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**CONTENT**

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1. Description and operation of the appliance and its components.....	4
1.1 The purpose of the device .....	4
1.2 The technical characteristics of the device .....	4
1.3 Completeness .....	6
1.4 Transducers types.....	6
1.5 Parts.....	6
1.6 Design and operation .....	8
1.7 Means of measurement, device and accessories .....	8
1.8 Labeling and sealing .....	8
1.9 Packagin .....	8
2. Intended use .....	9
2.1 Operational limitations.....	9
2.2 Preparing for use .....	9
2.2.1 Visual inspection.....	9
2.2.2 Installing the batteries .....	9
2.2.3 Connectiong the probe .....	9
2.3 Using the device.....	10
2.3.1 Turning-on .....	10
2.3.2 Operation in “MEASUREMENT” mode.....	11
2.3.3 Operation in the “SETTINGS” mode .....	12
2.3.4 Operation in "CALIBRATION" mode .....	13
2.3.5 Operation in “INFORMATION” mode .....	14
2.4 Making measurements .....	14
2.4.1 Preliminary calibration of the probe .....	14
2.4.2 Preparation of the object of control.....	15
2.4.3 Measurements .....	15
3. Safety precautions .....	15
4. Storage and transportation .....	15
5. Maintenance .....	15
6. Warranty.....	15



**Caution!**

Please read this instruction manual carefully before using the NOVOTEST UT-1M-IP ultrasonic thickness gauge.

The operating manual (hereinafter referred to as "OM") includes general information intended for acquaintance with information related to the operation and operation of equipment - the ultrasonic thickness gauge NOVOTEST UT-1M-IP (hereinafter referred to as the device or thickness gauge). The document contains specifications, description of construction and actions, as well as information necessary for the correct use of the products. Before use, it is necessary to study this document, as it is to be used by those familiar with the principles of operation and the design of the device. Correct and effective use of the control device requires mandatory availability:

- methods of control;
- conditions of control, incoming control methods;
- trained and studied user manual.

The manufacturer keeps the right to make minor changes that do not impair the technical characteristics of the product. These changes may not be mentioned in the text of this document. The set of delivery includes the complete operating documentation for the instrument and passports. Present MO is actual for all the modifications of the device.

## 1. DESCRIPTION AND OPERATION OF THE APPLIANCE AND ITS COMPONENTS

### 1.1 The purpose of the device

The device is designed to measure the thickness of objects in which ultrasonic vibrations propagate, with unilateral access to them.

Thickness gauge is used to control the thickness of products during their manufacture and operation in any industry.

### 1.2 The technical characteristics of the device

Ultrasonic thickness gauge NOVOTEST UT-1M (mod. UT-1M-IP) made in waterproof sealed housing with hermetically sealed connectors and rubberized anti-slip side surfaces.

The main characteristics of the device are mentioned in tab. 1.1.

Table 1.1 – The main characteristics

Measured thickness range (depending on the transducer), mm	from 0,8 to300
Setting range of ultrasound speed, m / s	1000 - 9999
Discreteness of counting on the digital indicator, mm	0,01
Velocity of ultrasound of standard sample of the device, m / s	6070 ±50
Frequency range of probes, MHz	1 – 15
Indication of programmable limits (low and high)	sound and visual
Measurement units	mm; inch
Languages	Russian, English, Spanish
Dimensions of the information processing unit, max, mm	122x65x23
Overall dimensions of the converter, no more than, mm	25x40
Powered by	3pcs AA 1,2 V batteries
Time of continuous operation, not less than, h	120
Weight of electronic unit with battery, less than, kg	0,4
Dimension of electronic unit, mm	148x90x26
Dimension of transducer, mm	25x40
Transducer weight, less than, kg	0,15
Body of electronic unit	waterproof sealed housing with hermetically sealed connectors and rubberized anti-slip side surfaces
IP (according to IEC 60529), not less	IP65
Operating temperature range of the information processing unit, ° C	from -20 to +40
Operating air humidity	up to 100 %

#### Parameters of the controlled products:

- surface roughness of the product -  $R_z \leq 20 \mu\text{m}$ ;
- minimum radius of curvature of the product surface - 10 mm.

