



Lintel

Automated laboratory equipment for quality control

Ductilometer. Ductility of Bituminous Materials.

***Lintel*[®] DB-20-100**

Operation manual

WIRELESS INTERFACE SUBSYSTEM

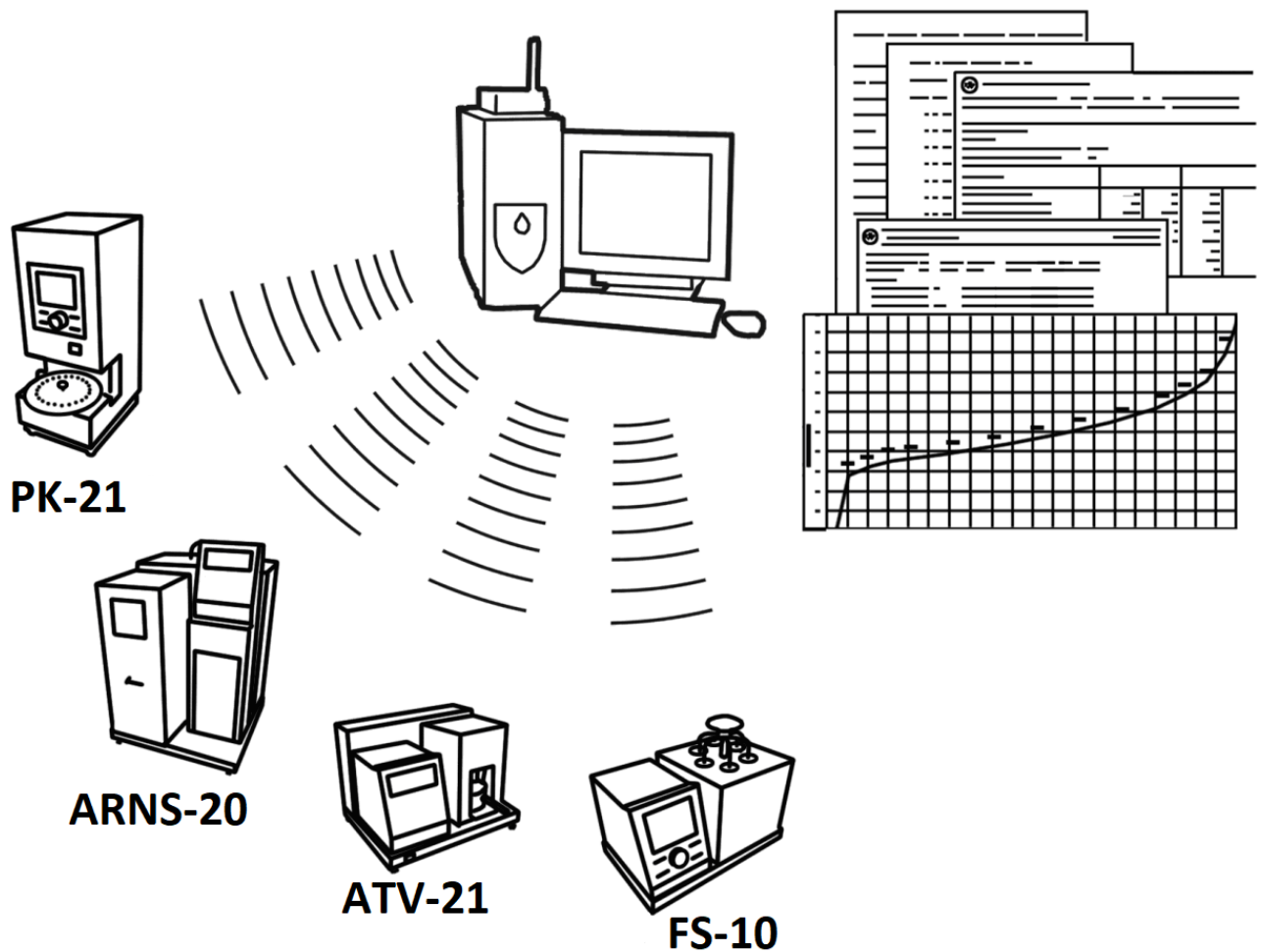
Wireless interface subsystem (further WIS) is designed for operation automation of petroleum product quality control laboratories.

Wireless interface subsystem has the following functions:

- automatic transfer of test results from the tester located in the laboratory to PC via wireless communications channel (IEEE 802.15.4/ZigBee standard);
- safe storage of information obtained from the tester in a common database;
- user-friendly, standardized representation of information to the user (in a table-oriented, graphical, printed view);
- providing tools for effective work with test results, tools for calculating accuracy parameters using standard methods.

Wireless interface subsystem provides communication at the distance up to 100 m indoors, all Lintel® tester can be integrated in a common network.

Lintel® tester are equipped with hardware and software providing tester operation with the Wireless Interface Subsystem¹.



System operation requires purchase and installation of a radio modem with USB interface and PC software. The software includes data communication protocol driver and Lintel® - LINK software. Test results are automatically transferred to the database, which simplifies access to data and schedules, improves the quality of work, and eliminates most routine operations.

¹ For additional information, please, call (347) 284-44-36, 284-27-47.

Up-to-date devices for petroleum product quality control

Thank you for purchasing and usage of Lintel® DB-20-100 automatic tester for determining the extensibility of petroleum bitumen.

Since 1959, BSDO Neftehimavtomatika JSC has been manufacturing and supplying tester for quality control of petroleum products in the laboratories of factories, airports, and fuel and energy complex enterprises.

Our tester's implement STANDARD METHODS, have passed metrological certification, are included in MI 2418-97 "Classification and application of technical means of testing of petroleum products" and the corresponding GOSTs Standards as a means of implementing quality control methods.

The tester has special solutions that allow you to implement in addition to standard methods and methods for performing research, which is especially important when developing new types of products. Lintel uses the latest technologies and components to ensure consistently high quality of tester, convenience of their operation, in order to reduce the time spent on testing and increase the efficiency of your work.

CONTENT

1 LIST OF ABBREVIATIONS	2
2 DESCRIPTION AND OPERATION.....	2
2.1 Purpose	2
2.2 Specifications	2
2.3 Arrangement and operation	3
3 PREPARATION FOR OPERATION.....	6
3.1 Requirements for installation place.....	6
3.2 Visual control	7
3.3 Test run	7
4 INTENDED USE.....	8
4.1 Additional equipment and materials	8
4.2 Operating limits.....	8
4.3 Sample preparation.....	8
4.4 Tester preparation for testing.....	9
4.5 Testing.....	9
4.6 Processing test results	19
4.7 Completing work.....	20
4.8 List of potential failures	24
4.9 Emergency response.....	25
5 MAINTENANCE	25
5.1 Maintenance	25
5.2 Additional equipment and materials	25
5.3 List of operations	26
5.4 Washing.....	26
5.5 The descaling.....	27
5.6 Cleaning of the molds	27
5.7 Checking the protective shutdown device.....	27
5.8 Checking the length meter.....	27
5.9 Checking the bath temperature sensor	28
5.10 Checking force sensors	29
5.11 Calibration of the length meter	31
5.12 Calibration of the bath temperature sensor.....	32
5.13 Calibration of force sensors	33
6 STORAGE AND TRANSPORTATION	35
6.1 Storage	35
6.2 Transportation	36
APPENDIX A. Data transfer by RS-232	37
APPENDIX B. USER INTERFACE.....	44

The operating manual contains information about the design, operating principle, characteristics of the automatic Lintel® DB-20-100 and instructions necessary for its correct and safe operation.

1 LIST OF ABBREVIATIONS

Tester –automatic tester DB-20-100 for determining the extensibility of petroleum bitumen

PC – personal computer.

PSD - protective shutdown device

2 DESCRIPTION AND OPERATION

2.1 Purpose

The tester is automatic Lintel® DB-20-100 (further tester) manufactured in accordance by TU 28.99.99-053-0015785-2016, it is a desktop-type test equipment and is designed to determining the tensile strength, elasticity, strain energy of petroleum bitumens, as well as testing plastics and polymers for tensile strength in accordance with standards GOST 11505, GOST 33138, GOST R 52056, GOST 11262, ASTM D 113, EN 13398, ASTM D 6084, EN 13703, EN 13587, EN 13589.

2.2 Specifications

2.2.1 Performance data of the tester given in Table 1.

Table 1 – Performance data

Parameters	Unit of measurement	Value
Tap water temperature	°C	from +5 to +15
Tap water consumption, not less than	liters /min	3
Number of simultaneously tested samples	pcs.	from 1 to 3
Maximum load on each meter	N	300
Range of supported bath temperature ¹	°C	from -10 to +40
Speed of movement of the carriage	cm/min	from 0,1 to 100
The volume of the bath	liters	17
Voltage	V	from 198 to 242
Frequency	Hz	from 49 to 51
Power consumption, max	W	650
Ambient temperature	°C	From 10 to 35
Relative humidity at +25°C, max	%	80
Barometric pressure	mm Hg	from 680 to 800

2.2.2 Weight and dimensions of the tester given in table 2.

Table 2 – Weight and dimension

Parameters	Unit of measurement	Value
Dimensions of the tester (width x height x depth)	mm	1750x260x370
Weight of the device in the package, max	kg	100
The volume of packaging, max	m ³	0.4

¹ At a tap water temperature of +10°C.

2.2.3 The accuracy parameters of the oven given in table 3.

Table 3 – The accuracy characteristics

Parameter	Unit of measurement	Value
Force measurement accuracy ¹	%	±1
Irregular temperature of the coolant in the bath, max	°C	0,5
The error of temperature measurement, max	°C	±0,2
Accuracy of carriage speed maintenance, max	cm/min	±0,25
Length measurement accuracy	mm	±2
Deviation of form dimensions		meet the standards

The manufacturer guarantees that the accuracy parameters confirmed during the initial certification after transportation remain unchanged.

2.2.4 List of automated functions:

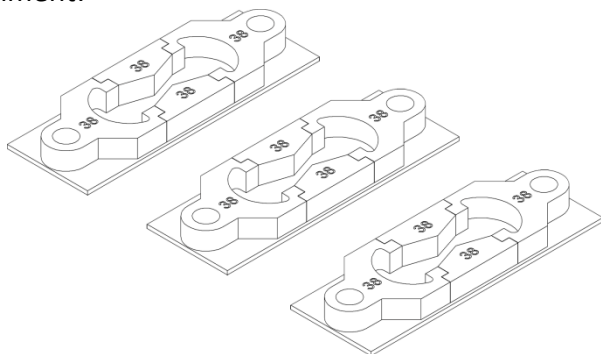
- 1) maintaining the set temperature of the coolant;
- 2) setting the carriage to the desired position;
- 3) moving the carriage at a set speed;
- 4) measuring the tension force of samples and displaying it on the display;
- 5) measurement of sample elongation;
- 6) fixing the sample break when the tension force falls below the specified threshold or when the operator presses a remote button;
- 7) determination of sample elasticity;
- 8) determination of the standard strain energy of samples;
- 9) storing test results and graphs of force dependence on elongation of samples in non-volatile memory of the device with the possibility of transmitting to a personal computer (PC) via RS-232 interface or using the wireless interface subsystem (WIS);
- 10) customizable timer for easy sample preparation;
- 11) delayed start of the thermostat;
- 12) overload protection of force sensors.

2.3 Arrangement and operation

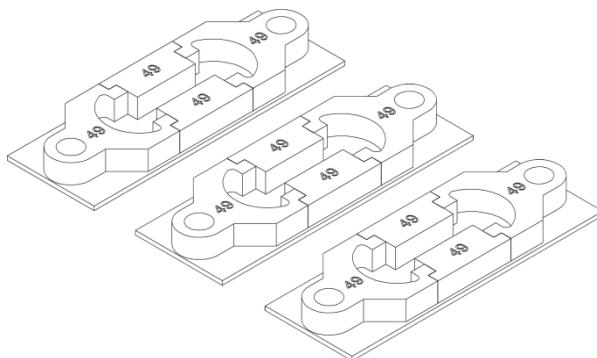
- 1) Scope of delivery:
- 2) Tester LinteL® DB-20-100 AIF 2.773.019.
- 3) Operational documents:
 - Operating manual AIF 2.773.019 RE;
 - Passport AIF 2.773.019 PS;
 - Certification program and procedure AIF 2.773.019 MA.

¹ Relative to the measured force; for a force less than 30 N, the error is not more than 0.3 N.

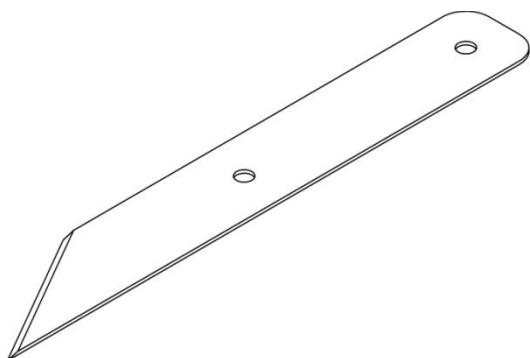
4) Attachment:



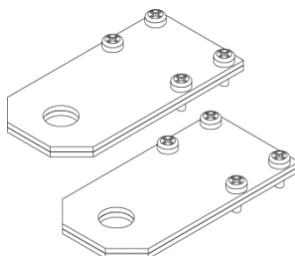
Mold assembly type 1 AIF 6.434.013-03
(EN 13398, ASTM D 113, GOST 11505, GOST
R 52056, GOST 33138)¹



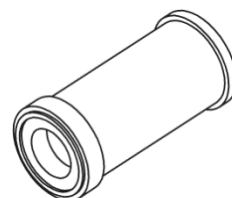
Mold assembly type 2 AIF 6.434.014²
(ASTM D 6084, EN 13589)¹



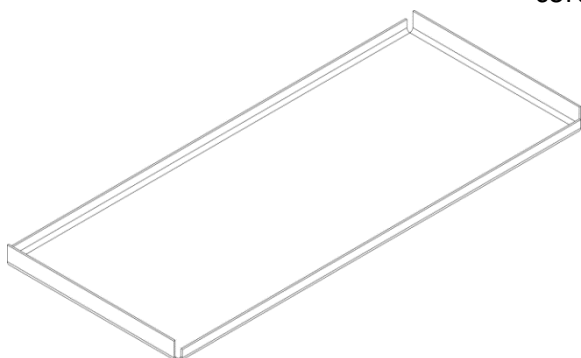
Knife



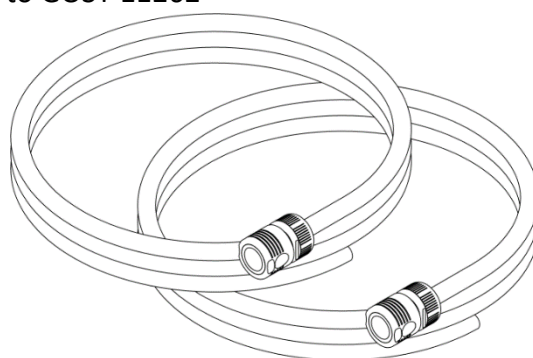
Clamps for testing ac-
cording to GOST 11262



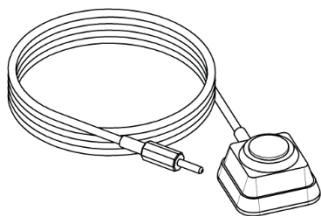
Coarse filter



Sample table



Hoses with quick-release couplings



Remote button

2.3.1 General view of the tester is shown in figure 1, page 5. Tester is switched on by the "**POWER**" toggle switch (1). Protective cover (2) covers the cable system of the carriage drive. The coarse filter (3) prevents debris from entering the outlet of the bath. The touch screen (4) is used to control the tester. The coolant is poured into the bath (5). Tube (6) is designed to drain the coolant.

