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DR 3900

USER MANUAL

2/2025 Edition 13

DOMINIQUE DUTSCHER SAS

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Section 1 Specifications

These are subject to change without notice!

Performance specifications	
Display mode	Transmittance (%), Absorbance and Concentration
Source lamp	Halogen lamp
Wavelength range	320–1100 nm
Wavelength Accuracy	± 1,5nm (wavelength range 340–900 nm)
Wavelength reproducibility	± 0,1 nm
Wavelength resolution	1 nm
Wavelength calibration	Automatic
Wavelength selection	Automatic, based on method selection
Scanning speed	≥ 8 nm/s (in steps of 1 nm)
Spectral bandwidth	5 nm
Photometric measuring range	± 3,0 Abs (wavelength range 340–900 nm)
Photometric accuracy	5 m abs at 0,0–0,5 abs 1 % at 0,50–2,0 Ext
Photometric linearity	< 0,5 % to 2 Abs ≤1 % at > 2 Abs with neutral glass at 546 nm
Stray light	< 0,1 %T at 340 nm with $NaNO_2$
Data log	2000 readings (Result, Date, Time, Sample ID, User ID)
User programs	100
Physical and environmental specifications	
Width	350 mm (13,78 in)
Height	151 mm (5,94 in)
Depth	255 mm (10,04 in)
Mass	4200 g (9,26 lb)
Ambient operating requirements	10–40 °C (50–104 °F), maximum 80 % relative humidity (without condensate formation)
Ambient storage requirements	–40–60 °C (–40–140 °F), maximum 80 % relative humidity (without condensate formation)
Additional technical data	
Power connector via external power supply	Input: 100–240 V/50–60 Hz Output: 15 V/40 VA
Interfaces	Use only shielded cable with maximum length of 3 m: 2× USB type A 1× USB type B Use only shielded cable (for example STP, FTP, S/FTP) with maximum length of 20 m: 1× Ethernet
Housing rating	IP40 (excluding interfaces and power supply)
Protection class	Class I

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Specifications

Performance specifications	
Altitude	2000 m
Pollution degree	2
Overvoltage category	II
Environmental conditions	Indoor use only
Power supply	External power supply

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2.1 Safety information

Read through the entire user manual carefully before you unpack the device, set up and put into operation. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To make sure that the protection provided by this instrument is not impaired, do not use or install this instrument in any manner other than that specified in these operating instructions.

⚠ DANGER

Indicates a potentially or imminently hazardous situation that, if not avoided, results in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation that, if not avoided, may result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation that, if it is not avoided, can lead to damage to the device. Information that requires special emphasis.

Note: *Information that supplements points in the main text.*

2.1.1 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. For symbols attached to the instrument, corresponding warning notes are found in the user manual.

	This symbol may be attached to the device and references the operation- and/or safety notes in the user manual.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems after 12 August 2005. In conformity with the applicable provisions, consumers in the EU must return old electrical equipment to the manufacturer for disposal from this date, at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and all auxiliary items for proper disposal.*

2.1.2 RFID module (not available on all models)

RFID technology is a radio application. Radio applications are subject to national conditions of authorisation. In case of doubt, please contact the distributor.

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The DR 3900 contains an RFID module to receive and transmit information and data. The RFID module operates with a frequency of 13,56MHz.

⚠ WARNING

The spectrophotometer may not be used in dangerous environments.
The manufacturer and its suppliers reject any express or indirect guarantee for use with high-risk activities.

Follow the following safety information, in addition to any local guidelines in force.

Safety information for the correct use of the instrument:

- Do not operate the instrument in hospitals or comparable establishments in proximity to medical equipment, like pace makers or hearing aids.
- Do not operate the instrument near highly flammable substances, such as fuels, highly combustible chemicals and explosives.
- Do not operate the device near combustible gases, vapors or dust.
- Do not vibrate or jolt the instrument.
- The instrument can cause interference in immediate proximity to televisions, radios and computers.
- Do not open the instrument.
- Guarantee is voided if the instrument is not used in accordance with the guidelines present in this document.

2.1.3 Chemical and Biological Safety

⚠ DANGER

Potential danger with contact with chemical/biological substances.
Working with chemical samples, standards and reagents can be dangerous.
Make yourself familiar with the necessary safety procedures and the correct handling of the chemicals before use and read and follow all relevant safety data sheets.

With normal operation of this device the use of chemicals risking health or biologically harmful samples can be required.

- Before handling these substances observe all danger notes and safety information printed on the containers of the original solutions and in the safety data sheet.
- Dispose of all consumed solutions in accordance with the national regulations and laws.
- Select the type of protective equipment suitable to the concentration and quantity of the dangerous material being used.

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2.2 Overview of product

The DR 3900 is a VIS spectrophotometer with a wavelength range of 320 to 1100 nm. The instrument is delivered with a complete series of application programs and supports several languages.

The spectrophotometer DR 3900 contains the following programs and operating types:

- Stored programs (pre-installed tests)
- Barcode Programs
- User Programs
- Favorites
- Single Wavelength
- Multi Wavelength
- Wavelength Scan
- Time course

The DR 3900 Spectrophotometer provides digital readouts in direct concentration units, absorbance or percent transmittance.

When selecting a user-generated or programmed method, the menus and prompts serve to direct the user through the test.

This menu system can also generate reports, statistical evaluations of generated calibration curves and to report instrument diagnostic checks.

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⚠ WARNING

Electrical and fire hazards.
Only use the supplied benchtop power supply LZV844.

Only qualified experts may perform the tasks described in this section of the manual, while adhering to all locally valid safety regulations.

3.1 Unpack the instrument

The DR 3900 Spectrophotometer comes packaged with the following items:

- DR 3900 spectrophotometer
- Dust cover
- USB dust cover, fitted as standard
- Benchtop power supply with power cord for EU
- Cell adapter A.
- Light shield, fitted as standard in the DR 3900
- Operator RFID tag (not available on all models)
- Basic operating instructions DR 3900, operating instructions LINK2SC

Further information, detailed user manuals and documentation are available on the website of the manufacturer.

Note: *If any of these items are missing or damaged, please contact the manufacturer or a sales representative immediately.*

3.2 Operating environment

Observe the following points to allow the instrument to function normally and give a long operating life.

- Position the instrument securely on a flat surface taking care to remove any objects from under the device.
- The ambient temperature must be 10–40 °C (50–104 °F).

NOTICE

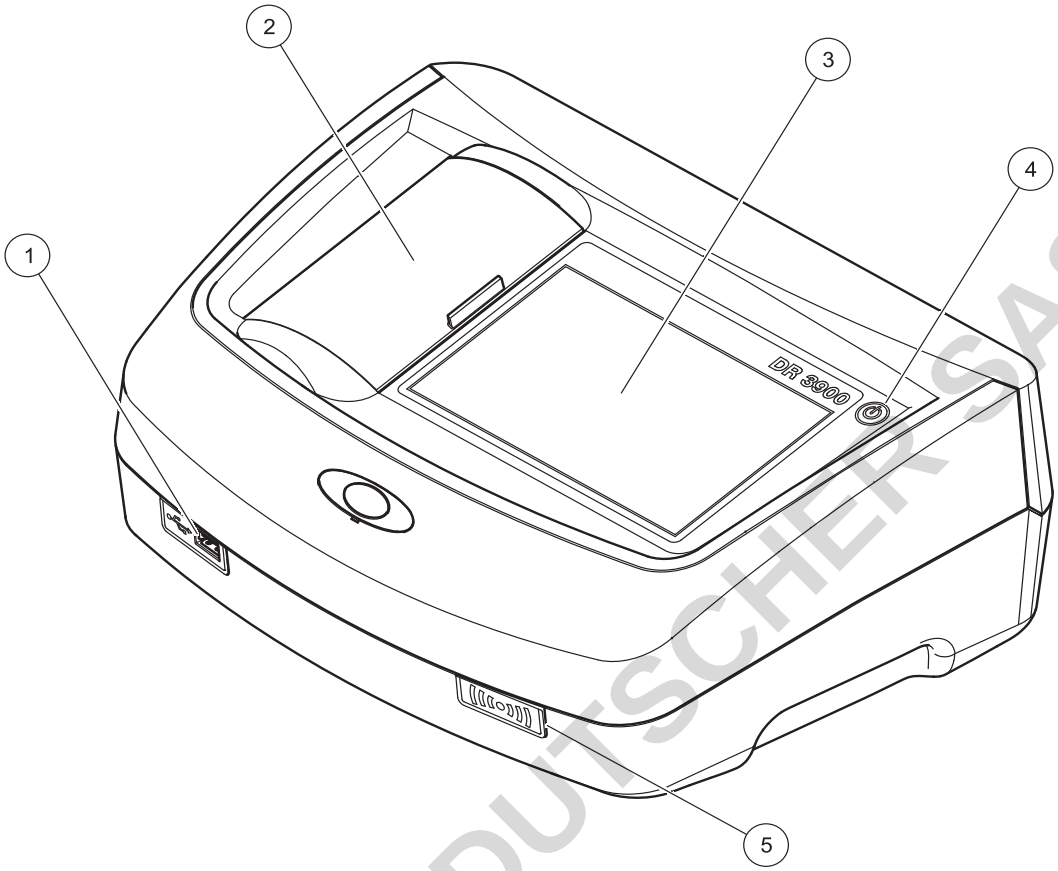
Protect the instrument from extreme temperatures from heaters, direct sunlight and other heat sources.

- The relative humidity should be less than 80 %; moisture should not condense on the instrument.
- Leave at least a 15 cm clearance at the top and on all sides for air circulation to avoid overheating of electrical parts.
- Do not use or store the device in extremely dusty, humid or wet places.
- Keep the surface of the instrument, the cell compartment and all accessories clean and dry at all times. Immediately remove splashes or spilt materials on or in the instrument (refer to Section 7).

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3.3 Front and back view

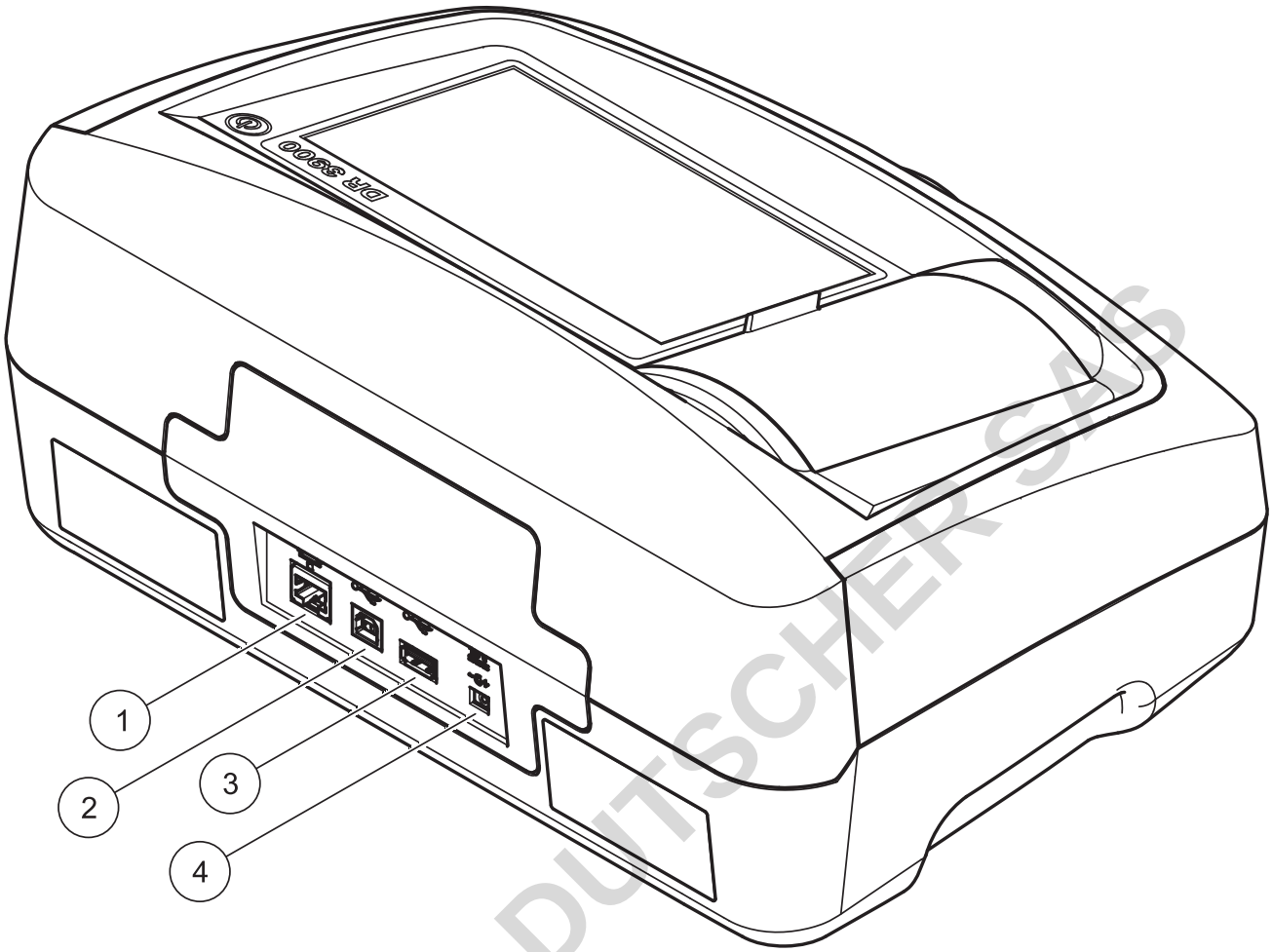
Figure 1 Front view



1	USB port type A	**4**	On/off switch
2	Cell compartment cover	**5**	RFID module (not available on all models)
3	Touch screen		

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Figure 2 Back view



1	Ethernet port	**3**	USB port type A
2	USB port type B	**4**	Connection for benchtop power supply

3.4 Power connections

⚠WARNING

Electrical and fire hazards.
Only use the supplied benchtop power supply LZV844.

1. Connect the power cable to the benchtop power supply.
2. Plug the benchtop power supply cable into the back of the instrument (Figure 2, page 17).
3. Insert the power cable plug into a mains socket (100–240 V~/50–60 Hz).
4. Turn on the power button next to the display to turn on the power supply (Figure 1, page 16).

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3.5 Interfaces

The DR 3900 features three USB ports and one Ethernet port as standard, located on the front and rear sides of the instrument (Figure 1 and Figure 2, page 17).

The USB type A ports are used for communications with a printer, USB memory stick or keyboard. A USB memory stick can be used to update the instrument software.

The USB type B port is used for communications with a PC. The optional Hach Data Trans software (refer to Section 9, page 137) must be installed on the PC for data transfer.

A USB hub may be used to connect several accessories at a time.

***Note: USB cables** must not be longer than **3 m**.*

These USB ports permit data to be exported to a printer or PC and also allow the instrument software to be upgraded (refer to section 6.8.2, page 111). The Ethernet port supports real-time data transfer in local networks, LIMS systems or SC controllers. Only use a shielded cable (e.g. STP, FTP, S/FTP) with a maximum length of 20 m for the Ethernet port.

3.6 Cell compartments, cell adapters and light shield

3.6.1 Cell compartments and adapters

The DR 3900 has two cell compartments (Figure 3). Only one cell type at a time can be used for a reading.

Cell compartment (1) for:

- 13 mm round cells

  ***Note:** Cell compartment (1) contains barcode detection for cells.*

Cell compartment (2) for:

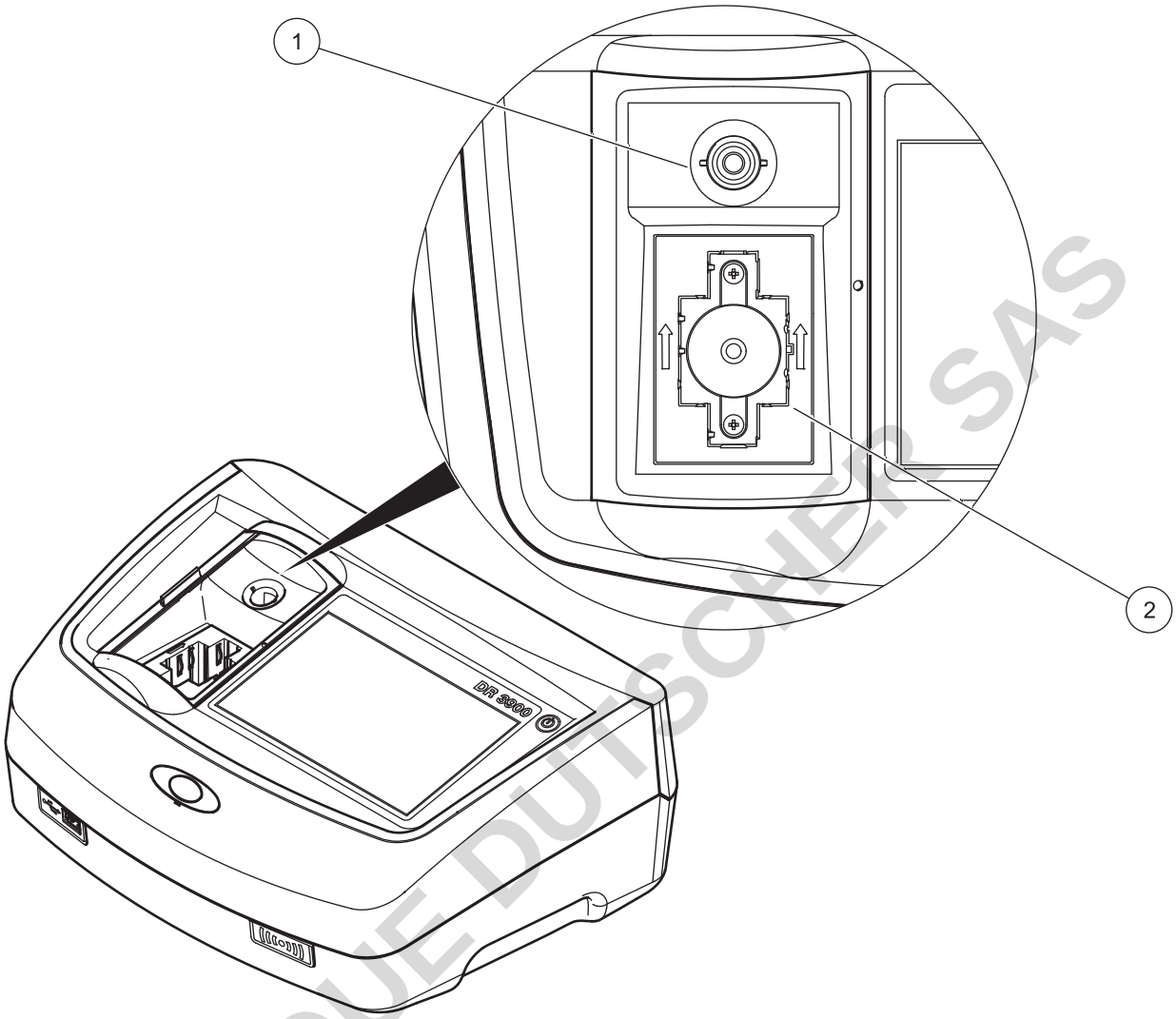
The following cell types can be used in cell compartment (2).

- Without cell adapter A, 50-mm cells, 1-inch rectangular cells and 1-inch flow cells can be used directly in cell compartment (2).
- With cell adapter A: 10 mm rectangular cells, 1-inch round cells and AccuVac® vials.

  ***Note:** These cells **must** be inserted using cell adapter A.*

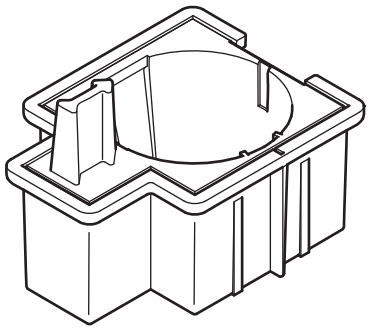
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Figure 3 Cell compartments



1	Cell compartment for round cells (1)	**2**	Cell compartment for rectangular cells (2)

Figure 4 Cell adapter



Cell adapter A: 10-mm rectangular cells/1-inch round cell

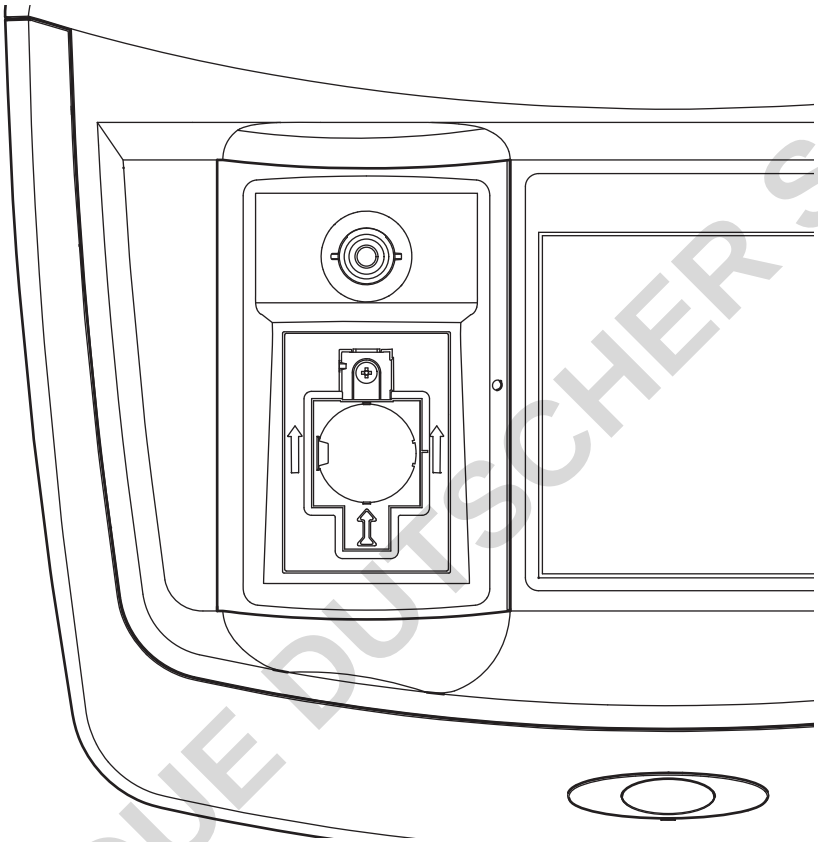
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3.6.2 Installation of cell adapter

1. Open the cell compartment.
2. Place the cell adapter into cell compartment (2) so that the arrow on the cell adapter points to the rear (Figure 5).

   Note: *The arrow on top of the cell adapter indicates the direction of the light beam path.*

Figure 5 Installation of a cell adapter



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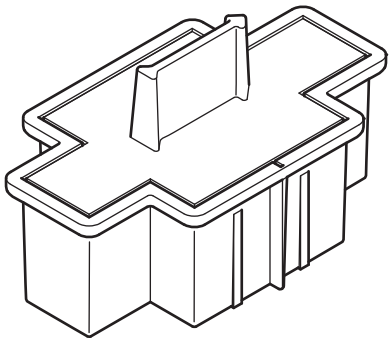
3.6.3 Use of the light shield for measurements

The light shield (Figure 6) prevents disruptive exposure to light when 13 mm round cells are used in the cell compartment (1).

Insert the light shield into cell compartment (2) before performing measurements in cell compartment (1).

The instrument is shipped with the light shield installed. Remove the light shield before using cell compartment (2).

Figure 6 Light shield



Installation of the light shield

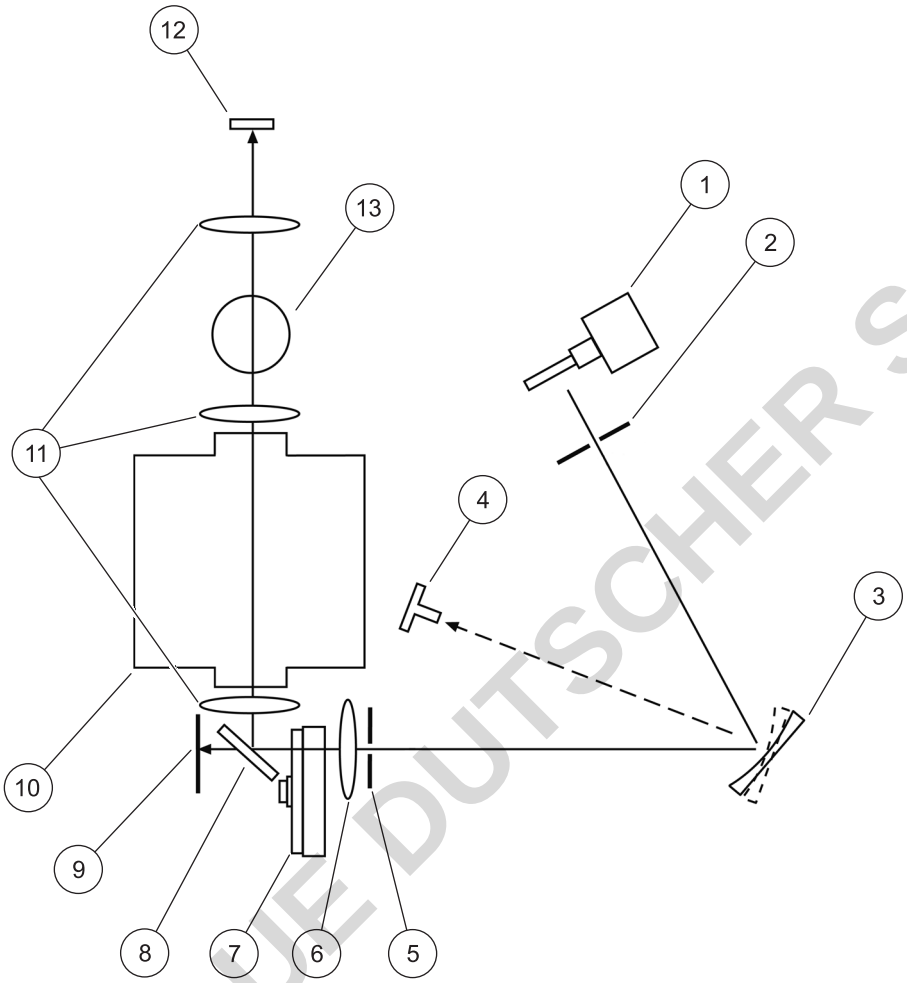
1. Open the cell compartment.
2. Place the light shield into cell compartment (2) so that the arrow on the light shield points to the rear.

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3.7 Beam path

Figure 7 shows the beam path of the DR 3900.

Figure 7 Beam path



1	Halogen lamp	**8**	Splitter mirror
2	Entrance slit	**9**	Reference element
3	Grating	**10**	Cell compartment (2) for rectangular cells
4	Grating angle indicator	**11**	Lens
5	Exit slit	**12**	Reading element
6	Lens	**13**	Cell compartment (1) for round cells
7	Filter wheel		

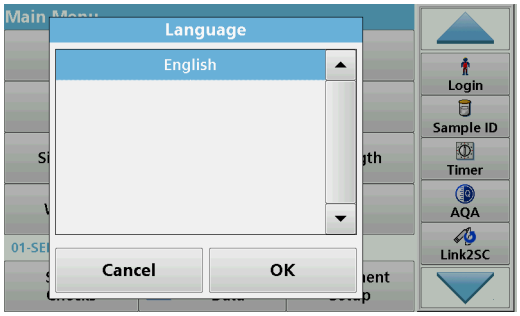
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4.1 Switch on the instrument, startup process

1. Connect the power cable to the mains outlet.
2. Switch on the instrument by using the power button next to the display.
3. The instrument starts automatically with a startup process lasting approximately 45 seconds. The display shows the logo of the manufacturer. At the end of the startup process, a startup melody is heard.

Note: *Wait approximately **20 seconds** before switching on again so as not to damage the electronics and mechanics of the instrument.*

4.2 Language selection



The DR 3900 software includes several language options. The first time the instrument is switched on, the language selection screen will be shown automatically after the startup process.

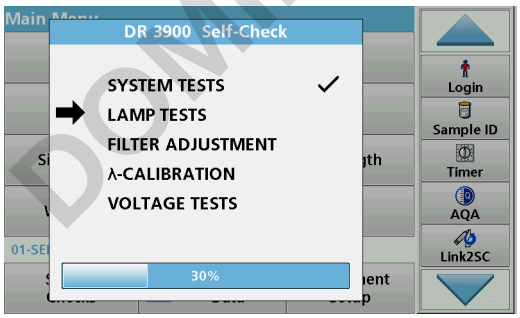
1. Select the required language.
2. Press **OK** to confirm the language selection. The self-check will then start automatically.

Change the language setting

The instrument functions in the selected language until the option is changed.

1. Turn the instrument on.
2. During the startup process, touch any point on the screen and maintain contact until the option for selecting a language is shown (approximately 45 seconds).
3. Select the required language.
4. Press **OK** to confirm the language selection. The self-check will then start automatically.

4.3 Self-check



Each time the instrument is powered up, a test program begins.

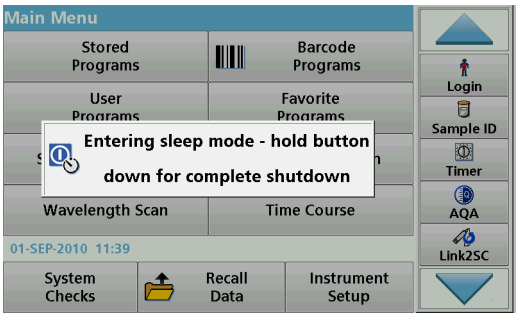
This procedure, which takes approximately two minutes, checks the system, lamp, filter adjustment, wavelength calibration and voltage. Each test that functions correctly is marked accordingly.

The Main Menu is displayed when diagnostics are completed.

Note: *In the event of further error messages during the test program, refer to* *Section 8, page 133.*

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4.4 Sleep mode



The instrument can be put into sleep mode.

1. Briefly press the power button next to the display.

   The "Sleep mode" message is shown. The display will then switch off automatically.

2. To switch on, press the power button next to the display.
   The self-check will start automatically.
   After that, the instrument is ready to use.

4.5 Power off the instrument

1. Press the power button next to the display for approximately 5 seconds.

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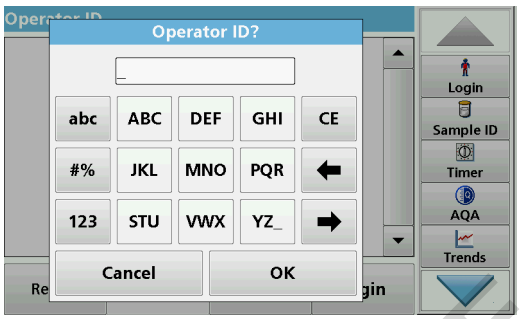
5.1 Overview

5.1.1 Tips for using the touch screen

The whole screen responds to touch. To choose an option, tap with a fingernail, fingertip, an eraser or a specialised stylus. Do not touch the screen with sharp objects, such as the tip of a ballpoint pen.

- Do not place anything on top of the screen, to prevent damage or scratches on the screen.
- Press buttons, words or icons to select them.
- Use scroll bars to move up and down long lists very quickly. Press and hold the scroll bar, then move up or down to move through the list.
- Highlight an item from a list by pressing it once. When the item has been successfully selected, it will be displayed as reversed text (light text on a dark background).

5.1.2 Use of the alphanumeric keypad



This display is used to enter letters, numbers and symbols as needed when programming the instrument. Unavailable options are disabled (grayed out). The icons on the right and left of the screen are described in Table 1.

The central keypad changes to reflect the chosen entry mode. Press a key repeatedly until the desired character appears on the screen. A space can be entered by using the underscore on the **YZ_** key.

Press **Cancel** to cancel an entry, or press **OK** to confirm an entry.

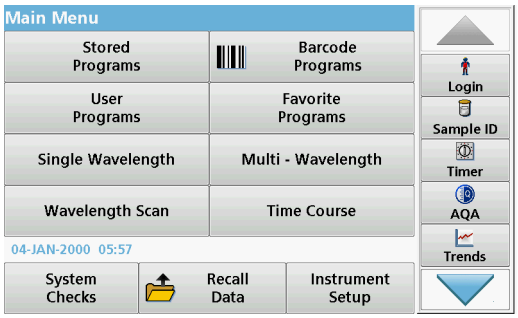
Note: *It is also possible to use a USB keyboard (with US keyboard layout) or a hand-held USB barcode scanner (refer to Section 9, page 137).*

Table 1 Alphanumeric keypad

Icon / key	Description	Function
ABC/abc	Alphabetic	Toggles the character input mode between upper and lower case.
# %	Symbols	Punctuation, symbols and numerical sub- and superscripts may be entered.
123	Numeric	For entering regular numbers.
CE	Clear Entry	Clear the entry.
Left Arrow	Back	Deletes the current character and goes back one position.
Right Arrow	Next	Navigates to the next space in an entry.

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5.1.3 Main menu



A variety of modes may be selected from the Main Menu. The following table briefly describes each menu option.

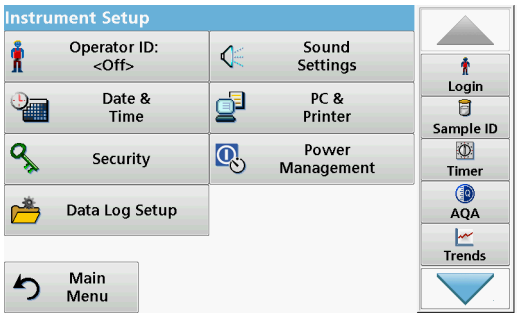
There is a toolbar on the right-hand side of the screen. Press to activate the various functions.

Table 2 Main Menu options

Option	Function
Stored Programs / Barcode Programs (HACH-LANGE programs)	Stored programs are pre-programmed methods that make use of HACH chemicals and HACH-LANGE pipette tests. The working procedures for HACH-LANGE tests are included in the test packs. Further information, as well as illustrated, step-by-step process instructions for analyses using HACH programs, are available on the website of the manufacturer.
User Programs	User programs make "made to measure analysis" possible: • Users can program methods they have developed themselves • Existing HACH and LANGE methods can be stored as user programs. The HACH-LANGE tests can then be modified to suit the user's requirements.
Favorites	List of methods/tests created by the user to suit his own requirements.
Single Wavelength	Single wavelength readings are: **Absorbance readings:** The light absorbed by the sample is measured in absorbance units. **Transmittance reading (%)**: Measures the percent of the original light that passes through the sample and reaches the detector. **Concentration readings:** A concentration factor can be entered to enable the measured absorbance values to be converted into concentration values.
Multi Wavelength	In the Multi Wavelength mode, absorbance (Abs) or percentage transmittance (%T) is measured at up to four wavelengths and absorbance differences and absorbance relationships are calculated. Simple conversions into concentrations can also be carried out.
Wavelength Scan	A wavelength scan shows how the light from a sample is absorbed over a defined wavelength spectrum. This function can be used to determine the wavelength at which the maximum absorbance value can be measured. The absorbance behavior is displayed graphically during the scan.
Time course	The time scan records the absorbance or % transmittance at a wavelength over a defined time.
System checks	The "System check" menu offers a number of options, including optical checks, output checks, lamp history, instrument update, service time, settings for analytical quality assurance and instrument backup.
Recall measurement data	Stored data can be called up, filtered, sent and deleted.
Instrument Setup	In this mode, user-specific or method-specific settings can be entered: operator ID, sample ID, date & time, sound, PC & printer, password, energy-saving mode and stored data.

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5.2 Instrument Setup

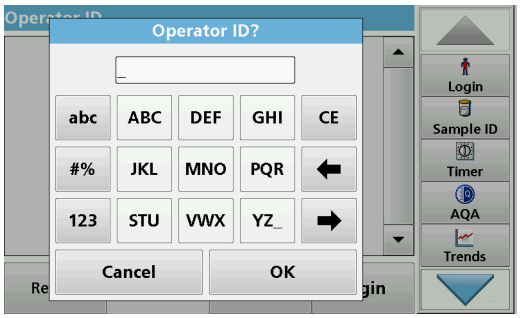


1. Select **Instrument Setup** in the Main Menu.

   A selection of functions appears in order to configure the functions of the instrument.

5.2.1 Operator ID

Use this option to enter up to 30 sets of operator initials (up to ten characters each) into the instrument. This feature helps record which operator measured each sample.



1. Press **Operator ID** in "Instrument Setup".
2. Press **Options>New** to enter a new operator ID.

   Note: *If no operator ID has yet been entered, the alphanumeric keyboard is immediately displayed.*
3. Use the alphanumeric keypad to enter a new operator ID.
4. Press **OK** to confirm the entry.

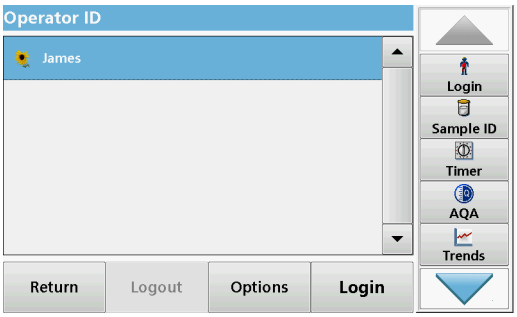


5. Choose an icon for the operator ID using the **Left Arrow** and **Right Arrow**.
6. Press **Operator Password** to protect the operator ID with a password.
7. Use the alphanumeric keyboard to enter an operator password.
8. Press **OK** to confirm the entry.

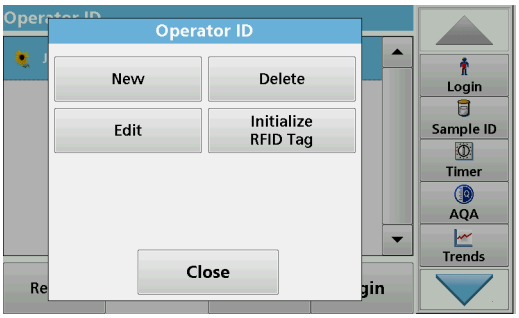


9. Press **Cancel** to delete the complete entry for the operator ID.
   Press **Back** to reach to the input screen for operator ID.
   Press **OK** to confirm the entry. The following screen is displayed.

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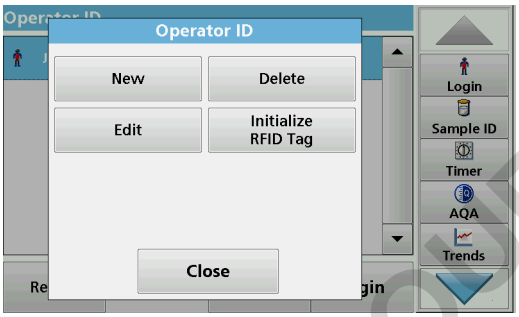


10. With **Back** the device returns to the menu "Instrument Setup".
    Press **Logout** to log out of an active operator ID.
    Press **Login** to activate a selected operator ID.
    Press **Options** to enter, change or delete additional operator IDs. The following screen is displayed.

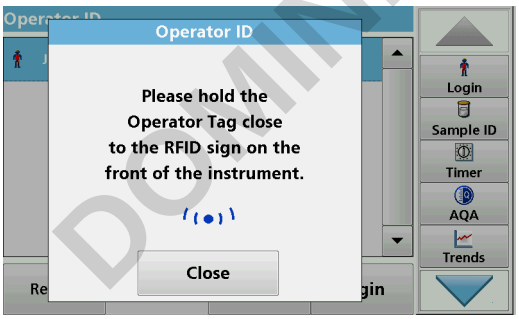


11. Press **New** to enter another operator ID.
    Press **Delete** to delete an operator ID.
    Press **Edit** to edit an operator ID.
    Press **Initialize RFID Tag** to write the operator ID to an optional operator RFID tag (not available on all models).
    Refer to section 5.2.1.1 for more information.

