

EKOMILK®

Spectra

Infrared-Ultrasonic Hybrid Milk Analyzer



USER'S GUIDE

Version 4.1

Revision: 03.01.2023



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1 General information

Ekomilk Spectra is designed for fast and cost effective control of milk quality - detecting adulterants (ammonium sulfate, urea, etc.) and milk parameters (Fat, Solids Not Fat, etc.). The mid-infrared spectral module allows for detection of adulterants and their concentration without the use of chemicals and the well established ultrasonic module measured the milk parameters. **Ekomilk Spectra** hybrid milk analyzer, uses two analytical methods, combined in the convenience of one simple instrument - infrared spectroscopy in the mid-infrared region, and ultrasonic measurement.

Mid-infrared spectral analysis

Different species in a sample have unique absorption patterns of the infrared light. Based on those patterns and how pronounced they are, the species (in our case adulterants) and their concentrations can be identified.

Ultrasonic measurement

Ultrasonic material analysis is based on a simple principle of physics: the motion of any wave will be affected by the medium through which it travels. Thus, changes in one or more of four easily measurable parameters associated with the passage of a high frequency sound wave through a material - transit time, attenuation, scattering and frequency content - can be correlated with parameters in milk.

Why not using only infrared technology for measurement of all parameters?

The short and simple answer is that this will increase the cost for the user 5-15 times without adding real value for the purpose of the device.

The longer answer is that, to measure all parameters of interest, a much larger portion of the spectrum needs to be measured and analyzed. However in order to do that either much more sophisticated mechanics and optics or more sensors are necessary. This will drastically increase the price and also make the device less suitable for a field instrument.

Application Area:

- Dairy farms
- Milk collecting points
- Dairy industry
- Veterinary and dairy laboratories

Key feature:

- Fast adulterant detection
- Simple and lightweight design
- Cost effective
- No acids or other chemicals used
- Data collection system
- Embedded Real time clock
- RS 232 and/or USB Interface
- USB port with Flash Drive and Numeric keyboard support
- LAN connection

Environmental conditions:

Ambient air temperature	15 °C ÷ 35 °C
Milk temperature	5 °C ÷ 35 °C
Relative humidity	30 % ÷ 80 %

Parameters:

Measuring ranges:	Limit of detection:
Fat	0,5 % ÷ 12 % ± 0,1% (abs.)
Solids non fat (SNF)	6 % ÷ 12% ± 0,2% (abs.)
Milk density (CLR)	1,0200 ÷ 1,0400 g/cm ³ ± 0,0005 g/cm ³ (abs.)
Protein	2 % ÷ 6 % ± 0,2 % (abs.)
Freezing Point	0 ÷ -1,000 °C ± 0,01 °C (abs.)
Added Water to Milk	0 % ÷ 60 % ± 5 % (abs.)
Lactose	0,5 % ÷ 7 % ± 0,2 % (abs.)
Specific adulterant detection:	
Ammonium sulfate	0,1 % ± 0,05 % (abs.)
Urea	0,15 % ± 0,05 % (abs.)
Melamine	0,15 % ± 0,05 % (abs.)
Nitrates (ammonium, potassium, sodium, etc.)	0,05 % ± 0,03 % (abs.)
Carbonates/Bicarbonates (ammonium, potassium, etc.)	0,08 % ± 0,05 % (abs.)
Added water	20 % ± 5 % (abs.)
Synthetic milk (veg. oil, urea, detergent, water)	20 % ± 5 % (abs.)
Sweeteners (sucrose, maltodextrin)	0,9 % ± 0,5 % (abs.)
Non-specific adulterants:	In case the milk has been contaminated with substantial volume of unknown adulterant the instrument could detect it.
Technical specifications:	
Average time per one measuring	45 sec.
Size	380 x 310 x 285 mm
Weight	<4,5 kg
Power consumption (avg.)	<50 W
AC Power Supply voltage	INPUT: 100 - 240VAC +10/-15% 50/60 Hz

2 Knowing the parts



1. Infrared module inlet with removable filter
2. Ultrasonic module inlet
3. Cuvette (Infrared module)
4. Infrared module outlet
5. Ultrasonic module outlet
6. Infrared module peristaltic pump
7. Ultrasonic module peristaltic pump
8. Touchscreen display



Filter

Measuring mug -25 ml.

Cleaning solution mug - 40 ml.

Mug for waste milk

3 Safety measures

1. Read carefully and strictly follow the instructions described in this user's guide.
2. Under no circumstances you should try to repair Analyzer's power lead by yourself.
3. EkoZero concentrate liquid, used for the infrared module is a chemical that is considered hazardous which in case of direct contact may cause severe eye irritation or even serious eye damage. It is also considered the that liquid has acute oral toxicity.
4. The cleaning set for the ultrasonic module (EkoDay and EkoWeek) contains base and acid, and is considered to have corrosive behavior. Use protection - gloves and glasses, when preparing the cleaning solutions with these chemicals and pay more attention when you work with them.
5. Do not eat, drink or smoke when using the concentrates for preparing cleaning and zeroing solutions (EkoZero, EkoDay, EkoWeek).
6. EkoSpectra Clean is a powder substance, which in case of direct contact can irritate respiratory organs and eyes.
7. Wear protective gloves/protective clothing/eye protection/face protection.
8. If by accident there is a direct contact the user should take these precautions:
 - **After inhalation:** Supply fresh air; consult doctor in case of complaints.
 - **After skin contact:** Rinse skin with running water thoroughly.
 - **After eye contact:** Rinse opened eye cautiously with water for several minutes. Remove contact lenses, if present and continue rinsing. Immediately call a poison center or doctor/physician.
 - **After swallowing:** Immediately call a poison center or doctor/physician.

4 Method of work

1. Place vertically the Analyzer on a table or any other flat surface.
2. Connect the Power Supply (Model AC/DC-CL-DT 12/10) to the power supply outlet "In 12 V DC" on the Power Supply Panel and to the mains socket.

Attention: Before start working with the device make sure all the preparation work is done.

3. Preparation of the EkoZero solution for zero setting and cleaning (Infrared only)

The EkoZero concentrate is a liquid. Before preparing the work solution from the concentrate, check the shelf life label on the bottle and follow the instructions to prepare the solution. Dissolve contents - 50 ml in 5 L deionized (or distilled) water or 10 ml in 1 L (0,01 %). It's recommended to use the EkoZero solution within 2 months from preparation.

NOTE: Store the prepared liquid in a cool place.

4. Place the mugs for cleaning solutions below the pumps of the infrared and ultrasonic modules(see section 7 for more information).
5. Check if all measuring parts are in place.
6. Check if the filter is in place and clean it if necessary.
7. Switch on the analyzer.
8. Cleaning procedure after switching on will begin (see more section 6.4).
9. Warming up

From a cool start after switching on the device it will take a few minutes for the modules to warm up. Status indicator in the top left corner on the main menu shows the progress in percentage. When the warming up is finished the status indicates "Ready" (Figure 1).

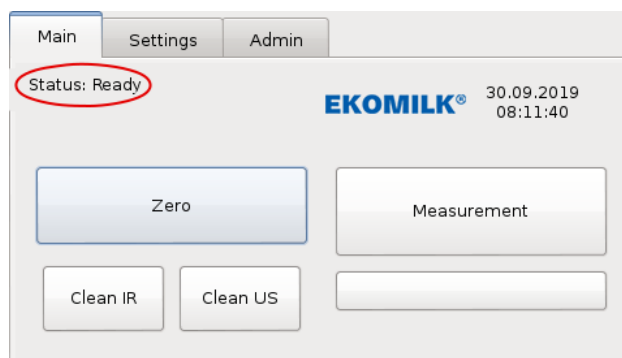


Figure 1: Status: Ready

10. Clean the two modules (IR with EkoZero solution, US with water).
11. "Zero Procedure" (for the infrared module) - see more in section 7.
12. Start measurement (IR, US, Combined IR + US)

Explanation: When working with the ultrasound module, it is recommended to pre-fill the system with milk. This can be done in two ways. The first way is to perform cleaning procedure, but instead of water/cleaning solution the cleaning is with milk. The second way is to measure a dummy sample (without considering the reported result). The purpose of these actions is to fill the system with milk for a more accurate result.

13. Instruction for preparing 500 ml EkoSpectra Clean working solution (3.5%), used for cleaning before switching off:
Take a transparent, non-sparkling 500ml water bottle with deionized water (or distilled water) and warm it up to about 30-35 °C. Then pour the 18 grams EkoSpectra Clean package into the bottle. Stir the mixture up to complete dissolving and then cool it down to 15-25 °C.

Note: The 3.5% EkoSpectra Clean solution is good for use up to 6 month after preparation if the container is properly closed after every use. The EkoSpectra Clean solution should be stored at room temperature. If the solution is stored below 14 °C, it will become an opaque and white gel. In that case, before using the solution, please warm up the solution above 30 °C to become transparent again.

14. Cleaning

In the end of the working day clean the analyzer well, following the instructions in section 6. After press turn off button, the procedure of cleaning before switching off will start (see more section 6.3).

5 Milk samples requirements

1. Mix the milk before measurement by shaking it gently 5 times, without making foam and air bubbles.
2. Before measurement, make sure that the temperature of the milk sample is between 15-25°C. When working with the ultrasonic module the sample temperature should be below 38°C, otherwise an error will occurs - **HOT SAMPLE**.
3. Put the milk sample in a ultrasonic bath for a few seconds - maximum a minute, according to the degree of aeration.

6 Cleaning procedure

This section is to give directions for daily and periodical cleaning of milk analyzers Ekomilk in order to assure their long life and proper functioning. Both modules must be cleaned - infrared and ultrasonic. The analyzer should not stay for more than 30 minutes with milk.

Attention: It is very important to note here that the cleaning solutions for the infrared and the ultrasonic modules are different. The cleaning solution for the ultrasonic module can damage the infrared module. That is why the cleaning is performed in two consecutive steps - first the one module is cleaned with the respective cleaning solution and then the other module is cleaned. The order of cleaning is not important.

6.1 Infrared module cleaning

Ekomilk Spectra cleaning procedure works on a reversal principle to prevent problems with cuvette clogging.

NOTE: Instructions for preparing EkoZero solution are on the packaging label of the concentrate, also described in the section 4.

Clean the infrared module, following the steps below:

- the mug for waste milk is placed under the infrared module input.
- the mug for cleaning liquid EkoZero is placed under the IR peristaltic pump.

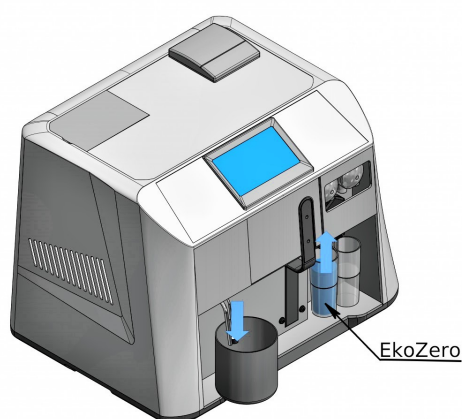


Figure 2: Cleaning

- when the <Clean IR> button is pressed - the system will request from the operator to load the cleaning solution. In the case of infrared module cleaning the cleaning solution is the same as the zero setting liquid - EkoZero liquid. When finish with loading the cleaning solution and press "OK" the pump will start rotates in the opposite direction of the measurement. The cleaning solution passes from right to left and falls into the mug for waste milk.

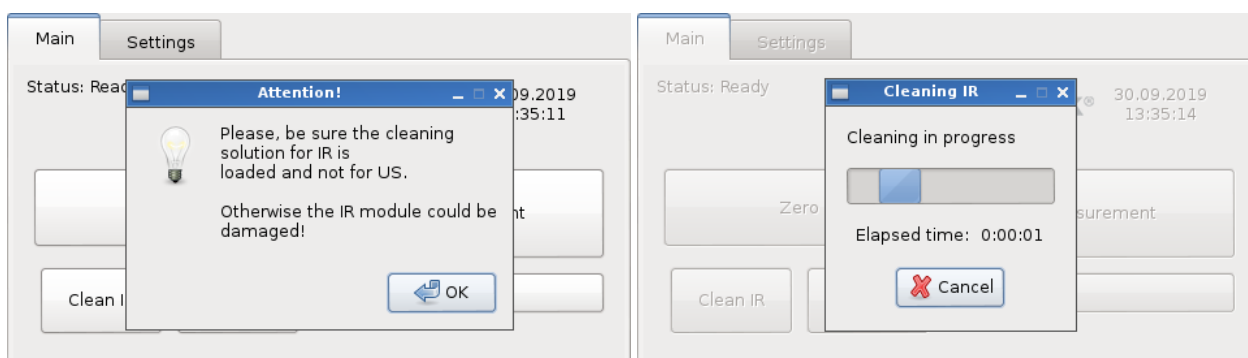


Figure 3: Clean IR

6.2 Ultrasonic module cleaning

Cleaning the ultrasonic module requires more time than cleaning the infrared module because different solutions are used to maintain the ultrasonic sensor in good condition. The cleaning of the ultrasonic module is similar to the cleaning of the infrared module:

- the mug for waste milk is placed under the ultrasonic module input.
- the mug for cleaning solution is placed under the US peristaltic pump.