ATTENTION

Do not use the device with the cable cover open to prevent injury in the event of a cable break.

¹ The appearance of forms for bitumen assembly type 1 and 2 may differ from the one presented in compliance with all sizes according to standards.

² It is delivered by the separate order.

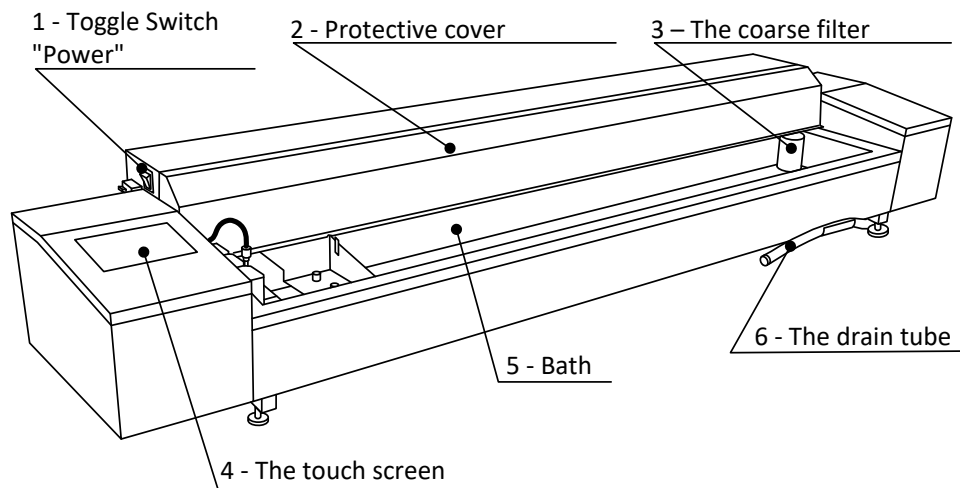
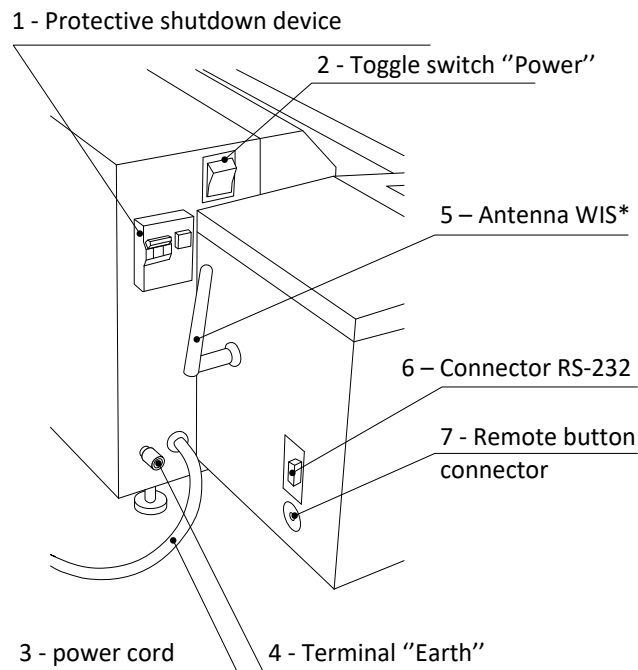


Figure 1 – General view of the tester

2.3.2 The power supply and communication connectors are shown in figure 2.



* Supplied with the module WIS as an option

Figure 2 – Power supply and communication connectors

2.3.3 Connecting tap water

ATTENTION

Do not operate the tester without installing a water softener filter. Otherwise, it is possible to reduce the performance of the cooling module and its failure.

The connection diagram of the tester to the water supply is shown in figure 3, page 6.

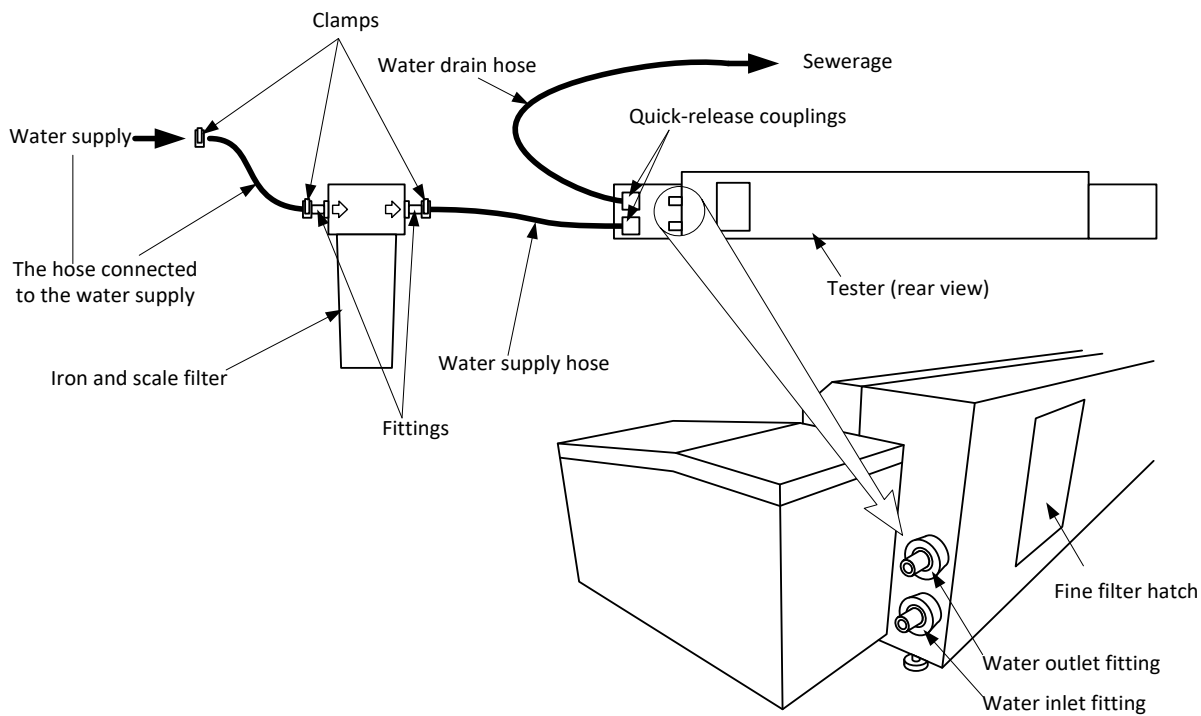


Figure 3 –Connecting to the water supply

2.3.4 The loading system is shown in figure 4. Before testing, the sample forms are mounted on pins on the force sensors (1) and on the movable carriage (4). The basic position of the carriage is marked on the casing of the cable system with the mark "0 cm" (6). The bath is filled with the coolant to the limit (5). A built-in temperature sensor (2) controls the temperature of the coolant. When the tester is certified, the exemplary thermometer is inserted into the socket (3).

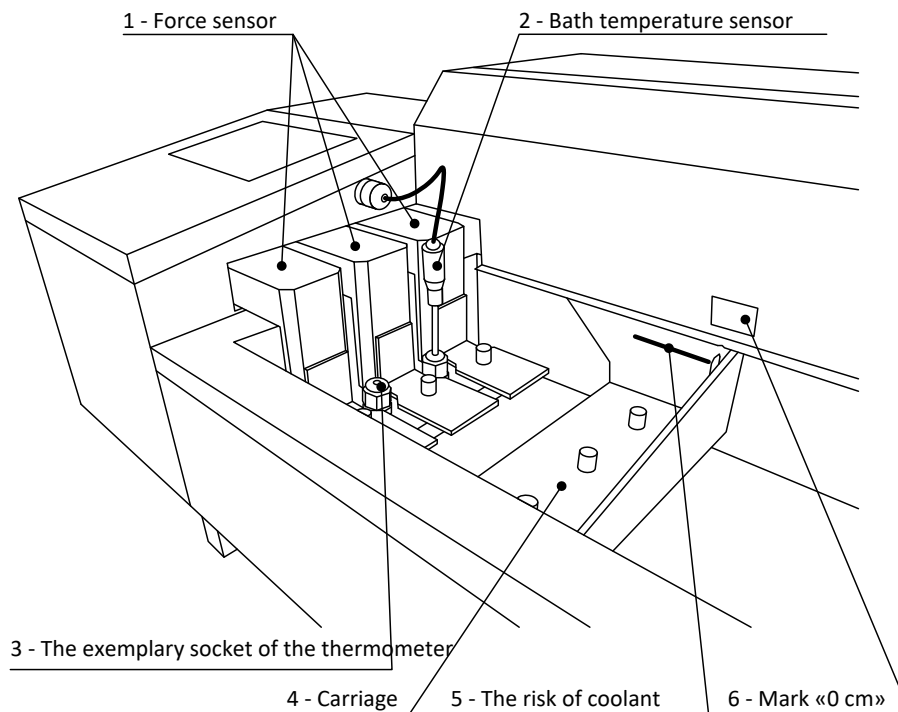


Figure 4 – Loading system

3 PREPARATION FOR OPERATION

3.1 Requirements for installation place

3.1.1 Tester design is intended for table-top installation.

3.1.2 At the installation site, vibration with a frequency of 5 to 25 Hz with an amplitude of no more than 0.1 mm is allowed.

3.1.3 The tester should be connected to a Euro socket that has a ground connection, and it should also be connected to a ground terminal (see figure 2, page 5). Use a ground loop that is not connected to the power one as the ground bus.

3.1.4 The tester should be connected to the water supply (see paragraph 2. 3. 4 of this Operating manual).

3.2 Visual control

Before using the tester:

- 1) unpack the tester;
- 2) check scope of supply;
- 3) perform visual control of the tester for damage;
- 4) check for supporting documentation.

An appropriate report is drawn up for all defects.

3.3 Test run

ATTENTION

After entering a heated room from a zone with a temperature below 10°C, keep the tester in the package for at least 4 hours.

3.3.1 Turn the power cord of the tester into a socket ~220V 50 Hz.

3.3.2 Turn on the tester with the "Power" toggle switch (see figure 1, page 5).

The safety shut-off device must also be switched to the "I" position (toggle up).

After 2-3 seconds, the initial window will appear on the display (see figure 5).

BASHKIR SPECIAL DESIGN OFFICE NEFTEHIMAVTOMATIKA	
DUCTILOMETER. DUCTILITY OF BITUMINOUS MATERIALS. LinteL ® DB-20	
450075, Ufa, Oktyabrya pr., 149 Telephone: (347) 284-28-32 Fax: (374) 284-26-00 E-Mail: support@bashnxa.ru Website: http://bashnxa.ru Skype: neftehimavtomatika	1.01
CONTINUE	

Figure 5 – The initial window

When the tester initialization is complete, a waiting window opens (see figure 6).

①	READY TO TEST				⑤
②	Bath temperature	35.4°C	MENU		⑤
	Force	0.0 N 0.0 N 0.0 N			
	Test parameters		TO BASE		⑥
	Method:	GOST R 52056-03			
	Mode:	relax. speed	<< < > >>		⑦
	t bath:	35°C			
③	Speed:	5 cm/min	TIMER 59:59		⑧
	Elongation:	10 cm, 5 min			
	Relaxation:	<0.1cm in 15 min	THERMOSTAT		⑨
	Fixation:	automatic 0.05 N			
	Sample:	ABCD-1234567890...			
	Technician:	Ivanov Ivan	TEST		⑩
	Bath: 6.1lit/min	Heat sink: 21.0°C			
④					

1 - status of the tester; 2 - the temperature of the coolant in the bath and readings of the force sensors; 3 - test parameters; 4 - the flow rate of the coolant in the bath and the temperature of the radiator; 5 - the menu button; 6 - button to set the carriage to the base position and reset the force sensor readings; 7 - buttons for adjusting the carriage position; 8 - start / stop button for the sample shutter speed timer; 9 - thermostat on / off button; 10 - test start button..

Figure 6 – Waiting window

4 INTENDED USE

4.1 Additional equipment and materials

The equipment, materials and method of sample preparation are specified in the standard according to which the test is performed.

4.2 Operating limits

- 1) it is forbidden to turn on and operate the tester if there are foreign objects in the bath that prevent the carriage from moving;
- 2) it is forbidden to hold the moving carriage with your hands, since the force exceeds 90 kg;
- 3) it is forbidden to turn on the tester after liquids or foreign objects get inside the electronic or process unit before removing them;
- 4) it is forbidden to turn on the tester with the covers removed;
- 5) during operation, the device should be earthed by connecting to the ground terminal, as well as connected to a Euro socket that has a ground connection. Use a ground loop that is not connected to the power supply as the ground bus;
- 6) when performing work related to removing the covers, disconnect the power plug from the outlet;
- 7) when working with the tester the service personnel should follow the safety rules when working with electrical installations with a voltage of up to 1000 V;
- 8) service personnel should:
 - pass training to work with the tester and get a permit;
 - know the principle of operation of the tester;
 - know the rules for safe maintenance;
 - know what to do when a failure occurs;
- 9) the tester's operation mode is continuous, with the operator switching off the power switch after the end of operation;
- 10) persons authorized to work with the tester should have safety training when working with testers of this type.

4.3 Sample preparation

4.3.1 Sample preparation is performed according to the requirements of the standard for the specified test method.

4.3.2 When preparing samples to meet the required time intervals, you can use the built-in timer; to open the timer menu in the waiting window, click the **[TIMER]** button (see figure 7).

①	← TIMER ×		⑤
②	Sample shutter speed	in the air	
③	Duration	30 minutes	
④	Timer	turned off	

1 – go to the main menu; 2 – select a preset value; 3 – set time interval; 4 – start / stop the timer; 5 – close the menu and go to the waiting window.

Figure 7 – Timer menu

Table 4 - The menu item «Timer»

Parameter	Value
Sample shutter speed	Select a preset timer value.
Duration	The specified time interval; when selecting the value of the «sample shutter speed» parameter, the duration is set automatically in accordance with the requirements of the standard for the specified test method; the value can be changed.
Timer	Start / stop the timer.

After starting the timer, you can close the menu. After the specified time interval has elapsed, the corresponding message will be displayed, accompanied by an audio signal.

4.4 Tester preparation for testing

4.4.1 Pour the coolant into the bath of the tester to the point marked on the carriage (see figure 4, page 6, position 5).

The composition and density of the coolant are specified in the standard for the method; if the standard does not allow the samples to be immersed in a liquid, pour the coolant 5-10 mm below the samples mounted on the carriage. The dependence of the solidification temperature of aqueous solutions on the concentration is given in APPENDIX B, page 44.

4.4.2 Install a coarse filter on the bath outlet to prevent clogging of the circulation pump (see figure 1, page 5, position 3). Place the filter on the bottom of the bathtub in an angle up to the stop with the sealing ring down.

4.4.3 Connect the water supply to the thermostat fittings (see figure 3, page 6).

4.4.4 Install the bath temperature sensor (see figure 4, page 6, position 2) so that the distance to the bottom is 2.5 mm.

