

# Electromagnetic–acoustic thickness gauge EM4000



## User Manual

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## PURPOSE OF THE DEVICE

Electromagnetic–acoustic thickness gauge EM4000 (hereinafter referred to as the device) is designed to measure the wall thickness of steel pipes, sheet metal, rods and other products made of steel, as well as aluminium and other metals, without the use of couplant and without preliminary surface preparation, with a working gap between the sensor and metal up to 3 mm. The gap can be a layer of rust, a layer of salt deposits or other non-conductive coating (paint, varnish, enamel, plastic etc.). The device also allows you to measure the thickness of non-conductive coatings such as paint, varnish, enamel, plastic etc. in the range from 0 to 5 mm.

## WORKING PRINCIPLE

The operation of the device is based on two physical methods. The ultrasonic method is used to measure the thickness of a metal sample. The eddy current method is used to measure the thickness of non-conductive coatings.

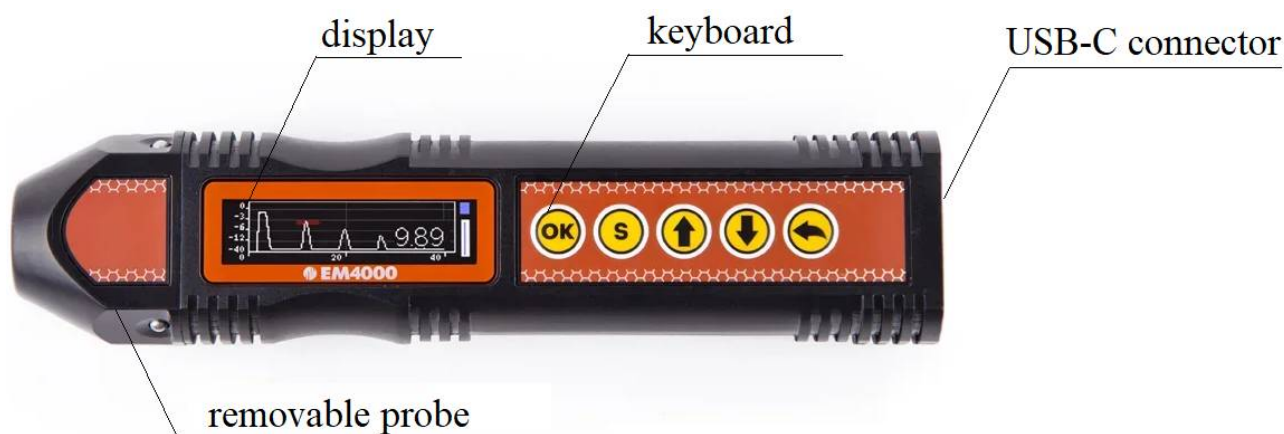
The ultrasonic method for measuring thickness is based on measuring the transit time of an acoustic wave through the material of the test sample. The measured time is converted into thickness using the specified value for the propagation speed of the ultrasonic wave. In this case, for the formation of an acoustic wave, the device uses an electromagnetic–acoustic conversion, due to which the formation of a wave occurs directly on the surface of the test sample, bypassing the contact medium between the converter and the sample. Thanks to this, there is no distortion of the wave in this environment.

The eddy current method for measuring the thickness of non-conductive coatings is based on measuring the amplitude of the field of eddy currents that are formed near the surface of the test sample due to the emitting coil located in the sensor of the device.

## SPECIFICATIONS

Measured thickness range for steel	2...80 mm
Measured thickness range for steel without gap	2..220 mm
Thickness measurement error	0.08 mm
Permissible gap between the sensor and the test sample	up to 3 mm
Measured thickness range of non-conductive coatings	0..5 mm
Coating thickness measurement error	0.1 mm $\pm$ 3 %
Permissible misalignment of the sensor relative to the normal to the surface of the test sample	$\pm 25^\circ$
The minimum permissible radius of curvature of the surface of the test sample	$\geq 10$ mm
Maximum number of measurements per second	16
Speed of sound setting range	1000...9999 m/s step of 1 m/s
Device operating frequency	4 MHz
Time of continuous work without recharging the battery	7 h
Working ambient temperature range	-20...+50 °C
Working temperature range of the test sample surface	-20...+80 °C (-20 ...+750 °C using the EMT40004T converter)
Dimensions	185 × 44 × 34 mm

## DEVICE APPEARANCE



*Device appearance*

The device has a colour liquid crystal screen for displaying measurement results. The device is controlled using the keyboard. On the side of the device there is a USB-C connector for connecting a charger. The device has a removable sensor that can be easily replaced with a new one due to the presence of a quick-detachable connection.

Control buttons have the following functions:



“OK” button — turning on / off the device, as well as the navigation button in the device menu;



“Return” button — allows one to return to the previous menu items, as well as close the menu;



“Up” button — navigation in the device menu, zoom control in the A-scan display mode, as well as control of gates;



“Down” button — navigation in the device menu, zoom control in the A-scan display mode, as well as control of gates;



“Save” button — allows one to save the measurement results in the memory of the device.

## DESCRIPTION OF OPERATIONS WITH THE DEVICE

### Enabling and disabling the device



To turn on the device, press the  button and hold it for some time. After that, the following window will appear on the device screen:




*Device information window*

After that, the main window of the device appears with the display of the measured thickness and other information.



*The main window of the device with information display*



To turn off the device, press and hold the  button for some time.

