



ULTRASONIC THICKNESS GAUGE

A1210

OPERATION MANUAL



Acoustic Control Systems Ltd.
Moscow 2016

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Current Operation Manual (hereinafter referred to as “the Operation Manual”) includes information on the technical specifications, description of the A1210 Ultrasonic Thickness Gauge and its operation principle, as well as information on proper use of the A1210 Ultrasonic Thickness Gauge (hereinafter referred to as “the thickness gauge” or “the instrument”).

Carefully study this Operation Manual before starting to work with the instrument.

1.2 Only properly trained personnel who carefully read the operation manual, and knows the general principles of the theory of ultrasonic vibrations should be allowed to work with the instrument.

For proper ultrasonic inspection the following preparatory works shall be performed: the control tasks shall be defined, the inspection schemes and the transducer shall be selected, the inspection conditions of the given materials shall be evaluated and etc.

During production of the instrument some modifications can be introduced to it due to constant improvement of its reliability and serviceability that do not affect the technical specifications.

The instrument is manufactured by:

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1 DESCRIPTION AND INSTRUMENT OPERATION

1.1 PURPOSE OF THE INSTRUMENT

1.1.1 Purpose and application range

The instrument represents a portable general-purpose ultrasonic device.

The instrument is designed to measure wall thickness of the tubes (including pipe-turns), boilers, reservoirs, pressure vessels, encasements and other objects from black and non-ferrous metals with smooth and corroded surfaces, as well as plastic objects and objects made of other materials with high ultrasonic attenuation with one-sided access to the surface of these objects.

The instrument can be used under the laboratory, field and workshop conditions in various industries. The surface of objects shall be prepared for inspection. Contact lubricants shall be used such as different oils, water, glycerine, special contact liquids and jelly for ultrasonic inspection, etc.

The instrument is equipped with a system of automatic adjustment to the curvature and roughness of the surface of the object being inspected. This system is patented in the Russian Federation (RF Patent № 2082160). This system enables equally valid readings of the instrument for all practical purposes.

The A-SCAN mode allows ruling out false results considerably increasing the inspection reliability, to conduct express-searches of foreign inclusions and laminations and to get true results of measuring through polymeric, varnish and paint and other types of insulated coating.

The instrument in the A-SCAN mode allows the user to adjust the image orientation by 90 degrees to the right or to the left.

The instrument stores the measurement results in its non-volatile memory and transfers them to personal computer (PC) for further procession, analysis and storage.

Instrument communicates with PC via the USB-port.

1.1.2 Operating conditions

The instrument is designed to work under the following operation conditions:

- temperature: from - 20 to +50 °C;
- relative air humidity up to 95 % at + 35 °C.

1.2 TECHNICAL SPECIFICATIONS

Main technical specifications of the instrument are presented in Table 1 .

T a b l e 1

Name of the parameter	Value
Measurement range of the thickness (steel), mm: with the D1771 4.0A0D12CL transducer with the S3567 2.5A0D10CL transducer	from 0.7 to 300.0 from 0.8 to 300.0
Limits of permissible absolute measurement accuracy of the thickness, mm, no more than, where X – thickness being measured: for thickness from 0.7 to 3.0 mm for thickness from 3.01 to 99.99 mm for thickness from 100.0 to 300.0 mm	$\pm(0.01 \cdot X + 0.1)$ $\pm(0.01 \cdot X + 0.05)$ $\pm(0.01 \cdot X + 0.1)$
Discreteness of thickness indication, mm: for thickness up to 99.99 mm for thickness from 100.0 mm	0.01; 0.1 0.1
The range of ultrasonic velocity, m/s	from 500 to 19 999
Power	A built-in lithium rechargeable battery
Nominal voltage, V	3.7 hours
Period of continuous operation of the instrument powered from the accumulator, no less than	9 hours
Overall dimensions of the electronic unit, no more than	161×70×24 mm
Maximum weight of the electronic unit	210 g
Average time between failures	18 000 hours
Average service life	5 years

1.3 INSTRUMENT DESIGN AND OPERATION PRINCIPLE

1.3.1 Design

The instrument is designed as an electronic unit (Figure 1) to which the removable piezoelectric transducers (PT) are connected via the cables.



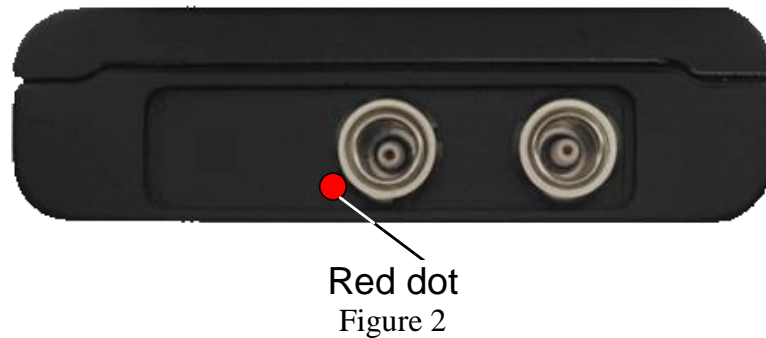
Figure 1

The upper part of the electronic unit's face panel bears a color TFT display. The display indicates the measurement results and service information required to control the instrument. The display ensures the full visual control over the inspection process with the help of color indication.

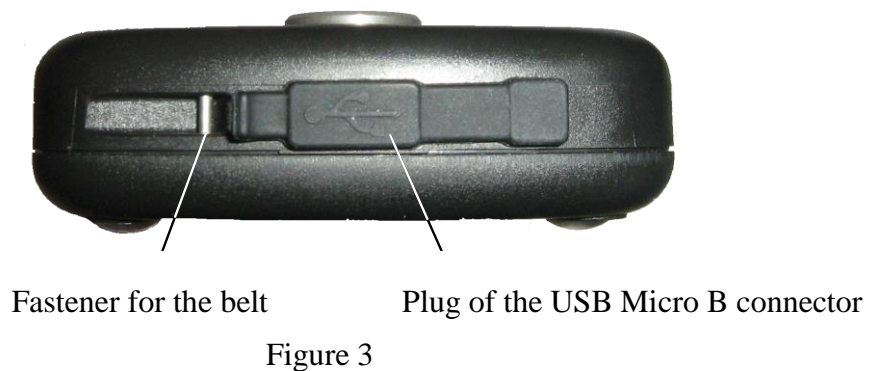
A membrane keyboard enabling control over the instrument is located under the display.

A control testing stainless steel 5 mm thick sample (propagation velocity of the ultrasonic waves in it is 5750 m/s) is located in the lower part of the face panel. The sample is designed to enable the adaptation of the instrument to the connected PT and rapid assessment of the instrument functionality.

The upper end face panel of the electronic unit bears the connectors for PT. One connector is marked with a red dot (Figure 2).



The lower end face panel of the electronic unit bears the fastener for the belt and a USB Micro B connector with a plug. The connector is used to connect the USB communication cable to PC and connect to the power adapter 220 V - USB to charge the built-in instrument's accumulator (Figure 3).




The “Micro B” connector of the USB cable shall be connected with the  sign and/or “B” letter facing upwards (Figure 4).



Figure 4

A magnetic holder is sewn into the back side of the instrument's case. The magnetic holder provides safe fastening of the instrument on the metal surfaces. It facilitates inspection in the hard-to-get places.

1.3.2 Operation principle

The instrument measures the time of double travels of ultrasonic oscillations through the material from one surface to another. This time is recalculated to the thickness value.

The PT operates as a sending and receiving element for ultrasonic oscillations and their reflections. The PT shall be put on the surface being tested in the point where the thickness should be measured. PT has a sharp directional characteristic of the emission and reception of ultrasound, thus the thickness of the object is determined directly under the place where the transducer is put on. If there are hollows on the opposite surface, then the ultrasonic pulses will

be reflected from them, and the thickness will be determined as the shortest distance between the external surface and these hollows.

1.3.3 Operation modes

Thickness gauge can be operated in the following modes:

- in the measurement mode with indication of the measurement result belonging to the set interval and actuation criteria of the automatic flaw alarm system (AFAS) - NORM;
- in the measurement mode with indication of the saved results - MEMORY;
- in the measurement mode with graphical display of the signal – A-SCAN;
- in the mode of settings and configuration of the measurement parameters - SETTINGS.

All measurement modes provide recording the results into the instrument’s memory.

In the NORM mode the thickness gauge allows quick determination of thickness of the object under test and allows the user to evaluate if it belongs to the set interval and criterion of the AFAS actuation.

In the MEMORY mode the thickness gauge allows quick determination of thickness of the object being inspected, viewing the recorded measurement results on the display, as well as correct the records performing the repeated measurements and recording data into the configurable memory cells.





The A-SCAN mode allows ruling out false results caused by inhomogeneity in the material of the object under test. In this mode the signals are displayed on the screen in the form of A-Scan; conditions and criteria of the measurements are adjusted directly in the process. The four measurement methods are available: when the signal exceeds the strobe level for the first time; by the signal maximum in the strobe; between two maximum signals in the strobe and auto correlation function (ACF) in strobe. The user also has the opportunity to view the selected parts of the signal, current parameters and settings, save the A-Scan image together with the measurement result.

The SETTINGS mode allows the user to change the selected measurement conditions and parameters. The set of the configurable parameters consist of the general parameters and individual parameters for a given measurement mode.

1.3.4 Instrument’s display

The upper line of the display indicated information on the current instrument’s operation mode and accumulator charge level in all operation modes. The icons of the operation modes are presented in Table 2.

Table 2

Tab	Operation mode
	NORM
	MEMORY
	A-SCAN
	SETTINGS

Icons of the measurement modes are always arranged from left to right as follows: NORM – MEMORY – A-SCAN , at that the icon of the active mode is highlighted in yellow (Figure 5).

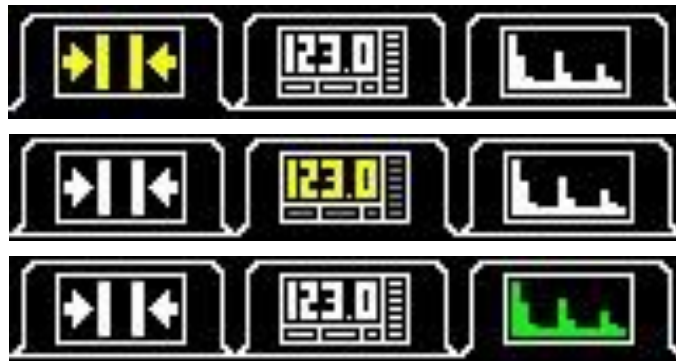


Figure 5

After the user entered the SETTINGS mode, its icon will replace the icon of the previous mode, the parameters and settings of the mode become configurable (Figure 6).

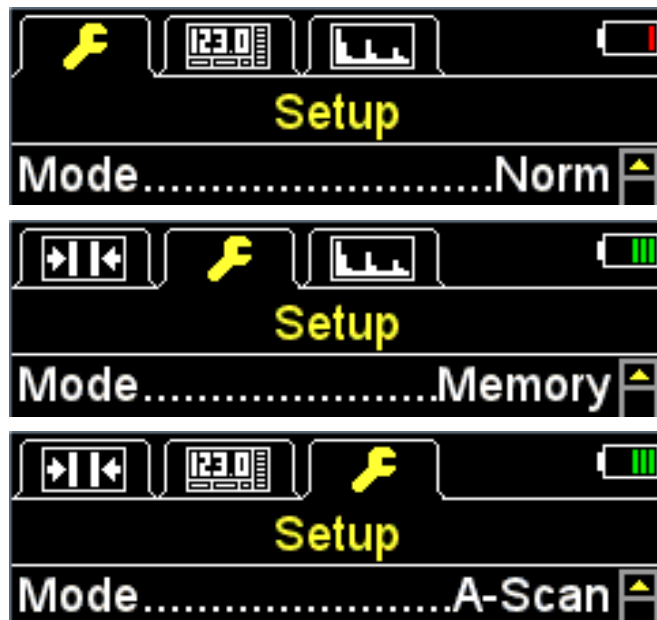









Figure 6

The characters informing on the presence of the signal and its level, as well as on the measurement method, information on the measurement units and digital value of the measurement result are always displayed in the NORM and MEMORY modes (see below).

Description of the indicators of the acoustic contact and measurement method is presented in Table 3.

Table 3

Type of the indicator	Description
	Level of the signal is maximal, amplification of the receive path is set to minimum
	Level of the signal is average, amplification of the receive path is set to average

Type of the indicator	Description
	Level of the signal is minimal, amplification of the receive path is set to maximum
	There is no signal or the signal is too weak for measurements
	No measurements
	Measurement using the ACF method
	Measurement using the threshold method

Display appearance of the thickness gauge in the NORM mode is presented on Figure 7.

