LinteL | Automated laboratory equipment for quality control

Automated Pensky Martens flash point analyzer (closed cup)

LinteL® ATV-21

Operating Manual

WIRELESS INTERFACE SUBSYSTEM

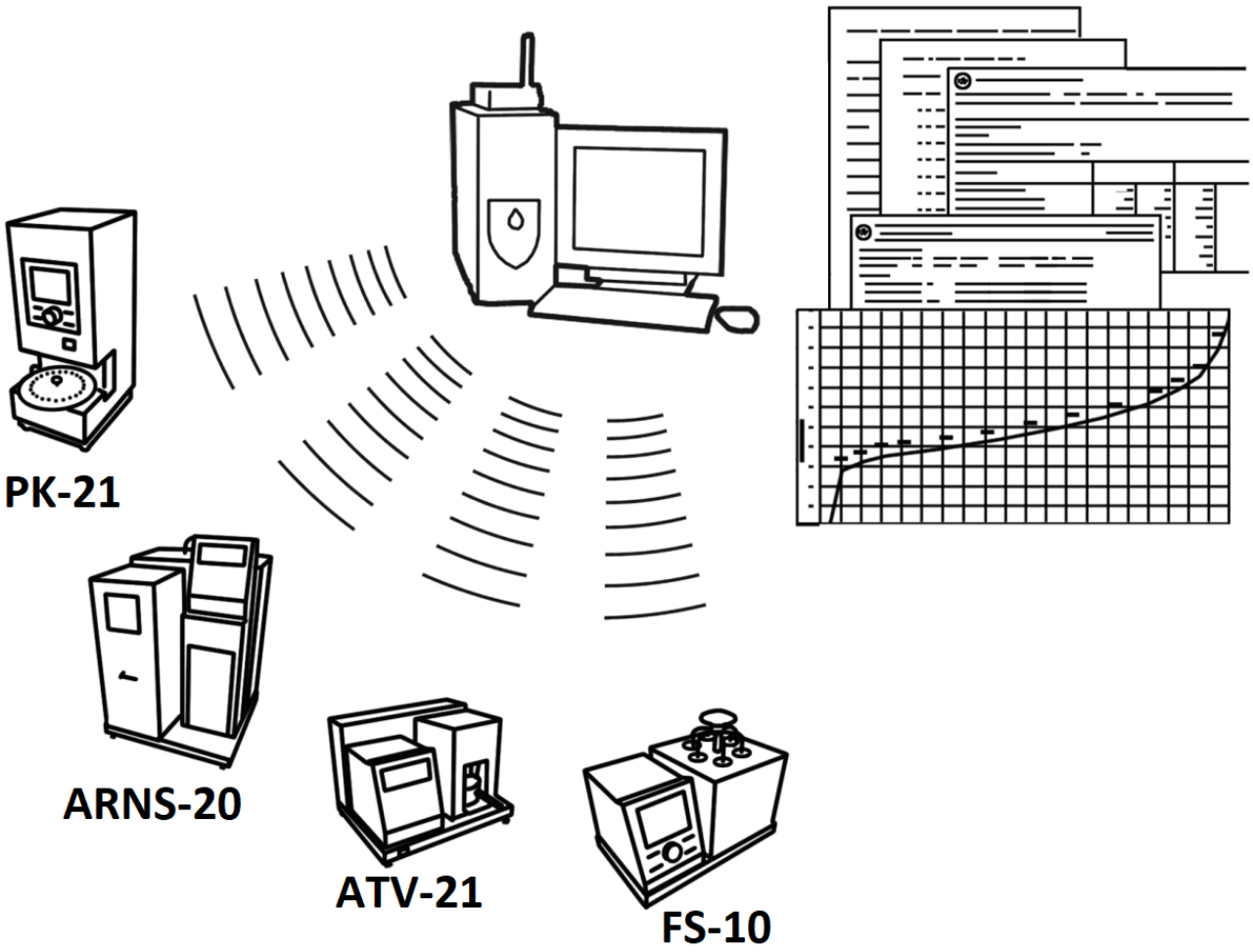
Wireless interface subsystem (further WIS) is designed for operation automation of petroleum product quality control laboratories.

Wireless interface subsystem has the following functions:

- automatic transfer of test results from the analyzer located in the laboratory to PC via wireless communications channel (IEEE 802.15.4/ZigBee standard);
- safe storage of information obtained from the analyzer 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*® analyzer can be integrated in a common network.

LinteL® analyzer are equipped with hardware and software providing analyzer operation with the Wireless Interface Subsystem[1].



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 diagram, improves the quality of work, and eliminates most routine operations.

[1] For additional information, please, call +7 (347) 284-44-36, 284-27-47.

Up-to-date devices for petroleum product quality control

Thank you for purchasing and usage of *LinteL*® ATV-21 automatic laboratory analyzer for determining the temperature of breaking point of oil bitumen.

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

The analyzer 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 analyzer, convenience of their operation, in order to reduce the time spent on testing and increase the efficiency of your work.

The purchased *LinteL*® ATV-21 analyzer incorporates most advanced design solutions relative to products of such type:

- Up-to-date control unit based on ARM Cortex-M4F STM32 microcontroller. Preferential use of foreign components and assemblies of enhance reliability.
- Color graphic touch screen, help system and device self-diagnostics improve operation convenience and reduce time required for mastering the device.
- Highly-stable temperature sensor.
- Automatic barometric pressure sensor.
- System providing constant parameters of electronic igniter.
- Automatic mode of power consumption and noise reduction at test completion.

CONTENT

The operating manual contains information about the design, operating principle, characteristics of the automatic LinteL® ATV-21 and instructions necessary for its correct and safe operation.

1 LIST OF ABBREVIATIONS

Analyzer – the analyzer is automatic LinteL® ATV-21.
PC – personal computer.

2 DESCRIPTION AND OPERATION

2.1 Purpose

LinteL® ATV-21 automatic laboratory analyzer (further analyzer) is a desktop type test equipment and is designed to determine the flash point in a closed cup in accordance with the standards ISO 2719 (methods A and B), ASTM D93 (methods A and B).

2.2 Specifications

2.2.1 Performance data of the analyzer given in table 1.

Table 1 – Performance data

Parameter	Unit of measurement	Value
Flash point range	^{0}C	from +12 to +370
Voltage	V	from 198 to 242
Frequency	Hz	from 49 to 51
Power consumption, max: - under test mode - under standby mode	 V·A V·A	 750 120
Ambient air temperature	^{0}C	from 10 to 35
Relative air humidity at +25°C, max	%	80
Barometric pressure range	mm Hg	from 680 to 800

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

Table 2 – Weight and dimensions

Parameter	Unit of measurement	Value
Dimensions (with the cup installed) (width × height × depth)	mm	420 × 310 × 455
Weight, max	kg	15

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

Table 3 – Accuracy parameters

Product under test	Flash point range, ^{0}C	Repeatability r, ^{0}C	Reproducibility R, ^{0}C
ISO 2719 Method A **ASTM D93 Method A**			
Paint and varnish	-	1.5	-
Distillate fuels and fresh lubricating oils	from 40 to 250	0.029X[1]	0.071X[1]
ISO 2719 Method B **ASTM D93 Method B**			
Residual fuels and fluxed bitumen	from 40 to 110	2.0	6.0
Used lubrication oil	from 170 to 210	5.0	16.0
Liquids prone to surface film formation; liquids with suspended solid materials, high-viscosity products	-	5.0	10.0

ATTENTION

*Accuracy parameters given in Table 3 are not applicable for assessment of results obtained while testing products with unknown flash point ("**Express**" method).*

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

2.3 Arrangement and operation

2.3.1 Scope of supply:

Analyzer LinteL® ATV-21 AIF 2.821.025-02.

Operational documents:

- The operating manual for AIF 2.821.025-02 RE;
- Passport AIF 2.821.025-02 PS;
- Certification program and procedure AIF 2.821.025-02 MA.

Set of attachments.

2.3.2 Principle of operation

2.3.2.1 General view of the analyzer is shown in Figure 1.

2.3.2.2 The analyzer structure includes electronic unit (1), control unit (2) with RS-232 port and process unit (10). The units are mounted on base (7) arranged on height-adjustable feet (6). The analyzer is switched on with "**Power**" toggle switch (5).

2.3.2.3. The electronic unit includes the analyzer control board and power supply unit.

2.3.2.4 Process unit (10) comprises the following:

- cup lifting mechanism;
- stirrer driving mechanism;
- transfer mechanism of the cup shutter;
- igniter;
- temperature sensor;
- flash sensor;
- table for cup installation (8).

[1] X is the average value of the compared test results.

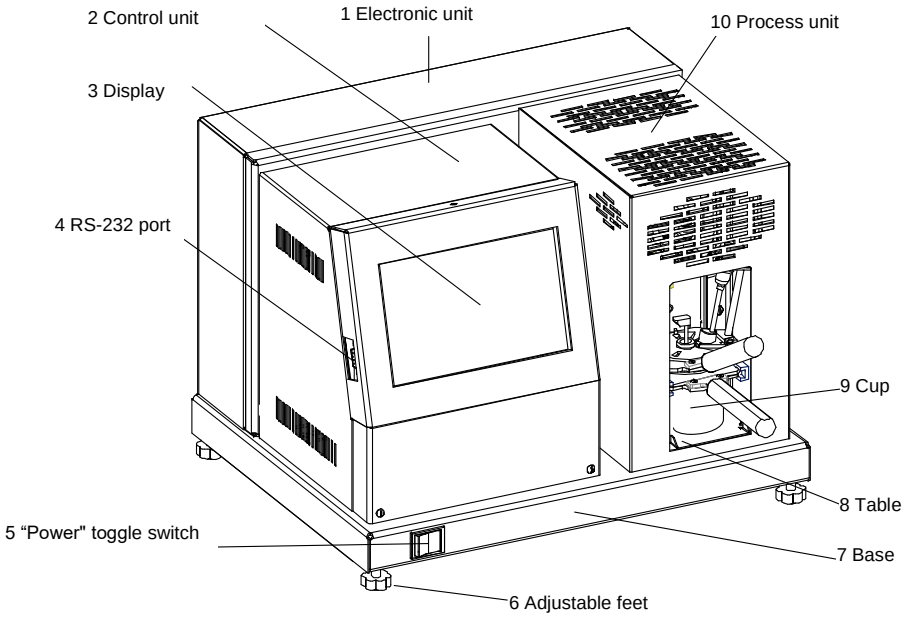


Figure 1 – Analyzer arrangement

2.3.2.5 The back side of the base (see Figure 2) has: a hole for mounting the Wireless Interface Subsystem antenna (1), “Ground” terminal (2) for analyzer grounding, fuse holders (3) and power cord input (4).

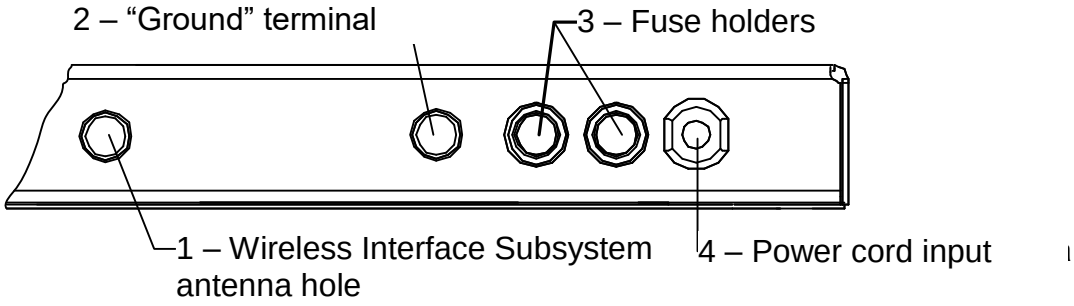


Figure 2 – Back View of the base

2.3.3 Analyzer operation

2.3.3.1 In course of test performance the cup with product filled in and the cover closed is put on table (8) (see Figure 1) and inserted into the analyzer along guides until full stop.