### Switching between device windows

The device has four windows, namely the main window, the A-scan window, the device settings window and the window for working with saved data. To move between

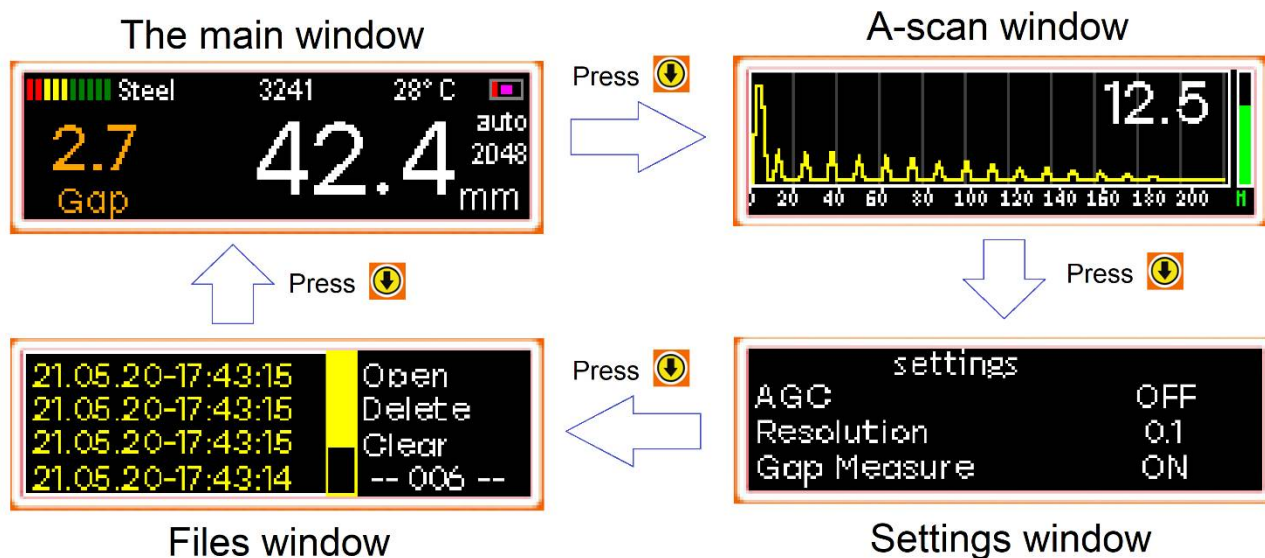


windows, use  and  buttons.

The figure below shows the options for windows that appear when you press the



button:

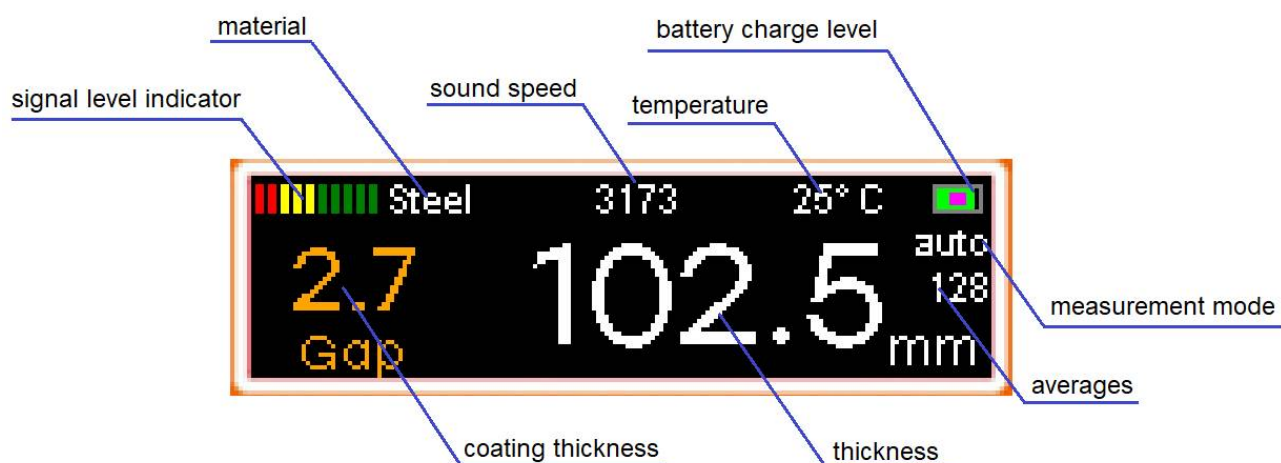


*Instrument window options*

You can also navigate through the windows with the button, in this case, the movement will occur in the other direction.

## The main window

The figure below shows the main window of the device:




*The main window of the device*

The following information is displayed in the main window:

- **Signal level indicator.** It shows how good the signal is at the measuring point. The more bars the indicator has, the stronger the useful signal.
- **Material.** This field displays information about what material is currently selected on the device.
- **Sound speed.** This field displays the value of the speed of sound used by the device to measure the thickness.
- **Temperature.** This field displays the temperature value of the test sample, which is currently selected in the device.
- **Battery charge level.** It shows the battery charge level
- **Coating thickness.** This field displays the measured thickness value of the non-conductive coating at the test sample.
- **Thickness.** This field displays the measured value of the thickness of the test sample.
- **Averages.** This field displays the number of accumulations (averages) used in the device.
- **Measurement mode.** This field displays information about which of the three measurement modes (auto, one-gate or two-gate) is currently selected.