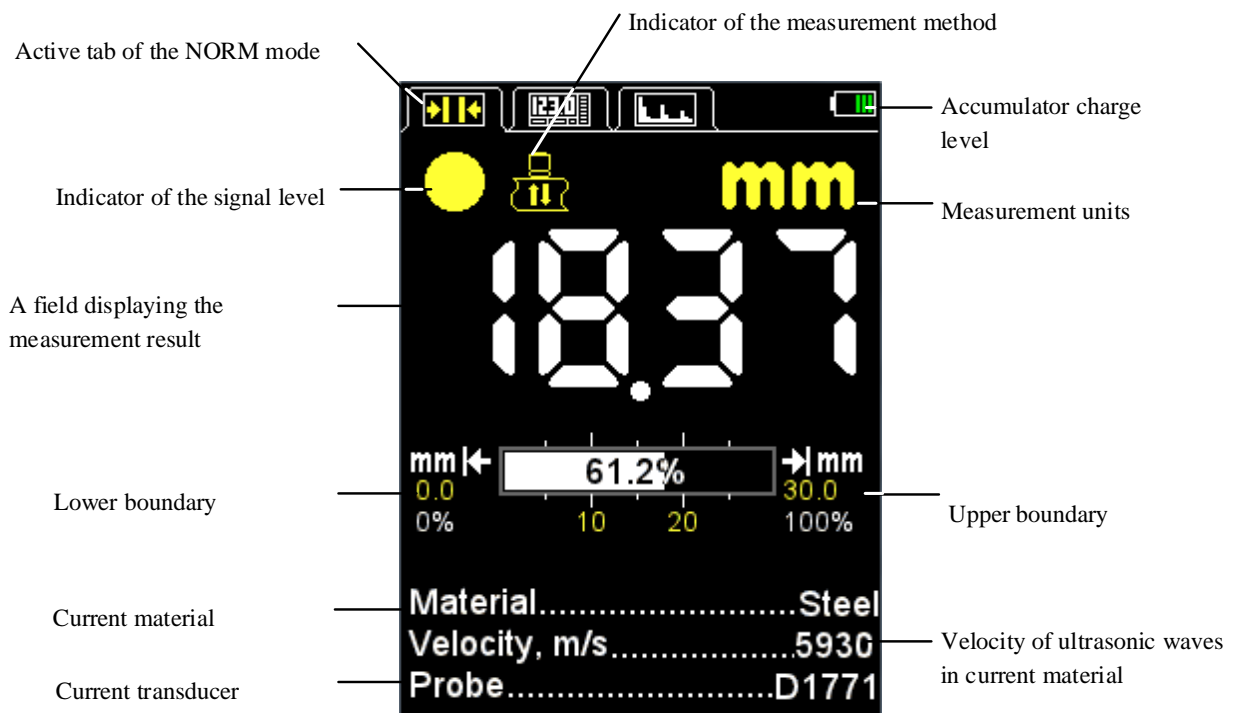


Figure 7

Display appearance of the thickness gauge in the MEMORY mode is presented on Figure 8.

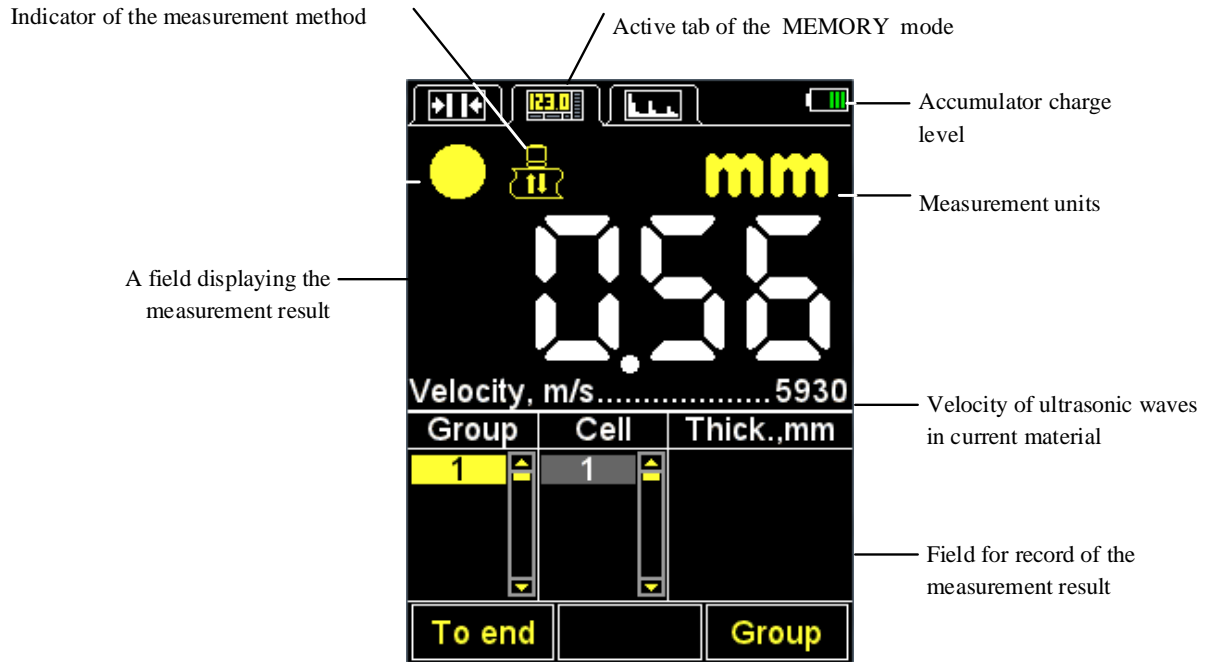


Figure 8

In the A-SCAN mode the display indicates a graphic imaging of the echoed signal, digital value of the measurement result, information on the measurement units and signal amplification. The control icons are located in the lower part of the display.

The instrument allows the user to rotate the image in the A-SCAN mode by 90 degrees to the right or to the left.

The appearance of the display depends on the selected image orientation:

- vertical;
- left-horizontal;
- right-horizontal.

Appearance of the display in the A-SCAN mode with activated left horizontal orientation of the display is presented on Figure 10.

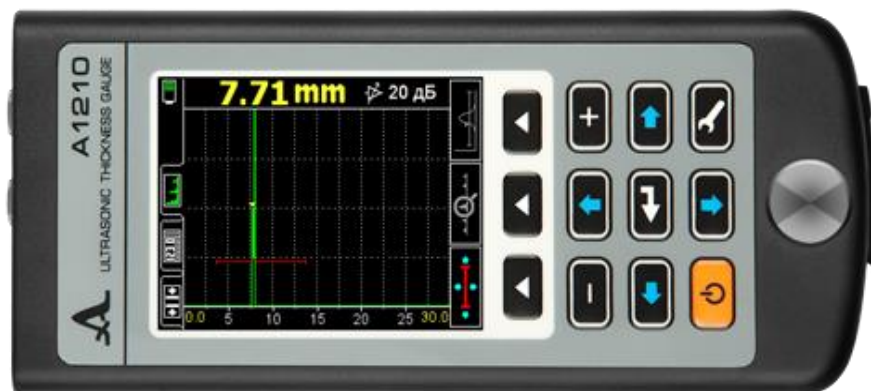


Figure 9

Appearance of the display of the thickness gauge in the A-SCAN mode with activated vertical orientation is presented on Figure 10.

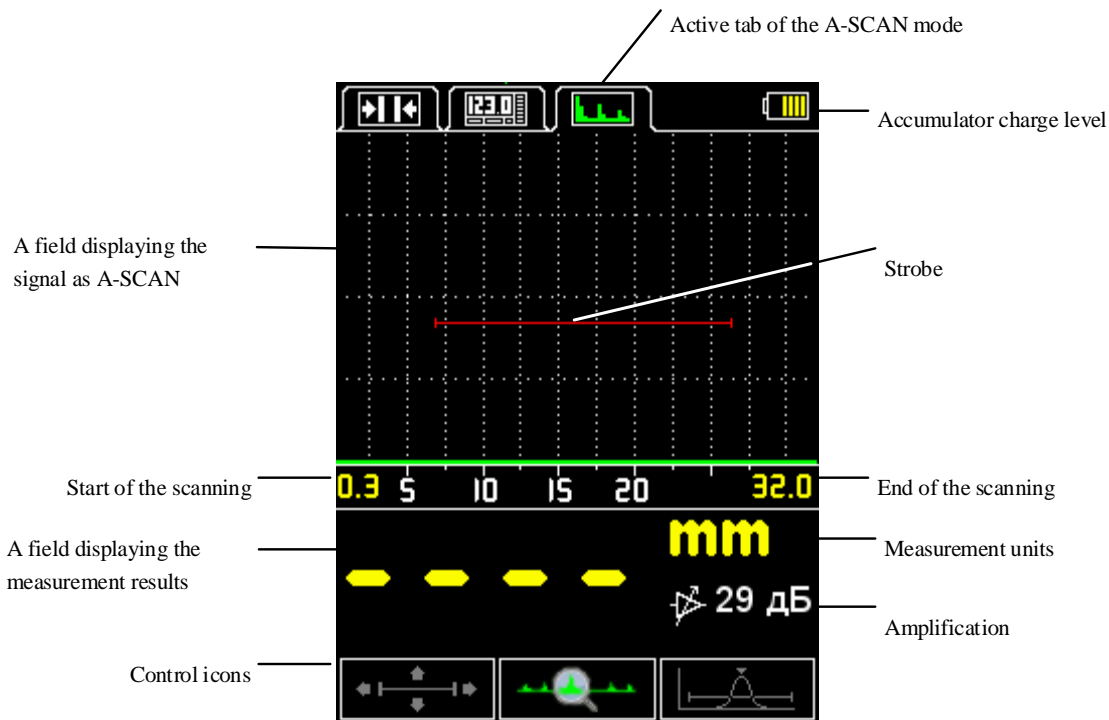


Figure 10


1.3.5 Keyboard

Instrument's keyboard (Figure 11) has 11 functional keys and one ON/OFF key.



Figure 11

Main functions of the keys:

- Key  (On/Off) switches on/off the instrument.

ATTENTION: THE INSTRUMENT WILL AUTOMATICALLY SWITCH OFF AFTER 10 MINUTES IN IDLE MODE (NO KEY IS PRESSED, NO MEASUREMENT IS GOING ON).

ATTENTION: AFTER 2 MINUTES THE DISPLAY BRIGHTNESS WILL AUTOMATICALLY BE SET TO THE MINIMAL LEVEL – 20%, IF NO KEY IS PRESSED DURING THIS TIME OR NO MEASUREMENT IS GOING ON!






- Functional keys  (F) possess different functions depending on the selected instrument's operation mode. The name of the current function is displayed over each key on the screen. The functional keys in this Operation Manual are numbered from left to right: F1, F2, F3 (Figure 12).



Figure 12

- Key  is used to switch from the measurement modes to the SETTINGS mode and vice versa.

- Key  (ENTER) depending on the operation mode and state of the thickness gauge can perform different functions.

- Keys  / ,  /  and  /  are used to select and configure the active parameters. Their functions are common for different instrument's operation modes. The keys are user-friendly since their icons indicate their functions.

2 PROPER USE OF THE INSTRUMENT

2.1 OPERATING RESTRICTIONS

The instrument is designed to be operated under conditions listed in Section **Ошибка!**
Источник ссылки не найден..

2.2 MAKING INSTRUMENT READY FOR OPERATION

2.2.1 Preparation of the surface

Loose or exfoliating rust, corrosion or dirt on the surface of the object being tested can influence the ultrasonic transmission to the material. Hence such surface should be cleaned of the rust and calx followed by applying more contact fluid as compared to contact fluid amount required for the smooth surface.

Thorough cleaning of the rough corroded surfaces will increase accuracy of the measurements and as well prolong the life-time of the transducer.

2.2.2 Connection of the transducer

Double crystal transducers and single crystal transducers are used to determine the thickness of the objects.

Connect the transducer to the instrument following the marking.

Two cable types shall be used depending on the type of the transducer; hence there are two ways to connect the PT.

Double crystal transducers shall be connected by means of the double cable with LEMO 00 type terminals.


The cable marked with a red shank shall be connected to the connector marked with a red dot (Figure 13).



Figure 13

Single crystal transducers shall be connected by means of the single cable LEMO 00 to the unmarked connector.

2.2.3 Switch on/off the instrument

Press the  key to switch off the instrument.



Press the  key to switch on the instrument. The instrument's screen will display a start-up window with instrument's name and firmware version (Figure 14).



Figure 14

The thickness gauge will automatically enter the mode being active before switching preserving the corresponding settings.

Note – If the same transducer remains connected to the instrument, then the instrument will be immediately ready for operation after switching on. If another transducer is connected, then adjust the instrument to it at first.

Press the  key to switch off the instrument manually. The instrument will switch off automatically if no keys are pressed within 10 minutes interval or no measurement process is going on.

All the adjustments are saved when the thickness gauge is switched off or its battery is dead.


2.2.4 Setting and adjustment of the instrument to the parameters of the currently used PT




ATTENTION: ALWAYS CONFIGURE AND ADJUST THE INSTRUMENT TO THE INDIVIDUAL PARAMETERS OF THE CURRENTLY USED PT BEFORE STARTING TO WORK WITH THE INSTRUMENT OR WHEN ANOTHER TRANSDUCER IS CONNECTED!

Otherwise the instrument will be unworkable; any attempt to switch to any measurement modes will display the warning message: "PT shall be tested".

2.2.4.1 Select the transducer

Do the following to select the transducer:

– press the  key to enter the SETTINGS mode.

– using the   keys switch to the PT option and press F3 key (Open) or  to enter the library of the transducers (Figure 15).

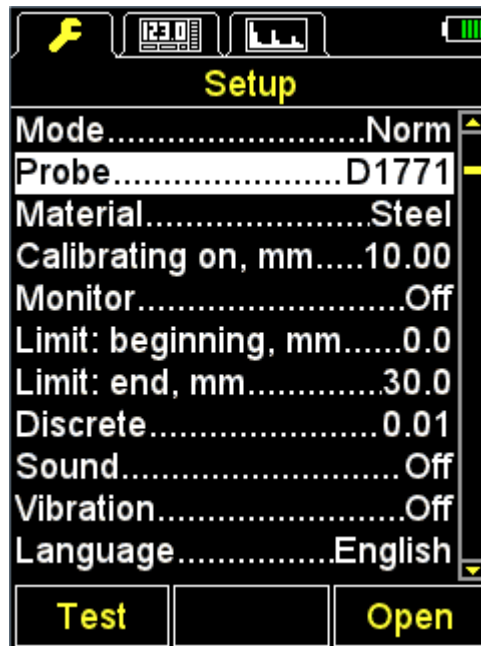





Figure 15

– using the keys   go to the line with the name of the connected PT and press  key to select it (Figure 16).