5.2.1.1 Operator RFID tag (not available on all models)



1. Define an operator ID (refer to section 5.2.1).
2. Press **Initialize RFID Tag.**



3. Follow the instructions on screen and hold the operator RFID tag over to the front-right of the RFID module.

   A sound indicates that the write process has been sucessful.
4. The operator RFID tag can be newly written at any time. To do so, confirm the "Overwrite Operator ID" message with **OK** and enter the password if the old operator ID is protected with a password.

   If the operator RFID tag is successfully overwritten, a message confirming this will briefly be shown on the display.

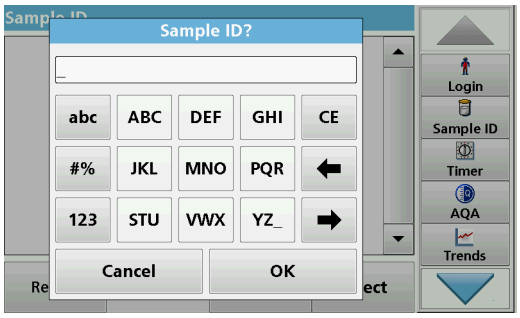
   The operator is logged on and the operator ID is shown in the toolbar.

5.2.2 Sample ID

Use this option to enter up to 100 Sample Identification tags (up to 20 characters each) into the instrument. Sample IDs can be

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used to specify the sample location or other sample specific information, for example.



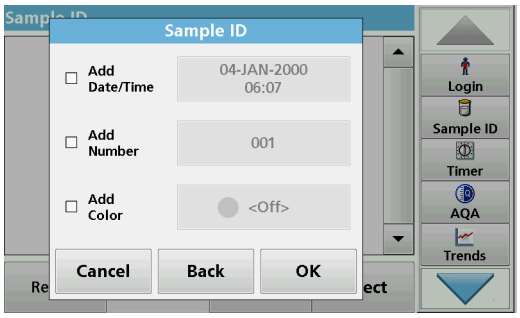
1. Press **Sample ID** in the toolbar on the right.
2. Press **New** to enter a new sample ID.

   Note: *If no sample ID has been entered yet, the alphanumeric keyboard is immediately displayed.*

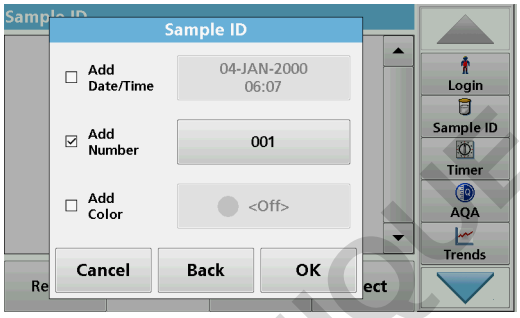
3. Use the alphanumeric keypad to enter a new Sample ID.

   Note: *If a USB Barcode handset scanner (refer to section 5.2.2.1, page 30) is connected, Sample IDs can also be scanned.*

4. Press **OK** to confirm the entry.

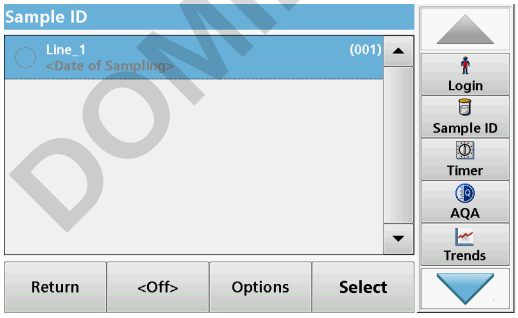


5. Assign the current time and date, a sequential number or a colour to the sample ID.



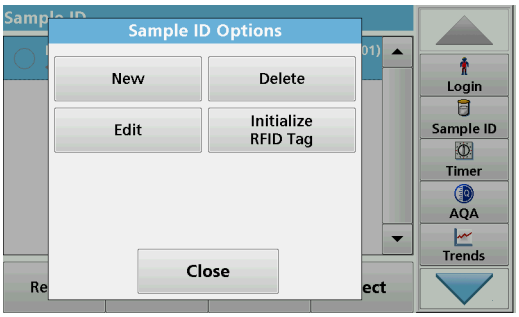
6. To number the sample IDs sequentially—e.g. Inflow (01) etc.—press **Add Number**.
   - Use the arrow keys to specify the first number of the sequence.
   - Use the key between the arrow keys to enter the first number of the sequence using the alphanumeric keypad.
7. Press **OK** to return to the "Instrument Setup" menu.

   The Sample ID is activated. Each Sample ID is automatically numbered in ascending order after a reading. The number is shown in parentheses behind the Sample ID.



8. Press **Back** to return the instrument to the "Instrument Setup" menu.
   Press **Off** to switch off the active sample ID.
   Press **Select** to activate the selected sample ID.
   Use **Options** to enter, change or delete additional sample IDs. The following screen is displayed:

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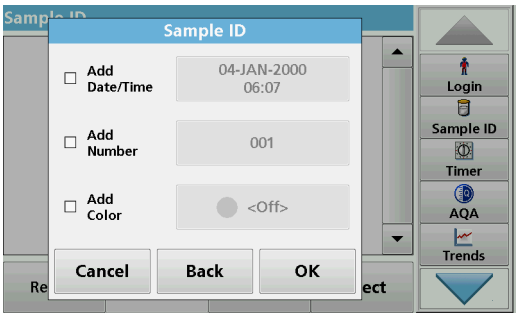


9. Press **New** to enter another sample ID.
   Press **Delete** to delete a sample ID.
   Press **Edit** to edit a sample ID.
   Press **Initialize RFID Tag** to write the sample ID to an optional location RFID tag (not available on all models).

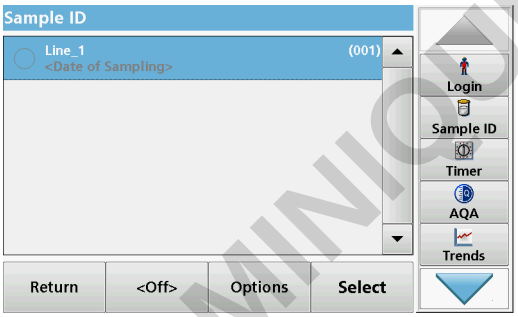
5.2.2.1 Sample ID with scanner method 1

1. Connect the scanner to the USB port.

   Successful connection is indicated by a sound.
2. Press **Sample ID>Options** and **New**.
3. Read barcode with scanner.



4. The sample ID can have the current date and time, a sequential number and a colour allocated to it.
   Select the required options or a colour.
5. Press **OK** to confirm the entry.



6. Press **New** again and repeat the process for each barcode.

5.2.2.2 Sample ID with scanner method 2

1. Read the sample ID on the screen with the barcode scanner and perform measurement.

   The barcode is stored along with the reading, but is not adopted into the list of sample IDs.

Note: *To delete a sample ID, select the ID and press* ***Delete****.*

Note: *A sample ID can be entered or changed in Reading Mode. On the results screen, press* ***Options****>****More****>****Instrument Setup****. If a Sample ID is already assigned, select the "Sample ID" symbol in the result display.*

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5.2.3 Sample ID and operator ID with the optional RFID Sample ID Kit (not available on all models)

The optional RFID Sample ID Kit consists of:

- A LOC 100 RFID Locator
- An operator RFID tag
- Five location RFID tags and
- Three sample bottle RFID labels each, in black, red, green, blue and yellow

The operator and location RFID tags can be written to and read in by the RFID module in the DR 3900 as often as required.

More information can be found in the user manual for the LOC 100 RFID Locator.

5.2.4 Security settings

The "Security" menu contains a variety of security settings to control access to various functions.

All functions can be allocated to three different security levels:

- **not secured**: every operator can make changes in this area.
- **one key**: every operator assigned this security level can make changes to non-secured functions and functions with one key.
- **two keys**: every operator assigned this security level can make changes in all functions



1. Press **Security** in the "Instrument Setup" menu.
2. In order to open the **Security List**, assign a password as security administrator. Press **Security Password**.

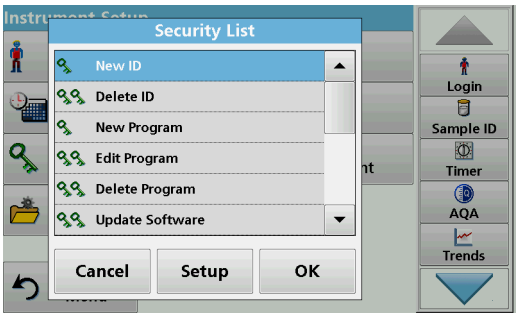


3. Use the alphanumeric keypad to enter a new security password (up to 10 characters) and press **OK** to confirm.

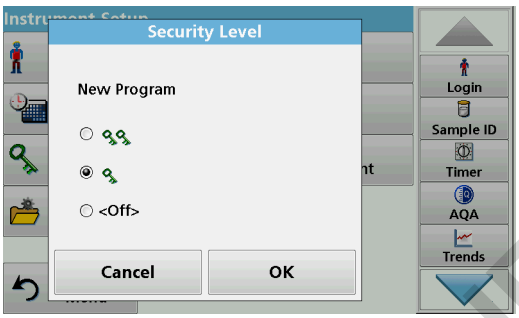
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4. Press **Security List** to access various functions with security level 1 or 2.



5. Select the required function and press **Setup**.



6. Select the required security level (two keys, one key or off) and confirm using **OK**.
7. Confirm the **Security List** using **OK** to return to the "Security" menu.



8. Press **On** to activate the new settings of the security list.
9. Press **OK** to return to the "Instrument Setup" menu.

Note: *The alphanumeric keypad for entering the password appears when a user tries to reach a locked setting.*

5.2.4.1 Assign operator security level

Every operator with an operator ID can be assigned a security level. This is connected to the operator password. Setup must be coordinated with the security administrator and the operator.

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1. Select **Operator ID** from "Instrument Setup".
2. Enter the security password and confirm by pressing **OK**.
3. Set up an operator ID (refer to section 5.2.1).

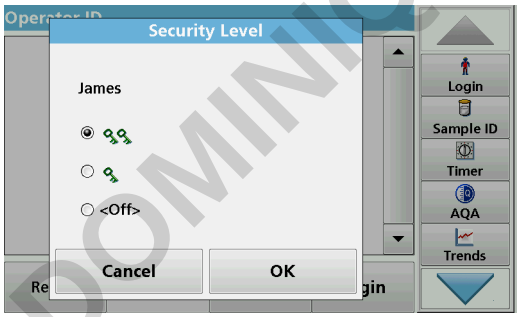


4. Press **Operator Password**.
5. Enter the operator password and confirm with **OK**.



6. Press **Security Level <Off>**
7. Enter the security password and confirm with **OK**.

   The current security level for the selected operator is shown.

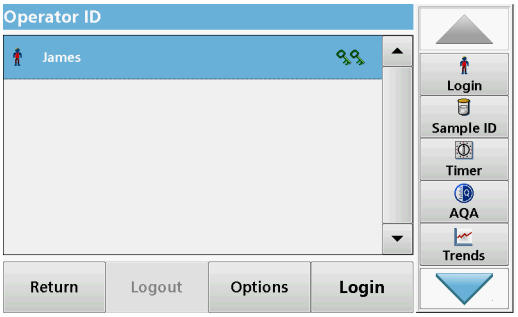


8. Select the required security level for this operator ID and confirm with **OK**.

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9. Press **OK**.



The operator ID is displayed with the selected security level.

10. Activate the selected operator ID by pressing **Login**.
11. Enter the operator password.
12. Confirm with **OK** and return to "Instrument Setup".

5.2.4.2 Deactivate password



1. Press **Security** in the "Instrument Setup" menu.
2. Enter the security password and confirm with **OK**.

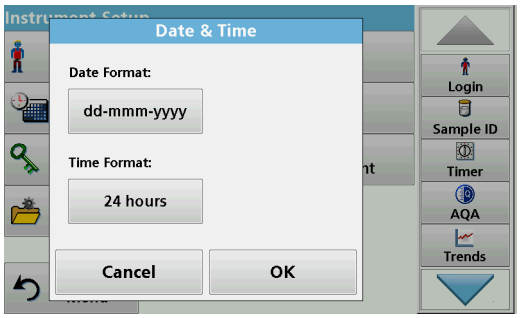


3. Press **Off** to deactivate the settings of the Security List.
4. Press **OK** and return to the "Instrument Setup" menu.

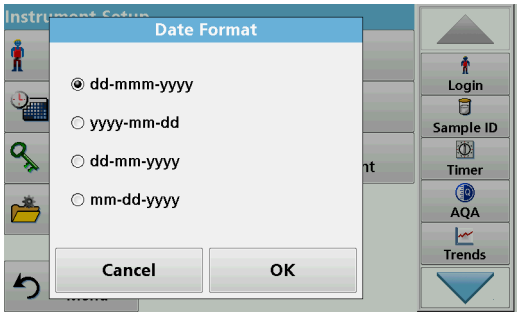
Note: *Use this function to delete the former password or to enter a new one.*

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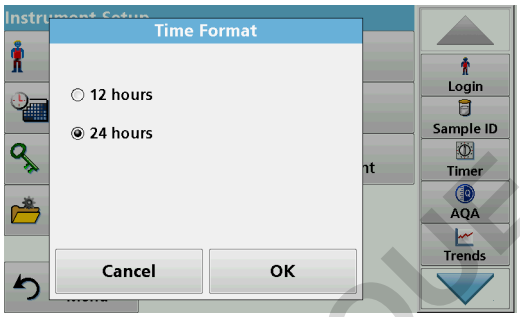
5.2.5 Date and time



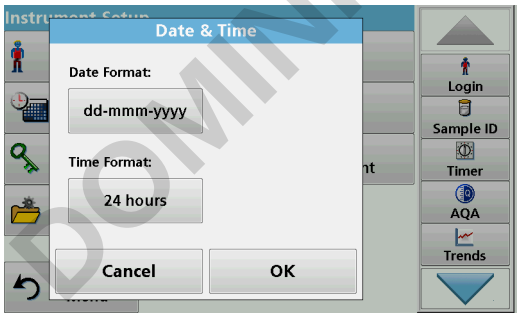
1. Press **Date & Time** in the "Instrument Setup".



2. Select a **Date Format** for the date.
3. Press **OK** to confirm the entry.

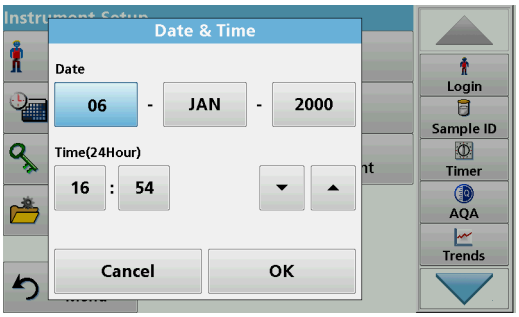


4. Select a **Time Format** for the time.
5. Press **OK** to confirm the entry.



6. Press **OK** to confirm the entry.

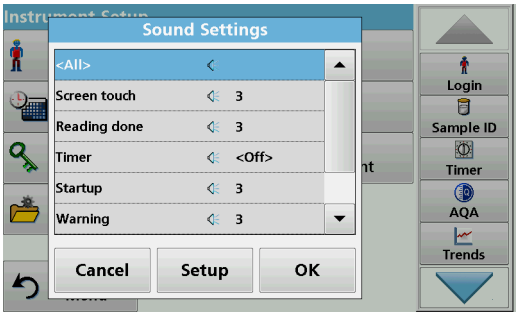
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7. Enter the current date and time. Change the information using the arrow keys.
8. Press **OK** to confirm the entry.

   The instrument then returns to "Instrument Setup".

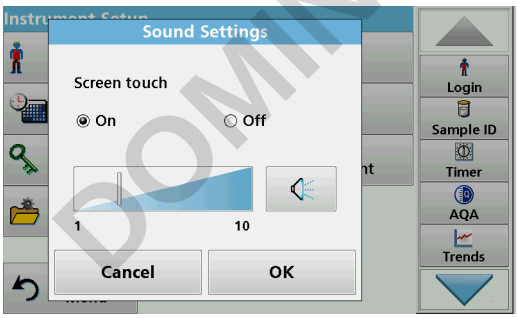
5.2.6 Sound settings



1. Press **Sound Settings** in "Instrument Setup".

The following options will be displayed:

- **All:** Activates/deactivates a sound with a variable volume for every function, with the exception of the timer.
- **Touch screen:** Activates/deactivates a short sound with variable volume every time the screen is touched.
- **Reading done:** Activates/deactivates a short sound with variable volume when the reading is done.
- **Timer:** Sets short/long sound with variable volume when timer has ended.
- **Startup**: Activates/deactivates a startup melody with variable volume when the test program is started.
- **Warning**: Activates/deactivates a short sound with variable volume if there is an error message.
- **RFID done**: Activates/deactivates a short sound with variable volume when a RFID transfer is done.
- **Shutdown**: Activates/deactivates a short sound with variable volume when shutting down.



2. Select the required action.
3. Press **Setup** and complete the required settings.
4. Press **OK** to confirm the entry.
5. Press **OK** to confirm the entry.

   The instrument then returns to "Instrument Setup".

5.2.7 PC and printer

The DR 3900 features an Ethernet port and two USB ports on the rear of the instrument, as well as one USB port on the front (refer to Figure 1 and Figure 2, page 17). These interfaces can be used for exporting data and graphics to a printer, updating data and

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transferring data to a PC and in a network. These interfaces can be used for the connection of a USB stick, an external USB keyboard or a USB Barcode handset scanner.

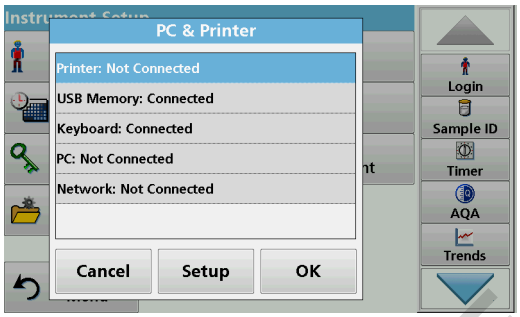
Note: *Various accessories can also be connected simultaneously using a USB hub.*

A USB memory stick is used to update data, refer to section 6.8.2, page 111.

Note: *A shielded **USB cable** must not be longer than **3 m**!*

Table 3 USB connector

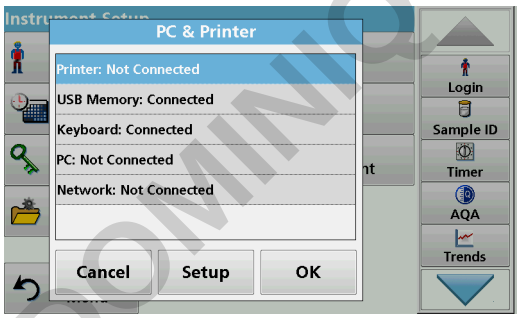
Interfaces	Description
USB (Type A)	This USB port can be used to connect a printer, a USB memory stick or a keyboard.
USB (Type B)	This USB port is only intended for the connection of the DR 3900 to a PC (with installation of the corresponding software).
Ethernet	The Ethernet port is intended for data transfer to a PC without installed software or in a local network . Only use a shielded cable (e.g. STP, FTP, S/FTP) with a maximum length of 20 m for the Ethernet port.



1. Press **PC & Printer** in "Instrument Setup".

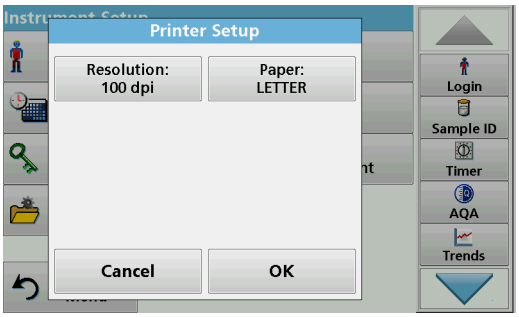
   A list with information about the connections opens.

5.2.7.1 Printer setup



2. Press **Printer**.
3. Press **Setup** to display the Printer Setup screen.

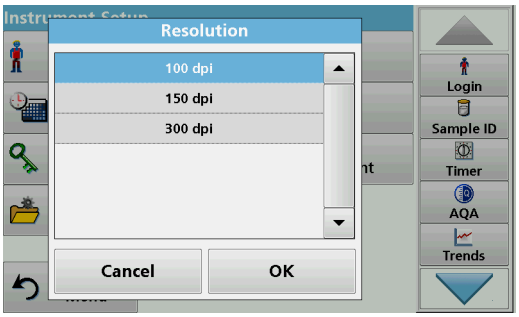
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Printer Setup:

- Resolution: Font size
- Paper: Paper size

Note: *If an optional Thermal Printer is connected, the function "Auto Send" on/off is available.*



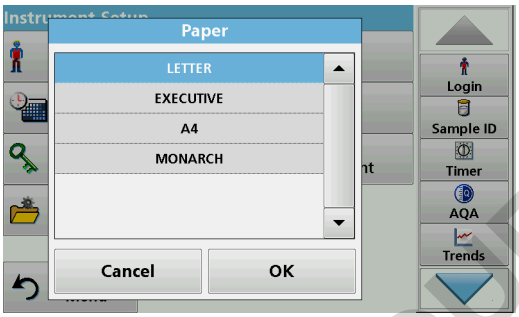
4. Press **Resolution** to select the print quality.

   Select between:

   - 100 dpi,
   - 150 dpi and
   - 300 dpi.

5. Press **OK** to confirm the entry.

Note: *Press **OK** again to return to the **"Instrument Setup"** menu.*



6. Press **Paper** to select the paper size.

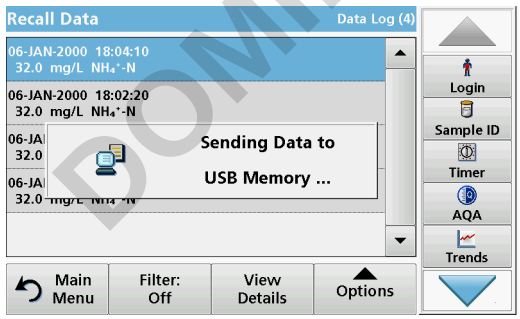
   Select between:

   - Letter,
   - Monarch,
   - Executive,
   - A4.

7. Press **OK** to confirm the entry.

Note: *Press **OK** again to return to the **"Instrument Setup"** menu.*

5.2.7.2 Print data



1. Press **Recall Data** from the Main Menu.
2. Select the data source, where the data to be printed are stored.

   A list is displayed. Data can be filtered. Refer to section 5.3.1.2, page 44 for more information.

3. Press the **Printer** icon to send the data (table, curve) immediately to the printer.
4. Highlight **Single point**, **Filtered data** or **All data** and press **OK** to confirm.

   Send data... appears on the display until the data is printed.

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5.2.7.3 Print data continuously

If all readings are to be printed out automatically straight after measurement, the use of a continuous form printer is recommended, e.g. the 4" paper thermal printer. Refer to Section 9, page 137.

1. Connect the thermal printer to a USB type A port.
2. Press **PC & Printer** in the "Instrument Setup" menu.

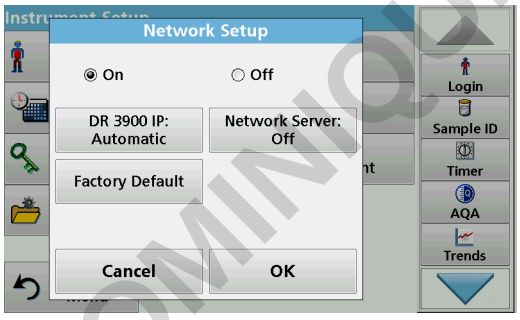
   A list with information about the connections opens.
3. Highlight **Printer**.
4. Press **Setup** to display the Printer Setup screen.
5. Select **Auto-Send: On** to send all measured data automatically to the Thermal printer.

5.2.7.4 Network setup

NOTICE

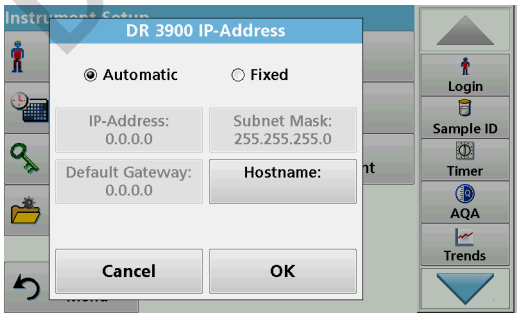
Network and access point security is the responsibility of the customer that uses the wireless instrument. The manufacturer will not be liable for any damages, inclusive however not limited to indirect, special, consequential or incidental damages, that have been caused by a gap in, or breach of network security.

The DR 3900 supports communication in local networks. To establish Ethernet communication in networks, special configuration is required. The manufacturer recommends support from a network administrator. Only use a shielded cable (e.g. STP, FTP, S/FTP) with a maximum length of 20 m for the Ethernet port. This section describes the setting options for the photometer in relation to network communication.



The connection parameters must be configured for data transfer to a PC or connection to a network.

1. Press **PC & Printer** in "Instrument Setup".
2. Press **Network>Setup**.
3. Press **On**.

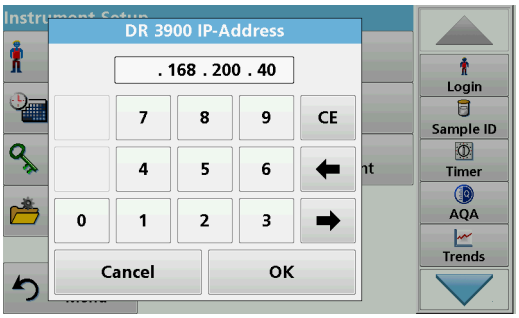


4. Press **IP address**.
   An IP address is used to send data from a sender to a pre-defined recipient.
   - If the IP for the DR 3900 is automatically issued in the network, no further settings are necessary. A hostname can optionally be assigned.
   - If the instrument address is fixed, the connection must be configured.

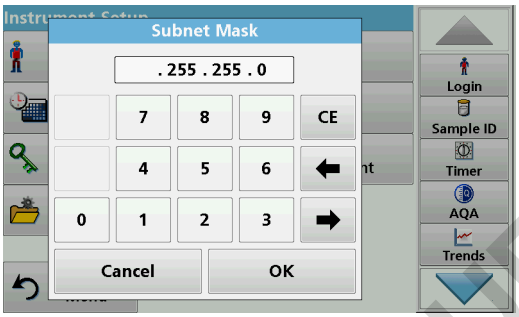
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5. Select **Fix** to configure the IP address.

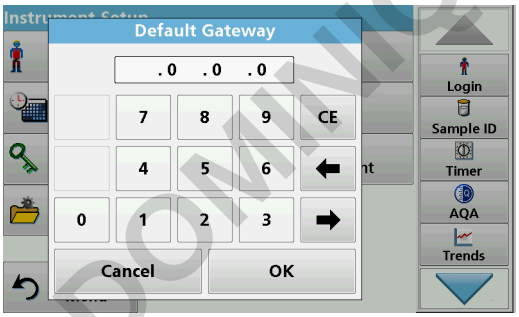


6. Press **IP address** and enter the address.



In conjunction with the IP address of an instrument, the subnet mask establishes which IP addresses are located within the local network.

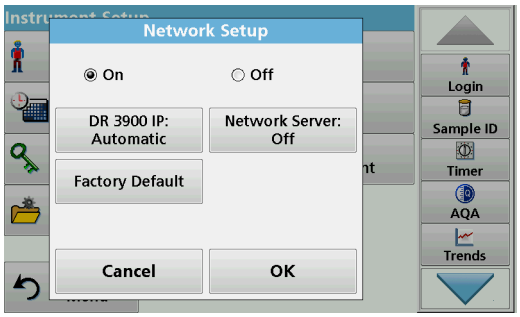
7. Press **Subnet Mask** and enter the address.



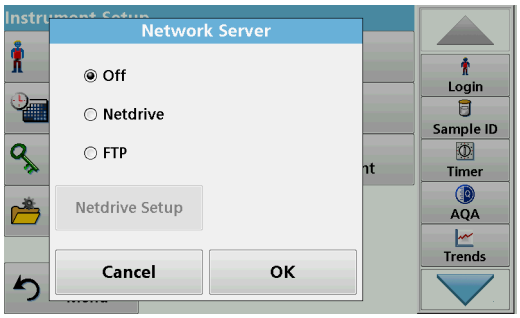
A Gateway enables data communication in networks that are based on varying protocols.

8. Press **Default Gateway** and enter the address.
9. Press **OK** to confirm the entry.

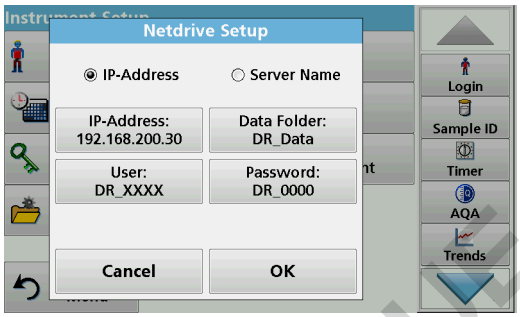
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10. Press **Network Server: <Off>** to determine the target site for the data transfer.

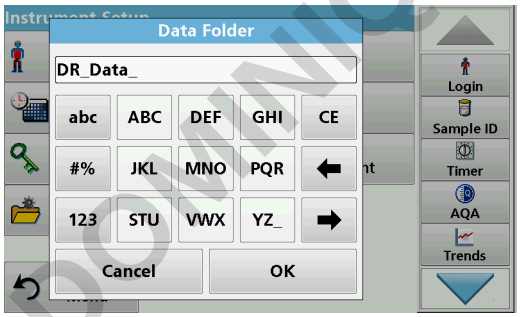


11. Select **Netdrive** and run Netdrive Setup.
Alternatively, select **FTP** and run FTP Setup.
The procedures are completely identical. As an example, Netdrive Setup is described here.



The target site can be defined by IP address or a server name.

12. Press **IP-Address** and enter the IP address or select **Server Name** and enter the server name.

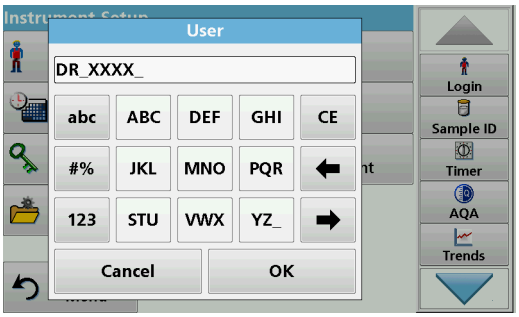


13. Press **Data Folder** and enter the target folder name.

Note: *A folder with the selected name must exist on the target system. Additionally, the folder must be shared with the operator, using the corresponding password.*

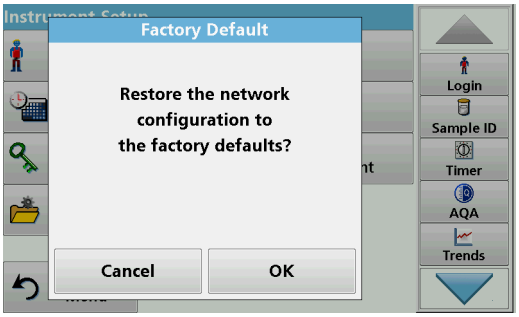
14. Press **OK** to confirm the entry.

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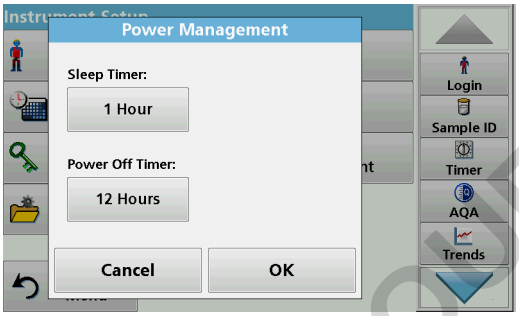
User and **password** must be identical to the settings on the target system.

15. Press **User** and enter the username.
16. Press **OK** to confirm.
17. Press **Password** and enter the password.
18. Press **OK** to confirm the entry.

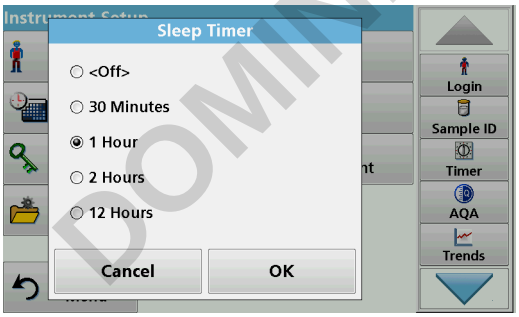


19. Press Factory Default to restore the Network Settings to the factory defaults.

5.2.8 Power Management

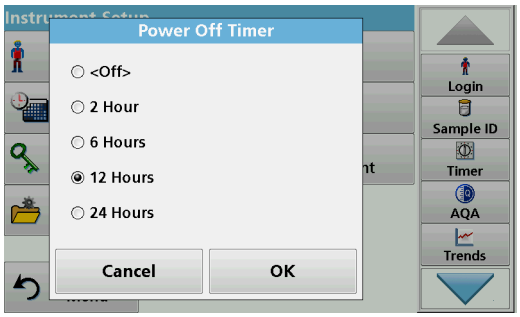


1. Press **Power Management** in "Instrument Setup".
2. Select **Sleep Timer** and press **OK**.



3. Select the required time span after which the instrument will go into energy-saving sleep mode if it is not used (refer to section 4.4, page 24), and confirm with **OK**.

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4. Select **Power Off Timer** and press **OK**.
5. Select the required time span after which the instrument will automatically be powered off if it is not used, and confirm with **OK**.
6. Press **OK** to confirm the entry.

   The instrument then returns to "Instrument Setup".

5.3 Save, recall, send and delete data

5.3.1 The data log

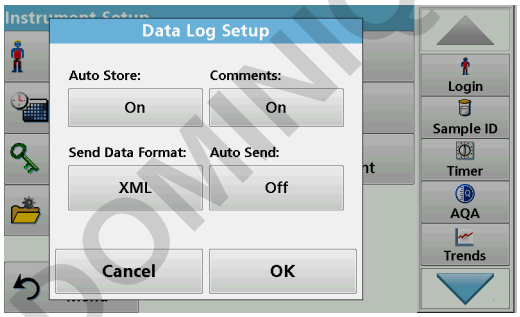
The data log can store up to 2000 readings saved by the following programs:

- Stored Programs,
- Barcode Programs,
- User programs,
- Favorites,
- Single Wavelength and
- Multi Wavelength.

A complete record of the analysis is stored, including the Date, Time, Results, Sample ID and Operator ID.

5.3.1.1 Auto/manual data storage

The data storage parameter indicates whether data is to be stored automatically or manually (in which case the user has to decide which data to store).



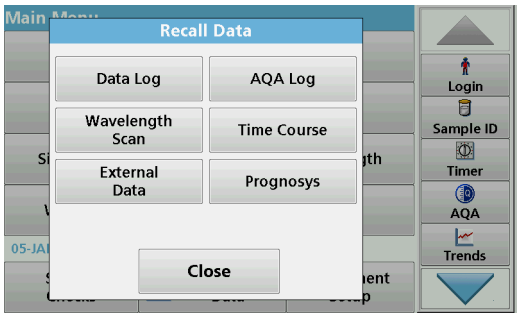
1. Press **Data Log Setup** in the "Instrument Setup" menu.
   - When the setting **Auto Store: On** is activated, the instrument will store all measurement data automatically.
   - When the setting **Auto Store: Off** is activated, the instrument will not store any measurement data. However, this setting can be changed on the results screen, via **Options>Auto Store: On**. The reading currently shown in the display is then stored.
2. Specify the output format of data to be exported using **Send Data Format**. Select **xml** or **csv**.
3. Press **OK** to confirm the entry.

   The instrument then returns to "Instrument Setup".

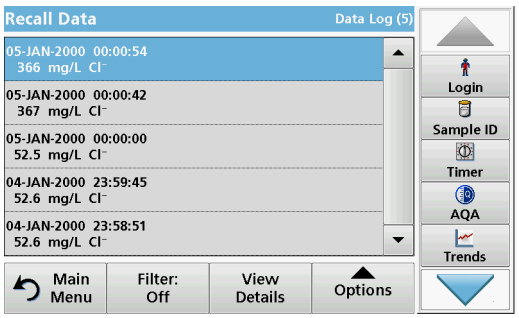
Note: *When the instrument memory (data log) is full, the oldest data is automatically deleted allowing the new data to be stored.*

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5.3.1.2 Recall stored data from the data log

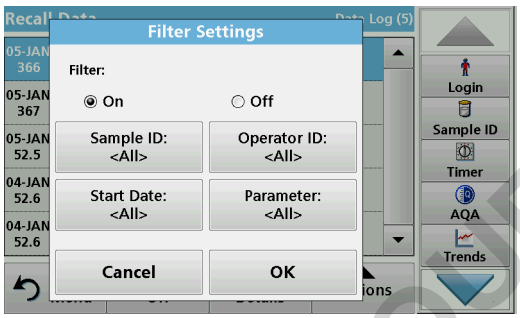


1. Press **Recall Data** in the Main Menu.



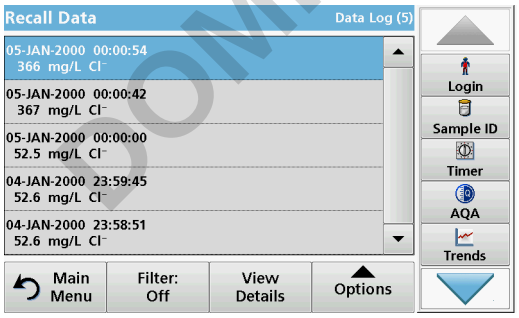
2. Press **Data Log**.

   A listing of the stored data is displayed.



3. Press **Filter: On/Off**.
   The function **Filter Settings** is used to search for specific items.
4. Activate **On**. The data can now be filtered using the following selection criteria.
   - Sample ID
   - Operator ID
   - Start Date
   - Parameter

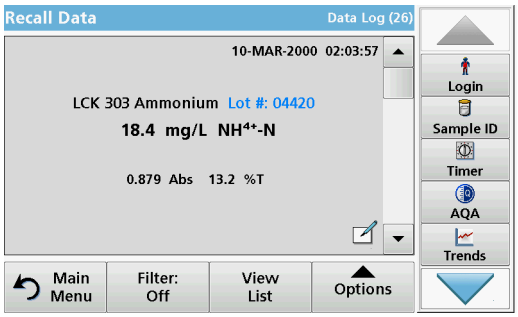
   or any combination of the four.



5. Press **OK** to confirm the selection.

   The chosen items are listed.

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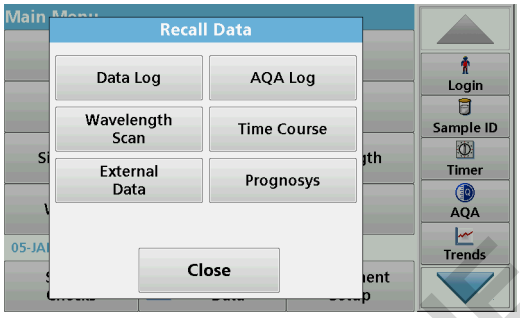


6. Press **View Details** to get more information.

5.3.1.3 Send data from the data log

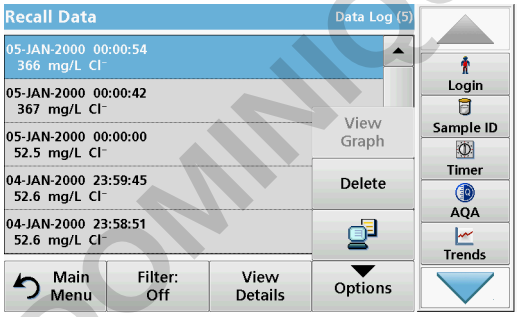
Data is sent from the internal data log as an XML (Extensible Markup Language) file or as a CSV (Comma Separated Value) file, to a directory with the name DataLog on a USB mass storage device or a network drive. The file can then be processed using a spreadsheet program. The file name has the format: DLYear-Month-Day_Hour_Minute_Second.csv or DLYear-Month-Day_Hour_Minute_Second.xml.

