



ADL UT20

art. - ADL.UT20.001

Ultrasonic Thickness Gauge

Instruction Manual

This instruction manual is intended for the study of the ultrasonic thickness gauge ADL UT20 (further referred to as the device or thickness gauge).

The operating manual contains a description of the design, menu, principle of operation, basic provisions for working with the device.



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1 DESCRIPTION AND OPERATION

1.1 Assignment

The thickness gauge is designed to measure the thickness of products made of structural metal alloys and isotropic non-metallic materials with one-way access to them.

The thickness gauge uses a method for providing acoustic contact by pressing the contact surface of the transducer to the surface of the controlled product.

The thickness gauge can work with any dual-element normal transducers operating at frequencies from 2.5 MHz to 10 MHz.

1.2 Specifications

Table 1 - Ranges of measured thicknesses

Transducer Type	Range of measured thicknesses, T, transducer, mm
П112-10-6/2 (analog DT1006)	0.8 - 10
П112-2.5-12/2 (analog DTB2512)	1.0 - 300

Table 2 - Sampling discreteness, mm

For measuring range	(0.80 – 99.99) mm	0.01
For measuring range	(100.0 – 300.0) mm	0.1

Limits of permissible basic absolute error of thickness measurements when measuring samples with surface roughness $R_z \leq 10 \mu\text{m}$ and a radius of curvature of at least 200 mm (Table 3):

Table 3 - Limits of permissible basic absolute error

0.8... 10 mm	$\pm (0.01T + 0.03)$
10... 300 mm	$\pm (0.01T + 0.1)$

where “T” is the nominal value of the thickness, mm.

Limits of permissible additional absolute error of thickness measurements at temperatures from -10 to +15 °C and from +25 to +50 °C, mm:



Table 4 – Limits of permissible additional absolute error

With a sample discreteness of 0.01 mm	$\pm (0.002T + 0.03)$
With a sample size of 0.1 mm	$\pm (0.002T + 0.1)$

where “T” is the nominal value of the thickness, mm.

Limits of permissible additional absolute measurement error on the limit values of the geometric parameters of the surface of products in the measuring zone:

- The limits of the permissible additional absolute error of thickness measurements with the roughness of the surface Rz of products in the measurement zone are given in Table 5.

Table 5 - Limits of permissible additional absolute error of thickness measurements at surface roughness Rz

Transducer Type	Value of the parameter roughly, μm	Limits of permissible additional absolute error of thickness measurements, mm, with sampling discreteness	
		0.01 mm	0.1 mm
П112-10-6/2 (analog DT1006)	$10 < R_z \leq 80$	± 0.08	± 0.2
П112-2.5-12/2 (analog DTB2512)		± 0.10	± 0.2

- The minimum allowable radius of curvature of the surface is 10 mm:
- for transducers П112-10-6/2 (analogue DT1006), П112-2.5-12/2 (analogue DTB2512);
- Limits of permissible additional absolute error of thickness measurements when measuring samples with a cylindrical surface in Table 6.

Table 6 - Limits of permissible additional absolute error of thickness measurements when measuring samples with a cylindrical surface

Transducer type	Radius of curvature, mm	Limits of permissible additional absolute error of thickness measurements, mm, with sampling discreteness	
		0.01 mm	0.1 mm
П112-10-6/2 (analog DT1006)	$10 \leq r < 200$	± 0.08	± 0.2
П112-2.5-12/2 (analog DTB2512)		± 0.10	± 0.2



The range of spread speeds of ultrasonic oscillation is 1000 to 9999 m/s.

Thickness measuring range from 0.8 mm to 300 mm depending on the type of transducer installed.

The thickness gauge is powered by a battery with a nominal voltage of 3.7 V.

The degree of protection of the thickness gauge housing is dust and moisture protection.

The thickness gauge provides messages about the level of discharge of the battery, as well as an additional message about the maximum allowable discharge of the battery. After issuing the last message, the device turns off.

When turned off, the thickness gauge provides memorization of the following parameters: settings for the transducer (correction of zero setting, amplification, set ultrasonic speed in the material and levels);

The thickness gauge provides settings for transducers to ensure the established metrological characteristics for them and store these settings in the memory of the device.

