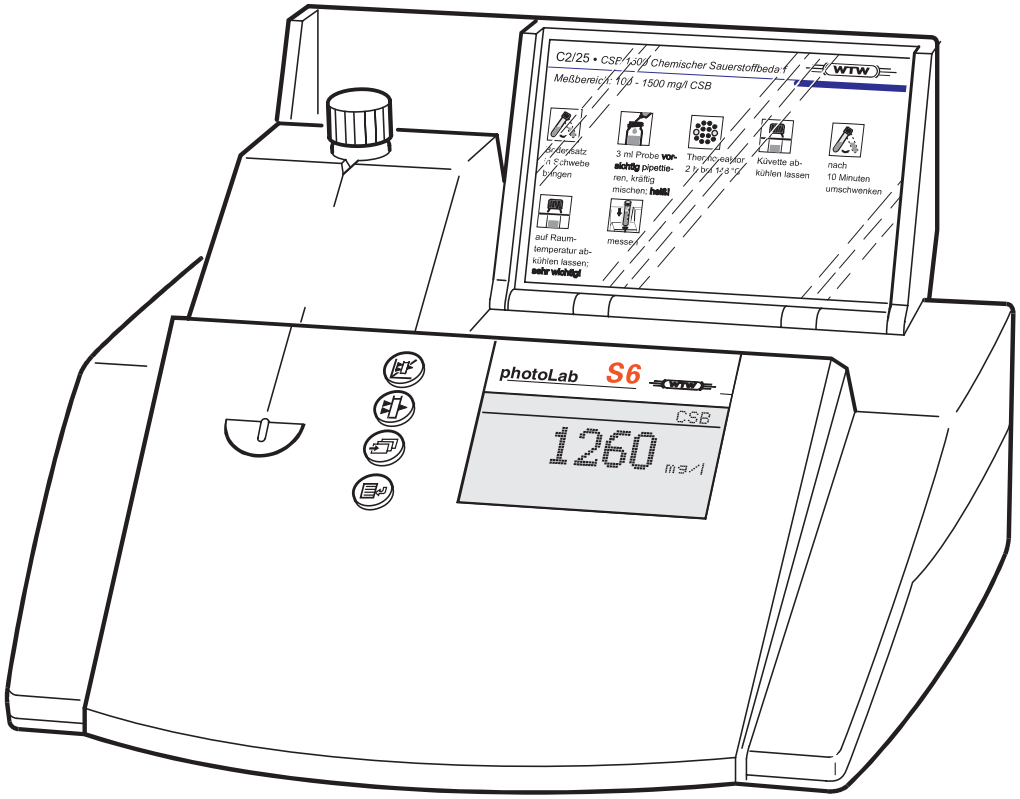
photoLab S6



Operating Instructions

Part 1: General Information

Part 2: Functional Description

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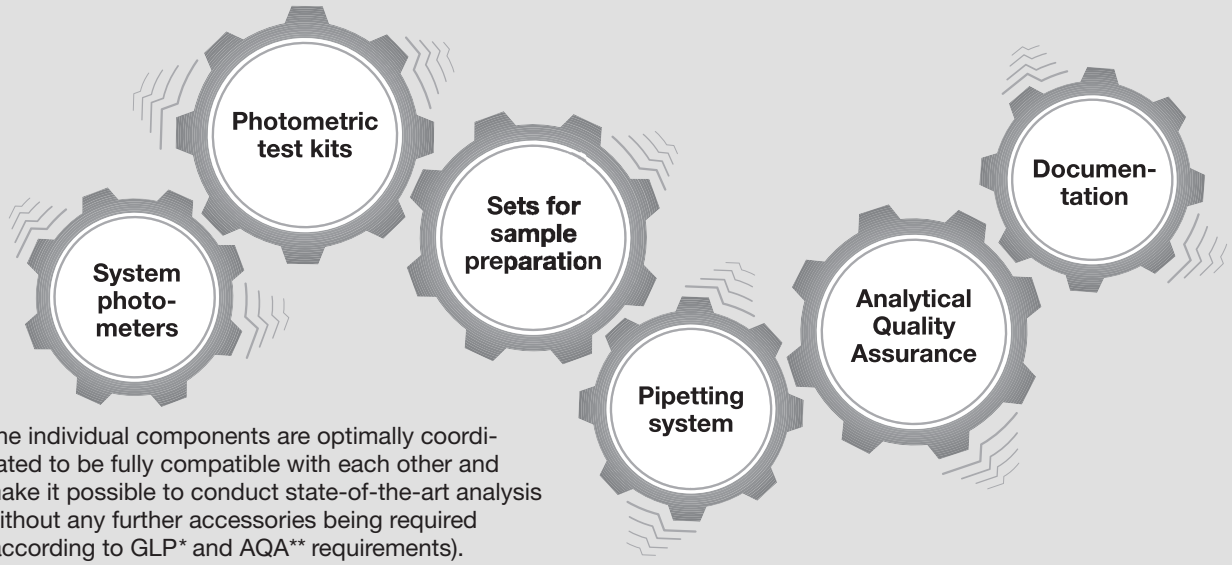
Contents

The **Spectroquant® Analysis System** consists of the following components:

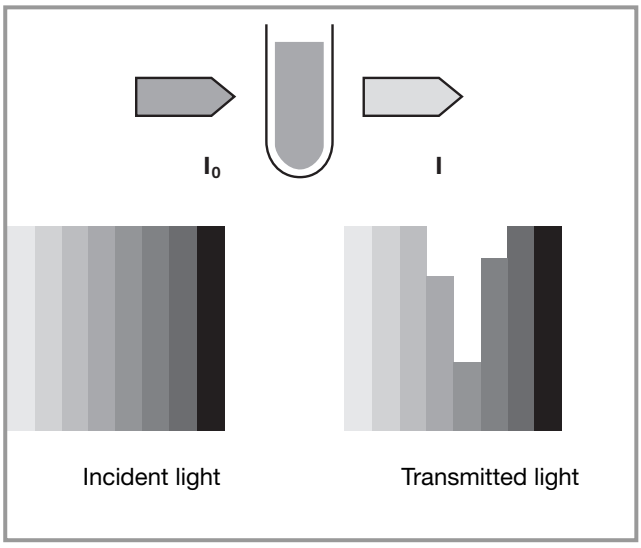


The individual components are optimally coordinated to be fully compatible with each other and make it possible to conduct state-of-the-art analysis without any further accessories being required (according to GLP* and AQA** requirements).

1. Photometers

1.1 Photometry

When a beam of light is transmitted through a coloured solution, then this beam loses its intensity, in other words a part of the light is absorbed by the solution. Depending on the substance in question, this absorption occurs at a specific wavelength.



The wavelength is selected from the overall spectrum of white light emitted by a tungsten-halogen lamp using narrow-band interference filters or other monochromators.

The intensity of the absorption can be characterized using the transmittance T (or, respectively, T in percent).

$$T = I/I_0$$

I_0 = Initial intensity of the light
I = Intensity of the transmitted light

If the light is not absorbed at all by a solution, then this solution has a transmittance of 100 %; a complete absorption of the light in the solution means 0 % transmittance.

The measure generally used for the absorption of light is the absorbance (A), since this correlates directly with the concentration of the absorbing substance. The following connection exists between absorbance and transmittance:

$$A = -\log T$$

Experiments by BOUGUER (1698–1758) and LAMBERT (1728–1777) showed that the absorbance is dependent on the thickness of the absorbing layer of the cell used. The relationship between the absorbance and the concentration of the analyte in question was discovered by BEER (1825–1863). The combination of these two natural laws led to the derivation of *Lambert-Beer's* law, which can be described in the form of the following equation:

$$A = \varepsilon_\lambda \times c \times d$$

ε_λ = Molar absorptivity, in l/mol x cm
d = Path length of the cell, in cm
c = Concentration of the analyte, in mol/l

*GLP – Good Laboratory Practice **AQA – Analytical Quality Assurance

1. Photometers

1.2 The Photometers

The photometers that belong to the Spectroquant® Analysis System differ from conventional photometers in the following important aspects:

- The calibration functions of all test kits are electronically stored.
- The measurement value can be immediately read off from the display in the desired form.
- The method is selected via the AutoSelect function (bar code on the cells/on the AutoSelector for reagent tests).
- The photometers possess AQA (Analytical Quality Assurance) functions to assure the quality of the measurement.
- New methods can be downloaded from our homepage www.merck.de and stored permanently in your photometer.

For technical data and instructions for use please refer to the section “Function description”.

2. Photometric Test Kits

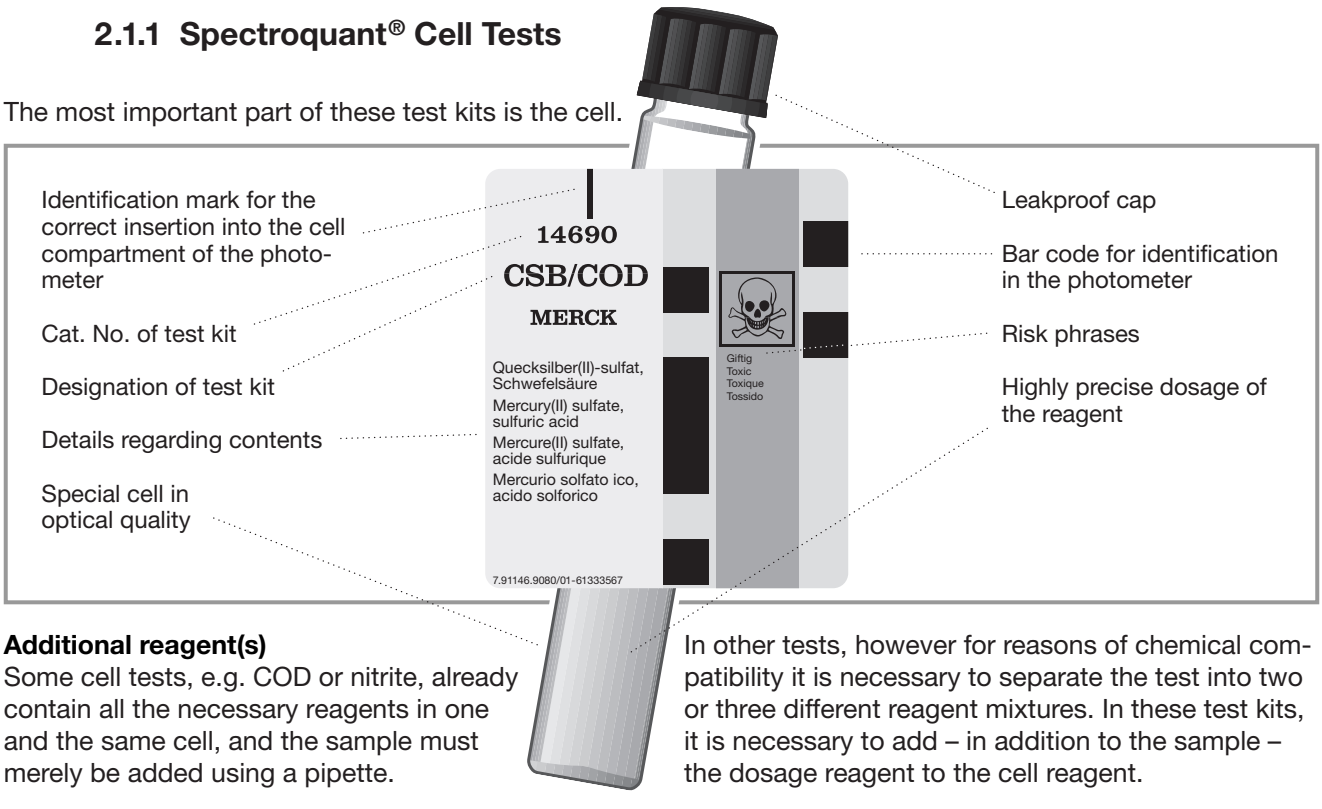
2.1 Basic Principle

By means of reagents, the component of a sample to be analyzed is converted into a coloured compound in a specific reaction. The reagents or reagent mixtures contain – in addition to the reagent selective for the parameter to be determined – a number of auxiliary substances that are essential for the course of the reaction. These include, for example, buffers for adjusting the pH to the optimal value for the reaction, and masking agents that suppress or minimize the influence of interfering ions.

The colour reactions are in most cases based on modified classical – in many cases also normed – analytical procedures. Details on the respective reference procedures are stated in the package insert or else in the parameter overview.

2.1.1 Spectroquant® Cell Tests

The most important part of these test kits is the cell.



Additional reagent(s)
Some cell tests, e.g. COD or nitrite, already contain all the necessary reagents in one and the same cell, and the sample must merely be added using a pipette.

In other tests, however for reasons of chemical compatibility it is necessary to separate the test into two or three different reagent mixtures. In these test kits, it is necessary to add – in addition to the sample – the dosage reagent to the cell reagent.

2.1.2 Spectroquant® Reagent Tests

The principle behind the reagent tests is that the reagents necessary for the colour reaction are combined in the form of liquid concentrates or solid-substance mixtures. In these tests, a few drops of the respective reagent concentrate are added to, for example, 5 ml of sample. This means that there is no need to dilute the sample, which in turn enhances the sensitivity of the detection. The making up of a sample in a volumetric flask to a defined volume usual in conventional photometry can be dispensed with.

2.2 Notes for Practical Use

2.2.1 Measuring Range

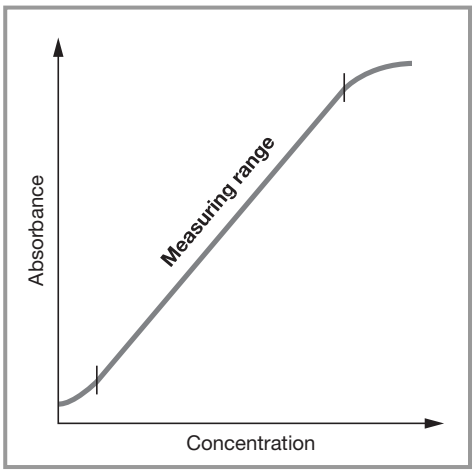
The intensity of the colour of a solution, measured as the absorbance, is proportional to the concentration of the respective analyte only within a specific range. This measuring range (effective range) is electronically stored in the photometers for each individual test kit (see overview table in section 1.3).

Below the specified measuring range, either a different cell or else another procedure must be used. The **lower limit of the measuring range** either takes the form of nonlinearity of the calibration curve, as shown in the figure below, or else is given by the limit of detection. The **limit of detection** of a given analytical method is the lowest concentration that differs from the zero concentration with a defined probability (e.g. 99%).

The **upper limit of the measuring range** is characterized by there no longer being any linear correlation between analyte concentration and absorbance. In such a case the sample must be diluted accordingly so that it lies ideally in the middle of the effective range (least-error measurement).

In photometry it is conventional practice to measure against the reagent blank value. Here the analysis is carried out “blind”, i.e. without any analyte added. Instead of the sample volume, the corresponding quantity of distilled or DI water is used. This **reagent blank value is already electronically stored** in the system photometers, meaning that a separate measurement is not necessary. It is possible, however, to enhance the accuracy of the determination at the measuring-range limit by measuring against a self-prepared reagent blank solution (for adjustment see Function description, “Blank-value correction”).

There are, however, also cases in which the colour intensity of the solution and thus the absorbance drop off again at **very high analyte concentrations**. These exemplary cases are listed in the table below. The values indicated in the display are correct up to the concentrations specified in the third column, and false measuring values are obtained above these concentrations. In such a case it is necessary to conduct a plausibility check by running preliminary tests using test strips or dilution.



Art.	Method	Correct indication of result up to sample conc.	Colour change
14752	Ammonium	25 mg/l	turquoise instead of green
14558	CT Ammonium	250 mg/l	turquoise instead of green
14544	CT Ammonium	100 mg/l	turquoise instead of green
14559	CT Ammonium	5000 mg/l	turquoise instead of green
14828	Chlorine	30 mg/l	yellow instead of red
14557	CT Fluoride	4 mg/l	brownish-yellow instead of violet
14553	CT Copper	25 mg/l	light blue/turquoise instead of blue
14767	Copper	25 mg/l	light blue/turquoise instead of blue
14551	CT Phenol	100 mg/l	weakening of colour
14831	Silver	5 mg/l	no change (flocculation)

2.2.2 Influence of pH

Chemical reactions follow an optimal course only within a certain pH range. The reagents contained in the test kits produce an adequate buffering of the sample solutions and ensure that the pH optimal for the reaction in question is obtained.

Highly acidic (pH < 2) and strongly alkaline (pH > 12) solutions can prevent the pH from being adjusted to an optimal range, since under certain circumstances the buffering capacity of the test-kit reagents may not be sufficient. In such cases the pH must be corrected by adding diluted sulfuric acid (0.5 mol/l; lowers the pH) or diluted sodium hydroxide solution (1 mol/l; raises the pH) dropwise, testing the pH with suitable indicator strips after each drop is added. The addition of the acid or lye results in a dilution of the test solution. When up to five drops are added to 10 ml of sample, the change in the volume can be neglected, since the resultant error is lower than 2 %. The addition of larger quantities should be duly considered by adjusting the sample volume accordingly.

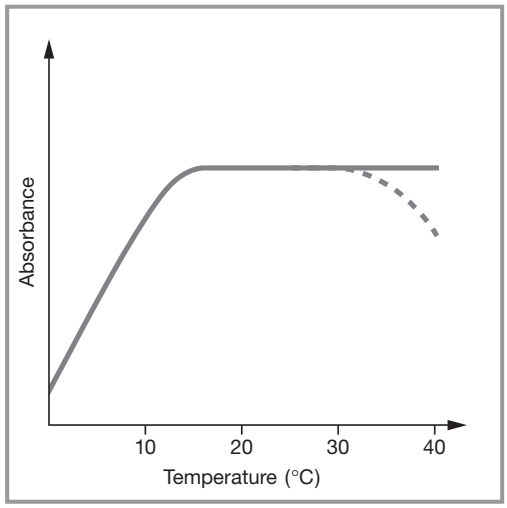
The specified pH values for the sample solution and, wherever applicable, for the measurement solution are defined in the respective package inserts and in the analysis instructions in chapter 3 of the manual.

2.2.3 Influence of Temperature

The temperature of the sample solution and reagents has a varying influence on the colour reaction and thus on the measurement result. The typical temperature course is illustrated in the figure at the right.

If the sample temperature is lower than 15 °C, false-low results must be reckoned with. Temperatures exceeding 30 °C generally influence the stability of the compound that is formed in the reaction. The optimal temperature for the colour reaction is stated in the package inserts of the respective Spectroquant® test kits.

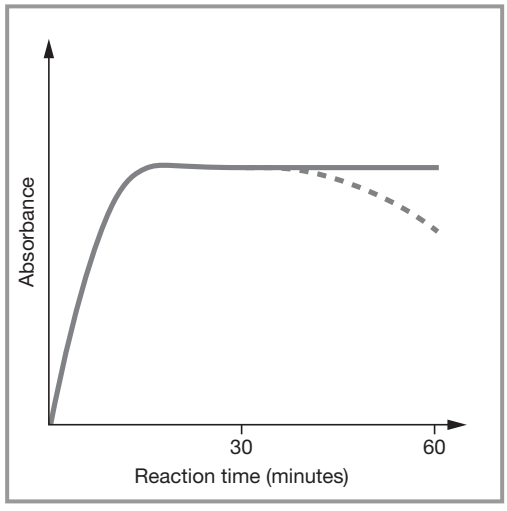
Attention! After thermic decomposition procedures, the determination of COD or total contents of nitrogen, phosphorus, or metal, a sufficient waiting time must be allowed for to permit the solution cool to room temperature.



2.2.4 Time Stability

Most of the colour reactions require a certain time to reach the maximum colour intensity. The solid curve in the figure at the right gives a schematic impression of a typical time course. The behaviour of relatively instable colour reactions with time is shown by the dotted curve.

The reaction time specified in the working instructions refers to the period of time from the addition of the last reagent until the actual measurement. In addition, the package inserts for the individual test kits also state the time interval in which the measurement value does not change. The maximum time interval is 60 minutes; this time should not be exceeded, even in the case of stable colour reactions.



2.2.5 Influence of Foreign Substances

Foreign substances in the sample solution can

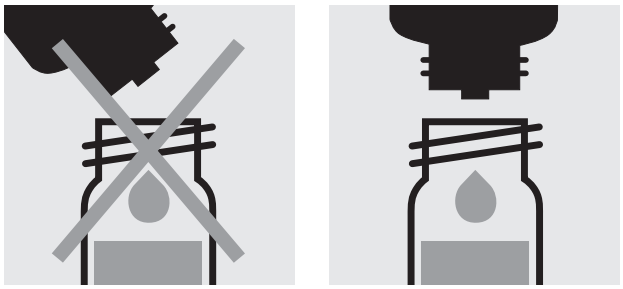
- raise the measurement value as a result of an amplification of the reaction, or
- lower the measurement value as a result of a prevention of the reaction.

A quantification of the effects is stated in tabular form in the respective package inserts for the most important foreign ions. The tolerance limits have been determined for the individual ions; they may not be evaluated cumulatively.

Suitability for use in salt water
A tabular survey (see pages XVI–XVII) provides information on the suitability of the tests in connection with salt water and also on the tolerances for salt concentrations.

2.2.6 Dosing the Reagents

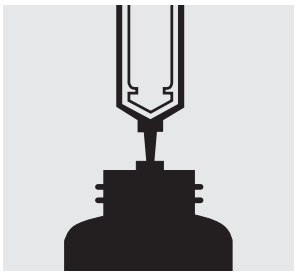
Small amounts of liquids are dosed by counting the number of drops from the leakproof bottle.



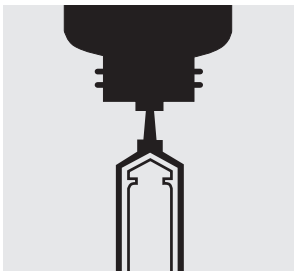
When using a dropping bottle, it is imperative that the bottle be held vertically and the reagent be slowly added dropwise (approx. 1 drop per second). Otherwise the correct drop size will not be achieved and the amount of reagent will be incorrect.

Larger amounts of liquids are dosed with the piston syringe enclosed with the respective test kit.

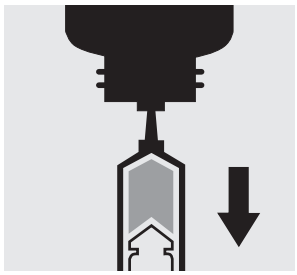
Handling:



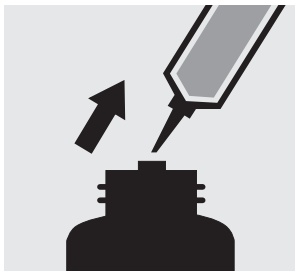
Depress the piston of the syringe to the zero position. Place the tip of the syringe firmly on the leakproof attachment of the bottle.



Turn the bottle with the piston syringe 180° so that the piston syringe is positioned underneath the bottle.



Slowly withdraw the piston downwards to the required volume (orientation aid: upper edge of the piston ring!). In the event that air bubbles are drawn into the syringe with the reagent, the syringe contents must be pressed back into the bottle and the filling process repeated.



Once the syringe has been filled free of air bubbles, turn the bottle with the piston syringe 180° back to the original position. Remove the filled piston syringe from the attachment of the bottle and carefully inject the contents into the reaction vessel.

In some cases in which an exact dosage of – generally small – quantities of reagent is called for, it is necessary to conduct the dosage procedure using a positive-displacement pipette; this is described in detail in the analysis instructions.

Solid substances are dosed either with the dose-metering cap or with microspoons that are integrated into the screw cap of the respective reagent bottle. The dose-metering cap (colour green: volume 0.025 ml; blue: 0.050 ml) can be used in cases when the solid substance or mixture is free-flowing. In all other cases the substances are dosed using the microspoon (colour grey: volume 0.01 ml; green: 0.03 ml; blue: 0.1 ml).

2. Photometric Test Kits

2.2.7 Shelf-life of the Reagents

The Spectroquant® test kits can be kept for up to three years when stored cool and dry. A few tests have a shorter shelf-life, 18 or 24 months, or must else be stored in the refrigerator. The exception here are all COD cell tests, which must be stored protected from light; then the three-year shelf-life is guaranteed.

The expiry date is printed on the outer label. The shelf-life may become shortened when the reagent bottles are not reclosed tightly after use.

3. Sample Preparation

Sample preparation covers all the steps necessary before the actual analysis can be performed.

3.1 Taking Samples

The taking of samples is the first and **most important step** on the way to obtaining the correct analysis result. Not even the most exact method of analysis can correct any mistakes made in the taking of the sample. The objective of the sampling procedure is to gain a sample with a representative composition. The most important precondition for **gaining a representative sample** is the identification of the suitable sampling site. Here it must be borne in mind that the solution to be investigated can display varying concentrations in different places at different times.

In sampling, a distinction is made between manual and automatic methods. In many cases a true picture of the average composition of the sample can be obtained only once several individual samples have been collected; this can be done manually or with an automatic sampler.

Clean plastic containers with a volume of 500 or 1000 ml are suitable for collecting samples. They should be rinsed several times, under vigorously shaken, with the water to be investigated, and then filled free of air bubbles and immediately closed tightly. The containers must be protected against the effects of air and heat and then be forwarded for the further analytical steps as soon as possible. In exceptional cases, preservation measures in the form of short-term refrigeration at +2 to +5 °C and chemical conservation can be taken.

