ElvaX ProSpector 3

Elvatech
Advanced XRF equipment and solutions

USER MANUAL
Revision 1.5

Elvatech 2021

Warning!

Do not cover the sampling window of the spectrometer with any body parts and never direct the instrument at the people. This may cause irradiation!

Study the operating manual carefully before the usage of spectrometer ProSpector. You should provide the radiation safety and carry out the customer training before the application.

Spectrometer is a sourcxe of x-ray radiation used to analyze samples. Therefore before starting operation it's necessary to ensure that all safety requirements are observed and users of the spectrometer have been trained.

Important!

The X-ray detector is equipped with a thin and fragile beryllium or graphene window. To avoid damage, do not touch the window with any objects.
Any mechanical impact may result in its breakage, requiring an expensive replacement of the entire detector.

Please note that damage to the window is not covered under warranty!

CONTENT

Elvatech

1.General Information

1.1. Specs

Specs

Digital X-Ray Source digiX-50 Anode:
Rh, W
Voltage: 50 kV
Current: 200 uAmp
Power: 5 W
8 positions filter changer
2 position collimator changer

X-Ray Detector Type:
SDD
Area: 10, 30, or 40 mm 2
Energy resolution: <140 eV @ 5.9 keV
Count rate: 500,000 cps

Electronics
DPP: proprietory DAS (Dynamically Adaptive Shaping) type, 80 MHz sampling rate
MCA: 4096 channels
Display: 4.3″
Connectivity: USB, Bluetooth, Wi-Fi
2 high-resolution video cameras

General
Dimensions: 236 x 193 x 68 mm
Weight: 0.82 kg, 1.05 with battery kg
Protection: IP67

Software
Operating system: Windows EC7
Analysis algorithms: Fundamental parameters (FPA), Empirical (regression) calibrations

ProSpector 3 models

	ProSpector 3	ProSpector 3 Advanced	ProSpector 3 Max
X-Ray Tube	W, 40 kV (option 50 kV)	Rh, 40 kV (option 50 kV)	Rh, 50 kV
Primary Filters	Single	automatic 8-position changer	automatic 8-position changer
Collimators	Single	automatic 2-position changer	automatic 2-position changer
X-Ray Detector	SDD (option – large area Fast SDD)	Large area Fast SDD	Extra large area Fast SDD with graphene window
Detector Window	Be, 12 um	Be, 8 um	Grafene, 1 um
Detection Range	S – U	Mg – U	Mg – U (Na – U)
CCD Camera	Sample view (option)	Sample view (option – macro view)	Sample view, macro view
Temperature correction	Yes	Yes	Yes
Barometric correction	No	Yes	Yes
Bluetooth	Option	Option	Yes
Wi-Fi	Option	Option	Yes
GPS	No	Option	Yes
Ingress Protection	IP65	IP65	IP67
He purge	No	No	Option

1.2. Briefing note

ProSpector 3 is the next-generation hand-held X-ray fluorescence analyzer. It offers a new level of analysis accuracy, speed and detection limits. ProSpector 3 is the smallest and lightest hand-held XRF on the market with an intuitive and user-friendly software interface.

PRODUCTIVITY
Highest accuracy within the shortest measurement time, excellent precision

STABILITY
Excellent calibration stability, compensation of influence of ambient temperature and pressure variations

MOBILITY
Small (236 x 193 x 68 mm), and light (1.05 kg) handheld analyzer.

RELIABILITY
Dustproof and waterproof instrument body, with IP-67 protection level.

FUNCTIONALITY
Two CCD cameras for macro- and micro- view combined with an automatic collimator

Bluetooth Wi-Fi
USB Micro SD

All interfaced to quick data exchange

1.3.Purpose and Structure of the Spectrometer

The spectrometer is designed to measure contents of chemical elements in metals and alloys.

The spectrometer can also be used to measure the mass and mass concentrations of chemical elements in other substances or materials in solid, powder or liquid form using appropriate measurement techniques

Scope of use of the spectrometer includes: metal working, metallurgy, mining, chemical, geological survey work, scrap processing, environmental monitoring, customs control, identification of objects and expertise, as well as quality control.

The spectrometer employs the method for determining the elemental composition by the characteristic (fluorescent) X-rays of the atoms of the test sample.

As a result of irradiation of the atoms of the substance by bremsstrahlung characteristic (secondary) radiation of its atoms occurs. Identifying the elemental composition is based on the fact that each chemical element has a different energy spectrum of the characteristic radiation of its atoms.

The spectrometer consists of a **Measuring unit**, the composition of which is described below, and an **Embedded computer**. Also, an external (desktop) computer can be used to control the measuring unit — *see 3.3.1.*

The source of X-ray bremsstrahlung used to irradiate the test sample in the spectrometer is an X-ray generator.

The X-ray generator consists of an x-ray tube, an adjustable source of current for the cathode of the x-ray tube, and an adjustable high-voltage source of anode voltage. For the formation of the primary x-ray beam and the correction of its energy distribution, the generator includes a filter and collimator changer.

The X-ray receiver consists of a detector, a pre-amplifier and a thermoelectric cooler.

The detector converts the energy of the detected X-ray quantum into an electrical pulse of proportional amplitude.

The operating temperature of the detector (≤ -250C) is supported by a thermoelectric cooler.

The pulse amplitude analyzer consists of a spectrometric pulse signal amplifier, a 12–bit analog–to–digital converter (ADC), a digital processing unit, in which the results of measurements of the pulse amplitudes are accumulated and the radiation spectrum of the sample under study is formed and the microprocessor communicates between the control computer and the measuring unit (sending control commands and data).

The measuring unit also includes a specialized power supply with control circuits for the internal nodes of the spectrometer.

Depending on the specification of the order, the spectrometer may be equipped with additional units and modules

1.4.Commissioning

Read this manual carefully.

Unpack the device.

Check for completeness — *2.2.*

The device is intended for use in the following conditions:

- Ambient temperature -10°C to 50°C;
- Relative humidity: up to 80% at 25°C;
- Atmospheric pressure from 84 to 106.7 kPa (630 to 800 mm Hg. Tbsp.).

Therefore, after transporting the device can be operated only after its body is of required temperature. Switching on the instrument, introduced into a warm room, can damage it!

Check the condition of the protective film in the measuring window of the device. If damaged – replace it — *3.4.1.*

Check the battery charge level. If necessary – charge — *p.3.4.2.*

Install the battery in the device — *p.3.4.2.*

If you intend to run the appliance from AC/DC adaptor – connect to the device to AC/DC adaptor.

If you intend to work with a desktop computer device – connect a PC to the device via mini-USB cable.

Spectrometer operability check.

Measure the composition of the supplied sample of 316 stainless steel and compare the composition with the table in the calibration certificate. If the deviations of elements concentrations from the certified concentrations are within the error range stated in the calibration certificate the spectrometer works properly.

Check spectrometer operability at least once a month. Contact the manufacturer if measured concentrations are beyond the allowed values.

Get to work — *Clause 3.2.*

2.Technical Data

2.1.General Description

Detectable elements range	From Ti (Z=22) to U (Z=92)
Option Light Elements Analysis	From Mg (Z=12) to U (Z=92)
Operation on battery (active measurement)	Up to 8 hours
Dimensions	240 mm x 196 mm x 68 mm
Weight (with battery)	825 g (1050 g)
Operation conditions: • ambient temperature • relative humidity • atmospheric pressure	 from - 10°C to + 50°C up to 80% at 25°C 84 to 106.7 kPa (630 to 800 mm Hg. Tbsp.).

2.2.Overview and Components and Spare Parts

The delivery set includes:

Spectrometer

AC/DC Adaptor

External Charger

2 Batteries ND2037HD or YL18650 with adaptor

Control Sample

MicroSD card (with adapter)

Cartridge with protective film (20 pcs.)

Additionally, a laboratory stand for carrying out measurements in stationary conditions can be included in the delivery set.

2.2.1.Specifications

X-ray tube	Rh or Ag anode, 50kV max (option 40kV max), 200mA max, 4W max (option 5W max), 8-position filter changer for light element analysis (option 5-position filter changer). Option – 2-position collimator changer: • hole size 3.7mm – spot size 6*7.5mm; • hole size 1mm – spot size 2*2.5mm. Option – Helium purge. Option – W anode without light element analysis.
X-ray detector	
Detector type	Fast SDD with thermo-electrical cooling (optional PIN detector)
Active Area	6 mm2 (optional 25 mm2)
Resolution	<140 eV @ Mn Kα at 500 kcps countrate.
Electronics	
Pulse Processor	Digital pulse processor based 80 MHz DSP Pile-up rejection Pulse shape selector Automatic adjustment to count rate
ADC	4096 channels
Data processing	Embedded computer 1.1 GHz
Display Camera	4.3-inch color touch-screen high resolution 480*800 pixels. Miniature VGA camera (640*480 pixels). Option – Additional overview VGA camera (640*480 pixels).
Software	
Operating systems	Microsoft Windows Embedded 7
Quantitative analysis algorithm's	Fundamental parameters method and empirical calibrations
Power	7.2V Lithium Ion Battery ND2037 6.8Ah. Option – 7.2V Lithium Ion Battery ND2017 4.8Ah with adaptor Hot swappable main batteries. Built-in backup battery for hot swapping main battery.

2.3. Technical Standards of Reference

Electrical safety of the spectrometer meets the requirements of **IEC 61010-1.**

Electro-magnetic compatibility of the spectrometer meets the requirements of **IEC 61326-1.**

3.Operation and Maintenance

3.1.Introduction

3.1.1.Spectrometer General Appearance

A protective cap with an X-ray transparent mesh is installed directly on the detector, which prevents the entrance window of the detector from damage when small objects get inside.

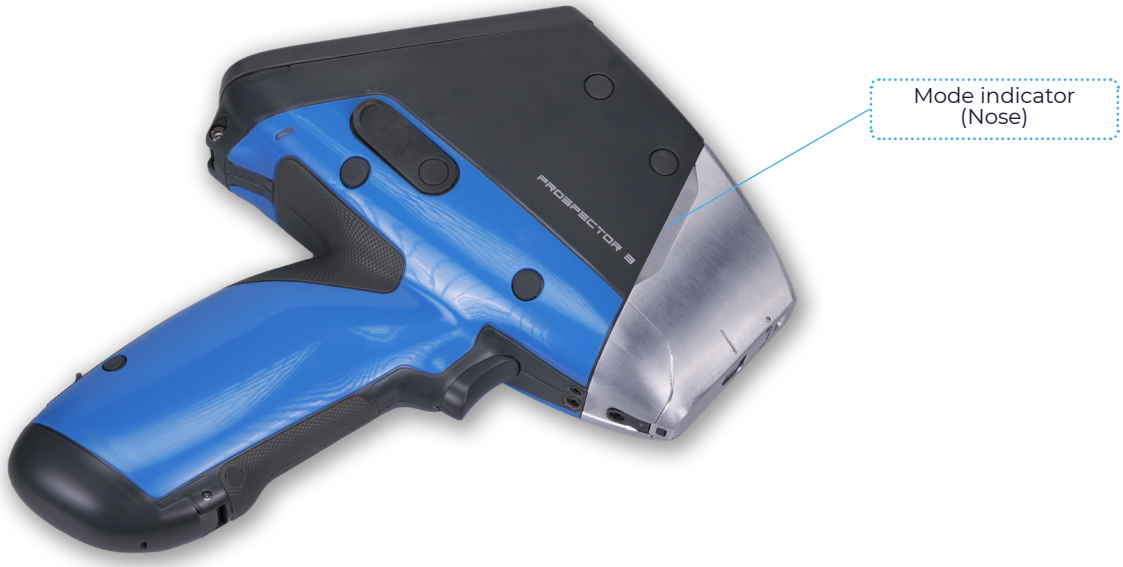
Additionally the Sample window is covered with a protective X-ray transparent film that prevents dust and moisture from entering the detector.

3.1.2.Indicating Lights Appearance

On the Embedded computer a mode indicator is installed. **Green** glow of the LED indicates the operability of the instrument. When the infrared sensor detects the presence of an object in front of the sample window then indicator changes color to **blue**. When X-ray generator turn on mode indicator changes color to **red**.

On the nose of the spectrometer, additional indicators are installed on both sides, signaling the presence of an object in front of the working window **(blue color)** and when the X-ray generator is on **(red color)**.

To perform a measurement it's necessary to put the spectrometer against the tested object so that the sample window of the spectrometer covers the object completely. If the object in front of the sample window is not found, the x-ray generator of the spectrometer will not turn on preventing accidental exposure of people.



Never cover the operating window of the spectrometer with any body parts, never point the device at others in order to avoid x-ray exposure!

3.1.3.Embedded computer

Embedded Computer runs under **Microsoft Windows Embedded 7.**

Embedded computer has:

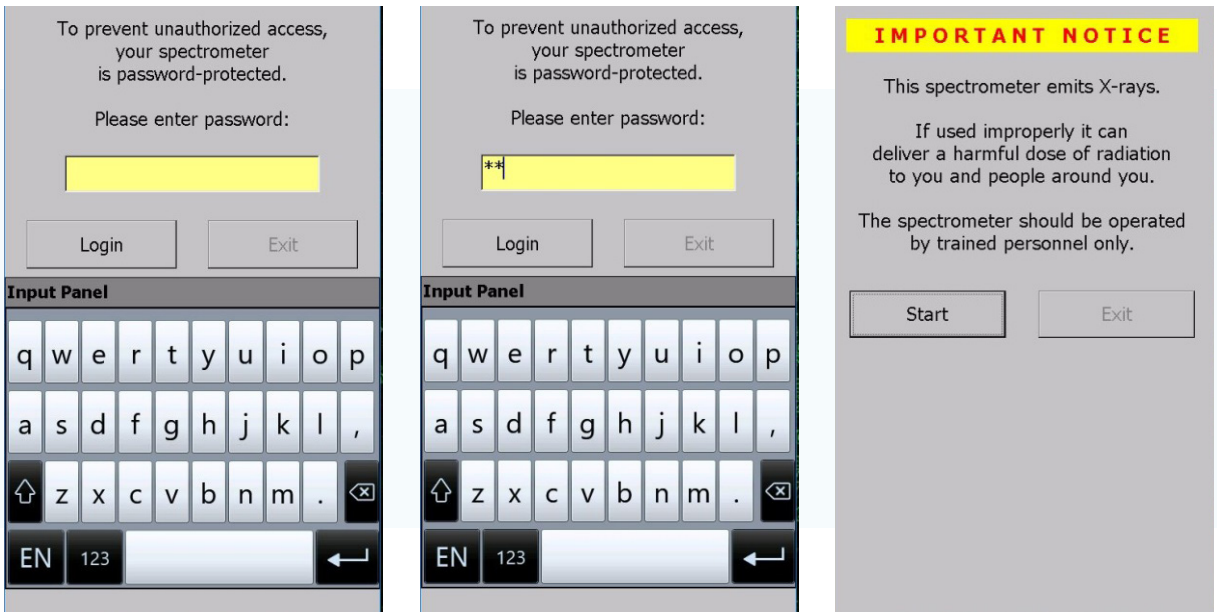
- CPU Texas Instruments Cortex A8 1.1 GHz;
- 180 MB RAM;
- 4.3-inch touch screen 480x800, 16-bit color;
- «internal disk» — flash memory in which the operating system, installed programs and data are stored;
- slot for an external MicroSD-card;
- accelerometer;
- pressure sensor for measurement correction;
- support WiFi;
- support GPS;
- support Bluetooth.

