ElvaX ProSpector 2

USER MANUAL

Revision 1.2

Elvatech 2023

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 source 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.

Comply with all safety instructions mentioned in the Operating manual item 3.3

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

CONTENTS

1. General Information
1.1. Declaration of conformity

Elvatech
Advanced XRF equipment and solutions

www.elvatech.com

CE **DECLARATION OF CONFORMITY**

This document is to confirm that the instruments manufactured by company Elvatech Ltd. listed below, comply with the following directives:

The Electromagnetic Compatibility Directive (EMC) 2014/30/EC

The Low Voltage Directive (LV) 2014/35/EC

ElvaX series X-Ray Fluorescence Spectrometer SER-01

Models: ElvaX ProSpector, ElvaX ProSpector LE, ElvaX ProSpector 2, ElvaX ProSpector 2 LE, ElvaX ProSpector 3, ElvaX ProSpector 3 Advanced, ElvaX ProSpector 3 MAX, ElvaX Basic, ElvaX Plus, ElvaX Pro, ElvaX Jewelry Lab, ElvaX S Lab, ElvaX RoHS, ElvaX GEO, ElvaX Art, ElvaX Mobile, ElvaX Mobile LE, PmX-5050.

Issued: May 25th, 2023. Kiev, Ukraine

Director of Elvatech Ltd.

Oleksandr Filipov

Elvatech Ltd.
50 Mashynobudivna str.,
Kyiv 03680, Ukraine
Phone: +38 (044) 599-11-43
Fax: +38 (044) 406-65-83
E-mail: office@elvatech.com

ТОВ «ЕЛВАТЕХ»
вул. Машинобудівна, 50
Київ 03680, Україна
Телефон: +38 (044) 599-11-43
Факс: +38 (044) 406-65-83
E-mail: office@elvatech.com

1.2. Limited Warranty

Elvatech LTD (hereinafter - the Company) warrants to the consumer that the Device complies with the basic parameters and specifications given in this manual.

Warranty' terms and conditions are specified in a sales contract.

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.

An X-ray generator is the source of Bremsstrahlung used to irradiate the test sample in the spectrometer.

The X-ray generator consists of the X-ray tube, adjustable current source for the cathode filament and the adjustable HV source for the anode.

The X-ray detector consists of a Si-PIN diode, preamplifier and thermoelectric cooler.

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

Operating temperature of the detector (≤ -25°C) is maintained by the thermoelectric cooler.

The pulse-height analyzer consists of pulsed signals spectrometric amplifier and 12- bit spectrometric analog-digital converter (ADC) that converts the pulse amplitudes in digital code.

ADC is equipped with a buffer memory, which accumulates the results of measurements of the pulse amplitudes and forms the emission spectrum of the test sample.

The dedicated controller comprises a microprocessor, non-volatile memory, timers, counters, buffer registers, etc. and is designed:

- For communication between the host computer and the X-ray detection unit (sending commands and data);
- To identify and account temporal characteristics of the measurement process ("Real time", "Live Time", "Dead time");
- To control operation of the thermo-cooler power supply (monitoring and maintaining the operating temperature of the detector);
- To control the X-ray generator (high voltage rise and discharge, monitoring and maintenance of the emission cathode DC).

1.4. Requirements of Pre-Commissioning

Read this manual carefully.
Unpack the device.
Check for completeness - 2.2.
The device is intended for use in closed heated (or cooled) premises air-conditioned or partially air-conditioned:
- 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 - 3.7.1.
Check the battery charge level. If necessary - charge - p.3.7.2.
Install the battery in the device - p.3.7.2.
If you intend to run the appliance from AC outlet - connect to the device to AC outlet.
If you intend to work with the device without stand - set the PDA into the instrument - p.3.7.4.
If the device is supposed to work with laboratory stand - set the device onto the stand, connect the PDA to the device using the connecting cable supplied, set the PDA onto the stand.
If you intend to work with a desktop computer device - connect a PC to the device instead of the PDA via mini-USB cable.

Spectrometer operability check.

Set the control sample (stainless steel 316) onto the sampling window. Conduct measurement and compare the obtained result 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.

1.5. Request for Technical Assistance and/or Parts

Applications for the maintenance, repair, spare parts should be sent to the manufacturer or his closest representative.

Address of the manufacturer:

Elvatech Ltd. 50 Mashinobudivna str., Kiev, Ukraine
Tel: +38-044-599-1143,
E-mail: office@elvatech.com.

Representatives of Elvatech are stated at www.elvatech.com.

2. Technical Data
2.1. General Description

Detectable elements range	From Cl (Z=17) 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	244 mm x 236 mm x 84 mm
Weight (with battery)	1230 g (1440 g)
Operation conditions:	
- ambient temperature	from -10°C to +50°C
- relative humidity	up to 80% at 25°C
- atmospheric pressure	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 Adaptor

External Charger

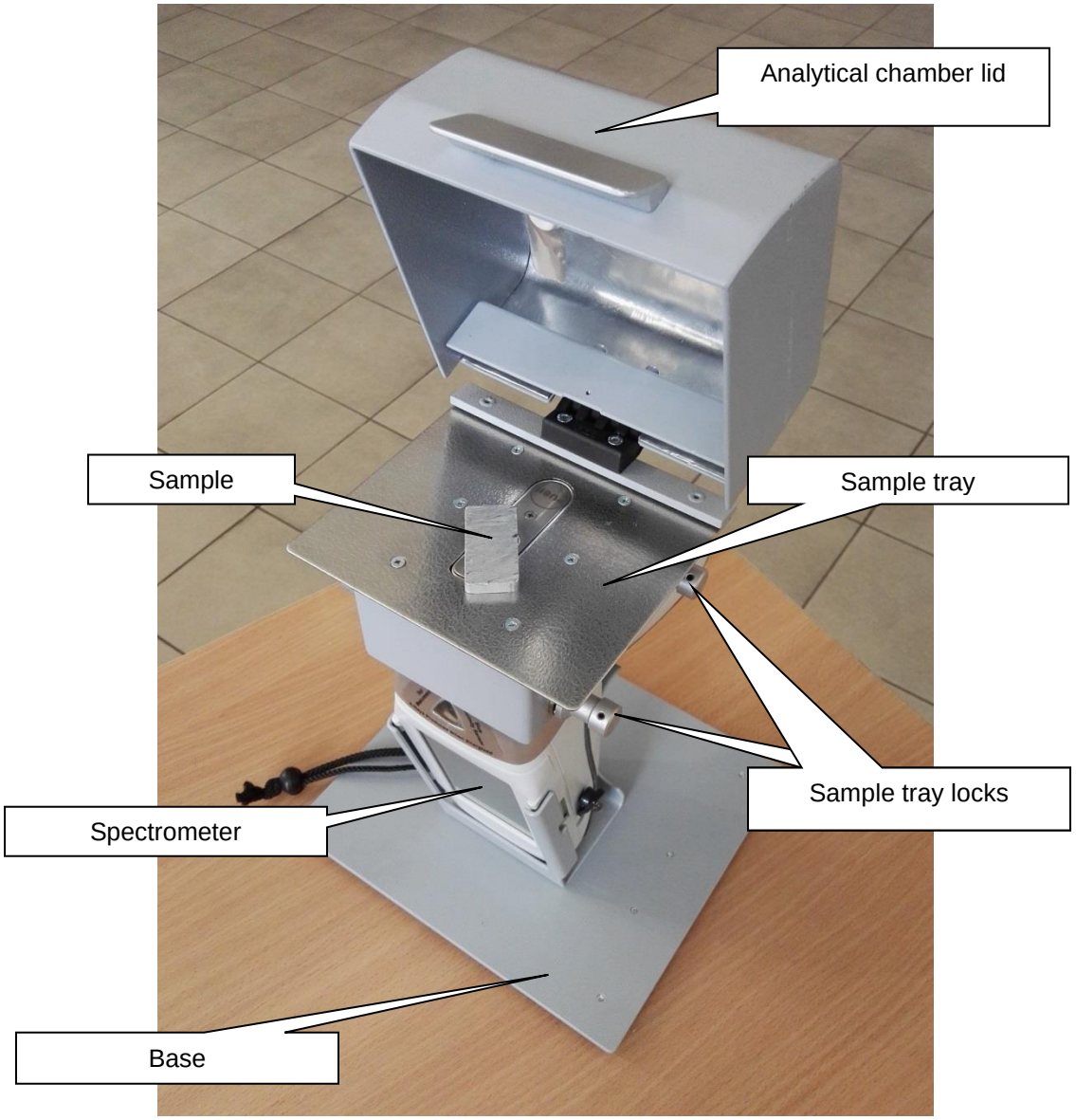
MicroSD card (with adapter)

2 Batteries

Control sample

Cartridges with protective film (20 pieces)

A laboratory stand can be ordered additionally for tabletop operation.



Laboratory stand (assembled)

2.3. Specifications

X-ray tube	
	W anode, 40 κV max (option 50 κV max), 100 мA max. Option: Rh or Ag anode for light element analysis Option: 5-position filter changer
X-ray detector	
Detector type	Silicone PIN-diode with thermo-electrical cooling (optional SDD detector)
Active Area	6 mm2 (optional 25 mm2)
Resolution	<165 eV at 5.9 keV (<140 eV for SDD)
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	4.3-inch color touch-screen high resolution 272*480 pixels.
Software	
Operating systems	Microsoft Windows Embedded 7
Quantitative analysis algorithm's	Fundamental parameters method and empirical calibrations