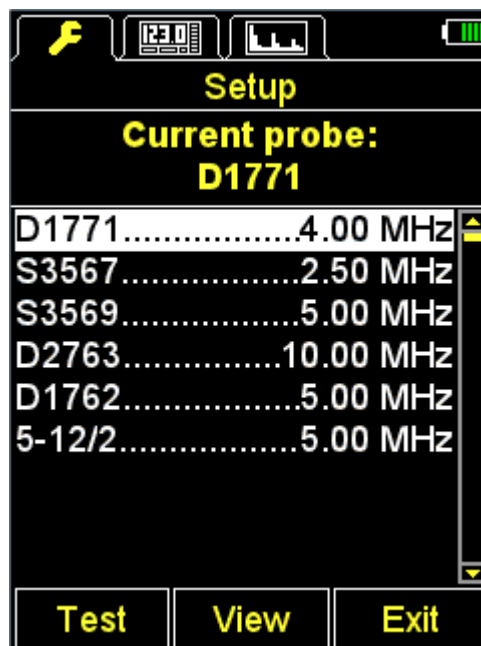




Figure 16

After the transducer is selected the testing of PT will be started automatically followed by the adjustment of the instrument to its individual parameters.

2.2.4.2 Adjustment of the instrument to the parameters of the currently used transducer

The adjustment is performed in two steps. At the first step the instrument will automatically analyze the characteristics of PT, at the second step it will adjust to them using the real echoed signal from the control testing sample built-in to the instrument.

Do the following to adjust the instrument to the individual parameters of the currently used PT:

- Enter the SETTINGS mode.
- Go to the “PT” line and press F1 key (Test). The screen will display: “**TEST PT** - Lift the PT in the air, clean off the oil from it and press ENTER”.
- Clean off the coupling media from the transducer. Don’t touch the control testing sample and press .
- The screen will display: “Testing is going on – Please, wait...”.
- Wait for the screen to display: “**TEST PT** - Place PT onto the control testing sample and press ENTER”.
- Apply some contact liquid onto the control testing sample and place the transducer on it. Press the  key.
- The screen will display: “Testing is going on – Please, wait...”.
- The screen will display the results of the testing when the test is completed. If the test result is positive, then the thickness value of the control testing sample will be indicated. If the test result is negative, then the corresponding message will be displayed (Figure 17).

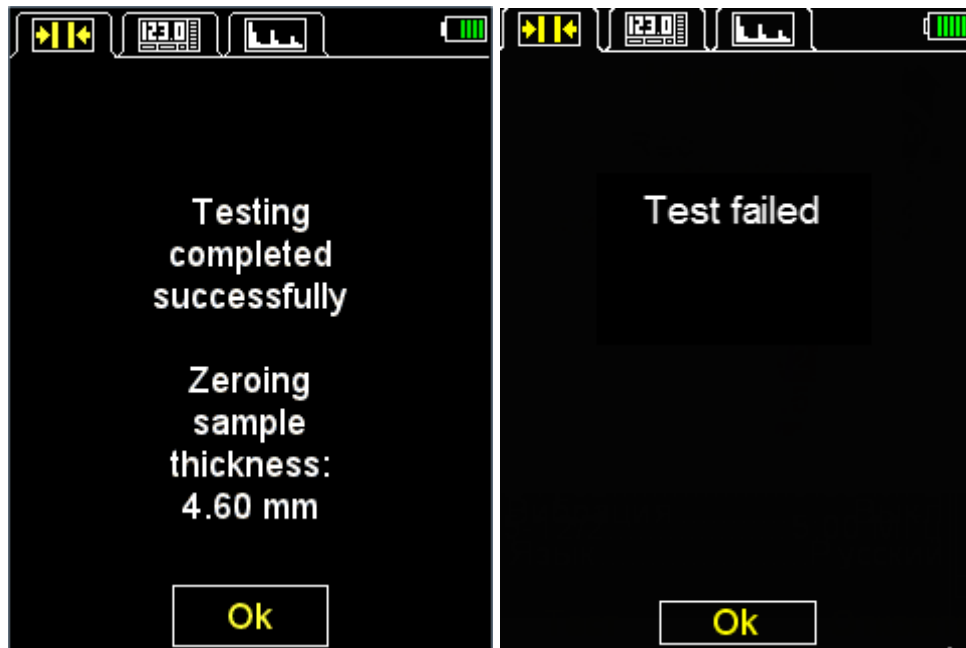


Figure 17

- Remove the transducer from the control testing sample.
 - Press the F2 key (OK). If the test is OK, then the instrument will enter the measurement mode, if the test failed, then the instrument will return to the main window of the SETTINGS mode.
- To cancel the testing at any stage: press the F2 key (Cancel). If so the instrument will return to the main window of the SETTINGS mode.
- Appearance of the instrument’s displays during successful adjustment is presented on Figure 18.

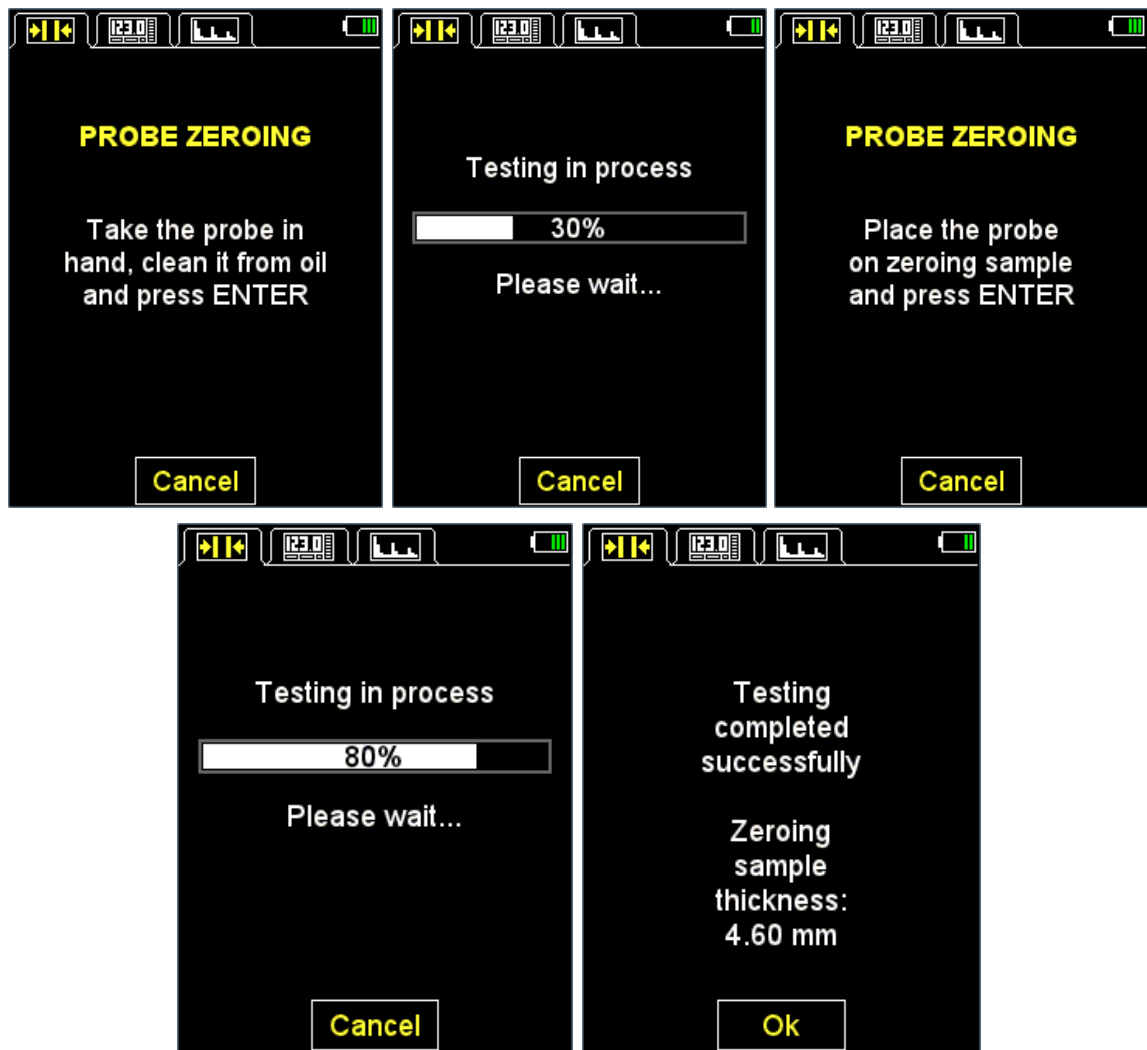


Figure 18

2.3 OPERATION

2.3.1 Working with the instrument

Do not slice over the surface of the inspected object with the work surface of the PT. Do not continuously scan the large surface if several points shall be inspected. Take the PT away from the surface and put to the point to be inspected. Scanning considerably accelerates wear of PT. Nevertheless if the scanning is required, for example to search for local thinning in the material, do it carefully not pressing the PT. The scanning shall be performed using clean coupling media on the surface cleared of dirt only.

Consider the temperature dependence of the ultrasonic propagation velocity in cooled or heated materials. Adjust the instrument to the ultrasonic velocity using the calibration sample of the same temperature as the temperature of the object being inspected to provide maximum measurement accuracy.

Note – Don't leave the PT on the coupling media after work is completed. Drops of the liquid can result in the echoed signal and the instrument will fail to switch off automatically.

2.3.2 The SETTINGS mode

The SETTINGS mode includes the following options: list of the configurable parameters, procedures of PT testing and velocity calibration on the sample, data transfer to PC, view the library of the transducers, as well as working with the library of the materials.

All instrument's settings shall be saved if the instrument is switched off and the accumulator battery discharges.

Display appearance in the SETTINGS-NORM mode is presented on Figure 19.

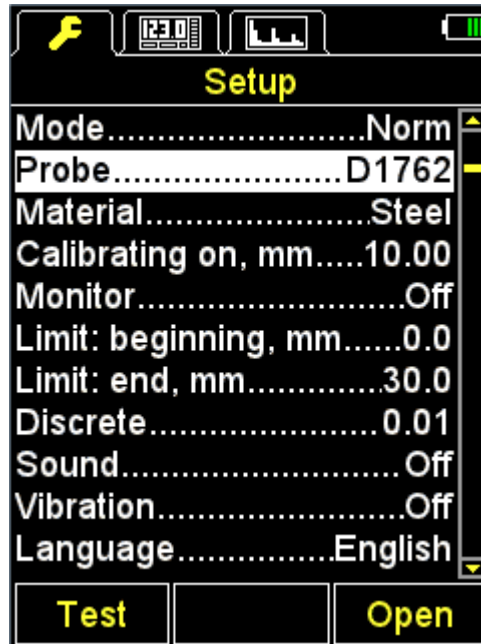


Figure 19

Keys being active in any menu of the SETTINGS mode:



- navigation of the active line along the menu options, the navigation is performed cyclically in both directions. The parameter highlighted by the active line becomes selectable or editable;



- decrease/increase the digital value of the selected parameter.

Menu options of the SETTINGS mode which are common for all measurement modes, corresponding parameters (in the metric system of measurement) and functions are presented in Table 4 .

T a b l e 4

Menu option (parameter)	Parameter value	Description
Mode	NORM / Memory / A-SCAN	Select the measurement mode
PT	Name of PT	Enter the library of the transducers. Starts the procedure of PT testing
Material	Material name	Enter the library of the materials
Calibration for, mm	from 2 to 80	Set the thickness of the reference sample followed by the velocity calibration on the sample
Sound	On / Off	Control over sound indication

Menu option (parameter)	Parameter value	Description
Vibro-	On / Off	Control over vibro-indication
Language	Russian / English	Select the interface language
Measurement unit	mm / inches	Select the system of the measurement units
Brightness, %	from 20 to 100	Adjust the display brightness

Additional menu options of the SETTINGS-NORM mode common for the NORM and MEMORY modes, corresponding parameters (in the metric system of measurement) and functions are presented in Table 5 .

T a b l e 5

Menu option (parameter)	Parameter value	Description
AFAS	OFF / Outside / Inside	OFF – switch off AFAS Inside / Outside – Setting the actuation criterion of the sound alarm if the measurement result is within the set boundaries (inside) or beyond them (outside)
BOUNDARY: FROM, mm	from 0 to 150	Setting the lower boundary of the AFAS actuation
BOUNDARY: TO, mm	from 1 to 300	Setting the upper boundary of the AFAS actuation
Discrete	0.01 / 0.1	Setting the discretization of the presentation of the result

Additional menu options of the SETTINGS-MEMORY mode and corresponding parameters (in the metric system of measurement) and functions are presented in Table 6 .

T a b l e 6

Menu option (parameter)	Parameter value	Description
Memory cleaning, %	from 0 to 100	Displays the memory usage. Starts deletion of the measurement results from the memory

Additional menu options of the SETTINGS mode - A-SCAN and corresponding parameters (in the metric system of measurement) and functions are presented in Table 7 .

T a b l e 7

Menu option (parameter)	Parameter value	Description
Scanning start, mm	from 0 to 150	Setting the scanning start
Scanning end, mm	from 5 to 300	Setting the scanning end
STROBE: FROM, mm	from 0 to 150	Setting the lower boundary of the strobe
Strobe: to, mm	from 1 to 300	Setting the upper boundary of the strobe
Amplification, dB	from 0 to 80	Setting the amplification value
View of A-Scan	Fill / Stroke	Selecting the view of the signal in the A-SCAN mode
Orientation	Auto / Horiz.Left / Vert / Horiz.Right	Select the orientation of the displayed A-Scan image

2.3.2.1 MODE option

Select the measurement mode:

- NORM - measurements with displaying the measurement results belonging to the set interval or criteria;

- MEMORY - measurements with displaying the measurement results saved in the instrument's memory.

- A-SCAN – measurements with displaying signals as A-Scan.

Active keys:

F1 (NORM) - select the NORM mode;

F2 (Memory) - select the MEMORY mode;

F3 (A-Scan) - select the A-SCAN mode;



- sequence switching between the modes.

Display of the MODE option is presented on Figure 20.