#### Housing protection:

The degree of the device housing protection from penetration of solid bodies and water corresponds to national standard requirements.

Mean time between failures.

Mean time to failure of the device excluding the index of reliability inverters for at least 6000 hours.

Note: The mean time between failures of the transducers is normalized taking into account the roughness parameter of the surface of the controlled article  $R_z = 1.0 \mu\text{m}$ .

Life time

The total average life time of the device is not less than 10 years.

The criterion for decommissioning is the economic inexpediency of restoring the operative state of the component parts of the instrument by repairing.

### 1.3 Completeness

- Information processing unit ..... 1 pc.
- Transducers:
  - P112-10-6/2..... As per order
  - P112-5-10/2..... As per order
  - P112-2,5-12/2..... As per order
- Reference sample ..... 1 pc.
- Rechargeable battery ..... 2 pcs.
- Protective silicone bumper ..... 1 pc.
- USB Cable..... 1 pc.
- Charger ..... 1 pc.
- Packaging container ..... 1 pc.
- Operation manual NOVOTEST.UT-1M-IP.000 OM ..... 1 pc.

\* At the request of the customer, the delivery kit can be expanded with additional equipment or parts. The exact information on the delivery set is indicated in the passport of the device.

### 1.4 Transducers types

The dual element probes of the P112 series are designed for measuring the thickness of products made of structural metal alloys and isotropic nonmetallic materials with unilateral access to them. Metrological characteristics of the transducers are presented in Table. 1.2.

Table 1.2 - Metrological characteristics of converters

Transducer type	Measurements range	Measurement error
P112-10-6/2	0,8 – 30 mm	$\pm (0,01h + 0,05) \text{ mm}$
P 112-5-10/2	1 – 75 mm	$\pm (0,01h + 0,05) \text{ mm}$
P 112-2,5-12/2	2,5 – 300 mm	$\pm (0,01h + 0,05) \text{ mm}$
P 112-1,25-20/2	4 – 300 mm	$\pm (0,01h + 0,05) \text{ mm}$

where: h – nominal thickness, mm.

Additional time error for 2 hours of continuous operation is no more than the basic.

### 1.5 Parts

The design of the device includes an electronic unit and a probe, connected via sockets. The detachable sockets are located on the upper end surface of the housing; a generator is to be connected to the left socket, and the receiver is to be connected to the right socket. Also, at the top of the case a mini USB connector is, for connecting the device to the computer. The control buttons are located on the front panel, which also has a graphic indicator (display). At the bottom rear of the housing of the device is the lid of the battery housing compartment in which batteries are installed (Fig. 1.1).

In Fig. 1.2 presents the unit's controls, as well as their functionality.



1 - generator socket; 2 - receiver socket; 3 – connector for PC connection and charging; 4 - electronic block; 5 - display; 6 - keyboard; 7 – battery storage; 8 - reference sample; 9 - protective silicone bumper; 10 - transducer; 11 - generator plug; 12 - battery compartment; 13 - receiver plug; 14 - battery compartment cover.

Figure 1.1 - Ultrasonic thickness gauge NOVOTEST UT-1M-IP



Figure 1.2 - Keyboard Buttons and Their Functions

where:



– power key / Left soft-key;



– right soft-key;



– move up in the instrument menu / increase the input values;



– move down to the instrument menu / decrease input values;



– measurement mode selection;



– gain calibration.

## **1.6 Design and operation**

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The device uses piezoelectric sensors that, when fed with a short electric pulse, emit sound waves whose frequency is much higher than the upper limit of the range perceived by the human ear (that is – US). The frequency values of the signal emitted by the sensor can be 1 MHz ... 20 MHz. Oscillations of this frequency do not spread well in the air; therefore, to eliminate the air gap and ensure good contact between the sensor and the surface of the object being inspected, a paste / gel layer (glycerin, water, oil, special gels) is needed.

Ultrasonic signals generated by the generator enter the piezoelectric emitter. Further, they pass through the outer surface of the object, propagate in the body of the object and are reflected from its internal surface (that is, from the boundary of a significant difference in the "metal-medium" densities). The sensor of the receiver perceives the reflected ultrasonic signal, converts it into electrical signal and transmits it to the meter, in which the time interval is converted to a thickness measurement result. The calculated thickness of the product is displayed on the device gauge.