3.2.Rules of Use

3.2.1.Running ElvaX ProSpector Software

ElvaX ProSpector software is started automatically after load operational system.

If you have set protection against unauthorized use the program will prompt you to enter the password.



After entering the password a warning message about spectrometer proper use will appear. The password will also be required in case of a long pause in operation (Embedded Computer sleep) — more than 20 minutes.

3.2.2.Use of ElvaX ProSpector

Before you begin, it is strongly recommended that you familiarize yourself with all the spectrometer setup options! *See clause 3.2.3.*

3.2.2.1.Main window ElvaX Prospector Software

For the user, the program consists of a start (main) window, in which available measuring modes are displayed in the form of pictures, and 2 status icons — a spectrometer and a battery.

In the main window of the program, you can also make the necessary settings for your convenient operation, control the spectrometer operation parameters using monitors, obtain information about the spectrometer configuration and software version — *see section 3.2.3.*

3.2.2.2.Status icons

There is no connection between the embedded computer and the measuring unit

Spectrometer running on battery

Spectrometer running on battery, the battery is charging (*connected to an external power supply)*

The battery cover is open to replace the main battery, the spectrometer is powered by the backup battery

Spectrometer running on an external power supply, no battery

Temperature parameters of the spectrometer outside the specified value (for example, cooling of the detector has not been completed, overheating of the X-ray tube case etc.)

X-ray generator is on

3.2.2.3.Spectrometer Turning On

Press the power button briefly. If battery power is sufficient, the device turns on with a beep. At the same time the Embedded Computer turns on too.

If you have set protection against unauthorized use you will be prompted to enter the password. The password will also be requested in the event of an extended pause in operation (Embedded Computer sleep) — more than 20 minutes.

In the upper right corner of the screen there is a battery charge indicator.

After powering up you must wait for cooling of the detector down to the operating temperature. A warning signal «cooling» is shown in the right upper corner of the computer screen

During operation, such a signal may appear in case of overheating of the spectrometer nodes, for example, during prolonged operation in conditions of high ambient temperature.

If the input window of the detector is damaged, it becomes impossible to cool it to operating temperature — in this case, the warning signal “cooling” will also be displayed.

Upon reaching the operating temperature the warning signal “cooling” disappears. Spectrometer is ready for operation.

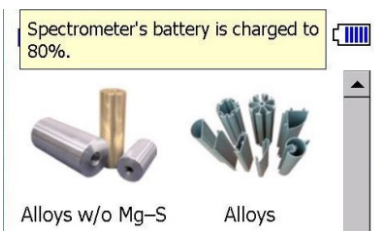
3.2.2.4.Spectrometer Turning Off

Press the power button briefly. Spectrometer will turn off with a beep automatically turning off the embedded computer. For emergency shutdown, hold down the power button for at least 5 seconds.

3.2.2.5.Battery Status

When the battery charge level is from 10% to 100%, the stability of the X-ray generator, voltage and current of the X-ray tube in all modes is ensured, which guarantees the stability of the measurement results.

Battery charge of the spectrometer can be estimated from the number of lines on the battery icon. Exact value can be found if you click on the icon:



Charging of the spectrometer battery is automatically switched on whenever spectrometer is connected to an external power supply. In this case, Embedded Computer battery starts charging as well.

The red arrow on the battery icon means that the battery is charging.

If the Embedded Computer battery is significantly discharged (charge ≤ 25%), the program starts charging the Embedded Computer battery from the spectrometer battery regardless of its charge.

If the charge of the main battery of the spectrometer is below 20%, a message will be displayed asking you to charge or replace the battery.

If enabled voice guidance, the spectrometer will give a voice message: “Battery is low”.

When the battery charge level is below 10%, to prevent overloading the battery by the output current, the possibility of measuring with the output of the corresponding message is blocked: “Battery charge is too low to power X-ray tube”.

When the battery level is below 5% the spectrometer is turned off automatically.

3.2.2.6.Hot swappable battery

The battery can be quickly replaced “on the go” without turning off the device. After replacing the battery, the spectrometer is immediately ready to continue.

Open the battery cover. In this case, the device’s power from the backup battery is automatically activated, the corresponding message will appear on the Embedded Computer screen and the battery status icon will change.

You can remove the discharged battery and install a new (charged) battery. Close the battery cover. The battery status icon will change to “normal”. Continue to work.

3.2.2.7.Measuring Mode Window. Performing Measurements

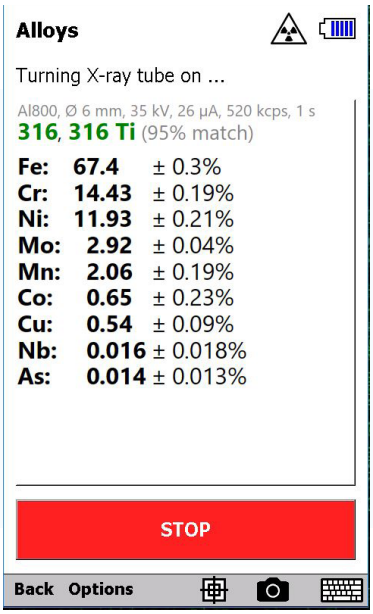
When you click on a measuring mode icon in the main window the window of a measuring mode is opened with the introductory text.

! For safe operation follow the instructions on the screen! !

Hold the spectrometer to the test object. The operation mode indicator changes color to **blue** when the object is close to the sample window. The **blue LED** on the spectrometer snout will turn on as well.

Put the device against the sample. Make sure that the snout is positioned at the right angle in relation to the sample and touches it tightly.

When you pull the trigger or **START** on the Embedded Computer screen the spectrometer will start measuring.

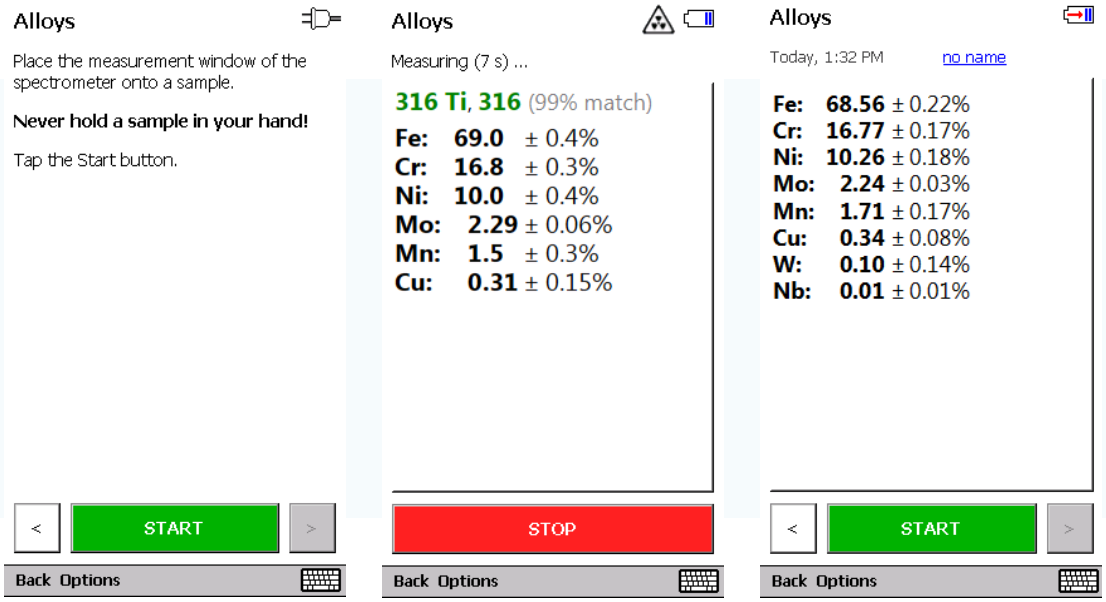


The operation mode indicator changes to **red** when the X-ray generator is running. The **red indicator** on the spectrometer snout signals running of the x-ray generator as well. In the program the sign below signals that the x-ray generator is on.

Metal alloys analysis typically requires from 1 to 10 seconds (depending on the required accuracy). When analyzing soil and plastic samples to obtain accurate results, the measurement time may be increased. The measurement time is displayed on the screen of the embedded computer.

During the measurement, intermediate results will be shown. After the time set for the mode has elapsed, the final result will be shown. Measurement can be interrupted by pressing the **STOP** button on the built-in computer screen or by releasing the trigger. In this case, the result may be inaccurate (intermediate).

To close the measuring mode and return to the main program window, press **BACK** button in the lower left corner of the screen.

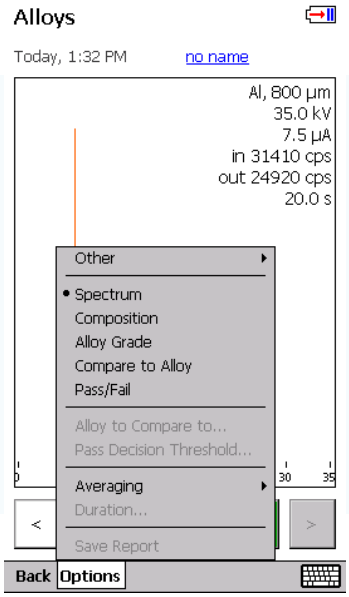


3.2.2.8.Viewing Previous Measurements

To view previously completed measurements, you need to press  button.

3.2.2.9.Measurement Results Display

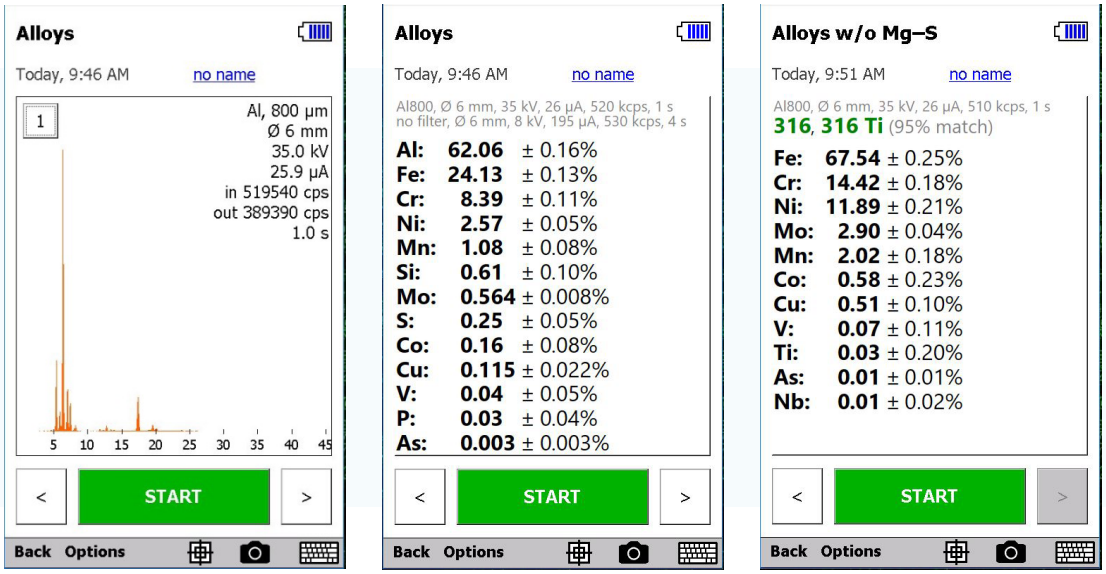
You can customize convenient mode for displaying measurement results. In the measuring window, click **Options** and select the appropriate display mode:



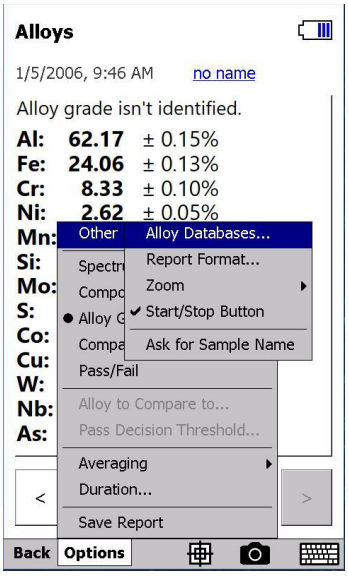
Spectrum – Graphical representation of the spectral lines of the sample;

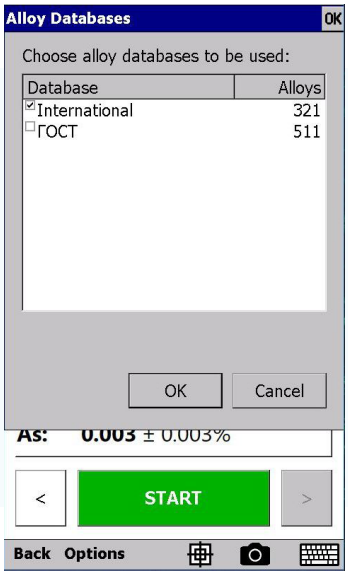
Composition – A list of found elements in the sample and their concentrations;

Alloy grade – According to the list of detected elements and their concentrations the closest grade and match percentage is determined.



To select a grader's alloy in the measurement mode window, press **Options – Other – Alloy Databases...** Select the checkbox next to the required grader and click **OK**.

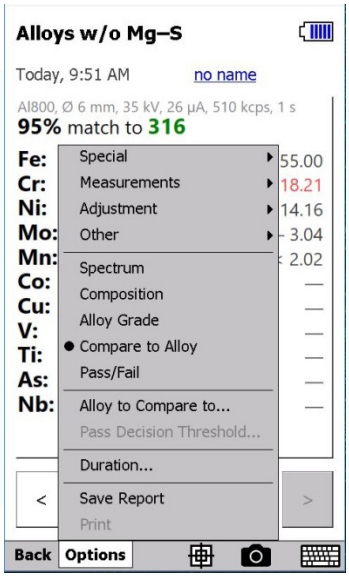




3.2.2.10.Compare to Alloy

The program allows you to compare the composition of the test sample with any alloy in the alloy library supplied with the spectrometer.