2.3.3.2 For test starting one shall select the test procedure and expected flash point of the sample.

2.3.3.3 The sample name and operator name can be specified. These parameters allow increase of results informative value; they shall be mandatorily filled in during analyzer operation as part of *LinteL*® LINK subsystem. Each new name is stored in analyzer memory and can be selected during further tests.

2.3.3.4 When “**Test**” button is pressed the cup is lifted along the guides into the operating position. Then temperature sensor is automatically placed into the cup, and contacts of the electrical heater arranged inside the cup are connected. The stirrer drive is switched on and the sample is stirred.

2.3.3.5 In course of flash test stirring is stopped, the cup shutter is opened, the igniter and flash point detector are lowered into the cup and remain in that lower position during specified period of time. After that the igniter and flash point detector are raised and the cup shutter is closed simultaneously.

2.3.3.6 When the sample under test flashes out, the temperature is recorded, the stirrer is stopped and the screen displays the flash point adjusted with regard to barometric pressure correction.

2.3.4 Analyzer options

2.3.4.1 In course of testing current test conditions, readings of the sample temperature sensor, heating rate and barometric pressure are shown on the display. One can switch over to the view mode to see the sample heating rate graph, if required.
2.3.4.2 The analyzer memory stored up to 100 test results and up to 100 test graphs.
2.3.4.3 When the laboratory is equipped with *LinteL*® LINK Wireless Interface Subsystem, test results, graphs and setting parameters of all analyzers manufactured by Neftehimavtomatica are automatically transferred to a database via a radio channel and entered into common database.
2.3.4.4 All it takes is to install *LinteL*® LINK subsystem on PC: the computer can be placed in another room or even another floor within the building – results will be transferred in any case. In such case no cables are required.
2.3.4.5 Using *LinteL*® LINK allows significant improvement of work quality and release from most of routine operations.

3 PREPARATION FOR OPERATION

3.1 Requirements for installation place

3.1.1 LinteL® ATV-21 is a desk-top device.
3.1.2 The analyzer shall be installed in a vent hood.
3.1.3 At the installation site, there should be no impact of shaking, bumps, vibrations that affect the normal operation of the device.
3.1.4 The installation surface should be flat and horizontal. If necessary, small irregularities can be compensated by adjusting the device's legs.
3.1.5 The analyzer shall be connected to a ground terminal, as well as to a grounded EU socket. Grounded circuit independent of the power supply one shall be used as the ground bus.
3.1.6 The analyzer comprises LED touch screen. While selecting the installation place one shall keep the display away from direct sunlight in order to increase the analyzer service life.

3.2 Visual control

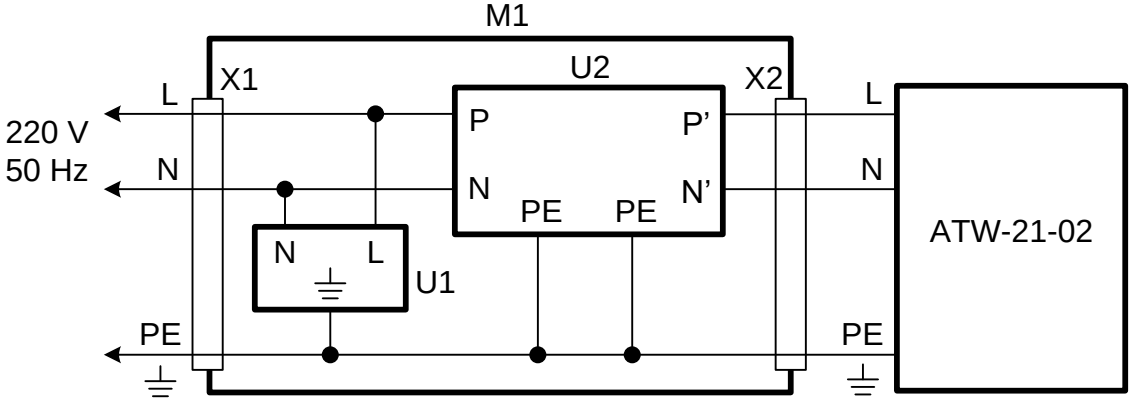
Before using the analyzer:

- unpack the analyzer;
- check scope of supply;
- perform visual control of the analyzer for damage;
- check for supporting documentation.

An appropriate report is drawn up for all defects.

3.3 Power connection

To protect the device from pulse overvoltage's that occur in the supply network when it is exposed to lightning discharges, as well as when switching powerful motors and other industrial equipment, it is necessary to use an external protection module when connecting the device to the network. It includes: Surge Protection Device (SPD) and network filter. The connection diagram of the device using the external protection module is shown in schematic diagram 1:



Schematic diagram 1. External protection module

Where: M1 - External protection module AIF 2.107.100, U1 - Surge arrester Schneider Easy9 «EZ9L33620», U2 - Multi-stage EMI Filter Schaffner «FN 352 Z-20-29»

The external protection module is a block with two connectors: input - X1 and output-X2. The input connector of the module is connected to the 220V 50Hz power supply network. The power plug of the ATV-21-02 device is connected to the output connector.

3.4 Test run

ATTENTION!

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

3.3.1 Plug the analyzer in and switch it on with **"Power"** toggle switch (5) (see Figure 1, page 5).

3.3.2 When using the LinteL® - Link[1] or LinteL® - LIMS[1] programs, you should install the antenna on the device (see figure 2, page 5) and the microcircuit of the wireless communication device. The antenna is installed in the socket on the back of the device.

3.3.3 After turning on the power, the device screen displays information about the operating system booting. Then the information shown in figure 3 is displayed.

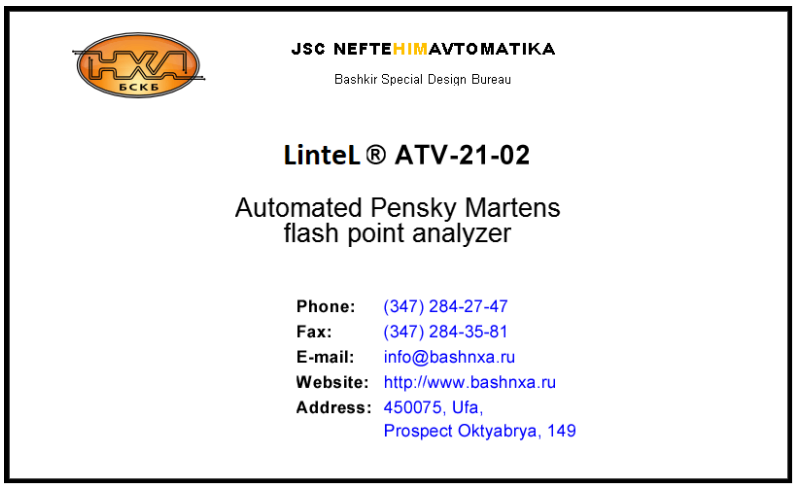


Figure 3 - Splash screen

3.3.4 Switching to test preparation mode is performed either by double-clicking on the display screen, or automatically after some time has passed.

4 INTENDED USE

4.1 Additional equipment and materials

Additional materials for operation given in Table 4.

Table 4 – Additional materials

Materials	Purpose
Gasoline solvent (nefras S2-80/120, S3-80/120); Gasoline solvent (nefras C5/170); technical detergent; direct distillation gasoline without additives.	wiping the outer and inner surfaces of the lid and shutter, the inner surface and the edge of the cup
Cotton napkin	

[1] It is delivered on a separate order.

4.2 Operating limits

1) During operation, the analyzer should be grounded by the "Ground" terminal, or connected to a Euro-socket that has a ground connection. Use a ground loop that is not connected to the power one as the ground bus. The analyzer can be switched on again no earlier than 5 minutes after it is switched off.

2) It is forbidden for foreign objects to fall into the space intended for the installation of the analyzer. The analyzer has nodes that are under high voltage, including a terminal device (a spark gap).

3) It is forbidden to turn on the analyzer when the cover is removed on any of the units. When performing work related to removing the cover, disconnect the power plug from the outlet.

4) The analyzer's operating mode is continuous. After the end of operation, the device is switched off by the "Power" toggle switch (see figure 1, page 5).

5) During work with the analyzer, the service personnel should perform safety regulations, working with electrical installations with a voltage of up to 1000 V.

6) Service personal should:

- to be trained to operate the analyzer and obtain a permit to;
- know how the analyzer works;
- know the rules for safe maintenance;
- know the procedure for a failure.

7) The analyzer display is covered with a sealed polymer film. When the film is contaminated, it can be wiped with a swab moistened in alcohol.

8) Toxic products shall be tested in a ventilation hood with observation of safety regulations adopted for working with toxic substances.

9) To prevent burn injuries the cup shall be removed using a handle and avoiding contact with other analyzer parts.

10) In order to avoid electric shock, work related to setting up, cleaning, and lubricating components and parts of the process unit should only be carried out when the power is turned off.

4.3 Sample preparation

4.3.1 Prepare a sample in accordance with ISO 2719 (methods A and B), ASTM D93 (methods A and B).

4.3.2. The sample in poured in the cup up to a hairline made on its internal surface. The sample is poured so that the cup internal surface above the hairline remains dry. Close the cup with a cover and check the cover shutter position: contact with the cover surface and window overlapping (extreme shutter position in clockwise direction relative to cover axis.) Cup and sample temperature shall be at least 17 °C lower than the expected flash point.

ATTENTION

To more accurately maintaince of sample heating rate within the operating range, cup and sample temperature shall be 30 °C lower than the expected flash point.

4.3.3 Install the cup into the analyzer:

- Take the cup by its handle and carefully (no shacking) put it on the analyzer table in horizontal position;
- Carefully move the cup along guides until full stop. At that moment side locks shall snap shut and hold the cup in such position.

ATTENTION

It is forbidden to install an empty cup or a cup with the product filled below the risk.

4.4 Analyzer preparation for testing

4.4.1 Remove the cup cover. Slightly raise the cover shutter. Wipe external and internal surfaces of the cover and shutter with cotton cloth moistened in water-free cleaning fluid (the types of washing liquids are indicated in table 4 of this Operating manual). Wipe the cut internal surface and edges with cotton cloth moistened in cleaning fluid. Do not allow liquids to enter the cup electrodes. Dry the cup and cover well, or blow with compressed air.

ATTENTION

It is prohibited to wash the cup by dipping it into cleaning fluid, cool the cup with water, install the cup into the analyzer with no product to be tested.

4.5 Testing

4.5.1 Testing by the **"EXPRESS" method**

4.5.1.1 "**EXPRESS**" tests are performed for samples with unknown flash point.

ATTENTION

In this case, test results are estimative and not regulated by any accuracy parameters.

4.5.1.2 Turn the analyzer power supply on as per paragraph 3.3 of this operating manual. The display shows the following, shown in Figure 4.