The thickness gauge has the ability to set the time of automatic shutdown from 1 to 9 minutes, as well as work without automatic shutdown.

Weight, kg, not more than (Table 7):

Table 7 – Weight of the device, kg

Information Processing Unit	0.24
Transducer	0.08

Overall dimensions, mm, not more than (Table 8):

Table 8 – Dimensions


Information Processing Unit	142×75×35
Transducer	Ø20

1.3 Design and operation

The thickness gauge consists of an information processing unit and transducers. The principle of operation of the thickness gauge with transducers is based on ultrasonic pulsed echo - a measurement method that uses the properties of ultrasonic oscillation to be reflected from the interface of media with different acoustic resistances.

The thickness gauge information processing unit produces a triggering pulse that is fed to the emitting plate of the transducer, which emits an ultrasonic pulse through the delay line to the product. The pulse of the ultrasonic device spread in the product to the inner surface of the product, is reflected from it, spread in the opposite direction and, having passed the delay line, is received by the receiving plate. The spread time of



ultrasound is uniquely related to the product thickness “T”. The received pulse is amplified and fed to the input of the information processing unit, which generates a digital code N, proportional to the pulse spread time in the product, taking into account the spread time in the delay lines, after which the product thickness “T” is calculated. The calculated “T” value is shown on the display. Also on the display, if there is acoustic contact between the transducer and the product, a label  is displayed.

Before using the thickness gauge, it is necessary to calibrate it to a thickness close to the measured thickness of the sample.

The design of the thickness gauge includes an information processing unit and transducers connected with connectors. The connectors are located on the end surface of the housing. The right connector of the thickness gauge is a generator, the left connector is a receiver.

1.4 Marking

The name of the thickness gauge is applied to the front cover of the information processing unit.

The back cover is marked with the serial number, production number and year of manufacture.

1.5 Packaging

The information processing unit and transducers are placed in a bag for storage and transportation.



2 THICKNESS GAUGE MENUS

2.1 Thickness gauge menu



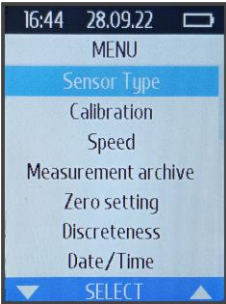


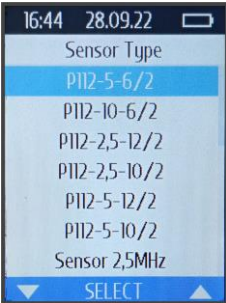
The thickness gauge menu consists of 11 tabs and a measurement window.

A brief description of the thickness gauge menu is given in Table 2.1.

The transition between the tabs of the thickness gauge menu is carried out by

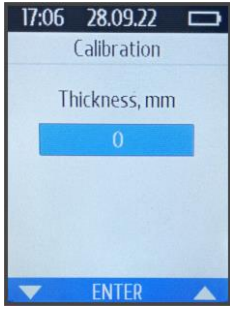
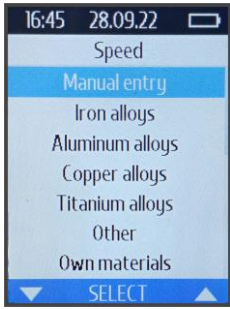
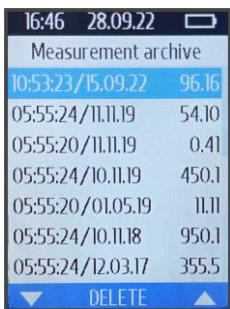
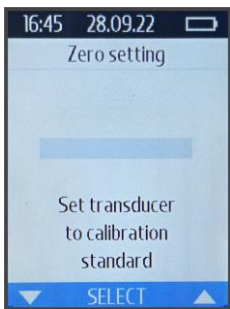


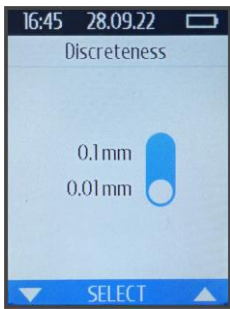
pressing the buttons  

Table 2.1 - Brief description of the thickness gauge menu

Tab name	Information displayed on the display
<p>1. Measurement window. It takes measurements, performs tolerance setting procedures, sets the amplification factor, and records the results in memory. It is used to enter the thickness gauge menu.</p>	
<p>2. View of the main menu.</p> <p>The main menu is entered using the button </p>	
<p>3. View of the "Transducer type" tab.</p> <p>Using the buttons  , you can select the desired transducer.</p>	