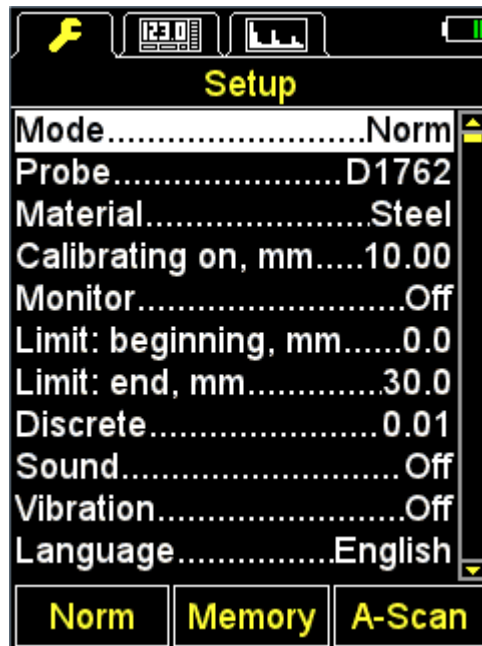



Figure 20

2.3.2.2 PT option

– Enter the library of the transducers.

Active keys:

F1 (Test) - starts the procedure of PT testing and adjustment of the instrument to the selected transducer;

F3 (Open) or  - enter the library of the transducers.

Display of the PT option is presented on Figure 21.

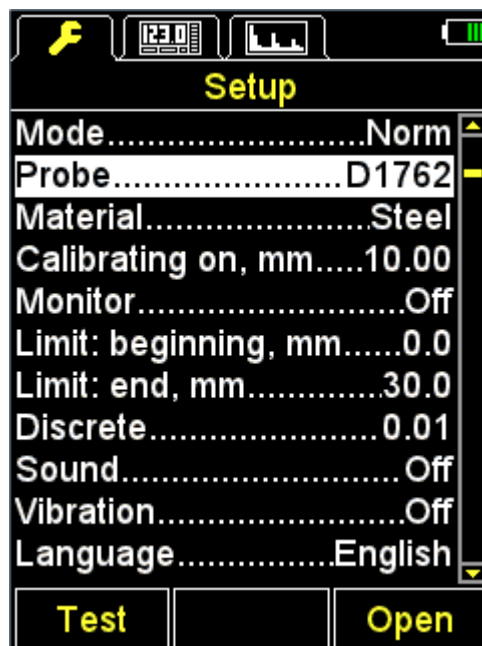


Figure 21

– View the library of the transducers.

The head of the window will display information on the currently used PT – “Current transducer:”.


ATTENTION: THE USER INDEPENDENTLY NEITHER CAN ADD NEW TRANSDUCERS TO THE LIBRARY NOR CONFIGURE THE LIBRARY!

Active keys:

F1 (Test) – starts the procedure of the setting and adjustment of the instrument to the individual parameters of PT.

F2 (View) – view detailed information on the transducer. Information on the type, name and frequency of PT will be displayed.

F3 (Exit) – returns to the main window of the SETTINGS mode.

 - select the transducer from the list, at that the procedure of the PT testing and adjustment of the instrument to its parameters will be started automatically. Detailed description of the procedure is presented in Section 2.2.4.2.

The instrument upon the library exit will remember the last active line. This line will be automatically selected when You enter the library again. The instrument will reset information on the active line of the library after switching off.

Display appearances when viewing the library of the transducers are presented on Figure 22.

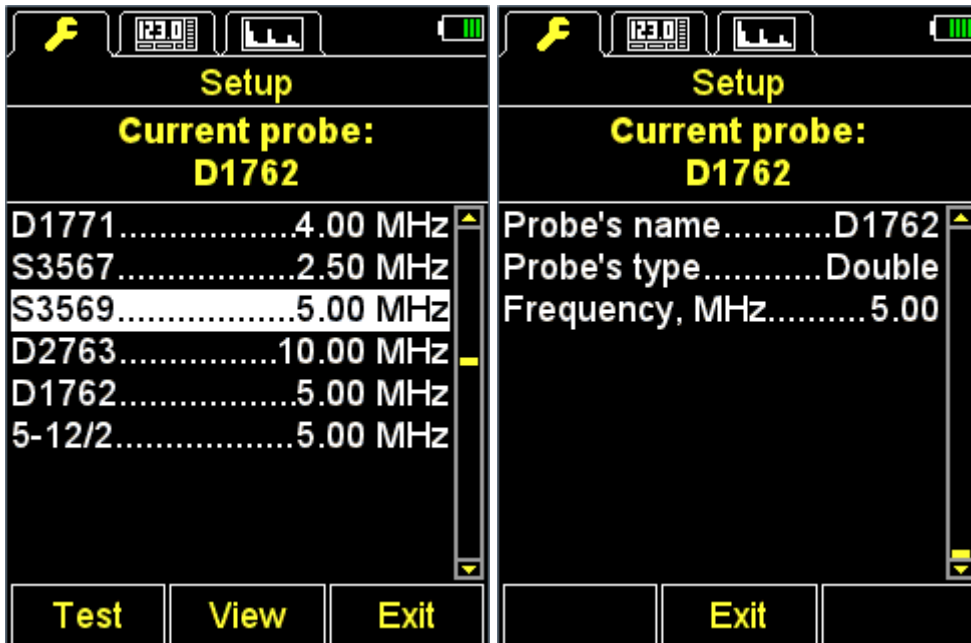



Figure 22

2.3.2.3 MATERIAL option

– Enter the library of the materials.

Active keys:

F2 (Open) or  - enter the library of the materials to record new and edit the existing materials, as well as select the material for operation.

Display of the MATERIAL option is presented on Figure 23.

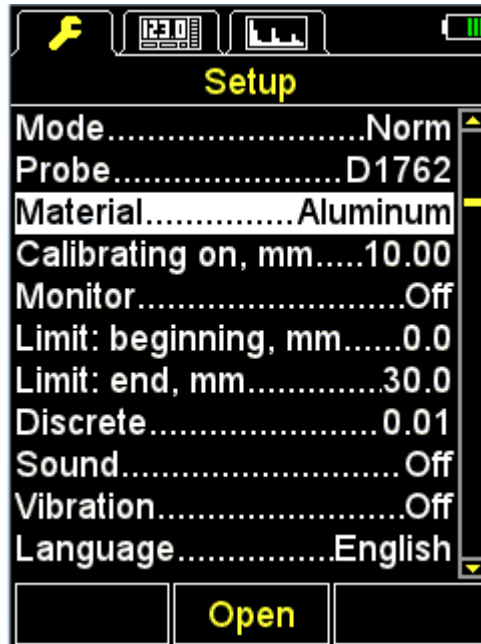


Figure 23

– Working with the library of the materials.

Instrument’s memory can store information on 64 materials.

The head of the window will display information on the currently used material (current) material and ultrasonic velocity propagation in it.

Add new material.

A NEW option is always listed first in the menu followed by the names and propagation velocities of ultrasound waves in the materials recorded into the instrument’s memory (Figure 24).

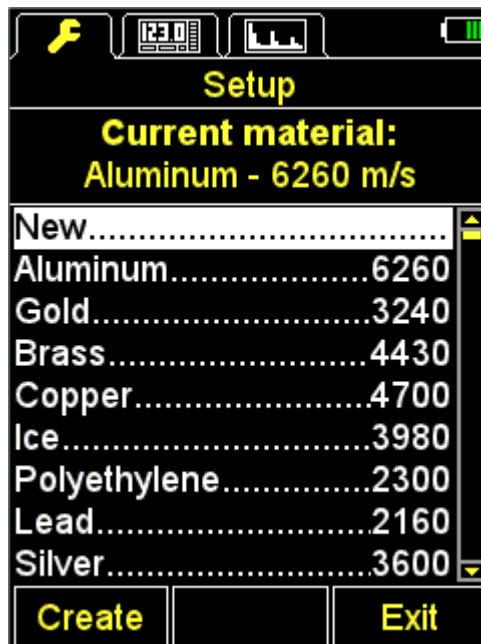


Figure 24

Active keys:


F1 (Create) – opens the edit field of the material name (Figure **Ошибка! Источник ссылки не найден.**).

F3 (Exit) - returns to the main window of the SETTINGS mode.




Figure 25

Active keys:



F1 () – Exits the editor saving the changes.

F2 (XXX) – Switching between the characters in the letter table “абв” – Russian low-case characters, “АБВ” – Russian upper-case characters, abc – English low-case characters, ABC – English upper-case characters.





F3 () – Exits the editor saving the changes.




When the material is created/the existing material is being edited, the current name of the material with an inverted active symbol in the material field name, propagation velocity of ultrasound waves in the material and tables with the available characters are displayed.

Do the following to change the name of the material:

– using the keys   select the character in the material name line to be changed or deleted, for example “S” – **Steel**;



– press F2 key to select the language and the case;



– using the keys , ,  and  select a new character in the table of the characters, for example “B” – **A B C D**, the function of the selected character deletion


–  or the character preceding the selected one – , press the  key;

– press F1 to confirm changes, press F3 to cancel.

Do the following to change the ultrasound propagation velocity in the material:

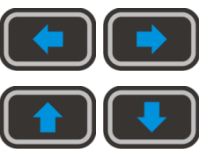




– using the keys  or  place the cursor to the velocity field. As soon as the velocity value becomes configurable, it changes its color from white: **5930** to red: **5930**. The value will be decreased/increased depending on the selected key.

– using the keys  or  set the required value of the ultrasonic velocity **Steel** **5902**;

– Press the key , the velocity value will change its color to white and the first character of the material name will become active **Steel** **5902**;

– press F1 to confirm changes, press F3 to cancel.

T a b l e 8

Key	Function
	Navigation along the table of the characters
	Select the character to edit in the material field name. Change the velocity value
	Replace the active character with a character from the table. The next character will be active after replacement
F1 ()	Exits the editor saving the changes
F2 (XXX)	Switching between the characters in the table fo the letters, where XXX: абв – Russian low-case characters АБВ – Russian upper-case characters abc – English low-case characters ABC – English upper-case characters
F3 ()	Exits the editor saving the changes


Editing the information on the material.

Active keys:

F1 (Edit) – opens the editor of the information on the selected material. The process is similar to the above-described one.

F2 (Delete) - deletes the material from the instrument’s memory.

F3 (Exit) - returns to the main window of the SETTINGS mode.

 - selects the material for working and returns to the main window of the SETTINGS mode.

The instrument upon the library exit will remember the last active line. This line will be automatically selected when You enter the library again. The instrument will reset information on the active line of the library after switching off.

Display of the library of the materials is presented on Figure 26.

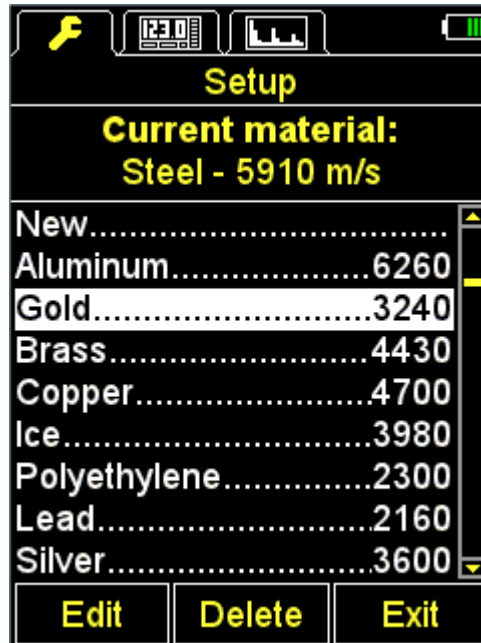


Figure 26

After the F2 key (Delete) is pressed, the «Delete the selected material?» message will be displayed (Figure 27). Confirm deletion by pressing F1 (Yes), or cancel it by pressing - F3 (No).



Figure 27

2.3.2.4 CALIBRATION FOR option

CALIBRATION FOR option is designed to determine the velocity of the ultrasound wave in the material of known thickness.

Thickness of the reference sample can be set within the range from 2 to 80 mm.

Display of the CALIBRATION FOR option is presented on Figure 28.

Active keys:

F1 (-) or  – decrease the thickness value of the reference sample.

F2 (Start) - starts the procedure of velocity calibration on the sample.

F2 (+) or  – increase the thickness value of the reference sample.

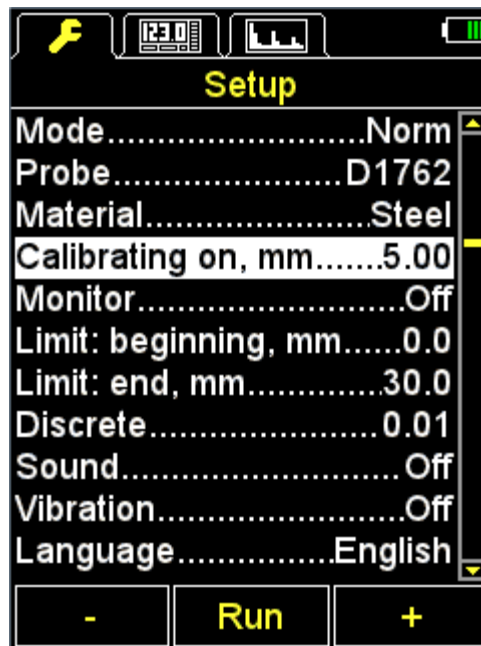



Figure 28

Set the thickness of the reference sample and procedure of the velocity calibration on the sample.

Do the following to calibrate the velocity:

- Set the thickness of the sample.
- Start the procedure of the velocity calibration on the sample.
- The screen will display: “Place PT on the control sample and press ENTER”.
- Apply the coupling media to the sample.

– Place the PT on the sample with preset thickness and press .

– The screen will display: “The data are being collected on the sample XX.XX mm”, where XX.XX – set thickness of the sample.

– Current measurement result of the velocity will be displayed on the screen. After the measurements are completed the screen will display the velocity value and “Save the result?” message.

Display appearances when doing the calibration are presented on Figure 29.