To send data to a printer, refer to section 5.2.7.2, page 38.



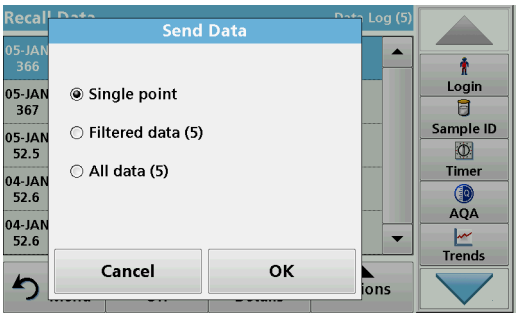
1. Plug the USB storage device into the USB type A port on the DR 3900, or connect the DR 3900 to a network drive (refer to section 5.2.7.4, page 39).
2. Press **Recall Data** from the Main Menu.
3. Select the data category to be transferred, e.g. **Data Log**.

   A list of the selected measurement data is displayed.



4. Press **Options** and then the **PC & Printer** icon.

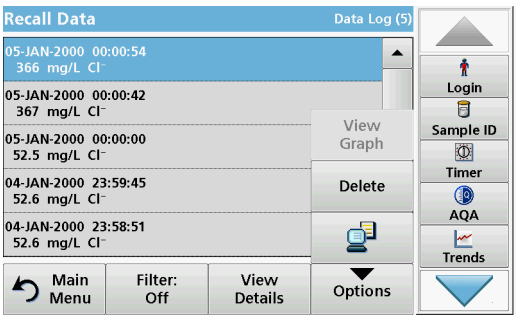
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5. Select the data to be sent.
   The following options are available:
   - **Single point**: only this selected reading will be sent
   - **Filtered data**: only readings that correspond to the set filters will be sent
   - **All data**: all data in the selected data category will be sent.
6. Press **OK** to confirm.

Note: *The number in parentheses is the total number of data sets assigned to this selection.*

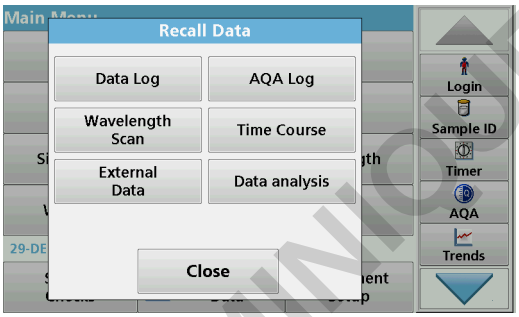
5.3.1.4 Delete stored data from the data log



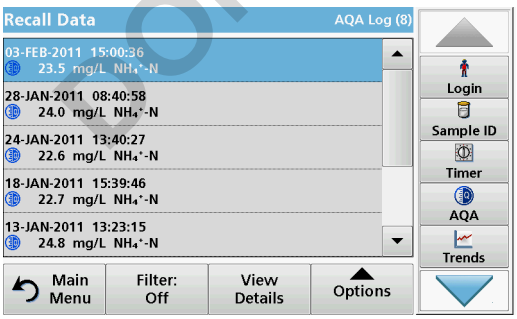
1. Press **Recall Data** from the Main Menu.
2. Press **Data Log>Options>Delete**.
3. Highlight **Single point**, **Filtered data** or **All data** and press **OK** to confirm.

   Note: *The number in parentheses is the total number of data sets assigned to this selection.*

5.3.2 Control charts for data from the AQA Log



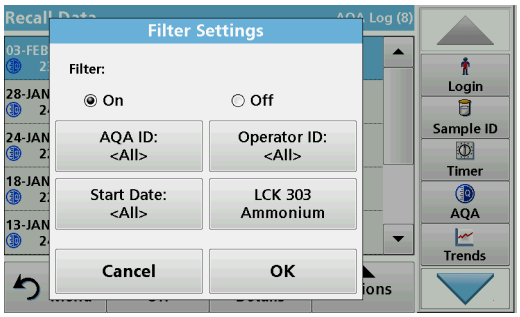
1. Press **Recall Data** in the Main Menu.



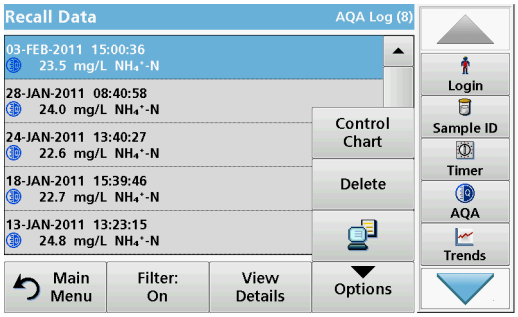
2. Press **AQA Log**.

   A listing of the stored data is displayed.

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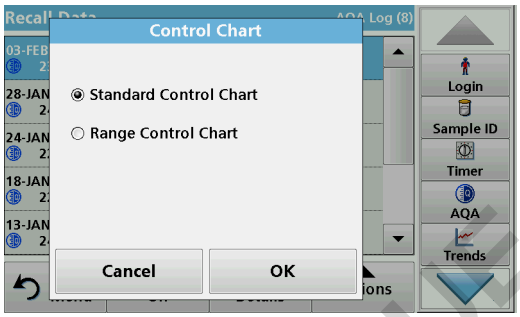


3. Press **Filter: On/Off**.
4. Activate **On**.
5. Select a required parameter.

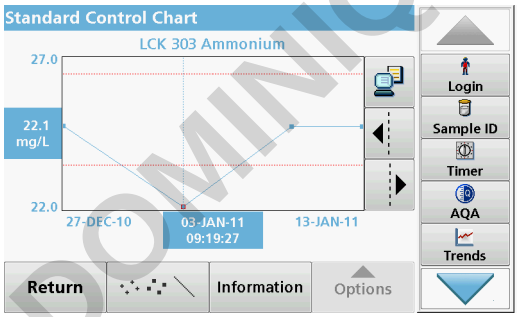


6. Press **OK** to confirm the selection.

   The chosen items are listed.
7. Press **Options>Control Chart**.

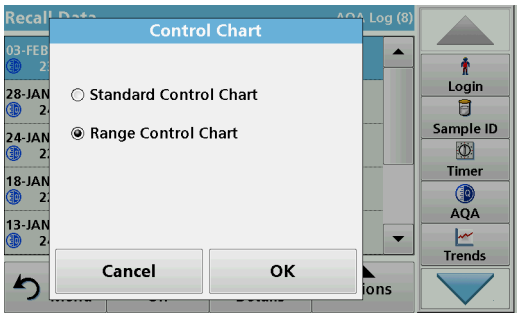


8. Press **Standard Control Chart** to choose the control chart of the selected standard.

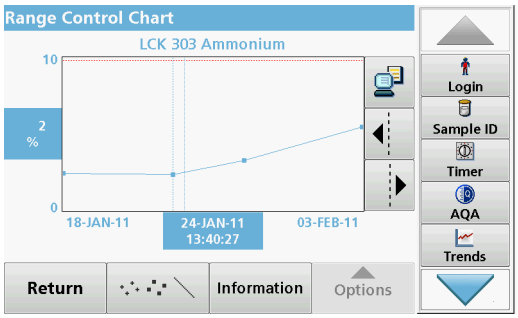


The measured standard concentrations are displayed graphically with the control limits and date.

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9. Press **Range Control Chart** to select the control chart of the range in % for multiple determinations.

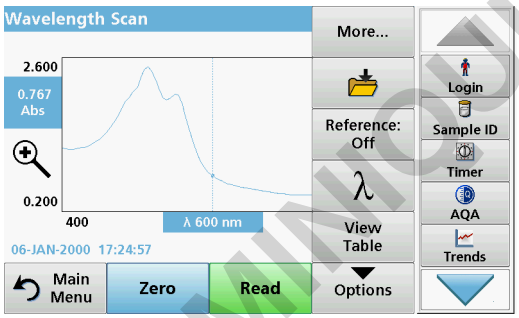


The range in % is displayed graphically with the control limits and date.

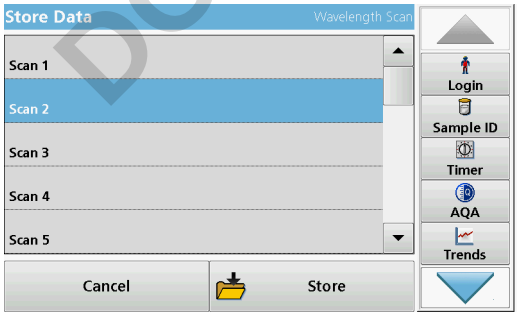
5.3.3 Store, recall, send and delete data from wavelength scan and time course

The instrument can store 20 datasets for the Wavelength Scan and 20 datasets for the Time Course. The data must be stored manually after it is displayed.

5.3.3.1 Data storage from wavelength scan or time course



1. Press the **Folder icon** in the "Options" menu after a reading is taken.



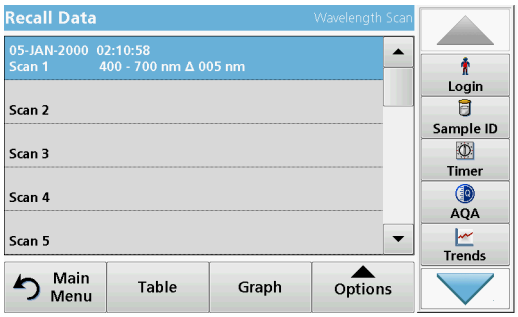
The Store Data list will be displayed.

2. Press **Store** to save the current scan to the highlighted numbered line.

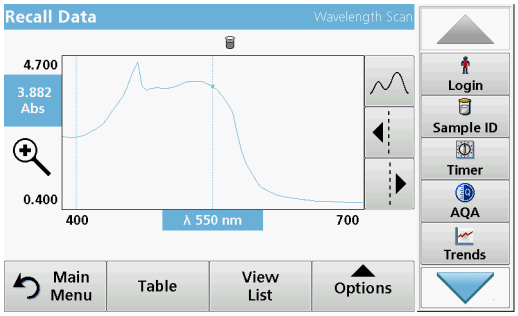
   Note: *Scans can be overwritten.*

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5.3.3.2 Recall stored data from wavelength scan or time course

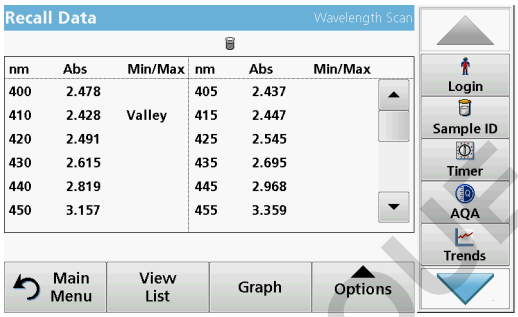


1. Press **Recall Data** from the Main Menu.
   a. Select **Wavelength Scan** or **Time Course** to recall data.
   b. If a program is already running, press **Options**>**More**>**Recall Data**.
2. Select the required data.



3. Tap on **Graph** to display details.

   Note: *Press **View Summary** to return to the "Recall Data" list.*

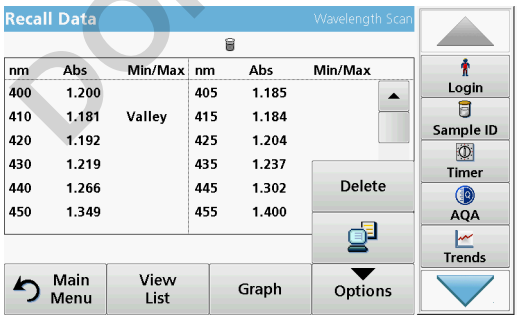


4. Press **Table** to look at the details.

   Note: *Press **View Summary** to return to the "Recall Data" list.*

5.3.3.3 Send data from wavelength scan or time course

There are two ways to recall sent data to a USB memory stick, printer or PC with Hach Data Trans.



Option 1:

1. Press **Recall Data** in the Main Menu and then **Wavelength Scan** or **Time Course**.
2. Press **Options** and then the **PC & Printer** icon to send the data to a USB memory stick, to a printer or to a PC with Hach Data Trans.
   - When a printer is connected, select how to send the data to the printer (graph, table or both graph and table).

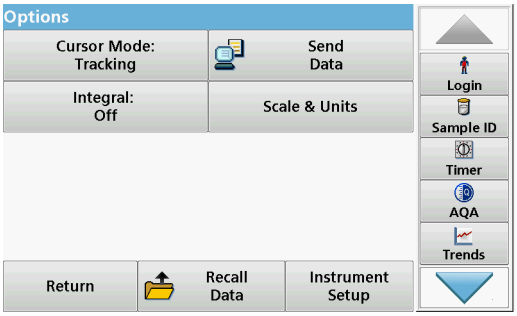
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- If a USB memory stick is connected, the files will be automatically sent to the USB memory stick as xml or csv files in the file folder "WLData (data of a wavelength scan) or "TCData" (data of a time course).

The file name will be formatted as: "ScanData_X.csv" (Wavelength Scan Data) or "TCData_X.csv" (Time Course Data).
X = number of scans (1–20).

For further processing use a spreadsheet program.

Note: *The message, "Data already present. Overwrite?" is displayed if the files are already stored. Press* ***OK*** *to overwrite the stored data.*



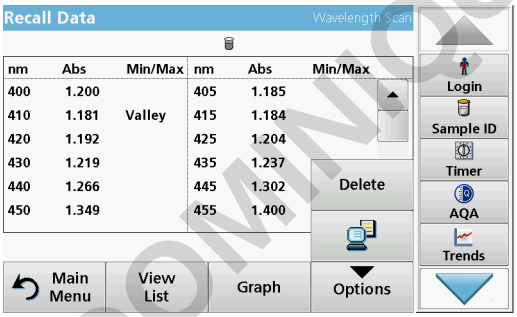
Option 2:

1. Press **Wavelength Scan** or **Time Course** and then **Options>More>Send Data** to send the data to a USB memory stick or to a printer.
   - When a printer is connected, select how to send the data to the printer (graph, table or both graph and table).
   - If a USB memory stick is connected, the files will be automatically sent to the USB memory stick as xml or csv files in the file folder "WLData (data of a wavelength scan) or "TCData" (data of a time course).

   The file name will be formatted as: "ScanData_X.csv" (Wavelength Scan Data) or "TCData_X.csv" (Time Course Data).
   X = number of scans (1–20).

   For further processing use a spreadsheet program.

5.3.3.4 Delete stored data from wavelength scan or time course



1. Press **Recall Data** in the Main Menu and then **Wavelength Scan** or **Time Course**.

   A listing of the stored data is displayed.
2. Highlight any data to delete.
3. Press **Delete** in the "Options" menu and press **OK** to confirm.

5.3.4 Data analysis

Consistent use of the sample ID function is necessary for all data analysis functions. Only data with identical sample IDs can be used in data analysis functions.

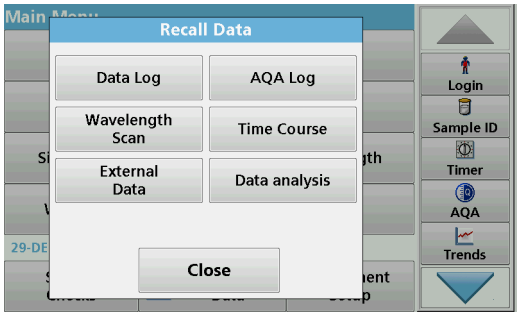
Use the **Trends** function to display a time-variation curve for the stored readings for each parameter and location. The concentration of the the corresponding parameter is shown graphically over time.

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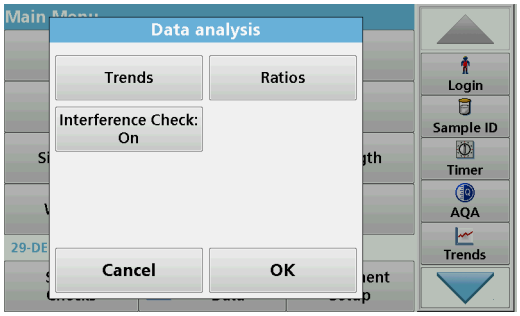
Use the **Ratio** function to monitor the parameter relationships at a particular location and display them in a graph.

Use the **Interference Check** function to display analyses with the same sample IDs and unfavourable levels of ion interference.

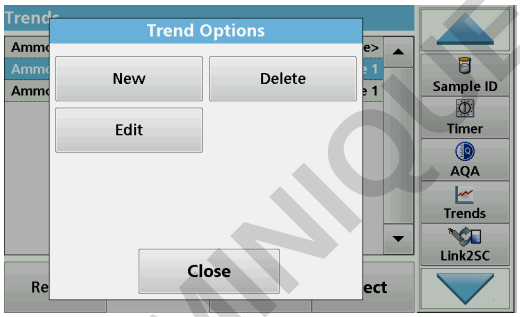
5.3.4.1 Trends



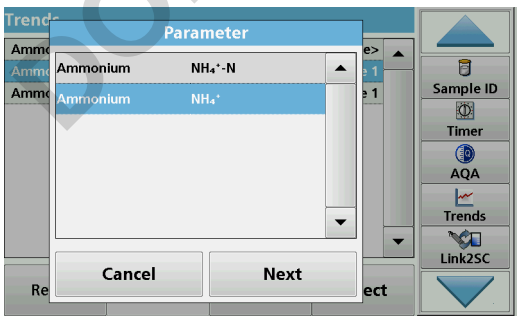
1. Press **Recall Data>Data analysis**.



2. Choose **Trends** and press **OK** to confirm.
   Alternatively, choose **Trends** from the toolbar.

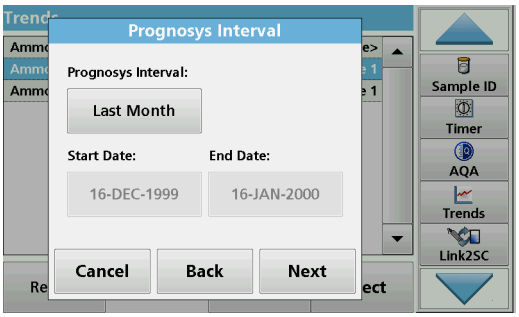


3. Press **Options>New**.

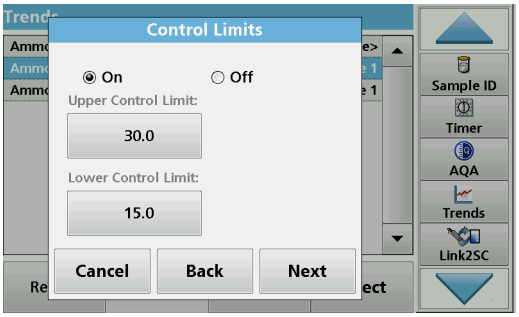


4. Select the required parameter and press **Next** to confirm.
5. Select the required sample ID and press **Next** to confirm.
6. Select the required operator ID and press **Next** to confirm.

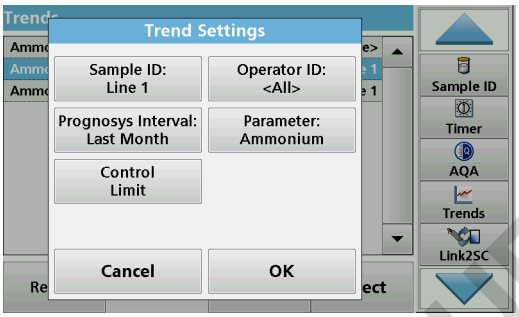
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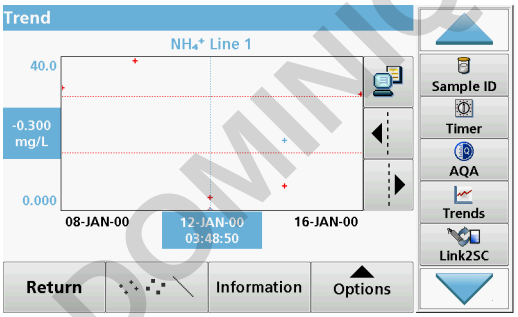
7. Select the required data analysis interval or the start and end date, and press **Next** to confirm.



8. Set an upper and lower control limit and press **Next** to confirm.



9. All of the selected functions are dispalyed in **Trend Settings**. Press **OK** to confirm.
10. Select the required trend with the created settings from the list. Press **Select**.



The trend can be displayed in several formats, as a line or a point.

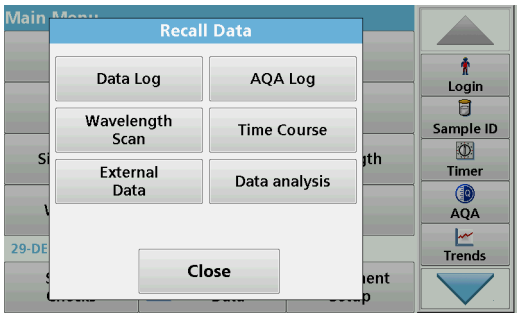
11. Select **Information** to see an overview of the parameter information.
12. Select **Options>Add Data** to add more readings to the trend.
13. Select **Options>Ratio:Off** to activate the Ratio function.

    The ratio corresponds to the first row of readings selected.

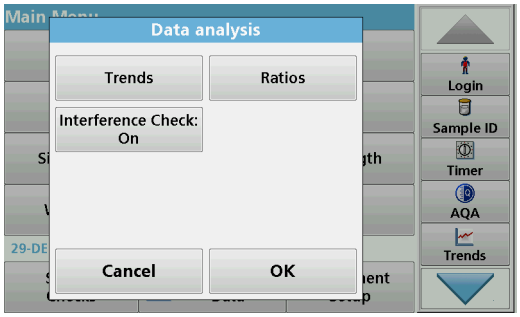
5.3.4.2 Ratios

The Ratio function is based on the precise classification of samples by their sample locations using the optional accessories "LOC 100 RFID Locator" and "RFID Sample ID Kit". The precise sample location, date and time are attached automatically. Ratio analysis calculates a ratio between two or three parameters. The last defined parameter is represented by 1. The first or second parameters are calculated as a ratio against this, e.g. 4:2:1.

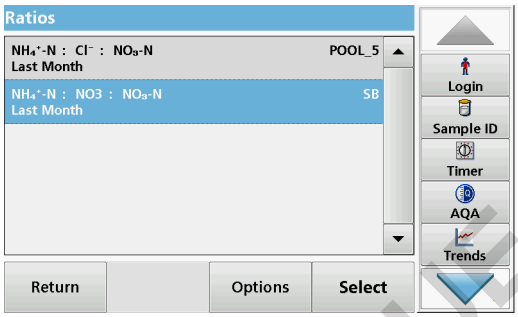
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1. Select **Recall Data>Data analysis**.

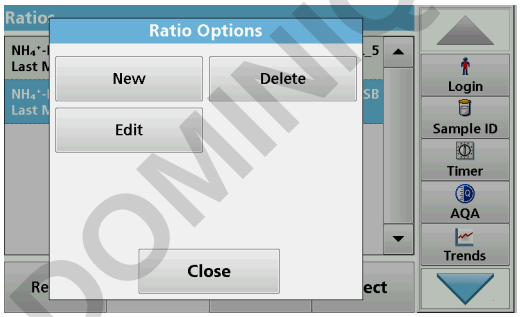


2. Select **Ratios**.



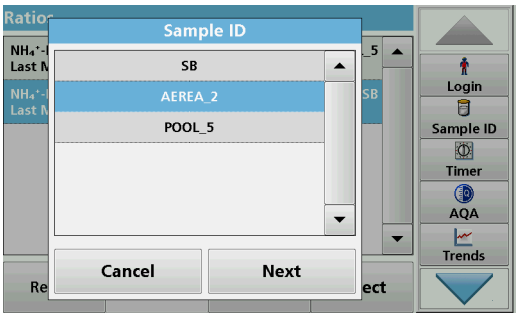
If a ratio analysis has already been carried out, a list of the defined analyses will be displayed.

3. Press **Options**.

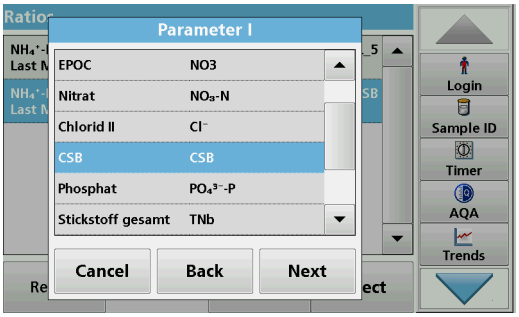


4. Press **New**, to define a new ratio analysis.

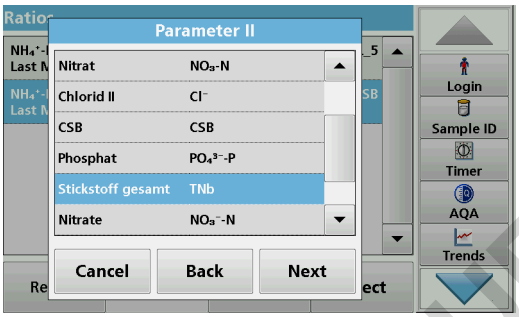
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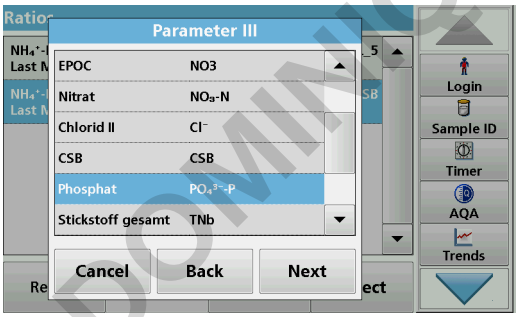
5. Select the required sample ID and press **Next** to confirm.



6. Select parameter I with the greatest concentration and press **Next** to confirm.

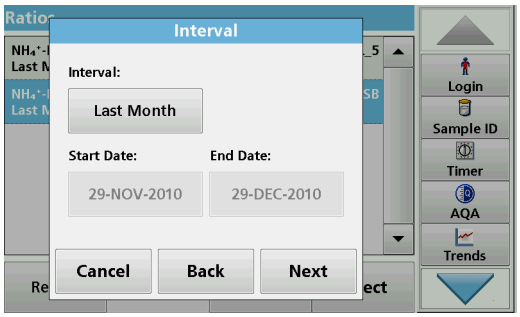


7. Select parameter II with the middle concentration and press **Next** to confirm.



8. Select parameter III with the smallest concentration and press **Next** to confirm.

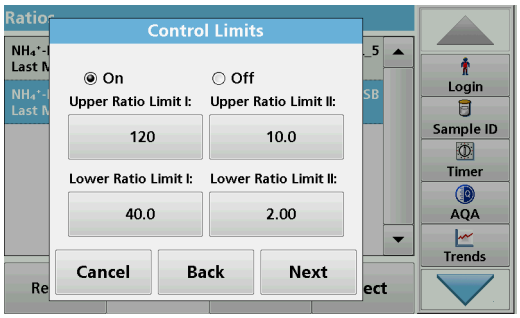
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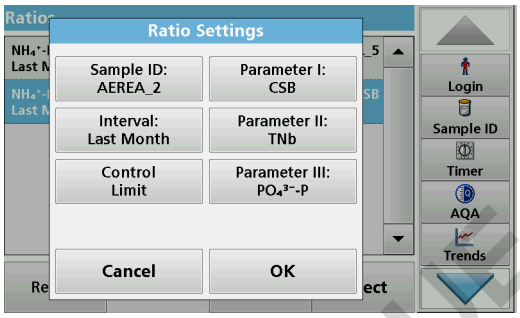
9. Select the required data analysis interval.

   It is possible to select a fixed interval and an specific customised interval with start and end dates.

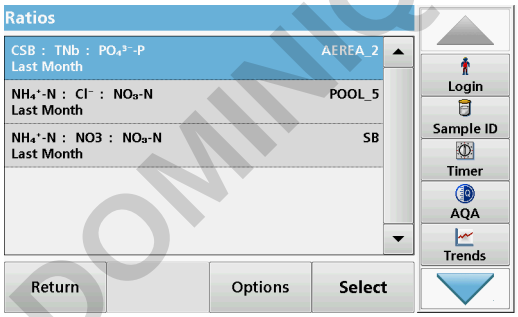
10. Press **OK** to confirm.



11. Choose an upper and lower control limit for the first and second parameters and press **Next** to confirm.



12. All of the selected functions are displayed in **Ratio Settings**. Press **OK** to confirm.



13. Select the ratio with the defined settings from the ratio directory. Press **Select**.

    A table with the defined values is shown.

    Values outside the defined limits are displayed in red.

5.3.4.3 Interference Check (not available on all models)

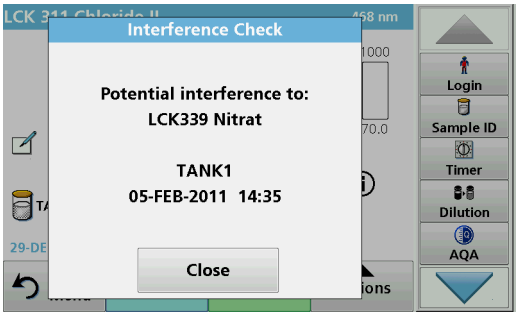
The DR 3900 automatically tests for interfering ions. Typical interferences, such as chloride for nitrate, are recognised from defined concentrations and a warning is displayed. This check is only carried out for barcode tests that are indicated with identical sample IDs.

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Example:

Analysis of ammonium with barcode test LCK303 and recording of the readings. According to the LCK303 ion interference table, nitrate concentrates > 50 mg/L will interfere with the analysis.

The instrument displays a warning if the same sample ID has a value > 50 mg/L for nitrate.

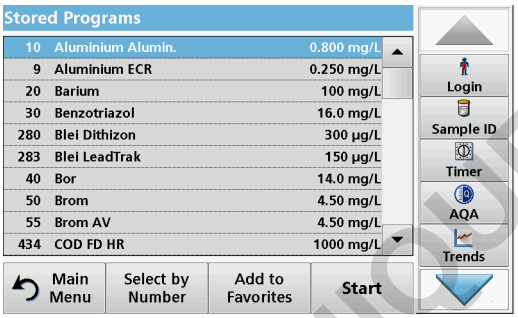


1. Select **Recall Data>Data analysis>Interference Check** to activate a check.

5.4 Stored Programs

Over 200 pre-programmed processes can be recalled via the **Stored Programs** menu. **Stored Programs** do not include any barcode tests.

5.4.1 Select a saved test/method; entering user-specific basic data



1. Press **Stored Programs** in the Main Menu to view an alphabetical list of stored programs with program numbers.

   The "Stored Programs" list will appear.

2. Highlight the required test.

   Note: *Select the program by name or scroll through the list using the arrow keys. Highlight the program or press* ***Select by No.*** *to search for a specific program number. Press* ***OK*** *to confirm.*

3. Press **Start** to run the program. The respective measurement window is displayed.

   Note: *All corresponding data (wavelength, factors and constants) is already preset.*

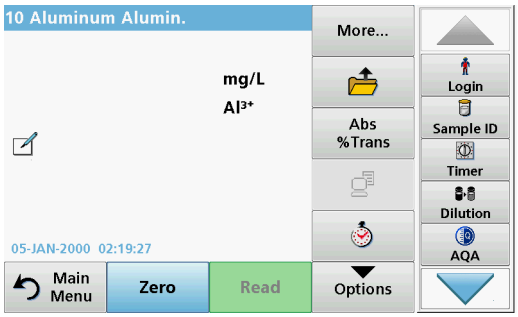
4. Follow the chemical procedural instructions. Further information is available on the website of the manufacturer.

   Note: *To display the procedural instructions in the display, press the info icon. This option is not available for all tests.*

5.4.2 Stored programs options

1. Press **Stored Programs** in the Main Menu. Select the required process and press **Start**.
2. Press **Options** to enter specific data. The following describes the options Table 4.

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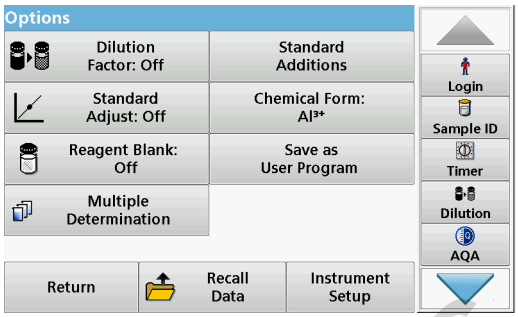


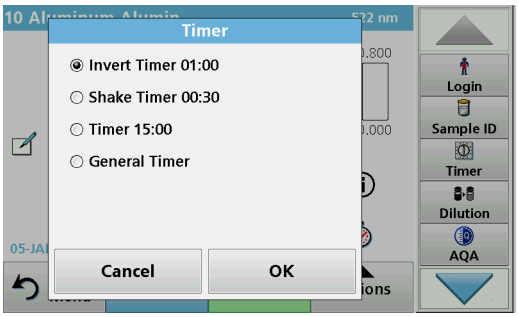
Table 4 Stored programs options

Options	Description
More	For further Options
Store Off/On	With the **Store On** setting, all measurement data is stored automatically. With the **Store Off** setting, no measurement data is stored.
% Trans/Conc/Abs	To switch to % transmittance, concentration or absorbance readings
Send Data icon / Send Data	To send data to a printer, network drive, computer or USB memory stick (USB type A or Ethernet port)
Timer icon	This functions as a stopwatch. It helps to make sure that the steps of an analysis are correctly timed (e. g. reaction times, wait times, etc., can be exactly specified). When the specified time has elapsed, a sound is emitted. The use of the timer has no influence on the reading program.
Dilution Factor Off/On	A corrective dilution factor can be entered in order to take account of certain properties. The number entered at the dilution factor prompt will be multiplied by the result to compensate for the adjustment. For example, if the sample has been diluted by a factor of 2, enter 2. The default setting of the dilution factor is turned off. ***Note:*** *When a dilution is in effect, the dilution icon will appear on the display.*
Standard Addition	This option enables the accuracy of the measurements to be checked. The procedural instructions for test parameters contain a detailed explanation of how to use this function.
Standard Adjust	The procedural instructions for test parameters indicate whether a standard adjustment is necessary and, if so, how to proceed.
Chemical Form	Some of the stored tests/methods allow selection of the chemical form and measuring range.
Reagent Blank	Some of the stored tests/methods include the "Reagent Blank" function. This enables the reagent blank value to be added to or subtracted from, the subsequent readings. The reagent blank value shifts the calibration curve along the y-axis, without changing the shape or gradient of the curve. The effect corresponds to a y-axis intercept of the calibration straight line. This is clarified by the following formula: concentration =[conc. factor) x Abs] - (reagent blank)
Save as User Program	To store the selected parameters as a User Program, refer to section 6.1, page 73.
Multiple determination	This option allows the multiple determination of a sample.
Recall Data	To recall saved measurement data or time courses, refer to section 5.3, page 43.
Instrument Setup mode	Basic data for the instrument, refer to section 5.2, page 27.

5.4.3 Use of program timers

Some procedures do not require the use of timers. Other procedures require several timers. These timers are pre-programmed into each **Stored Program**, along with a description of the activity to be performed during the timed period.

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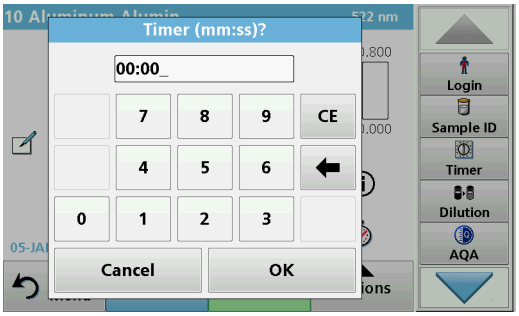
1. Press the **Timer** icon.
2. Press **OK** to start the first timer.

   The timer will count down on the screen.
3. To start the next timed activity for the Stored Program, press the Timer icon and **OK**.

   Note: *Press* ***Close*** *to view the reading screen while the timer is running. The time will be shown on the lower left side instead of the date.*

   Note: *Press* ***Cancel*** *to stop the timer midway through the countdown.*

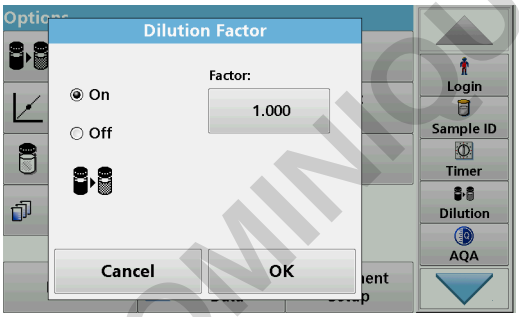
   Note: *The timer will beep when the timed interval ends.*



A general purpose timer is also available in many programs. Type the timer icon and select **General Timer**. Enter the length of the timed interval and press **OK** to start the timer. The timer will beep when the timed interval ends.

5.4.4 Set the dilution factor

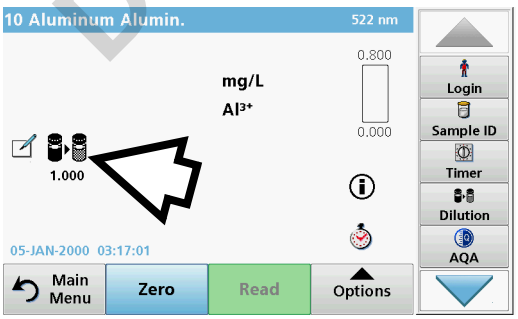
The Dilution Factor function is used to calculate the original concentration of a sample that has been diluted by a known ratio.



1. Press **Options>More…>Dilution Factor**.

   The number entered at the dilution factor prompt will be multiplied by the result to compensate for the adjustment.

   For example , if the sample has been diluted by a factor of 2, enter 2. The default setting of the dilution factor is turned off.
2. Press **OK** to confirm. Press again **OK**.



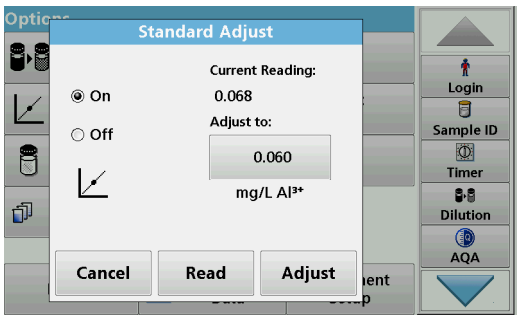
Note: *When a dilution is in effect, the dilution icon will appear on the display.*

Note: *If using undiluted samples, set the dilution factor off again.*

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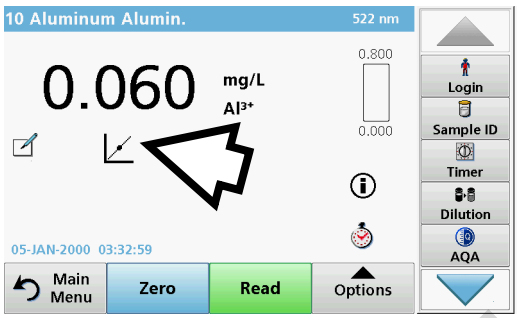
5.4.5 Run a standard adjust

The Standard Adjust functions allows the calibration curve for a stored program to be adjusted based on analysis of a known standard solution. The Accuracy Check section of written procedures often suggests a standard solution concentration for this purpose.



1. Follow the entire procedure, using a known standard for the sample.
2. After reading the concentration, press **Options>More>Standard Adjust**.
3. Press **On**.

   The "Current Reading" will show the concentration. The box on the right will show the default standard value for the test, as mentioned in the procedure.
4. To set the standard concentration, press the button and enter the new value. Press **OK** to confirm.



5. Press **Adjust** to enable the Standard Adjust. The Standard Adjust icon will appear.

   Note: *The adjustment must be within certain limits, which vary with each program. The allowable percentage is shown after "Adjustment".*

5.4.6 Set the chemical form

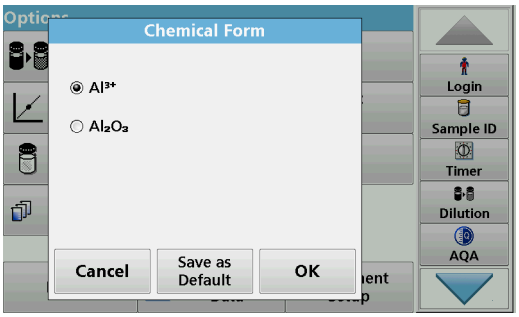
Some Stored Programs allow a variety of chemical forms tobe selected.