To activate this function in the measuring window press **Options – Compare to Alloy.**



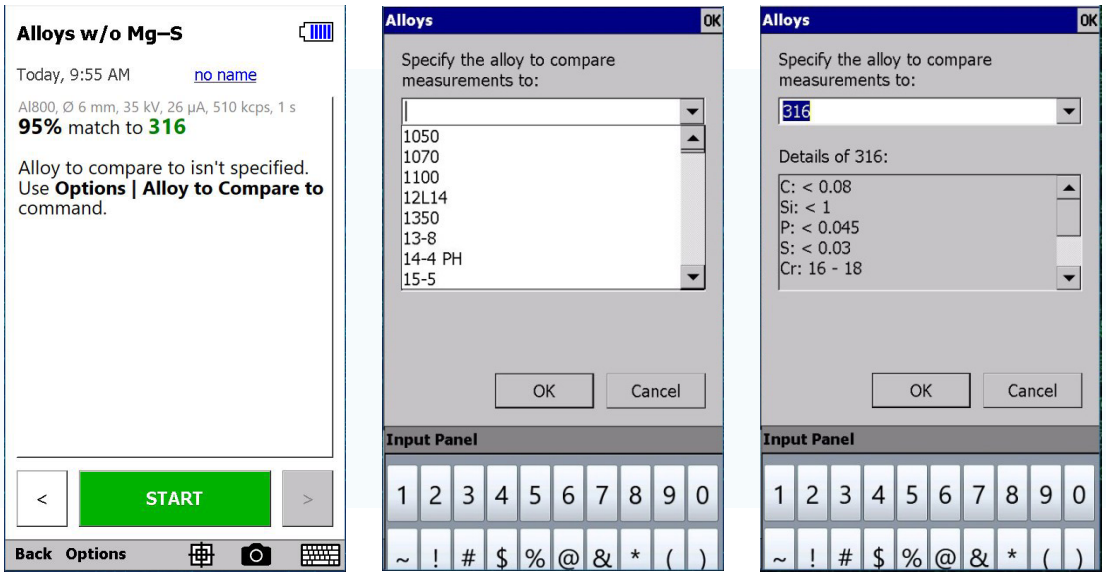
To select an alloy for comparison in the measuring window press **Options – Alloy to Compare to**. Select the required alloy from the list. For a quick search, you can type on the keyboard the name of the alloy.

The composition of the alloy will be displayed in the window under its name.

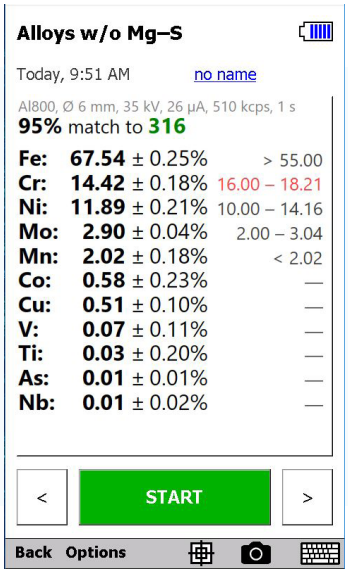
Click **OK** to complete the selection.

Now, in all measurements match % of the measurement to the selected alloy will be indicated.

Large black font shows measured concentrations of elements (left column). The report also indicates concentrations of elements in the alloy selected for comparison (right column). If the measured concentrations are higher than that in the alloy selected for comparison, the value in the right column is colored **blue**. If the measured concentrations are lower the values in the right column will be colored **red**.



If the measured concentration are within the range of values for the alloy, the value in the right column is not colored (black).



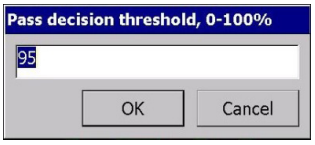
3.2.2.11.Sorting

The program allows to perform sorting determining if composition of a test object matches an alloy selected for comparison.

To activate this function press **Options – Pass/Fail**.

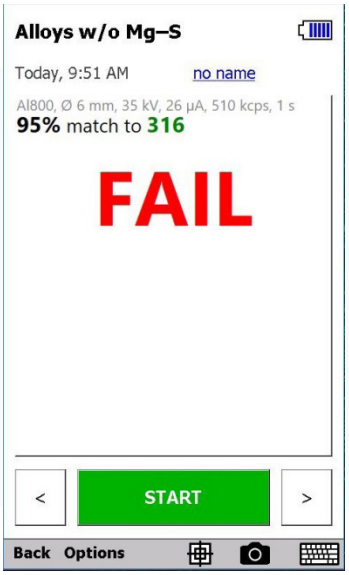
The pass decision threshold is set as match % of the test sample to the selected alloy. To set or change the

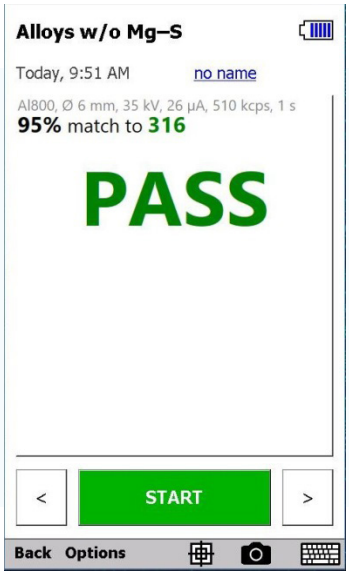
value of the threshold press **Options – Pass Decision Threshold**.



Enter the required value and click **OK**.

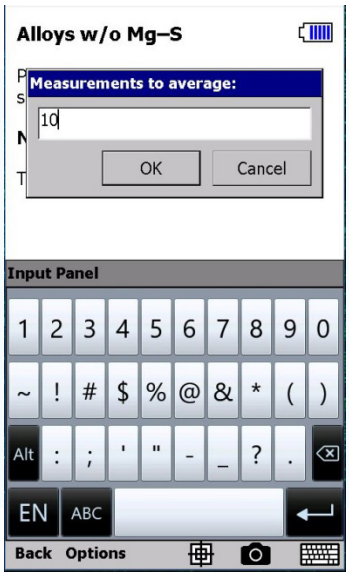
Now the analysis of the measurement displays the name of an alloy selected for comparison, the match % of the sample composition to an alloy and the result of alloy matching – PASS or FAIL.





3.2.2.12.Averaging

The program allows you to average over several measurements in order to enhance the final result. To activate this function in the measuring window press **Options – Averaging**.

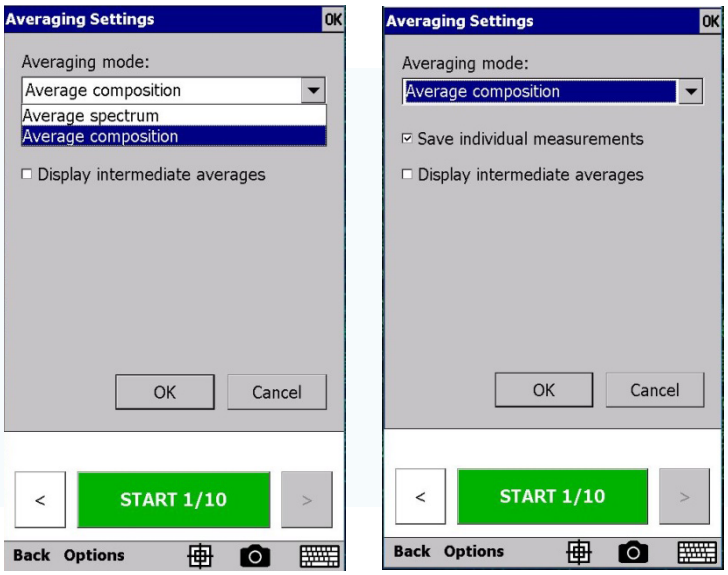


Select the number of measurements for averaging – 3,5 or manually specify a different value.

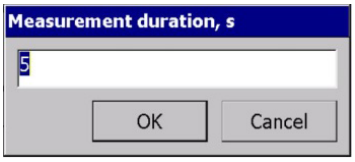
Also set the averaging mode – in the measuring window, press **Options – Averaging – Averaging Settings**. In the window that opens select – **Averaging composition or Averaging spectrum**. If necessary individual measurements can be saved and intermediate averages can be displayed. To activate these

features enable the appropriate options .

Select the options you want and click **OK**.



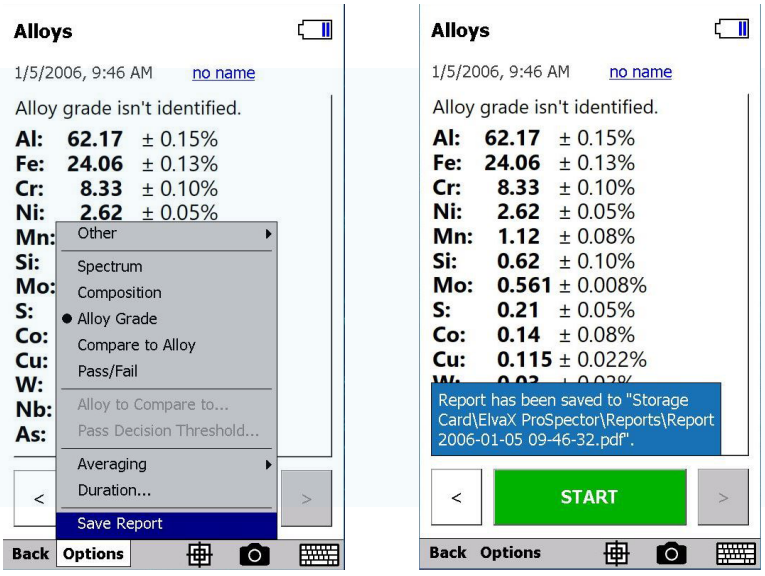
3.2.2.13.Measurement time



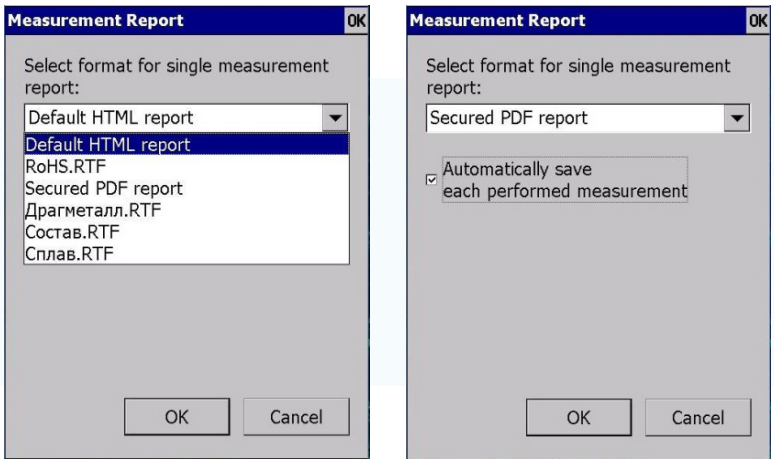
The measurement time for each measurement mode is set at the factory. To change it, press **Options – Duration...** Enter the desired value and click **OK**.

3.2.2.14.Reports

To save the report on the results of a single measurement in html format in the measurement window, press **Options – Save Report**. The report will be saved in the location specified in the export settings — see section *3.2.3.2* ***Measurements Storage***.

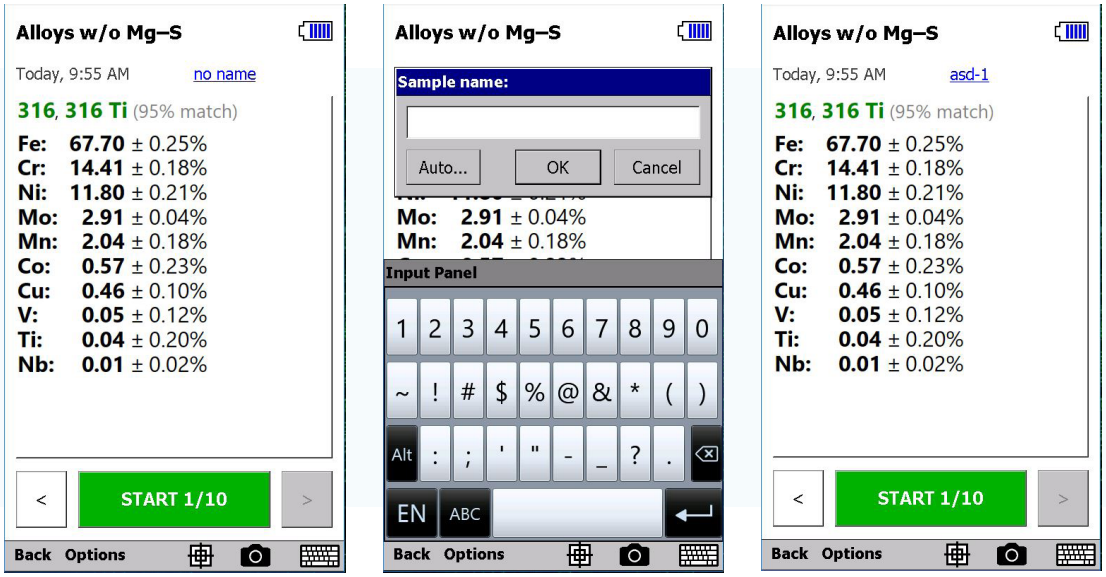


The spectrometer has several predefined report templates. To view the available templates and select the template that will be used in the analysis task, press **Options – Other – Report Format...** Select a template from the list. To automatically save reports of subsequent measurements, select **Automatically save every performed measurement** check box. Click **OK** to save the selected settings.



3.2.2.15.Naming measurement results

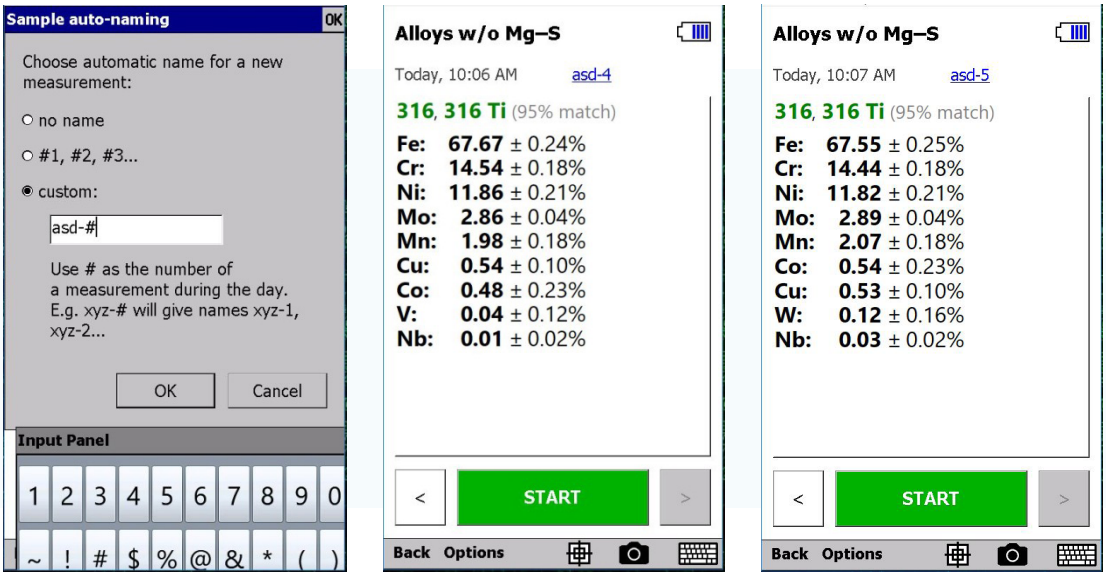
Each completed measurement **is automatically** saved in the database of measurements with date/time stamp and with reference to the current task. If the measurement is needed to be referenced in the future, it can be given a name. To do this, after completion of the measurement, tap the blue underlined **no name** text to the right of the date/time of the measurement. In the opened window, enter the name of the sample and tap the **OK** button.