The user can change the value of the fields "Material", "Sound speed", "Temperature", "Thickness", "Averages", "Measurement mode". To do this, first, you must select an editable field, and then enter this field and edit.



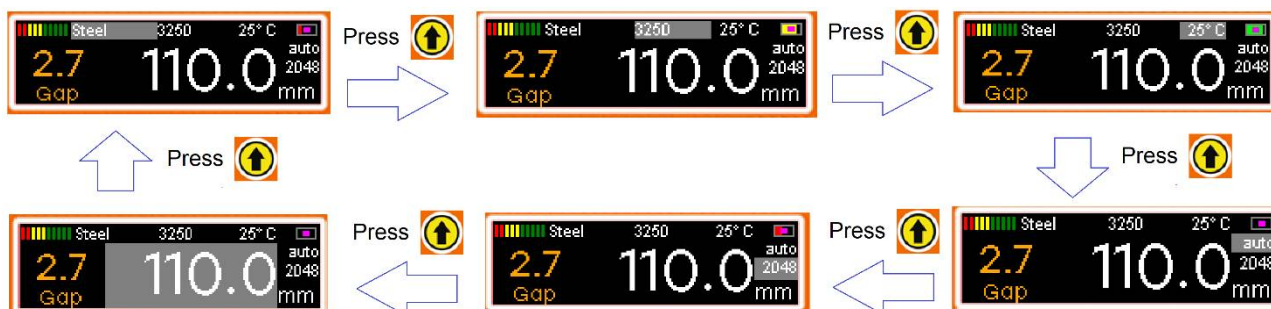
In order to select the required field, press the  button while in the main window. After that, one of the fields will be highlighted with a brighter colour, as shown in the figure below:




*Editable field selection mode*







Further, by pressing the  or  buttons, you need to select the desired field. The different options for the editing fields are shown in the figure below:



After the required field is selected, you must press the  button to enter the edit mode for the value of this field. In this case, the highlight colour of the selected field will change to a darker one, as shown in the figure below:

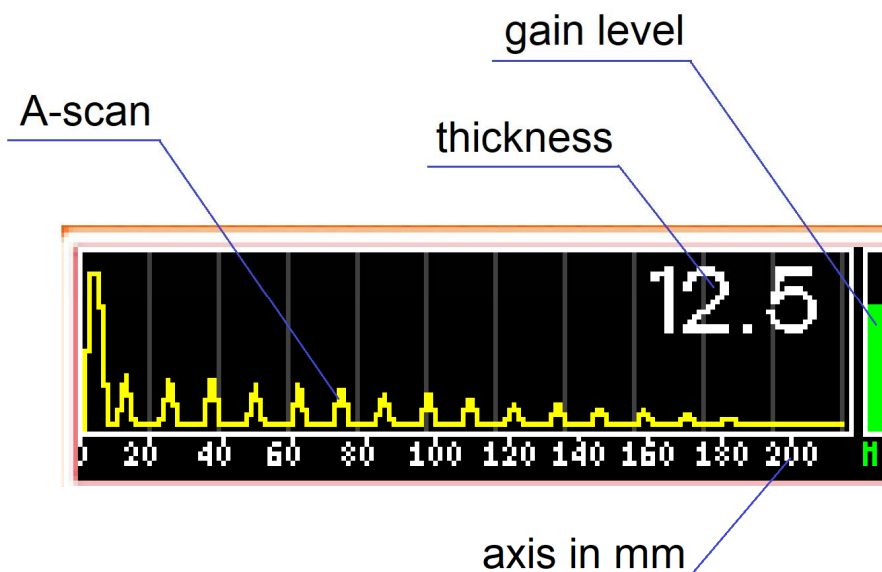


In the mode of value editing of the selected field, you must set the desired value by pressing or holding the  or  buttons.

After finishing editing the field, you must press the  button to return to the field selection mode and again press the  button to exit to the main window of the device.

## A-scan window

The A-scan window is shown in the figure below:



*A-scan display mode*

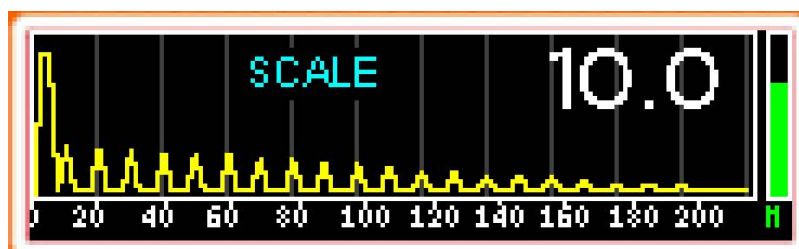
The horizontal axis on the A-scan is measured in millimetres or inches, depending on the units of measurement selected in the instrument settings (see the “Settings window” section). In addition to the A-scan, this window also displays the measured thickness of the test sample. The gain level in the device is shown in the right part of the window.

The user has the ability to change the scale of the A-scan, set the position of two gates, as well as change the gain.



### Changing the scale of the A-scan display




To change the scale, press the  button. The “scale” message will appear on the screen. An example of such a window is shown in the figure below:





*A-scan scaling*


In this case, the user can zoom in or out by pressing  or  buttons.


Pressing the  button again switches the “scale” mode to the “offset” mode, in which you can move along the enlarged A-scan by selecting the necessary part of it. The appearance of such a window is shown in the figure below:



*A-scan offset mode*


In this case, the user can navigate the A-scan by pressing the  or  buttons.

To exit the “scale” mode, press the  button.

