NOVOTEST

ULTRASONIC TESTER OF BUILDING MATERIALS STRENGTH NOVOTEST IPSM-U

Operating Manual

2015

CONTENTS

1. Introduction

The following operation manual explains the preparation, setup, principles of operation, usage and troubleshooting of the Ultrasonic Tester NOVOTEST IPSM-U.

Please, read this instructions carefully for operate the Ultrasonic Tester NOVOTEST IPSM-U functions quickly and effectively.

In doing this you will be able to take full advantage of the function range of the instrument. At the same time, you will also avoid errors and wrong operation which in turn would cause incorrect test results and thus could lead to injury and damage.

2. Appointment

2.1. Ultrasonic Tester NOVOTEST IPSM-U is designed to assess the properties of solid materials and inspection time and velocity of spreading and the shape of the received ultrasonic oscillations at the surface and through-sounding.

2.2. The device allows detecting defects, determining strength, density and modulus of construction materials, as well as audio index abrasives on preset calibration curve parameter data of the velocity of ultra-sound waves.

2.3. Main areas of application:
- determination of concrete strength according to GOST 17624-87;
- identifying defects in the concrete structures under anomalous reduction velocity and form of displayed signals of ultrasonic waves;
- determination of the depth of cracks;
- determination of porosity and fracture anisotropy composite materials and rocks;
- determination of modulus of elasticity and density of the materials.

2.4. The device produced with a basic configuration, focused on heavy concrete middle marks. For other marks and materials required calibration and adjustment in accordance with GOST 17624, GOST 24332 and methodological recommendations MDS 62-2.01 control the strength of concrete monolithic structures by ultrasonic method of surface sounding.

2.5. The device provides a visualization of the received ultrasonic waves (A signal), has a mode of the oscilloscope for viewing and analyzing the signals A.

2.6 The device provides operation:
- at the surface sounding with the surface sounding probe on the fixed base (120 ± 1) mm with a dry contact;
- at the through-sounding with ultrasonic probes at random basis with contact lubricant or surface and angular sounding with dry contact (protectors, conical nozzle) or with a lubricant on an random basis.

2.7. Operating conditions: temperature range: from -20 ° C to 50 ° C, relative humidity up to 80% non-condensing humidity, atmospheric pressure 86 ... 106 kPa.

3. Specifications

Measuring range of ultrasonic pulse spreading time, μs	10…999,9
Measurement resolution of time of ultrasonic pulses, μs	0,01
The limits of permissible basic error spreading time of ultrasonic pulses, μs	±(0,01t + 0,1), where t – measurement time

The limit of additional measurement error spreading time of the ultrasonic pulses in the deviation of the operating temperature of the environment at every 10 °C within the operating range, portion of the basic error of not more than	0,5
Fixed measurement base at surface sounding, mm	120 ±3
The absolute sensitivity of the instrument, dB, not less	110
Limits of the changing of the intensification dB (1 dB step)	12 - 96
Limit of the period of probing pulses Hz	1
The operating frequency of the ultrasonic pulse kHz	60 and 100
Overall dimensions: - electronic control unit - through-sounding probe - surface sounding probe	 65x120x20 Ø30x70 200x100x55
Electronic control unit weight, kg, not more than	0,15
Probe weight kg, not more than	0,20

3.2. The device is powered by two NiMH rechargeable batteries or other AA batteries with a nominal voltage of 1.5 V.

3.3. Time of continuous operation from a newly charged battery, at least 10 hours.

4. Packing list

4.1. Electronic control unit - 1pc.

4.2. Probes:

Surface sounding probe		
Through-sounding probe		

4.3. Battery charger - 1 pc.

4.4. Recharge batteries AA type - 2 pc.

4.5. Case - 1 pc.

4.6. Manual - 1 pc.

4.7. Plexiglas testing sample - 1 pc.

4.7. Additional equipment:

5. Labeling and packaging

On the front panel of the unit there is the symbol of the instrument with the trademark of the manufacturer. On the back panel, under the battery cover there is device's serial number.

Information processing unit and probes are stored in a case that would prevent them being damaged during transport.