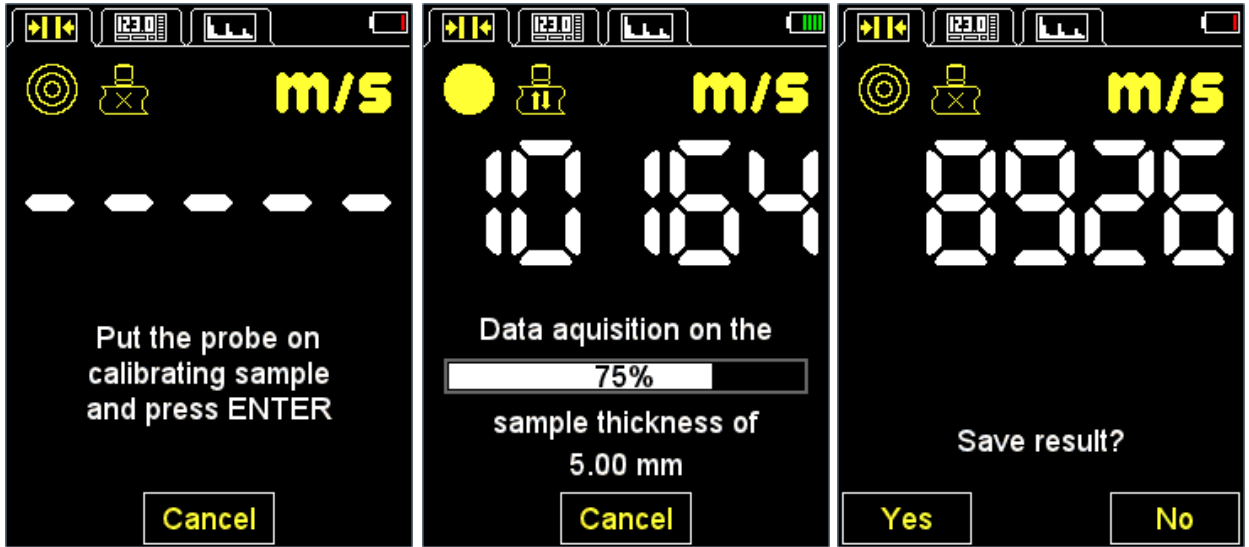


Figure 29

Saving the velocity value determined during calibration.

Active keys:

F1 (Yes) – saves the determined velocity value for the material from the library which shall be selected from the list, (Figure 30) or create a new one by selecting the “New” option (Figure 31), and pressing the F1 key (Save).

F3 (No) - exits without saving the result.



Figure 30



Figure 31

2.3.2.5 AFAS option (for the NORM and MEMORY modes only)

Set the actuation condition of the color, sound and vibro-alarms during measurements.

Select the actuation condition:

INSIDE - the measurement result is within the set range;

OUTSIDE - the measurement result is beyond the set interval (range);

OFF - AFAS is switched off.

Display of the AFAS options presented on Figure 32.

Active keys:

F1 (Inside) - select the actuation condition INSIDE;

F2 (OFF) - AFAS is switched off;

F3 (Outside) - select the actuation condition OUTSIDE;



- switching between the INSIDE / OFF / OUTSIDE conditions.

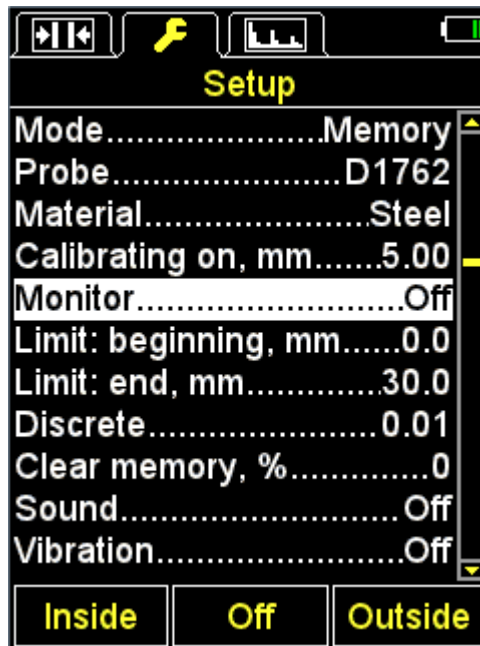


Figure 32


2.3.2.6 BOUNDARY: FROM option (for the NORM and MEMORY modes only)


Set the lower boundary of the AFAS actuation.

Permitted values of 0 to 150 mm.

Display of the BOUNDARY: FROM option is presented on Figure 33.

Active keys:

F1 (-) or  – decrease the value of the lower boundary of the AFAS actuation.

F2 (+) or  – increase the value of the lower boundary of the AFAS actuation.

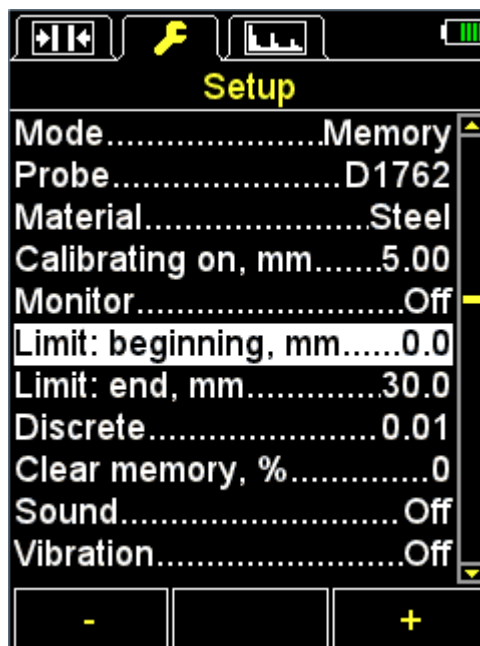


Figure 33


2.3.2.7 BOUNDARY: TO option (for the NORM and MEMORY modes only)


Set the upper boundary of the AFAS actuation.

Range of the permitted values: from 1 to 300 mm.

Display of the BOUNDARY: TO option is presented on Figure 34.

Active keys:

F1 (-) or  – decrease the value of the upper boundary of the AFAS actuation.

F2 (+) or  – increase the value of the upper boundary of the AFAS actuation.

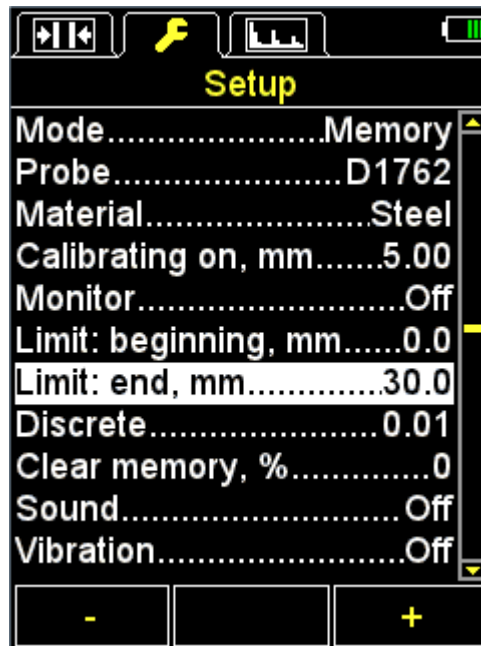


Figure 34

2.3.2.8 DISCRETE option (for the NORM and MEMORY modes only)


Setting the discretization of the presentation of the displayed result .

Display of the DISCRETE option (for the metric measurement system) is presented on Figure 35.

Active keys:

F1 (0.1) – sets the display of the measurement results with one character after the decimal point;

F3 (0.01) - sets the display of the measurement results with two characters after the decimal point;

 - switching between the discretization values 0.1 and 0.01.

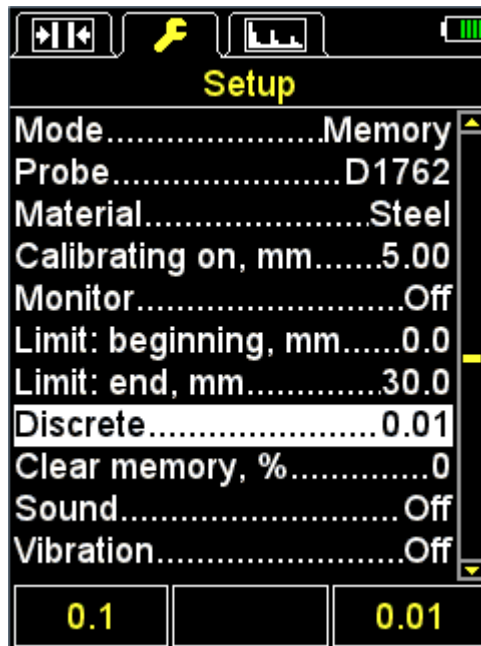


Figure 35


2.3.2.9 MEMORY CLEANING option (for the MEMORY mode only)

Delete the measurement results from the memory.

The parameter indicates the filling percentage of the memory with the measurement results.

Display of the MEMORY CLEANING option is presented on Figure 36.

Active keys:

F2 (Start) or  - starts the procedure of memory cleaning.

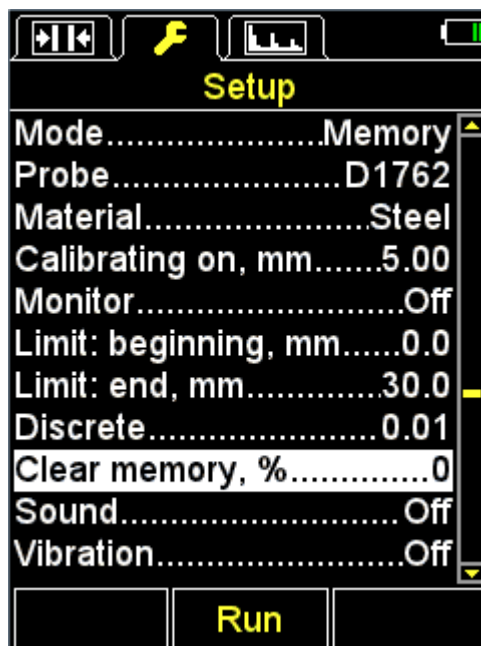


Figure 36

After the memory cleaning is started, the “Saved data will be deleted. Continue?” message will be displayed (Figure 37).

Active keys:

F1 (Yes) - confirms the data deletion.

F3 (No) – cancels the data deletion.

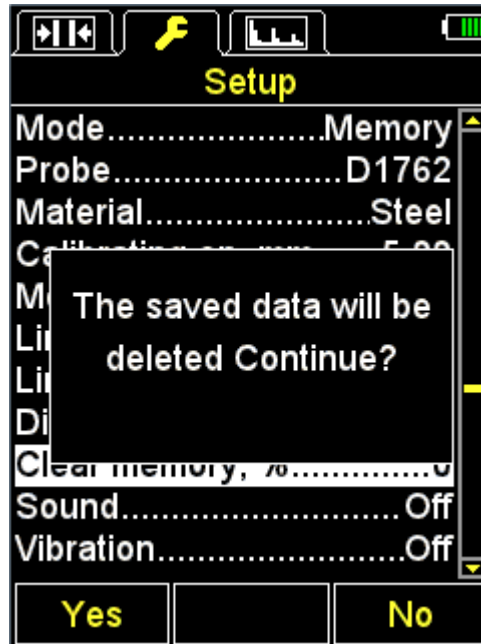


Figure 37


2.3.2.10 SCANNING START option (for the A-SCAN mode only)


The SCANNING START option allows setting the beginning of the A-Scan display area on the screen.

Value of the scanning start can be set within the 0 - 150 mm range.

Display of the SCANNING START option is presented on Figure 38.

Active keys:

F1 (–) or  – decrease the value of the scanning start.

F2 (+) or  – increase the value of the scanning start.

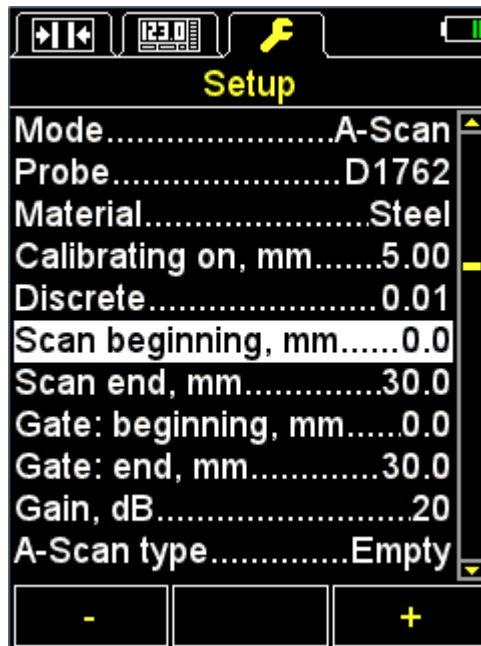


Figure 38


2.3.2.11 SCANNING END option (for the A-SCAN mode only)


The SCANNING END option allows setting the end of the A-Scan display area on the screen.

Value of the scanning end can be set within the 5 - 300 mm range.

Display of the SCANNING END option is presented on Figure 39.

Active keys:

F1 (-) or  – decrease the value of the scanning end.

F2 (+) or  – increase the value of the scanning end.

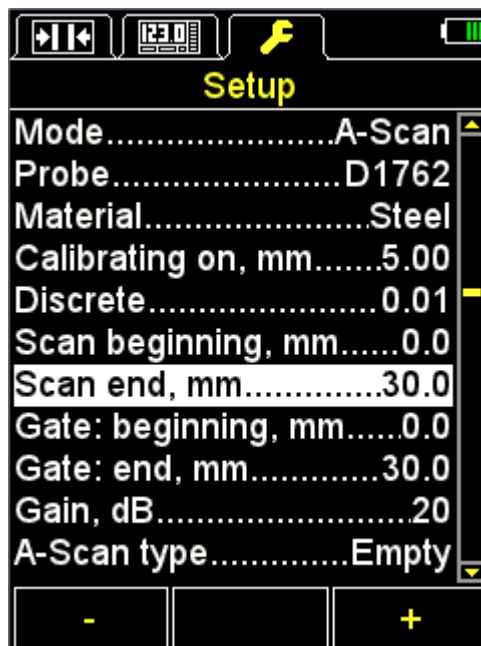


Figure 39


2.3.2.12 STROBE: FROM option (for the A-SCAN mode only)


The STROBE: FROM option allows setting the lower boundary of the strobe.