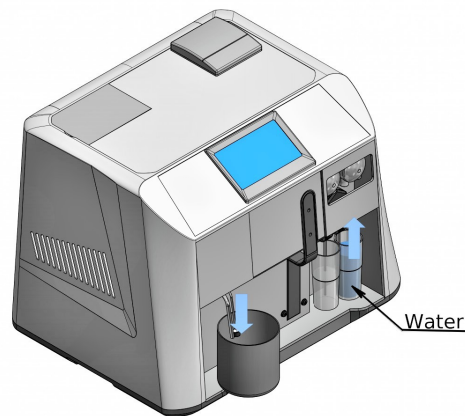


Figure 4: Cleaning

- when the <Clean US> button is pressed, the pump starts to rotate in the opposite direction of the measurement, the cleaning solution/water passes from right to left and falls into the mug for waste milk.
** the cleaning solution for the US module cleaning should be considered according to the type of cleaning (daily or periodic).*

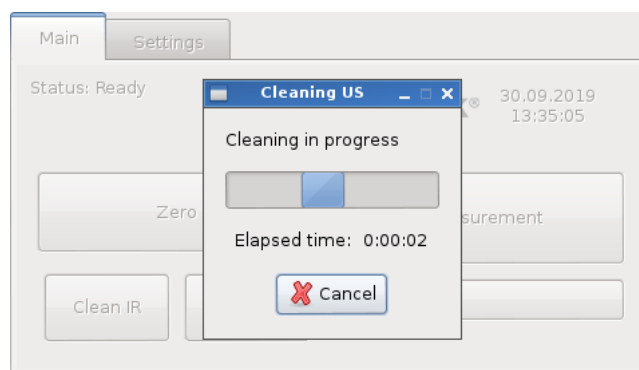


Figure 5: Clean US

- After cleaning procedure, the ultrasonic module system is filled with air and there should be no cleaning solution or water residues, the amount of solution/water in the mug for cleaning solution is adjusted to the pump revolutions, so in the end of the cleaning procedure the mug stays empty and the pump should suck only air. *Do not add extra solution/water in the cleaning solution mug under the US pump.*

Methods for daily and periodic clean of the Ekomilk Spectra analyzer's ultrasonic module

1. DAILY CLEANING

Daily cleaning is required when:

- The interval between two consecutive measurements is more than half of one hour.
- The daily job is finished.

1.1. Cleaning out when the interval between two consecutive measurements is more than half an hour.

Steps:

- 1.1.1. Fill the mug for cleaning solution (below the US peristaltic pump) with clean and warm, but not hot, water (40°C-60°C). On the input of the ultrasonic module place the mug for waste milk, press the button <Cleaning US>, cleaning starts immediately.
- 1.1.2. Remove the mug and throw away the muddy water. Repeat this procedure several times until clean water comes out from the Analyzer.

1.2. Cleaning out at the end of a working day.

This procedure prevents formation and collection of fat and "Milk stone" deposits into the sensor. Milk stone consists of milk solids, calcium, magnesium, iron, sulfates, etc. Milk and water mineral deposits become hardened and layered on the sensor and vinyl pipes inner surfaces, which contact with milk and disturbs the milk analyzer work. Cleaning will be effective if a reagent which attacks the "milk stone" is used. We recommend EkoDay to be used as a daily cleaning solution.

Preparation of EkoDay working solution:

Dissolve 2 g of powder detergent EkoDay in 100 ml distilled or deionized water. The solution can be used within 7 days after preparation.

Take care this solution does not contact your eyes or skin!

Attention! Use only EkoDay working solution as a cleaning agent. The EkoDay concentrate can damage your analyzer!

Steps:

- 1.2.1. First clean the analyzer with pure water as it is described in procedure 1.1. (see above).

Attention! Always clean analyzer with pure water before using the cleaning agent. Using cleaner EkoDay without first cleaning analyzer for removing the fats and proteins will result in fixing the "milk stone" to the surface.

- 1.2.2. Fill the cleaning solution mug with cleaner EkoDay (25°C-40°C), place the mug for waste milk on the input of the US module. Press the button <Cleaning US>, cleaning starts immediately. Make 5 cycles.
- 1.2.3. Fill the cleaning solution mug with alkaline clean water, press the button <Cleaning US>. Make 5 cycles. It's important to remove all the residues from the cleaning solution EkoDay!

2. PERIODICAL CLEANING PROCEDURE

To ensure a good work of the Milk Analyzer it is advisory to clean the device at least once a week strictly performing underwritten procedure. This procedure uses acid cleaner EkoWeek as a periodical cleaning solution.

Preparation of EkoWeek working solution:

Dissolve 1.8 g of powder detergent EkoWeek in 100 ml distilled or deionized water. The solution can be used within 30 days after preparation.

Take care this solution does not contact your eyes or skin!

Attention! Use only EkoWeek working solution as a cleaning agent. The EkoWeek concentrate can damage your analyzer!

2.1. Perform the daily cleaning first.

Attention! Make sure that the analyzer is properly cleaned with pure water before going on to the next item of the procedure. Mixing both cleaning solutions- alkaline EkoDay and acid EkoWeek will result in forming "milk stone".

2.2. Fill the cleaning solution mug with solution of the acid cleaner EkoWeek(25°C- 40°C), place the mug for waste milk on the input of the US module. Press the button <Cleaning US>, cleaning starts immediately. Make 5 cycles.

2.3. Open the top cover by pressing its left side - Figure 6 - step 1.

2.4. Remove the plug as it is shown on the - Figure 6 - step 2.

2.5. Insert the plunger instead of the plug Figure 6 - step 3.

2.6. Fill the measuring mug with clean and warm, but not hot, water (40°C- 60°C), dip the tube (sucker) into the water and place the measuring mug on the Ekomilk working surface.

Move up and down the plunger several times. Remove the mug and throw away the water. Fill the mug with clean and warm water and repeat this step 4-5 times - step 3.

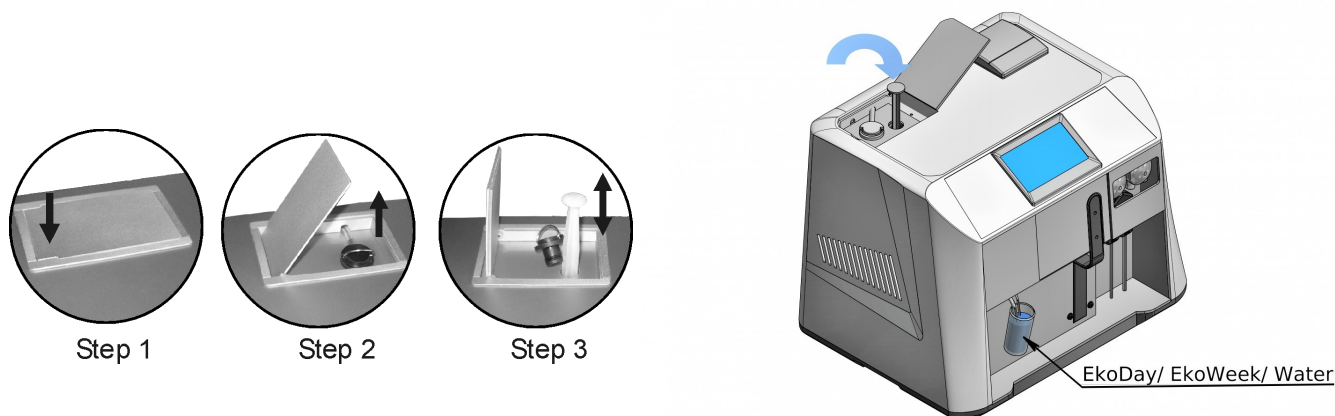


Figure 6: Hand-cleaning

2.7. Take the plunger out of the hole. Wait until all water comes out. Insert the plunger again and press it to the bottom.

2.8. Remove the measuring mug and move the plunger out. Put the plug firmly and close the top cover.

2.9. Done.

Note: During the daily and periodic cleaning of the analyzer, it is not desirable to use "solid" (high salt) water. The water used for cleaning should be "soft" (low in salt), and it is best to use distilled or deionized water.

6.3 Cleaning before switching off

When you press the power button to turn off the analyzer, the cleaning procedure will begin:

- place cleaning solution mug filled with EkoZero solution under the IR peristaltic pump (figure 2)
- place an empty mug for waste milk under the inlet of the infrared module
- click "OK" the displayed window
- after procedure finished, remove the mug with EkoZero solution and put another cleaning solution mug filled with EkoSpectra Clean solution (figure 7).

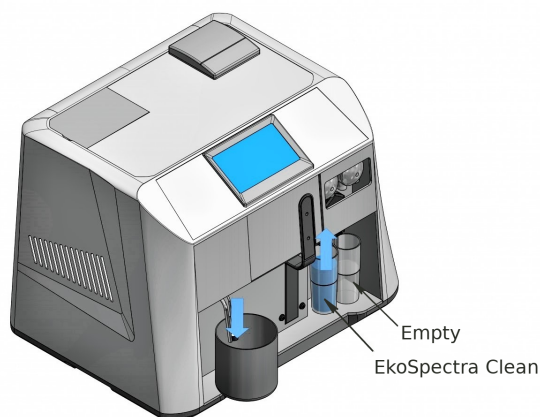


Figure 7: Clean IR with EkoSpectra Clean solution

- when procedure finished, remove mug for waste milk
- place measuring mug with clean water under the inlet of the ultrasound module
- continue with the procedure
- the device will switch off

Note: Please read the instructions that appear on the screen of the device carefully!

6.4 Cleaning after switching on

When turn on the analyzer, the procedure of cleaning will begin:

- place an empty mug for waste milk under the inlet of the ultrasonic module
- when click "OK" unloading of the liquid from ultrasound module will begin
- after procedure finished, place cleaning solution mug filled with EkoZero solution under the IR peristaltic pump (figure 2)
- remove the milk filter from the infrared module inlet and clean it (section 13.1)
- click "OK" on the displayed window
- without displace the mugs, continue with next procedure
- cleaning procedure on switching on will be finished successful
- place the cleaned milk filter at the inlet of the infrared module

Note: Please read the instructions that appear on the screen of the device carefully!

7 Zero procedure

The "zero procedure" must be performed at the beginning of the working day and on every hour during the day. This procedure is necessary to account for imperceptible changes in the environmental conditions of the measurements and their compensation.

Failure to set to zero may adversely affect measurement accuracy. The analyzer automatically warns of the need to perform a new procedure through the message "Zero Required!".

The measuring mug (25ml) is filled with EkoZero solution, the mug for cleaning liquid under the IR pump is empty (otherwise it will overflow).

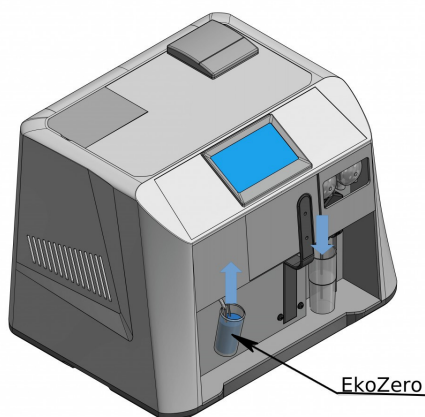


Figure 8: Zero

To begin the procedure press the <Zero> button in the main menu (Figure 9). A new window opens (see Figure 9a) with signalization to load zero solution in the measuring mug. When the solution is loaded press <OK>. The zero setting starts and a progress bar indicates the state of the procedure (Figure 9b). After the zero is done successfully, in the right side of the button <Zero> appears a timer, which indicates the reminding time to the next zero procedure (<Zero 1:00>, Figure 9c), so after 1h 00min the zero will be expired. When this happens the timer disappear and a new zero procedure should be done.

Note: The first sample after zeroing should be discarded, so we recommend to make two measurements with the first milk!