6. Principle of operation

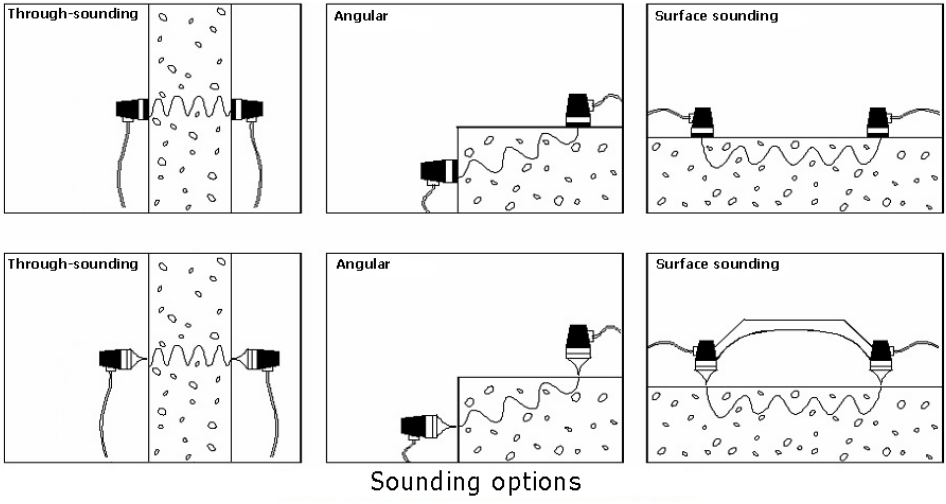
6.1. Operation options

6.1.1. The device operation is based on the measurement of the ultrasonic pulse in the material product from the transmitter to the receiver. Ultrasonic velocity is calculated by dividing the distance between transmitter and receiver measured at the time.

6.1.2. The spreading velocity of the ultrasonic waves in the material depends on its density and elasticity, the presence of defects (cracks and voids), which determine the strength and quality. Consequently, sounding elements of products, designs and constructions can obtain information on:

- strength and uniformity;
- modulus of elasticity and density;
- the presence of defects and their location;
- form of A signal.

6.1.3. There are options are sounding with the lubricated and dry contact (protectors, conical nozzle).



Sounding options

6.1.4. The device visualizing received ultrasonic waves (with flaw detection mode), has built-in digital filters, improving the ratio of "signal to noise ratio." Flaw detection mode allows you to view the signals on the display (in the given time scale and intensification), manually set the cursor to the position of the reference mark for the first entry. The user can manually change the intensification measurement channel and shift the axis of time for review and analysis A signals (signals of the first entry and the enveloping).

6.2. Display

6.2.1. After switch on the screen appears:

6.2.2. After that, the unit automatically enter to the main mode of.

6.2.3. Other modes of operation are described in the relevant sections of this manual.

6.3. Keyboard

6.3.1. The keyboard of the device:

6.3.2. The buttons:


– on / off the device, left soft key;


– right soft key;

– mode button;

– parameter selection button;


– move up in the menu, increase of input values;


– move down in the menu, reduction of input values.

7. Device Menu

7.1. After switching on, the device enter to the mode that was before.

7.2. The presence of modes depends on the modification

7.2.1. IPSM-U – the simplest modification to measure the strength of building materials:

7.2.1.1. Measurement strength;

7.2.1.2. Measurement density;

7.2.1.3. Measurement elastic modulus;

7.2.1.4. Measurement of the sound index.

7.2.2. IPSM-U+T – additionally allows to test homogeneity, measure depth of cracks. All modes are listed before: 7.2.1.1, 7.2.1.2, 7.2.1.3, 7.2.1.4, plus

7.2.2.1. Crack depth measurement mode (Russian method).
7.2.2.2. Crack depth measurement mode (English method).

7.2.3. IPSM-U+T+D – flaw detector. All modes are listed before: 7.2.1.1, 7.2.1.2, 7.2.1.3, 7.2.1.4, 7.2.2.1 and p.7.2.2.2 plus
7.2.3.1. Flaw detector mode

7.3. Select modes of the device by pressing 

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7.4. By pressing  right soft key takes you to the menu of the device, which contains the following items:

- Coefficients
- Calibration
- Threshold
- Backlight
- Power
- Memory
- Information
- Switch off

7.4.1. Coefficients
The item is used to set the individual calibration coefficients. For each given material composition and each of the measured parameters, strength, density, modulus of elasticity, the sound index. User can independently carry out calibration on test samples of concrete and enter the calibration coefficients for the dependence of the "velocity of ultrasound - the measured value."