4.4.5 Switching on the tester in accordance with paragraph 3.3 of this Operating manual.

4.5 Testing

4.5.1 Test conditions

4.5.1.1 Setting the test method

In waiting mode, click on the "Test parameters" table (see figure 6, page 7, position 3) - the "TEST PARAMETERS" menu opens (see figure 8).

TEST PARAMETERS	
Method	GOST R 52056-03
Bath temperature	35 °C
Speed	5 cm/min
Elongation	10 cm
Relaxation	< 0.1 cm in 15 min
Fixing relaxation	automatic
1	2

1 - go to the main menu; 2 - menu items; 3 - select a page if all items do not fit on the screen; 4 - menu name; 5 - close the menu and go to the waiting window

Figure 8 – «Test Parameters» menu

Click on the "Method" parameter and select the desired value from the list.

4.5.1.2 Setting the bath temperature

If the method allows you to perform tests at different bath temperatures, click on the "**Bath temperature**" parameter and set the desired value.

Close the menu with the **[x]** button in the upper-right corner of the display.

4.5.1.3 Checking the thermostat bath:

- the connection to the water supply, the level of the coolant in the bath and the installation of the built-in bath temperature sensor should comply with paragraph 4.4.1 - 4.4.4 of this Operation manual;
- the freezing point of the coolant should be lower than the test temperature (see APPENDIX B, page 47);
- the density of the coolant should match the density of the samples;
- the flow rate and temperature of the tap water should correspond to the values indicated in table 1, page 2.

4.5.1.4 Starting stabilization of the bath temperature.

When the thermostat is on, the status of the tester (top line on the display) takes on the value "**EXIT MODE**"; after stabilization of the temperature at a given level, the status changes to "**READY FOR TEST**".

NOTES

*If there is insufficient flow, the message "**LOW EXPENSE**" is displayed. In this case, the thermostat turns off until the required flow rate is restored. Possible reasons are indicated in paragraph 4.8 of this Operation manual.*

4.5.1.5 Installing the carriage in the base position

Installing the carriage in the base position is performed before installing the samples:

- 1) remove foreign objects between the force sensors and the movable carriage;
- 2) press the button **[BASE]** – the carriage will be set to the base position;
- 3) after installing the carriage on the base, the force sensor readings will be reset to zero;
- 4) install the sample forms on the pins on the force sensors and the carriage; if necessary, adjust the carriage position using the buttons **[<<]**, **[<]**, **[>]** and **[>>]** (the carriage moves while the button is pressed).

ATTENTION

Install the carriage in the base position after the temperature of the bath has stabilized immediately before the test begins.

When installing the carriage in the base position, free the force sensors from foreign objects; do not touch the force sensors until the operation is complete and the values of the "Force" parameter are reset (see figure 6, page 7, position 2).

4.5.2 Additional test parameters

4.5.2.1 Touch threshold

The presence of the sample and the moment when it begins to elongate are recorded when the touch threshold is exceeded on the corresponding force sensor. The touch threshold selects the backlash that occurs when the form is installed with the sample.

To change the touch threshold in waiting mode, go to **[MENU] > «Settings» > «Check» > «Loading system»**, select page 3 in the bottom line of the display, and edit the **«Touch threshold»** parameter.

If the touch threshold is set incorrectly, the situations described in table 5 are possible.

Table 5 - Setting the touch threshold

Situation	Fix a problem
The sample is not installed, but the tester registers the presence of the sample	Increase the touch threshold
The sample is installed, but the tester does not detect its presence, or detects the presence of the sample after the start of elongation	Reduce the touch threshold

The manufacturer has set the touch threshold to 0.5 N.

4.5.2.2 Graph threshold

During the test, graphs of the force dependence on the sensors on the carriage position are plotted. New data is recorded when the force on one of the sensors changes by more than the specified graph sensitivity threshold.

If necessary, the threshold can be changed. To do this, go to **[MENU] > «Settings» > «Check» > «Loading system»** in waiting mode, select tab 3 and edit the **«Graph threshold»** parameter.

If the graph threshold is set incorrectly, the situations described in table 6 are possible.

Table 6 - Setting the graph threshold

Situation	Fix a problem
The initial section is missing from the graph	Increase the graph threshold
Insufficient of detail in graphics	Reduce the graph threshold

The manufacturer has set the graph threshold to 0.05 N.

4.5.2.3 Delayed start of the thermostat

It is possible to delay the start of the thermostat in order to ensure the temperature of the coolant before the start of the working day.

For a delayed start, you should do the following:

- 1) connect the water supply to the tester and ensure that the water consumption is not less than the value specified in table 1, page 2;
- 2) in the waiting window, click the **[MENU]** button and select **«Delayed start»**;
- 3) in the opened numerical editor, enter the delay of inclusion in hours;
- 4) leave the tester on.

After the specified time, the thermostat will be turned on; it will take additional time to reach the set temperature.

4.5.2.4 Thermostat mode during testing

By default, the thermostat and mixing of the coolant in the bath automatically stop when the test starts and resume after completion. The setting can be changed. To do this, press the **[MENU]** button in waiting mode and select **«Turning off the thermostat»**, then select the mode from the list shown in table 7.

Table 7 – Turning off the thermostat during the test

Parameter value «Turning off the thermostat»	Explanation
At the operator's command	The thermostat and mixing of the coolant in the bath are switched on and off only when the operator commands ([THERMOSTAT] button in waiting mode)
During the test *	Before the test starts, the thermostat and mixing of the coolant are switched off, and after the test is completed, they are automatically switched on
Before the test	Before the test starts, the thermostat and mixing of the coolant in the bath are switched off; switching on again at the operator's command

* default value.

Regardless of the set mode, the thermostat and mixing can be turned on and off manually during the test (see the sections describing test methods).

4.5.3 Test according to ASTM D 113, GOST 11505, GOST 33138

4.5.3.1 Setting test parameters

Before starting the test, check and, if necessary, change the test parameters. To do this, click on the **«Test parameters»** table in the waiting window (see figure 6, page 7, position 3) - the **«TEST PARAMETERS»** menu opens (see table 8).

Table 8 – Test parameters for burst test methods

Parameter	Value
Method	The method by which the test will be performed
Test mode	«rupture» - samples are stretched to a rupture
Bath temperature	The set temperature of the coolant in the bath (for ASTM D 113, you cannot change it)
Carriage speed	The speed of carriage movement when extending samples (for standard methods, you cannot change)
Fixing the rupture	«automatic» - the break of samples is fixed automatically when the load decreases below the value of the «Breaking force» parameter»; «manually» - the break of samples is fixed by pressing the remote button or on-screen buttons.
Breaking force	If the force decreases below this value, the sample rupture is automatically detected
Sample	The name of the sample
Laboratory technician	Laboratory technician performing the test

If the sample break is not detected correctly in automatic mode, set the «**Breaking force**» parameter (see table 9).

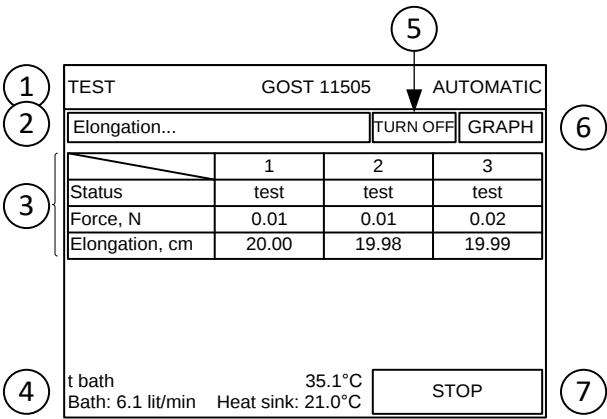
Table 9 – Setting up the break force

Situation	Fix a problem
The sample didn't break, but the tester detected a break	To reduce the breaking force
The sample ruptured, but the device did not record the rupture	Increase the breaking force

At the manufacturer, the breaking force is set to 0.05 N.

4.5.3.2 Starting the test

To start the test, press the **[TEST]** button (see figure 6, page 7, position 10) – the test window will appear on the display (see figure 9).



1-test method and mode; 2-test status; 3-sample status; 4-current bath temperature, coolant flow rate in the bath and the temperature of the radiator; 5 - button for turning on / off the thermostat and coolant pump; 6-switching to view the sample loading sample; 7 - button for stopping the test.

Figure 9 – The rupture test

If necessary, the thermostat and mixing of the coolant in the bath can be turned on or off at any time by pressing the button (see figure 9, position 5).

During the test, the carriage moves at a set speed. When the load on the force sensors exceeds the touch threshold, the elongation of the corresponding sample begins to count (both in automatic and manual modes).

If the test is performed in automatic mode (the inscription «**AUTOMATIC**» in the upper right corner of the display, the parameter «**Fixing the rupture**» = «**automatic**», see paragraph 4. 5. 3. 1 of this Operat-

ing manual), the rupture of samples is fixed when the force on the sample becomes less than the value of the parameter «**Breaking Force**» (see paragraph 4.5.3.1 of this Operating manual).

If the test is performed in manual mode («**MANUALLY**» in the upper right corner of the display, the parameter «Fixing the rupture» = «manually», see paragraph 4. 5. 3. 1 of this Operating manual), the rupture of samples is fixed by pressing the remote button (in this case, the sequence of break samples is not controlled) or by clicking on the corresponding column in the sample table (see figure 9, position 3).

During the test, the sample loading graph shall be constructed. To view the graph, click the **[GRAPH]** button (see figure 10).

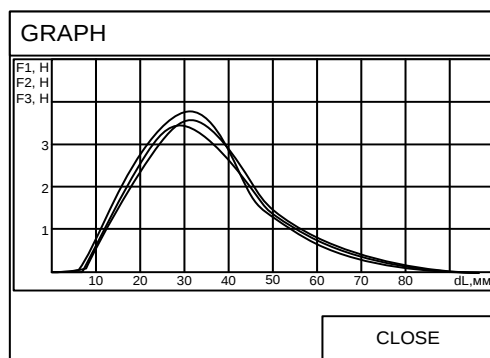
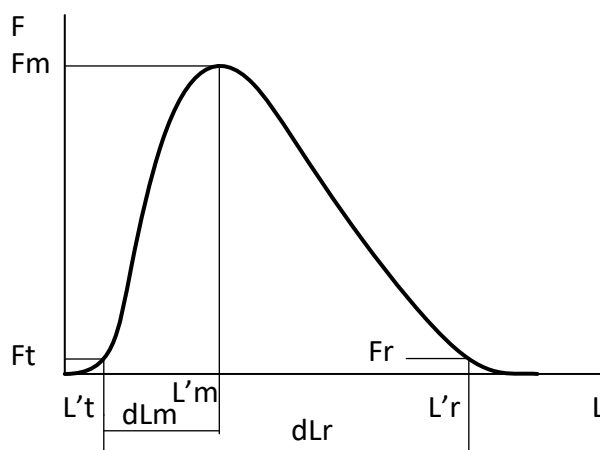


Figure 10 – Sample loading graph

On the graph, the vertical axis shows the force on the samples, and the horizontal axis shows the carriage position relative to the base, which corresponds to the elongation of the samples when using standard sample mounts.

If the graph is displayed incorrectly, set the «Graph threshold» parameter (see paragraph 4. 5. 2. 2 of this Operating manual).

The parameters defined for each sample during the burst test are shown in figure 11, page 13.



dLm – elongation of the sample at maximum force; dLr – elongation of the sample at the moment of rupture; Ft – touch threshold: when the force exceeds the specified threshold, the touch of the sample is detected and the elongation measurement begins; L't - to the position of the carriage corresponding to the touch threshold; Fm – maximum force; L'm – the position of the carriage corresponding to maximum force; Fr - force at which a fixed rupture; L'r – the position of the carriage corresponding to the rupture.

Figure 11 – Performance of the burst test

4.5.4 Test according to EN 13398, ASTM D 6084, GOST R 52056

ATTENTION

Results are not saved during manual testing.

When tested in automatic mode:

- *the test pieces shall not be cut; the elasticity shall be determined by the return of the carriage with the minimum load on the samples maintained;*
- *during the test according to GOST P 52056, the samples shall be lengthened by a given value at the same temperature at which their reduction (0°C or 35°C) will be performed.*

4.5.4.1 Setting test parameters

Before starting the test, check and, if necessary, change the test parameters. To do this, click on the «Test parameters» table in the waiting window (see figure 6, page 7, position 3) - the «**TEST PARAMETERS**» menu opens (see table 10).

Table 10 – Test parameters for relaxation test methods

Parameter	Value
Method	Test Method
Test mode	« relaxation » - samples are stretched to a specified distance
Bath temperature	The set temperature of the coolant in the bath (can only be changed for GOST R 52056)
Carriage speed	The speed of carriage movement when extending samples (for standard methods, you can not change)
Pre-extension	Samples are lengthened by a specified amount
Exposure	After elongation the samples are kept in a stretched state for a specified time
Fixation of relaxation	« automatic » - determination of elasticity automatically; « manually » - elasticity is determined manually
Thread tension	The amount of force supported on the samples when determining elasticity in automatic mode
Relaxation mode	«by time» - sample recovery is performed within a given time interval (the «Relaxation» parameter); «by speed» - sample recovery is performed until the sample recovery speed is less than the set value («Relaxation» parameter). You can't change the relaxation mode for standard methods
Relaxation	The value of the sample recovery time or speed (depending on the value of the parameter « Relaxation mode »). For standard methods the parameter value cannot be changed
Sample	The name of the sample
Laboratory technician	Laboratory technician performing the test

In case of incorrect operation when restoring samples in automatic mode, set the parameter «**Thread tension**» (see table 11).

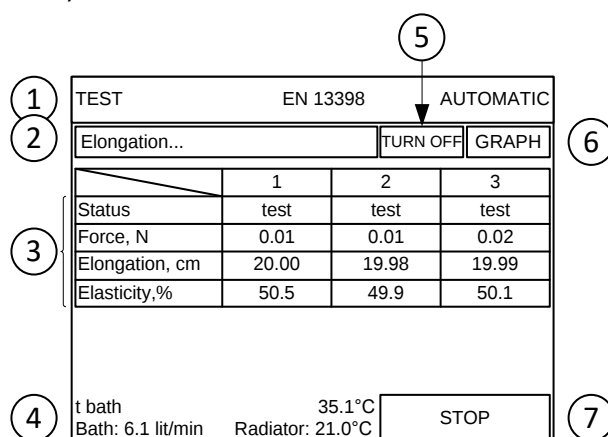
Table 11 – Thread tension setting

Situation	Fix a problem
There is no fixed break in the samples when stretched. Threads are folded during recovery	To increase the value of the parameter « Thread tension »
The tester detects the rupture of samples when stretched. The threads are too tight (received the elasticity will be less)	Decrease the value of the parameter « Thread tension »

At the manufacturer, the value of the thread tension force is set to 0.02 N.

4.5.4.2 Starting the test

To start the test, press the **[TEST]** button (see figure 6, page 7, position 10) – the test window will appear on the display (see figure 12).



1-test method and mode; 2-test status; 3-sample status; 4-current bath temperature, coolant flow rate in the bath and the temperature of the radiator; 5 - button for turning on / off the thermostat and coolant pump; 6-switching to view the sample loading graph; 7 - button for stopping the test.

