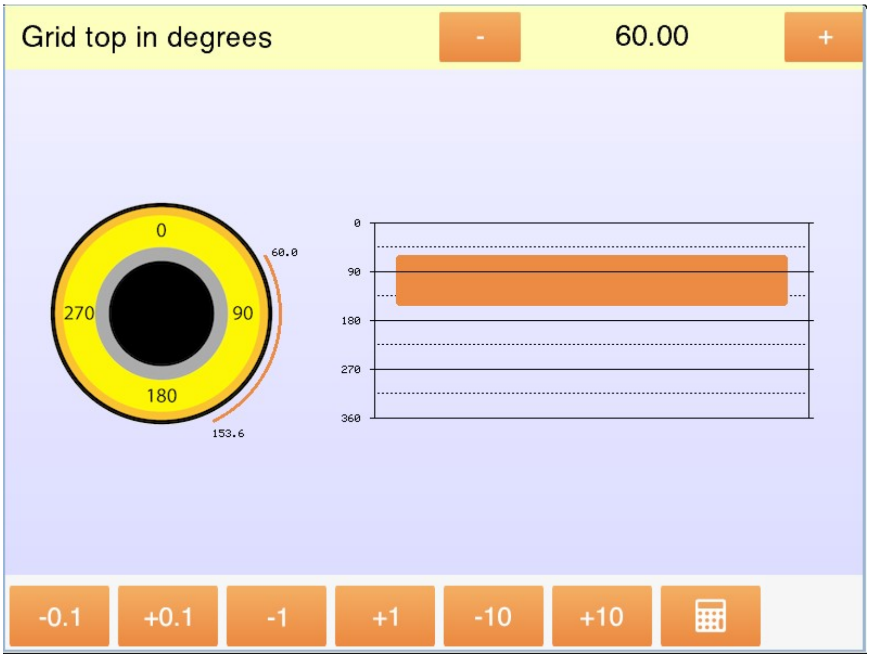


Figure 20. Grid position change

We recommend to use our self-adhesive grids. An example of such grid located on the pipe is shown in Figure 21.

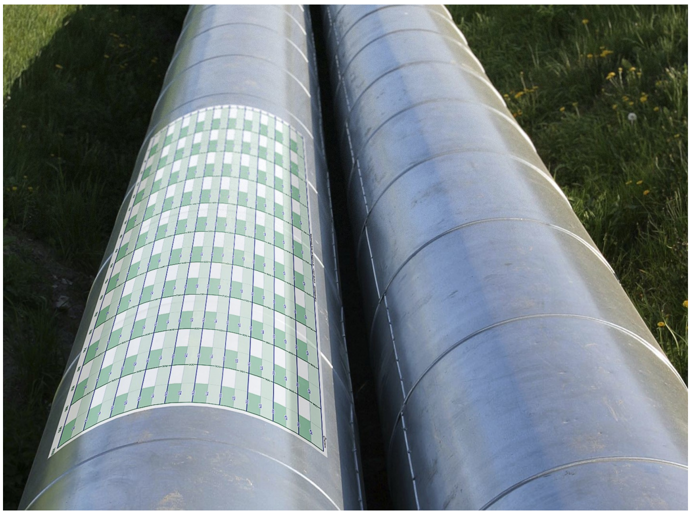


Figure 21. Self-adhesive grid on the pipe.

Use of this grid will save time for its drawing.

To set the grid position on the pipe, set the "Grid top in degrees" parameter using the  keys or the  keys under the -1 +1 -10 +10 -100 +100 icons.

For quick entry of the specified parameter, you can use the key under the icon. For quick entry window appearance, see Figure 22. To change over between the number registers, use the keys under the icons or the keys. The keys under the icons and the icons are used to change value of the selected digit position.

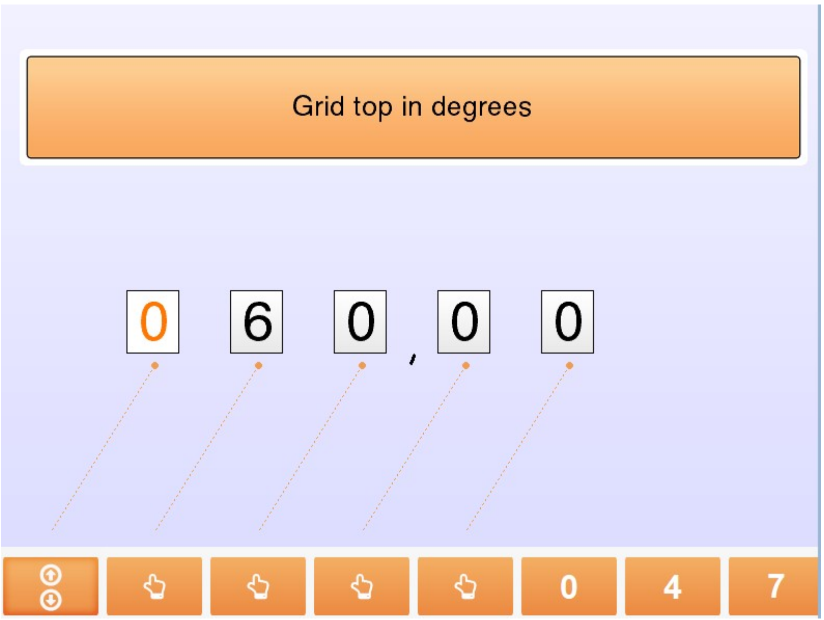


Figure 22. Quick entry window

To save the changes, press on the key.

Grid application

To activate the selected changes in the grid parameters, press on the "Apply grid" key. In this case, the window shown in Figure 23 will appear.

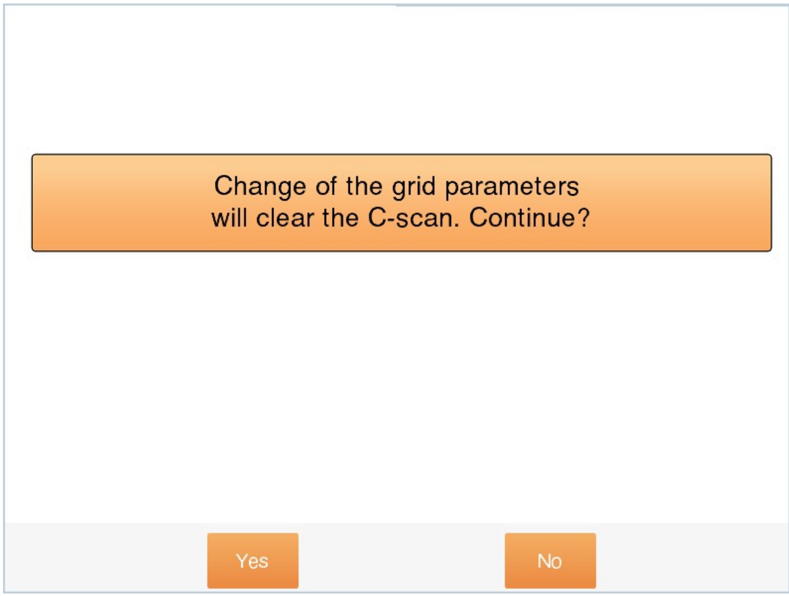


Figure 23. Grid application

To confirm the selected operation, use the key under the icon.

WARNING! You can get access to "Grid" menu through the Device main menu key.

Test item parameters

To operate the Device, you shall enter data on the test item. Figure 24 shows the window for test item parameters entry.

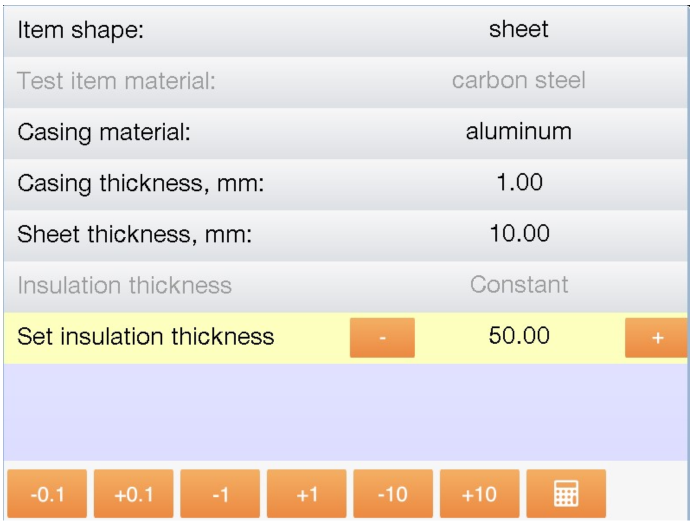


Figure 24. Window with test item parameters.

This window contains the following menu items:

Item shape.

This menu item is used to select the test item shape. To select the test item shape, use the keys or the keys under the ‹ › icons. There are two options: "pipe" and "sheet".

Casing material.

This menu item is used to select the material of the protective casing. To select the material, use the keys or the keys under the ‹ › icons. The casing material options are aluminum and tin. You can also select the option when the casing is not available.

Casing thickness.

To enter the casing thickness, use the keys or the keys under the -1 +1 -0.1 +0.1 +1 -1 icons.

For quick entry, use the key under the icon. In this case, the quick entry window shown in Figure 25 will appear.

Figure 25. Quick entry window.

To change over between the digit positions, use the keys or the keys under the icons.

Enter values for each position using the keys or the keys under the icons.

Pipe wall thickness

You shall set the nominal thickness of the pipe wall. The pipe wall thickness is entered in the same manner as above described for entry of the casing thickness.

Insulation thickness

You shall set the thickness of insulation. This value will be used for calibration of device. It is possible to set it using the keys or the keys under the icons.

Insulated pipe diameter.

This menu item is used to enter the outside diameter of the insulated pipe. This parameter is necessary to display degrees correctly on C-scan.