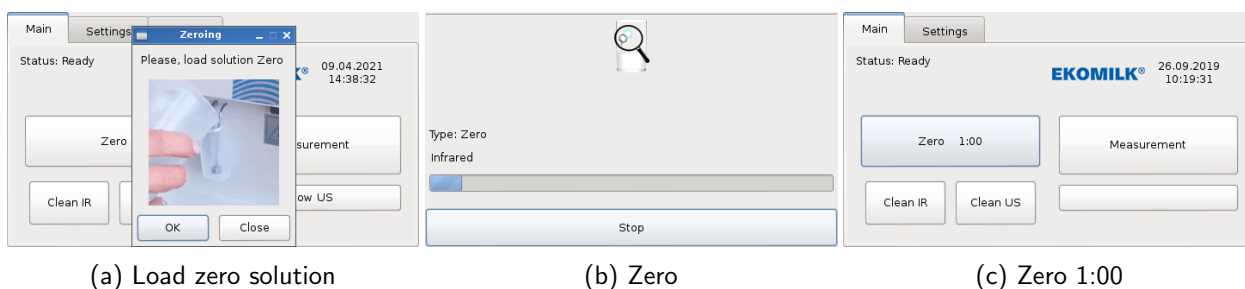


Figure 9: Zero procedure

8 Milk analysis

Since Ekomilk Spectra is a hybrid analyzer using infrared technology for adulterant detection and ultrasonic for standard milk parameters measurement, it can make complex measurements using both modules, or it can be set to only use either the infrared or the ultrasonic module for measurement. So if there is a problem with one of the modules the analyzer can continue working with the other module.

8.1 Position of components and work

Position when using the infrared module:

- place the measuring mug, filled with sample on the Ekomilk Spectra's working surface.
- fill the mug for cleaning solution, under the IR pump with EkoZero solution.

Work of infrared module:

Attention: Before the first measuring, the infrared module is filled with cleaning/zeroing solution - EkoZero. This is done during cleaning procedure (Clean IR) and zero procedure (see section 6 and section 7).

When the measurement starts, the infrared module's peristaltic pump takes a sample of milk (yellow arrows, figure 10) that pushes the cleaning solution into the mug underneath the infrared pump. The IR pump rotates normally (from left to right). When the sample is analyzed in the cuvette, the IR peristaltic pump reverses (from right to left), and pushes back the analyzed milk in the measuring mug, while at the same time refills the system with cleaning solution EkoZero (blue arrows, figure 10). The returned milk sample should not be used again, because is mixed with the cleaning solution EkoZero.

Note: During IR measuring the mug for cleaning solution should be always filled with EkoZero solution, otherwise the IR peristaltic pump will take air, this air will pass into the system, respectively in the cuvette. When work properly the cleaning solution EkoZero in the mug for cleaning solution should stay clear, without milk contamination.

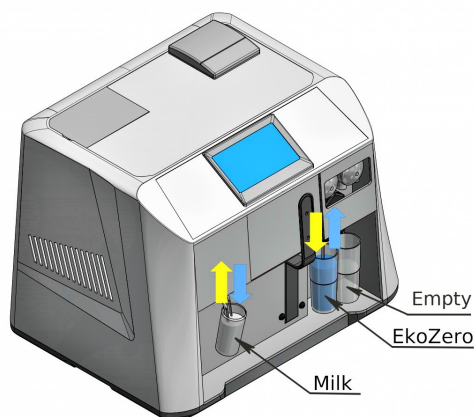


Figure 10: Measurement

Position when using the ultrasound module:

Ultrasound measurement is similar to infrared. The difference is that the mug for cleaning solution under the US peristaltic pump should be empty. Here the use of the mug for cleaning solution is for safety reasons. If there are drops of milk or cleaning solution left in the system, they will fall into the mug.

Position of the components: (Figure 11)

- place the measuring mug, filled with sample on the Ekomilk Spectra's working surface
- place the empty mug for cleaning solution under the US peristaltic pump

Work of ultrasound module:

When initiating a measurement, the peristaltic pump on the ultrasound module takes a sample of milk (a yellow arrow, Figure 11), which fills the ultrasonic sensor. In the end of the measurement, the peristaltic pump returns the measured milk in the measuring mug, while the ultrasonic sensor remains filled with air (blue arrows, Figure 11).

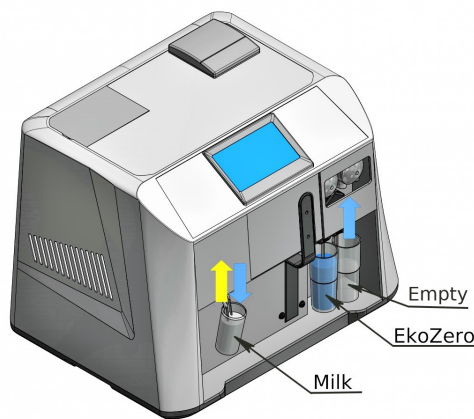


Figure 11: Measurement

8.2 Start measurement

To initiate a measurement press the <Measurement> button from the main menu (Figure 12).

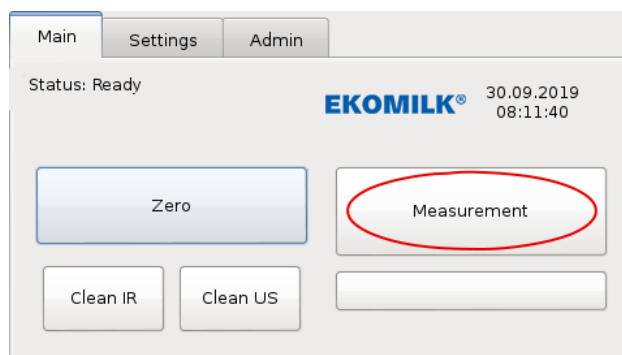


Figure 12: Main menu

A new window pops up asking for the measurement configuration (Figure 13). The main thing here is to select what modules of the hybrid analyzer to be used for the measurement process. To use only the infrared or the ultrasound the check in the corresponding check box must be ticked. To use both infrared and ultrasound simultaneously for complex measurement both check boxes should be marked. Double-check button is available for infrared measurement. His role is to recheck the concentration of adulterants and show it more accurately. When measuring with the ultrasonic module, the type of milk must be indicated in advance, which is selected immediately after the type of measurement is selected.

The configuration windows (Figure 13) will appear every time a new measurement is performed. That can be annoying and unnecessary. To skip this step the "Remember" check box should be ticked in the lower right corner of the window.

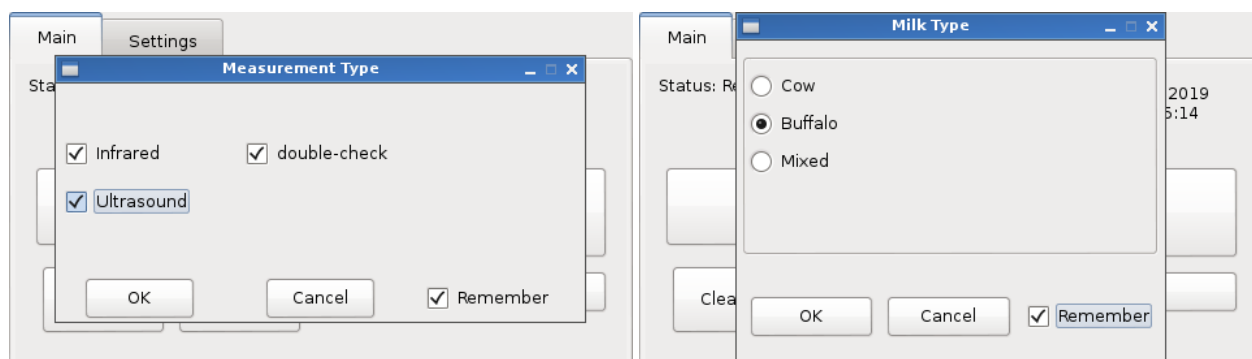


Figure 13: Measurement configuration

By clicking the <OK>button the measurement starts.

Resetting: In the main menu under <Measuring>button a configuration text should appear in a gray box. To clear the setting just press the text, in our case <Buffalo><US>. A message asking you to delete measurement configuration will pop up, Figure 14.

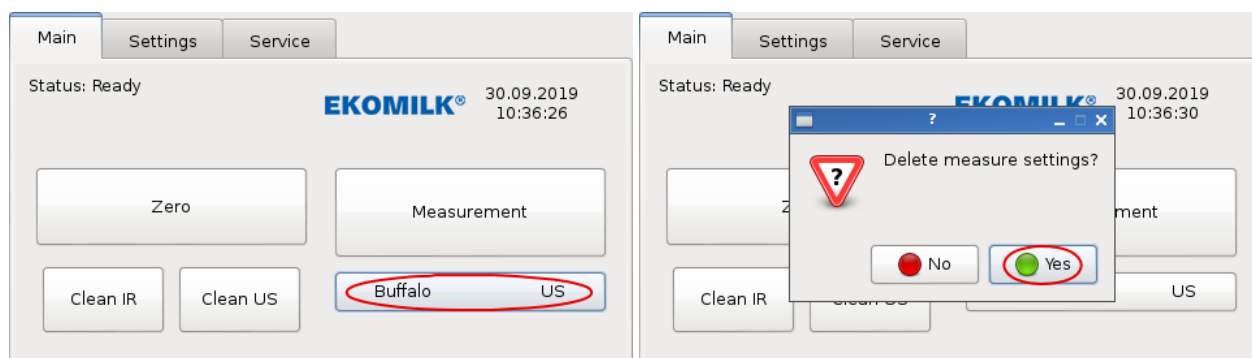


Figure 14: Resetting configuration

After the measurement finishes successfully a window appears with measured milk parameters and adulterants if any detected (Figure 15, 17). If a substantial volume of unknown adulterant is detected - you will see "Abnormal sample".

Note: If there is more than one adulterant in the milk - as a result will shown is the one that changes the parameters of the milk the most.

If the adulterant does not indicate what it is (for example - an ammonium compound), you can click on the yellow rectangle and see the adulterant and the probability of it being present in the current sample (Figure 18).



Figure 15: Measurement with infrared

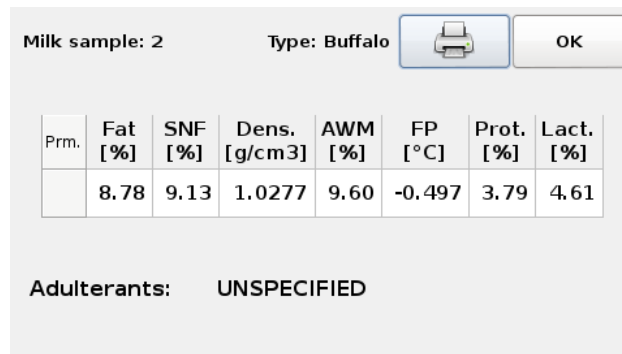


Figure 16: Measurement with ultrasound

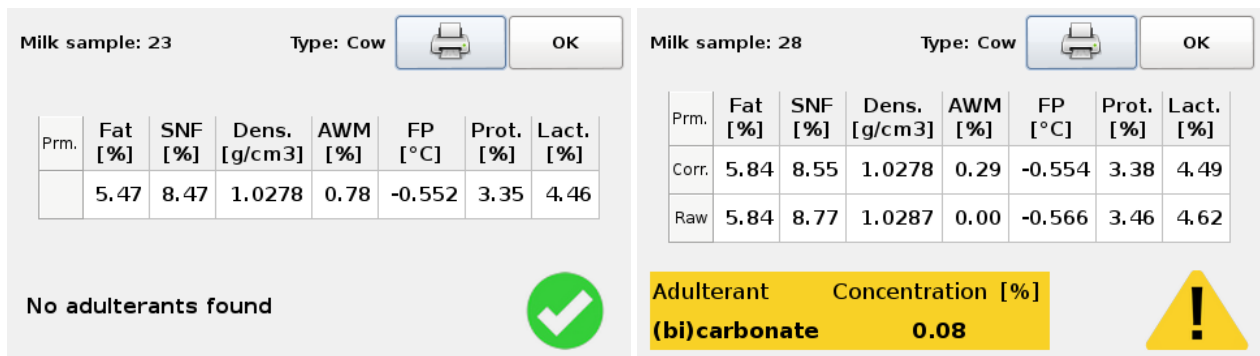


Figure 17: Measurement with infrared and ultrasound

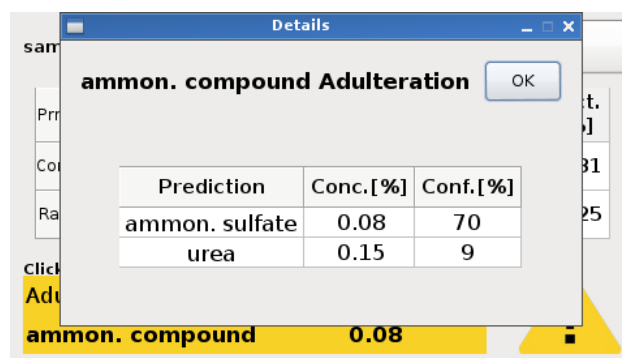


Figure 18: Adulterant and probability

8.3 Testing with reference samples

Use the attached adulterants (Urea, Sodium Bicarbonate- 3 gr and 5 gr for 0.3 % and 0.5 % sample concentration) to check the operation of the device.

Preparation of reference sample:

Add the contents of the package to 1 liter pasteurized milk 3.5 % fat at a constant temperature of 20 °C and stir until completely dissolved.

Note: The period of using of the sample is up to 12 hours after preparation of the solution. Store the solution in refrigerator.