Figure 12 – Relaxation test

If necessary, the thermostat and mixing of the coolant in the bath can be turned on or off at any time by pressing the button (see figure 12, position 5).

During the test, the carriage moves at a set speed. When the load on the force sensors exceeds the touch threshold, the elongation of the corresponding sample begins to count (both in automatic and manual modes).

When the first detected sample is extended by a specified amount, the carriage stops and a timer starts for holding the samples in a stretched state, if required by the test standard.

If the test is performed in automatic mode (the inscription « **AUTOMATIC** » in the upper right corner of the display, the setting « **Relaxation fixation** » = « **automatic** », see paragraph 4.5.4.1 of this Operating manual), after the exposure time of the samples in the stretched condition runs slow carriage return with minimum load on the samples (parameter « **Thread tension** »). The elasticity of samples is calculated using the formula:

$$R = \frac{E - X}{E} \cdot 100\% \quad (1)$$

where:

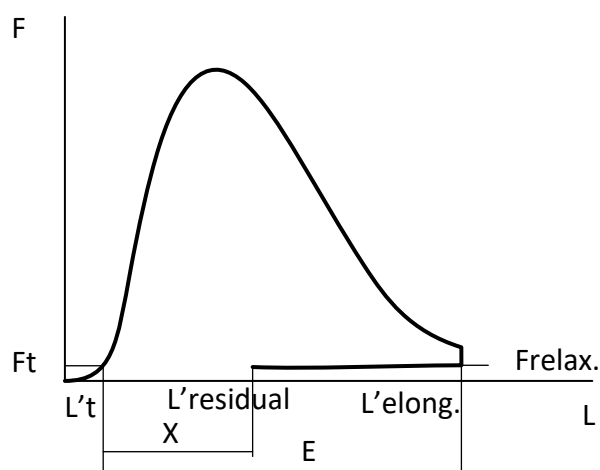
R – elasticity;

E – elongation of the sample during tension;

X – residual elongation of the sample after recovery.

If the test is performed in manual mode (« **MANUAL** » in the upper right corner of the display, the parameter « **Relaxation fixation** » = « **manual** », see paragraph 4.5.4.1 of this Operating manual), an audible signal is given when the sample holding time in the stretched state is exceeded. After this, it is necessary to cut the samples in the middle. If the value of the parameter « **Relaxation mode** » = « **by time** », the time is counted down and an audio signal is given after the time specified in the parameter « **Relaxation** ». If « **Relaxation mode** » = « **by speed** », then a direct countdown is performed; the decision to complete the test is made by the operator.

During the test, the sample loading graph shall be constructed. To view the graph, click the **[GRAPH]** button (see figure 10). The appearance of the graph is similar to a break test (see figure 10, page 13). The parameters defined for each sample during the relaxation test are shown in figure 13, page 16.



E – elongation of the sample; X - residual elongation of the sample; F_t – touch threshold; $L't$ – position of the carriage corresponding to the touch threshold; $L'elong.$ – position of the carriage at a given elongation of the samples; $F_{relax.}$ – force supported on the samples during recovery; $L'_{residual}$ - position of the carriage after recovery of the samples.

Figure 13 - Parameters for the relaxation test

The elongation of the sample is determined from the point where the touch of the sample is recorded.

4.5.5 Test according to EN 13587, EN 13589

4.5.5.1 Setting test parameters

Before starting the test, check and, if necessary, change the test parameters. To do this, click on the «**Test parameters**» table in the waiting window (see figure 6, page 7, position 3) - the «**TEST PARAMETERS**» menu opens (see table 12).

Table 12 - Test parameters for strain energy testing methods

Parameter	Value
Method	Test method
Test mode	« energy » - standard energy is calculated for each sample
Bath temperature	Set temperature of the coolant in the bath
Carriage speed	The speed of movement of the carriage when the elongation of the samples
Sample cross section	Первоначальная площадь сечения образцов (для стандартных методов параметр изменить нельзя) Initial sample cross-section area (for standard methods, this parameter cannot be changed)
Energy calculation from L1	Elongation of samples, at which the strain energy calculation begins (for standard methods, the parameter cannot be changed)
Energy calculation up to L2	Elongation of samples at which the strain energy calculation ends (for standard methods, the parameter cannot be changed)
Elongation	Sample elongation value (for standard methods, this parameter cannot be changed)
Breaking force	If the force decreases below this value, the sample rupture is fixed
Sample	The name of the sample
Laboratory technician	Laboratory technician performing the test

If the sample break is detected incorrectly in automatic mode, set the «**Breaking force**» parameter (see table 9, page 12).

4.5.5.2 Starting the test

To start the test, press the **[TEST]** button (see figure 6, page 7, position 10) – the test window will appear on the display (see figure 14, page 17).

1

2

3

4

5

6

7

TEST		EN 13589		AUTOMATIC	
Elongation...			TURN OFF	GRAPH	
	1	2	3		
Status	test	test	test		
Force, N	0.01	0.01	0.02		
Elongation, cm	45.00	44.98	35.55		
Fluidity Ff, N	10.5	9.9	10.1		
Fluidity dLf, cm	5.01	4.98	5.05		
Ei, J/cm2	0.11	0.13	---		
Force FL2	2.00	1.98	---		
Rupture Fr, N	---	---	0.05		
Rupture Lr, cm	---	---	15.55		
Bath temperature		35.1°C		STOP	
Bath: 6.1 lit/min		Radiator: 21.0°C			

1-test method and mode; 2-test status; 3-sample status; 4-current bath temperature, coolant flow rate in the bath and radiator temperature; 5 - button for turning on / off the thermostat and coolant pump; 6-switching to view the sample loading graph; 7 - button for stopping the test.

Figure 13 – Strain energy test

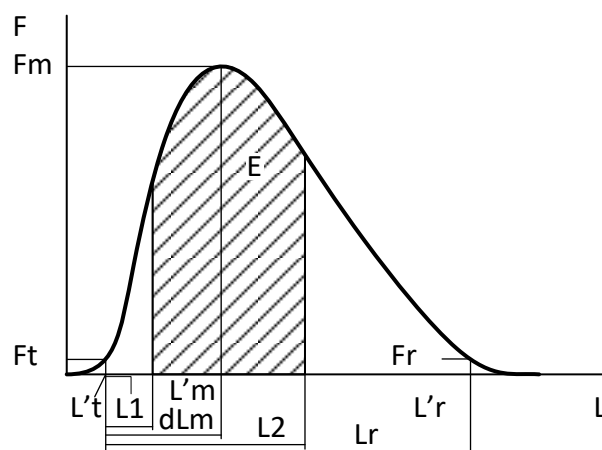
If necessary, the thermostat and mixing of the coolant in the bath can be turned on or off at any time by pressing the button (see figure 14, position 5).

During the test, the carriage moves at a set speed. When the load on the force sensors exceeds the touch threshold, the elongation of the corresponding sample begins to count.

During the test, the sample loading graph shall be constructed. To view the chart, click the **[GRAPH]** button. The appearance of the graph is similar to a break test (see figure 10, page 13).

The standard energy for each sample is calculated in accordance with EN 13703.

The parameters determined for each sample when tested for strain energy are shown in figure 15.



Fr - force, which recorded the rupture of the sample; Lr – elongation at which the sample break is fixed; E- is the energy of deformation of the sample; L1 - is the elongation at which it begins the computation of the strain energy; L2 – extension, which ends the calculation of the strain energy; L't - to the position of the carriage, wherein the fixed-tap sample; Fm – L'r – the position of the carriage in which are recorded the rupture of the sample.

Figure 15 - Parameters for strain energy testing

4.5.6 Testing according to GOST 11262

4.5.6.1 Setting test parameters

Before starting the test, check and, if necessary, change the test parameters. To do this, click on the **«Test parameters»** table in the waiting window (see figure 6, page 7, position 3) - the **«TEST PARAMETERS»** menu opens (see table 13).

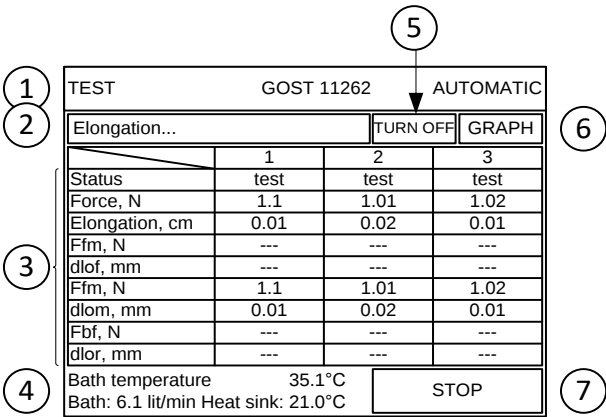
Table 13 – Test parameters for test methods according to GOST 11262

Parameter	Value
Method	Test method
Test mode	« plastic » – the samples are stretched to breaking
Bath temperature	Set temperature of the coolant in the bath
Carriage speed	Carriage speed during elongation of samples (cannot be changed for standard methods)
Breaking force	When the force becomes less than this value, the sample rupture is fixed
Sample	The name of the sample
Laboratory technician	Laboratory technician performing the test

If the rupture is detected incorrectly, set the «**Breaking force**» parameter (see table 13).

4.5.6.2 Starting the test

To start the test, press the **[TEST]** button (see figure 6, page 7, position 10) – the test window will appear on the display (see figure 16).



1-test method and mode; 2-test status; 3-sample status; 4-current bath temperature, coolant flow rate in the bath and radiator temperature; 5 - button for turning on / off the thermostat and coolant pump; 6-switching to view the sample loading graph; 7 - button for stopping the test.

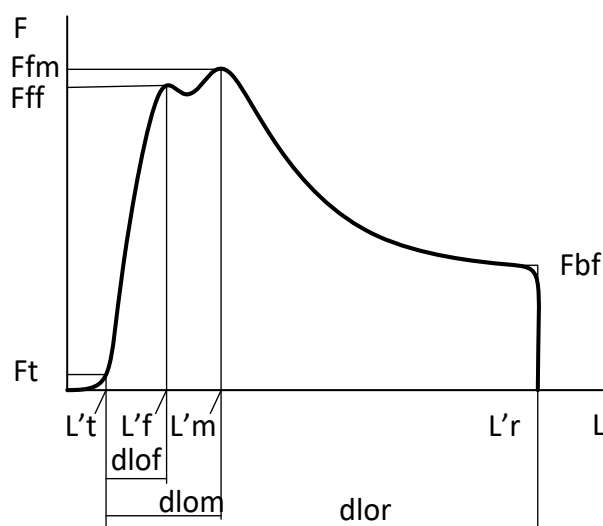
Figure 16 - Test according to GOST 11262

If necessary, the thermostat and mixing of the coolant in the bath can be turned on or off at any time by pressing the button (see figure 16, position 5).

During the test, the carriage moves at a set speed. When the load on the force sensors exceeds the touch threshold, the elongation of the corresponding sample begins to count.

During the test, the sample loading graph shall be constructed. To view the chart, click the **[GRAPH]** button. The appearance of the graph is similar to a break test (see figure 10, page 13).

The parameters defined for each sample during testing according to GOST 11262 are shown in figure 17.



Fff - turnover force (no conditional turnover determined); *Ffm* - force strength (maximum force); *Fbf* - the breaking force; *dlof* – elongation corresponding to turnover force; *dlom* – elongation corresponding to the strength; *dl or* – elongation at which the rupture was observed; *L't* - elongation at which carriage position where a tear was recorded by touching the sample; *L'f* – the position of the carriage corresponding to the force of fluidity; *L's* – the position of the carriage corresponding to the strength of the carriage; *L'r* – is the position of the carriage at which the rupture of the sample is recorded.

Figure 17-Parameters for testing according to GOST 11262

4.5.7 Test in research mode

Tests in the research mode are similar to tests using standard methods for testing bitumen before breaking, for relaxation, or for strain energy.

A distinctive feature is that all test parameters can be changed.

To test in research mode, click on the table «**Test parameters**» (see figure 6, page 7, position 3) – the «**TEST PARAMETERS**» menu opens – and set the parameter «**Method**» = «**RESEARCH**». Set the value of the «**Test mode**» parameter and perform further actions in accordance with the required test mode (see paragraphs 4.5.3 – 4.5.5 of this Operating manual).

4.6 Processing test results

4.6.1 View results

To view the results log in waiting mode, click [**MENU**] > «**Results**» (see figure 18).

RESULTS				✕	3
№	Date	Sample	Method		
6	01.01.01	BND XX/XX	EN 13398		
7	01.01.01	BND XX/XX	EN 13398		
8	01.01.01	BND XX/XX	EN 13398		
1	2				

1-results; 2 - select a page (if all results do not fit on one screen); 3 – go to the menu.

Figure 18 - Results log

For a detailed view, click on the line with the desired result.

The composition and number of fields in the result window depends on the method used for the test (see paragraphs 4.5.3 - 4.5.7 of this Operating manual).

To view the loading graph, click the [] button in the upper line of the result window. The appearance of the graph is similar to a break test (see figure 10, page 13).

To return from the graph view mode to viewing the result, click **[CLOSE]**.

4.6.2 Transfer results to a personal computer

4.6.2.1 Transmitting results over the wireless interface

If the laboratory is equipped with *Lintel*® LINK wireless communication system, the test results are transmitted automatically.

The device should be equipped with a wireless communication module (available on request).

To configure the network number and communication channel from the waiting window, go to **[MENU] > «Settings» > «Wireless»**.

4.6.2.2 Transmitting results via the RS-232 interface

The computer should meet the following requirements:

- 1) hardware COM port and COM port extension cable or USB com port emulator;
- 2) a terminal program configured to receive from the COM port at a speed of 19200 bits/sec (see APPENDIX A, page 37).

To transfer the results on the computer, start writing data to a file, and on the tester go to **[MENU] > «Settings» > «Service» > «Print results»** from the waiting window.

After the transfer of the results log on the computer is complete, finish writing data to the file.

4.7 Completing work

4.7.1 Completion of the test according to ASTM D 113, GOST 11505, GOST 33138

After rupture all samples or the carriage limit is reached, the test is completed; if there are samples for which a rupture is fixed, the result is stored in the device's power-independent memory and displayed (see figure 19).

		④		⑤				
①			RESULT		1			⑥
Completed				01.01.01 09:00				
Sample				BND-XX/XX				
Method				GOST 11505				
Mode				rupture				
②	t bath			25.1°C (25.0 ... 25.3)				
Carriage speed				5 cm/min				
Breaking force Fr				--- / 0.05 / 0.05 N				
Rupture elongation dLr				--- / 3.32 / 3.72 cm				
Max. force Fm				--- / 5.55 / 5.81 N				
③		1	2					

1-go to the results log; 2-result fields; 3 - select a page (all result fields do not fit on the same screen); 4 – show the loading graph; 5 – result number; 6 – go to the waiting window.