7.4.1.1. "The velocity of ultrasound - strength"
You need to set the coefficients that relate strength with velocity of ultrasound. This is third degree polynomial (Eq. 1), and it has the form:

$$R=A_0+A_1V+A_2V^2+A_3V^3 \quad (1);$$

where,
R - strength (required in MPa);
V - the numerical value of the velocity of ultrasound;
Ai - coefficients (i = 0,1,2,3), are entered into the device in exponential form MPa (e.g., if Ai = 256, it must be written as Ai = +2,56 E +2, which corresponds to Ai = +2 56 * 102.)

Attention! The conversion coefficients for the calculation of the strength must be entered only with MPa dimension.

7.4.1.2. "The velocity of ultrasound - density"
You need to set the coefficients that relate density with ultrasound velocity. This is a second degree polynomial, and it has the form (Eq. 2):

$$\rho=B_0+B_1V+B_2V^2 \quad (2);$$

where,
ρ – density, g/cm3 t/m3;
V – the numerical value of the velocity of ultrasound;
B_i – coefficients (i = 0,1,2), written in exponential form (Bi = 256 should be written as Bi = +2,56 E +2, which corresponds Bi = 2,56 · 10 2).

7.4.1.3. « The velocity of ultrasound – elastic modulus»
You need to set the coefficients relating the rate of ultrasound velocity with an elastic modulus (Eq. 3):

$$E = \frac{\gamma * V}{9{,}81 * \varphi} * 10^5 \quad (3);$$

where,
E – elastic modulus, GPa;
V – the numerical value of the velocity of ultrasound;
G – volumetric weight, t/m;
F – coefficient.

7.4.1.4. "The velocity of ultrasound - sound index"
You need to set the coefficients relating the rate of ultrasound velocity with sound index (Eq. 4):

$$SI = K * V/100 \quad (4);$$

where,
SI – sound index;
V – the numerical value of the velocity of ultrasound;
K – dimensionless coefficient (the ability to set the value from 1.0 to 1.2).

7.4.2. Calibration
The item "Calibration" is used to verify that the device operate correctly and hardware delay compensation in the measuring channel of the device. Calibration is performed on a control sample.

To enter in calibration press «SELECT»  , place the probe on the control sample, and press the up or down keys for setting conformity display value time with the time specified on the control sample.

7.4.3. Threshold
This menu item is required to set the trigger level of the comparator. With the factory settings threshold comparator device is set to the first entry and the half-wave is _____ μs.

Do not change this setting without necessary.

If you change the parameter, return it to the factory settings, or achieve the minimum velocity of ultrasonic waves on the selected base.

7.4.4. Backlight
On and off the backlight.

7.4.5. Power
Turning on the power for remote control (a special version of the device).

7.4.6. Memory
Operation with memory of the device.

7.4.7. Information
Information about the manufacturer, the device version and serial number.

8. **Operation**

8.1. Preparation for use.

8.1.1. Connection of the probe.

Connect the receiver and the transmitter to the connectors on the top of the electronic processing unit.

Attention! To prevent instrument failure and loss guarantee, connection to the instrument cables of the probe must be doing with the power off device, preventing accidental circuit of the output device on one of its input connectors.

8.2. Battery operation

8.2.1. Install the battery into the battery compartment, observing the proper polarity.

8.2.2. To control the battery charge, turn on the device by long pressing the button  .

8.2.3. Battery level is shown on the top left of the display electronics unit symbol "battery." Completely dark square inside the symbol indicates a full charge the battery. The battery squares disappear sequentially, from left to right. One dark square or squares absence means need to recharge the battery. The "battery" is on display in any mode of the device.