9 Graphical user interface

The graphical user interface consists of three principal menus - <Main>, <Settings>, <Admin> and the operator can switch between them by pressing the respective of the horizontal tabs, Figure 19.

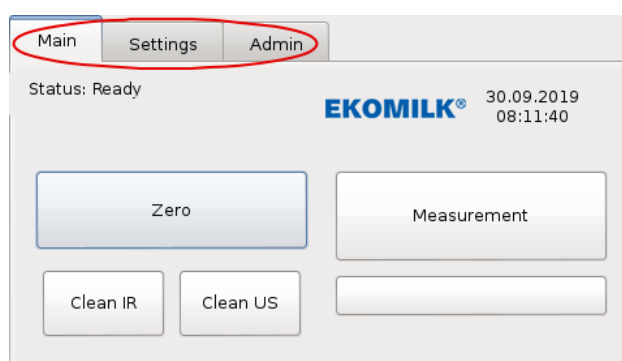


Figure 19: Main menu

9.1 Main menu

The main menu contains the most important and commonly used buttons: <Measurement>, <Zero>, <Clean IR>, <Clean US> and measuring configuration.

9.2 Settings menu

This section describes how to configure and use other Ekomilk Spectra options.

9.2.1 Calibrate touchscreen

Settings → System → Touchscreen

To calibrate your touch screen please, follow the instructions that will appear. In case of a mistake, turn off the device without completing the procedure.

9.2.2 Display parameters

Settings → System → Display params.
You can configure result view. You can:

- hide ultrasound parameters
- hide corrected or raw values of ultrasound parameters
- display 1 or 2 decimal places for fat and SNF
- display on CLR instead density
- display US or IR protein
- hide the concentration of adulterant

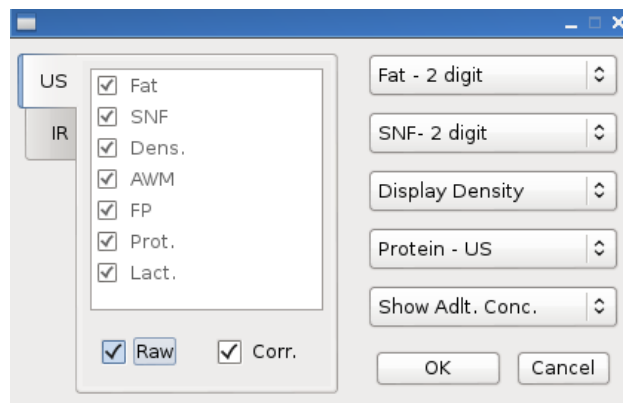
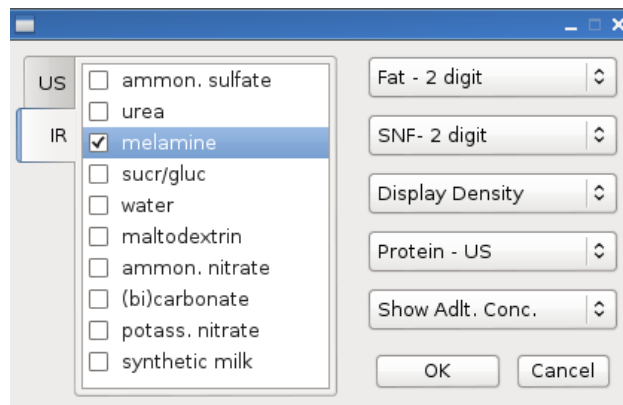


Figure 20: Configure result view

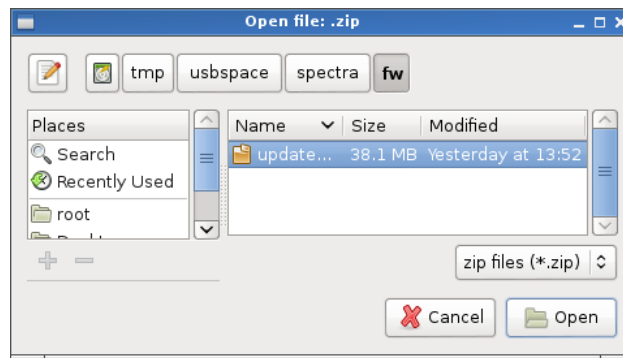
Clicking the IR tab, displays list of adulterants. This functionality is used to not detect selected adulterants.



For example: If the purpose is not detecting melamine adulterant then select it from the menu. Starting IR module measuring will show "No adulterants found" result.

9.2.3 Firmware update/GUI/OS

On USB flash drive you need to create folder with name "spectra". After that open "spectra" folder and create folder with name "fw" and then you need to copy update file(for firmware (.bfu), for GUI/OS (.zip)) into "fw" folder. Take the USB flash drive and plug the USB stick in one of the Ekomilk Spectra USB ports. For Firmware open Settings → Files → System → Infrared → Firmware update or for GUI/OS Settings → Files → System → GUI/OS → GUI/OS Update. Then select update file and press "Open".



9.2.4 Infrared Eeprom update

On USB flash drive you need to create folder with name "spectra". After that open "spectra" folder and create folder with the device id name (you can see it from: Settings → Sys Info, Figure 21), open it and create folder with name "eedata" (for example: spectra/188/eedata) and then you need to copy eeprom file into "eedata" folder. Take the USB flash drive and plug the USB stick in one of the Ekomilk Spectra USB ports. For infrared eeprom update open: Settings → Files → System → IR → EEPROM write.

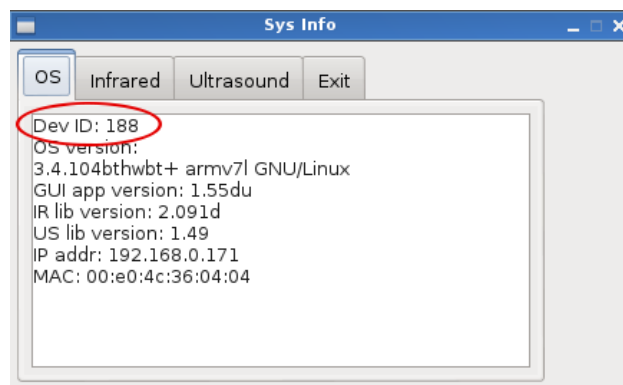


Figure 21: Device ID

9.2.5 Ultrasound Eeprom update

Settings → Files → System → US → EEPROM write.

On a flash drive, the US eeprom should be in the "/spectra/device.id" folder (for example: spectra/188/).

9.2.6 Printers

Settings → System → Reports Printer → Printers

Ekomilk Spectra supports 2 type of printers - internal (Panel EP108PP) and external (Datecs EP50).

- Printer mode - manual, auto(printing after every measurement).
- Printer parameters - you can choose which parameters you want to print and sort.

9.2.7 Licenses

Settings → System → GUI/OS → License key

License key unlocks additional features. The license is of type - operating hours of the device. For purchase and more information contact us.

Currently available licenses are:

- DPS (Data Processing System) - see the DPS manual
- Titratable acidity - see the Conductivity and pH guide

On a flash drive, the license key should be in the "/spectra/device.id/licenses" folder

9.3 Data

9.3.1 Export Data with USB Flash Drive

Settings → Files → Export

When inserting a USB flash drive into the devices USB port, located on the back panel of the analyzer, the button <Files>becomes active and the data transfer to the external memory is now available. When we select the button <Export Files>- a new window appears with the time period for the data export(Figure 22). We can export all data or the data for a desired time period, by adjusting the date (Start from: date, period: 1, 2, n days).

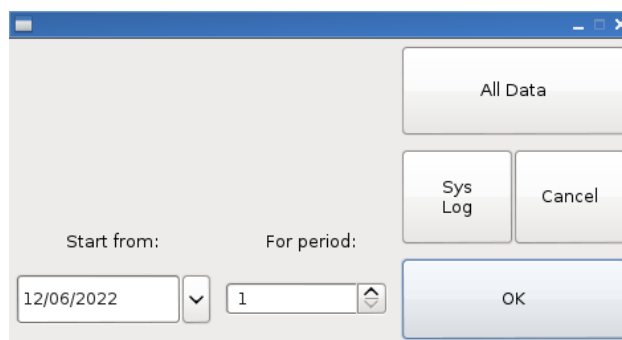


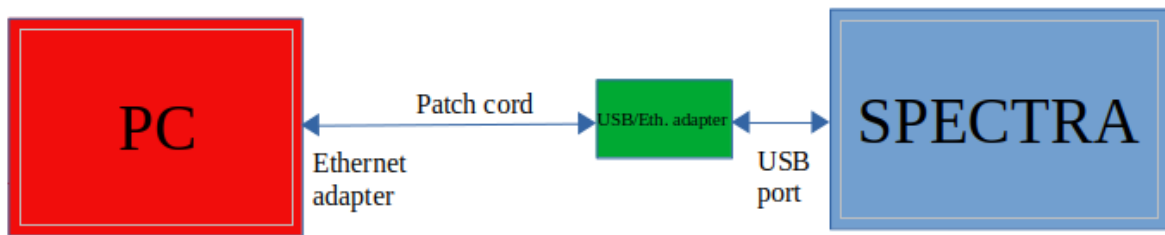
Figure 22: Export data

9.3.2 Export Data via LAN

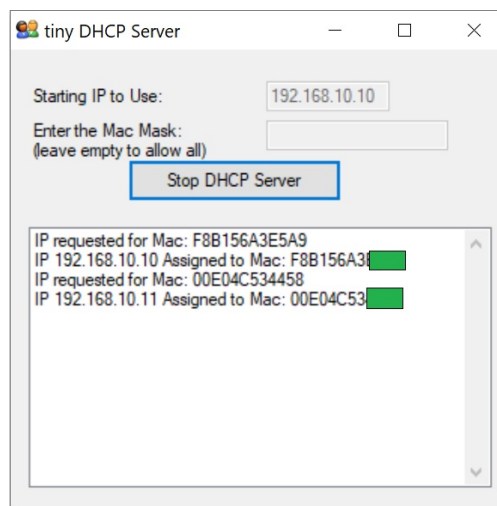
The conception for data transfer from Spectra to PC, using of Local Area Network (LAN), includes few steps and ways to download ready data in convenient format (CSV).

1. Connect PC and Spectra in LAN

- a) To connect both units, PC and Spectra, in LAN it needs except patch cord (UTP/STP cable) and an USB to Ethernet adapter because Spectra does not have inbuilt LAN adapter. Spectra got 4 available USB ports. All of them are appropriate to plug USB/Ethernet adapter. Next figure shows how to connect units in LAN:



- b) When both devices are connected via cable and adapter it needs to make visible them each other. Easiest way is to make PC as DHCP server with a small program called SmallIDHCPServer.exe (files will be sent separately). Executing that program allows PC set IP (in same subnet) to Spectra. Initial IP of PC will be 192.168.10.10. Spectra has to get IP 192.168.10.11, for example. That IP is needed when the data has to be downloaded. Executing SmallIDHCPServer.exe (always Run as administrator!) has to start with next window:



As can be seen PC and Spectra got assigned IP - 192.168.10.10 for PC and 192.168.10.11 - Spectra. Spectra IP can be different and can be found on Spectra Settings menu:

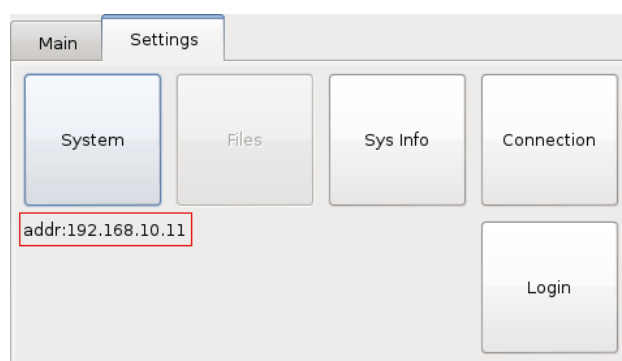


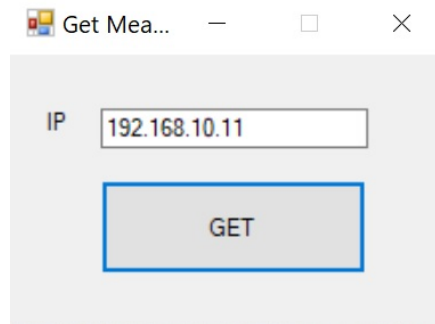
Figure 23: IP address

When the connection is established SmallIDHCPClient could be minimized, even though closed till next start. Once again - DHCP Server program must be Run as administrator! Otherwise error will appear. Next step is to download necessary file with last measurement result.

2. Download measurement result

There are few ways to download last data including app, HTTP request, batch scripts, via SFTP. Following text describes some of them. All of them convert necessary data (last measurement) in CSV file format.

