Water Analysis

MACHEREY-NAGEL

# *NANOCOLOR*® *VIS* II and *NANOCOLOR*® $^{UV}/_{VIS}$ II

Smart photometry

## Manual

Distributed by:

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# Content

# 1 Introduction

Welcome and thank you for deciding on a spectrophotometer from MACHEREY-NAGEL.The *NANOCOLOR*® $^{UV}/_{VIS}$ II and *NANOCOLOR*® *VIS* II are powerful, fast and compact spectrophotometers for water analysis, which are able to evaluate MACHEREY-NAGEL *NANOCOLOR*® tube and standard tests. In addition, the instruments are also capable of determining the nephelometric turbidity measuring of a sample by light diffusion at a 90° angle. The combination of a 10.1" HD display with an intuitive, icon based menu structure enables a fast, comfortable and enjoyable handling of the spectrophotometers. Thus, the spectrophotometers are the ideal laboratory photometer for the entire spectrum of water analysis.

## 1.1 CE mark

The CE mark declares that the product complies with the harmonization legislation of the European Community listed below:

European Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2)

European Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)

European Directive 2014/30/EU on the harmonization of the laws of the member states relating to electromagnetic compatibility (EMC)

European Directive 2014/35/EU of electrical equipment designed for use with certain voltage limits (LVD)

## 1.2 Nameplate

*NANOCOLOR*® $^{UV}/_{VIS}$ II:


*NANOCOLOR*® *VIS* II:


## 1.3 Explanation of symbols

The nameplate of the device contains the symbols and terms listed below with the following meanings:

| Term / Symbol | Meaning |
|---|---|
| *NANOCOLOR*® $^{UV}/_{VIS}$ II;<br>*NANOCOLOR*® *VIS* II; | Device type designation |
| SN: | Serial number of the device |
| 110 V - 240 V, 50/60 Hz 60 VA | Power supply *NANOCOLOR*® $^{UV}/_{VIS}$ II |
| 12 V DC / 3.0 A | Power supply *NANOCOLOR*® *VIS* II |
| CLASS – 1M LASER-PRODUCT | The barcode reader of the *NANOCOLOR*® spectrophotometers is subject to laser protection class 1M. |

| | |
|---|---|
|  | According to 2012/19/EU, it is prohibited to dispose of the device through public waste disposal systems. Note also the information in the “Disposal” section. |
|  | The CE symbol indicates fulfillment of the applicable harmonization legislation of the European Community. |
| MACHEREY-NAGEL | Identification of the manufacturer |

## 1.4 Technical description

A halogen lamp and a deuterium lamp cover the wavelength range from 190 nm – 1100 nm in the *NANOCOLOR*® $^{UV}/_{VIS}$ II. A halogen lamp covers the wavelength range from 320 nm – 1100 nm in the *NANOCOLOR*® *VIS* II. The light of the respective lamp is diffracted via a concave grating and sent through a slit into the instrument’s cuvette slot. After the light has passed through the sample, the amount of absorbed light is calculated by detecting the remaining light. Matching the measured absorbed light with a pre-set calibration, the instrument can calculate the concentration of the sought analyte.

## 1.5 Technical details

| | *NANOCOLOR*® $^{UV}/_{VIS}$ II | *NANOCOLOR*® *VIS* II |
|---|---|---|
| Type: | Spectrophotometer with reference detector technology (RDT) | |
| Light sources: | Deuterium lamp (UV range), Halogen lamp (visible range) | Halogen lamp |
| Optical system: | Monochromator | |
| Wavelength range: | 190 nm – 1100 nm | 320 nm – 1100 nm |
| Wavelength accuracy: | ± 1 nm | |
| Wavelength resolution: | 0.1 nm | |
| Wavelength calibration: | Automatic | |
| Wavelength selection: | Automatic, barcode, manual | |
| Scan speed: | 1 complete scan < 1 min | 1 complete scan < 1 min |
| Spectral bandwidth: | < 2 nm | < 4 nm |
| Photometric range: | ± 3.0 E in wavelength range (200 nm – 900 nm) | ± 3.0 E in wavelength range (340 nm – 900 nm) |
| Photometric accuracy: | 0.005 E at 0.0 – 0.5 E; 1 % at 0.5 – 2.0 E | |
| Photometric linearity: | < 0.5 % at 2 E; ≤ 1 % at > 2 E | |
| Stray light: | < 0.05 % | < 0.5 % |
| Measuring modes: | More than 200 preprogrammed tests and special methods; 100 user defined methods; absorbance; transmission; factor; kinetics; 2-point calibration; scan; nephelometric turbidity measurement | |
| Turbidity measurement: | Nephelometric turbidity measurement, 0.1–1000 NTU | |
| Cuvette slot: | Test tubes 16 mm AD<br>Rectangular cuvettes 2 mm, 10 mm, 20 mm, 40 mm and 50mm | |
| Data memory: | 16 GB Micro SDHC card, 5000 measured data sets / 100 spectra, GLP conform | |
| Display: | HD 10.1 inch, anti-reflective cover glass with projected capacitive touch screen (PCAP) and background LED lighting | |
| Operation: | Barcode technology, icon-based menu guidance, touch screen | |
| Languages: | DE / EN / FR / ES / PT / PL / HU / NL / CZ / RO / IT | |
| External light: | Insensitive, open cuvette slot | |
| Interfaces: | LAN (CAT 6; only use shielded cable of max. 20 m length)<br>2 x USB (Host), 1 x USB (Function) and 1 x RS232 (only use shielded cable of max. 3 m length) | |
| Update: | Via Internet / PC and USB stick | |

# 2 Safety precautions

Please read the instruction manual carefully before setting up and using the instrument. In case instructions are disregarded, the instrument may malfunction or get damaged. To ensure perfect performance of the instrument, it may only be used as described in this manual. Please pay particular attention to the following warning notices, which indicate special dangers when using the instrument.

Caution:
Imminent danger of an electric shock.

*Caution*:
Follow the instructions in this section carefully to ensure the device does not become damaged.

**Warning:** The instructions in this section must be followed carefully to ensure that no further dangers or hazards exist, otherwise the device will very likely become damaged.

Caution:
Indicates danger by laser radiation.

Warning against biological hazards to users that can result from the use of the device. Note also the information in the “Chemical and biological safety” section.

## 2.1 Input supply

To ensure safe functioning of the instrument, please use the included power cable or power adapter only.

## 2.2 Chemical and biological safety

**Warning**: Working with chemicals can be hazardous. Handling chemicals without protection can lead to serious injuries. When working with the *NANOCOLOR*® spectrophotometers wear the required personal protective equipment.

During normal operation of this device, it may be necessary to use chemicals that are hazardous to your health or biologically harmful samples.

Before handling these substances, read all hazard statements and safety information printed on the containers with the original solutions and in the safety data sheets. All used solutions must be disposed of in accordance with the national laws and regulations. The type of protective equipment must be selected according to the concentration and amount of the hazardous substance present at the corresponding workplace. Rinse the hoses and cuvettes thoroughly after use with distilled water or a rinsing solution recommended by the manufacturer.

## 2.3 Protective clothing

As protective clothing we recommend to wear protection gloves and a laboratory coat.

## 2.4 Improper handling

In case of improper handling or handling operation by untrained personnel, MACHEREY-NAGEL declines any warranty claims.

## 2.5 Damage of casing

*Caution*: If the housing is damaged, the instrument needs to be sent in for repair. In such a case, the proper functioning of the instrument as well as the correctness of the measurement results cannot be guaranteed anymore.

## 2.6 Damage of cable

*Caution*: In case of a damaged cable, switch off the instrument and replace the cable immediately.

## 2.7 Transport

For transporting the instrument, the cardboard box used for the initial shipment as well as the protective inner parts are perfectly appropriate. Therefore, we recommend keeping the box. In case the original box is not available anymore, a large cardboard box and plenty of soft packing material, which prevents the instrument from shifting during transport, can be used.

## 2.8 Lamps

*Caution*: The *NANOCOLOR*® $^{UV}/_{VIS}$ II features a halogen and a deuterium lamp. The *NANOCOLOR*® *VIS* II features a halogen lamp. Both get very hot during operation. Hence, there is a risk of severe burns. Before exchanging the lamps, let them cool down for at least 30 minutes.

Please disconnect the instrument from the power source before starting any maintenance work in order to avoid electric shock.

*Caution*: The deuterium lamp generates ultraviolet radiation, which can harm your eyes. Never look directly into the light source without suitable UV protection glasses. Also, protect your skin against direct UV light.

The barcode reader of *NANOCOLOR*® spectrophotometer is subject to laser protection class 1M.


## 2.9 Instrument set-up

### 2.9.1 Set-up location

Only use the instrument in a suitable location. It should be placed on a dry, clean, leveled and plain surface. The operating temperature is between 10°C – 40°C. Make sure to protect the instrument from drastic changes in temperature. Avoid positioning the instrument close to windows, hot plates, ovens etc. To ensure correct functioning and reliable results, the instrument should not be exposed to direct sunlight or other bright, focused light sources. For optimal performance, humidity should be between 20% – 80 %

### 2.9.2 Package content

Please open the shipping box carefully with a sharp tool. Make sure not to damage its contents. Remove the instrument and all other parts carefully. Check the package, instrument and accessories for visible damages. In case a part is damaged, please contact your distributor or MACHEREY-NAGEL's technical support (see chapter 11.4).

The following list contains all items inside the package. Please ensure that your shipment is complete. In case of missing items, please also contact your local distributor or MACHEREY-NAGEL's technical support.

*Note: Keep the original box as well as the packaging material from the initial shipment to optimally protect the instrument in case of a return-shipment.*

Package content:

- *NANOCOLOR*® $^{UV}/_{VIS}$ II or *NANOCOLOR*® *VIS* II
- Cuvette slot cover
- Protective covering
- Power plug (only for *NANOCOLOR*® $^{UV}/_{VIS}$ II)
- Power supply with country specific adapters (only for *NANOCOLOR*® *VIS* II)
- USB connection cable
- Quickstart guide
- Calibration cuvette
- Microfiber cloth for cleaning of display and cuvettes
- USB stick
- Touch pen

# 3 Outer appearance

## 3.1 Front and side view


Figure 1: Front view $^{UV}/_{VIS}$ II


Figure 2: Front view *VIS* II


Figure 3: Side view $^{UV}/_{VIS}$ II


Figure 4: Side view *VIS* II

a Stereo speakers
b 10.1″ HD touch screen with PCAP
c Universal cuvette slot for tube tests of 16 mm OD and rectangular cuvettes of 2 mm, 10 mm, 20 mm, 40 mm and 50 mm
d Lamp compartment with halogen and deuterium lamp (SDHC card slot)
e 2D bar code scanner
f USB A interface (Host)

### 3.2 Back view


Figure 5: Back view $^{UV}/_{VIS}$ II


Figure 6: Back view *VIS* II

① USB A interface (Host)
② USB B interface (Function)
③ Ethernet (LAN) interface
④ RS 232 interface
⑤ Connection for power supply 110-240 V (~ 50/60 Hz)
⑥ Main switch
⑦ SDHC card slot ($^{UV}/_{VIS}$ II refer to Fig. 1d)
⑧ Connection for power supply 12 V DC 3A

## 4 Operating instruction

The *NANOCOLOR*® $^{UV}/_{VIS}$ II requires a voltage of 110 V – 240 V (~ 50/60 Hz). Plug in the power cable into the connection for power supply (Figure 5 ⑤) on the instrument's back side. The *NANOCOLOR*® *VIS* II requires a voltage of 12 V (min. 3A). Plug in the power adapter into the power supply and establish the connection to power supply (Figure 6 ⑧) on the instrument's back side afterwards. Then, plug the power plug into the electrical outlet. Please ensure that the power plug or power adapter is intact with neither cable break nor other damages. Otherwise, there is an imminent danger of an electric shock.

### 4.1 Connectivity

Next to the electrical connection, four more types of interfaces are available within the *NANOCOLOR*® $^{UV}/_{VIS}$ II as indicated on page 6 and 7:

2 x USB A (Host) (Figure 5 ① and Figure 3 f)
1 x USB B (Function) (Figure 5 ②)
1 x Ethernet (LAN) (Figure 5 ③)
1 x RS232 (Figure 5 ④ for the connection of different devices as well as laboratory information management systems (LIMS)

Next to the electrical connection (Figure 6 ⑧) 5 more types of interfaces are available within the *NANOCOLOR*® *VIS* II as indicated on page 12:

1 x SDHC-card slot (Figure 6 ⑦)
2 x USB Host (Figure 6 ① and Figure 4 f)
1 x USB function (Figure 6 ②)
1 x Ethernet (LAN) (Figure 6 ③)
1 x RS232 (Figure 6 ④ for the connection of different devices as well as laboratory information management systems (LIMS))

### 4.2 Turning on the instrument

The main switch of *NANOCOLOR*® $^{UV}/_{VIS}$ II (Figure 5 ⑥) / *NANOCOLOR*® *VIS* II (Figure 6⑥) can be found on the instrument's back side. Turn on the instrument. Subsequently, a boot screen appears displaying the MACHEREY-NAGEL logo. Afterwards, the instrument

performs a self test which takes about one minute. Next, a pop-up informing about the results of the performance check will be displayed. Press  or  to move to the start screen. Now the instrument is ready to use. The instrument's operating state can be checked in the upper left corner of the display by pressing the status-icon. A green icon indicates that the instrument is ready to use. A red icon indicates that the instrument is performing a measurement. In case the instrument is not ready to use an error message will be displayed.

## 4.3 Operation and user guidance

The spectrophotometer features a 10.1″ HD display with a projective, capacitive touch screen (PCAP). The instrument's cover-glass is non-reflecting. It can be easily and conveniently cleaned with the microfiber cloth included in your package or with a soft cotton cloth.


Figure 7: Start screen

### 4.3.1 Operation of the touch screen

The spectrophotometer features a 10.1″ HD display with a PCAP touch screen sensitive to touches of one or more fingers. This enables handling by means of pressing or wiping on the screen with either fingers or a touchpen (special pen for projective, capacitive touch screens). Wearing protective gloves does not impair handling the instrument properly. In selected menus, you can zoom in and out by moving two fingers in opposite directions or towards each other. Numbers or texts can be inserted to the respective number or text fields, by touching the respective field, which automatically opens a pop-up displaying a text or numeric keypads.

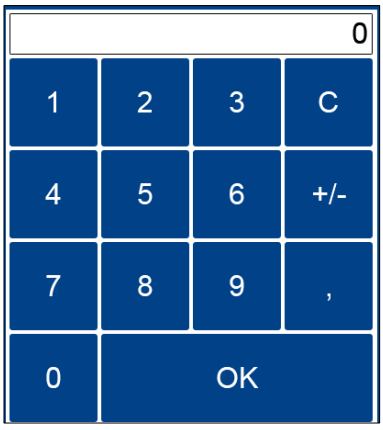



Figure 8: Numeric keypad

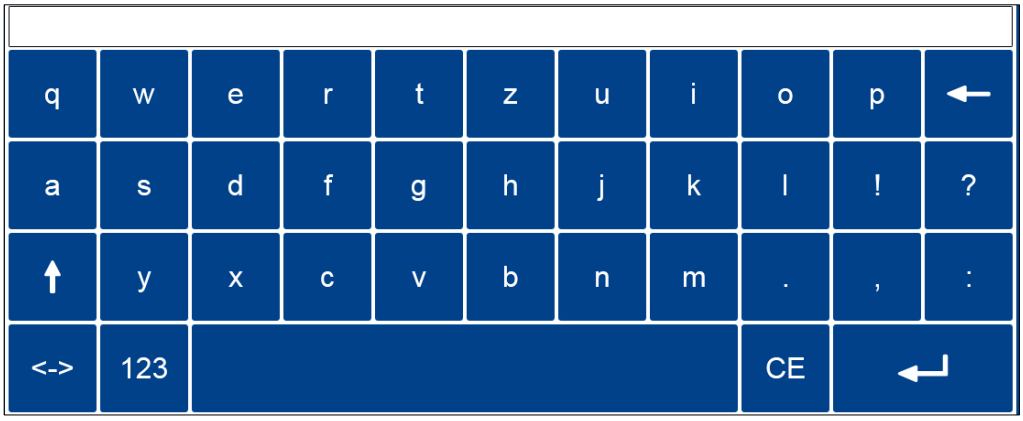



Figure 9: Text keypad I

Press the <-> key to switch between the keypad layouts QWERTZ, QWERTY and AZERTY, depending on which language you are using.
Press the 123 / abc key to switch between letters and numbers or special characters.

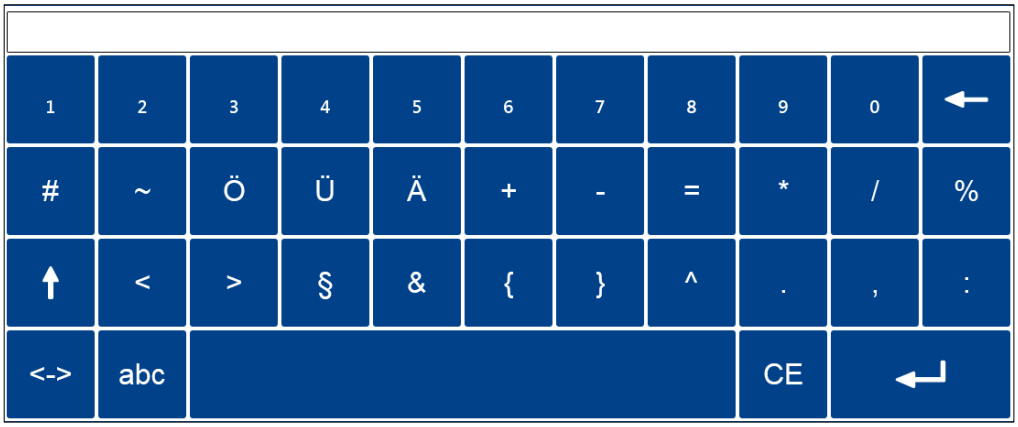



Figure 10: Text keypad II

Pressing the ↑ key on the special character layout will switch to another keypad of special characters. Via the text keypad, this key is used to capitalize letters.

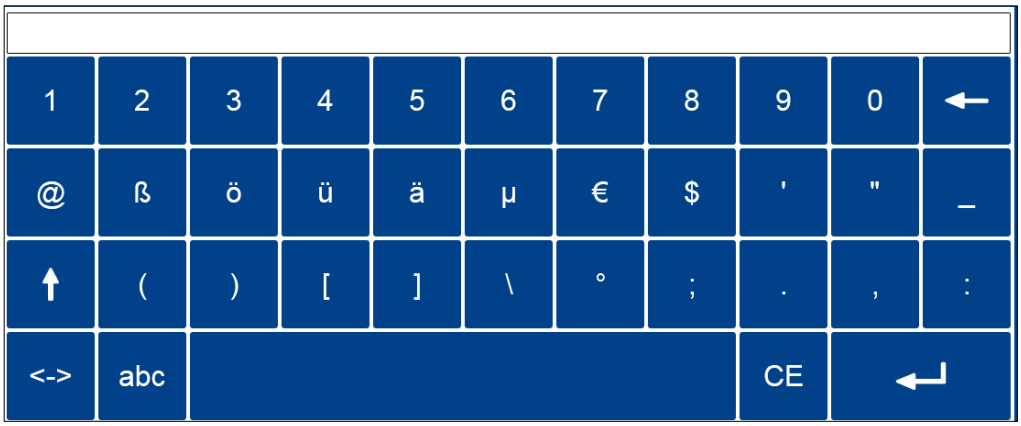



Figure 11: Text keypad III

### 4.3.2 Task and status bar

The spectrophotometer menu is equipped with a status information bar at the top and a task bar at the bottom of the display. Both bars are always displayed. The upmost bar displays the instrument's operating status.


Figure 12: Status bar

In case of activated special features (e.g. memory, reaction time, etc.), a status icon appears. The status icon in the upper left corner displays whether the instrument is ready to use. A green icon indicates that the instrument is ready to use. A red icon indicates that the instrument is currently busy, e.g. with a measurement process. The instrument can be operated via the task bar.

Figure 13: Task bar

During the measuring process the bar is inactive (shaded appearance).

Task bar functions:

Home icon:

By pressing this icon at any position in the menu, one is guided back to the start screen *(see Figure 7)*. From the start screen, it is not possible to get back to the last application via the  icon.

Back icon:

By pressing this icon, one goes back to the application or level that was used last.

Please consider that some menus cannot be retrieved by pressing the  icon (e.g. measurement menu), as the process has been ended by leaving the respective menu.

Feature icon:

By tapping this icon, one can activate additional features as long as they are available in the selected menu.

Test icon:

By pressing this icon, basic features as well as MACHEREY-NAGEL tests and applications, such as special methods, scan, color measurement or test number can be selected in the method menu.

Main menu icon:

By pressing this icon, one can get to the main menu, including settings, the IQC menu as well as other functions.

Memory icon:

By pressing this icon, the measurement memory is opened. All measurement results obtained via the programs in the methods menu (  icon) are saved here.

### 4.3.3 Favorites bar

Figure 14: Favorites bar on the start screen

The instrument allows you to add favorites to the start screen to personalize the instrument and to provide quick access to the most preferred functions. Initially, the favourites bar features the icon for *NANOCOLOR*® tube tests. Other icons can be added to the favorite bar

by holding and moving them to the blue colored area. Removal of icons from the favorites bar is done by holding an icon and moving it out of the blue colored area.

### 4.3.4 Option buttons and check boxes

Option buttons are framed in black. Activated option buttons are filled with a black dot. Please consider that only one selection point can be activated at a time. You can activate a selection point by touching it. By leaving the menu, the selected options will be saved automatically.

Check boxes are square shaped. Touching an empty check box or its text will set a checkmark and activate the box. It is possible to select more than one check box at once. Touching a checkbox with a checkmark deactivates the box and removes the checkmark.

### 4.3.5 List functions

When editing text or numeric fields, it is possible that a selection window with a list will be opened instead of a keypad. This list can be scrolled down by finger movement on the display. A suitable field can be selected by touching it. The background of the currently selected entry will be colored. There are two kinds of lists: pre-defined lists (e.g. choice of region) cannot be edited and complemented, while dynamic lists can be adjusted.

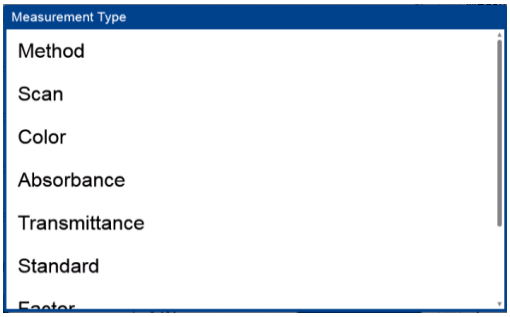



Figure 15: Predefined list

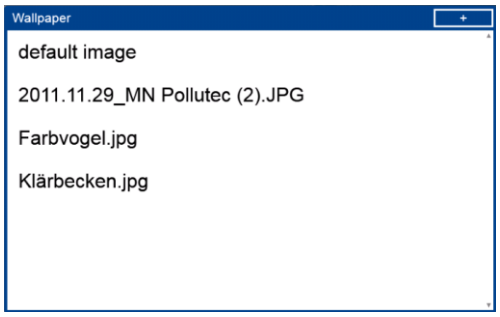



Figure 16: Dynamic list

A new entry can be added by pressing  at the upper right corner of a dynamic list. A numeric or text keypad will appear in order to add the new entry. Confirming the entry will add it to the list. Entries can only be deleted in dynamic lists by pressing the respective entry for a moment until a recycle bin  appears. Pressing will remove the entry from the list.

# 5 Methods

The method selection window can be opened by pressing . The available options are shown in Figure 17. Press the appropriate icon to open the desired window.

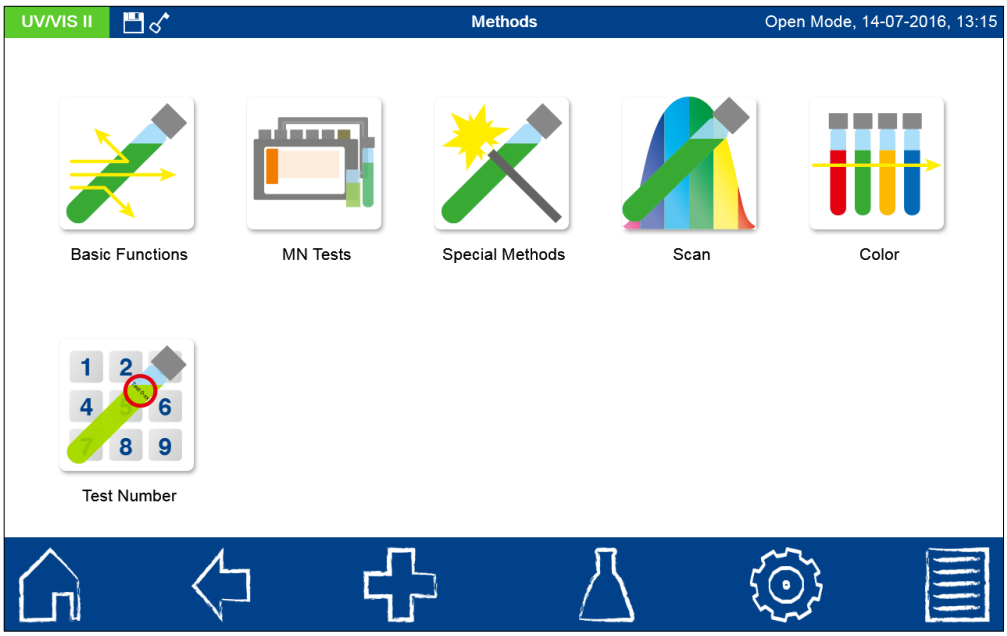



Figure 17: Method selection window

***Note: For measurements in the UV-range, please make sure to always cover the cuvette slot. Otherwise result fluctuations cannot be excluded!***

## 5.1 Basic functions

Pressing the icon will open the basic functions menu. There are six different measurement options to choose from.

### 5.1.1 Factor

The basic function “Factor” enables the determination of measurement results through the multiplication of an absorbance with a user defined factor. After having selected this method, a window will appear asking for the factor and the wavelength for the measurement and calculation. Confirming with opens the measurement window. Inserting the zero solution and pressing will initiate the zero measurement. After the successful measurement of the zero solution, the sample solution needs to be inserted. Pressing will start the measurement process. After the measurement has been completed, the measurement result will be displayed in the result window.

### 5.1.2 Standard

The basic function “Standard” enables the definition of a sample’s concentration on basis of the concentration of a standard solution and a zero solution. After having selected this method, a window will appear asking for the standard concentration and the wavelength for the measurement. Confirming the entries by pressing will open the measurement window. Inserting the zero solution and pressing will initiate the zero measurement. Then, the standard solution needs to be inserted. Pressing will start the sample measurement. After the standard solution the sample solution has to be inserted. Pressing will start the sample measurement. After the measurement has been

completed, the measurement result will be displayed in the result window (see 6.1.3). In case more samples need to be investigated the next sample can be inserted. Pressing ▶ will start the measurement of the next sample.

### 5.1.3 Absorbance


The basic function “Absorbance” enables the measurement of a sample’s absorbance against a zero solution. After having selected this method, a window will appear asking for the wavelength of the measurement. By pressing the Add button a set of wavelengths can be selected. The wavelenghts list can be cleared or selected entries can be deleted by pressing the Remove button.

Confirming with ✓ will open the measurement window. The instrument asks for a zero measurement. Inserting the zero solution and pressing 0 will initiate the zero measurement. After the successful measurement of the zero solution, the sample solution needs to be inserted. Pressing ▶ will start the measurement process. After the measurement has been completed, the measurement result is displayed in the result window (figure 18).

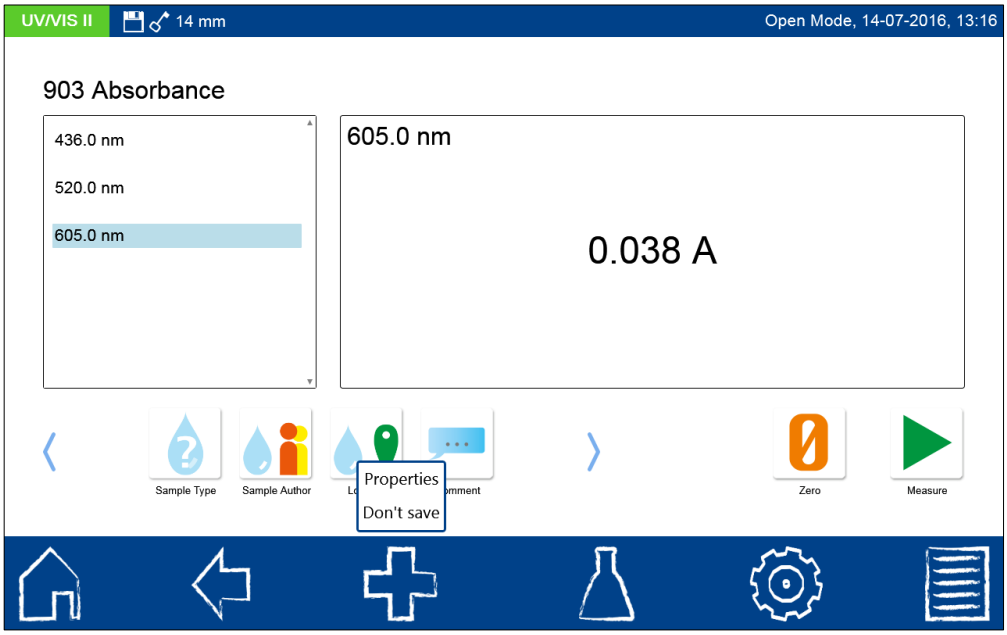



Figure 18: Result window of the absorbance measurement

The absorbance of the individual wavelengths can be displayed by selecting the appropriate wavelength from the list on the left. Use the icons below the result window to enter various types of sample information. Press the ✚ icon to see other available options. Via the “Properties” command, new sample information can be added below the measurement menu. For this purpose, the desired icon from the opened dialogue must be held down and then dragged into the blue flashing sample information bar. *(Please note: If the icon is already present in the sample information bar, this option will not be available. For more information about the available options, please see Section 6.2.1)* The “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

### 5.1.4 Kinetics

The basic function “Kinetics” enables the measurement of a sample’s kinetic against a zero solution. After having selected this method, a window will appear asking for the measurement time, a time interval and the measurement wavelength. Confirming the entries with ✓ opens the measurement window. Inserting the

zero solution and pressing 0 will initiate the zero measurement. After the successful measurement of the zero solution, the sample solution needs to be inserted. Pressing ▶ starts the measurement process. A diagram will be displayed showing the live-recording of the measurement results.

### 5.1.5 Transmission

The basic function “Transmission” enables the measurement of a sample’s transmission against a zero solution. After having selected this method, a window will appear asking for the wavelength of measurement. By pressing the Add button a set of wavelengths can be added to the list. The wavelenghts list can be cleared or selected entries can be deleted by pressing the Remove button. Confirming with ✓ will open the measurement window. A request for a zero solution will appear. Inserting the zero solution and pressing 0 initiates the zero measurement. After the successful measurement of the zero solution, the sample solution needs to be inserted. Pressing ▶ starts the measurement process. After the measurement has been completed, the measurement result will be displayed in the measurement window.

### 5.1.6 Turbidity

The basic function “Turbidity” enables the measurement of a samples nephelometric turbidity. You will be prompted to insert the sample solution. Insertion of the test tube and pressing ▶ initiates the measurement. After the measurement has been completed, the measurement result will be displayed in the result window. When measuring against a zero value, the cuvette with the zero solution must be measured before measuring the sample solution. The measurement of the zero solution is started by pressing 0 .

## 5.2 MN tests

The MN test menu is opened by pressing . The available options are shown in Figure 19. Press the appropriate icon to open the desired menu.

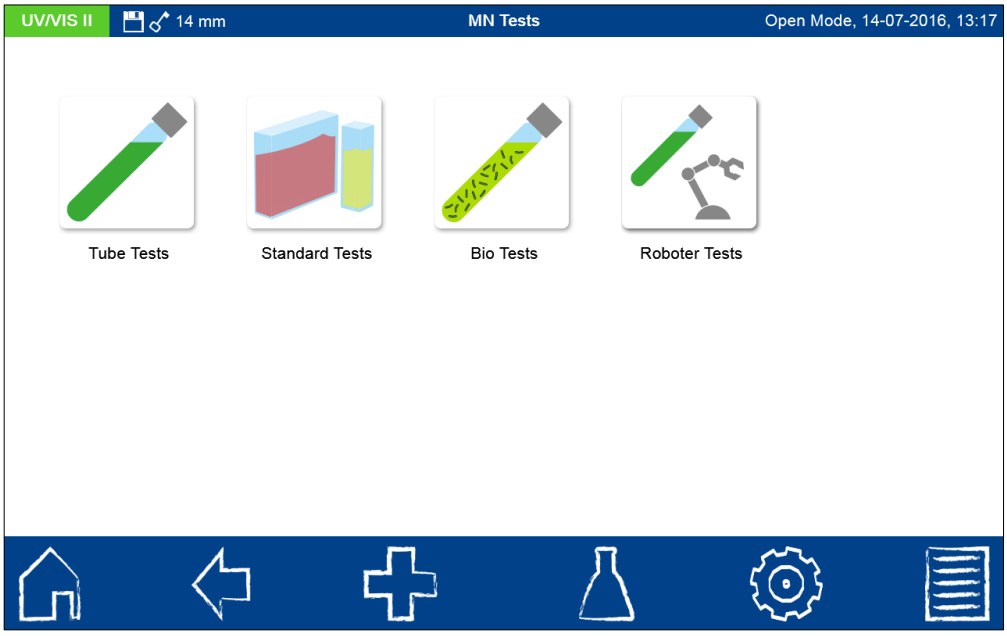



Figure 19: MN tests

***Note: For measurements in the UV-range, please make sure to always cover the cuvette slot. Otherwise result fluctuations cannot be excluded!***

### 5.2.1 Tube tests

MACHEREY-NAGEL tube tests can be selected in different ways with the spectrophotometer. All test tubes are labeled with a barcode. When the start screen is active or the device is in measuring mode, the barcode of the inserted test tube will be scanned automatically. The instrument detects the tube test and the measuring process is initiated automatically (*Please note: tube tests which need to be measured against a zero solution cannot be measured automatically using the barcode*). After the measurement has been completed, the measurement result will be displayed in the result window (figure 20).

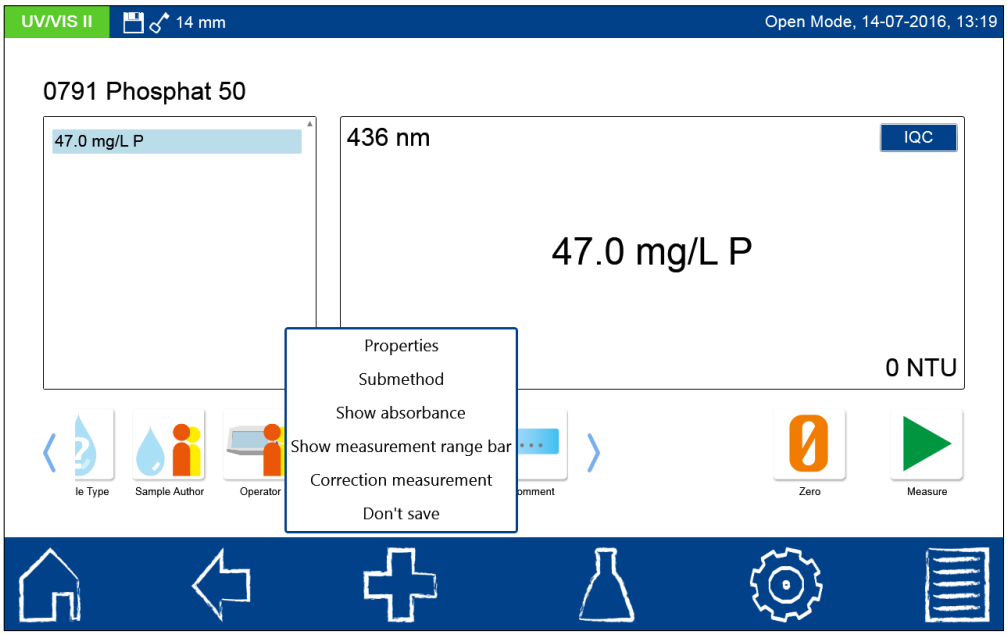



Figure 20: Result window of the cuvette measurement

Via and the icons below the result window, different sample information can be added. Via the “Properties” command, new sample information can be added below the measurement menu. For this purpose, the desired icon in the opened dialogue must be held down and then dragged into the blue flashing sample information bar with a wiping motion. *(Please note: If the icon is already present in the sample information bar, this option is not available.*) To remove the icon from the sample information bar, the procedure is similar. This time the icon must be removed from the blue flashing sample information bar with a wiping motion after holding it down. The following sample information can be added to the sample:

- Sample number: Sample numbers are assigned automatically and consecutively by the instrument. By pressing the sample number icon, you can assign a sample number manually. Thereafter, the instrument will count forward based on the manually assigned sample number.
- Date&Time: Enter the date and time of sampling here.
- Sample type: Enter information, such as 24 hr composite sample or 2 hr random sample here.
- Sampler: The name of the sampler can be assigned to the sample here.
- Comments: Additional information, such as appearance of the sample, turbidity or other characteristics may be noted here.
- Sampling location: Make a note of the sampling location here. Sampling locations already recorded are available for selection after each measurement.
- Dilution: The dilution of the sample can be entered here. Depending on the setting in the Settings / Dilution Formula menu (see Section 6.1.13), the dilution is displayed either as "1+X" or 1:X." The result of the measurement is converted automatically.
- User: A name can be entered here, for example, if a user has not been specified by the user account adminstrator or if the user is not the user currently logged-in.

The "Submethod" entry allows you to change the submethod of the respective method, and thus change the reference unit and the reference value (e.g. $PO_4$, see Figure 21). The activated submethod is highlighted in orange. When changing the submethod, the result is automatically converted. Removing the cuvette or exiting the measuring menu via the other icons in the taskbar quits the measurement, and the result will be stored in the measured value memory of the instrument.

The "Show absorbance" entry activates the display of the absorbance and transmittance value of the measurement in the lower left hand corner of the measurement result window. When the "Show 20-80% measurement range" entry is tapped, a colored bar will appear in the bottom center of the result window, which shows the position of the measurement result within the measuring range. If the bar is colored green, the result is within the 20-80% measuring range. If displayed in yellow, the measured value is still within the measuring range, but outside of the 20-80% measuring range. If the bar is colored red, the measured value is out of range.

The "Correction measurement" option can be used when a correction value (see Section 5.3) is applied to compensate for a measurement error in colored or turbid samples. *(Please note: This option is not available for every parameter.)*

Pressing the “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

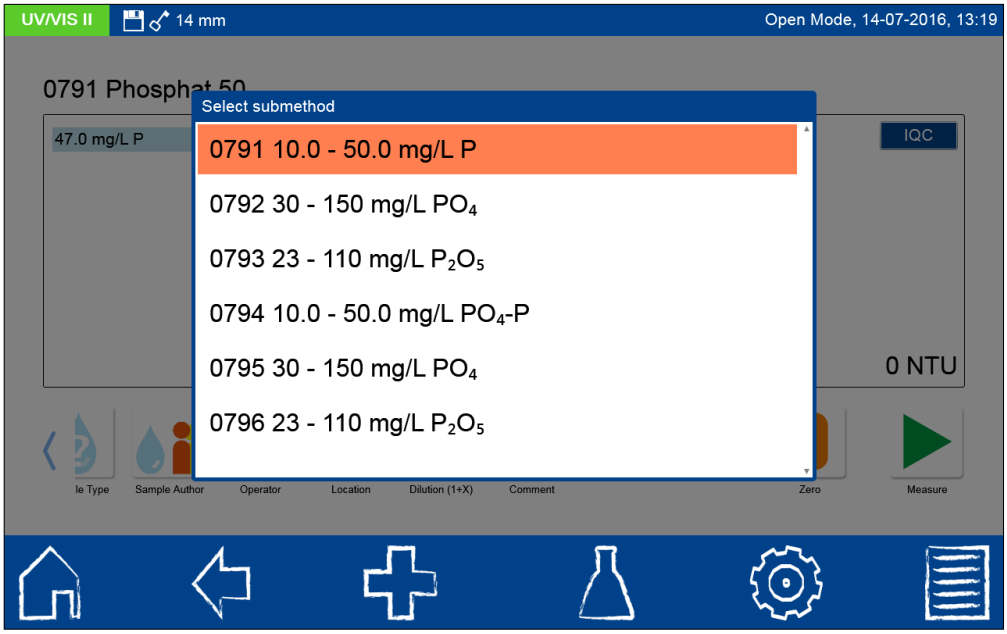



Figure 21: Selecting a submethod for cuvette tests

#### 5.2.1.1 Retrieving from a list box

Pressing this icon opens the list box of the tube tests (Figure 22). By selecting an entry the corresponding test will be highlighted. After confirming with , the measurement window will open. For multiple tube tests, a test protocol can be activated. By pressing the icon , the corresponding pictogram of the test will be displayed (see section 6.8).

Besides the scroll function in the list box, a filter function is also available. By entering the name of the test via the text keypad and confirming with Enter, the list will be searched for matches (Figure 23).

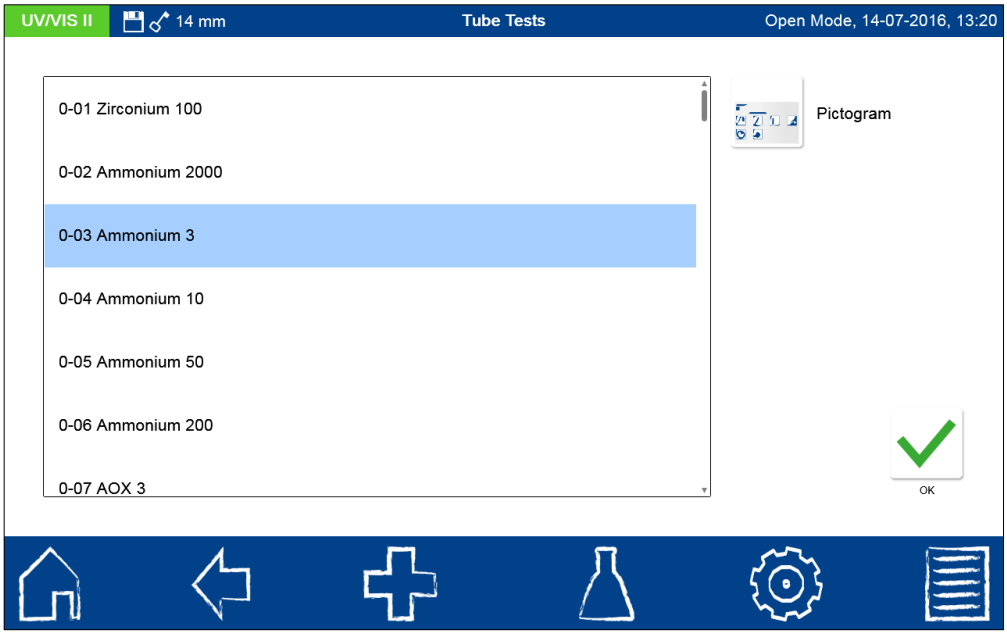



Figure 22: List box for tube tests

Whenever a test is selected by means of the list box, the measurement of the cuvette will not start automatically after it is inserted. The measurement has to be started manually by pressing or .