Figure 19 - Burst test result

Table 14 – Burst test result

Field	Value
Completed	Test completion date and time
Sample	Sample name
Method	Method used for performing the test
Mode	«rupture» - elongation of samples is performed before they break
bath t	Average bath temperature during the test (minimum and maximum values are shown in parentheses)
Carriage speed	Speed of carriage when samples are elongated
Breaking force Fr	The force at which the break of each sample was recorded*
Rupture elongation dLr	Elongation of each sample at break*
Max. force Fm	The maximum force for each sample*
Elongation (at Fm) dLm	Elongation of samples corresponding to the maximum force*
Fixation	«automatic» - the rupture of samples was fixed by reducing the load below the specified threshold (see paragraph 4.5.3.1 of this Operating manual); «manually» - the break of samples was recorded at the operator's command
Laboratory technician	Laboratory technician performing the test

* values from left to right, respectively, for samples 1, 2, and 3; if the corresponding sample is marked «---», then the sample was not installed or was not torn.

To switch to waiting mode, press the [x] button in the upper-right corner of the display.

4.7.2 Completion of the test according to EN 13398, ASTM D 6084, GOST R 52056

In manual mode, the result is not saved. In the case of a time-relaxation test, the tester sends a signal after the specified relaxation time has elapsed; in the case of a speed-relaxation test, the operator decides to complete the test.

In automatic mode, when the specified relaxation time has elapsed or when the sample recovery rate has decreased below the specified one (depending on the specified test conditions), the test is completed; if there are samples with elasticity greater than 0 and less than 100%, the result is saved and displayed (see figure 20).

①	③	④	⑤
⏪	⏩	RESULT	1
Completed	01.01.01 09:00		
Sample	BND-XX/XX		
Method	GOST 11505		
Mode	rupture		
t bath	25.1°C (25.0 ... 25.3)		
Carriage speed	5 cm/min		
Elongation E	--- / 10 / 9.95 cm		
Residual elongation X	--- / 3.32 / 3.72 cm		
Elasticity R	--- / 55.5 / 58.1 %		
Technician	Petrov Peter		

1-go to the results log; 2-result fields; 3-show loading graph; 4-result number; 5-go to the waiting window.

Figure 14 – Relaxation test result

NOTES

If, after the relaxation time has elapsed, the load on the sample is lower than the thread tension (see paragraph 4.5.4.1 of this Operating manual), after the countdown is complete, the carriage will shift to eliminate the thread sagging until the load appears on the sensor.

Table 15 – Relaxation test result

Field	Value
Completed	Test completion date and time
Sample	Sample name
Method	Method used for performing the test
Mode	«rupture» - elongation of samples is performed before they break
Bath t	Average bath temperature during the test (minimum and maximum values are shown in parentheses)
Carriage speed	Speed of carriage when samples are elongated
Elongation E	The value of elongation of samples before recovery*
Residual elongation X	The residual elongation of the samples after recovery*
Elasticity R	Elasticity of samples calculated by the formula (1)*
Laboratory technician	Laboratory technician performing the test

* values from left to right, respectively, for samples 1, 2, and 3; if the value for the corresponding sample is «---», it means that the sample has not been set or that it has obtained an elasticity of 0 or 100%.

To switch to waiting mode, press the [x] button in the upper-right corner of the display.

4.7.3 Completion of the test according to EN 13587, EN 13589

Manual testing mode is not provided.

The test is completed if:

- one of the samples is stretched by a specified amount;
- all detected samples are torn;
- reached the limit position of the carriage;
- the operator stopped the test with the [STOP] button.

The test result is saved if there is at least one sample for which an extension of at least the value «**Energy calculation up to L2**» is obtained.

The saved result is displayed (see figure 21).

RESULT	
Completed	01.01.01 09:00
Sample	BND-XX/XX
Method	EN 13359
Mode	energy (0...0.2) m
Bath t	25.1°C (25.0 ... 25.3)
Carriage speed	5 cm/min
Sample cross section	1 cm ²
Standard energy Ei	--- / 3.32 / 3.72 J/cm ²
Yield strength F	2.51 / 2.59 / 2.49 N
1	2

1-go to the results log; 2-result fields; 3 - select a page (all result fields do not fit on the same screen); 4 – show the loading graph; 5 – result number; 6 – go to the waiting window.

Figure 21 - Result of the strain energy test

Table 16– The result of the test strain energy

Field	Value
Completed	Test completion date and time
Sample	Sample name
Method	Method used for performing the test
Mode	«energy» (the initial and final elongations at which the strain energy is calculated are indicated in parentheses).
Bath t	Average bath temperature during the test (minimum and maximum values are shown in parentheses)
Carriage speed	Speed of carriage when samples are elongated
Sample cross section	Sample cross section before the test
Standard energy Ei	The ratio of strain energy to the cross section of the samples*
Yield strength F	The maximum force when the elongation of the samples*
Yield strength L	Elongation of samples, at maximum force*
Force at L1	The force when extending the sample by the amount at which the energy calculation begins*
Breaking force	Force immediately before fixing the sample break*
Elongation at rupture	Elongation at which a sample break is detected*
Laboratory technician	Laboratory technician performing the test

* values from left to right, respectively, for samples 1, 2, and 3; if the value for the corresponding sample is «---», then the parameter has not been defined (the sample is not set or is torn before the elongation at which the energy calculation is completed).

To switch to waiting mode, press the **[x]** button in the upper-right corner of the display.

4.7.4 Completion of the test according to GOST 11262

Manual testing mode is not provided.

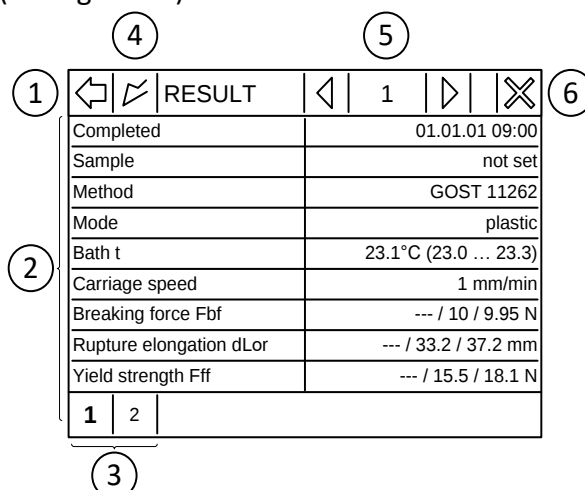
The test is completed if:

- all detected samples are torn;
- reached the limit position of the carriage;
- the operator stopped the test with the **[STOP]** button.

Результат испытания сохраняется, если есть хотя бы один образец, для которого зафиксирован разрыв.

The test result is saved if there is at least one sample for which a break is recorded.

The saved result is displayed (see figure 22).



1-go to the results log; 2-result fields; 3 - select a page (all result fields do not fit on the same screen); 4 – show the loading graph; 5 – result number; 6 – go to the waiting window.

Figure 15 - Test result according to GOST 11262

Table 17 – Test result according to GOST 11262

Field	Value
Completed	Test completion date and time
Sample	Sample name
Method	Method used for performing the test
Mode	« plastic » - the test is performed before all samples break
Bath t	Average bath temperature during the test (minimum and maximum values are shown in parentheses)
Carriage speed	Speed of carriage when samples are elongated
Breaking force Fbf	The force just before the sample breaks*
Elongation of the rupture dlor	Elongation at which the sample break is detected*
force fluidity Fff	The force at which the sample fluidity is fixed*
Elongation of fluidity dlof	Elongation at which the sample fluidity is fixed*
Strength force Fsf	The force at which the strength of the sample is fixed*
Strength elongation dlos	Elongation at which the strength of the sample is fixed*
Laboratory technician	Laboratory technician performing the test

* values from left to right, respectively, for samples 1, 2, and 3; if the value for the corresponding sample is «---», then the parameter was not defined (the sample was not set or broken).

To switch to waiting mode, press the **[x]** button in the upper-right corner of the display.

4.7.5 Turn off the tester by pressing the «**POWER**» switch (see figure 1, page 5). The safety shut-off tester should also be switched off to the «**0**» position (toggle switch down). Disconnect the tester from the network.

4.8 List of potential failures

Possible reasons for incorrect operation of the tester and methods of their elimination are presented in table 18.

Table 18 – Potential failures

Failure description	Probable cause	Elimination
Incorrect sample presence	The touch threshold is incorrectly configured	Please see paragraph 4.5.2.1 of Operation manual
The sample rupture is not fixed correctly	The break force is incorrectly configured	Please see paragraph 4.5.3.1 of Operation manual
	Plastic samples are tested: there is no force on the force sensors	To lower the temperature of the test or perform the test in manual mode (not possible with all test methods)
	The « Additional rupture monitoring, mN » parameter is incorrectly configured	Please see table 15 of Operation manual
The graph is displayed incorrectly	Graph sensitivity threshold not configured correctly	Please see paragraph 4.5.2.2 of Operation manual
The error in measuring length, force, or temperature exceeds the permissible values (see table 6 of Operating manual)	Calibration required	Please see paragraph 5.6, 5.7, 5.11 of Operation manual

Continuation of table 18

Failure description	Probable cause	Elimination
Low flow rate of the coolant in the bath	Air lock	Forcibly pump the coolant into the drain hole of the bath.
	Freezing of the coolant in the radiator	Lower the freezing point of the coolant (see APPENDIX B, page 47)
	Coolant circulation system blocked	Please see paragraph 5.4 of Operating manual
Increasing the bath temperature stabilization time	Freezing of the coolant in the radiator	Lower the freezing point of the coolant (see APPENDIX B, page 47)
	Scale formation in the radiator	Please see paragraph 5.5 of Operating manual

In case of other malfunctions, contact the manufacturer.

4.9 Emergency response

If liquids or foreign objects get inside the tester, you should:

- 1) turn off the tester with the «**POWER**» toggle switch;
- 2) remove the power plug from the wall outlet;
- 3) open the block cover by turning the fastening screws;
- 4) remove liquid or foreign objects;
- 5) close the lid.

NOTES

It is recommended to use compressed air to remove the liquid. The faster the liquid is removed, the more likely it is that the tester will remain functional. After removing the liquid, the tester should be kept for at least 16 hours before switching on again.

5 MAINTENANCE

5.1 Maintenance

It is necessary to monitor the condition of the tester, remove dust and dirt. If the tester has not been used for a long time, carefully inspect it before turning it on, clean it from dust with a cotton cloth moistened with ethyl alcohol (nefras) and dry it.

5.2 Additional equipment and materials

The list of additional maintenance materials given in table 19.

Table 19 –List of additional materials

Material	Purpose
Ethyl alcohol, or an alcohol-toluene mixture	cleaning the display, tester case and mechanical components from dirt
Cotton napkin	
Nefras GOST 8505-80	cleaning the walls and bottom of the bath, sample forms from bituminous stains
Cotton napkin	
A brush with soft bristles	flushing filters
Citric acid GOST 908-2004	descaling the internal surfaces of the radiator
Water	
5% aqueous solution of ethyl alcohol or nefras GOST 8505-80	calibration of the bath temperature sensor

The list of additional equipment for maintenance is shown in table 20.

Table 20 – List of additional devices

Device	Measurement range	Error	Purpose
Ruler GOST 427-75	1000 mm	0,2 mm, max	calibration of the length meter
Thermometer TSTM 9410/M2 with sensor TTST 01-180	from -50 to +200°C	±0,2°C, max at 0 and 25°C	calibration of the bath temperature sensor
Dynamometer ATSD/1R-0,5/1I-1	from 0,05 to 0,5 kN	±0,24 %	calibration of force sensors

It is allowed to use measuring instruments that meet the requirements of standards for test methods and are structurally compatible with the tester.

5.3 List of operations

The list of maintenance operations given in table 21.

Table 21 –List of operations

Operation	Paragraph	Periodicity
Cleaning the display from contamination	-	As required, if any contamination is present
Cleaning the case from contamination	-	As required, if any contamination is present
Drain the coolant	5.4	if necessary, if the tester is idle for longer than 24 hours when using solutions that cause corrosion of the bath (for example, salt solutions)
Washing the bath, cleaning the filters	5.4	As required, if any contamination is present
Descaling the radiator	5.5	Monthly
Mold cleaning	5.6	At the end of the test
Checking the protective shutdown device	5.7	Monthly
Checking the length meter	5.8	Annually
Checking the bath temperature sensor	5.9	
Calibration of the bath temperature sensor	5.10	

5.4 Washing

5.4.1 To increase the service life of the tester, it is recommended to keep the bath clean by draining the coolant through the tube (see figure 1, page 5, and position 6). Wash off deposits on the walls and bottom of the bath, without using of abrasive and aggressive detergents, wipe off the bituminous stains with a napkin moistened with nefras, without using of sharp hard objects.

ATTENTION

If the tester is idle for more than 24 hours when using solutions that cause corrosion of the bath (for example, salt), it is recommended to drain the coolant and wipe the bath dry.

5.4.2 If the coolant flow rate decreases, flush the coolant pipes and filters. To flush the pipes, bring a hot water hose to the suction hole at the bottom of the bath (in the far right corner) and supply water with a flow rate of at least 4 liter/min for at least 1 minute. Wash the filters in warm water with a soft-bristled brush.

Flushing may be required for the coarse filter installed in the bath above the suction port, as well as for the fine filter, which is accessed through a hatch on the back of the tester. To remove the hatch, unscrew the 4 screws at its corners (see figure 23).

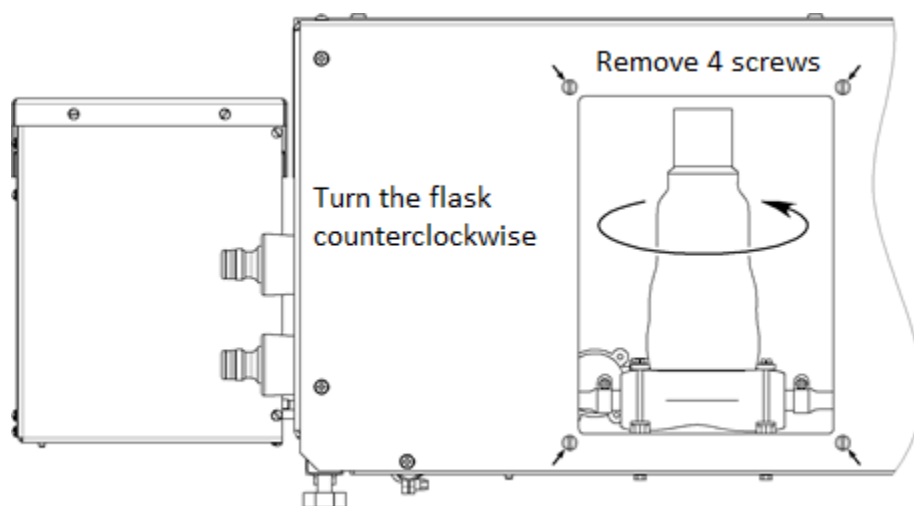


Figure 16 – Fine filter

5.4.3 To flush the fine filter, drain the water from the tester's bath and turn the filter flask counterclockwise. When re-installing the flask, pay attention to the correct installation of the o-ring seal to avoid leaks.

5.5 The descaling

During long-term operation, deposits may form on the inner surfaces of the radiator. This can lead to reduced performance and even failure of the thermoelectric modules. It is recommended to pour a concentrated solution of citric acid into the radiator and leave it overnight.

5.5.1 Disconnect the hoses from the water supply and drain the radiator.

5.5.2 Pour 1 liter of the solution into the inlet hose through the funnel, avoiding air bubbles (about 0.5 liter of the solution will flow out of the drain hose).