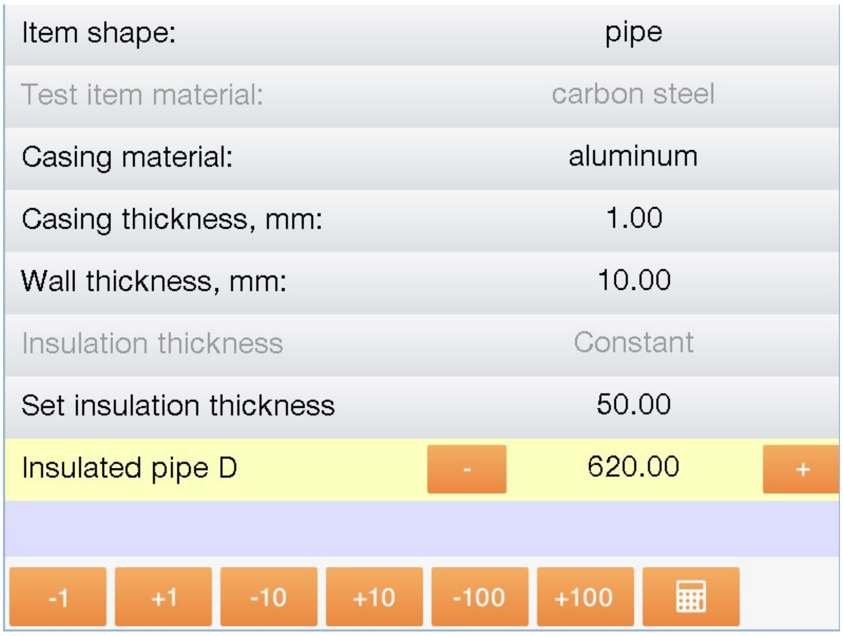


Figure 26. Insulated pipe diameter entry.

To enter the pipe diameter, use the keys under the icons (see Figure 26) or the keys.

For quick entry, you can use the key under the icon. In this case, the window shown in Figure 27 will appear.

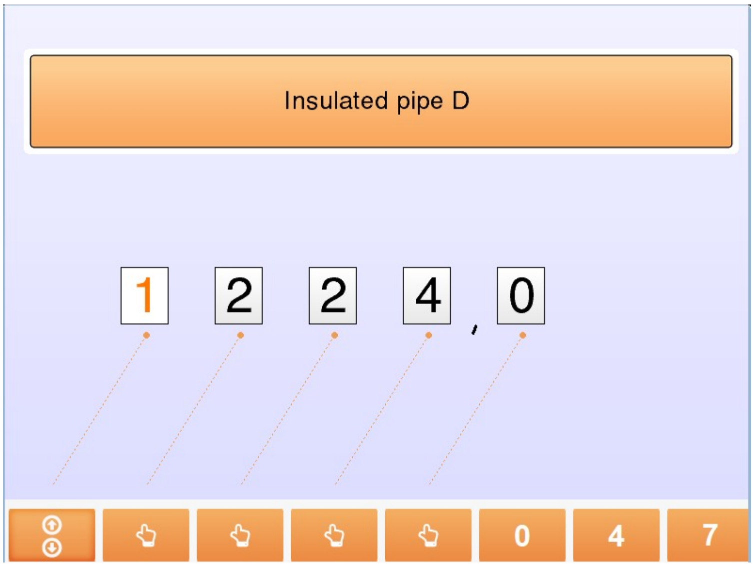


Figure 27. Quick entry window.

To select the digit position, use the keys under the icons or the keys. Enter value for each position using the keys or the keys under the 0 4 7 icons. To save changes, press on the OK key.

WARNING! You can get access to test item parameters menu through the M Device main menu key.

A-scan window

This item is used to change the scale of A-scan.

This window is shown in Figure 28.

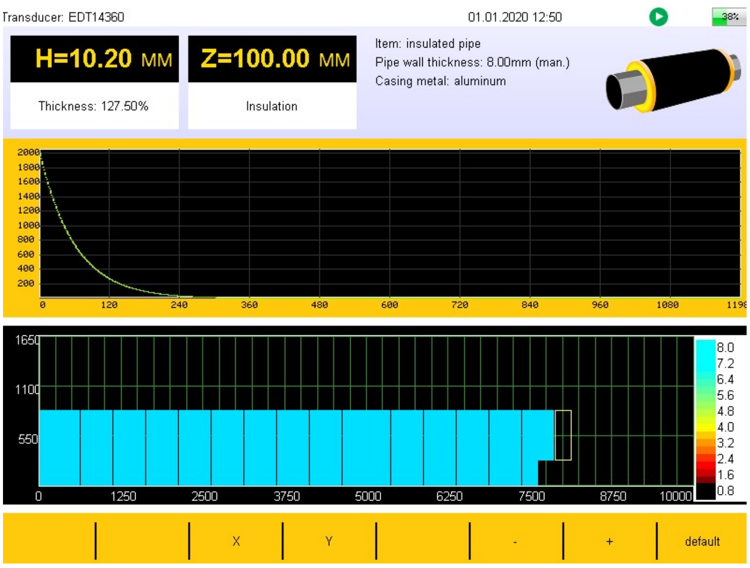


Figure 28. A-scan scale change window.

This window has the following tools:

X – enables to change the horizontal axis scale. By pressing the key under the X icon once, you can change over the A-scan window to the mode of changing the maximum value along this axis. This window is shown in Figure 29.

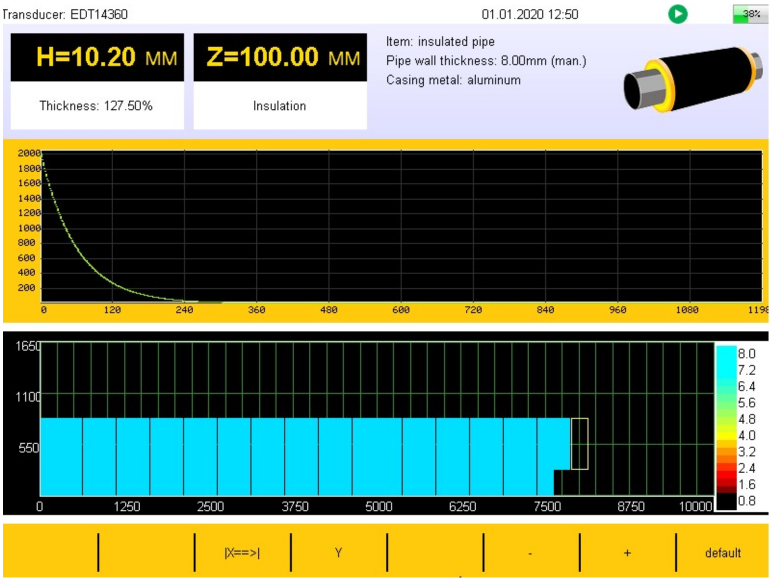


Figure 29. Change of A-scan size along the horizontal axis

You can change the maximum value on A-scan by increasing or decreasing it using the  keys under the [- | +] icons.

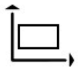
By pressing the  key under the [X] icon twice, you can change over the A-scan window to the A-scan scrolling mode. In this mode, when you press on the  keys located under the [- | +] icons, you will scroll the A-scan to the left or to the right.

By pressing on the  key under the [X] icon thrice, you can return the window to the initial state.

[Y] – enables to change the vertical axis scale. The scale can be changed in the same manner as for the horizontal axis. (See the previous paragraph [X]).

[default] – returns the A-scan display parameters to default settings.

C-scan window

By pressing on the  key under the  icon, you will get access to C-scan scale change menu. This window is shown in Figure 30.

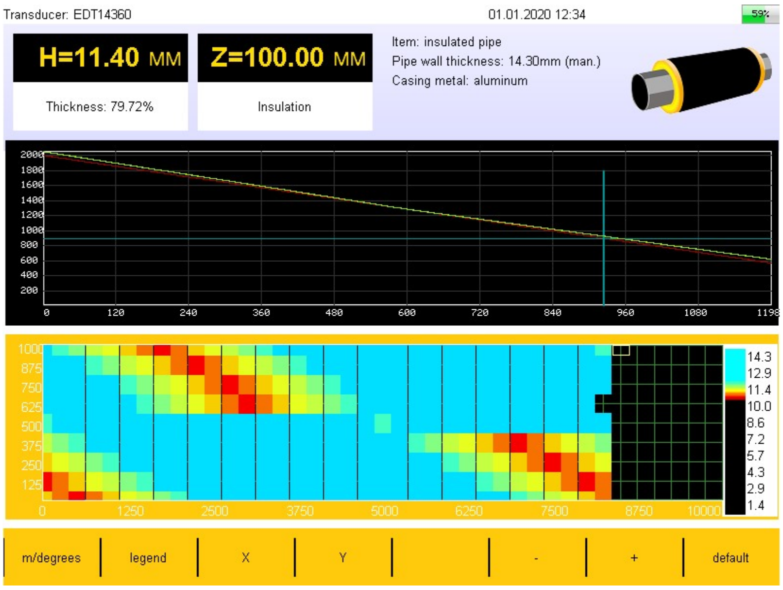
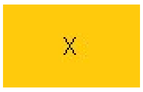


Figure 30. C-scan scale change window.

This window has the following tools:

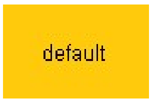
– For the test item of "pipe" type, you can select units of measurement to be displayed for the vertical axis; possible options are millimeters and degrees. This key changes over display modes between millimeters and degrees.

– Switching on or off of the legend.



– Horizontal axis scale change. You can navigate through this window in the similar manner as you do in the A-scan window (see the above description).

– Vertical axis scale change. You can navigate through this window in the similar manner as you do in the A-scan window (see the above description).



– Return of the C-scan display parameters to default settings.

Thresholds

The PEC Flaw Detector PE4332 has the scan mode using which you can fill C-scan with thickness measurements performed in the grid nodes. Each thickness measurement is displayed on C-scan of the Device as a rectangle highlighted in certain color. You can set positions of the upper and the lower thresholds in the Device. The appearance of the window where you can select the positions of two thresholds is shown in Figure 31.

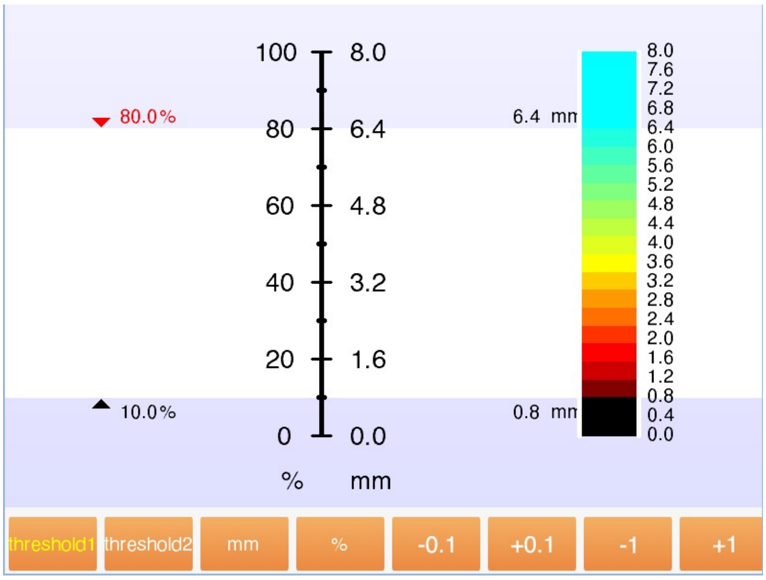


Figure 31. Window for threshold position change.