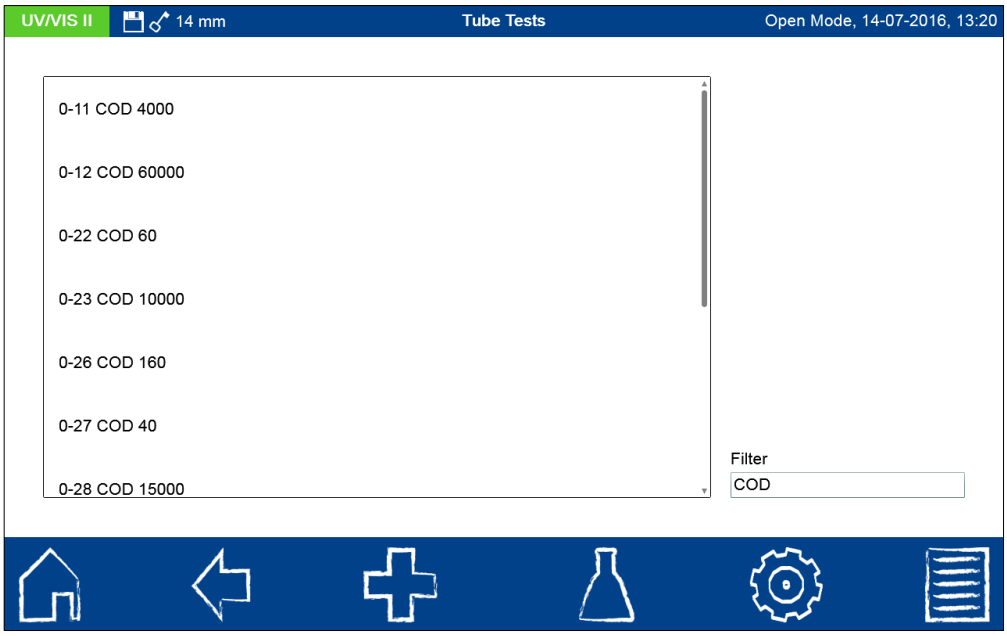



Figure 23: Filter function in the test list box

### 5.2.2 Standard tests

MACHEREY-NAGEL standard tests can be selected in different ways. It is, however, not possible to select a standard test by barcode identification. The appropriate measurement menu for a specific standard test can be manually selected in the test menu from a list through. Additionally, the test number (see section 6.7) can be manually inserted.

A request for a zero solution will appear. After insertion of the rectangular cuvette, the measurement is initiated by pressing . After the successful measurement of the zero

solution, the sample solution needs to be inserted. Pressing starts the measurement process. After the measurement has been completed, the measurement result will be displayed in the result window. Via and the icons below the result window, different sample information can be added. Removal of the cuvette or leaving the menu via the task bar icons quits the measurement process and stores the measurement result in the measurement memory of the device.

### 5.2.3 Bio tests

*NANOCOLOR*® bio tests can be retrieved in the device in different ways. The cuvettes are equipped with a bar code. If the instrument is set to the home screen or to a measurement menu, then the cuvette can be inserted and the barcode will be read automatically. The corresponding cuvette test will be activated in the device and the measurement will be started automatically (automatic measurements are not performed for bio tests that have to be measured against a zero solution). The desired test can also be retrieved by entering the test number (see section 5.7). After completion of the measurement, the result will be displayed in the measurement window. Via and the icons below the result window, various types of sample information can be added (see section 5.2.1). Removing the cuvette or exiting the measuring menu via the other icons in the taskbar quits the measurement, and the result will be stored in the measured value memory of the instrument.

## 5.3 Procedures for colored or turbid samples

These instructions are to be applied only in conjunction with the original instructions of the *NANOCOLOR*® cuvette tests. The photometric analysis of water samples with inherent color or turbidity always requires determination of a correction value. Color and turbidity both cause increased light absorption (increased absorbance), which leads to wrong results. Determination of correction values requires individual procedures for every test.

For example, it is not possible simply to measure the color of the sample without reagents and then substract this value from the test result. In many cases, the reagents alter the color or turbidity of the sample. All changes of the sample during analysis, such as dilution or addition of chemicals which alter pH or redox state have to be taken into account. Only the main reagent, which forms the measured color complex, is not added.

For the spectrophotometers *NANOCOLOR*® $^{UV}/_{VIS}$ II and *VIS* II, after the normal analysis (value A) is completed, activate the correction value program (see Figure 20) by selecting the “Correction value” entry via the icon in the result window.

The instrument asks for the cuvette with the correction value (value B) and measures the correction. The corrected measurement result is displayed and stored. For some tests it is neccessary to measure an additional blank value.

Basic procedure:

Determine measuring result as per original instruction = A

Determine correction value as per special instruction = B

Analytical result = A – B

Exceptions: Methods, where decreasing absorbancess are measured against a reagent blank value. In these cases, analytical result = A + B. The corresponding analytical instructions point out this fact.

It is very important to substract only values with equal dimensions (e.g. mg/L N; mg/L $NH_4$; $mmol/m^3$; E).

If, in the same matrix, the correction factor for several samples is so low that it can be neglected, it may be possible to work without correction. However, this conclusion can only be drawn from practical experience and cannot be predicted!

For measurement of the correction value use a clean, empty test tube filled with distilled water as a blank value (exceptions: test 0-59 / 0-64 / 0-65 / 0-66).

| Test | Test tube for correction (value B) |
|---|---|
| 0-01 Zirconium | Proceed as described in the instructions for Test 0-01, but **do not add *NANOFIX* R2**, seal, mix. |
| 0-02, 0-03, 0-04, 0-05, 0-06, 0-08 Ammonium 3-2000 | Procee<br>d as described in the instructions for test 0-02 / 0-03 / 0-04 / 0-05 / 0-06 / 0-08, but **do not add *NANOFIX* R2**, close, mix. |
| 0-07 AOX 3 | Almost all colors and turbidities are destroyed under test conditions and do not interfere. Resistant colors and turbidities cause deviating results which cannot be circumvented. |
| 0-09 Lead 5 | The original test already contains a correction. |
| 0-14 Cadmium 2 | Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close and mix. |
| 0-15 Carbonate hardness 15 | Open carbonate hardness test tube, add 4.0 mL sample solution, close, mix and adjust to zero (value B). Open test tube again, add ***NANOFIX* R2**, close and shake well. Measure after 2 min (analytical result = A – B). |
| 0-17 Chlorine/Ozone 2<br>0-18 Chlorine dioxide 5 | Fill **empty** test tube with 4.0 mL sample for each test. |
| 0-19 Chloride 200 | Open chloride test tube, add 1.0 mL sample solution and 1.0 mL distilled water, close, mix. |
| 0-21 Chloride 50 | Open chloride test tube, add 4.0 mL sample solution and 1.0 mL distilled water, close, mix. |
| 0-24 Chromate 5 | Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close, mix. |
| 0-11, 0-12, 0-22, 0-23, 0-26, 0-27, 0-28, 0-29, 0-30, 0-33, 0-36, 0-38 COD 40–60000 | Almost all colors and turbidities are destroyed under test conditions and do not interfere. COD resistant colors and turbidities cause deviating results which cannot be circumvented. |
| 0-31 Cyanide 08 | Proceed as described in the instructions for test 0-31, but add 0.5 mL distilled water instead of 0.5 mL R3. |
| 0-32 Anionic surfactants 4 | Proceed as described in the instructions for test 0-32, but instead of 0.5 mL R2 add 0.5 mL distilled water. |
| 0-34 Kationic surfactants 4 | Proceed as described in the instructions for test 0-34, but instead of 0.5 mL R2 add 0.5 mL distilled water. |
| 0-35 DEHA 1 | Open DEHA test tube, add 4.0 mL sample, close and mix. |
| 0-37 Iron 3 | No correction possible. |
| 0-40 Fluoride 2 | No correction possible. |
| 0-41 Formaldehyde 8 | Open formaldehyde test tube, add 2.0 mL sample solution, close and mix. |
| 0-43 Hardness 20 | Open hardness test tube, add 0.2 mL sample solution, close and mix. |
| 0-44 Hardness Ca / Mg | No correction possible. |
| 0-45 Potassium 50 | Open potassium test tube, add 2.0 mL sample solution, close and mix. |
| 0-46 Formaldehyde 10 | Fill **empty** test tube with 2.0 mL distilled water, 2.0 mL sample solution and 1.0 mL R2, close and mix. |
| 0-47 Nonionic surfactants 15 | No correction possible. |
| 0-49 Silver 3 | Proceed as described in the instructions for test 0-49, but add 0.5 mL DMSO instead of 0.5 mL R3. |
| 0-50 Organic acids 3000 | Proceed as described in the instructions for test 0-50, but instead of 2.0 mL R5 add 2.0 mL distilled water. |
| 0-52 Complexing agents 10 | Fill **empty** test tube with 4.0 mL sample and 1.0 mL distilled water, close and mix (analytical result = A + B). |
| 0-53 Copper 5 | Proceed as described in the instructions for test 0-53, |

| | |
|---|---|
| | but add 0.1 mL DMSO instead of 0.1 mL R2. |
| 0-54 Copper 7 | Fill **empty** test tube with 4.0 mL sample and 0.4 mL distilled water, add 0.2 mL R2, close and mix. |
| 0-56 Molybdenum 40 | No correction possible. |
| 0-57 KW 300 | The original test already contains a correction. |
| 0-58 Manganese 10 | Fill **empty** test tube with 4.0 mL sample solution, 0.5 mL distilled water and 0.5 mL R2, close and mix. Add 1 measuring spoon R3, close and shake vigorously. |
| 0-59 total-Chromium 2 | Almost all colors and turbidities are destroyed under test conditions and do not interfere. For samples which are still colored or turbid after decomposition: Fill **empty** test tube with 4.0 mL sample solution. |
| 0-61 Nickel 7 | Proceed as described in the instructions for test 0-61, but instead of 1.0 mL R2 add 1.0 mL NaOH 14 %. |
| 0-64, 0-65 Nitrate 8–50 | Open nitrate test tube, add 0.5 mL sample and 0.5 mL 2-propanol, close, mix. Blank value for correction: Open nitrate test tube, add 0.5 mL distilled water and 0.5 mL 2-propanol, close, mix. |
| 0-66 Nitrate 250 | Open nitrate test tube, add 0.2 mL sample and 0.5 mL 2-propanol, close, mix. Blank value for correction: Open nitrate test tube, add 0.2 mL distilled water and 0.5 mL 2-propanol, close, mix. |
| 0-68 Nitrite 2 | Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close, mix. |
| 0-69 Nitrite 4 | Open nitrite test tube, add 4.0 mL sample solution, close, mix. |
| 0-70 POC 200 | Proceed as described in the instructions for test 0-70, but instead of 1.0 mL R2 add 1.0 mL distilled water. |
| 0-71 Nickel 4 | Proceed as described in the instructions for test 0-71, but instead of 1.0 mL R2 add 1.0 mL NaOH 14 %. |
| 0-72 pH 6,5–8,2 | The original test already contains a correction. |
| 0-73 Sulfide 3 | Fill **empty** test tube with 0.5 mL sulfuric acid 50 %, add 1 measuring spoon R2 and 4.0 mL sample solution, close and shake gently. Add 200 µl R3, close, mix. |
| 0-74 Phenolic index 5 | Fill **empty** test tube with 0.5 mL R2, add 1,0 mL sample solution, close and mix. Add 1 **NANOFIX *R3***, close and mix. Using the extraction procedure does not require a correction value. |
| 0-55, 0-76, 0-80, 0-81, 0-95 ortho- and total- Phosphate LR 1–45 | Proceed as described in the instructions for test 0-55 / 0-76 / 0-80 / 0-81 / 0-95, but instead of R4 add 0.2 mL distilled water, close, mix. |
| 0-79 ortho- and total-Phosphate 50 | Proceed as described in the instructions for test 0-79, but instead of R3 add 1.0 mL sulfuric acid 20 %, close, mix. |
| 0-82 Oxygen 12 8-22, 8-25 BSB5 | The original tests already contain a correction. |
| 0-83, 0-88, 0-92 total-Nitrogen TNb 22 / 60 / 220 | Almost all colors and turbidities are destroyed under test conditions and do not interfere. For samples which are still colored or turbid after decomposition, correction values are determined as described above for test 0-64. |
| 0-84 Residual hardness 1 | Open Residual hardness test tube, add 5.0 mL sample solution, close and mix. |
| 0-85 Starch 100 | No correction possible. |
| 0-86 Sulfate 200 | The original tests already contain a correction. |

| | |
|---|---|
| 0-87 Sulfate 1000 | |
| 0-89 Sulfite 10 | Open sulfite test tube, add 4.0 mL sample solution and 0.2 mL distilled water, close and mix. |
| 0-90 Sulfite 100 | Fill **empty** test tube with 0.2 mL R2, 4.0 mL sample solution and 1.0 mL distilled water, close, mix. Analytical result = A + B |
| 0-91 Thiocyanate 50 | Fill **empty** test tube with 4.0 mL sample. |
| 0-93, 0-94, 0-99 TOC 25–600 | The original tests already contain a correction. |
| 0-96 Zinc 4 | Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close and mix. |
| 0-97 Tin 3 | Proceed as described in the instructions for test 0-97, add 1.0 mL ethanol instead of R4. |
| 0-98 Aluminium 07 | Proceed as described in the instructions for test 0-98, add 0.5 mL distilled water instead of R3. |
| 8-38 Ethanol 1000 | Open ethanol test tube, add 4.0 mL R1 and 0.5 mL sample solution (consider dilution), mix, add 2 drops R3, close and mix. |
| 8-59 Methanol 15 | Open methanol test tube, add 3.0 mL R1 and 1.5 mL sample solution (consider dilution), mix, add 2 drops R3, close and mix. |
| 8-71 Peroxide 2 | Fill **empty** test tube with 4.0 mL sample. |

Table 1: Determining the correction value for *NANOCOLOR*® tube tests

## 5.4 Special methods

The special methods menu is opened by pressing the icon sequence → . This menu allows you to retrieve not only all of the special methods pre-programmed by MACHEREY-NAGEL, but also the special methods created by the user.

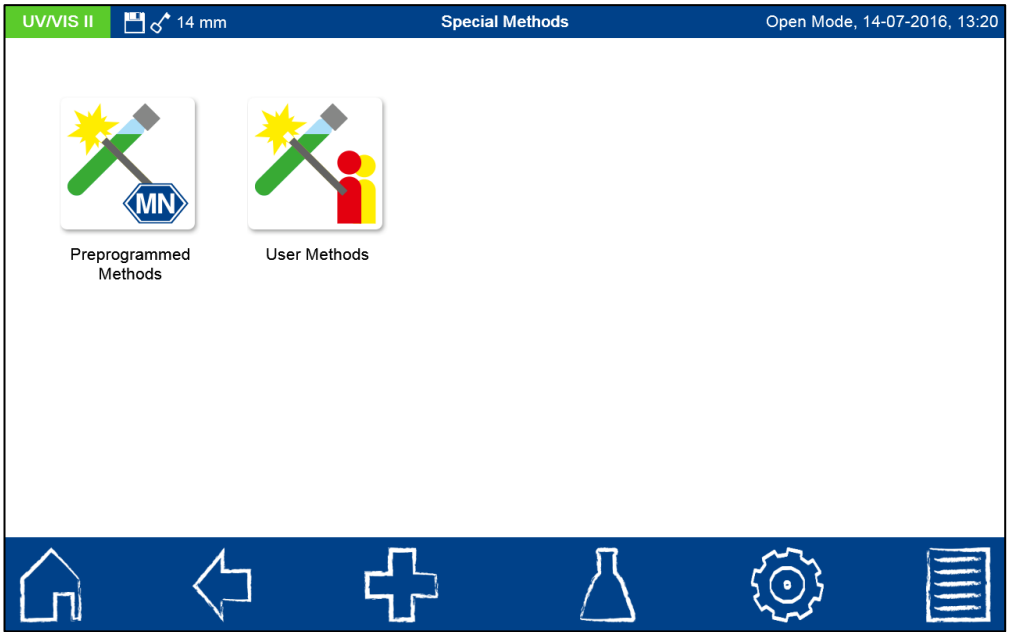



Figure 24: Menu for selecting special methods

### 5.4.1 Pre-defined methods

Pressing the icon will open the list box containing the MACHEREY-NAGEL pre-programmed special methods. The pre-programmed special methods involve important standard analytical methods in the fields of drinking water analysis, brewery analysis and turbidity measurements. For the brewery analysis, MACHEREY-NAGEL provides for the performance of all photometric analysis methods (with the exception of enzymatic testing) in

compliance with MEBAK, Volume II, 2002. Simply select the desired test, insert the required cuvette in the photometer when prompted and read off the measured value. The following table renders a list of the programmed methods for brewery analysis.

| Method name | Reference |
|---|---|
| Anthocyannins acc. to Harris and Ricketts | MEBAK 2.17.2 |
| Beer color EBC | MEBAK 2.13.2 |
| Bitterness units | MEBAK 2.18.1 |
| Total carotenoids fraction | MEBAK 3.7.2.1 |
| Total carotenoids in carrot juice | MEBAK 3.7.2.2 |
| Total polyphenols | MEBAK 2.17.1 |
| Copper (Cuprethol) | MEBAK 2.29.4 |
| Copper ZDBT | MEBAK 2.29.5 |
| Nickel | MEBAK 2.29.6 |
| Vicinal diketones | MEBAK 2.23 |
| Thiobarbituric acid value | MEBAK 2.4 |
| α-acids | MEBAK 2.18.2 |
| Iso-α-acids | MEBAK 2.18.2 |
| Cyclamate | MEBAK 3.11.4 |
| Iron | MEBAK 2.29.3 |
| Free amino-nitrogen FAN | MEBAK 2.8.4.1 |
| Total carotenoids acc. to Wesergold | MEBAK 3.7.2.3 |
| Photometric iodine sample | MEBAK 2.3.2 |
| Total carbohydrates in beer | MEBAK 2.11 |

Table 2: Pre-programmed methods of brewery analysis

To run a method, select the appropriate entry from the list (see Figure 25) and confirm with ✓. The list box offers not only a scroll function, but also a filter function. By entering the name of the test via the text keypad and confirming with Enter, the list will be searched for matches.

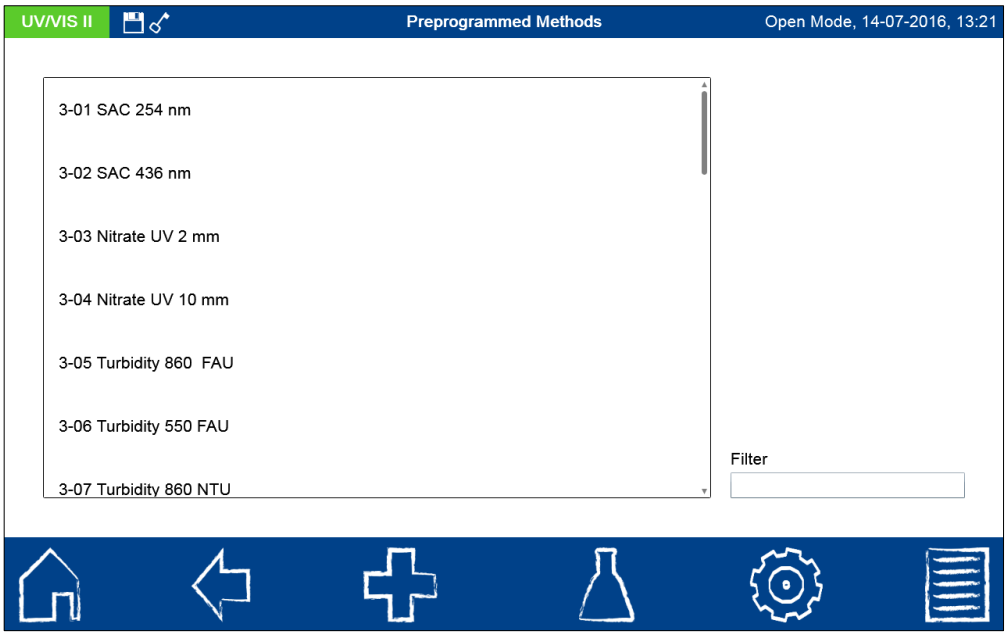



Figure 25: List box of the pre-defined special methods

Whenever a test is selected by means of the list box, the measurement of the cuvette will not start automatically after it is inserted. The measurement has to be started manually by

pressing  or  . The display of the result is similar to the procedure for tube tests and rectangular cuvette tests (see Section 5.2.1).

### 5.4.2 User methods

Pressing the  icon opens the submenu for creating and displaying user-defined special methods (see Figure 26).

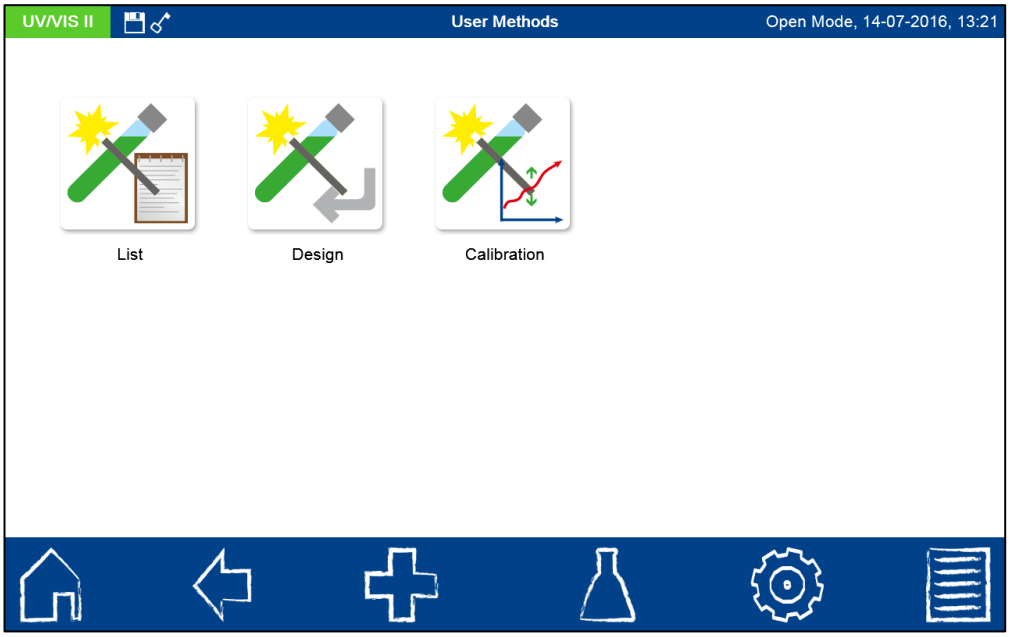



Figure 26: Options for user method creation

#### 5.4.2.1 Lists

Pressing the  icon opens the list containing all of the special methods that have already been created by the user. Besides the scroll function in the list box, a filter function is also available. By entering the name of the test via the text keypad and confirming with Enter, the list will be searched for matches. If the list is empty, then no special methods have been created by the user yet (see sections 5.4.2.2 and 5.4.2.3).

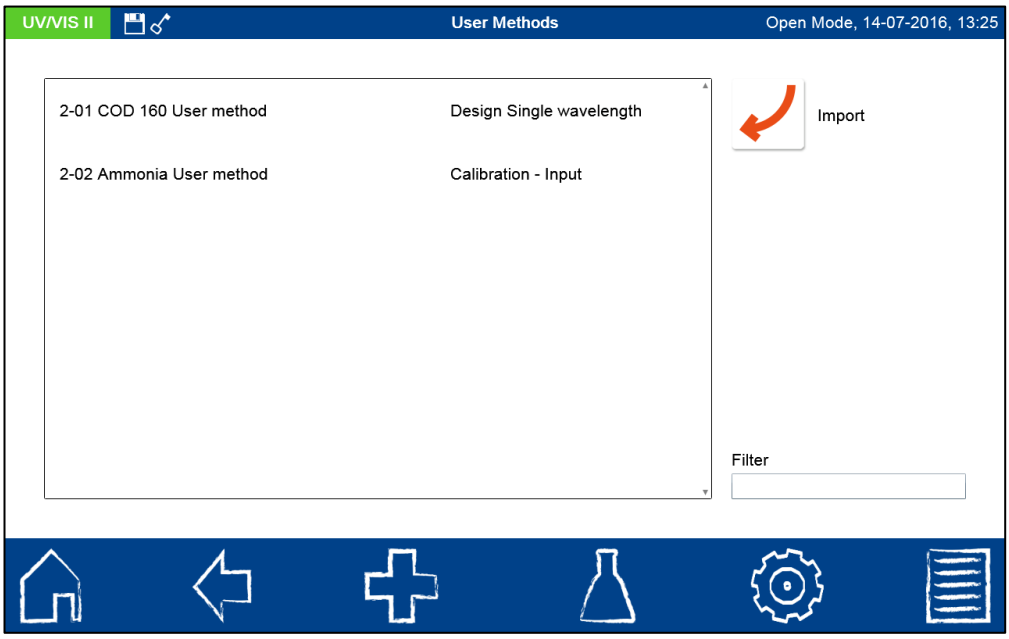



Figure 27: List of user-defined special methods

A user-defined special method can be imported into the same type of device via the icon (Example: The special method from the *NANOCOLOR*® $^{UV}/_{VIS}$ II with the serial number NUV20001 can be imported into the *NANOCOLOR*® $^{UV}/_{VIS}$ II device with serial number NUV20056). In order to import the desired special method, connect the mass storage device containing the saved method to the spectrophotometer. After pressing the icon, a list box will open showing the methods on the mass storage device available for import (see Figure 28). Tapping on the desired entry will import the special method into the list of special methods (see section 5.4.2.1).

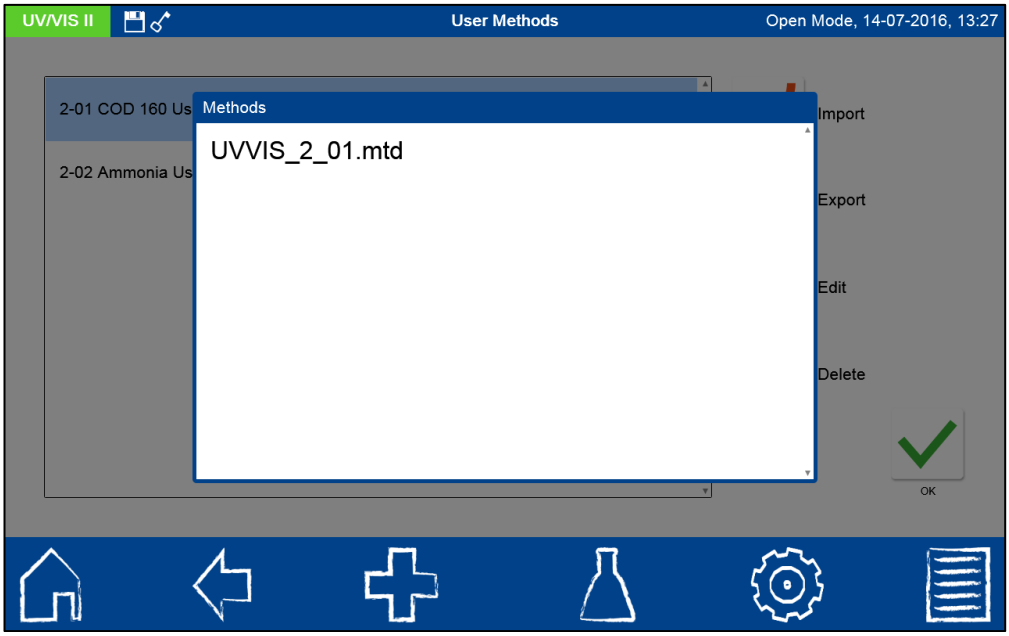



Figure 28: Method import from external mass storage device

When you tap on an entry in the list of user-defined special methods, additional options will appear on the right hand side (see Figure 29).

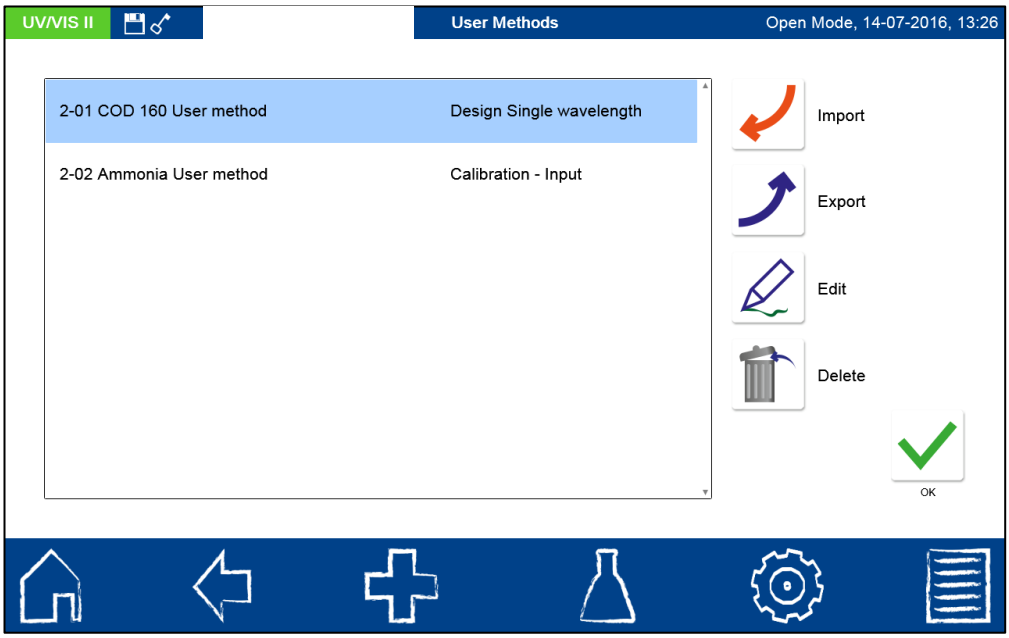



Figure 29: Options for a list entry in the user methods menu

Press the icon to export the selected special method as a MTD file. Connect a mass storage device to the spectrophotometer for this purpose. After pressing the icon, the text

keypad will appear so that you can enter a name for the export file. Entering the desired name and confirming by pressing Enter will save the special method to the external memory. The method can then be imported into a photometer of the same type.

Press the icon to edit the selected special method. A window will open with the properties of the special method (see section 5.4.2.2). These can be viewed or changed. Afterwards, press the icon to confirm and save the changes. Press the icon to remove the selected method from the list. A dialogue box will open asking you to confirm the deletion. After confirming with “Yes,” the method will be removed permanently from the list of special methods. To run a method, select the appropriate entry from the list and confirm with .

### 5.4.2.2 Design

The design menu allows you to create special methods based on previously established method information, such as factors and wavelengths of the measurement. In the single wavelength mode, the measurements are carried out at a defined wavelength. The multi-wavelength mode allows measurements to be made while taking into account (sum, difference and ratio) of several absorbance values that were measured at up to four different wavelengths. A calibration function to the fourth degree can be shown. Pressing the icon opens a pop-up window for selecting a single wavelength method or a multi-wavelength method (see Figure 30).


Figure 30: Selection of the method design

Depending on which selection is made, a window will open in which the data of the special method can be entered. In the case of the multi-wavelength method (see Figure 32), not only the wavelengths of the measurement are requested, but also the factors for the multiplication and corresponding calculation formula.

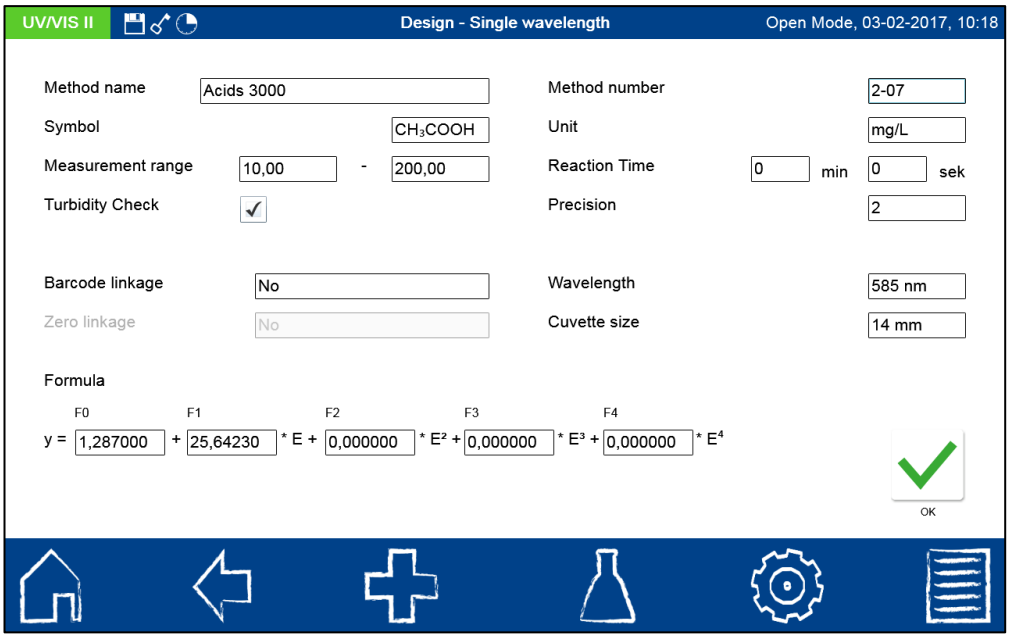



Figure 31: Entering the properties of a special method in the single wavelength mode

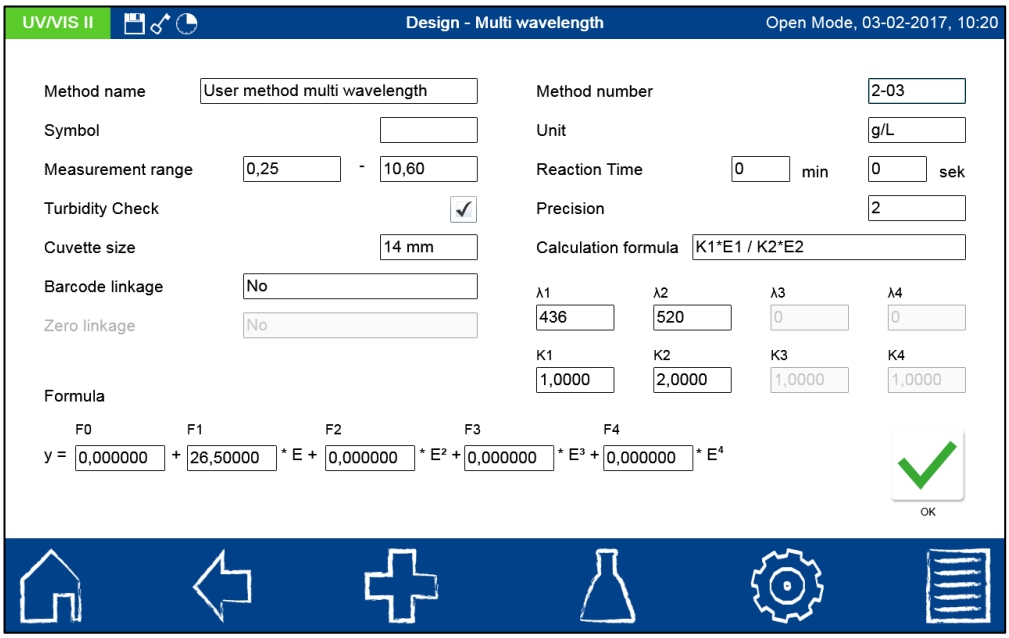



Figure 32: Entering the properties of a special method in the multi-wavelength mode

*Method name:* Enter a method name via the text keypad. The name should not exceed 20 characters in length. Confirm the entry with Enter.

*Method number:* The method number is a specific number with which the method can be retrieved later from the list box in the "User methods" menu. Enter a method number between 1 and 99 using the numeric keypad. The lowest available number will appear automatically. Confirm the entry with OK. Should the chosen method number not be available, the message "This method number is already in use" will appear. Either select another method number or delete the method having that number.

*Symbol:* Enter a symbol via the text keypad which will be shown after the unit when the result is displayed. Confirm the entry with Enter. No more than 10 characters are allowed.

*Unit:* Enter a unit via the text keypad which will be shown when the result is displayed. Confirm the entry with Enter. No more than 10 characters are allowed.

*Measuring range:* Enter the desired measuring range of the method using the numeric keypad.

*Reaction time:* Enter the reaction time using the numeric keypad and confirm your entry with OK. The reaction time is given in minutes and seconds. If the reaction time has been activated in the settings, the entered time will count down before each measurement (see section 6.1.8).

*Turbidity control:* When activated, the nephelometric turbidity of the sample will also be measured with each measurement and evaluated on the basis of the limit stored in the settings (see Section 6.1.10). This function is available only with the 14 mm (ID) test tubes.

*Precision:* Enter the number of decimals on the numeric keypad and confirm your entry with OK. The result will be displayed with the selected number of decimals. A maximum of three decimals is possible.

*Calculation formula (multi-wavelength measurements):* In this section, the wavelengths and coefficients given in the selected calculation formula are defined. The number of wavelengths is determined by the choice of the calculation formula. To enter, tap on the calculation formula entry and select the desired formula from the list. Tap on the fields for the wavelengths and coefficients and enter the values using the numeric keypad. The list of calculation formulas includes the options shown in Figure 33, with E1 as absorbance value of the wavelength 1, E2 as absorbance value of the wavelength 2, K1 as multiplication factor of the wavelength 1, K2 as multiplication factor of the wavelength 2, etc. To include a subtraction step in one of the formulas, the K factors can be programmed with a minus sign.

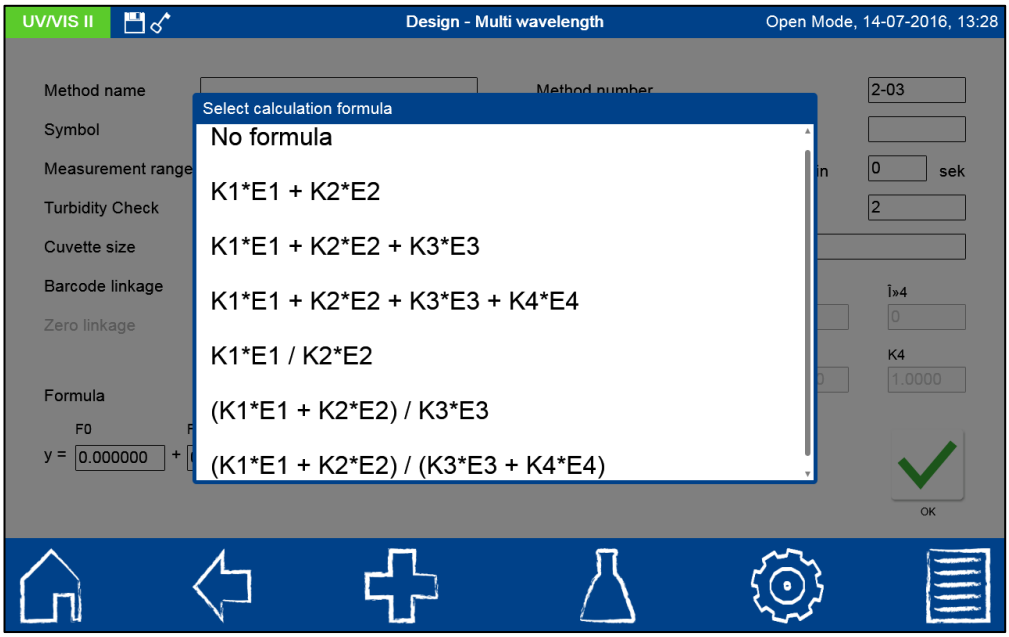



Figure 33: List of possible calculation formulas for multi-wavelength measurements

*Barcode link:* Tap here to open the list of all barcode tests stored in the photometer. In order to retrieve the special method with the barcode of a MACHEREY-NAGEL cuvette, choose the desired test from the list.

*Wavelength (single wavelength measurements):* Enter the wavelength of the measurement using the numeric keypad and confirm your entry with OK. A wavelength in the 190 nm –

1100 nm range (*NANOCOLOR® UV/VIS* II) or 320 nm - 1100 nm range (*NANOCOLOR® VIS* II) can be entered.

*Zero link:* When the "Barcode link" option is used, the "Zero link" option is enabled. When the corresponding test is selected, the zero stored for the MACHEREY-NAGEL tube test will be used for the calculation. This allows a measurement without a zero solution. This option is available only for the test which was selected in the context of the barcode link and for which a zero is already stored in the photometer.

*Cuvette size:* Select the cuvette size from the displayed list box. When methods are carried out, the photometer detects automatically whether the correct cuvette is being used.

*Formula:* The formula field is where the factors for the final calculation of the measurement result are entered. Formulas to the 4th degree can be entered. Tapping on the individual fields will open a numeric keypad for entering numerical values. Negative factors can be depicted by entering a minus sign before the numeric value.

*Please note: The formula has the format $y = F0 + F1*E + F2*E^2 + F3*E^3 + F4*E^4$ with E as absorbance value and F as factors of the equation. The factors are input as an equation, as determined by a plot of concentration values (x-axis) against the absorbance values (y-axis).*

After successfully entering all parameters, confirm the entries with . The method will be saved and included in the list of user methods (see section 5.4.2.1). The properties that were entered can be edited there via the icon. A report on the special method properties and data can be printed by pressing the icon and selecting "Print." The entries "Export to PNG file" and "Export to CSV file" allow the method report to be exported to a connected storage medium.

### 5.4.2.3 Calibration

The Calibration menu is opened by pressing the icon. This menu is used to determine absorbance values for standard solutions of known concentrations as part of creating a user-defined special method (see Figure 34).

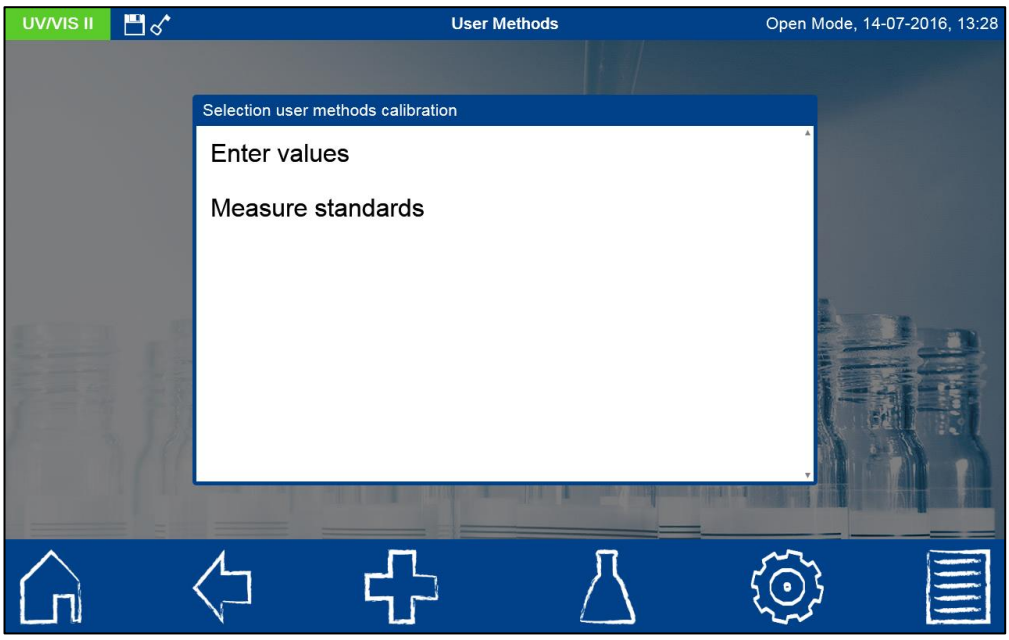



Figure 34: Selection of the mode for calibrating a special method

In the "Enter values" mode, one can create a calibration curve by manually entering the known concentration values and corresponding absorbance value pairs of standard solutions. The "Measure standards" mode enables one to create a calibration table by entering the concentration of the standard solutions and then measuring the corresponding absorbance values. In both cases, the concentrations of stock solutions and the absorbance values are plotted in a diagram. The calibration curve is charted, and all relevant statistical data and the calibration function are calculated and displayed. A calibration function to the 4th degree can be plotted. Before starting the measurement, all data for the method must have been filled in (see Figure 35).