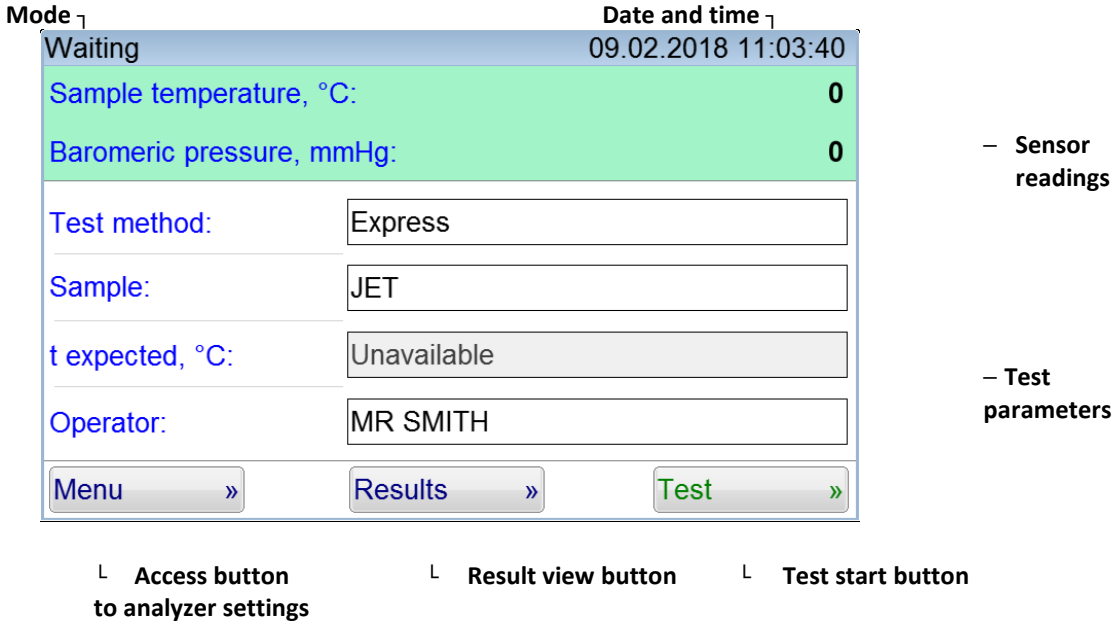


Figure 4 - Waiting window

4.5.1.3 Prepare the sample as per paragraph 4.2 of this operating manual.

4.5.1.4 Select "**EXPRESS**" test method (see Appendix B, B3).

4.5.1.5 Select the name of the sample under test from the Sample list. If new sample shall be entered (see Appendix B, B4).

4.5.1.6 Select operator from the list. If new operator shall be entered (see Appendix B, B5).

4.5.1.7 At completion of all preparatory operations install the cup with a sample, press "**Test**" button

(see paragraph 4.5.6 of this operating manual).

4.5.1.8 After pressing "**Test**" button the cup is raised automatically and the stirrer is switched on in the accelerated mode (240 rpm). The sample will be preliminary stirred for 60 sec in order to reach the temperature balance.

4.5.1.9 Then the analyzer heats the sample at rate (17.5 ± 2.5) °C/min and performs flash point test in every 5 °C.

4.5.1.10 At the moment of flash point test the following takes place:

- Stirring is stopped;
- A spark is supplied to the igniter;
- Mechanism, which opens the shutter and lowers the igniter into the cup within 0.5 sec, is actuated;
- The igniter is kept in the cup for 1 sec;
- The spark is switched off, the igniter is raised, the shutter is closed, stirring is actuated.

4.5.1.11 The flash point is accepted to be a corrected reading of the digital temperature meter at the moment of distinct occurrence of the first flame above the sample surface inside the cup, considering the barometric pressure correction.

4.5.1.12 When the flash point is recorded, the test is completed. The analyzer is automatically set to the result view mode (see paragraph 4.6 of this operating manual). At that moment a tune denoting test completion, is repeated regularly. It is required to press "**Close**" button to quit from the view mode and switch off the tune.

4.5.1.13 If "**Stop**" button is pressed during the test, the analyzer is set to the test preparation mode.

4.5.1.14 When readings on the digital temperature meter of the bath reach plus 395 °C, the test is stopped, the analyzer issues a message about overheating. In this case "**Stop**" button shall be pressed.

4.5.1.15 Then the test is stopped, the heating is turned off.

4.5.2 Testing according to the methods of ISO 2719, ASTM D93 (Method A)

4.5.2.1 Turn on the power supply of the device in accordance with paragraph 3.3 of this operating manual. The display will show the information, shown in Figure 5.

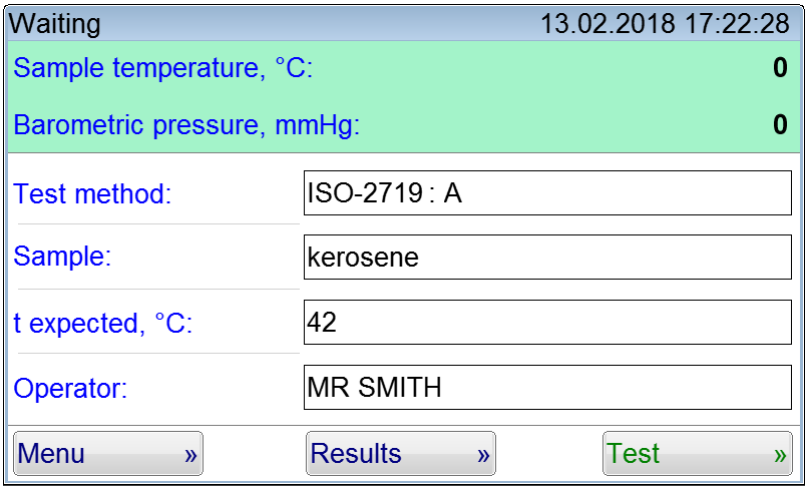


Figure 5 - Waiting window for ISO 2719: A

4.5.2.2 Prepare the sample as per paragraph 4.3 of this operating manual.

4.5.2.3 Select test method (see Appendix B, B3).

4.5.2.4 Select the name of the sample under test from the Sample list. If new sample shall be entered (see Appendix A, Sample list).

4.5.2.5 Set the expected flash point (see Appendix B, B1). The expected temperature shall be within the range from 12 to 370 °C.
4.5.2.6 Select operator from the list. If new operator shall be entered (see Appendix B, B5).
4.5.2.7 At completion of all preparatory operations install the cup with a sample, press **"Test"** button (see paragraph 4.5.6 of this operating manual).
4.5.2.8 After pressing "**Test**" button the cup is raised automatically and the stirrer is switched on in the accelerated mode (240 rpm). The sample will be preliminary stirred for 60 sec in order to reach the temperature balance.
4.5.2.9 Then the analyzer heats the sample. The stirrer is switched over to 120 rpm.
If "Preheating" check-box is selected (✔) (see paragraph 4.10.3 of this operating manual), the sample will be preliminary heated. In course of testing the sample is initially heated at accelerated rate. Then 50–60 degrees prior to the expected flash point the heating rate is changed in accordance to the method selected. Such mode allows reduction of testing time for samples with high flash point.
4.5.2.10 When temperature is 23 ± 5 °C lower than the expected flash point (the value is set in "**Test parameters"** mode, paragraph 4.10.3.10 "**First flame test**" of this manual), the analyzer starts performance of flash point tests in every 1 °C at the expected flash point up to 110 °C (in every 2 °C at the expected flash point higher than 110 °C). It maintains sample heating at rate of (5.5 ± 0.5) °C/min.
4.5.2.11 At the moment of flash point test the following takes place:

- Stirring is stopped;
- A spark is supplied to the igniter;
- Mechanism, which opens the shutter and lowers the igniter into the cup within 0.5 sec, is actuated;
- The igniter is kept in the cup for 1 sec;
- The spark is switched off, the igniter is raised, the shutter is closed, stirring is actuated.

4.5.2.12 The flash point is accepted to be a corrected reading of the digital temperature meter at the moment of distinct occurrence of the first flame above the sample surface inside the cup, considering the barometric pressure correction and rounded off within the accuracy of 0.5 °C.
4.5.2.13 When the flash point is recorded, the test is completed. The analyzer is automatically set to the result view mode (see paragraph 4.6 of this operating manual). At that moment a tune denoting test completion, is repeated regularly. Press "**Close**" button to quit from the view mode.
4.5.2.14 If "Stop" button is pressed during the test, the analyzer is set to the test preparation mode.
4.5.2.15 When readings on the digital temperature meter exceed plus 395 °C, or 28 spark tests have been completed, the test is stopped. The analyzer issues an intermittent audible alarm and displays the error message on the screen. In this case "**Stop**" button shall be pressed.
4.5.2.16 At test stop heating is switched off.

4.5.3 Testing the methods of ISO 2719, ASTM D93 (Method B)

4.5.3.1 Turn on the power supply of the device in accordance with paragraph 3.3 of this operating manual. The display will show the information (shown in Figure 6)

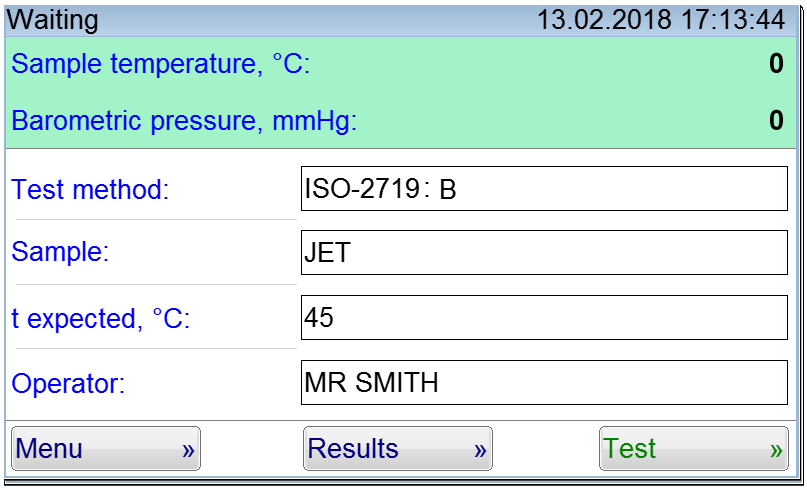


Figure 6 - Waiting window for ISO 2719: B

4.5.3.2 Prepare the sample as per paragraph 4.3 of this operating manual

4.5.3.3 Select test method (see Appendix B, B4).

4.5.3.4 Select the name of the sample under test from the Sample list. If new sample shall be entered (see Appendix B, B4).

4.5.3.5 Set the expected flash point (see Appendix A, **Value editor**). The expected temperature shall be within the range from 12 to 370 °C.

4.5.3.6 Select operator from the list. If new operator shall be entered (see Appendix B, B5).

4.5.3.7 At completion of all preparatory operations install the cup with a sample, press "**Test**" button (see 4.5.6 of this operating manual).

4.5.3.8 After pressing "**Test**" button the cup is raised automatically and the stirrer is switched on in the accelerated mode (240 rpm). The sample will be preliminary stirred for 60 sec in order to reach the temperature balance.

4.5.3.9 Then the analyzer heats the sample.

If "**Preheating**" check-box is selected (✔) (see para 3.3), the sample will be preliminary heated. In course of testing the sample is initially heated at accelerated rate. Then 50–60 degrees prior to the expected flash point the heating rate is changed in accordance to the method selected. Such mode allows reduction of testing time for samples with high flash point.

4.5.3.10 When temperature is 23 ± 5 °C lower than the expected flash point (the value is set in "**Test parameters"** mode, paragraph 4.10.3.10 "**First flame test**" of this manual), the analyzer starts performance of flash point tests in every 1 °C at the expected flash point up to 110 °C (in every 2 °C at the expected flash point higher than 110 °C). It maintains sample heating at rate of (5.5 ± 0.5) °C/min.