Pressing the  button again leads to reset of all changes of the A-scan scale and setting the scale to default.

## Gain change


The user has the ability to change the gain of the device. In this case, this opportunity appears only if the automatic gain control (AGC) mode is disabled in the device settings (see the “Settings window” section).

To select the gain change mode, press the  button three times. In this case, the screen will display the “gain” message, as shown in the figure below:



*Manual gain mode*



In this case, the user can change the gain by pressing or holding the  or buttons.



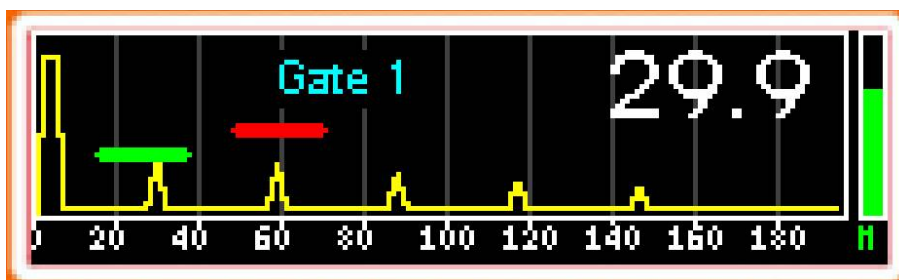
To exit the manual gain control mode, press the button.

## Gate installation



The device has three measurement modes: auto, one-gate and two-gates. To operate in manual one-gate and two-gates measurement modes, the device has the ability to install these gates on the A-scan.



To set gate 1, press the button several times until the message “Gate 1” appears on the screen. An example of such a window is shown below:



*Setting the position of the gates*

In this case, the user can change the position of gate 1 by pressing or holding the  or  buttons. It should be borne in mind that the possibility of setting gate 1 appears only when the measurement mode “one-gate” or “two-gates” is selected in the main window of the device (see “The main window” section).

Similarly, the user can change the position of the gate 2. It should be mentioned that the possibility of setting gate 2 appears only when the measurement mode “two-gates” is selected in the main window of the device (see “The main window” section).






To exit the gate setting mode, press the button.


## Settings window

The figure below shows the window with the device settings:



*Settings window*

To navigate through the lines in this window, press the  button and after that select the desired line using  or  buttons.

To change the values of the selected line or enter a submenu, press the  button.

To exit the line parameters editing mode, use the  button.

This window contains the following lines:

- **A-scan length**

This parameter can take the following values: 10 mm, 25 mm, 50 mm, 100 mm, 150 mm, and 220 mm. It limits the length of the horizontal axis on the A-scan.

- **AGC**

This parameter can be “on” or “off”. It determines whether the device is using the automatic gain control mode or not.

In most cases, it is recommended to use this setting “on”.

- **Resolution**


This parameter can take values of “0.1” and “0.01”. It determines how many decimal places are displayed on the device when measuring the thickness of the test sample and the thickness of the non-conductive coating.

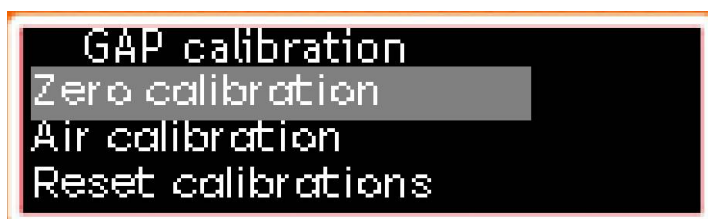
- **Measurement of coating thickness**

This parameter can be “on” and “off”. It determines whether the device measures the thickness of the coatings or not.

- **Gap calibration**


- This menu item is designed to calibrate the coating thickness

measurement channel. To enter this menu, press the  button. In this case, the user enters the submenu, the appearance of which is shown in the figure below:





*Coating thickness measurement channel calibration menu*

There are 4 items in this menu: zero calibration, air calibration, thickness calibration and reset calibration.

Navigation through the menu items is carried out using the  and



buttons. To select the desired item, press the  button. To

exit to the previous menu, press the  button.

For more information on calibrating the coating thickness measurement channel, see the “Presets and Calibration” section.

- **Brightness**

This parameter can take values in the range from 1 % to 100 %. It determines the brightness of the screen.

- **Date**

This menu allows you to set the date in the device.

- **Time**

This menu allows you to set the time in the device.

- **Language**

The device allows you to choose one of three interface languages: Russian, Chinese and English.

- **Units**

This parameter can take the value of millimetres or inches.

## Files window

The appearance of this window is shown in the figure below:





*Files window*




To enter this window, press the  button. After that, the appearance of the window will change and become as shown in the figure below:








After that, you can select one of the saved files using the  and 

buttons. After the desired file is selected, you need to press the  button to view or delete this file. In this case, the window will change and will be as shown below:



In this window, using , , and  buttons you need to select the action that you want to perform with the selected file. The file can be opened or deleted. Additionally, in this menu it is possible to delete all saved files.

To exit the menu, press the  button the required number of times.

## Presets and calibration

There are a number of steps to take before starting measurements:

- 1) In the main window of the device, select the material of the test sample from the list (see “The main window” section).
- 2) Select the temperature of the test sample (see “The main window” section). The speed of sound in a material is temperature dependent. Therefore, it is necessary to try to set the temperature of the test sample as accurately as possible so that the device takes into account the change in the speed of sound. This is especially important for measuring the thickness of heated samples.