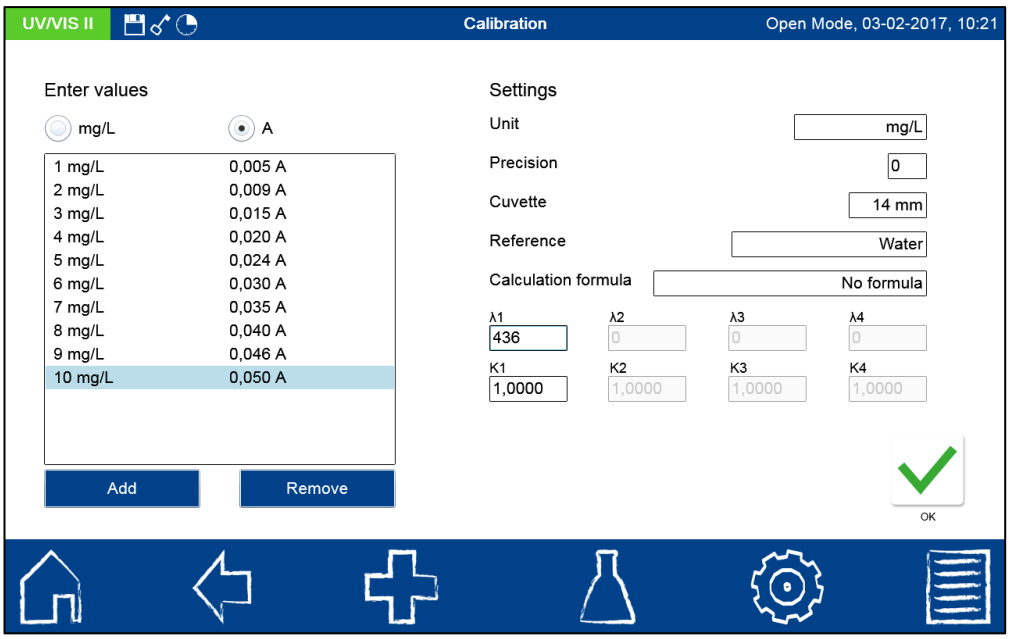



Figure 35: Entering samples for the measurement of a calibration function

Press the Add icon to enter the particular concentration on the numeric keypad. Unwanted concentrations can be deleted from the list by pressing Remove. To create a calibration, at least three concentration-absorbance value pairs must be entered. To increase the statistical certainty level of the calibration function, a multiple determination can also be performed for the respective concentrations. To do so, enter the desired value of the concentration. The absorbance and concentration values will be entered in the correct columns when the selection button above the table is pressed.

*Wavelength:* Enter the wavelength of the measurement using the numeric keypad and confirm your entry with OK. A wavelength in the 190 nm - 1100 nm range (*NANOCOLOR*® *UV/VIS* II) or in the 320 nm-1100 nm range (*NANOCOLOR*® *VIS* II) can be entered.

*Unit:* Enter a unit via the text keypad, which will be shown when the result is displayed. Confirm the entry with Enter. No more than 10 characters are allowed.

*Precision:* Enter the desired number of decimals using the keypad and confirm your entry with OK. The measurement result will be displayed with the selected number of decimals.

*Cuvette size:* Select the cuvette size from the list box that pops up. The photometer detects automatically whether the correct cuvette size is being used.

*Reference:* Select the desired reference for the measurement. In addition to water, the reagent blank value can also be chosen here. If values are measured, the device will ask for the insertion of the corresponding reference cuvette. The specification appears in the report on the special method.

*Please note:* When the “reagent blank value” option is used, the photometer assumes that the corresponding regression line passes through the zero point. If the regression line is supposed to pass through the zero point even when measured against water, please use the option "Zero force“ by pressing the icon in the window for editing the calibration curve (see Figure 37).

*Calculation formula:* In this section, the wavelengths and the coefficients specified in the selected caluclation formula are defined. The number of wavelengths is determined by the choice of the calculation formula. Tap on the calculation formula entry and select the desired formula from the list. Tap on the fields for the wavelengths and coefficients to enter the values via a numeric keypad. The list of calculation formulas includes the options shown in Figure 33, with E1 as absorbance value of the wavelength 1, E2 as absorbance value of wavelength 2, K1 as a multiplication factor of the wavelength 1, K2 as a multiplication factor of the wavelength 2, etc. To include a subtraction step in one of the formulas, the K factors can be programmed with a minus sign.

In the “Enter values” mode, the calibration curve will be calculated and displayed by pressing . In the “Measure standards” mode, enter all of the parameters and start the measurement by pressing . The photometer will ask you to insert in succession the sample solutions in the concentrations entered previously (see Figure 36). The first measurement is always the measurement of the zero solution. The user must decide independently whether to make a zero measurement against a reagent blank value or whether to use water as a reference. The measurement series is created by inserting the cuvettes in the given order. The progress of the measurement series is indicated by a progress bar.

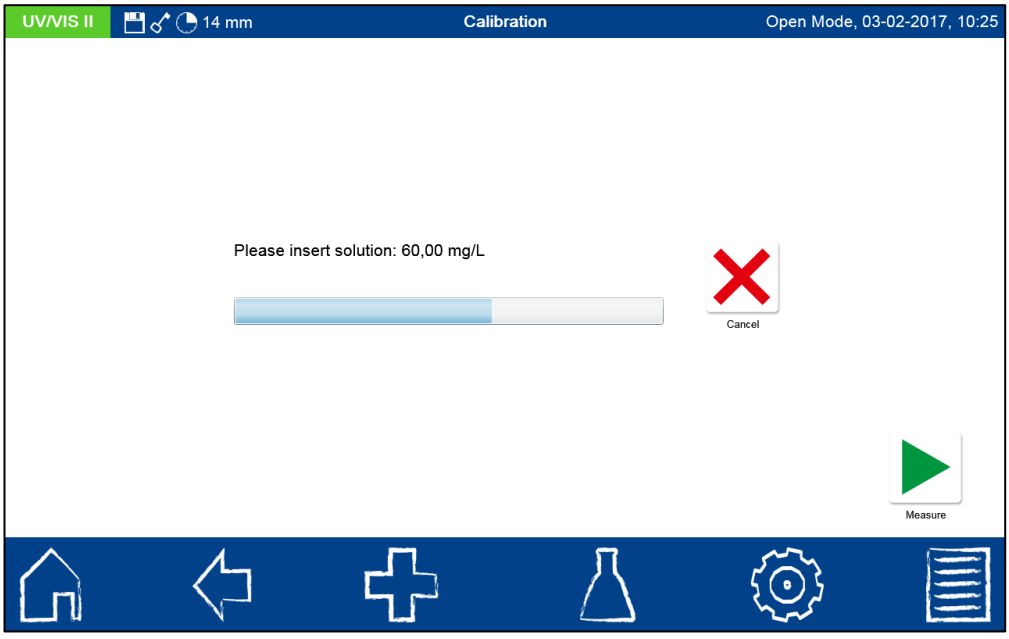



Figure 36: Measurement procedure for the calibration of a user-defined special method

After the last cuvette has been removed from the photometer, all statistical parameters will be calculated and plotted as shown in Figure 37.

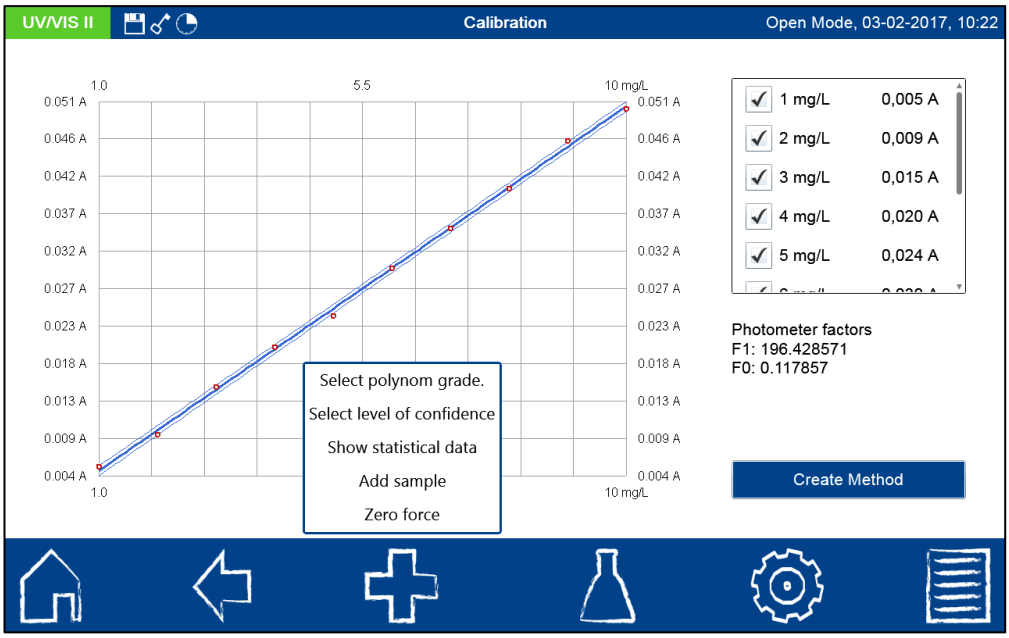



Figure 37: Calibration curve as a result of the measurement of individual standard solutions

For linear and quadratic functions, the confidence interval of the statistical calculation is shown as hyperbolas in the form of thin blue lines. *(Please note: The factors F0 to F4 are the photometer factors, not the factors of the compensatory function!)* The concentration and absorbance pairs appear next to the graph and can be included or excluded by selecting or deselecting the checkbox in front of the pair of values in the analysis. Following the deselection or selection of data pairs, the calibration function and statistical data will be recalculated automatically.

The degree of the polynomial can be changed after the measurement by pressing  and then tapping the entry “Select degree of the polynomial.” A list box for selecting the desired degree of the polynomial will open (see Figure 38). Whenever another polynomial degree is selected, the calibration function and statistical data will be recalculated automatically.

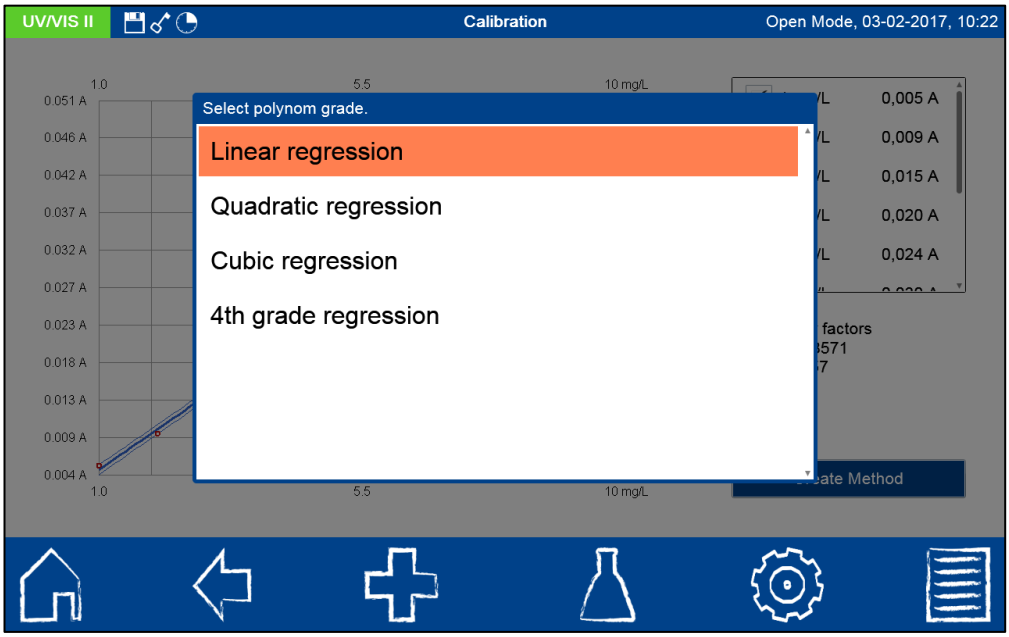



Figure 38: Setting the degree of the polynomial

For the representation of the confidence interval and statistical data specifications, the accuracy with which the results are calculated can be specified. The confidence level or significance level is set by default to 95%.

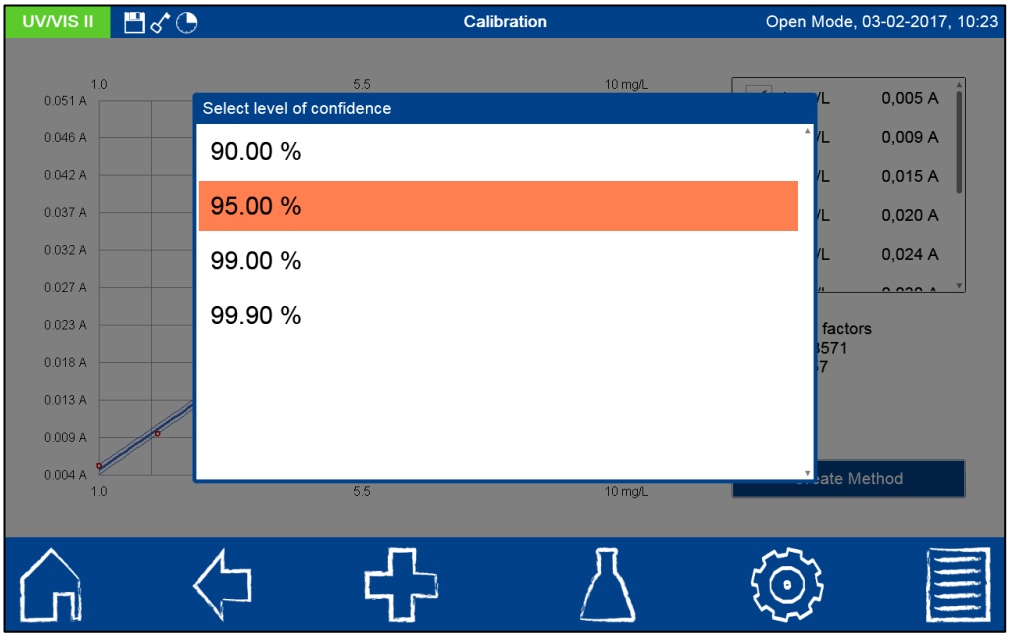



Figure 39: Setting the confidence level for the regression

The values for limit of detection, limit of quantification and detection capability can be viewed by pressing and tapping the entry “Statistical data” (see Figure 40).

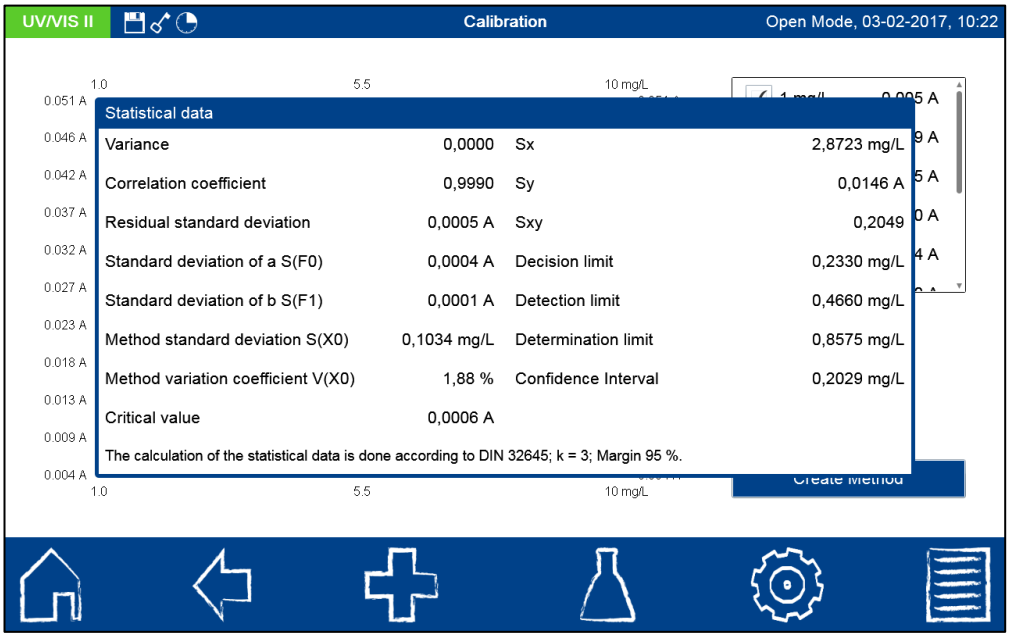



Figure 40: View of the statistical data of the user-defined special method

When creating calibration curves, outliers can occur due to errors in the preparation of the solution and measurement, and these lead to a widening of the confidence interval. There are two ways to handle outliers. One way would be to exclude outliers from the calculation by deselecting the corresponding measured value from the list. The calibration line is then automatically redrawn. The confidence interval is much narrower. This way, any arbitrary measurement point can either be excluded from the calculation or be included again.

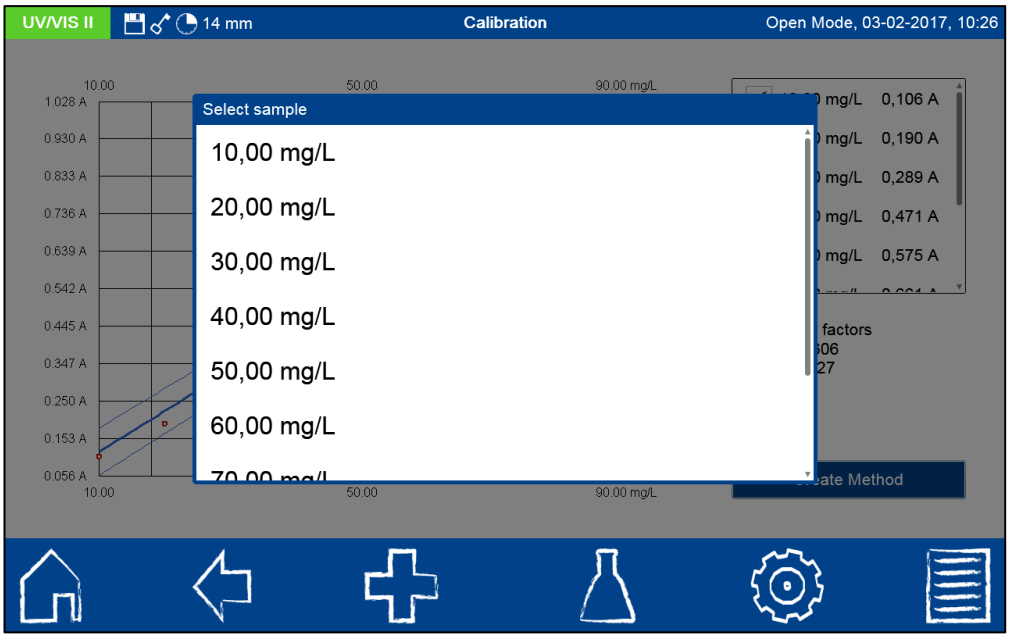



Figure 41: Re-measuring the sample of the standard series

The second method of correcting outliers would be to make a new preparation of the faulty solution and re-measure it. Pressing and selecting the option “Repeat measurement” will open a list box with the various samples (see Figure 41). By selecting the sample to be re-measured and then inserting the sample after being prompted by the photometer, the value in the measurement data will be replaced and the calibration function and statistical data will be re-calculated.

To increase the accuracy of a method, where there is a linear relationship between concentration and absorbance, each concentration of the series can be entered multiple times and measured. It is important, however, not to measure each cuvette several times, but rather, to make several individual experiments for each concentration.

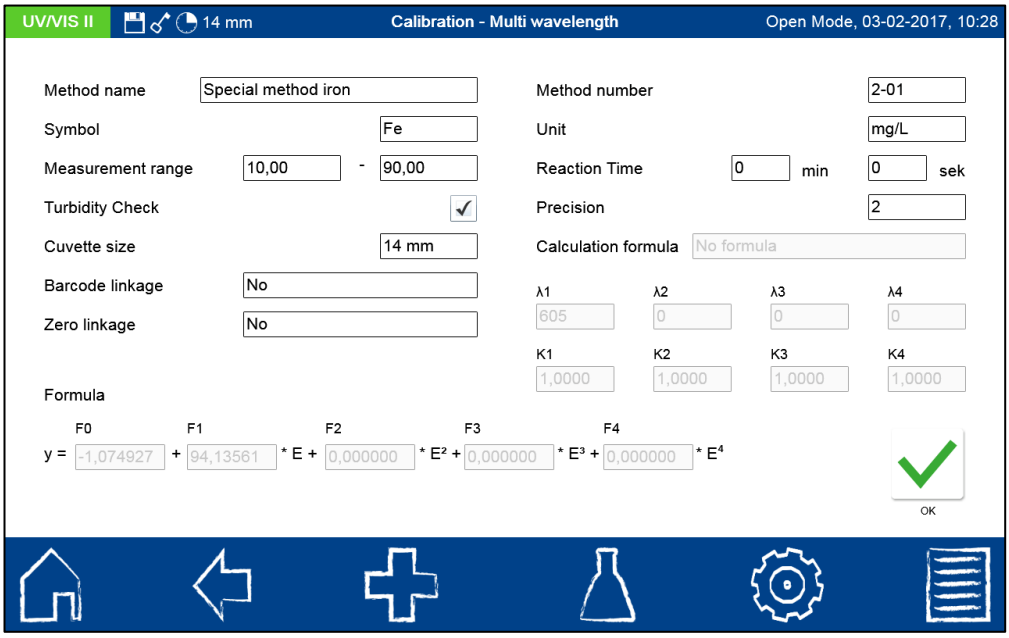



Figure 42: Entering the properties of the calibrated special method

After finalization of the calibration function, the corresponding method can be created by pressing Create Method . A dialogue (see Figure 42) identical to the method design dialogue will open so that you can enter the properties of the user-defined calibration (see

section 5.4.2.2). After all the data has been entered and you confirm it by pressing , the calibrated special method will be stored in the list of special methods (see section 5.4.2.1). You will not be able to edit the calibration parameters yourself there, and that's why they are shown in gray.

#### 5.4.2.4 Editing a special method and reporting function

After measurement of a special method, the data that was input can always be viewed and output again. Via the icon, the entered properties for a special method can be edited in the list of special methods (see Figure 27). The entries "Export in PNG file" and "Export in CSV file" allow you to export all of the special method parameters associated with the method to a connected storage medium. The report on the properties and data of the special method can be printed by pressing the icon and tapping on the entry "Print." In the case of special methods based on a calibration as described in Section 5.4.2.3, the measured absorbance and concentration pairs can be viewed and edited via the entry "Edit calibration."

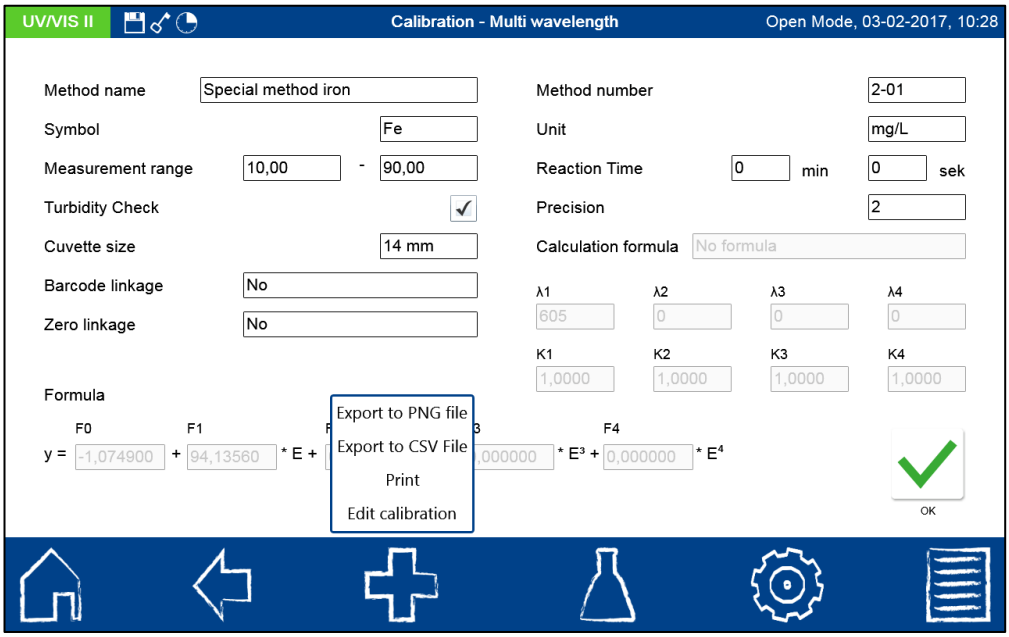



Figure 43: Options for editing and outputting the data of a special method

Confirming with the icon initiates the saving of the data. If you do not wish to make any changes to the method, you can exit the menu by pressing or any other buttons in the task bar.

## 5.5 Scan

The spectrophotometer enables to record a sample's absorbance in the range of 190 nm – 1100 nm (for *NANOCOLOR*® *UV/VIS* II) or 320 nm – 1100 nm (for *NANOCOLOR*® *VIS* II). Dependent on the selected wavelength range, the scan is performed with the light from the halogen and / or the deuterium lamp. The measurement is defined against a zero solution. After having selected this method through , a sample description can be inserted. Furthermore, the wavelength range needs to be specified. Confirming with opens the measurement window. A request for a zero solution will appear. Inserting the zero solution and pressing will initiate the scan of the zero solution.

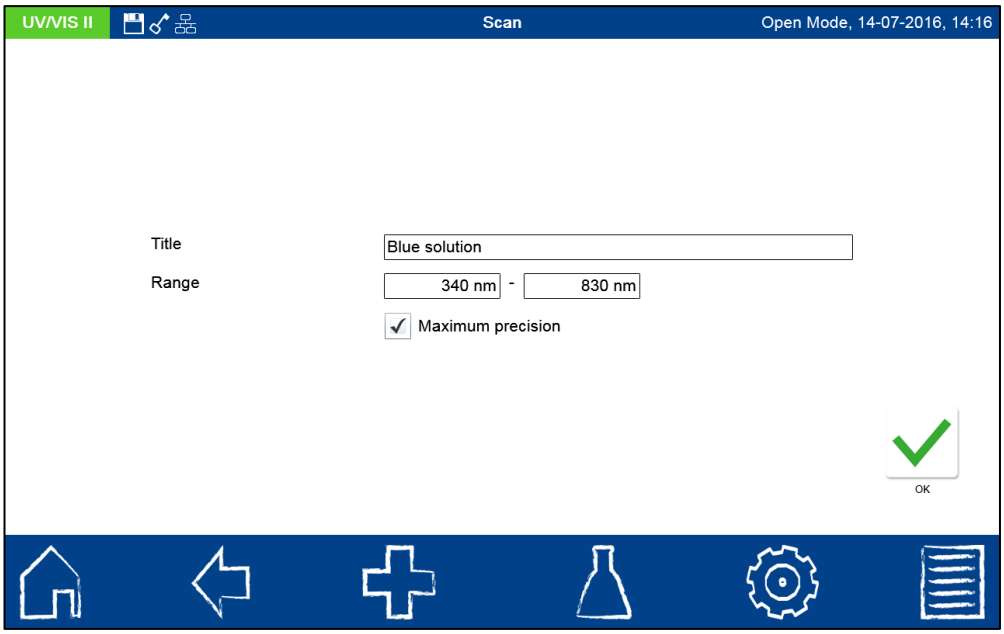



Figure 44: Scan menu

After the successful measurement of the zero solution, the sample solution needs to be inserted. A graphic depicting the wavelengths will appear. The scan of the whole wavelength range can be observed live. After the measurement has been completed, the complete scan will be displayed in the result window.

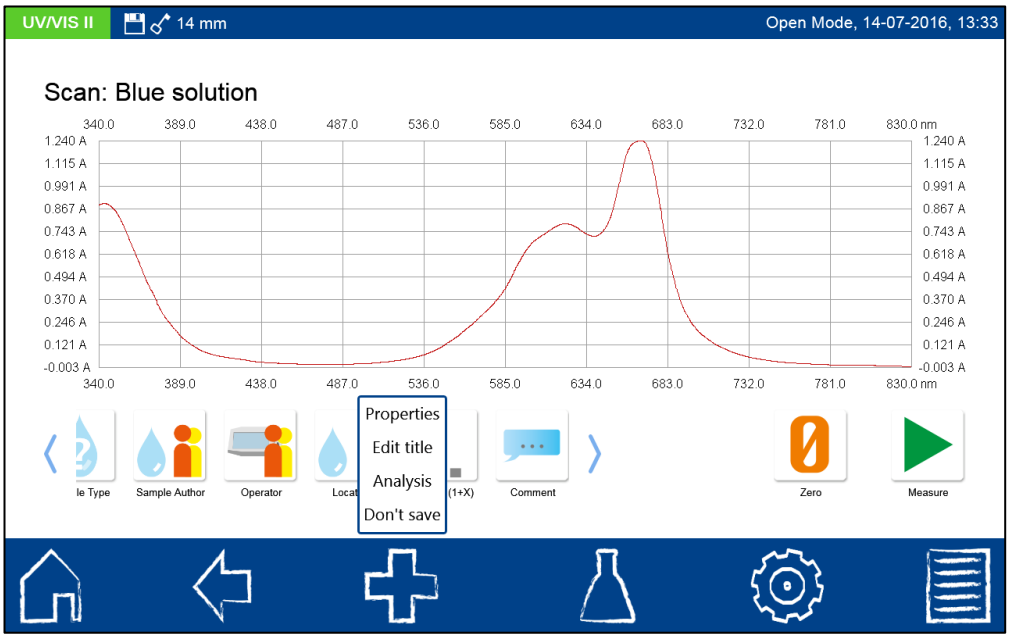



Figure 45: Result window of the scan

Various types of sample information can be entered using the icons located below the result window. Press the icon to view other available options. Via the “Properties” command, new sample information can be added below the measurement menu (see Section 5.2.1). The title of the current scan can be edited by pressing the “Edit title” command. If the title is not edited, the next scan will be given the same title and be assigned the next serial number. The menu for the scan analysis can be opened via “Analysis” or by opening an individual result in “Scan” in the instruments memory and then pressing the icon. Pressing the “Do not save” command prevents the measurement result from being stored in the instrument’s

memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

Removing the cuvette or exiting the measurement menu by means of other icons in the task bar will end the measuring process and the result will be stored in the measured value memory of the device.

## 5.6 Color measurements

The spectrophotometer provides the possibility to determine different color types and furthermore allows the comparison of these with stored color references.

After having selected this menu through  , one can decide via option buttons to perform either a color measurement or a color comparison against a reference (as far as a color reference is defined via the color analysis menu already, yet (figure 45). A sample description can be inserted in the field “title”. After selecting the button “color measurement”, one can decide on the color type to be measured; the field “light source” and “observer” are automatically filled in. These can always be manually changed. In this case, however, the selection of the color number automatically indicates the preference CIE L*a*b.

Confirming with  opens the measurement window.

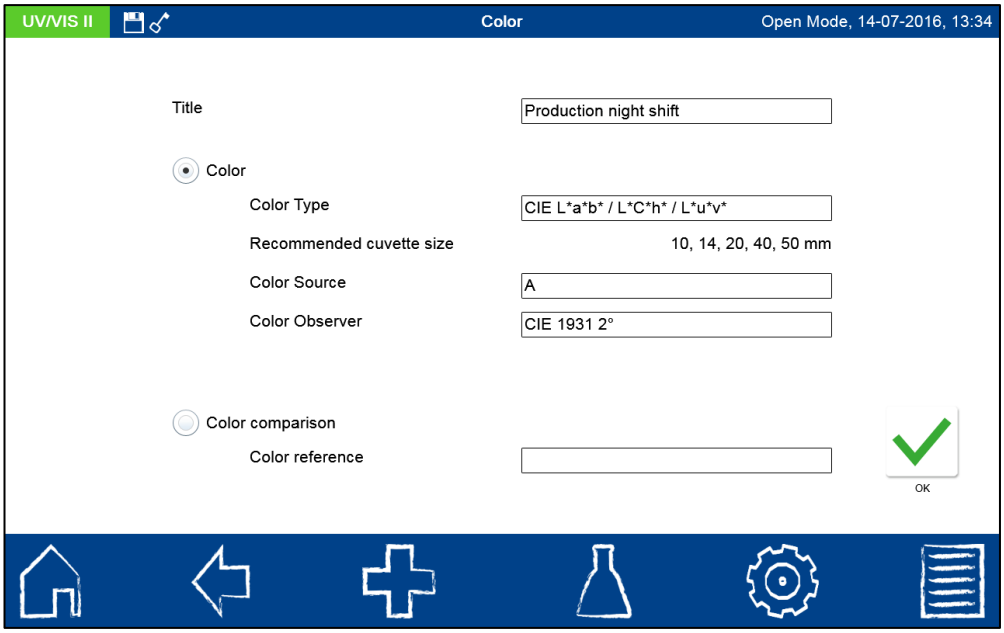



Figure 46: Color measurement menu

***Note: Please make sure to always cover the cuvette slot during color measurement!***

After measurement of the zero solution and the color sample, the result is displayed in the result window.

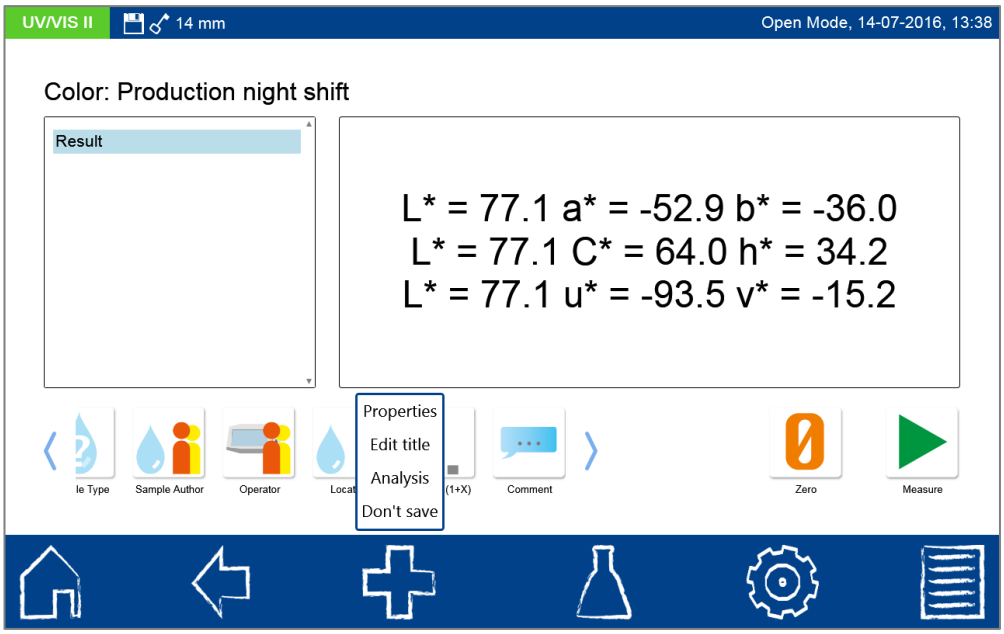



Figure 47: Result window of the color measurement

Various types of sample information are entered using the icons below the result window. Press the icon to view other available options. Via the “Properties” command, new sample information are added below the measurement menu (see Section 5.2.1). The title of the current color measurement is edited using the “Edit Title” command. If the title is not edited, the next color measurement will be given the same title assigned with a serial number. To analyze the color measurement use the “Analysis” command or select the result from the memory and press . Pressing the “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

### 5.6.1 Color analyis

The *NANOCOLOR*® spectrophotometes can also be used for color analysis. The color analysis menu is depicted in figure 48. It implies the comparison of colors, the DE analysis, the comparison against color references and the quality control of color measurements. The color analysis mode can be entered as described in the previous section. Color preview mode.

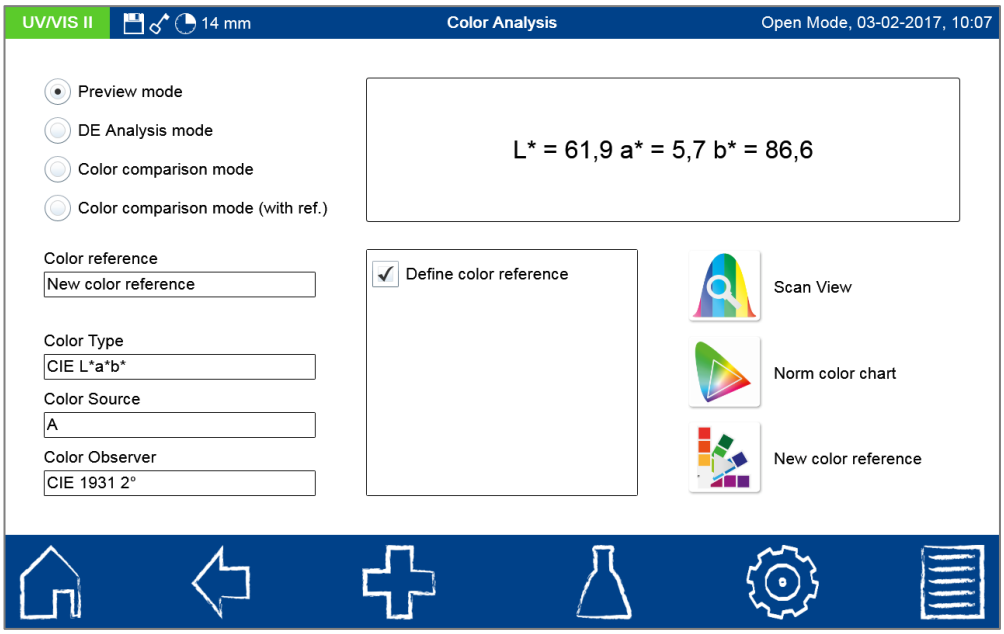



Figure 48: Color analysis view

Each color measurement is based on a scan from 360 nm to 830 nm. Therefore each color measurement can also be expressed as scan by pressing on the icon  . Here the scan can be viewed, zoomed and analysed.

Pressing the icon  opens the CIE XYZ color space as a Yxy transformation. The values X,Y and Z are called standard color values or tristimulus values.

An absolute color space is a three-dimensional coordinate system containing all colors that the human eye can perceive. Every color clearly corresponds to a point in the coordinate system. The position of a color in the color space only depends on the spectral composition of the light used and the absorption characteristics of the sample. All absolute color spaces are based on the XYZ color space created by the International Commission on Illumination (CIE).

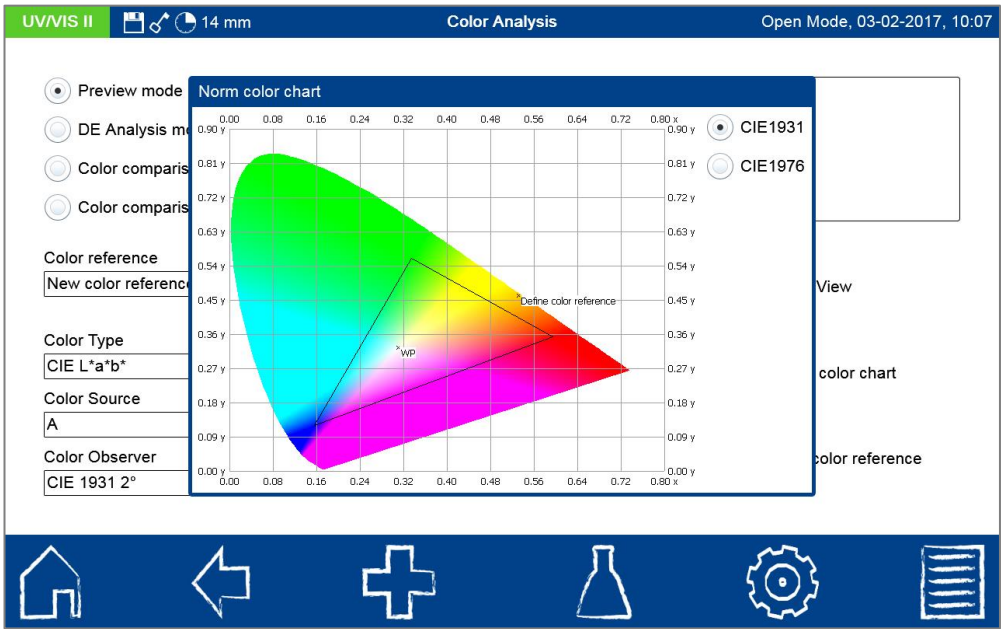



Figure 49: CIE XYZ color space as a Yxy transformation (see Chapter 1.3, page 13).

The x coordinate represents the red component of the color and the y coordinate represents the green component. The z coordinate is perpendicular to the xy plane and represents the

lightness (brightness). This chromaticity diagram contains (in schematic form) all visible colors. The pure spectral colors (e.g. the color at 560 nm) are on the outer curved boundary of the diagram. The black triangle represents schematically the color gamut of a device using the RGB color space. As it can be observed, a monitor can display considerably fewer colors than the human eye can see. The point “WP” in the middle of the diagram is the so called white point of the color scape. Each color measurement is expressed with a black cross and corresponding title in this scheme. The user can switch between two different views of the color charts corresponding to the mentioned norms CIE1931 and CIE1976.

**Important: this diagram is very often misunderstood! It should be always remembered that this is a very schematic representation. Of course, you can also see the colors located outside both gamuts on a monitor or a printout. The reason is that it is impossible to create digital pictures containing the true XYZ colors. All digital pictures are GIF or JPG files that contain the RGB color space. If it was possible to pack the XYZ colors in a JPG file, all colors outside of the black triangle would appear black on the monitor! The diagram just illustrates the nature of XYZ colors that can be seen in the real world, but cannot be displayed by a monitor.**

#### 5.6.1.1 Color references

If you regularly had to measure the color difference of a series of samples with regard to a reference, for example compare the color of a batch with the color of a product specification, the procedure of color comparison, described in this section, can be used. The “color references” function was conceived for these kinds of applications. Measure your reference sample and save the color values within a list of color references. The next time you want to make a measurement with these values, you do not need to measure a reference again, but just choose the respective color reference from a list and conduct only the measurement of the samples. The comparison will be done automatically by the photometer.

If your color standard is defined by a reference substance and the statistical color distribution of your samples is well known, you can create a color reference from a single measurement.

After performing the color measurement of the reference substance, press the  icon in the color analysis menu. A screen for the definition of a new color reference will open (figure XX). Enter an unambiguous name for the color reference and define a DE value, which corresponds to your quality control aims. You can even enter known L*a*b* values of a color reference manually. Confirm your entry with  . The new color reference will be automatically stored in the database and can from now on be found in the liste of color references in the color analysis view. A color reference can be deleted by choosing the respective entry from the list of color references and confirming the entry “Delete current color reference” via the  icon. Editing of color references is not possible. Therefore, please note down the L*a*b* values of the stores color reference, in case these information are important for the user. These values can only be viewed in the photometer, if the corresponding color measurement is still available.

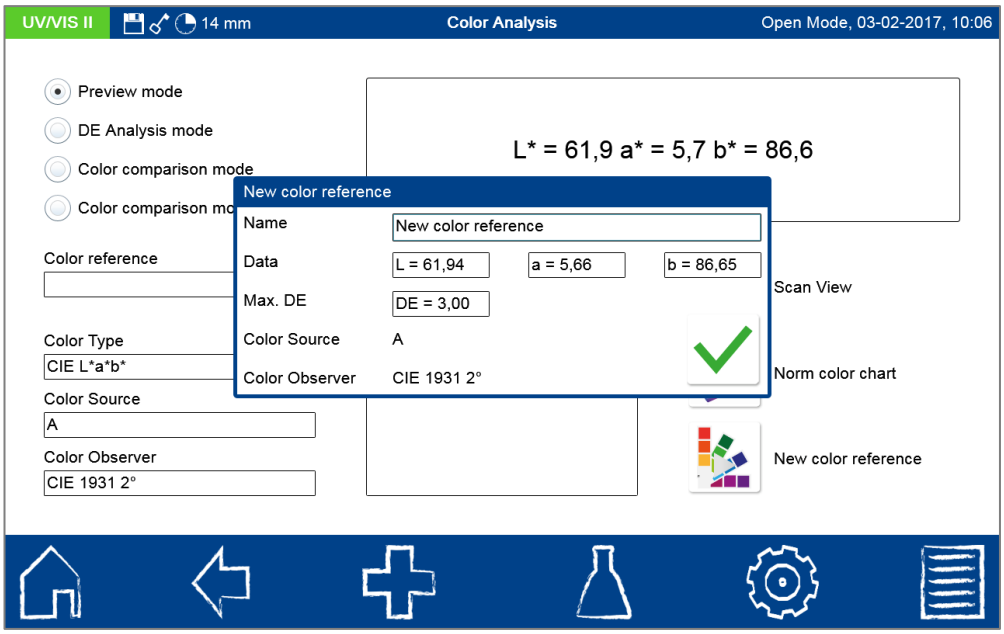



Figure 50: Entering the name of a color reference

Choosing the option button “color comparison mode (with ref.) in the color analysis menu can be used to compare a measure color with a stored color reference. Therefore a color measurement from the list in the middle of the color analysis menu as well as a color reference from the list of color references must be choosen. The calculated result is expressed in the result view as a DE value.