4.5.3.11 At the moment of flash point test the following takes place:

- Stirring is stopped;
- A spark is supplied to the igniter;
- Mechanism, which opens the shutter and lowers the igniter into the cup within 0.5 sec, is actuated;
- The igniter is kept in the cup for 1 sec;
- The spark is switched off, the igniter is raised, the shutter is closed, stirring is actuated.

4.5.3.12 The flash point is accepted to be a corrected reading of the digital temperature meter at the moment of distinct occurrence of the first flame above the sample surface inside the cup, considering the barometric pressure correction and rounded off within the accuracy of 0.5 °C.

4.5.3.13 When the flash point is recorded, the test is completed. The analyzer is automatically set to the result view mode (see paragraph 4.6 of this operating manual). At that moment a tune denoting test completion, is repeated regularly. Press **"Close"** button to quit from the view mode.

4.5.3.14 If **"Stop"** button is pressed during the test, the analyzer is set to the test preparation mode.

4.5.3.15 When readings on the digital temperature meter exceed plus 395 °C, or 28 spark tests have been completed, the test is stopped. The analyzer issues an intermittent audible alarm and displays the error message on the screen. In this case "**Stop**" button shall be pressed.

4.5.3.16 At test stop heating is switched off.

4.5.4 Information display in the test mode

4.5.4.1 After pressing **"Test"** button in the test preparation mode the following is displayed on the screen (shown in Figure 7)

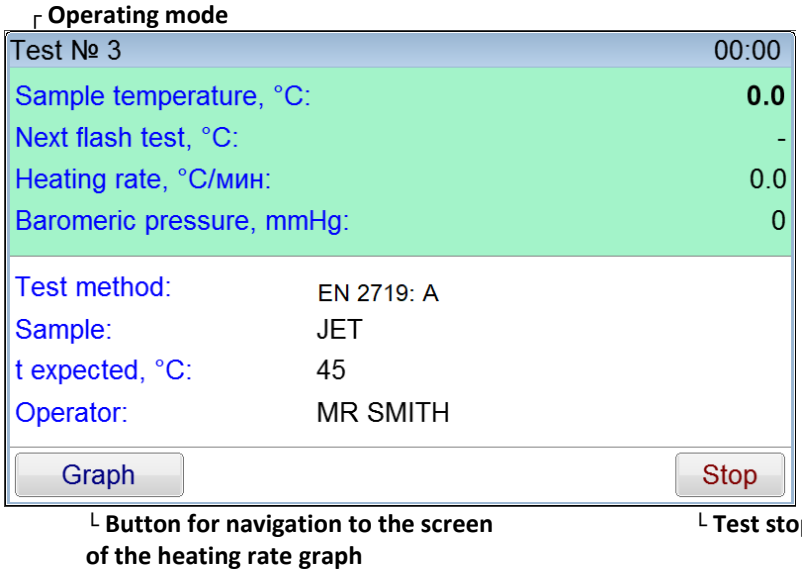


Figure 7 – Test window

4.5.4.2 Beside test conditions this window shows the following:

- current values of sample temperature;
- sample heating rate (displayed after preliminary stirring);
- barometric pressure.

4.5.4.3 If **"Graph"** button is pressed in the test mode, the following is displayed (shown in Figure 8)

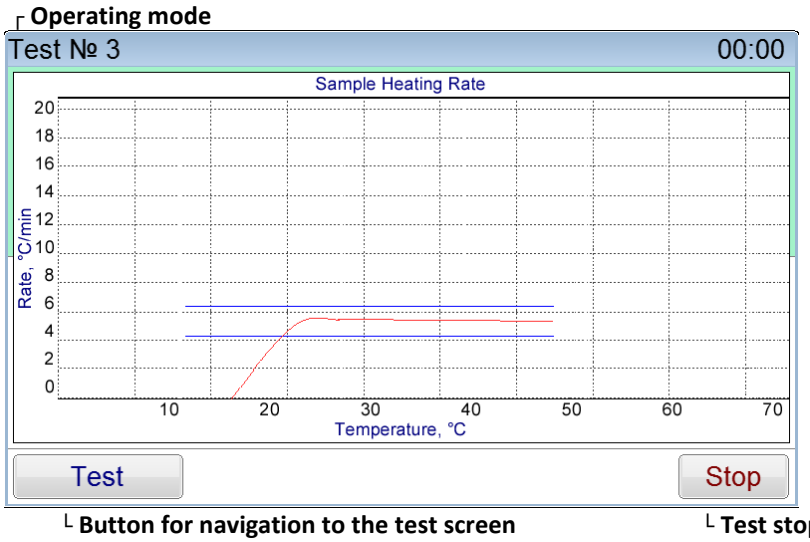


Figure 8 – Test schedule window

4.5.4.4 The graph presents the following data:

- Sample heating rate graph (°C/min);

- Range lines of permissible heating rate.

Scale axes:

- Vertical – sample heating rate (°C/min);
- Horizontal – sample temperature (°C).

4.5.4.5 After pressing **"Test"** button the display turns back to the test screen.

4.6 Viewing and processing of test results

4.6.1 Processing of results

4.6.1.1 The results are processed in accordance with the standard used for the test.

4.6.2 Results log

4.6.2.1 In order to view a complete list of results one shall press "**Results**" button in the test preparation mode. The screen will show the following (see figure 9):

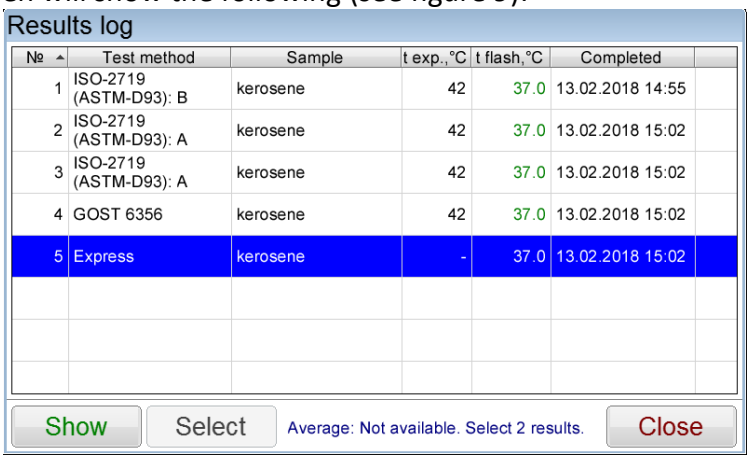


Figure 9- Results log window

The table comprises the following columns:

- Test number;
- Test method;
- Sample name;
- Expected flash point (°C);
- Flash point corrected by the barometric pressure (°C);
- Date and time of test completion.

4.6.2.2 List navigation is provided with use of a vertical scroll bar (on the right). Detailed viewing of results requires selection of the specified item from the list and pressing **"Show"** button. In this case the result window will open (see paragraph 4.6.3 this operating manual).

4.6.2.3 While viewing the log an average flash point can be calculated based on results of one test method.

4.6.2.4 Getting the average value requires selection of two to nine results and marking them by pressing **"Select"** button located at the screen bottom. Marked entries are highlighted with green background of **"№"** field. After the second pressing, the average value data appear at the screen bottom (see figure 10).

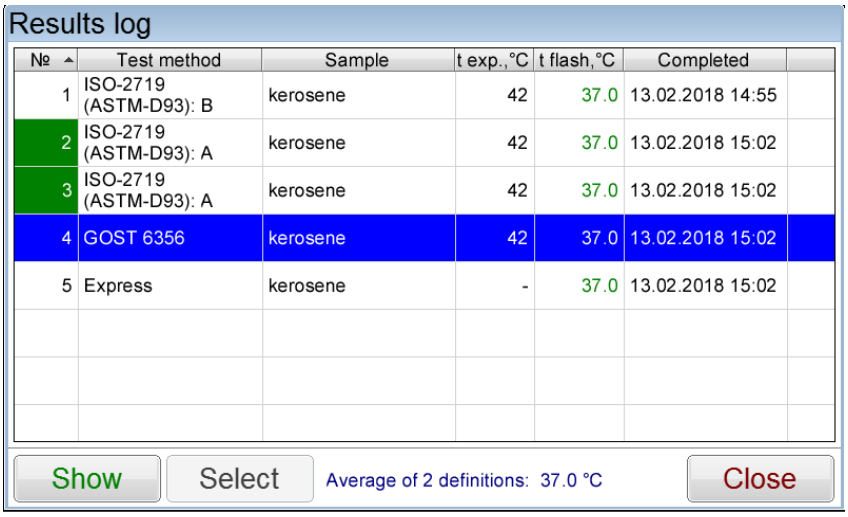


Figure 10 – Results log

4.6.2.5 For unchecking it is required to select the marked entry again and press **“Select”** button. Press **“Close”** button to quit from the test result log.

4.6.3 Result viewing

4.6.3.1 The result viewing mode opens automatically after recording of the flash point in the test mode (for the last result) or at pressing **“Show”** button in the test log viewing mode (for the selected result). In this case the screen shows the following (see figure 11):

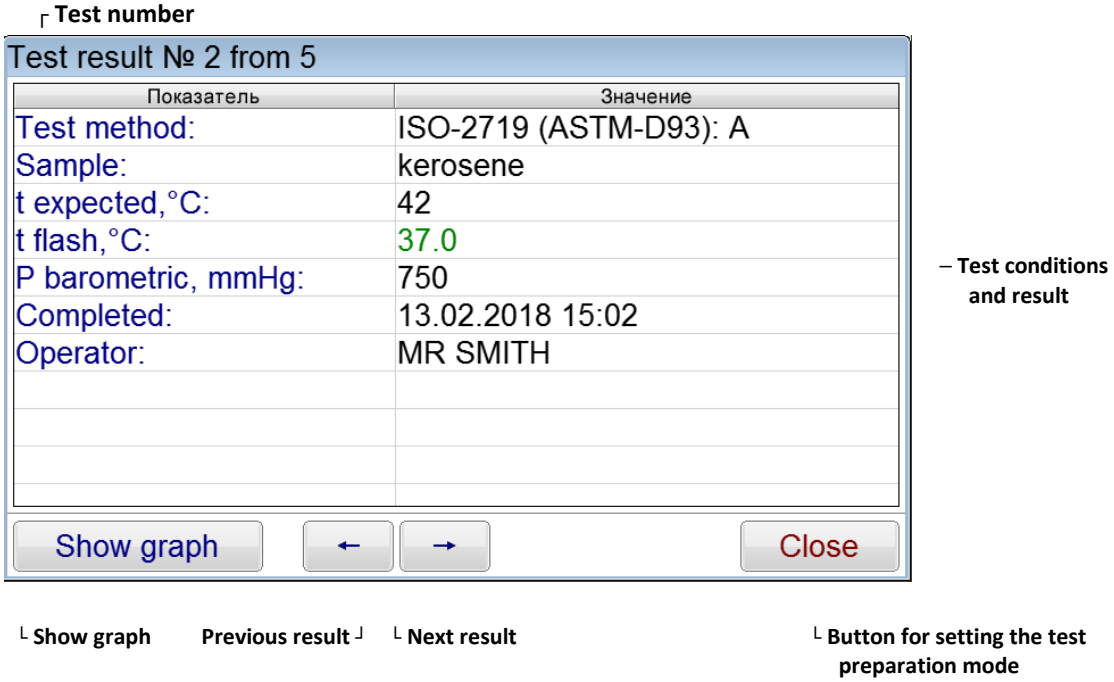


Figure 11 - Window for viewing the test result

The screen displays:

- Test method;
- Sample name;
- Expected flash point (°C);
- Flash point (°C);
- Barometric pressure (mm Hg);
- Date and time of test completion;
- Operator name.