Parameter	Preservation
COD	+2 to +5 °C max. 24 h or –18 °C max. 14 days
N compounds: NH_4-N, NO_3-N, NO_2-N	analyze immediately, only in exceptional cases +2 to +5 °C max. 6 h
P compounds: PO_4-P, P total	short-term storage, no preservation; with nitric acid to ph 1, max. 4 weeks
Heavy metals	short-term storage, no preservation; with nitric acid to ph 1, max. 4 weeks

Correct measurement results can be obtained only within the measuring range specified for each individual parameter. When dealing with sample solutions of an unknown concentration, it is advisable to establish whether the sample concentration is indeed within the specified measuring range, ideally roughly in the middle of the range.

Preliminary tests enhance the analytical reliability and make the determination of the necessary dilution ratios in the case of high concentrations easier. **Merckoquant® Test Strips** are very well suited for preliminary tests.

3.3 Dilution

Dilution of samples is necessary for two reasons:

- The concentration of the parameter under investigation is too high, i.e. it lies outside the measuring range.
- Other substances contained in the sample interfere with the determination (matrix interference); false-high or false-low results may ensue.

The following auxiliaries are absolute prerequisites for the dilution of the sample:

- Volumetric flasks of varying sizes (e.g. 50, 100 and 200 ml)
- Positive-displacement pipette
- Distilled or DI water

Only dilutions carried out with these auxiliary products are of sufficient reliability in the area of trace analysis, to which photometry belongs (for the simplified procedure see below).

An important aspect here is that once the volumetric flask has been filled up to the mark with distilled water the flask is closed and the contents are thoroughly mixed.

The **dilution factor (D_F)** resulting from the dilution procedure is calculated as follows:

$$D_F = \frac{\textbf{Final volume} \text{ (total volume)}}{\textbf{Initial volume} \text{ (sample volume)}}$$

The analytical result is subsequently multiplied by the dilution factor.

A calculation can be dispensed with when the dilution is programmed into the photometer. The **dilution number** (see the table at the right) is entered and the measurement value is subsequently calculated correctly and immediately displayed (for settings see Function description, “Method parameters: Dilution”).

All dilutions should be made in such a way that the measurement value lies in the middle of the measuring range. As a rule, the dilution factor should never be greater than 100. In the event that yet larger dilutions become necessary all the same, then this must be done in two separate steps.

Example:

Step 1: Make up 2 ml of sample to 200 ml with destilled water;
D_F = 100, dilution number 1+99

Step 2: Take 5 ml of the above solution and make up to 100 ml;
D_F = 20, dilution number 1+19

The dilution factor for the total dilution is calculated by multiplying the individual dilutions:

$D_{F\,total} = D_{F1} \times D_{F2} = 100 \times 20 = 2000$, dilution number 1+1999

Simplified procedure
Dilutions up to 1:10 can also be prepared without volumetric flasks in a glass beaker, measuring the volumes of the sample and the dilution water using a previously calibrated positive-displacement pipette (see table below for instructions).

Desired dilution	Volume of sample in ml	Volume of dist. water in ml	Dilution factor	Dilution number
1:2	5	5	2	1+1
1:3	5	10	3	1+2
1:4	2	6	4	1+3
1:5	2	8	5	1+4
1:10	1	9	10	1+9

Strongly turbid samples require pretreatment before they can determined in a photometer, since the effect of turbidity can result in considerable variations in the measurement values and in false-high readings. Care must be taken here to ensure that the substance to be determined is not contained in the suspended material, in which case a sample decomposition must be carried out.

Compounds that always occur in dissolved form (for example ammonium, nitrate, nitrite, chlorine, chloride, cyanide, fluoride, orthophosphate, and sulfate) permit a previous filtration, even when the sample solution is strongly turbid.

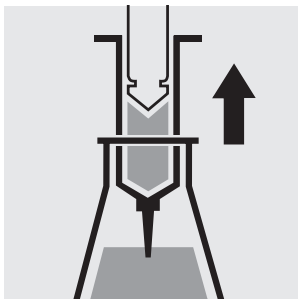
Weak turbidity is eliminated by the **automatic turbidity-correction** feature built into the photometer (see Function description, “Device set-up/Correction function”); in such cases it is not necessary to filter the sample before analysis.

3. Sample Preparation

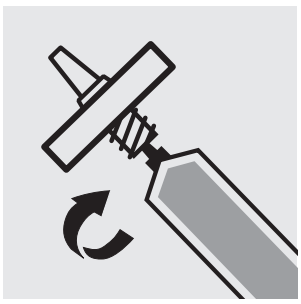
As a measure to distinguish between dissolved and undissolved water-borne substances, the water sample can be filtered through a simple paper filter.

Following the recommendations stated in the reference methods, membrane filters with a pore size of 0.45 µm are required for fine filtration.

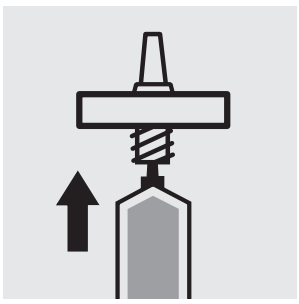
Procedure for microfiltration



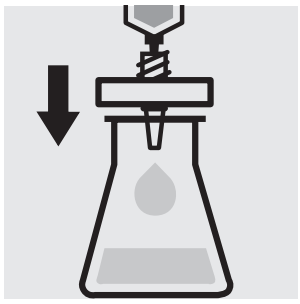
Draw out the liquid to be filtered with the syringe.



Screw the syringe tightly into the front side of the membrane-filter attachment.



Hold the syringe upright and slowly depress the piston upwards until the membrane-filter is fully wetted free of air bubbles.



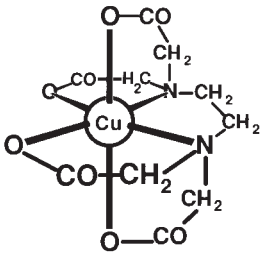
Filter the contents of the syringe into the intended glass vessel.

3.5 Homogenization

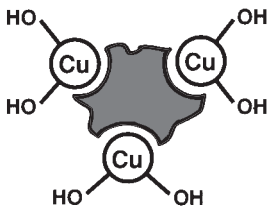
As a measure to ensure that a representative sample can be taken in the presence of suspended matter in the water sample in question, for certain parameters (for example COD, total content of heavy metals) the sample must be homogenized. This must be carried out using a magnet stirrer (2 minutes at 700 – 900 rpm and taking the sample while stirring; cf. DIN 38402 A30).

Water-borne substances can be present in the sample for investigation in a variety of forms: as the ion, bound more or less solidly in a complex, or as a solid substance.

Ion



Complex

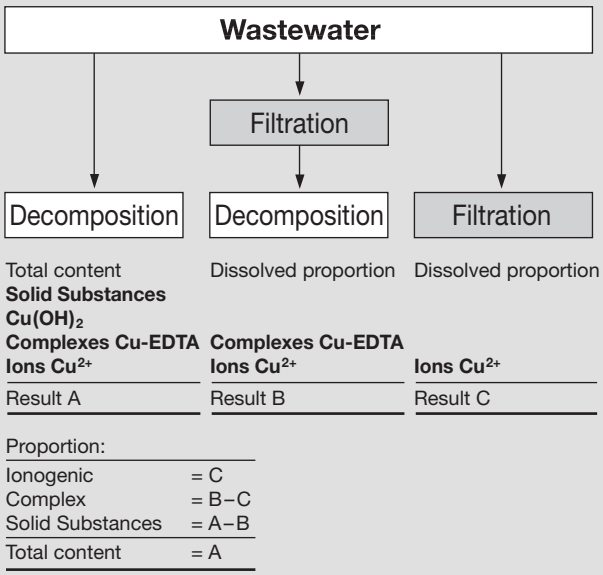


Solid substance

3. Sample preparation

The manner in which the sample is pretreated enables the three proportions to be distinguished from each other. This can be illustrated using a copper-containing wastewater sample as an example.

Example



Decomposition converts the substance to be determined into an analyzable form. In most cases, decomposition agents take the form of acids in combination with oxidizing agents; in exceptional cases (e.g. in the determination of total nitrogen) an alkaline decomposition is more effective. The type of decomposition procedure used depends on the analyte to be determined and the sample matrix.

The ready-to-use sample-decomposition products **Spectroquant® Crack Set** 10 and 20 are suited for the preparation of the sample materials for the determinations stated in the table below.

Determination of	Sample preparation with
Phosphorus total*	Crack Set 10/10C**
Chromium total* [= sum of chromate and chromium(III)]	Crack Set 10/10C
Metal total [= sum of free and complex-bound metal]	Crack Set 10/10C
Nitrogen total*	Crack Set 20

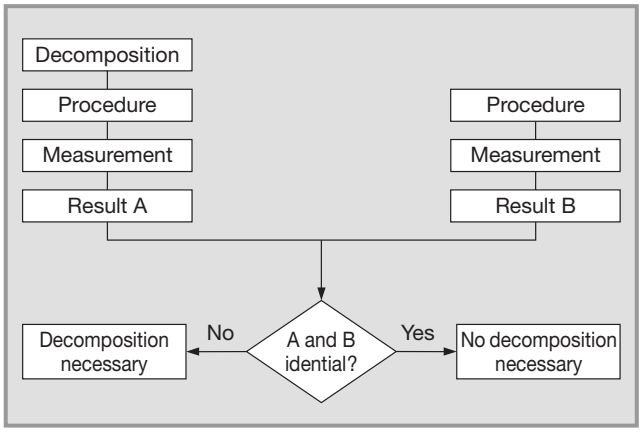
* The decomposition reagents are already contained in the packs of the respective cell tests.

** Decomposition cells are included in the pack; empty cells are required for the decomposition for Crack Sets 10 and 20.

The decomposition processes are carried out in the **thermoreactor** (capacity: 8/12 decomposition cells) at 120 °C or, respectively, 100 °C. Details regarding the heating times and further treatment can be found in the package inserts contained in the **Spectroquant® Crack Set** packs.

In the event that the sample to be analyzed is a highly contaminated material (high proportion of organic substances) or water-insoluble samples, decomposition using concentrated acids and other agents is indispensible. Corresponding examples are described in the **Application Compendium** (obtainable from your local Merck representative; see Appendix), a collection of analytical specifications for real samples.

The necessity for decomposition can be checked according to the following diagram:



For wastewater with a consistent composition, this check as a rule need be carried out only once. It is, however, advisable to check the result periodically.

4. Pipetting System

Positive-displacement pipettes permit

- an exact dosage of the sample volume, and
- a precise measurement of sample and reagent volumes and of the volumes of water for dilution purposes.

Pipettes of varying volumes and also ones with a fixed volume are available.

Sources of error and hints on how to avoid them:

- Closely follow the instructions for use contained with the pipette in question.
- Check the pipetted volumes by weighing using analytical scales (weighing accuracy ±1 mg), 1 ml of water at 20 °C = 1.000 g ±1 mg.
- Check the pipetted volume using Spectroquant® PipeCheck; this is a photometric check of the pipette, and scales are not necessary (see section "AQA").
- Avoidance of spread effects by rinsing the pipette several times with the solution to be pipetted.
- Always exchange the pipette tip.
- Draw up the liquid slowly and depress piston completely to discharge the liquid.

5. Analytical Quality Assurance (AQA)

The objective of analysis must always be to determine the true content of the analyte in question as accurately and precisely as possible.

Analytical Quality Assurance represents a suitable and indispensible method by which the quality of the user's own work can be assessed, errors in the measurement system diagnosed, and the comparability with the results obtained using the respective reference methods demonstrated.

Details regarding the necessity of AQA can be found in the memorandum M 704 of the German "Abwassertechnische Vereinigung" (ATV, Wastewater-technical Association) and in the corresponding self-control/self-monitoring regulations of the German federal states (available in english).

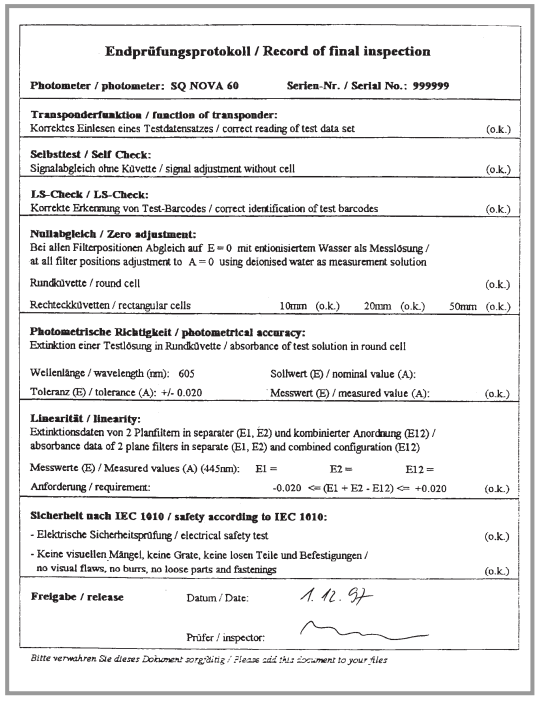
Causes for errors can include:

- the working materials used;
- the handling; and/or
- the sample under investigation.

These errors have effects on both the accuracy and precision of the results obtained.

Photometers and photometric test kits possess specifications that are adhered to and above all else also documented by the manufacturer.

The **certificate for the photometer** enclosed with each device documents the quality of the measuring device.



Endprüfungsprotokoll / Record of final inspection

Photometer / photometer: SQ NOVA 60 **Serien-Nr. / Serial No.: 999999**

Transponderfunktion / function of transponder:
Korrektes Einlesen eines Testdatensatzes / correct reading of test data set (o.k.)

Selbsttest / Self Check:
Signalabgleich ohne Küvette / signal adjustment without cell (o.k.)

LS-Check / LS-Check:
Korrekte Erkennung von Test-Barcodes / correct identification of test barcodes (o.k.)

Nullabgleich / Zero adjustment:
Bei allen Filterpositionen Abgleich auf E = 0 mit entionisiertem Wasser als Messlösung /
at all filter positions adjustment to A = 0 using deionised water as measurement solution

Rundküvette / round cell (o.k.)

Rechteckküvetten / rectangular cells 10mm (o.k.) 20mm (o.k.) 50mm (o.k.)

Photometrische Richtigkeit / photometrical accuracy:
Extinktion einer Testlösung in Rundküvette / absorbance of test solution in round cell

Wellenlänge / wavelength (nm): 605 Sollwert (E) / nominal value (A):

Toleranz (E) / tolerance (A): +/- 0.020 Messwert (E) / measured value (A): (o.k.)

Linearität / linearity:
Extinktionsdaten von 2 Planfiltern in separater (E1, E2) und kombinierter Anordnung (E12) /
absorbance data of 2 plane filters in separate (E1, E2) and combined configuration (E12)

Messwerte (E) / Measured values (A) (445nm): E1 = E2 = E12 =

Anforderung / requirement: -0.020 <= (E1 + E2 - E12) <= +0.020 (o.k.)

Sicherheit nach IEC 1010 / safety according to IEC 1010:
- Elektrische Sicherheitsprüfung / electrical safety test (o.k.)
- Keine visuellen Mängel, keine Grate, keine losen Teile und Befestigungen /
no visual flaws, no burrs, no loose parts and fastenings (o.k.)

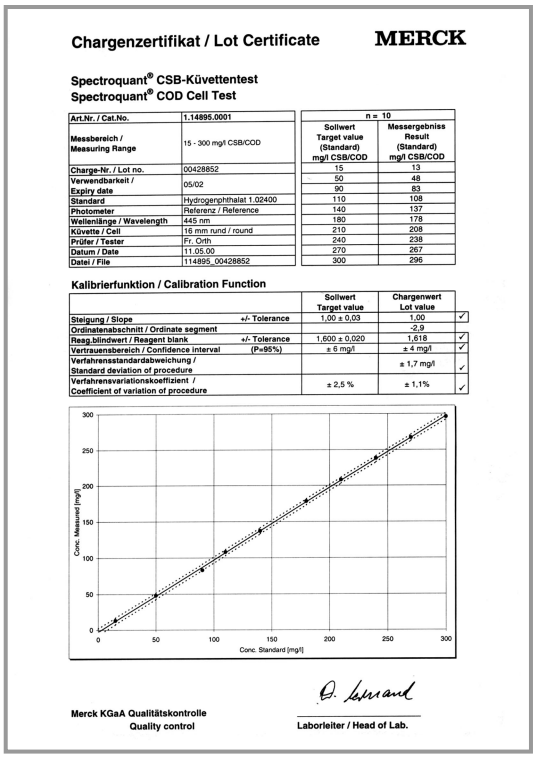
Freigabe / release Datum / Date: 1.12.97

Prüfer / inspector:

Bitte verwahren Sie dieses Dokument sorgfältig / Please add this document to your files

5. Analytical Quality Assurance (AQA)

The **certificate for the test kit,** available for each lot produced, documents the quality of the reagents contained in the test kit.



Chargenzertifikat / Lot Certificate **MERCK**

Spectroquant® CSB-Küvettentest
Spectroquant® COD Cell Test

Art.Nr. / Cat.No.	1.14895.0001
Messbereich / Measuring Range	15 - 300 mg/l CSB/COD
Charge-Nr. / Lot no.	00428852
Verwendbarkeit / Expiry date	05/02
Standard	Hydrogenphthalat 1.02400
Photometer	Referenz / Reference
Wellenlänge / Wavelength	445 nm
Küvette / Cell	16 mm rund / round
Prüfer / Tester	Fr. Orth
Datum / Date	11.05.00
Datei / File	114895_00428852

n = 10

Sollwert Target value (Standard) mg/l CSB/COD	Messergebniss Result (Standard) mg/l CSB/COD
15	13
50	48
90	83
110	108
140	137
180	178
210	208
240	238
270	267
300	296

Kalibrierfunktion / Calibration Function

		Sollwert Target value	Chargenwert Lot value	
Steigung / Slope	+/- Tolerance	1,00 ± 0,03	1,00	✓
Ordinatenabschnitt / Ordinate segment			-2,9	
Reag.blindwert / Reagent blank	+/- Tolerance	1,600 ± 0,020	1,618	✓
Vertrauensbereich / Confidence interval	(P=95%)	± 6 mg/l	± 4 mg/l	✓
Verfahrensstandardabweichung / Standard deviation of procedure			± 1,7 mg/l	✓
Verfahrensvariationskoeffizient / Coefficient of variation of procedure		± 2,5 %	± 1,1%	✓

Merck KGaA Qualitätskontrolle
Quality control

Laborleiter / Head of Lab.

Calibration function:
The calculated function must agree, within specified tolerances, with the function electronically stored in the photometer.

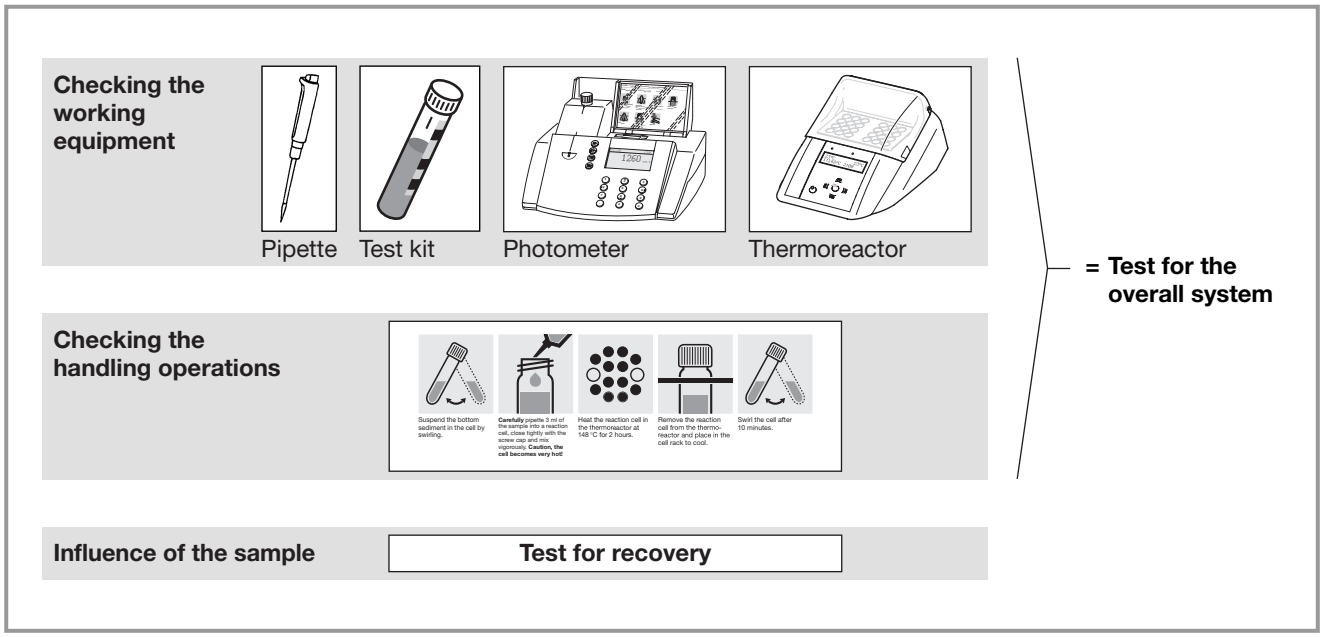
Confidence interval:
Maximum deviation from the desired value over the entire measuring range; every measurement value can be affected by this deviation; this parameter is a measure for the accuracy.

Standard deviation for the procedure:
Measurement for the dispersion of the measurement values over the entire measuring range, expressed in ± mg/l.

Coefficient of variation for the procedure:
Measurement for the dispersion of the measurement values over the entire measuring range, expressed in %. The smaller the standard deviation/coefficient of variation for the procedure, the more pronounced the linearity of the calibration curve.

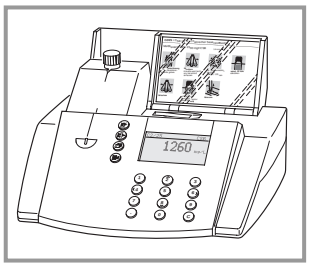
A complete check comprises the entire system, i.e. the working equipment and the mode of operation. The photometer offers an optimum degree of support in this regard, in the form of the different quality mode. The instrument, or the whole system (including reagents and all accessories) will be checked, depending on which quality mode selected. All of checking operations can thus be supported by the photometer and the check values accordingly documented as per GLP (Good Laboratory Practice) recommendations (see Function description, “Analytical Quality Assurance”).

The following diagram provides an overview regarding internal quality-assurance aspects:



5.2.1 Checking the Photometer

As soon as the photometer is activated it is running a Self-Check. This means the hardware and the software of the photometer is checked and compared with internal standards.



The photometer itself is checked in the **AQA 1 mode** using the **Spectroquant® PhotoCheck.** The pack includes round cells containing stable test solutions **(secondary standards)** for checking the photometer at the 445, 525, and 690 nm wavelengths. The test solutions are measured in a reference photometer monitored with primary standards, and the absorbance values are documented in the package insert. These desired values with the permissible tolerances are entered into the photometer or else handwritten into the control chart. For the measurement the cell is placed in the compartment for the round cell and identified by the photometer via the bar code, and the measured absorbance is compared with the desired value. The absorbance is shown in the display and can be entered into the corresponding control chart.

The measurement of at least one cell (preferably cell -2 or -3) per wavelength is recommended when checking the photometer. The measurement of four cells for a given wavelength tests – in addition to the wavelength accuracy – also the linearity of the absorbance over the effective range.

The verification of the instrument, as it is required by DIN/ISO 9000 or GLP, can be easily performed by using the PhotoCheck. The PhotoCheck allows you to check the linearity of the filters, hence offering the possibility to check the instrument. All of the corresponding documentation, required by these certification guidelines, is done by the photometer automatically. We guarantee for the Spectroquant® PhotoCheck a 2 year warrantee.

5.2.2 Checking the Overall System

Test for the overall system includes checking the working equipment and checking the handling operations.

The **overall system** can be checked using standard solutions of a known content, preferably with the Spectroquant® CombiCheck; this corresponds with the **AQA 2 mode** in the photometer.

Spectroquant® CombiCheck are ready-to-use standard solutions that in terms of the analyte concentration are finely adjusted to the individual test kits. They contain a mixture of several analytes that do not interfere with each other. The standard solution (R-1) is used in the same way as a sample. A double determination is recommended as a measure to diagnose any random errors.

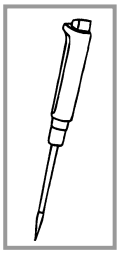
The desired values with the permissible tolerances are already electronically stored with the method in the photometer. The AQA check mode is selected for the measurement, which can be prompted using the **MemoChip AQA.** The cells containing the standard solution are then identified as test solutions by the photometer, and the measured concentration is then compared with the desired value. When the result agrees with desired value within the permissible tolerance range, the display shows the measurement value and the “OK” sign.

In addition to the CombiCheck, it is also possible to use ready-to-use single-element standard solutions for this checking procedure. These contain 1000 mg of the respective analyte per liter of solution. They can be diluted to different final concentrations, which should preferably lie approximately in the middle of the measuring range of the respective test kit.
The table on page XVIII provides an overview of the available CombiCheck and ready-to-use standard solutions.