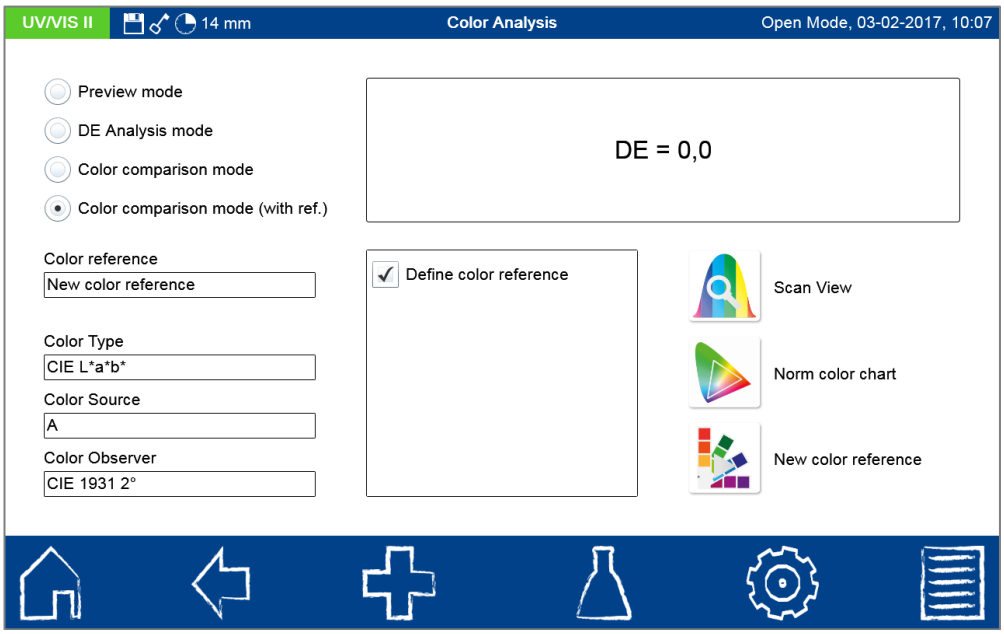



Figure 51: Color comparison with a color reference in the color analysis menu

For a more convenient analysis against a color references one can also use the color comparison mode in the color measurement menue (figure XX). In case a color reference has already been created, it can be choosen from the list of color references.

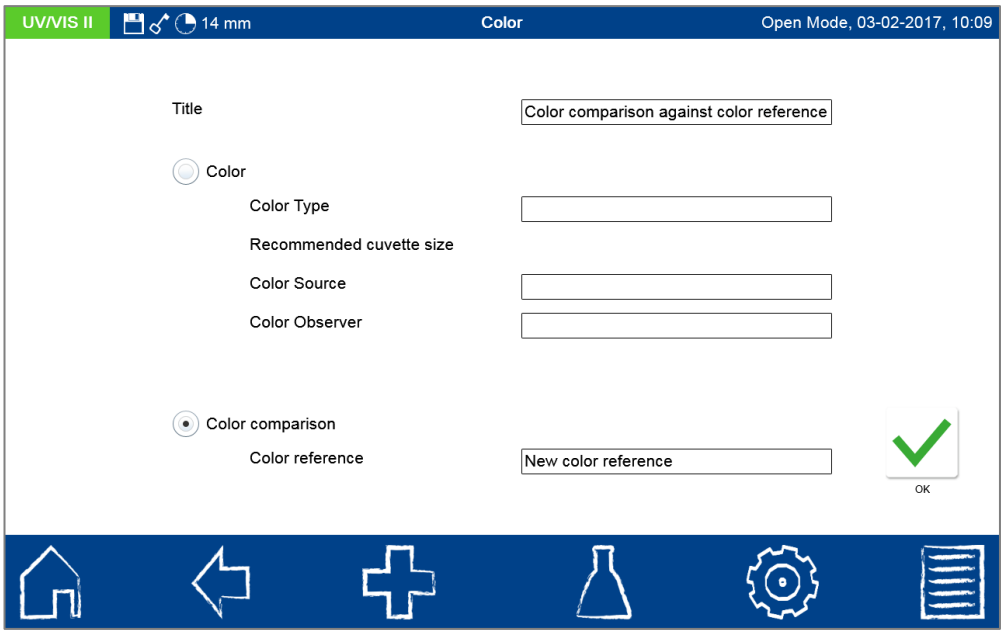



Figure 52: Color comparison using the color measurement menu

Confirming with  leads to the measurement screen. Inserting a zero followed by insertion of the sample shows the result of the measurement in the result view screen (figure XX). The device automatically evaluates the measurement. The measured DE value is compared against the accepted DE value of the color reference and evaluated as “failed” or “passed”. The user can enter sample imformation via the sample info icons.

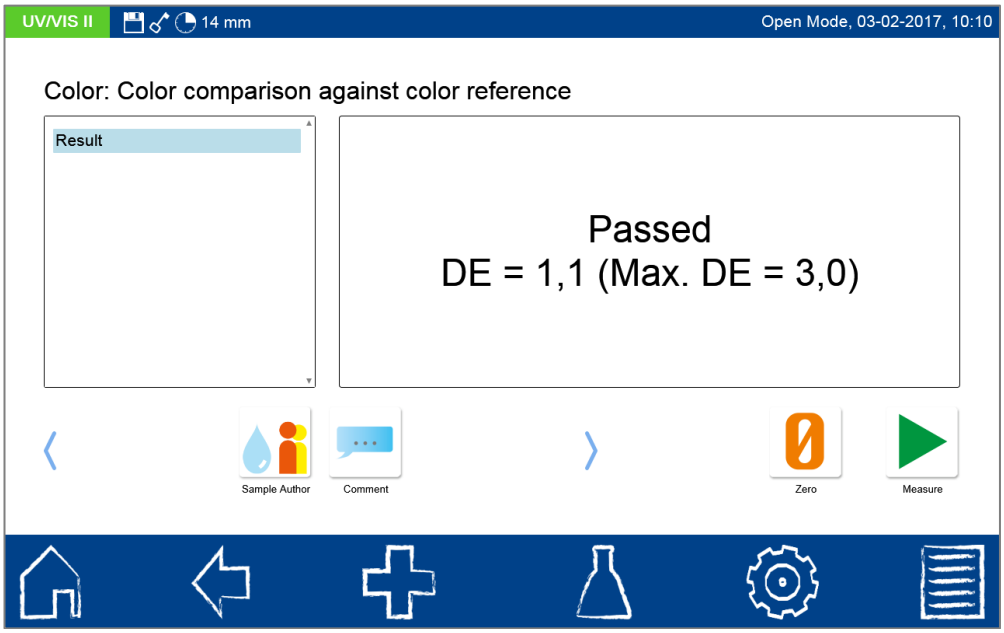



Figure 53: Color comparison with automatic evaluation

Removing the tube or leaving the menu will store the result in the memory.

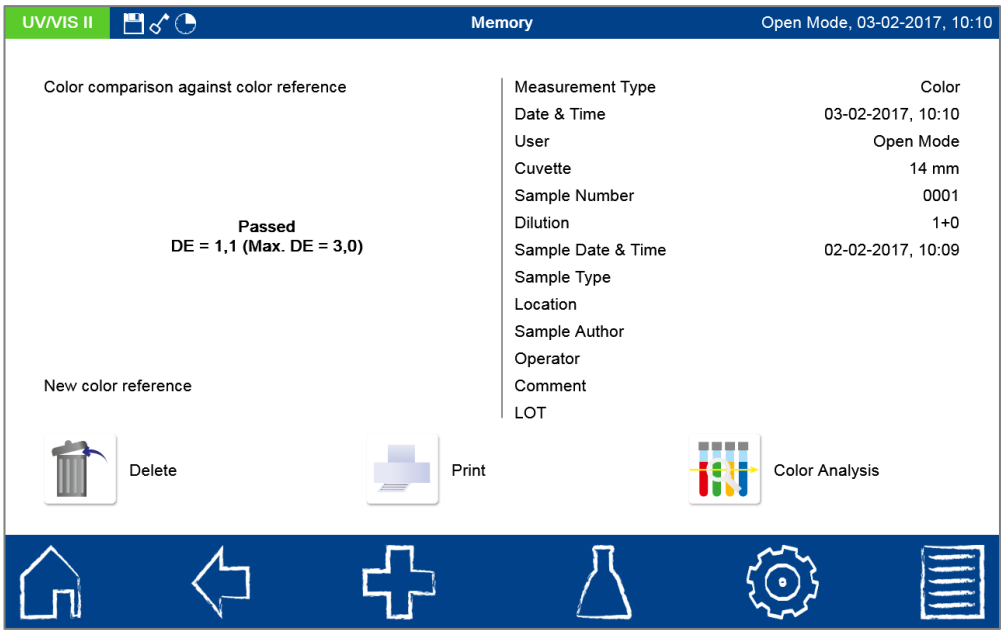



Figure 54: Memory entry of color comparison against color reference

### 5.6.1.2 DE analysis

If your samples show a distribution of color values, e.g. lemonades made of natural fruit juice with seasonal differences in color quality or different origin, you have to determine your color reference from the samples color distribution. Therefore e.g. ten representative samples from different LOTs can be measured and evaluated via the DE analysis mode in the color analysis menu. Mark the color measurements, which are supposed to be compared. The device automatically calculated a maximal DE value, which is display in the result view.

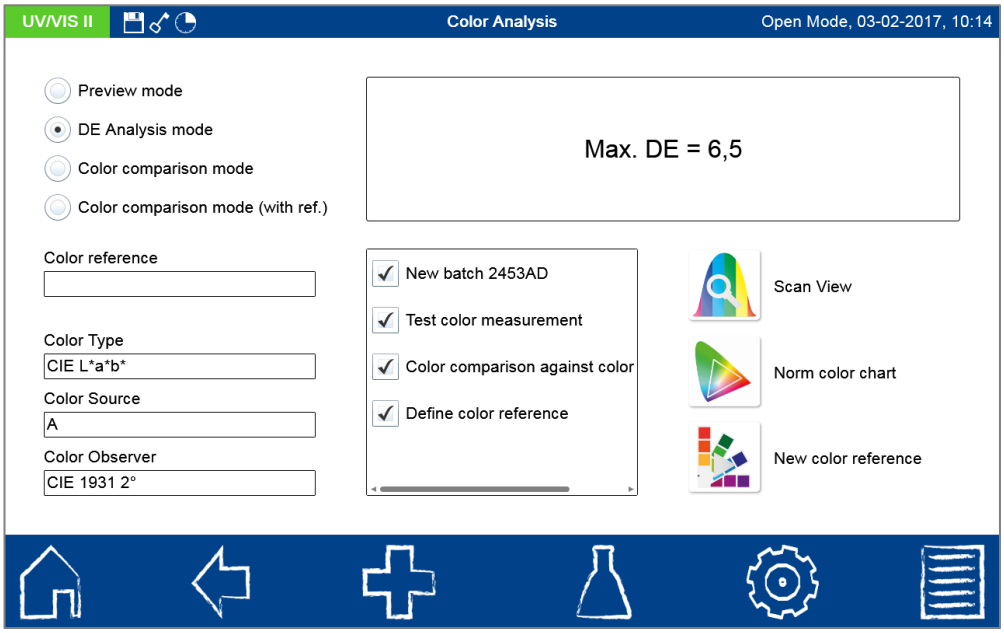



Figure 55: DE analysis of different color measurements

### 5.6.1.3 Preview mode

The preview mode enables the use to see the results of chosen color measurement from the list of color measurements in the middle of the screen. In this view only one color measurement can be selected. Otherwise an error message will be displayed in the result view screen. The results are shown dependent on the color type chosen in the left bottom corner of the color analysis menu. The preview mode therefore can be used to recalculate

color measutrements into a different color scale. A CIE L+a*b* result e.g. can be also expressed as a APHA/Hazen/PtCo ASTM D 5386 result.

### 5.6.2 Performing color measurements

In the following, the basics of the programmed color measurements of the spectrophotometer and the measurement of colored, translucent samples are described. The color measurement does not require extensive sample preparation or any reagents. However, the sample must be absolutely clear, which usually means that all samples, whose color is to be measured, must be filtered through a 0.45 µm membrane filter (e.g. CHROMAFIL®). The actual color of the sample may be affected by this, since at least a part of the visually perceived color could be caused by the turbidity particles.

### 5.6.3 Practicable measurements

The spectrophotometer enables you to determine the following parameters:

**Color spaces:** standard color value X, Y, Z; chromaticity coordinates x, y, z; CIE-L*a*b*; CIE-L*Ch; CIE-L*u*v*; Hunter-Lab; RGB; CMYK; HSB; HSL; YUV

**Color differences:** ΔE CIE 1976, ΔE CIE 1994, measurement against standards, ΔE analysis

**Color scales:** Hazen/APHA/PtCo color index, iodine color index, ICUMSA sugar color, beer color according to EBC and ASBC, yellowness index, Hess-Ives color unit, coloring according to Ph. Eur., Gardner color index, ADMI color index, ASTM color index, Saybolt color index, Klett color index,

Colorimetric density, true coloration according to EN ISO 7887-3.

**The following paramaters important to the colorimetric analysis can be used:**

CIE observer: CIE 1931 2°, CIE 1964 10°

Illuminants: A, C, D65, D50, D55, D75, E, FL11

### 5.6.4 Calculation of color indexes

The color indexes measurable with the spectrophotometers are determined in different ways. Besides color indexes which are simply calculated from the absorbance for one or more wavelengths, there are also color indexes that are calculated from CIE-L*a*b* or XYZ values. Furthermore, there are color indexes for which there is no mathematical definition because they are only defined visually.

### 5.6.5 Color indexes from absorbance

The European beer color EBC, the US beer color EBC, the Hess-Ives color unit, ICUMSA sugar color and the Klett color index (see also Section 5.6.9) are calculated from absorbance.

#### 5.6.5.1 EBC and ASBC

The beer color according to EBC MEBAK 2.16.2 is calculated as folllows from absorbance at 430 nm, measured in 10 mm cuvettes:

$$EBC = E_{430} \times 25 \times F \qquad \text{Formula 1}$$

In this case, F is the dilution factor of the beer sample. The US beer color is calculated as follows from the ASBC EBC color:

$$ASBC = EBC \times 0{,}375 + 0{,}46 \qquad \text{Formula 2}$$

The ZERO reference is distilled water.

#### 5.6.5.2 Hess-Ives color unit

The Hess-Ives color index is calculated as follows from four absorbances at the wavelengths 640 nm, 560 nm, 470 nm and 460 nm according to DGK 0.50.2:

$$H - I = \frac{(R+G+B)\times 6}{d}$$ Formula 3

$$R = 43{,}45 \times E_{640}$$ Formula 4

$$G = 162{,}38 \times E_{560}$$ Formula 5

$$B = 22{,}89 \times \frac{E_{460}+E_{470}}{2}$$ Formula 6

In this case, d is the layer thickness in mm.

#### 5.6.5.3 ICUMSA sugar color

The coloring of sugar solutions is calculated according to ICUMSA GS1/3-7 from absorbance at 420 nm as follows:

$$ICUMSA = 1000 \times \frac{E_{420,\ 50\ Brix}}{c\times b}$$ Formula 7

In this case, c is the concentration of the sugar solution in g/mL and b is the layer thickness in cm. The ZERO reference is distilled water.

### 5.6.6 Color scales from L*a*b* or XYZ values

For the Gardner color index there is a DIN EN ISO conversion method from CIE L*a*b* values. This makes it the only color index for which normalized calculation rules exist! Furthermore, the ASTM color index and the Saybolt color index are calculated from L*a*b* values. The ADMI color index is defined through ΔE values of platinum-cobalt solutions against distilled water.

#### 5.6.6.1 Gardner color index

The Gardner color index can be applied to all colorations, ranging from 1 (lightest value) to 18 (darkest value) and is measured in 10 mm cuvettes. The Gardner color indexes are defined by the CIE chromaticity coordinates x and y. All of the color indexes are defined by a calibration, and the decimal places are calculated by a complex calculation of the x and y values of the next and the previous measuring points. For more detailed information, please refer to EN ISO 4630-2. As part of the calculations of the Gardner color index, the software checks the Y-value against the information provided by the standard EN ISO 4630-2: 2004. If the value is outside the permitted range, the instrument will display an exclamation mark in addition to the measured value. This indicates that the sample is either too bright or too dark for the analysis according to the standard. The ZERO reference is distilled water.

#### 5.6.6.2 ASTM color index

The ASTM color index is defined by the CIE standard color values X, Y, Z, and is therefore suitable for all colors. It ranges from 0.5 (lightest value) to 8 (darkest value) in increments of 0.5. If the reading is between two values, the color value of the darker value is given with the prefix "L" (for lower). This calibration applies to 32.5 mm cuvettes and is based on the standard ASTM D1500-07. You can use 20 mm or 50 mm cuvettes; the software automatically converts the measurements to 32.5 mm layer thickness.

$$ASTM = 0{,}25 + 0{,}8695 \times (\Delta X + \Delta Y + \Delta Z)$$ Formula 8

$$\Delta X = -\log(\frac{X}{98{,}074})$$ Formula 9

$$\Delta Y = -\log(\frac{Y}{100}) \qquad \text{Formula 10}$$

$$\Delta Z = -\log(\frac{Z}{188{,}232}) \qquad \text{Formula 11}$$

The ZERO reference is distilled water.

#### 5.6.6.3 Saybolt color index

The Saybolt color index can be applied to all colorations, ranging from -16 (lightest value) to +30 (darkest value) and is measured in 50 mm cuvettes. The Saybolt color index is calculated from CIE L*a*b* values based on the standard ASTM D6045-12 as follows.

$$Saybolt = \alpha + (\frac{\beta}{log_{10}\,\Delta E - \theta}) \qquad \text{Formula 12}$$

$$\alpha = 51{,}1 \quad \beta = 44{,}5 \quad \theta = 2{,}55$$

$$\Delta E = \sqrt{(100 - L^*)^2 + a^{*2} + b^{*2}} \qquad \text{Formula 13}$$

The ZERO reference is distilled water.

#### 5.6.6.4 ADMI color index

Similar to the PtCo color scale, the ADMI color index is defined by the coloring of hexachloroplatinate solutions. It is measured in a 50 mm cuvette. But in order to measure colorations that are not in the yellow-orange gamut, CIE L*a*b* values are not used for the calibration, but rather, the ΔE values of the PtCo solutions are measured against water. Therefore, a solution with 50 ADMI units exhibits the same ΔE value as a Hazen/APHA/PtCo standard solution with 50 mg/L Pt, but it could also be colored red, green or blue. The ADMI values are not obtained by comparison with the PtCo calibration, but rather, calculated based on the standard AWWA 2120F through a 4th degree polynomial. The ZERO reference is distilled water.

#### 5.6.6.5 Yellowness-Index

The yellowness index is calculated from CIE XYZ values. Although it can be calculated for all colorations, it is defined only for yellow shades. For the yellowness index, the following formula applies based on the ASTM standard E313-05:

$$YI = \frac{100\times(C_X\times X - C_Z\times Z)}{Y} \qquad \text{Formula 14}$$

Pure "white" samples have a YI value of 0. Yellow-red tints produce positive YI values. The parameters $C_X$ und $C_Z$ are dependent on the selected illuminant and the observer. The ZERO reference is distilled water.

#### 5.6.6.6 Hazen/APHA/PtCo color index

The Hazen / APHA / PtCo color index covers the gamut of colors from colorless (<1) to light yellow-orange (500). It is defined from solutions of hexachloroplatinate in water containing hydrochloric acid and is expressed in mg/L Pt. The measurement is made in 50 mm cuvettes. Photometrically, the platinum-cobalt color index is calculated according to ASTM D5386-05 from the yellowness index according to ASTM E313-05. The ZERO reference is distilled water.

### 5.6.7 Visual color scales

The color indexes Hazen / APHA / PtCo, the iodine color index, and the Ph. Eur. color index are defined only visually. The spectrophotometer performs an approximation of the measured CIE-L*a*b* values against a calibration table ("estimate").

#### 5.6.7.1 Iodine color index

The iodine color index measures the color gamut from colorless to yellowish to dark brown and is measured in 10 mm cuvettes. The values according to DIN 6162 range from 10 (light yellow) to 100 (brown). Samples are compared to solutions containing 10 mg, 20 mg, 30 mg, 40 mg, etc. of iodine in a 100 ml solution of potassium iodide. Intermediate values are not specified, but may be stipulated. The use of the iodine color index requires that the sample has a "similar" color to the color of iodine. The iodine color index is expressed in mg iodine / 100 ml solution. The ZERO reference is distilled water.

#### 5.6.7.2 Ph. Eur. color index

The European Pharmacopoeia defines three color standards for red (cobalt chloride / HCl), blue (copper chloride / HCl) and yellow (iron (III) chloride / HCl). These are used to mix five color schemes for the colors red, brown, brown-yellow, yellow and yellow-green. They are then further diluted. It covers colors that are brighter. The color is specified as red, brown, brown-yellow, yellow, yellow-green and the number specifies the solution according to Ph Eur 2:02:02. The strongest color solution always has the number 1. B ranges from B1 to B9, all other color solutions only to 7. A differentiation of the bright solutions B9, GY7 and G7 is difficult even with a photometer. The Ph. Eur. Color index is measured in 50 mm cuvettes based on DAB 4.00/2.02.02.00. The ZERO reference is distilled water.

### 5.6.8 Distinction of the color index according to Ph. Eur. Sec. 2.2.2

Once you have selected the Ph. Eur. color scale and tapped on a list entry, a window will appear in which you can choose the color scheme to be used for the comparison (Figure 56).

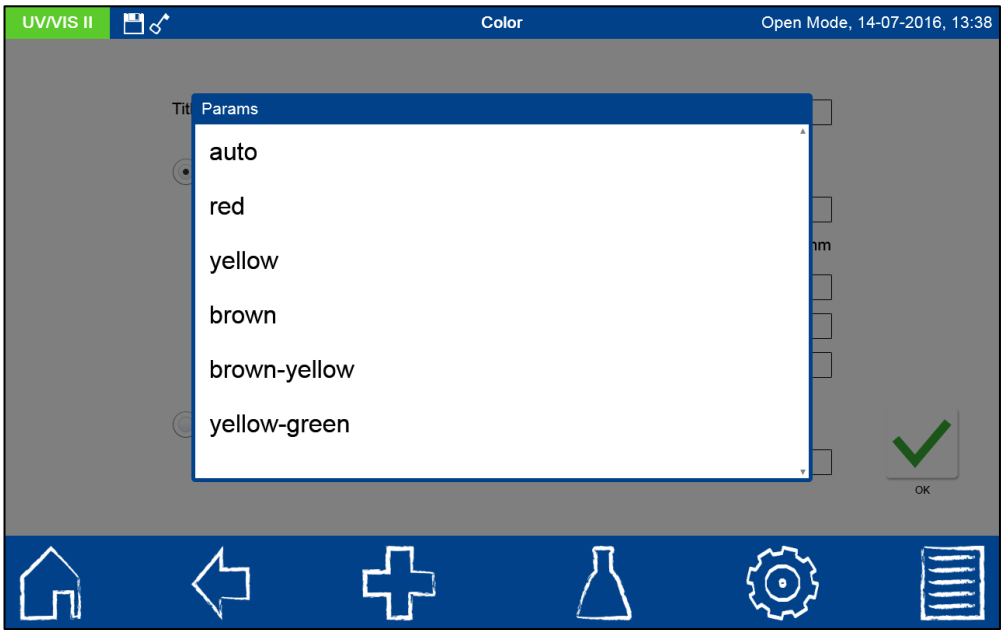



Figure 56: List box of the Ph. Eur. color scheme

You can compare all of the color schemes by using the *automatic* option, or a single scheme by using the option button *red*, *brown*, *brown-yellow*, *yellow* and *yellow-green*. A result is shown in Figure 57.

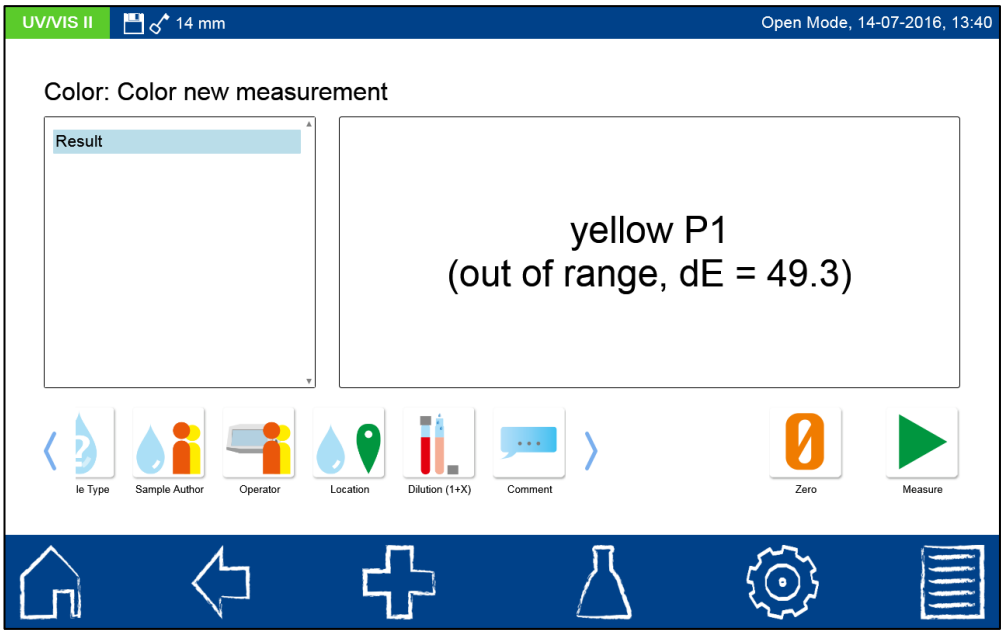



Figure 57: Ph. Eur. color measurement out of range

If the sample is out of range, this will be indicated in the measurement result (see Figure 57).

### 5.6.9 Characteristics of the Klett color index

The Klett color index is one of the oldest photometric color indexes of all. It is measured with an American Klett-Summerson photometer. The construction of these photometers has remained practically unchanged since 1939. These photometers operate with simple glass filters. In contrast to the first European photometers, the measured value is not the transmittance or absorbance, but rather a value on an **arbitrary logarithmic scale** from 1 to 1000, the Klett scale. This scale follows the Lambert Beer Law and is therefore proportional to the concentration. Due to the properties of colored glasses, the filters originally used in the Klett colorimeter have a relatively large transmission range; for instance, the filter KS-42 allows the transmission of light in the range of 400 to 450 nm. **The original Klett index is thus an integral measurement value over a range of about 50 nm.**

**Klett photometers are still used today in bioanalysis for monitoring the growth of cell cultures. However, it is not the absorption that is measured, but rather, the stray light. Since the measurement of stray light depends on the geometry of the measuring device, the Klett index determined by the *NANOCOLOR*® spectrophotometer software cannot be used for monitoring cell cultures!**

### 5.6.10 Measurement methods and references

For each color determination, the tristimulus values and chromaticity coordinates are calculated as specified by International Commission on Illumination CIE, Publication *CIE 15:2004, 3rd Edition*. **The following color indexes are calculated directly from X, Y, Z or x, y, z data:**

XYZ, xyz, L*a*b* and L*u*v* according to *CIE 15:2004, 3rd Edition*.

Hunter-Lab according to *HunterLab Application Note "Hunter Lab Color Scale," August-1-15, 1996 Vol. 8, No. 9*

Gardner color index according to *DIN EN ISO 4630-2*

Yellowness index according to *ASTM E 313-05* und *ASTM D1925* (outdated)

RGB, CMYK, YUV, HSB, HSL according to *www.brucelindbloom.com*

ASTM color index according to *ISO 2049*

Saybolt color index according to *ASTM D156, D6045*

Hazen/APHA/Pt-Co color index according to *ASTM D 5386-05*

**The following color indexes are calculated from absorbances at certain wavelengths:**

ICUMSA sugar color according to ICUMSA *Method GS1/3-7*, *GS2/3-9* and *GS2/3-10*

Beer color EBC (*Analysis Methods for Breweries Vol. 2*, EBC 9.4, MEBAK 2.16.2) and ASBC.

Hess-Ives according to DGK test method F 050.2

**The following colors indexes are calculated from CIE-L*a*b chromaticities:**

Iodine color index according to *DIN 6162*

Ph. EUR. coloring according to *Ph. Eur. 2.2.2*

### 5.6.11 Differences compared to other colorimeters

To make things faster, most commercially available colorimeters measure only the wavelength range from 360 nm to 780 nm, in some cases only to 720 nm, with an increment of 10 nm. The *NANOCOLOR*® spectrophotometers adhere to the strict recommendations of the CIE. 360 nm to 830 nm, increment 1 nm. Therefore, slightly different values for L * a * b * can be measured. These values are not incorrect, but rather, they are more accurate. The following differences were observed on average: L* below 1% a* to 2% for red solutions, otherwise below 1%, b* to 5% for green solutions, 2% for yellow solutions, otherwise around 1%. Differences depend on the type and concentration of the sample.

### 5.6.12 Measuring speed

The *NANOCOLOR*® spectrophotometers are not simply colorimeters, but rather, full-fledged spectrophotometers which can be used either as a colorimeter or for nephelometric turbidity measurement. These instruments were not designed for speed, but rather, for precision and versatility. Since the *NANOCOLOR*® spectrophotometers make proper use of the CIE recommendations, the measuring takes longer than with other colorimeters. A color measurement (ZERO or sample) takes about 30 seconds at an integration from 360 nm to 830 nm.

### 5.6.13 Combinations of illuminants, observers and cuvette size

For an absolute color measurement, all cuvette sizes, illuminants and observers are allowed, as long as the parameters are listed in the measurement log (see CIE publication). **Different types of illuminants, observers or cuvette sizes will lead to different measurement results!**

Table 3 shows the allowable values for illuminant, observer and cuvette for each color index / color scale. The cuvette size indicates the inner diameter ID and the layer thickness d. The 14 mm cuvette is the *NANOCOLOR*® test tube; all the other cuvette sizes denote rectangular cuvettes. The last column of the table "according to standard" means the layer thickness specified by the relevant standard (see table 3). Some color indexes can be measured using any cuvette size, even if the standard dictates a specific size. If a dash (-) is entered as the standard size, then either the standard does not specify a size or the result is divided by the film thickness in the calculation. If a dash (-) is entered in the *observer* or *illuminant* column, the color index is calculated from the absorbance and not from chromaticity, so this setting is not an issue.

**For precise color measurements, the use of the 14 mm test tube is not recommended.**

| Color measurement | Observer | Illuminant | Cuvette [mm ID/d] | Standard [mm ID/d] |
|---|---|---|---|---|
| Standard color value | 2°, 10° | A, C, D65, D50, D55, D75 | 10, 14, 20, 50 | - |
| Chromaticity coordinates | 2°, 10° | A, C, D65, D50, D55, D75 | 10, 14, 20, 50 | - |
| CIE-L*a*b* | 2°, 10° | A, C, D65, D50, D55, D75 | 10, 14, 20, 50 | - |
| CIE-L*u*v* | 2°, 10° | A, C, D65, D50, D55, D75 | 10, 14, 20, 50 | - |
| Hunter-Lab | 2°, 10° | A, C, D65, D50, D55, D75 | 10, 14, 20, 50 | - |

| | | | | |
|---|---|---|---|---|
| PtCo/Hazen/ APHA | 2° | C | 10, 14, 20, 50 | 50 |
| Iodine | 2° | C | 10, 14, 20, 50 | 10 |
| Gardner | 2° | C | 10 | 10 |
| Hess-Ives | - | - | 10, 14, 20, 50 | - |
| Yellowness index | 2° | C | 10, 14, 20, 50 | - |
| Yellowness index E313 | 2°, 10° | D65, C | 10, 14, 20, 50 | - |
| Beer color EBC | 2° | C | 10 | 10 |
| Beer color ASBC | 2° | C | 10 | 10 |
| ICUMSA sugar color | - | - | 10, 14, 20, 50 | 10, 20, 50 |
| ADMI color | 2° | D65 | 10, 14, 20, 50 | 50 |
| ASTM color | 2° | C | 10, 14, 20, 50 | 32.5 |
| Saybolt color | 2° | C | 10, 14, 20, 50 | 50 |
| Ph. Eur. | 2° | C | 50 | 12, 16 |
| Klett | 2° | C | 10, 50 | - |

Table 3: Allowable combinations of illuminants, observers and cuvette types

## 5.7 Test number

Besides opening the measurement menu of the cuvette tests via barcode detection, it can also be opened by selecting the related test from a list of tube tests or by entering the test number (Figure 58). Upon entering the three-digit test number, the information for the last submethod to be selected will be shown (Figure 58). By entering the three-digit test number plus the corresponding submethod number, the information for that submethod can be viewed. Tap C to delete the entry. Confirming with ✓ will initiate the start of the selected method.

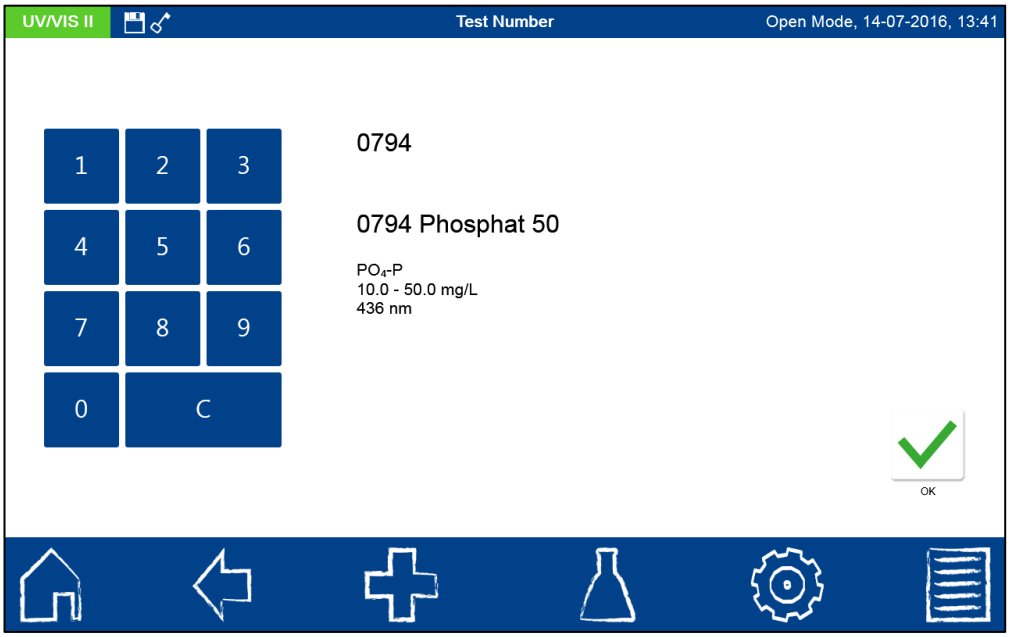



Figure 58: Opening a method entering a test number

# 6 Main Menu

Press the icon to open the main menu. Now you can choose from the options shown in Figure 59.

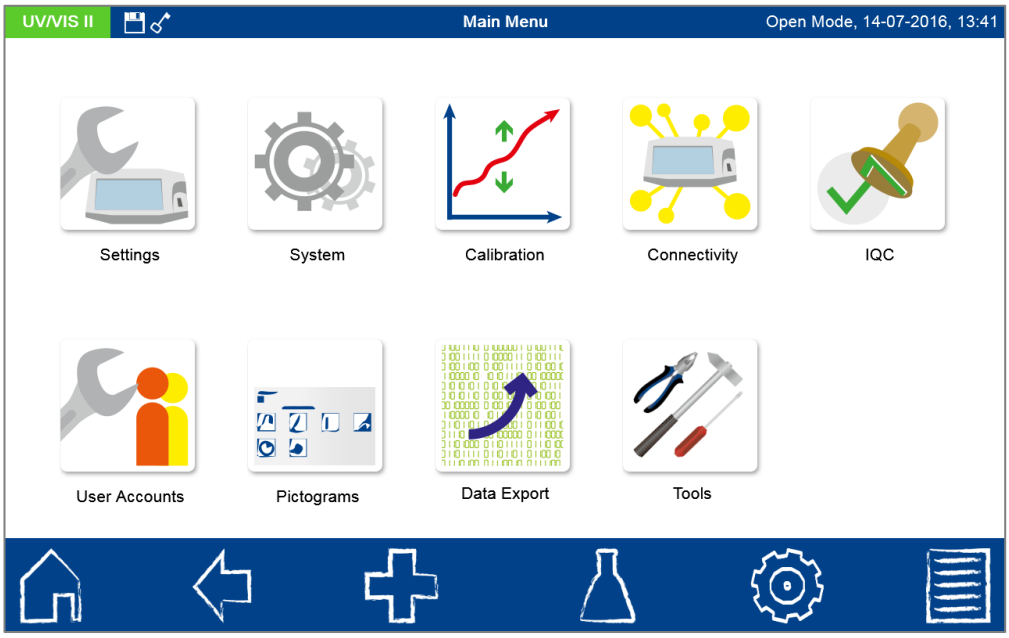



Figure 59: Main menu

## 6.1 Settings

In this menu, general settings for the instrument can be made or options which affect the measurement process can be selected.

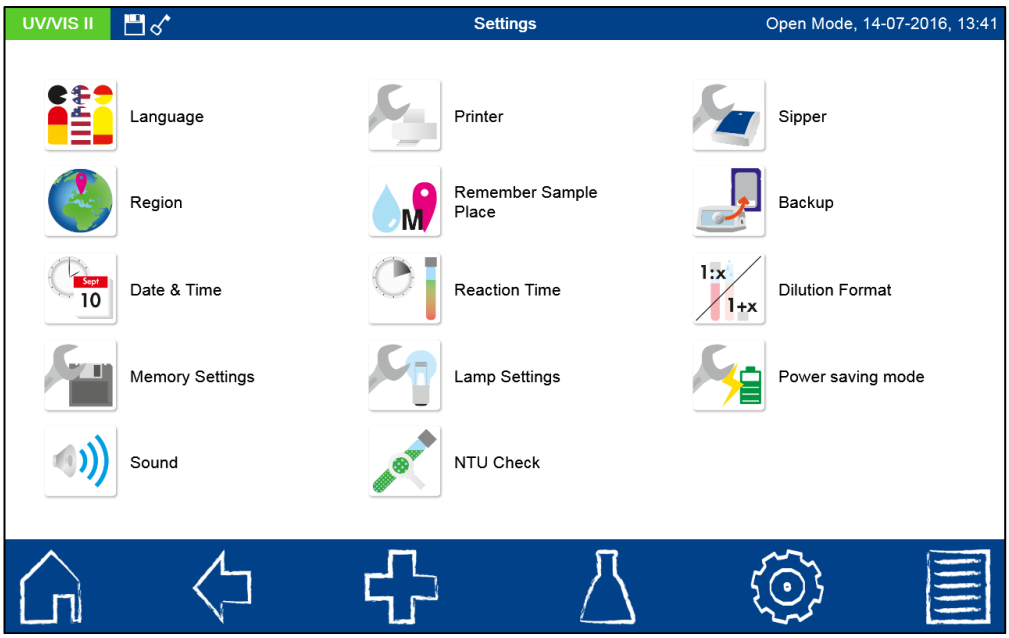



Figure 60: Settings menu

### 6.1.1 Language

Click on the icon to select the language of the instrument from the list that pops up. After you have selected the desired language, the list will close and the chosen language will be applied as the general display language for the entire device.

### 6.1.2 Region

Click on the icon to select the region of the device from the list that pops up (Figure 61). After you have selected the desired region, the list will close and the chosen region will be applied. Changing the regional settings will affect the display of the measurement result. This can change the way the thousands separator and the decimal place are depicted (Example: DE (Germany) 1.567,222; UK (United Kingdom) 1,567.222).

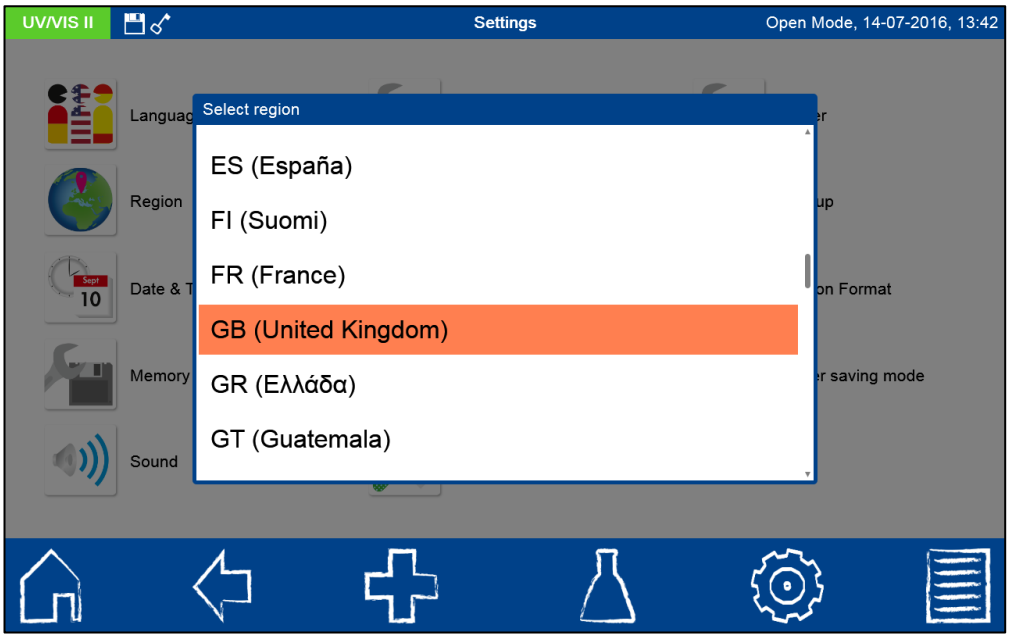



Figure 61: List box of regional settings

### 6.1.3 Date & time

Click the icon to change the date and time display format. Four different options are available for the date format (Figure 62). After changing the display format, the date will be shown in the status bar in the chosen format. Two options are available for the clock display – 12 hrs and 24 hrs. After changing the clock display format, the time will be shown in the status bar in the chosen format. The setting will be saved upon exiting the menu.

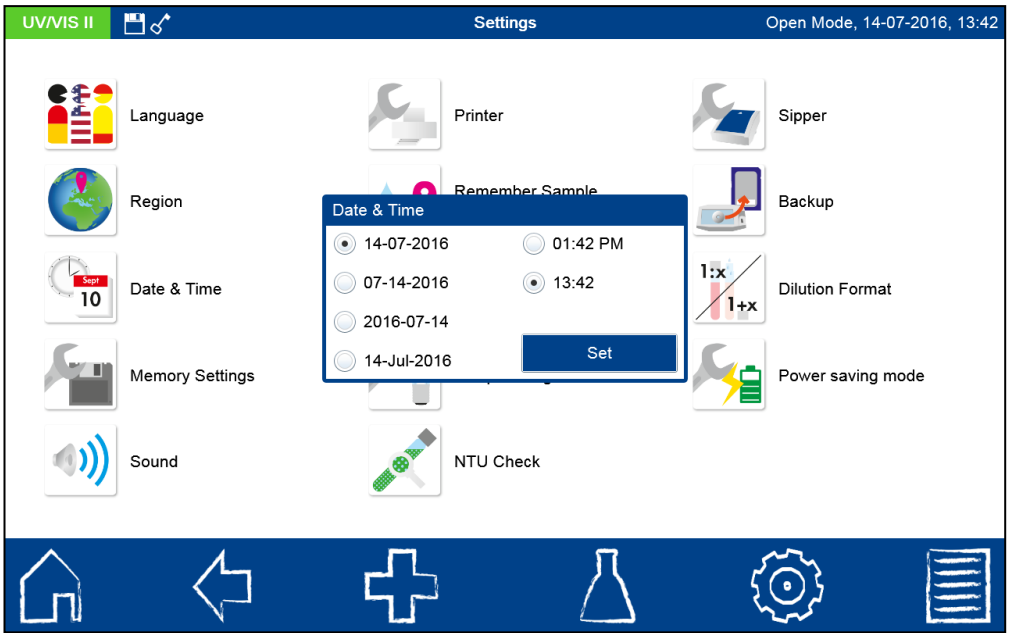



Figure 62: Settings for the date and time display format

Press the Set button to open the date and time settings window (Figure 63). Press the arrow button to set the desired date and time. Confirming with the OK button saves the settings. A preview of the date and time display can be seen in the lower left hand corner of the pop-up window.