8.2.4. To charge the battery, turn off the device by long pressing the button  , and then remove the battery from the battery compartment and make its charge in accordance with p. 8.2.5.

8.2.5. Charging the battery

To charge the battery:

- connect the battery to the charger contacts;
- turn the charger in socket.

Time of full charge the battery - 14 hours. Do not leave the charger unattended while charging. To avoid failure of the battery during storage battery recharging is necessary to carry out with time interval at least 2 months, even if it is not used.

8.3. Switching on and off of the device.
8.3.1. Prepare the device in accordance with p. 8.1, and turn it on by long pressing the button  .
After pressing the button the device will switch on. After turning on the device goes to the main mode and the it is ready for measurement.
8.3.2. Long press the button turns off the device.

8.4. Operating modes.
The device has the following modes:
- Strength measurement mode;
- Density measurement mode;
- Modulus of elasticity measurement mode;
- Sound Index measurement mode;
- The mode of measuring the depth of the crack (Russian method), the version of the device IMSP- U + T;
- The mode of measuring the depth of the crack (English method), version of the device IMSP- U + T;
- Flaw detector mode, device version IMSP- U + T + D.

Switching modes of the device with button 

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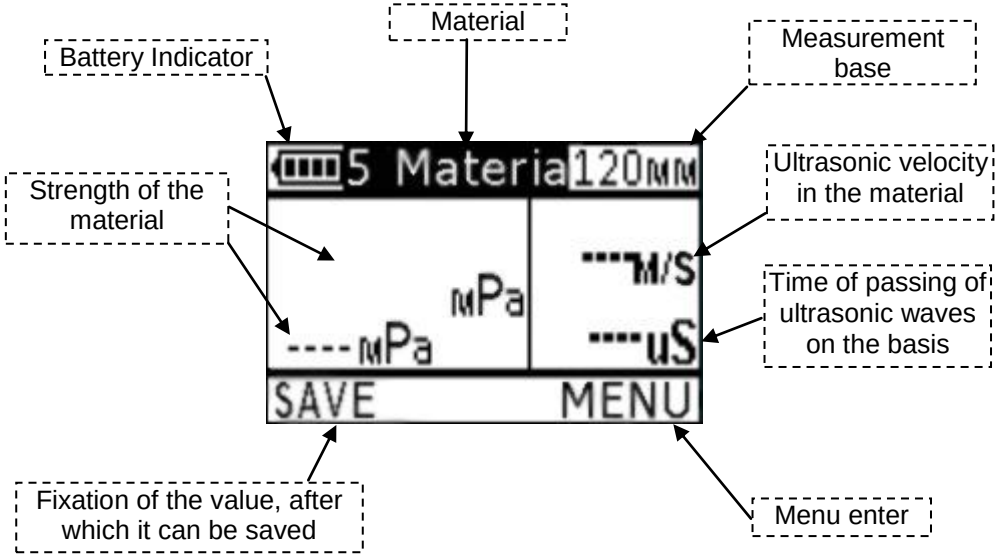
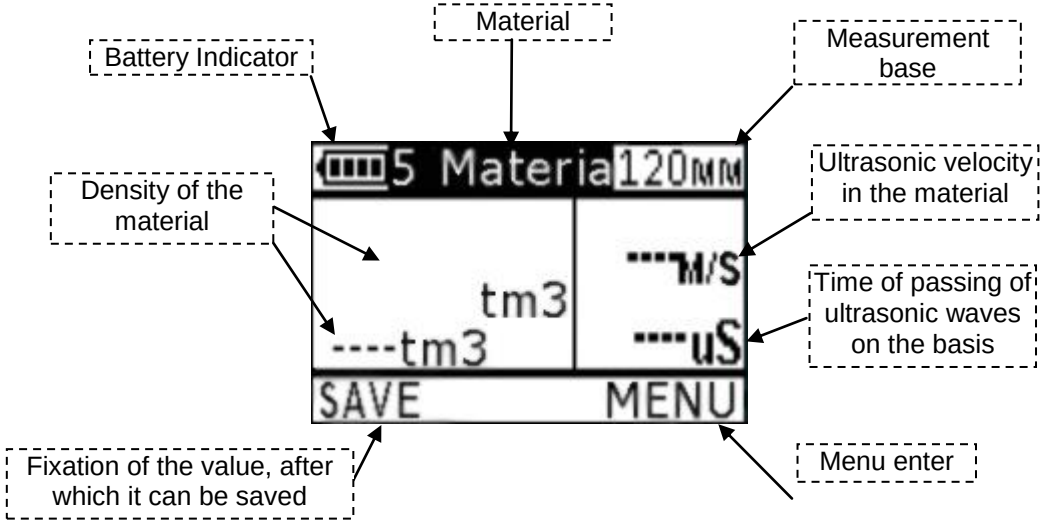
8.4.1. Strength measurement mode.
Strength measurement mode has the form:

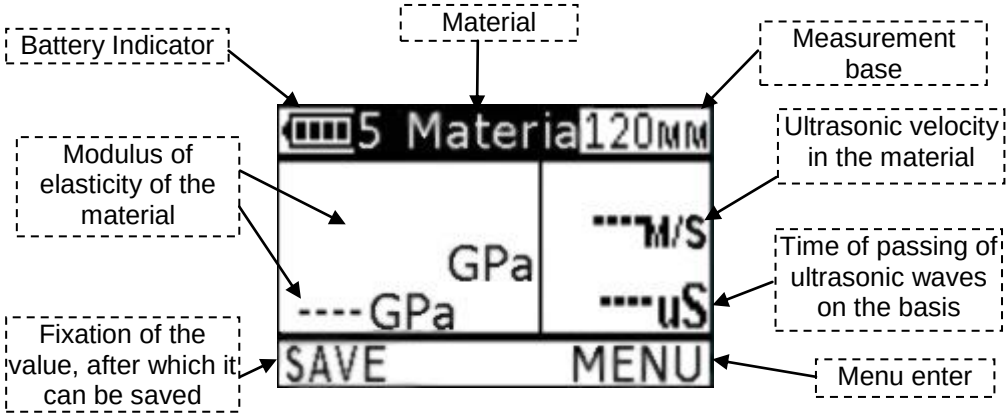


8.4.2. Density measurement mode.

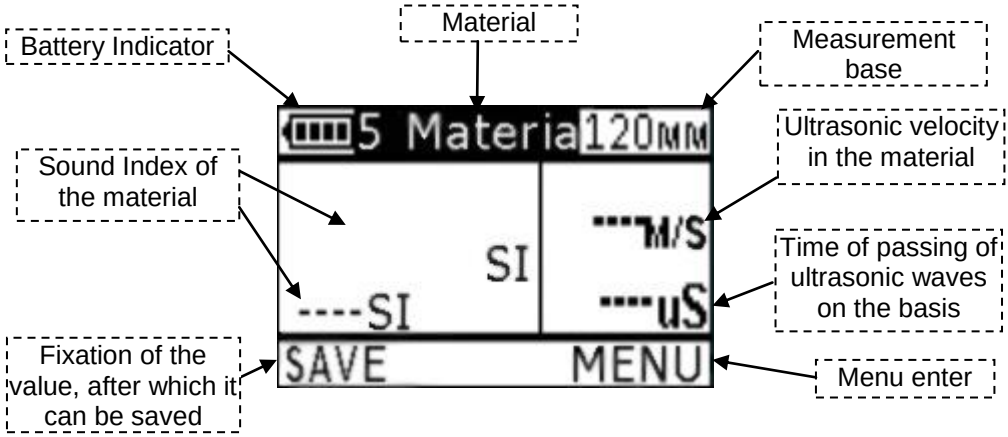
Density measurement mode has the form:



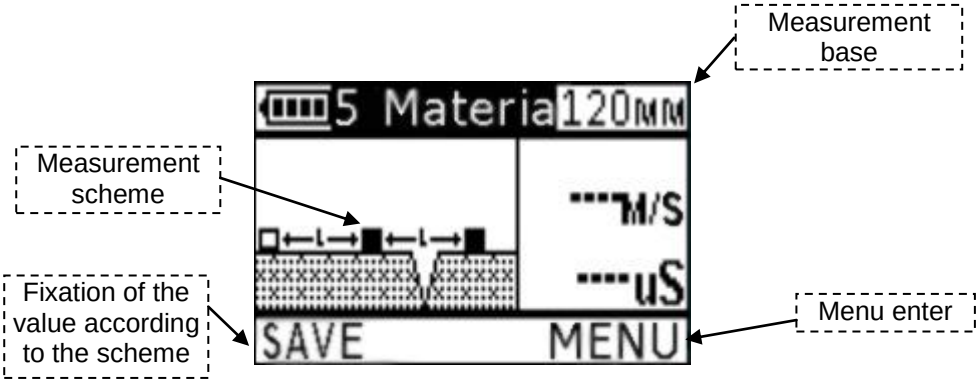
8.4.3. Modulus of elasticity measurement mode.
Modulus of elasticity measurement mode has the form:



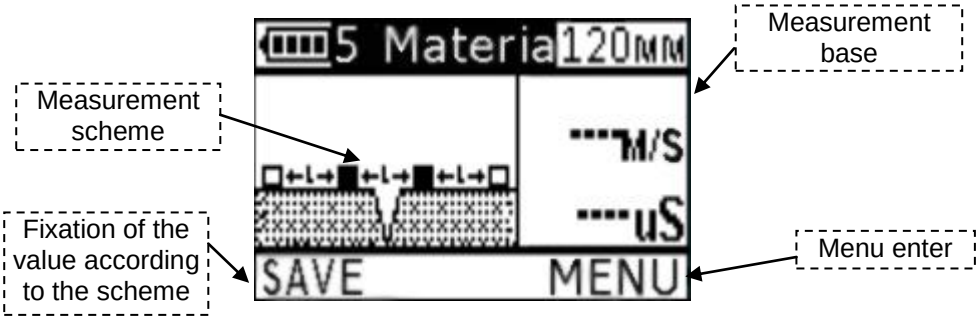
8.4.4. Sound Index measurement mode.
Sound Index measurement mode has the form:



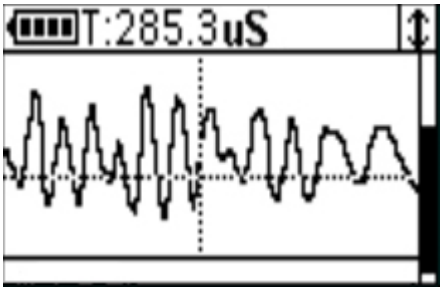
8.4.5. The mode of measuring the depth of the crack (Russian method) has the form:



8.4.6. The mode of measuring the depth of the crack (English method) has the form:



8.4.7. Flaw detector mode



8.4.7.1. At the top right of the screen displays the parameter to change:

 - intensification;

 - delay of the scanning;

 - duration of the scanning;

 - marker movement along the X axis;

 - marker movement along the Y axis (changes in the level of the comparator response, the parameter "threshold" п.7.4.3).

8.4.7.2. To select parameter of flaw detector press the button 

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8.5. Changing of the material and the measurement base.
The selected material and measurement base are displayed at the top of the screen. Choosing a variable parameter (material or base)

by pressing 

. The selected option becomes inverted. Change the parameter by pressing the  or  .