4.6.3.2 Transition for viewing the next (previous) test is provided with buttons ← and →.

4.6.3.3. Press **“Show graph”** button to view the test graph.
4.6.3.4 Press **“Close”** button to quit from the test result window.

4.6.4 Result graph
4.6.4.1 Press **“Show graph”** button in the result view window to view the test graph. The screen shows the following (see figure 12):

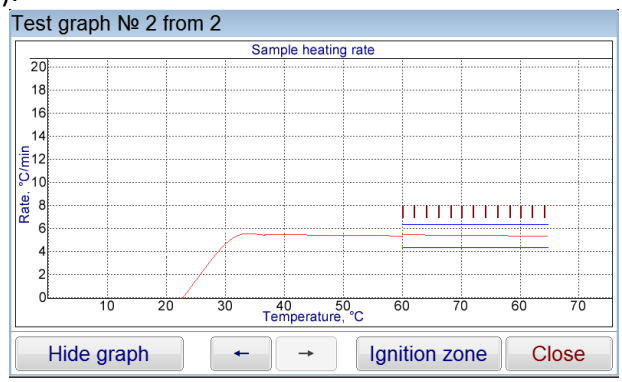


Figure 12 - The graph window of the result

The graph presents the following data:
- sample heating rate graph (°C/min);
- range lines of permissible heating rate.

Scale axes:
- Vertical – sample heating rate (°C/min);
- Horizontal – sample temperature (°C).

4.6.4.2 Transition for viewing the next (previous) test is provided with buttons ← and →.
4.6.4.3 Press **“Ignition zone”** button to view the graph within the range from the first to the last ignition (see figure 13).

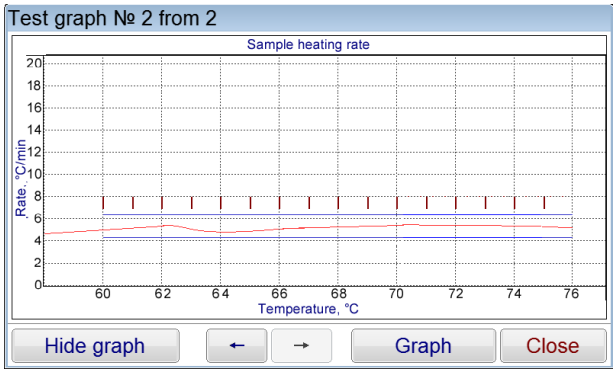


Figure 13 - The graph window of the ignition zone

4.6.4.4 Press **“Graph”** button to see the entire graph.
4.6.4.5 Press **“Hide graph”** button to view test results.
4.6.4.6 Press **“Close”** button to quit from the window of the test graph.

4.7 Work completion

4.7.1 Turn off the device with the **"Power"** toggle switch (5). Disconnect the device from the network (see figure 1, page 5).

4.8 List of potential failures

4.8.1 Potential failures and methods of their elimination are given in the table 5:

Table 5 - Potential failures and methods of their elimination

Failure description, external appearance	Probable cause	Elimination method
The analyzer is connected to the mains, but there is no indication	No supply voltage	Check supply voltage.
	Faulty fuse	Unplug the analyzer from the socket. Replace fuses.

4.8.1.1 In case of other malfunctions, turn off the device, wait at least 5 minutes and turn it on again. If the malfunction repeats, contact the manufacturer (for contact information see the passport AIF 2.821.025-02 PS).
4.8.1.2 In case of other malfunctions or when the above reappears, contact the manufacturer.

4.9 Contingency actions

If liquids or foreign objects get inside the process or electronic unit, you should:

1) turn off the device by pressing the **"Power"** switch;
2) unplug the power cord from the power outlet;
3) remove the protective cover;
4) remove liquid or foreign objects;
5) install the cover in place.

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 analyzer will remain functional. After removing the liquid, the analyzer should be kept for at least 16 hours before switching on again.

4.10 Additional function

4.10.1 Service menu

Access to check, calibration, service, analyzer data viewing and analyzer setting modes is provided via a service menu.

When "**Menu**" button is pressed in the test preparation mode, the analyzer sets to the service menu mode (see figure 14):

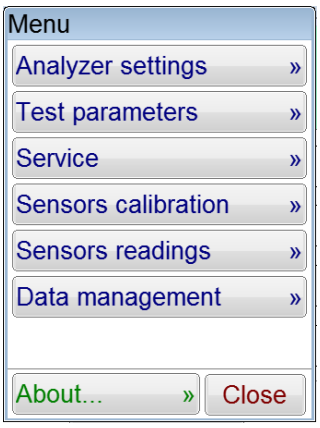


Figure 14 – Service menu

Menu options are accessed by pressing corresponding menu buttons.

Press "**Close**" button to quit from the menu mode.

4.10.2 **"Analyzer settings"** mode

In the test preparation mode press **"Menu"** button and select **"Analyzer settings"** option. The following screen is displayed (see figure 15):

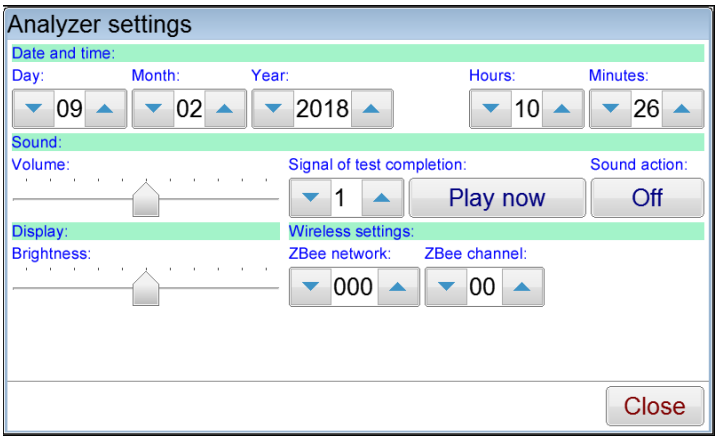


Figure 15 – Analyzer setting

Press **“Close”** button to return to the service menu mode.

4.10.2.1 Date and time setting

In test preparation mode, press the **"Menu"** button and select "**Analyzer settings**". This will open the “**Analyzer settings**” window. At the top of the screen are the input elements “**Date and Time**” (see Figure 16).

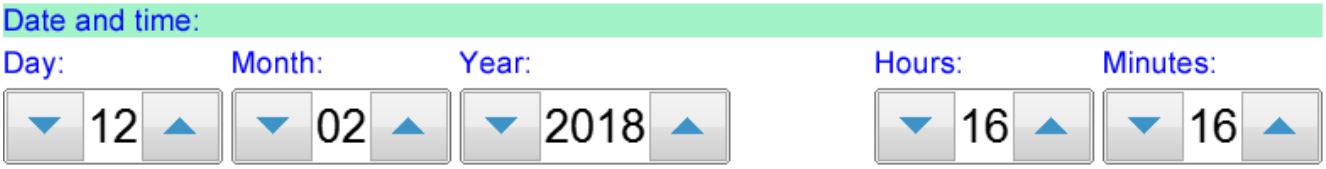


Figure 16 – Data and time

To change the date or time, use the buttons and . A single click changes the parameter by one.
When you press and hold the button, the parameter increases (decreases) faster.
When you release the button, the new value is automatically stored.

4.10.2.2 Sound control

The sound level is altered using volume slider .
Number of the test completion signal is selected with buttons and .
Press **“Play now”** button to listen to the selected tune.
Press **“Off”** button to turn off the sound of button pressing.

4.10.2.3 Display brightness

The display brightness level is altered using volume slider .

4.10.2.4 Settings of the Wireless Interface Subsystem

The network number and channel number shall be set only when the Laboratory Information Management System (LIMS)[1] is used.
The network number is selected using buttons and (permissible values – from 0 to 255).
The channel number is selected using buttons and (permissible values – from 1 to 12).

4.10.3 **“Test parameters” mode**

In the test preparation mode press **“Menu”** button and select **“Test parameters”** option. The following screen is displayed (see figure 17):

[1] It is delivered on a separate order.

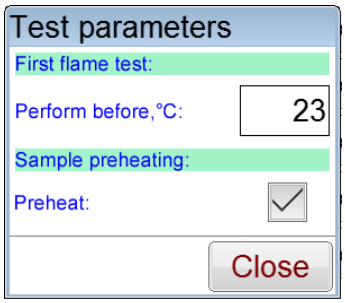


Figure 17 – Test parameters

Press **"Close"** button to return to the service menu mode.

4.10.3.1 First flame test

This parameter specifies the temperature starting from which flame tests as per ISO 2719 (23 ± 5 ºC) will be performed.

To change the parameter, press the parameter display window "**Perform before, ºC:**" and enter a new value (permissible values – from 18 to 28)

4.10.3.2 Sample preheating

The sample preheating mode is switched on and off by selecting ☑ "**Preheat:"** check-box.

If **"Preheat"** check-box is selected (✔), the sample will be preliminary heated. In course of testing the sample is initially heated at accelerated rate. Then 50–60 degrees prior to the expected flash point the heating rate is changed in accordance to the method selected.

Such mode allows reduction of testing time for samples with high flash point.

Deselect the check-box switch off the sample heating mode.

4.10.4 **"Service" mode**

In the test preparation mode press **"Menu"** button and select **"Service"** option. The following screen is displayed (see figure 18):

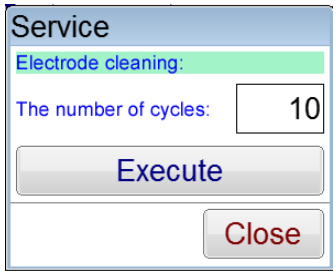


Figure 18 – Service

Press **"Close"** button to return to the service menu mode.

4.10.4.1 Electrode cleaning

In course of analyzer operation carbon can be deposited on igniter electrodes. To ensure reliable operation of the igniter it is recommended to clean electrodes at least once in a month.

The window shows the specified number of spark supply cycles (10 is the recommended default value) and **"Execute"** button.

Press **"Execute"** button to execute the electrode cleaning procedure. After that spark discharge will be actuated 10 times in a sequence.

In course of electrode cleaning inscription on **"Execute"** button looks like **"XX (Stop)"**, where XX is the number of spark supply cycles performed. At pressing this button, the electrode cleaning procedure is stopped.

When working with heavy oil samples the number of cycles is recommended to be increase up to 50.

To change the number of cleaning cycles, press the window displaying that parameter and enter a new value (permissible values – from 1 to 100).

4.10.5 **"Sensor calibration"** mode

In the test preparation mode press **"Menu"** button and select **"Sensor calibration"** option. The following screen is displayed (see figure 19):

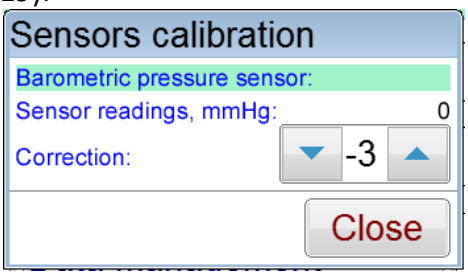


Figure 19 –Sensor calibration

Press **"Close"** button to return to the service menu mode.