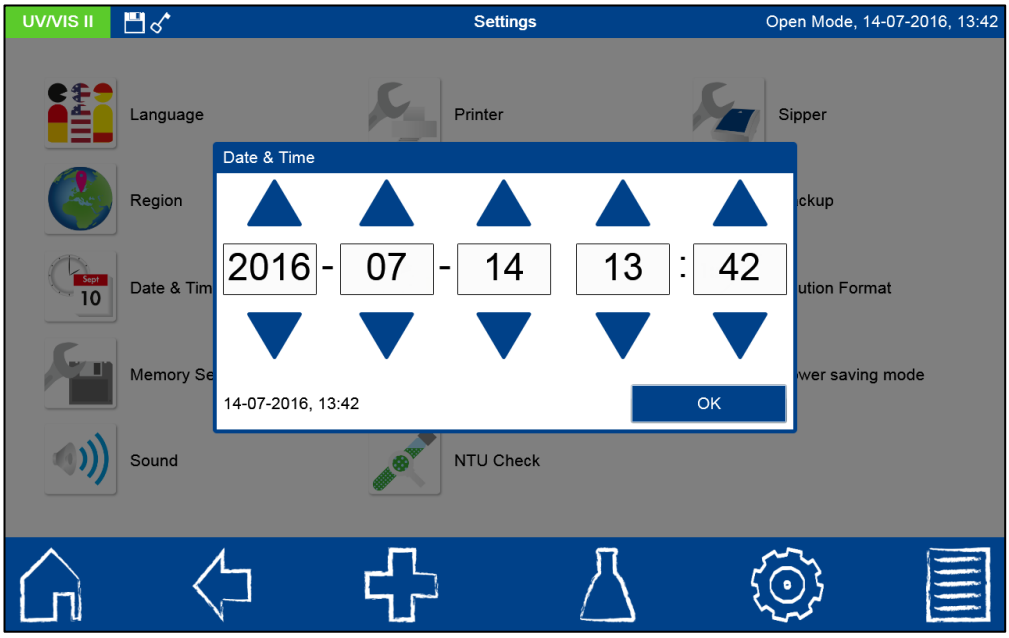



Figure 63: Setting the date and time

### 6.1.4 Memory settings

Press the icon to view the memory settings. Besides an overview of the memory usage, the saving of measurement results can be switched on and off here. The bars in conjunction with the percentage readings provide information about the usage of the RAM and the instrument's memory as well as the SD card memory. The available storage space is shown beneath the bar.

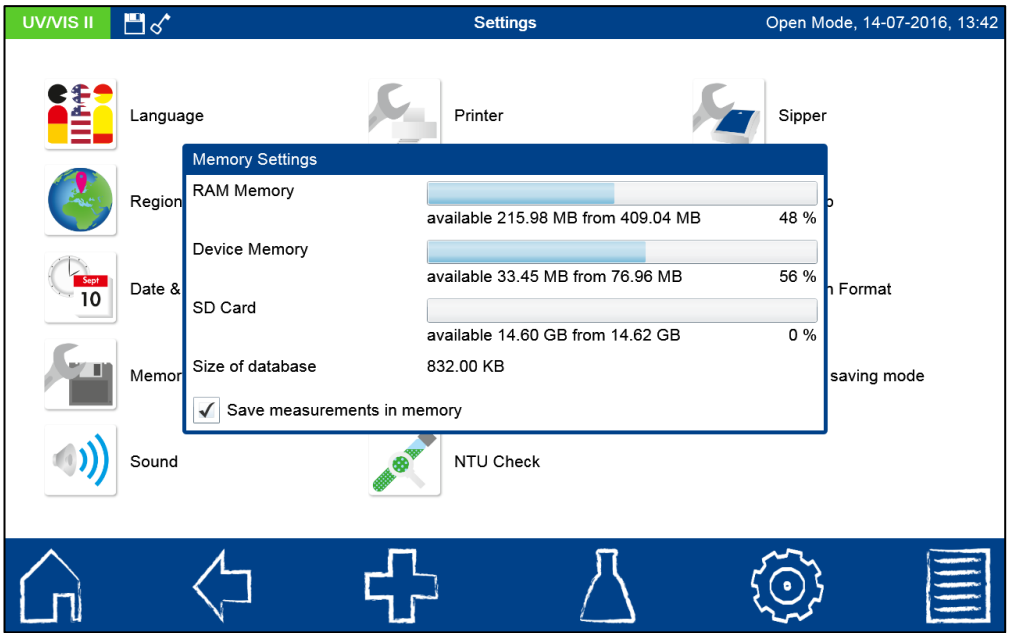



Figure 64: Memory settings

The automatic saving of all measurement results can be switched on or off using the “Save measurement results” checkbox. If the box is unchecked, all of the measurement results will be displayed but not saved. *Please note: The option for switching off the measurement results memory is only available in the “Open Mode” (see also Section 6.6.2).*

The setting will be saved upon exiting the menu.

### 6.1.5 Acoustic signal

Press the  icon to adjust and test the sound level of the acoustic signals (Figure 65). Press the volume symbol to open a list for selecting the sound level. The sound level can be adjusted from 0–10. The settings affect all of the acoustic signals that the instrument has to offer. Press the 

button to test the adjusted volume. The setting will be saved upon exiting the menu.

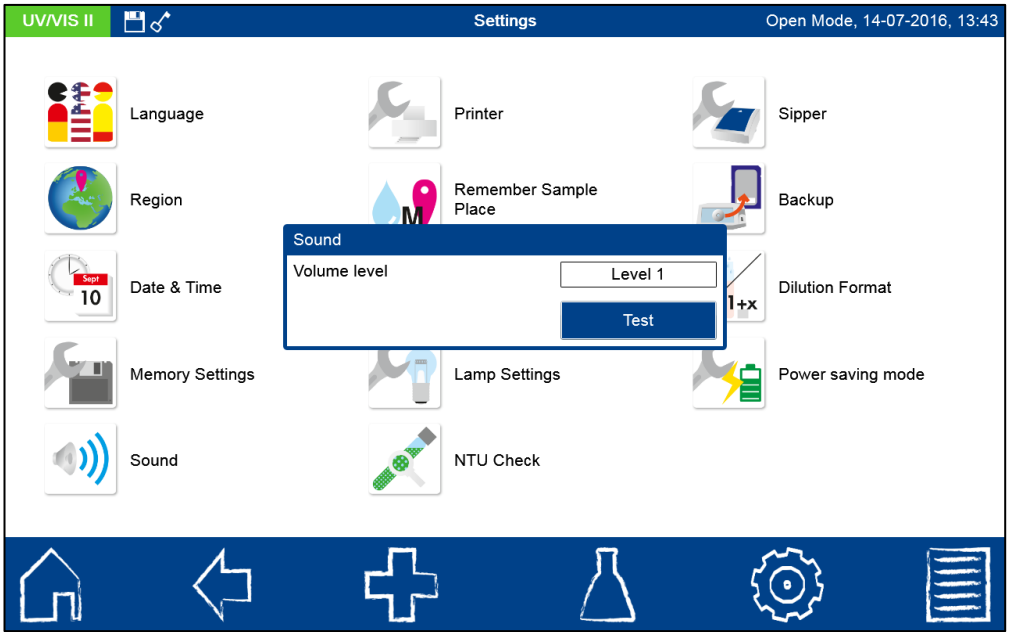



Figure 65: Acoustic signal settings

### 6.1.6 Printer

Press the  icon to adjust the printer settings. A printer can be connected directly to the spectrophotometer via the two USB A ports. In addition to standard printer models *(Please note: PCL6 protocol must be supported.)* MACHEREY-NAGEL also offers thermal printers for the connection to the spectrophotometers. The check box "color printing" is only relevant for printers that support color printing. If the color printing option is deselected, the print-outs will be in black and white. The "Automatic printing of measurement" checkbox determines whether a connected printer prints out the measurement results immediately after measuring. Choosing the entry “Extended printout” the printout of results will contain all information about a measurement. In case the checkbox is not set, the measurement results on the printout will only contain the most important information. Setting the checkbox “Inverted printout”, the printout will start with the latest measured result. When deselectiong this option the first result will be the oldest in memory. The settings will be saved upon exiting the menu.

*Please note: Printouts with a thermal printer are limited to the measurement of tube tests and rectangular cuvette tests. They cannot print out results of a scan or a color measurement.*

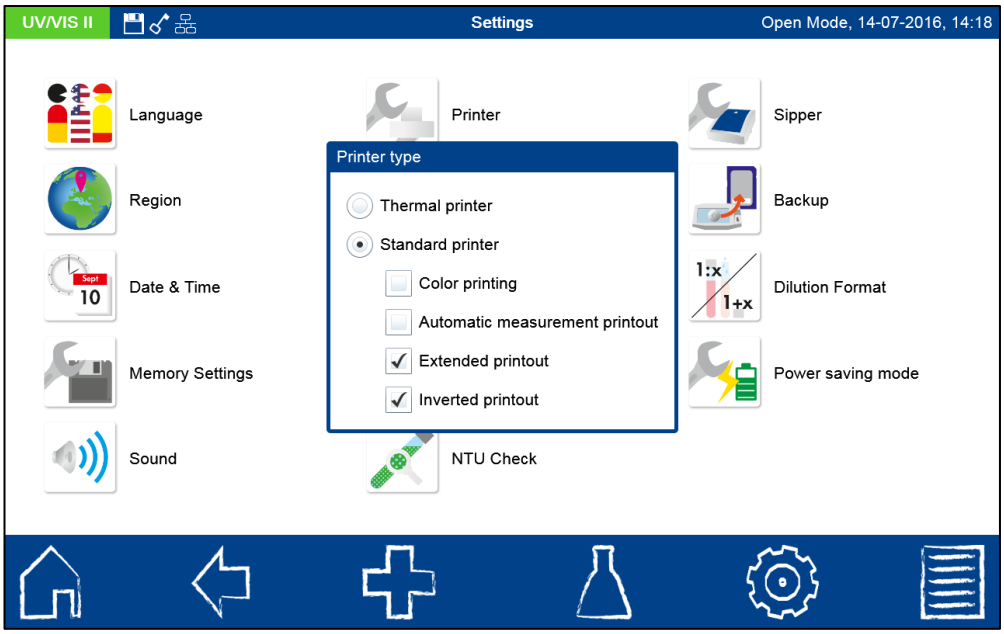



Figure 66: Printer settings

### 6.1.7 Remember sampling location

Press the  icon to open a window to turn on this function. When activated, once a sample location has been entered, it will be applied to every subsequent measurement until this option is deselected. A sampling location flag  in the status bar tells you whether or not this function has been turned on. The setting will be saved upon exiting the menu.

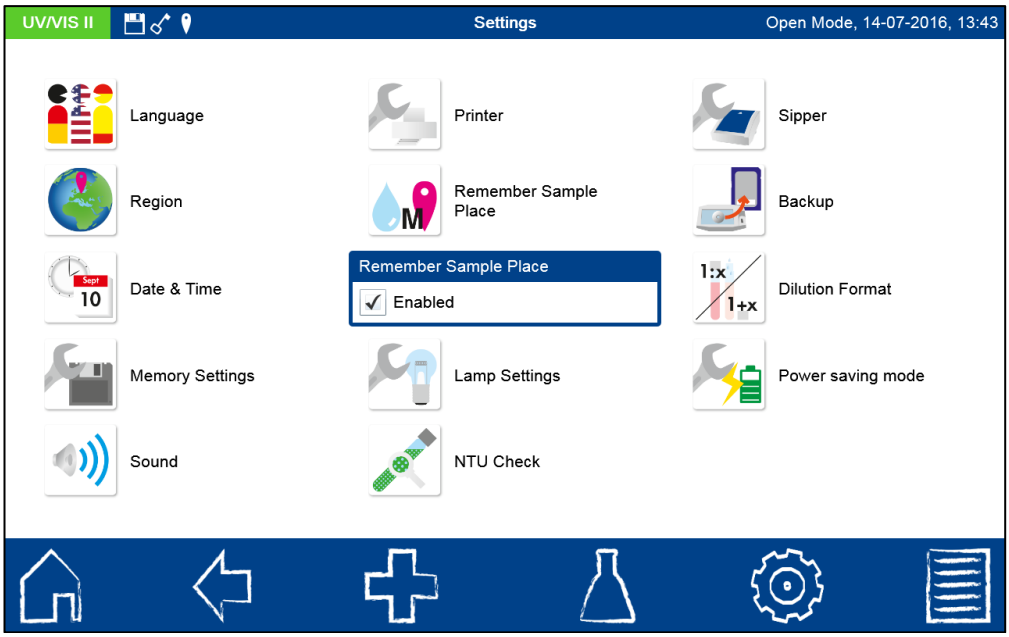



Figure 67: Activate “Remember sample place”

### 6.1.8 Reaction time

Press the  icon to open a window to turn on this function. When turned on, the reaction time stored for a test will begin to count down automatically before the measurement. After the reaction time has counted down, the measurement will then take place automatically. Marking the checkbox (see Figure 68) will activate the function and a reaction time flag will appear in the status bar. The setting will be saved upon exiting the menu.

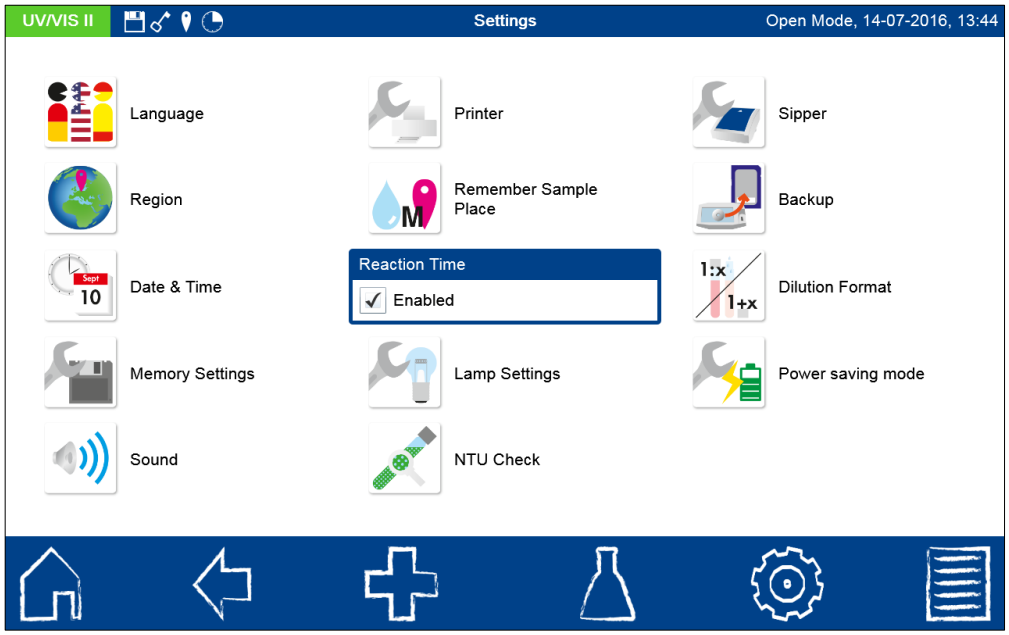



Figure 68: Acivate “Reaction time”

### 6.1.9 Lamp control

Press the  icon to open the lamp control window. In this menu, the running time of the spectrophotometer’s halogen lamp (and UV lamp: *NANOCOLOR*® *UV/VIS* II only) is shown. In case of replacement, the running time can be reset by pressing the “Reset” button. Furthermore, the switch-off time for the UV lamp can be set via this menu. The warm-up time before use of the deuterium lamp is 90 seconds. The warming up process of the deuterium

lamp is indicated by a popup window, showing the warm up time. Activation of the deuterium lamp is indicated by the "UV" flag in the status bar of the device. The maximum service life of the deuterium lamp is 1000 hours on average.

Adjusting the lamp change point controls the use of the UV lamp in the wavelength range from 335 nm-345 nm. Enter the desired lamp change point on the numeric keypad and confirm your entry with "OK". The settings will be saved upon exiting the menu.

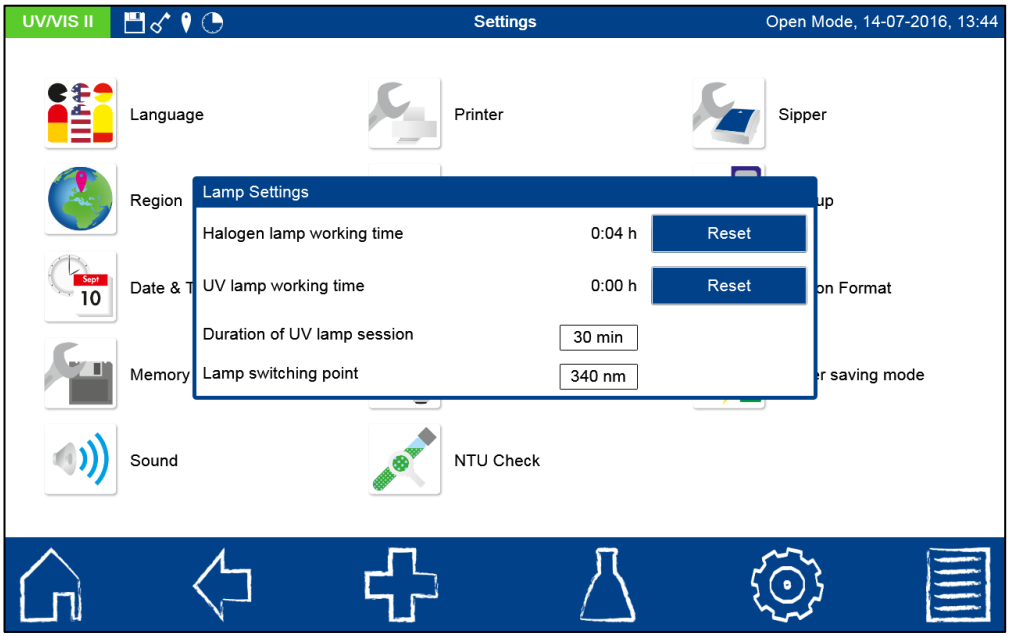



Figure 69: Lamp settings menue

### 6.1.10 NTU check

This function allows the detection of potentially interfering turbidity during the measurement of light transmission in tube tests. The result of the turbidity measurement is stored together with the actual measurement result.

Press the  icon to open a window for turning on this function. Mark the checkbox to turn on the NTU check (see Figure 70). Define a warning limit and enter it via the numerical keypad. If the specified warning limit is reached during a measurement, the measurement result will be displayed in red as a warning. It is recommended that you pre-set the warning limit to 10 NTU. The setting will be saved upon exiting the menu.

When activated, parallel to each measurement of a tube test for which the measurement of the nephelometric turbidity is to be included, the NTU value (nephelometric turbidity units) will be determined. The turbidity measurement is performed at a 90° angle at 860 nm. When this option is activated, the measuring time for tube tests will be prolonged by a few seconds.

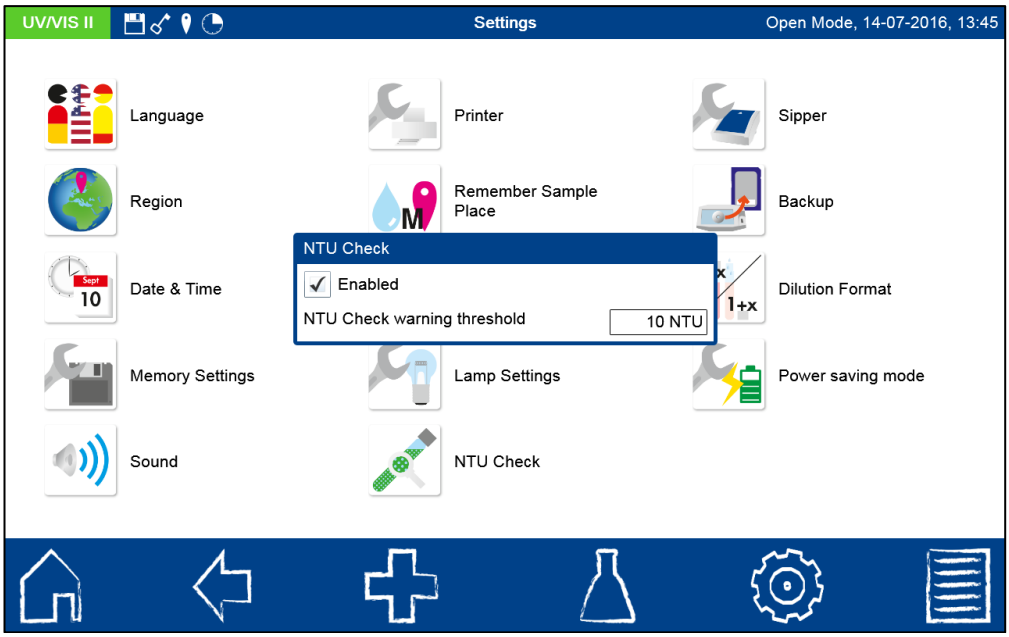



Figure 70: Activate “NTU-Check” function

### 6.1.11 Sipper

Press the  icon to open the window for the sipper pump settings. When a sipper pump is connected, the settings made here for pump time, flush time and delay time will be applied. To connect the sipper pump to the spectrophotometer, please consult Section 6.5.1 and observe the instructions in the sipper manual. The settings will be saved upon exiting the menu.

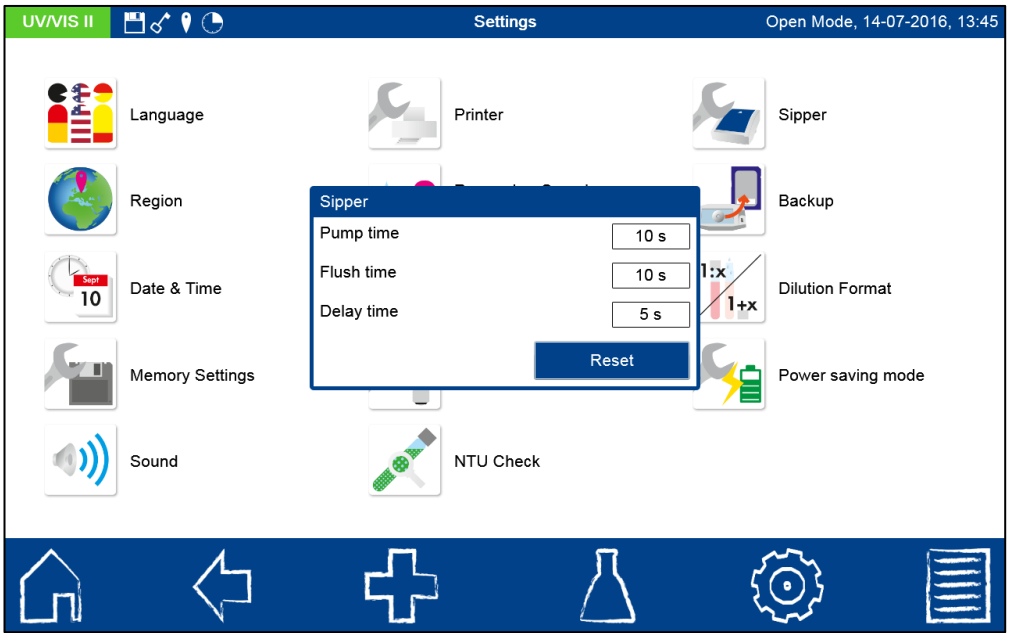



Figure 71: Sipper settings

### 6.1.12 Backup

Press the  icon to open the window for saving a backup. We recommend securing the saved measurement results, user-defined settings, and special methods in the form of a backup before servicing the unit or before an update. In addition to the built-in SDHC

memory card, the backup can be stored on an external USB drive. Select the desired storage medium via the option buttons (see Figure 72).

When the Backup button is pressed, the photometer data will be backed up to the selected storage medium. The message “Backup complete” confirms that the backup process was successful. To end the process, confirm with “OK.”

By pressing the Restore button, the data backed-up to the storage medium will be transferred to the spectrophotometer. A confirmation prompt will appear to continue the process. Confirming with "OK" opens a list of backup files available on the internal SDHC card. The file names are marked with the date and time. Select a backup file in order to import its contents. To retrieve a backup from a USB drive, press + in the list. The backup files on the connected USB storage device will be shown.

*Please note: Restoring an instrument backup permanently erases the current data.*

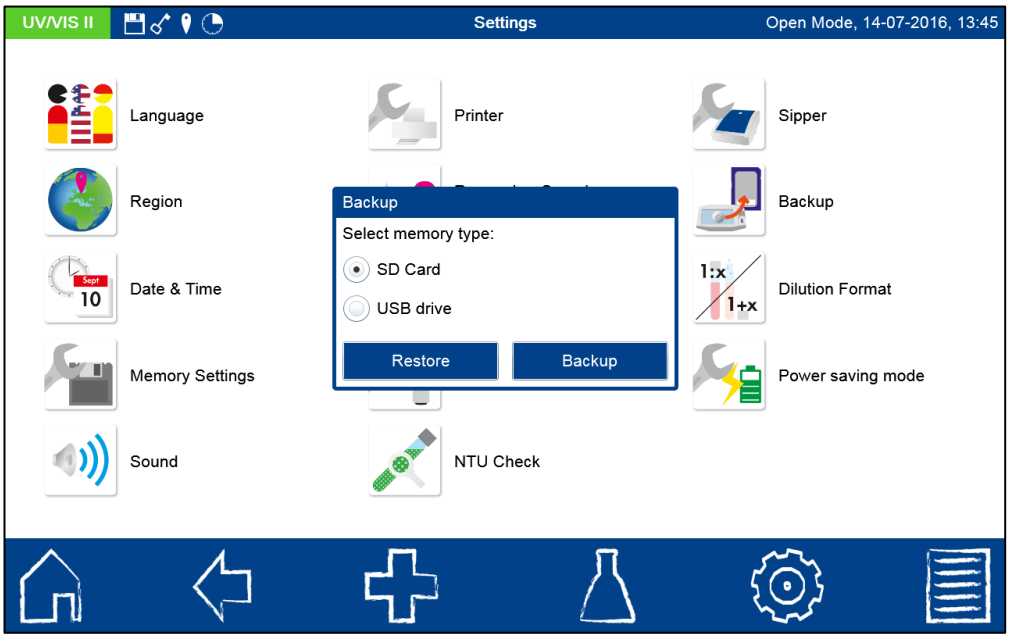



Figure 72: Create and restore a backup

### 6.1.13 Dilution format

Press the 1:x / 1+x icon to open a window for setting the dilution format. You can choose between the formats “1+X” and “1:X.” When activated, the selected dilution will be displayed in this format and applied in the IQC menu dilution series. The setting will be saved upon exiting the menu.

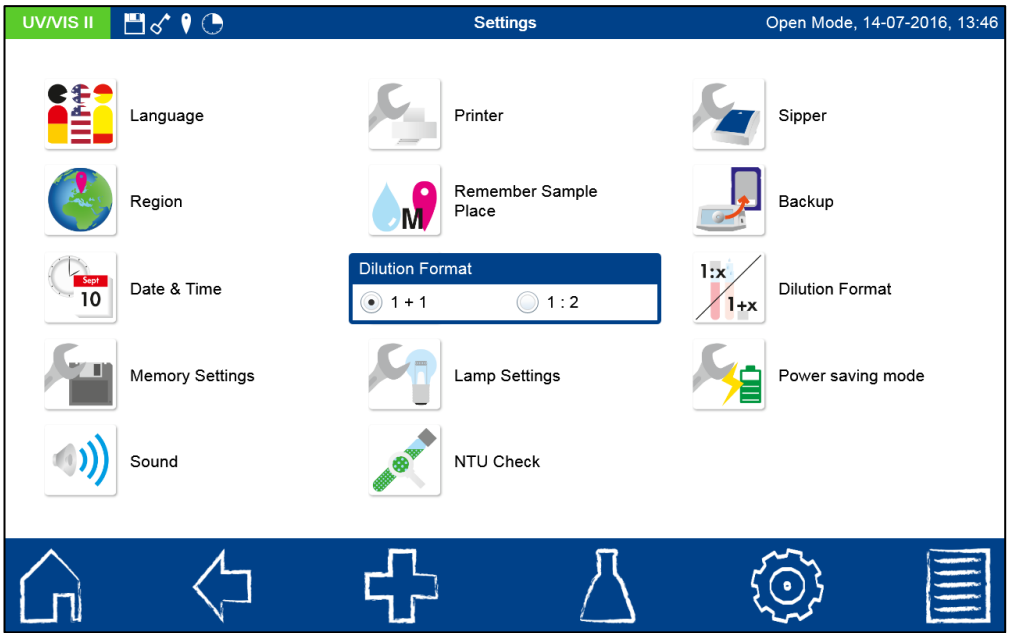



Figure 73: Choose dilution format

### 6.1.14 Power saving mode

Press the  icon to open a window for activating this function (Figure 74). This is where you set the time for the display to switch off when not in use in order to save energy. Simply tap on the black display in the energy saving mode to switch it back on and start using the instrument. The setting will be saved upon exiting the menu. The default setting is 5 minutes. Select 0 minutes to deactivate the energy saving mode.

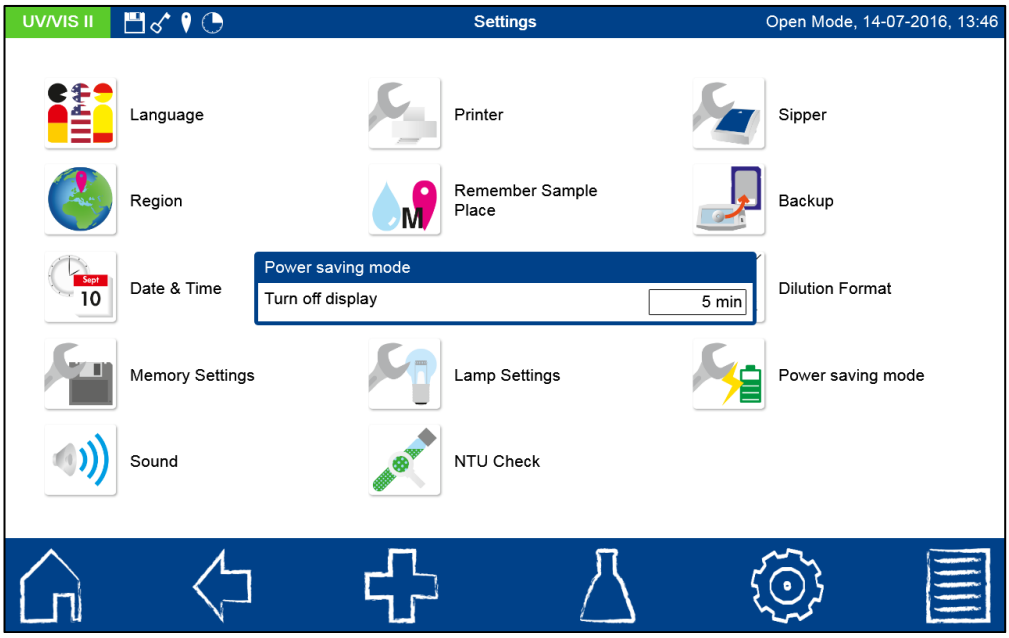



Figure 74: Energy saving mode

## 6.2 System

Press the  icon to open the system menu.

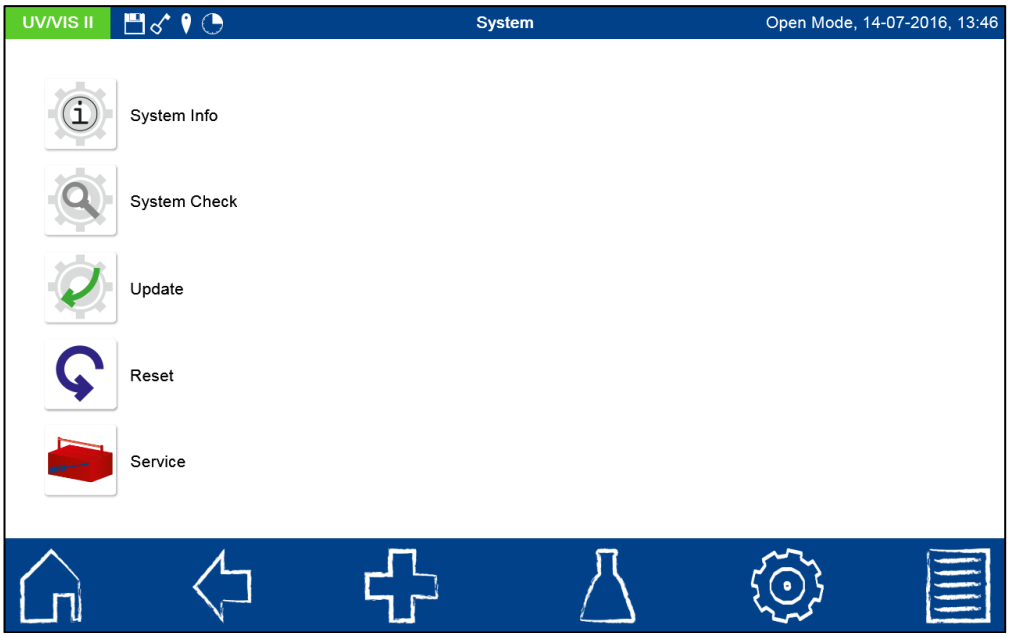



Figure 75: System menu

### 6.2.1 System info

Press the icon to open a window showing the instrument data (Figure 76). This is where information on the manufacturer, instrument model, serial number, operating system version, software and firmware version, and the number of system starts are listed. Please have this information ready when contacting the MACHEREY-NAGEL technical support.

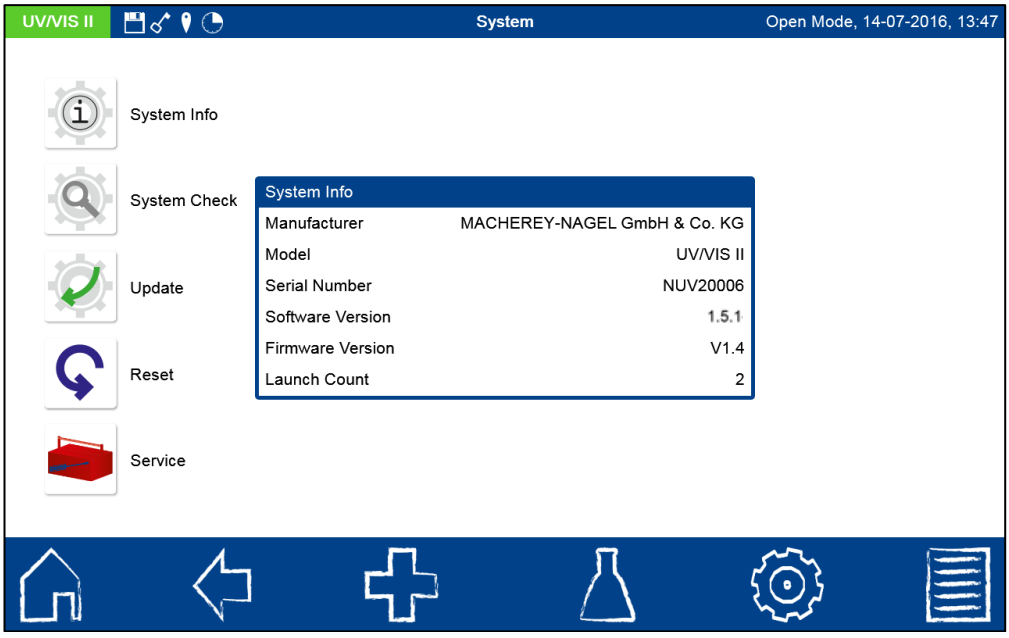



Figure 76: System info

### 6.2.2 System check

Press the icon to open the dialogue for the system check menu. This is where a periodic check of the system can be arranged by marking the checkbox. When activated, it will be performed every 180 minutes following the latest measurement.

The system check can be triggered manually by pressing . A lamp test, a wavelength

accuracy test, a filter test, and detector test will be performed. This can take a few minutes. During this time no measurements are possible. The result of the system check is then displayed in the overview window.

If the result of one or more of the tests is rated “Fail,” restart the instrument and repeat the system check. If the problem persists, please contact the manufacturer or your local distributor.

## 6.3 Update

We suggest that you perform a backup before each update (see Section 6.1.12), even if the update has no influence on the data. In order to backup customer-defined user methods, we recommend that they are exported to an external storage medium, such as a USB drive.

Download the update file from the MACHEREY-NAGEL homepage and extract the ZIP file on your PC. Copy the .mns update file to the top level of a USB stick and connect it to the instrument. Press the → → icons and select the required update file from the list. Wait until a message appears indicating the termination of the update process. (This process can take up to a few minutes). Restart your device when prompted. Wait until the unit has restarted and has conducted the necessary self-tests. Please do not turn off the device during this process.

Press the → → icons to see whether the update was successful. The installed version will now be shown.

### 6.3.1 Reset

A system reset sets the device back to the default setting. All data, special methods and custom settings will be deleted. We suggest that you backup all saved data, special methods, and the user-defined settings beforehand on an SD card (see Section 6.1.12).

After pressing the icon, a dialogue with a confirmation prompt will open (see Figure 77). Confirming with “Yes” will reset the instrument to the default settings. The data stored on the internal SD card will remain unaffected by the system reset.

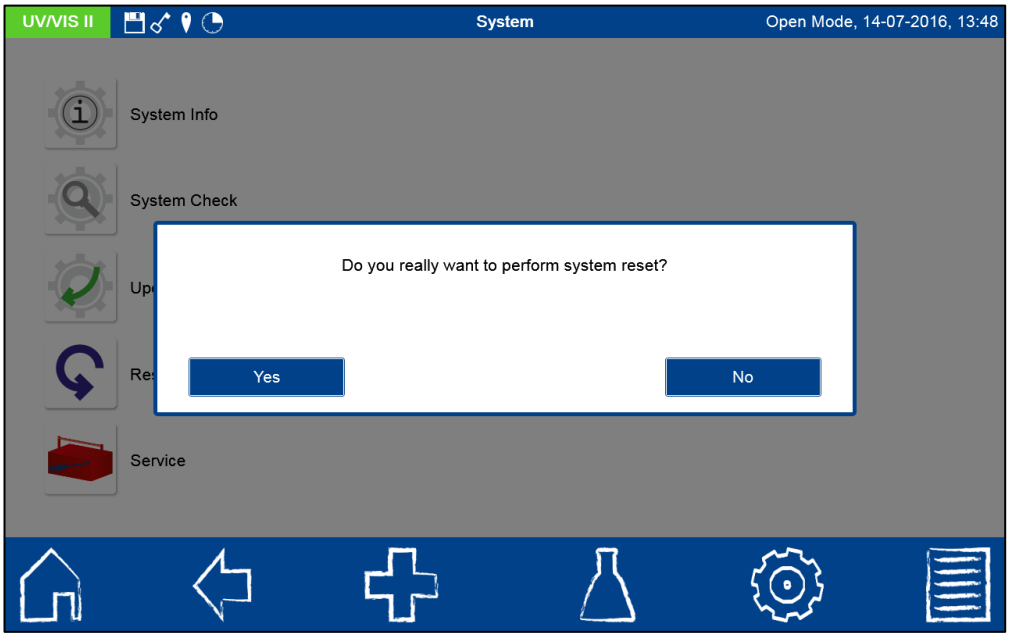



Figure 77: System reset

### 6.3.2 Service

Use of the service menu is protected by a service code. The use of this menu is reserved exclusively for service technicians for servicing purposes.

## 6.4 Calibration

The spectrophotometer performs a self-test each time it starts to check the basic calibration. The basic calibration or zero calibration as well as the calibration of the nephelometric turbidity measurement can be performed manually, if required, via the calibration menu.

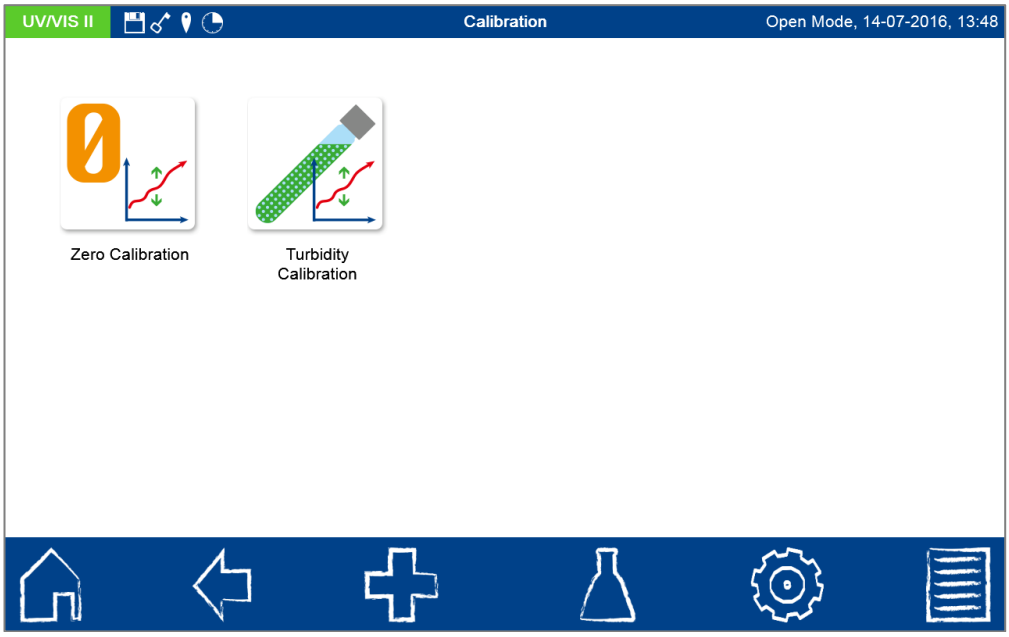



Figure 78: Calibration menu

### 6.4.1 Zero calibration

Press the icon to open the window for the zero calibration of the instrument. Start the calibration process by confirming with . The instrument first takes an air measurement and then asks for the insertion of the calibration cuvette. Place the supplied and clean calibration cuvette in the cuvette slot; the calibration will continue automatically.

When calibration is complete, the date of calibration is stored in the device and displayed the next time the calibration process is activated.

### 6.4.2 Turbidity calibration

Press the icon to open the window for the turbidity calibration of the instrument (see Figure 79). Select the range to be calibrated. The turbidity standards you use can be entered in the list box on the left. The predefined standards can be deleted and replaced with the desired values. Start the calibration process by confirming with . The instrument will scan the series of standards after insertion and start the respective measurement automatically. When calibration is complete, the date of calibration is stored in the device and displayed the next time the calibration process is activated.