- a) First of methods is with program called `getData.exe`. After start, enter IP of the Spectra and push GET button - last record will be downloaded in current directory with name `last_record.csv`



- b) Second method is with HTTP request. Either web request with browser or http request in script, program and etc. response includes last record and return it as CSV file (`last_record.csv`). For example:

`http://192.168.10.11/dwnldLastRecord.php`

will download last measurement result.

- c) Third method is via windows batch script called on Windows PowerShell (Command Prompt). Next example how to execute script with Spectra's IP as parameter:

```
PS C:\Users\root> .\dwnldLastRecord.bat 192.168.10.11
C:\Users\root>curl --connect-timeout 10 -o C:\Users\root\last_record.csv "http://192.168.10.11/dwnldLastRecord.php"
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
           Dload  Upload   Total     Spent    Left     Speed
100  123    100    123     0     0    123     0  0:00:01 --:--:--  0:00:01   788
```

As first method result will be downloaded in current directory, where script is called. This method is like second one but request is executed via `.BAT` script.

- d) Fourth method is via SFTP - see more in section 9.6.

9.4 Connections

9.4.1 Wi-Fi

Ekomilk Spectra works with only one Wi-Fi dongle (you need to order it extra). To connect to the network, you must first plug the Wi-Fi module into one of the Ekomilk Spectra USB ports (Figure 24). Then from Settings → Connections → Wi-Fi you can find your network and connect to it.



Figure 24: Wi-Fi

9.4.2 GPRS

Ekomilk Spectra works with many different GPRS dongles. The same as Wi-fi, first plug the GPRS dongle into one of the Ekomilk Spectra USB ports (Figure 24). Then from Settings → Connections → GPRS you can turn on an Internet connection.

9.4.3 Bluetooth

Ekomilk Spectra offers Bluetooth which makes it possible to establish communication with variety types of devices. When you are connected via simple commands (standard RFCOMM protocol) you can control and manage the main functions - cleaning (infrared and ultrasound), start measuring, zero and stop processes. Ekomilk Spectra works with many different Bluetooth dongles. The same as Wi-fi, first plug the Bluetooth dongle into one of the Ekomilk Spectra USB ports (Figure 24). Then from Settings → Connections → Bluetooth you can turn on. On the Bluetooth button you will see the pin code that is needed when you try to pair the device. To communicate with Spectra, you can use Terminal app or write your own app.

RFCOMM communication protocol

Command list

ZR	Start zero procedure.
cleanI	Start Infrared system cleaning procedure.
cleanU	Start Ultrasound system cleaning procedure.
MEAS:a,b	Start the measurement process. There are two arguments 'a' and 'b'.
STOP	Stop current process.

Detailed description

[Command]	An ASCII case-sensitive command.
[Argument]	Describes an argument value.
[Outline]	Describes a bunch of data that the command returns.

- Connecting

After a successful connection to the device, the virtual serial communication port returns "Connected".

- Zero procedure

[Command]	ZR
[Outline]	<ul style="list-style-type: none">– OK - commands is accepted and procedure is being started.– PR:x/y - Progress of the process. Arguments 'x' and 'y' represent respectively past steps and all numbers of steps of the procedure.– FIN - The procedure is completed.

- Cleaning procedure

[Command]	cleanI (for Infrared) / cleanU (for Ultrasound)
[Outline]	<ul style="list-style-type: none">– OK - commands is accepted and procedure is being started.– Cleaning in progress... - On every 5 seconds– FIN - the procedure is completed.

- Errors

If errors occur, Spectra sends them to the virtual serial port:

- ERR:'x' - 'x' is the error

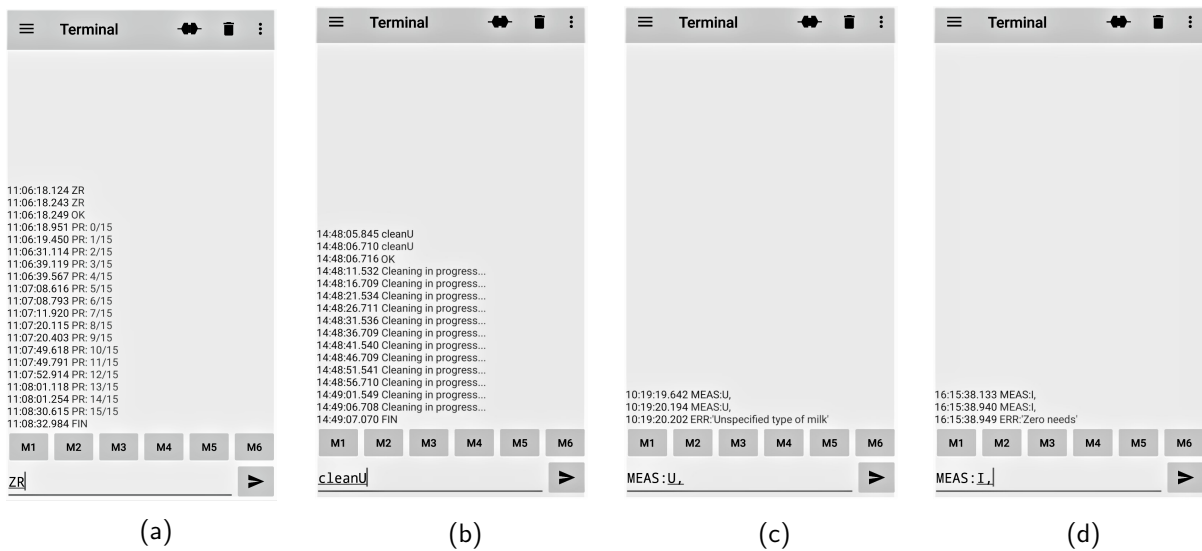


Figure 25: (a) Zero procedure (b) Cleaning procedure (c) - (d) Errors

- Stop the current procedure

[Command]	STOP
[Outline]	– x is canceled - the 'x' argument indicates which procedure was canceled

Example:

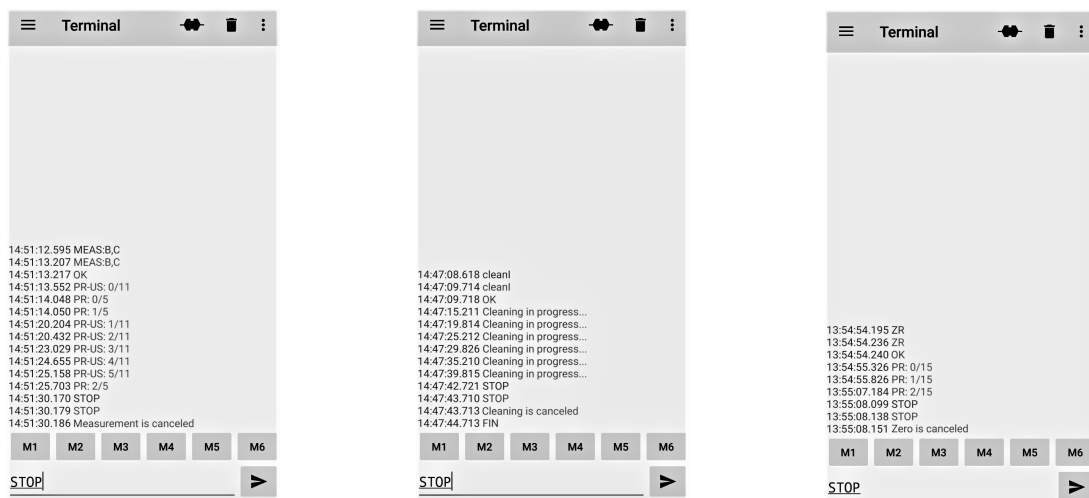


Figure 26: Stop the current procedure

- Measurement procedure

[Command]	MEAS:a,b (for Infrared the command is MEAS:a,)	
[Argument]	'a' - type of measurement:	'b' - type of milk:
	<ul style="list-style-type: none"> – I (for Infrared) – U (for Ultrasound) – B (for Both) – IR (for Infrared with double-check) – BR (for Both with double-check) 	<ul style="list-style-type: none"> – C (for Cow) – B (for Buffalo) – M (for Mixed) – S (for Sheep) – G (for Goat) – H (for Creamy) – CH (for Cow (homogenised))
[Outline]	<ul style="list-style-type: none"> – OK - commands is accepted and procedure is being started. – PR:x/y - progress of the process. Arguments 'x' and 'y' represent respectively past steps and all numbers of steps of the procedure. – PR-US:x/y - progress of the process of Ultrasound, if the module is use. Arguments 'x' and 'y' represent respectively past steps and all numbers of steps of the procedure. – Milk sample: x - 'x' is milk sample id – US-RES: x/y - result of Ultrasound module. 'x' is Ultrasound parameter, 'y' is concentration. – US-RES-RAW: x/y - the raw result of the Ultrasound, if measurement is started with both modules and raw result and corrected are different. 'x' is Ultrasound parameter, 'y' is concentration. – Adulterant: a - 'a' is adulterant. – Adulterant conc.: a - 'a' is concentration. – READY - the measurement is ready, but the procedure is not yet complete – FIN - the procedure is completed. 	

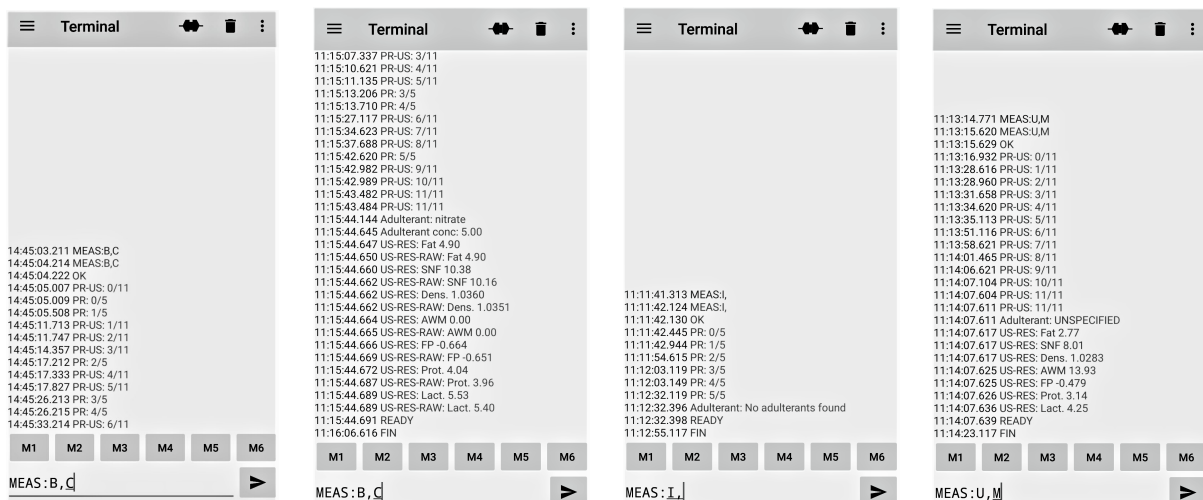


Figure 27: Example of a measurement procedure

9.5 Admin menu

The "Administrative Menu" is a password protected menu (the default password is 001122334455). To open it, you need to click "Login" on the "Settings" tab and enter your password. To close it on the same tab press the button "Logout". You can change password from Admin → Change password.

9.5.1 Calibration

Admin → Calibration

The calibration is for the infrared module to set the device to measure adulterants and their concentrations correctly. This menu helps us to do the calibration remotely. Use of this menu is rare - for example, when the Ekomilk Spectra is damaged and part of the infrared system needs to be replaced (the cuvette, the glass of the cuvette, measuring board, etc.).

On the figure 28a you can see the calibration menu. Choosing the number of cycle - this is a how many times milk will be measure before reverse back into the measuring mug. We recommend to choose two or three measurement cycles.

Note: Before start calibration you need to zero infrared. The first sample after zeroing should be discarded, so you have to make three measurement cycles!

After the measurement is complete, you can add a comment about the current sample(Figure 28b) - specifics for milk, specifics for adulterants or something else that is important to the current sample. The field may also be skip.

Note: If you have more than one adulterant, please enter the concentration of the higher adulterant. You can enter the lower one in the comment filed.