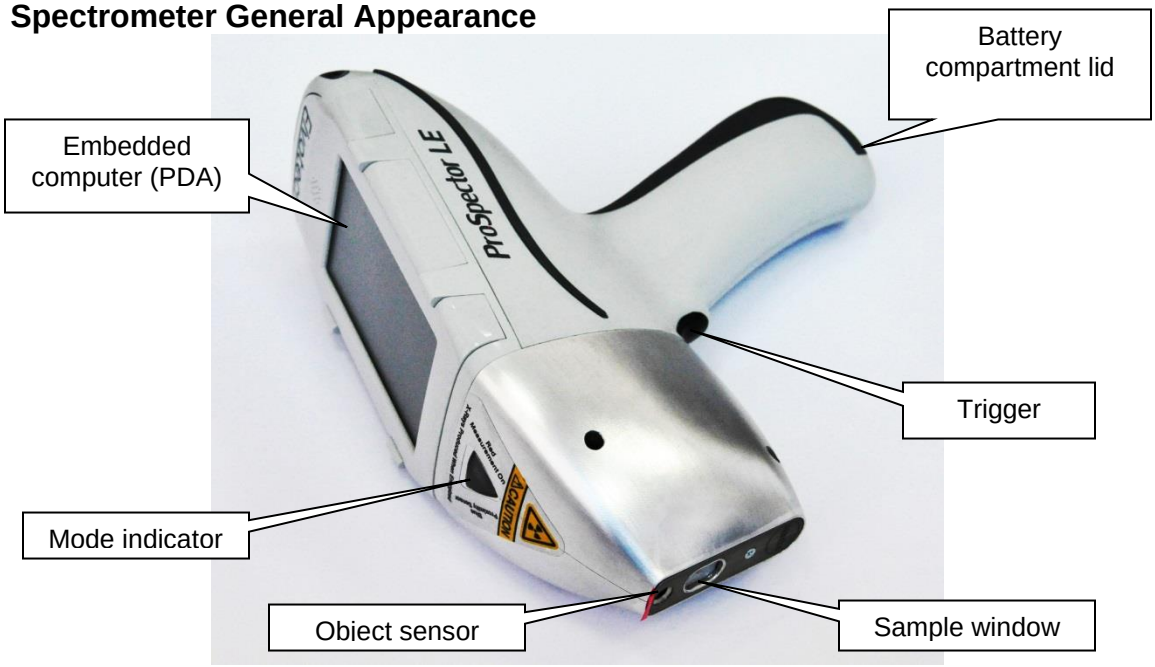
2.4. Technical Standards of Reference

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

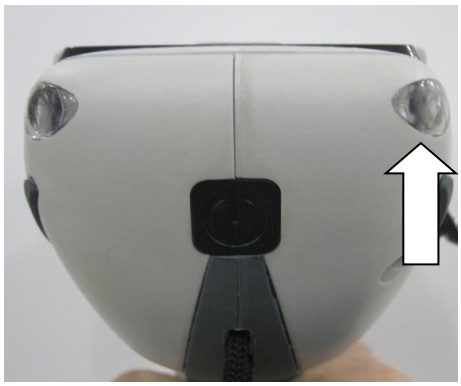
3.1. Introduction

3.1.1. Spectrometer General Appearance



3.1.2. Indicating Lights

On the rear right side of the spectrometer 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.



The presence of an object before the sample window (blue color) and the inclusion of the X-ray generator (red color) is indicated by the mode indicator on the nose of the spectrometer.
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 (hereinafter referred – **PDA**) 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 272x480, 16-bit color;
• "internal disk" – flash memory in which the operating system, installed programs and data are stored, a slot for an external MicroSD-card.
• internal additional battery.
• support for Bluetooth.

3.1.4. Software Components

ElvaX ProSpector software comprises:

• Software in the narrow sense - the main application ElvaXCe with resource libraries in different languages. Installed in \ ProgramFiles \ ElvaXProSpector.
• Driver FTDI, providing access to the spectrometer via a virtual serial port. Installed in the \ Windows. The original company FTDI driver has been modified according to the manufacturer's instructions so that spectrometer appears in the system as EVTx: (EVT0-EVT9) not as a COMx:, as EVTx: (EVT0-EVT9). This speeds up the automatic search of the port, which is connected to the spectrometer.
• Dataset is the list of analytical tasks (measurement modes), supplied with a specific spectrometer, as well as their data and settings. In particular, the parameters of the X-ray mode, duration of measurement, list of measured elements and their concentration ratios, regression coefficients, the database of X-ray fundamental parameters, alloy grades library, etc. It represents a directory tree with the binary database files and text (UTF- 16) configuration files. Installed by default in the folder \ ApplicationData \ Elvatech \ ElvaXCe \ Pxxx, where Pxxx is the serial number. You can specify a different location (see "Load Data

Program "). Thus, one embedded computer can have multiple datasets for different spectrometers. The software works with only one Dataset and allows you to select a working dataset available.
Such separation - a program / driver / dataset - makes it possible to update the program or driver that does not affect datasets. However, due to the significant changes made to the software on during assembly, datasets are updated as well.

3.1.5. Derived Data

While the program is working some data is generated and saved:

• If measurements saving is enabled, conducted measurements are stored on the memory card - to the internal flash memory by default or to the external MicroSD-card - as a SQLite3 database in subfolders \ ElvaXCeData \ Modes \ xxx, where xxx is the name of the measuring mode. Number of storable results is set in the settings.
• When you export a single measurement in the form of HTML- report, it is protected in the folder \ My Documents \ ElvaX ProSpector \ Printouts
• When you export the log measurements as a CSV-file, it is saved in the folder \ My Documents \ ElvaX ProSpector \ Logs
• When exporting spectra measurements they are stored on the external MicroSD-card to folder TempExport
• Before importing the spectra should be placed on the external MicroSD-card to a folder TempImport

Important! Neither measurements, nor logs, nor reports are affected when you reinstall the software. Measurements, even if they are stored in the internal memory will not be erased even when the Reset of the PDA is performed.

3.2. Rules of Use

3.2.1. Installation and launching the software

3.2.1.1. Software installation

ElvaX ProSpector 2 spectrometers are supplied with a completely installed software, so simply turn on the device and enjoy it.

3.2.1.2. Software Re-Installation

To reinstall the software, simply insert the installation MicroSD-card into the PDA and go through the procedure again, giving answers to all questions by default. Any preliminary actions such as removing software are not required.

Do not use an installation card for any other purpose - storage of measurements, export reports and results etc.! Keep it in case recovery software!

3.2.1.3. Updating / upgrading Software

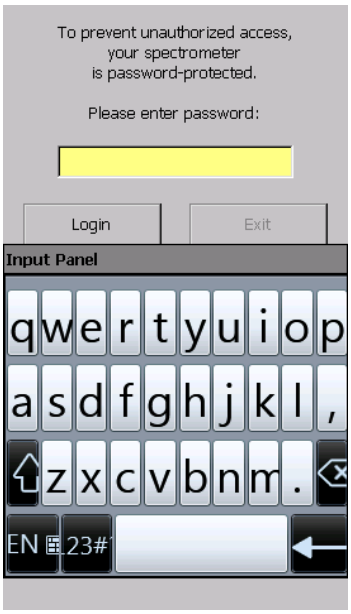
To update the program and /or the dataset for a specific device, for example, to fix a problem, add an analytical task, etc., it is necessary to prepare new software and form the content of the new installation card. These procedures are performed by the manufacturer.

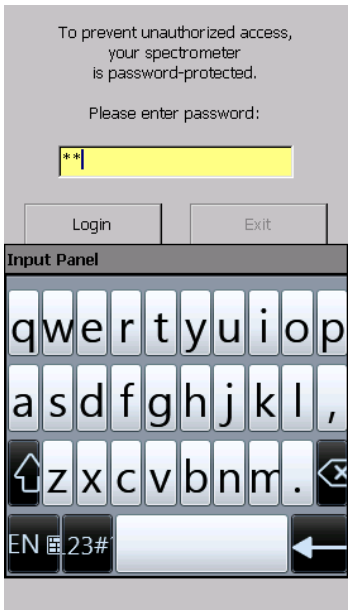
The content of the MicroSD-card is packed in a ZIP-archive uploaded on Elvatech site into downloads section. The link to the archive is sent to the customer. Customer should download the file, decompress it on an empty MicroSD-card, insert it into the PDA and perform the standard installation procedure. Now use this card as an installation card.

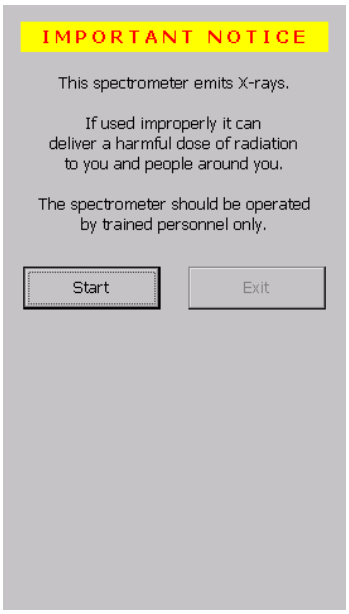
3.2.1.4. Running ElvaX ProSpector Software

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 (PDA sleep) – more than 30 minutes.

3.2.2. Use of ElvaXProSpector

3.2.2.1. Status icons

 Spectrometer was not detected

 Spectrometer detected, running on battery

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

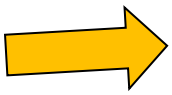
 Spectrometer detected, running on an external power supply, no battery

 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

3.2.2.2. Spectrometer Turning On

Press the power button. If battery power is sufficient, the device turns on with a beep. At the same time the PDA 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 (PDA sleep) - more than 30 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.

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

3.2.2.3. Spectrometer Turning Off

Press the power button. Spectrometer will turn off with a beep automatically turning off the PDA.

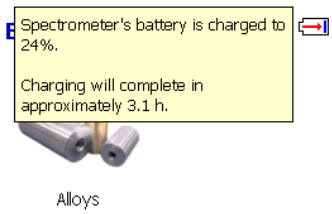
3.2.2.4. Main Window of ElvaX ProSpector Software

The program consists of a start (main) window in available measurement modes are displayed, and 2 status icons of the spectrometer and battery.

You can also make necessary settings using the monitors, obtain information about the configuration of the spectrometer and software versions - see section 3.2.4.

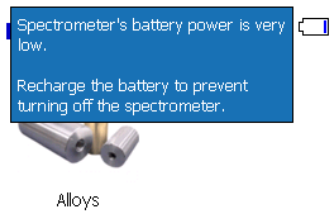
3.2.2.5. Battery Status

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, PDA battery starts charging as well. The red arrow on the battery icon means that the battery is charging. If the PDA battery is significantly discharged (charge ≤ 25%), the program starts charging the PDA battery from the spectrometer battery regardless of its charge.

If the spectrometer battery charge falls below 20%, you will get a warning:



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

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

3.2.2.6. Measuring Mode Window. Performing Measurements

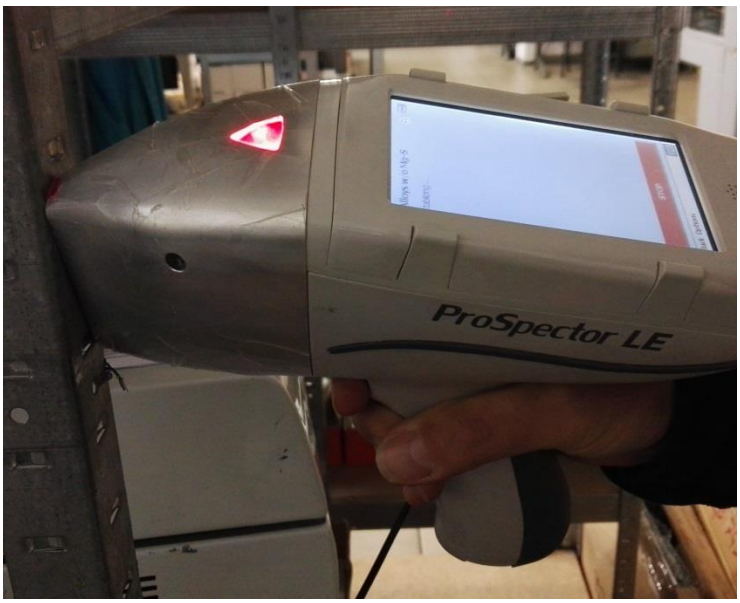
When you click on a measuring mode icon in the main window the window of a measuring mode is opened with the introductory text.