All thickness measurements which are higher than the upper threshold (threshold 1) will be displayed in blue on C-scan. All thickness measurements which are lower than the lower threshold (threshold 2) will be displayed in black on C-scan. The thickness measurements between two thresholds are displayed on C-scan in color according to the legend shown in Figure 31.

Each threshold has both the absolute value in mm and the relative value of the thickness in percents (relative to the nominal thickness of the test item specified in the test item parameters).

To select the required threshold, press on the key located under threshold 1 or threshold 2.

You can select which parameter to be changed: mm or %. To this end, press on the key under the MM or % icon respectively.

To change position of "Threshold 1" and "Threshold 2", use the keys under the -0.1 +0.1 -1 +1 **icons.**

When positions of both thresholds are set, press on the OK key.

WARNING! You can get access to threshold position change menu through the M Device main menu key.

Σ Averaging

To reduce impact of such interfering factors as network interference, acoustic noise, etc., the Device can use averaging. The averaging means averaging of measurements many times performed in one point. To change averaging number, use the key under the Σ icon. The averaging number selection window is shown in Figure 32.

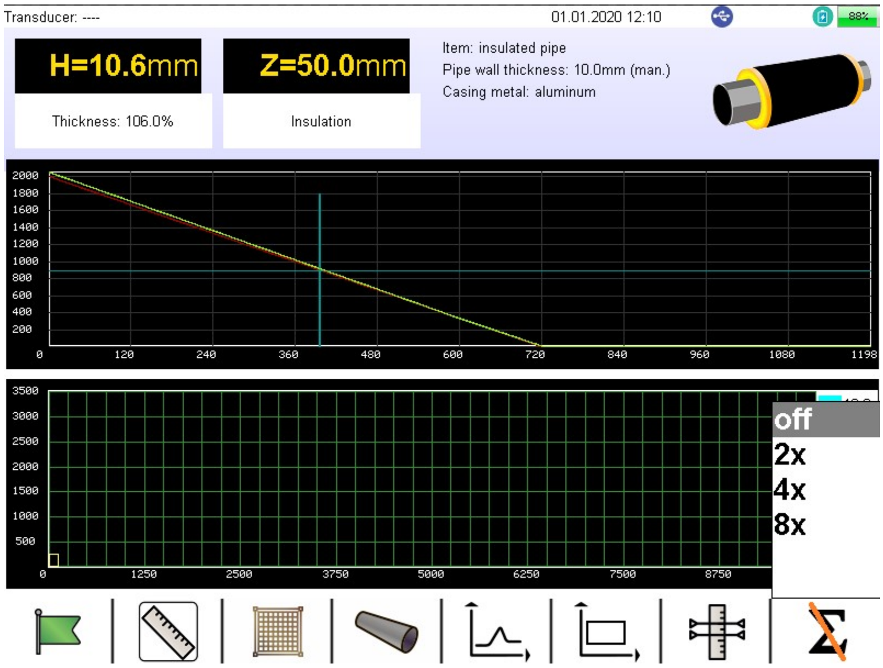


Figure 32. Averaging number change.

Select averaging number from the list using the and keys. After selection of the required averaging number, press on the OK key.

Depending on the selected accumulation number, the number of measurements in one point will be increased in two, four, or eight times respectively.

We recommend to increase the averaging number up to four or eight times when you test the pipes with tin protective casing. We also recommend to increase the averaging number when you operate in immediate vicinity of noise sources such as fluorescent lamps, powerful machines and other electrical equipment.

By default, averaging is off.

WARNING! The averaging number can be also changed through the M Device main menu key in the "Settings" tab.

M Main menu

Figure 33 shows the Device main menu.

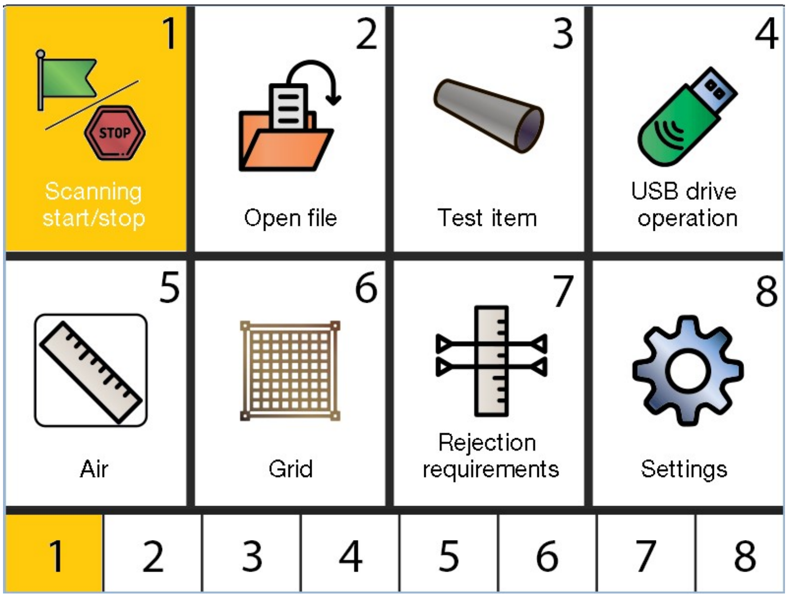


Figure 33. Device main menu

You can get access to this menu by pressing on the 

key when you are in the Device main window (see Figure 12). This menu contains the following menu items:

- Scanning start/stop/continuation menu
- Open file,
- Test item parameters,
- USB drive operation,
- Probe zero calibration (Air),
- Grid,
- Thresholds,
- Settings.

The menu items of "Scanning start/stop/continuation menu", "Test item parameters", "Calibration", "Grid", "Thresholds" are described in Section "DEVICE MENU".

Open file

This menu allows you to load the pre-saved archives to review, adjust or continue scanning. For menu appearance, see Figure 34.

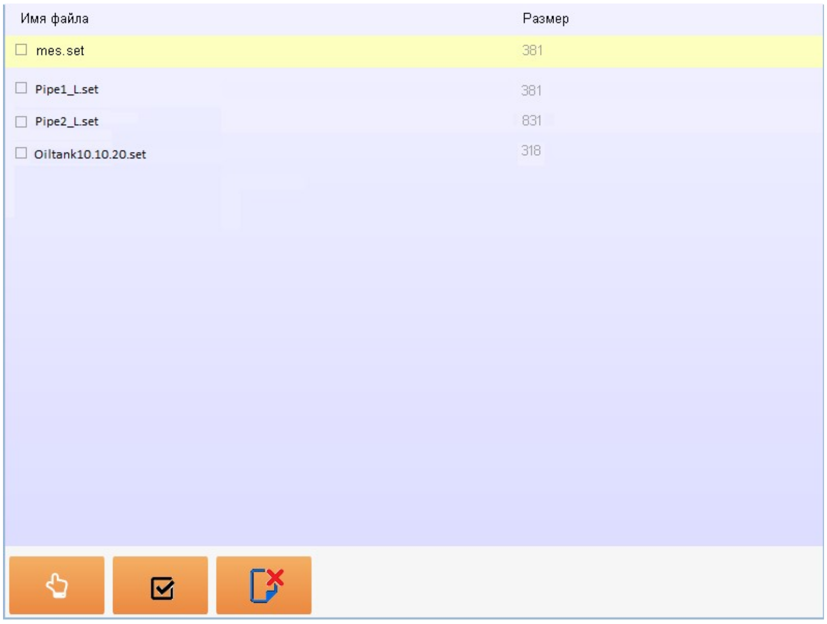


Figure 34. Window for selection the archive for opening

To open the required archive, select it from the list of available files using the keys and press on the key or the key under the icon.

In addition to opening the archive, you can delete the saved archive. To this end, select the required archive using the keys and press on the key under the icon.

You can delete several archives simultaneously. To this end, select the required archives using the key under the icon and then press on the key under the icon.

USB drive operation

You can copy all saved archives to the external USB drive. To this end, insert the USB drive into USB-A connector and select the Device menu the "USB drive operation" menu item. In this case, the window shown in Figure 35 will appear on the Device screen.

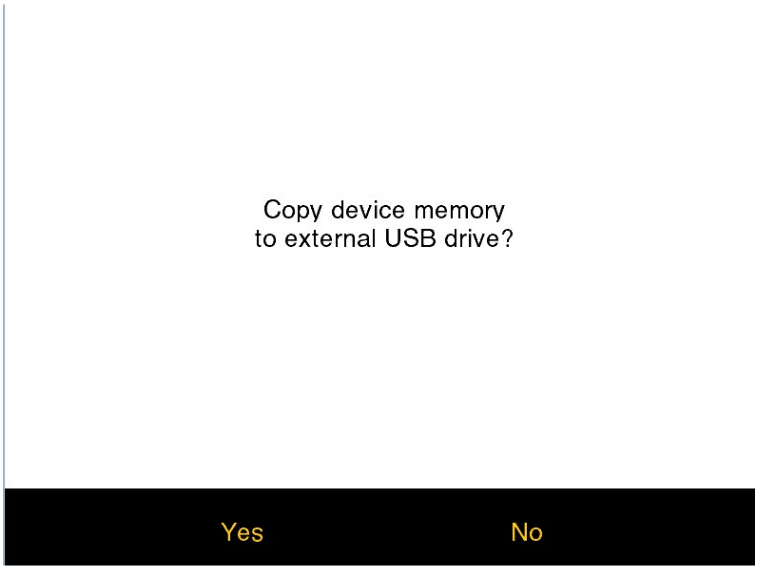


Figure 35. Window for data copying to the USB drive.

In this window, press on the key under the Yes icon.

Settings

The settings window appearance is shown in Figure 36.