*Note: Turbidity standards for the calibration of the NANOTURB Sensitive range can be purchased from GLS chemicals (US).*

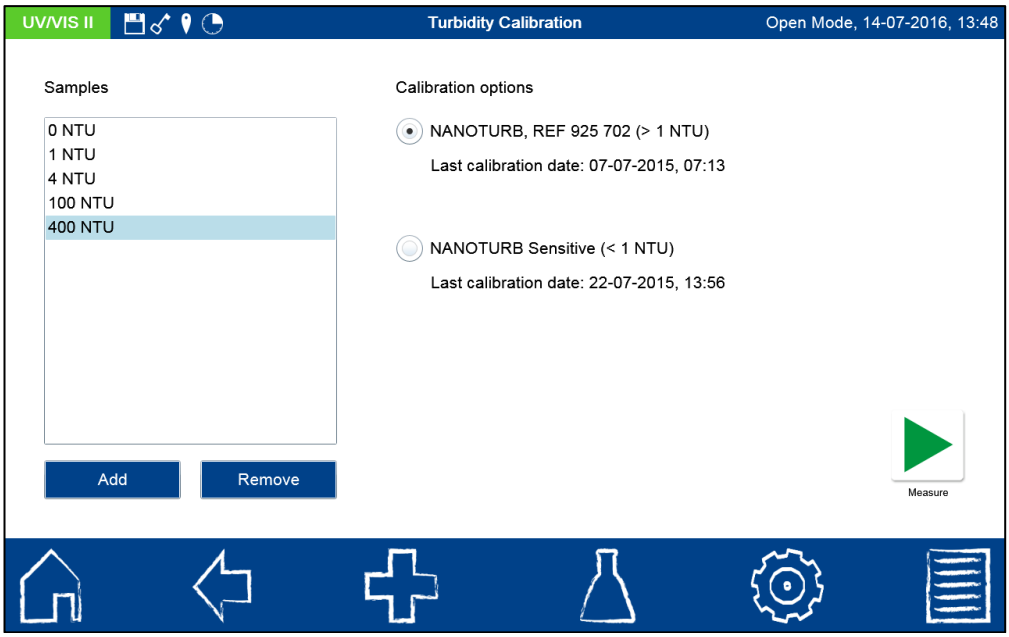



Figure 79: Turbidity calibration

## 6.5 Connectivity

In the connectivity menu, settings are made for the interfaces RS232, LAN and USB which the instrument provides.

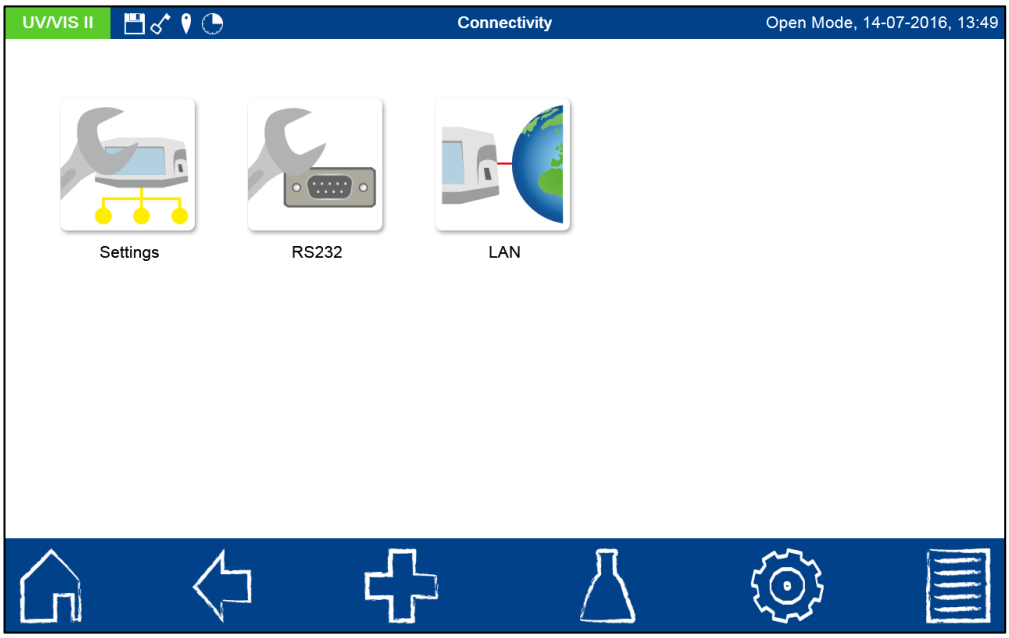



Figure 80: Connectivity menu

### 6.5.1 Settings

In the connectivity settings (see Figure 81) the various types of interfaces on the device can be controlled. It is not possible to send several records at the same time through an interface. The assignment of the corresponding interface, therefore, has to be done manually. When the sipper pump (choose respective model *NANOCOLOR*® FP-100 or FP-200) is used, the RS232 checkbox must be marked. Only one option can be set for each interface. Confirm with ✓ to save the settings.

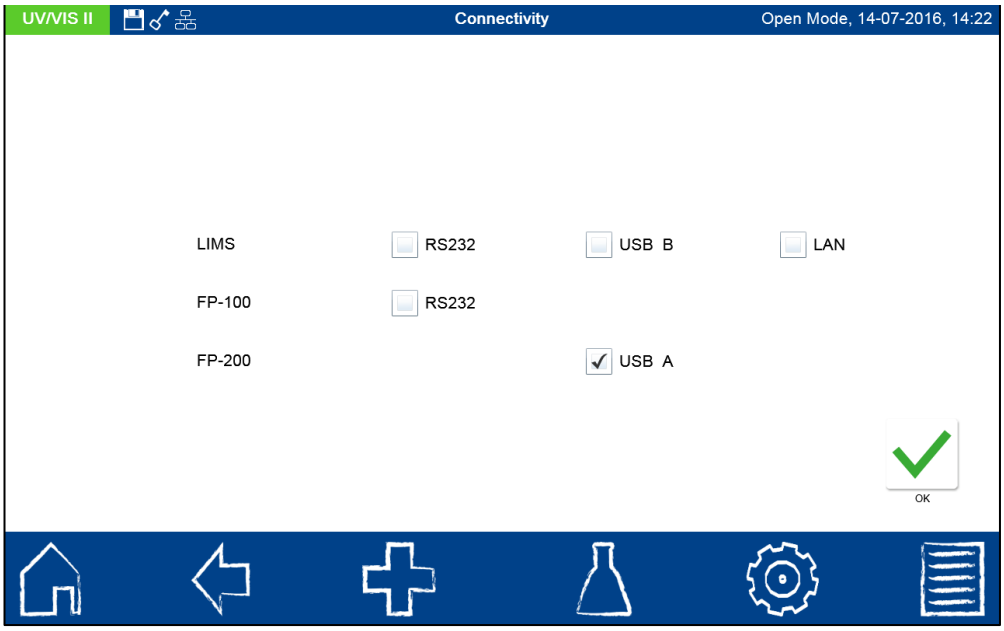



Figure 81: Connectivity settings

### 6.5.2 RS232

In the RS232 settings (see Figure 82) the baud rate, bits and parity can be set. Tap on the respective text field to open a list box with the available settings. Confirm with ✓ to save the settings. *Please note: In case of data transfer problems, make sure the connectivity settings match the connected devices* (see Section 6.9.1).

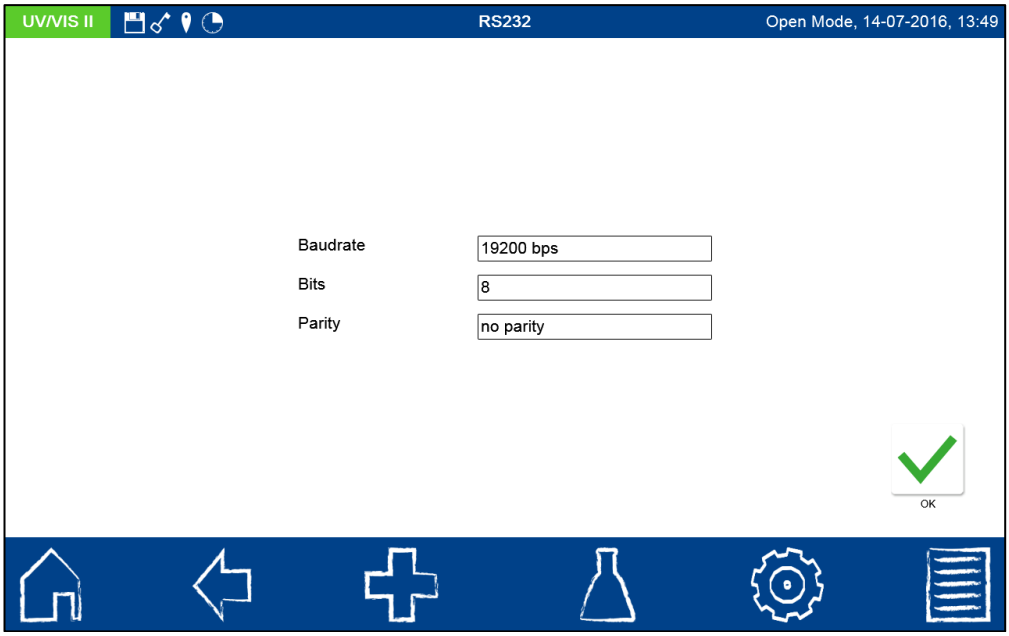



Figure 82: RS232 settings

### 6.5.3 LAN

Press the icon to open the overview of the LAN settings (Figure 83). If the device is part of a DHCP network, an IP-address will automatically be assigned, which can be viewed here along with the MAC address, subnet mask, gateway and the DNS-Servers. In case of a network setup with static IP addresses, the selection button needs to be set to “static”. The respective fields will get editable and the necessary data can be entered.

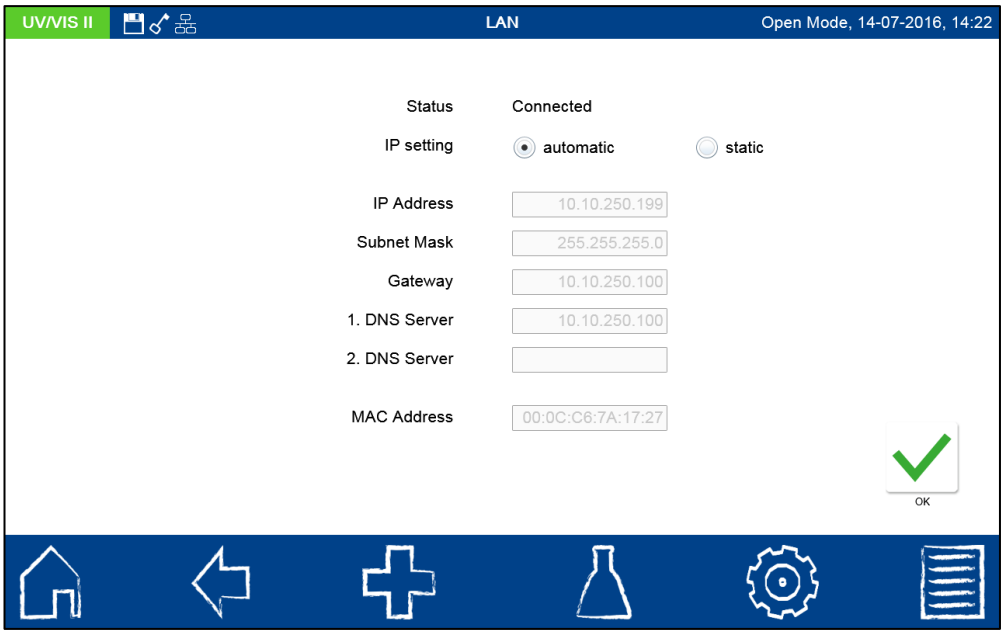



Figure 83: Overview of the LAN settings

## 6.6 IQC

The menu for internal quality control (IQC) is activated by pressing the icon and it contains the options shown in Figure 84. The various options make it possible to model the internal quality control document. Even though the limits for standard measurements, multiple determinations, dilution series, and spike additions that are stored in the menu are based on German requirements, they can always be changed by the user.

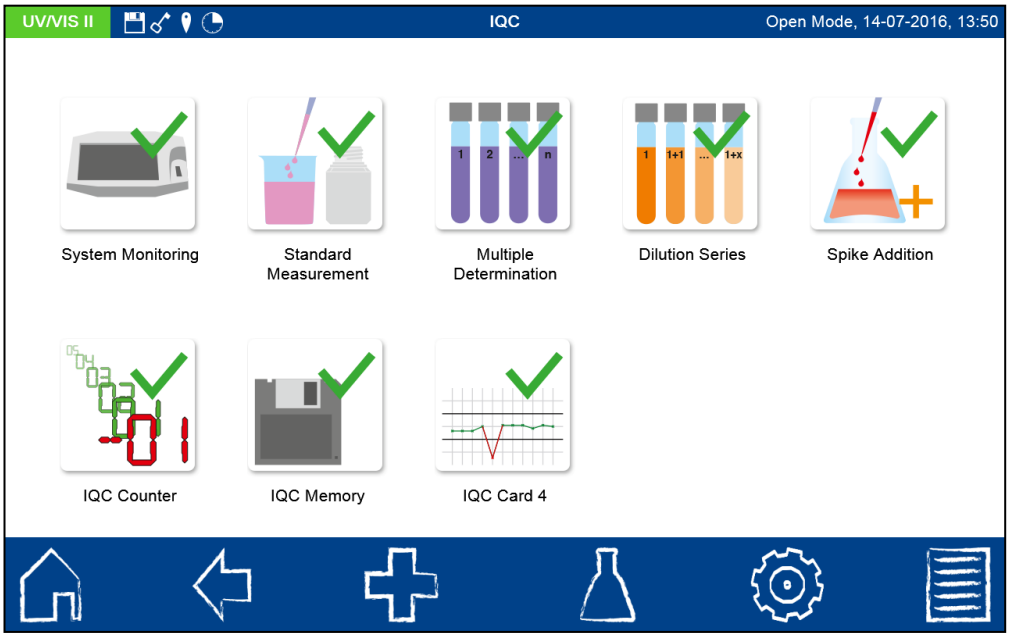



Figure 84: IQC-Menue

### 6.6.1 Monitoring of inspection, measuring and test equipment

Press the icon to open the menu for the monitoring of inspection, measuring and test equipment (see Figure 85). The inspection, measuring and test equipment monitoring contains the programs for checking the optical properties of the instrument. Except for the tests for photometric accuracy and stray light, all other tests can be performed directly with the instrument without the need for extra material.

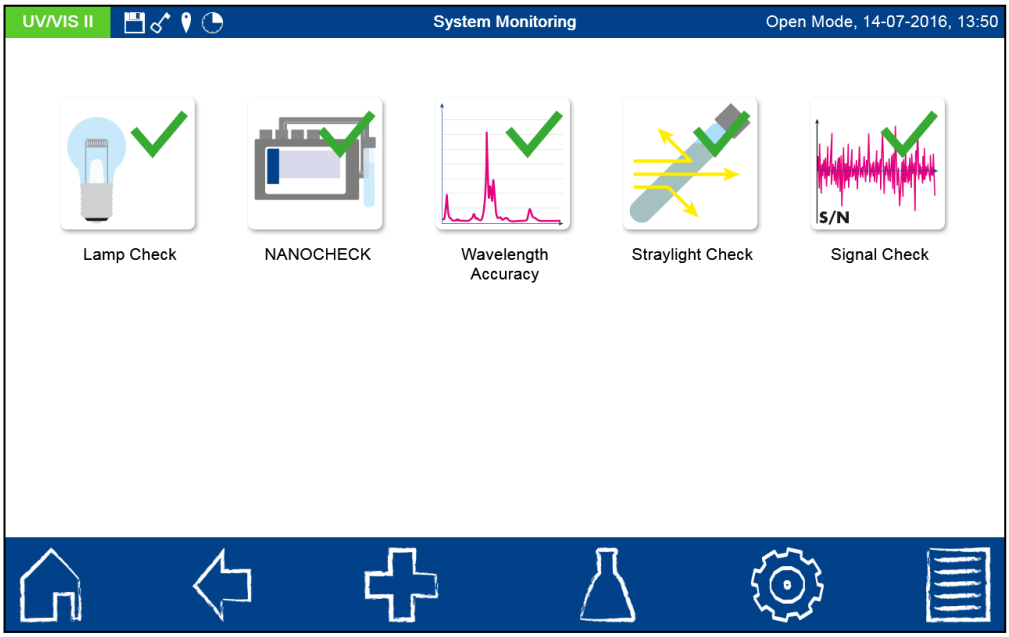



Figure 85: Options of inspection equipment monitoring

### 6.6.1.1 Lamp check

The lamp check serves to ensure that the installed lamp(s) are working properly. When you press the icon on the *NANOCOLOR® UV/VIS* II, a window will open with a selection of the lamps to check (see Figure 86).

*Please note: This selection is omitted in the user guide of the NANOCOLOR® VIS II. The halogen lamp is checked directly.*

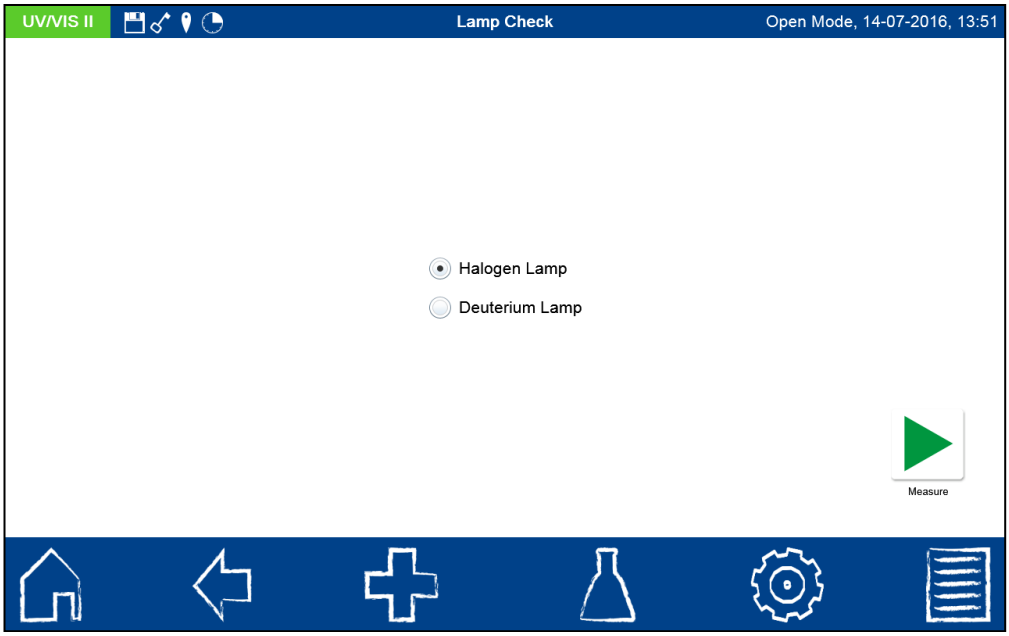



Figure 86: Selection of lamps in the lamp check menu

After selecting the lamp and confirming with , the measuring process will start. The instrument takes a lamp curve and compares it with the stored reference values. This is followed by an evaluation of the test. Via the icon, the result of the test can be printed as a certificate or stored in the form of a CSV- and PNG-file on an external storage medium.

When the deuterium lamp is tested, please remember that it has to be heated up beforehand, which takes about 90 seconds.

### 6.6.1.2 NANOCHECK

The NANOCHECK program is used to check the photometric accuracy of the spectrophotometer. For this purpose, you will need the *NANOCONTROL* NANOCHECK test solutions (REF 925 701) offered by MACHEREY-NAGEL. Press the icon to open the NANOCHECK program menu (see Figure 87). In order to enter the wavelength, reference value, and confidence interval data from the product certificate, each field must be manually selected and the corresponding value entered via the alphanumeric keypad. The data for the input NANOCHECK lot will be saved automatically after the program is run for the first time. Alternatively, a pre-programmed LOT can be chosen from the list box for the NANOCHECK LOT via the icon. This list also includes all of the LOTs entered manually. To delete a LOT with all of its associated data, press and hold down that entry for a few seconds. Press the icon that appears to delete the entry from the list.

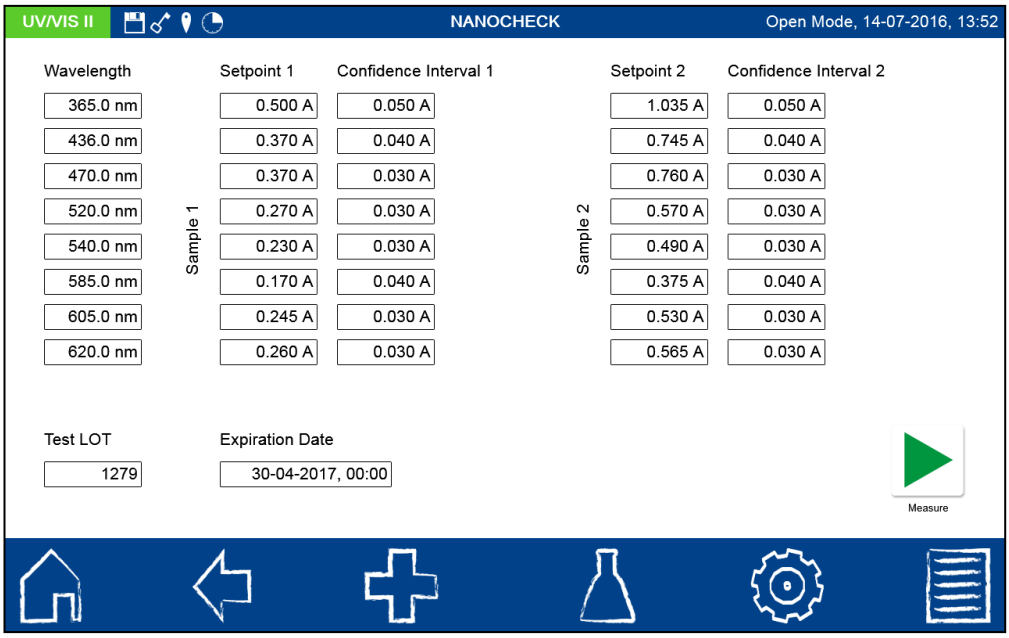



Figure 87: Entering the desired values for *NANOCONTROL* NANOCHECK test solutions

After selecting the desired LOT or entering all necessary data, the measurement is started by pressing the icon. An automatic menu guide will ask you to insert the NANOCHECK test solutions (see Figure 88). The progress of the test is shown by the advancing progress bar.


Figure 88: Running the NANOCHECK program

After all test solutions have been measured, the measured values will be displayed in the evaluation table to the right of the respective wavelength (see Figure 89). If the value falls within the confidence interval, it will be displayed in green, otherwise the value will be displayed in red and the entire measurement will be given a “Failed” rating. If all values are within the specified confidence intervals, the test will be given a "Passed" rating.

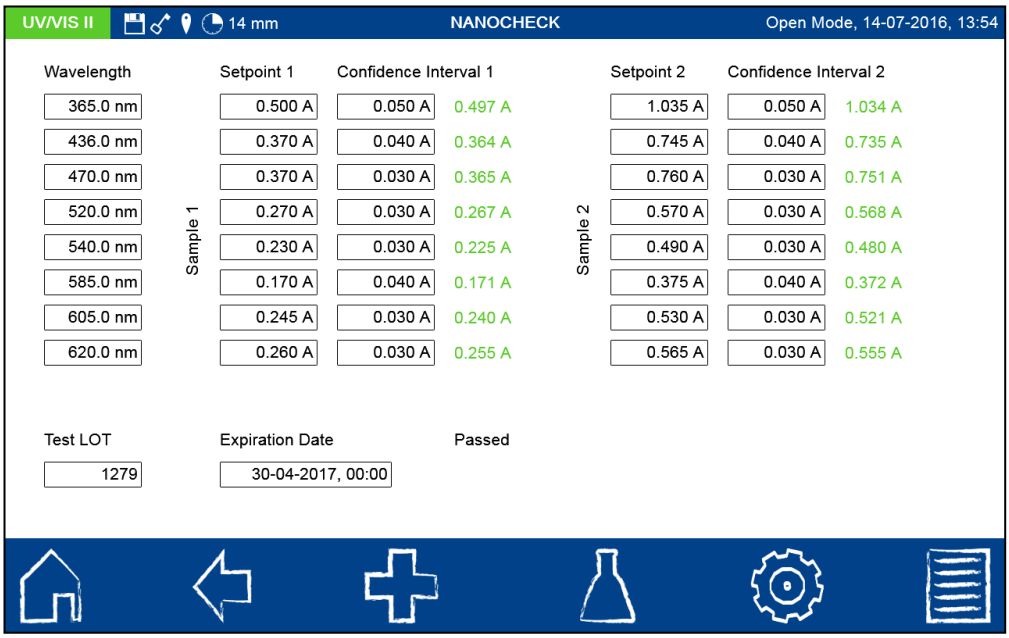



Figure 89: Results of the screening using the *NANOCONTROL* NANOCHECK

Via the icon, the result of the test can be printed as a certificate or stored in the form of a CSV- and PNG-file on an external storage medium.

If the results of the check exceed or fall below the allowed tolerances given in the certificate, please contact the manufacturer or your local distributor.

### 6.6.1.3 Wavelength accuracy test

The wavelength accuracy test checks the accuracy of the wavelength at 360 nm, 453 nm and 536 nm. For measuring purposes, an internal holmium oxide filter is placed into the

beam path. Press the icon to open the program for the wavelength accuracy test. Confirm with to start the automatic measuring process. After testing, the result of the measurement will be displayed (see Figure 90). The actual values are compared against the reference values stored for the built-in holium oxide filter. The maximum allowed deviation is +/- 1.0 nm. If all of the values are within the specified confidence intervals, the test will be rated "Passed."

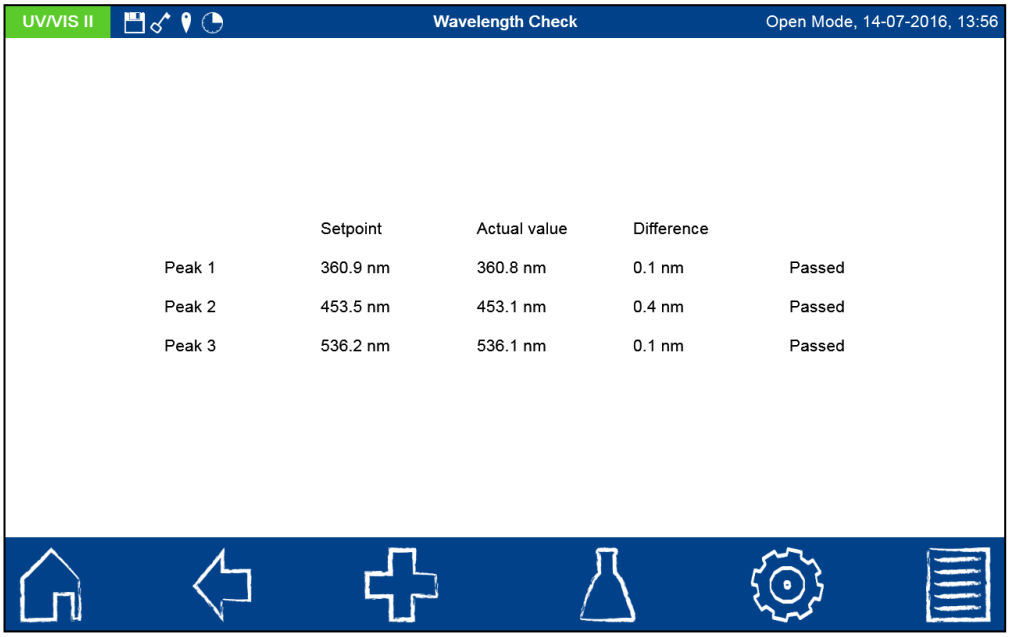



Figure 90: Result of the wavelength accuracy test

Via the icon, the result of the test can be printed as a certificate or stored in the form of a CSV- and PNG-file on an external storage medium.

If the results of the check exceed or fall below the allowed tolerances, please contact the manufacturer or your local distributor.

#### 6.6.1.4 Stray light test

Press the icon to start the program for measuring the stray light in the instrument. In addition to the stray light test according to DAB and Ph. Eur. at 340 nm and 370 nm with potassium nitrate, there is an alternative stray light test available for to the UV range at 220 nm using potassium iodide. To perform a stray light test, you need the appropriate solutions and a 10 mm quartz glass cuvette. The solutions can be mixed as follows: Dissolve 61.5 g of potassium nitrite (p.a.) in 1 L ultrapure water and 12.0 g of potassium iodide in 1 L ultrapure water. Select the desired method via the option button and start the automated measurement process by pressing . The result of the measurement will be displayed upon completion of the test.

Via the icon, the result of the test can be printed as a certificate or stored in the form of a CSV- and PNG- file on an external storage medium.

If the results of the check exceed or fall below the allowed tolerances, please contact the manufacturer or your local distributor.

#### 6.6.1.5 Signal test

The signal test allows you to check the instrument for the signal to noise values in the visual range at the wavelengths 345 nm, 436 nm, 540 nm, 585 nm and 700 nm. Press the icon to start the automated test. The test performs 50 individual measurements for each wavelength and determines the signal scattering of the detector.

*Please note: This test can take up to 15 minutes.*

The result of the measurement will be displayed upon completion of the test. For each wavelength, the mean detector value *I* and the standard deviation $\sigma$ of the scattering of detector values are given. Furthermore, the largest absolute difference between two values is given as $\Delta$. The user specifies the test criteria for passing or failing the signal test. Via the icon, the result of the test can be printed as a certificate or stored in the form of a CSV- and PNG-file on an external storage medium.

### 6.6.2 Standard measurement

Standard measurements are used to check your own work and that of the photometer and analytical accessories. Standards are available for purchase in the form of standard and spiking solutions (see also www.mn-net.com).

Press the icon to open the window for specifying the desired standards (see Figure 94). Select the entry “Standard” to open the list of pre-defined standards in the device. Now either the desired standard can be selected from this dynamic list or a new standard can be defined via the + icon.

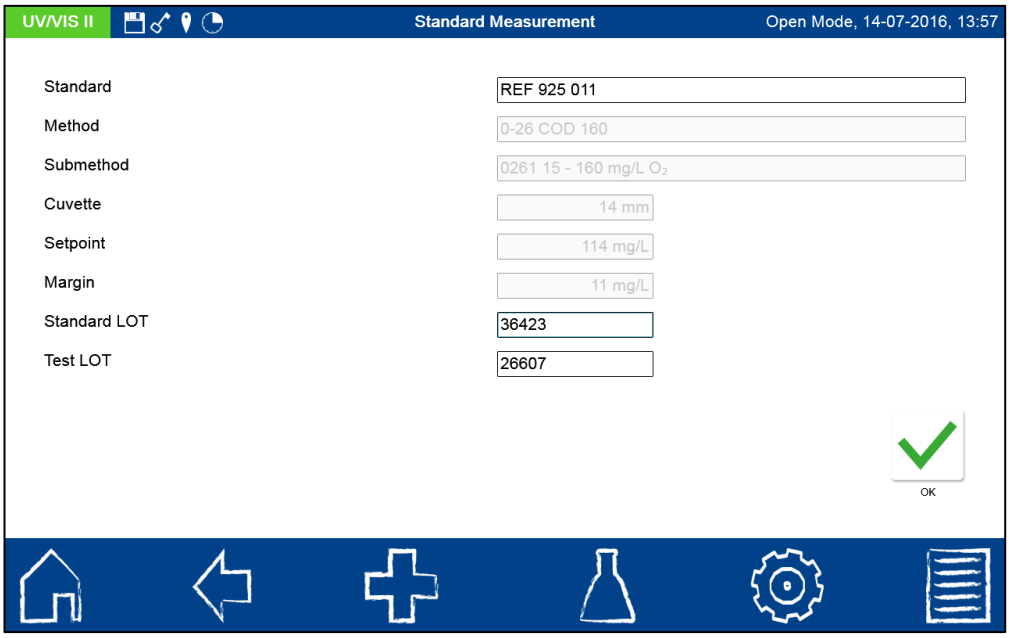



Figure 91: Entering the data for measuring a standard

After selecting a pre-defined standard, the remainder of the fields will be filled in with the values for method, submethod, cuvette, reference value, and confidence interval. Entering the LOT for test kit and standard via the text keypad and then confirming with will open the measurement window. After inserting the appropriate sample solution and confirming with , the measurement will be carried out and the result will be displayed as shown in Figure 92. The result will be given a “Passed” (green) or “Failed” (red) rating in the upper right corner. The measured value is compared against the reference value of the standard solution.

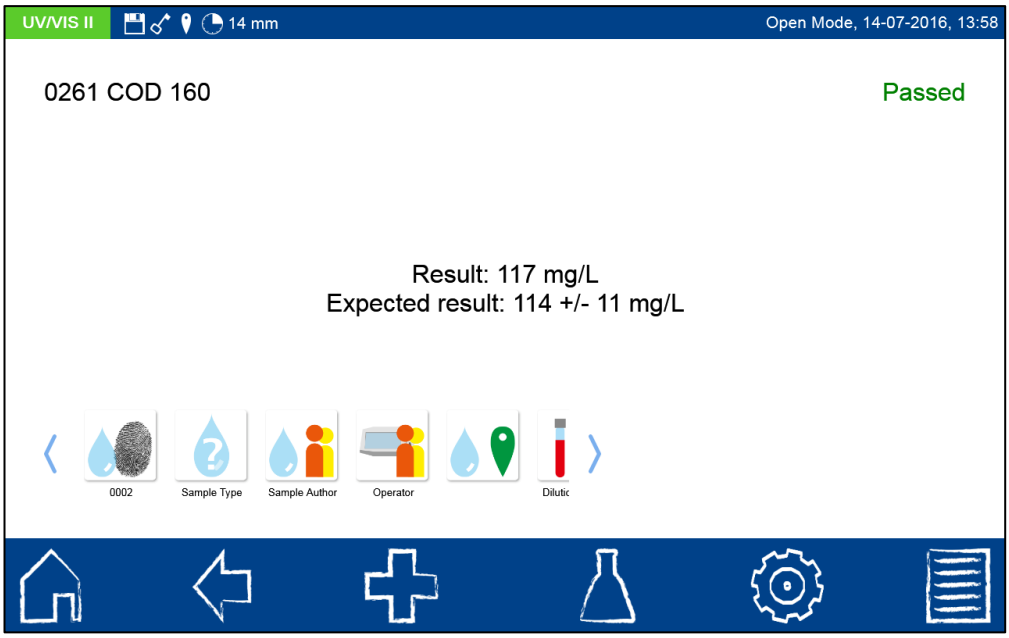



Figure 92: Result of a standard measurement

Various types of sample information can be entered using the icons located below the result window. Press the icon to view other available options. Via the “Properties” command, new sample information can be added below the measurement menu (see Section 5.2.1). The “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

Removing the cuvette or exiting the measurement menu by means of one of the other icons in the task bar will end the measurement process and save the result in the IQC memory (see Section 6.6.7) of the device.

Alternatively, a standard measurement can also be defined later as part of a measurement process. Following a measurement using the standard menu of the spectrophotometer, press the IQK icon in the upper right hand corner of the result window to define a measurement as a standard measurement. A window will open for the selection of the desired IQC standard (see Figure 93). After entering the LOT for test kit and standard via the text keypad and confirming with OK, the result will be rated as shown in Figure 92.

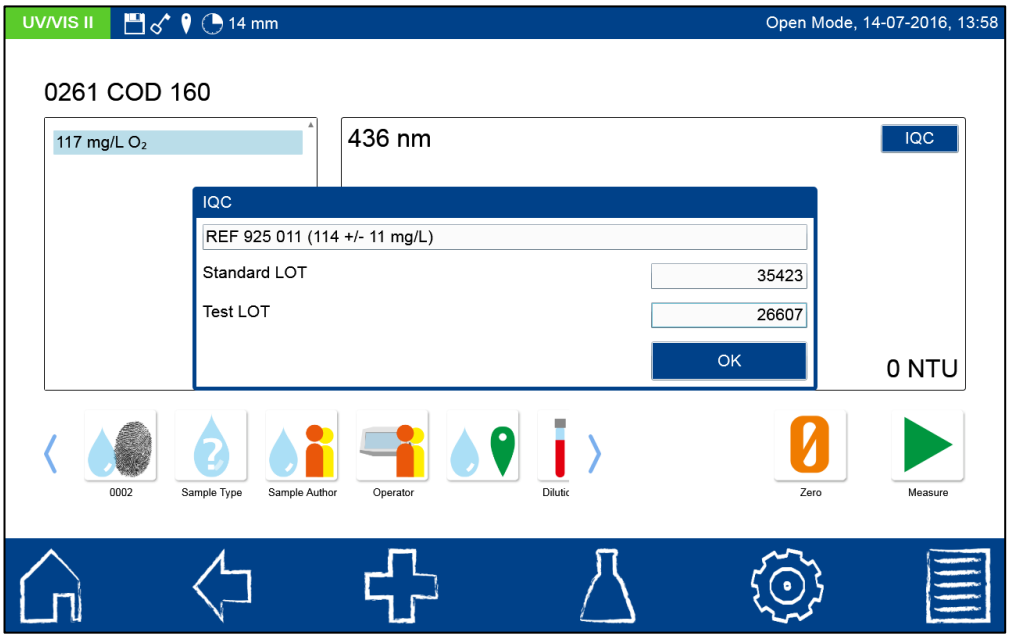



Figure 93: Measuring a standard using the measurement menu for cuvette tests

In order to enter a user-defined standard, the + icon must be pressed in the “Select standard” dynamic list (see Figure 94).

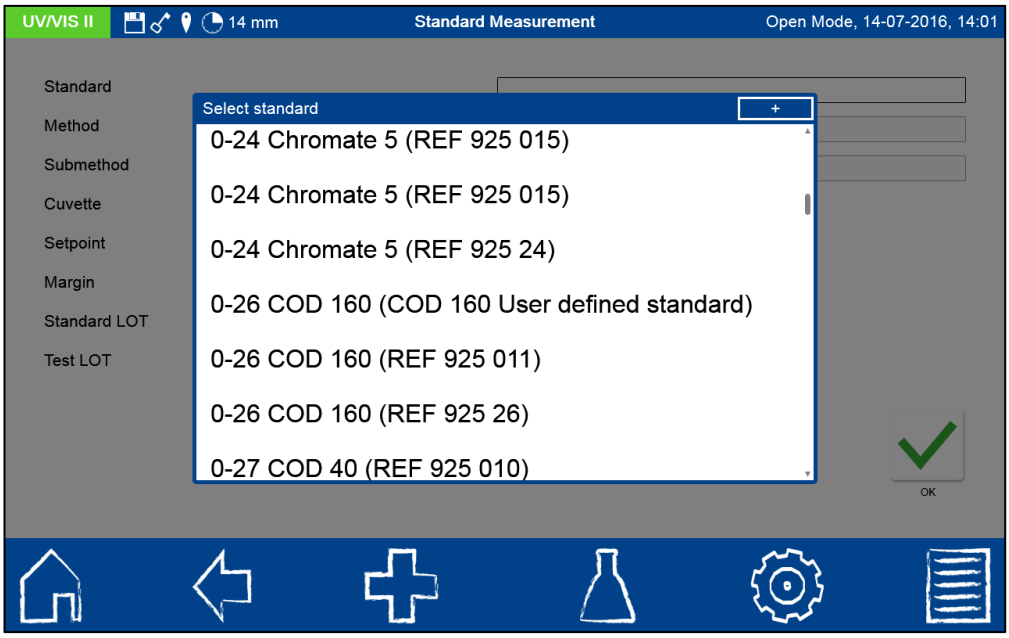



Figure 94: Selecting a standard

A text keypad will pop up for entering the name of the user-defined standard. After the first measurement with the self-defined standard, the name entered here will appear in the dynamic list for standard selection along with the test number and test name (see Figure 94 “User defined Standard” entry).

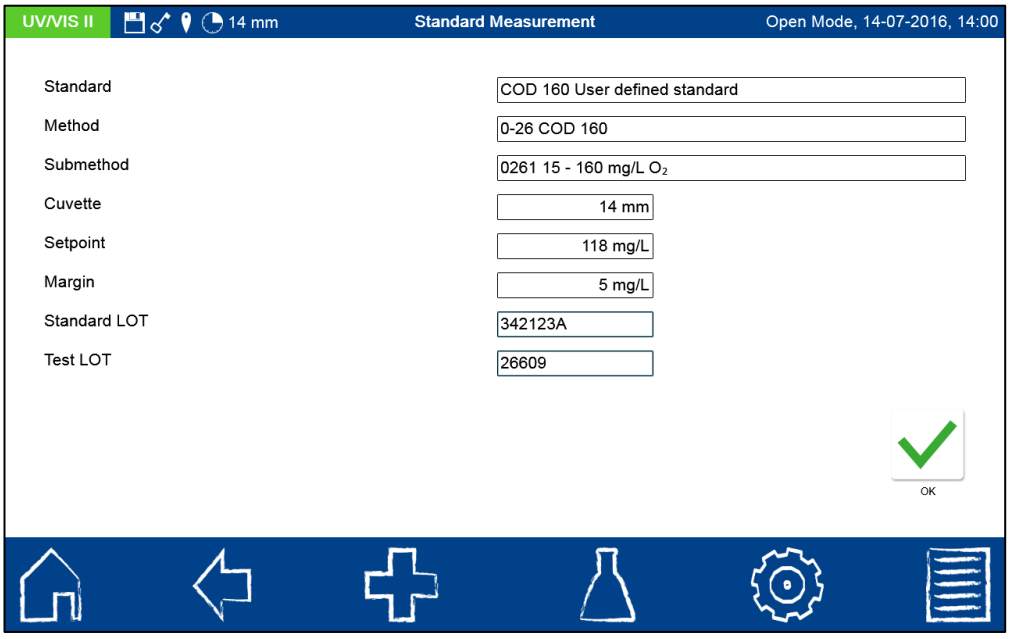



Figure 95: Creating a user-defined standard

Tap the entry “Method,” and then select the method for which you want to define the standard from the “Select method” list that appears (see Figure 95). The submethod field can be used to select submethods, provided that multiple submethods are available for a method. Use the numeric keypad to enter the reference value and confidence interval for the standard in the “setpoint” and “margin” fields. Enter the LOT for test kit and standard via the text

keypad and confirm with to open the measurement window. After inserting the appropriate sample solution and confirming with , the measurement will be carried out and the result will be displayed as shown in Figure 92. The user-defined standard will not be saved in the list of standards until the measurement has been carried out.

The results of the standard measurements can be viewed in the IQC memory (see Section 6.6.7) of the instrument.

### 6.6.3 Multiple determination

The analysis of a multiple determination increases the precision of a method and allows the detection of outliers.

Press the icon to open the window for selecting the desired method of the multiple determination (see Figure 96). Tap the entry “Method” to open the list of methods available on the instrument. Now you can select the desired method from this list. The submethods can be selected in the submethod field, provided that mutiple submethods are available for a method. Use the alphanumeric keypad to enter the maximum permissible diffusion percentage in the “Margin” field. This is calculated as part of the measurement on the basis of the largest difference in readings between two measured values based on the average of the measurements.

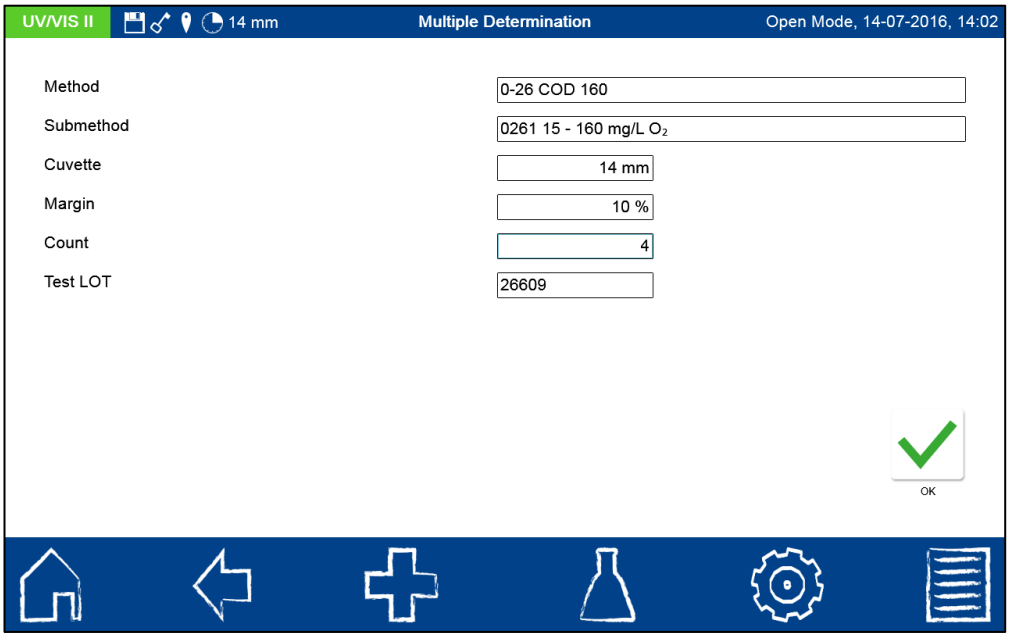



Figure 96: Entering the data for performing a multiple determination

Enter the number of measurements and the LOT of the test kit used via the text keypad and then confirm with to open the measurement window. The sample solutions must be inserted in the order they are retrieved (see Figure 97). Confirm with to start the particular measurement process.