Various factors can influence the operation of the device. If there are inhomogeneity in the material of the investigated object, cavities, cracks, its surface is corroded (and others), the results can be distorted.

In addition, in order to obtain reliable results of thickness measurement, it is necessary to use the correct propagation velocity of US in this particular material. The actual speed of ultrasound in different materials is very different both from material to material and from the reference data. The best results can be obtained if the instrument is previously calibrated using an object of a known thickness (reference) made of the same material as the object under study. The standard should have a flat smooth surface and a thickness not less than the thickness of the object. It should be borne in mind that the speed of sound in the same material can be unstable. For example, heat treatment of a material can significantly change the sound propagation speed of that object. This should be taken into account when assessing the accuracy of measurements. To reduce errors, it is useful to check the calibration after measurements.

## **1.7 Means of measurement, device and accessories**

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To test the performance of the instrument, it is necessary to perform measurements on the integrated calibration element (reference sample). The inconsistency of the readings of the device should not exceed the permissible error (Table 1.2).

In the event of a malfunction, repair and adjustment of the device must be carried out by the manufacturer.

## **1.8 Labeling and sealing**

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The symbol of the unit with the trademark of the manufacturer is applied to the front panel.

The serial number is printed on the back panel, under the battery compartment cover of the instrument.

## **1.9 Packaging**

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The electronic unit and the probe are supplied in the packaging container, which excludes their damage during transportation.

To avoid mechanical damage to the cable and connectors of the device, it is necessary to disconnect the transducer from the device before packing.

## 2. INTENDED USE

### 2.1 Operational limitations

Operation of the device must be carried out under the influence of factors and taking into account the parameters of the monitored facilities in accordance with the specified technical characteristics, and the device must be used within its technical specifications.

Only the user familiar with the operational documentation for this device is allowed to work with the instrument.

To prevent the device from failing due to condensation, after moving the unit from cold to a warm place, leave it in the package for at least 2 hours.

### 2.2 Preparing for use

#### 2.2.1 Visual inspection

Inspect the device ensure that there is no mechanical damage to the information processing unit, transducer, cable plugs and sockets.

#### 2.2.2 Installing the batteries

Insert the batteries into the battery compartment by opening the battery cover lightly and pulling it down until the cover is completely detached. The batteries are to be installed according to the polarity indicated on the device. Close the battery cover until it clicks.

#### 2.2.3 Connecting the probe

Using the connecting cable, connect the desired probe to the sockets on the upper end surface of the housing. The generator must be connected to the left socket (marked with a red label); the transducer's receiver must be connected to the right socket.



Figure 2.1 - Connecting probe.



#### **Caution!**

To prevent damage to the connectors and cables, follow the instructions for using the connectors below!



The used in the instrument connectors (. Figure 2.2) consist of two parts: the socket and the plug.

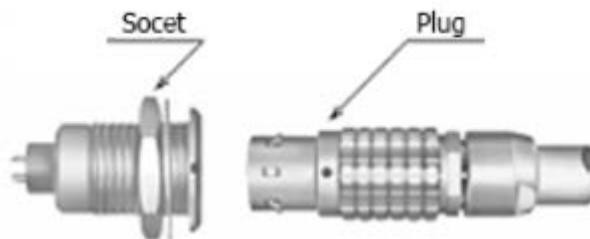


Figure 2.2 - Connectors used in the instrument

The method for connecting and disconnecting the plug and socket is shown on Fig. 2.3.



### Caution!

When disconnecting the plug from the socket, grasp its housing in a corrugated area and in no case should you pull the cable!