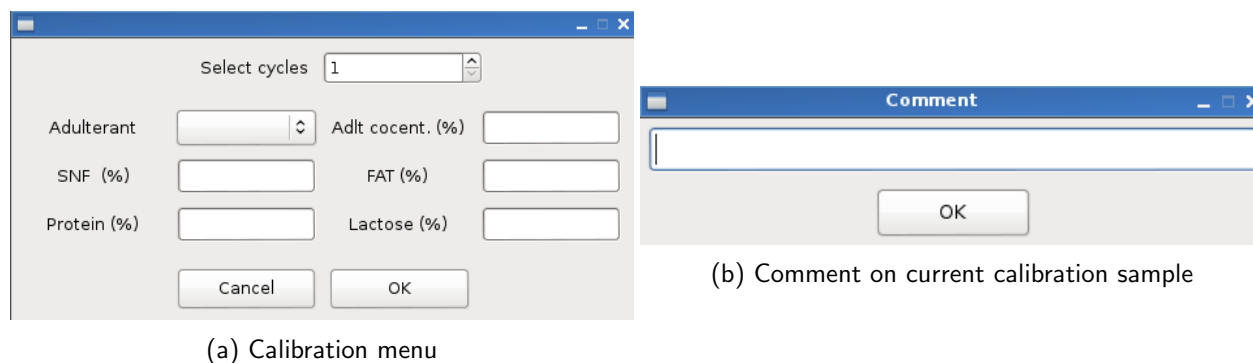


Figure 28: Calibration

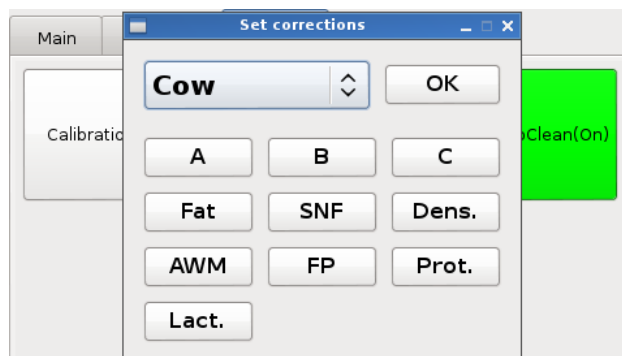
After making enough measurements, you should download current date files (from data folder) and calibration file (also from data folder, calibration files have same name, but they finished with "-R.txt"). How to download see: section 9.3.1, section 9.3.2 or section 9.6. Then you need to send them to us and we will send you an infrared eeprom file. And then you need to update infrared eeprom (how to update infared eeprom see section 9.2.4 or section 9.6).

9.5.2 Ultrasound corrections

Admin → Corrections

If any of the parameters constantly show higher or lower values compared to an exact reference instrument. Then you can change those of Ekomilk Spectra.

But strongly recommend to don't touch them, unless you are not absolutely sure what you do and reference instrument is really exact. From drop-down menu select for which milk type you want to set correction, then click desired parameter, which you want to correct. A, B and C are constants, used in internal calculations of ultrasound measurement board.



When click on desired parameter, next dialog will appear (Figure 29). Use top-down arrow or USB keyboard to enter desired value (it can be a negative too, if you want to decrements measured values) and click <OK>button.

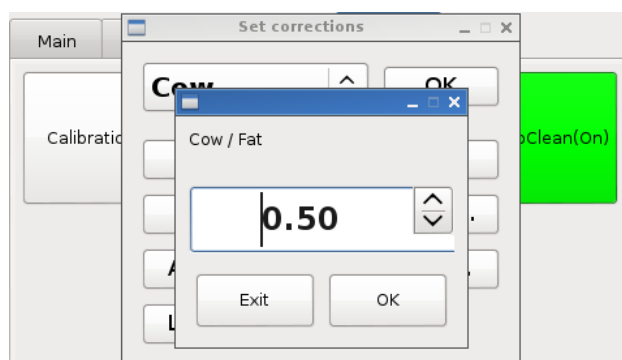
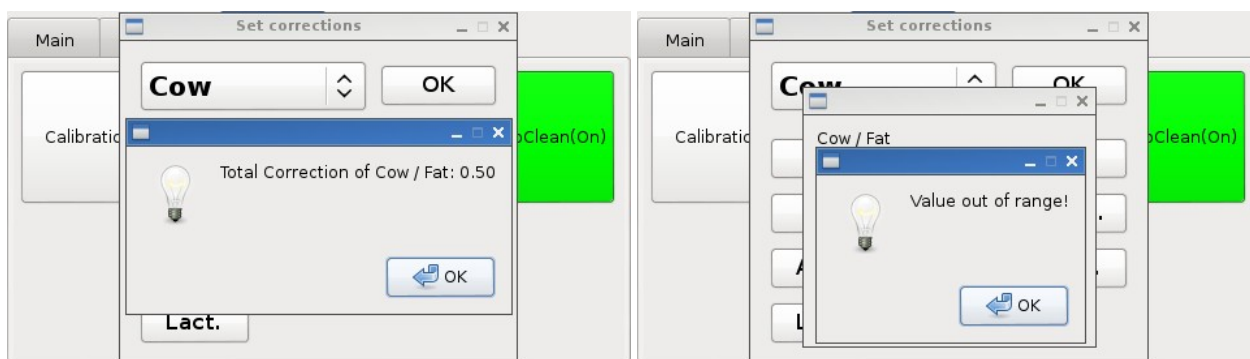


Figure 29: Set correction

Entered correction will be added to previously entered correction (if any) and total correction will be displayed, if total correction doesn't exceed limits, else "Value out of range!" will be displayed and correction will be not accepted.



Ranges are:

Density: $-12.5 \div 12.5$ (indeed this is $-0.00125 \text{ g/sm}^3 \div 0.00125 \text{ g/sm}^3$)

AWM: $-25 \div 25$

FP: $-25.4 \div 25.4$ (indeed this is $-0.254 \text{ }^{\circ}\text{C} \div 0.254 \text{ }^{\circ}\text{C}$)

All others: $-2.54 \div 2.54$

9.5.3 Auto Cleaning

Admin → AutoClean

This function stop reverse after every measurement. But after a certain number of measurements, the cuvette will become clogged. We recommend to don't touch them, unless you are not absolutely sure what you do.

9.5.4 Sending results to FTP server

Admin → Send results → FTP server

Ekomilk Spectra can send results to FTP server. The results are stored in comma separated value (CSV) file with this header:

- CP_code - Collection Point Code of the analyzer. It serves as the ID.
- Milk sample
- Time - this is the time at which the sample was analyzed
- Adulterant name
- Adulterant concentration
- Fat (raw)
- SNF (raw)
- Density (raw)
- AWM (raw)
- FP (raw)
- Protein (raw)
- Lactose (raw)
- Fat (corr)
- SNF (corr)
- Density (corr)
- AWM (corr)
- FP (corr)
- Protein (corr)
- Lactose (corr)

Here is the steps you need to doing to sending results files to FTP server:

1. Set Collection point code (this is to know which device the results are from).
Admin → Send results → FTP server → CP Code
2. Set number of working shifts and their working time.
Admin → Send results → FTP server → Working shifts
3. Enter information about your server. Address, username, password, port and target directory. In the text field of target directory enter the path, where ftp files need to be upload, if you don't set it - the files will be upload to the default directory. To test, whether to results file will be uploaded to the correct directory - press button "Send test file". This button will generate empty file "Test.txt" and will send it. Once you receive the test file in the correct directory, you can proceed to the next step.
Admin → Send results → FTP server → Server

4. Send result - this step is the most important, because the ftp file is generated at the end of every shift and sending to your server, if Ekomilk Spectra is connected to the internet. If you don't have internet connection, you can send files manual. If you turn off the device, before the end of working shift - ftp result file, will not be created. To make sure the file is created please wait 5 - 10 seconds after end of shift, before turn off your device.

Admin → Send results → FTP server → Send results

The names of results files are on this principle:

shift_year_month_day.txt (for example - first_2020_04_07.txt)

- Another option you have is to encrypt the result file. This option encrypts the file before sending it to the server. The file name is on the same principle, but the name is started with enc_ (for example: enc_first_2020_04_07.txt).

enc_shift_year_month_day.txt is the file that is uploaded to the server. To decrypt it, you must use the following command:

"openssl des3 -d -in enc_shift_year_month_day.txt -out outputfile.txt -pass pass: spectra"

Instead of "enc_shift_year_month_day.txt", enter the name of the file you want to decrypt and instead of "outputfile.txt" - as you want to be the name of a decrypted file

Admin → Send results → FTP Server → Encryption

9.5.5 Long measurement

Admin → Long measurement

This functionality is used to start a set of samples. We use results to generate a "data eeprom". The procedure need to be perform in very rare situations - for example, when the Ekomilk Spectra was damaged and the infrared board is replaced.

9.5.6 Inactivity cleaning

Admin → Inactivity cleaning

This is an automatic reminder function for infrared cleaning in case of inactivity after measurement. You can set the reminder to appear after a certain time. Or select 0 to turn off the reminder.

9.5.7 Sending results to HTTP server

Admin → Send results → HTTP server

Ekomilk Spectra can send results to HTTP server. The results are stored in JSON file. Format of file is represented in next example:

Here is the steps you need to doing to sending json files to HTTP server:

```
{
  "1": {
    "CP_code": "188",
    "Milk_Sample": "1",
    "Time": "13:39:54",
    "Type": "Mixed",
    "Adulterant": "veg. fat/det",
    "Concentration": "1.50",
    "Fat(r)": "2.41",
    "SNF(r)": "7.60",
    "Dens.(r)": "1.0269",
    "AWM(r)": "18.31",
    "FP(r)": "-0.454",
    "Prot.(r)": "2.98",
    "Lact.(r)": "4.03",
    "Fat(c)": "0.91",
    "SNF(c)": "7.60",
    "Dens.(c)": "1.0282",
    "AWM(c)": "18.64",
    "FP(c)": "-0.452",
    "Prot.(c)": "2.96",
    "Lact.(c)": "4.06"
  }
}
```

1. Set Collection point code (this is to know which device the results are from).

Admin → Send results → HTTP server → CP Code

2. Enter information about your HTTP server - Address (if server use authentication - enter username and password). To verify that the json files will be uploaded correctly - press button "Send test file". This button will generate file "Test.json" and will send it.

Admin → Send results → Server

- Send result after every measurement.

Admin → Send results → HTTP server → Send results

- Send to the server - json file with all measurements within the specified time period of the current day.

Admin → Send results → HTTP server → Bulk mode

The name of result file is current date:

year_month_day.json (for example - 2020_04_07.json)

9.6 SFTP access to Ekomilk Spectra

With this functionality you can download data/result files, update firmware, update eeprom, etc. To make SFTP connection, first you need to connect Ekomilk Spectra to the Network and see IP address (Figure 23).

User: **ftp_user**

Password: **passw**

- To change the password of the Spectra device, create a new file named: **FtpNewPsw**, which contains your new password. After that create another one file with name: **pswChngReq**. Then open Windows PowerShell (Command Prompt) and navigate to where they are created (for example: C:/Users/root/Desktop). After that open Windows PowerShell (Command Prompt) and write - sftp ftp_user@<Ekomilk Spectra IP>(for example: sftp ftp_user@192.168.0.173) to connect to the Ekomilk Spectra.

```

Windows PowerShell
PS C:\Users\root\Desktop> sftp ftp_user@192.168.0.173
ftp_user@192.168.0.173's password:
Connected to ftp_user@192.168.0.173.
sftp>

```

Having already connected Ecomilk Spectra - navigate to **spectra/fw** and after than upload file **FtpNewPsw** and **pswChngReq** - in the same order.

```

Windows PowerShell
sftp> cd /spectra/fw
sftp> put FtpNewPsw
Uploading FtpNewPsw to /spectra/fw/FtpNewPsw
FtpNewPsw                                     100%   6    2.6KB/s   00:00
sftp> put pswChngReq
Uploading pswChngReq to /spectra/fw/pswChngReq
pswChngReq                                   100%   0    0.0KB/s   00:00
sftp>

```

- Update Firmware - As a password change, if you have a new firmware update, on your computer you need to create file with name: **trig**. In the **trig** file you need to write the name of firmware update file, without extension (for example: if your firmware update file is IR_218.bfu, in the **trig** file you need to write IR_218). Then with Windows PowerShell (Command Prompt) connect to Ekomilk Spectra and navigate to **spectra/fw**. After that upload firmware update file (.bfu) and **trig** file - in the same order.
- Update EEPROM - As a password change, if you have a new eeprom update, on your computer you need to create empty file with name: **trig**. Then with Windows PowerShell (Command Prompt) connect to Ekomilk Spectra and navigate to **spectra/eedata**. After that upload eeprom update file (.eep) and **trig** file - in the same order.
- Download data/result file - to download data/result file open Windows PowerShell (Command Prompt) and navigate to the directory where you want to download the data/result files. After that connect to Ekomilk Spectra and navigate to data/result directory. With command **get** followed by file name you will start download (for example: get 2019_10_25.txt).

```

Windows PowerShell
sftp> cd /spectra/results
sftp> ls
2019_09_17.txt    2019_09_18.txt    2019_09_19.txt    2019_09_24.txt    2019_09_25.txt    2019_10_03.txt
2019_10_04.txt    2019_10_05.txt    2019_10_06.txt    2019_10_07.txt    2019_10_10.txt    2019_10_24.txt
2019_10_25.txt
sftp> get 2019_10_25.txt
Fetching /spectra/results/2019_10_25.txt to 2019_10_25.txt
/spectra/results/2019_10_25.txt                100% 145    47.2KB/s   00:00
sftp>

```

10 Errors list

Error message	PROBLEM/CAUSE/REMEDY
MLMS ERROR !	Ultrasonic measuring system damaged
Empty Camera	<ol style="list-style-type: none"> 1. Air bubbles in the measuring sensor. Fill again the mug with milk and repeat the measurement. 2. The suction system has some air leak. 3. The measuring system is contaminated or damaged.
Hot Sample	<ol style="list-style-type: none"> 1. The milk samples temperature is above the spec. Fill again the mug with proper temperature milk sample and make a fresh start. 2. If the problem still exists, the measuring system is contaminated or damaged.
Error 1	Preheating 1 Fault
Error 2	Preheating 2 Fault
Error 3	Cuvette Heating Fault
Error 4	IR transmitter Fault
Error 5	MB Security chip error
Error 6	Cuvette Security chip error
Error 7	Cuvette presence error
Error 8	Sensor Board Error
Error 16	Flush Presence Error
Error 17	Measurement is waiting (transient process, noise, ...)
Error 18	Measurement is Canceled with Error
Error 19	Out of Range
Error 20	Low Signal Level
Error 21	Incorrect Result
Error 22	EEPROM Error
Error 23	Data EEPROM
Error 24	Calibration EEPROM
Error 28	LUT writing Error flag
Error 29	Factory Input Calibration Fault

11 Appendix 1 - Some reason for Ekomilk accuracy and repeatability deviations

Below are described some reasons that may worsen the accuracy and repeatability of the Ekomilk Spectra Analyzers measurement results. Some information about the way to avoid these problems is provided as well.