The value can be set within the range from 0 to 150 mm.

Display of the STROBE: FROM option is presented on Figure 40.

Active keys:

F1 (-) or  – decrease the value of the lower boundary of the strobe.

F2 (+) or  – increase the value of the lower boundary of the strobe.

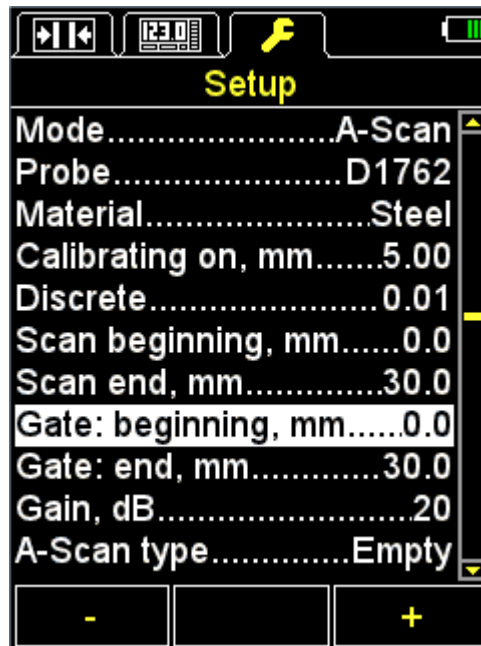


Figure 40


2.3.2.13 STROBE: TO option (for the A-SCAN mode only)


The STROBE: TO option allows setting the upper boundary of the strobe.

The value can be set within the range from 1 to 300 mm.

Display of the STROBE: TO option is presented on Figure 41.

Active keys:

F1 (-) or  – decrease the value of the upper boundary of the strobe.

F2 (+) or  – increase the value of the upper boundary of the strobe.

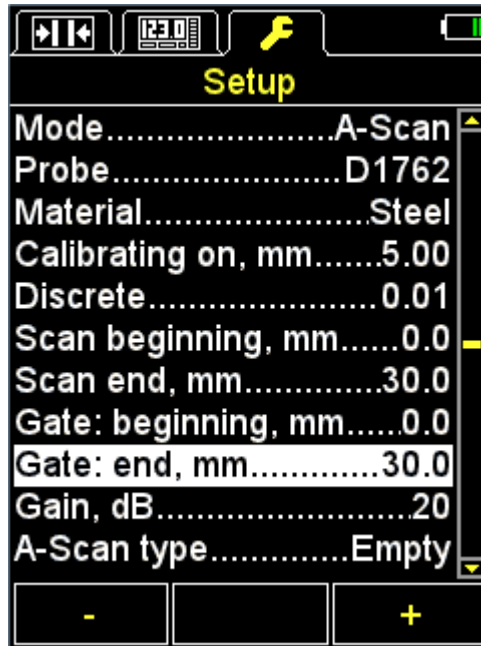


Figure 41


2.3.2.14 AMPLIFICATION option (for the A-SCAN mode only)


The AMPLIFICATION option allows setting the amplification value of the receive path of the instrument.

The value can be set within the range from 0 to 80 dB.

Display of the AMPLIFICATION option is presented on Figure 42.

Active keys:

F1 (-) or  – decrease the amplification value.

F2 (+) or  – increase the amplification value.

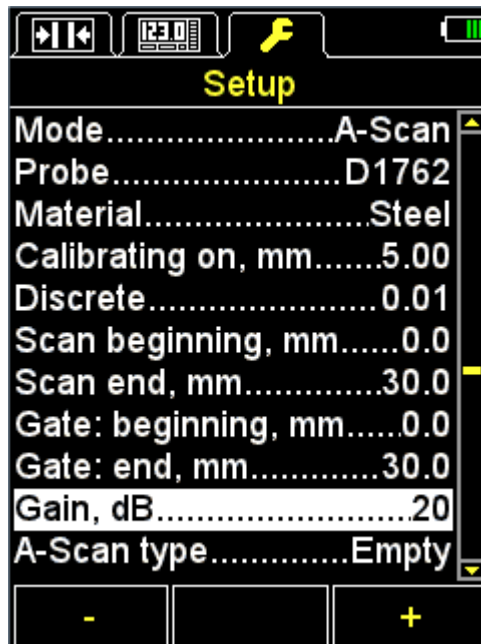


Figure 42

2.3.2.15 A-SCAN DISPLAY option (for the A-SCAN mode only)

Select the display of the signal in the A-SCAN mode and for viewing the saved A-Scans in the MEMORY mode – FILL / STROKE.

Display of the SCAN DISPLAY option is presented on Figure 43.

Active keys:

F1 (Fill) - the detected signal is displayed in the filled form.

F3 (Stroke) - the detected signal is displayed in the form of a contour line.



- switching between the signal display views.

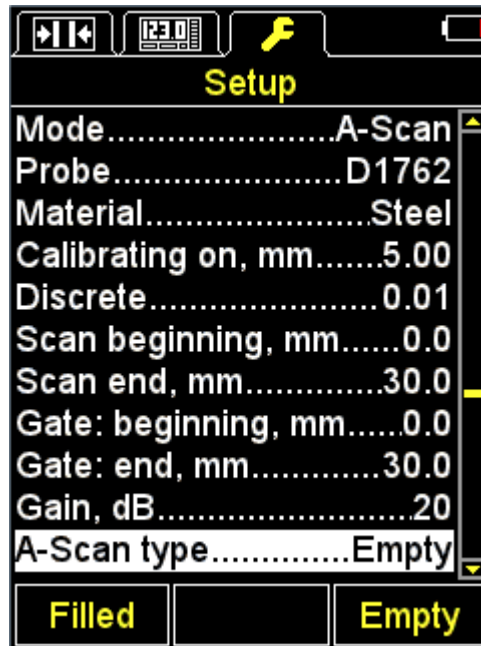


Figure 43

2.3.2.1 ORIENTATION option (for the A-SCAN mode only)

Select the form of the image orientation in the A-SCAN mode – AUTO / HORIZ.RIGHT / VERT / HORIZ.LEFT.

Display of the ORIENTATION option is presented on Figure 43.

Active keys:

F1 (Horiz.Left) – horizontal left.

F2 (Bepr) – vertical.

F3 (Horiz.Right) – horizontal right.



- switches to the mode of automatic adjustment of the image orientation depending on the instrument position.

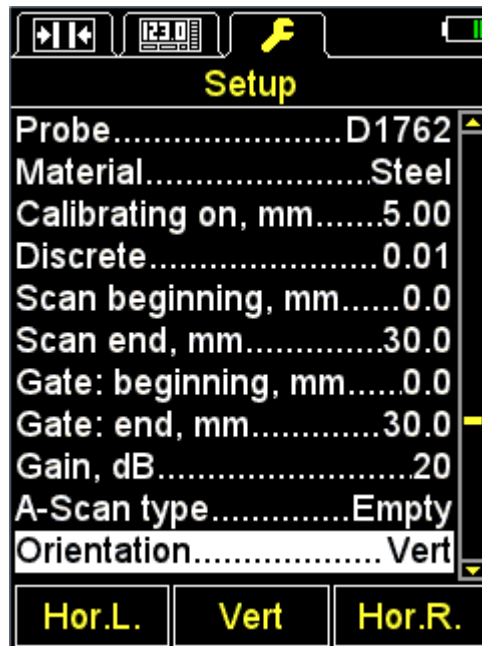


Figure 44

2.3.2.2 SOUND option

SWITCH ON / SWITCH OFF the sound indication of the instrument.

To improve the usability of the thickness gauge the main events occurring in the thickness gauge during measurements, adjustments, and when the keys are pressed, are accompanied with the sound indication. The sound indication as well is used for auditory monitoring of the ultrasound signals reception. The sound signals inform the operator about the processes not affecting the measurement results.

Display of the SOUND option is presented on Figure 45.

Active keys:

F1 (ON) - switch on the sound indication.

F3 (OFF) - switch off the sound indication;



- switch on/switch off the sound indication.

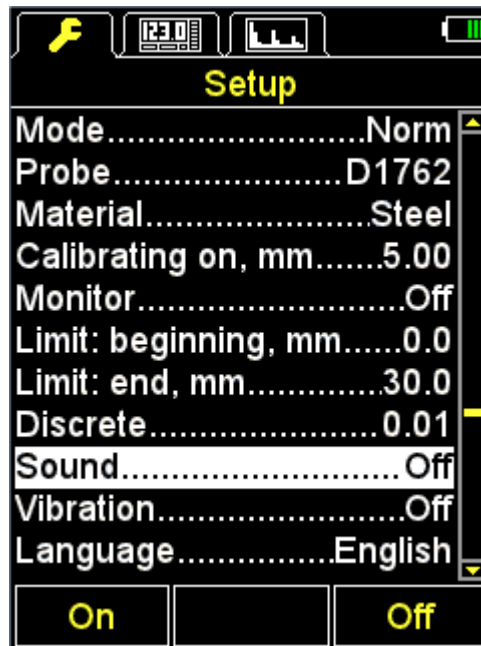


Figure 45

2.3.2.3 VIBRO- option

SWITCH ON / SWITCH OFF the vibro-indication of the instrument.

To improve the usability of the thickness gauge the main events occurring in the thickness gauge during measurements, adjustments, and when the keys are pressed, are accompanied with the vibro-indication. The vibro-indication informs the operator about the processes not affecting the measurement results

Display of the VIBRO- option is presented on Figure 46.

Active keys:

F1 (ON) - switch on the vibro-indication.

F3 (OFF) - switch off the vibro-indication;



- switch on/switch off the vibro-indication.

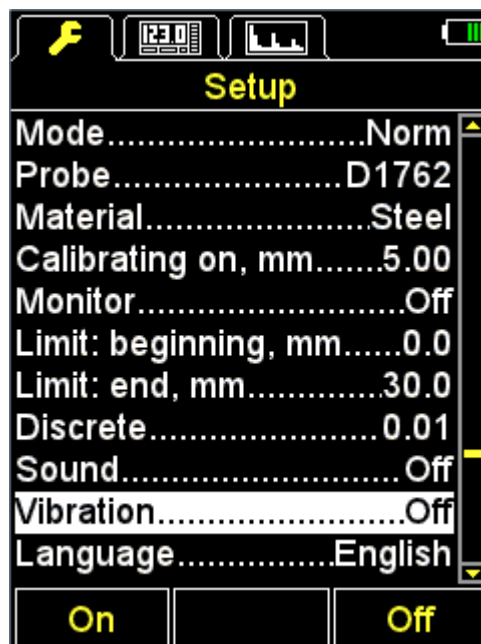


Figure 46

2.3.2.4 LANGUAGE option

The following instrument interface languages can be selected:

- Russian;
- English;
- German;
- French;
- Italian;
- Portuguese;
- Spanish;
- Chinese.

Display of the LANGUAGE option is presented on Figure 47.

Active keys:

F1 (Russian) – scroll left to select the language;

F3 (→) – scroll right to select the language;



- switching between the available interface languages.

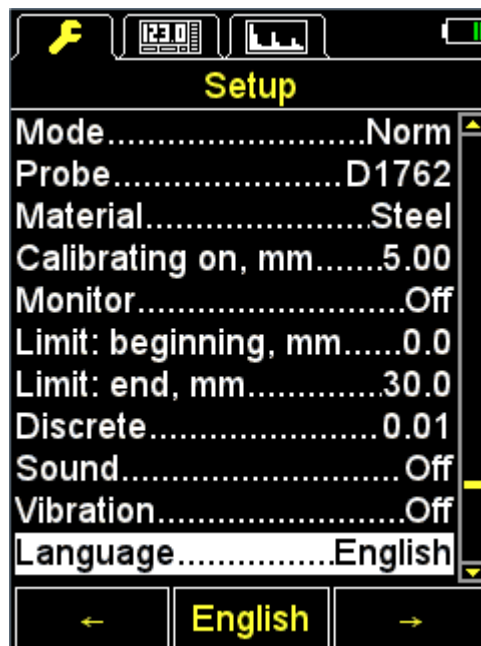


Figure 47

2.3.2.5 MEASUREMENT UNITS option

Select the system of the measurement units – mm / inches.

Display of the MEASUREMENT UNITS option is presented on Figure 48.

Active keys:

F1 (mm) - metric measurement units. The thickness shall be displayed in mm, velocity – in m/s.

F3 (inches) – British Imperial measurement units. The thickness shall be displayed in inches, velocity – in inch/microsecond;



- switching between the measurement systems.




Figure 48


2.3.2.6 BRIGHTNESS option

Set the display brightness within the range from 20 to 100 %.

Display of the BRIGHTNESS option is presented on Figure 49.

Active keys:

F1 (-) or  - decreases the display brightness.

F3 (+) or  - increases the display brightness.

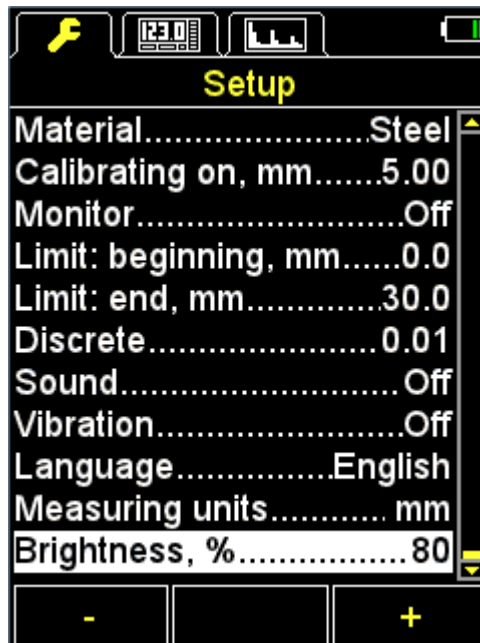


Figure 49

2.3.3 NORM mode

Work in this mode to determine if the thickness of the object under control is within the set limits.