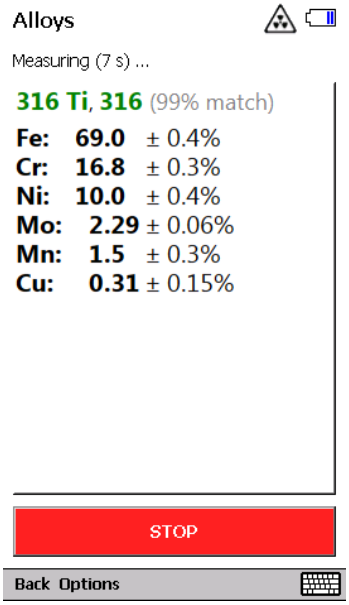
For safe operation follow the instructions on the screen!

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 PDA screen the spectrometer will start measuring.



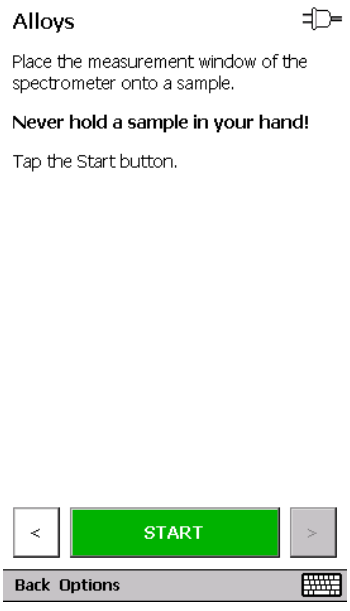


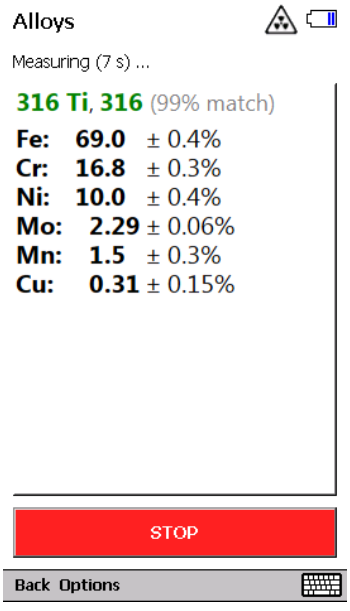
The operation mode indicator changes to red when the X-ray generator is running. The red indicator on the spectrometer snout signals running of the x-ray generator as well. In the program the sign below signals that the x-ray generator is on.

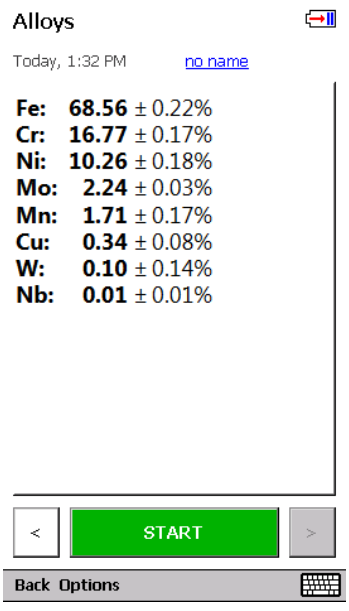
Metal alloys analysis typically requires from 2 to 20 seconds (depending on the required accuracy). Analysis of soil and plastic samples requires at least 60 second. The progress is shown on the PDA screen.

Intermediate results are shown during measurement. The final result is shown after a preset time period, or on pressing the **STOP** button, or when releasing the trigger.

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





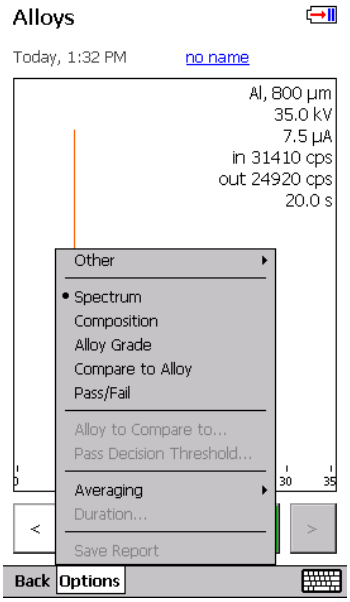


3.2.2.7. Viewing Previous Measurements

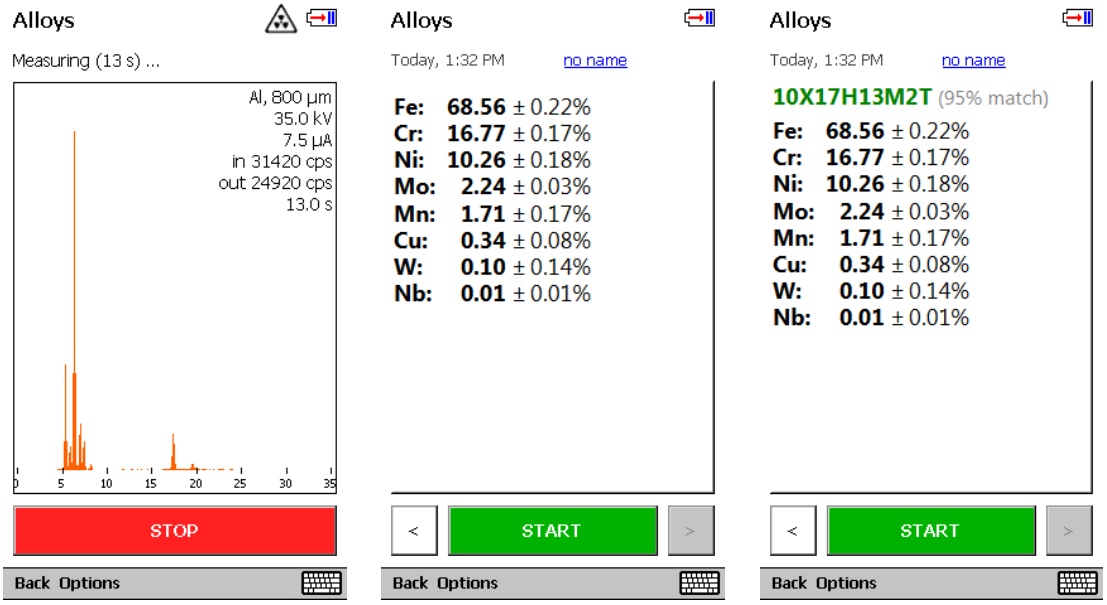
To view previously completed measurements, you need to press < button.

3.2.2.8. Measurement Results Display

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



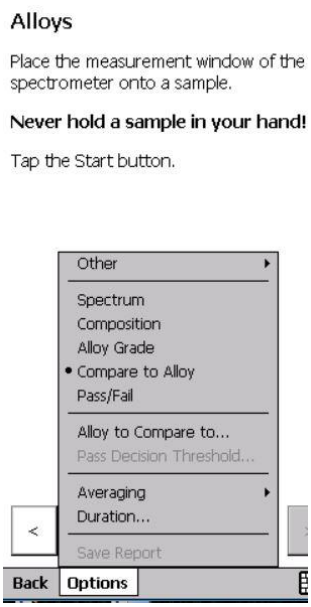
Spectrum - Graphical representation of the spectral lines of the sample;
Composition - A list of found elements in the sample and their concentrations;
Alloy grade - According to the list of detected elements and their concentrations the closest grade and match percentage is determined.



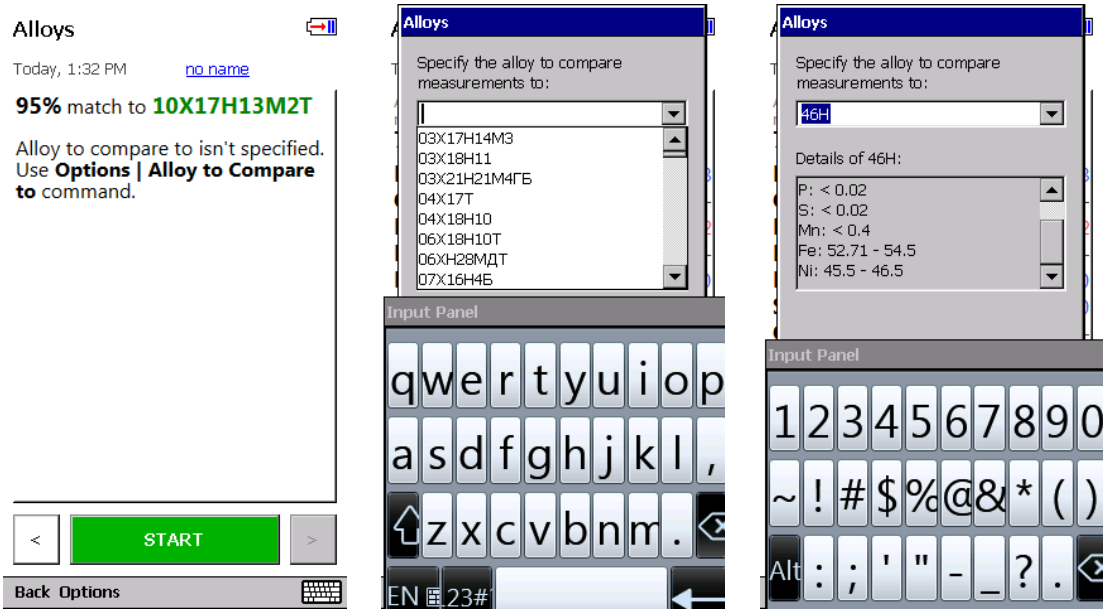
3.2.2.9. Compare to Alloy

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**.



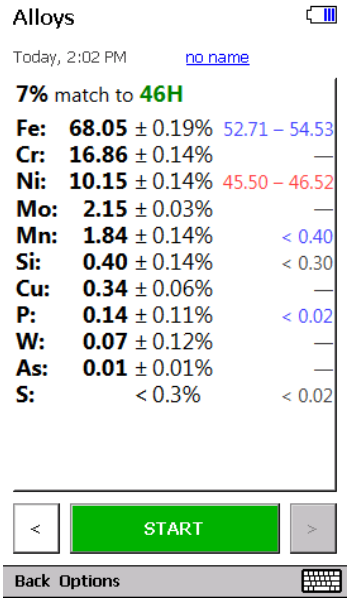
To select an alloy for comparison in the measuring window press **Options - Alloy to Compare to**. Select the required alloy from the list. For a quick search, you can type on the keyboard the name of the alloy.



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

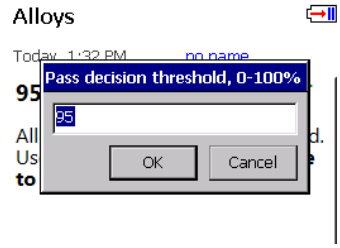


3.2.2.10. Sorting

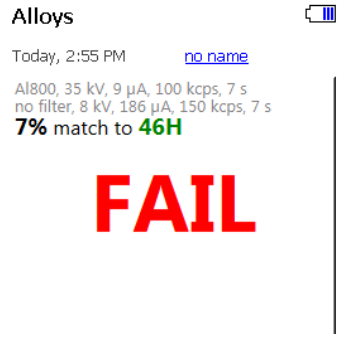
The program allows to perform sorting determining if composition of a test object matches an alloy selected for comparison.