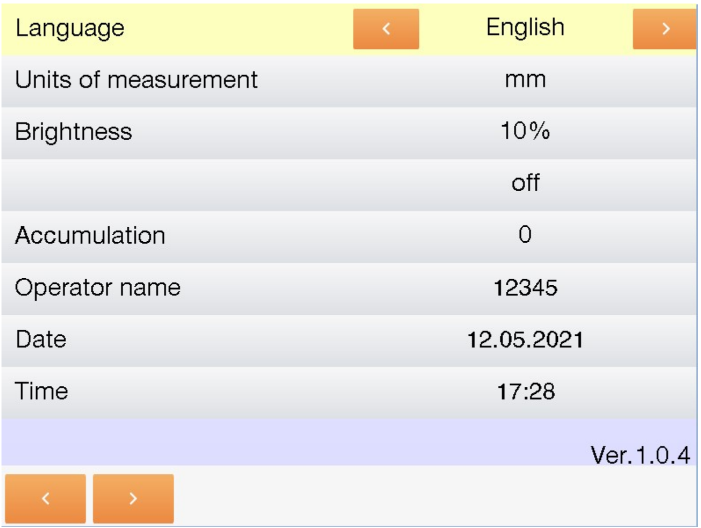


Figure 36. Settings window.

You can navigate through the menu items using the keys.

To change the parameters, use the keys or the functional keys under the icons.

Language

You can change the Device interface language. To this end, use the keys or the keys under the icons to select the language; possible options are **“Chinese”, “English”** or **“Russian”.**

Averaging

You can change the averaging number (see Section "DEVICE MENU"). To change the averaging number, use the keys or the keys under the icons. You can select the averaging number from the following options: 0, 2, 4, or 8.

Operator

You can set the operator’s name. In this case, the operator’s name will be automatically used in the scan mode as the name of the employee who performs the test.

To set the operator’s name, use the on-screen keyboard shown in Figure 37.

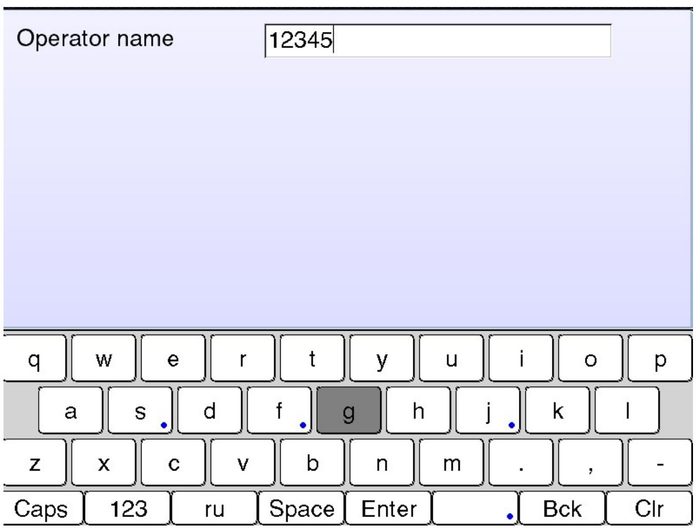


Figure 37. Entry of Operator name

The name is entered sequentially one character at a time. To navigate the keyboard, use the keys. The selected character is entered when the

OK key is pressed on. To complete entry of the name and to exit from this window, press on the key under the Enter icon (see Figure 37).

Table 5 shows the icons used for text entry.

Table 5.

Icon	Purpose
Caps	Switching on or off of the upper case
123 or ABC	Change-over between letter mode and number mode
en or ru	Change-over of the language: English or Russian
Space	Space key
Enter	Saving information and exit from the keyboard mode
.	Quick change-over between the keys similarly marked on the keyboard
Bck	Erasion of one character

Clr or Undo	Complete clearing of the entry field or cancellation of entry field clearing

DATE AND TIME CHANGE

You can set the date and time. The windows for changing the date and time are shown in Figure 38.

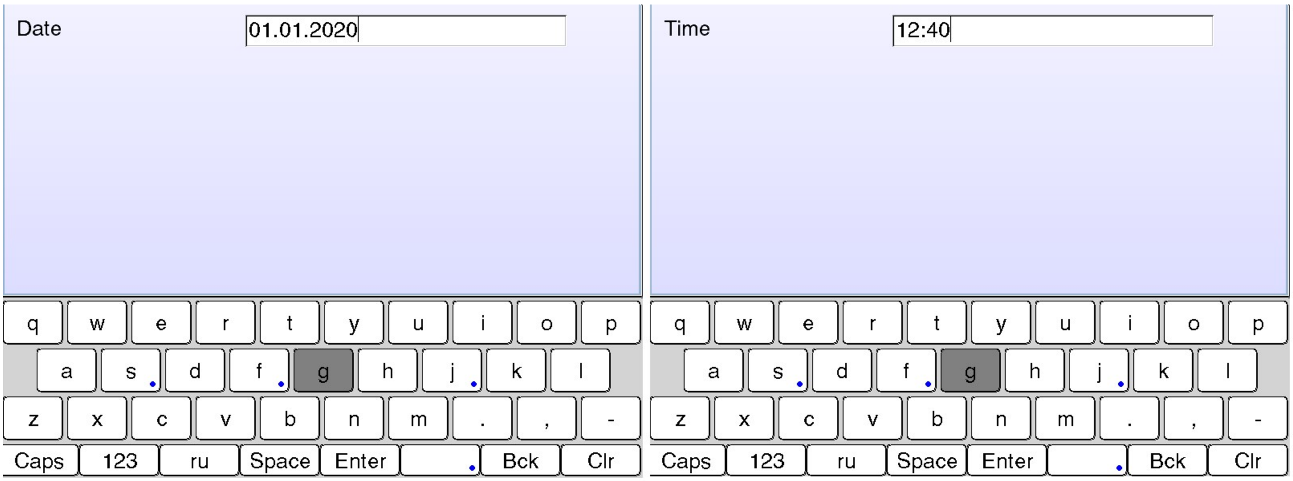


Figure 38. Date and time entry.

The date and time are entered sequentially by the digit positions. To navigate through the keyboard, use the  keys. The text is entered by pressing on the  key.

DEVICE OPERATION

The PEC Flaw Detector PE4332 can operate in two modes. They are the simple mode of thickness measurements and the scan mode.

The scan mode is used when it is necessary to test any expanded area of the test item. In this mode, you shall apply the special grid to the test item and sequentially save the thicknesses measured in the grid nodes in the Device memory.

When a large data array is not required and it is enough to measure only a few test points, then you can use the simple mode of thickness measurements instead of the scan mode.

Prior to operation beginning, select the sensor suitable for this test item.

Sensor Selection

The PEC Flaw Detector PE4332 can operate with either of three sensors: PEC433205, PEC433204, or PEC433206. The standard scope of Device supply includes one sensor PEC433204.

The sensor shall be selected depending on the thickness range to be tested, insulation thickness range, as well as material of the insulation casing.

Figures 39 and 40 show a diagram for sensor selection depending on the above parameters.

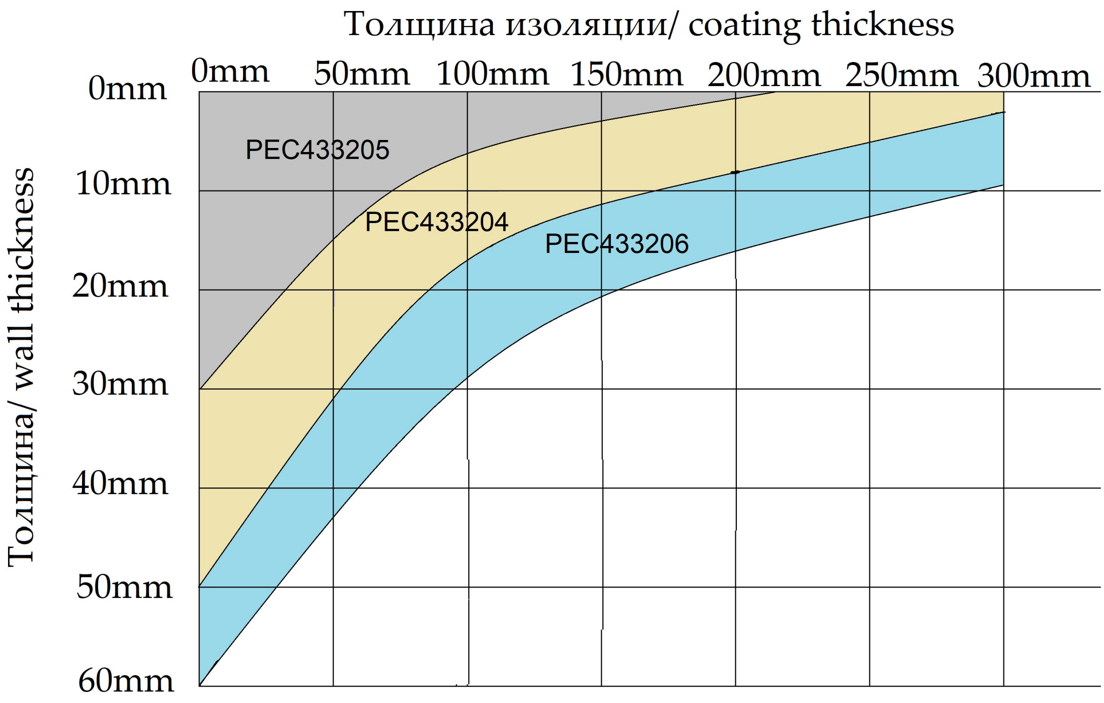


Figure 39. Diagram for sensor selection, for aluminum casing or for option without casing