To the new measurements the names will be assigned automatically, for example asd-4, asd-5 etc., click on the button **Auto...**, choose style naming and then confirm with **OK**.

Subsequent measurements will be named according to the selected settings.

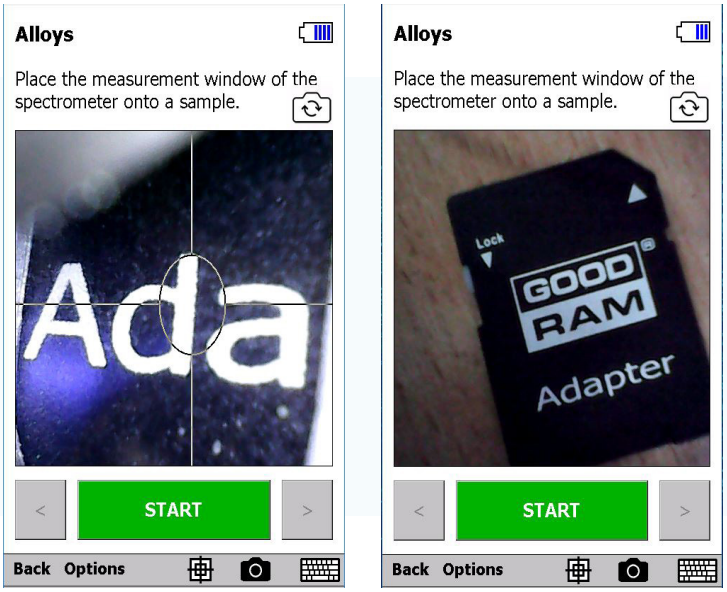
If necessary, you can enable the name query mode at the end of the measurement. To do this, press **Options** – **Other** and select the **Ask for Sample Name**. In this mode, after completing each measurement, the program will ask you to enter a name in accordance with the previously selected automatic naming settings. You can simply confirm the proposed name — click **OK**, edit the proposed name or cancel the naming — click **Cancel**.



3.2.2.16.Camera

If the spectrometer is equipped with a video camera(s), it is possible to use it for accurate positioning on the test sample. The main camera is located inside the spout of the device and indicates the location of the "spot" of x-ray radiation on the sample using the "sight". You can also take a photo of the sample and save it along with the measurement. To turn on the camera and view the image in the measurement mode window, click on the camera icon in the bottom line of the screen. When you click on the icon again, the camera turns off and the image is hidden.

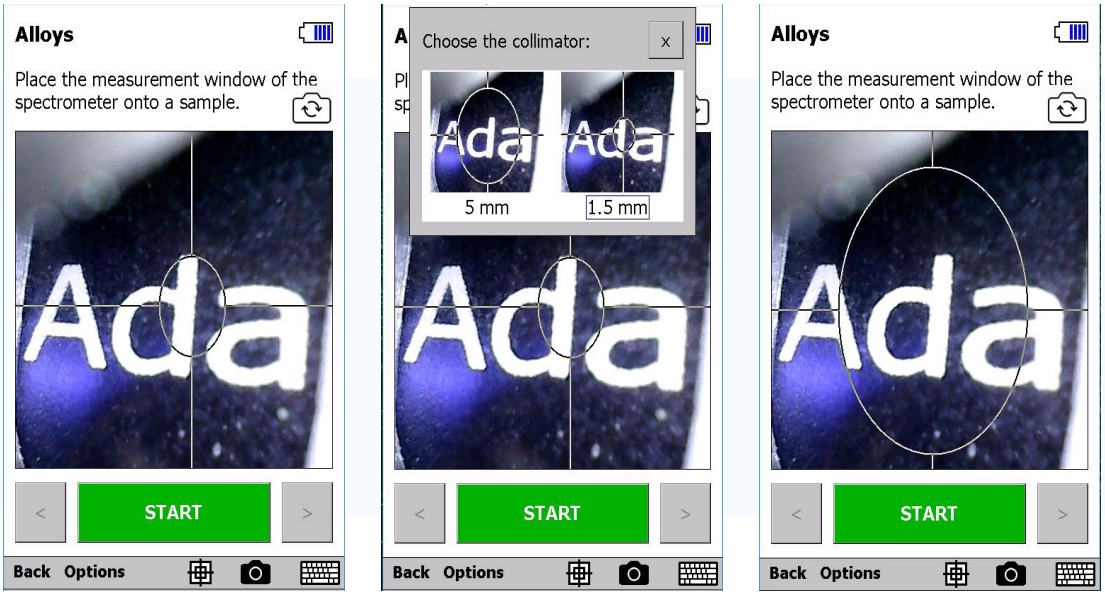
If the spectrometer is equipped with an additional (overview) camera, to switch cameras, click on the camera change icon .



Note: In order to save battery power, the camera is turned off. Therefore, to save a photo together with the measurement, required enable this mode in the program settings - see section 3.2.3.2 *Take Photos of Sample*. Also, before starting it is necessary to turn on the camera manually or use the automatic turn on the camera when a sample is detected - see section 3.2.3.2 *Auto Turn On Video Camera*.

3.2.2.17.Collimator changer

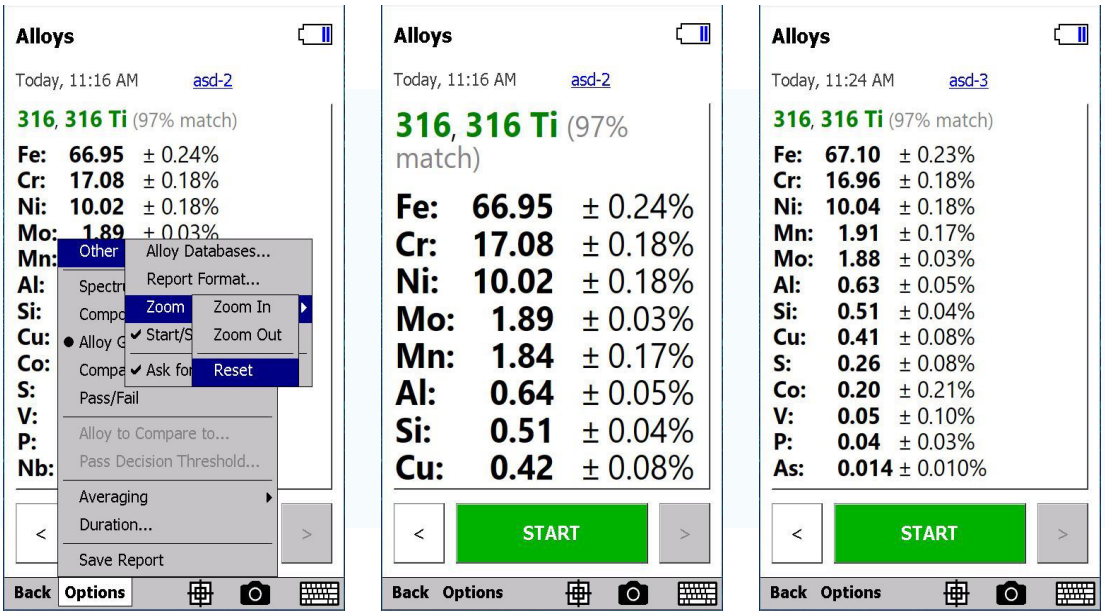
If the spectrometer is equipped with a collimator changer, in measurement mode window, click on the collimator icon in the bottom line of the screen.



In accordance with the size of the collimator, the size of the "sight" will change for precise positioning on the sample. The main camera should be turned on.

3.2.2.18.Font size (zoom)

For user convenience, the font size can be changed in the measurement mode window. To do this, press **Options – Other – Zoom**. Press (repeat several times if necessary) **Zoom In** or **Zoom Out** and choose a convenient font size. To return to the default font size, press **Reset**.



3.2.2.19.Return to the main program window

After completing the measurements, close the window of the current task to return to the main program window (press **Back**).

3.2.3.Spectrometer settings

In the **Options** menu of the main program window, you can:

in **Special**, launch special procedures;

in **Settings**:

- adjust the brightness of the screen backlight;
- select trigger mode;
- show/hide the **START/STOP** button and scrolling buttons;
- enable/disable voice messages;
- enable/disable auto-rotate screen;
- enable/disable the automatic turning on the camera when the sample is detected,;
- if there is a GPS option enable/disable automatic recording of marks in measurements;
- enable/disable sample photography;
- connect to roll Bluetooth or to network printer;
- configure measurement storage options;
- configure export options and export measurements;
- set date and time;
- change password to protect against unauthorized access;
- view the settings of the embedded computer;
- enter the name of the operator, which is displayed in reports and printing.

in Network:

- turn on/off WiFi;
- configure file access:

in Monitors:

- display diagnostic monitors of parameters and device status;

in Language:

- choose the language of the program interface.

3.2.3.1.Options – Special

At any time, you can reconnect the Embedded Computer to the device (measuring unit) or restart the Embedded Computer (if necessary).

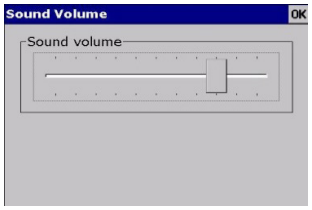
3.2.3.2.Options – Settings

In this menu item you can configure the operation of the spectrometer.

Screen Brightness

Move the slider to adjust the desired brightness of the screen backlight and press **OK**.

Sound Volume

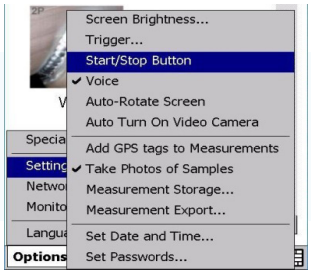


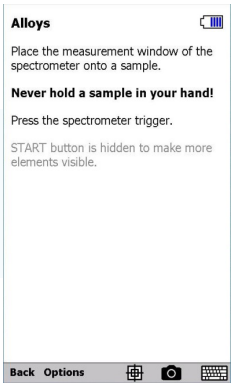
To set the required volume for the voice guidance, move the slider and press **OK**.

Trigger

Choose trigger mode for your preference.

Start / Stop Button





Typically, the measurement mode window has a **START** button and buttons to scroll through the results below. If necessary, these buttons can be hidden, and the space given to the result, so that without scrolling you can see more elements. To turn on or off, press the **START/STOP BUTTON**.

To prevent the user from worrying about where the start/stop buttons disappeared, a note has been added to the welcome text of the measurement mode.

Voice

To turn voice guidance on or off, press **Voice**.

Auto-Rotate Screen

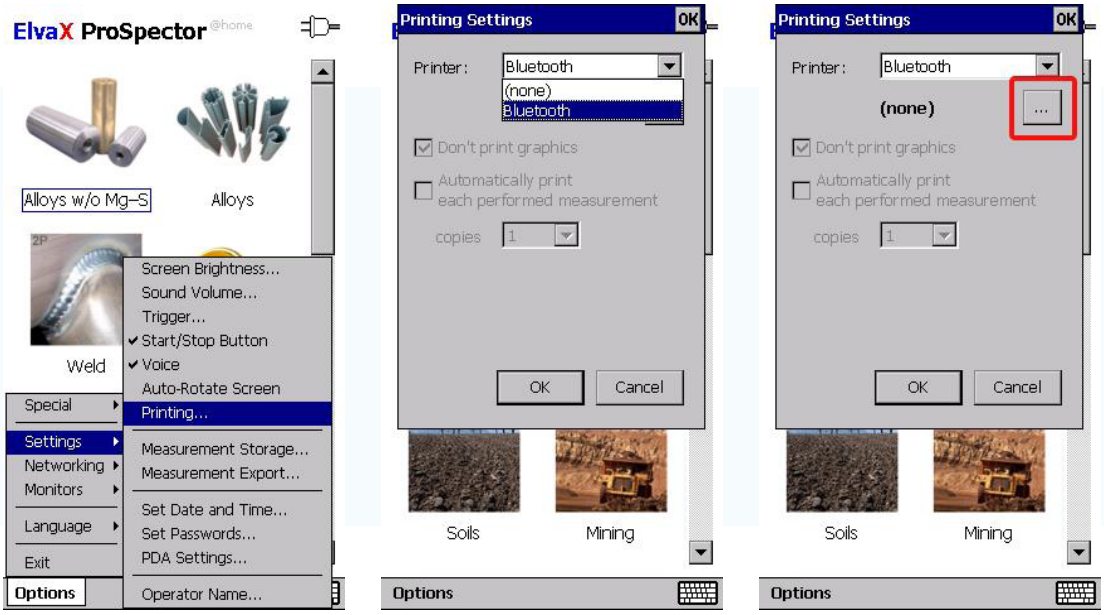
To enable or disable auto-rotate the screen, press **Auto-Rotate Screen**.

Auto Turn On Video Camera

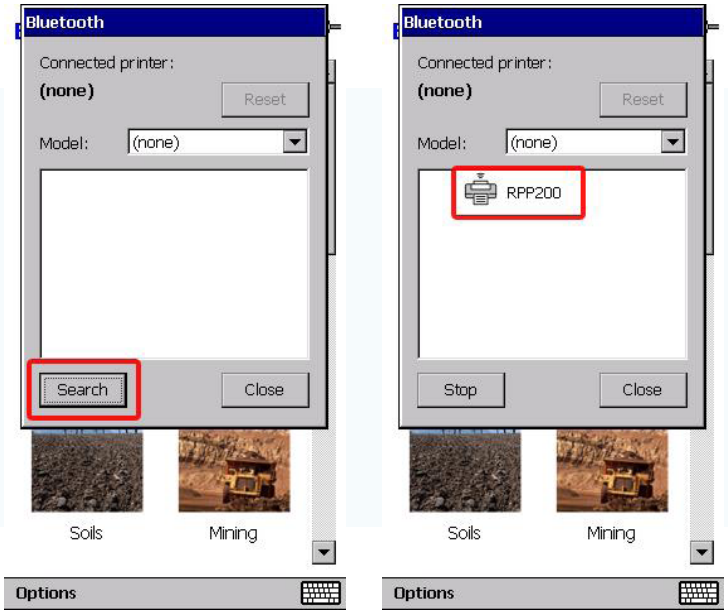
To enable or disable the ability to automatically turn on the camera when the object's sensor is triggered (when holding the device to the sample), press **Auto Turn On Video Camera**.