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**.

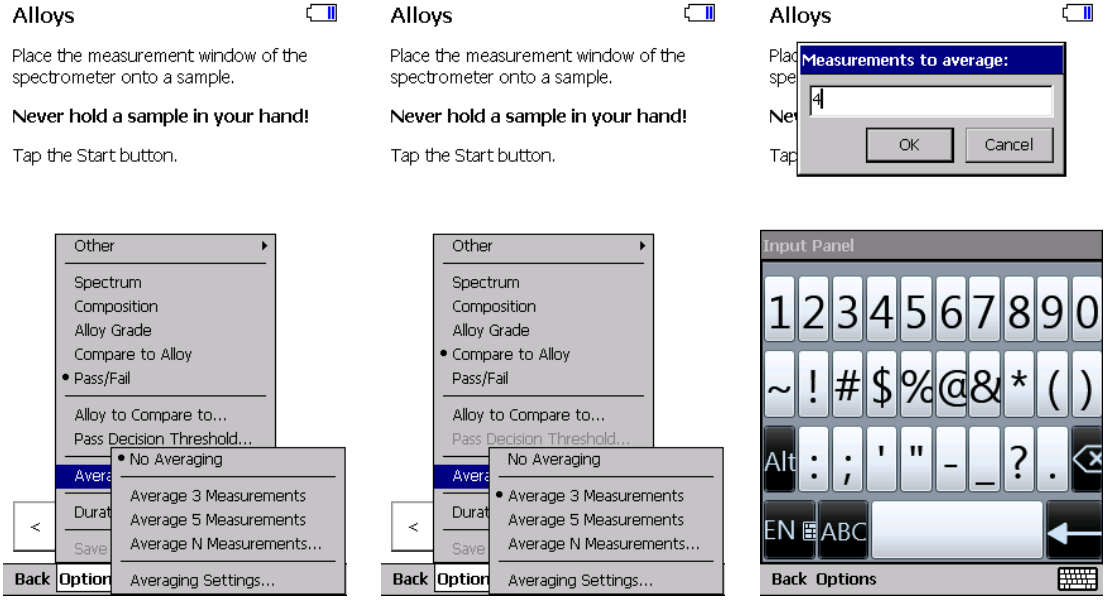


Now the analysis of the measurement displays the name of an alloy selected for comparison, the match % of the sample composition to an alloy and the result of alloy matching - PASS or FAIL.



3.2.2.11. Averaging

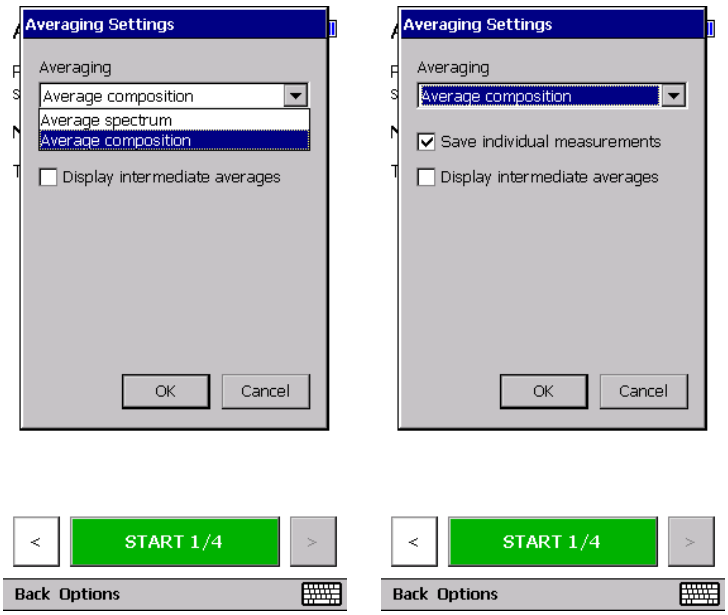
The program allows you to average over several measurements in order to enhance the final result. To activate this function in the measuring window press **Options - Averaging**.



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

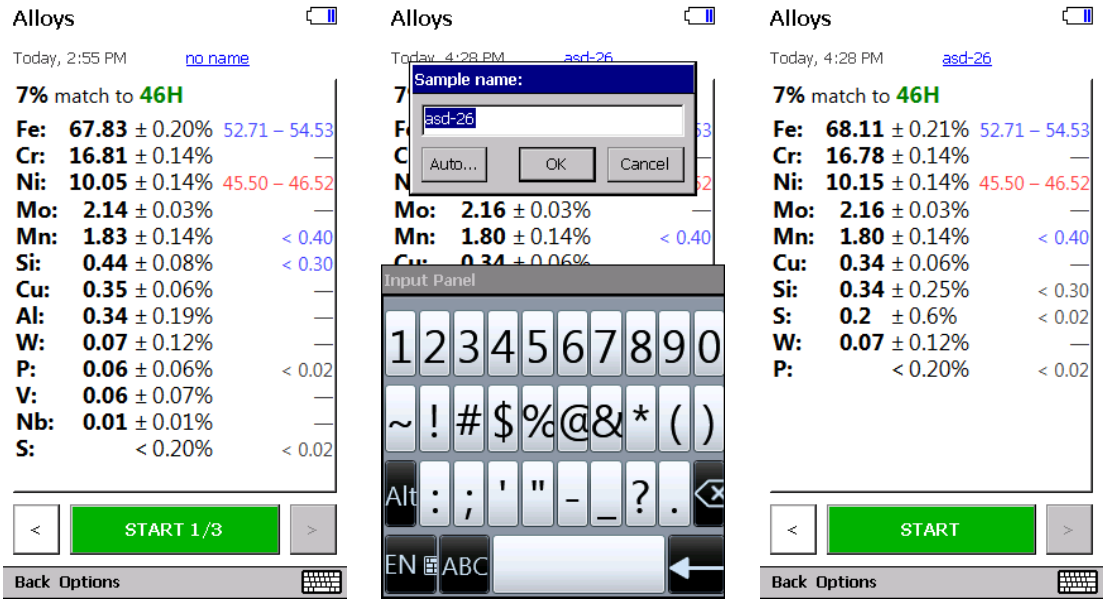
Also set the averaging mode - in the measuring window, click **Options - Averaging - Averaging Settings**. In the window that opens select - **Averaging composition or Averaging spectrum**. If necessary individual measurements can be saved and intermediate averages can be displayed. To activate these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

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

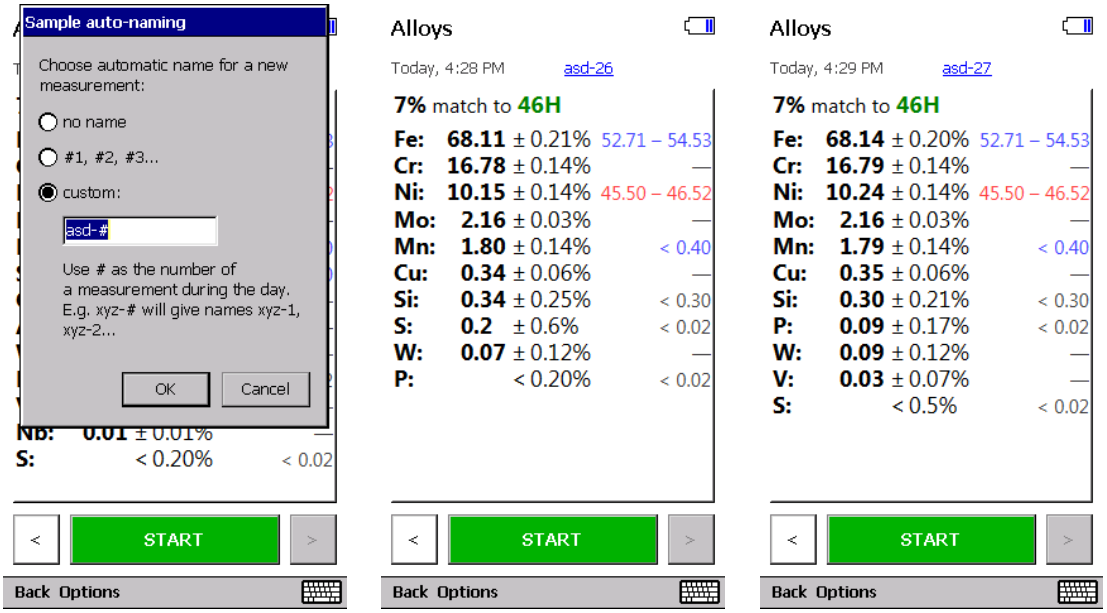


3.2.2.12. Naming measurement results

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-26, asd-27 etc., click on the button **Auto…,** choose style naming and then confirm with **OK**.



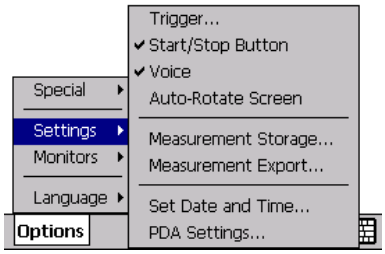
You can "browse" stored measurements using < and >.

After measuring close the current task to return to the main window (press **Back** button).

3.2.3. Advanced features

3.2.3.1. Settings in Main window

In the main window you can:



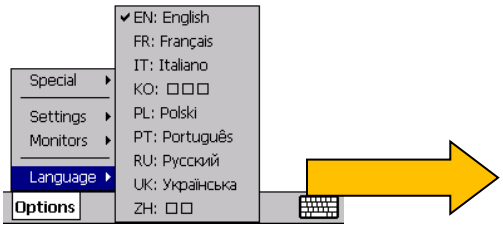
- Use of special procedures;
- Select trigger mode;
- Show / hide button START and scroll buttons
- Enable / disable voice messages;
- Enable / disable Auto-Rotate Screen PDA;
- Configure measurement results saving and export;
- Set Date and Time;
- Check / Adjust PDA Settings – Control Panel;
- Check the settings of the spectrometer using the monitors, obtain information about the configuration and version of the spectrometer;
- Choose the language of the program;

Use of special procedures

You can at any time perform (if necessary) to reconnect to the spectrometer or restart PDA. Click

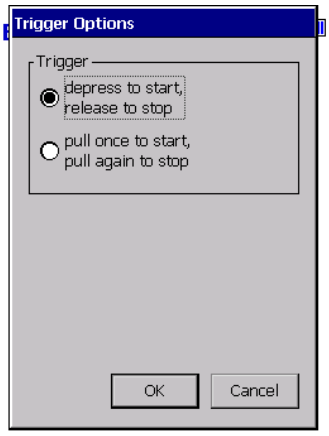
Select interface language of the program

You can choose the interface language that is most convenient for you. Click **Options - Language**. Tick the desired language.