4.10.5.1 Correction of barometric pressure sensor readings

If during analyzer operation readings of the barometric pressure sensor are observed to differ from those of the standard barometer, readings of the integrated barometric pressure sensor can be adjusted.

With buttons and correct the readings of the integrated barometric pressure sensor so that the gap between values on the screen and readings of the standard barometer does not exceed 1.0 mm Hg.

4.10.6 **"Sensor readings"** mode

In the test preparation mode press **"Menu"** button and select **"Sensor readings"** option to display the window with reading of analyzer sensors.

This mode is a service one and used when technical support is required in course of analyzer operation.

Press **"Close"** button to return to the service menu mode.

4.10.7 **"Data management"** mode

In the test preparation mode press **"Menu"** button and select **"Data management"** option. The following screen is displayed (see figure 20):

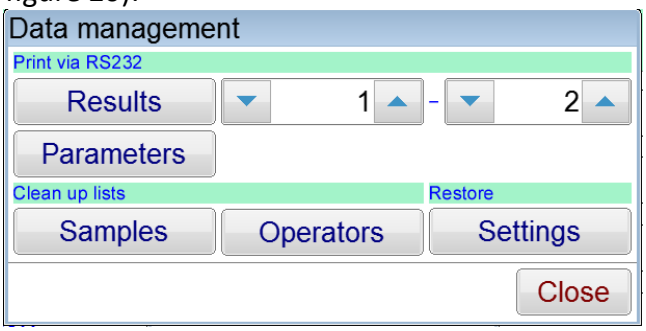


Figure 20- Data management

Press "**Close**" button to return to the service menu mode.

4.10.7.1 Printing via RS-232

Data transmission via RS-232 interface requires installation of PuTTY software on PC (see Appendix A, page 26). The analyzer shall be connected to the PC with a standard RS-232 cable (optional supply).

4.10.7.1.1 Result print-out

With buttons and select the print range (the starting and closing test number to be printed out from the test log content). Press **"Results"** button.

All results from the specified range stored in the analyzer memory will be transmitted to the PC.

An example of results print-out (see figure 21):

Test results of the analyzer ATV-21-02 № 310

№	Date and time	Test method	Sample	t ex.	t fl.	P bar.	Operator
1	24.07.2017 16:19	ISO 2719 (ASTM-D93): A	Oil	230	233.0	741	Mr. Smith
2	24.07.2017 16:57	ISO 2719 (ASTM-D93): B	Oil	232	233.0	740	Mr. Smith
3	25.07.2017 08:42	GOST 6356	JET	45	44.5	740	Mr. Smith

Date and time of printing: 07.02.2018 09:03

Figure 21 - Example of printing results

4.10.7.1.2 Parameter printing
Press **“Parameters”** button.
Data about setting parameters will be transmitted to the PC.
This mode is a service one and used when technical support is required in course of analyzer operation.
4.10.7.2 Lists cleanup
4.10.7.2.1 Sample list cleanup
Press **“Samples”** button in **“Clean up lists”** group. This opens the request window shown in figure 22.

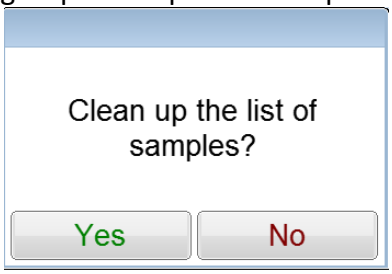


Figure 22 - Request to clear the list of samples

At pressing **“Yes”** button the current Sample list will be cleaned up.
At pressing **“No”** button the prompt box is closed without the Sample list cleanup.
4.10.7.2.2 Operator list cleanup
Press **“Operators”** button in **“Clean up lists”** group. This opens the request window shown in figure 23.

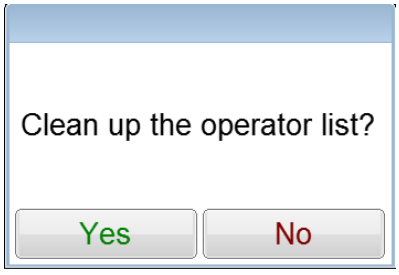


Figure 23 - Request to clear the list of operators

At pressing **“Yes”** button the current Operator list will be cleaned up.
At pressing **“No”** button the prompt box is closed without the Operator list cleanup.
4.10.7.3 Reset to factory setting
Press **“Settings”** button in **“Reset”** group. This opens the request window shown in figure 24.

Figure 24 - A request to restore the factory settings

At pressing **"Yes"** button current analyzer settings will be replaced with those assigned by the manufacturer.
At pressing **"No"** button the prompt box is closed without setting changes.

ATTENTION

Perform only upon the recommendation of the manufacturer.

4.10.8 **"About…"** mode
In the test preparation mode press **"Menu"** button and select **"About…"** option. The following screen with additional information about the analyzer will be displayed (see figure 25):

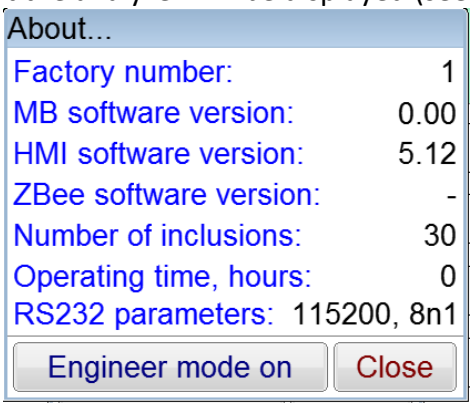


Figure 25 - The information window about the analyzer

Press **"Close"** button to return to the service menu mode.
"Engineer mode ON" button is a service one and required for providing access to the analyzer engineering menu.

5 MAINTENANCE

To increase the service life of the device, it is necessary to carry out maintenance. The frequency of maintenance depends on the intensity and operating conditions of the analyzer.

5.1 Additional equipment and materials

The list of additional maintenance materials given in table 6.
Table 6 – List of additional materials

Material	Purpose
Ethyl alcohol, or an alcohol-toluene mixture	cleaning the display and the device case from dirt
Cotton napkin	
Gasoline solvent (nefras S2-80/120, S3-80/120; gasoline solvent (nefras S5/170); technical detergent; direct distillation gasoline without additives	cleaning the cup

5.2 List of operations

The list of maintenance operations given in table 7.
Table 7 – List of operations

Operation	Paragraph	Periodicity
Cleaning the display from contamination	5.3	As required, if any contamination is present
Cleaning the case from contamination	5.3	As required, if any contamination is present
Cleaning the cup	5.4	After each test
Cleaning the electrodes	5.5	At least once a month

5.3 Wiping the display surface and the device body

5.3.1 Wipe the surface of the display and the case of the device as it becomes dirty with a napkin dipped in ethyl alcohol.

5.4 Cleaning the cup

5.4.1 Remove the lid from the cup. Lift the lid flap. Wipe the outer and inner surfaces of the lid and flap with a cloth dipped in washing liquid. Carefully wipe the inner surface and edges of the cup. Do not allow liquids to enter the cup electrodes. Dry the cup and cover well, or blow with compressed air.

ATTENTION

It is forbidden to wash the crucible by immersion in the washing liquid.

5.5 Cleaning the electrodes

During the operation of the device, carbon deposits may form on the electrodes of the ignition device. To ensure reliable operation of the ignition device, it is recommended to clean the electrodes at least once a month (paragraph 4.10.4.1 of this operating manual).

6 STORAGE AND TRANSPORTATION

6.1 Storage

6.1.1 The storage conditions of the analyzer in terms of the impact of climatic factors should be correspond to the group-moderate and cold macroclimatic regions.

6.1.2 The analyzer should be stored in closed, heated rooms in a package on racks that are not subject to vibration or shock.

6.1.3 The analyzer should be stored at an air temperature of 5 °C to 40 °C and a relative humidity of 80 % at +25 °C.

6.1.4 Storage of the analyzer without packaging is not allowed.

6.1.5 Shelf life of the analyzer is 6 years.

6.1.6 The analyzer is preserved according to Unified system of corrosion and ageing protection (temporary corrosion protection of products).

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

6.2 Transportation

6.2.1 Conditions for transporting the analyzer in terms of the impact of climatic factors should correspond to the group of storage conditions in moderate and cold macroclimatic regions.

6.2.2 The analyzer 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 analyzer to a personal computer (PC) via the RS-232 interface, the PC should be equipped with:

1) RS-232 DB9M port (currently rare), the analyzer is connected by RS232 DB9F-DB9M cable (mouse extension cable, not included in the package);
2) USB port, the analyzer 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 manual 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 analyzer is connected.

For this, press the buttons simultaneously on the PC keyboard  and  the «Run» program opens (see figure 2.1).

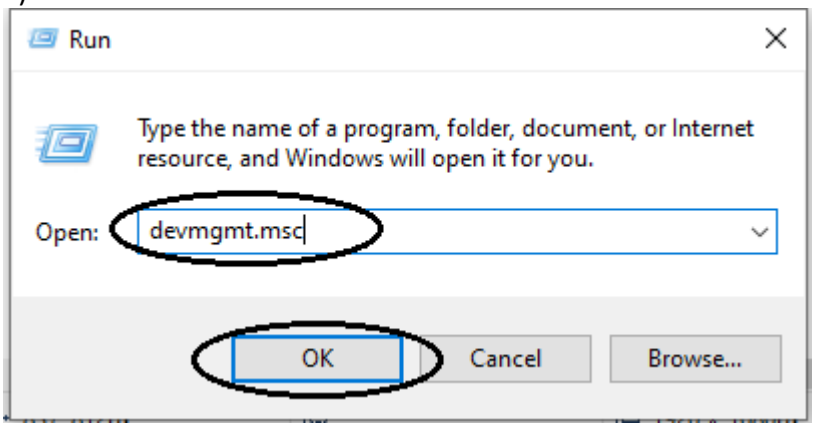


Figure A2.1 – Program **«Run»**

In the text field, type **«devmgmt.msc»** and click **[OK]** - the analyzer manager opens (see figure A2.2).

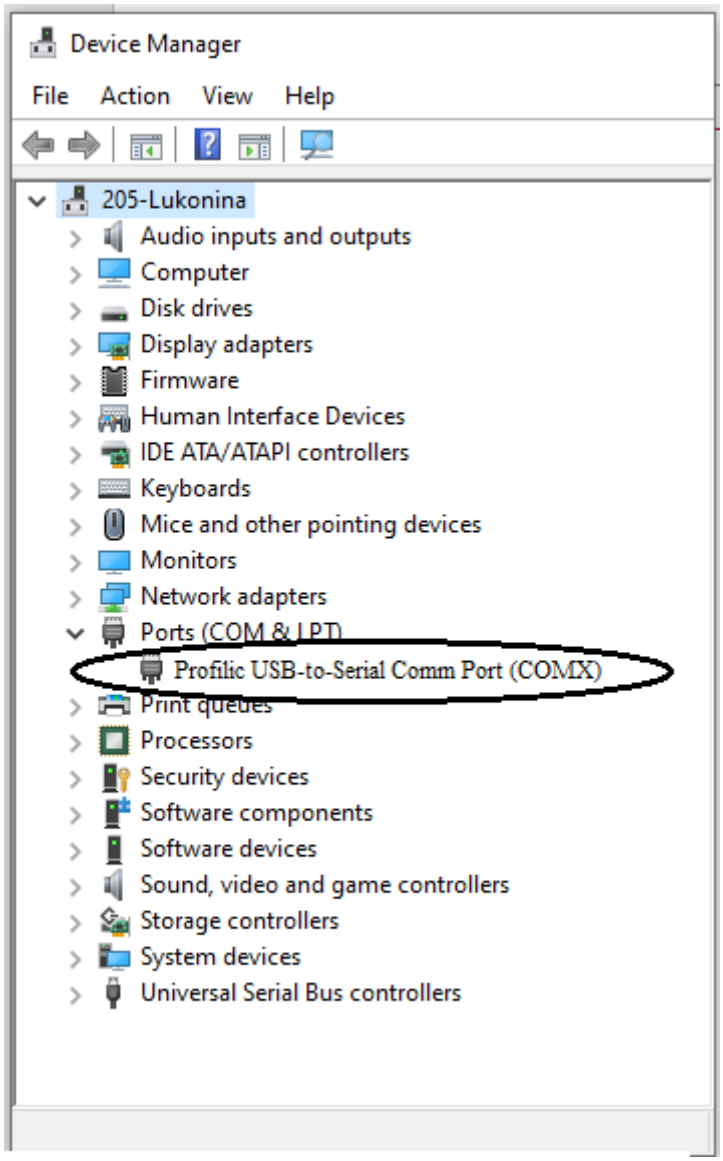


Figure A2.2 – Device manager

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 analyzer 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 A2. 3).