Press the unit (e. g. mg/L) or the chemical representation of the evaluation form (e. g. Al^{3+}). A list of available evaluation forms appear. Select the required form by pressing the corresponding entry in the list.

Note: *When exiting the program, the evaluation form reverts to the standard setting.*

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5.4.6.1 Change of the default setting of the chemical form



1. In the result display, press **Options>More>Chemical Form**.
2. A list of available evaluation forms appear. Select the new default setting.
3. Press **Save as Default.**

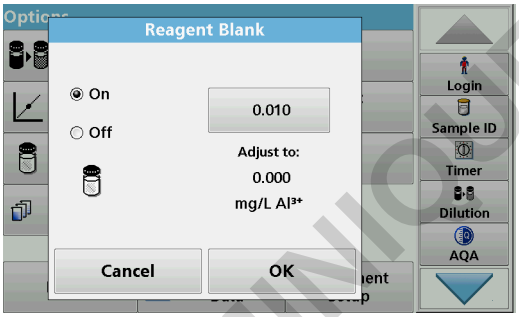
The current result and all further readings will be displayed in the new chemical form.

5.4.7 Run a reagent blank

Some of the stored tests/methods include the "Reagent Blank" function. This enables the reagent blank value to be measured and then taken into account in calculating the reading result.

Reading/analysis of a reagent blank:

1. Prepare the test corresponding to the specification/procedural instructions. Use distilled water instead of a sample to determine the reagent blank value.
2. Select the test. Insert the zero solution into the cell compartment, if required by the procedural instructions. Press **Zero**.
3. Insert the prepared sample cell into the cell compartment. Press **Read**. The result will be displayed.

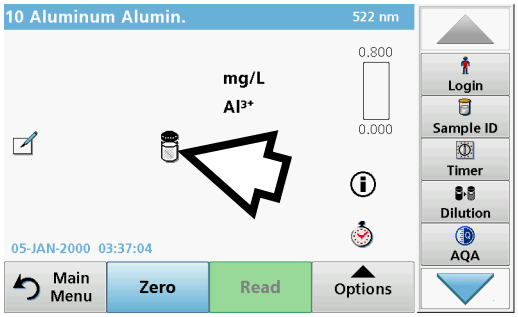


4. Press **Options>More>Reagent Blank**.
5. Press **On** to highlight the Reagent Blank function.
6. The concentration shown on the button is the reading of the reagent blank. To use this value for more analyses of this parameter, press **OK**.
7. To change the value displayed on the button, press the button. Use the alphanumeric keypad to enter the new value.
8. Next press **OK**.

Note: *The "Reagent Blank" function is deactivated when the reading program is left. To use the same blank value later for other tests using the same reagent lot, enter the value per step 7.*

Note: *The results calculated using the reagent blank value must lie within the limits of the measuring range of the test/method.*

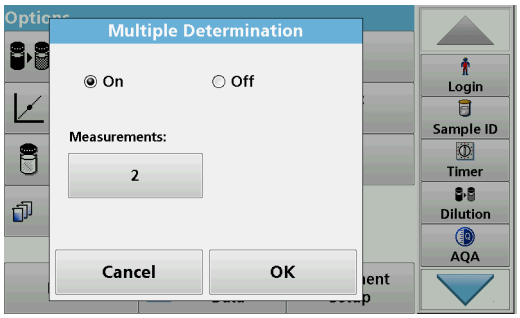
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Note: *The reagent blank icon is shown in the result display (refer to arrow) when the function is active.*

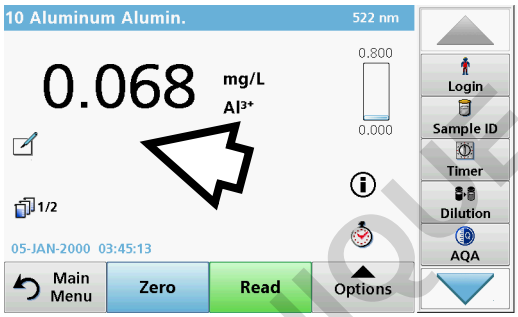
5.4.8 To carry out a multiple determination

A sample can be measured several times using the multiple determination functions.



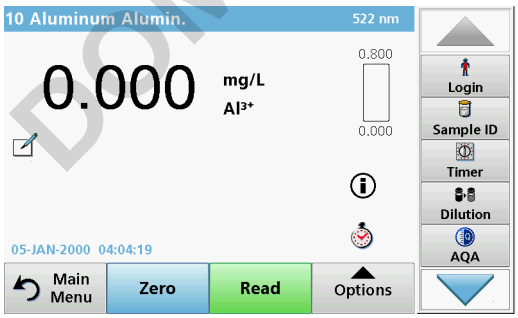
1. Before reading the concentration, press **Options>More>Multiple Determination**.
2. Press **On**.

   The number of multiple determinations is shown under "Measurements".
3. To change the value displayed on the button, press the button. Use the alphanumeric keypad to enter the new value. Press **OK** to confirm.



4. The Multiple Determination icon will be shown on the display.

5.4.9 Analysis of samples



1. Press **Stored Programs** and select a program.

   Note: *If available, the procedural instruction is indicated on the display via the Info icon.*
2. Insert the zero solution cell into the cell compartment.
3. Press **Zero**.

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4. Remove the zero solution cell from the cell compartment. Insert the sample cell into the cell compartment.
5. Press **Read**. The result will be displayed.

   Note: *To define a sample dilution, press the* ***Dilution*** *key in the toolbar.*
6. For data storage, refer to section 5.3.1, page 43.

5.4.10 Update/edit tests (not available on all models)

5.4.10.1 General advices for program update and edit

For a manual test update and for a new programming of a test, refer to section 5.4.10.2, page 62 and section 5.4.10.3, page 63.

Note: *Only in very few cases does the revision of a test require the test specifications to be updated.*

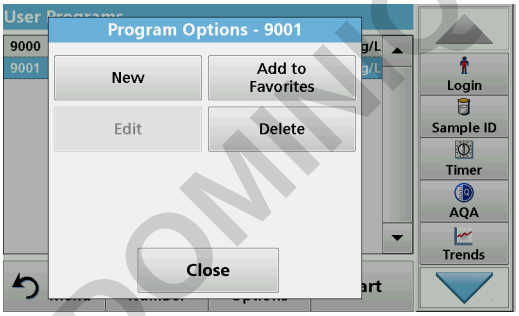
To update and edit barcode tests, refer to section 5.5.5, page 67.

5.4.10.2 Manual update of test data

When a test is selected the instrument automatically sets the reading wavelength and factors.

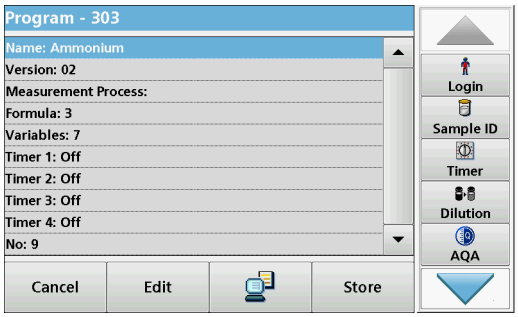
Tests are continuously reviewed for simplified handling and to make sure current legal requirements are followed. This can lead to a change in the procedural instructions or an alteration to the factors. If such an alteration is indicated on the test packaging, update the instrument data according to the data supplied on the process specification inside the test packaging.

For updating from the Internet, refer to section 5.5.5.4, page 70.



1. Press **Stored Programs** in the Main Menu and select a program.
2. Press **Program Options** and then **Edit**.

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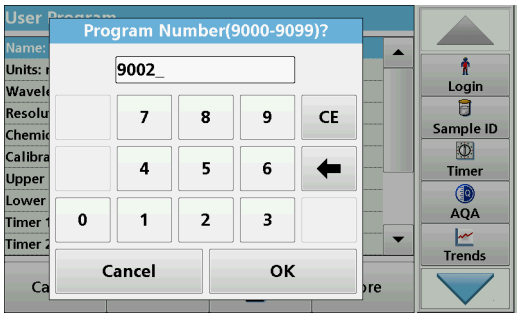


The Data list of the corresponding test will appear.

The process specification of the corresponding test contains the new data (Wavelength, Factors, reading Ranges, Conversion Factor for chemical Form etc.).

3. Highlight the corresponding line in the data overview and press **Edit**.
4. Press **OK** and then **Store** after editing the test.

5.4.10.3 Program a new test



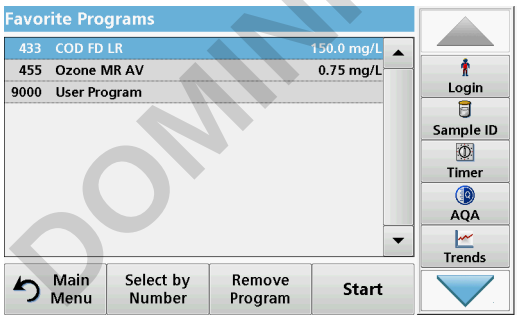
1. Press **Stored Programs** in the Main Menu.
2. Press **Program Options** and then **New**.
3. Use the alphanumeric keypad to enter the Program Number indicated in the working procedure.

   An overview of the data for the test to be programmed is displayed.

   The process specification of the corresponding test contains the new data (Wavelength, Factors, reading Ranges, Conversion Factor for chemical Form etc.).
4. Highlight the line containing the test specification that is to be programmed, then press **Edit** and enter the data in the appropriate program lines.
5. Press **OK** and then **Store** after editing the test.

5.4.11 Add stored programs to the favorite programs list

The "Favorites" menu simplifies test selection by creating a list of the most frequently used tests from the Stored Programs and User Programs.



1. Press **Stored Programs** in the Main Menu. The "Stored Programs" list will appear.
2. Highlight the selection by pressing it or **Select by Number** to search for the program by number.
3. Press **Add to Favorites** and press **OK** to confirm.

   The program can now be selected from **"Favorite Programs"** menu in the Main Menu.

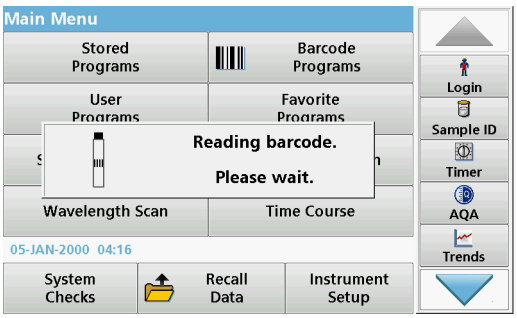
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5.5 Barcode Programs

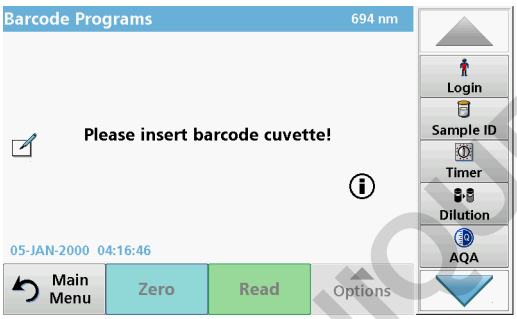
A special barcode reader in cell compartment #1 automatically reads the barcode on the 13 mm cuvette/vial as the cuvette/vial completes a single rotation. The instrument uses the barcode identification to automatically set the correct wavelength for the analysis and calculates the result immediately with the help of stored factors.

In addition, readings are recorded at 10 different positions during a rotation. A special outlier-elimination program is run and then the average of the measured values is calculated. Cell and round cell faults and contaminations are detected and therefore a very precise result is determined.

5.5.1 Perform a barcode test

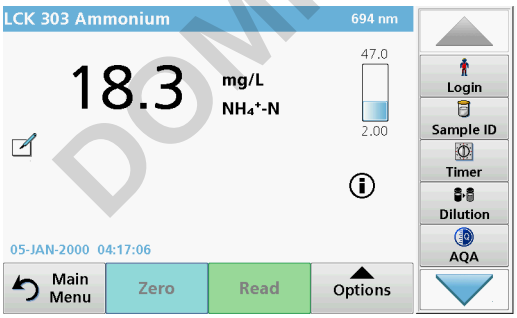


1. Insert the light shield into cell compartment (2).
2. Prepare the barcode test in accordance with the process specification and insert the cell in cell compartment (1).
   - When a coded cell is placed in cell compartment #1 (Figure 3, page 19), the corresponding reading program is automatically activated in the Main Menu.



- Otherwise, press **Barcode Programs** in the Main Menu and insert a zero cell (depending on process specification) into cell compartment (1).

Note: *For further information about the Help Guide ("Information" icon), refer to Appendix A, page 141.*



The measurement is started automatically and the results are shown.

Note: *To define a sample dilution, press the* ***Dilution*** *key in the toolbar.*

To evaluate other cell tests and other parameters, insert the prepared cell into the cell compartment and read off the result.

Note: *The control bar displayed on the right of the screen shows the relationship of the reading result to the measurement range. The black bar shows the measured result independently of any dilution factor that was entered.*

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5.5.2 Select the chemical evaluation form

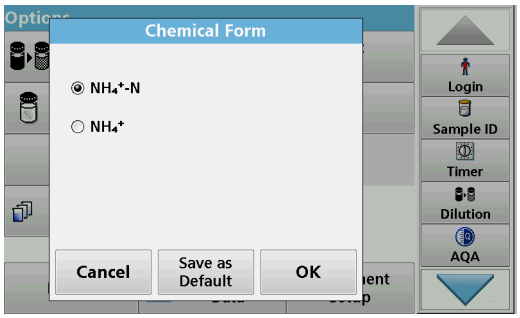
The chemical form of the test result of a number of parameters can be selected individually.

1. In the result display, press the unit (e. g. mg/L) or the chemical representation of the evaluation form (e. g. PO_4^{3-}–P).

   A list of available evaluation forms appears.

2. Select the required form from the list. Press **OK** to confirm.

Another way of changing the standard setting is:



1. In the result display, press **Options>More>Chemical Form**.

   A list of available evaluation forms appear.

2. Select the required chemical form and press **OK** to confirm.

   Note: *The selected chemical form is displayed, but does not become the default. To change the default, refer to section 5.5.2.1.*

5.5.2.1 Change of the default setting of the chemical form

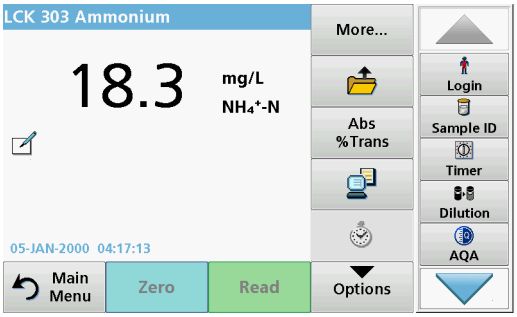
1. Insert the zero cell or sample cell (corresponding to the process specification) into the cell compartment.
2. In the result display, press **Options>More>Chemical Form**.
3. A list of available evaluation forms appear. Select the new default setting.
4. Press **Save as Default**.

The current result and all further readings will be displayed in the new chemical form.

5.5.3 Basic test-specific and sample-specific data settings

Press **Options** to change test or sample specific settings.

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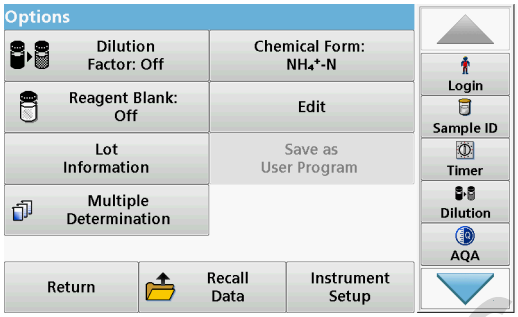
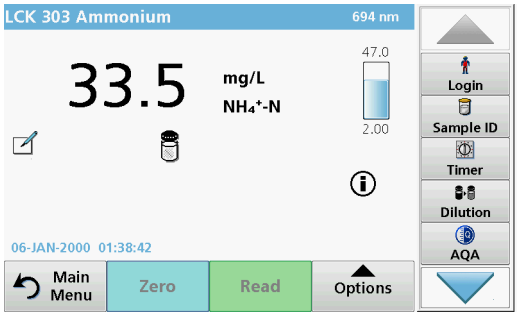


Table 5 Barcode program options

Options	Description
More	For further Options
Store Off/On	**Store: On** stores all measurement data automatically **Store: Off** does not store any measurement data.
Abs % Trans	To switch to % transmittance or absorbance readings
Send Data icon / Send Data	To send data to a printer, computer or USB memory stick (USB A) or network.
Timer icon	This functions as a stopwatch. It helps to make sure that the steps of an analysis are correctly timed (e. g. reaction times, wait times, etc., can be exactly specified). When the specified time has elapsed, a sound is emitted. The use of the timer has no influence on the reading program.
Dilution Factor Off/On	A corrective dilution factor can be entered in order to take account of certain properties. The number entered at the dilution factor prompt will be multiplied by the result to compensate for the adjustment. For example, if the sample has been diluted by a factor of 2, enter 2. The default setting of the dilution factor is turned off. ***Note:*** *When a dilution is in effect, the dilution icon will appear on the display.* ***Note:*** *If undiluted samples are used, set the dilution factor off.*
Chemical Form	Some of the stored tests/methods allow selection of the chemical form and measuring range.
Reagent Blank	The function "Reagent Blank" is available for several barcode tests. This enables the reagent blank value to be added to or subtracted from, the subsequent readings. The reagent blank value shifts the calibration curve along the y-axis, without changing the shape or gradient of the curve. The effect corresponds to a y-axis intercept of the calibration straight line. This is clarified by the following formula: concentration =[conc. factor) * Abs] - (reagent blank)
Edit	To modify an existing program
Lot information	All relevant manufacturing data is stored here.
Save as User Program	To store the selected parameters as a User Program, refer to section 6.1, page 73.
Multiple determination	This option allows the multiple determination of a sample.
Recall measurement data	Recall saved measurement data, wave-length scans or time courses, see section 5.3, page 43.
Instrument Setup mode	For basic instrument data, refer to section 5.2, page 27.

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5.5.4 Sample blank



Turbidity and colour in the sample matrix can falsify the results of a photometric analysis. The interference factors come from the sample or are created by reactions with the reagents.

The influence of turbidity and/or colour can be eliminated or reduced by taking a sample blank reading.

After the sample reading has been carried out, a special cell (LCW919) with the sample blank is inserted in the cell compartment. Measurement is automatic. The value of the sample measurement is then corrected through addition or subtraction of the blank value. The result is shown in the display with the Blank Correction icon.

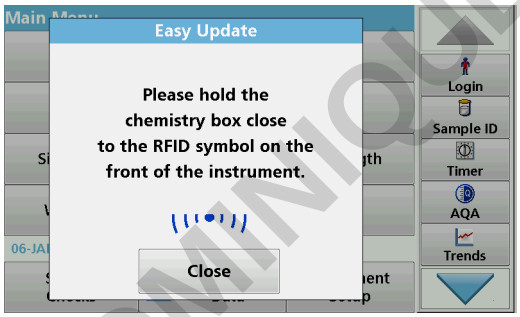
Some barcode tests do not require a sample blank value to be determined, as turbidity and colour are dealt with during the test procedure.

Note: *For further information about the Help Guide ("Information" icon), refer to* *Appendix A, page 141*.

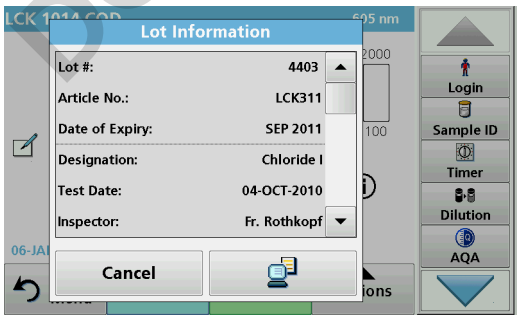
5.5.5 Update/edit barcode tests

5.5.5.1 Update barcode tests with test packaging (not available on all models)

Using the data provided in the barcode, the instrument automatically sets the reading wavelength and factors. If a deviation in barcode data from the stored data is detected, the instrument will require a data update and display the error message "Barcode control number? Update program data!" .



1. Hold the packaging of the barcode test with the RFID symbol in front of the RFID module of the instrument. A sound indicates the successful transfer of data; the test is automatically assessed



If the packaging is held in front of the RFID module a second time, the current lot information of the test is shown in the display. The test can be performed next according to the process specification.

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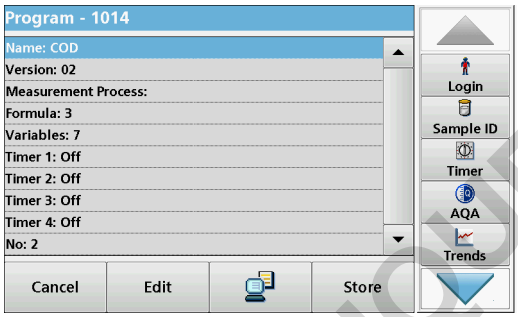
5.5.5.2 Manual update of a barcode test

Note: *Only in very few cases does the revision of a test require all test specifications to be updated.*

The various data types that determine a barcode test are described in Table 6.

Table 6 Program update options

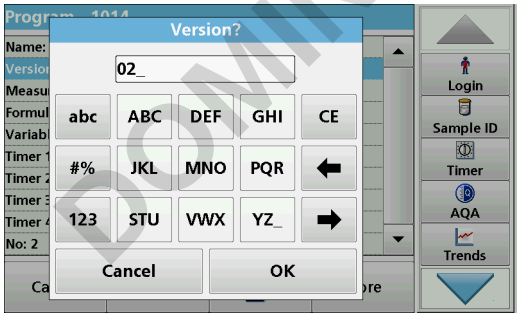
Program point	Description
Name	Name of the analysis parameter
Version	An abbreviation assigned by the user or the version number, etc. is entered here
Measurement process	Exact definition of the test: the number of wavelengths at which readings are carried out, the number of absorbance readings needed, the keys to be used, any waiting periods between readings, etc.
Formula	Definition of the evaluation formulas with which the test result is calculated
Variables	The number of variables shown in the display depends on the definition of the measurement process and the formulas. Input of the numerical values of the wavelengths, factors, constants, etc.
Timer 1, Timer 2, Timer 3, Timer 4	This function can be used to enter abbreviations and defined times for up to four timers. Highlight the corresponding line and press **Edit**. The timers are activated or deactivated with the control boxes on the left of the display. In the next column, a selection can be made from a list of names that describe the corresponding work step. In the third column, the times for each active timer are entered.



Enter the Name

Check the process specification in advance to determine whether this point needs to be changed.

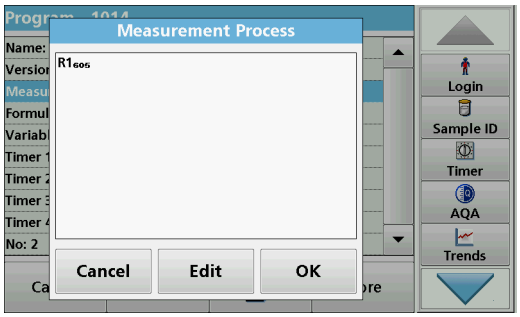
1. Highlight the line containing **Name** and press **Edit**. Use the alphanumeric keypad to enter the name indicated in the process specification.
2. Press **OK** to confirm.



Enter the Version

1. Highlight the line containing **Version** and press **Edit**. Use the alphanumeric keypad to enter the name indicated in the process specification.
2. Press **OK** to confirm.

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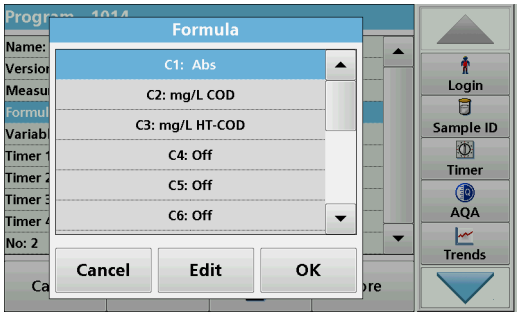


Enter the measurement process

For detailed information on entering the measurement process, refer to section 6.1.2, page 82.

Check the process specification in advance to determine whether this point needs to be changed.

1. Highlight the **Measurement process** line in the data overview and press **Edit**.
2. Press **Edit**, select the sequence to be edited and press **Delete**.
3. Press **New** and use the alphanumeric keypad to enter the process indicated in the process specification.

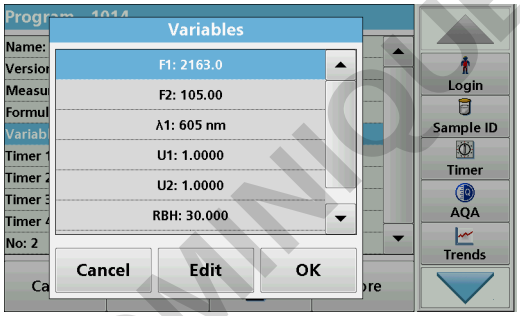


Enter the Formula, Concentration Units, Designation, Measuring Ranges

For detailed information on entering the Formula, refer to section 6.1.2, page 82.

Check the process specification in advance to determine whether this information needs to be changed.

1. Highlight the **Formula** line in the data overview and press **Edit**.
2. Select the formula; press **Edit**, and enter the data (refer to process specification) (for C1=, C2=, units, name, measurement range limits, etc.). Press **OK** to confirm the entry.



Enter the Variables (Factors, Wavelength and Coversion Factors)

For detailed information on entering the Variables, refer to section 6.1.2, page 82.

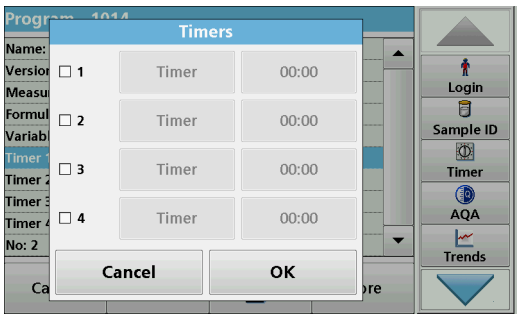
Check the process specification in advance to determine whether this point needs to be changed.

1. Highlight the **Variables** line in the data overview and press **Edit**.
2. Select the variable, tap on **Edit**, and enter the data (refer to process specification) with the alphanumeric keypad (for F1, F2, λ 1, U1 etc.). Confirm each entry with **OK**.

Abbreviation of Variables:

F1: Factor 1
F2: Factor 2
λ1: Wavelength 1
U1: Conversion factor 1 for the first chemical form
U2: Conversion factor 2 for additional chemical forms, etc.

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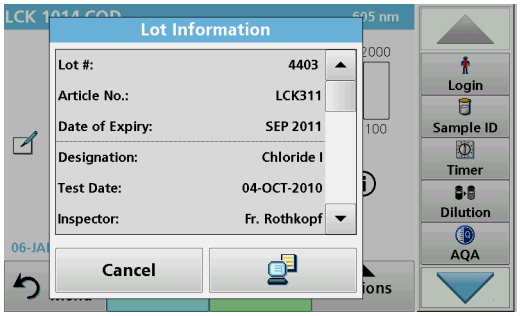
Timer 1, Timer 2, Timer 3 and Timer 4:

The timers are activated or deactivated with the control boxes on the left of the display. In the next column, a selection can be made from a list of names that describe the corresponding work step. In the third column, the times for each active timer are entered.

3. When finished programming, press **Store** and then **Cancel** to return to the "User Programs" menu.
4. Press **Start** to begin the test with the new data.

5.5.5.3 Manual check/revision of test data

If an incorrect entry was made during the data update and is not recognized via the barcode of the cuvette/sample cell (e. g. an incorrect measuring range), another option is available for checking and if necessary revising, the test data.



1. Insert the light shield in cell compartment #2.

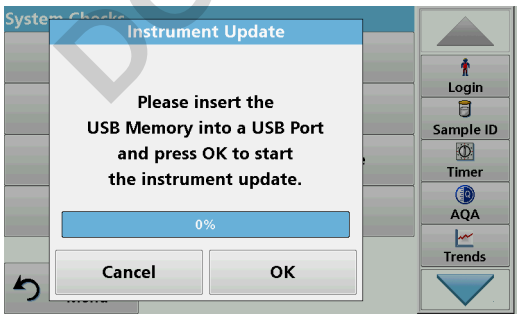
   The instrument needs to be at the "Main Menu". Alternatively, select
   Barcode Programs **in the Main Menu**.
2. Insert the zero cell or sample cell (corresponding to the process specification) into cell compartment (1).
3. Press **Options>More>Edit**.

   A data overview is displayed, with the specifications of the test that is to be revised.
4. Compare the displayed data with the data in the process specification and edit the displayed data in accordance with the process specification.

5.5.5.4 Update via the Internet

Update via USB memory stick

To obtain the software for the update from the Internet at **www.hach-lange.com**:



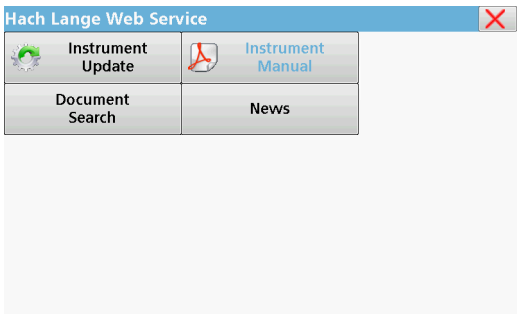
1. Go to **http://www.hach-lange.com**.
2. Select the country and go to **Download>Software**.
3. Enter **DR 3900** in "Search for documents".
4. Navigate to the corresponding file for download.
5. Open the ZIP file and save the files to the USB storage device or PC. The files must be unpacked before they are saved on the USB storage device or PC.
6. Press **Instrument Update** in the "System Check" menu.

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7. Connect the USB memory stick to the USB port (type A) on the instrument, refer to section 3.5, page 18.
8. Press **OK**. The link is established automatically and the software is updated.
9. Press **OK** to return to the "System Check" menu.

Update via the web function

1. Connect the instrument to the network via an Ethernet cable.
2. Activate the Internet connection by selecting **Instrument Setup>PC & Printer** (section 5.2.7.4, page 39).



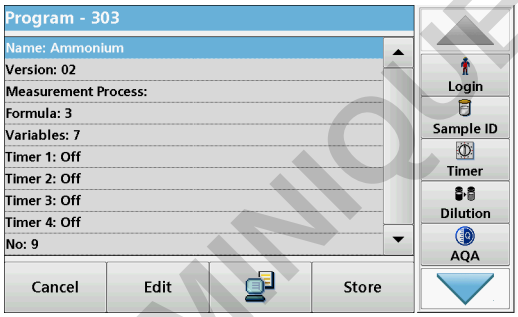
3. Press **Web Function** on the toolbar.
4. Press **Instrument Update**.

   The update will start automatically.

Note: *When the instrument software has been updated, a prompt to restart the instrument is displayed.*

5.5.5.5 Program a new test

1. The instrument needs to be at the "Main Menu" or press **Barcode Programs** in the Main Menu.
2. Insert the zero cell or sample cell (corresponding to the process specification) into the cell compartment.



   The message "Program not available" is shown, followed by a data overview with the specifications of the test that is to be revised.

   The process specification of the corresponding test contains the new data (Wavelength, Factors, Reading Ranges, Conversion Factor for chemical form etc.).

3. Highlight the corresponding line including the specifications of the test that is to be programmed and press **Edit**.
4. To finish programming, press **Store** and then **Cancel** to return to the Main Menu.
5. Press **Start** to begin the test with the new data.

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6.1 User programs

User programs provide the opportunity to complete "made to measure" analysis.

The "User Programs" database is empty when the instrument leaves the factory and is used to accommodate programs created by users for specific needs. User programs with 13 mm round cells can only be performed with the empty cells LCW906. Here are a few examples of entries:

- Programming of user-created procedures.
  The analysis procedure must be developed first, before it can be programmed. The user must define or determine the program sequences, absorbance formulas, reading wavelengths, factors, measuring range limits, etc.
- Modified tests
- Assignment of user programs to the "Favorites" menu for frequently used tests.
- Creation of a specific selection of methods and tests.

1. Select **User Programs** in the "Main Menu"
2. Select **Program Options**.

The **Program Options** menu contains several input and editing options (Table 7):

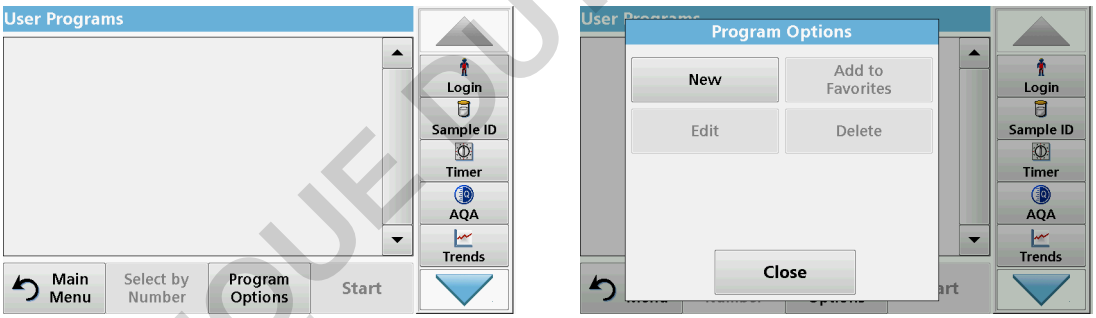


Table 7 Program options for user programs

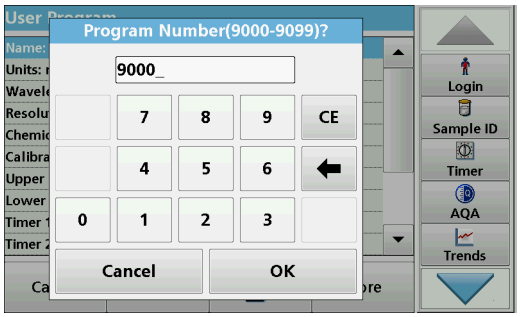
Options	Description
New	Select **New** to program a new user program. ***Note:*** *The first time* ***Program Options*** *is selected, only the* ***New*** *option is available. The other options remain inactive (grey) until the first program has been created.*
Add to favorites	Select **Add to favorites** to add an existing user program to the Favorites list.
Edit	Select **Edit** to modify an existing program
Delete	Select **Delete** to remove a program from the list of user programs. The program will be simultaneously deleted from the Favorites list.

6.1.1 Program a user method

All input steps and their significance and options are explained in the following sections.

1. Select **New** in the "Program Options" menu.

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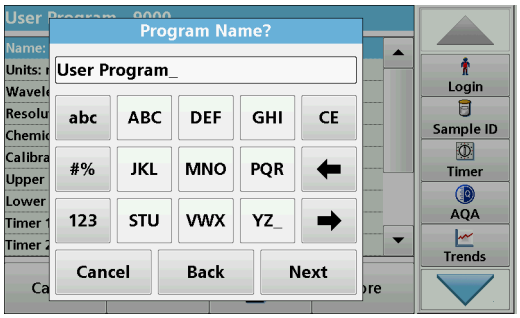


Program Number:

The program number is a specific test number, with which the program can subsequently be called up from the selection list in the **User Programs** menu or the **Favorites** menu.

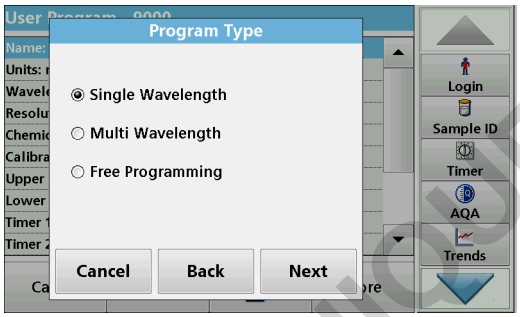
2. Use the alphanumeric keypad to enter a program number between 9000 and 9099. The lowest available number appears automatically.
3. Press **OK**.

   Note: *If a program number is already allocated to another user program, a query appears asking whether the present program is to be replaced. If* ***OK*** *is pressed, the existing program is overwritten.*



Program name:

4. Use the alphanumeric keypad to enter a program name. The name can be a maximum of 28 characters long.
5. Press **Back** to go back to the previous program point or press **Next** to continue with the input of the program data.



Program type:

6. Select the required program type (Table 8) and press **Next**.
7. If the options **Single Wavelength** (section 6.1.1.1, page 75) or **Multi-Wavelength** (section 6.1.1.2, page 76) are selected, define the programming parameters:
   - Unit
   - Wavelength
   - Calculation formula
   - Wavelength λx
   - Concentration factor Kx
   - Concentration solution
   - Chemical form
   - Calibration equation

For more information on free programming parameters refer to section 6.1.2, page 82.

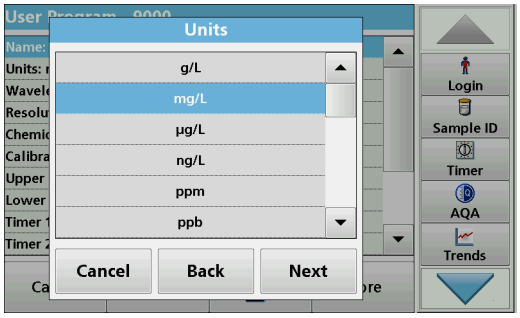
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Table 8 Program descriptions

Program type	Description
Single Wavelength	Readings at a defined wavelength
Multi Wavelength	In the Multi Wavelength mode, absorbance values can be measured at up to four wavelengths and the results can be mathematically processed to obtain sums, differences and relationships.
Free programming	A high degree of flexibility results in individual options to create a user program. The free programming is an expanded form of test or method programming.

6.1.1.1 Single wavelength settings

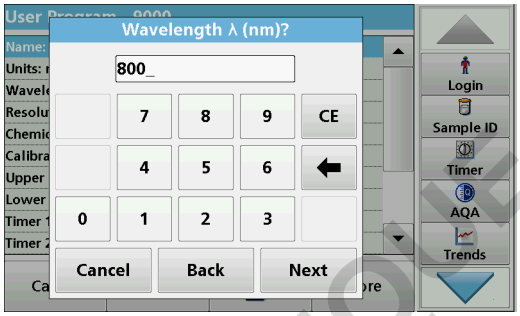
The following parameters can be defined when selecting the single wavelength mode:



Units:

1. Select the required unit from the list
2. Press **Continue**.

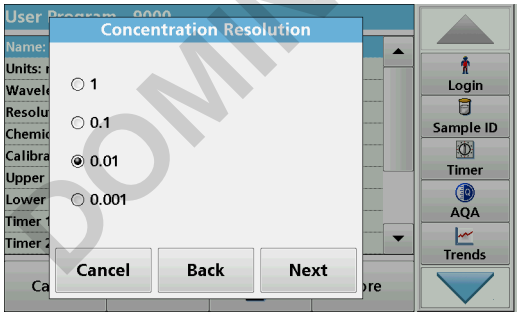
Note: *Units of measure not included in this list can be added in the edit program under* ***Program Options, Edit.*** *Select* ***Units, Edit*** *and then* ***New****.*



Wavelength (single wavelength program type):

1. Enter measured wavelength.

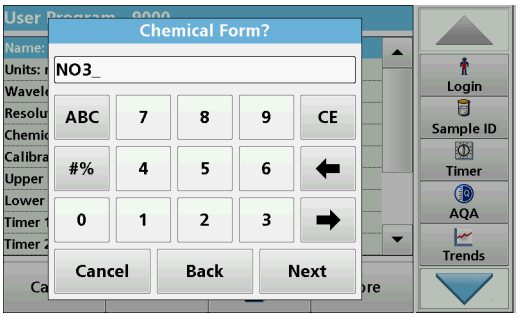
   The entered wavelength must be in the range from 320–1100 nm.
2. Press **Continue**.