8.6. Measurements.

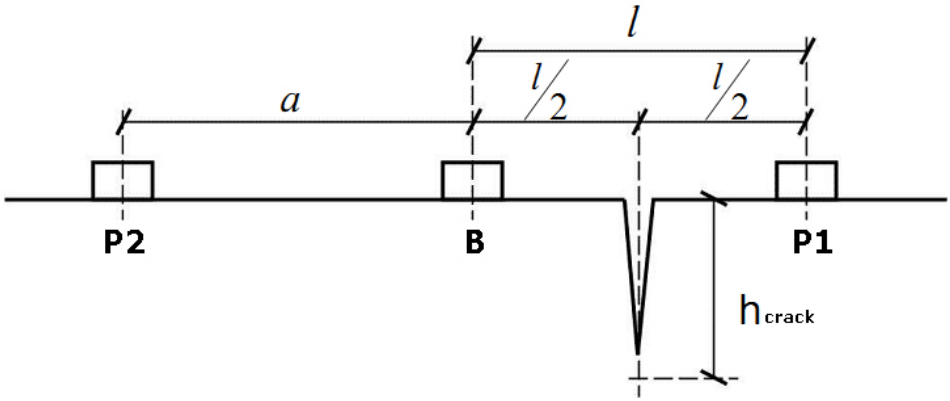
8.6.1 Surface sounding.
Surface sounding performed with the surface sounding probes on holder with the fixed base (120 ± 1) mm. Install the probe on the surface of the test object with cone nozzles, to hold fixed in the plane perpendicular to the surface and press with a load of 5 - 10 kg. Controlling on the display the measured time T to ensure its stability and the deviation of the time on the 0.1 ... 0.2 μs from the displayed value, press the function button "SAVE"  , fixing the measured parameter. To continue the series of measurements on other areas of the object, need to fix each measurement of the series by pressing the button "SAVE"  .

8.6.2. Through-sounding.
The through-sounding with additional ultrasonic probes for through-sounding on the random bases with the contact lubricante or with dry contact (protectors, conical nozzle).
For each particular through-sounding method (contact grease, protectors, cone nozzles) it is necessary to calibrate the device on the control sample, in accordance with p.7.4.2.
Use a ruler to measure the thickness of the test object at the planned area of measurement, and enter it in accordance with p.8.5.

up to 1 mm. Install sensors coaxially along the line sounding on opposite sides of the test object, press lapping to the surface.
Controlling on the display the measured time T to ensure its stability and the deviation of the time on the 0.1 ... 0.2 μs from the displayed value, press the function button "SAVE"  , fixing the measured parameter. For the next measurement remove probes from the object and similarly make the measurement on the next area. At the end of the measurements - the average value of the measured parameter will shown on the display.

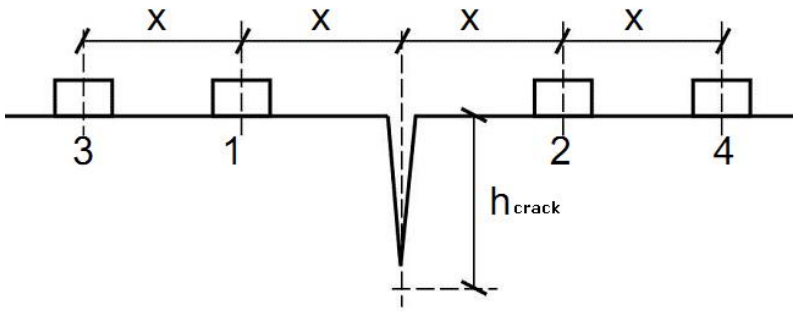
8.6.3. Measuring the depth of the crack.
The display shows the schematic of the probes for this mode. For the measurement install the probes as shown in the picture below and get first measurement. Then press the function button "SAVE"  , (for fixing the first stage of measurement), move the probe according the new scheme, and get the second measurement. After next pressing the function key "SAVE"  , display shows the calculated value of the crack depth.

According to the procedure adopted in Russia probes installed according to the following scheme:



where,
l – measurement base through a crack in the concrete (the position of the probes B-P1), the crack is located exactly in the middle, and the time of spreading waves – t_1;
a – measurement base on "clean" concrete - without defects (the position of the probes B-P2), provided always a = l, and the time of spreading waves – t_a.

According to the procedure adopted in the United Kingdom (standard BS 1881 p.203) is used difference scheme of installation the probes:



First, probes are installed on the 1-2 point scheme (crack is in the middle, ie l = 2x), and the time t_1, then the probes are installed at the point of 3-4 (crack - in the middle l = 4x), time is measured t_2 and when you press the function key "SAVE"  the depth of the crack calculates automatically.

8.5.4. If after the change of area on the tested object speeds significantly different from each other, it is necessary to verify the compliance of the installation base of measurement and quality of acoustic coupling of the "probe-object", defects in the concrete and reinforcement effect.

9. Technical maintenance, special conditions of operation

9.1 On the whole, Ultrasonic Tester of Building Materials Strength do not require any special maintenance. However, for the purpose of device stable operation, regular maintenance is advisable.