5.5.3 Squeeze the inlet and outlet hoses or lift their ends so that the solution does not leak out.

5.5.4 Leave the solution in the radiator for at least 8 hours, then drain.

5.6 Cleaning of the molds

5.6.1 After each test, the molds should be cleaned of bitumen.

ATTENTION

It is forbidden to scrape off the bitumen with hard sharp objects, as this may lead to a change in their size.

5.6.2 It is recommended to pre-soak the molds with the remaining samples in a container with nefras.

5.7 Checking the protective shutdown device

5.7.1 Turn on the tester with the «**POWER**» toggle switch. The screen saver should appear on the display (see figure 5, page 7).

5.7.2 Press the «**T**» button (**TEST**) of the safety device (see figure 2, page 5). Tester should turn off.

5.7.3 After releasing the «**T**» button (**TEST**), move the safety switch to the upper position. The tester should turn on.

5.7.4 Turn off the tester with the «**POWER**» toggle switch.

5.7.5 The tester that has not passed the test is not allowed for further use.

5.8 Checking the length meter

5.8.1 Remove all foreign objects from the tester's bath.

5.8.2 Turn on the tester.

5.8.3 In the waiting window (see figure 6, page 7), press the [**BASE**] button and wait for the carriage to be set to the base position; the check mark on the carriage should be exactly at the «**0 cm**» mark (see figure 4, page 6); if necessary, adjust the carriage position using the adjustment buttons.

5.8.4 Go to [MENU] > «Settings» > «Check» > «Carriage drive».

CARRIAGE DRIVE	
Start / end / button	- / - / -
Carriage speed	50 mm/min
Mode	base
Distance	100 mm
Start / stop	stopped

Figure 17 – Length meter check menu

Table 22 –Menu items for checking the built-in length meter

Menu item	Value
Start / end / button	Status of carriage limiters and user buttons: «-» - the limiter is free / the button is not pressed «+» - stroke limit / button pressed
Carriage speed	Set speed of carriage movement in the « by distance » mode
Mode	« base » - the carriage will be set to the base position at the maximum speed; « by distance » - the carriage will be moved relative to the current position by the specified distance (or to the stroke limit)
Distance	The specified distance to which the carriage will be moved after starting in the « by distance » mode
Start / stop	Starting the carriage in the specified mode

5.8.5 Set the «Carriage speed» parameter value = 50 mm/min.

5.8.6 Set the value of the «Mode» = «by distance» parameter.

5.8.7 Set the «Distance» parameter value = 1000 mm.

5.8.8 Start the carriage by clicking on «Start / stop» - the carriage will be moved by 1000 mm.

5.8.9 Use a standard length meter to measure the distance traveled by the carriage and compare it with the value of the «Distance» parameter: the discrepancy should not exceed the value shown in table 3, page 3; if there is a larger discrepancy, the built-in length meter should be calibrated (see paragraph 5.11).

5.9 Checking the bath temperature sensor

5.9.1 From the waiting window, go to [MENU] > «Settings» > «Check» > «Bath t sensor».

BATH t SENSOR		
Thermostat		turned off
t set		0 °C
Bath t		20.75°C
Bath pump		turned off
Bath consumption/t radiator		0.0 / 21.0
1	2	

Figure 25 - Menu for checking the bath temperature sensor

Table 23 – Menu items for checking the bath temperature sensor

Menu item	Value
Thermostat	«turned off» - the thermostat is off; «turned on (x%)» - the thermostat is turned on at the set temperature (the current capacity of the thermostat is indicated in parentheses). Power is not supplied if the flow of tap water or coolant in the bath is insufficient
t set	The set temperature of the thermostat
Bath t	Current temperature of the heat carrier according to the built-in sensor
Bath pump	«turned off» - the bath coolant pump is off; «turned on» - the bath coolant pump is on. The pump turns on automatically when the thermostat is turned on.
Bath consumption/t radiator	The current flow rate of the coolant in the bath and the temperature of the radiator

5.9.2 Pour a 5% aqueous solution of ethyl alcohol into the bath until it is at risk (see figure 4, page 6, position 5).

5.9.3 Connect the water supply to the tester fittings (see figure 3, page 6).

5.9.4 Install the built-in and exemplary sensors in the sockets (see figure 4, page 6) so that the sensors remain 2-5 mm from the bottom of the bath.

5.9.5 Set the parameter value «t set» = 0°C.

5.9.6 Turn on the thermostat by clicking on «Mode».

5.9.7 After stabilizing the temperature of the coolant according to the readings of the sample thermometer, wait for at least 15 minutes.

5.9.8 Compare the readings of the built-in temperature sensor (parameter «bath t») and the exemplary thermometer: the discrepancy should not exceed the value shown in table 3, page 3, plus the error of the exemplary thermometer. Otherwise, calibration is required (see paragraph 5.12).

5.9.9 Set the parameter value «t set» = 35°C.

5.9.10 After stabilization of the bath temperature according to the indications of the exemplary thermometer, wait for at least 15 minutes.

5.9.11 Compare the reading of the exemplary thermometer and the value of the «bath t» parameter: the difference should not exceed the value shown in table 3, page 3, plus the error of the exemplary thermometer. Otherwise, calibration is required (see paragraph 5.12).

5.10 Checking force sensors

5.10.1 Remove all foreign objects from the bath and drain the coolant.

5.10.2 Turn on the tester and in waiting mode by pressing the buttons [<<], [<], [>] and [>>] adjust the position so that the exemplary dynamometer is freely mounted on the pins.

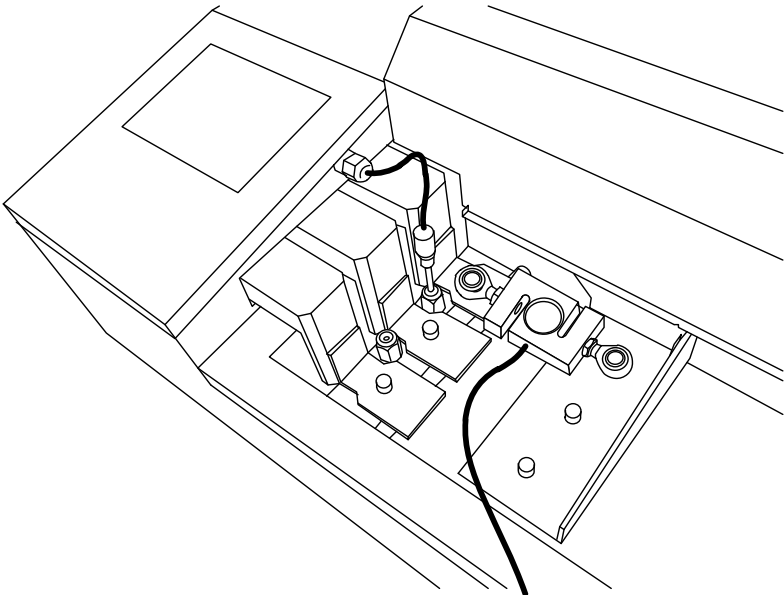


Figure 18 – Installation of an exemplary dynamometer

- 5.10.3 Install the exemplary dynamometer on the force sensor № 1.
- 5.10.4 From the waiting window, go to [MENU] > «Settings» > «Check» > «Loading system».

		LOADING SYSTEM					
Mode			stop				
Load (reset)			0.0 0.0 0.0				
Set load			300 N				
Carriage speed			50 mm/min				
Distance			100 mm				
Total load			0.0 N				
1	2						

Figure 19 – Force sensor test menu

Table 24 – Menu items for checking force sensors

Menu item	Value
Mode	«stop» - the carriage is stopped; «base» - the carriage moves to the base position; «unloading» - the carriage moves in the direction of reducing the load; «loading» - maintaining the specified load; «test» - moving a specified distance under load
Load (reset)	Current readings of force sensors from left to right № 1, 2, 3 (when you click on the item, the readings are reset to zero)
Set load	The specified value of the load in the «loading»
Carriage speed	The speed of movement of the carriage in the «test»
Distance	The distance the carriage will be moved in «test» mode
Total load	Total load on all force sensors
Threshold of touch	The force at which the presence of the sample is detected
Graph threshold	Changing the force at which data is written to the graph
Break control, milliNewtons	If the load on the sample is reduced to this value and does not change more than 5 mm of the stroke of the carriage, the break of the sample is recorded (if you set the value to 0, additional control will not be performed)
Load 1	Load on the force sensor No. 1 (farthest from the operator)
Load 2	Load on the force sensor No. 2 (medium)
Load 3	Load on force sensor No. 3 (nearest to the operator)

5.10.5 Reset the exemplary dynamometer to zero.

5.10.6 Reset the force sensor readings: click «Load (reset)».

5.10.7 Set the value of the parameter «Set load» = 300 N.

5.10.8 Set the value of the parameter «Mode» = «loading» – the sensor will be loaded to the specified load.

5.10.9 After stabilization of the readings, wait for at least 1 minute and compare the readings of the exemplary dynamometer and the value of the parameter «Load (reset)» (sensor № 1 corresponds to the left value): the deviation should not exceed the value shown in table 3, page 3. Otherwise, the force sensor should be calibrated (see paragraph 5.13).

5.10.10 Check the force sensor readings for a load of 50, 160, 300 N.

5.10.11 Set the value of the parameter «Mode» = «unloading», after removing the load, remove the dynamometer.

5.10.12 Check the other force sensors in the same way.

5.11 Calibration of the length meter

5.11.1 Calibration is performed if the tester does not pass the test (see p. 5.8).

5.11.2 From the waiting window, go to [MENU] > «Settings» > «Calibration» > «Carriage drive».

NOTES

To enter the «CALIBRATION» menu, when prompted for a password, enter «37201».

Table 26 – Menu items for calibrating the bath temperature sensor

Menu item	Value
Thermostat	See table 23
Set t	
Bath t	
Bath pump	
Bath consumption / t radiator	
Point 1 (uncalibrated)	«~~~»- calibration data is not specified; «0.64 (0.02)» - the exemplary thermometer reading at the calibration point, the uncalibrated readings of the built-in temperature sensor are shown in parentheses; the values are given conditionally
Point 2 (uncalibrated)	
Calibrate	«no data» - no indication of the exemplary thermometer at any calibration point; «calibrate» - everything is ready for calibration
Bath slope kt	Slope coefficient of the temperature sensor
Bath bt offset	The offset characteristics of the temperature sensor

5.12.3 Before setting it, it is recommended to write down the value of the parameters **«Slope kt of the bath»** and **«Offset bt of the bath»**.

5.12.4 Pour a 5% aqueous solution of ethyl alcohol into the bath before use (see figure 4, page 6, position 5).

5.12.5 Connect the water supply to the tester fittings (see figure 3, page 6).

5.12.6 Install the built-in and exemplary sensors in the sockets (see figure 4, page 6) so that the sensors remain 2-5 mm from the bottom of the bath.

5.12.7 Set the parameter value **«t set»** = 0°C.

5.12.8 Turn on the thermostat by clicking on **«Mode»**.

5.12.9 After stabilizing the temperature of the coolant according to the readings of the exemplary thermometer, wait for at least 15 minutes.

5.12.10 Click on the menu item **«Point 1 (uncalibrated)»** and enter the readings of the exemplary thermometer.

5.12.11 Set the parameter value **«t set»** = 35°C.

5.12.12 After stabilization of the bath temperature according to the indications of the exemplary thermometer, wait for at least 15 minutes.

5.12.13 Click on the menu item **«Point 2 (uncalibrated)»** and enter the readings of the exemplary thermometer.

5.12.14 Click on **«Calibrate»** - the built-in temperature sensor will be calibrated (the parameters **«Slope kt bath»** and **«Offset bt bath»** have been changed).

5.12.15 After calibration, the built-in temperature sensor should be checked again at both points.

5.13 Calibration of force sensors

5.13.1 Calibration is performed if the tester has not passed the test (see paragraph 5.10).

5.13.2 Remove all foreign objects from the bath and drain the coolant.

5.13.3 Turn on the tester and in waiting mode by pressing the buttons [**<<**], [**<**], [**>**] and [**>>**] adjust the position so that the exemplary dynamometer is freely mounted on the pins.

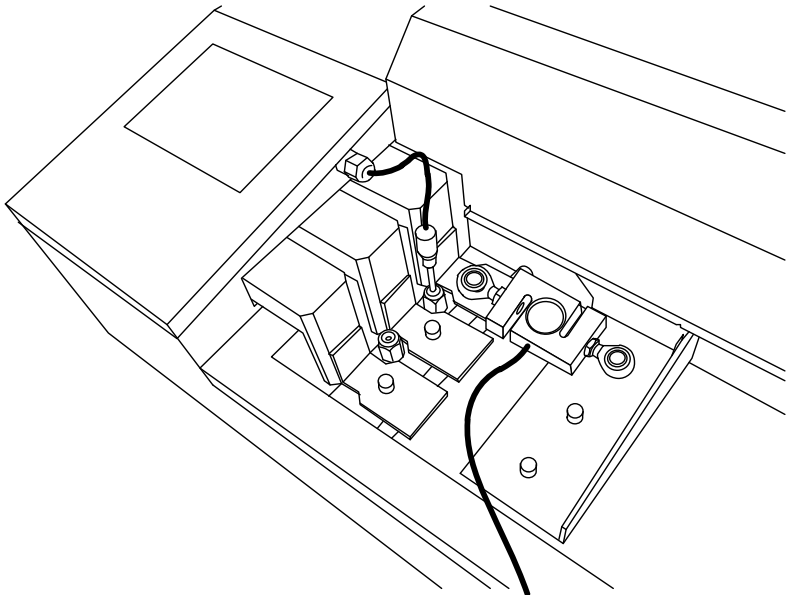


Figure 22 – Installation of an exemplary dynamometer

- 5.13.4 Install the exemplary dynamometer on the calibrated force sensor.
- 5.13.5 From the waiting window, go to [MENU] > «Settings» > «Calibration» > «Loading system».

NOTES
To enter the «**CALIBRATION**» menu, when prompted for a password, enter «**37201**».

← LOADING SYSTEM ×			
Mode		stop	
Load (reset)		0.0 0.0 0.0	
Set load		300 N	
Carriage speed		50 mm/min	
Distance		100 mm	
Total load		0.0 N	
1	2	3	

Figure 23 – Force sensor calibration menu

Table 27 – Menu items for force sensor calibration

Menu item	Value
Mode	see table 24
Load (reset)	
Set load	
Carriage speed	
Distance	
Total load	
Threshold of touch	
Graph threshold	
Break control, milliNewtons (mN)	
Load 1	
Load 2	
Load 3	
OTC 1	Operating transmission coefficient of force sensors
OTC 2	
OTC 3	

5.13.6 Reset the exemplary dynamometer to zero.

5.13.7 Reset the force sensor readings: clicking «**Load (reset)**».

5.13.8 Set the value of the parameter «**Set load**» = 300 N.

5.13.9 Set the value of the parameter «**Mode**» = «**loading**» – the sensor will be loaded to the specified load.

5.13.10 After stabilizing the readings, wait for at least 1 minute.

5.13.11 Change the value of the parameter «**Load X**» («**X**» is the number of the sensor to be calibrated) in accordance with the readings of the exemplary dynamometer.