Concentration resolution (number of decimal places)

1. Select the required number of decimal places to be displayed after the decimal point from the displayed list.
2. Press **Continue**.

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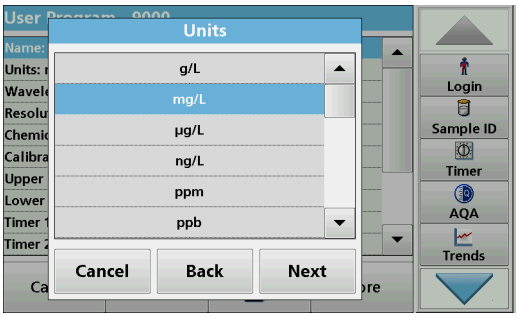


Chemical form:

1. Enter the chemical formula used in the display to represent the analysis parameter.
2. Press **Continue**.

6.1.1.2 Multi wavelength settings

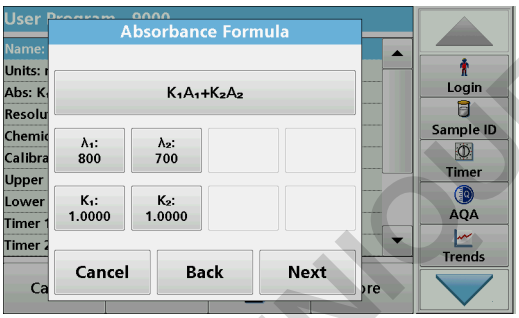
When selecting the Multi-Wavelength mode, the following parameters can be defined:



Units:

1. Select the required unit from the list
2. Press **Continue**.

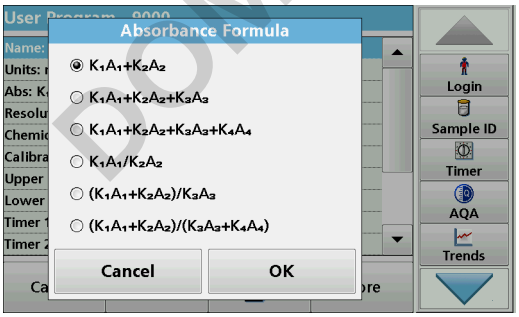
Note: *User-specific units not included in this list can be added in the edit program under* ***Program Options***, ***Edit.*** *Select* ***Units***, ***Edit*** *and then* ***New***.



Absorbance formula (Multi Wavelength program type):

Define the wavelengths and the coefficients used in the formula. The absorbance formula defines the calculation for the multi wavelength reading.

1. Press **Formula**.
2. Select the formula relevant to the programming from the displayed list.
3. Press **OK** to confirm the selection.



List of the available absorbance formulae

A_1 is the absorbance at wavelength 1,

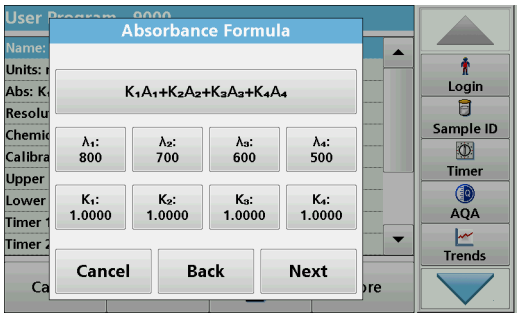
A_2 is the absorbance at wavelength 2 and so on

K_1 is the factor at wavelength 1,

K_2 is the factor at wavelength 2 and so on

If a subtraction has to be performed, the factors can be entered with a minus sign.

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Wavelength λ_x:

1. Press the λ_x buttons.

   The number of wavelengths results from the calculation formula.

2. Enter the required wavelengths.
3. If necessary, repeat until all values for the formula have been entered.

   The entered wavelengths must be in the range from 320-1100 mm.

4. Press **OK** to confirm.

Concentration factor K_x

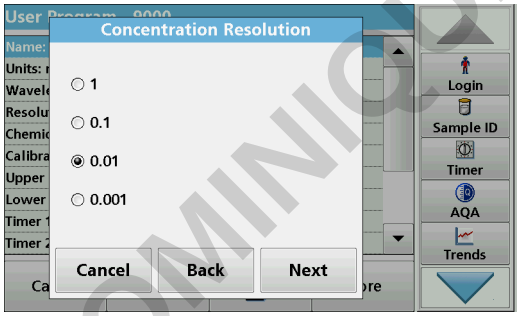
The concentration factor K_x is a multiplication factor to convert absorbance values into concentration values.

1. Press the **K_x** buttons.

   The number of the concentration factors results from the calculation formula.

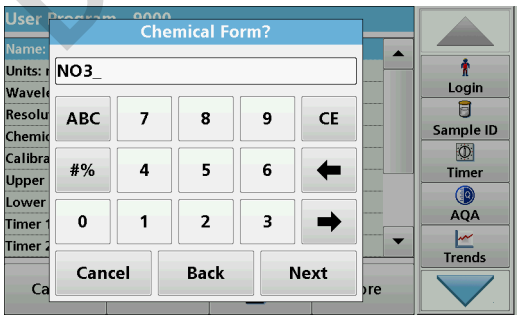
2. Enter the required factor.
3. If necessary, repeat until all the values for the formula have been entered.
4. Press **OK** to confirm.
5. Press **Continue**.

Note: *Up to 5 digit place values can be entered. A maximum of 4 decimal places are possible.*



Concentration resolution (number of decimal places)

1. Select the required number of decimal places to be displayed after the decimal point from the list.
2. Press **Continue**.



Chemical form:

1. Enter the chemical formula used in the display to represent the analysis parameter.
2. Press **Continue**.

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6.1.1.3 Calibration settings for single and Multi Wavelength mode

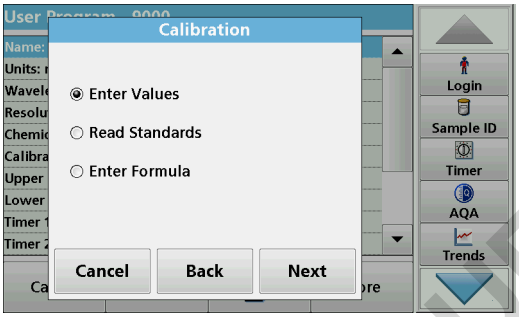
A method is calibrated by determining the absorbance values of several standard solutions of known concentration.

Create and save a calibration curve by entering **values** or **measuring standards** or **entering formulas** (Table 9).

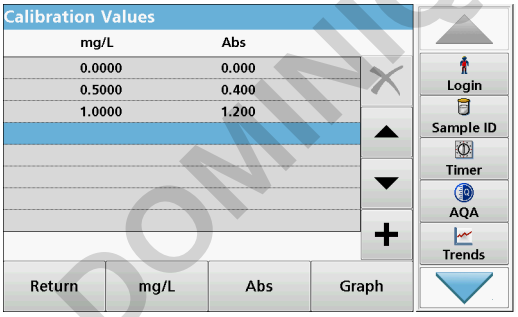
Table 9 Calibration settings

Option	Description
Enter values	Create a calibration table by entering the concentration values and the corresponding absorbance values of the standard solutions be measured. The absorbance values are applied in a diagram against the concentrations of the standard solutions. The calibration curve is graphically presented (page 78).
Measure standards	Create a calibration table by entering the concentration values of the standard solutions to be measured and then determining the corresponding absorbance values by measuring the standard solutions. The absorbance values are applied in a diagram against the concentrations of the standard solutions. The calibration curve is graphically presented (page 79).
Enter formula	If it is possible to determine the calibration curve from the mathematical relationship between concentration and absorbance through linear regression or another curve adaptation, the respective formula (linear, polynomial 2nd or 3rd order can be selected from a list and the corresponding factors can be entered (page 80).

Calibration by "Enter values"



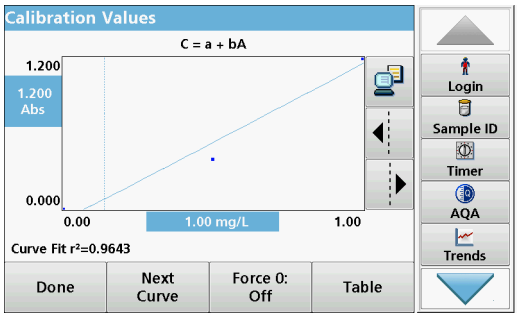
1. Select **Enter values**.
2. Press **Continue**.



3. Press **+**.
4. Enter the standard concentration.
5. Press **OK** to confirm.
6. Enter the corresponding absorbance value.
7. Press **OK** to confirm.
8. If necessary, repeat until all values have been entered.

Note: *To change a value in the table, mark the corresponding row. Press the key of the unit (e. g.* ***mg/L****) or* ***Ext****. Enter the changed value.*

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9. Press **Graph**.

   The entered data is shown as a calibration curve.

   Note: *The correlation coefficient (r^2) is shown on the left below the axes.*

   The linear equation corresponds to the standard setting.

10. Press **Next graph**.

    The presentation changes to polynomial curve of the second order.

11. Press **Next graph**.

    The presentation changes to polynomial curve of the third order.

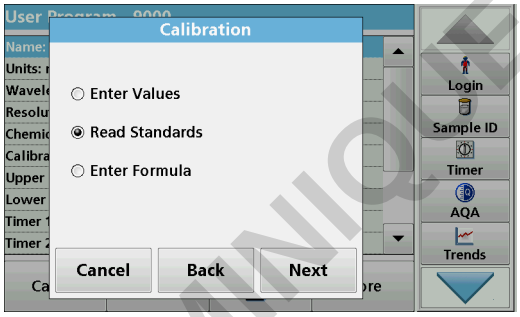
12. Press **Force 0** to change the setting from **Off** to **On**. The curve then passes through the origin of the coordinate system.

    Note: *This may have an adverse effect on the correlation coefficient (r^2).*

13. Press **Table** to return to the values table.

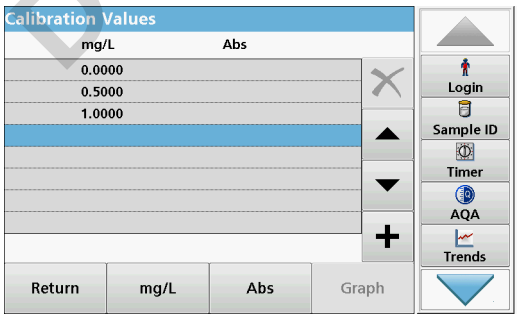
14. When the table has been completed and the curve type has been chosen, press **Done** when the graph is displayed or **Exit** when the table is displayed. Go to section 6.1.1.4, page 81.

Calibration using "Measure standards"



1. Press **Measure standards.**
2. Press **Continue**.
3. Press **+**.
4. Enter the standard concentration.
5. Press **OK** to confirm.
6. If necessary, repeat until all values have been entered. A maximum of 24 values can be entered.

   Note: *To change a value in the table, mark the corresponding row. Press the key of the unit (e. g.* ***mg/L****). Enter the changed value.*



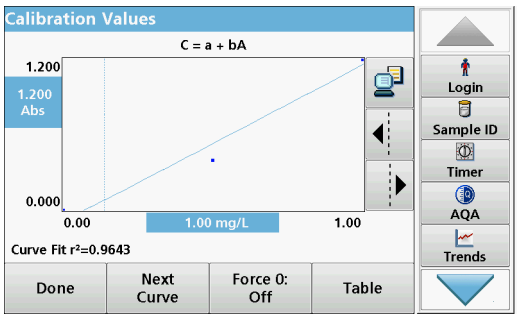
7. Insert the zero solution into the cell compartment.
8. Press **Zero**.
9. Mark the row with the first standard concentration and insert the respective cell.
10. Press **Read**.
11. If necessary, repeat until all standard solutions are measured.

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The entered and measured data is shown in the table.

Note: *To delete a standard concentration, highlight the appropriate line and press the* ***Delete*** *icon.*

The timer icon shown in the display helps to make sure, when necessary, that the steps of an analysis are correctly timed (e. g. reaction times, wait time, etc., can be exactly specified). When the specified time has elapsed, an acoustic signal is emitted. The use of the timer has no influence on the reading program.



12. Press **Graph**.

The entered and measured data is shown as a calibration curve.

Note: *The correlation coefficient (r^2) is shown on the left below the axes.*

The linear equation corresponds to the standard setting.

13. Press **Next graph**.

The presentation changes to polynomial curve of the second order.

14. Press **Next graph**.

The presentation changes to polynomial curve of the third order.

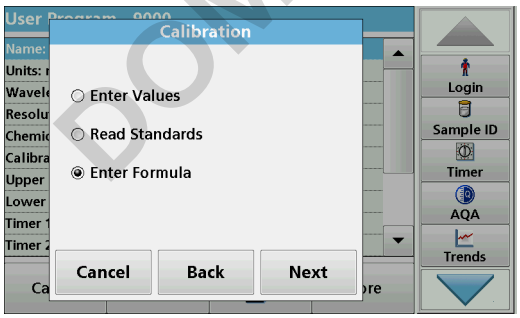
15. Press **Force 0** to change the setting from **Off** to **On**. The curve then passes through the origin of the coordinate system.

Note: *This may have an adverse effect on the correlation coefficient (r^2).*

16. Press **Table** to return to the values table.

17. When the table has been completed and the curve type has been chosen, press **Done** when the graph is displayed or **Exit** when the table is displayed. Go to section 6.1.1.4, page 81.

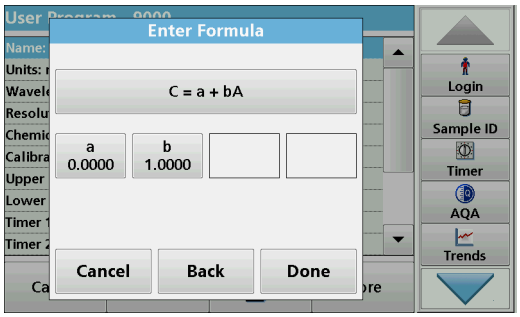
Calibration using "Enter formula"



1. Press **Enter formula.**

2. Press **Continue**.

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3. Press the Formula key.

   A list of available formulas (linear and 2nd and 3rd order polynomial order) is displayed. Up to 4 coefficients can be entered, depending on the selected formula.

4. Press the required formula.

   According to the selected formula, the required factors (a, b, c...) are shown.

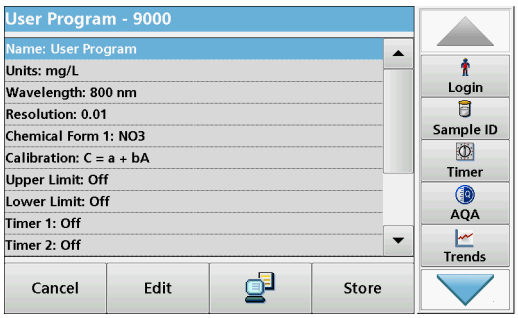
5. Press the factors keys and enter the corresponding values.

6. Press **OK** to confirm each factor entry.

   Note: *The coefficients can have 5 digits and can have a positive or a negative sign.*

7. Press **OK** to confirm.

6.1.1.4 Store a user program



The input of the basic data is complete. An overview of the variable program data is displayed.

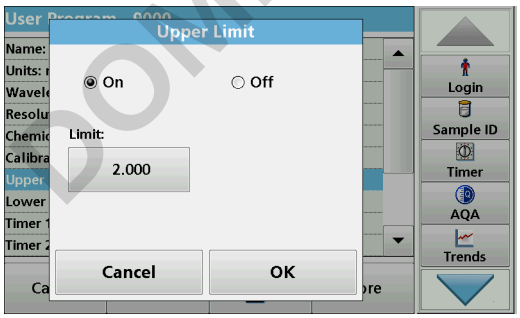
1. To enter more specifications or change existing ones, highlight the appropriate line and press **Edit**.

2. Select **Store** to save the user program.

6.1.1.5 Additional user-defined parameters and functions

In addition to the previously defined basic data, additional parameters and functions can be defined for user programs:

- measuring range upper and lower limits
- timer functions
- chemical forms



Upper and lower limits of the measuring range

It is possible to enter a maximum (upper) and minimum (lower) reading value. An error message is displayed if a reading is above the upper limit or below the lower limit.

1. Mark the **Upper limit** or **Lower limit** row.

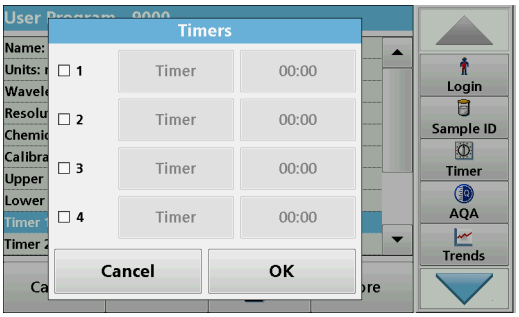
2. Press **Edit**.

3. Select **On.**

4. Press **0.000** and enter the measuring range limit.

5. Press **OK** to confirm.

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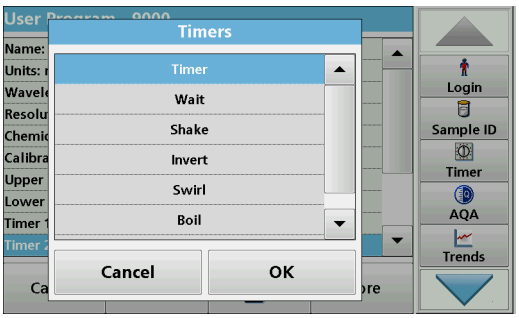


Timer 1 / Timer 2 / Timer 3 / Timer 4:

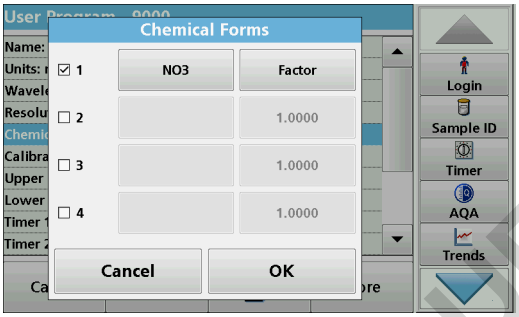
Up to four time intervals can be defined as timers with this function. Descriptions of the individual work steps, such as shaking, waiting, and stirring can be allocated to the timers.

1. Mark the **Timer x row.**
2. Press **Edit**.

   Activate or deactivate the timers using the check box in the lower area of the display.



3. Activate a timer.
4. Press **Timer**.
5. Select the designation from the displayed list that describes the respective process and confirm with **OK**.
6. Press **00:00**.
7. Enter the required time interval (in mm:ss) and confirm with **OK**.



Chemical form 2 / chemical form 3 / chemical form 4:

If a **chemical form 1** was defined, up to three additional alternative forms can be entered.

1. Mark the **Chemical form x** row.
2. Press **Edit**.

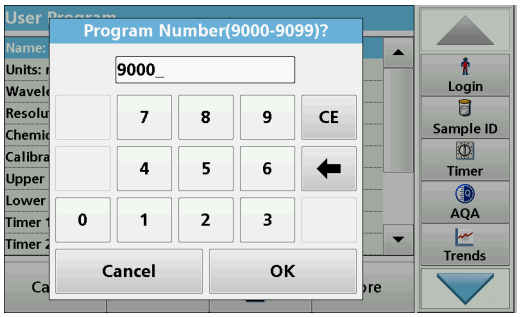
   Activate or deactivate the chemical form using the check box in the left area of the display.
3. Press the left key to enter an additional chemical form.
4. Press **OK** to confirm.
5. Press the right key to enter the conversion factor for this additional chemical form.
6. Press **OK** to confirm.
7. Press **Store** to save the program data. Press **Cancel** to return to the Main Menu.

6.1.2 "Free programming" program type

Free programming is an advanced option for entering original user-developed methods. The data overview contains the specifications of the programmed tests. Each entry option can be activated by pressing the respective row and can be changed using **Edit** (refer to Table 10).

1. Select **New** in the "Program Options" menu.

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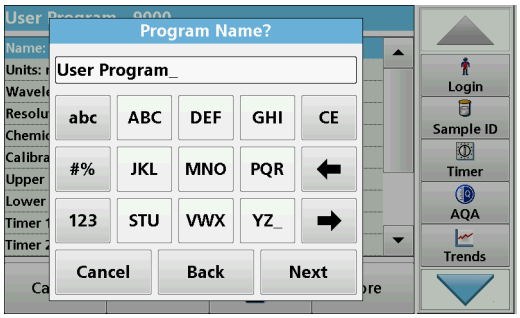


Program Number:

The program number is a specific test number, with which the program can subsequently be called up from the selection list in the **User Programs** menu or the **Favorites** menu.

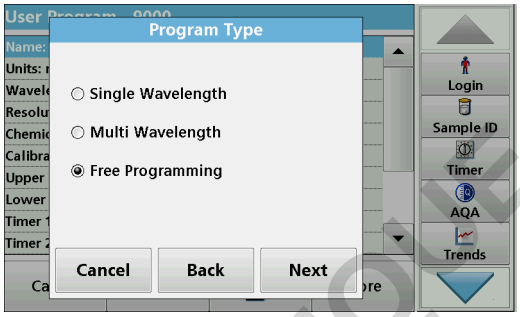
2. Enter a program number between 9000 and 9099. The lowest available number appears automatically.
3. Press **OK**.

   Note: *If a program number is already allocated to another user program, a query appears asking whether the present program is to be replaced. If* ***OK*** *is pressed, the existing program is overwritten.*



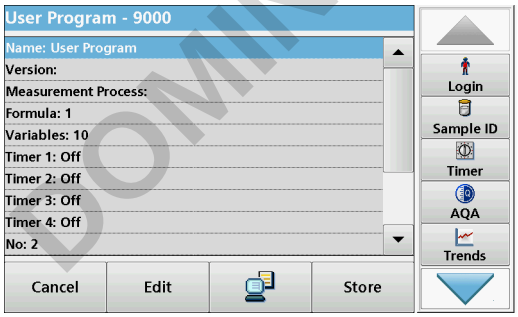
Program name:

4. Use the alphanumeric keypad to enter a program name. The name can be a maximum of 28 characters long.
5. Press **Back** to go back to the previous program point or press **Next** to continue with the input of the program data.



Program type:

6. Select **Free programming** and then press **Continue**.



7. Highlight the line containing the program point that is to be edited or defined and press **Edit**.

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Table 10 Definitions of the program points

Program point	Description
Name	Name of the analysis parameter
Version	An abbreviation or version number assigned by the user is entered here.
Measurement process	Exact definition of the test: the number of wavelengths at which readings are carried out, the number of absorbance readings needed, the keys to be used, any waiting periods between readings, etc.
Formula	Definition of the formulas with which the test result is calculated.
Variables	The number of variables shown in the display depends on the definition of the measurement process and the formulas. Input of the numerical values of the wavelengths, factors, constants, etc.
Timer 1, Timer 2, Timer 3, Timer 4	This function can be used to enter abbreviations and defined times for up to four timers. Highlight the corresponding line and press **Edit**. The timers are activated or deactivated with the control boxes on the left of the display. In the next column, a selection can be made from a list of names that describe the corresponding work step. In the third column, the times for each active timer are entered.

6.1.2.1 Measurement process

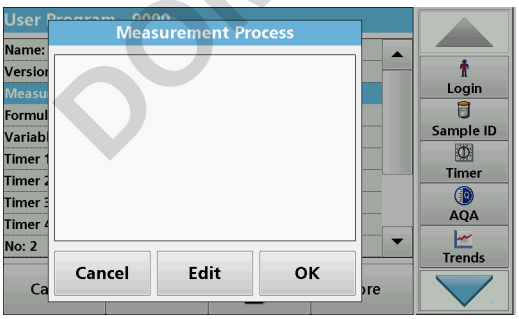
The measurement process defines the handling and the readings of the test:

- At which and how many wavelengths should readings be completed
- How many absorbance readings must be completed?
- When should the zero reading and the sample reading be completed?
- Are waiting times necessary between readings?
- Should individual program sequences be repeated?

The elements of a measuring sequence, such as zero and sample readings and the timer(s) (reaction times, waiting times, etc.) are individually defined.

6.1.2.2 Enter a new element of a measuring sequence

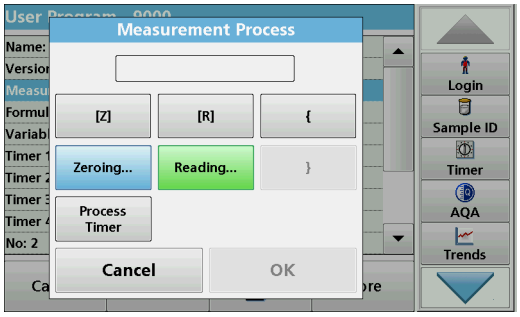
Note: *Each component of the measurement process* ***must*** *be entered in the order in which it will be completed.*



1. Mark the **Measurement process** row in the data overview.
2. Press **Edit**.
3. Press **Edit.**
4. Press **New**.

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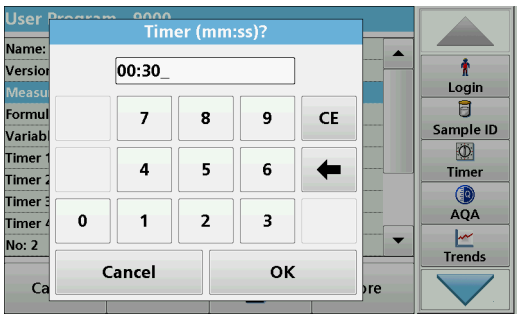
Content and definition of the keys



[Z] key / Zeroing

1. Press **[Z]** to program a zero reading.
2. Press **OK** to confirm.
3. Press **New.**
4. Press **Zeroing** and enter the wavelength for which the zero reading is to be performed.
5. Press **OK** and confirm the entry.
6. Press **OK**.
7. If zero readings are to be carried out at a number of wavelengths, repeat the steps starting with 1 for each wavelength.

   Note: *The entered reading sequence is displayed.*

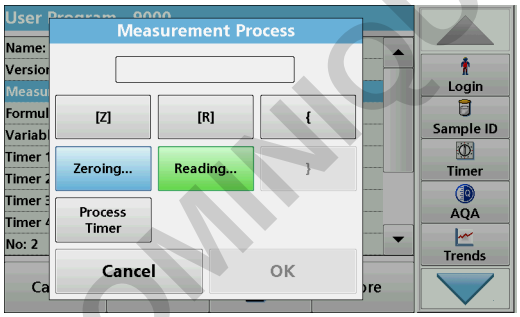


Process Timer key

1. Press **New**.
2. Press **Process timer** to enter wait, reaction or handling times.
3. Press **OK** and confirm the entry.
4. Press **OK**.

Note: *This time is integrated into the measurement process.*

Note: *The entered reading sequence is displayed.*

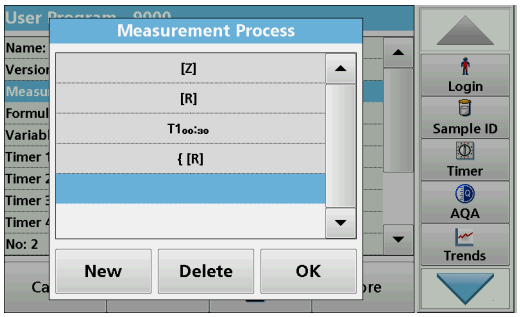


[R] key / Reading...

1. Press **New**.
2. Press **[R]** to program a reading of the substance that is to be analyzed.
3. Press **OK** to confirm.
4. Press **New.**
5. Press **Read...**and enter the wavelength for which the measurement is to take place.
6. Press **OK** and confirm the entry.
7. Press **OK**.
8. If readings are to be completed at a number of wavelengths, repeat the steps starting with 1 for each wavelength.

   Note: *The entered reading sequence is displayed.*

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Key { }

Elements of the reading sequence that are to be repeated are placed in brackets.

The left bracket **{** marks the start of the sequence to be repeated and the right bracket **}** marks the end.

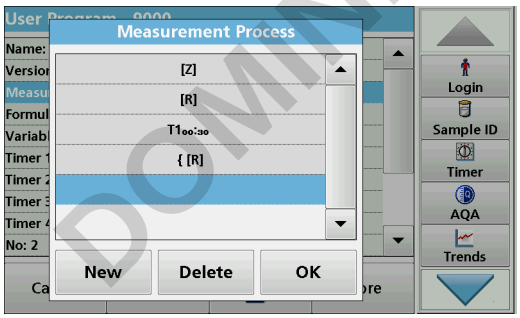
Note: *The showing the right bracket remains inactive until a left bracket is entered.*

1. To start the repetition sequence, press **New**.
2. Press **{**.
3. Press the key that defines the sequence that is to be repeated: **[Z]** or **[R]**.
4. Press **OK**.
5. Press **New.**
6. Press **Zeroing** or **Read...**, and enter the wavelength for which the measurement is to occur.
7. Press **OK** and confirm the entry.
8. Press **OK**.

   Define additional steps that are to be included in the repetition sequence.
9. At the end of the repetition sequence, press **New**.

   Define the last step that is to be included in the repetition sequence. Do **not** press OK.
10. Press **}**.
11. Press **OK**.

    Note: *If an action such as a zero reading recurs at different stages of a reading sequence, the series of actions is numbered sequentially (e. g. Z1, Z2, etc.).*



Delete an element of a measuring sequence

1. Mark the respective row.
2. Press **Delete**.

   The element is deleted.

Insertion of an element of a measuring sequence

1. Mark the row **below** the reading sequence to be inserted.
2. Press **New**.

   A new element can be entered at the selected position.
3. When the input is complete, press **OK** in the "Measurement Process" display.

   The measurement process is displayed in the overview.
4. Press **OK**.

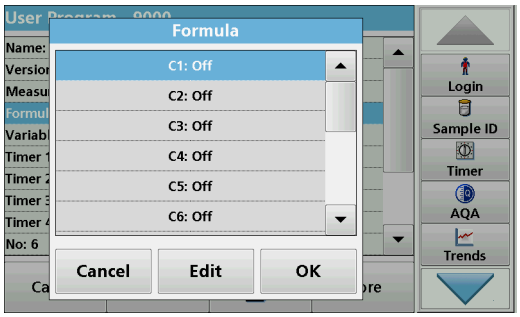
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6.1.2.3 Enter the calibration formula (evaluation formula)

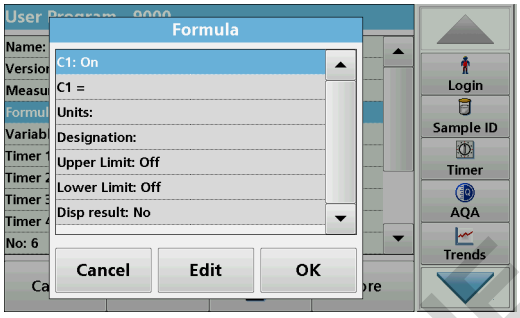
The calibration formula (evaluation formula) defines the calculation and display of intermediate and final results. The previously defined elements of the measuring sequence are the basis for calculating the concentrations.

Enter calibration formula C1

1. Mark the **Formula** row in the data overview.
2. Press **Edit**.

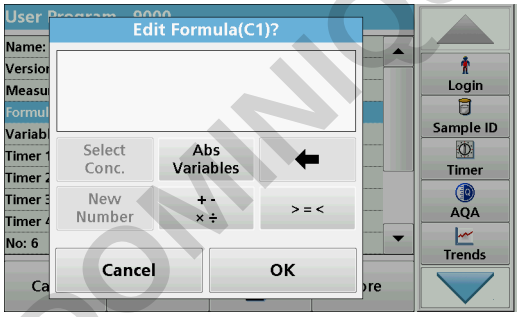


3. Mark the **C1 row: Off.**
4. Press **Edit**.



5. Mark **C1: Out.**
6. Press **Edit**.

   The display changes to **C1: On**.
7. Mark the next row **C1=**, to define the formula.
8. Press **Edit.**.



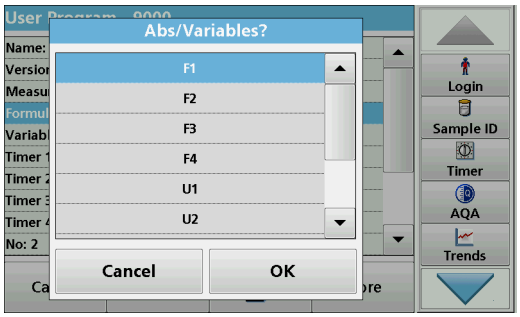
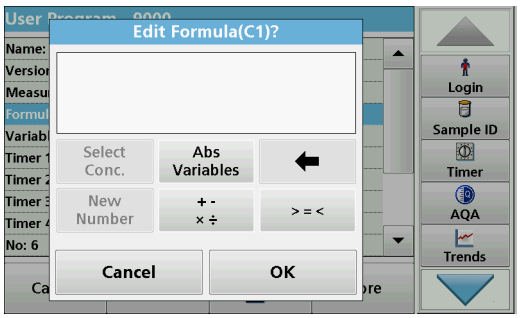
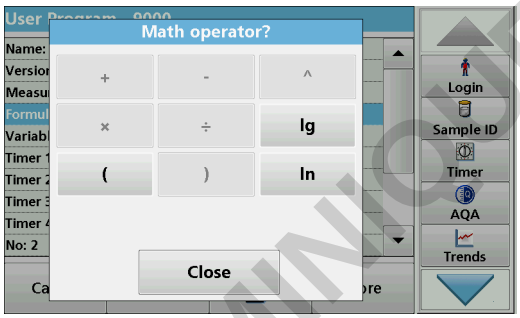
Refer to Table 11 for detailed information on the Edit formula keys.

Note: *The evaluation formula is built up successively in the display in accordance with the input.*

Note: *The **arrow** key deletes the most recently entered element of the formula.*

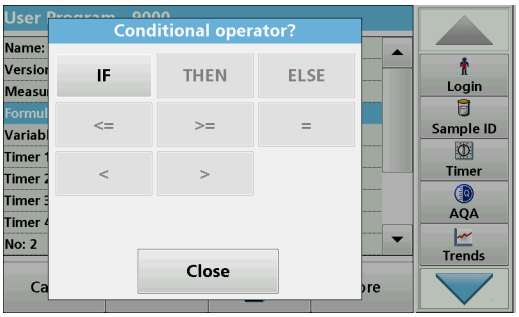
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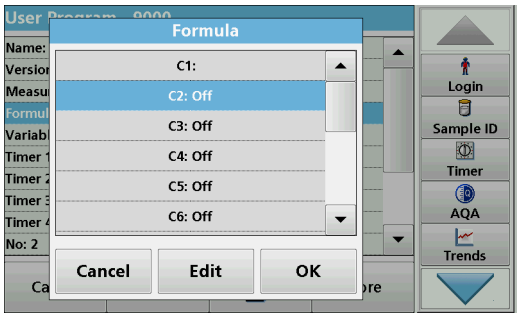
Table 11 Description of the keys for the editing of formulae

Screen	Key	Description
	**Abs/Variables**	Press the **Abs/Variables** key to select, from the displayed list, the required element of the defined measuring sequence and therefore the corresponding reading wavelength, so that this can be taken into account in the formula.
	**New Number**	Press **New Number** to enter a new factor or constant.
	**+ – ÷ ×**	Press **+ – ÷ ×** to enter a mathematical operation. Select the operation and press **OK** to confirm. The available choice of mathematical operations depends on the defined formula. This means that functions such as "**( )**" or "**ln**"/"**log**" etc. are only active if a term in parentheses or the calculation of a logarithm is mathematically permissible in the defined formula (this also applies to the basic mathematical operations). The following mathematical operations are available: • + (Addition) • - (Subtraction) • ÷ (Division) • × (Multiplication) • ^ (Exponent) • Ln (Natural logarithm) • Log (Common logarithm)

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Table 11 Description of the keys for the editing of formulae(Continued)

Screen	Key	Description
	>=<	Press >=< to include logic statements/links/conditions in the formula. The following functions are available: = (Equal to), < (Less than), > (Greater than), <= (Less than or equal to), >= (Greater than or equal to), IF, THEN, ELSE When the evaluation formula C1 has been entered completely, press **OK** to confirm. Press **OK** again to return to the Formula display. When the formula C1 has been entered and confirmed, the parameter name, upper and lower limits of the measuring range and display result (yes, no) can be entered.

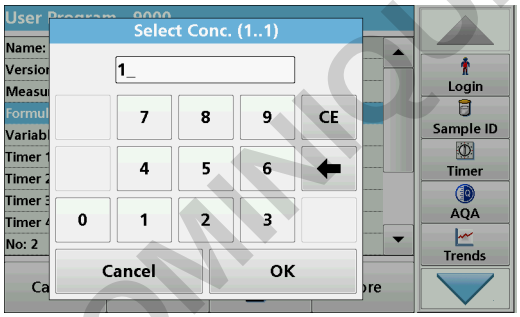


Entering the next calibration formula (C2 or Cn)

1. Mark **C2: Out.**
2. Press **Edit**.
3. Mark **C2: Out**.
4. Press **Edit**.

   The display switches to **C2: On**.
5. Mark the next row **C2=** to define the formula.
6. Press **Edit**.

In addition to the keys described in Table 11, only one other function is available:



Select Conc. key

1. If an already defined formula, in this case C1, is to be taken into account in the formula for C2, press **Select conc.**
2. Enter the numbering of the equation (e. g. 1 for C1).
3. Press **OK** to confirm the entry.

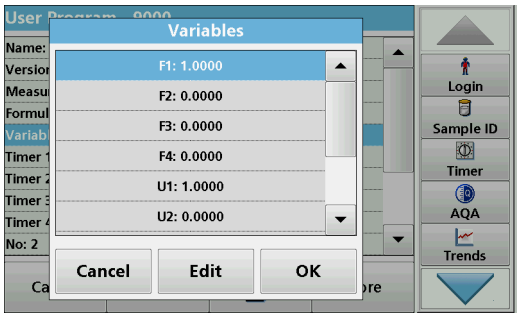
   Cn can now be linked with a mathematical operation.

Note: *The Cn concentrations that are to be calculated are numbered in sequence: C1, C2, C3, etc.*

Note: *When the first Cn formula has been defined, the Formula list is automatically extended by Cn+1.*

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6.1.2.4 Enter variables



1. Mark the **Variables** row in the data overview.
2. Press **Edit**.
3. Select the variable to be edited.
4. Press **Edit** and enter the data (refer to process specification) (for F1, F2, λ1, U1 etc.)
5. Press **OK** to confirm each entry.

Abbreviation of Variables:

F1: Factor 1

F2: Factor 2

λ 1: Wavelength 1

U1: Conversion Factor 1 for the first chemical form

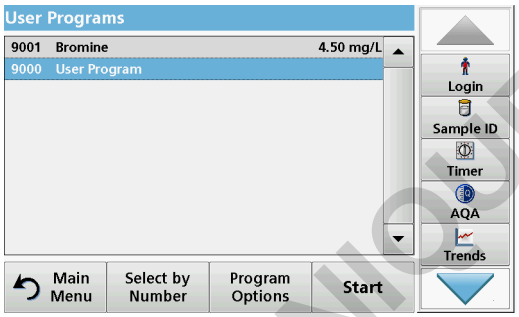
U2: Conversion Factor 2 for an additional chemical form etc.

6.1.2.5 Save a free programming user program

1. Press **Store** to save the entered data.

   The data can be stored under any data point (measurement sequence, formula, timer, etc.).

6.1.3 Select a user program



1. Press **User Programs in the Main Menu.**

   An alphabetical list of user programs with program numbers is displayed.

   Note: *Use the scroll bar to scroll through the list quickly.*

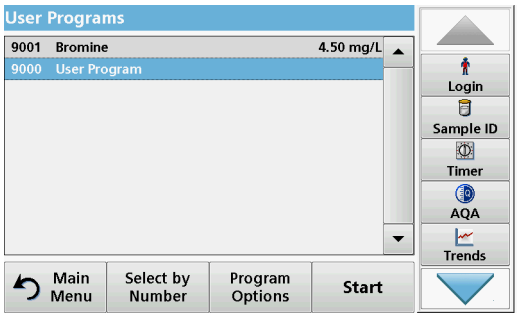
   Note: *Highlight the selection by pressing it or* ***Select by Number*** *to search for the program by number.*

2. Press **Start** to run the program.

6.1.4 Add, edit and delete user programs from the favorites list

The most frequently used tests/methods in the "User Programs" menu can also be added to the list of favorites to simplify their selection.