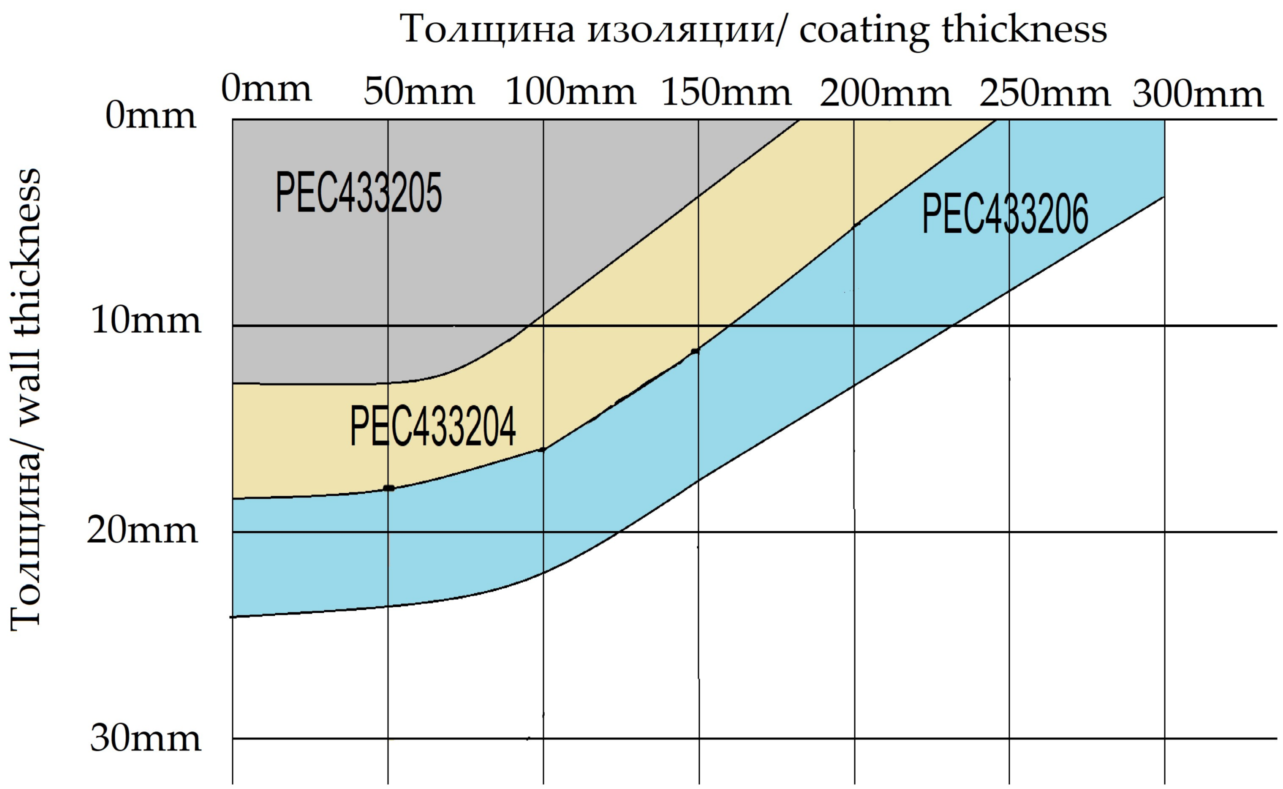


Figure 40. Diagram for sensor selection, for tin casing.

The larger is the thickness range and insulation thickness range, the larger is the sensor. The sensor measures the averaged thickness beneath it, and therefore, the larger is the sensor, the larger is the area over which the averaging takes place and, accordingly, the larger is the minimum fault that the device can detect. Therefore, it is advisable to use as small sensor as possible.

For example: suppose you want to test a pipe with 10 mm wall thickness, 100 mm thick insulation and aluminum casing. Then, according to Figure 39, you shall use sensor PEC433204. The transducer PEC433206 will also work in this case, however, its selection will not be reasonable as PEC433206 has the greater area where the Device measures the average thickness.

For example: suppose you should test a pipe with 20 mm wall thickness, 150 mm thick insulation and aluminum casing. Then, according to Figure 39, you shall use sensor PEC433206, and other transducer will not work in this case.

Special plastic protector for working with tin casings.

When operating of pulsed eddy current flaw detectors on pipes with a tin casing, there is a problem associated with the formation of a parasitic sound wave in the tin casing and the microphone effect, which interferes with measurements. To solve this problem, the PE4332 flaw detector is equipped with a special plastic protector, which must be used when working with such objects. The appearance of such a plastic protector is shown in Figure 41.

Figure 41. The plastic protector for tin casings.

All transducers have a rubber protector by default. If you need to work with objects with a tin casing, and such a casing is selected in the test item parameter menu , then you need to change the rubber protector to a plastic one. And vice versa, if the parameters of the test item menu  are set to an aluminum casing or "no casing", then you need to return the rubber protector to the transducer.

The process of replacing protectors is shown in Figure 42:

Figure 42. The replacement of plastic and rubber protectors.

Average thickness measurement area

The Device measures the average thickness in a certain area under the sensor. The dimensions of this area depend on the sensor type as well as on the insulation thickness. Figure 43 shows the sensor located over the steel sheet. As we can see, the metal magnetization area (highlighted in black) increases its size according to increase of the distance between the sensor and the sheet. When distance between the sensor and the metal is small, the size of the magnetization area is minimum. When the sensor is lifted above the sheet surface to the maximum height, the size of the metal magnetization area under the sensor is maximum. The device calculates the average thickness in the magnetization area. This effect shall be taken into account. The size of the thickness averaging area depending on the type of sensor and insulation thickness is shown in Table 6.

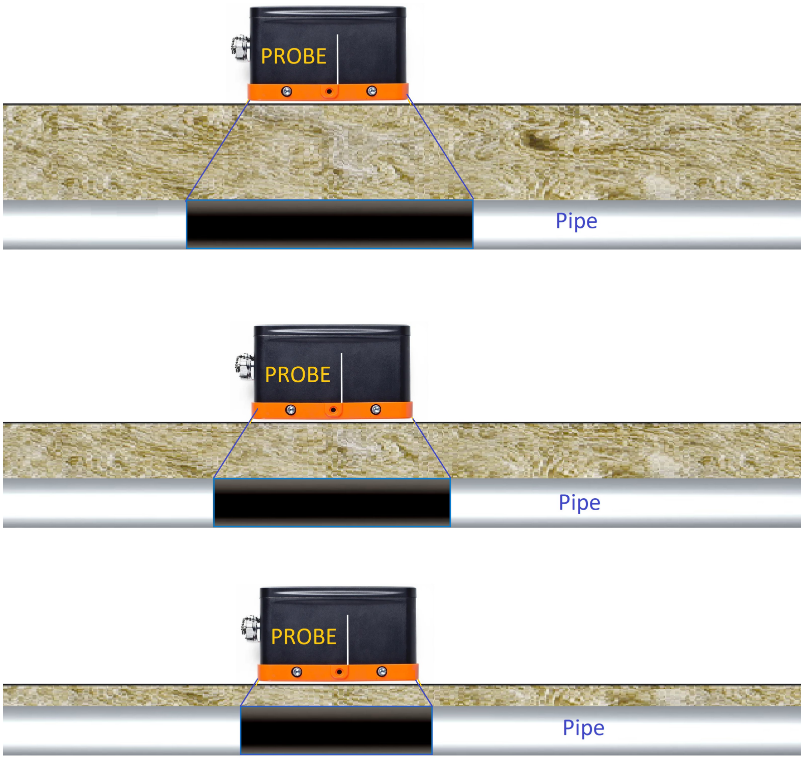


Figure 43. Dependence of magnetization area size on insulation thickness.

Table 6. Size of averaging area

Sensor name	Insulation thickness, mm							
	0	25	50	100	150	200	250	300
PEC433205	160mm X 70mm	170mm X 70mm	180mm X 75mm	210mm X 80mm	230mm X 90mm	260mm X 100mm	280mm X 105mm	310mm X 110mm
PEC433204	210mm X 90mm	230mm X 95mm	240mm X 100mm	280mm X 110mm	310mm X 120 mm	340mm X 130mm	380mm X 140mm	410mm X 150mm
PEC433206	315mm X 135mm	330mm X 140mm	350mm X 145mm	380mm X 155	415mm X 165mm	450mm X 175mm	480mm X 185mm	515mm X 195mm

Edge Effect

The pulsed eddy current technique of inspection is characterized by an edge effect which consists in the fact that the thicknesses measured near the pipe end can be very much reduced. For correct operation of the Device, select measurements area located at a distance of at least 25 cm from the edge. The example of such sensor layout is shown in Figure 44.

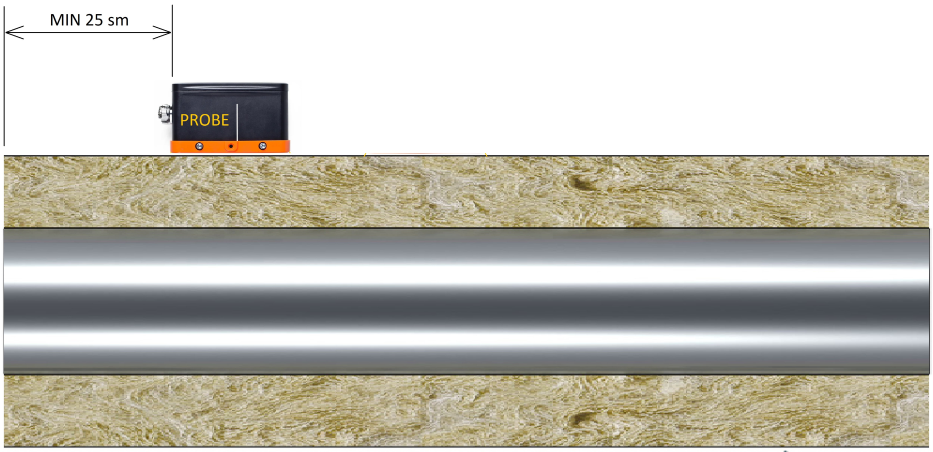


Figure 44. Install the sensor at a distance of at least 25 cm from the pipe end.

Besides the pipe end, the Device readings can be affected by fasteners, supports, metal structures immediately adjacent to the test area. Keep the distance of 25 cm from each of the above items.

Thickness Measurement

The PE4332 measures thicknesses by analyzing the metal demagnetization under the sensor. The demagnetization process is always displayed on A-scan. An example of A-scan is shown in Figure 45

Figure 45. Example of A-scan appearance.

The demagnetization time is a point when the signal amplitude falls below the threshold level; in the Device, this point is fixed by a vertical line which is visible in Figure 45 on the right side. During operation, it is necessary to control the position of this line. If this line is unavailable, then the measured thickness shall be considered incorrect; such example is shown in Figure 46.