Due to limited shelf-life characteristics, there are no CombiCheck or ready-to-use standard solutions for certain parameters. Attached to the table are the instructions describing the reagents and working steps necessary to make your own solutions of a defined concentration. This allows the control of parameters where there are no simple to prepare solutions available.

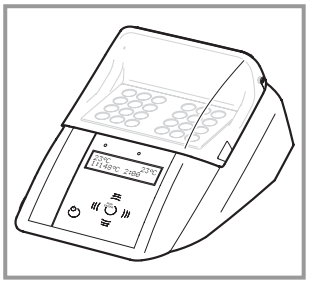
The individual results are flagged as AQA2 if the AQA-Check of the entire system has passed. If not, an error message is given and the individual components of the instrument have to be checked in detail.

5.2.3 Checking the Pipettes



The **Spectroquant® PipeCheck** is used to check the pipettes. The pack contains cells filled with colour-dye concentrates. After the addition of a predefined volume of water using the pipette in question, the cell is measured against a corresponding reference cell also contained in the pack. The difference in the absorbance values of the measurement cell and reference cell may not exceed the tolerances given in the package insert. If the tolerances are exceeded, the instructions given in the section “Pipetting system” must be followed accordingly.

5.2.4 Checking Thermoreactors



The thermoreactors are checked at 100/120 and 148 °C. Here a round cell filled to one half with glycerol is place in any one of the compartments of the thermoreactor, and the thermoreactor is heated as described in the instructions for use. After the control lamp has gone out, the temperature in the cell is measured using a calibrated thermometer. The following desired temperatures must be achieved:

Block temperature 100 °C = desired temp. 100 ±3°C*
Block temperature 120 °C = desired temp. 120 ±3°C*
Block temperature 148 °C = desired temp. 148 ±3°C*

5.2.5 Testing for Handling Errors

Carefully pipette 3 ml of the sample into a reaction cell, close tightly with the screw cap and mix vigorously. **Caution, the cell becomes very hot!**

The user’s own mode of operation must also be subjected to an exact analysis. The following questions may serve as a guide in this regard:

- Is the test kit optimal for the measurement assignment in question?
- Is the test kit’s measuring range suitable?
- Were the operating instructions for the test followed?
- Was the sample volume correct?
- Was the pipette handled properly?
- Was a new pipette tip used?
- Is the pH correct?
- Was the reaction time adhered to?
- Does the sample and reagent temperature lie within the correct range?
- Is the cell clean?
- Has the expiry date for the test kit been exceeded?

The influence of other substances contained in the sample may, under certain circumstances, be so great that their recovery rates lie in the region of several percent. It is recommended to check for any influence by using the addition solution contained in the Spectroquant® CombiCheck pack.

A defined quantity of the **addition solution** (R-2), which contains a known concentration of the respective analyte, is added to the sample and the recovery rate is determined.

The following difference is then calculated:

Result (sample + addition solution) – Result (sample)

If the calculated difference is equal to the concentration of analyte of addition solution that was added, the recovery rate is 100 %. If the difference is less than 90 %, then a matrix interference is present.

* The block temperature compensates for any heat lost due to insufficient heat transfer.

5.4 Definition of Errors

It is obvious that measurement results as a rule may be associated with errors. This applies equally to standardized methods of analysis (reference methods) and to routine analysis. The discovery and the minimization of errors must be the objective here.

A distinction is made between systematic errors and random errors.

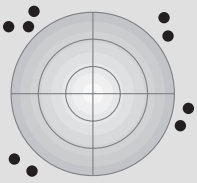
Systematic errors are present when all the results of an analysis deviate from the true value with the same algebraic sign. Examples here include: a wrong sample volume, a wrong pH, a wrong reaction time, a sample-matrix influence, etc. Systematic errors thus affect the **accuracy** of the method of analysis.

Accuracy = Deviation of the measured concentration from the true concentration

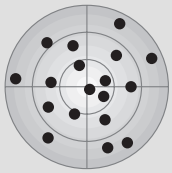
Random errors manifest themselves in the form of a wide range of deviation of the results of a given sample. These can be kept to a minimum by ensuring good operating techniques and multiple determination with calculation of the mean values. Random errors make the result of the analysis unreliable; they influence the **precision**.

Precision = Dispersion of the results among each other

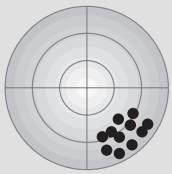
The following diagram illustrates the aspects of accuracy and precision:



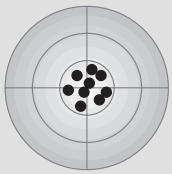
Accuracy: poor
Precision: poor
Major errors have been made!



Accuracy: good
Precision: poor
Calculation of the mean values from at least three – or better even more – parallel determinations yields an approximation of the true value.



Accuracy: poor
Precision: good
The high degree of precision mistakenly indicates a correct value!



Accuracy: good
Precision: good
The ideal objective!

Suitability of Test Kits for Testing Salt Water

Test kit	Art.	Seawater	Limit of tolerance, salts in %		
			NaCl	$NaNO_3$	Na_2SO_4
Alkohol Cell Test	14965	no	–	–	–
Aluminium Test	14825	yes	10	20	20
Ammonium	A5/25	yes	20	10	15
Ammonium Cell Test	14739	no	5	5	5
Ammonium Cell Test	14558	yes	20	10	15
Ammonium Cell Test	14544	yes	20	15	20
Ammonium Cell Test	14559	yes	20	20	20
Ammonium Test	14752	no	10	10	20
Ammonium Test	00683	yes	20	20	20
AOX Cell Test	00675	no	0.4	20	20
BOD Cell Test	00687	yes	20	20	20
Boron Cell Test	00826	yes	10	20	20
Boron Test	14839	no	20	5	20
Bromine Test	00605	no	10	10	10
Cadmium Cell Test	14834	no	10	10	10
Cadmium Test	01745	no	1	10	1
Calcium Cell Test	00858	no	2	2	1
Calcium Test	14815	yes	20	20	10
Chlorine Cell Test	00595	no	10	10	10
Chlorine Cell Test	00597	no	10	10	10
Chlorine Test	00598	no	10	10	10
Chlorine Test	00602	no	10	10	10
Chlorine Test	00599	no	10	10	10
Chlorine Test	14828	no	10	10	10
Chlorine Test	14732	no	10	10	10
Chlorine dioxide Test	00608	no	10	10	10
Chlorine dioxide	14732	no	10	10	10
Chloride Cell Test	14730	yes	–	20	1
Chloride Test	14897	yes	–	10	0,1
Chromate Cell Test	14552	yes	10	10	10
Chromium total Cell Test	14552	no	5	10	10
Chromate Test	14758	yes	10	10	10
COD	C1/25	no	0.4	10	10
COD	C2/25	no	0.4	10	10
COD Cell Test	14560	no	0.4	10	10
COD Cell Test	14540	no	0.4	10	10
COD Cell Test	14895	no	0.4	10	10
COD Cell Test	14690	no	0.4	20	20
COD Cell Test	14541	no	0.4	10	10
COD Cell Test	14691	no	0.4	20	20
COD Cell Test	14555	no	1.0	10	10
COD Cell Test (Hg free)	09772	no	0	10	10
COD Cell Test (Hg free)	09773	no	0	10	10
Copper Cell Test	14553	yes	15	15	15
Copper Test	14767	yes	15	15	15
Cyanide Cell Test	14561	no	10	10	10
Cyanide Test	09701	no	10	10	10
Fluoride Cell Test	14557	no	10	10	10
Fluoride Test	14598	yes	20	20	20
Formaldehyde Cell Test	14500	no	5	0	10
Formaldehyde Test	14678	no	5	0	10
Gold Test	14821	yes	10	20	5
Hardness, see Total Hardness	Cell Test				
Hydrazine Test	09711	no	20	5	2
Hydrogenperoxide Cell Test	14731	yes	20	20	20
Iodine Test	00606	no	10	10	10
Iron Cell Test	14549	yes	20	20	20
Iron Cell Test	14896	no	5	5	5
Iron Test	14761	yes	20	20	20
Iron Test	00796	yes	20	20	20
Lead Cell Test	14833	no	20	20	1
Lead Cell Test	09717	no	20	5	15
Magnesium Cell Test	00815	yes	2	2	1
Manganese Cell Test	00816	no	20	20	20
Manganese Test	14770	no	20	20	20
Molybdenum Cell Test	00860	no	20	20	5
Monochloramine Test	01632	no	10	10	20
Nickel Cell Test	14554	no	20	20	20
Nickel Test	14785	no	20	20	20
Nitrate	N1/25	no	0.2	–	20
Nitrate Cell Test	14542	no	0.4	–	20
Nitrate Cell Test	14563	no	0.2	–	20
Nitrate Cell Test	14764	no	0.5	–	20
Nitrate Cell Test	00614	no	2	–	20

Suitability of Test Kits for Testing Salt Water

Test kit	Art.	Seawater	Limit of tolerance, salts in % NaCl	$NaNO_3$	Na_2SO_4
Nitrate Test	14773	no	0.4	–	20
Nitrate Test	09713	no	0.2	–	20
Nitrate Cell Test (salt water)	14556	yes	20	–	20
Nitrate Test (salt water)	14942	yes	20	–	20
Nitrite	N4/25	yes	20	20	15
Nitrite Cell Test	14547	yes	20	20	15
Nitrite Test	14776	yes	20	20	15
Nitrogen total, see Total Nitrogen Cell Test					
Oxygen Cell Test	14694	no	10	5	1
Ozone Test	00607	no	10	10	10
Ozone Test	14732	no	10	10	10
pH Cell Test	01744	yes	–	–	–
Phenol Cell Test	14551	yes	20	20	15
Phenol Test	00856	yes	20	20	20
Phosphate	P4/25	yes	5	10	10
Phosphate/P total	P4/25	no	1	10	10
Phosphate	P5/25	yes	20	20	20
Phosphate/P total	P5/25	yes	5	20	20
Phosphate Cell Test	14543	yes	5	10	10
Phosphate Cell Test/P total	14543	no	1	10	10
Phosphate Cell Test	14729	yes	20	20	20
Phosphate Cell Test/P total	14729	yes	5	20	20
Phosphate Cell Test	00616	yes	20	20	20
Phosphate Test	14848	yes	5	10	10
Phosphate Test	00798	yes	15	20	10
Phosphate Cell Test	14546	yes	20	20	20
Phosphate Test	14842	yes	20	20	20
Potassium Cell Test	14562	yes	20	20	20
Potassium Cell Test	00615	yes	20	20	20
Residual Hardness Cell Test	14683	no	0.01	0.01	0.01
Silicate (Silicic Acid) Test	14794	yes	5	10	5
Silicate (Silicic Acid) Test	00857	no	5	10	2.5
Silver Test	14831	no	0	1	5
Sodium Cell Test	00885	no	–	10	1
Sulfate Cell Test	14548	yes	10	20	–
Sulfate Cell Test	00617	yes	10	20	–
Sulfate Cell Test	14564	yes	10	20	–
Sulfate Test	14791	no	0.2	0.2	–
Sulfide Test	14779	no	0.5	1	1
Sulfite Cell Test	14394	no	20	20	20
Sulfite Test	01746	no	20	20	20
Surfactants (anionic) Cell Test	14697	no	0.1	0.01	10
Tin Cell Test	14622	yes	20	20	20
TOC Cell Test	14878	no	0,5	10	10
TOC Cell Test	14879	no	5	20	20
Total Hardness Cell Test	00961	no	2	2	1
Total Nitrogen Cell Test	14537	no	0.5	–	10
Total Nitrogen Cell Test	00613	no	0.2	–	10
Total Nitrogen Cell Test	14763	no	2	–	20
Zinc Cell Test	00861	no	20	20	1
Zinc Cell Test	14566	no	10	10	10
Zinc Test	14832	no	5	15	15

Spectroquant® CombiCheck and Standard Solutions

Test kit, Art.	CombiCheck, Art.	Evaluation as	Confidence interval Spec. value for the standard	tolerance	Other standards** Art.
Alcohol Cell Test, 14965	–	C_2H_5OH	3 g/l	± 0.3 g/l	09008
Aluminium Test, 14825	CombiCheck 40, 14692	Al	0.75 mg/l	± 0.08 mg/l	19770
Ammonium, A5/25	CombiCheck 10, 14676	NH_4-N	4.00 mg/l	± 0.30 mg/l	19812
Ammonium Cell Test, 14739	CombiCheck 50, 14695	NH_4-N	1.00 mg/l	± 0.10 mg/l	19812
Ammonium Cell Test, 14558	CombiCheck 10, 14676	NH_4-N	4.00 mg/l	± 0.30 mg/l	19812
Ammonium Cell Test, 14544	CombiCheck 20, 14675	NH_4-N	12.0 mg/l	± 1.0 mg/l	19812
Ammonium Cell Test, 14559	CombiCheck 70, 14689	NH_4-N	50.0 mg/l	± 5.0 mg/l	19812
Ammonium Test, 14752	CombiCheck 50, 14695	NH_4-N	1.00 mg/l	± 0.10 mg/l	19812
Ammonium Test, 00683	CombiCheck 70, 14689	NH_4-N	50.0 mg/l	± 5.0 mg/l	19812
AOX Cell Test, 00675	–	AOX	1.00 mg/l*	± 0.10 mg/l	00680
BOD Cell Test, 00687	–	O_2	210 mg/l	± 20 mg/l	00718
Boron Cell Test, 00826	–	B	1.00 mg/l*	± 0.15 mg/l	19500
Boron Test, 14839	–	B	0.400 mg/l*	± 0.040 mg/l	19500
Bromine Test, 00605	–	Br_2	4,00 mg/l	± 0,40 mg/l	see prep. instr.
Cadmium Cell Test, 14834	CombiCheck 30, 14677	Cd	0.500 mg/l	± 0.060 mg/l	19777
Cadmium Test, 01746	–	Cd	0.250 mg/l	± 0.010 mg/l	19777
Calcium Cell Test, 00858	–	Ca	75 mg/l*	± 7 mg/l	19778
Calcium Test, 14815	–	Ca	80 mg/l*	± 8 mg/l	19778
Chlorine Cell Test, 00595	–	Cl_2	4.00 mg/l*	± 0.40 mg/l	see prep. instr.
Chlorine Cell Test, 00597	–	Cl_2	4.00 mg/l*	± 0.40 mg/l	see prep. instr.
Chlorine Test, 00598	–	Cl_2	4.00 mg/l*	± 0.40 mg/l	see prep. instr.
Chlorine Test, 00602	–	Cl_2	4.00 mg/l*	± 0.40 mg/l	see prep. instr.
Chlorine Test, 00599	–	Cl_2	4.00 mg/l*	± 0.,40 mg/l	see prep. instr.
Chlorine Test, 14828	–	Cl_2	4.00 mg/l*	± 0.40 mg/l	see prep. instr.
Chlordioxide Test, 00608	–	ClO_2	4.00 mg/l*	± 0.40 mg/l	see prep. instr.
Chlorine dioxide, Chlorine, Ozone Test, 14732	–	Cl_2	2.50 mg/l*	± 0.25 mg/l	see prep. instr.
Chloride Cell Test, 14730	CombiCheck 20, 14675	Cl	60 mg/l	± 10 mg/l	19897
	CombiCheck 10, 14676		25 mg/l	± 6 mg/l	19897
Chloride Test, 14897	CombiCheck 60, 14696	Cl	125 mg/l	± 13 mg/l	19897
	–		12.5 mg/l	± 0.13 mg/l	19897
Chromate Cell Test, 14552	CombiCheck 40, 14692	Cr	1.00 mg/l	± 0.10 mg/l	19780
Chromate Test, 14758	CombiCheck 40, 14692	Cr	1.00 mg/l	± 0.10 mg/l	19780
COD 160, C1/25	CombiCheck 10, 14676	COD	80 mg/l	± 12 mg/l	see prep. instr.
COD 1500, C2/25	CombiCheck 20, 14675	COD	750 mg/l	± 75 mg/l	see prep. instr.
COD Cell Test, 14560	CombiCheck 50, 14695	COD	20.0 mg/l	± 4.0 mg/l	see prep. instr.
COD Cell Test, 14540	CombiCheck 10, 14676	COD	80 mg/l	± 12 mg/l	see prep. instr.
COD Cell Test, 14895	CombiCheck 60, 14696	COD	250 mg/l	± 20 mg/l	see prep. instr.
COD Cell Test, 14690	CombiCheck 60, 14696	COD	250 mg/l	± 25 mg/l	see prep. instr.
COD Cell Test, 14541	CombiCheck 20, 14675	COD	750 mg/l	± 75 mg/l	see prep. instr.
COD Cell Test, 14691	CombiCheck 80, 14738	COD	1500 mg/l	± 150 mg/l	see prep. instr.
COD Cell Test, 14555	CombiCheck 70, 14689	COD	5000 mg/l	± 400 mg/l	see prep. instr.
COD Cell Test, 09772	CombiCheck 10, 14676	CSB	80 mg/l	± 12 mg/l	see prep. instr.
COD Cell Test, 09773	CombiCheck 20, 14675	CSB	750 mg/l	± 75 mg/l	see prep. instr.
Copper Cell Test, 14553	CombiCheck 30, 14677	Cu	2.00 mg/l	± 0.20 mg/l	19786
Copper Test, 14767	CombiCheck 30, 14677	Cu	2.00 mg/l	± 0.20 mg/l	19786
Cyanide Cell Test, 14561	–	CN	0.250 mg/l*	± 0.030 mg/l	19533
Cyanide Test, 09701	–	CN	0.250 mg/l*	± 0.030 mg/l	19533
Fluoride Cell Test, 14557	–	F	0.75 mg/l*	± 0.08 mg/l	19814
Fluoride Test, 14598	–	F	1.00 mg/l*	± 0.15 mg/l	19814
			10.0 mg/l*	± 1.2 mg/l	19814
Formaldehyde Cell Test, 14500	–	HCHO	5.00 mg/l*	± 0.50 mg/l	see prep. instr.
Formaldehyde Test, 14678	–	HCHO	4.50 mg/l*	± 0.50 mg/l	see prep. instr.
Gold Test, 14821	–	Au	6.0 mg/l*	± 0.6 mg/l	70216
Hardness, see Total Hardness Cell Test					
Hydrazine Test, 09711	–	N_2H_4	1.00 mg/l*	± 0.10 mg/l	see prep. instr.
Hydrogenperoxide Cell Test, 14731	–	H_2O_2	10.0 mg/l*	± 1.0 mg/l	see prep. instr.
Iodine Test, 00606	–	I_2	4.00 mg/l	± 0.40 mg/l	see prep. instr.
Iron Cell Test, 14549	CombiCheck 30, 14677	Fe	1.00 mg/l	± 0.15 mg/l	19781
Iron Cell Test, 14896	–	Fe	25.0 mg/l*	± 2.5 mg/l	19781
Iron Test, 14761	CombiCheck 30, 14677	Fe	1.00 mg/l	± 0.15 mg/l	19781
Iron Test, 00796	CombiCheck 30, 14677	Fe	1.00 mg/l	± 0.15 mg/l	19781
Lead Cell Test, 14833	CombiCheck 40, 14692	Pb	2.00 mg/l	± 0.20 mg/l	19776
Lead Test, 09717	CombiCheck 40, 14692	Pb	2.00 mg/l	± 0.20 mg/l	19776
Magnesium Cell Test, 00815	–	Mg	40.0 mg/l*	± 4.0 mg/l	19788
Manganese Cell Test, 00816	CombiCheck 30, 14677	Mn	1.00 mg/l	± 0.15 mg/l	19789
Manganese Test, 14770	CombiCheck 30, 14677	Mn	1.00 mg/l	± 0.15 mg/l	19789
Molybdenum Cell Test, 00860	–	Mo	0,50 mg/l*	± 0.05 mg/l	70227
Monochloramine Test, 01632	–	Cl_2	5.00 mg/l	± 0.50 mg/l	see prep. instr.
Nickel Cell Test, 14554	CombiCheck 40, 14692	Ni	2.00 mg/l	± 0.20 mg/l	09989
Nickel Test, 14785	CombiCheck 40, 14692	Ni	2.00 mg/l	± 0.20 mg/l	09989
Nitrate, N1/25	CombiCheck 20, 14675	NO_3-N	9.0 mg/l	± 0.9 mg/l	19811
Nitrate Cell Test, 14542	CombiCheck 20, 14675	NO_3-N	9.0 mg/l	± 0.9 mg/l	19811

Spectroquant® CombiCheck and Standard Solutions

Test kit, Art.	CombiCheck, Art.	Evaluation as	Confidence interval Spec. value for the standard	tolerance	Other standards** Art.
Nitrate Cell Test, 14563	CombiCheck 20, 14675	NO_3-N	9.0 mg/l	± 0.9 mg/l	19811
Nitrate Cell Test, 14764	CombiCheck 80, 14738	NO_3-N	25.0 mg/l	± 2.5 mg/l	19811
Nitrat Cell Test, 00614	–	NO_3-N	100 mg/l	± 10 mg/l	19811
Nitrate Test, 14773	CombiCheck 20, 14675	NO_3-N	9.0 mg/l	± 0.9 mg/l	19811
Nitrate Test, 09713	CombiCheck 20, 14675	NO_3-N	9.0 mg/l	± 0.9 mg/l	19811
Nitrate Cell Test, 14556	CombiCheck 10, 14676	NO_3-N	1.50 mg/l	± 0.15 mg/l	19811
Nitrate Test, 14942	CombiCheck 20, 14675	NO_3-N	8.0 mg/l	± 0.8 mg/l	19811
Nitrite, N4/25	–	NO_2-N	0.300 mg/l*	± 0.030 mg/l	19899
Nitrite Cell Test, 14547	–	NO_2-N	0.300 mg/l*	± 0.030 mg/l	19899
Nitrite Test, 14776	–	NO_2-N	0.50 mg/l*	± 0.05 mg/l	19899
Nitrogen total, s. Total Nitrogen Cell Test					
Oxygen Cell Test, 14694	–	O_2	–	± 0.6 mg/l	compare with O_2-Sensor
Ozone Test, 00607	–	O_3	4.00 mg/l	± 0.40 mg/l	see prep. instr.
pH Cell Test, 01744	–	pH	7.0	± 0.2	09407
Phenol Cell Test, 14551	–	Phenol	1.25 mg/l*	± 0.13 mg/l	see prep. instr.
Phenol Test, 00856	–	C_6H_5OH	2.50 mg/l	± 0.25 mg/l	see prep. instr.
Phosphate, P4/25	CombiCheck 10, 14676	PO_4-P	0.80 mg/l	± 0.08 mg/l	19898
Phosphate, P5/25	CombiCheck 20, 14675	PO_4-P	8.0 mg/l	± 0.7 mg/l	19898
Phosphate Cell Test, 14543	CombiCheck 10, 14676	PO_4-P	0.80 mg/l	± 0.08 mg/l	19898
Phosphate Cell Test, 14729	CombiCheck 80, 14738	PO_4-P	15.0 mg/l	± 1.0 mg/l	19898
	CombiCheck 20, 14675		8.0 mg/l	± 0.7 mg/l	19898
Phosphat Cell Test, 00616	–	PO_4-P	50.0 mg/l*	± 5.0 mg/l	19898
Phosphate Test, 14848	CombiCheck 10, 14676	PO_4-P	0.80 mg/l	± 0.08 mg/l	19898
Phosphate Test, 00798	–	PO_4-P	50.0 mg/l*	± 5.0 mg/l	19898
Phosphate Cell Test, 14546	–	PO_4-P	15.0 mg/l*	± 1.0 mg/l	19898
Phosphate Test, 14842	–	PO_4-P	15.0 mg/l*	± 1.0 mg/l	19898
Potassium Cell Test, 14562	–	K	25.0 mg/l*	± 4.0 mg/l	70730
Potassium Cell Test, 00615	–	K	150 mg/l*	± 15 mg/l	70730
Residual Hardness Cell Test, 14683	–	Ca	2.50 mg/l	± 0.30 mg/l	19778
Silicate (Silicic Acid) Test, 14794	–	Si	2.50 mg/l*	± 0.25 mg/l	70236
	–		0.375 mg/l*	± 0.040 mg/l	70236
Silicate (Silicic Acid) Test, 00857	–	Si	25.0 mg/l*	± 2.5 mg/l	70236
Silver Test, 14831	–	Ag	1.50 mg/l*	± 0.20 mg/l	19797
Sulfate Cell Test, 14548	CombiCheck 10, 14676	SO_4	100 mg/l	± 15 mg/l	19813
Sulfat Cell Test, 00617	CombiCheck 10, 14676	SO_4	100 mg/l	± 15 mg/l	19813
Sulfate Cell Test, 14564	CombiCheck 20, 14675	SO_4	500 mg/l	± 75 mg/l	19813
Sulfate Test, 14791	CombiCheck 10, 14676	SO_4	100 mg/l	± 15 mg/l	19813
Sulfide Test, 14779	–	S	0.75 mg/l*	± 0.08 mg/l	see prep. instr.
Sulfite Cell Test, 14394	–	SO_3	12.5 mg/l*	± 1.5 mg/l	see prep. instr.
Sulfite Test, 01746	–	SO_3	30.0 mg/l	± 1.0 mg/l	see prep. instr.
Surfactants (anionic) Cell Test, 14697	–	MBAS	1.00 mg/l*	± 0.20 mg/l	see prep. instr.
Tin Cell Test, 14622	–	Sn	1.25 mg/l*	± 0.13 mg/l	70242
TOC Cell Test, 14878	–	TOC	40.0 mg/l*	± 3.0 mg/l	09017
TOC Cell Test, 14879	–	TOC	400 mg/l*	± 30 mg/l	09017
Total Hardness Cell Test, 00961	–	Ca	75 mg/l*	± 7 mg/l	19778
Total Nitrogen Cell Test, 14537	CombiCheck 50, 14695	N	5.0 mg/l	± 0.7 mg/l	see prep. instr.
Total Nitrogen Cell Test, 00613	CombiCheck 50, 14695	N	5.0 mg/l	± 0.7 mg/l	see prep. instr.
Total Nitrogen Cell Test, 14763	CombiCheck 70, 14689	N	50 mg/l	± 7 mg/l	see prep. instr.
Zinc Cell Test, 00861	–	Zn	0.500 mg/l	± 0.050 mg/l	19806
Zinc Cell Test, 14566	CombiCheck 40, 14692	Zn	2.00 mg/l	± 0.40 mg/l	19806
Zinc Test, 14832	–	Zn	1.25 mg/l*	± 0.20 mg/l	19806

* Self prepared, recommended concentration

** c = 1000 mg/l analyte

Instructions for the Preparation of Standard Solutions

Standard solution of bromine acc. to DIN EN ISO 7393

Preparation of a KIO_3 stock solution:
In a 1000-ml volumetric flask dissolve 1.005 g of KIO_3, art.1.02404, in 250 ml of distilled water. Subsequently make up to the mark with distilled water.