1. **Aired milk** - this is milk with a lot of tiny air bubbles inside. This air bubbles are very small and it takes long time - from one to more than 10 or even 20 hours for these air bubbles to get out of the milk. This time depends on the milk parameters and mainly on the milk Fat contents - the higher milk fat contents is the longer time is required for the air bubbles to get out of the milk. The ultrasonic method is not suitable for aired milk testing since the measurement results are with significant deviations from the real values and even in some particular cases the measurement can not be completed successfully.

The milk becomes aired usually during the milk processing - milking, homogenization, UHT, etc., but it can be aired even when the milk sample is mixed if this is made by hard continuous shaking. This is why the sample should be mixed smoothly and carefully.

There are two known methods that allow aired milk to be quickly recovered. The first method requires the measuring mug with the milk sample to be processed for about 10 to 15 seconds in an ultrasonic cleaning machine. The cavitation phenomena of the powerful ultrasonic field removes the air bubbles almost instantaneously. The other method requires the milk sample to be put under pressure - several kg/cm² for about 10 to 20 seconds. Unfortunately as you may note both methods require additional equipment but as long as there are small inexpensive ultrasonic cleaning machines commercially available it is easier to apply the first method if necessary.

2. **Milk acidity** - The ultrasonic method requires the milk sample to be warmed during the measurement process. In case the milk has an increased acidity a milk coagulation may occur when the milk is warmed and the measurement results will have significant deviations from the real values and even in some particular cases the measurement can be not completed successfully. For your reference the milk acidity of the milk sample must be less than 25°C for cow, buffalo and goat milk and less than 28°C for sheep milk. Another issue is the milk coagulation contaminates the ultrasonic sensor and it must be properly cleaned then.
3. **Separated milk fat** - If you try to test cool (refrigerated) milk which has some milk fat/cream separated you will probably get wrong result especially for the milk fat contents. In this case you need to warm up the milk up to 40°C-42°C first, mix the milk in order to solve the separated fat, the cool it down to 20°C - 25°C and then you can test it with the analyzer.
4. **Contaminated milk** - Any solid particle with a size above 0.5 mm may cause measurement result deviations. This is why we recommend the milk sample to be filtered before it is tested if there is a doubt the milk is contaminated.
5. **Milk preservatives** - The milk preservatives change the measurement results. Usually the result deviation is not big but it will depend on the particular preservative used.
6. **Contaminated sensor** - During the normal work of the analyzer some solid deposits are laid on the ultrasonic sensor walls. In case the analyzer is not regularly and properly cleaned these deposits are gradually accumulated and the measurement results begin to differ from the real milk parameters. This is why it is very important the milk analyzers to be always properly cleaned in accordance with their cleaning procedure.
7. **Power supply** - The power supply can also cause problems with the measurement results accuracy and repeatability. Generally this can happen if the power supply voltage is out of the specified range (220/110V \pm 5%) or if the power supply line is too noisy - especially if there is a powerful equipment working nearby and connected to the same power supply line.

8. **Measurement system leakage** - Once the milk sample is sucked into the measurement system it must remain immobile until the test completes. In case there is some leakage and the measurement system is not sealed well the milk sample would drain out more or less slowly. This will cause measurement results deviation or the measurement even may fail in case some air goes into the ultrasonic sensor. A clear indication of measurement system leakage is if the sample is dropping out of the Analyzer's sucking nozzle during the measurement time (just few drops per measurement is normal). Most often some leakage occurs since the plastic plug with the rubber O - ring is not properly plugged into the syringe.
9. **Ultrasonic sensor conditioning** - Sometimes after the analyzer has not been used for a long time (several days or more) the ultrasonic sensor dries inside and this may result in increase measurement results deviations for the first tested samples. In this case it is recommended several dummy samples (with water or milk) to be made before the real samples are tested.
10. **Wrong milk type tested** - Ekomilk Spectra is factory calibrated for three different kinds of milk - cow, buffalo and mixed milk. If another kind of milk is tested it may result in a measurement result deviation out of the Analyzer's specification.

12 Appendix 2 - Send last result over serial port(Continuous mode)

This mode can be available after measurement (Figure 31). You can send data manual or auto (after every measurement). The data is sent until you close the results dialog.

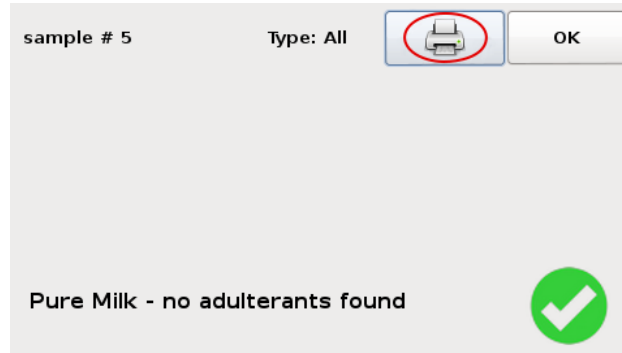


Figure 31: Send data

Data of Spectra last measurement can be send over serial port like 93 chars long packet(as ASCII string, contains 18 subpackets, starts with "[" and ends with "]") in the following format:

VERSION	MILK SAMPLE	FAT(r)	SNF(r)	DEN(r)	AWM(r)	FP(r)	PROT(r)	LACT(r)
FAT(c)	SNF(c)	DEN(c)	AWM(c)	FP(c)	PROT(c)	LACT(c)		
ADULTERANT NAME	ADULTERANT CONCENTRATION						CHECK SUM	

It starts with version subpacket, followed by milk sample number, subpackets representing Ultrasound results respectively in raw [(r)] and corrected [(c)] format, Adulterant name, Concentration(Infrared measurement) and the last is CheckSum.

First two chars shows version of current sending method:

VERSION 0 1 (For example - version 1)

Next four chars shows milk sample number:

MILK SAMPLE 0 0 0 5 (For example - sample 5)

- **Ultrasound parameters**

FAT, SNF, DEN, AWM, FP, PROT(for both Raw and Corrected format) subpackets are 4 chars long each and represent (in decimal) relative result multiplied by 100 (except FP, which is multiplied by (-100)) in ASCII format. For example:

Parameters	Value	Multiplied by	Result	Subpacket
FAT	5.25	*100	525	0525 (ASCII - 0x30 0x35 0x32 0x35)
SNF	10.2	*100	1020	1020 (ASCII - 0x31 0x30 0x32 0x30)
DEN	1.15	*100	115	0115 (ASCII - 0x30 0x31 0x31 0x35)
AWM	0.00	*100	0	0000 (ASCII - 0x30 0x30 0x30 0x30)
FP	-0.20	*(-100)	20	0020 (ASCII - 0x30 0x30 0x32 0x30)
PROT	3.42	*100	342	0342 (ASCII - 0x30 0x33 0x34 0x32)
LACT	3.75	*100	375	0375 (ASCII - 0x30 0x33 0x37 0x35)

If there is no ultrasound measurement all 14 subpackets are filled with 0000 (ASCII 0x30 0x30 0x30 0x30). If there is no infrared measurement or there is one but with no adulterant available

(PURE milk) subpackets with corrected values will be filled with 0000 (ASCII 0x30 0x30 0x30 0x30). This is a full list of measurable ultrasound parameters. Possible, in some cases user don't want to see all of them. If some parameter is disabled for displaying, it's place in this packet will be filled with spaces (0x20). By this way, receiver will know this is no valid value. If there are not started ultrasound measurement or is started, but is finished with error, then all packet will contains spaces (0x20).

- **Infrared parameters**

- *ADULTERANT NAME* is a 20 chars long subpacket and contains the name of adulterant in ASCII format. If there is no infrared measurement the text is "NA" or "na"). If the name is shorter than 20 chars it is supplemented with SPACE (ASCII - 0x20). For example:

Adulterant name - 'nitrate' (7 chars,in ASCII - 0x6E 0x69 0x74 0x72 0x61 0x74 0x65).It has to be added 13 SPACE chars and the end result will be following one: 0x6E 0x69 0x74 0x72 0x61 0x74 0x65 0x20 0x20 0x20 0x20 0x20 0x20 0x20 0x20 0x20 0x20 0x20 0x20.

If there are not started infrared measurement or is started, but is finished with error, then this packet will contains spaces (0x20) only. In some cases may contains "ABNORMAL", this mean no error occurred during measurement, but results cannot be recognized, may be caused by air bubbles in the sample, some hardware problem or some unknown adulterant. Value field (see bellow) will contains spaces only, cause here are not valid value available. Or "IGNORED", if fat is below 1.5 %.

- *ADULTERANT CONCENTRATION* - concentration (%) of the adulterant. Subpacket is 4 chars long. As ultrasound parameters it is multiplied by 100 and result in decimal is represented in ASCII format:

Conc	2.16	*100	216	0.216 (ASCII - 0x30 0x32 0x31 0x36)
------	------	------	-----	-------------------------------------

If there are not started infrared measurement or is started, but is finished with error, then this packet will contains spaces (0x20) - not valid result. If adulterant name contains only spaces (0x20), and value contains only zeroes (0x30). This will mean pure sample - no adulterant found.

- **Check Sum**

Check sum (5 chars long packet) is the sum of all bytes (86, in HEX format) forming all subpackets. Result in decimal is represented in ASCII format. For example:

Checksum = 0x30 + 0x35 + 0x32 + 0x35 + 0x31 + 0x30 + 0x32 + ... (etc. all 86 chars) = 0xD1E (hex), which is 3358 in decimal. Check sum (CS) packet is formed like 03358(ASCII - 0x30 0x33 0x33 0x35 0x38).

If any error occurred during measurement Spectra will send "ERROR" over serial port instead of the packet. RS232 settings are 2400, e, 7, 1 (2400bps, Parity: Even, 7 data bits, 1 stop bit).

In continuous mode packet is sent every 500ms.

13 Appendix 3 - Troubleshooting

13.1 Filter clogging(infrared only)

In case of air bubbles visible in the thin tubing entering the cuvette, the filter on the spout of the infrared module could be clogged (see more section 2). This is often the problem when that happens because the peristaltic pump cannot suck in enough sample and vacuum is created in the system. The filter should be replaced with a new one or well cleaned.