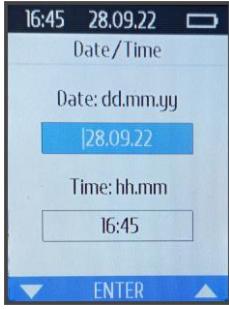
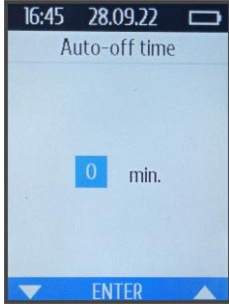



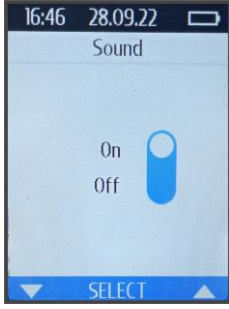
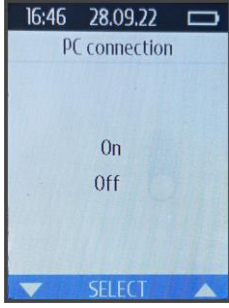


Continuation of Table 2.1

<p>4. View of the "Calibration" tab. In this tab, the transducer is calibrated to a given thickness.</p>	
<p>5. View of the "Speed" tab. There is a selection or manual input of the speed of the ultrasonic device for various materials.</p>	
<p>6. Tab "Archive of measurements". In this tab you can see all previously saved measurement results</p>	
<p>7. Zero tab. It is used to set zero when connecting the transducer to the device. When you set zero, the transducer is automatically calibrated to the standard measure that comes with it. Setting zero should be carried out each time a new transducer is connected to the device, or after its long line of operation.</p>	
<p>8. Tab "Discreteness". In this tab, with the buttons  , the user can select the discreteness of the reference.</p>	



Continuation of Table 2.1

<p>9. Date/Time tab. Set the date and time.</p>	
<p>10. Auto Power Off Time tab. Here, the user can set the auto power off time in the range from 0 to 9 minutes.</p>	
<p>11. Display Brightness tab. In this tab, using the buttons  , you can adjust the brightness of the display.</p>	
<p>12. Sound tab. It is used to turn on or off the sound of the instrument keys.</p>	
<p>13. Utility tab "Communication with PC". Connecting the device to a personal computer. When using the original software, it allows the specialists of the service center to quickly configure and reflash the device.</p>	



2.2 Assigning keyboard buttons



- button for moving and entering data in the thickness gauge menu; in the measurement window performs the following functions:

- reduction of the current amplification - short presses;
- saving the measurement results to the archive – prolonged clamping of this key.



- button for moving and entering data in the thickness gauge menu; in the measurement window performs the following functions:

- increase the current amplification - short presses;
- setting the minimum and maximum tolerance - prolonged clamping of this key.



- back key, delete value or cancel; in the measurement window, a short press of the button exits the tolerance value, a long holding of this key disables the tolerance mode.



- On/off key of the thickness gauge. To turn on or off the device, you should hold down the key for 3-5 seconds



- key to enter the thickness gauge menu and confirm data entry.

The amplification is displayed on the display as a message in the lower left corner, below the measurement result (Figure 2.1)



Figure 2.1 – Displaying the amplification

The amplification value is displayed in dB relative to the input signal level. And can be changed in the range of +20...+60 dB in increments of 1 dB.

To increase the amplification, you must press the button, to decrease - the button



2.3 Assigning display service tags

Label "Acoustic contact". The displayed view of the label is shown in Fig. 2.2.



Figure 2.2 - Service tag indicating the presence of acoustic contact

The presence of this service tag signals the presence of acoustic contact (indicates the arrival of a reflected ultrasonic echo pulse in the thickness gauge).

The Save label. Appears in the Measurements window when you hold down a key



for a long time (See Figure 2.3).