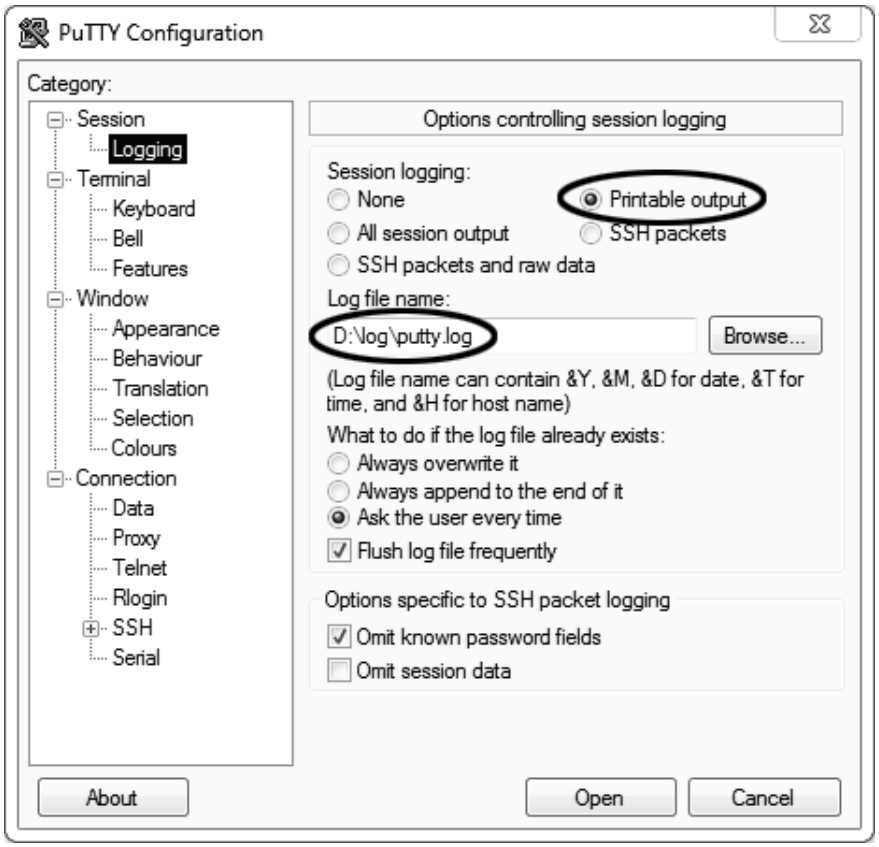


Figure A2.3 – Program **«PuTTY»**

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

Set settings on the tab **«Terminal»** (see figure A2.4).

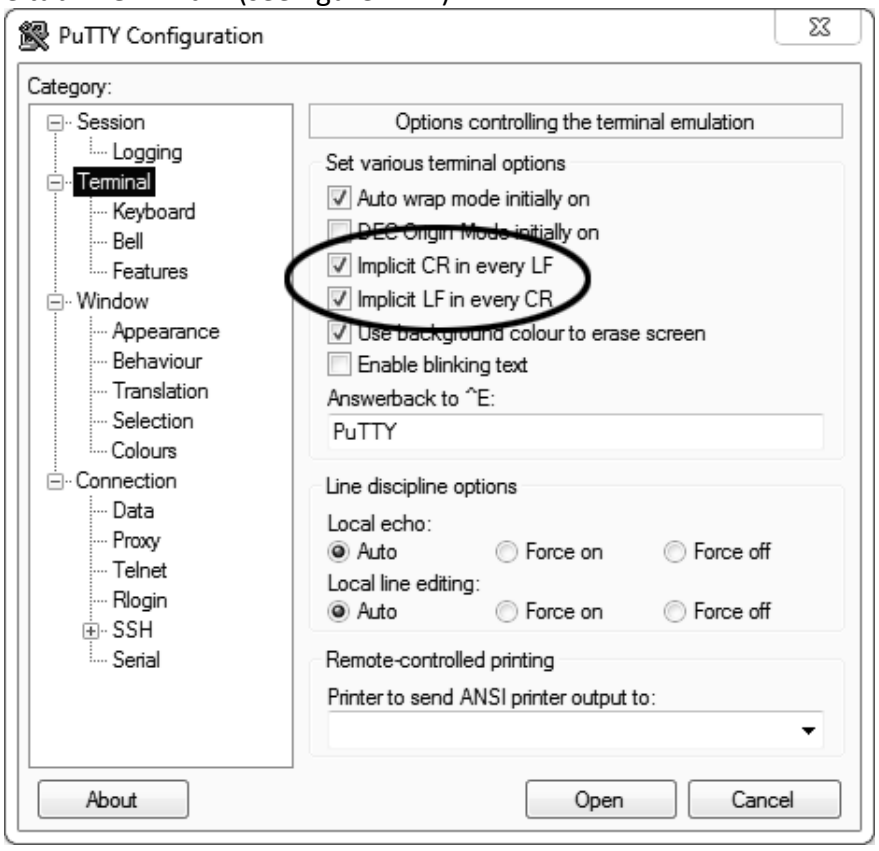


Figure A2.4 – Set setting

Set settings on the tab **«Window › Translation»** (see figure A2.5).

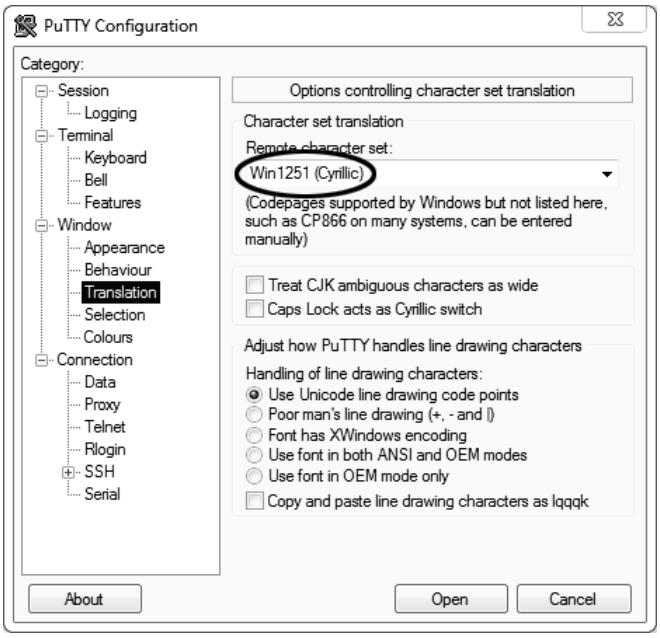


Figure A2.5 – Set setting

Open the tab **«Connection › Serial»** (see figure A2.6).

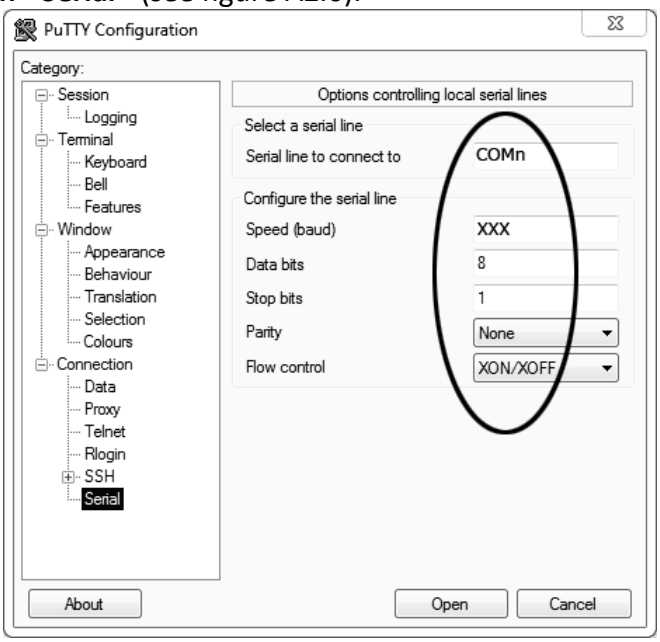


Figure A2.6

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 115200;
- Data bits 8;
- Stop bits 1;
- Parity None;
- Flow control XON/XOFF.

Open the tab **«Session»** (see figure A2.7).

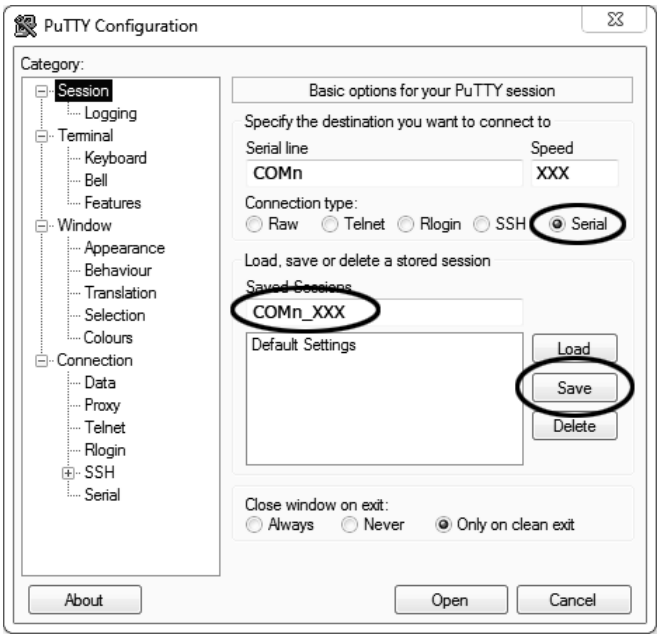


Figure A2.7 – Tab «Session»

Select the **«Serial»** connection type, name the connection according to the port number and data rate (for example, **«COM_8_115200»**), 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 A2. 8).