▼

Preparation of a KIO_3/KI standard solution:
Transfer 8.90 ml of the KIO_3 stock solution to a 1000-ml volumetric flask, add approx. 1g of KI, art. 1.05043, and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.020 mg of bromine.

▼

Preparation of the bromine standard solution:

Pipette 10 ml KIO_3 /KI standard solution into a 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, art. 1.09072, leave to stand for 1 min, and then add NaOH 2 mol/l, art. 1.09136, dropwise (approx. 1 ml) until the solution just loses its colour. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 2.00 mg/l bromine.

▼

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place. The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place. The dilute bromine standard solution remains stable for a maximum of 5 minutes.

▼

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide GR
1.09072.1000	Sulfuric acid 0.5 mol/l
1.09136.1000	Sodium hydroxide solution 2 mol/l

Standard solution of free chlorine

Preparation of a stock solution of free chlorine:
First prepare a 1:10 dilution using a sodium hypochlorite solution containing approximately 13 % of active chlorine. For this pipette 10 ml of sodium hypochlorite solution into a calibrated or conformity-checked 100 ml volumetric flask and then make up to the mark with DI water.

▼

Precise assay of the stock solution for free chlorine:
Pipette 10.0 ml of the stock solution into a 250 ml ground-glass-stoppered conical flask containing 60 ml of DI water. Subsequently add to this solution 5 ml of hydrochloric acid 25% GR. and 3 g of potassium iodide. Close the conical flask with the ground-glass stopper, mix thoroughly, and leave to stand for 5 min.

Titrate the eliminated iodine with sodium thiosulfate solution 0.1 mol/l until a weakly yellow colour emerges. Add 2 ml of zinc iodide-starch solution and titrate from blue to colourless.

▼

Calculation:

1 ml sodium thiosulfate solution = 3.55 mg free chlorine

Further investigational concentrations may be prepared from the stock solution prepared according to the procedure described above by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for approximately one week. Further dilutions (investigational concentrations) are stable for approximately 2 hours.

▼

Reagents required:

1.00316.1000	Hydrochloric acid 25 % GR
1.05614.9025	Sodium hypochlor. solution techn. approx. 13 % active chlorine
1.09147.1000	Sodium thiosulfate solution 0.1 mol/l 0.1 N solution
1.05043.0250	Potassium iodide GR
1.05445.0500	Zinc iodide-starch solution GR
1.16754.9010	Water GR

Standard solution of free chlorine acc. to DIN EN ISO 7393

Preparation of a KIO_3 stock solution:
In a 1000-ml volumetric flask dissolve 1.005 g of KIO_3, art.1.02404, in 250 ml of distilled water. Subsequently make up to the mark with distilled water.

▼

Preparation of a KIO_3/KI standard solution:
Transfer 10.0 ml of the KIO_3 stock solution to a 1000-ml volumetric flask, add approx. 1g of KI, art. 1.05043, and make up to the mark with distilled water (this solution must be prepared freshly).
1 ml of this solution is equivalent to 0.010 mg of chlorine.

▼

Preparation of the chlorine standard solution:

Pipette 20 ml KIO_3 /KI standard solution into a 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, art. 1.09072, leave to stand for 1 min, and then add NaOH 2 mol/l, art. 1.09136, dropwise (approx. 1 ml) until the solution just loses its colour. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 2.00 mg/l chlorine.

▼

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place. The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place. The dilute chlorine standard solution remains stable for a maximum of 5 minutes.

▼

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide GR
1.09072.1000	Sulfuric acid 0.5 mol/l
1.09136.1000	Sodium hydroxide solution 2 mol/l

Standard solution of free chlorine

Preparation of a standard solution:
Dissolve 1.85 g of dichloroisocyanuric acid, sodium salt, GR with DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l free chlorine.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution and the diluted investigational solutions remain stable for one day.

▼

Reagents required:

1.02426.0250	Dichloroisocyanuric acid, sodium salt, GR
1.16754.9010	Water GR

Standard solution of total chlorine

Preparation of a standard solution:
Dissolve 4.00 g of chloramine T GR with DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l total chlorine.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution and the diluted investigational solutions remain stable for one day.

▼

Reagents required:

1.02426.0250	Chloramine T GR
1.16754.9010	Water GR

Standard solution of chlorine dioxide acc. to DIN EN ISO 7393

Preparation of a KIO_3 stock solution:
In a 1000-ml volumetric flask dissolve 1.005 g of KIO_3, art.1.02404, in 250 ml of distilled water. Subsequently make up to the mark with distilled water.

▼

Preparation of a KIO_3/KI standard solution:
Transfer 10.5 ml of the KIO_3 stock solution to a 1000-ml volumetric flask, add approx. 1g of KI, art. 1.05043, and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.020 mg of chlorine dioxide.

▼

Preparation of the chlorine dioxide standard solution:

Pipette 10 ml KIO_3 /KI standard solution into a 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, art. 1.09072, leave to stand for 1 min, and then add NaOH 2 mol/l, art. 1.09136, dropwise (approx. 1 ml) until the solution just loses its colour. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 2.00 mg/l chlorine dioxide.

▼

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place. The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place. The dilute chlorine dioxide standard solution remains stable for a maximum of 5 minutes.

▼

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide GR
1.09072.1000	Sulfuric acid 0.5 mol/l
1.09136.1000	Sodium hydroxide solution 2 mol/l

Standard solution of formaldehyde

Preparation of a stock solution:
In a calibrated or conformity-checked 1-l volumetric flask make up 2.50 ml of formaldehyde solution min. 37 % GR to the mark with DI water. The stock solution prepared according to this procedure has a concentration of approximately 1000 mg/l formaldehyde.

▼

Precise assay of the standard solution (stock solution) for formaldehyde:
Pipette 40.0 ml (full pipette) of the formaldehyde stock solution of approximately 1000 mg/l into a 300-ml ground-glass conical flask, and add 50.0 ml (buret) of iodine solution 0.05 mol/l and 20 ml of sodium hydroxide solution 1 mol/l.

Leave to stand for 15 minutes and subsequently add 8 ml of sulfuric acid 25 % GR. Add 1 ml of zinc iodide-starch solution and subsequently titrate to the end point with sodium thiosulfate solution 0.1 mol/l.

▼

Calculation of the exact content of the formaldehyde solution:
C1 = consumption of sodium thiosulfate solution 0.1 mol/l
C2 = quantity of iodine solution 0.05 mol/l

$$mg/l\ Formaldehyde = (C2 - C1) \times 37.525$$

Further investigational concentrations may be prepared from the stock solution exactly determined according to the procedure described above by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for one week. After this time, the stock solution must be determined anew and the corresponding value must be duly accounted for in the further use. The further dilution solutions (investigational concentrations) must be used immediately.

▼

Reagents required:

1.04003.1000	Formaldehyde solution min. 37 % GR
1.09099.1000	Iodine solution 0.05 mol I2/l 0.1 N solution
1.09147.1000	Sodium thiosulfate solution 0.1 mol/l 0.1 N solution
1.09137.1000	Sodium hydroxide solution 1 mol/l 1 N solution
1.00716.1000	Sulfuric acid 25 % GR
1.05445.0500	Zinc iodide-starch solution GR
1.16754.9010	Water GR

Standard solution of COD

Preparation of a standard solution:
In a calibrated or conformity-checked 1-l volumetric flask make up 0.850 g of potassium hydrogen phthalate GR volumetric standard to the mark with DI water. The stock solution prepared according to this procedure has a concentration of 1000 mg/l COD.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for one month. When stored under appropriate cool conditions (refrigerator), further investigational concentration dilutions remain stable – depending on the respective concentration – for approximately one week to one month.

▼

Reagents required:

1.02400.0080	Potassium hydrogen phthalate GR volumetric standard
1.16754.9010	Water GR

Standard solution of hydrazine

Preparation of a standard solution:
Dissolve 4.07 g of hydrazinium sulfate GR with oxygen-low (boil previously) DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l hydrazine.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution and the further diluted investigational solutions remain stable for one day.

▼

Reagents required:

1.04603.0100	Hydrazinium sulfate GR
1.16754.9010	Water GR

Standard solution of iodine acc. to DIN EN ISO 7393

Preparation of a KIO_3 stock solution:
In a 1000-ml volumetric flask dissolve 1.005 g of KIO_3, art.1.02404, in 250 ml of distilled water. Subsequently make up to the mark with distilled water.

▼

Preparation of a KIO_3/KI standard solution:
Transfer 5.60 ml of the KIO_3 stock solution to a 1000-ml volumetric flask, add approx. 1g of KI, art. 1.05043, and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.020 mg of iodine.

▼

Preparation of the iodine standard solution:

Pipette 10 ml KIO_3 /KI standard solution into a 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, art. 1.09072, leave to stand for 1 min, and then add NaOH 2 mol/l, art. 1.09136, dropwise (approx. 1 ml) until the solution just loses its colour. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 2.00 mg/l iodine.

▼

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place. The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place. The dilute iodine standard solution remains stable for a maximum of 5 minutes.

▼

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide GR
1.09072.1000	Sulfuric acid 0.5 mol/l
1.09136.1000	Sodium hydroxide solution 2 mol/l

Instructions for the Preparation of Standard Solutions

Standard solution of ozone acc. to DIN EN ISO 7393

Preparation of a KIO_3 stock solution:
In a 1000-ml volumetric flask dissolve 1.005 g of KIO_3, art.1.02404, in 250 ml of distilled water. Subsequently make up to the mark with distilled water.

▼

Preparation of a KIO_3/KI standard solution:
Transfer 14.8 ml of the KIO_3 stock solution to a 1000-ml volumetric flask, add approx. 1g of KI, art. 1.05043, and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.010 mg of ozone.

▼

Preparation of the ozone standard solution:

Pipette 20 ml KIO_3 /KI standard solution into a 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, art. 1.09072, leave to stand for 1 min, and then add NaOH 2 mol/l, art. 1.09136, dropwise (approx. 1 ml) until the solution just loses its colour. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 2.00 mg/l ozone.

▼

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place. The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place. The dilute ozone standard solution remains stable for a maximum of 5 minutes.

▼

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide GR
1.09072.1000	Sulfuric acid 0.5 mol/l
1.09136.1000	Sodium hydroxide solution 2 mol/l

Standard solution of total nitrogen

Preparation of a standard solution:
Dissolve 5.36 g of glycine GR with DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l total nitrogen.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for one week. The diluted investigational concentrations must be used immediately.

▼

Reagents required:

1.04201.0100	Glycine GR
1.16754.9010	Water GR

Standard solution of phenol

Preparation of a standard solution:
Dissolve 1.00 g of phenol GR with DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l phenol.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for one week. The diluted investigational solutions must be used immediately.

▼

Reagents required:

1.00206.0250	Phenol GR
1.16754.9010	Water GR

Standard solution of sulfide

Preparation of a stock solution:
Place 7.2 g of glass-clear, if necessary washed crystals of sodium sulfide hydrate approx. 35 % GR in a calibrated or conformity-checked 1-l volumetric flask, dissolve with DI water, and make up to the mark. The stock solution prepared according to this procedure has a concentration of approx. 1000 mg/l sulfide.

▼

Precise assay of the standard solution (stock solution) for sulfide:
Place 100 ml of DI water and 5 ml (full pipette) of sulfuric acid 25 % GR in a 500 ml ground-glass conical flask. To this solution add 25.0 ml (full pipette) of the sulfide stock solution of approx. 1000 mg/l and 25.0 ml (full pipette) of iodine solution 0.05 mol/l. Shake the contents of the flask thoroughly for about one minute, subsequently titrate with sodium thiosulfate solution 0.1 mol/l until the yellow iodine colour has disappeared, add 1 ml of zinc iodide-starch solution, and continue to titrate until a milky, pure white colour emerges.

▼

Calculation of the exact content of the sulfide solution:
C1 = consumption of sodium thiosulfate 0.1 mol/l
C2 = quantity of iodine solution 0.05 mol/l (25.0 ml)

$$mg/l\ sulfide = (C2 - C1) \times 64{,}1026$$

Further investigational concentrations may be prepared from the stock solution exactly determined according to the procedure described above by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for at most one day. The further diluted solutions (investigational concentrations) must be used immediately.

▼

Reagents required:

1.09099.1000	Iodine solution 0.05 mol I2/l 0.1 N solution
1.06638.0250	Sodium sulfide hydrate approx. 35 % GR
1.09147.1000	Sodium thiosulfate solution 0.1 mol/l 0.1 N solution
1.00716.1000	Sulfuric acid 25 % GR
1.05445.0500	Zinc iodide-starch solution GR
1.16754.9010	Water GR

Standard solution sulfite

Preparation of a standard solution:
Dissolve 1.57 g of sodium sulfite GR and 0.4 g of Titriplex III GR. with DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l sulfite.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for only one day

▼

Reagents required:

1.06657.0500	Sodium sulfite GR
1.08418.0100	Titriplex III GR
1.16754.9010	Water GR

Standard solution of a-surfactants

Preparation of a standard solution:
Dissolve 1.00 g of sodium 1-dodecanesulfonate with DI water in a calibrated or conformity-checked 1-l volumetric flask and make up to the mark. The stock solution prepared according to this procedure has a concentration of 1000 mg/l anionic surfactants.

Further investigational concentrations may be prepared from this stock solution by diluting accordingly.

▼

Stability:
When stored in a cool place (refrigerator), the stock solution remains stable for one month. The diluted investigational solutions must be used immediately.

▼

Reagents required:

1.12146.0005	Sodium 1-dodecanesulfonate
1.16754.9010	Water GR

Standard solution of hydrogen peroxide

Preparation of a stock solution:
Place 10 ml of Perhydrol 30 % H_2O_2 GR in a calibrated or conformity-checked 100-ml volumetric flask and make up to the mark with DI water. Transfer 30 ml (full pipette) of this solution to a calibrated or conformity-checked 1-l volumetric flask and make up to the mark with DI water. The stock solution prepared according to this procedure has a concentration of approximately 1000 mg/l hydrogen peroxide.

▼

Precise assay of the standard solution (stock solution) for hydrogen peroxide:
Pipette 50.0 ml (full pipette) of the hydrogen peroxide stock solution of approx. 1000 mg/l into a 500-ml conical flask, dilute with 200 ml of DI water, and add 30 ml of sulfuric acid 25 % GR. Titrate with a 0.02 mol/l potassium permanganate solution until the colour changes to pink.

▼

Calculation of the exact content of the hydrogen peroxide concentration:

Consumption of potassium permanganate (ml) x 34.02 = content of hydrogen peroxide, in mg/l

Further investigational concentrations may be prepared from the stock solution exactly determined according to the procedure described above by diluting accordingly.

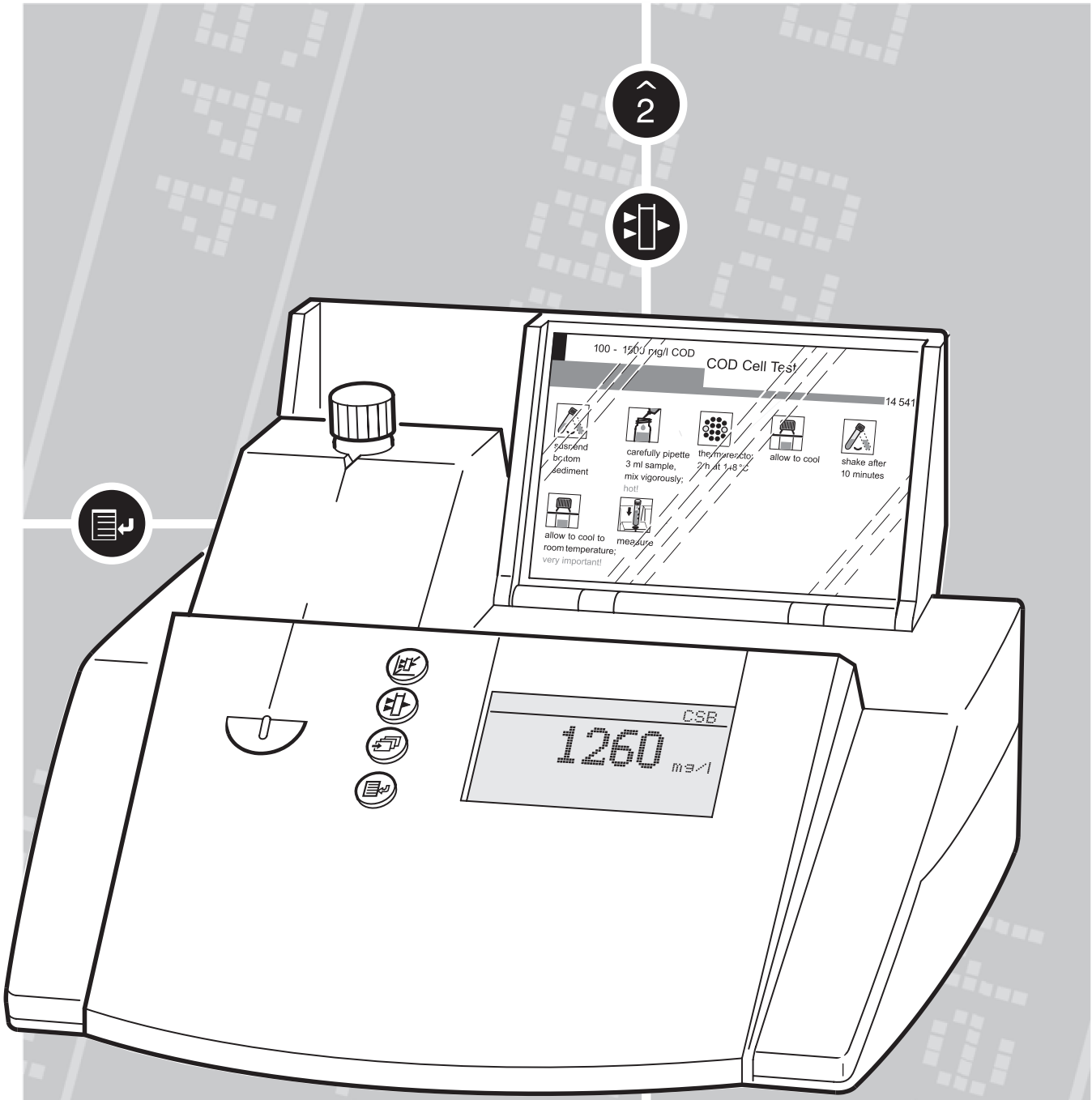
▼

Stability:
When stored in a cool place (refrigerator), the stock solution and the further diluted investigational solutions remain stable for one day.

▼

Reagents required:

1.09122.1000	Potassium permanganate solution 0.02 mol/l 0.1 N
1.07209.0250	Perhydrol 30 % GR
1.00716.1000	Sulfuric acid 25 % GR
1.16754.9010	Water GR



Functional description

Edition 03/2004 · Order no. BA41107d05

General instructions

Notes on this operating manual

To ensure that you become rapidly acquainted with your photometer, the first chapter contains an overview and a short manual of the meter. The second chapter contains notes for the safe operation of the photometer.
Chapter 3 describes the commissioning of the photometer. The remaining chapters provide a comprehensive description of the functions and technical data of the photometer.

Symbols used

indicates notes that you must read – for your own safety, the safety of others and to protect your meter from being damaged.

indicates notes that draw your attention to special features.

Scope of delivery

- Photometer
- Power pack
- AQA MemoChip
- Product documentation

Warranty

The designated meter is covered by a warranty of 2 years from the date of purchase. The meter warranty extends to manufacturing faults that are determined within the period of warranty. The warranty excludes components that are replaced during maintenance, such as batteries, accumulators, lamps etc.
The warranty claim extends to restoring the meter to readiness for use but not, however, to any further claim for damages. Improper handling or unauthorized opening of the instrument invalidates any warranty claim.
To ascertain the warranty liability, return the meter and proof of purchase together with the date of purchase freight paid or prepaid.

Accuracy when going to press

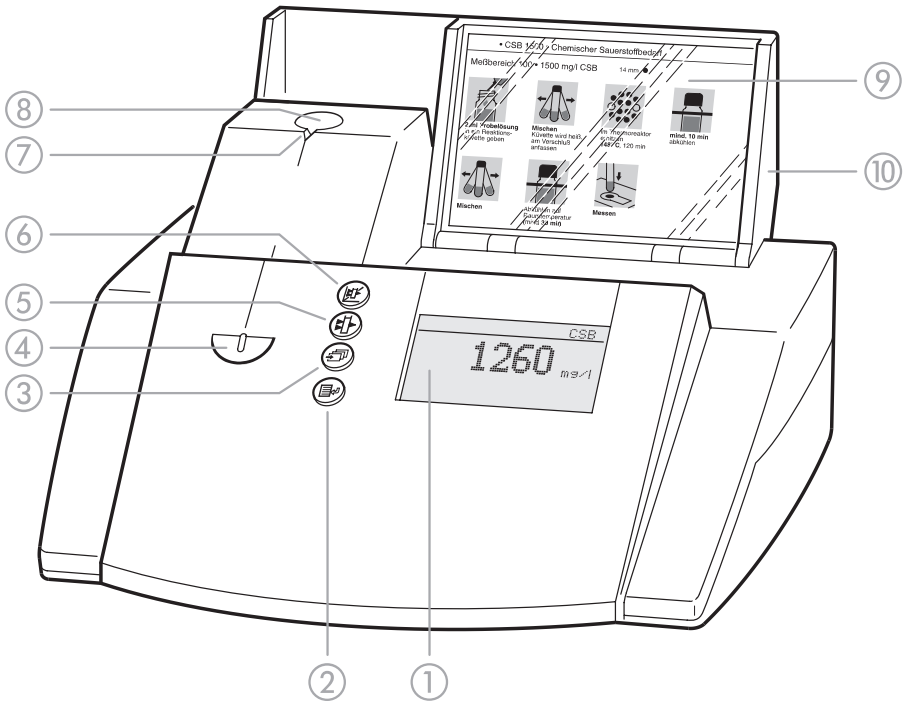
The use of advanced technology and the high quality standard of our instruments are the result of continuous development. This may result in differences between this operating manual and your meter. We cannot guarantee that there are absolutely no errors in this manual. We are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions. The information in this manual is subject to change without notice.

Contents

Contents

1. Overview

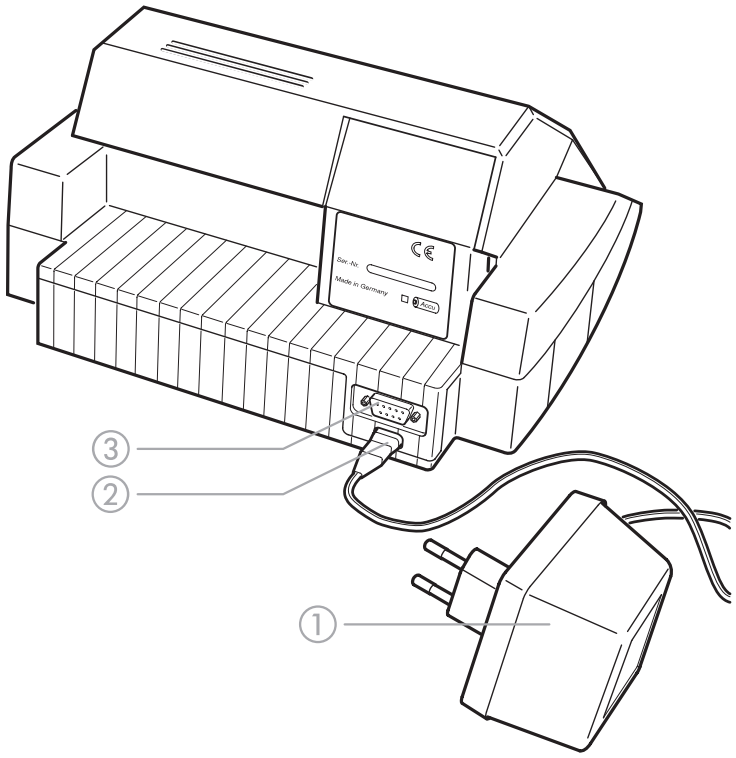
1.1 Description of the operating elements



① Display
② Menu call/Enter key
③ Scroll key
④ Recess for MemoChip
⑤ Absorbance measurement key
⑥ Concentration measurement key
⑦ Notch for cell alignment
⑧ Round cell shaft
⑨ Storage space for analysis regulations (short form)
⑩ Cover with integrated on/off switch

1.2 Identifying the connectors

① Power pack
② Connection for power pack
③ RS 232 interface



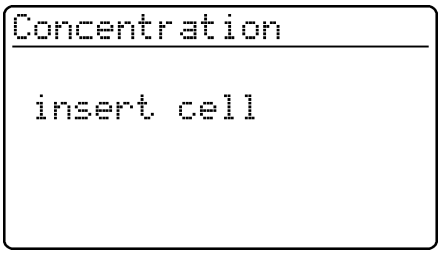
1.3 Short manual

The short manual lists all of the steps necessary to determine the concentration of a sample and to activate AQA2 at a glance.