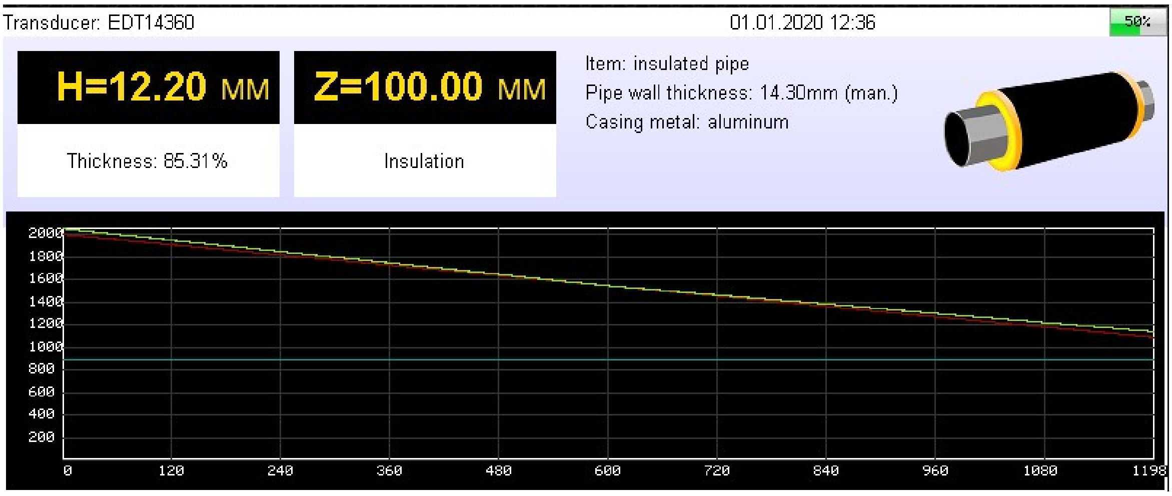


Figure 46. Unavailable point of crossing the threshold on A-scan

Such situation may arise, if you have incorrectly set the value of "Insulation thickness" and the test item parameters such as the nominal wall thickness and the material of the insulation casing. If such situation arises, then it is necessary to enter the correct parameters.

It is also necessary to ensure that, before crossing the threshold, the demagnetization process is monotonous, close to the line. There can be situations when the signal waveform on the A-scan can become non-monotonous with a variable component. Such example of A-scan is shown in Figure 47.

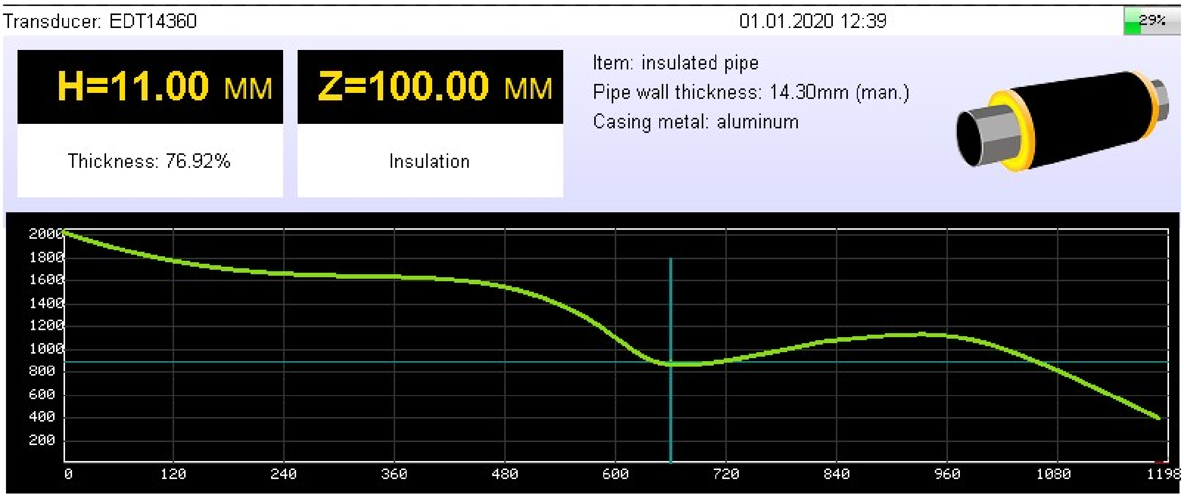


Figure 47. Fluctuations on A-scan

With such signal waveform, the thickness measurements will be most likely incorrect. At points with a similar A-scan, it is required to re-measure the thickness. This signal waveform can occur when there are interference sources near the test item or when the pipes with the tin casing are tested. To avoid interferences, the interference sources shall be removed from the test site, if possible. If it is impossible to remove the interference source, it is recommended to use averaging with the averaging number of 4 or 8 (see "Averaging"). In case of inspection of the pipes with the tin casing, this distortion appears mainly due to the acoustic effect which can be reduced by pressing the sensor closer to the casing surface.

WARNING!

To work with objects with a tin casing, it is necessary to change the rubber protector to the plastic one included in the delivery set of the device!

You shall also enter data in the  menu ("Test item parameters"), particularly, nominal thickness of the test item, material of the insulation casing, and thickness of the insulation casing.

Any thickness measurement to be carried out with PE4332 is performed relative to the known thickness in a certain point of the test item. Therefore, prior to the thickness measurements, it is necessary to calibrate the Device for this test item. For calibration, install the sensor on the test item and calibrate the Device using the  menu ("Calibration").

After calibration, you can measure the thicknesses. To measure the thickness, install the sensor on the test item, press on the  key (single thickness measurement key) on the Device keyboard. The Device will measure the thickness, and the measured value will be displayed on the Device and sensor screens. You can start the continuous measuring mode using the  sensor key. In this mode, the Device performs thickness measurements periodically; it updates the readings on the Device and sensor screens each time after measuring. To deactivate the continuous measuring mode, press on the  key again.

Scan mode

When you need not just to measure the thickness in some points, but to measure a certain area completely, then you shall use the scan mode.

For this mode, you shall apply a special grid on the test item to perform measurements in the grid nodes. We produce the special self-adhesive grid which can be attached to the test item. The example of such grid is shown in Figure 48.

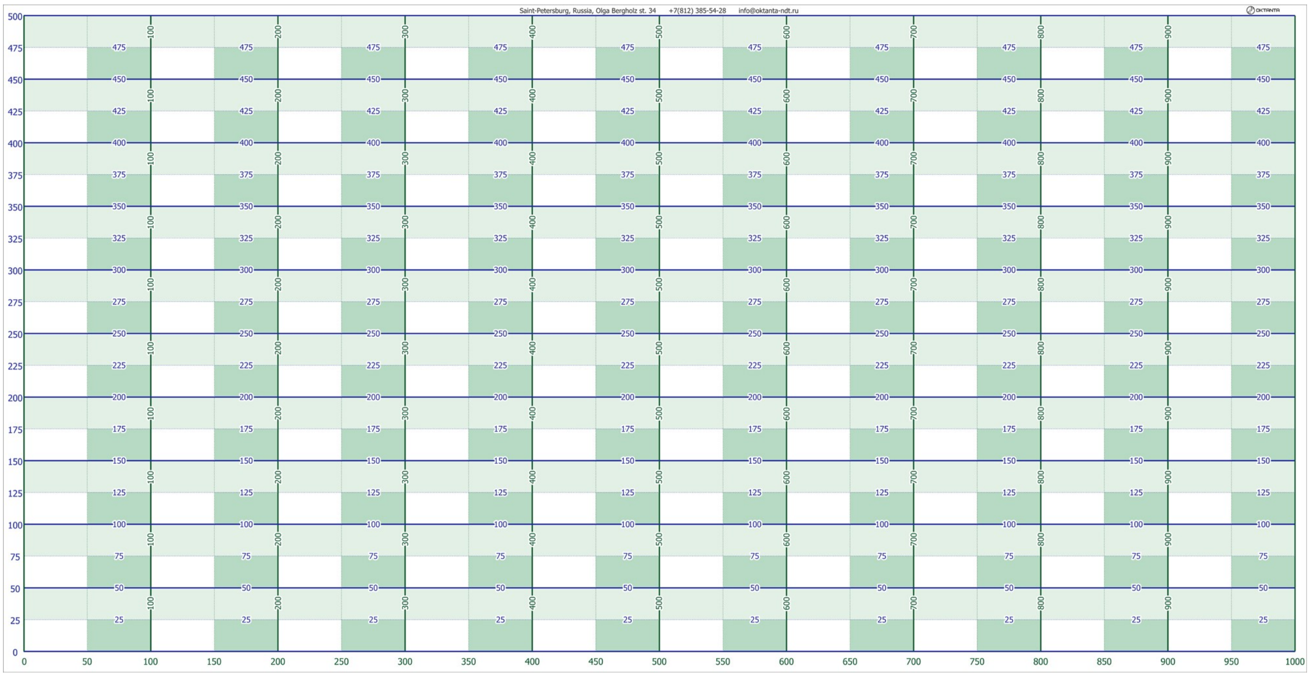


Figure 48. Example of self-adhesive grid produced by Oktanta.

You can manually draw the grid on the test item using a ruler and a marker, however, we do not recommend this method as it requires a lot of time.

Appearance of the self-adhesive grid attached to the pipe is shown in Figure 49.

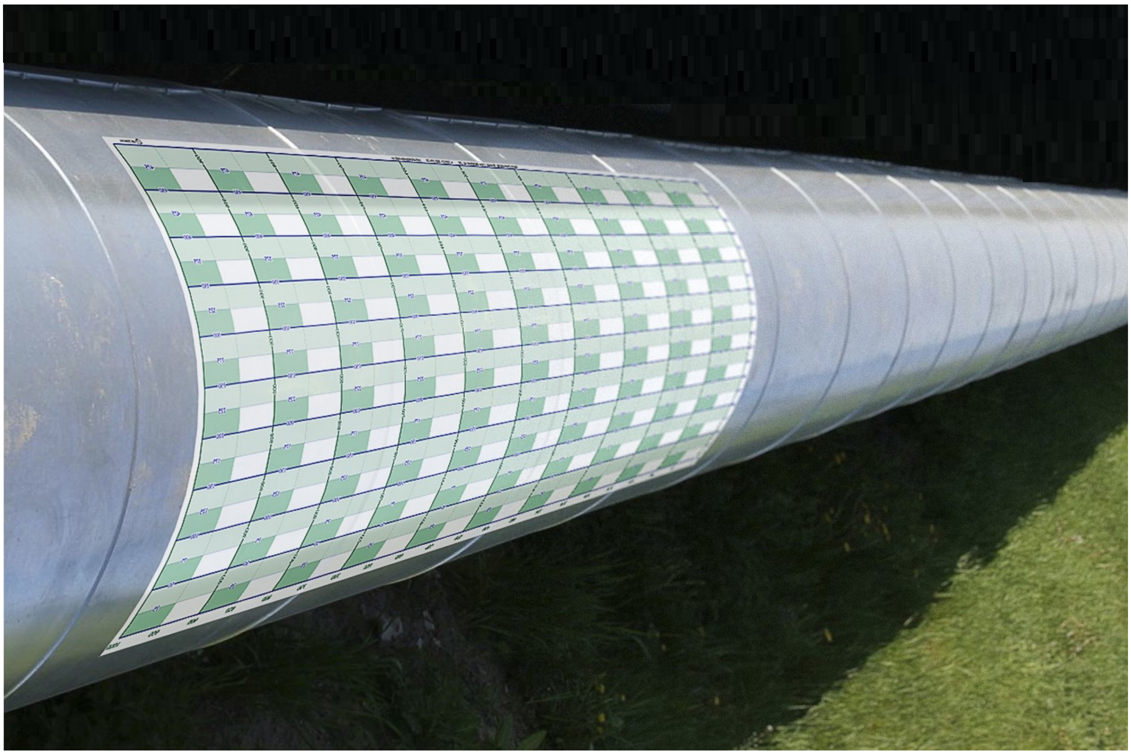


Figure 49. Self-adhesive grid on the pipe.