Apply some coupling media onto the surface being tested to conduct the measurements. Put the transducer to the object under control. The indicator of the level of the acoustic contact and the indicator of the measurement method will be displayed in the upper left corner of the screen.

The instruments with enabled sound indication accompany the new readings in the AFAS menu by the beeps.

Display appearance in the NORM mode if AFAS actuation-INSIDE or AFAS-OUTSIDE is selected, is presented on Figure 50 (the measurement result is displayed in red if the AFAS actuation is activated, in white – if not activated).



Figure 50

Active keys:



- changes the velocity of ultrasound waves in the material.

If the instrument produces sound signals and the readings are being changed on the display, then you should fix the position of the ultrasonic transducer during 2-3 seconds and wait for stable readings.

ATTENTION: AFTER THE PT IS REMOVED FROM THE OBJECT UNDER TEST THE MEASUREMENT RESULT WILL IMMEDIATELY CHANGE INTO THE HORIZONTAL STROKES!




- saves the current result.

Note – The result will be recorded into the first free cell of the last existing group, created in the MEMORY mode. Enter the MEMORY mode to select the groups and view the saved value.

Value recorded into the instrument's memory in the NORM mode, can be adjusted in the MEMORY mode according to the instructions presented in Section 2.3.4.3.



After the  key is pressed, the “Save current result?” message will be displayed (Figure 51).

Active keys:

F1 (Save) - saves the result.

F3 (Cancel) - refuses to save.

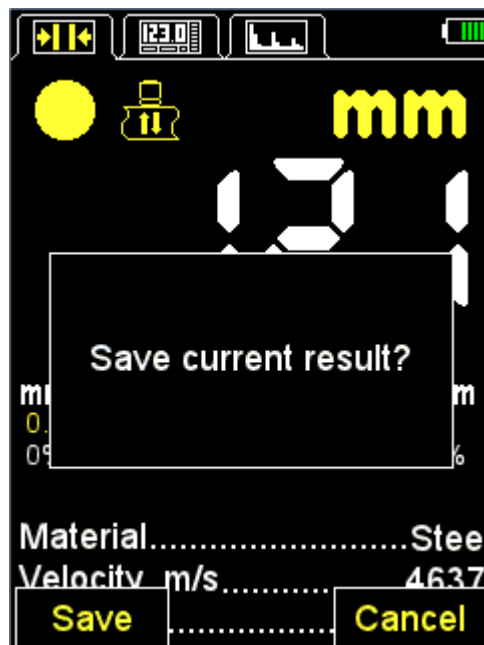


Figure 51

2.3.4 MEMORY mode

In the MEMORY mode the screen is divided into two parts: the upper part displays the measurement information in the same way as in the NORM mode (thickness, level of the signal, measurement method, velocity of the ultrasound wave in the current material); the lower part

displays information on the results already saved in the NORM, MEMORY and A-SCAN modes (groups, cells of the groups and thickness measurement results) (Figure 52).

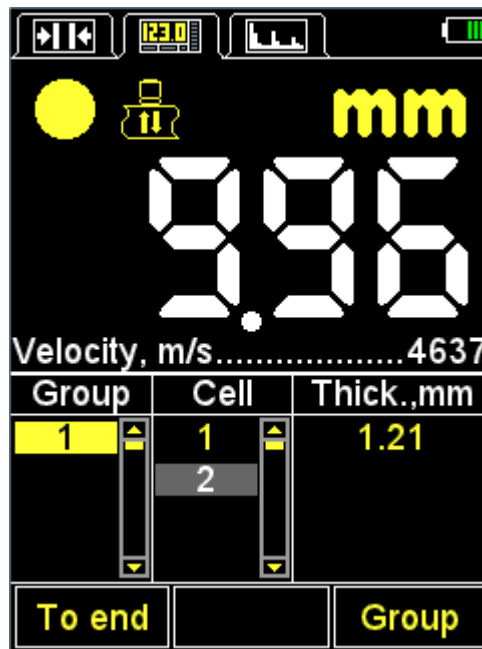




Figure 52

Active keys:

F1 (To end) – goes to the empty cell (the cell following the last recorded) of the last of the existing group.

F3 (Group) - adds new group/delete the last on of the groups.

 - saves the measurement result in the current group. Select any existing group before measurement or during it to save the result.

 - views and adjusts the measurement results recorded in the instrument's memory.

2.3.4.1 Add new group/delete the last one of the groups

Press the F3 key and the “Add /+/ new or delete /-/ the last group?” message will be displayed (Figure 53).

Active keys:

F1 (–) – deletes the last group.

F2 (Cancel) - exits the procedure.

F3 (+) - adds a new group, provided that the last existing group is not empty.

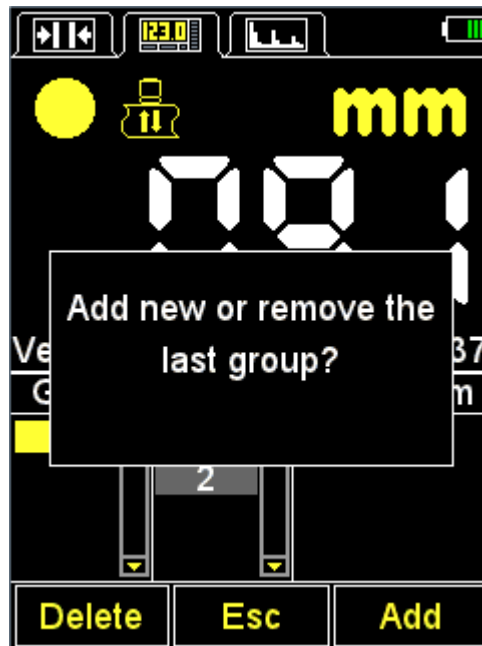


Figure 53

2.3.4.2 Save the result

Measurement results are stored in the instrument's memory in the cells. The cells form the groups. The groups and the cells in the groups are identified by the serial numbers. Numbering of the groups and the cells in each group is starting with 1.

Maximum quantity of the cells in the group - 500.




Maximum quantity of the groups - 100.

When the quantity of the cells in the group becomes maximum the instrument's display will indicate a corresponding information message.

In practice it is more convenient to record the results into small groups (by several dozen values). You can create a new group when required (Section 2.3.4.1). You can return to any existing group if required and continue recording the results into it.

2.3.4.3 View and adjustment of the measurement results

The user can view any result recorded into the instrument's memory. The result can be remeasured in the same point and overwritten if the user doubts about its reliability.

Key  - enters the mode of view and edition of the results. After the  key is pressed, the  (Figure 54) will be displayed.

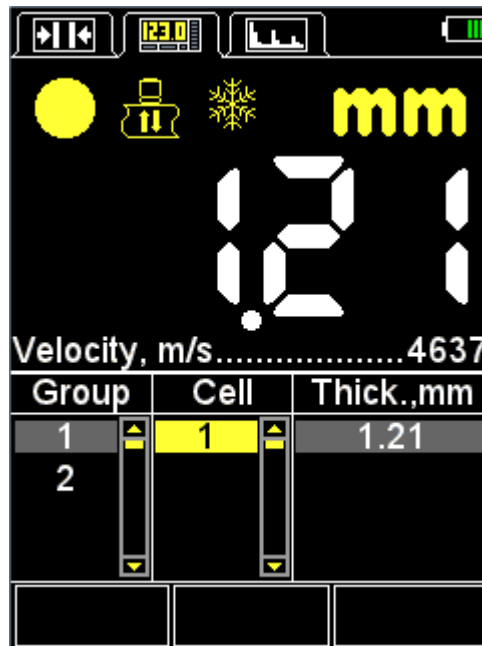









Figure 54


Key  - returns to the MEMORY mode.


To view the recorded results use the   keys. Scrolling along the measurement results is performed successively by the cells of the groups, according to the selected view mode. After the first/last cell in the group is reached, the program switches to the next/previous group of the results correspondingly.

To the following to correct the result:

– using the keys   switch to the cell with the recorded result which will be corrected;

– press the key , at that the  sign will disappear.

Note – Actually the result will remain in the instrument's memory up to the moment it will be recorded to the selected cell of new purpose. To return to the view mode not changing the result in the cell, press the  key.

– perform the measurement. If the measurement result is satisfactory, then press the key  to record in into the selected cell. The instrument will automatically return to the view mode after doing it.

2.3.5 The A-SCAN mode

The measurement of the thickness in the A-SCAN mode represents analysis of the image shape of the echoed signal, selecting the analysis interval and criteria of calculation of the passage time of the ultrasonic pulses going through the material of the object from one surface to another. The time related to the propagation velocity of the ultrasound impulses going through the material will be recalculated into the thickness value of the object being tested.

In the A-SCAN mode with the vertical orientation the display is divided into two parts: the upper parts displays the signal in the form of A-Scan, and the lower part displays the digital values of the parameters and control icons (Figure 55).

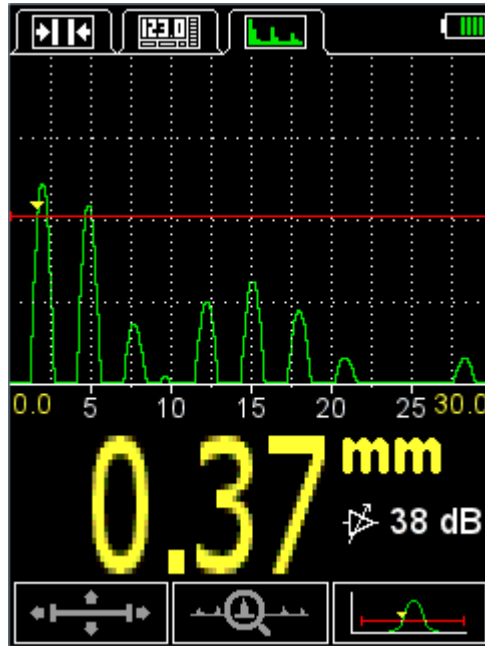






Figure 55

Main Active keys:

F1 () – control over the size and position of the strobe.

F2 () – control over the signal display.



F3 () – selects the measurement methods: first overshoot of the strobe/ between two peaks of the signal / auto correlation function (ACF) in strobe / maximum point at the strobe.



 - saves the measurement result.

Note – The result will be recorded into the first free cell of the last existing group, created in the MEMORY mode. Enter the MEMORY mode to select the groups and view the saved value.

Functional purpose of the keys with the first active icon is presented in Table 9 .







Table 9

Key	Function
	Change the length of the strobe relative to its left boundary
	Vertical displacement of the strobe

Key	Function
 	Horizontal displacement of the strobe



Functional purpose of the keys with the second active icon is presented in Table 1 0 .

Table 1 0


Key	Function
 	Change the scanning length
 	Change the amplification value
 	Horizontal scrolling of the signal on the display

Functional purpose of the keys with the third active icon is presented in Table 1 1 .

Table 1 1

Key	Function
 	Change the amplification value

2.3.5.1 Save the A-Scan

After the  key is pressed the display will show the “Save current A-Scan?” confirmation message (Figure 56).

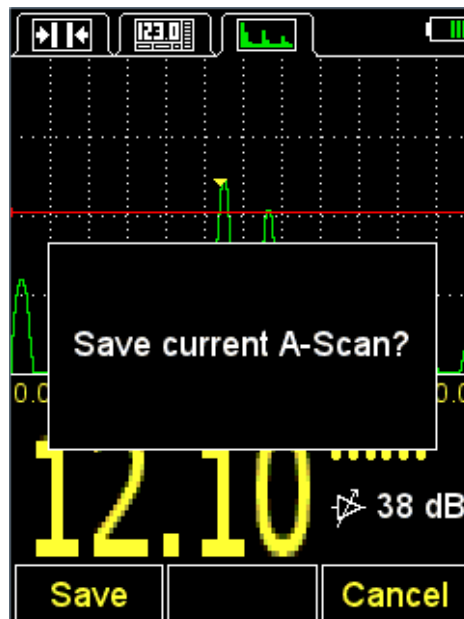


Figure 56


Note – The result will be recorded into the first free cell of the last existing group created in the MEMORY mode. Enter the MEMORY mode to select the groups and view the saved value.

Active keys:

F1 (Save) - saves the digital value of the measurement result and its A-Scan.

F3 (Cancel) - refuses to save.

2.3.5.2 Viewing the saved A-Scans

Enter the MEMORY mode to view the saved A-Scans and corresponding measurement results. The data for which the A-Scans are saved in the column of the measurement result are marked with the  sign in front of the result value (Figure 57).

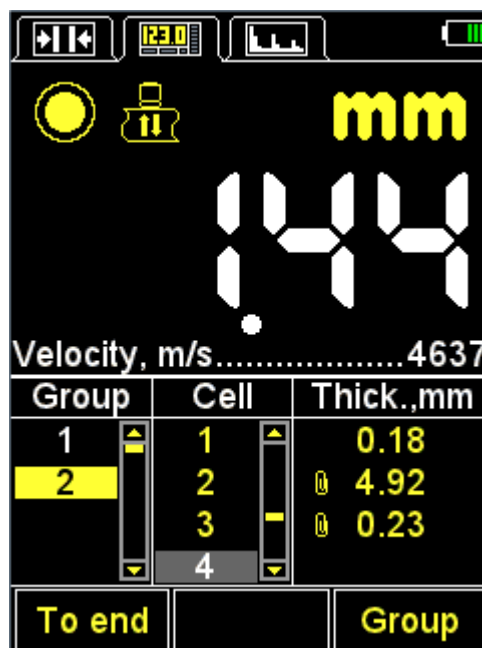



Figure 57

Press the key  to enter the view mode and press the F2 key (A-Scan) (Figure 58).