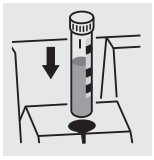
1.3.1 Measuring the concentration

– To switch on the photometer, open the cover.

The photometer performs a check (*Self-Check*) of the entire system and then switches automatically to the *concentration measuring mode*.



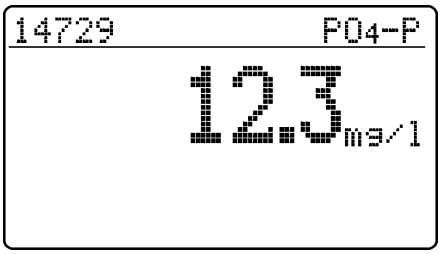
Measuring mode, *concentration*



– Insert the round cell with barcode in the round cell shaft until it clicks into place.

Align the line mark to the notch of the photometer. The message *measuring... appears.*

If the *select method* menu is displayed, align the line mark of the round cell to the notch of the photometer.

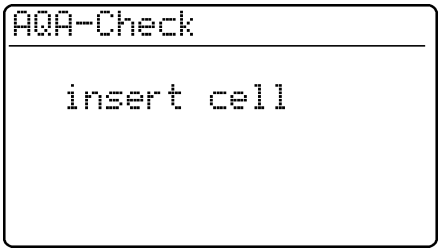


The measured value appears on the display.
Measured values outside the specified measuring range are output in small numerals.
Repeat the measurement:

– Press .

1.3.2 Activating AQA2

– Place the AQA MemoChip in the recess on the photometer.
  The following display appears:



The action of placing the AQA MemoChip in the recess directly activates the AQA check without having to press any key.

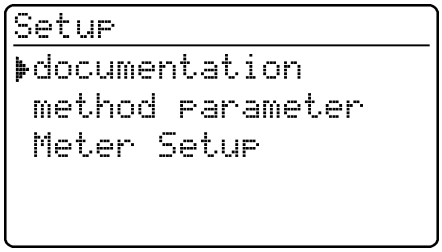
Standard concentrations and tolerances are listed in the table "Spectroquant® CombiCheck and standard solutions" in the part, "General information".

1.4 Selecting and calling up the menu items

– To switch on the photometer, open the cover.

– Press .

The following display appears:



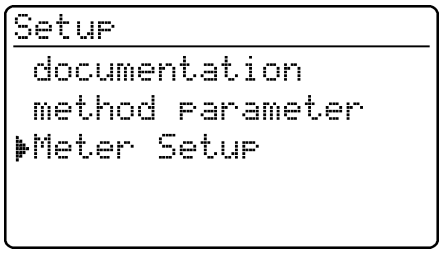
Example:

The *documentation* menu item is preselected in the *setup* menu (▶).

Select a menu item, e. g. *meter setup*:

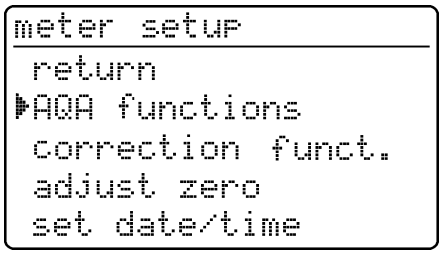
– Press .

The following display appears:



The *meter setup* menu item is preselected (▶).

– Call up the *meter setup* submenu by pressing .



The required menu item is

– selected using

– called up using .

Selection lists:

– Changes to the settings are accepted after confirmation by pressing

– Current settings are marked by "✣".

– Change to other configuration levels by
  - Selecting the menu item, *return*
  - Pressing

– Scroll with .

Character input:

– by using ,
the character to be input is shown in reverse video.

– Confirm each input with .

2. Safety

This operating manual contains basic instructions to be followed in the commissioning, operation and maintenance of the meter. Consequently, all responsible personnel must read this operating manual before working with the meter.
The operating manual must always be available in the vicinity of the meter.

2.1 Authorized use

The photometer is authorized exclusively for analyzing substances in water and aqueous solutions using round cells or rectangular cells (special optical glass).

Observe the technical specifications of the cells according to chapter 15 TECHNICAL DATA.
Any other use is considered **unauthorized**.

2.2 General instructions

The photometer is constructed and tested according to the EN 61010-1 safety regulations for electronic measuring instruments. It left the factory in a safe and secure technical condition.
The smooth functioning and operational safety of the photometer can only be guaranteed under the climatic conditions specified in chapter 15 TECHNICAL DATA of this operating manual.
Opening the photometer or adjustment, maintenance and repair work must only be performed by personnel authorized by the manufacturer.
The only exceptions to this are the activities described in chapter 14 MAINTENANCE. Non-compliance results in the loss of warranty claims.
Follow the points listed below when operating the photometer:

- Follow local safety and accident prevention regulations.
- Observe the enclosed instructions concerning reagents and accessories.
- Observe the regulations when dealing with dangerous substances.
- Follow the operating instructions at the workplace.
- Use only original spare parts.

2.2.1 Labeling of notes

indicates notes that you must read – for your own safety, the safety of others and to protect your meter from being damaged.

indicates notes that draw your attention to special features.

2.2.2 Dangers of disregarding the safety instructions

Disregarding the safety instructions can adversely affect the safety of both the user and the environment as well as the equipment.

Non-compliance with the safety instructions will result in the loss of any warranty claims.

2.2.3 Qualification of the personnel

The personnel responsible for the commissioning, operation and maintenance must have the necessary qualifications for this work. If the personnel do not have the required skills they have to be instructed.

Furthermore, it must be ensured that the personnel read and completely understand the present operating manual.

2.2.4 Technical state of the meter

It is the responsibility of the operator to continuously observe the overall technical condition (externally recognizable deficits and damage as well as alterations to the operational behavior) of the meter.
If safe operation is no longer possible, the equipment must be taken out of service and secured against inadvertent operation.

Safe operation is no longer possible if

- the equipment has been damaged in transport
- the equipment has been stored under adverse conditions for a lengthy period of time
- the equipment is visibly damaged
- the equipment no longer operates as prescribed.

If you are in any doubt, please contact the supplier of the photometer.

3. Commissioning

The photometer operates at an environmental temperature of +5 °C to +40 °C. During transport from cold to warm surroundings, condensation can form resulting in the malfunction of the meter.

Before putting the photometer into service, wait until it has adapted to the new environmental conditions (see also chapter 15 TECHNICAL DATA).

3.1 Preparing the photometer

– Place the photometer on a hard, flat surface and protect it against intensive light and heat.

Line operation

– Plug the original power pack into the socket on the photometer
– Plug the power pack into the line socket
– Switch on the photometer (open the cover).

Battery operation

– Charge the battery for approx. 5 hours before the initial commissioning. To do this:
  - Plug the original power pack into the socket on the photometer
  - Plug the power pack into the line socket and then the battery will be charged.

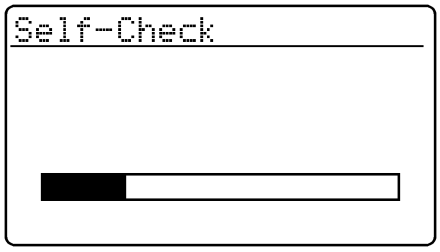
During battery operation or when the meter is at a standstill for longer periods of time, the battery runs down. This can result in your photometer no longer being ready for operation.

When the following symbol is displayed, charge the battery: 

3.2 Switching on the photometer

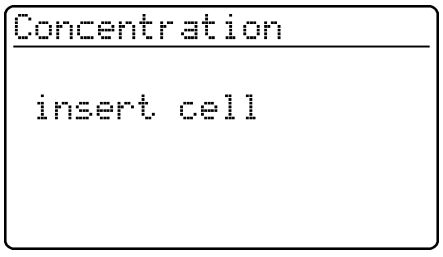
– To switch on the photometer, open the cover.

The photometer performs a check (*Self-Check*) of the entire system and then switches automatically to the *concentration* measuring mode.



Self-check of the photometer

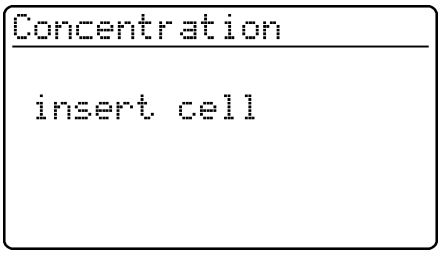
After approx. 5 s:



Automatic change to the measuring mode, *concentration*

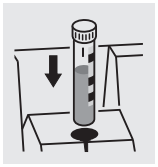
4. Measuring the Concentration

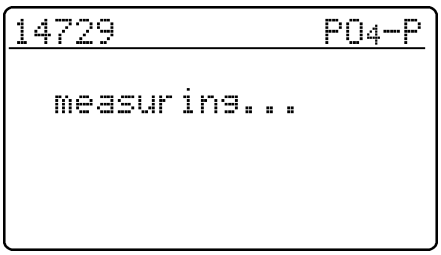
– Call up the *concentration* measuring mode by actuating .



Measuring mode, *concentration*

4.1 Measuring using cell tests

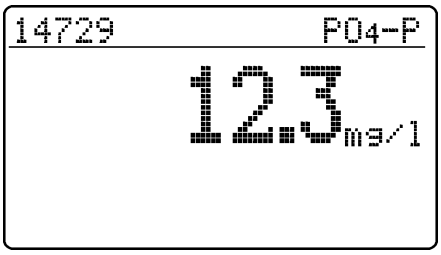




– Insert the round cell with barcode into the round cell shaft until it clicks into place.
  Align the line mark to the notch of the photometer.

The photometer reads the barcode of the round cell and automatically selects the relevant method.

After approx. 2 s:



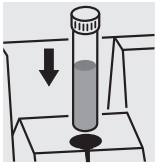
The measured value appears on the display.

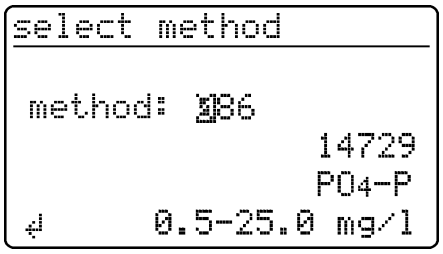
If the *select method* menu is displayed, align the line mark of the round cell to the notch of the photometer.

4. Measuring the Concentration

4.2 Measuring using tests without barcode (manual method selection)

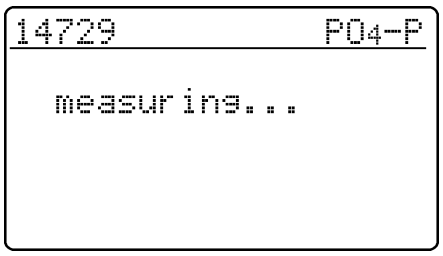
When measuring using cell tests without barcode, the method must be selected manually.



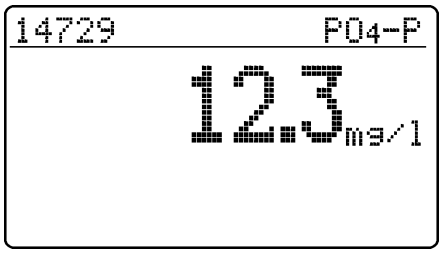


The last method set up manually appears on the display.

– Select the required method with
– Confirm with .



After approx. 2 s:

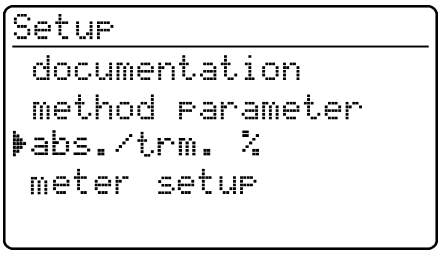


The measured value appears on the display.

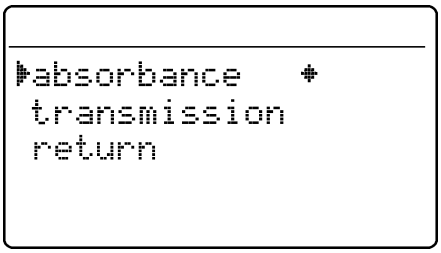
5. Measuring the Absorbance/Transmission

5.1 Switching to the Absorbance/ Transmission measuring mode

– Call up the *setup* measuring mode by actuating .



– In the *setup* menu, call up the *abs./trm. %* submenu.

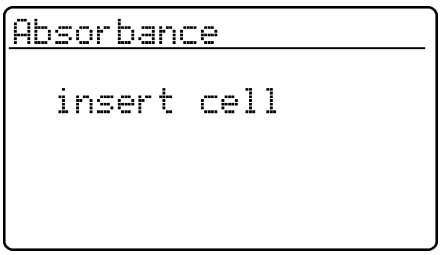


Selection of the measuring mode:

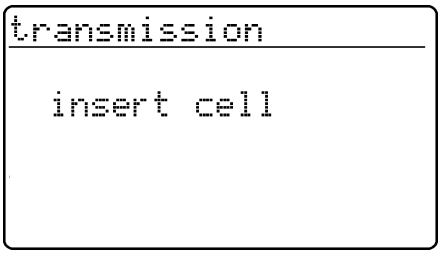
- *absorbance*
- *transmission*

5.2 Measuring the absorbance or transmission

– Call up the *absorbance* or *transmission* measuring mode (depending on the selection in the *abs./trm. %* menu) by actuating .



Measuring mode, *absorbance*



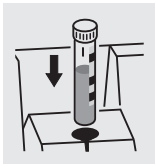
Measuring mode, *transmission*

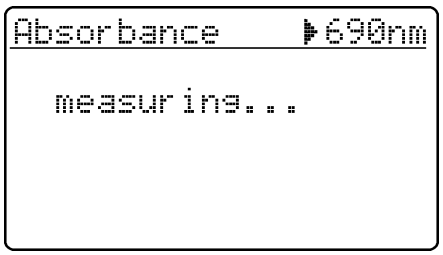
The transmission measurement is not described separately in the following example as it operates in exactly the same way as the absorbance measurement. However, the result of the measurement is displayed as % Transmission instead of A for Absorbance.

A measured reference absorbance is also effective in the measuring mode, *transmission*. It is displayed as reference absorbance.

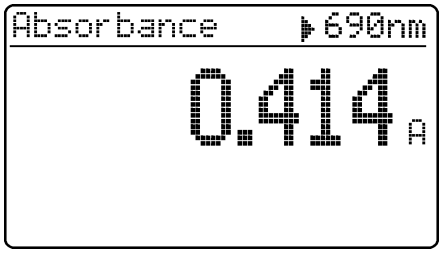
5. Measuring the Absorbance/Transmission

5.3 Measuring using cell tests



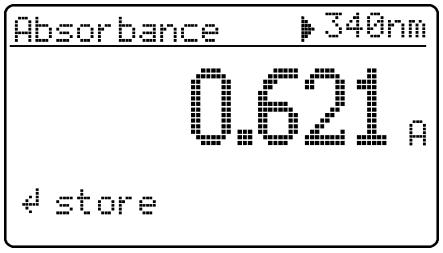


– Insert the round cell with barcode into the round cell shaft until it clicks into place.
Align the line mark to the notch of the photometer.

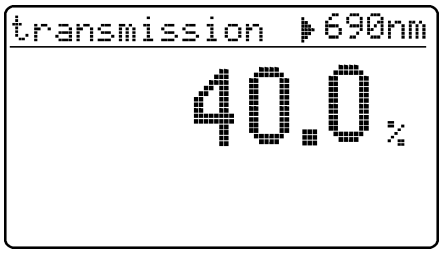


The measured value for the wavelength displayed at the top right appears. This measured value is automatically stored.
If necessary, call up further wavelengths:

– with .

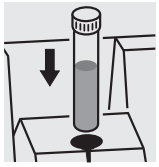


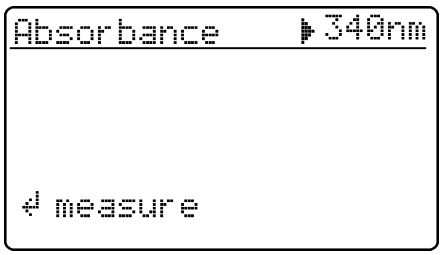
The measured value for the selected wavelength appears and can be stored and output to the interface with .



– Sample display for transmission measurement

5.4 Measuring using tests without barcode





The last wavelength measured appears on the display.

– Select the wavelength:
with

– Start the measurement:
Press .

6. Documentation

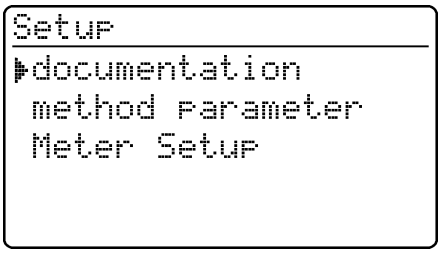
The measured values can be documented as follows:

- Storage in the measured value memory
- Output to a connected printer via the serial interface (automatic when a printer is connected)
- Transmission to a PC for further processing (by using the relevant software, e.g. Multi/ACHATII or – less conveniently – by means of a terminal program).

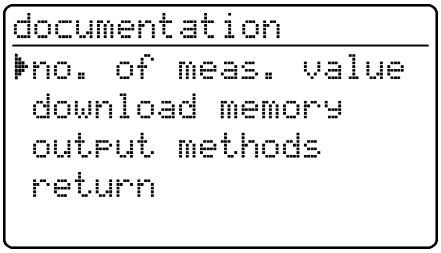
– To switch on the photometer, open the cover.

– Press  .

The following display appears:



– Call up the *documentation* menu with  .



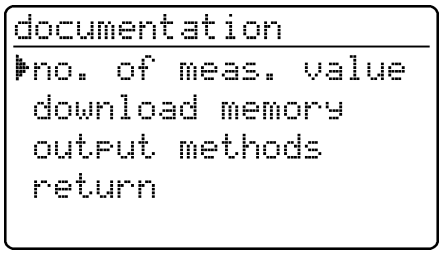
The following functions can be selected:

- *no. of meas. value*
  - reset the number
- *download memory*
  - total
  - from date
- output methods
  - all

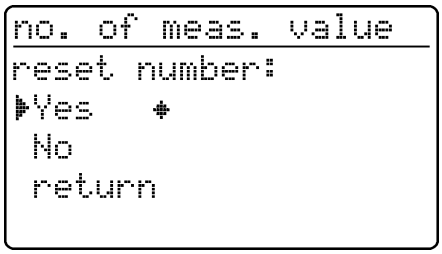
The current settings are marked by "✙" in the selection lists of the respective submenus.

6. Documentation

6.1 Resetting the number of the measured value



– Call up the *no. of meas. value* submenu.



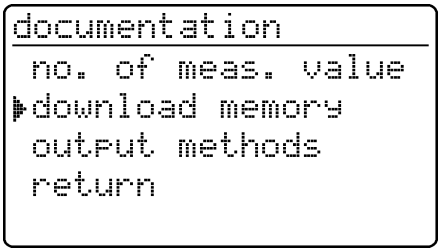
- *yes*
  The numbering of the measured values starts again with 001 (default)
- *no*
  Consecutive numbering of the measured values (from 001 to 999)

– Select the menu item with 

– Confirm with  .

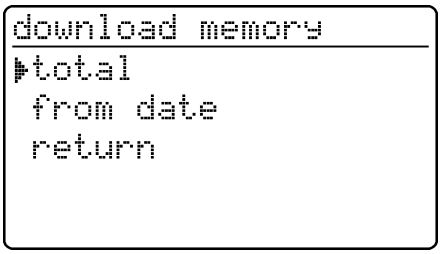
6.2 Download memory

The measured value storage can be selectively downloaded to either the display or serial interface.
The selection of the output medium is made after the specification of the sorting criteria.



– Call up the *download memory* submenu.

The *download memory* menu item only appears after at least one measurement has been performed.



The following sorting criteria can be set:

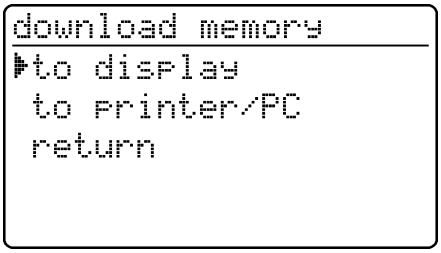
- *total* – all stored measured values
- *from date* – all measured values from a special date

– Select the menu item with 

– Confirm with  .

6. Documentation

Selecting "total"



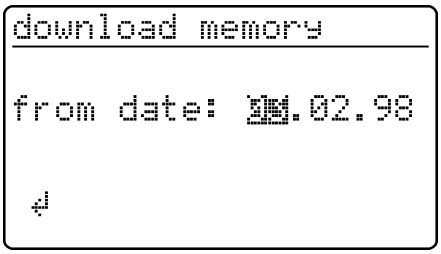
Select the output medium:

- *to display*
- *to printer/PC* (serial interface).

– Select the menu item with

– Confirm with to start the memory download.

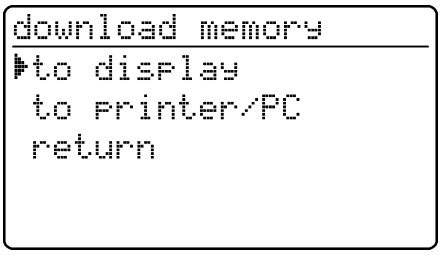
Selecting "from date"



– Input the date using

– Erase the input using C

– Confirm with .



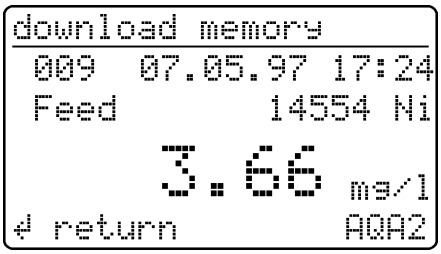
Select the output medium:

- *to display*
- *to printer/PC* (serial interface).

– Select the menu item with

– Confirm with to start the memory download.

Memory download to display

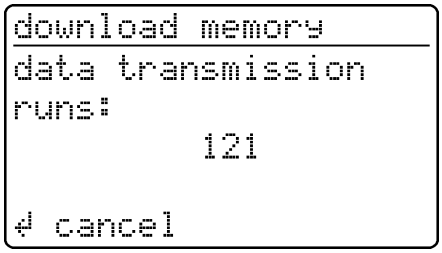


Each data record appears individually on the display beginning with the data record just measured.
The display shows:

- no. of meas. value
- date/time
- I. D. number
- method designation
- citation
- meas. value
- unit
- Where necessary, AQA ID, e.g. AQA2.

– Scroll with .

Memory download to printer/PC



Memory download to the serial interface:

- Display of the transmitted no. of measured value (continuation display) beginning with the last measured value.

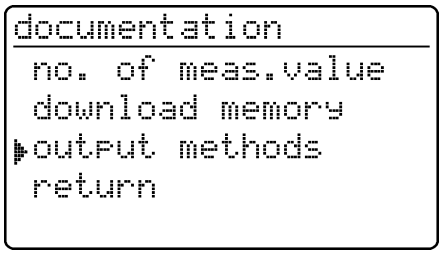
– Cancel with .

Sample printout:

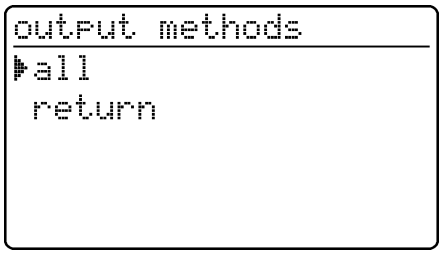
003	14541	10.02.98	11:56:33	t		80	mg/l	COD
002	14541	10.02.98	11:54:21	t		70	mg/l	COD
001	14729	03.02.98	18:30:53		*	0.3	mg/l	PO4-P

6.3 Download of the methods list

The stored methods are downloaded to the printer/PC via the serial interface.



– Call up the *output methods* submenu.



The following parameters can be set:

- *all* – Download of all stored methods

– Select the menu item with .

– Start the download with .

7. Method Parameters

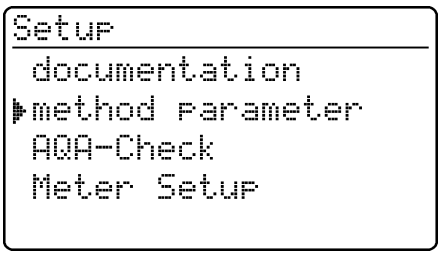
The following parameters can be set in the *method parameters* menu:

- citation
- unit

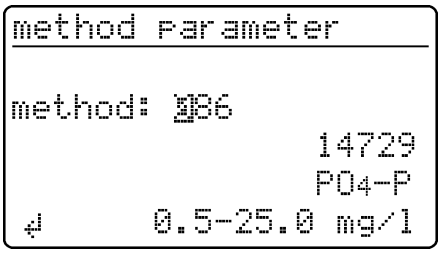
– To switch on the photometer, open the cover.