### ATTENTION!

**When measuring the thickness of a sample with a surface temperature of more than 80 °C, it is necessary to use the EMT40004T converter.**



The external view of the device with the EMT40004T sensor is shown in the figure below:



*Device with EMT40004T sensor*

Standard EMT40001 converter is designed for operation in the range of  $-20..+80\text{ }^{\circ}\text{C}$

### ATTENTION!

**Using the EMT40001 converter at temperatures above  $80\text{ }^{\circ}\text{C}$  may damage it.**

EMT40004T converter characteristics:

Excited wave type	Transverse, radially polarised
Working frequency range	1 MHz...10 MHz
Aperture diameter	23 mm
Dimensions	40 mm × 150 mm
Operating temperature range	$-20\text{ }^{\circ}\text{C}... 750\text{ }^{\circ}\text{C}$

Measurement modes with EMT40004T converter:

Temperature range, $^{\circ}\text{C}$	Measurement duration, s
0–320	continuously
320–700	0–5 (interval between measurements is 15 seconds)

**ATTENTION!**

**When working with test samples, the temperature of which is higher than 350 degrees, the thickness measurement with the EMT40004T converter must be performed for a short time, with pauses, according to the table above.**

- 3) Set the speed of sound in the device (see “The main window” section). When you select a material, the speed of sound is automatically set from the default values for that material. But the user can set any value of the speed of sound if it is known more precisely. The device uses a transverse acoustic wave. The speed of this wave for various materials is presented in the table below:

Material	Speed of sound, m/s
Steel	3250
Stainless steel	3250
Aluminium	3130
Bronze	2500
Copper	2260
Brass	2120
Titanium	3120

*The speed of propagation of a transverse wave in metals*

**ATTENTION!**

**The device uses a transverse wave. The typical transverse wave speed in steel is 3250 m/s.**

- 4) Set the required number of averages. The user can select the number of averages from the range of 16, 32, 64, 128, 256, and 1024. For most cases, it is recommended to use the number of averages equal to 128. The larger the number of averages, the higher the quality of the useful signal, but the slower the device works. If the test sample is strongly corroded or has a large layer of dirt or rust on the surface, then it is recommended to increase the number of averages up to 256..512. If measurements take place on samples without coatings and without corrosion, then the number of averages can be reduced to 32..64, this will increase the operation rate of the device.
- 5) Select the measurement mode. In the EM4000 thickness gauge, three thickness measurement algorithms are implemented: an automatic algorithm, a one-gate thickness measurement algorithm and a two-gate thickness measurement algorithm.

The automatic algorithm is suitable for most applications and allows you to obtain the thickness value without operator intervention.

The algorithm for measuring the thickness in “one-gate” mode calculates the position of the maximum in the first gate on the A-scan and recalculates the found value into the thickness. The position of the first gate and its length are set by the operator. The algorithm is recommended to be used to test samples made by casting, as well as test samples subject to severe corrosion, for example, ship hulls.

The algorithm for measuring the thickness in “two-gate” mode calculates the position of the maxima in two gates. The difference between the maximum position in one gate and the maximum position in the other gate is used to calculate the thickness. The position of the gates is set by the operator.

- 6) Calibrate if necessary. The device has two independent measuring channels. This is the channel for measuring the thickness of the test sample and the channel for measuring the thickness of the non-conducting coating. These channels are also calibrated independently.






## Calibration of the channel for measuring the thickness of the test sample.

This calibration allows you to determine automatically the speed of sound in a sample with a predetermined thickness. To perform the calibration, you must perform the following steps:

- Place the device on a sample of known thickness.
- In the main window of the device, highlight the value of the measured thickness (see “The main window” section). The appearance of such a window is shown below:



*Highlighted thickness value*

- Next, you need to press the  button and using  and  buttons set the real known value of the sample thickness instead of the measured value. Then press the  button and after that press the  button. In this case, the device will set a new value for the speed of sound.

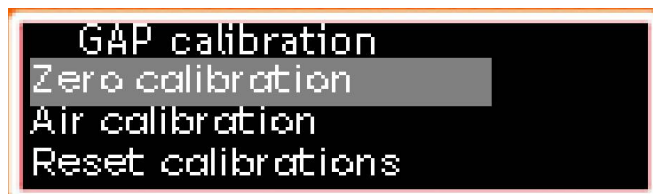
## Calibration of the coating thickness measurement channel.

This calibration is required when replacing the EMT40001 converter. Calibration is performed using a sample supplied with the device. The sample is made of steel; therefore, it should be set as the “steel” material (see “The main window” section). The sample is shown in the figure below:



*Sample supplied with the device*


The menu “Calibration of the coating thickness measurement channel” can be accessed through the “Settings” window (see the “Settings window” section). The appearance of this menu is shown in the figure below:




*Coating thickness measurement channel calibration menu*


This menu consists of four items. Calibration is performed in three steps.

### **Air calibration is performed first.**

To do this, select the appropriate menu item and press the  button. After that, the text “Place the device outside metal objects and press OK” appears on the screen of the device. The device should be removed from the metal so that the distance from it to any metal object is more than 10 cm and

while holding the device in this position, press the  button.

### **The second step is to perform zero calibration.**


To do this, select the appropriate menu item and press the  button. After that, the text “Place the device close to the metal and press OK” appears on the screen of the device. Install the device in the centre, on the sample supplied, as shown in the figure below:



*Positioning the device for zero calibration*

and press the  button.