Prior to the beginning of measurements in the scan mode, do as follows:

- Enter all data in the  menu ("Test item parameters"). Select the casing material, casing thickness, nominal thickness of the test item, as well as set the insulation thickness.

- Open the  menu ("Grid"). In this menu, set all grid parameters such as vertical size, horizontal size, vertical grid spacing, horizontal grid spacing. Or you can loaf the grid data from the pre-saved files. After setting all grid parameters, apply the grid.

- Select a point on the test item relative to which all measurements will be carried out.

- Install the sensor in the selected point, perform calibration through the  menu ("Calibration").

- Using the  menu ("Thresholds"), set the required values of thresholds which influence on the color used to display one or another thickness. We recommend to set 80% of nominal pipe thickness for threshold 1 and 50% of nominal pipe thickness for threshold 2.

- Start scanning through the  menu ("Scanning Start/Stop/Continuation Menu). In this case, the main window of the Device will appear as shown in Figure 50.

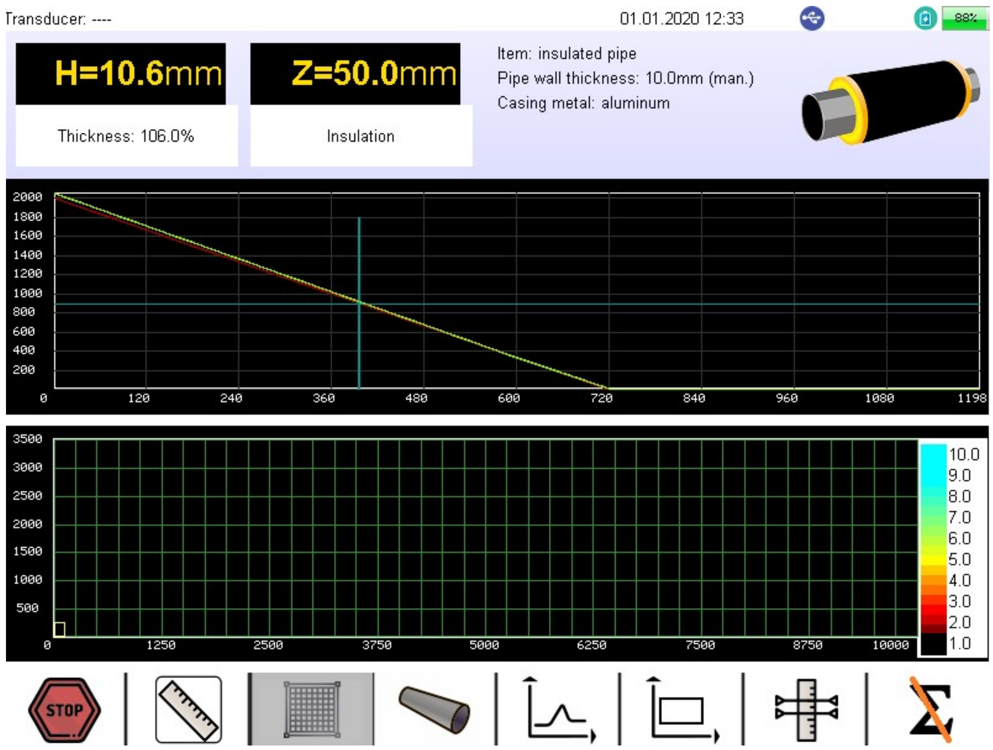


Figure 50. Main window of the Device in scan mode

In this case, the  scan mode indicator is displayed in the upper part of the Device screen as well as on the sensor screen.

- The current sensor position indicator is displayed in the lower left angle of C-scan. Immediately after the start of scanning, the sensor position indicator is in the C-scan point with coordinate (0.0). This position is shown in Figure 51.

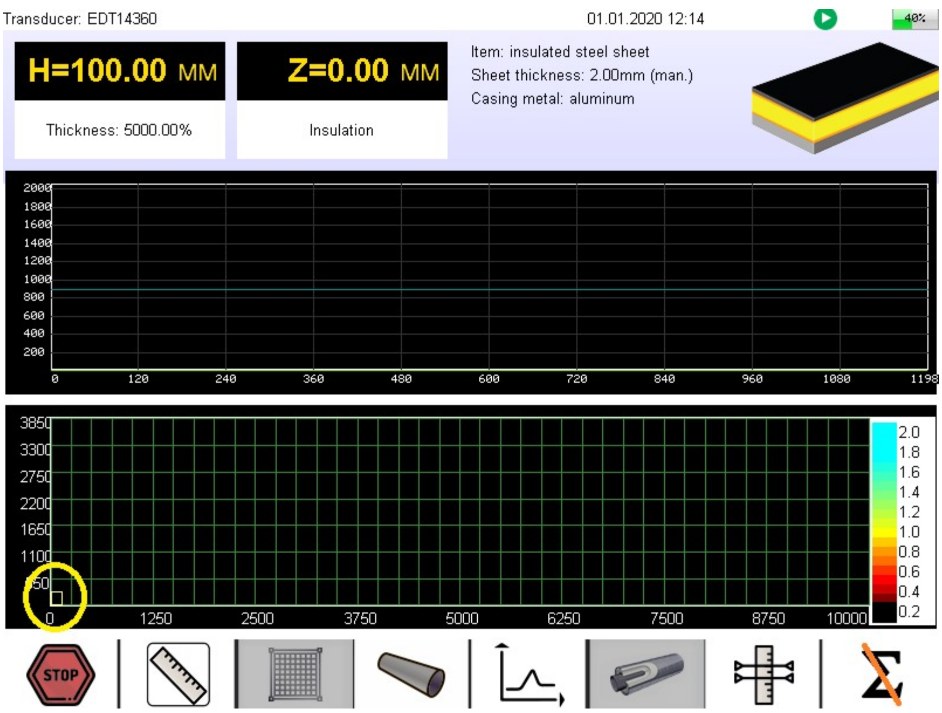


Figure 51. Sensor position indicator.

The current coordinates of the sensor are displayed on the sensor screen.

You shall install the sensor in the grid node with coordinate (0.0). The Device sensors have the keyboard with a cross; you shall install the sensor so that the cross point on the keyboard coincides with the grid node. The example of such location is shown in Figure 52.

Figure 52. Sensor located in point (0.0).

While holding the sensor in this position, press on the  key on the sensor keyboard. Then, the Device will measure the thickness and automatically move to the next point.

- You shall move the sensor to the next grid node, for example, point (100.0) and press on the  key of the sensor keyboard. The example of sensor location at the second step of scanning is shown in Figure 53.

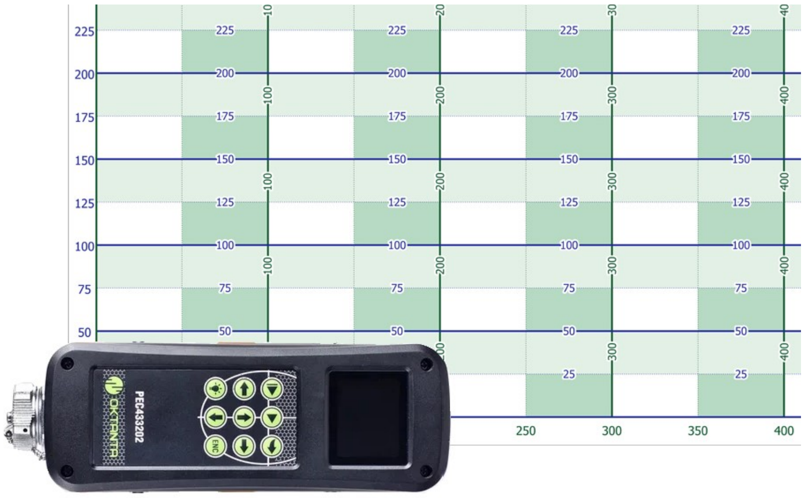


Figure 53. Sensor located in point with coordinate (100.0).

- Then, repeat operations as described above until the whole length of C-scan is passed. The sensor position in this case is shown in Figure 54.

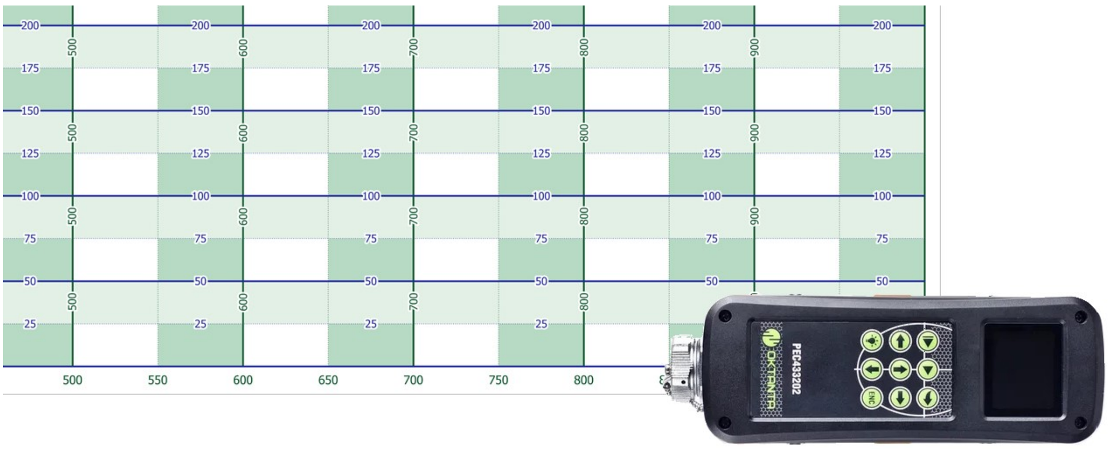


Figure 54. Sensor location at the extreme right point of the scan area.