Figure 2.3 - Service tag that appears when saving the results to the instrument memory

The "Tolerance" label. Displayed on the screen if thickness tolerances are enabled (Figure 2.4).




Figure 2.4 - Service tag indicating that tolerances are enabled



3 INTENDED USE

3.1 Preparation of the thickness gauge for use

Connect the required transducer to the connectors on the end panel of the information processing unit.

Turn on the thickness gauge by pressing the . A message with the name of the thickness gauge and the version of the software will briefly appear on the display, after which the thickness gauge will show the measurement window.

3.1.1 Operation by built-in rechargeable battery.

During the operation of the device, in the upper right corner of the display, the battery charge indicator is shown (Fig. 3.1).

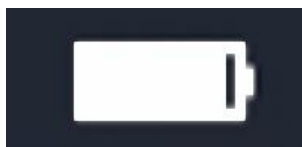


Figure 3.1 – Battery Indicator

If the device is completely discharged, it will display a message on the screen that the battery is low and will automatically turn off.

3.1.2 Battery charge.


To charge the built-in battery of the device, you must connect it to the charger, using a USB cable, and turn the charger into the network. A sign of the normal operation of the charger is the glow of the LED on the end of the device, next to the charging socket. The battery charge time from the charger is at least 3-4 hours. The battery should be charged without interruption in time.

It is forbidden to leave the charger unattended during the charge.

A lit green LED indicates that the device is fully charged.

3.2 Working procedures

3.2.1 Specifying and testing the type of connected transducer.

Prepare the thickness gauge for operation in accordance with clause 3.1 and turn it on by pressing the button .

Then you should select the type of transducer connected (Figure 3.2).



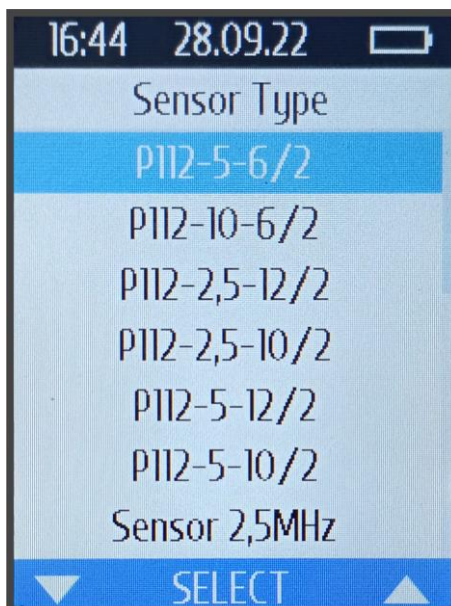


Figure 3.2 – Selecting the type of transducer

3.2.2 Setting the transducer to zero.

To exclude the influence of the time of passage of ultrasonic oscillation in the delay lines on the result of measuring the thickness of the product “T”, before starting the measurements, the zero of the connected transducers should be set, for which:

- apply a layer of contact grease to the calibration measure;
- install the transducer with the contact surface on the calibration measure and press it tightly;
- select the "Setting Zero" tab in the menu (Fig. 3.3).

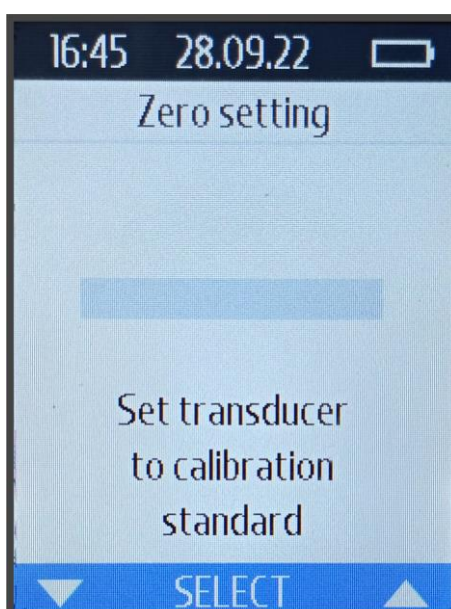


Figure 3.3 – Zero Setting

Based on the results of the measurement, the effect of the mileage time of ultrasonic



oscillation in the delay lines on the result of measuring the thickness of the product “T”. The display automatically displays the measured value of the ultrasonic thickness of the setting measure for the specified ultrasound speed (readings 6.00 ± 0.05 mm). When performing operations on this item, the transducer must be constantly pressed to the installation measure.