**The third step is thickness calibration.**

To do this, select the appropriate menu item and press the  button. After that, a field appears on the device screen, in which you can enter the value of the thickness of the reference coating. The very value of this thickness is indicated on the sample supplied. Install the instrument on the sample as shown in the figure below:



*Positioning the device for zero calibration*

and press the  button.

After completing these three points, the device should correctly measure the thickness of the plastic coating on the sample from the delivery set.

**ATTENTION!**


**Calibrate the coating thickness measurement channel only in the sequence specified in this section and only with the EMT40001 converter installed.**

## Measurement of the thickness of the test sample

The device can operate in three modes of thickness measurement: automatic, one-gate measurement mode, two-gate measurement mode.


### Automatic mode.

To measure thickness in this mode, you need to:

1. Select which converter to use (EMT40001 or EMT40004T), depending on the temperature of the test sample (see the “Presets and Calibration” section). Install the selected converter on the device.
2. Switch on the device by pressing the  button. Make initial settings of parameters. Including set the measurement mode “auto” (see the “Presets and Calibration” section).
3. If necessary, calibrate the device (see the “Presets and Calibration” section).
4. Place the device on the surface of the test sample. After a period of time from 100 ms to 3 seconds, depending on the selected number of averages, the measured value of the thickness will be displayed on the device screen.

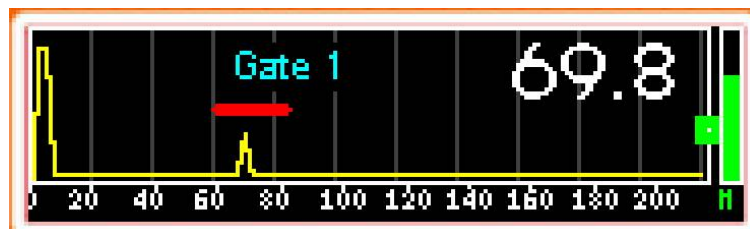
### One-gate measurement mode.

To measure thickness in this mode, you need to:

1. Select which converter to use (EMT40001 or EMT40004T), depending on the temperature of the test sample (see the “Presets and Calibration” section). Install the selected converter on the device.
2. Switch on the device by pressing the  button. Make initial settings of parameters. Including set the measurement mode “Gate 1” (see the “Presets and Calibration” section).
3. If necessary, calibrate the device (see the “Presets and Calibration” section).
4. Install the device on the surface of the test sample.
5. Open the A-scan window (see the “Switching between device windows” section).

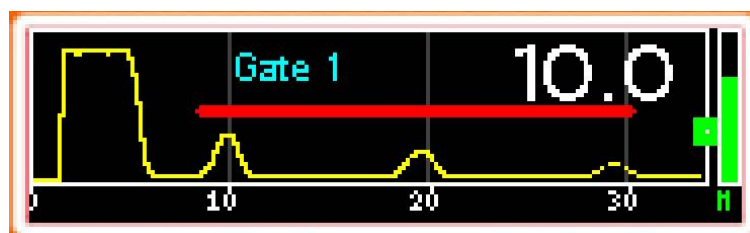
- Set the gate position (see the “A-scan window” section) so that it picks up the background signal. After that, the value of the measured thickness appears on the A-scan.

An example of the position of the gate above the bottom signal is shown in the figure below:



*Gate location above the bottom signal*

In the figure above, the gate captures only one bottom signal. A situation is acceptable when the gate picks up several bottom signals, as shown in the figure below:



*Gate location over multiple bottom signals*


In both cases, the device searches a maximum on the A-scan within one gate, and it is this maximum that is taken as the one by which it is necessary to calculate the thickness of the test sample.

## Two-gate measurement mode.

To measure thickness in this mode, you need to:

- Select which converter to use (EMT40001 or EMT40004T), depending on the temperature of the sample to be monitored (see the “Presets and Calibration” section). Install the selected converter on the device.

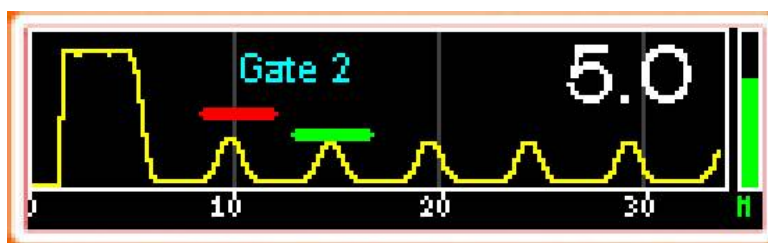


- Switch on the device by pressing the  button. Make initial settings of parameters including set the measurement mode “Gate 2” (see the “Presets and Calibration” section).



3. If necessary, calibrate the device (see the “Presets and Calibration” section).
4. Install the device on the surface of the test sample.
5. Open the A-scan window (see the “Switching between device windows” section).
6. Set the position of gate 1 (see the “A-scan window” section) so that it captures the first bottom signal.
7. Set the position of gate 2 (see the “A-scan window” section) so that it captures the second bottom signal.

An example of such a position of the gates above the bottom signals is shown in the figure below:



*The location of two gates above the bottom signals*

The device searches the coordinate of the maximum in the first gate, then searches the coordinate of the maximum in the second gate, then finds their difference and, using this found difference, measures the thickness, which is displayed on the screen of the device.