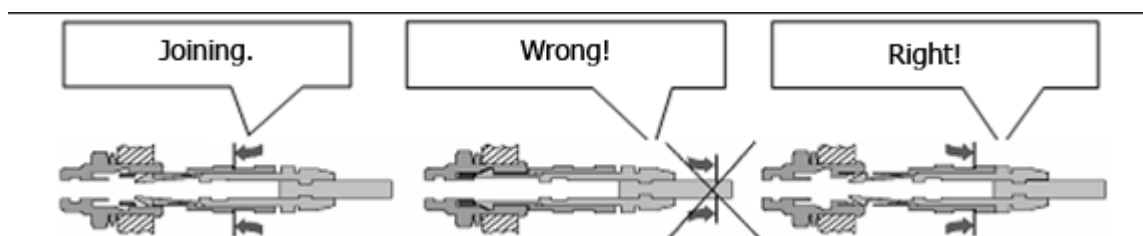


Figure 2.3 - Manipulating the LEMO connectors

## 2.3 Using the device

### 2.3.1 Switching-on



Switch the device on by a long press key «  » on the control panel until a short-time splash screen appears (Figure 2.4) on the graphic display.



Figure 2.4 – the splash screen

After this, the device switches to the main menu (fig. 2.5).

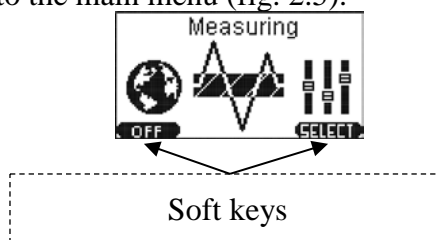





Figure 2.5 - The main menu of the device

### 2.3.2 Operation in the "MEASUREMENT" mode

To enter the "MEASUREMENTS" mode press the key «» or «» when you are in the main menu, select the desired mode and confirm your selection by pressing «», Then the device will go into the "MEASUREMENT" mode (fig. 2.6).

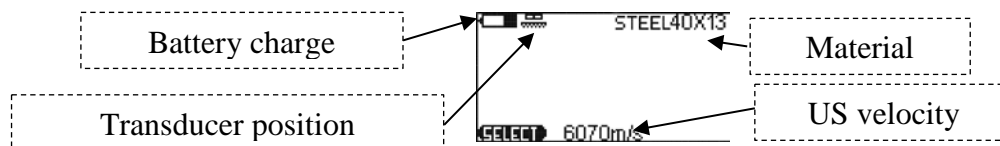






Figure 2.6 - "MEASUREMENT" mode

When the device is in the "MEASUREMENT" mode, the display shows the battery charge level, the transmitter position indication, the selected monitoring material, the established propagation velocity of the ultrasound in the control material, and the measured value.

The speed of the ultrasound in the control material is changed by means of the keys «» and «». Discreteness of speed setting 1 m / s.

By pressing the key «» The action selection menu is opened in which you can delete the current measured value "DELETE" Delete all measured values "DELETE". ALL ", go to the main menu" EXIT ", and also cancel the press and close the "CANCEL" selection menu.

#### 2.3.2.1 Measuring modes

The device operates in several measurement modes, to switch between modes, use keys «»», After it is pressed, the menu for selecting the mode of operation appears: "NORM", "STAT", "B SCAN" and "CALIBER".

The "NORM" mode is intended for carrying out the usual measurement without outputting additional statistics and information.

The "STAT" mode is intended for measuring with the output of additional statistics (figure 2.7) with the indication of the maximum and minimum measured values, as well as the number of measurements.

STEEL40X13	
CURRENT	6.05
Max Min	11.93 6.47
Average	9.20
Num.	2
6070m/s SAVE	

Figure 2.7 - Measurement mode with additional statistics output

The "B SCAN" mode is used to display the B-Scanned profile of the thickness of the controlled article (Fig. 2.8). Also, the "B SCAN" mode is used to search for corrosion damage, identify local abrasions and delaminations when checking control objects with a graphic B-scan.



Figure 2.8 - Measurement mode with the B-Scan output

The "CALIBER" mode is intended for the pre-measurement calibration of the converter (zero-setting of the converter) before the start of the measurement, in order to exclude the influence of the transit time of ultrasonic oscillations in the delay lines.





Also in the device there is a mode of calibration of amplification of a signal by the receiver, for transition in this mode it is necessary to press a key «  », After that, the speed of the ultrasound in the material changes to the gain adjustment in dB (Figure 2.9). To change the gain use the keys «  » и «  ». Для выхода с режима калибровки усиления нужно повторно нажать клавишу «  ».