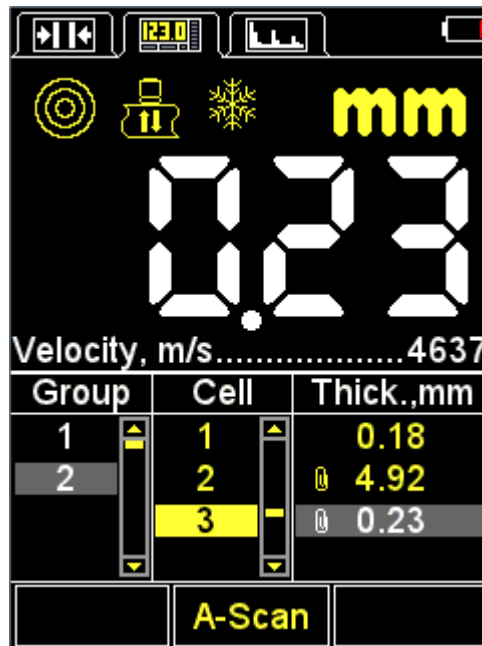


Figure 58

The A-Scan saved for the selected result (Figure 59) will be displayed in the upper part of the screen.

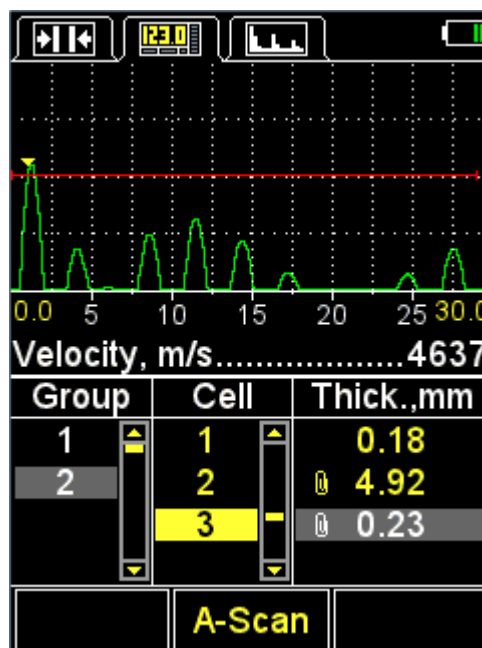


Figure 59

Press the F2 key (A-Scan) to return to the view mode of the results.

Value recorded into the instrument's memory in the A-SCAN mode, can be adjusted in the MEMORY mode as described in Section 2.3.4.3.

ATTENTION: THE GRAPHIC IMAGE OF THE SIGNAL (A-SCAN) WILL BE LOST AFTER CORRECTION OF THE DIGITAL VALUE!

2.4 MEASUREMENTS

Before doing the measurements: select the transducer from the library, adjust the instrument and select the material for measurement. If the set velocity in the material differs from the real one, then adjust the velocity manually or perform the calibration.

Accuracy of the measurement results depends on the accuracy of the velocity settings. If the evaluation measurements are permitted, then you can use the Table presented in the Appendix A and set the value listed in the Table.

If the accurate measurement results are required: take the reference of the same material as the object being inspected and adjust the velocity value to it. The velocity shall be adjusted with the same PT which will be used for measurement. The manufacturer recommends using a plane parallel sample with smooth surfaces. You should remember that the thicker the sample is (in limits of the presented ranges) and the better is surfaces, the more exactly settings of the device on the ultrasonic waves velocity you will make.

The surface where the transducer will be placed shall be clean, have no sharp bulges or hollows making it difficult to place the transducer on the surface. Drop some contact liquid on the surface. You cannot measure the hollows where the transducer cannot be placed.

2.4.1 Measurements with double crystal (PC) transducer

To perform the measurements of the flat objects you just have to carefully press the ultrasonic transducer to the testing surface and wait for 2-3 seconds to squeeze the excess of the lubricant. During this time the readings of the instrument should stop changing and show the final result. Read the measurement result from the instrument's display or record it into the memory depending on the selected measurement method with the instrument being on the surface.

If the surface of the testing object is corroded, then it is recommended to scrape the loose rust off and put more contact liquid, than when testing the smooth surface. If there is no indication of the acoustic contact on the display, then thoroughly clear the surface being inspected and repeat the measurement. Such scraping of the rough corroded surfaces allows increasing of the measuring exactness, and prolongs the service life of the transducer.

The measurement process of the cylindrical objects has some peculiarities. When measuring the tube wall thickness, especially of the small diameters, it is recommended to use more viscous fluid than the water and to put more of them on the contact point. Orient the screen (its end face in the form of a light strip is located on the diameter of the working surface that divides the prisms of the transducer) across the tube's axis. Pressing the transducer to the tube's wall and looking after the instrument readings, slowly tilt the transducer in the plane perpendicular with the tube's axis to both directions. At that the transducer at that shall roll along the tube wall. The transducer should not slide along the tube wall. Usually at the deviation of the transducer from the average location, the readings increase a little. Usually the readings are minimal in the position when the transducer touches the tube wall with the middle of its working surface, i.e. the longitudinal axis of the transducer intersects the tube's axis. At strong deviation of the transducer from this position the readings will increase stepwise. You should take the minimal most stable readings for the real value of measurement when the PT touches the tube wall with a middle of its working surface.

2.4.2 Measurements with single-crystal transducer

When the PT touches the surface of the object being inspected, the stable acoustic contact of the transducer and the object will be established in a second as a rule. At that the instrument's display will indicate the readings. These readings will change during measurement of the small-

diameter pipes when the transducer is tilted; the readings will remain stable when measuring the flat surfaces.

When inspecting the flat metal objects with a thickness of less than 4-5 mm there is no need to make the contact liquid layer as thin as possible, i.e. there is no need to strongly press the transducer against the surface, forcing it against the surface. Press the transducer a little so that to make the thickness gauge to display the measurement results. From this moment the readings will remain almost the same.

Press the transducer stronger against the surface if the thickness of the flat object is more than 20 mm.

The measurement process of the tube walls is quite simple since there is no need to position the transducer relative to the tube. There is no need to tilt the transducer on the tube looking for the minimal measured value. Place the transducer with a middle of its working surface against the element of the tube. Take a thick coupling media, such as petrolatum or litol.

While testing the objects with dual convex curvature always provide the contact point of the object with the center of the working surface of the transducer.

The single-crystal transducer has advantages as compared to the PT transducer when doing measurements of the objects with rough or coarse surfaces. The single-crystal transducer enables scanning even the rough surfaces with presence of the abrasive particles. This can be useful when searching for thinnings. For this mode it is recommended to use flowable contact liquids, for example, mineral engine oil.

In all cases you should wait 1-2 seconds after the readings appear on the display to evaluate their stability. After that, with the transducer on the surface, read the measurement result from the instrument's screen or save it to the memory.

2.4.3 Functionality check of the instrument during inspection

You will have to check the functionality of the instrument during inspection if, for example, you have a series of questionable readings during measurement.

Use the control testing sample built in the instrument to check the functionality. Sample thickness is 5 mm, and propagation velocity of the ultrasonic waves in it is 5750 m/s.

Set the velocity value in the instrument to 5750 m/s, apply some coupling media onto the control (reference) sample and place the ultrasonic transducer on the sample. If the instrument is working properly, the thickness measurement result will equal to 5 mm considering the measurement error.

2.5 TRANSFER DATA TO PC

Digital data are saved in the instrument's memory in the **CSV** format convenient for export. Thus the measurement results can be further analysed and processed by means of the external programs (Figure 60). The data will be saved into a single file named "**results.csv**". The results are arranged in the file according to the number of the group.

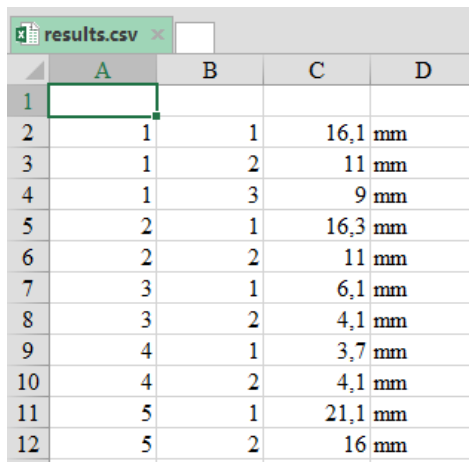
A-Scans shall be saved into the files named as "**aXXX-YYY.bmp**", where **XXX**- a serial number of the group, and **YYY**- a serial number of the measurement in the group.

Do the following to transfer the data from the instrument to PC: connect the instrument to PC via the USB A – Micro B cable included into the delivery kit.

The OS will detect the instrument as an external removable disk named "**ACSYS DISC**" openable in the MS Windows "Explorer" or any File Explorer.

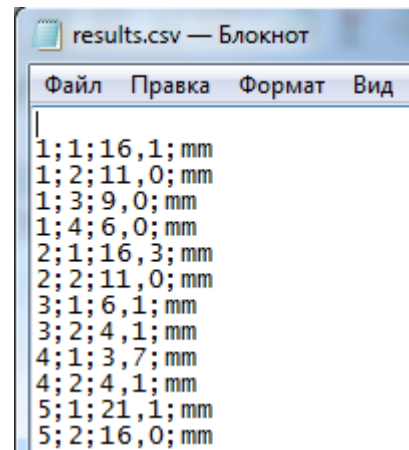
The data can be read directly from the instrument as well as copied to the PC.

You can name the data file as required for copying.



	A	B	C	D
1				
2	1	1	16,1 mm	
3	1	2	11 mm	
4	1	3	9 mm	
5	2	1	16,3 mm	
6	2	2	11 mm	
7	3	1	6,1 mm	
8	3	2	4,1 mm	
9	4	1	3,7 mm	
10	4	2	4,1 mm	
11	5	1	21,1 mm	
12	5	2	16 mm	

Data in MS Excel



```
1;1;16,1; mm
1;2;11,0; mm
1;3;9,0; mm
1;4;6,0; mm
2;1;16,3; mm
2;2;11,0; mm
3;1;6,1; mm
3;2;4,1; mm
4;1;3,7; mm
4;2;4,1; mm
5;1;21,1; mm
5;2;16,0; mm
```

Data in Notepad

Figure 60

3 TECHNICAL MAINTENANCE

Technical maintenance of the thickness gauge includes cleaning the electronic unit of dirt and dust and charging the accumulator.

3.1 ACCUMULATOR

Instrument's accumulator is designed to be operated within a broad temperature range.

At negative temperatures the accumulator capacity is reduced. At the lower value of the temperature range the capacity is 15% below the capacity at normal temperature.

The instrument will automatically switch off when the accumulator is completely discharged.

The accumulator is equipped with built-in battery overcharge protection, overdischarge, overcurrent and over temperature.

The accumulator service life is designed for the guaranteed service life of the instrument.

The accumulator shall be replaced by the service centers only.

ATTENTION: THE INSTRUMENT WARRANTY WILL BE VOIDED IF THE USER REPLACES THE ACCUMULATOR INDEPENDENTLY!

3.2 CHARGE THE ACCUMULATOR

The accumulator shall be charged via the external charger or PC (USB port).

Charge time depends on the depletion of the accumulator. Total charge time is 4-5 hours. The accumulators of this type can be recharged often.

The instrument can be operated during charging of the accumulator, though the charge time at the time will increase in 2-3 times.

3.3 POSSIBLE MALFUNCTIONS

Always contact the manufacturer representatives if there are any malfunctions or questions about instrument operation.

4 STORAGE

The thickness gauge shall be stored in the bag included into its delivery kit. Storage conditions shall correspond to GOST15150 69 (placement category 1).

The instruments shall be stored on shelves.

The arrangement of the instruments in warehouses shall enable their free movement and unrestricted access to them.

Distance between the instruments and the walls, floor of the warehouse and other warehoused instruments shall be at least 100 mm.

Distance between the heating units in the warehouses and the instruments shall be at least 0.5 m.

The storage room shall be free from the current-conducting dust, admixtures of aggressive gases and corrosive vapors able to attack the instruments.

5 TRANSPORTATION

Thickness gauge shall be transported in the bag included into its delivery kit.

Transportation conditions with regard to the impact of the external environment climatic factors should correspond to storage conditions (placement category 5) according to GOST 15150-69.

Packaged instruments can be transported in any vehicles to any distances without speed limits.

When transported in open vehicles the instruments shall be protected against protected from rain and water splashes.

Packaged instruments should be properly and steadily fixed to prevent their hitting against one another and against vehicle walls during transportation.

Transportation conditions of the instruments shall correspond to technical requirements and norms valid for the given type of the transport.

If shipped by air transport, properly packed instruments should be placed in hermetically sealed heated compartments.

If transportation conditions differ from the operation conditions, then the instruments shall be kept under normal climatic conditions for at least 2 hours prior to operation.

APPENDIX A

(reference)

Velocity of the longitudinal ultrasonic waves in some materials are presented in Table A.1.

Table A.1

Material	Velocity, m/s	Material	Velocity, m/s
Aluminium	6260	Concrete	2000 - 5400
Aluminium alloyD16T	6320	Basalt	5930
Phosphorus bronze	3530	Gabbro 38	6320
Vanadium	6000	Gypsum	4790
Bismuth	2180	Foliated granite	7870
Tungsten	5460	Granite	4450
Iron	5850	Toadstone 85	5800
Gold	3240	Dolomite	4450
Constantan	5240	Lime-stone	6130
Brass	4430	Lime-stone 86	4640
Brass-LS-59-1	4360	Capron	2640
Magnesium	5790	Silica glass	5930
Manganin	4660	Labradorite 44	5450
Mangan	5561	Ice	3980
Copper	4700	Marble	6150
Molybdenum	6290	Plexiglas	2670
Nickel	5630	Polystyrene plastics	2350
Stannum	3320	Rubber	1480
Osmium	5478	Mica	7760
Lead	2160	Organic glass	2550
Silver	3600	Silicate glass	5500
Ceramized glass	6740	Steel X15H15ГC	5400
Steel 20 ГЧДМ	6060	Steel St3	5930
Steel XH77TIOP	6080	Textolite	2920
Steel 40XHMA	5600	Teflon	1350
Steel XH70BMTIO	5960	Porcelain	5340
Steel XH35BT	5680	Hardened rubber	2400
Tantalum	4235	Zirconium	4900
Chrome	6845	Cast iron	3500 - 5600
Zinc	4170		



A1210 Ultrasonic Thickness Gauge

OPERATION MANUAL

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