3.2.3 Calibration of thickness gauge.

In order for the thickness gauge readings to correspond to the real values of the thickness of the product, it is necessary to calibrate it. It shall be calibrated to a thickness close to the measured thickness of the specimen.

Calibration of the thickness gauge is possible in two versions - according to control samples and by ultrasound speed.











- Calibration of thickness gauge according to control samples.


It is produced when controlling products with an unknown ultrasonic speed, or if it is necessary to carry out measurements with high accuracy.

To calibrate the thickness gauge from control samples, it is necessary:

- prepare control samples of products made of material and according to technology similar to the material and technology of the products subject to control, to certify them in terms of thickness at specified points;
- prepare the thickness gauge for operation in accordance with paragraph 3.1.
- set the zero in accordance with paragraph 3.2.2.
- select the "Calibration" tab in the menu;
- enter the thickness, in mm.

If the thickness is less than 10 mm, then the input is carried out in the following

way: after going to the “Calibration” tab , press the button again, after which the display should show two zeros “00”, then set the thickness value with the buttons  , and then press the button . After that, press the button , a dot should appear. Then we press the button . We continue to enter tenths of the thickness with the buttons  , confirming the entry with the button , after that you should enter hundredths of the thickness by repeating the same operations and pressing the button ;

- install the transducer on a section of the control sample known in thickness and pre-lubricated with contact liquid, wait for the appearance of the mark ;

- the new ultrasound speed value will be displayed on the display automatically at the end of the calibration.



At the end of the calibration, the user will be asked to save this speed.

- Calibration by ultrasound speed.

Calibration of the thickness gauge by the speed of ultrasound is carried out in the case when its value for the material of the products to be controlled is known.

To calibrate the thickness gauge by ultrasound speed, it is necessary:

- prepare the thickness gauge for operation in accordance with paragraph 3.1.
- set the zero in accordance with paragraph 3.2.2.
- set the required ultrasound rate in the material.

Installation procedure:

1. Go to the "Speed" menu tab.
2. Select "Manual Input"
3. Enter the desired speed.

After that, the entered speed should be displayed in the lower right corner of the thickness gauge measurement window (Figure 3.4).

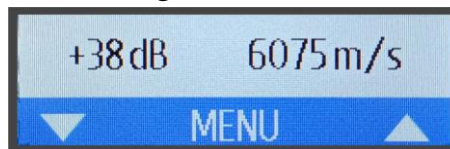


Figure 3.4 – Ultrasound Speed Display

3.2.4 Setting the discreteness of the measurement.


Depending on the required measurement error and the speed of control, the thickness gauge allows you to set one of two discreteness values - 0.01 or 0.1 mm.

Measurements with a discreteness of 0.01 mm are characterized by the highest speed - 10 measurements per second (this mode is convenient when working with fixing the minimum readings, in the case of scanning product areas without lifting the transducer from the surface).

Measurements with a discreteness of 0.1 mm are characterized by a speed of 4 measurements per second, while ensuring an appropriate measurement error.

In order to change the discreteness of the measurement of the device, you should:



1. In the menu of the device select the tab "Discreteness"
2. Select the desired discreteness of measurements.

3. Press the button 

3.2.5 Adjusting the brightness of the display.

For the convenience of working with the device, the function of adjusting the brightness of the display is provided.




In order to adjust the brightness, you should go to the menu tab "Display

Brightness" and   adjust the brightness of the display with the buttons.



3.2.6 Setting the auto-disconnect time.

The thickness gauge allows you to set the time of automatic shutdown - the time interval after which it is automatically turned off if measurements were not made or the keyboard buttons were not pressed.

In order to set the auto-disconnect time, select the menu tab "Auto Power Off Time" and set   the desired auto-disconnect time, in the range from 0 to 9, and press the button  (Fig. 3.5).