Figure 2.9 - Gain calibration mode

### 2.3.3 Working in the "Settings" mode

When the "SETTINGS" menu item is selected, the device enters the setting mode of the following parameters (Figure 2.10):

- "LANGUAGE": selection of the menu language of the device (available in English, Russian, etc);
- "BRIGHTNESS": change the brightness of the display (from 0 to 100%, the resolution is 10%);
- "AUTO OFF": Set the device to automatically turn off when not in use (off, 1, 5, 10, 30 minutes);
- "RETRO": allows you to return to the measurement mode with the last measurements saved after the device is rebooted;
- "SCALE": select the units of measurement (mm or inch (inches));
- "MATERIAL": selection of the material of the object to be monitored (User; Steel 40X13; Steel St3; Steel X15N15GS; Steel XN35VT; Steel XN70BMTY; Steel 40HNMA; Steel XN77UYUR; Steel 20GNDM; Bronze; Iron; Tungsten; Aluminum; D16T; Aluminum; Silver; Gold; Lead, Tin, Nickel, Molybdenum, Copper, Manganese, Magnesium, Brass LS-51-1, Brass, Capron, Caprolon, ED-5, Ebonite, Cast Iron, Zinc, Chrome, Porcelain, Teflon, Textolite, Silicate glass; Org Glass, Rubber, Polystyrene, Plexiglas);
- "REFERENCE": thickness of the reference sample (mm);
- "SPEED REF": speed of propagation of ultrasound in the reference sample (m / s);
- "TOP": upper measuring range (mm);
- "TOP": upper measuring range (mm).

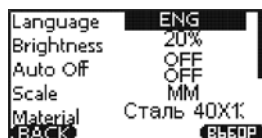









Figure 2.10 - "SETTINGS" mode

To make changes in the "SETTINGS" mode, you need to select the required parameter with the keys «  » and «  », then confirm by pressing «  » and change the setting to the desired

value using keys «» and «», then confirm by pressing «». To exit the settings and save the changes, press key «».

### 2.3.4 Working in the "CALIBRATION" mode

When the menu item "CALIBRATION" is selected, the instrument switches to the calibration mode (Figure 2.11).

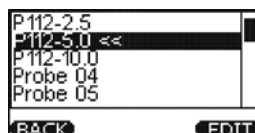






Figure 2.11 - CALIBRATION mode

This mode is used to select the saved calibration settings for the connected probe, as well as for creating new calibrations, by editing the stored settings "PROBE".





#### 2.3.4.1 Selecting the inverter calibration

To select a calibration, you must:

1. Using keys «» and «» select the calibration for the inverter to be used.
2. By pressing the key «» open the action menu with the calibrations, highlight the item "SELECT" and confirm with the key «».

#### 2.3.4.2 Creating a new inverter calibration

To create a new calibration, you need to:

1. Using keys «» and «» select a saved calibration with the name "PROBE" for editing.
2. Using key «» open the action menu with the calibrations, highlight the item "EDIT" and confirm with the key «». The instrument will go into the calibration editing mode (Figure 2.12).
- 3.

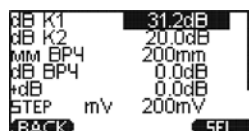

















Figure 2.12 - Calibration editing mode

4. Specify the parameters of the converter. Select a parameter with the keys «» and «», then confirm by pressing key «» and change the setting to the desired value using the «» and «» keys, confirm with the key «».

5. Exit from the calibration editing mode by pressing the key «  ».
6. Rename the changed calibration by pressing the key «  » open the action menu with the calibrations, highlight the "MOVE" item and confirm with the key «  ».
7. Enter a new calibration name. Moving the cursor on the virtual keyboard is done using the keys «  » and «  », and confirm with key «  ». To save a new name, you need to move the cursor to the "SAVE" button and press the enter key «  ».

### 2.3.5 Work in "INFORMATION" mode

In this mode, you can find data about the manufacturer. Also in the "INFORMATION" mode, you can see the information about the device and the number of measurements. For this, using keys «  » and «  » find the needed page.






## 2.4 Making measurements

Before using the device for measurements, make sure that the battery has a sufficient level of charge; the level of charge is indicated on the graphical display in the form of a battery (the indicator). A completely dark indicator indicates that the battery is 100% charged. One line inside the indicator field corresponds to approximately 20% of the charge volume.