Then, press on the  key on the sensor keyboard to move the sensor position indicator on C-scan to the next line beginning. This position is shown in Figure 55.

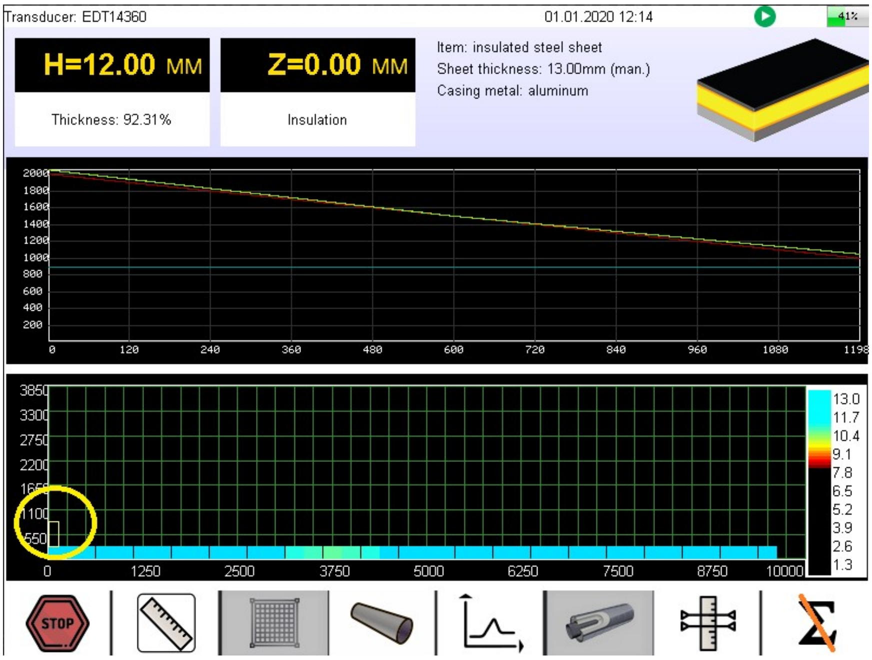


Figure 55. Sensor indicator position at the second line beginning.

You shall carry the sensor to the beginning of the second line on the grid. This position is shown in Figure 56.

Figure 56. Sensor location on the grid at the second line beginning.

While holding the sensor in this position, press on the key on the sensor keyboard. The Device will measure the thickness and move to the next point.

- Thus, sequentially point by point, row by row, you will fill the entire C-scan. The example of such C-scan is shown in Figure 57.

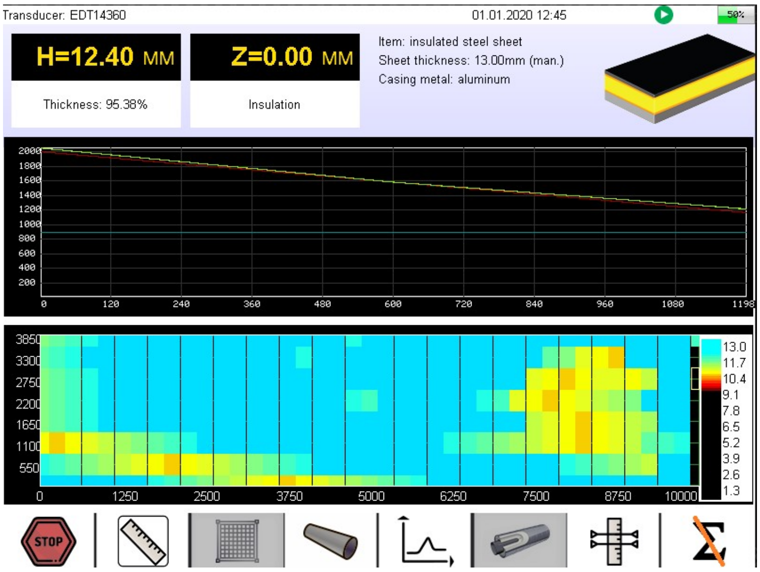


Figure 57. Example of C-scan.

During filling C-scan, monitor the signal waveform on A-scan, see "Thickness Measurement".

Encoder.

You can use the encoder (not included in the standard package) in the scan mode. To this end, press on the ENC key of the sensor keyboard. You can move the sensor from the grid node to the next node. When moving the sensor by the grid spacing, the sensor position indicator will automatically move to a new position. To deactivate the encoder, press on the ENC key again. When the encoder is activated, the Device screen and the sensor screen display the Enc indicator.

Data Transfer

You can open the measurements saved in C-scan through Excel or other application which supports file in CSV format. To transfer data to the PC, the Device have two functionalities: data transfer using external USB drive and data transfer with direct connection to the PC.

Data transfer using USB drive.

To transfer data using external USB drive, insert this drive into the USB-A connector located on the Device housing. Then, open the Device main menu using the M key on the Device keyboard. In the main menu, select the "USB drive operation" and copy the Device memory to the external USB drive. In this case, each archive will be saved in an individual folder with file in CSV format which can be used.

Data transfer using PC connection.

You can connect the PEC Flaw Detector PE4332 to the PC using a USB-B – USB-A cable. To this end, insert the USB-B connector into the Device, and the USB-A connector into the PC. Switch on the Device. When you connect the switched-on Device to the PC, the PC considers the Device as the external USB drive; in this case, you can copy any archive or all archives to the PC hard drive.

The file in CSV format has a matrix form. Its first column contains vertical coordinates of the grid nodes, its first string contains horizontal coordinates of the grid nodes. All other points are thickness measurements in the grid nodes.

MAINTENANCE

Battery Replacement

Figure 58 shows the appearance of the rear cover of the PEC Flaw Detector PE4332 housing. The Figure show screws with D-ring.

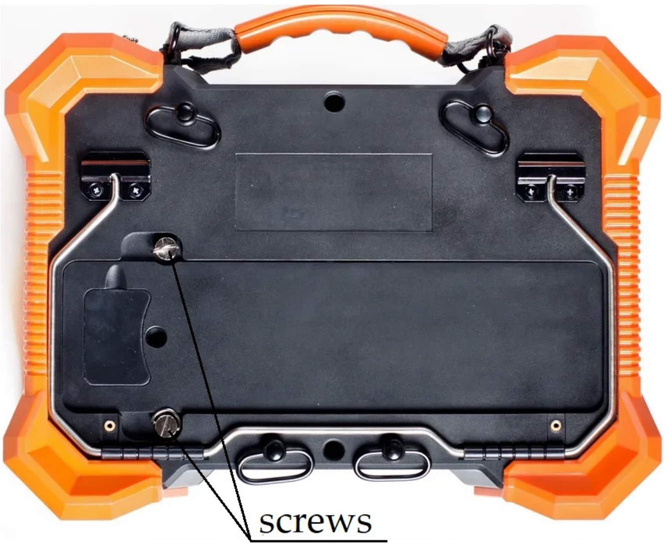


Figure 58. Battery replacement.

To replace the battery, do as follows:

- Switch off the Device,
- Loosen the screws (see Figure 58) using a slot screwdriver or fingers (D-rings enable to loosen the screws without the screwdriver),
- Remove the battery by the D-rings,
- Install the new battery,
- Tighten the screws

WARNING!

The battery of the PEC Flaw Detector PE4332 is a 12.V 18Ah lithium-ion battery. Do not disassemble, heat, or expose to mechanical shocks the battery. These actions can cause spontaneous ignition of the battery!!!

Sensor Replacement

To replace the sensor, do as follows:

- Switch off the Device,
- Disconnect the sensor.
- Connect the new sensor.

- Switch on the Device.
- Do a probe zero calibration (Air) from the main menu of device

Encoder Installation and Removal

To install the encoder, do as follows:

- Switch off the Device,
- Take the encoder from the scope of supply,
- Fix the encoder on the sensor housing using screws,
- Switch on the Device.

The encoder layout on the sensor is shown in Figure 59.

Figure 59. Encoder layout on the sensor.

To remove the encoder, perform the above actions in the reverse order:

- Switch off the Device,
- Loosen the fixing screws of the encoder,
- Disconnect the encoder and put it into a case or another place,
- Switch on the Device.

TRANSPORTATION AND STORAGE

During storage and transportation of the Device, maintain the following climatic conditions:

Air temperature:	+5 to +30 °C
Humidity	80% at +25 °C

Store and transport the Device only in a case from the scope of supply. Avoid any mechanical damages of the case and Device.

The Device battery will discharge during long-term storage. Long-term discharge state of the battery can reduce its capacity. So, we recommend to perform regular check (at least once per year) of the Device charge level and, if necessary, to recharge the battery.

SCOPE OF SUPPLY

The standard scope of supply of the Device includes:

Flaw detector PE4332	1 pc.
Sensor PEC433204	1 pc.
The plastic protector	1 pc.
Charger	1 pc.
Operation Manual	1 pc.
Transportation case	1 pc.
Transportation shoulder strap	1 pc.

MANUFACTURER WARRANTY

The warranty period for the Device is 2 years from the purchase date. Within the warranty period, the Manufacturer shall rectify faults of the Device provided that the housing is not damaged and the warranty seals are available.

The Manufacturer may withdraw its warranty obligations when:

1. The Device is used for purposes other than those specified in this operation manual;

2. The equipment operation, storage, and transportation conditions and requirements specified in this operation manual are not met;

3. There are mechanical damages of the equipment as a result of careless handling.

WARRANTY CERTIFICATE

Equipment	**PEC Flaw Detector** ___________**PE4332**___________
Serial Number	__________________________
Warranty Period	__________________________
Manufacturer	Oktanta Mayakovsky Street, 22-34, Saint Petersburg, +7(812)385-54-28 info@oktanta-ntd.ru __________________ Signature, stamp

INFORMATION ABOUT REPAIR

Date of Application	Fault Type	Repair	Completed/Not Completed (Date, Signature, Stamp)