– Press .

The following display appears:

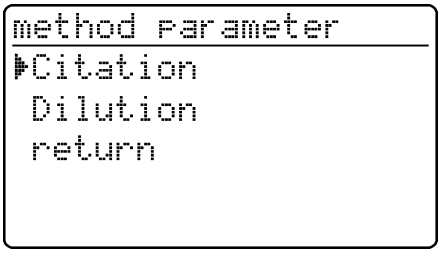


– Call up the *method parameters* submenu.



– Input the method number

– Confirm with .



– Select the menu item with

– Call up the parameter by pressing .

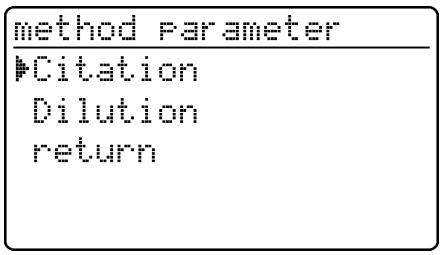
7. Method Parameters

7.1 Citation form

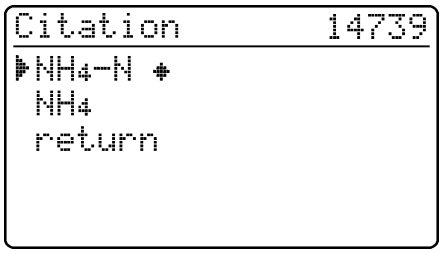
7.1.1 Changing the citation form

Example:

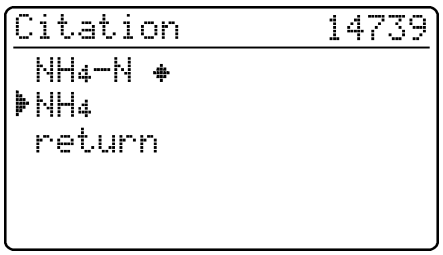
Change the citation form from "NH_4-N" to "NH_4".



– Call up the *citation* submenu.

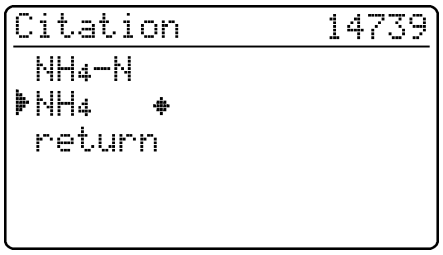


The current setting: *NH_4-N* (✥).



– Using , scroll to *NH_4*

– Confirm with .



– Citation form *NH_4* is set (✥).

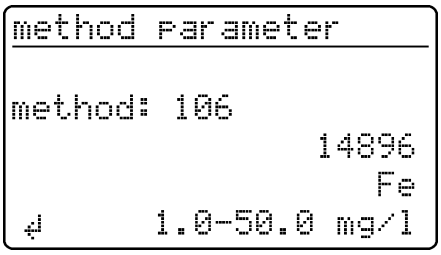
7.1.2 Performing a difference measurement

Difference measuring is possible for some methods (e.g. Iron II/III, Ca-/Mg Hardness).

For more information on this, see part, "Analysis specifications".

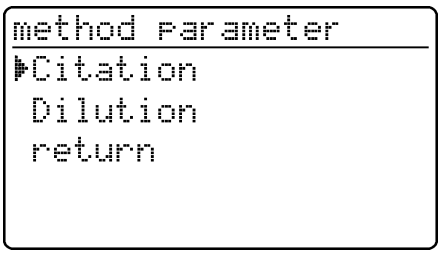
Example:

Determination of iron (II) and iron (III).

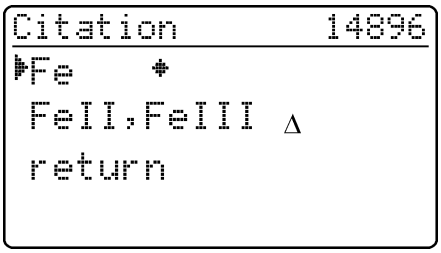


– Enter method *106*

– Confirm with .



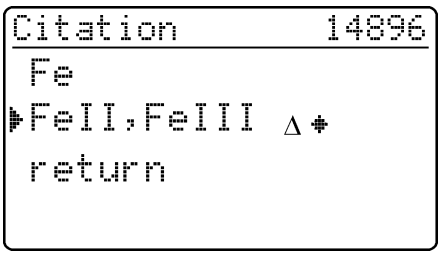
– Call up the *citation* menu item.



The current setting: *Fe*

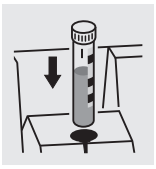
– Using scroll to *Fe II*, *Fe III*Δ

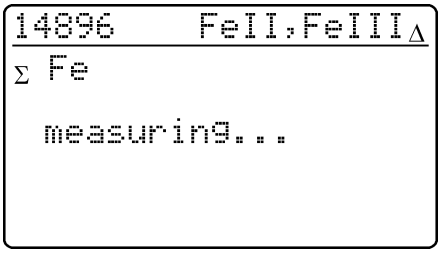
– Confirm with .



– Citation form *Fe II*, *Fe III*Δ (✥) is set.

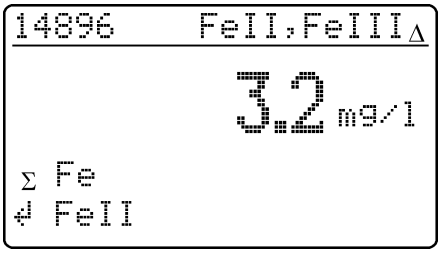
– Change to measuring by pressing .





– Start the 1st measurement by inserting cell 1.

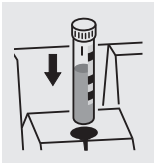
After approx. 2 s:

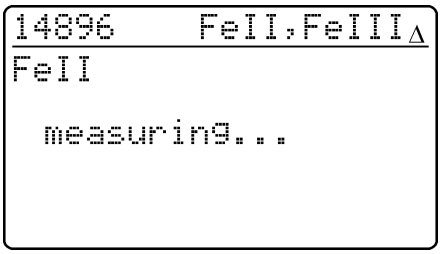


The 1st measured value appears on the display: Σ *Fe*.

– Remove cell 1

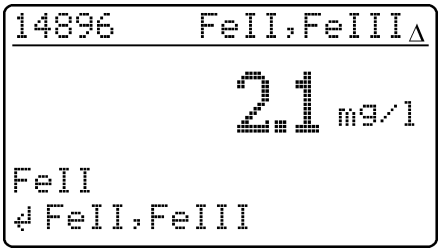
– Press .





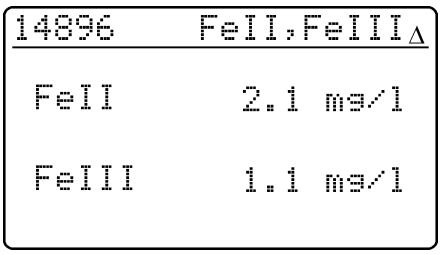
– Start the 2nd measurement by inserting cell 2.

After approx. 2 s:



The 2nd measured value appears on the display: *Iron II*.

– Continue to the display of both measured values using .

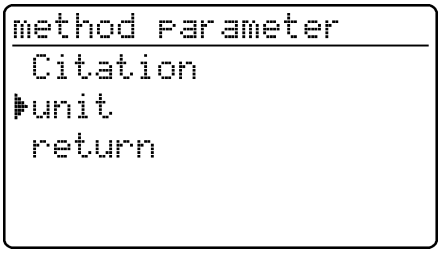


Display of both measured values as a summary.

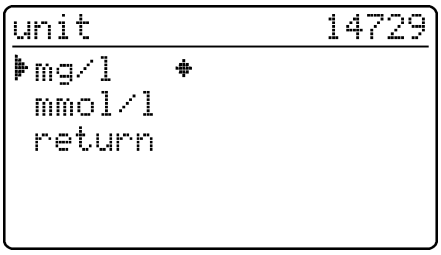
7. Method Parameters

7.2 Selecting the unit

The preset unit is "mg/l".
It can be changed to "mmol/l".



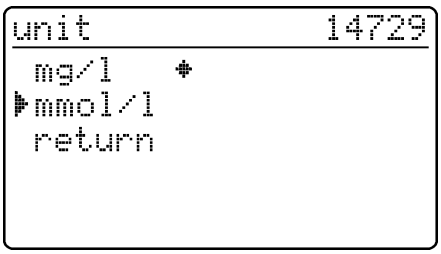
– Call up the *unit* submenu.



The current setting: *mg/l* (✥)

– Using scroll to *mmol/l*

– Confirm with .



– Unit *mmol/l* (✥) is set.

8. Analytical Quality Assurance (AQA)

Analytical quality assurance (AQA) can be performed in two steps:

- **AQA1** – Photometer monitoring
- **AQA2** – Total system monitoring with standard solutions

The total system monitoring (AQA2) is a method-specific check using standard solutions.
If this is performed successfully, it also includes photometer monitoring (AQA1).

See also part "General information" for further information on Analytical Quality Assurance (AQA).

The AQA mode must be activated in the photometer. In the delivery state it is switched off.

The AQA mode is activated:

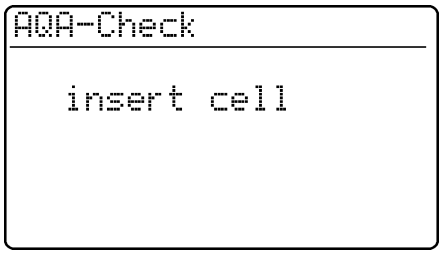
- by inserting the AQA MemoChip
  - monitoring of the total system using standard solutions (AQA2)
- by using a menu to select
  - monitoring of the photometer (AQA1)
  - monitoring of the total system using standard solutions (AQA2)

8.1 Activating AQA

– To switch on the photometer, open the cover.

8.1.1 Activating AQA using the AQA MemoChip

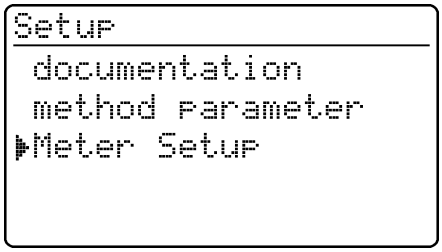
– Place the AQA MemoChip in the recess on the photometer.
The following display appears:



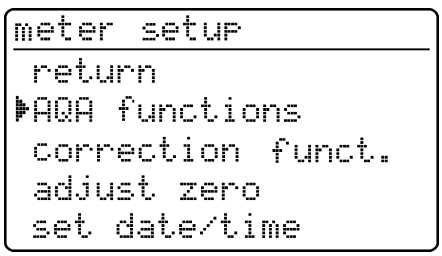
The action of placing the AQA MemoChip in the recess directly activates the AQA2 check (see section 8.3.4).

8.1.2 Activating AQA via the menu guide

– Press .



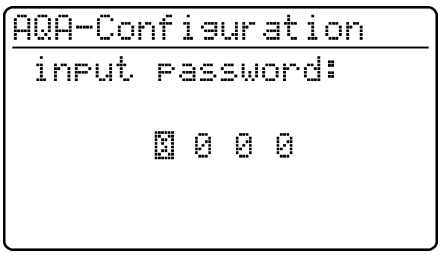
– Call up the *meter setup* submenu.



The *meter setup* submenu appears with the *AQA functions* menu item preselected.

– Confirm with .

A password request appears:

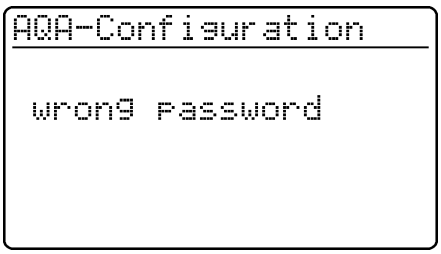


A separate password protects settings of the AQA-configuration against unauthorized access (Changing the password see section 8.1.5).

– Input the password with : Only **numeric** characters are allowed. Default: *0000*

– Confirm with .

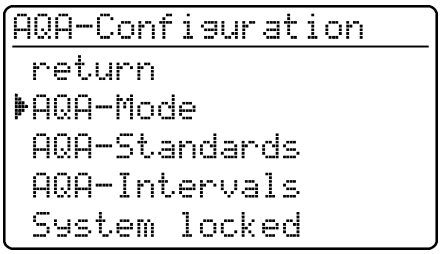
If the input was incorrect:



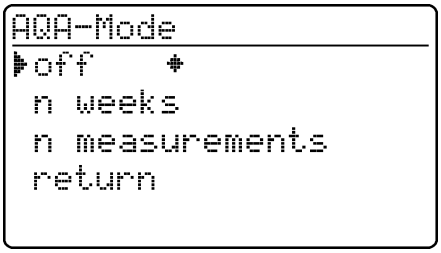
– Repeat the input.

If you have forgotten the password, contact the service department.

After the password has been successfully input, the *AQA configuration* submenu appears:



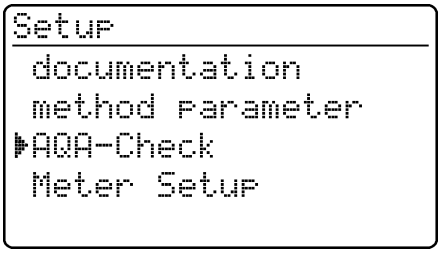
– Call up the *AQA mode* function.



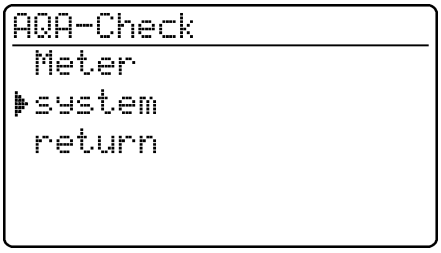
Default: *off* (no monitoring)

– Select *AQA mode*:
  – *off*
  – *n weeks*
  – *n measurements*

– Confirm with .



– In the *setup* menu, call up the *AQA check* submenu.



Selection of the AQA mode:

- *meter*
- *system*

The menu item, *meter*, only appears after the corresponding PhotoCheck standards have been input (see section 8.2.1).

8.1.3 Changing AQA intervals

AQA intervals specify the interval between two AQA checks. A fixed time interval (*n weeks*) or a number of measurements (*n measurements*) can be specified as the interval.
The respective values that were input remain stored even if they are not activated.
Additionally, two separate intervals can be set up for both photometer monitoring (AQA1) and system monitoring (AQA2).

For the total system monitoring (AQA2), a change of the time interval (*n weeks*) even retroactively applies to monitoring processes that are already running.

Changing the number of measurements (*n measurements*) does not affect monitoring processes already running.
Thus, individual numbers of measurements can be set for different methods.

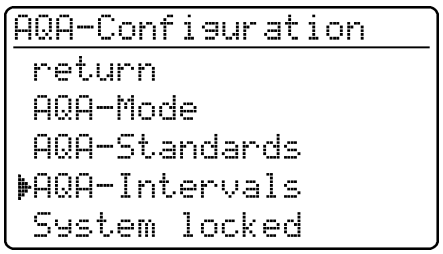
After an interval has expired, the following consequences become effective:

- Warning and loss of AQA identification
- Locking of the method for concentration measurements (as long as the locking is active).

Setting ranges:

- Photometer monitoring (AQA1):
  - 1 to 52 weeks (default: 12 weeks) or
  - 1 to 9999 measurements (default: 1500)
- Monitoring of the total system using standard solutions (AQA2):
  - 1 to 52 weeks (default: 4 weeks) or
  - 1 to 9999 measurements (default: 100)

With the *n measurements* setting, a difference measurement (see section 7.1.2) is counted as one measurement only.



– In the *AQA configuration* menu, call up the *AQA intervals* submenu.
According to the selection in the *AQA mode* menu, a fixed time interval (*n weeks*) or a number of measurements (*n measurements*) is set in the *AQA intervals* menu.

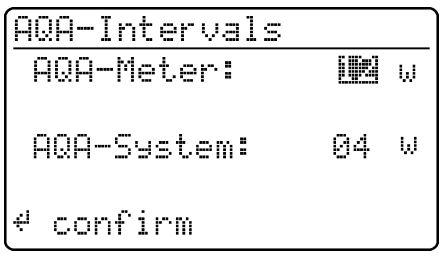
If the *AQA mode* function is switched off, the *AQA intervals* submenu is not available.

AQA interval, "n weeks"

The AQA interval, *n weeks*, is only effective if the *n weeks* setting is active for the *AQA mode* function.
The specified number of *n weeks* applies to:

- the photometer with AQA1
- all methods with AQA2.

– In the *AQA intervals* menu, call up the *n weeks* submenu.



– To return without change, press three times
– Enter the time interval for *AQA meter* with , confirm with .

AQA interval, "n measurements"

The AQA interval, *n measurements*, is only effective if the *n measurements* setting is active for the *AQA mode* function.
The AQA2 check starts the monitoring for one method at a time.

The specified number of *measurements* applies to:

- the instrument with AQA1 (total number of measurements performed, independent of whether AQA2 is active for some parameters)
- each method an AQA check will then be performed for with AQA2.
  Thus, it is possible to define individual numbers of measurements for different methods.
  The measurements are counted separately for each monitored method.

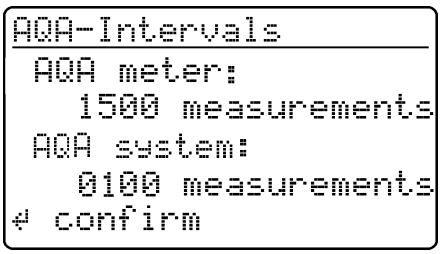
The monitoring intervals of AQA2 monitoring processes already started for other methods are not affected by changing the number of *measurements*. Thus the number of *measurements* can be set for further methods no matter which monitoring processes were started before.

When an AQA2 check is performed, the number of *measurements* last set in the *AQA intervals* menu is automatically taken over.

Therefore, you should check and, if necessary, change the currently set number of *measurements* before each AQA2 check.

The currently set number of *measurements* for the AQA2 check is saved for the active method and output in the report individually (section 8.3.4).

– In the *AQA intervals* menu, call up the *n measurements* submenu.



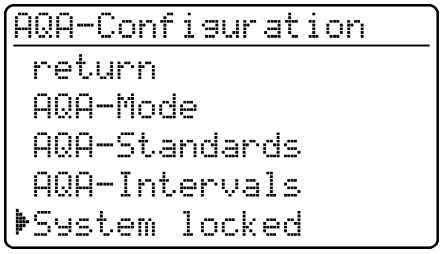
– To return without change, press ↵ three times
– Enter the number of measurements for *AQA meter* with ⇆, confirm with ↵
– Enter the number of measurements for *AQA system* with ⇆, confirm with ↵

8.1.4 Locking the system

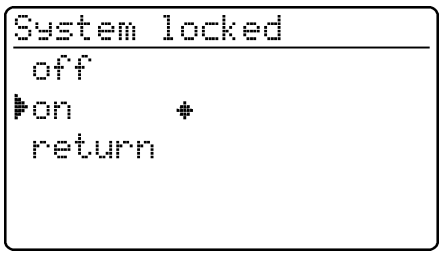
The function *system locked* is effective if, for a monitored method,

- no AQA check was performed,
- the AQA check “system” has expired.

As a result, a concentration measurement is not possible for this method.



– Call up the *system locked* submenu.

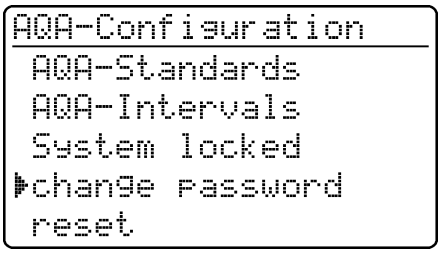


– Select the menu item with 

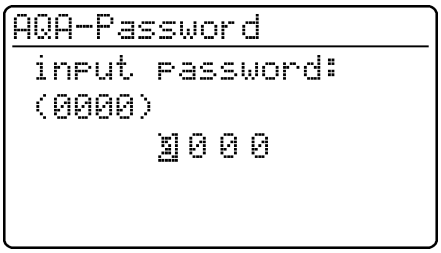
– Confirm with  .

8.1.5 Changing the password

When delivered, the default password is *0000*. This password can be changed as follows:



– Call up the *change password* submenu.
– Confirm with .

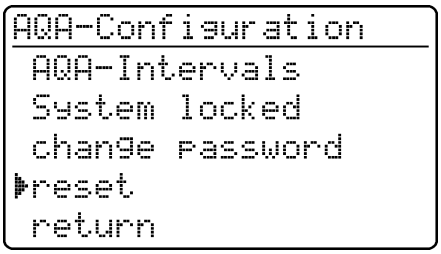


– Input the required password, e.g. *0100*, with .
– Confirm with .

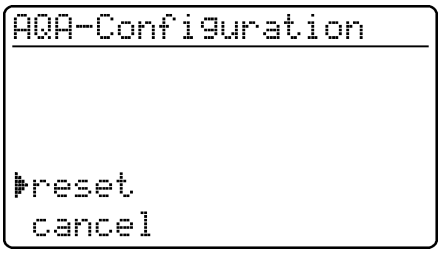
– Input the password once again:
– Confirm with .

8.1.6 Performing an AQA reset

If the Analytical Quality Assurance is to be switched off completely or reset to the delivery state, this can be made via the *reset* function in the *AQA configuration* submenu.



– Call up the *reset* submenu
– Confirm with .



– Select the *reset* menu item
– Confirm with .

An AQA reset is performed.

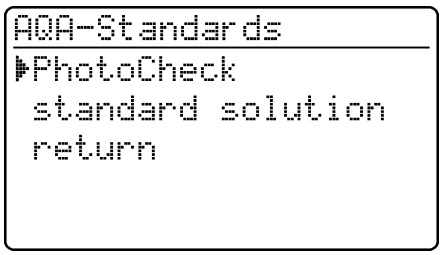
8. Analytical Quality Assurance (AQA)

8.2 Photometer monitoring (AQA1)

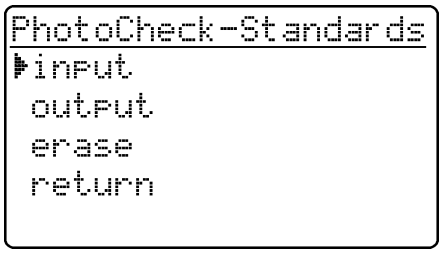
8.2.1 Entering PhotoCheck standards

A Spectroquant® PhotoCheck is required to perform the photometer monitoring (AQA1). **At least 1 standard** must be input. We recommend, however, to input all available standards.

– Press to call up the *setup* menu
– Call up the *meter setup* submenu.
– Call up the *AQA functions* submenu.
– Input the password
– Call up the *AQA standards* submenu and the following display appears:



– Call up the *PhotoCheck* submenu.



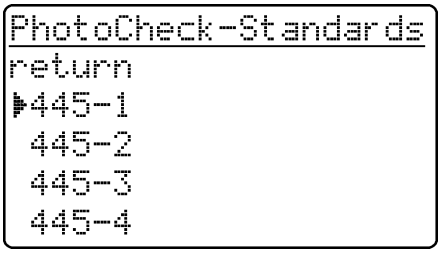
Select between

- *input*
  Input the theoretical value (absorbance) from the lot certificate of Spectroquant® PhotoCheck
- *output*
  Print/display theoretical values
- *erase*
  Erase theoretical values.

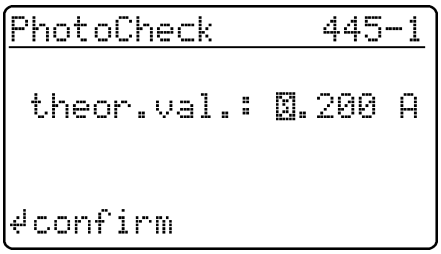
The *erase* and *output* menu items only appear after at least one standard has been input.

Example:

445-1 nm, theoretical value (absorbance) 0.200,
admissible tolerance ± 0.020

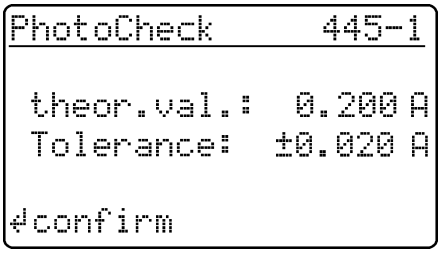


– Select with
– Quit via the menu item, *return*
– Confirm with .

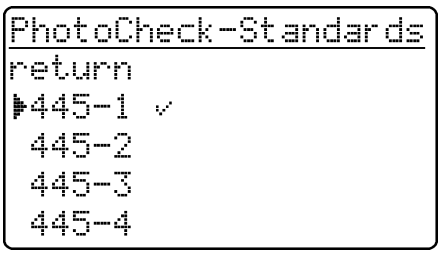


– Input the theoretical value, 445-1
– Confirm with .

If the standard is already stored, this value appears on the display.