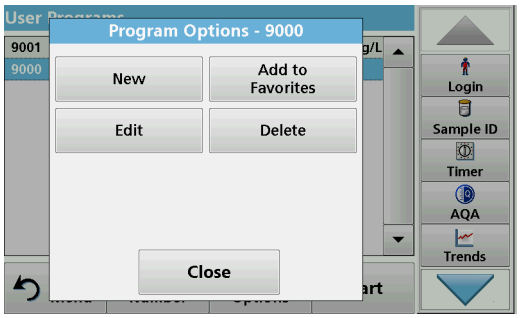
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1. Press **User Programs** in the Main Menu.

   The User Programs list will appear.

2. Highlight the selection by pressing it or **Select by Number** to search for the program by number.



3. Press **Program Options**.

   Using **Add to favorites, add the selected** program to the favorite list.

   Use **Edit** to edit **the selected** program.

   Use **Delete** to delete **the selected** program**.**

   Note: *If the stored program is deleted in User Programs, it will also be deleted in Favorites Programs.*

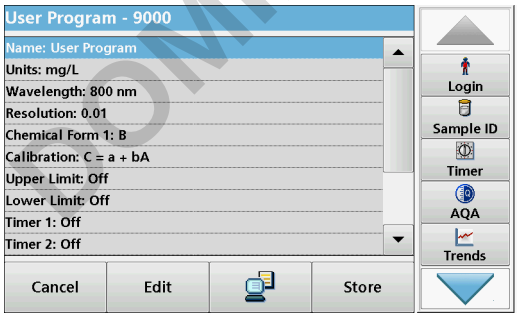
6.1.4.1 Add to Favorites



1. Press **Add to Favorites.**
2. Press **OK** to confirm.

   The program is added to the Favorites.

6.1.4.2 Edit

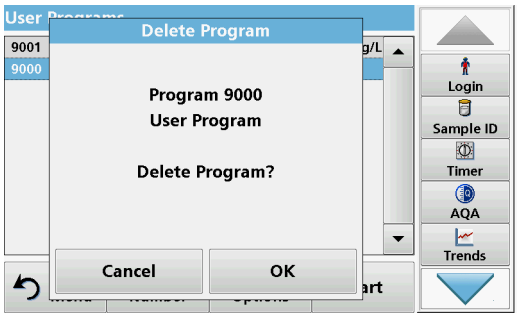


1. Press **Edit.**
2. Press **OK** to confirm.

   A data overview that contains the specifications of the programmed test is shown. More information about the input options is provided in the section 6.1.2, page 82.

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6.1.4.3 Delete program



1. Press **Delete.**
2. Press **OK** to confirm.

   The program will be deleted from the list of user programs.

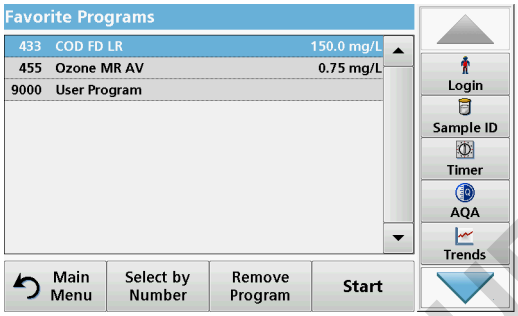
   Note: *If the stored program is deleted in User Programs, it will also be deleted in Favorites Programs.*

6.2 Favorites

The most frequently used tests/methods in the **Stored Programs** menu and the **User Programs** menu can also be added to the list of favorites to simplify their selection.

To add **Stored Programs** and/or **User Programs** to the favorites list or the favorite programs, refer to section 6.1.4, page 90.

6.2.1 Recall a favorite program



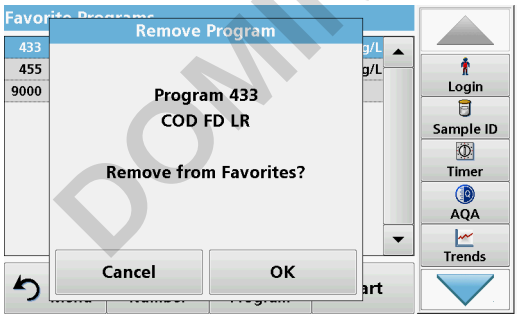
1. Press **Favorite Programs** in the Main Menu.

   The "Favorite Programs" list will appear.
2. Highlight the selection by pressing it.

   Note: *Use the scroll bar to scroll through the list quickly.*

   Note: *Press **Select by Number** to search for the program by number. Use the alphanumeric keypad to enter the test number (program number) and confirm the input by pressing **OK**.*
3. Press **Start**.

6.2.2 Delete a favorite program



1. Press **Favorite Programs** in the Main Menu.

   The "Favorite Programs" list will appear.
2. Highlight the selection by pressing it.

   Note: *Use the scroll bar to scroll through the list quickly.*

   Note: *Press **Select by Number** to search for the program by number. Use the alphanumeric keypad to enter the test number (program number) and confirm the input by pressing **OK**.*
3. Press **Remove program.**

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4. Press **OK** to confirm.

Note: *If a* ***Favorite Program*** *is deleted, it will stay in the* ***User Programs*** *or* ***Stored Programs****.*

Note: *If the stored program is deleted in* ***User Programs****, it will also be deleted in* ***Favorites Programs****.*

6.3 Standard Addition - monitoring/checking results

The accuracy of readings (their correspondence with the actual concentration of the analyte in the sample) and their precision (correspondence of the reading results obtained from several samples containing the same concentration of the test analyte) can be determined or improved using the standard addition method

This method (also known as standard-addition or spiking) serves to detect sample-specific faults:

- The analysis was compromised by substances or interferences in the sample (sample matrix effect),
- defective measuring device,
- impure reagents.

Method:

Add a defined quantity (concentration) of the substance to be tested to the sample as a standard solution. The detection rate (concentration of the added standard solution) should be close to 100 %.

$$\text{Detection rate} = \frac{\text{Reading of successful standard addition}}{\text{Expanded value after successful standard addition}}$$

Detection rate	**Conclusion**	
100 %	Probability that the reading results are correct is high.	
≠ 100 %	Assumption: The analysis was compromised by substances or interferences in the sample (sample matrix effect) **Test to determine whether a sample matrix effect is present:** Use distilled water instead of the sample. Add standard solution as described in the procedure.	
	Detection rate	**Conclusion**
	100 %	Ions in the sample are interfering with the analysis, causing false results to be obtained.
	≠ 100 %	No interference ions.

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Measures to identify other interference factors:

Checklist:

1. Check if the procedure is completed correctly:
   a. Are the reagents added in the correct order?
   b. Is enough time allowed for colour development?
   c. Is the correct glassware in use?
   d. Is the glassware clean?
   e. Does the test require the sample to be at a certain temperature?
   f. Was the pH of the sample in the correct range?
   g. Is the pipette volume correct?
2. Check the reagents. Repeat the standard additions using fresh reagents.

<table>
<tr><th>Detection rate</th><th colspan="2">Conclusion</th></tr>
<tr><td rowspan="3">100 %</td><td colspan="2">The originally used reagents were defective.
Check the standard solution:
Repeat the standard addition procedure with a freshly prepared standard solution and distilled water!</td></tr>
<tr><td>Detection rate</td><td>Conclusion</td></tr>
<tr><td>100 %</td><td>The originally used standard solution was deficient.</td></tr>
</table>

If none of these measures resolves the problem, please contact the manufacturer.

6.3.1 Complete a standard addition

Carry out the standard addition in accordance with the corresponding procedure.

There are two different methods:

Max. Volume (standard addition)

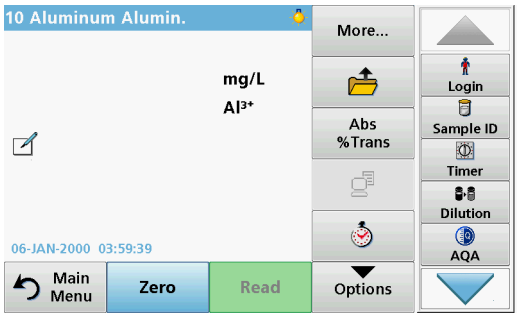
A defined volume of a standard solution of known concentration is incrementally added to a previously tested sample and the sample is newly measured after every standard addition.

Sample volume:

A defined volume of a standard solution of known concentration is added to the volume of sample specified in the procedure and the sample is measured after each addition. In most cases three different standard solutions are prepared and the procedure is repeated for each of them.

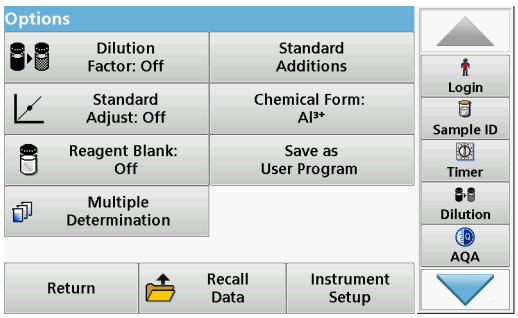
Note: *The units and chemical forms used for the sample are used for the standard solutions. Be careful to make sure that to use the correct units for subsequent entries.*

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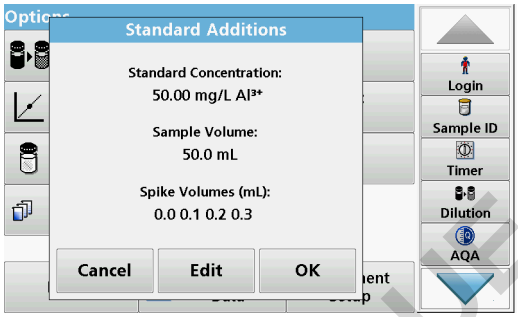


Maximum Method Volume/Sample volume

1. Press **Stored Programs** in the Main Menu.
2. Select the required program.
3. Press **Start**.
4. Analyze a sample without added standard solution in accordance with the instructions in the Procedures Manual. When the reading is complete, leave the sample cuvette/cell in the cuvette/sample cell compartment.

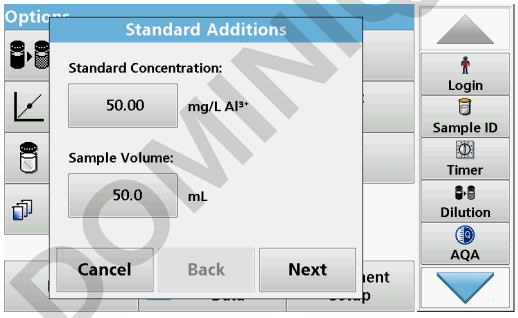


5. Press **Options>More>Standard Addition**.



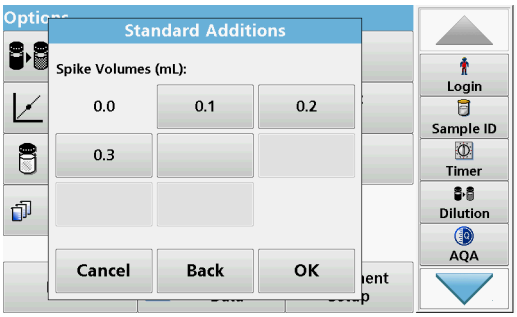
An overview of the data of the standard addition procedure is displayed.

6. Press **OK** to accept the standard values for standard concentration, sample volume (total) and standard addition volume.
7. Press **Edit**, to change these values.

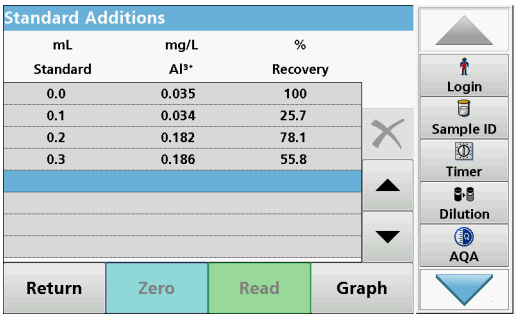


8. Press the key of the value to change it. Use the alphanumeric keypad to change the value.
9. Press **OK** to confirm.

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10. Press the keys to change the standard addition volumes. Use the alphanumeric keypad to enter the new data.
11. Press **OK** to confirm.



Description of the table of readings

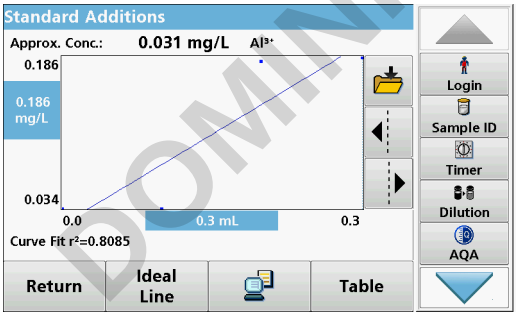
- The **first** column shows the standard addition volume. 0 ml stands for a sample containing no added standard.
- The **second** column shows the reading of the samples with and without added standard.
- The **third** column shows the detection rate of the added standard.

Note: *The black highlighted line is active.*

The reading of the sample in the instrument, without added standard, is automatically shown under 0 mL.

12. Prepare the standard addition solution as described in the procedure.
13. Press the standard addition volume in the table.
14. Insert the cell with the respective addition volume into the cell compartment.
15. Press **Read**.

Repeat the procedure with all the other standard addition solutions.



16. After all the standard addition solutions have been measured, press **Graph**.

    The regression line through the standard addition data points is displayed.

    The correlation coefficient r^2 indicates how close the data points are to the line.

    If the correlation coefficient = 1, the curve is linear.

    The concentration shown above the curve is the estimated concentration of the sample without the added standard.

    Note: *In the Graph menu, the name on the **Graph** key switches to Table. Press **Table** to display all the data in the table again.*

17. Press **Ideal Line** to display the relationship between the additions and the ideal line (detection rate 100 %).

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6.4 Single Wavelength (absorbance, concentration and transmittance readings)

The Single Wavelength mode can be used in three ways. For sample readings at a single wavelength, the instrument can be programmed to measure the absorbance, % transmittance or concentration of the analyte.

- Absorbance readings: The light absorbed by the sample is measured in absorbance units.
- % Transmittance measures the percent of the original light that passes through the sample and reaches the detector.
- Turning on the concentration factor allows selection of a specific multiplier for converting absorbance readings to concentration. In a graph of concentration versus the absorbance, the concentration factor is the slope of the line.

6.4.1 Set up Single Wavelength mode

1. Press **Single Wavelength** in the Main Menu.
2. Press **Options** for Parameter Setup.

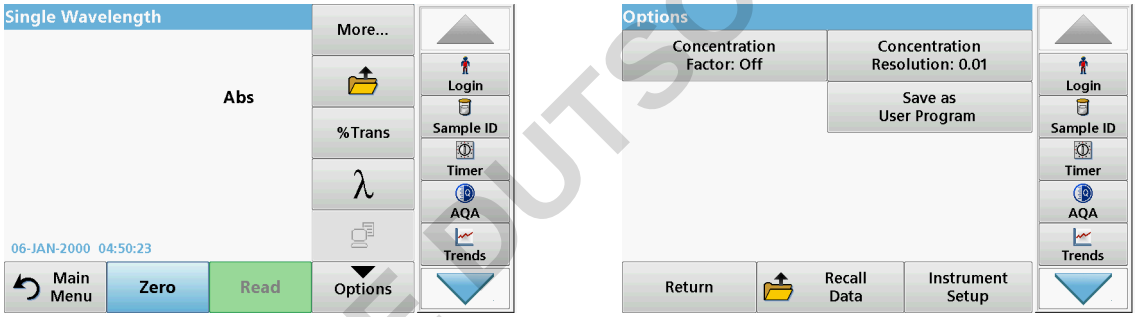
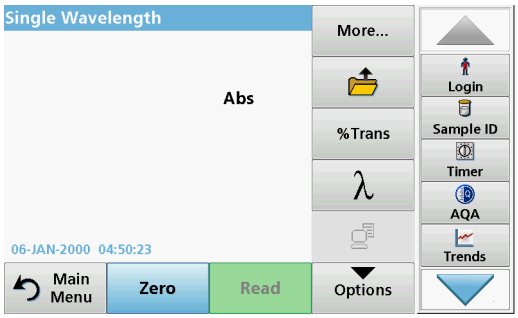


Table 12 Options for Single Wavelength

Options	Description
More	For further Options
Recall measurement data symbol	Recall saved measurement data, wavelength scans or time courses, refer to section 5.3, page 43.
%Trans/Ext (% Trans/Abs)	To switch to % transmittance, concentration or absorbance readings
λWavelength	To input the wavelength setting. Use the alphanumeric keypad to enter the reading wavelengths. The entered wavelength must be in the range from 320-110 nm.
Timer icon	This functions as a stopwatch. It helps to make sure that the steps of an analysis are correctly timed (e. g. reaction times, wait times, etc., can be exactly specified). When the specified time has elapsed, a sound is emitted. The use of the timer has no influence on the reading program.
Concentration Factor	Multiplication factor for converting absorbance values into concentration values.
Concentration Resolution	To select the number of decimal places.

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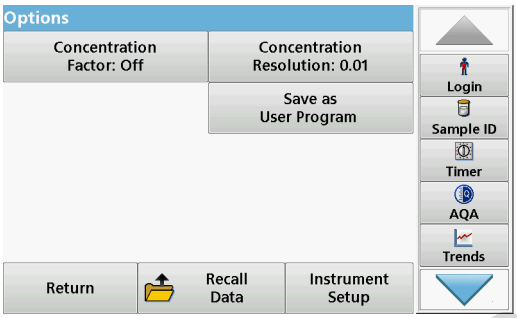
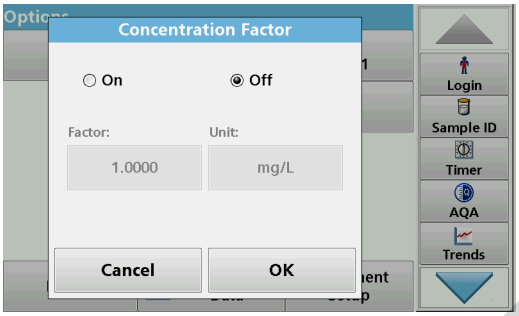


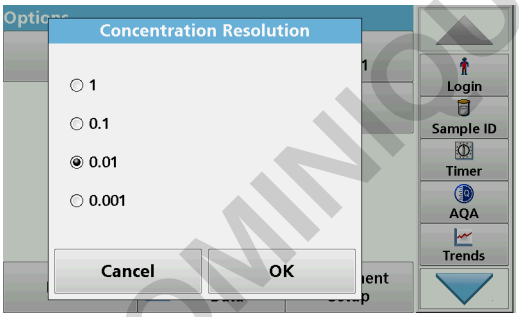
Table 12 Options for Single Wavelength(Continued)

Options	Description
Save as User Program	To store the selected parameters as a User Program, refer to section 6.1, page 73.
Recall measurement data	Recall saved measurement data, wavelength scans or time courses, refer to section 5.3, page 43.
Instrument Setup mode	Basic data of the instrument, refer to section 5.2, page 27.



Concentration Factor:

1. Press **Concentration Factor: Off** in the "Options" menu.
2. Press **On** to highlight this feature.
3. Press Factor and enter the factor.
4. Press **Unit** and select the corresponding units for concentration from the displayed list.
5. Press **OK** to confirm.



Concentration Resolution:

1. Press **Concentration Resolution** in the "Options" menu.
2. Select the resolution.
3. Press **OK** to confirm.
4. Next press **Return** to return to the results screen.

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6.4.2 Take single wavelength readings (single reading)



1. Insert the zero solution cell into the cell compartment.
2. Press **Zero**.

   Note: *The **Read** key is only active after the zero reading has been completed.*

3. Insert the analysis cell into the cell compartment.
4. Press **Read**.
5. For data storage, refer to section 5.3.1, page 43.

6.5 Multi Wavelength mode – readings with more than one wavelength

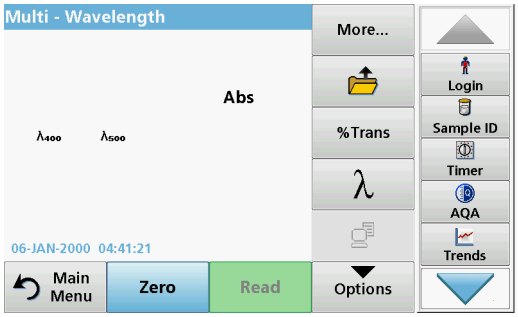
In the Multi Wavelength mode, absorbance values can be measured at up to four wavelengths and the results can be mathematically processed to obtain sums, differences and relationships.

- Absorbance readings: The light absorbed by the sample is measured in absorbance units.
- % Transmittance measures the percent of the original light that passes through the sample and reaches the detector.
- Turning on the concentration factor allows selection of a specific multiplier for converting absorbance readings to concentration. In a graph of concentration versus the absorbance, the concentration factor is the slope of the line. Concentration is calculated using a single factor for each wavelength, which is input by the user.

6.5.1 Set the Reading mode at different wavelengths

Press **Multi Wavelength** in the Main Menu. Press **Options** for Parameter Setup.

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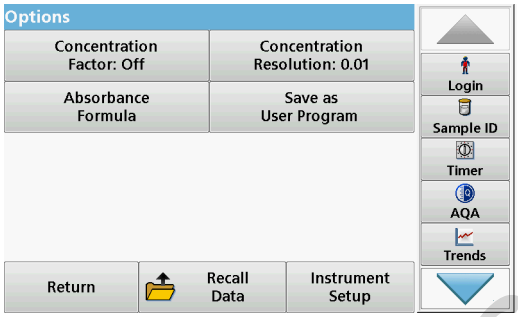
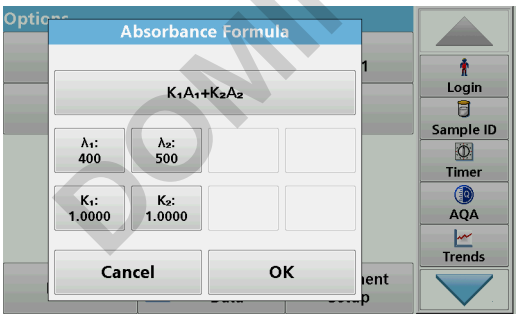


Table 13 Multi wavelength setup options

Options	Description
More	For further Options
Recall measurement data symbol	Recall saved measurement data, wavelength scans or time courses, refer to section 5.3, page 43.
%Trans/Ext (% Trans/Abs)	To switch to % transmittance, concentration or absorbance readings
λWavelength	To input the wavelength setting. Use the alphanumeric keypad to enter the reading wavelengths. The entered wavelength must be in the range from 320–1100 nm.
Timer icon	This functions as a stopwatch. It helps to make sure that the steps of an analysis are correctly timed (e. g. reaction times, wait times, etc., can be exactly specified). When the specified time has elapsed, a sound is emitted. The use of the timer has no influence on the reading program.
Concentration Factor	Multiplication factor for converting absorbance values into concentration values.
Concentration Resolution	To select the number of decimal places.
Absorbance Formula	Calculation basis for evaluating samples
Save as User Program	To store the selected parameters as a User Program, refer to section 6.1, page 73.
Recall measurement data	Recall saved measurement data, wavelength scans or time courses, see section 5.3, page 43.
Instrument Setup mode	Basic data of the instrument, refer to section 5.2, page 27.



λ/ Absorbance Formula:

1. Press **Absorbance Formula**.
2. The formula selected in the top key determines the number of wavelength and coefficient keys that will appear below.
3. Press the key to change the calculation formula.
4. Select a formula from the displayed list.
5. Press **OK**.

   When a new formula is selected, the number of variables below changes to match.

The following formulas are available:

$K_1 A_1 + K_2 A_2$

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$K_1 A_1 + K_2 A_2 + K_3 A_3$
$K_1 A_1 + K_2 A_2 + K_3 A_3 + K_4 A_4$
$K_1 A_1 / K_2 A_2$
$(K_1 A_1 + K_2 A_2) / K_3 A_3$
$(K_1 A_1 + K_2 A_2) / (K_3 A_3 + K_4 A_4)$

A_1 refers to the absorbance at wavelength 1

A_2 refers to the absorbance at wavelength 2, etc.

K_1 refers to the coefficient at wavelength 1

K_2 refers to the coefficient at wavelength 2, etc.

If a subtraction has to be completed, the factors can be entered with a minus sign.

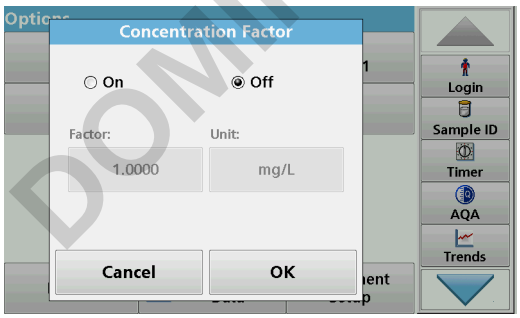


6. To change the wavelength, press the λ**x** key.
7. Enter the required wavelength factor using the alphanumeric keypad.
8. Press **OK** to confirm the selection.



9. To change a coefficient, press one of the "K_X" keys.
10. Enter the required coefficient using the alphanumeric keypad.
11. Press **OK** to confirm the selection.

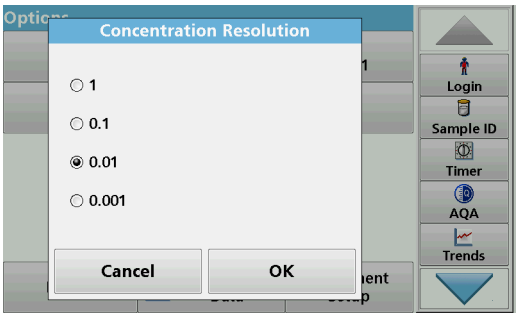
Note: *Up to 5 digit number values can be entered! A maximum of four decimals places are possible.*



Concentration Factor:

1. Press **Concentration Factor: Off** in the "Options" menu.
2. Press **On** to highlight this feature.
3. Press **Factor**.
4. Enter the factor with which the absorbance measurement is to be multiplied.
5. Press **Unit**.
6. Select the respective concentration unit from the displayed list.
7. Press **OK** to confirm.

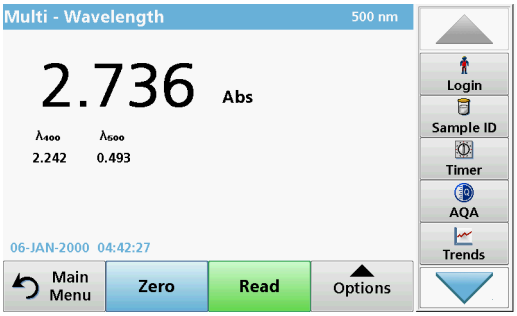
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Concentration Resolution:

1. Press **Concentration Resolution** in the "Options" menu.
2. Select the resolution.
3. Press **OK** to confirm.
4. Press **Return** to return to the results screen.

6.5.2 Complete a reading in the Multi Wavelength mode



1. Insert the zero solution cell into the cell compartment.
2. Press **Zero**.

   Note: *The **Read** key does not become active until the zero reading has been completed.*

3. Insert the analysis cell into the cell compartment.
4. Press **Read**.
5. For data storage, refer to section 5.3.1, page 43.

6.6 Wavelength Scan mode – recording of absorbance and transmission spectrums

In the Wavelength Scan mode, the absorbance of the light in a solution over a defined wavelength spectrum is measured. While the scan is taking place, the cell compartment cover must be closed. Therefore, a scan of the round cell compartment is not possible.

The reading results can be displayed as a curve, as percentage transmittance (%T) or as Absorbance (Abs). The collected data can be printed as a table or a curve.

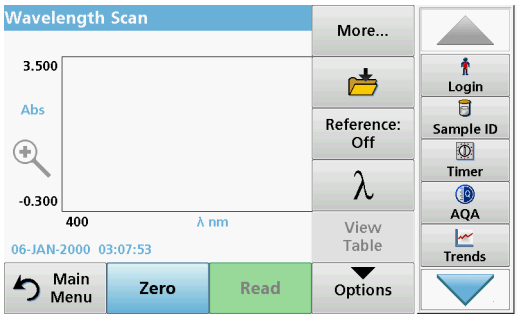
The data is available for formatting changes. These include automatic scaling and zoom functions. Maximum and minimum values are determined and shown as a table.

The cursor can be moved to any point on the curve for the purpose of reading off the absorbance or transmittance value and the wavelength. The data associated with each data point can also be shown as a table.

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6.6.1 Set up the wavelength scan

Press **Wavelength Scan** in the Main Menu. Press **Options** for Parameter Setup.



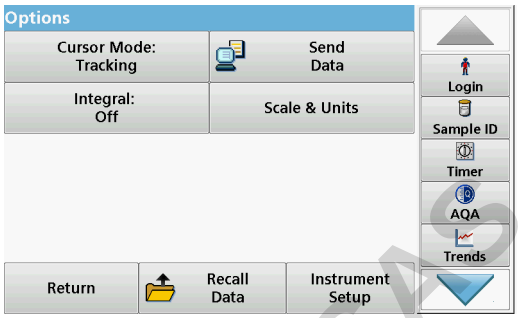
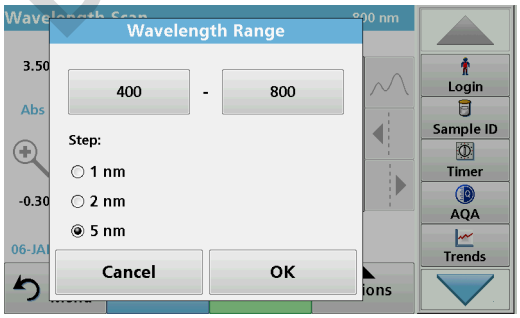


Table 14 Options during wavelength scan

Option	Description
More	Further options are displayed
Folder icon	To store the scan data
Reference Off/On	From the displayed list of stored scans, a record is selected for use as a reference scan/superimposed scan. This can be highlighted or shown in the background in comparison with the actual measured scan. ***Note:*** *This option is only available when there are stored scans with the same wavelength range and step.*
λ	Enter the wavelength spectrum and scan interval
Select View	Enables the user to switch the display back and forth between the scan data tables (wavelength/absorbance) and the graph of the curve. ***Note:*** *"Select View" will be activated after the first reading.*
Cursor Mode	To select **Track** or **Peak/Valley**. The selection for this menu item determines to which points on the graph the cursor moves.
Send Data	To send data to a printer, computer or USB memory stick (Type A)
Integral: On/Off	The integral gives the area and the derivative of the integral gives the original function
Scale & Units	**Scale**: In the automatic Scaling mode, the y-axis is automatically adjusted so that the total scan is displayed. The manual Scaling mode allows sections of the scan to be displayed. **Units:** Choice of absorbance or transmittance.
Recall measurement data	Recall saved measurement data, wave-length scans or time courses, see section 5.3, page 43.
Instrument Setup mode	Basic data of the instrument, refer to section 5.2, page 27.



λ Setting of the wavelength

1. Press the λ key in the "Options" menu to select the wavelength range and the wavelength step.
2. Press the upper left key to select the lower wavelength.
3. Enter the lower wavelength.
4. Press **OK** to confirm.
5. Press the upper right key to select the upper wavelength.

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6. Enter the upper wavelength.
7. Press **OK** to confirm.

   Note: *Do not select the same wavelength for minimum and maximum.*

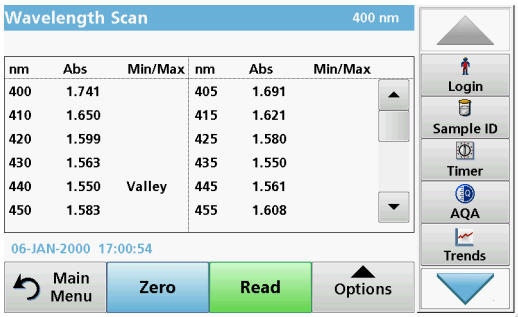
8. Highlight the required wavelength step.

   Note: *The selection of the interval influences the duration and resolution of the Wavelength Scan. Scans with a high resolution take longer than scans with a low resolution. The larger the increments of the intervals selected, the faster the scan runs. In contrast, the resolution of the determined data decreases.*
   In summery maximally 780 measuring steps can be accomplished during a Scan.

   Note: *The maximum wavelength adjust automatically if the difference between the maximum and minimum wavelength is not a multiple of the interval.*

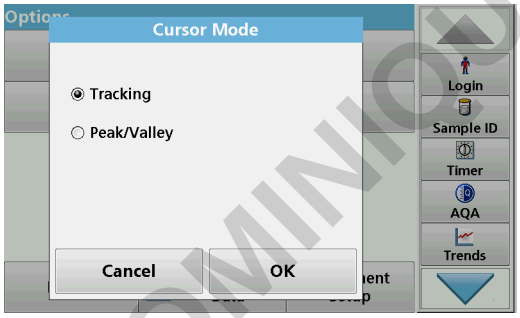
9. Press **OK** to return to the Scan mode.

   Selected parameters are displayed along the graph‘s x-axis.



Select view (display table)

1. Perform a Wavelength Scan (section 6.6.2, page 105)
2. Press **Display table** in the "Options" menu.
3. A table with the results is displayed.
4. To return to the graph press **Options** and then **View Graph**.

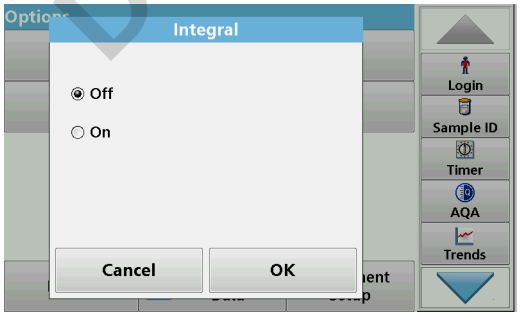


Cursor Mode

1. Press **Cursor mode: tracking** in the "Options" menu.

   The selection for this menu item determines what data is displayed in the table.

2. Highlight **Track** or **Peak/Valley.**
3. Press **OK** to confirm.
4. Press **Return** to return to the Scan mode.



Integral

The Integral applies to the whole wavelength range of the scan.

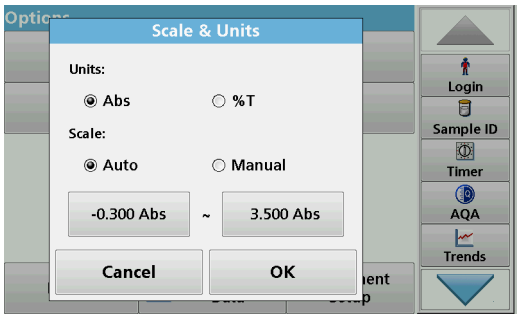
1. Press **Integral: Off** in the "Options" menu.
2. Highlight **On** to show the Integral.
3. To find the integral of other wavelength ranges, change the wavelength range and scan again.
4. Press **OK** to confirm.

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5. Press **Return** to return to the Scan mode.

Note: *The Integral is shown instead of the date on the display.*

Note: *For the next scan reading the setting for the Integral will be* ***On****.*



Scale & Units

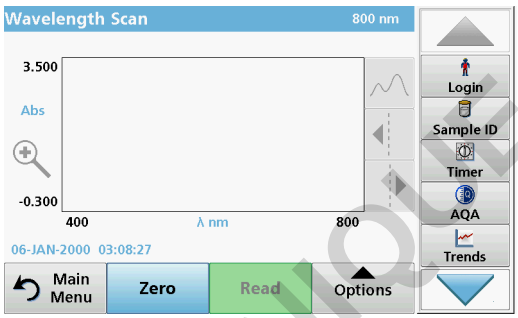
1. Press **Options>More..>Scale & Units**.
2. Highlight the required units (**Abs** or **%T**).
3. Highlight **Auto** or **Manual** scaling on the graph's y-axis.

Note: *When selecting the manual scaling, the limit values* y_{min} *and* y_{max} *can be entered using the alphanumeric keypad. The graph is adjusted to display only the values in the selected range. If automatic scaling is selected, the instrument sets the limits automatically so that the total range can be displayed.*

4. Press **OK**.
5. Press **Return** to return to the Scan mode.

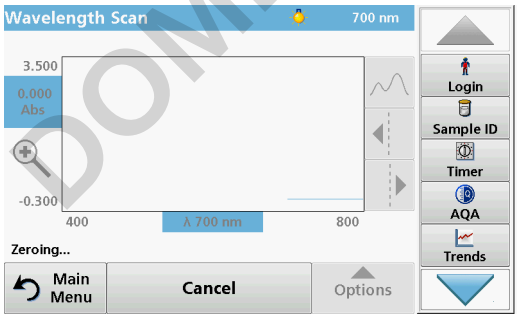
6.6.2 Perform a wavelength scan

After selecting all scan parameters, record a base line (initial zero reading). If a scan parameter is changed, a new base line must be recorded. When the baseline has been scanned, the instrument is ready to scan one or more samples.



1. Select in the main menu the menu option **Wavelength Scan**.
2. Insert the zero solution cell into the cell compartment and close the cell compartment cover.

   Note: *The cell compartment must be closed via the cell compartment cover during a scan. Therefore, no scans can be performed with 13-mm round cells.*



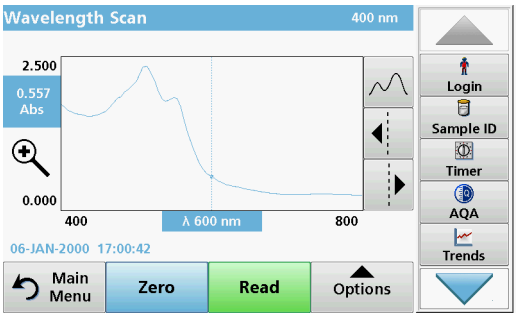
3. Press **Zero**.

   "Zeroing" is shown below the graph as the baseline scan begins.

4. Insert the prepared analysis cell into the cell compartment and close the cell compartment cover.
5. Press **Read**.

   Under the graph, the display "Reading..." appears, and a graph of the absorbance or transmittance values for the scanned wavelengths is continuously displayed.

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The Wavelength Scan is complete, if

- the graph is shown full-size,
- the scaling of the x-axis occurs automatically,
- the Cursor functions in the vertical navigation bar are highlighted.
- a signal sounds

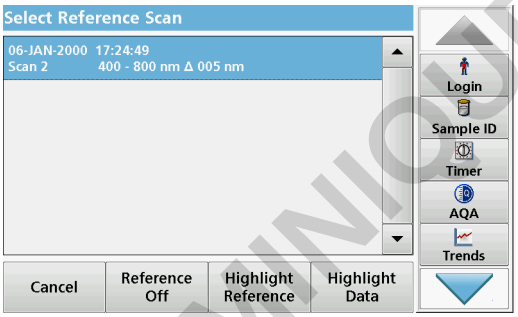
6.6.2.1 Navigation of the wavelength scan graph or a wavelength scan analysis

Table 15 Navigating the wavelength scan

Cursor function/ Zoom function	Description
Curve Icon (Choice of Cursor mode)	Choice of Cursor mode **Peak/Valley** (cursor moves between minimum/maximum absorbance values) or Cursor mode **Tracking** (cursor moves over each data point of the scan).
Arrow keys	The arrow keys (right/left) are used to move the cursor (depending on the selected mode) to the next data point. The data of the data point (wavelength/absorbance or transmittance value) are highlighted on the x and y axes. ***Note:*** *Press any point on the curve to display the associated data.*
Zoom Icon	This function is used to magnify the section of the curve in the vicinity of the cursor. The original curve size can be restored by pressing the zoom icon again.

6.6.3 Work with reference scans

There are two options to work with **Reference Scan**:



First option:

1. Press **Reference: Off** in the "Options" menu to select another scan to display on the same screen with the current scan. Highlight the required scan number and press **Highlight reference**.