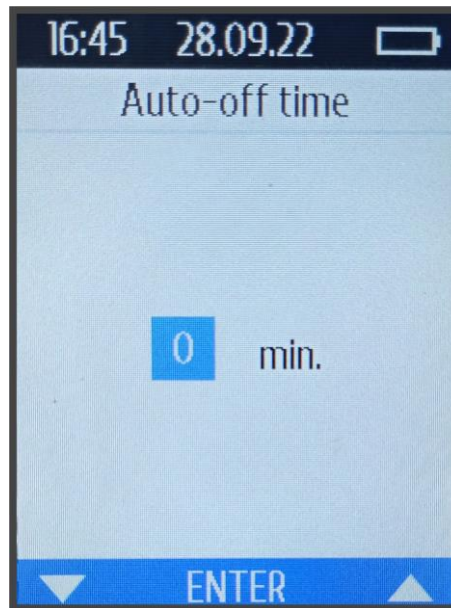






Figure 3.5 – Setting the time of automatic shutdown of the device

3.2.7 Adjustment of the thickness gauge amplification.

If it is necessary to carry out measurements on products with high roughness or when controlling small diameter pipes and controlling products made of materials with a high attenuation coefficient (copper, lead, polyethylene, etc.), as well as when changing the characteristics of the transducer due to wear, it may be necessary to adjust the amplification factor of the thickness gauge.

If you need to adjust the amplification, you must briefly press the button  to increase the amplification or the button  to reduce the amplification.

When you press the buttons  , the amplification value begins to change, and its current value is displayed on the display (in dB relative to the level of the input signal). At the same time, the range of amplification changes is 20 ... 60 units in increments of 1 unit (Figure 3.6).



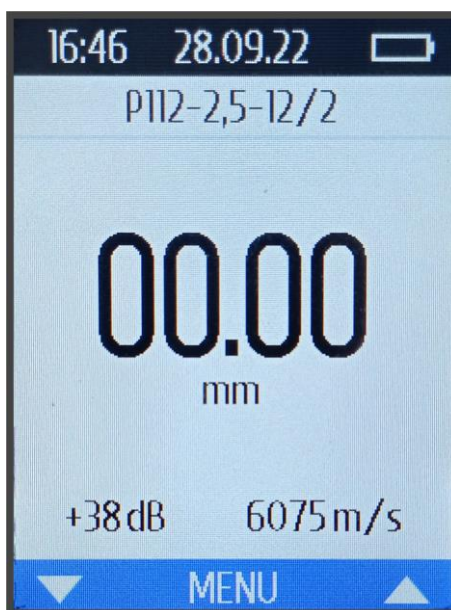




Figure 3.6 – Amplification Display, dB

When the device is turned off and subsequently turned on, the amplification value is stored at the set value.

The correctness of the adjustment is the repeatability of the measurement results, and their correspondence to the real thickness at the measurement points of the control samples.

3.2.8 Enabling/disabling the minimum/maximum reading (Tolerance).

In many cases, during the inspection, it is important to record the minimum/maximum readings during the presence of acoustic contact (for example, when controlling pipes, when searching for local thinning, voids in the product areas, in which the specialist scans the surface of the product in the selected area). Measurements with fixation of the minimum/maximum are carried out in the measurement window.

In order to enable minimum/maximum locking (Tolerance), you should hold down the button  while in the measurement window and enter the minimum and maximum thickness (Figure 3.7). After that, press the . In the measurement window, the specified, minimum and maximum, thickness tolerances will be displayed (Fig. 3.8).