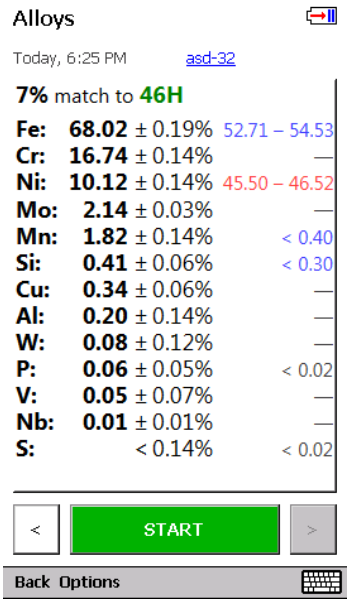
Selecting the trigger operating mode

Tap **Options - Settings -Trigger**. In the dialog box, select the preferred trigger mode. After selecting close the dialog box to return to the main window (tap **ok**)

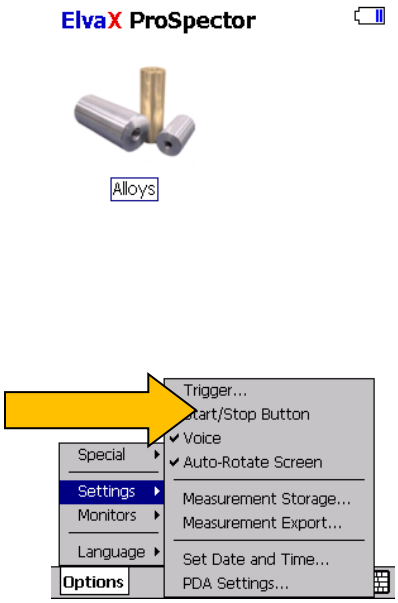


The button " Start / Stop " - enlarging the screen of the analytical mode

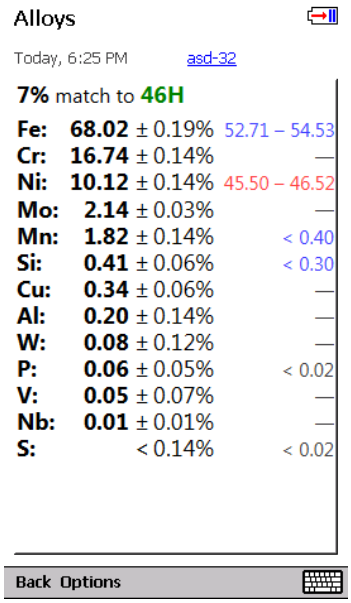
Normally there are START and STOP buttons at the bottom of the measuring screen. If necessary (e.g. a list of detected elements is too long), these buttons can be hidden. At the same time will also be hidden scroll buttons < and > - i.e. all the lower buttons. To do this press **Options - Settings - Start/ Stop Button** in the main window:



Buttons enables

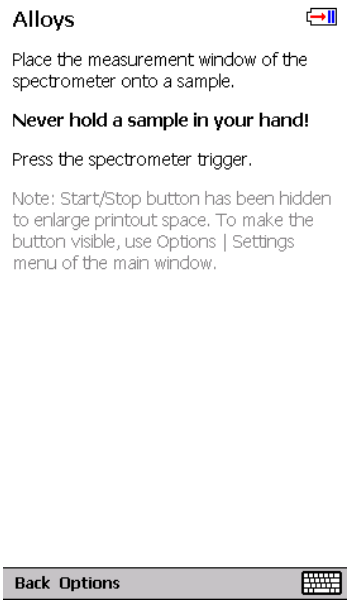


Enable/disable option



Buttons disabled

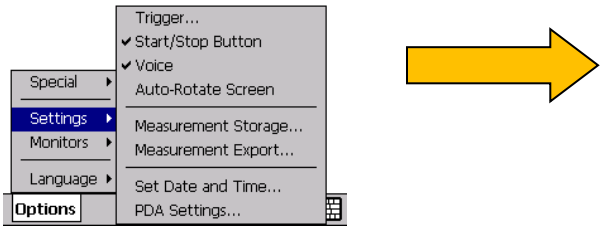
Note 1. A welcome note is added explaining that the Start/Stop button is disabled:



Note 2. Even if the lower buttons are hidden, scroll through the results is not available. To view a long list of elements it is possible to use the option **Zoom** – see 3.2.3.3.

Enabling / disabling voice guidance

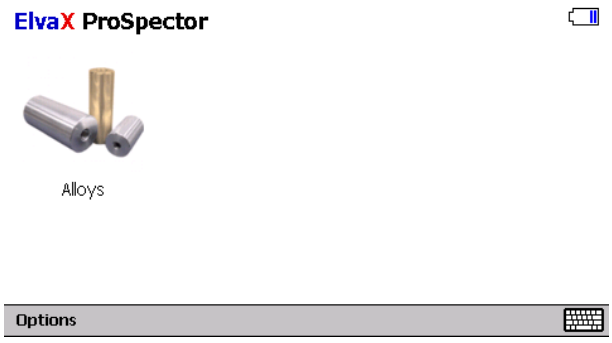
Tap on **Options - Settings**.
In the menu tick or untick **Voice**.



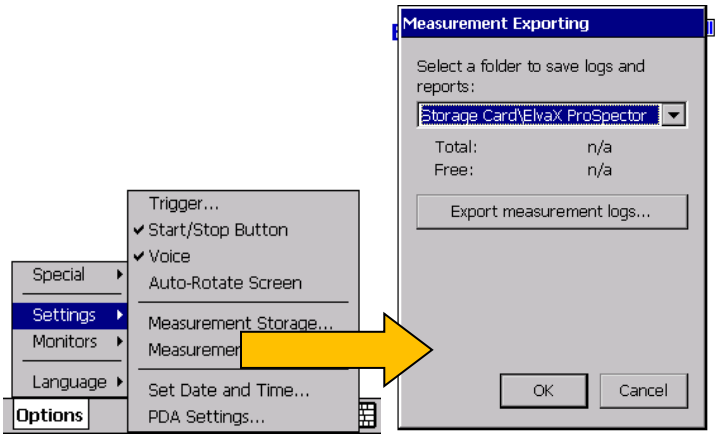
Enabling / disabling Auto-Rotate Screen PDA

.

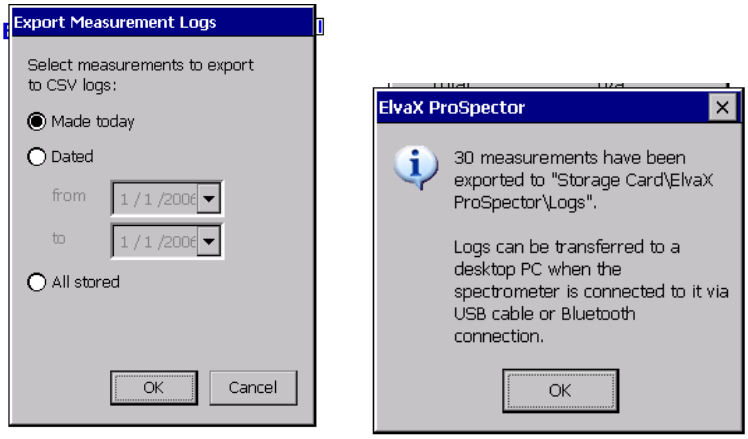
Tap on **Options - Settings**. In the menu tick or untick **Auto-Rotate Screen**. When the option **Auto-Rotate** image on the screen will always keep turn-by-turn spectrometer housing. To secure the desired position of the screen is necessary to give the screen the desired position, and then turn off the **Auto-Rotate** option.



To export measurement results into MS Excel log return to the main window of the program, insert Storage Card to PDA and click **Options - Settings - Measurement Export**. In the window that opens, click **Export measurement logs…**



In the next window, select the measurements you want to export: Made today, Dated or All stored and click **OK** to finish.



Measurements log will be saved to "\Storage Card\ElvaXProSpector\Logs\".

Reports and logs can be copied from Storage Card to the desktop computer.

Adjustment of parameters of measurement results saving

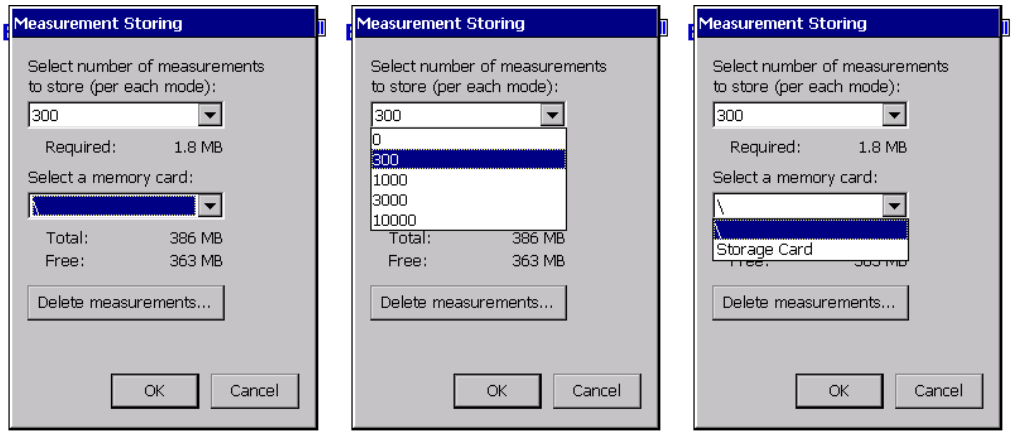
The program stores the measurement data. Up to 500 measurements can be stored. Newer measurements are automatically deleted. The PDA internal memory can be used as well as an Storage Card (MicroSD-card).

To save the settings, press sequentially:

Options – Settings - Measurement Storage. You can select the number of measurements to store. Select also a place to store the measurement results:

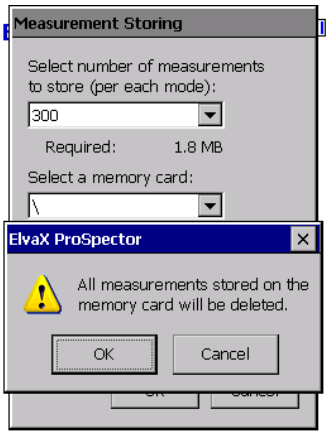
\ - internal PDA memory;

Storage Card - the external SD-card will be used (see the description of the PDA).



If you want to clear the memory and delete the previously stored measurement results press **Delete Measurements** and confirm.

When you're finished, close the dialog box to return to the main window (tap **OK** or **Cancel**).



Adjustment of parameters of measurement export

This option described in detail in 3.2.2.13.

3.2.3.2. Storing and exporting measurement results

Performed measurements, i.e., x-ray spectra of samples with the results of their analysis are **automatically** saved in databases that are stored on the internal flash memory of the spectrometer or an external flash drive. Each analytical task stores the measurement in a separate database. The number of stored measurements is specified in the settings of the spectrometer (see s. **Помилка! Джерело посилання не знайдено.**). When this number is exceeded, the oldest measurements are automatically removed.