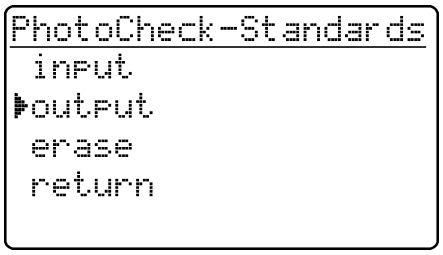
– Input the tolerance with
– Confirm with .



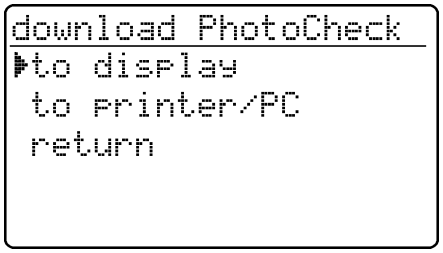
PhotoCheck standard 445-1 is input.

– Select the next one with
– Input all PhotoCheck standards in this way.

8.2.2 Download of PhotoCheck standards



– In the *PhotoCheck standards* submenu, call up the *output* menu item.



Select the output medium:

- *to display*
- *to printer/PC* (serial interface).

– Select with

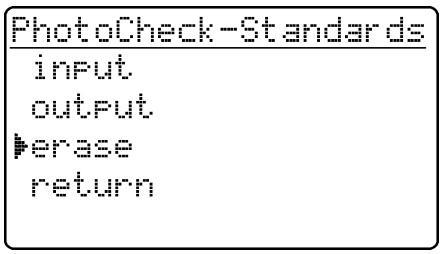
– Confirm with to start the download.

Example: Report output

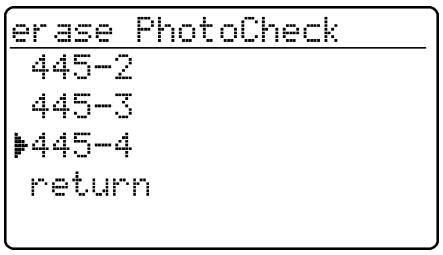
AQA check meter		AQA1		
26.08.97		13:19		
AQA interval		12 weeks		
test sol.	unit	theor. val.	tolerance	AQA date
445-1	A	0.200	0.020	26.08.97

8.2.3 Erasing PhotoCheck standards

At least 1 standard must still be stored to be able to perform the AQA check function (meter monitoring).



– In the *PhotoCheck standards* submenu, call up the *erase* menu item.



Displays the stored PhotoCheck standards:

– Select with

– Quit via *return*

– Erase with .

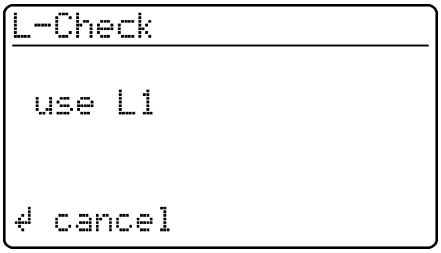
8.2.4 Performing Photometer monitoring

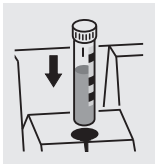
Photometer monitoring (AQA1) includes a check of the

- Light barriers using the L1/L2 cells (contained within the scope of delivery of the Spectroquant® PhotoCheck)
- Absorbance measurement using PhotoCheck standards.

– Press to call up the *setup* menu
– Call up the *AQA check* submenu
– Call up the *meter* submenu.

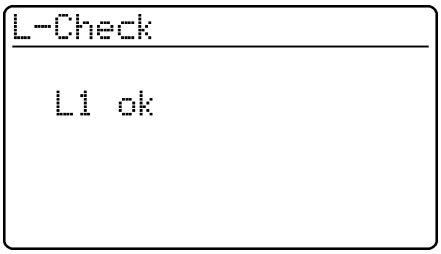
The following display appears:





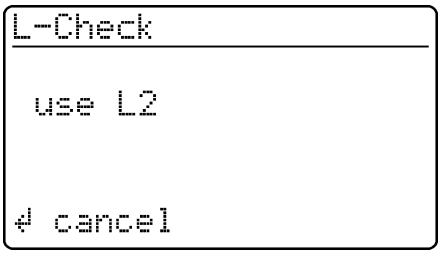
– Insert the L1 cell.

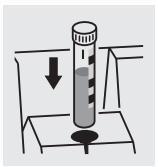
After approx. 1 s:



If the *error* message appears, clean the cell shaft with a damp, lint-free cloth and repeat the check.
If the message reoccurs, inform the service department.

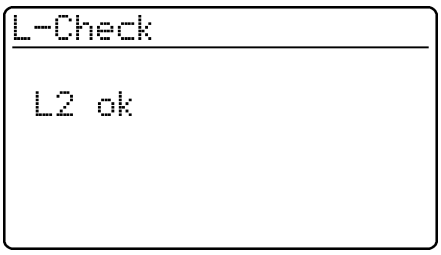
After approx. 4 s:





– Insert the L2 cell.

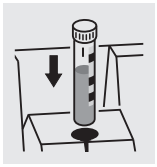
After approx. 1 s:



8. Analytical Quality Assurance (AQA)

After successful light barrier testing, the PhotoCheck standards (test solutions) are measured.

Example:



```
PhotoCheck        445-1

 use test
 solution       445-1

↲ cancel
```

– Insert a cell with the test solution, 445-1.
The photometer measures the absorbance of the test solution and compares the result with the value entered.

Absorbance test OK...

After approx. 3 s:

```
PhotoCheck        445-1

                0.211 A

          ok
```

...or error message

```
PhotoCheck        445-1

                ----- A

        Error
```

- Insert the next test solution
- Cancel:
  To cancel the check means no release for the next “meter" AQA interval!

Error elimination:

1. Repeat the measurement (insert the cell again)
2. If necessary, perform a zero adjustment and repeat the check
3. Exchange the test solution (each packet contains two identical test solutions)
4. Use a new Spectroquant® PhotoCheck packet
5. Quit and have the photometer checked in the factory

The absorbance test is terminated if an error message occurs and the meter is **not released**. On switching on, the warning message "AQA interval expired" appears until the AQA was successfully performed or the AQA mode was switched off.

Example: Report output

AQA check meter			AQA1		
26.08.97			10:23		
operator:					
AQA interval			12 weeks		
AQA check AQA1			ok		
L check			ok		
test sol.	meas. value	unit	theor. val.	tolerance	result
445-1	0.211	A	0.200	0.020	ok

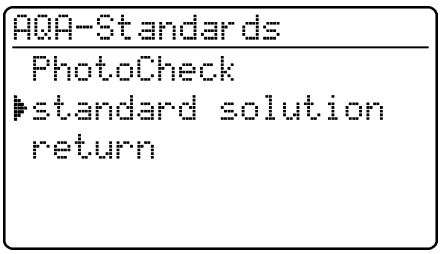
8. Analytical Quality Assurance (AQA)

8.3 Total system monitoring with standard solutions (AQA2)

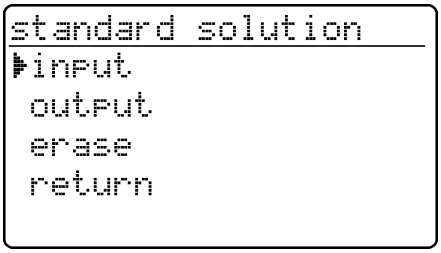
8.3.1 Entering standards

The standards compiled in the table “Spectroquant® CombiCheck and standard solutions” (see part "General information") are already stored method-specifically in the photometer. These values can be overwritten.
For **total system monitoring** (AQA2), only one standard per test can be stored at a time. The input of a standard is only complete with the input of the tolerances for finding it again, i.e. it is then first stored (no premature quitting).

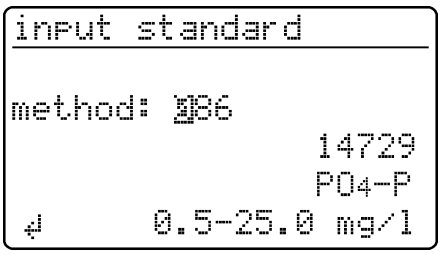
– Press to call up the *setup* menu
– Call up the *meter setup* submenu.
– Call up the *AQA functions* submenu
– Input the password
– Call up the *AQA standards* submenu and the following display appears:



– Call up the *standard solutions* submenu.



Select between
- *input*
  Enter standards
- *output*
  Print/display standards
- *erase*
  Erase standards.



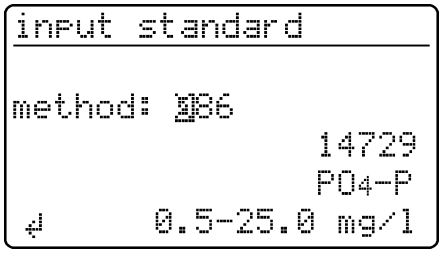
Displays the last selected method.

– Select the method with
– Confirm with
– Input the standards.

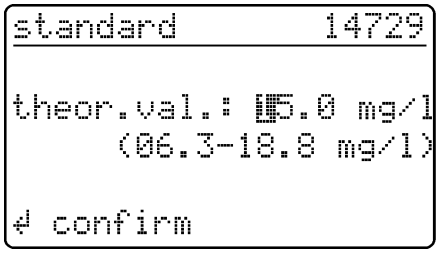
Example:

Method 14729 with a preset theoretical value of 15.0 mg/l and tolerance of 1.0 mg/l (CombiCheck 80).

Change to: theoretical value = 8 mg/l, tolerance = 0.7 mg/l (CombiCheck 20).

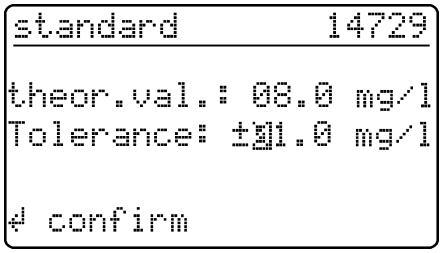


– Confirm with .



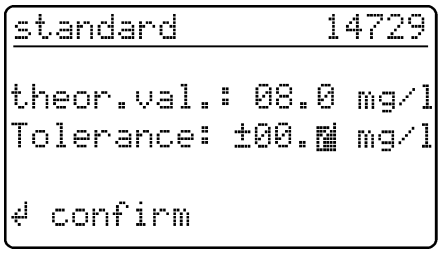
– Enter the new theoretical value, e.g. 8.0 mg/l, with .
Values in parentheses indicate the range in which the theoretical value should move.

– Confirm with .



– Input the tolerance (0.7 mg/l) with .

– Confirm with .

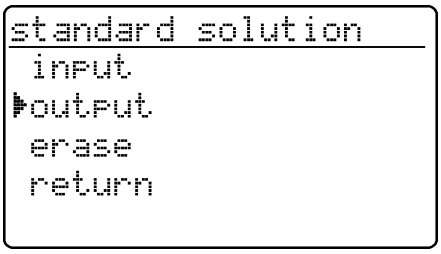


Both standard and tolerance values have been overwritten.

– Confirm with .

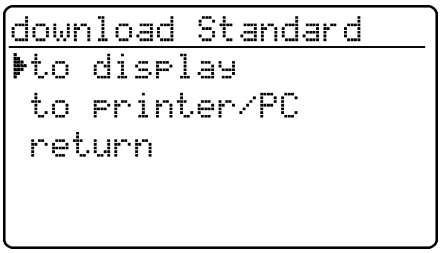
8.3.2 Output of standards

The current list of stored standards is output via the RS 232 interface (PC/printer) or via the display.



– Select the *output* submenu

– Confirm with .



Select the output medium:

- *to display*
- *to printer/PC* (serial interface).

– Select with

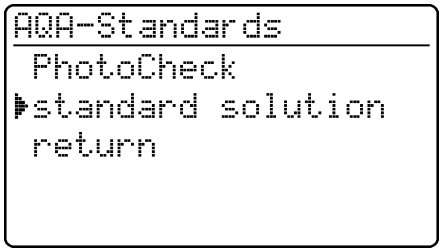
– Confirm with to start the download.

Example: Report output

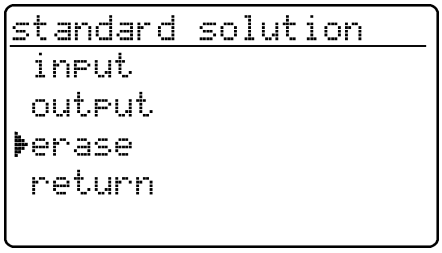
AQA check system		AQA2		
26.08.97		13:57		
system locked		on		
method	unit	theor. val.	tolerance	AQA date
14554	mg/l	2.00	0.20	24.08.97
14555	mg/l	5000	400	26.08.97

8.3.3 Erasing standards

Erasing the method-specific standard solutions leads to the change of the measured value identification from AQA2 to AQA1 (with activated AQA mode).

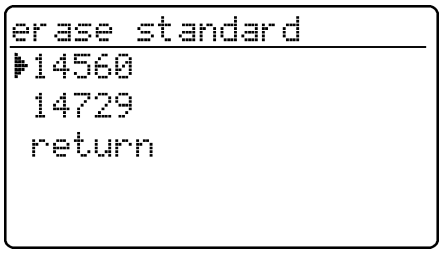


– Call up the *standard solutions* submenu.



– Select the menu item, *erase* with

– Confirm with .



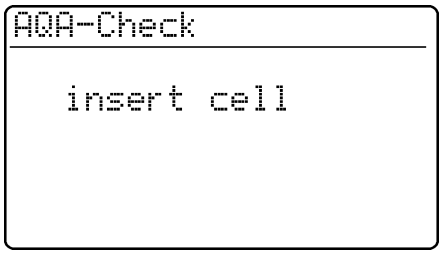
– Select the standard to be erased with

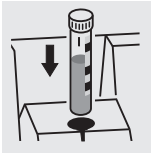
– Erase with .

8.3.4 Monitoring of the total system using standard solutions

The AQA2 check can be performed after it has been activated (see section 8.1).
The following display appears:

For AQA2 with the setting, *n measurements*, we recommend to check and, if necessary, change the currently set number of *measurements* before each AQA check (8.1.3 CHANGING AQA INTERVALS).

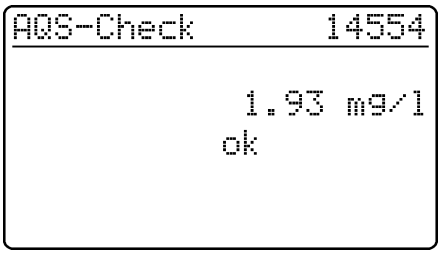




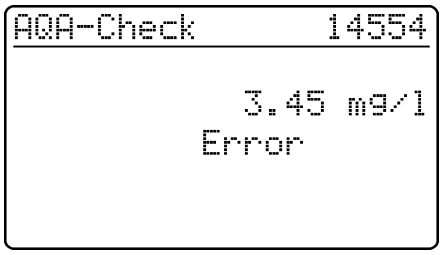
– Insert cell with prepared solution ready to be measured (e.g. using Spectroquant ® CombiCheck). The photometer reads the barcode, identifies the method and performs the AQA2 check.

AQA check OK ...

After approx. 2 s:



...or error message



– Repeat the check
  If the error is repeated, perform troubleshooting of the error. See "Analytical Quality Assurance" in part "General information".

The *system* AQA2 check must be performed **separately** for each method monitored.
The release is stored with the date and the specified interval. The AQA2 interval *system* set up for the respective method begins again.

Example: Report output (*AQA mode*: *n weeks*)

AQA check system AQA2
26.08.97 11:02
operator:

AQA interval 4 weeks

method	meas. value	unit	theor. val.	tolerance	result
14554	1.95	mg/l	2.00	0.20	ok

Example: Report output (*AQA mode*: *n measurements*)

AQA check system AQA2
26.08.97 11:02
operator:

AQA interval 100 measurements

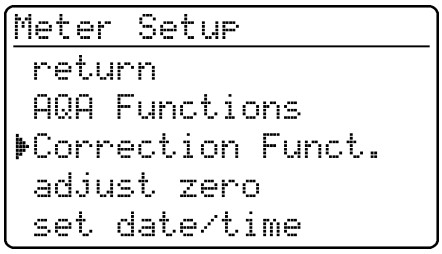
method	meas. value	unit	theor. val.	tolerance	result
14554	1.95	mg/l	2.00	0.20	ok

9. Correction functions

– To switch on the photometer, open the cover.

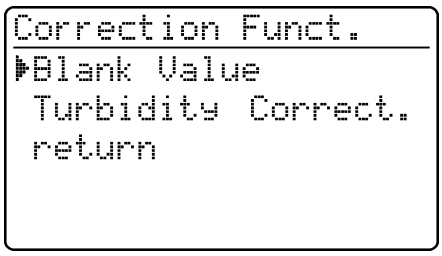
– Press .

– In the *setup* menu, call up the *meter setup* submenu.
The following display appears:



– Call up the *correction funct.* submenu.

The following display appears:



Select the correction function:

- blank value
- turbidity correct.

– Confirm with .

9.1 Blank value

The blank value (= reagent blank value) for each method is stored in the photometer. When the *blank value* function is active, the stored value is ignored and the measured value of a self-prepared reagent blank solution is used instead.

This procedure increases the measuring accuracy for some tests (for more information, see part "Analytical procedures").

A blank value is always stored for the method that was just called up. A maximum of 10 measured blank values can be stored, each of which is permanently assigned to a method.
A blank value remains stored until it is erased (menu item, *erase blank value*) or overwritten.

The *reset setup* function sets the *blank value* to *off*. The stored blank values, however, remain stored. The *reset total* function resets all settings and blank values at once.

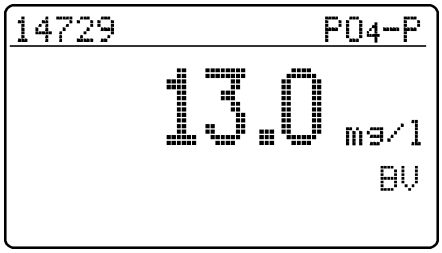
If a measured blank value is stored and the *blank value* function is active for a method, this blank value is used for determining the measured value and the measured value is documented accordingly.

The *blank value* function is not active when delivered.

9. Correction functions

Measuring the concentration with a blank value

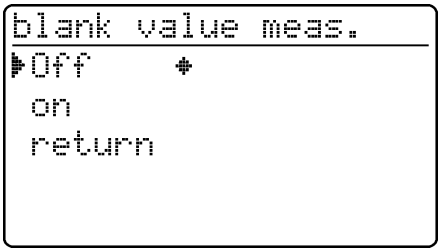
– Press  to call up the *concentration* measuring mode.



The value measured against the prepared blank solution is displayed.

9.1.1 Activating the blank value measurement

– In the *correction funct.* menu, call up the *blank value* submenu. The following display appears:



The *blank value meas.* function appears:

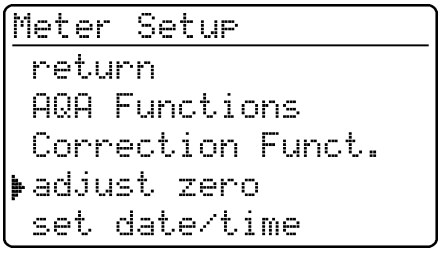
– Select the *on* menu item with 

– Confirm with  .

The stored blank values determined from blank solutions prepared by the user can be deactivated by switching off the blank value measurement. When doing so, the blank values remain stored in the memory and can be reactivated later.

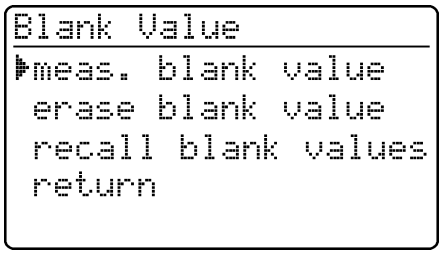
Activating or deactivating the blank value function applies to all measurements using methods a blank value was stored for in the memory.

The *blank value* function is active and appears in the *setup* menu:



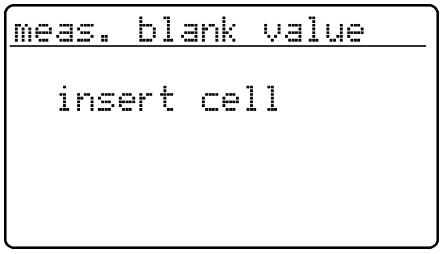
– To measure the blank value, call up the *blank value* submenu in the *setup* menu.

9.1.2 Measuring the blank value



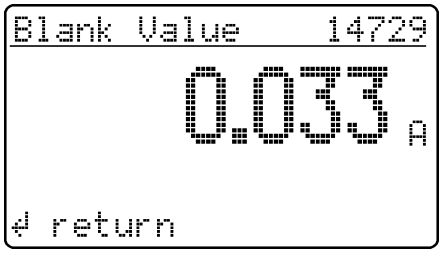
– Call up the *meas. blank value* menu item.

The menu items, *erase blank value* and *recall blank values* first appear after at least one blank value has been measured.

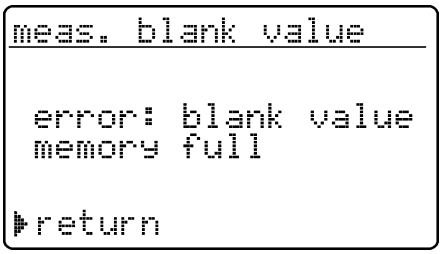


– Insert a cell with blank solution to start a measurement.
The message, *measuring...,* appears on the display.

After approx. 2 s:

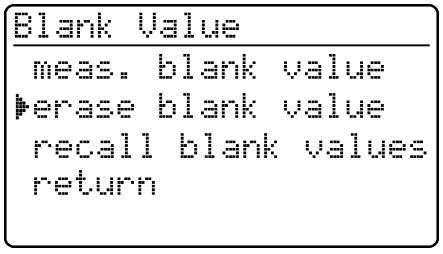


Or, if all 10 storage locations for blank values are already occupied:



If the blank value of a method for which a blank value was already stored is measured again, this error message does not appear and the new measured value replaces the old measured value (new date as well).

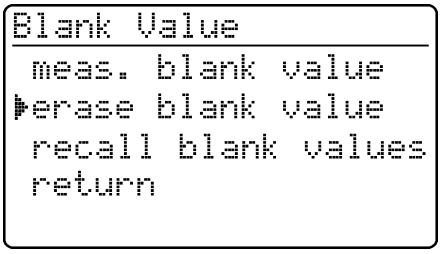
– Selecting the menu item, *return*, returns to the menu item, *blank value*



– Before measuring and storing erase the old blank value.

9.1.3 Erasing blank values

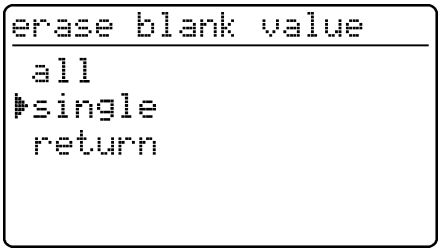
A measured blank value is erased via the menu item, *erase blank value*.



– Select the *erase blank value* menu item

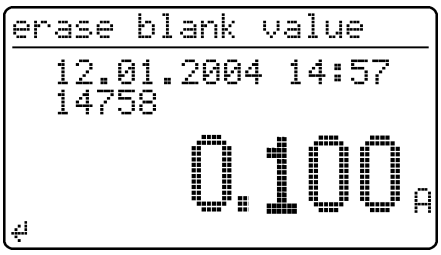
– After confirming with the *erase blank value* menu opens.

The *erase blank value* menu item first appears after a blank value has been measured.



Select between

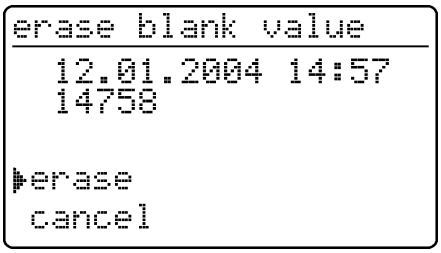
- *all*
  Erase all stored blank values
- *single*
  Erase individual stored blank value



Each stored blank value is displayed with the date of the blank value measurement and the relevant method designation.

– Select the blank value with

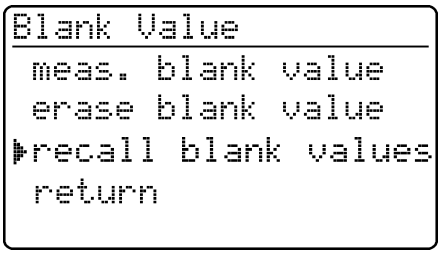
– Erase the displayed blank value with .



– Select the *erase* menu item with

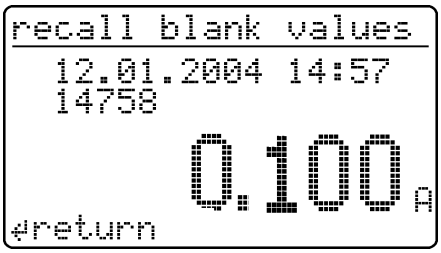
– Confirm with .

9.1.4 Recalling blank values



– Select the *recall blank values* menu item with

– Confirm with .



– Select the blank value with

– Return with .