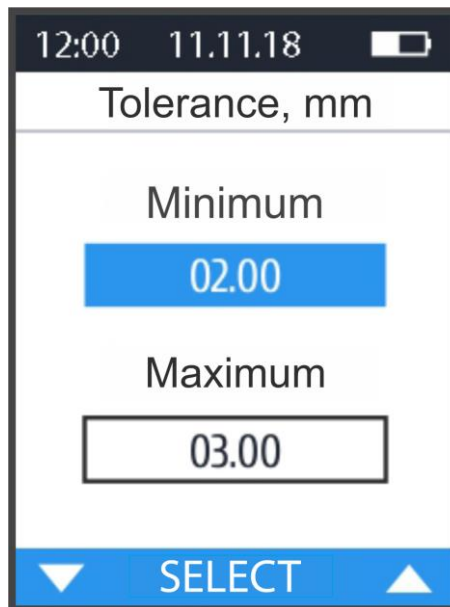


Figure 3.7 – Setting thickness tolerances

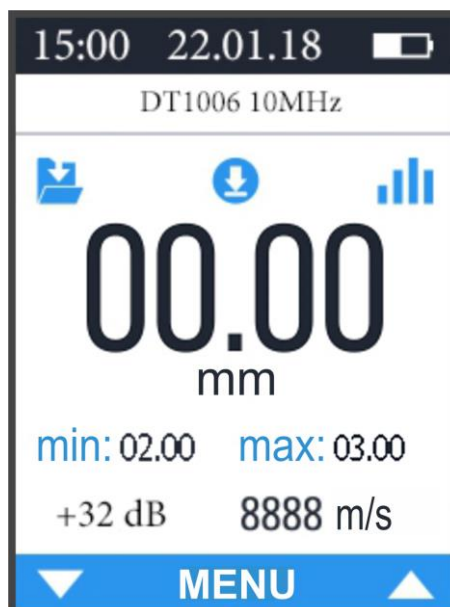




Figure 3.8 – Established thickness tolerances

Further, when carrying out measurements, the thickness gauge will record and display the measurement results during the acoustic contact of the transducer with the product, if the result is below or above the tolerance level, the device will "freeze" the last obtained thickness value and, with the help of color highlighting, will show which tolerance level was exceeded (Fig. 3.9)





Figure 3.9 – Exceeding the level of maximum thickness

In order to "defrost" the thickness gauge screen, you should press the button  the color selection should disappear, allowing you to take measurements again. If the device repeatedly registers an excess of tolerance levels, you can disable the tolerance mode and measure the thickness of the area of interest without the tolerance mode. To disable the tolerance mode, you should, while in the measurement window, hold down the key  for about 2-3 seconds.

3.2.9 Measurement of the thickness of products.

- Prepare the thickness gauge for operation in accordance with paragraph 3.1.
- Set the zero of the connected transducer in accordance with paragraph 3.2.2.
- If necessary, calibrate the transducer in accordance with paragraph 3.2.3.

Depending on the surface condition of the monitored product, the type of transducer connected and the measurement error to be provided, the surface preparation should be carried out as follows:

a) When controlled by transducers of products with a highly corrosion surface and paint residues, clean the surface of the product with mechanical brushes from rust, peeling scale, protective coatings, metal cladding and other coarse micro-irregularities of the surface;



b) if it is necessary to reduce the error from the influence of surface roughness and control of pipes with a diameter of less than 60 mm, additionally clean the surface with a grinding skin;

c) when inspecting products with a painted surface, clean the surface from the paint.


Apply a layer of contact grease to the surface of the monitored product at the transducer installation points.

After applying the contact lubricant, install the transducer with a contact surface





on the surface of the product, rub it well, achieve illumination of the mark  and stable readings, save the measurement result to memory with a long press of the button .

After removing the transducer, the measurement result will remain on the display. When removing the transducer from the surface, it is necessary to ensure that a thick layer of lubricant doesn't remain on the contact surface, which can lead to the appearance of false echoes and indications. To ensure the required measurement error, the zero transducers should be installed periodically in accordance with paragraph 3.2.2.

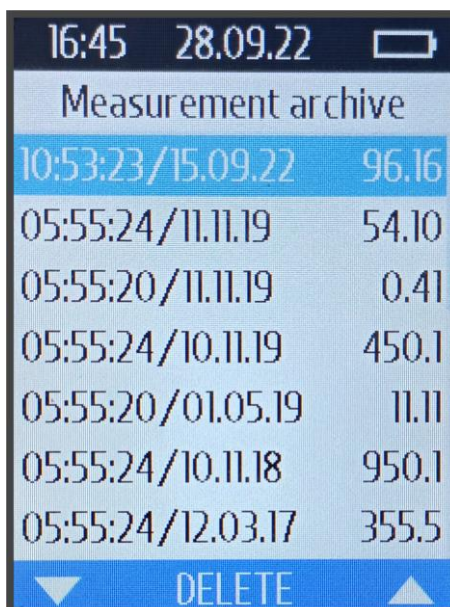
When controlling in the mode of fixing the minimum/maximum readings after selecting this mode in accordance with paragraph 3.2.8 and applying contact lubricant, install the transducer with a contact surface on the surface of the product, grind it well, achieve illumination of the mark  and, moving the transducer on the surface, record the readings. After the transducer is detached, the measurement result will remain on the display.