If there is no or insufficient charge, recharge the battery using charger.

### 2.4.1 Preliminary calibration of the probe

To exclude the influence of the transit time of ultrasonic oscillations in the delay lines on the result of measuring the thickness of the product, it is necessary to calibrate the connected transducer before making measurements, for which purpose:

1. In the "MEASUREMENT" mode, press the key «  » And select the "CALIBER" mode.
2. Set using the keys «  » and «  » The propagation velocity of the US, corresponding to the reference measure on the device (6070 m/s).
3. Clean the contact surface of the inverter from grease, if any.
4. Put the transducer into the air, according to the instruction, on the display of the device "PULL IN AIR", then confirm the action by pressing the key «  ». The instrument will take a measure and display a new instruction.
5. Apply a layer of contact lubricant on the built-in reference thickness sample block.
6. Install the transducer's contact surface on the reference measure and press firmly, according to the instructions, on the displays of the device "INSTALL ON THE SAMPLE", then confirm the action by pressing the key «  ». The instrument will measure and after the display of the results go into the normal measurement mode.



#### Caution!

Preliminary calibration of the transducer should be carried out only on the sample (measure) built-in the thickness gauge.

The operation of preliminary calibration of the transducer is desirable to be carried out in the event of changes in operating conditions (a significant change in the ambient temperature), when the converter is first turned on, after a prolonged intensive operation of the converter.

## 2.4.2 Preparation of the object of control

*Note: The accuracy of the measurement depends strongly on the state of contact between the transducer and the product surface.*

If the surface of the product being tested is strongly roughened, corroded or covered with a large layer of rust, it may be necessary to clean the surface with a file, a rasp, a grinding paper, etc..

It is especially necessary to prepare the surface when measuring on pipes with a diameter of less than 40 mm.

The paint does not need to be removed if its layer is thin and it is well adhered to the material that is being measured. However, it should be borne in mind that the thickness of the paint will go into the resulting measurement result.

## 2.4.3 Measurements

To make measurements:




1. Set the speed of propagation of ultrasound in the object of control. To do this, go to the "SETUP" mode and select the material of the monitoring object in the "MATERIAL" parameter. If the required material is not in the base of the device, you need to select the material "USER".
2. Go to the "MEASUREMENTS" mode and with the keys «» and «» Correct the speed of ultrasound, if necessary, for example, when selecting the material "USER".
3. Apply a contact lubricant layer on the controlled object surface.
4. Install the transducer on the product normally to the surface and press it down, avoiding rocking (Figure 2.14).
5. Obtain stable results of the measured thickness on the display.
- 6.



Figure 2.14 - Measurement

7. To turn off the device, press and hold the button «».

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### 3. SAFETY PRECAUTIONS

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- 3.1. Operation thickness gauge is permitted only after reading the manual.
- 3.2. Of minor faults of the device is allowed after it is turned off, repairs are carried out exclusively by the manufacture.

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### 4. STORAGE AND TRANSPORTATION

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- 4.1. The device should be stored at ambient temperature from +5 to +40 °C and relative humidity up to 80% at 25 °C.
- 4.2. The storage should be free of dust, fumes acids, alkalis and corrosive gases.
- 4.3. Transportation of the device in case may be made by any mode of transport in accordance with the requirements and rules of transportation operating in these types of transport.
- 4.4. During transportation, handling and storage of stock the device should be kept from shock, bumps and moisture.

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### 5. MAINTENANCE

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- 5.1. Maintenance of the device is made by the manufacturer in the event of faults in the device operation.

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### 6. WARRANTY

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- 6.1. The manufacturer guarantees the normal operation of the unit for 12 months from date of purchase, and undertakes to make repair it during this time when a breakage, and failures.
- 6.2. Warranty does not apply to breaches of operation, transportation and storage conditions and the presence of mechanical damage to the electronic unit and transducer.
- 6.3. Warranty does not cover cables and batteries.

Date of manufacture

\_\_\_\_\_ Signature

Sale date

\_\_\_\_\_ Signature

Notes:

The manufacturer reserves the right to make without notice in the design of ultrasonic thickness change does not impair its performance and metrological characteristics.