In factory configuration spectrometer saves 300 recent measurements for each analytic task, and uses internal memory of the built-in computer for database storage. Optional flash drive is not required.

When 301st measurement is performed, the oldest measurement is deleted. All of the 300 recent measurements are **available for scrolling** with < and > buttons in the measurement mode.

If the settings (s. **Помилка! Джерело посилання не знайдено.**) specify to store more than 300 measurements per task (for example, 1,000) in order to prevent delays, two

databases in the measurement process are used – operating and *archive*. When 301st measurement is complete, the oldest measurement is not deleted but moved into the archive. When the total number of measurements in the analytical task exceeds 1,000, the oldest measurement is deleted from the archive. Last 300 measurements of the task are available for scrolling with < and > buttons. Measurements moved to archive are **not available for scrolling** in the measurement mode, but all the information about them can be exported into logs (s. ???).

3.2.3.3. Exporting measurement results to a Desktop computer

There are several options for exporting the measurements results performed with the ElvaX ProSpector 2 spectrometer. You may:

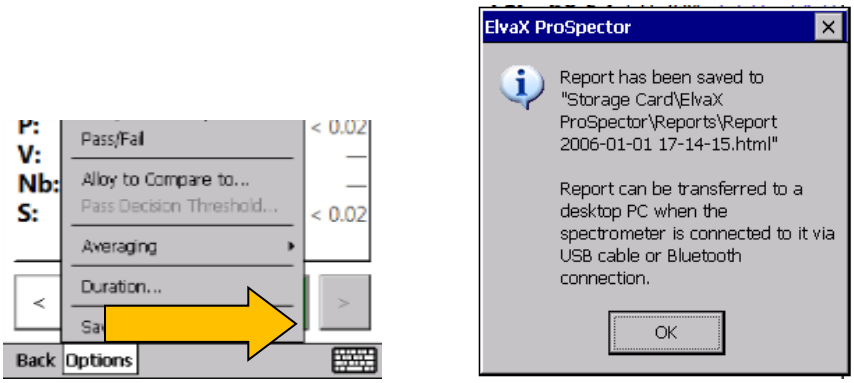
- Export a single measurement in the form of **an HTML file** which can be opened with any Internet browser on the desktop computer. Appearance of the HTML report is identical to the image on the screen of the PDA.
- Export a single measurement as **an RTF document**, which can be opened on the desktop computer with most text editors, such as Microsoft Word. Appearance of RTF report can be configured. The spectrometer is pre-installed with several predefined report templates. You can amend the existing or create a new one by inserting all the additional information which you wish to see in the reports – the company name, logo, address, etc. (see s. ???)
- Export a log of measurements made during a certain period of time, in the form of **CSV tables** that can be opened on the desktop computer with most spreadsheet applications, such as Microsoft Excel. The logs contain the date/times and the names of measurements, concentrations of the detected elements, as well as technical information about measurements (see s. ???)

By default, as a place for export, an external MicroSD card is used. That is, before exporting insert a MicroSD card from any manufacturer into connector (), and after exporting remove the drive and insert it into the desktop computer.

Please do not use the installation MicroSD card for this purpose since it can cause the loss of original calibration data of the spectrometer stored on the setup drive and can lead to accidental reinstallation of the software and data.

Exporting a report of a single measurement as an HTML file

To export the report on the measurement displayed on the screen insert empty MicroSD card to PDA and click **Options - Save Report**.



The report will be saved to "\Storage Card\ElvaXProSpector\Reports\".

Exporting a report of a single measurement as an RTF document

To have reports in user's style and with user's additional information, RTF templates technology is provided.

The report template is a text document formatted in accordance with the user's needs and containing *placeholders* – special words surrounded by percent characters (such as %date%,%conc%, etc.). Placeholders are replaced by actual values when the report of a measurement is being saved. For instance, the following template (fig. 1)

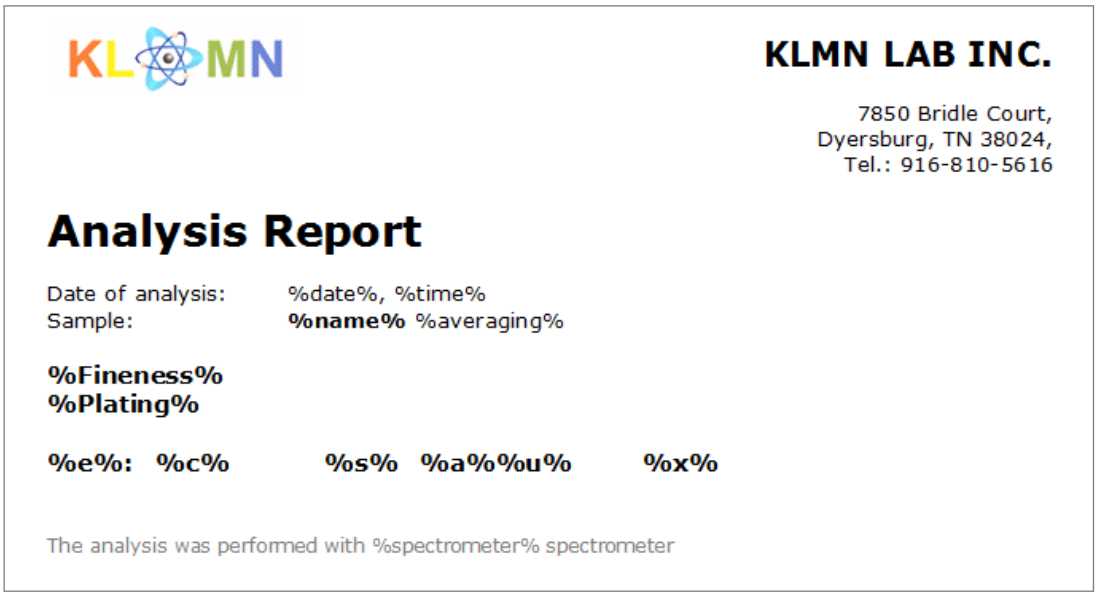


Fig. 1. Example of a report template with place-holders.

Will produce the following report: (fig. 2):

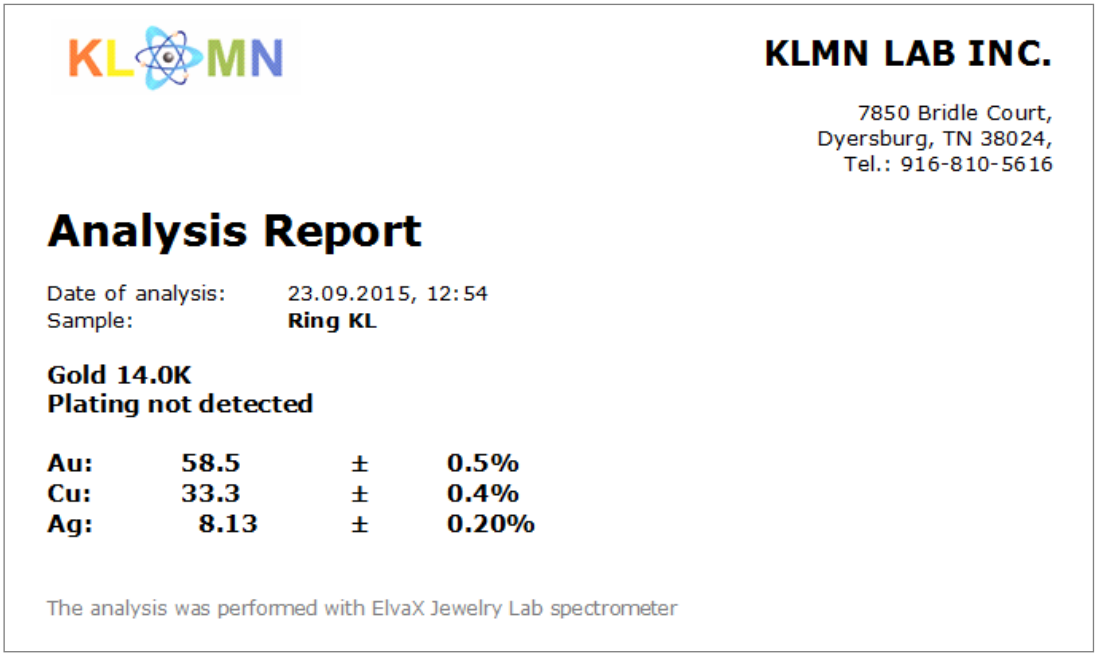


Fig. 2. Example of a report with actual values instead of place-holders.

There are several predefined report templates pre-installed in the spectrometer. To see the available templates and choose the template to be used in the analytical task, tap **Options | Other | Report Format** in the measuring mode (fig. 3).

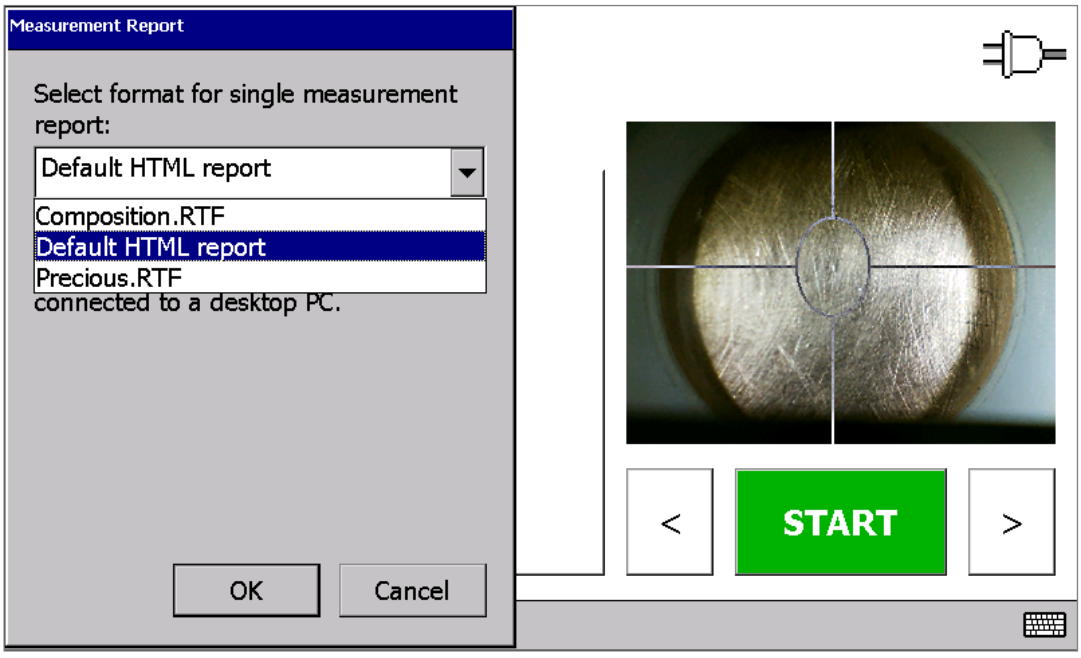


Fig. 3. Selection of the report format.