Printing

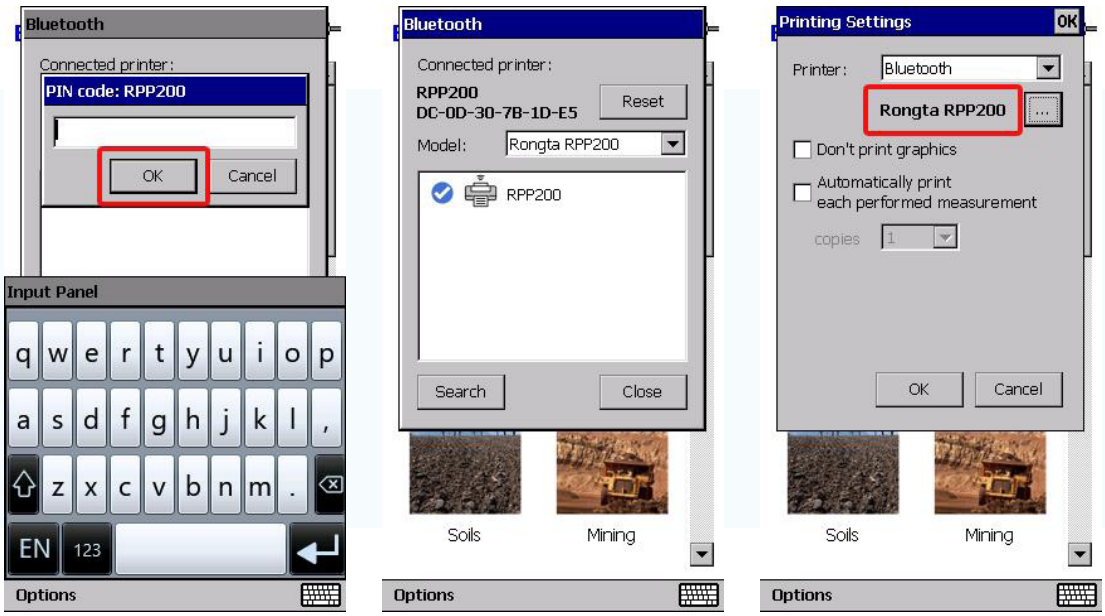
To connect a roll Bluetooth printer to the device, in the window that opens, select Bluetooth from the list and click on the button **"..."**



Turn on the Bluetooth printer, click the **Search** button and wait for the printer to appear in the list of detected Bluetooth devices.



Click on the printer icon and enter the pin code (must be specified in the printer documentation). The program will try to connect to the printer, and if successful, will put a blue checkmark; also the address of the printer will appear in the *Connected printer field*. You don't need to touch the model, it should get out automatically.

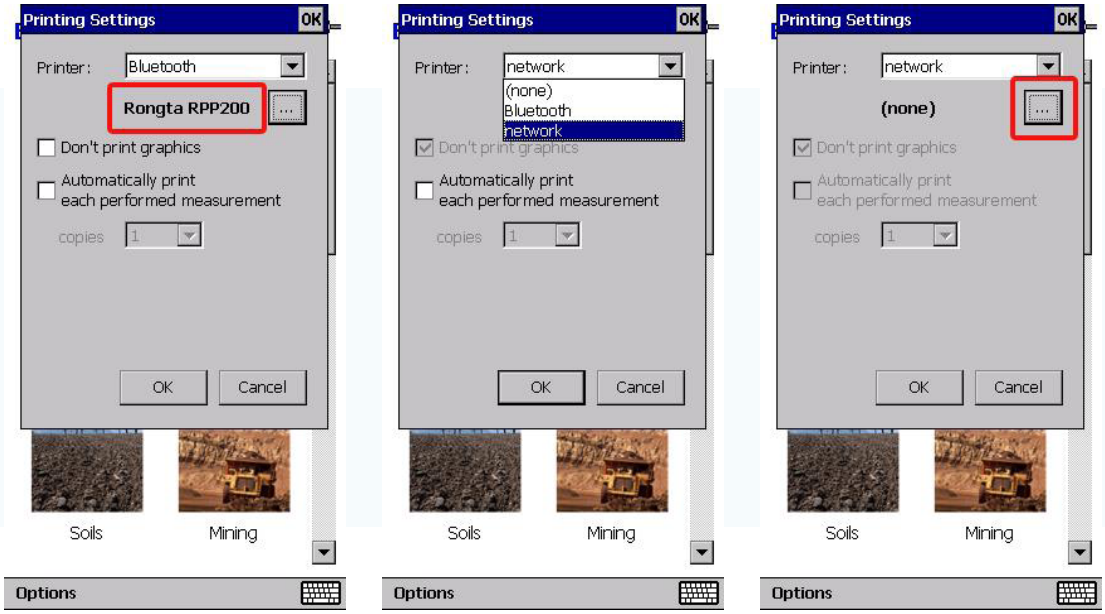


Additionally, you can disable graphics printing – to speed up the printing process, as well as enable/disable the option of automatic printing upon completion of each measurement and set the number of copies.

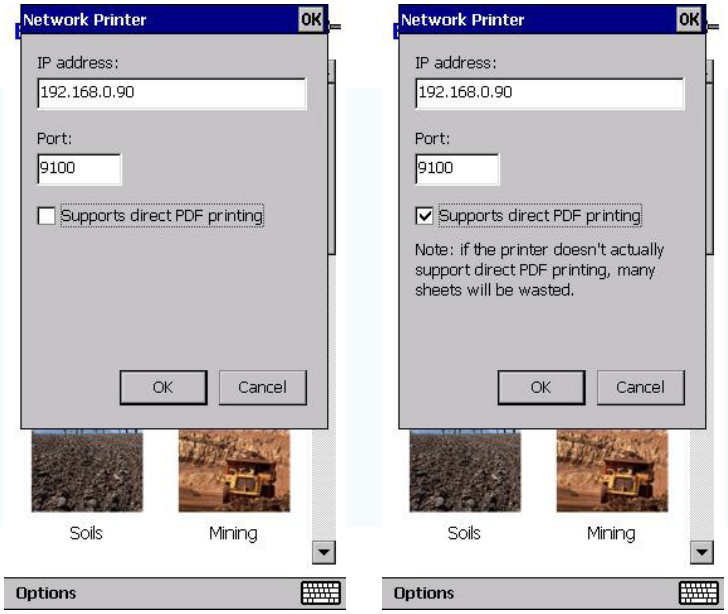
Click on the **Close** button – the connected printer will appear in the print settings. Click **OK** to finish.

When using a network printer, printing is available in two formats — *text report and PDF report*. PDF reports look nicer and contain a photo of the sample (if this option is enabled).

To connect a network printer to the device, in the window that opens, select network from the list and click on the button **"..."**.

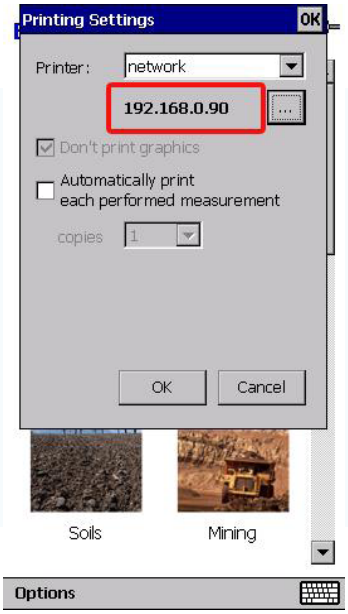


Enter the IP address of the network printer (check with your system administrator, for example – 192.168.0.90). Port – by default 9100. If the printer supports direct printing of PDF documents, enable the corresponding checkbox. The format of the printed report (text / PDF) depends on the state of this checkbox. If the checkbox is checked and the printer does not actually support PDF direct printing, it will print many junk pages.



Additionally, you can enable / disable the option of automatic printing upon completion of each measurement and set the number of copies.

Click on the **OK** button – the connected printer will appear in the print settings.



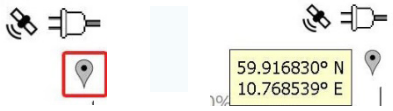
Click **OK** to finish.

Add GPS tags to Measurements

The ProSpector 3 spectrometer may have an option – a built-in GPS receiver to determine the geographic location of the device and assign latitude/longitude marks for measurements.

By default, the GPS receiver is turned off for energy saving reasons. To turn on the receiver, in the main window of the spectrometer, press **Options – Settings – Add GPS tags to Measurements**. The receiver will begin to collect satellite signals to determine the location. After completing this process, the satellite icon will be displayed at the top of the screen.

While the satellite icon is displayed, each measurement taken has its own geotag. A location icon is added to the right of the dimension name. When you click on this icon, latitude and longitude coordinates are displayed.



When measurements are exported to the log, coordinates are also exported.

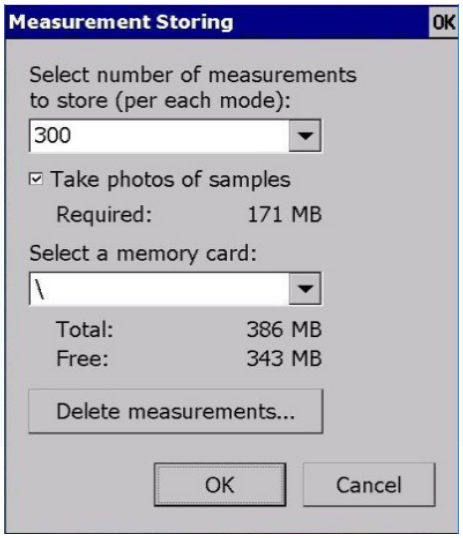
Detailed information on the current state of the GPS receiver can be viewed through **Options – Monitors – GPS monitor.**

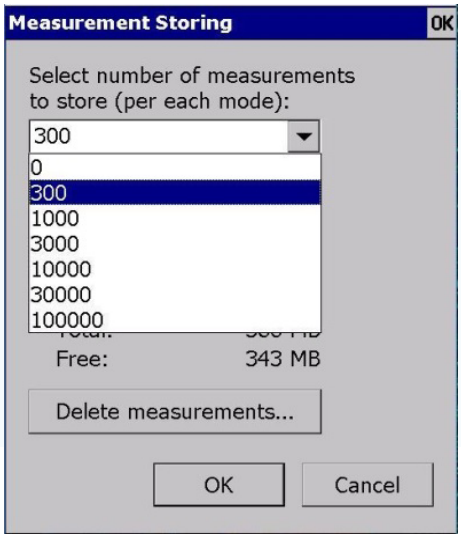
Take Photos of Samples

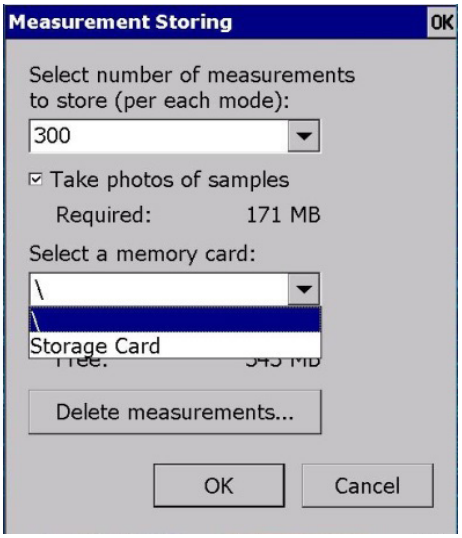
To enable or disable automatic photographing of the sample and save the photograph to the measurement, press **Take Photos of Samples**.

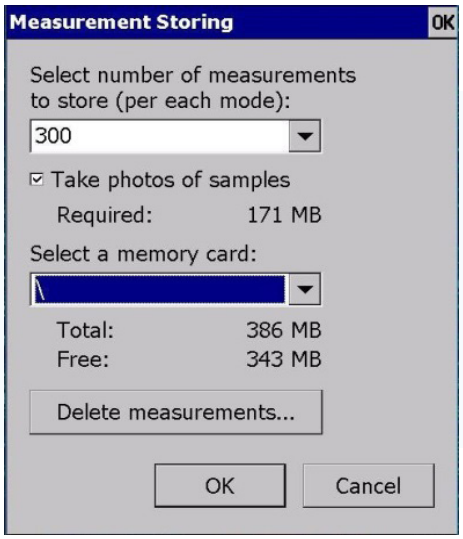
Measurement storage

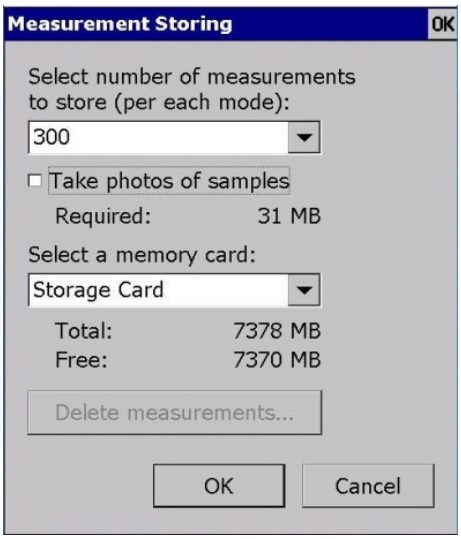
To select the storage location for the measurement results, press **Measurement Storage.**









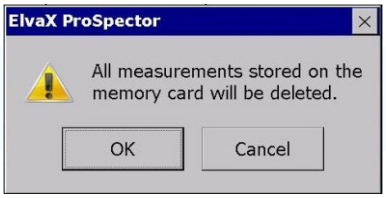


n the window that opens, select the number of stored measurements (in each mode) and the location in which the measurements will be saved. If the “Take samples” checkbox is selected, the image of the measured sample will be saved together with the measurement result, which will require a larger amount of memory.

Each time you change the settings, the required volume is displayed.

Be careful when designating a Storage Card (MicroSD card) as the location for measuring measurements - if the MicroSD card is removed before the measurement or during the measurement, the program will have nowhere to save the result. In this case, do not forget to “return” the MicroSD-card to the Embedded Computer before starting the measurement in order to avoid troubles.