9.2. Probe maintenance

Clean probes from dust, mud and oil traces. Use soft cloth impregnated with alcohol solution.

9.3. Information processing unit maintenance

To clean from any pollution, use soft dry cloth. Do not use the water, since the device is neither spray-proof nor water-proof due to the joints on its body.

Do not use any solvents, they can damage indication signs and writings on the front and back sides of the body.

9.4. Battery maintenance

The battery average life is not less than 3 years. The battery used in compliance with the "C" or "AA" international standard. It is done for

the convenience of it s replacement when it is required or sharp reduction of the continuous operation time independently of the country. Replacement is possible only by the battery with similar characteristics in compliance with the marking on it. From environmental protection point of view, the best thing is to use the battery.

9.5. Storage
9.5.1. Device shall be kept in the carry case, the probe and the batterys shall be disconnected.
9.5.2. If device is kept in the carry case for than 14 days, the battery shall be taken out from its compartment in the information processing unit.
9.5.3. It is recommended to keep device in closed premises with the relative humidity not more than 80%, there shall be no mold, paints, acids, chemical agents and other chemicals, the evaporation of which my give a harmful effect. Sharp fluctuations of temperature and humidity which can result in dew formation are not allowed.

9.6. Transportation
9.6.1. Device transportation in the carry case shall be only in closed vehicles, where the possibility of mechanical damage or atmospheric precipitation is excluded.
9.6.2. The way packed in carry cases devices are located inside the vehicle shall exclude.

9.7. Putting into operation after storage and transportation.
After storage or transportation under the temperature lower than -5°C, before starting device operation, it is necessary to keep it not longer than 1 hour under the temperature higher than +10°C and not less than 2 hours under the temperature higher than 0°C.

9.8. Special operation conditions
9.8.1. Increased dust content and humidity. Put the information processing unit of device into a transparent plastic bag. Tighten it at the level of connective cable a bit lower than the probe plug.
After the work under such conditions is finished, information processing unit shall taken out of the plastic bag and air it.
9.8.2. Frost (<0°C). Information processing unit is the most sensitive to low temperature part of the device, especially LCD. If there is a possibility, keep the device closer to your body and protect it with your coat or keep in the inside pocket, taking it out time from time for inputting the data into the archive.

10. Precautions and trouble shouting

10.1. Treat the device with care. Any wrong treatment may result in the violation of the present Technical Reference and Operation Manual regulations and, thus, lead to the manufacturer device warranty cessation.
10.2. Always check the integrity of the cables, Information processing unit and probes. Provide immediate replacement of the damaged parts by the original ones. This job shall be performed by skilled personnel.
10.3. Do not expose the device to aggressive chemical medium.
10.4. Do not leave the device in the direct Sun.
10.5. Do not sink the device into any liquids. If the device gets wet, take the battery out and leave for 24 hours to get dry. If the device is used under the increased humidity or dust conditions, place the information processing unit into the plastic bag. After work period is over, it is mandatory to get the device dry.

11. Manufacturer's guarantee and service maintenance

11.1. In case when device (information processing unit and probes), supplied by the Seller within one year since the delivery date used properly, appear defective, the Seller shall repair or replace them or supply new parts therefore and send them to the Buyer. The other parts of the device (battery, charger, bag) warranty does not cover. The Buyer must prepay any shipping charges, taxes, or duties associated with transportation of the product to the service location, and Seller pays return shipping and associated costs. In addition, the Buyer shall be responsible for insuring any product shipped or returned to an authorized service location, and the Buyer shall bear risk of loss during shipping to the service location, and Seller all risks during delivery to the Buyer. In order to exercise its rights the Buyer shall inform the Seller as soon as possible after the date when such defect appeared.

11.2. Prepare technically grounded reclamation document and send it together with the device to the guarantee service or to the manufacturer at the address: Scientific and Technical Centre "Industrial devices and technologies " Ltd., 51200. Ukraine, Novomoskovsk, Spasskaya str., 5, Phone: +38067 593 59 77

11.3. Post guarantee maintenance is conducted by the manufacturer service centre upon the Customer request.