Recommended Procedure for Creating Your Own Report Template

To customize a report template for an ElvaX ProSpector spectrometer with embedded PDA, please follow these instructions:

1) Switch the spectrometer software to the service mode (double-tap the ElvaX logo in the title of the software's main window. A login dialog will appear. Enter the service mode password **xrf** and tap the Login button).
2) Insert an empty micro-SD card into the spectrometer.
3) In the main window's menu, tap *Options* | *Special* | *Backup Settings to Card*. Wait until settings are copied and the software window appear again.
4) Take the mini-SD card out of the spectrometer and insert it into mini-SD slot of the desktop PC (if your computer doesn't have a mini-SD slot, you will need an external card reader).
5) Open the *<mini-SD card>: \Setup\Data\Pxxx\CustomReports* folder.
6) In the *CustomReports* folder, choose the template you want to customize and make copy of it with a distinctive name, e.g. *My Report.rtf.*
7) Open *My Report.rtf* and edit it according to your needs, e.g., put your logo image, address, footer information, styling etc. or remove placeholders (*%xxx%*) for data you don't want to be in reports.

Important note on images: Some RTF editors (e.g., Microsoft Word or Windows Wordpad) puts images to RTF documents in uncompressed text-coded form, and thus even a 20 KB JPG image which is decoded to a 1MB bitmap will enormously inflate the resulting template. Here are the tips to keep templates small in size:

- Make images reasonably small in dimensions. 200 x 150 px is quite enough for most logos.
- Use 256-color PNGs instead of true-color JPGs or BMPs.

8) When all editing is done, save *My Report.rtf*.
9) Safely remove the mini-SD card from the desktop PC and insert it into the spectrometer.
10) In the main window's menu of the spectrometer software, tap *Options* | *Special* | *Restore Settings from Card*. Wait until restoring is completed and the software window appear again.
11) In the menu of the analytical mode, tap *Options* | *Other* | *Report Format* and choose *My Report.rtf* in the list.
12) Test the template by saving a report for any measurement. By default, reports are saved to the ElvaX ProSpector folder on the mini-SD card. If anything should be changed, repeat steps 7-11.
13) Switch the spectrometer software back to the user mode (double-tap the ElvaX logo in the title of the software's main window. A login dialog will appear. Enter the user mode password **ex** and tap the Login button).

Exporting logs of measurements as CSV tables

To export a log with information about a series of measurements made within a certain period of time, exit the measurement mode into the main window by tapping the **Menu** touch arrow button in the upper-left corner of the screen. In the main window, tap **Options** | **Adjustment** | **Measurement Exporting** (fig. 4).

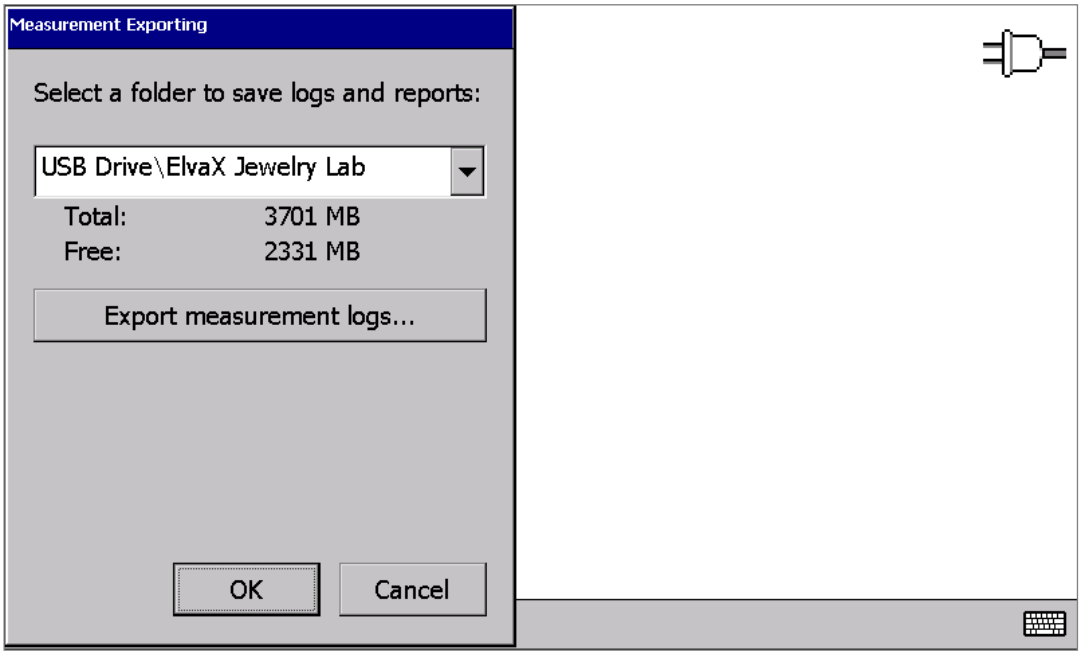


Fig. 4. Parameters of measurement export.

In the opened window, specify a folder to be used for logs and reports. So, to continue export, insert SD-card to device and then tap the **Export measurement logs.** button. In the new opened window (fig. 5), specify what measurements are to be exported – made today, dated within a range, or all stored – and tap the OK button.

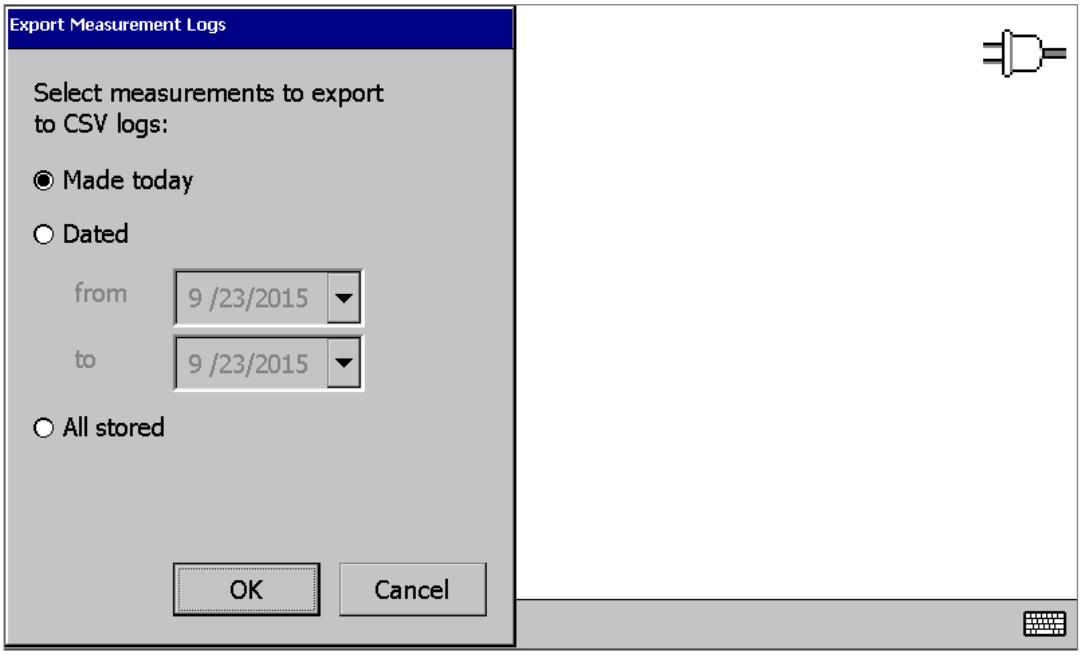


Fig. 5. Parameters of log export.

The software will search all databases, including archives, for measurements that meet the chosen date condition, and will export information on them as CSV logs. A separate log will be created for each analytical task. When the flash drive is inserted into the desktop computer, these logs can be opened by most spreadsheet applications, such as Microsoft Excel (fig. 6).

	A	B	C	D	E	F	G	H	I	J	K	L
1	Date	Time	Reading	Averaging	Name	Filter1	Voltage1	Current1	RealTime1	InCPS1	OutCPS1	Filter2
2	6/18/2015	17:44	1		Evt-Al-SUS	2	35	102.7	1.29	328192	242322	
3	6/18/2015	17:47	2		Evt-Si	2	35	114.3	1.28	190312	154981	
4	6/18/2015	17:48	3		Evt-Cu-174	2	35	10.3	1.36	397626	313822	
5	6/18/2015	17:49	4		Evt-Cu-175	2	35	10.3	1.28	419656	332842	
6	6/18/2015	17:50	5		Evt-Cu-128	2	35	10.5	1.28	398987	316190	
7	6/18/2015	18:04	6		Evt-Cu-128	2	35	11	1.28	394966	313377	
8	6/18/2015	18:06	7		Evt-Cu-391	2	35	9.2	1.28	412288	323756	
9	6/18/2015	18:11	8		Drz-Al-186	2	35	96.9	1.28	328671	246182	
10	6/18/2015	18:14	9		Drz-Al-185	2	35	97	1.35	326575	244568	
11	6/18/2015	18:15	10		Drz-Al-184	2	35	94.3	1.28	329223	248009	
12	6/18/2015	18:17	11		Drz-Al-183	2	35	98.5	1.38	326992	244416	
13	6/18/2015	18:19	12		Drz-Al-182	2	35	92.9	1.36	331127	248833	
14	6/18/2015	18:23	13		Drz-Al-181	2	35	98.7	1.35	329357	246102	
15	6/18/2015	18:27	14		Drz-Al-205	2	35	57.8	1.28	359555	280030	

Fig. 6. Example of CSV log

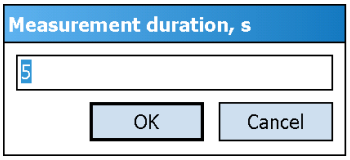
The log displays the date/times and the names of measurements, concentrations of the detected elements, as well as technical information on measurements. List of the exported columns is fixed. You can delete unneeded columns and format the table according to your liking in Microsoft Excel. Do not forget to save the edited table as an XLS file since CSV format does not support formatting.

In the settings window (fig. 4), you can specify a different folder for the export of logs and reports, for example, to work without additional SD-card.

3.2.3.4. Settings in Mode windows

Measurement time

The measurement time for each measurement mode is preset at the factory. To change it, tap the **Options - Measurement time**. Enter the required value and click **OK**.



3.3. General Safety

- 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.

Example of incorrect use

3.4. 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.

3.5. Residual risks and hazards present

Risk and hazards related to the use of ElvaX ProSpector are described in **General Safety** - see 3.3. Safety precautions described in this manual must be observed at all times.

3.6. 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.