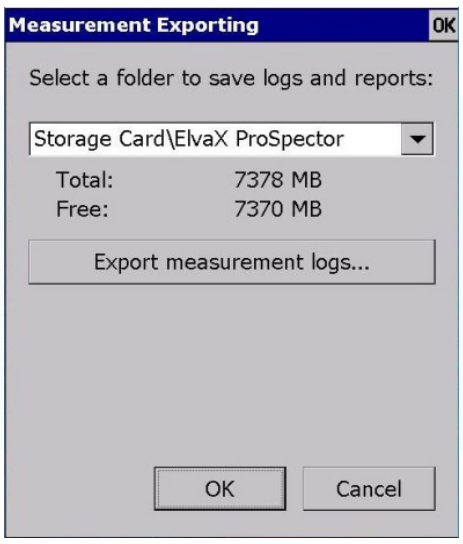
If previously taken measurements are no longer needed and you need to clear the memory to save new measurements — click on the **Delete** measurements button and confirm with **OK**. The memory will be cleared, previously taken measurements will be deleted.



Measurement Export

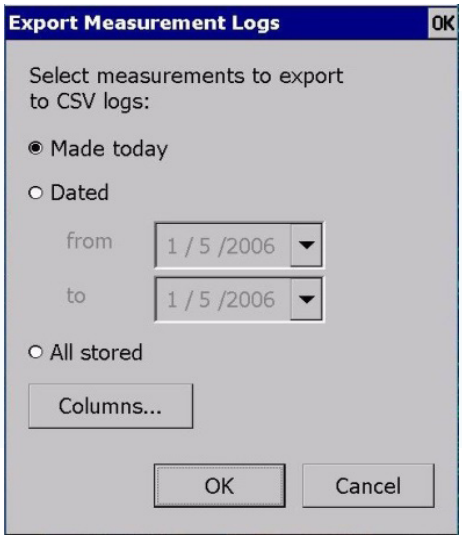
To configure the export of measurement results, press **Measurement Export...** In the window that opens, select the location (folder) in which the logs and reports will be saved.

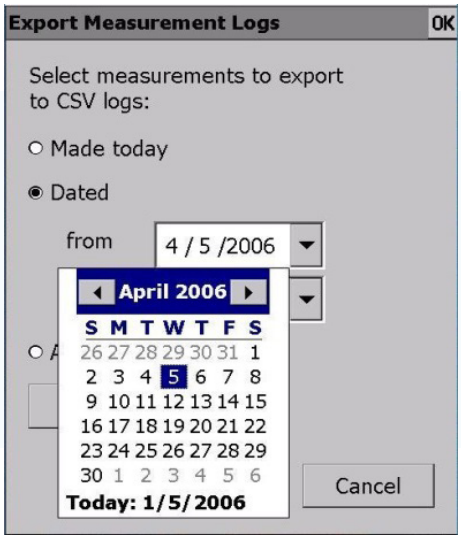
By default, measurements are exported to the *\StorageCard\ElvaX ProSpector* folder. If Wi-Fi is activated in the device, you can specify an available network folder for saving logs and reports — click on the text **Add a network folder...** and enter the path to an available network folder.

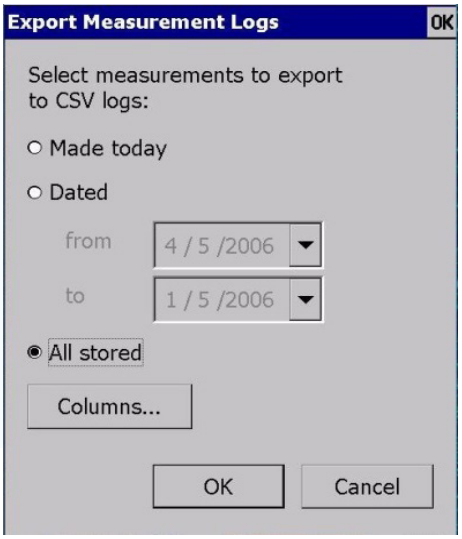


To export accumulated measurements as a log (in csv format), press button **Export measurement logs...** and select the measurements you want to export — *Taken today, Dated in the desired range,* or *All stored*.

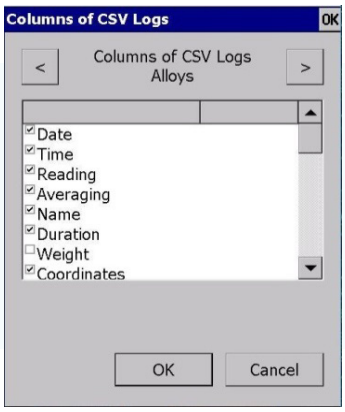
Additionally, you can specify the desired columns in the log table. Click the **Columns** button and select the required columns in the displayed list. Lists of journal columns can be configured individually for each measurement mode.

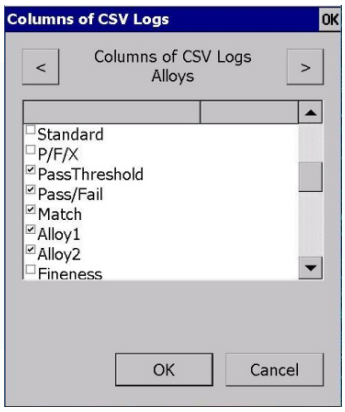


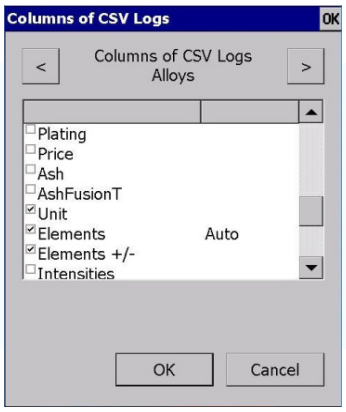


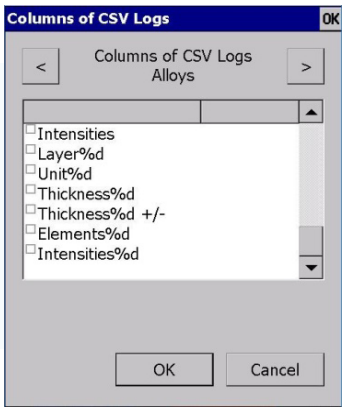


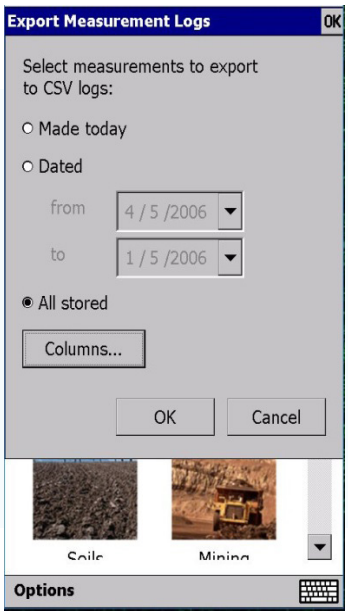
The name of the measuring mode is displayed under the text *"Columns of CSV logs"*. Use < and > buttons to "scroll through" the measurement modes and view the selected log columns. Confirm your selection with **OK**. If you click **Cancel**, the column lists will remain unchanged.

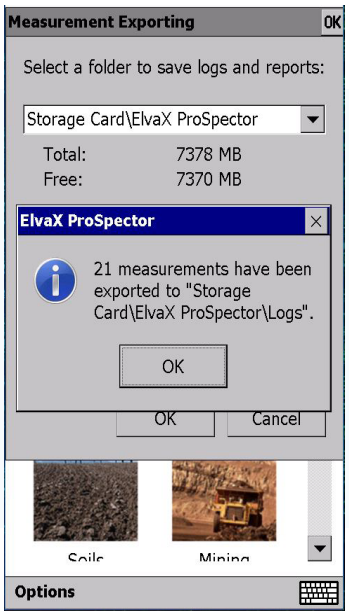






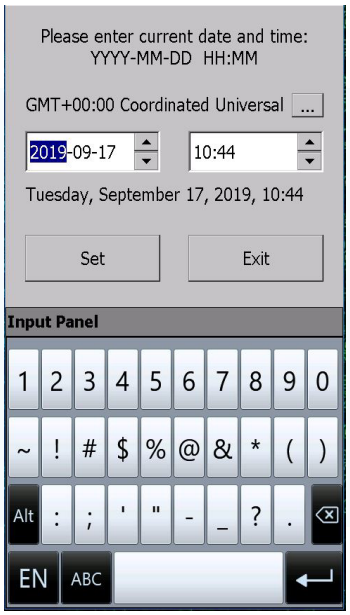


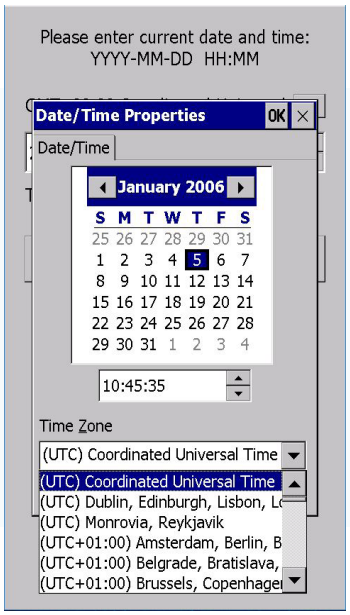




Set Date and Time

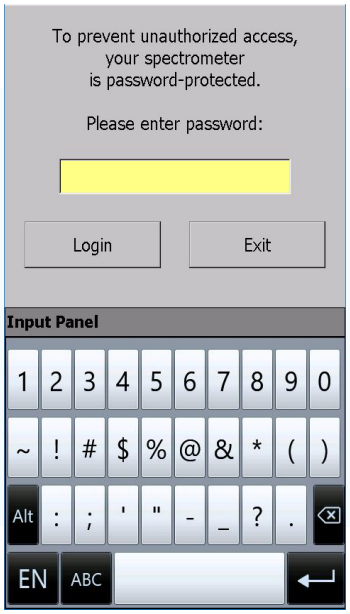
This menu item is used to set (correct) the current date and time.

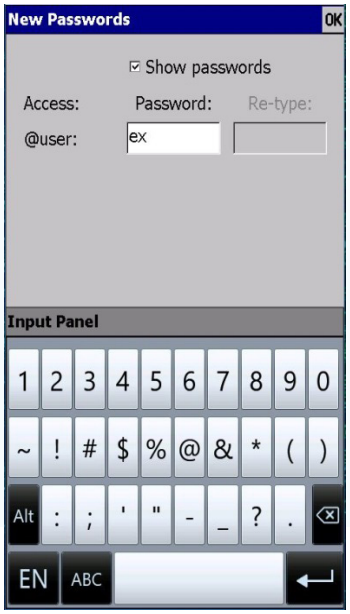


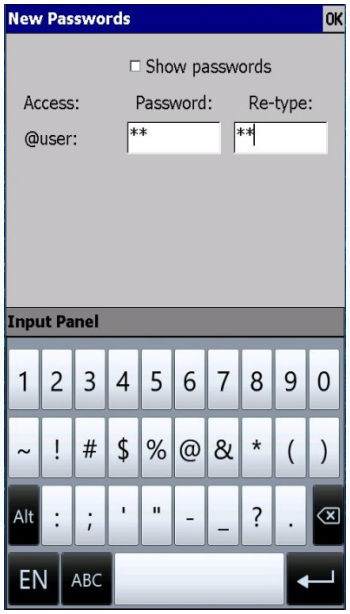


Set Passwords

It is possible to change the password for access to the program. When you select this item, the program will ask you to enter the current password:







By default, the password is displayed when you enter. If you uncheck the **Show passwords** box, the password will be shown with asterisks, but then it will need to be re-entered.

Passwords are stored in a file on the PDA's internal disk in the form of cryptographic hashes (irreversible functions). Unauthorized modification or deletion of this file will lead to the fact that the program cannot be entered at all.

If the user has forgotten the entered passwords, to return to the default passwords, you must completely reinstall the data from the installation card

Operator Name

The software allows you to enter the operator's name, which is displayed in reports and on printing.

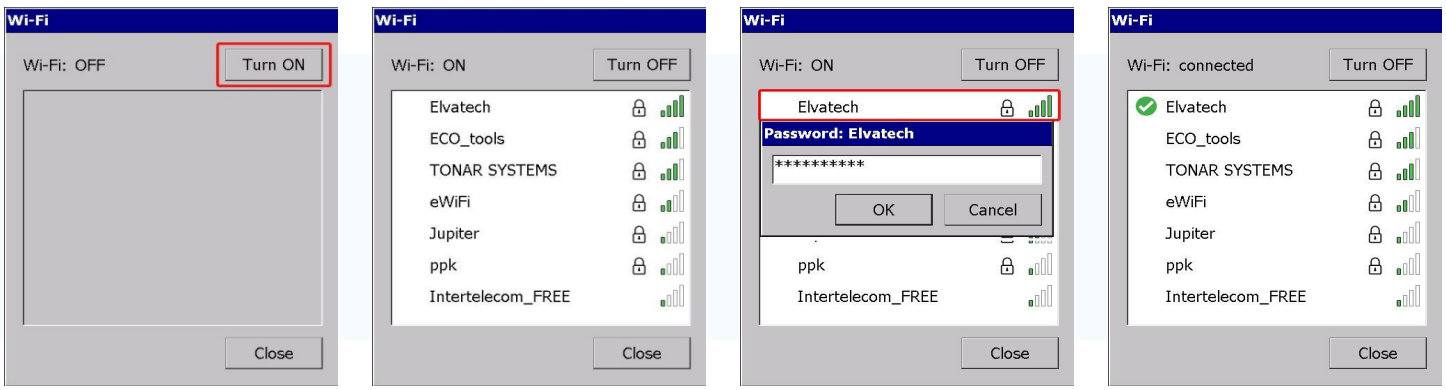
3.2.3.3.Options – Network

The ProSpector 3 Spectrometer can connect to networks using Wi-Fi wireless technology. After the spectrometer is connected to some of its data folders, for example, with exported measurements, you can get remote access from desktop computers.

Wi-Fi

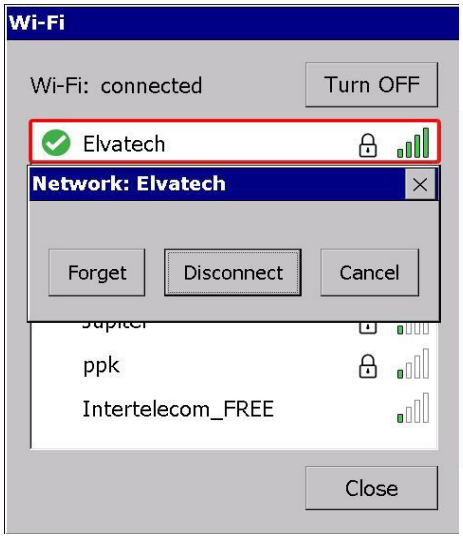
By default, the Wi-Fi module is disabled due to power saving. To enable Wi-Fi, in the main window of the spectrometer, press **Options – Network – Wi-Fi ...** The Wi-Fi dialog box opens. Click the **Enable** button. After a short delay, a list of available networks appears.