Figure 97: Measurement process of a multiple determination

After inserting and measuring all of the sample solutions, the result of the measurement will be displayed as shown in Figure 98. The result will be given the rating “Passed” (green) or “Failed” (red) in the upper right hand corner. The measured value is compared against the specified confidence interval. All of the measurement results are listed in sequence and compared against both, the calculated and maximum diffusion.

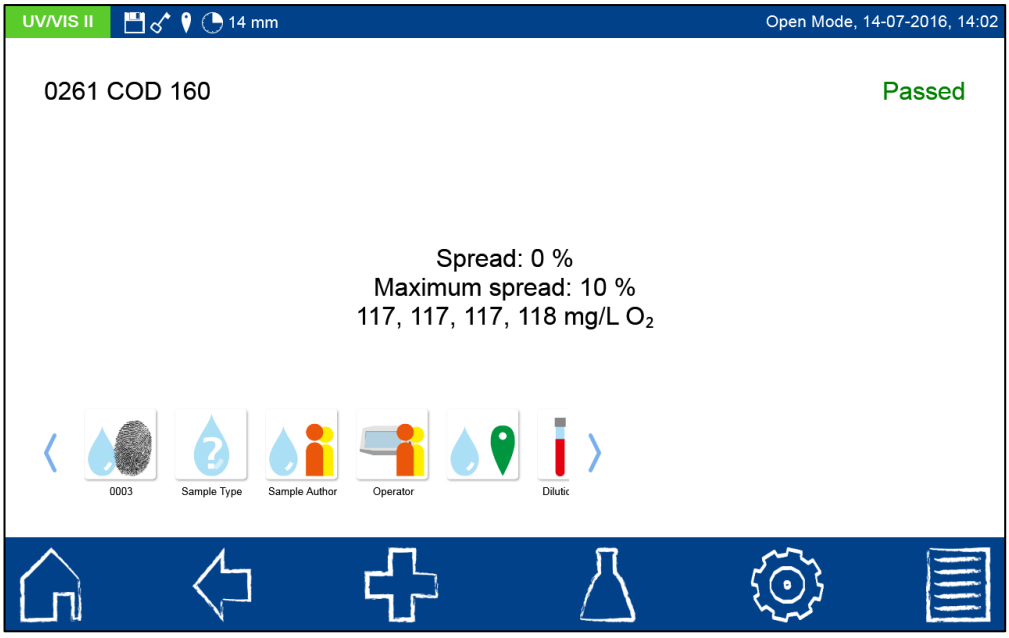



Figure 98: Result of a multiple determination

In the example above, the average value of the measurements is 117 mg/L $O_2$ and the greatest difference of two measurement results 1 mg/L $O_2$. The resulting 0% spread, therefore, is lower than the set limit of 10%; the quality objective is rated as having "Passed." Press the icon to view other available options. Via the “Properties” command, new sample information can be added below the measurement menu (see Section 5.2.1). The “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

Removing the cuvette or exiting the measurement menu by means of one of the other icons in the task bar will end the measurement process and save the result in the IQC memory (see Section 6.6.7) of the device.

### 6.6.4 Dilution series

Through the analysis of a dilution series, interferences or problems with the sample can be sought and detected.

Press the icon to open the window for specifying the desired dilution series method (see Figure 96). Tap the entry “Method” to open the list of methods available on the instrument. Now you can select the desired method from this list. The submethods can be selected in the submethod field, if mutiple submethods are available for a method. Specify the dilution factor for the subsequent calculation by entering the dilution in the “Dilution” field. Use the alphanumeric keypad to enter the maximum permissible deviation in percent in the “Margin” field. This is calculated as part of the measurement based on the absolute measured value difference between the expected value and the measured value based on the measured value. Enter the LOT of the test kit used via the text keypad and then confirm with to open the measurement window. After inserting the retrieved sample solutions (“diluted sample” and “undiluted sample”) and confirming with , the measurement will be carried out and the result will be displayed.

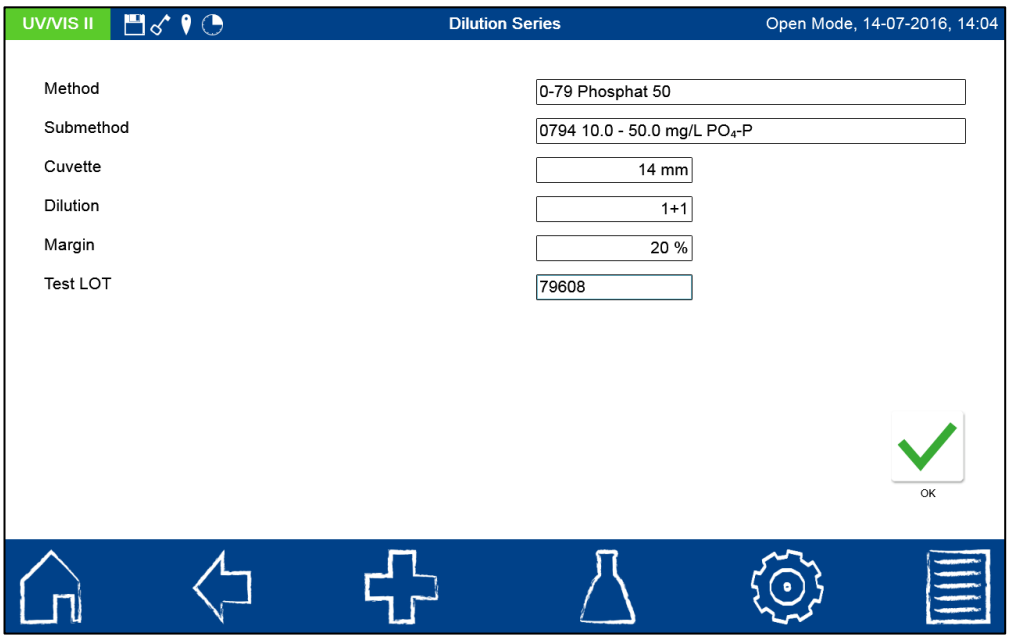



Figure 99: Entering the data for the measurement of a dilution series

After inserting and measuring both sample solutions, the result of the measurement will be displayed as shown in Figure 100. In the upper right hand corner the result will be rated “Passed” (green) or “Failed” (red). The measured value is compared against the specified deviation. In addition to the measurement results, the calculated values for absolute and relative deviation as well as the expected value for the sample are displayed.

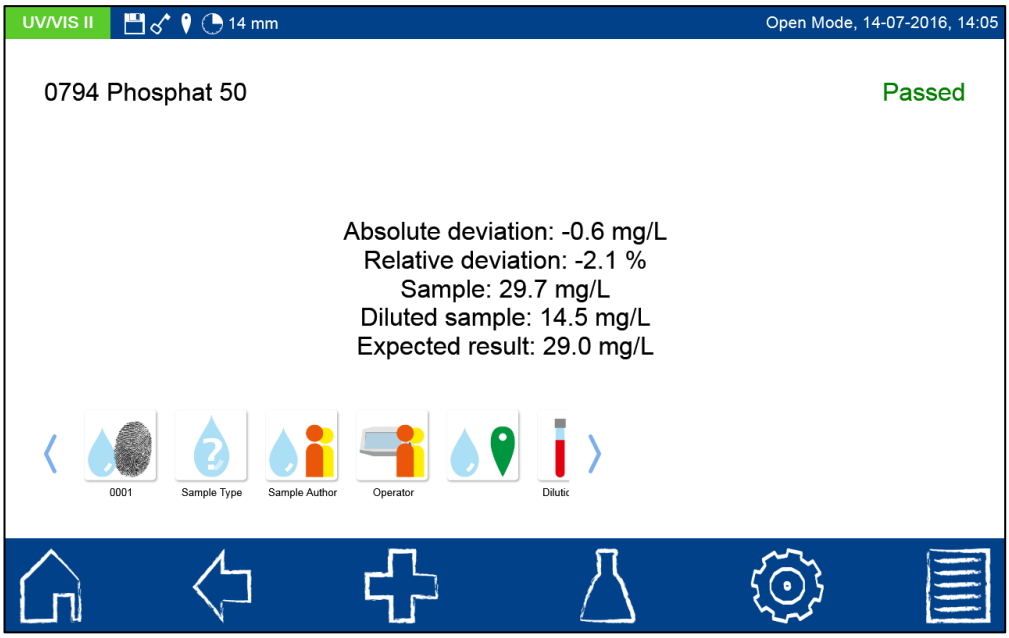



Figure 100: Result of the dilution series measurement

In the example above, the measured value of the diluted sample is 14.5 mg/L. The dilution factor of a 1+1 dilution is two. The expected value can be calculated as 29.0 mg/L. Based on the measured value of the undiluted sample with 29.7 mg/L, this means an absolute deviation of -0.6 mg/L. The relative deviation of -2.1% was therefore lower than the set margin of 20%; the quality objective is given a "Passed" rating.

Various types of sample information can be entered using the icons located below the result window. Press the icon to view other available options. Via the “Properties” command, new sample information can be added below the measurement menu (see Section 5.2.1). The “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

Removing the cuvette or exiting the measurement menu by means of one of the other icons in the task bar will end the measurement process and save the result in the IQC memory (see Section 6.6.7 of the device.

### 6.6.5 Spike additions

Through the analysis of spike additions, interferences or problems with the sample can be sought and detected.

Press the icon to open a window for specifyfing the desired standard for the spike addition measurement. Select the entry “Standard” to open the list of the standards in the device. Now the desired standard can be selected from this dynamic list or a new standard can be defined via the + icon. After selecting a pre-defined standard, the rest of the fields will be filled in automatically with the values for method, submethod, cuvette, increase in concentration through spiking, and confidence interval. Entering the LOT for test kit and standard via the text keypad and then confirming with opens the measurement window.

In order to enter a user-defined standard, the + icon must be pressed in the “Select standard” dynamic list. A keypad will pop up for entering the name of the user-defined standard. After the first measurement with the self-defined standard, the name entered here will appear in the dynamic list for selection of the standard.

Tap the entry “Method” and then select the method for which you want to define the standard from the “Select method” list that pops up. The submethod field can be used to select submethods, if multiple submethods are available for a method. Use the alphanumeric keypad to enter in the “Concentration increase” field the amount of analyte to be added to the

sample through the standard addition. Enter the confidence interval of the expected value in the “Confidence interval” field using the alphanumeric keypad.

Enter the LOT for test kit and standard on the alphanumeric keypad and confirm with ✓ to open the measurement window. The user-defined standard will not be saved in the list of standards until the measurement has been carried out.

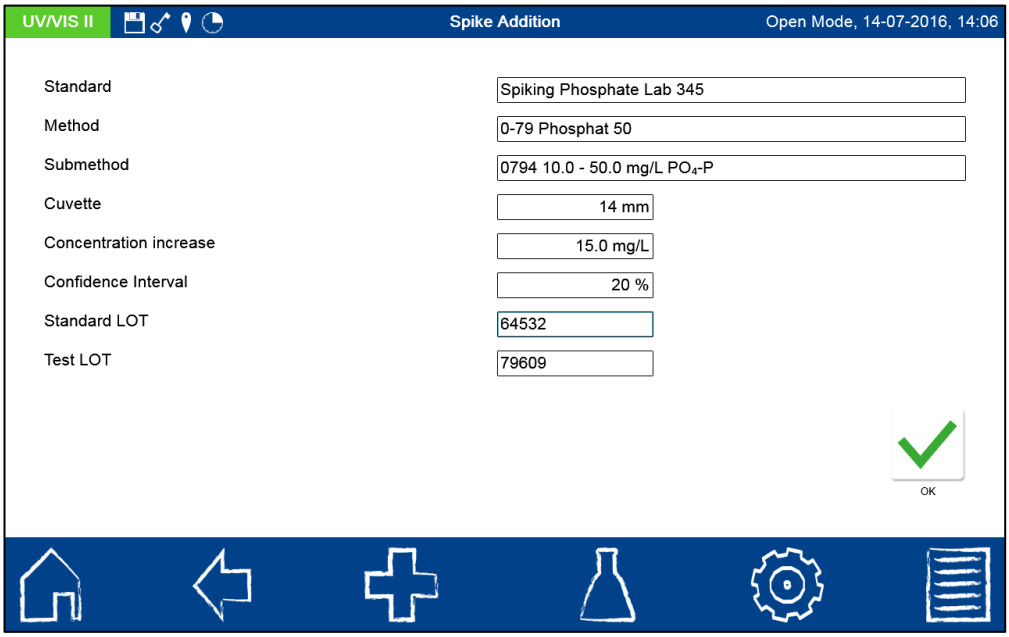



Figure 101: Entering the data of a spike addition measurement

After inserting and measuring the two sample solutions, the result of the measurement will be displayed as shown in Figure 102. In the upper right corner the result will be rated “Passed” (green) or “Failed” (red). The measured value is compared against specified confidence interval. In addition to the measurement results for the original sample and the spiked sample, the calculated increase in concentration and the expected value are also displayed.

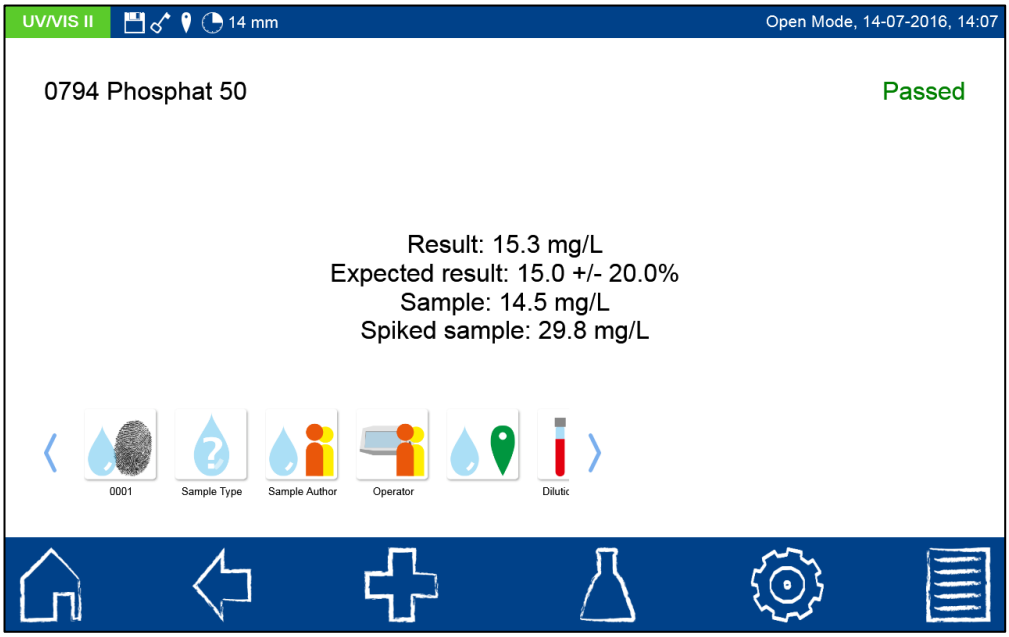



Figure 102: Result of a spike addition measurement

In the sample above, the measured value of the sample is 14.5 mg/L. The measured value of the spiked sample is 29.8 mg/L. Therefore, the increase in concentration due to the spike addition is 15.3 mg/L. When compared to the expected value of 15.0 mg/L at the permissible confidence level of 10%, a deviation is not detected; the quality objective is given a “Passed” rating.

Various types of sample information can be entered using the icons located below the result window. Press the icon to view other available options. Via the “Properties” command, new sample information can be added below the measurement menu (see Section 5.2.1). The “Do not save” command prevents the measurement result from being stored in the instrument’s memory when the cuvette is removed or when the menu is exited *(Please note: This function is only available in the "Open Mode")*.

Removing the cuvette or exiting the measurement menu by means of one of the other icons in the task bar will end the measurement process and save the result in the IQC memory (see Section 6.6.7) of the device.

### 6.6.6 IQC counter

The IQC counter serves as a reminder to conduct a standard measurement. Press the icon to open a window for setting the IQC counter (see Figure 103). Marking the checkbox “Enable IQC counter” will activate it. In the “Maximum number of days” field, you can set the number of days to wait until the warning is given. In the “Maximum number of measurements” field, you can set the number of measurements until the warning is to be given. The number of measurements always refers to the measurements within a method.

Confirming with saves the settings and returns you to the IQC menu.

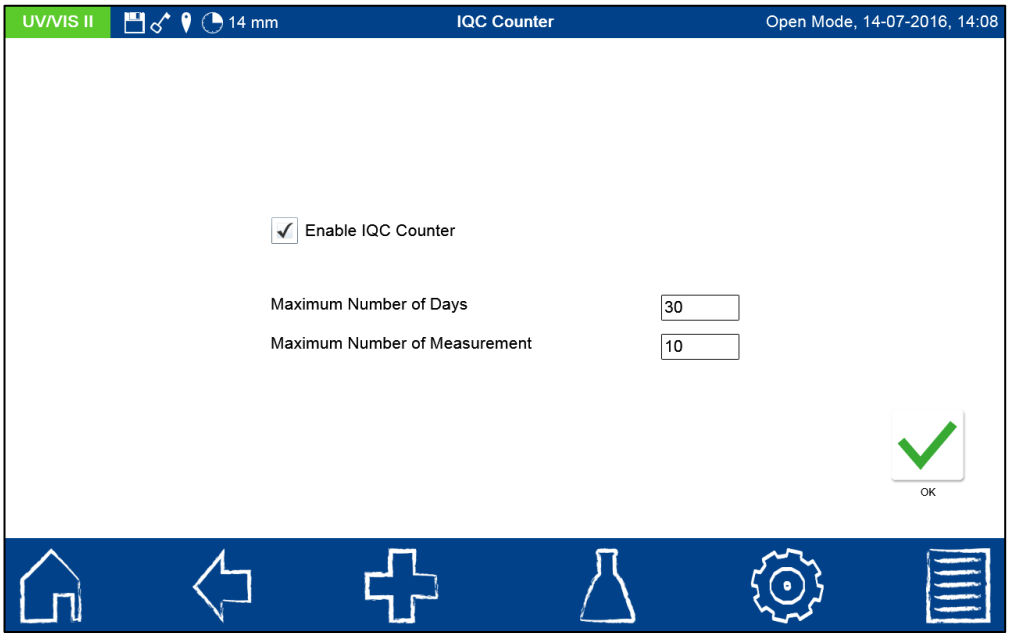



Figure 103: Setting the IQC counters

### 6.6.7 IQC memory

The IQC memory saves all measurement results that are generated through the IQC menu and the IQC button in the results window. These are results of internal quality control which are stored separately from the general measurement results. The IQC memory is accessed via the icon in the IQC menu (see Section 6.6). The IQC card 4 among others is created from the results stored here (see Section 6.6.8). Next to the type of IQC measurement, the associated method for each measurement is shown and rated by a color code as either “Passed” (green) or “Failed” (red).

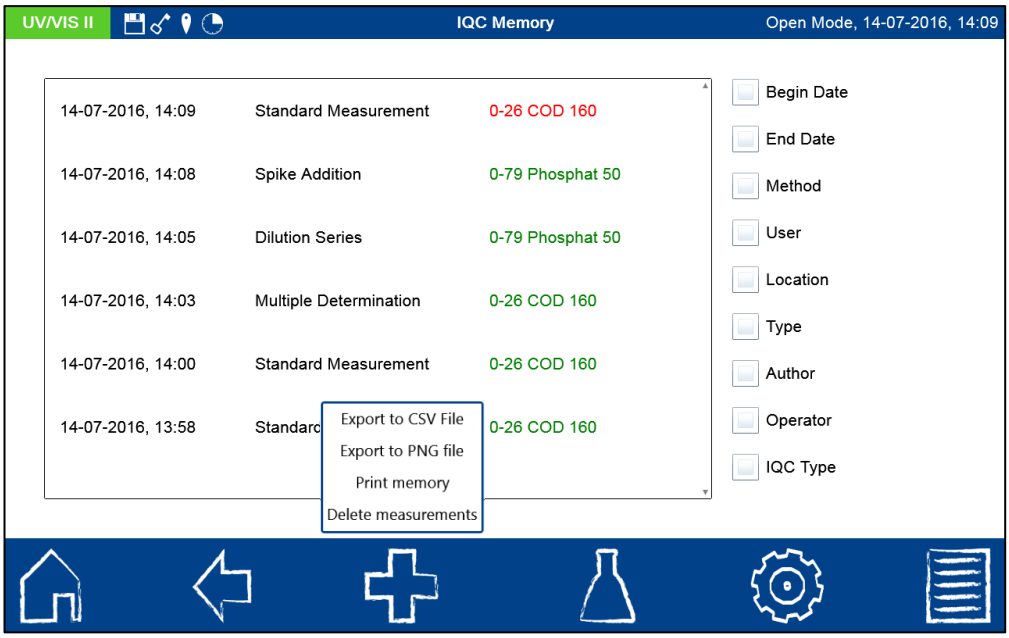



Figure 104: Overview of the measurements in the IQC memory

You have the option of printing the results, exporting them as CSV- or PNG file or deleting them (*Please note: Deleting results in the user mode is only available when administrator rights are given"*). Furthermore, the IQC memory can be selected according to various criteria. Figure 105 shows the selection according to the IQC type. The list box is opened by tapping the entry "IQC type" in the IQC memory (see Figure 104). After selecting an IQC type, the IQC memory is selected accordingly.

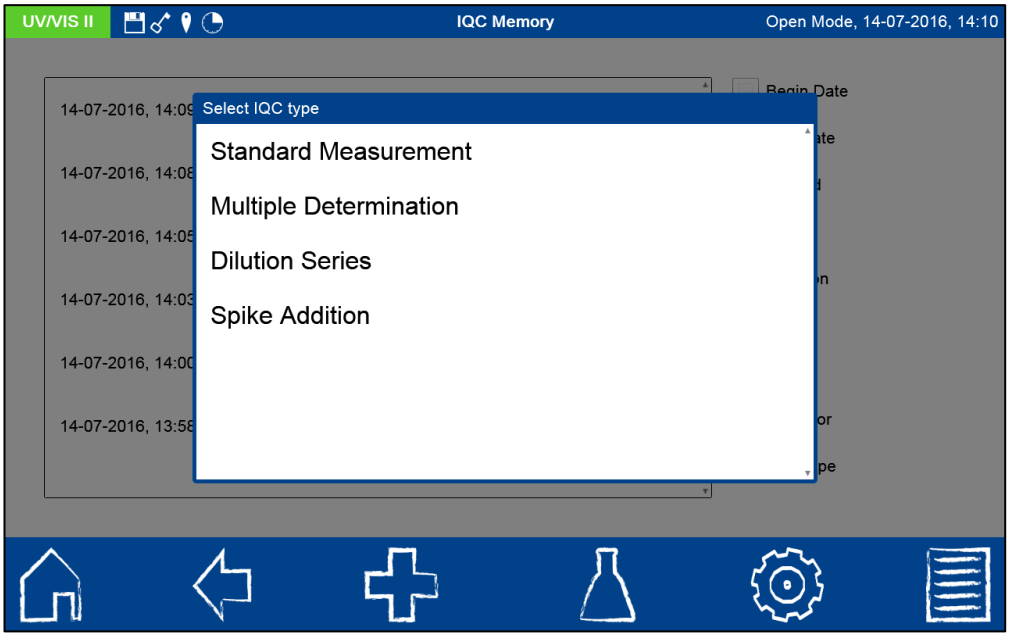



Figure 105: Selection of the IQC type

Various selection criteria can be applied simultaneously. Pressing the icon gives you the option of deleting the selection or exporting the selected data as a CSV (Comma Separated Value) file to an external mass storage device. A name for the export folder can be entered on the text keypad. The file it contains can then be processed further in a spreadsheet program. The file name has the following format:

SNDevice_IQC_results_YYYYMMDD_HH:MM:SS.csv

Results can be send to a directly connected printer, or can be exported as PNG-file to an external storage device and then be printed from another workstation. When measurement results are printed or exported as PNG-file, the print-out will contain a selection of the most important information on the sample or all information available on the sample, depending on the chosen print settings (see Section 6.1.6).

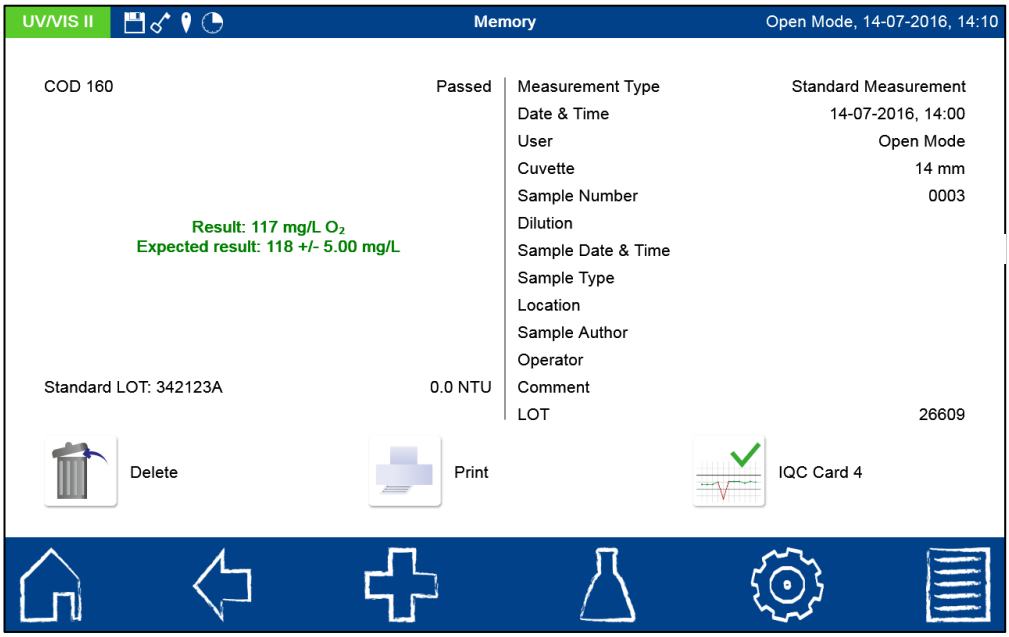



Figure 106: Display of an IQC single result

Details of a measurement can be obtained by selecting a single measured result from the memory (see Figure 107). It will show not only the result, but also all of the sample information entered. The information obtained this way can also be printed or exported via the icon.

### 6.6.8 IQC Card 4

Click on the icon in the IQC menu to open a list box of all the standards for which at least one standard measurement exists (see Figure 107).

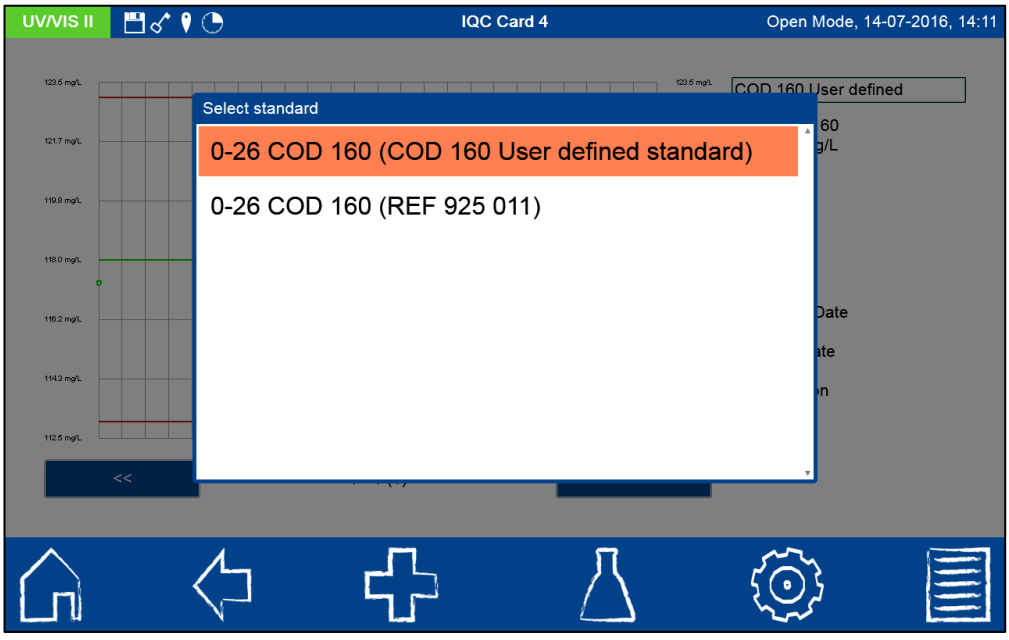



Figure 107: Selecting the standard for the display of the control card

By tapping on the desired entry, all of the IQC measurements belonging to this standard will be compiled in a standard control card (see Figure 108).

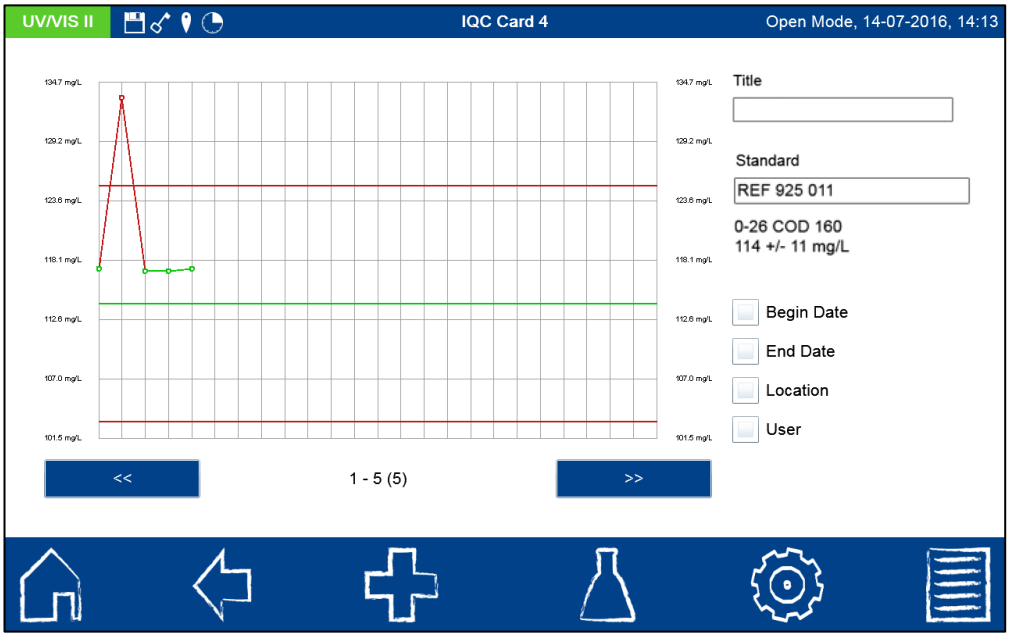



Figure 108: IQC 4 control card

The middle green line reflects the reference value of the standard. The upper and lower red lines indicate the limits of the confidence interval of the standard. The individual standard measurements are shown in the form of dots and given the color-coded rating of either "Passed" (green) or "Failed" (red). Green lines connect measurements within the confidence interval, whereas red lines connect out-of-range measurements. When there are more than 25 results, the << >> buttons can be used to browse through the individual pages of the control card. Within the control card various selection criteria on the right hand side are available. The standard can be changed in the entry field “REF 925 011.” The list box from Figure 107 will reopen. A 30 digit tilte for the IQC chart can be added in the field “title” on the right hand side.

When you press the icon, you are given the option of either exporting the displayed data in the form of a PNG file (see Figure 109) or printing it out on a connected printer.

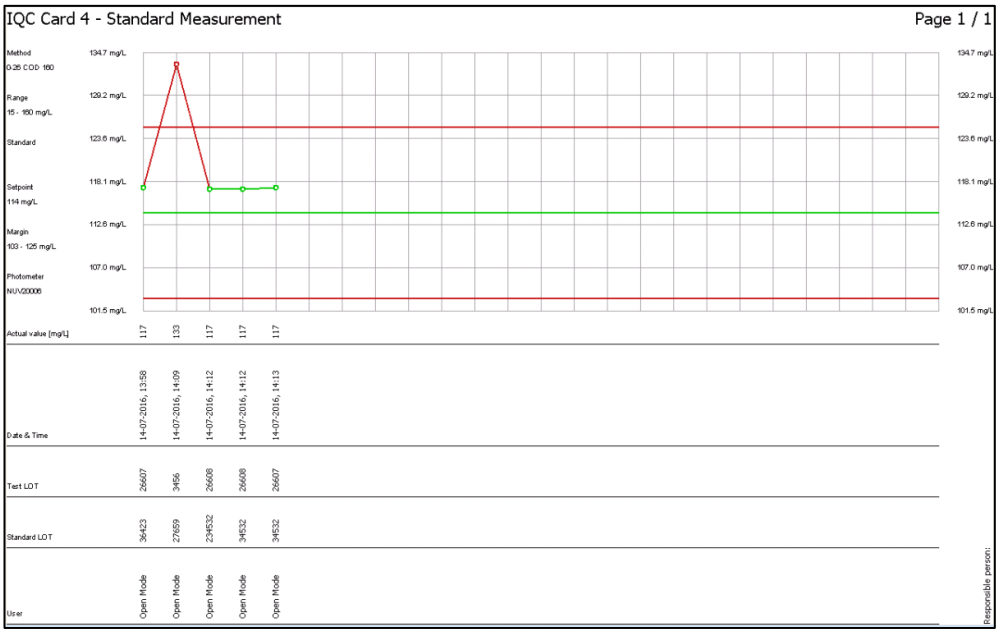
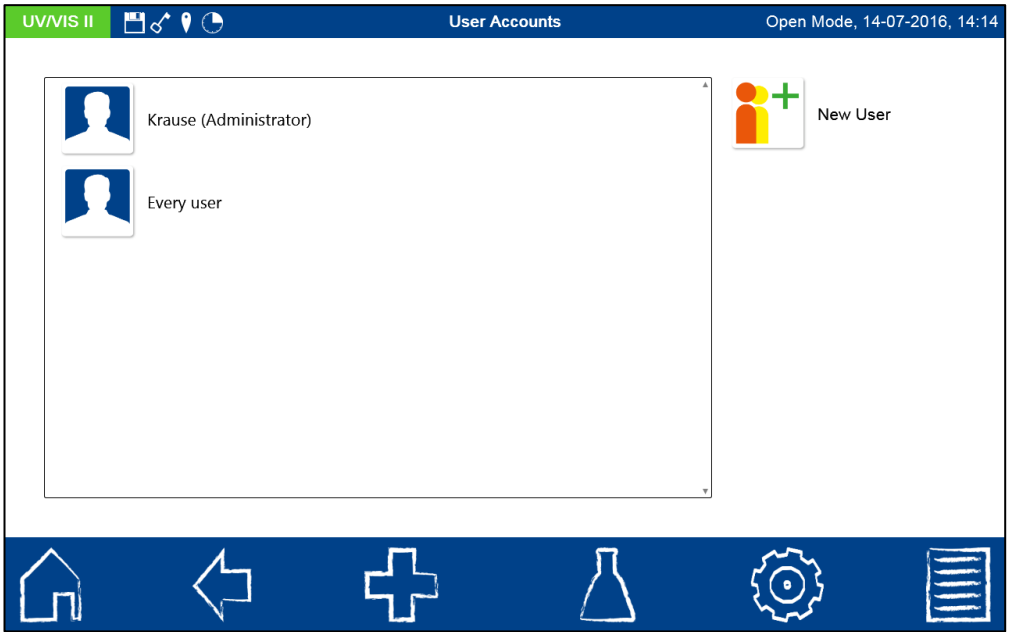



Figure 109: Export of the IQC control chart as PNG file

## 6.7 User accounts

The spectrophotometer allows a user management system with the creation of multiple user accounts with various rights. The instrument is delivered in the Open Mode by default. There are no limitations to user rights in this mode. To switch to the User Mode, first a user account has to be created. Afterwards, the “Open Mode” can be enabled und disabled using the icon (see Figutre 110).

Press the icon to access the menu to create a user account. In the user account menu, the users already registered are listed in a window on the left hand side (Figutre 110). If a user has not been created yet, the list will be empty.




Figutre 110: User accounts list

Press the icon to create a new user (see Figure 111). Enter a user name and password using the text keypad. The password has to be entered twice. If the administrator checkbox is checked, the user has unlimited rights with the instrument. When disabled, the user is no longer allowed to change selected instrument settings, delete measurement values or edit users. Setting up a password is mandatory for adminstrator accounts. The new user can be given a user avatar by tapping on the default image. It can either be chosen from the list of pre-defined avatars or be uploaded from an external storage device after pressing the symbol. Confirming with saves the new account and adds it to the the list of users.

All enterd users will be automatically available for selection of sample information in the field “User” after the measurement process (see Section 5.2.1).

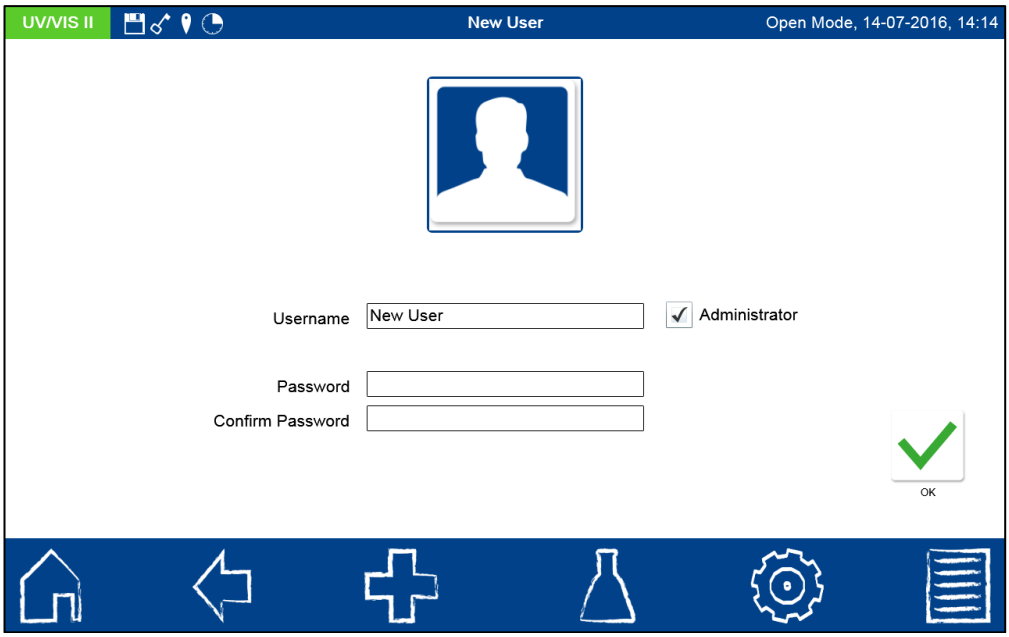



Figure 111: Creating an user account

Press the icon to edit the settings for a user (see Figutre 110). In User Mode, a user account can only be edited by someone with administrator privileges.

Press the icon to delete a highlighted user. Following the confirmation prompt, the user will be deleted from the list. In the User Mode, a user account can only be deleted by someone with administrator privileges. (*Please note: The last user can only be deleted in the Open Mode.*)

To change the User Mode, press the icon in the user accounts menu and select the entry “Turn off Open Mode” or “Turn on Open Mode” depending on which user mode is enabled. Following the confirmation prompt, the instrument will switch into User Mode and wait for a registered user to log in (see Figure 112).

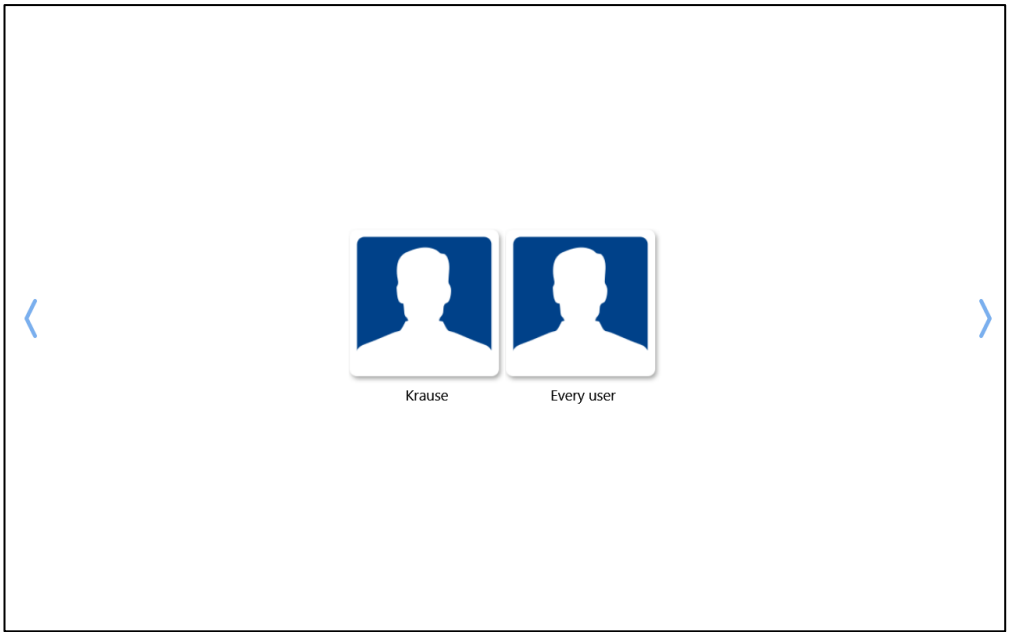



Figure 112: User log-in

Tapping on a user name and entering the password enables the device, and the logged-in user is shown in the status bar (see Figure 113). To change users, tap on the user avatar.

The user will be asked to log off. After confirming, the instrument will be disabled again (see Figure 112).

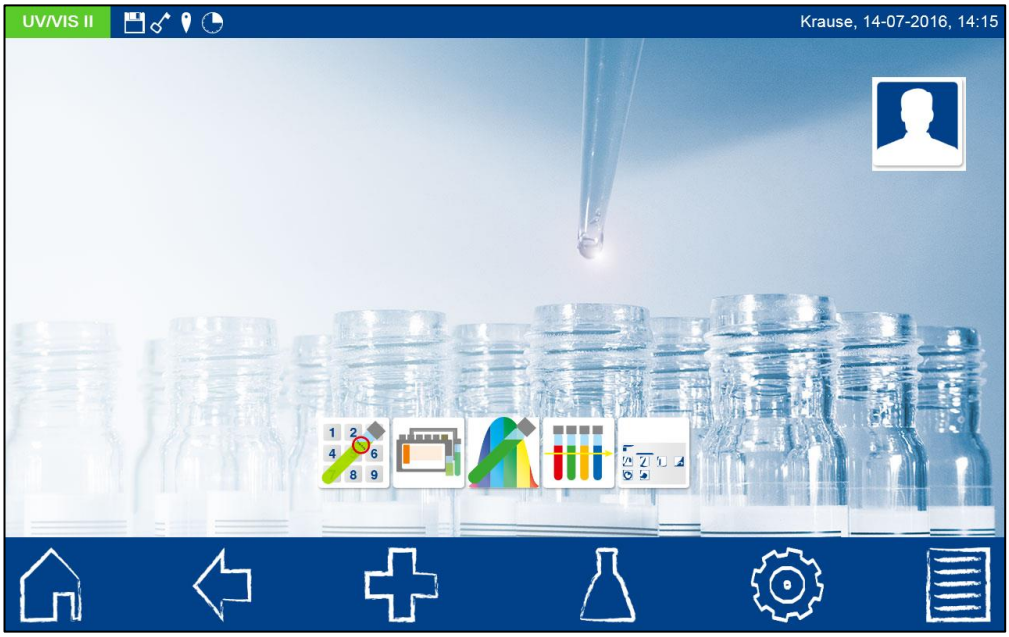



Figure 113: User mode window

In User Mode, the log-in credentials will be asked for every time. The device will already start up in the background during the prompt. The rights of a user can be discerned by the key icon in the status bar. If the key is being shown, then the user has administrator privileges.