3.2.10 Recording the results in memory and viewing them.

The thickness gauge allows you to record in memory, save when the power is turned off and then view the measurement results with the ability to transfer to a computer.

To write the results to memory in the measurement window, you must hold down the button , wait for the label  to appear, release the button.



Saved measurement results can be viewed in the menu tab "Measurement Archive" (Fig. 3.10).




Measurement archive	
10:53:23/15.09.22	96.16
05:55:24/11.11.19	54.10
05:55:20/11.11.19	0.41
05:55:24/10.11.19	450.1
05:55:20/01.05.19	11.11
05:55:24/10.11.18	950.1
05:55:24/12.03.17	355.5

Figure 3.10 – Measurement Archive



In order to delete one or all records from the measurement archive, you should, being in the measurement archive, click the button , and in the window that appears (Fig. 3.11) select the desired action, press the button  again, and then confirm or cancel the operation.

3.2.11 Switching off the thickness gauge.

After completing the work, turn off the thickness gauge with a long press of the button .

3.2.12 Transmission of information about the device and its technical characteristics to a computer.

Utility tab "Link to PC". Connecting the device to a personal computer. When using the original software, it allows the specialists of the service center to quickly configure the device (Fig. 3.11).

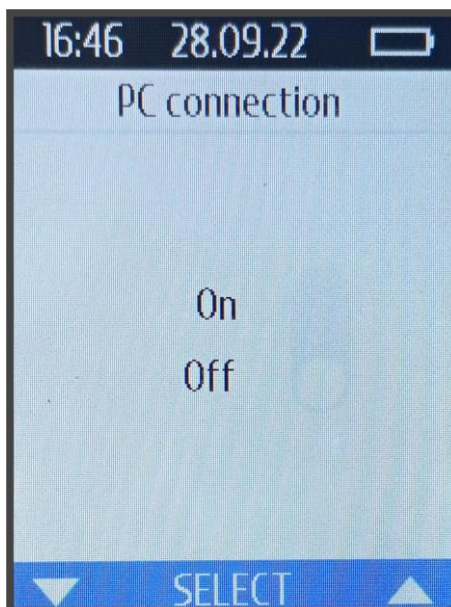



Figure 3.11 – View of the service tab "Connect to PC"

3.2.11 Setting the Date and Time.

For the convenience of saving and viewing measurements, the device has a date and time setting function. In order to set the date and time, in the "Date and Time" menu tab, set the desired date and time value and press the button . After that, the date and time will be displayed at the top of the instrument display (Fig. 3.12).

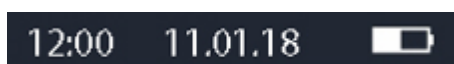


Figure 3.12 – Display of date and time on the display of the device



3.2.12 Sound when the instrument keys are pressed.

The device provides for turning on or off the sound when you press the keys of the device.

In order to turn on or off the sound, go to the menu tab "Sound" and select the desired value (Fig. 3.13)

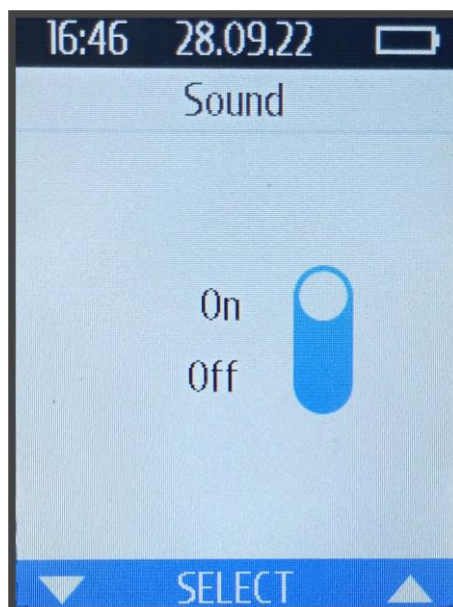


Figure 3.13 – Sound Menu Tab





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