## Measurement of coating thickness at the test sample


To measure the thickness of the coating, it is necessary to:

1. Install the EMT40001 converter on the device.

### **ATTENTION!**

**The EMT40004T converter does not have the ability to measure coating thickness.**

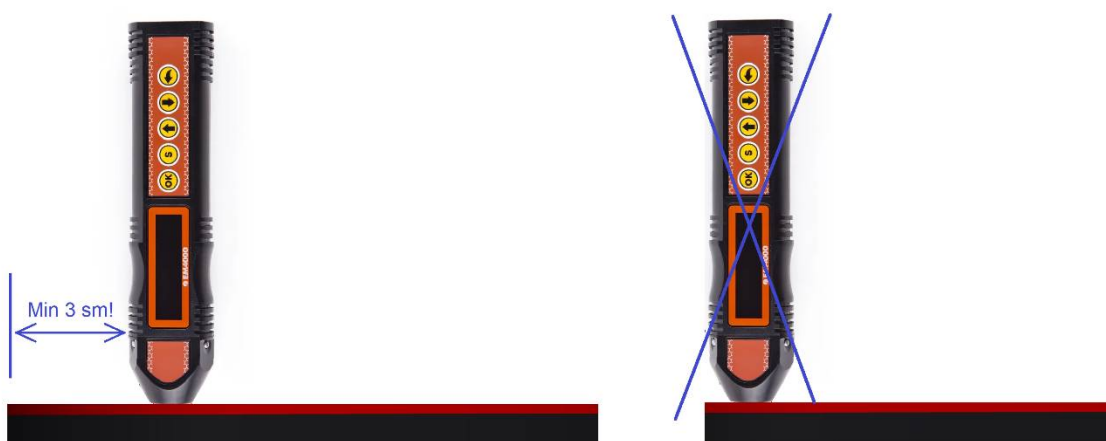


2. Switch on the device by pressing the  button. Select the material of the sample to be inspected (see the “Presets and Calibration” section). In

the device settings, set the parameter “measurement of coating thickness” to “on” (see the “Settings window” section).

3. If necessary, calibrate the device (see the “Presets and Calibration” section).
4. Place the device on the surface of the test sample. After a period of time from 100 ms to 3 seconds, depending on the selected number of averages, the measured value of the coating thickness will be displayed on the device screen.


The coating thickness measurement channel has an edge effect. This means that if the device is placed close to the edge, then the readings of the measured coating thickness will not be correct. Therefore, do not position the device so that the distance from the edge of the test sample to the edge of the device is less than 3 cm (see the figure below):



*To measure the thickness of coatings, do not place the device on the edge of the test sample*

## Data saving

The user has the ability to save measurement data. In order to save the current

measurement result, you must press the  button. Each measurement is recorded as a separate file, the name of which contains the number, time and date. To view the saved files, the device has a special files window (see the “Files window” section).

## Battery charge

Use the supplied charger and USB-C cable to charge the battery.

It takes at least five hours to charge a fully discharged battery to 100 %. It is recommended to charge the device in the off state.

### **ATTENTION!**

**Prolonged exposure of the device battery in a completely discharged state can lead to a decrease in the capacity of the battery and a decrease in its service life. When the battery is completely discharged, it is recommended to charge it as soon as possible. This requirement must be taken into account during long-term storage of the device.**

## Features of working with the device

The electromagnetic-acoustic converter, which is connected to the device, contains a permanent magnet, the presence of which introduces a number of requirements:

1. Care should be taken when moving the converter near knives, forks, needles, or other sharp metal objects. Such objects can become magnetically attached to the convert housing and injure the operator.
2. When installing the converter on a loose, relatively light test sample, hold the sample with your hand;
3. Placing plastic magnetic cards near the converter can damage the magnetic cards;
4. At sharp, inaccurate installation of the converter on the test sample, a shock may occur due to the additional acceleration caused by the magnetic field. To increase the service life of the converter, it is recommended to install it on the test sample smoothly, without throwing, holding it with your hands;
5. It is recommended to install the converter on the test sample at an angle of  $\sim 60^\circ$ . After the converter touches the surface of the test sample, it should be straightened to an angle of  $90^\circ$ .

During the entire service life of the device, it is necessary to monitor the integrity of the converter protector. If the protector is damaged with the opening of the emitting coil, it is necessary to replace the converter.

**ATTENTION!**

**Prolonged operation of the device with a damaged sensor can lead to the failure of the device. Contact of a damaged sensor (with opening the coil wires) with metal can lead to spark formation.**

**DEVICE VERIFICATION TECHNIQUE**

The device is checked by the bodies of the State Metrological Service or other authorised organisations accredited to carry out such work.

The result of verification is either confirmation of the suitability of the measuring instrument for use or recognition of the measuring instrument as unsuitable for use.

If the measuring instrument according to the verification results is recognised as suitable for use, then in the technical documentation a mark on verification is put on the device or a verification certificate is issued.

In case of negative results of verification, the device is not allowed for further operation; in the technical documentation a mark is put on the device about unsuitability.

**Verification procedure**

During verification, the following operations must be performed:

1. Visual inspection;
2. Functionality check;
3. Determination of measurement error.

By agreement with the authorities conducting the verification of the device, verification may not be performed in full.

**Verification tools**

Verification tools must have valid verification certificates or marks.