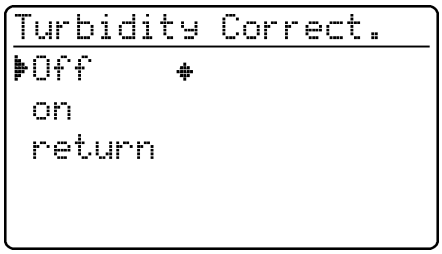
9.2 Turbidity correction

Turbidity correction is used in sample solutions that contain finely distributed suspended particles. The suspended particles cause a light absorption.
This leads to incorrect (too high) measured values. The function remains permanently switched on after it has been activated. Values that were measured using turbidity correction are given an identifier in the **display** and in the **documentation** (printout and storage).

The *turbidity correct.* function is not active when delivered.

This function is not necessary, or useful, in all methods. If the turbidity correction is active, the photometer automatically decides whether to perform the function or not depending on the method.

– In the *correction funct.* menu, call up the *turbidity correct.* submenu.
The following display appears:

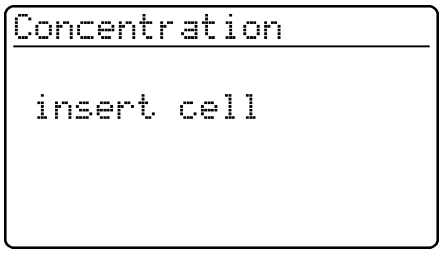


The *turbidity correct.* function appears:

– Select the *on* menu item with 

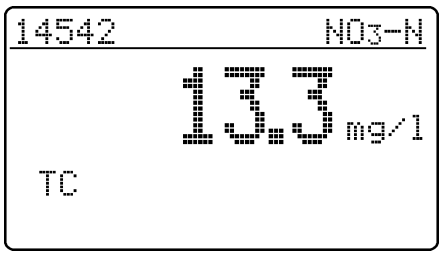
– Confirm with  .

– Press  to call up the *concentration* measuring mode.



– Insert the measuring cell.

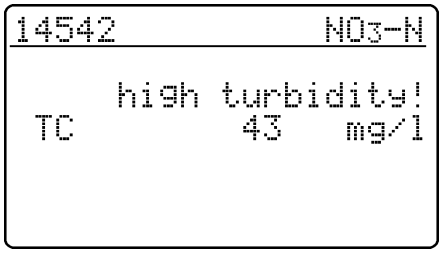
After approx. 2 s:



Display of the measured value with turbidity correction switched on: Identified by *TC.*

Warning of excessive turbidity:

If the turbidity absorbance of *0.100 A* is exceeded, the meter displays the measured value together with a warning.



10. Zero adjustment

Zero adjustment is necessary

- after changing the lamp
- after the error message, *PhotoCheck* (AQA1) occurs
- on initial commissioning
- if the photometer was mechanically stressed, e.g. percussion, transport
- if the ambient temperature changed by more than 5 °C since the last zero adjustment
- at least every six months.

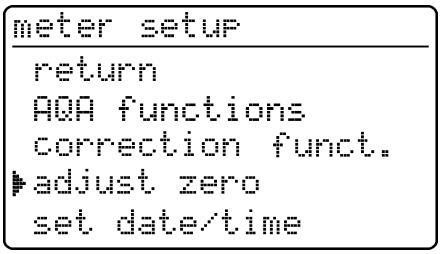
When performing the zero adjustment observe the following points:

- Only use a clean, scratch-free round cell with distilled water. A prepared zero cell is provided with your photometer. In addition, a prepared zero cell is contained in the scope of delivery of the *PhotoCheck* (article 14693).
- If the round cell is visibly contaminated, or at least every 24 months, clean and refill it (minimum filling level 20 mm). Then check the cell for scratches.

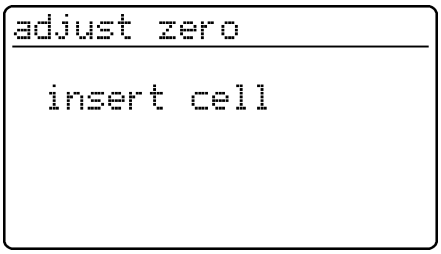
Only perform the zero adjustment against distilled water in an optically perfect cell.

– Press 

– In the *setup* menu, call up the *meter setup* submenu.
The following display appears:

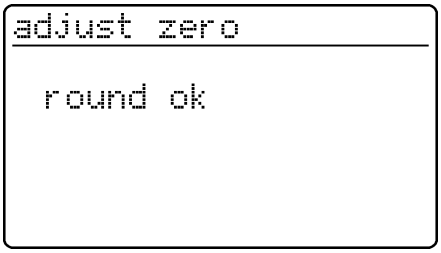


– Call up the *zero adjustment* submenu with  .



– Insert a cell with distilled water.
The message, *measuring...*, appears on the display.

After approx. 2 s:



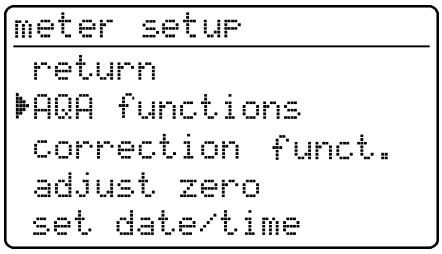
Successful zero adjustment

11. Meter Setup

– To switch on the photometer, open the cover.

– Press 

– In the *setup* menu, call up the *meter setup* submenu.
The following display appears:



This chapter describes four functions of the *meter setup* menu:

- *select language*
- *set date/time*
- *Performing a meter reset*
- *system info*

11.1 Selecting the language

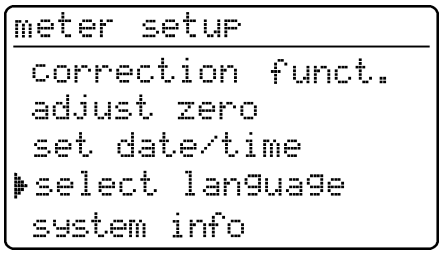
The following languages are stored in the photometer:

- Deutsch (German)
- English
- Français (French)
- Italiano (Italian)
- Português (Portuguese)
- Polski (Polish)
- Dansk (Danish)
- Svenska (Swedish)
- Español (Spanish)
- Nederlands (Dutch)
- Indonesia (Indonesian)
- Ceština (Czech)
- Magyar (Hungarian)
- Russkij (Russian)
- Türkçe (Turkish)
- Brasil (Brasilian)

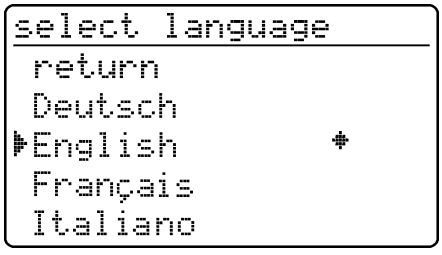
This is the order in which the available languages appear in the *select language* menu.

The available languages are listed in the language of the respective country in the photometer.

When *Russkij* is selected as the language, the Cyrillic alphabet is used for the user guidance. Method designation and ID numbers are always displayed in Latin script.
For output to the RS 232 C interface, Cyrillic characters are converted to Latin characters according to GOST.



– Call up the *select language* menu item.



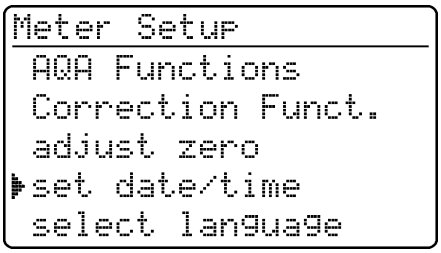
– Select a language, e.g. English

– Confirm with 

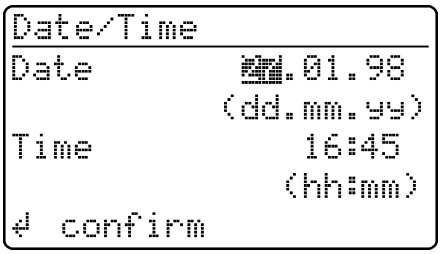
– Press the  key again:
Return to the *meter setup* submenu.

The displays appear in English.

11.2 Setting the date/time



– Call up the *set date/time* menu item.

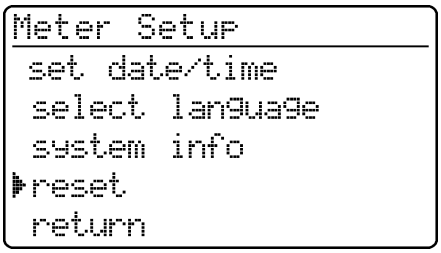


– Input the date using
– Confirm with
– Input the time with
– Confirm with .

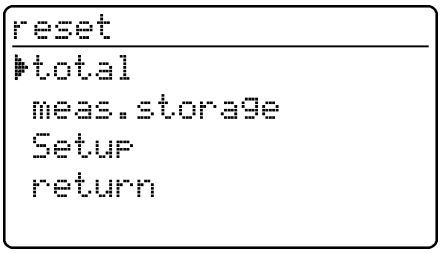
11.3 Reset

It is possible to reset the photometer to its factory settings (delivery state) in single steps. The *reset total* function resets all settings and blank values at once.

All AQA functions are retained when *meter setup* is used.
See section 8.1.6 for AQA reset.



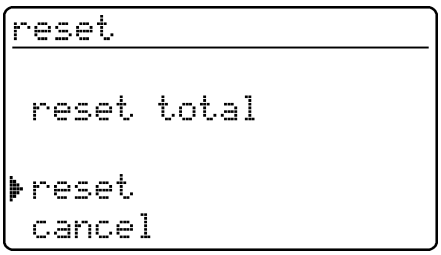
– Call up the *reset* menu item.



Select between

- *total*
  Erase the measured value storage and reset the settings to the delivery state
- *meas. storage*
  Erase the measured value storage
- *setup*
  Reset all settings to the delivery state.

Example: Performing a total reset

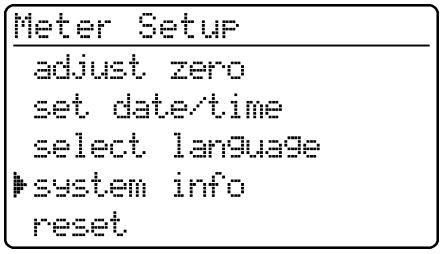


– Select the *reset* menu item
– Confirm with .

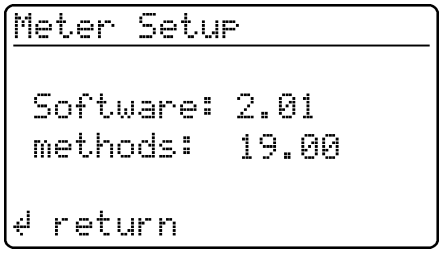
A meter reset is performed (measured value memory and setup).

11. Meter Setup

11.4 System info



– Call up the *system info* menu item.



Sample display

12. Updating method data

You will always find the latest method data for your photometer on the Internet. A method update contains all new test sets and methods respectively. Additionally, minor modifications of already existing methods are transferred with it. With a method update, you receive all new methods and, at the same time, can easily and conveniently update all method data.

The software provided for downloading contains the program file and method data. It can be downloaded from our homepage with a mouse click.
The files are packed in a self-decompressing archive file (*.exe) or in a zip file (*.zip) and can be decompressed after the download.

To download and update the photometer method data via the built-in RS232 interface, you need the following:

- PC (Win 95 or higher) with Internet connection
- PC cable (available as an accessory)
- An *.exe or *.zip file from the Internet; contains the "UpdateMethodData.exe" program file and 6 method data files (pls6md.xxx, pls12md.xxx, plspekmd.xxx, nova30md.xxx, nova60md.xxx, nova400md.xxx; xxx = version).

Carry out the update as follows:

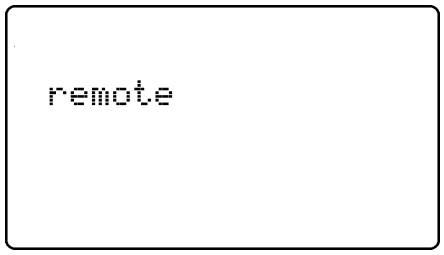
– Switch on the photometer (open the cover).
– Switch on the PC.
– Download from the Internet the software including the method data (*.exe or *.zip) and copy it into a separate directory or on a floppy disk.
– Decompress the *.exe file with a double-click or decompress the *.zip file with Winzip.
– Connect the serial interfaces of the PC and photometer with the cable.
– Start the "UpdateMethodData.exe" program file by double-clicking. The "Update Method Data" window appears. In the upper half of the window there is the name of your photometer (among other things), behind it there is the method version in brackets (e.g. 8.00).

All method data are reloaded into the photometer with the update. The old method data are overwritten by this.

– Click on the "Search meter" button.
The program automatically recognizes the connected photometer. Another "Update Method Data" window appears.
– Click on the "Start" button to start the method download. The process takes approx. 3 minutes. You can terminate it at any time by clicking on the "Cancel" button. In this case, however, the download has to be carried out once again completely so that the photometer can save the method data and is operative.

12. Updating method data

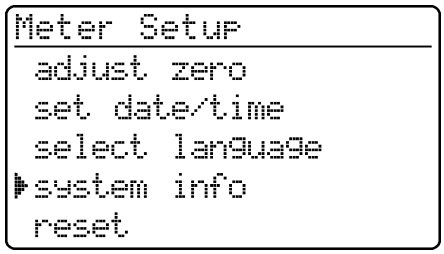
During the download, the following display appears on the photometer screen:



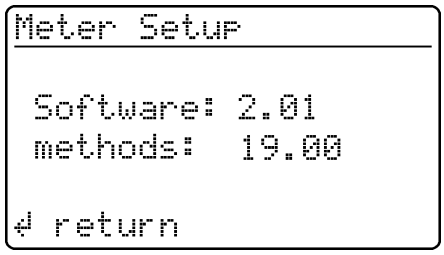
– After the download, confirm the "Data successfully downloaded" message. The download is finished. The photometer returns to the *concentration* measuring mode.

You can check whether the new method data are stored in the photometer.
To do so, proceed as follows:

– In the setup menu, call up the meter setup submenu.



– Call up the *system info* menu item.



Sample display (the software version is irrelevant here).
The method version (here: 19.00) has to agree with the method version for your photometer in the "Update Method Data" window during the download.

Error messages

Message	Meaning	Remedy
No meter found	Connection PC - photometer out of order or not available	– Tightly connect the cable to the serial interfaces of the PC and photometer.
		– Use the correct cable
	Photometer not recognized	– Select the photometer manually

13. RS 232 C interface

Via the interface, data can be

- output to a printer and
- exchanged with a personal computer (PC)

For this, the following items are available as accessories:

- Printer cable
- Printer
- Interface cable
- Communication software.

13.1 Principle course of the remote control

String to meter	Reply from meter	Operating mode
S <CR>	> <CR>	Remote (remote control)
Command xx (see 15.2 command list)	Reply string command xx <CR>	Remote (remote control)
.		
.		
.		
CLOC <CR>		Concentration measurement

The keyboard of the photometer is locked in the *remote* operating mode.

13.2 Command list

Command	Function
S	Begin communication
CLOC	Switchover to normal operation (concentration measurement)
CDAT [anz]	Reads out stored measured values; [anz] = number of the measured values to be output
CMES [MMM]	Measurement and transmission of the concentration value with date/time; [MMM] = method number (e.g. 086 for method 14729)
CEXT [LLL]	Measurement and transmission of the absorbance value for the wavelength; [LLL] = wavelength
CBLA [MMM]	Measurement and transmission of the sample blank value; [MMM] = method number
CCLB [MMM]	Erase measured sample blank values; [MMM] = method number

The error message, *Invalid command,* appears if commands are unknown or cannot be carried out (e. g. if optional parameters do not agree with the cell coding). Optional parameters [MMM] and [LLL] need only be input for uncoded cells.

13. RS 232 C interface

13.3 Output format of measured values

Character	Meaning
3	consecutive number (not required for interface commands CMES, CEXT and CBLA)
5	method designation
6	I. D. number
17	date and time
4	special characters
9	meas. value
10	unit
12	citation
4	AQA ID (AQA2/AQA1)

Notes:
Data fields are separated by spaces.
Character set: IBM, code page 437

Meaning of the special characters:

! = Measuring with blank value (concentration) or reference absorbance (absorbance)

t/T = Measurement with turbidity correction/with high turbidity

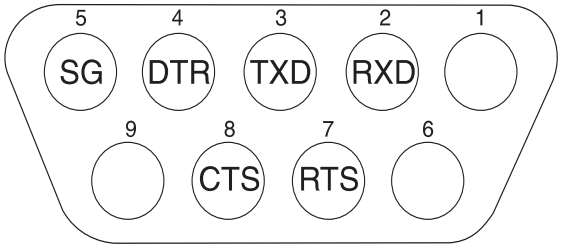
* = Measured value outside the measuring range

Q = AQA measurement

13.4 Data transmission

Baud rate	4800
Data bits:	8
Stop bits:	1
Parity:	none
Handshake:	Hardware
Max. cable length	15 m

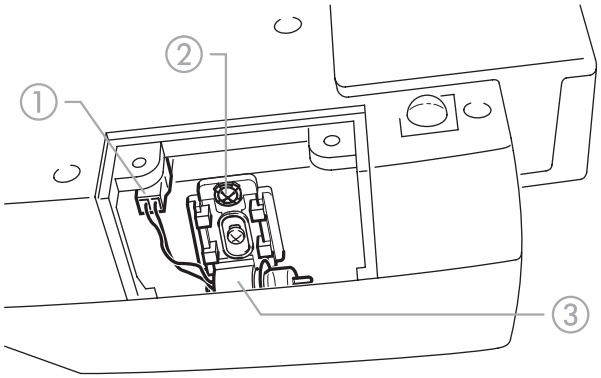
13.5 Pin assignment



Photometer 9-pin socket	Computer 9-pin socket	25 pin plug	Printer with RS 232 C interface
1	4	20	-
2	3	2	TXD
3	2	3	RXD
4	1 and 6	6	-
5	5	7	SG
6	4	20	-
7	8	5	-
8	7	4	DTR (if not available: short-circuit CTS and RTS)
9		-	-

14. Maintenance

14.1 Changing the lamp



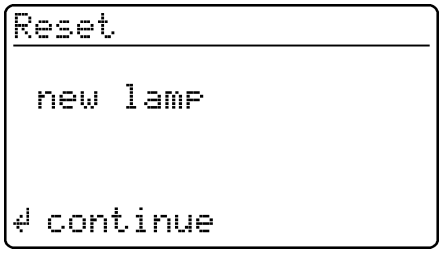
– Switch off the photometer and disconnect it from the power line
– Carefully turn up the photometer and park it safely
– Screw off the lamp cover on the underside of the photometer

Let the lamp of the photometer cool down.

– Pull out the plug ①
– Unscrew the screw ②
– Remove the lamp with its holder ③ by pulling it gently upwards

Do not touch the new light bulb of the photometer.

– Insert a new preset lamp and screw it tight using the screw ②
– Connect the plug ① of the new lamp
– Screw the lamp cover on again
– Set up the photometer again and connect it to the power line
– Press and hold
– Switch on the meter (open the cover) and after the following display appears, release :



– Press

14.2 Actions to take if a cell is broken

Do not rotate the photometer to pour out the liquid!

The photometer has a draining mechanism under the cell shaft that, when operated correctly, prevents any liquid coming into contact with electronic components.

– Switch off the photometer (close the cover) and disconnect it from the line power
– Let the liquid drain off
– Carefully remove any pieces of glass, e.g. using tweezers
– Carefully clean the cell shaft with a damp, lint-free cloth
– Let the cell shaft dry

After it is dry, check the photometer:

– Perform a photometer monitoring (see section 8.2).

15. Technical Data

Optical measuring principle	Filter photometer with reference beam absorption measurement; simultaneous recording of all wavelengths
Light source	Tungsten halogen lamp, preset
Receiver	6 x photo diode array
Optical filters	340 nm, 445 nm, 525 nm, 550 nm, 605 nm, 690 nm, Accuracy: ±2 nm; Half width: 340 nm = 30 nm ±2 nm; all others = 10 nm ±2 nm
Photometric reproducibility	0.001 A at 1.000 A
Photometric resolution	0.001 A
Warm-up time	none
Measuring time	approx. 2 s
Types of measurement	Concentration (method dependent, selectable display form), absorbance, transmission
Measuring range absorbance	–0.300 A to 3.200 A
Measuring range transmission	0.1 % to 1000 %
Balancing	Permanently stored
Drift correction	Automatic on each Self-Check
Retrofitting of new methods	via the Internet
Bar code recognition	automatic selection of the method; automatic recognition of the reagents lot
Cell recognition	automatic
Self-Check	*Test:* Memory, optics, electronic measured value recording, barcode recognition, cell recognition *Automatic calibration:* Optics, electronic measured value recording, barcode recognition
Time/Date	Real-time clock in the photometer
Dimensions	H: 140 mm, D: 270 mm, W: 260 mm
Weight	approx. 2.3 kg (battery version: 2.8 kg)
Meter safety	EN 61010, IEC 1010
Safety class	EN 61010-1/class 3
Power pack	
● **Type**	Friwo FW6798/11.8363 * Friwo Part-No. 1810502 Input: 230 V~ ±10%/50 Hz/25 VA Output: 12 V~/1540 mA Friwo FW6798/11.8365 * Friwo Part-No. 1769227 Input: 120 V~ ±10%/60 Hz/24 VA Output: 12 V~/1540 mA * compulsory for meters with UL/cUL test certificates FRIWO FW 7555O/15 Friwo Part. No. 1822367 Input: 100 ... 240 V ~ / 50 ... 60 Hz / 400 mA Output: 15 V DC / 1 A
● **Meter safety**	EN 60950
Battery operation (optional)	Built-in battery: NiCad rechargeable battery 7.2 V/2200 mAh, operating time with new, fully charged battery: typical 40 hours with 10 measurements per hour, trickle charging in line operation, approx. 5 h charging time for a discharged battery, total discharge protection
Power consumption in line operation	max. 1300 mA
EMC	EU directive 89/336/EEC EN 61326-1 EN 61000-3-2 A14 EN 61000-3-3 FCC class A
Climatic class	2, VDI/VDE 3540
Ambient temperature	Storage: –25 °C to +65 °C Operation: +5 °C to +40 °C
Allowable relative humidity	Annual mean: 75 % 30 days/year: 95 % other days: 85 %
Test certificate	CE

15. Technical Data

Operating elements	On/off switch actuated by opening/closing the lid of the cell shaft cover Silicon keyboard with 4 function keys Cell shaft – for round cells (flat cell floor, external/internal diameter 16 mm / 13.8 mm) Recess for MemoChip
Display	Graphical display 128 x 64 pixels
Connections	
● **Digital interface**	RS 232 C 9-pin socket to connect to PC or printer
● **Power supply**	2-pin socket to connect the plug-in power supply unit
Data storage	Cyclical memory to record 500 measured values

FCC Class A Equipment Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Software settings when delivered	
Measured value number:	1
blank value is:	Off
turbidity correct.:	Off
language:	English
Date of the last valid AQA1 check:	invalid (not yet measured)
AQA1 interval:	12 weeks
AQA2 interval:	4 weeks
AQA password:	0000
AQA mode:	Off
Lock measurement if AQA2 expired:	Off
Checks to be measured with AQA1:	none
AQA2 values:	none

Settings after reset - total
Measured value storage and setup reset

Settings after reset - meas. storage	
Meas. value number:	1
Measured values:	none

Settings after reset - setup	
Measured value number:	1
blank value:	Off
reference absorbance:	Off
turbidity correct.:	Off
Language:	unchanged

Settings after reset - AQA	
Date of the last valid AQA1 check:	invalid (not yet measured)
AQA1 interval:	12 weeks
AQA2 interval:	4 weeks
AQA password:	0000
AQA mode:	Off
Lock measurement if AQA2 expired:	Off
Checks to be measured with AQA1:	none (Input theoretical values and tolerances are not erased and are offered again with the next input).
AQA2 values:	none (theoretical values and tolerances of all methods are set to default values according to the "Spectroquant® CombiCheck and standard solutions" table in the part "General information".)

16. What to do if…

The display remains blank when switched on	Connect the photometer to the line power via the power pack. In the case of battery operation: Battery empty, charging required (approx. 5h); line operation is possible without restrictions during charging time.
 **appears**	Battery nearly empty. Charging required (see chapter 3 COMMISSIONING).
Date/time is lost when switched off	The backup battery of the real time clock is empty and has to be replaced. Send the photometer to the service department for this.
MemoChip is not recognized	The MemoChip is not recognized by the photometer though it is in the recess during switching on. Operate the photometer with line power (see chapter 3 COMMISSIONING). Repeat the procedure.
Password forgotten	Inform the service department.
Photometer does not react	The connected printer is off line. Switch on the printer or pull out the interface cable.
Error messages:	
remove cell	The message remove cell appears on the display although no cell is inserted. Clean the cell shaft with a damp, lint-free cloth. If the error message still appears, return the photometer to the service department.
lamp defective	Replace the lamp (see chapter chapter 14 MAINTENANCE).
no zero adjustment	No zero adjustment is stored in the meter for the cell. Perform zero adjustment (see chapter chapter 11 ZERO ADJUSTMENT).
method invalid	No data is stored in the photometer for the selected method. Update method data (see chapter chapter 12 UPDATING METHOD DATA).
wrong method	During a difference measurement, the method was changed between the first and second measurement. During a difference measurement, the method must remain identical.
E_0	Hardware error: Send the photometer to the service department.
E_1*, *E_2* or *E_3	Replace the lamp (see chapter chapter 14 MAINTENANCE). If the error message remains, send the meter to the service department.