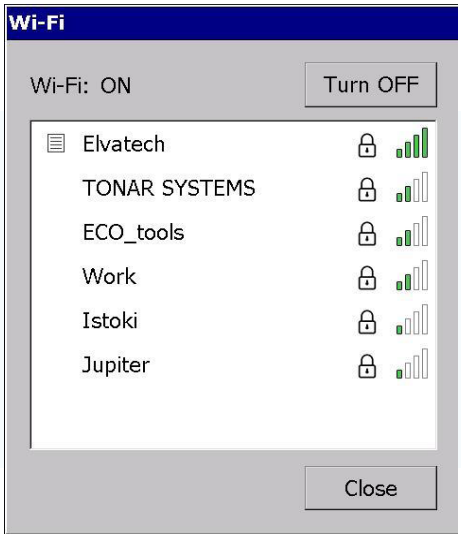
To connect to the network, just click on it. If the network is protected (has a lock icon), a password will be requested. The connected network will be marked with a green tick.

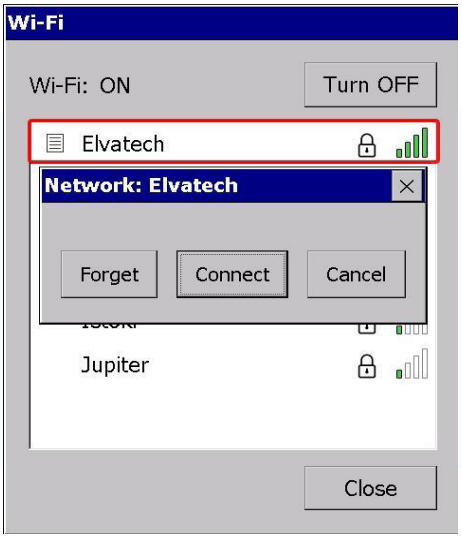


If Wi-Fi is turned off and then back on, the last successful connection is restored (if available).

To disconnect the network without disconnecting Wi-Fi, click the **Network**, and then click **Disconnect** (password will be saved). To connect a temporarily disconnected network (without re-entering the password), click **Connect**. To forget a previously entered password, click **Forget**.

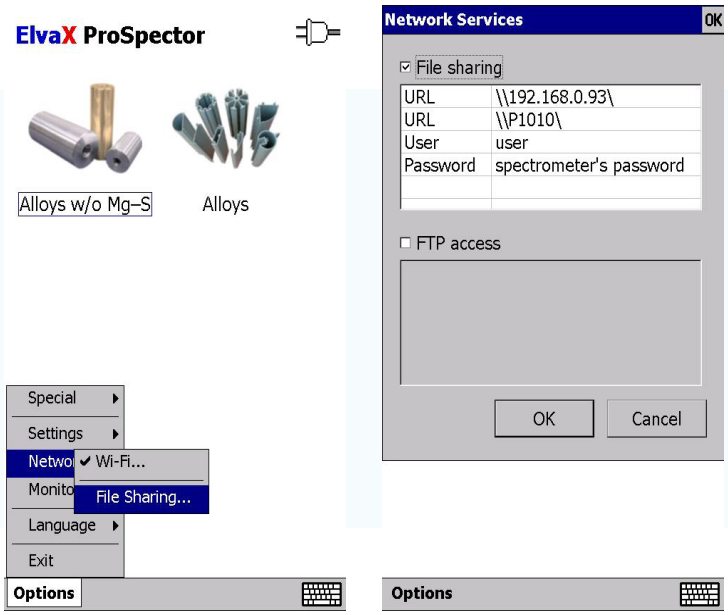






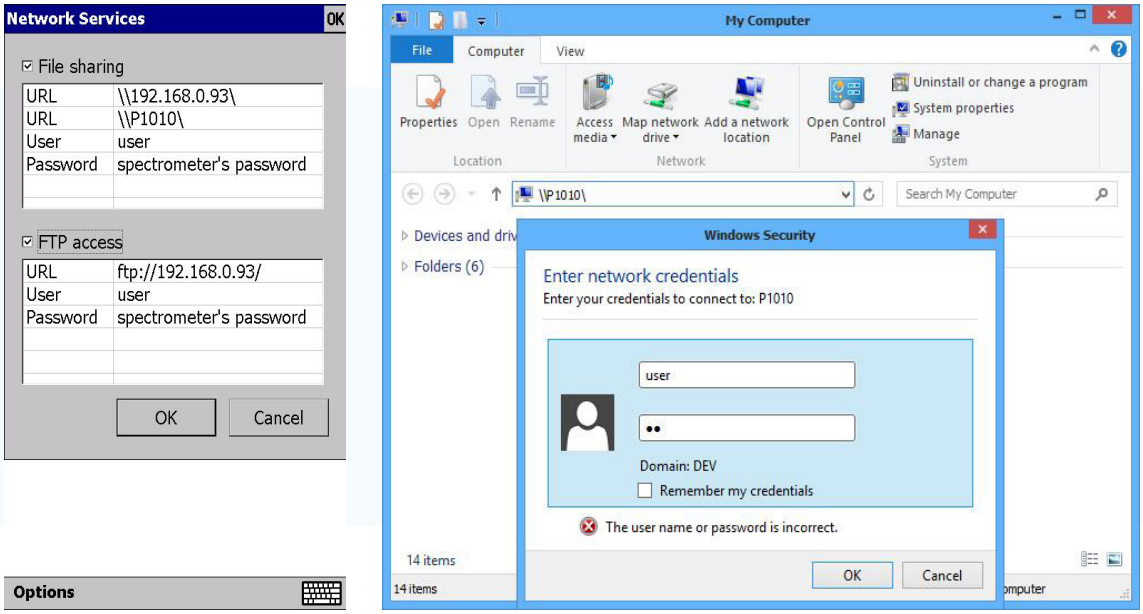
File Sharing

After establishing a network connection, you can gain remote access to the data folders of the spectrometer. The software supports 2 network services — file sharing over a network (SMB) and file transfer protocol (FTP). By default, file sharing is enabled and FTP is disabled. To change this selection, in the spectrometer main window, press **Options – Network – File Sharing...** Active services are checked and their access settings are displayed in the table.

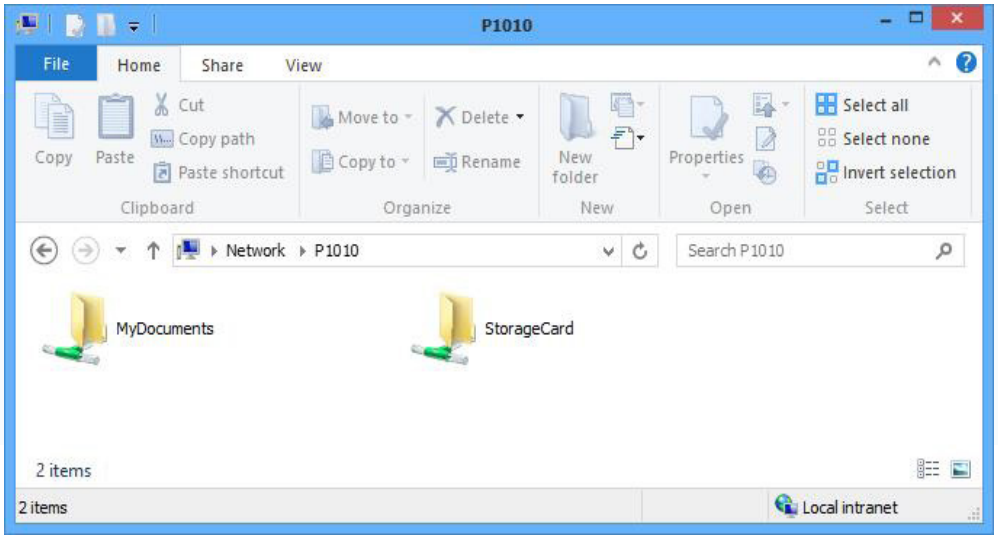


Click **Options – Network – File Sharing...** to find out the access settings — URL, username and password. On a Windows desktop computer, open “This Computer” (“My Computer”) and enter the spectrometer URL in the address bar. As the URL, you can use the IP address (in this example *\\192.168.0.93*) or the

serial number (in this example *\\P1010*). Windows will find the spectrometer and request credentials. The username is displayed in the parameters under the URL (user), and the remote access password is identical to the on-screen password login (ex by default).



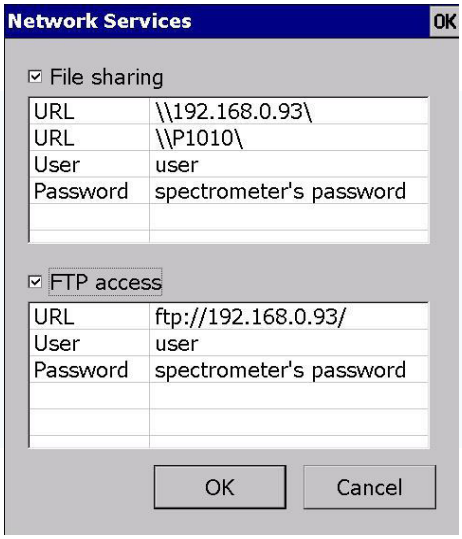
When access is allowed, the public content of the spectrometer will be displayed as a network drive with read and write permission.

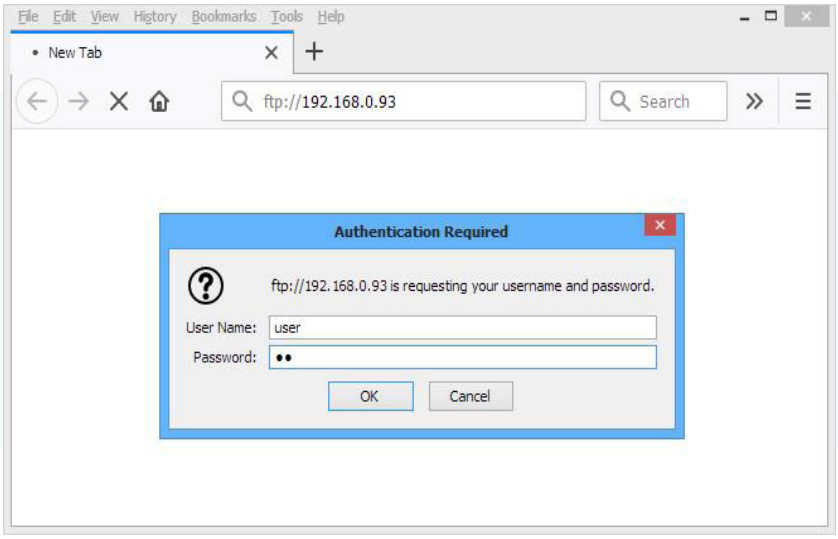


By default, measurements are exported to a folder *\StorageCard\ElvaX ProSpector*. See point Measurement Export... for change location.

Click **Options – Network – File Sharing** to enable the FTP service and find out the access settings — URL, username and password. On your desktop computer, open an Internet browser and enter the spectrometer URL *(ftp://192.168.0.93/)* in the address bar. The browser will find the spectrometer and request credentials. The username is displayed in the parameters under the URL (user), and the remote access password is identical to the on-screen password login (for example, user by default).

Note: not all modern browsers fully support FTP access. Mozilla Firefox and Microsoft Internet Explorer do, but Opera and Google Chrome do not.



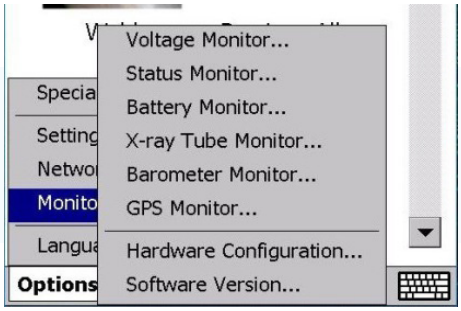


When access is granted, the public contents of the spectrometer will be displayed as an FTP directory with read and write permission.

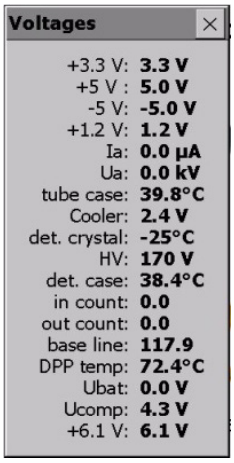
3.2.3.4.Options – Monitor

The program constantly monitors the operating parameters of the spectrometer, the current values of which can be displayed in the form of monitor windows.

In the main window, press **Options – Monitors**. In the menu that opens, select the desired item.

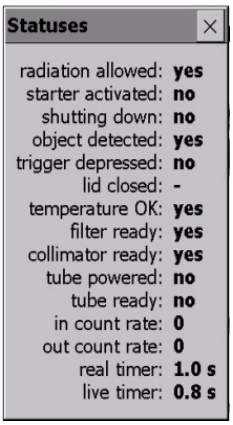


Voltage Monitor



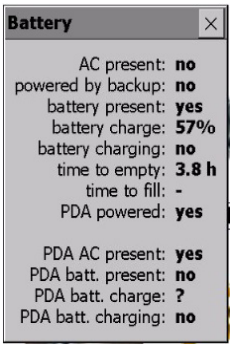
The values of the voltages of internal power sources, the temperature of the main components of the device, the current and voltage of the X-ray tube, input and output countrate are displayed. The voltage monitor allows you to monitor changes in these parameters both at rest and “in dynamics” — during measurement and thereby monitor the correct operation of the spectrometer.

Status Monitor



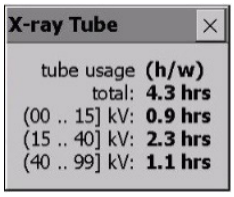
The status values (logical state) of the control signals are displayed, as well as the readings of the load and time counters. The status monitor allows you to monitor changes in these signals both at rest and “in dynamics” during measurement and thereby monitor the correct operation of the spectrometer.

Battery Monitor



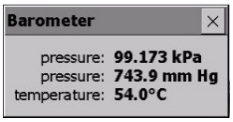
Spectrometer battery status, charge information, and estimated runtimes are displayed.

X-ray Tube Monitor



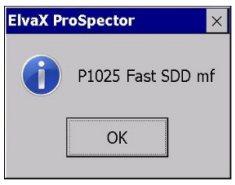
Information about the real-time operation of the X-ray tube is displayed — total and in various modes.