## 6.8 Pictograms

To facilitate the use of MACHEREY-NAGEL tube tests, the pictograms on the lids of test packs are stored in the instrument. This way the procedure can be tracked directly on the device and is always at hand. The pictograms can be retrieved either from the pictogram menu or from the test list by highlighting a parameter and then displaying the corresponding pictogram (see Section 5.2.1.1). Press the icon to retrieve the pictograms (see Figure 114).

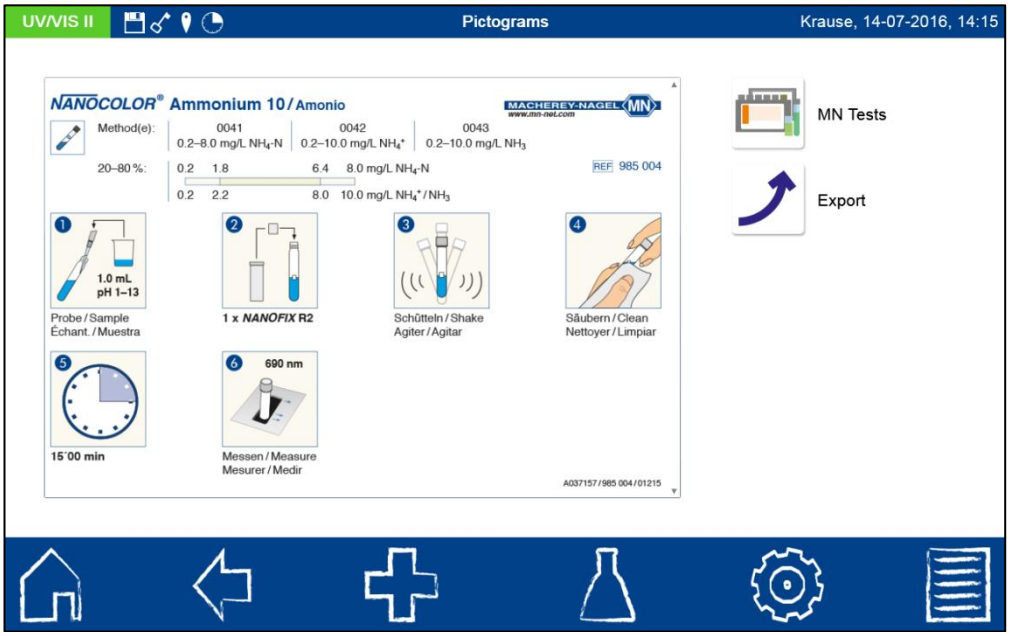



Figure 114: Pictogram menu

Press the icon to open the list of the MACHEREY-NAGEL tube tests. Select the test from this list for which you want to display the pictogram. The last pictogram to be retrieved will be shown on the display. (*Please note: Pictograms are not available for all of the tube tests*). You can view pictograms with several pages by scrolling vertically on the screen. Press the icon to export the pictogram currently being displayed as an image file to a connected data storage device.

## 6.9 Data export

### 6.9.1 LIMS

The LIMS configurator allows the compilation of a user-defined data set that can be transmitted from the memory of the photometer to a Laboratory Information and Management System (LIMS). Press the icons → → to open the LIMS configurator (see Figure 115). On the left hand side of the window, the desired fields can be selected and deselected with the check boxes, while the Move up and Move down buttons can be used to change their order. On the right hand side of the window are the settings for formatting the data set. Entries can be made for a data start field, a separator field, a data end field, an end of line feld, and the decimal point.

Selecting the checkbox “Send header” will result in a header being sent with each data set which shows the photometer type, the serial number of the device, and the firmware version installed.

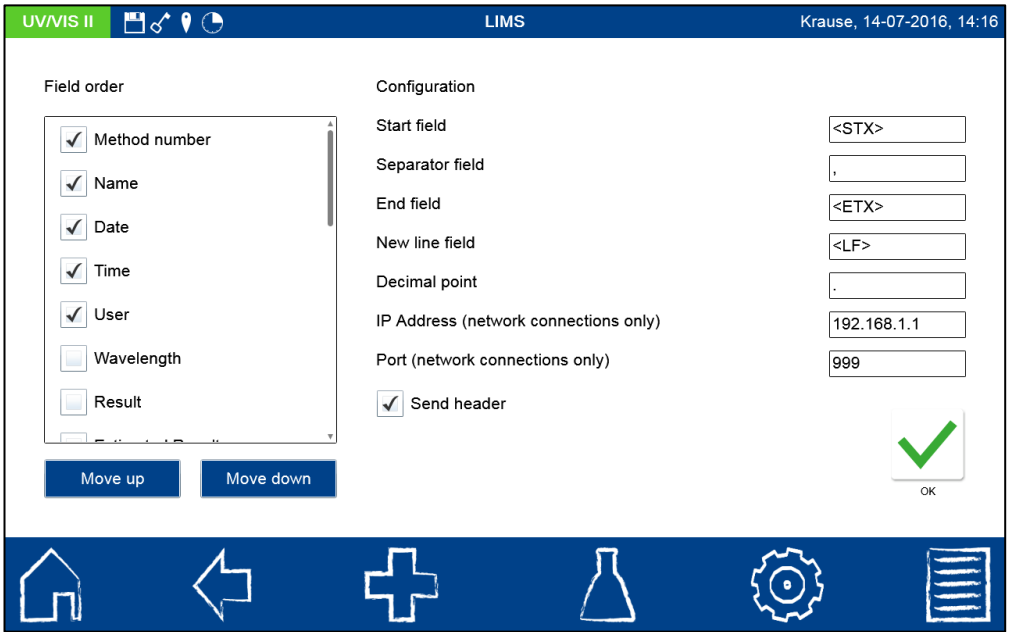



Figure 115: LIMS configurator

In addition to the settings for the data set, the interface through which the data is transmitted has to be defined. Press → to view and change the settings for the interface (see Section 6.5.1). Select the desired connection for the LIMS from these options (see Figure 116).

*Attention: In order to use the RS232 interface, the LIMS has to have a serial-COM data reader. For connections via LAN, the LIMS has to have an http data reader. The connection via USB is realized as a LAN adapter in the photometer.*

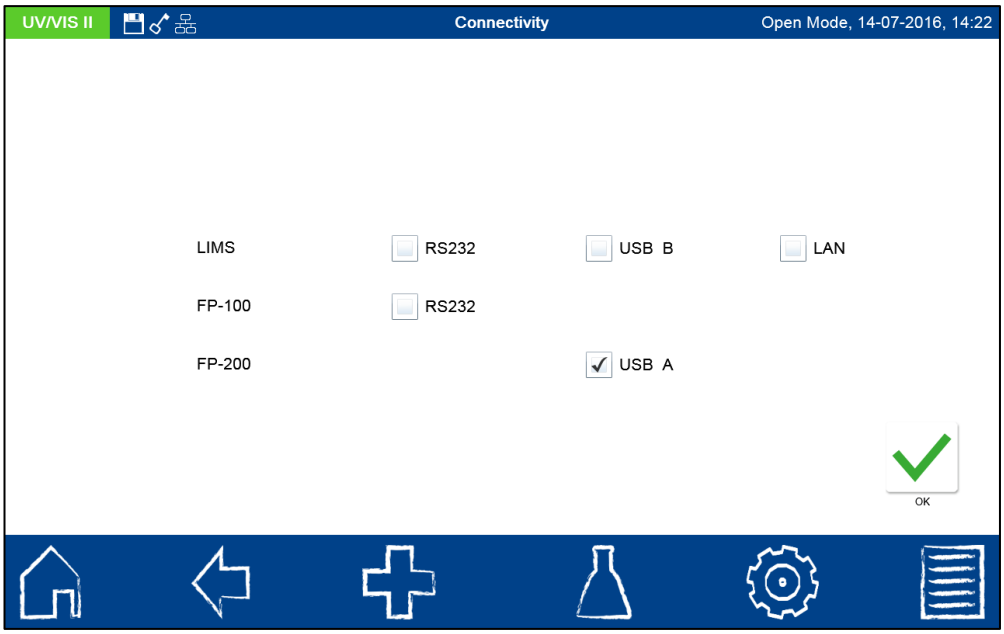



Figure 116: Settings for the data transfer interface

To export the data to LIMS, press and select “Export to LIMS” from the measurement result memory (see Figure 121). The data will be transferred as the type configured above.

### 6.9.2 ACRON

In order to export to ACRON, this menu contains the settings for changing the data export to a format adapted to ACRON. For more information on transferring data to ACRON is available through the technical support of MACHEREY-NAGEL.

## 6.10 Tools

The menu with tools can be accessed via the main menu followed by choosing the icon.

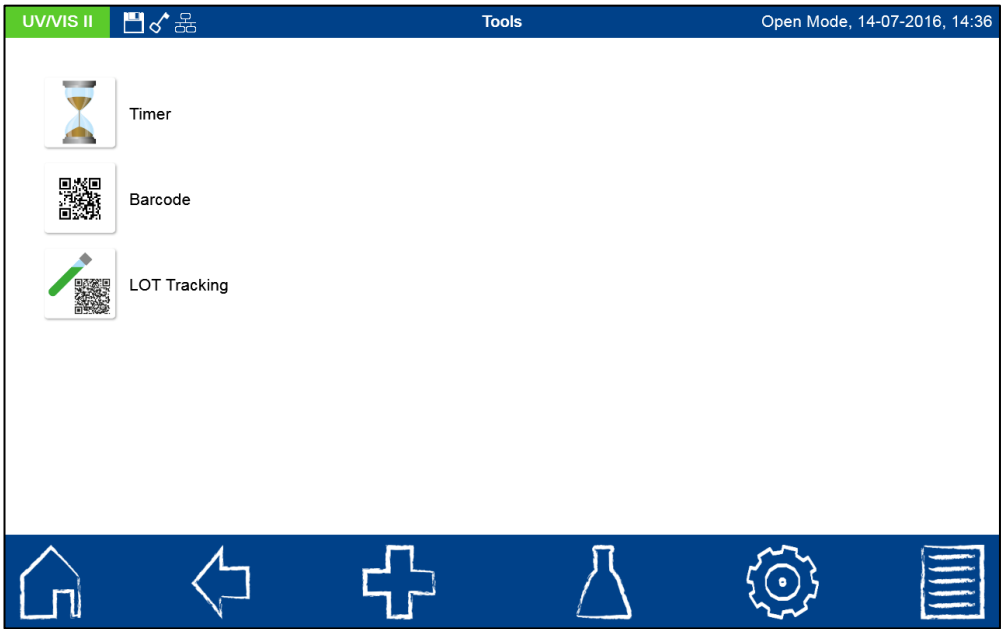



Figure 117: Tools menu

### 6.10.1 Timer

The spectrophotometer has an integrated timer function (see Figure 118). The Minute and Second buttons can be used to set any time in the format hh/mm/ss. By pressing the button Start / Stop, you can stop or start the countdown. Press the Reset button to reset the time.

*Please note: You can open the timer function at any time by touching the screen in the upper right hand corner of the status bar.*

When the timer is activated, the time will run down in the status bar and be shown in place of the date and time. When the time for the alarm has expired, an acoustic signal will be emitted, provided that the volume level has been set high enough. Once the alarm reaches zero, it will continue to countdown automatically in negative numbers.

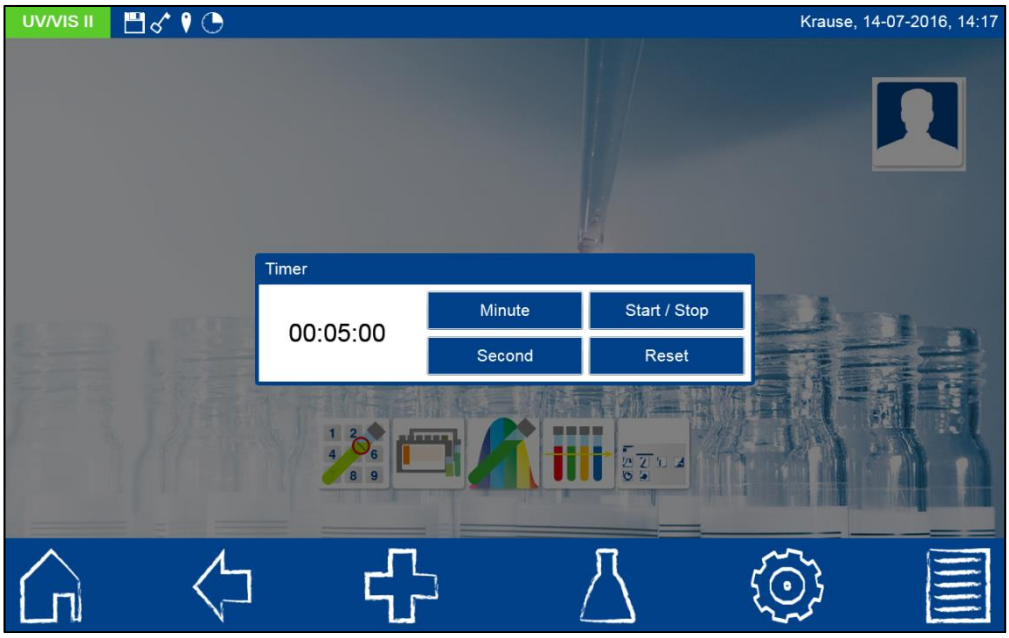



Figure 118: Timer

### 6.10.2 LOT tracking

The LOT tracking menu enables the management of the used test kits with its LOT numbers. It serves as the database for adding the LOT numbers to the measurement result kit.

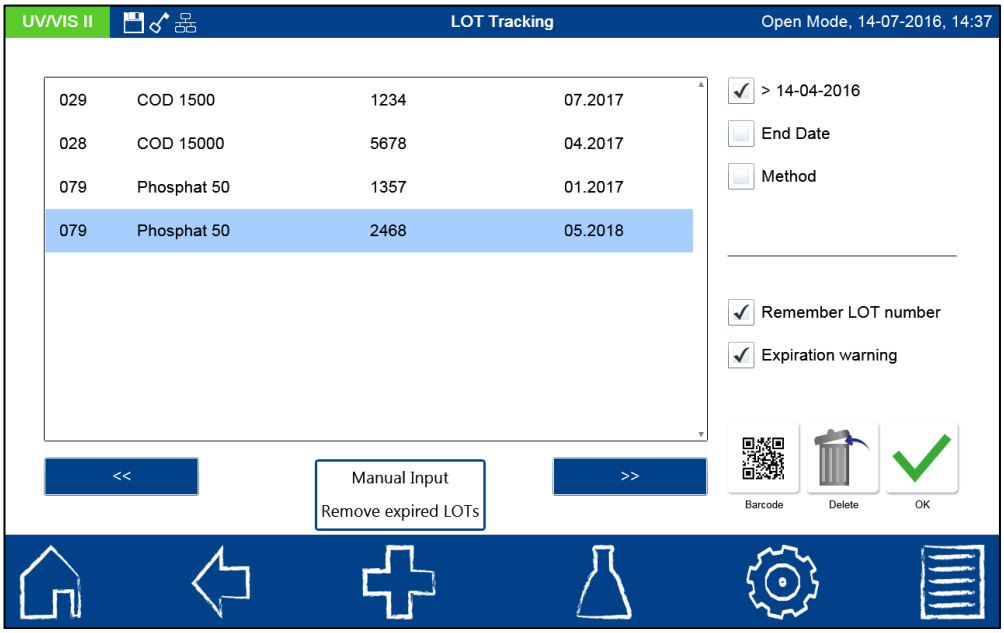



Figure 119: LOT tracking menu

MACHEREY-NAGEL tube test boxes have a 2D barcode on the back, which contains the LOT number of the test. When pressing the barcode icon in the LOT tracking menu, the 2D barcode scanner will become active and the 2D barcode from the box can be scanned. Test name, test numer, LOT number and expiration date are automatically entered into the list in the LOT tracking menu.

In case a test without 2D barcode is used, the 2D barcode is damaged or user specific method is used, the LOT information can be entered manually by choosing the entry “Manual entry” via the icon. The respective test can be choosen from the list of all tests. The LOT number and the expiration date need to entered manually. Confirming with ok saves the entry in the list.

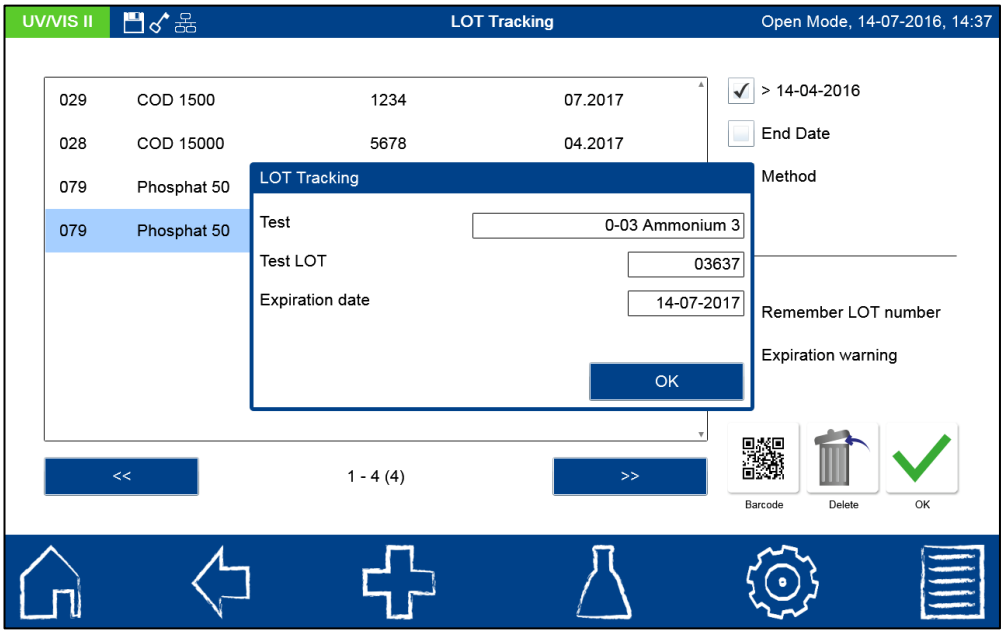



Figure 120: Manual entry of

List entries can be deleted when marking them followed by pressing the icon. Confirming the popup with the safety questions, will delete the entry from the list. Expired LOTs can be easily deleted choosing the option “Remove expired LOTs via the icon.

When setting the checkbox “Remember LOT number” the device will remind the LOT number, which has been assigned to a test kit after measurement. He next time the test kit is measured, the latest entered LOT number will automatically be added to the sample information. When removing the cuvette, the LOT information will be stored together with the result in the result memory (see also section 7).

Setting the checkbox “Expiration warning” will trigger the popping up of an expiration warning, when a LOT number is choosen, which has expired. The user can decide weather to cancel the measurement or to proceed with the expired chemistry. When proceeding, the information that an expired LOT has been used will be stored together with the result and also will be exported to the CSV file.

The LOT number can be added to any measurement result after the measurement by opening the sample information “LOT”.

# 7 Memory

The measurement memory can store up to 5000 measurements and 100 scans or color measurements.

Attention: When the maximum storage capacity has been reached, the oldest measurement results will be overwritten. Before the memory becomes full, a warning to save the results will appear in the home screen. Color references will not be affected by the automatic overwriting process.

In addition to the measurement results, all other sample information that was entered will also be saved. The sample information will be linked to the measurement results in a tamperproof way (GLP conformity). The measurement results can be retrieved by pressing the icon in the task bar. All measurement resuts are shown in a list arranged by date (see

Figure 121). In addition to the type of measurement (method, scan, absorbance, etc.), the result of the measurement is also shown. Whenever the measurement memory is retrieved, the measurement results of the past month are pre-selected.

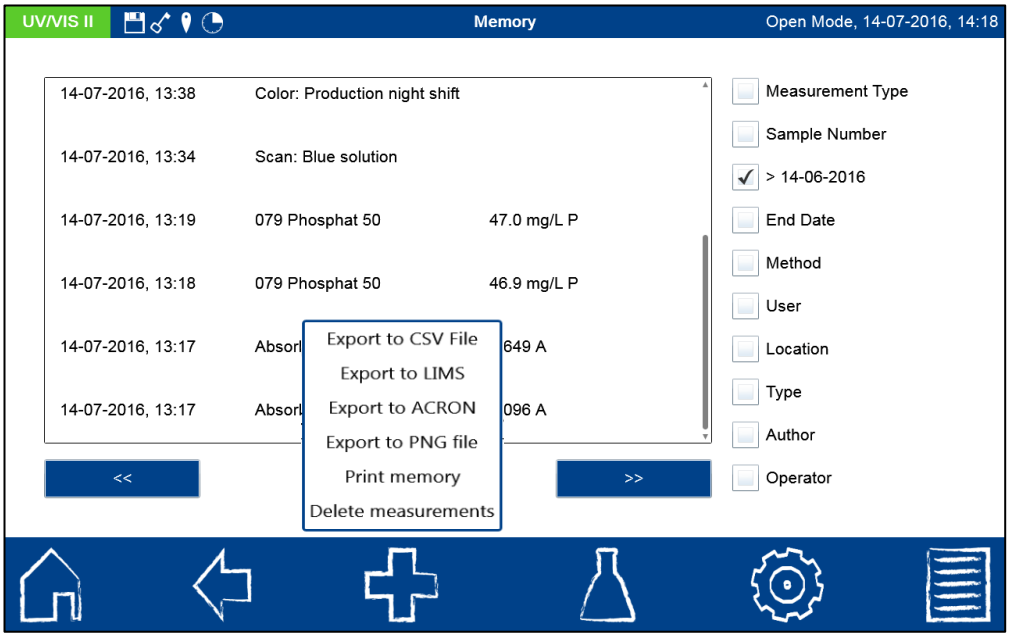



Figure 121: Measurement memory display with options

The << >> buttons can be used to browse through the individual pages of the memory. Measurement results can be printed, exported as csv.files, selected or deleted.

Results can be send to a directly connected printer, or can be exported as PNG-file to an external storage device and then be printed from another workstation. When measurement results are printed or exported as PNG-file, the print-out will contain a selection of the most important information on the sample or all information available on the sample, depending on the chosen print settings (see Section 6.1.6).

Detailed information can be retrieved by selecting the individual result in the measurement memory. Along with the result, all sample information that was entered is shown here (see Figure 122).

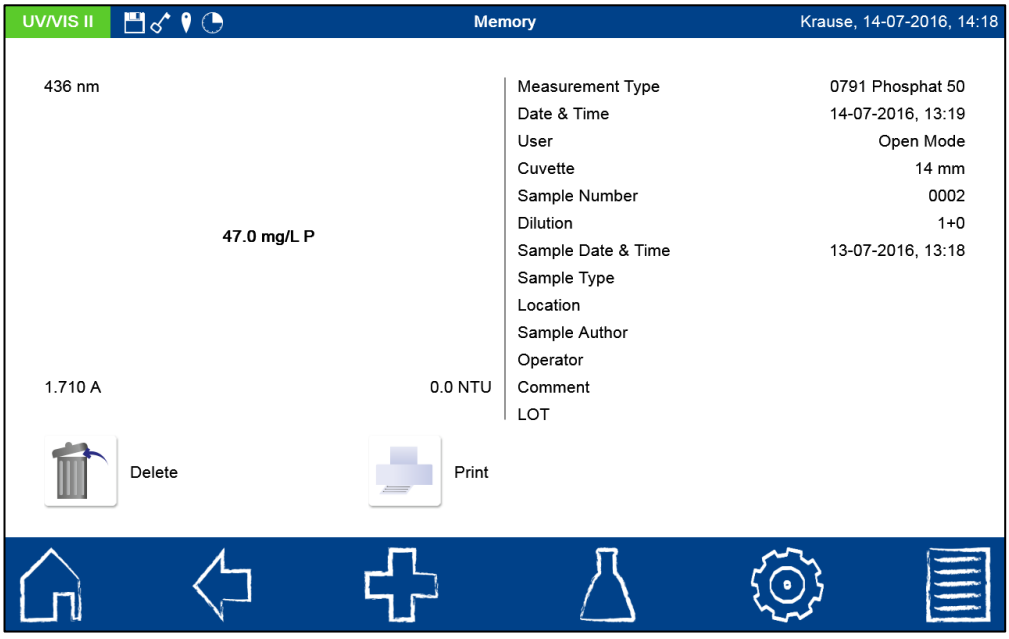



Figure 122: Display of an individual measurement

The information obtained in this way can be printed, deleted or exported again. In the case of a scan and a kinetics measurement, a detailed view of the spectrum or the evaluation diagram is shown. Furthermore, in case of a color measurement or a scan, press or to open the respective menu for the color or scan analysis (see also Section 5.6.1 and 5.5).

## 7.1 Memory selection

In the memory menu, you can make selections according to various types of sample information as well as according to the measurement method.

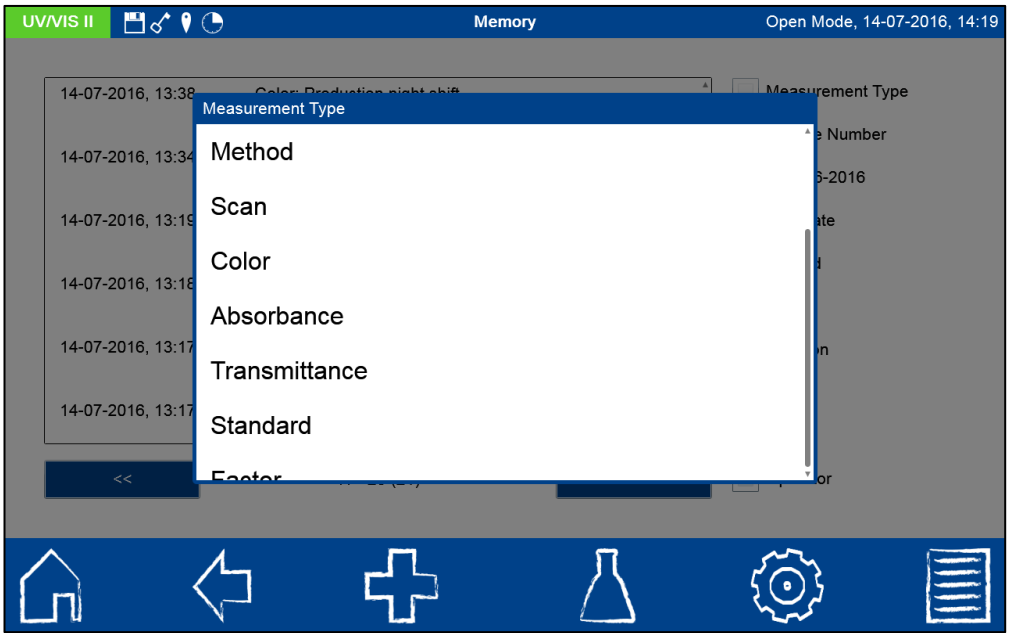



Figure 123: Memory selection according to type of measurement

Figure 123 shows selection according to the type of measurement. Open the list box by tapping the entry “Measurement type” in the memory menu (see Figure 121). After the type of measurement is selected, the appropriate memory contents will be selected. Various selection criteria can be applied simultaneously. For instance, in addition to the type of measurement, the method can also be selected (see Figure 124).

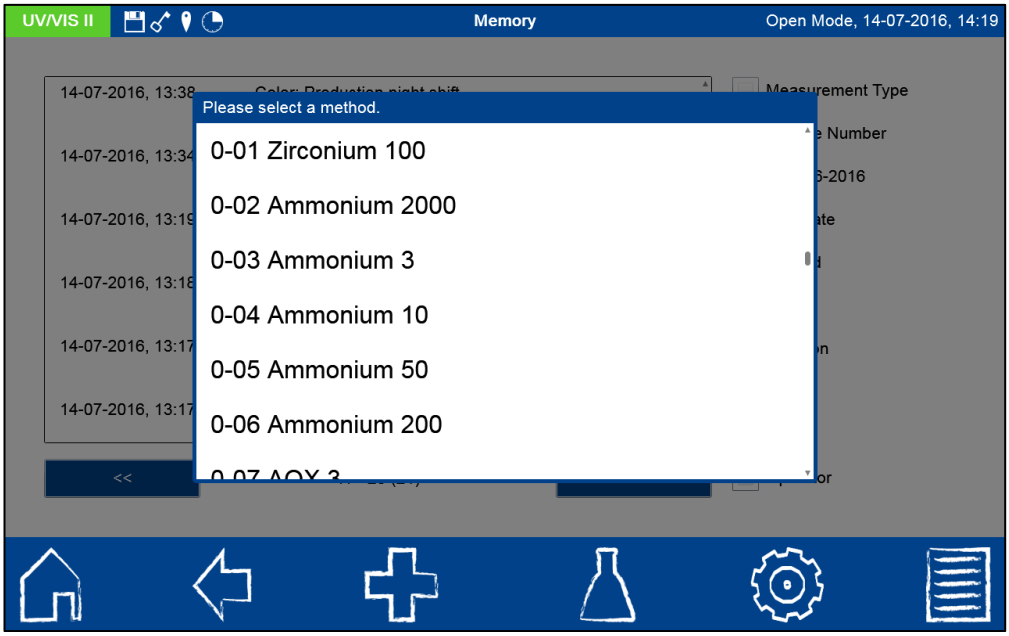



Figure 124: Memory selection according to method

After selecting the data, this selection can also be printed, deleted or exported as CSV- and PNG-file.

## 7.2 Printing from the memory

The measurement results in the memory can be sent individually to a connected printer or to an external storage device as printable PNG-files. The printout contains the same information that is provided in the detailed view of the individual measurements. In the case of a scan or kinetics measurement, the spectrum or the recording of the measurement results will also be printed.

Results can be send to a directly connected printer, or can be exported as PNG-file to an external storage device and then be printed from another workstation. When measurement results are printed or exported as PNG-file, the print-out will contain a selection of the most important information on the sample or all information available on the sample, depending on the chosen print settings (see Section 6.1.6).

## 7.3 Memory export

The results of the memory can be output in various ways. In addition to external data processing programs, the data can also be sent to the Laboratory Information Management System or be provided to special laboratory chroniclers, such as ACRON.

### 7.3.1 Export as CSV

Press the  icon in order to export the selected data as a CSV file (Comma Separated Value) to an external mass storage device. A name for the export folder can be entered on the text keypad. The file it contains can then be processed further in a spreadsheet program. The file name has the following format:

SNDevice_results.csv or

SNDevice_result_X.csv (data of the scan with the number X)

### 7.3.2 Export to LIMS

For exports to the Laboratory Information Management System (LIMS) a separate menu for the user-defined compilation of measurement data is available (see Section 6.9.1).

### 7.3.3 Export to ACRON

For the export to ACRON, a special data format is provided. For more information on transferring data to ACRON pleases contact the technical support of MACHEREY-NAGEL.

## 7.4 Deletion of memory

It is possible to delete the entire memory, individual results or a selection of results. *Please note: Deleting information from the device memory is legitimized only in the "Open Mode" or by administrators in the "User Mode."* Pressing the  icon in the memory menu (see Figure 121) followed by confirmation of the “Delete measurements” entry triggers a popup box to which asks for the deletion of the entire memory or the selected results. If you confirm the subsequent security question with “Yes,” depending on the choice of the user, the selected results or all measurements will be permanently deleted. The IQC memory remains unaffected by this action. To delete an individual result, the  icon has to be pressed in the individual result display mode (see Figure 122). After confirming the security question with “Yes,” the measurement will be permanently deleted.

# 8 Screen management

The background of the start screen as well as the avatars for the individual users can be customised. In addition to a series of pre-defined background images and avatars, user-defined background images and avatars can also be uploaded.

## 8.1 Background images

To select a background image, press the icon on the start screen followed by “Select wallpaper” (see Figure 125) or press and hold the start screen for a few seconds.

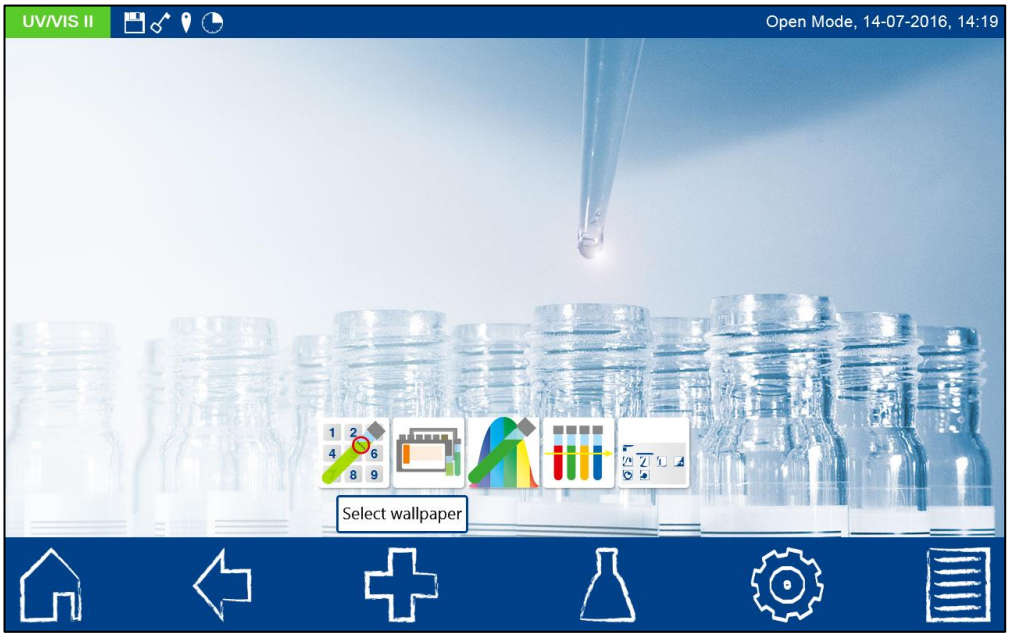



Figure 125: Changing the wallpaper

A dynamic list of saved images will open. Selecting an entry from the list will set the image as the background. To add a background, press the icon and select an image file from a connected USB storage medium. You can delete the list entry by pressing and holding down the list entry for several seconds and then confirming with the icon (see Figure 126).

*Please note: MACHEREY-NAGEL recommends the use of widescreen images with a resolution of 1280 x 800 pixels.*

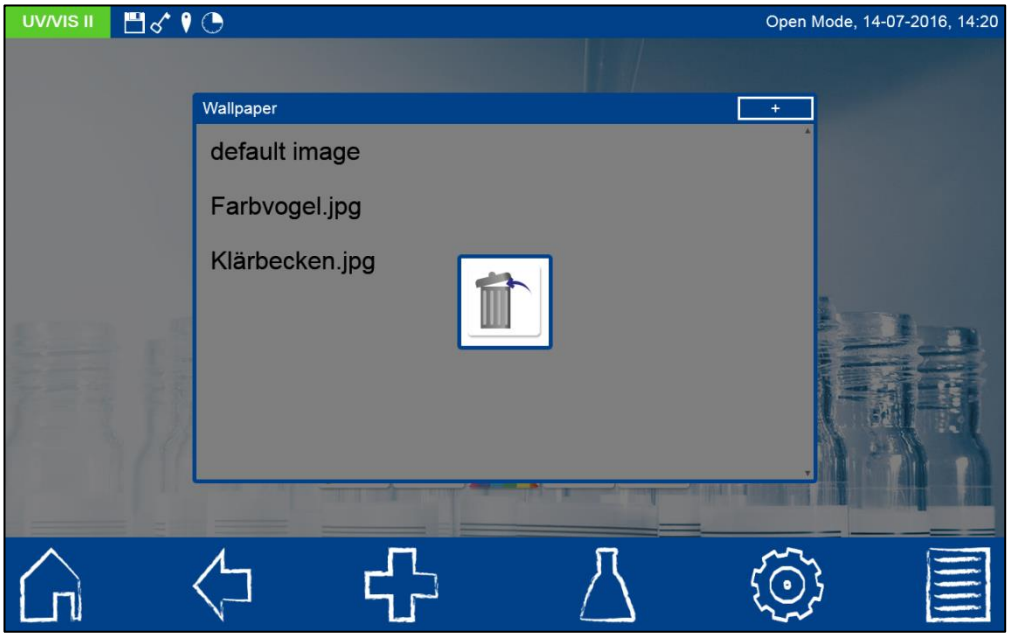



Figure 126: Removing a wallpaper

The wallpaper can be defined separately for each user in User Mode.

### 8.2 Avatars

In the User Mode (see Section 6.7), an avatar can be assigned to each new user. This helps to clearly identify the logged-in user. It will be shown in the upper right hand corner of the start screen. If an avatar has not been selected, the instrument will use the default avatar. In the "Open Mode," an avatar can only be changed through the user account. In the user mode, all logged-in users and the administrators are able to change their own avatar. To select an avatar, press the icon in the start screen (*Please note: User mode has to be activated*) followed by "Select avatar." A dynamic list with the stored avatars will open. By selecting one of the entries, it will be set as the avatar. To add an avatar, press the icon and select an image file from a connected USB storage medium. You can delete the list entry by pressing and holding down the list entry for several seconds and then confirming with the icon.

*Please note: MACHEREY-NAGEL recommends the use of images with a resolution of 180 x 180 pixels.*

## 9 Connection of External Devices

### 9.1 Printer

An external printer can be connected to the spectrophotometer via the two USB A ports. For printer settings, please also see Section 6.1.6. For the continuous printing of measurement results, the use of a fan-fold paper printer is recommended (*Please note: MACHEREY-NAGEL recommends the use of NANOCOLOR® thermal printers for UV/VIS II and VIS II; REF 919655*). The results of the tube and rectangular cuvette tests are sent to the printer automatically after measurements are made, provided that "Print automatically" has been activated in the settings menu for the printer.

### 9.2 Scanner

Connect the scanner to one of the instrument's USB-A interfaces. An acoustic signal will confirm that the scanner has been connected. (*Please note: MACHEREY-NAGEL recommends the use of the NANOCOLOR® USB handheld scanner; REF 919134*). After connecting the scanner, it can be used anywhere the keypad appears. A string of up to 20 characters can be entered. The scanner can be used to add sample information conveniently following the measurement. To do this, after the measurement process, press the icon with the desired sample information and then, in the list that opens, press the icon to activate the keypad. The barcode can now be scanned and confirmed by pressing Enter. The scanned sample information is stored together with the measurement result. The barcode scanner can be used in any case a keyboard or numeric field is opened.

## 10 Service

### 10.1 Error messages

The instrument displays several kinds of error messages. The source of error can either be wrong handling or the instrument's malfunctioning. In case of exercising wrong actions within a method, a pop-up will appear hinting at the kind of mistake. In case the instrument detects that the measuring ability cannot be guaranteed, an error message will be displayed. In case of permanent errors, please contact your distributor or technical support of MACHEREY-NAGEL.

### 10.2 Maintenance and cleaning of the instrument

*Caution:* Please do not use any chlorinated cleansers for cleaning. Chlorine compounds can develop lethal gases when subjected to UV radiation.

**Warning:** Always disconnect the instrument from the power supply before cleaning.

**Warning:** When cleaning the instrument, display or accessories, never use any solvents, such as acetone, turpentine, pentane or the like.

### 10.2.1 Cleaning the display

Clean the display using the special display cleaning cloth included with delivery. Please do not use any glass cleaner. Wipe off any excess moisture immediately. Avoid scratching the display. Please do not use ballpoint pens or other sharp objects to operate the touchscreen. The touchscreen can be operated with the accompanying touchpen or any other touchpen suitable for PCAP displays.

### 10.2.2 Cleaning the cuvette slot

*Caution:* The cuvette slot can be cleaned and dried with a soft cotton cloth. When cleaning, please do not use any sharp objetcs or brushes in order to avoid damaging mechanical parts. Leaking liquids in the cuvette slot are discharged through a drain on the underside of the instrument. In general, the cuvettes you use and the instrument itself must always be kept clean. Impurities in the cuvette slot may affect the measurements and cause false readings. The cuvettes you use can be cleaned with the special cuvette cleaning cloth included with delivery

### 10.2.3 Cleaning the housing

The instrument's housing can be cleaned with a wet cloth. Splashes and spillings need to be immediately removed from the instrument. A mild soap solution can also be used where needed.

### 10.2.4 Lamp replacement

**Warning:** Danger of electrical shock. Disconnect the instrument from the power supply and let the lamps cool down before replacing them. Do not reconnect the instrument to the power supply until the lamp replacement is completely finished.

**Warning:** The lamps can be hot. When touched it might cause severe burnings.

A halogen lamp provides light for measurements from 320-1100 nm. For each standard measurement, the lamp emits a corresponding light pulse. This results in very low power consumption and a long service life of the lamp.

*Please note: During scanning, the lamp burns for the duration of the scan.*

A deuterium lamp (*NANOCOLOR*® $^{UV}/_{VIS}$ II only) provides light for measurements from 190-340 nm (400 nm). An auto-off function ensures efficient operation and thus a long service life of the lamp.

Lamp replacement *NANOCOLOR*® *UV/VIS* II :

Disconnect the instrument from the power supply. Remove the screw of the lamp cover on the top of the unit and remove the cover flap (see Section 3.1). Pull the connector plug of the lamp to be changed out of the lamp board and loosen the screws holding the lamp socket. Insert the new lamp socket with the help of the guide pin and fix it with the retaining screw. Connect the connector plug to the contacts and close the lamp cover. Both, halogen and deuterium lamp are fixed with a screw and are arranged by a guide pin. Reinserting in a wrong way thereby is excluded.

Lamp replacement *NANOCOLOR*® *VIS* II :

Disconnect the instrument from the power supply and place it upside down on a soft surface. Remove the screw of the lamp cover on the bottom of the unit and remove the cover flap. Pull the connector plug out of the lamp board and loosen the retaining screw of the retaining clip of the lamp socket. Remove the old lamp socket and insert the new lamp socket with the help of the guide pin and fix it with the retaining screw. Connect the connector plug to the contacts and screw down the lamp cover carefully using the appropriate screw.

## 10.3 Spare parts, accessories and consumables

| Description | REF |
|---|---|
| Halogen lamp | 919604 |
| UV lamp | 919603 |
| LAN cable (1.5 m) | 919682 |

| | |
|---|---|
| Thermal printer for *NANOCOLOR® VIS* II and $^{UV}/_{VIS}$ II | 919655 |
| USB connection cable AB | 919687 |
| Handheld scanner for *NANOCOLOR® VIS* II and $^{UV}/_{VIS}$ II | 919993 |

## 10.4 Contact

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## 10.5 Warranty, liability and complaints

This instrument is guaranteed for 24 months from the date of purchase. The original invoice serves as proof of purchase and must be presented when making a claim. Improper handling and / or maintenance of the unit will void the warranty. It does not include defects that are attributable to power supplies other than the supplied external power supply. The warranty is limited to the repair of faulty parts or - at our discretion - to the delivery of a faultless replacement instrument. The recourse to warranty does not affect the warranty period of 24 months. A right of withdrawal does not exist. Further claims are excluded. These include in particular all claims for damages arising from consequential or indirect damages. In addition, our general terms and conditions apply in their current version, as printed on all price lists.

## 10.6 Waste disposal

Dispose of according to Directive 2012/19/EU (WEEE). In agreement with the European Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), MACHEREY-NAGEL will take back the old equipment and dispose of it free of charge.

*Please note:* It is prohibited to dispose of the device through public waste disposal systems. Please contact your local MACHEREY-NAGEL representative.


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