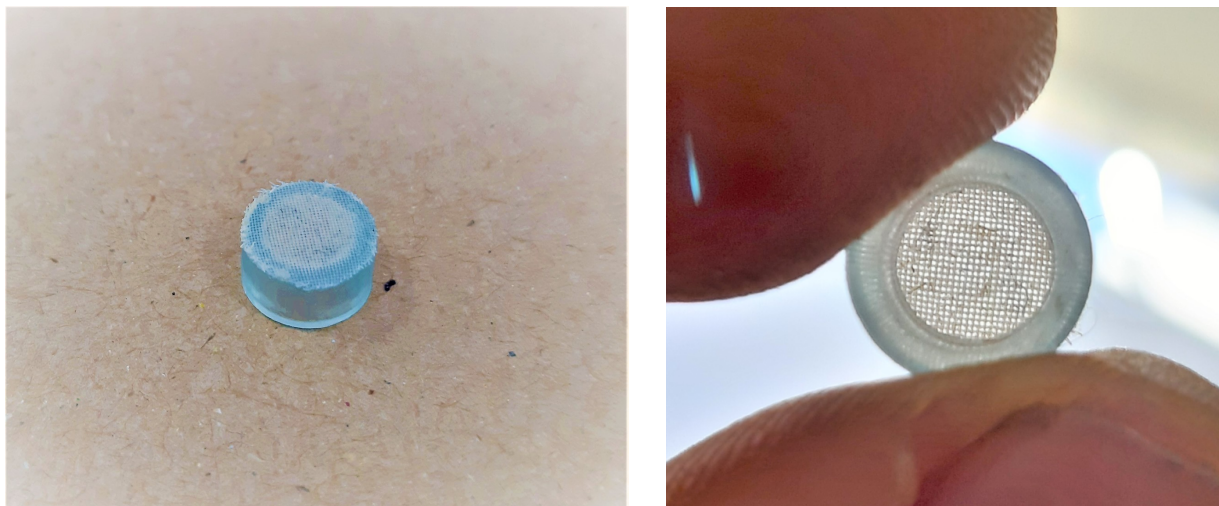


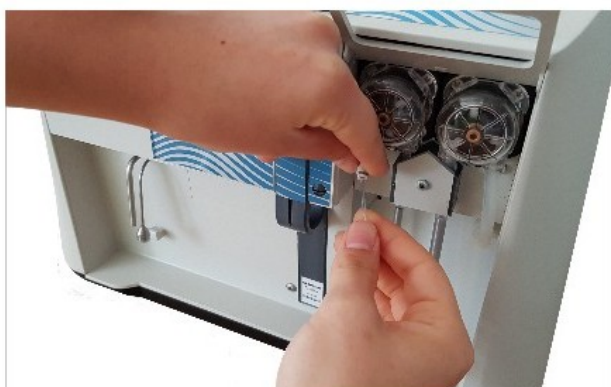
Figure 32: Clogged filter

13.2 Cuvette clogging(infrared only)

When clogging the cuvette, the following should be done as soon as possible:

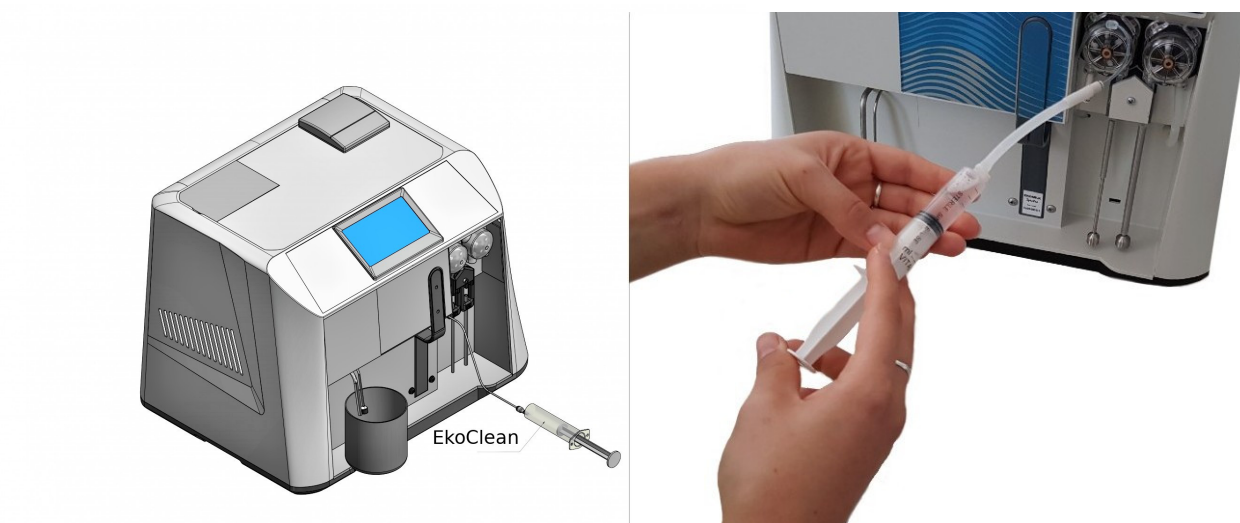
1. Remove the filter from the infrared module inlet and clean it (section 13.1)
2. Unplug the thin hose between the cuvette exit and the peristaltic pump.

Press the nozzle where the hose is fixed with one hand, while with the other hand pull out the hose.



3. Using the syringe with a nozzle from the packing set - take 5-10 ml of cleaning solution EkoZero.

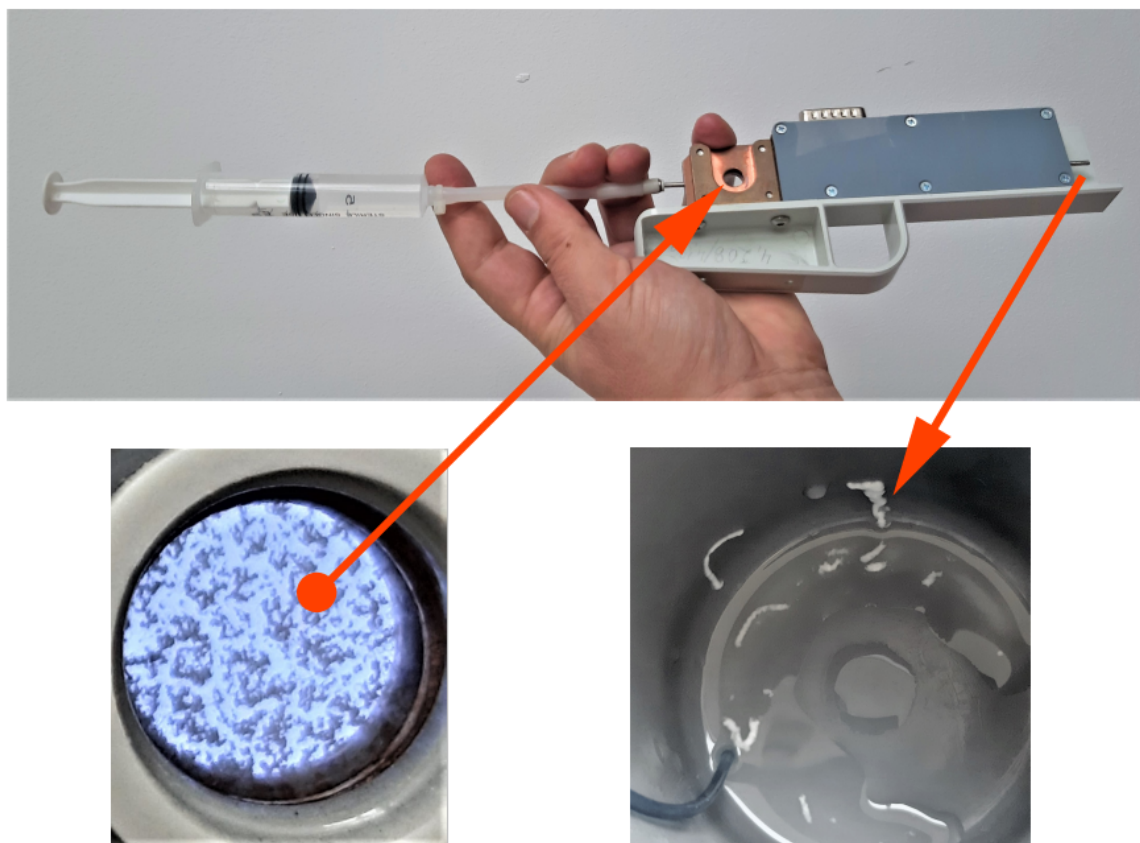
4. Plug the syringe to the thin tube and gently pull the piston. This creates vacuum that suck any particles that might have been stuck in pockets and acting as valves. Try in the opposite direction if the attempt is not successful. You can repeat this several times, until you manage to unclogging the cuvette minimally to continue with further washing procedures.



5. Again using the syringe with nozzle from the packing kit - take 10 ml of cleaning 3.5% EkoSpectra Clean solution.
6. Insert the syringe into the thin tube and gently push the plunger. This creates pressure. Thus, inject EkoSpectra Clean into the device until 1-2 ml comes out of the milk inlet. Leave the EkoSpectra Clean solution in the device for 1-2 hours. Then gently push the plunger to inject the remaining amount into the syringe.
7. Unplug the syringe from the thin tube and reconnect it to the peristaltic pump sleeve.
8. Perform the full infrared cleaning procedure - section 6.1 (with EkoSpectra Clean and deionized water, but without waiting 24 hours described in the procedure)
9. Perform Infrared cleaning procedure (with EkoZero)- section 6.1
10. Place the cleaned milk filter at the inlet of the infrared module.
11. Perform Zero procedure.

In case of impossibility to unclog the cuvette as a last action to resort to the following:

1. Eject the cuvette - see more section 14 (**The operation of cuvette ejecting or replacement should be performed by an authorized service or technician**)
2. Using the syringe with nozzle from the packing kit - take 10 ml of cleaning 3.5% EkoSpectra Clean solution.



3. Attach the syringe to the cuvette tube and gently push the plunger. This creates pressure. Thus, inject EkoSpectra Clean into the cuvette until 1-2 ml comes out of the other side. Leave the EkoSpectra Clean solution in the device for 1-2 hours. Then gently push the plunger to inject the remaining amount into the syringe.
4. Unplug the syringe with the cuvette.
5. Reconnect the thin tubes with the cuvette.
6. Insert cuvette in to the device (see more section 14)
7. Perform the full infrared cleaning procedure - section 6.1 (with EkoSpectra Clean and deionized water, but without waiting 24 hours described in the procedure)
8. Perform Infrared cleaning procedure (with EkoZero)- section 6.1
9. Place the cleaned milk filter at the inlet of the infrared module.
10. Perform Zero procedure.

13.3 Sticking of pump's silicone hose(infrared and ultrasound)

If the Ekomilk Spectra has not been used for a long time or has not been cleaned, the pump hose may become stuck. Signs of this are, for example, if the pump is rotating but cannot suck milk or cleaning solution.

1. Lift the external cover of the pumps.
2. Take a flat screwdriver and carefully insert it into the hole on the underside of the pump.
3. Carefully rotate the screwdriver to one side and hear the plastic cover snap open.



4. Slowly pull out the plastic cover.
5. Remove the silicone hose from the pump and see where it stuck.
6. Then grasp it with two fingers and begin to massage it.



7. Once it has blown off you can start assembling it. When replacing the silicone hose, you can gently rotate the pump to make it easier to install.
8. Carefully put the plastic cover on the pump and you will hear it fasten. Then release the outer pump cover and you are ready.



14 Maintenance

Instructions for cuvette ejecting and replacement

Note: Never subtract the cuvette, while the device is turn on.

Note: If the cuvette is removed, the calibration may not be appropriate and the Ekomilk Spectra may will not measure correctly.

The operation of cuvette ejecting or replacement should be performed by an authorized service or technician. Otherwise the guarantee will be invalidate.

1. Unplug the power supply before unlocking the cuvette.



Figure 37: Cuvette locked

2. Release the locking mechanism, by pushing the piston.



(a) Unlock Cuvette



(b) Cuvette unlocked

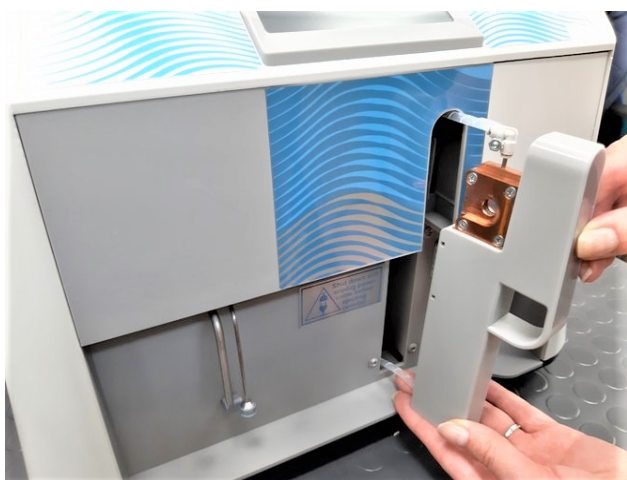
3. When the cuvette is unlocked, pull it out.



4. The cuvette is released from the system, when unplugging the upper and lower hose from the nozzles.



5. Inserting the cuvette into the system.



NOTE: When inserting the cuvette back in the analyzer, it is very important to take care of the direction of the hoses, help manually to ensure their proper direction and to avoid hose pinching and bending.

6. Locking the cuvette with the locking mechanism, by pressing the piston.



15 Guarantee

Guarantee card	<p>Guarantee period is one year after purchasing data. Improper handling, transport and storage will invalidate the guarantee. Guarantee is void if warranty labels are removed. The guarantee period for the cuvette windows* is 6 months.</p> <p><i>*The cuvette windows are slightly soluble in water and they need to be replaced every 6 months, otherwise the measurement correctness will be affected.</i></p>
SPECTRA	
Date of purchase:	
Serial N:	
Distributor:	
Signature:	
Stamp:	

Purchaser

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Service report

Service entry date	Damage	Delivery date	Signature