Verification is performed using the following test samples:

1. A set of standard samples of equivalent ultrasonic thickness KUSOT-180 or a set of exemplary ultrasonic thickness measures KMT-176M-1 (KMTS-97);
2. A set of plane-parallel samples made from one steel billet with the following parameters:

Thickness / mm	Roughness $R_z$ / $\mu\text{m}$
$2 \pm 0.01$	$>10$
$10 \pm 0.015$	$>20$
$60 \pm 0.03$	$>20$

It is allowed to use means other than those indicated above, but with characteristics that are not inferior to these means and are sufficient to obtain a reliable result. The use of such means of verification must be coordinated with the bodies of the State Standard.

## Verification conditions

Verification must be carried out under the following climatic conditions:

Air temperature	$+5...+30\text{ }^{\circ}\text{C}$
Humidity	80 % at a temperature $+25\text{ }^{\circ}\text{C}$
Atmosphere pressure	86...106 kPa

## Verification procedure

### Visual inspection

When conducting a visual inspection, the following requirements should be checked:

1. The completeness of the device must correspond to that specified in the user manual;
2. Marking and serial number of the device must correspond to the marking and serial number indicated in the user manual;
3. The device should not have any mechanical damage affecting the performance of the device and deteriorating its technical characteristics.

### Functionality check

The device functionality check must be carried out in accordance with the instructions in the “Description of operations with the device” section and using a test sample from the delivery kit or another test sample that has the required certificate.

The health check is performed in the following order:

1. Calibrate the instrument using a test sample;
2. Measure the thickness of the test sample. The measured value of the sample thickness should not differ from the actual value (10 mm) by more than 0.04 mm.

### **Determination of measurement error**

Determination of the measurement error is performed using a set of samples made from one workpiece in the following order:

1. Place the device on a 2 mm thick test sample;
2. Calibrate the device using a known thickness calibration of the test sample;
3. Take five measurements of the thickness at five different points of the test sample with a thickness of 2 mm;
4. Determine the maximum measurement error  $\Delta$  by the formula:

$$\Delta = \max(H_i - H_s)$$

where  $H_i$  is a measurement result;  $H_s$  is a sample thickness;

5. Repeat the steps specified in points 1–4 for test samples with a thickness of 10 and 60 mm.

The verification results are considered positive if the obtained value of the instrument error for all test samples does not exceed  $\pm 0.08$  mm.

## MAINTENANCE

### Converter replacement

If the plastic cover of the EMT40001 converter is worn out or the protector of the EMT40004T converter is worn out, it is necessary to replace them with new ones.

#### ATTENTION!

**It is recommended to replace the converter when the device is turned off.**

To replace the EMT40001 converter, it must be disconnected from the device. For this:

- 1) It is necessary to press on the metal ball-shaped buttons located in the front of the device as shown in the picture below:



- 2) While holding these two buttons pressed, pull the converter and disconnect it as shown in the figure below:



*Disconnecting the EMT40001 converter*

- 3) Then replace the disconnected converter with a new one. To do this, you just need to pull it over the body.
- 4) After replacing the converter, it is necessary to calibrate the coating thickness measurement channel (see the “Presets and Calibration” section).

The replacement of the EMT40004T converter is carried out in the same way, **but the calibration of the coating thickness measurement channel should not be done**, since the EMT40004T converter does not have a coating thickness measurement channel. The replacement of the EMT40004T converter is carried out in a similar way.

## Battery replacement

Battery replacement can be performed ONLY at the service centre of the Oktanta LLC. It is recommended to replace the battery every three years.

### **ATTENTION!**

**Do not replace the battery yourself!!!**



## TRANSPORTATION AND STORAGE

When storing and transporting the device, the following climatic conditions must be followed:

Air temperature	+5...+30 °C
Humidity	80 % at a temperature +25 °C

Store and transport the device only in the case included in the delivery kit. In this case, it is necessary to avoid mechanical damage to the case and the device.

When stored for a long time, the battery of the device is discharged, which may affect the operation of the device in the future. Therefore, it is recommended to periodically (at least once a year) check the charge level of the device and, if necessary, charge the battery (see the “Battery charge” section).

## **DELIVERY KIT**

### **Basic kit**

EM4000 thickness gauge	1 pc.
Device storage case	1 pc.
Charger	1 pc.
EMT40001 converter	1 pc.
USB-C cable	1 pc.
User manual	1 pc.
CP40001 SOP	1 pc.

### **Optional equipment**

EMT40004T converter	1 pc.
Tablet with installed software for working with the device	1 pc.

## MANUFACTURER'S WARRANTY

The warranty period is 24 months from the date of purchase. During the warranty period, the Manufacturer undertakes to eliminate device malfunctions subject to the integrity of the case and the availability of warranty seals.

The manufacturer has the right to prematurely withdraw its warranty obligations in the following cases:

1. Use of the device for purposes other than those specified in this user manual;
2. Violation of the conditions and requirements for operation, storage and transportation of the device specified in this user manual;
3. Mechanical damage to the device resulting from careless handling.

### WARRANTY CARD

<b>Device name</b>	<u>EMA thickness gauge EM4000</u>
<b>Factory number</b>	_____
<b>Warranty period</b>	_____
<b>Manufacturer</b>	Oktanta LLC Saint Petersburg, 22–34 Mayakovskogo st. +7(812)385-54-28 <u>info@oktanta-ntd.ru</u> <div style="text-align: right;">           _____            signature, seal         </div>

**REPAIR INFORMATION**

<b>Date of the request</b>	<b>Type of the defect</b>	<b>Repairs carried out</b>	<b>Completion mark (date, signature, seal)</b>

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**VERIFICATION INFORMATION**

<b>Verification date</b>	<b>Validity</b>	<b>Implementer data</b>