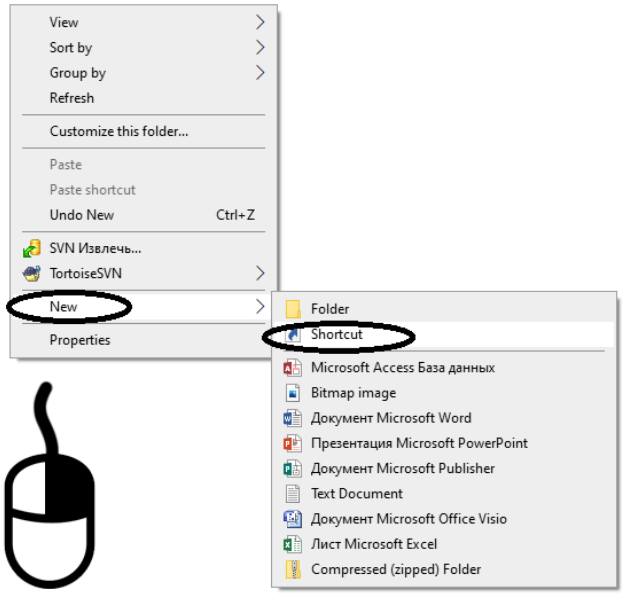


Figure A2.8 – Item selection

A dialog box opens (figure A2.9):

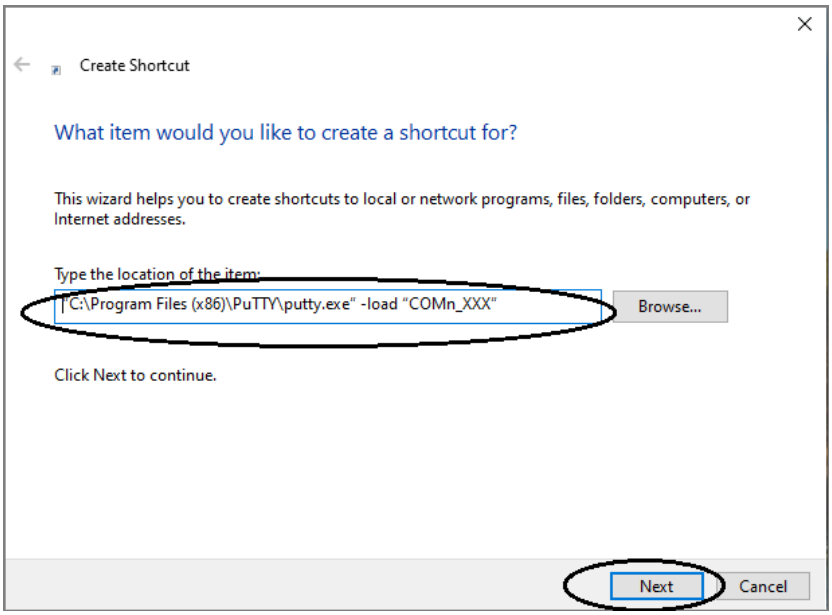


Figure A2.9 – Dialog box

In the text field, type the path to the program location and space-separated parameter **«-load "COM_8_115200"»**, where **«COM_8_115200»** 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_115200"»**

Click **[Next]** to open the next window (figure 2.10):

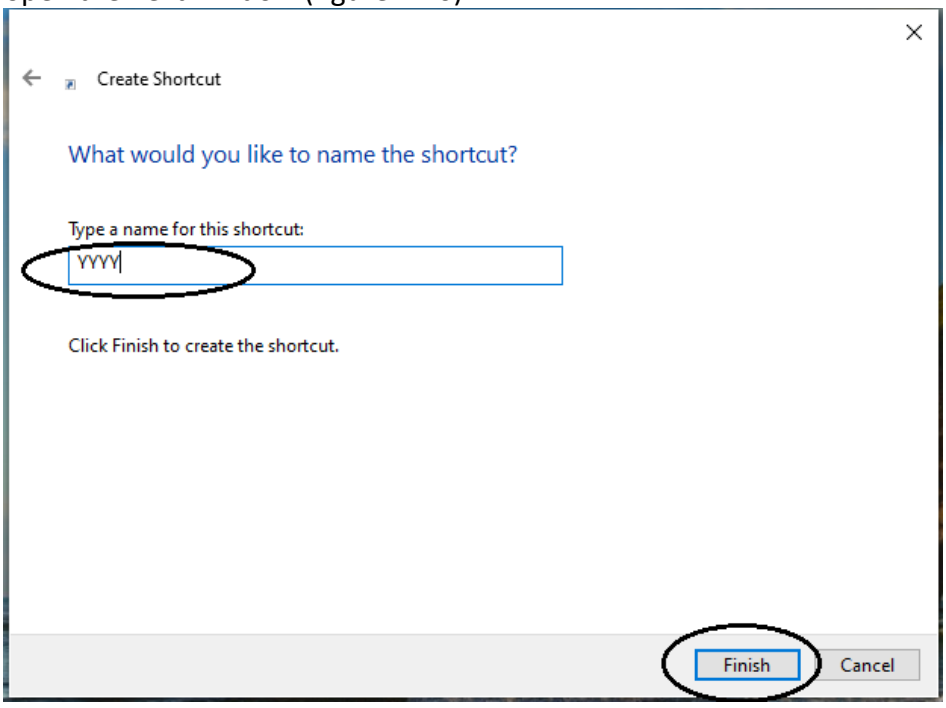


Figure A2.10

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

Click **[Finish]** to complete the shortcut setup.

Now the **PuTTY** program can be started by double-clicking on the shortcut (see figure 2.11).

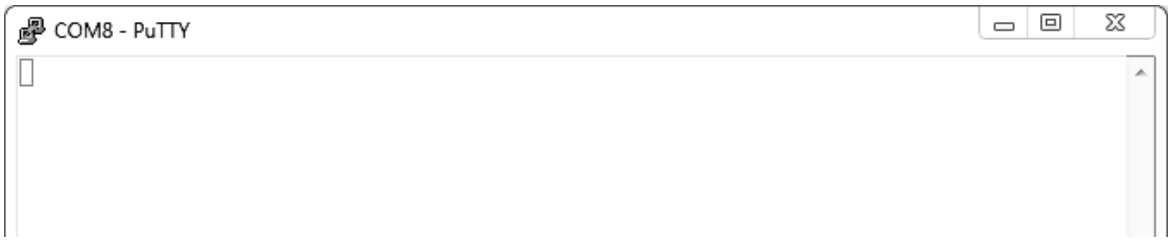


Figure A2.11

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 Value editor

The value editor is called by pressing the field to be edited.
At pressing the value input editor opens (see figure B1.1):

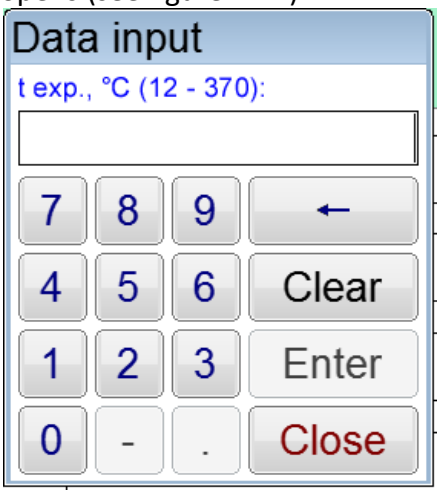


Figure B1.1 – Value editor

The keyboard comprises a set of digital and special keys:

Key	Action
.	Decimal point input (active as required)
-	Change of number sign (active as required)
Clear	Deleting of the whole value
←	Deleting of the last digit input
Close	Closing of the editor window with no value saving
Enter	Closing of the editor window with value saving

When quitting the editor with value saving, the input value replaces that of the parameter being edited.
If the input value falls out of the permissible range, the editor window is closed without saving the input value.

B2 Text editor

The text editor is called by pressing **“Add”** or **“Change”** buttons arranged in the directory editor window.
The text editor opens at button pressing, and the input field shows the current parameter value or an empty space, if a new entry is added (see figure B2.1):

Figure B2.1 – Text editor

The keyboard comprises the following set of special keys:

Key	Action
←	Deleting of the character left of the cursor
Clear	Clearing of the whole line
← →	Cursor movements to the left/right
UCase Caps	Keyboard switch to the upper/lower case letters mode
Lat. Rus.	Keyboard switch to Latin/Cyrillic letters mode
Close	Closing of the editor window with no value saving
Enter	Closing of the editor window with value saving

When quitting the window with value saving, the result replaces the edited list entry or adds a new one.

B3 List of test methods

The list of test methods is called by pressing a test method output line.
In this case the following box opens (see figure B3.1):

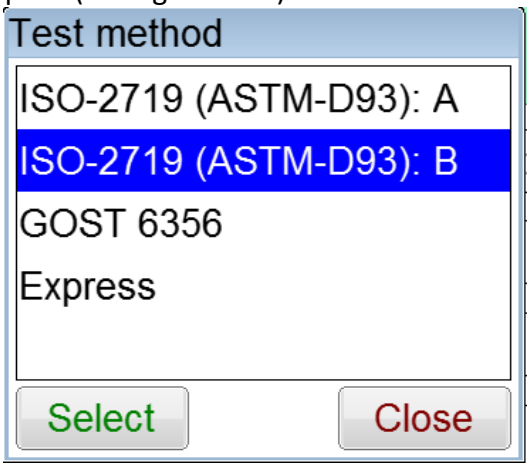


Figure B3.1 - Test method

The listbox comprises the following key set:

Key	Action
Select	Selection of the test method
Close	Closing of the listbox without test method selection

The selected entry is highlighted in blue.

B4 Samples list

The samples list is called by pressing the sample name input line.
In this case the following box opens (see figure B4.1):

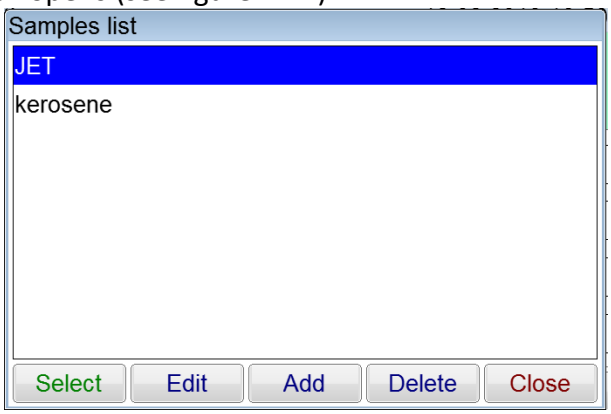


Figure B4.1 – Samples list

The listbox comprises the following key set:

Key	Action
Select	Selection of the sample name
Edit	Changing of the sample name
Add	Adding a new sample in the directory
Delete	Deleting of the selected sample from the directory
Close	Closing of the listbox without sample name selection

The selected entry is highlighted in blue.

B5 Operator list

The operator list is called by pressing the operator name input line.
In this case the following box opens (see figure B5.1):

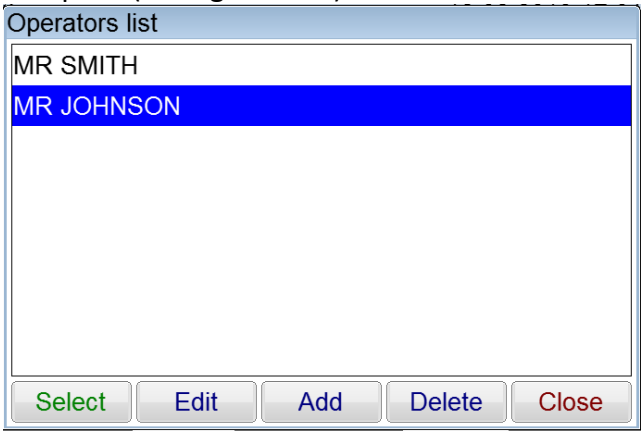


Figure B5.1 – Operator list

The listbox comprises the following key set:

Key	Action
Select	Selection of the operator
Edit	Changing of the operator name
Add	Adding a new operator to the directory
Delete	Deleting of the selected operator from the directory
Close	Closing of the listbox without operator name selection

The selected entry is highlighted in blue.