Barometer Monitor



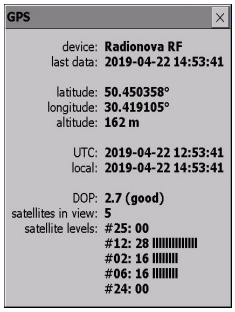
The readings of the barometer integrated in the Embedded Computer and the temperature sensor of the motherboard of the Embedded Computer are displayed.

Hardware Configuration



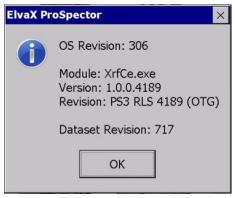
Summary of instrument configuration is displayed.

GPS Monitor



Detailed information on the current status of the GPS receiver is displayed.

Software Version



Information about the revision (version) of the operating system, the revision (version) of the program, and the revision (version) of the instrument database is displayed

3.2.3.5.Options — Language

You can choose the language of the program interface that is most convenient for you. Click **Settings – Language**. Check the box next to your language.

3.3.Work with an external computer

3.3.1.Control of the measuring unit from an external computer

If necessary, the measuring unit of the spectrometer can be controlled using software installed on an external (desktop) computer.

This is necessary if you are using ElvaX desktop software to conduct a detailed (expert) analysis of the studied samples.

It will also be required in case of diagnostics /tuning/repair of the measuring unit using special Elvatech software.

For such a connection, a standard mini-USB cable is required and the software and spectrometer drivers are installed on a desktop computer.

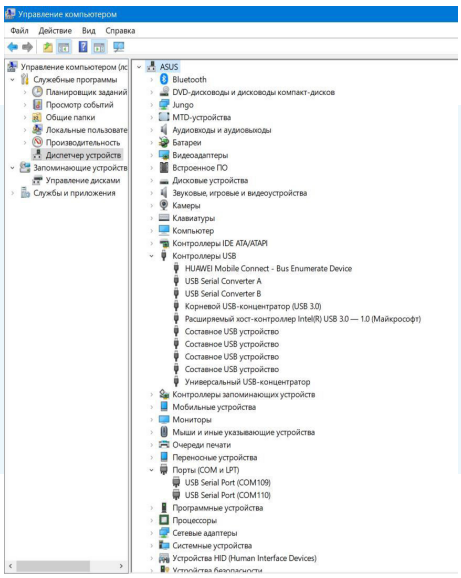
You can download the current version of the software and spectrometer drivers from a permanent link:

https://docs.google.com/document/d/1UWZVorMsArjtxfH2GSvNAXlQmm8Pec-4aLlRCJcPzzs/pub

After installation, connect the mini-USB cable to an external computer and to the measuring unit of the spectrometer — **CONTROL** connector.

Since the external computer is used as the control computer during this connection, the connection between the embedded computer and the measuring unit will be interrupted — the *“lost connection”* icon will be displayed on the embedded computer screen — a red cross in the upper right corner of the screen. If you click on the icon, a corresponding message will be displayed.

If the spectrometer drivers were installed, then the external computer will detect the connected spectrometer in the Device Manager in two sections — USB controllers as USB Serial Converter (two channels) and Ports (COM and LPT) as USB Serial Port (two ports). You can run ElvaX desktop software and work.



3.3.2.Connecting an external computer to the embedded computer

If necessary, an external computer can be connected directly to the embedded computer of the spectrometer. At the same time, the functionality of the embedded computer and the spectrometer as a whole is fully preserved. This type of connection is required when exchanging data between computers directly, as well as for the ability to remotely control the spectrometer’s embedded computer directly from an external computer — a function **Remote Control**.

Such a connection requires a standard micro-USB cable and the installation of mobile device support on a desktop computer.

For computers running Windows 7, 10, Microsoft Mobile Device Center software will be required,

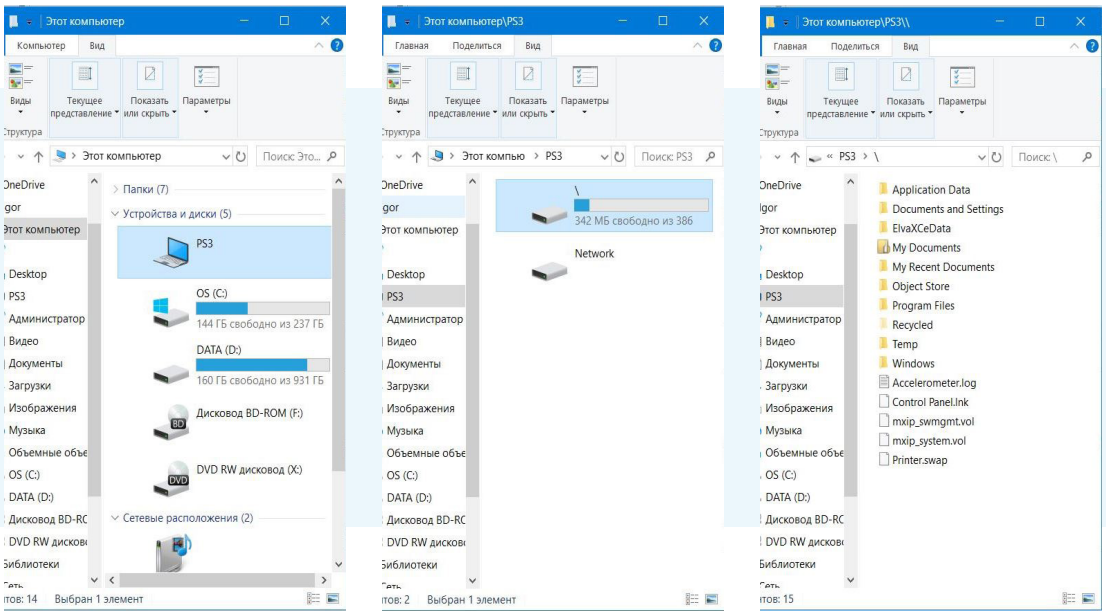
moreover, for computers running Windows 7, it is enough to complete the first paragraph from the document below, and for computers running Windows 10, it is imperative that all points of the document below are fully completed. Microsoft Mobile Device Center installation instructions can be downloaded here:

http://bit.ly/wmdc61win10

After installation, connect the micro – USB cable to an external computer and to the spectrometer's embedded computer – **SYNC** connector.

The embedded computer of the spectrometer will give a sound signal and display a message about the detection of the connection of an external computer to it. No buttons are required to be pressed — the message will be hidden automatically after a few seconds.

Also wait for the spectrometer to be detected by an external computer — the first time you connect to it, Microsoft Mobile Device Center should automatically start on it. You can close the window of this application — only drivers installed in conjunction with the Microsoft Mobile Device Center are required to work with the device.

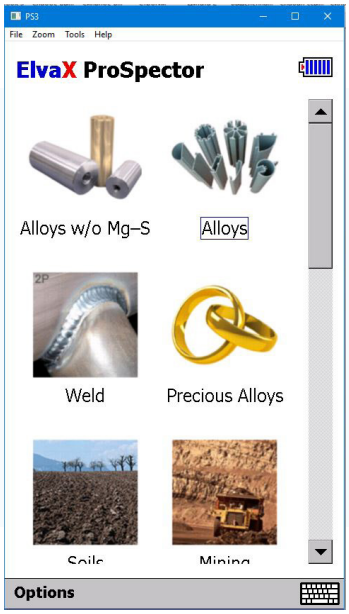


Now the "memory contents" of the built-in computer will be available from an external computer as a removable disk.

To use the Remote Control function, you must copy (do not move!) To the external computer the corresponding file from the spectrometer's embedded computer. On the embedded computer, open the location **\\Windows\RemoteControl**, copy file **PDA Remote Control.exe** to an external computer and run it on an external computer.

Now the screen of the embedded computer is fully accessible in a separate window on the screen of the external computer.

You can control the spectrometer remotely, while the built-in computer continues to work as before.



3.4.Maintenance

3.4.1.Replacing the protective film

A cartridge with a special film is installed in the spectrometer's working window, which protects the detector and emitter from dust and moisture, as well as from mechanical damage to the detector's inlet window. During operation, it is necessary to constantly monitor the integrity of the protective film. At the slightest damage, immediately replace the cartridge with the damaged protective film with a new one, which is supplied with the spectrometer. *To replace a cartridge with a protective film, you must:*

- Power off the spectrometer.
- Press the button at the bottom of the nose of the spectrometer to open the front panel. The front panel will be lifted to release the cartridge.
- Carefully remove the old cartridge. If the film is torn, remove any residue.
- Insert a new cartridge and close the front panel.

Use extreme caution - the input window of the detector is close, the damage of which cannot be repaired and entails the replacement of the detector (if the detector is damaged, the spectrometer does not guarantee)

3.4.2.Battery

The rechargeable battery (accumulator) is located inside the handle of the device. A fully charged battery provides the spectrometer for at least 8 hours.

If the battery is not hot-swappable *(Section 3.2.2.6)*, to remove or replace the battery, turn off the device, press the handle of the battery compartment cover of the handle, turn it and remove the battery.

A power indicator is installed on the right rear side of the spectrometer housing. A **flashing red** indicator indicates a low *(less than 15%)* battery charge. When the battery charge is *less than 5%*, the spectrometer **turns off** automatically. A **green** light indicates that the network adapter is connected to the spectrometer. During charging, the indicator lights up in **blue**.

The spectrometer turns on and works when the network adapter is connected, even if the spectrometer's battery is completely discharged or removed. There are two ways to charge the battery.

Method A.

Remove the battery. On the end wall of the ND2037 battery there is an LCD charge indicator.

The YL18650 battery also has a charge indicator on the side of the battery. To check the battery level of the YL18650, press and hold the white PUSH button.

Connect the AC adapter to an external charger. A **blue** light indicates that the charger is in good condition and there is power. Insert the battery into the charger. A **red** light indicates a charge process. At the end of the charge, the red indicator goes off.

Method B.

Without removing the battery from the spectrometer, connect the latter to the standard network adapter through the connector located on the right side of the device.

The battery of the embedded computer is charged in the same way. The Embedded computer battery starts charging from the spectrometer battery if the charge level of the spectrometer battery exceeds the charge level of the embedded computer battery at least two times.

3.5.Safety

The spectrometer is equipped with the following security systems:

- The spectrometer uses a closed X-ray tube.
- To detect the presence of a sample, the spectrometer is equipped with a proximity sensor based on an open channel optocoupler that operates in the infrared range. In the absence of a sample in front of the measuring window, the spectrometer blocks the activation of the X-ray tube and the operation of the spectrometer. The proximity sensor operates in a pulsed mode — the signal from the photodetector is processed by a synchronous detector. This eliminates false alarms in the presence of extraneous light in the measurement area. When the sample is removed from the sensor during the measurement, the X-ray tube is also turned off and the spectrometer is blocked. Strong extraneous light (for example, the sun) "blinds" the sensor, it loses sensitivity and also blocks the activation of the X-ray tube and the operation of the spectrometer.
- Optionally, instead of an optical proximity sensor, a mechanical locking system can be installed, which does not allow the X-ray tube to be turned on with one hand. To work with the device, which is equipped with a mechanical locking system, it is necessary to tightly attach the device to the test sample, press and hold the trigger with one hand, and with the other hand start the measurement process with the Start button from the control computer screen. When the trigger is released or the instrument moves away from the sample, the X-ray tube is immediately disabled.
- Turning on the X-ray tube and the operation of the device is blocked at a low intensity of secondary radiation — in the absence of a sample or false triggering of the proximity sensor — for example, the sensor is out of order or it is covered with a hand or some object, leaving the measuring window of the spectrometer open.
- In the event of a malfunction in the operation of the light indication (indication of the detection of the sample and the activation of the X-ray tube), the activation of the X-ray tube and the operation of the spectrometer are blocked.
- When the spectrometer is operated for a long time in harsh conditions, to prevent burns and overheating of the spectrometer above 60 ° C, further activation of the X-ray tube is also blocked.

Nevertheless, when working with the spectrometer, you must strictly follow **the safety rules:**

- Do not allow any unauthorized persons closer than 1 meter to the primary X-ray beam emanating from the snout of the spectrometer.
- Never point the X-ray beam on yourself or anyone else. Do not cover the detector with your fingers or other body parts.
- Ensure a snug fit of the spectrometer to the test object during the time of measurement.
- To reduce radiation scattering keep the spectrometer at the right angle (90˚) to the sample.
- Use the laboratory stand, an anti-radiation partition or shield to reduce the scattering of radiation

in the analysis of small objects or multiple analyses of low-density materials such as plastics, wood, paper, soil or minerals, as well as samples with light elements.

- The design of the laboratory stand does not allow turning on the X-ray tube with an open protective cover and prevents the possibility of irradiation.

Example of incorrect use

3.6.Intended use is not expected, incorrect

ElvaX ProSpector should be used only for the purposes and in the ways described in this manual. Not following the recommendations of this manual may harm the operator or other persons.

3.7.Residual risks and hazards present

Risk and hazards related to the use of ElvaX ProSpector are described in *General Safety — see 3.5.* Safety precautions described in this manual must be observed at all times.

3.8.Description and Suggestions for Sample Preparation and Analysis

Make sure that the protective film is not damaged, and the sample window of the device clean. Any dust on the surface of the window can significantly affect the results.

Analysis of metal samples

For metal alloys, a typical measurement time is 2 – 20 seconds (depending on the required accuracy). If necessary, make sure that it provides a small enough mean square deviation (STD).

Make sure the sample is located in the center of the window. If possible, close all of the sample window.

If you analyze a sample of small size, set measurement time longer than usual.

Note if there is a coating on the sample. Maximum analysis depth of a metal sample is not more than 0.5 mm.

Rusty, contaminated or painted surface can distort analysis results. Clean the surface before analysis. Clean samples with a clean file. Small samples can be cleaned using a lathe or milling machine. After cleaning carefully removed from the surface of the sample sawdust and shavings. Use a clean cloth moistened with alcohol.

Flat surface is required for analyzing alloys containing light elements.

Ultralene protective film is required for measuring alloys containing light elements.

Analysis of powder samples

We recommend using the laboratory stand — a sample must be placed above the window measuring instrument.

Powder materials must be ground before measurement using a mill to ensure homogeneity of the sample. Fill at least 2/3 of a sample cell with the test material. Always use clean protective film.

Powder materials containing light elements must be compressed before measurement into a pellet. Be sure to use protective film Ultralene.

Analysis of liquid samples

We recommend using the laboratory stand — a sample must be placed above the window measuring instrument.

Fill at least 2/3 of a sample cell with the test material. Always use clean protective film.

If the sample material is volatile — use an open cell.

If light elements are present in the sample use protective film Ultralene.

4.Disposal

We recommend using the laboratory stand — a sample must be placed above the window measuring instrument.

Fill at least 2/3 of a sample cell with the test material. Always use clean protective film.

If the sample material is volatile — use an open cell.

If light elements are present in the sample use protective film Ultralene.