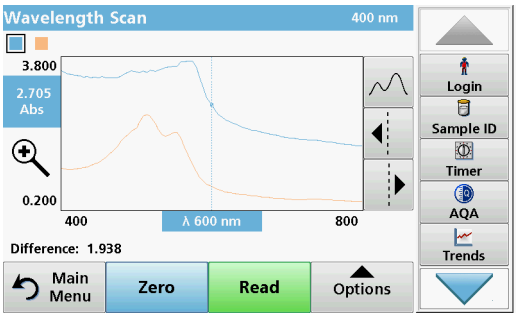
   Note: *Once a reference scan has been selected, the* ***Reference: Off*** *key in the "Options" menu turns into* ***Reference: On****.*

   Note: *Only scans that have the same wavelength range and step can be displayed using the overlay option. This process can be repeated until all matching scans are displayed.*

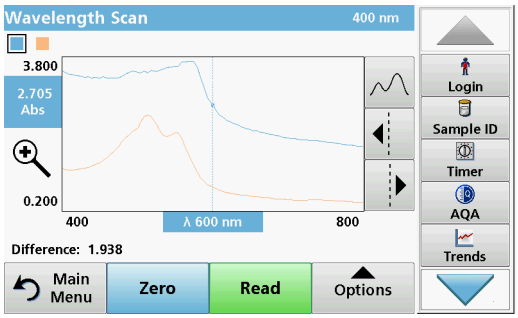
2. The reference curve is shown in orange. The absorbance or transmittance value and the associated wavelength are highlighted in grey.

   Note: *A black and an orange box are shown in the top left corner of the display. The orange box relates to the reference scan and the black one relates to the current wavelength scan.*

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3. To complete the wavelength scan reading, refer to section 6.6.2, page 105.
   - The newly plotted wavelength scan curves are shown in black.
   - The absorbance or transmittance value and the associated wavelength are highlighted in black.
   - In addition, the display shows the difference between the wavelength scan curve and the reference curve against the wavelength.
4. Press the black or orange small box in the left upper corner on the screen to switch between the actual wavelength scan and reference scan.



Second option:

1. Insert the zero solution cell into the cell compartment. Press **Zero**.
2. Insert the analysis cell into the cell compartment. Tap on **Read**.
   - The newly plotted wavelength scan curves are shown in black.
   - The absorbance or transmittance value and the associated wavelength are highlighted in black.
3. Press **Options** and then **Reference: Off** in the "Options" menu to select another scan to display on the same screen with the current scan. Highlight the required scan number and press Highlight Reference.

   Note: *After selecting a reference scan the* ***Reference: Off*** *key in the "Options" menu turns into* ***Reference: On****.*

   Note: *Only scans that have the same wavelength range and step can be displayed using the overlay option. This process can be repeated until all matching scans are displayed.*
4. The reference curve is shown in orange. The absorbance or transmittance value and the associated wavelength are highlighted in orange.
   - In addition, the difference of the absorbance and/or transmission value between the two scans (measured scan and reference scan) is indicated/highlighted at each position of the cursor.

   Note: *A blue and an orange box are shown in the left corner of the display. The orange box relates to the reference scan and the black one relates to the current wavelength scan.*
5. Press the black or orange small box in the left upper corner on the screen to switch between the actual wavelength scan and reference scan.

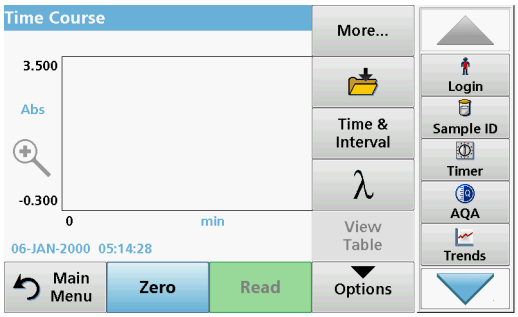
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6.7 Time course of absorbance/transmittance

The Time Course mode is used to collect data in either absorbance or transmittance for a user-specified length of time. This data can be displayed in either graphic or tabular format. While the time scan is taking place, the cell compartment cover must be closed. Therefore, a scan of the round cell compartment is not possible.

6.7.1 Time course setup parameters

1. Press **Time Course** mode in the Main Menu.
2. Press **Options** to configure parameters.



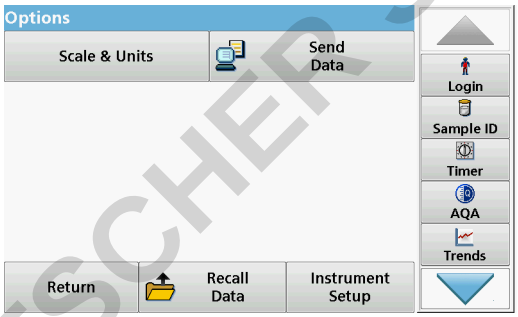
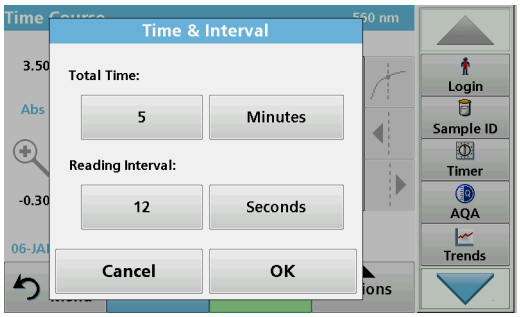


Table 16 Time course options

Options	Description
More	For further options
Folder icon	To store the scan data
Time & Interval	To input the total time for data collection and the time interval between the collection of data points
λ	To input the wavelength setting
View Table	To display readings in absorbance, transmittance or concentration. This can be changed after sample data is collected
Scale & Units	**Scale**: In the automatic Scaling mode, the y-axis is automatically adjusted so that the total scan is displayed. The manual Scaling mode allows sections of the scan to be displayed. **Units:** Choice of absorbance or transmittance.
Send Data	To send Data to a printer, computer or USB memory stick (Type A)
Recall measurement data	Recall saved measurement data, wave-length scans or time courses, see section 5.3, page 43.
Instrument Setup	Basic data of the instrument, refer to section 5.2, page 27.

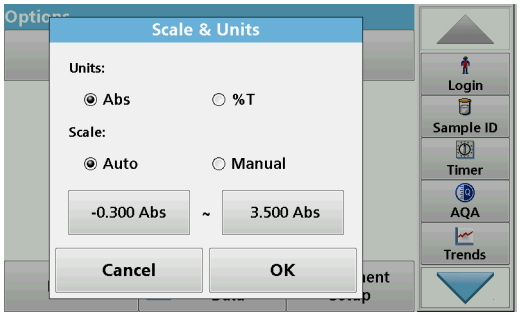
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Time & Interval:

1. Press **Time & Interval** in the "Options" menu.
2. Enter the total time and measurement interval.
3. Press **OK** to confirm.

Note: *In total, 500 measuring steps can be accomplished during a scan. To select a total time and a time interval that would cause this number of readings to be exceeded, the time interval is defined automatically and the **OK** key is inactivated.*



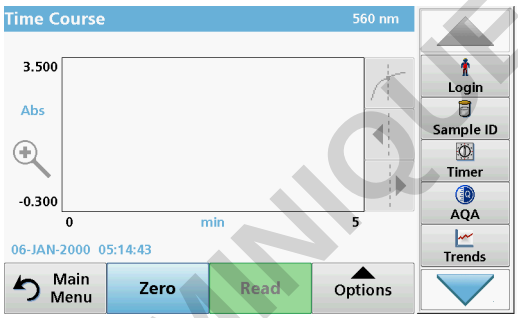
Scale & Units:

1. Press **Scale & Units** in the "Options" menu.
2. Highlight **Abs** or **%T** as the required units.
3. Highlight Auto or Manual scaling on the graph's y-axis.

Note: *When selecting the manual scaling, the limit values y_{min} and y_{max} can be entered using the alphanumeric keypad. The graph is adjusted to display only the values in the selected range. If automatic scaling is selected, the instrument sets the limits automatically so that the total range can be displayed.*

4. Press **OK** to confirm.
5. Press **Return** to return to the Scan mode.

6.7.2 Time course scan reading



After all scan parameters have been selected, the instrument must then be zeroed. Afterward the sample can be analyzed.

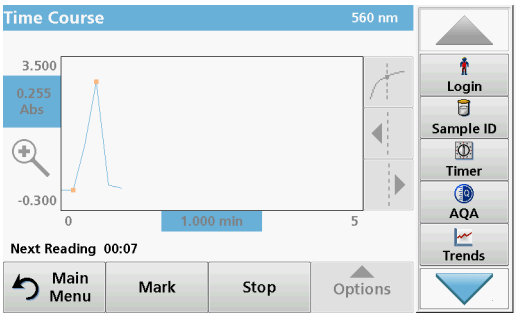
1. Insert the zero solution cell in the cell compartment and close the cell compartment cover.
2. Press **Zero**.

   The blank reading is shown on the display.
3. Insert the analysis cell in the cell compartment and close the cell compartment cover.
4. Press **Read**.

   The instrument will begin collecting Time Course data (kinetic data).

   Note: *During the reading the **Zero** and **Read** keys change to **Mark** and **Stop**.*

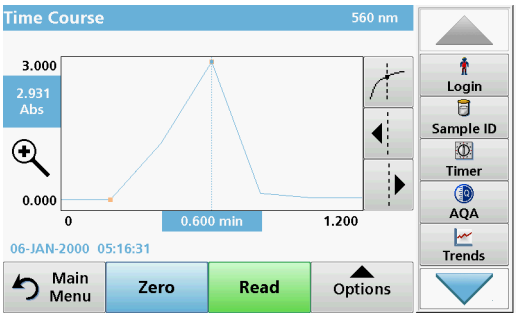
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- **Select Mark** to mark the next data point collected. This mark is not used by the instrument, but is available for the user and may indicate a significant event, such as the addition of a sample or other reagent. The mark is also shown in the table.
- Select **Stop** to stop taking sample readings.

6.7.3 Analysis of time course data

After the Time Course data has been collected, the following manipulations can be done on the graphic data:



The **Time Course** Program is complete, if

- the instruments beeps after completion of the overall time
- the graph is shown full-size,
- the scaling of the x-axis occurs automatically,
- the Cursor functions in the vertical navigation bar are highlighted.

6.7.3.1 Navigation of a time scan or a time scan analysis

After a time scan has been completed, the time and the absorbance/transmittance data is displayed as a curve.

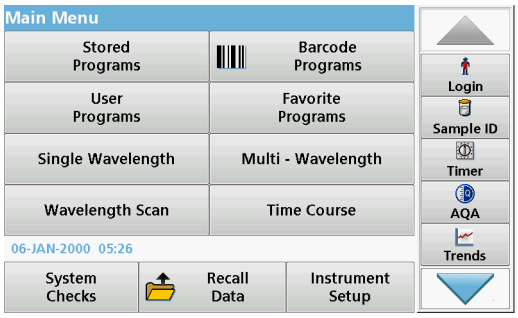
Where the cursor is positioned on the curve, the elapsed time up to this point and the corresponding absorbance are highlighted.

Table 17 Navigating the time scan

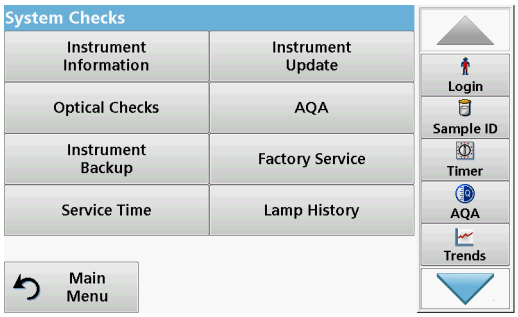
Cursor function/ Zoom function	Description
Curve Icon (Choice of Cursor Mode)	**Delta mode:** A second cursor is highlighted. The position of the fixed cursor was previously defined in Cursor mode Single. Use the active cursor to select any point on the reading curve. The difference to the fixed cursor is shown on the curve. The delta values are correspondingly highlighted and displayed on the x and y axes. The gradient of the curve and the correlation coefficient (r^2) between the cursor points in the Delta mode are shown under the curve.
	Cursor mode, single: The cursor moves to each selected measuring point of the scan.
Arrow keys	The arrow keys (right/left) are used to move the cursor (depending on the selected mode) to the next data point. The data of the data point (wavelength, absorbance or transmittance value) are highlighted on the x and y axes. ***Note:*** *Press any point on the curve to display the associated data.*
Zoom Icon	This function is used to magnify the section of the curve in the vicinity of the cursor. The original curve size can be restored by pressing the zoom icon again.

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6.8 System Checks

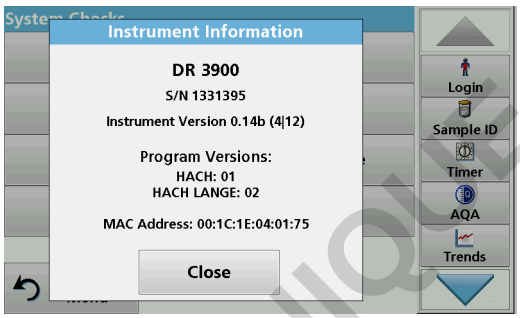


1. Press **System Checks** in the Main Menu.



The "System Check" menu contains instrument information and various performance tests.

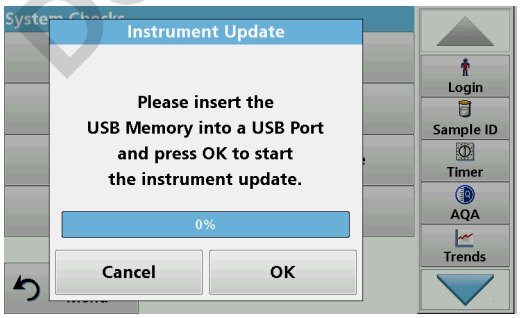
6.8.1 Instrument Information



1. Press **Instrument Information** in the "System Check" menu.
2. The model, serial number and software version are displayed.

6.8.2 Update the instrument software

To obtain the software for the update from the Internet at **www.hach-lange.com**.



1. Go to **http://www.hach-lange.com**.
2. Select the country and go to **Download**>**Software**.
3. Enter **DR 3900** in "Search for documents".
4. Navigate to the corresponding file for download.
5. Open the ZIP file and save the files to the USB storage device or PC. The files must be unpacked before they are saved on the USB storage device or PC.
6. Press **Iinstrument Update** in the "System Check" menu.

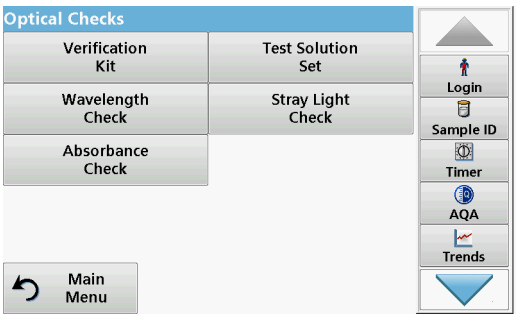
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7. Connect the USB memory stick to the USB port (type A) on the instrument, refer to section 3.5, page 18.
8. Press **OK** to confirm.

   The link is established automatically and the software is updated.
9. Press **OK** to return to the "System Check" menu.

Note: *After the instrument update, a prompt to restart the instrument will be displayed.*

6.8.3 Optical Checks



1. Press **Optical Checks** in the "System Check" menu.

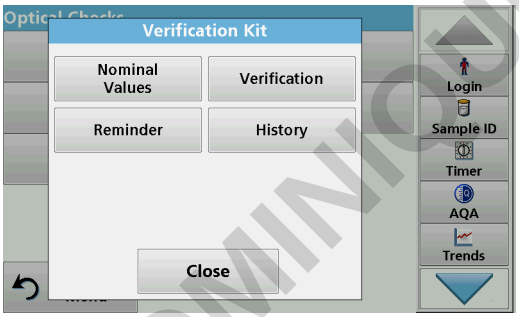
The "Optical Checks" menu contains programs for checking the wavelength accuracy, stray light and photometric accuracy.

An optional test filter set (Verification Kit) Section 9, page 137 containing six precision glass filters, target values and instructions is available as an aid for carrying out comprehensive in-house instrument checks.

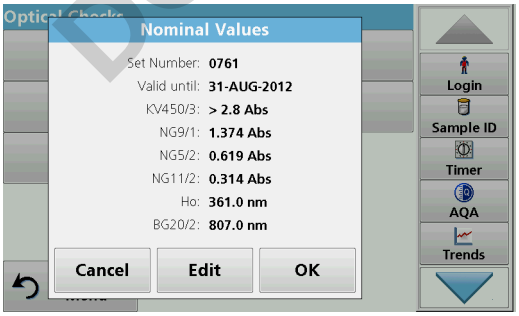
6.8.3.1 Verification kit

The Verification Kit (refer to Section 9, page 137) is designed for periodic monitoring of scattered light, photometric accuracy and the wavelength accuracy of the spectrophotometers.

When results exceed allowable tolerances (given in the quality control certificate to the test record), contact the manufacturer.



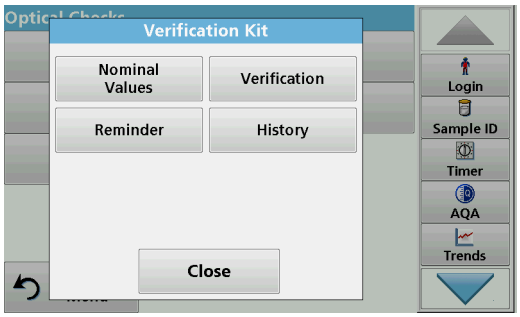
1. Press **Verification Kit** in the "Optical Checks" menu.
2. Press **Nominal Values**.



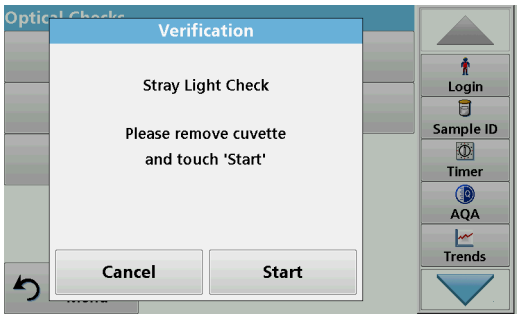
3. Press **Edit**.

   An automatic menu guidance queries values (filters, wavelength, nominal values and tolerances) given in the quality control certificate, to the following specifications:
   - Stray light
   - Photometrical accuracy
   - Wavelength accuracy
4. Press **OK** when all values are entered and the overview is displayed.

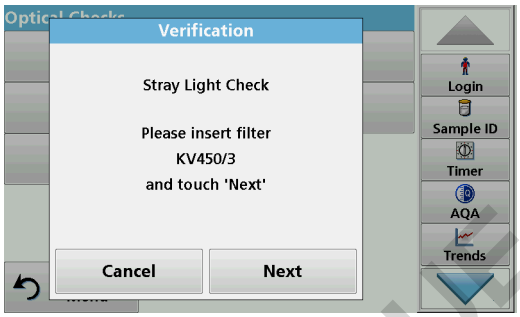
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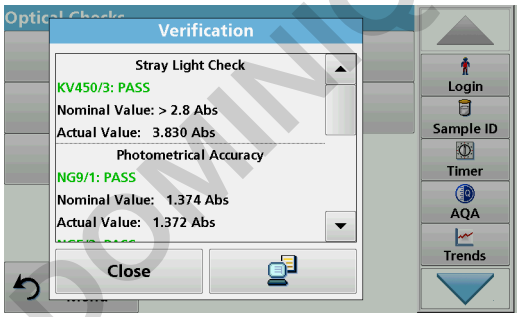
5. Press **Verification**.
6. Insert cell adapter A (Figure 3, page 19) in cell compartment (2).



7. Remove any remaining cells from the cell compartment.
8. Close the cell compartment cover.
9. Press **Start**.



10. Follow the directions on the display and set various filters one after another in the order displayed.
11. Press **Next** after inserting a filter.



After the last reading the results are displayed.

12. Press **PC & Printer** icon to send the data to a USB memory stick, PC or to a printer.

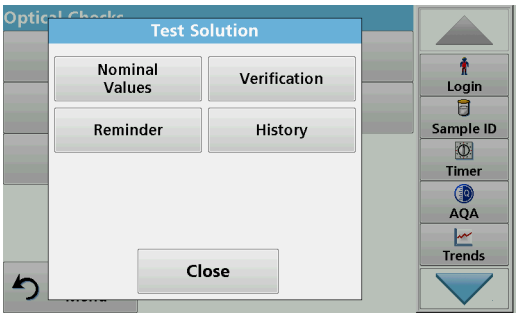
    The files will be stored automatically as CSV files (Comma Separated Value). The file name will be formatted as "Verification.csv".

6.8.3.2 Test solution

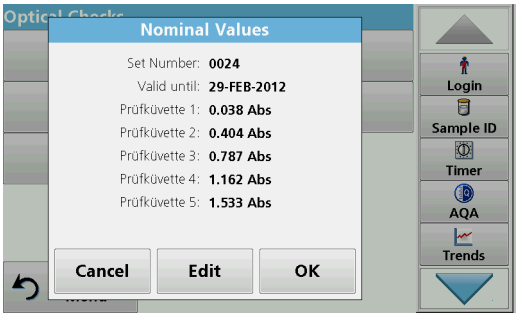
The test solution (refer to Section 9, page 137) serves as a regular quality control for the photometric accuracy of or the relevant spectral photometer.

When results exceed allowable tolerances (given in the quality control certificate to the test record), contact the manufacturer.

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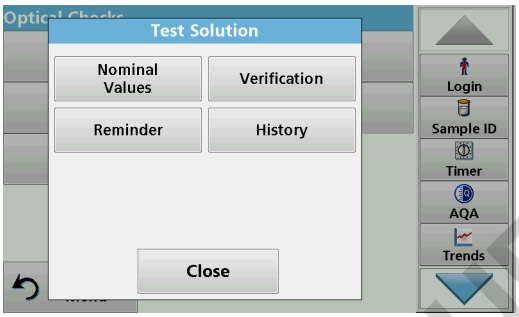
1. Press **Test Solution** in the "Optical Checks" menu.
2. Press **Nominal Values**.



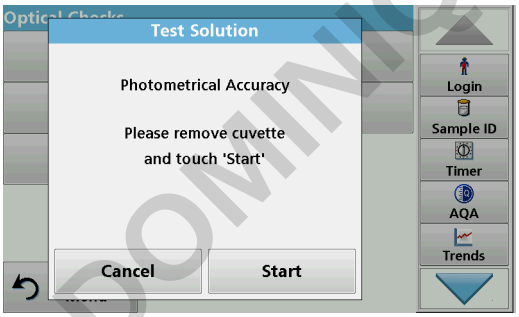
3. Press **Edit**.

   An automatic menu guidance queries values (filters, wavelength, and nominal, minimum and maximum values) given in the quality control certificate, to the following specifications:

4. Press **OK** when all values are entered and the overview is displayed.

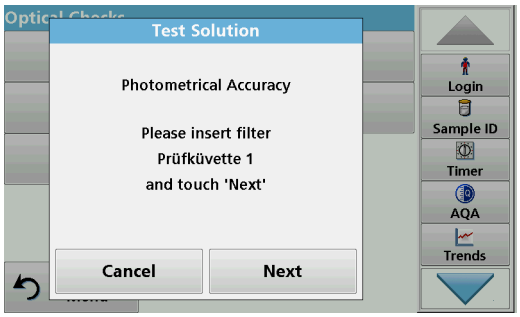


5. Press **Verification**.

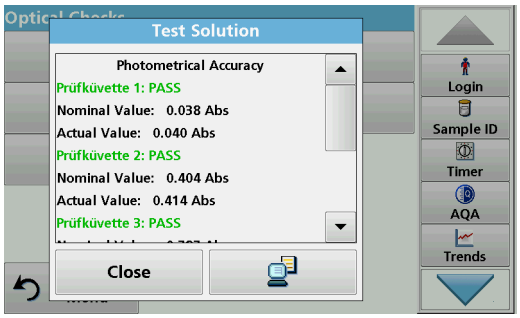


6. Remove all cells and press **Start**.

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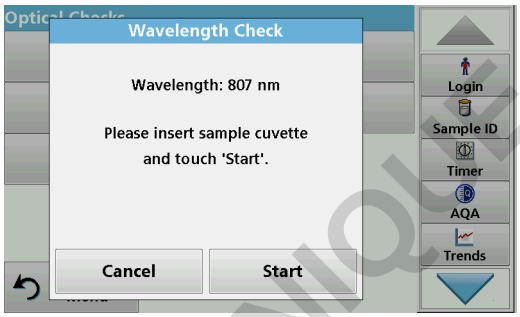
7. Inset sample cell 1 (Figure 3, page 19) in cell compartment (1) a press **Next**.
8. Follow the dialog indicated.



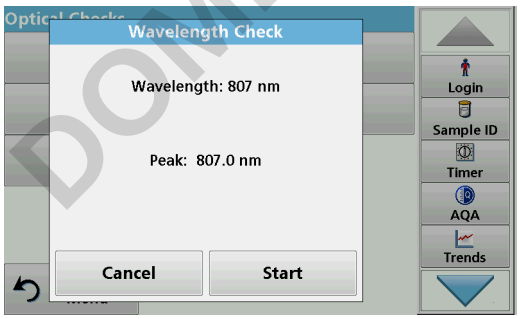
9. After the fifth test cell, the photometrical accuracy is displayed in a log.

6.8.3.3 Wavelength check

The Wavelength Check test is used to check wavelength accuracy at 807 nm.



1. Press **Wavelength Check** in the "Optical Checks" menu.
2. Insert the cell adapter (A) for 10-mm rectangular cells in the cell compartment (2).
3. Place the analysis cell (Neodym or BG20/2) in the cell adapter.
4. Close the cell compartment cover.
5. Press **Start**.



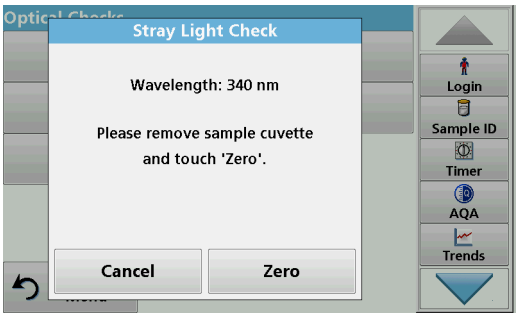
The result will be displayed.

6. Compare the result with the analysis cell required values.
7. Press **Cancel** to return to Optical Checks.

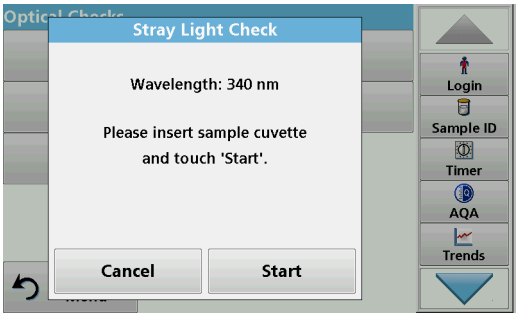
6.8.3.4 Stray light check

The Stray Light test is used to measure the stray light in the instrument at 340 nm.

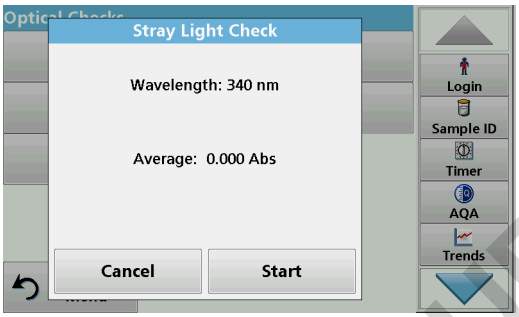
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1. Press **Stray Light Check** in the "Optical Checks" menu.
2. Remove any cuvettes/analysis cuvettes from the cell compartment.
3. Place the cell adapter (A) for 10-mm rectangular cells in the cell compartment (2).
4. Close the cell compartment cover.
5. Press **Zero**.



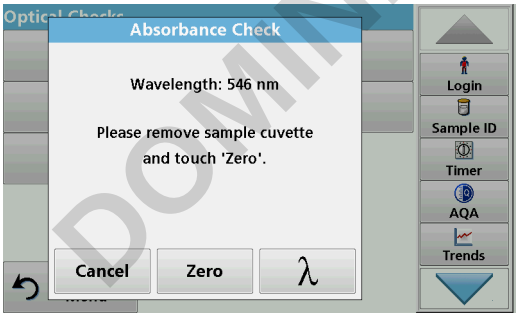
6. Insert the analysis cell into the cell compartment (2).
7. Close the cell compartment cover.
8. Press **Start**.



The mean value is calculated from three consecutive absorbance measurements.
The result will be displayed.

9. Compare the result with the required value from the analysis cell.
10. Press **Cancel** to return to Optical Checks.

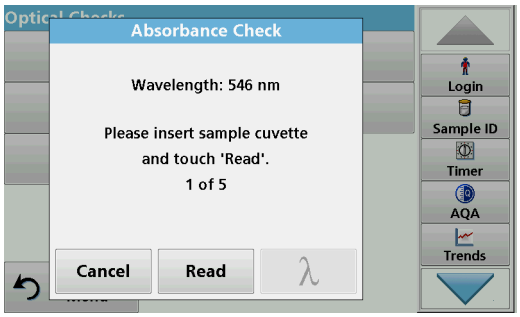
6.8.3.5 Absorbance check



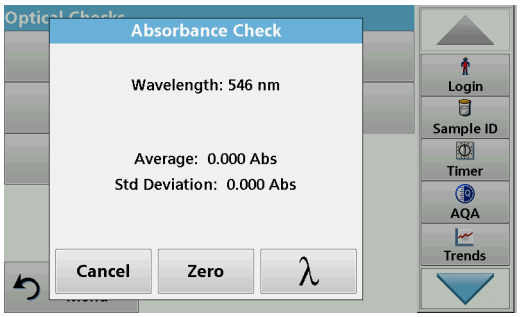
The Absorbance Check test is used to test the photometric accuracy and repeatability of the instrument.

1. Press **Absorbance Check** in the "Optical Checks" menu.
2. Press λ to enter the wavelength.
3. Press **OK** to confirm.
4. Remove any cells from the cell compartment.
5. Close the cell compartment cover.
6. Press **Zero**.

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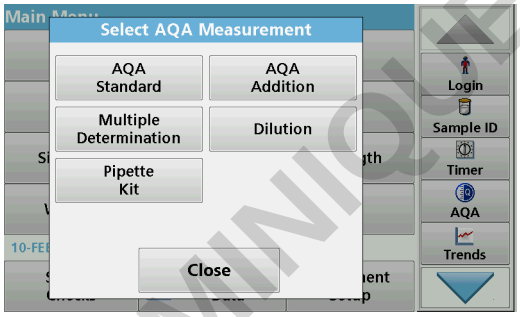
7. Place the analysis cell in the cell compartment.
8. Close the cell compartment cover.
9. Press **Read**.
10. Remove the analysis cell.
11. Close the cell compartment cover.
12. Press **Zero**.
13. Place the analysis cell in the cell compartment.
14. Close the cell compartment cover.
15. Press **Read**.
16. Repeat this procedure until 5 comparison measurements have been obtained.



The result will be displayed.

17. Compare the result with the analysis cell required values.
18. Press **Cancel** to return to Optical Checks.

6.8.4 AQA - Analytical Quality Assurance



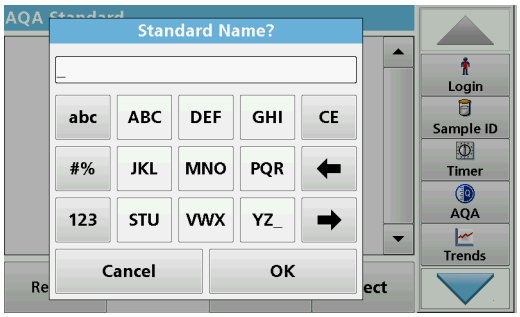
1. Press **AQA** in the System Checks menu to configure AQA measurement or **AQA** in the toolbar to the right of the display, to carry out AQA measurement.

The AQA menu in System Checks contains the program for checking the analytical quality. Configuration is done here, for example the individual working method being controlled by standard solutions or the cross-sensitivities of the analyses identified by standard additon solutions, multiple determinations and dilutions.

As optional accessories for full individual control, standard and top-up solutions are available (Section 9, page 137).

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6.8.4.1 AQA Standard configuration



The working method, photometers, and accessories can be checked by the analysis of a standard solution.

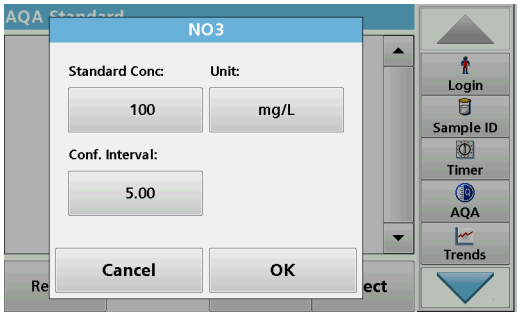
1. Press **AQA Standard**

   A screen with standard sets opens (not available on all models), alternatively an individual standard can be defined.

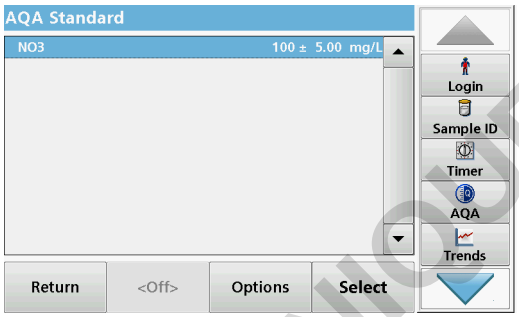
2. Select **Options>New** to define a new standard.

   Note: *If a standard has not yet been defined, in some models the alphanumeric keypad is displayed directly.*

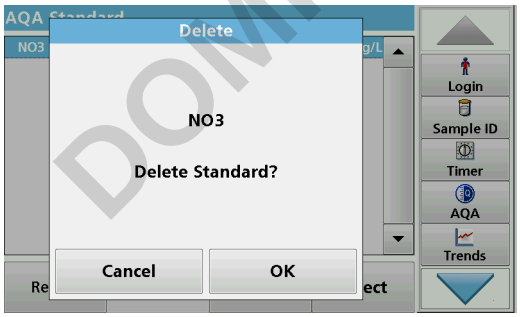
3. Enter the **name** of the standard solution and confirm with **OK**.



4. Enter the **concentration unit** and **confidence interval** by touching the corresponding fields.
5. Press **OK** to confirm the entry.

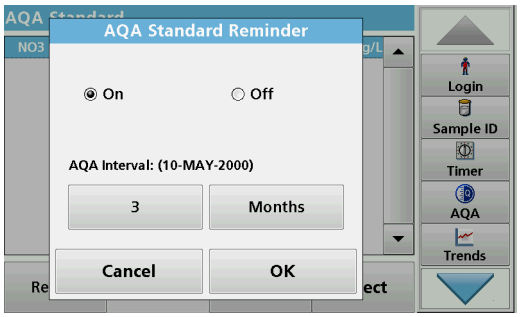


6. All the standard solutions entered are shown on the screen.
7. Select **Options>Edit** to alter the settings.

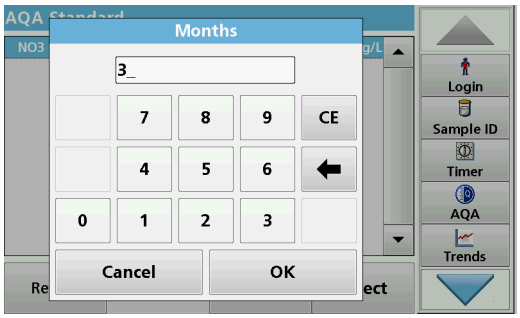


8. Select **Options>Delete** to delete the standard. Select **Options>New** to define a new standard.

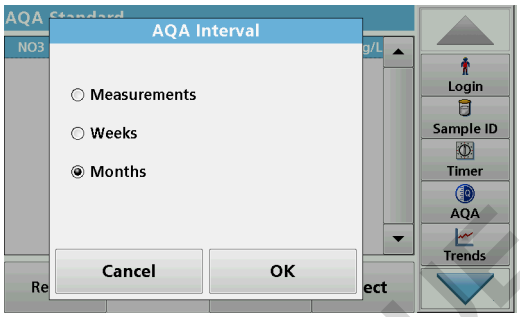
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9. Select **Options>Reminder** to enter an automatic interval when a standard analysis is required to be carried out.
10. Press **On**.

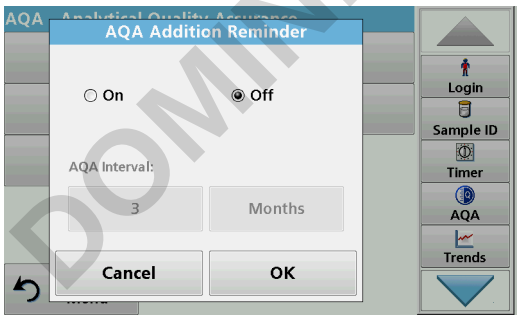


11. Select the required interval. Press **OK** to confirm the entry.



12. Select a unit for the interval. Press **OK** to confirm the entry.

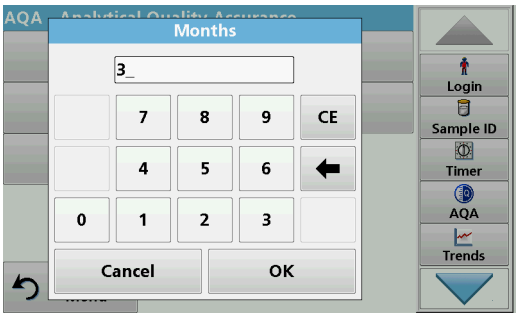
6.8.4.2 AQA Addition



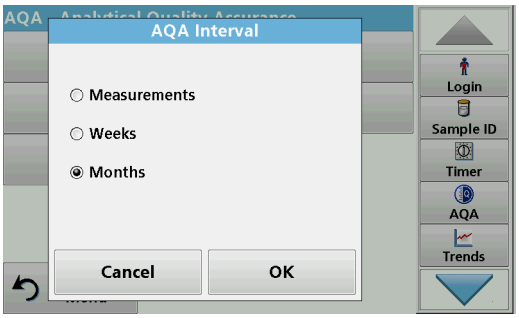
Analysis of an addition solution allows for a check for errors and interferences in the sample.

1. Press **AQA Addition**.
2. Press **On**.

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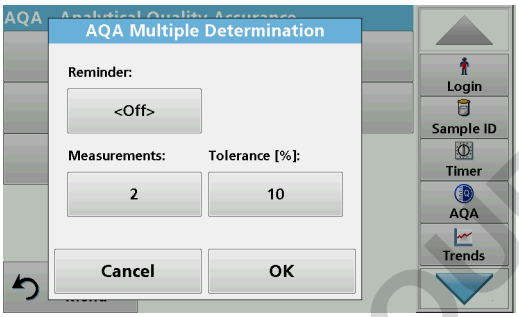


3. Enter the required interval, and the system will automatically issue a prompt to add an analysis. Press **OK** to confirm the entry.

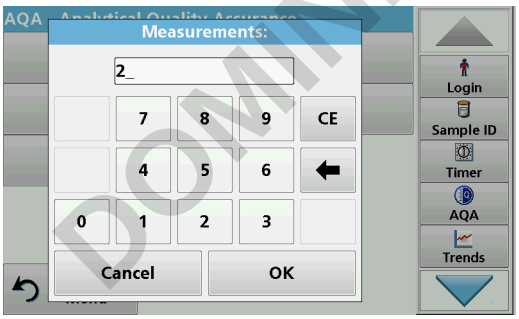


4. Define the required unit for the interval. Press **OK** to confirm the entry.

6.8.4.3 Multiple Determination



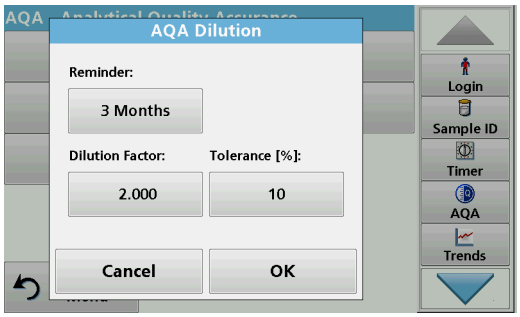
1. Press **Multiple Determination**.
2. Press Reminder**<Off>.**
3. Press **On**.
4. Select the required interval. Press **OK** to confirm the entry.
5. Select a unit for the interval. Press **OK** to confirm the entry.