3.7. Maintenance Instructions

3.7.1. Replacement of the protective film

In the main window of the spectrometer there's a film cartridge protecting the detector and X-ray generator preventing dust and moisture from getting inside as well as from a mechanical damage. In the course of operation, it is necessary to constantly monitor the integrity of the protective film. At the slightest damage immediately replace the cartridge with a damaged protective film with a new one, supplied with the spectrometer. To replace the cartridge with a protective film perform the following steps:

- Turn off the power of the spectrometer.
- Press your finger on the lower part of the front pad with the word PUSH on the snout of the spectrometer - the top of pad will be lifted, releasing the cartridge.

- Carefully remove the old cartridge. If the film is torn, remove all of its residues.

Exercise extreme caution - the entrance window of the detector is close, whose damage cannot be repaired and entails detector replacement (if the detector is damaged spectrometer guarantee does not apply)!

- Keeping the front pad pressed, gently insert the new cartridge with the protective film to match the windows on the cartridge with the windows on the nose pad.
- Release the pad.

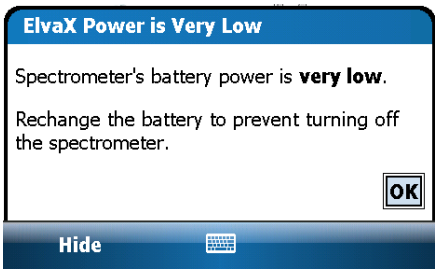
3.7.2. Battery

The battery is positioned inside the spectrometer handle. A fully charged battery provides continuous operation of the instrument during at least 8 hours. The PDA has its own battery, which can be charged from the spectrometer battery.

When battery replacement is necessary turn off the spectrometer, press the lid on the handle, slide it back and remove the battery.

On the left side of the spectrometer case there's a battery charge indicator. If the indicator blinks in red color, it means that battery charge is low (less than 15%). When battery charge is less than 5% the spectrometer is turned off automatically. When the adaptor is connected to the spectrometer the indicator becomes green. When the battery is being charged the indicator is blue.

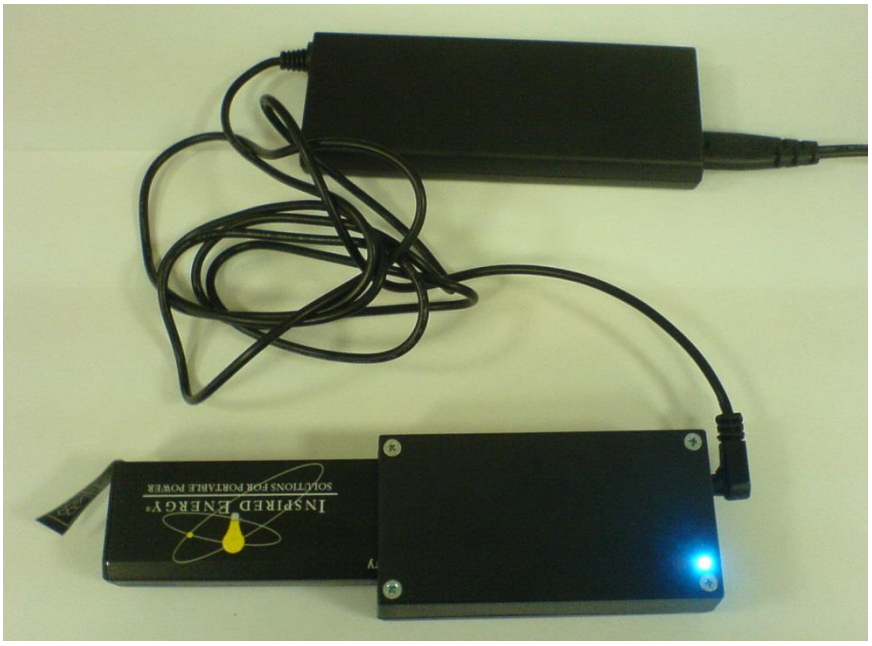
Battery charge level is indicated in the upper right corner of the ***ElvaX ProSpector*** software. When battery charge level is low a warning message pops up.



The spectrometer can be turned on and operated when the adapter is connected even when the battery is low or removed.

Method A. Take out the battery. There is a charge indicator on the side face of the battery. Press and hold the button in order to check the battery charge. If one LED lights, you should charge the battery before measurements.

Connect the AC adapter to the charger. The blue indicator demonstrates good condition of the charger and availability of power supply. Put the battery into the charger. The red indicator demonstrates the charging process. When the battery is fully charged, the red indicator goes down.



Method B. You should not remove the battery from the spectrometer, just connect it to the AC adapter through the connector situated on the right side of the device.

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

4. Disposal

After completion of the service life of the spectrometer it should be returned to the manufacturer for disposal of the x-ray generator.

Appendix A

Perform the following steps to edit alloy data base:

Editing Alloy Database of ElvaX ProSpector Embedded

To edit the alloy database of an ElvaX ProSpector spectrometer with embedded PDA, please follow these instructions:

1) Switch the spectrometer software to the service mode (double-tap the ElvaX logo in the title of the software's main window. A login dialog will appear. Enter the service mode password **xrf** and tap the Login button).

2) Insert an empty micro-SD card into the spectrometer.

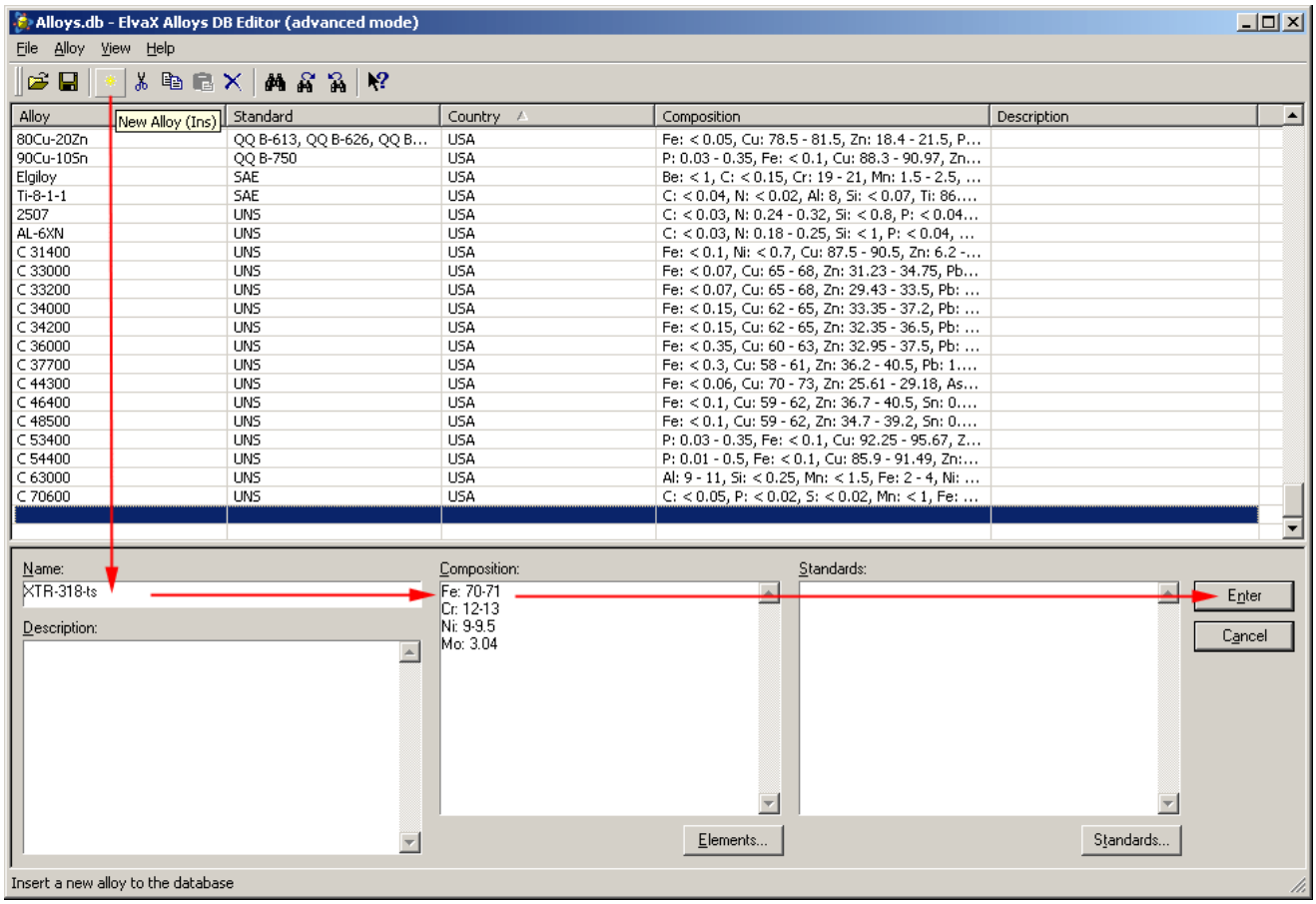
3) In the main window's menu, tap *Options* | *Special* | *Backup Settings to Card*. Wait until settings are copied and the software window appear again.

4) Take the mini-SD card out of the spectrometer and insert it into mini-SD slot of the desktop PC (if your computer doesn't have a mini-SD slot, you will need an external card reader).

5) Download the ElvaX Alloys DB Editor:
http://elvatech.com/downloads/ElvaX_Alloys_DB_Editor_1.0.0.45.zip
The software doesn't require installation. Just unzip all the files to a separate folder on your desktop PC, for instance, on your PC's desktop.

6) Run the ElvaX Alloys DB Editor (ADE.exe) and open *Alloys.db* from the mini-SD card. The file is located in the *<mini-SD card>:\Setup\Data\Pxxx\Alloys* folder.

7) Using the ADE you can add, delete, and edit alloys. For instance, to add an alloy, click the *New Alloy* button, then enter alloy name and composition and then click the *Enter* button.



Important note: When entering composition of an alloy, it is crucial to specify the concentration of the matrix element (Fe for steels, Cu for brasses and bronzes and so on). It is necessary for proper alloy grade recognition. Please also note that entering all the elements (even undetectable ones like C) is also preferable.
Concentration of the matrix element can be calculated:

- when concentration of other elements are given as ranges *min* - *max*: **min concentration** for matrix element = 100 – **sum of max concentrations** for other elements
  max concentration for matrix element = 100 – **sum of min concentrations** for other elements
- when concentration of other elements are given as exact values: **concentration** for matrix element = 100 – **sum of concentrations** for other elements

Note: The spectrometer software normally operates when number of alloys is less than 500. You can check the number using the *File* | *DB Properties* command.
8) When all editing is done, click the *Save* button and close the ADE.
9) Safely remove the mini-SD card from the desktop PC and insert it into the spectrometer.
10) In the main window's menu of the spectrometer software, tap *Options* | *Special* | *Restore Settings from Card*. Wait until restoring is completed and the software window appear again.
11) Switch the spectrometer software back to the user mode (double-tap the ElvaX logo in the title of the software's main window. A login dialog will appear. Enter the user mode password **ex** and tap the Login button).