5.13.12 After adjustment, wait for load stabilization and re-check the readings.

5.13.13 Set the value of the parameter «**Mode**» = «**unloading**», after removing the load, remove the dynamometer.

5.13.14 After calibration of the force sensors, their readings should be checked again (see paragraph 5.10).

6 STORAGE AND TRANSPORTATION

6.1 Storage

6.1.1 The storage conditions of the tester in terms of the impact of climatic factors should comply with the group «L» GOST 15150-69.

6.1.2 The tester should be stored in closed, heated rooms in the packaging on racks that are not subject to vibrations and shocks.

6.1.3 The tester should be stored at an air temperature of 5 °C to 40 °C and a relative humidity of no more than 80 %.

6.1.4 Storage of the tester without packaging is not allowed.

6.1.5 Shelf life of the tester is 6 years.

6.1.6 The tester is preserved according to the version VZ-10 of GOST 9.014-78, the packaging version is VU-5.

6.1.7 If after unpacking the tester was not used for its intended purpose, then it should be stored in a case made of polyethylene GOST 10354-82.

6.2 Transportation

6.2.1 Conditions for transporting the tester in terms of the impact of climatic factors should correspond to the group of storage conditions 5 (OZH4) according to GOST 15150-69.

6.2.2 The tester may be transported by all means of transport in covered vehicles (air transport in heated sealed compartments) for any distance.

APPENDIX A. Data transfer by RS-232

A1 General

To transfer data from the tester to a personal computer (PC) via the RS-232 interface, the PC should be equipped with:

- 1) RS-232 DB9M port (currently rare), the tester is connected by RS232 DB9F-DB9M cable (mouse extension cable, not included in the package);
- 2) USB port, the tester is connected via a USB – RS-232 interface converter, such as «TRENDnet TU-S9» (cable RS-232 DB9F-DB9M cable may also be required, for extension, the converter and cable are not included).

The terminal program should also be installed on the PC. This guide describes how to configure the "PuTTY" program.

Program page on the network: «www.putty.org»

Download link: «<http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe>».

The program does not require installation, and can be started immediately, after downloading. In this example, after downloading the program, it is placed in a folder «C:\Program files (x86)\PuTTY». The actual placement of the program is determined by the convenience of further use.

A2 Program setting

A2.1 Port definition

Before setting up the program, you need to determine the port number to which the tester is connected.

For this, press the buttons simultaneously on the PC keyboard  and  the «Run» program opens (see figure 32).

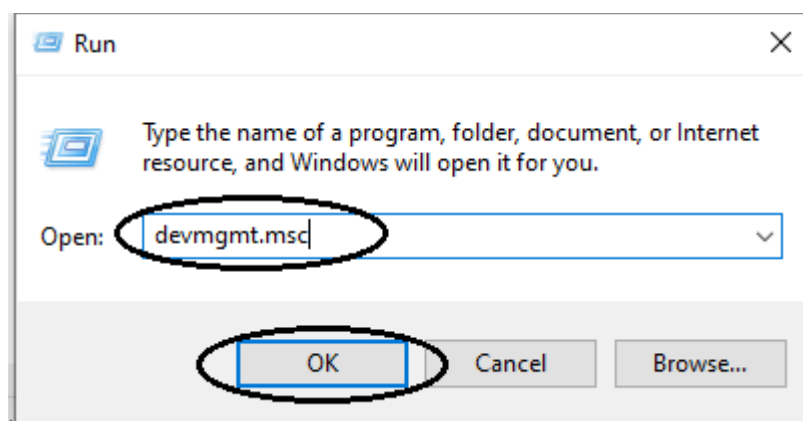


Figure 24 – Program «Run»

In the text field, type «**devmgmt.msc**» and click [OK] - the tester manager opens (see figure 33).

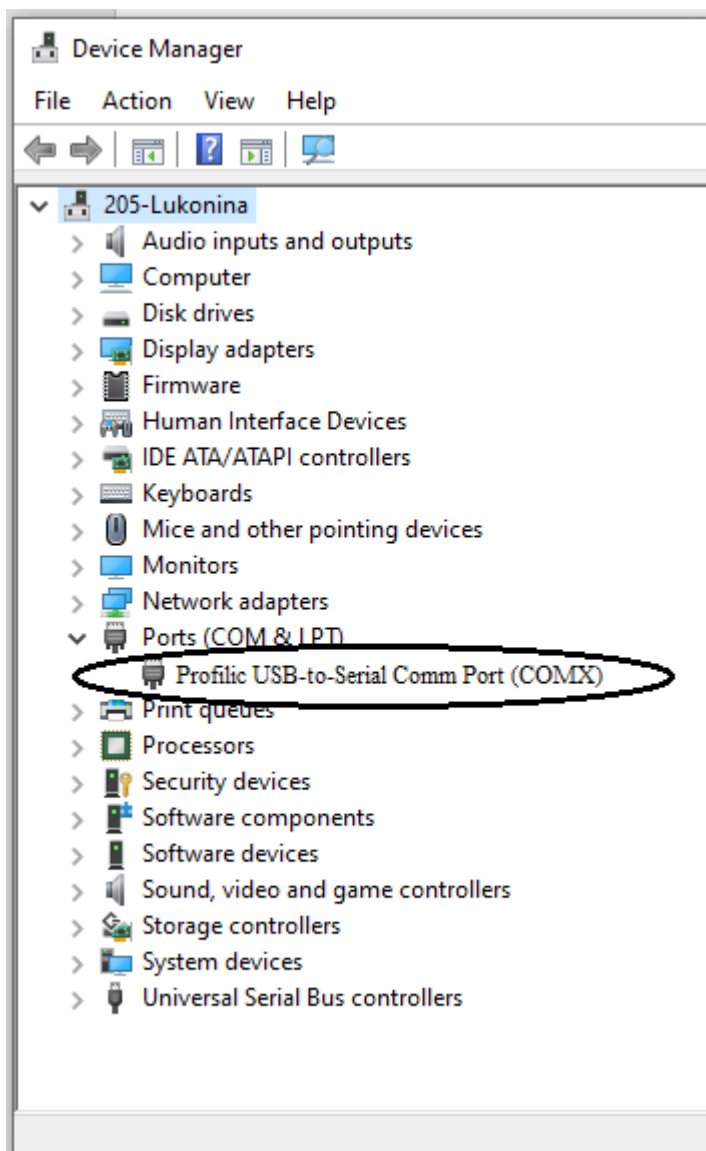


Figure 25 – Device manager

In the «**Ports (COM and LPT)**» section, find the port number to which the cable is connected: in the case of the TRENDnet TU-S9 pre-educator, the port will be called «**Profilic USB-to-Serial Comm Port (COMX)**», where **COMX** is the desired port number. When you disconnect the converter from the USB connector, the port disappears from the list of devices, and appears again when you connect it. You should always connect the converter to the same USB port, because otherwise the port number changes and you will have to configure it again.

If the computer is equipped with an RS-232 port and the tester is connected without a USB-RS-232 converter, you can only determine the port number by experimentally, setting the program to all the «**COM**» ports from the list of devices (the port name should not contain «**USB**»).

A2.2 Connection setup

Start the «**PuTTY**», program, set the settings on the «**Session > Logging**» tab (see figure 34).

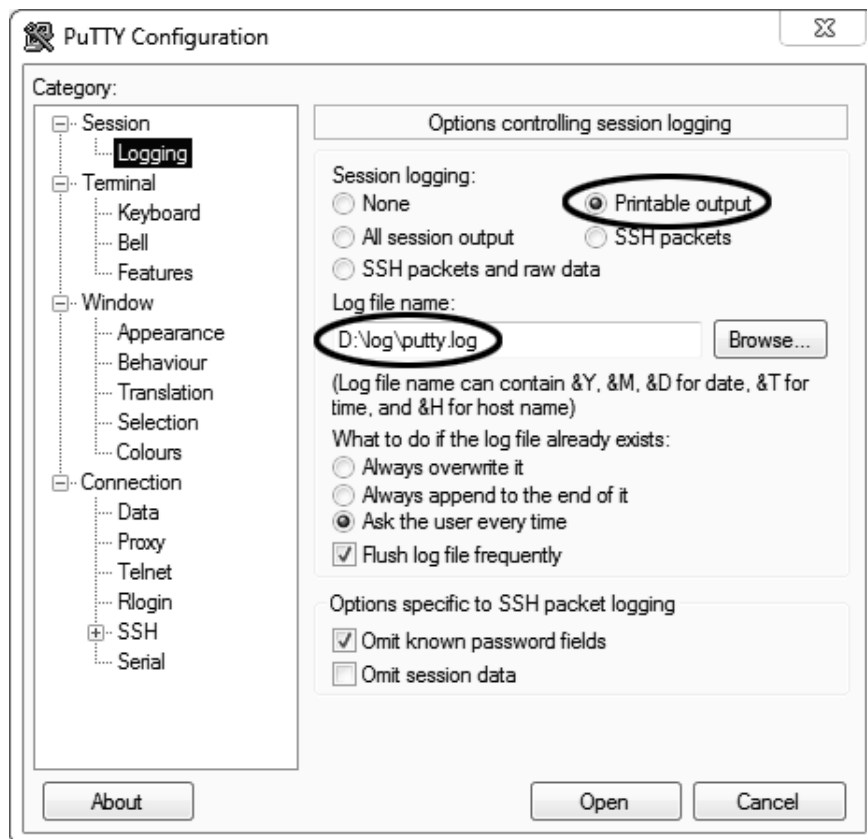


Figure 26 – Program «PuTTY»

«D:\log\putty.log» –a way of storing data received from the tester. The parameter can be changed if necessary.

Set settings on the tab «Terminal» (see figure 35).

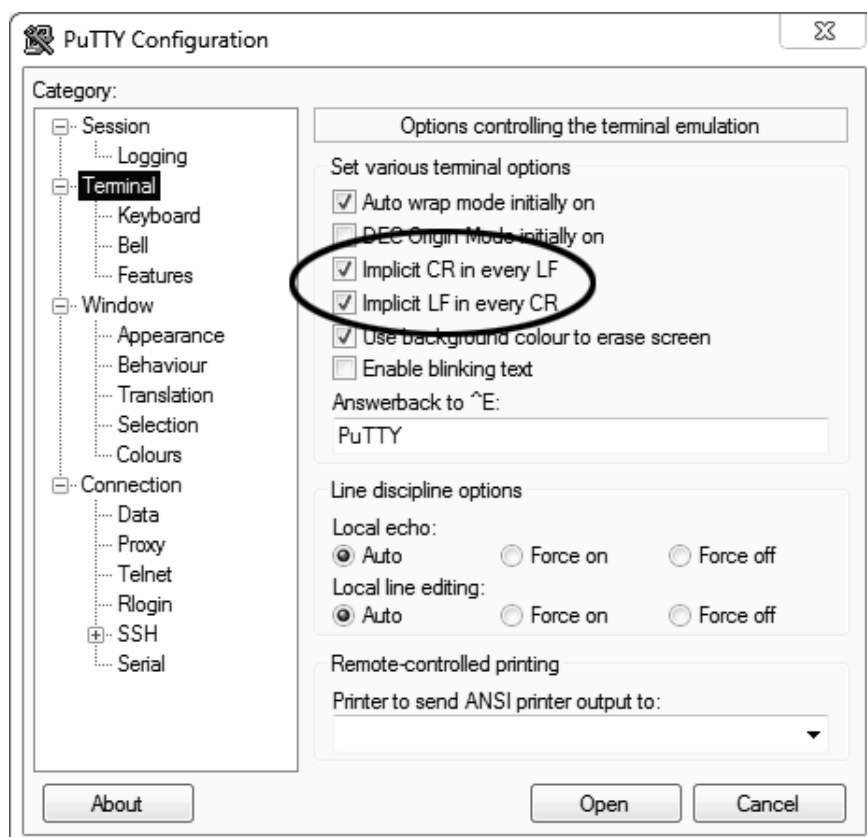


Figure 27 – Set setting

Set settings on the tab «**Window › Translation**» (see figure 36).

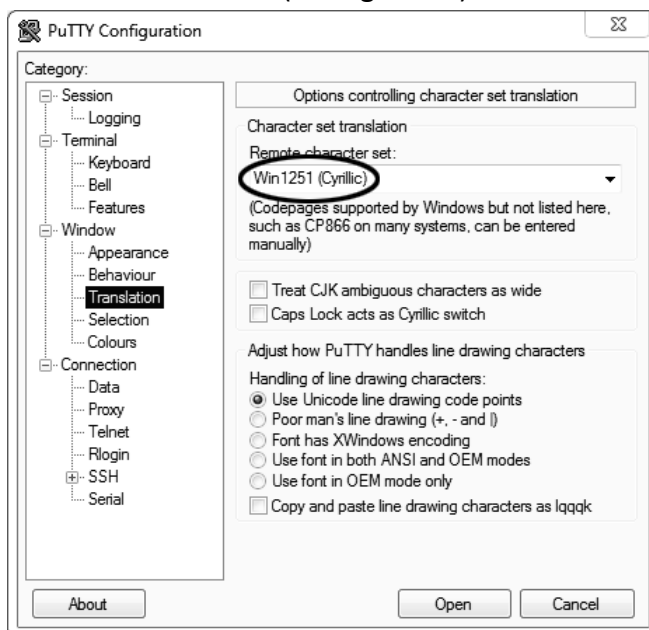


Figure 28 – Set setting

Open the tab «**Connection › Serial**» (see figure 37).

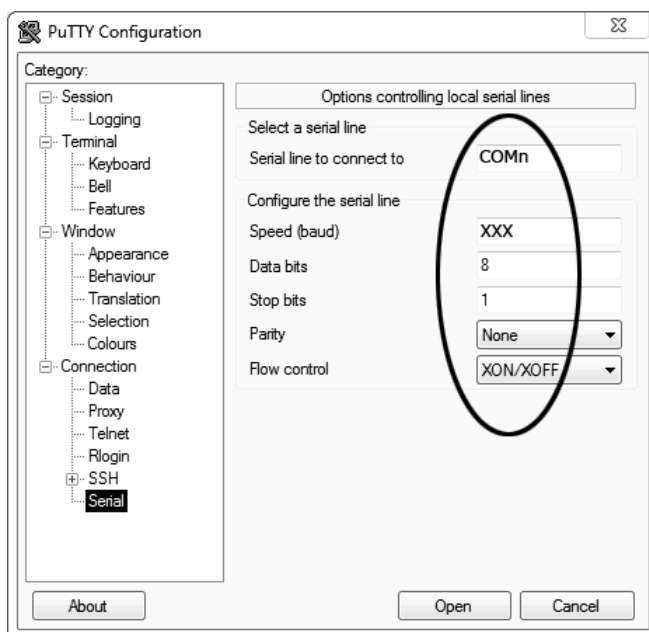


Figure 29

Specify the port number, defined earlier in paragraph 2.1 of this Appendix (for example, this is the COM8 port).

Configure other connection parameters:

- Speed:..... 19200;
- Data bits: 8;
- Stop bits: 1;
- Parity: None;
- Flow control:XON/XOFF.

Open the tab «**Session**» (see figure 38).