6. Enter the number of measurements for multiple definitions. Press **OK** to confirm.
7. Enter the tolerance as a percentage. Press **OK** to confirm.
8. Press **OK** to confirm all the entries.

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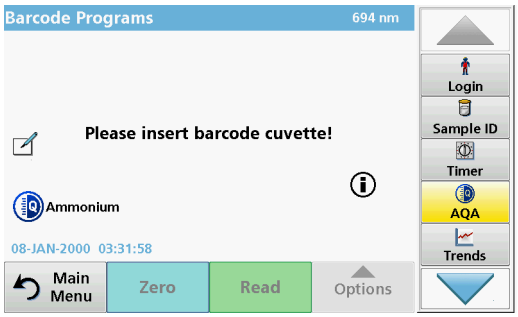
6.8.4.4 Dilution



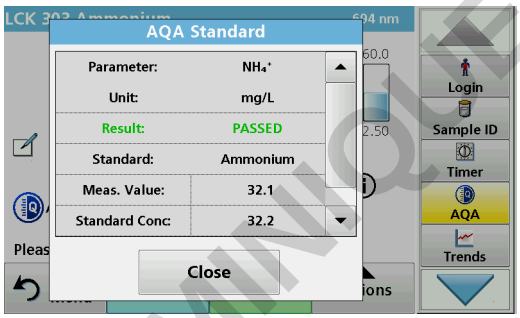
1. Press **Dilution**.
2. Press **On**.
3. Select the required interval. Press **OK** to confirm the entry.
4. Select a unit for the interval. Press **OK** to confirm the entry.
5. Enter the dilution factor. Press **OK** to confirm.
6. Enter the tolerance as a percentage. Press **OK** to confirm.
7. Press **OK** to confirm all the entries.

6.8.4.5 Performing AQA measurement

If a reminder function has been set, once the set interval has elapsed the requirement to perform an AQA measurement is issued.



1. Select the required AQA measure – for example a standard measurement here.
2. Perform the standard measurement via **stored program** or **barcode program**.
3. An AQA symbol is displayed in the measurement window, the AQA key in the toolbar is displayed as yellow.



4. The AQA measure is shown in a log as **Passed** or **Failed**.

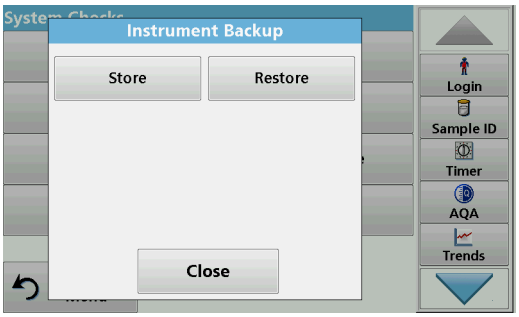
6.8.4.6 Pipette test set

This function and the optional accessories tests the accuracy of the pipette test set. To carry it out follow the instructions in the pipette test set.

6.8.5 Instrument backup

Prior to the next service date, the "**Instrument Backup**" offers the opportunity to store all programs, measurement data, user IDs, passwords, as well as all adjustable data on a USB stick.

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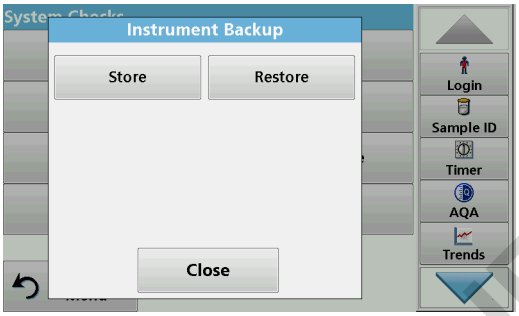


1. Press **Instrument Backup** in the "System Check" menu.
2. Insert the USB stick (refer to section 3.5, page 18).
3. Press **Store** to start a Backup.



If the file was stored, the message "Instrument Backup is stored" will be displayed.

4. Press **OK** to return to the "System Check" menu.



Restore backup data:

Note: *All current data will be overwritten when restoring the Backup file!*

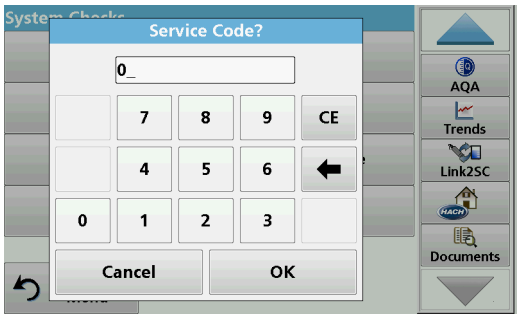
1. Press **Instrument Backup** in the "System Check" menu.
2. Insert the USB stick with the backup (refer to section 3.5, page 18).
3. Press **Restore** to pass back the data.



4. The report "Restore instrument backup from S/N XXXXXXX. ?" displays the version of the backup. Press **OK** to confirm.
5. Restart the instrument after the backup is complete.

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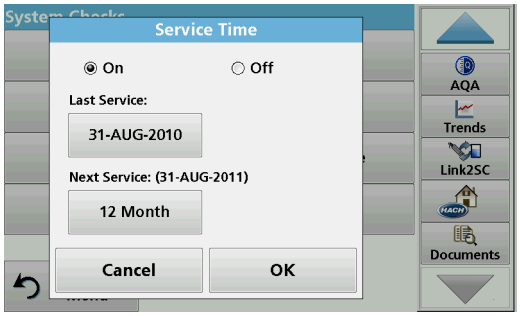
6.8.6 Service menu



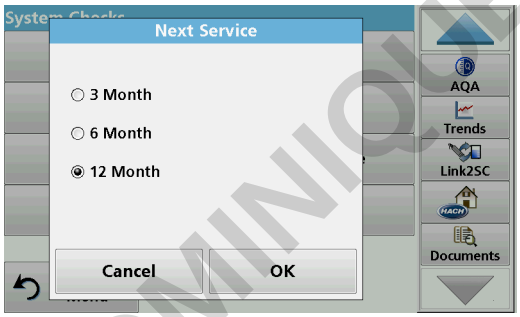
Use of the service menu requires a service code. This menu is reserved exclusively for servicing tasks.

6.8.7 Service time

In order to make sure a regular inspection is performed, an automatic memory reference for the service times can be entered. After switching the instrument on, this memory reference will be activated and indicated at the appropriate time.



1. Press **Service Time** in the "System Check" menu.
2. Activate the **On checkbox.**
3. Press **Last service.**
4. Enter the date of the last service.
5. Press **OK** to confirm the selection.



6. Activate the options field under **Next service.**
7. Select a time interval for the next service.
8. Press **OK** to confirm the selection.

When the next service is due the report "**Next service due!!**" is displayed when the instrument is switched on.

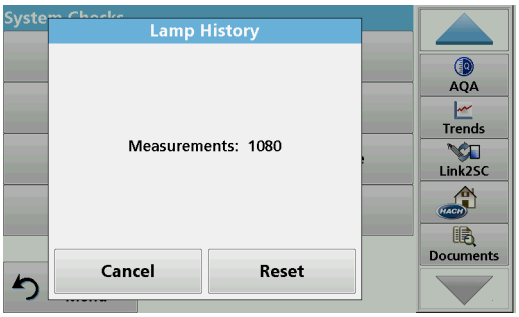
9. Press **OK** to return to the Main Menu.

Contact the manufacturer to schedule the next service date.

6.8.8 Lamps operating time

The "Lamps operating time" provides information on the switch-on cycles of the lamps.

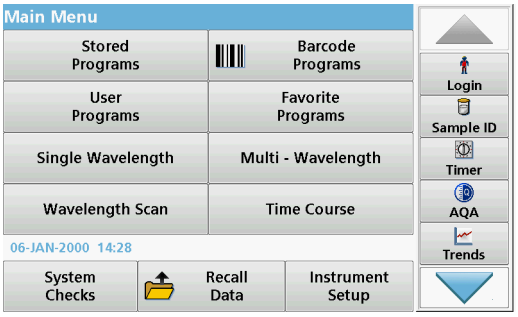
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After a lamp is replaced, the display of the switch-on cycles is reset to 0.

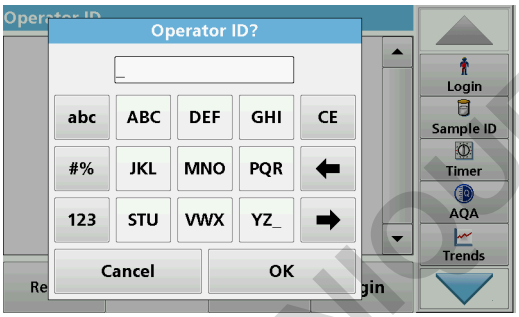
1. Press **Lamp History** in the "System Check" menu.
2. Press **Reset** and the lamp data are reset.
3. Press **OK** to return to the "System Check" menu.

6.9 Toolbar



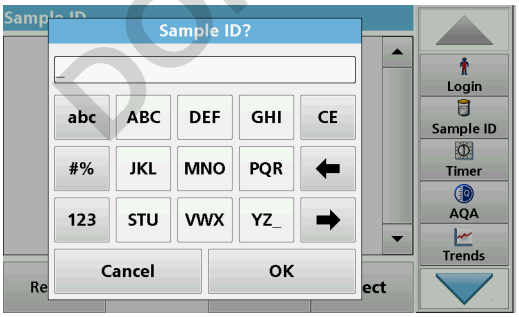
The right of the display contains a toolbar with various programs. Many of these programs can also be called up via a menu but the operation is the same.

6.9.1 Log on



Use this function to enter up to 30 different operator initials (up to 10 characters each) into the instrument. This feature helps record which operator measured each sample. For a detailed description, refer to section 5.2, page 27.

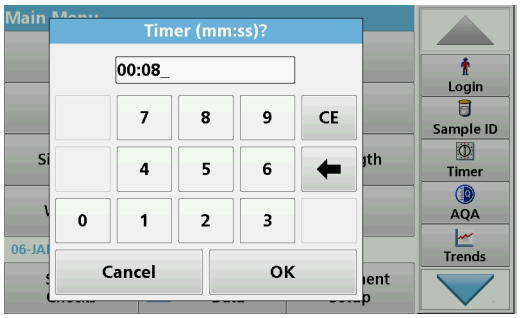
6.9.2 Sample ID



Use this option to enter up to 100 different Sample Identification tags (with up to 20 characters each) into the instrument. Sample IDs can be used to specify the sample location or other sample specific information, for example. For a detailed description, refer to section 5.2.2, page 28.

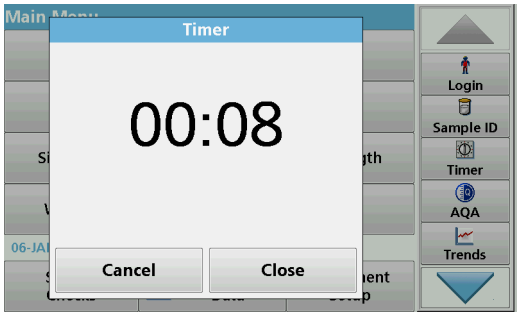
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6.9.3 Timer



Use this function to activate a timer at any time.

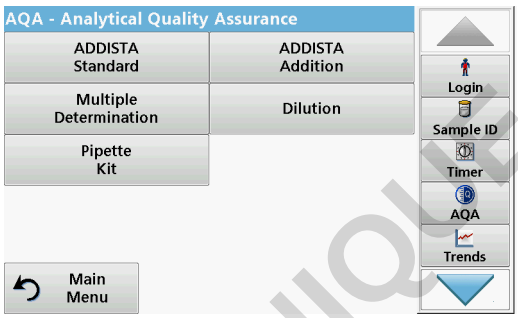
1. In the toolbar, press **Timer**.
2. Enter the required time and confirm with **OK**.



The count-down starts automatically.

3. Press **Close** to let the timer run in the background.
   Press **Cancel** to stop the timer.
4. When the timer has finished a sound is emitted.

6.9.4 AQA



The "AQA" menu contains the programs for testing the analytical quality. For example, this controls the individual working method with standard solutions or the cross-sensitivities of the analyses identified by addition solutions, multiple determinations and dilutions. For a detailed description, refer tosection 6.8.4, page 117.

6.9.5 Trends

Use this function to call up a load curve of the stored measurement values for each parameter or sample location. The concentration of the corresponding parameter is shown graphically over time. For a detailed description, refer to section 5.3.4.1, page 51.

6.9.6 Link2SC

Link2SC enables measurement values to be exchanged between on-line process probes and the DR 3900. In this way on-line data can be verified and process probes can be corrected.

The on-line data are sent to the DR 3900 in a "job file". After the laboratory measurement values have been produced, the job file is sent to the controller again for the corresponding probe to be corrected.

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Data transfer is either via memory card or network (LAN). For a detailed description, refer to the Link2SC operating instructions.

6.9.7 Website DR 3900

Use this function to call up an Internet website on an existing network connection. Current software updates, as well as documentation and information on the DR 3900 can be found here.

The labeling of the key varies from model to model and may vary from the illustration in these instructions.

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⚠ CAUTION

Potential Chemical, Biological Eye and Skin Hazards.

Only qualified personnel should conduct the tasks described in this section of the manual.

NOTICE

Remove all cells remaining in the instrument. Dispose of the cells or their contents in an authorized manner.

7.1 Cleaning requirements

⚠ CAUTION

Potential Pinch, Eye, Burn and Chemical Hazards.

Before cleaning, always disconnect the instrument from the power source.

NOTICE

Never use solvents like turpentine, acetone or similar to clean the instrument, including the display and accessories.

7.1.1 Spectrophotometer

- Only clean the housing, the cell compartments and all accessories with a soft, damp cloth. A mild soap solution can also be used.
- Do not get excess water in the cell compartments.
- Do not insert a brush or sharp object into cell compartment #1 to avoid damaging the mechanical components.
- Dry the cleaned parts carefully with a soft cotton cloth.

7.1.2 Display

- Do not scratch the display. Never touch the display with ball pens, pencils or similar pointed objects.
- Clean the display with a soft, lint- and oil-free cotton cloth. Diluted window cleaner liquid can also be used.

7.1.3 Cuvettes/cells

⚠ CAUTION

Potential Chemical/ Biological Exposure Hazards.

User correct laboratory practices if a risk of chemical exposure exists.

1. After use, clean the glass cells with cleaning agents.

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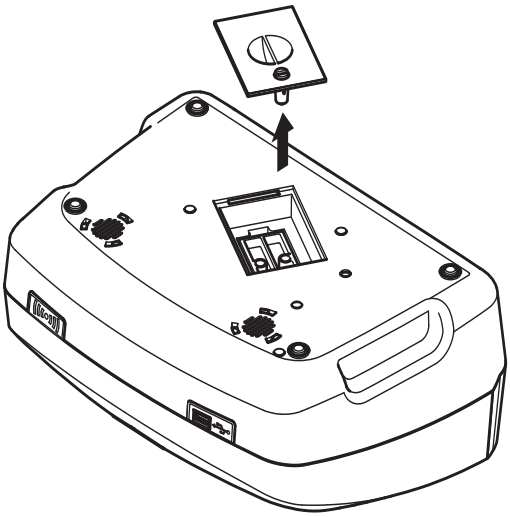
2. Afterwards, rinse the cuvettes/sample cells several times with tap water and then thoroughly with deionized water.

Note: *Glass cuvettes/sample cells that have been used for organic solvents (such as chloroform, benzene, toluene, etc.) must be rinsed with acetone before being treated with cleaning agents. In addition, another rinse with acetone is necessary as a final treatment step before the cuvettes/sample cells are dried.*

7.2 Lamp replacement

⚠ CAUTION

To avoid a possible electric shock, disconnect the instrument from the power source before servicing the lamp.

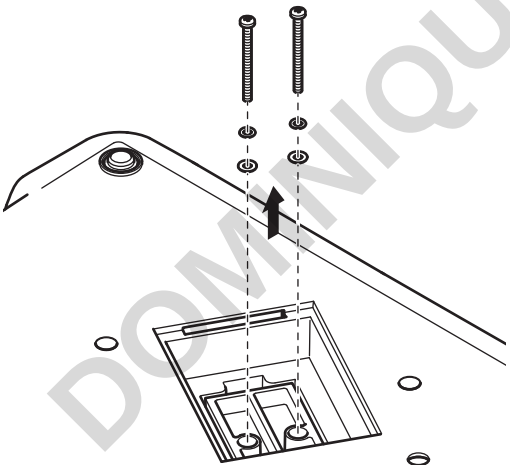


1. Switch off instrument.
2. Remove the power cable from the instrument.
3. Turn the instrument to allow work access to the underside.
4. Using a slot-head screwdriver, undo the lamp cover screws.
5. Remove the cover.

NOTICE

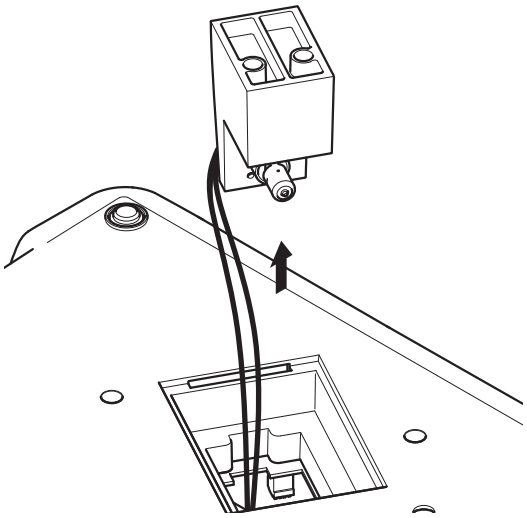
Burn hazard.

Wait until the lamp cools down. Contact with the hot lamp can cause burns.



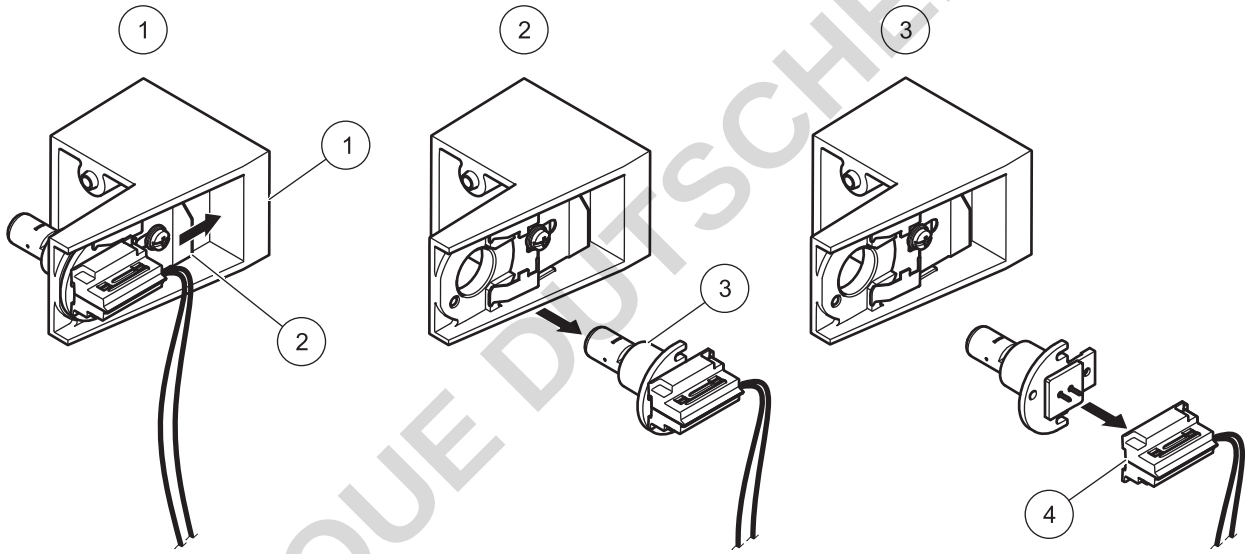
6. Using a cross-head screwdriver, remove the two screws for the lamp holder.

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7. Lift out the lamp holder upwards.
8. Turn the lamp holder so that the connector with the cable guide points forwards.
9. Push the clamp slide as far as possible to the right (Step 1).
10. Grasp the connector along with the lamp, pulling it out of the lamp holder (Step 2).
11. Release the connector from the lamp (Step 3).

Figure 8 Lamp replacement



1	Lamp holder	**3**	Lamp
2	Clamp slide	**4**	Connector

To fit a new lamp carry out the procedure in reverse.

NOTICE

Only hold lamp at lamp holder. Avoid touching the glass, as substances on the skin can bake onto the lamp bulb and thus accelerate the ageing process of the lamp.

1. Connect a new lamp to the connector.
2. Install the lamp with the connector in the lamp holder.
3. Secure the lamp with the clamp slide. To do this, push the connector downwards and push the clamp slide as far as possible to the left.

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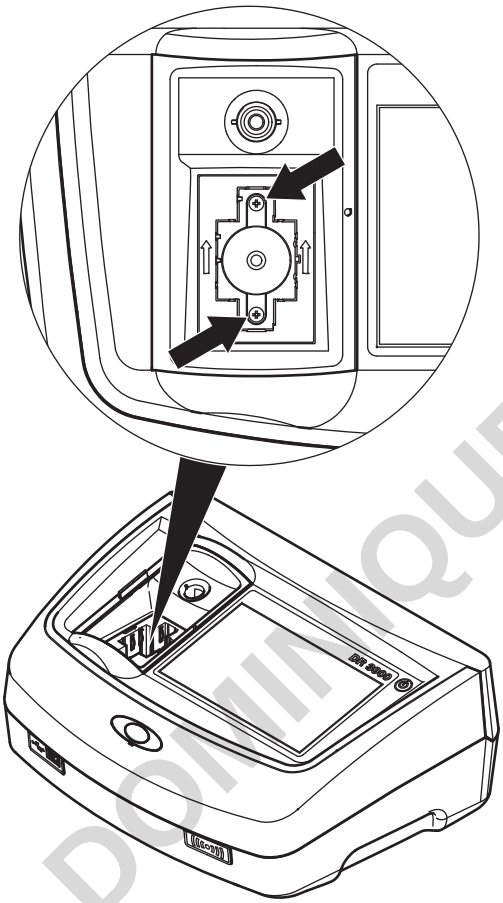
4. Install the lamp holder in the instrument.

   Note: *Take care that the lamp cable is not pinched by the cable guide.*

5. Using a cross-head screwdriver, tighten the two lamp holder screws.
6. Replace the lamp cover.
7. Using a slot-head screwdriver tighten the cover screws.
8. Connect the power cable to the instrument.
9. Reset the lamp operating time section 6.8.8, page 123.

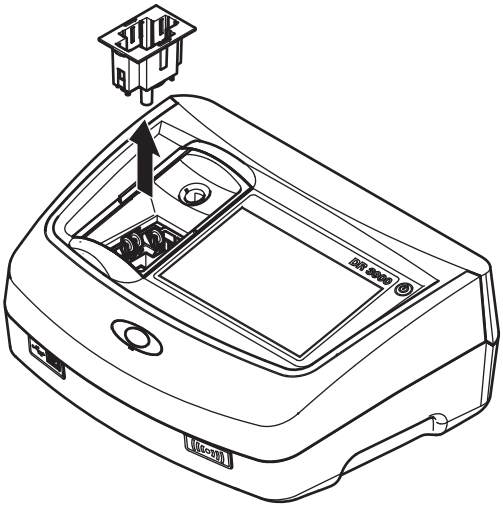
7.3 Exchange of the replaceable cell compartment

If there is severe soiling, the complete cell compartment (2) can be replaced.



1. Switch off instrument.
2. Remove the power cable from the instrument.
3. Using a cross-head screwdriver, undo the two screws on the floor of the cell compartment.

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4. Lift the cell receptacle upwards and out.
5. Emplace the new cell receptacle so that the pressure rollers guide slot is to the left.
6. Using a cross-head screwdriver, tighten the two screws on the floor of the cell compartment.
7. Connect the power cable to the instrument.

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Error displayed	Definition	Resolution
Attention! **Please insert the light shield.**	Readings with barcode cuvettes generally require the light shield.	Insert the light shield. Press **OK**.
Barcode label not read	Barcode faulty	Reinsert the cell. If the barcode is not recognised, contact the manufacturer or his representative.
An error occurred when uploading the instrument data.		Start the procedure again or contact technical support.
An error occurred when reading from the USB memory stick.		Start the procedure again or contact technical support.
An error occurred when writing to the USB memory stick.		Start the procedure again or contact technical support.
Please check on the current update file.	Error during update.	Check the USB memory stick.
Please contact Customer Service.	Error during update.	
Please check network configuration.		
Please check the connection.		
Please close the cover.		Close the cover.
Please insert the USB memory stick.		Insert a USB memory stick into a USB A port on the instrument.
Please check the connection and contact the administrator.	Network setup or FTP error	
Blank value correction not possible!	Blank value correction not possible with LCW919.	
File for instrument update missing.	Error during update.	Check the USB memory stick.
File for instrument update is faulty.	Error during update.	Save the update file again and repeat the procedure.
It's recommended to execute a Full System Check	Check of the air values failed	Switch the instrument off and then back on again. If the system check is not successful, contact the manufacturer or his representative.
Entry invalid!	Password incorrect	Forgotten your password? Contact the manufacturer or his representative.
Absorbance > 3.5!	The measured absorbance exceeds 3.5	Dilute sample and measure again
Fault **Barcode check number?** **Please update program data!**	Deviation to the stored data	Update program data
Error when calling up the local IP address.	Network setup: DHCP client has no connection to the DHCP server	Enter the IP address again.
Error during default gateway setup.	Network setup: default gateway cannot be set for fixed IP address	Try to create the connection again.
Error during network drive setup!	Error during network setup	Check the settings.
Error during subnet mask setup.	Network setup: Subnet mask cannot be set for fixed IP address	Enter the subnet mask again.

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Error displayed	Definition	Resolution
Error copying from USB memory stick.	Error during update	Start the procedure again or contact the manufacturer or his representative.
Error in FTP connection.	FTP error	Make sure that the instrument is connected to the network.
Fault **Program not accessible.** **Please update program data!**	Barcode test not present	Update program data
Fault **Clean cuvette!**	The cuvette is dirty or there are undissolved particles in the cuvette	Clean the cuvette; allow the particles to settle
Fault **Test program stopped!** **Please check lamp** **Close the lid.** **Error [xx]**	Test program stops when the instrument is started	Check the lamp and replace it if necessary. Close lid. Press **Start Again**.
Fault **Test program stopped!** **Please remove the cuvette** **Close the lid.**	Test program stops when the instrument is started	Remove the cuvette/sample cell from the cell compartment. Press **OK**.
Error **Selfcheck stopped.** **Hardware error.** **Error [x]**	Electronic defect	Contact technical support and indicate the error number
Error **Too much ambient light!** **Move instrument into shade** **or close the lid**	The instrument sensors detects too much ambient light.	Decrease ambient light. (Avoid direct sunlight.) Close lid.
No help function is available for this program.		
Shelf life exceeded! **Use chemicals?**		The analysis is possibly erroneous. Use new chemicals
No evaluation!	Error in the test database / user database	Check programming Contact technical support
No barcode!	No barcode found	Reinsert the cell. If the barcode is not recognised, contact the manufacturer or his representative.
No instrument backup present!		Check the USB memory stick.
No valid data for these parameters!	Data analysis not possible, no measurement data	Change the selection.
No valid data found!	View Data not possible in data log	Change the selection.
No measurement data present!	Data analysis settings cannot be configured without measurement data.	Change the selection.
Control range not reached!	Data analysis limits not reached	This is a warning notice. The control limit set was not reached.
Control range exceeded!	Data analysis limits exceeded.	This is a warning notice. The control limit was exceeded.
Concentration too high!	Calculated concentration is higher than 999999	Dilute sample and measure again
Over measuring range	The measured absorbance is above the calibration range of the test	Dilute sample and measure again

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Error displayed	Definition	Resolution
Under measuring range	The measured absorbance is below the calibration range of the test	If possible, select a test with a lower reading range or use a cuvette with a longer path length
Possible interference by:	Interference Check	The analysis is possibly erroneous due to interferences.
Possible interference from:	Interference Check	The analysis is possibly erroneous due to interferences.
Next service is due!	The service reminder is activated.	Contact technical support for an inspection of the instrument. For setting the service reminder, refer to section 6.8.7, page 123
Negative result!	The calculated result is negative	Check concentration of sample
Network switched off.	Network setup off, when accessing the Instruments homepage via the sidebar	Activate the online connection.
Remote server cannot be reached.	Error during network setup	Make sure that the instrument is connected to the network.
Unstable lighting conditions!		Avoid direct sunlight at the measuring location.
Insufficient memory for update .	Error during update.	Select a memory with more space.
System check incorrect!	Measurement of air values failed	Switch the instrument off and then back on again. If the system check is not successful, contact technical support.
Temperature too high. Measurement not possible!		Switch of the instrument and allow it to cool for a few minutes. If necessary, move it to a cooler place.
Update file is faulty.	Error during update.	Save the update file again and repeat the procedure.
USB memory stick is not connected.	Update not possible.	Check the USB memory stick.
Web server cannot be reached.	Instruments homepage cannot be reached	Try the connection again later. Make sure that the instrument is connected to the network.

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Section 9 Replacement parts

9.1 Accessories

Description	Cat. No.
SIP 10 sipper set for DR 3900 with 1 inch round cell, EU	LQV157.99.10001
RFID read/write device LOC 100: Transponder for location RFID, EU	LQV156.99.10001
DR/check gel test standard	2763900
Verification kit	LZV537
Test solution	LZV810
Hand barcode scanner	LZV566
USB-Memory Stick	LZV568
Protective cap for USB port	LZV881
USB extension cord	LZV567
SD memory card	LZY520
Reader for SD/MMC memory card, USB connection	LZY522
Ethernet cable, shielded, 2 m in length.	LZV873
Interface cable USB - computer	LZV632
Cross-over cable	LZX998
1 inch rectangular cells, matched pair, glass (10 ml)	2495402
1 cm rectangular cells, matched pair, glass (3.5 ml)	2095100
1 cm rectangular cell, quartz	2624410
1 inch round cell, glass, with cap (10 ml)	2122800
13 mm round cells with rubber stopper	LCW906
1 cm single use rectangular micro-cell (1.5 ml)	2629500
1 cm rectangular plastic cells	2743400
5 cm rectangular cell, glass (17.5 ml)	2629250
5 cm rectangular cell, quartz (17.5 ml)	2624450
5 cm rectangular cell, plastic with lid	LZP341
5 cm semi-micro cell, optical special glass	LZP269
1 cm rectangular flow cell, quartz, (450 µl)	LZV510
5 cm rectangular flow cell, quartz (370 µl)	LZV649
Stoppers, neoprene for 1 inch rectangular cells	1480801

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9.2 Replacement parts

Description	Cat. No.
Halogen lamp	LPZ440.99.00007
Cell adapter A for 1-cm rectangular and 1-inch round cells	LZV846
Cell adapter B for 3-cm rectangular cells, China only	LZV847
Light shield	LZV849
Bench top power supply	LZV844
Power cord EU	YAA080
Power cord CH	XLH051
Power cord UK	XLH057
Power cord US	XLH055
Power cable China/Australia	XLH069
Dust Cover	LZV845
Cell compartment	LZV848

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The manufacturer warrants that the product supplied is free of material and manufacturing defects and undertakes the obligation to repair or replace any defective parts at zero cost.

The warranty period for instruments is 24 months. If a service contract is taken out within 6 months of purchase, the warranty period is extended to 60 months.

With the exclusion of further claims, the supplier is liable for defects including the lack of assured properties as follows: All those parts that, within the warranty period calculated from the day of the transfer of risk, can be demonstrated to have become unusable or that can only be used with significant limitations due to a situation present prior to the transfer of risk, in particular due to incorrect design, poor materials or inadequate finish will be improved or replaced, at the supplier's discretion. At the discretion of the supplier, these deficiencies will be corrected or the instrument replaced. The identification of such defects must be notified to the supplier in writing without delay, however at the latest seven days after the identification of the fault. If the customer fails to notify the supplier, the product is considered approved despite the defect. Further liability for any direct or indirect damages is not accepted.

If equipment-specific maintenance and servicing work defined by the supplier is to be performed within the warranty period by the customer (maintenance) or by the supplier (servicing) and these requirements are not carried out, claims for damages are rendered void due to the failure to comply with the requirements.

Any further claims, in particular claims for consequential damages, cannot be made.

Consumables and damage caused by imcorrect handling, unsafe assembly or by incorrect use are excluded from this provision.

The instruments of the manufacturer are of proven reliability in many applications and are therefore often used in automatic control loops to provide the most economical possible operation of the related process.

To avoid or limit consequential damage, it is therefore recommended to design the control loop such that a malfunction in an instrument results in an automatic change over to the backup control system, which is the most secure operating condition for the environment and for the process.

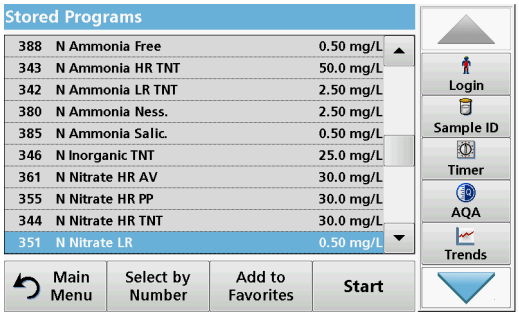
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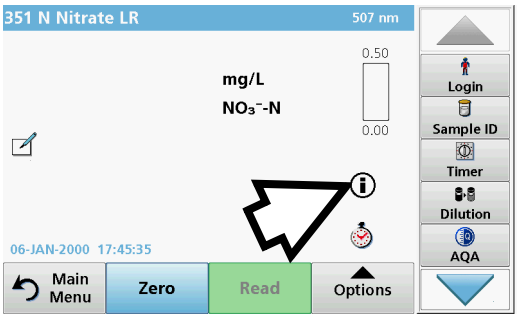
Appendix A Help Guide

The Help Guide is a step by step set of instructions for the DR 3900, for the execution of a stored program or procedure in accordance with process specifications. The Help Guide is available for the most used HACH LANGE tests and the Hach powder pillow reagent tests.

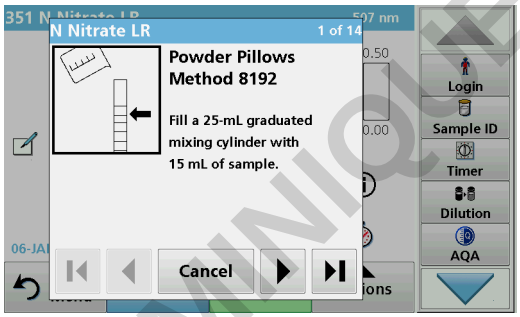
A.1 Display of the Help Guide for stored programs



1. Press **Stored Programs** in the Main Menu to view an alphabetical list of stored programs with program numbers. Highlight the required test and press **Start**.



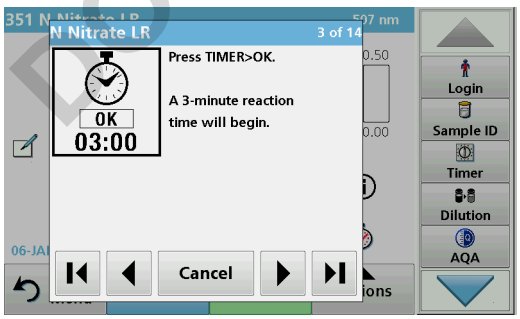
2. Press the information icon.



3. The first procedure step according to the selected test/method will be displayed.

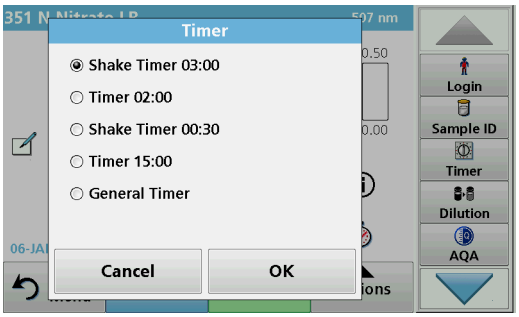
   Note: *Use the arrow keys to navigate through the next or previous pages or to the first or last page.*

4. Follow the step-by-step descriptions on the screen.



5. If the method requires a timer, press **Cancel** and then press the timer icon.

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A list of preset times will be displayed.

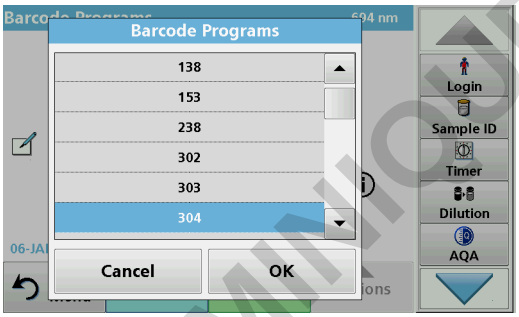
6. Select the necessary time.
7. After the timer has finished, return to the Help Guide by pressing the information icon.
8. The next help screen will be activated
9. Press **Cancel** to return to the reading screen of the test/method.
10. Press the information icon to return to the last current page of the Help Guide and proceed with the test.

A.2 Display of the Help Guide for barcode programs

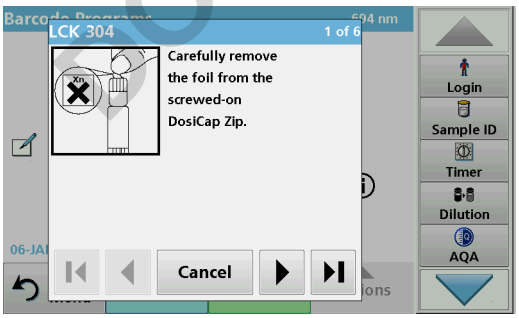
1. Insert the light shield in cell compartment (2).
2. Press **Barcode Programs** in the Main Menu. Refer to section 5.5, page 64 for more information.



3. Press the information icon.



4. The list of barcode tests is shown in ascending numerical order.
5. Select the required test.

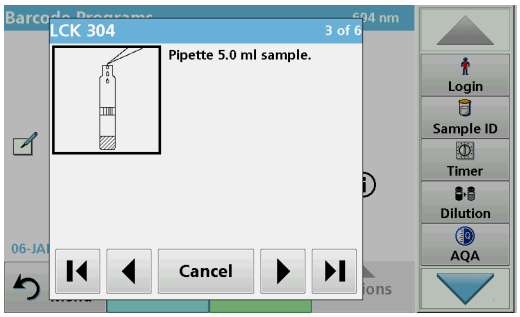


6. Prepare the barcode test in accordance with current process specifications and follow the step-by-step instructions for the procedure.

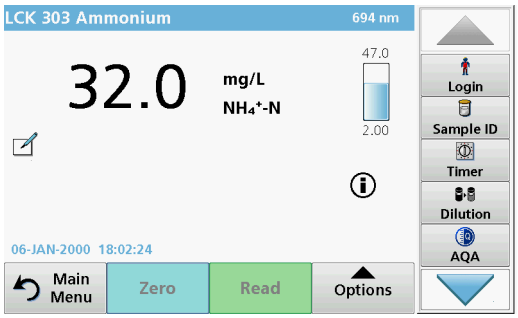
   Note: *Make sure that the values of the current process specification are used.*

   Note: *Use the arrow keys to navigate through the next or previous pages or to the first or last page.*

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7. Press **Cancel** to return to the measurement screen for the test.
8. Press the information icon to return to the last current page of the Help Guide and complete the test.
9. Insert the zero cell or sample cell (corresponding to the process specification) into the cell compartment.



The reading is started automatically and the results are displayed.

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