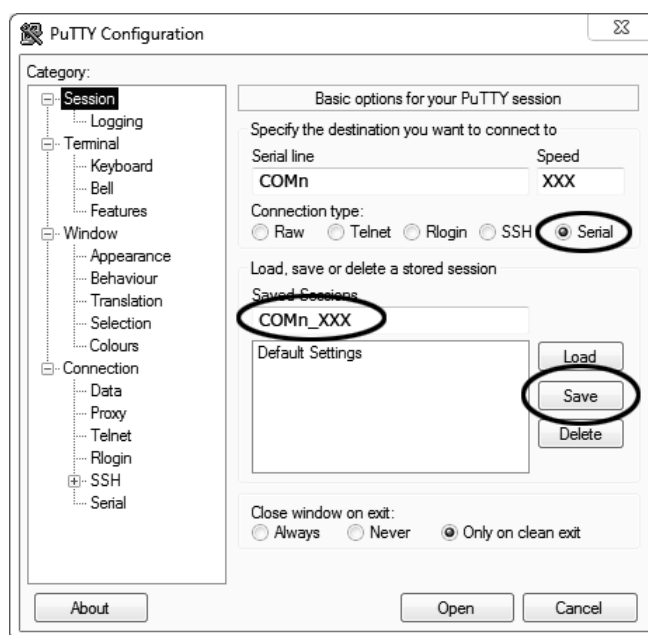


Figure 30 – Tab «Session»

Select the «**Serial**» connection type, name the connection according to the port number and data rate (for example, «**COM_8_19200**»), and click [**Save**].

Close the «**PuTTY**» program.

In the free area of the desktop, right-click and select «**Create » Shortcut**» from the context menu (see figure 39).

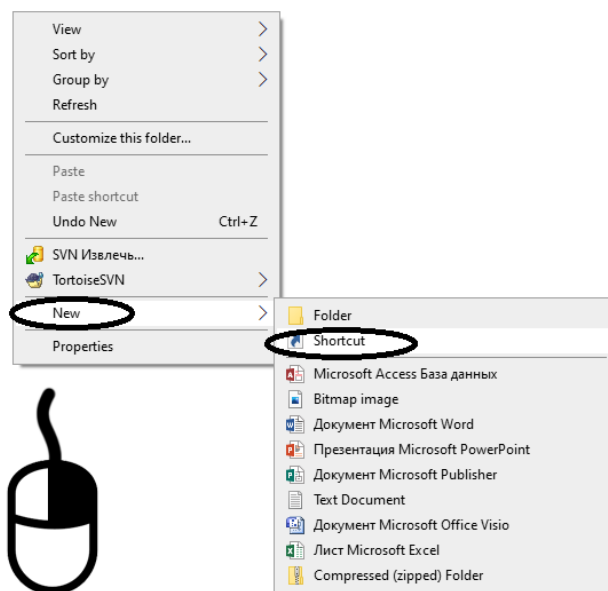


Figure 31 – Item selection

A dialog box opens (figure 40):

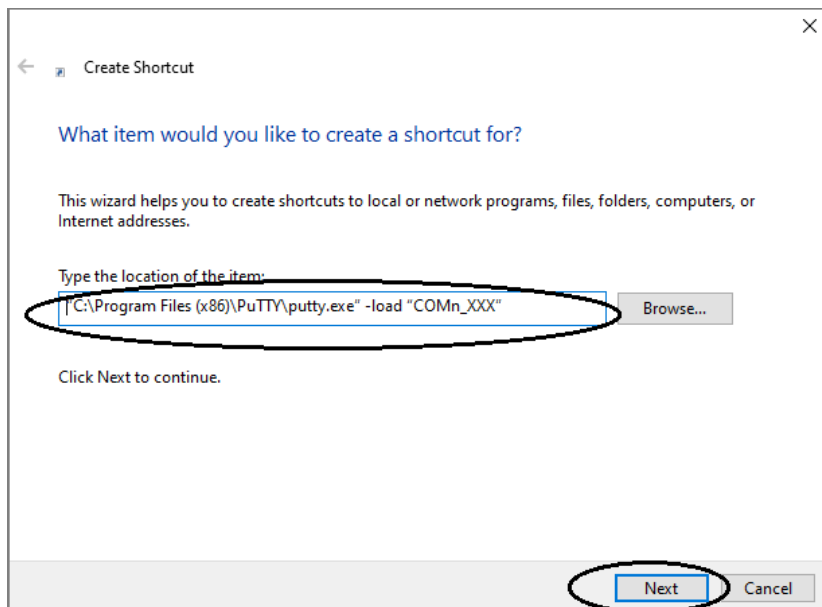


Figure 32 – Dialog box

In the text field, type the path to the program location and space-separated parameter «-load "COM_8_19200"», where «COM_8_19200» is the name of the connection saved when setting up the "PuTTY" program. The name of the connection should be enclosed in quotation marks. If there are spaces in the program location path, then the path should also be enclosed in quotation marks. For example, the value is entered in the text field «"C:\Program Files (x86)\PuTTY\putty.exe" -load "COM_8_19200"»

Click [Next] to open the next window (figure 41):

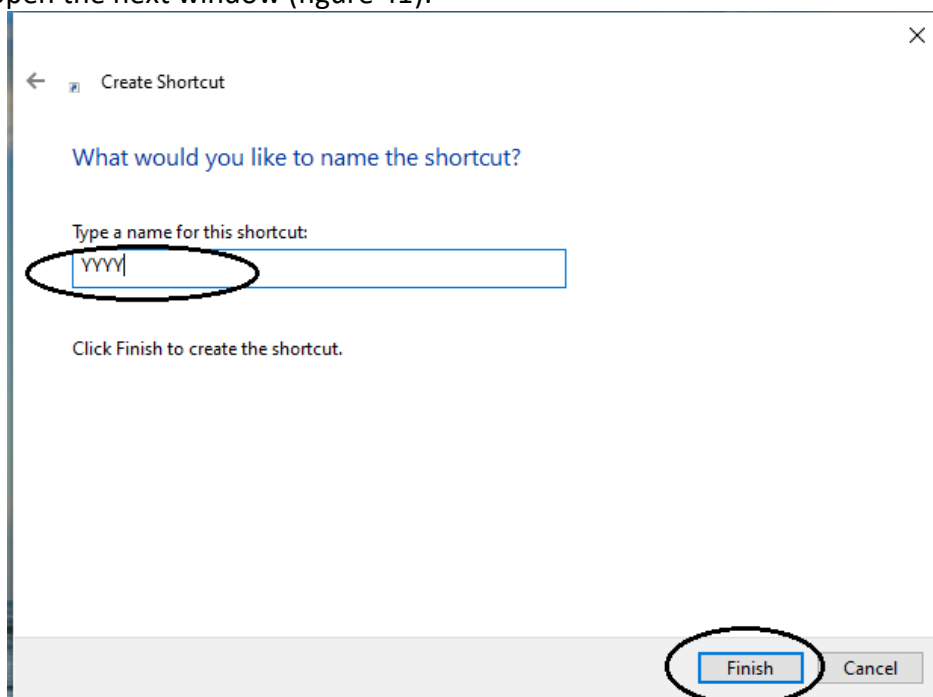


Figure 33

In the YYYY text field, enter a shortcut name that is convenient for further use.

Click [Done] to complete the shortcut setup.

Now the PuTTY program can be started by double-clicking on the shortcut (see figure 42).

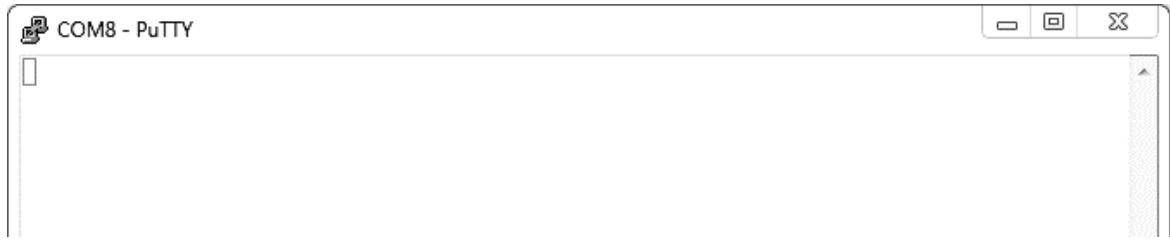


Figure 34

When you connect the analyzer and start transmitting, the received data will be displayed in the window that opens. They are automatically saved to the file specified when setting up the connection. To finish receiving data, close the **PuTTY** program with the **[x]** button in the upper-right corner of the window.

APPENDIX B. USER INTERFACE

B1 Main window

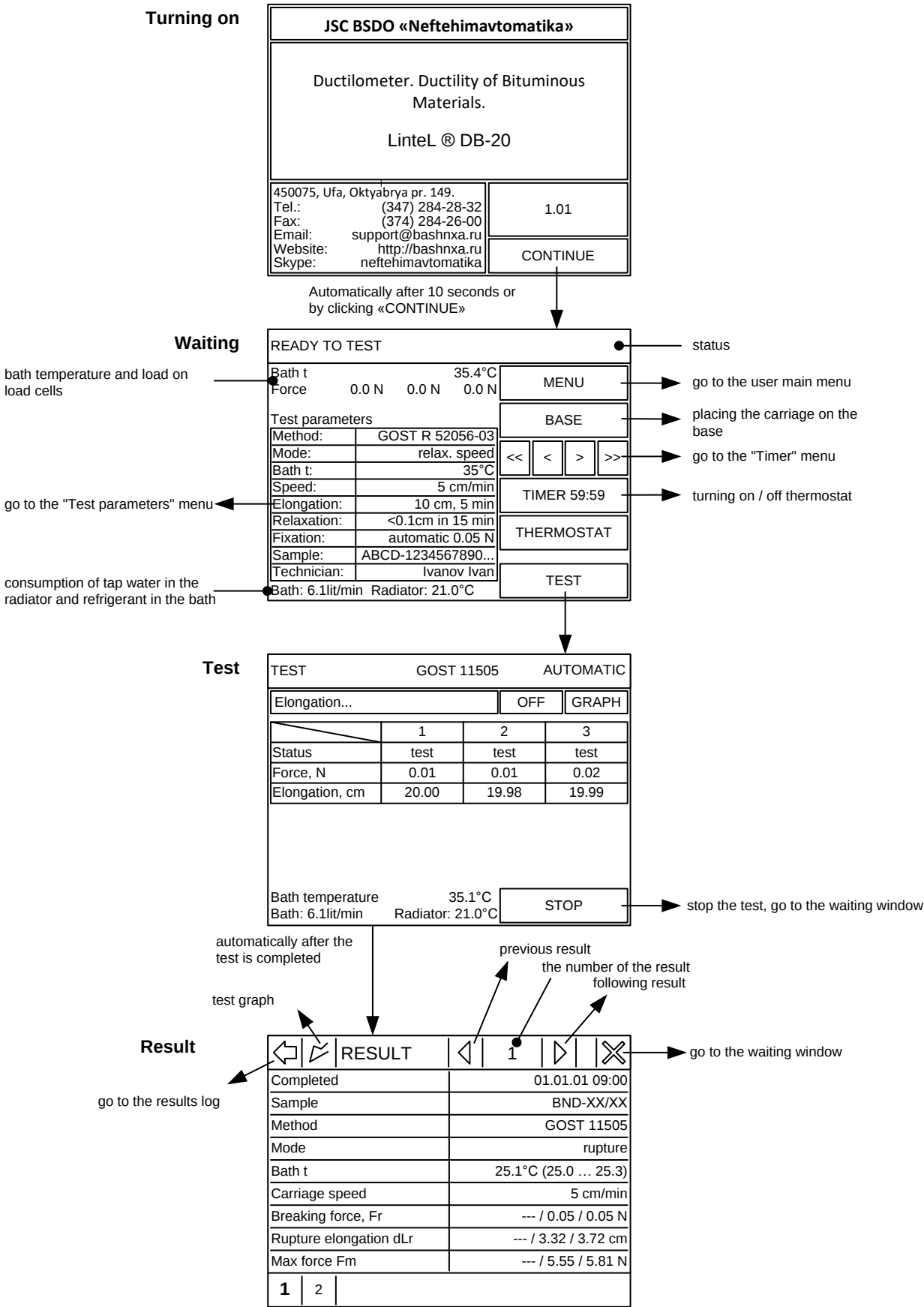


Figure 35 – Main window

B2 Menu system

B2.1 MAIN MENU

In the waiting window, click the **[MENU]** button.

Table 1

Test parameters	Go to the menu for editing test parameters (see paragraph 4.5.3 - 4.5.6 of this Operating manual)
Timer	Go to the start and stop menu of the sample exposure timer (see paragraph 4.3 of this Operating manual)
Delayed start	Delayed activation of the thermostat (see paragraph 4.5.2.3 of this Operating manual)
Turning off the thermostat	Thermostat mode during testing (see paragraph 4.5.2.4 of this Operating manual).
Results	Go to the results log (see paragraph 4.6.1 of this Operating manual)
Settings	Go to the « SETTINGS » menu (see below)
Device information	Go to the « DEVICE INFORMATION » menu (displays the software version of the device, operating time, number of turns on the device and tests performed)
Return, mm/min	The speed at which the carriage will return to its base position

B2.2 MENU «SETTINGS»

In the main menu, select "**Settings**".

Table 2

Interface	Go to the « INTERFACE » menu (editing the device's clock and calendar, display brightness, sound volume, and the test completion ringtone)
Wireless communication	Go to the WIS menu (edit the network number and channel of the WIS module)
Check	Go to the « CHECK » menu (see below)
Calibration	Go to the « CALIBRATION » menu (see below)
Service	Go to the « SERVICE » menu (see below)

B2.3 MENU «CHECK»

In the «**SETTINGS**» menu, select **Check**.

Table 3

The drive carriage	Go to the « CARRIAGE DRIVE » menu (see clause 5. 8 of this Operation manual)
The t sensor bath	Go to the « BATH SENSOR t » menu (see item 5. 9 of this Operation manual)
Loading system	Go to the « LOADING SYSTEM » menu (see clause 5.10 of this Operation manual)

B2.4 «CALIBRATION» MENU

In the «**SETTINGS**» menu, select «**Calibration**» and enter the password «**37201**».

Table 4

The drive carriage	Go to the « CARRIAGE DRIVE » menu (see item 5. 11 of this Operation manual)
The t sensor bath	Go to the « BATH SENSOR t » menu (see item 5. 12 of this Operation manual)
Loading system	Go to the « LOADING SYSTEM » menu (see clause 5.13 of this Operation manual)

52.4 «SERVICE» MENU

In the «SETTINGS» menu, select «Service».

Table 5

Print the results	Transfer of the results log to the PC via RS-232 (see item 4.6.2 of this Operation manual)
Printing parameters	Transmitting the device's settings to a PC via RS-232
Printing errors	Sending the error log to the PC via RS-232
Sensor readings	Go to the «SENSOR READINGS» menu (displays the device's sensor readings)
Delete results	Clear the results log
Delete the list of samples	Clear the list of sample names
Delete the list of laboratory assistants	Clear the list of laboratory assistants
Reset settings	To load the factory setup parameters
Factory menu	For specialists of the manufacturer

FREEZING POINT OF WATER SOLUTIONS

Table 6

Glycerin		Sodium chloride NaCl		Ethyl alcohol	
Content, % by weight	Freezing point, °C	Content, % by weight	Freezing point, °C	Content, % by weight	Freezing point, °C
10	-1,6	0	0	5	-2,2
20	-4,8	5	-2,8	10	-4,7
40	-9,5	10	-6,4	15	-6,8
50	-15,4	15	-11,1	20	-10,4